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

MEMORANDUM

JUN 16 1988

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

SUBJECT: Review of avian reproduction studies submitted in response to TPTH Registration Standard.
Record No. 175645
Record No. 178059

FROM: David Warburton, Wildlife Biologist
Ecological Effects Branch
Hazard Evaluation Division (TS-769-C)

Dave Warburton 6/15/88

THRU: Douglas J. Urban, Section Head 3
Ecological Effects Branch
Hazard Evaluation Division (TS-769-C)

6/15/88

THRU: James W. Akerman, Chief
Ecological Effects Branch
Hazard Evaluation Division (TS-769-C)

6/16/88

TO: Lois Rossi, PM 21
Herbicide Fungicide Branch
Registration Division (TS-767-C)

This is to notify you that EEB has completed review of the attached studies:

1) Triphenyltin Hydroxide (TPTH) Technical: A One-Generation Reproduction Study with the Bobwhite (Colinus virginianus) Final Report - Project No.: 190-109.

2) Triphenyltin Hydroxide (TPTH) Technical: A One-Generation Reproduction Study with the Mallard (Anas platyrhynchos) Final Report - Project No.: 190-110.

Both studies are classified as "Supplemental" primarily due to inadequate dosage levels employed in each test. It is also very important that the registrant address all discrepancies discussed under Section 14 of the reviews. Although EEB will consider reparability of each test following registrant's response, it is recommended that each test be repeated using higher dose levels so as to be useful in a hazard assessment. Copies of the reviews are attached.

RERES.

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EEB FILE

Tech. Avian Reprod
Bobwhite
Mallard

Supplemental

175645
RECORD NO.

083601
SHAUGHNESSEY NO.

REVIEW NO.

EEB REVIEW

DATE: IN 6/19/86 OUT JUN 16 1988

FILE OR REG. NO 53265-O

PETITION OR EXP. NO

DATE OF SUBMISSION: 6/6/86

DATE RECEIVED BY HED: 6/18/86

RD REQUESTED COMPLETION DATE: 10/6/86

EEB ESTIMATED COMPLETION DATE: 9/29/86

RD ACTION CODE/ TYPE OF REVIEW: 400

TYPE PRODUCT(S): FUNGICIDE

ACCESSION NUMBER(S): 263193

PRODUCT MANAGER: L. Rossi

PRODUCT NAME(S): TPTH

COMPANY NAME: W.R. Landis Assoc., Inc. representing: Wesley Industries, Inc.; Hoechst-Roussel Agri-Vet Company; M&T Chemicals, Inc.; and Griffin Corporation

PURPOSE OF SUBMISSION: Submission of avian reproduction studies in response to Registration Standard.

SHAUGHNESSEY NO.	CHEMICAL AND FORMULATION	%A.I.
083601	TPTH	

2

178059
RECORD NO.

083601
SHAUGHNESSEY NO.

REVIEW NO.

EEB REVIEW

DATE: IN 8/4/86 OUT JUN 16 1988

FILE OR REG. NO 53265-O

PETITION OR EXP. NO

DATE OF SUBMISSION: 7/10/86

DATE RECEIVED BY HED: 7/31/86

RD REQUESTED COMPLETION DATE: 11/17/86

EEB ESTIMATED COMPLETION DATE: 11/10/86

RD ACTION CODE/ TYPE OF REVIEW: 401

TYPE PRODUCT(S): FUNGICIDE

ACCESSION NUMBER(S): 263954

PRODUCT MANAGER: L. Rossi

PRODUCT NAME(S): TPTH

COMPANY NAME: W.R. Landis Assoc., Inc. representing: Wesley Industries, Inc.; Hoechst-Roussel Agri-Vet Co.; M&T Chemicals, Inc.; and Griffin Corporation

PURPOSE OF SUBMISSION: Amended pages to avian reproduction studies currently under review.

SHAUGHNESSEY NO.	CHEMICAL AND FORMULATION	%A.I.
083601	TPTH	

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DATA EVALUATION RECORD

1. Chemical: Triphenyltin Hydroxide (TPTH)

2. Test Material: Triphenyltin Hydroxide (TPTH) Technical (97.1% active ingredient).

3. Study Type: Avian Reproduction

   Species Tested: Mallard duck (Anas platyrhynchos)

4. Study ID: Triphenyltin Hydroxide (TPTH) Technical: A One-Generation Reproduction Study with the Mallard (Anas platyrhynchos). Final Report. Wildlife International Ltd. Project No. 190-110. Submitted to W.R. Landis Associates, Inc., Valdosta, GA. May 13, 1986. EPA Accession Nos. 263193 and 263954 (Amendment).

5. Reviewed By: David Warburton
   Wildlife Biologist
   EEB/HED
   Signature: Dave Warburton
   Date: 6/15/88

6. Approved By: Douglas J. Urban
   Section Head 3
   EEB/HED
   Signature: Douglas J. Urban
   Date: 6/15/88

7. Conclusions:

The submitted study concluded that dietary concentrations of TPTH technical at 1 and 3 ppm did not result in effects on mallard duck reproductive parameters; there may have been a slight reduction in embryo viability and hatchling success at the 10 ppm concentration. However, EEB noted treatment-related effects at 1 and 10 ppm with possible dose-related pathological effects (regressed ovaries, egg yolk peritonitis) at 3 ppm. Treatment levels are inadequate to use this study in a hazard assessment at current TPTH label use rates. The study is considered "Supplemental" due to dosage levels below EEC's and deviations from recommended procedures.

8. Recommendations:

The registrant should address all items discussed under Section 14a-c.

9. Background:

The study was submitted as per data requirements specified under the TPTH Registration Standard.

10. Discussion of Individual Tests:

A supplement was submitted (EPA Accession No. 263954) but provides no new substantive data; changes relate to improved readability of graphics.

11. Materials and Methods (excerpted in part from submission):.

a. Test Animals

Pen-reared mallards, that were apparently healthy and phenotypically indistinguishable from wild birds, were purchased from Whistling Wings, Hanover, Illinois. All birds were from the same hatch and were approximately 16 weeks of age at test initiation. The birds were approaching their first breeding season and had not been used in previous testing. Birds that were injured or did not appear healthy were discarded.

b. Dose/Diet Preparation/Feed Consumption

Diets for the adult birds and their offspring contained 28% protein minimum, 2.5% fat minimum, and 5% fiber maximum. Neither the adults nor offspring received any form of medication during the study. Test diets were prepared by mixing TPTH technical into a pre-mix which was used for weekly preparation of the final diet. Control diet and three test concentrations (1, 3, and 10 ppm) were prepared weekly and presented to birds on Friday of each week. The control diet contained an amount of the carrier corn oil equivalent to that in the treated diets (0.05%). Dietary concentrations were not adjusted for purity of the test material. The adults were fed a game bird ration formulated for breeding birds. All offspring received a game bird ration formulated for young growing birds. The test substance was not mixed into the diet of the offspring. Water from a well approximately 400 feet deep on the Wildlife International Ltd. site and feed were provided ad libitum during acclimation and during the test.

Samples of the control diet and each of the test diets were taken each week immediately after mixing for analysis.

Feed consumption was measured for each pen for a seven-day period every week throughout the study.

c. Procedures

Test Material

The test material, a white powder, was identified on the label as "Fentin Hydroxide Substanz Tech, (TPTH) HOE 029664 OF 2D97 0004 02.05.85". It was assigned Wildlife International Ltd. identification number WIL-989. Percent active ingredient identified by study sponsor was 97.1%.

Study Design

One hundred and twenty-eight (128) mallards (64 drakes and 64 hens) were randomly distributed into four groups, as follows:

Nominal Concentration	Number Of Pens	Birds Per Pen	
		Drakes	Hens
1. Control (0 ppm)	16	1	1
2. 1 ppm TPTH	16	1	1
3. 3 ppm TPTH	16	1	1
4. 10 ppm TPTH	16	1	1

Treatment levels were based on known toxicity data. Sex of the birds was determined by a visual examination of the feather coat. Adult birds were identified by individual leg bands.

The primary phases of the study and their approximate durations were:

1. Acclimation- 15 days.
2. Pre-photostimulation- Approximately 8 weeks.
3. Pre-egg laying (with photostimulation)- estimated 4 weeks.
4. Egg laying- 9 weeks.
5. Final incubation, hatching, and 14-day offspring rearing period- 6 weeks.

Pen Facilities

Adult birds were housed indoors in a separate study room in galvanized wire/sheeting pens measuring approximately 72 X 90 X 33 cm high. Pens were equipped with a feeder and waterer. Average temperature in the study room was 23° ± 4°C (SD) with an average relative humidity of 86%.

During acclimation and upon initiation of the study, the birds were maintained under a photoperiod of 8 hours of light per day. From 8 weeks until terminal sacrifice, the photo-period was increased to 17 hours of light per day. Birds

received approximately 12 footcandles of illumination throughout the study.

