

US EPA ARCHIVE DOCUMENT

Data Evaluation Report on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)

PMRA Submission Number {.....}

EPA MRID Number 001537-78

Data Requirement:	PMRA DATA CODE	{.....}
	EPA DP Barcode	D315644
	OECD Data Point	
	EPA MRID	001537-78
	EPA Guideline	72-1(d)

Test material: ARSENAL® Herbicide **Purity:** 22.6%
Common name: Salt of Imazapyr
Chemical name: IUPAC: 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid
CAS name: Not reported
CAS No.: Not reported
Synonyms: ~~AG-243,997~~
 Not reported

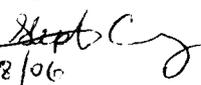
Primary Reviewer: Rebecca Bryan
Staff Scientist, Dynamac Corporation

Signature: 
Date: 5/2/2005

QC Reviewer: John Marton
Staff Scientist, Dynamac Corporation

Signature: 
Date: 6/02/2005

Primary Reviewer: ~~Pamela Hurley~~, ^{Steve Carey} Biologist
OPP/EFED/ERB - ~~3~~

Signature: 
Date: 12/8/06

Secondary Reviewer(s):
PMRA

Date:

Reference/Submission No.:

Company Code:
Active Code:
EPA PC Code: 128829

Date Evaluation Completed:

CITATION: McAllister, W. 1984. Acute Toxicity of ARSENAL® Herbicide to Rainbow Trout (*Salmo gairdneri*). Unpublished study performed by Analytical Bio-Chemistry Laboratories, Inc., Columbia, Missouri. Laboratory Project No. 32180. Study submitted by American Cyanamid Company, Agricultural Research Division, Princeton, NJ. Study initiated October 30, 1984 and submitted October 24, 1984.

US EPA ARCHIVE DOCUMENT

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)

PMRA Submission Number {.....}

EPA MRID Number 00153778

EXECUTIVE SUMMARY:

In a 96-hour acute toxicity study, Rainbow Trout (*Salmo gairdneri*) were exposed to Arsenal (Salt of Imazapyr) at nominal treatment concentrations of 0 (negative control), 32, 56, 100, 180, and 320 mg Arsenal/L under static conditions. Analytical verification of the test material in the test solution was not conducted at any point during the definitive test.

By 96-hours, mortality was 0% in the negative control and nominal 56 mg Arsenal/L treatment level and 10, 40, 90 and 90% in the nominal 32, 100, 180 and 320 mg Arsenal/L treatment levels, respectively. Sub-lethal effects included surfacing, loss of equilibrium, dark discoloration, fish on bottom and quiescence in the nominal 100, 180, and 320 mg Arsenal/L treatment groups by 96 hours. The test solutions were not analytically verified in this study, so the actual concentrations that test organisms were exposed to are unknown. Toxicity values and categorization derived using nominal test concentrations may not be indicative of exposure to the test substance under these study conditions.

This study is scientifically sound but does not satisfy the guideline requirements for an acute toxicity study with rainbow trout [§72-1] using the formulated product because the test fish weight (0.402-1.074 g) ranged lower than EPA recommendations (0.5-5.0 g) and the test concentrations were not analytically verified. Toxicity values are based on the nominal concentrations. This study is classified as SUPPLEMENTAL for a formulated product.

Results Synopsis

Test Organism Size/Age (mean Weight or Length): mean: 0.81 (0.402-1.074) g, 37 (30-41) mm (control fish at test termination)

Test Type (Flow-through, Static, Static Renewal): Static

96-Hour Results;

LC₅₀: 112 mg Arsenal/L 95% C.I.: 82-157 mg Arsenal/L

Probit slope: 3.47 95% C.I.: 1.91-5.02

NOAEC: 56 mg Arsenal/L

LOAEC: 100 mg Arsenal/L

Endpoints affected: Mortality and sublethal effects

I. MATERIALS AND METHODS

GUIDELINE FOLLOWED: The study protocol was based on procedures outlined in U.S. EPA Methods of Acute Toxicity Tests with Fish, Macroinvertebrates and Amphibians and APHA Standard Methods for Examination of Water and Wastewater. Deviations from §72-1d included:

- The stability of the test substance under test conditions was not verified by analytical determination at any point during the definitive test.
- The age of the fish at test initiation was not reported.
- The lighting regime and biomass loading rates were not reported.
- It was not reported whether or not the test vessels were aerated.

