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# **PEST MANAGEMENT REGULATORY AGENCY**

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## **RESIDUE CHEMISTRY GUIDELINES**

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### **SECTION 10**

#### **PROCESSED FOOD/FEED**

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## 10.1 Preface

This Guideline describes the scientific data requirements of the *Food and Drugs Act and Regulations* (FDAR) and the *Pest Control Products Act and Regulations* (PCPAR).

## 10.2 Introduction

Processing studies are required to determine whether residues in raw commodities may be expected to degrade, reduce or concentrate during food processing. If residues do concentrate in a processed commodity, a maximum residue limit (MRL) may be established. However, if residues do not concentrate in processed commodities, the MRL for the raw agricultural commodity (RAC) itself applies to all processed food derived from it. If residues concentrate in a processed commodity that is an animal feed, data on the transfer of residues to meat, milk, poultry, and eggs are required as outlined in Section 8, *Meat/Milk/Poultry/Eggs*, and in Section 11, *Proposed MRLs*.

## 10.3 Concentration of residues on processing

- i) Whenever there is a possibility of residue levels in processed foods exceeding the level in a RAC, processing data are required. Examples of processed foods in which residues may concentrate are apple juice and apple pomace; canola meal, crude and refined oil; or sugar dried pulp and molasses from sugar beet roots. A list of processed byproducts is contained in Table I, Section 8, *Meat/Milk/Poultry/Eggs*.
- ii) Processing studies should simulate commercial practices as closely as possible. RAC samples used in processing studies should contain field-treated, quantifiable residues, preferably at or near the proposed MRL, so that concentration factors for the various byproducts can be determined. As discussed in subsection 10.6.3 of this section, this may require field treatment at exaggerated application rates to obtain sufficient residue levels for processing studies. Processing studies utilizing spiked samples are not acceptable, unless it can be demonstrated that the RAC residue consists entirely of a surface residue.
- iii) Only one processing study is required for each crop, in Table I of Section 8, *Meat/Milk/Poultry/Eggs*, having a processed commodity. However, it is advisable to have multiple samples of the RAC and processed commodities in the study. As stated in subsection 10.6.2 of this section, if multiple processing studies are available for a given crop, the Pest Management Regulatory Agency (PMRA) may use the average concentration factor obtained across these studies. In some cases, the requirement for a processing study may be waived based on field trial data for the RAC reflecting exaggerated application rates. This is discussed in more detail in subsection 10.6.3 of this Guideline.

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- iv) The residue of concern (ROC) should be measured in the RAC at the time processing is initiated and in all processed commodities of the crop listed in Table I of Section 8, *Meat/Milk/Poultry/Eggs*. With the exception of the small grains, the Agency will not normally translate data between crops. In the case of small grains, a processing study on wheat satisfies the requirement for studies on barley, buckwheat, millet, oats and rye if the pesticide is applied to all these crops in a similar manner and comparable residue levels occur in the grains.
  - v) Unless the processed commodities are analyzed within thirty days of their production, data demonstrating the stability of residues in representative, processed commodities during storage are required as described in Section 5, *Storage Stability*.
  - vi) If the processing of the RAC may result in alteration of the residue, then a radiolabeled processing study to determine the nature of the residue in food, as it is consumed, may be needed. If significant alteration of the residue occurs, and the additional residue components are of toxicological concern, then the MRL should include the additional residue component(s).

#### **10.4 Reduction of the residue level on processing**

In those cases where the residues occurring in processed commodities result in unacceptable exposure, then the petitioner has the option of submitting data on food prepared for consumption. The Agency will take into account data on washing, trimming, cooking, peeling or processing to the extent that these procedures are used on specific commodities. Although the lower levels of residues resulting from such processes may be used in the risk assessment, the MRL will still be set on the commodity at harvest. Of course, if these data indicate that residues concentrate in some fractions while decreasing in others, both the higher and lower residue levels will be used in the risk assessment. The Agency will also take into account the wide variation in techniques used to prepare food. For example, if cooking completely destroys the residue on a vegetable, the Agency will use, at a maximum, the limit of quantitation (LOQ) in the cooking study as the residue level for cooked vegetables. The Agency will also use the consumption of uncooked vegetables and the MRL to estimate the exposure from uncooked vegetables. As noted above, if significant alteration in the nature of the residue could occur on processing, then a radiolabeled study may be needed to determine the nature of the residue following processing.

#### **10.5 Maximum theoretical concentration factors**

This section addresses maximum theoretical concentration factors for use in determination of the exaggerated application rate that is needed for field trials on commodities that can be processed. The use of exaggerated rate studies is discussed in more detail in section 10.6.3 of this Guideline. Table I of Appendix A (this Guideline) provides a listing of maximum theoretical

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concentration factors. A secondary use of this list could be for worst case dietary exposure assessment when experimental processing data are unavailable.

Table I of Appendix A is not all inclusive since factors are not available for all processed commodities listed in Table I of Section 8, *Meat/Milk/Poultry/Eggs*. In addition, some processed commodities may have greater potential for concentration than those processed commodities for which factors were calculated. For those commodities for which the Agency expects higher concentration, the Agency has tabulated some experimental concentration factors by comparing residues resulting from processing studies to the established MRLs for the RAC. Additional factors may be added or updated in the future as further information becomes available.

There are two types of processes for which maximum theoretical concentration factors can easily be calculated. The first type is where the concentration is based on the loss of water during processing. In this case, the theoretical concentration factor is the ratio of the percent of dry matter (DM) in the processed commodity to the percent of DM in the RAC. For example, grapes contain 18% DM and raisins contain 85% DM. The theoretical concentration factor for the processing of grapes into raisins is 85/18 or 4.7X. The second type of process is that in which a RAC is separated into components, such as the processing of corn grain into corn oil. In this case, the theoretical concentration factor is 100% divided by the percentage of the processed commodity in the raw commodity. Corn grain may contain as little as 4% corn oil. The theoretical concentration factor for processing of corn into oil then is 100/4, or 25X.

To determine the theoretical concentration factors, the Agency examined a number of reference sources for the percent of DM in a commodity (or the percent of water), and the composition of raw commodities. In looking for these percentages, the Agency searched for the percentage that would yield the highest theoretical concentration factor. So, for percent of DM, the Agency looked for the highest percent of DM in the processed commodity, and the lowest percent of DM in the raw commodity. For the composition of raw commodities, the Agency looked for the lowest percentage of the processed commodity in the raw commodity. Where a crop had multiple processed fractions, only the fraction having the highest maximum theoretical concentration factor is listed in Table 1 of Appendix A. In some cases, only typical yields were available for a particular RAC, especially for the grains. A factor was still calculated, but may not actually be the maximum theoretical concentration factor. A bibliography and three tables showing how the factors were determined are included in Appendix A. Table 2 shows calculations for those commodities where concentration is based on loss of water. Table 3 shows calculations for those commodities where concentration is based on separation into components. Table 4 is a tabulation of experimentally determined factors that were obtained by comparing residues resulting from processing studies to the established MRLs for the RAC.

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## **10.6 Determining the need for food/feed guideline MRLs**

### **10.6.1 RAC Residue Value.**

The Agency will consider using an average residue value from field trials if it can be determined that there is sufficient mixing during processing, such that variation among individual samples from a field will be substantially evened out. The most relevant average residue value from crop field trials is the highest average residue value from the series of individual field trials. This value is sometimes referred to as the HAFT (highest average field trial). Other average values, e.g., average of all field trials, may be considered if the circumstances involved in processing of the crop warrant it. An example would be where processing is likely to involve blending of crop from across a regional or national market.

As a result of the above Agency policy, it is necessary to determine the HAFT for each RAC for which a processing study has shown concentration of residues. For each field trial reflecting the maximum residue, (i.e., maximum number and rate of application, and minimum preharvest interval [PHI]), considered acceptable for determining a maximum residue limit (i.e., values discarded for reasons such as contamination should not be included), residue values for all samples at that site reflecting that use should be averaged. Note that if residues were corrected for low method recoveries or for losses during storage in order to determine the MRL, the corrected values should also be used in this exercise. The highest such average value is the HAFT and is to be used to calculate the maximum expected residue in processed commodities. For field trials in which only one sample per site reflects the maximum residue use, no averaging can be done, and the highest individual residue value becomes the HAFT.

### **10.6.2 Multiple Processing Studies.**

Whenever more than one processing study has been conducted for a particular pesticide on a given RAC, excluding acutely toxic compounds, the average concentration factor should be used for each processed commodity when determining a MRL. Similarly, if multiple samples or subsamples are analyzed within a processing study, the average residue value should be used for each commodity as opposed to using the lowest value from the RAC samples and the highest value for the processed fraction samples, which would result in the highest concentration factors. If only one processing study has been conducted and the theoretical concentration factor has been exceeded, the MRL, if applicable, should be based on the factor, if available, listed in Appendix A.

As stated in subsection 10.3.2, processing studies should reflect actual commercial practices. If several studies are available and one does not include a step that is routinely used in the processing of that RAC, e.g., washing, it may be inappropriate to include that study in the calculation of the average concentration factor.

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### 10.6.3 Use of Exaggerated Rate Studies.

The Agency encourages the use of field trials with exaggerated application rates in cases where residues near or below the analytical method's LOQ are expected in the RAC from the maximum registered rate (1x). Processing studies should use RAC samples that contain quantifiable residues.

For uses that result in quantifiable residues in the RAC from the registered application rate, exaggerated rate applications are not needed to generate RAC samples for processing if all field trials lead to residues well above the LOQ. However, if residues below or near the LOQ are observed in some field trials, it is advisable for an exaggerated application rate to be used to generate RAC samples for the processing study. Regardless of whether exaggerated application rates are used, if a proposed MRL is based on the presence of quantifiable residues, and a concentration of residues is observed in a processed commodity, that concentration factor will be used in conjunction with the HAFT or other applicable average value and other relevant factors, e.g., variability of the analytical method, to determine the need for a MRL.

In other words, the concentration factor will *not* be adjusted for the use of exaggerated rates in cases where quantifiable residues are observed in the RAC from the registered use.

In those cases where all RAC samples from the field trials show residues below the LOQ and the residue data cover all significant growing regions for the crop as delineated in Section 9, *Crop Field Trials*, it may be possible to waive the processing study based on the results of field trials conducted at exaggerated application rates. If exaggerated rate data are available and these field trials result in no quantifiable residues in the RAC, then no processing study is required, provided that the rate was exaggerated by at least the highest theoretical concentration factor (Appendix A) among all the processed commodities derived from that crop, *or* 5X, whichever is less.

If no quantifiable residues are found in the RAC from the maximum registered rate, but the exaggerated rate does produce quantifiable residues, the latter samples should be processed, and residues should be measured in the appropriate commodities. Any residues still above the LOQ in the processed commodities should be adjusted for the degree of exaggeration. These adjusted residues should then be compared to the LOQ for the RAC.

One additional scenario needs to be discussed, regarding use of exaggerated rates. In some cases, no quantifiable residues may be found in the RAC, but the exaggerated rate is less than the maximum theoretical concentration factor, or 5x, whichever is less, due to phytotoxicity limitations. In these instances, a decision will be made case-by-case as to the need for a processing study. If a processing study is deemed necessary, any quantifiable residues in processed fractions would be adjusted for the degree of exaggeration as explained in the

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previous paragraph. Some of the factors to consider when determining if the processing study is needed include how close the degree of exaggeration comes to the theoretical factor, or 5x, whichever is less, and whether detectable residues, i.e., greater than limit of detection but <LOQ, are found in any RAC samples. Another consideration would be whether the pesticide is likely to be present on a specific portion of the RAC based on when it is applied and/or its ability to translocate. For example, a pesticide applied late in the growing season would be more likely to be on the surface of a fruit and have greater potential to concentrate in pomace than one applied only at the bloom stage or earlier.

## **10.7 Data report format**

Submitted studies will be screened for completeness before being accepted for evaluation. Study-specific screening forms are available on the PMRA web site or may be obtained upon request from the PMRA.

The following describes the order and format for a study report:

### **10.7.1 Title/Cover Page.**

Title page and additional documentation requirements, i.e., requirements for data submission and procedures for claims of confidentiality of data, if relevant to the study report, should precede the content of the study formatted below.

### **10.7.2 Table of Contents.**

### **10.7.3 Summary/Introduction.**

### **10.7.4 Materials.**

- i) Test substance.
  - A) Identification of the pesticide formulated product used in the field trial from which the RAC used in the processing study was derived, including the active ingredient (ai) therein, or if spiked RAC samples were used in the processing study, identity of the spiking substance(s).
  - B) Identification and amount of residue(s) in experimentally treated RAC samples at the time that the processing study is initiated.
  - C) Other, constituting any and all additional information that the petitioner considers appropriate and relevant to provide a complete and thorough description and identification of the test substance(s) used in the processing study.

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- ii) Test commodity.
    - A) Identification of the RACs, i.e., crop/type/variety; and the specific crop part(s) used in the processing study.
    - B) Sample identification, i.e., source of sample(s); field trial identification number; control or weathered residue sample; and coding and labeling information that should be the same as, or cross-referenced to, the sample coding/labeling assigned at harvest.
    - C) Treatment histories, i.e., pesticide(s) used, rate(s), number of applications, PHIs, etc., of the RAC samples used in the processing study.
    - D) The developmental stage(s); general condition, e.g., immature/mature, green/ripe, fresh/dry, etc.; and size(s) of the RAC samples used in the processing study.
    - E) Other, constituting any and all additional information that the petitioner considers appropriate and relevant to provide a complete and thorough description of the RACs used in the processing study.

#### **10.7.5 Methods.**

- i) Experimental design. For example:
  - A) Number of test/control samples.
  - B) Number of replicates.
  - C) Residue levels in the RACs to be used.
  - D) Representativeness of test commodities to the matrices of concern, etc.
- ii) Test procedures.
  - A) Spiking procedure, if used. Detail the manner in which the test compound(s) were introduced to the RACs.
  - B) A description of the processing procedure used, and how closely it simulates commercial practice. Quantities of starting RAC and of resulting processed commodities.



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- C) A description of the methods of residue analysis. See Section 3, *Residue Analytical Method*.
  - D) A description of the means of validating the method(s) of residue analysis. See Section 3, *Residue Analytical Method*.
  - E) A description of any storage stability validation studies that may have been done. See Section 5, *Storage Stability Data*.

#### **10.7.6 Results/Discussion.**

- i) Residue results.
  - A) Raw data with correction factor(s) applied, if any.
  - B) Recovery levels.
  - C) Storage stability levels, if applicable.
  - D) Direct comparison of residues in the RAC with those in each processed product or processing fraction derived from that sample, etc.
- ii) Statistical treatment(s). Describe test(s) applied to the raw data.
- iii) Quality control. If not covered elsewhere, control measures/precautions that were followed to ensure the fidelity of the processing study.
- iv) Other, constituting any and all additional information that the petitioner considers appropriate and relevant to provide a complete and thorough description of the processing study or studies.

#### **10.7.7 Conclusions.**

Discuss conclusions that may be drawn, concerning the concentration/reduction of the test compound(s) in the test matrices as a function of the standard commercial processing procedure, and the need of MRLs.

#### **10.7.8 Certification.**

Certification of authenticity by the Study Director, including signature, typed name, title, affiliation, address, telephone number and date.

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### **10.7.9 Tables/Figures.**

- i) Table(s) of raw data from the processing study, method recovery data, storage stability recovery data, if applicable, etc.
- ii) Graphs, figures, flowcharts, etc., as relevant. Include the processing procedure with weights of RAC and processed fractions.

### **10.7.10 References.**

### **10.7.11 Appendix(es).**

- i) Representative chromatograms, spectra, etc., as applicable.
- ii) Reprints of methods and other studies that will support the petitioner's conclusions, unless physically located elsewhere in the overall data submission, in which case cross-referencing will suffice.
- iii) Other, i.e., any relevant material not fitting into any of the other sections of this report.

## **10.8 References**

1. U.S. Environmental Protection Agency, *Residue Chemistry Test Guidelines*, OPPTS860. EPA Report No.7/2-C-96-169, August 1996.

Available from the National Technical Information Service, Springfield, VA, U.S.

# **APPENDIX A**

## **Maximum Theoretical Concentration Factor Tables**

<b>Table 1</b>	
<b>Maximum Theoretical Concentration Factors by Crop</b>	
<b>Crop</b>	<b>Maximum Concentration Factor</b>
Apples	>14x*
Barley	8x
Beets, sugar	>20x*
Citrus	1000x
Coconut	3x
Coffee	4.4x
Corn	25x
Cottonseed	6x
Figs	4x
Grapes	>30x*
Mint	330x
Oats	>22x*
Peanuts	3x
Pineapple	4x
Potatoes	5x
Plums (prunes)	4x
Rapeseed	3x
Rice	8x
Rye	10x
Safflower	9x
Soybeans	12x
Sugarcane	20x*
Sunflower	5x
Tomatoes	>80x*
Wheat	9x
* Experimental factor	

<b>Table 2 Theoretical Concentration Factors Based on Loss of Water</b>			
	<b>% dry matter</b>	<b>Factor</b>	<b>Reference</b>
Figs	22		PAM I Sec. 202.12
dry figs	76	3.5	PAM I Sec. 202.12
Grapes	18		Harris Guide
raisins	85	4.7	Harris Guide
Potatoes	20		U.S.D.A.
dried (flakes, granules)	93	4.7	U.S.D.A.
Plums	21		PAM I Sec. 202.12
prunes	72	3.4	PAM I Sec. 202.12
Tomatoes	6		<i>Commercial Vegetable Processing</i> , second ed., p. 311
puree	8.5	1.4	<i>Commercial Vegetable Processing</i> , second ed., p. 272
paste	33	5.5	<i>Commercial Vegetable Processing</i> , second Ed., p. 277

<b>Table 3 Theoretical Concentration Factors Based on Separation into Components</b>			
	<b>min % of whole</b>	<b>Factor</b>	<b>Reference</b>
Barley grain			
hulls	13	7.7	<i>Principles of Field Crop Production</i> , p. 426
pearled	82	1.2	<i>Principles of Field Crop Production</i> , p. 426
Beets, sugar			
sugar	8	12.5	<i>Advances in Sugar Beet Production: Principles and Practices</i>
molasses			
dried pulp			
Citrus			
peel	30	3.3	<i>Foods and Food Production Encyclopedia</i> , Considine, p. 1391
molasses			
oil	0.1	1000	PAM I Sec 202.12
pulp, dehy			
juice	50	2	<i>Foods and Food Production Encyclopedia</i> , Considine, p. 1387
Coconut			
meal			
oil	35	2.9	PAM I Sec 202.15
copra (dried meal)		2.1	DRES (from U.S.D.A. Handbook No. 102)
Coffee			
roasted bean		1.2	18% loss in weight in roasting, Considine, p. 459
instant		4.4	PP#0E3875-based on weights in processing study
Corn grain			
oil	4	25.0	<i>Corn, Culture, Processing, Products</i> , p. 243
Cottonseed			

