US EPA ARCHIVE DOCUMENT
MEMORANDUM  JUN 6 1988

Record No. 175645
Record No. 178059

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

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

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

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:


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 reevalabilty of each test following registart'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.
EEB REVIEW

DATE: IN 6/19/86 OUT JUN 16 1988
FILE OR REG. NO 53265-0
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 }

Supplemental
178059
RECORD NO.

083601
SHAUGHNESSEY NO.

EEB REVIEW

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

FILE OR REG. NO. 53265-0

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
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)


5. **Reviewed By:** David Warburton
   - **EEB/HED**
   - **Signature:** [Signature]
   - **Date:** 6/15/88

6. **Approved By:** Douglas J. Urban
   - **Section Head 3**
   - **EEB/HED**
   - **Signature:** [Signature]
   - **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 hatching 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:

<table>
<thead>
<tr>
<th>Nominal Concentration</th>
<th>Number Of Pens</th>
<th>Birds Per Pen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control (0 ppm).</td>
<td>16</td>
<td>1 Drakes</td>
</tr>
<tr>
<td>2. 1 ppm TP4H</td>
<td>16</td>
<td>1 Drakes</td>
</tr>
<tr>
<td>3. 3 ppm TP4H</td>
<td>16</td>
<td>1 Drakes</td>
</tr>
<tr>
<td>4. 10 ppm TP4H</td>
<td>16</td>
<td>1 Drakes</td>
</tr>
</tbody>
</table>

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 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 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 hatching 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%.
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-
significant (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:

<table>
<thead>
<tr>
<th>Use</th>
<th>Max. Rate (lb ai per acre)</th>
<th>Estimated Environmental Concentration (ppm)</th>
<th>Mean Ave</th>
<th>Mean Ave</th>
<th>Mean Ave</th>
<th>Max Ave</th>
<th>Max Ave</th>
<th>Max Ave</th>
<th>Max Ave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>0.285</td>
<td></td>
<td>68</td>
<td>36</td>
<td>31</td>
<td>26</td>
<td>36</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Potatoes, Sugar beets</td>
<td>0.297</td>
<td></td>
<td>71</td>
<td>37</td>
<td>33</td>
<td>27</td>
<td>37</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Peanuts, Carrots</td>
<td>0.238</td>
<td></td>
<td>57</td>
<td>30</td>
<td>26</td>
<td>22</td>
<td>30</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>Pecans</td>
<td>0.713</td>
<td></td>
<td>171</td>
<td>89</td>
<td>78</td>
<td>66</td>
<td>89</td>
<td>25</td>
<td>41</td>
</tr>
</tbody>
</table>

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:


