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

OFFICE OF PREVENTION, PESTICIDE AND TOXIC SUBSTANCES

MEMORANDUM

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

Date: 6/12/2008

SUBJECT: **Ingredient:** Fenbuconazole
Title: Petition for Registration for Use on Pepper, Bushberry Subgroup (13-B), and Cranberry. Summary of Analytical Chemistry and Residue Data.

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Decision No.: 354084, 354085, 383131, 383432
Petition Nos.: 9E5041, 1E6252, and 7E7256
Risk Assessment Type: None
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Regulatory Action: Section 3
Case No.: None
CAS No.: 114369-43-6
40 CFR: 180.480

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This document was originally prepared under contract by Dynamac Corporation (1910 Sedwick Road, Building 100, Suite B, Durham NC 27713; submitted 1/23/2008). The document has been reviewed by the Health Effects Division (HED) and revised to reflect current Office of Pesticide Programs (OPP) policies.

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Executive Summary

Fenbuconazole [α-[2-(4-chlorophenyl)ethyl]-α-phenyl-1*H*-1,2,4-triazole-1-propanenitrile] is a broad spectrum, triazole-type fungicide that acts by inhibiting sterol biosynthesis in fungi. It is formulated as a flowable concentrate (FlC) or wettable powder (WP), and is currently registered for use on the following food/feed crops: cranberries, the Bushberry Subgroup (Crop Subgroup 13-B), almonds, apples, bananas, citrus fruits, pecans, peanuts, stone fruits, sugar beets, and wheat. Permanent tolerances are established for the combined residues of fenbuconazole and its lactone metabolites, RH-9129 and RH-9130 [trans- or cis-5-(4-chlorophenyl)dihydro-3-phenyl-3-(1*H*-1,2,4-triazol-1-ylmethyl)-2(3*H*)-furanone], expressed as parent in/on plant commodities at levels ranging from 0.05 ppm in/on almonds and pecans to 40 ppm in citrus oil [40 CFR §180.553(a)]. Permanent tolerances have also been established at 0.05 ppm for the combined residues in meat byproducts of cattle, goats, horses, and sheep.

A tolerance of 0.3 ppm is currently in effect for Crop Subgroup 13-B, the Bushberry Subgroup, and a tolerance of 0.5 ppm is in effect for cranberries. These tolerances were recommended by HED in a human health risk assessment performed for several commodities (Memo, D316607, M. Collantes, et al., 8/3/2006). Although the field trial data for blueberries and cranberries were reviewed and a residue chemistry summary document was prepared, the summary document was never finalized. The human health risk assessment referenced above was prepared, however. The bushberry registration was made conditional, and the registrant was asked to submit two additional field trials for blueberries. The blueberry and cranberry field trial data are being included in this document and the associated human health risk assessment (Memo, D344351, D. Dotson, 6/12/2008).

A 75% WP formulation of fenbuconazole (INDAR® 75WSP; EPA Reg, No 62719-421) is currently registered to Dow AgroSciences for use on a variety of fruit and nut crops, sugar beets, and wheat. Interregional Research Project No. 4 (IR-4) has submitted a petition proposing the use of this formulation on peppers for control of Cercospora leafspot and powdery mildew. The proposed use is for multiple broadcast foliar applications to peppers at up to 0.188 lb ai/A/application with a minimum retreatment interval (RTI) of 10 days, for a maximum of 0.75 lb ai/A/season. Applications may be made using either ground or aerial equipment, although use of aerial equipment is not recommended. Ground applications should be made in a minimum volume of 30 gal/A, and can include the use of a non-ionic surfactant. The minimum preharvest interval (PHI) is 7 days for peppers. In conjunction with this use, IR-4 is proposing the following permanent tolerance for the combined residues of fenbuconazole and its lactone metabolites, RH-9129 and RH-9130, expressed as fenbuconazole:

Pepper..... 0.4 ppm

The qualitative nature of fenbuconazole residues in plants is adequately understood based upon the adequate peach, peanut, sugar beet, and wheat metabolism studies. The residues of concern in/on peppers, bushberries, and cranberries, for purposes of both tolerance expression and risk assessment, are fenbuconazole and its lactone metabolites, RH-9129 and RH-9130.

The crop uses being proposed in this petition do not include any regulated livestock feedstuffs. As a result, issues pertaining to livestock metabolism, analytical methods, storage stability in animal commodities, and residues in livestock commodities are not relevant to the current petitions.

A GC/NPD method, 34-90-47R, is currently available for enforcing tolerances of fenbuconazole and its two lactone metabolites (RH-9129 and RH-9130) in/on stone fruits, and a slightly modified version of this method was demonstrated to be adequate for determining residues in peppers. For this method, the validated limit of quantitation (LOQ) for residues in/on peppers is 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The statistically calculated limit of detection (LOD) was 0.003-0.004 ppm for each analyte. The method was adequately validated in conjunction with the pepper field trials.

Method 34-90-47R was demonstrated to be adequate for determining residues in bushberries and cranberries. The validated LOQ is 0.01 ppm for each analyte in/on berries, for a combined LOQ of 0.03 ppm. The LOD was not reported. As currently written, the method expresses residues of RH-9129 and RH-9130 in terms of the individual analytes. To calculate combined residues (expressed as parent), the metabolites must be multiplied by the molecular weight conversion factor of 0.95x. The above method was adequately validated in conjunction with the blueberry and cranberry field trials. The average method recoveries were 89-106% for the three analytes.

Adequate storage stability data were submitted with the pepper field trials, indicating that fenbuconazole and its lactone metabolites are stable in peppers at <-10°C for up to 16.6 months of storage. These data adequately support the maximum duration of frozen storage (16.4 months) from the pepper field trials.

The available storage stability data indicate that residues of fenbuconazole, RH-9129, and RH-9130 are stable in frozen storage for at least 8 months in blueberries and 5.5 months in cranberries. In the current field trials, the maximum frozen storage durations were approximately 8 months for blueberries and approximately 5 months for cranberries.

Adequate field trial data are available supporting the proposed use on peppers. Following the last of four or five broadcast foliar applications of fenbuconazole (WP) at rates totaling 0.66-0.84 lb ai/A/season (0.9-1.1x rates), the combined residues of fenbuconazole, RH-9129, and RH-9130 were 0.05-0.23 ppm in/on 18 samples of bell and non-bell peppers harvested 6-7 days after the last treatment (DAT). Average combined residues were 0.14 ppm in/on peppers at ~7 DAT, and residues were shown to decline at longer post-treatment intervals. No processing studies are required for this petition, as there are no regulated processed commodities associated with peppers.

The available cranberry data are adequate and support the use of up to five foliar applications of fenbuconazole (WP or FlC) at up to 0.188 lb ai/A/application, for a maximum seasonal rate of 0.94 lb ai/A. The data support the label PHI of 30 days, a minimum RTI of 10 days, and the use of a non-ionic surfactant in the spray mix. In the five cranberry field trials, the combined residues of fenbuconazole and its lactone metabolites were 0.09-0.49 ppm in/on 10 samples harvested 25-28 DAT, and average combined residues were 0.199 ppm.

Nine of the ten submitted blueberry field trials are adequate. Eight acceptable field trials are needed for blueberries. Data from the blueberry field trials support the use of up to five foliar applications of fenbuconazole (WP or FlC) to bushberries at up to 0.094 lb ai/A/application, for a maximum seasonal rate of 0.47 lb ai/A. The data support the label PHI of 30 days, a minimum RTI of 10 days, and the use of a non-ionic surfactant in the spray mix. The combined residues of fenbuconazole, RH-9129, and RH-9130 (expressed as parent) were <0.03-0.24 ppm in/on 18 samples harvested 25-35 DAT and average combined residues were 0.083 ppm.

Adequate confined rotational crop studies are available and indicate that the metabolite profile in rotational crops is similar to the metabolite profile in primary crops. The rotational crop restrictions on the current label for the 75% WP are adequate. No limited rotational crop field trials or rotational crop tolerances are required.

Regulatory Recommendations and Residue Chemistry Deficiencies

In its February 7, 2006 risk assessment for 1,2,4-triazole and its metabolites, triazole alanine and triazole acetic acid (M. Doherty et al, DP# 322215), HED recommended that resolution of various issues be made a condition of registration for new uses of triazole-derivative fungicides and for new active ingredients which contain the 1,2,4-triazole ring. The requirement for a chronic toxicity/oncogenicity study in male rats and female mice in the 2/7/2006 memo was later modified by HED to a 1-year chronic study in male and female rats (D321328, Kit Farwell, 5/10/2006). The other conditions of registration that were listed in the 2/7/2006 risk assessment have not been satisfied and are conditions for the use of fenbuconazole on peppers.

No major deficiencies were noted in the subject petition that would preclude establishing a permanent tolerance for fenbuconazole on peppers. However, an error was noted in the proposed use directions and no data were provided on residues of 1,2,4-triazole, triazole alanine, or triazole acetic acid. These deficiencies (see below) need to be resolved as a condition of registration. HED recommends establishing a permanent tolerance with a conditional registration for the combined residues of fenbuconazole and Metabolites RH-9129 and RH-9130, expressed as parent, in/on pepper at 0.40 ppm.

- The use directions contain an error in the single use rate. The single application rate is specified as 2-4 oz. of product (75% WP)/A/application, which is equivalent to 0.094-0.188 lb ai/A/application. However, in terms of lb ai/A, the directions indicate that the rate is 0.10-0.167 lb ai/A. This error should be corrected. The data will support a maximum single use rate of up to 0.188 lb ai/A.

- Although adequate residue data were provided on fenbuconazole and its regulated metabolites RH-9129 and RH-9130, none of the samples were analyzed for residues of triazole, triazole alanine, or triazole acetic acid, as required by current Agency guidance (Memo, D327788, M. Doherty, 4/25/2006).

For Crop Subgroup 13-B, the Bushberry Subgroup, HED is in agreement with the registrant that adequate field trials have been submitted. In order for the conditional registration to be

converted to unconditional, the data for the triazole metabolites, discussed above, should be submitted and be considered to be adequate by the Agency.

Deficiencies Cited in Previous Actions

In its risk assessment of 8/3/2006, HED noted several data deficiencies (Memo, D316607, M. Collantes, et al, 8/3/2006). Dow AgroSciences addressed some of these deficiencies in two letters that were submitted to the Agency (3/30/2007 and 7/12/2007). HED has evaluated Dow's responses to the data deficiencies.

HED requested that Dow submit updated analytical reference standards for fenbuconazole, RH-9129, and RH-9130. These standards have been submitted.

HED requested that Dow submit an apple processing study. This study has been submitted; however, it has not been reviewed by HED.

HED requested that Dow submit the results of two additional blueberry field trial studies. As discussed in this summary document, two acceptable studies were submitted.

HED requested that Dow submit the results of 20 field trials performed on wheat forage and 12 field trials performed on wheat hay. Dow has not submitted the requested data. Dow's representative responded by stating that Dow is of the opinion that the 8 field trials that were performed for each commodity should be sufficient. The OPPTS Series 860 Guidelines recommend that 20 field trials be performed for each of these commodities. As stated above, Dow performed 8 trials for each. The forage trials were performed at a 2x application rate. Dow's representative gave 3 reasons as to why Dow felt that the original 8 trials should be satisfactory: (1) the maximum application rates used in the 8 trials were the same or lower than the currently labeled ones, (2) the cattle dietary intake of fenbuconazole residues through ingestion of wheat forage and hay is insignificant because very little wheat is treated with fenbuconazole (compared to other commodities), and because wheat forage and hay make up a small fraction of cattles' diets, and (3) based on the results of the ruminant metabolism study, the secondary residues in cattle would be very low. Most forage and hay used for cattle feed is grown in the Southern United States. The field trials were performed in Ohio, Michigan, Minnesota, North Dakota, South Dakota, Nebraska, Montana, and Wyoming. Most of these states are more northern. HED continues to request that twenty field trials be performed for forage and 12 trials be performed for hay. HED bases this request on the following three factors: 1) considerably fewer trials were performed than are generally needed, 2) all of the forage trials were performed at a 2x rate, and 3) the trials were not performed in major feedstuff producing geographical regions.

HED requested that Dow submit another citrus processing study. In the original study, samples were not analyzed within the time interval for which residues have been demonstrated to be stable. Fenbuconazole residues have been shown to be stable in fruit for 8 months and in oil and dried pulp for 12 months. In the citrus processing study, the maximum storage durations were 24 months for fruit and 39 months for oil and dried pulp. Rather than performing another citrus processing study, Dow requested that the Agency translate peach and apple storage stability data

to the processed citrus fractions. In peaches and apples, very little decay occurred in residues of fenbuconazole and the metabolites RH-9129 and RH-9130 over a period of 54 months (4.5 years) and 36 months, respectively. In peaches, percent recovery after 54 months for the 3 analytes is as follows: fenbuconazole (94%), RH-9129 (91%), and RH-9130 (87%). In apples, percent recovery after 36 months for the 3 analytes is as follows: fenbuconazole (103%), RH-9129 (97%), and RH-9130 (93%). The available storage stability data for peaches, apples, and processed citrus fractions demonstrate to the satisfaction of HED that residues of fenbuconazole, RH-9129, and RH-9130, would be stable in citrus fruit for 24 months and oil and dried pulp for 39 months.

Finally, HED informed Dow that the analytical method proposed for enforcement of tolerances on animal commodities (GC/NPD Method TR 34-94-142), must undergo a tolerance method validation. BEAD/ACB has not performed the validation.

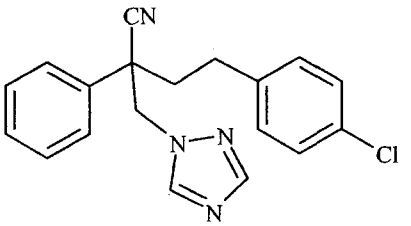
Background

Fenbuconazole is a broad spectrum, triazole-type fungicide used to control various fungal diseases. It acts by inhibiting sterol biosynthesis in fungi (MOA Group 3). Fenbuconazole is formulated as a 2 lb/gal FlC or 75% WP and is registered to Dow AgroSciences, LLC, for use on almonds, apples, bananas, bushberries, citrus fruits, cranberries, pecans, peanuts, stone fruits, sugar beets, and wheat.

IR-4 submitted a petition proposing the use of fenbuconazole, formulated as a 75% WP (Indar® 75WSP; EPA Reg. No. 62719-421), on peppers for the control of Cercospora leaf spot and powdery mildew. The nomenclature of fenbuconazole and its regulated metabolites is presented in Table 1, and the physicochemical properties of fenbuconazole are presented in Table 2.

On behalf of the Blueberry Research Council and the Cranberry Institute, IR-4 submitted tolerance petitions PP#9E5041 and PP#1E6252 supporting the use of fenbuconazole, formulated as a 75% WP, on various bushberries and cranberries for control of mummyberry disease, Septoria leaf spot, anthracnose leaf spot, cottonball disease, and fruit rot diseases. In conjunction with these uses, the petitioner proposed the establishment of permanent tolerances for the combined residues of fenbuconazole and its metabolites RH-9129 and RH-9130, expressed as fenbuconazole, in/on cranberries and Crop Subgroup 13-B, the Bushberry Subgroup. The tolerances are established at 0.3 ppm for bushberries and 0.5 ppm for cranberries.

Table 1. Fenbuconazole Nomenclature.

Compound	
Common name	Fenbuconazole

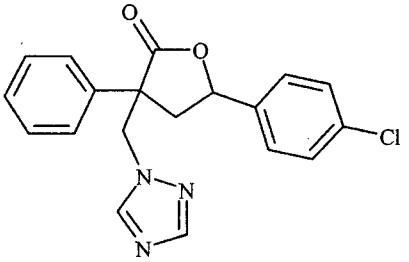
Company experimental name	RH-7592
IUPAC name	(*RS*)-4-(4-chlorophenyl)-2-phenyl-2-(1*H*-1,2,4-triazol-1-ylmethyl)butyronitrile
CAS name	α-[2-(4-chlorophenyl)ethyl]-α-phenyl-1*H*-1,2,4-triazole-1-propanenitrile
CAS #	114369-43-6
End-use product/EP	75% WP (Indar® 75 WSP Fungicide, EPA Reg. No. 62719-421)
Metabolites	 *cis* and *trans* isomers
Common name	*cis* and *trans* lactone metabolites; Lactones A and B
Company experimental names	RH-9129 and RH-9130
IUPAC names	(3R,5R) or (3S,5R)-5-(4-chlorophenyl)-3-phenyl-3-(1H-1,2,4-triazol-1-ylmethyl)dihydrofuran-2(3H)-one
CAS names	*trans*- or *cis*-5-(4-chlorophenyl)dihydro-3-phenyl-3-(1*H*-1,2,4-triazol-1-ylmethyl)-2(3*H*)-furanone
CAS #	*cis* isomer, 146887-38-9; *trans* isomer, 146887-37-8

Table 2. Physicochemical Properties of the Technical Grade Fenbuconazole.

Parameter	Value		Reference
Melting point/range	127°C		DP# D310959, S. Oonnithan, 7/25/2006
pH	not available		
Density (20°C)	0.50 g/mL		
Water solubility (mg/L at 22°C)	3.8 mg/L		
Solvent solubility (g/L at 25°C)	Acetonitrile: 231 Cyclohexanone: 445 ethyl alcohol: 39 1-octanol: 13	aromatic 200: 77 ethyl acetate: 159 heptane: 1.0	
Vapor pressure at 25°C	0.37×10^{-7} mm Hg (4.9×10^{-6} Pa)		
Dissociation constant (pK_a)	Not expected to dissociate in water		
Octanol/water partition coefficient Log(K_{OW})	3.02 ± 0.08		
UV/visible absorption spectrum	λ max (nm) 196 262 268 275	ε ($L \cdot mol^{-1} \cdot cm^{-1}$) 53,000 750 740 480	

860.1200 Directions for Use

There are currently three fenbuconazole end-use products (EPs) registered to Dow AgroSciences for use in the U.S. on food/feed crops. These EPs are marketed under the trade names Enable™ and Indar™ and include a 2 lb/gal FlC and two 75% WPs. IR-4 is proposing the use of a 75% WP (Indar™ 75 WSP; EPA Reg. No. 62719-421) on peppers. An example label was provided for the 75% WP, and the proposed use directions are summarized below in Table 3.

A 75% WP formulation is registered for use on bushberries and cranberries. The use directions are summarized in Table 3.

