Shaughnessy Number: 084301

Date out of EAB: JUN 28 1988

To: Taylor/Yowell
Product Manager 25
Registration Division (TS 767C)

From: Emil Regelman, Supervisory Chemist
Review Section #3
Exposure Assessment Branch
Hazard Evaluation Division (TS 769C)

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

Attached, please find the EAB review of...

Reg./File #: 1471-148

Chemical Name: Benefin

Type Product: ~~Fungicide~~ Herbicide

Company Name: Elanco Products

Purpose: submission of additional data on aqueous photolysis, soil dissipation, and rotational crop residues

Date Received: 4/18/88

Action Code: 576

Date Completed: 6/28/88

EAB #(s): 80698

Monitoring Study Requested: _____

Total Reviewing Time: 3.5 days

Monitoring Study Volunteered: _____

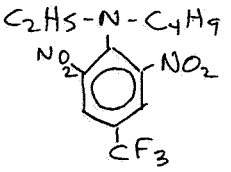
Deferrals to: _Ecological Effects Branch

_Residue Chemistry Branch

_Toxicology Branch

1. CHEMICAL:

chemical name: N-butyl-N-ethyl-alpha, alpha, alpha-trifluoro-2,6-dinitro-p toluidine
common name: Benefin
trade name: n.a.
structure:



CAS #: 1861-40-1
Shaughnessy #: 084301

2. TEST MATERIAL: see DERs

3. STUDY/ACTION TYPE: photolysis, soil dissipation, rotational crop accumulation

4. STUDY IDENTIFICATION:

Moran, J.W. Photolysis of Benefin in Aqueous Solution. performed by Lilly Research Laboratories, Greenfield, IN. dated 1/21/86, received EPA 12/23/87, under Acc. # 404572-01.

Golab, T. Radiochemical Studies with ^{14}C Benefin in Soil and Various Rotational Crops. performed by Agricultural Biochemistry, Lilly Research Laboratories, Greenfield, IN. dated 4/14/84, received EPA 12/23/87, under Acc. # 404572-02.

5. REVIEWED BY:

Typed Name: E. Brinson Conerly
Title: Chemist, Review Section 3
Organization: EAB/HED/OPP

EB Conerly 6/28/88

6. APPROVED BY:

Typed Name: Emil Regelman
Title: Supervisory Chemist, Review Section 3
Organization: EAB/HED/OPP

JUN 28 1988

7. CONCLUSIONS:

The study on aqueous photolysis only provides supplemental information. It can be made acceptable if the applicant can provide sufficient additional information as described in the DER. Despite its deficiencies, this study indicates that photodegradation in water is rapid, and can be expected to be a major route of dissipation. The study on soil dissipation and rotationalcrop accumulation is not acceptable and we do not believe it can be made acceptable, for reasons described in detail in the DER.

8. RECOMMENDATIONS:

The applicant should proceed with new soil dissipation and rotational crop studies, with close attention to current standards regarding these studies. In order to have the aqueous photolysis study become acceptable, the applicant should submit the requested information on material balance, identity of unextracted degradates, and a copy of the reference describing the similarity of the light source to natural sunlight. Elanco's proposal to conduct a supplementary soil metabolism study, characterizing only volatile degradates and total ^{14}C will not be acceptable -- a complete study must be done.

9. BACKGROUND:

The most recent prior review (EBC 1/8/87) gives the following as the state of the data base for benefin:

hydrolysis	satisfied
aqueous photolysis	not satisfied, discussed in this review
aerobic soil metabolism	not satisfied
leaching	not satisfied
field dissipation	not satisfied, discussed in this review
fish accumulation	not satisfied -- the cover letter of this submission indicates that the applicant has submitted a study, but there is no review in our files

10. DISCUSSION OF INDIVIDUAL TESTS OR STUDIES: See individual DERs.

11. COMPLETION OF ONE-LINER: n.a.

12. CBI APPENDIX: attached to individual DERs

DATA EVALUATION REVIEW

I. Study Type: Aqueous Photolysis

II. Citation:

Moran, J.W. Photolysis of Benefin in Aqueous Solution. performed by Lilly Research Laboratories, Greenfield, IN. dated 1/21/86, received EPA 12/23/87, under Acc. # 404572-01.

