



Boscalid/7969-197/PC Code 128008/BASF Corporation/7969  
 DACO 7.4.4/OPPTS 860.1900/OECD IIA 6.6.3, 6.8.7 and IIIA 8.6  
 Field Accumulation in Rotational Crops - Sugar Beet, Garden Beet, and Turnip

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Peer Reviewer William Drew, Chemist, RAB2 *W. Drew* Date: 10/7/2005

This DER was originally prepared under contract by Dynamac Corporation (1910 Sedwick Rd., Suite B; Durham, NC 27713; submitted 1/14/2005). The DER has been reviewed by the HED and revised to reflect current OPP policies.

### **STUDY REPORT:**

46210606 Leonard, R. (2003) Sugar Beet, Garden Beet, and Turnip Field Rotational Crop Study for BAS 510 02 F Residues. Lab Project Number: 130727: 2002/5004273. Unpublished study prepared by BASF Corporation. 74 p. {OPPTS 860.1900}

### **EXECUTIVE SUMMARY:**

Fourteen field rotational crop trials were conducted at field sites in AR, CA, GA, ID, NE, ND (4 tests), OK, SD, TX, VA, and WI during 1998-2002 on the representative crops of the leaves of root and tubers vegetable crop group. At each test site, the bare soil was treated three times with boscalid (70% WDG) at 0.70-0.74 lb ai/A for the first application and 0.53-0.56 lb ai/A for the second and third applications, for a total of 1.79-1.86 lb ai/A/season. Applications were made using ground equipment with a re-treatment interval (RTI) of 6-8 days. The maximum seasonal use rate for any rotated crop is 1.8 lb ai/A on bulb vegetables. At each site, rotational crops of sugar beet (7 tests), garden beet (2 tests), or turnips (5 tests) were planted 13-14 days after the last treatment. A single control and duplicate treated samples of roots and tops from each rotational crop were harvested at intervals reflecting normal agricultural practices. Samples were stored frozen for a maximum of 6 months, an interval that is supported by the available storage stability data.

Samples were analyzed for residues of boscalid using an adequate LC/MS/MS method (BASF Method Number D9908). For this method, residues are extracted with methanol:water:2 N HCl, concentrated, cleaned up by solvent partitioning and analyzed by LC/MS/MS. The limit of quantitation (LOQ) was 0.05 ppm for residues of boscalid in/on all matrices; the LOD was not reported. However, based on raw data from all treated and control samples, apparent residues could be reliably detected below the 0.05 ppm (LOQ), but were reported as <0.05 ppm. Therefore, when calculating average residues, the reviewer used the LOQ value (0.05 ppm) for all residues reported to be <0.05 ppm.

Residues of boscalid were 0.051-0.066 ppm in/on 4 of 14 sugar beet top samples, 0.066 and 0.082 ppm in/on 2 of 10 turnip tops samples, and 0.050 and 0.053 ppm in/on 2 of 10 turnip root samples. Residues were <0.05 ppm (<LOQ) in all remaining raw agricultural commodity (RAC)



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samples collected from the rotational sugar beet, garden beet, and turnip matrices. Average residues were 0.05 ppm in/on sugar beet roots, garden beet tops and roots, and turnip roots, and were 0.052 ppm in/on sugar beet tops and 0.055 ppm in/on turnip tops.

#### **STUDY/WAIVER ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS:**

Under the conditions and parameters used in this study, the field rotational crop data are classified as scientifically acceptable. The acceptability of this study for regulatory purposes is addressed in the associated U.S. EPA Residue Chemistry Summary Document (D322235).

