5/30/74 118

ENVIRONMENTAL CHEMISTRY EVALUATION for 1-(5-tert-butyl-1,3,4-thiadiazol-2-yl)-1,3-dimethylurea (terbuthiuron, El-103, Spike)

Reg. No. 1471-OT
Elanco Products Co.

I. INTRODUCTION

1. This is the first environmental review for this chemical. Terbuthiuron is the proposed name. This is a herbicide which is not registered.

2. The name of the product is Spike 80W.

3. Spike is a preemergence and postemergence herbicide for total control of vegetation in areas such as railroad right-of-ways, industrial sites, lumberyards and mills, rail sidings, petroleum tank farms, machinery yards, roadway and highway medians, airports, guard rails, transformes stations, outdoor industrial storage areas, firelanes, military bases, pipeline right-of-ways and fuel tanks.

II. DIRECTIONS FOR USE

Apply Spike before or during period of active growth of plants to be controlled. Apply 5-20 lbs/A (4-16 lbs A/A) depending on vegetation to be controlled.

Do not apply near desirable trees or other plants or on areas where their roots may extend in locations where the chemical may be washed into contact with their roots as severe injury or death may occur.

Do not use on walks, driveways, lawns, patios, tennis courts, or similar areas where roots of desirable trees or plants extend.

III. DISCUSSION OF DATA

1. Analytical Method

   a. Radiochemical Assay
   25 grams of soil are extracted with 1:1 mixture of MeOH:2n HCl.
   The filtrates are extracted with CHc13.

   Clay soil is extracted with MeOH:H_2O

   b. TLC identification

119

2. Soil degradation and metabolism study
^{14}C ring labeled terbuthiuron used. Loam soil treated at a rate of 8 ppm. Three samples at temperatures of 25, 30, and 37°C. Soil at 20% moisture level approx. 70% of field capacity.

	% ^{14}C recovered from soil		
	25°C	30°C	37°C
Days			
0	102.8	101.9	95.2
27	87.5	87.7	92.2
70	97.6	101.5	89.5
126	85.5	91.2	92.1
217	99.1	99.9	88.6
273	85.5	95.	96.5

Compounds found at 273 days expressed as %. of Extracted Radiooctivity

	25°C	30°C	37°C
EL-103	85.1	88.3	85.2
EL-104	12.4	9.8	12.6
EL-105	.7	.7	.8
EL-107	1.8	1.2	1.4

Conclusion

a. Terbuthiuron is very stable in soil. The half life is so long, the only prediction is 3 years.

b. The major degradation product is EL-104.

c. This is one of the most persistent chemicals that has been in, in years. Estimated 1/2 life is 3 years and about 11 years when only 10% remains.

2

120

3. Field persistence and leaching studies. ^{14}C-ring labeled terbuthiuron was used. Four soils were used in this study. Rainfall data given.

		% ^{14}C in each segment (inches)				
Soil	days	0-3	3-6	6-12	Recovered % of theory	Inches Rain
Clay	56	69.5	30.5		150	7.95
	112	62.2	15.5	21.7	106	18.71
Loam	56	82.6	15	2.3	117	6.6
	98	89.0	9.5	1.5	118	10.4
Loam	84	96	4		117	2.25
	168	79	13	8	81	3.11
	217	80	16	14	110	3.11
Muck	56	85	14.5		110	16.7
	84	56.9	19.5	23.5	180	20.5
	112	78.5	6.6	15	92	23.7

The only explaination for high recovery is unevern distrubution of ^{14}C in soil.

Distribution of Extracted Radioactivity
% in soil segment (inches)

Soil	Compound	Day	0-3	3-6	6-12
Clay	EL 103	112	95	93.2	96.1
	104		4	6.8	6.8
	107		1		3.8
Loam	103	98	79.7	89.7	
	104		13.9	10.3	
	105		2.4		
	107		2.5		
	108		1.4		
Loam	103	217	97.4	2.6	
	104		94.3	5.7	
Muck	103	112	97.7	96.6	
	104		2.2	2.7	
	107		.1	.7	

Conclusion

a. Terbuthiuron is highly persistent and can leach under field condition

b. Major soil degradation product is EL-104, and 107, 105 and 108 as minor ones. No build up of any noted.

