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Pesticide risk profile for the feeding of pineapple forage, tops and bran to cattle and sheep

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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.

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Potential for violative residues in cattle and sheep fed pineapple forage, tops and bran

For by-products to be useful as animal feeds, they must not present safety or health problems to the animals nor present a risk of contaminating the animal product to be sold. In the production and utilization of by-products, all parties must take care to prevent contamination with pesticides, mycotoxins, and other materials that could be dangerous to the animals or contaminate the animal product.

Pineapples (*Ananas comosus*) are perennial stemless plants with long, narrow, fibrous and usually spiny leaves. They are native to tropical America, but are now cultivated in many countries including Australia. The fruit grows on an erect stout stalk at the centre of the plant.

Up to 80 tonnes of leaves per hectare are available annually after harvesting of the fruits. The leaves are a good feed for ruminants and can be used fresh, artificially dried or ensiled. Ruminants can be fed 15-20 kg of fresh or ensiled plants daily. No harmful effects have been recorded. The leaf meal cannot be used for pigs or poultry. It is reported that the dried leaves can advantageously be pelleted.

When the fruits are canned, the outer peel and the central core are discarded. The waste, called pineapple bran, accounts for about 50% of the total pineapple weight, corresponding to about 10 tonnes of fresh bran or one ton of dry bran per hectare. The bran can be used fresh for feeding, but may also be dried and ground into a meal.

The bran, either fresh or dried, is reported to be a good feed for ruminants and is usually mixed with grass as the roughage portion of the diet. Fresh leaves contain approximately 21% dry matter, silage of leaves 19% and dried bran (cannery residue) 88%.

Chemical residues in animal feeds may be transferred to the tissues of livestock on feeding. While it is unlikely that the chemical residues present in meat and offal arising from feeding represent a concern regarding food safety they can result in disruption to trade where the relevant Australian and overseas market standards differ.

The observation of chemical product withholding periods does not guarantee that the chemical residues in the feed are such that when fed to livestock, the residues in meat and offal will meet export market requirements.

The aim of the current report is to profile the risk of violative residues in export meat and edible offal posed by the presence of pesticide residues in pineapple commodities fed to cattle and sheep.

Assessment of currently registered chemicals that may be used on pineapple crops

Estimates of residues in livestock tissues and milk are usually made on the basis of 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 the highest individual animal tissue divided by the nominal feed level. If the highest residue was not reported the average residue divided by the nominal feed level were used instead. In the case of milk the average residue was divided by the nominal feed level.

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 fruit by-products (including pineapple pulp) incorporated in animal feed as 20% and however, 30% was used in the current evaluation. Estimates of residues in pineapple waste 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 feed items it is accepted practice to calculate dietary burdens for a ration on a dry matter basis.

The estimated residue in animal commodities is:

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

Unless stated otherwise, the following assumptions have been used in the risk assessment:

- The pineapples are harvested at maturity and that the cannery waste (bran) is derived on processing.
- The crop has been treated at the maximum rate and with the shortest interval between application and harvest permitted by the product label⁴.
- The maximum rate of incorporation in the ration/diet is 100% for forage and 30% for bran.

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

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.

- That residue transfer for cattle is greater than for sheep and therefore that the assessment of residues in cattle also covers sheep.

The potential for violative residues in animals is assessed against the Australian, Codex and US tolerances as listed in December 2005⁵. 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 pineapple forage and 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 pineapples.

Most of the compounds registered for use on pineapples 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).

The conclusion of the analysis is the risk of residue violations in meat and edible offal posed by the feeding of pineapple forage and processing waste derived from pineapple crops treated with currently registered products is low for the majority of chemicals. However, additional information on several pesticides, especially lindane in both soil and foliage is desirable.

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
Lindane	Fat	0.6	0.1	No	Yes
Prochloraz	Liver	0.67	0.01	No	No
Pyrethrins	Fat	0.075	0.05	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: diuron.

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 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.

⁵ MRLs and approved use patterns change with time. The assessments include the most recent decisions of the Codex Alimentarius Commission (28th Session, July 2005) with regard to Codex MRLs, US tolerances as listed in the Code of Federal Regulations at December 2005 and MRLs as they appear in Table 1 of the APVMA *MRL Standard* as at December 2005.

Appendix 1

Ametryn

-is a selective herbicide use don pineapples and sugarcane for the control of grasses and broad-leaved weeds. The maximum application rate for pineapples is 4 kg ai/ha.

Do not apply within 98 days of harvest.

