US EPA ARCHIVE DOCUMENT

EEB BRANCH REVIEW

DATE: IN _____ OUT _____ IN 11/11/76 OUT 12/16/76 IN _____ OUT _____

FISH & WILDLIFE ENVIRONMENTAL CHEMISTRY EFFICACY

FILE OR REG. NO. 3125-236, 237 & 283

PETITION OR EXP. PERMIT NO. _____

DATE DIV. RECEIVED _____

DATE OF SUBMISSION _____

DATE SUBMISSION ACCEPTED _____ 3C1D - 2B - Yes

TYPE PRODUCT(S): I, D, H, F,(N,)R, S _____

PRODUCT MGR. NO. 21 - Wilson

PRODUCT NAME(S) NEMACUR 3, NEMACUR 15% GRANULAR, NEMACUR 10% GRANULAR

COMPANY NAME Chemagro

SUBMISSION PURPOSE To revise "restrictions" for rotation crops

CHEMICAL & FORMULATION Nemacur

Ethyl 3-methyl-4-(methylthio) phenyl
(1-methylethyl) phosphoroamidate

38 pages

1.0 Introduction

1.1 Bay 68138, Fenamiphos, Isoprop

1.2 Percent Active

Nemacur 3	-	35% (3 lbs ai/gal)
Nemacur 15% Granular	-	15%
Nemacur 10% Granular	-	10%

1.3 Data is submitted to revise restrictions for rotation crops. The registrant wishes to delete the following:

"Do not replant treated areas with any food crop not specified on this label within 12 months after last application."

The registrant wishes to add the following:

"Do not plant onions in treated soil within 12 months after application. Do not replant treated soil with any other food crop not specified on this label within 4 months after application."

1.4 Other environmental reviews:

3125-283,237, 236	2/13/76
3F1399	10/03/73, 7/29/74
0F0982	8/28/70
38412-EUP-1 & 2	11/05/76
3125-236, 237, 238	10/07/76
3125-236,237	5/03/76
3F1693	11/11/75
3125-EXP	3/25/74
3125-EGT, EGA, EEA	3/31/72
3125-EGA, EGT	1/03/73

2.0 Directions for Use

2.1 Nemacur 3

2.1.1 Application rates are as follow:

Field Crops	Band (Fluid oz/1000 ft. of row)	Broadcast (Gals/acre)
Cotton	5.3 to 10.7 fl. oz. for any row spacing (or 2.2 to 4.3 qts. per acre on 40-inch rows)	Use only band application on cotton.
Peanuts	4.5 to 7.3 fl. oz. for any row spacing (or 2 to 3.3 qts. per acre on 36-inch rows)	1 to 1.7 gals. (3 to 5.1 lbs. ai)
Soybeans	3 to 11 fl. oz. for any row spacing (or 1.3 to 5 qts. per acre on 36-inch rows)	1.3 to 2 gals. (3.9 to 6 lbs. ai)

2.1.2 For band application, apply specified dosage in fluid oz. per 1,000 ft. of row as a water emulsion spray in a 12 to 18 inch band. Use sufficient water to incorporate thoroughly to insure uniform distribution.

2.1.3 For broadcast application, apply as a water emulsion spray using sufficient water and thorough incorporation to insure uniform distribution.

2.1.4 Do not contaminate water by cleaning of equipment or disposal of wastes.

2.1.5 Do not reuse empty container. Empty contents and bury unused chemical at least 18 inches deep in an isolated location away from water supplies. Rinse empty can by filling with water and adding 2 tablespoons of household lye. Bury rinse solution at least 18 inches deep in an

isolated area away from water supply. Punch holes in the top and bottom of the can, crush the can, and bury deeply in an isolated location.

2.2 Nemacur 10% Granular

2.2.1 Apply Nemacur 10% Granular at the following rates:

Field Crops	Band (oz/ 1000 ft. of row)	Broadcast (lbs/acre)
Cotton	20 to 40 oz. for any row spacing (or 16.5 to 33 lbs. per acre on 40-inch rows).	Use only band application on cotton
Peanuts	16.5 to 28 oz. for any row spacing (or 15 to 25.5 lbs. per acre on 36-inch rows)	30 to 50 lbs. (3 to 5 lbs. ai)
Soybeans	10-40 oz. for any row spacing (or 9 to 36 lbs. per acre on 36-inch rows)	40 to 60 lbs. (4 to 6 lbs. ai)
Vegetables	Band (Oz/1000 ft. of row)	Broadcast (lbs/acre)
Cabbage	16.5 to 33 oz. for any row spacing (or 15 to 30 lbs. per acre on 36-inch rows)	40 to 60 lbs. (4 to 6 lbs. ai)
Brussel Sprouts (transplanted)	16.5 to 33 oz. for any row spacing (or 15 to 30 lbs. per acre on 36-inch rows)	40 to 60 lbs. (4 to 6 lbs. ai)

2.2.2 For band application, apply specified dosage in oz. per 1000 ft. of row as a 12 to 18 inch band for field crops or as a 12 to 15 inch band for vegetables. Incorporate to a depth of 2 to 6 inches.

2.2.3 For broadcast application, distribute granules uniformly and immediately incorporate to a depth of 2 to 6 inches by disking or tilling.

2.2.4 Nemacur 10% Grranular can be applied to turf grasses on golf courses, cemetaries, sod farms, industrial grounds, parkways, and roadways. Apply at the following rate:

Ornamentals	Dosage
Turf Grass (Bermuda, Centipede, Bluegrass, and Bentgrass)	2 1/3 to 4 2/3 lbs. per 1000 sq. ft. (100 to 200 lbs. Nemacur 10 per acre or 10 to 20 lbs. ai/acre)

2.2.5 Do not use on residential lawns or public recreational areas other than golf courses.

2.2.6 Do not reuse empty container. Empty contents and bury unused chemical at least 18 inches deep in an isolated location away from water supplies. Burn the empty container. Avoid the smoke.

