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Pesticide risk profile for the grazing of pasture and/or cutting of hay and feeding 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
F	MRL is based on the residue in the fat portion of the tissue
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 pasture and hay

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 pasture and hay fed to cattle and sheep.

Assessment of currently registered chemicals that may be used on pasture

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.

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>

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 forage and fodder included in animal feed as 100% and this value was used in the current evaluation. Estimates of residues in pasture and hay were obtained from scaling of literature studies, MRLs or based on conservative assumptions. The dietary burden is then the residue in crop × 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. Hay is typically 88% dry matter and it was not considered necessary to adjust residue values as any correction would be minor. In the case of pasture which typically contains 25% dry matter, a correction of residues in pasture was not used as most residue estimates were based on conservative assumptions (e.g. day of application residues) and the correction would lead to gross overestimates of animal dietary exposures.

The estimated residue in animal commodities is:

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

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

- The pasture is harvested according to good agricultural practice (label) and that the fodder/silage/hay is derived at this time.
- 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%
- 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 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 pasture and hay 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 pasture.

Most of the compounds registered for use on pasture also have registrations in other crops that are major animal feed commodities.

The conclusion of the analysis is the risk of residue violations in meat and edible offal posed by the feeding of forage and hay derived from pasture treated with currently registered products is low for the majority of chemicals.

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.

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.

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
2,4-DB	Liver	0.44	0.05	Yes	No
Asulam	Kidney	0.1-0.2	0.01	No	No
Bromoxynil	Offal	1.4	0.01	No	No
Carbaryl	Kidney	1.25	0.2	Yes	No
Chlorpyrifos	Fat	0.6	0.3	Yes	No
Clopyralid	Kidney	1.5	0.01	Yes	Yes
Cypermethrin(s)	Fat	0.25	0.05	Yes	Yes
Deltamethrin	Fat	0.15	0.05	Yes	Yes
Dicamba	Kidney	0.36	0.05	No	No
Diuron	tissues	10	0.01	No	No
Fluazifop	Fat	0.4	0.01	No	No
Haloxifop	Kidney	0.95	0.01	Yes	Yes
Lambda-cyhalothrin	Fat	0.5	0.01	Yes	Yes
MCPA	Kidney	0.2	0.01	Yes	Yes
Tebuthiuron	Kidney	1.75	0.01	No	No
Triclopyr	Kidney	10	0.05	Yes	Yes

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: 2,2-DPA (dalapon), bromoxynil, diclofop-methyl, diflufenican, dimethoate, diuron, flupropanate, fluroxypyr, maldison, MCPB, methabenzthiazuron, metolachlor, metsulfuron-methyl, parathion-methyl, prometryn, propyzamide and terbutryn.

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.

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 rate for lucerne is 3.7 kg ai/ha while for pasture is up to 20.7 kg ai/ha (Qld only) or up to 7.4 kg ai/ha for Parramatta grass and 5.9 kg ai/ha for serrated tussock.

No harvest WHP is required.

All crops have the following grazing restraint:

DO NOT graze or cut for stock food for 6 weeks 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. No data was located for residues on grass or lucerne following application. 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}.

Note: the US EPA revoked tolerance for grass and rangeland pasture was 5 ppm. Utilising the US EPA revoked tolerances a conservative TF of 0.01 is estimated for meat and offal and 0.006 for milk. Assuming residues occur at the US revoked tolerance for pasture, anticipated maximum residues in tissues are $5 \times 0.01 = 0.05$ mg/kg.

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

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. Application to pasture is at 1.12 kg ai/ha.

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

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. The Australian MRL for cereal grains is 0.2 mg/kg.

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.

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

(1998 JMPR) Residues in forage of grass pasture treated at 2.2 kg ai/ha were 19-125 ppm in forage at 7 days after application and 39-330 ppm in hay. Scaling the forage and hay results to the Australian rate gives maximum residues of 63 ppm for forage and 165 ppm for hay. Using TFs from the 1446 ppm feeding study, anticipated residues in kidney and fat from feeding at 100% of the diet are $165 \times 0.0045 = 0.74$ mg/kg and $165 \times 0.00035 = 0.06$ 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 $165 \times 0.00006 = 0.01$ mg/kg.

(Using the extensive 2,4-D 0 day data, maximum residues at day 0 in forage were 358 ppm, scaling to 1 kg ai/ha gives a maximum residue of 163 ppm in pasture for foliar application of any pesticide at 1 kg ai/ha.)

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

2,4-DB

- is a selective herbicide used widely for the control of weeds. It is registered on a variety of crops including potential animal feeds pasture, lucerne, medics and clover. Application is at 1.6 kg ai/ha. No harvest WHP is required.

DO NOT graze or cut for stock food for 7 days after application.

There are Australian but no Codex or USA MRLs for 2,4-DB in animal tissues. The Australian MRLs are 0.2 mg/kg for meat (mammalian) and edible offal (mammalian) and *0.05 mg/kg for milks.

The US residue definition for plant commodities is the sum of 2,4-DB and its metabolite 2,4-D.

The US EPA reported⁹ that in a ruminant feeding study “residues of 2,4-DB were at or below the limit of quantitation (≤ 0.01 ppm) for all milk samples from the 1×, 3×, and 10× (the maximum theoretical dietary burden [sic 1.65 ppm in the US]) feeding rate. For all tissue matrices, residues of 2,4-DB were <0.05 ppm (LOQ) in samples from the 1× and 3× dose groups. One sample each of kidney and liver from the 10× dose group bore residues of 2,4-DB at 0.05 and 0.11 ppm, respectively. All other tissue samples from the 10× dose group were <0.05 ppm. The appropriate tolerance for 2,4-DB is 0.05 ppm (LOQ) in the meat byproducts of cattle, goats, hogs, horses, and sheep. There is no reasonable expectation of the transfer of residues of 2,4-DB from feedstuffs to livestock meat, fat or milk; therefore, the current use of 2,4-DB with respect to these commodities should be classified as Category 3 under 40 CFR 180.6(a), and tolerances for residues of 2,4-DB in milk or in the meat and fat of cattle, goats, hogs, horses, and sheep are not required”.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 1.6 kg ai/ha gives a day 0 residue of 261 ppm). From data reported by the US EPA, the half-life for residues in forage is approximately 3.5 days. At 7 days after treatment residues in forage are anticipated to be less than 65 ppm. There is a possibility that residues in kidney (0.2 mg/kg) and liver (0.44 mg/kg) will exceed the likely method LOQ of 0.05 mg/kg for 2,4-DB.