3

4. Sterile water vs nonsterile water. Degradation in natural water at 20°C.

Conclusion

a. No degradation took place in 4 weeks.

b. Aquatic microbes did not degrade EL-103 in this study.

c. Stable in water

5. Hydrolysis

Sterile and nonsterile natural river water used. Water temperature was 20°C and no light

a. at a pH 5, 7 and 9 almost no hydrolysis took place in any sample

b. Does not hydrolyze, stable.

c. Microbes did not degrade EL-103 as also shown by any water study.

6. Photodegradation studies

(A) Photodegradation in water ^{14}C-ring labeled EL-103 used. Light source was 20-watt GE F40BL fluorescent blacklight or a Westinghouse FS20 fluorescent sunlamp temperature of solutions with black light was 28-34°C. Solution deionized water pH 7.1 and natural water pH 8.1 from a stream near Green field, Ind.

Days	(25 ppm) H_2O	EL 103	Distribution of CH_2Cl_2 Extractable 14C (%) 104	105	107	108
0	deionized	100				
	Watural	100				
7	deionized	99.4	:4	.1	.1	
	maturál	98.9	1.1			
14	deionized	98.6	.9	.1	.2	.2
	natural	94.6	.4	.6		.7
23	deionized	97.7	1.5	.2	.4	.3
	natural	92.0	5.8	.8		1.3

120

This study was run under blacklight

2.5 ppm in natural water
Distribuition of $CHcl_3$ extractable ^{14}C

Days	Lamp EL	103	104	105	108
0	Bland S1	100	-	-	-
4	BL	94.6	3.1	.4	.4
	SL	87.5	6.2	1.0	0
9	BL	88.5	6.2	1.0	1.0
	SL	73.2	14.1	2.1	1.8
15	BL	83.1	8.8	1.2	1.1
	SL	57.5	21.8	1.7	1.5

BL = Blacklight, SL = sunlamp.

Conclusion

a. Sunlamps photodegraded EL 103 faster than blacklight

b. EL-104 was major photo product.

c. Photodegradation was slow.

(B) Photodegradation on soil thin-layer plates.
Helling and Turner method lights 5 cm from plates.

% of ^{14}C

Days	EL 103	104	105	Polar product
13	85.5	2.3	.5	10

Conclusion

a. Photodegradation was slow

b. EL-104 major photo product

c. Unknown polar product formed.

5

123

(C) Photodegradation on thin films Equivalent of 2 lb/A on bottom half of petri desh. Irradiated simultaneously with blacklight and sunlamp. Lights where 5 cm above dishes.

	% of ^{14}C		
Days	E 103	104	105
14	96.9	1.2	.3

Conclusions

a. Photodegradation was slow.

b. EL-104 major photo product.

7. Effects on soil microorganism

	Loamy Sand	Mucka	Sand	Clay
CO_2	R	NR	NR	LNR
Fungi	SR-RAT	SR-RAT	-	SR-RAT
Actinomycetes	SR-RAT	LNR	GS	LNR
Bacteria	SR-RAT	SR-RAT	GS	LNR

Reduction (R)
Some Reduction (SR)
Little or No Reduction (LNR)
No Reduction (NR)
Regrowth after time (RAT)
Growth Stimulated (GS)

Conclusion

a. Very little effects on microbes are noted

[A] Is the product persistent in soil to the extent that label cautions are needed for rotational crops.