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)
PMRA Submission Number {.....}

EPA MRID Number 00153778

- The reported pH (7.0-7.4) ranged lower than recommended (7.2-7.6).
- The TOC and presence of particulate matter and chlorine were not reported. Lead, mercury and zinc were detected in the dilution water in concentrations of 0.017, 0.0008 and 0.001 mg/L, respectively.

The failure to determine mean-measured concentrations and the use of smaller than recommended fish affected the acceptability of this study. All other deviations were considered minor.

COMPLIANCE: Signed and dated GLP and Quality Assurance statements were provided. This study was conducted in accordance with GLP standards of the U.S. EPA (40 CFR Part 160).

A. MATERIALS:

1. Test Material Arsenal® Herbicide (Salt of Imazapyr)

Description: Clear viscous liquid

Lot No./Batch No. : 403K004S

Purity: 22.6%

Stability of Compound Under Test Conditions: Not determined.

OECD requires water solubility, stability in water and light, pK_a , P_{ow} , and vapor pressure of the test compound. OECD requirements were not reported.

Storage conditions of test chemicals: Stored refrigerated in the dark.

2. Test organism:

Species: Rainbow Trout (*Salmo gairdneri*)

Age at test initiation: Not reported

Weight at study initiation: mean: 0.81 (0.402-1.074) g (control fish at test termination)

EPA requires: mean 0.5 - 5 g

Length at study initiation: mean: 37 (30-41) mm (control fish at test termination)

EPA requires: Longest not > 2x shortest; OECD requires 2.0 ± 1.0 cm for bluegill and 5.0 ± 1.0 cm for rainbow trout

Source: Trout Lodge, McMillan, Washington.

B. STUDY DESIGN:

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)

PMRA Submission Number {.....}

EPA MRID Number 00153778

1. Experimental Conditions

a) Range-finding Study: Fish were exposed to nominal concentrations of 0 (negative control), 1, 10, and 100 mg Arsenal/L. Mortality was 60% in the 100 mg Arsenal/L treatment group after 96 hours. No mortalities were observed in the 1.0 and 10 mg Arsenal/L treatment groups. The sub-lethal effects of quiescent and fish on bottom were observed in the 100 mg Arsenal/L treatment group. The test concentrations for the definitive study were based on the range-finding test results.

b) Definitive Study:

Table 1. Experimental Parameters

Parameter	Details	Remarks
		Criteria
Acclimation period:	All fish were acclimated for at least 14 days.	
Conditions: (same as test or not)	Same as test	<i>EPA requires: minimum 14 days; no feeding during test OECD requires minimum of 12 days.</i>
Feeding:	Commercial fish food (Rangen's), was provided daily except during the 48 hours prior to and during testing.	
Health: (any mortality observed)	During acclimation, mortality was observed, however the data is illegible by the reviewer.	
Duration of the test	96-hour	<i>EPA/OECD requires: 96 hour</i>
Test condition		<i>EPA: Must provide reproducible supply of toxicant, with a consistent flow rate of 5-10 vol/24 hours, and meter systems calibrated before study and checked twice daily during test period</i>
static/flow through	Static	
Type of dilution system- for flow through method.	N/A	
Renewal rate for static renewal	N/A	
Aeration, if any	It was not reported whether or not the test vessels were aerated.	<i>EPA requires: no aeration; OECD permits aeration</i>
<u>Test vessel</u>		<i>EPA requires: Size 19 L (5 gal) or 30 x 60 x 30 cm Fill volume: 15-30 L of solution</i>
Material: (glass/stainless steel)	Glass vessels	
Size: Fill volume:	5 gallon 15 L	

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)

