5-18-00

13544

003381

Chemical:	**1H-1,2,4-Triazole, 1-{2-(2,4-dichlorophe**
PC Code:	**120603**
HED File Code	**11000 Chemistry Reviews**
Memo Date:	**05/18/2000**
File ID:	**DPD259321**
Accession Number:	**412-01-0084**

HED Records Reference Center
01/23/2001

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Image 3

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

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM

DATE: 18-MAY-2000

SUBJECT: PP# 9F06023. Tetraconazole use on Peanuts. **Evaluation of Residue Data and Analytical Methods**. MRID#s 448654-03, 448654-07, and 449005-01. Barcode D259321. Chemical# 120603. Case# 289222. Submission# S537973.

FROM: William H. Donovan, Ph.D., Chemist
Registration Action Branch 1 (RAB1)
Health Effects Division (HED) (7509C)

THRU: George F. Kramer, Ph.D., Chemist
Melba Morrow, D.V.M., Branch Senior Scientist
RAB1/HED (7509C)

TO: Mary Waller/Lisa Jones, PM Team 21
Registration Division (7505C)

Sipcam Agro USA, Inc., formerly Sostram Corporation (c/o Landis, International, Inc.), has submitted a petition for the establishment of permanent tolerances for residues of the fungicide tetraconazole, [(±)-2-(2,4-dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl-1,1,2,2-tetrafluoroethyl ether], in/on the commodities listed below as a result of the petitioner's request to register use of the fungicide on peanuts:

Peanuts (nutmeat)	0.03 ppm
Peanut meal	0.03 ppm
Peanut oil	0.1 ppm

Tetraconazole is a new synthetic fungicide and is a member of the conazole class of pesticides. Other members of this class include hexaconazole and propiconazole. On peanuts, tetraconazole is intended to control fungal diseases such as early leafspot, late leaf spot, rust, web blotch, Southern blight, and *Rhizoctonia* limb rot.

The attached contractor's document has been reviewed and revised to reflect HED policy.

Executive Summary of Chemistry Deficiencies

- Revised Section B
- Final identification of residues of concern in plants, livestock, and rotational crops
- Poultry metabolism study
- Radiovalidation of the analytical method
- Agency validation of the analytical method
- Confirmatory method
- Multiresidue testing results
- Bovine feeding study with a minimum dose rate equivalent to 6.2 ppm tetraconazole
- Storage stability data supporting the rotational crop study
- New rotational crop study using phenyl-labeled tetraconazole
- Revised Section F

RECOMMENDATIONS

The residue chemistry database does not presently support the establishment of tolerances for residues of tetraconazole *per se* in/on the raw agricultural and processed commodities of peanuts. The petitioner should address the deficiencies discussed in Conclusions 1a, 1b, 2b, 3b, 3c, 4b, 4c, 5a, 5b, 6, 10b, 11, 12a, 12b, and 12c. The petitioner should submit a revised Section F to delete the peanut meal tolerance (Conclusion 9b), correct the commodity definitions, and increase the tolerance levels for "peanut" (Conclusion 8b) and "peanut, refined oil" (Conclusion 9c). HED will initiate a human health risk assessment for the proposed uses of tetraconazole on peanuts when the above deficiencies have been resolved.

Attachment 1 - contractor review

cc: PP#9F06023, W. Donovan, O. Odiott
RDI: G. Kramer (17-MAY-2000), M. Morrow (18-MAY-2000), RAB1 Chemists (04-MAY-2000), ChemSAC (17-MAY-2000)
W.H. Donovan:806R:CM#2:(703)305-7330:7509C:RAB1

TETRACONAZOLE
PC Code 120603
(DP Barcode D259321)

PP#9F06023; EVALUATION OF RESIDUE CHEMISTRY DATA TO SUPPORT PERMANENT TOLERANCES FOR USE OF TETRACONAZOLE ON PEANUTS

January 11, 2000

Contract No. 68-D4-0010

Submitted to:
U.S. Environmental Protection Agency
Arlington, VA

Submitted by:
Dynamac Corporation
The Dynamac Building
2275 Research Boulevard
Rockville, MD 20850-3268

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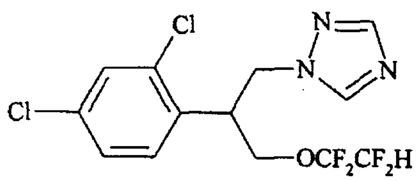
TETRACONAZOLE



PP#9F06023: EVALUATION OF RESIDUE CHEMISTRY DATA TO SUPPORT PERMANENT TOLERANCES FOR USE OF TETRACONAZOLE ON PEANUTS

PC CODE NO. 120603

(DP BARCODE D259321)

INTRODUCTION

Sostram Corporation (c/o Landis, International, Inc.) has submitted a petition for the establishment of permanent tolerances for residues of the fungicide tetraconazole, [(±)-2-(2,4-dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl 1,1,2,2-tetrafluoroethyl ether], in/on the commodities listed below as a result of the petitioner's request to register use of the fungicide on peanuts:

Peanuts (nutmeat)	0.03 ppm
Peanut meal	0.03 ppm
Peanut oil	0.1 ppm

Tetraconazole is a new synthetic fungicide and is a member of the conazole class of pesticides. Other members of this class include hexaconazole and propiconazole. On peanuts, tetraconazole is intended to control fungal diseases such as early leafspot, late leaf spot, rust, web blotch, Southern blight, and *Rhizoctonia* limb rot.

Included in the data-review package for this petition are residue chemistry data pertaining to magnitude of the residue in peanut (1999; MRID 44865403), peanut processed commodities (1999; MRID 44900501), and a confined rotational crop study (1999; MRID 44865407). These data are evaluated in this document for their adequacy in fulfilling registration requirements.

Time-limited tolerances for residues of tetraconazole *per se* have recently been established [40 CFR §180.557(b)] in/on sugar beet roots at 0.10 ppm, sugar beet tops at 6.0 ppm, sugar beet dried pulp at 0.20 ppm, sugar beet molasses at 0.30 ppm, cattle fat at 0.60 ppm, cattle kidney at 0.20 ppm, cattle liver at 6.0 ppm, cattle meat at 0.030 ppm, cattle meat byproducts (except kidney and liver) at 0.030 ppm, and milk at 0.050 ppm [FR Vol. 64, No. 233, pp. 68046-68052, 12/6/99]. These time-limited tolerances were established in connection with an emergency exemption under FIFRA Section 18 authorizing use of tetraconazole on sugar beets in North Dakota and Minnesota. The tolerances will expire on December 31, 2001. Information concerning exposures and risks related to this Section 18 exemption request was summarized by HED in a 3/18/99 memorandum (DP Barcodes D252214 and D252213, W. Dykstra, L. Cheng, and S. Tadayon).

In addition to the present peanut petition, Sipcam Agro has concurrently requested the establishment of an import tolerance for residues of tetraconazole *per se* in/on bananas (PP#7E04830) and permanent tolerances for residues of tetraconazole *per se* in/on commodities of sugar beets and livestock commodities (PP#9F05066). Residue chemistry data associated with these two petitions are the subject of separate reviews but are referenced in this document where appropriate.

The HED Metabolism Assessment Review Committee (MARC) considered the results of the available tetraconazole metabolism studies in two meetings held 07- and 14-MAR-2000 (D264157, W. Donovan and D. Nixon, 19-APR-2000). Conclusions reached and data gaps identified by the MARC are also included in this document. The MARC determined that triazole (a tetraconazole metabolite) should be considered by the HIARC for endpoint selection and confirmation of the need to include it in the tetraconazole tolerance expression and risk assessment. This chemistry review was prepared under the assumption that the HIARC will confirm the MARC's concern about triazole. Should the HIARC determine that triazole is not of concern, then the conclusions in this review pertaining to triazole will need to be modified.

CONCLUSIONS

OPPTS GLN 860.1200: Proposed Uses

1a. The proposed use pattern for tetraconazole on peanuts, described by the petitioner in the specimen label, does not match the parameters of the field trials conducted for magnitude of the residue in peanut. HED assumes that the petitioner wishes to support the single and seasonal rates reflected in the peanut field trials. Accordingly, the petitioner should submit a revised Section B for the 1 lb/gal formulation of tetraconazole [Product Name = Eminent™] to specify a maximum of seven foliar spray applications at 0.107 lb ai/A/application for a maximum seasonal rate of 0.75 lb ai/A. If the current label instructions are as intended, then the petitioner should conduct a new set of peanut field trials reflecting the label use rate and use pattern (4 applications at 0.203 lb ai/A/application, for a maximum seasonal rate of 0.813 lb ai/A).

1b. No rotational crop restrictions are included on the submitted label. Based on the results of a confined rotational crop study reviewed in this document, a revised Section B is required

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to incorporate the following crop restrictions: "Peanuts and sugar beets may be rotated at any time. Rotation to all other crops is prohibited."

OPPTS GLN 860.1300: Nature of the Residue in Plants

2a. No plant metabolism studies were included with this petition; however, the petitioner previously submitted the results of grape and wheat metabolism studies in conjunction with a banana import tolerance petition (PP#7E04830, D259205, W. Donovan, in preparation), and a sugar beet metabolism study with the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation). Deficiencies found in the metabolism studies are discussed in the referenced reviews.

2b. The HED MARC tentatively determined that the residue of concern in sugar beets, peanuts, and bananas is tetraconazole *per se*. However, this conclusion cannot be finalized until the MARC considers the results of additional data as specified in the MARC decision memo (D264157, W. Donovan and D. Nixon, 19-APR-2000).

OPPTS GLN 860.1300: Nature of the Residue in Livestock

3a. No livestock metabolism studies were included with this petition; however, goat metabolism studies were submitted with the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation). The studies were deemed acceptable, pending submission of supporting storage stability data. The principal residues identified in goat milk, muscle, and kidney were unchanged tetraconazole and triazole.

3b. A tetraconazole poultry metabolism study was not submitted in support of this petition but is required because peanut meal is a poultry feed item.

3c. The HED MARC tentatively determined that the residues of concern in livestock commodities are tetraconazole and triazole. However, before this conclusion can be finalized, the Committee must consider the findings from a scheduled Hazard Identification Assessment Review Committee (HIARC) meeting on triazole and evaluate data from a poultry nature of the residue study (D264157, W. Donovan and D. Nixon, 19-APR-2000).

OPPTS GLN 860.1340: Residue Analytical Method - Plant Commodities

4a. The petitioner utilized a GC/ECD method for the determination of tetraconazole residues in/on samples of peanut commodities collected from the field, processing, and storage stability studies. The validated method limits of quantitation (LOQs) were 0.010 ppm for peanut nutmeat, meal, and refined oil, and 0.10 ppm for hay. The method validation and concurrent method recovery data indicate that this method is adequate for data collection. In addition, the petitioner submitted an ILV of the GC/ECD method, demonstrating adequate recoveries from fortified samples of milk, eggs, muscle, fat.

