2.2.94

MRID No. 421455-01

DATA EVALUATION RECORD

1. **CHEMICAL:** Benefin. Shaughnessey No. 083401.

2. **TEST MATERIAL:** Benefin (N-(n-butyl)-N-ethyl-2,6-dinitro-∝,∝,∝-trifluoro-p-toluidine); Lot No. 231EF4; 95.64% purity.

3. **STUDY TYPE:** Avian Reproduction Study.
Species Tested: Mallard duck (*Anas platyrhynchos*).

4. **CITATION:** Murray, A.G., J.R. Smith, and D.W. Grothe. 1991. The Toxicity of Benefin to Mallards in a One-Generation Reproduction Study. Laboratory Project No. A01090. Prepared by Toxicology Research Laboratories, Lilly Research Laboratories, Greenfield, Indiana. Submitted by DowElanco, Indianapolis, Indiana. EPA MRID No. 421455-01.

5. **REVIEWED BY:**

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Associate Scientist
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Signature: Rosemary Graham Mora
Date: 4/23/92

6. **APPROVED BY:**

Michael L. Whitten, M.S.
Wildlife Toxicologist
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Signature: Michael L. Whitten
Date: 4/23/92

Henry T. Craven, M.S.
Supervisor, HED/EFED
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Signature: 2/2/94 DS 2-2-94
Date:

7. **CONCLUSIONS:** This study is scientifically sound and fulfills the guideline requirements for an avian reproduction study. Mean measured dietary concentrations of benefin at 97 ppm, 288 ppm, and 975 ppm had no effects upon mortality, behavior, or adult food consumption in mallards during the 22-week exposure period. The NOEC was 288 ppm, due to an increase in the percentage of eggs cracked at 975 ppm.

8. **RECOMMENDATIONS:** N/A.

9. **BACKGROUND:**

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

11. MATERIALS AND METHODS:

A. Test Animals: The birds used in the test were pen-reared mallards (*Anas platyrhynchos*) purchased from Whistling Wings, Hanover, Illinois. All birds were of the same hatch date. For this study, 174 birds were quarantined and acclimated to the facilities for 3 weeks prior to initiation of the test. One male and one female were assigned to each pen. At test initiation, two pairs of birds were rejected due to weight loss and were replaced. The birds were 18 weeks of age at the beginning of the preproduction phase of the study.

B. Dose/Diet Preparation/Food Consumption: Test diets were prepared on a weekly basis by dissolving the appropriate amount of benefin in acetone. This mix was added intermittently to two 8-kg batches of diet and mixed for 15 minutes. These two treated batches were combined with 104-kg batches of untreated diet and mixed for 10 minutes. The control diet and three test concentrations (100, 300, and 1,000 parts per million [ppm]) were prepared weekly and presented *ad libitum* to the birds. Each of the four groups of adult birds was fed the appropriate diet from test initiation until terminal sacrifice. The potency of the test material was assumed 100% for the purpose of diet preparation. Acetone accounted for no more than 1% of the total diet.

The composition of the basal diets for adult birds and their offspring was presented in the report. The test substance was not mixed into the diet of the offspring. Food and water were supplied *ad libitum* during acclimation and during the test for adults and offspring.

Samples of freshly prepared diets were collected on four occasions during the study for the analysis of benefin using gas chromatography. The homogeneity and stability of the test material at 100 and 1,000 ppm were determined prior to this study.

C. Design: The pens were assigned to treatment levels using a computer-generated table of random numbers. The test birds were distributed to the test pens using a computer-generated table of random numbers. The four groups were comprised of the following:

Benefin Nominal Concentration	Number of Pens	Birds Per Pen	
		Males	Females
Control (0 ppm)	18	1	1
100 ppm	18	1	1
300 ppm	18	1	1
1,000 ppm	18	1	1

Treatment levels were based, in part, upon acute toxicity data. Adult birds were identified by individual leg bands. The primary phases of the study and their approximate durations were as follows:

1. Acclimation - 3 weeks
2. Pre-production - 10 weeks
3. Production - 12 weeks
4. Post-adult sacrifice (final incubation, hatching, 14-day offspring rearing period) - 5 weeks.

D. **Pen Facilities:** Adult birds were housed indoors in pens constructed of stainless steel. Pens measured approximately 57.5 x 76.2 x 40.6 cm high. The temperature in the adult study room was approximately 21°C with an average relative humidity of 40-70%.