There are no Codex MRLs for ametryn. Nor are there any US MRLs for animal tissues although there are MRLs for pineapples (0.25 mg/kg) and pineapple fodder and forage (0.25 mg/kg). The Australian MRLs for meat (mammalian), edible offal (mammalian) and milks are *0.05 mg/kg. The MRL for pineapple is also *0.05 mg/kg. The Australian use-pattern is such that significant residues are not expected in pineapples at harvest.

The octanol water partition coefficient ($\log P_{ow} = 2.63$) suggests ametryn will not concentrate in fat.

The US EPA reported residue data from a total of 13 tests conducted in Hawaii on pineapple⁶. Ametryn (80% WP) was applied as a single broadcast application to the planting or ratoon pineapple crop at rates of 8.1 kg ai/ha (1×) in 8 tests, 16 kg ai/ha (2×) in 3 tests, and 24 kg ai/ha (3×) in 2 tests. Samples of pineapple were harvested at 142-161 days after treatment; the labeled PHI in the US is 160 days. Residues of ametryn were <0.02-0.05 mg/kg and residues of GS-11354, GS-11355, and GS-26831 were each <0.02 mg/kg in/on 16 samples of pineapples from the 1× application; combined residues were <0.08-<0.11 mg/kg. Residues of ametryn and each metabolite were <0.02 mg/kg in/on the 6 treated samples from the 2× trials and the 4 treated samples from the 3× trials. Residues of ametryn and the three metabolites were each <0.02 mg/kg (<LOQ) in/on whole pineapples treated at 1× or 3×, and were <0.02 mg/kg in juice, pulp, and slices, and <0.1 mg/kg (<LOQ) in bran processed from 1× and 3× treated fruits.

In a ruminant feeding study reported by the EPA, three groups of dairy cattle (3 cows/group) were dosed orally via capsules once a day for 28-30 consecutive days with ametryn at levels equivalent to 2.15, 6.20, and 20.1 ppm in the feed. 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 mg/kg (<LOQ) in all milk samples from cows dosed at 20.1 ppm, for combined residues of <0.04 mg/kg, and residues were also <0.01 mg/kg 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 mg/kg (<LOQ) in liver, kidney, muscle, and fat from each cow in the 20.1 ppm dose group, for combined residues of <0.08 mg/kg in each matrix.

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

Bromacil

- is a selective herbicides used for the control of certain broad-leaved weeds and grasses in citrus and pineapples. It is applied to grass/weeds as a spot spray or inter-row application at rates of up to 3.6 kg ai/ha.

No harvest WHP required.

There are no Codex or USA MRLs for bromacil. The Australian MRLs are *0.04 mg/kg for meat (mammalian) and edible offal (mammalian). In fact all MRLs for bromacil including pineapple

⁶ MEMORANDUM dated: 03 Nov 2004. Subject: Ametryn. Residue Chemistry Considerations for Reregistration Eligibility Decision. DP Barcode: D307104 Case No. 2010 PC Codes: 080801 40 CFR.: §180.258 From: William H. Donovan, Ph.D., Chemist Reregistration Branch 3 (RRB3) Health Effects Division (HED) (7509C) To: Mark T. Howard, CRM Reregistration Branch 3 Special Review and Registration Division (7508C)

have been set at *0.04 mg/kg implying that no residues are expected. The US MRL for pineapples is 0.1 mg/kg.

A 1970 study reported residues of bromacil *per se* of 0.116 ppm in milk from a dairy cow fed bromacil at 30 ppm in the diet. In a ruminant metabolism study with dosing at the equivalent of 9.2 ppm the levels of TRR in milk were 0.04 mg equiv./kg and in tissue samples 0.02 mg equiv./kg⁷.

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

Carbaryl

-is a carbamate insecticide used for the control of various insects in crops. It is registered on fruits (general) for the control of wingless grasshopper. The application rate is up to 87.5 g ai/hL.

The harvest WHP is 3 days

Do not graze or cut for stock food for 1 day after application.

Carbaryl residues decline with typical half-lives of 10 and 7 days for soil and foliage respectively.

There are Australian, Codex and USA MRLs for carbaryl in animal tissues. The Australian and Codex residue definition is carbaryl for both plant and animal commodities. The Australian MRLs for edible offal and meat are 0.2 mg/kg while that for milk is 0.05 mg/kg. The Codex MRL for kidney is 3 mg/kg and liver 1 mg/kg while the MRL for meat is 0.05 mg/kg. The Codex milk MRL is 0.05 mg/kg.

The USA residue definition is the sum of carbaryl and 1-naphthol expressed as carbaryl for plant commodities, the sum of carbaryl, 1-naphthol, 5,6-dihydrodihydroxycarbaryl and 5,6-dihydrodihydroxynaphthol expressed as carbaryl for animal tissues. The US tolerance for cattle kidney and liver is 1 mg/kg and that for milk 0.3 mg/kg. The US MRL for pineapple is 2 mg/kg and for pineapple bran (wet and dry) 20 ppm.