2.2.7 Do not use or store in or around the home.

2.3 Nemacur 15% Granular

2.3.1 Do not reuse empty container. Empty the contents and bury unused chemical at least 18 inches deep in an isolated location away from water supplies. Burn the empty container. Avoid the smoke.

2.3.2 Do not use or store in or around the home.

2.3.3 Apply at the following recommended rates:

CROP	DOSAGE NEMACUR 15% GRANULAR BAND: OZS./ 1,000 Ft. of Row	BROADCAST: LBS./ Acre
FIELD CROPS		
Cotton	13.5 to 27 ounces for any row spacing (or 11 to 22 pounds per acre on 40-inch rows)	(USE ONLY BAND APPLICAION ON COTTON)
Peanuts	11 to 18.7 ounces for any row spacing (or 10 to 17 pounds per acre on 36-inch rows)	20 to 33.5 pounds (3.0 to 5.0 lbs. a.i./acre)
Soybeans	6.7 to 26.7 ounces for any row spacing (or 6 to 24 pounds per acre on 36-inch rows)	26.7 to 40 pounds (4.0 to 6.0 lbs. a.i./acre)
VEGETABLES		
Cabbage (direct seeded and transplanted)	11 to 22 ounces for any row spacing (or 10 to 20 pounds per acre on 36-inch rows)	26.7 to 40 pounds (4.0 to 6.0 lbs. a.i./acre)
Brussels sprouts (transplanted)	11 to 22 ounces for any row spacing (or 10 to 20 pounds per acre on 36-inch rows)	26.7 to 40 pounds (4.0 to 6.0 lbs. a.i./acre)

CROP	PEST	DOSAGE NEMACUR 15% GRAN.
ORNAMENTALS		
Turf Grasses (Bermuda, Centipede, Bluegrass & Bentgrass)	Nematodes	1 1/2 to 3 pounds per 1000 square feet (68 to 134 lbs./acre or 10.2 to 20.1 lbs. a.i./acre)

2.3.4 For band application, apply specified dosage in oz./1000 ft. of row as a 12 to 18 inch band for field crops or as a 12 to 15 inch band for vegetables. Incorporate the granules to a depth of 2 to 6 inches.

2.3.5 For broadcast application, distribute granules uniformly and incorporate to a depth of 2 to 6 inches by disking or tilling.

2.4 Do not use band widths that will allow treated acres to overlap.

2.5 Do not feed or graze cotton foliage, soybean vines, green peanut vines or peanut vine hay. Do not hog down treated peanut fields.

2.6 Do not use on crops other than those specified.

2.7 Do not replant treated areas with any food crop not specified on the label within 12 months after last application. Any cover crops planted during the 12 month period must be plowed under and not grazed.

2.8 Keep out of lakes, streams, or ponds.

2.9 When applying to turf grasses, irrigate immediately with a half inch of water. Do not treat newly seeded areas. Do not apply more than twice per year. Do not allow livestock or poultry to feed on grass or grass clippings.

2.10 Use higher recommended rates in fields with high populations of nematodes or in fields having a history of serious nematode damage.

3.0 Discussion of Data

3.1 The following studies submitted in Supplement 1, Volumes I and II, dated April 5, 1976, are not required by environmental chemistry:

1. A Gas Chromatographic Method for the Determination of BAY 68138 and Metabolite Residues in Crops - J. S. Thornton, Research and Development, Chemagro, Kansas City, Missouri — 25402

2. Recovery of BAY 68138 and Metabolites from Various Crops - Research and Development, Chemagro, Kansas City, Missouri — 25542

3.	A Gas Chromatographic Method for the Determination of Residues of BAY 68138 and Metabolites in Animal Tissues and Milk - Research and Development, Chemagro, Kansas City, Missouri	25697
4.	Recovery of BAY 68138 and Metabolites from Animal Tissues and Milk - Research and Development, Chemagro, Kansas City, Missouri	25744
6.	Recovery of NEMACUR (BAY 68138) from Milk - Research and Development, Chemagro, Kansas City, Missouri	27011
7.	Recovery of NEMACUR (BAY 68138) from Soil - Research and Development, Chemagro, Kansas City, Missouri	27012
8.	Recovery of NEMACUR (BAY 68138) from Cattle Tissues - Research and Development, Chemagro, Kansas City, Missouri	27073
11.	Metabolism of NEMACUR [Ethyl 4-(methylthio)-m tolyl isopropylphosphoramidate] in Tobacco Plants - A. M. Khasawinah, Research and Development, Chemagro, Kansas City, Missouri	29142
12.	Recovery of NEMACUR from Soils - Research and Development, Chemagro, Kansas City, Missouri	30890
13.	Determination of Residues of NEMACUR and Its Metabolites in Plant and Animal Tissues - John S. Thornton, Research and Development, Chemagro, Kansas City, Missouri	31143
14.	Metabolism of NEMACUR [Ethyl 4-(methylthio)-m-tolyl isopropylphosphoramidate] and Identification of Two Metabolites in Plants - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri	32181
15.	Metabolism of NEMACUR [Ethyl 4-(methylthio)-m-tolyl isopropylphosphoramidate] by Rat Liver Microsomes In Vitro - A. M. Khasawinah and D. R. Flint, Research and Development, Chemagro, Kansas City, Missouri	34217

The majority of the nematicide is excreted within 12-15 hours. The main degradation pathway involved oxidation to sulfoxide and sulfone analogs. Deamination, hydrolysis and conjugation follow to give non-organosoluble compounds with a molecular weight of 400-800.