Table 3. Summary of Directions for Use of Fenbuconazole.

Applic. Timing, Type, and Equip. [1]	Formulation [EPA Reg. No.]	Applic. Rate (lb ai/A)	Max. No. Applic. per Season	Max. Seasonal Applic. Rate (lb ai/A)	PHI (days)	Use Directions and Limitations [2]
Peppers (Including but not limited to: bell, chili, cooking, non-bell, pimento and sweet)						
Broadcast foliar applications to peppers when disease first appears Ground or aerial equipment	75% WP [62719-421]	0.188 [3]	NS	0.75	7	Apply in a minimum of 30 gal/A, using ground equipment. The minimum RTI is 10-14 days. Use of NIS is recommended.
Bushberry Subgroup (including blueberry, currant, elderberry, gooseberry, and huckleberry)						
Broadcast foliar applications beginning at bud break (green tip) through fruit development. Ground or aerial equipment	75% WP [62719-421]	0.094	5	0.47	30	A minimum retreatment interval of 10 days specified. Do apply through any type of irrigation system. For ground and aerial applications, apply in a minimum volume of 10 and 20 gal/A, respectively. A non-ionic surfactant should be used in the spray mix.
Cranberries						
Broadcast foliar applications beginning when 50% of shoots show ¼ inch of new growth, through fruit development. Ground or aerial equipment	75% WP [62719-421]	0.188	5	0.94	30	A minimum retreatment interval of 7 days is specified. Do apply through any type of irrigation system. For aerial applications, apply in a minimum volume of 10 gal/A. A non-ionic surfactant should be used in the spray mix.

[1] Do not apply through any type of irrigation system. Although application using aerial equipment is permitted, ground application is recommended.

[2] Rotational crop restrictions: the minimum plant-back interval is 35 days when the last application of the product is <0.188 lb ai/A, and 210 days when the last application of the product is 0.2-1 lb ai/A.

[3] The maximum use rate is based on the use of 4 oz product/acre/application.

NS = not specified.

Conclusions. The use directions are adequate to allow for evaluation of the residue data relative to the proposed use. The available field trial data on peppers are adequate and support the proposed use; however, the maximum use rate on the label needs to be corrected. The label specifies a maximum application rate of 4 oz product/A or 0.167 lb ai/A; however, 4 oz product/A is actually equivalent to 0.188 lb ai/A. Although the single application rates used in the field trials were ~0.167 lb ai/A (0.9x rate), the residue data from these tests support the 0.188 lb ai/A/application rate.

The available blueberry and cranberry field trial data support the label use directions. Although only the WP formulation is registered for use on bushberries and cranberries, the field trial data using the 75% WP also support the use of FlC and dry flowable (DF) formulations.

860.1300 Nature of the Residue - Plants

MARC Decision memo (N. Dodd and W. Wassell, 3/9/94)
Memo, D200171, N. Dodd, 4/5/94
Memo, D241864, G. Otakie, 3/30/06

Adequate studies are available depicting the metabolism of [^{14}C]fenbuconazole in peaches, peanuts, and wheat. Results from these studies were previously summarized for review by the HED Metabolism Committee (Memo, N. Dodd and W. Wassell, 12/10/93).

In the peach metabolism study, peach trees received five foliar applications of either [phenyl-^{14}C] or [triazolyl-^{14}C] fenbuconazole (6.8% emulsifiable concentrate (EC)) at rates totaling approximately 1 lb ai/A, and whole fruit were sampled at 22 days after the last application. For both ^{14}C-labels, the major residues identified in fruit were fenbuconazole (16-45% TRR) and the lactone metabolite RH-9129 (4-14% TRR). Triazole alanine (RH-3968, 48% TRR) and triazole acetic acid (RH-4098, 7% TRR) were also identified in the [triazolyl-^{14}C]-labeled fruit, and additional analysis by the petitioner detected only minor amounts of glucose conjugates of RH-4911 (4.4% TRR).

In the peanut metabolism study, vine and nutmeat samples were collected 28 days after the last of four foliar applications of either [phenyl-^{14}C] or [triazolyl-^{14}C] fenbuconazole (6.8% EC) at one-month intervals, at rates totaling ~2 lb ai/A. For both ^{14}C-labels, the major residues in vines were parent (45-54% TRR), RH-9129 (4-5% TRR), RH-6467 (8-10% TRR), and the glucose conjugates of 4911 (18-19% TRR). Triazole alanine (7% TRR) was also identified in the [triazolyl-^{14}C]-labeled vines. The major residues in nutmeats were triazole alanine (88% TRR) from the [triazolyl-^{14}C]-label and the glucose conjugate of 4911 (29% TRR) from the [phenyl-^{14}C] label.

In the wheat metabolism study, plants received two foliar applications, 8 days apart, of either [Phenyl-^{14}C] or [Triazolyl-^{14}C] fenbuconazole (7% EC) at rates totaling ~0.72 lb ai/A. Samples of straw, chaff, and grain were collected at 39 days after the second application. For both ^{14}C-labels, the major residues in straw were parent (65% TRR), RH-9129 (8% TRR), and RH-6467 (3-5% TRR). The glucose conjugates of 4911 (3% TRR) were only a minor component of wheat straw. The major residue identified in [phenyl-^{14}C]-labeled grain was parent (12.5% TRR), and the major residues identified in [triazolyl-^{14}C]-labeled grain were triazole alanine (48% TRR) and triazole acetic acid (20% TRR).

Based on the above metabolism studies, the HED Metabolism Committee concluded that the residues of concern for uses on stone fruit, wheat, pecans, bananas, apples, and almonds are fenbuconazole and its lactone metabolites RH-9129 and RH-9130 (N. Dodd and W. Wassell, 3/9/94). Based on differences in metabolism between the three crops, the Committee also concluded that a metabolism study would be required for any crop not botanically similar to the crops for which metabolism studies are available.

The conclusion regarding the residues of concern was contingent upon the petitioner providing data showing that RH-4911 is only a minor residue in these crops. The petitioner subsequently

fulfilled this requirement by providing data from the wheat and peach metabolism studies showing that conjugates of RH-4911 accounted for <5% of the TRR in peaches and wheat straw (D200171, N. Dodd, 4/5/94).

In addition, the Metabolism Committee noted that the iminolactone metabolite (RH-6468) would also be included *de facto* in the residues of concern, as the petitioner has indicated that this compound is converted to the lactones by the analytical methodology.

In addition to the above metabolism studies, an adequate sugar beet metabolism study was reviewed (D241864, 44343303.der) in conjunction with a petition for use on sugar beets. In this study, [phenyl-^{14}C] fenbuconazole (EC) was applied to sugar beets as three foliar applications at 39, 103, and 183 days after planting, at rates totaling 3 lb ai/A, and samples of tops and roots were collected 7 days after the final application. The major residue identified in both tops and roots was parent (83-91% TRR), along with minor amounts of the lactone metabolites (<3% TRR).

Conclusions. Adequate studies are available depicting the metabolism of [^{14}C]fenbuconazole in peaches, peanuts, sugar beets, and wheat. The qualitative nature of fenbuconazole residues in plants is adequately understood for the purposes of the current tolerance petitions. The residues of concern in/on peppers, bushberries, and cranberries are fenbuconazole, its lactone metabolites, RH-9129 and RH-9130, and the triazole metabolites, 1,2,4-triazole, triazole alanine, and triazole acetic acid.

860.1300 Nature of the Residue - Livestock

There are no livestock feedstuffs associated with the established or proposed uses on peppers, bushberries, or cranberries; therefore, data requirements for livestock metabolism are not relevant to this tolerance petition

860.1340 Residue Analytical Methods

A GC/NPD tolerance enforcement method, 34-90-47R, is available for determining residues of fenbuconazole, RH-9129, and RH-9130 in/on stone fruits. For this method, residues are extracted with methanol, filtered through Celite, diluted with aqueous 9.1% NaCl, and partitioned into methylene chloride. Residues are then concentrated, redissolved in toluene:acetone (100:10, v:v), and cleaned up using a silica gel column eluted with toluene:acetone (100:30, v:v). Residues in the resulting eluate are concentrated to dryness, redissolved in toluene:acetone (100:5, v/v), and eluted through a Florisil column with toluene:acetone (100:30, v:v). Residues are again concentrated to dryness, redissolved in toluene:methanol (100:3, v:v), and analyzed by GC/NPD using external standards. The reported LOQ is 0.01 ppm each for fenbuconazole, RH-9129, and RH-9130.

Residues in/on peppers were determined using a slightly modified version of the above method. The modifications were made to improve the performance of the method. The GC/NPD method was adequately validated prior to, and in conjunction with, the analysis of field trial samples

using control samples fortified with each analyte at 0.01-1.0 ppm. The validated LOQ for each analyte is 0.01 ppm in/on peppers, for a combined LOQ of 0.03 ppm.

The above method was validated for analysis on blueberries and cranberries in conjunction with the field trials. For cranberry samples fortified with each analyte separately at 0.01-2.0 ppm, average method recoveries were 101% with a standard deviation (s.d.) of 10% for parent, 100% (s.d. 14%) for RH-9129, and 97% (s.d. 13%) for RH-9130. For blueberry samples fortified with each analyte separately at 0.01-1 ppm, average method recoveries were 102% (s.d. 9%) for parent, 95% (s.d. 6%) for RH-9129, and 96% (s.d. 4%) for RH-9130.

Conclusions. The available GC/NPD method, TR 34-90-47R, is adequate for enforcing tolerances and collecting data on fenbuconazole residues in/on peppers, bushberries, and cranberries.

860.1360 Multiresidue Methods

Adequate multiresidue method testing data are available for fenbuconazole and its lactone metabolites. The FDA PESTDATA database, dated 11/01 (PAM Vol. I, Appendix I), indicates that fenbuconazole is completely recovered using Multiresidue Methods Section 302 (Protocol D), but is not recovered by Methods 303 and 304 (Protocols E and F). The recovery of the lactone metabolites (RH-9129 and RH-9130) through Method 302 was variable or partial (68-92% for RH-9129 and 48-71% for RH-9130), and the recovery of RH-6467 was small (<50%). None of these metabolites were recovered through Methods 303 or 304.

860.1380 Storage Stability

Memo, D249012, W. Wassell, 11/19/98
Memo, D223761, W. Wassell. 4/23/96
Memo, D239002, G. Otakie, 3/30/06

Adequate storage stability data are available indicating that fenbuconazole and its lactone metabolites (RH-9129 and RH-9130) are stable in frozen storage for up to 54 months in pecans and stone fruits, and 36 months in apples, wheat grain, and wheat straw.

In addition, a freezer storage stability study was conducted in conjunction with the pepper field trials. A separate control sample of homogenized peppers was fortified with fenbuconazole, RH-9129, and RH-9130, each at 1.0 ppm, and stored under the same conditions (≤-10°C) as the field trial samples. No 0-day analysis was conducted prior to placing the samples in frozen storage; therefore, the original fortification levels could not be verified. After 16.6 months of frozen storage, the stored samples were analyzed in triplicate along with a control sample and control samples freshly fortified with each analyte at 1.0 ppm. The average recovery (corrected for concurrent recovery) was 89% for fenbuconazole and RH-9130 and 91% for RH-9129. These data indicate that fenbuconazole, RH-9129, and RH-9130 are stable in frozen peppers for up to 16.6 months. Samples from the pepper field trials were stored at <-10°C for up to 16.4 months prior to analysis.

Studies examining the stability of fenbuconazole, RH-9129, and RH-9130 during frozen storage were conducted in conjunction with the blueberry (44690601.der) and cranberry (45296001.der) field trials. Triplicate control samples of blueberry fruit were fortified separately with the three analytes at ~1 ppm and placed in frozen storage (<-14°C) for 240 days, and triplicate control samples of cranberry fruit were fortified separately with the three analytes at 2.02 ppm and placed in frozen storage (<-10°C) for up to 168 days. The stored samples were analyzed along with freshly fortified control samples. For blueberry, average corrected recoveries of parent, RH-9129, and RH-9130 were 99%, 98%, and 100%, respectively, following 7.9 months of frozen storage. For cranberry, average corrected recoveries of parent, RH-9129, and RH-9130 were 91%, 81%, and 91%, respectively, following 5.5 months of frozen storage. In the field trials, the maximum frozen storage durations were 7.9 months for blueberries and 5.3 months for cranberries.

Conclusions. In the pepper storage stability study, no 0-day analysis was conducted on the fortified samples prior to storage. However, for the purposes of the pepper tolerance petition, HED accepts the available data to support the pepper field trials.

The available storage stability data are adequate and support the sample storage durations and conditions used in the blueberry and cranberry field trials.

860.1400 Water, Fish, and Irrigated Crops

There are no proposed uses that are relevant to this guideline topic.

860.1460 Food Handling

There are no proposed uses that are relevant to this guideline topic.

860.1480 Meat, Milk, Poultry, and Eggs

As there are no livestock feedstuffs associated with the proposed/established uses on peppers, blueberries, and cranberries, data requirements pertaining to meat, milk, poultry, and eggs are not relevant to these tolerance petitions.

860.1500 Crop Field Trials

47215801.der (peppers)

IR-4 submitted field trial data on bell and non-bell peppers to support the proposed use of fenbuconazole (WP) on peppers. The results from these tests are discussed below, and the residue data are summarized in Table 4.

Table 4. Summary of Residue Data from Pepper Field Trials with Fenbuconazole (WP).									
Crop matrix	Total Applic. Rate (lb ai/A)	PHI (days)	Combined Residue Levels (ppm) [1]						
			n	Min.	Max.	HAFT [2]	Median	Mean	Std. Dev.
Peppers (proposed use = 0.75 lb ai/A total application rate, 7-day PHI)									
Bell and Non-bell Peppers	0.656-0.844	6-7	18	0.05	0.22	0.21	0.15	0.14	0.06

[1] The calculated LOQs were 0.008 ppm for fenbuconazole, 0.010 ppm for RH-9129 and 0.011 ppm for RH-9130. The calculated LODs were 0.003 ppm for fenbuconazole and RH-9129, and 0.004 ppm for RH-9130. The LLMV in/on peppers for each analyte is 0.01 ppm, for a combined LLMV of 0.03 ppm.

[2] HAFT = Highest average field trial result.

Nine field trials were conducted on bell peppers (6 tests) and non-bell peppers (3 tests) during 2000 in EPA Growing Zones 2, 3, 5, 6, and 10. At each test site, fenbuconazole (75% WP) was applied to peppers during fruit development and maturation as four or five broadcast foliar applications at rates of 0.163-0.173 lb ai/A (0.9x single rate), at RTIs of 10-14 days, for totals of 0.66-0.68 or 0.84 lb ai/A (0.9-1.1x total rate). Three of the nine trials used a fifth application because peppers in these tests were too immature for harvest following the fourth application. All applications were made using ground equipment in volumes of 29-53 gal/A, and included the use of non-ionic surfactants at 0.12-0.13% v/v. Single control and duplicate treated samples of peppers were harvested from each test site at 6-7 DAT. Additional samples from three field trials were collected at 0 and 14 DAT to measure residue decline. Samples were stored frozen for up to 493 days, a duration supported by available storage stability data.

The GC/NPD method used to determine residues of fenbuconazole and Metabolites RH-9129 and RH-9130 in/on peppers was adequately validated prior to, and in conjunction with, the analysis of field trial samples. This method is a slightly modified version of the current tolerance enforcement method for stone fruits. The statistically calculated LOQs were 0.008 ppm for fenbuconazole, 0.010 ppm for RH-9129 and 0.011 ppm for RH-9130. The calculated LODs were 0.003 ppm for fenbuconazole and RH-9129, and 0.004 ppm for RH-9130. The lower limit of method validation (LLMV) in/on peppers for each analyte is 0.01 ppm, for a combined LLMV of 0.03 ppm.

Following four or five foliar applications of fenbuconazole (WP) to peppers at rates totaling 0.66-0.68 or 0.84 lb ai/A (0.9x or 1.1x maximum seasonal rate), residues of fenbuconazole were 0.03-0.21 ppm in/on all 18 samples of bell and non-bell peppers harvested at 6-7 DAT. The extra fifth application had no apparent effect on residue levels. Residues of metabolites RH-9129 and RH-9130 were $\leq$0.01 ppm in/on all pepper samples harvested at 6-7 DAT. The average combined fenbuconazole residue in/on peppers was 0.14 ppm and the highest average field trial (HAFT) combined residues were 0.21 ppm. In the three residue decline tests, average combined fenbuconazole residues in/on peppers declined from 0.25-0.43 ppm at 0 DAT to 0.10-0.19 ppm by 14 DAT.

44690601.der (blueberry)
45268401.der (blueberry)
45296001.der (cranberry)

To support the use of fenbuconazole (75% WP) on cranberries and bushberries, IR-4 submitted field trial data for cranberries and high bush blueberries, respectively. Blueberries are the representative crop for Crop Subgroup 13-B. The results from these field trials are discussed below and summarized in Table 5.

Table 5. Summary of Residue Data for Crop Field Trials using Fenbuconazole (WP).

Commodity (MRIDs)	Formulation	Total Rate (lb ai/A)	PHI (days)	Combined Residues (ppm) [1]						
				n	Min.	Max.	HAFT [3]	Median (STMdR[4])	Mean (STMR[4])	Std. Dev.
Bushberries (proposed use = 0.47 lb ai/A total application rate, 30-day PHI)										
Blueberry [5] (44690601 & 45268401)	75% WP	0.47	25-35	18	0.03	0.24	0.19	0.080	0.083	0.048
Cranberry (proposed use = 0.94 lb ai/A total application rate, 30-day PHI)										
Cranberry (45296001)	75% WP	0.918-0.944	25-28	10	0.09	0.49	0.45	0.160	0.20	0.13

[1] The combined residues include parent and the lactone metabolites RH-9129 and RH-9130, expressed in parent equivalents. The LOQ is 0.01 ppm for each analyte in/on berries, for a combined LOQ of 0.03 ppm. For calculation of the median, mean, and standard deviation, ½LOQ was used for samples with residues <LOQ.
[3] HAFT = Highest Average Field Trial.
[4] STMdR = Supervised Trial Median Residue; STMR = Supervised Trial Mean Residue.
[5] Includes data from the 9 acceptable blueberry field trials only.

