1 of 10

1 on EFB 2/3/93

OPP OFFICIAL RECORD
HEALTH EFFECTS DIVISION
SCIENTIFIC DATA REVIEWS
EPA SERIES 361

Shaughnessy Number: 128997

Date out of EFGWB: APR 17 1991

To: S. Lewis/J. Fairfax
Product Manager 21
Registration Division (H7505C)

From: Akiva Abramovitch, Section Head
Environmental Fate Review Section #3
Environmental Fate and Ground Water Branch
Environmental Fate and Effects Division (H7507C)

Thru: Hank Jacoby, Chief
Environmental Fate and Ground Water Branch
Environmental Fate and Effects Division (H7507C)

Hank Jacoby

Attached, please find the EFGWB review of...

Reg./File #: 3125-GIG, -GOU, - GII, -GOE, -GOG

Chemical Name: te(r)buconazole

Type Product: fungicide

Product Name: various

Company Name: Bayer AG

Purpose: submission of additional rotational crop uptake data -- response to registration standard

Date Received: 09/02/90

Total Reviewing Time (days):

Action Code:

EFGWB#(s): 90-0869, -0870, -0871, -0872, -0873

Deferrals to:

___Ecological Effects Branch, EFED

___Dietary Exposure Branch, HED

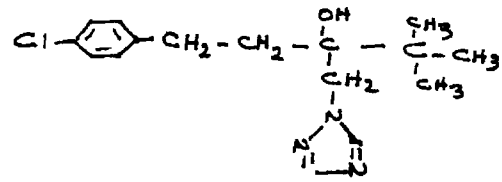
___Toxicology Branch, HED

___Non-Dietary Exposure Branch, HED

___Science Integration and Policy Staff, EFED

1. CHEMICAL:

chemical name: a-[2-(4-Chlorophenyl)ethyl]-a-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol
common name: te[r]buconazole, folicur
trade name: Elite
structure:
CAS #: unknown
Shaughnessy #: 128997



2. TEST MATERIAL:

3. STUDY/ACTION TYPE: submission of additional information on rotational crop study

4. STUDY IDENTIFICATION:

Thornton, J.S. Mobay, Inc. correspondence dated 8/15/90 regarding the study listed below

Leimkuehler, W.M.; Lenz, C.A.; Delk, J.L. **Radioactive Residues of ^{14}C - Folicur in Rotational Crops**. performed and submitted by Mobay Corp., Ag. Chem. Div., Stilwell, KS. dated 1/15/88. rec'd EPA 8/20/90 . MRID # 415958-01.

5. REVIEWED BY:

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

E.B. Conerly 4/16/91

6. APPROVED BY:

Typed Name: Akiva Abramovitch
Title: Section Head, Review Section 3
Organization: EFGWB/EFED/OPP

Akiva Abramovitch
APR 17 1991

7. CONCLUSIONS:

1) MRID#s 407009-64 (previously reviewed) and 415958-01 (submitted with this review package) are reports of the **same** rotational crop study. MRID 415958-01 has been revised to respond to some of EFGWB's comments on the earlier version. Together with the supplemental information in the correspondence from Mr. Thornton, it is now acceptable.

2) Residues of varying nature and amount are present in all crop groups at all times sampled, although it should be noted that the application rate was approximately double the highest label rate. Samples from plantings 29 days post treatment are reported to have measurable residues of parent and/or other organosoluble compounds. Later samples (from plantings at 122 and 273 days post treatment) contain measurable amounts only of water-soluble materials, i.e. triazolyl metabolites. Toxicology Branch has determined (correspondence attached) that the triazolyl residues are of little concern. If there is a concern for the parent and other organosoluble degradates, then a 29 day post-harvest interval is insufficient, but a 4 month (120-day) replanting interval might be appropriate. Since there are no data for intervals between 29 and 122 days on which to base a recommendation, EFGWB cannot suggest an interval shorter than 120 days at this time.

3) Available data from a currently unacceptable study (DER attached) *with one exception* indicate minimal (near level-of-detection) residues in all crop groups planted 30 and 120 days post treatment. However, these crops were only analyzed for parent.