3.2.2 Animal Health Section, Chemagro, Kansas City, Missouri - Plot Location: Stanley, Kansas; and Chemagro, Kansas City, Missouri. 27076

Cows were fed treated feed for 28 days between 11/18/69 and 12/17/69. Milk was sampled later (2/4/70 and 2/5/70). Negligible (less than 0.001 ppm) residues were found at that time.

3.2.3 Animal Health Section, Chemagro, Kansas City, Missouri - Plot Location: Stanley, Kansas; and Chemagro, Kansas City, Missouri. 27079

Bovine were fed treated feed for 28 days (11/18/69 to 12/17/69). Samples of animal tissues were analyzed at later dates (3/12/70, 2/17/70, 2/11/70, 2/26/70, 3/18/70, 3/10/70, 1/28/70, 1/23/70, 1/19/70, 1/18/70). Residues of less than 0.01 ppm were found at those times.

3.2.4 Residues of NEMACUR in Poultry Eggs and Tissue - R. R. Gronberg, C. E. Simmons, H. R. Shaw, II, Chemagro, Kansas City, Missouri. 35995

Residues in eggs were below the sensitivity of the analytical method (2.56 + 0.18 ppb for eggs). Residues in tissues of hens were also below the minimum quantifiable residue (2.46 to 5.32 ppb for various tissues).

3.2.5 The Metabolite Fate of NEMACUR Sulfoxide Administered Orally to a Lactating Dairy Cow - R. R. Gronberg, D. R. Flint, and K. H. Pither, Research and Development, Chemagro, Kansas City, Missouri. 41104

Thirty-nine percent of the dose was excreted in the urine in 4 hours. Forty-seven percent was present in the rumen at 4 hours after dosage. The concentration of total ^{14}C in milk was 0.06 ppm (almost the highest level) at 4 hours.

Tissue levels were less than 0.1 ppm. Concentration in kidney tissue was 1.6 ppm. Metabolism involves oxidation or hydrolysis, and phenolic conjugation. In the rumen, some Nemacur was formed.

3.2.6 NEMACUR Residues in Poultry and Eggs - R. L. Bell, K. Jacobs, and R. R. Gronberg, Research and Development, Chemagro, Kansas City, Missouri. 41726

Hens, after 6 days of eating treated feed at 4- and 10-ppm, produced eggs with residues of 4 and 10 ppm, respectively. Residues in kidney, liver, gizzard, and blood ranged from 12 ppb for kidney to 37 ppb for gizzard for 10 ppm feeding level. Other tissue residues were below the sensitivity of the method.

3.2.7 The Metabolism of NEMACUR Sulfoxide in the Pig - R. L. Bell and R. R. Gronberg, Research and Development, Chemagro, Kansas City, Missouri. 42042

Fifty-seven percent of the dosage was excreted within 5 hours. 91.3% was excreted after 48 hours. All tissue residues at 48 hours were below 0.1 ppm.

3.3 Field Soil Dissipation

See conclusions for all reports in Section 3.3 at the end of the section.

3.3.1 NEMACUR Residues in Clay - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 27013

Nemacur 10% Granular was applied broadcast and rototilled to a depth of 4 to 6 inches. Total rainfall from application to 5/15/69 was 37.99 inches. Soil characteristics and net residues were as follow:

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
7.1	3.1	22	36	42	25

Application Dates	ppm. Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	2/05/70	
5/10/68	10.0	0	2/18/70	1.73
"	"	98	2/09/70	2.65
"	"	178	"	1.30
"	"	370	"	0.61

3.3.2 NEMACUR Residues in Silt Loam - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 27014

Nemacur 10% Granular was applied broadcast and rototilled to a depth of 4 to 6 inches. Total rainfall from application to 5/15/69 was 37.99 inches. Soil characteristics and net residues were as follow:

pH	% OM	% Sand	% Silt	% Clay	CEC(mEq/100g)
6.7	3.2	8	62	30	12

Application Dates	ppm. Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	2/5/70	
5/10/68	10.0	0	2/9/70	1.53
"	"	98	"	1.08
"	"	178	"	0.17
"	"	370	"	0.12

3.3.3 NEMACUR Residues in Silt Loam - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 27015

Nemacur was sprayed and rototilled to a depth of 4 to 6 inches. Total rainfall from application to 5/15/69 was 37.99 inches. Soil characteristics and net residues were as follow:

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
6.7	3.2	8	62	30	12

Application Dates	ppm. Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	2/05/70	
5/10/68	10.0	0	2/09/70	1.19
"	"	35	2/18/70	5.39
"	"	98	2/09/70	0.80
"	"	178	"	0.12
"	"	370	"	0.13

3.3.4 NEMACUR Residues in Clay - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 27074

Nemacur was sprayed and rototilled to a depth of 4 to 6 inches. Total rainfall from application to 5/15/69 was 37.99 inches. Soil characteristics and net residues were as follow:

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
7.1	3.1	22	36	42	25

Application Dates	ppm. Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	2/5/70	
5/10/68	10.0	0	2/9/70	0.96
"	"	35	"	3.65
"	"	98	"	1.50
"	"	178	"	0.56
"	"	370	"	0.71

3.3.5 NEMACUR Residues in Low Humic Latosol - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 31446

Nemacur 10% Granular was applied broadcast and rototilled to a depth of 4 to 6 inches in Hawaii. Total rainfall from application to 1/17/72 was 81.32 inches. Soil characteristics and residues were as follow:

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
7.0	2.5	26	38	36	11

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	5/24/71	
12/10/69	20	0	8/10/71	33.48
"	20	40	8/10/71	13.23
"	20	93	8/11/71	13.24
"	20	193	8/11/71	6.50
"	20	406	9/10/71	1.25
"	"	565	6/22/72	0.36
"	"	768	"	0.21

3.3.6 NEMACUR Residues in Low Humic Latosol - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 31447

Nemacur was sprayed and rototilled to a depth of 4 to 6 inches in Hawaii. Total rainfall from application to 1/17/72 was 81.32 inches. Soil characteristics as residues were as follow:

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
7.0	2.5	26	38	36	11

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	5/10/71	
12/10/69	20	0	8/11/71	26.10
12/10/69	20	40	8/10/71	9.13
12/10/69	20	93	8/10/71	7.09
12/10/69	20	193	8/11/71	2.47
12/10/69	20	406	8/11/71	0.50
12/10/69	"	565	6/22/72	0.27
"	"	768	"	0.14

3.3.7 NEMACUR Residues in Sand-Muck - T. B. Waggoner, Research and Development, Chemagro, Kansas City,. Missouri. 31448

Rainfall from application to 6/16/71 was 41.12 inches.