Adult Observations/Gross Pathology

All adult birds were observed at least once daily throughout the study for signs of toxicity or abnormal behavior. A record was maintained of all mortalities and observations. All birds that died during the study were necropsied. In addition, at the conclusion of the adult exposure period, all birds were sacrificed and necropsied.

Adult body weights were measured at study initiation, on Weeks 2, 4, 6, 8, and at terminal sacrifice. Body weights were not measured during egg laying.

Eggs/Eggshell Thickness

Eggs were collected daily and marked according to pen of origin. The eggs were then washed to prevent pathogen contamination and stored in a cold room at 13°C ± 0.5°C (SD) and approximately 88% relative humidity until incubated. At weekly intervals all eggs were removed from the cold room and candled with a Speed King (Model 32) egg candling lamp to detect egg shell cracks. Cracked eggs were discarded. All eggs that were not cracked or used for egg shell thickness measurements were then fumigated to prevent pathogen contamination and placed in a Petersime Incubator (Model No. S20) where the temperature was maintained at 37.5°C ± 0.14°C (SD) and relative humidity was 56%. The incubator was also equipped with an automatic egg rotation device designed to rotate eggs 50° off vertical in opposite directions. Eggs were candled again on Day 14 of incubation to determine embryo viability; and on Day 21 to determine embryo survival. On Day 24 of incubation, the eggs were placed in a Petersime Hatcher (Model S20), separated by pen and allowed to hatch, keeping hatchlings separated by pen of origin. Temperature in the hatchling compartment was 39°C ± 0.69°C (SD) with a relative humidity of 79%.

Weekly throughout the egg laying period, one egg was collected, when available, from each of the odd numbered pens during odd numbered weeks (1, 3, 5, etc.) and from each of the even numbered pens during even numbered weeks (2, 4, 6, etc.). The eggs were opened at the waist, the contents removed, and the shell thoroughly washed. The shells were then allowed to air dry for at least one week at room temperature. The average thickness of the dried shell plus the membrane was determined by measuring five points around the waist of the egg using a micrometer. Measurements were made to the nearest 0.005 mm.

Hatchlings

All hatchlings, unhatched eggs and egg shells were removed from the hatcher on Day 26 or 27 of incubation. The average body weight of the hatchlings by pen was then determined. Hatchlings were toe and web clipped for identification by pen of origin and then housed according to the appropriate parental concentration grouping in brooding pens (galvanized wire mesh/sheeting pens measuring 72 X 90 X 24 cm high; temperature maintained at 38°C for 5-7 days) until 14 days of age. The hatchlings were fed untreated diet. At 14 days of age the average body weight by parental pen of all surviving ducklings was determined before being sacrificed.

Statistics

Upon completion of the study, Dunnett's method (Dunnett 1955) was used to determine statistically significant differences between the control group and each of the treatment groups. Sample units were the individual pens within each experimental group. Any pen in which a mortality occurred was not used in statistical comparisons of the reproductive data. Each of the following parameters was analyzed statistically:

Adult Body Weight
Adult Feed Consumption
Eggs Laid of Maximum Laid
Eggs Cracked of Eggs Laid
Viable Embryos of Eggs Set
Live 3-week Embryos of Viable Embryos
Hatchlings of 3-Week Embryos
14-Day Old Survivors of Hatchlings
14-Day Old Survivors of Eggs Set
Hatchlings of Maximum Set
14-Day Old Survivors of Maximum Set
Offspring's Body Weight
Eggshell Thickness

12. Reported Results (excerpted in part from submission):

a. Diet Analysis

The average concentration of TPTH at the 3 ppm level in the 8 preparations (Weeks 1, 4, 5, 9, 11, 16, 19 and 21) was 2.59 ppm or 86.3% of the nominal level. Values obtained from the analysis of feed prepared for the fifth week at this level were low (36-63%). The average concentration of test material for the 8 preparations at the 10 ppm level was 99.7% of the claimed concentration with a range of 77.2% to 112.8%.

In the material stability test, the initial concentration of triphenyltin hydroxide in 3 test preparations (3, 10, and 30 ppm) averaged 102.0% of the claimed level. At the end of the 5 day period, the average concentration of TPTH in the 3 levels analyzed was 82.1%.

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b. Mortalities

Only one mortality occurred during the study- a drake from the control group during Week 7. No external lesions were noted. Internal lesions pathognomic of viceral gout, including white plaques on the heart, liver and throughout the abdominal cavity, were noted. Crystalline-like lesions also were observed in the kidneys.

c. Clinical Observations

No overt signs of toxicity were observed during the study. One hen at 10 ppm displayed loss of coordination and lower limb weakness one day during Week 16 and slight lower limb weakness the following day. This hen appeared normal at all other times and the signs observed were not attributed to treatment. All other birds showed only those lesions or abnormal behavior associated with pen wear and tear.

d. Gross Necropsy

Birds sacrificed at the termination of the study from control and treatment groups were subject to gross necropsy. Necropsy results are listed in a table from the submission entitled "Appendix IV, Gross Pathological Observations, TPTH Technical- Project Number 190-110, Birds Sacrificed at Termination of the Study" (photocopy attached). None of the lesions observed in necropsy appeared to be treatment related.

e. Adult Body Weight and Feed Consumption

When compared with controls, there were no statistically significant differences ($P < .05$) in body weight at 1, 3, or 10 ppm. There was no treatment related effect upon feed consumption at 1, 3 or 10 ppm. Feed consumption at 1, 3 and 10 ppm was not statistically different ($P < .05$) from that observed in the control group throughout the study.

f. Reproductive Results

At the 1 ppm concentration there was a slight reduction in embryo viability and hatching success that was not statistically different ($P < .05$) from the control. The reductions in viability and hatching success did result in a statistically significant ($P < .05$) reduction in the number of 14-day old survivors as a percent of eggs set. The differences from the control at 1 ppm were not dose responsive and not attributed to treatment.

At the 3 ppm concentration there were no statistically signi-

ficant ($P < .05$) effects upon any of the reproductive parameters. All reproductive results were similar to those in the control.

The 10 ppm concentration also showed a reduction in viable embryos that was not statistically significant ($P < .05$) and a reduction in hatching success and 14-day old survivors as a percentage of eggs set that was statistically significant ($P < .05$).

g. Egg Shell Thickness

There were no treatment related reductions in egg shell thickness at the 1, 3, or 10 ppm treatment groups. When treated groups were compared with the control, there were no statistically significant ($P < .05$) differences in egg shell thickness of any concentration tested.

h. Offspring Body Weights

There were no treatment related differences in the body weight of hatchlings or 14-day old survivors at any concentration tested. When compared with the control, there were no statistically significant differences ($P < .05$) in hatchling body weight or body weight of 14-day old survivors at any concentration tested.

13. Study Author's Conclusions/QA Measures (excerpted in part from submission):

Dietary concentrations of TPTH technical of up to 10 ppm did not result in mortality or overt signs of toxicity during the adult exposure period of 21 weeks. There were no apparent treatment related effects upon body weight or feed consumption among adults or body weight of hatchlings at any of the concentrations tested. There were no treatment related effects upon reproductive parameters at the 1 ppm or 3 ppm concentrations. There may have been a slight reduction in embryo viability and hatching success at the 10 ppm concentration. However, the differences could be attributed to variability as evidenced by the reproductive results at 1 ppm. The no-observed-effect concentration for TPTH technical in this study was 3 ppm, and may have been 10 ppm.

Quality assurance audits were performed by Lee F. Doggett. Final report was determined to be an accurate reflection of results obtained.

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

a. Test Procedures

The report states only that treatment levels were "based upon known toxicity data". This data was not included nor was there any further rationale provided for the levels selected. EEB notes that environmental concentrations that may be expected to occur with TPTH use are considerably greater than the test levels chosen. Typical and maximum residues expected immediately after each application with each use rate of TPTH, based on Hoerger and Kenaga 1972, are as follows:

Use	Max. Rate (lb ai per acre)	Estimated Environmental Concentration (ppm)									
		Short grass		Long grass		Leaves		Forage/ Sm.insect		Pods/ Lg.insect	
		max	ave	max	ave	max	ave	max	ave	max	ave
Tobacco	0.285	68	36	31	26	36	10	17	9	3	1
Potatoes, Sugar beets	0.297	71	37	33	27	37	10	17	10	4	1
Peanuts, Carrots	0.238	57	30	26	22	30	8	14	8	3	1
Pecans	0.713	171	89	78	66	89	25	41	24	9	2

Given repeated applications at 10-14 day intervals, actual residues are likely to exceed the above values. Therefore, EEB believes that a nominal test level of 40-50 ppm bracketed by lower (e.g. 5 ppm) and higher (e.g. 80-100 ppm) test levels would be more appropriate for use in a hazard assessment than the test levels selected for this study.

Other discrepancies and/or deviations from recommended procedures are as follows:

1. Diet palatability/repellency was not reported.

2. The report did not state the rationale for selecting eggs for shell thickness analysis. Were eggs randomly chosen? Were cracked eggs included in those selected? Also, mechanically damaged eggs were neither reported nor accounted for in the text.

3. Percent active ingredient of the test material was not

reported within the procedures/methods section; the information was provided only in the Appendix.