There is no Australian MRL for pineapple. The use-pattern suggests significant residues will occur.

The TF for kidney is 0.007 for the Australian/Codex residue definition and 0.012 for the US residue definition⁸ giving rise to anticipated maximum residues in kidney from feeding pineapple forage/fodder/waste at 100% of the diet with residues at the US MRL of 20 ppm for bran of $0.007 \times 20 = 0.14$ mg/kg and $0.012 \times 20 = 0.24$ mg/kg respectively for the Australian/Codex and USA residue definitions.

The TF for milk is 0.0002 for the Australian/Codex residue definition and 0.002 for the US residue definition giving rise to anticipated maximum residues in milk from feeding pineapple forage/fodder/waste at 100% of the diet of $0.0002 \times 20 = 0.004$ mg/kg and $0.002 \times 20 = 0.04$ mg/kg respectively for the Australian/Codex and USA residue definitions.

(Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residue in forage would be $87.5 \text{ i/hL} \times 20 \text{ hL} / 80 \text{ tonnes} = 22$ ppm.)

It is considered extremely unlikely that pineapple crops would be sprayed within 7 days of harvest or a failed crop (forage) would have been sprayed with carbaryl within 2-4 weeks of feeding to animals.

⁷ Reregistration Eligibility Decision Bromacil List A, Case 0041, EPA 738-R-96-013, August 1996, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

⁸ 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 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

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

Chlorpyrifos

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on pineapples for the control of white grubs when applied pre-plant (soil incorporated) and for control of pineapple mealy bugs and ant (foliar applications). The application rate is up to 50 g ai/hL for foliar application and 2.5 kg ai/ha for soil incorporation.

A harvest WHP is not required.

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 T0.5, 1 and 0.3 mg/kg for Australia, Codex and the USA respectively. The MRLs for milk are T0.2 [milk in the fat] mg/kg, *0.01 mg/kg and 0.01 mg/kg (0.25 mg/kg for milk fat). There is an Australian MRL for pineapple of T0.5 mg/kg.

The maximum transfer factor for feeding cattle at 10 ppm in the diet was 0.016 for cattle fat⁹. Bran comprises up to 25% of the harvested pineapple giving a theoretical processing factor of 4 for pineapple to bran if all the residue is concentrated in the bran. Residues from feeding pineapple bran with residues of $0.5 \times 4 = 2$ ppm at 30% of the diet would be $0.3 \times 2 \times 0.016 = 0.009$ mg/kg, below the Australian, Codex and USA MRLs USA MRL for fat. Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residue in forage would be $50 \text{ g ai/hL} \times 20 \text{ hL}/80 \text{ tonnes} = 12.5$ ppm. Residues from feeding pineapple forage with residues of 12.5 ppm at 100% of the diet would be $12.5 \times 0.016 = 0.2$ mg/kg, below the Australian, Codex and USA MRLs for fat.

Anticipated residues for milk would be $12.5 \times 0.0007 = 0.009$ mg/kg.

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

Diazinon

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on pineapples for the control of pineapple scale and mealy bugs. The application rate is up to 52 g ai/hL for scale and 2.4 kg ai/ha for mealy bugs.

The harvest WHP is 14 days.

Do not harvest, graze or cut for stock food crops or pastures for 14 days after application

There are Australian, Codex and USA MRLs for diazinon in animal tissues. The MRLs for cattle fat are 0.7 mg/kg for Australia, Codex and the US. For milk the MRLs are 0.5 [in the fat], 0.02 F mg/kg and not specified. There is an Australian MRLs for pineapples at 0.5 mg/kg (fruit). The US MRL for pineapples is also 0.5 mg/kg while the MRL for pineapple forage is 40 ppm.

The TF for diazinon in animal fat is 0.001¹⁰. Anticipated residues in cattle fat from feeding pineapple forage with residues at the US MRL for forage are $40 \times 0.001 = 0.04$ mg/kg, below the relevant international MRLs. No residues were detected in milk of cows dosed at the equivalent of 120 ppm in the diet.

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

⁹ 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>

¹⁰ 1996 JMPR - Pesticide Residues in Food - 1996 Evaluations, Part I: Residues FAO Plant Production and Protection Paper 142. FAO and WHO 1997

Dimethoate

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on pineapples (Qld Board Approval) for the control of pineapple flat mite. The application rate is up to 44 g ai/hL.

The harvest WHP is 14 days.