1. All uses proposed are nonfood uses. Rotational crop data and restrictions are not needed.

2. Terbuthiuron is highly persistent as parent compound. The 1/2 life in soil of parent is extrapolated to be 3 years. Very little is bound in soil. It is also extrapolated that the time when only 10% would remain would be 12 years. Yearly applications would cause indefinitely persistent of this chemical

6 01

124

8. Fish accumulation study ^{14}C-ring labeled terbuthiuron

ppm in edible tissue

Days	.01 ppm exposure	1 ppm exposure
1	.045	3.3
3	.076	8.5
7	.1	10.5
10	.031	5.6
14	.038	3.2
21	.073	3.4
28	.055	3.8
1 WD	.029	3.1
7 WD	.034	3.2
14 WD	.027	3.2

Conclusion

a. No mortality observed

b. Maximum tissue concentration at 1 ppm exposure was 10X.

c. At 0.01 ppm exposure 55% was extractable in hexane and 40% in MeOH at 28 days. At 1 ppm exposeure 63% extractable in hexane and 30% in MeOH at 28 days. Residues in non edible tissue at 28 days was 0.16 ppm (0.01 ppm level) and 7.4 ppm (1.0 ppm level).

d. At 28 days the relative distribution between viscera and carcass indicated that only 2-3X level in edible portion occured in the non-edible portion

c. Accumulation in fish is not a problem.

9. Fish accumulation study ^{14}C-ring labeled Terbuthiuron

Total ^{14}C exoressed as EL-103
Exposure level 1.0 ppm

Days	Bluegill PPM	Trout PPM
4	2.29	2.82
7	1.88	2.47
Withdrawal		
3	.43	.31
7	.12	.29

125

10. Animal feeding studies ^{14}C-ring labeled terbuthiuron used.

% ^{14}C exereted

96 hours	Rat	Rabbit	Dog	Malland Duck
Urine	92.8	93.2	03.3	88
Feces	1.7	1.1	2.4	

% distribution

Urine Metabolites		Rat	Rabbit	Dog	Duck
	A	.2	.1	2.9	3.7
EL-104,	B	10.9	15.2	4.9	4.3
EL-105,	C	6.1	28.8	15.0	51.6
	D	11.8	.2	3.2	0
EL-106,	E	15.0	22.8	40.2	15.8
	F	36.7	20.4	14.4	5.5
	G	8.5	6.8	9.2	13.1
	H	10.1	5.3	9.6	4.5
Terbuthiuron		.7	.4	.6	1.5

Conclusion

a. Terbuthiuron was rapidly absorbed metabolized and excreted. All test animals excereted most of the ^{14}C compounds in urine. Metabolism in each animal was some what different as shown by the percentages of the different metabolites found in urine.

b. Analysis for residues in tissue was not made.

[B] Potential for accumulation in the food chain.

1. No accumulation was noted in fish. The accumulation factor was 10X at the highest exposure level (1 ppm).

2. About 90+% was excreted by rats, dogs and rabbits, and 88% by ducks.

3. Accumulation does not appear to be a problem.

4. Terbuthiuron is stable in water.

126

11. Leaching ^{14}C-ring labeled study EL-103 was added to a 12 inch column (8lbs/A).
Elution was 4A inches water for loamy sand & loam, 8 inches for muck, and 20A inches for Lakeland fine sand.

Recent of material found on column'

Inches	Loamy sand	Loam	Muck
0-1	1.2	2.9	51.4
1-2	1.0	14.4	33.0
2-3	2.2	10.9	12.5
3-4	4.2	18.2	3.2
4-6	9.2	16.9	
6-8	31.4	24.4	
8-10	42.3	4.8	
10-12	8.8	5.7	

% of Eluted Radioactivity from Lakeland fine sand column

A inches of H_2O	%
0-4	-
4-8	73
8-12	20.9
12-16	4.4
16-20	1.7

Soil	Amount of H_2O applied in Acre inches
Loamy Sand	4
Loam	4
Lakeland sand	20
Muck	8

9

Conclusion

a. All ^{14}C was eluted from lakeland sand.

b. ^{14}C leached in loamy Sand and Loam to 12 inches. If more than 4 A inches of H_2O had been used ^{14}C would have eluted.

c. ^{14}C did not readily leach in muck.

d. Terbuthiuron can leach.

12. Runoff study

A tray 36 inches long X 12 inches wide X 3 inches deep was used and elevated to 7° angle. A loam soil was used. Three pesticides were used to determine if EPA runoff study was workable.