<table>
<thead>
<tr>
<th>Parameter</th>
<th>Nominal Concentration of TPTH (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Eggs laid</td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>446</td>
</tr>
<tr>
<td>Number/hen</td>
<td>29.7</td>
</tr>
<tr>
<td>Eggs cracked</td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>20</td>
</tr>
<tr>
<td>Number/hen</td>
<td>1.3</td>
</tr>
<tr>
<td>Percent of eggs laid</td>
<td>4.5</td>
</tr>
<tr>
<td>Eggs set</td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>372</td>
</tr>
<tr>
<td>Percent of eggs laid</td>
<td>83.4</td>
</tr>
<tr>
<td>Viable embryos (14-day)</td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>303</td>
</tr>
<tr>
<td>Percent of eggs laid</td>
<td>67.9</td>
</tr>
<tr>
<td>Percent of eggs set</td>
<td>81.5</td>
</tr>
<tr>
<td>Live embryos (21-day)</td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>296</td>
</tr>
<tr>
<td>Percent of viable embryos</td>
<td>97.7</td>
</tr>
<tr>
<td>Hatchlings</td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>230</td>
</tr>
<tr>
<td>Percent of eggs laid</td>
<td>51.6</td>
</tr>
<tr>
<td>Percent of eggs set</td>
<td>61.8</td>
</tr>
<tr>
<td>Percent of viable embryos</td>
<td>75.9</td>
</tr>
<tr>
<td>Percent of live embryos</td>
<td>77.7</td>
</tr>
<tr>
<td>14-day-old survivors</td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>224</td>
</tr>
<tr>
<td>Number/hen</td>
<td>14.9</td>
</tr>
<tr>
<td>Percent of normal hatchlings</td>
<td>97.4</td>
</tr>
<tr>
<td>Average hatchling weight (g)</td>
<td>35</td>
</tr>
<tr>
<td>Average 14-day-old survivor weight (g)</td>
<td>215</td>
</tr>
</tbody>
</table>
Table 1. Continued.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Nominal Concentration of TPTH (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Adult weight</td>
<td></td>
</tr>
<tr>
<td>At study termination</td>
<td></td>
</tr>
<tr>
<td>Females (g/bird)</td>
<td>1146</td>
</tr>
<tr>
<td>Males (g/bird)</td>
<td>1161</td>
</tr>
<tr>
<td>Increase from study initiation</td>
<td></td>
</tr>
<tr>
<td>Females (g/bird)</td>
<td>+157</td>
</tr>
<tr>
<td>Males (g/bird)</td>
<td>+15</td>
</tr>
<tr>
<td>Mean eggshell thickness (mm)</td>
<td>0.369</td>
</tr>
<tr>
<td>Average feed consumption (g/bird/day)</td>
<td></td>
</tr>
<tr>
<td>Pre-egg production</td>
<td>98.1</td>
</tr>
<tr>
<td>Egg production</td>
<td>144.8</td>
</tr>
<tr>
<td>Mean total</td>
<td>118.1</td>
</tr>
</tbody>
</table>
## APPENDIX IV

GROSS PATHOLOGICAL OBSERVATIONS

TPTH TECHNICAL - PROJECT NUMBER 190-110

BIRDS SACRIFICED AT TERMINATION OF THE STUDY

<table>
<thead>
<tr>
<th></th>
<th>MALES</th>
<th>FEMALES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PPM</td>
<td>CONTROL</td>
</tr>
<tr>
<td>Slight Egg Yolk Peritonitis</td>
<td>0/16</td>
<td>0/16</td>
</tr>
<tr>
<td>Egg Yolk Peritonitis</td>
<td>0/16</td>
<td>0/16</td>
</tr>
<tr>
<td>Massive Egg Yolk Peritonitis</td>
<td>0/16</td>
<td>0/16</td>
</tr>
<tr>
<td>Abnormal Egg in Uterus</td>
<td>0/16</td>
<td>0/16</td>
</tr>
<tr>
<td>Regressing Ovary</td>
<td>0/16</td>
<td>0/16</td>
</tr>
<tr>
<td>Regressed Ovary</td>
<td>0/16</td>
<td>0/16</td>
</tr>
<tr>
<td>Juvenile Ovary</td>
<td>0/16</td>
<td>0/16</td>
</tr>
<tr>
<td>Regressing Testes</td>
<td>0/16</td>
<td>1/16</td>
</tr>
<tr>
<td>Abscess - Right Lobe of Liver</td>
<td>0/16</td>
<td>0/16</td>
</tr>
<tr>
<td>Multi-focal Abscess - Liver Firm and Granular</td>
<td>0/16</td>
<td>0/16</td>
</tr>
<tr>
<td>Not Remarkable</td>
<td>16/16</td>
<td>15/16</td>
</tr>
</tbody>
</table>
**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

GENERAL LINEAR MODELS PROCEDURE

DUNCAN’S MULTIPLE RANGE TEST FOR VARIABLE: RESP

NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE.

ALPHA=0.05 DF=59 MSE=147.799
HARMONIC MEAN OF CELL SIZES = 15.7777

NUMBER OF MEANS 2 3 4
CRITICAL RANGE 9.67779 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 29.125 16 C
A 28.750 16 B

2. ANALYSIS OF EC DATA 11:20 TUESDAY, MAY 31, 1988

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS LEVELS VALUES

TRT 4 A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

2. ANALYSIS OF EC DATA 11:20 TUESDAY, MAY 31, 1988

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 93.95033333 1.59251412 ROOT MSE
78.98412698 1.26194854
78.98412698 1.01587302