Blueberry

Eight blueberry field trials were conducted during 1996 and 1997 (44690601.der) in EPA Growing Zones 1 (NH, 1 trial), 3 (NJ, NC, GA, 1 trial each), 5 (MI, 3 trials) and 12 (OR, 1 trial). Except in the NJ field trial, fenbuconazole (75% WP) was applied to high bush blueberries as five broadcast foliar applications beginning at green tip and continuing through fruit development at target rates of 0.094 lb ai/A/application, for a total of 0.47 lb ai/A/season. Actual application rates were reported for the NJ test only, in which fenbuconazole was applied below the target rate, for a total of 0.28 lb ai/A (0.6x rate). RTIs varied considerably, but were generally 7 to 21 days between the first 4 applications, and 28-39 days between the fourth and fifth applications. In each trial, applications were made using ground equipment at 16-91 gal/A and included the use of a non-ionic surfactant at an unspecified rate. Duplicate control and treated samples of berries were collected from each test at 25-35 DAT. Samples were stored frozen from collection to analysis for up to 7.9 months, a duration supported by the available stability data.

Residues of fenbuconazole, RH-9129, and RH-9130 were determined using the current GC/NPD tolerance enforcement method (Report No. 34-90-47R), with minor modifications. The method was adequately validated in conjunction with the field trial analyses and has an LOQ of 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The LOD was not reported.

There is a question as to the adequacy of the three Michigan field trials that were performed in 1996 and 1997. The trials were conducted with a hand-pumped sprayer. It took about 50 seconds to spray the plot. The sprayer was pumped to 60 psi and then re-pumped to 60 psi after every 15 seconds of spray time. IR-4 personnel stated that they were not certain that that procedure would maintain the appropriate spray pressure, and the low pressures reached were not recorded. Because of the question concerning the adequacy of the Michigan field trials, IR-4 performed two additional trials in 1998. HED considered these trials to be adequate (Memo, D316607, M. Collantes, *et al.*, 8/3/2006). However, HED felt that only six of the ten blueberry field trials that were submitted were adequate. Three were considered to be inadequate because of the pump pressure issue, and the New Jersey trial was considered to be inadequate because it was performed at a 0.6x application rate. In 2006, HED recommended in favor of a conditional registration on bushberries and requested that IR-4 perform two additional field trials. HED requested that these two trials be performed because eight were needed for the Bushberry Subgroup and, as stated above, HED felt that only six acceptable trials had been submitted.

IR-4 personnel responded by stating that they felt that the three original Michigan field trials should be considered to be acceptable. They were of that opinion because the person who made the applications in the field trials was an experienced applicator. They stated that the applicator probably observed the pressure drop during previous applications and compensated for it by re-pumping every 15 seconds of spray time. He calibrated his apparatus in this manner. They also stated that the results of the Michigan field trials were consistent with the results of the other four acceptable field trials. The data from 2 of the 3 trials fall within the ranges of the data from the other trials. Excluding the Michigan trials, the combined residues of parent and metabolites range from 0.05 ppm to 0.24 ppm. In 2 of the Michigan trials the residues range from 0.05 to 0.09 ppm. In the 3rd trial, the combined residues are 0.03 ppm for both samples. In that case, the parent and isomers were all detected at the LOQ of 0.01 ppm.

In the eight field trials, residues of fenbuconazole ranged from <0.01 ppm to 0.20 ppm. Residues of RH-9129 ranged from <0.01ppm to 0.03 ppm, and residues of RH-9130 were either at, or below, the LOQ of 0.01 ppm. Combined residues, expressed as parent equivalents, ranged from 0.03 ppm to 0.24 ppm.

In the 2 additional blueberry field trials conducted during 1998 in Michigan (45268401.der), fenbuconazole (75% WP) was applied to high bush blueberries as five broadcast foliar applications beginning at green tip and continuing through fruit development at 0.094-0.096 lb ai/A/application, for a total of 0.47 lb ai/A/season. RTIs were 7-17 days between the first 4 applications, and 54-64 days between the fourth and fifth applications. Applications were made using ground equipment at ~50 gal/A and included the use of a non-ionic surfactant at ~0.1% of the spray mix. Duplicate control and treated samples of berries were collected from each test at 30 DAT. Samples were stored frozen from collection to analysis for up to 5.2 months, a duration supported by the available stability data.

Residues of fenbuconazole, RH-9129, and RH-9130 were determined using the current GC/NPD tolerance enforcement method (Report No. 34-90-47R), with minor modifications. The method was adequately validated in conjunction with the field trial analyses and has an LOQ of 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The LOD was not reported.

Residues of fenbuconazole were 0.06-0.07 ppm in/on the 4 blueberry samples from the two additional trials, and residues of both RH-9129 and RH-9130 were at or below the LOQ of 0.01 ppm in all samples. Combined residues (expressed in parent equivalents) were 0.08 to 0.09 ppm.

Considering both sets of blueberry field trials together, nine field trials are available reflecting the 1x application. The combined residues of fenbuconazole, RH-9129, and RH-9130 (expressed as parent) were 0.03-0.24 ppm in/on 18 samples harvested 25-35 DAT. Average combined residues are 0.083 ppm (with a standard deviation of 0.048 ppm) and combined HAFT residues are 0.19 ppm. Apparent residues of each analyte are <LOQ in/on all 18 control samples.

The geographical representation of field trials is not completely in accordance with that which is recommended in the OPPTS Series 860 Guidelines. Three trials in Zone 2 are recommended, but only two acceptable trials were submitted. The New Jersey trial was performed in Zone 2, but it is not acceptable. However, 5 acceptable trials were performed in Zone 5 whereas only 3 are recommended.

Cranberry

In five field trials conducted during 1998, fenbuconazole (75% WP) was applied to cranberries as five broadcast foliar applications at 0.178-0.194 lb ai/A/application, for a total of 0.918-0.944 lb ai/A/season. Applications began at flowering and continued through fruit development at RTIs of 10-14 days. Applications were made using ground equipment at 30-300 gal/A and included the use of a non-ionic surfactant at ~0.1% of the spray volume. Duplicate control and treated samples of cranberries were harvested from each test at 25-28 DAT. Samples were stored frozen from collection to analysis for up to 5.3 months, a duration supported by the available storage stability data.

Residues of fenbuconazole, RH-9129, and RH-9130 were determined using the GC/NPD tolerance enforcement method (Report No. 34-90-47R), with minor modifications. The method was adequately validated in conjunction with the field trial analyses and has an LOQ of 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The LOD was not reported.

At 25-28 days after the final application, residues of fenbuconazole were 0.07-0.45 ppm in/on 10 treated cranberry samples. Residues of RH-9129 were 0.01-0.04 ppm and residues of RH-9130 were <0.01-0.01 ppm, for total combined residues of 0.09-0.49 ppm (expressed in parent equivalents). Average combined residues were 0.20 ppm and combined HAFT residues were 0.45 ppm. Apparent residues of each analyte were <LOQ in/on all 10 control samples.

Conclusions. Although the single application rates for peppers were slightly below (0.9x) the maximum proposed use rate, the submitted field trial data are adequate and support the use of fenbuconazole (WP) on peppers. Adequate numbers of tests were conducted in the appropriate geographical regions, and samples were analyzed for residues of concern using an adequate data collection method.

HED concludes that nine of the ten submitted blueberry field trials are adequate. The trial performed in New Jersey is not adequate because the application rate is only 0.6x the label rate.

HED feels that the three original Michigan field trials are acceptable. Although there is a question as to the application technique, the results of the trials in question are consistent with the results of the other trials. In one of these trials, residues were below the range of residue values in the other trials; however, they were not significantly below. When the recommended tolerance is determined using HED's statistical tolerance generator, the same tolerance is generated regardless of whether or not this sample is included. The recommended tolerance is 0.25 ppm. In addition, the field report states that application instrumentation was calibrated at each application.

In the nine acceptable field trials, fruit samples were collected at the appropriate intervals, and were analyzed using an adequate method. The sample storage durations are also supported by the available storage stability data. Data from these nine blueberry field trials support the use of up to five foliar applications of fenbuconazole (WP or FlC) to bushberries at up to 0.094 lb ai/A/application, for a maximum seasonal rate of 0.47 lb ai/A. The data support the established PHI of 30 days, a minimum RTI of 10 days, and the use of a non-ionic surfactant in the spray mix.

For cranberries, adequate numbers of tests were conducted in representative geographic regions, and the fruit samples were collected at intervals slightly shorter than the proposed PHI. Samples were analyzed using an adequate method, and the sample storage durations are supported by the available storage stability data. The available cranberry data are adequate and support the use of up to five foliar applications of fenbuconazole (WP or FlC) at up to 0.188 lb ai/A/application, for a maximum seasonal rate of 0.94 lb ai/A. The data support the proposed PHI of 30 days, a minimum RTI of 10 days, and the use of a non-ionic surfactant in the spray mix. As maximum combined residues were 0.49 ppm at 25-28 DAT, a tolerance of 0.5 ppm will be sufficient to cover the 30-day PHI. In the pepper, blueberry, and cranberry field trials, no residue data were provided on 1,2,4-triazole, TA, or TAA as required under the current guidance for field trials using triazole compounds (Memo, D327788, M. Doherty, 4/25/2006).

860.1520 Processed Food and Feed

HED does not require residue data for any processed commodities associated with peppers, blueberries, or cranberries. Therefore, data requirements for processed food and feed are not relevant to these tolerance petitions.

860.1650 Submittal of Analytical Reference Standards

Analytical reference standards for fenbuconazole and its metabolites, RH-9129 and RH-9130, are available at the EPA National Standards Repository (Electronic communication, D. Wright, 4/21/2008). Their expiration dates are as follows: fenbuconazole (3/21/2009), RH-9129 (1/4/2009), and RH-9130 (8/17/2009).

860.1850/1900 Confined and Field Accumulation in Rotational Crops

D259204, S. Oonnithan, 7/25/06

An adequate confined rotational crop study is available indicating that the metabolite profile for fenbuconazole in rotational crops is similar to the metabolism in primary crops. Limited rotational crop field trials and rotational crop tolerances are not required provided that the labels specify a minimum PBI of 35 days following applications to peppers totaling ≤0.188 lb ai/A and a minimum PBI of 210 days following applications totaling 1.0 lb ai/A.

As bushberries and cranberries are perennial crops, requirements pertaining to rotational crops are not relevant to these petitions.

860.1550 Proposed Tolerances

For purposes of establishing tolerances, HED has concluded that the residues of concern in plants include fenbuconazole and its lactone metabolites, RH-9129 and RH-9130. A permanent tolerance is established for the combined residues of fenbuconazole and Metabolites RH-9129 and RH-9130, expressed as parent equivalents on cranberries at 0.5 ppm. A tolerance is established for the Bushberry Subgroup, Crop Subgroup 13-B, at 0.3 ppm.

Using the Agency's *Guidelines for Setting Pesticide Tolerances Based on Field Trial Data*, the appropriate tolerance for pepper was calculated using the 6-7 DAT residue data from the adequate U.S. field trials conducted at a 0.9x rate. The calculated tolerance for peppers was 0.40 ppm (Appendix II). The tolerances that are generated for cranberries and blueberries are 0.70 ppm and 0.25 ppm, respectively.

Maximum residue limits (MRLs) for residues of fenbuconazole have been established by Codex, Canada, and Mexico. The residue definition for both Codex and Mexico is fenbuconazole, *per se*, and the Canadian residue definition is the combined residues of fenbuconazole and its metabolites, RH-9129 and RH-9130, each expressed as parent (*i.e.*, the same as the U.S. tolerance definition). As there are no established or proposed Canadian, Mexican, or Codex MRLs for fenbuconazole on peppers, there are no international harmonization issues for the pepper tolerance petition.

The U.S. has already established tolerances for cranberries at 0.5 ppm and bushberries at 0.3 ppm. Mexico established tolerances for these commodities based on the established U.S. tolerances. Therefore, HED recommends that the current tolerances remain in effect, even though they are different than the tolerances that are recommended by HED's statistical tolerance generator. As a result, HED recommends that the 0.30 ppm tolerance for bushberries remain in effect, even though the tolerance generator recommends a tolerance of 0.25 ppm, and the 0.50 ppm tolerance for cranberries remain in effect, even though the tolerance generator recommends a tolerance of 0.70 ppm.

Table 6. Tolerance Summary for Fenbuconazole.

Commodity	Proposed Tolerance (ppm)	Recommended Tolerance (ppm)	Comments; Correct Commodity Definition
Pepper	0.4	0.40	Adequate field trial data are available on peppers. Commodity definition: Pepper

References

Fenbuconazole on Stone Fruit, Pecans, Almonds, Bananas, Apples, and Wheat. New Chemical Registration. Issues to be Presented at the 12/15/93 Meeting of the HED Metabolism Committee., N. Dodd and W. Wassell, 12/10/93

Fenbuconazole Metabolism in Stone Fruit, Pecans, Almonds, Bananas, Apples, and Wheat. The HED Metabolism Committee Meeting Held on 3/1/94., N. Dodd and W. Wassell, 3/9/94.

D200171, PP#1F3995. Fenbuconazole on Pecans. Amendment dated 2/25/94, N. Dodd, 4/5/1994.

D197760, PP# 1F3989 - Fenbuconazole on Stone Fruit. Revised Enforcement Method, N. Dodd, 4/8/94, MRID: 43044401.

D223758, PP#2F4127. Fenbuconazole, Govern 2F and Govern 75WSP Agricultural Fungicide in or on Wheat. Amendment of 2/1/96, W. Wassell, 4/23/96.

D249012, Fenbuconazole (RH-7592 Technical, Enable 2F and Indar 75WSP, respectively) in/on the Crop Group Stone Fruit (except plums and prunes) and the Crops Bananas and Pecans. Evaluation of Crop Field Trial Data and Storage Stability Data, W. Wassell, 11/19/98.

D241864, Fenbuconazole. Request for Tolerances on Sugar Beets. Summary of Analytical Chemistry and Residue Data. Petition Number: 7F4887, G. Otakie, 3/30/06.

D239002, Fenbuconazole. Request for Tolerances on Apples. Summary of Analytical Chemistry and Residue Data. Petition Number 2F4135, G. Otakie, 3/30/06.

327788, Triazole-Based Metabolites: Guidance On Residue Chemistry Data Submissions, M. Doherty, 4/25/2006.

D259204, Fenbuconazole. Request for Tolerances on Peanuts. Summary of Analytical Chemistry and Residue Data, S. Oonnithan, 7/25/06.

Multiresidue Test Information for Updating PAM I, N. Dodd, 1/27/93, MRID: 41875044.

Attachments:

Appendix I – International Residue Limit Status sheet
Appendix II - Tolerance Assessment Calculations and Field Trial Results

Appendix I. International Tolerances

INTERNATIONAL RESIDUE LIMIT STATUS

Chemical Name:	Common Name:	X Proposed tolerance	Date: 1/22/2008
α-[2-(4-chlorophenyl)ethyl]-α-phenyl-1*H*-1,2,4-triazole-1-propanenitrile	Fenbuconazole	☐ Reevaluated tolerance ☐ Other	

Codex Status (Maximum Residue Limits)	**U. S. Tolerances**
☐ No Codex proposal step 6 or above X No Codex proposal step 6 or above for the crops requested	**Petition Numbers**: 7F7256 **DP Number:** 345256 **Other Identifier:**
Residue definition (step 8/CXL): Fenbuconazole	**Reviewer/Branch:** C. Swartz/RAB2
	Residue definition: Combined residues of fenbuconazole and its lactone metabolites, RH-9129 and RH-9130, each expressed as fenbuconazole.

Crop (s)	MRL (mg/kg)	Crop(s)	Tolerance (ppm)
		Peppers	0.40
		Bushberry Subgroup	0.3
		Cranberry	0.5

Limits for Canada	**Limits for Mexico**
☐ No Limits X No Limits for the crops requested	☐ No Limits ☐ No Limits for the crops requested
Residue definition: Combined residues of fenbuconazole and its lactone metabolites, RH-9129 and RH-9130, each expressed as fenbuconazole.	Residue definition: Fenbuconazole

Crop(s)	MRL (mg/kg)	Crop(s)	MRL (mg/kg)
		Blueberries	0.3 ppm (US tolerance)
		Cranberries	0.5 ppm (US tolerance)

Notes/Special Instructions:

Appendix II - Tolerance Assessment Calculations and Field Trial Results.

The dataset used to establish a tolerance for fenbuconazole on peppers consisted of field trial data representing application rates of 0.66-0.84 lb ai/A (4 or 5 applications at 0.163-0.173 lb ai/A/application, 0.9x single rate) with a 6 or 7-day PHI. As specified by the *Guidance for Setting Pesticide Tolerances Based on Field Trial Data* SOP, the field trial application rates and PHIs are within 25% of the maximum label application rate and minimum label PHI, respectively. The residue values used to calculate the tolerance are provided in Table II-1. The combined residues of fenbuconazole and its metabolites were above the LOQ (0.03 ppm) in all field trial samples.

The dataset was entered into the tolerance spreadsheet. Visual inspection of the lognormal probability plot (Figure II-1) provided in the spreadsheet indicates that the dataset is reasonably lognormal. The result from the approximate Shapiro-Francia test statistic (Figure II-2) confirmed that the assumption of lognormality should not be rejected. Because the field trial data for the combined residues represent a large dataset (>15 samples) and are reasonably lognormal, the 99th percentile was selected as the appropriate percentile for the pepper tolerance level (0.40 ppm).

