

US EPA ARCHIVE DOCUMENT



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

OFFICE OF  
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

TO: Herman Toma, Team 25  
Registration Division, TS-767c

THRU: Harry Craven *Harry Craven* 7/20/89  
Registration Standard Coordinator  
Ecological Effects Branch  
Hazard Evaluation Division, TS-769c

THRU: Clayton Bushong, Chief *Clayton Bushong*  
Ecological Effects Branch  
Hazard Evaluation Division, TS-769c

SUBJECT: Pendimethalin Registration Standard - Transmittal of Topical Discussion  
and Disciplinary Review.

This transmits EEB's portion of the Pendimethalin Registration Standard. Included are the topical discussion and disciplinary review.

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pendimethalin Topical Discussion

Abbreviated Reviews

The following studies were abbreviated reviews and were insufficient to be used in a hazard assessment.

Author	Fiche ID. No.
Sleight, B.H. III	00058831
Sleight, B.H. III	00058833
Jefferson, R.N.; Morishita, F.S.	00007824
Wallen, I.E.; Greer, W.C.;	00068428
Lasater, R.	

AQUATIC ORGANISM TESTING

Effects on Freshwater Fish

Table I contains the eleven (11) studies in four (4) citations which are acceptable for use in the hazard assessment for freshwater fish.

Table I - Studies Evaluated

Author	Fiche ID. No.
Bentley, R.E.	00037927
Sleight, B.	00106764
Sousa, J.V.	FAOPEN01
EG&G	00037940

The minimum data required for establishing the acute toxicity of Pendimethalin for fresh water fish are the results from two(2) 96-hour studies with technical pendimethalin; one coldwater species (preferably rainbow trout) and one warm water species (preferably bluegill sunfish). Guideline requirements are covered in 72-1. The acceptable acute toxicity data from studies using technical grade Pendimethalin are listed in Table II.

Table II

Acute Toxicity Studies Using Technical Pendimethalin

<u>Species</u>	<u>% Active</u>	<u>Results 96-hr. LC50</u>	<u>Author</u>	<u>Date</u>	<u>ID</u>	<u>Fulfills Guideline Requirements</u>
<u>Lepomis macrochirus</u> Bluegill sunfish	93.2	0.199 ppm (0.162-0.244) NEL 0.1	Sleight, B	1973	00106764	Yes
<u>Salmo gairdneri</u> Rainbow Trout	93.2	0.138 ppm (0.113-0.169) NEL 0.075	Sleight, B	1973	000106764	Yes
<u>Ictalurus punctatus</u> Channel catfish	93.2	0.418 ppm (0.310-0.564) NEL 0.32	Sleight, B	1973	000106764	Yes

The guideline requirements for acute toxicity studies on cold and warmwater fish species are satisfied. There is sufficient information to characterize technical pendimethalin as "highly toxic" to both coldwater and warmwater fish species.

Aquatic toxicity studies on formulated (end-use) products can be required as per 72-1 (A)(B), (ii), (iii); the end use product will be introduced directly into the aquatic environment when applied to rice.

The acceptable acceptable acute studies are listed in Table III.