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4b. The registration requirements for residue analytical methods in plants remain unfulfilled. The GC/ECD method should be subjected to radiovalidation using samples from the plant metabolism studies to determine whether the method recovers total toxic residues of tetraconazole from weathered plant matrices. The GC/ECD plant method has been forwarded to the Agency laboratories for petition method validation (D264681, W. Donovan, 07-APR-2000). Conclusions about the adequacy of the analytical method for enforcement purposes will be deferred until completion of the PMV.

4c. The GC/ECD method should be supplemented by a confirmatory method that is significantly different (such as mass spectrometry). Provided that a specific confirmatory method is provided, HED will not require an interference study.

OPPTS GLN 860.1340: Residue Analytical Methods - Livestock Commodities

5a. The petitioner is not proposing tolerances for tetraconazole residues of concern in milk and ruminant tissues as a result of the proposed uses on peanuts; however, the petitioner has proposed tolerances for secondary transfer of residues in milk and ruminant tissues as a result of the proposed uses of tetraconazole on sugar beets (PP#9F05066). Adequate data-collection methods are available for determining tetraconazole residues in milk and ruminant tissues. The requirements for enforcement method(s) capable of determining tetraconazole residues of concern in milk and ruminant tissues are specified in the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation).

5b. Should the requested poultry metabolism study indicate that tolerances for tetraconazole residues of concern need to be established for eggs and poultry tissues, the petitioner will be required to develop data collection and enforcement methods specific to these matrices.

OPPTS GLN 860.1360: Multiresidue Method

6. Data concerning the recovery of tetraconazole residues of concern using FDA's multiresidue protocols (PAM Vol. I) have not been submitted and are required for this tolerance petition request.

OPPTS GLN 860.1380: Storage Stability Data

7. The storage intervals and conditions for peanut commodities collected from the field and processing studies are supported by adequate storage stability data. Residues of tetraconazole have been demonstrated to be stable under frozen storage conditions (-20 C) in/on peanut nutmeat and hay for up to 84 days (~3 months) and in peanut meal and refined oil for up to 56 days (~2 months). Field trials samples were stored frozen for up to 83 days, and processing study samples were stored frozen for up to 69 days (nutmeat) and 51-56 days (meal and refined oil).

OPPTS GLN 860.1500: Crop Field Trials

Peanut

8a. In support of this petition, 11 trials reflecting the maximum proposed use pattern for sugar beets were conducted. For the establishment of tolerances on peanut commodities, Tables 1 and 5 of OPPTS GLN 860.1500 specify that 12 field trials should be conducted in Regions 2 (8 trials), 3 (1 trial), 6 (2 trials), and 8 (1 trial). HED will not require the petitioner to conduct an additional peanut field trial in Region 2 because there does not appear to be wide variability in residues obtained in the current submission.

8b. The submitted field trial data indicate that residues of tetraconazole may exceed the proposed tolerance of 0.03 ppm in/on peanut nutmeat when the 1 lb/gal SC formulation of tetraconazole is applied. Residues of tetraconazole ranged from nondetectable (<0.010) to 0.0344 ppm in/on nutmeat inverted in the field 14 days (and field dried for 4-6 days) following the last of seven sequential broadcast applications of the 1 lb/gal SC formulation at 0.107 lb ai/A/application. The petitioner is requested to submit a revised Section F to correct the commodity definition for the proposed tetraconazole tolerance for peanuts (nutmeat) to "peanut" and to increase the proposed tolerance from 0.03 to 0.05 ppm.

8c. Residues of tetraconazole ranged from 1.46 to 22.6 ppm in/on peanut hay harvested and treated according to the use pattern described above. The petitioner is not proposing a tolerance for residues of tetraconazole in/on peanut hay because the label prohibits the feeding of treated hay to livestock. HED considers this feeding restriction to be appropriate and allowable.

OPPTS GLN 860.1520: Processed Food/Feed

Peanut

9a. The submitted peanut processing data are adequate for the purposes of this petition. Residues of tetraconazole concentrated 1.12x in meal and 3.34x in refined oil processed from peanuts bearing detectable residues.

9b. The maximum expected residue of tetraconazole in peanut meal as a result of the implied use pattern is 0.037 ppm. This value is derived by multiplying the HAFT residue (0.033 ppm; see peanut field trial) and the observed concentration factor (1.12x). Because the maximum expected residue of 0.037 ppm in peanut meal is lower than the recommended tolerance of 0.05 ppm for the RAC (peanut nutmeat), a separate tolerance for peanut meal is not required. The petitioner should submit a revised Section F that omits the peanut meal tolerance.

9c. The maximum expected residue of tetraconazole in peanut refined oil as a result of the proposed use pattern is 0.11 ppm. This value is derived by multiplying the HAFT residue (0.033 ppm; see peanut field trial) and the observed concentration factor (3.34x). Based on these data, the petitioner is requested to submit a revised Section F to correct the commodity definition for the proposed tetraconazole tolerance for peanut oil to "peanut, refined oil" and to increase the proposed tolerance from 0.1 to 0.15 ppm.

OPPTS GLN 860.1480: Meat, Milk, Poultry, Eggs

Milk, meat, and meat byproducts of ruminants

10a. The only commodity of peanut which may used as a feed item for beef and dairy cattle is peanut meal. The calculation of the maximum theoretical dietary burden of tetraconazole for beef and dairy cattle is detailed in the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation). The anticipated maximum dietary burdens for dairy cattle and beef cattle were calculated to be 3.2 ppm and 6.2 ppm, respectively. Peanut meal was included in the dietary burden calculation but not peanut hay because of the proposed feeding restriction.

10b. In conjunction with the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation), the petitioner has proposed tolerances for residues of tetraconazole in milk, cattle meat, cattle meat byproducts, and cattle fat. In support of these tolerances, the petitioner has submitted dairy cattle feeding studies which were also reviewed in the sugar beet petition. HED concluded that the dairy cattle feeding studies are adequate for the purpose of establishing a tolerance for tetraconazole and triazole residues in milk, but not in the fat, meat, and meat byproducts of ruminants. A new bovine feeding study at a feed level equivalent to at least 6.2 ppm tetraconazole is needed to set tolerances in ruminant tissues.

Eggs, fat, meat, and meat byproducts of poultry

11. HED will determine the need for a poultry feeding study and tolerances for eggs, fat, meat, and meat byproducts of poultry following evaluation of the requested poultry metabolism study.

OPPTS GLNs 860.1850 and 860.1900: Confined/Field Accumulation in Rotational Crops

12a. Pending submission of storage stability data to validate the storage conditions and intervals of rotational crop commodities, the submitted confined rotational crop study for triazole-labeled tetraconazole is adequate for the purposes of this petition. However, as the triazole-labeled study showed evidence for cleavage of tetraconazole occurring between the phenyl and triazole rings, a rotational crop study using phenyl-labeled tetraconazole is needed to determine whether this moiety is translocated into the rotational crops.

12b. Although the petitioner has not proposed plantback restrictions for rotational crops on the product label, rotational restrictions are required. Subject to change based on the results of the requested phenyl-labeled tetraconazole rotational crop study, the rotational restrictions are specified in the "OPPTS GLN 860.1200: Proposed Uses" section of this document. If the petitioner wishes to have rotational restrictions other than those specified in this document, then the petitioner should submit limited field trial data depicting tetraconazole residues of concern in/on rotational crops at the plantback interval(s) the petitioner wants to support.

12c. The HED MARC tentatively determined that the residue of concern in rotational crops is tetraconazole *per se*. However, before this conclusion can be finalized, the MARC requires review of the requested rotational crop study using phenyl-labeled tetraconazole, and consideration of the HIARC deliberations on triazole (D264157, W. Donovan and D. Nixon, 19-APR-2000).

Codex Issues

13. There are no established Codex, Canadian, or Mexican limits for residues of tetraconazole in/on plant or livestock commodities. Therefore, no compatibility issues exist with regard to the proposed tolerances discussed in this petition review.

RECOMMENDATIONS

The residue chemistry database does not presently support the establishment of tolerances for residues of tetraconazole *per se* in/on the raw agricultural and processed commodities of peanuts. The petitioner should address the deficiencies discussed in Conclusions 1a, 1b, 2b, 3b, 3c, 4b, 4c, 5a, 5b, 6, 10b, 11, 12a, 12b, and 12c. The petitioner should submit a revised Section F to delete the peanut meal tolerance (Conclusion 9b), correct the commodity definitions, and increase the tolerance levels for "peanut" (Conclusion 8b) and "peanut, refined oil" (Conclusion 9c). HED will initiate a human health risk assessment for the proposed uses of tetraconazole on peanuts when the above deficiencies have been resolved.

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DETAILED CONSIDERATIONS

OPPTS GLN 860.1200: Proposed Uses

The petitioner provided a specimen label for a soluble concentrate (SC) formulation [Product Name = Eminent™ 125 SL; EPA Symbol No. 60063-RE] containing 11.6% or 1 lb ai/gal of tetraconazole which is proposed for use on peanuts for the control of fungal diseases such as early leafspot, late leaf spot, rust, web blotch, Southern blight, and *Rhizoctonia* limb rot. The formulation is proposed for up to four foliar spray applications at 26 fl. oz. product per application (equivalent to 0.203 lb ai/A/application), for a total seasonal rate of 0.813 lb ai/A. Applications are to be made beginning approximately 6 weeks after planting and repeated at 14-day intervals. The label specifies that if conditions for leafspot diseases are favorable, other fungicides containing chlorothalonil should be used after the 4-spray block treatment program with Eminent™. Ground or aerial equipment may be used, and applications may be made in a minimum of 20 gal of water/A for dilute sprays and 5 gal of water/A for concentrate sprays. The proposed preharvest interval (PHI) is 14 days, and the proposed restricted entry interval is 24 hours. The feeding of hay from treated fields to livestock is prohibited. No rotational crop restrictions are included on the label.

Conclusions: The proposed use pattern for tetraconazole on peanuts, described by the petitioner in the specimen label, does not match the parameters of the field trials conducted for magnitude of the residue in peanut. HED assumes that the petitioner wishes to support the single and seasonal rates reflected in the peanut field trials. Accordingly, the petitioner should submit a revised Section B for the 1 lb/gal formulation of tetraconazole [Product Name = Eminent™] to specify a maximum of seven foliar spray applications at 0.107 lb ai/A/application for a maximum seasonal rate of 0.75 lb ai/A. If the current label instructions are as intended, then the petitioner should conduct a new set of peanut field trials reflecting the label use rate and use pattern (4 applications at 0.203 lb ai/A/application, for a maximum seasonal rate of 0.813 lb ai/A).

No rotational crop restrictions are included on the submitted label. Based on the results of a confined rotational crop study reviewed in this document, a revised Section B is required to incorporate the following crop restrictions: "Peanuts and sugar beets may be rotated at any time. Rotation to all other crops is prohibited."