There are Australian, Codex and USA MRLs for dimethoate in animal tissues. The Australian and Codex MRLs for animal commodities have been set at *0.05 mg/kg while the US ones are set at 0.02 mg/kg. There are Australian MRLs of 5 mg/kg for fruits (includes pineapples).

Bran comprises up to 25% of the harvested pineapple giving a theoretical processing factor of 4 for pineapple to bran if all of the residue is concentrated in the bran. Maximum residues in pineapple bran are estimated to be $5 \times 4 = 20$ ppm. Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residues in forage would be $44 \text{ g ai/hL} \times 20 \text{ hL} / 80 \text{ tonnes} = 11$ ppm.

A metabolism study with lactating goats dosed orally with dimethoate suggests that residues are not expected in animal tissues¹¹.

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 to both plant crops and ratoons. The application is directed away from the pineapple plants. The application rate is up to 3.6 g 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 while the MRL for pineapples is 0.5 mg/kg. The USA MRL for pineapple is 1 mg/kg.

It is considered unlikely that residues in pineapple bran would exceed $4 \times 0.5 = 2$ ppm, much less than the Australian primary animal feed commodity MRL.

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) \div 4.8 ppm (dietary burden) = 0.2 (crude estimate). Feeding bran with residues of 2 ppm at 30% of the diet could result in residues of $0.3 \times 2 \times 0.2 = 0.12$ mg/kg.

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

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

¹¹ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

Ethephon

-is a plant growth regulator. It is applied for inducement of flowering and for fruit ripening. The application rate is up to 1.2 kg ai/ha for fruit ripening.

The harvest WHP is 7 days.

There are Australian, Codex and USA MRLs for animal commodities. The Australian and USA MRL for edible offal is 0.2 mg/kg while the Codex MRL is 0.1 mg/kg. The Australian MRL for milk [in the fat] is 0.1 mg/kg, USA 0.5 mg/kg for milk fat and Codex 0.004 F mg/kg. The US MRL for pineapple is 2 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 pineapple is 2 mg/kg.

Bran comprises up to 25% of the harvested pineapple giving a theoretical processing factor of 4 for pineapple to bran if all of the residue is concentrated in the bran. Maximum residues in pineapple bran are estimated to be $2 \times 4 = 8$ ppm. Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residues in forage would be $1200 \text{ g ai/ha} / 80 \text{ tonnes} = 15 \text{ ppm}$.

The 1994 JMPR reported residues in foliage of up to 5.4 ppm at 7-8 days after application at 2.24 kg ai/ha and 1.2 ppm in bran at 7-8 days after application at 1.1 kg ai/ha.

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 for milk¹².

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 pineapples for the control of soil borne plant pathogenic nematodes. The application rate is up to 4.8 kg ai/ha.

No harvest or grazing WHPs are required.

There is no Codex MRL for fenamiphos in animal tissues. The relevant Australian and USA MRLs for fenamiphos in animal tissues are *0.05 mg/kg for meat. The Australian and US MRLs for milk are *0.005 and 0.01 mg/kg respectively. The primary animal feed commodity MRL for fenamiphos is 1 mg/kg. The US MRL for pineapple is 0.3 mg/kg and for pineapple bran 10 mg/kg. Australian use-pattern is such that significant residues are not expected in fenamiphos at harvest (MRL *0.05 mg/kg).

The JMPR reported residues in animal feeds derived from pineapple crops treated soil with foliar applications at 1.1- 11 kg ai/ha and harvested at up to 27-270 days after the last application were <0.01-8.68 mg/kg in foliage, <0.01-0.71 mg/kg in wet bran, <0.01-2.27 mg/kg in crowns, <0.02-0.02 mg/kg in dry bran and <0.01-0.13 mg/kg in stumps. In a dairy cattle feeding study, residues in tissues of cattle fed at the equivalent of 20 ppm in the diet were $\leq 0.01 \text{ mg/kg}$ ¹³.

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

¹² 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

¹³ 1999 JMPR - Pesticide Residues in Food - 1999 Evaluations, Part I Residues FAO Plant Production and Protection Paper 157. FAO and WHO 2000

Fenthion

- is an organophosphate insecticide used for the control of various insects and nematodes. It is registered on pineapples for the control of fruit fly. The application rate is up to 41.25 g ai/hL when used as a foliar spray or as a post-harvest dip.

The harvest WHP is 7 days.

There are Australian and US (due to expire 1/4/06) but no Codex MRLs for fenthion in animal tissues. The relevant Australian and USA MRLs for fenthion in animal tissues are 1 mg/kg in Australia and 0.1 mg/kg in the US. The relevant milk MRLs are 0.2 and 0.01 (N) mg/kg respectively. The MRL for pineapples is 5 mg/kg.