Table III

<u>Acute Studies Using Formulated Pendimethalin</u>						
<u>Species</u>	<u>Product</u>	<u>Results</u> <u>96 hr. LC50</u>	<u>Author</u>	<u>Date</u>	<u>ID</u>	<u>Fulfills</u> <u>Guideline</u> <u>Requirements</u>
<u>Lepomis</u> <u>macrochirus</u> Bluegill sunfish	Prowl 3E	1.04 ppm (0.69-1.57) NEL 0.75	Bentley, R.	1974	00037927	Yes
<u>Lepomis</u> <u>macrochirus</u> Bluegill sunfish	Prowl 4E	0.92 pm (0.71-1.12) NEL 0.42	Bentley, R.	1974	00037927	Yes
<u>Lepomis</u> <u>macrochirus</u> Bluegill sunfish	Avenge 2-S	90.4 ppm (68.7-119.0) NEL 56	Bentley, R.	1974	00037927	Yes
<u>Ictalurus</u> <u>punctatus</u> Channel catfish	Prowl 4E	1.9 ppm (1.3-2.6) NEL <0.78	Sousa, J.	1983	FAOPEN01	Yes
<u>Salmo</u> <u>gairdneri</u> Rainbow trout	Prowl 3E	1.0 ppm (0.78-1.29) NEL 0.42	Bentley, R.	1974	00037927	Yes
<u>Salmo</u> <u>gairdneri</u> Rainbow trout	Prowl 4E	0.52 ppm (0.39-0.69) NEL 0.21	Bentley, R.	1974	00037927	Yes
<u>Salmo</u> <u>gairdner</u> Rainbow trout	Avenge 2-S	86.6 ppm (75-100) NEL 75	Bentley, R.	1974	00037927	Yes

The requirement for formulated product studies on cold and warmwater fish are satisfied. There is sufficient information to characterize formulated Pendimethalin as "slightly toxic to very highly toxic" to coldwater and warmwater fish.

A fish life-cycle study can be required when an end-use product can be expected to transport to water from the intended use site as covered in guidelines 72-5 (A). The use pattern requiring this study is rice. In addition such uses as corn, cotton soybeans may (pending results of environmental fate data) also require this study. The acceptable study is presented in Table IV.

Table IV

Fish Life-Cycle Test

<u>Species</u>	<u>% Active</u>	<u>Results</u>	<u>Author</u>	<u>Date</u>	<u>ID</u>	<u>Fulfills Guideline Requirements</u>
<u>Pimephales promelas</u> Fathead minnow	98.3	Egg production was reduced at 9.8 ppb, and reduced hatchability at 22 and 43 ppb. The MATC IS >6.3<9.8 ppb.	EG&G	1977	000037940	Yes

The requirement for a fish life-cycle study has been satisfied.

Precautionary labeling:

Based on available data, products containing Pendimethalin will require a statement of fish toxicity.

Effects on Freshwater Invertebrates

Table V contains three (3) citations which are acceptable for use in the hazard assessment for aquatic invertebrates

Table V - Studies Evaluated

Author	Fiche ID No.
EG&G Bionomics	FAOPEN05
Thompson, C. M.; et al.	00071123
Graney, R. L.	00100504

The minimum data requirement for establishing the acute toxicity of Pendimethalin to freshwater invertebrates is the result from one (1) 48 hour study with the technical Pendimethalin on a native freshwater invertebrate species, preferably Daphnia magna (72-2). The acceptable studies are listed in Table VI.

Table VI

Acute Toxicity Study Testing Technical Pendimethalin On An Aquatic Invertebrate

<u>Species</u>	<u>% Active</u>	<u>Results</u>	<u>Author</u>	<u>Date</u>	<u>ID</u>	<u>Fulfills Guideline Requirements</u>
<u>Daphnia magna</u>	93.2	0.28 ppm (0.23-0.33) NEL 0.16	EG&G	1976	FAOPEN05	Yes
<u>Procambarus simulans</u> Crawfish	94.2	>1,000ppm	Thompson,C et al.	1980	00071123	Partial

The guideline requirements for an acute study on a native freshwater invertebrate has been satisfied. There is sufficient information to characterize technical Pendimethalin as "practically non-toxic to highly toxic" to freshwater aquatic invertebrates

Aquatic toxicity studies on formulated (end-use) products can be required as per 72-2 (1),(ii). The end use product will be introduced directly into the aquatic environment when applied to rice.

No studies on a formulated product were submitted. The requirement is unfulfilled.

Aquatic invertebrate life-cycle studies can be required when the end-use product is expected to be transported to water from the intended use site or if any LC50 or EC50 value determined in testing required by 72-1,-2,or-3 is less than 1 mg/l as covered in the guidelines 72-4(a)(i),(ii). The use pattern requiring this study is rice. In addition such uses as corn, cotton, soybeans may (pending results of environmental fate data) also require this study. The results of this test are given in Table VII.