OPPTS GLN 860.1300: Nature of the Residue in Plants

No plant metabolism studies were included with this petition; however, the petitioner previously submitted the results of grape and wheat metabolism studies in conjunction with a banana import tolerance petition (PP#7E04830, D259205, W. Donovan, in preparation), and a sugar beet metabolism study with the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation). Deficiencies found in the metabolism studies are discussed in the referenced reviews.

The HED MARC tentatively determined that the residue of concern in sugar beets, peanuts, and bananas is tetraconazole *per se*. However, this conclusion cannot be finalized until the MARC considers the results of additional data as specified in the MARC decision memo (D264157, W. Donovan and D. Nixon, 19-APR-2000).

OPPTS GLN 860.1300: Nature of the Residue in Livestock

No livestock metabolism studies were included with this petition; however, goat metabolism studies were submitted with the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation). The studies were deemed acceptable, pending submission of supporting storage stability data. The principal residues identified in goat milk, muscle, and kidney were unchanged tetraconazole and triazole.

A tetraconazole poultry metabolism study was not submitted in support of this petition but is required because peanut meal is a poultry feed item.

The HED MARC tentatively determined that the residues of concern in livestock commodities are tetraconazole and triazole. However, before this conclusion can be finalized, the Committee must consider the findings from a scheduled Hazard Identification Assessment Review Committee (HIARC) meeting on triazole and evaluate data from a poultry nature of the residue study (D264157, W. Donovan and D. Nixon, 19-APR-2000).

OPPTS GLN 860.1340: Residue Analytical Method - Plant Commodities

Residue data-collection method

Samples of peanut commodities from the field, processing, and storage stability studies were analyzed by Wildlife International, Ltd. (Easton, MD) for residues of tetraconazole using a GC/ECD method. A brief description of the method follows. Peanut matrices (except refined oil) were homogenized, and residues were repeatedly extracted with acetone followed by centrifugation and filtration. The acetone extracts were combined, a saturated solution of sodium chloride was added to the combined extracts, and residues were partitioned with dichloromethane. The organic phase was filtered and concentrated by rotary evaporation. The concentrated residues of nutmeat and meal were re-dissolved in hexane and partitioned with acetonitrile (2x; ACN); the combined ACN phases were concentrated by rotary evaporation. Refined oil samples were solubilized in hexane and partitioned with ACN (2x); the ACN phase was filtered and evaporated to dryness. Concentrated residues (hay following dichloromethane partitioning, and nutmeat, meal, and refined oil following ACN partitioning) were re-dissolved in hexane:acetone (9:1, v:v). Residues were purified by alumina column chromatography; residues were eluted with hexane:acetone (7:3, v:v). The solvent was evaporated, and residues were re-dissolved in ethyl acetate for quantitation by GC/ECD.

To assess the suitability of the GC/ECD method for data collection, the petitioner provided method validation data. Method validation and concurrent method recoveries were generated by fortifying untreated peanut commodities with tetraconazole and then analyzing the spiked samples with the data-collection method. The results of the method validation are presented in Table 1. The reported limits of quantitation (LOQs) were 0.010 ppm for nutmeat, meal, and refined oil, and 0.10 ppm for hay. Sample calculations and representative chromatograms were provided.

Conclusions: The petitioner utilized a GC/ECD method for the determination of tetraconazole residues in/on samples of peanut commodities collected from the field, processing, and storage stability studies. The validated method LOQs were 0.010 ppm for peanut nutmeat, meal, and refined oil, and 0.10 ppm for hay. The method validation and concurrent method recovery data indicate that this method is adequate for data collection. In addition, the petitioner submitted an ILV of the GC/ECD method, demonstrating adequate recoveries from fortified samples of peanut, peanut oil, banana, and refined sugar (D254411, W. Donovan, in preparation).

The registration requirements for residue analytical methods in plants remains unfulfilled. The GC/ECD method should be subjected to radiovalidation using samples from the plant metabolism studies to determine whether the method recovers total toxic residues of tetraconazole from weathered plant matrices. The GC/ECD plant method has been forwarded to the Agency laboratories for petition method validation (D264681, W. Donovan, 07-APR-2000). Conclusions about the adequacy of the analytical method for enforcement purposes will be deferred until completion of the PMV.

The GC/ECD method should be supplemented by a confirmatory method that is significantly different (such as mass spectrometry). Provided that a satisfactory confirmatory method is provided, HED will not require an interference study.

Table 1. Method validation and concurrent method recoveries of tetraconazole from fortified untreated samples of peanut commodities analyzed using GC/ECD.

Commodity	Fortification Level, ppm	% Recovery [a]	Mean ± s.d. [b]
Method Validation Data			
Peanut, nutmeat	0.010	93.4-97.1 (3)	95.3 ± 1.9
	1.0	75.9-84.0 (3)	80.0 ± 4.1
Peanut, hay	0.10	108-113 (3)	110 ± 2.9
	1.0	93.2-97.4 (3)	94.9 ± 2.2
Peanut, meal	0.010	110-113 (3)	112 ± 1.7
	1.0	92.8-97.0 (3)	95.0 ± 2.1
Peanut, refined oil	0.010	105-107 (3)	106 ± 1.0
	1.0	91.6-96.7 (3)	94.7 ± 2.7
Concurrent Method Recovery Data			
Peanut, nutmeat	0.010	92.6-118 (6)	105 ± 8.4
	0.10	84.5-92.7 (4)	88.4 ± 3.5
	0.50	88.1-93.1 (6)	90.5 ± 1.7
	1.0	92.9, 93.1	93.0 ± 0.14
Peanut, hay	0.10	107-108 (3); 126 (2)	115 ± 10.2
	0.20	111	111
	0.50	91.2, 97.8	94.6 ± 4.5
	1.0	92.5, 97.1	94.8 ± 3.3
	5.0	90.2, 92.1	91.2 ± 1.3
	10.0	92.2, 93.0	92.6 ± 0.6
	15.0	92.2, 95.9	94.1 ± 2.6
	25.0	92.6, 94.3	93.5 ± 1.2
Peanut, nutmeat (processing)	0.010, 0.00	87.8, 100	93.9 ± 8.6
- meal	0.010-1.0	92.7-110 (3)	98.8 ± 9.7
- refined oil	0.010-1.0	95.8-103 (3)	98.7 ± 3.8

[a] Each recovery value represents one sample unless otherwise indicated in parentheses.

[b] The mean and standard deviation were calculated by the petitioner, except for processing samples which were calculated by the study reviewer.

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OPPTS GLN 860.1340: Residue Analytical Methods - Livestock Commodities

The petitioner is not proposing tolerances for tetraconazole residues of concern in milk and ruminant tissues as a result of the proposed uses on peanuts; however, the petitioner has proposed tolerances for secondary transfer of residues in milk and ruminant tissues as a result of the proposed uses of tetraconazole on sugar beets (PP#9F05066). An adequate data-collection method, GC/ECD, is available for determining tetraconazole residues in milk and ruminant tissues. The requirements for enforcement method(s) capable of determining tetraconazole residues of concern in milk and ruminant tissues are detailed in the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation).

Should the requested poultry metabolism study indicate that tolerances for tetraconazole residues of concern need to be established for eggs and poultry tissues, the petitioner will be required to develop data collection and enforcement methods specific to these matrices.

OPPTS GLN 860.1360: Multiresidue Method

Data concerning the recovery of tetraconazole residues of concern in plants and livestock using FDA's multiresidue protocols (PAM Vol. I) have not been submitted and are required for this tolerance petition request.

OPPTS GLN 860.1380: Storage Stability Data

Sample storage conditions and intervals

Samples of peanut nutmeat and hay, collected from the field trials, were allowed to dry in the field for 4-6 days to achieve optimum moisture content. The field-dried samples were placed into coolers containing blue or dry ice; some samples were immediately frozen within 2 hours of harvest. Samples were shipped frozen by FedEx or ACDS freezer truck to Wildlife International Ltd. (Easton, MD) for residue analysis. Samples were stored frozen (-20 C) until analysis. The maximum storage intervals were 76 days (~2.5 months) for nutmeat and 83 days (~2.8 months) for hay.

Samples of peanuts from the processing study were collected by hand following field drying for 10 days. The dried samples were transported under ambient conditions to Texas A&M University (Bryan, TX) for processing. Separate RAC samples were shipped frozen directly to the analytical laboratory (Wildlife International, Ltd., Easton, MD). Upon arrival of samples at Texas A&M University, they were stored frozen prior to and following processing. Peanut samples were processed into meal and refined oil within 18 days of harvest. The maximum storage intervals were 69 days (~2.3 months) for peanut nutmeat, 56 days (~1.9 months) for meal, and 51 days (~1.7 months) for refined oil.

Storage stability

A freezer storage stability study was conducted concurrently with the peanut field and processing studies. Samples of untreated peanut commodities were fortified with tetraconazole and stored under frozen conditions. Samples were analyzed for residues of tetraconazole at 0-, 34- to 37-, and 56- or 84-day storage intervals using the previously described GC/ECD method. Unfortified samples were fortified with tetraconazole at the time of analysis for fresh fortification recoveries. The reported LOQs were 0.010 for nutmeat, meal, and refined oil, and 0.100 ppm for hay. Apparent residues of tetraconazole were less than the lowest analytical standard of the respective calibration curve (<0.0833 ppm for nutmeat, meal, and refined oil, and <0.167 ppm for hay) in/on three samples each of untreated peanut nutmeat, hay, meal, and refined oil. The results of the storage stability study are presented in Table 2.

Table 2. Stability of tetraconazole in/on peanut matrices fortified with tetraconazole and stored frozen for up to 84 days.

Crop/Matrix	Storage Interval (days)	Fresh Fortification %Recovery [a]	Stored Sample % Recovery	Stored Sample Corrected % Recovery [b]
Peanut, nutmeat	0	84.3, 90.8, 90.9, 91.3	--	--
	35	92.7, 93.3 (93.0)	92.5, 94.8	99.5, 101.9
	83	89.1, 90.0 (89.6)	90.4, 91.4	100.9, 102.0
Peanut, hay	0	91.7, 91.7, 92.1, 92.6	--	--
	37	103, 106 (104.5)	98.1, 98.7	93.9, 94.4
	84	103, 105 (104)	101, 102	97.1, 98.1
Peanut, meal	0	92.8, 93.6, 94.0, 95.9	--	--
	34	92.8, 93.8 (93.3)	64.2, 91.4	68.8, 98.0
	56	95.6, 99.2 (97.4)	92.5, 95.4	95.0, 97.9
Peanut, refined oil	0	99.0, 100, 100, 101	--	--
	34	98.1, 98.7 (98.4)	97.1, 97.2	98.7, 98.8
	56	109, 111 (110)	110, 111	100, 101

[a] Average recovery value is reported in parentheses.

