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

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

MEMORANDUM

Date: **May 19, 2021**

Subject: **Emamectin Benzoate**. Petition for the Establishment of a Permanent Tolerance for Residues in/on Soybeans. Summary of Analytical Chemistry and Residue Data.

PC Code: 122806
Decision No.:559030
Petition No.: 9F8817
Risk Assessment Type: NA
TXR No.: NA
MRID Nos.: 51022701

DP Barcode: D461598
Registration Nos.: 100-1270, 100-903
Regulatory Action: Section 3 Registration
Case No.: NA
CAS No.: 155569-91-8
40 CFR: §180.505

From: Johnnie L Smith II, Chemist
Risk Assessment Brach III (RAB3)
Health Effects Division (HED; 7509P)

Through: George F. Kramer, Ph.D., Senior Chemist
RAB1; HED (7509P)
and
Thomas Moriarty, Branch Chief
RABIII/HED (7509P)

To: Brent Davis, Risk Assessor
RAB3; HED (7509P)
and
Jasmin Jackson, Risk Manager
Gene Benbow, PM 7
Invertebrate-Vertebrate Branch III (IVB 3)
Registration Division (7505P)

Summary of Submitted Residue Chemistry Studies		
OCSPP 860 Series Guideline	MRID Number	Citation
1500; 1380	51022701	Bledsoe, S. (2019) Emamectin Benzoate – Emamectin (A10325A) – Magnitude of Residues in or on Soybeans Following Foliar Application, USA 2018. Study Numbers: TK0347414; 87513. Unpublished study prepared by Eurofins EAG Agroscience, LLC and submitted by Syngenta Crop Protection, LLC. 572 p

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1.0 Executive Summary

The active ingredient (ai), emamectin benzoate (referred to in this assessment as emamectin), is a derivative of abamectin and is a mixture of two homologue compounds, 90% 4′-epi-methylamino-4′-deoxyavermectin B_{1a} and 10% 4′-epi-methylamino-4′-deoxyavermectin B_{1b}. Emamectin is a natural fermentation product of the soil bacterium *Streptomyces avermitilis* and is an insecticide/miticide developed to control insect species by interfering with the nervous system, causing insect paralysis. Emamectin and abamectin form the candidate common mechanism group (CMG) of the avermectin macrocyclic lactones.

Syngenta Crop Protection, LLC submitted a request to establish a tolerance in or on soybeans for the ai emamectin benzoate at 0.01 ppm. The proposed use pattern is a single foliar application of an emulsifiable-concentrate (EC) formulation with emamectin at 0.0015 lb ai/A and 7-day pre-harvest interval (PHI).

Tolerances are established under 40 CFR §180.505(a)(1) for the combined residues of emamectin and its metabolites 8,9-isomer of the B_{1a} and B_{1b} component of the parent (8,9-ZMA), or 4'-deoxy-4'-epi-amino-avermectin B_{1a} and 4'-deoxy-4'-epi-amino-avermectin B_{1b}; 4'-deoxy-4'-epi-amino-avermectin B_{1a} (AB_{1a}); 4'-deoxy-4'-epi-(*N*-formyl-*N*-methyl)amino-avermectin (MFB_{1a}); and 4'-deoxy-4'-epi-(*N*-formyl)amino-avermectin B_{1a} (FAB_{1a}) in/on various plant commodities at levels ranging from 0.02 ppm (tree nuts and pistachios, and crop groups 8 and 9) to 0.20 ppm (almond hulls).

Tolerances are established under 40 CFR §180.505(a)(2) for the combined residues of emamectin (MAB_{1a} + MAB_{1b} isomers) and the associated 8,9-Z isomers (8,9-ZB_{1a} + 8,9-ZB_{1b}) in/on livestock commodities at levels ranging from 0.002 ppm in hog meat to 0.05 ppm in liver of cattle, goat, horse, and sheep. No tolerances have been established for poultry commodities.

The nature of the residues in plants and ruminants is adequately understood. HED previously concluded that the following residues are required in the tolerance expression and dietary risk assessment for plants & livestock: emamectin (MAB_{1a} + MAB_{1b}), the associated 8,9-Z isomers (8,9-ZB_{1a} + 8,9-ZB_{1b}), and the metabolites/degradates AB_{1a}, MFB_{1a}, and FAB_{1a}. The residues to be included in the tolerance expression and dietary risk assessment for cattle, goat, hog, horse, and sheep commodities are emamectin (MAB_{1a} + MAB_{1b}) and its 8,9-Z isomers (8,9-ZB_{1a} + 8,9-ZB_{1b}).

There are no new livestock feedstuffs associated with the proposed uses. Therefore, no additional livestock metabolism data, livestock commodity enforcement methods, livestock commodity storage stability data, or feeding studies are required to support this petition. Available data relevant to livestock have been previously submitted to and reviewed by HED.

Adequate high-performance liquid chromatography with fluorescence detection (HPLC/FLD) enforcement methods are available for determining residues of emamectin and its regulated isomers and degradates/metabolites in/on plant commodities (Method 244-92-3 and Method 244-92-3, Revision 1). The methods determine residues of emamectin in the following analyte combinations: MAB_{1a} + 8,9-ZB_{1a}, MAB_{1b} + 8,9-ZB_{1b}, AB_{1a}, and MFB_{1a} + FAB_{1a}, with a limit of

quantitation (LOQ) of 0.005 ppm for each analyte or analyte combination, for a combined LOQ of 0.02 ppm.

Adequate field trial data were submitted in support of the petition reflecting the proposed use pattern. Twenty field trials were conducted in the recommended growing zones. The test substance was an EC formulation (A10325A) with a nominal composition of 19.2 g ai/L. No residues of emamectin B_{1a}, emamectin B_{1b} and metabolites (emamectin 8,9-Z, NOA438309, NOA415692, and NOA415693) equal to or greater than the LOQ (0.001 ppm) were found in any untreated control or treated samples.

Adequate processing data were submitted. Residues in/on the two samples of aspirated grain fraction (AGF) (generated from seed treated at an exaggerated rate) were 0.004 and 0.019 ppm for emamectin MAB_{1a} and below the LOQ (<0.001 ppm) for MAB_{1b}; <0.001 and 0.002 ppm for 8,9-ZB_{1a}; <0.001 and 0.004 ppm for AB_{1a}; 0.005 and 0.014 ppm for MFB_{1a}; and <0.001 and 0.002 ppm for FAB_{1a}. Combined residues in/on AGF were <0.014 and <0.041 ppm.

Comparison of the residues in/on the seed (RAC) and AGF indicate that residues of the following analytes concentrate in AGF: emamectin MAB_{1a} (median processing factor of >13x); 8,9-ZB_{1a} (>2.3x); AB_{1a} (>3.5x); MFB_{1a} (>9.8x); and FAB_{1a} (>2.0x). Processing factors for residues of MAB_{1a} could not be determined as residues were below the LOQ in/on both the seed and AGF at both trials.

All field trial and processing data are adequately supported by existing storage stability data. These data adequately support the sample storage conditions and durations from the submitted study. The maximum storage intervals for samples between harvest/collection and extraction for analysis were 10.1 months for soybean seed and 2.8 months for AGF. Samples were analyzed within 1 day of extraction.

Data requirements for rotational crops, and livestock meat, milk, poultry, and eggs, are adequately addressed in the existing database. Food handling establishments and irrigated crops are not relevant to this petition.

2.0 Regulatory Recommendations

There are no residue chemistry considerations that would preclude granting the requested registration and establishing the recommended tolerances for emamectin on soybean. The specific tolerance recommendations are discussed in 2.2.

2.1 Data Deficiencies/Data Needs

None

2.2 Tolerance Considerations

2.2.1 Enforcement Analytical Method

D267346, M. Xue, 2/19/2002

An HPLC/FLD method (Method 244-92-3) is available for the enforcement of established tolerances on plant commodities. HED previously concluded that Revision 1 of this method is adequate for enforcement purposes for the determination of residues of emamectin (MAB_{1a} and MAB_{1b}) and its isomers, metabolites/degradates in/on *Brassica* leafy vegetables, fruiting vegetables, leafy vegetables, cottonseed, cotton gin byproducts, and tomato and cotton processed commodities (DP#267346). The methods determine residues of emamectin in the following analyte combinations: MAB_{1a} + 8,9-ZB_{1a}, MAB_{1b} + 8,9-ZB_{1b}, AB_{1a}, and MFB_{1a} + FAB_{1a}, with an LOQ of 0.005 ppm for each analyte or analyte combination, for a combined LOQ of 0.02 ppm.

2.2.2 Recommended Tolerances

HED recommends that 40 CFR §180.505(a)(1) be updated to include the following tolerance:

Table 2.2.2. Tolerance Summary for Emamectin.

Commodity	Proposed Tolerance (ppm)	HED-Recommended Tolerance (ppm)	Comments (*correct commodity definition*)
40 CFR §180.505(a)(1)			
Soybean, seed	**--**	**0.01**	Revised commodity definition
Soybeans	0.01	--	

2.2.3 Revisions to Petitioned-For Tolerances

The petitioned-for tolerance was revised with respect to the correct commodity definition currently used by the Agency as indicated in Table 2.2.2.

2.2.4 International Harmonization

The U.S. and Codex residue definitions for emamectin are not harmonized. The U.S. residue definition for emamectin includes the sum of emamectin and its metabolites (8,9-isomer) for plants and livestock. The Codex residue definition includes only emamectin for plants and livestock commodities. There are no Canadian maximum residue limits (MRLs) established for emamectin.

There are currently no maximum residue limits (MRLs) established for residues of emamectin in/on soybean under Codex; therefore, there are no issues with harmonization

2.3 Label Recommendations

None

3.0 Introduction

Emamectin benzoate is an insecticide that is a benzoate salt mixture of ≥90% of 4'-epi-methylamino-4'-deoxyavermectin B_{1a} (MAB_{1a}) and ≤10% of 4'-epi-methylamino-4'-deoxy-avermectin B_{1b} (MAB_{1b}). The pesticidal mode of action is through inhibition of muscular contraction via continuous flow of chlorine ions in the GABA (γ-aminobutyric acid) and H-Glutamate receptor sites. The compound penetrates leaf tissue and has been observed to form residues within leaves (Fanigliulo, A. and Sacchetti, M. Emamectin benzoate: new insecticide against *Helicoverpa armigera*. Communications in Agricultural and Applied Biological Sciences. 2008;73(3):651-3)