Table II-1.	**Residue data used to calculate tolerance for fenbuconazole on peppers.**	
Regulator:	EPA	
Chemical:	Fenbuconazole	
Crop:	Bell and Non-Bell Peppers	
PHI:	6-7 days	
App. Rate:	0.66-0.84 lb ai/A/season	
Submitter:	IR-4	
MRID Citation:	MRID 47215801	
	Combined Residues	
	0.05	0.16
	0.06	0.16
	0.07	0.17
	0.07	0.17
	0.07	0.18
	0.07	0.19
	0.10	0.22
	0.12	0.22
	0.14	0.22

Figure II-1. Lognormal probability plot of fenbuconazole field trial data for peppers

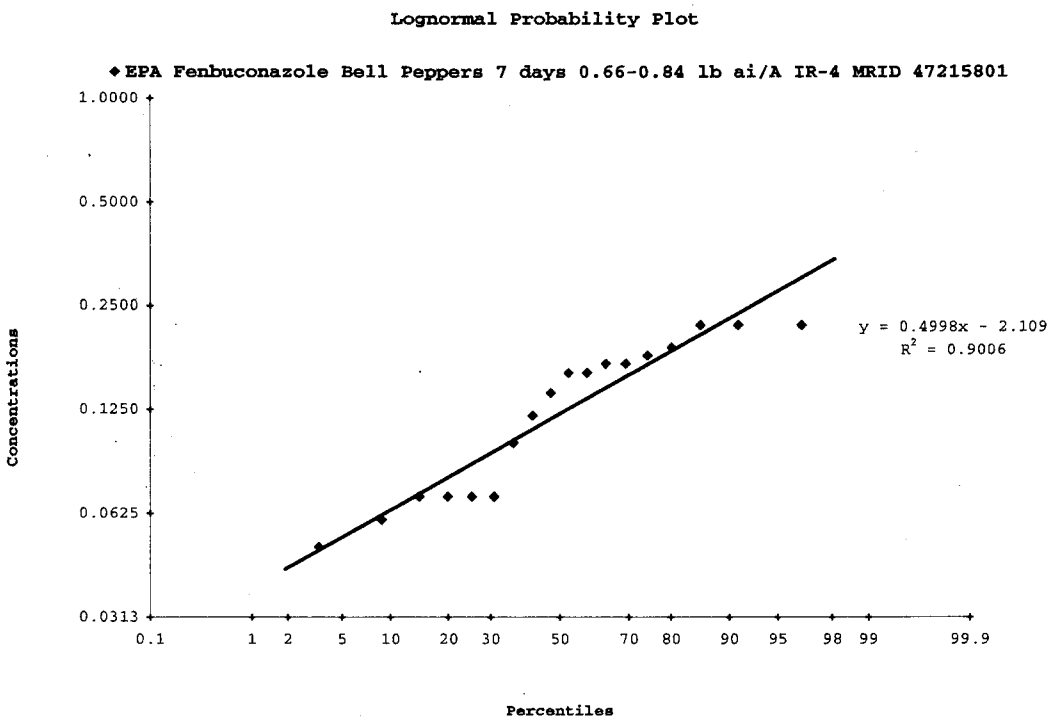


Figure II-2. Tolerance spreadsheet summary of fenbuconazole field trial data for peppers.

Regulator:	EPA
Chemical:	Fenbuconazole
Crop:	Bell Peppers
PHI:	7 days
App. Rate:	0.66-0.84 lb ai/A
Submitter:	IR-4
MRID Citation:	MRID 47215801
n:	18
min:	0.05
max:	0.22
median;	0.15
average:	0.14

	95th Percentile	99th Percentile	99.9th Percentile
EU Method I Normal	0.25 (0.30)	0.30 (0.35)	0.35 (--)
EU Method I Log Normal	0.30 **(0.45)**	**0.40** (0.70)	0.60 (--)
EU Method II Distribution-Free	0.40		
California Method μ + 3σ	**0.35**		
UPLMedian95th	**1.0**		
Approximate Shapiro-Francia Normality Test	0.9006 p-value > 0.05 : Do not reject lognormality assumption		

Would you like the above values rounded? (Y or N)==> Y

Table II-2.	**Blueberry Field Trial Data**	
Chemical:	Fenbuconazole	
Crop:	Blueberries	
PHI:	25-35 days	
App. Rate:	0.47 lb ai/A/season	
Submitter:	IR-4	
MRID Citation:	MRIDs 44690601 and 45268401	
	Combined Residues (ppm)	
	0.03	0.08
	0.03	0.08
	0.05	0.08
	0.05	0.09
	0.05	0.09
	0.05	0.10
	0.07	0.12
	0.08	0.13
	0.08	0.24

Table II-3.	**Cranberry Field Trial Data**	
Chemical:	Fenbuconazole	
Crop:	Cranberries	
PHI:	25-28 days	
App. Rate:	0.92-0.94 lb ai/A/season	
Submitter:	IR-4	
MRID Citation:	MRID 45296001	
	Combined Residues (ppm)	
	0.09	0.17
	0.10	0.17
	0.11	0.20
	0.12	0.41
	0.16	0.47

Fenbuconazole/129011/IR-4
DACO 7.4.1/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIIA 8.3.1, 8.3.2, 8.3.3
Crop Field Trial – Blueberry

Primary Evaluator: Douglas Dotson, Ph.D., Chemist — Date: 6/12/2008

Peer Reviewer: William Drew, Chemist — Date: 6/12/2008

This DER was originally prepared under contract by Dynamac Corporation (1910 Sedwick Rd., Building 100, Suite B; Durham, NC 27713; submitted 5/11/2005). The DER has been reviewed by the HED and revised to reflect current OPP policies.

STUDY REPORT:

44690601 Thompson, D. (1998) Fenbuconazole: Magnitude of the Residue on Blueberry (High Bush). Lab Project Numbers: 06368, 06368.96-DEL02, 06368.96-GA13, 06368.96-MI13, 06368.96-MI14, 06368.96-MI15, 06368.96-NC11, 06368.96-NH04, 06368.96-NJ36, and 06853.98-OR20. Unpublished study prepared by Interregional Research Project No. 4 and Del Monte Research Center. 453 p.

EXECUTIVE SUMMARY:

Eight blueberry field trials were conducted during 1996 and 1997 in the major blueberry producing regions of the U.S. Except in the NJ field trial, fenbuconazole (75% wettable powder (WP)) was applied to high bush blueberries as five broadcast foliar applications beginning at green tip and continuing through fruit development at target rates of 0.094 lb ai/A/application, for a total of 0.47 lb ai/A/season. Actual application rates were reported only for the NJ test, in which fenbuconazole was applied below the target rate, for a total of 0.28 lb ai/A (0.6x rate). Retreatment intervals (RTIs) varied considerably, but were generally 7-21 days between the first 4 applications, and 28-39 days between the fourth and fifth application. In each trial, the applicators made the applications using ground equipment at a rate of 16-91 gal/A. Applications included a non-ionic surfactant at an unspecified rate. Duplicate control and treated samples of berries were collected from each test at 25-35 days after the final application. Samples were stored frozen from collection to analysis for up to 7.9 months, a duration supported by the available stability data.

Residues of fenbuconazole and its two lactone metabolites, RH-9129 and RH-9130, in/on blueberries were determined using the current GC/NPD tolerance enforcement method (Report No. 34-90-47R), with minor modifications. For this method, residues are extracted with methanol, diluted with 10% aqueous NaCl, and partitioned into methylene chloride. Residues are then cleaned up using silica gel and Florisil columns. The residues are concentrated, redissolved in toluene/methanol, and analyzed by GC/NPD using external standards. The method was adequately validated in conjunction with the field trial analyses and has a limit of quantitation (LOQ) of 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The limit of detection (LOD) was not reported.

Questions concerning the adequacy of the application techniques used in the 3 tests conducted in MI (Region 5) could not be resolved because raw data were lost; therefore, these tests are considered to be inadequate. The NJ (Region 2) test is also inadequate as fenbuconazole was applied at rates (0.6x) substantially below the target rate.

Only data from the acceptable field trials conducted in GA, NC, NH, and OR will be considered in assessing possible tolerance levels for blueberry. In these four acceptable field trials, residues of fenbuconazole were 0.03-0.20 ppm in/on 8 blueberry samples harvested 25-35 days following the last of five foliar applications of fenbuconazole (75% WP) at rates totaling 0.47 lb ai/A. For these same samples, residues were <0.01-0.03 ppm for RH-9129, and ≤0.01 ppm for RH-9130. Combined residues, expressed in parent equivalents, were 0.05-0.24 ppm. The average combined residues were 0.0.084 ppm with a standard deviation (s.d.) of 0.055 ppm, and combined HAFT residues were 0.19 ppm. Apparent residues of each analyte were <LOQ in/on all 8 control samples.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the blueberry residue data from 4 of the 8 field trials are classified as scientifically acceptable. The 3 field trials conducted in Region 5 and one of the tests conducted in Region 2 (NJ) are inadequate and cannot be upgraded. Therefore, four additional field trials are required on blueberry in these respective regions. The acceptability of this study for regulatory purposes is addressed in the USEPA. Residue Chemistry Summary Document (Memo, D313752, D. Dotson, 6/12/2008).

COMPLIANCE:

Signed and dated GLP, quality assurance, and data confidentiality statements were provided. No deviations from regulatory requirements were reported that would have an adverse impact on the validity of the study.

A. BACKGROUND INFORMATION

Fenbuconazole is a broad spectrum, triazole-type fungicide, which acts by inhibiting sterol biosynthesis in fungi. In the U.S., fenbuconazole is registered to Dow AgroSciences and is formulated as a 2 lb/gal flowable concentrate (FlC) or 75% wettable powder (WP) under the trade names ENABLE™ and INDAR™, respectively. On behalf of the Blueberry Research Council, IR-4 has submitted a petition (PP#9E5041) proposing the use of fenbuconazole on bushberries for the control of mummyberry disease, Septoria leaf spot, and anthracnose leaf spot. The 75% WP formulation is being proposed for multiple foliar applications to various members of the bush berry subgroup (13B) from bud break through flowering and fruit development.

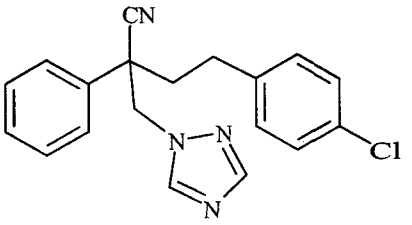
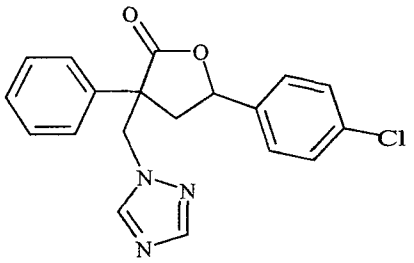
TABLE A.1. Nomenclature of Fenbuconazole and its Regulated Metabolites	
Compound	
Common name	Fenbuconazole
Company experimental names	RH-7592
IUPAC name	(*RS*)-4-(4-chlorophenyl)-2-phenyl-2-(1*H*-1,2,4-triazol-1-ylmethyl)butyronitrile
CAS name	α-[2-(4-chlorophenyl)ethyl]-α-phenyl-1*H*-1,2,4-triazole-1-propanenitrile
Molecular weight	336.8
CAS #	114369-43-6 (119611-00-6, racemate)
End-use products/EP	2 lb/gal FlC and 75% WPs
Metabolites	 *cis* and *trans* isomers
Common name	*cis* and *trans* lactone metabolites
Company experimental names	RH-9129 and RH-9130
IUPAC names	not available
CAS names	*trans*- or *cis*-5-(4chlorophenyl)dihydro-3-phenyl-3-(1*H*-1,2,4-triazol-1-ylmethyl)-2(3*H*)-furanone
Molecular weights	353.8
CAS#s	*cis* isomer, 146887-38-9 *trans* isomer, 146887-37-8

TABLE A.2. Physicochemical Properties of the Technical Grade Fenbuconazole			
Parameter	Value		Reference
Melting point/range	127°C		D310959, S. Oonnithan, 7/25/2006
pH	not available		
Bulk Density	0.50 g/mL		
Water solubility at 22°C	3.8 mg/L		
Solvent solubility (g/L) at 25°C	acetonitrile, 231 cyclohexanone, 445 ethyl alcohol, 39 1-octanol, 13	aromatic 200, 77 ethyl acetate, 159 heptane, 1.0	
Vapor pressure at 25°C (PAI)	0.37×10^{-7} mm Hg (4.9×10^{-6}Pa)		
Dissociation constant (pK_a) (PAI)	Not expected to dissociate in water		
Octanol/water partition coefficient Log(K_{OW})	302 ± 0.08		
UV/visible absorption spectrum	λ max (nm) 196 262 268 275	ε ($LAmol^{-1}Acm^{-1}$) 53,000 750 740 480	

B. EXPERIMENTAL DESIGN

B.1. Study Site Information

Soil type and characteristics were provided for only the 1997 field trial in NJ (Table B.1.1); however, these data are not essential given that fenbuconazole is applied as a foliar application. Detailed meteorological data for rainfall and air temperatures were also not provided, although a general summary of weather conditions was given for each field site. The only unusual weather conditions noted occurred at the GA field site, where a cold period occurred during early bloom, resulting in the loss of most of the flowers. After a delay of 31 days, the fourth application was made to additional flower buds that had opened. These weather conditions were not adverse enough to affect the integrity of the study results. The study use patterns are summarized in Table B.1.2.

TABLE B.1.1 Trial Site Conditions.

Trial Identification (City, State, Year)	Soil characteristics				Meteorological data	
	Type	%OM	pH	CEC	Total weekly rainfall	Overall temperature range (□C)
Byron, GA, 1996	NR	NR	NR	NR	NR	NR
Grand Junction, MI, 1996	NR	NR	NR	NR	NR	NR
Grand Junction, MI, 1996	NR	NR	NR	NR	NR	NR
Grand Junction, MI, 1996	NR	NR	NR	NR	NR	NR
Kensington, NH, 1996	NR	NR	NR	NR	NR	NR
Castle Hayne, NC, 1996	NR	NR	NR	NR	NR	NR
Aurora, OR, 1996	NR	NR	NR	NR	NR	NR
Bridgeton, NJ, 1997	Sandy Loam	2	5.8	NR	NR	NR

NR= Not reported

TABLE B.1.2. Study Use Pattern on Blueberry.

Location (City, State, Year)	Application							
	EP [1]	Method [2]; Timing	Volume (gal/A)	Single Rate (lb ai/A) [3]	No. of Appl.	RTI (days)	Total Rate (lb ai/A) [3]	Tank Mix Adjuvants [4]
Byron, GA, 1996	75% WP	Broadcast foliar; green tip through fruit development	30	0.094	5	7, 19, 31, 34	0.47	Latron AG98
Grand Junction, MI, 1996	75% WP	Broadcast foliar; green tip through fruit development	50	0.094	5	7, 8, 8, 38	0.47	Latron B-1956
Grand Junction, MI, 1996	75% WP	Broadcast foliar; green tip through fruit development	50	0.094	5	7, 8, 8, 38	0.47	Latron B-1956
Grand Junction, MI, 1996	75% WP	Broadcast foliar; green tip through fruit development	50	0.094	5	7, 8, 8, 38	0.47	Latron B-1956
Kensington, NH, 1996	75% WP	Broadcast foliar; green tip through fruit development	16-19	0.094	5	11, 4, 7, 31	0.47	APSA-80
Castle Hayne, NC, 1996	75% WP	Broadcast foliar; green tip through fruit development	91	0.094	5	11, 7, 8, 28	0.47	X-77
Aurora, OR, 1996	75% WP	Broadcast foliar; green tip through fruit development	70	0.094	5	8, 23, 11, 39	0.47	Latron B-1956
Bridgeton, NJ, 1997	75% WP	Broadcast foliar; green tip through fruit development	41-45	0.093[5] 0.046-0.047	5	11, 21, 14, 28	0.28	Agri Dex (1.2%)

[1] EP = End-use Product.
[2] All applications were made using ground equipment.
[3] The maximum proposed use rate is 0.094 lb ai/A/application for a total of 0.47 lb ai/A/season, but the actual use rate was reported for the NJ test site only.
[4] Each field trial used a non-ionic surfactant, but the actual use rate was reported for the NJ test site only.

[5] At the 1997 test in NJ, the first application was made at the target rate of 0.093 lb ai/A, but the four subsequent applications were made at approximately 0.047 lb ai/A (0.5x target rate).

TABLE B.1.3. Trial Numbers and Geographical Locations.

NAFTA Growing Region [1]	Blueberry (high bush)		
	Submitted	Requested	
		Canada	US[1]
1	1	NA	1
2	3	NA	3
3	--	NA	--
4	--	NA	--
5	3	NA	3
6	--	NA	--
7	--	NA	--
8	--	NA	--
9	--	NA	--
10	--	NA	--
11	--	NA	--
12	1	NA	1
Total	8	NA	8

[1] Regions 13-21 and 1A, 5A, 5B, and 7A were not included as the use is for the US only.
NA = not applicable.

B.2. Sample Handling and Preparation

Duplicate control and treated samples of early mature and mature blueberry fruit (2-3 lb per sample) were collected by hand from each test site at 25-35 days following the final application. With the exception of the NH trial, samples were placed in frozen storage within 6 hours of collection and held for 14-37 days in freezers (≤-13°C) at the field sites. Samples were then shipped by ACDS freezer truck to the analytical laboratory, Del Monte Research Center (Walnut Creek, CA), where samples were stored frozen (<-14°C) prior to analysis. Samples from the NH test were placed in frozen storage (-18°C) within 1.5 hours of collection and held at the field site for 5 days prior to shipment by auto to the IR-4 Northeast Regional Laboratory (Geneva, NY). These samples were subsequently shipped by freezer truck to the analytical laboratory. Blueberry samples were stored frozen from collection to analysis for up to 7.9 months.

B.3. Analytical Methodology

Samples from the blueberry field trials were analyzed for residues of fenbuconazole (RH-7592) and its two lactone metabolites (RH-9129 and RH-9130) using the current GC/NPD tolerance enforcement method (Report No. 34-90-47R), with several very minor modifications. This method has been validated by the Agency (DP Barcode D197760, N. Dodd, 4/8/94). A brief description of the method follows.

Chopped samples are mixed with Celite, and residues are extracted by blending with methanol. The extract is filtered and diluted with 10% aqueous NaCl, and residues are partitioned into methylene chloride and concentrated to dryness. Residues are then redissolved in toluene:acetone (100:10) and cleaned up using a silica gel column eluted with toluene:acetone (100:30). Residues in the final eluate are concentrated to dryness, redissolved in toluene:acetone (100:5), and eluted through a Florisil column with toluene:acetone (100:30). Residues are again concentrated to dryness, redissolved in toluene:methanol (100:3), and then analyzed by GC/NPD using external standards for quantitation. The validated LOQ is 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The LOD was not reported. In the study report, residues of RH-9129 and RH-9130 were expressed in terms of the individual metabolites, not in parent equivalents.

In conjunction with the analysis of the field samples, the above GC/NPD method was validated using control samples of blueberry fruit fortified separately with each analyte (in at least triplicate) at levels of 0.01-1 ppm.