Table VII

Aquatic Invertebrate Life-Cycle Tests

<u>Species</u>	<u>% Active</u>	<u>Results</u>	<u>Author</u>	<u>Date</u>	<u>ID</u>	<u>Fulfills Guideline Requirements</u>
<u>Daphnia magna</u>	92.2	Reproductive impairment after 15 days at 22.1 ppb and 17.2 ppb after 21 days. NEL at 14 ppb.	Graney, R.	1981	00100504	Yes

The requirements for an aquatic invertebrate and fish life-cycle tests are satisfied.

Precautionary labeling:

Based on available data, products containing Pendimethalin will require a statement of aquatic invertebrate toxicity.

Effects On Estuarine and Marine Organisms

Table VIII contains six (6) studies in three citations acceptable for use in the hazard assessment for marine and estuarine organisms.

Table VIII - Studies Evaluated

Author	Fiche ID No
Ward, G.S.	FAOPEN02
Ward, G.S.	FAOPEN03
Ward, G.S.	FAOPEN04

Data on the acute toxicity of a pesticide to estuarine and marine organisms are required when the end-use product is intended for direct application to the estuarine or marine environment or expected to enter this environment in significant concentrations because of its expected use or mobility patterns (72-3). Pendimethalin's use on rice requires this data. The acceptable studies are listed in Tabel IX.

Table IX

Acute Toxicity Tests For Estuarine And Marine Organisms

<u>Species</u>	<u>% Active</u>	<u>Results</u>	<u>Author</u>	<u>Date</u>	<u>ID</u>	<u>Fulfills Guideline Requirements</u>
<u>Cyprinodon variegatus</u> Sheeps head minnow	92.2	.707 ppm (0.552-0.907)	Ward, G.S.	1983	FAOPEN02 131772	Yes
<u>Crassostrea virginica</u> Eastern oyster	92.2	.210 ppm (0.16-0.34)	Ward, G.S.	1983	FAOPEN03 131774	Yes
<u>Penaeus duorarum</u> Pink shrimp	92.2	1.6 ppm (1.2-2.2)	Ward, G.S.	1983	FAOPEN03 131775	Yes

There is sufficient data to characterize technical Pendimethalin as "moderately to highly toxic" to marine and estuarine organisms

Marine and estuarine studies on formulated (end-use) products can be required as 72-3 (A),(B); the product will be introduced directly into the aquatic environment when used as directed or the expected environmental concentration is equal to or greater than the LC50 of the technical product

The acceptable studies testing marine and estuarine organisms with formulated

Pendimethalin are listed in Table X.

Table X

Acute Toxicity Studies Testing Formulated Products On Marine And Estuarine Organisms

<u>Species</u>	<u>Product</u>	<u>Results</u>	<u>Author</u>	<u>Date</u>	<u>ID</u>	<u>Fulfills Guideline Requirements</u>
<u>Cyprindon variegatus</u> Sheepshead minnow	Prowl 4E	1.7 ppm (1230-3560)	Ward, G.S.	1983	FAOPEN02	Yes
<u>Crassostrea virginica</u> Eastern oyster	Prowl 4E	.450 ppm (.330-.710)	Ward, G.S.	1983	FAOPEN03	Yes
<u>Penaeus duorarum</u> Pink shrimp	Prowl 4E	11 ppm (8.9-16)	Ward, G.S.	1983	FAOPEN04	Yes

The requirement for formulated product testing on marine and estuarine organisms are satisfied. There is sufficient information to characterize formulated pendimethalin as "slightly toxic to highly toxic" to marine and estuarine organisms.

Precautionary labeling:

Based upon available data, products for use impacting estuarine or marine areas will require a caution for estuarine organisms.

AVIAN TESTING

Effects On Birds

Table XI contains three (3) studies which are acceptable for use in the hazard assessment for birds.