[b] Corrected percent recovery was calculated by the study reviewer by dividing each stored sample recovery by the average of the fresh fortification recoveries.

Conclusions: The storage intervals and conditions for peanut commodities collected from the field and processing studies are supported by adequate storage stability data. Residues of tetraconazole have been demonstrated to be stable under frozen storage conditions (-20 C) in/on peanut nutmeat and hay for up to 84 days (~3 months) and in peanut meal and refined oil for up to 56 days (~2 months). Field trials samples were stored frozen for up to 83 days, and processing study samples were stored frozen for up to 69 days (nutmeat) and 51-56 days (meal and refined oil).

OPPTS GLN.860.1500: Crop Field Trials

Peanut

The petitioner submitted peanut field trial data (citation listed below) to support the establishment of the proposed tolerance for residues of tetraconazole *per se* in/on peanuts (nutmeat) at 0.03 ppm.

> 44865403 Hattermann, D. (1999) Raw Agricultural Commodity (RAC) Residue and Residue Decline Evaluation of Tetraconazole Applied to Peanuts: Lab Project Number: 38007A017: 1714-98-380-01-07C-55. Unpublished study prepared by Landis International, Inc.422 p.

A total of eleven peanut field trials were conducted during the 1998 growing season in AL(1), GA(4), FL(1), NC(2), OK(1), and TX(2). Each test site consisted of one control and one treatment plot. Mature peanut plants were dug up and inverted in the field 14 days following the last of seven sequential broadcast spray applications, with a 12- to 16-day retreatment interval, of the 1 lb/gal SC formulation at 0.107 lb ai/A/application (1x the implied maximum single and seasonal application rates). Applications were made in 12.0-28.3 gal/A of water using a tractor mounted, CO_2 backpack, or hand-held boom sprayer. The inverted peanut plants were allowed to dry in the field for 4-6 days in order to achieve optimum moisture content. Following field drying, the dried whole plants were collected by hand or machine and then sorted into hay and nutmeat. In order to generate residue decline data, additional samples of whole peanut plants were dug up and inverted in the field from the GA test site at 0, 3, 7, 32, and 58 days following the last application.

All collected samples were bagged, placed into coolers containing blue or dry ice or field freezers within 2 hours of sampling. Samples were shipped frozen by FedEx or ACDS freezer truck to Wildlife International Ltd. (Easton, MD) for residue analysis. Samples were stored frozen (-20 C) until analysis. Samples were analyzed for residues of tetraconazole using the GC/ECD method described under "Residue Analytical Methods" section. This method is adequate for data collection based on concurrent method recovery data (see Table 1). Apparent residues of tetraconazole were less than the LOQ (0.010 ppm for nutmeat and 0.10 ppm for hay) in/on 16 samples each of untreated peanut nutmeat and hay. Residues of tetraconazole in/on treated samples of peanut matrices are presented in Table 3.

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Table 3. Residues of tetraconazole in/on peanuts following seven applications at 0.107 lb ai/A/application (1x the implied maximum application rate) of the 1 lb/gal SC formulation.

Trial Location (EPA Region)	PHI [a] (days)	Tetraconazole Residues (ppm) [b]	
		Nutmeat	Hay
Henry, AL (Region 2)	14	<0.010, <0.010	3.07, 9.00
Marion, FL (Region 3)	14	0.0185, 0.0209	21.7, 22.6
Macon, GA (Region 2)	0	0.0211	18.1
	3	0.0194	13.5
	7	0.0168	11.0
	14	0.0225, 0.0239	14.6, 16.4
	32	0.0213	10.2
	58	0.0216	10.2
Macon, GA (Region 2)	14	0.0142, 0.0172	15.7, 16.8
Dooly, GA (Region 2)	14	<0.010, <0.010	7.74, 7.83
Henry, GA (Region 2)	14	0.0149, 0.0183	7.94, 16.2
Martin, NC (Region 2)	14	<0.010, <0.010	4.35, 5.45
Washington, NC (Region 2)	14	<0.010, <0.010	4.48, 9.14
Caddo, OK (Region 6)	14	<0.010, <0.010	14.2, 15.3
Hockley, TX (Region 8)	14	<0.010, <0.010	1.46, 2.44 [c]
Waller, TX (Region 6)	14	0.0316, 0.0344 (0.0330 HAFT)	2.07, 2.98

[a] PHI= preharvest interval

[b] Residues were not corrected for concurrent recoveries.

[c] The highest residue value of duplicate analyses is reported.

Conclusions: In support of this petition, 11 trials reflecting the maximum proposed use pattern for sugar beets were conducted. For the establishment of tolerances on peanut commodities, Tables 1 and 5 of OPPTS GLN 860.1500 specify that 12 field trials should be conducted in Regions 2 (8 trials), 3 (1 trial), 6 (2 trials), and 8 (1 trial). HED will not require the petitioner to conduct an additional peanut field trial in Region 2 because there does not appear to be wide variability in residues obtained in the current submission.

The submitted field trial data indicate that residues of tetraconazole may exceed the proposed tolerance of 0.03 ppm in/on peanut nutmeat when the 1 lb/gal SC formulation of tetraconazole is applied. Residues of tetraconazole ranged from nondetectable (<0.010) to 0.0344 ppm in/on nutmeat inverted in the field 14 days (and field dried for 4-6 days) following the last of seven sequential broadcast applications of the 1 lb/gal SC formulation at 0.107 lb ai/A/application. The petitioner should submit a revised Section F to correct the commodity definition for the proposed tetraconazole tolerance for peanuts (nutmeat) to "peanut", and to increase the proposed tolerance from 0.03 to 0.05 ppm.

Residues of tetraconazole ranged from 1.46 to 22.6 ppm in/on peanut hay harvested and treated according to the use pattern described above. The petitioner is not proposing a tolerance for residues of tetraconazole in/on peanut hay because the label prohibits the feeding of treated hay to livestock. HED considers this feeding restriction to be appropriate and allowable.

OPPTS GLN 860.1520: Processed Food/Feed

Peanut

The petitioner submitted one volume of data depicting the potential for concentration of residues of tetraconazole in the processed commodities of peanuts. The citation is listed below.

> 44900501 Hattermann, D. (1999) Processed Commodity (PC) Residue Evaluation of Tetraconazole Applied to Peanuts: Final Report: Lab Project Number: 38007A018: AGR 95/963239:1714-98-380-01-07C-66. Unpublished study prepared by Landis International, Inc. 143 p.

One peanut field trial was conducted during the 1998 growing season in GA. Mature peanut plants were dug and inverted in the field 14 days following the last of seven sequential broadcast foliar applications, with 13- to 15-day retreatment intervals, of the 1 lb/gal SC formulation at 0.32 lb ai/A/application. The total applied rate was 2.25 lb ai/A (~3x the implied maximum seasonal application rate). Applications were made in 19.1-20.2 gal of water/A using a CO_2 tractor-mounted boom sprayer. A separate plot was left untreated and served as a control.

Untreated and treated samples of peanuts were collected by hand following 10 days of field drying. The field-dried samples were immediately transported under ambient conditions to Texas A&M University, Food Protein Research and Development Center (Bryan, TX) for processing. Separate frozen RAC samples were shipped directly to the analytical laboratory (Wildlife International, Ltd., Easton, MD). Samples received at Texas A&M University were stored frozen prior to and following processing. Peanut samples were processed into peanut meal and refined oil within 10 days of harvest according to simulated commercial procedures. A brief description of the processing procedures follows.

Peanuts were dried in an oven at 54-71 C to achieve a moisture content of 7-12%. Light impurities were removed using an aspirator. Samples were then screened to separate large and small foreign particles from the peanuts. The hull and kernel (nutmeat) were separated using a sheller and aspirator. The kernel was dried in an oven at 54-71 C to a final moisture content of 7-10%. The kernel was moisture conditioned to 12%, heated to 93-104 C, and then pressed in an expeller to yield crude oil. The presscake from the expeller was extracted (3x) with hexane at

49-60 C to wash the remaining crude oil from the presscake (meal). The solvent was removed from the miscella (crude oil in hexane washings) using a recovery unit and heating to 73-90 C. Crude oil from the expeller and solvent extractions were combined and refined; refined oil and soapstock were separated. The petitioner submitted adequate descriptions and material balance sheets for the processing procedures. The processed samples were shipped frozen to Wildlife International, Ltd. (Easton, MD) where samples were stored frozen until residue analysis.

Samples of processed peanuts were analyzed for residues of tetraconazole using the GC/ECD method previously described under the "Residue Analytical Methods" section. Apparent residues of tetraconazole were less than the LOQ (<0.01 ppm) in/on two samples of untreated peanuts, and one sample each of meal and refined oil processed from untreated peanuts. Residues of tetraconazole in/on treated samples are presented in Table 4.

Table 4. Residues of tetraconazole in the processed commodities of peanuts following seven foliar applications of the 1 lb/gal SC formulation at 0.32 lb ai/A (3x the maximum proposed seasonal rate).

Substrate	Tetraconazole Residues (ppm) [a]	Concentration/Reduction Factor
Peanut	0.0521, 0.0699 (0.061)	--
- Meal	0.0370, 0.0998 (0.0684)	1.12x
- Refined oil	0.183, 0.225 (0.204)	3.34x

[a] Average residues are reported in parentheses.

Conclusions: The submitted peanut processing data are adequate for the purposes of this petition. Residues of tetraconazole concentrated 1.12x in meal and 3.34x in refined oil processed from peanuts bearing detectable residues.

The maximum expected residue of tetraconazole in peanut meal as a result of the implied use pattern is 0.037 ppm. This value is derived by multiplying the HAFT residue (0.033 ppm; see peanut field trial) and the observed concentration factor (1.12x). Because the maximum expected residue of 0.037 ppm in peanut meal is lower than the recommended tolerance of 0.05 ppm for the RAC (peanut nutmeat), a tolerance for peanut meal is not required. Tetraconazole residues expected in peanut meal will not exceed the recommended tolerance for the RAC.

The maximum expected residue of tetraconazole in peanut refined oil as a result of the proposed use pattern is 0.110 ppm. This value is derived by multiplying the HAFT residue (0.033 ppm; see peanut field trial) and the observed concentration factor (3.34x). Based on these data, the petitioner is requested to submit a revised Section F to correct the commodity definition for the proposed tetraconazole tolerance for peanut oil to "peanut, refined oil" and to increase the proposed tolerance from 0.1 to 0.15 ppm.

OPPTS GLN 860.1480: Meat, Milk, Poultry, Eggs

Milk, meat, and meat byproducts of ruminants

The only commodity of peanut which may used as a feed item for beef and dairy cattle is peanut meal. The calculation of the maximum theoretical dietary burden of tetraconazole for beef and dairy cattle is detailed in the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation). The anticipated maximum dietary burdens for dairy cattle and beef cattle were calculated to be 3.2 ppm and 6.2 ppm, respectively. Peanut meal was included in the dietary burden calculation but not peanut hay because of the proposed feeding restriction.