CORRECTED TOTAL 62 98.98412698 1.26194854
98.98412698 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
2. ANALYSIS OF EC DATA 11:20 TUESDAY, MAY 31, 1988 8

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 = 15.7777

NUMBER OF MEANS 2 3 4
CRITICAL RANGE 0.900772 0.947134 0.977698
DUNCAN GROUPING MEAN N TRT

A 1.3333 15 A
A 1.1250 16 B
A 1.0625 16 D
A 0.5625 16 C

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

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

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 6773.5250000 114.80550847

CORRECTED TOTAL 62 6851.5555555

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

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
### Analysis of Ve Data

**CLASS LEVEL**

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<th>CLASS LEVELS</th>
<th>VALUES</th>
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<tbody>
<tr>
<td>A</td>
<td>24.300</td>
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<tr>
<td>B</td>
<td>24.438</td>
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<tr>
<td>C</td>
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**DELS PROCEDURE**

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</tr>
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<tbody>
<tr>
<td>DF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SUM OF SQUARES</td>
<td>222.59107143</td>
<td>74.1970281</td>
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</tr>
<tr>
<td>MEAN</td>
<td>0.81</td>
<td>0.4936</td>
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</tr>
<tr>
<td>R-SQUARE</td>
<td>0.039541</td>
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<tr>
<td>C.V.</td>
<td>19.90476190</td>
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**CORRECTED TOTAL**

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<th>B</th>
<th>C</th>
<th>D</th>
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<tr>
<td>DF</td>
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<td>222.59107143</td>
<td>81</td>
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<td>MEAN</td>
<td>0.81</td>
<td>0.4936</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-SQUARE</td>
<td>0.039541</td>
<td></td>
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<tr>
<td>C.V.</td>
<td>19.90476190</td>
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**SOURCE**

<table>
<thead>
<tr>
<th>TYPE I SS</th>
<th>F VALUE</th>
<th>PR &gt; F</th>
<th>DF</th>
<th>TYPE III SS</th>
<th>F VALUE</th>
<th>PR &gt; F</th>
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<tbody>
<tr>
<td>TRT</td>
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<td>0.81</td>
<td>0.4936</td>
<td>3</td>
<td>222.59107143</td>
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**NOTE:** THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE, ALPHA=0.05, DF=39, MSE=9.6413

**C MEAN OF CELL SIZES=15.7377**

**NUMBER 3**

<table>
<thead>
<tr>
<th>CRITICAL RANGE</th>
<th>6.83312</th>
<th>7.18461</th>
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**MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.**

<table>
<thead>
<tr>
<th>TRT</th>
<th>A</th>
<th>22.375</th>
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</thead>
<tbody>
<tr>
<td>B</td>
<td>19.938</td>
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</table>

**ANALYSIS OF VE DATA**

**CLASS LEVEL INFORM**

**SUM OF DATAWAY, MAY 31, 1988**

<table>
<thead>
<tr>
<th>TRT</th>
<th>4</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUM OF SQUARES</td>
<td>200.30079365</td>
<td>66.76693122</td>
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<td></td>
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</tr>
<tr>
<td>MEAN</td>
<td>0.77</td>
<td>0.5173</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>R-SQUARE</td>
<td>0.49.4976</td>
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**L. ERROR**

<table>
<thead>
<tr>
<th>TRT</th>
<th>59</th>
<th>5138.68333333</th>
<th>87.09632768</th>
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<tbody>
<tr>
<td>DF</td>
<td></td>
<td>TYPE III SS</td>
<td>F VALUE</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>200.30079365</td>
<td>0.77</td>
</tr>
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</table>

**GENERATED RANGE TEST FOR HOMOGENESS, DEEP**
**1. Analysis of ES/EL Data**

**Analysis:**

- **Type I SS:**
  - Source: 57
  - Sum of Squares: 25523.31212906
  - Mean Square: 517.95284437
  - F Value: 22.7585725
  - P: 0.00065

- **Type III SS:**
  - Source: 57
  - Sum of Squares: 25523.31212906
  - Mean Square: 517.95284437
  - F Value: 22.7585725
  - P: 0.00065