#### **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.

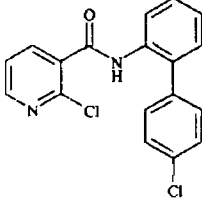
#### **A. BACKGROUND INFORMATION**

Boscalid is an anilide fungicide that inhibits mitochondrial respiration, thereby inhibiting spore germination, germ tube elongation, mycelial growth, and sporulation of pathogenic fungi on the leaf surface. Permanent tolerances have been established in 40 CFR §180.589 for residues of boscalid in/on numerous plant commodities, ranging from 0.05 ppm in/on peanuts and tuberous and corm vegetables (subgroup 1C) to 35 ppm in/on dried hop cones. Separate tolerances have also been established for indirect or inadvertent residues of boscalid in rotational crops, ranging from 0.05 ppm in several commodities to 8.0 ppm in grass forage, fodder, and hay (group 17). Tolerances for the combined residues of boscalid and its glucuronic acid conjugate are also established on animal commodities, ranging from 0.02 ppm in eggs to 0.35 ppm in meat byproducts of cattle, goats, horses, and sheep. Based on previously reviewed rotational crop data, there is a 14-day plant-back restriction for all crops not registered for use. In addition, the label prohibits the rotation of crops treated with boscalid to sugarbeets, garden beets, turnip, or radishes. In a limited field accumulation study, detectable residues of boscalid were observed in radish tops and roots at the longest (45-day) plant-back interval studied; therefore, extensive rotational crop field trials were required. The registrant has submitted data from extensive field rotational crop studies on representative crops (sugar beet, garden beet, and turnip) from the leaves of root and tuber vegetables group (Crop Group 2) to support the establishment of indirect residue tolerances for rotational crop commodities.

The nomenclature and physicochemical properties of boscalid are presented below in Tables A.1. and A.2.



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Compound	
Common name	Boscalid
Company experimental names	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 products/EP	70% WDG (Endura™ fungicide; EPA Reg. No. 7969-197)

Parameter	Value	Reference
Melting point	143.4-143.6°C (TGAI); 142.8-143.8°C (PAI)	D278385, M. Nelson, 8/15/03
pH (23°C)	5.5 (1% solution)	
Density	1.394g/cm <sup>3</sup> (TGAI); 1.381g/cm <sup>3</sup> (PAI)	
Water solubility (20°C)	4.64 mg/L (PAI)	
Solvent solubility (g/100 mL at 20°C)	PAI: 16-20 in acetone; 4-5 in acetonitrile; 4-5 in methanol; 6.7-8 in ethylacetate; 20-25 in dichloromethane; 2-2.5 in toluene; <1 in 1-octanol	
Vapour pressure at 20°C	7 x 10 <sup>-9</sup> hPa (PAI)	
Dissociation constant (pK <sub>a</sub> )	Does not dissociate in water.	
Octanol/water partition coefficient at 21°C Log(K <sub>ow</sub> )	2.96 (PAI)	
UV/visible absorption spectrum	Not available	

## B. EXPERIMENTAL DESIGN

### B.1. Study Site Information

Fourteen field rotational crop trials were conducted at field sites in AR, CA, GA, ID, NE, ND (4 tests), OK, SD, TX, VA, and WI during 1997-2002. At each of the test sites, bare soil was treated three times with boscalid (70% WDG) at 0.70-0.74 lb ai/A for the first application and 0.53-0.56 lb ai/A for the second and third applications, for a total of 1.79-1.86 lb ai/A/season. Applications were made using ground equipment with RTIs of 6-8 days. The maximum seasonal use rate for any rotated crop is 1.8 lb ai/A on bulb vegetables. At each site, rotational crops of sugar beet (7 tests), garden beet (2 tests), and turnip (5 tests) were planted 13-14 days after the last treatment.



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**TABLE B.1.1. Trial Site Conditions.**

