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PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

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MEMORANDUM

SUBJECT: Residue Chemistry Chapter for the Monosodium and Disodium Salts of Methanearsonic Acid (PC codes 013802 and 013803) Reregistration Eligibility Decision (RED); DP Barcode D~~267722~~²⁶⁹²¹⁵; Case 2395.

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Attached is a residue chemistry chapter prepared by Dynamac Corporation for the reregistration eligibility decision of disodium and monosodium salts of methanearsonic acid RED document. This information has undergone secondary review in Reregistration Branch 2 and is consistent with current Agency policies.

cc: Sherrie L. Kinard (RRB2), DSMA and MSMA List B File, DSMA and MSMA Subject File, RF, LAN.
RD/I: MAA Team Review (8/17/00), Chemistry SAC (8/23/00).

7509C: RRB2: S. Kinard: CM#2:Rm 722B: 703-305-0563:8/25/2000.

METHANEARSONIC ACID (MAA) AND SALTS

REREGISTRATION ELIGIBILITY DECISION

RESIDUE CHEMISTRY CONSIDERATIONS

Case 2395; PC Codes 013802 and 013803

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METHANEARSONIC ACID (MAA) AND SALTS

REREGISTRATION ELIGIBILITY DECISION

RESIDUE CHEMISTRY CONSIDERATIONS

Case 2395: PC Codes 013802 and 013803

INTRODUCTION

Methanearsonic acid and its salts are selective postemergence organic arsenical herbicides registered for use on citrus, cotton, non-bearing fruit and nut trees (including almond, apple, cherry, grapefruit, lemon, lime, orange, peach, pear, pecan, plum/prune, tangerine, walnut), and non-crop areas (including lawns and ornamental turf). The methanearsonic acid and its salts comprise Case No. 2395 and the PC codes listed below.

List of Methanearsonic Acid and Salts with Corresponding PC Codes.

| PC Code | Chemical Name | Status |
|---------|-----------------------------|---|
| 013802 | MAA, disodium salt (DSMA) | Currently being supported for reregistration and has active products with food/feed uses. |
| 013803 | MAA, monosodium salt (MSMA) | Currently being supported for reregistration and has active products with food/feed uses. |
| 013804 | MAA, octylammonium salt | Not being supported and there are no active products. |
| 013805 | MAA, dodecylammonium salt | Not being supported and there are no active products. |
| 013806 | MAA, calcium salt | No registered food/feed uses. |

Only disodium methanearsonic acid (DSMA, PC Code 013802) and monosodium methanearsonic acid (MSMA, PC Code 013803) have active registered products with food/feed uses. The reregistration of DSMA and MSMA is being supported by the MAA Task Force, which consists of Albaugh, Inc., Drexel/APC Holding Company, Luxembourg-Pamol, Inc., and Zeneca Agriculture/GB Biosciences Corporation. Registered DSMA and MSMA products are marketed under the trade names Ansar®, Arsonate®, Bueno®, and Daconate®. End-use formulations include the soluble concentrate liquid and solid (SC/L and SC/S) which may be applied using ground or aerial equipment. On established citrus fruit trees, the formulations may be applied as directed sprays to the ground, and as topical broadcast sprays on cotton during preplant and postplant.

REGULATORY BACKGROUND

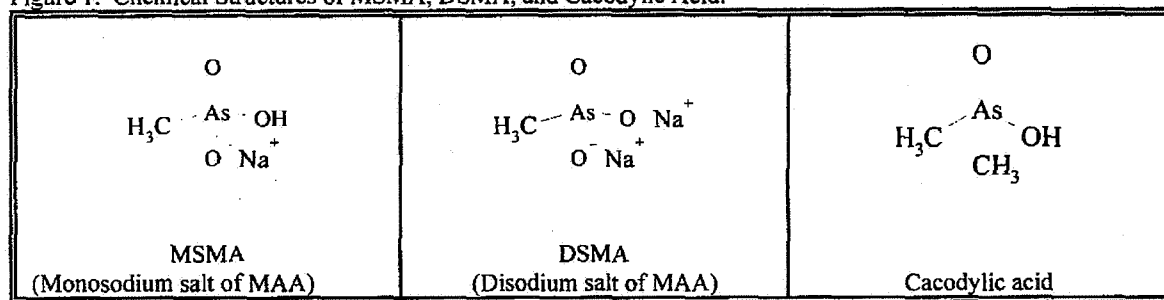
MAA and its salts are List B reregistration pesticides. The Methanearsonic Acid and Salts Phase 4 Reviews for DSMA and MSMA were issued on 3/26/91 (C. Olinger). Data-Call-In (DCI) Notices for DSMA and MSMA were issued on 6/14/91, 3/3/95, and 10/13/95 requiring the registrants to submit several residue chemistry studies in order to fulfill reregistration requirements. Members of the MAA Task Force have submitted several of the studies requested in the DCIs, and the majority of these studies have undergone Phase 5 Review. The data requirements for a few studies still remain unfulfilled. The information contained in this document summarizes the Residue Chemistry Science Assessments with respect to the reregistration of DSMA and MSMA.

Tolerances have been established [40 CFR §180.289(a)] for residues of the herbicide methanearsonic acid, calculated as arsenic trioxide (As₂O₃, a.k.a. arsine), resulting from application of the disodium and monosodium salts of methanearsonic acid in/on citrus fruit (0.35 ppm), cottonseed (0.7 ppm), and cottonseed hulls (0.9 ppm).

Cacodylic acid (Case No. 2080; PC Codes 012501 and 012502) is a metabolite of MSMA, and is found in cotton and citrus raw agricultural commodities (RACs) treated with MSMA.

Tolerances have been established [40 CFR §180.311] for residues of the defoliant cacodylic acid (dimethylarsinic acid), expressed as As₂O₃, in/on cottonseed (2.8 ppm), kidney and liver of cattle (1.4 ppm), and in meat, fat and meat by-products (except kidney and liver) of cattle (0.7 ppm). According to 40 CFR §180.3(d)(4), where a tolerance is established for more than one pesticide containing arsenic found in/on a RAC, the total amount of such pesticide shall not exceed the highest established tolerance, calculated as As₂O₃. Figure 1 depicts the chemical structures of MSMA, DSMA, and cacodylic acid.

Figure 1. Chemical Structures of MSMA, DSMA, and Cacodylic Acid.



Methods for the enforcement of tolerances for residues of methanearsonic acid and cacodylic acid are published in the Pesticide Analytical Manual (PAM) Vol. II. These methods involve the conversion of methanearsonic acid, cacodylic acid, as well as other arsenicals to arsine and detection of arsine colorimetrically. The methods have a sensitivity of 0.05 ppm for MAA and 0.01 ppm for cacodylic acid. Although these subject methods are adequate to determine total residues of arsenic (not speciated) in/on raw agricultural commodities from all potential sources of arsenic exposure including background levels of arsenic, it is not adequate to selectively determine residues of MAA or cacodylic acid in/on raw agricultural commodities.

SUMMARY OF SCIENCE FINDINGS

GLN 860.1200: Directions for Use

There are presently 38 DSMA and MSMA end-use products (EPs) registered under FIFRA Section 3 to the MAA Research Task Force which may be used on citrus fruits and cotton [Source: REFS search, conducted 3/6/00]. These EPs are listed in Table A1.

Table A1. List of DSMA and MSMA End-Use Products with Food/Feed Uses which are Registered to the MAA Task Force.

| EPA Reg. No. | Label Acceptance Date ¹ | Formulation | | Product Name |
|--|------------------------------------|-------------------------------|-------------------------------|---|
| DSMA (Disodium Salt of MAA) | | | | |
| Luxembourg-Pamol, Inc. | | | | |
| 42519-6 | 3/7/97 | 63% SC/S | | LUXEMBOURG-PAMOL DRY DSMA |
| 42519-7 | 1/31/95 | 81% SC/S | | LUXEMBOURG-PAMOL DSMA 81 P |
| 42519-15 | 12/22/97 | 4 lb/gal SC/L ² | 2.52 lb/gal SC/L ³ | DSMA 4 AQ |
| 42519-16 | 10/9/97 | 3.68 lb/gal SC/L ² | 2.32 lb/gal SC/L ³ | DSMA 3.6 AQ PLUS |
| Zenica Agriculture/GB Biosciences Corporation | | | | |
| 50534-15 | 11/2/95 | 63% SC/S | | DSMA POWDER |
| 50534-27 ⁴ | 11/2/95 | 3.6 lb/gal SC/L ² | 2.27 lb/gal SC/L ³ | DSMA LIQUID |
| 50534-38 | 7/19/94 | 63% SC/S ⁵ | | ANSAR 184 HERBICIDE |
| 50534-42 | 5/5/94 | 3.6 lb/gal SC/L ² | 2.27 lb/gal SC/L ³ | ANSAR DSMA LIQUID |
| 50534-46 | 11/2/95 | 81% SC/S | | ANSAR 8100 HERBICIDE |
| 50534-52 | 7/22/94 | 81% SC/S | | ANSAR 81 HERBICIDE (SOUTHERN FORMULATION) |
| 50534-158 | 5/12/95 | 4 lb/gal SC/L ² | 2.52 lb/gal SC/L ³ | DSMA 4 |
| 50534-186 | 4/4/95 | 3.6 lb/gal SC/L ² | 2.27 lb/gal SC/L ³ | LIQUID DSMA |

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(continued; footnotes follow).