**Notes:**

- S test controls the Type I comparisonwise error rate.
- Duncan's grouping:
  - A: 654
  - A: 67.029
  - A: 68.825
  - A: 66.106

**Variables:**

<table>
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<tr>
<th>VARIABLE</th>
<th>N</th>
<th>MEAN</th>
<th>STANDARD</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
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<tbody>
<tr>
<td>EL</td>
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<td>29.73333333</td>
<td>11.46090664</td>
<td>12.000000</td>
<td>47.15240000</td>
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<tr>
<td>WT</td>
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<td>29.7346090664</td>
<td>12.00000000</td>
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<tr>
<td></td>
<td>15</td>
<td>0.83280477</td>
<td>0.05524026</td>
<td>0.73684211</td>
<td>0.91176471</td>
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**Queue:**

- 1.770999
- 1.780999
- 1.790999

**4. Analysis of VE Data**

- **General Linear Models Procedure**
- **Class Level Information**
  - **Class Levels Values**
    - TRT: 4 A B C D
  - Number of Observations in Data Set = 63

**5. Analysis of VE Data**

**General Linear Models Procedure**

**Dependent Variable: Resp**

- **Source:**
  - DF | SUM OF SQUARES | MEAN SQUARE | F VALUE | P R > F | R-SQUARE | C.V.
<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>TYPE I SS</th>
<th>F VALUE</th>
<th>PR &gt; F</th>
<th>DF</th>
<th>TYPE III SS</th>
<th>F VALUE</th>
<th>PR &gt; F</th>
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<tbody>
<tr>
<td>TRT</td>
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<td>222.59107143</td>
<td>0.81</td>
<td>0.4976</td>
<td>3</td>
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<td>0.81</td>
<td>0.4976</td>
</tr>
</tbody>
</table>

4. ANALYSIS OF VE DATA

11:20 TUESDAY, MAY 31, 1988

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

\[ \alpha = 0.05 \quad DF = 59 \quad MSE = 91.6413 \]

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

NUMBER OF MEANS = 2
CRITICAL RANGE = 6.83312, 7.18481, 7.41666

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

<table>
<thead>
<tr>
<th>DUNCAN GROUPING</th>
<th>MEAN</th>
<th>N</th>
<th>TRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>22.375</td>
<td>16</td>
<td>C</td>
</tr>
<tr>
<td>A</td>
<td>20.200</td>
<td>15</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>19.938</td>
<td>16</td>
<td>D</td>
</tr>
<tr>
<td>A</td>
<td>17.125</td>
<td>16</td>
<td>B</td>
</tr>
</tbody>
</table>

5. ANALYSIS OF LE DATA

11:20 TUESDAY, MAY 31, 1988

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS LEVELS VALUES
TRT = 4 A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

5. ANALYSIS OF LE DATA

11:20 TUESDAY, MAY 31, 1988

GENERAL LINEAR MODELS PROCEDURE

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLE: RESP</th>
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<tbody>
<tr>
<td>UACE</td>
</tr>
<tr>
<td>DF</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>813</td>
</tr>
<tr>
<td>815</td>
</tr>
<tr>
<td>817</td>
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</table>
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=87.0463

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 7.22041

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

6. ANALYSIS OF NH DATA

11:20 TUESDAY, MAY 31, 1988

******************************

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS LEVELS VALUES

TRT 4 A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 63

6. ANALYSIS OF NH DATA

11:20 TUESDAY, MAY 31, 1988

******************************

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 2989.9583333 50.67725989

R-SQUARED 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

6. ANALYSIS OF NH DATA

11:20 TUESDAY, MAY 31, 1988
CHEMICAL: TPTH-MAUAA

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
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<tr>
<td><strong>TOTAL NUMBER OF PAIRS (PENS):</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>NUMBER OF CONTROL PAIRS (PENS):</strong></td>
<td>15</td>
</tr>
<tr>
<td><strong>CONTROL MEAN:</strong></td>
<td>1.3333</td>
</tr>
<tr>
<td><strong>TOTAL NUMBER OF PAIRS (PENS):</strong></td>
<td>63</td>
</tr>
<tr>
<td><strong>MEAN SQUARE ERROR:</strong></td>
<td>1.592514</td>
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<tr>
<td><strong>ERROR DEGREES OF FREEDOM:</strong></td>
<td>59</td>
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</table>