C. RESULTS AND DISCUSSION

In the field trials, fenbuconazole (75% WP) was applied to high bush blueberries as five broadcast foliar applications beginning at green tip. Applications continued through fruit development at target rates of 0.094 lb ai/A/application, for a total of 0.47 lb ai/A/season (except for the New Jersey trial). Actual application rates were reported only for the New Jersey test. In this trial, fenbuconazole (75% WP) was applied at 0.093 lb ai/A for the initial application, and at approximately 0.047 lb ai/A for the four subsequent applications, for a total of 0.28 lb ai/A (0.6x the target rate). Retreatment intervals varied considerably, but were generally 7-21 days between the first 4 applications, and 28-39 days between the fourth and fifth application. In each trial, applications were made using ground equipment at 16-91 gal/A, and included the use of a non-ionic surfactant at an unspecified rate. Duplicate control and treated samples of berries were collected from each test at 25-35 days after the final application.

The GC/NPD method, Report No. 34-90-47R, which was used to determine residues of fenbuconazole and its metabolites RH-9129 and RH-9130 in/on blueberry fruit is adequate for data collection. The method was validated in conjunction with the analysis of field trial samples. For the 1996 tests, the average method recoveries from blueberry samples fortified at 0.01-1 ppm were 102% with a standard deviation (s.d.) of 9% from 9 samples fortified with fenbuconazole, 95% (s.d. 6%) from 9 samples fortified with RH-9129, and 96 (s.d. 4%) from 9 samples fortified

with RH-9130 (Table C.1). For the 1997 tests, average recoveries of each analyte were 93-96%. Apparent residues of each analyte were <LOQ in/on all 16 control samples. The validated LOQ for parent and each of the metabolites is 0.01 ppm, for a combined LOQ of 0.03 ppm. For calculation of combined residues, the metabolites were converted to parent equivalents using the molecular weight ratio of 0.95x. Adequate sample calculations and chromatograms were provided.

Samples were stored frozen from collection to analysis for up to 7.9 months (Table C.2.1). To demonstrate the stability of residues during storage, triplicate control samples of blueberry fruit were fortified separately with the three analytes at approximately 1 ppm and placed in frozen storage (<-14°C) for 240 days prior to analysis along with freshly fortified samples. Average corrected recoveries of parent, RH-9129, and RH-9130 were 99%, 98%, and 100%, respectively, following 7.9 months of frozen storage (Table C.2.2). These data are adequate and will support the storage durations in the current blueberry field trials.

Residue data from all eight field trials are reported in Table C.3; however, only data from the acceptable field trials (GA, NC, NH, and OR) are included in the summary (Table C.4). In the four acceptable field trials, residues of fenbuconazole were 0.03-0.20 ppm in/on 8 blueberry samples harvested 25-35 days after the last of five foliar applications of fenbuconazole (75% WP) at rates totaling 0.47 lb ai/A. For these same samples, residues were <0.01-0.03 ppm for RH-9129, and ≤0.01 ppm for RH-9130. Combined residues, expressed in parent equivalents, were 0.05-0.24 ppm. The average combined residues were 0.084 with a s.d. of 0.055 ppm and combined HAFT residues were 0.19 ppm.

Common cultural practices were used to maintain plants, and the weather conditions and the maintenance chemicals and fertilizer used in the study did not have a notable impact on the residue data.

TABLE C.1 Recovery of Fenbuconazole Residues from Blueberry Fruit Using GC/NPD Method (Report No. 34-90-47R).

Matrix	Analyte	Spiking Level (mg/kg)	Sample size	Recoveries (%)	Mean % Recovery ± SD
Concurrent Method Recoveries (1996 tests)					
Blueberry	Fenbuconazole	0.0105	3	103-118	102 ± 9
		0.105	3	94-99	
		1.05	3	92-99	
	RH-9129	0.0122	3	81-101	95 ± 6
		0.122	3	94-98	
		1.22	3	96	
	RH-9130	0.0117	3	89-104	96 ± 4
		0.117	3	92-97	
		1.17	3	94-99	
Concurrent Method Recoveries (1997 test)					
Blueberry	Fenbuconazole	0.026, 0.876	3	91-95	93 ± 2
	RH-9129	0.025, 0.816	3	87-111	96 ± 14
	RH-9130	0.023, 0.776	4	76-116	96 ± 16

TABLE C.2.1 Summary of Freezer Storage Conditions.

Matrix	Storage Temp. (°C)	Actual Storage Duration (days) [1]	Limit of Demonstrated Storage Stability (days) [2]
Blueberry	<-10°C	97-240	240

[1] Extracts were stored frozen for 4-7 days prior to analysis.
[2] Storage stability data were submitted concurrently with the field trials (Table C.2.2).

TABLE C.2.2 Stability of Fenbuconazole Residues in Blueberry Fruit Following Storage at <-14°C.

Matrix	Analyte	Spike level (ppm)	Storage interval (days)	% Recovery	Corrected % recovery[1]
Blueberry	Fenbucon-azole	1.05	0 [2]	92	NA
		1.05	240	92, 92, 90	100, 100, 98 (99) [3]
	RH-9129	1.17	0	93	NA
		1.03	240	92, 91, 90	99, 98, 97 (98)
	RH-9130	1.22	0	92	NA
		1.11	240	93, 92, 90	101, 100, 98 (100)

[1] Corrected for concurrent method recoveries.
[2] Subsamples were spiked and analyzed concurrently with stored samples.
[3] Average corrected recovery is listed in parentheses.
NA = not applicable

TABLE C.3. Residue Data from Blueberry Field Trials with Fenbuconazole (75% WP).

Trial ID (City, Country, Year)	EPA Region	Variety	Total Rate (lb ai/A)	PHI (days) [1]	Residues (ppm) [2]			
					Fenbucon.	RH-9129	RH-9130	Combined [3]
Byron, GA, 1996	2	Georgia Gem	0.47	27	0.03, 0.03	<0.01, <0.01	<0.01, <0.01	0.05, 0.05
Grand Junction, MI, 1996	5	Jersey	0.47	30	0.06, 0.07	0.01, <0.01	<0.01, <0.01	0.08, 0.09
Grand Junction, MI, 1996	5	Jersey	0.47	30	0.03, 0.03	<0.01, <0.01	<0.01, <0.01	0.05, 0.05
Grand Junction, MI, 1996	5	Jersey	0.47	30	0.01, <0.01	<0.01, <0.01	<0.01, <0.01	0.03, 0.03
Kensington, NH, 1996	1	Blue Ray	0.47	25	0.05, 0.06	0.01, 0.01	<0.01, 0.01	0.07, 0.08
Castle Hayne, NC, 1996	2	Croatan	0.47	27	0.20, 0.10	0.03, 0.02	0.01, 0.01	0.24, 0.13
Aurora, OR, 1996	12	Bluecrop	0.47	35	0.08, 0.10	0.01, <0.01	<0.01, <0.01	0.10, 0.12
Bridgeton, NJ, 1997	2	Duke	0.28	25	0.03, 0.04	<0.01, <0.01	<0.01, <0.01	0.05, 0.06

[1] The proposed PHI for blueberry is 30 days.
[2] The LOQ is 0.01 ppm for each analyte; the LOD was not reported.
[3] Combined residues are expressed in parent equivalents, which were calculated by the reviewer using a 0.95x molecular weight conversion factor for the metabolites.

TABLE C.4. Summary of Residue Data for Blueberry from Crop Field Trials using Fenbuconazole (75% WP). [1]

Commodity	Formulation	Total Rate (kg ai/ha)	PHI (days) [2]	Combined Residues (ppm) [3]						
				n	Min.	Max.	HAFT [4]	Median (STMdR[5])	Mean (STMR[5])	Std. Dev.
Blueberry	75% WP	0.47	25-35	14	0.04	0.25	0.19	0.075	0.084	0.055
Blueberry	75% WP	0.28	25	2	0.05	0.06	0.06	0.06	0.06	-

[1] The proposed PHI for blueberry is 30 days.
[2] The combined residues include parent (RH-7592) and its two lactone metabolites RH-9129 and RH-9130, expressed in parent equivalents. Each metabolite was present at ≤0.03 ppm. The LOQ is 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. For calculation of the median, mean, and standard deviation, ½LOQ was used for samples with residues <LOQ.
[3] HAFT = Highest Average Field Trial.
[4] STMdR = Supervised Trial Median Residue; STMR = Supervised Trial Mean Residue.

D. CONCLUSION

The field trial data from the GA, NC, NH, MI, and OR tests are adequate and reflect the use of up to five foliar applications of fenbuconazole (WP) at 0.094 lb ai/A/application during flowering and fruit development, for a total of 0.47 lb ai/A/season. The field trial data from the NJ test are also adequate and reflect the use of up to five foliar applications of fenbuconazole (75%WP), one at 0.093 lb ai/A followed by 4 at 0.046 lb ai/A during flowering and fruit development, for a total of 0.26 lb ai/A/season. The data for all trials also support a minimum RTI of 10 days, a preharvest interval of 30 days, and the use of a non-ionic surfactant.

E. REFERENCES

D197760, PP# 1F3989 - Fenbuconazole on Stone Fruit. Revised Enforcement Method.
N. Dodd, 4/8/94

F. DOCUMENT TRACKING

Petition Number: 9E5041
DP Barcode: D313753
PC Code: 129011

Primary Evaluator _____ Date: 6/12/2008
Douglas Dotson, Ph.D., Chemist, RAB2

Peer Reviewer _____ Date: 6/12/2008
William Drew, Chemist, RAB2

This DER was originally prepared under contract by Dynamac Corporation (1910 Sedwick Rd., Building 100, Suite B; Durham, NC 27713; submitted 5/11/2005). The DER has been reviewed by the HED and revised to reflect current OPP policies.

STUDY REPORT:

45268401 Thompson, D. (1998) Fenbuconazole: Magnitude of the Residue on Blueberry (High Bush). Lab Project Numbers: A6368, A6368.98-DEL08, A6368.98-MI16, and A6368.98-MI17. Unpublished study prepared by IR-4 and Del Monte Research Center. 139 p.

EXECUTIVE SUMMARY:

Two blueberry field trials were conducted during 1998 in MI (Region 5). In both trials, fenbuconazole (75% wettable powder (WP)) was applied to high bush blueberries as five broadcast foliar applications beginning at green tip and continuing through fruit development at 0.094-0.096 lb ai/A/application, for a total of 0.47 lb ai/A/season. Retreatment intervals (RTIs) varied considerably, but were 7-17 days between the first 4 applications, and 54-64 days between the fourth and fifth application. Applications were made using ground equipment at approximately 50 gal/A and included the use of a non-ionic surfactant at 0.1% of the spray mix. Duplicate control and treated samples of berries were collected from each test at 30 days after the final application. Samples were stored frozen from collection to analysis for up to 5.2 months, a duration supported by the available stability data.

Residues of fenbuconazole and its two lactone metabolites, RH-9129 and RH-9130, in/on blueberries were determined using the current GC/NPD tolerance enforcement method (Report No. 34-90-47R), with minor modifications. For this method, residues are extracted with methanol, diluted with 10% aqueous NaCl, and partitioned into methylene chloride. Residues are then cleaned up using silica gel and Florisil columns. The residues are concentrated, redissolved in toluene/methanol, and analyzed by GC/NPD using external standards. The method was adequately validated in conjunction with the field trial analyses and has a limit of quantitation (LOQ) of 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The limit of detection (LOD) was not reported.

Residues of fenbuconazole were 0.06-0.07 ppm in/on 4 blueberry samples harvested 30 DAT, and residues of RH-9129 and RH-9130 were 0.01 and ≤0.01 ppm, respectively, for combined residues (expressed in parent equivalents) of 0.08-0.09 ppm. The average combined residues

were 0.079 ppm with a standard deviation of 0.005 ppm, and combined HAFT residues were 0.085 ppm. Apparent residues of each analyte were <LOQ in/on all 8 control samples.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the blueberry residue data from these two field trials are classified as scientifically acceptable. The acceptability of this study for regulatory purposes is addressed in the USEPA Residue Chemistry Summary Document (Memo, D313752, D. Dotson, 6/12/2008).

COMPLIANCE:

Signed and dated GLP, quality assurance, and data confidentiality statements were provided. No deviations from regulatory requirements were noted that would impact the study results or their interpretation.

A. BACKGROUND INFORMATION

Fenbuconazole is a broad spectrum, triazole-type fungicide, which acts by inhibiting sterol biosynthesis in fungi. In the U.S., fenbuconazole is registered to Dow AgroSciences and is formulated as a 2 lb/gal flowable concentrate (FlC) or 75% wettable powder (WP) under the trade names ENABLE™ and INDAR™, respectively. On behalf of the Blueberry Research Council, IR-4 has submitted a petition (PP#9E5041) proposing the use of fenbuconazole on bushberries for the control of control of mummyberry disease, Septoria leaf spot, and anthracnose leaf spot. The 75% WP formulation is being proposed for multiple foliar applications to various members of the bush berry subgroup (13B) from bud break through flowering and fruit development. The current blueberry field trials were submitted to supplement an earlier series of field trials (44690601.der, under review).

TABLE A.1. Nomenclature of Fenbuconazole and its Regulated Metabolites

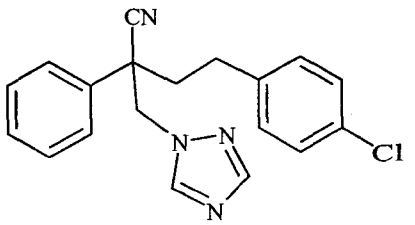
Compound	
Common name	Fenbuconazole
Company experimental names	RH-7592
IUPAC name	(*RS*)-4-(4-chlorophenyl)-2-phenyl-2-(1*H*-1,2,4-triazol-1-ylmethyl)butyronitrile
CAS name	α-[2-(4-chlorophenyl)ethyl]-α-phenyl-1*H*-1,2,4-triazole-1-propanenitrile
Molecular weight	336.8

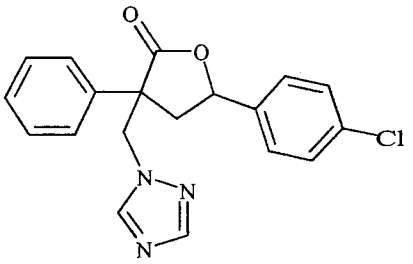
TABLE A.1. Nomenclature of Fenbuconazole and its Regulated Metabolites	
CAS #	114369-43-6 (119611-00-6, racemate)
End-use products/EP	2 lb/gal FlC and 75% WPs
Metabolites	 *cis* and *trans* isomers
Common name	*cis* and *trans* lactone metabolites
Company experimental names	RH-9129 and RH-9130
IUPAC names	not available
CAS names	trans- or cis-5-(4chlorophenyl)dihydro-3-phenyl-3-(1*H*-1,2,4-triazol-1-ylmethyl)-2(3*H*)-furanone
Molecular weights	353.8
CAS#s	*cis* isomer, 146887-38-9 *trans* isomer, 146887-37-8

TABLE A.2. Physicochemical Properties of the Technical Grade Fenbuconazole			
Parameter	Value		Reference
Melting point/range	127°C		D310959, S. Oonnithan, 7/25/2006
pH	not available		
Bulk Density	0.50 g/mL		
Water solubility at 22°C	3.8 mg/L		
Solvent solubility (g/L) at 25°C	acetonitrile, 231 cyclohexanone, 445 ethyl alcohol, 39 1-octanol, 13	aromatic 200, 77 ethyl acetate, 159 heptane, 1.0	
Vapor pressure at 25°C (PAI)	0.37×10^{-7} mm Hg (4.9×10^{-6} Pa)		
Dissociation constant (pK_a) (PAI)	Not expected to dissociate in water		
Octanol/water partition coefficient $Log(K_{OW})$	302 ± 0.08		
UV/visible absorption spectrum	λ max (nm) 196 262 268 275	ε ($LAmol^{-1}Acm^{-1}$) 53,000 750 740 480	

B. EXPERIMENTAL DESIGN

B.1. Study Site Information

Soil type and characteristics were provided for both field trials (Table B.1.1). Detailed meteorological data for rainfall and air temperatures were not provided; however, a general summary of weather conditions was provided noting that the growing season was drier than normal. No other unusual weather conditions were noted. These weather conditions were not adverse enough to affect the integrity of the study results. The study use patterns are summarized in Table B.1.2.

TABLE B.1.1 Trial Site Conditions

Trial Identification (City, State, Year)	Soil characteristics				Meteorological data	
	Type	%OM	pH	CEC	Total weekly rainfall	Overall temperature range (°C)
Douglas, MI, 1998	Sandy loam	2.6	5.1	NR	NR	NR
Douglas, MI, 1998	Sandy loam	2.6	5.0	NR	NR	NR

NR= Not reported

TABLE B.1.2. Study Use Pattern on Blueberry.

Location (City, State, Year)	Application							
	EP [1]	Method [2]; Timing	Volume (gal/A)	Single Rate (lb ai/A) [3]	No. of Appl.	RTI (days)	Total Rate (lb ai/A) [3]	Tank Mix Adjuvants [4]
Douglas, MI, 1998	75% WP	Broadcast foliar; green tip through fruit development	50-51	0.094-0.096	5	9, 17, 7, 64	0.47	0.12% L1-700
Douglas, MI, 1998	75% WP	Broadcast foliar; green tip through fruit development	50	0.094-0.095	5	9, 14, 7, 54	0.47	0.12% L1-700

[1] EP = End-use Product.
[2] All applications were made using ground equipment.
[3] The maximum proposed use rate is 0.094 lb ai/A/application for a total of 0.47 lb ai/A/season.
[4] The amount of non-ionic surfactant is given in terms of percent tank mix.

TABLE B.1.3. Trial Numbers and Geographical Locations.

NAFTA Growing Region [1]	Blueberry (high bush)		
	Submitted	Requested	
		Canada	US[1]
1	--	NA	1
2	--	NA	3
3	--	NA	--
4	--	NA	--
5	2	NA	3
6	--	NA	--
7	--	NA	--
8	--	NA	--
9	--	NA	--
10	--	NA	--
11	--	NA	--
12	--	NA	1
Total	2	NA	8

[1] Regions 13-21 and 1A, 5A, 5B, and 7A were not included as the use is for the US only.
NA = not applicable.

B.2. Sample Handling and Preparation

Duplicate control and treated samples of mature blueberry fruit (2-3 lb per sample) were collected by hand from each test at 30 days following the final application. Samples were placed in frozen storage within 1 hour of collection and held for 4-12 days in freezers (≤-14°C) at the field site. Samples were then shipped by ACDS freezer truck to the analytical laboratory, Del Monte Research Center (Walnut Creek, CA), where samples were stored frozen (<-10°C) prior to analysis. Blueberry samples were stored frozen from collection to analysis for up to 5.2 months.