In conjunction with the sugar beet petition (PP#9F05066, D254411, W. Donovan, in preparation), the petitioner has proposed tolerances for residues of tetraconazole in milk, cattle meat, cattle meat byproducts, and cattle fat. In support of these tolerances, the petitioner has submitted dairy cattle feeding studies which were also reviewed in the sugar beet petition. HED concluded that the dairy cattle feeding studies are adequate for the purpose of establishing tolerances for tetraconazole and triazole residues in milk, but not in the fat, meat, and meat byproducts of ruminants. A new bovine feeding study at a feed level equivalent to at least 6.2 ppm tetraconazole is needed to set tolerances in ruminant tissues.

Eggs, fat, meat, and meat byproducts of poultry

HED will determine the need for a poultry feeding study and tolerances for eggs, fat, meat, and meat byproducts of poultry following evaluation of the requested poultry metabolism study.

OPPTS GLN 860.1850: Confined Accumulation in Rotational Crops

The petitioner has submitted the results of a study (citation listed below) investigating the metabolism of [^{14}C]tetraconazole in rotational crops. The in-life and analytical phases of the study were conducted by Isagro Ricerca Srl (Novara, Italy).

> 44865407 [illegible]zzo, F.; Pizzingrilli, G. (1999) Uptake Translocation and Metabolism of ((carbon-14)-Triazole)Tetraconazole in Rotated Crops of Winter Wheat, Carrots and Lettuce: Lab Project Number: R/ABT.96.05: PR/ABT.96.05. Unpublished study prepared by Isagro Ricerca Srl. 284 p.

The radioactive test substance, [triazole-^{14}C]tetraconazole (specific activity 137.17 μCi/mg, radiochemical purity >98%), was mixed with nonlabeled tetraconazole in acetonitrile to yield a formulated test substance with a final specific activity of 12.676 μCi/mg. Following dilution of the formulated test substance with water, it was applied to eighteen pots of sandy loam soil (58.5% sand, 37% silt, and 4.5% clay, 2.01% organic matter, pH 5.35, cation exchange capacity 18.27 meq/100 g) by a single dropwise application at 0.446 lb ai/A (0.6x the implied maximum seasonal rate for peanuts). To generate samples with sufficient radioactive residues for metabolite identification, twelve additional pots received a single dropwise application of the test substance at 2.23 lb ai/A (~3x). Six control pots received treatments with ACN:water (20:80, v:v) without any itraconazole. All treated and control pots were maintained outdoors. Carrot, lettuce, and winter wheat were planted to the pots 30, 120, and 365 days after treatment (DAT). For each plantback interval (PBI), six pots containing 0.6x-treated soil were planted with carrot (1 pot), lettuce (1 pot), and wheat (4 pots). The same procedure was used with the 3x-treated pots, except one pot was used for carrot, one pot for lettuce, and two pots for wheat. Water, fertilizer, and maintenance insecticides were applied to the crops as necessary. Adequate information concerning preparation of the test substance, field conditions, and plant maintenance was provided.

Samples of immature wheat forage were collected 189 days after planting and gently rinsed with water. The remaining RACs were collected at maturity: 98 days after planting for carrots and lettuce, and 242 days after planting for wheat grain and straw. Carrots were harvested by pulling the entire plant from the ground and separating the roots from the tops; the roots were gently rinsed with water. Lettuce and mature wheat samples were collected by cutting the entire plant two inches above the soil; lettuce and the lower stems of wheat were also gently rinsed with water. Wheat grain and straw were separated. Samples were either analyzed immediately or frozen (-20 C) immediately after sampling.

<u>Total radioactive residues (TRR)</u>

Whole crop samples (carrot roots and tops, lettuce, wheat forage, grain, and straw) were separately cut up and ground with dry ice. Ten aliquots of each rotational crop commodity were subjected to combustion/LSC for TRR determinations. The TRR in rotational crop commodities are presented in Table 5.

Table 5. Total radioactive residues in rotational crop commodities grown in soil treated with [^{14}C]tetraconazole at an application rate of 0.446 or 2.23 lb ai/A (0.6x or 3x, respectively).

Commodity	TRR, ppm [^{14}C]tetraconazole equivalents [a]					
	0.6x-Treated			3x-Treated		
	30-DAT [b]	120-DAT	365-DAT	30-DAT	120-DAT	365-DAT
Mature carrot roots	0.206	0.427	0.393	1.136	1.776	1.543
Mature carrot tops	0.557	0.599	0.834	1.889	1.703	3.937
Mature lettuce	0.295	0.435	0.836	2.197	2.461	2.191
Immature wheat forage	0.188	0.417	0.512	1.162	1.480	1.056
Mature wheat grain	0.902	2.617	1.497	7.785	10.958	4.573
Mature wheat straw	1.494	1.460	0.821	5.893	6.405	3.967

[a] TRR is the mean of ten replicate analyses.
[b] DAT = Days after treatment.

Extraction and hydrolysis of residues

Homogenized samples of rotational crop commodities were subjected to residue extraction procedures. During the fractionation procedures, aliquots of extracts and nonextractable residues were analyzed for radioactivity by LSC or combustion/LSC. Extracts were concentrated by rotary evaporation, when necessary, prior to HPLC or TLC analysis. The general extraction procedures are summarized below.

Radioactive residues in homogenized samples were sequentially extracted with acetone:water (2x; 7:3, v:v), acetone:water (5:5, v:v), and acetone. Wheat straw and nonextractable grain residues were further extracted with water at 37 C for 24 hours. The acetone:water extracts were combined; only the acetone:water (7:3, v:v) extracts for carrot were combined. The acetone was allowed to evaporate from the combined extracts, and the aqueous extract was sequentially extracted with hexane (2x), ethyl acetate (2x), and water-saturated n-butanol (1x). The remaining aqueous phase of carrots was concentrated and precipitated with acetone. The organic extracts and the aqueous phase (concentrated for carrots) were reserved for TLC analysis.

The distribution and characterization of radioactive residues in rotational crop commodities grown in soil treated with [triazole-^{14}C]tetraconazole at 0.446 lb ai/A (0.6x) is presented in Table 6.

Characterization/Identification of residues

Extracts were analyzed by two-dimensional TLC on silica gel 60 F_{254} plates using solvent systems of ethyl acetate or chloroform:methanol:water (55:40:5, v:v:v). Radioactivity was detected and quantified using a radioanalytic imaging system. Nonlabeled standards were detected by UV (195, 225, or 254 nm) light. Metabolites were identified by comparison of retention times or by cochromatography with reference standards of tetraconazole, triazolylacetic acid (TAA), triazolylhydroxypropionic acid (THP), and triazolylalanine (TA).

To further characterize unidentified components, subsamples from rotational crops treated at the 3x rate were subjected to extraction procedures described above then subjected to further analytical procedures. Preparative TLC was used to isolate metabolites RC-3 and RC-5 from the aqueous phases of carrot tops and lettuce. Metabolite RC-3 from the aqueous extract of 30-day wheat grain was derivatized with Dabsyl chloride (in 0.3 M $NaHCO_3$ and 0.3 M Na_2CO_3 at 40 C for 5 minutes), and the Dabsyl chloride extract was evaporated to remove acetone. TLC analysis of the Dabsyl chloride extract identified RC-3 as TA. Metabolite RC-5 was identified as THP by TLC and MS cochromatography with nonlabeled THP standard. Metabolite RC-6 was identified as TAA based on the TLC cochromatography with the TAA standard following butyl derivatization.

A summary of the characterized and identified ^{14}C-residues in rotational crop commodities grown in soil treated with [triazole-^{14}C]tetraconazole at 0.446 lb ai/A (0.6x) is presented in Table 7.

Table 6. Distribution and characterization of radioactive residues in rotational crop commodities grown in soil treated with [triazole-^{14}C]tetraconazole at 0.446 lb ai/A (0.6x).

Fraction	% TRR	ppm	Characterization/Identification [a]
30-DAT Carrot Root (TRR = 0.206 ppm)			
Acetone:water	NR [b]	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.
n-Hexane	8.74	0.018	TLC analysis resolved: Tetraconazole 8.74% TRR 0.018 ppm
n-Butanol	--	--	Not further analyzed (N/A).
Aqueous	95.63	0.197	TLC analysis resolved: TA 66.99% TRR 0.138 ppm THP 17.48% TRR 0.036 ppm Metabolite RC-1 1.94% TRR 0.004 ppm Metabolite RC-2 9.22% TRR 0.019 ppm
Nonextractable	<LOD	<LOD	N/A.
120-DAT Carrot Root (TRR = 0.427 ppm)			
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.
n-Hexane	9.84	0.042	TLC analysis resolved: Tetraconazole 9.84% TRR 0.042 ppm
n-Butanol	--	--	N/A.
Aqueous	92.04	0.393	TLC analysis resolved: TA 55.27% TRR 0.236 ppm THP 24.35% TRR 0.104 ppm Metabolite RC-1 4.21% TRR 0.018 ppm Metabolite RC-2 8.20% TRR 0.035 ppm
Nonextractable	<LOD	<LOD	N/A.
365-DAT Carrot Root (TRR = 0.393 ppm)			
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.
n-Hexane	3.82	0.015	TLC analysis resolved: Tetraconazole 3.82% TRR 0.015 ppm
n-Butanol	--	--	N/A.
Aqueous	94.91	0.373	TLC analysis resolved: TA 65.65% TRR 0.258 ppm THP 19.59% TRR 0.077 ppm Metabolite RC-1 0.26% TRR 0.001 ppm Metabolite RC-2 9.41% TRR 0.037 ppm
Nonextractable	1.02	0.004	N/A.
30-DAT Carrot Tops (TRR = 0.557 ppm)			
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.
n-Hexane	2.33	0.013	TLC analysis resolved: Tetraconazole 2.33% TRR 0.013 ppm

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(continued; footnotes follow)

Table 6 *(continued)*.

