**Data Evaluation Report on the Acute Dietary Toxicity of XDE-638 to Mallard Duck (*Anas Platyrhynchos*)**

PMRA Submission Number                                                                 EPA MRID Number 45831003

| Data Requirement: | PMRA DATA CODE | |
|---|---|---|
| | EPA DP Barcode | D288160 |
| | OECD Data Point | |
| | EPA MRID | 45831003 |
| | EPA Guideline | §71-2b |

| | | | |
|---|---|---|---|
| **Test material:** | XDE-638 | **Purity:** | 97.5% |
| Common name: | Penoxsulam | | |
| Chemical name: | IUPAC: Not reported | | |

CAS name: 2-(2,2-Difluoroethoxy)-N-(5,8-dimethoxy[1,2,4]triazolo[1,5-C]pyrimidin-2-yl)-6-(trifluoromethyl)benzenesulfonamide

CAS No.: Not reported

Synonyms: Not reported

**Primary Reviewer:** Rebecca Bryan     **Signature:** *Rebecca Bryan*
Staff Scientist, Dynamac Corporation     **Date:** 10/17/03

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Staff Scientist, Dynamac Corporation     **Date:** 10/17/03

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OPP/EFED/ERB - III     **James J. Goodyear, Ph.D.**
                                  **Ecological Effects Biologist**
**Secondary Reviewer(s)** **Office of Pesticide Programs**     **Date:**
{EPA/OECD/PMRA}     **703-305-7726**

**Reference/Submission No.:**

**Company Code:**
**Active Code:**
**EPA PC Code:** ~~199031~~ 119031

**Date Evaluation Completed:**

**CITATION:** Troup, R. and B.A. Medlicott. 2000. XDE-638: Avian Acute Dietary Toxicity Test with the Mallard (*Anas platyrhynchos*). Unpublished study performed by Genesis Laboratories, Inc., Wellington, CO. Laboratory Study No. 99024. Study sponsored by Dow AgroSciences LLC, Indianapolis, IN. Study initiated August 9, 1999 and completed March 23, 2000.

2051787

# DATA EVALUATION RECORD
## EFFECTS ON SOIL NON-TARGET MICRO-ORGANISMS
### US EPA Guideline: N/A (Non-guideline)

**1. CHEMICAL:** Penoxsulam                     PC Code No.: 119031

**2. TEST MATERIAL:** XDE-638                     Purity: 97.7%

**3. CITATION:**

| | |
|---|---|
| Author: | Van Der Kolk, J. |
| Title: | XDE-638: Determination of Effects on Soil Microflora Acitivity |
| Study Completion Date: | September 10, 2002 |
| Laboratory: | Springborn Smithers Laboratories (Europe) Ag<br>Seestrasse 21, Postfach<br>CH-9326 Horn, witzerland |
| Sponsor: | The Dow Chemical Company<br>Midland, MI 48674<br>for<br>Dow AgroSciences LLC<br>9330 Zionsville Road<br>Indianapolis, IN 46268 |
| Lab.Report ID: | 1072.001.747 |
| MRID No.: | 45831103 |
| DP Barcode: | D288160 |

**4. REVIEWED BY:** Christie E. Padova, Staff Scientist, Dynamac Corporation

   **Signature:**                                         **Date:** 10/31/03

   **APPROVED BY:** Teri S. Myers, Ph.D., Staff Scientist, Dynamac Corporation

   **Signature:**                                         **Date:** 10/31/03

**5. APPROVED BY:** James J Goodyear, Ph.D., Biologist, EFED, ERB3

   **Signature:**                                         **Date:**

**SECONDARY REVIEWER:**

   **Signature**                                          **Date:**

## 6. STUDY PARAMETERS:

| | |
|---|---|
| **Soil Type:** | Loamy sand, Sevelen (method of classification not specified) |
| **Definitive Test Duration:** | April 29 - June 10, 2002 (42 days) |
| **Test substance:** | XDE-638 (penoxsulam, 97.7% purity) |
| **Application rate:** | 0.13 and 0.67 mg/kg dry soil (2 and 10X the maximum single application rate of 50 g/ha soil) |

## 7. CONCLUSIONS:

In this study, XDE-638 (penoxsulam) was applied to a loamy sand agricultural soil at a single maximum rate of 0.13 or 0.67 mg a.i./kg dry soil (equivalent to 2 or 10X the maximum single application rate of 50 g a.i./ha soil). As indicators of soil microbial biomass metabolic activity, carbon mineralization was measured over a 29-day period, and nitrogen transformation was measured over a 42-day period. Response in the treated groups was compared to response in an untreated control group. Lucerne meal (3.25% nitrogen) was used to amend the experimental soil used in the nitrification portion of the study. The experimental method was validated in a concurrent positive control study using dinoseb acetate at 33.3 mg a.i./kg dry soil.

XDE-635 (penoxsulam) had no lasting effects on respiration and nitrification processes in soil at the concentrations tested. Over the course of the study, the microbial respiration (mg $O_2$/kg dry soil/hour) of soil samples treated with 0.13 mg a.i./kg deviated -3, -6, 4, and -9% from the untreated control soil on Days 0, 7, 14, and 29, respectively. The soil treated with 0.67 mg a.i./kg deviated 0, -13*, 13, and 9% from the control soil on Days 0, 7, 14, and 29, respectively (*statistical significance at $p<0.05$). Due to accumulations of ammonium in the 0.13 mg a.i./kg soil on Day 7 and in the 0.67 mg a.i./kg soil on Days 7 and 14, the test was extended to Day 42; no detectable (LOD 0.36 mg $NH_4+$/kg dry soil) ammonium was found on Day 42 in the control or either treated soil group. Nitrate transformation rates in the soil treated at 0.13 mg a.i./kg deviated from the control values by -17.7*, 3.6, 13.9, and 0% on Days 7, 14, 28, and 42, respectively (*statistical significance at $p<0.05$; Table 7, p. 34). In the soil treated at 0.67 mg a.i./kg, rates deviated from the control values by -26.0*, 0.1, 25.2*, and 7.7% on Days 7, 14, 28, and 42, respectively. These results indicate that the loamy sand microflora from the control group transformed Lucern meal-bound nitrogen into nitrate-bound nitrogen, without accumulation of nitrite or ammonium. In the treated samples, a transient accumulation of ammonium occurred.

This study is scientifically sound, but it is classified as **Supplemental** because data for this type of study are not required by US EPA and there are no guidelines by which to evaluate it. The information that this study provides on the metabolic activity of soil

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microorganisms may be useful for risk assessment purposes.

## 8. ADEQUACY OF THE STUDY:

**A. Classification:** Supplemental

**B. Rationale:** U.S. EPA does not require this type of study and there are no guidelines by which to evaluate it.

**C. Repairability:** N/A

## 9. GUIDELINE DEVIATIONS: N/A

**10. SUBMISSION PURPOSE:** This study was submitted to determine the effects of XDE-638 (penoxsulam) on nitrogen transformation and carbon mineralization by soil microflora, for the purpose of pesticide registration. This study was conducted in accordance with OECD Guidelines 216 and 217 (2000).

## 11.   MATERIALS AND METHODS:

### A.  Field information and handling procedures.

| Information | Details |
|---|---|
| Geographic location | Sevelen, Switzerland (p. 15) |
| Pesticide use history at the collection site | No treatments with plant protectants, organic or mineral fertilizers for 2 years. |
| Collection procedures | Top layer of soil and turf was removed; collection procedures of the underlying soil were not described. |
| Sampling depth (cm) | 8- to 20-cm depth. |
| Storage conditions | Room temperature. |
| Storage length | 7 days from time of sampling (April 22, 2002) until study initiation (April 29, 2002). |
| Soil preparation | Sieved (2 mm). |

### B.  Properties of the soil.

| Property | Details |
|---|---|
| Soil texture* | Loamy sand (Table 1, p. 28) |
| % sand (63 µm - 2 mm) | 68.5 |
| % silt (2 µm - 63 µm) | 25.8 |
| % clay (<2 µm) | 5.7 |
| pH (0.01 M $CaCl_2$) | 7.38 (control at test initiation; Table 2, p. 29) |
| Organic carbon (%) | 0.92 |
| CEC (mEq/100 g) | Not specified |
| Maximum water holding capacity (%) | 44.8 |
| Bulk density (g/cm³) | Assumed to be 1.5 (p. 15) |
| Total nitrogen content (mg N/g soil): | 1.2 |
| Total biomass (mg C/g soil): | 0.18 |

| Property | Details |
|---|---|
| Microbial biomass (%): | 2.0% (pp. 21-22) |
| Soil Taxonomic classification | Not reported. |
| Soil mapping unit (for EPA) | Not reported. |
| Other: | N/A |

* The method used for soil classification was not reported.