4. Adult birds were exposed to 12 foot-candles of illumination; 6 foot-candles recommended.

5. Adult birds were kept at a relative humidity of 86%; 55% recommended.

6. Eggs were stored at a temperature of 13°C and a relative humidity of 88%; 16°C and 65% recommended.

7. Report states that samples of each test diet were analyzed for TPTH concentration; however, there are no results of detected TPTH concentrations for the nominal 1 ppm test level.

8. Low actual concentration (36-63% of nominal) of TPTH in the 3 ppm group during the fifth week.

9. Quality assurance information submitted only reported on accuracy of results; report should also reference validity of procedures and compliance with Good Laboratory Practice regulations.

These items should be addressed as to any influences on study results.

b. Statistical Analysis

Statistical procedures were not appropriate. There is no basis for transforming the number of eggs laid, the number of hatchlings, and the number of 14-day old survivors to percentile values of the maximum number of eggs laid or set in any test group, which were then used in statistical procedures. EEB evaluated the following parameters using an ANOVA program and Duncan's multiple range test: eggs laid, eggs cracked, eggs set, viable embryos, live embryos, and normal hatchlings. Results (attached) detected a significant decrease in the number of normal hatchlings in the 1 ppm test group as compared to the control group.

c. Discussion/Results

Based upon the reported results of this test, EEB does not concur with the study author's conclusions. Although detected differences could be partially attributed to variability within the test, there are other indications of treatment related effects. Table 1 summarizes reproductive data provided by the report. Most notable are the decreases in the number of hatchlings (per eggs set) and number of 14-day old survivors (per hen) in the 1 ppm and 10 ppm treatment levels

compared to controls. These may in turn be attributed to the decreased percentage of viable 14-day old embryos noted at these test levels. Further, there is a decrease in the number of live 21-day old embryos as a percentage of viable embryos in a dose-dependent manner. Also, data provided in Appendix IV (birds sacrificed at termination of the study- gross pathological observations) revealed "egg yolk peritonitis" and "massive egg yolk peritonitis" increasing in females in a nearly dose-dependent manner. The study author should provide a rationale as to why "none of the lesions observed appeared to be treatment related" as well as an explanation as to the 5 of 15 control hens exhibiting regressing/regressed ovaries. The no-observed-effect concentration for TPTH technical may have been 3 ppm; however, the low actual concentration of TPTH detected in the diet at this level during Week 5 may have contributed to a lack of effects.

The most significant item of concern to EEB is the low treatment levels used in this study (see Section 14a). Although the study may be considered valid (pending registrant response to above items), it is of little use in a hazard assessment for current TPTH label use rates. EEB recommends the study be repeated using test levels more indicative of expected environmental residues.

d. Adequacy of Study

1) Classification: Supplemental.

2) Rationale: Inadequate dosage levels and deviations from recommended test procedures.

3) Reparability: Reparability pending registrant response to items discussed under Section 14a-c.

15. Literature Cited:

Dunnett, C.W. 1955. A multiple comparison procedure for comparing several treatments with a control. J. Amer. Stat. Assoc. 50: 1096-1121.

Hoerger, F.D. and E.E. Kenaga. 1972. Pesticide residues on plants- correlation of representative data as a basis for estimation of their magnitude in the environment. Environmental Quality. Academic Press. New York. I: 9-28.

Table 1. Summary of TPTH effects on mallard duck reproductive parameters.

Parameter	Nominal Concentration of TPTH (ppm) 0	1	3	10
Eggs laid				
Total number	446	460	466	509
Number/hen	29.7	28.8	29.1	31.8
Eggs cracked				
Total number	20	18	9	17
Number/hen	1.3	1.1	0.6	1.1
Percent of eggs laid	4.5	3.9	1.9	3.3
Eggs set				
Total number	372	391	410	437
Percent of eggs laid	83.4	85.0	88.0	85.9
Viable embryos (14-day)				
Total number	303	274	358	319
Percent of eggs laid	67.9	59.6	76.8	62.7
Percent of eggs set	81.5	70.1	87.3	73.0
Live embryos (21-day)				
Total number	296	262	340	300
Percent of viable embryos	97.7	95.6	95.0	94.0
Hatchlings				
Total number	230	157	242	173
Percent of eggs laid	51.6	34.1	51.9	34.0
Percent of eggs set	61.8	40.2	59.0	39.6
Percent of viable embryos	75.9	57.3	67.6	54.2
Percent of live embryos	77.7	59.9	71.2	57.7
14-day-old survivors				
Total number	224	149	238	170
Number/hen	14.9	9.3	14.9	10.6
Percent of normal hatchlings	97.4	94.9	98.3	98.3
Average hatchling weight (g)	35	36	36	37
Average 14-day-old survivor weight (g)	215	220	224	231

Table 1. Continued.

Parameter	Nominal Concentration of TPTH (ppm) 0	1	3	10
Adult weight				
At study termination				
Females (g/bird)	1146	1188	1198	1176
Males (g/bird)	1161	1183	1170	1178
Increase from study initiation				
Females (g/bird)	+157	+185	+148	+179
Males (g/bird)	+15	+2	-5	+28
Mean eggshell thickness (mm)	0.369	0.383	0.389	0.377
Average feed consumption (g/bird/day)				
Pre-egg production	98.1	98.3	98.4	102.0
Egg production	144.8	143.1	133.9	144.0
Mean total	118.1	117.5	113.6	120.0

APPENDIX IV

GROSS PATHOLOGICAL OBSERVATIONS

TPTH TECHNICAL - PROJECT NUMBER 190-110

BIRDS SACRIFICED AT TERMINATION OF THE STUDY

	MALES PPM				FEMALES PPM			
	CONTROL	1	3	10	CONTROL	1	3	10
Slight Egg Yolk Peritonitis	0/16	0/16	0/16	0/16	3/15	0/16	2/16	0/16
Egg Yolk Peritonitis	0/16	0/16	0/16	0/16	0/15	0/16	5/16	3/16
Massive Egg Yolk Peritonitis	0/16	0/16	0/16	0/16	0/15	0/16	0/16	2/16
Abnormal Egg in Uterus	0/16	0/16	0/16	0/16	0/15	0/16	1/16	0/16
Regressing Ovary	0/16	0/16	0/16	0/16	3/15	4/16	3/16	3/16
Regressed Ovary	0/16	0/16	0/16	0/16	2/15	0/16	2/16	1/16
Juvenile Ovary	0/16	0/16	0/16	0/16	0/15	1/16	0/16	0/16
Regressing Testes	0/16	1/16	2/16	0/16	0/15	0/16	0/16	0/16
Abscess - Right Lobe of Liver	0/16	0/16	0/16	1/16	0/15	0/16	0/16	0/16
Multi-focal Abscess - Liver Firm and Granular	0/16	0/16	0/16	0/16	0/15	1/16	0/16	0/16
Not Remarkable	16/16	15/16	14/16	15/16	7/15	11/16	5/16	7/16