<b>Table 3 Theoretical Concentration Factors Based on Separation into Components</b>			
	<b>min % of whole</b>	<b>Factor</b>	<b>Reference</b>
hulls	26	3.8	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 187
meal	45	2.2	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 187
oil	16	6.3	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 187
Grapes			
juice	82	1.2	Harris Guide
Oats			
hulls	25	4.0	<i>Oats: Chemistry and Technology</i> , p. 372
flour			
rolled oats	70	1.4	<i>Cereal Crops</i> , pp. 577-8
Peanuts			
meal	46	2.2	<i>Peanuts, Production, Processing, Products</i> , p. 139 by difference, see p. 293
oil	36	2.8	PAM I Sec 202.25
Mint			
oil	0.3	333	15 mL oil from 10 lb. hay
spent hay			
Pineapple			PP#6F0482
process residue	26	3.8	
juice			
Potatoes			
processed waste	25	4.0	NorthWest Food Processors Assoc.
Rapeseed			
meal	52	1.9	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 259, by difference
oil	33	3.0	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 259

<b>Table 3</b>			
<b>Theoretical Concentration Factors Based on Separation into Components</b>			
	<b>min % of whole</b>	<b>Factor</b>	<b>Reference</b>
Rice grain (rough rice)			
hulls	20	5.0	<i>Cereal Crops</i> , pp. 649, 652
bran	13	7.7	<i>Cereal Crops</i> , pp. 649, 652
Rye grain			
bran	10	10.0	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , pp. 244-5
flour			
Safflower			
hulls	38	2.6	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 114
meal	11	9.1	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 114
oil (safflower)	30	3.3	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 114
Soybeans			
hulls	9	11.3	MRID No. 424482-03, Appendix B, p.67
meal	46	2.2	CBRS No. 10541, D. Miller, 1/29/93
oil	8	12.0	CBRS No. 10541, D. Miller, 1/29/93
Sugarcane			
molasses			
sugar	8.5	11.8	<i>Principles of Field Crop Production</i> , p. 426
Sunflower			
hulls	22	4.5	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 146
meal	22	4.5	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 146 by difference
oil	40	2.5	<i>CRC Handbook of Processing and Utilization in Agriculture</i> , p. 146
Tomatoes			



<b>Table 3</b>			
<b>Theoretical Concentration Factors Based on Separation into Components</b>			
	<b>min % of whole</b>	<b>Factor</b>	<b>Reference</b>
juice	70	1.4	<i>Commercial Vegetable Processing</i> , second ed., p. 303
Wheat grain			
bran	13	7.7	Considine, p. 2125
flour	72	1.4	<i>Cereal Crops</i> , pp. 295-6
shorts	12	8.3	<i>Cereal Crops</i> , pp. 295-6

**Table 4****Maximum Observed (Experimental) Concentration Factors**

These factors are based on a comparison of residues resulting from processing studies to the established MRLs on RACs.

apple pomace	14x
grape pomace, dry	20x
raisin waste	30x
oat milled fractions	22x
sugar beet pulp, dry	20x
sugarcane molasses	20x
tomato pomace, dry	80x

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## Bibliography

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12. *Cereal Crops*, Leonard, W. H., and J. H. Martin, Macmillan Co., New York, 1963.
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# **PEST MANAGEMENT REGULATORY AGENCY**

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## **RESIDUE CHEMISTRY GUIDELINES**

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### **SECTION 11**

#### **PROPOSED MRLs**

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## 11.1 Preface

This Guideline describes the scientific data requirements of the *Food and Drugs Act and Regulations* (FDAR) and the *Pest Control Products Act and Regulations* (PCPAR).

## 11.2 Introduction

### 11.2.1 Determining the maximum residue level (MRL)

To obtain a MRL, the petitioner proposes a MRL level, based on residue field trial data, that reflects the maximum residue that may occur under worst case conditions, i.e., maximum per season rate and minimum preharvest interval (PHI), as a result of the proposed use of the pesticide. These data sets may contain data points that would be termed outliers. The Agency will deal with these data points on a case-by-case basis, and the MRL established may be lower than that proposed by the petitioner. The pesticide active ingredient and any significant metabolites are together called the residue of concern (ROC). The MRL must include significant metabolites of toxicological concern, and must be high enough to cover all components of the ROC.

### 11.2.2 Significant metabolites of concern and the MRL expression

Using the results of plant and animal metabolism studies, the Pest Management Regulatory Agency (PMRA) determines which metabolites are of concern and need to be included in the MRL expression. In each case, this decision is based on the following:

- i) the toxicity of the metabolite, and
- ii) the magnitude of its residue.

Metabolites that are toxicologically significant and occur at significant levels require a suitable analytical method. In some cases, the MRL may be based on only a portion of the ROC in order to ease enforcement or to harmonize with international MRLs. This may be referred to as an indicator or marker compound, which typically would be the parent pesticide. However, residue data are still required for all ROCs for dietary risk assessment purposes.

## 11.3 Proposed MRLs

MRLs should be proposed in terms that best represent the ROC on the raw agricultural commodity (RAC), whether it be the parent pesticide, altered forms of it, or both. The proposed MRL should not be based on an average residue value but should be large enough to include any residue values that could be reasonably expected, based on the available data.

The MRL should not be larger than is needed for the proposed use although some limited accommodation to this rule may be necessary in the interest of avoiding an inordinate

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multiplicity of MRL levels for a single pesticide on a number of different crops. When the analytical method is based on measurement of a common chemical moiety, it will usually determine one or more conversion products along with the parent compound. In such cases, it may be appropriate to propose a combined MRL for all of the compounds calculated as the parent compound, toxicological considerations permitting.

The petitioner should consider whether the proposed MRL can be made compatible with MRLs established by the Codex Alimentarius Commission, an organization established under the auspices of the United Nations to facilitate international trade, or the MRLs established by the U.S. or Mexico. The MRL comparison should include compatibility of the numerical level proposed, the residue definition (ROC), i.e., the parent plus metabolites included in the MRL, and the commodity definition.

An exemption from the requirement of a MRL may also be proposed when appropriate. See subsection 11.4 of this Guideline. When an exemption is proposed, data should be presented to show the level of residues to be expected. Reasons for the requested exemption should be outlined in a scientifically defensible rationale.

In the case of the use of pesticides in food handling establishments, it is contemplated that the regulation may or may not include a numerical MRL on foods. However, a numerical indication of the expected residue levels is preferred. In either case, the proposed regulation should specify the conditions of use of the pesticide. The determination of whether a numerical MRL is needed will be based on the toxicity of the residue and the level of possible contamination.

## **11.4 Exemptions from the requirement of a MRL**

### **11.4.1 Active ingredients**

Exemptions from the requirement of a MRL are appropriate for pesticides for which no enforcement action can be anticipated, i.e., covered under section B.15.002(2) of the FDA and Regulations. Since an exemption from the requirement of a MRL means that there is no limit on the level of residue that could occur, exemptions are limited to relatively nontoxic pesticides. Examples of active ingredients for which an exemption is appropriate are silicon dioxide and sulfur. Exemptions from the requirement of a MRL for an active ingredient should be requested by submission of a petition. Residue chemistry data requirements, i.e., metabolisms and residue chemistry, may be waived for toxicologically innocuous, active ingredients. An analytical method is rarely needed for enforcement purposes. Exemptions from a MRL requirement must still go through the process of notification and promulgation, to be included under B.15.002(2) of the Food and Drugs Regulations.

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### 11.4.2 Adjuvants

Adjuvants of pesticide formulations have been determined to be agricultural chemicals within the meaning of the FDA and Regulations. A large number of these adjuvants have been exempted from the requirements of a MRL (B.15.002(2)(b), Food and Drugs Regulations). Requests to add other adjuvants should be submitted as petitions for exemption. Data requirements for adjuvants will not ordinarily be as extensive as for active ingredients. However, an analytical method may be required and a basis for estimation of the level of residues likely to result must be provided. Limitations on the use may be imposed in the exemption regulation. Any listings of adjuvants by other sections of the FDAR should be referenced. The amount of residue chemistry data needed for the exemption of an adjuvant will vary with the nature of the chemical. The minimum information required is a description of the identity of the chemical and the possible uses involved. If the adjuvant cannot be deemed toxicologically innocuous, then additional data will be required. In some cases, the full data requirements described for active ingredient MRLs will be required, while in other cases only an analytical method and residue data for representative crops will be required. The amount of data required will depend on the toxicity of the chemical and the use restrictions imposed. The petitioner is also referred to the PMRA Regulatory Directive 93-15, *Registration Requirements for Adjuvant Products*, for further details concerning data requirements for adjuvants.

### 11.5 MRLs for foreign uses

However, proposals for MRLs for residues in any imported foods should be submitted under the FDAR. MRLs proposed in conjunction with requests for domestic registration are submitted under the PCPAR. Petitions submitted for MRLs to cover imports should contain the same types of information, including sample labelling, and data as those submitted under the PCPAR.

### 11.6 References

1. The U.S. Environmental Protection Agency, *Residue Chemistry Test Guidelines*, OPPTS860. EPA Report No.7/2-C-96-169, August 1996.

Available from the National Technical Information Service, Springfield, VA, U.S.

2. The PMRA Regulatory Directive 93-15, *Registration Requirements for Adjuvant Products*.

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# **PEST MANAGEMENT REGULATORY AGENCY**

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## **RESIDUE CHEMISTRY GUIDELINES**

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### **SECTION 12**

#### **REASONABLE GROUNDS IN SUPPORT OF THE PETITION**



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## 12.1 Preface

This Guideline describes the scientific data requirements of the *Food and Drugs Act and Regulations* (FDAR) and the *Pest Control Products Act and Regulations* (PCPAR).

## 12.2 Reasonable grounds in support of the petition

The petitioner should present the rationale of how the residue data support the proposed maximum residue limit (MRL). The presentation should include brief discussions on the adequacy of the analytical method with respect to sensitivity and quantitation of the residue of concern (ROC), an explanation of any aberrant residue values reported, an explanation for proposed scientific data waiver requests of requirements set forth in these Guidelines, and any other residue considerations pertinent to the proposed use. Where appropriate, a discussion should be furnished on the status of other components of the formulations.

In those instances where the dietary risk from use of the pesticide is likely to be unacceptable, assuming MRL level residues on the entire crop, the petitioner should provide information or data that could be used to estimate a more realistic dietary exposure. In the case of concerns with chronic risk, determination of the median residue obtained in crop field trials would be useful. Also, information on actual or projected market shares for existing or proposed uses, respectively, can be submitted for review to the Product Sustainability and Coordination Division of the Pest Management Regulatory Agency.

## 12.3 References

1. The U.S. Environmental Protection Agency, *Residue Chemistry Test Guidelines*, OPPTS860. EPA Report No.7/2-C-96-169, August 1996.

Available from the National Technical Information Service, Springfield, VA, U.S.

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# **PEST MANAGEMENT REGULATORY AGENCY**

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## **RESIDUE CHEMISTRY GUIDELINES**

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### **SECTION 13**

### **CONFINED ACCUMULATION IN ROTATIONAL CROPS**

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## 13.1 Preface

This Guideline describes the scientific data requirements of the *Food and Drugs Act and Regulations* (FDAR) and the *Pest Control Products Act and Regulations* (PCPAR).

## 13.2 Introduction

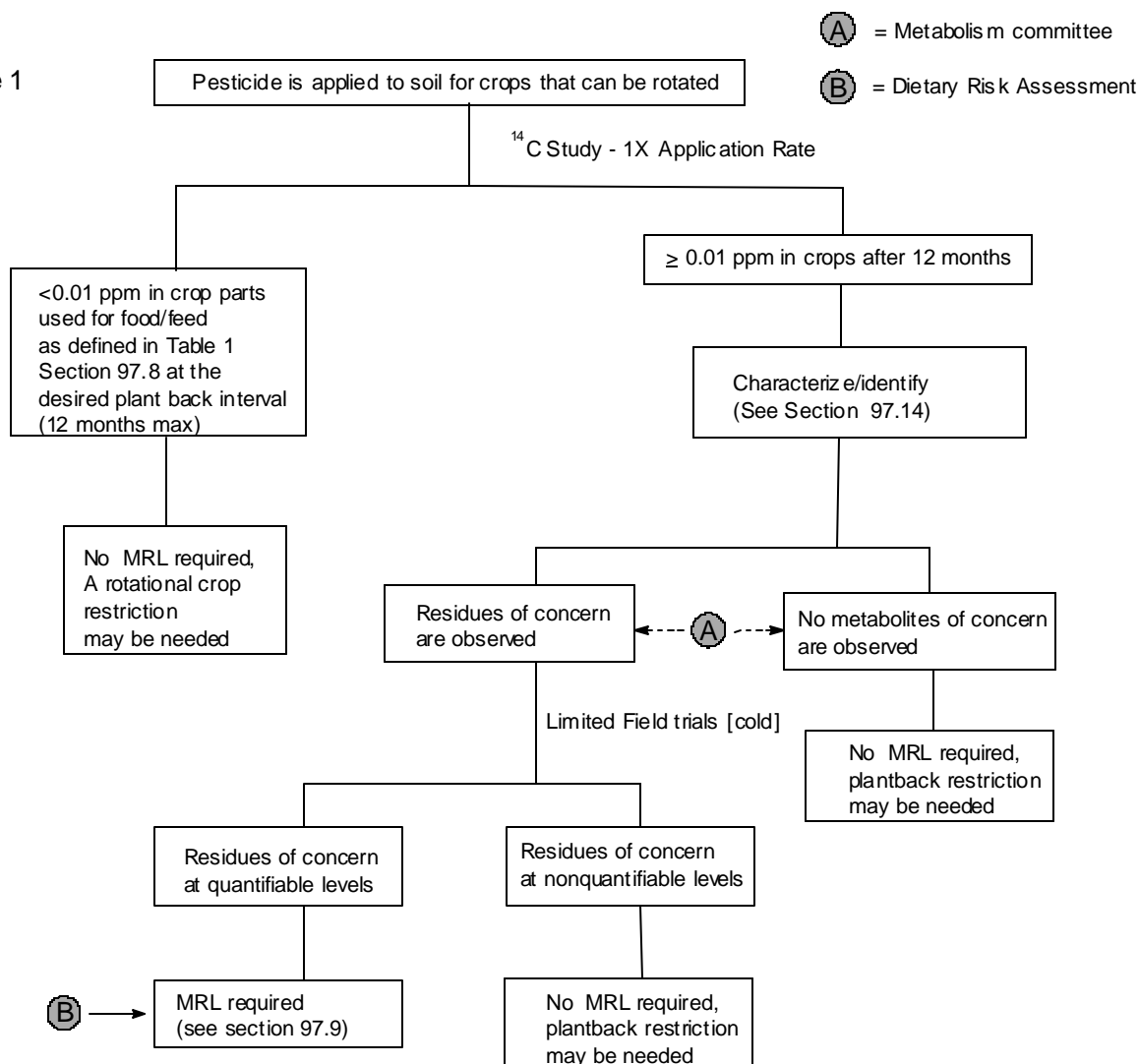
The confined accumulation study elucidates the translocation and disposition of the radiolabeled pesticide in a confined microplot, usually, but not exclusively, performed in a greenhouse environment. Data from confined accumulation studies on rotational crops will enable the Pest Management Regulatory Agency (PMRA) to determine the nature and amount of pesticide residue uptake in rotational crops. Such data are used to establish realistic crop rotation restrictions, i.e., the time from application to a time when rotation crops can be planted, or, to provide information for determining if limited field trials are needed for rotational crops.

### 13.2.1 Historical

Studies on confined rotational crops are conditionally required for uses of pesticides on terrestrial food crops and aquatic food crops. A rotational crop use is any field-vegetable crop use, aquatic crop use or any other site use on which it is reasonably foreseeable that any food or feed crop may be produced after the harvest of a treated crop. The purpose of these studies is to determine the nature and amount of pesticide residue uptake into rotational crops. The confined study uses radioactive material applied to a small plot. Results of these hot, i.e., radiolabelled agricultural chemical, studies are used to determine whether field studies, using nonradioactive pesticide, are needed. Based on these data, appropriate crop rotation restrictions, i.e., the time from application to planting of rotational crop, may be established and the need for maximum residue limits (MRLs) on the rotated crops determined.

The Agency has determined that rotational crop studies will *not* be required for uses of pesticides on the following commodities or crop groups: asparagus, avocado, banana, berries crop group, citrus fruits crop group, coconut, cranberry, date, fig, ginseng, globe artichoke, grape, guava, kiwi fruit, mango, mushroom, olive, papaya, passion fruit, pineapple, plantain, pome fruits crop group, rhubarb, stone fruits crop group, and tree nuts crop group. Refer to Section 15, *Crop Groups*, for complete lists of the crops in each crop group.

Figure 1



### 13.2.2 Scientific Considerations

Confined rotational crop studies are essentially metabolism studies; therefore, Section 2, *Nature of the Residue - Plants, Livestock*, should be consulted before conducting a confined rotational crop study. It should be noted that in the case of confined rotational crop studies, the application rate is 1X, not an exaggerated rate. This section will refer frequently to that document when discussing various phases of the subject experiments. A flow diagram describing the approach discussed in this Guideline is provided in Figure 1.

The following should be considered when a confined rotational crop study is to be conducted. The test material should be the pure active ingredient radiolabeled with <sup>14</sup>C in a nonlabile position, e.g., in a ring. The parent compound only should be applied to the appropriate soil type, usually a sandy loam, at the maximum seasonal label rate (1X), and the required three

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rotated crops: small grain, e.g., wheat, barley, oats and rye; leafy vegetable, e.g., spinach and lettuce; and root/tuber crop, e.g., radish, table beets and carrots; should be planted at appropriate soil aging intervals, e.g., 1, 4, and 12 months. The representative root crop should not be a bulb vegetable, such as onions or garlic. It is acceptable to substitute soybeans for a leafy vegetable due to the importance of this crop in rotational practices. Growing a primary crop in the soil during the aging period is not precluded, provided that the soil is treated prior to planting. The primary crop should be harvested in a manner consistent with typical agricultural practices. Sampling of the soil is not required and need not be performed at the discretion of registrants.

The three rotated crops should be harvested and the appropriate plant parts (see Table I in Section 8, *Meat/Milk/Poultry/Eggs*) should be sampled and combusted to determine the TRR. At this point, if each of the three crops demonstrate a TRR of <0.01 ppm<sup>1</sup> (parts per million) in edible portions at one of the plantback or soil aging intervals, then no further work may be needed. An appropriate rotational crop restriction can be set at the shortest interval where no TRR is \$0.01 ppm, provided that the petitioner is willing to place this interval on the label. If the TRR is <0.01 ppm in all three crops at the one month interval, then no plantback restriction will be needed on the label. If, however, in the three confined studies, the minimum intervals at which the TRR is <0.01 ppm differ, then the rotational crop restrictions will be set at the interval appropriate to each tested crop group with the longest interval being applied to all other, i.e., untested, rotated crops. The following example should be considered:

The TRR for leafy vegetables is <0.01 ppm at the 1 month plantback interval, the root crop TRR is <0.01 ppm at the 4 month interval and the grain crop TRR is <0.01 ppm at the 9 month interval. The rotational crop restrictions would be 1 month for leafy vegetables, 4 months for root crops and 9 months for small grains and all other rotated crops. It is the petitioner's prerogative to perform additional confined rotational crop studies on other crops to establish less restrictive intervals based on levels of radioactivity.

In rare cases, the presence of a pesticide or metabolite occurs at levels <0.01 ppm. Determination of the presence or absence of specific metabolites of concern at levels <0.01 ppm may be required in these cases.