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

alpha-Cypermethrin

⁹ US EPA RED (2004) 2,4-DB [4-(2,4-dichlorophenoxy) butyric acid] and 2,4-DB dimethylamine salt (PC Codes 030801, 030819): REVISED Product Chemistry and Residue Chemistry Summary Documents for the Reregistration Eligibility Decision Document (RED). Reregistration Case 0196. DP Barcode. D291212.

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. The application rates for lucerne and pasture is up to 16 g ai/ha
The harvest WHP (for stock food) is 14 days. Pasture: Do not graze for 3 days after application.

Alpha-cypermethrin residues decline with typical half-lives of 30 and 5 days for soil and foliage respectively. The half-life for the decline of residues in animal tissues is approximately 7 days.

There are Australian, Codex and USA MRLs for cypermethrin in animal tissues. The relevant MRLs for cattle fat are 0.5, 0.2 and 1 mg/kg for Australia, Codex and the USA respectively. The respective milk MRLs are 1 [in the fat = 0.04 mg/kg whole milk], 0.05 F mg/kg and 2.5 mg/kg for Australia, Codex and the USA. The US also has separate MRLs for zeta cypermethrin of 1 mg/kg for cattle fat and 2.5 mg/kg in milk fat (reflecting a residue of 0.1 mg/kg in whole milk). The Australian PAFC MRL for cypermethrin is 5 ppm.

(Scaling anticipated residues in forage at day 0 of 163 ppm after application at 1 kg ai/ha for application at 0.016 kg ai/ha gives a day 0 residue of 2.6 ppm). The 1981 JMPR reported residues in alfalfa (green) at 1-4 days after application at 25-28 g ai/ha of 0.12-2.5 ppm. The TF for fat is $0.1^{10,11}$. Anticipated residues in fat are $2.5 \times 0.1 = 0.25$ mg/kg if fed at 100% of the diet. Anticipated residues in whole milk (TF 0.003-0.1) are the same as for fat.

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

Aminopyralid

-is a herbicide used to control weeds in a variety of situations. The application rate for *fallow* is up to 5 g ai/ha.

No harvest WHP is required.

ESI 3 days. EGI 42 days. EAFI 42 days.

There are Australian, Codex and US MRLs for aminopyralid in animal commodities. The Australian MRLs are 0.3 mg/kg for kidney, 0.03 mg/kg for other offal, *0.01 mg/kg for meat and *0.01 mg/kg for milk. The Codex MRLs are 1 mg/kg for kidney, 0.05 mg/kg for other offal, 0.1 mg/kg for meat and 0.02 mg/kg for milk. The US tolerances are 0.3 mg/kg for kidney, 0.02 mg/kg for fat, meat and other offal and 0.03 mg/kg for milk. The Australian MRL for mixed pastures (leguminous/grasses) ppm.

The 2006 JMPR reported: Groups of lactating dairy cows received the equivalent of 0, 32.8, 64.5, 181.5 and 644.7 ppm in the feed for 28 days. Following the dosing period, there was an additional depuration phase of 14 days, with slaughter intervals of 3, 7 and 14 days after withdrawal from dosing. Residues in whole milk following dosing at 32.8 ppm in the feed were < 0.01 mg/kg over the 28 days period. Residues reached plateau within 2 to 3 days of dosing. Residues in milk ranged <0.01–0.024 mg/kg and 0.011–0.028 mg/kg following dosing at 64.5 and 181.5 ppm, respectively. Aminopyralid residues ranged 0.023–0.127 mg/kg following dosing at 644.7 ppm. Residues had declined to < 0.01 mg/kg within 2 days of withdrawal from dosing at the highest level of 644.7 ppm. The highest aminopyralid residues in tissues following dosing at 32.8 ppm level were: muscle < 0.01 mg/kg, fat 0.01 mg/kg, liver < 0.01 mg/kg, and kidney 0.1 mg/kg. Following dosing at 64.5 ppm, aminopyralid residues were < 0.01 mg/kg in muscle, 0.01 mg/kg in fat and liver and 0.2

¹⁰ Chen-AW; Fink-JM; Letinski-DJ; Barrett-GP; Pearsall-JC (1997) Residue of cypermethrin and its major acid metabolites in milk and tissues from dairy bovines treated with cypermethrin. *J. Ag. Food Chem.* 45: 12, 4850-4855.

¹¹ 1981 JMPR Pesticide Residues in Food - 1981 Evaluations, FAO Plant Production and Protection Paper 42. FAO and WHO 1982 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

mg/kg in kidney. The highest aminopyralid residues in tissues following dosing at 181.5 ppm level were 0.05 mg/kg in muscle and liver, 0.09 mg/kg in fat, and 1.5 mg/kg in kidney. The highest aminopyralid residues in tissues following dosing at 644.7 ppm level were 0.03 mg/kg in muscle, 0.04 mg/kg in fat, 0.06 mg/kg in liver, and 2.5 mg/kg in kidney.

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

Amitrole

-is a herbicide used to control weeds in a variety of situations. The application rate for *pastures* is up to 1.4 kg ai/ha pre-plant when used as part of the preparation for sowing. No harvest WHP is required.

There are Australian but no Codex or US MRLs for amitrole in animal commodities. The Australian MRLs, including milk, have all been set at *0.01 mg/kg.

The JMPR have stated that¹² “*There do not appear to be any grounds for assuming that livestock grazing on plant materials growing on land that had been treated with amitrole for the control of weeds would absorb or retain significant amounts of amitrole or its metabolites*”.

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

Asulam

-is a herbicide used on lucerne at 1.68 kg ai/ha and pasture at up to 4.8 kg ai/ha. Do not graze or cut for stock food for 21 days after application.