Trial Identification (County, State; Year)	Soil characteristics				Meteorological data <sup>1</sup>	
	Type	%OM	pH	CEC (meq/g)	Average monthly rainfall range (inches)	Overall monthly temperature range (°C)
Carington, ND, 2002	Loam	3.7	6.3	20.8	NR = not reported	NR
Fitchburg, WI, 2002	Silt loam	2.0	5.9	15.1	NR	NR
Briton, SD, 2002	Clay loam	3.1	7.8	32.0	NR	NR
York, NE, 2001	Silt loam	2.7	5.9	17.7	NR	NR
Brampton, ND, 2002	Clay loam	3.8	7.7	29.5	NR	NR
Velva, ND, 2002	Loam	3.2	5.4	20.0	NR	NR
Madera, CA, 2001	Loamy sand	0.9	8.1	8.0	NR	NR
Payette, ID, 1998	Loam	1.8	6.5	14.9	NR	NR
Suffolk, VA, 2002	Sandy loam	0.9	5.8	4.4	NR	NR
Chula, GA, 2002	Loamy sand	0.9	6.9	5.0	NR	NR
Newport, AR, 2002	Sandy loam	0.6	5.1	5.7	NR	NR
Carrington, ND, 2002	Loam	3.7	6.3	20.8	NR	NR
Uvalde, TX, 2002	Clay loam	2.8	8.1	32.9	NR	NR
Colony, OK, 1997	Sandy loam	0.9	6.6	8.2	NR	NR

<sup>1</sup> Detailed meteorological data were not provided.

Weather conditions were reported to be normal, with the following exceptions: (i) conditions were wetter than normal in four locations (ID, GA, OK, and TX) and drier than normal in two locations (SD and ND); (ii) conditions were warmer than normal at one location (VA) in October and cooler than normal at three ND locations in May. No unusual conditions that would affect the integrity of the study were reported. Information pertaining to irrigation was not provided.

**TABLE B.1.3. Trial Numbers and Geographical Locations.**

NAFTA Growing Region <sup>1</sup>	Sugar beet or Garden beet			Turnip		
	Submitted	Requested		Submitted	Requested	
		Canada	US		Canada	US
1	--	NA	--	--	NA	--
2	--	NA	--	2	NA	2
3	--	NA	--	--	NA	--
4	--	NA	--	1	NA	1
5	5	NA	5	1	NA	1
6	--	NA	--	1	NA	1
7	1	NA	1	--	NA	--
8	1	NA	1	--	NA	--
9	--	NA	--	--	NA	--
10	1	NA	1	--	NA	--
11	1	NA	1	--	NA	--
12	--	NA	--	--	NA	--

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**TABLE B.1.3. Trial Numbers and Geographical Locations.**

NAFTA Growing Region <sup>1</sup>	Sugar beet or Garden beet			Turnip		
	Submitted	Requested		Submitted	Requested	
		Canada	US		Canada	US
13	--	NA	--	--	NA	--
Total	9	NA	9	5	NA	5

<sup>1</sup> Regions 14-21 and 1A, 5A, 5B, and 7A were not included as the proposed use is for the US only.  
 NA = not applicable

**TABLE B.1.2. Study Use Pattern.**

Location (County, State), Year	EP <sup>1</sup>	Application						Tank Mix Adjuvants
		Method; Timing	Vol. (GPA <sup>2</sup> )	Single Rate (lb ai/A)	No. of Appl.	RTI <sup>2</sup> (days)	Total Rate (lb ai/A)	
Carrington, ND, 2002	70% WDG	broadcast; bare ground	27	(1 <sup>st</sup> appl.) 0.72 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.55	3	6-8	1.82	None
Fitchburg, WI, 2002	70% WDG	broadcast; bare ground	27-30	(1 <sup>st</sup> appl.) 0.71 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.55	3	7	1.81	None
Briton, SD, 2002	70% WDG	broadcast; bare ground	9-10	(1 <sup>st</sup> appl.) 0.72 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.54-0.55	3	7	1.81	None
York, NE, 2001	70% WDG	broadcast; bare ground	20	(1 <sup>st</sup> appl.) 0.73 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.55	3	7	1.83	None
Brampton, ND, 2002	70% WDG	broadcast; bare ground	10	(1 <sup>st</sup> appl.) 0.72 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.55	3	7	1.82	None
Velva, ND, 2002	70% WDG	broadcast; bare ground	27	(1 <sup>st</sup> appl.) 0.72 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.54-0.55	3	6-8	1.81	None
Madera, CA, 2001	70% WDG	broadcast; bare ground	27	(1 <sup>st</sup> appl.) 0.71 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.55	3	7	1.81	None
Payette, ID, 1998	70% WDG	broadcast; bare ground	30	(1 <sup>st</sup> appl.) 0.71 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.54	3	7	1.79	None
Suffolk, VA, 2002	70% WDG	broadcast; bare ground	23-24	(1 <sup>st</sup> appl.) 0.74 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.56	3	7	1.86	None
Chula, GA, 2002	70% WDG	broadcast; bare ground	21	(1 <sup>st</sup> appl.) 0.73 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.54	3	7	1.81	None
Newport, AR, 2002	70% WDG	broadcast; bare ground	20	(1 <sup>st</sup> appl.) 0.71 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.54-0.55	3	7	1.80	None
Carrington, ND, 2002	70% WDG	broadcast; bare ground	26-27	(1 <sup>st</sup> appl.) 0.72 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.54-0.55	3	6-8	1.81	None
Uvalde, TX, 2002	70% WDG	broadcast; bare ground	14-19	(1 <sup>st</sup> appl.) 0.72 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.53-0.56	3	7	1.81	None
Colony, OK, 1997	70% WDG	broadcast; bare ground	10-11	(1 <sup>st</sup> appl.) 0.70 (2 <sup>nd</sup> & 3 <sup>rd</sup> ) 0.56	3	8	1.82	None