3.1 Chemical Identity

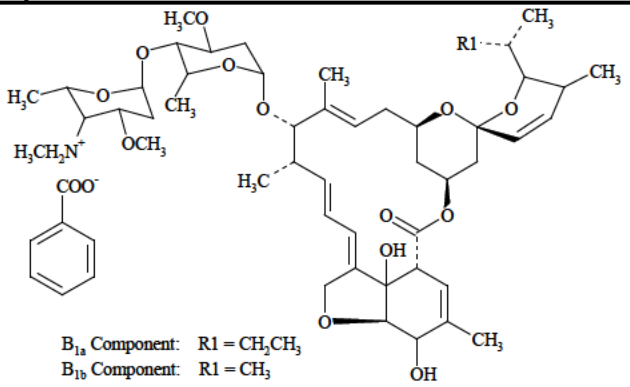
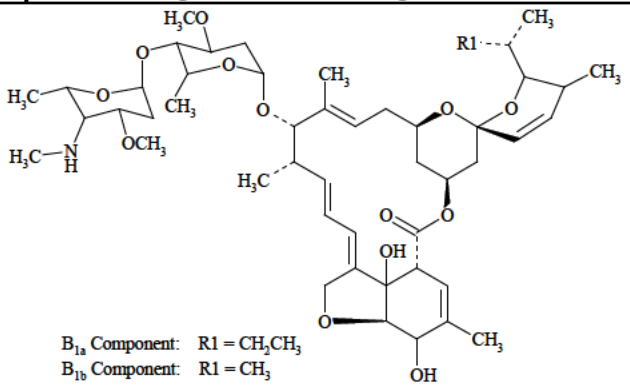
Table 3.1. Nomenclature for Emamectin Benzoate and Metabolites of Interest.	
Common name	Emamectin benzoate (B_{1a} = NOA426007; B_{1b} = NOA422390)
Identity	Mixture of >90% emamectin B_{1a} benzoate and <10% emamectin B_{1b} benzoate
CAS name	(4"*R*)-4"-deoxy-4"-(methylamino)avermectin B_1 benzoate (salt)
CAS registry number	155569-91-8 (formerly 137512-74-4)
Molecular weight	B_{1a} = 1008.26 g/mol; B_{1b} = 994.23 g/mol
Company experimental name	MK244
	
Name	Emamectin (B_{1a} = NOA426007; B_{1b} = NOA422390)
CAS registry number	11979-41-2
Molecular weight	B_{1a} = 886.14 g/mol; B_{1b} = 872.12 g/mol
	
Metabolite name	8,9-*Z* isomer[1] (8,9-*Z*B_{1a}; isomer for B_{1a}; NOA438376)

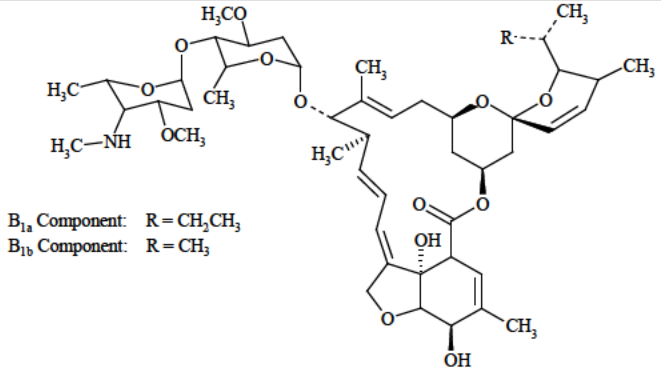
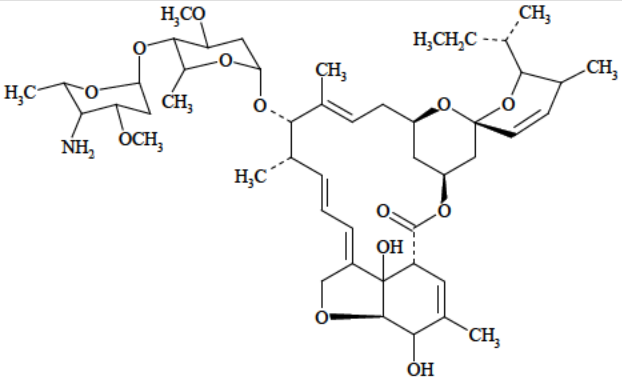
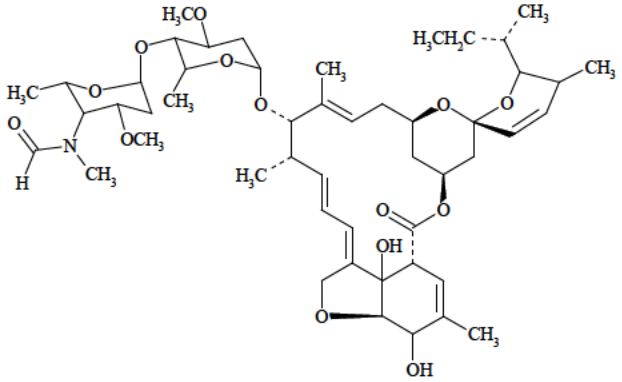
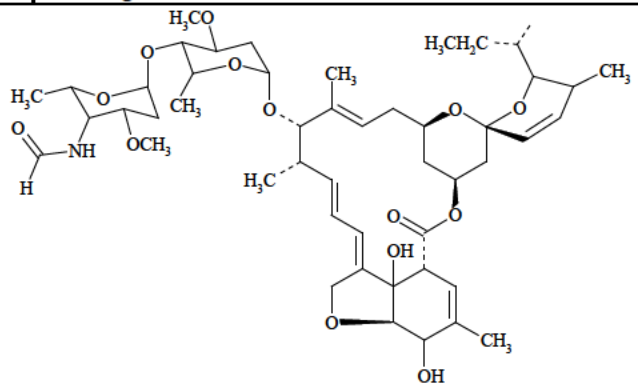
Table 3.1. Nomenclature for Emamectin Benzoate and Metabolites of Interest.	
Molecular weight	B_{1a} = 886.14 g/mol; B_{1b} = 872.12 g/mol
	
Metabolite name	AB_{1a} (L'649; NOA438309)
Molecular weight	872.12 g/mol
	
Metabolite name	MFB_{1a} (L'599; NOA415692)
Molecular weight	914.15 g/mol
	

Table 3.1. Nomenclature for Emamectin Benzoate and Metabolites of Interest.	
Metabolite name	FAB_{1a} (L'831; NOA415693)
Molecular weight	900.13 g/mol
	

[1] Only the B_{1a} isomer of 8,9-Z was determined in this study.

3.2 Physical/Chemical Characteristics

Emamectin is a solid with neutral pH at room temperature. It is readily soluble in water below pH 9.0, and in numerous organic solvents. The vapor pressure is negligible, and it is not expected to volatilize.

Table 3.2. Physicochemical Properties of Emamectin.		
Parameter	Value	Reference
Melting point/range	141-146°C	47002103
pH (at 25°C)	6-7	
Density	1.20 g/cm^3	
Water solubility (average of emamectin B_{1a} + B_{1b} at 21°C)	105 mg/L at pure water 101 mg/L at pH 5.0 93 mg/L at pH 7.0 No peaks were observed at pH 9.0.	
Solvent solubility (at 25°C)	Toluene 20.8 mg/mL Cyclohexane 0.23 mg/mL NMP 576 mg/mL Acetone 140 g/L Dichloromethane >500 g/L Ethyl acetate 81 g/L Hexane 77 g/L Methanol 270 g/L Octanol 48 g/L Toluene 26 g/L	
Vapor pressure (at 21°C)	3.0 x 10^{-8} torr or 3.0 x 10^{-8} mmHg	
Dissociation constant, pK_a	4.2 (benzoic acid) 7.6 (methyl-amino)	
Octanol/water partition coefficient	Shake Flask Method Log P_{ow} = 5.7 (emamectin B_{1a}) Log P_{ow} = 5.2 (emamectin B_{1b})	

Table 3.2. Physicochemical Properties of Emamectin.		
Parameter	Value	Reference
UV/visible absorption (molar absorption coefficients at the absorbance maxima)	Neutral: 37,367 L/mol•cm at 245 nm 22,584 L/mol•cm at 245 nm Acidic: 36,841 L/mol•cm at 245 nm 22,131 L/mol•cm at 245 nm Basic: 28,952 L/mol•cm at 245 nm No further absorption maximum between 280 and 750 nm was observed.	

3.3 Pesticide Use Pattern/Directions for Use (860.1200)

Table 3.3. Use Profile for Proposed Emamectin Benzoate.							
Proposed Use	**Product Formulation [EPA Reg. No.]**	**Application Equipment**	**Max. Single Applic. Rate**	**Max. No. Applic. Per Year**	**Max. Annual Applic. Rate lb ai/A**	**PHI[1] (days)**	**Use Directions and Limitations**
Soybean	Denim Insecticide [EPA Reg. No. 100-903] EC 2.15% Emamectin Benzoate, 0.16 lb ai/gal	Ground, Aerial, or Handheld equipment	6-12 fl oz/gal (0.015) (0.003 lb ai/gal)	3	0.045	28	Apply Denim to plant foliage when larvae first appear, but before populations reach damaging levels. Chemigation is prohibited. Not for use in CA. No aerial application in NY. Do not allow livestock to graze in treated areas. Do not harvest treated soybean forage, straw, or hay as feed for meat or dairy cattle. Do not feed treated soybean fodder or silage to meat or dairy cattle. No more than two apps before rotating MOA2. GPA3 5 gallons fo r ground; RTI4 = 7 days. R EI5 = 12 hours PPE6: "Baseline attire", coveralls, plus c
USE RESTRICTIONS DO NOT allow livestock to graze in treated areas. DO NOT harvest treated soybean forage, straw, or hay as feed for meat or dairy animals. DO NOT feed treated soybean fodder or silage to meat or dairy animals. Pre-harvest Interval (PHI): 28 days							

[1] Preharvest Interval (PHI).
[2] Mode of Action.
[3] Gallons per acre.
[4] Retreatment Interval.
[5] Restricted entry Interval.
[6] Personal protective equipment.

Conclusions.
The use directions are adequate to allow evaluation of the residue data relative to the proposed uses.

4.0 Metabolite/Degradant Residue Profile

No additional metabolism residue studies have been submitted in support of this petition.

4.1 Nature of the Residue

4.1.1 Summary of Plant Metabolism (860.1300)

D245202, TXR 0050048, J. Stokes, 4/15/1998 (MARC memo)
D226277 and D227092, J. Stokes, 12/11/1996
D194566, M. Flood, 5/04/1994

No new plant metabolism data have been submitted with this petition. Adequate metabolism studies with emamectin on lettuce, cabbage, and sweet corn have been reviewed. The major metabolite identified in lettuce, cabbage, and corn treated with [^{14}C]emamectin B_{1a} (MAB_{1a}) was the parent MAB_{1a}. The metabolites 8,9-ZB_{1a}, AB_{1a}, MFB_{1a}, and FAB_{1a} were identified, and each accounted for <5% of the total radioactive residue (TRR). MAB_{1a} initially degrades rapidly to numerous residues of MAB_{1a}-like structures, nearly all contributing only a small amount to the total residue; these initial degradants undergo further degradation to yield a very complex residue. These degradations are probably a result of photolysis, and after this photolytic process, these degradants can be fragmented and incorporated into natural plant constituents.

Conclusion. Metabolism data are available on cabbage (leafy vegetable), lettuce (leafy vegetable), and sweet corn (non-oily grain). The OCSPP Guideline 860.1300 requires similar metabolism to be discerned across three distinct crops in order to determine metabolism is conserved across all crops. In the case of emamectin, metabolism data have only been provided for two distinct crop types (leafy vegetable and non-oily grain). A root crop, oilseed, or fruit/ fruiting vegetable should also be assessed for metabolism of emamectin in order to complete the database. HED's preference would be on a fruit, such as apple, as tolerances have been established for pome fruit, crop group 11-10. HED previously concluded that the following residues are required in the tolerance expression and dietary risk assessment for plants: emamectin (MAB_{1a} + MAB_{1b}), the associated 8,9-Z isomers (8,9-ZB_{1a} + 8,9-ZB_{1b}), and metabolites/photodegradants AB_{1a}, MFB_{1a}, and FAB_{1a} (D245202, TXR 0050048, J. Stokes, 4/15/1998).