There are Australian and US but no Codex for asulam in animal commodities. The Australian MRLs, including milk, have all been set at *0.1 mg/kg. The US MRL have all been set at 0.05 for animal commodities except meat byproducts which is 0.2 mg/kg.

In a ruminant feeding study lactating dairy cows were dosed with asulam *per se* at 50, 200, or 800 ppm in the diet for 28 days¹³. Half the test animals were sacrificed within 24 hours of the final dose and the remaining animals were sacrificed after a 14- or 21-day withdrawal period. Residues of asulam and its metabolites containing the sulfanilamide moiety were determined using an adequate HPLC method (Method No. 154) in fat, kidney, liver, muscle, and milk. At the 50 ppm dose level, residues ranged from 0.04 - 0.11 mg/kg in milk and from <0.05 - 0.34 mg/kg in the tissues; at the 200 ppm dose level residues ranged from 0.10 - 0.32 mg/kg in milk and from <0.05 - 1.03 mg/kg in tissues; and at the 800 ppm dose level residues ranged from 0.48 - 1.16 mg/kg in milk and from <0.05 - 3.56 mg/kg in tissues. Kidney tissue had the highest residue levels (>4×) as compared to the other tissues.

In a second ruminant feeding study, lactating dairy cows were dosed with asulam *per se* at 0.5, 5, 50, 200, or 800 ppm in the diet for 28 days. Residues of asulam were determined using an adequate spectrophotometric method. Residues were nondetectable (<0.025 mg/kg) in milk from cows dosed at 0.5- 50 ppm. Residues were nondetectable (<0.05 mg/kg) in all tissues of cows dosed at 0.5 ppm and in the fat of cows from all feeding levels. In cows fed at 5 ppm, residues were nondetectable (<0.05 mg/kg) in all tissues except kidney (0.06-0.12 mg/kg). In cows fed at 50 ppm, residues were

¹² 1974 JMPR. Evaluations of some pesticide residues in food. FAO/AGP/1974/M/11; WHO Pesticide Residues Series No. 4, 1975

¹³ 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. <http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

nondetectable in all tissues except kidney (0.11-0.13 mg/kg) and heart (0.06 mg/kg). In cows fed at 200 ppm, residues were nondetectable in all tissues except kidney (0.32-0.34 mg/kg) and heart (0.07 mg/kg). In cows fed at 800 ppm, residues were 1.19-1.39 mg/kg in kidney, 0.10-0.11 mg/kg in liver, 0.08-0.10 mg/kg in muscle, 0.13-0.17 mg/kg in heart, and 0.07 mg/kg in brain.

The anticipated residue in pasture is 5.4 ppm (fresh weight basis). Resulting residues in kidney are expected to be 0.1-0.2 mg/kg.

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

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 to lucerne at rates up to 0.55 kg ai/ha and pasture up to 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 and milk are lower (0.02 mg/kg for cattle fat, mbyp, meat and milk) than the Australian MRL of T*0.1 mg/kg for edible offal mammalian. The Australian milk MRL is T*0.01 mg/kg. There is an Australian PAFC MRL of T40 ppm. Residues in soil and foliage decline with typical half-lives of 60 and 5 days respectively.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 3 kg ai/ha gives a day 0 residue of 489 ppm). Feeding at 37.5 ppm in the diet for 28 days gave residues that were <0.01 mg/kg in milk and tissues at slaughter¹⁴. It is uncertain whether feeding at higher rates will lead to detectable residues of atrazine in animal commodities.

Note the draft final APVMA ECRP recommendations for atrazine include a recommendation that the WHP for grazing of forage crops be 28 days¹⁵.

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

Bendiocarb

-is a carbamate insecticide used for the control of seed harvesting ants. It is applied to pasture seed at 160 g ai/100 kg seed (also has veterinary/direct animal use).

No grazing/stock food WHP required (other than do not feed treated seed).

There are Australian but no Codex or US MRLs for bendiocarb in animal commodities. The Australian MRLs are 0.1 for cattle meat, 0.2 mg/kg for cattle edible offal (no sheep MRLs) and 0.1 for milks.

Residue trials reported by JMPR indicate that residues of bendiocarb in grass pasture at 21 or more days after sowing are <0.2 ppm, even when applied at rates of up to 4 kg ai/100 kg seed. In feeding studies with lactating dairy cattle fed at up to 25 ppm in the diet, residues in muscle and fat were

¹⁴ Atrazine Reregistration Eligibility Decision Residue Chemistry Considerations PC Code 080803; Case 0062 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

¹⁵ The reconsideration of approvals of the active constituent atrazine, registrations of products containing atrazine, and their associated labels. Second Draft Final Review Report Including additional assessments October 2004 Australian Pesticides & Veterinary Medicines Authority Canberra Australia

<0.02 mg/kg, in liver <0.05 mg/kg and kidney <0.1 mg/kg (<LOQs for individual tissues) and <0.02 mg/kg in milk¹⁶.

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

Beta-cyfluthrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on lucerne and pastures for the control of red-legged earth mites and blue oat mites at application rates of up to 5 g ai/ha. Cyfluthrin residues decline with typical half-lives of 60 and 3-5 days for soil and foliage respectively.

Do not graze or cut for stock feed for 3 days after application.

There are Australian, USA and Codex MRLs for cyfluthrin. The relevant MRLs for cattle fat are 0.5, 1 and 2 mg/kg for Australia, Codex and the USA respectively. The relevant MRLs for cattle milk are 0.1, 0.04 and 5 mg/kg for milk fat (1 mg/kg in whole milk) for Australia, Codex and the USA respectively. There are Australian MRLs for grass pasture (green) of 2 ppm and legume pastures (except vetch) (green) 3 ppm.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.005 kg ai/ha gives a day 0 residue of 0.8 ppm, at 3 days residues would be expected to be 0.4 ppm).

The US EPA¹⁷ reported magnitude of residue data were collected from four supervised crop field trials with grass at application rates of 0.027-0.034 kg ai/ha with pre-harvest interval(s) of 0 days for grass forage and 6-7 days for hay. The results from these trials show that the residues of cyfluthrin in grass forage ranged from 0.24 ppm to 4.8 ppm after a total application rate of 0.027-0.034 kg ai/ha and a PHI of 0 days, and the residues of cyfluthrin in grass hay ranged from 0.62 ppm to 6 ppm after a total application rate of 0.027-0.034 kg ai/ha and a pre-harvest interval (PHI) of 6-7 days.