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
7.3	49	32	57	11	21

Application Method: Blended in mixer using 3 lb./gal. S.C. (Mixed in laboratory, then placed outside in soil plots one meter square by 8" deep.)

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	9/27/71	
6/16/70	10	0	9/24/71	5.13
6/16/70	10	30	9/14/71	5.11
6/16/70	10	90	9/22/71	0.08
6/16/70	10	180	9/22/71	0.68
6/16/70	10	365	9/15/71	0.63

3.3.8 NEMACUR Residues in Sand - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 31449

Rainfall from application to 6/16/71 was 41.12 inches.

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
5.9	0.8	92	1	7	1.1

Application Method: Blended in mixer using 3 lb./gal. S.C. (Mixed in laboratory, then placed outside in soil plots one meter square by 8 inches deep.)

Application Dates	ppm Active per Applin.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	9/27/71	
6/16/70	10	0	9/24/71	5.52
6/16/70	10	30	9/15/71	0.30
6/16/70	10	90	9/20/71	0.11
6/16/70	10	180	9/20/71	0.06
6/16/70	10	365	9/15/71	0.04

3.3.9 NEMACUR Residues in Sand-Muck - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 31450

Total rainfall from application to 6/16/71 was 41.12 inches.

Application Method: Blended in mixer using 15% Granular. (Mixed in laboratory, then placed outside in soil plots one meter square by 8" deep.)

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	9/27/71	
6/16/70	10	0	9/24/71	6.29
6/16/70	10	30	9/15/71	5.77
6/16/70	10	90	9/22/71	0.10
6/16/70	10	160	9/22/71	0.96
6/16/70	10	365	9/15/71	0.43

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
7.3	49	32	57	11	21

3.3.10 NEMACUR Residues in Sand-Clay - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 31451

Total rainfall from application to 6/16/71 was 44.12 inches.

Application Method: Blended in mixer using 3 lb./gal. s.c. (Mixed in laboratory, then placed outside in soil plots.) Soil plots were 1 meter square by 8 inches deep.

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
5.6	1.3	61	10	29	3.1

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	9/27/71	
6/16/70	10	0	9/27/71	6.83
6/16/70	10	30	9/14/71	4.36
6/16/70	10	90	9/22/71	1.21
6/16/70	10	160	9/24/71	0.14
6/16/70	10	365	9/14/71	0.06

3.3.11 NEMACUR Residues in Sand - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 31452

Total rainfall from application to 6/16/71 was 41.12 inches.

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
5.9	0.8	92	1	7	1.1

Application Method: Blended in mixer using 15% Granular. (Mixed in laboratory, then placed outside in soil plots 1 meter square by 8" deep.)

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	9/27/71	
6/16/70	10	0	9/27/71	5.49
6/16/70	10	30	9/14/71	0.61
6/16/70	10	90	9/20/71	0.21
6/16/70	10	180	9/20/71	0.07
6/16/70	10	166	9/27/71	0.03

3.3.12 NEMACUR Residues in Sand-Clay - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 31453

Total rainfall from application to 6/16/71 was 41.12 inches.

Application Method: Blended in mixer using 15% Granular. (Mixed in laboratory, then placed outside in soil plots 1 meter square by 8" deep.)

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
6.5	1.0	61	10	29	2.1

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	9/27/71	
6/16/70	10	0	9/24/71	8.49
6/16/70	10	30	9/14/71	2.97
6/16/70	10	90	9/24/71	0.46
6/16/70	10	180	9/20/71	0.14
6/16/70	10	365	9/14/71	0.14

3.3.13 NEMACUR Residues in Peat - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 32059

Total rainfall from application to 5/31/71 was 26.50 inches.

Application Method: Spray prepared with 3 lb./gal. S.C., rototilled to a depth of 4-6 inches.

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
6.2	60	50	32	18	43

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	8/19/71	
5/26/70	10	0	9/09/71	15.09
5/26/70	10	31	9/09/71	19.55
5/26/70	10	90	8/30/71	12.53
5/26/70	10	184	8/26/71	8.81
5/26/70	10	370	8/23/71	6.29

3.3.14 NEMACUR Residues in Silt Loam - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 32061

Nemacur 15% Granular was applied broadcast and rototilled into soil to a depth of 4-6 inches. Total rainfall from

application to 5/31/71 was 66.11 inches. Soil characteristics and residues were as follow:

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
4.8	15	22	52	26	13

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	8/27/71	
5/26/70	10	0	9/01/71	15.40
5/26/70	10	31	9/01/71	12.40
5/26/70	10	90	9/01/71	14.80
5/26/70	10	184	8/26/71	3.01
5/26/70	10	370	8/23/71	1.84

3.3.15 NEMACUR Residues in Fox Sand - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 32062

Nemacur 15% Granular was applied broadcast and rototilled to a depth of 4 to 6 inches. Total rainfall from application to 5/11/71 was 34.39 inches. Soil characteristics and residues were as follow:

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	5/04/71	
5/11/70	10	0	9/08/71	4.29
5/11/70	10	31	9/07/71	6.30
5/11/70	10	92	9/08/71	3.15
5/11/70	10	184	9/08/71	1.26
5/11/70	10	365	9/08/71	0.35

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
6.9	3	63	24	13	6.1

3.3.16 NEMACUR Residues in Silt Loam - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 32063

Total rainfall from application to 5/31/71 was 66.11 inches.