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Table A1 (continued).

| EPA Reg. No. | Label Acceptance Date ¹ | Formulation | | Product Name |
|--|------------------------------------|------------------------------|-------------------------------|--|
| Drexel/APC Holding Company | | | | |
| 63239-4 | 12/9/93 | 81% SC/S | | DSMA 81% DRY POWDER FOR SELECTIVE POST-EMERGENT WEED CONTROL |
| 63239-14 | 4/16/96 | 7.2 lb/gal SC/L ² | 4.53 lb/gal SC/L ³ | APC HOLDING DSMA SLURRY |
| 63239-16 | 7/31/95 | 3.6 lb/gal SC/L ² | 2.27 lb/gal SC/L ³ | APC HOLDINGS DSMA LIQUID |
| 63239-17 | 11/8/95 | 4 lb/gal SC/L ² | 2.52 lb/gal SC/L ³ | APC HOLDINGS DSMA LIQUID 4 |
| MAA, Monosodium Salt (MSMA) | | | | |
| Luxembourg-Pamol, Inc. | | | | |
| 42519-1 | 1/31/95 | 6.6 lb/gal SC/L | | LUXEMBOURG-PAMOL TARGET MSMA 6.6 |
| 42519-3 | 10/7/97 | 6 lb/gal SC/L | | LUXEMBOURG-PAMOL TARGET MSMA 6 PLUS |
| 42519-12 | 11/9/95 ⁵ | 55% SC/S ⁷ | | LUXEMBOURG-PAMOL MAGMA DRY MSMA |
| Zeneca Agriculture/GB Biosciences Corporation | | | | |
| 50534-2 | 11/2/95 | 4 lb/gal SC/L | | DACONATE |
| 50534-5 | 11/2/95 | 6 lb/gal SC/L | | DACONATE-6 |
| 50534-6 ⁸ | 11/2/95 | 6 lb/gal SC/L | | BUENO-6 |
| 50534-16 ⁹ | 11/2/95 | 6.6 lb/gal SC/L | | ARSONATE LIQUID |
| 50534-18 | 11/2/95 | 4 lb/gal SC/L | | BUENO |
| 50534-31 | 11/2/95 | 8 lb/gal SC/L | | SUPER BRAND ARSONATE |
| 50534-36 | 7/19/94 | 6.6 lb/gal SC/L | | ANSAR 170 HERBICIDE |
| 50534-37 | 7/19/94 | 4 lb/gal SC/L | | ANSAR 529 HERBICIDE |
| 50534-41 ¹⁰ | 5/2/95 | 6 lb/gal SC/L | | ANSAR 529 H.C. HERBICIDE |
| 50534-43 | 12/14/83 | 6 lb/gal SC/L | | ANSAR 3A.G. HERBICIDE MSMA |
| 50534-44 | 7/19/94 | 4 lb/gal SC/L | | MONEX HERBICIDE |
| 50534-48 | 7/19/94 | 8 lb/gal SC/L | | ANSAR 170-H.C. HERBICIDE |
| 50534-50 | 7/22/94 | 6 lb/gal SC/L | | MONEX 3 HERBICIDE |
| 50534-51 | 12/14/83 | 6 lb/gal SC/L | | ANSAR 529 H.C. HERBICIDE (WESTERN FORMULATION) |
| 50534-53 | 11/2/94 | 6 lb/gal SC/L | | ANSAR 529 H.C. HERBICIDE (SOUTHERN FORMULATION) |
| 50534-54 | 07/22/94 | 8 lb/gal SC/L | | ANSAR 170 H.C. HERBICIDE (SOUTHERN FORMULATION) |

Table A1 (continued).

| EPA Reg. No. | Label Acceptance Date ¹ | Formulation | Product Name |
|----------------------------|------------------------------------|-----------------|--|
| Drexel/APC Holding Company | | | |
| 63239-1 | 3/23/94 | 4 lb/gal EC | DIUMATE |
| 63239-2 | 12/2/93 | 6 lb/gal SC/L | VERSAR 600 MSMA LIQUID PLUS SURFACTANT |
| 63239-3 | 12/2/93 | 6.6 lb/gal SC/L | VERSAR 660 MSMA LIQUID HERBICIDE |

- ¹ Date of the most recently EPA-approved label found in the product jacket or Pesticide Product Label System (PPLS).
- ² For certain DSMA formulations, the active ingredient listed on the label is expressed in terms of "lb disodium methanearsonate hexahydrate".
- ³ The active ingredient was converted by Dynamac from "lb disodium methanearsonate hexahydrate" to lb/gal of DSMA *per se*. The conversion was made using a molecular weight conversion factor of 0.63 obtained by dividing the molecular weight of 183.93425 g/mol for DSMA with the molecular weights of 292.02629 g/mol for DSMA hexahydrate.
- ⁴ Including SLN Nos. CA770096, GA770007, NM780005, OK780002, and SC770014.
- ⁵ Product formulation is listed as wettable powder in REFs; however, upon examination of the product label, the formulation should be classified as a soluble concentrate/solid (SC/S).
- ⁶ The 11/9/95 label obtained from PPLS is illegible; use directions were extracted from the EPA-accepted label dated 3/11/95.
- ⁷ Product formulation is listed as granular in REFs; however, upon examination of the product label, the formulation is listed as "soluble granules" and should be classified as a soluble concentrate/solid (SC/S).
- ⁸ Including SLN Nos. CA770095, CA790189, GA770008, GA960005, LA880008, MO770005, MS900025, NC770018, NM780004, SC770015, and VA940002.
- ⁹ Including SLN Nos. LA880009 and MS900032.
- ¹⁰ Including SLN No. CA800077.

Citrus fruits and cotton are the only registered food/feed uses of DSMA and MSMA. DSMA and MSMA are also registered for uses on non-bearing nuts and fruits with a restriction limiting application to crops which will not bear nuts or fruit within one year of application; hence, the non-bearing nut and fruit uses are considered non-food uses.

A comprehensive summary of the uses of DSMA and MSMA on citrus fruits and cotton, based on the product labels registered to the members of the MAA Task Force, is presented in Table A2. For the purpose of generating this Residue Chemistry Chapter, the Agency examined the registered food/feed use patterns and re-evaluated the available residue chemistry database. Label amendments are required to incorporate the parameters of use patterns reflected in the submitted field trials. Details of the required label amendments are presented in the respective endnotes for citrus fruits and cotton under GLN 860.1500 (Crop Field Trials) of Table B.

A tabular summary of the residue chemistry science assessments for reregistration of DSMA and MSMA is also presented in Table B. The status of reregistration requirements for each guideline topic listed in Table B is based on the use patterns registered to the members of the MAA Task Force. When end-use product DCIs are developed (e.g., at issuance of the RED), RD should

require that all end-use product labels (e.g., MAI labels, SLNs, and products subject to the generic data exemption) be amended such that they are consistent with the basic producer labels.

GLN 860.1300: Nature of the Residue - Plants

The qualitative nature of the residue in plants is adequately understood. Acceptable metabolism studies on citrus and cotton have been submitted by the MAA Task Force and reviewed by the Agency. The citrus and cotton studies were conducted using MSMA labeled with ^{14}C in the methyl group as the test substance. The Agency previously specified that translation of MSMA metabolism studies to DSMA is acceptable, according to a Phase 4 response (3/26/91 memo of C. Olinger). The results of these reviewed studies were presented on 12/19/94 to the HED Metabolism Committee (C. Swartz memo of 1/25/95). Based on the metabolism studies conducted by the registrants for MSMA, as well as metabolism data for MSMA and DSMA from published sources, the Committee concluded that the residues of concern (i.e., that which is of toxicological concern and requires regulation) associated with the use of MSMA and DSMA are MSMA *per se* and cacodylic acid expressed as As_2O_3 . This decision was predicated on the low rate or lack of demethylation, and the inability to distinguish between background arsenic and arsenic resulting from pesticide use. The salient features of the conducted plant metabolism studies are summarized below.

Citrus: Lemon trees were treated three times with [^{14}C]MSMA at 1x the maximum label rate. The three applications were made 104, 59, and 28 days PHI. Lemon peel contained 0.44 ppm of radioactivity (53% of the fruit TRR); lemon pulp contained 0.07 ppm of radioactivity (24% of the TRR); and lemon juice contained 0.12 ppm (23% of the fruit TRR). Lemon matrices were subjected to solvent extraction. Neither acid nor base hydrolysis was required to release additional radioactive residues. In lemon peel, 94% of the radioactivity was identified, with 40.5% as MSMA (including Unknown 1) and 54.2% as cacodylic acid. In lemon pulp, 97% of the radioactivity was identified, as (35.8% MSMA (including Unknown 1) and 61.2% as cacodylic acid. In lemon juice, 92.1% of the radioactivity was identified, 40.3% as MSMA (including Unknown 1) and 51.8% cacodylic acid.

Cotton: Cotton plants that were in the mid-bloom stage were treated with [^{14}C]MSMA at 1.1x the maximum label rate. The treatments were made with a 110 and 97 days PHI. The total radioactive residue (TRR) in treated mature cottonseed was 1.49 ppm. Cottonseed was subjected to solvent extraction, followed by acid and base hydrolysis. Metabolites were characterized and/or identified using HPLC, TLC, and GC/MS. Approximately 67% of the cottonseed TRR was identified as MSMA and cacodylic acid. Bound residues constituted 9% of the cottonseed TRR, and the remaining radioactivity was either unidentified or was not recovered through the extraction and hydrolysis procedures.

GLN 860.1300: Nature of the Residue - Animals

The qualitative nature of the residue in animals is adequately understood based on acceptable ruminant and poultry metabolism studies. The HED Metabolism Committee (C. Swartz memo of 1/25/95) concluded that there is no reasonable expectation of detectable MSMA residues of concern in meat, milk, poultry, and eggs as a result of registered uses; that is, residues in meat, milk, poultry, and eggs can be classified under Category 3 of CFR §180.6(a). Tolerances and feeding studies are not required at this time. A brief summary of the reviewed animal metabolism studies is presented below.

Ruminants: Two lactating goats were orally dosed with [¹⁴C]MSMA once daily for seven days at a dietary level of 42 ppm (~40x the maximum theoretical dietary exposure of ~1.0 ppm burden to beef cattle). It is noted that various combinations of cottonseed, cotton hulls, and wet or dried citrus pulp can be used as a cattle diet with dietary exposure ranging from ~0.6 ppm to 1.2 ppm. In goat tissues, the TRR levels were highest in kidney (0.292 and 0.335 ppm) and liver (0.215 and 0.249 ppm), and lowest in fat (0.012 ppm) and muscle (0.085 to 0.106 ppm). In milk, TRR levels ranged from 0.015 ppm to 0.038 ppm, with radioactive residues reaching a plateau at days 3 or 5. Goat tissue and milk samples were subjected to solvent extraction; nonextractable residues of certain tissue samples were subjected to acid, base, and enzyme hydrolysis. Residue components were characterized and/or identified using TLC and HPLC. MAA was identified in day-5 milk at 34% TRR and in leg muscle at 3% TRR. Cacodylic acid was the principal residue component identified in liver at 74% TRR, in kidney at 85% TRR, in loin muscle at 31% TRR, in leg muscle at 81% TRR, and in day-5 milk at 15% TRR.

Poultry: Ten laying hens were orally dosed with [¹⁴C]MSMA once daily for seven days at a dietary level of 42 ppm. This dosage represents >265x the maximum theoretical dietary exposure of 0.157 ppm, based on a diet consisting of 20% cottonseed meal with cottonseed tolerance-level residues of 0.7 ppm. Total radioactivity accumulated to 0.340 ppm in egg yolk and 0.108 ppm in egg white, and did not plateau over the 7-day dosing period. TRR levels in other tissues were 0.023 ppm (fat), 0.083 ppm (thigh muscle), 0.119 ppm (breast muscle), 0.101 ppm (liver), and 0.158 ppm (kidney). Poultry eggs and tissue samples were subjected to solvent extraction; nonextractable residues of certain tissue samples were subjected to acid, base, and enzyme hydrolysis. Metabolites were characterized and/or identified using TLC and HPLC. The principal residues identified were MAA and cacodylic acid. MAA was identified in breast muscle at 4% TRR, in skin/fat at 17% TRR, and in egg yolk at 21% TRR. Cacodylic acid was identified in liver at 68% TRR, in kidney at 82% TRR, in breast muscle at 85% TRR, in thigh muscle at 28% TRR, in skin/fat at 11% TRR, in egg yolk at 14% TRR, and in egg white at 74% TRR.

