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

5

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

MEMORANDUM

Date: 2/10/2004

Subject: Boscalid. Tolerance Petition for the Use of Boscalid on Hops, Soybeans, and Pome Fruit. Summary of Analytical Chemistry and Residue Data. Petition Numbers 2F6434 (Hops and Pome Fruit) and 3F6580 (Soybeans)

DP Barcode:	D290185	Case No.:	296028
PC Code:	128008	Submission:	S635737
40 CFR:	180.589	MRID Nos.:	45623410, 45645802, 45645803, 45645804, 45903602

From: Douglas A. Dotson, Chemist D. Dotson
RAB2
Health Effects Division (7509C)

Through: William Drew, Chemist
RAB2
Health Effects Division (7509C)

Richard Loranger, Branch Senior Scientist R. Loranger
RAB2
Health Effects Division (7509C)

To: Dennis McNeilly/Cynthia Giles-Parker, PM22
Fungicide Branch
Registration Division (7505C)

RC 03/04

1

Executive Summary

Boscalid, 3-pyridinecarboxamide, 2-chloro-N-(4'-chloro[1,1'-biphenyl]-2-yl), is a fungicide and a member of the carboxamide (anilide) class of compounds. Two formulated end-use products are proposed for use on pome fruit and soybeans. One of these is Endura™ Fungicide (EPA Reg. No. 7969-197), which contains 70% boscalid. The other end-use product is Pristine™ Fungicide (EPA Reg. No. 7969-199), which contains a 2:1 mixture of boscalid and pyraclostrobin as co-active ingredients (25.2%:12.8%). Pristine™ Fungicide is also proposed for use on hops. Crops are to be treated with a broadcast spray which can be made by either ground or aerial equipment (except for hops which cannot be treated aerially). Soybeans may receive a maximum of two treatments with a seven day retreatment interval. Hops may receive a maximum of three treatments with a ten day retreatment interval. Pome fruit may receive a maximum of six treatments with a seven day retreatment interval. PHIs range from zero days for pome fruit to 21 days for soybean mature seed and forage. Application rates range from 0.29 lb ai/A for pome fruit to 0.48 lb ai/A for soybeans. Maximum seasonal application rates range from 0.96 lb ai/A for soybeans to 1.3 lb ai/A for hops.

The nature of the residue has been adequately delineated in target crops, livestock, and rotational crops. In target crops the parent was the only compound identified in grapes and lettuce (92-98% TRR). Parent was the predominant compound present in beans. Small amounts of cleavage products were also identified. The MARC determined that in target crops, the parent only was the residue of concern for risk assessment and tolerance expression. In rotational crop studies performed on radish, head lettuce, and wheat, parent boscalid was the only residue identified in wheat grain. Parent was the major residue identified in lettuce, radish roots, radish tops, and wheat forage. Smaller amounts of the glucoside metabolite were also found (1-21% TRR). Again, the MARC determined that the parent only was the residue of concern for risk assessment and tolerance expression. In goat and hen metabolism studies, the parent, a hydroxy metabolite, and the glucuronide of the hydroxy metabolite were the major residues identified. The MARC concluded that the combined residues of these three compounds are the residues of concern for risk assessment and tolerance expression. In the bean metabolism study, residues were found in the pods as well as in the bean seeds. Boscalid is a systemic fungicide; therefore, residues are expected to be found in all plant parts, edible as well as non-edible.

An adequate enforcement method is available for enforcement of the proposed tolerances. BASF Corporation has proposed a GC/MS method, Method D0008, for the enforcement of proposed tolerances for residues of boscalid in plant commodities. Plant matrix samples are extracted with methanol/water/2N HCl (or hexane/ACN for oil commodities). An aliquot of the extract is partitioned with iso-octane, and the iso-octane phase is cleaned up by solid phase extraction. Residues are separated and detected by GC/MS. The method has not as yet been published in PAM I or II; however, it is available from the Biological and Economic Analysis Division's Analytical Chemistry Branch.

The first tolerances for boscalid were published on July 30, 2003 in 40CFR §180.589. These tolerances were established on a wide variety of commodities including the following crop groups and subgroups: root vegetables (Subgroup 1A), tuberous and corm vegetables (Subgroup 1C), bulb vegetables (Group 3), Brassica leafy vegetables (Group 5), legume vegetables (Subgroups 6A, 6B, and 6C, except soybeans, cowpea, field pea, and grain lupin), fruiting

vegetables (Group 8), cucurbit vegetables (Group 9), stone fruits (Group 12), berries (Group 13), tree nuts (Group 14). Tolerances were established on other individual commodities as well. Tolerances range from 0.05 ppm on peanuts and tuberous and corm vegetables to 30 ppm on peppermint and spearmint tops. Tolerances were also established for a variety of rotational crops at levels ranging from 0.05 ppm to 8.0 ppm. The tolerance expression for both target crops and rotational crops includes parent only. Tolerances were established for a variety of animal commodities ranging from 0.02 ppm in eggs to 0.35 ppm in meat byproducts of cattle, goat, horse, and sheep. The tolerance expression for animal commodities includes parent, a hydroxy metabolite (M510F01), and the glucuronide conjugate of the hydroxy metabolite. In the current petitions, tolerances are being proposed for hops at 35.0 ppm, pome fruit at 3.0 ppm, apple pomace at 20.0 ppm, soybean (immature) at 2.2 ppm, soybean seed at 0.1 ppm, soybean hulls at 0.2 ppm, and soybean aspirated grain fraction at 2.5 ppm.

There is a high level of confidence in the data being used to determine the tolerances. The soybean, hops, apple, and pear field trials were performed in the major crop producing regions for each commodity. For soybeans, apples, and pears, the number of field trials performed exceeded the number recommended in the OPPTS Series 860 Guidelines. In soybean field trials residue values were below the LOQ in all samples of mature seed and in most samples of immature seed. Detectable residues were found in all samples of forage and hay, however. Detectable residues were found on all samples of hops, apples, and pears. The parent compound was determined in all field trials. The parent is the only residue of concern in crops. Therefore, all residues of concern were measured. The data can be used for dietary risk assessment.

Processing studies were conducted on soybeans and apples. Soybeans were processed into hulls, meal, and refined oil. Residues concentrated in hulls by a factor of 1.8x. Residues reduced in both meal and refined oil. The processing factors for meal and oil were 0.2x and 0.4x, respectively. Apples were processed into juice and wet apple pomace. Residues concentrated in wet apple pomace by a factor of 5.5x. Residues were reduced in apple juice. The processing factor was 0.08x. Rotational crop tolerances have been established. No additional rotational crop tolerances are required as a result of the uses proposed in the current risk assessment.

Residue Chemistry Deficiencies

The registrant needs to submit a revised Section F in which the following tolerances are proposed:

Apple pomace, wet	10 ppm
Soybean, vegetable	2.0 ppm
Hops cones, dried	35 ppm
Soybean aspirated grain fractions	3.0 ppm

The proposed tolerances and commodity names for the remaining foods/feeds are appropriate (i.e., those for pome fruit, soybean seed, and soybean hulls).

Note to Product Manager: The original petition for boscalid established soybean seed and hull tolerances under rotational crops at the same levels as needed for the present action. These rotational crop tolerances should be deleted when the new tolerances are established for direct use on soybeans. In addition, the conditions of registration noted in our previous chemistry chapter (8/15/03) and risk assessment (9/8/03) should apply to the present uses if they have not been satisfied.

Background

The first human health risk assessment for boscalid (formerly BAS 510 F) was completed on 9/8/2003 by Y. Donovan, *et al.* (D290022). The Health Effects Division (HED) recommended in favor of the establishment of tolerances on a number of plant and animal commodities. These tolerances were published in the Federal Register Environmental Documents (July 30, 2003).. Two formulated end-use products are proposed for use on soybeans and pome fruit: Endura™ Fungicide (EPA Reg. No. 7969-ROT), which contains 70% boscalid, and Pristine™ Fungicide (EPA Reg. No. 7969-199), which contains a 2:1 mixture of boscalid and pyraclostrobin as co-active ingredients (25.2%:12.8%). Pristine™ Fungicide is also proposed for use on hops.

Boscalid has effects on the thyroid and/or liver of several species. The toxicity endpoints are all based on these effects.

TABLE 1. Test Compound Nomenclature

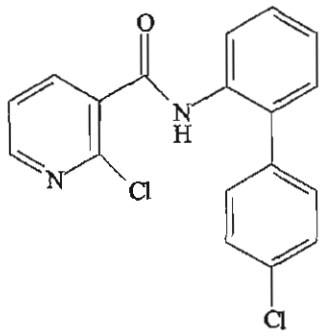
Compound	Chemical Structure
	 Boscalid
Common name	Boscalid
Company experimental name	BAS 510F
IUPAC name	2-Chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide
CAS name	3-Pyridinecarboxamide, 2-chloro-N-(4'chloro[1,1'-biphenyl]-2-yl)
CAS #	188425-85-6
End-use product/EP	Endura and Pristine

TABLE 2. Physicochemical Properties	
Parameter	Value
Melting point/range	142.8-143.8°C
pH	Unspecified
Density	1.39 g/cm^3 (powder), 1.38 g/cm^3 (crystalline)
Water solubility (20°C)	4.64 mg/L (crystalline form)
Solvent solubility (mg/L at 20°C)	Crystalline Form: Acetone: 16-20 g/100 mL Acetonitrile: 4-5 g/100 mL Methanol: 4-5 g/100 mL Ethyl Acetate: 6.7-8 g/100 mL Dichloromethane: 20-25 g/100 mL Toluene: 2-2.5 g/100 mL 1-Octanol: <1g/100 mL
Vapor pressure at 20°C	Crystalline Form: 7 x 10^{-7} Pa
Vapor pressure at 25°C	Crystalline Form: 2 x 10^{-6} Pa
Dissociation constant (pK_a)	No dissociation in water.
Octanol/water partition coefficient Log(K_{ow})	log K_{ow} of crystalline form = 2.96 (21°C)
UV/visible absorption spectrum	Unspecified

860.1200 Directions for Use

Table 3. Summary of Directions for Use of Boscalid.						
Applic. Timing, Type, and Equip.	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
Hops						
Begin applications of Pristine prior to disease development and continue on a 10 to 21 day interval.	Pristine Fungicide [7969-199]	0.44 lb ai/A	3	1.32 lb ai/A	14	Do not make more than 2 sequential applications of Pristine before alternating to a labeled non-strobilurin or non-carboximide fungicide having different modes of action for at least one application. Do not use more than 200 gallons per acre.

Table 3. Summary of Directions for Use of Boscalid.						
Applic. Timing, Type, and Equip.	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
Pome Fruit						
Begin applications of Pristine or Endura prior to disease development and continue on a 7 to 14 day interval.	Endura Fungicide [7969-197] Pristine Fungicide [7969-199]	0.29 lb ai/A	4	1.16 lb ai/A	0	Do not make more than 2 sequential applications of Pristine or Endura before alternating to a labeled non-strobilurin fungicide having a different mode of action for at least one application.
Soybeans						
Begin applications of Pristine or Endura prior to disease development and continue on a 7 to 14 day interval.	Endura Fungicide [7969-197] Pristine Fungicide [7969-199]	Endura: 0.48 lb ai/A Pristine: 0.25 lb ai/A	Endura: 2 Pristine: 3	Endura: 0.96 lb ai/A Pristine: 0.75 lb ai/A	21	Do not make more than 2 sequential applications of Pristine or Endura before alternating to a labeled fungicide having a different mode of action for at least one application.

Conclusions. The labels are adequate to allow evaluation of the residue data relative to the proposed uses. The hops and soybean field trials were carried out at the 1x label rate. The pome fruit field trials were carried out at 1.6x the maximum label rate. No additions, revisions, or clarifications to the label are recommended. There are no data deficiencies that will impact the regulatory recommendations for this action.