Maximum residues in pineapple bran are estimated to be $5 \text{ mg/kg} \times 4 = 20 \text{ ppm}$. Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residues in forage would be $41.25 \times 20 \text{ g ai/ha} / 80 \text{ tonnes} = 10 \text{ ppm}$.

Residues in tissues of lactating dairy cows fed at a nominal feed level of 7.6 ppm were all $< 0.05 \text{ mg/kg}$ ¹⁴. It is considered unlikely that feeding of pulp derived from fenthion treated pineapple forage, fodder or bran would give rise to residues above regulatory method LOQs in tissues. The TF for milk is 0.002.

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

Fluazifop-p

- is a selective post-emergent herbicide used for the control of certain grasses in crops such as canola, cotton, sunflower, legumes and pastures. The application rate for pineapples is up to 0.424 kg ai/ha.

The harvest WHP is 14 days.

There are Australian and USA but no Codex animal tissue MRLs for fluazifop. The relevant Australian MRLs are *0.05 for edible offal and meat and 0.1 for milk. The US tolerances for animal commodities have all been set at 0.05 mg/kg (fluazifop-butyl). The Australian MRL relevant to pineapples is 0.05 mg/kg.

Maximum residues in pineapple bran are estimated to be $0.05 \text{ mg/kg} \times 4 = 0.2 \text{ ppm}$. Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residues in forage would be $424 \text{ g ai/ha} / 80 \text{ tonnes} = 5.3 \text{ ppm}$.

The relevant TFs for fluazifop are 0.01 for kidney and milk and 0.005 for fat (12 ppm feeding level)¹⁵. Anticipated maximum residues are $5.3 \times 0.01 = 0.05 \text{ mg/kg}$ for kidney and milk.

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

Fluometuron

- is a selective post-emergent herbicide used for the control of certain grasses in crops such as canola, cotton, sunflower, legumes and pastures. The application rate for pineapples is up to 3.6 kg ai/ha.

The harvest WHP is 7 weeks.

¹⁴ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

¹⁵ UK PSD Evaluation of fully approved or provisionally approved products. Issue No. 10 Evaluation on: Fluazifop-P-butyl, October 1988

There are no Australian, Codex or US animal tissue MRLs for fluometuron. The Australian MRLs for pineapples have been set at *0.1 mg/kg.

It is considered unlikely that residues of fluometuron would be detected in animal tissues.

Fosetyl-Aluminium

-is a fungicide used for the control of heart rot and root rot in pineapples. It is applied both as a soil drench and foliar spray, the later at 3.86 kg ai/ha.

The harvest WHP is 7 days.

The Australian MRL for pineapples is 5 mg/kg. Animal metabolism studies show that the major components of the residue are phosphorous acid and aluminium. There is no expectation of residues¹⁶.

There are US MRLs for aluminum *tris*(O-ethylphosphonate) in pineapples, pineapple forage and pineapple fodder of 0.1 mg/kg.

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

Glufosinate ammonium

-is a non-selective foliar herbicide used for the control of broadleaf weeds and grasses in crops such as cotton, maize, sorghum and winter cereals as well as pastures. It is applied as a shielded spray to pineapples. The application rate is up to 1 kg ai/ha.

No harvest WHPs are required.

Do not graze or cut treated areas for stock food for 8 weeks after application

The Australian MRLs are 5 mg/kg for offal, 0.1 mg/kg for meat and *0.05 mg/kg for milk. The Codex MRLs are *0.1 mg/kg for edible offal, *0.05 mg/kg for meat and *0.02 mg/kg for milks. The relevant USA MRL is 6 mg/kg for cattle mbyp while the MRLs for meat and fat are 0.15 and 0.4 mg/kg respectively. The US MRL for milk is 0.02 mg/kg. There is an Australian MRL for pineapples of 0.2 mg/kg.

The JMPR have reported that residues were <0.01 mg/kg in edible offal and meat of cattle fed at the equivalent of 27 ppm in the diet¹⁷.

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

Haloxypop-R

- is a selective post-emergent herbicide used for the control of certain grasses in crops such as grain legumes, oilseeds (including cotton) and legume pastures. The application rate for pineapples is up to 416 g ai/ha as a directed spray.

No harvest WHP required

There are Australian but no USA or Codex animal tissue MRLs for haloxypop. The relevant Australian MRLs are 0.5 mg/kg for edible offal, 0.02 mg/kg for meat (fat) and 0.02 mg/kg for milk. The Australian MRL relevant to pineapple is *0.05 mg/kg.