## C: Experimental design.

| Parameter | | Details |
|---|---|---|
| Duration of the test | | 42 Days (final pH measurements for the nitrification samples were taken on Day 49). |
| Condition of soil: | Air dried/fresh: | Fresh. The water content, measured 4 days prior to testing, was 43.5% of maximum water holding capacity (p. 15). |
| | Sterile/Non-sterile: | Non-sterile. |
| Test concentrations (mg a.i./kg soil): Nominal: Measured: | | 0.13 and 0.67 mg a.i./kg dry soil (2 and 10X the maximum application rate of 50 g XDE-638/ha, p. 15). Not reported. |
| Dark controls used (Yes/No): Method to maintain darkness: | | Yes. Samples were incubated in brown-glass flasks in a temperature-controlled climate chamber. |
| Replications | | Triplicate. |
| Identity and concentration of co-solvent: | | Acetone, 1.1% (v:w), evaporated completely Quartz sand, 8.3% (w:w) |
| Pesticide application | Volume of test solution used/treatment | Control: 5 mL acetone + 38.4 g quartz sand + 4588 g wet soil (3840 g dry soil equivalent, p. 16).<br><br>2X Treatment: 5 mL of 0.103 mg a.i./mL stock solution + 38.4 g quartz sand + 4588 g wet soil (3840 g dry soil equivalent).<br><br>10X Treatment: 5 mL of 0.517 mg a.i./mL stock solution + 38.4 g quartz sand + 4588 g wet soil (3840 g dry soil equivalent). |
| | Method of application | The test substance, dissolved in acetone, was added to quartz sand. The acetone was allowed to evaporate, and the sand was thoroughly mixed with a hand mixer into samples of moist soil. |

| Parameter | | Details |
|---|---|---|
| Test apparatus: Type/Material/ Volume | Nitrogen transformation: | Sub-samples (238.60 g moist; 200 g dry) of soil from each treatment group were placed into brown glass flasks. The soil samples were amended with 1 g of Lucerne meal (3.25% nitrogen), and incubated in a temperature-controlled climate chamber. |
| | Carbon mineralization: | Sub-samples (1192.8 g moist; 1000 g dry) of soil from each treatment group were placed into brown glass flasks, and incubated in a temperature-controlled climate chamber. |
| Any indication of the test material adsorbing to the walls of the test apparatus | | Not indicated. |
| Experimental Conditions | Temperature: | 19.0 to 21.0°C (p. 11). |
| | Moisture content: | 43% of maximum water holding capacity (19.28% based on dry weight). |
| | Moisture maintenance method | Method not specified. |
| | Duration of light/darkness: | Continuous. |
| Other details, if any | | The microbial biomass of the soil was determined prior to test initiation (p. 17). Sub-samples (100 g dry weight) of soil were transferred to 500 mL flasks, and amended with 0, 500, 1000, 2001, 3003, or 4002 mg glucose/kg. Flasks were fitted with a OxiTop measuring head and a trap containing lime soda and incubated for an unspecified time in a temperature-controlled climate chamber. The highest initial hourly $CO_2$ production rate was 0.437 mL $CO_2/100$ g dry soil equivalent in the 2001 mg/kg glucose-amended soil at 22°C (p. 22). |

### D: Sampling details.

| Criteria | Nitrogen transformation | Carbon mineralization |
|---|---|---|
| Sampling intervals | 0, 7, 14, 28, and 42 Days post-treatment. | 0, 7, 14, and 29 Days post-treatment. |
| Sampling method | At each sampling interval, a 20-g (dry weight equivalent) sub-sample of soil per replicate was transferred to a centrifuge tube, and extracted twice with 0.1 M potassium chloride (p. 18). | At each sampling interval, a 100-g (dry weight equivalent) sub-sample of soil per replicate was transferred to a 500-mL Duran glass bottle, and amended with 200 mg of glucose and 0.5 g talc (p. 17). |

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| Criteria | Nitrogen transformation | Carbon mineralization |
|---|---|---|
| | The samples were centrifuged, and extracts were filtered prior to analysis. | The bottles were fitted with OxiTop measuring heads and soda lime traps, and incubated in a temperature-controlled room. Data were measured over a period of 20 hours, beginning ~1 hour following glucose supplement. |
| Sampling intervals/times for:<br>    Sterility check, if any<br>    Moisture content: | Sterile controls were not used.<br>Days 7, 14, 22 and 28, 36, and 42 (p. 16). | Sterile controls were not used.<br>Days 7, 14, 22 and 29. |
| Sample storage before analysis | None specified. | N/A |
| Other observations, if any | None | None |

## E. Analytical methods.

Nitrification:

| Criteria | Conditions |
|---|---|
| Ammonium<br>(mg $NH_4^+$/kg dry soil): | Instrument: Dionex DX-100 Ion Chromatograph (p. 19)<br>Column: Dionex IonPac CS12<br>Mobile Phase: 20.0 mMol/L methanesulfonic acid<br>LOD: 0.36 mg $NH_4^+$/kg dry soil. |
| Nitrite<br>(mg $NO_2^-$/kg dry soil): | Instrument: Dionex DX-100 Ion Chromatograph (p. 18)<br>Column: Dionex IonPac AS12A<br>Mobile Phase: 2.7 mMol $Na_2CO_3$/L mixed with 0.3 mMol $NaHCO_3$/L<br>LOD: 0.40 mg $NO_2^-$/kg dry soil. |
| Nitrate<br>(mg $NO_3^-$/kg dry soil): | Instrument: Dionex DX-100 Ion Chromatograph (p. 18)<br>Column: Dionex IonPac AS12A<br>Mobile Phase: 2.7 mMol $Na_2CO_3$/L mixed with 0.3 mMol $NaHCO_3$/L<br>LOD: Not specified |

## F. Statistical analysis.

Values that appeared to differ from other replicate values were analyzed using the Dixon Test (Sachs, 1969) to determine if these values could be classified as outliers (p. 21). Differences between the control and the treated soils were then analyzed using ANOVA followed by Dunnett's t-test.

## G. Supplementary experiment:

The suitability of dinoserb acetate [2-(1-methylpropyl)-4,6-dinitrophenyl acetate; purity 99.5%) as a reference substance was concurrently determined using the experimental procedures described in the main study (p. 13, and Appendix I, pp. 40-49). Dinoserb acetate was applied to the Sevelen loamy sand soil at a concentration of 33.3 mg a.i./kg dry soil (equivalent to a field application rate of 25 kg a.i./ha). Samples were collected for analysis as previously described on Days 0, 7, 14, and 28 (nitrification)/29 (respiration).

Effects of the treated soil at differences >25% from untreated soil were observed. After 29 days of incubation, respiration rates (mg $O_2$/kg dry soil/hour) of the treated soil were -52% different than the untreated soil (Table 8, p. 43). After 28 days of incubation, nitrate transformation rates (mg $NO_3$-/kg dry soil/day) were 88% different than the untreated soil (Table 12, p. 47). Therefore, the study author concluded that the procedures used to determine the effects of test items on respiration and nitrification of the soil microflora at this laboratory were appropriate.

## 12. REPORTED RESULTS:

### A. General Results

Over the course of the study, the microbial respiration (mg $O_2$/kg dry soil/hour) of soil samples treated with 0.13 mg a.i./kg deviated -3, -6, 4, and -9% from the untreated control soil on Days 0, 7, 14, and 29, respectively (p. 23 and Table 3, p. 30). The soil treated with 0.67 mg a.i./kg deviated 0, -13*, 13, and 9% from the control soil on Days 0, 7, 14, and 29, respectively (*statistical significance at p<0.05). These deviations in respiration rates were below the guideline trigger value of 25% from the control after 29 days; therefore, it was concluded that XDE-638 had no lasting effects on respiration (p. 25).

Concentrations of ammonium decreased in the control samples during the study, from 8.23 mg $NH_4$+/kg dry soil on Day 0, to 2.68, 0.71, and 1.60 mg $NH_4$+/kg dry soil on Days 7, 14, and 28, respectively (p. 23 and Table 4, p. 31). In the 0.13 mg a.i./kg treated soil, ammonium concentrations were comparable to control values on Days 0, 14, and 28;

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however, concentrations increased to 13.45 mg $NH_4^+$/kg dry soil on Day 7.  In the 0.67 mg a.i./kg treated soil, ammonium concentrations were comparable to control values on Days 0 and 28; however, concentrations increased to 21.75 mg $NH_4^+$/kg dry soil on Day 7 and were 6.18 mg $NH_4^+$/kg dry soil on Day 14.  Since an accumulation of ammonium was found in the 0.13 mg a.i./kg soil on Day 7 and in the 0.67 mg a.i./kg soil on Days 7 and 14, the test was extended to Day 42.  No detectable (LOD 0.36 mg $NH_4^+$/kg dry soil) ammonium was found on Day 42 in the control or either treated soil group.

Aside from one sample on Day 0 in the 0.13 mg a.i./kg treated soil (at 1.48 mg $NO_2^-$/kg dry soil), no nitrite was detected in the control or test samples (p. 24 and Table 5, p. 32).

Concentrations of nitrate increased in the control samples during the study, from 38.3 mg $NO_3^-$/kg dry soil on Day 0, to 137, 212, 283, and 343 mg $NO_3^-$/kg dry soil on Days 7, 14, 28, and 42, respectively (p. 24 and Table 6, p. 33).  In the 0.13 mg a.i./kg treated soil, nitrate concentrations increased from 40.4 mg $NO_3^-$/kg dry soil on Day 0 to 345 mg $NO_3^-$/kg dry soil on Day 42, and in the 0.67 mg a.i./kg treated soil, nitrate concentrations increased from 38.9 mg $NO_3^-$/kg dry soil on Day 0 to 367 mg $NO_3^-$/kg dry soil on Day 42.