4.1.2 Summary of Livestock Metabolism (860.1300)

D267346, M. Xue, 2/19/2002

An adequate goat metabolism study was previously reviewed. Following oral administration of [^{14}C]MAB_{1a} to lactating goats for 7 consecutive days at a feeding level of ~9.6 ppm (310x the theoretical dietary burden for dairy cattle), emamectin (MAB_{1a}) was the major residue identified in all matrices, at 39->100% of the radioactivity. Metabolite AB_{1a} was also identified (0.4-6% TRR) in all goat milk and tissue samples.

A poultry metabolism study has not been conducted. Based on Residue data for cottonseed was taken from submissions supporting petitions PP#6G3320 and PP#7F3500, no secondary residues are expected to occur in poultry commodities; therefore, no poultry metabolism study is required.

Accordingly, the nature of the residue in poultry and swine are not relevant to this petition. The nature of the residue in poultry and swine have not yet been established.

The HED Metabolism Assessment Review Committee (MARC) concluded that emamectin isomers (MAB_{1a} + MAB_{1b}) are the residues of concern in goat milk, fat, meat and meat byproducts; however, the analytical method for the determination of residues of emamectin and its metabolites in livestock commodities cannot distinguish between emamectin (MAB_{1a} + MAB_{1b}) and its 8,9-Z isomers (8,9-ZB_{1a} + 8,9-ZB_{1b}). In the absence of toxicity data, the committee concluded that the 8,9-Z isomers (8,9-ZB_{1a} + 8,9-ZB_{1b}) are of comparable toxicity to the parent. Therefore, the HED MARC concluded that emamectin (MAB_{1a} + MAB_{1b}) and its 8,9-Z isomers (8,9-ZB_{1a} + 8,9-ZB_{1b}) should be included in the tolerance expression and dietary risk assessment for ruminant commodities.

4.1.3 Summary of Confined Rotational Crops (860.l850)

D226277 and D227092, J. Stokes, 12/11/1996

An acceptable confined rotational crop study was previously reviewed. Total radioactive residues were <0.01 ppm in/on immature and mature head lettuce, carrots, and barley from all plant-back intervals (30, 120/141, and 365 days); only barley straw had residues at >0.01 ppm (0.016 and 0.030 ppm) at the 30- and 141-day plant-back intervals. Emamectin and its metabolites were not identified in 30- and 141-DAT barley straw. Based on the results of the reviewed confined rotational crop study, it was concluded that there is no indication that emamectin residues of concern would be present in rotational crops at levels ≥0.01 ppm, and no plant-back restrictions need be listed on the labels.

4.1.4 Summary of Metabolites and Degradants

The structures and properties of emamectin, metabolites, and degradants can be found in Table 3.1.

4.2 Comparison of Metabolic Pathways

The metabolism database for emamectin is incomplete, but sufficient to fully assess the current and proposed uses. Two distinct crop types, leafy greens and non-oily grain, have been reviewed HED. Current uses include tree nuts (high oil),pome fruits (fruit/high acid) and the cherries subgroup (fruit/high acid). Confined rotational crop studies do not supplement these metabolism data, as only barley samples provided any detectible residues, and these were only of parent compound. The observed metabolism in crops is primarily caused by photolysis to the degradants AB_{1a}, MFB_{1a}, and FAB_{1a} with additional metabolism from parent emamectin to the isomers 8,9-ZB_{1a} and 8,9-ZB_{1b}. In livestock, the photolysis is not observed, but breakdown into 8,9-ZB_{1a} and 8,9-ZB_{1b} is similar. Environmental breakdown is similar to that observed in crops, with photolysis being the primary breakdown process. In drinking water, parent emamectin, isomers 8,9-ZB_{1a} and 8,9-ZB_{1b}, and photodegradants AB_{1a}, MFB_{1a}, and FAB_{1a} are observed. Of

the above, the photodegradants AB_{1a}, MFB_{1a}, and FAB_{1a} were not observed in the rat metabolism studies. The toxicity of these compounds is considered to be equivalent to parent emamectin.

4.3 Residues of Concern Summary and Rationale

D245202, TXR 0050048, J. Stokes, 4/15/1998

The residues of concern for tolerance enforcement and risk assessment have been determined to include parent emamectin, the isomers 8,9-ZB_{1a} and 8,9-ZB_{1b}, and photodegradants AB1a, MFB1a, and FAB1a in crops. In ruminants, the residues of concern for tolerance enforcement and risk assessment include parent emamectin, and the isomers 8,9-ZB_{1a} and 8,9-ZB_{1b} only, as the photodegradants are not observed in ruminants. No decision has been made at this time concerning the residues of concern in poultry and swine. For drinking water, the residues of concern for risk assessment have been determined to include parent emamectin, the isomers 8,9-ZB_{1a} and 8,9-ZB_{1b}, and photodegradants AB1a, MFB1a, and FAB1a. Table 4.3, below, summarizes these conclusions.

Table 4.3. Summary of Metabolites and Degradants to be Included in the Risk Assessment and Tolerance Expression.

Matrix		Residues Included in Risk Assessment	Residues Included in Tolerance Expression
Plants	Primary Crop (leafy greens and non-oily grain)	emamectin (MAB_{1a} plus MAB_{1b}), isomers 8,9-ZB_{1a} and 8,9-ZB_{1b} metabolites/photodegradants AB_{1a}, MFB_{1a}, and FAB_{1a}	emamectin (MAB_{1a} + MAB_{1b}), isomers 8,9-ZB_{1a} and 8,9-ZB_{1b} metabolites/photodegradants AB_{1a}, MFB_{1a}, and FAB_{1a}
	Rotational Crop		
Livestock	Ruminant	emamectin (MAB_{1a} plus MAB_{1b}) isomers 8,9-ZB_{1a} and 8,9-ZB_{1b}	emamectin (MAB_{1a} plus MAB_{1b}) isomers 8,9-ZB_{1a} and 8,9-ZB_{1b}
	Poultry	Not Established	Note Established
Drinking Water		emamectin (MAB_{1a} + MAB_{1b}), the associated 8,9-Z isomers (8,9-ZB_{1a} + 8,9-ZB_{1b}), and metabolites/degradants AB_{1a}, MFB_{1a} and FAB_{1a}	Not Applicable

5.0 Residue Profile

5.1 Residue Analytical Methods (860.1340)

5.1.1 Data-Collection Methods

51022701.der
50426201, D448126, R. McGovern, 07/18/2018
50426202, D448126, R. McGovern, 07/18/2018
50426203, D448126, R. McGovern, 07/18/2018

Samples were analyzed for residues of emamectin (MAB_{1a} and MAB_{1b}), 8,9-Z isomer 8,9-ZB_{1a}, and metabolites AB_{1a}, MFB_{1a}, and FAB_{1a} by high-performance liquid chromatography with tandem mass spectrometry detection (LC/MS/MS) using method RAM 465/02. This method was adapted from RAM 465/01, which has been reviewed by the Agency and found to be acceptable for data collection (DP# 448126). In the submission, residues reported as emamectin $B1_a$ and $B1_b$ or emamectin benzoate $B1_a$ and $B1_b$ were determined in emamectin benzoate equivalents. Residues of these analytes were converted to emamectin equivalents by the study reviewer using a molecular weight conversion factor (MWCF) of 0.88 for each analyte. Residues of metabolites AB_{1a}, MFB_{1a}, and FAB_{1a} were also converted to emamectin equivalents by the study reviewer using MWCFs of 1.02, 0.97, and 0.98, respectively; no conversion was needed for 8,9-ZB_{1a}. The limit of quantitation (LOQ; determined as the lowest level of method validation, LLMV) was 0.001 ppm for each analyte. The LOQs for the analytes in emamectin equivalents were 0.0009 ppm for MAB_{1a} and MAB_{1b}, and 0.001 ppm for AB_{1a}, MFB_{1a}, and FAB_{1a}; the combined LOQ for all six analytes was 0.006 ppm. Acceptable method validation and concurrent recoveries were obtained from samples of soybean seed and AGF fortified with each analyte at 0.001 and 0.010 ppm. The fortification levels were adequate to represent measured residue levels.

Table 5.1.1. Monitored Ion transitions of Emamectin and Metabolites/Degradants in Crops[1].

Analyte	Quantitation ion transition	Confirmatory ion transition
Emamectin MAB_{1a}	*m/z* 886.5 → 158.2	*m/z* 886.5 → 82.1
Emamectin MAB_{1b}	*m/z* 872.6 → 158.2	*m/z* 872.6 → 82.1
8,9-ZB_{1a}	*m/z* 886.6 → 158.2	*m/z* 886.6 → 82.1
AB_{1a} (L'649)	*m/z* 872.5 → 144	*m/z* 872.5 → 112
MFB_{1a} (L'599)[1]	*m/z* 914.5 → 186.3	*m/z* 914.5 → 154
FAB_{1a} (L'831)[1]	*m/z* 900.6 → 139.9	*m/z* 900.6 → 172

[1] Ion transitions monitored are reported from other submissions using the standard analytical method as cited in the current petition.

Conclusions. The analytical method is sufficiently validated and is acceptable for use reporting residue concentrations of emamectin and metabolites in/on soybean.

5.1.2 Multi-Residue Methods (860.1360)

D241907, W. Cutchin, 1/26/1999

HED has previously reviewed data pertaining to the multiresidue methods (MRMs) testing of emamectin (MAB_{1a} and MAB_{1b}), the associated 8,9-Z isomers (8,9-ZB_{1a}+ 8,9-ZB_{1b}), and metabolites/photodegradates AB_{1a}, MFB_{1a}, and FAB_{1a}. These data demonstrate that residues of emamectin are not likely to be recovered by the FDA MRMs; the results of the multiresidue testing for emamectin have been forwarded to FDA for inclusion in Pesticide Analytical Manual (PAM), Volume I.

Conclusions.
The MRMs are not appropriate as enforcement methods for determining residues of emamectin.

5.1.3 Tolerance Enforcement Methods

D267346, M. Xue, 2/19/2002

An HPLC/FLD method (Method 244-92-3) is available for the enforcement of established tolerances on plant commodities. HED previously concluded that Revision 1 of this method is adequate for enforcement purposes for the determination of residues of emamectin (MAB_{1a} and MAB_{1b}) and its isomers, metabolites/degradates in/on *Brassica* leafy vegetables, fruiting vegetables, leafy vegetables, cottonseed, cotton gin byproducts, and tomato and cotton processed commodities (DP#267346). The methods determine residues of emamectin in the following analyte combinations: MAB_{1a} + 8,9-ZB_{1a}, MAB_{1b} + 8,9-ZB_{1b}, AB_{1a}, and MFB_{1a} + FAB_{1a}, with an LOQ of 0.005 ppm for each analyte or analyte combination, for a combined LOQ of 0.02 ppm.

Conclusions.
The enforcement method is adequate to support the petitioned uses of emamectin.

5.1.4 Submittal of Analytical Reference Standards (860.1650)

Analytical reference standards are available at the Analytical Chemistry Branch (ACB) Repository.

Standards available, and their expiration dates, are:

Emamectin benzoate (mixture of B1a and B1b)	11/30/23
Emamectin 8,9-z isomer (NOA438376)	1/31/22
Emamectin desmethyl (AB1a; NOA438309)	2/28/22
Emamectin des-n-methyl n-formyl B1a (NOA415693)	9/30/21
Emamectin n-formyl B1a (NOA415692)	3/31/21

5.2 Storage Stability (860.1380)

51022701.der
50426201, D448126, R. McGovern, 07/18/2018
50426202, D448126, R. McGovern, 07/18/2018
50426203, D448126, R. McGovern, 07/18/2018
D328149, N. Dodd, 7/17/2008
D267346, M. Xue, 2/19/2002

The maximum storage intervals for samples between harvest/collection and extraction for analysis were 10.1 months for soybean seed and 2.8 months for AGF (Table 5.2). Samples were analyzed within 1 day of extraction. Acceptable storage stability data are available (DP# 448126) indicating that residues of emamectin and its metabolites and degradants are stable under frozen storage for 9 months in cotton seed and gin byproducts and for 24-36 months in various other crop matrices (leafy vegetables, fruiting vegetables, fruits, and processed matrices). Given that the majority of samples were analyzed within ≤9 months of collection and all analytes

were below the LOQ in/on seed, these data adequately support the sample storage conditions and durations from the submitted study.