<table>
<thead>
<tr>
<th>MEAN 1</th>
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</tr>
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<tbody>
<tr>
<td>1.33</td>
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<td><strong>NUMBER OF PENS:</strong></td>
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</table>

<table>
<thead>
<tr>
<th>MEAN 2</th>
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<tbody>
<tr>
<td>1.13</td>
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<table>
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<th>MEAN 3</th>
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<tbody>
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<td>0.56</td>
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<tr>
<td><strong>NUMBER OF PENS:</strong></td>
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<table>
<thead>
<tr>
<th>MEAN 4</th>
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<tbody>
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**GRAND MEAN:** 1.020825

\[ \Phi = 0.8883496 \quad ****THIS \ IS \ THE \ VALUE \ TO \ LOOK \ UP \quad P_{\text{POWER}} = 0.30 \]

\[ D = 118.9956 \quad \text{PERCENT CHANGE DETECTION LIMIT} \]
CHEMICAL: TPTH - MALLARD

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 = 0.4122626  ****THIS IS THE VALUE TO LOOK UP  Power = 0.30
D = 54.31839  PERCENT CHANGE DETECTION LIMIT
CHEMICAL: TPTH-MALLARDO

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: 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  \( P_{\text{pow}} < 0.30 \)
D = 59.45988 PERCENT CHANGE DETECTION LIMIT
CHEMICAL: \( \text{TPTH - Mallard} \)

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

---

\( \Phi = 1.384312 \)  \( \text{***THIS IS THE VALUE TO LOOK UP} \)  \( \text{Power} = 0.60 \)

\( D = 58.37093 \)  \( \text{PERCENT CHANGE DETECTION LIMIT} \)
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)


5. Reviewed By: David Warburton Wildlife Biologist EEB/HED Signature: [Signature]

6. Approved By: Douglas J. Urban Section Head 3 EEB/HED Signature: [Signature]

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:

<table>
<thead>
<tr>
<th>Nominal Concentration</th>
<th>Number Of Pens</th>
<th>Birds Per Pen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control (0 ppm)</td>
<td>16</td>
<td>1 1</td>
</tr>
<tr>
<td>2. 3 ppm TPTH</td>
<td>16</td>
<td>1 1</td>
</tr>
<tr>
<td>3. 10 ppm TPTH</td>
<td>16</td>
<td>1 1</td>
</tr>
<tr>
<td>4. 30 ppm TPTH</td>
<td>16</td>
<td>1 1</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Feed Consumption</td>
<td>Offspring’s Body Weight</td>
</tr>
<tr>
<td>Adult Body Weight</td>
<td>Hatchlings of Maximum Set</td>
</tr>
<tr>
<td>Eggs Laid of Maximum Laid</td>
<td>14-Day Old Survivors of Maximum Set</td>
</tr>
<tr>
<td>Eggs Cracked of Eggs Laid</td>
<td>14-Day Old Survivors of Eggs Set</td>
</tr>
<tr>
<td>Viable Embryos of Eggs Set</td>
<td>14-Day Old Survivors of Hatchlings</td>
</tr>
<tr>
<td>Live 3-week Embryos of Viable Embryos</td>
<td>Eggshell Thickness</td>
</tr>
<tr>
<td>Hatchlings of 3-Week Embryos</td>
<td></td>
</tr>
</tbody>
</table>

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 hemor-
rhage 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
cranial. 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 sacri-
ficed 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 signifi-
cant 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 sig-
nificant 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 signifi-
cant (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/OA 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 P. 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:

<table>
<thead>
<tr>
<th>Use</th>
<th>Max. Rate (lb ai per acre)</th>
<th>Estimated Environmental Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Short grass max ave</td>
</tr>
<tr>
<td>Tobacco</td>
<td>0.285</td>
<td>68</td>
</tr>
<tr>
<td>Potatoes, Sugar beets</td>
<td>0.297</td>
<td>71</td>
</tr>
<tr>
<td>Peanuts, Carrots</td>
<td>0.238</td>
<td>57</td>
</tr>
<tr>
<td>Pecans</td>
<td>0.713</td>
<td>171</td>
</tr>
</tbody>
</table>