If any of the plants in the confined studies exceeds the trigger value (0.01 ppm) at the 12 month interval, then the nature of the residue in those test crops having a TRR >0.01 ppm must be determined. The petitioner is referred to the guidance provided in Section 2, *Nature of the Residue -Plants, Livestock*, for a description of the terms of reference and proposal for 0.01 ppm level procedures that need to be followed to accomplish this determination; however, see

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<sup>1</sup> The PMRA recognizes that in Canada, the general regulation limit of 0.1 ppm is normally considered a reference point; however, when international trade with the U.S. is considered, along with its zero tolerance limits, an elucidation of residues below this reference level may be required.

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also the above comment regarding the application rate for confined rotational crop studies. If any one of the three crops shows <0.01 ppm at a given interval, but the petitioner desires a shorter interval on the label for that crop where the TRR is >0.01 ppm, then the composition of the TRR in that rotated crop, at the desired interval, should be determined as described above for the crop parts where the trigger value, i.e., 0.01 ppm, was exceeded. If several samples of the crop are available at the desired interval, the sample having the highest TRR should be utilized. In either of the above cases, this information is needed in order that the Agency can make a conclusion as to whether the residue is an inadvertent residue of no concern or whether cold, i.e., not radiolabeled, field trials as discussed in Section 14, *Field Accumulation in Rotational Crops*, are needed to make that determination.

If the metabolism in rotated crops appears to be different than that in the primary crop, that is, if different metabolites are observed in rotated crops than in primary crops, the Agency will make a determination, normally through the Health Evaluation Division (HED) Metabolism Committee, as to whether the different rotational crop metabolites are of concern at the levels observed.

The following are examples of the situations described above.

The primary or target crop metabolism studies indicate that the parent and metabolites A, B, C, D and E are present in the plant. The Agency decides that only the parent and metabolite B need to be regulated in the MRL expression. The following three scenarios might be encountered regarding rotational crops:

- i) The confined rotational crop studies indicate that the TRR is >0.01 ppm and that parent and metabolites A, B, C and D are present. Limited rotational crop field trials will normally be required with analysis for parent and metabolite B if it is determined that these residues could be present at detectable levels. If, however, metabolites A, C and D are present at much higher levels in the rotational crops than in the primary crop, the HED Metabolism Committee may be consulted as to whether the other metabolites need to be quantitated.
- ii) The confined rotational crop studies show that the TRR is >0.01 ppm and that the radioactive residue consists of only metabolites D and E. In this case, the Agency would normally conclude that this is an inadvertent residue of no concern situation, and no field trials would be required. A rotational crop restriction, i.e., plantback interval, may be necessary. As above, however, if metabolites D and E are present at much higher levels in the rotational crops than in the primary crop, the HED Metabolism Committee may be consulted as to whether these metabolites need to be quantitated.
- iii) The confined rotational crop studies indicate that the TRR is >0.01 ppm and that there is no parent present, but that the major portion of the TRR consists of a new metabolite F.

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This will require a decision as to whether there is toxicological concern over the new metabolite. At this point, the HED Metabolism Committee may be consulted for an expedited decision. If it is concluded that the metabolite is of concern at the levels likely to be present, then metabolite F should be analyzed for its presence in the limited rotational crop field trials. If it is decided that metabolite F is of no concern, then as in (ii) above, this is an inadvertent residue of no concern situation, and no field trials are necessary. However, a rotational crop restriction may be necessary.

It is recommended that the petitioner consult with the Agency once the confined studies have been completed. This consultation will allow the review of these data to determine any effects on the residue of concern (ROC). This will also allow the petitioner to design the field trials in a more efficient manner, i.e., to determine what compounds require analysis in the rotation crop field trial samples.

### **13.3 Test standards**

#### **13.3.1 Test substance**

The study shall be conducted using the radiolabeled analytical grade ingredient. If multiple ring structures or toxicologically significant sidechains are present, separate studies reflecting labeling of each ring or sidechain will normally be required. See Section 2, *Nature of the Residue - Plants/Livestock*.

#### **13.3.2 Test procedures**

- i) The study should be performed using a sandy loam soil that has been treated with the test substance applied at a rate equivalent to the maximum seasonal rate (1X) under actual field-use conditions. However, if the label instructions of the product limit its use to one soil type other than the sandy loam, then the study should be run with the soil type specified on the label. In either case, the soil should *not* be sterilized. Also, if the maximum seasonal application rate can only be attained by multiple treatments under actual use conditions, e.g., many foliar insecticides and fungicides, the radiolabeled material may be applied to the soil in a similar manner. In other words, the entire dose for the season need not be applied at once for such active ingredients. In such cases, the aging period for the soil will be considered to start at the last application.
- ii) The study may be performed either in a greenhouse or on an outdoor plot or container. Following application to the soil, the pesticide may be incorporated into the soil if the product label so instructs, or if this represents typical agricultural practice.
- iii) Following soil treatment, the pesticide should be aged under aerobic conditions in the soil for a time approximating the anticipated agricultural practice, e.g., 1 year for crops rotated the following year, 120 days for crops rotated immediately after harvest, and 30

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days for assessing circumstances of crop failure. Growing a primary crop in the soil during the aging period is not precluded, provided that the soil is treated prior to planting.

- iv) Crops planted in the treated and aged soil should include those expected in the proposed rotational schedule and, where possible, be representative of each of the following crop groupings: root and tuber vegetable, e.g., radish, table beets and carrots; small grain, e.g., wheat, barley, oats and rye; and leafy vegetable, e.g., spinach and lettuce. Soybeans may be substituted for a leafy vegetable due to the importance of this crop in rotational practices. The selected crops shall be analyzed for residues at appropriate harvest intervals. Residue analyses will be performed on selected crops at multiple intervals if both immature and mature crops are normally harvested in the course of usual agricultural practices.

#### 13.4 Reporting and evaluation of data

- i) The petitioner should characterize and, when feasible, identify and provide analytical values for significant residues in the crops tested. Significant residues include parent compound, closely related degradates, metabolites and/or their conjugates in the crop. In cases where identification of residues is not feasible due to an insufficient sample, then pooling of samples obtained from replicate experiments that have been conducted simultaneously should be carried out to enable residue identification to be achieved. From the results of this study, the Agency will determine whether additional studies to measure the accumulation of pesticide residues in rotated crops under actual field conditions are needed. If such field studies are needed, the petitioner will have to determine whether to conduct the limited field studies described in Section 14, *Field Accumulation in Rotational Crops*, i.e., two trials each on representative crop(s), or to carry out a complete set of crop field trials as described in Section 9, *Crop Field Trials*, necessary to support the establishment of a MRL in the rotated crop(s).
- ii) Depending on the crop tested, separate analyses should be conducted on those portions of the plant considered to be raw agricultural commodities (RACs). See Table I in Section 8, *Meat/Milk/Poultry/Eggs*. However, even if the aerial portion for the particular root crop is not in Table I, both the aerial and root portions of root crops should be analyzed.
- iii) Soil should be sampled after treatment, at time of plantback and at harvest to determine soil concentrations of TRRs.
- iv) A description of the growing conditions should be reported. If the study is conducted outdoors, rainfall data, temperature monitoring data, and general climatic conditions should be reported for the test period.



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Submitted studies will be screened for completeness before being accepted for evaluation. Study-specific screening forms are available on the PMRA web site or may be obtained upon request from the PMRA.

### 13.5 Format of data report

The following describes the order and format for a study report item-by-item.

#### 13.5.1 Title/Cover Page

Title page and additional documentation requirements, i.e., requirements for data submission and statement of confidentiality of data, if relevant to the study reported, should precede the content of the study formatted below. See Regulatory Directives, Dir97-01, *Comprehensive Data Summaries*, and Dir97-03, *Residue Chemistry Guidelines*.

#### 13.5.2 Table of Contents

The table of contents must follow the title, data confidentiality, and *Good Laboratory Practice* (GLP) pages. This page should indicate the overall organization of the study, including tables and figures.

#### 13.5.3 Abstract

This section should contain the overall summary of the study, addressing the following points:

- i) The chemical name (use the same name throughout the report), the formulation and the mode of application. Structures of the chemical and metabolites may be included in this section.
- ii) Maintenance of the treated plot.
- iii) A table similar to the following with an appropriate title:

Plant Tissue	Days Between Application and Planting	Residues (ppm)		
		Total	Parent	Metabolites <sup>1</sup>

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<sup>1</sup> Metabolites may need to be named and quantitated individually.

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- iv) A discussion of problems, such as technical difficulties or unusual weather, that necessitated deviations from the intended test protocol, and a description of the effects of these deviations on the results of the study.
  - v) Provide a name and phone number of a contact person in the event that the reviewer has technical questions about the study. This is optional; however, providing this information will facilitate efficient review in case of questions.

#### **13.5.4 Introduction**

This section should open with a description of the purpose of the study, what requirement it is intended to satisfy and, if applicable, how it supports the position of the registrant. Background and historical information relative to the study should be placed in this section.

#### **13.5.5 Materials/Methods**

The petitioner may elect to describe materials and methods in separate sections or to combine them into a single section. The following format combines the two into one section. This section should be in narrative form. All details, including drawings and photographs, with regard to the materials, equipment, experimental design, test plots or containers, procedures used in conducting the study, and of different phases of the study should be placed in this section. In addition, the following are to be included, when appropriate:

- i) Chemical. Provide the purity of the material, its activity in Curies/mole, disintegrations per minute per gram (dpm/g), and the site of radiolabeling.
- ii) Site
  - A) If outdoor test plots are used:
    - 1) Provide a map describing the location, topography and size, and location and size of any control plots in relation to the test plot, and provide an indication of whether the test plot contains a subsurface drainage system.
    - 2) Describe the means by which the test material is confined in the areas surrounding the test plantings, e.g., aluminum pipe sunk in the ground.
    - 3) Provide the soil characteristics, i.e., % sand, % silt, % clay, % organic matter, pH, cation exchange capacity, and moisture capacity, of the plot.
    - 4) Provide a complete record of daily temperature, daily rainfall and pan evaporation data throughout the study and how they compare to average

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temperature and rainfall at the test site, based on records from the nearest weather station.

5) Include crop and pesticide use history on the plot for the three year period preceding the study.

B) If test containers, either indoor or outdoor, are used, provide information on the size of the containers, amount of soil, its type and characteristics as detailed in Part A above, and other distinctive details, e.g., temperature and rainfall.

iii) Test method.

A) General.

- 1) The date and technique of plot or container preparation prior to pesticide application.
- 2) A description of how and when the pesticide was applied, the ambient conditions at the time of application, the application rate and the application technique. Also provide similar descriptions for each of any additional applications made, information on how much pesticide was applied in comparison to actual use rates, and if the application technique differed from the label recommendations.
- 3) A description of what was done to the plot after harvest of the primary crop before planting of the secondary rotational crop, during planting of the rotational crop, and during its growth.
- 4) The identity of the primary and secondary crop, if applicable, and a description of how and when the primary and secondary crops were planted.
- 5) A description of any posttreatment crop maintenance, such as use of fertilizers and other pesticides; irrigation, i.e., when applied, how much, and its source; tilling; weeding; etc.
- 6) A description of the crop sampling harvesting technique, procedure and devices used, and the date of harvest of the primary and secondary crops.
- 7) Identity of the rotational crops planted should be placed in this section. Also, provide a description of the procedure used in planting the rotational crops, the number of days between treatment of the initial crop with the pesticide and planting of the rotational crop, and a description of all procedures used in the

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maintenance of the rotational crops, as done for the treated crop, sampling method and how many samples/replicates were taken. All dates should be provided in terms of days from pesticide application.

- 8) A description of the handling of the crop samples from the time of the taking of the samples until analysis, with special attention to the conditions under which they were stored and the thawing procedure, if frozen; in addition, the storage stability data to be used in determining if the pesticide residues are stable under the storage conditions, and the dates that the samples were stored/frozen, thawed, extracted and analyzed.
- 9) Information on how long samples will be retained and under what conditions they will be retained, in the event that additional analytical work is necessary.
- 10) An elaboration on any difficulties or special problems that arose during the study that necessitated deviation from the intended test protocol, and a report on the effects that the deviations had on the results.

B) Analytical method.

- 1) The full description of each method used in this study should be placed in this section. Note that methods for degradation products, when appropriate, are included. This section should also include the method validation data, recovery and limit of detection and quantitation data, quality control procedures and results, sample chromatograms, and sample calculations. The detailed description of the procedures used in preparation and handling of the sample throughout the method should also be placed here.
- 2) The identity of the instrumentation, equipment and reagents used and the operating conditions of the instrumentation.
- 3) Figures/photographs of any special equipment used in the methods, and flow diagrams of particularly complex extraction/cleanup procedures are to be included here.
- 4) The results of analyses of all crop samples.

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### **13.5.6 Results/Discussion**

- i) This section should contain the scientific results of the study; for instance,
  - A) Narrative and tables describing the steps taken in determining the pesticide residues in the crop samples, in addition to the graphical presentations of the data, accompanied by the tables of the actual values from which the graphs were constructed.
  - B) Results of the analysis of any control plots. The registrant should note that the crop samples for both control and treated plots and/or containers are to be analyzed for levels of radioactive residues.
  - C) Significant residues should be characterized and/or identified and discussed with special attention to known degradates from plant metabolism, soil metabolism, hydrolysis and photolysis.
- ii) This section should contain the table of structures and chemical names/designations, and levels in ppm and % of TRR, for the parent compound and degradation products discussed in the study.

### **13.5.7 Conclusion**

This section should contain the discussion of the nature, magnitude and toxicological significance of the residues of parent, metabolites and degradates found in the rotational crops.

### **13.5.8 Certification**

- i) Signatures of each of the Study Director and senior scientific personnel responsible for the study must be included.
- ii) Certification by the petitioner that the report is a complete and unaltered copy of the report provided by the testing facility must also be included.

### **13.5.9 Tables/Figures**

It is recommended that tables and figures be numbered using Arabic numerals for figures and Roman numerals for tables.

### **13.5.10 References**

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### 13.5.11 Appendix(es)

At the registrant's option, reprints of methods and other studies, raw data, copies of relevant letters/memos and material that will help support the registrant's conclusions, but do not fit into any of the other sections, should be placed in an appendix.

### 13.6 References

1. U.S. Environmental Protection Agency, *Residue Chemistry Test Guidelines*, OPPTS860. EPA Report No.7/2-C-96-169, August 1996.

Available from National Technical Information Service, Springfield, VA, U.S.

2. Revised Product Chemistry Regulatory Directives, Dir98-02, *Chemistry Requirements for the Registration of a Technical Grade of Active Ingredient or an Integrated System Product*, and Dir98-03, *Chemistry Requirements for the Registration of a Manufacturing Concentrate or an End-Use Product Formulated from Registered Technical Grade of Active Ingredients or Integrated System Products*.

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# **PEST MANAGEMENT REGULATORY AGENCY**

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## **RESIDUE CHEMISTRY GUIDELINES**

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### **SECTION 14**

#### **FIELD ACCUMULATION IN ROTATIONAL CROPS**

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## 14.1 Preface

This Guideline describes the scientific data requirements of the *Food and Drugs Act and Regulations* (FDAR) and the *Pest Control Products Act and Regulations* (PCPAR).

## 14.2 Introduction

Data from field accumulation studies on rotational crops will enable the Pest Management Regulatory Agency (PMRA) to determine under actual field-use conditions, the amount of pesticide residue uptake in rotational crops. Such data are used to establish realistic crop rotation restrictions, i.e., the time from application to a time when rotation crops can be planted, and to provide information for determining whether maximum residue limits (MRLs) are needed in rotational crops.

### 14.2.1 Historical

Studies on confined rotational crops and field rotational crops are conditionally required for uses of pesticide on terrestrial food crops and aquatic food crops. A rotational crop use is any field-vegetable crop use, aquatic crop use or any other site use on which it is reasonably foreseeable that any food or feed crop may be produced after harvest of a treated crop. The purpose of these studies is to determine the nature and amount of pesticide residue uptake into rotational crops. The study uses a typical end-use product applied to a field plot. Results of these studies are used to determine whether residues occur in rotational crops that are grown under actual field conditions. Based on these data, appropriate crop rotation restrictions, i.e., time from application to planting of rotational crop, may be established and the need for MRLs on the rotated crops determined.

The Agency has determined that rotational crop studies will not be required for uses of pesticides on the following commodities or crop groups: asparagus, avocado, banana, berries crop group, citrus fruits crop group, coconut, cranberry, date, fig, ginseng, globe artichoke, grape, guava, kiwi fruit, mango, mushroom, olive, papaya, passion fruit, pineapple, plantain, pome fruits crop group, rhubarb, stone fruits crop group, and tree nuts crop group. Refer to Section 15, *Crop Groups*, for complete lists of the crops in each crop group.

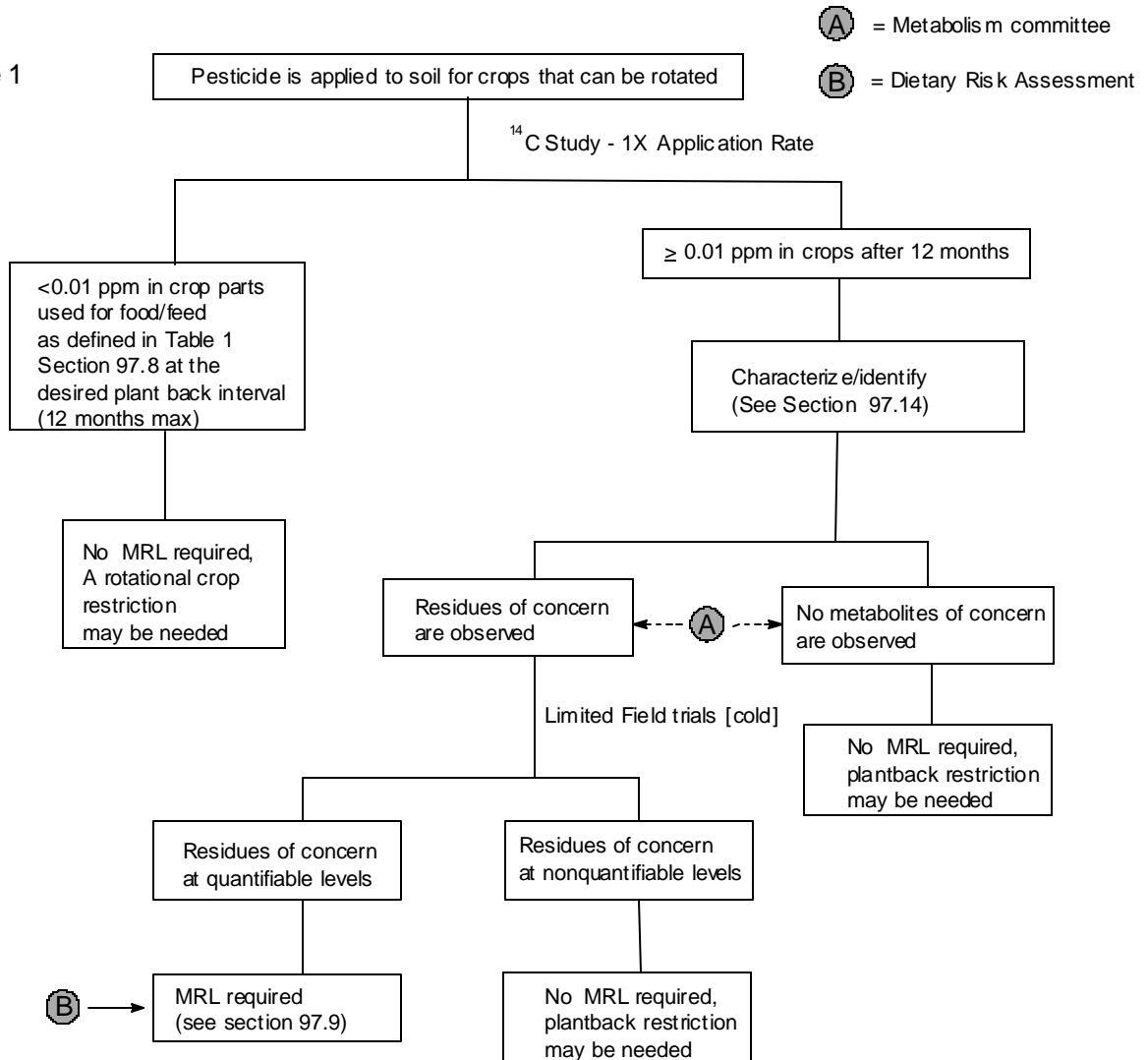
### 14.2.2 Scientific considerations

If the level of the total radioactive residue (TRR) in the confined rotational crops is equal to or exceeds 0.01 parts per million (ppm) at the desired rotational interval or at 12 months, and once the nature of the residue in the rotational crops is understood, then the petitioner should consider the Agency's position concerning the residue to be regulated in the primary crop. See Section 13, *Confined Accumulation in Rotational Crops*, and Figure 1 to decide whether the first tier of field trials should be initiated. That is, if the composition of the TRR in the rotational crops is such that residues that need to be regulated are observed at levels  $\geq 0.01$  ppm in the rotational crop, following the criteria set forth in Section 2, *Nature of the Residue - Plants*,



*Livestock*, then field trials should be performed. If residues of concern (ROCs) in the confined study are  $\leq 0.01$  ppm, but less than the limit of quantitation (LOQ) of the analytical method to be used on field trial samples, the Agency will consider waiving the need for field trials on a case-by-case basis.