GLN 860.1340: Residue Analytical Methods

Plant commodities: For tolerance enforcement, the Pesticide Analytical Manual (PAM), Vol. II, lists two colorimetric methods for separate determination of residues of methanearsonic acid and cacodylic acid (Pesticide Reg. Sec. 180.289 and 180.311, respectively). The methods involve the digestion of the crop with a mixture of nitric and sulfuric acids, the reduction of residues to arsine, and a colorimetric determinative step using silver diethyldithiocarbamate or ammonium molybdate. The methods have a sensitivity of 0.05 ppm for MAA and 0.01 ppm for cacodylic acid. The Phase 4 Reviews for MAA and cacodylic acid requested that the registrant submit new enforcement methods for determination of residues of concern in/on plant commodities.

For data collection, samples of citrus and cotton RACs that were collected from the submitted field and processing studies were analyzed for residues of MSMA and cacodylic acid using a gas chromatography method with electron capture detection (GC/ECD). Residues of DSMA are converted to MSMA during the extraction process. Briefly, residues are extracted with water, and the extract is acidified. Following washing with hexane and diethyl ether, the extract is made alkaline with the addition of sodium hydroxide and then concentrated. The concentrated extract is acidified and refluxed for 16-18 hours. Following cleanup by solid phase extraction, residues are derivatized with methylthioglycolate and partitioned into hexane. The hexane phase is analyzed by GC/ECD for the derivatized residues of MSMA and cacodylic acid. Depending on the matrix, the reported LOQs of the analytical method were 0.04-0.05 ppm. The method was adequately validated by the registrants. Radiovalidation data have also been submitted and reviewed; the data indicate that the GC/ECD can adequately and separately quantitate residues of MSMA and cacodylic acid in/on aged samples of lemons generated from a citrus metabolism study.

Since the enforcement methods listed in PAM Volume II are not specific to arsenic residues resulting from the use of DSMA and MSMA, the Agency recommends that this GC/ECD method be proposed as an enforcement method. The registrant is referred to OPPTS 860.1340 for specific requirements concerning regulatory methods. OPPTS 860.1340 requires that any proposed enforcement method be subjected to an independent laboratory validation (ILV) as per PR Notice 96-1. If the Agency determines that the registrant has submitted the results of a successful ILV trial by an independent laboratory, then the method will be validated by Agency chemists.

Animal commodities: Analytical methods for eggs, milk, and animal tissues are not required to support reregistration of DSMA and MSMA; however, should the registrants propose in the future to additionally register feed crops which could potentially increase the maximum theoretical dietary exposure of residues of concern to animal commodities, then the Agency may require an animal enforcement method.

It is noted that the MAA Task Force has submitted a GC/ECD method for quantitation of MSMA and cacodylic acid residues in beef (fat, liver, kidney and muscle) and milk. In its review of the method, the Agency commented that the method may be acceptable for the reregistration of cacodylic acid provided further method development are undertaken prior to initiation of an ILV.

GLN 860.1360: Multiresidue Methods

The reregistration requirements for multiresidue method testing requirement for MSMA and cacodylic acid are waived. Having considered the decision tree for PAM, Vol. I, Appendix II, Paragraph (d)(1) and accompanying guidance found in the suggestions for producing quality data, it is deemed unlikely that residues of MSMA and cacodylic acid will be adequately recovered using any of the existing multiresidue method protocols. The Residue Chemistry Chapter for Cacodylic Acid waived the multiresidue method testing requirement, and the HED's Chemistry Science Advisory Council, in a meeting conducted on 3/15/00, concurred with this decision. The 10/99 PESTDATA database (PAM, Vol. I, Appendix I) does not contain any information for MSMA or cacodylic acid.

GLN 860.1380: Storage Stability Data

Plant commodities: No storage stability data are available to support the storage conditions and intervals of samples collected from the citrus and cottonseed processing studies which were stored frozen for maximums of 15 and 9 months, respectively, after processing and prior to residue analysis. The registrants are required to submit data investigating the frozen storage stability of residues of MSMA and cacodylic acid in the processed fractions of citrus fruits (dried pulp, oil, and juice) and cottonseed (meal, hulls, and refined oil) at the maximum storage intervals.

Adequate storage stability data are available to support the storage conditions and intervals of samples collected from field residue trials and metabolism studies. Residues of MSMA are stable under frozen storage conditions in/on cottonseed for ~20 months and in/on grapefruit, lemons, and oranges for 15 months. Storage stability data from plant metabolism studies suggest that residues of cacodylic acid are stable under frozen storage conditions for up to one year in/on citrus fruit and cottonseed.

Animal commodities: Storage stability data for animal commodities are not part of the reregistration requirements because no tolerances exist or are required for milk, eggs, and livestock tissues.

GLN 860.1500: Crop Field Trials

The reregistration requirements for magnitude of the residue in/on citrus fruit and cottonseed are fulfilled pending submission of confirmatory data, label revisions, and tolerance reassessment. Residue data are required for cotton gin byproducts.

The MAA Task Force has submitted field residue data depicting the magnitude of MSMA and cacodylic acid residues in/on citrus fruit and cottonseed. These data were obtained using an analytical method (GC/ECD) adequately validated for data collection. Storage stability data support the integrity of the residue data. In general, the field studies met the criteria for the required number of trials, and were conducted in locations representative of the major growing

regions specific to the crops tested. The test systems utilized representative product formulations, applied at maximum rates the registrants wish to support, using application equipment in accordance with label specifications. A brief summary of the supporting residue data for citrus fruit and cottonseed is listed below.

Citrus fruit: In one study, 27 field trials were conducted to determine the magnitude of MSMA and cacodylic acid residues in/on grapefruit, lemons, limes, and oranges following side-by-side applications of representative DSMA and MSMA formulations according to the use patterns the registrants are supporting. Mature fruits were collected at 0-day PHI following the last of three applications of DSMA and MSMA formulations at 4.9 lb a.i./A/application and 4.0 lb a.i./A/application, respectively. All treated citrus fruits each bore residues of MSMA below the analytical method's LOQ of 0.05 ppm; citrus fruit samples from treated areas bore nondetectable (<0.05 ppm) residues of cacodylic acid except for three samples.

The Agency is requiring confirmatory residue decline data to determine whether residues of MSMA and cacodylic acid are taken up by plants at longer PHIs. A total of 9 residue decline trials on oranges (3 trials), lemon (3 trials), and grapefruit (3 trials) should be conducted in major citrus growing regions. Representative DSMA and MSMA formulations should be tested side-by-side in each trial site.

The Agency also recommends label revisions to reflect the parameters of use patterns for which adequate residue data are available. All DSMA formulations with use claims on citrus fruits should be amended to specify a maximum single application rate of 4.9 lb ai/A with a maximum of three applications per growing season or a maximum seasonal rate of 14.7 lb ai/A. Similarly, all MSMA formulations should be amended to specify a maximum single application rate of 4.0 lb ai/A, a maximum of three applications per growing season or a maximum seasonal rate of 12.0 lb ai/A.

No field trial data are required to support the registered uses of MAA on non-bearing citrus because product labels contain a restriction limiting application to crops which will not bear fruit within one year of application.

Cottonseed: In one study, 23 field trials were conducted to determine the magnitude of the residues of MSMA and cacodylic acid in/on delinted cottonseed following applications of a representative MSMA formulation according to two types of use patterns the registrants are supporting. The combined residues of MSMA and cacodylic acid in/on delinted cottonseed harvested 71-130 days were: (i) <0.10-<0.29 ppm following two directed spray applications at 2 lb ai/A/application; and (ii) <0.10-<0.20 ppm following a single topical application at 1 lb ai/A followed by a directed spray application at 2 lb ai/A. The RAC that was analyzed in the submitted cotton field study was delinted cottonseed as opposed to undelinted cottonseed as per Table 1 (OPPTS 860.1000); however, it is noted that the field trials were initiated in the 1993 growing season which is prior to the 1996 issuance of the revised Table 1. The Agency is requiring confirmatory field trial data on undelinted cottonseed. Residue data are also required for cotton gin byproducts (commonly called gin trash which include the plant residues from the

ginning of cotton and consist of burrs, leaves, stems, lint, immature seeds, and sand and/or dirt). A total of 9 field trials should be conducted in major cotton growing regions using representative DSMA and MSMA formulations tested side-by-side in each trial site. For the generation of residue data on cotton gin by products, cotton must be harvested by commercial equipment (stripper and mechanical picker) to provide an adequate representation of plant residues for the ginning process. Residue data must be submitted for each type of harvesting equipment.

Label revisions are required for cotton. All DSMA and MSMA formulations with use claims on cotton should be amended to reflect maximum seasonal rates of either (i) 4 lb ai/A when uses include two directed spray applications at 2 lb ai/A/application or (ii) 3 lb ai/A when uses include a single topical application at 1 lb ai/A followed by a directed spray application at 2 lb ai/A. Because a PHI has not been established for cottonseed, the registrant should propose a PHI; the interim data suggest that a 71-day PHI would be appropriate.

GLN 860.1520: Processed Food/Feed

Pending submission of supporting storage stability data, the reregistration requirements for magnitude of the residue in the processed commodities of citrus fruit and cottonseed have been fulfilled. A brief summary of the available processing data is presented below.

Citrus fruit: In a reviewed orange processing study, residues of MSMA and cacodylic acid were each below the analytical method's LOQ of 0.05 ppm in/on all samples of mature oranges collected at 0-day PHI following the last of three broadcast spray application directed to the base of the tree using a representative MSMA formulation at 1x and 5x the maximum label rates. Following processing of 1x-treated oranges, no concentration of residues was observed in any orange processed fractions. Following processing of 5x-treated oranges, no concentration of residues was observed in oil and juice; however, the combined residues of MSMA and cacodylic acid concentrated 2.6x in molasses and 3.4x in dried pulp. The results of the orange processing study tentatively suggest that a tolerance for the combined residues of MSMA and cacodylic acid (expressed as As_2O_3) in citrus dried pulp may be needed. A definitive regulatory conclusion concerning the need for a tolerance on citrus dried pulp will be made when the highest average field trail (HAFT) residue in/on the RAC has been determined from the requested confirmatory field study. A tolerance for molasses need not be proposed since this item has been deleted from Table 1 (OPPTS 860.1000) as a processed fraction of citrus fruit.