Table 5.2. Summary of Storage Conditions.

Soybean Matrix	Storage Temperature (°C)	Actual Storage Duration[1]	Interval of Demonstrated Stability During Frozen Storage
Seed	Field: frozen Processor/Laboratory: ≤-10	30-307 days (1.0-10.1 months)	Residues of emamectin and its metabolites and degradants are stable in cotton seed and gin byproducts for at least 9 months and in various other crop matrices for 24-36 months.[2]
AGF		23-84 days (0.8-2.8 months)	

[1] Interval from harvest/collection to extraction. Samples were analyzed within 0-1 days of extraction.
[2] DP# 448126, 7/18/2019, R. McGovern.

Conclusions
Adequate storage stability data are available to support the submitted residue studies.

5.3 Residue Data

5.3.1 Crop Field Trials (860.1500)
51022701.der

Syngenta submitted field trial data for emamectin benzoate on soybean (seed only) from 20 independent field trials conducted in the United States during the 2018 growing season.

Each trial consisted of one untreated plot and one or two treated plots reflecting three foliar applications of a 0.16 lb ai/gal (EC) formulation of emamectin benzoate. At one plot (P2) at all trials, applications were made at 0.014-0.016 lb ai/A for total seasonal rates of 0.045-0.046 lb ai/A. At two trials, a second plot (P3) was treated at 0.076-0.079 lb ai/A for a total seasonal rate of 0.232 or 0.236 lb ai/A (5x the application rate of the corresponding P2 plots) for generation of AGF. Applications were made at 6- to 8-day retreatment intervals (RTIs) using ground equipment in spray volumes of 12-32 gal/A. An adjuvant (crop oil concentrate or nonionic surfactant) was added to the spray mixture for each application at all trials. Duplicate treated samples of soybean seed were harvested at a PHI of 27-30 days from the P2 plots at all trials, except for one trial at which samples were collected at a 35-day PHI. At three trials, samples were collected at additional PHIs of 20-21, 25-27, 31-32, and 35-36 days to assess residue decline. Single bulk samples of soybean seed were collected from the two P3 plots at a 28- to 29-day PHI, and the seed was processed into AGF using simulated commercial practices at the processing facility.

The results from the submitted field trials are summarized in Table 5.3.1. Following foliar broadcast applications of emamectin benzoate at a total rate of 0.045-0.046 lb ai/A, residues of each analyte were below the LOQ in/on all soybean seed samples. Residues of each analyte were also below the LOQ in/on seed treated at an exaggerated rate (~5x the field trial rates). Residues in/on AGF were 0.0044 and 0.0185 ppm for emamectin MAB_{1a} and below the LOQ (<0.0009 ppm) for MAB_{1b}; <0.0010 and 0.0023 ppm for 8,9-ZB_{1a}; <0.0010 and 0.0036 ppm for AB_{1a}; 0.0053 and 0.0136 ppm for MFB_{1a}; and <0.0010 and 0.0020 ppm for FAB_{1a}.

Comparison of the residues in/on the seed (RAC) and AGF indicates that residues of the following analytes concentrated in AGF: emamectin MAB_{1a} (median processing factor of 13x), 8,9-ZB_{1a} (>2.3x), AB_{1a} (>3.5x), MFB_{1a} (>9.8x), and FAB_{1a} (>2.0x). Processing factors for residues of MAB_{1a} could not be determined as residues were below the LOQ in/on both the seed and AGF at both trials.

In the residue decline trials, residues of each analyte were below the LOQ at all sampling intervals; therefore, no decline trend could be determined for any analyte in soybean seed.

Table 5.3.1. Summary of Residues from Soybean Field Trials with Emamectin Benzoate.

Crop Matrix	Total Application Rate (lb ai/A)	PHI (days)	n[1]	Combined Residues[2] (ppm parent equivalents)						
				Min.[3]	Max.[3]	LAFT[4]	HAFT[4]	Median[4]	Mean[4]	SD[4]
Seed	0.045-0.046	27-35	20	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	N/A
Seed	0.232 or 0.236	28, 29	2	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	N/A
AGF		28, 29	2	<0.014	<0.041	<0.014	<0.041	0.027	0.027	N/A

[1] n = number of independent field trials.
[2] Combined residues of MAB_{1a}, MAB_{1b}, 8,9-ZB_{1a}, AB_{1a}, MFB_{1a}, and FAB_{1a}.
[3] Values based on residues in individual samples.
[4] Values based on per-trial averages. LAFT = lowest average field trial, HAFT = highest average field trial, SD = standard deviation. For computation of the LAFT, HAFT, median, mean, and standard deviation, values <LOQ are assumed to be at the LOQ (<0.006 ppm). N/A = not applicable.

Conclusions.
The submitted field trial data adequately demonstrate the residues resulting from the nominal labeled application rate of emamectin to soybean. The numbers of trials, geographic distributions, and application rates and patterns are all adequate. The residue data are supported by available storage stability data, and appropriately address all residues of concern. Data were generated using validated data-collection methods and are adequately supported by storage stability data. HED considers the submitted data adequate for tolerance-setting purposes.

5.3.2 Field Rotational Crops (860.1900)

D226277 and D227092, J. Stokes, 12/11/1996

The confined rotational crop study did not identify residues above the LOQ in any matrix at the 30-day (or any other) plantback interval. The field rotational crop data are therefore not required.

5.3.3 Processed Food and Feed (860.1520)

Residues of each analyte were also below the LOQ in/on seed treated at an exaggerated rate (~5x the field trial rates). Residues in/on the two samples of AGF were 0.004 and 0.019 ppm for emamectin MAB_{1a} and below the LOQ (<0.001 ppm) for MAB_{1b}; <0.001 and 0.002 ppm for 8,9-ZB_{1a}; <0.001 and 0.004 ppm for AB_{1a}; 0.005 and 0.014 ppm for MFB_{1a}; and <0.001 and 0.002 ppm for FAB_{1a}. Combined residues in/on AGF were <0.014 and <0.041 ppm.

Comparison of the residues in/on the seed (RAC) and AGF indicate that residues of the following analytes concentrate in AGF: emamectin MAB_{1a} (median processing factor of >13x); 8,9-ZB_{1a} (>2.3x); AB_{1a} (>3.5x); MFB_{1a} (>9.8x); and FAB_{1a} (>2.0x). Processing factors for

residues of MAB_{1a} could not be determined as residues were below the LOQ in/on both the seed and AGF at both trials.

Conclusions.
The processing study provided is adequate to assess the proposed uses of emamectin.

5.3.4 Meat, Milk, Poultry and Eggs (860.1480)

Livestock feed items are associated with the proposed uses on soybeans (*Table 1 Feedstuffs*, June 2008). No poultry metabolism study has been submitted and none is required. Based on Residue data for cottonseed was taken from that submitted to support PP#6G3320 and PP#7F3500, no secondary residues are expected to occur in poultry commodities.

5.3.5. Food Handling (860.1460)

Guideline not relevant to this petition.

5.3.6 Water, Fish, and Irrigated Crops (860.1400)

Guideline not relevant to this petition.

5.4 Food Residue Profile

Emamectin is used on a variety of vegetable and oil crops, with tolerances ranging from 0.02 ppm to 0.10 ppm. These residues include parent emamectin and numerous metabolites of concern, but the total emamectin residues are at relatively low concentrations. Processing commodities treated with emamectin results in slight concentration. Comparison of the residues in/on the seed (RAC) and AGF indicate that residues of the following analytes concentrate in AGF: emamectin MAB_{1a} (median processing factor of >13x); 8,9-ZB_{1a} (>2.3x); AB_{1a} (>3.5x); MFB_{1a} (>9.8x); and FAB_{1a} (>2.0x). Processing factors for residues of MAB_{1a} could not be determined as residues were below the LOQ in/on both the seed and AGF at both trials.
Tolerances are also established for secondary residues of emamectin (parent plus 8,9-Z isomers) in mammalian -livestock commodities, at concentrations ranging from 0.01 ppm to 0.05 ppm. No emamectin tolerances are established in poultry commodities.

Overall, the population is expected to be exposed to toxic residues of emamectin at low concentrations in a limited variety of crops including green vegetables, cucurbits, fruiting vegetables, tree nuts, apples and cherries, and in most non-poultry livestock commodities.

6.0 Tolerance Derivation

The Organization for Economic Co-operation and Development (OECD) calculator was not used to derive a tolerance for soybean because all residues <LOQ.

Appendix A. Field Trial Geographic Distribution

Table B.7.6.1.1-2. Trial Numbers and Geographical Locations.

Crop	No. Trials	NAFTA Growing Zone												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
Soybean	Sub.		1		2	17								20
	Req.[1]		2/2		3/2	15/11								20/15

[1] As per Table 5 of 860.1500 for soybean (dried); the second number reflects a 25% reduction in the number of field trials allowed for the crop as a representative commodity in support of a crop group tolerance as applicable (refer to Table 2) or when application results in no quantifiable residues.

Appendix B. International Residue Limits Table

Table B. Summary of US and International Tolerances and Maximum Residue Limits.

Residue Definition:

US	Canada			Codex
40 CFR §180.103: (a)(1) plants: emamectin (a mixture of a minimum of 90% 4′-epi-methylamino-4′-deoxyavermectin B_{1a} and maximum of 10% 4′-epi-methylamino-4′-deoxyavermectin B_{1b}) and its metabolites 8,9-isomer of the B_{1a} and B_{1b} component of the parent (8,9-ZMA), or 4′-deoxy-4′-epi-amino-avermectin B_{1a} and 4′-deoxy-4′-epi-amino-avermectin B_{1b}; 4′-deoxy-4′-epi-amino avermectin B_{1a} (AB_{1a}); 4′-deoxy-4′-epi-(N-formyl-N-methyl)amino-avermectin (MFB_{1a}); and 4′-deoxy-4′-epi-(N-formyl)amino-avermectin B_{1a} (FAB_{1a}), calculated as the stoichiometric equivalent of emamectin (a)(2) livestock: emamectin (MAB_{1a} + MAB_{1b} isomers) and the associated 8,9-Z isomers (8,9-ZB_{1a} and 8,9-ZB_{1b})	No residue definition found			Emamectin B1a benzoate ((4″*R*)-4″-deoxy-4″-(methylamino)avermectin B1 benzoate)
	Tolerance (ppm)/Maximum Residue Limit (mg/kg)			
Commodity[1]	Established/ Proposed	HED-Recommended	Canada	Codex
Soybean	-	**0.01**	-	-

Completed using Global MRL. 03/15/2021

B.7.6 Residues Resulting from Supervised Trials (Annex IIA 6.3; Annex IIIA 8.3)

B.7.6.1 Residues in Target Crops

B.7.6.1.1 Soybean

Document ID:	MRID No. 51022701 PMRA No. Not Available
Report:	Bledsoe, S. (2019) Emamectin Benzoate – Emamectin (A10325A) – Magnitude of Residues in or on Soybeans Following Foliar Application, USA 2018. Study Numbers: TK0347414; 87513. Unpublished study prepared by Eurofins EAG Agroscience, LLC and submitted by Syngenta Crop Protection, LLC. 572 p.
Guidelines:	EPA OCSPP Harmonized Test Guideline 860.1500 Crop Field Trials (August 1996) PMRA Regulatory Directive DIR98-02 – Residue Chemistry Guidelines, Section 9 – Crop Field Trials PMRA Regulatory Directive DIR2010-05 – Revisions to the Residue Chemistry Crop Field Trial Requirements OECD Guideline 509 Crop Field Trial (September 2009)
GLP Compliance:	No deviations from U.S. EPA regulatory requirements were reported which would have an impact on the validity of the study.
Acceptability:	The study is considered scientifically acceptable. The acceptability of this study for regulatory purposes is addressed in the forthcoming U.S. EPA Residue Chemistry Summary Document, DP# D461598
Evaluator:	Johnnie L Smith II

Note: This Data Evaluation Record (DER) was prepared under contract by CDM/CSS-Dynamac Joint Venture (submitted 3/2/2021). The CDM/CSS-Dynamac Joint Venture role does not include establishing Agency policies. The DER has been reviewed by HED and revised as necessary to reflect current Office of Pesticide Programs (OPP) policies.

