EAB

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

DEC - 4 1987

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Addendum to Groundwater Statement in Terbufos Registration Standard (FRSTR)

TO: William Miller, PM 16
Registration Division (TS-767C)

Amy Rispin, Director
Science Integration Staff, HED (TS-769C)

THRU: Paul F. Schuda, Branch Chief
Exposure Assessment Branch, HED (TS-769C)

Therese M. Dougherty, Chief Section 1
Exposure Assessment Branch, HED (TS-769C)

FROM: Herbert L. Manning, Microbiologist
Exposure Assessment Branch, HED (TS-769C)

This addendum to the groundwater statement in the Terbufos Registration Standard (FRSTR) is to define more precisely EAB's assessment of terbufos' potential to leach to groundwater.

Based on an inadequate data base, no definitive conclusions can be made about the potential for terbufos to leach to groundwater. However, the limited data available appear to indicate that under most environmental conditions terbufos would be unlikely to leach to groundwater in measureable quantities.

17 pages

Revised Tables/footnotes
for EAB Chapter on
Terbutos.

HJM

rec'd 11/24/87/mm

2

TABLE A
GENERIC DATA REQUIREMENTS FOR CHEMICAL: TERBUFOS

Data Requirement		Composition[1]/	Use Pattern[2]/	Does EPA Have Data to Satisfy This Requirement? (Yes, No or Partially)	Bibiliographic Citation	Must Additional Data Be Submtted Under FIFRA 3(c)(2)(B)
§158.130 Environmental Fate (continued)						
DISSIPATION STUDIES-FIELD:						
164-1	Soil	TEP	A	No	-	Yes 12/
164-2	Aquatic (Sediment)	TEP	-	No	-	No 9/
164-3	Forestry	TEP	-	No	-	No 13/
164-4	Combination and Tank Mixes		-	No	-	No 14/
164-5	Soil, Long-Term	TEP	-	No	-	No 15/
ACCUMULATION STUDIES:						
165-1	Rotational Crops (Confined)	PAIRA	A	Yes	00087692	No
165-2	Rotational Crops (Field)	TEP	A	Partial	000161568 000161569	Yes 16/
165-3	Irrigated Crops	TEP	-	No	-	No 17/
165-5	In Fish	PAIRA/TGAI	A	No	-	Yes 18/
165-5	In Aquatic Non-Target Organism	TEP	-	No	-	No 8/

TABLE A
GENERIC DATA REQUIREMENTS FOR TERBUFOS

§158.130 Environmental Fate (continued)

14/ There are no curent registered combination or tank mixes for terbufos.

15/ The requirement for this study is reserved pending the results of the field dissipation study (§164-1).

16/ The two studies reviewed in this FRSTR may be acceptable provided sample storage stability data are supplied.

17/ This study is not required to support the current use pattern which does not include aquatic uses.

18/ This study must be repeated because the treated soil was aged 30 days before adding water and fish, the test material exceeded 1/10 LC_{50}, and a flow-through system was not used to maintain a level concentration of terbufos. The study is required to determine if accumulation in fish occurs since terbufos is very toxic to fish and the corn/sorghum use has the potential to reach fish in ponds, etc. The 1982 Task 1 and 2 also reviewed the study as unacceptable.

5

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OCT 27 1987

OFFICE OF
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MEMORANDUM

SUBJECT: Terbufos Registration Standard (FRSTR)

TO: William Miller, PM 16
Registration Division (TS-767C)

Amy Rispin, Director
Science Integration Staff, HED (TS-769C)

THRU: Robert W. Holst, Acting Branch Chief
Exposure Assessment Branch, HED (TS-769C)

Therese M. Dougherty, Chief Section 1
Exposure Assessment Branch, HED (TS-769C)

FROM: Herbert L. Manning, Microbiologist
Exposure Assessment Branch, HED (TS-769C)

Attached is the EAB Science Chapter (Phase II document) for the Terbufos Registration Standard (FRSTR). All studies previously reviewed (1983) were reviewed again for this FRSTR Standard. Four studies previously accepted in the 1983 standard are no longer acceptable under our current guidelines:

§ 162-2 Anerobic soil metabolism: The study reviewed in the 1983 Standard (North and Champagne, 00087690) is now unacceptable because only one sample was taken, the treatment rate was not reported, and the recovery was poor (73.8%). The study reviewed as a FRSTR in 1987 (Peterson, 00156853) is unacceptable because the material balances (recoveries) were low (47.5 and 44.1%).

