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Pesticide risk profile for the feeding of sugarcane tops and trash to animals

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Abbreviations

ai	active ingredient
APVMA	Australian Pesticide and Veterinary Medicines Authority
bw	body weight
DM	dry matter
ECRP	Existing Chemical Review Program
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
g	gram
GAP	good agricultural practice
ha	hectare
HAFT	Highest average field trial
JMPR	Joint Meeting on Pesticide Residues
kg	kilogram
LOD	Limit of detection for the analytical method, sometimes also used for limit of determination which is the same as LOQ
LOQ	limit of analytical quantitation
mby	meat by products
mg	milligram = 0.001 grams
MRL	maximum residue limit
N	Negligible residue (when next to US MRL)
PAFC	primary animal feed commodity
PHI	pre-harvest interval
P _{ow}	octanol water partition coefficient
ppm	parts per million = mg/kg
PSD	Pesticide Safety Directorate
TF	transfer factor = concentration in animal tissue or milk divided by concentration in feed
TRR	total radioactive residue
US EPA	United States of America Environmental Protection Agency
WHP	withholding period
*	before MRL indicates that the residue is at or about the LOQ, <i>i.e.</i> should be less than the LOQ.

Table of Contents

Disclaimer	2
Acknowledgements	2
Abbreviations	3
Assessment of currently registered chemicals used on sugarcane	7
Assessment of persistent organochlorine pesticides	8
Appendix 1	10
2,2-DPA (2,2-dichloropropionic acid also known as dalapon)	10
2,4-D	10
Aldicarb	11
Ametryn	11
Asulam	12
Atrazine	12
Bifenthrin	12
Cadusafos	13
Carbendazim	13
Carbofuran	13
Chlorpyrifos	13
Coumatetralyl	14
Diazinon	14
Dicamba	14
Diquat	15
Diuron	15
Ethephon	16
Ethoxysulfuron	16
Fenamiphos	17
Fipronil	17
Fluroxypyr	18
Glyphosate	19
Halosulfuron-methyl	19
Hexazinone	19
Imazapic	21
Imidacloprid	21
Ioxynil	22
Isoxaflutole	22
MCPA (4-chloro-2-methylphenoxy)acetic acid	22
Mercury as methoxyethyl mercuric chloride	23
Metolachlor	23
MSMA (monosodium methylarsenate)	23
Paraquat	24
Pendimethalin	24
Permethrin	24
Picloram	25
Prochloraz	25
Propiconazole	26
Tebuconazole	26
Terbutryn	26

Triadimefon.....	27
Triadimenol.....	27
Trichlorfon.....	27
Trifloxysulfuron.....	27
Trifluralin.....	28
Trinexapac-ethyl.....	28

Potential for violative residues in cattle and sheep fed contaminated sugarcane tops and trash

A relatively abundant potential source of animal feed in Queensland is sugarcane waste, trash and tops. The following details the potential risk that the feeding of such waste to animals poses to Australian trade in red meat.

Estimates of residues in livestock tissues and milk are usually made based on the propensity of a chemical to transfer to tissues and milk combined with anticipated animal dietary exposure.

Most experiments in the area of transfer of pesticide residues to animal tissues and milk following ingestion have been designed based on the requirements of regulators. The relevant studies required are livestock metabolism studies (lactating goat or dairy cow) and animal transfer (feeding) studies.

The feeding studies are used to determine transfer factors (TF) that are defined as the ratio of the pesticide residue in the tissue or commodity of interest (fat, muscle, liver, kidney or milk) to the residue in the diet (expressed on a dry matter intake basis).

In utilizing transfer factors derived from feeding or metabolism studies for risk assessment management purposes, the user needs to be aware of the limitations and assumptions used. The TF derived is dependent on the duration of the feeding or dosing, the concentration in the feed or dose level, the nature of the feed (if added to the feed), lactational status, bodyweight, age, sex and breed of the animal studied. For chemicals administered as a mixture, the presence of other chemicals may alter the metabolism and/or rate of excretion by induction of the various routes of decontamination. The duration of a feeding study required for the steady state concentration to be reached in tissue or milk is a function of the elimination half-life. Residue definitions set by different regulators are not always the same and residue definition is a factor that should also be taken into account when utilizing TF for managing residue risks and trade. Care must be taken in extrapolating TFs from goat metabolism studies to all ruminants as is demonstrated by endosulfan, for which the residue definition is the sum of α -endosulfan, β -endosulfan and endosulfan sulphate, where only low levels of residues are found in goats but significant transfer to tissues occurs for cattle^{1,2}.

The transfer factors utilised here were calculated from residues reported in the scientific literature using, where reported, the highest individual animal tissue, or in the case of milk the average, residue divided by the nominal feed level, else the mean residues were used.

For the purposes of profiling risk conservative estimates of animal dietary burden (intake) are required. The APVMA “*Stockfeed Guideline Document 1 Primary Feed Commodities As A Proportion of Livestock Diets*” (Version 1.1 March 2002)³ lists the maximum proportion of sugar cane tops (fodder) included in animal feed as 100% and this was used in the current evaluation. Estimates of residues in sugar cane tops were obtained from scaling of literature studies, MRLs or based on conservative assumptions. The dietary burden is then the residue in crop \times maximum proportion in the diet. To overcome errors that may result from differences in moisture contents of

¹ Indraningsih, McSweeney, C.S. & Ladds, P.W. (1993) Residues of endosulfan in the tissues of lactating goats. *Aust. Vet. J.*, **70**, 59-62.

² Reregistration Eligibility Decision for Endosulfan Case No. 0014 EPA 738-R-02-013 November 2002 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.

<http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

³ http://www.apvma.gov.au/residues/Stockfeed_Guideline_1.pdf

feed items it is accepted practice to calculate dietary burdens for a ration on a dry matter basis (40% DM assumed where necessary).

The estimated residue in animal commodities is:

$$\text{Residue} = TF \times \text{dietary burden} \text{ [ppm DM basis]}$$

Assessment of currently registered chemicals used on sugarcane

It is assumed that the sugarcane is harvested at maturity and that the trash and tops are derived at this time and that the crop was treated at the maximum rate permitted in the relevant product label⁴. The potential for violative residues in animals is assessed against the Australian, Codex and US tolerances as listed in February 2010⁵. Other markets may have different standards however, for the bulk of Australian meat exports it is assumed that if the lower of these tolerances (or the LOQ of the analytical method if no Codex or US tolerance exists) can be met, the feeding of sugarcane waste will not pose an unacceptable risk.

Appendix 1 provides the details of a risk assessment for each of the compounds registered in Australia for use on sugarcane. The conclusion of the assessment is that risk of residue violations for the chemicals in appendix 1 in animals fed sugarcane trash or tops is low. This is not surprising as most of the chemicals are herbicides and as such are generally applied early in the growth cycle of sugarcane. In addition most herbicides have low fat solubility and are rapidly cleared upon feeding to animals.

Most of the compounds registered for use on sugarcane also have registrations in other crops that are major animal feed commodities. Indeed, for most compounds listed in appendix 1 the major route of exposure for animals to the chemical is expected to be through feeding of these other crops (e.g. pasture, cereal waste etc). To date, none of the chemicals listed in appendix 1 have caused disruption to the Australian red meat trade.

Based on the available information, the following pesticides are identified as requiring further investigation and/or the development of additional risk management strategies:

Pesticide	Tissue	Residue (mg/kg)		Decline information located	
		Estimated ¹	Target ²	Crop	Animal
Picloram	Kidney	0.5	0.01	No	Yes
Terbutryn	Offal	3	0.01	No	No

¹residue in tissue estimated using assumptions outlined above

²target residue = lowest of Australian, Codex and US MRL or in absence of these the LOQ (often assumed to be 0.01 mg/kg)

Adequate data were not located to enable an assessment to be made for the following compounds: fluroxypyr.

The current assessment has only identified pesticides of concern and not considered industry based QA programs that address the potential for residues in animal feeds to transfer to animals and

⁴ In general, only one or two product labels were selected per pesticide. There is a possibility that the maximum permitted rate may be higher than identified.

⁵ MRLs and approved use patterns change with time. The assessments include the most recent decisions of the Codex Alimentarius Commission (32nd Session, July 2009) with regard to Codex MRLs, US tolerances as listed in the Code of Federal Regulations at February 2010 and MRLs as they appear in Table 1 of the APVMA *MRL Standard* as at February 2010.

mitigate risks; The National Vendor Declaration (NVD) form for traded livestock and the Commodity Vendor Declaration (CVD) and By-product Vendor Declaration (BVD) forms which are used for traded livestock feedstuffs.

Assessment of persistent organochlorine pesticides

It should be noted that cane growers have in the past used persistent organochlorine compounds (OCs) and that the trash/tops may be contaminated with organochlorine residues. The last use of persistent organochlorines was in the early 1990s. The following OCs were used on sugarcane in Australia prior to 1985-1987 when they were deregistered; BHC, dieldrin/aldrin, heptachlor and lindane.