Application Method: Spray prepared with 3 lb./gal. S.C., rototilled to a depth of 4-6 inches.

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
4.8	15	22	52	26	13

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	8/27/71	
5/26/70	10	0	9/01/71	12.70
5/26/70	10	31	9/01/71	10.50
5/26/70	10	90	8/30/71	10.70
5/26/70	10	184	8/30/71	6.53
5/26/70	10	370	8/26/71	2.46

3.3.17 NEMACUR Residues in Peat - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 32064

Nemacur 15% Granular was applied broadcast and rototilled to a depth of 4-6 inches. Total rainfall from application to 5/31/71 was 26.50 inches. Residues and soil characteristics were as follow:

Application Dates	ppm Active per Appln.	Days Final Appln. to Sampling	Analysis Date	Net Residue ppm.
Control	-	-	8/19/71	
5/26/70	10	0	9/09/71	16.54
5/26/70	10	31	9/01/71	17.33
5/26/70	10	90	8/30/71	16.59
5/26/70	10	184	8/26/71	6.02
5/26/70	10	370	8/23/71	7.21

pH	% OM	% Sand	% Silt	% Clay	CEC (mEq/100g)
4.8	15	22	52	26	13

3.3.18 NEMACUR Residues in Silt Loam - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 46782

Nemacur was applied to silt loam soil as an incorporated broadcast spray. Residues were found as follows:

Application Date	Oz Active/Acre Per Appln.	Days Final Appln. To Sampling	Sampling Depth, Inches	Analysis Date	Gross Residue, ppm
6/22/73	96	0	0-6	12/08/75	3.74
"	"	0	6-12	12/12/75	2.12
"	"	33	0-6	12/08/75	2.17
"	"	33	6-12	"	0.73
"	"	61	0-6	"	0.55
"	"	61	6-12	12/12/75	2.33
"	"	123	0-6	12/08/75	1.14
"	"	123	6-12	12/12/75	0.15
"	"	248	0-6	12/12/75	0.83
"	"	248	6-12	12/15/75	0.10
"	"	368	0-6	12/12/75	0.53
"	"	368	6-12	"	0.28
6/22/73, 6/25/74	"	0	0-6	12/15/75	3.32
"	"	0	6-12	"	1.52
"	"	35	0-6	"	2.46
"	"	35	6-12	"	0.47
"	"	66	0-6	"	1.12
"	"	66	6-12	"	0.15

Soil characteristics were as follow:

pH	% Sand	% Silt	% Clay	% OM
5.1	6	58	36	2.0

Total rainfall from application to 10/23/75 was 60.87 inches.

3.3.19 NEMACUR Residues in Clay - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 46783

Nemacur was applied to silt loam soil as an incorporated broadcast spray. Residues were found as follows:

Application Date	Oz Active/Acre per Appln.	Days Final Appln. To Sampling	Sampling Depth, Inches	Analysis Date	Gross Residue, ppm
Control	-	-	0-6	12/01/75	<0.01
"	-	-	0-12	12/08/75	0.01
7/13/73	96	0	0-6	12/01/75	3.64
"	"	33	0-6	"	1.00
"	"	33	6-12	12/04/75	0.10
"	"	69	0-6	12/01/75	0.36
"	"	69	6-12	12/04/75	0.20
"	"	123	0-6	12/01/75	0.21
"	"	123	6-12	12/04/75	0.04
"	"	250	0-6	12/01/75	0.11
"	"	250	6-12	12/04/75	0.02
"	"	367	0-6	12/04/75	0.07
"	"	367	6-12	12/05/75	0.02
"	"	615	0-6	12/04/75	0.04
"	"	615	6-12	12/05/75	<0.01
7/13/73, 7/16/74	"	0	0-6	12/01/75	6.52
"	"	0	6-12	12/05/75	0.15
"	"	247	0-6	12/05/75	0.15
"	"	247	6-12	12/05/75	0.06

Total rainfall from application to 7/15/74 was 44.12 inches.

Conclusion for Section 3.3:

The following reports (Section 3.3) are field soil dissipation studies which are not acceptable under any guidelines:

27013	31447	31452	32063
27014	31448	31453	32064
27015	31449	32059	46782
27074	31450	32061	46783
31446	31451	32062	

Deficiencies according to the current draft guidelines are as follow:

1) Only gross residues or net residue is analyzed in reports in Section 3.3. Patterns of formation and decline of degradation products are needed and are not given. Identity of residues comprising more than 10% of the initial concentration or 0.01 ppm are needed.

2) More sampling times are needed to define the decline curve and establish half-life for all reports in Section 3.3. Suggested sampling times are preapplication, day of application, and shortly post-application for each application. Succeeding samples are dependent on degradation and metabolism characteristics.

3) For field, vegetable, fruit, and nut crops, soil should be analyzed in increments to a depth of 12 inches. This was not possible in soil plots 8 inches deep (reports 31448, 31449, 31450, 31451, 31452, 31453). Depth, weight, and volume of each sample should be reported. Depth of sample was given only in reports 46782 and 46783. Weight and volume were not given in any reports.

4) Bulk density of the soils should be reported.

3.4 Photodegradation

3.4.1 Photodecomposisiton of NEMACUR - L. D. Houseworth and B. G. Tweedy, University of Missouri, Department of Plant Pathology, Columbia, Missouri. 41338

Nemacur-ring-UL-^{14}C was degraded as a thin film on glass plates, silica gel coated plates, and soil-coated plates. Photodegradation in distilled water was also studied.