The photoperiod for acclimation and the preproduction period of the study was 8 hours of light per day at an intensity of 235 lux. The photoperiod was increased to 17 hours of light per day two weeks prior to the production period.

E. **Adult Observations/Gross Pathology:** The adult and juvenile birds were observed twice daily on the weekdays and once daily on the weekends and holidays throughout the study for signs of toxicity or abnormal behavior. All birds that died during the study were necropsied. The pen mate of dead birds was sacrificed and necropsied. At study termination, all surviving birds were sacrificed and necropsied. Adult birds were weighed at test initiation, weekly during acclimation and the preproduction period, and at study termination. Food consumption per pen was determined weekly throughout the study.

F. **Eggs/Eggshell Thickness:** Eggs were collected daily, marked (date, pen number, and treatment level), candled, and stored in a refrigerator at 15°C. Cracked eggs or soft-shelled eggs were recorded and discarded. All cracked eggs for Set 4 and 6 were measured for

eggshell thickness and discarded. The remaining eggs were incubated in an incubator with a dry bulb temperature of 100°F and a wet bulb temperature of 85-90°F. The eggs were candled on days 14 and 21. On day 24 of incubation, live eggs were transferred to a hatcher with a dry bulb temperature of 98-100°F and a wet bulb temperature of 85-100°F.

When possible, the 7th, 14th, and 21st egg from each pen was collected for eggshell thickness determination. These eggs were opened at the girth, the contents removed, and the shell washed thoroughly to remove the albumen and allowed to air dry at room temperature for at least 48 hours. The average thickness of the dried shell plus membrane was determined by measuring (to the nearest 0.001 mm) two points around each half of the waist of the egg using a micrometer.

G. **Hatchlings:** All hatchlings and unhatched eggs were removed from the hatcher on day 27 of incubation. The average body weight of the hatchlings by pen was then determined. Hatchlings were wingbanded for identification by parental pen and placed in brooding pens until 14 days of age. Each brooding pen measured 43.2 x 75.2 x 27.9 cm high with plastic-coated wire mesh floors. Each brooder was equipped with two heat lamps which maintained the temperature in the brooding pens at approximately 37°C during the 14-day survival period. Continuous light was provided. Relative humidity was maintained at 25-60%. At 14 days of age, the average body weight of all survivors was determined.

H. **Statistics:** Upon completion of the study, two-factor repeated measures analysis of variance (ANOVA) was used to assess the effects of benefin on adult body weight, hatchling body weight, and hatchling body weight gain. All other variables were analyzed using a one-way ANOVA. Proportional data (e.g., EC/EL and VE/ES) were subjected to arcsine transformation prior to analysis. "F-statistics were used to test the statistical significance of all main effect and interactions terms. Additionally, the statistical significance of linear trends across the concentration levels of benefin were examined to determine the concentration level below which no significant trend could be detected. All references to statistical significance represent $p \leq 0.05$."

Each of the following parameters was analyzed statistically:

Adult Body Weight	Offspring Body Weight
Adult Feed Consumption	Offspring Food Consumption
Egg Production	14-Day Old Survivors
Eggs Laid per Hen	14-Day Survivors per Hen
Number of Eggs Laid	14-Day Old Survivors of Eggs Laid
Eggs Cracked of Eggs Laid	14-Day Old Survivors of of Hatchlings
Viable Embryos of Eggs Set	Egg Shell Thickness
Live 3-Week Embryos of Viable Embryos	
Hatchlings of 3-Week Embryos	

12. REPORTED RESULTS

A. **Diet Analysis:** Analyses conducted prior to this study showed that homogeneity and stability after 2 weeks were within acceptable limits. The results of the diet analyses are presented in Table 2 (attached). Nominal and mean measured concentrations of freshly prepared diets were as follows:

Benefin (ppm)		
Nominal Concentration	Mean Measured Concentration	Percent of Nominal
0	<2	NA
100	97	97%
300	288	96%
1,000	975	97.5%

Subsequent discussions refer to the treatment groups using their mean measured concentrations.

B. **Mortality and Behavioral Reactions:** "No signs of toxicity were observed at any treatment level." One incidental mortality occurred in the control, 97-ppm group, and 288-ppm group.

Necropsy results of all mortalities and sacrificed birds were included in the report. "No compound-related gross or microscopic lesions were detected."