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 results; report should also reference validity of procedures and compliance with Good Laboratory Practice regulations.

b. *Statistical Analysis*

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-β) ranged from only <0.3 to approximately 0.35.

c. *Discussion/Results*

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:


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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Nominal Concentration of TPTH (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Eggs laid</td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>581</td>
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<tr>
<td>Number/hen</td>
<td>38.7</td>
</tr>
<tr>
<td>Eggs cracked</td>
<td></td>
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<tr>
<td>Total number</td>
<td>79</td>
</tr>
<tr>
<td>Number/hen</td>
<td>5.3</td>
</tr>
<tr>
<td>Percent of eggs laid</td>
<td>13.6</td>
</tr>
<tr>
<td>Eggs set</td>
<td></td>
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<tr>
<td>Total number</td>
<td>446</td>
</tr>
<tr>
<td>Percent of eggs laid</td>
<td>76.8</td>
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<td>Viable embryos (11-day)</td>
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<tr>
<td>Total number</td>
<td>421</td>
</tr>
<tr>
<td>Percent of eggs laid</td>
<td>72.5</td>
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<tr>
<td>Percent of eggs set</td>
<td>94.4</td>
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<td>Live embryos (21-day)</td>
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<td>Total number</td>
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<tr>
<td>Percent of viable embryos</td>
<td>98.3</td>
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<tr>
<td>Hatchlings</td>
<td></td>
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<tr>
<td>Total number</td>
<td>384</td>
</tr>
<tr>
<td>Percent of eggs laid</td>
<td>66.1</td>
</tr>
<tr>
<td>Percent of eggs set</td>
<td>86.1</td>
</tr>
<tr>
<td>Percent of viable embryos</td>
<td>91.2</td>
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<tr>
<td>Percent of live embryos</td>
<td>92.8</td>
</tr>
<tr>
<td>14-day-old survivors</td>
<td></td>
</tr>
<tr>
<td>Total number</td>
<td>337</td>
</tr>
<tr>
<td>Number/hen</td>
<td>22.5</td>
</tr>
<tr>
<td>Percent of normal hatchlings</td>
<td>87.8</td>
</tr>
<tr>
<td>Average hatchling weight (g)</td>
<td>6</td>
</tr>
<tr>
<td>Average 14-day-old survivor weight (g)</td>
<td>27</td>
</tr>
</tbody>
</table>
Table 1. Continued.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Nominal Concentration of TPTH (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Adult weight</td>
<td></td>
</tr>
<tr>
<td>At study termination</td>
<td></td>
</tr>
<tr>
<td>Females (g/bird)</td>
<td>231</td>
</tr>
<tr>
<td>Males (g/bird)</td>
<td>218</td>
</tr>
<tr>
<td>Increase from study initiation</td>
<td></td>
</tr>
<tr>
<td>Females (g/bird)</td>
<td>+36</td>
</tr>
<tr>
<td>Males (g/bird)</td>
<td>+21</td>
</tr>
<tr>
<td>Mean eggshell thickness (mm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.215</td>
</tr>
<tr>
<td>Average feed consumption</td>
<td></td>
</tr>
<tr>
<td>(g/bird/day)</td>
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</tr>
<tr>
<td>Pre-egg production</td>
<td>20.0</td>
</tr>
<tr>
<td>Egg production</td>
<td>22.8</td>
</tr>
<tr>
<td>Mean total</td>
<td>19.8</td>
</tr>
</tbody>
</table>
**TPTH AVIAN REPRODUCTION DERM-BURJ**

**SHAUNNESSY NO. 083601**

**RECORD NO. 175645/178059 (AMENDMENT)**

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086  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

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 38.01639544

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 RANGÉ TEST FOR VARIABLE: RESP
NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
AND 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  38.733  15  A
      A  37.933  15  D
      A  35.750  16  C

2. ANALYSIS OF EC DATA  10:51 MONDAY, MAY 16, 1988  6
******************************

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS LEVELS  VALUES
TRT    4    A     B     C     D