III. Reviewer:

Typed Name: E. Brinson Conerly
Title: Chemist, Review Section 3
Organization: EAB/HED/OPP

IV. Conclusions:

The study is not acceptable to satisfy requirements for aqueous photolysis data without acceptable additional information:

1) a material balance
2) characterization of unextracted products or a discussion of efforts made to characterize them.
3) a copy of the reference cited as proof that the light source was essentially equivalent to summer sunlight -- Hirt, Schmitt, Searle, and Sullivan, J.Opt. Soc., 1960, 50, 706.

V. Materials and Methods:

test compounds
alpha-C labelled 14c benefin (3.7 uCi/mg, radiopurity > 95%)
analytical standard benefin, unlabelled
reference standards
5-trifluoromethyl-3-nitro-1,2-benzenediamine (compound V)
2-ethyl-5-trifluoromethyl)-7-nitrobenzimidazole-1-oxide
2-ethyl-5-trifluoromethyl-7-nitrobenzimidazole
5-trifluoromethyl-2-methyl-7-nitrobenzimidazole (compound VIII)
test buffers
pH 5 -- 0.02 M acetic acid adjusted with 0.02M NaOH using a pH meter
pH 7 -- 0.02 M monobasic potassium phosphate adjusted as above
pH 9 -- 0.02 M sodium bicarbonate adjusted as above
light source -- fluorescent sunlamps and black lights which [per applicant] together produce a ultraviolet spectral energy similar to natural summer sunlight. The lamps were mounted in a circle surrounding the exposed samples, which were rotated on a turntable so that all received the same irradiation.
exposure temperature -- maintained at 25.5° C
rate study exposure protocol -- uv-opaque test tubes containing 20 ml each of 0.25 mcg/ml benefin in buffer with 0.5% acetonitrile were

exposed and removed at sampling intervals of 1, 2, 4, 6, and 8 hours. Removed samples were stored in the dark until analysis. Controls were as follows: acetonitrile and buffer only, aluminum-wrapped fortified, and dark-stored fortified.

photoproduct quantitation exposure protocol -- as above except with a 50 mcg/ml tube added. Sampling times were 4,8, 12, and 16 hours.

isolation and identification exposure protocol -- 4 x 1000 ml each of 0.25 mcg/ml benefin irradiated for 12 hours.

quantitation of photoproducts

rate study - each sample was diluted with 5% NaCl solution, partitioned 2x with dichloromethane (DCM). The DCM fractions were rotary evaporated, redissolved in toluene, and analyzed for parent by EC gas chromatography.

^{14}C photoproduct study -

samples were diluted with MeOH and analyzed for total radioactivity by LSC.

diluted samples were buffered to pH 7.0 and extracted in a similar manner to the rate study. These samples were analyzed for total radioactivity by LSC, for parent by EC gas chromatography, and for products by TLC in 2 different systems [DCM:EtOH:ammonium hydroxide, 100:5:0.5; and toluene]. Photoproducts were quantified by scraping and LSC.

Neutral aqueous phases were acidified to pH 3.0, reextracted with DCM, and analyzed by LSC for total radioactivity and by TLC in toluene for products.

The remaining aqueous phase material was adjusted to pH 11 with 2N NaOH, reextracted with DCM, and analyzed as the acidic extracts [LSC and TLC in toluene].

isolation and identification of photoproducts -- the entire sample from the irradiation was extracted with DCM, rotary evaporated, and subjected 2x to preparative TLC in system 1 above. Isolated zones were then subjected to MS analysis (direct insertion probe).

VI. Study Author's Results and/or Conclusions:

Results:

"...Benefin degraded steadily at the 3 pH levels tested. After 8 hours of irradiation the percent of initial benefin remaining was 43% at pH 5.0, 36% at pH 7.0, and 42% at pH 9.0. Benefin concentration ...plotted on a logarithmic scale versus time ... resulted in a linear relationship ... indicating the photolysis proceeded by first-order kinetics. Least squares analysis of the data yielded first-order rate constants of 0.102, 0.125, and 0.109 h^{-1}, and half-lives of 6.8, 5.5, and 6.4 hours for pH 5, 7, and 9, respectively. ...Benefin half-lives of 6.9, 6.2, and 6.7 [for the photoproduct quantification] agree well with the rate study half-lives...