PMRA Submission Number {.....}

EPA MRID Number 00153778

Parameter	Details	Remarks
		Criteria
Source of dilution water	Soft reconstituted well water.	
		<i>EPA 1975; Soft reconstituted water or water from a natural source, not dechlorinated tap water; OECD permits dechlorinated tap water.</i>
<p><u>Water parameters:</u> Hardness</p> <p>pH</p> <p>Dissolved oxygen</p> <p>Total Organic Carbon</p> <p>Particulate Matter</p> <p>Metals</p> <p>Pesticides</p> <p>Chlorine</p> <p>Temperature</p> <p>{Salinity for marine or estuarine species}</p> <p>Intervals of water quality measurement</p>	<p>40-45 mg CaCO₃ /L</p> <p>7.0-7.4</p> <p>7.5-9.0 mg/L (>68% saturation)</p> <p>Not reported</p> <p>Not reported</p> <p>Some detected</p> <p>Not detected</p> <p>Not reported</p> <p>11-12°C</p> <p>N/A</p> <p>The temperature, DO and pH were measured at test initiation and at 48 and 96 hours during testing. Hardness, alkalinity, and conductivity were measured in dilution water prior to test initiation.</p>	<p>The reported pH (7.0-7.4) ranged lower than recommended (7.2-7.6). Alkalinity and Conductivity were 30-35 mg CaCO₃ /L and 700 µmhos/cm, respectively. Lead, mercury and zinc were detected in the dilution water in concentrations of 0.017, 0.0008 and 0.001 ppm, respectively.</p> <p>Hardness and pH EPA requires hardness of 40-48 mg/L as CaCO₃ and pH of 7.2-7.6; 8.0-8.3 for marine-stenohaline fishes, 7.7-8.0 for estuarine-euryhaline fishes; monthly range <0.8. OECD allows hardness of 10-250 mg/L as CaCO₃ and pH between 6 and 8.5.</p> <p>Dissolved Oxygen Renewal: ≥60% during 1st 48 hrs and ≥ 40% during 2nd 48 hrs Flow-through: ≥60% through out test. OECD requires at least 80% saturation value.</p> <p>Temperature EPA requires 22 ± 1 °C for estuarine/marine. OECD requires range of 21 - 25 °C for bluegill and 13-17 °C for rainbow trout.</p> <p>Salinity 30-34 ‰ (parts per thousand) salinity, weekly range < 6 ‰</p> <p>EPA water quality measured at beginning of test and every 48 hours</p>

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)
 PMRA Submission Number {.....}

EPA MRID Number 00153778

Parameter	Details	Remarks
		Criteria
<u>Concentration of test material:</u> nominal: measured:	0 (negative control), 32, 56, 100, 180, and 320 mg Arsenal/L. Not reported	Analytical verification of the test material in the test solution was not conducted at any point during the test, consequently, mean-measured values could not be determined. Concentrations were not corrected for purity of active ingredient. <i>EPA/OECD requires: Control and five treatment levels. Each conc. should be 60% of the next highest conc., and should be in a geometric series</i>
Solvent (type, percentage, if used)	N/A	<i>EPA requires: Not to exceed 0.5 mL/L for static tests or 0.1 mL/L for flow-through tests; OECD requires solvent, exceed 100 mg/L.</i>
<u>Number of fish/replicates:</u> negative control: solvent control: treated:	10 fish total NA 10 fish/level	<i>EPA: ≥ 10/concentration; OECD requires at least 7 fish/concentration</i>
Biomass loading rate	Not reported	<i>Static: ≤ 0.8 g/L at ≤ 17°C, ≤ 0.5 g/L at > 17°C; flow-through: ≤ 1 g/L/day; OECD requires maximum of 1 g fish/L for static and semi-static with higher rates accepted for flow-through</i>
Lighting	Not reported	<i>EPA requires: 16 hours light/8 hours dark; OECD requires 12 -16 hours photoperiod.</i>
Feeding	Not fed during testing.	<i>EPA/OECD requires: No feeding during the study</i>

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)

PMRA Submission Number {.....}

EPA MRID Number 00153778

Parameter	Details	Remarks
		Criteria
Recovery of chemical	Not reported.	
Level of Quantitation	N/A	
Level of Detection	N/A	
Positive control {if used, indicate the chemical and concentrations}	Antimycin A was tested at concentrations of 0.000014, 0.000024, 0.000042, 0.000075, and 0.00014 mg/L.	The LC ₅₀ (95% C.I.) was 5.6 x 10 ⁻⁵ (4.2x10 ⁻⁵ -7.5x10 ⁻⁵) mg/L.
Other parameters, if any	N/A	