Two F40-BL lamps provided ultraviolet light with wavelength 300-400 nm and intensity of 1,020 uW/cm^2. Temperature of the chamber was 19°C.

Residues were analyzed by co-chromatography, thin layer chromatography, autoradiography, and liquid scintillation counting. Material balance for all studies was approximately 100%.

For photodecomposition on soil, Louisiana Commerce Loam soil with the following characteristics was used:

% OM	% Silt	% Clay
0.7	42.8	7.6

Nemacur on glass surfaces decomposed within 32 hours. Half-life was less than two hours. The sulfone and sulfoxide analogs were the predominant degradation products. Nemacur on glass in the dark was only slightly decomposed.

For Nemacur on silica gel surfaces, 99.2% was decomposed at 32 hours. Half-life was less than two hours. The major degradate was the sulfoxide, which accounted for 93.6% of the applied radioactivity at 32 hours. Anthroquinone, a sensitizer, increased the degradation rate and number of degradation products. For Nemacur on soil surfaces, only 42.8% was present when applied at a concentration of 7.3 ppm and immediately extracted before exposure to ultraviolet light. Nemacur on soil in the dark was completely degraded when first measured at 128 hours. Sulfoxide was the major degradate in the dark. Exposure to sunlight increased the amount of sulfone and the number of other degradation products as shown below:

PHOTODEGRADATION OF NEMACUR ON SOIL SURFACES[1]

Compound	Hours exposed to UV radiation									Dark	
	0	2	4	8	16	32	64	128	256	128	256
NEMACUR - phenol sulfone	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEMACUR - parent	42.8	41.8	37.9	33.4	6.9	18.1	6.5	3.4	4.6	0.0	0.0
NEMACUR - sulfone	0.0	0.4	1.7	2.9	8.0	5.4	16.0	25.9	27.8	8.2	4.9
NEMACUR - phenol sulfoxide	0.0	0.0	0.4	0.9	1.6	0.6	2.7	2.4	4.0	0.0	0.0
NEMACUR - sulfoxide	54.4	55.4	56.9	59.2	72.5	67.9	55.1	57.9	55.2	97.9	93.1
Polar Metabolites[2]	2.4	1.2	1.6	1.5	8.0	5.0	15.1	3.9	1.4	1.7	1.3
Soil Residue[3]	0.4	1.2	1.5	2.1	3.0	2.8	4.6	6.5	7.0	0.4	0.7

[1] Percent of original radioactivity added.

[2] Includes radioactivity remaining in aqueous phase of the extraction solvent and radioactivity remaining at the origin on TLC plates.

[3] Determined by combustion

No Nemacur parent compound was found when placed in water at a concentration of 0.1 ppm and immediately extracted.

The major metabolite at zero time was Nemacur sulfoxide. Upon exposure to U.V. light, the number of degradates increased with corresponding decrease in amount of sulfoxide as shown below:

PHOTODEGRADTION OF NEMACUR IN WATER[1]

Compound	Hours exposed to UV radiation									Dark	
	0	2	4	8	16	32	64	128	256	128	256
NEMACUR - phenol sulfone	0.0	0.0	0.0	0.0	0.0	0.0	3.7	4.5	4.7	0.0	2.2
NEMACUR - parent	0.0	5.1	7.0	1.7	4.2	3.6	4.2	5.8	5.3	0.0	0.2
NEMACUR - sulfone	0.0	2.4	1.2	2.9	3.2	3.1	3.2	5.8	5.3	0.0	0.2
NEMACUR - phenol sulfoxide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEMACUR - sulfoxide	93.9	85.1	87.3	79.6	79.3	80.9	58.1	43.6	37.0	95.5	94.9
Polar metabolites[2]	6.2	7.3	3.5	10.8	6.8	5.5	8.7	9.7	9.7	2.8	2.6
Nonextractable radioactivity[3]	0.1	0.1	0.9	4.9	6.4	6.7	22.1	30.6	38.0	0.1	0.1

[1] Percent of original radioactivity added.

[2] Consists of products remaining at the origin.

[3] Radioactivity remaining in the water after extraction.

Conclusions:

Nemacur on glass plates was almost completely decomposed by 32 hours. Half-life was less than 2 hours. The sulfoxide analog was the major degradate.

On soil at time zero, only 42% of the applied radioactivity was present as Nemacur. In water, none was present as Nemacur. The major degradate was the sulfoxide.

This is an acceptable study. However, the following data required under the current draft guidelines is not submitted:

1. pH, cation exchange capacity, and bulk density of the soil.

2. pH, temperature, and oxygen content of the water.

3.4.2 Photodecomposition of Thin Films of NEMACUR - A. M. Khasawinah and F. E. Sandie, Research and Development, Chemagro, Kansas City, Missouri. 39217

Thin films of ethyl-1-^{14}C, methylthio-^{3}H Nemacur were coated on glass plates and silica gel coated glass plates. These plates were placed outside for 4 hours to 22 days. Nemacur was rapidly oxidized to Nemacur sulfoxide and then to Nemacur sulfone. Some hydrolysis of the sulfone to the free phenol followed.