Nitrate transformation rates in the soil treated at 0.13 mg a.i./kg deviated from the control values by -17.7*, 3.6, 13.9, and 0% on Days 7, 14, 28, and 42, respectively (*statistical significance at $p<0.05$; Table 7, p. 34).  In the soil treated at 0.67 mg a.i./kg, rates deviated from the control values by -26.0*, 0.1, 25.2*, and 7.7% on Days 7, 14, 28, and 42, respectively.

These results indicate that the loamy sand microflora from the control group transformed Lucern meal-bound nitrogen into nitrate-bound nitrogen, without accumulation of nitrite or ammonium (p. 24).  In the treated samples, a transient accumulation of ammonium occurred.

**Effects Data**

**Respiration rates (mg $CO_2$/kg dry soil/hour, n=3).**

| Treatment Group | Days | | | |
|---|---|---|---|---|
| | 0 | 7 | 14 | 29 |
| Control | 5.2 | 5.0 | 3.9 | 3.7 |
| 0.13 mg a.i./kg dry soil (% difference from control) | 5.0 (-3) | 4.7 (-6) | 4.0 (4) | 3.4 (-9) |
| 0.67 mg a.i./kg dry soil (% difference from control) | 5.2 (0) | 4.4 (-13*) | 4.4 (13) | 4.0 (9) |

* $p<0.05$

## Analysis of ammonium levels in soil (mg NH$_4$+/kg dry soil, n=3).

| Treatment Group | Days | | | | |
|---|---|---|---|---|---|
| | 0 | 7 | 14 | 28 | 42 |
| Control | 8.28 | 2.68 | 0.71 | 1.60 | <LOD |
| 0.13 mg a.i./kg dry soil | 7.63 | 13.45 | 0.85 | 1.75 | <LOD |
| 0.67 mg a.i./kg dry soil | 7.03 | 21.75 | 6.18 | 1.78 | <LOD |

## Analysis of nitrite levels in soil (mg NO$_2$-/kg dry soil, n=3).

| Treatment Group | Days | | | | |
|---|---|---|---|---|---|
| | 0 | 7 | 14 | 28 | 42 |
| Control | <LOD | <LOD | <LOD | <LOD | <LOD |
| 0.13 mg a.i./kg dry soil | <LOD | <LOD | <LOD | <LOD | <LOD |
| 0.67 mg a.i./kg dry soil | <LOD | <LOD | <LOD | <LOD | <LOD |

## Analysis of nitrate levels in soil (mg NO$_3$-/kg dry soil, n=3).

| Treatment Group | Days | | | | |
|---|---|---|---|---|---|
| | 0 | 7 | 14 | 28 | 42 |
| Control | 38.3 | 137 | 212 | 283 | 343 |
| 0.13 mg a.i./kg dry soil | 40.4 | 121 | 220 | 319 | 345 |
| 0.67 mg a.i./kg dry soil | 38.9 | 112 | 213 | 345 | 367 |

## Nitrate Transformation Rates in soil (mg NO$_3$-/kg dry soil/day, n=3).

| Treatment Group | Days | | | |
|---|---|---|---|---|
| | 7 | 14 | 28 | 42 |
| Control | 14.1 | 12.4 | 8.7 | 7.3 |
| 0.13 mg a.i./kg dry soil (% difference from control) | 11.6 (-17.7*) | 12.9 (3.6) | 10.0 (13.9*) | 7.3 (0) |
| 0.67 mg a.i./kg dry soil (% difference from control) | 10.4 (-26.0*) | 12.4 (0.1) | 10.9 (25.2*) | 7.8 (7.7) |

*p<0.05

## 13. VERIFICATION OF STATISTICAL RESULTS:

Method: Respiration rate, ammonium concentration, nitrate concentration, and nitrate transformation rate data were analyzed at each measurement period (i.e., days 0, 7, 14, 28, and 42) to determine if the control group differed from the treatment groups. Data were analyzed to determine if they satisfied the assumptions of ANOVA; if the assumptions of normality and variance homogeneity were met, ANOVA was conducted, followed by William's test (if necessary). Data for ammonium concentration on day 14 had to be transformed (inverse transformation) prior to conducting ANOVA. These analyses were conducted using TOXSTAT statistical software.

No significant differences were detected for respiration rate at any time period. Significant ammonium concentrations were detected in the treatment groups at days 7 and 14, but not at days 28 and 42. Nitrate transformation rates in the treatment groups were significantly higher than control at day 28, but there were no differences from control at day 42.

## 14. REVIEWER'S COMMENTS:

While this study provides supplemental information and there are no US EPA guidelines to evaluate it, the reviewer considered the following to be deficiencies in the experimental method and the study report:

1.  The method used for soil texture classification was not reported, and the cation exchange capacity of the soil was not reported.

2.  Data were not provided to confirm that environmental conditions were maintained throughout the study. Although the study author reported that the soil moisture was monitored and maintained, no data was reported.

3.  The test substance was applied by adding aliquots of a stock solution to quartz sand, which was then mixed with a hand mixer into the wet soil (38.4 g quartz sand per 3840 g dry soil). The final concentration of quartz sand in the soil was 10% (w:w), which may significantly alter the texture classification of the soil tested.

4.  The storage stability of the test substance was not confirmed. Also, the possibility that the test substance may absorb to the walls of the test apparatus were not determined.

5.   The nominal application rates of the test substance (0.13 and 0.67 mg a.i./kg dry soil) were not verify by measuring the test substance in the soil systems.

The study author reported the maximum single application rate of XDE-638 to an unspecified target is 50 g a.i./ha soil (p. 13).  In this study, XDE-638 was applied in a single application rate equivalent to two or ten times the maximum (0.13 or 0.67 mg a.i./kg dry soil; conversion calculation provided on p. 15).  No further rational was provided.

The reviewer's results were similar to the study author's; respiration rates were not adversely impacted during the study and reductions in nitrate transformation rates (at both treatment levels) were transient, disappearing after day 7.  Furthermore, accumulation of ammonium in the treatment groups disappeared by day 28.

## 15. REFERENCES:

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## APPENDIX I. OUTPUT OF REVIEWER'S STATISTICAL VERIFICATION:
**respiration rate day 7**
File: 1103r7     Transform: NO TRANSFORMATION

### ANOVA TABLE

------------------------------------------------------------------------

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 2 | 0.602 | 0.301 | 2.333 |
| Within (Error) | 6 | 0.773 | 0.129 | |
| Total | 8 | 1.376 | | |

Critical F value = 5.14 (0.05,2,6)
**Since F < Critical F FAIL TO REJECT Ho:All groups equal**

respiration rate day 7
File: 1103r7     Transform: NO TRANSFORMATION

DUNNETTS TEST - TABLE 1 OF 2          Ho:Control<Treatment

------------------------------------------------------------------------

| GROUP | IDENTIFICATION | TRANSFORMED MEAN | MEAN CALCULATED IN ORIGINAL UNITS | T STAT | SIG |
|---|---|---|---|---|---|
| 1 | control | 5.033 | 5.033 | | |
| 2 | 0.13 | 4.733 | 4.733 | 1.023 | |
| 3 | 0.67 | 4.400 | 4.400 | 2.160 | |

Dunnett table value = 2.34   (1 Tailed Value, P=0.05, df=6,2)

respiration rate day 7
File: 1103r7     Transform: NO TRANSFORMATION

DUNNETTS TEST - TABLE 2 OF 2          Ho:Control<Treatment

------------------------------------------------------------------------

| GROUP | IDENTIFICATION | NUM OF REPS | Minimum Sig Diff (IN ORIG. UNITS) | % of CONTROL | DIFFERENCE FROM CONTROL |
|---|---|---|---|---|---|
| 1 | control | 3 | | | |
| 2 | 0.13 | 3 | 0.686 | 13.6 | 0.300 |
| 3 | 0.67 | 3 | 0.686 | 13.6 | 0.633 |

respiration rate day 7

File: 1103r7      Transform: NO TRANSFORMATION

### WILLIAMS TEST  (Isotonic regression model)   TABLE 1 OF 2

| GROUP IDENTIFICATION | | ORIGINAL N | MEAN | TRANSFORMED MEAN | ISOTONIZED MEAN |
|---|---|---|---|---|---|
| 1 | control | 3 | 5.033 | 5.033 | 5.033 |
| 2 | 0.13 | 3 | 4.733 | 4.733 | 4.733 |
| 3 | 0.67 | 3 | 4.400 | 4.400 | 4.400 |

respiration rate day 7
File: 1103r7      Transform: NO TRANSFORMATION

### WILLIAMS TEST  (Isotonic regression model)   TABLE 2 OF 2

| IDENTIFICATION | ISOTONIZED MEAN | CALC. WILLIAMS | SIG | TABLE P=.05 WILLIAMS | DEGREES OF FREEDOM |
|---|---|---|---|---|---|
| control | 5.033 | | | | |
| 0.13 | 4.733 | 1.023 | | 1.94 | k= 1, v= 6 |
| 0.67 | 4.400 | 2.161 | * | 2.06 | k= 2, v= 6 |

$s =$  0.359
Note: df used for table values are approximate when v > 20.