Fraction	% TRR	ppm	Characterization/Identification [a]		
n-Butanol	5.21	0.029	<u>TLC analysis resolved</u>:		
			Tetraconazole	**1.26% TRR**	0.007 ppm
			THP	**2.51% TRR**	0.014 ppm
			Metabolite RC-8	1.08% TRR	0.006 ppm
			Metabolite RC-9	0.36% TRR	0.002 ppm
Aqueous	86.18	0.480	<u>TLC analysis resolved</u>:		
			TA	2.69% TRR	0.015 ppm
			THP	**66.97% TRR**	0.373 ppm
			Metabolite RC-1	2.88% TRR	0.016 ppm
			Metabolite RC-2	6.64% TRR	0.037 ppm
			Metabolite RC-4	**7.00% TRR**	0.039 ppm
Nonextractable	5.39	0.030	N/A.		
120-DAT Carrot Tops (TRR = 0.599 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.		
n-Hexane	2.34	0.014	<u>TLC analysis resolved</u>:		
			Tetraconazole	2.34% TRR	0.014 ppm
n-Butanol	5.84	0.035	<u>TLC analysis resolved</u>:		
			Tetraconazole	**2.00% TRR**	0.012 ppm
			THP	**2.00% TRR**	0.012 ppm
			Metabolite RC-8	1.33% TRR	0.008 ppm
			Metabolite RC-9	0.50% TRR	0.003 ppm
Aqueous	84.47	0.506	<u>TLC analysis resolved</u>:		
			TA	11.52% TRR	0.069 ppm
			THP	**57.76% TRR**	0.346 ppm
			Metabolite RC-1	4.01% TRR	0.024 ppm
			Metabolite RC-2	5.68% TRR	0.034 ppm
			Metabolite RC-4	5.51% TRR	0.033 ppm
Nonextractable	6.34	0.038	N/A.		
365-DAT Carrot Tops (TRR = 0.834 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.		
n-Hexane	2.04	0.017	<u>TLC analysis resolved</u>:		
			Tetraconazole	2.04% TRR	0.017 ppm
n-Butanol	4.32	0.036	<u>TLC analysis resolved</u>:		
			Tetraconazole	**1.20% TRR**	0.010 ppm
			THP	**2.04% TRR**	0.017 ppm
			Metabolite RC-8	0.84% TRR	0.007 ppm
			Metabolite RC-9	0.24% TRR	0.002 ppm

(continued; footnotes follow)

Table 6 *(continued)*.

Fraction	% TRR	ppm	Characterization/Identification [a]		
Aqueous	89.33	0.745	TLC analysis resolved:		
			TA	12.23% TRR	0.102 ppm
			THP	61.03% TRR	0.509 ppm
			Metabolite RC-1	4.20% TRR	0.035 ppm
			Metabolite RC-2	6.11% TRR	0.051 ppm
			Metabolite RC-4	5.75% TRR	0.048 ppm
Nonextractable	4.56	0.038	N/A.		
30-DAT Lettuce (TRR = 0.295 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.		
n-Hexane	1.69	0.005	TLC analysis resolved:		
			Tetraconazole	1.69% TRR	0.005 ppm
n-Butanol	6.78	0.020	TLC analysis resolved:		
			Tetraconazole	1.69% TRR	0.005 ppm
			TA	0.68% TRR	0.002 ppm
			THP	3.05% TRR	0.009 ppm
			Metabolite RC-8	1.02% TRR	0.003 ppm
			Metabolite RC-9	0.34% TRR	0.001 ppm
Aqueous	86.44	0.255	TLC analysis resolved:		
			TA	14.23% TRR	0.042 ppm
			THP	56.27% TRR	0.166 ppm
			Metabolite RC-1	1.02% TRR	0.003 ppm
			Metabolite RC-2	5.76% TRR	0.017 ppm
			Metabolite RC-4	9.15% TRR	0.027 ppm
Nonextractable	4.75	0.014	N/A.		
120-DAT Lettuce (TRR = 0.435 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.		
n-Hexane	0.92	0.004	TLC analysis resolved:		
			Tetraconazole	0.92% TRR	0.004 ppm
n-Butanol	9.43	0.041	TLC analysis resolved:		
			Tetraconazole	2.75% TRR	0.012 ppm
			TA	1.15% TRR	0.005 ppm
			THP	3.91% TRR	0.017 ppm
			Metabolite RC-8	1.15% TRR	0.005 ppm
			Metabolite RC-9	0.46% TRR	0.002 ppm
Aqueous	83.22	0.362	TLC analysis resolved:		
			TA	17.70% TRR	0.077 ppm
			THP	43.45% TRR	0.189 ppm
			Metabolite RC-1	4.83% TRR	0.021 ppm
			Metabolite RC-2	8.73% TRR	0.038 ppm
			Metabolite RC-4	8.50% TRR	0.037 ppm
Nonextractable	5.52	0.024	N/A.		

(continued; footnotes follow)

Table 6 *(continued)*.

Fraction	% TRR	ppm	Characterization/Identification [a]
365-DAT Lettuce (TRR = 0.836 ppm)			
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.
n-Hexane	0.96	0.008	TLC analysis resolved: Tetraconazole 0.96% TRR 0.008 ppm
n-Butanol	4.19	0.035	TLC analysis resolved: Tetraconazole 0.96% TRR 0.008 ppm THP 2.03% TRR 0.017 ppm Metabolite RC-7 0.60% TRR 0.005 ppm Metabolite RC-8 0.48% TRR 0.004 ppm Metabolite RC-9 0.12% TRR 0.001 ppm
Aqueous	91.51	0.765	TLC analysis resolved: TA 5.38% TRR 0.045 ppm THP 77.87% TRR 0.651 ppm Metabolite RC-1 1.20% TRR 0.010 ppm Metabolite RC-2 2.87% TRR 0.024 ppm Metabolite RC-4 4.19% TRR 0.035 ppm
Nonextractable	3.59	0.030	N/A.
30-DAT Wheat Forage (TRR = 0.188 ppm)			
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.
n-Hexane	6.91	0.013	TLC analysis resolved: Tetraconazole 6.91% TRR 0.013 ppm
n-Butanol	12.23	0.023	TLC analysis resolved: Tetraconazole 1.60% TRR 0.003 ppm TA 2.66% TRR 0.005 ppm THP 2.13% TRR 0.004 ppm Metabolite RC-1 0.53% TRR 0.001 ppm Metabolite RC-2 0.53% TRR 0.001 ppm Metabolite RC-7 2.13% TRR 0.004 ppm Metabolite RC-8 2.13% TRR 0.004 ppm Metabolite RC-9 0.53% TRR 0.001 ppm
Aqueous	73.94	0.139	TLC analysis resolved: TA 37.23% TRR 0.070 ppm THP 16.49% TRR 0.031 ppm TAA 14.89% TRR 0.028 ppm Metabolite RC-1 1.06% TRR 0.002 ppm Metabolite RC-2 4.26% TRR 0.008 ppm
Nonextractable	7.45	0.014	N/A.
120-DAT Wheat, forage (TRR = 0.417 ppm)			
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.

(continued; footnotes follow)

Table 6 *(continued)*.

Fraction	% TRR	ppm	Characterization/Identification [a]		
n-Hexane	5.99	0.025	TLC analysis resolved:		
			Tetraconazole	5.99% TRR	0.025 ppm
n-Butanol	7.19	0.030	TLC analysis resolved:		
			Tetraconazole	0.72% TRR	0.003 ppm
			TA	1.20% TRR	0.005 ppm
			THP	1.20% TRR	0.005 ppm
			TAA	0.96% TRR	0.004 ppm
			Metabolite RC-1	0.48% TRR	0.002 ppm
			Metabolite RC-2	0.96% TRR	0.004 ppm
			Metabolite RC-7	0.72% TRR	0.003 ppm
			Metabolite RC-8	0.48% TRR	0.002 ppm
			Metabolite RC-9	0.48% TRR	0.002 ppm
Aqueous	76.98	0.321	TLC analysis resolved:		
			TA	38.85% TRR	0.162 ppm
			THP	23.74% TRR	0.099 ppm
			TAA	9.59% TRR	0.040 ppm
			Metabolite RC-1	0.72% TRR	0.003 ppm
			Metabolite RC-2	4.08% TRR	0.017 ppm
Nonextractable	9.35	0.039	N/A.		
365-DAT Wheat Forage (TRR = 0.512 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.		
n-Hexane	1.17	0.006	TLC analysis resolved:		
			Tetraconazole	1.17% TRR	0.006 ppm
n-Butanol	6.25	0.032	TLC analysis resolved:		
			Tetraconazole	0.98% TRR	0.005 ppm
			TA	1.37% TRR	0.007 ppm
			THP	1.17% TRR	0.006 ppm
			TAA	0.78% TRR	0.004 ppm
			Metabolite RC-1	0.20% TRR	0.001 ppm
			Metabolite RC-2	0.59% TRR	0.003 ppm
			Metabolite RC-7	0.20% TRR	0.001 ppm
			Metabolite RC-8	0.58% TRR	0.003 ppm
			Metabolite RC-9	0.39% TRR	0.002 ppm
Aqueous	84.18	0.431	TLC analysis resolved:		
			TA	41.60% TRR	0.213 ppm
			THP	24.80% TRR	0.127 ppm
			TAA	11.33% TRR	0.058 ppm
			Metabolite RC-1	0.39% TRR	0.002 ppm
			Metabolite RC-2	6.05% TRR	0.031 ppm
Nonextractable	8.20	0.042	N/A.		

(continued; footnotes follow)

Table 6 *(continued)*.

Fraction	% TRR	ppm	Characterization/Identification [a]		
30-DAT Wheat, grain (TRR = 0.902 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, ethyl acetate, n-butanol, and water.		
n-Hexane/EtOAc	9.31	0.084	TLC analysis resolved:		
			Tetraconazole	2.77% TRR	0.025 ppm
			TAA	5.88% TRR	0.053 ppm
			Metabolite RC-7	0.22% TRR	0.002 ppm
			Metabolite RC-8	0.44% TRR	0.004 ppm
n-Butanol	--	--	N/A.		
Aqueous	58.54	0.528	TLC analysis resolved:		
			TA	39.58% TRR	0.357 ppm
			TAA	18.96% TRR	0.171 ppm
Nonextractable	NR	NR	Extracted with water at 37 C and centrifuged.		
Aqueous	23.50	0.212	TLC analysis resolved:		
			TA	15.52% TRR	0.140 ppm
			TAA	5.99% TRR	0.054 ppm
			Metabolite RC-7	2.00% TRR	0.018 ppm
Nonextractable	6.32	0.057	N/A.		
120-DAT Wheat, grain (TRR = 2.617 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, ethyl acetate, n-butanol, and water.		
n-Hexane/EtOAc	4.24	0.111	TLC analysis resolved:		
			Tetraconazole	1.30% TRR	0.034 ppm
			TAA	2.60% TRR	0.068 ppm
			Metabolite RC-7	0.11% TRR	0.003 ppm
			Metabolite RC-8	0.23% TRR	0.006 ppm
n-Butanol	--	--	N/A.		
Aqueous	72.60	1.900	TLC analysis resolved:		
			TA	23.61% TRR	0.618 ppm
			TAA	48.99% TRR	1.282 ppm
Nonextractable	NR	NR	Extracted with water at 37 C and centrifuged.		
Aqueous	23.50	0.615	TLC analysis resolved:		
			TA	17.46% TRR	0.457 ppm
			TAA	5.08% TRR	0.133 ppm
			Metabolite RC-7	0.96% TRR	0.025 ppm
Nonextractable	2.37	0.062	N/A.		
365-DAT Wheat, grain (TRR = 1.497 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.		

(continued; footnotes follow)

Table 6 *(continued)*.