Figure 1



The limited field trials should be conducted on a representative crop as defined in Section 15, *Crop Groups*, at two sites per crop for the following three crop groups, totalling six trials: root and tuber vegetables; leafy vegetables; and small grains e.g., wheat, barley, oats and rye. As with confined studies, Section 13, *Confined Accumulation in Rotational Crops*, soybeans may be substituted for the leafy vegetable. The six trials should be conducted on crops that the petitioner intends to have as rotational crops on the label.

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If there is no uptake of ROCs in one or two of the representative crops in the confined study, the Agency still requires six field trials. The trials may be distributed at the petitioner's discretion among the representative crops showing uptake. In addition, some of the six trials could be conducted using other crops that are typically involved in crop rotation, such as alfalfa and soybeans.

The soil should be treated at the maximum label rate and the maximum number of applications, and the appropriate crops should be planted after the minimum aging interval. However, if the pesticide is only to be applied to foliage, then the treatment in the field studies may be done in the same manner. The crops should be harvested and all of the plant parts, including the leaves of the root and tuber vegetable, prescribed as raw agricultural commodities (RACs) in Table I of Section 8, *Meat/Milk/Poultry/Eggs*, should be analyzed for the ROC observed in primary crops. Any other ROCs specific to rotational crops that fulfill the criteria set forth in Section 13, *Confined Accumulation in Rotational Crops*, should also be determined. Quantitation limits for rotational crops should be comparable to those for primary crops. The petitioner should describe how the value for the LOQ was calculated and cite any appropriate references.

The methods employed to analyze the rotational crops should be specific for all pesticide ROCs in the subject commodities. If the analytical procedure determines interfering compounds, the procedure would be considered to be deficient, and this would be a cause for rejection of the studies. It would also be desirable to employ sites on which the test pesticide had not been previously applied. If residues are found in control crop samples, the Agency will not automatically reject the field studies. The total study will be examined, and consideration will be given to factors, such as the relative levels of residues in treated and control samples. As with the confined accumulation in rotational crops study, soil should be analyzed after treatment, at time of plantback and at harvest to determine ROC terminal residues.

If no residues above the LOQ are observed in the RACs in the limited field trials, then no MRLs will be needed. However, plantback restrictions will normally be needed unless the confined study shows no ROCs at a 30 day plantback interval.

If the limited field studies above indicate that quantifiable residues will occur, then rotational crop MRLs will be required. The requirement for the number of trials would be the same as that to establish primary tolerances on all crops or crop groups that the petitioner intends to have as rotational crops on the label. If the petitioner desires to allow the universe of crops to be rotated, then magnitude of the residue data are required on representative crops. See Section 15, *Crop Groups*, for all crop groups that could be planted in a typical crop rotation sequence. With respect to treatment, these trials should be conducted in the same manner as discussed above for the limited trials. If the petitioner believes that a lesser number of crops would be rotated because of the nature of the pesticide or due to the way it is used, then guidance should be obtained from the Agency regarding specific data requirements in those cases.

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If MRLs exist on the crops to be rotated, then rotational data on these crops would be required only if residues in rotated crops exceeded established MRLs.

### **14.3 Test standards**

#### **14.3.1 Test substance**

The test substance shall be a typical formulation. If more than one formulation type is registered, several factors need to be considered as to which type(s) should be used. If one formulation has a significantly higher application rate than the others, it should be applied to the plots in which the rotational crops will be grown. If all formulations have similar application rates, but one has been specifically designed to have a longer half-life in the environment, e.g., controlled release product, then this one should be the test substance. The discussion on formulations in Section 9, *Crop Field Trials*, should also be consulted. For target crops, residue data can be translated among formulations that are diluted in water and then applied early in the growing season. Such translation would also be appropriate for rotational crop field studies. Therefore, rotational crop data reflecting use of a wettable powder would cover formulations, such as emulsifiable concentrates and water dispersible granules. However, as with target or primary crops, separate studies will normally be required on rotational crops reflecting uses of granular formulations, unless data are available to show the relative soil half-lives of the active ingredient (ai) as a function of formulation.

#### **14.3.2 Test procedure**

i) Sites.

Study sites may be located outside Canada, provided that the site(s) is located in a region common to Canada and the U.S. on the map shown in Section 9, Appendix IV, *Major and Minor Field Trial Regions for Canada and the U.S.*, or in a region not common to Canada, but for which a scientific rationale is provided in support of the site's equivalence to a common Canada/U.S. region. Field accumulation studies should be conducted in at least two different sites per crop. These sites should be representative of the areas where rotated crops are expected to be grown. If possible, the soil type at one of the test sites should be the same as that used in the confined accumulation study of Section 13, *Confined Accumulation in Rotational Crops*. For restricted use patterns where only one typical area is involved, data from two similar sites should be submitted.

ii) Application.

A) The soil at the test site should be treated with the test substance and be applied by the method stated in the directions for use specified on the product label, and be applied at the highest recommended label rate. However, if the pesticide is only to

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be applied to foliage, then the treatment in the field studies may be done in the same manner.

B) Following treatment, the pesticide should be aged under aerobic conditions in the soil for a time approximating the anticipated agricultural practice, e.g., 1 year for crops rotated the following year, 120 days for crops rotated immediately after harvest, and 30 days for assessing circumstances of crop failure. Growing a primary crop in the soil during the aging period is not precluded.

iii) Sampling.

A) Representative root and tuber vegetables, small grain, and leafy vegetable crops should be planted as rotational crops. Soybeans may be substituted for the leafy vegetable.

B) If the registrant is proposing a MRL for residues in a rotated crop, that crop should be planted, harvested, and analyzed for residues at test sites selected in accordance with the requirements described in detail in Section 9, *Crop Field Trials*.

C) The rotational crop RACs, including the foliage of the root and tuber vegetables, as prescribed in Table I of Section 8, *Meat/Milk/Poultry/Eggs*, should be analyzed for residues at appropriate harvest times.

D) Test duration. Residue data should be collected in rotational crops until the time that the mature portions of the crops are normally harvested.

#### 14.4 Reporting and evaluation of data

In addition to the applicable reporting requirements specified in Section 9, *Crop Field Trials*, the following data should be reported:

1) Field test data, including:

i) Dates of planting and harvesting of primary and secondary, i.e., rotational, crops;

ii) Amount of rainfall and irrigation water, accumulated from application to harvest;

iii) Temperature monitoring data and a description of the general climatic conditions at the test site during the study;

iv) Techniques and times of planting, culture, and harvesting;

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- v) Pesticide application dates and method;
  - vi) Sampling times and techniques for primary, if applicable, and secondary, i.e., rotational, crop RACs;
  - vii) Stages of crop development at times of sampling;
  - viii) Application-to-harvest interval, i.e., preharvest interval (PHI); and
  - ix) Weight of each sample taken for analysis.
- 2) Analysis for residues of parent compound and metabolites in the crops. Separate analyses should be conducted on different portions of the plant as outlined in Table I of Section 8, *Meat/Milk/Poultry/Eggs*. In addition, analysis of both the aerial and root portions of root crops should be conducted.

Submitted studies will be screened for completeness before being accepted for evaluation. Study-specific screening forms are available on the PMRA web site or may be obtained upon request from the PMRA.

## **14.5 Format of data report**

The following describes the order and format for a study report item-by-item.

### **14.5.1 Title/Cover Page**

Title page and additional documentation requirements, i.e., requirements for data submission and statement of confidentiality of data, if relevant to the study reported, should precede the content of the study formatted below. These requirements are described in the PMRA Regulatory Directives, Dir98-02, *Chemistry Requirements for the Registration of a Technical Grade of Active Ingredient or an Integrated System Product*, and Dir98-03, *Chemistry Requirements for the Registration of a Manufacturing Concentrate or an End-Use Product Formulated from Registered Technical Grade of Active Ingredients or Integrated System Products*.

### **14.5.2 Table of Contents**

The table of contents must follow the title, data confidentiality and Good Laboratory Practice (GLP) pages. This page should indicate the overall organization of the study, including tables and figures.

### **14.5.3 Abstract**

This section should contain the overall summary of the study, addressing the following points:

- 
- i) The chemical name and formulation of the pesticide and the method of application to the primary, i.e., treated, crop. Structures of the pesticide and metabolites may be included in this section.
  - ii) Maintenance of the treated plots.
  - iii) A narrative or a table with an appropriate title that provides the following information:
    - A) Days between treatment and planting of secondary, i.e., rotational, crops.
    - B) Age of crop in days at each sampling point, e.g., at forage, hay and grain stages.
    - C) Total residues (ppm). Parent and all metabolites of concern should also be reported separately, if so determined by the method.
  - iv) Indication of problems, such as technical difficulties or unusual weather, resulting in necessary deviations from the intended test protocol, and a description of the effects of these deviations on the results of the study.
  - v) Provide a name and phone number of a contact person in the event that the reviewer has technical questions about the study. This is optional; however, providing this information will facilitate efficient review in case of questions.

#### **14.5.4 Introduction**

This section should open with a description of the purpose of the study, what requirement it is intended to satisfy and, if applicable, how it supports the position of the petitioner. Background and historical information relative to the study should be placed in this section.

#### **14.5.5 Materials/Methods**

This section should be in narrative form in the following order and should contain all details with regard to the materials, equipment, experimental design, field plots, and procedures used in conducting the study. The registrant is encouraged to include drawings and photographs of the plot, equipment and different phases of the study.

- i) Chemical.
  - A) Ai and type of formulation.
  - B) Include the percent by weight of the ai and, for liquid formulations, the weight of the ai per unit of liquid measure.

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ii) Site.

- A) Include a map of the test plots, indicating their location, topography and size, and location and size of the control plots in relation to the test plots, as well as the soil characteristics, i.e., percent sand, silt, clay, and organic matter, pH, and water-holding capacity.
- B) Include a complete record of daily temperature and daily rainfall throughout the study and how they compare to average temperature and rainfall at the test site.

iii) Crop.

- A) Crop and pesticide-use history on the plot for the three year period preceding the study.
- B) The date and technique of plot preparation prior to pesticide application.
- C) The identity of the primary, i.e., treated, crop; a description of how and when the primary crop was planted; how and when the subject pesticide was applied; the weather, i.e., temperature, rainfall, windspeed and direction, and the condition of the field at time of application; the formulation of the pesticide applied and adjuvants or other compounds added to the spray/application mixture; and the application rate and the application technique. Also, provide a similar description for each of any additional applications made of the subject pesticide. Indicate how much pesticide was applied in comparison to actual use rates and if application technique differed from label recommendations.
- D) A description of any posttreatment crop maintenance, such as use of fertilizers and other pesticides; irrigation, i.e., when applied, how much, and source; and tilling, weeding, etc.

iv) Test method.

A) General.

- 1) The date of harvest of the treated crop. Describe what was done to the plot after harvest in preparation for planting of the rotational crops.
- 2) The identity of the rotational crops planted in the study, a description of the procedure used in planting the rotational crops, and days elapsed between planting of crops and treatment with pesticide. A description of all procedures

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used in the maintenance of the rotational crops as done for the treated crop, the sampling/harvest method and number of samples/replicates should be included.

- 3) Describe handling from the time of taking of the samples until analysis, with special attention to the conditions under which the sampled rotational crops were stored and the thawing procedure, if frozen. Determine storage stability of pesticide residues. Provide dates when the samples were frozen, thawed, and analyzed.
- 4) Describe any deviation from the intended test protocol and the effects on the results.

B) Analytical method.

- 1) Describe methods fully or reference them if previously submitted, including method validation data, recovery and method sensitivity data, sample chromatograms, and sample calculations. Preparation and handling of the sample throughout the method should be described in detail. Note that methods for metabolites may also be needed.
- 2) Identify instrumentation, equipment and reagents used and the operating conditions of the instrumentation. If the extraction/clean-up procedure is complex, a flow diagram should be submitted.
- 3) Identify all plant fractions analyzed in the study, such as grain, forage, hay, and straw in the case of small grains, and root and aerial (leafy) portions in the case of root crops.

#### **14.5.6 Results/Discussion**

- i) This section should contain the scientific results of the study; for instance,
  - A) Narrative and tables describing the steps taken in determining the pesticide residues in crop samples. All graphical presentations of the data should be accompanied by the tables of the actual values from which the graphs were constructed.
  - B) A table of structures and chemical names/designations for the parent compound and metabolites.
  - C) Total ROCs for all RACs as prescribed in Table I of Section 8, *Meat/Milk/Poultry/Eggs*.



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### **14.5.7 Conclusion**

Provide discussion as to the significance of the residues taken up, if any; at what intervals residues are taken up by rotational crops, i.e., in which crop fractions and at what levels; and at what interval no quantifiable ROCs can be expected to be taken up by rotational crops.

### **14.5.8 Certification**

- i) Signatures of each of the senior scientific personnel responsible for the study must be included.
- ii) Certification by the registrant that the report is a complete and unaltered copy of the report provided by the testing facility must also be included.

### **14.5.9 Tables/Figures**

Use Arabic numerals for figures and Roman numerals for tables.

### **14.5.10 References**

### **14.5.11 Appendix(es)**

Reprints of methods and other studies cited, actual results of analyses (raw data), copies of relevant letters and memos, and other material not fitting into any of the other sections and that support the petitioner's case should be placed in this section.

## **14.6 References**

1. The U.S. Environmental Protection Agency, *Residue Chemistry Test Guidelines*, OPPTS860. EPA Report No.7/2-C-96-169, August 1996.

Available from the National Technical Information Service, Springfield, VA, U.S.

2. The Revised Product Chemistry Regulatory Directives, Dir98-02, *Chemistry Requirements for the Registration of a Technical Grade of Active Ingredient or an Integrated System Product*, and Dir98-03, *Chemistry Requirements for the Registration of a Manufacturing Concentrate or an End-Use Product Formulated from Registered Technical Grade of Active Ingredients or Integrated System Products*.

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# **PEST MANAGEMENT REGULATORY AGENCY**

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## **RESIDUE CHEMISTRY GUIDELINES**

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### **SECTION 15 CROP GROUPS**

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## 15.1 Preface

The Pest Management Regulatory Agency (PMRA) is creating pesticide maximum residue limit (MRL) crop-grouping regulations. The PMRA expects these regulations will simplify establishing MRLs, and facilitate the availability of pesticides for minor crop uses.

## 15.2 Introduction

The proposed crop grouping regulations are similar to those proposed by the U.S. Environmental Protection Agency (EPA) (40 CFR Part 180, [OPP-300269A; FRL-4939-9], RIN 2070-AB78). Crop groupings are meant to simplify the establishment of MRLs for a group of crops, based on residue data for certain crops that are representative of the group. There are also subgroups within the groups. Each subgroup is a smaller and more closely related grouping of the commodities included in the parent crop group, and the representative commodities for each subgroup are also a smaller subset of those for the parent group. This action is intended to improve utilization of existing and new residue data. Several miscellaneous commodities (Section 15.3.3 below) are excluded from the crop group concept because their cultural practices and residue chemistry concerns are distinct from other commodities, e.g., grape, banana and strawberry.

## 15.3 General

### 15.3.1 Addition of Crops

Future changes to the crop group tables or other portions thereof will be considered on a case-by-case basis.

### 15.3.2 Regional/Common Names for Commodities

Additional regional/common names will be added to Index III, *Index to Commodities*, as warranted, with references to the commodity as it is named in the crop group tables. In order not to lengthen the crop group tables unnecessarily, new common names will be added only to the Index.

### 15.3.3 Miscellaneous Commodities

Crops that were intentionally not included in any groups are:  
asparagus, avocado, banana, cranberry, fig, globe artichoke, grape, hops, kiwifruit, mango, mushroom, okra, papaya, pawpaw, peanut, persimmon, pineapple, strawberry, water chestnut, and watercress.

#### i) Addition of New Crop Groups

Any future, recommended changes to the crop groups or subgroups should be presented in a form that includes all of the necessary background and supporting information, such

as a list of all commodities to be included, accompanied by scientific names, naming all representative commodities and providing a rationale for selecting the particular commodities and representative commodities to be included. The PMRA welcomes an opportunity to evaluate crop group/subgroup proposals, when they are submitted from interested parties, and/or to work with such parties on the types of information and data necessary to evaluate a new crop group.

ii) Other Comments

A request to establish a commodity definition may be submitted to the PMRA for review as a separate amendment. The amendment should include rationale for change, comparative cultural practices including pest problems, application timing, food/feed uses, and geographical distribution for commodity production, as well as processing food items.

At this time, the PMRA has no plans to set MRLs on a crop group or subgroup basis for pesticide residues in processed food or animal feed commodities, even when the parent raw agricultural commodity (RAC) is a member of a crop group. Generally, the processed forms of commodities are very different from their raw forms and, within a crop group, also different from each other's processed forms, including expected residues. Also, processed commodities may have incurred pesticide residues from direct or indirect application of pesticides to the processed food, as well as, application to the raw form from which the processed form is derived. This would present a problem of too much variability in expected residues in the various processed commodities. In addition, some chemicals have a tendency to concentrate as a result of processing whereas others may remain constant or decrease during processing; this lack of consistency in resulting residues would also make it difficult to set a crop group to cover several dissimilar processed commodities.

iii) Index to Commodities

The table below contains an alphabetical index to the crops in all the crop groups, giving the Crop Group number.