<sup>1</sup> EP = End-use Product.  
<sup>2</sup> All applications were made using ground equipment.

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Duplicate treated samples and a single control sample of roots and tubers from the representative crops were harvested at intervals reflecting normal agricultural practices at each site. Samples were harvested 115-145 (sugar beet), 59-79 (garden beet), and 49-90 (turnip) days after planting (DAP). After collection, plant samples were placed in frozen storage at the test facility, stored frozen for 1-80 days, then shipped frozen by ACDS freezer truck to the analytical laboratory, BASF Agro Research, RTP, NC, and stored frozen ( $<-10^{\circ}$  C) prior to analysis. Samples were stored frozen from collection to analysis for up to 6 months.

## B.2. Analytical Methodology

Residues of boscalid were determined using an LC/MS/MS method (BASF Method Number D9908). Method D9908 was validated in conjunction with a previous boscalid petition (DP Barcode D278385, M. Nelson, 8/15/03) and deemed acceptable for data collection. A brief description of the method follows.

Residues are extracted with methanol:water:2 N HCl (70:25:5, v/v/v), concentrated, and cleaned up by partitioning into cyclohexane and then using a silica gel solid phase extraction cartridge eluted with 4% ethyl acetate in methylene chloride. Residues are analyzed by LC/MS/MS using the positive ionization mode monitoring ion transitions from  $m/z$  343 to 307. Quantitation is obtained using an external calibration curve of boscalid. The LOQ is 0.05 ppm for residues of boscalid in/on roots and tops; the LOD was not reported.

In the current submission, the LC/MS/MS method was validated using concurrent method recoveries of the various RAC samples fortified with boscalid at 0.05-0.50 ppm.

## C. RESULTS AND DISCUSSION

The number and geographic representation of the rotational field trials are adequate for leaves of root and tuber vegetables (Crop Group 2). A total of nine field trials were conducted using sugar or garden beets in Regions 5 (5 tests), 7, 8, 10 and 11; and another five field trials were conducted on turnips in Regions 2 (2 tests), 4, 5 and 6..

The LC/MS/MS method (BASF Method Number D9908) used to determine residues of boscalid in/on sugar beet, garden beet, and turnip matrices is adequate for data collection. Average concurrent recoveries were 86-100% (Table C.1). Apparent residues of boscalid were  $<LOQ$  in/on all control samples. The LOQ was 0.05 ppm for residues of boscalid in/on all matrices; the LOD was not reported. However, based on raw data from all treated and control samples, apparent residues could be reliably detected below the 0.05 ppm LOQ, but were reported as  $<0.05$  ppm. Therefore, when calculating average residues, the reviewer used the LOQ value (0.05 ppm) for all residues reported to be  $<0.05$  ppm. Adequate sample calculations and chromatograms were provided.