Cottonseed: In a reviewed cottonseed processing study, the combined residues of MSMA and cacodylic acid did not concentrate in meal and refined oil processed from cottonseed bearing detectable residues of MSMA and nondetectable residues of cacodylic acid. The combined residues, however, concentrated 2.2-2.5x in hulls. The adequacy of the established tolerance for cotton hulls cannot be established at this time since the HAFT residue in/on the RAC (undelinted cottonseed) will be determined when the requested confirmatory field data have been submitted and evaluated.

GLN 860.1480: Meat, Milk, Poultry, Eggs

The Agency has determined that no animal feeding studies are needed to determine secondary transfer of DSMA/MSMA residues of concern in milk, eggs, and edible tissues. Based on TRR values in tissues from ruminant and poultry metabolism studies, and on 1x feeding levels, there is no reasonable expectation of detectable MSMA residues in animal tissues, milk, and eggs resulting from use patterns being considered for reregistration. Residues in livestock can be classified under Category 3 of 40 CFR §180.6(a).

GLN 860.1400: Water, Fish, and Irrigated Crops

MAA products are not presently registered for direct use on water and aquatic food and feed crops; therefore, no residue chemistry data are required under these guideline topics.

GLN 860.1460: Food Handling

MAA products are not presently registered for use in food-handling establishments; therefore, no residue chemistry data are required under this guideline topic.

GLN 860.1850 and 860.1900: Confined/Field Accumulation in Rotational Crops

The registrants have submitted a confined rotational crop study (DP Barcode No. D206872, MRID No. 443326101) which was deemed unacceptable because of incomplete characterization and identification of radioactive residues in/on rotational commodities collected at several plantback intervals. Although inadequate, the Agency did not require the study to be upgraded provided the Task Force did not object to a 12-month plantback interval for all crops rotated following MSMA/DSMA applications. The Task Force has responded and indicated that a 12-month interval is impractical; therefore, the Agency has recommended that limited field rotational crop studies be conducted.

GLN 860.1900 specifies that limited field trials should be conducted on a representative crop at two sites per crop for three crop groups – root and tuber vegetables, leafy vegetables, and small grains. Since the possibility of rotational crop residues in peanuts has been identified in conjunction with a misuse of MSMA on peanuts grown in GA, the Agency recommends that the limited field trials substitute peanuts for small grains.

Table A2. Food/Feed Use Patterns on EP Labels Subject to Reregistration for MAA (Case 2395).

| Site | Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|--|---|---|--|--|-----------------------------------|---------------------------------|---|
| MAA, disodium salt (DSMA) | | | | | | | |
| Food/Feed Crop Uses | | | | | | | |
| Citrus fruit (including grapefruit, lemon, lime, orange, and tangerine) | | | | | | | |
| Directed spray Ground | | 81% SC/S [42519-7] [50534-46] | 4.86 lb/A or 4.86 lb/100 gal [100 gal of finished spray/A] | 3 | Not specified (NS) | NS | Use limited to bearing and nonbearing citrus; use prohibited in FL. Ground applications may be diluted with 100 gal of water plus 1-2 qt of a suitable surfactant and applied at a 100 gal/A rate. Do not allow spray solution to contact fruit, leaves, stems or bark. |
| | | 2.27 lb/gal SC/L [50534-42] ² | 4.54 lb/A or 2.27 lb/50 gal [50 gal of finished spray/A] | 3 | NS | NS | Use limited to bearing and nonbearing citrus; use prohibited in FL. Ground applications may be diluted with 50 gal of water and applied at a 50 gal/A rate. Do not allow spray solution to contact fruit, leaves, stems or bark. |
| | | 4.53 lb/gal SC/L [63239-14] ² | 4.53 lb/A or 2.27 lb/50 gal [50 gal of finished spray/A] | 3 | NS | NS | Use limited to bearing and nonbearing citrus; use prohibited in FL. Ground applications may be diluted with 50 gal of water and applied at a 50 gal/A rate. Do not allow spray solution to contact fruit, leaves, stems or bark. |
| | | 2.52 lb/gal SC/L [42519-15] ² | 4.10 lb/A or 2.21 lb/50 gal [50 gal of finished spray/A] | 3 | NS | NS | Use limited to bearing and nonbearing citrus; use prohibited in FL. Ground applications may be diluted with 50 gal of water plus 1-2 qt of a suitable surfactant and applied at a 50 gal/A rate. Do not allow spray solution to contact fruit, leaves, stems or bark. |

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(continued; footnotes follow).

| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|--|--|--|-----------------------------------|---------------------------------|---|
| Citrus fruit (including grapefruit, lemon, lime, orange, and tangerine)(continued) | | | | | | |
| Directed spray Ground | 2.32 lb/gal SC/L [42519-16] ² | 4.06 lb/A or 2.03 lb/50 gal [50 gal of finished spray/A] | 3 | NS | NS | Use limited to bearing and nonbearing citrus; use prohibited in FL. Ground applications may be diluted with 50 gal of water and applied at a 50 gal/A rate. Do not allow spray solution to contact fruit, leaves, stems or bark. |
| Cotton | | | | | | |
| Preplant or postplant (up to cracking) Ground or aerial | 2.27 lb/gal SC/L [50534-27] ² or [50534-186] ² [63239-16] ² [CA770096] [GA770007] [NM780005] | 2.27 lb/A or 2.27 lb/40 gal [40 gal of finished spray/A] | 1 | NS | NS | A single preplant application may be made. Application may be made using ground equipment in a minimum of 40 gal of water/A or using aerial equipment in 5-10 gal of water/A. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 2.52 lb/gal SC/L [50534-158] ² [63239-17] ² | 2.21 lb/A or 2.21 lb/40 gal [40 gal of finished spray/A] | 1 | NS | NS | A single preplant application may be made. Application may be made using ground equipment in a minimum of 40 gal of water/A plus 1 qt of a nonionic surfactant or using aerial equipment in 5-10 gal of water/A. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations |
|---|-------------------------------------|---|--|-----------------------------------|---------------------------------|--|
| Cotton (continued) | | | | | | |
| Topical broadcast spray Ground or aerial | 63% SC/S [42519-6] | 2.27 lb/A | NS | NS | NS | Applications may be made when cotton plants are three to four inches high until first bloom; application before or after this period is not recommended. Ground applications may be diluted with 40 gal of water plus 3 pt of a suitable surfactant and applied at a 40 gal/A rate. Aerial applications may be diluted in 50 gal of water plus 1 qt of a mild agricultural surfactant and applied at a 5 gal/A rate. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 81% SC/S [42519-7] [50534-46] | 2.27 lb/A or 5.67 lb/100 gal [40 gal of finished spray/A] | NS | NS | NS | Applications may be made when cotton plants have 1-2 true leaves to first square. If first application is made topically, a second application may be made as a directed spray one to three weeks after the first. Ground applications may be diluted with 100 gal of water plus 1-2 qt of a mild agricultural surfactant and applied at a rate of 40 gal of spray for each inch of band width per acre. Aerial applications may be diluted in 50 gal of water plus 1 qt of a mild agricultural surfactant and applied at a 5 gal/A rate. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

(continued; footnotes follow).

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|--|---|--|-----------------------------------|---------------------------------|--|
| Cotton (continued) | | | | | | |
| Topical broadcast spray Ground or aerial | 4.53 lb/gal SC/L [63239-14] ² | 2.27 lb/A or 5.66 lb/100 gal [40 gal of finished spray/A] | NS | NS | NS | Applications may be made when cotton plants have 1-2 true leaves to first square. If first application is made topically, a second application may be made as a directed spray one to three weeks after the first. Ground applications may be diluted with 100 gal of water and applied at a rate of 40 gal of spray for each inch of band width per acre. Aerial applications may be diluted in 50 gal of water and applied at a minimum of 5 gal/A rate. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 2.52 lb/gal SC/L [42519-15] ² [63239-17] ² | 1.26 lb/A or 1.26 lb/40 gal [40 gal of finished spray/A] | NS | NS | NS | Applications may be made when cotton plants have 1-2 true leaves to first square. If first application is made topically, a second application may be made as a directed spray one to three weeks after the first. Ground applications may be diluted with 40 gal of water plus 1-2 pt of a mild agricultural surfactant; per acre rate is not specified. Aerial applications may be diluted in 5-10 gal of water plus 0.5-1 pt of a mild agricultural surfactant and applied at a 5-10 gal/A rate. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

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(continued; footnotes follow).

| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|--|--|--|-----------------------------------|---------------------------------|---|
| Cotton (continued) | | | | | | |
| Topical broadcast spray Ground or aerial | 2.32 lb/gal SC/L [42519-16] ² | 1.16 lb/A or 1.16 lb/40 gal [40 gal of finished spray/A] | NS | NS | NS | Applications may be made when cotton plants have 1-2 true leaves to first square. If first application is made topically, a second application may be made as a directed spray one to three weeks after the first. Ground applications may be diluted with 40 gal of water; per acre rate is not specified. Aerial applications may be diluted in 5-10 gal of water and applied at a 5-10 gal/A rate. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 2.27 lb/gal SC/L [50534-27] ² [50534-186] ² [63239-16] ² [SC770014] | 1.14 lb/A or 1.14 lb/40 gal [40 gal of finished spray/A] | NS | NS | NS | Applications may be made when cotton plants are 3 to 6 inches high or up to early first square stage. If first application is made topically, a second application may be made as a directed spray one to three weeks after the first. Ground applications may be diluted with 40 gal of water and applied at a 40 gal/A rate. Aerial applications may be diluted in 5-10 gal of water and applied at a 5-10 gal/A rate. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|--|--|--|---|-----------------------------|---------------------------|--|
| Cotton (continued) | | | | | | |
| Topical broadcast spray Ground or aerial | 2.27 lb/gal SC/L [CA770096] | 2.27 lb/A or 2.27 lb/40 gal [40 gal of finished spray/A] | 1 | NS | NS | Use limited to CA. A single application may be made when cotton plants are 3 to 6 inches high or up to early first square stage. Ground application may be diluted with 40 gal of water and applied at a 40 gal/A rate. Aerial application may be diluted in 5-10 gal of water and applied at a 5-10 gal/A rate. |
| | 2.27 lb/gal SC/L [CA770096] [GA770007] [NM780005] [OK780002] | 1.70 lb/A or 1.70 lb/40 gal [40 gal of finished spray/A] | 2 | NS | NS | Use limited to CA, GA, NM, and OK. Applications may be made when cotton plants are 3 to 6 inches high or up to early first square stage. A second application may be made one to three weeks after the first. Ground applications may be diluted with 40 gal of water and applied at a 40 gal/A rate. Aerial applications may be diluted in 5-10 gal of water and applied at a 5-10 gal/A rate. |
| Topical broadcast spray Ground or aerial | 2.52 lb/gal SC/L [50534-158] ² | 1.26 lb/A or 1.26 lb/40 gal [40 gal of finished spray/A] | NS | NS | NS | Applications may be made when cotton plants are 3 to 6 inches high or up to early first square stage. If first application is made topically, a second application may be made as a directed spray one to three weeks after the first. Ground applications may be diluted with 40 gal of water plus 1-2 pt of a nonionic surfactant and applied at a 40 gal/A rate. Aerial applications may be diluted in 5-10 gal of water plus 0.5 pt nonionic surfactant and applied at a 5-10 gal/A rate. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|--|--|---|---|-----------------------------|---------------------------|--|
| Cotton (continued) | | | | | | |
| Directed spray/band treatment Ground | 63% SC/S [42519-6] | 2.27 lb/A | NS | NS | NS | Applications may be made when cotton plants are three to four inches high until first bloom; application before or after this period is not recommended. Ground applications may be diluted with 60 gal of water plus 3 pt of a suitable surfactant and applied at a 60 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| Directed spray/band treatment Ground | 81% SC/S [42519-7] [50534-46] | 2.27 lb/A or 5.67 lb/100 gal [40 gal of finished spray/A] | NS | NS | NS | If no topical application is made, two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 100 gal of water plus 1-2 qt of a mild surfactant and applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 2.32 lb/gal SC/L [42519-15] ² [50534-158] ² [63239-17] ² | 2.32 lb/A or 2.32 lb/40 gal [40 gal of finished spray/A] | NS | NS | NS | If no topical application is made, two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 40 gal of water and applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|---|--|--|-----------------------------------|---------------------------------|---|
| Cotton (continued) | 2.27 lb/gal SC/L [50534-27] ² [50534-42] ² [50534-186] ² [63239-16] ² [CA770096] [GA770007] [NM780005] | 2.27 lb/A or 2.27 lb/40 gal [40 gal of finished spray/A] | NS | NS | NS | If no topical application is made, two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 40 gal of water and applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 4.53 lb/gal SC/L [63239-14] ² | | | | | |
| Directed spray/band treatment Ground | 81% SC/S [63239-4] | 2.27 lb/A | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 40 gal of water plus 1 pt of a good agricultural surfactant. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Banded applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|-------------------------------|---|--|-----------------------------------|---------------------------------|--|
| Cotton (continued) | | | | | | |
| Directed spray/band treatment Ground | 81% SC/S [50534-52] | 5.67 lb/100 gal | NS | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 100 gal of water plus 1-2 qt of a mild surfactant (acre rate is not specified on label). For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Banded applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 63% SC/S [50534-15] | 2.21 lb/A | 2 | NS | NS | Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. For directed sprays, applications may be diluted with 40 gal of water plus 1-1.75 qt of surfactant and applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