C. **Adult Body Weight and Food Consumption:** There were no significant differences in food consumption during the preproduction period between the control and treatment levels (Table 8, attached). A significant decrease in food consumption during the production period was noted

at the two lower test concentrations (Table 9, attached). However, no significant decrease was noted at the higher test level. Therefore, the slight decrease noted at the two lower test levels "does not appear to be related to increasing concentrations of benefin."

There were no apparent treatment related effects upon body weight or weight gain among birds at any of the concentrations tested (Tables 4-7, attached).

D. **Reproduction:** When compared to the control group, there were no statistically significant differences in reproductive parameters, except the percentage of eggs cracked/eggs laid, at any concentration tested (Tables 10-12, attached). The ratio of eggs cracked/eggs laid was significantly higher at the highest test level (975 ppm) when compared to the control.

E. **Egg Shell Thickness:** Eggshell thickness for cracked eggs and normal eggs was not affected by treatment. There was no significant difference between the control and test concentrations in mean egg shell thickness for normal eggs. Cracked control eggs were significantly thinner than normal eggs and thinner than cracked eggs from all treatment levels (Table 13, attached).

F. **Offspring Body Weight:** When compared to the control, there was no significant reduction in mean body weights or body weight gain in any treatment group (Tables 16 and 17, attached). "Mean food consumption was slightly lower for hatchlings fed benefin when compared to the control." Mean offspring food consumption (g/bird/day) was as follows: 81 (control), 75 (97 ppm), 77 (288 ppm), and 67 (975 ppm).

13. **STUDY AUTHOR'S CONCLUSIONS/QUALITY ASSURANCE MEASURES:** "Based upon the results of this study and maximum use rate patterns, benefin is not expected to have any adverse effect to mallards." The NOEC was 288 ppm, due to an increase in the percentage of cracked eggs at 975 ppm.

The report stated that the study was conducted in compliance with EPA (FIFRA 40 CFR, Part 160), OECD and Japanese MAFF GLP standards. Quality assurance audits were conducted during the study and the final report was signed by the Quality Assurance Representative and the Study Director.

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

A. **Test Procedure:** The test procedures were in accordance with Subdivision E - Hazard Evaluation: Wildlife and Aquatic Organisms, ASTM, and SEP guidelines except for the following deviations:

The physical properties of the test material (i.e., powder, liquid) were not reported.

A withdrawal study period (using basal diet only) was not added to the test phase.

For this study, the light intensity provided to the test birds was 235 lux (22 footcandles). The light intensity recommended by the guidelines is 65 lux (6 footcandles).

During the preproduction phase of this study, the period of light provided to adult birds was 8 hours. The SEP recommends 7 hours of light.

For this study, the temperature in the offspring pens was 37°C. ASTM guidelines recommend a temperature gradient from the heat source to about 21°C in order to allow the birds to seek a proper temperature.

The report did not indicate whether the mallards used in this study were phenotypically indistinguishable from wild mallards as recommended.

Behavioral observations of offspring were not reported.

Observations on food palatability were not reported.

All eggs were transferred to the hatcher on day 24. The guidelines recommend the transfer on day 23.

On page 29 of the report, the authors state, "Mean food consumption was slightly lower for hatchlings fed benefin when compared to the control." However, benefin was not added to the hatchling diet (TEKLAD AN11DU) (pages 16 and 18). This is assumed to be a discrepancy in the report, rather than a deviation in procedures.

B. **Statistical Analysis:** Statistical analyses of study parameters were performed by the reviewer using analysis of variance (ANOVA) following square-root transformation of the count data and arcsine square-root transformation of the ratio data. The comparison between control data and data from each treatment level

was made using multiple comparison tests. The computer program used is based on the EEB Bigbird program, with an exception that the count data were square-root transformed before the ANOVA. The significance level was $p \leq 0.05$.

Analyses of study parameters were verified (attached) and found to match those reported by the author, with the exception of the percentage of eggs cracked. The authors reported a significant difference between the ratio of eggs cracked/eggs laid in the control and those of the 975 ppm group ($p=0.03$), while the reviewer's analysis showed no significant difference. However, the reviewer's analysis showed a difference at 975 ppm approaching the level of significance ($p=0.089$ for eggs cracked and $p=0.061$ for eggs laid/eggs cracked). Therefore, a conservative approach would be to assume that this is a treatment-related effect.

The reduced food consumption at 97 and 288 ppm does not appear to be a treatment effect.