Persistent organochlorine compounds are the most commonly monitored analytes in surveillance programs. The table below shows some internationally accepted MRLs for the OCs that have been registered in Australia for use on sugarcane; BHC, dieldrin, heptachlor and lindane.

International MRLs for beef fat

Compound	MRL (mg/kg)						
	Australia	Codex	Canada	EU	Japan	Korea	USA
BHC	0.3	-	-	0.3	-	2	0.3
Dieldrin/aldrin	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Heptachlor	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Lindane	2	2	2	2	-	-	7

Note Japan and Korea will utilise Codex MRLs when they have not set tolerances of their own

In Australia, the following stock food MRLs apply. They have been set at levels that will ensure that the Australian (and international) MRLs for meat (fat) will be met.

Standards for stock food in NSW and Queensland

Compound	Primary animal feed commodity MRL (mg/kg)		
	NSW ¹	Qld ²	MRL Standard ³
BHC	0.02	0.02	0.02 (*0.005)
Dieldrin/aldrin	0.01	0.01	0.01 (*0.01)
Heptachlor	0.02	0.02	0.02 (0.02)
Lindane	0.1	0.1	0.1

¹ *Stock Foods Act 1940; Stock Foods Regulation 1997*

² *Agricultural Standards Regulation 1997 (adopts stock food tolerances from Table 4 of the MRL Standard)*

³ figures in parentheses are for sugarcane

Provided that the sugarcane trash and/or tops meet the Australian standard for the different OCs, there should not be any concerns over violative residues. The above table also includes the extraneous MRLs for sugarcane listed in the MRL Standard. It should be noted that the extraneous MRLs for sugarcane are all lower than the relevant primary animal feed MRLs. The sugarcane MRLs are based on monitoring data and reflect the residue levels expected in tops and trash. As stated above, provided these MRLs are met there should not be any concerns over the feeding of tops and trash to animals.

To ensure that sugarcane waste fed to animals does not present any residue concerns, the OC residue status of the trash should be first determined (by residue analysis) before feeding trash or tops to animals. If the Australian standards for stockfood are met then the waste could be allowed to

be fed to animals, else the waste should be disposed of by other means. This could be achieved through purchasers of stock feed requiring a certificate of analysis detailing the OC residue status of the feed.

Results of cane top analyses from Queensland indicate that the major source of OCs is not the foliage but any adhering soil (*pers. comm.* Rick Webster). Strategies can be implemented to minimise contamination from soil such as ensuring the tynes are set high when bailing tops or trash.

In summary, provided adequate care is taken to identify the OC residue status of the tops and trash there does not appear to be any reason to deny the feeding of sugarcane tops and trash to animals.

Appendix 1

2,2-DPA (2,2-dichloropropionic acid also known as dalapon)

- is a systemic herbicide used for the control of annual and perennial grasses and rushes. It is registered on a variety of crops including potential animal feeds sunflower, maize, soybean and pastures. The application rates are 1.5-3.7 kg ai/ha for the crops mentioned above and up to 7.4 kg ai/ha for sugarcane. Application to sugar cane is early season with spray applied between rows when the cane is 12-15 cm high.

The harvest WHP is 7 days

All crops have the following grazing restraint:

DO NOT graze or cut for stock food for 2 days after application

There are no Codex or USA MRLs for 2,2-DPA in animal tissues. The critical Australian MRL is 0.2 mg/kg for meat (mammalian) and *0.1 mg/kg for milks. Significant residues are not expected in sugarcane at harvest MRL *0.1 mg/kg). Dalapon and all of its known breakdown products dissolve easily in water. They are readily washed from cells and tissues. Because dalapon is insoluble in organic solvents and lipids, it does not build up in animal tissues^{6,7}.

It is anticipated that animal product residues will be below typical method LOQs.

2,4-D

- is a selective herbicide used widely for the control of weeds. It is registered on a variety of crops including potential animal feeds pasture and cereals at rates up to 2.2 kg ai/ha, the same as for sugarcane. Application to sugar cane is pre-emergent, or as a ripening aid pre harvest.

No harvest WHP is required.

All crops have the following grazing restraint:

DO NOT graze or cut for stock food for 7 days after application (NB: applies only to pastures/forage crops)

There are Australian, Codex and USA MRLs for 2,4-D in animal tissues however, the residue definitions that apply differ. The residue definition for Codex and Australia is parent compound. For the USA the residue definition is the sum of 2,4-D and 2,4-DCP. This added complication potentially makes comparison of the respective MRLs more difficult. The Australian MRLs are 0.2 mg/kg for meat (mammalian), 2 mg/kg for edible offal (mammalian) and *0.05 mg/kg for milks. The critical USA tolerance is 4 mg/kg for cattle kidney while the MRL for milk is 0.05 mg/kg. The critical Codex tolerances are 5 mg/kg for edible offal, 0.2 mg/kg for meat (mammalian) while the MRL for milk is 0.01 mg/kg.

Higher residues are expected if used pre-harvest as a ripener, cf Australian MRL of 5 mg/kg for cane. In an animal transfer study cows were dosed at the equivalent of 1446, 2890, 5779 and 8585 ppm in the diet for 28 days⁸. Residues in liver, kidney, muscle and fat for the 1446 ppm group were 0.2, 6.5, 0.24 and 0.51 mg/kg respectively. Assuming tops have residues at the same level as the MRL for cane, contain 40% dry matter and using TFs from the 1446 ppm feeding study, anticipated

⁶ Kuhnert M, Freytag B, Freytag HH, Fuchs V. (1992) [The tolerance and residue accumulation of sodium-2,2-dichloropropionate (Dalapon) administered over 90 days to dairy cows] *Dtsch Tierarztl Wochenschr.* 99 (4), 148-51. German.

⁷ Fertig, S. N.; Schreiber, M. M. (1961). Effects Of Herbicide Ingestion. Effect of dalapon ingestion on performance of dairy cattle and levels of residue in the milk. *J. Ag. Food Chem.* 9:369

⁸ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

residues in kidney and fat from feeding at 100% of the diet are $5 \times 0.0045 \div 0.4 = 0.06$ mg/kg and $5 \times 0.00035 \div 0.4 = 0.0044$ mg/kg respectively. The LOQ for tissues was reported to be 0.05 mg/kg. Residues in tissues of animals dosed at the highest feed level declined with a half-life of <1.5 days. The TF for milk is 0.00006 (2890 ppm feed level) giving an anticipated residue in milk of $5 \times 0.00006 \div 0.4 = 0.00075$ mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Aldicarb

- is a carbamate insecticide used for the control of various insects and nematodes. It is registered on sugarcane as a single application incorporated into the soil when the cane is at no later than the 3-5 leaf stage. The application rate is up to 2.6 kg ai/ha.

No harvest WHP is required.

Sugarcane has the following grazing restraint:

DO NOT allow stock to graze in treated area

There are Australian and Codex but no USA MRLs for aldicarb in animal tissues. The MRLs for meat (mammalian) and milk are the same at *0.01 mg/kg for Australia and Codex. The Australian use-pattern is pre-emergent application and as such significant residues are not expected in sugarcane at harvest. MRL for sugarcane is *0.02 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Ametryn

- is a selective herbicide used for the control of grass and weeds in pineapples and sugarcane. It is applied when weeds are up to 38 cm high and grass to 30 cm high. Contact with sugarcane should be avoided. The application rate is up to 3 kg ai/ha.

No harvest WHP is required.

There are no Codex MRLs for ametryn. There are no US MRLs for animal tissues although there are MRLs for sugarcane (0.05 mg/kg). The Australian MRLs for meat (mammalian) and milks are *0.05 mg/kg. The Australian use-pattern is such that significant residues are not expected in sugarcane at harvest (MRL 0.05 mg/kg).

The octanol water partition coefficient ($\log P_{ow} = 2.63$) suggests ametryn will not concentrate in fat. In a feeding study reported by the US EPA, three groups of dairy cattle were dosed orally via capsules once a day for 28-30 consecutive days with ametryn at levels equivalent to 2.15, 6.2, and 20.1 ppm in the feed. Milk samples were collected on Study Days 1, 3, 7, 14, 21, and 26, and samples of blood, liver, kidneys, muscle, and fat were collected within 24 hours of the final dose. Milk and tissue samples were analyzed for residues of ametryn and its three thiomethyl metabolites (GS-11354, GS-11355, and GS-26831) using an adequate GC/NPD method. LOQ for ametryn and each metabolite is 0.02 ppm in tissues and 0.01 ppm in milk.