TPTH AVIAN REPRODUCTION DER - MALLA
SHAUGHNESSEY No. 083601
RECORD No. 175645/178059 (AMENDME

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loc 8673
 JOB#  JOBNAME    QUEUE    POSITION  LINES  DESTINATION
  8673 RMHXX     XEQ EPA2 A       12
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loc 8673
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     3 RMHXX     OUTPUT   A    1670     1440 HOLD
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   484                                                   1   A    37    1   31   25   24   19
   485                                                   2   A    12    0   10    8    7    6
   486                                                   3   A    42    3   35   31   30   27
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   489                                                   6   A    20    0   16   15   15   10
   490                                                   7   A    44    5   33   28   28   23
   491                                                   8   A    21    2   16   15   14    6
   492                                                   9   A    32    2   27   25   24   19
   493                                                  10   A    47    4   39   34   34   30
   494                                                  11   A    45    1   39   18   18   11
                                                        12   A    34    0   31   29   29   24
                                                        13   A    19    0   14    9    9    3
   497                                                  14   A    25    2   20   12   12   12
   498                                                  15   A    18    0   16   13   12   10
   499                                                  16   B    40    0   36    0    0    0
   500                                                  17   B    34    2   28   20   19   11
   501                                                  18   B    46    3   39   30   29   22
   502                                                  19   B    22    3   17   14   14   12
   503                                                  20   B    31    2   26   11   11    8
   504                                                  21   B    35    0   31   28   27   16
   505                                                  22   B    29    2   24   20   19   16
   506                                                  23   B    53    1   43   39   39   13
   507                                                  24   B    34    0   32   19   19   16
   508                                                  25   B    13    0   11    9    8    3
   509                                                  26   B    39    0   35   23   22   15
   510                                                  27   B    16    1   14   11    9    1
   511                                                  28   B     0    0    0    0    0    0
   512                                                  29   B    26    2   20   19   19   10
   513                                                  30   B    13    1   10    8    7    3
   514                                                  31   B    29    1   25   23   20   11
   515                                                  32   C    33    0   29   27   26   10
   516                                                  33   C    36    0   33   28   27   24
   517                                                  34   C     0    0    0    0    0    0
   518                                                  35   C    36    0   33   30   29   25
                                                        36   C    46    2   39   36   31   23
                                                        37   C    30    0   27   20   19    8
                                                        38   C    18    0   16   15   14    7
   522                                                  39   C    37    0   34   31   30   22
   523                                                  40   C    27    0   24   24   22   18
   524                                                  41   C    39    1   33   32   32   23
   525                                                  42   C    31    1   27   22   21   13
   526                                                  43   C    26    0   24   21   21   17
```

17

46	C	40	2	36	29	26	16
47	C	23	1	18	16	14	10
48	D	27	0	23	16	15	5
49	D	37	0	34	4	2	0
50	D	19	0	17	11	11	8
51	D	56	1	51	39	37	17
52	D	43	3	35	32	30	15
53	D	39	0	36	29	28	16
54	D	26	3	20	14	14	10
55	D	39	0	34	21	19	9

SAS 11:20 TUESDAY, MAY 31, 1988 2

OBS	TRT	EL	EC	ES	VE	LE	NH
56	D	33	0	29	25	24	17
57	D	31	1	24	20	17	5
58	D	36	1	31	24	23	17
59	D	4	1	2	0	0	0
60	D	19	1	16	14	14	8
61	D	46	5	37	24	23	20
62	D	25	0	23	23	23	15
63	D	29	1	25	23	20	11

1. ANALYSIS OF EL DATA 11:20 TUESDAY, MAY 31, 1988 3

****

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

1. ANALYSIS OF EL DATA 11:20 TUESDAY, MAY 31, 1988 4

****

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	89.59345238	29.86448413	0.20	0.8946	0.010170	40.7181
ERROR	59	8720.12083333	147.79865819		ROOT MSE		RESP MEAN
CORRECTED TOTAL	62	8809.71428571			12.15724715		29.85714286

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	89.59345238	0.20	0.8946	3	89.59345238	0.20	0.8946

1. ANALYSIS OF EL DATA 11:20 TUESDAY, MAY 31, 1988 5

****

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=59 MSE=147.799

(8

HARMONIC MEAN OF CELL SIZES=15.7377

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	8.67778	9.12441	9.41886

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	31.813	16	D
A			
A	29.733	15	A
A			
A	29.125	16	C
A			
A	28.750	16	B

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	5.02579365	1.67526455	1.05	0.3764	0.050774	124.2231
ERROR	59	93.95833333	1.59251412		ROOT MSE		RESP MEAN
CORRECTED TOTAL	62	98.98412698			1.26194854		1.01587302

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	5.02579365	1.05	0.3764	3	5.02579365	1.05	0.3764

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=59 MSE=1.59251

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.7377

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	0.900772	0.947134	0.977698

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	1.3333	15	A
A			
A	1.1250	16	B
A			
A	1.0625	16	D
A			
A	0.5625	16	C

3. ANALYSIS OF ES DATA 11:20 TUESDAY, MAY 31, 1988 9

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

3. ANALYSIS OF ES DATA 11:20 TUESDAY, MAY 31, 1988 10

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	78.03055556	26.01018519	0.23	0.8776	0.011389	41.9272
ERROR	59	6773.52500000	114.80550847		ROOT MSE		RESP MEAN
CORRECTED TOTAL	62	6851.55555556			10.71473324		25.55555556

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	78.03055556	0.23	0.8776	3	78.03055556	0.23	0.8776

3. ANALYSIS OF ES DATA 11:20 TUESDAY, MAY 31, 1988 11

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=59 MSE=114.806

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.7377

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	7.64812	8.04176	8.30127

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	27.313	16	D
A			

20

727 A
728 A 24.800 15 A
729 A
730 A 24.438 16 B
731 4. ANALYSIS OF VE DATA 11:20 TUESDAY, MAY 31, 1988 12

****

734 DELS PROCEDURE
735
736 CLASS LEVEL
738 CLASS LEVELS VALUES
739
740 TRT 4 A B C D
741
742
743 NUMBER OYSIS OF VE DATA 11:20 TUESDAY, MAY 31, 1986 13
745 GENERAL LINEAR MODELS PROCEDURE
748
749 DEPENDENT VARIABLE: RESP
75051 SOURCE DF SUM OF SQUARES MEAN R-SQUARE C.V.
752
753 MODEL 3 222.59107143 74.19702381 0.81 0.4936 0.039541 5
MEAN
756
757 CORRECTED TOTAL 62 9.57294696 19.90476190
758
759
760 SOURCE DF TYPE I SS F VALUE PR > F DF TYPE III SS F VALUE PR > F
761
762 TRT 222.59107143 0.81 0.4936 3 222.59107143 81 DATA 1
764 GENERAL LINEAR MODELS PROCEDURE
767

NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
ALPHA=0.05 DF=59 MSE=91.6413

773
774 C MEAN OF CELL SIZES=15.7377
776
777 NUMBER 3 4
778 CRITICAL RANGE 6.83312 7.18481 7.41666
779
780 MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.
781
782 784 A 22.375 16
785 .200 A
788 A 19.938 16 D
789 16 B
791 5. ANALYSIS OF LE DATA 11:20 TUESDAY, MAY 31, 1988 15
795
796 CLASS LEVEL INFORM TRT
801
802
803 NUMB LE DATAAY, MAY 31, 1988 16
805 **********
806
807 DF SUM OF SQUARES MEAN SQUARE F VALUE PR > F R-SQUARE
812
817 MODEL 3 200.30079365 66.76693122 0.77 0.5173 0.037517 49.0776

ERROR 59 5138.68333333 87.09632768 ROOT5338.98412698
8 F DF TYPE III SS F VALUE PR > F
821
822 TRT 3 200.30079365 0.77 0.5173 3 200.30079365 0.77 0.517
****
825
826 GENERAL F RANGE TEST FOR VARIABLE: RESP

21

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR	0.1086	0.100085
ERROR	57	29523.31212906	517.95284437				22.75857738

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	2							

****

S TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE.
RIMENTWISE ERROR RATE

ALPHA= MSE=517.953

WARNING: CELL SIZES ARE NOT EQUAL.

BER OF MEANS 2 3 4
CRITICAL RANGE 16.9504 17.3705 17.9319

EANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
654			A
A	67.029	15	B
A	66.825	16	D