C. **Discussion/Results:** This study is scientifically sound and fulfills the guideline requirements for an avian reproduction study. The mean measured dietary concentrations of benefin (97 ppm, 288 ppm, and 975 ppm) had no effects upon mortality, behavior, adult food consumption, or adult body weights in mallards during the 22-week exposure period. However, due to a high percentage of cracked eggs at 975 ppm, the NOEC was 288 ppm.

D. **Adequacy of the Study:**

(1) **Classification:** Core.

(2) **Rationale:** Deviations from protocols were minor and did not affect the validity of the study.

(3) **Repairability:** N/A.

15. **COMPLETION OF ONE-LINER:** Yes; April 7, 1992.

BENEFIN: MALLARD REPRODUCTION

		TRT	EL	EC	ES	VE
CASE	1	0	54	1	49	44
CASE	2		39	1	35	28
CASE	3		52	0	49	45
CASE	4		46	0	43	39
CASE	5		46	3	40	34
CASE	6		53	8	42	33
CASE	7		67	1	63	57
CASE	8		45	2	40	37
CASE	9		61	8	48	41
CASE	10		61	2	56	51
CASE	11		56	6	47	43
CASE	12		69	17	49	44
CASE	13		36	2	31	30
CASE	14		57	1	53	52
CASE	15		31	0	28	27
CASE	16		62	1	58	55
CASE	17		61	1	57	41
CASE	18		54	5	46	45
CASE	19	1	57	2	52	47
CASE	20		33	0	30	29
CASE	21		57	4	50	48
CASE	22		60	1	56	49
CASE	23		75	15	57	51
CASE	24		63	0	60	55
CASE	25		45	2	40	37
CASE	26		61	2	56	51
CASE	27		2	0	0	0
CASE	28		44	0	41	40
CASE	29		0	.	.	.
CASE	30		56	6	47	42
CASE	31		46	0	43	39
CASE	32		59	9	47	44
CASE	33		63	14	46	46
CASE	34		45	3	39	31
CASE	35		14	0	12	11
CASE	36		13	0	12	5
CASE	37	2	41	1	37	34
CASE	38		30	2	25	25
CASE	39		47	1	43	39
CASE	40		9	2	5	5

CASE	41	54	5	46	0
CASE	42	40	29	8	8
CASE	43	63	9	51	45
CASE	44	76	3	70	70
CASE	45	.	.	.	.
CASE	46	68	0	65	64
CASE	47	47	0	44	42
CASE	48	53	1	49	46
CASE	49	36	12	21	20
CASE	50	68	1	64	23
CASE	51	58	2	53	52
CASE	52	22	2	17	16
CASE	53	75	2	70	67
CASE	54	77	2	72	69
CASE	55	65	1	61	59
CASE	56	58	4	51	47
CASE	57	38	6	28	26
CASE	58	59	21	35	34
CASE	59	26	1	22	21
CASE	60	51	6	42	37
CASE	61	59	5	51	35
CASE	62	72	4	65	58
CASE	63	33	4	26	25
CASE	64	40	14	21	15
CASE	65	61	2	56	50
CASE	66	37	8	26	24
CASE	67	36	1	32	32
CASE	68	48	1	44	41
CASE	69	54	1	50	48
CASE	70	45	17	25	24
CASE	71	64	3	58	49
CASE	72	69	6	60	51

BENEFIN: MALLARD REPRODUCTION

		TRT	LE21	HAT	TWOWK
CASE	1	0	43	7	7
CASE	2		28	13	11
CASE	3		45	41	38
CASE	4		39	34	28
CASE	5		32	26	12
CASE	6		33	23	22
CASE	7		57	26	23
CASE	8		35	32	32
CASE	9		39	6	5
CASE	10		51	31	23
CASE	11		42	31	21
CASE	12		44	32	24
CASE	13		30	23	22
CASE	14		51	39	37
CASE	15		26	13	11
CASE	16		53	45	44
CASE	17		40	27	23
CASE	18		45	31	30
CASE	19	1	47	40	18
CASE	20		29	27	24
CASE	21		48	31	31
CASE	22		49	42	33
CASE	23		39	1	1
CASE	24		53	32	28
CASE	25		37	35	30
CASE	26		50	30	30
CASE	27		0	0	0
CASE	28		39	32	27
CASE	29		.	.	.
CASE	30		42	38	29
CASE	31		39	33	30
CASE	32		44	40	39
CASE	33		46	40	35
CASE	34		31	16	16
CASE	35		10	7	6
CASE	36		5	5	5
CASE	37	2	34	23	23
CASE	38		25	15	4
CASE	39		39	34	30
CASE	40		4	2	2