2. Observations:

Table 2: Observations

Criteria	Details	Remarks/Criteria
Parameters measured including the sub-lethal effects/toxicity symptoms	Mortality and sub-lethal effects	
Observation intervals	0, 24, 48, 72, and 96 hrs	(EPA/OECD requires: minimally every 24 hours)
Were raw data included?	Yes, sufficient	
Other observations, if any	N/A	

II. RESULTS AND DISCUSSION:

A. MORTALITY:

By 96-hours, mortality was 0% in the negative control and nominal 56 mg Arsenal/L treatment level and 10, 40, 90 and 90% in the nominal 32, 100, 180 and 320 mg Arsenal/L treatment levels, respectively. The NOAEC and LC₅₀ (95% CI) values based on mortality were 56 and 110 (82-160) mg Arsenal/L, respectively.

Table 3: Effect of Salt of Imazapyr (Arsenal® Herbicide) on Mortality of Rainbow Trout (*Salmo gairdneri*).

Treatment, ppm form., Nominal	No. of Fish at Start of	Mortality at		
		24 Hours	48 Hours	96 Hours

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)
 PMRA Submission Number {.....}

EPA MRID Number 00153778

		No Dead	% Mortality	No Dead	% Mortality	No Dead	% Mortality
Negative control	10	0	0	0	0	0	0
32	10	0	0	0	0	1	10
56	10	0	0	0	0	0	0
100	10	0	0	1	10	4	40
180	10	1	10	7	70	9	90
320	10	3	30	8	80	9	90
NOAEC (mortality)	56 mg Arsenal/L						
LC ₅₀ (95% C.I.)	112 (82-157) mg Arsenal/L ^a						
Positive control, Antimycin A							
Mortality:	There was 0% mortality in the controls and 0.000014, 0.000024, and 0.000042 mg/L treatment groups. The 0.000075 and 0.00014 mg/L treatment groups had 100% mortality.						
LC ₅₀ (95% C.I.):	5.6 x 10 ⁻⁵ (4.2x10 ⁻⁵ -7.5x10 ⁻⁵)mg/L ^b						

^a This LC₅₀ was calculated using the probit method.

^b This LC₅₀ was calculated using the binomial method.

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)
 PMRA Submission Number {.....}

EPA MRID Number 00153778

B. NON-LETHAL TOXICITY ENDPOINTS:

Sub-lethal effects included surfacing, loss of equilibrium, dark discoloration, fish on bottom and quiescence at the 100, 180, and 320 mg Arsenal/L treatment groups by 96 hours. The NOAEC based on sub-lethal effects was 56 mg Arsenal/L.

Table 4. Sub-Lethal Effect of Salt of Imazapyr (Arsenal® Herbicide) on Rainbow Trout (*Salmo gairdneri*).

Treatment, ppm form, Nominal Concentration	Observation Period			
	Endpoint at 24 Hours	Endpoint at 48 Hours	Endpoint at 72 Hours	Endpoint at 96 Hours
	% Affected ¹	% Affected ¹	% Affected ¹	% Affected ¹
Negative control	No abnormalities detected	No abnormalities detected	No abnormalities detected	No abnormalities detected
32	No abnormalities detected	No abnormalities detected	No abnormalities detected	No abnormalities detected
56	No abnormalities detected	No abnormalities detected	No abnormalities detected	No abnormalities detected
100	No abnormalities detected	No abnormalities detected	No abnormalities detected	Loss of equilibrium and on bottom-17%; surfacing - 33%; and dark discoloration and quiescent-17%
180	Quiescent-22%	No abnormalities detected	Loss of equilibrium and on bottom-67%; quiescent-33%	Loss of equilibrium and on bottom-100%
320	Dark discoloration and loss of equilibrium-14%	No abnormalities detected	Quiescent-100%	Quiescent-100%
NOAEC	56 mg Arsenal/L			
LOAEC	100 mg Arsenal/L			
EC ₅₀	Not reported			
Positive control, Antimycin A				
% Sub-lethal effect:	The sub-lethal effects of surfacing, loss of equilibrium, dark discoloration, fish on bottom and quiescence was observed in the 0.000075 and 0.00014 mg/L treatment groups during testing.			
EC ₅₀	Not reported			

¹ Reviewer-calculated from number of surviving fish exhibiting effects (p. 13).