EXECUTIVE SUMMARY

Syngenta Crop Protection, LLC has submitted field trial data for emamectin benzoate on soybean (seed only) from 20 independent field trials conducted in the United States during the 2018 growing season. Trials were conducted in North American Free Trade Agreement (NAFTA) Growing Zones 2 (GA; 1 trial), 4 (LA and MO; 2 trials), and 5 (IA, IL, IN, KS, MN, MO, ND, and NE; 17 trials).

Each trial consisted of one untreated plot and one or two treated plots reflecting three foliar applications of a 0.16 lb ai/gal (19.2 g ai/L) emulsifiable concentrate (EC) formulation of emamectin benzoate. At one plot (P2) at all trials, applications were made at 0.014-0.016 lb ai/A/application (0.016-0.018 kg ai/ha/application) for total seasonal rates of 0.045-0.046 lb ai/A (0.050-0.051 kg ai/ha). At two trials, a second plot (P3) was treated at 0.076-0.079 lb ai/A/application (0.086-0.089 kg ai/ha/application) for a total seasonal rate of 0.232 or 0.236 lb

ai/A (0.260 or 0.264 kg ai/ha; ~5x the application rate of the corresponding P2 plots) for generation of aspirated grain fractions (AGF). Applications were made at 6- to 8-day retreatment intervals (RTIs) using ground equipment in spray volumes of 12-32 gal/A (112-299 L/ha). An adjuvant (crop oil concentrate or nonionic surfactant) was added to the spray mixture for each application at all trials. Duplicate treated samples of soybean seed were harvested at a preharvest interval (PHI) of 27-30 days from the P2 plots at all trials, except for one trial at which samples were collected at a 35-day PHI. At three trials, samples were collected at additional PHIs of 20-21, 25-27, 31-32, and 35-36 days to assess residue decline. Single bulk samples of soybean seed were collected from the two P3 plots at a 28- to 29-day PHI, and the seed was processed into AGF using simulated commercial practices at the processing facility, GLP Technologies (Navasota, TX).

Samples were maintained frozen at the field sites, at the processing facility (bulk and AGF samples), during shipping, and at the laboratory prior to analysis. The maximum storage intervals for samples between harvest/collection and extraction for analysis were 10.1 months for soybean seed and 2.8 months for AGF. Samples were analyzed within 1 day of extraction. Acceptable storage stability data are available indicating that residues of emamectin and its metabolites and degradants are stable under frozen storage in cotton seed and gin byproducts for at least 9 months (D448126, R. McGovern, 7/18/2019). These data adequately support the sample storage conditions and durations from the submitted study.

Samples were analyzed for residues of emamectin (MAB_{1a} and MAB_{1b}), 8,9-Z isomer 8,9-ZB_{1a}, and metabolites AB_{1a}, MFB_{1a}, and FAB_{1a} by high performance liquid chromatography with tandem mass spectrometry detection (LC/MS/MS) using method RAM 465/02. This method was adapted from RAM 465/01, which has been reviewed by the Agency and found to be acceptable for data collection (D448126, R. McGovern, 7/18/2019). In the submission, residues reported as emamectin $B1_a$ and $B1_b$ or emamectin benzoate $B1_a$ and $B1_b$ were determined in emamectin benzoate equivalents. Residues of these analytes were converted to emamectin equivalents by the study reviewer using a molecular weight conversion factor (MWCF) of 0.88 for each analyte. Residues of metabolites AB_{1a}, MFB_{1a}, and FAB_{1a} were also converted to emamectin equivalents by the study reviewer using MWCFs of 1.02, 0.97, and 0.98, respectively; no conversion was needed for 8,9-ZB_{1a}. The limit of quantitation (LOQ; determined as the lowest level of method validation, LLMV) was 0.001 ppm for each analyte. The LOQs for the analytes in emamectin equivalents were 0.0009 ppm for MAB_{1a} and MAB_{1b}, and 0.001 ppm for AB_{1a}, MFB_{1a}, and FAB_{1a}; the combined LOQ for all six analytes was 0.006 ppm. Acceptable method validation and concurrent recoveries were obtained from samples of soybean seed and AGF fortified with each analyte at 0.001 and 0.010 ppm. The fortification levels were adequate to represent measured residue levels.

Following the last of three foliar applications totaling 0.045-0.046 lb ai/A, residues of emamectin (MAB_{1a} and MAB_{1b}), 8,9-Z isomer 8,9-ZB_{1a}, and metabolites AB_{1a}, MFB_{1a}, and FAB_{1a} were each below the respective LOQ in/on soybean seed harvested at a PHI of 27-35 days, for total emamectin residues of <0.006 ppm. Residues of each analyte were also below the LOQ in/on seed harvested 28 or 29 days following applications at an exaggerated rate (~5x the field trial rates). Residues in/on the two samples of AGF (generated from seed treated at an exaggerated rate) were 0.004 and 0.019 ppm for emamectin MAB_{1a} and below the LOQ (<0.001 ppm) for

MAB_{1b}; <0.001 and 0.002 ppm for 8,9-ZB_{1a}; <0.001 and 0.004 ppm for AB_{1a}; 0.005 and 0.014 ppm for MFB_{1a}; and <0.001 and 0.002 ppm for FAB_{1a}. Combined residues in/on AGF were <0.014 and <0.041 ppm.

Comparison of the residues in/on the seed (RAC) and AGF indicate that residues of the following analytes concentrate in AGF: emamectin MAB_{1a} (median processing factor of >13x); 8,9-ZB_{1a} (>2.3x); AB_{1a} (>3.5x); MFB_{1a} (>9.8x); and FAB_{1a} (>2.0x). Processing factors for residues of MAB_{1a} could not be determined as residues were below the LOQ in/on both the seed and AGF at both trials.

In the residue decline trials, residues of each analyte were below the LOQ at all sampling intervals; therefore, no decline trend could be determined for any analyte in soybean seed.

I. MATERIALS AND METHODS

A. MATERIALS

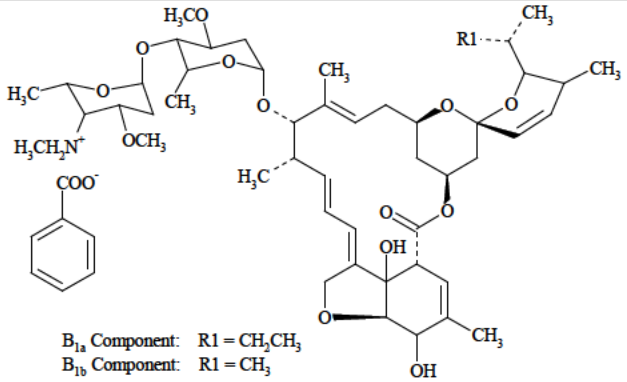
Table B.7.6.1.1-1. Nomenclature for Emamectin Benzoate and Metabolites of Interest.	
Common name	Emamectin benzoate (B_{1a} = NOA426007; B_{1b} = NOA422390)
Identity	Mixture of >90% emamectin B_{1a} benzoate and <10% emamectin B_{1b} benzoate
CAS name	(4"R)-4"-deoxy-4"-(methylamino)avermectin B_1 benzoate (salt)
CAS registry number	155569-91-8 (formerly 137512-74-4)
Molecular weight	B_{1a} = 1008.26 g/mol; B_{1b} = 994.23 g/mol
Company experimental name	MK244
	
Name	Emamectin (B_{1a} = NOA426007; B_{1b} = NOA422390)
CAS registry number	11979-41-2
Molecular weight	B_{1a} = 886.14 g/mol; B_{1b} = 872.12 g/mol

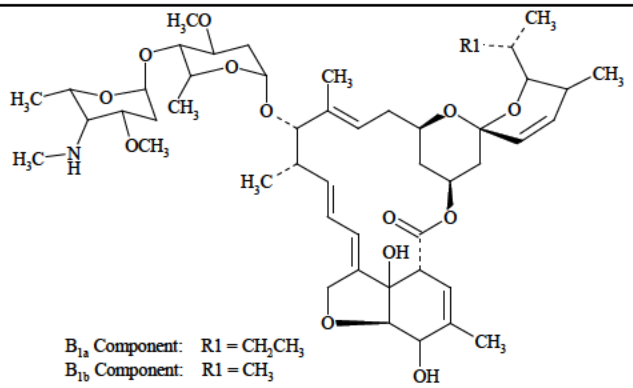
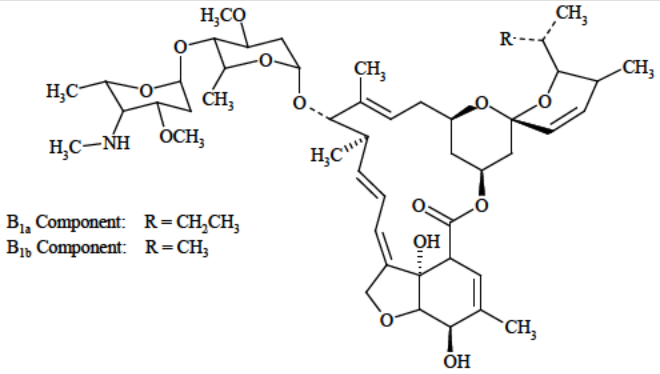
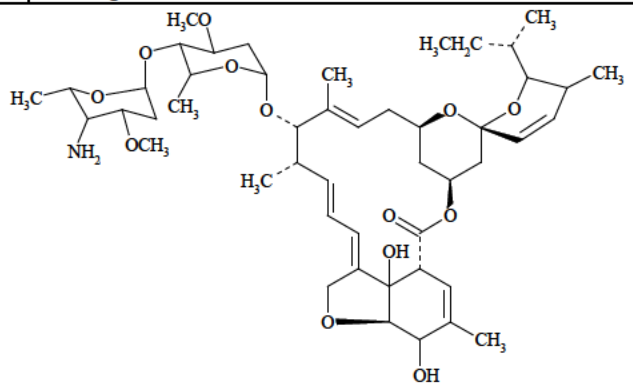
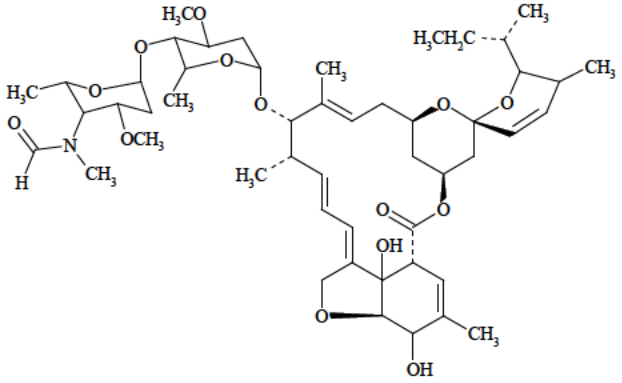
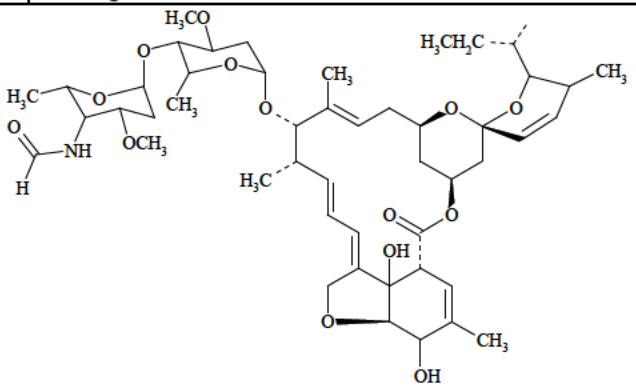
Table B.7.6.1.1-1. Nomenclature for Emamectin Benzoate and Metabolites of Interest.	
	