All samples of milk and tissues were analyzed from the 20.1 ppm dose group, but only milk (day 26) and muscle were analyzed from the 2.15 and 6.2 ppm dose groups. Residues of each analyte were <0.01 ppm (<LOQ) in all milk samples from cows dosed at 20.1 ppm, and residues were also <0.01 ppm for each analyte in the selected milk samples from the 2.15 and 6.2 ppm dose groups. In tissues, residues of each analyte were <0.02 ppm (<LOQ) in blood, liver, kidney, muscle, and fat from each cow in the 20.1 ppm dose group.

It is anticipated that animal product residues will be below typical method LOQs.

Asulam

- is a selective herbicide used for the control of grass and weeds in crops and pastures. It is applied post-emergent to cane when weeds are less than 25 cm high. Can be used in salvage situations when application by aircraft may be necessary. The application rate is up to 3.4 kg ai/ha. No harvest or grazing WHP is required.

There are no Codex MRLs for asulam. The US MRLs for animal commodities is 0.05 for cattle fat, meat and milk while 0.2 mg/kg for meat byproducts. US MRL for sugarcane is 1 and molasses is 30 mg/kg. The US use-pattern specifies a harvest WHP of 90 days. The Australian MRL for meat (mammalian) is *0.1 mg/kg. Residues in soil and foliage decline with typical half-lives of 7 and 3 days respectively. The Australian use-pattern is such that significant residues are not expected in sugarcane at harvest (MRL *0.1 mg/kg).

In a study reported by the US EPA⁹ residues were non-detectable in tissues of lactating dairy cows dosed with asulam *per se* at 0.5 ppm (tissue LOQ <0.05 mg/kg) while at higher dose rates residues were detected in kidney. At 5 ppm feeding the residues in kidney were 0.06-0.12 mg/kg while at 50 ppm the residues in kidney were 0.11-0.13 mg/kg. Note the method measured the sum of asulam and metabolites containing the sulphanilamide moiety while the Australian definition is parent compound.

It is anticipated that animal product residues will be below typical method LOQs.

Atrazine

- is a triazine herbicide used for the control of grass and weeds in crops such as sugarcane, maize, lupins, canola and sorghum. It is applied pre-emergent to cane. The application rate is up to 2-3 kg ai/ha.

No harvest or grazing WHP is required.

There are no Codex animal tissue MRLs for atrazine. The US MRLs for animal tissues are lower (0.02 mg/kg for cattle fat, mby, meat and milk) than the Australian MRL of T*0.1 mg/kg for edible offal mammalian and T*0.01 mg/kg for milk. The US also has MRLs for sugarcane at 0.2 mg/kg. The Australian MRLs for sugarcane (*0.1 mg/kg) and sugarcane forage and fodder (primary feed commodities?) are T40 mg/kg. Residues in soil and foliage decline with typical half-lives of 60 and 5 days respectively. Feeding at 37.5 ppm in the diet for 28 days gave residues that were <0.01 mg/kg in milk and tissues at slaughter¹⁰.

It is anticipated that animal product residues will be below typical method LOQs.

Bifenthrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on sugarcane for in-furrow application at the time of planting. The application rate is up to 0.0375 kg ai/ha. Bifenthrin residues decline with typical half-lives of 26 and 7 days for soil and foliage respectively.

No harvest or grazing WHPs are required.

⁹ Reregistration Eligibility Decision, Asulam List A Case 0265 EPA 738-R-95-024 September 1995 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.

¹⁰ Atrazine Reregistration Eligibility Decision Residue Chemistry Considerations PC Code 080803; Case 0062 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

There are Australian, Codex and USA MRLs for bifenthrin in animal tissues. The relevant MRLs for cattle fat are 2, 0.5 and 1 mg/kg for Australia, Codex and the USA respectively. The MRLs for milk are 0.5 mg/kg, *0.05 mg/kg (cattle milk) and 1 mg/kg (milk fat, 0.1 mg/kg for whole milk). The Australian use-pattern is pre-emergent application and as such significant residues are not expected in sugarcane at harvest. This is reflected in the Australian MRL for sugarcane of *0.01 mg/kg and sugarcane fodder of *0.02 mg/kg. Therefore no residues are expected to result from the feeding of sugarcane trash or tops to animals.

It is anticipated that animal product residues will be below typical method LOQs.

Cadusafos

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on sugarcane for application up to early tillering. The application rate is up to 2-4 kg ai/ha. No harvest or grazing WHPs are required.

There are no Australian, Codex and USA MRLs for cadusafos in animal tissues despite MRLs having been set for crops. The Australian use-pattern is for pre-emergent and early post-emergent application and as such significant residues are not expected in sugarcane at harvest. This is reflected in the Australian MRL for sugarcane of *0.01 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Carbendazim

- is a systemic fungicide used for the control of Pineapple disease in sugarcane. Application is to cut seed pieces at a rate of 32.5 g ai/100L.

There are Australian and Codex but no USA MRLs for carbendazim. The relevant MRL for cattle meat is 0.2 mg/kg for Australia. MRLs for milk are all *0.1 to 0.1 mg/kg.

The use is a nil residue situation

It is anticipated that animal product residues will be below typical method LOQs.

Carbofuran

- is a systemic insecticide used for the control of various insects and nematodes in crops. It is registered on sugarcane for incorporation into bands of soil on each side of the rows of cane at the 3-5 leaf stage. The application rate is up to 3 kg ai/ha. Carbofuran residues decline with typical half-lives of 50 and 2 days for soil and foliage respectively.

There is a harvest WHP of 30 weeks.

There are Australian, Codex and USA MRLs for carbofuran in animal tissues. The relevant MRLs for meat are *0.05 mg/kg. Milk MRLs are *0.05, *0.05 and 0.1 mg/kg for Australia, Codex and the USA (expired 31/12/2009) respectively. The Australian use-pattern is such that significant residues are not expected in sugarcane at harvest. This is reflected in the Australian MRL for sugarcane of *0.1 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Chlorpyrifos

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on sugarcane for the control of armyworm and locusts and so involves application late in the cane growth. The application rate is up to 0.45-0.75 kg ai/ha. The harvest WHP is 7 days. The grazing WHP is 2 days.

There are Australian, Codex and USA MRLs for chlorpyrifos in animal tissues. The Australian and Codex residue definition is chlorpyrifos while the USA definition includes the metabolite TCP. The MRLs for cattle fat are 0.5, 1 and 0.3 mg/kg for Australia, Codex and the USA respectively. The MRLs for milk are 0.2 [milk in the fat] mg/kg, 0.02 mg/kg and 0.01 mg/kg (0.25 mg/kg for milk fat). The Australian use-pattern includes late application for locust control which is expected to give rise to the highest residues in tops and trash. Although no data are available for sugarcane, an indication of the worst-case residue in tops and trash can be obtained from US trials on sorghum. Residues on the day of application to sorghum at 0.3× the Australian sugarcane rate were *ca.* 3 mg/kg (JMPR 2000). Scaling this to the Australian rate would give residues of chlorpyrifos in sugarcane (tops and trash) of 9 mg/kg. The maximum transfer factor for feeding cattle at 10 ppm in the diet was 0.016 for cattle fat¹¹. Residues from feeding sugarcane tops or trash with residues of 9 ppm would be $9 \times 0.016 = 0.14$ mg/kg; below the lowest of the Australian, Codex and USA MRLs. Anticipated residues for milk would be $9 \times 0.0007 = 0.006$ mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Coumatetralyl

- is a rodenticide used as a bait and not expected to result in residues in grazing animals.

It is anticipated that animal product residues will be below typical method LOQs.

Diazinon

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on sugarcane for the control of locusts and so involves application late in the cane growth. The application rate is up to 0.68 kg ai/ha.

The harvest WHP is 14 days. The grazing WHP is 2 days. (NB: 14 days on most product labels)

There are Australian, Codex and USA MRLs for diazinon in animal tissues. The MRLs for cattle fat are 0.7 mg/kg for Australia, 2 for Codex and 0.5 mg/kg for the US. For milk the MRLs are 0.5 [in the fat], 0.02 F mg/kg and not specified. The Australian use-pattern is for late application for locust control which is expected to give rise to residues in tops and trash (sugarcane MRL 0.5 mg/kg). No residues were detected in milk of cows dosed at the equivalent of 120 ppm in the diet¹².

It is anticipated that animal product residues will be below typical method LOQs.

Dicamba

- is a selective herbicide used for the control of broadleaf weeds in crops and pastures. It is applied post-emergent to cane when weeds have less than 8 true leaves. The application rate is up to 0.28 kg ai/ha.

No harvest WHP is required. The grazing WHP is 7 days.