A	66.106	15	

7. ANALYSIS OF ES/EL D

*

VARIABLE	N	MEAN	STANDARD	MINIMUM	IATION	VALUE	VALUE	OF MEAN	
EL	15	29.73333333	11.46090664	12.00000	47.	15	24.8000000	10.001275	372.00000000	94.17142857	39
WT	15	29.73.46090664	12.00000000	47.00000000	2.95919337	446.00000000	131.35238095	38.546	
	15	0.83280477	0.05524026	0.73684211	0.91176471	97	12.	1.0321328]	

QUEUE
]
QUEUE
1 730 999

A	24.438	16	B	

****

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

****

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.

MODEL	3	[illegible]	[illegible]	0.81	0.4936	[illegible]
ERROR	59	5406.83750000	91.64131356		ROOT MSE	RESP MEAN
CORRECTED TOTAL	62	5629.42857143			9.57294696	19.90476190

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	222.59107143	0.81	0.4936	3	222.59107143	0.81	0.4936

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=59 MSE=91.6413

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.7377

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	6.83312	7.18481	7.41666

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	22.375	16	C
A			
A	20.200	15	A
A			
A	19.938	16	D
A			
A	17.125	16	B

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	200.30079365	66.76693122	0.77	0.5173	0.037517	49.0776
ERROR	59	5138.68333333	87.09632768		ROOT MSE	23	RESP MEAN
CORRECTED TOTAL	62	5338.98412698			9.33254133		19.01587302

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	200.30079365	0.77	0.5173	3	200.30079365	0.77	0.5173

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=59 MSE=87.0963

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.7377

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	6.66152	7.00438	7.23041

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	21.250	16	C
A			
A	19.733	15	A
A			
A	18.750	16	D
A			
A	16.375	16	B

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	388.45436508	129.48478836	2.56	0.0639	0.114981	55.9207
ERROR	59	2989.95833333	50.67725989		ROOT MSE		RESP MEAN
CORRECTED TOTAL	62	3378.41269841			7.11879624		12.73015873

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	388.45436508	2.56	0.0639	3	388.45436508	2.56	0.0639

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=59 MSE=50.6773

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.7377

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	5.08136	5.34289	5.5153

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	15.333	15	A
A			
B A	15.125	16	C
B A			
B A	10.813	16	D
B			
B	9.813	16	B

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

NOTE: ALL DEPENDENT VARIABLES ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES. HOWEVER,
ONLY 61 OBSERVATIONS CAN BE USED IN THIS ANALYSIS.

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE
WEIGHT: WT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	3283.46159586	1094.48719862	2.11	0.1086	0.100085	33.4832
ERROR	57	29523.31212906	517.95284437		ROOT MSE		RESPONSE MEAN
CORRECTED TOTAL	60	32806.77372492			22.75857738		

	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	3283.46159586	2.11	0.1086	3	3283.46159586	2.11	0.1086

GENERAL LINEAR MODELS PROCEDURE

EST CONT NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.60 HARMONIC MEAN OF S

CHEMICAL: TPTH - MALLARD

EL

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 29.733

TOTAL NUMBER OF PAIRS(PENS): 63

MEAN SQUARE ERROR: 147.7987

ERROR DEGREES OF FREEDOM: 59

MEAN 1
%29.73
NUMBER OF PENS: 15

MEAN 2
%28.75
NUMBER OF PENS: 16

MEAN 3
%29.13
NUMBER OF PENS: 16

MEAN 4
%31.81
NUMBER OF PENS: 16

GRAND MEAN: 29.85525

==========

Phi = .3893608 ****THIS IS THE VALUE TO LOOK UP POWER = <0.30

D = 51.40599 PERCENT CHANGE DETECTION LIMIT

CHEMICAL: TPTH - MALLARD

EC

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 1.3333

TOTAL NUMBER OF PAIRS(PENS): 63

MEAN SQUARE ERROR: 1.592514

ERROR DEGREES OF FREEDOM: 59

MEAN 1
1.33
NUMBER OF PENS: 15

MEAN 2
1.13
NUMBER OF PENS: 16

MEAN 3
0.56
NUMBER OF PENS: 16

MEAN 4
1.06
NUMBER OF PENS: 16

GRAND MEAN: 1.020825

==========

Phi = .8883496 ****THIS IS THE VALUE TO LOOK UP POWER = <0.30

D = 118.9956 PERCENT CHANGE DETECTION LIMIT

CHEMICAL: TPTH - MALLARD

ES

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 24.8

TOTAL NUMBER OF PAIRS(PENS): 63

MEAN SQUARE ERROR: 114.8055

ERROR DEGREES OF FREEDOM: 59

MEAN 1
%24.80
NUMBER OF PENS: 15

MEAN 2
%24.44
NUMBER OF PENS: 16

MEAN 3
%25.63
NUMBER OF PENS: 16

MEAN 4
%27.31
NUMBER OF PENS: 16

GRAND MEAN: 25.544

==========

Phi = .4122626 ****THIS IS THE VALUE TO LOOK UP POWER = <0.30

D = 54.31839 PERCENT CHANGE DETECTION LIMIT

CHEMICAL: TPTH - MALLARD

VE

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 20.2

TOTAL NUMBER OF PAIRS(PENS): 63

MEAN SQUARE ERROR: 91.64131

ERROR DEGREES OF FREEDOM: 59

MEAN 1
%20.20
NUMBER OF PENS: 15

MEAN 2
%17.13
NUMBER OF PENS: 16

MEAN 3
%22.38
NUMBER OF PENS: 16

MEAN 4
%19.94
NUMBER OF PENS: 16

GRAND MEAN: 19.9095

==========

Phi = .7792559 ****THIS IS THE VALUE TO LOOK UP POWER = <0.30

D = 59.58151 PERCENT CHANGE DETECTION LIMIT

CHEMICAL: TPTH - MALLARD

LE

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 19.733

TOTAL NUMBER OF PAIRS(PENS): 63

MEAN SQUARE ERROR: 87.09633

ERROR DEGREES OF FREEDOM: 59

MEAN 1
%19.73
NUMBER OF PENS: 15

MEAN 2
%16.38
NUMBER OF PENS: 16

MEAN 3
%21.25
NUMBER OF PENS: 16

MEAN 4
%18.75
NUMBER OF PENS: 16

GRAND MEAN: 19.027

==========

Phi = .7582496 ****THIS IS THE VALUE TO LOOK UP Power: <0.30

D = 59.45988 PERCENT CHANGE DETECTION LIMIT

30

CHEMICAL: TPTH - MALLARD

NH

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 15.333

TOTAL NUMBER OF PAIRS(PENS): 63

MEAN SQUARE ERROR: 50.67726

ERROR DEGREES OF FREEDOM: 59

MEAN 1
%15.33
NUMBER OF PENS: 15

MEAN 2
9.81
NUMBER OF PENS: 16

MEAN 3
%15.13
NUMBER OF PENS: 16

MEAN 4
%10.81
NUMBER OF PENS: 16

GRAND MEAN: 12.771

==========

Phi = 1.384312 ****THIS IS THE VALUE TO LOOK UP POWER= 0.60

D = 58.37093 PERCENT CHANGE DETECTION LIMIT

DATA EVALUATION RECORD

1. Chemical: Triphenyltin Hydroxide (TPTH)

2. Test Material: Triphenyltin Hydroxide (TPTH) Technical (97.1% active ingredient).

3. Study Type: Avian Reproduction

   Species Tested: Bobwhite quail (*Colinus virginianus*)

4. Study ID: Triphenyltin Hydroxide (TPTH) Technical: A One-Generation Reproduction Study with the Bobwhite (*Colinus virginianus*). Final Report. Wildlife International Ltd. Project No. 190-109. Submitted to W.R. Landis Associates, Inc., Valdosta, GA. May 13, 1986. EPA Accession Nos. 263193 and 263954 (Amendment).

5. Reviewed By: David Warburton, Wildlife Biologist, EEB/HED — Signature: David Warburton — Date: 6/15/88

6. Approved By: Douglas J. Urban, Section Head 3, EEB/HED — Signature: Douglas J. Urban — Date: 6/15/88

7. Conclusions:

The submitted study concluded that dietary concentrations of TPTH technical at 3 and 10 ppm did not result in effects on bobwhite quail reproductive parameters. At 30 ppm there appeared to be an effect on the number of 14-day old survivors. Statistical analysis indicated the no-observed-effect-level to be 10 ppm. However, these results may not be reliable due to major data discrepancies. Specifically, high percentages of cracked eggs in the control group and the treatment levels selected are of greatest concern to EEB. The study is classified as "Supplemental".

8. Recommendations:

The registrant should address all items discussed under Section 14a-c.

9. Background:

The study was submitted as per data requirements specified under the TPTH Registration Standard.

10. Discussion of Individual Tests:

A supplement was submitted (EPA Accession No. 263954) but provides no new substantive data; changes relate to a minor typographical error and improved readability of graphics.

11. Materials and Methods (excerpted in part from submission):

a. Test Animals

Bobwhite quail, approximately 20 weeks old at beginning of study. All birds were obtained from Fritt's Quail Farm, Phillipsburg, NJ, and were from the same hatch, pen-reared, and indistinguishable from wild birds. Birds that were injured or did not appear healthy at test initiation were discarded.

b. Dose/Diet Preparation/Feed Consumption

Test diets were prepared by mixing TPTH technical into a premix which was used for preparation of the final diet. Control diet and three test concentrations (3, 10, 30 ppm) were prepared weekly and presented to birds on Friday of each week. The control diet contained an amount of the carrier corn oil equivalent to that in the treated diets (0.05%). Dietary concentrations were not adjusted for purity of the test material. Adults were fed a game bird ration formulated for breeding birds. All offspring received a game bird ration formulated for young growing birds as well as a water soluble vitamin mix in their water from day of hatch until 14 days of age. Water and feed were provided ad libitum during acclimation and during the test.

Samples of the control diet and each of the test diets were taken each week immediately after mixing for analysis.

Feed consumption was measured for each pen for a seven-day period every week throughout the study.

c. Procedures

Test Material