§ 163-1 Leaching: The one study reviewed (Hui, 00087709) is now unacceptable because the aged leaching residue recovery was low (60.1%).

§ 165-4 Fish accumulation: The one study reviewed (Sleight, 00085184) is now unacceptable because bioconcentration of parent was not adequately determined due to the test material being aged in soil for 30 days prior to addition of fish and water and no constant concentration of terbufos was maintained in water. In addition, the concentration exceeded 1/10 the LC_{50} .

5

ASSESSMENT OF ENVIRONMENTAL EXPOSURE TO TERBUFOS

The assessment of the environment exposure to TERBUFOS includes consideration of its potential to leach to groundwater, its movement in surface water, its terrestrial degradation and persistence, its behavior in air currents (spray drift, volatility), and its photodegradative capacity.

The potential of TERBUFOS to leach to groundwater is presently uncertain because the mobility data (soil column leaching and field dissipation) is incomplete. The data to date does not indicate the presence of TERBUFOS in groundwater in any state. Aqueous photodegradation data are incomplete and anaerobic soil metabolism data is unavailable. Two pieces of data that are of value are known: TERBUFOS hydrolyzes (pH 5,7,9) with a half-life of 2.2 weeks (major degradate was formaldehyde) and degrades in aerobic soil with a halflife of 26.7 days, with major degradates being the sulfoxide (30 days to maximum level, T1/2 about 150 days) and the sulfone (60 days to maximum level, T1/2 about 210 days) Because of the lack of environmental fate information, EAB cannot assess the potential of TERBUFOS to leach to groundwater. At this time, we are not requiring groundwater monitoring studies, although they may be necessary in the future.

The movement and present of TERBUFOS in surface waters was determined by a search of the STORET database. Sampling was performed at 317 stations, 55 surface water stations, and 262 groundwater stations. TERBUFOS was found in surface water in 134 of 2016 samples analyzed. The maximum concentration found was 2.25 ug/L; the 85th percentile value of all non-zero samples was 0.10 ug/L. The states in which TERBUFOS was found in surface water samples in any concentration above zero are: OH, IL, IA, MN. TERBUFOS was not found in groundwater. It should be noted that data directly drawn from STORET in this fashion has not

be required in the future. While no monitoring study results have been received by EAB, we did require in the 1983 Standard a soil, water, sediment, and fish monitoring study of treated fields, and ponds adjacent to fields, where TERBUFOS is used. The monitoring study has not yet been performed because American Cyanamid has requested a recalculation of the EEC's (Estimated Environmental Concentration) for TERBUFOS by EAB using the SWRRB and EXAMS models. The recal -culation will be done within two months to evaluate the need for a monitoring study.

DYNAMAC
CORPORATION

TERBUFOS

Final Report

Task 1: Review and Evaluation of Individual Studies

Task 2: Environmental Fate Assessment

Contract No. 68-02-4250

OCTOBER 7, 1987

Submitted to:
Environmental Protection Agency
Arlington, VA 22202

Submitted by:
Dynamac Corporation
The Dynamac Building
11140 Rockville Pike
Rockville, MD 20852

INTRODUCTION

Terbufos is a cholinesterase-inhibiting insecticide/nematicide/acaricide developed for use on terrestrial food crops. Of the total amount of terbufos used in the United States in a typical year, 80-90% is applied to field corn as an insecticide, 9-10% is applied to field corn as a nematicide, <1% is applied to sweet corn as an insecticide, 1% is applied to sugar beets as an insecticide, and <1% is applied to sugar beets as a nematicide. The PQUA (6-87) states that 1-2% is applied to grain sorghum in Texas and Oklahoma annually; the Index (1-87) counters that the terbufos label does not list sorghum as a use site but does contain tolerances for sorghum. Application rates are 1 lb/A on field corn, 1.2-2.4 ounces/1000 foot row on sweet corn and popcorn, and 0.675-2.7 ounces/1000 foot row on sugar beets. The 15% G is the only formulation registered for use. It is applied at planting or after plant emergence, and may be applied from the ground or by aircraft.

Anaerobic soil metabolism studies: Two studies were reviewed. The first study (North and Champagne, 00087690) is unacceptable because the sampling protocol (one sampling interval) was inadequate to accurately assess the anaerobic degradation of terbufos. In addition, this study would not fulfill data requirements because incubation conditions (soil moisture and incubation temperature) were not reported; the test substance was not analytical grade or purer and contained a contaminant that interfered with the analytical procedure; and the extraction efficiency of the analytical method was poor. The second study (Peterson, 00156853) is unacceptable because the material balances were incomplete (low recoveries), a residue decline curve was not established, and all degradates detected at >0.01 ppm were not characterized, Terbufos should be ^{14}C-labeled at two appropriate sites in the molecule to detect all major degradates. All data are required.