¹¹ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

¹² 1996 JMPR - Pesticide Residues in Food - 1996 Evaluations, Part I: Residues FAO Plant Production and Protection Paper 142. FAO and WHO 1997

There are no Codex MRLs for dicamba. The US (parent + metabolite) and Australian (parent) residue definitions differ. The relevant US MRLs for animal tissues are 0.25 mg/kg for meat, 25 mg/kg for kidney and 0.2 mg/kg for milk. The Australian MRLs are meat (mammalian) at 0.05 mg/kg and milks at 0.1 mg/kg. Residues in soil and foliage decline with typical half-lives of 14 and 9 days respectively. The Australian use-pattern is such that residues in forage and fodder at harvest are less than 0.1 mg/kg (MRL). Australian MRLs for sugarcane and molasses 0.1 and 2 mg/kg respectively.

The APVMA Stockfeed data sheet¹³ summarised some residue data for dicamba:

Lactating dairy cattle were fed dicamba in the diet for 30 days at doses equivalent to 40, 120 and 400 ppm in the diet. Residues of dicamba and its DCSA metabolite in tissues of the high dose group were 0.89 mg/kg in kidney, 0.21 mg/kg in liver, 0.037 mg/kg in muscle and 0.059 mg/kg in fat. Maximum milk residues were 0.32 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Diquat

- is a herbicide used for the control of weeds in various crops. It is applied to cane at any time up to 4 days before harvest. The application rate is up to 0.4-0.6 kg ai/ha. The harvest and grazing WHPs are 4 and 1 day respectively.

The Australian and Codex MRLs for diquat in meat (mammalian) are the same at *0.05 mg/kg. The US MRL for meat is 0.02 mg/kg. The MRLs for milk are *0.01 mg/kg, *0.01 mg/kg and 0.02 mg/kg respectively. Residues in soil and foliage decline with typical half-lives of *ca.* 1000 and 30 days respectively. The MRL for sugarcane is *0.05 mg/kg. No residues were detected in tissues of cows fed diquat for 28 days at 100 ppm in the diet and slaughtered on the last day of dosing (LOD 0.01 mg/kg)¹⁴. Residues in tops and trash would be expected to be less than 100 ppm.

It is anticipated that animal product residues will be below typical method LOQs.

Diuron

- is a herbicide used for the control of weeds in crop. It is applied pre-emergent to cane or as a directed spray when weeds are less than 15 cm high. The application rate is up to 3.6 kg ai/ha. No harvest or grazing WHP is required.

There are no Codex MRLs for diuron. The US and Australian residue definitions differ with the Australian definition including a metabolite in addition to the parent compound. The relevant US MRL for animal tissues is 1 mg/kg for cattle mbyop while the Australian MRL for edible offal of cattle is 3 mg/kg (the higher value probably reflecting the inclusion of the metabolite in the residue definition). The Australian MRL for milk is 0.1 mg/kg. Residues in soil and foliage decline with typical half-lives of 90 and 30 days respectively. Australia has a primary animal feed commodity MRL of 50 mg/kg. The MRL for sugarcane is 0.2 mg/kg.

¹³ <http://www.apvma.gov.au/residues/stockfeed.shtml>

Dicamba September 2004

¹⁴ Reregistration Eligibility Decision, Diquat Dibromide, List A, Case 0288, EPA 738-R-95-016 July 1995
Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.
<http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

NOTE: US MRLs have been established for animal feed items (including alfalfa forage and hay at 2 ppm and citrus pulp dry at 4 ppm) as well as for animal commodities. If the US MRLs are used to estimate the dietary burden using the US EPA Guideline, a dietary burden of ca. 4.8 ppm is estimated. An anticipated TF is the 1 ppm (animal commodity tolerances) ÷ 4.8 ppm (dietary burden) = 0.2 (crude estimate).

It is anticipated that animal product residues will be below typical method LOQs.

Ethephon

- is a plant growth regulator. It is applied close to harvest. The application rate is up to 0.72 kg ai/ha with no more than 1 application per season.

A harvest WHP of 6 weeks applies.

The Codex and Australian MRLs for ethephon in edible offal are the same at 0.2 mg/kg. The Codex and Australian milk MRLs are *0.05 and 0.1 mg/kg. The US tolerance for offal is 0.2 except kidney which is 1 mg/kg, the tolerance for fat and meat is 0.02 and milk 0.1 mg/kg. Residues in soil and foliage decline with typical half-lives of 10 and 5 days respectively. Australia has a primary animal feed commodity MRL of 10 mg/kg. The MRL for sugarcane is 0.5 mg/kg and that for sugarcane molasses is 7 mg/kg. The 1994 JMPR reported a field trial with ethephon applied aerially at 2.24 kg ai/ha, about three times the recommended Australian rate. The ethephon residue in the cane stalks decreased rapidly from about 4.6 mg/kg immediately after treatment to about 1.3 mg/kg one week later, then more gradually to about 0.2 mg/kg at maturity 79 days after treatment. Residues in stalks and tops at 6 weeks after treatment would be expected to be well below half the Australian primary feed commodity MRL of 10 mg/kg.

In a study where dairy cows were fed at up to 150 ppm in the diet for 28 days, residues in tissues were <0.1 mg/kg for muscle, <0.2 mg/kg for fat, liver and kidney and <0.12 mg/kg in milk¹⁵.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Ethoxysulfuron

-is a sulfonylurea herbicide used to control various weeds in sugar cane. Application is at 150 g ai/ha.

Do not harvest for 19 weeks after application.

Do not graze or cut for stock food for 19 weeks after application..

The Australian MRLs for animal commodities are *0.05 mg/kg for edible offal and meat and *0.01 mg/kg for milk. The Australian MRL for sugarcane and sugarcane fodder [fresh weight] is *0.01 mg/kg.

The APVMA reported 4 Australian residue trials on sugarcane conducted in Queensland and New South Wales. Summaries of 2 trials conducted in Brazil were also provided. In the Australian trials, plant sugarcane was treated with ethoxysulfuron at 150 or 300 g ai/ha at different stages, between pre-emergence to out-of-hand (~ 100 cm tall) stage of crop development. Samples of cane tops (top 30 cm of canes) and cane billets (equal portions of top, middle and bottom sections) were collected at 133, 238, 272 or 293 days after application. Residues of ethoxysulfuron in samples of billets, tops, juice and bagasse from crops treated at 150-300 g ai/ha (1-2×) were all <0.01 mg/kg. No correction for dry matter content was applied to the results for cane tops. The LOQ of the method

¹⁵ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

was 0.01 mg/kg. For the 2 trials conducted in Brazil, residues of ethoxysulfuron in billets harvested 153-159 days after application at 150-300 g ai/ha were <0.05 mg/kg.

The APVMA also reported: a grazing withholding period of 19 weeks ... effectively precludes grazing of failed crops, although it is understood that grazing of failed cane crops would be extremely rare. In the sugar cane metabolism study total radioactive residues in treated leaves were 9.4, 10.6, 4.2 and 15.7 mg equiv./kg at 0, 7, 32 and 132 days respectively after treatment at 90 g ai/ha. It should be noted that the results reflect residues only in leaves that were directly treated with radiolabel, rather than a sample from a sprayed plant.

In the absence of animal transfer data livestock dietary exposure must be negligible. Residues in tops harvested 19 weeks after application (just prior to out-of-hand stage) were <0.01 mg/kg.

Livestock consuming tops from mature cane crops should be exposed to negligible levels of ethoxysulfuron.

It is anticipated that animal product residues will be below typical method LOQs.

Fenamiphos

- is an organophosphate insecticide used for the control of various insects and nematodes. It is registered on sugarcane for use from planting to early tillering with applications incorporated into the soil. The application rate is up to 4 kg ai/ha.

No harvest or grazing WHPs are required.

There is no US MRL for fenamiphos in animal tissues. The relevant Australian and Codex MRLs for fenamiphos in animal tissues are *0.05 and *0.01 mg/kg respectively. The Australian and Codex MRLs for milk are *0.005 mg/kg. The primary animal feed commodity MRL for fenamiphos is 1 mg/kg. Australian use-pattern is such that significant residues are not expected in sugarcane at harvest (MRL *0.05 mg/kg). In a dairy cattle feeding study, residues in tissues of cattle fed at the equivalent of 20 ppm in the diet were ≤0.01 mg/kg¹⁶.

It is anticipated that animal product residues will be below typical method LOQs.

Fipronil

- is a phenylpyrazole insecticide. Application is to plant pieces (setts) or when the first millable internode appears to a stalk height of 40 cm. The application rate is 1.14 g ai/100 m of row.

The harvest WHP is 12 weeks. The grazing WHP is 12 weeks.

The relevant Australian, Codex and US tolerances for fipronil in animal fat are 0.1, 0.5 (cattle meat in the fat) and 0.4 mg/kg respectively while the milk MRLs are 0.01, 0.02 mg/kg while the US MRL is 1.5 mg/kg for milk fat (representing 0.05 mg/kg in whole milk). There is an Australian sugarcane MRL of *0.01 and fodder MRL of 0.01 mg/kg. Foliar residues of fipronil are reported to decline with a typical half-life of 2-4 days. The 2001 JMPR¹⁷ reported several residue trials for fipronil on sugarcane. Residues in cane were very low as expected for such an early treatment. Fipronil is not systemic and is not applied to the leaves. Negligible residues are expected to result from the feeding of sugarcane trash or tops to animals (<0.002 mg/kg).