8. RECOMMENDATIONS: The remaining required data should be submitted as soon as possible.

9. BACKGROUND:

The toxicological evaluation is incomplete as of 4/2/91, but previous opinions from the TOX branch indicate that triazolyl metabolites are of little concern. A tolerance petition for barley, oats, peanuts, wheat, grapes, and grasses grown for seed is currently under review. Available data indicate persistence but low soil mobility. Some plant uptake occurs.

The status of data requirements is as follows:

hydrolysis -- fulfilled 6/9/89, stable at pH 5, 7, and 9 -- no hydrolysis after 28 days incubation

photolysis in water -- fulfilled 6/9/89 -- no photodegradation detected; extrapolated $t_{1/2}$ of 600 days

soil photodegradation -- fulfilled 6/9/89 -- slow reaction; extrapolated $t_{1/2}$ ca 191 days, producing 2 unidentified degradates (<3% of applied)

aerobic soil metabolism -- fulfilled -- additional data on product identification was required 6/9/89, but a reevaluation of available information indicates that the previously submitted study should be accepted -- resistant to metabolism -- extrapolated $t_{1/2}$ 610 days in sandy loam soil. Residues at 1 year were tebuconazole at 67.4%, unextractables at 29.1% [ca. 20% of this (3% of the total applied) was parent compound], an unidentified extractable material at 2.1%, extractable polar compounds at 1.1%, and CO_2 at less than 0.7%.

anaerobic soil metabolism -- fulfilled (see aerobic soil study) -- extrapolated $t_{1/2}$ ca 400 days

leaching/adsorption/desorption -- fulfilled as of 6/9/89 -- in column leaching studies on sand, sandy loam, silt loam, and silty clay loam, little leaching occured below 6 cm.

terrestrial field dissipation -- **study submitted, but not accepted** because of inadequate analytical methods and lack of detail in the report. EFGWB has required a *turf field dissipation study* because of this compound's use pattern

confined accumulation on rotational crops -- fulfilled by this submission taken together with the previously submitted study -- additional data discussed in this review characterizing residues -- The original DER is attached.

[^{14}C]Terbuconazole residues accumulated in kale, beets, and wheat planted 29, 122, and 273 days after the second of two applications of [^{14}C]terbuconazole; the first application was to wheat growing in a tub and the second application, 50 days later, was directly to the sandy loam soil surface. The concentration of [^{14}C]residues in crops from the 122-day rotation was ≈4 to 9x greater than the concentration in crops from the 29-day rotation; the concentration of [^{14}C]residues in crops from the 273-day rotation was generally ≈2-4x greater

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than the concentration in crops from the 29-day rotation. The 122 and 273-day interval organosoluble fractions could not be analyzed because of inadequate amounts of organosoluble [^{14}C] residues. No organosoluble [^{14}C] residue was present at >2% except in immature wheat (8%). Values below are taken from tables in the report received under MRID# 415958-01.

In crops planted at 29 days posttreatment,
total [^{14}C]residues at harvest

0.3 ppm in kale
- 15 % terbuconazole
- 0.4% terbuconazole-t-butyl-hydroxy
- 8.5% unidentified organosoluble (baseline and other)
- 56.2% triazolylalanine
- 3.3% triazolylacetic acid
- 4.3% unidentified aqueous
- 12.3% unextracted

0.2 ppm in beet tops
- 7.2% terbuconazole
- 1.1% terbuconazole-t-butyl-hydroxy
- 4.3% unidentified organosoluble (baseline and other)
- 19.5% triazoylalanine
- 6.8% triazolylacetic acid
- 20.5% triazolyl-lactic acid
- 20.8% unidentified aqueous
- 17.1% unextracted

0.2 ppm in beet roots
- 4.8% terbuconazole
- 0.4% terbuconazole-t-butyl-hydroxy
- 3.6% unidentified organosoluble (baseline and other)
- 6.8% triazole
- 58 % triazoylalanine
- 13.6% unidentified aqueous
- 12.8% unextracted

3.8 ppm in wheat grain
- in immature wheat
  - 22.9% terbuconazole
- in wheat grain
  - no detectable terbuconazole

1.1 ppm in wheat straw
- 5.4% terbuconazole
- 9.3% terbuconazole-t-butyl hydroxy

Organosoluble residues ranged from 0.4 to 22.9% of the recovered radioactivity.
Water-soluble residues ranged from 51.1 to 88.6%.
Unextractable residues ranged from 5.8 to 29.7%.
Five unknowns (0.4-1.6%) were detected.