Metabolite name	8,9-Z isomer[1] (8,9-ZB_{1a}; isomer for B_{1a}; NOA438376)
Molecular weight	B_{1a} = 886.14 g/mol; B_{1b} = 872.12 g/mol
	
Metabolite name	AB_{1a} (L'649; NOA438309)
Molecular weight	872.12 g/mol
	
Metabolite name	MFB_{1a} (L'599; NOA415692)
Molecular weight	914.15 g/mol

Table B.7.6.1.1-1. Nomenclature for Emamectin Benzoate and Metabolites of Interest.	
	
Metabolite name	FAB_{1a} (L'831; NOA415693)
Molecular weight	900.13 g/mol
	

[1] Only the B_{1a} isomer of 8,9-Z was determined in this study.

B. Study Design

1. Test Procedure

Twenty field trials on soybean were conducted with an EC formulation during the 2018 growing season. Field trial locations by NAFTA growing zone are summarized in Table B.7.6.1.1-2. All trials were found to be independent based on the criteria described in 568_Criteria for Independence of Trials 4/23/2013 (EPA and PMRA).

Table B.7.6.1.1-2. Trial Numbers and Geographical Locations.

Crop	No. Trials	NAFTA Growing Zone												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
Soybean	Sub.		1		2	17								20
	Req.[1]		2/2		3/2	15/11								20/15

[1] As per Table 5 of 860.1500 for soybean (dried); the second number reflects a 25% reduction in the number of field trials allowed for the crop as a representative commodity in support of a crop group tolerance as applicable (refer to Table 2) or when application results in no quantifiable residues.

Locations and detailed use patterns for the trials are provided in Table B.7.6.1.1-3. At all trials, applications were made ~42, ~35, and ~28 days before harvest, targeting a 28-day PHI. At two trials, a second plot was treated at an exaggerated rate (5x) for generation of AGF and soybean processed commodities. The processed samples (meal, hulls, crude oil, refined oil, soy milk,

tofu, pollards, soy sauce, miso, and flour) were not analyzed as all residues were below the LOQ in/on the seed (RAC) treated at the exaggerated rate.

Table B.7.6.1.1-3. Study Use Pattern.

Location: City, State; Year (Trial TK0347414-)	End-use Product[1]	Plot[2]	Method of Application; Timing of Application	Volume (gal/A) [L/ha]	Rate per Application (lb ai/A) [g ai/ha]	RTI (days)	Total Rate (lb ai/A) [g ai/ha]	Surfactant/ Adjuvant[3]
Chula, GA; 2018 (01)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 79	21 [196]	0.015 [17]	--	0.045 [50]	NIS
			2. Foliar broadcast; BBCH 81-82	21 [196]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 83-84	21 [196]	0.015 [17]	7		
Cheneyville, LA; 2018 (02)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 72-73	15 [140]	0.015 [17]	--	0.045 [51]	NIS
			2. Foliar broadcast; BBCH 75-77	15 [140]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 77-79	15 [140]	0.015 [17]	7		
Fisk, MO; 2018 (03)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 76-77	15 [140]	0.015 [17]	--	0.045 [50]	NIS
			2. Foliar broadcast; BBCH 79	15 [140]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 79	15 [140]	0.015 [17]	6		
New Providence, IA; 2018 (04)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 72-74	27 [253]	0.015 [17]	--	0.046 [51]	COC
			2. Foliar broadcast; BBCH 75-76	29 [271]	0.016 [18]	8		
			3. Foliar broadcast; BBCH 77-78	28 [262]	0.015 [17]	7		
Cresco, IA; 2018 (05)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 73	25 [234]	0.015 [17]	--	0.045 [50]	COC
			2. Foliar broadcast; BBCH 74	25 [234]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 77	25 [234]	0.015 [17]	8		
Richland, IA; 2018 (06)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 78-79	19 [178]	0.015 [17]	--	0.045 [51]	COC
			2. Foliar broadcast; BBCH 78-79	19 [178]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 78-79	21 [196]	0.015 [17]	6		
		P3	1. Foliar broadcast; BBCH 78-79	25 [234]	0.078 [87]	--	0.236 [264]	COC
			2. Foliar broadcast; BBCH 78-79	30 [281]	0.079 [89]	7		
			3. Foliar broadcast; BBCH 78-79	32 [299]	0.078 [88]	6		
Stewardson, IL; 2018 (07R)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 77-79	15 [140]	0.015 [17]	--	0.045 [51]	NIS
			2. Foliar broadcast; BBCH 79	14 [131]	0.015 [17]	6		
			3. Foliar broadcast; BBCH 79-81	14 [131]	0.015 [17]	7		
Carlyle, IL; 2018 (08)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 77	15 [140]	0.015 [17]	--	0.045 [51]	NIS
			2. Foliar broadcast; BBCH 77	12 [112]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 78-79	17 [159]	0.015 [17]	7		
		P3	1. Foliar broadcast; BBCH 77	15 [140]	0.076 [86]	--	0.232 [260]	NIS
			2. Foliar broadcast; BBCH 77	12 [112]	0.078 [88]	7		
			3. Foliar broadcast; BBCH 78-79	17 [159]	0.078 [87]	7		
Manilla, IN; 2018 (09)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 77	16 [150]	0.015 [17]	--	0.045 [50]	NIS
			2. Foliar broadcast; BBCH 79	16 [150]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 79	15 [140]	0.015 [16]	7		
Stilwell, KS; 2018 (10)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 71-73	25 [234]	0.015 [17]	--	0.045 [51]	NIS
			2. Foliar broadcast; BBCH 73-75	24 [224]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 77-79	21 [196]	0.015 [17]	7		
Lawrence, KS; 2018 (11)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 77-78	16 [150]	0.015 [17]	--	0.045 [51]	NIS
			2. Foliar broadcast; BBCH 78-79	16 [150]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 79-80	15 [140]	0.015 [17]	7		
Stafford, KS; 2018 (12)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 75	19 [178]	0.016 [17]	--	0.045 [50]	NIS
			2. Foliar broadcast; BBCH 77	17 [159]	0.014 [16]	8		
			3. Foliar broadcast; BBCH 79	18 [168]	0.015 [17]	6		

Table B.7.6.1.1-3. Study Use Pattern.								
Location: City, State; Year (Trial TK0347414-)	End-use Product[1]	Plot[2]	Method of Application; Timing of Application	Volume (gal/A) [L/ha]	Rate per Application (lb ai/A) [g ai/ha]	RTI (days)	Total Rate (lb ai/A) [g ai/ha]	Surfactant/ Adjuvant[3]
St. Cloud, MN; 2018 (13)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 78-79	20 [187]	0.015 [17]	--	0.045 [51]	NIS
			2. Foliar broadcast; BBCH 80	20 [187]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 81	20 [187]	0.015 [17]	7		
Aquila, MO; 2018 (14)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 76-77	15 [140]	0.015 [17]	--	0.045 [50]	NIS
			2. Foliar broadcast; BBCH 77-78	15 [140]	0.015 [17]	6		
			3. Foliar broadcast; BBCH 79-81	15 [140]	0.015 [17]	8		
Anabel, MO; 2018 (15R)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 77-79	16 [150]	0.016 [17]	--	0.045 [51]	NIS
			2. Foliar broadcast; BBCH 78-79	15 [140]	0.015 [16]	6		
			3. Foliar broadcast; BBCH 79	16 [150]	0.015 [17]	6		
Northwood, ND; 2018 (16)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 79	20 [187]	0.015 [17]	--	0.045 [50]	NIS
			2. Foliar broadcast; BBCH 79	20 [187]	0.015 [17]	8		
			3. Foliar broadcast; BBCH 81	20 [187]	0.015 [17]	6		
Tolna, ND; 2018 (17)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 79	20 [187]	0.015 [17]	--	0.045 [51]	COC
			2. Foliar broadcast; BBCH 79	20 [187]	0.015 [17]	6		
			3. Foliar broadcast; BBCH 81-82	20 [187]	0.015 [17]	8		
Louisville, NE; 2018 (18)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 77-79	14 [131]	0.015 [17]	--	0.045 [50]	NIS
			2. Foliar broadcast; BBCH 79	14 [131]	0.015 [17]	8		
			3. Foliar broadcast; BBCH 80-81	14 [131]	0.015 [16]	6		
Brunswick, NE; 2018 (19)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 76-77	13 [122]	0.015 [17]	--	0.045 [50]	NIS
			2. Foliar broadcast; BBCH 78-79	13 [122]	0.015 [17]	7		
			3. Foliar broadcast; BBCH 84-85	13 [122]	0.015 [17]	7		
York, NE; 2018 (20)	0.16 lb ai/gal EC	P2	1. Foliar broadcast; BBCH 79	20 [187]	0.015 [17]	--	0.045 [50]	NIS
			2. Foliar broadcast; BBCH 79	19 [178]	0.015 [17]	6		
			3. Foliar broadcast; BBCH 81	20 [187]	0.015 [17]	7		

[1] A 0.16 lb ai/gal (19.2 g ai/L) EC formulation of emamectin benzoate (A10325A).
[2] P2 plots received applications at ~0.015 lb ai/A/application and P3 plots received applications at an exaggerated rate of ~0.076 lb ai/A/application.
[3] NIS = Nonionic surfactant; COC = Crop oil concentrate.

Soybeans were grown and maintained using typical agricultural practices. Irrigation was used between application and harvest at Trials 12 and 19; no irrigation was used between the first application and harvest at Trials 01, 03, and 20, and no irrigation was used at the remaining trials. No unusual weather conditions were reported to have adversely affected crop growth or yields during the study. It is noted that Trial 07 was canceled and restarted as Trial 07R due to an accidental premature harvest, and Trial 15 was canceled and restarted as Trial 15R due to mistiming of applications relative to harvest.