Terbuthiuron	1 lb A/A EL 103 80W
Atrazine	1 lb A/A 80W
Dieldrin -	6.6 lb A/A of 1.5 EC

Pesticides where lift on soil 24 hours prior to simulated rainfall at 30°C room temp. Dieldrin was incorporated and the other two applied to surface .

128

Simulated Rain fall

Days	inches/hr.	Total inches applied	H_2O collected liters	H_2O collected as % applied	Soil V.G.
1	1.25	2.55	.332	1.83	96
3	1	1.95	1.08	7.82	181
7	1	2	.57	4.02	22

Compound	Days	Run off H_2O ppm	Run off Soil ppm	% of amount Applied
EL 103	1	.139	3.51	.44
	3	.099	2.04	1.03
	7	.044	8.47	.24
Atrazine	1	.076	---	.24
	3	.055	---	.58
	7	.025	---	.15
Dieldrin	1	.008	4.33	.004
	3	.009	12.54	.01
	7	.006	48.73	.006

Atrazine in soil could not be determine due to background.

129

Conclusion

a. Runoff of EL-103 does not appear to present a problem.

b. Elunco states that ".... the laboratory model is fairly reliable to determine runoff of a compound under controlled conditions. The % of dieldrin in runoff was 0.02% by this method and 0.07% found in field studies by Caro and Taylor.

[C] Does the pesticide exhibit special propensity for mobility?

1. Leaching studies showed that this chemical can leach in sandy soil.

2. Runoff study showed that runoff in water may not be a problem.

13. Degradation

terbuthiuron (1-(5-tert-butyl-1,3,4-thiadiazol-2-yl)-1,3-dimithylurea soil, water

EL-104; (B) 1-(5-tert-butyl-1,3,4-thiadiazol-2-yl) methylurea major in soil; major photo in water; major in urine of not, rabbit and minor in urine of dog and duck

EL-105; (C) 1-(5-tert-butyl-1,3,4-thiadiazol-2-yl)-3-methylurea minor in soil; minor photo in water; major in urine of rabbit, dog and duck; and minor in urine of rat

(G) 1-[5-(1,1-dimethyl-2-hydroxycthyl-1,3,4-thiadiazole-2-yl]-2-methylurea major in urine of duck, and minor in urine of rat, dog and rabbit

(H) 1-[5-(1,1-dimethyl-2-hydroxyethyl)-1,3,4-thiadiazole-2-yl] area major in rat urine, minor in dog, rabbit and duck urine.

(F) 1-[5-(1,1-dimethyl-2-hydroxyethyl)-1,3,4-thiadiazole-2-yl) methylurea major in rat, dog and rabbit urine and minor in duck urine.

EL-106; (E) 1-(5-tert-butyl-1,3,4-thiadiazole-2-yl) area major in rat, dog, rabbit and duck urine.

EL-107 2-methylamino-5-tert-butyl-1,3,4-thiadiazole minor in soil, minor photo in water.

EL-108 2-amino-5-tert-butyl-1,3,4-thiadiazole minor photo in water.

12857

(D) 1-(5-tert-butyl-1,3,4-thiadiazole-2-yl)-3-methoxy-1-methyl area major in rat urine; minor in dog and rabbit urine; none in duck urine

unknown (A) minor in rat, dog, rabbit and duck urine.

IV. CONCLUSIONS

1. Terbuthiuron (EL-103) is a highly persistent chemical with a 1/2 life in soil extrapolated to be about 3 years as parent compound. It is not bound in soil.

2. EL-103 does not readily runoff byt it does leach.

3. EL-103 does not accumulate in fish and is excreated by rats, dogs,rabbits and ducks.

4. No food uses are proposed therfore data on rotational crops or restrictions are not needed.

5. No crop residue data or analytical methods are submitted as the proposed use in non-food uses.

6. We do not know if residues would be taken up by crop accidently receiving a spray of terbuthiuron (drift or runoff during heavy rain fall).