¹⁶ Reregistration Eligibility Document. Aluminum tris(o-ethyl-phosphonate) (referred to as fosetyl-Al) December 1990 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

¹⁷ Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

Maximum residues in pineapple bran are estimated to be $0.05 \text{ mg/kg} \times 4 = 0.2 \text{ ppm}$. Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residues in forage would be $416 \text{ g ai/ha} / 80 \text{ tonnes} = 5.2 \text{ ppm}$. However, the use pattern is as a directed spray and it is considered unlikely that more than 10% of the application would contact leaves or be translocated into the pineapple forage from the soil. A conservative estimate of residues in forage is $<0.1 \times 5.2 = <0.52 \text{ ppm}$.

The TF for cattle fat is 0.05 and cattle kidney 0.19¹⁸. If it is assumed residues are present at $<0.5 \text{ ppm}$ in forage residues in cattle tissues would be $<0.5 \times 0.05 = <0.025 \text{ mg/kg}$ in fat and $<0.5 \times 0.19 = <0.095 \text{ mg/kg}$ in kidney if forage was included at 100% of the diet.

The TFs for milk and cream are 0.016 and 0.15. If it is assumed residues are present at $<0.5 \text{ ppm}$ in forage, residues in milk and cream would be $<0.5 \times 0.016 = <0.008 \text{ mg/kg}$ in milk and $<0.5 \times 0.15 = 0.075 \text{ mg/kg}$ in cream.

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

Lindane

-is used for the control of white grubs and symphylids in pineapples with application at rates of up to 4.6 kg ai/ha made at the time of planting.

Keep all livestock out and away from treated areas.

There are Australian, US and Codex MRLs for lindane in animal commodities. The Australian MRLs are 2 mg/kg for both edible offal (mammalian) and meat (mammalian) (in the fat) and 0.2 mg/kg for milk [in the fat]. The Australian MRL applicable to pineapples is 0.5 mg/kg (fruits). The US MRL of 1 mg/kg for pineapples. The fat MRL in the US is 7 ppm (cattle and sheep). The Codex MRLs are 0.1 mg/kg for mammalian fat and *0.01 mg/kg for milk.

The TF for lindane in fat is *ca.* 1 while residues in fat deplete with a half-life of 7-10 days when animals are put on clean feed¹⁹. Assuming the residue concentrates in the bran, maximum residues in bran are estimated to be $0.5 \times 4 = 2 \text{ ppm}$. Feeding at 30% of the diet should not result in residues that exceed the Australian or US MRLs but may exceed the Codex MRL ($0.3 \times 2 \times 1 = 0.6 \text{ mg/kg}$). No information was located for likely residues in forage or soil. The TF for milk is 0.05 giving anticipated residues of $0.3 \times 2 \times 0.05 = 0.03 \text{ mg/kg}$.

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

Metalaxyl

- is a fungicide used on a variety of crops. It is used on pineapples for the control of heart rot and root rot at an application rate of 0.5 kg ai/ha.

The harvest WHP is 4 weeks.

There are Australian and US but no Codex MRLs for metalaxyl in animal commodities. The Australian and Codex residue definition is parent compound. The Australian MRL for edible offal is *0.05 mg/kg while the MRL for meat is *0.05 mg/kg and *0.01 mg/kg MRL for milk. The US residue definition is the sum of metalaxyl and its metabolites containing the 2,6-dimethylaniline moiety, and N-(2-hydroxymethyl-6-methylphenyl)-N-(methoxyacetyl)-alanine methyl ester, each

¹⁸ Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

¹⁹ 2003 JMPR. Pesticide Residues in Food - 2003 Evaluations – Part I: Residues, FAO Plant Production and Protection Paper xxx. FAO and WHO 2004

expressed as metalaxyl equivalents. The USA MRLs are 0.4 mg/kg for fat, liver and kidney and 0.05 mg/kg for meat and meat by-products and 0.02 mg/kg for milk. The US MRL for pineapples is 0.1 mg/kg and for pineapple forage and fodder 0.1 mg/kg. The Australian pineapples is 0.1 mg/kg.

In a lactating goat metabolism study conducted at a dose level equivalent of feeding at 7 ppm, radioactive residues in tissues, expressed in metalaxyl equivalents, were all <0.06 mg/kg²⁰.

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

Metaldehyde

-is a molluscicide that is used for the control of slugs and snails in *fruit* crops.

It is applied at an application rate of 0.75 kg ai/ha.

The harvest WHP is 7 days.

There are no Australian, Codex or US MRLs for metaldehyde in animal commodities.

The Australian MRL for fruits is 1 mg/kg.

The US EPA reported²¹ that “metaldehyde is expected to be rapidly metabolized in mammalian systems with subsequent incorporation of degradates into naturally occurring components. This conclusion is supported by the extensive metabolism observed in rat metabolism studies.