<b>Commodities</b>	<b>Crop Group Number</b>
Achiote (see annatto seed) . . . . .	19
Achira (see canna, edible) . . . . .	1
Acorn squash (see squash, winter) . . . . .	9
Adzuki bean (see bean [Vigna spp.]) . . . . .	6
Alfalfa (forage, fodder, straw, hay) . . . . .	18
Allspice . . . . .	19

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<b>Commodities</b>	<b>Crop Group Number</b>
Almond . . . . .	14
Amaranth . . . . .	4
Angelica . . . . .	19
Angola bean (see pigeon pea) . . . . .	6
Anise (anise seed) . . . . .	19
Annatto seed . . . . .	19
Annual marjoram (see marjoram) . . . . .	19
Apple . . . . .	11
Apple, balsam (see Momordica spp.) . . . . .	9
Apricot . . . . .	12
Arracacha . . . . .	1
Arrowroot . . . . .	1
Arugula . . . . .	4
Asian pear (see pear, oriental) . . . . .	11
Asparagus bean (see bean [Vigna spp.]) . . . . .	6
Asparagus lettuce (see celtuce) . . . . .	4
Aubergine (see eggplant) . . . . .	8
Australian arrowroot (see canna, edible) . . . . .	1
Austrian winter pea (see pea [Pisum spp.] [field pea]) . . . . .	6
Azuki bean (see bean [Vigna spp.] [adzuki bean]) . . . . .	6
Balm . . . . .	19
Balsam apple (see Momordica spp.) . . . . .	9
Balsam pear (see Momordica spp.) . . . . .	9
Barley . . . . .	15
Barley (forage, fodder, straw) . . . . .	16
Basil . . . . .	19
Bay leaf (see sweet bay) . . . . .	19
Bean . . . . .	6
Bean (foliage) . . . . .	7
Bean, velvet (forage, fodder, straw, hay) . . . . .	18
Bean, yam . . . . .	1
Beech nut . . . . .	14
Beet . . . . .	1
Beet (foliage) . . . . .	2
Beetroot (see beet, garden) . . . . .	1
Bell pepper (see pepper [Capsicum spp.]) . . . . .	8
Bingleberry (see blackberry) . . . . .	13
Birdsfoot trefoil (see trefoil) . . . . .	18
Bitter cassava . . . . .	1
Bitter cassava (foliage) . . . . .	2

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<b>Commodities</b>	<b>Crop Group Number</b>
Bitter gourd (see balsam pear) . . . . .	9
Bitter melon (see Momordica spp.) . . . . .	9
Bitter orange (see orange, sour) . . . . .	10
Black caraway . . . . .	19
Black cumin (see caraway, black) . . . . .	19
Black pepper . . . . .	19
Black raspberry . . . . .	13
Black salsify . . . . .	1
Black salsify (foliage) . . . . .	2
Black satin berry (see blackberry) . . . . .	13
Black walnut . . . . .	14
Blackberry . . . . .	13
Blackeyed pea (see bean [Vigna spp.]) . . . . .	6
Blero (see amaranth) . . . . .	4
Blood orange (see orange, sweet) . . . . .	10
Blueberry . . . . .	13
Bok choy (see cabbage, Chinese [bok choy]) . . . . .	5
Bok choy sum (see cabbage, Chinese [bok choy]) . . . . .	5
Bor choi (see mustard spinach) . . . . .	5
Bor tsai (see mustard spinach) . . . . .	5
Bottle gourd (see gourd, edible [cucuzza]) . . . . .	9
Borage . . . . .	19
Borecole (see kale) . . . . .	5
Borekale (see kale) . . . . .	5
Boy choy sum (see cabbage, Chinese [bok choy]) . . . . .	5
Boysenberry (see blackberry) . . . . .	13
Brazil nut . . . . .	14
Broad bean . . . . .	6
Broad bean (foliage) . . . . .	7
Broccoflower (see cauliflower) . . . . .	5
Broccoli . . . . .	5
Broccoli raab . . . . .	5
Brussels sprouts . . . . .	5
Buckwheat . . . . .	15
Buckwheat (forage, fodder, straw) . . . . .	16
Bullace plum (see plum, Damson) . . . . .	12
Bulrush millet (see millet, pearl) . . . . .	15
Burdock, edible . . . . .	1
Burdock, edible (foliage) . . . . .	2
Burnet . . . . .	19

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<b>Commodities</b>	<b>Crop Group Number</b>
Bush nut (see macadamia nut) . . . . .	14
Butter bean (see bean [Phaseolus spp.] [lima bean]) . . . . .	6
Butternut . . . . .	14
Butternut squash (see squash, winter) . . . . .	9
Cabbage . . . . .	5
Cajan pea (see pigeon pea) . . . . .	6
Calabash gourd (see gourd, edible [cucuzzi]) . . . . .	9
Calabaza (see squash, winter) . . . . .	9
Calaloo (see amaranth) . . . . .	4
Calamondin . . . . .	10
Calilu (see amaranth) . . . . .	4
Camomile . . . . .	19
Canna, edible . . . . .	1
Cantaloupe (see muskmelon) . . . . .	9
Cape gooseberry (see groundcherry) . . . . .	8
Caper buds . . . . .	19
Caraway . . . . .	19
Cardoni (see cardoon) . . . . .	4
Cardoon . . . . .	4
Cardamom . . . . .	19
Carrot . . . . .	1
Carrot (foliage) . . . . .	2
Casaba (see muskmelon) . . . . .	9
Cashew . . . . .	14
Cassava, bitter and sweet . . . . .	1
Cassava, bitter and sweet (foliage) . . . . .	2
Cassia bark . . . . .	19
Cassia buds . . . . .	19
Catjang (see bean [Vigna spp.]) . . . . .	6
Catmint (see catnip) . . . . .	19
Catnip . . . . .	19
Cauliflower . . . . .	5
Cavalo broccolo . . . . .	5
Celeriac . . . . .	1
Celeriac (foliage) . . . . .	2
Celery . . . . .	4
Celery cabbage (see cabbage, Chinese [napa]) . . . . .	5
Celery mustard (see cabbage, Chinese [bok choy]) . . . . .	5
Celery root (see celeriac) . . . . .	1
Celery seed . . . . .	19

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<b>Commodities</b>	<b>Crop Group Number</b>
Celtuce . . . . .	4
Ceylon spinach (see spinach, vine) . . . . .	4
Chayote (fruit) . . . . .	9
Chayote (root) . . . . .	1
Cherokee blackberry (see blackberry) . . . . .	13
Cherry, sweet . . . . .	12
Cherry, tart . . . . .	12
Chervil . . . . .	4
Chervil (dried) . . . . .	19
Chervil, turnip-rooted . . . . .	1
Chervil, turnip-rooted (foliage) . . . . .	2
Chesterberry (see blackberry) . . . . .	13
Chestnut . . . . .	14
Cheyenne blackberry (see blackberry) . . . . .	13
Chickasaw plum . . . . .	12
Chickpea . . . . .	6
Chickpea (foliage) . . . . .	7
Chicory . . . . .	1
Chicory (foliage) . . . . .	2
Chihili cabbage (see cabbage, Chinese [napa]) . . . . .	5
Chili pepper (see pepper [Capsicum spp.]) . . . . .	8
China pea (see pea [Pisum spp.] [snow pea]) . . . . .	6
China star anise (see anise, star) . . . . .	19
Chinese artichoke . . . . .	1
Chinese broccoli . . . . .	5
Chinese cabbage (bok choy) . . . . .	5
Chinese cabbage (napa) . . . . .	5
Chinese celery . . . . .	4
Chinese celery cabbage (see cabbage, Chinese [napa]) . . . . .	5
Chinese chive . . . . .	19
Chinese cucumber (see Momordica spp.) . . . . .	9
Chinese green mustard (see cabbage, Chinese mustard) . . . . .	5
Chinese green mustard cabbage (see cabbage, Chinese mustard) . . . . .	5
Chinese kale (see broccoli, Chinese) . . . . .	5
Chinese lantern plant (see tomatillo) . . . . .	8
Chinese leek (see chive, Chinese) . . . . .	19
Chinese longbean (see bean [Vigna spp.]) . . . . .	6
Chinese mustard (see mustard greens) . . . . .	5
Chinese mustard cabbage . . . . .	5

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<b>Commodities</b>	<b>Crop Group Number</b>
Chinese okra (see gourd, edible) . . . . .	9
Chinese parsley (see coriander) . . . . .	19
Chinese pea (see pea [Pisum spp.] [snow pea]) . . . . .	6
Chinese pear (see pear, oriental) . . . . .	11
Chinese preserving melon (see Chinese waxgourd) . . . . .	9
Chinese radish (see radish, oriental) . . . . .	1
Chinese spinach (see amaranth) . . . . .	4
Chinese squash (see Chinese waxgourd) . . . . .	9
Chinese turnip (see radish, Oriental) . . . . .	1
Chinese waxgourd . . . . .	9
Chinese white cabbage (see cabbage, Chinese [bok choy])	5
Chinquapin . . . . .	14
Chironja (see citrus hybrids) . . . . .	10
Chive . . . . .	19
Choi sum (see cabbage, Chinese [bok choy]) . . . . .	5
Chopsuey greens (see chrysanthemum, edible-leaved) . . .	4
Choy sum (see cabbage, Chinese cabbage [bok choy]) . .	5
Chrysanthemum, edible-leaved . . . . .	4
Chrysanthemum, garland . . . . .	4
Chufa . . . . .	1
Ciboule (see onion, Welsh) . . . . .	3
Cilantro (see coriander) . . . . .	19
Cilantro del monte (see culantro) . . . . .	19
Cinnamon . . . . .	19
Citrus citron . . . . .	10
Citron melon . . . . .	9
Citrus hybrids (Citrus spp.) . . . . .	10
Clary . . . . .	19
Clove buds . . . . .	19
Clover (forage, fodder, straw, hay) . . . . .	18
Cluster bean (see guar) . . . . .	6
Cocoyam (see tanier) . . . . .	1
Cocoyam (foliage) . . . . .	2
Collards . . . . .	5
Common bean (see bean [Phaseolus spp.] [kidney bean])	6
Common millet (see millet, proso) . . . . .	15
Common vetch (see vetch) . . . . .	18
Congo pea (see pigeon pea) . . . . .	6
Cooking pepper (see pepper [Capsicum spp.]) . . . . .	8
Coriander (leaf and seed) . . . . .	19

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<b>Commodities</b>	<b>Crop Group Number</b>
Corn . . . . .	15
Corn (forage, fodder) . . . . .	16
Corn salad . . . . .	4
Coryberry (see blackberry) . . . . .	13
Costmary . . . . .	19
Courgette (see squash, summer) . . . . .	9
Cowpea (see bean [Vigna spp.]) . . . . .	6
Crabapple . . . . .	11
Crenshaw melon (see muskmelon) . . . . .	9
Cress . . . . .	4
Christophine (see chayote) . . . . .	9
Crookneck squash (see squash, summer) . . . . .	9
Crowder pea (see bean [Vigna spp.]) . . . . .	6
Crown vetch (forage, fodder, straw, hay) . . . . .	18
Cucumber . . . . .	9
Cucuzza (see gourd, edible) . . . . .	9
Cuczzi (see gourd, edible) . . . . .	9
Culantro (leaf) . . . . .	19
Culantro (seed) . . . . .	19
Cumin . . . . .	19
Currant . . . . .	13
Curry leaf . . . . .	19
Cush cush yam (see yam, true) . . . . .	1
Custard marrow (see chayote) . . . . .	9
Daikon (see radish, oriental) . . . . .	1
Damson plum . . . . .	12
Dandelion . . . . .	4
Darrowberry (see blackberry) . . . . .	13
Dasheen . . . . .	1
Dasheen (foliage) . . . . .	2
Dewberry (see blackberry) . . . . .	13
Dill seed . . . . .	19
Dillweed . . . . .	19
Dirksen thornless berry (see blackberry) . . . . .	13
Dock . . . . .	4
Dwarf pea (see pea [Pisum spp.]) . . . . .	6
Eddoe (see dasheen) . . . . .	1
Edible burdock . . . . .	1
Edible burdock (foliage) . . . . .	2
Edible canna . . . . .	1

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<b>Commodities</b>	<b>Crop Group Number</b>
Edible gourd . . . . .	9
Edible-leaved chrysanthemum . . . . .	4
Edible-pod pea (see pea [Pisum spp.]) . . . . .	6
Eggplant . . . . .	8
Elderberry . . . . .	13
Elephant garlic (see garlic, great-headed) . . . . .	3
Endive . . . . .	4
English pea (see pea [Pisum spp.]) . . . . .	6
English walnut . . . . .	14
Escarole (see endive) . . . . .	4
Estragon (see tarragon) . . . . .	19
European plum (see prune (fresh)) . . . . .	12
Fava bean (see broad bean) . . . . .	6
Fennel, common . . . . .	19
Fennel, Florence . . . . .	4
Fennel, Florence (seed) . . . . .	19
Fennel flower (see caraway, black) . . . . .	19
Fenugreek . . . . .	19
Field bean (see bean [Phaseolus spp.]) . . . . .	6
Field pea (see pea [Pisum spp.]) . . . . .	6
Filbert . . . . .	14
Finocchio (see fennel, Florence) . . . . .	4
Flax; Linseed (Linum usitatissimum) . . . . .	20
Florence fennel . . . . .	4
Florence fennel (seed) . . . . .	19
Flowering bok choy (see cabbage, Chinese [bok choy]) . . . . .	5
Flowering leek (see chive, Chinese) . . . . .	19
Flowering pak choy (see cabbage, Chinese [bok choy]) . . . . .	5
French bean (see bean [Phaseolus spp.] [kidney bean]) . . . . .	6
French parsley (see chervil) . . . . .	4
Gai choy (see cabbage, Chinese mustard) . . . . .	5
Gai lon (see broccoli, Chinese) . . . . .	5
Garbanzo bean (see chickpea) . . . . .	6
Garden beet . . . . .	1
Garden beet (foliage) . . . . .	2
Garden clary (see clary) . . . . .	19
Garden cress . . . . .	4
Garden pea (see pea [Pisum spp.]) . . . . .	6
Garden purslane . . . . .	4
Garland chrysanthemum . . . . .	4

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<b>Commodities</b>	<b>Crop Group Number</b>
Garlic . . . . .	3
Garlic chive (see chive, Chinese) . . . . .	19
Gau choi (see chive, Chinese) . . . . .	19
Gau tsoi (see chive, Chinese) . . . . .	19
Gherkin . . . . .	9
Ginger . . . . .	1
Ginseng . . . . .	1
Girasole (see artichoke, Jerusalem) . . . . .	1
Gobo (see burdock, edible) . . . . .	1
Golden pershaw melon (see muskmelon) . . . . .	9
Gooseberry . . . . .	13
Gooseberry, cape (see groundcherry) . . . . .	8
Gourd, edible . . . . .	9
Gow choy (see chive, Chinese) . . . . .	19
Grain lupin (see bean [Lupinus spp.]) . . . . .	6
Grains of paradise . . . . .	19
Grapefruit . . . . .	10
Grasses (either green or cured) . . . . .	17
Great-headed garlic . . . . .	3
Greater burdock (see burdock, edible) . . . . .	1
Green bean (see bean [Phaseolus spp.] [snap bean]) . . . . .	6
Green cauliflower (see cauliflower) . . . . .	5
Green onion (see onion) . . . . .	3
Green pea (see pea [Pisum spp.]) . . . . .	6
Groundcherry . . . . .	8
Guar . . . . .	6
Guar (foliage) . . . . .	7
Guinea grains (see grains of paradise) . . . . .	19
Guinea yam (see yam, true) . . . . .	1
Hairy vetch (see vetch) . . . . .	18
Hazelnut (see filbert) . . . . .	14
Head lettuce (see lettuce) . . . . .	4
Hechima (see gourd, edible) . . . . .	9
Hickory nut . . . . .	14
Himalayaberry (see blackberry) . . . . .	13
Honey balls (see muskmelon) . . . . .	9
Honeydew melon (see muskmelon) . . . . .	9
Horehound . . . . .	19
Horseradish . . . . .	1
Hubbard squash (see squash, winter) . . . . .	9

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<b>Commodities</b>	<b>Crop Group Number</b>
Huckleberry . . . . .	13
Hullberry (see blackberry) . . . . .	13
Husk tomato (see tomatillo) . . . . .	8
Hyacinth bean (see lablab bean) . . . . .	6
Hyotan (see gourd, edible) . . . . .	9
Hyssop . . . . .	19
Indian mustard (see mustard greens) . . . . .	5
Indian rice (see wild rice) . . . . .	15
Indian saffron (see turmeric) . . . . .	1
Indian spinach (see spinach, vine) . . . . .	4
Irish potato (see potato) . . . . .	1
Italian fennel (see fennel, Florence) . . . . .	4
Italian fennel (seed) (see fennel, Florence [seed]) . . . . .	19
Jackbean . . . . .	6
Jackbean (foliage) . . . . .	7
Japanese artichoke (see artichokes, Chinese) . . . . .	1
Japanese bunching onion (see onion, Welsh) . . . . .	3
Japanese chrysanthemum (see chrysanthemum, edible- leaved) . . . . .	4
Japanese greens (see mizuna) . . . . .	5
Japanese medlar (see loquat) . . . . .	11
Japanese mustard (see mizuna) . . . . .	5
Japanese pear (see oriental pear) . . . . .	11
Japanese plum . . . . .	12
Japanese radish (see radish, oriental) . . . . .	1
Japanese squash (see Chinese waxgourd) . . . . .	9
Jerusalem artichoke . . . . .	1
Jicama (see yam bean) . . . . .	1
Juniper berry . . . . .	19
Kai choy (see cabbage, Chinese mustard) . . . . .	5
Kai lan (see broccoli, Chinese) . . . . .	5
Kale . . . . .	5
Kalonji (see caraway, black) . . . . .	19
Kidney bean (see bean [Phaseolus spp.]) . . . . .	6
Kintsai (see celery, Chinese) . . . . .	4
Kohlrabi . . . . .	5
Komatsuna (see mustard spinach) . . . . .	5
Kudzu (forage, fodder, straw, hay) . . . . .	18
Kumquat . . . . .	10
Kunchoi (see celery, Chinese) . . . . .	4

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<b>Commodities</b>	<b>Crop Group Number</b>
Kyona (see cabbage, Chinese mustard) . . . . .	5
Lablab bean . . . . .	6
Lablab bean (foliage) . . . . .	7
Lavacaberry (see blackberry) . . . . .	13
Lavender . . . . .	19
Leaf lettuce (see lettuce) . . . . .	4
Leafy amaranth (see amaranth) . . . . .	4
Leek . . . . .	3
Leek, flowering (see chive, Chinese) . . . . .	19
Lemon . . . . .	10
Lemon balm (see balm) . . . . .	19
Lemongrass . . . . .	19
Lentil . . . . .	6
Lentil (foliage) . . . . .	7
Leren . . . . .	1
Lespedeza (forage, fodder, straw, hay) . . . . .	18
Lesser Asiatic yam (see yam, true) . . . . .	1
Lettuce . . . . .	4
Lima bean (see bean [Phaseolus spp.]) . . . . .	6
Lime . . . . .	10
Lipstick plant (see annatto seed) . . . . .	19
Lobok (see radish, oriental) . . . . .	1
Lo pak (see radish, oriental) . . . . .	1
Loganberry . . . . .	13
Loquat . . . . .	11
Lovage (leaf and seed) . . . . .	19
Lowberry (see blackberry) . . . . .	13
Lucretiaberry (see blackberry) . . . . .	13
Lupin (foliage) . . . . .	7
Lupin (forage, fodder, straw, hay) . . . . .	18
Lupin (grain) (see bean [Lupinus spp.]) . . . . .	6
Lupine (see lupin) . . . . .	6
Macadamia nut . . . . .	14
Mace . . . . .	19
Malabar cardamom (see cardamom) . . . . .	19
Malabar spinach (see spinach, vine) . . . . .	4
Mammoth blackberry (see blackberry) . . . . .	13
Mandarin . . . . .	10
Mango melon (see muskmelon) . . . . .	9
Mango squash (see chayote) . . . . .	9