¹⁶ 1999 JMPR - Pesticide Residues in Food - 1999 Evaluations, Part I Residues FAO Plant Production and Protection Paper 157. FAO and WHO 2000

¹⁷ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

Sugar cane residues from soil and foliar applications (JMPR 2001).

Country, Year, Reference	Application			PHI, days	Residues, as mg/kg				RPA 200766
	Form	g ai/ha	No.		Fipronil	MB 45950	MB 46136	MB 46513	
Soil treatment, in furrow spray at planting, 2 replicates									
Australia, 1995, Tully, Queensland	WG	100	1	340	<0.002	<0.002	<0.002	<0.002	NR
		200	1	340	0.002	<0.002	<0.002	<0.002	
		400	1	340	0.002	<0.002	0.003	<0.002	
Australia, 1995, Tully, Queensland	WG	100	2	245	0.002	<0.002	<0.002	<0.002	NR
		200	2	245	<0.002	<0.002	<0.002	<0.002	
		400	2	245	0.002	<0.002	<0.002	<0.002	
Spray on the bottom of the stalk, 2 replicates									
Australia, 1995, Mowilyan, Queensland	WG	100	1	181	0.002	<0.002	0.002	<0.002	NR
Australia, 1995, Mowilyan, Queensland	WG	200	1	181	0.00	<0.002	0.002	0.002	NR
Australia, 1995, Mowilyan, Queensland	WG	50	2	134	<0.002	<0.002	<0.002	<0.002	NR
Australia, 1995, Mowilyan, Queensland	WG	100	2	53	0.025	<0.002	0.008	0.003	NR
		400	2	53	0.02	<0.002	0.007	0.003	
Spray on the bottom of the stalk, 2 replicates									
Australia, 1997, Kurrimine Beach, Queensland	SC	75	1	101	<0.002	<0.002	<0.002	<0.002	NR
Soil treatment, in furrow spray followed by stool spray, 2 replicates									
Australia, 1996, Kurrimine Beach, Queensland	WG + SC	100 soil + 50 foliar	1 + 2	95	0.002	<0.002	0.002	<0.002	NR
Australia, 1996, Kurrimine Beach, Queensland	WG + SC	200 soil + 100 foliar	1 + 2	95	0.002	<0.002	0.003	0.002	NR
		400 soil + 200 foliar	1 + 2	95	0.003	<0.002	0.003	0.002	
Kurrimine Beach Queensland	WG + SC	400 soil + 200 foliar	1 + 2	95	0.005	<0.002	0.006	0.008	NR
Soil treatment, in furrow spray at planting, 2 replicates									
Brazil, 1994 Sao Paulo	WG	400	1	87	<0.01	<0.01	<0.01	<0.01	<0.01
		800	1	87	<0.01	<0.01	<0.01	<0.01	<0.01
Soil treatment, in furrow spray at planting, 2 replicates									
Brazil, 1994 Sao Paulo	WG	400	1	87	<0.01	<0.01	<0.01	<0.01	<0.01
		800	1	87	0.01	<0.01	<0.01	<0.01	0.01

NR = not reported

It is anticipated that animal product residues will be below typical method LOQs.

Fluroxypyr

- is a selective herbicide used for the control of broadleaf weeds in crops such as sugarcane, maize, sorghum and winter cereals as well as pastures. It is applied post-emergent to cane from early tillering to maturity. The application rate is up to 0.3 kg ai/ha.

No harvest WHP is required. Do not graze failed crops and cut for stock feed for 7 days after application.

There are no Codex animal tissue MRLs for fluroxypyr. The US (parent + metabolite) residue definition differs to that used in Australia (parent). The relevant US MRL for animal tissue is 1.5 mg/kg for cattle kidney. The relevant Australian MRL is 0.1 mg/kg for edible offal (mammalian) except kidney which is 1 mg/kg. The MRL for milk in Australia is 0.1 and the US is 0.3 mg/kg. The Australian MRLs for sugarcane forage and fodder are 100 mg/kg. Fluroxypyr residues decline rapidly upon cessation of dosing at 1000 ppm for 28 days such that after 6 days residues in all tissues are less than the limit of analytical quantitation.

Insufficient data were located to provide confident opinion on livestock residue risks.

Glyphosate

-is a non-selective foliar herbicide used for the control of broadleaf weeds and grasses in crops such as sugarcane, maize, sorghum and winter cereals as well as pastures. It is applied post-emergent to cane. The application rate is up to 3.2 kg ai/ha.

No harvest or grazing WHPs are required.

The relevant Australian and Codex MRLs are the same at 2 mg/kg for cattle offal. The MRL for milk is *0.1 and *0.05 mg/kg for milk. The relevant USA MRL is 5 mg/kg for cattle meat byproducts. The primary animal feed commodity MRL for glyphosate is 150 mg/kg while that for sugarcane is T0.3 and molasses is T5 mg/kg.

Residues in cattle, pig and poultry meat, eggs and milk were negligible after the animals were fed with a diet containing 100 mg/kg glyphosate and aminoglyphosate acid¹⁸. The highest residues were in pig liver and kidney (up to 0.16 and 0.91 mg/kg, respectively) and cattle kidney (up to 1.4 mg/kg).

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Halosulfuron-methyl

-is a selective post-emergent herbicide used for the control of nutgrass on sugarcane, corn/maize and sorghum. It is applied post-emergent to cane at an application rate of up to 0.0975 kg ai/ha. No harvest or grazing WHPs are required.

There are no Codex MRLs for halosulfuron. The US (parent + metabolite) and Australian (parent) residue definitions differ. The relevant US MRLs for animal tissues are 0.1 mg/kg for offal while the Australian MRL for edible offal (mammalian) is 0.2 mg/kg. The Australian use-pattern is such that significant residues in forage and fodder at harvest are not expected. The sugarcane and sugarcane forage MRL in Australia has been set at *0.05 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Hexazinone

-is a herbicide used for the control of weeds in sugarcane. It is applied after harvest to ratoons or to plant cane at an application rate of up to 0.52 kg ai/ha.

No harvest or grazing WHPs are required.

There are Australian and US but no Codex MRLs for hexazinone in animal commodities. The Australian MRLs are *0.1 mg/kg for edible offal (mammalian) and meat (mammalian) and *0.05 mg/kg for milk while the US tolerances for cattle and sheep tissues and milk have also all been set at 0.1 mg/kg.

The Australian use-pattern is such that significant residues in forage and fodder at harvest are not expected. The sugarcane MRL in Australia has been set at *0.1 mg/kg. Dairy cows given small amounts of hexazinone in their diets for 30 days had no detectable residues in milk, fat, liver, kidney, or lean muscle, but did have detectable levels of a hexazinone metabolite in their milk¹⁹.

¹⁸ FAO/WHO (1986a) Pesticide residues in food - Evaluations 1986. Part I - Residues. Joint Meeting of the FAO Panel of Experts Residues in Food and the Environment and the WHO Expert Group on Pesticide Residues, Rome, 29 September-8 October 1986. Rome, Food and Agriculture Organization of the United Nations (FAO Plant Production and Protection Paper 78/1).

¹⁹ Reregistration Eligibility Decision Hexazinone List A Case 0266, EPA 738-R-94-022 September 1994, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

Lactating goats given small amounts of hexazinone for 5 days also had small amounts of the compound in their milk and livers.

The US EPA reported that:

“Sugarcane

The available data indicate that the combined residues of hexazinone and its regulated metabolites, as measured by the data-collection method, were <0.35 (or <0.05 ppm for each compound) in/on samples of sugarcane treated with the 90% SC formulation of hexazinone from the following test locations: (i) in Puerto Rico where sugarcane was harvested 288 days following a single postemergence application at 0.5 kg ai/ha (0.5× the maximum registered seasonal rate for this area); (ii) in TX where sugarcane was harvested 234 days following one preemergence application followed by one postemergence application at 0.756 kg ai/ha/application (0.75× the maximum seasonal rate in TX); and (iii) in HI where sugarcane was harvested 179-181 days following a total of four applications (one preemergence application at 1.5 or 1.6 kg ai/ha, a postemergence application at 0.5 kg ai/ha/A/application, followed by two postemergence applications at 2.0 kg ai/ha /application) for a total rate of 6.0-6.2 kg ai/ha/A/season (1.5× the maximum seasonal rate in HI). Based on the combined LOQs (0.55 ppm) of the enforcement method, HED is now recommending that the RAC tolerance be reassessed from 0.20 ppm to 0.60 ppm.