**respiration rate (day 29)**
File: 1103r29      Transform: NO TRANSFORMATION

### ANOVA TABLE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 2 | 0.667 | 0.333 | 1.088 |
| Within (Error) | 6 | 1.833 | 0.306 | |
| Total | 8 | 2.500 | | |

Critical F value =  5.14  (0.05,2,6)
**Since  F < Critical F  FAIL TO REJECT  Ho:All groups equal**

**respiration rate (day 29)**
File: 1103r29      Transform: NO TRANSFORMATION

DUNNETTS TEST · TABLE 1 OF 2        Ho:Control<Treatment
------------------------------------------------------------------
                  TRANSFORMED   MEAN CALCULATED IN
GROUP  IDENTIFICATION   MEAN      ORIGINAL UNITS   T STAT  SIG
------ ------------------- ---------- ------------------- ------- ---
1        control   3.733        3.733
2        0.13   3.400        3.400       0.738
3        0.67   4.067        4.067       -0.738
------------------------------------------------------------------
Dunnett table value = 2.34   (1 Tailed Value, P=0.05, df=6,2)

respiration rate (day 29)
File: 1103r29   Transform: NO TRANSFORMATION

DUNNETTS TEST · TABLE 2 OF 2        Ho:Control<Treatment
------------------------------------------------------------------
               NUM OF  Minimum Sig Diff % of    DIFFERENCE
GROUP  IDENTIFICATION  REPS   (IN ORIG. UNITS) CONTROL  FROM CONTROL
------ ------------------- ------- ---------------- ------- -----------
1        control   3
2        0.13   3       1.057    28.3     0.333
3        0.67   3       1.057    28.3     -0.333
------------------------------------------------------------------

respiration rate (day 29)
File: 1103r29   Transform: NO TRANSFORMATION

WILLIAMS TEST  (Isotonic regression model)   TABLE 1 OF 2
------------------------------------------------------------------
GROUP                ORIGINAL   TRANSFORMED   ISOTONIZED
       IDENTIFICATION   N   MEAN      MEAN        MEAN
------ ------------------- --- ---------- ---------- ----------
1        control  3   3.733       3.733       3.567
2        0.13  3   3.400       3.400       3.567
3        0.67  3   4.067       4.067       4.067
------------------------------------------------------------------

respiration rate (day 29)
File: 1103r29   Transform: NO TRANSFORMATION

WILLIAMS TEST  (Isotonic regression model)   TABLE 2 OF 2
------------------------------------------------------------------
              ISOTONIZED  CALC.  SIG   TABLE     DEGREES OF
IDENTIFICATION    MEAN    WILLIAMS P=.05  WILLIAMS   FREEDOM
------------------- ---------- ---------- ----- ---------- ------------
     control   3.567
     0.13   3.567   0.369        1.94    k= 1, v= 6
     0.67   4.067   0.739        2.06    k= 2, v= 6

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--------------------------------------------------------------------------
s =   0.553
Note: df used for table values are approximate when v > 20.

**ammonium day 0**
File: 1103a0       Transform: NO TRANSFORMATION

### ANOVA TABLE
--------------------------------------------------------------------------

| SOURCE | DF | SS | MS | F |
|--------|-----|-------|-------|--------|
| Between | 2 | 2.358 | 1.179 | 53.591 |
| Within (Error) | 6 | 0.134 | 0.022 | |
| Total | 8 | 2.492 | | |

Critical F value =  5.14  (0.05,2,6)
Since  F > Critical F  REJECT  Ho:All groups equal

ammonium day 0
File: 1103a0       Transform: NO TRANSFORMATION

     DUNNETTS TEST  -  TABLE 1 OF 2          Ho:Control<Treatment
--------------------------------------------------------------------------

| | | TRANSFORMED | MEAN CALCULATED IN | | |
|-------|----------------|------|---------------|--------|-----|
| GROUP | IDENTIFICATION | MEAN | ORIGINAL UNITS | T STAT | SIG |
| 1 | control  8.280 | | 8.280 | | |
| 2 | 0.13  7.627 | | 7.627 | 5.395 | * |
| 3 | 0.67  7.027 | | 7.027 | 10.349 | * |

Dunnett table value = 2.34    (1 Tailed Value, P=0.05,  df=6,2)

ammonium day 0
File: 1103a0       Transform: NO TRANSFORMATION

     DUNNETTS TEST  -  TABLE 2 OF 2          Ho:Control<Treatment
--------------------------------------------------------------------------

| | | NUM OF | Minimum Sig Diff | % of | DIFFERENCE |
|-------|----------------|------|------------------|---------|--------------|
| GROUP | IDENTIFICATION | REPS | (IN ORIG. UNITS) | CONTROL | FROM CONTROL |
| 1 | control  3 | | | | |
| 2 | 0.13  3 | | 0.283 | 3.4 | 0.653 |
| 3 | 0.67  3 | | 0.283 | 3.4 | 1.253 |

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-------------------------------------------------------------------------

ammonium day 0
File: 1103a0     Transform: NO TRANSFORMATION

         WILLIAMS TEST  (Isotonic regression model)   TABLE 1 OF 2
-------------------------------------------------------------------------

| GROUP IDENTIFICATION | | ORIGINAL N | MEAN | TRANSFORMED MEAN | ISOTONIZED MEAN |
|---|---|---|---|---|---|
| 1 | control | 3 | 8.280 | 8.280 | 8.280 |
| 2 | 0.13 | 3 | 7.627 | 7.627 | 7.627 |
| 3 | 0.67 | 3 | 7.027 | 7.027 | 7.027 |

-------------------------------------------------------------------------

ammonium day 0
File: 1103a0     Transform: NO TRANSFORMATION

         WILLIAMS TEST  (Isotonic regression model)   TABLE 2 OF 2
-------------------------------------------------------------------------

| IDENTIFICATION | ISOTONIZED MEAN | CALC. WILLIAMS | SIG P=.05 | TABLE WILLIAMS | DEGREES OF FREEDOM |
|---|---|---|---|---|---|
| control | 8.280 | | | | |
| 0.13 | 7.627 | 5.351 | * | 1.94 | k= 1, v= 6 |
| 0.67 | 7.027 | 10.265 | * | 2.06 | k= 2, v= 6 |

-------------------------------------------------------------------------

s =   0.150
Note: df used for table values are approximate when v > 20.

ammonium day 7
File: 1103a7     Transform: NO TRANSFORMATION

                      ANOVA TABLE
-------------------------------------------------------------------------

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 2 | 548.929 | 274.465 | 1115.711 |
| Within (Error) | 6 | 1.474 | 0.246 | |
| Total | 8 | 550.403 | | |

-------------------------------------------------------------------------

Critical F value =  5.14  (0.05,2,6)
Since  F > Critical F  REJECT  Ho:All groups equal

17

ammonium day 7
File: 1103a7     Transform: NO TRANSFORMATION

        DUNNETTS TEST  ·  TABLE 1 OF 2        Ho:Control<Treatment
------------------------------------------------------------------------
                  TRANSFORMED   MEAN CALCULATED IN
GROUP   IDENTIFICATION      MEAN       ORIGINAL UNITS   T STAT  SIG
----- -------------------  -----------  -----------------  -------  ---

| GROUP | IDENTIFICATION | TRANSFORMED MEAN | MEAN CALCULATED IN ORIGINAL UNITS | T STAT | SIG |
|---|---|---|---|---|---|
| 1 | control | 2.680 | 2.680 | | |
| 2 | 0.13 | 13.453 | 13.453 | -26.603 | |
| 3 | 0.67 | 21.757 | 21.757 | -47.106 | |

------------------------------------------------------------------------
Dunnett table value = 2.34    (1 Tailed Value, P=0.05,  df=6,2)


ammonium day 7
File: 1103a7     Transform: NO TRANSFORMATION

        DUNNETTS TEST  ·  TABLE 2 OF 2        Ho:Control<Treatment
------------------------------------------------------------------------
                  NUM OF   Minimum Sig Diff  % of    DIFFERENCE
GROUP   IDENTIFICATION   REPS   (IN ORIG. UNITS) CONTROL  FROM CONTROL
----- -------------------  -------  ----------------  -------  -----------

| GROUP | IDENTIFICATION | NUM OF REPS | Minimum Sig Diff (IN ORIG. UNITS) | % of CONTROL | DIFFERENCE FROM CONTROL |
|---|---|---|---|---|---|
| 1 | control | 3 | | | |
| 2 | 0.13 | 3 | 0.948 | 35.4 | -10.773 |
| 3 | 0.67 | 3 | 0.948 | 35.4 | -19.077 |

------------------------------------------------------------------------


ammonium day 7
File: 1103a7     Transform: NO TRANSFORMATION

        WILLIAMS TEST (Isotonic regression model)   TABLE 1 OF 2
------------------------------------------------------------------------
GROUP                   ORIGINAL   TRANSFORMED   ISOTONIZED
        IDENTIFICATION   N    MEAN       MEAN       MEAN
------ -------------------  ---  -----------  -----------  -----------

| GROUP | IDENTIFICATION | N | ORIGINAL MEAN | TRANSFORMED MEAN | ISOTONIZED MEAN |
|---|---|---|---|---|---|
| 1 | control | 3 | 2.680 | 2.680 | 2.680 |
| 2 | 0.13 | 3 | 13.453 | 13.453 | 13.453 |
| 3 | 0.67 | 3 | 21.757 | 21.757 | 21.757 |