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<b>Commodities</b>	<b>Crop Group Number</b>
Manioc (see cassava) . . . . .	1
Manioc pea (see yam bean) . . . . .	1
Marigold . . . . .	19
Marionberry (see blackberry) . . . . .	13
Marjoram (Origanum spp.) . . . . .	19
Marrow (see squash, summer) . . . . .	9
Marrow, vegetable (see squash, summer) . . . . .	9
Marrow, custard (see chayote [fruit]) . . . . .	9
Mayhaw . . . . .	11
Melegueta pepper (see grains of paradise) . . . . .	19
Melons . . . . .	9
Mexican husk tomato (see tomatillo) . . . . .	8
Mexican parsley (see coriander [cilantro] [leaf]) . . . . .	19
Mexican water chestnut (see yam bean) . . . . .	1
Mibuna (see mizuna) . . . . .	5
Milk vetch (forage, fodder, straw, hay) . . . . .	18
Millet . . . . .	15
Millet (forage, fodder, straw) . . . . .	16
Milo (see sorghum) . . . . .	15
Mizuna . . . . .	5
Mo qua (see Chinese waxgourd) . . . . .	9
Momordica spp. . . . .	9
Moth bean (see bean [Vigna spp.]) . . . . .	6
Multiplier onion (see onion, Welsh) . . . . .	3
Mung bean (see bean [Vigna spp.]) . . . . .	6
Muskmelon . . . . .	9
Mustard cabbage (see cabbage, Chinese mustard) . . . . .	5
Mustard greens . . . . .	5
Mustard seed . . . . .	19
Mustard seed (Brassica nigra; Sinapis alba) . . . . .	20
Mustard seed, Field (Brassica campestris) . . . . .	20
Mustard seed, Indian (Brassica juncea) . . . . .	20
Mustard spinach . . . . .	5
Mysore cardamom (see cardamom) . . . . .	19
Napa cabbage (see cabbage, Chinese [napa]) . . . . .	5
Nashi (see pear, oriental) . . . . .	11
Nasturtium . . . . .	19
Navy bean (see bean [Phaseolus spp.]) . . . . .	6
Nectarberry (see blackberry) . . . . .	13
Nectarine . . . . .	12

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<b>Commodities</b>	<b>Crop Group Number</b>
New Zealand spinach . . . . .	4
No-eye pea (see pigeon pea) . . . . .	6
Nutmeg . . . . .	19
Oat . . . . .	15
Oat (forage, fodder, straw) . . . . .	16
Okra, Chinese (see gourd, edible) . . . . .	9
Olallieberry (see blackberry) . . . . .	13
Onion . . . . .	3
Orach . . . . .	4
Orange, sour . . . . .	10
Orange, sweet . . . . .	10
Oregano (see marjoram) . . . . .	19
Oregon evergreen berry (see blackberry) . . . . .	13
Oriental garlic (see chive, Chinese) . . . . .	19
Oriental pear . . . . .	11
Oriental radish . . . . .	1
Oriental radish (foliage) . . . . .	2
Oyster plant (see salsify) . . . . .	1
Pak choy (see cabbage, Chinese cabbage [bok choy]) . . . . .	5
Pak tsoi sum (see cabbage, Chinese cabbage [bok choy]) . . . . .	5
Parsley . . . . .	4
Parsley, Chinese (see coriander) . . . . .	19
Parsley (dried) . . . . .	19
Parsley, turnip-rooted . . . . .	1
Parsnip . . . . .	1
Parsnip (foliage) . . . . .	2
Pea (Pisum spp.) . . . . .	6
Pea (foliage) . . . . .	7
Peach . . . . .	12
Pear . . . . .	11
Pear, balsam (see Momordica spp.) . . . . .	9
Pearl millet . . . . .	15
Pearl millet (forage, fodder, straw) . . . . .	16
Pecan . . . . .	14
Peking cabbage (see cabbage, Chinese [napa]) . . . . .	5
Pennyroyal . . . . .	19
Pepino . . . . .	8
Pepper (Capsicum spp.) . . . . .	8
Pepper, black . . . . .	19
Pepper, white . . . . .	19

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<b>Commodities</b>	<b>Crop Group Number</b>
Persian melon (see muskmelon) . . . . .	9
Persian walnut (see walnut, English) . . . . .	14
Pe-tsai (see cabbage, Chinese [bok choy]) . . . . .	5
Phenomenalberry (see blackberry) . . . . .	13
Pigeon pea . . . . .	6
Pigeon pea (foliage) . . . . .	7
Pimento (see pepper [Capsicum spp.]) . . . . .	8
Pineapple melon (see muskmelon) . . . . .	9
Pinto bean (see bean [Phaseolus spp.]) . . . . .	6
Plum . . . . .	12
Plumcot . . . . .	12
Pomelo (see pummelo) . . . . .	10
Popcorn . . . . .	15
Popcorn (forage, fodder) . . . . .	16
Poppy seed . . . . .	19
Pot marjoram (see marjoram) . . . . .	19
Potato bean (see yam bean) . . . . .	1
Potherb mustard (see mizuna) . . . . .	5
Potato . . . . .	1
Potato bean (see yam bean) . . . . .	1
Proso millet . . . . .	15
Proso millet (forage, fodder, straw) . . . . .	16
Prune (fresh) . . . . .	12
Prune plum (see prune [fresh]) . . . . .	12
Pummelo . . . . .	10
Pumpkin . . . . .	9
Purple arrowroot (see canna, edible) . . . . .	1
Purslane, garden . . . . .	4
Purslane, winter . . . . .	4
Queensland arrowroot (see canna, edible) . . . . .	1
Queensland nut (see macadamia nut) . . . . .	14
Quince . . . . .	11
Radicchio . . . . .	4
Radish . . . . .	1
Radish (foliage) . . . . .	2
Ranberry (see blackberry) . . . . .	13
Rape greens . . . . .	5
Rape Seed (Brassica napus) . . . . .	20
Rape Seed, Indian (Brassica campestris) . . . . .	20
Rapini (see broccoli raab) . . . . .	5

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<b>Commodities</b>	<b>Crop Group Number</b>
Raspberry, black . . . . .	13
Raspberry, red . . . . .	13
Ravenberry (see blackberry) . . . . .	13
Recao (see culantro) . . . . .	19
Recaito (see culantro) . . . . .	19
Red chicory (see radicchio) . . . . .	4
Red gram (see pigeon pea) . . . . .	6
Red raspberry . . . . .	13
Rhubarb . . . . .	4
Rice . . . . .	15
Rice (forage, fodder, straw) . . . . .	16
Rice bean (see bean [Vigna spp.]) . . . . .	6
Rocket salad (see arugula) . . . . .	4
Roquette (see arugula) . . . . .	4
Rosemary . . . . .	19
Rosberry (see blackberry) . . . . .	13
Rucola (see arugula) . . . . .	4
Rue . . . . .	19
Runner bean (see bean [Phaseolus spp.]) . . . . .	6
Rutabaga . . . . .	1
Rutabaga (foliage) . . . . .	2
Rye . . . . .	15
Rye (forage, fodder, straw) . . . . .	16
Safflower (Carthamus tinctorius) . . . . .	20
Saffron . . . . .	19
Sage . . . . .	19
Sainfoin (forage, fodder, straw, hay) . . . . .	18
Salsify . . . . .	1
Salsify, black (foliage) . . . . .	2
Sandpear (see pear, oriental) . . . . .	11
Santa Claus melon (see muskmelon) . . . . .	9
Satsuma mandarin . . . . .	10
Savory, summer . . . . .	19
Savory, winter . . . . .	19
Seville orange (see orange, sour) . . . . .	10
Scallop squash (see squash, summer) . . . . .	9
Shaddock (see pummelo) . . . . .	10
Shallot . . . . .	3
Shawnee blackberry (see blackberry) . . . . .	13
Skirret . . . . .	1

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<b>Commodities</b>	<b>Crop Group Number</b>
Small cardamom (see cardamom) . . . . .	19
Snake melon (see muskmelon) . . . . .	9
Snap bean (see bean [Phaseolus spp.]) . . . . .	6
Snow pea (see pea [Pisum spp.]) . . . . .	6
Sorghum . . . . .	15
Sorghum (forage, fodder, straw) . . . . .	16
Sorrel (see dock) . . . . .	4
Sour cherry (see tart cherry) . . . . .	12
Sour orange . . . . .	10
Southern pea (see bean [Vigna spp.]) . . . . .	6
Southernwood (see wormwood) . . . . .	19
Soybean . . . . .	6
Soybean (foliage) . . . . .	7
Soybean (immature seeds) (edible-pod) . . . . .	6
Spaghetti squash (see squash, winter) . . . . .	9
Spanish salsify . . . . .	1
Spinach . . . . .	4
Spiny coriander (see culantro) . . . . .	19
Sprouting broccoli (see broccoli) . . . . .	5
Squash, summer . . . . .	9
Squash, winter . . . . .	9
Star anise . . . . .	19
Stem turnip (see kohlrabi) . . . . .	5
Straightneck squash (see squash, summer) . . . . .	9
String bean (see bean [Phaseolus spp.] [snap bean]) . . . . .	6
Sugar beet . . . . .	1
Sugar beet (foliage) . . . . .	2
Sugar pea (see pea [Pisum spp.] [snow pea]) . . . . .	6
Sugar snap pea (see pea Pisum spp.) . . . . .	6
Sunchoke (see Jerusalem artichoke) . . . . .	1
Sunflower seed (Helianthus annuus) . . . . .	20
Summer savory . . . . .	19
Summer squash . . . . .	9
Swede (see rutabaga) . . . . .	1
Sweet Alice (see anise) . . . . .	19
Sweet anise (see fennel, Florence) . . . . .	4
Sweet bay . . . . .	19
Sweet cassava . . . . .	1
Sweet cassava (foliage) . . . . .	2
Sweet cherry . . . . .	12

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<b>Commodities</b>	<b>Crop Group Number</b>
Sweet clover (see clover) . . . . .	18
Sweet corn (see corn) . . . . .	15
Sweet fennel (see fennel, Florence) . . . . .	4
Sweet fennel (seed) (see fennel, Florence [seed]) . . . . .	19
Sweet lupin (see bean [Lupinus spp.]) . . . . .	6
Sweet marjoram (see marjoram) . . . . .	19
Sweet orange . . . . .	10
Sweet pepper (see pepper [Capsicum spp.]) . . . . .	8
Sweet potato . . . . .	1
Sweet potato (foliage) . . . . .	2
Swiss chard . . . . .	4
Sword bean . . . . .	6
Sword bean (foliage) . . . . .	7
Table beet (see beet, garden) . . . . .	1
Tampala (see amaranth) . . . . .	4
Tangelo (see citrus hybrids) . . . . .	10
Tangerine (see mandarin) . . . . .	10
Tangor (see citrus hybrids) . . . . .	10
Tanier . . . . .	1
Tanier (foliage) . . . . .	2
Tansy . . . . .	19
Taro (see dasheen) . . . . .	1
Tarragon . . . . .	19
Tart cherry . . . . .	12
Teosinte . . . . .	15
Teosinte (forage, fodder, straw) . . . . .	16
Tepary bean (see bean [Phaseolus spp.]) . . . . .	6
Thousand-veined mustard (see mizuna) . . . . .	5
Thyme . . . . .	19
Tiger nut (see chufa) . . . . .	1
Tomatillo . . . . .	8
Tomato . . . . .	8
Tree melon (see pepino) . . . . .	8
Trefoil (forage, fodder, straw, hay) . . . . .	18
Triticale . . . . .	15
Triticale (forage, fodder, straw) . . . . .	16
True cantaloupe (see muskmelon) . . . . .	9
True yam . . . . .	1
True yam (foliage) . . . . .	2
Tsai shim (see cabbage, Chinese [bok choy]) . . . . .	5

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<b>Commodities</b>	<b>Crop Group Number</b>
Tsoi sim (see cabbage, Chinese [bok choy]) . . . . .	5
Turmeric . . . . .	1
Turnip . . . . .	1
Turnip (foliage) . . . . .	2
Turnip-rooted chervil . . . . .	1
Turnip-rooted chervil (foliage) . . . . .	2
Turnip-rooted parsley . . . . .	1
Ugli (see pummelo) . . . . .	10
Upland cress . . . . .	4
Urd bean (see bean [Vigna spp.]) . . . . .	6
U-toy (see cabbage, Chinese [bok choy]) . . . . .	5
Vanilla . . . . .	19
Vegetable marrow (see squash, summer) . . . . .	9
Vegetable pear (see chayote) . . . . .	9
Velvet bean (forage, fodder, straw, hay) . . . . .	18
Vetch (forage, fodder, straw, hay) . . . . .	18
Vine spinach . . . . .	4
Walnut . . . . .	14
Watermelon . . . . .	9
Wax bean (see bean [Phaseolus spp.]) . . . . .	6
Waxgourd, Chinese . . . . .	9
Welsh onion . . . . .	3
Wheat . . . . .	15
Wheat (forage, fodder, straw) . . . . .	16
White flowering broccoli (see broccoli, Chinese) . . . . .	5
White lupin (see bean [Lupinus spp.]) . . . . .	6
White pepper . . . . .	19
White sweet lupin (see bean [Lupinus spp.]) . . . . .	6
White potato (see potato) . . . . .	1
Wild marjoram (see marjoram) . . . . .	19
Wild rice . . . . .	15
Wild rice (forage, fodder, straw) . . . . .	16
Winter cress (see cress, upland) . . . . .	4
Winter melon (see waxgourd, Chinese) . . . . .	9
Winter purslane . . . . .	4
Winter radish (see radish, oriental) . . . . .	1
Winter savory . . . . .	19
Winter squash . . . . .	9
Wintergreen . . . . .	19
Wong bok (see cabbage, Chinese [napa]) . . . . .	5

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Commodities	Crop Group Number
Woodruff . . . . .	19
Wormwood . . . . .	19
Yam, true . . . . .	1
Yam, true (foliage) . . . . .	2
Yam bean . . . . .	1
Yardlong bean (see bean [Vigna spp.]) . . . . .	6
Yellow rocket (see cress, upland) . . . . .	4
Yellow sweet clover (see clover) . . . . .	18
Yellow yam (see yam, true) . . . . .	1
Youngberry (see blackberry) . . . . .	13
Zucchini (see squash, summer) . . . . .	9

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#### 15.4 MRLs for crop groups

- a) Group or subgroup MRLs may be established as a result of the following:
  - a.1) A petition from a person who has submitted an application for the registration of a pesticide under the *Pest Control Products Act* (PCPA).
  - a.2) On the initiative of the PMRA.
- b) Crop group tables are to be used in conjunction with this section for the establishment of crop group MRLs. Each crop group table lists a group of RACs that are considered to be related, for the purposes of this section.
- c) When there is an established or proposed MRL for all of the representative commodities for a specific group or subgroup of related commodities, a MRL may be established for all commodities in the associated group or subgroup. MRLs may be established for a crop group or, alternatively, MRLs may be established for one or more of the subgroups of a crop group.
- d) The representative crops are given as an indication of the minimum residue chemistry database that is acceptable to the Agency for the purposes of establishing a group MRL. The Agency may, at its discretion, allow group MRLs when data on suitable substitutes for the representative crops are available, e.g., garden beet instead of sugar beet.
- e) Since a group MRL reflects maximum residues likely to occur on all individual crops within a group, the proposed or registered patterns of use for all crops in the group or subgroup must be similar before a group MRL is established. The pattern of use consists of the amount of pesticide applied, the number of times applied, the timing of the first

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application, the interval between applications, and the interval between the last application and harvest. The pattern of use will also include the type of application, for example, soil or foliar application, or application by ground or aerial equipment.

- f) When the crop grouping contains commodities or byproducts that are utilized for animal feed, any needed MRL or exemption from a MRL for the pesticide in meat, milk, poultry and/or eggs must be established before a MRL will be granted for the group as a whole. The representative crops include all crops in the group that could be processed such that residues may concentrate in processed food and/or feed. Processing data will be required prior to establishment of a group MRL, and food additive MRLs will not be granted on a group basis.
- g) In general, if maximum residues for the representative crops vary by more than a factor of five from the maximum value observed for any crop in the group, a group or subgroup MRL will ordinarily not be established. In this case, individual crop MRLs, rather than group MRLs, will normally be established.
- h) Alternatively, a commodity with a residue level significantly higher or lower than the other commodities in a group may be excluded from the group MRL, e.g., cereal grains, except corn. In this case, an individual MRL at the appropriate level for the unique commodity would be established, if necessary. The alternative approach of excluding a commodity with a significantly higher or lower residue level will not be used to establish a MRL for a commodity subgroup. Most subgroups have only two representative commodities; to exclude one such commodity and its related residue data would likely provide insufficient residue information to support the remainder of the subgroup. Residue data from crops additional to those representative crops in a grouping may be required for systemic pesticides.
- i) The commodities included in the groups will be updated periodically either at the initiative of the Agency or at the request of an interested party.

## **15.5 Crop group tables**

- i) The tables in this section are to be used in conjunction with the rules described above to establish crop group MRLs.
- ii) Commodities that are not listed are not considered as being included in the groups for the purposes of this paragraph, and individual MRLs must be established. Miscellaneous commodities that are intentionally not included in any group include asparagus, avocado, banana, cranberry, fig, globe artichoke, grape, hops, kiwifruit, mango, mushroom, okra, papaya, pawpaw, peanut, persimmon, pineapple, strawberry, water chestnut, and watercress.

- iii) Each group is identified by a group name and consists of a list of representative commodities followed by a list of all commodity members for the group. If the group includes subgroups, each subgroup lists the subgroup name, the representative commodity or commodities, and the member commodities for the subgroup. Subgroups, which are a subset of their associated crop group, are established for some but not all crops groups.

**(1) Crop Group 1: Root and Tuber Vegetables Group**

**(I) Representative commodities. Carrot, potato, radish, and sugar beet.**

The following Table 1 lists all the commodities included in Crop Group 1 and identifies the related crop subgroups.