Sugarcane molasses and refined sugar

An acceptable sugarcane processing study is available. The reviewed study indicate that residues of the parent hexazinone were 0.23 ppm in/on the RAC (sugarcane) following application of the 90% SC formulation at a total rate of 8.1 kg ai/ha (2.0× the maximum seasonal application rate for sugarcane grown in HI). Residues of metabolites A, B, C, D, and E were each nondetectable (<0.05 ppm) in/on treated RAC samples. Following processing of the RAC according to simulated commercial practices, residues of hexazinone and/or metabolites A through E concentrated in bagasse (1.6×) and “A molasses” (4.0×). However, residues declined in raw sugar (reduction factor of 0.2×) and processed sugar (reduction factor of 0.2×). The presently regulated processed commodities of sugarcane are molasses and refined sugar; bagasse has been removed from Table 1 of OPPTS 860.1000. Samples of treated “A molasses” from the above study were re-analyzed to confirm results. The average total residues of hexazinone and its regulated metabolites, from duplicate analysis, were 1.915 ppm for “A molasses”. Based on this re-analysis, residues of hexazinone and metabolites concentrated about 8.0× in “A molasses”. The registrant reported that a 4.0× concentration factor should be considered when “A molasses” is further processed to final (blackstrap) molasses, the form of molasses typically fed to livestock. To reassess the adequacy of the established 0.5 ppm tolerance for sugarcane molasses, HED will consider the HAFT residue reported from the field study as well as the concentration factors observed from the processing study. Data from the sugarcane field trials indicate that residues of hexazinone and its regulated metabolites, as measured by the data-collection method, were <0.35 ppm (or <0.05 ppm for each compound) in/on samples of sugarcane treated according to the maximum registered use pattern. According to OPPTS GDLN 860.1520, 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 adjusted for the degree of exaggeration. These adjusted residues should then be compared to the LOQ for the RAC. If the adjusted residues are greater than or equal to twice the LOQ, then a tolerance is needed.

The maximum average combined residue of hexazinone and its regulated metabolites was 1.915 ppm for “A molasses”. To correct concentrations in “A molasses” to blackstrap molasses, residues in “A molasses” are multiplied by a concentration factor of 4.0×, resulting in 7.66 ppm. Adjusting for the degree of exaggeration (2.0×) used in the processing study, the residue for blackstrap molasses is 3.83 ppm. Because this result is greater than twice the LOQ for the RAC (sugarcane),

the available data suggest that the established tolerance for sugarcane molasses should be decreased from 5.0 ppm to 4.0 ppm”.

It is anticipated that animal product residues will be below typical method LOQs.

Imazapic

-is a herbicide used for the pre-emergent control of grass and broadleaf weeds in sugarcane and peanuts. It is applied at an application rate of up to 0.096 kg ai/ha.

No harvest or grazing WHPs are required.

There are no Codex MRLs for imazapic. The relevant US MRLs for animal tissues are 1 mg/kg for kidney and 0.1 mg/kg for meat, fat and mbyp except kidney while the Australian MRL for edible offal (mammalian) is *0.05 mg/kg, for meat (mammalian (in the fat) *0.05 mg/kg and for milk *0.01 mg/kg. The Australian use-pattern is such that significant residues in forage and fodder at harvest are not expected. The sugarcane MRL in Australia has been set at *0.05 mg/kg. Feeding at this level is not expected to result in significant residues in animals.

In the goat metabolism study 3 goats were exposed to ¹⁴C-imazapic at doses of 0, 3.76 and 15.1 mg in gelatin capsules for seven consecutive days²⁰. These levels were considered to be 0, 33×, and 197× of maximum residue that foraging animals would likely receive in the diet in the US. The limits of detection for imazapic were 0.02 mg/kg in fat and 0.01 mg/kg for milk and tissues. Daily milk residues were below the limits of detection as were all tissue concentrations with the exception of the kidney: 0.01 mg/kg at the low dose and 0.05 mg/kg at the high dose. Residues from the kidney consisted of 30% parent compound.

The US EPA reported a feeding study where Holstein dairy cows were dosed orally for 28 days at rates equivalent to 67, 232 and 676 ppm in the diet. Animals were slaughtered within 24 h of the last dose. Residues of metabolite CL263284 were not detected.

Maximum residues of imazapic (mg/kg) were:

Matrix	66.8 ppm	232 ppm	676 ppm
Muscle	<0.05	<0.0674	0.086
Liver	<0.05	0.126	0.231
Kidney	0.465	2.2	3.75
Fat	<0.05	<0.054	0.053
Milk	0.035	0.121	0.374

It is anticipated that animal product residues will be below typical method LOQs.

Imidacloprid

- is a selective insecticide and is used for control of insect pests in a wide range of crops. In cane it is applied to ratoon crops for cane grub control at a rate of 0.36-0.5 kg ai/ha.

No harvest WHP is required.

The grazing WHP is 21 weeks for spray application and 27 weeks for granular application.

There are Australian, Codex and US MRLs for imidacloprid in animal tissues. The relevant Australian and US tolerances for imidacloprid in edible offal are 0.2 and 0.3 mg/kg respectively and

²⁰ ERA TR 00-21-28-01e IMAZAPIC [Plateau and Plateau DG]-Human Health and Ecological Risk Assessment Final Report Prepared for: USDA, Forest Service Task No. 28 USDA/FS Contract No. 53-3187-5-12 USDA/FS Order No. 43-3187-0-0153 Submitted to: Leslie Rubin, COTR Animal and Plant Health Inspection Service (APHIS) Biotechnology, Biologics and Environmental Protection Environmental Analysis and Documentation United States Department of Agriculture Submitted by: Syracuse Environmental Research Associates, Inc. January 28, 2001

for milk 0.05 and 0.1 mg/kg. The Codex MRLs are 0.05 mg/kg for edible offal and *0.02 mg/kg for meat and milk. The Australian and USA residue definitions are the same. There is an Australian MRL for sugarcane fodder (dry) of 2 mg/kg and an MRL for sugarcane of *0.05 mg/kg. The worst-case tissue transfer factor is for liver with a TF of 0.01²¹. Feeding at the MRL would give rise to residues in liver approximating $2 \times 0.01 = 0.02$ mg/kg. The TF for milk is 0.003. Anticipated maximum residues in milk are $0.5 \times 0.003 = 0.0015$ mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Ioxynil

-is a selective herbicide used for the control of broad-leafed weeds in sugarcane. It is applied post-emergent to cane when vines are less than 1 m and weeds less than 25 cm high. The application rate is up to 0.4 kg ai/ha.

The harvest WHP is 60 days.

No grazing WHP is required.

There are no Australian, Codex or US animal tissue MRLs for ioxynil. Detectable residues are not expected in sugarcane, sugarcane tops or trash at the time of harvest; the Australian MRLs for ioxynil in sugarcane is *0.02 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Isoxaflutole

-is a herbicide used for the control of grass and broadleaf weeds in sugarcane and chickpeas. It is applied at an application rate of up to 0.15 kg ai/ha.

The harvest WHP is 19 weeks. The following grazing restraint applies: Do not graze on treated crops.

There are no Codex and US MRLs for isoxaflutole for animal tissue. The relevant The Australian MRLs for edible offal, meat (mammalian) (fat) and milk are *0.05 mg/kg. The Australian use-pattern is such that significant residues in forage and fodder at harvest are not expected. The sugarcane and sugarcane fodder MRLs in Australia have been set at *0.01 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

MCPA (4-chloro-2-methylphenoxy)acetic acid

-is a selective herbicide used for the control of broadleaf weeds in sugarcane, cereals and pastures etc. It is applied at an application rate of up to 5 kg ai/ha when used pre-emergent and 1.05 kg ai/ha post-emergent.

No harvest or grazing WHPs are required.

There are no Codex MRLs for MCPA in animal tissues. The Australian (parent) and US (parent + metabolite) residue definitions differ. The Australian MRL for meat (mammalian) is *0.05 mg/kg as is the milk MRL. The US MRL for meat is 0.1 mg/kg as is the milk MRL. Residues decline in soil and foliage with typical half-lives of 25 and 8 days respectively. There is no Australian MRL for sugarcane. Cattle and sheep fed low to moderate doses of MCPA in the diet for 2 weeks showed no

²¹ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003

residues from levels less than about 18 mg/kg²². The major metabolite of MCPA is 2-methyl-4-chlorophenol in the free and conjugated form, which is formed in the liver. The US has a tolerance of 300 mg/kg for pasture indicating that feeding at this level should not result in residues in animal tissues above the US MRL (i.e. the residues would be <LOQ or 0.1 mg/kg).