860.1300 Nature of the Residue - Plants

Nature of the Residue: Metabolism Study - Lettuce	MRID 45405021
Nature of the Residue: Metabolism Study - Grapes	MRID 45405022
Nature of the Residue: Metabolism Study - Beans	MRID 45405023
Nature of the Residue: Metabolism Study - Rotational Crops	MRID 45405024
HED MARC Decision Memo	D286786 (1/9/2003)

The nature of the residue in plants has been summarized in a previous residue chemistry summary document (PP# 1F6313, D278385, M. Nelson, 8/15/03). The MARC has concluded that the residue of concern in plants for both tolerance and risk assessment purposes is the parent compound (9/11/02 meeting, see memo D286786, M. Nelson, 1/9/03).

860.1300 Nature of the Residue - Livestock

Nature of the Residue: Metabolism Study - Goat	MRID 45405024 and 45405025
Nature of the Residue: Metabolism Study - Poultry	MRID 45405026
HED MARC Decision Memo	D286786 (1/9/2003)

The nature of the residue in livestock has been summarized in a previous residue chemistry summary document (PP# 1F6313, D278385, M. Nelson, 8/15/03). The MARC has concluded that the residues of concern in livestock for both tolerance and risk assessment purposes are the parent, the hydroxy metabolite, and its glucuronide conjugate (9/11/02 meeting, D286786).

860.1340 Residue Analytical Methods

Data Collection Method (D9908) - Plants	MRID 45405027
Proposed Enforcement Method (D0008) - Plants	MRID 45405028 and 45405101

The data collection method for plants and the tolerance enforcement method have been summarized in a previous residue chemistry summary document (PP# 1F6313, D278385, M. Nelson, 8/15/03). The data collection method for plants, Method D9908 (MRID 45405027) was used for data collection in the hops, soybean, and pome fruit field trials.

This method determines residues of boscalid (and, separately, also pyraclostrobin and its metabolite BF 500-3) in plant matrices. Residues are extracted with an aqueous organic solvent mixture followed by liquid/liquid partitioning and column clean-up. Quantitation of boscalid is by LC/MS/MS, using the positive ionization mode to monitor ion transitions from *m/z* 343 to 307 for boscalid. Quantitation is obtained using an external calibration curve of boscalid standards. The validated limit of quantitation (LOQ) is reported to be 0.05 ppm for residues of boscalid in/on plant matrices. Provided concurrent method validations are conducted in conjunction with field samples, this method is considered to be acceptable for data collection purposes.

A separate GC/MS method (Method D0008) is proposed as the enforcement method for residues of boscalid in/on plant matrices (refer to the DER for MRIDs 45405028 and 45405101). The Analytical Chemistry Branch in BEAD concluded that the method is acceptable for enforcement purposes in plants without the need for an EPA validation (8/12/03, D. Swineford and E. Kolbe, D284510). An enforcement method is also available for the residues of concern in livestock. Method DFG S19 is based on GC with electron capture detection and was successfully validated by ACB/BEAD (7/17/03 Memo, D. Swineford and E. Kolbe).

860.1360 Multiresidue Methods

Multiresidue Methods Testing	*MRID 45405107*

The multiresidue methods (MRMs) have been summarized in a previous residue chemistry summary document (PP# 1F6313, D278385, M. Nelson, 8/15/03). Residues of boscalid and its hydroxy metabolite were not adequately recovered using the MRMs.

860.1380 Storage Stability

Frozen Storage Stability - Crops	MRID 45405109

The frozen storage stability of boscalid has been summarized in a previous residue chemistry

summary document (PP# 1F6313, D278385, M. Nelson, 8/15/03). Residues of boscalid are stable for twelve months at -20°C in sugar beet roots, canola seeds, peas, peaches, and wheat forage, grain, and straw.

860.1480 Meat, Milk, Poultry, and Eggs

Magnitude of the Residue: Feeding Study - Cattle MRID 45405110
Magnitude of the Residue: Feeding Study - Poultry MRID 45405110

The results of the cattle and poultry feeding studies have been summarized in a previous residue chemistry summary document (PP# 1F6313, D278385, M. Nelson, 8/15/03). The current tolerance petitions include commodities that have animal feed items associated with them, most notably wet apple pomace and soybean commodities (i.e., forage, hay, meal, and aspirated grain fractions). Both the Endura and Pristine labels have label restrictions which prohibit the feeding of soybean forage and hay to livestock. As a result, these livestock feed items are not included in the maximum theoretical dietary burden (MTDB) calculations. The MTDB for poultry does not change from that calculated in the previous action (Memo, PP# 1F6313, D278385, M. Nelson, 8/15/03). As a result, the poultry and egg tolerances do not need to be revised. The addition of wet apple pomace to the diets of cattle causes increases in the MTDBs for both beef and dairy cattle. The MTDB for beef cattle increases from 8.74 ppm to 15 ppm, and the MTDB for dairy cattle increases from 8.74 ppm to 12 ppm. These increases do not result in the need for increases in the tolerances for cattle, goat, horse, or sheep commodities. The addition of soybean aspirated grain fractions to the diet of hogs causes a small increase in the MTDB (i.e., 1.57 ppm to 2.03 ppm). This small increase does not result in the need for increases in the tolerances for hog commodities. The derivations of the MTDBs for cattle and hogs are given in Tables 4 through 6. For the poultry MTDB, see Memo, PP# 1F6313, D278385, M. Nelson, 8/15/03.

Table 4. Theoretical Worst Case Diet for Beef Cattle, Based on Commodities with Proposed and Established Tolerances

Feed Item	Proposed Tolerance Level, ppm	% Dry Matter (DM)	Tolerance ÷ DM Fraction (ppm)	% of Diet	Dietary Burden ppm*
Apple Pomace	10	40	25	40	10.0
Grass Hay	8.0	88	9.09	60	5.45
Total				100	15

*Dietary burden = (tolerance level ÷ dry matter fraction) x (% of diet).

Table 5. Theoretical Worst Case Diet for Dairy Cattle, Based on Commodities with Proposed and Established Tolerances

Feed Item	Proposed Tolerance Level, ppm	% Dry Matter (DM)	Tolerance ÷ DM Fraction (ppm)	% of Diet	Dietary Burden ppm*
Apple Pomace	10	40	25	20	5.0
Grass Hay	8.0	88	9.09	60	5.45
Carrot Culls	1.0	12	8.33	20	1.67
Total				100	12

*Dietary burden = (tolerance level ÷ dry matter fraction) x (% of diet).

Table 6. Theoretical Worst Case Diet for Hogs, Based on Commodities with Proposed and Established Tolerances			
Feed Item	Proposed Tolerance Level, ppm	% of Diet	Dietary Burden ppm*
Canola Meal	3.5	15	0.53
Flax Meal	3.5	10	0.35
Soybean AGF	3.0	20	0.60
Turnip Root	1.0	40	0.40
Carrot Culls	1.0	10	0.10
Trefoil Forage	1.0	5	0.05
Total		100	2.03

*Dietary burden = (tolerance level) x (% of diet).

860.1500 Crop Field Trials

Magnitude of the Residue: Crop Field Trials - Hops MRID 45645802
Magnitude of the Residue: Crop Field Trials - Pome Fruit MRID 45645803
Magnitude of the Residue: Crop Field Trials - Soybeans MRID 45903602

The results of the hops, pome fruit, and soybean field trials are given in Table 7.

Table 7. Summary of Residues from the Crop Field Trials with Boscalid							
Crop Matrix	Applic. Rate (lb ai/A)	PHI (days)	Residues (ppm)				
			Mean	Std. Dev.	HAFT	Min.	Max.
HOPS (proposed use = 1.32 lb ai/A total application rate, 14-day PHI)							
Hops	1.35 lb ai/A	14	21	11	22	11	31
POME FRUIT (proposed use = 1.16 lb ai/A total application rate, 0-day PHI)							
Apple	1.8 lb ai/A	0	0.76	0.38	1.4	0.17	2.1
Pear	1.8 lb ai/A	0	0.93	0.51	1.6	0.37	2.3
SOYBEANS (proposed use = 0.96 lb ai/A total application rate, 21-day PHI)							
Soybean Mature Seed	1.0 lb ai/A	21	<0.05	0	<0.05	<0.05	<0.05
Soybean Immature Seed	1.0 lb ai/A	5	0.11	0.28	1.2	<0.05	1.3
Forage	1.0 lb ai/A	14	5.6	3.5	16	0.27	16
Hay	1.0 lb ai/A	21	5.5	4.9	21	0.07	22
Aspirated Grain Fractions	1.0 lb ai/A	21	1.6	-	1.6	0.71	2.4

Hops

Supervised crop field trials were conducted with hops at three sites in the United States (Regions 11 and 12) at seasonal application rates of 0.45 lb a.i./A (0.50 kg a.i./ha) with pre-harvest intervals of 0, 7, and 14 days. The number and location of trials are consistent with the recommendations in the OPPTS Series 860 Guidelines, Section 1500. The analytical method used for data collection is BASF Analytical Method Number D9908. Residues of boscalid are extracted from the samples with a 70:25:5 methanol/water/2N HCl mixture. An aliquot of the extract is removed and cleaned by liquid/liquid partition with cyclohexane. If necessary, a silica, solid phase extraction, micro-column was used to further clean the extract. Boscalid residues are determined by LC/MS/MS. Analysis of fortified control samples demonstrated that the method is acceptable as a data-gathering method. Samples were stored frozen for six months or less. Residues of boscalid have been shown to be stable in plant commodities under frozen storage conditions for up to one year. The results of these trials show that maximum residues are 31 ppm at the proposed PHI of 14 days, 40 ppm at a 7-day PHI, and 52 ppm at a 0-day PHI. Residue decline data show that boscalid residues decrease with increasing pre-harvest intervals.

Pome Fruit

Supervised crop field trials were conducted on apples (16 sites in the U.S. and Canada) and pears (10 sites in the U.S. and Canada) at seasonal application rates of 1.8 lb a.i./A (2.0 kg a.i./ha) with a pre-harvest interval of 0 days. The recommended numbers of field trials were performed in the specified regions (OPPTS Series 860 Guidelines, Section 1500). Residues of boscalid are extracted from pome fruit samples with a 70:25:5 methanol/water/2N HCl mixture. An aliquot of the extract is removed and cleaned by liquid/liquid partitioning. The final chromatographic analysis of boscalid is performed using LC/MS/MS. This method (BASF Analytical Method D9908) is acceptable as a data-gathering method. It was validated through the analysis of fortified control samples. Samples were stored for a maximum of 7 months. Residues of boscalid have been shown to be stable in a variety of commodities for up to 12 months. The results from these trials show that maximum residues are 2.1 ppm in apples and 2.3 ppm in pears. Residue decline data are not available as samples were taken at a 0-day PHI only.

Soybeans

Supervised crop field trials were conducted on soybeans at seventeen sites in the United States (thirteen in Region 5 and two each in Regions 2 and 4) at a seasonal application rate of 0.5 lb a.i./A, with a pre-harvest interval of 21 days for mature seed, forage, and aspirated grain fractions, 5 days for immature seed, and 14 days for forage. Two applications were made for a total application rate of 1.0 lb a.i./A. An LC/MS/MS method was used for residue analysis. Through analysis of fortified control samples, the method was demonstrated to be adequate for data collection. Samples were stored frozen for six months or less. Residues of boscalid have been shown to be stable in plant commodities under frozen storage conditions for up to one year. The results of these trials show that maximum residues are <0.05 ppm in mature seed, 1.3 ppm in immature seed, 16 ppm in forage, 22 ppm in hay, and 2.4 ppm in aspirated grain fractions. Residue decline data were not submitted.