Table XI - Studies Evaluated

<u>Author</u>	<u>Fiche ID No.</u>
Fink, R	00026674
Fink, R	00026675
Fink, R	00059739

The minimum data required for establishing the acute toxicity of Pendimethalin to birds are the results from one (1) single dose LD<sub>50</sub> study on either an upland game species (preferably bobwhite or other native quail, or the ring-necked pheasant) or a wildwaterfowl (preferably the mallard duck), as per 71-1, using technical Pendimethalin. The acceptable data for hazard assessment are listed in Table XII.

Table XII

Single-Dose Oral LD<sub>50</sub> - Technical Pendimethalin

<u>Species</u>	<u>% Active</u>	<u>Results</u>	<u>Author</u>	<u>Date</u>	<u>ID</u>	<u>Fulfills Guideline Requirements</u>
<u>Anas platyrhynchos</u> Mallard duck	tech.	1,421 mg/kg	Fink, R.	1976	00059739	Yes

The guideline requirement is satisfied. The available information indicates that technical Pendimethalin is "slightly toxic" to birds in single oral doses.

The minimum requirement for establishing the dietary (subacute) toxicity of Pendimethalin to birds are the results from at least two (2) avian dietary toxicity (LC<sub>50</sub>) studies as per 71-2. These test one upland game bird (preferably bobwhite or other native quail, or the ring-necked pheasant) plus one wild waterfowl (preferably mallard duck). Acceptable data addressing this topic are listed in Table XIII.

Table XIII

Dietary Toxicity To Birds - Technical Pendimethalin

<u>Species</u>	<u>% Active</u>	<u>Results</u>	<u>Author</u>	<u>Date</u>	<u>ID</u>	<u>Fulfills Guideline Requirements</u>
<u>Anas platyrhynchos</u> Mallard duck	tech.	>4,640 ppm	Fink, R.	1973	00026674	Yes
<u>Colinus virginianus</u> Bobwhite quail	tech.	4,187 ppm (3,149-5,567)	Fink, R.	1973	00026675	Yes

The guideline requirements for two (2) avian dietary toxicity studies are satisfied. There is sufficient information to characterize Pendimethalin as "slightly toxic" to birds when administered in subacute dietary tests.

Precautionary labeling:

Based on available data products containing Pendimethalin will not require a statement of toxicity to birds

## Pendimethalin - Ecological Effects Disciplinary Review

### 1. Ecological Effects Profile

#### A. Manufacturing Use Product (MUP)

##### Avian Studies

One study (00059739) using the technical grade product had an LD<sub>50</sub> of 1,421 mg/kg for the mallard duck. Two dietary, subacute studies (00026674, 00026675) on the mallard duck and bobwhite quail had LC<sub>50</sub>s of >4,640 and 4,187 ppm respectively. The guideline requirements have been satisfied for avian toxicology. The studies indicate that Pendimethalin is considered "slightly toxic to birds."

##### Freshwater Aquatic Organisms

###### Fish

There are three acceptable studies under one citation (0010764) on warm and cold water fish. Bluegill, channel catfish, and rainbow trout were used. The LC<sub>50</sub> for bluegills was 0.199 ppm, channel catfish 0.418 ppm and rainbow trout 0.138 ppm respectively. The guideline requirements for an LC<sub>50</sub> test on both a warmwater and coldwater fish have been satisfied. Pendimethalin can be considered "highly toxic to fish."

A fathead minnow life-cycle test was submitted (00037940). Egg production was reduced at 9.8 ppb and hatchability reduced at 22 and 43 ppb. The MATC is >6.3<9.8 ppb.

###### Aquatic Invertebrates

Two studies, one on Daphnia magna (FAOPEN05), the other with the crawfish (00071123) had LC<sub>50</sub>s of 0.28 ppm and >1,000ppm respectively. The guideline requirement for an acute LC<sub>50</sub> on a freshwater aquatic invertebrate has been satisfied. Pendimethalin can be considered "practically non-toxic to highly toxic to aquatic invertebrates."