Leaching and adsorption/desorption studies: One study (Hui, 00087709) was reviewed and is scientifically invalid. This study does not fulfill data requirements because: unaged - the test substance was not characterized; and aged - the test substance was not characterized, the aged [^{14}C]residues were not adequately characterized before or after leaching, and incubation conditions during aging were not reported, and residue recoveries were low. The study should be repeated using aged soils: one of sand soil and one other representative soil. Residues in soil and leachate should be adequately identified.

Laboratory volatility studies: One study (North and Champagne, 00087690) was reviewed and is unacceptable because there was no material balance and the application rate of terbufos to the soil was not confirmed with an immediate posttreatment sample analysis. In addition, this study would not fulfill data requirements because the test substance was not a typical end-use product and contained a contaminant which interfered with the analytical method; volatility was not expressed as ug/cm^2/hr; air concentrations were not reported; and the relative humidity and temperature within the trapping systems were not reported. However, the study was waived (1983) because of low vapor pressure of the granulated product and its being soil incorporated. No data are required.

Terrestrial field dissipation studies: Four studies were reviewed. The first study (Higham et al., 00087709) is unacceptable because the sampling protocol was inadequate (the first sampling interval occurred at 40 days posttreatment) to accurately assess the dissipation of terbufos in field soil. In addition, this study would not fulfill data requirements because the pattern of formation and decline of degradates was not addressed, and field test data were incomplete, only one site tested, and a half-life estimate not given. The second study (Peterson et al, 00036125) is unacceptable because the sampling protocol was inadequate (the first sampling interval occurred at 31-40 days posttreatment) to accurately assess the dissipation of terbufos in field soil. In addition, this study would not fulfill data requirements because the pattern of formation and decline of degradates was not addressed, field test data were incomplete, soil was not sampled deep enough to define the extent of leaching, and the control plots were contaminated with terbufos

Field volatility studies: No data are required because the lab volatility study was waived because of low vapor pressure and soil-incorporation of product.

Aquatic field dissipation studies: No data were reviewed; however, not data are required because terbufos has no aquatic or aquatic impact uses.

Forestry dissipation studies: No data were reviewed; however, no data are required because terbufos currently has no registered forestry uses.

Dissipation studies for combination products and tank mix uses: No data were reviewed; however, no data are required because data requirements for combination products and tank mix uses are currently not being imposed.

Long-term field dissipation studies: No data were reviewed; however, no data are required because less than 50% of terbufos residues remain upon subsequent application.

Accumulation studies on irrigation crops: No data were reviewed; however, no data are required because terbufos has no aquatic food crop or aquatic nonfood uses.

Field accumulation studies on aquatic nontarget organisms: No data were reviewed; however, no data are required because terbufos has no aquatic, forestry, or aquatic impact uses.

Monitoring Studies (soil, sediment, water, and fish): A letter from American Cyanamid, dated 18 Dec 1985, notes correspondence between EPA and the registrant concerning the monitoring studies. Section 4 of EAB plans to complete a reassessment for terbufos using the SWRRB and EXAMS models within two months to evaluate the need for a monitoring study.

Groundwater Assessment:

Terbufos is not hydrolytically persistent (T1/2 = 2.2 weeks). Under aerobic soil conditions, the parent and degradates are persistent. Parent T1/2 = 26.7 days; major degradates are the sulfoxide (30 days to maximum level, T1/2 = 150 days) and the sulfone (60 days to maximum level, T1/2 = 210 days). Anaerobic soil metabolism data are not available at this time. Mobility data are incomplete at this time. To date, terbufos has not been detected in groundwater. Because of the lack of environmental fate data, a leaching assessment on terbufos cannot be made at this time. No groundwater monitoring studies are required at this time. Pending more complete environmental fate information, groundwater monitoring studies may be required in the future.

Protective Clothing:

PROPOSED LABELING FOR TERBUFOS GRANULAR PRODUCT

WORK SAFETY RULES

REPEATED EXPOSURES TO CHOLINESTERASE INHIBITORS SUCH AS ARE CONTAINED IN THIS PRODUCT MAY, WITHOUT WARNING, CAUSE PROLONGED SENSITIVITY TO VERY SMALL DOSES OF ANY CHOLINESTERASE INHIBITOR.