------------------------------------------------------------------------


ammonium day 7
File: 1103a7     Transform: NO TRANSFORMATION

        WILLIAMS TEST (Isotonic regression model)   TABLE 2 OF 2
------------------------------------------------------------------------

```
              ISOTONIZED   CALC.    SIG     TABLE      DEGREES OF
 IDENTIFICATION     MEAN     WILLIAMS  P=.05  WILLIAMS   FREEDOM
------------------ ---------- ---------- ------ ---------- -------------
       control    2.680
        0.13    13.453   26.621     *     1.94     k= 1, v= 6
        0.67    21.757   47.139     *     2.06     k= 2, v= 6
-------------------------------------------------------------------
s =   0.496
Note: df used for table values are approximate when v > 20.
```

**ammonium day 14**
File: 1103a14      Transform: 1/Y (INVERSE)

### ANOVA TABLE

---

| SOURCE | DF | SS | MS | F |
|--------|----|----|----|---|
| Between | 2 | 2.628 | 1.314 | 1314.000 |
| Within (Error) | 6 | 0.008 | 0.001 | |
| Total | 8 | 2.637 | | |

---

Critical F value =  5.14  (0.05,2,6)
Since  F > Critical F  REJECT  Ho:All groups equal

ammonium day 14
File: 1103a14      Transform: 1/Y (INVERSE)

    DUNNETTS TEST  ·  TABLE 1 OF 2        Ho:Control<Treatment

---

| GROUP | IDENTIFICATION | TRANSFORMED MEAN | MEAN CALCULATED IN ORIGINAL UNITS | T STAT | SIG |
|-------|----------------|------------------|-----------------------------------|--------|-----|
| 1 | control | 1.404 | 0.713 | | |
| 2 | 0.13 | 1.181 | 0.847 | 8.612 | * |
| 3 | 0.67 | 0.162 | 6.187 | 48.074 | * |

---

Dunnett table value =  2.34    (1 Tailed Value, P=0.05,  df=6,2)

ammonium day 14
File: 1103a14      Transform: 1/Y (INVERSE)

    DUNNETTS TEST  ·  TABLE 2 OF 2        Ho:Control<Treatment

---

| GROUP | IDENTIFICATION | NUM OF REPS | Minimum Sig Diff (IN ORIG. UNITS) | Sig Diff % of CONTROL | DIFFERENCE FROM CONTROL |
|-------|----------------|-------------|-----------------------------------|-----------------------|-------------------------|
| 1 | control | 3 | | | |
| 2 | 0.13 | 3 | -0.032 | -4.5 | -0.133 |
| 3 | 0.67 | 3 | -0.032 | -4.5 | -5.473 |

ammonium day 14
File: 1103a14      Transform: 1/Y (INVERSE)

### WILLIAMS TEST (Isotonic regression model)   TABLE 1 OF 2

| GROUP | IDENTIFICATION | N | ORIGINAL MEAN | TRANSFORMED MEAN | ISOTONIZED MEAN |
|-------|----------------|---|---------------|------------------|-----------------|
| 1 | control | 3 | 0.713 | 1.404 | 1.404 |
| 2 | 0.13 | 3 | 0.847 | 1.181 | 1.181 |
| 3 | 0.67 | 3 | 6.187 | 0.162 | 0.162 |

ammonium day 14
File: 1103a14      Transform: 1/Y (INVERSE)

### WILLIAMS TEST (Isotonic regression model)   TABLE 2 OF 2

| IDENTIFICATION | ISOTONIZED MEAN | CALC. WILLIAMS | SIG P=.05 | TABLE WILLIAMS | DEGREES OF FREEDOM |
|----------------|-----------------|----------------|-----------|----------------|--------------------|
| control | 1.404 | | | | |
| 0.13 | 1.181 | 7.331 | * | 1.94 | k= 1, v= 6 |
| 0.67 | 0.162 | 40.924 | * | 2.06 | k= 2, v= 6 |

s =  0.037
Note: df used for table values are approximate when v > 20.

**ammonium day 28**
File: 1103a28      Transform: NO TRANSFORMATION

### ANOVA TABLE

| SOURCE | DF | SS | MS | F |
|--------|----|----|----|----|
| Between | 2 | 0.054 | 0.027 | 2.250 |
| Within (Error) | 6 | 0.070 | 0.012 | |

```
-----------------------------------------------------------------------
Total        8          0.124
-----------------------------------------------------------------------
```

Critical F value =  5.14  (0.05,2,6)
**Since  F < Critical F  FAIL TO REJECT  Ho:All groups equal**


ammonium day 28
File: 1103a28     Transform: NO TRANSFORMATION

    DUNNETTS TEST  -  TABLE 1 OF 2        Ho:Control<Treatment

| GROUP | IDENTIFICATION | TRANSFORMED MEAN | MEAN CALCULATED IN ORIGINAL UNITS | T STAT | SIG |
|-------|----------------|------------------|-----------------------------------|--------|-----|
| 1 | control | 1.603 | 1.603 | | |
| 2 | 0.13 | 1.743 | 1.743 | -1.565 | |
| 3 | 0.67 | 1.783 | 1.783 | -2.012 | |

Dunnett table value = 2.34    (1 Tailed Value, P=0.05, df=6,2)


ammonium day 28
File: 1103a28     Transform: NO TRANSFORMATION

    DUNNETTS TEST  -  TABLE 2 OF 2        Ho:Control<Treatment

| GROUP | IDENTIFICATION | NUM OF REPS | Minimum Sig Diff (IN ORIG. UNITS) | % of CONTROL | DIFFERENCE FROM CONTROL |
|-------|----------------|-------------|-----------------------------------|--------------|-------------------------|
| 1 | control | 3 | | | |
| 2 | 0.13 | 3 | 0.209 | 13.1 | -0.140 |
| 3 | 0.67 | 3 | 0.209 | 13.1 | -0.180 |


ammonium day 28
File: 1103a28     Transform: NO TRANSFORMATION

    WILLIAMS TEST (Isotonic regression model)   TABLE 1 OF 2

| GROUP IDENTIFICATION | N | ORIGINAL MEAN | TRANSFORMED MEAN | ISOTONIZED MEAN |
|----------------------|---|---------------|------------------|-----------------|
| 1 | control | 3 | 1.603 | 1.603 | 1.603 |
| 2 | 0.13 | 3 | 1.743 | 1.743 | 1.743 |
| 3 | 0.67 | 3 | 1.783 | 1.783 | 1.783 |

ammonium day 28
File: 1103a28      Transform: NO TRANSFORMATION

WILLIAMS TEST  (Isotonic regression model)   TABLE 2 OF 2
----------------------------------------------------------------------

| IDENTIFICATION | ISOTONIZED MEAN | CALC. WILLIAMS | SIG P=.05 | TABLE WILLIAMS | DEGREES OF FREEDOM |
|---|---|---|---|---|---|
| control | 1.603 | | | | |
| 0.13 | 1.743 | 1.585 | | 1.94 | k= 1, v= 6 |
| 0.67 | 1.783 | 2.038 | | 2.06 | k= 2, v= 6 |

----------------------------------------------------------------------
s =   0.108
Note: df used for table values are approximate when v > 20.

nitrate day 14
File: 1103n14      Transform: NO TRANSFORMATION

ANOVA TABLE
----------------------------------------------------------------------

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 2 | 118.222 | 59.111 | 1.622 |
| Within (Error) | 6 | 218.667 | 36.444 | |
| Total | 8 | 336.889 | | |

----------------------------------------------------------------------

Critical F value =  5.14  (0.05,2,6)
**Since  F < Critical F  FAIL TO REJECT  Ho:All groups equal**

nitrate day 14
File: 1103n14      Transform: NO TRANSFORMATION

DUNNETTS TEST  -  TABLE 1 OF 2          Ho:Control<Treatment
----------------------------------------------------------------------

| GROUP | IDENTIFICATION | TRANSFORMED MEAN | MEAN CALCULATED IN ORIGINAL UNITS | T STAT | SIG |
|---|---|---|---|---|---|
| 1 | control | 212.000 | 212.000 | | |
| 2 | 0.13 | 220.000 | 220.000 | -1.623 | |
| 3 | 0.67 | 212.667 | 212.667 | -0.135 | |

----------------------------------------------------------------------
Dunnett table value =  2.34    (1 Tailed Value, P=0.05,  df=6,2)

nitrate day 14
File: 1103n14      Transform: NO TRANSFORMATION

DUNNETTS TEST · TABLE 2 OF 2        Ho:Control<Treatment
-------------------------------------------------------------------------
              NUM OF  Minimum Sig Diff  % of    DIFFERENCE
GROUP   IDENTIFICATION   REPS   (IN ORIG. UNITS) CONTROL  FROM CONTROL
-----  -------------------  -------  -----------------  -------  -----------

| GROUP | IDENTIFICATION | NUM OF REPS | Minimum Sig Diff (IN ORIG. UNITS) | % of CONTROL | DIFFERENCE FROM CONTROL |
|---|---|---|---|---|---|
| 1 | control | 3 | | | |
| 2 | 0.13 | 3 | 11.534 | 5.4 | -8.000 |
| 3 | 0.67 | 3 | 11.534 | 5.4 | -0.667 |