3.5 Rotational Crop Study

3.5.1 Determination of Soil Bound Residues and Uptake by Rotational Crops from Soil treated with NEMACUR - H. R. Shaw II, Research and Development, Chemagro, Kansas City, Missouri. 44226

^{3}H-Nemacur (52.2 mg), ^{14}C-Nemacur (44.3 mg), and technical Nemacur (305.5 mg) were mixed together and applied to 6.7 kg of soil. A cabbage plant was grown in the soil for 2 months. Then untreated soil was added, altering the treatment rate to 3 lb. AI per acre (4 ppm). A corn plant was grown in one pot of soil and a cotton plant was grown in

the other. These plants were harvested after 103 days and analyzed. Soybeans were planted in extracted and non-extracted soils in which the cotton had grown. Cotton was planted in extracted and nonextracted soils in which corn had grown. One soybean and one cotton plant were grown to maturity in non-extracted soil. The others were harvested when 10 to 15 inches tall. Soil characteristics were as follow:

Class	% Sand	% Silt	% Clay	pH	% OM
Loam	46	28	26	4.9	4

Bulk density (gm/cc)

1.2

Conclusion: The corn and cotton plants planted after cabbage took up 20 and 5% of the applied radioactivity. Soybeans planted after cotton absorbed 1.1% in non-extracted soil and 0.74% in extracted soil. Cotton planted after corn absorbed 0.08% of the applied radioactivity.

Since residues are found, a field study under actual use conditions should be conducted on a root crop, small grain, and leafy vegetable.

3.5.2 NEMACUR Residues in Corn - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 46777

A rotational crop of corn was planted in silt loam soil 350 days after broadcast spray application of 96 oz. active ingredient per acre. Samples of kernal, cob, husk, and forage were taken 109 days after planting.

Conclusion: Gross residues in rotational corn were less than 0.01 ppm for kernal, cob, husk, and forage. Only one sample analysis for each part of the plant is reported. This is not an acceptable study because more than one sample analysis is needed to provide adequate data on residues.

3.5.3 NEMACUR Residues in Snap Beans - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 46778

A rotational crop of snap beans was planted in silt loam soil 350 days after broadcast spray application of 96 oz. a.i./acre. Samples of beans in pod and vines were taken 61 days later.

Conclusion: Gross residue in snap beans in pod was less than 0.01 ppm. Gross residue in vines was 0.07 ppm. Only one sample analysis for each part of the plant is reported. Residue in vines, which are fed to livestock, may be a problem and is not covered by tolerance. There is not adequate data to support a change in the crop rotation restriction.

3.5.4 NEMACUR Residues in Peas - T. B. Waggoner - Research and Development, Chemagro, Kansas City, Missouri. 46779

A rotational crop of peas was planted in silt loam soil 350 days after broadcast spray application of 96 oz. a.i./acre. Samples of peas, pods, and vines were analyzed 54 days later as follows:

	Gross Residue, ppm
Peas	Less than 0.01
Pods	0.01
Vines	0.07

Conclusion: Only one sample analysis for each part of the plant is reported. Less than 0.01 ppm gross residue was found in peas while more was found in pods (0.01 ppm) and vines (0.07 ppm). Residue in vines, which are fed to livestock, may be a problem. There is not adequate data to support a change in the crop rotation restriction.

3.5.5 NEMACUR Residues in Sanp Beans - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 46780

Snap beans were planted as a rotational crop in clay 368 days after application of 96 oz. ai/acre as a broadcast spray.

Conclusion: Samples of beans in pod and vines analyzed after 63 days had gross residues of less than 0.01 ppm. Only one sample analysis for each part of the plant was reported. There is not adequate data to support a change in the crop rotation restriction. This is not an acceptable study.

3.5.6 NEMACUR Residues in Sorghum Forage - T. B. Waggoner, Research and Development, Chemagro, Kansas City, Missouri. 46781

A rotational crop os sorghum forage was planted in clay 368 days after broadcast spray application of 96 oz. a.i./acre. A sample was analyzed 99 days after planting.

Conclusion: Less than 0.01 ppm gross residue was found in the one sorghum forage sample reported. This is not an acceptable study since more than one sample analysis is needed to provide adequate data.

3.6 Aerobic and Anaerobic Soil Metabolism

The Metabolism of NEMACUR Soil Residues under Aerobic and Anaerobic Conditions - R. R. Shaw and D. R. Flint, Research and Development, Chemagro, Kansas City, Missouri. 39909

Metabolism of Nemacur in soil after 30 days aerobic incubation was studied under aerobic and anaerobic conditions. A mixture of Nemacur labeled with tritium in the methylthio group and Nemacur labeled with carbon-14 in the aromatic ring was used.

Soil characteristics are as follow:

Texture	% Sand	% Silt	% Clay	pH	% OM
Red Silty Clay	4.0	45.0	51.0	6.5	1.7

Bulk Density (gm/cc)

1.23

Anaerobicity was obtained by catalytically replacing oxygen with carbon dioxide.

Samples were analyzed by thin layer chromatography and liquid scintillation counting.

Results of analysis were as follow:

Recovery and Distribution of NEMACUR-^{14}C,^{3}H Residues in Soil Following Aerobic and Anaerobic Incubation

Type of Incubation	Secondary Incubation Period[1]	Soil Fraction	dpm ^{3}H / dpm ^{14}C[2]	Total Fraction	Percent of Applied Radiocarbon (^{14}C) NEMACUR	NEMACUR SO	NEMACUR SO_2	SO_2 Phenol
Aerobic	30 days	Organosoluble	2.52	85.5	5.2	66.3	14.0	ND[3]
		Watersoluble	0.98	1.7				
		Insoluble	2.80	10.2				
		Total		97.4				
Aerobic	61 days	Organosoluble	2.27	80.3	ND	58.7	16.2	5.8
		Watersoluble	0.94	1.6				
		Insoluble	2.50	10.6				
		Total		92.5				
Anaerobic	30 days	Organosoluble	2.45	87.9	22.2	56.2	9.5	ND
		Watersoluble	1.23	1.2				
		Insoluble	3.21	6.8				
		Total		95.9				
Anaerobic	61 days	Organosoluble	2.30	85.8	27.6	48.4	9.8	ND
		Watersoluble	1.33	1.1				
		Insoluble	2.42	11.0				
		Total		97.9				

[1]Beginning after 30 days aerobic incubation (primary).