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(continued; footnotes follow).

| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|--|--|--|---|-----------------------------|---------------------------|---|
| Cotton (continued) | | | | | | |
| Directed spray/band treatment Ground | 63% SC/S [50534-38] | 2.27 lb/A or 5.67 lb/100 gal [40 gal of finished spray/A] | 2 | NS | NS | Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. For directed sprays, applications may be diluted with 100 gal of water plus 1-2 qt of a mild surfactant and applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| Nonbearing Crops | | | | | | |
| Fruit and Nuts (including almond, walnut, grapefruit, lemon, lime, orange, tangerine, apple, cherries, peaches, pears, plums, and prunes) | | | | | | |
| Directed spray treatment Ground | 2.27 lb/gal SC/L [50534-27] ² [50534-186] ² [63239-16] ² | 3.97 lb/A or 1.99 lb/50 gal | 3 | NS | NS | Use around trees or vines from which crops will be harvested within one year is prohibited. For directed sprays, applications may be diluted with 50 gal of water and applied to just short of run-off. Do not allow spray solution to contact leaves, stems or bark of trees or vines. The grazing of treated areas is prohibited. |

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|---|---|--|-----------------------------------|---------------------------------|--|
| Directed spray treatment Ground | 2.52 lb/gal SC/L [50534-158] ² [63239-17] ² | 4.10 lb/A or 2.21 lb/50 gal | 3 | NS | NS | Use around trees or vines from which crops will be harvested within one year is prohibited. For directed sprays, applications may be diluted with 50 gal of water and applied to just short of run-off. Do not allow spray solution to contact leaves, stems or bark of trees or vines. The grazing of treated areas is prohibited. |

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations |
|--|----------------------------|---------------------------------------|---|-----------------------------|---------------------------|--|
| MAA, monosodium salt (MSMA) | | | | | | |
| Food/Feed Crop Uses | | | | | | |
| Citrus fruit (including grapefruit, lemon, lime, orange, and tangerine) | | | | | | |
| Directed spray Ground | 4 lb/gal SC/L [50534-37] | 4 lb/A or 2 lb/50 gal | 3 | NS | NS | Use limited to bearing and nonbearing citrus; use prohibited in FL. Ground applications may be diluted with 50 gal of water and applied at a 50-100 gal/A rate. Do not allow spray solution to contact fruit, leaves, stems or bark. |
| | 6 lb/gal SC/L [50534-41] | 4 lb/A or 2 lb/75 gal | 3 | NS | NS | Use limited to bearing and nonbearing citrus; use prohibited in FL. Ground applications may be diluted with 75 gal of water. For spot treatments, applications may be diluted with 100 gal and applied to the point of run-off. Do not allow spray solution to contact fruit, leaves, stems or bark. |
| | 6 lb/gal SC/L [50534-51] | 4 lb/A or 2 lb/75 gal | 3 | NS | NS | Use limited to bearing citrus; use limited to CA. Ground applications may be diluted with 75 gal of water and applied to just short of run-off. Do not allow spray solution to contact fruit, leaves, stems or bark. |
| | 6 lb/gal SC/L [CA 790189] | 4 lb/A or 2 lb/75 gal | 3 | NS | NS | Use limited to bearing and nonbearing citrus. Ground applications may be diluted with 50 gal of water. Do not allow spray solution to contact fruit, leaves, stems or bark. |
| | 6 lb/gal SC/L [50534-53] | 2 lb/A or 2 lb/50 gal | 3 | NS | NS | Use limited to bearing and nonbearing citrus. Ground applications may be diluted with 50 gal of water. Do not allow spray solution to contact fruit, leaves, stems or bark. |
| | 6 lb/gal SC/L [50534-53] | 2 lb/A or 2 lb/50 gal | 3 | NS | NS | Use limited to bearing and nonbearing citrus. Ground applications may be diluted with 50 gal of water. Do not allow spray solution to contact fruit, leaves, stems or bark. |

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|--|---|--|---|-----------------------------|---------------------------|--|
| Cotton | | | | | | |
| Preplant Ground | 6 lb/gal SC/L [50534-41] | 2 lb/A or 4.5 lb/90 gal [40 gal of finished spray/A] | 1 | NS | NS | A single preplant application may be made; diluted with 90 gal of water and applied at a 40 gal/A rate. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 6 lb/gal SC/L [50534-53] | 4.5 lb/90 gal | 1 | NS | NS | A single preplant application may be made; diluted with 90 gal of water. Application per acre rate was not specified. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| Preplant or postplant (up to cracking) Ground or aerial | 6 lb/gal SC/L [CA770095] [CA800077] [GA770008] [LA880008] [MO770005] [MS900025] [NC770018] [VA940002] | 2 lb/A or 2 lb/40 gal [40 gal of finished spray/A] | 1 | NS | NS | Use limited to CA, GA, LA, MO, MS, NC, and VA. A single preplant application may be made. Application may be made using ground equipment in a minimum of 40 gal of water/A or using aerial equipment in 5-10 gal of water/A. |
| | 6.6 lb/gal SC/L [LA880009] [MS900032] | 2.06 lb/A or 2.06 lb/40 gal [40 gal of finished spray/A] | 1 | NS | NS | Use limited to LA and MS. A single preplant application may be made. Application may be made using ground equipment in a minimum of 40 gal of water/A plus a suitable surfactant or using aerial equipment in 5-10 gal of water/A. |

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|---|--|--|-----------------------------------|---------------------------------|---|
| Cotton (continued) | | | | | | |
| Topical broadcast spray Ground or aerial | 6 lb/gal SC/L [CA770095] | 2 lb/A or 2 lb/40 gal [40 gal of finished spray/A] | 1 | NS | NS | Use limited to CA. A single application may be made when cotton plants are 3 to 6 inches high or up to early first square stage. Ground application may be diluted with 40 gal of water and applied at a 40 gal/A rate. Aerial application may be diluted in 5-10 gal of water and applied at a 5-10 gal/A rate. |
| | 6 lb/gal SC/L [CA770095] [CA800077] [GA770008] [LA880008] [MO770005] [MS900025] [NC770018] [SC770015] [VA940002] | 1 lb/A or 1 lb/40 gal [40 gal of finished spray/A] | 2 | NS | NS | Use limited to CA, GA, LA, MO, MS, NC, SC, and VA. Applications may be made when cotton plants are 3 to 6 inches high or up to early first square stage. A second application may be made one to three weeks after the first. Ground applications may be diluted with 40 gal of water and applied at a 40 gal/A rate. Aerial applications may be diluted in 5-10 gal of water and applied at a 5-10 gal/A rate. The feeding of livestock or grazing of treated areas is prohibited. |
| | 6.6 lb/gal SC/L [LA880009] [MS900032] | 1.03 lb/A or 1.03 lb/40 gal [40 gal of finished spray/A] | 2 | NS | NS | Use limited to LA and MS. Applications may be made when cotton plants are 3 to 6 inches high or up to early first square stage. A second application may be made one to three weeks after the first. Ground applications may be diluted with 40 gal of water plus a suitable surfactant and applied at a 40 gal/A rate. Aerial applications may be diluted in 5-10 gal of water and applied at a 5-10 gal/A rate. |

(continued, footnotes follow).

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|-------------------------------|--|--|-----------------------------------|---------------------------------|--|
| Cotton (continued) | | | | | | |
| Directed spray/band treatment Ground | 6 lb/gal SC/L [50534-41] | 2 lb/A or 4.5 lb/90 gal [40 gal of finished spray/A] | NS | NS | NS | If no preplant application is made, two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 90 gal of water and applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 6 lb/gal SC/L [50534-53] | 4.5 lb/90 gal | NS | NS | NS | Two banded directed spray applications may be made with a one to three week interval. For banded directed sprays, applications may be diluted with 90 gal of water. Application per acre rate was not specified. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

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(continued; footnotes follow).

| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|---|---|--|-----------------------------------|---------------------------------|---|
| Cotton (continued) | | | | | | |
| Directed spray/band treatment Ground | 6.6 lb/gal SC/L [42519-1] [50534-36] | 2.06 lb/A or 4.95 lb/100 gal [40 gal of finished spray/A] | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 100 gal of water plus 1-2 qt of a suitable surfactant. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 6.6 lb/gal SC/L [63239-13] [L-A.880009] [MS900032] | 2.06 lb/A or 2.06 lb/40 gal [40 gal of finished spray/A] | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 40 gal of water plus 1 pt of a suitable surfactant. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

(continued; footnotes follow).