Residues in the animal diet from pastures would not be expected to lead to exposure of greater than 0.4 ppm in the diet. TF fat = 0.05¹⁸. Estimated residues in fat are $0.4 \times 0.05 = 0.02$ mg/kg. The TF for milk is 0.005 giving anticipated residues of $0.4 \times 0.005 = 0.002$ mg/kg.

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

Bifenthrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on lucerne, clover and subterranean clover for control of mites and pasture looper. The application rate is up to 20 g ai/ha. Bifenthrin residues decline with typical half-lives of 26 and 7 days for soil and foliage respectively.

Do not graze or cut for stock food for 4 weeks after application

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

¹⁶ 1982 JMPR Pesticide Residues in Food - 1982 Evaluations, FAO Plant Production and Protection Paper 49. FAO and WHO 1983

¹⁷ [Federal Register: January 28, 2004 (Volume 69, Number 18)] [Notices] [Page 4143-4147] ENVIRONMENTAL PROTECTION AGENCY [OPP-2003-0407; FRL-7339-6] Cyfluthrin; Notice of Filing of Pesticide Petitions to Establish a Tolerance for a Certain Pesticide Chemical in or on Food

¹⁸ 1998 JECFA Residues of some veterinary drugs in animals and foods. Forty-eighth meeting of the Joint FAO/WHO Expert Committee on Food Additives, 1998, FAO Food and Nutrition Paper 41/10

corresponding 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 MRL for alfalfa fodder [lucerne] and alfalfa forage (green) are 0.1 ppm, for clover hay and fodder *0.05 ppm and for clover forage (green) *0.05 ppm.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.02 kg ai/ha gives a day 0 residue of 3.26 ppm, at 28 days residues would be expected to be 0.2 ppm). Assuming residues in pasture are present at 0.2 ppm, the forage is fed at 100% of the diet and a maximum TF of 0.3¹⁹ would give anticipated residues in fat of $0.2 \times 0.3 = 0.06$ mg/kg, below the relevant international MRLs. The TF for milk is 0.02 giving anticipated residues in milk of $0.2 \times 0.02 = 0.004$ mg/kg.

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

Bromoxynil

- is a selective herbicide used for the control of broad-leaved weeds in cereals (wheat, barley, oats and triticale) and pasture. The application rate is up to 0.4 kg ai/ha.

Do not graze or cut for stock food for 14 days after application.

There are no Codex animal tissue MRLs for bromoxynil. The Australian residue definition for bromoxynil is parent compound while the US definition includes a metabolite (DBHA). The US MRLs for animal tissues are 0.5 mg/kg for meat and 3.5 mg/kg for mbyp, 0.1 mg/kg for milk. The Australian MRL of T1 mg/kg for meat (mammalian) and T0.1 mg/kg for milk. The primary animal feed commodity MRL is 1 ppm. Residues of bromoxynil in soil and foliage decline with typical half-lives of 7 and 3 days respectively.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.4 kg ai/ha gives a day 0 residue of 65 ppm, residues at 14 days or 4 half-lives are expected to be 4 ppm. In a study where bromoxynil was fed to lactating dairy cows for 4 days at 5 ppm, bromoxynil (parent compound) was not detected in milk (LOD 0.1 ppm)²⁰.

The APVMA reported: The bromoxynil residue (expressed as bromoxynil phenol) in tissues and milk after dosing at 0.7 ppm (as bromoxynil phenol – dosed as bromoxynil octanoate at 1 ppm) for 29 days (mean of 2 observations for tissues, 3 for milk) and also the highest bromoxynil residue (expressed as bromoxynil phenol) in tissues and milk after dosing at 42 ppm (bromoxynil phenol) for 34 days.

Sample	Residue (mg/kg expressed as bromoxynil phenol)	
	0.7 ppm	42 ppm
Liver	0.98	11.7
Kidney	0.46	18.7
Muscle	<0.05	3.2
Fat	0.31	9.8
Milk	0.04	0.58

Anticipated residues in offal when feeding at the level of the PAFC are $1 \text{ ppm} \times 1.4 = 1.4$ mg/kg for offal (US residue definition).

Livestock residues may exceed international and/or domestic market standards

¹⁹ 1992 JMPR - Pesticide Residues in Food – 1992 evaluations. Part II. Toxicology. WHO, WHO/PCS/93.34, Geneva, 1993

²⁰ Reregistration Eligibility Decision Bromoxynil List B Case 2070EPA738-R-98-013 December 1998 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

Anticipated residues when feeding at the predicted level for forage are $4 \text{ ppm} \times 1.4 = 5.6 \text{ mg/kg}$ for offal (US residue definition).

Livestock residues may exceed international and/or domestic market standards. Insufficient data were located to provide confident opinion on livestock residue risks.

Butroxydim (p)

-is a cyclohexanedione herbicide used for the control of grass weeds in various crops. The application rate for lucerne is up to 45 g ai/ha.

Do not graze or cut for stock food for 14 days after application.

There are no Codex or USA MRLs for butroxydim. The Australian residue definition for butroxydim is parent compound. The Australian MRLs are *0.01 mg/kg for meat (mammalian), edible offal (mammalian) and milk. There is a legume animal feed MRL of *0.01 ppm.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.045 kg ai/ha gives a day 0 residue of 7 ppm).

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 lucerne and pasture for control of various pests. The application rate is up to 1.1 kg ai/ha.

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 T0.2 mg/kg while that for milk is T*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 meat is 1 mg/kg, fat 0.5 and that for milk 1 mg/kg.

The Australian MRLs are T5 mg/kg for cereal grains, T100 ppm for forage of cereal grains and T100 ppm for straw and fodder (dry) of cereal grains.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 1.1 kg ai/ha gives a day 0 residue of 179 ppm).