Sample Handling and Preparation

Single control and duplicate treated samples of soybean seed were harvested at normal harvest (BBCH ~89) at a PHI of 27-30 days from all trials, except Trial 17 at which samples were collected at a 35-day PHI (without explanation). The study author also noted that at three trials (Trials 04, 05, and 16), samples at normal harvest were collected 2 days outside the targeted PHI instead of within the ±1 day allowance. At Trials 03, 16, and 19, samples were collected at additional PHIs of 20 or 21, 25-27, 31 or 32, and 35 or 36 days to assess residue decline. Single control and treated bulk samples of seed were collected at normal harvest (PHI of 28 or 29 days)

at Trials 06 and 08 from the plot treated at an exaggerated rate for processing into AGF. All samples were placed in frozen storage (temperature and timing not specified) at the field sites. Field samples were shipped frozen by freezer truck to the analytical laboratory, Eurofins EAG Agroscience, LLC (Columbia, MO). Bulk samples were shipped by freezer truck to the processing facility, GLP Technologies (Navasota, TX) for generation of AGF using simulated commercial practices; processing was completed within 7.2 months of harvest. Prior to and following processing, samples were stored frozen (≤-12 °C); the RAC (seed) and AGF samples were shipped by freezer truck from the processing facility to the analytical laboratory. At the analytical laboratory, seed samples were stored frozen (-25 to -10 °C) until homogenization in the presence of dry ice and all samples were stored frozen until extraction for analysis.

The percent moisture was determined for one sample of soybean seed and AGF from each trial. Percent moisture was determined to be 11-39% for soybean seed and 9-10% for AGF.

2. Description of Analytical Procedures

Samples were analyzed for residues of emamectin (MAB_{1a} and MAB_{1b}), 8,9-Z isomer 8,9-ZB_{1a}, and metabolites AB_{1a}, MFB_{1a}, and FAB_{1a} using LC/MS/MS method RAM 465/02. This method was adapted from RAM 465/01, which has been reviewed by the Agency and found to be acceptable for data collection (D448126, R. McGovern, 7/18/2019). A complete description of the method was included in the submission. Matrix-matched mixed standards were used for quantitation of all analytes in soybean seed and AGF.

Briefly, samples were extracted with methanol by homogenization for 3-5 minutes and the extract was isolated by centrifugation and analyzed directly by LC/MS/MS. The following transitions were monitored:

Analyte	Quantitation ion transition	Confirmatory ion transition
Emamectin MAB_{1a} (NOA426007)	*m/z* 886.6 → 158.2	*m/z* 886.6 → 82.0
Emamectin MAB_{1b} (NOA422390)	*m/z* 872.8 → 158.2	*m/z* 872.8 → 82.0
8,9-ZB_{1a} (NOA438376)	*m/z* 886.5 → 158.2	*m/z* 886.5 → 82.0
AB_{1a} (NOA438309)	*m/z* 872.6 → 144.4	*m/z* 872.6 → 68.2
MFB_{1a} (NOA415692)	*m/z* 914.6 → 186.2	*m/z* 914.6 → 154.1
FAB_{1a} (NOA415693)	*m/z* 900.5 → 172.0	*m/z* 900.5 → 140.3

The limit of quantitation (LOQ; determined as the LLMV) was 0.001 ppm for each analyte. In the submission, residues reported as emamectin $B1_a$ and $B1_b$ or emamectin benzoate $B1_a$ and $B1_b$ were determined in emamectin benzoate equivalents (based on the reference standards used for preparation of the calibration solutions). Residues of these analytes were converted to emamectin equivalents by the study reviewer using a MWCF of 0.88 for each analyte. Residues of metabolites AB_{1a}, MFB_{1a}, and FAB_{1a} were also converted to emamectin equivalents by the study reviewer using MWCFs of 1.02, 0.97, and 0.98, respectively; no conversion was needed for 8,9-ZB_{1a}. The LOQs for the analytes in emamectin equivalents were 0.0009 ppm for MAB_{1a} and MAB_{1b}, and 0.0010 ppm for AB_{1a}, MFB_{1a}, and FAB_{1a}; the combined LOQ for all six analytes was 0.0058 ppm.

II. RESULTS AND DISCUSSION

Method performance was evaluated by use of method validation and concurrent recovery samples of soybean seed and AGF fortified with emamectin (MAB_{1a} and MAB_{1b}), 8,9-Z isomer 8,9-ZB_{1a}, and metabolites AB_{1a}, MFB_{1a}, and FAB_{1a} each at 0.001 and 0.010 ppm. Recoveries were essentially within the acceptable range of 70-120%; therefore, the method is considered valid for the determination of residues of emamectin and its metabolites in soybean seed and AGF (Table B.7.6.1.1-4). The fortification levels were adequate to represent the measured residues. Concurrent recoveries were not corrected for apparent residues in controls.

The detector response was linear (coefficient of determination, $r^2 \geq 0.9779$) within the range of 0.030-2.5 ng/mL. Representative chromatograms of control samples, fortified samples, and treated samples were provided. The control chromatograms generally had no peaks of interest above the chromatographic background. The fortified sample chromatograms contained only the analyte of interest, and peaks were symmetrical and well defined. Apparent residues in/on controls were below the LOQ (<0.001 ppm as analyte).

Table B.7.6.1.1-4. Summary of Concurrent Recoveries of Emamectin and Metabolites from Soybean Matrices.

Matrix	Analyte	Fortification Level (ppm)	Sample Size (n)	Recoveries[1] (%)	Mean ± Std. Dev.[2] (%)
Method Validation					
Seed	Emamectin MAB_{1a}	0.001, 0.010	6	85-97	91 ± 5
	Emamectin MAB_{1b}	0.001, 0.010	6	89-94	92 ± 2
	8,9-ZB_{1a}	0.001, 0.010	6	86-95	90 ± 4
	AB_{1a}	0.001, 0.010	6	87-94	90 ± 3
	MFB_{1a}	0.001, 0.010	6	86-90	88 ± 2
	FAB_{1a}	0.001, 0.010	6	78-99	89 ± 7
AGF	Emamectin MAB_{1a}	0.001, 0.010	4	90-94	93 ± 2
	Emamectin MAB_{1b}	0.001, 0.010	4	87-95	91 ± 4
	8,9-ZB_{1a}	0.001, 0.010	4	93-104	98 ± 6
	AB_{1a}	0.001, 0.010	4	94-101	98 ± 3
	MFB_{1a}	0.001, 0.010	4	89-98	92 ± 4
	FAB_{1a}	0.001, 0.010	4	99-104	102 ± 2
Concurrent Recoveries					
Seed	Emamectin MAB_{1a}	0.001, 0.010	14	91-108	100 ± 5
	Emamectin MAB_{1b}	0.001, 0.010	14	91-105	98 ± 4
	8,9-ZB_{1a}	0.001, 0.010	14	92-107	99 ± 5
	AB_{1a}	0.001, 0.010	14	92-118	99 ± 7
	MFB_{1a}	0.001, 0.010	14	79-115	97 ± 10
	FAB_{1a}	0.001, 0.010	14	80-112	97 ± 10
Seed (pre-processing)	Emamectin MAB_{1a}	0.001, 0.010	2	97, 100	99
	Emamectin MAB_{1b}	0.001, 0.010	2	100, 101	101
	8,9-ZB_{1a}	0.001, 0.010	2	99, 101	100
	AB_{1a}	0.001, 0.010	2	96, 97	97
	MFB_{1a}	0.001, 0.010	2	91, 99	95
	FAB_{1a}	0.001, 0.010	2	89, 101	95

Table B.7.6.1.1-4. Summary of Concurrent Recoveries of Emamectin and Metabolites from Soybean Matrices.					
Matrix	Analyte	Fortification Level (ppm)	Sample Size (n)	Recoveries[1] (%)	Mean ± Std. Dev.[2] (%)
AGF	Emamectin MAB_{1a}	0.001, 0.010	2	92, 94	93
	Emamectin MAB_{1b}	0.001, 0.010	2	92, 92	92
	8,9-ZB_{1a}	0.001, 0.010	2	102, 104	103
	AB_{1a}	0.001, 0.010	2	93, 97	95
	MFB_{1a}	0.001, 0.010	2	95, 103	99
	FAB_{1a}	0.001, 0.010	2	95, **122**	109

[1] Concurrent recoveries were not corrected for apparent residues in controls. **Bolded** values are outside the 70-120% acceptable recovery range.
[2] Standard deviation is not calculated for sample sizes <3.

The maximum storage intervals for samples between harvest/collection and extraction for analysis were 10.1 months for soybean seed and 2.8 months for AGF (Table B.7.6.1.1-5). Samples were analyzed within 1 day of extraction. Acceptable storage stability data are available (D448126, R. McGovern, 7/18/2019) indicating that residues of emamectin and its metabolites and degradants are stable under frozen storage for 9 months in cotton seed and gin byproducts and for 24-36 months in various other crop matrices (leafy vegetables, fruiting vegetables, fruits, and processed matrices). Given that the majority of samples were analyzed within ≤9 months of collection and all analytes were below the LOQ in/on seed, these data adequately support the sample storage conditions and durations from the submitted study.

Table B.7.6.1.1-5. Summary of Storage Conditions.			
Soybean Matrix	Storage Temperature (°C)	Actual Storage Duration[1]	Interval of Demonstrated Stability During Frozen Storage
Seed	Field: frozen Processor/Laboratory: ≤-10	30-307 days (1.0-10.1 months)	Residues of emamectin and its metabolites and degradants are stable in cotton seed and gin byproducts for at least 9 months and in various other crop matrices for 24-36 months.[2]
AGF		23-84 days (0.8-2.8 months)	

[1] Interval from harvest/collection to extraction. Samples were analyzed within 0-1 days of extraction.
[2] D448126, R. McGovern, 7/18/2019.

The results from the submitted field trials are presented in Table B.7.6.1.1-6 and summarized in Table B.7.6.1.1-7. Following foliar broadcast applications of emamectin benzoate at a total rate of 0.045-0.046 lb ai/A, residues of each analyte were below the LOQ in/on all soybean seed samples. Residues of each analyte were also below the LOQ in/on seed treated at an exaggerated rate (~5x the field trial rates). Residues in/on AGF were 0.0044 and 0.0185 ppm for emamectin MAB_{1a} and below the LOQ (<0.0009 ppm) for MAB_{1b}; <0.0010 and 0.0023 ppm for 8,9-ZB_{1a}; <0.0010 and 0.0036 ppm for AB_{1a}; 0.0053 and 0.0136 ppm for MFB_{1a}; and <0.0010 and 0.0020 ppm for FAB_{1a}.

Comparison of the residues in/on the seed (RAC) and AGF indicates that residues of the following analytes concentrated in AGF: emamectin MAB_{1a} (median processing factor of 13x), 8,9-ZB_{1a} (>2.3x), AB_{1a} (>3.5x), MFB_{1a} (>9.8x), and FAB_{1a} (>2.0x). Processing factors for residues of MAB_{1a} could not be determined as residues were below the LOQ in/on both the seed and AGF at both trials.

In the residue decline trials, residues of each analyte were below the LOQ at all sampling intervals; therefore, no decline trend could be determined for any analyte in soybean seed.