CASE	41	0	0	0
CASE	42	8	6	4
CASE	43	45	32	17
CASE	44	70	46	29
CASE	45	.	.	.
CASE	46	64	38	38
CASE	47	41	29	25
CASE	48	45	32	29
CASE	49	18	15	15
CASE	50	23	20	19
CASE	51	52	34	17
CASE	52	16	6	5
CASE	53	67	45	42
CASE	54	69	56	56
CASE	55	56	29	26
CASE	56	47	30	24
CASE	57	26	23	23
CASE	58	34	20	20
CASE	59	21	19	16
CASE	60	37	29	24
CASE	61	34	10	10
CASE	62	58	52	48
CASE	63	25	19	16
CASE	64	14	2	2
CASE	65	50	25	25
CASE	66	24	12	12
CASE	67	31	25	22
CASE	68	37	36	25
CASE	69	48	36	36
CASE	70	24	9	9
CASE	71	49	42	38
CASE	72	50	32	21

BENEFIN: MALLARD REPRODUCTION

ANOVA on SQR(Eggs Laid)

LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT
0.000 1.000 2.000 3.000

DEP VAR: SEL N: 71 MULTIPLE R: 0.251 SQUARED MULTIPLE R: 0.063

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	11.110	3	3.703	1.506	0.221
ERROR	164.793	67	2.460		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	9.415	1	9.415	3.828	0.055
ERROR	164.793	67	2.460		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	0.597	1	0.597	0.243	0.624
ERROR	164.793	67	2.460		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	0.237	1	0.237	0.096	0.757
ERROR	164.793	67	2.460		

BENEFIN: MALLARD REPRODUCTION

ANOVA on SQR(Eggs Cracked)
LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000 1.000 2.000 3.000

DEP VAR: SEC N: 70 MULTIPLE R: 0.268 SQUARED MULTIPLE R: 0.072

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	7.530	3	2.510	1.709	0.174
ERROR	96.942	66	1.469		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	0.260	1	0.260	0.177	0.675
ERROR	96.942	66	1.469		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	0.336	1	0.336	0.229	0.634
ERROR	96.942	66	1.469		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	4.386	1	4.386	2.986	0.089
ERROR	96.942	66	1.469		

BENEFIN: MALLARD REPRODUCTION

ANOVA on SQR(Eggs Set)
LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000	1.000	2.000	3.000

DEP VAR: SES N: 70 MULTIPLE R: 0.169 SQUARED MULTIPLE R: 0.028

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	4.591	3	1.530	0.643	0.590
ERROR	157.041	66	2.379		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	4.465	1	4.465	1.877	0.175
ERROR	157.041	66	2.379		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	1.745	1	1.745	0.733	0.395
ERROR	157.041	66	2.379		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	1.511	1	1.511	0.635	0.428
ERROR	157.041	66	2.379		

BENEFIN: MALLARD REPRODUCTION

ANOVA on SQR(Viable Embryos)
LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000	1.000	2.000	3.000

DEP VAR: SVE N: 70 MULTIPLE R: 0.184 SQUARED MULTIPLE R: 0.034

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	6.468	3	2.156	0.772	0.514
ERROR	184.316	66	2.793		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	3.859	1	3.859	1.382	0.244
ERROR	184.316	66	2.793		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	5.418	1	5.418	1.940	0.168
ERROR	184.316	66	2.793		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	1.246	1	1.246	0.446	0.506
ERROR	184.316	66	2.793		

BENEFIN: MALLARD REPRODUCTION

ANOVA on SQR(21-day Live Embryos)
LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000 1.000 2.000 3.000

DEP VAR: SLE21 N: 70 MULTIPLE R: 0.183 SQUARED MULTIPLE R: 0.034

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	6.419	3	2.140	0.766	0.517
ERROR	184.364	66	2.793		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	4.110	1	4.110	1.471	0.229
ERROR	184.364	66	2.793		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	5.131	1	5.131	1.837	0.180
ERROR	184.364	66	2.793		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	1.195	1	1.195	0.428	0.515
ERROR	184.364	66	2.793		