Five photoproducts were detected and designated as zones 1 to 5.

... Zones 1 and 2 were identified as nitrobenzimidazoles and were

produced in greatest quantity after irradiation for 8-12 hours at pH 5. 6.1% and 7.6% of initial was found for Zones 1 and 2 respectively. [These compounds were identified as 1-butyl-5-trifluoromethyl-2-methyl-7-nitrobenzimidazole-3-oxide and 1-ethyl-5-trifluoromethyl-2-propyl-7-nitrobenzimidazole-3-oxide, respectively.]

Products observed in Zones 3 [identified as 5-trifluoromethyl-2-methyl-7-nitrobenzimidazole] and 5 [identified as 5-trifluoromethyl-2-propyl-7-nitrobenzimidazole] reached maximums of 11.5 and 12.6% at pH 7 after 8 hours of irradiation before declining to 3.9 and 5.0 % after 16 hours.

The Zone 4 product, [identified as 5-trifluoromethyl-3-nitro-1,2-benzendiamine], also reached its maximum of 3.8% at pH 5 after 16 hours of irradiation.

Conclusions:

"The photoproducts formed suggest that benefin photodegrades by the same photochemical pathway proposed by Leitus and Crosby (1974) for trifluralin aned by Saunders and Smith (1983) for isopropalin. These herbicides are similar to benefin.

Estimates of photolysis rates in sunlight were made based upon published photolysis data for trifluralin at 40° N latitude, seasonally averages sunlight intensity, 40% cloud cover, and varying concentrations of suspended solids. These calculated rates and the actual rates obtained by this experiment indicate that any benefin reaching natural surface waters would photodegrade."

VII. Reviewer's Comments:

We have developed the following table from the applicant's own data [attached]. Percentages are expressed as % of initial.:

pH 5	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Total
hour 0	0.8%	0.8%	0.6%	0.4%	0.6%	90.7%	93.9%
hour 4	3.1%	4.6%	2.1%	0.9%	2.4%	67.8%	80.9%
hour 8	5.6%	7.6%	3.1%	3.3%	3.2%	49.4%	72.2%
hour 12	6.1%	7.4%	3.7%	3.7%	4.2%	30.5%	55.6%
hour 16	5.4%	7.5%	4.2%	3.8%	4.5%	28.3%	53.7%

By the end of the exposure period, it appears that ca. half the initial material has become unextractable from the aqueous phase by the procedures used, and the applicant so states. At the other pHs the results are

similar. This unextracted material remains uncharacterized, and no discussion is provided to describe any efforts which were made to this end.

Characterization of isolated products appears satisfactory.

The applicant cites a reference to support the claim that the light is similar to summer sunlight, but has not provided a copy.

VIII. CBI Information Addendum: attached

BENEFIN SH.# 084301

Page_____ is not included in this copy.

Pages 8 through 19 are not included.

The material not included contains the following type of information:

____ Identity of product inert ingredients.

____ Identity of product impurities.

____ Description of the product manufacturing process.

____ Description of quality control procedures.

____ Identity of the source of product ingredients.

____ Sales or other commercial/financial information.

____ A draft product label.

____ The product confidential statement of formula.

____ Information about a pending registration action.

X FIFRA registration data.

____ The document is a duplicate of page(s) _____.

____ The document is not responsive to the request.

The information not included is generally considered confidential by product registrants. If you have any questions, please contact the individual who prepared the response to your request.

DATA EVALUATION REVIEW

I. Study Type: soil dissipation and rotational crop accumulation

II. Citation:

Golab, T. Radiochemical Studies with ^{14}C Benefin in Soil and Various Rotational Crops. performed by Agricultural Biochemistry, Lilly Research Laboratories, Greenfield, IN. dated 4/14/84, received EPA 12/23/87, under Acc. # 404572-02.

III. Reviewer:

Typed Name: E. Brinson Conerly
Title: Chemist, Review Section 3
Organization: EAB/HED/OPP

IV. Conclusions:

This study is not acceptable to fulfill the requirements for soil dissipation and rotational crop accumulation because of inadequate sampling, and analytical methods, and also because of the (apparent) unusually long storage period of samples.