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|---|--|--|-----------------------------------|---------------------------------|---|
| Cotton (continued) Directed spray/band treatment Ground | 4 lb/gal SC/L [50534-2] [50534-18] | 2 lb/A | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 40 gal of water. For directed sprays of the 8 lb/gal SC/L formulation, applications may be diluted with 40 gal of water plus 1-2 qt of a suitable surfactant and applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 6 lb/gal SC/L [42519-3] [50534-5] [50534-6] | 2 lb/A | 2 | NS | NS | |
| | 8 lb/gal SC/L [50534-31] | 2 lb/A or 2 lb/40 gal [40 gal of finished spray/A] | NS | NS | NS | |
| | 6 lb/gal SC/L [CA770095] [CA800077] [GA770008] [LA880008] [MO770005] [MS900025] [NC770018] [VA940002] | 2 lb/A or 2 lb/40 gal [40 gal of finished spray/A] | NS | NS | NS | Use limited to CA, GA, LA, MO, MS, NC, and VA. For directed sprays, applications may be diluted with 40 gal of water. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. |

(continued; footnotes follow).

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|--|---|--|-----------------------------------|---------------------------------|---|
| Cotton (continued) Directed spray/band treatment Ground | 4 lb/gal SC/L [50534-37] 8 lb/gal SC/L [50534-48] | 2 lb/A or 5 lb/100 gal [40 gal of finished spray/A] | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 100 gal of water applied at a 40 gal/A rate. For directed sprays of the 8 lb/gal SC/L formulation, applications may be diluted with 40 gal of water plus 1-2 qt of a suitable surfactant and applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 8 lb/gal SC/L [50534-54] | 5 lb/100 gal | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 100 gal of water plus 1-2 qt of a suitable surfactant; per acre rate is not specified. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

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(continued; footnotes follow).

| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|--|---|--|---|-----------------------------|---------------------------|---|
| Cotton (continued) | | | | | | |
| Directed spray/band treatment Ground | 6 lb/gal SC/L [50534-51] | 2 lb/A or 5.25 lb/100 gal [40 gal of finished spray/A] | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 100 gal of water applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 4 lb/gal SC/L [50534-44] 4 lb/gal EC [63239-1] | 2 lb/A or 2 lb/40 gal [40 gal of finished spray/A] | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 40 gal of water applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are six inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations |
|---|-------------------------------|--|--|-----------------------------------|---------------------------------|--|
| Cotton (continued) Directed spray/band treatment Ground | 6 lb/gal SC/L [63239-2] | 2 lb/A or 2 lb/40 gal [40 gal of finished spray/A] | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 40 gal of water applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 6 lb/gal SC/L [50534-43] | 2 lb/A or 6 lb/30 gal [10 gal of finished spray/A] | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 30 gal of water applied at a 10 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one qt of spray solution per inch of band width per acre. Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

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(continued; footnotes follow).

| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Pretarvest Interval, Days | Use Directions and Limitations |
|---|-------------------------------|--|--|-----------------------------------|---------------------------------|---|
| Cotton (continued) Directed spray/band treatment Ground | 55% SC/S [42519-12] | 1.87 lb/A or 4.675 lb/100 gal [40 gal of finished spray/A] | 2 | NS | NS | Applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. For directed sprays, applications may be diluted with 100 gal of water and applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| | 6.6 lb/gal SC/L [50534-16] | 2.475 lb/A | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 40 gal of water plus 1.5-2 qt of suitable surfactant. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Banded applications may be made when cotton plants are three inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|--|----------------------------|--|---|-----------------------------|---------------------------|--|
| Cotton (continued) | | | | | | |
| Directed spray/band treatment Ground | 6 lb/gal SC/L [50534-50] | 3 lb/A or 3 lb/40 gal [40 gal of finished spray/A] | 2 | NS | NS | Two directed spray applications may be made with a one to three week interval. For directed sprays, applications may be diluted with 40 gal of water applied at a 40 gal/A rate. For band applications in 40-inch rows, applications may be made at a rate of one gal of spray solution per inch of band width per acre. Applications may be made when cotton plants are six inches high until first bloom; application after first bloom is not recommended. The feeding of treated foliage to livestock or grazing of treated areas is prohibited. |
| Nonbearing Crops | | | | | | |
| Fruit and Nuts (including almond, walnut, grapefruit, lemon, lime, orange, tangerine, apple, cherries, peaches, pears, plums, and prunes) | | | | | | |
| Directed spray/spot treatment Ground | 6 lb/gal SC/L [42519-3] | 2 lb/100 gal | 3 | NS | NS | Use around trees or vines from which crops will be harvested within one year is prohibited. Directed applications may be made to the point of run-off. Do not allow spray solution to contact foliage, stems or bark of trees or vines. |
| Directed spray/spot treatment Ground | 6 lb/gal SC/L [50534-6] | 2 lb/100 gal [100 gal of finished spray/A] | 3 | NS | NS | Use around trees or vines from which crops will be harvested within one year is prohibited. For directed sprays, applications may be diluted with 100 gal of water and applied at a 100 gal/A rate. For directed sprays of the 8 lb/gal SC/L formulation, applications may be diluted with 100 gal of water plus 1-2 qt of a suitable surfactant and applied at a 100 gal/A rate. For spot treatments, applications may be diluted with 50 gal and applied to the point of run-off. Do not allow spray solution to contact foliage, stems or bark of trees or vines. The grazing of treated areas is prohibited. |

(continued; footnotes follow).

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| Site Application Timing Application Type Application Equipment | Formulation [EPA Reg. No.] | Maximum Single Application Rate, a.i. | Maximum Number of Applications Per Season | Maximum Seasonal Rate, a.i. | Preharvest Interval, Days | Use Directions and Limitations ¹ |
|---|--|--|---|-----------------------------|---------------------------|--|
| Fruit and Nuts (including almond, walnut, grapefruit, lemon, lime, orange, tangerine, apple, cherries, peaches, pears, plums, and prunes)(continued) | | | | | | |
| Directed spray Ground | 4 lb/gal SC/L [50534-37] 6 lb/gal SC/L [50534-41] | 4 lb/A or 2 lb/50 gal | 3 | NS | NS | Use around trees or vines from which crops will be harvested within one year is prohibited. Ground applications may be diluted with 50 gal of water and applied at a 50-100 gal/A rate. Do not allow spray solution to contact leaves, stems or bark. |
| Directed spray Ground | 6 lb/gal SC/L [50534-53] | 2 lb/50 gal | 3 | NS | NS | Use around trees or vines from which crops will be harvested within one year is prohibited. Ground applications may be diluted with 50 gal of water; per acre use rate was not specified. Do not allow spray solution to contact leaves, stems or bark. |
| Directed spray/spot treatment Ground | 55% SC/S [42519-12] | 4.675 lb/100 gal [100 gal of finished spray/A] | 3 | NS | NS | Use around trees or vines from which crops will be harvested within one year is prohibited. For directed sprays, applications may be diluted with 100 gal of water and applied at a 100 gal/A rate. For spot treatments, applications may be diluted with 50 gal and applied to the point of run-off. Do not allow spray solution to contact foliage, stems or bark of trees or vines. |
| Pecans | | | | | | |
| Directed spray Ground | 6 lb/gal SC/L [GA960005] | 2 lb/A or 2 lb/50 gal [50 gal of finished spray/A] | 3 | NS | NS | Use limited to GA. Use around trees from which crops will be harvested within one year is prohibited. Ground applications may be diluted with 50 gal of water and applied at a 50 gal/A rate. Do not allow spray solution to contact leaves, stems or bark. The grazing of treated areas is prohibited. |

The restricted entry interval (REI) for the 55%, 63%, and 81% SC/S and the 2.27, 2.32, 2.52, 3.6, 4, 4.53, 6, 6.6, 8 lb/gal SC/L (EPA Reg. Nos. 42519-1, 42519-3, 42519-6, 42519-7, 42519-12, 42519-15, 42519-16, 50534-2, 50534-3, 50534-5, 50534-6, 50534-15, 50534-16, 50534-18, 50534-27, 50534-36, 50534-38, 50534-41, 50534-42, 50534-44, 50534-48, 50534-52, 50534-53, 50534-54, 50534-158, 50534-186, 63239-1, 63239-2, 63239-4, 63239-13, 63239-14, 63239-16, and 63239-17) formulations is 12 hours.

¹ Formulation in terms of DSMA per se; based on molecular weights of 292.02629 g/mol for DSM/A hexahydrate and 183.93425 g/mol for DSM/A (mw weight ratio of 0.630).

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(continued; footnotes follow).

Table B. Residue Chemistry Science Assessments for Reregistration of MAA.

| GLN: Data Requirements | Current Tolerances, ppm [40 CFR §180.289(a)] | Must Additional Data Be Submitted? | References ¹ |
|--|--|------------------------------------|---|
| 860.1200: Directions for Use | N/A = Not Applicable | Yes ² | See Tables A1 and A2 |
| 860.1300: Plant Metabolism | N/A | No | 42216101 ³ , 42324401 ³ , 42391201 ³ , 43013401 ⁴ |
| 860.1300: Animal Metabolism | N/A | No | 42009701 ⁵ , 42009702 ⁵ , 42525001 ⁶ , 42525002 ⁶ |
| 860.1340: Residue Analytical Methods | | | |
| - Plant commodities | N/A | Yes ⁷ | 43279301 ⁸ , 43630101 ⁸ , 43630201 ⁸ , 43769101 ⁸ , 43802501 ⁸ , 44125501 ⁸ , 44825201 ⁹ |
| - Animal commodities | N/A | No | 43615901 ¹⁰ |
| 860.1360: Multiresidue Methods | N/A | No | |
| 860.1380: Storage Stability Data | | | |
| - Plant commodities | N/A | Yes ¹¹ | 43605901 ¹² , 43817101 ¹³ |
| - Animal commodities | N/A | No | |
| 860.1500: Crop Field Trials | | | |
| <u>Citrus Fruits (<i>Citrus spp.</i> and <i>Fortunella spp.</i>) Group</u> | 0.35 | Yes ¹⁴ | 43605901 ¹² , 43683101 ¹² |

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| GLN: Data Requirements | Current Tolerances, ppm [40 CFR §180.289(a)] | Must Additional Data Be Submitted? | References ¹ |
|---|--|------------------------------------|--|
| <u>Miscellaneous Commodities</u> | | | |
| - Cotton, seed and gin byproducts | 0.7, seed | Yes ¹⁵ | 43720701 ⁸ , 43817101 ¹³ |
| 860.1520: Processed Food/Feed | | | |
| - Citrus | None established | No | 44195901 ¹⁶ , 43803701 ⁸ |
| - Cottonseed | 0.9, hulls | No | 43959801 ⁸ |
| 860.1480: Meat, Milk, Poultry, Eggs | | | |
| - Milk and the Fat, Meat, and Meat Byproducts of Cattle, Goats, Hogs, Horses, and Sheep | None established | No | |
| - Eggs and the Fat, Meat, and Meat Byproducts of Poultry | None established | No | |
| 860.1400: Water, Fish, and Irrigated Crops | N/A | No | |
| 860.1460: Food Handling | N/A | No | |
| 860.1850: Confined Rotational Crops | N/A | No | 43326101 ¹⁷ |
| 860.1900: Field Rotational Crops | None established | Yes ¹⁸ | |

1. References were reviewed as noted. No references were reviewed in the MAA Phase 4 Review.

2. Label amendments are required to incorporate the parameters of use patterns reflected in the submitted field trials. Details of the required label amendments are presented in the respective endnotes for citrus fruits and cotton under GLN 860.1500 (Crop Field Trials).