Fraction	% TRR	ppm	Characterization/Identification [a]
n-Hexane/EtOAc	0.80	0.012	<u>TLC analysis resolved</u>: Tetraconazole 0.54% TRR 0.008 ppm Metabolite RC-7 0.07% TRR 0.001 ppm Metabolite RC-8 0.20% TRR 0.003 ppm
n-Butanol	--	--	N/A.
Aqueous	72.34	1.083	<u>TLC analysis resolved</u>: TA 40.75% TRR 0.610 ppm TAA 29.53% TRR 0.442 ppm Metabolite RC-2 2.07% TRR 0.031 ppm
Nonextractable	NR	NR	Extracted with water at 37 C and centrifuged.
Aqueous	18.70	0.280	<u>TLC analysis resolved</u>: TA 13.29% TRR 0.199 ppm TAA 4.28% TRR 0.064 ppm Metabolite RC-7 1.14% TRR 0.017 ppm
Nonextractable	5.48	0.082	N/A.
30-DAT Wheat, straw (TRR = 1.494 ppm)			
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, ethyl acetate, n-butanol, and water.
n-Hexane/EtOAc	9.97	0.149	<u>TLC analysis resolved</u>: Tetraconazole 9.10% TRR 0.136 ppm Metabolite RC-7 0.47% TRR 0.007 ppm Metabolite RC-8 0.40% TRR 0.006 ppm
n-Butanol	7.90	0.118	<u>TLC analysis resolved</u>: THP 1.20% TRR 0.018 ppm TAA 1.07% TRR 0.016 ppm Metabolite RC-7 1.87% TRR 0.028 ppm Metabolite RC-8 2.74% TRR 0.041 ppm Metabolite RC-9 1.00% TRR 0.015 ppm
Aqueous	63.92	0.955	<u>TLC analysis resolved</u>: TA 27.85% TRR 0.416 ppm THP 36.08% TRR 0.539 ppm
Nonextractable	NR	NR	Extracted with water at 37 C and centrifuged.
Aqueous	3.21	0.048	<u>TLC analysis resolved</u>: Tetraconazole 0.87% TRR 0.013 ppm THP 0.47% TRR 0.007 ppm TAA 0.60% TRR 0.009 ppm Metabolite RC-1 0.40% TRR 0.006 ppm Metabolite RC-4 0.27% TRR 0.004 ppm Metabolite RC-7 0.60% TRR 0.009 ppm
Nonextractable	15.26	0.228	N/A.

(continued; footnotes follow)

Table 6 *(continued)*.

Fraction	% TRR	ppm	Characterization/Identification [a]		
120-DAT Wheat Straw (TRR =1.460 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, ethyl acetate, n-butanol, and water.		
n-Hexane/EtOAc	9.93	0.145	TLC analysis resolved:		
			Tetraconazole	**8.70%** TRR	0.127 ppm
			Metabolite RC-7	**0.62%** TRR	0.009 ppm
			Metabolite RC-8	**0.62%** TRR	0.009 ppm
n-Butanol	9.66	0.141	TLC analysis resolved:		
			Tetraconazole	**1.71% TRR**	0.025 ppm
			THP	**1.92% TRR**	0.028 ppm
			TAA	**1.51% TRR**	0.022 ppm
			Metabolite RC-7	**1.85% TRR**	0.027 ppm
			Metabolite RC-8	1.92% TRR	0.028 ppm
			Metabolite RC-9	0.75% TRR	0.011 ppm
Aqueous	63.77	0.931	TLC analysis resolved:		
			TA	**9.79% TRR**	0.143 ppm
			THP	**32.40% TRR**	0.473 ppm
			TAA	**12.95% TRR**	0.189 ppm
			Metabolite RC-1	3.36% TRR	0.049 ppm
			Metabolite RC-2	**2.40% TRR**	0.035 ppm
			Metabolite RC-4	2.88% TRR	0.042 ppm
Nonextractable	NR	NR	Extracted with water at 37 C and centrifuged.		
Aqueous	3.97	0.058	TLC analysis resolved:		
			Tetraconazole	**0.89% TRR**	0.013 ppm
			TA	**0.62% TRR**	0.009 ppm
			THP	**0.48% TRR**	0.007 ppm
			TAA	**0.55% TRR**	0.008 ppm
			Metabolite RC-2	**0.41% TRR**	0.006 ppm
			Metabolite RC-7	**0.55% TRR**	0.008 ppm
			Metabolite RC-8	**0.48% TRR**	0.007 ppm
Nonextractable	14.11	0.206	N/A.		
365-DAT Wheat, straw (TRR = 0.821 ppm)					
Acetone:water	NR	NR	Evaporated to aqueous and sequentially extracted with n-hexane, n-butanol, and water.		
n-Hexane/EtOAc	7.19	0.059	TLC analysis resolved:		
			Tetraconazole	**5.97% TRR**	0.049 ppm
			Metabolite RC-7	**0.73% TRR**	0.006 ppm
			Metabolite RC-8	**0.49% TRR**	0.004 ppm

(continued; footnotes follow)

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Table 6 *(continued)*.

Fraction	% TRR	ppm	Characterization/Identification [a]		
n-Butanol	9.50	0.078	TLC analysis resolved:		
			Tetraconazole	**0.97% TRR**	0.008 ppm
			THP	**2.92% TRR**	0.024 ppm
			TAA	**1.95% TRR**	0.016 ppm
			Metabolite RC-7	**1.71% TRR**	0.014 ppm
			Metabolite RC-8	**1.46% TRR**	0.012 ppm
			Metabolite RC-9	0.49% TRR	0.004 ppm
Aqueous	68.45	0.562	TLC analysis resolved:		
			TA	**17.78% TRR**	0.146 ppm
			THP	**24.73% TRR**	0.203 ppm
			TAA	**9.99% TRR**	0.082 ppm
			Metabolite RC-1	**5.36% TRR**	0.044 ppm
			Metabolite RC-2	**4.75% TRR**	0.039 ppm
			Metabolite RC-4	**5.85% TRR**	0.048 ppm
Nonextractable	NR	NR	Extracted with water at 37 C and centrifuged.		
Aqueous	4.75	0.039	TLC analysis resolved:		
			Tetraconazole	**0.49% TRR**	0.004 ppm
			TA	**0.85% TRR**	0.007 ppm
			THP	**1.10% TRR**	0.009 ppm
			TAA	**1.10% TRR**	0.009 ppm
			Metabolite RC-7	**0.49% TRR**	0.004 ppm
			Metabolite RC-8	**0.73% TRR**	0.006 ppm
Nonextractable	11.45	0.094	N/A.		

[a] **Bolded** percent TRR values were calculated by the study reviewer from the ppm values.

[b] NR = Not reported.

Table 7. Summary of the characterization/identification of radioactive residues in rotational crop commodities grown in soil treated with [triazole-^{14}C]tetraconazole at 0.446 lb ai/A (0.6x).

	30-DAT Carrot, root (TRR = 0.206 ppm)		120-DAT Carrot, root (TRR = 0.427 ppm)		365-DAT Carrot, root (TRR = 0.393 ppm)		30-DAT Carrot, tops (TRR = 0.557 ppm)		120-DAT Carrot, tops (TRR = 0.599 ppm)		365-DAT Carrot, tops (TRR = 0.834 ppm)	
Metabolite [a]	%TRR	ppm	%TRR	ppm	%TRR	ppm	% TRR	ppm	%TRR	ppm	%TRR	ppm
Identified [b]												
Tetraconazole	8.74	0.018	9.84	0.042	3.82	0.015	3.59	0.020	4.34	0.026	3.24	0.027
Triazolyl alanine (TA; RC-3)	66.99	0.138	55.27	0.236	65.65	0.258	2.69	0.015	11.52	0.069	12.23	0.102
Triazolylhydroxypropionic acid (THP; RC-5)	17.48	0.036	24.35	0.104	19.59	0.077	69.48	0.387	59.76	0.358	63.07	0.526
Triazolylacetic acid (TAA; RC-6)	--	--	--	--	--	--	--	--	--	--	--	--
Total identified	**93.21**	**0.192**	**89.46**	**0.382**	**89.06**	**0.350**	**75.76**	**0.422**	**75.62**	**0.453**	**78.54**	**0.655**
Characterized												
Metabolite RC-1	1.94	0.004	4.21	0.018	0.26	0.001	2.88	0.016	4.01	0.024	4.20	0.035
Metabolite RC-2	9.22	0.019	8.20	0.035	9.41	0.037	6.64	0.037	5.68	0.034	6.11	0.051
Metabolite RC-4	--	--	--	--	--	--	7.00	0.039	5.51	0.033	5.75	0.048
Metabolite RC-7	--	--	--	--	--	--	--	--	--	--	--	--
Metabolite RC-8	--	--	--	--	--	--	1.08	0.006	1.33	0.008	0.84	0.007
Metabolite RC-9	--	--	--	--	--	--	0.36	0.002	0.50	0.003	0.24	0.002
Total characterized/ identified	**104.37**	**0.215**	**101.87**	**0.435**	**98.73**	**0.388**	**93.72**	**0.522**	**92.65**	**0.555**	**95.68**	**0.798**
Nonextractable	<LOD	<LOD	<LOD	<LOD	1.02	0.004	5.39	0.030	6.34	0.038	4.56	0.038

(continued; footnotes follow)

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Table 7 *(continued)*.

Metabolite [a]	30-DAT Lettuce (TRR = 0.295 ppm)		120-DAT Lettuce (TRR = 0.435 ppm)		365-DAT Lettuce (TRR = 0.836 ppm)		30-DAT Wheat, forage (TRR = 0.188 ppm)		120-DAT Wheat, forage (TRR = 0.417 ppm)		365-DAT Wheat, forage (TRR = 0.512 ppm)	
	%TRR	ppm	%TRR	ppm	%TRR	ppm	% TRR	ppm	%TRR	ppm	%TRR	ppm
Identified [b]												
Tetraconazole	3.39	0.010	3.68	0.016	1.92	0.016	8.51	0.016	6.71	0.028	2.15	0.011
Triazolyl alanine (TA; RC-3)	14.91	0.044	18.85	0.082	5.38	0.045	39.89	0.075	40.05	0.167	42.97	0.220
Triazolylhydroxypropionic acid (THP; RC-5)	59.32	0.175	47.36	0.206	79.90	0.668	18.62	0.035	24.94	0.104	25.98	0.133
Triazolylacetic acid (TAA; RC-6)	--	--	--	--	--	--	14.89	0.028	10.55	0.044	12.11	0.062
Total identified	**77.62**	**0.229**	**69.89**	**0.304**	**87.20**	**0.729**	**81.91**	**0.154**	**82.25**	**0.343**	**83.21**	**0.426**
Characterized												
Metabolite RC-1	1.02	0.003	4.83	0.021	1.20	0.010	1.59	0.003	1.20	0.005	0.58	0.003
Metabolite RC-2	5.76	0.017	8.73	0.038	2.87	0.024	4.79	0.009	5.04	0.021	6.64	0.034
Metabolite RC-4	9.15	0.027	8.50	0.037	4.19	0.035	--	--	--	--	--	--
Metabolite RC-7	--	--	--	--	0.60	0.005	2.13	0.004	0.72	0.003	0.20	0.001
Metabolite RC-8	1.02	0.003	1.15	0.005	0.48	0.004	2.13	0.004	0.48	0.002	0.58	0.003
Metabolite RC-9	0.34	0.001	0.46	0.002	0.12	0.001	0.53	0.001	0.48	0.002	0.39	0.002
Total characterized/ identified	**94.91**	**0.280**	**93.56**	**0.407**	**96.66**	**0.808**	**93.08**	**0.175**	**90.17**	**0.376**	**91.60**	**0.469**
Nonextractable	4.75	0.014	5.52	0.024	3.59	0.030	7.45	0.014	9.35	0.039	8.20	0.042

(continued; footnotes follow)

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Table 7 *(continued)*.