A Daphnia magna life-cycle test was submitted (00100504) was submitted. Reproductive impairment occurred after a 15 day exposure to 22.1 ppb, and after a 21 day exposure at 17.2 ppb. The no effect level was 14 ppb.

##### Marine and Estuarine Fish and Aquatic Organisms

Sheepshead minnow (FAOPEN02), eastern oyster (FAOPEN03), and pink shrimp (FAOPEN04) studies using the technical product were submitted. The results were: sheepshead minnow, 0.707 ppm; eastern oyster, 0.210 ppm; and pink shrimp, 1.6 ppm respectively. The requirement for acute marine and estuarine studies with technical grade product are satisfied. Pendimethalin can be considered "moderately to highly toxic" to marine organisms.

B. Formulated Product

Fish and aquatic invertebrates

Formulation

3E The LC<sub>50</sub>s were:

1. Bluegill sunfish	1.04 ppm	(00037927)
2. Rainbow trout	1.0 ppm	" "
3. Sheepshead minnow	1.7 ppm	(FAOPEN02)
4. Eastern oyster	0.45 ppm	(FAOPEN03)
5. Pink shrimp	11.0 ppm	(FAOPEN04)

This formulation can be considered slightly toxic to shrimp; moderately toxic to bluegill sunfish, rainbow trout and sheepshead minnow; and highly toxic to the eastern oyster.

4E The LC<sub>50</sub>s were:

1. Bluegill sunfish	0.92 ppm	(00037927)
2. Rainbow trout	0.52 ppm	" "
3. Channel catfish	1.9 ppm	" "

This formulation can be considered moderately toxic to the channel catfish; and highly toxic to the bluegill sunfish and rainbow trout.

Avenge 2-S The LC<sub>50</sub>s were:

1. Bluegill sunfish	90.4 ppm	(00037927)
2. Rainbow trout	86.6 ppm	" "

This formulation can be considered slightly toxic to bluegill sunfish and rainbow trout.

2. Hazard Assessment

Pendimethalin is a broad spectrum herbicide. Its action is on germinating weeds and will not control established weeds. Uneven or improper soil incorporation can reduce weed control or cause crop injury. It is used as a preplant, incorporated; preemergent or postemergent herbicide. Postemergent treatments are limited to corn, rice, and sorghum. Before application all emerged weeds must be removed before use. The major uses are corn, cotton, and soybeans. The compound has recently been registered for peanuts, potatoes, rice, sorghum, sunflowers, and tobacco (as a growth regulator).

The only anticipated hazard at present is with the rice use. EEB received an estimated environmental concentration (EEC) from EAB in 3/11/81. The scenario assumed that the field was flooded two days after application and drained two days later. The application rate was 1 lb. ai/acre of Pendimethalin. It was assumed that a steady state equilibrium was reached in a bayou two days after drainage. Under these conditions the EEC was 7 ppb in the bayou.

Rice is considered to have a possible estuarine and marine impact.

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Marine studies with the technical and formulated product have LC<sub>50</sub> values well above the EEC of 7 ppb. However, life-cycle studies on the fathead minnow with the technical product showed reduced egg production at 9.8 ppb and impaired hatchability at 22 ppb. Daphnia showed reproductive impairment at 17.2 ppb after a 21 day exposure. A possible threat exists because Pendimethalin is stable to hydrolysis. Based on this data, EEB is requesting a study to monitor aquatic sites in areas receiving water from rice fields.

### 3. Endangered Species Considerations

Pendimethalin is not anticipated to have any effects on endangered plants because of its physiological action. If drift occurs, it should have little or no effect on emerged plants. It is not effective on emerged weeds. For best results the planting area should be disked before application. If endangered plants were present, they would be destroyed by mechanical means prior to application.

Given the low toxicity of Pendimethalin to birds, no hazard is expected to endangered species.

pendimethalin was reviewed for endangered species in the cotton, corn, sorghum, and soybean clusters. Only the cotton use triggered concern for aquatic species. EEB is not recommending any use restrictions or label precautions for endangered species prior to finalization of respective clusters. The hazard to endangered species potentially exposed to Pendimethalin from other uses - particularly the rice use - can not be easily determined without environmental fate or monitoring data.