N/A = Not Applicable

C. REPORTED STATISTICS:

Statistical Method: The 96-hour LC₅₀ was calculated using the probit method of the Stephan computer program. The NOAEC and LOAEC values were determined visually based on mortality and sub-lethal effects data.

96-Hour

LC₅₀: 110 mg Arsenal/L 95% C.I.: 82-160 mg Arsenal/L
Probit slope: 3.47 95% C.I.: 1.82-5.03
NOAEC: 56 mg Arsenal/L
LOAEC: 100 mg Arsenal/L
Endpoints affected: Mortality and sublethal effects

D. VERIFICATION OF STATISTICAL RESULTS:

Statistical Method: The LC₅₀ value was determined using the probit method via Toxanal Statistical Software. The NOAEC and LOAEC values based on mortality and sub-lethal effects were determined visually due to a lack of mortality and effects in the control and nominal 56 mg Arsenal/L treatment level and the observed 40% mortality and observed effects in the nominal 100-320 mg Arsenal/L treatment levels. All toxicity values were determined using the nominal concentrations and were rounded to two significant figures.

96-Hour

LC₅₀: 112 mg Arsenal/L 95% C.I.: 82-157 mg Arsenal/L
Probit slope: 3.47 95% C.I.: 1.91-5.02
NOAEC: 56 mg Arsenal/L
LOAEC: 100 mg Arsenal/L
Endpoints affected: Mortality and sublethal effects

E. STUDY DEFICIENCIES:

The failure to determine mean-measured concentrations and the use of smaller than recommended fish affected the acceptability of this study. All other deviations were considered minor.

F. REVIEWER'S COMMENTS:

The reviewer's conclusions were identical to those of the study authors. The test solutions were not analytically verified in this study, so the actual concentrations that test organisms were exposed to are unknown. This study is classified as SUPPLEMENTAL for a formulated product.

The study author reported that the single mortality in the nominal 32 mg Arsenal/L treatment level was aberrant, since all other fish at the level were observed to be normal and no mortality or effects were observed in the next higher treatment level (56 mg Arsenal/L).

G. CONCLUSIONS:

This study is scientifically sound but does not satisfy the guideline requirements for an acute toxicity study with rainbow trout [§72-1] using a formulated product because the test concentrations were not measured.

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)
PMRA Submission Number {.....}

EPA MRID Number 00153778

Consequently, this study is classified as SUPPLEMENTAL. The study provides information that may be useful for future risk assessment purposes. Based on the results of this study, Salt of Imazapyr (Arsenal) is categorized as practically non-toxic to juvenile Rainbow Trout (*Salmo gairdneri*) on an acute toxicity basis. The 96-hour NOAEC based on mortality and sub-lethal effects was 56 mg Arsenal/L and the LC₅₀ (95% CI) was 110 (82-160) mg Arsenal/L.

96-Hour Results:

LC₅₀: 112 mg Arsenal/L 95% C.I.: 82-157 mg Arsenal/L
Probit slope: 3.47 95% C.I.: 1.91-5.02
NOAEC: 56 mg Arsenal/L
LOAEC: 100 mg Arsenal/L
Endpoints affected: Mortality and sublethal effects