The TF for kidney is 0.007 for the Australian/Codex residue definition and 0.012 for the US residue definition²¹ giving rise to anticipated maximum residues in kidney from feeding pasture at 100% of the diet of $0.007 \times 179 = 1.25 \text{ mg/kg}$ and $0.012 \times 179 = 2.1 \text{ mg/kg}$ respectively for the Australian/Codex and USA residue definitions.

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

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 pasture at 100% of the diet of $0.0002 \times 179 = 0.036$ mg/kg and $0.002 \times 179 = 0.36$ mg/kg respectively for the Australian/Codex and USA residue definitions.

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

Carbendazim

- is a carbamate fungicide used for the control of fungal diseases in crops. It is applied to subterranean clover with an application rate of up to 0.275 kg ai/ha.

Do not graze or cut for stock food for 14 days after application.

Residues decline with typical half-lives of 60 and 3-5 days for soil and foliage respectively.

There are Australian but no Codex or USA MRLs for carbendazim. The relevant MRLs for cattle meat is 0.2 mg/kg for Australia while the milk MRL is *0.1 mg/kg. The animal feed MRL for legume animal feeds is 25 ppm.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.275 kg ai/ha gives a day 0 residue of 45 ppm, 14 days after or *ca.* 3 half-lives residues would be expected to be 5.6 ppm).

In studies in which dairy cows were fed either carbendazim or benomyl at levels of 2, 10, or 50 ppm in the diet for 28 days, no benomyl residues were found in samples of lean muscle, liver, kidney or fat although in the carbendazim feeding study low-level residues of 5-HBC were observed in the liver (0.01 mg/kg) and kidneys (0.06 mg/kg) of cows in the group receiving 50 ppm carbendazim²². However, residues of this compound were also apparent in a kidney sample in the control group. One week after the end of treatment with the test material no residues were detectable in any tissue sample.

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

Carfentrazone-ethyl

-is a selective aryl triazolinone herbicide used for the control of marshmallow and annual nettles in pasture. The maximum application rate is 18 g ai/ha.

Do not allow stock to graze treated areas for 14 days after application.

There are Australian and US but no Codex MRLs for carfentrazone ethyl in animal commodities. The Australian residue definition is parent compound while the US residue definition is carfentrazone-ethyl and its metabolite carfentrazone-chloropropionic acid (alpha, 2-dichloro-5-[-4-difluoromethyl]-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl]-4-fluorobenzenepropanoic acid). The Australian animal commodity MRLs have all been set at *0.05 mg/kg and milk at *0.025 mg/kg. The US MRLs are 0.1 for meat and meat by-products and 0.05 mg/kg for milk. The MRL for pasture is *0.05 mg/kg.

²² 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999.

In an animal transfer study, lactating cows were fed at levels equivalent to 1, 3 and 10 ppm in the diet for 28 consecutive days²³. No detectable residues (<0.005 ppm) of carfentrazone-ethyl, carfentrazone or F8426-propionic acid were found in any of the milk samples taken, except for low concentrations of carfentrazone (0.005 – 0.008 ppm) in three isolated samples from the 10 ppm dose group. No detectable residues (<0.01 ppm) of carfentrazone-ethyl, carfentrazone or F8426-propionic acid were found in any of the tissue or cream samples with the exception of kidney samples where trace amounts of carfentrazone (0.012 – 0.013 ppm) were found in samples from the 10 ppm dose group. There were no detectable residues of carfentrazone in kidney from cows fed clean feed for 7 days after dosing for 28 days, indicating that this residue was readily cleared from the kidney and excreted from the animal over a relatively short period of time.

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 lucerne, medic and pasture for the control as a foliar spray at rates up to 0.75 kg ai/ha for the control of various pests including locusts (highest rate).

Do not graze or cut for stock food for 2 days after application.

There are Australian, Codex and USA MRLs for chlorpyrifos in animal tissues. 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, 0.02 mg/kg and 0.01 mg/kg (0.25 mg/kg for milk fat) respectively.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.75 kg ai/ha gives a day 0 residue of 122 ppm). The JMPR reported trials in forage and hay. Crops treated at 0.8 kg ai/ha had residues in forage at 12-14 days after the last application of 0.32-10 ppm and in hay cut at 12-14 day +10 days curing of 0.57-30 ppm. Residues in forage and cured hay at 7 days after application at 1.12 kg ai/ha were 3-14 ppm in forage and 5.1-51 ppm in cured hay (3.8-38 ppm if scaled for Australian rate).

The maximum transfer factor for feeding cattle at 10 ppm in the diet was 0.016 for cattle fat and at 30 ppm in the diet was 0.007 for milk²⁴. Residues from feeding hay with residues of 38 ppm at 100 % of the diet $38 \text{ ppm} \times 0.016 = 0.61 \text{ mg/kg}$, below the Codex but above the Australian and USA MRLs. Anticipated residues for milk would be $38 \times 0.0007 = 0.027 \text{ mg/kg}$.

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

Chlorthal dimethyl (DCPA)

-is a benzoic acid herbicide used for weed control in perennial grasses and lucerne. The application rate is up to 11.25 kg ai/ha with application pre crop emergence (at time of sowing).

No grazing WHP required.

There are Australian but not Codex or US MRLs for chlorthal-dimethyl.

The Australian MRLs for animal tissues and milk have all been set at *0.05 mg/kg.

²³ Public Release Summary on Evaluation of the new active CARFENTRAZONE-ETHYL in the product AFFINITY 400 DF HERBICIDE National Registration Authority for Agricultural and Veterinary Chemicals April 2000 Canberra Australia

²⁴ 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>

The US EPA noted that “There are no established tolerances for DCPA residues in eggs, milk, animal fat, meat, and meat by-products. The maximum theoretical daily dietary intake of DCPA for cattle is approximately 10 ppm based on a dairy cattle diet consisting of 50% potato waste, 25% cottonseed, 15% bean seed, and 10% bean forage. In a 1963 cattle feeding study DCPA feeding levels of 200 and 20 ppm were used. At the 20 ppm feeding level, combined residues of DCPA, MTP, and TPA were non-detectable in milk and fat. Muscle, liver, and kidney were not analyzed. These existing cattle feeding studies are of limited usefulness because edible tissues were not analyzed”.