~~2~~

3. CBRS Nos. 9525, 9942, and 10245, DP Barcodes D175070, D178793, and D180717, 5/28/93, C. Swartz.
4. CBRS No. 12891, DP Barcode D197117, 5/18/94, C. Swartz.
5. CBRS No. 8647, DP Barcode D168990, 4/7/92, C. Olinger.
6. CBRS No. 10836, DP Barcode D184346, 1/24/95, C. Swartz.
7. Because the enforcement methods listed in PAM Volume II are colorimetric methods, the Agency recommends that an existing GC/ECD data-collection method be proposed as an enforcement method. The registrant is referred to OPPTS 860.1340 for specific requirements concerning regulatory methods. OPPTS 860.1340 requires that any proposed enforcement method be subjected to an independent laboratory validation (ILV) as per PR Notice 96-1. If the Agency determines that the registrant has submitted the results of a successful ILV trial by an independent laboratory, then the method will be validated by Agency chemists.
8. DP Barcodes D205012, D205663, D214330, D215133, D217721, D219102, D219963, D220073, D224764, D230542, and D232748; 7/20/00; S. Kinard.
9. DP Barcode D256117, 7/20/00; S. Kinard.
10. DP Barcode D214494, 6/6/96, C. Swartz.
11. No storage stability data are available to support the storage conditions and intervals of samples collected from the citrus and cottons processing studies which were stored frozen for maximums of 15 and 9 months, respectively, prior to residue analysis. The registrants are required to submit data investigating the frozen storage stability of residues of MSMA and cacodylic acid in the processed fractions of citrus fruit (dried pulp, oil, and juice) and cottonseed (meal, hulls, and refined oil) at the maximum storage intervals.
12. DP Barcodes D214330 and D216740, 7/12/00, S. Kinard.
13. DP Barcode D220374, 7/20/00, S. Kinard.
14. The Agency requires confirmatory residue decline data to determine whether residues of MSMA and cacodylic acid are taken up by plants at longer PHIs. A total of 9 residue decline trials on oranges (3 trials), lemon (3 trials), and grapefruit (3 trials) should be conducted in major citrus growing regions. Representative DSMA and MSMA formulations should be tested side-by-side in each trial site. Label revisions are required to reflect the parameters of use patterns for which adequate residue data are available. All DSMA formulations with use claims on citrus fruits should be amended to specify a maximum single application rate of 4.9 lb ai/A, a maximum of three applications per growing season or a maximum seasonal rate of 14.7 lb ai/A, and a 0-day PHI. Similarly, all MSMA formulations should be amended to specify a maximum single application rate of 4.0 lb ai/A, a maximum of three applications per growing season or a maximum seasonal rate of 12.0 lb ai/A, and a 0-day PHI.
15. The Agency is requiring confirmatory field trial data on undelinted cottonseed. Residue data are also required for cotton gin byproducts (commonly called gin trash which include the plant residues from the ginning of cotton and consist of burrs, leaves, stems, lint, immature seeds, and sand and/or dirt). A total of

9 field trials should be conducted in major cotton growing regions using representative DSMA and MSMA formulations tested side-by-side in each trial site. For the generation of residue data on cotton gin by products, cotton must be harvested by commercial equipment (stripper and mechanical picker) to provide an adequate representation of plant residues for the ginning process. Residue data must be submitted for each type of harvesting equipment.

Label revisions are required for cotton. All DSMA and MSMA formulations with use claims on cotton should be amended to reflect maximum seasonal rates of either (i) 4 lb ai/A when uses include two directed spray applications at 2 lb ai/A/application or (ii) 3 lb ai/A when uses include a single topical application at 1 lb ai/A followed by a directed spray application at 2 lb ai/A. Because a PHI has not been established for cottonseed, the registrant should propose a PHI; the interim data suggest that a 71-day PHI would be appropriate.

16. DP Barcode D232748, 7/17/00, S. Kinard.
17. CBRS No. 14258, DP Barcode D206872, 2/20/97, C. Swartz.
18. Limited field trials should be conducted on a representative crop at two sites per crop for three crop groups –root and tuber vegetables, leafy vegetables, and small grains. Since the possibility of rotational crop residues in peanuts has been identified in conjunction with a misuse of MSMA on peanuts grown in GA, the Agency recommends the limited field trials substitute peanuts for small grains.

TOLERANCE REASSESSMENT SUMMARY

Tolerances are established under 40 CFR §180.289(a) for residues of the herbicide methanearsonic acid (calculated as As_2O_3) from application of the disodium and monosodium salts of methanearsonic acid in/on citrus fruit at 0.35 ppm, cottonseed at 0.7 ppm, and cottonseed hulls at 0.9 ppm.

The qualitative nature of the residue in plants is adequately understood based on acceptable metabolism studies on citrus and cotton. The HED Metabolism Committee (C. Swartz memo of 1/25/95) concluded that the residues of concern associated with the use of MSMA and DSMA are MSMA *per se* and cacodylic acid expressed as As_2O_3 . The phrase "calculated as As_2O_3 " in 40 CFR §180.289(a) should be replaced with "expressed as As_2O_3 ."

The qualitative nature of the residue in animals is adequately understood based on acceptable ruminant and poultry metabolism studies. The HED Metabolism Committee (C. Swartz memo of 1/25/95) concluded tolerances in meat, milk, poultry, and eggs need not be established. There is no reasonable expectation of detectable MSMA residues of concern in animal commodities as a result of registered uses [Category 3 of CFR §180.6(a)].

A summary of tolerance reassessments for methanearsonic acid is presented in Table C.

Tolerances Listed Under 40 CFR §180.289(a):

Citrus fruit: The interim field trial data for citrus fruit indicate that residues of MSMA were below the analytical method's LOQ of 0.05 ppm in/on mature fruits harvested at 0-day PHI following the last of three applications of DSMA and MSMA formulations at 4.9 lb ai/A/application and 4.0 lb ai/A/application, respectively; citrus fruit samples from treated areas bore nondetectable (<0.05 ppm) residues of cacodylic acid except for three samples.

For tolerance reassessment, residues of MSMA and cacodylic acid are to be converted to As_2O_3 equivalents (and expressed as As_2O_3) based on molecular weight ratios. The conversion factor for MSMA to As_2O_3 equivalents is 0.8, and the conversion factor for cacodylic acid to As_2O_3 equivalents is 0.7.

The orange residue data conducted in Sanger, CA resulted in the highest residues of cacodylic acid (0.11 ppm) in/on citrus fruits; residues of MSMA in/on the same orange sample was nondetectable (<0.05 ppm). When individual residues of MSMA and cacodylic acid are converted to As_2O_3 equivalents using the above conversion factors, the combined residues (expressed as As_2O_3 equivalents) are <0.12 ppm which is below the established group tolerance of 0.35 ppm for citrus fruit. Pending submission of confirmatory residue decline data (to

determine whether residues of MSMA and cacodylic acid are taken up by plants at longer PHIs) and label revisions, the tolerance for citrus fruit is reassessed at 0.2 ppm on an interim basis.

Cottonseed: The RAC that was analyzed in the submitted cotton field study was delinted cottonseed as opposed to undelinted cottonseed as per Table 1 (OPPTS 860.1000). The adequacy of the established 0.7 ppm tolerance level for cottonseed will be reassessed when the requested confirmatory data for undelinted cottonseed have been received and evaluated. Label revisions are required to reflect the parameters of use patterns the registrants wish to support for cotton.

Cotton hulls: The available cottonseed processing study indicates that the combined residues of MSMA and cacodylic acid concentrated 2.2-2.5x in hulls. The adequacy of the established 0.9 ppm tolerance level for cotton hulls cannot be reassessed at this time since the highest average field trial (HAFT) residue in/on the RAC (undelinted cottonseed) will be determined when the requested confirmatory field data have been submitted and evaluated.

Tolerances to be Proposed Under 40 CFR §180.289(a):

Citrus dried pulp: The available orange processing study indicates that the combined residues of MSMA and cacodylic acid concentrated 3.4x in dried pulp. The results of the orange processing study tentatively suggest that a tolerance for the combined residues of MSMA and cacodylic acid (expressed as As_2O_3) in citrus dried pulp may be needed. A regulatory conclusion concerning the real need for a tolerance on citrus dried pulp will be made when the HAFT residue in/on the RAC has been determined from the requested confirmatory field study.

Cotton gin byproducts: As a result of a September 1996 Agency revision to the residue chemistry test guidelines, cotton gin byproducts was added as a recognized raw agricultural commodity of cotton. Therefore, a tolerance for the combined residues of MSMA and cacodylic acid (expressed as As_2O_3 equivalents) should be proposed once acceptable residue data become available.

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Table C. Tolerance Reassessment Summary for Methanearsonic Acid.

| Commodity | Established Tolerance, ppm | Reassessed Tolerance, ppm | Comments [Correct Commodity Definition] |
|---|----------------------------|---------------------------|---|
| Tolerances Listed Under 40 CFR §180.289(a) | | | |
| Citrus fruit | 0.35 | 0.2 | A tentative reassessment. Submission of confirmatory residue decline data and label revisions are required. |
| Cottonseed | 0.7 | TBD ¹ | The established tolerance will be reassessed when the requested confirmatory field trial data on undelinted cottonseed have been received and evaluated. Label revisions are required to reflect the parameters of use patterns the registrants wish to support. [Cotton, undelinted seed] |
| Cottonseed hulls | 0.9 | TBD | The established tolerance will be reassessed when the HAFT residue in/on the RAC (undelinted cottonseed) has been determined from the requested confirmatory field study. [Cotton, hulls] |
| Tolerances To Be Proposed Under 40 CFR §180.289(a) | | | |
| Citrus, pulp, dried | None | TBD | A regulatory conclusion concerning the real need for a tolerance on citrus dried pulp will be made when the HAFT residue in/on the RAC has been determined from the requested confirmatory field study. |
| Cotton, gin byproducts | None | TBD | Residue data are required. |

¹ TBD = To be determined. Residue data remain outstanding.