BENEFIN: MALLARD REPRODUCTION

ANOVA on SQR(Hatched)
LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000 1.000 2.000 3.000

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DEP VAR: SHAT N: 70 MULTIPLE R: 0.086 SQUARED MULTIPLE R: 0.007

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	1.427	3	0.476	0.164	0.920
ERROR	191.417	66	2.900		

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Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	0.683	1	0.683	0.236	0.629
ERROR	191.417	66	2.900		

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Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	1.335	1	1.335	0.460	0.500
ERROR	191.417	66	2.900		

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Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	0.417	1	0.417	0.144	0.706
ERROR	191.417	66	2.900		

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BENEFIN: MALLARD REPRODUCTION

ANOVA on SQR(Two week Survivors)
LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000	1.000	2.000	3.000

DEP VAR: STWOWK N: 70 MULTIPLE R: 0.120 SQUARED MULTIPLE R: 0.014

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	2.492	3	0.831	0.320	0.811
ERROR	171.549	66	2.599		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	0.557	1	0.557	0.214	0.645
ERROR	171.549	66	2.599		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	2.234	1	2.234	0.860	0.357
ERROR	171.549	66	2.599		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	0.107	1	0.107	0.041	0.840
ERROR	171.549	66	2.599		

BENEFIN: MALLARD REPRODUCTION

ANOVA on EC/EL

LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000 1.000 2.000 3.000

DEP VAR: RESP1 N: 70 MULTIPLE R: 0.306 SQUARED MULTIPLE R: 0.094

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	804.830	3	268.277	2.274	0.088
ERROR	7785.896	66	117.968		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	24.620	1	24.620	0.209	0.649
ERROR	7785.896	66	117.968		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	151.506	1	151.506	1.284	0.261
ERROR	7785.896	66	117.968		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	429.353	1	429.353	3.640	0.061
ERROR	7785.896	66	117.968		

BENEFIN: MALLARD REPRODUCTION

ANOVA on VE/ES

LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000	1.000	2.000	3.000

DEP VAR: RESP2 N: 69 MULTIPLE R: 0.038 SQUARED MULTIPLE R: 0.001

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	16.736	3	5.579	0.031	0.992
ERROR	11564.154	65	177.910		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	0.199	1	0.199	0.001	0.973
ERROR	11564.154	65	177.910		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	6.378	1	6.378	0.036	0.850
ERROR	11564.154	65	177.910		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	12.587	1	12.587	0.071	0.791
ERROR	11564.154	65	177.910		

BENEFIN: MALLARD REPRODUCTION

ANOVA on LE21/VE

LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000 1.000 2.000 3.000

DEP VAR: RESP3 N: 68 MULTIPLE R: 0.083 SQUARED MULTIPLE R: 0.007

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	22.540	3	7.513	0.147	0.931
ERROR	3263.906	64	50.999		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	4.203	1	4.203	0.082	0.775
ERROR	3263.906	64	50.999		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	18.453	1	18.453	0.362	0.550
ERROR	3263.906	64	50.999		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	14.137	1	14.137	0.277	0.600
ERROR	3263.906	64	50.999		

BENEFIN: MALLARD REPRODUCTION

ANOVA on HAT/LE21

LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000	1.000	2.000	3.000

DEP VAR: RESP4 N: 68 MULTIPLE R: 0.195 SQUARED MULTIPLE R: 0.038

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	535.351	3	178.450	0.848	0.473
ERROR	13471.965	64	210.499		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	440.570	1	440.570	2.093	0.153
ERROR	13471.965	64	210.499		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	28.538	1	28.538	0.136	0.714
ERROR	13471.965	64	210.499		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	3.488	1	3.488	0.017	0.898
ERROR	13471.965	64	210.499		

BENEFIN: MALLARD REPRODUCTION

ANOVA on TWOWK/HAT

LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT
0.000 1.000 2.000 3.000

DEP VAR: RESP5 N: 68 MULTIPLE R: 0.202 SQUARED MULTIPLE R: 0.041

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	573.589	3	191.196	0.905	0.444
ERROR	13527.810	64	211.372		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	92.384	1	92.384	0.437	0.511
ERROR	13527.810	64	211.372		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	11.732	1	11.732	0.056	0.815
ERROR	13527.810	64	211.372		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	343.518	1	343.518	1.625	0.207
ERROR	13527.810	64	211.372		