In a goat metabolism study the TF for fat was 0.0003²⁵. If it is assumed that the maximum exposure for animals arises from feeding at 10 ppm in the diet (US estimated exposure) maximum anticipated residues in fat are 10×0.0003 = 0.003 mg/kg. The US EPA RED concluded that until new cattle feeding studies are received, the data from the 1994 goat metabolism study will be used to estimate residues in meat and milk for purposes of a human dietary risk assessment.

Chlorthal-dimethyl can contain up to 100 mg/kg hexachlorobenzene (HCB)²⁶, an application rate of 11.25 kg ai/ha corresponds to a potential application of HCB at 1.125 g/ha. Note the half-life for HCB in soil is 3-6 years. Uptake of HCB by various crops was such that the ratio of soil to grass residues ranges from 0.09 – 2.4 for aerial parts with the highest concentrations in the lower 5 cm of the grass blades while for grass roots the ratio was up to 39. Assumed two applications might be made in a 10-15 year period as is only applied at pasture establishment. The contribution from previous years applications (1.125 g HCB/ha ×2 = 2.25 g HCB/ha), distributed in the top 20 cm soil with density 1 g/mL would be 2250 mg/2000000 kg = 0.001125 ppm. Residues in plant parts utilizing a soil to plant ratio of 2.4 would be 0.0027 mg/kg giving rise to anticipated residues of 0.0027×8 = 0.022 mg/kg in fat and 0.0027×8.4 = 0.023 mg/kg in milk fat.

EFSA reported a feeding trial where two Jersey-Holstein× dairy cows were fed a diet containing 200 ppm chlorthal-dimethyl, 40 ppm TPA, 4 ppm MPA and 1 ppm HCB or 20 ppm chlorthal-dimethyl, 0.4 ppm TPA, 0.4 ppm MPA and 0.1 ppm HCB for 24 days. Residues were monitored in milk during the study period and in biopsies of body fat sampled after 24 days of exposure and also after 12 days on “clean” feed.

Residues in milk on feeding 200 ppm chlorthal-dimethyl

Day	Residues (mg/kg)			
	Chlorthal-dimethyl	MPA	TPA	HCB
1	nd	nd	Nd	nd
4	0.05	0.06	Nd	0.04
8	0.04	0.07	Nd	0.05
12	0.02	0.06	Nd	0.15
16	0.02	0.02	0.03	0.10
20	0.02	0.04	Nd	0.10
24	nd	0.02	Nd	0.26
1	nd	nd	Nd	0.18
3	nd	nd	Nd	0.16
5	nd	nd	Nd	0.20
7	nd	nd	Nd	0.12
9	nd	<0.01	<0.01	0.10
12	nd	0.01	0.01	0.13

²⁵ Reregistration Eligibility Decision (RED) DCPA List A Case 0270 Environmental Protection Agency Office of Pesticide Programs, Special Review and Reregistration Division, EPA 738-R-98-005, November 1998

²⁶ Australian Pesticides And Veterinary Medicines Authority, Minimum Compositional Standards (MCS) for Active Constituents as of 30 January 2004, <http://www.apvma.gov.au/tgac/mincompstandards.pdf>

At 24 days of exposure, residues in fat were <LOD for chlorthal-dimethyl and TPA but 0.26 mg/kg for MPA and 0.32 mg/kg for HCB. After 12 days on clean feed the only residues detected in fat were HCB at 0.01 mg/kg.

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

Clethodim

-is a herbicide used for the control of certain weeds in legume pastures. Application on pastures is up to 120 g ai/ha.

Do not graze or cut treated pastures for stock feed for 14 days after application.

There are Australian, Codex and US MRLs for clethodim. The Australian and Codex residue definition is clethodim and its metabolites containing 5-(2-ethylthiopropyl)cyclohexane-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexane-3-one moieties and their sulfoxides and sulphones, expressed as clethodim. The US residue definition is clethodim and its metabolites containing the 2-cyclohexen-1-one moiety. The Australian MRLs for animal commodities have been set at *0.05 mg/kg. The Codex MRLs are *0.2 mg/kg for edible offal and meat and *0.05 mg/kg for milk. The US MRLs for cattle tissues are all 0.2 mg/kg. There are Australian animal feed MRLs of 15 ppm for Legume animal feeds [except peanut fodder and peanut forage (green)], 10 ppm for Peanut fodder, Peanut forage (green) and Rape seed fodder and forage.

The TF for the US residue definition is 0.006²⁷ for offal giving an anticipated residue of $15 \times 0.006 = 0.09$ mg/kg for liver and kidney, below the US MRL.

Anticipated residues in milk (TF 0.0011) are $15 \times 0.0011 = 0.016$ mg/kg.

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

Clopyralid

-is a selective pyridine herbicide used for the control of certain weeds in pastures and plantation forests. Application on pastures is up to 1.2 kg ai/ha for weeds such as thistles and up to 2.4 kg ai/ha when used for control of silver wattle.

Do not graze or cut treated pastures for stock feed for 7 days after application of rates of 1.6 kg ai/ha or less.

Do not graze or cut treated cereals for stock feed for 4 weeks after application if rate is in excess of 120 g/ha

There are Australian and US but no Codex MRLs for clopyralid in animal commodities. The Australian MRLs are 0.1 mg/kg for meat (mammalian), 5 mg/kg for kidney of cattle goats, pigs and sheep, 0.5 mg/kg for edible offal (mammalian) except kidney and 0.05 mg/kg for milk. The US MRLs are 36 mg/kg for meat by-products except liver, 3 mg/kg for liver, 1 mg/kg for fat and meat and 0.2 mg/kg for milk. There is an animal feed MRL of 100 ppm for pasture.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 1.2 kg ai/ha gives a day 0 residue of 196 ppm, at 7 days or after one t¹/₂, residues would be 98 ppm).

Grass treated at 560 g ai/ha, the maximum use rate for rangeland and permanent grass pastures in Canada, contained residues of clopyralid of 23-86 ppm at 0 days after treatment (DAT) while

²⁷ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

residues in hay were 32-225 ppm. Residues declined steadily for 42 days. Half-lives calculated for clopyralid residues were 7 and 8 days for grass and hay, respectively.