Conclusions. The submitted field trials performed on hops, pome fruit, and soybeans are adequate to support the proposed tolerances. The hops and soybean field trials were performed according to the use directions. For pome fruit, the total application rate used in field trials was 1.6x that specified on the proposed label. The individual application rate was the specified rate; however, six applications were made as opposed to the four that were specified. The actual total application rate was not considerably higher than the proposed total application rate. As a result, the field trials are considered to be adequate for tolerance setting purposes. Adequate storage stability studies have been submitted to demonstrate that boscalid residues are stable over the storage periods used in field trials. The analytical method used for data collection has been demonstrated to be adequate for analysis of hops, pome fruit, and soybean commodities. Parent boscalid only was measured in the field trials. The parent compound is the only residue of concern in plant commodities.

The following tolerances are supported by the field trial data: hops cones, dried (35 ppm), pome fruit (3.0 ppm), soybean vegetable (2.0 ppm), soybean seed (0.1 ppm), soybean aspirated grain fractions (3.0 ppm). The registrant needs to submit a revised Section F in which a tolerance of 2.0 ppm is proposed for soybean vegetable and a tolerance of 3.0 ppm is proposed for soybean aspirated grain fractions. The proposed tolerances of 3.0 for pome fruit, 0.1 ppm for soybean seed, and 35 ppm for hops are adequate. The revised Section F should specify the correct commodity definition for hops as hops cones, dried. The registrant did not propose tolerances for soybean forage and hay. As the boscalid labels have feeding restrictions on forage and hay; it is not necessary to establish tolerances for these commodities.

860.1520 Processed Food and Feed

Magnitude of the Residue: Processing Trial - Apple	MRID 45645804
Magnitude of the Residue: Processing Trial - Soybeans	MRID 45623410

Apple

Boscalid, 200 g/L SE formulation, was applied to apple trees at a rate of 0.53 lb a.i./A (0.59 kg a.i./ha). Four applications were made for a total application rate of 2.1 lb ai/A (2.4 kg ai/ha). Six apple samples were processed into fresh pomace and apple juice. Two of these samples were taken on the last day of application, and the other four were taken thirteen to fifteen days after the last application. The method used for sample analysis is BASF Method 445/0. The samples are extracted with a mixture of methanol, water, and hydrochloric acid. An aliquot is centrifuged and partitioned with cyclohexane. Boscalid residues are determined by HPLC/MS/MS. Samples were stored for a maximum of six months. Residues of boscalid have been shown to be stable in a variety of commodities for up to twelve months. A comparison of the residues in the RAC with those in each processed fraction resulted in processing factors of 0.08x for apple juice and 5.5x for wet apple pomace. The OPPTS Series 860 Residue Chemistry Guidelines do not give theoretical concentration factors for apple juice or wet pomace. The Guidelines give a maximum observed concentration factor for apple pomace of 14x. This value is higher than the value obtained for boscalid.

Soybean

The results of the soybean processing study have been summarized in a previous residue chemistry summary document (PP# 1F6313, D278385, M. Nelson, 8/15/03). The results were summarized as follows: "The processing data indicate that residues of BAS 510 F reduced in soybean meal (<0.05 ppm; <0.2x processing factor) and oil (0.115-0.133 ppm; 0.4x processing factor), and concentrated in hulls (0.522-0.563 ppm; 1.7-1.8x processing factors). The observed processing factor of 1.8x for soybean hulls is less than the theoretical maximum concentration factor of 11.3x (OPPTS 860.1520, Table 3, Dir 98-02 Section 10 Table 3)."

Table 8. Processing Factors for Apple and Soybean Commodities

Apple Juice	Apple Wet Pomace	Soybean Hulls	Soybean Meal	Soybean Refined Oil
0.07	5.5	1.8	0.2	0.4

Conclusions. The apple and soybean processing studies were conducted at exaggerated rates. The apple trial was conducted at a 1.8x rate. The soybean trial was conducted at a 2.2x rate (compared to the Pristine label rate) or a 2.6x rate (compared to the Endura label rate). The residue data are supported by the storage stability studies, and the analytical methods are adequate for the analysis of parent boscalid (the only residue of concern in plants). The apple processing study supports a tolerance of 10 ppm for apple pomace [(HAFT of 1.4 ppm) x (5.5 concentration factor) = (7.7 ppm)]. As residues do not concentrate in apple juice, a separate tolerance is not required for juice. The soybean processing study supports the proposed tolerance of 0.2 ppm for soybean hulls. As residues do not concentrate in meal or oil, tolerances are not required for these commodities. There are no data deficiencies that would preclude the establishment of the tolerances for apple or soybean processing commodities. The registrant needs to submit a revised Section F in which a tolerance of 10 ppm is proposed for apple pomace, wet.

860.1850 Confined Accumulation in Rotational Crops

Nature of the Residue - Rotational Crops MRID 45405204

The nature of the residue in rotational crops has been summarized in a previous residue chemistry summary document (PP# 1F6313, D278385, M. Nelson, 8/15/03).

860.1900 Field Accumulation in Rotational Crops

Limited Field Accumulation Study in Three Representative Rotational Crops - Cabbage, Radish, and Winter Wheat MRID 45405203

Extended Field Accumulation Study in Rotational Crops: Legume Vegetables - Soybean MRID 45623412

Extended Field Accumulation Study in Rotational Crops: Foliage of Legume Vegetables - Cowpea, Field Pea, and Soybean (MRID 45623409 and 45623412).

Extended Field Accumulation Studies in Rotational Crops. Cereal Grains - Corn, Rice, Sorghum, and Wheat Forage, Fodder, and Straw of Cereal Grains - Corn, Rice, Sorghum, and Wheat. (MRID 45623412)

Extended Field Accumulation Studies in Rotational Crops. Grass Forage, Fodder, and Hay - Grasses (blue, Bermuda, brome, rye, and fescue) NonGrass Animal Feeds - Alfalfa and Clover (MRID 45623411)

Extended Field Accumulation Study in Rotational Crop: Cotton (MRID 45623413)

The field accumulation in rotational crop studies have been summarized in a previous residue chemistry summary document (PP# 1F6313, D278385, M. Nelson, 8/15/03).

860.1550 Proposed Tolerances

The MARC determined that the residues to be included in the tolerance expression are parent only in crops, and parent plus hydroxy metabolite (free plus bound) in livestock commodities. The first tolerances for boscalid were published on July 30, 2003 in 40CFR §180.589. There are no Codex MRLs for boscalid. The previous risk assessment for boscalid, which included the crops which currently have tolerances, was done as a joint review with PMRA/Canada. Table 9 provides a summary of the recommended tolerances and the correct commodity definitions for the commodities in PP#s 2F6434 and 3F6580.

Table 9. Tolerance Summary for Boscalid

Commodity	Proposed Tolerance (ppm)	Recommended Tolerance (ppm)	Comments (correct commodity definition)
Pome Fruits	3.0	3.0	
Apple Pomace	20.0	10	Apple pomace, wet
Hops	35.0	35	Hops cones, dried
Soybean (Immature)	2.2	2.0	Soybean, vegetable
Soybean Seed	0.1	0.1	
Soybean Hulls	0.2	0.2	
Soybean Aspirated Grain Fractions	2.5	3.0	

Boscalid (BAS510F)/128008/BASF Corporation/7969
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 - Soybeans

Primary Evaluator	Douglas Dotson, Chemist, USEPA/OPP/HED/RAB2	Date: 2/10/04 D. Dotson
Reviewer	William Drew, Chemist USEPA/OPP/HED/RAB2	Date: 2/11/04 WDrew

STUDY REPORTS:

MRID No. 45903602, Raymond C. Leonard (3/28/03) Study title: Magnitude of BAS 500 F and BAS 510 F Residues in Soybean. Lab Project Number: 140578. Unpublished study prepared by BASF Agro Research, 157 pages.

EXECUTIVE SUMMARY:

Supervised crop field trials were conducted on soybeans at seventeen sites in the United States (thirteen in Region 5 and two each in Regions 2 and 4) at a seasonal application rate of 0.5 lb a.i./A, with a pre-harvest interval of 5 days for immature seed (i.e., soybean vegetable), 14 days for forage, and 21 days for mature seed and hay. Two applications were made for a total application rate of 1.0 lb a.i./A. An LC/MS/MS method was used for residue analysis. Through analysis of fortified control samples, the method was demonstrated to be adequate for data collection. Samples were stored frozen for six months or less. Residues of boscalid have been shown to be stable in plant commodities under frozen storage conditions for up to one year. The results from these trials show that maximum residues are <0.05 ppm in mature seed, 1.3 ppm in soybean vegetable, 16 ppm in forage, 22 ppm in hay, and 2.4 ppm in aspirated grain fractions. Residue decline data were not submitted.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the field trial residue data are classified as scientifically acceptable. There are no deficiencies. In the Field Procedures section of the field trial final report a typographical error occurred which the registrant has clarified by electronic communication to D. McNeilly (K. Akkari, 9/8/03). Field trial site number 2002218 (which is a number for a non-existent site) should be changed to 2002216 (the Quebec site).

The acceptability of this study for regulatory purposes is addressed in the U.S. EPA Residue Chemistry Summary Document (DP Barcode D290185).

COMPLIANCE:

Signed and dated GLP, Quality Assurance and Data Confidentiality statements were provided. The study meets the requirements of 40 CFR part 160, FIFRA Good Laboratory Practices with the following exceptions: (1) weather data were not collected in accordance with GLP standards; (2) agronomic practices (irrigation, cultural practices, etc.) and maintenance pesticide applications (past and present) were not conducted in accordance with GLP standards; and (3) the sample weights taken by the field investigator were not taken in accordance with GLP standards in that a calibrated balance was not always used for their measurement. These exceptions had no impact on the study.

A. BACKGROUND INFORMATION

The first human health risk assessment for boscalid (formerly BAS 510 F) was completed on 9/8/2003 by Y. Donovan, *et al.* (D290022). The Health Effects Division (HED) recommended in favor of the establishment of tolerances on a number of plant and animal commodities. These tolerances were published in the Federal Register Environmental Documents (July 30, 2003). Two formulated end-use products are proposed for use on soybeans: Endura™ Fungicide (EPA Reg. No. 7969-197), which contains 70% boscalid, and Pristine™ Fungicide (EPA Reg. No. 7969-199), which contains a 2:1 mixture of boscalid and pyraclostrobin as co-active ingredients (25.2%:12.8%).

TABLE A.1. Test Compound Nomenclature

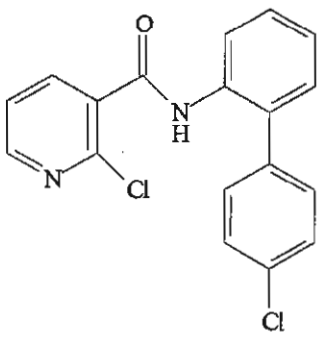
Compound	Chemical Structure
	 Boscalid
Common name	Boscalid
Company experimental name	BAS 510F
IUPAC name	2-Chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide
CAS name	3-Pyridinecarboxamide, 2-chloro-N-(4'chloro[1,1'-biphenyl]-2-yl)
CAS #	188425-85-6
End-use product/EP	Endura and Pristine

TABLE A.2. Physicochemical Properties	
Parameter	Value
Melting point/range	142.8-143.8°C
pH	Unspecified
Density	1.39 g/cm^3 (powder), 1.38 g/cm^3 (crystalline)
Water solubility (20°C)	4.64 mg/L (crystalline form)
Solvent solubility (mg/L at 20°C)	Crystalline Form: Acetone: 16-20 g/100 mL Acetonitrile: 4-5 g/100 mL Methanol: 4-5 g/100 mL Ethyl Acetate: 6.7-8 g/100 mL Dichloromethane: 20-25 g/100 mL Toluene: 2-2.5 g/100 mL 1-Octanol: <1g/100 mL
Vapor pressure at 20°C	Crystalline Form: 7 x 10^{-7} Pa
Vapor pressure at 25°C	Crystalline Form: 2 x 10^{-6} Pa
Dissociation constant (pK_a)	No dissociation in water.
Octanol/water partition coefficient Log(K_{OW})	log K_{ow} of crystalline form = 2.96 (21°C)
UV/visible absorption spectrum	Unspecified

B. EXPERIMENTAL DESIGN

B.1. Study Site Information

TABLE B.1.1 Soil Characterization.				
Study Location	Soil characteristics			
	Type	%OM	pH	CEC
All Locations	Not Specified	Not Specified	Not Specified	Not Specified

The soil type, percent organic matter, pH, and cation exchange capacity were not specified for any of the sites. The registrant did not state that these values affected the use pattern in any location. With a few exceptions, rainfall and air temperatures during the duration of the study were normal. "Normal" for rainfall is defined as levels which are within 20% of the 10-year seasonal norm, and "normal" for temperature indicates that average maximum and minimum air temperatures are within 10% of the monthly norm. Rainfall levels were above normal at the Arkansas, WI site and at the Gardner, ND site. Rainfall levels were below normal at the Britton, SD site. In addition, air temperatures were above normal at the Chula, GA and Suffolk, VA sites (for month of October only), at the York NE site (for June, July, and August), and at the Quebec site (September only). Air temperatures were below normal at the Arkansas, WI and Quebec sites (May and October), and at the Gardner, ND site in May only. These conditions had no adverse effects on the study. Irrigation was done at some sites, when necessary, to ensure that the crop developed normally.