V. Methods:

experimental plots -- "...constructed from round galvanized pipes 91.4 cm (36 in) diameter and 61 cm (24 in) high ... sunk 40 cm (15.75 in) into the soil. Each plot was approximately 0.65 m^2 (7.14 ft^2)." Four experimental and four control plots were used.
test soil -- medium silty loam, characteristics attached
crops --
primary -- Burley tobacco
rotational -- wheat, cabbage, corn, soybean, sugar beets
treatment protocol -- preplant incorporation, May 18, 1977 [sic] -- soil was mixed with radioactive benefin at a rate of 1.266 kg/ha (1.128 lb/A) and tumbled to insure uniformity, then applied evenly over the plots. "All experimental plots were fertilized with... hand hoeing...[and] seven tobacco plants were transplanted into each plot.... the soil was left undisturbed except for soil sampling. After... harvest, the top 7.5 cm of soil was turned over. At appropriate times rotational crops were planted. Natural rainfall was supplemented with tap water as needed."
sampling protocol -- six cores from each plot were taken and combined. Soil was sampled at planting and sampling time for each crop, to a depth of 15 cm, and air-dried before analysis. Plant samples were taken as follows:
tobacco (primary crop) -- 17 weeks after transplantation
wheat -- planted 22 weeks after benefin treatment, harvested 52 weeks after benefin treatment (30 weeks after planting), and again at 60 weeks (38 weeks after planting)

cabbage -- planted following wheat, 63 weeks after benefin treatment, sampled after 67 weeks (4 weeks after planting) and 73 weeks (10 weeks after planting)
corn -- planted 52 weeks after treatment, sampled after 57 weeks (5 weeks after planting), 61 weeks (9 weeks after planting), and 73 weeks (21 weeks after planting)
soybeans -- planted 52 weeks after treatment, sampled after 58 weeks (6 weeks after planting), 61 weeks (9 weeks after planting), and 73 weeks (21 weeks after planting)
sugar beets -- planted 52 weeks after treatment, sampled after 58 weeks (6 weeks after planting), 61 weeks (9 weeks after planting), and 73 weeks (21 weeks after planting)

analytical methods --
total radioactivity -- combustion followed by LSC
specific compounds
soil -- described in Enclosure 1 [Reviewer's note: this document is not included in the submission]
plants -- solvent fractionation followed by TLC in benzene-carbon tetrachloride (40/60)

VI. Reported Results:

"Analyses of soil samples treated with ^{14}C benefin indicated that this herbicide degrades in a predictable rate and pattern. The first half-life of benefin...was approximately 6 weeks and the second half life was approximately 17 weeks. One year after application 13.0 to 15.7 percent of the benefin remained in the soil. The degradation pathway and products formed in soil were described previously. (Enclosure 1). [Reviewer's note: this document is not included in the submission.

Crop plants grown in rotation to the primary crop (tobacco) absorbed and translocated only negligible amounts of ^{14}C residues -- none of which was identified as benefin. ... Results ... indicate that the ^{14}C was not accumulated in any particular plant constituent...[and] that extensive metabolism of benefin has occurred and incorporated the ^{14}C into various plant constituents. No benefin was detected in any plant tissues examined."

VII. Reviewer's Discussion:

1) The sampling was inadequate on several counts --

a) Six soil samples were taken at each period from each plot, but were composited before analysis, resulting in only one sample/plot/time period
b) the first non 0-time soil sampling was done when ca. half the material had already degraded
c) crop samples also appear to have been composited

2) Samples were analyzed only by TLC and only in one system.

3) The study was reformatted from earlier work. However, it appears not to have been completed for 7 years after the experimental work began. This raises questions of stability of stored samples.

4) Supporting material referred to as Enclosure 1 was not included.

5) The plant residue data do appear to indicate that there is little, if any accumulation in crops planted at least 22 weeks following treatment.

VIII. CBI Information Addendum -- included

BENEFIN Sh# 084301

Page_____ is not included in this copy.

Pages 23 through 48 are not included.

The material not included contains the following type of information:

_____ Identity of product inert ingredients.

_____ Identity of product impurities.

_____ Description of the product manufacturing process.

_____ Description of quality control procedures.

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