BENEFIN: MALLARD REPRODUCTION

ANOVA on HAT/ES

LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT

0.000	1.000	2.000	3.000

DEP VAR: RESP6 N: 69 MULTIPLE R: 0.148 SQUARED MULTIPLE R: 0.022

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	306.671	3	102.224	0.484	0.694
ERROR	13715.914	65	211.014		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	188.921	1	188.921	0.895	0.348
ERROR	13715.914	65	211.014		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	8.688	1	8.688	0.041	0.840
ERROR	13715.914	65	211.014		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	9.009	1	9.009	0.043	0.837
ERROR	13715.914	65	211.014		

BENEFIN: MALLARD REPRODUCTION

ANOVA on TWOWK/ES

LEVELS ENCOUNTERED DURING PROCESSING ARE:
TRT
0.000 1.000 2.000 3.000

DEP VAR: RESP7 N: 69 MULTIPLE R: 0.175 SQUARED MULTIPLE R: 0.031

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
TRT	379.139	3	126.380	0.688	0.563
ERROR	11938.949	65	183.676		

Post-hoc contrast of treatment 1 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	114.549	1	114.549	0.624	0.433
ERROR	11938.949	65	183.676		

Post-hoc contrast of treatment 2 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	68.375	1	68.375	0.372	0.544
ERROR	11938.949	65	183.676		

Post-hoc contrast of treatment 3 with control.
TEST FOR EFFECT CALLED: TRT
TEST OF HYPOTHESIS

SOURCE	SS	DF	MS	F	P
HYPOTHESIS	28.519	1	28.519	0.155	0.695
ERROR	11938.949	65	183.676		

BENEFIN: MALLARD REPRODUCTION

SUMMARY STATISTICS FOR EL

BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES

CHI-SQUARE = 11.060 DF= 3 PROBABILITY = 0.011

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	PROBABILITY
BETWEEN GROUPS	787.932	3	262.644	0.888	0.452
WITHIN GROUPS	19811.026	67	295.687		

SUMMARY STATISTICS FOR EC

BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES

CHI-SQUARE = 4.701 DF= 3 PROBABILITY = 0.195

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	PROBABILITY
BETWEEN GROUPS	74.232	3	24.744	0.788	0.505
WITHIN GROUPS	2072.111	66	31.396		

SUMMARY STATISTICS FOR ES

BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES

CHI-SQUARE = 10.774 DF= 3 PROBABILITY = 0.013

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	PROBABILITY
BETWEEN GROUPS	337.672	3	112.557	0.416	0.742
WITHIN GROUPS	17854.971	66	270.530		

SUMMARY STATISTICS FOR VE

BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES

CHI-SQUARE = 14.299 DF= 3 PROBABILITY = 0.003

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	PROBABILITY
BETWEEN GROUPS	266.936	3	88.979	0.340	0.796
WITHIN GROUPS	17259.007	66	261.500		

BENEFIN: MALLARD REPRODUCTION

SUMMARY STATISTICS FOR LE21

BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES

CHI-SQUARE = 14.591 DF= 3 PROBABILITY = 0.002

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	PROBABILITY
BETWEEN GROUPS	261.636	3	87.212	0.338	0.798
WITHIN GROUPS	17009.850	66	257.725		

SUMMARY STATISTICS FOR HAT

BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES

CHI-SQUARE = 2.964 DF= 3 PROBABILITY = 0.397

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	PROBABILITY
BETWEEN GROUPS	32.733	3	10.911	0.058	0.982
WITHIN GROUPS	12502.353	66	189.430		

SUMMARY STATISTICS FOR TWOWK

BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES

CHI-SQUARE = 2.850 DF= 3 PROBABILITY = 0.415

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	PROBABILITY
BETWEEN GROUPS	40.411	3	13.470	0.085	0.968
WITHIN GROUPS	10449.889	66	158.332		

BENEFIN: MALLARD REPRODUCTION

KOLMOGOROV-SMIRNOV ONE SAMPLE TEST USING STANDARD NORMAL DISTRIBUTION

VARIABLE	N-OF-CASES	MAXDIF	PROBABILITY (2-TAIL)
EL	71.000	0.972	0.000
EC	70.000	0.670	0.000
ES	70.000	0.986	0.000
VE	70.000	0.971	0.000
LE21	70.000	0.971	0.000
HAT	70.000	0.934	0.000
TWOWK	70.000	0.934	0.000