Metabolite [a]	30-DAT Wheat, grain (TRR = 0.902 ppm)		120-DAT Wheat, grain (TRR = 2.617 ppm)		365-DAT Wheat, grain (TRR = 1.497 ppm)		30-DAT Wheat, straw (TRR = 1.494 ppm)		120-DAT Wheat, straw (TRR = 1.460 ppm)		365-DAT Wheat, straw (TRR = 0.821 ppm)	
	%TRR	ppm	%TRR	ppm	%TRR	ppm	% TRR	ppm	%TRR	ppm	%TRR	ppm
Identified [b]												
Tetraconazole	2.77	0.025	1.30	0.034	0.54	0.008	9.97	0.149	11.31	0.165	7.43	0.061
Triazolyl alanine (TA)	55.10	0.497	41.07	1.075	54.04	0.809	27.85	0.416	10.41	0.152	18.63	0.153
Triazolylhydroxypropionic acid (THP)	--	--	--	--	--	--	37.75	0.564	34.79	0.508	28.75	0.236
Triazolylacetic acid (TAA)	30.82	0.278	56.67	1.483	33.80	0.506	1.67	0.025	15.00	0.219	13.03	0.107
Total identified	**88.69**	**0.800**	**99.04**	**2.592**	**88.38**	**1.323**	**77.24**	**1.154**	**71.51**	**1.044**	**67.84**	**0.557**
Characterized												
Metabolite RC-1	--	--	--	--	--	--	0.40	0.006	3.36	0.049	5.36	0.044
Metabolite RC-2	--	--	--	--	2.07	0.031	--	--	2.81	0.041	4.75	0.039
Metabolite RC-4	--	--	--	--	--	--	0.27	0.004	2.88	0.042	5.85	0.048
Metabolite RC-7	2.22	0.020	1.07	0.028	1.20	0.018	2.95	0.044	3.01	0.044	2.92	0.024
Metabolite RC-8	0.44	0.004	0.23	0.006	0.20	0.003	3.15	0.076	3.01	0.044	2.68	0.022
Metabolite RC-9	--	--	--	--	--	--	1.00	0.047	0.75	0.011	0.49	0.004
Total characterized/ identified	**91.35**	**0.824**	**100.34**	**2.626**	**91.85**	**1.375**	**85.01**	**1.270**	**87.33**	**1.275**	**89.89**	**0.738**
Nonextractable	6.32	0.057	2.37	0.062	5.48	0.082	15.26	0.228	14.11	0.206	11.45	0.094

[a] See Figure 1 (Attachment II) for chemical names and structures of identified metabolites.
[b] Tetraconazole was identified by TLC.

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Storage stability

The petitioner did not include the actual extraction and analysis dates; however, the experimental start and end dates were reported. Based on the reported start and end dates, samples of rotational crop commodities may have been stored for up to 769 days (~25.5 months). No supporting storage stability data were provided; storage stability data demonstrating the stability of tetraconazole residues in representative crop matrices are required to support this study.

Study summary

The total radioactive residues, expressed as [^{14}C]tetraconazole equivalents, accumulated at levels ≥0.01 ppm in the RACs of carrot, lettuce, and wheat planted in sandy loam soil 30, 120, and 365 days after treatment (DAT) of the soil with [triazole-^{14}C]tetraconazole at 0.446 lb ai/A (0.6x the implied maximum seasonal rate for peanuts). The study suggests that tetraconazole is more extensively metabolized in rotated crops than in primary crops. Tetraconazole was identified in all rotational commodities from all plantback intervals at 0.54-11.31% of TRR (0.008-0.165 ppm). The following additional metabolites were identified at >10% TRR: triazolyl alanine, triazolylhydroxypropionic acid, and triazolylacetic acid.

Conclusions: Pending submission of storage stability data to validate the storage conditions and intervals of rotational crop commodities, the submitted confined rotational crop study for triazole-labeled tetraconazole is adequate for the purposes of this petition. However, as the triazole-labeled study showed evidence for cleavage of tetraconazole occurring between the phenyl and triazole rings, a rotational crop study using phenyl-labeled tetraconazole is needed to determine whether this moiety is translocated into the rotational crops.

Although the petitioner has not proposed plantback restrictions for rotational crops on the product label, rotational restrictions are required. Subject to change based on the results of the requested phenyl-labeled tetraconazole rotational crop study, the rotational restrictions are specified in the "OPPTS GLN 860.1200: Proposed Uses" section of this document. If the petitioner wishes to have rotational restrictions other than those specified in this document, then the petitioner should submit limited field trial data depicting tetraconazole residues of concern in/on rotational crops at the plantback interval(s) the petitioner wants to support.

The HED MARC tentatively determined that the residue of concern in rotational crops is tetraconazole *per se*. However, before this conclusion can be finalized, the MARC requires review of the requested rotational crop study using phenyl-labeled tetraconazole, and consideration of the HIARC deliberations on triazole (D264157, W. Donovan and D. Nixon, 19-APR-2000).

Codex Issues

There are no established Codex, Canadian, or Mexican limits for residues of tetraconazole in/on plant or livestock commodities (see Attachment I). Therefore, no compatibility issues exist with regards to the proposed tolerances discussed in this petition review.

List of Attachments

I. International Residue Limit Status Sheet
II. Figure 1

AGENCY MEMORANDA CITED IN THIS DOCUMENT

CBTS No(s):	16886
DP Barcode:	D222979
Subject:	Tetraconazole - Review of 8/16/95 Meeting Landis - Field Trial Requirements for Imported Coffee and Bananas.
From:	G.F. Kramer
To:	S. Robbins
Date:	2/14/96
MRIDs:	None

DP Barcode:	D252214 and D252213
Subject:	ID#99ND0005. Section 18 Exemption for the Use of Tetraconazole on Sugarbeets in North Dakota and Minnesota.
From:	W. Dykstra and L. Cheng
To:	D. Deegan/M. Laws
Date:	3/18/99
MRIDs:	None

DP Barcode:	D254411
Subject:	PP#9F05066; Petition For Permanent Tolerances For Use Of Tetraconazole On Sugar Beets
From:	W. Donovan
To:	M. Waller/L. Jones
Date:	Currently Under Review
MRIDs:	44751311-44751318

DP Barcode:	D259205
Subject:	PP#7E04830; Petition For Import Tolerances For Use Of Tetraconazole On Bananas
From:	W. Donovan
To:	M. Waller/L. Jones
Date:	Currently Under Review
MRIDs:	44268106-44268111

DP Barcode:	D264157
Subject:	Tetraconazole. Results of the HED Metabolism Assessment Review Committee (MARC) Meetings Held on 07- and 14-MAR-2000.
From:	W. Donovan and D. Nixon

To:	G.F. Kramer
Date:	19-APR-2000
DP Barcode:	D264681
Subject:	Tetraconazole in/on Bananas, Peanuts, and Sugar Beets. Request for Petition Method Validation (PMV).
From:	W. Donovan
To:	E.D. Griffith, Jr.
Date:	07-APR-2000

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ATTACHMENT I

INTERNATIONAL RESIDUE LIMIT STATUS

CHEMICAL: Tetraconazole

CODEX NO. N/A

CODEX STATUS:	PROPOSED U.S. TOLERANCES:
✓ No Codex Proposal Step 6 or above	Petition No: PP#9F06023
	Agency Reviewer: W. Donovan
Residue (if Step 8):	Residues Proposed For Inclusion in the Tolerance Expression: Tetraconazole [(±)-2-(2,4-dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl 1,1,2,2-tetrafluoroethyl ether]

Crop(s)	Limit (mg/kg)	Crop(s)	Limit (mg/kg)
		Peanuts (nutmeat)	0.03 ppm
		Peanut meal	0.03 ppm
		Peanut oil	0.1 ppm

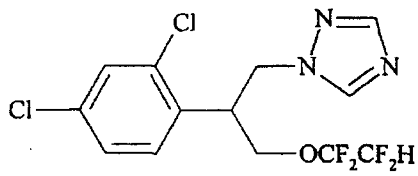
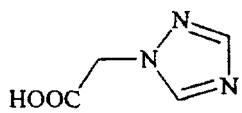
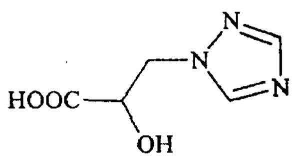
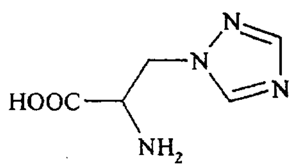
CANADIAN LIMITS:	MEXICAN LIMITS:
✓ No Canadian limit	✓ No Mexican limit
Residue:	Residue:

Crop(s)	Limit (mg/kg)	Crop(s)	Limit (mg/kg)

NOTES:

ATTACHMENT II

Figure 1. Tetraconazole and its metabolites in rotational crop commodities (MRID 44865407.

Common Name Chemical Name	Structure	Substrate
Tetraconazole (±)-2-(2,4-dichlorophenyl)-3-(1H-1,2,4-triazol-1-yl)propyl 1,1,2,2-tetrafluoroethyl ether		30-, 120-, 365-DAT carrot root and top 30-, 120-, 365-DAT lettuce 30-, 120-, 365-DAT wheat forage, grain, and straw
Triazolyl acetic acid (TAA) (1H-1,2,4-triazol-1-yl)acetic acid		30-, 120-, 365-DAT wheat forage, grain, and straw
Triazolyl-hydroxypropionic acid (THP) (2-hydroxy-3-[1H-1,2,4-triazol-1-y]propionic acid		30-, 120-, 365-DAT carrot root and top. 30-, 120-, 365-DAT lettuce 30-, 120-, 365-DAT wheat forage and straw
Triazolyl alanine (TA) 3-(1H-1,2,4-triazol-1-yl)alanine		30-, 120-, 365-DAT carrot root and top 30-, 120-, 365-DAT lettuce 30-, 120-, 365-DAT wheat forage, grain, and straw