TABLE B.1.2. Study Use Pattern.

Location (City, State)	EP[1]	Application						Tank Mix Adjuvants
		Timing	Rate, lb a.i./A (kg a.i./ha)	RTI[2] (days)	Treat No.	Method	Total Rate, lb a.i./A (kg a.i./ha)	
Chula, GA	Combination of BAS 510 02 F (boscalid) and BAS 500 02 F (pyraclo-strobin)	1st application: 12 days prior to harvest of soybean vegetable. 2nd application: 28 days prior to harvest of mature seed	0.50 lb ai/A (0.56 kg ai/ha)	7	2	Broad-cast Spray	1.0 lb ai/A (1.1 kg ai/ha)	Non-silicone spray adjuvant
Suffolk, VA								
Proctor, AR								
Newport, AR								
Arkansas, WI								
Arkansas, WI								
Webster City, IA								
Webster City, IA								
York, NE								
York, NE								
Gardner, ND								
Gardner, ND								
Britton, SD								
Britton, SD								
Carlyle, IL								
Wyoming, IL								
St-Paul d'Abbotsford, QB								

[1]EP = End-use Product
[2] Retreatment Interval

17

TABLE B.1.3. Trial Numbers and Geographical Locations

NAFTA Growing Region	Soybeans		
	Submitted	Requested	
		Canada	US
1			
1A			
2	2		2
3			
4	2		2
5	12		11
5A			
5B	1		0
6			
7			
7A			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
Total	17	0	15

B.2. Analytical Methodology

The analytical method used for data collection is BASF Analytical Method Number D9908. This method is reviewed in the DER prepared for MRID 45405027 (D278386, W. Drew, 7/2/03). Residues of boscalid are extracted from the samples with a 70:25:5 methanol/water/2N HCl mixture. An aliquot of the extract is removed and cleaned by liquid/liquid partition with cyclohexane. If necessary, a silica, solid phase extraction, micro-column was used to further clean the extract. Boscalid residues are determined by LC/MS/MS. The method was validated for the determination of boscalid residues in plant commodities through the analysis of residues in almond nutmeat, onion, and plum (D278386). Overall recoveries were acceptable in the validation study. The LOQ was determined to be 0.05 ppm for residues in plant commodities. The LOD was quoted as 5 pg/µL.

C. RESULTS AND DISCUSSION

The results of the residue analyses are given in Tables C.3.1 through C.3.5. Residues in mature soybean seed were below the LOQ of 0.05 ppm in all samples. In soybean vegetable (referred to as immature seed by the registrant), residues were below the LOQ (0.05 ppm) in 25 out of 34 samples. The highest residue found was 1.29 ppm. Two samples of aspirated grain fractions were prepared and analyzed. Residues were 0.71 and 2.42 ppm. Residues were considerably higher in forage and hay. In forage, residues ranged up to 16 ppm, and in hay, residues ranged up to 21 ppm. Weather conditions were typical during the field trials. The registrant reported that the minor variations from the norm did not affect the field trials. As a result, the field trial values are adequate for tolerance-setting purposes. Adequate numbers of field trials were performed, and geographic representation of the field trials is adequate. Seventeen field trials were performed whereas only fifteen are required when a crop group tolerance is being requested. Tolerances have been established for Crop Subgroups 6A, 6B, and 6C. The human health risk assessment which includes these subgroups was completed on 9/8/03 (Memo, PP#1F6313, D290022, Y. Donovan). Residue decline data for soybeans were not submitted.

The analytical method used for data collection is BASF Analytical Method Number D9908. This method is suitable for data collection. Mature seed, soybean vegetable, forage, and hay were fortified at both the LOQ (0.05 ppm) and at 1.0 ppm. Forage and hay were also fortified at 50 ppm. Recoveries in the various matrices ranged as follows: mature seed (78% to 104%), soybean vegetable (74% to 83%), forage (81% to 125%), and hay (86% to 116%). Mean recoveries ranged from 78% to 99%. Standard deviations as a percentage of the mean ranged from 4% to 19%. The method LOD was reported to be 0.1 ng/mL. A sample calibration curve showed good detector linearity (correlation coefficient of 0.998).

The registrant submitted a storage stability study which was performed to investigate the frozen storage stability of boscalid residues in sugar beet root, cabbage, canola seed, pea, peach, wheat forage, wheat grain, and wheat straw. Fortified commodities were stored at -20°C for 12 months.

Residues were measured after 0, 1, 3, 6, and 12 months of storage. This study has been reviewed, and a DER has been prepared (MRID 45405109, D278386, M. Nelson, 7/2/03). Residues of boscalid were stable for up to 12 months of frozen storage in all commodities. In the soybean field trial studies, no commodity was stored for more than 6 months in any trial. The results of the storage stability study support the storage periods used in the soybean field trials.

TABLE C.1. Summary of Concurrent Recoveries of Boscalid from Soybean Commodities.

Matrix	Analyte	Spike level (mg/kg)	Sample size (n)	Recoveries (%)	Mean ± std dev (%)
Mature Seed	Boscalid	0.05	3	92.2, 78.2, 95.6	88.7 ± 9.2
		1.0	3	104.4, 91.2, 94.2	96.6 ± 6.9
Soybean Vegetable		0.05	3	74.4, 77.0, 82.8	78.1 ± 4.3
		1.0	3	81.6, 76.0, 82.8	80.1 ± 3.6
Forage		0.05	4	125.2, 81.0, 91.6, 101.8	99.9 ± 18.9
		1.0	3	83.0, 96.0, 100.4	93.1 ± 9.1
		50.0	1	87.2	87.2
Hay		0.05	3	115.8, 90.4, 91.8	99.3 ± 14.3
		1.0	2	101.6, 86.4	94.0 ± 10.8
		50.0	1	91.8	91.8

TABLE C.2. Summary of Storage Conditions

Matrix (RAC or Extract)	Storage Temp. (°C)	Actual Storage Duration (months)	Limit of Demonstrated Storage Stability (months)
Mature Seed	-10°C	4	12
Soybean Vegetable	-10°C	5	12
Forage	-10°C	6	12
Hay	-10°C	5	12

TABLE C.3.1. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Soybean Variety	Commodity	Total Rate (lbs ai/A)	PHI (days)	Residues 1 (ppm)	Residues 2 (ppm)
Chula, GA	2	NK RR S73-Z5	Mature Seed	1.01	21	<0.05	<0.05
Suffolk, VA	2	NK S53Q7 7B-1001		1.02		<0.05	<0.05
Proctor, AR	4	AG4403		1.00		<0.05	<0.05
Newport, AR	4	AG5603		1.00		<0.05	<0.05
Arkansas, WI	5	BR2099RR		1.00		<0.05	<0.05
Arkansas, WI	5	BR2099RR		1.01		<0.05	<0.05
Webster City, IA	5	SG2531RR		1.03		<0.05	<0.05
Webster City, IA	5	SG2533RR		1.02		<0.05	<0.05
York, NE	5	Asgrow A2553		1.00		<0.05	<0.05
York, NE	5	Asgrow 2703		1.00		<0.05	<0.05
Gardner, ND	5	Mycogen 5007		1.01		<0.05	<0.05
Gardner, ND	5	Mycogen 5007		1.01		<0.05	<0.05
Britton, SD	5	CropOland RT0583		1.00		<0.05	<0.05
Britton, SD	5	CropOland RT0583		1.00		<0.05	<0.05
Carlyle, IL	5	B-T 441 CR		1.00		<0.05	<0.05
Wyoming, IL	5	Asgrow Ag3302		1.01		<0.05	<0.05
St-Paul d'Abbotsford, QB	5b	DKB07-51		0.95		<0.05	<0.05

TABLE C.3.2. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Soybean Variety	Commodity	Total Rate (lbs ai/A)	PHI (days)	Residues 1 (ppm)	Residues 2 (ppm)
Chula, GA	2	NK RR S73-Z5	Soybean Vegetable (Green)	1.01	5	<0.05	<0.05
Suffolk, VA	2	NK S53Q7 7B-1001		1.02		0.06	<0.05
Proctor, AR	4	AG4403		1.00		1.07	1.29
Newport, AR	4	AG5603		1.00		<0.05	0.05
Arkansas, WI	5	BR2099RR		1.00		0.07	0.08
Arkansas, WI	5	BR2099RR		1.01		0.08	0.31
Webster City, IA	5	SG2531RR		1.03		<0.05	<0.05
Webster City, IA	5	SG2533RR		1.02		<0.05	<0.05
York, NE	5	Asgrow A2553		1.00		<0.05	<0.05
York, NE	5	Asgrow 2703		1.00		0.13	<0.05
Gardner, ND	5	Mycogen 5007		1.01		<0.05	<0.05
Gardner, ND	5	Mycogen 5007		1.01		<0.05	<0.05
Britton, SD	5	CropOland RT0583		1.00		<0.05	<0.05
Britton, SD	5	CropOland RT0583		1.00		<0.05	<0.05
Carlyle, IL	5	B-T 441 CR		1.00		<0.05	<0.05
Wyoming, IL	5	Asgrow Ag3302		1.01		<0.05	<0.05
St-Paul d'Abbotsford, QB	5b	DKB07-51		0.95		<0.05	<0.05

TABLE C.3.3. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Soybean Variety	Commodity	Total Rate (lbs ai/A)	PHI (days)	Residues I (ppm)	Residues 2 (ppm)
Chula, GA	2	NK RR S73-Z5	Forage	1.01	14	3.99	4.62
Suffolk, VA	2	NK S53Q7 7B-1001		1.02		5.88	3.08
Proctor, AR	4	AG4403		1.00		16.3	15.7
Newport, AR	4	AG5603		1.00		3.36	2.59
Arkansas, WI	5	BR2099RR		1.00		1.73	1.51
Arkansas, WI	5	BR2099RR		1.01		6.42	6.76
Webster City, IA	5	SG2531RR		1.03		5.30	5.33
Webster City, IA	5	SG2533RR		1.02		0.27	2.08
York, NE	5	Asgrow A2553		1.00		6.46	6.88
York, NE	5	Asgrow 2703		1.00		9.40	6.47
Gardner, ND	5	Mycogen 5007		1.01		5.25	5.60
Gardner, ND	5	Mycogen 5007		1.01		8.00	9.40
Britton, SD	5	CropOland RT0583		1.00		6.38	3.07
Britton, SD	5	CropOland RT0583		1.00		10.35	6.15
Carlyle, IL	5	B-T 441 CR		1.00		3.11	2.98
Wyoming, IL	5	Asgrow Ag3302		1.01		3.64	3.61
St-Paul d'Abbotsford, QB	5b	DKB07-51		0.95		4.81	4.43

TABLE C.3.4. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Soybean Variety	Commodity	Total Rate (lbs ai/A)	PHI (days)	Residues 1 (ppm)	Residues 2 (ppm)
Chula, GA	2	NK RR S73-Z5	Hay	1.01	21	1.07	1.50
Suffolk, VA	2	NK S53Q7 7B-1001		1.02		2.67	1.88
Proctor, AR	4	AG4403		1.00		4.64	4.45
Newport, AR	4	AG5603		1.00		1.99	2.24
Arkansas, WI	5	BR2099RR		1.00		3.45	0.07
Arkansas, WI	5	BR2099RR		1.01		2.77	2.79
Webster City, IA	5	SG2531RR		1.03		4.36	5.21
Webster City, IA	5	SG2533RR		1.02		2.22	1.76
York, NE	5	Asgrow A2553		1.00		20.9	21.6
York, NE	5	Asgrow 2703		1.00		1.11	1.65
Gardner, ND	5	Mycogen 5007		1.01		8.61	4.85
Gardner, ND	5	Mycogen 5007		1.01		7.68	6.47
Britton, SD	5	CropOland RT0583		1.00		7.80	7.75
Britton, SD	5	CropOland RT0583		1.00		10.95	11.60
Carlyle, IL	5	B-T 441 CR		1.00		5.05	5.60
Wyoming, IL	5	Asgrow Ag3302		1.01		7.25	7.35
St-Paul d'Abbotsford, QB	5b	DKB07-51		0.95		3.59	3.55

TABLE C.3.5. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Soybean Variety	Commodity	Total Rate (lbs ai/A)	PHI (days)	Residues 1 (ppm)	Residues 2 (ppm)
York, NE	5	Asgrow 2703	Aspirated Grain Fractions	1.00	21	2.42	0.71

29

TABLE C.4. Summary of Residue Data from Crop Field Trials with Boscalid.