Metaldehyde is rapidly absorbed, distributed, and metabolized in the rat. Between 78-98% of the administered dose was recovered as expired air within 24 hours as ¹⁴CO₂ in the rat metabolism study”.

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

Piperonyl butoxide (PBO)

- is a synergist used to increase the effectiveness of various synthetic pyrethroid (SP) insecticides. It is registered for use with various SPs but particularly pyrethrin in the control of insect pests on fruits. The application rate is up to 52 g ai/ha.

The harvest WHP is 1 day.

There are Australian and Codex but no US MRLs for PBO in animal commodities. PBO is exempt from the requirement for tolerances in the US. The Australian MRLs for animal tissues have all been set at 0.1 mg/kg. The Codex MRL for mammalian meat (fat) (except cattle) is 2 mg/kg and for cattle meat (fat) 5 mg/kg. The Australian MRL for milks is *0.05 mg/kg. There is an Australian MRL of 8 mg/kg for fruits. The US MRL for pineapples (post-harvest) is 8 mg/kg.

Maximum residues in pineapple bran are estimated to be 8 mg/kg ×4 = 32 ppm. Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residues in forage would be 52×20 g ai/ha /80 tonnes = 13 ppm. The TF for PBO in fat is 0.004 (feeding at 100 ppm in the diet)²² resulting in an anticipated maximum residue from feeding pineapple forage, fodder or bran with residues at 13 ppm of 0.05 mg/kg, less than the relevant Australian and Codex MRL.

²⁰ 1982 JMPR Pesticide Residues in Food - 1982 Evaluations, FAO Plant Production and Protection Paper 49. FAO and WHO 1983

²¹ MEMORANDUM dated 20 December 2005. SUBJECT: Metaldehyde: HED Chapter of the Reregistration Eligibility Decision Document (RED). PC Code: 053001; DP Barcode: DP311884 FROM: Matthew Lloyd TO: Jill Bloom.

²² 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

The TF for PBO in milk is 0.0001 (feeding at 100 ppm in the diet) resulting in an anticipated maximum residue from feeding pineapple forage, fodder or bran at 100% of the diet of $13 \times 0.0001 = 0.0013$ mg/kg, less than the relevant Australian, Codex and US MRLs and likely regulatory method LOQ.

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

Prochloraz

-is an imidazole fungicide used for the control of water blister in pineapples. It is applied as a post-harvest dip at 24.75 g ai/hL.

Do not feed treated fruit or by-products from treated processed fruit to livestock.

There are Codex but no Australian or US MRLs for prochloraz in animal commodities. The Codex MRLs are 5 mg/kg for cattle edible offal, 0.5 mg/kg for cattle fat and *0.1 mg/kg for cattle meat and milk. The Australian MRL for pineapples is 2 mg/kg.

The use pattern is such that significant quantities of treated pineapples are unlikely to be fed to animals. Maximum residues in pineapple bran are estimated to be 2 mg/kg $\times 4 = 8$ ppm. The 1990 JMPR reported a feeding study in which cattle were dosed at rates of 10, 30 and 100 ppm for 28 days²³. At the lowest dose level, residues of 2.8, <0.05, 0.5 and 0.1-0.2 mg/kg, respectively, were found in liver, muscle, kidney and fat. Anticipated residues in liver are $0.3 \times 8 \times 0.28 = 0.67$ mg/kg.

Livestock residues may exceed international and/or domestic market standards. Pineapples treated post-harvest are unlikely to be fed.

Propiconazole

-is a DMI fungicide used for the control of base rot in pineapples. Application is as a pre-plant dip at 5 g ai/hL.

A harvest WHP is not required.

There are Australian, Codex and US MRLs for propiconazole in animal commodities. The Australian MRLs (propiconazole) are 1 mg/kg for edible offal, 0.1 mg/kg for meat and *0.01 mg/kg for milk. The Codex MRLs are (propiconazole) 0.05 mg/kg for edible offal, *0.05 mg/kg for meat (mammalian) and *0.01 mg/kg for milk. The US residue definition is the sum of propiconazole and its metabolites determined as 2,4-dichlorobenzoic acid, expressed as parent compound. The US MRLs are 2 mg/kg for liver and kidney, 0.1 mg/kg for fat and meat by-products (except liver and kidney) and 0.05 mg/kg for milk. The US MRL for pineapples is 0.1 mg/kg and for pineapple fodder 0.1 mg/kg. The Australian MRL for pineapples is 0.05 mg/kg.