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The total frozen (< -10° C) storage intervals were 3-6 months for sugar beet, garden beet, and turnip commodity samples (Table C.2). Storage stability data are available on representative plant commodities indicating that boscalid is stable in frozen storage for at least 12 months (D278385, M. Nelson, 8/15/03). These data will support the current field rotational crop trials.

**TABLE C.1. Summary of Concurrent Recoveries of Boscalid from Turnip, Garden Beet, and Sugar Beet Matrices.**

Matrix	Analyte	Spike level (mg/kg)	Sample size (n)	Recoveries (%)	Mean ± std dev
Sugar beet roots	Boscalid	0.05	2	82, 118	98 ± 22
		0.10	1	76	
		0.50	1	116	
Sugar beet tops	Boscalid	0.05	2	70, 87	86 ± 11
		0.10	1	92	
		0.50	1	96	
Garden beet roots	Boscalid	0.05	1	96	100
		0.50	1	104	
Garden beet tops	Boscalid	0.05	1	74	89
		0.50	1	103	
Turnip roots	Boscalid	0.05	1	90	94
		0.50	1	97	
Turnip tops	Boscalid	0.05	1	93	97
		0.50	1	100	

Residues of boscalid were 0.051-0.066 ppm in/on 4 of 14 sugar beet tops samples, 0.066 and 0.082 ppm in/on 2 of 10 turnip tops samples, and 0.050 and 0.053 ppm in/on 2 of 10 turnip root samples (Table C.3). Residues of boscalid were <0.05 ppm (<LOQ) in all remaining RAC samples collected from the rotational sugar beet, garden beet, and turnip matrices. Average residues were 0.05 ppm in/on sugar beet roots, garden beet tops and roots, and turnip roots, and were 0.052 ppm in/on sugar beet tops and 0.055 ppm in/on turnip tops (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.2. Summary of Storage Conditions**

Matrix	Storage Temp. (°C)	Actual Storage Duration (months)	Limit of Demonstrated Storage Stability (months) <sup>1</sup>
Sugar beet tops and roots	< -10	4-5	12
Garden beet tops and roots		3-5	
Turnip tops and roots		3-6	

<sup>1</sup> Storage stability data are available indicating that boscalid is stable in frozen plant commodities for at least 12 months (D278385, M. Nelson, 8/15/03).



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**TABLE C.3. Residues of Boscalid in Representative Rotational Crops of Leaves of Root and Tuber Vegetables Following Three Broadcast Applications of Boscalid (WDG).**

Location (County, State, Year)	EPA Region	Crop/ Variety	Total Rate (lb a.i./A)	PBI <sup>2</sup> (days)	Harvest DAP <sup>1</sup>	Matrix	Residues (ppm) <sup>3</sup>
Carington, ND, 2002	5	Sugar beet/ Beta 6104	1.82	14	119	roots	<0.05, <0.05
						tops	<0.05, <0.05
Fitchburg, WI, 2002	5	Sugar beet/ Beta 6600	1.81	14	126	roots	<0.05, <0.05
						tops	<0.05, <0.05
Briton, SD, 2002	5	Sugar beet/ Vanderhave	1.81	14	115	roots	<0.05, <0.05
						tops	0.055, <0.05, <0.05 (0.052) <sup>4</sup> 0.052, <0.05, <0.05 (0.051) <sup>4</sup>
York, NE, 2001	5	Sugar beet/ Monogerty 1640	1.83	14	145	roots	<0.05, <0.05
						tops	<0.05, <0.05
Brampton, ND, 2002	5	Sugar beet/ Vanderhave	1.82	14	115	roots	<0.05, <0.05
						tops	<0.05, <0.05
Velva, ND, 2002	7	Sugar beet/ Crystal 196	1.81	14	123	roots	<0.05, <0.05
						tops	<0.05, <0.05
Madera, CA, 2001	10	Sugar beet/ Spreckles NB7R	1.81	14	144	roots	<0.05, <0.05
						tops	0.084, <0.05, <0.05 (0.061) <sup>4</sup> 0.097, <0.05, <0.05 (0.066) <sup>4</sup>
Payette, ID, 1998	11	Garden beet/ Detroit Dark Red	1.79	14	59	roots	<0.05, <0.05
						tops	<0.05, <0.05
Suffolk, VA, 2002	2	Turnip/ Purple Top	1.86	13	56	roots	<0.05, <0.05
						tops	<0.05, <0.05
Chula, GA, 2002	2	Turnip/ Purple Top	1.81	14	56	roots	<0.05, <0.05
						tops	<0.05, <0.05
Newport, AR, 2002	4	Turnip/ Purple Top	1.80	14	49	roots	0.059 <0.05, <0.05 (0.053) <sup>4</sup> <0.05, <0.05, <0.05 (0.050) <sup>4</sup>
						tops	0.113, <0.05 (0.082) <sup>4</sup> 0.074, 0.075, <0.05 (0.066) <sup>4</sup>
Carrington, ND, 2002	5	Turnip/ Royal Crown	1.81	14	90	roots	<0.05, <0.05
						tops	<0.05, <0.05
Uvalde, TX, 2002	6	Turnip/ Purple Top White Glo	1.81	14	58	roots	<0.05, <0.05
						tops	<0.05, <0.05
Colony, OK, 1997	8	Garden beet/ Detroit Dark Red	1.82	14	94	roots	<0.05, <0.05
						tops	<0.05, <0.05