In a feeding study where calves were fed in the diet at 250 or 500 ppm for 28 days, residues were <LOQ in meat and fat at slaughter and <LOQ for liver at the 250 ppm feeding level²³. Residues in kidney at 250 ppm feed level were 1.4 mg/kg. Residues in kidney and liver at the 500 ppm feed level were 0.14 and 2.3 mg/kg respectively. Residues at 7 days on clean feed after feeding at 500 ppm were 0.1 mg/kg in kidney. The half-life for depletion in tissues is estimated to be <2 days. Estimated TF for fat is $<0.1 \text{ mg/kg} \div 500 \text{ ppm} = <0.0002$ and for offal (kidney) is $2.3 \text{ mg/kg} \div 500 \text{ ppm} = 0.005$. No residues are expected in milk of animals fed at up to 300 ppm in the diet.

It is anticipated that animal product residues will be below typical method LOQs.

Mercury as methoxyethyl mercuric chloride

-is a fungicide used for the control of Pineapple disease in sugarcane. It is applied to seed pieces at an application rate of up to 15 g mercury/hL. No harvest or grazing WHPs are required.

This is a nil residue situation.

It is anticipated that animal product residues will be below typical method LOQs.

Metolachlor

-is a selective herbicide used for the control of annual grasses and broadleaf weeds in sugarcane, maize, sweet corn and sorghum. It is applied at an application rate of up to 2.8 kg ai/ha. No harvest or grazing WHPs are required.

There are no Codex MRLs for metolachlor in animal tissues. The Australian (parent) and US (parent + metabolite) residue definitions differ. The relevant US MRLs for animal tissues are 0.02 mg/kg for cattle meat, 0.2 mg/kg for cattle kidney and 0.02 mg/kg for milk. The Australian MRLs for meat (mammalian) and milk are *0.05 mg/kg. Residues decline in soil and foliage with typical half-lives of 90 and 5 days respectively. The Australian MRL for sugarcane is *0.05 mg/kg. Metolachlor has a primary animal feed commodity MRL of 5 mg/kg.

In a study cows were fed 60 ppm metolachlor in the diet for up to 28 days (equivalent to 2.4 mg ai/kg bw/day)²⁴, metolachlor residues in meat and fat were all below the LOQ (<0.02 mg/kg); and residues in milk were all <LOQ (<0.01 mg/kg). In contrast, finite residues of ~0.4 mg/kg for kidney and ~0.1 mg/kg for liver were reported.

It is anticipated that animal product residues will be below typical method LOQs.

MSMA (monosodium methylarsenate)

²² MCPA. List A Reregistration Case 0017. Chemical No. 030501, 030502, 030516, 030564. Revised Product and Residue Chemistry Chapters for the Reregistration Eligibility Decision. DP Barcode: D299360

²³ Leng, M.L., Comparative metabolism of phenoxy herbicides in animals, in Fate of pesticides in large animals edited by Ivie, G.W. and Dorough, H.W., Academic Press, New York 1977.

²⁴ Revised Metolachlor and S-Metolachlor Residue Chemistry Chapter for the Tolerance Reassessment Eligibility Decision (TRED); PC codes 108801 and 108800; DP Barcode D282931; Rereg. Case 0001. Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

-is a selective herbicide used on cotton and sugarcane. It is applied at an application rate of up to 4.75 kg ai/ha when cane is 50-80 cm high.

No harvest WHP is required.

The grazing WHP is 5 weeks.

There are no Codex or US or Australian MRLs for MSMA in animal tissues. In animals MSMA would be converted to arsenic and regulated as such. The Australian MRL for sugarcane is 0.3 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Paraquat

- is a herbicide used for the control of weeds in various crops. The application rate is up to 0.4 kg ai/ha.

There is no harvest WHP. The following grazing restraints apply:

Do not graze or cut sprayed vegetation for stock food for 1 day after application. Remove stock from treated areas at least 3 days before slaughter

The Australian and Codex MRLs for paraquat in kidney are 0.5 and 0.05 mg/kg respectively while *0.01 and 0.005 mg/kg for milk respectively. The US MRL for kidney is 0.5 mg/kg and for milk 0.01 mg/kg. Residues in soil and foliage decline with typical half-lives of *ca.* 1000 and 30 days respectively. The MRL for sugarcane is *0.05 mg/kg. For residues in kidney to be less than the US MRL of 0.5 mg/kg, cattle would have to fed at less than *ca.* 80 ppm in the diet. Noting that the MRL for sugarcane is *0.05 mg/kg, it is considered unlikely that residues in tops and trash would exceed 80 ppm.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Pendimethalin

-is a selective herbicide used for the control of annual ryegrass and certain broadleaf weeds in sugarcane, cereals etc. It is applied at an application rate of up to 1.49 kg ai/ha and is applied as soon as possible after planting.

No harvest or grazing WHPs are required.

There are no Codex or US MRLs for pendimethalin in animal tissues while the Australian MRLs have all been set at *0.01 mg/kg (offal/meat/milk). Residues decline in soil and foliage with typical half-lives of 90 and 50 days respectively. The Australian MRL for sugarcane is *0.05 mg/kg. The US EPA notes that animal metabolism studies in goats conducted at exaggerated feeding levels indicate that there is no reasonable expectation for residues of pendimethalin in tissues²⁵.

It is anticipated that animal product residues will be below typical method LOQs.

Permethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on sugarcane for the control of armyworm and can be applied at anytime. The application rate is up to 0.05-0.1 kg ai/ha. Permethrin residues decline with typical half-lives of 30 and 8 days for soil and foliage respectively.

No harvest (8 weeks shown on one product label) or grazing WHPs are required.

²⁵ Reregistration Eligibility Decision Pendimethalin List A Case 0187, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

There are Australian, Codex and USA MRLs for permethrin in animal tissues. The Australian and Codex residue definitions are parent compound while the USA residue definition includes some metabolites. The relevant MRLs for fat are 1, 1 and 1.5 mg/kg for Australia, Codex and the USA respectively. The relevant MRLs for offal are 0.5, 0.1 and 0.1 mg/kg for Australia, Codex and the USA respectively. The relevant MRLs for milk are 0.1 F, 0.1 F and 3 mg/kg for Australia, Codex and the USA respectively, the latter is for milk fat and represents 0.25 mg/kg on a whole milk basis. The Australian MRL for sugarcane is *0.1 mg/kg.

The TF for fat is 0.04²⁶. Permethrin can be fed at ca. 4 ppm in the diet and meet the Australian MRL for fat. Noting the MRL for sugarcane, it is unlikely that residues in tops and trash would exceed 4 ppm.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Picloram

- is a selective herbicide used widely for the control of weeds. It is registered on a variety of crops including potential animal feeds pasture and cereals. The application rate for sugarcane is 0.0525-0.1125 kg ai/ha.

The following WHPs are required:

DO NOT harvest for 8 weeks after application

DO NOT graze or cut for stock food for 8 weeks after application

There are no Codex MRLs for picloram. The residue definition for the US and Australia is parent compound. The Australian MRL for edible offal (mammalian) is 5 mg/kg while the US tolerance for cattle kidney is 5 mg/kg. The corresponding milk MRLs are *0.05 and 0.05 mg/kg. The Australian MRLs for sugarcane, sugarcane forage and sugarcane fodder are *0.01, 50 and 50 ppm respectively. Picloram does not accumulate in fat. The TF for kidney is 0.01²⁷ and milk 0.0003²⁸. Picloram residues decline rapidly upon withdrawal of picloram from the diet when fed at 1600 ppm for 28 days such that after 3 days residues are less than the limit of analytical quantitation (0.05 mg/kg) for all tissues except kidney which had residues of 0.06 mg/kg. Anticipated residues in kidney from feeding sugarcane fodder with residues of 50 ppm are $50 \times 0.01 = 0.5$ mg/kg.

Livestock residues may exceed international and/or domestic market standards.

Prochloraz

-is a fungicide used for the control of Pineapple disease in sugarcane. It is applied to seed pieces at an application rate of up to 9 g ai/hL.

No harvest or grazing WHPs are required.

This is a nil residue situation.

It is anticipated that animal product residues will be below typical method LOQs.

²⁶ 1981 JMPR Pesticide Residues in Food - 1981 Evaluations, FAO Plant Production and Protection Paper 42. FAO and WHO 1982

²⁷ Kutchinski, A.H. and Riley, V. (1969) Residues in various tissues of steers fed 4-amino-3,5,6-trichloropicolinic acid, *J. Agr. Food Chem.* 17 (2) 283-287.

²⁸ Kutchinski, A.H. (1969) Residues in milk from cows fed 4-amino-3,5,6-trichloropicolinic acid, *J. Agr. Food Chem.* 17 (2) 288-290.

Propiconazole

-is a fungicide used for the control of Pineapple disease in sugarcane. It is applied to seed pieces at an application rate of up to 5 g ai/hL.

No harvest or grazing WHPs are required.

This is a nil residue situation.

It is anticipated that animal product residues will be below typical method LOQs.