-------------------------------------------------------------------------


nitrate day 14
File: 1103n14      Transform: NO TRANSFORMATION

WILLIAMS TEST (Isotonic regression model)   TABLE 1 OF 2
-------------------------------------------------------------------------
GROUP                  ORIGINAL   TRANSFORMED  ISOTONIZED
       IDENTIFICATION   N   MEAN        MEAN       MEAN
------  -------------------  ---  ----------  ----------  ----------

| GROUP | IDENTIFICATION | N | ORIGINAL MEAN | TRANSFORMED MEAN | ISOTONIZED MEAN |
|---|---|---|---|---|---|
| 1 | control | 3 | 212.000 | 212.000 | 212.000 |
| 2 | 0.13 | 3 | 220.000 | 220.000 | 216.333 |
| 3 | 0.67 | 3 | 212.667 | 212.667 | 216.333 |

-------------------------------------------------------------------------


nitrate day 14
File: 1103n14      Transform: NO TRANSFORMATION

WILLIAMS TEST (Isotonic regression model)   TABLE 2 OF 2
-------------------------------------------------------------------------
              ISOTONIZED  CALC.   SIG    TABLE    DEGREES OF
IDENTIFICATION    MEAN    WILLIAMS  P=.05  WILLIAMS   FREEDOM
--------------------  ----------  ----------  -----  ----------  ------------

| IDENTIFICATION | ISOTONIZED MEAN | CALC. WILLIAMS | SIG P=.05 | TABLE WILLIAMS | DEGREES OF FREEDOM |
|---|---|---|---|---|---|
| control | 212.000 | | | | |
| 0.13 | 216.333 | 0.879 | | 1.94 | k= 1, v= 6 |
| 0.67 | 216.333 | 0.879 | | 2.06 | k= 2, v= 6 |

-------------------------------------------------------------------------
s =  6.037
Note: df used for table values are approximate when v > 20.


nitrate day 7
File: 1103n7      Transform: NO TRANSFORMATION

                    ANOVA TABLE
-------------------------------------------------------------------------

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 2 | 980.667 | 490.333 | 16.973 |
| Within (Error) | 6 | 173.333 | 28.889 | |
| Total | 8 | 1154.000 | | |

Critical F value = 5.14 (0.05,2,6)
Since F > Critical F REJECT Ho:All groups equal

nitrate day 7
File: 1103n7     Transform: NO TRANSFORMATION

        DUNNETTS TEST  -  TABLE 1 OF 2          Ho:Control<Treatment

| | | TRANSFORMED | MEAN CALCULATED IN | | |
|---|---|---|---|---|---|
| GROUP | IDENTIFICATION | MEAN | ORIGINAL UNITS | T STAT | SIG |
| 1 | control | 137.000 | 137.000 | | |
| 2 | 0.13 | 121.333 | 121.333 | 3.570 | * |
| 3 | 0.67 | 111.667 | 111.667 | 5.773 | * |

Dunnett table value = 2.34    (1 Tailed Value, P=0.05, df=6,2)

nitrate day 7
File: 1103n7     Transform: NO TRANSFORMATION

        DUNNETTS TEST  -  TABLE 2 OF 2          Ho:Control<Treatment

| | | NUM OF | Minimum Sig Diff | % of | DIFFERENCE |
|---|---|---|---|---|---|
| GROUP | IDENTIFICATION | REPS | (IN ORIG. UNITS) | CONTROL | FROM CONTROL |
| 1 | control | 3 | | | |
| 2 | 0.13 | 3 | 10.269 | 7.5 | 15.667 |
| 3 | 0.67 | 3 | 10.269 | 7.5 | 25.333 |

nitrate day 7
File: 1103n7     Transform: NO TRANSFORMATION

        WILLIAMS TEST (Isotonic regression model)   TABLE 1 OF 2

| GROUP | | ORIGINAL | | TRANSFORMED | ISOTONIZED |
|---|---|---|---|---|---|
| | IDENTIFICATION | N | MEAN | MEAN | MEAN |

| 1 | control | 3 | 137.000 | 137.000 | 137.000 |
| 2 | 0.13 | 3 | 121.333 | 121.333 | 121.333 |
| 3 | 0.67 | 3 | 111.667 | 111.667 | 111.667 |

nitrate day 7
File: 1103n7    Transform: NO TRANSFORMATION

### WILLIAMS TEST (Isotonic regression model)    TABLE 2 OF 2

| IDENTIFICATION | ISOTONIZED MEAN | CALC. WILLIAMS | SIG P=.05 | TABLE WILLIAMS | DEGREES OF FREEDOM |
|---|---|---|---|---|---|
| control | 137.000 | | | | |
| 0.13 | 121.333 | 3.570 | * | 1.94 | k= 1, v= 6 |
| 0.67 | 111.667 | 5.773 | * | 2.06 | k= 2, v= 6 |

s =   5.375
Note: df used for table values are approximate when v > 20.

nitrate day 14
File: 1103n14    Transform: NO TRANSFORMATION

### ANOVA TABLE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 2 | 118.222 | 59.111 | 1.622 |
| Within (Error) | 6 | 218.667 | 36.444 | |
| Total | 8 | 336.889 | | |

Critical F value =  5.14  (0.05,2,6)
**Since  F < Critical F  FAIL TO REJECT  Ho:All groups equal**

nitrate day 14
File: 1103n14    Transform: NO TRANSFORMATION

### DUNNETTS TEST  -  TABLE 1 OF 2          Ho:Control<Treatment

| GROUP | IDENTIFICATION | TRANSFORMED MEAN | MEAN CALCULATED IN ORIGINAL UNITS | T STAT | SIG |
|---|---|---|---|---|---|
| 1 | control | 212.000 | 212.000 | | |

```
2          0.13   220.000        220.000     -1.623
3          0.67   212.667        212.667     -0.135
```
-------------------------------------------------------------------
Dunnett table value = 2.34    (1 Tailed Value, P=0.05, df=6,2)

nitrate day 14
File: 1103n14     Transform: NO TRANSFORMATION

      DUNNETTS TEST  -  TABLE 2 OF 2          Ho:Control<Treatment
-------------------------------------------------------------------
               NUM OF  Minimum Sig Diff  % of    DIFFERENCE
GROUP  IDENTIFICATION  REPS   (IN ORIG. UNITS) CONTROL FROM CONTROL
-----  --------------  ------  ----------------  -------  ------------

 1        control   3
 2          0.13   3       11.534        5.4      -8.000
 3          0.67   3       11.534        5.4      -0.667
-------------------------------------------------------------------

nitrate day 14
File: 1103n14     Transform: NO TRANSFORMATION

      WILLIAMS TEST (Isotonic regression model)   TABLE 1 OF 2
-------------------------------------------------------------------
GROUP                ORIGINAL    TRANSFORMED  ISOTONIZED
       IDENTIFICATION   N    MEAN        MEAN         MEAN
------ --------------  ---  ----------  -----------  -----------

 1        control   3   212.000      212.000      212.000
 2          0.13   3   220.000      220.000      216.333
 3          0.67   3   212.667      212.667      216.333
-------------------------------------------------------------------

nitrate day 14
File: 1103n14     Transform: NO TRANSFORMATION

      WILLIAMS TEST (Isotonic regression model)   TABLE 2 OF 2
-------------------------------------------------------------------
             ISOTONIZED  CALC.   SIG    TABLE    DEGREES OF
IDENTIFICATION   MEAN    WILLIAMS  P=.05  WILLIAMS   FREEDOM
-------------- ----------- --------- ----- ---------- ------------
      control  212.000
        0.13   216.333   0.879       1.94    k= 1, v= 6
        0.67   216.333   0.879       2.06    k= 2, v= 6
-------------------------------------------------------------------
s =   6.037
Note: df used for table values are approximate when v > 20.