Commodity	Total Applic. Rate, lb a.i./A (kg a.i./ha)	PHI (days)	Analyte	Residue Levels (ppm)					
				n	Min.	Max.	HAFT*	Mean	Std. Dev.
Mature Seed	1.0 lb ai/A (1.1 kg ai/ha)	21	Boscalid	34	<0.05	<0.05	<0.05	<0.05	0
Soybean Vegetable		5		34	<0.05	1.29	1.18	0.11	0.28
Forage		14		34	0.27	16.3	16.0	5.6	3.5
Hay		21		34	0.07	21.6	21.3	5.5	4.9
AGF		21		2	0.71	2.42	1.57	1.57	-

* HAFT = Highest Average Field Trial.

D. CONCLUSION

The soybean field trials have been performed in accordance with the OPPTS Series 860 Residue Chemistry Test Guidelines. The total application rate was 1.0 lb a.i./acre. The PHIs were 5 days for soybean vegetable, 14 days for forage, and 21 days for forage and hay. Adequate numbers of field trials were performed in the major soybean-growing regions of the country. There were no adverse weather conditions which would affect the results of the study. The analytical method has been demonstrated to be adequate for data collection. Residues of boscalid have been shown to be stable over the storage periods used in the study. Residues in mature soybean seed were below the LOQ of 0.05 ppm in all samples. In soybean vegetable, residues were below the LOQ (0.05 ppm) in 25 out of 34 samples. The highest residue found was 1.29 ppm. Two samples of aspirated grain fractions were prepared and analyzed. Residues were 0.71 and 2.42 ppm. Residues were considerably higher in forage and hay. In forage, residues ranged up to 16 ppm, and in hay, residues ranged up to 21 ppm.

E. REFERENCES

Human Health Risk Assessment for New Fungicide BAS 510 F (Common Name: Boscalid) – Proposal for Tolerances for Residues in/on Numerous Crops and Livestock Commodities, PP# 1F6313, D290022, Y. Donovan, 9/8/03.

Residue Analytical Methods DER, Plant Commodities, BAS 510 F, PP# 1F6313, D278386, W. Drew, 7/2/2003.

Storage Stability Data DER, Plant Commodities, BAS 510 F, PP# 1F6313, D278386, M. Nelson, 7/2/2003.

Boscalid (BAS510F)/128008/BASF Corporation/7969
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 - Hops

Primary Evaluator	Douglas Dotson, Chemist, USEPA/OPP/HED/RAB2	Date: 2/10/04 D. Dotson
Reviewer	William Drew, Chemist USEPA/OPP/HED/RAB2	Date: 2/11/04 WTDew

STUDY REPORTS:

MRID No. 45645802, Jeannine Marie Jordan (3/22/02) Study title: Magnitude of the Residue of BAS 500 02 F and BAS 510 UCF in Hops. Lab Project Number: 64550. Unpublished study prepared by BASF Agro Research, 68 pages.

EXECUTIVE SUMMARY:

Supervised crop field trials were conducted with hops at three sites in the United States (Regions 11 and 12) at seasonal application rates of 1.35 lb a.i./A (1.50 kg a.i./ha) with pre-harvest intervals of 0, 7, and 14 days. The number and location of trials are consistent with the recommendations in the OPPTS Series 860 Guidelines, Section 1500. The analytical method used for data collection is BASF Analytical Method Number D9908. Residues of boscalid are extracted from the samples with a 70:25:5 methanol/water/2N HCl mixture. An aliquot of the extract is removed and cleaned by liquid/liquid partition with cyclohexane. If necessary, a silica, solid phase extraction, micro-column was used to further clean the extract. Boscalid residues are determined by LC/MS/MS. Analysis of fortified control samples demonstrated that the method is acceptable as a data-gathering method. Samples were stored frozen for six months or less. Residues of boscalid have been shown to be stable in plant commodities under frozen storage conditions for up to one year. The results from these trials show that maximum residues are 31 ppm at a PHI of 14 days, 40 ppm at a 7-day PHI, and 52 ppm at a 0-day PHI. Residue decline data show that boscalid residues decrease with increasing pre-harvest intervals.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the field trial residue data are classified as scientifically acceptable. There are no deficiencies, and there are no issues which the registrant needs to clarify.

The acceptability of this study for regulatory purposes is addressed in the U.S. EPA Residue Chemistry Summary Document (DP Barcode D290185).

COMPLIANCE:

Signed and dated GLP, Quality Assurance and Data Confidentiality statements were provided. The study meets the requirements of 40 CFR Part 160, FIFRA Good Laboratory Practices.

A. BACKGROUND INFORMATION

The first human health risk assessment for boscalid (formerly BAS 510 F) was completed on 9/8/2003 by Y. Donovan, *et al.* (D290022). The Health Effects Division (HED) recommended in favor of the establishment of tolerances on a number of plant and animal commodities. These tolerances were published in the Federal Register Environmental Documents (July 30, 2003). One formulated end-use product is proposed for use on hops: Pristine™ Fungicide (EPA Reg. No. 7969-199), which contains a 2:1 mixture of boscalid and pyraclostrobin as co-active ingredients (25.2%:12.8%).

TABLE A.1. Test Compound Nomenclature

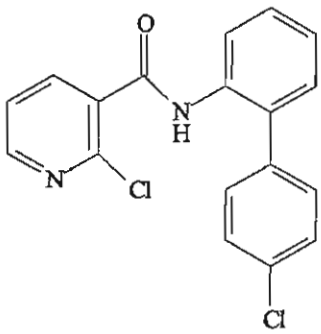
Compound	Chemical Structure
	 Boscalid
Common name	Boscalid
Company experimental name	BAS 510 F
IUPAC name	2-Chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide
CAS name	3-Pyridinecarboxamide, 2-chloro-N-(4'chloro[1,1'-biphenyl]-2-yl)
CAS #	188425-85-6
End-use product/EP	Pristine

TABLE A.2. Physicochemical Properties	
Parameter	Value
Melting point/range	142.8-143.8°C
pH	Unspecified
Density	1.39 g/cm^3 (powder), 1.38 g/cm^3 (crystalline)
Water solubility (20°C)	4.64 mg/L (crystalline form)
Solvent solubility (mg/L at 20°C)	Crystalline Form: Acetone: 16-20 g/100 mL Acetonitrile: 4-5 g/100 mL Methanol: 4-5 g/100 mL Ethyl Acetate: 6.7-8 g/100 mL Dichloromethane: 20-25 g/100 mL Toluene: 2-2.5 g/100 mL 1-Octanol: <1g/100 mL
Vapor pressure at 20°C	Crystalline Form: 7 x 10^{-7} Pa
Vapor pressure at 25°C	Crystalline Form: 2 x 10^{-6} Pa
Dissociation constant (pK_a)	No dissociation in water.
Octanol/water partition coefficient Log(K_{OW})	log K_{ow} of crystalline form = 2.96 (21°C)
UV/visible absorption spectrum	Unspecified

B. EXPERIMENTAL DESIGN

B.1. Study Site Information

TABLE B.1.1 Soil Characterization.				
Study Location	Soil characteristics			
	Type	%OM	pH	CEC
Moxee, WA	Sandy Loam	Not Specified	Not Specified	Not Specified
Moxee, WA	Sandy Loam			
Greenleaf, ID	Silt Loam			
Greenleaf, ID	Silt Loam			
Woodburn, OR	Silt Loam			
Woodburn, OR	Silt Loam			

The submitted study did not specify the temperature or rainfall that occurred during the study. There was also no discussion of historic values of these parameters. At the Washington site, drip irrigation was used; at the Idaho site, furrow irrigation was used; and at the Oregon site, big gun irrigation was used.

TABLE B.1.2. Study Use Pattern.

Location (City, State)	EP[1]	Application						Tank Mix Adjuvants
		Timing	Rate, lb a.i./A (kg a.i./ha)	RTI[2] (days)	Treat. No.	Method	Total Rate, lb a.i./A (kg a.i./ha)	
Moxee, WA	Combination of: BAS 510 UCF (boscalid) and BAS 500 02F (pyraclostro-bin)	1st application: 20 days prior to first sampling date	0.45 lb ai/A (0.50 kg ai/ha)	10	3	Broad-cast Spray	1.35 lb ai/A (1.50 kg ai/ha)	Induce
Moxee, WA								Induce
Greenleaf, ID								R-11
Greenleaf, ID								R-11
Woodburn, OR								R-11
Woodburn, OR								R-11

[1]EP = End-use Product
[2] Retreatment Interval

TABLE B.1.3. Trial Numbers and Geographical Locations

NAFTA Growing Region	HOPS		
	Submitted	Requested	
		Canada	US
1			
1A			
2			
3			
4			
5			
5A			
5B			
6			
7			
7A			
8			
9			
10			
11	2		Not Specified
12	1		Not Specified
13			
14			
15			
16			
17			
18			
19			
20			
21			
Total	3	0	3

For hops, the minimum number of field trials and the minimum number of samples required for a tolerance are 3 and 6, respectively. The OPPTS Series 860 Test Guidelines do not specify the regions in which the field trials should be performed. Ninety-four percent of the hops grown in the United States are grown in Region 11, however. Two of the test sites, Moxee, WA and Greenleaf, ID, are in Region 11. The third site, Woodburn, OR, is located in Region 12, close to the border of Region 11.

B.2. Analytical Methodology

The analytical method used for data collection is BASF Analytical Method Number D9908. This method is reviewed in the DER prepared for MRID 45405027 (D278386, W. Drew, 7/2/03). Residues of boscalid are extracted from the samples with a 70:25:5 methanol/water/2N HCl mixture. An aliquot of the extract is removed and cleaned by liquid/liquid partition with cyclohexane. If necessary, a silica, solid phase extraction, micro-column was used to further clean the extract. Boscalid residues are determined by LC/MS/MS. The method was validated for the determination of boscalid residues in plant commodities through the analysis of residues in almond nutmeat, onion, and plum (D278386). Overall recoveries were acceptable in the validation study. The LOQ was determined to be 0.050 ppm for residues in plant commodities. The LOD was quoted as 5 pg/μL.