Exposure Assessment:

Worker Exposure/Risk Assessment

The extreme oral and dermal acute toxicities of terbufos are indicated by their placement in Toxicity Category I. A further demonstration of the extreme acute toxicity of terbufos is its capacity to cause lethality in rabbits in short term eye irritation tests.

Although EAB currently has no reports of terbufos poisoning incidences in its files, presumably due to the limited use of terbufos, EAB is concerned that exposure to this acutely toxic pesticide could present a health risk to agricultural workers. Thus, to insure the safe use of terbufos, EAB is recommending changes in the label related to improving the section on protective clothing (see above section).

REFERENCES

American Cyanamid Company. 1972. CL 92,100: Determination of total CL 92,100-related residues in soil. Method M-370 dated Oct. 2, 1972. Unpublished study received June 10, 1975 under 5F1640; CDL:094445OL.

American Cyanamid Company. 1975. Counter (R) 15G soil insecticide: Counter-related residues in follow crops. Compilation; unpublished study received Oct. 9, 1975 under 241-238; CDL:224099-A. (00049233)

Gatterdam, P. and K. Jenney. 1974. Counter soil insecticide: Residue levels in soybeans grown as a fallow crop on soil previously treated with ^{14}C-CL 92,100. Report No. C-422. Unpublished study received May 1, 1974 under 4F1496; submitted by American Cyanamid Co., Princeton, NJ; CDL:091409-I.

Higham, J.W., M.E. Weis, and J. Owens. 1974. Counter 15 G: Total Counter (CL 92,100)-related residues in soil (Iowa). Report No. C-444. Includes method M-370 dated October 2, 1972. Unpublished study received May 1, 1974 under 4F1496; prepared in cooperation with Iowa State University, Department of Zoology and Entomology, submitted by American Cyanamid Co., Princeton, NJ, CDL:091837-I.

Hui, T. 1973. Counter soil insecticide: soil leaching studies of CL 92,100. PD-M 10:455-483. Final report. Unpublished study received May 1, 1974 under 4F1496; submitted by American Cyanamid Co., Princeton, NJ. CDL:091409-J.

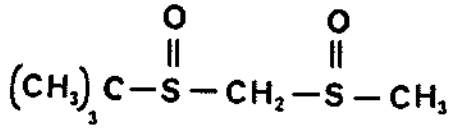
Lee, T. and D. Belcher. 1986a. Counter terbufos (CL 92,100): Residues of CL 92,100-related compounds in soil and rotational crops (cabbage, red beets, and wheat) from a treated corn field (Waunakee, WI, 1984). (C-0532, C-0880, C-2642): Report No. C-2658: Project No. 0402. Unpublished study prepared by American Cyanamid Co.

Lee, T., and D. Belcher. 1986b. Counter terbufos (CL 92,100): Residues of CL 92,100-related compounds in soil and rotational crops (cabbage, sugar beets, and wheat) from a treated corn field (York, NE, 1984) (C-1689, C-0532, C-0880, C-2642): Report No. C-2721: Project No. 0403. Unpublished study prepared by American Cynamid Co.

APPENDIX

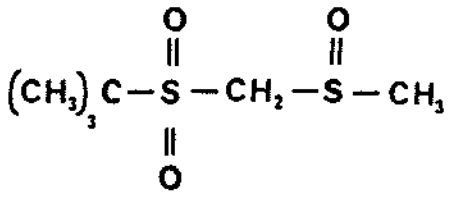
TERBUFOS AND ITS DEGRADATES

13



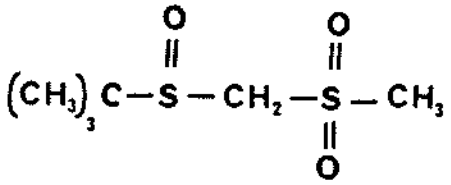
t-Butylsulfinyl(methylsulfinyl)-methane

(CL 202,474)



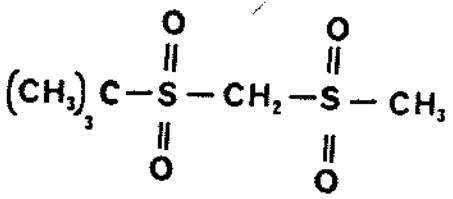
t-Butylsulfonyl(methyl)methyl sulfoxide

(CL 99,844)



t-Butyl(methylsulfonyl)methyl sulfoxide

(CL 99,843)



t-Butyl(methylsulfonyl)methyl sulfone

(CL 99,875)