B.3. Analytical Methodology

Samples from the blueberry field trials were analyzed for residues of fenbuconazole and its two lactone metabolites (RH-9129 and RH-9130) using the current GC/NPD tolerance enforcement method (Report No. 34-90-47R), with several very minor modifications. This method has been validated by the Agency (DP Barcode D197760, N. Dodd, 4/8/94). A brief description of the method follows.

Chopped samples are mixed with Celite, and residues are extracted by blending with methanol. The extract is filtered and diluted with 10% aqueous NaCl, and residues are partitioned into methylene chloride and concentrated to dryness. Residues are then redissolved in toluene:acetone (100:10) and cleaned up using a silica gel column eluted with toluene:acetone (100:30). Residues in the final eluate are concentrated to dryness, redissolved in toluene:acetone (100:5) and eluted through a Florisil column with toluene:acetone (100:30). Residues are again concentrated to dryness, redissolved in toluene:methanol (100:3), and then analyzed by GC/NPD using external standards for quantitation. The validated LOQ is 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The LOD was not reported. Residues of RH-9129 and RH-9130 were expressed in terms of the individual metabolites, not in parent equivalents.

The above GC/NPD method was validated in conjunction with the analysis of the field samples. Control samples of blueberry fruit were fortified separately with each analyte at either 0.01 or 0.10 ppm.

C. RESULTS AND DISCUSSION

To replace three earlier blueberry field trials conducted in MI during 1996 (44690601.der), two additional blueberry field trials were conducted in MI during 1998. Although this submission includes only 2 of the required 8 field trials for blueberry, the adequacy of the geographic representation of field trials will be addressed in the summary document (Memo, D313752, D. Dotson, x/x/2008).

In both tests, fenbuconazole (75% WP) was applied to high bush blueberries as five broadcast foliar applications beginning at green tip and continuing through fruit development at 0.094-0.096 lb ai/A/application, for a total of 0.47 lb ai/A/season. RTIs varied considerably, and were 7-17 days between the first 4 applications and 54-64 days between the fourth and fifth application. Applications were made using ground equipment at 50-51 gal/A and included the use of a non-ionic surfactant at 0.12% of the spray mix. Duplicate control and treated samples of berries were collected from both tests at 30 days after the final application.

The GC/NPD method (Report No. 34-90-47R) used to determine residues of fenbuconazole and its metabolites RH-9129 and RH-9130 in/on blueberry fruit is adequate for data collection. The method was validated in conjunction with the analysis of field trial samples. Average method recoveries for the three analytes were 100-106% from control samples fortified at 0.01 or 1.0 ppm (Table C.1). Apparent residues of each analyte were <LOQ in/on all 4 control samples. The validated LOQ for parent and each of the metabolites is 0.01 ppm, for a combined LOQ of 0.03 ppm. For calculation of combined residues, the metabolites were converted to parent equivalents using the 0.95x molecular weight conversion factor. Adequate sample calculations and chromatograms were provided.

Samples were stored frozen from collection to analysis for up to 5.2 months (Table C.2). This storage duration is supported by the available storage stability data indicating that residues of all three analytes are stable in frozen blueberries for at least 7.9 months (44690601.der).

Residues of fenbuconazole were 0.06-0.07 ppm in/on 4 blueberry samples harvested 30 days after the last of five foliar applications of fenbuconazole (75% WP) totaling 0.47 lb ai/A (Table C.3). Residues of RH-9129 and RH-9130 were 0.01 and ≤0.01 ppm, respectively, for combined residues (expressed in parent equivalents) of 0.08-0.09 ppm. The average combined residues were 0.079 ppm with a standard deviation of 0.005 ppm, and combined HAFT residues were 0.085 ppm (Table C.4).

Common cultural practices were used to maintain plants, and the weather conditions and the maintenance chemicals and fertilizer used in the study did not have a notable impact on the residue data.

TABLE C.1 Recovery of Fenbuconazole Residues from Blueberry Fruit Using GC/NPD Method (Report No. 34-90-47R).

Matrix	Analyte	Spiking Level (mg/kg)	Sample size	Recoveries (%)	Mean % Recovery ± SD
Concurrent Method Recoveries					
Blueberry	Fenbuconazole	0.010	1	104	102
		0.101	1	100	
	RH-9129	0.010	1	107	106
		0.100	1	104	
	RH-9130	0.010	1	100	100
		0.100	1	100	

TABLE C.2.1 Summary of Freezer Storage Conditions.

Matrix	Storage Temp. (°C)	Actual Storage Duration (days) [1]	Limit of Demonstrated Storage Stability (days) [2]
Blueberry	<-10°C	151-159	240

[1] Extracts were stored frozen for 10 days prior to analysis.
[2] Storage stability data were submitted concurrently with another blueberry field trial submission (44690601.der).

TABLE C.3. Residue Data from Blueberry Field Trials with Fenbuconazole (75% WP).

Trial ID (City, Country, Year)	EPA Region	Variety	Total Rate (lb ai/A)	PHI (days) [1]	Residues (ppm) [2]			
					Fenbucon.	RH-9129	RH-9130	Combined [3]
Douglas, MI, 1998	5	Jersey	0.47	30	0.07, 0.06	0.01, 0.01	<0.01, <0.01	0.09, 0.08
Douglas, MI, 1998	5	Jersey	0.47	30	0.06, 0.06	0.01, 0.01	0.01, <0.01	0.08, 0.08

[1] The proposed PHI for blueberry is 30 days.
[2] The LOQ is 0.01 ppm for each analyte; the LOD was not reported.
[3] Combined residues are expressed in parent equivalents, which were calculated by the reviewer using the 0.95x molecular conversion factor for the metabolites.

TABLE C.4. Summary of Residue Data for Blueberry from Crop Field Trials using Fenbuconazole (75% WP).

Commodity	Formulation	Total Rate (kg ai/ha)	PHI (days) [1]	Combined Residues (ppm) [2]						
				n	Min.	Max.	HAFT [3]	Median (STMdR[4])	Mean (STMR[4])	Std. Dev.
Blueberry	75% WP	0.47	30	4	0.080	0.090	0.085	0.078	0.079	0.005

[1] The proposed PHI for blueberry is 30 days.
[2] The combined residues include parent (RH-7592) and its two lactone metabolites RH-9129 and RH-9130, expressed in parent equivalents. Each metabolite was present at ≤0.01 ppm. The LOQ is 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. For calculation of the median, mean, and standard deviation, ½LOQ was used for samples with residues <LOQ.
[3] HAFT = Highest Average Field Trial.
[4] STMdR = Supervised Trial Median Residue; STMR = Supervised Trial Mean Residue.

D. CONCLUSION

The two Michigan field trials are adequate and reflect the use of up to five foliar applications of fenbuconazole (75% WP) at 0.094 lb ai/A/application during flowering and fruit development, for a total of 0.47 lb ai/A/season. The data also support a minimum RTI of 10 days, a preharvest interval of 30 days, and the use of a non-ionic surfactant at 0.1% of the spray mix.

E. REFERENCES

D197760, PP# 1F3989 - Fenbuconazole on Stone Fruit. Revised Enforcement Method., N. Dodd, 4/8/1994

F. DOCUMENT TRACKING

Petition Number: 9E5041
DP Barcode: D313753
PC Code: 129011

Primary Evaluator D. Dotson Date: 6/12/2008
Douglas Dotson, Ph.D., Chemist, RAB2

Peer Reviewer W T Drew Date: 6/12/2008
William Drew, Chemist, RAB2

This DER was originally prepared under contract by Dynamac Corporation (1910 Sedwick Rd., Building 100, Suite B; Durham, NC 27713; submitted 5/11/2005). The DER has been reviewed by the HED and revised to reflect current OPP policies.

STUDY REPORT:

45296001 Thompson, D. (2000) Fenbuconazole: Magnitude of the Residue on Cranberry. Lab Project Numbers: 06853.98-DEL02, 06853.98-MA01, 06853.98-NJ11, 06853.98-OR12, 06853.98-WI08 and 06853.98-WI09. Unpublished study prepared by Interregional Research Project No. 4 and Del Monte Research Center. 209 p.

EXECUTIVE SUMMARY:

In five field trials conducted during 1998, fenbuconazole (75% wettable powder (WP)) was applied to cranberries as five broadcast foliar applications at 0.178-0.194 lb ai/A/application, for a total of 0.918-0.944 lb ai/A/season. Applications were made beginning at flowering and continuing through fruit development at retreatment intervals (RTIs) of 10-14 days. Applications were made using ground equipment at 30-300 gal/A and included the use of a non-ionic surfactant at 0.1% of the spray volume. Duplicate control and treated samples of cranberries were harvested from each test at 25-28 days after the final application. Samples were stored frozen from collection to analysis for up to 5.3 months, a duration supported by the available stability data.

Residues of fenbuconazole and its two lactone metabolites, RH-9129 and RH-9130, in/on cranberries were determined using the current GC/NPD tolerance enforcement method (Report No. 34-90-47R), with minor modifications. For this method, residues are extracted with methanol, diluted with 10% aqueous NaCl, and partitioned into methylene chloride. Residues are then cleaned up using silica gel and Florisil columns. The residues are concentrated, redissolved in toluene/methanol, and analyzed by GC/NPD using external standards. The method was adequately validated in conjunction with the field trial analyses and has a limit of quantitation (LOQ) of 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The limit of detection (LOD) was not reported.

At 25-28 days following the final application, residues of fenbuconazole were 0.07-0.45 ppm in/on 10 treated cranberry samples. Residues of RH-9129 were 0.01-0.04 ppm and residues of RH-9130 were <0.01-0.01 ppm, for total combined residues of 0.09-0.49 ppm (expressed in

parent equivalents). Average combined residues were 0.20 ppm (with a standard deviation of 0.14 ppm), and combined HAFT residues were 0.45 ppm in/on cranberries. Apparent residues of each analyte were <LOQ in/on all 10 control samples.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the cranberry field trial data are classified as scientifically acceptable. The acceptability of this study for regulatory purposes is addressed in the USEPA Residue Chemistry Summary Document (Memo, D. Dotson, D313752, 6/12/08).

COMPLIANCE:

Signed and dated GLP, quality assurance, and data confidentiality statements were provided. No deviations from regulatory requirements were noted that would impact the study results or their interpretation.

A. BACKGROUND INFORMATION

Fenbuconazole is a broad spectrum, triazole-type fungicide, which acts by inhibiting sterol biosynthesis in fungi. In the U.S., fenbuconazole is registered to Dow AgroSciences and is formulated as a 2 lb/gal flowable concentrate (FlC) or 75% WP under the trade names ENABLE™ and INDAR™, respectively. On behalf of the Cranberry Institute, IR-4 has submitted a petition (PP#1E6252) proposing the use of fenbuconazole on cranberries for the control of cottonball disease and fruit rot diseases. The 75% WP formulation is being proposed for multiple foliar applications to cranberry from bud break through flowering.

TABLE A.1. Nomenclature of Fenbuconazole and its Regulated Metabolites

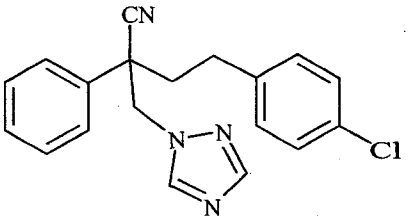
Compound	
Common name	Fenbuconazole
Company experimental names	RH-7592
IUPAC name	(*RS*)-4-(4-chlorophenyl)-2-phenyl-2-(1*H*-1,2,4-triazol-1-ylmethyl)butyronitrile
CAS name	α-[2-(4-chlorophenyl)ethyl]-α-phenyl-1*H*-1,2,4-triazole-1-propanenitrile
Molecular weight	336.8
CAS #	114369-43-6 (119611-00-6, racemate)
End-use products/EP	2 lb/gal FlC and 75% WPs

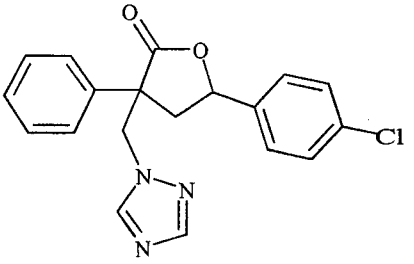
TABLE A.1. Nomenclature of Fenbuconazole and its Regulated Metabolites	
Metabolites	 *cis* and *trans* isomers
Common name	*cis* and *trans* lactone metabolites
Company experimental names	RH-9129 and RH-9130
IUPAC names	not available
CAS names	trans- or cis-5-(4chlorophenyl)dihydro-3-phenyl-3-(1*H*-1,2,4-triazol-1-ylmethyl)-2(3*H*)-furanone
Molecular weights	353.8
CAS#s	*cis* isomer, 146887-38-9 *trans* isomer, 146887-37-8

TABLE A.2. Physicochemical Properties of the Technical Grade Fenbuconazole			
Parameter	Value		Reference
Melting point/range	127°C		D310959, S. Oonnithan, 7/25/2006
pH	not available		
Bulk Density	0.50 g/mL		
Water solubility at 22°C	3.8 mg/L		
Solvent solubility (g/L) at 25°C	acetonitrile, 231 cyclohexanone, 445 ethyl alcohol, 39 1-octanol, 13	aromatic 200, 77 ethyl acetate, 159 heptane, 1.0	
Vapor pressure at 25°C (PAI)	0.37×10^{-7} mm Hg (4.9×10^{-6}Pa)		
Dissociation constant (pK_a) (PAI)	Not expected to dissociate in water		
Octanol/water partition coefficient $Log(K_{OW})$	302 ± 0.08		
UV/visible absorption spectrum	λ max (nm) 196 262 268 275	ε ($LAmol^{-1}Acm^{-1}$) 53,000 750 740 480	

B. EXPERIMENTAL DESIGN

B.1. Study Site Information

Soil type and characteristics were provided for each field trial site (Table B.1.1). Detailed meteorological data for rainfall and air temperatures were not provided; however, a general summary of weather conditions was provided for each field site. At the Massachusetts field site, a mild winter and wet conditions were noted in spring, with drier than normal conditions in July and August. Crop yields were poor. The growing season was described as hotter and drier than normal at the New Jersey test site, and as slightly drier than average at the Oregon site. At the Wisconsin sites, the spring was prolonged, cool, and wet, with drier than normal conditions in July. These weather conditions were not adverse enough to affect the integrity of the study results. The study use patterns are summarized in Table B.1.2.

TABLE B.1.1 Trial Site Conditions.

Trial Identification (City, State, Year)	Soil characteristics				Meteorological data	
	Type	%OM	pH	CEC	Total weekly rainfall	Overall temperature range (°C)
East Wareham, MA, 1998	Sand	2.0	5.1	NR	NR	NR
Bridgeton, NJ, 1998	Sand	2.7	4.3	NR	NR	NR
Bandon, OR, 1998	Sand:organic matter (1:1)	50	5.6	NR	NR	NR
Babcock, WI, 1998	Sand	2.4	5.2	NR	NR	NR
Biron, WI, 1998	Sand	1.1	5.1	NR	NR	NR

NR= Not reported

TABLE B.1.2. Study Use Pattern on Cranberry.

Location (City, State, Year)	Application							
	EP [1]	Method [2]; Timing	Volume (gal/A)	Single Rate (lb ai/A) [3]	No. of Appl.	RTI (days)	Total Rate (lb ai/A) [3]	Tank Mix Adjuvants [4]
East Wareham, MA, 1998	75% WP	Broadcast foliar; flowering through fruit development	296-300	0.186-0.188	5	10-11	0.932	0.1% Latron B1956
Bridgeton, NJ, 1998	75% WP	Broadcast foliar; flowering through fruit development	38-48	0.178-0.192	5	14	0.918	0.1% Latron
Bandon, OR, 1998	75% WP	Broadcast foliar; flowering through fruit development	30-49	0.186-0.194	5	11-66	0.944	0.1% Kinetic non-ionic wetting agent

TABLE B.1.2. Study Use Pattern on Cranberry.

Location (City, State, Year)	Application							
	EP [1]	Method [2]; Timing	Volume (gal/A)	Single Rate (lb ai/A) [3]	No. of Appl.	RTI (days)	Total Rate (lb ai/A) [3]	Tank Mix Adjuvants [4]
Babcock, WI, 1998	75% WP	Broadcast foliar; flowering through fruit development	30-31	0.187-0.188	5	10-14	0.936	0.1% Latron CX7
Biron, WI, 1998	75% WP	Broadcast foliar; flowering through fruit development	30-31	0.186-0.188	5	10-14	0.936	0.1% Latron CX7

[1] EP = End-use Product.
[2] All applications were made using ground equipment.
[3] The maximum proposed use rate is 0.188 lb ai/A/application for a total of 0.94 lb ai/A/season.
[4] The amount of surfactant is expressed as the % of the spray mix.

TABLE B.1.3. Trial Numbers and Geographical Locations.

NAFTA Growing Region [1]	Cranberry		
	Submitted	Requested	
		Canada	US[1]
1	1	NA	2
2	1 [2]	NA	--
3	--	NA	--
4	--	NA	--
5	2	NA	2
6	--	NA	--
7	--	NA	--
8	--	NA	--
9	--	NA	--
10	--	NA	--
11	--	NA	--
12	1	NA	1
Total	5	NA	5

[1] Regions 13-21 and 1A, 5A, 5B, and 7A were not included as the use is for the US only.
[2] The trial in Region 2 was conducted in New Jersey, adjacent to Region 1.
NA = not applicable.

B.2. Sample Handling and Preparation

Duplicate control and treated samples of mature cranberry fruit (2 lb per sample) were collected by hand from each test site at 25-28 days following the final application. At the Massachusetts field site, samples were immediately packed in dry ice and shipped by overnight courier to the analytical laboratory, Del Monte Research Center, Walnut Creek, CA. At the remaining four sites, samples were placed in frozen storage within 3 hours of sampling and held for 5-28 days in freezers (≤-7°C) at the field sites. Samples were then shipped by ACDS freezer truck or on dry ice by overnight courier to the analytical laboratory, where samples were stored frozen (<-10°C) prior to analysis. Samples were stored frozen from collection to analysis for up to 5.3 months.

B.3. Analytical Methodology

Samples from the cranberry field trials were analyzed for residues of fenbuconazole (RH-7592) and its two lactone metabolites (RH-9129 and RH-9130) using the current GC/NPD tolerance enforcement method (Report No. 34-90-47R), with several very minor modifications. This method has been validated by the Agency (DP Barcode D197760, N. Dodd, 4/8/94). A brief description of the method follows.