In crops planted at 122 days posttreatment

total [^{14}C]residues at harvest

2.7 ppm in kale
- 0.64% unidentified organosoluble (diffuse/baseline)
- 56.2% triazolylalanine (this is an apparent typo, other data indicate a more complete recovery than this shows)
- 3.3% triazolylacetic acid
- 4.3% unidentified aqueous
- 12.3% unextracted

1.3 ppm in beet tops
- 1.4% unidentified organosoluble degradates
- 21.5% triazolylalanine
- 7.2% triazolylacetic acid
- 49.1% triazolyl-lactic acid
- 20.8% unidentified aqueous
- 17.1% unextracted

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0.8 ppm in beet roots
- 2.2% unidentified organosoluble degradates
- **14.8% triazole**
- **54.8% triazolylalanine**
- 3.3% triazolylacetic acid
- 3.5% triazolyl-lactic acid
- 7.2% unextracted

35.4 ppm in wheat
- 8.0% unidentified organosoluble in immature wheat
- **28.5% (12.7 ppm) triazolylalanine**
- **50.8% triazolylacetic acid**
- 8.0% unidentified aqueous

- **71.0% triazolylalanine** in wheat grain
- **25.7% triazolylacetic acid** in wheat grain.
- 3.8% unidentified aqueous in wheat grain
- 1.3% unextracted

4.2 ppm in wheat straw
- 1.1% unidentified organosoluble
- **24.1% triazolylalanine**
- **25.0% triazolylacetic acid**
- **26.6% triazolyl-lactic acid**
- 9.2% unidentified aqueous
- 14.0% unextracted

15.0 ppm in wheat chaff

Organosoluble residues ranged from 0.6 to 8.1% of the recovered radioactivity, and were not further characterized.

Water-soluble residues ranged from 85.5 to 100%
- Triazolylalanine was the primary degradate in all crops.
- Triazolylacetic acid was another degradate in all crops
- Triazolyl-lactic acid was detected in beet tops and roots and wheat straw
- Triazole was detected in beet roots

unextractable residues ranged from 0 to 13%.

In crops planted at 273 days posttreatment
Total [^{14}C]residues at harvest

2.0 ppm in kale
- 0.53% unidentified organosoluble
- **85.5% triazolylalanine**
- 5.8% triazolylacetic acid
- 5.2% unidentified aqueous
- 3.0% unextracted

1.0 ppm in beet tops
- 1.7% unidentified organosoluble
- **20.6% triazolylalanine**
- 4.8% triazolylacetic acid
- **34.3% triazolyl-lactic acid**
- **11.2% unidentified aqueous**
- 27.4% unextracted

0.9 ppm in beet roots
- 1.3% unidentified organosoluble
- 16.8% triazole
- **52.2% triazolylalanine**
- 3.3% triazolylacetic acid
- 3.5% triazolyl-lactic acid
- **16.7% unidentified aqueous**
- 7.2% unextracted

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7.6 ppm in wheat grain
59.0% triazolylalanine
36.2% triazolylacetic acid
4.1% unidentified aqueous
0.7% unextracted

2.6 ppm in wheat straw
15.7% triazolylalanine
16.2% triazolylacetic acid
52.0% triazolyl-lactic acid
9.1% unidentified aqueous
5.7% unextracted

6.0 ppm in wheat chaff

Organosoluble residues and unextractable residues were not further characterized.

In the 0- to 6-inch soil depth, total [^{14}C]residues were 1.5 ppm immediately following application of formulated [^{14}C]terbuconazole to the soil surface, 0.52 ppm at 29 days posttreatment, 0.29 ppm at 122 days posttreatment, and 0.16 ppm at 273 days posttreatment. Between 29 and 273 days posttreatment, extractable [^{14}C]residues decreased from 84 to 14% of the total radioactivity; terbuconazole was the only compound detected in extracts from the 29- and 122-day soil samples. The residue in the soil at harvest of the 273-day interval was 0.18 ppm. This was slightly higher than at planting (0.16 ppm). Although it would seem that the soil residue should have dropped between planting and harvest instead of remaining essentially the same, the uptake of [^{14}C] residues by the 273-day crops was not significant compared to the amount of total [^{14}C] residue remaining in the tub. The [^{14}C] residue in the soil prior to the surface treatment was not characterized, however, the [^{14}C] residue at the time of surface treatment was characterized [Table V, attached]...The [^{14}C] residue at this point was 93% FOLICUR. Considering a 0-time [^{14}C] concentration of 1.5 ppm, there could not have been any [^{14}C] residue other than FOLICUR present in the soil at a concentration of >0.1 ppm [at day 273]. The [^{14}C] residue in the soil at the time of harvest was not characterized, but...not enough material was extractable for characterization. This was also the case for the 273-day harvest interval [^{14}C] residue.In soil stored frozen, the amount of methanol extractable material decreases by approximately 10% relative to the amount of material present, with an equivalent increase in bound material. Total recovery has also decreased slightly, with virtually all of the material recovered in the extractable portion identified as parent tebuconazole. There has been no dramatic change during storage. The same general pattern holds true for plant materials as well.