The test material, a white powder, was identified on the label as "Fentin Hydroxide Substanz Tech, (TPTH) HOE 029664 OF 2D97 0004 02.05.85". It was assigned Wildlife International Ltd. identification number WIL-989. Percent active ingredient identified by study sponsor was 97.1%.

Study Design

One hundred and twenty-eight (128) bobwhite (64 cocks and 64 hens) were randomly distributed into four groups, as follows:

Nominal Concentration	Number Of Pens	Birds Per Pen	
		Cocks	Hens
1. Control (0 ppm)	16	1	1
2. 3 ppm TPTH	16	1	1
3. 10 ppm TPTH	16	1	1
4. 30 ppm TPTH	16	1	1

Treatment levels were based on known toxicity data. Sex of the birds was determined by a visual examination of the feather coat. Adult birds were identified by individual leg bands.

The primary phases of the study and their approximate durations were:

1. Acclimation- 14 days.
2. Pre-photostimulation- 8 weeks.
3. Pre-egg laying (with photostimulation)- estimated 3 weeks.
4. Egg laying- approximately 9 weeks.
5. Post-adult sacrifice (final incubation, hatching, 14-day offspring rearing period)- 5 weeks.

Pen Facilities

Adult birds were housed indoors in a separate study room in galvanized wire/sheeting pens measuring 30 X 51 X 21 to 26 cm high. Pens were equipped with a feeder and waterer. Average temperature in the study room was 24°C ± 3°C (SD) with an average relative humidity of 74%.

During acclimation and upon initiation of the study, the birds were maintained under a photoperiod of 8 hours of light per day. From 8 weeks until terminal sacrifice, the photoperiod was increased to 17 hours of light per day. Birds received approximately 12 footcandles of illumination throughout the study.

Adult Observations/Gross Pathology

All adult birds were observed at least once daily throughout the study for signs of toxicity or abnormal behavior. A record was maintained of all mortalities and observations. All birds that died during the study were necropsied. In addition, at the conclusion of the adult exposure period all birds were sacrificed by cervical dislocation and necropsied.

Adult body weights were measured at study initiation, on weeks 2, 4, 6, 8, and at terminal sacrifice, but not during egg laying.

Eggs/Eggshell Thickness

Eggs were collected daily and marked according to pen of origin, and then stored in a cold room at 13°C ± 0.5°C (SD) and approximately 88% relative humidity until incubated. At weekly intervals all eggs were removed from the cold room and candled with a Speed King (Model 32) egg candling lamp to detect egg shell cracks. Cracked eggs were discarded. All eggs that were not cracked or used for egg shell thickness measurements were then fumigated to prevent pathogen contamination and placed in a Petersime Incubator (Model No. S20) where the temperature was maintained at 37.5°C ± 0.14°C (SD) and relative humidity was 56%. The incubator was also equipped with an automatic egg rotation device designed to rotate eggs 50° off vertical in opposite directions. Eggs were candled again on Day 11 of incubation to determine embryo viability; and on Day 21 to determine embryo survival. On Day 21 of incubation, the eggs were placed in a Petersime Hatcher (Model S20), separated by pen and allowed to hatch. Temperature in the hatchling compartment was 39°C ± 0.69°C with a relative humidity of 79%.

Weekly throughout the egg laying period, one egg was collected, when available, from each of the odd numbered pens during odd numbered weeks (1, 3, 5, etc.) and from each of the even numbered pens during even numbered weeks (2, 4, 6, etc.). The eggs were opened at the waist, the contents removed, and the shell thoroughly washed. The shells were then allowed to air dry for at least one week at room temperature. The average thickness of the dried shell plus the membrane was determined by measuring five points around the waist of the egg using a micrometer. Measurements were made to the nearest 0.005 mm.

Hatchlings

All hatchlings, unhatched eggs and egg shells were removed from the hatcher on Day 25 or 26 of incubation. The average body weight of the hatchlings by pen was then determined. Hatchlings were leg banded or toe-clipped for identification by pen of origin and then housed according to the appropriate parental concentration grouping in brooding pens (galvanized wire mesh/sheeting pens measuring 72 X 90 X 23 cm high; temperature maintained at 38°C) until 14 days of age. The hatchlings were fed untreated diet. At 14 days of age the average body weight by parental pen of all surviving chicks was determined.

Statistics

Upon completion of the study, Dunnett's method (Dunnett 1955) was used to determine statistically significant differences between the control group and each of the treatment groups. Sample units were the individual pens within each experimental group. Pens in which a mortality occurred were not used in statistical comparisons of the reproductive data. Each of the following parameters was analyzed statistically:

- Adult Feed Consumption
- Adult Body Weight
- Eggs Laid of Maximum Laid
- Eggs Cracked of Eggs Laid
- Viable Embryos of Eggs Set
- Live 3-week Embryos of Viable Embryos
- Hatchlings of 3-Week Embryos
- Offspring's Body Weight
- Hatchlings of Maximum Set
- 14-Day Old Survivors of Maximum Set
- 14-Day Old Survivors of Eggs Set
- 14-Day Old Survivors of Hatchlings
- Eggshell Thickness

12. Reported Results (excerpted in part from submission):

a. Diet Analysis

The concentration of triphenyltin hydroxide in the three levels averaged 102.0% and ranged from 94.3% to 112.8% of the claimed level. At the 3 ppm level, the average concentration of TPTH in seven of eight preparations (weeks 4, 5, 9, 11, 16, 19 and 21) was 91.5% of the theoretical level with values ranging from 72.7% to 104.3%. Values obtained from the analysis of feed prepared for the fifth week at this level were low (i.e., 36 to 63%). The average concentration of test material for the eight preparations at the 10 ppm level was 99.7% of the claimed concentration with a range of 77.2% to 112.8%. At the 30 ppm level, the concentration of TPTH in the eight weekly preparations analyzed averaged 95.9% with values ranging from 84.3% to 110.2%.

In a material stability test, the initial concentration of triphenyltin hydroxide in the three preparations averaged 102.0% of the claimed level. At the end of the five day period, the average concentration of TPTH in the three levels analyzed was 82.1%.

b. Mortalities

Three adult mortalities occurred during the study. All mortalities appeared to be incidental to treatment. One female from the control group was found dead during Week 12. Gross necropsy revealed no discernible lesions. A female from the 3 ppm group was found dead during Week 13. The bird showed feather loss from the right flank and rump. Internally there

was fatty degeneration of the liver with a possible hemorrhage in the left central lobe (approximately one third of the liver mass), and a ruptured yolk. A cock from the 30 ppm group was found dead during Week 3. The bird was found to have a broken neck, with hemorrhage in the cervical area and cranium. The bird appeared to have struck his head on the cage. No other mortalities occurred.

c. Clinical Observations

No overt signs of toxicity were observed during the course of the study. Only those lesions or abnormal behavior associated with pen wear and tear or cannibalism were observed during the study.

d. Gross Necropsy

All birds found dead during the study as well as birds sacrificed at the termination of the study were subjected to gross necropsy. Overt lesions observed in all birds found dead and those birds sacrificed at termination of the study appeared to be incidental to treatment.

e. Adult Body Weight and Feed Consumption

There were no treatment related effects upon body weight at any of the concentrations tested. There was no statistically significant difference from the controls in the body weight of hens at any concentration or of cocks at 3 ppm and 10 ppm. When compared to controls there was a statistically significant difference ($P < .05$) in the body weights of males at 30 ppm during Weeks 4 and 6. The difference observed was very slight and was not attributed to treatment.

There was no treatment related effect upon feed consumption at 3, 10, or 30 ppm. At 3 ppm, there was a statistically significant difference from the controls at $P < .05$ during Weeks 3, 10, and 20 and at $P < .01$ during Week 13. At 10 ppm there was a statistically significant difference from the controls at $P < .05$ during Weeks 3, 11, and 20 and at $P < .01$ during Week 13. A statistically significant difference ($P < .05$) in feed consumption was observed in the 30 ppm group during Weeks 10 and 20, and at $P < .01$ during Week 19. In all instances the difference in feed consumption was slight, and did not appear to be treatment related.

f. Reproductive Results

There were no apparent effects on reproductive parameters at the 3 ppm and 10 ppm concentrations. A statistically significant ($P < .05$) effect was observed at 30 ppm in the number of 14-day old survivors as a percent of eggs set. A heater