### 4. Precautionary Labeling

#### A. Manufacturing - Use Product

"Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters unless this product is specifically identified and addressed in an NPDES permit. Do not discharge without previously notifying the sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA."

#### B. Formulated Products

##### Non Aquatic Uses

"This pesticide is toxic to fish. Do not apply directly to water. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water by cleaning of equipment or disposal of wastes."

##### Aquatic Uses (Rice)

"This pesticide is toxic to fish and aquatic organisms. Fish may be killed at application rates recommended on the label. Do not contaminate water by cleaning of equipment or disposal of wastes."

TABLE A  
GENERIC DATA REQUIREMENTS FOR PENDIMETHALIN

Data Requirement	Composition <sup>1</sup>	Use Pattern <sup>2</sup>	Does EPA Have Data To Satisfy This Requirement? (Yes, No, or Partially)	Bibliographic Citation	Must Additional Data Be Submitted Under FIFRA? Section 3(c)B(2)
158.145 Wildlife and aquatic Organisms					
<u>Avian and Mammal Testing</u>					
1-1 Avian Oral LD50	TGAI	A,B,C	Yes	00059739*	No
1-2 Avian Dietary LC50	TGAI	A,B,C	Yes	00026674*	No
a. Waterfowl			Yes	00026675*	No
b. Upland game			Yes		No
1-3 Wild Mammal Toxicity			---		No
1-4 Avian Reproduction			---		No
1-5 Simulated and Actual Field Testing on Mammals and Birds			---		No
<u> aquatic Organism Testing</u>					
2-1 Freshwater Fish LC50	TGAI	A,B,C	Yes	00106764*	No
a. Warmwater fish			Yes	00037927* FAOPEN01*	No
b. Coldwater	TGAI	A,B,C	Yes	00160764*	No
			Yes	FAOPEN01* 00037927*	No

Table A Con't

Data Requirement	Composition	Use Pattern <sub>2</sub>	Does EPA Have Data To Satisfy This Requirement? (Yes, No, Partially)	Bibliographic Citation	Must Additional Data Be Submitted Under FIFRA? Section 3(c)B(2)
2-2 Acute LC50 Freshwater Invertebrate	TGAI	A,B,C	Yes	FAOPEN05* 00071123**	No
	TEP	C	No	_____	Yes <sup>3</sup>
2-3 Acute LC50 Marine and Estuarine Organisms a. oyster	TGAI	A,C	Yes	FAOPEN03*	No
	TEP	A <sup>4</sup> ,C	Yes	FAOPEN03*	No
	TGAI	A,C	Yes	FAOPEN03*	No
	TEP	A <sup>4</sup> ,C	Yes	FAOPEN04*	No
	TGAI	A,C	Yes	FAOPEN02*	No
	TEP	A <sup>4</sup> ,C	Yes	FAOPEN02*	No
2-4 Aquatic Invertebrate Life-Cycle	TGAI	A <sup>4</sup> ,C	Yes	00100504*	No
2-5 Fish Life-Cycle	TGAI	A <sup>4</sup> ,C	Yes	00037940*	No
2-6 Aquatic Organism Accumulation	TGAI	A,C	No	_____	No
2-7 Aquatic Field Study	TEP	C	No	_____	Yes <sup>3,8</sup>

## Footnotes

1. Composition: TGAI = Technical grade of active ingredient  
TEP = Typical end use product
  2. Use Patterns: A = Terrestrial food crop  
B = Terrestrial non-food crop  
C = Aquatic food crop
  3. This study is necessary to support the rice use.
  4. Pending results of environmental fate data such uses as cotton, corn and soybeans may require this study.
  5. This is a study to monitor for residues in aquatic sites adjacent to rice fields.
- \* Study fulfill requirements on its own.  
\*\* Study in conjunction with another study fulfills requirement.