accumulation in field rotational crops -- partially fulfilled (MRID# 409959-23) -- spinach, turnips, and wheat or sorghum were planted 30 and 120 days post-treatment in soil which had received seven applications of terbuconazole at 3.5 ppm at 10 - 25 day intervals. The original DER is attached. Except for 0.11 ppm of terbuconazole in straw from wheat planted at approximately 120 days posttreatment, terbuconazole detected in the crops from the treated plots did not significantly exceed the apparent limits of determination of terbuconazole in the various plant matrices.

Terbuconazole was <0.03 ppm in spinach leaves, turnip roots and tops, and wheat or sorghum grain planted approximately 30 and 120 days after 7 applications at 10- to 25-day intervals of terbuconazole to sandy loam/sandy clay loam soil and silt loam/silty clay loam soil.

In crops planted at approximately 30 days posttreatment, terbuconazole at harvest was 0.02 ppm in spinach; 0.02-0.03 and 0.01-0.03 ppm in turnip tops and roots, respectively; 0.01 and 0.03 ppm in wheat grain and straw (IN site), respectively; and 0.03 and 0.04 ppm in sorghum grain and straw (KS), respectively. In immature sorghum forage harvested at 45 days postplanting, terbuconazole was 0.01 ppm.

In crops planted at approximately 120 days posttreatment, terbuconazole was 0.02 ppm in spinach (KS site only); <0.01 ppm in turnip tops (KS site only); 0.01-0.02 ppm in turnip roots; 0.01 and 0.11 ppm in wheat grain and straw, respectively; and 0.01 and 0.02 ppm in sorghum grain and straw, respectively. In immature wheat forage harvested at 45 days post-planting, terbuconazole was 0.05 ppm.

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In control crops, apparent terbuconazole was 0.01-0.02 ppm in spinach; <0.01-0.02 and 0.01-0.03 ppm in turnip tops and roots, respectively; 0.02 and 0.01 ppm in wheat forage and grain; and 0.01, 0.01, and 0.02-0.06 ppm in sorghum forage, grain, and straw, respectiyely.

In the 0- to 6-inch soil depth from plots treated for the 30-day plant-back, terbuconazole was 0.17-0.41 ppm immediately following the final application of terbuconazole; 0.07-0.19 ppm at 31-33 days posttreatment, and 0.04-0.12 ppm at harvest (87-308 days posttreatment). From plots treated for the 120-day plant-back, terbuconazole in the soil (0- to 6-inch depth) was 0.21-2.42 ppm immediately following the final application, 0.19-0.35 ppm at 124-126 days posttreatment, and 0.01-0.10 ppm at harvest (171-245 days posttreatment).

fish bioaccumulation -- study submitted and under review at this time

10. DISCUSSION OF INDIVIDUAL TESTS OR STUDIES:

The applicant has provided additional data on rotational crop degradate identification to respond to EFGWB comments contained in the Registration Standard chapter. The relevant comments were as follows:

1) EFGWB comment -- ... the organosoluble and water-soluble [^{14}C] residues in all crops from all three rotations should be characterized...

Mobay response -- ... Tables VIII and IX,...[attached] contain the additional data which includes the 29 and 273-day interval samples. The 122 and 273-day interval organosoluble fractions could not be analyzed because of inadequate amounts of organosoluble [^{14}C] residues. No organosoluble [^{14}C] residue was present at >2% except in immature wheat (8%).

EFGWB reply -- The data are provided as Mobay states. This deficiency is resolved.