failure in one brooding pen containing hatchlings from the 30 ppm concentration resulted in 21 mortalities. However, when the mortalities were discounted, the effect upon the number of 14-day old survivors was still apparent although not statistically significant ($P < .05$). There were no other reproductive effects at 30 ppm.

g. Egg Shell Thickness

There was no treatment-related effect on egg shell thickness at any concentration tested. There were no statistically significant ($P < .05$) differences in egg shell thickness at any concentration.

h. Offspring Body Weights

There were no treatment related differences in the body weight of hatchlings or in the body weight of the 14-day old survivors at any concentration tested. When compared with the controls, there was a statistically significant increase ($P < .05$) in hatchling body weight between the controls and the 30 ppm treatment group. This difference was a one gram increase in mean body weight and was not considered to be meaningful.

13. Study Author's Conclusions/QA Measures (excerpted in part from submission):

Dietary concentrations of TPTH technical at 3, 10, or 30 ppm did not result in mortality or overt signs of toxicity during the exposure period of approximately 21 weeks. There were no apparent treatment-related effects upon body weight or feed consumption at any of the concentrations tested. Dietary concentrations of TPTH technical at 3 ppm and 10 ppm did not result in effects upon reproductive parameters. At 30 ppm there appeared to be an effect upon the number of 14-day old survivors. The no-observed-effect concentration for TPTH technical in this study was 10 ppm.

Quality assurance audits performed by Lee F. Doggett. Final report was determined to be an accurate reflection of results obtained.

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

a. Test Procedures

The percentage of cracked eggs in the control group (13.6%, Table 1) is of significant concern. Variability in percentage of cracked eggs in the control group ranged from 0 to 39%. Typically, 0.6 to 2.0% may be expected for the bobwhite. EPA

Environmental Research Laboratory, Corvallis, OR, reports the percentage of eggs cracked for the bobwhite in sloped cage facilities to be typically 1 to 2% and rarely exceeding 5% (C. Brassard, EEB). No explanation was provided by the study author for the unusually large value for percentage of cracked eggs.

Another significant item of concern to EEB is the treatment levels used in this study. The report states only that levels were "based upon known toxicity data". This data was not included nor was there any further rationale provided for the levels selected. EEB notes that environmental concentrations that may be expected to occur with TPTH use are considerably greater than the test levels chosen. Typical and maximum residues expected immediately after each application with each use rate of TPTH, based on Hoerger and Kenaga 1972, are as follows:

Use	Max. Rate (lb ai per acre)	Estimated Environmental Concentration (ppm)									
		Short grass		Long grass		Leaves		Forage/ Sm.insect		Pods/ Lg.insect	
		max	ave	max	ave	max	ave	max	ave	max	ave
Tobacco	0.285	68	36	31	26	36	10	17	9	3	1
Potatoes, Sugar beets	0.297	71	37	33	27	37	10	17	10	4	1
Peanuts, Carrots	0.238	57	30	26	22	30	8	14	8	3	1
Pecans	0.713	171	89	78	66	89	25	41	24	9	2

Given repeated applications at 10-14 day intervals, actual residues are likely to exceed the above values. Therefore, EEB believes that a nominal test level of 40-50 ppm bracketed by lower (e.g. 10 ppm) and higher (e.g. 80-100 ppm) test levels would be more appropriate for use in a hazard assessment than the test levels selected for this study. Further, the highest level tested (30 ppm nominal concentration) may have been effectively reduced given the results of the test diet analysis. With an average 95.5% TPTH concentration detected at the 30 ppm level and an average 80.2% TPTH concentration remaining after 5 days at the 30 ppm level, it is quite possible that the 30 ppm test level was actually below 25 ppm for a significant portion of the test.

Other discrepancies and/or deviations from recommended pro-

cedures are as follows:

1. Neither palatability nor feed spillage was reported or accounted for.

2. The report did not state the rationale for selecting eggs for shell thickness analysis. Were eggs randomly chosen? Were cracked eggs included in those selected? Also, mechanically damaged eggs were neither reported nor accounted for in the text.

3. Percent active ingredient of the test material was not reported within the procedures/methods section; the information was provided only in the Appendix.

4. Adult birds were exposed to 12 foot-candles of illumination; 6 foot-candles recommended.

5. Adult birds were kept at a relative humidity of 74%; 55% recommended.

6. Eggs were stored at a temperature of 13°C and a relative humidity of 88%; 16°C and 65% recommended.

7. Table 6 (p.31 of report) contains reference to "Ducklings" (vs. bobwhite quail chicks).

8. Quality assurance information submitted only reported on accuracy of <u>results</u>; report should also reference validity of <u>procedures</u> and compliance with Good Laboratory Practice regulations.

b. <u>Statistical Analysis</u>

Statistical procedures were not appropriate. There is no basis for transforming the number of eggs laid and the number of hatchlings to percentile values of the maximum number of eggs laid or set in any test group, which were then used in statistical procedures. EEB evaluated the following parameters using an ANOVA program and Duncan's multiple range test: eggs laid, eggs cracked, eggs set, viable embryos, live embryos, and normal hatchlings. Results (attached) indicated no significant differences in treatment group means from the control mean; however, the power of the test (1-ß) ranged from only <0.3 to approximately 0.35.

c. <u>Discussion/Results</u>

The study author should provide a detailed explanation of: 1) the unusually high percentage of cracked eggs in the control group (Table 1), and 2) the rationale for selecting

treatment levels in this test, as discussed above. Other discrepancies from recommended procedures, as outlined under Section 14a, should also be addressed as to any influences on study results.

d. Adequacy of Study

1) Classification: Supplemental.

2) Rationale: Deviations from required test procedures (see Sec. 14a) and expected control parameters are of significant concern.

3) Reparability: Reparability pending registrant response to items discussed under Section 14a-c.

15. Literature Cited:

Dunnett, C.W. 1955. A multiple comparison procedure for comparing several treatments with a control. J. Amer. Stat. Assoc. 50: 1096-1121.

Hoerger, F.D. and E.E. Kenaga. 1972. Pesticide residues on plants- correlation of representative data as a basis for estimation of their magnitude in the environment. Environmental Quality. Academic Press. New York. I: 9-28.

Table 1. Summary of TPTH effects on bobwhite quail reproductive parameters.

Parameter	Nominal Concentration of TPTH (ppm) 0	3	10	30
Eggs laid				
Total number	581	597	572	569
Number/hen	38.7	39.8	35.8	37.9
Eggs cracked				
Total number	79	35	101	88
Number/hen	5.3	2.3	6.3	5.9
Percent of eggs laid	13.6	5.9	17.7	15.5
Eggs set				
Total number	446	499	406	419
Percent of eggs laid	76.8	83.6	71.0	73.7
Viable embryos (11-day)				
Total number	421	432	372	360
Percent of eggs laid	72.5	72.4	65.0	63.3
Percent of eggs set	94.4	86.6	91.7	85.9
Live embryos (21-day)				
Total number	414	430	368	356
Percent of viable embryos	98.3	99.5	98.9	98.9
Hatchlings				
Total number	384	410	350	325
Percent of eggs laid	66.1	68.7	61.2	57.1
Percent of eggs set	86.1	82.2	86.2	77.6
Percent of viable embryos	91.2	94.9	94.1	90.3
Percent of live embryos	92.8	95.3	95.1	91.3
14-day-old survivors				
Total number	337	385	311	241
Number/hen	22.5	25.7	19.4	16.1
Percent of normal hatchlings	87.8	93.9	88.9	74.2
Average hatchling weight (g)	6	6	6	7
Average 14-day-old survivor weight (g)	27	29	28	27

Table 1. Continued.

Parameter	Nominal Concentration of TPTH (ppm) 0	3	10	30
Adult weight				
At study termination				
Females (g/bird)	231	230	228	231
Males (g/bird)	218	209	217	207
Increase from study initiation				
Females (g/bird)	+36	+36	+40	+37
Males (g/bird)	+21	+16	+22	+18
Mean eggshell thickness (mm)	0.215	0.220	0.210	0.210
Average feed consumption (g/bird/day)				
Pre-egg production	20.0	18.7	17.7	18.3
Egg production	22.8	22.9	21.9	22.0
Mean total	19.8	19.6	19.2	18.9

TPTH AVIAN REPRODUCTION DER-BOBW
SHAUGHNESSEY NO. 083601
RECORD NO. 175645/178059(AMENDMENT)

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CARY, N.C. 27511-8000

10:51 MONDAY, MAY 16, 1988 1

OBS	TRT	EL	EC	ES	VE	LE	NH
1	A	39	0	36	35	35	33
2	A	49	7	38	37	36	36
3	A	46	18	24	23	21	21
4	A	46	7	32	29	27	26
5	A	32	1	27	23	22	20
6	A	44	3	36	35	35	32
7	A	33	8	23	18	18	5
8	A	41	12	25	22	22	22
9	A	33	8	23	23	22	21
10	A	42	8	31	31	31	31
11	A	28	0	24	24	24	24
12	A	43	1	38	37	37	35
13	A	51	1	46	43	43	41
14	A	32	2	27	25	25	21
15	A	22	3	16	16	16	16
16	B	59	1	53	44	44	43
17	B	50	1	45	34	34	34
18	B	36	4	27	26	26	23
19	B	40	1	35	34	34	34