Chopped samples are mixed with Celite, and residues are extracted by blending with methanol. The extract is filtered and diluted with 10% aqueous NaCl, and residues are partitioned into methylene chloride and concentrated to dryness. Residues are then redissolved in toluene:acetone (100:10) and cleaned up using a silica gel column eluted with toluene:acetone (100:30). Residues in the final eluate are concentrated to dryness, redissolved in toluene:acetone (100:5) and eluted through a Florisil column with toluene:acetone (100:30). Residues are again concentrated to dryness, redissolved in toluene:methanol (100:3), and then analyzed by GC/NPD using external standards for quantitation. The validated LOQ is 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. The LOD was not reported. Residues of RH-9129 and RH-9130 were expressed in terms of the individual metabolites, not in parent equivalents.

Prior to analysis of field trial samples, the above GC/NPD method was validated using control samples of cranberry fruit fortified separately with each analyte (in triplicate) at levels of 0.01, 0.32, and 2.0 ppm. In conjunction with the field trial analyses, duplicate control samples were also fortified separately with each analyte at 0.10 ppm, and analyzed along with the field trial samples.

C. RESULTS AND DISCUSSION

The number and geographic distribution of the cranberry field trials are adequate. Five field trials were conducted during 1998 in Regions 1, 2, 5 and 12. In each field trial, fenbuconazole (75% WP) was applied to cranberries as five broadcast foliar applications beginning at flowering and continuing through fruit development at 0.178-0.194 lb ai/A/application, for a total of 0.918-0.944 lb ai/A/season. RTIs were 10-14 days, with the exception of one 66 day interval at the

Oregon site. In each trial, applications were made using ground equipment at 30-300 gal/A and included the use of a non-ionic surfactant at 0.1% of the spray volume. Duplicate control and treated samples of berries were collected from each test at 25-28 days after the final application.

The GC/NPD method (Report No. 34-90-47R) used to determine residues of fenbuconazole and its metabolites RH-9129 and RH-9130 in/on cranberry fruit is adequate for data collection. The method was validated prior to sample analysis, and average method recoveries from cranberry samples fortified at 0.01-2.0 ppm were 101% with a standard deviation (s.d.) of 10% from 9 samples fortified with fenbuconazole, 100% (s.d. of)14% from 9 samples fortified with RH-9129, and 97% (s.d. of 13%) from 9 samples fortified with RH-9130 (Table C.1). Apparent residues of each analyte were <LOQ in/on all 10 control samples. The validated LOQ for parent and each of the metabolites is 0.01 ppm, for a combined LOQ of 0.03 ppm. For calculation of combined residues, the metabolites were converted by the reviewers to parent equivalents using the 0.95x molecular conversion factor. Adequate sample calculations and chromatograms were provided.

Samples were stored frozen from collection to analysis for up to 5.3 months (Table C.2.1). To demonstrate the stability of residues during storage, triplicate control samples of fruit were fortified separately with the three analytes at 2.02 ppm and placed in frozen storage (<-10°C) for up to 168 days prior to analysis along with freshly fortified samples. Average corrected recoveries of parent, RH-9129, and RH-9130 were 91%, 81%, and 91%, respectively, following 5.5 months of frozen storage (Table C.2.2). These data are adequate and will support the storage durations in the current cranberry field trials.

Following five foliar applications of fenbuconazole (75% WP) at rates totaling 0.918-0.944 lb ai/A, residues of fenbuconazole were 0.07-0.45 ppm in/on 10 cranberry samples harvested approximately 28 days after the final application (Table C.3). For the same samples, residues were 0.01-0.04 ppm for RH-9129 and <0.01-0.01 ppm for RH-9130. Combined residues, expressed in parent equivalents, were 0.09-0.49 ppm. The average combined residues were 0.20 ppm (with a standard deviation of 0.14 ppm), and combined HAFT residues were 0.45 ppm.

Common cultural practices were used to maintain plants, and the weather conditions and the maintenance chemicals and fertilizer used in the study did not have a notable impact on the residue data.

TABLE C.1 Recovery of Fenbuconazole Residues from Cranberry Fruit Using GC/NPD Method (Report No. 34-90-47R).

Matrix	Analyte	Spiking Level (mg/kg)	Sample size	Recoveries (%)	Mean Recovery ± SD
Method Validation Recoveries					
Cranberry	RH-7592	0.010	3	107-116	101 ± 10
		0.322	3	99-104	
		2.02	3	84-95	
	RH-9129	0.010	3	111-118	100 ± 14
		0.321	3	98-102	
		2.01	3	78-87	
	RH-9130	0.010	3	94-125 (1) [1]	97 ± 13
		0.320	3	96-101	
		2.00	3	80-88	
Concurrent Method Recoveries					
Cranberry	RH-7592	0.101	2	85, 93	89
	RH-9129	0.100	2	100, 101	101
	RH-9130	0.100	2	88, 91	90

[1] The number of recoveries outside the acceptable 70-120% range is listed in parentheses.

TABLE C.2.1 Summary of Freezer Storage Conditions

Matrix	Storage Temp. (°C)	Actual Storage Duration (days) [1]	Limit of Demonstrated Storage Stability (days) [2]
Cranberry	<-10□C	136-161	168

[1] Extracts were stored frozen for 3-7 days prior to analysis.
[2] Storage stability data were submitted concurrently with the field trials (Table C.2.2).

TABLE C.2.2 Stability of Fenbuconazole Residues in Cranberry Fruit Following Storage at <-10°C.

Matrix	Analyte	Spike level (ppm)	Storage interval (days)	% Recovery	Corrected % recovery[1]
Cranberry	Fenbucon.	0.10	0 [2]	85	NA
		2.02	168	72, 80, 76	90, 93, 89 (91) [3]
	RH-9129	0.100	0	101	NA
		2.02	168	83, 87, 76	82, 86, 75 (81)
	RH-9130	0.100	0	91	NA
		2.02	168	80, 90, 81	87, 98, 89 (91)

[1] Corrected for concurrent method recoveries.
[2] Subsamples were spiked and analyzed concurrently with stored samples.
[3] Average corrected recovery is listed in parentheses.
NA = not applicable

TABLE C.3. Residue Data from Cranberry Field Trials with Fenbuconazole (75% WP).

Trial ID (City, Country, Year)	EPA Region	Variety	Total Rate (lb ai/A)	PHI (days) [1]	Residues (ppm) [2]			
					Fenbucon.	RH-9129	RH-9130	Combined [3]
East Wareham, MA, 1998	1	Howes	0.932	28	0.07, 0.09	0.01, 0.01	<0.01, <0.01	0.09, 0.11
Bridgeton, NJ, 1998	1	Early Black	0.918	25	0.07, 0.09	0.02, 0.02	<0.01, <0.01	0.10, 0.12
Bandon, OR, 1998	5	Stevens	0.944	27	0.45, 0.37	0.03, 0.03	0.01, 0.01	0.49, 0.41
Babcock, WI, 1998	5	Ben Lear	0.936	28	0.12, 0.13	0.03, 0.03	<0.01, 0.01	0.16, 0.17
Biron, WI, 1998	12	Ben Lear	0.936	28	0.15, 0.13	0.04, 0.03	0.01, <0.01	0.20, 0.17

[1] The proposed PHI for cranberry is 30 days.
[2] The LOQ is 0.01 ppm for each analyte; the LOD was not reported.
[3] Combined residues are expressed in parent equivalents, which were calculated by the reviewer using the 0.95x molecular conversion factor for the metabolites.

TABLE C.4. Summary of Residue Data for Cranberry from Crop Field Trials using Fenbuconazole (75% WP).

Commodity	Formulation	Total Rate (kg ai/ha)	PHI (days) [1]	Combined Residues (ppm) [2]						
				n	Min.	Max.	HAFT [3]	Median (STMdR[4])	Mean (STMR[4])	Std. Dev.
Cranberry	75% WP	0.918-0.944	25-28	10	0.09	0.49	0.45	0.159	0.199	0.138

[1] The proposed PHI for cranberry is 30 days.
[2] The combined residues include parent (RH-7592) and its two lactone metabolites RH-9129 and RH-9130, expressed in parent equivalents. Each metabolite was present at ≤0.04 ppm. The LOQ is 0.01 ppm for each analyte, for a combined LOQ of 0.03 ppm. For calculation of the median, mean, and standard deviation, ½LOQ was used for samples with residues <LOQ.
[3] HAFT = Highest Average Field Trial.
[4] STMdR = Supervised Trial Median Residue; STMR = Supervised Trial Mean Residue.

D. CONCLUSION

The cranberry field trial data are adequate and reflect the use of up to five foliar applications of fenbuconazole (WP) at approximately 0.188 lb ai/A/application during flowering and fruit development, for a total of approximately 0.94 lb ai/A/season. The data also support a minimum RTI of 10 days, a preharvest interval of 28 days, and the use of a non-ionic surfactant at 0.1% of the spray volume.

E. REFERENCES

D197760, PP# 1F3989 - Fenbuconazole on Stone Fruit. Revised Enforcement Method., N. Dodd, 4/8/94

F. DOCUMENT TRACKING

Petition Number: 1E6252
DP Barcode: D313752
PC Code: 129011

Fenbuconazole/129011/IR-4
DACO 7.4.1/7.4.2/OPPTS 860.1500/OECD IIA 6.3.1, 6.3.2, 6.3.3 and IIIA 8.3.1, 8.3.2, 8.3.3
Crop Field Trials - Peppers

Primary Evaluator D. Dotson — Date: 6/12/2008
Douglas Dotson, Ph.D., Chemist, RAB2

Peer Reviewer — Date: 6/12/2008
William Drew, Chemist, RAB2

This DER was originally prepared under contract by Dynamac Corporation (1910 Sedwick Road, Building 100, Suite B, Durham NC 27713; submitted 1/23/2008). The DER has been reviewed by the Health Effects Division (HED) and revised to reflect current Office of Pesticide Programs (OPP) policies.

STUDY REPORT:

47215801 Thompson, D. (2006) Fenbuconazole: Magnitude of the Residue on Pepper. Project Number: 06372. Unpublished study prepared by IR-4. 270 p.

EXECUTIVE SUMMARY:

Interregional Research Project No. 4 (IR-4) has submitted field trial data supporting the use of fenbuconazole on peppers. Nine field trials were conducted on bell peppers (6 tests) and non-bell peppers (3 tests) during 2000 in EPA Growing Zones 2, 3, 5, 6, and 10. At each test site, a 75% wettable powder (WP) formulation of fenbuconazole was applied to peppers during fruit development and maturation as four or five broadcast foliar applications at rates of 0.163-0.173 lb ai/A, at retreatment intervals (RTIs) of 10-14 days, for totals of 0.66-0.68 or 0.83-0.84 lb ai/A. Three of the nine trials used a fifth application because peppers in these tests were too immature for harvest following the fourth application. All applications were made using ground equipment in volumes of 29-53 gal/A, and included the use of non-ionic surfactants (NIS) at 0.12-0.13% v/v. Single control and duplicate treated samples of peppers were harvested from each test site 6-7 days after the final treatment (DAT). Additional samples from three field trials were collected at 0 and 14 DAT to measure residue decline. Samples were stored frozen for up to 493 days, a duration supported by available storage stability data.

The GC/NPD method used to determine residues of fenbuconazole and Metabolites RH-9129 and RH-9130 in/on peppers was adequately validated prior to, and in conjunction with, the analysis of field trial samples. For this method, residues were extracted with methanol, partitioned into methylene chloride, and cleaned up using silica gel and Florisil columns. Residues were then analyzed by GC/NPD using external standards. The statistically calculated limits of quantitation (LOQs) were 0.008 ppm for fenbuconazole, 0.010 ppm for RH-9129 and 0.011 ppm for RH-9130. The calculated limits of detection (LODs) were 0.003 ppm for fenbuconazole and RH-9129, and 0.004 ppm for RH-9130. The lower limit of method validation (LLMV) in/on peppers for each analyte is 0.01 ppm, for a combined LLMV of 0.03 ppm.

Following four or five foliar applications of fenbuconazole (75% WP) to peppers at rates totaling 0.66-0.68 or approximately 0.84 lb ai/A, residues of fenbuconazole were 0.03-0.21 ppm in/on all 18 samples of bell and non-bell peppers harvested at 6-7 DAT. The extra fifth application had

no apparent effect on residue levels. Residues of metabolites RH-9129 and RH-9130 were ≤0.01 ppm (≤LLMV) in/on all pepper samples harvested at 6-7 DAT. The average combined fenbuconazole residue in/on peppers was 0.14 ppm and the highest average field trial (HAFT) combined residue was 0.21 ppm. In the three residue decline tests, average combined fenbuconazole residues in/on peppers declined from 0.25-0.43 ppm at 0 DAT to 0.10-0.19 ppm by 14 DAT.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the peppers field trial data are classified as scientifically acceptable. The acceptability of this study for regulatory purposes is addressed in the U.S. EPA Residue Chemistry Summary Document (Memo, D313752, D. Dotson, 6/12/2008).

COMPLIANCE:

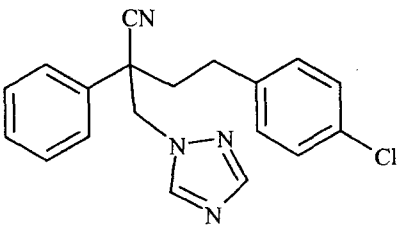
Signed and dated Good Laboratory Practice (GLP), Quality Assurance and Data Confidentiality statements were provided. No deviations from regulatory requirements were reported which would have an adverse impact on the validity of the study.

A. BACKGROUND INFORMATION

Fenbuconazole is a broad spectrum, triazole-type fungicide, which acts by inhibiting sterol biosynthesis in fungi (MOA Group 3). Fenbuconazole is formulated as a 2 lb/gal flowable concentrate and several 75% WP formulations and is registered to Dow AgroSciences, LLC, for use on a variety of fruit, nut, and field crops for the control of anthracnose, Cercospora leafspot, powdery mildew, and Alternaria fruit rot.

IR-4 has submitted field trial data supporting the use of fenbuconazole, formulated as a 75% WP (Indar® 75 WSP, 62719-421), on peppers (PP# 7F7256). The chemical structures and nomenclature of fenbuconazole and its metabolites are listed in Table A.1. The physicochemical properties of technical grade fenbuconazole are listed in Table A.2.

Table A.1. Nomenclature for Fenbuconazole and Its Regulated Metabolites.

Compound	
Common name	Fenbuconazole
Company experimental name	RH-7592
IUPAC name	(*RS*)-4-(4-chlorophenyl)-2-phenyl-2-(1*H*-1,2,4-triazol-1-ylmethyl)butyronitrile

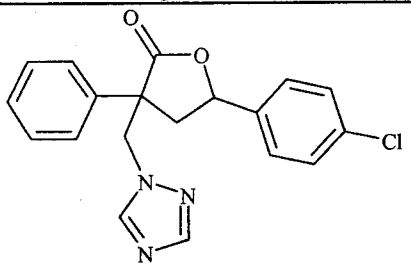
CAS name	α-[2-(4-chlorophenyl)ethyl]-α-phenyl-1*H*-1,2,4-triazole-1-propanenitrile
CAS #	114369-43-6
End-use product/EP	75% WP (Indar® 75 WSP Fungicide, EPA Reg. No. 62719-421)
Metabolites	 *cis* and *trans* isomers
Common name	*cis* and *trans* lactone metabolites; Lactones A and B
Company experimental names	RH-9129 and RH-9130
IUPAC names	(3R,5R) or (3S,5R)-5-(4-chlorophenyl)-3-phenyl-3-(1H-1,2,4-triazol-1-ylmethyl)dihydrofuran-2(3H)-one
CAS names	trans- or cis-5-(4-chlorophenyl)dihydro-3-phenyl-3-(1*H*-1,2,4-triazol-1-ylmethyl)-2(3*H*)-furanone
CAS #	cis isomer, 146887-38-9; trans isomer, 146887-37-8

Table A.2. Physicochemical Properties of the Technical Grade Fenbuconazole.

Parameter	Value		Reference
Melting point/range	127.0°C		D310959, S. Oonnithan, 7/25/2006
pH	not available		
Density (20°C)	0.50 g/mL		
Water solubility (mg/L at 22°C)	3.8 mg/L		
Solvent solubility (g/L at 25°C)	acetonitrile, 231 cyclohexanone, 445 ethyl alcohol, 39 1-octanol, 13	aromatic 200, 77 ethyl acetate, 159 heptane, 1.0	
Vapor pressure at 25°C	0.37×10^{-7} mm Hg (4.9×10^{-6} Pa)		
Dissociation constant (pK_a)	Not expected to dissociate in water		
Octanol/water partition coefficient Log(K_{OW})	3.02 ± 0.08		
UV/visible absorption spectrum	λ max (nm) 196 262 268 275	ε ($L \cdot mol^{-1} \cdot cm^{-1}$) 53,000 750 740 480	

B. EXPERIMENTAL DESIGN

B.1. Study Site Information

Nine pepper field trials were conducted in Zones 2, 3, 5, 6, and 10 during 2000 (Table B.1.1), with 6 tests on bell peppers and 3 tests on non-bell pepper. In each test, fenbuconazole (75% WP) was applied to peppers as four or five broadcast foliar applications during fruit development

and maturation at rates of 0.163-0.173 lb ai/A/application, for a total of 0.656-0.678 lb ai/A or 0.828-0.844 lb ai/A with RTIs of 12-16 days. Applications were made using ground equipment in volumes of 29-53 gal/A, and included the use of NIS spray adjuvants at 0.12-0.13% v/v (Table B.1.2).

TABLE B.1.1. Trial Site Conditions.

Trial Identification (City, State, Year)	Soil characteristics [1]			
	Type	%OM	pH	CEC (meq/100 g)
Salisbury, MD 2000	Loamy sand	0.8	6.0	11.8
Tifton, GA 2000	Sand	0.20	6.7	NR
Gainesville, FL 2000	Sand	2.6-2.8	5.9-6.0	NR
Weslaco, TX 2000	Sandy clay loam	0.5	8.1	NR
Fremont, OH 2000	Sandy loam	3.1	6.7	11.5
Visalia, CA 2000	Sandy loam	1.77	7.25	NR
Weslaco, TX 2000	Sandy clay	1.0	8.3	NR
Gainesville, FL 2000	Sand	2.6-2.8	5.9-6.0	NR
Visalia, CA 2000	Sandy loam	1.77	7.25	NR

[1] These parameters are optional except in cases where their value affects the use pattern for the chemical.
NR= not reported.