C. RESULTS AND DISCUSSION

The registrant performed three field trials for hops. These trials were performed in Moxee, WA, Greenleaf, ID, and Woodburn, OR. The proposed PHI is 14 days. The Washington and Idaho sites are the only sites where samples were taken at a 14-day PHI. At all three locations samples were taken at 0 and 7-day PHIs. Each field trial consisted of two plots which were treated with different spray volumes. The results of the residue analyses are given in Table C.3.1. The OPPTS Series 860 Test Guidelines recommend that the minimum number of field trials that should be performed for hops is three, and that a total of six samples should be analyzed.

Residues in the 14-day PHI samples ranged up to 31 ppm. The maximum residue in the 7-day PHI samples is 40 ppm, and the maximum residue in the 0-day PHI samples is 52 ppm. In the case of the maximum residue and the HAFT, residues decreased with increasing PHI. This trend also occurs in the case of the mean residue values when the Woodburn, OR samples are excluded from the calculations. At the Woodburn site, no 14-day PHI samples were taken so the 0-day and 7-day PHI residue calculations (for residue decay purposes) should not include the Woodburn site either. Residues at this site were considerably lower than the residues at the other two sites for the 0-day and 7-day PHI samples. Residues declined from 48 to 24 to 21 ppm as the PHI increased from 0 to 7 to 14 days (i.e., when the Woodburn samples were excluded). Weather conditions during the field trials were not addressed in the submission.

The analytical method used for data collection is BASF Analytical Method Number D9908. The method was modified slightly to obtain an improved separation of the hops matrix from the analytes of interest. The method was modified as follows: the final volume of the final extract was increased to 3 mL, and the length of the LC run was increased from five minutes to 12 minutes to allow for further chromatographic clean-up. This method is suitable for data collection. Control hops samples were fortified at 0.10 ppm, 20 ppm, and 50 ppm. The limit of quantitation for boscalid in hops was defined as the lowest level for which the method was tested and good fortification recovery data obtained. This level was determined to be 0.10 ppm. A standard calibration curve showed good linearity. The correlation coefficient was 0.999. As only one fortified sample was run for each fortification level, the mean recovery value in Table C.1 is equal to the individual recovery value.

The registrant submitted a storage stability study which was performed to investigate the frozen storage stability of boscalid residues in sugar beet root, cabbage, canola seed, pea, peach, wheat forage, wheat grain, and wheat straw. Fortified commodities were stored at -20°C for 12 months. Residues were measured after 0, 1, 3, 6, and 12 months of storage. This study has been reviewed, and a DER has been prepared (MRID 45405109, D278386, M. Nelson, 7/2/03). Residues of boscalid were stable for up to 12 months of frozen storage in all commodities. In the hops field trial studies, no samples were stored for more than 6 months in any trial. The results of the storage stability study support the storage periods used in the hops field trials.

TABLE C.1. Summary of Concurrent Recoveries of Boscalid from Hops.

Matrix	Analyte	Spike level (mg/kg)	Sample size (n)	Recoveries (%)	Mean ± std dev (%)
Hops	Boscalid	0.10	1	98	98
		20.0	1	99	99
		50.0	1	96	96

TABLE C.2. Summary of Storage Conditions

Matrix (RAC or Extract)	Storage Temp. (°C)	Actual Storage Duration (months)	Limit of Demonstrated Storage Stability (months)
Hops.	< -10°C	6	12

TABLE C.3.1. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Crop/Variety	Commodity	Total Rate, lbs ai/A (kg a.i./ha)	PHI (days)	Residues 1[1] (ppm)	Residues 2[2] (ppm)
Moxee, WA	11	Hops/Warrior	Hops	1.35/(1.51)	0	51.9	40.4
Greenleaf, ID	11	Hops/Zeus		1.34/(1.50)	0	52.1	48.7
Woodburn, OR	12	Hops/Liberty		1.36/(1.53)	0	17.0	16.6
Moxee, WA	11	Hops/Warrior		1.35/(1.51)	7	24.8	16.4
Greenleaf, ID	11	hops/Zeus		1.34/(1.50)	7	39.7	14.9

32

TABLE C.3.1. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Crop/Variety	Commodity	Total Rate, lbs ai/A (kg a.i./ha)	PHI (days)	Residues 1[1] (ppm)	Residues 2[2] (ppm)
Woodburn, OR	12	hops/Liberty		1.36/(1.53)	7	7.6	9.9
Moxee, WA	11	hops/Warrior		1.35/(1.51)	14	29.4	10.7
Greenleaf, ID	11	hops/Zeus		1.34/(1.50)	14	31.1	11.8

1: Residues from trial in which concentrated spray was used.
2: Residues from trial in which dilute spray was used.

TABLE C.4. Summary of Residue Data from Crop Field Trials with Boscalid.

Commodity	Total Applic. Rate, lb a.i./A (kg a.i./ha)	PHI (days)	Analyte	Residue Levels (ppm)					
				n	Min.	Max.	HAFT*	Mean	Std. Dev.
Hops	1.35/(1.51)	0	Boscalid	6	16.6	52.1	50.4	37.8	16.8
	1.35/(1.51)	7		6	7.6	39.7	27.3	18.9	11.8
	1.35/(1.51)	14		4	10.7	31.1	21.5	20.8	11.0

* HAFT = Highest Average Field Trial.

D. CONCLUSION

The hops field trials have been performed in accordance with the OPPTS Series 860 Residue Chemistry Test Guidelines. The trials were performed at a total application rate of 1.35 lb a.i./acre and at 0, 7, and 14-day PHIs. Adequate numbers of field trials were performed in the major hops-growing region of the country. The analytical method has been demonstrated to be adequate for data collection. Residues of boscalid have been shown to be stable over the storage periods used in the study. Residues in hops ranged up to 31.1 ppm in the 14-day PHI samples.

E. REFERENCES

Human Health Risk Assessment for New Fungicide BAS 510 F (Common Name: Boscalid) – Proposal for Tolerances for Residues in/on Numerous Crops and Livestock Commodities, PP# 1F6313, D290022, Y. Donovan, 9/8/2003.

Residue Analytical Methods DER, Plant Commodities, BAS 510 F, PP# 1F6313, D278386, W. Drew, 7/2/2003.

Storage Stability Data DER, Plant Commodities, BAS 510 F, PP# 1F6313, D278386, M. Nelson, 7/2/2003.

Boscalid/128008/BASF Corporation/7969
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 - Pome Fruit (Apples and Pears)

Primary Evaluator	Douglas Dotson, Chemist USEPA/OPP/HED/RAB2	Date: 2/10/04 D. Dotson
Reviewer	William Drew, Chemist USEPA/OPP/HED/RAB2	Date: 2/11/04 (WBDrew)

STUDY REPORTS:

MRID No. 45645803. Kukel, C., Wofford, J., Abdel-Baky, S., (3/27/02) Study title: The Magnitude of BAS 500 F and BAS 510 F Residues in Pome Fruit. Lab Project Number: 66898. Unpublished study prepared by BASF Agro Research. 116 pages.

EXECUTIVE SUMMARY:

Supervised crop field trials were conducted on apples (sixteen sites in the U.S. and Canada) and pears (ten sites in the U.S. and Canada) at seasonal application rates of 1.8 lb a.i./A (2.0 kg a.i./ha) with a pre-harvest interval of 0 days. The recommended numbers of field trials were performed in the specified regions. Residues of boscalid are extracted from pome fruit samples with a 70:25:5 methanol/water/2N HCl mixture. An aliquot of the extract is removed and cleaned by liquid/liquid partitioning. The final chromatographic analysis of boscalid is performed using LC/MS/MS. This method (BASF Analytical Method D9908) is acceptable as a data-gathering method. It was validated through the analysis of fortified control samples. Samples were stored for a maximum of 7 months. Residues of boscalid have been shown to be stable in a variety of commodities for up to 12 months. The results from these trials show that maximum residues are 2.1 ppm in apples and 2.3 ppm in pears. Residue decline data are not available as samples were taken at a 0-day PHI only.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the field trial residue data are classified as scientifically acceptable. There are no deficiencies, and there are no issues that the registrant needs to clarify.

The acceptability of this study for regulatory purposes is addressed in the U.S. EPA Residue Chemistry Summary Document (DP Barcode D290185).

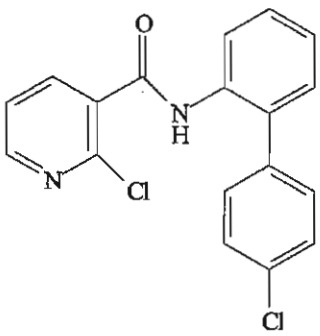
COMPLIANCE:

Signed and dated GLP, Quality Assurance and Data Confidentiality statements were provided. The study meets the requirements of 40 CFR Part 160, FIFRA Good Laboratory Practices.

A. BACKGROUND INFORMATION

The first human health risk assessment for boscalid (formerly BAS 510 F) was completed on 9/8/2003 by Y. Donovan, *et al.* (D290022). The Health Effects Division (HED) recommended in favor of the establishment of tolerances on a number of plant and animal commodities. These tolerances were published in the Federal Register Environmental Documents (July 30, 2003). Two formulated end-use products are proposed for use on apples and pears: Endura™ Fungicide (EPA Reg. No. 7969-197), which contains 70% boscalid, and Pristine™ Fungicide (EPA Reg. No. 7969-199), which contains a 2:1 mixture of boscalid and pyraclostrobin as co-active ingredients (25.2%:12.8%).

TABLE A.1. Test Compound Nomenclature

Compound	Chemical Structure
	 Boscalid
Common name	Boscalid
Company experimental name	BAS 510 F
IUPAC name	2-Chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide
CAS name	3-Pyridinecarboxamide, 2-chloro-N-(4'chloro[1,1'-biphenyl]-2-yl)
CAS #	188425-85-6
End-use product/EP	Endura and Pristine

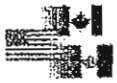


TABLE A.2. Physicochemical Properties	
Parameter	Value
Melting point/range	142.8-143.8°C
pH	Unspecified
Density	1.39 g/cm^3 (powder), 1.38 g/cm^3 (crystalline)
Water solubility (20°C)	4.64 mg/L (crystalline form)
Solvent solubility (mg/L at 20°C)	Crystalline Form: Acetone: 16-20 g/100 mL Acetonitrile: 4-5 g/100 mL Methanol: 4-5 g/100 mL Ethyl Acetate: 6.7-8 g/100 mL Dichloromethane: 20-25 g/100 mL Toluene: 2-2.5 g/100 mL 1-Octanol: <1g/100 mL
Vapor pressure at 20°C	Crystalline Form: 7 x 10^{-7} Pa
Vapor pressure at 25°C	Crystalline Form: 2 x 10^{-6} Pa
Dissociation constant (pK_a)	No dissociation in water.
Octanol/water partition coefficient Log(K_{ow})	log K_{ow} of crystalline form = 2.96 (21°C)
UV/visible absorption spectrum	Unspecified

B. EXPERIMENTAL DESIGN

B.1. Study Site Information

All field trials were performed in 2001.

TABLE B.1.1 Soil Characterization.				
Study Location	Soil characteristics			
	Type	%OM	pH	CEC
Germansville, PA	Gravelly silt loam	Not Specified	Not Specified	Not Specified
Dundee, NY	Gravelly loam			
Dundee, NY	Sandy loam			
Dundee, NY	Sandy loam			
Somerset, Nova Scotia	Loam			
Somerset, Nova Scotia	Sandy loam			
Ivor, VA	Clay loam			
Conklin, MI	Loam			
Branchton, Ontario	Loam			
Conklin, MI	Loam			
Conklin, MI	Loam			
Branchton, Ontario	Loam			

TABLE B.1.1 Soil Characterization.