**nitrate day 28**
File: 1103n28       Transform: NO TRANSFORMATION

ANOVA TABLE

------------------------------------------------------------------------

| SOURCE | DF | SS | MS | F |
|--------|----|----|----|----|
| Between | 2 | 5874.889 | 2937.444 | 54.286 |
| Within (Error) | 6 | 324.667 | 54.111 | |
| Total | 8 | 6199.556 | | |

------------------------------------------------------------------------

Critical F value =  5.14  (0.05,2,6)
Since  F > Critical F  REJECT  Ho:All groups equal


nitrate day 28
File: 1103n28       Transform: NO TRANSFORMATION

DUNNETTS TEST  -  TABLE 1 OF 2          Ho:Control<Treatment

------------------------------------------------------------------------
|       |                | TRANSFORMED | MEAN CALCULATED IN | | |
| GROUP | IDENTIFICATION | MEAN | ORIGINAL UNITS | T STAT | SIG |
|-------|----------------|------|----------------|--------|-----|
| 1 | control | 283.000 | 283.000 | | |
| 2 | 0.13 | 319.000 | 319.000 | -5.994 | |
| 3 | 0.67 | 345.333 | 345.333 | -10.378 | |

------------------------------------------------------------------------
Dunnett table value = 2.34    (1 Tailed Value, P=0.05,  df=6,2)


nitrate day 28
File: 1103n28       Transform: NO TRANSFORMATION

DUNNETTS TEST  -  TABLE 2 OF 2          Ho:Control<Treatment

------------------------------------------------------------------------
|       |                | NUM OF | Minimum Sig Diff | % of | DIFFERENCE |
| GROUP | IDENTIFICATION | REPS | (IN ORIG. UNITS) | CONTROL | FROM CONTROL |
|-------|----------------|------|------------------|---------|--------------|
| 1 | control | 3 | | | |
| 2 | 0.13 | 3 | 14.054 | 5.0 | -36.000 |
| 3 | 0.67 | 3 | 14.054 | 5.0 | -62.333 |

------------------------------------------------------------------------


nitrate day 28
File: 1103n28       Transform: NO TRANSFORMATION

WILLIAMS TEST (Isotonic regression model)  TABLE 1 OF 2
------------------------------------------------------------------------
| GROUP | IDENTIFICATION | N | ORIGINAL MEAN | TRANSFORMED MEAN | ISOTONIZED MEAN |
|-------|----------------|---|---------------|------------------|-----------------|
| 1 | control | 3 | 283.000 | 283.000 | 283.000 |
| 2 | 0.13 | 3 | 319.000 | 319.000 | 319.000 |
| 3 | 0.67 | 3 | 345.333 | 345.333 | 345.333 |
------------------------------------------------------------------------

nitrate day 28
File: 1103n28     Transform: NO TRANSFORMATION

WILLIAMS TEST (Isotonic regression model)  TABLE 2 OF 2
------------------------------------------------------------------------
| IDENTIFICATION | ISOTONIZED MEAN | CALC. WILLIAMS | SIG P=.05 | TABLE WILLIAMS | DEGREES OF FREEDOM |
|----------------|-----------------|----------------|-----------|----------------|--------------------|
| control | 283.000 | | | | |
| 0.13 | 319.000 | 5.994 | * | 1.94 | k= 1, v= 6 |
| 0.67 | 345.333 | 10.378 | * | 2.06 | k= 2, v= 6 |
------------------------------------------------------------------------

s =  7.356
Note: df used for table values are approximate when v > 20.

nitrate day 42
File: 1103n42     Transform: NO TRANSFORMATION

ANOVA TABLE
------------------------------------------------------------------------
| SOURCE | DF | SS | MS | F |
|--------|----|-----|-----|-----|
| Between | 2 | 1081.556 | 540.778 | 6.153 |
| Within (Error) | 6 | 527.333 | 87.889 | |
| Total | 8 | 1608.889 | | |
------------------------------------------------------------------------

 Critical F value =  5.14  (0.05,2,6)
 Since  F > Critical F  REJECT  Ho:All groups equal

nitrate day 42
File: 1103n42     Transform: NO TRANSFORMATION

```
        DUNNETTS TEST  -  TABLE 1 OF 2        Ho:Control<Treatment
-------------------------------------------------------------------------
                        TRANSFORMED   MEAN CALCULATED IN
GROUP   IDENTIFICATION     MEAN        ORIGINAL UNITS   T STAT  SIG
-----  -------------------  ----------  -----------------  -------  ---
  1        control   343.000          343.000
  2          0.13   345.333          345.333           -0.305
  3          0.67   367.333          367.333           -3.179
-------------------------------------------------------------------------
Dunnett table value =  2.34    (1 Tailed Value, P=0.05,  df=6,2)
```

nitrate day 42
File: 1103n42      Transform: NO TRANSFORMATION

```
        DUNNETTS TEST  -  TABLE 2 OF 2        Ho:Control<Treatment
-------------------------------------------------------------------------
                NUM OF   Minimum Sig Diff  % of    DIFFERENCE
GROUP   IDENTIFICATION    REPS    (IN ORIG. UNITS)  CONTROL  FROM CONTROL
-----  -------------------  -------  ----------------  -------  -----------
  1        control   3
  2          0.13   3       17.912           5.2      -2.333
  3          0.67   3       17.912           5.2     -24.333
-------------------------------------------------------------------------
```

nitrate day 42
File: 1103n42      Transform: NO TRANSFORMATION

```
        WILLIAMS TEST  (Isotonic regression model)   TABLE 1 OF 2
-------------------------------------------------------------------------
GROUP                    ORIGINAL   TRANSFORMED   ISOTONIZED
        IDENTIFICATION    N   MEAN        MEAN         MEAN
------  -------------------  ---  ----------  -----------  -----------
  1        control   3   343.000      343.000      343.000
  2          0.13   3   345.333      345.333      345.333
  3          0.67   3   367.333      367.333      367.333
-------------------------------------------------------------------------
```

nitrate day 42
File: 1103n42      Transform: NO TRANSFORMATION

```
        WILLIAMS TEST  (Isotonic regression model)   TABLE 2 OF 2
-------------------------------------------------------------------------
                ISOTONIZED   CALC.   SIG    TABLE    DEGREES OF
IDENTIFICATION     MEAN     WILLIAMS  P=.05  WILLIAMS   FREEDOM
-------------------  ----------  ----------  -----  ----------  ------------
        control   343.000
          0.13   345.333    0.305           1.94     k= 1, v= 6
          0.67   367.333    3.179     *     2.06     k= 2, v= 6
```

---------------------------------------------------------------------
s = 9.375
Note: df used for table values are approximate when v > 20.

**nitrate transformation day 7**
File: 1103t7     Transform: NO TRANSFORMATION

### ANOVA TABLE
---------------------------------------------------------------------

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 2 | 20.562 | 10.281 | 25.199 |
| Within (Error) | 6 | 2.447 | 0.408 |  |
| Total | 8 | 23.009 |  |  |

---------------------------------------------------------------------

Critical F value = 5.14 (0.05,2,6)
Since F > Critical F REJECT Ho:All groups equal

**nitrate transformation day 7**
File: 1103t7     Transform: NO TRANSFORMATION

DUNNETTS TEST  -  TABLE 1 OF 2          Ho:Control<Treatment
---------------------------------------------------------------------

| GROUP | IDENTIFICATION | TRANSFORMED MEAN | MEAN CALCULATED IN ORIGINAL UNITS | T STAT | SIG |
|---|---|---|---|---|---|
| 1 | control | 14.033 | 14.033 |  |  |
| 2 | 0.13 | 11.600 | 11.600 | 4.666 | * |
| 3 | 0.67 | 10.400 | 10.400 | 6.967 | * |

---------------------------------------------------------------------
Dunnett table value = 2.34    (1 Tailed Value, P=0.05, df=6,2)

**nitrate transformation day 7**
File: 1103t7     Transform: NO TRANSFORMATION

DUNNETTS TEST  -  TABLE 2 OF 2          Ho:Control<Treatment
---------------------------------------------------------------------

| GROUP | IDENTIFICATION | NUM OF REPS | Minimum Sig Diff (IN ORIG. UNITS) | % of CONTROL | DIFFERENCE FROM CONTROL |
|---|---|---|---|---|---|
| 1 | control | 3 |  |  |  |
| 2 | 0.13 | 3 | 1.220 | 8.7 | 2.433 |

```
3            0.67   3        1.220    8.7    3.633
```
-------------------------------------------------------------------


nitrate transformation day 7
File: 1103t7      Transform: NO TRANSFORMATION

       WILLIAMS TEST (Isotonic regression model)   TABLE 1 OF 2
-------------------------------------------------------------------

| GROUP IDENTIFICATION | | ORIGINAL N | MEAN | TRANSFORMED MEAN | ISOTONIZED MEAN |
|---|---|---|---|---|---|
| 1 | control | 3 | 14.033 | 14.033 | 14.033 |
| 2 | 0.13 | 3 | 11.600 | 11.600 | 11.600 |
| 3 | 0.67 | 3 | 10.400 | 10.400 | 10.400 |

-------------------------------------------------------------------


nitrate transformation day 7
File: 1103t7      Transform: NO TRANSFORMATION

       WILLIAMS TEST (Isotonic regression model)   TABLE 2 OF 2
-------------------------------------------------------------------

| IDENTIFICATION | ISOTONIZED MEAN | CALC. WILLIAMS | SIG P=.05 | TABLE WILLIAMS | DEGREES OF FREEDOM |
|---|---|---|---|---|---|
| control | 14.033 | | | | |
| 0.13 | 11.600 | 4.667 | * | 1.94 | k= 1, v= 6 |
| 0.67 | 10.400 | 6.968 | * | 2.06 | k= 2, v= 6 |

-------------------------------------------------------------------
s =   0.639
Note: df used for table values are approximate when v > 20.




nitrate transformation day 14
File: 1103t14     Transform: NO TRANSFORMATION

                    ANOVA TABLE
-------------------------------------------------------------------


| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 2 | 0.407 | 0.203 | 0.886 |
| Within (Error) | 6 | 1.373 | 0.229 | |
| Total | 8 | 1.780 | | |