Tebuconazole

-is a DMI fungicide used for the control of orange rust in susceptible varieties of sugarcane. The application rate is up to 125 g ai/ha.

The harvest WHP is 28 days.

Do not graze or cut for stock food for 28 days after application.

There are Australian, Codex and US MRLs for tebuconazole in animal tissues. The Australian and Codex residue definition is tebuconazole while the USA residue definition is the sum of tebuconazole and its 1-(4-chlorophenyl)-4,4-dimethyl-3-(1H-1,2,4-triazole-1-yl-methyl)-pentane-3,5-diol metabolite. The Australian MRLs 0.5 mg/kg for edible offal mammalian, 0.1 mg/kg for meat (mammalian) and 0.05 mg/kg for milk. The Codex MRLs are *0.05 mg/kg for both cattle meat and cattle edible offal and *0.01 mg/kg for milk. The US MRLs are 0.2 mg/kg for meat byp and 0.1 mg/kg for milk.

The Australian MRL for sugarcane is 0.1 mg/kg. There is a PAFC MRL of 50 ppm.

Residues of tebuconazole were not detected (<0.05 mg/kg) in muscle and fat of dairy cattle dosed at the equivalent of 250 ppm in the diet for 28 days²⁹. The residues in liver were 0.2 mg/kg. The TF for liver is 0.0008.

It is anticipated that animal product residues will be below typical method LOQs.

Terbutryn

- is a selective herbicide used for the control of seedling broadleaf weeds in cereals, pasture and sugarcane. In sugarcane, it is applied when weeds are up to 30 cm high and vines to 1 m. The application rate is up to 1.1 kg ai/ha.

No harvest or grazing WHPs are required when applied alone. Tank mixes with ametryn should not be applied later than 9 months before harvest.

There are no Codex or US MRLs for terbutryn. The Australian MRLs for meat (mammalian) (fat) and milk are both 0.1 mg/kg while the MRL for edible offal is 3 mg/kg. MRL for sugarcane is *0.05 mg/kg.

The APVMA Animal Residue Data Sheet (July 2003) notes that the Australian animal MRLs were based on a feeding and/or metabolism study where animals were dosed at the equivalent of 60 ppm in the diet. Anticipated residues in offal from feeding sugarcane fodder are ca. 3 mg/kg.

Livestock residues may exceed international and/or domestic market standards.

²⁹ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

Triadimefon

-is a fungicide used for the control of Pineapple disease in sugarcane. It is applied to seed pieces at an application rate of up to 12.5 g ai/hL.

No harvest or grazing WHPs are required.

This is a nil residue situation.

It is anticipated that animal product residues will be below typical method LOQs.

Triadimenol

-is a fungicide used for the control of Pineapple disease in sugarcane. It is applied to seed pieces at an application rate of up to 5 g ai/hL.

No harvest or grazing WHPs are required.

This is a nil residue situation.

It is anticipated that animal product residues will be below typical method LOQs.

Trichlorfon

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on sugarcane for the control of armyworm and so involves application late in the cane growth. The application rate is up to 0.6 kg ai/ha.

The harvest WHP is 2 days. The grazing WHP is 2 days.

There are no Codex MRLs for trichlorfon in animal tissues. The Australian MRL for cattle fat is 0.1 mg/kg and 0.5 mg/kg for the US tolerance. The Australian MRL for milks is *0.05 mg/kg while no milk MRL has been set in the US. The Australian MRL for sugarcane is *0.05 mg/kg. Residues decline in soil and foliage with typical half-lives of 10 and 3 days respectively. Following peroral uptake of the trichlorfon (12.5 and 20 ppm in feed), no trichlorfon residues were detected (<0.1 ppm) in any of the examined tissues and organs (brain, heart, kidney, steak, fat) after a four week feeding period³⁰. Residues in sugarcane tops and trash are expected to be less than 20 ppm.

It is anticipated that animal product residues will be below typical method LOQs.

Trifloxysulfuron

-is a sulfonyleurea herbicide used to control various weeds in sugar cane. Application is at 150 g ai/ha.

DO NOT harvest for 4 weeks after application

DO NOT graze or cut for stock food for 4 weeks after application

There are Australian but no Codex or US MRLs for trifloxysulfuron in animal commodities. The Australian MRLs for animal commodities are all *0.01 mg/kg. The MRL for sugarcane is *0.01 mg/kg and those for sugarcane fodder (fresh weight) *0.02 mg/kg and sugarcane forage (fresh weight) *0.02 mg/kg.

Livestock consuming tops from mature cane crops should be exposed to negligible levels of trifloxysulfuron.

³⁰ 1971 JMPR. Evaluations of some pesticide residues in food. AGP/1971/M/9/1; WHO Pesticide Residues Series No. 1, 1972

It is anticipated that animal product residues will be below typical method LOQs.

Trifluralin

- is a selective herbicide of the dinitroaniline class and is used for the control of grass and broadleaf weeds in crops including sugarcane. It is applied to plant cane after emergence to the “out-of-hand” stage and to ratoon cane immediately after harvest. The application rate is up to 1.4 kg ai/ha. No harvest WHP is required.

There are no Codex or US MRLs for trifluralin in animal tissues although there are registrations in the US including on sugarcane (MRL 0.05 mg/kg). There are no Codex or US MRLs for trifluralin in animal tissues. The Australian MRL for meat (mammalian) and milk are *0.05 mg/kg. Residues decline in soil and foliage with typical half-lives of 60 and 3 days respectively. The sugarcane MRL is *0.05 mg/kg.

The US EPA evaluation of trifluralin states that based on a goat metabolism study where animals were fed at exaggerated rates there is no expectation of finite residues of trifluralin in animal tissues³¹.

It is anticipated that animal product residues will be below typical method LOQs.

Trinexapac-ethyl

-is used to enhance yield and quality in sugarcane. Application is at 200 g ai/ha.

DO NOT harvest for 5 weeks after application

DO NOT graze or cut for stock food for 5 weeks after application

There are Australian but no Codex or US MRLs for trifloxysulfuron in animal commodities. The Australian MRL for edible offal is 0.05 mg/kg, for meat *0.02 and milks *0.005 mg/kg The MRL for sugarcane is 0.2 mg/kg and those for sugarcane fodder and sugarcane forage 2 mg/kg.

EFSA report a feeding study where lactating dairy cows were dosed at the equivalent of 2, 5.6 and 20 ppm in the feed for 28 days. Animals were slaughtered 20 h after the last dose. Residues (mg/kg) were:

Tissue	2 ppm	5.6 ppm	20 ppm
Muscle	<0.02	<0.02	<0.02
Fat	<0.02	<0.02	0.02
Liver	<0.02	<0.02	0.03
Kidney	0.03	0.05	0.29
Milk average	<0.005	<0.005	0.011

Livestock consuming tops from mature cane crops should be exposed to negligible levels of trifloxysulfuron.

It is anticipated that animal product residues will be below typical method LOQs.

³¹ Reregistration Eligibility Decision, Trifluralin, List A Case 0179, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division EPA 738-R-95-040, April 1996

Transfer factors and depletion half-lives for organochlorine compounds in sheep fat

Compound	Feeding level (ppm)	Transfer factor	Half-life	Reference
BHC (α -, β -, γ -BHC)	0.12 (0.07 grass + 10% soil at 0.5)	<0.4 (no residue detected, assumed LOD 0.05 mg/kg)	-	Fries & Marrow 1976
Dieldrin	0.1	1	ca 6 weeks	Gannon et al 1959
	0.25	1.6		
	0.75	0.4		
	2.25	0.84		
	0.2	3-4	4-17 weeks	Paton & Petterson 1997
Heptachlor	-	-	-	
Lindane (γ -BHC)	ca 3-8	0.5-1.3	ca 9 days	Collett & Harrison 1968

Clothianidin

-is a systemic insecticide. It is used to control Greyback canegrub (*Dermolepida albohirtum*) at 7.5 g ai/100 m row.

Restrains : DO NOT apply more than one soil application of Shield per crop per season.

DO NOT apply as a foliar application.

Withholding periods:

Harvest: Do not harvest for 21 weeks after application.

Grazing: Do not graze or cut for stock food for 21 weeks after application.

In Australian trials, the proposed soil treatment with clothianidin resulted in the following residue levels in sugar cane billets and tops at 20-25 weeks after application.

APPLICATION RATE	CLOTHIANIDIN RESIDUE (mg/kg)		
	BILLETS	TOPS	
		FRESH WEIGHT	DRY WEIGHT
7.5 g ai/100m row (1x the proposed rate)	<0.01, <0.02, 0.02, 0.02, 0.04	<0.01, 0.02, 0.04, 0.07, 0.10	0.08, 0.15, 0.17, 0.27
15 g ai/100m row (2x the proposed rate)	<0.01, 0.03, 0.05, 0.06	<0.01, 0.03, 0.06, 0.07	0.27, 0.34, 0.38