Study Location	Soil characteristics			
	Type	%OM	pH	CEC
St. Paul d'Abbotsford, Quebec	Sandy gravelly loam			
St. Paul d'Abbotsford, Quebec	Gravelly sandy loam			
Delta, CO	Sandy loam			
Chico, CA	Loam			
Porterville, CA	Loam			
Chico, CA	Loam			
Porterville, CA	Loam			
Ephrata, WA	Sandy loam			
Ephrata, WA	Coarse sandy loam			
Hood River, OR	Silt loam			
Caldwell, ID	Silt loam			
Ephrata, WA	Silt loam			
Hood River, OR	Loam			
Caldwell, ID	Silt loam			

The actual temperature readings were reported on the day of boscalid application. The rainfall levels were not reported. The historical temperature and rainfall averages were not specified in the submission. The registrant did not state whether or not irrigation was used.

TABLE B.1.2. Study Use Pattern.

Location (City, State/Year)	EP[1]	Application						Tank Mix Adjuvants
		Timing	Rate, lb a.i./A (kg a.i./ha)	RTI[2] (days)	Treat. No.	Method	Total Rate, lb a.i./A (kg a.i./ha)	
Germansville, PA	Combination of BAS 510 UCF (boscalid 70% WG) and BAS 500 02 F (pyraclostrohin)	7-day re-treatment interval beginning 35 days prior to harvest	0.30 lb a.i./A (0.34 kg a.i./ha)	7	6	Tractor-mounted airblast sprayer	1.8 lb ai/A (2.0 kg ai/ha)	X-77
Dundee, NY								LI700
Dundee, NY								LI700
Dundee, NY								LI700
Somerset, Nova Scotia								Agral 90
Somerset, Nova Scotia								Agral 90
Ivor, VA								BioSurf

TABLE B.1.2. Study Use Pattern.

Location (City, State/Year)	EP[1]	Application						Tank Mix Adjuvants
		Timing	Rate, lb a.i./A (kg a.i./ha)	RTI[2] (days)	Treat. No.	Method	Total Rate, lb a.i./A (kg a.i./ha)	
Conklin, MI								Latron B-1956
Branchton, Ontario								Agral 90
Conklin, MI								Latron B-1956
Conklin, MI								Latron B-1956
Branchton, Ontario								Agral 90
St. Paul d'Abbotsford, Quebec								Surf 92
St. Paul d'Abbotsford, Quebec								Surf 92
Delta, CO								X-77
Chico, CA								Adwet
Porterville, CA								Latron B-1956
Chico, CA								Kinetic
Porterville, CA								Latron B-1956
Ephrata, WA								Induce
Ephrata, WA								Induce
Hood River, OR								Latron B-1956
Caldwell, ID								X-77
Ephrata, WA								Induce
Hood River, OR								Latron B-1956
Caldwell, ID								X-77

[1]EP = End-use Product
[2] Retreatment Interval

TABLE B.1.3. Trial Numbers and Geographical Locations

NAFTA Growing Region	Apples			Pears		
	Submitted	Requested		Submitted	Requested	
		Canada	US		Canada	US
1	3		3	1		1
1A	1			1		
2	1		1			
3						
4						
5	2		2	3		
5A						
5B	2					
6						
7						
7A						
8						
9	1		1			
10	2		1	2		2
11	4		4	3		3
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
Total	16	0	12	10	0	6

B.2. Analytical Methodology

The analytical method used for data collection is BASF Analytical Method Number D9908. This method is reviewed in the DER prepared for MRID 45405027 (D278386, W. Drew, 7/2/03). Residues of boscalid are extracted from the samples with a 70:25:5 methanol/water/2N HCl mixture. An aliquot of the extract is removed and cleaned by liquid/liquid partition with cyclohexane. Boscalid residues are determined by LC/MS/MS. The method was validated for the determination of boscalid residues in plant commodities through the analysis of residues in almond nutmeat, onion, and plum (D278386). Overall recoveries were acceptable in the validation study. The LOQ was determined to be 0.050 ppm for residues in plant commodities. The LOD was quoted as 5 pg/µL.

C. RESULTS AND DISCUSSION

The individual residue values for both apples and pears are given in Table C.3., and a summary of the values is given in Table C.4. The apple field trial values range from 0.17 ppm to 2.08 ppm. The mean residue value is 0.76 ppm with a standard deviation of 0.38 ppm. The OPPTS Series 860 Test Guidelines recommend that twelve field trials be performed for apples when a pome fruit crop group tolerance is being requested. The registrant submitted a total of sixteen apple field trials. The recommended numbers of field trials were performed in the specified regions. For pears, the field trial values range from 0.37 ppm to 2.31 ppm. The mean residue value is 0.93 ppm with a standard deviation of 0.51 ppm. The Test Guidelines recommend that a minimum of six field trials be performed when a crop group is being requested. The registrant performed a total of ten field trials. The recommended numbers of field trials were performed in the specified regions.

The registrant did not report that any farming practices or environmental conditions had any effect on the residue values in either the apple or pear field trials. The proposed PHI is 0 days. No residue decline data were submitted.

The analytical method used for data collection is BASF Analytical Method Number D9908. This method is suitable for data collection. Apple and pear control samples were fortified with boscalid to determine method efficiency. Apples were fortified at 0.050, 1.0, 5.0, and 100 ppm. Recoveries ranged from 78 to 119%. The mean recoveries ranged from 92 to 96%. Pears were fortified at 0.05, 1.0, and 5.0 ppm. Recoveries ranged from 94 to 126%. Of the eight fortified pear control samples, only one had a percent recovery that exceeded 120%. The mean recoveries ranged from 108 to 117%.

The method LOD was reported to be 0.025 ppm. A sample calibration curve showed good detector linearity (correlation coefficient of 0.996).

The registrant submitted a storage stability study which was performed to investigate the frozen storage stability of boscalid residues in sugar beet root, cabbage, canola seed, pea, peach, wheat forage, wheat grain, and wheat straw. Fortified commodities were stored at -20°C for 12 months. Residues were measured after 0, 1, 3, 6, and 12 months of storage. This study has been reviewed, and a DER has been prepared (MRID 45405109, D278386, M. Nelson, 7/2/03). Residues of boscalid were stable for up to 12 months of frozen storage in all commodities. In the apple and pear field trial studies, no samples were stored for more than 7 months in any trial. The results of the storage stability study support the storage periods used in the apple and pear field trials.

TABLE C.1. Summary of Concurrent Recoveries of Boscalid from Pome Fruit.

Matrix	Analyte	Spike level (mg/kg)	Sample size (n)	Recoveries (%)	Mean ± std dev (%)
Apple	Boscalid	0.05	6	112, 78, 102, 82, 102, 98	96 ± 13
Apple	Boscalid	1.0	5	112, 79, 119, 93, 78	96 ± 19
Apple	Boscalid	5.0	1	92	92
Apple	Boscalid	100	1	95	95
Pear	Boscalid	0.05	4	100, 116, 94, 122	108 ± 13
Pear	Boscalid	1.0	1	115	115
Pear	Boscalid	5.0	3	118, 126, 107	117 ± 9.5

TABLE C.2. Summary of Storage Conditions

Matrix (RAC or Extract)	Storage Temp. (°C)	Actual Storage Duration (months)	Limit of Demonstrated Storage Stability (months)
Apples and Pears	< -10°C	7	12 months

TABLE C.3. Residne Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Crop/ Variety	Commodity	Total Rate, lbs ai/A (kg a.i./ha)	PHI (days)	Residues 1 (ppm)	Residues 2 (ppm)
Germanville, PA	1	Apple/Starkrimson Red Delicious	Apple	1.8 (2.0)	0	1.13	0.61
Dundee, NY	1	Apple/Empire	Apple	1.8 (2.0)	0	1.17	1.11
Dundee, NY	1	Apple/Red Delicious	Apple	1.8 (2.0)	0	0.78	0.72
Somerset, NS	1A	Apple/McIntosh	Apple	1.8 (2.0)	0	0.94	0.96

TABLE C.3. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Crop/ Variety	Commodity	Total Rate, lbs ai/A (kg a.i./ha)	PHI (days)	Residues 1 (ppm)	Residues 2 (ppm)
Ivor, VA	2	Apple/Earligold	Apple	1.8 (2.0)	0	0.42	0.17
Conklin, MI	5	Apple/Empire	Apple	1.8 (2.0)	0	0.49	0.34
Branchton, ON	5	Apple/Spartan	Apple	1.8 (2.0)	0	1.34	0.60
St. Paul d'Abbotsford, QU	5B	Apple/Vista Bella	Apple	1.8 (2.0)	0	0.48	0.46
St. Paul d'Abbotsford, QU	5B	Apple/Spartan	Apple	1.8 (2.0)	0	0.73	0.43
Delta, CO	9	Apple/Red Delicious	Apple	1.8 (2.0)	0	0.82	0.92
Chico, CA	10	Apple/Light Red Fuji	Apple	1.8 (2.0)	0	0.42	1.11
Porterville, CA	10	Apple/Granny Smith	Apple	1.8 (2.0)	0	1.07	0.84
Ephrata, WA	11	Apple/Red Delicious	Apple	1.8 (2.0)	0	0.85	0.90
Ephrata, WA	11	Apple/Gala	Apple	1.8 (2.0)	0	2.08	0.68
Hood River, OR	11	Apple/Jonagold	Apple	1.8 (2.0)	0	0.62	0.62
Caldwell, ID	11	Apple/Red Delicious	Apple	1.8 (2.0)	0	0.31	0.24

TABLE C.3. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Crop/ Variety	Commodity	Total Rate, lbs ai/A (kg a.i./ha)	PHI (days)	Residues 1 (ppm)	Residues 2 (ppm)
Dundee, NY	1	Pear/Bartlett	Pear	1.8 (2.0)	0	0.57	0.74
Somerset, NS	1A	Pear/Clapps	Pear	1.8 (2.0)	0	1.89	1.26
Conklin, MI	5	Pear/Bartlett	Pear	1.8 (2.0)	0	1.22	0.74
Conklin, MI	5	Pear/Bartlett	Pear	1.8 (2.0)	0	0.78	0.56
Branchton, ON	5	Pear/Bosc	Pear	1.8 (2.0)	0	2.31	0.85

TABLE C.3. Residue Data from Crop Field Trials with Boscalid.

Location (City, State)	Region	Crop/ Variety	Commodity	Total Rate, lbs ai/A (kg a.i./ha)	PHI (days)	Residues 1 (ppm)	Residues 2 (ppm)
Chico, CA	10	Pear/Bosc	Pear	1.8 (2.0)	0	0.69	1.70
Porterville, CA	10	Pear/Bosc	Pear	1.8 (2.0)	0	0.89	0.85
Ephrata, WA	11	Pear/Bartlett	Pear	1.8 (2.0)	0	0.83	0.87
Hood River, OR	11	Pear/Starkrimson	Pear	1.8 (2.0)	0	0.54	0.65
Caldwell, ID	11	Pear/Bartlett	Pear	1.8 (2.0)	0	0.37	0.38

TABLE C.4. Summary of Residue Data from Crop Field Trials with Boscalid.

Commodity	Total Applic. Rate, lb a.i./A (kg a.i./ha)	PHI (days)	Analyte	Residue Levels (ppm)					
				n	Min.	Max.	HAFT*	Mean	Std. Dev.
Apple	1.8 (2.0)	0	Boscalid	32	0.17	2.08	1.38	0.76	0.38
Pear	1.8 (2.0)	0	Boscalid	20	0.37	2.31	1.58	0.93	0.51

* HAFT = Highest Average Field Trial.

D. CONCLUSION

The apple and pear field trials have been performed in accordance with the OPPTS Series 860 Residue Chemistry Test Guidelines. The trials were performed at a total application rate of 1.8 lb a.i./acre and at a 0-day PHI. Adequate numbers of field trials were performed in the major apple and pear growing regions of the country (and Canada). The registrant did not report that there were any adverse weather conditions which would affect the results of the study. The analytical method has been demonstrated to be adequate for data collection. Residues of boscalid have been shown to be stable over the storage periods used in the study. Residues in apples ranged up to 2.1 ppm, and residues in pears ranged up to 2.3 ppm.