In trials conducted in France, Spain, and the UK where pasture was treated at 200-240 g ai/ha, residues in grass at 7 days after application were 3.0-8.5 ppm. Scaling for an application rate of 1200 g ai/ha (1.2 kg ai/ha) gives maximum residues of 51 ppm (not stated if on a dry weight basis).

Average clopyralid residues in tissues at the end of an experiment where calves were dosed at the equivalent of 1000 ppm in the diet for 28 days were 0.3 mg/kg in muscle, 0.2 mg/kg in fat, 1.3 mg/kg in liver and 15 mg/kg in kidney²⁸. Anticipated residues in kidney on feeding pasture with residues at the MRL are $100 \times 0.015 = 1.5$ mg/kg.

Two goats were fed radiolabeled clopyralid at rates equivalent to 230 and 69 ppm in feed for 7 days²⁹. The residues in liver (approx. 0.04 ppm) and kidney (approx. 0.6 ppm) tissues were shown to be unchanged clopyralid. Residues in muscle and fat were too low (less than 0.02 ppm) to characterize. The milk residue averaged approximately 0.03 ppm and was shown to consist of approximately equal amounts of clopyralid and its glycine conjugate.

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

Cyanazine

-is a triazine herbicide used for the control of various weeds in vetches. The application rate is up to 1.5 kg ai/ha. It is applied post-sowing pre-crop emergence and is not expected to result in significant residues in forage or fodder.

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

Deltamethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on vetch. The application rate is up to 13.75 g ai/ha. Deltamethrin residues decline with typical half-lives of 7 and 4-8 days for soil and foliage respectively. The half-life for the decline of residues in animal tissues is approximately 7-10 days.

The harvest WHP is 7 days for vetch

There are no grazing restraints

There are Australian, Codex and USA MRLs for deltamethrin in animal tissues. The relevant MRLs for cattle fat are 0.5, 0.5 and 0.05 mg/kg for Australia, Codex and the USA respectively. The Australian MRL for milks is 0.05 mg/kg. The Codex MRL for milks is 0.02 F mg/kg. The US MRL is for milk fat 0.1 mg/kg reflecting 0.02 mg/kg in whole milk.

The 2002 JMPR reported residues of 0.25-2.9 ppm in grass at 0-2 days after application at 10-18 g ai/ha. When expressed on a dry weight the maximum residue was 5.1 ppm. The TF for deltamethrin in fat is roughly 0.03³⁰. Feeding of pasture with residues of 5 ppm at 100% of the diet could result in deltamethrin residues in fat of $5 \times 0.03 = 0.15$ mg/kg, this is less than the Australian and Codex

²⁸ Draft Assessment Report (DAR) – public version- Initial risk assessment provided by the rapporteur Member State Finland for the existing active substance Clopyralid of the second stage of the review programme referred to in Article 8(2) of Council Directive 91/414/EEC, Volume 3, Annex B, B.7, February 2005.

²⁹ Dow Agrosiences Technical profile: Clopyralid, July 1998

³⁰ 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

but higher than the likely USA tolerances. Anticipated residues in milk (TF 0.009) are $5 \times 0.009 = 0.045$ mg/kg.

Livestock residues may 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 pastures for the control of various pests including grasshoppers and locusts. The application rate is up to 1.12 kg ai/ha.

Do not graze or cut for stock food 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, 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.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 1.12 kg ai/ha gives a day 0 residue of 183 ppm. The $t_{1/2}$ for foliage is estimated to be 3-4 days giving an estimated residue at 14 days of 46 ppm).

The TF for fat from a dairy cow feeding study (400 ppm feed level) was 0.002³¹. Feeding pasture at 100% of the diet could result in fat residues of $46 \text{ ppm} \times 0.002 = 0.09$ mg/kg. 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.

Dicamba

- is a selective herbicide used for the control of broadleaf weeds in pasture (Nufarm Kamba Dry 54534). The application rate is up to 1.4 to 2 kg ai/ha (Qld, NT for grass pastures).

Do not harvest, graze or cut for stock food for 7 days after application.

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 liver and 0.2 mg/kg for milk. The Australian MRL for meat (mammalian) is 0.05 mg/kg while the MRL for milk is 0.1 mg/kg. Residues in soil and foliage decline with typical half-lives of 14 and 9 days respectively.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 2 kg ai/ha gives a day 0 residue of 326 ppm. The $t_{1/2}$ for foliage is estimated to be 7-9 days giving an estimated residue at 7 days of 163 ppm).

The APVMA Stockfeed data sheet³² 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.

³¹ 1996 JMPR - Pesticide Residues in Food - 1996 Evaluations, Part I: Residues FAO Plant Production and Protection Paper 142. FAO and WHO 1997

³² <http://www.apvma.gov.au/residues/stockfeed.shtml>
Dicamba September 2004

Anticipated residues from feeding pasture at 100% of the diet are $163 \text{ ppm} \times 0.0022 = 0.36 \text{ mg/kg}$ for kidney and $163 \text{ ppm} \times 0.00015 = 0.02 \text{ mg/kg}$ for fat (US residue definition and below US MRLs).

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

Dichlorprop (2,4-DP)

-is a herbicide used for the control of lantana and coral cactus in pasture (APVMA permit 3159). The application rate is up to 4.8 kg ai/ha in non-crop rights of way; aerial use. Use is as a spot spray and is unlikely to lead to residues in pasture grazed by animals.

No grazing instruction on the label.

There are no Australian, Codex or US MRLs for animal commodities. The Australian residue definition is parent compound. There is an Australian MRL for citrus fruits at 0.1 mg/kg.

The log P_{ow} of 1.8-3.0 reported in the literature for dichlorprop suggests accumulation in tissues is unlikely.

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

Diclofop-methyl

-is an aryloxyphenoxypropionate herbicide used for control of annual grasses in leguminous pasture. The application rate is up to 750 g ai/ha. Do not graze or cut for stock feed for 7 weeks after application.