The Australian use-pattern is such that no or very low residues are expected in pineapples or derived animal feeds. Animal transfer studies were reported by the 1987 JMPR at feeding levels of 15-100 ppm for cows and 4.5 ppm for goats resulted in undetectable parent residues in milk and tissues (<0.05 mg/kg)²⁴. After feeding cows for 14 days at 15 ppm the total residues were undetectable in milk and 0.63 mg/kg in kidney.

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

²³ 1990 JMPR. Pesticide Residues in Food - 1990 Evaluations, Part I Residues FAO Plant Production and Protection Paper 103/1. FAO and WHO 1990

²⁴ 1987 JMPR Pesticide Residues in Food - 1987 Evaluations, Part I Residues FAO Plant Production and Protection Paper 86/1. FAO and WHO 1988

Pyrethrins

- is a natural pyrethroid insecticide used for the control various insect pests in fruit crops. The application rate is up to 13 g ai/hL.
The harvest WHP is 1 day.

There are US but no Australian or Codex MRLs for pyrethrins in animal commodities. The MRLs applicable to cattle fat (target tissue) have all been set at 0.1 mg/kg. The MRL for milk fat is 0.5 mg/kg reflecting negligible residues in whole milk. There is an Australian MRL of 1 mg/kg for fruits, while the US MRL for pineapples is also 1 mg/kg (post-harvest).

Maximum residues in pineapple bran are estimated to be 1 mg/kg $\times 4 = 4$ ppm. Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residues in forage would be 13×20 g ai/ha /80 tonnes = 3.25 ppm. In a feeding study with lactating cows, residues in tissues of animals dosed orally at a level equivalent to 5 ppm in the feed had residues in tissues that were <LOQ (0.038 mg/kg) for muscle, liver and kidney and 0.048-0.075 mg/kg in fat²⁵.

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

Quizalofop ethyl

is a herbicide used for the control of various grass weeds in pineapples crops. The maximum application rate is 100 g ai/ha.
The harvest WHP is 7 days.

There are Australian and US but no Codex MRLs for animal commodities. The Australian MRL for meat (mammalian) has been set at *0.02 mg/kg, edible offal (mammalian) at 0.2 mg/kg and milk at 0.1 mg/kg. The US MRLs are 0.05 mg/kg for fat and meat by-products and 0.02 mg/kg for meat. The US MRL for milk is 0.01 mg/kg and for milk fat 0.05 mg/kg. The US residue definition is the sum of quizalofop-ethyl, quizalofop- methyl and quizalofop expressed as quizalofop ethyl. The US MRL is 0.1 mg/kg for pineapple. The Australian MRL for pineapple is *0.05 mg/kg.

Maximum residues in pineapple bran are estimated to be 0.05 mg/kg $\times 4 = 0.2$ ppm. Assuming an application volume of 2000 L/ha and a forage yield of 80 tonnes wet weight, residues in forage would be 100 g ai/ha /80 tonnes = 1.25 ppm.

In a feeding study²⁶, three groups of lactating dairy cows were fed 0.1, 0.5, and 5.0 ppm quizalofop ethyl ester (encapsulated) for 28- consecutive days. Two cows were sacrificed after 28 days with samples of fat, skeletal muscle, liver, and kidney being collected and analyzed. The remaining cow in each test group was fed a regular diet without encapsulated quizalofop ethyl ester for an additional 7 days before sacrifice. Whole milk, skim milk, and cream from the control, and the 0.1 and 0.5 ppm dose groups showed no quizalofop to < 0.02 ppm (0.05 ppm in cream). From the 5 ppm dose, quizalofop residues ranged from 0.01 to 0.02 ppm in whole, and when these samples were separated into cream and skim milk, the quizalofop partitioned into the cream with residues plateauing at 0.26 to 0.31 ppm. No quizalofop to < 0.02 ppm was detected in skeletal muscle, and to < 0.05 ppm was detected in any liver or fat sample from any of the three doses. Quizalofop was detected in one kidney sample as 0.05 ppm from the 5 ppm dose. TF kidney = 0.01.

²⁵ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

²⁶ US EPA ([Federal Register: August 25, 2004 (Volume 69, Number 164)] [Notices] [Page 52256-52261] ENVIRONMENTAL PROTECTION AGENCY [OPP-2004-0245; FRL-7372-4] Quizalofop-Ethyl; Notice of Filing a Pesticide Petition to Establish a Tolerance for a Certain Pesticide Chemical in or on Food)

Feeding forage with residues of 1.25 ppm at 100% of the diet would give rise to residues in kidney of $1.25 \times 0.01 = 0.0125$ mg/kg. Anticipated residues in milk are $1.25 \times 0.004 = 0.005$ mg/kg and in cream $1.25 \times 0.06 = 0.075$ mg/kg.

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