**Table 1--Crop Group 1: Root and Tuber Vegetables**

<b>Commodities</b>	<b>Related crop subgroups</b>
Arracacha ( <i>Arracacia xanthorrhiza</i> ) . . . . .	1-C, 1-D
Arrowroot ( <i>Maranta arundinacea</i> ) . . . . .	1-C, 1-D
Artichoke, Chinese ( <i>Stachys affinis</i> ) . . . . .	1-C, 1-D
Artichoke, Jerusalem ( <i>Helianthus tuberosus</i> ) . . . . .	1-C, 1-D
Beet, garden ( <i>Beta vulgaris</i> ) . . . . .	1-A, 1-B
Beet, sugar ( <i>Beta vulgaris</i> ) . . . . .	1-A
Burdock, edible ( <i>Arctium lappa</i> ) . . . . .	1-A, 1-B
Canna, edible (Queensland arrowroot) ( <i>Canna indica</i> ) . . . . .	1-C, 1-D
Carrot ( <i>Daucus carota</i> ) . . . . .	1-A, 1-B
Cassava, bitter and sweet ( <i>Manihot esculenta</i> ) . . . . .	1-C, 1-D
Celeriac (celery root) ( <i>Apium graveolens</i> var. <i>rapaceum</i> ) . . . . .	1-A, 1-B
Chayote (root) ( <i>Sechium edule</i> ) . . . . .	1-C, 1-D
Chervil, turnip-rooted ( <i>Chaerophyllum bulbosum</i> ) . . . . .	1-A, 1-B
Chicory ( <i>Cichorium intybus</i> ) . . . . .	1-A, 1-B
Chufa ( <i>Cyperus esculentus</i> ) . . . . .	1-C, 1-D
Dasheen (taro) ( <i>Colocasia esculenta</i> ) . . . . .	1-C, 1-D
Ginger ( <i>Zingiber officinale</i> ) . . . . .	1-C, 1-D
Ginseng ( <i>Panax quinquefolius</i> ) . . . . .	1-A, 1-B
Horseradish ( <i>Armoracia rusticana</i> ) . . . . .	1-A, 1-B
Leren ( <i>Calathea allouia</i> ) . . . . .	1-C, 1-D
Parsley, turnip-rooted ( <i>Petroselinum crispum</i> var. <i>tuberosum</i> ) . . . . .	1-A, 1-B
Parsnip ( <i>Pastinaca sativa</i> ) . . . . .	1-A, 1-B
Potato ( <i>Solanum tuberosum</i> ) . . . . .	1-C
Radish ( <i>Raphanus sativus</i> ) . . . . .	1-A, 1-B



**Table 1--Crop Group 1: Root and Tuber Vegetables**

<b>Commodities</b>	<b>Related crop subgroups</b>
Radish, oriental (daikon) ( <i>Raphanus sativus</i> subvar. longipinnatus) . . . . .	1-A, 1-B
Rutabaga ( <i>Brassica campestris</i> var. napobrassica) . . . . .	1-A, 1-B
Salsify (oyster plant) ( <i>Tragopogon porrifolius</i> ) . . . . .	1-A, 1-B
Salsify, black ( <i>Scorzonera hispanica</i> ) . . . . .	1-A, 1-B
Salsify, Spanish ( <i>Scolymus hispanicus</i> ) . . . . .	1-A, 1-B
Skirret ( <i>Sium sisarum</i> ) . . . . .	1-A, 1-B
Sweet potato ( <i>Ipomoea batatas</i> ) . . . . .	1-C, 1-D
Tanier (cocoyam) ( <i>Xanthosoma sagittifolium</i> ) . . . . .	1-C, 1-D
Turmeric ( <i>Curcuma longa</i> ) . . . . .	1-C, 1-D
Turnip ( <i>Brassica rapa</i> var. <i>rapa</i> ) . . . . .	1-A, 1-B
Yam bean (jicama, manioc pea) ( <i>Pachyrhizus</i> spp.) . . . . .	1-C, 1-D
Yam, true ( <i>Dioscorea</i> spp) . . . . .	1-C, 1-D

Table 2 identifies the crop subgroups for Crop Group 1, specifies the representative commodity(ies) for each subgroup, and lists all the commodities included in each subgroup.

**Table 2--Crop Group 1 Subgroup Listing**

<b>Representative commodities</b>	<b>Commodities</b>
Crop Subgroup 1-A. Root vegetables subgroup. Carrot, radish, and sugar beet.	Beet, garden; beet, sugar; burdock, edible; carrot; celeriac; chervil, turnip-rooted; chicory; ginseng; horseradish; parsley, turnip-rooted; parsnip; radish; radish, oriental; rutabaga; salsify; salsify, black; salsify, Spanish; skirret; turnip.
Crop Subgroup 1-B. Root vegetables (except sugar beet) subgroup. Carrot and radish	Beet, garden; burdock, edible; carrot; celeriac; chervil, turnip-rooted; chicory; ginseng; horseradish; parsley, turnip-rooted; parsnip; radish; radish, oriental; rutabaga; salsify; salsify, black; salsify, Spanish; skirret; turnip.
Crop Subgroup 1-C. Tuberous and corm vegetables subgroup. Potato	Arracacha; arrowroot; artichoke, Chinese; artichoke, Jerusalem; canna, edible; cassava, bitter and sweet; chayote (root); chufa; dasheen; ginger; leren; potato; sweet potato; tanier; turmeric; yam bean; yam, true.

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**Table 2--Crop Group 1 Subgroup Listing**

<b>Representative commodities</b>	<b>Commodities</b>
Crop Subgroup 1-D. Tuberous and corm vegetables (except potato) subgroup. Sweet potato.	Arracacha; arrowroot; artichoke, Chinese; artichoke, Jerusalem; canna, edible; cassava, bitter and sweet; chayote (root); chufa; dasheen; ginger; leren; sweet potato; tanier; turmeric; yam bean; yam, true.

**(2) Crop Group 2: Leaves of Root And Tuber Vegetables (Human Food Or Animal Feed) Group**

**(I) Representative commodities. Turnip and garden beet or sugar beet.**

ii) Commodities. The following is a list of all the commodities included in Crop Group 2:

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**Crop Group 2:  
Leaves of Root and Tuber Vegetables (Human Food or Animal Feed) Group**

**Commodities**

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Beet, garden (*Beta vulgaris*)  
Beet, sugar (*Beta vulgaris*)  
Burdock, edible (*Arctium lappa*)  
Carrot (*Daucus carota*)  
Cassava, bitter and sweet (*Manihot esculenta*)  
Celeriac (celery root) (*Apium graveolens* var. *rapaceum*)  
Chervil, turnip-rooted (*Chaerophyllum bulbosum*)  
Chicory (*Cichorium intybus*)  
Dasheen (taro) (*Colocasia esculenta*)  
Parsnip (*Pastinaca sativa*)  
Radish (*Raphanus sativus*)  
Radish, oriental (daikon) (*Raphanus sativus* subvar. *longipinnatus*)  
Rutabaga (*Brassica campestris* var. *napobrassica*)  
Salsify, black (*Scorzoneria hispanica*)  
Sweet potato (*Ipomoea batatas*)  
Tanier (cocoyam) (*Xanthosoma sagittifolium*)  
Turnip (*Brassica rapa* var. *rapa*)  
Yam, true (*Dioscorea* spp.)

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**(3) Crop Group 3: Bulb Vegetables (*Allium* spp.) Group**

**(I) Representative commodities. Onion, green; and onion, dry bulb.**

ii) Commodities. The following is a list of all the commodities in Crop Group 3:

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**Crop Group 3:  
Bulb Vegetables (Allium spp.) Group**

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**Commodities**

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Garlic (*Allium sativum*)  
 Garlic, great-headed (elephant) (*Allium ampeloprasum* var. *ampeloprasum*)  
 Leek (*Allium ampeloprasum*, *A. porrum*, *A. tricoccum*)  
 Onion, dry bulb and green (*Allium cepa*, *A. fistulosum*)  
 Onion, Welch (*Allium fistulosum*)  
 Shallot (*Allium cepa* var. *cepa*)

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**(4) Crop Group 4. Leafy Vegetables (Except Brassica Vegetables) Group.**

**(I) Representative commodities. Celery, head lettuce, leaf lettuce, and spinach (*Spinacia oleracea*).**

The following Table 1 lists all the commodities included in Crop Group 4 and identifies the related crop subgroups.

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**Table 1--Crop Group 4: Leafy Vegetables (Except Brassica Vegetables) Group**

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<b>Commodities</b>	<b>Related crop subgroups</b>
Amaranth (leafy amaranth, Chinese spinach, tampala) ( <i>Amaranthus</i> spp.) . . . . .	4-A
Arugula (Roquette) ( <i>Eruca sativa</i> ) . . . . .	4-A
Cardoon ( <i>Cynara cardunculus</i> ) . . . . .	4-B
Celery ( <i>Apium graveolens</i> var. <i>dulce</i> ) . . . . .	4-B
Celery, Chinese ( <i>Apium graveolens</i> var. <i>secalinum</i> ) . . . . .	4-B
Celtuce ( <i>Lactuca sativa</i> var. <i>angustana</i> ) . . . . .	4-B
Chervil ( <i>Anthriscus cerefolium</i> ) . . . . .	4-A
Chrysanthemum, edible-leaved ( <i>Chrysanthemum coronarium</i> var. <i>coronarium</i> ) . . . . .	4-A
Chrysanthemum, garland ( <i>Chrysanthemum coronarium</i> var. <i>spatiosum</i> ) . . . . .	4-A
Corn salad ( <i>Valerianella locusta</i> ) . . . . .	4-A
Cress, garden ( <i>Lepidium sativum</i> ) . . . . .	4-A
Cress, upland (yellow rocket, winter cress) ( <i>Barbarea vulgaris</i> ) . . . . .	4-A
Dandelion ( <i>Taraxacum officinale</i> ) . . . . .	4-A
Dock (sorrel) ( <i>Rumex</i> spp.) . . . . .	4-A
Endive (escarole) ( <i>Cichorium endivia</i> ) . . . . .	4-A
Fennel, Florence (finocchio) ( <i>Foeniculum vulgare</i> Azoricum Group) . . . . .	4-B

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**Table 1--Crop Group 4: Leafy Vegetables (Except Brassica Vegetables) Group**

<b>Commodities</b>	<b>Related crop subgroups</b>
Lettuce, head and leaf ( <i>Lactuca sativa</i> ) . . . . .	4-A
Orach ( <i>Atriplex hortensis</i> ) . . . . .	4-A
Parsley ( <i>Petroselinum crispum</i> ) . . . . .	4-A
Purslane, garden ( <i>Portulaca oleracea</i> ) . . . . .	4-A
Purslane, winter ( <i>Montia perfoliata</i> ) . . . . .	4-A
Radicchio (red chicory) ( <i>Cichorium intybus</i> ) . . . . .	4-A
Rhubarb ( <i>Rheum rhabarbarum</i> ) . . . . .	4-B
Spinach ( <i>Spinacia oleracea</i> ) . . . . .	4-A
Spinach, New Zealand ( <i>Tetragonia tetragonioides</i> , <i>T. expansa</i> ) . . . . .	4-A
Spinach, vine (Malabar spinach, Indian spinach) ( <i>Basella alba</i> ) . . . . .	4-A
Swiss chard ( <i>Beta vulgaris</i> var. <i>cicla</i> ) . . . . .	4-B

The following Table 2 identifies the crop subgroups for Crop Group 4, specifies the representative commodities for each subgroup, and lists all the commodities included in each subgroup.

**Table 2--Crop Group 4 Subgroup Listing**

<b>Representative commodities</b>	<b>Commodities</b>
Crop Subgroup 4-A. Leafy greens subgroup. Head lettuce and leaf lettuce, and spinach ( <i>Spinacia oleracea</i> ).	Amaranth; arugula; chervil; chrysanthemum, edible-leaved; chrysanthemum, garland; corn salad; cress, garden; cress, upland; dandelion; dock; endive; lettuce; orach; parsley; purslane, garden; purslane, winter; radicchio (red chicory); spinach; spinach, New Zealand; spinach, vine.
Crop Subgroup 4-B. Leaf petioles subgroup. Celery.	Cardoon; celery; celery, Chinese; celtuce; fennel, Florence; rhubarb; Swiss chard.

**(5) Crop Group 5: Brassica (Cole) Leafy Vegetables Group**

- (I) Representative commodities. Broccoli or cauliflower; cabbage; and mustard greens.**

The following Table 1 lists all the commodities included in Crop Group 5 and identifies the related crop subgroups.

**Table 1--Crop Group 5: Brassica (Cole) Leafy Vegetables**

<b>Commodities</b>	<b>Related crop subgroups</b>
Broccoli (Brassica oleracea var. botrytis) . . . . .	5-A
Broccoli, Chinese (gai lon) (Brassica alboglabra) . . . . .	5-A
Broccoli raab (rapini) (Brassica campestris) . . . . .	5-B
Brussels sprouts (Brassica oleracea var. gemmifera) . . . . .	5-A
Cabbage (Brassica oleracea) . . . . .	5-A
Cabbage, Chinese (bok choy) (Brassica chinensis) . . . . .	5-B
Cabbage, Chinese (napa) (Brassica pekinensis) . . . . .	5-A
Cabbage, Chinese mustard (gai choy) (Brassica campestris) . . . . .	5-A
Cauliflower (Brassica oleracea var. botrytis) . . . . .	5-A
Cavalo broccolo (Brassica oleracea var. botrytis) . . . . .	5-A
Collards (Brassica oleracea var. acephala) . . . . .	5-B
Kale (Brassica oleracea var. acephala) . . . . .	5-B
Kohlrabi (Brassica oleracea var. gongylodes) . . . . .	5-A
Mizuna (Brassica rapa Japonica Group) . . . . .	5-B
Mustard greens (Brassica juncea) . . . . .	5-B
Mustard spinach (Brassica rapa Perviridis Group) . . . . .	5-B
Rape greens (Brassica napus) . . . . .	5-B

The following Table 2 identifies the crop subgroups for Crop Group 5, specifies the representative commodity(ies) for each subgroup, and lists all the commodities included in each subgroup.

**Table 2--Crop Group 5 Subgroup Listing**

<b>Representative commodities</b>	<b>Commodities</b>
Crop Subgroup 5-A. Head and stem Brassica subgroup Broccoli or cauliflower; and cabbage.	Broccoli; broccoli, Chinese; brussels sprouts; cabbage; cabbage, Chinese (napa); cabbage, Chinese mustard; cauliflower; cavalo broccolo; kohlrabi
Crop Subgroup 5-B. Leafy Brassica greens subgroup. Mustard greens.	Broccoli raab; cabbage, Chinese (bok choy); collards; kale; mizuna; mustard greens; mustard spinach; rape greens

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**(6) Crop Group 6: Legume Vegetables (Succulent or Dried) Group**

**(I) Representative commodities. Bean (*Phaseolus* spp.; one succulent cultivar and one dried cultivar); pea (*Pisum* spp.); one succulent cultivar and one dried cultivar); and soybean.**

The following Table 1 lists all the commodities included in Crop Group 6 and identifies the related crop subgroups.

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**Table 1--Crop Group 6: Legume Vegetables (Succulent or Dried)**

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<b>Commodities</b>	<b>Related crop subgroups</b>
Bean ( <i>Lupinus</i> spp.) (includes grain lupin, sweet lupin, white lupin, and white sweet lupin)	6-C
Bean ( <i>Phaseolus</i> spp.) (includes field bean, kidney bean, lima bean, navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean)	6-A, 6-B, 6-C
Bean ( <i>Vigna</i> spp.) (includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, Crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean, yardlong bean)	6-A, 6-B, 6-C
Broad bean (fava bean) ( <i>Vicia faba</i> )	6-B, 6-C
Chickpea (garbanzo bean) ( <i>Cicer arietinum</i> )	6-C
Guar ( <i>Cyamopsis tetragonoloba</i> )	6-C
Jackbean ( <i>Canavalia ensiformis</i> )	6-A
Lablab bean (hyacinth bean) ( <i>Lablab purpureus</i> )	6-C
Lentil ( <i>Lens esculenta</i> )	6-C
Pea ( <i>Pisum</i> spp.) (includes dwarf pea, edible-pod pea, English pea, field pea, garden pea, green pea, snow pea, sugar snap pea)	6-A, 6-B, 6-C
Pigeon pea ( <i>Cajanus cajan</i> )	6-A, 6-B, 6-C
Soybean ( <i>Glycine max</i> )	N/A
Soybean (immature seed) ( <i>Glycine max</i> )	6-A
Sword bean ( <i>Canavalia gladiata</i> )	6-A

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The following Table 2 identifies the crop subgroups for Crop Group 6, specifies the representative commodities for each subgroup, and lists all the commodities included in each subgroup.

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**Table 2--Crop Group 6 Subgroup Listing**

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<b>Representative commodities</b>	<b>Commodities</b>
Crop Subgroup 6-A. Edible-podded legume vegetables subgroup. Any one succulent cultivar of edible-podded bean ( <i>Phaseolus</i> spp.) and any one succulent cultivar of edible-podded pea ( <i>Pisum</i> spp.).	Bean ( <i>Phaseolus</i> spp.) (includes runner bean, snap bean, wax bean); bean ( <i>Vigna</i> spp.) (includes asparagus bean, Chinese longbean, moth bean, yardlong bean); jackbean; pea ( <i>Pisum</i> spp.) (includes dwarf pea, edible-pod pea, snow pea, sugar snap pea); pigeon pea; soybean (immature seed); sword bean.
Crop Subgroup 6-B. Succulent shelled pea and bean subgroup. Any succulent shelled cultivar of bean ( <i>Phaseolus</i> spp.) and garden pea ( <i>Pisum</i> spp.).	Bean ( <i>Phaseolus</i> spp.) (includes lima bean (green)); broad bean (succulent); bean ( <i>Vigna</i> spp.) (includes blackeyed pea, cowpea, southern pea); pea ( <i>Pisum</i> spp.) (includes English pea, garden pea, green pea); pigeon pea.
Crop Subgroup 6-C. Dried shelled pea and bean (except soybean) subgroup Any one dried cultivar of bean ( <i>Phaseolus</i> spp.); and any one dried cultivar of pea ( <i>Pisum</i> spp.).	Dried cultivars of bean ( <i>Lupinus</i> spp.) (includes grain lupin, sweet lupin, white lupin, and white sweet lupin); ( <i>Phaseolus</i> spp.) (includes field bean, kidney bean, lima bean (dry), navy bean, pinto bean; tepary bean; bean ( <i>Vigna</i> spp.) (includes adzuki bean, blackeyed pea, catjang, cowpea, Crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean); broad bean (dry); chickpea; guar; lablab bean; lentil; pea ( <i>Pisum</i> spp.) (includes field pea); pigeon pea.

**(7) Crop group 7: Foliage of Legume Vegetables Group**

**(I) Representative commodities. Any cultivar of bean (*Phaseolus* spp.), field pea (*Pisum* spp.), and soybean.**

The following Table 1 lists the commodities included in Crop Group 7.

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**Table 1--Crop Group 7: Foliage of Legume Vegetables Group**

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<b>Representative commodities</b>	<b>Commodities</b>
Any cultivar of bean ( <i>Phaseolus</i> spp.) and field pea ( <i>Pisum</i> spp.), and soybean ( <i>Glycine max</i> ).	Plant parts of any legume vegetable included in the legume vegetables that will be used as animal feed.

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The following Table 2 identifies the crop subgroup for Crop Group 7 and specifies the representative commodities for the subgroup, and lists all the commodities included in the subgroup.