E. REFERENCES

Human Health Risk Assessment for New Fungicide BAS 510 F (Common Name: Boscalid) – Proposal for Tolerances for Residues in/on Numerous Crops and Livestock Commodities, PP# 1F6313, D290022, Y. Donovan, 9/8/2003.

Residue Analytical Methods DER, Plant Commodities, BAS 510 F, PP# 1F6313, D278386, W. Drew, 7/2/2003.

Storage Stability Data DER, Plant Commodities, BAS 510 F, PP# 1F6313, D278386, M. Nelson, 7/2/2003.

99

Boscalid/128008/BASF Corporation/7969
DACO 7.4.5/OPPTS 860.1520/OECD IIA 6.5.4 and IIIA 8.5
Processed Food and Feed - Apple Juice and Wet Pomace

Primary Evaluator	Douglas Dotson, Chemist USEPA/OPP/HED/RAB2	Date: 2/10/04 D. Dotson
Reviewer	William Drew, Chemist USEPA/OPP/HED/RAB2	Date: 2/11/2004 WDDrew

STUDY REPORTS:

MRID No. 45645804. H. Schultz (3/6/02). Study title: Determination of the Residues of BAS 500 F and BAS 510 F In Apples and Processed Products Following Treatment with BAS 516 01 F Under Field Conditions in Germany 2001. Lab Project Number: 2001/1015047. Unpublished study prepared by BASF Corporation. 107 pages.

EXECUTIVE SUMMARY:

Boscalid, 200 g/L SE formulation, was applied to apple trees at a rate of 0.53 lb a.i./A (0.60 kg a.i./ha). Four applications were made for a total application rate of 2.1 lb ai/A (2.4 kg ai/ha). Six apple samples were processed into wet pomace and apple juice. Two of these samples were taken on the last day of application, and the other four were taken thirteen to fifteen days after the last application. The method used for sample analysis is BASF Method 445/0. The samples are extracted with a mixture of methanol, water, and hydrochloric acid. An aliquot is centrifuged and partitioned with cyclohexane. Boscalid residues are determined by HPLC/MS/MS. Samples were stored for a maximum of six months. Residues of boscalid have been shown to be stable in a variety of commodities for up to twelve months. A comparison of the residues in the RAC with those in each processed fraction resulted in processing factors of 0.08x for apple juice and 5.5x for wet apple pomace. The OPPTS Series 860 Residue Chemistry Guidelines do not give theoretical concentration factors for apple juice or wet pomace. The Guidelines give a maximum observed concentration factor for apple pomace of 14x. This value is higher than the value obtained for boscalid.

STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:

Under the conditions and parameters used in the study, the processing data are classified as scientifically acceptable. There are no deficiencies, and there are no clarifications that the registrant needs to make.

The acceptability of this study for regulatory purposes is addressed in the U.S. EPA Residue Chemistry Summary Document (DP Barcode D290185).

COMPLIANCE:

Signed and dated GLP, Quality Assurance and Data Confidentiality statements were provided. The processing facility was not certified in accordance with GLP guidelines. No circumstances were observed that might have had an adverse effect on the integrity of the study.

A. BACKGROUND INFORMATION

The first human health risk assessment for boscalid (formerly BAS 510 F) was completed on 9/8/2003 by Y. Donovan, *et al.* (D290022). The Health Effects Division (HED) recommended in favor of the establishment of tolerances on a number of plant and animal commodities. These tolerances were published in the Federal Register Environmental Documents (July 30, 2003). Two formulated end-use products are proposed for use on apples: Endura™ Fungicide (EPA Reg. No. 7969-197), which contains 70% boscalid, and Pristine™ Fungicide (EPA Reg. No. 7969-199), which contains a 2:1 mixture of boscalid and pyraclostrobin as co-active ingredients (25.2%:12.8%).

TABLE A.1. Test Compound Nomenclature

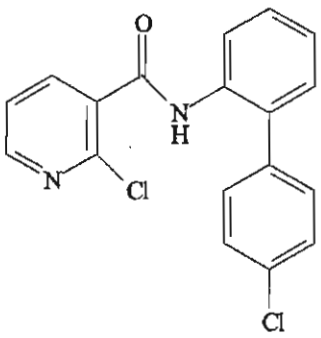
Compound	Chemical Structure
	 Boscalid
Common name	Boscalid
Company experimental name	BAS 510 F
IUPAC name	2-Chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide
CAS name	3-Pyridinecarboxamide, 2-chloro-N-(4'chloro[1,1'-biphenyl]-2-yl)
CAS #	188425-85-6
End-use product/EP	Endura and Pristine

TABLE A.2. Physicochemical Properties	
Parameter	Value
Melting point/range	142.8-143.8°C
pH	Unspecified
Density	1.39 g/cm^3 (powder), 1.38 g/cm^3 (crystalline)
Water solubility (20°C)	4.64 mg/L (crystalline form)
Solvent solubility (mg/L at 20°C)	Crystalline Form: Acetone: 16-20 g/100 mL Acetonitrile: 4-5 g/100 mL Methanol: 4-5 g/100 mL Ethyl Acetate: 6.7-8 g/100 mL Dichloromethane: 20-25 g/100 mL Toluene: 2-2.5 g/100 mL 1-Octanol: <1g/100 mL
Vapor pressure at 20°C	Crystalline Form: 7 x 10^{-7} Pa
Vapor pressure at 25°C	Crystalline Form: 2 x 10^{-6} Pa
Dissociation constant (pK_a)	No dissociation in water.
Octanol/water partition coefficient Log(K_{ow})	log K_{ow} of crystalline form = 2.96 (21°C)
UV/visible absorption spectrum	Unspecified

B. EXPERIMENTAL DESIGN

B.1. Application and Crop Information

TABLE B.1.2. Study Use Pattern.								
Location (City, State/Year)	EP[1]	Application						Tank Mix Adjuvants
		Timing	Rate, lb a.i./A (kg a.i./ha)	RTI[2] (days)	Treat No.	Method	Total Rate, lb a.i./A (kg a.i./ha)	
Germany/ 2001	BAS 516 01 F SE Formula-tion (200 g/L boscalid, 100 g/L pyraclostrobin)	8-day intervals beginning 24 days prior to harvest	0.53 lb ai/A (0.60 kg ai/ha)	8	4	Air blast sprayer	2.1 lb ai/A (2.4 kg ai/ha)	Not Specified

[1]EP = End-use Product
[2] Retreatment Interval

47

B.2. Processing Procedures

A rack and cloth press was used for the production of apple juice and pomace. A cloth in each rack was filled with the pulp and folded in such a way that the pulp was completely covered. Several racks were stacked together. The pressure was increased step by step from 0 to 200 bar and was maintained for as long as apple juice was dripping out (30 to 45 minutes). The juice was passed through a hair sieve in order to separate coarse particles, which were combined with the fresh pomace. The fresh pomace was mixed by hand and a portion was taken as sample and identified as fresh pomace.

For clarification of the juice, pectinase was added to the sieved juice in order to release the lees. The pectinase reaction took 20 to 60 minutes. The complete degradation of the pectin was controlled by a quick test using alcohol precipitation which proved negative with every sample. For this test, a 5 mL sample of the juice was placed in a test tube and 5 mL of alcohol were added. Had pectin still been present in the juice, a plug would have been formed on the surface within a few seconds.

To the whole amount of juice, first gelatine (12 g/hL) and 10 minutes later Kieselsol (120 g/hL) were added and the solution was filtered using a cross-flow filtration plant. The filtration lasted for 25-95 minutes. The clear juice (permeate) was then pasteurized. For pasteurization, an aliquot of the clear juice was placed in a glass bottle which was capped with a screw cap. The bottle was placed in a water bath and pasteurized at 90°C for 30 minutes. The bottles were allowed to cool, after which the sample was taken.

B.3. Analytical Methodology

The samples were analyzed with BASF Method 445/0. Residues are extracted with a mixture of methanol, water, and hydrochloric acid. An aliquot of the extract is centrifuged and partitioned with cyclohexane. The final determination of the boscalid residue is made by HPLC/MS/MS. The limit of quantitation (LOQ) of the method is 0.05 mg/kg in all apple commodities.

C. RESULTS AND DISCUSSION

The analytical method used (BASF Method 445/0) is suitable for data collection. The method is similar to Method D9908 which was validated on almond nutmeat, onion, and plum (D278386). Method 445/0 was validated through the analysis of fortified control samples. Samples of apple, apple juice, and wet apple pomace were fortified to levels of 0.05 and 5.0 ppm. Recoveries ranged from 82% to 109%. Individual sample recoveries are given in Table C.1. A typical calibration curve for boscalid showed good linearity with a correlation coefficient of 0.998. The method LOQ is 0.05 ppm.

The empirical processing factor for apple juice is 0.08x. The OPPTS Series 860 Guidelines do not provide a maximum theoretical processing factor for apple juice or pomace. The empirical processing factor for wet apple pomace is 5.5x. The Guidelines give a maximum observed concentration factor of 14x for wet apple pomace.

The registrant submitted a storage stability study which was performed to investigate the frozen storage stability of boscalid residues in sugar beet root, cabbage, canola seed, pea, peach, wheat forage, wheat grain, and wheat straw. Fortified commodities were stored at -20°C for 12 months. Residues were measured after 0, 1, 3, 6, and 12 months of storage. This study has been reviewed, and a DER has been prepared (MRID 45405109, D278386, M. Nelson, 7/2/03). Residues of boscalid were stable for up to 12 monts of frozen storage in all commodities. In the apple processing study, a maximum of six months elapsed between harvest and final analysis of the apple commodities. The results of the storage stability study support the storage periods used in the apple processing study.

TABLE C.1. Summary of Concurrent Recoveries of Boscalid from Apples.

Matrix	Analyte	Spike level (mg/kg)	Sample size (n)	Recoveries (%)	Mean ± std dev (%)
Apple	Boscalid	0.05 5.0	2	108.59, 89.65	99.1
Apple Juice	Boscalid	0.05 5.0	2	83.90, 81.62	82.8
Wet Apple Pomace	Boscalid	0.05 5.0	2	94.31, 90.16	92.2

TABLE C.2. Summary of Storage Conditions

Matrix (RAC or Extract)	Storage Temp. (°C)	Actual Storage Duration (months)	Limit of Demonstrated Storage Stability (months)
Apple	≤ - 18°C	< 6 months	12 months
Apple Juice	≤ - 18°C	< 6 months	12 months
Wet Apple Pomace	≤ - 18°C	< 6 months	12 months

Table C.3. Residue Data from Appple Processing Study with Boscalid.

RAC	Processed Commodity	Total Rate lbs ai/A (kg a.i./ha)	PHI (days)	Residues (ppm)	Processing Factor	Mean Processing Factor
Apple	Apple Juice	2.1 lbs ai/A (2.4 kg ai/ha)	0	0.078	0.078	0.08
			0	0.099	0.080	
			14	0.052	0.066	
			14	0.107	0.047	
			13	<0.05	0.086	
			15	<0.05	0.102	
Apple	Wet Apple Pomace	2.1 lbs ai/A (2.4 kg ai/ha)	0	3.91	3.91	5.5
			0	2.58	2.08	
			14	5.28	6.75	
			14	14.5	6.38	
			13	4.79	8.20	
			15	2.81	5.75	

D. CONCLUSION

The apple processing study has been performed in accordance with the OPPTS Series 860 Residue Chemistry Test Guidelines. An application rate of 2.1 lb a.i./acre was used. The analytical method was demonstrated to be adequate for data collection. Residues of boscalid have been shown to be stable over the storage periods used in the study. Residues were reduced in apple juice. The processing factor was 0.08x. Residues concentrated in wet apple pomace by a factor of 5.5x.

E. REFERENCES

Residue Analytical Methods DER, Plant Commodities, BAS 510 F, PP# 1F6313, D278386, W. Drew, 7/2/2003.

Storage Stability Data DER, Plant Commodities, BAS 510 F, PP# 1F6313, D278386, M. Nelson, 7/2/2003.