III. REFERENCES:

- Committee on Methods for Toxicity Tests with Aquatic Organisms (C.E. Stephan, Chairman). 1975. Methods for Acute Toxicity Tests with Fishes, Macroinvertebrates and Amphibians. Environmental Protection Agency, Ecological Research Series EPA-660/3-75-009, April, 1975. 61 p.
- Berger, B.L., *et al.* 1969. Laboratory Studies on Antimycin A as a fish toxicant. U.S. Department of Interior, Investigations in Fish Control No. 26. 21 p.
- American Public Health Association. 1980. Standard Methods for the Examination of Water and Waste Water. 15th Ed. Washington, D.C., 1134 p.
- Eddy, Samuel. 1969. The Freshwater Fishes. 2nd ed. W.C. Brown Company, Dubuque, IA. 286 p.
- Brauhn, J.L and Schoettger, R.A. 1975. Acquisition and Culture of Research Fish: Rainbow Trout, Fathead Minnows, Channel Catfish and Bluegills. Environmental Protection Agency, Ecological Research Series EPA 660/3-75-011. May 1975. 45 p.
- Stephan, C.E. 1977. Methods for Calculating and LC₅₀. p. 65-84 In: F.L. Meyer and J.L. Hamelink, (eds.). Aquatic Toxicology and Hazard Evaluation. ASTM Special Technical Publication 634, ASTM Philadelphia.
- Stephan, C.E., *et al.* 1978. A computer program for calculating an LC50. U.S. Environmental Protection Agency, Duluth, Minnesota, pre-publication manuscript, August, 1978.
- U.S. Food and Drug Administration. 1978. Nonclinical Laboratory Studies, Good Laboratory Practice Regulations (21 CFR, Part 58). Federal Register, Vol. 43, No. 247:59986-60025.
- U.S. Environmental Protection Agency. 1983. Pesticide Programs; Good Laboratory Practice Standards; Final Rule (40 CFR, Part 160). Federal Register, Vol. 48, No. 230:53946-53969.
- U.S. Environmental Protection Agency. 1983. Toxic Substances Control; Good Laboratory Practice Standards; Final Rule (40 CFR, Part 792). Federal Register, Vol. 48, No. 230:53922-53944.
- Organization for Economic Cooperation and Development. 1981. OECD Guidelines for Testing of Chemicals, Principles of Good Laboratory Practice Annex 2, C (81) 30 (Final): 7-28.
- Environmental Protection Agency- FIFRA GLPS; Title 40 CFR Part 160- Federal Insecticide, Fungicide and

**Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to
Rainbow Trout (*Salmo gairdneri*)**

PMRA Submission Number {.....}

EPA MRID Number 00153778

Rodenticide Act (FIFRA); Good Laboratory Practice Standards, Final Rule.

OECD Series on Principles of Good Laboratory Practice and Compliance Monitoring, Number 1. OECD Principles on Good Laboratory Practice (as revised in 1997) ENV/MC/CHEM(98)17.

Data Evaluation Record on the acute toxicity of Arsenal® Herbicide (Salt of Imazapyr) to Rainbow Trout (*Salmo gairdneri*)

PMRA Submission Number {.....}

EPA MRID Number 00153778

APPENDIX I. OUTPUT OF REVIEWER'S STATISTICAL VERIFICATION:

CONC.	NUMBER EXPOSED	NUMBER DEAD	PERCENT DEAD	BINOMIAL PROB. (PERCENT)
320	10	9	90	1.074219
180	10	9	90	1.074219
100	10	4	40	37.69531
56	10	0	0	9.765625E-02
32	10	1	10	1.074219

THE BINOMIAL TEST SHOWS THAT 56 AND 180 CAN BE USED AS STATISTICALLY SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS, BECAUSE THE ACTUAL CONFIDENCE LEVEL ASSOCIATED WITH THESE LIMITS IS GREATER THAN 95 PERCENT.

AN APPROXIMATE LC50 FOR THIS SET OF DATA IS 111.3065

RESULTS CALCULATED USING THE MOVING AVERAGE METHOD

SPAN	G	LC50	95 PERCENT CONFIDENCE LIMITS
4	.2536706	124.4757	83.60657 214.5956

RESULTS CALCULATED USING THE **PROBIT METHOD**

ITERATIONS	G	H	GOODNESS OF FIT PROBABILITY
4	.2006593	1	.1755777

SLOPE = 3.472959

95 PERCENT CONFIDENCE LIMITS = 1.917247 AND 5.028672

LC50 = 112.5845

95 PERCENT CONFIDENCE LIMITS = 81.78206 AND 157.3207

LC10 = 48.50609

95 PERCENT CONFIDENCE LIMITS = 22.58972 AND 69.27453