CODEX HARMONIZATION

There are no established Codex MRLs for MAA. Therefore, issues of Codex harmonization do not exist.

DIETARY EXPOSURE ASSESSMENT

No monitoring data for residues of MAA or cacodylic acid *per se* are available from FDA and USDA. The available monitoring data on total arsenic (as As₂O₃) from the FDA Total Diet Study (Market Baskets 91-3 through 97-1) are limited for the food/food-forms of concern here and are likely to significantly overestimate dietary exposure from MAA or cacodylic acid resulting from the supported use rates of DSMA/MSMA since they include residues of arsenic from all potential sources including background. Hence, all anticipated residue estimates should be based on available field trial data for DSMA/MSMA incorporating percent of crop treated as appropriate. Anticipated residue estimates should be provided for all citrus commodities as well as cotton commodities. The available animal metabolism and magnitude of the residue data demonstrate that there is no reasonable expectation of finite residues of MAA or cacodylic acid in tissues of poultry and swine from the feed stuffs derived from raw agricultural commodities treated with DSMA/MSMA (40 CFR §180.289(a)).

AGENCY MEMORANDA RELEVANT TO REREGISTRATION

DP Barcode: None
Subject: Meeting with Registrants of Cacodylic Acid, MSMA, and DSMA.
From: S. Funk
To: CBRS File
Dated: 12/10/91
MRID(s): None

CBRS No. 8998
DP Barcode: D171625
Subject: Reregistration of Monosodium Methanearsonate. ISK-Biotech Corp.
Response to Phase 4 Review of Residue Chemistry; Waiver Request.
From: S. Funk
To: B. Crompton
Dated: 1/13/92
MRID(s): None

CBRS No. 8810
DP Barcode: D170296
Subject: Reregistration of Disodium Methanearsonate. Luxembourg-Pamol, Inc.
Response to Phase 4 Review of Residue Chemistry.
From: S. Funk
To: B. Crompton
Dated: 1/13/92
MRID(s): 41982001, 41976201, and 41976202

CBRS No. 8647
DP Barcode: D168990
Subject: Methanearsonate (MSMA/DSMA) Livestock Metabolism Studies;
Chemical No. 13803; Case No. 2395.
From: C. Olinger
To: B. Crompton/B. Briscoe
Dated: 4/7/92
MRID(s): 42009701 and 42009702
CBRS No. None
DP Barcode: None
Subject: Monosodium methanearsonate (MSMA). Issues to be Presented to the
Metabolism Committee on June 8, 1992.
From: C. Swartz
To: The HED Metabolism Committee
Dated: 6/3/92
MRID(s): None

CBRS No. None
DP Barcode: None
Subject: Monosodium Methanearsonate (MSMA). Outcome of the 6/8/92 Meeting of the HED Metabolism Committee.
From: C. Swartz
To: The HED Metabolism Committee
Dated: 6/19/92
MRID(s): None

CBRS No. None
DP Barcode: None
Subject: Required Number of Field Trials for Citrus Crop Group Tolerance for MSMA and DSMA
From: M. Metzger
To: CB Files
Dated: 3/8/93
MRID(s): None

CBRS Nos. 9525, 9942, and 10245
DP Barcodes: D175070, D178793, and D180717
Subject: Monosodium methanearsonate (MSMA). List B Reregistration Case No. 2395. Metabolism Studies in Cotton and Citrus (Lemon).
From: C. Swartz
To: B. Briscoe
Dated: 5/28/93
MRID(s): 42216100, 42216101, 42324400, 42324401, 42391200, and 42391201

CBRS No. 12891
DP Barcode: D197117
Subject: Monosodium Methanearsonate (MSMA). List B Reregistration Case No. 2395/Chemical ID No. 013803. Submission to Upgrade the Cotton Metabolism Study.
From: C. Swartz
To: T. Myers
Dated: 5/18/94
MRID(s): 43013401

CBRS No. None
DP Barcode: None
Subject: Monosodium methanearsonate (MSMA); Disodium methanearsonate (DSMA); Cacodylic acid (CA). Issues to be presented at the 12/19/94 meeting of the HED Metabolism Committee.
From: C. Swartz and B. Cropp-Kohlligian
To: HED Metabolism Committee
Dated: 12/8/94
MRID(s): None

CBRS No. 13945
DP Barcode: D204932
Subject: Monosodium methanearsonate (MSMA). List B Reregistration Case No. 2395/Chemical ID No. 013803. MAA Task Force Submission of Protocols for Ruminant and Poultry Feeding Studies.
From: C. Swartz
To: V. Dietrich/R. Kendall
Dated: 1/24/95
MRID(s): None

CBRS No. 10836
DP Barcode: D184346
Subject: Monosodium methanearsonate (MSMA). List B Reregistration Case No. 2395/Chemical ID No. 013803. MAA Task Force Submission to Upgrade Ruminant and Poultry Metabolism Studies [GLN 171-4(b)].
From: C. Swartz
To: B. Briscoe
Dated: 1/24/95
MRID(s): 42525001 and 42525002 CBRS No. None
DP Barcode: None
Subject: Monosodium methanearsonate (MSMA); Disodium methanearsonate (DSMA); Cacodylic acid (CA). Outcome of the 12/19/94 meeting of the HED Metabolism Committee.
From: C. Swartz and B. Cropp-Kohlligian
To: HED Metabolism Committee
Dated: 1/26/95
MRID(s): None

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CBRS No. 15487
DP Barcode: D214494
Subject: Monosodium methanearsonate (MSMA). List B Reregistration Case No. 2395. Guideline Ref. No. 171-4(d): Analytical methods for MSMA and cacodylic acid in beef (fat, liver, muscle and kidney) and milk.
From: C. Swartz
To: M. Wilhite
Dated: 6/6/96
MRID(s): 43615901

CBRS No. None
DP Barcode: D229937
Subject: ID# GA960005 Special Local Need (Section 24(c)) Registration for the Use of MSMA (Methanearsonic Acid and Salts) in/on Non-bearing Pecan Orchards in the State of Georgia.
From: C. Lewis, J. Morales, and S. Williams-Foy
To: C. Giles-Parker/J. Bazuin
Dated: 10/17/96
MRID(s): None

CBRS No. 14258
DP Barcode: D206872
Subject: Monosodium methanearsonate (MSMA). List B Reregistration Case No. 2395/Chemical ID No. 013803. MAA Task Force Submission of a Confined Rotational Crop Study [GRN 860.1850].
From: C. Swartz
To: T. Myers
Dated: 2/20/97
MRID(s): 443326101
CBRS No. None
DP Barcode: D240863
Subject: Monosodium methanearsonate (MSMA). List B Reregistration Case No. 2395/Chemical ID No. 013803. Requirement for Limited Field Rotational Crop Studies.
From: C. Swartz
To: J. Housenger and D. McNeilly
Dated: 11/18/97
MRID(s): None

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CBRS No. None
DP Barcode: D242329
Subject: Monosodium methanearsonate (MSMA). Interim Human Health Risk Assessment/Determination of Safety for Potential Inadvertent Residues in the Rotational Crop Peanuts. Chemical ID No. 013803/Reregistration Case No. 2395.
From: C. Swartz
To: J. Housenger
Dated: 1/21/98
MRID(s): None

CBRS No. None
DP Barcode: D232748
Subject: [Disodium methanearsonate (DSMA). List B Reregistration Case No. 2395/Chemical ID No. 013802. Citrus Processing Study].
From: S. Kinard
To: Tom Myer
Dated: 7/17/00
MRID(s): 44195901
CBRS No. None
DP Barcodes: D205012, D205663, D214330, D215133, D217721, D219102, D219963, D220073, D224764, D230542, and D232748
Subject: [Monosodium methanearsonate (MSMA). List B Reregistration Case No. 2395/Chemical ID No. 013803. Analytical Methods for Quantitation of Residues of MSMA and its Metabolite Cacodylic Acid in/on Cottonseed and Oranges; Magnitude of the Residue in/on Cottonseed and Oranges; and Magnitude of the Residue in the Processed Commodities of Cottonseed].
From: S. Kinard
To: Tom Myer
Dated: 7/20/00
MRID(s): 43279301, 43630101, 43630201, 43720701, 43769101, 43802501, 43803701, 43959801, and 44125501

CBRS No. None
DP Barcode: D256117
Subject: [Monosodium methanearsonate (MSMA). List B Reregistration Case No. 2395/Chemical ID No. 013803. Analytical Methods (Radiovalidation in Cottonseed)].
From: S. Kinard
To: Tom Myer
Dated: 7/20/00
MRID(s): 44825201

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CBRS No. None
DP Barcode: D220374
Subject: [Disodium methanearsonate (DSMA). List B Reregistration Case No. 2395/Chemical ID No. 013802. Magnitude of the Residue in Cotton].
From: S. Kinard
To: Tom Myer
Dated: 7/20/00
MRID(s): 43817101

CBRS Nos. 15435 and 15796
DP Barcodes: D214330 and D216740
Subject: [Disodium methanearsonate (DSMA)/Monosodium methanearsonate (MSMA). List B Reregistration Case No. 2395/Chemical ID Nos. 013802 and 013803. Magnitude of the Residue in Citrus].
From: S. Kinard
To: Tom Myer
Dated: 7/12/00
MRID(s): 43605901 and 43683101

MASTER RECORD IDENTIFICATION NUMBERS

References Used To Support Reregistration

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43013401 O'Neal, S.; Johnson, T. (1992) Metabolic Fate and Distribution of (carbon 14)-Monosodium Methanearsonate in Cotton and Citrus: Supplemental Report to MRID No. 42216101 (Cotton) and MRID No. 42324401 (Citrus): Lab Project Number: 1388: 1414: 468.

43279301 Howard, J. (1994) Analytical Method for Residues of Monosodium Methanearsonate and its Metabolite (Cacodylic Acid) in Citrus: Lab Project Number: 746: 1595. Unpublished study prepared by PTRL East, Inc. 42 p.

43326101 O'Neal, S. (1994) A Confined Rotational Crop Study with ¹⁴C-Monosodium Methanearsonate (MSMA) Using Carrots (*Daucus carota*), Lettuce (*Lactuca sativa*) and Barley (*Hordeum vulgare*). Laboratory Project ID:PTRL Project No. 603, PTRL Report No. 1546. Unpublished study prepared by Chemical Consultants International, Inc. for the MAA Task Force. 184 p.

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44195901 Johnson, T. (1996) Disodium Methanearsonate: Field Crop Residue Trials for DSMA on Citrus (Processed Commodities): Final Report: Lab Project Number: 769: 1856: 769-21. Unpublished study prepared by PTRL East, Inc. 221 p.

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