The monthly rainfall and temperature ranges observed during the study period were provided. The temperatures were outside the average historical ranges in the Florida, Ohio, and California trials, and rainfall amounts were lower than average historical values. The Maryland trial was unusually cool and wet in the spring and early summer, the Georgia trial had extremely dry weather from May through August, the Florida trial had drought conditions during April and May, and the Ohio trial had a wet spring and summer. Irrigation was used to supplement rainfall as needed. The tests were conducted according to normal agricultural practices for the region, and information was provided on maintenance pesticides and fertilizers used at each site.

TABLE B.1.2. Study Use Pattern.

Location (City, State; Year) Trial ID	End-Use Product	Application Information [1]					
		Method; Timing	Volume (gal/A)	Single Rate (lb ai/A)	RTI [2] (days)	Total Rate (lb ai/A)	Tank Mix/ Adjuvants
Salisbury, MD 2000 MD12	75% WP	Four foliar broadcast applications from first bloom to 2-4 in. diameter fruits	52-53	0.164-0.165	13-16	0.656	Kinetic (0.12% v/v)
Tifton, GA 2000 GA23	75% WP	Five foliar broadcast applications from vegetative to fruit development	50-51	0.168-0.170	14-16	0.844 [4]	Silwet (0.12% v/v)
Gainesville, FL 2000 FL59	75% WP	Five foliar broadcast applications from vegetative to fruit development	29-30	0.164-0.167	14	0.828 [4]	Induce (0.13% v/v)

TABLE B.1.2. Study Use Pattern.

Location (City, State; Year) Trial ID	End-Use Product	Application Information [1]					
		Method; Timing	Volume (gal/A)	Single Rate (lb ai/A)	RTI [2] (days)	Total Rate (lb ai/A)	Tank Mix/ Adjuvants
Weslaco, TX 2000 TX45	75% WP	Four foliar broadcast applications from flowering to mature fruit	41-44	0.163-0.173	12-13	0.673	Silwet (0.13% v/v)
Fremont, OH 2000 OH18	75% WP	Four foliar broadcast applications from vegetative to fruit present	45-47	0.165-0.172	14	0.678	Kinetic (0.13% v/v)
Visalia, CA 2000 CA111	75% WP	Four foliar broadcast applications from first fruit to 10% fruits turning	40	0.167-0.168	14	0.671	Latron B-1956 (0.12-0.13% v/v)
Weslaco, TX 2000 TX44	75% WP	Four foliar broadcast applications from blooming to mature fruit	48-49	0.166-0.170	12-13	0.674	Kinetic (0.12% v/v)
Gainesville, FL 2000 FL60	75% WP	Five foliar broadcast applications from vegetative to fruit development	30	0.166-0.169	14	0.837 [4]	Induce (0.13% v/v)
Visalia, CA 2000 CA112	75% WP	Four foliar broadcast applications from fruit initiation to 5% fruits turning	40-41	0.167-0.168	14	0.670	Latron B-1956 (0.12-0.13% v/v)

[1] No spray adjuvants were used in either test.
[2] RTI = Retreatment Interval.
[3] All of the adjuvants were non-ionic surfactants (NIS).
[4] Three tests used a fifth application in order to allow the peppers to mature before harvest.

TABLE B.1.3. Trial Numbers and Geographical Locations.

NAFTA Growing Zones	Peppers		
	Submitted	Requested	
		Canada	U.S.
1	--	--	--
2	2	--	2
3	2 [1]	--	2
4	--	--	--
5	1	4	1
5A	--	--	--
5B	--	1	--
6	2 [1]	--	1
7	--	--	--
8	--	--	--
9	--	--	--
10	2 [1]	--	2
11	--	--	--
12	--	--	--
13	--	--	--
Total	9	5	8

[1] Non-bell peppers were used in one of the two trials in these regions.

B.2. Sample Handling and Preparation

Single control and duplicate treated samples of mature peppers were harvested at 6-7 DAT. Additional samples from three sites were collected at 0 and 14 DAT to measure residue decline. Samples (≥1 lb each) were placed into frozen storage within 2.25 hours of harvest and stored frozen at the field site for 7-64 days prior to shipment with dry ice via ACDS freezer truck, Airborne Express, or Federal Express to the analytical laboratory, Del Monte Research Center, Walnut Creek, CA. At the analytical laboratory, samples were stored at <-10°C until extraction for analysis.

B.3. Analytical Methodology

Residues in/on peppers were determined using a GC/NPD Method Report Number 34-90-47R, "Revised Residue Analytical Method for Parent RH-7592 and its Lactone Metabolites RH-9129 and RH-9130 in Stonefruit," with minor modifications. This method is the current tolerance enforcement method for fruit commodities.

For this method, residues were extracted from pepper samples with methanol, filtered through Celite, diluted with aqueous 9.1% NaCl, and partitioned into methylene chloride. Residues were then concentrated, redissolved in toluene:acetone (100:10, v:v) and cleaned up using a silica gel column eluted with toluene:acetone (100:30, v:v). Residues in the final eluate are concentrated to dryness, redissolved in toluene:acetone (100:5, v/v) and eluted through a Florisil column with toluene:acetone (100:30, v:v). Residues are again concentrated to dryness, redissolved in toluene:methanol (100:3, v:v), and analyzed by GC/NPD using external standards. The statistically calculated LOQs were 0.008 ppm for fenbuconazole, 0.010 ppm for RH-9129 and 0.011 ppm for RH-9130. The calculated LODs were 0.003 ppm for fenbuconazole and RH-9129, and 0.004 ppm for RH-9130. The LLMV in/on peppers for each analyte is 0.01 ppm, for a combined LLMV of 0.03 ppm.

The above method was validated prior to, and in conjunction with, the analysis of field trial samples using control samples fortified with each analyte at 0.01-1.0 ppm.

C. RESULTS AND DISCUSSION

The GC/NPD method used for determining residues of fenbuconazole and its metabolites in/on peppers was adequately validated prior to, and in conjunction with, the analysis of field trial samples. The average method validation recoveries (± the standard deviation (S.D)) were 107 ± 6% for fenbuconazole, 106 ± 4% for RH-9129, and 110 ± 8% for RH-9130. The average concurrent recoveries (±S.D) were 99 ± 9% for fenbuconazole, 94 ± 5% for RH-9129, and 99 ± 8% for RH-9130. Apparent residues of fenbuconazole were non-detectable in/on control samples of peppers. Adequate sample calculations and example chromatograms were provided.

Samples were stored at <-10°C for up to 493 days for peppers prior to analysis (Table C.2.1). To support this storage duration, a concurrent freezer storage stability study was conducted using control samples of non-bell peppers fortified with fenbuconazole and its metabolites at 1.0 ppm.

The fortified samples were stored under the same conditions as the field trial samples. However, no zero-day analysis was conducted on the stored samples; therefore, the original fortification levels could not be verified. The average corrected recoveries from the stored samples (89-91%) indicate that fenbuconazole and its metabolites are stable in peppers at <-10°C for up to 499 days (16.6 months, Table C.2.2). Although no 0-day analysis was conducted, these data support the storage durations and conditions incurred by the field trial samples.

Following four or five foliar applications of fenbuconazole (75% WP) to peppers at rates totaling 0.66-0.84 lb ai/A, residues of fenbuconazole were 0.03-0.21 ppm in/on all 18 samples of bell and non-bell peppers harvested at 6-7 DAT (Tables C.3). The extra fifth application had no apparent effect on residue levels. Residues of metabolites RH-9129 and RH-9130 were ≤0.01 ppm (≤ LOQ) in/on all pepper samples harvested at 6-7 DAT. The average combined fenbuconazole residue was 0.14 ppm and the combined HAFT residue was 0.21 ppm (Table C.4). In the three residue decline tests, average combined fenbuconazole residues in/on peppers declined from 0.25-0.43 ppm at 0 DAT to 0.10-0.19 ppm by 14 DAT (Figure C.1).

Common cultural practices were used to maintain plants, and the weather conditions and maintenance chemicals and fertilizer used in this study did not have a notable impact on the residue data.

TABLE C.1. Summary of Method Validation and Concurrent Recoveries of Fenbuconazole and its Metabolites from Peppers.

Matrix	Analyte	Spike Level (ppm)	Sample Size (n)	Recoveries (%)	Mean ± Std. Dev. (%)
Method Validation					
Peppers	Fenbuconazole	0.010	3	105, 116, 104	108 ± 7
		0.101	3	113, 108, 114	112 ± 3
		1.01	3	102, 103, 102	102 ± 1
		Total	**9**	**102-116**	**107 ± 6**
	RH-9129	0.010	3	106, 110, 104	107 ± 3
		0.099	3	108, 108, 113	110 ± 3
		0.992	3	105, 101, 102	103 ± 2
		Total	**9**	**102-113**	**106 ± 4**
	RH-9130	0.010	3	110, 123, 119	117 ± 7
		0.099	3	111, 108, 112	110 ± 2
		0.988	3	101, 104, 101	102 ± 2
		Total	**9**	**101-123**	**110 ± 8**

TABLE C.1. Summary of Method Validation and Concurrent Recoveries of Fenbuconazole and its Metabolites from Peppers.

Matrix	Analyte	Spike Level (ppm)	Sample Size (n)	Recoveries (%)	Mean ± Std. Dev. (%)
Concurrent Recovery					
Peppers	Fenbuconazole	0.010	1	103	103
		0.101	1	106	106
		1.01	1	88.3	88.3
		Total	**3**	**88.3-106**	**99 ± 9**
	RH-9129	0.010	1	92.7	92.7
		0.099	1	100	100
		0.992	1	89.4	89.4
		Total	**3**	**89.4-100**	**94 ± 5**
	RH-9130	0.010	1	105	105
		0.099	1	102	102
		0.988	1	90.0	90.0
		Total	**3**	**90.0-105**	**99 ± 8**

TABLE C.2.1 Summary of Storage Conditions.

Matrix	Storage Temperature (°C)	Actual Storage Duration (days)[1]	Interval of Demonstrated Storage Stability (days)
Bell Peppers	<-10	479	499
Non-Bell Peppers		493	

[1] Interval from harvest to analysis. Extracts were stored up to 8 days prior to analysis.

TABLE C.2.2 Stability of Fenbuconazole and its Metabolites in Peppers Stored at <-10°C.

Analyte	Spike Level (ppm)	Storage interval (days)	Freshly Fortified Recovery (%)	Stored Sample Residues (ppm)	Average Corrected Stored Recovery (%)[1]
Fenbuconazole	1.00	499	92	87, 80, 80	89
RH-9129	1.02		90	84, 78, 85	91
RH-9130	1.00		93	87, 79, 81	89

TABLE C.3. Residue Data from Pepper Field Trials with Fenbuconazole (75% WP).

Trial ID (City, State; Year)	Zone	Variety	Total Rate (lb ai/A)	PHI (days)	Residues (ppm) [1]							
					Fenbuconazole		RH-9129		RH-9130		Combined [3]	
Bell Peppers												
MD12 Salisbury, MD 2000	2	Boynton	0.656	7	0.05	0.05	<0.01	<0.01	<0.01	<0.01	0.07	0.07
GA23 Tifton, GA 2000 GA23	2	Keystone	0.844	7	0.15	0.08	<0.01	<0.01	0.01	<0.01	0.17	0.10
FL59 Gainesville, FL 2000	3	Camelot	0.828	0	0.21	0.24	<0.01	<0.01	<0.01	<0.01	0.23	0.26
				7	0.10	0.12	<0.01	<0.01	<0.01	<0.01	0.12	0.14
				14	0.08	0.07	<0.01	<0.01	<0.01	<0.01	0.10	0.09

TABLE C.3. Residue Data from Pepper Field Trials with Fenbuconazole (75% WP).

Trial ID (City, State; Year)	Zone	Variety	Total Rate (lb ai/A)	PHI (days)	Residues (ppm) [1]							
					Fenbuconazole		RH-9129		RH-9130		Combined [3]	
TX45 Weslaco, TX 2000	6	Jupiter	0.673	0	0.27	0.19	0.01	0.01	<0.01	<0.01	0.29	0.21
				7	0.17	0.20	0.01	0.01	<0.01	<0.01	0.19	0.22
				14	0.16	0.17 (0.15)[2]	0.01	0.02 (0.02)[2]	0.01	<0.01 (0.13)[2]	0.18	0.20
OH18 Fremont, OH 2000	5	King Arthur	0.678	6	0.15	0.14	<0.01	<0.01	<0.01	<0.01	0.17	0.16
CA111 Visalia, CA 2000	10	Jupiter	0.671	7	0.04	0.03	<0.01	<0.01	<0.01	<0.01	0.06	0.05
Non-Bell Peppers												
TX44 Weslaco, TX 2000	6	Sonora Anaheim	0.674	6	0.20	0.16	0.01	0.01	<0.01	<0.01	0.22	0.18
FL60 Gainesville, FL 2000	3	Mesilla	0.837	0	0.29	0.52 (0.51)[2]	<0.01	<0.01 (0.01)[2]	<0.01	<0.01 (0.09)[2]	0.31	0.61
				7	0.21	0.14	<0.01	<0.01	<0.01	<0.01	0.22	0.16
				14	0.09	0.15	<0.01	0.01	<0.01	<0.01	0.10	0.17
CA112 Visalia, CA 2000	10	Mitla jalapeno	0.670	7	0.05	0.05	0.01	0.01	<0.01	<0.01	0.07	0.07

[1] The calculated LOQs were 0.008 ppm for fenbuconazole, 0.010 ppm for RH-9129 and 0.011 ppm for RH-9130. The calculated LODs were 0.003 ppm for fenbuconazole and RH-9129, and 0.004 ppm for RH-9130. The LLMV in/on peppers for each analyte is 0.01 ppm, for a combined LLMV of 0.03 ppm.

[2] Samples were reanalyzed because of inference in the RH-9130 value. The 2nd analysis values were used for all calculations (original residue value in parentheses).

[3] Residues <0.01 ppm (<LOQ) were estimated to be 0.01 ppm for calculation of combined residues. Combined residues are expressed in parent equivalents, which were calculated by the reviewer using the 0.95x molecular conversion factor for the metabolites.

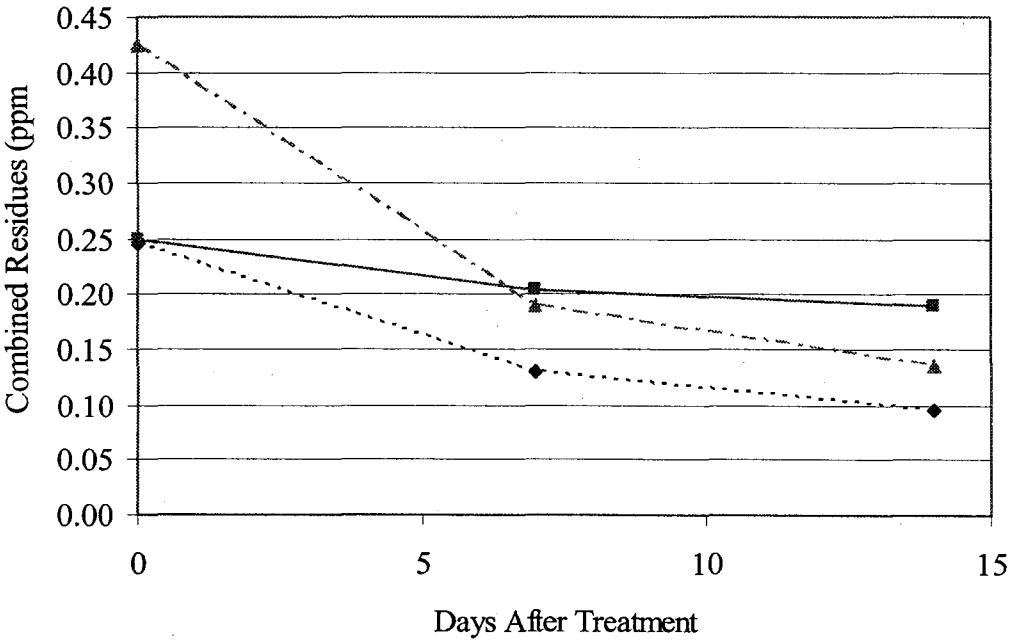
TABLE C.4. Summary of Residue Data from Pepper Field Trials with Fenbuconazole (WP).

Commodity	Residues	Total Applic. Rate (lb ai/A)	PHI (days)	Residue Levels (ppm) [1]						
				n	Min.	Max.	HAFT [2]	Median (STMdR)	Mean (STMR)	Std. Dev.
Peppers	Parent	0.66-0.84	6-7	18	0.03	0.21	0.19	0.13	0.12	0.06
	RH-9129	0.66-0.84	6-7	18	0.01	0.01	0.01	0.01	0.01	0.00
	RH-9130	0.66-0.84	6-7	18	0.01	0.01	0.01	0.01	0.01	0.00
	Combined	**0.66-0.84**	**6-7**	**18**	**0.05**	**0.23**	**0.21**	**0.15**	**0.14**	**0.06**

[1] The calculated LOQs were 0.008 ppm for fenbuconazole, 0.010 ppm for RH-9129 and 0.011 ppm for RH-9130. The calculated LODs were 0.003 ppm for fenbuconazole and RH-9129, and 0.004 ppm for RH-9130. The LLMV in/on peppers for each analyte is 0.01 ppm, for a combined LLMV of 0.03 ppm. Residues <0.01 ppm (<LOQ) were estimated to be 0.01 ppm for all calculations. Combined residues are expressed in parent equivalents.

[2] HAFT = Highest Average Field Trial.

Figure C.1. Decline in Combined Fenbuconazole Residues in Peppers Following Treatment.



D. CONCLUSION

The pepper field trial data are adequate and support the use of fenbuconazole (75% WP) on peppers as up to four broadcast foliar applications during fruit development at ~0.168 lb ai/A/application for a total of 0.67 lb ai/A/season. The data support a minimum RTI of 10 days and a minimum preharvest interval of 7 days. The data also support use of an NIS adjuvant at up to 0.125% of the spray volume.

E. REFERENCES

None

F. DOCUMENT TRACKING

Petition Number: 7E7256
DP#: 313752
PC Code: 129011