<sup>1</sup> DAP = Days After Planting

<sup>2</sup> PBI = Plant Back Interval.

<sup>3</sup> The LOQ is 0.05 ppm for each matrix; the LOD was not reported.

<sup>4</sup> Samples were analyzed in duplicate or in triplicate; results of the reanalyses are in *italics*. The average (in parentheses) was calculated by the reviewer using 0.05 ppm for residues <0.05 ppm and was used in all subsequent calculations.

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**TABLE C.4. Summary of Residue Data on Representative Rotational Crops for the Leaves of Root and Tuber Vegetables Crop Group, Following Treatment of Bare Soil with Boscalid (70% WDG).**

Commodity	Total Rate (lb ai/A)	PBI (days)	Boscalid Residue Levels (ppm) <sup>1</sup>						
			n	Min.	Max.	HAFT <sup>2</sup>	Median (STMdR <sup>3</sup> )	Mean (STMR <sup>4</sup> )	Std. Dev.
Sugar beet roots	1.81-1.83	14	14	<0.05	<0.05	<0.05	<0.05	0.050	0
Sugar beet tops		14	14	<0.05	0.066	0.064	0.05	0.052	0.005
Garden beet roots	1.79-1.82	14	4	<0.05	<0.05	<0.05	<0.05	0.050	0
Garden beet tops		14	4	<0.05	<0.05	<0.05	<0.05	0.050	0
Turnip roots	1.80-1.86	13-14	10	<0.05	0.053	0.052	0.05	0.050	0.001
Turnip tops		13-14	10	<0.05	0.082	0.074	0.05	0.055	0.011

<sup>1</sup> The LOQ is 0.05 ppm for each matrix; the LOD was not reported.

<sup>2</sup> HAFT = Highest Average Field Trial.

<sup>3</sup> STMdR = Supervised Trial Median Residue.

<sup>4</sup> STMR = Supervised Trial Mean Residue. In calculating the average, the LOQ was used for samples listed as having residues <LOQ.

NA = not applicable

**D. CONCLUSION**

The field rotational crop data are adequate and support rotational crop tolerances and a 14-day PBI on sugar beets, garden beets and turnips following applications of boscalid totaling 1.8 lb ai/A. The maximum seasonal use rate for any rotated crop is 1.8 lb ai/A on bulb vegetables.

**E. REFERENCES**

D278385, PP#0F06313. BAS 510 F (Common Name: Boscalid), New Fungicide Active Ingredient. Residue Chemistry Summary Document, M. Nelson, 8/15/03.

**F. DOCUMENT TRACKING**

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