-------------------------------------------------------------------

 Critical F value =  5.14 (0.05,2,6)

**Since F < Critical F FAIL TO REJECT Ho:All groups equal**

nitrate transformation day 14
File: 1103t14　　Transform: NO TRANSFORMATION

　　　DUNNETTS TEST - TABLE 1 OF 2　　　Ho:Control<Treatment
-------------------------------------------------------------------
　　　　　　　　　　TRANSFORMED　MEAN CALCULATED IN
GROUP　IDENTIFICATION　　MEAN　　ORIGINAL UNITS　T STAT SIG
----- -------------------　-----------　------------------ ------ ---
1　　　control　12.400　　　　12.400
2　　　　0.13　12.867　　　　12.867　　-1.194
3　　　　0.67　12.433　　　　12.433　　-0.085
-------------------------------------------------------------------
Dunnett table value = 2.34　　(1 Tailed Value, P=0.05, df=6,2)

nitrate transformation day 14
File: 1103t14　　Transform: NO TRANSFORMATION

　　　DUNNETTS TEST - TABLE 2 OF 2　　　　Ho:Control<Treatment
-------------------------------------------------------------------
　　　　　　　　　　NUM OF　Minimum Sig Diff　% of　　DIFFERENCE
GROUP　IDENTIFICATION　REPS　(IN ORIG. UNITS)　CONTROL　FROM CONTROL
----- -------------------　-------　----------------- ------- -----------
1　　　control　3
2　　　　0.13　3　　　　0.914　　7.4　　-0.467
3　　　　0.67　3　　　　0.914　　7.4　　-0.033
-------------------------------------------------------------------

nitrate transformation day 14
File: 1103t14　　Transform: NO TRANSFORMATION

　　　WILLIAMS TEST (Isotonic regression model)　TABLE 1 OF 2
-------------------------------------------------------------------
GROUP　　　　　　　ORIGINAL　TRANSFORMED　ISOTONIZED
　　IDENTIFICATION　N　MEAN　　MEAN　　　MEAN
------ -------------------- --- ----------　----------　----------
1　　　control　3　12.400　　12.400　　12.400
2　　　　0.13　3　12.867　　12.867　　12.650
3　　　　0.67　3　12.433　　12.433　　12.650
-------------------------------------------------------------------

nitrate transformation day 14
File: 1103t14　　Transform: NO TRANSFORMATION

　　　WILLIAMS TEST (Isotonic regression model)　TABLE 2 OF 2

```
--------------------------------------------------------------
            ISOTONIZED  CALC.   SIG    TABLE    DEGREES OF
IDENTIFICATION    MEAN    WILLIAMS  P=.05  WILLIAMS   FREEDOM
-------------------- ----------- ---------- ------ ----------- ------------
      control   12.400
        0.13   12.650   0.640         1.94    k= 1, v= 6
        0.67   12.650   0.640         2.06    k= 2, v= 6
--------------------------------------------------------------
s =   0.478
```
Note: df used for table values are approximate when v > 20.

**nitrate transformation day 28**
File: 1103t28      Transform: NO TRANSFORMATION

### ANOVA TABLE

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 2 | 7.296 | 3.648 | 57.905 |
| Within (Error) | 6 | 0.380 | 0.063 | |
| Total | 8 | 7.676 | | |

Critical F value =  5.14  (0.05,2,6)
Since  F > Critical F  REJECT  Ho:All groups equal

nitrate transformation day 28
File: 1103t28      Transform: NO TRANSFORMATION

DUNNETTS TEST  -  TABLE 1 OF 2          Ho:Control<Treatment

| GROUP | IDENTIFICATION | TRANSFORMED MEAN | MEAN CALCULATED IN ORIGINAL UNITS | T STAT | SIG |
|---|---|---|---|---|---|
| 1 | control | 8.733 | 8.733 | | |
| 2 | 0.13 | 9.967 | 9.967 | -6.018 | |
| 3 | 0.67 | 10.933 | 10.933 | -10.735 | |

Dunnett table value = 2.34    (1 Tailed Value, P=0.05,  df=6,2)

nitrate transformation day 28
File: 1103t28      Transform: NO TRANSFORMATION

DUNNETTS TEST  -  TABLE 2 OF 2          Ho:Control<Treatment

```
------------------------------------------------------------------
            NUM OF  Minimum Sig Diff  % of    DIFFERENCE
GROUP   IDENTIFICATION  REPS   (IN ORIG. UNITS) CONTROL FROM CONTROL
------ -------------------- ------- ---------------- ------- -----------
  1        control   3
  2          0.13    3        0.480     5.5     -1.233
  3          0.67    3        0.480     5.5     -2.200
------------------------------------------------------------------
```

nitrate transformation day 28
File: 1103t28    Transform: NO TRANSFORMATION

WILLIAMS TEST  (Isotonic regression model)   TABLE 1 OF 2
```
------------------------------------------------------------------
GROUP                   ORIGINAL   TRANSFORMED  ISOTONIZED
      IDENTIFICATION  N    MEAN        MEAN       MEAN
------ -------------------- --- ---------- ----------- -----------
  1        control   3   8.733       8.733       8.733
  2          0.13    3   9.967       9.967       9.967
  3          0.67    3  10.933      10.933      10.933
------------------------------------------------------------------
```

nitrate transformation day 28
File: 1103t28    Transform: NO TRANSFORMATION

WILLIAMS TEST  (Isotonic regression model)   TABLE 2 OF 2
```
------------------------------------------------------------------
          ISOTONIZED  CALC.   SIG    TABLE    DEGREES OF
IDENTIFICATION   MEAN   WILLIAMS P=.05 WILLIAMS  FREEDOM
-------------------- ---------- ----------- ----- ---------- ------------
     control    8.733
       0.13    9.967   6.002    *    1.94    k= 1, v= 6
       0.67   10.933  10.707    *    2.06    k= 2, v= 6
------------------------------------------------------------------
```
s =  0.252
Note: df used for table values are approximate when v > 20.

nitrate transformation day 42
File: 1103t42    Transform: NO TRANSFORMATION

ANOVA TABLE
```
------------------------------------------------------------------
SOURCE       DF      SS       MS       F
------------------------------------------------------------------
Between       2     0.642    0.321    4.586
```

| Within (Error) | 6 | 0.420 | 0.070 |

| Total | 8 | 1.062 |

Critical F value =  5.14  (0.05,2,6)
**Since  F < Critical F  FAIL TO REJECT  Ho:All groups equal**


nitrate transformation day 42
File: 1103t42     Transform: NO TRANSFORMATION

      DUNNETTS TEST  -  TABLE 1 OF 2          Ho:Control<Treatment

|  |  | TRANSFORMED | MEAN CALCULATED IN |  |  |
|---|---|---|---|---|---|
| GROUP | IDENTIFICATION | MEAN | ORIGINAL UNITS | T STAT | SIG |
| 1 | control | 7.267 | 7.267 |  |  |
| 2 | 0.13 | 7.267 | 7.267 | -0.000 |  |
| 3 | 0.67 | 7.833 | 7.833 | -2.623 |  |

Dunnett table value = 2.34    (1 Tailed Value, P=0.05,  df=6,2)


nitrate transformation day 42
File: 1103t42     Transform: NO TRANSFORMATION

      DUNNETTS TEST  -  TABLE 2 OF 2          Ho:Control<Treatment

|  |  | NUM OF | Minimum Sig Diff | % of | DIFFERENCE |
|---|---|---|---|---|---|
| GROUP | IDENTIFICATION | REPS | (IN ORIG. UNITS) | CONTROL | FROM CONTROL |
| 1 | control | 3 |  |  |  |
| 2 | 0.13 | 3 | 0.505 | 7.0 | -0.000 |
| 3 | 0.67 | 3 | 0.505 | 7.0 | -0.567 |


nitrate transformation day 42
File: 1103t42     Transform: NO TRANSFORMATION

      WILLIAMS TEST  (Isotonic regression model)   TABLE 1 OF 2

| GROUP |  | ORIGINAL | TRANSFORMED | ISOTONIZED |
|---|---|---|---|---|
|  | IDENTIFICATION | N | MEAN | MEAN | MEAN |
| 1 | control | 3 | 7.267 | 7.267 | 7.267 |
| 2 | 0.13 | 3 | 7.267 | 7.267 | 7.267 |
| 3 | 0.67 | 3 | 7.833 | 7.833 | 7.833 |

nitrate transformation day 42
File: 1103t42      Transform: NO TRANSFORMATION

WILLIAMS TEST  (Isotonic regression model)    TABLE 2 OF 2
-----------------------------------------------------------------------------
                ISOTONIZED  CALC.   SIG    TABLE     DEGREES OF
IDENTIFICATION    MEAN     WILLIAMS  P=.05  WILLIAMS   FREEDOM
----------------- --------- --------- ------ --------- ------------
        control    7.267
         0.13     7.267    0.000          1.94     k= 1, v= 6
         0.67     7.833    2.623     *    2.06     k= 2, v= 6
-----------------------------------------------------------------------------
s =   0.265
Note: df used for table values are approximate when v > 20.