TABLE A
GENERIC DATA REQUIREMENTS FOR CHEMICAL: TERBUFOS

Data Requirement		Composition[1]/	Use Pattern[2]/	Does EPA Have Data to Satisfy This Requirement? (Yes, No or Partially)	Bibiliographic Citation	Must Additional Data Be Submtted Under FIFRA 3(c)(2)(B)
158.130 Environmental Fate						
DEGRADATION STUDIES-LAB:						
161-1	Hydrolysis	PAI RA	A	Yes	00087694	No
Photodegradation						
161-2	in Water	PAI RA	A	Partial	000161567	Yes 4/
161-3	on Soil	PAI RA or TGAI	-	No	-	No 5/
161-4	in Air	PAI RA or TGAI	A	No	-	No 6/
METABOLISM STUDIES-LAB:						
162-1	Aerobic Soil	PAI RA	A	Yes	00156853	No
162-2	Anaerobic Soil	PAI RA or TGAI	A	No	-	Yes 7/
162-3	Anaerobic Aquatic	PAI RA or TGAI	-	No	-	No 8/
162-4	Aerobic Aquatic	PAI RA or TGAI	-	No	-	No 9/
MOBILITY STUDIES:						
163-1	Leaching and Adsorption/Des.	PAI RA	A	No	-	Yes 10/
163-2	Volatility (lab)	TEP	A	No	-	No 11/
163-3	Volatility (field)	TEP	A	No	-	No 11/

TABLE A
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Data Requirement	Composition[1]/	Use Pattern[2]/	Does EPA Have Data to Satisfy This Requirement? (Yes, No or Partially)	Bibiliographic Citation	Must Additional Data Be Submtted Under FIFRA 3(c)(2)(B)
158.142 Spray Drift					
202-1 Drift Field Evaluation	TEP	A	No	-	No 5/
202-1 Drift Size Spectrum	TEP	A	No	-	No 5/

TABLE A
GENERIC DATA REQUIREMENTS FOR TERBUFOS

§158.130 Environmental Fate (continued)

14/ There are no curent registered combination or tank mixes for terbufos.

15/ The requirement for this study is reserved pending the results of the field dissipation study (§164-1).

16/ The two studies reviewed in this FRSTR may be acceptable provided sample storage stability data are supplied.

17/ This study is not required to support the current use pattern which does not include aquatic uses.

18/ This study must be repeated because the treated soil was aged 30 days before adding water and fish, the test material exceeded 1/10 LC_{50}, and a flow-through system was not used to maintain a level concentration of terbufos. The study is required to determine if accumulation in fish occurs since terbufos is very toxic to fish and the corn/sorghum use has the potential to reach fish in ponds, etc. The 1982 Task 1 and 2 also reviewed the study as unacceptable.

19/ The objective of this monitoring requirment is to measure real world levels of terbufos and metabolites in treated fields and ponds adjacent to fields where terbufos is used.
The majority of terbufos marketed is used for corn rootworm control and it is most likely that environmental concerns will arise in the corn growing areas of the U.S. The application sites chosen should possess a known application history and be adjacent to ponds. Geographic areas for sampling should include: corn belt states, plains states, and lake states.
Soil in treated fields should be monitored before and after application of terbufos. Pond water, sediment, and fish should be monitored before and after fields are treated with terbufos. The scheme of monitoring (where, when, how) should reflect the attempt to measure maximum residues. Fish samples should be analyzed for cholinesterase inhibition, as well as terbufos residues. Baseline cholinesterase levels in fish should be established both in ponds at the treatment sites and in an area without any history of anticholinesterase pesticide use (e.g., ponds near pastureland, but not where hay is harvested). The pH-stat technique as described by Coppage (1971) should be used. Metabolites as well as parent levels should be monitored (Cook, et. al., 1976). Additional information on this type of field study can be found in Tagatz, et. al. (1974) and Coppage and Braidech (1976).
Treatment rates should be at highest recommended rate for that site and crop. Normal agricultural practice should be followed, including repeated applications if appropriate. If possible, some sites with a history of terbufos treatment should also be chosen.
The monitoring protocol (including analyical methodology) must be submitted to the Agency, prior to initiating the study, with enough lead time for Agency review (two months).
A letter from American Cyanamid of 18 Dec 1985 notes correspondence between EPA and the registrant concerning the monitoring studies. Section 4 of EAB plans to complete a reassessment for terbufos using the SWRRB and EXAMS models within two months to evaluate the need for a monitoring study.