2) EFGWB comment -- [not verbatim] ... please provide storage stability for the materials tested.

Mobay response -- ... the storage stability data requested can be found in Tables X [soil], XI [plant matrices], and XII [plant matrices]. [All are attached.]

EFGWB reply -- In soil stored frozen, the amount of methanol extractable material decreases by approximately 10% relative to the amount of material present, with an equivalent increase in bound material. Total recovery has also decreased slightly, with virtually all of the material recovered in the extractable portion identified as parent tebuconazole. There has been no dramatic change during storage. The same general pattern holds true for plant materials as well. This deficiency is resolved.

3) EFGWB comment -- ...[^{14}C] residues in the soil prior to the soil surface treatment and at the time of harvest of the rotational crops should be quantified and [^{14}C] residues from those two intervals plus [^{14}C] residues in the soil immediately after the soil surface application should be characterized.

Mobay response -- ...Information on the concentration of [^{14}C] residues in the soil prior to the surface treatment (0.20 ppm) ... can be found in Table IV [attached]. The residue in the soil at harvest

of the 273-day interval was 0.18 ppm. This was slightly higher than at planting (0.16 ppm). Although it would seem that the soil residue should have dropped between planting and harvest instead of remaining essentially the same, the uptake of [^{14}C] residues by the 273-day crops was not significant compared to the amount of total [^{14}C] residue remaining in the tub. The [^{14}C] residue in the soil prior to the surface treatment was not characterized, however, the [^{14}C] residue at the time of surface treatment was characterized [Table V, attached]...The [^{14}C] residue at this point was 93% FOLICUR. Considering a 0-time [^{14}C] concentration of 1.5 ppm, there could not have been any [^{14}C] residue other than FOLICUR present in the soil at a concentration of >0.1 ppm [at day 273]. The [^{14}C] residue in the soil at the time of harvest was not characterized, but...not enough material was extractable for characterization. This was also the case for the 273-day harvest interval [^{14}C] residue.

EFGWB reply -- The cited Tables indicate that the soil radioactivity content is back to pre-treatment level at day 273. There is a steady decrease in extractable material and a concomitant increase in bound material. Methanol-extractable material is virtually all parent tebuconazole. Reviewer calculated figures indicate that tebuconazole content in the soil is ca. 20 ppb at day 273. This deficiency is resolved.

4) EFGWB comment -- ...the following details about the analytical methodology should be included a) the type of TLC plate used, b) how unlabeled tebuconazole was detected following TLC, c) what compounds were being derivatized to, and d) at what stage of the methodology the plant extracts were analyzed for free triazole (which apparently required a separate derivatization step). In addition recovery efficiencies of tebuconazole and degradates from fortified soil and plant samples were not provided.

Mobay response -- This report was revised to include the following information: (a) the TLC plate was a silica gel 60 plate by Merck, 250 µm thick, (b) unlabeled standards were visualized under UV light, (c) all derivatives can be examined on page 36 (attached) of the revised report, and were performed after the ion exchange column procedure, and (d) free triazole was derivatized after being eluted off of the cation exchange column with monochloropinacolone. The derivative was then analyzed by HPLC.

Recovery efficiencies usually could not be done because [^{14}C] labeled standards of the metabolites which made up the major part of the [^{14}C] residue were not available. **However, unextracted or bound material did not exceed more than approximately 10 percent on average for any component other than beet top.**

EFGWB reply -- The applicant has stated that direct measurements of recovery by analysis of fortified samples was not done due to unavailability of labeled standards. This reviewer interprets the final sentence [emphasized above] in the Mobay response as stating indirectly that recovery as extractable material was ca. 90% in all materials except for beet top. If that is the case, recovery is satisfactory and this deficiency is resolved. The applicant should confirm that this interpretation is correct.

5) EFGWB comment -- requested information on plant growing conditions

Mobay response -- In response to the request for information on plant growing conditions, the following are presented: a) the crops were grown under normal greenhouse conditions and watered as needed, b) temperatures and humidities were held at the levels normally found in a greenhouse (humidity 60-70% and temperatures around 80°F), and c) day to day data were recorded on both humidity and temperature.

EFGWB reply -- this information is satisfactory, and the deficiency is resolved.

11. COMPLETION OF ONE-LINER: appropriate information added

12. CBI APPENDIX: n.a.

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END OF DOCUMENT