Table B.7.6.1.1-6. Residue Data from Soybean Field Trials with Emamectin Benzoate.[1]												
Location: City, State; Year (Trial TK0347414-)	Zone	Crop Variety	Rate (lb ai/A) [kg ai/ha]	Matrix	PHI[2] (days)	Residues[3] (ppm emamectin equivalents) [Average]						
						MAB_{1a}	MAB_{1b}	8,9-ZB_{1a}	AB_{1a}	MFB_{1a}	FAB_{1a}	Total Emamectin[4]
Chula, GA; 2018 (01)	2	AG 7535	0.045 [0.050]	Seed	27	ND, <0.0009 [<0.0009]	<0.0009, ND [<0.0009]	<0.0010, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Cheneyville, LA; 2018 (02)	4	AG46X6	0.045 [0.051]	Seed	29	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Fisk, MO; 2018 (03)	4	S120090	0.045 [0.050]	Seed	21	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					25	ND, ND [<0.0009]	<0.0009, ND [<0.0009]	<0.0010, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					28	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					32	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					36	ND, ND [<0.0009]	ND, ND [<0.0009]	<0.0010, <0.0010 [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
New Providence, IA; 2018 (04)	5	Asgrow AG2203	0.046 [0.051]	Seed	30	<0.0009, <0.0009 [<0.0009]	<0.0009, <0.0009 [<0.0009]	<0.0010, <0.0010 [<0.0010]	<0.0010, <0.0010 [<0.0010]	<0.0010, <0.0010 [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Cresco, IA; 2018 (05)	5	Asgrow AG2035	0.045 [0.050]	Seed	30	<0.0009, <0.0009 [<0.0009]	<0.0009, <0.0009 [<0.0009]	<0.0010, <0.0010 [<0.0010]	<0.0010, <0.0010 [<0.0010]	<0.0010, <0.0010 [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]

Table B.7.6.1.1-6. Residue Data from Soybean Field Trials with Emamectin Benzoate.[1]													
Location: City, State; Year (Trial TK0347414-)	Zone	Crop Variety	Rate (lb ai/A) [kg ai/ha]	Matrix	PHI[2] (days)	Residues[3] (ppm emamectin equivalents) [Average]						
						MAB_{1a}	MAB_{1b}	8,9-ZB_{1a}	AB_{1a}	MFB_{1a}	FAB_{1a}	Total Emamectin[4]
Richland, IA; 2018 (06)	5	P31A22X	0.045 [0.051]	Seed	29	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
			0.236 [0.264]	Seed[5]	29	<0.0009, <0.0009, <0.0009 [<0.0009]	<0.0009, <0.0009, ND [<0.0009]	ND, ND, ND [<0.0010]	<0.0010, ND, ND [<0.0010]	ND, ND, ND [<0.0010]	ND, ND, ND [<0.0010]	<0.0058, <0.0058, <0.0058 [<0.0058]
				AGF		0.0044	<0.0009	<0.0010	<0.0010	0.0053	<0.0010	<0.0136
				Processing Factor[6]		>5.0x	NC	NC	NC	>5.5x	NC	NA
Stewardson, IL; 2018 (07R)	5	394L4	0.045 [0.051]	Seed	28	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Carlyle, IL; 2018 (08)	5	H45L17	0.045 [0.051]	Seed	28	<0.0009, <0.0009 [<0.0009]	ND, <0.0009 [<0.0009]	ND, <0.0010 [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
			0.232 [0.260]	Seed[5]	28	<0.0009, <0.0009, <0.0009 [<0.0009]	<0.0009, ND, <0.0009 [<0.0009]	ND, ND, ND [<0.0010]	ND, ND, <0.0010 [<0.0010]	ND, ND, ND [<0.0010]	ND, ND, ND [<0.0010]	<0.0058, <0.0058, <0.0058 [<0.0058]
				AGF		0.0185	<0.0009	0.0023	0.0036	0.0136	0.0020	<0.0408
				Processing Factor[6]		>21x	NC	>2.3x	>3.5x	>14x	>2.0x	NA
Manilla, IN; 2018 (09)	5	P40A47X	0.045 [0.050]	Seed	28	<0.0009, <0.0009 [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Stilwell, KS; 2018 (10)	5	425-2R	0.045 [0.051]	Seed	28	<0.0009, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Lawrence, KS; 2018 (11)	5	MG 4247NXS	0.045 [0.051]	Seed	28	<0.0009, <0.0009 [<0.0009]	<0.0009, <0.0009 [<0.0009]	<0.0010, <0.0010 [<0.0010]	<0.0010, <0.0010 [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Stafford, KS; 2018 (12)	5	P37T32X-SU28	0.045 [0.050]	Seed	29	<0.0009, <0.0009 [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]

Table B.7.6.1.1-6. Residue Data from Soybean Field Trials with Emamectin Benzoate.[1]													
Location: City, State; Year (Trial TK0347414-)	Zone	Crop Variety	Rate (lb ai/A) [kg ai/ha]	Matrix	PHI[2] (days)	Residues[3] (ppm emamectin equivalents) [Average]						
						MAB_{1a}	MAB_{1b}	8,9-ZB_{1a}	AB_{1a}	MFB_{1a}	FAB_{1a}	Total Emamectin[4]
St. Cloud, MN; 2018 (13)	5	P14T70R2	0.045 [0.051]	Seed	28	ND, <0.0009 [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	<0.0010, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Aquila, MO; 2018 (14)	5	456L4	0.045 [0.050]	Seed	28	ND, ND [<0.0009]	ND, ND [<0.0009]	<0.0010, <0.0010 [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Anabel, MO; 2018 (15R)	5	P40T84X	0.045 [0.051]	Seed	27	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Northwood, ND; 2018 (16)	5	AG03X7/ 01056929	0.045 [0.050]	Seed	20	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					27	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					29	<0.0009, <0.0009 [<0.0009]	ND, ND [<0.0009]	<0.0010, <0.0010 [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					32	<0.0009, <0.0009 [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					35	<0.0009, <0.0009 [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Tolna, ND; 2018 (17)	5	AG03X7/ 01056929	0.045 [0.051]	Seed	35	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
Louisville, NE; 2018 (18)	5	Asgrow 29x8	0.045 [0.050]	Seed	27	<0.0009, <0.0009 [<0.0009]	<0.0009, ND [<0.0009]	<0.0010, ND [<0.0010]	<0.0010, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]

Table B.7.6.1.1-6. Residue Data from Soybean Field Trials with Emamectin Benzoate.[1]													
Location: City, State; Year (Trial TK0347414-)	Zone	Crop Variety	Rate (lb ai/A) [kg ai/ha]	Matrix	PHI[2] (days)	Residues[3] (ppm emamectin equivalents) [Average]						
						MAB_{1a}	MAB_{1b}	8,9-ZB_{1a}	AB_{1a}	MFB_{1a}	FAB_{1a}	Total Emamectin[4]
Brunswick, NE; 2018 (19)	5	AG24X7	0.045 [0.050]	Seed	21	<0.0009, <0.0009 [<0.0009]	ND, ND [<0.0009]	<0.0010, <0.0010 [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					26	ND, ND [<0.0009]	ND, ND [<0.0009]	<0.0010, <0.0010 [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					28	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					31	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
					36	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]
York, NE; 2018 (20)	5	GH2981X	0.045 [0.050]	Seed	29	ND, ND [<0.0009]	ND, ND [<0.0009]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	ND, ND [<0.0010]	<0.0058, <0.0058 [<0.0058]

[1] A 0.16 lb ai/gal (19.2 g ai/L) EC formulation of emamectin benzoate (A10325A) was used.

[2] The nominal harvest PHI is **bolded** for the decline trials.

[3] ND = No observable chromatographic response or a response less than the y-intercept (as defined by the study author). The LOQ was 0.001 ppm for each analyte; residues below the LOQ were not reported. Residues reported in the submission as emamectin $B1_a$ and $B1_b$ or emamectin benzoate $B1_a$ and $B1_b$ were determined as emamectin benzoate equivalents and were converted to emamectin equivalents by the study reviewer using a MWCF of 0.88 for each analyte. Residues of metabolites AB_{1a}, MFB_{1a}, and FAB_{1a} were also converted to emamectin equivalents by the study reviewer using MWCFs of 1.02, 0.97, and 0.98, respectively; no conversion was needed for 8,9-ZB_{1a}. The LOQs for the analytes in emamectin equivalents were 0.0009 ppm for emamectin MAB_{1a} and MAB_{1b}, and 0.0010 ppm for 8,9-ZB_{1a}, AB_{1a}, MFB_{1a}, and FAB_{1a}. Per-trial averages and combined residues were calculated by the study reviewer using the LOQ for all residues reported as <LOQ.

[4] Combined residues of MAB_{1a}, MAB_{1b}, 8,9-ZB_{1a}, AB_{1a}, MFB_{1a}, and FAB_{1a}; the combined LOQ was 0.0058 ppm.

[5] Seed samples collected immediately prior to processing.

[6] Processing Factor = [Residue for analyte in AGF]/[Average residue for analyte in the RAC]. Processing factors were calculated by the study reviewer using unrounded residue values. NC = Not calculated; residues were below the LOQ in the RAC and AGF. NA = Not applicable; processing factors are not calculated for combined residues.

Table B.7.6.1.1-7. Summary of Residues from Soybean Field Trials with Emamectin Benzoate.										
Crop Matrix	Total Application Rate (lb ai/A) [kg ai/ha]	PHI (days)	n[1]	Combined Residues[2] (ppm parent equivalents)						
				Min.[3]	Max.[3]	LAFT[4]	HAFT[4]	Median[4]	Mean[4]	SD[4]
Seed	0.045-0.046 [0.050-0.051]	27-35	20	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	N/A
Seed	0.232 or 0.236 [0.260 or 0.264]	28, 29	2	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	N/A
AGF		28, 29	2	<0.014	<0.041	<0.014	<0.041	0.027	0.027	N/A

[1] n = Number of independent field trials.
[2] Combined residues of MAB_{1a}, MAB_{1b}, 8,9-ZB_{1a}, AB_{1a}, MFB_{1a}, and FAB_{1a}.
[3] Values based on residues in individual samples.
[4] Values based on per-trial averages. LAFT = lowest average field trial, HAFT = highest average field trial, SD = standard deviation. For computation of the LAFT, HAFT, median, mean, and standard deviation, values <LOQ are assumed to be at the LOQ (<0.006 ppm). N/A = Not applicable.

III. CONCLUSIONS

The soybean field trials are considered scientifically acceptable. Following foliar broadcast applications of an EC formulation of emamectin benzoate at a total rate of 0.045-0.046 lb ai/A, residues of each analyte were below the LOQ in/on all soybean seed samples, for a combined residues of <0.006 ppm. Residues of each analyte were also below the LOQ in/on seed treated at an exaggerated rate (~5x the field trial rates). Residues in/on the two samples of AGF were 0.004 and 0.019 ppm for emamectin MAB_{1a} and below the LOQ (<0.001 ppm) for MAB_{1b}; <0.001 and 0.002 ppm for 8,9-ZB_{1a}; <0.001 and 0.004 ppm for AB_{1a}; 0.005 and 0.014 ppm for MFB_{1a}; and <0.001 and 0.002 ppm for FAB_{1a}. Combined residues in/on AGF were <0.014 and <0.041 ppm.

Comparison of the residues in/on the seed (RAC) and AGF indicate that residues of the following analytes concentrate in AGF: emamectin MAB_{1a} (median processing factor of >13x); 8,9-ZB_{1a} (>2.3x); AB_{1a} (>3.5x); MFB_{1a} (>9.8x); and FAB_{1a} (>2.0x). Processing factors for residues of MAB_{1a} could not be determined as residues were below the LOQ in/on both the seed and AGF at both trials.

In the residue decline trials, residues of each analyte were below the LOQ at all sampling intervals; therefore, no decline trend could be determined for any analyte in soybean seed.

An acceptable method was used for residue quantitation, and adequate storage stability data are available to support sample storage durations and conditions for all analytes.

REFERENCES

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