NUMBER OF OBSERVATIONS IN DATA SET = 61

2. ANALYSIS OF EC DATA  10:51 MONDAY, MAY 16, 1988  7
******************************

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
CORRECTED TOTAL  60   1755.93442623  5.31373180  RESP MEAN

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

2. ANALYSIS OF EC DATA  10:51 MONDAY, MAY 16, 1988  8
******************************

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

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<tbody>
<tr>
<td>6.313</td>
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<td>5.267</td>
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<tr>
<td>2.333</td>
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3. ANALYSIS OF ES DATA

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

DF   SUM OF SQUARES   MEAN SQUARE   F VALUE   PR > F   R-SQUARE   C.V.
MODEL 3   508.43360656   169.47786856   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

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

3. ANALYSIS OF ES DATA

GENERAL LINEAR MODELS PROCEDURE

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 7.26982 7.66494 7.91269

Means with the same letter are not significantly different.

DUNCAN GROUPING

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<thead>
<tr>
<th>MEAN</th>
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<th>TRT</th>
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<tr>
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### 4. Analysis of VE Data

**General Linear Models Procedure**

**Dependent Variable: Resp**

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<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Pr &gt; F</th>
<th>R-Square</th>
<th>C.V.</th>
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<tr>
<td>Model</td>
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<td>362.65027322</td>
<td>120.88342441</td>
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<td>89.79532164</td>
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**Source**

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<th>F Value</th>
<th>Pr &gt; F</th>
<th>Type III SS</th>
<th>F Value</th>
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<td>0.2685</td>
<td>362.65027322</td>
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**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 28.800 15 A
A 28.067 15 A
A 24.000 15 D
A 23.250 16 C

5. ANALYSIS OF THE DATA

***************

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS LEVELS VALUES
TRT 4 A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 61
5. ANALYSIS OF THE DATA

***************

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

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

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

5. ANALYSIS OF THE 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=88.4889

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=15.2381
MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING   MEAN   N   TRT

A  28.667   15   B
A  27.600   15   A
A  23.733   15   D
A  23.000   16   C

6. ANALYSIS OF NH DATA

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS LEVELS VALUES

TRT   4   A B C D

NUMBER OF OBSERVATIONS IN DATA SET = 61

6. ANALYSIS OF NH 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   358.57349727   119.52449909   1.43   0.2436   0.069971   37.9707
ERROR   57   4766.01666667   83.61432749   9.14   0.0000   0.14006702   24.08196721
CORRECTED TOTAL   60   5124.59016393

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.

DUNCAN GROUPING MEAN N TRT
GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

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<tr>
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NUMBER OF OBSERVATIONS IN DATA SET = 61

GENERAL LINEAR MODELS PROCEDURE

CORRECTED TOTAL

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<th>MEAN SQUARE</th>
<th>F VALUE</th>
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HARMONIC MEAN OF CELL SIZES=15.2381

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

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MAXIMUM | STD ERROR | SUM | VARIANCE | C.V. | DEVIATION | VALUE | VALUE | MEAN |
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10:51 MONDAY, MAY 16, 1988
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 \rightarrow Power < .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

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

---

\[ \Phi = 1.005022 \quad *** \text{THIS IS THE VALUE TO LOOK UP} \rightarrow P_{\text{ower}} \approx 0.3 \]

\[ D = 42.4471 \quad \text{PERCENT CHANGE DETECTION LIMIT} \]
CHEMICAL: TPTH
LE

TOTAL NUMBER OF PAIRS (PENS): 14
NUMBER OF CONTROL PAIRS (PENS): 15
CONTROL MEAN: 27.6
TOTAL NUMBER OF PAIRS (PENS): 61
MEAN SQUARE ERROR: 88.8
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

\textit{Phi} = 1.009895 \textit{**This is the value to look up} \quad \textit{\textbf{D}} = 42.85017 \quad \textit{Percent Change Detection Limit}
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  \( \text{Power} \approx 0.3 \)

D = 45.64969  PERCENT CHANGE DETECTION LIMIT

\( 57 \)