20	B	42	2	36	32	32	31
21	B	35	1	30	26	26	25
22	B	38	1	32	32	32	30
23	B	26	2	21	20	20	20
24	B	43	7	31	17	17	17
25	B	47	7	36	25	25	24
26	B	45	1	40	39	39	31
27	B	42	4	34	30	30	28
28	B	20	0	17	15	15	15
29	B	37	1	30	30	28	27
30	B	37	2	32	28	28	28
31	C	19	3	13	6	6	5
32	C	43	20	19	17	17	17
33	C	39	14	21	17	17	16
34	C	44	18	21	21	21	20
35	C	63	19	38	34	34	31
36	C	34	6	24	22	22	22
37	C	44	1	37	35	35	35
38	C	40	0	37	37	36	34
39	C	49	3	42	39	39	37
40	C	22	0	19	19	19	16
41	C	19	1	14	13	13	13
42	C	47	3	40	37	36	33

44	C	55	7	43	41	40	40
45	C	19	0	16	15	15	14
46	C	33	6	22	19	18	17
47	D	41	4	33	26	26	25
48	D	25	5	17	17	17	16
49	D	45	3	38	31	31	29
50	D	36	6	26	25	24	21
51	D	32	4	24	17	17	16
52	D	47	1	38	29	29	28
53	D	39	3	33	31	31	29
54	D	22	1	18	16	16	13
55	D	40	6	30	29	29	26

OBS	TRT	EL	EC	ES	VE	LE	NH
56	D	62	5	53	47	46	37
57	D	24	4	16	14	13	10
58	D	26	6	16	14	14	14
59	D	47	16	27	22	21	21
60	D	34	4	25	21	21	21
61	D	49	20	25	21	21	19

1. ANALYSIS OF EL DATA
****

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 61

1. ANALYSIS OF EL DATA
****

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	137.71693989	45.90564663	0.34	0.7979	0.017479	30.6547
ERROR	57	7741.26666667	135.81169591		ROOT MSE		RESP MEAN
CORRECTED TOTAL	60	7878.98360656			11.65382752		38.01639344

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	137.71693989	0.34	0.7979	3	137.71693989	0.34	0.7979

1. ANALYSIS OF EL DATA
****

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=57 MSE=135.812

HARMONIC MEAN OF CELL SIZES=15.2381

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	8.45948	8.89479	9.18229

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	39.800	15	B
A			
A	38.733	15	A
A			
A	37.933	15	D
A			
A	35.750	16	C

EGGS LAID

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 61

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	146.49692623	48.83230874	1.73	0.1712	0.083430	106.9761
ERROR	57	1609.43750000	28.23574561		ROOT MSE		RESP MEAN
CORRECTED TOTAL	60	1755.93442623			5.31373180		4.96721311

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	146.49692623	1.73	0.1712	3	146.49692623	1.73	0.1712

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=57 MSE=28.2357

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.2381

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	3.85722	4.05571	4.1868

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	6.313	16	C
A			
A	5.867	15	D
A			
A	5.267	15	A
A			
A	2.333	15	B

EGGS CRACKED

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 61

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	508.43360656	169.47786885	1.68	0.1814	0.081259	34.6097
ERROR	57	5748.55000000	100.85175439		ROOT MSE		RESP MEAN
CORRECTED TOTAL	60	6256.98360656			10.04249742		29.01639344

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	508.43360656	1.68	0.1814	3	508.43360656	1.68	0.1814

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=57 MSE=100.852

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.2381

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	7.28982	7.66494	7.91269

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	33.267	15	B

47

A	29.733	15	A	
A				
A	27.933	15	D	
A				
A	25.375	16	C	

EXCEL SET

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	362.65027322	120.88342441	1.35	0.2685	0.066165	36.4693
ERROR	57	5118.33333333	89.79532164		ROOT MSE		RESP MEAN
CORRECTED TOTAL	60	5480.98360656			9.47603934		25.98360656

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	362.65027322	1.35	0.2685	3	362.65027322	1.35	0.2685

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

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.2381

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	6.87863	7.23259	7.46636

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	28.800	15	B
A			
A	28.067	15	A
A			
A	24.000	15	D
A			
A	23.250	16	C

VIABLE EMBRYOS

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 61

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	360.82185792	120.27395264	1.36	0.2645	0.066761	36.5955
ERROR	57	5043.86666667	88.48888889		ROOT MSE		RESP MEAN
CORRECTED TOTAL	60	5404.68852459			9.40685329		25.70491803

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	360.82185792	1.36	0.2645	3	360.82185792	1.36	0.2645

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=57 MSE=88.4889

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.2381

NUMBER OF MEANS 2 3 4

CRITICAL RANGE 6.63841 6.97727 7.21165

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	28.667	15	B
A			
A	27.600	15	A
A			
A	23.733	15	D
A			
A	23.000	16	C

LIVE EMBRYOS

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 61

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	358.57349727	119.52449909	1.43	0.2436	0.069971	37.9707
ERROR	57	4766.01666667	83.61432749		ROOT MSE		RESP MEAN
CORRECTED TOTAL	60	5124.59016393			9.14408702		24.08196721

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	3	358.57349727	1.43	0.2436	3	358.57349727	1.43	0.2436

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=57 MSE=83.6143

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.2381

NUMBER OF MEANS	2	3	4
CRITICAL RANGE	6.63767	6.97923	7.20481

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

50

DUNCAN GROUPING	MEAN	N	TRT

A
A 25.600 15 A

HATCHLINGS

A
A 21.875 16 C
A
A 21.667 15 D

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	4	A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 61

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE
WEIGHT: WT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	3	22864.48341989	7621.49447330	3.18	0.0307	0.143415	79.5775
ERROR	57	136564.22762593	2395.86364256		ROOT MSE		RESPONSE MEAN
CORRECTED TOTAL	60	159428.71104582			48.94756013		61.50932987

SOURCE	DF	TYPE I SS	F VALUE	PR > F
TRT	3	22864.48341989	3.18	0.0307

NALYSIS OF ES/EL DATA 10:51 MOND

****

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE R

NOT THE EXPERIMENTWISE ERROR RATE 903

W

HARMONIC MEAN OF CELL SIZES=15.2381

NUMBER OF ME 38.5668

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

A 66.11 15 B
A
A
A 59.17 15 D
55.17

7. ANALYSIS OF ES/EL DATA 10:51 MONDAY, MA

MAXIMUM	STD ERROR DEVIATION	SUM VALUE	VARIANCE VALUE	C.V. OF MEAN

--- TRT=A ---

EL 15 38.73333333 8.3449442
ES 15 29.73333333 7.87824007 16.00000000 46.00000000 2.5284 44429 22.00000000 51.00000000 2.154655
15 0.76890322 0.11368314 0.52173913 0.92307692 0.02935286 11.53354828 0.0 14.785

57

CHEMICAL: TPTH

EL

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 38.733

TOTAL NUMBER OF PAIRS(PENS): 61

MEAN SQUARE ERROR: 135.8117

ERROR DEGREES OF FREEDOM: 57

MEAN 1
%38.73
NUMBER OF PENS: 15

MEAN 2
%39.80
NUMBER OF PENS: 15

MEAN 3
%35.75
NUMBER OF PENS: 16

MEAN 4
%37.93
NUMBER OF PENS: 15

GRAND MEAN: 38.054

==========

Phi = .5036425 ****THIS IS THE VALUE TO LOOK UP → POWER < 0.3

D = 37.82723 PERCENT CHANGE DETECTION LIMIT

CHEMICAL: TPTH

EC

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 5.267

TOTAL NUMBER OF PAIRS(PENS): 61

MEAN SQUARE ERROR: 28.23575

ERROR DEGREES OF FREEDOM: 57

MEAN 1
5.27
NUMBER OF PENS: 15

MEAN 2
2.33
NUMBER OF PENS: 15

MEAN 3
6.31
NUMBER OF PENS: 16

MEAN 4
5.87
NUMBER OF PENS: 15

GRAND MEAN: 4.945

==========

Phi = 1.139249 ****THIS IS THE VALUE TO LOOK UP → Power ~ 0.35

D = 128.9359 PERCENT CHANGE DETECTION LIMIT

CHEMICAL: TPTH

ES

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 29.733

TOTAL NUMBER OF PAIRS(PENS): 61

MEAN SQUARE ERROR: 100.8518

ERROR DEGREES OF FREEDOM: 57

MEAN 1
%29.73
NUMBER OF PENS: 15

MEAN 2
%33.27
NUMBER OF PENS: 15

MEAN 3
%25.38
NUMBER OF PENS: 16

MEAN 4
%27.93
NUMBER OF PENS: 15

GRAND MEAN: 29.077

==========

Phi = 1.122951 ****THIS IS THE VALUE TO LOOK UP ⟶ Power ~ 0.35

D = 42.46393 PERCENT CHANGE DETECTION LIMIT

CHEMICAL: TPTH

VE

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 28.067

TOTAL NUMBER OF PAIRS(PENS): 61

MEAN SQUARE ERROR: 89.79532

ERROR DEGREES OF FREEDOM: 57

MEAN 1
%28.07
NUMBER OF PENS: 15

MEAN 2
%28.80
NUMBER OF PENS: 15

MEAN 3
%23.25
NUMBER OF PENS: 16

MEAN 4
%24.00
NUMBER OF PENS: 15

GRAND MEAN: 26.02925

==========

Phi = 1.005022 ****THIS IS THE VALUE TO LOOK UP → Power ~ 0.3

D = 42.4471 PERCENT CHANGE DETECTION LIMIT

CHEMICAL: TPTH

LE

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 27.6

TOTAL NUMBER OF PAIRS(PENS): 61

MEAN SQUARE ERROR: 88.48889

ERROR DEGREES OF FREEDOM: 57

MEAN 1
%27.60
NUMBER OF PENS: 15

MEAN 2
%28.67
NUMBER OF PENS: 15

MEAN 3
%23.00
NUMBER OF PENS: 16

MEAN 4
%23.73
NUMBER OF PENS: 15

GRAND MEAN: 25.75

==========

Phi = 1.009895 ****THIS IS THE VALUE TO LOOK UP Power ~0.3

D = 42.85017 PERCENT CHANGE DETECTION LIMIT

56

CHEMICAL: TPTH

NH

TOTAL NUMBER OF PAIRS(PENS): 4

NUMBER OF CONTROL PAIRS(PENS): 15

CONTROL MEAN: 25.6

TOTAL NUMBER OF PAIRS(PENS): 61

MEAN SQUARE ERROR: 83.61433

ERROR DEGREES OF FREEDOM: 57

MEAN 1
%25.60
NUMBER OF PENS: 15

MEAN 2
%27.33
NUMBER OF PENS: 15

MEAN 3
%21.88
NUMBER OF PENS: 16

MEAN 4
%21.67
NUMBER OF PENS: 15

GRAND MEAN: 24.11875

==========

Phi = 1.035463 ****THIS IS THE VALUE TO LOOK UP Power ~ 0.3

D = 45.64969 PERCENT CHANGE DETECTION LIMIT