[2]Standard ratio was 2.57

[3]None detected.

Conclusion: This study was acceptable on 2/13/76 but is now being reviewed under current draft guidelines.

Nemacur continued to degrade under aerobic conditions. No further degradation occurred under anaerobic conditions.

This study is not acceptable as an anaerobic soil metabolism study because anaerobicity was established by catalytically replacing oxygen with CO_2. Anaerobicity should be obtained by waterlogging or purging with inert gas.

This study is not acceptable as an aerobic soil metabolism study because samples were first analyzed after 30 days. For an aerobic study, samples should be analyzed at pretreatment, 0, 1, 2, and 7 days, 2 and 3 weeks, and 1, 2, 4, 6, 9, and 12 months.

For both the aerobic and anaerobic studies, the cation exchange capacity is needed and not given.

The soil used should be sandy loam, loam, silt loam, or other soil appropriate to the intended application sites. The soil used in this study was silty clay.

3.7 Leaching

Leaching of "Aged" NEMACUR Residues in Sandy Loam Soil - 40506
B. G. Tweedy and L. D. Houseworth, University of Missouri, Department of Plant Pathology, Columbia, Missouri

Ring-UL-^{14}C Nemacur was incubated in a greenhouse for 30 days in sandy loam soil with the following characteristics:

% OM	% Sand	% Silt	% Clay	CEC	pHw
0.6	65.2	21.2	13.6	12.5	8.0

Concentration was 2 mg/10g of soil (approximately 4 lb. AI/acres). The soil was then placed in a 12 inch long column and eluted with 0.5 acre-inch of water per day for 45 days. Soil analyzed by liquid scintillation counting showed the following distribution of radioactivity:

Distribution of NEMACUR "Aged" Residues in Amarillo Sandy Loam Soil as Expressed in Total Percent of Radioactivity

Soil Depth (Inches)	Percent Radioactivity
1	65.1
2	5.8
3	6.6
4	6.3
5	6.8
6	4.3
7	3.0
8	1.7
9	0.9
10	0.5
11	0.3
12	0.4
Leachate	2.3
Material Balance	104.0

Conclusion: This study was accepted on 2/13/76 but is now being reviewed under current draft guidelines.

Nemacur also slightly leaches. 65.1% of the radioactivity remained in the first inch of soil. 2.3% of the radioactivity was recovered in the leachate.

This is an acceptable aged leaching study. However, the bulk density of the soil is required by the current draft guidelines and was not given.

4.0 Conclusions

4.1 Environmental chemistry studies acceptable under current draft guidelines are the following:

1. Photodegration (on soil and in water) #41338.
(The pH, cation exchange capacity, and bulk density of the soil are not given. The pH, temperature, and oxygen content of the water are not given.)

2. Aged leaching study. #40506
(The bulk density of the soil is not reported as required by current draft guidelines.)

4.2 Studies accepted previously but not accepted under current draft guidelines are the following:

1. Aerobic and Anaerobic Soil Metabolism #39909

This study is not acceptable as an anaerobic soil metabolism study becuase anaerobicity was established by catalytically replacing oxygen with carbon dioxide. The soil should be waterlogged or purged with inert gas.

The study is not acceptable as an aerobic soil metabolism study because the soil was first analyzed after 30 days, which is too late.

For both the anaerobic and aerobic studies, another deficiency is lack of cation exchange capacity of the soil. Another possible deficiency is use of a silty clay soil which may not be appropriate to the intended application sites.

4.3 All other environmental chemistry studies not accepted:

1. Field Soil Dissipation Studies (#27013, 27014, 27015, 27074, 31446, 31447, 31448, 31449, 31450, 31451, 31452, 31453, 32059, 32061, 32062, 32063, 32064, 46782, 46783).

Deficiencies according to the current draft guidelines are as follow:

a) Only gross residue or net residue is analyzed in reports in section 3.3. Patterns of formation and decline of degradation products are needed and are not given. Identity of residues comprising more than 10% of the initial concentration or 0.01 ppm are needed.

b) More sampling times are needed to define the decline curve and establish half-life for all reports in Section 3.3. Suggested sampling times are preapplication, day of application, and shortly post-application for each application. Succeeding samples are dependent on degradation and metabolism characteristics.

c) For field, vegetable, fruit, and nut crops, soil should be analyzed in increments to a depth of 12 inches. This was not possible in soil plots 8 inches deep (reports 31448, 31449, 31450, 31451, 31452, 31453). Depth, weight, and volume of each sample should be reported. Depth of sample was given only in reports 46782 and 46783. Weight and volume were not given in any reports.

d) Bulk density of the soils should be reported.

2. Rotational Crop Studies #46777, 46780, 46781

For these studies, more than one sample analysis is needed to provide adequate data. The sample should be taken at harvest if this was not done.

4.4 Rotational crop studies show residues and cannot support a change in the crop rotation restriction. The studies are #46778 and 46779. The data on rotational crops of snap beans and peas show residues in vines. This is no data to support earlier intervals. Additional sampling is needed.

4.5 A rotational crop study on a root crop is required and was not submitted.

4.6 The following studies were erroneously called "not environmental chemistry" in the review of 2/13/76: 31446, 31447, 31448, 31449, 31450, 31451, 31453, 32059, 32061, 32062, 32063, 32064.

5.0 Recommendations

We do not concur with the proposed change of the crop rotation restriction. There is not adequate data to support a change. Data submitted shows residues in vines. Only limited sampling and analyses was carried out. Therefore we are unable to concur. Data are also needed on root crops.

Nancy Dodd 1/6/77

Ronald E. Ney, Jr. 12/16/76
Nancy Dodd 12/10/76
Environmental Chemistry Section
Efficacy and Ecological Effects Branch