7. No data have been submitted to show presence or absence of mitrosoamines (N,N^1-Dimethylnitrosoamino), in soil.

8. The chemical would be stable in the aquatic environment.

V. RECOMMENDATIONS

A. Object to registration for the following reasons

1. The soil characteristic after the soil leaching study cannot be interputed. Which soil characteristic go with which soil study?

2. Was work done to determine if nitrosoamines would be formed in soil? Whould they be formed in soil? If so how much?

131

3. All radio labeled studies should be supported with the following.

   a. Sample calculations.

   b. Counting efficiencies.

   c. Counting time,

   d. Background level.

   e. Probable error with sentillation techniques

4. Terrestrial non-crop sites are classified according to the expected permanence of present use and also the ecological sensitivity of adjacent non-target areas.

   Ecological sensitivity is considered primarily in terms of aquatic systems. Although terrestrial organisms are of concern, the intent is to identify and classify as low sensitivity those sites where movement of an applied herbicide to non-target aquatic areas is not likely to occur, and as high sensitivity those sites where movement is likely to occur. Persistent herbicides moving from highly sensitive sites may accumulate and produce hazards to aquatic organisms that cannot be evaluated in the absence of chronic toxicity data.

   The registration criteria that follow are not intended to conflict with or be substituted for current experimental permit or registration requirements involving, among others, efficacy and toxic residuals to non-target organisms.

I. Terrestrial non-crop sites determined to have extended permanence of use and low ecological sensitivity.

Long-term herbicide persistence on these sites is not a deterrent to granting of experimental permits and registrations. Such sites include:

A. Under foundations, pavements and slabs where conditions are such that the herbicide is essentially immobilized:

1. Building foundations

2. Roadways and parking areas

B. Restricted areas:

1. Airport runways

2. Utility substations

3. Tank farms

C. Remote or isolated areas:

1. Railway roadbeds and ballast

D. Certain restricted areas:

1. Around industrial buildings

2. Lumberyards

3. Railroad yards

II. Terrestrial non-crop sites determined to have tenuous permanence of use and/or high ecological sensitivity.

The extent of herbicide persistence on these sites shall be evaluated for the purpose of granting experimental permits and registrations. Such sites include:

A. Remote or isolated areas:

1. Reforestation tracts
2. Utility rights-of-way
3. Firebreaks
4. Wildlife habitat improvements, clearings, and impoundments

B. Rural areas:

1. Holding pens
2. Agricultural fencerows
3. Farm out-buildings
4. Shelterbelts and woodlots

C. Commercial areas:

1. Parking lots
2. Driveways
3. Nurseries
4. Easements
5. Highway rights-of-way

D. Urban and recreational areas:

1. Tennis courts
2. Sidewalks
3. Fences

4. Golf courses

5. Athletic fields

6. Parks

7. Ornamental Plantings

8. Lawns and home gardens

9. Cemetaries

Experimental permits or registrations, for use of herbicides on these non-crop sites shall be controlled as described below. Laboratory persistence and degradation studies will be acceptable for purposes of issuing experimental permits.

1. Herbicides and their significant degradation products, having half-life values of 6 months or less (less than 12.5% of the applied herbicide remaining after 18 months) as determined (a) under actual conditions of use or (b) in soil textures typical of the pattern of use having equivalents of 1.0 lb active ingredient per acre 3 inches in depth. Experimental permits and registrations may be issued without supporting chronic toxicity data for aquatic organisms.

2. Herbicides and their significant degradation products, having half-life values greater than 6 months (more than 12.5% of the applied herbicide remaining after 18 months) as determined (a) under actual conditions of use or (b) in soil textures typical of the pattern of use having equivalents of 1.0 lb active ingredient per acre 3 inches in depth:

    a. Experimental permits of limited scope may be issued without supporting aquatic organism chronic toxicity

    b. Registrations may be issued providing supporting chronic toxicity data for aquatic organisms incicate acceptability.

Ronald E Ney, Jr 5/30/74

Ronald E. Ney, Jr. 4/18/74
Environmental Chemistry Section
Ecological Effects Branch

EBB/j.t. 5/29/74