**Table 2--Crop Group 7 Subgroup Listing**

<b>Representative commodities</b>	<b>Commodities</b>
Crop Subgroup 7-A. Foliage of legume vegetables (except soybeans) subgroup Any cultivar of bean ( <i>Phaseolus</i> spp.), and field pea ( <i>Pisum</i> spp.).	Plant parts of any legume vegetable (except soybeans) included in the legume vegetables group that will be used as animal feed.

**(8) Crop Group 8. Fruiting Vegetables (Except Cucurbits) Group.**

**(I) Representative commodities. Tomato, bell pepper, and one cultivar of non-bell pepper.**

(ii) Commodities. The following is a list of all the commodities included in Crop Group 8:

**Crop Group 8: Fruiting Vegetables (Except Cucurbits)**

**Commodities**

Eggplant (*Solanum melongena*)  
Groundcherry (*Physalis* spp.)  
Pepino (*Solanum muricatum*)  
Pepper (*Capsicum* spp.)  
(includes bell pepper, chili pepper, cooking pepper, pimento, sweet pepper)  
Tomatillo (*Physalis ixocarpa*)  
Tomato (*Lycopersicon esculentum*)

**(9) Crop Group 9: Cucurbit Vegetables Group**

**(I) Representative commodities. Cucumber, muskmelon, and summer squash.**

The following Table 1 lists all the commodities included in Crop Group 9 and identifies the related subgroups.

**Table 1--Crop Group 9: Cucurbit Vegetables**

<b>Commodities</b>	<b>Related crop subgroups</b>
Chayote (fruit) ( <i>Sechium edule</i> )	9-B



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**Table 1--Crop Group 9: Cucurbit Vegetables**

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<b>Commodities</b>	<b>Related crop subgroups</b>
Chinese waxgourd (Chinese preserving melon) ( <i>Benincasa hispida</i> )	9-B
Citron melon ( <i>Citrullus lanatus</i> var. <i>citroides</i> )	9-A
Cucumber ( <i>Cucumis sativus</i> )	9-B
Gherkin ( <i>Cucumis anguria</i> )	9-B
Gourd, edible ( <i>Lagenaria</i> spp.) (hyotan, cucuzza); ( <i>Luffa acutangula</i> , <i>L. cylindrica</i> ) (includes hechima, Chinese okra)	9-B
Momordica spp. (includes balsam apple, balsam pear, bitter melon, Chinese cucumber)	9-B
Muskmelon (hybrids and/or cultivars of <i>Cucumis melo</i> ) (includes true cantaloupe, cantaloupe, casaba, crenshaw melon, golden pershaw melon, honeydew melon, honey balls, mango melon, Persian melon, pineapple melon, Santa Claus melon, and snake melon)	9-A
Pumpkin ( <i>Cucurbita</i> spp.)	9-B
Squash, summer ( <i>Cucurbita pepo</i> var. <i>meloepo</i> ) (includes crookneck squash, scallop squash, straightneck squash, vegetable marrow, zucchini)	9-B
Squash, winter ( <i>Cucurbita maxima</i> ; <i>C. moschata</i> ) (includes butternut squash, calabaza, hubbard squash); ( <i>C. mixta</i> ; <i>C. pepo</i> ) (includes acorn squash, spaghetti squash)	9-B
Watermelon (includes hybrids and/or varieties of <i>Citrullus lanatus</i> )	9-A

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The following Table 2 identifies the crop subgroups for Crop Group 9, specifies the representative commodities for each subgroup, and lists all the commodities included in each subgroup.

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**Table 2--Crop Group 9 Subgroup Listing**

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<b>Representative commodities</b>	<b>Commodities</b>
Crop Subgroup 9-A. Melon subgroup	Citron melon; muskmelon; watermelon
Cantaloupes Crop Subgroup 9-B. Squash/cucumber subgroup.	Chayote (fruit); Chinese waxgourd; cucumber; gherkin; gourd, edible; Momordica spp.; pumpkin; squash
One cultivar of summer squash and cucumber.	summer; squash, winter.

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**(10) Crop Group 10: Citrus Fruits (Citrus spp., Fortunella spp) Group**

**(I) Representative commodities. Sweet orange; lemon and grapefruit.**

(ii) Commodities. The following is a list of all the commodities in Crop Group 10:

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**Crop Group 10: Citrus Fruits (Citrus spp., Fortunella spp.) Group**

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**Commodities**

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Calamondin (Citrus mitis X Citrofortunella mitis)  
Citrus citron (Citrus medica)  
Citrus hybrids (Citrus spp.) (includes chironja, tangelo, tangor)  
Grapefruit (Citrus paradisi)  
Kumquat (Fortunella spp.)  
Lemon (Citrus jambhiri, Citrus limon)  
Lime (Citrus aurantiifolia)  
Mandarin (tangerine) (Citrus reticulata)  
Orange, sour (Citrus aurantium)  
Orange, sweet (Citrus sinensis)  
Pummelo (Citrus grandis, Citrus maxima)  
Satsuma mandarin (Citrus unshiu)

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**(11) Crop Group 11: Pome Fruits Group**

**(I) Representative commodities. Apple and pear.**

(ii) Commodities. The following is a list of all the commodities included in Crop Group 11:

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**Crop Group 11: Pome Fruits Group**

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**Commodities**

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Apple (Malus domestica)  
Crabapple (Malus spp.)  
Loquat (Eriobotrya japonica)  
Mayhaw (Crataegus aestivalis, C. opaca, and C. rufula)  
Pear (Pyrus communis)  
Pear, oriental (Pyrus pyrifolia)  
Quince (Cydonia oblonga)

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**(12) Crop Group 12: Stone Fruits Group**

**(I) Representative commodities. Sweet cherry or tart cherry; peach; and plum or fresh prune (*Prunus domestica*, *Prunus* spp.).**

(ii) Commodities. The following is a list of all the commodities included in Crop Group 12:

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**Crop Group 12: Stone Fruits Group**

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**Commodities**

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Apricot (*Prunus armeniaca*)  
Cherry, sweet (*Prunus avium*),  
Cherry, tart (*Prunus cerasus*)  
Nectarine (*Prunus persica*)  
Peach (*Prunus persica*)  
Plum (*Prunus domestica*, *Prunus* spp.)  
Plum, Chickasaw (*Prunus angustifolia*)  
Plum, Damson (*Prunus domestica* spp. *insititia*)  
Plum, Japanese (*Prunus salicina*)  
Plumcot (*Prunus. armeniaca* X *P. domestica*)  
Prune (fresh) (*Prunus domestica*, *Prunus* spp.)

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**(13) Crop Group 13: Berries Group**

**(I) Representative commodities. Any one blackberry or any one raspberry; and blueberry.**

The following Table 1 lists all the commodities included in Crop Group 13 and identifies the related subgroups.

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**Table 1--Crop Group 13: Berries Group**

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<b>Commodities</b>	<b>Related crop subgroups</b>
Blackberry ( <i>Rubus eubatus</i> ) (including bingleberry, black satin berry, boysenberry, Cherokee blackberry, Chesterberry, Cheyenne blackberry, coryberry, darrowberry, dewberry, Dirksen thornless berry, Himalayaberry, hullberry, Lavacaberry, lowberry, Lucretiaberry, mammoth blackberry, marionberry, nectarberry, olallieberry, Oregon evergreen berry, phenomenalberry, rangeberry, ravenberry, rossberry, Shawnee blackberry, youngberry, and varieties and/or hybrids of these)	13-A
Blueberry ( <i>Vaccinium</i> spp.)	13-B
Currant ( <i>Ribes</i> spp.)	13-B
Elderberry ( <i>Sambucus</i> spp.)	13-B

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**Table 1--Crop Group 13: Berries Group**

<b>Commodities</b>	<b>Related crop subgroups</b>
Gooseberry (Ribes spp.)	13-B
Huckleberry (Gaylussacia spp.)	13-B
Loganberry (Rubus loganobaccus)	13-A
Raspberry, black and red (Rubus occidentalis, Rubus strigosus, Rubus idaeus)	13-A

The following Table 2 identifies the crop subgroups for Crop Group 13, specifies the representative commodities for each subgroup, and lists all the commodities included in each subgroup.

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**Table 2--Crop Group 13 Subgroups Listing**

<b>Representative commodities</b>	<b>Commodities</b>
Crop Subgroup 13-A. Caneberry (blackberry and raspberry) subgroup. Any one blackberry or any one raspberry.	Blackberry; loganberry; red and black raspberry; cultivars and/or hybrids of these.
Crop Subgroup 13-B. Bushberry subgroup. Blueberry, highbush.....	Blueberry, highbush and lowbush; currant; elderberry; gooseberry; huckleberry.

**(14) Crop Group 14: Tree Nuts Group**

**(I) Representative commodities. Almond and pecan.**

(ii) Commodities. The following is a list of all the commodities included in Crop Group 14:

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**Crop Group 14: Tree Nuts**

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**Commodities**

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Almond (*Prunus dulcis*)  
Beech nut (*Fagus* spp.)  
Brazil nut (*Bertholletia excelsa*)  
Butternut (*Juglans cinerea*)  
Cashew (*Anacardium occidentale*)  
Chestnut (*Castanea* spp.)  
Chinquapin (*Castanea pumila*)  
Filbert (hazelnut) (*Corylus* spp.)  
Hickory nut (*Carya* spp.)  
Macadamia nut (bush nut) (*Macadamia* spp.)  
Pecan (*Carya illinoensis*)  
Walnut, black and English (Persian) (*Juglans* spp.)

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**(15) Crop Group 15: Cereal Grains Group**

**(I) Representative commodities. Corn (fresh sweet corn and dried field corn), barley, and wheat.**

(ii) Commodities. The following is a list of all the commodities included in Crop Group 15:

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**Crop Group 15: Cereal Grains**

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**Commodities**

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Barley (*Hordeum* spp.)  
Buckwheat (*Fagopyrum esculentum*)  
Corn (*Zea mays*)  
Millet, pearl (*Pennisetum glaucum*)  
Millet, proso (*Panicum milliaceum*)  
Oats (*Avena* spp.)  
Popcorn (*Zea mays* var. *everta*)  
Rice (*Oryza sativa*)  
Rye (*Secale cereale*)  
Sorghum (milo) (*Sorghum* spp.)  
Teosinte (*Euchlaena mexicana*)  
Triticale (*Triticum-Secale* hybrids)  
Wheat (*Triticum* spp.)  
Wild rice (*Zizania aquatica*)

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**(16) Crop Group 16: Forage, Fodder, and Straw of Cereal Grains Group**

**(I) Representative commodities. Corn, wheat, and any other cereal grain crop.**

(ii) Commodities. The commodities included in Crop Group 16 are: Forage, fodder, and straw of all commodities included in the group cereal grains group.

**(17) Crop Group 17: Grass Forage, Fodder, and Hay Group**

**(I) Representative commodities. Bermuda grass; bluegrass; and bromegrass or fescue.**

(ii) Commodities. The commodities included in Crop Group 17 are: Any grass, Gramineae family (either green or cured) except sugarcane and those included in the cereal grains group, that will be fed to or grazed by livestock, all pasture and range grasses and grasses grown for hay or silage.

**(18) Crop Group 18: Nongrass Animal Feeds (Forage, Fodder, Straw, And Hay) Group**

**(I) Representative commodities. Alfalfa and clover (Trifolium spp.).**

(ii) Commodities. The following is a list of all the commodities included in Crop Group 18:

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**Crop Group 18: Nongrass Animal Feeds (Forage, Fodder, Straw, and Hay) Group**

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**Commodities**

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Alfalfa (*Medicago sativa* subsp. *sativa*)  
Bean, velvet (*Mucuna pruriens* var. *utilis*)  
Clover (*Trifolium* spp., *Melilotus* spp.)  
Kudzu (*Pueraria lobata*)  
Lespedeza (*Lespedeza* spp.)  
Lupin (*Lupinus* spp.)  
Sainfoin (*Onobrychis viciifolia*);  
Trefoil (*Lotus* spp.)  
Vetch (*Vicia* spp.)Vetch, crown (*Coronilla varia*)  
Vetch, milk (*Astragalus* spp).

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**(19) Crop Group 19: Herbs And Spices Group**

**(I) Representative commodities. Basil (fresh and dried); black pepper; chive; and celery seed or dill seed.**

The following Table 1 lists all the commodities included in Crop Group 19 and identifies the related subgroups.

**Table 1--Crop Group 19: Herbs and Spices Group**

<b>Commodities</b>	<b>Related crop subgroups</b>
Allspice ( <i>Pimenta dioica</i> )	19-B
Angelica ( <i>Angelica archangelica</i> )	19-A
Anise (anise seed) ( <i>Pimpinella anisum</i> )	19-B
Anise, star ( <i>Illicium verum</i> )	19-B
Annatto (seed)	19-B
Balm (lemon balm) ( <i>Melissa officinalis</i> )	19-A
Basil ( <i>Ocimum basilicum</i> )	19-A
Borage ( <i>Borago officinalis</i> )	19-A
Burnet ( <i>Sanguisorba minor</i> )	19-A
Camomile ( <i>Anthemis nobilis</i> )	19-A
Caper buds ( <i>Capparis spinosa</i> )	19-B
Caraway ( <i>Carum carvi</i> )	19-B
Caraway, black ( <i>Nigella sativa</i> )	19-B
Cardamom ( <i>Elettaria cardamomum</i> )	19-B
Cassia bark ( <i>Cinnamomum aromaticum</i> )	19-B
Cassia buds ( <i>Cinnamomum aromaticum</i> )	19-B
Catnip ( <i>Nepeta cataria</i> )	19-A
Celery seed ( <i>Apicum graveolens</i> )	19-B
Chervil (dried) ( <i>Anthriscus cerefolium</i> )	19-A
Chive ( <i>Allium schoenoprasum</i> )	19-A
Chive, Chinese ( <i>Allium tuberosum</i> )	19-A
Cinnamon ( <i>Cinnamomum verum</i> )	19-B
Clary ( <i>Salvia sclarea</i> )	19-A
Clove buds ( <i>Eugenia caryophyllata</i> )	19-B
Coriander (cilantro or Chinese parsley) (leaf) ( <i>Coriandrum sativum</i> )	19-A
Coriander (cilantro) (seed) ( <i>Coriandrum sativum</i> )	19-B
Costmary ( <i>Chrysanthemum balsamita</i> )	19-A
Culantro (leaf) ( <i>Eryngium foetidum</i> )	19-A
Culantro (seed) ( <i>Eryngium foetidum</i> )	19-B

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**Table 1--Crop Group 19: Herbs and Spices Group**

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<b>Commodities</b>	<b>Related crop subgroups</b>
Cumin ( <i>Cuminum cyminum</i> )	19-B
Curry (leaf) ( <i>Murraya koenigii</i> )	19-A
Dill (dillweed) ( <i>Anethum graveolens</i> )	19-A
Dill (seed) ( <i>Anethum graveolens</i> )	19-B
Fennel (common) ( <i>Foeniculum vulgare</i> )	19-B
Fennel, Florence (seed) ( <i>Foeniculum vulgare</i> Azoricum Group)	19-B
Fenugreek ( <i>Trigonella foenumgraecum</i> )	19-B
Grains of paradise ( <i>Aframomum melegueta</i> )	19-B
Horehound ( <i>Marrubium vulgare</i> )	19-A
Hyssop ( <i>Hyssopus officinalis</i> )	19-A
Juniper berry ( <i>Juniperus communis</i> )	19-B
Lavender ( <i>Lavandula officinalis</i> )	19-A
Lemongrass ( <i>Cymbopogon citratus</i> )	19-A
Lovage (leaf) ( <i>Levisticum officinale</i> )	19-A
Lovage (seed) ( <i>Levisticum officinale</i> )	19-B
Mace ( <i>Myristica fragrans</i> )	19-B
Marigold ( <i>Calendula officinalis</i> )	19-A
Marjoram ( <i>Origanum</i> spp.) (includes sweet or annual marjoram, wild marjoram or oregano, and pot marjoram)	19-A
Mustard (seed) ( <i>Brassica juncea</i> , <i>B. hirta</i> , <i>B. nigra</i> )	19-B
Nasturtium ( <i>Tropaeolum majus</i> )	19-A
Nutmeg ( <i>Myristica fragrans</i> )	19-B
Parsley (dried) ( <i>Petroselinum crispum</i> )	19-A
Pennyroyal ( <i>Mentha pulegium</i> )	19-A
Pepper, black ( <i>Piper nigrum</i> )	19-B
Pepper, white	19-B
Poppy (seed) ( <i>Papaver somniferum</i> )	19-B
Rosemary ( <i>Rosemarinus officinalis</i> )	19-A
Rue ( <i>Ruta graveolens</i> )	19-A
Saffron ( <i>Crocus sativus</i> )	19-B
Sage ( <i>Salvia officinalis</i> )	19-A
Savory, summer and winter ( <i>Satureja</i> spp.)	19-A



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**Table 1--Crop Group 19: Herbs and Spices Group**

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<b>Commodities</b>	<b>Related crop subgroups</b>
Sweet bay (bay leaf) ( <i>Laurus nobilis</i> )	19-A
Tansy ( <i>Tanacetum vulgare</i> )	19-A
Tarragon ( <i>Artemisia dracunculus</i> )	19-A
Thyme ( <i>Thymus</i> spp.)	19-A
Vanilla ( <i>Vanilla planifolia</i> )	19-B
Wintergreen ( <i>Gaultheria procumbens</i> )	19-A
Woodruff ( <i>Galium odorata</i> )	19-A
Wormwood ( <i>Artemisia absinthium</i> )	19-A

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The following Table 2 identifies the crop subgroups for Crop Group 19, specifies the representative commodities for each subgroup, and lists all the commodities included in each subgroup.

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**Table 2--Crop Group 19 Subgroups**

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<b>Representative commodities</b>	<b>Commodities</b>
Crop Subgroup 19-A. Herb subgroup. Basil (fresh and dried) and chive.	Angelica; balm; basil; borage; burnet; camomile; catnip; chervil (dried); chive; chive, Chinese, clary; coriander (leaf); costmary; culantro (leaf); curry (leaf); dillweed; horehound; hyssop; lavender; lemongrass; lovage (leaf); marigold; marjoram ( <i>Origanum</i> spp.); nasturtium; parsley (dried); pennyroyal; rosemary; sweet bay; tansy; tarragon; thyme; wintergreen; woodruff; and wormwood.
Crop Subgroup 19-B. Spice subgroup. Black pepper; and celery seed or dill seed.	Allspice; anise (seed); anise, star; annatto (seed); caper (buds); caraway; caraway, black; cardamom; cassia (buds); celery (seed); cinnamon; clove (buds); coriander (seed); culantro (seed); cumin; dill (seed); fennel, common; fennel, Florence (seed); fenugreek; grains of paradise; juniper (berry); lovage (seed); mace; mustard (seed); nutmeg; pepper, black; pepper, white; poppy (seed); saffron; and vanilla.

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**(20) Crop Group 20: Oilseed**

**(I) Representative commodities. Rape seed and sunflower**

(ii) Commodities. The following is a list of all the commodities included in Crop Group 20:

Rape Seed (Brassica napus)  
Rape Seed, Indian (Brassica campestris)  
Mustard seed, Indian (Brassica juncea)  
Mustard seed, Field (Brassica campestris)  
Mustard seed (Brassica nigra; Sinapis alba)  
Flax; Linseed (Linum usitatissimum)  
Sunflower seed(Helianthus annuus)  
Safflower(Carthamus tinctorius)

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