There are Australian but no Codex or US tolerances for diclofop-methyl in animal commodities. The Australian MRLs have all been set at $<0.05 \text{ mg/kg}$.

The US EPA reported an animal feeding study for diclofop methyl and noted that animal MRLs would be required to be established. Four groups of lactating dairy cows were dosed orally *via* capsules for 28 consecutive days with diclofop-methyl at levels equivalent to 0.11, 0.33, 1.1, and 25 ppm in the diet³³. In tissues, residues were highest in kidney and lowest in muscle. For the 25 ppm feed level, the combined residues were 12-23 mg/kg in kidney, 3.9-6.1 mg/kg in liver, 0.75-0.85 mg/kg in fat, and 0.32-0.57 mg/kg in muscle. The TF for kidney and fat were 0.9 and 0.03 respectively. Residues in whole milk plateaued by day 4 at all dose levels. The maximum combined residues in whole milk were 0.023, 0.114, 0.212, and 2.759 ppm for the 0.11, 0.33, 1.1, and 25 ppm groups, respectively. Diclofop-methyl residues concentrated in milk fat, with residues in cream being 2.4-3.4× higher than in whole milk.

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

Di flufenican

-is a nicotinanilide herbicide used to control various weeds in clover based pasture. Application is at rates of up to 100 g ai/ha.

Do not graze or cut for stock food for 7 days after application.

³³ Diclofop-Methyl Reregistration Eligibility Decision Residue Chemistry Considerations PC Code 110902; Case 2160 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

There are Australian but no Codex or US MRLs for diflufenican in animal commodities. The Australian MRLs (parent compound) are 0.1 mg/kg for edible offal mammalian and 0.01 mg/kg for meat (mammalian) and milk. The MRL for legume animal feeds is 5 mg/kg.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.1 kg ai/ha gives a day 0 residue of 16.3 ppm).

EFSA DAR - In a metabolism study lactating cows were dosed at 1 and 20 ppm feed with [difluorophenyl-¹⁴C]-diflufenican and 5 and 50 ppm feed with [pyridine-¹⁴C]-diflufenican for 7 days (2 doses/day). Cows were sacrificed 18-23 h after the last dose. TRR in milk reached a plateau after 3 days at 0.01 and 0.02 mg/kg in the 20 and 50 ppm feeding studies respectively. Parent compound represented 48-52% of TRR in milk. TRR in tissues were <0.01 mg/kg for muscle, 0.07-0.08 mg/kg for fat, 0.03-0.04 mg/kg for kidney and 0.26-0.40 mg/kg for liver in the 20 and 50 ppm studies. At the 1 and 5 ppm dose levels residues in tissues were <0.01 mg/kg with the exception of liver (0.02-0.05 mg/kg) and fat (<0.01-0.03 mg/kg). Parent compound represented 82-91% of the TRR in fat. Parent residues in the highest residue liver sample were 0.02 mg/kg (about 6% TRR)

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

Dimethoate

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on lucerne and pasture at application rates of up to 0.30 kg ai/ha.

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

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 is an Australian MRL of 1 ppm for lupin forage.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.3 kg ai/ha gives a day 0 residue of 49 ppm).

A metabolism study with lactating goats dosed orally with dimethoate at a rate equivalent to feeding at 30 ppm in the diet³⁴ suggests that residues are not expected in animal tissues when fed at this rate, however, the dose level in the goat metabolism study is too close to the anticipated exposure in cattle to draw any conclusions about the likelihood of residues in cattle tissues.

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

Diquat

- is a herbicide used for the control of weeds in various crops. It is applied to pasture with application rates up to 0.3 kg ai/ha.

Do not graze or cut sprayed vegetation for stock food for at least 1 day after application.

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. There is a legume animal feed MRL of T100 ppm. 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

³⁴ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

dosing (LOD 0.01 mg/kg)³⁵. Residues in hay/ forage would be expected to be less than 100 ppm. This suggests that no residues would be detected in animal tissues if fed forage or hay from pasture.

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

Disulfoton

-is an organophosphate insecticide used for the control of aphids in seedling lucerne. Application is at 250 g ai/ha.

Do not graze or cut for stock food for 70 days after application.

There are Australian but no USA or Codex MRLs for disulfoton in animal tissues. The Australian MRLs for animal commodities have been set at 0.02 mg/kg for meat and edible offal and at 0.01 mg/kg for milk. The Codex MRL for milk is 0.01 mg/kg.

The JMPR reported³⁶ residue trials carried out in the US. Applications were usually at 1.1 kg ai/ha although 0.56 or 2.24 kg ai/ha were used in two treatments. Where there was adequate rainfall during the trial, most residues were at or about the LOQ of 0.01 mg/kg at 30 to 120 days after treatment. The occasional high results can be related to rainfall or irrigation and were up to 3 mg/kg at 65 days after application at 1.1. kg ai/ha.

Available dairy cattle feeding data have been reviewed, at feeding levels of 3.6 and 7.2 ppm (and 18 ppm for milk only). Maximum residues were 0.03 ppm in tissue, and 0.012 ppm in milk³⁷.

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 dormant lucerne with application rates up to 1.75 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 mbyf 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 US does not have a milk MRL while 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.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 1.75 kg ai/ha gives a day 0 residue of 285 ppm).

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

³⁵ 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>

³⁶ 1981 JMPR - Pesticide Residues in Food - 1981 Evaluations, Part I Residues FAO Plant Production and Protection Paper 42. FAO and WHO 1982

³⁷ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

estimated. An anticipated TF is the 1 ppm (animal commodity tolerances) ÷ 4.8 ppm (dietary burden) = 0.2 (crude estimate). Assuming residues are present at the PAFC MRL and the TF derived from the US tolerances, anticipated residues in tissues are 50×0.2 = 10 mg/kg.

Livestock residues may exceed international and/or domestic market standards. Insufficient data were located to provide confident opinion on livestock residue risks.

EPTC (eptam)

-is a thiocarbamate herbicide used for the pre-emergent control of certain grasses and broad-leaved weeds and is used as a pre-plant application in crops. It is used on lucerne and pasture crops at 3.96 kg ai/ha.

No harvest WHP required.

There are Australian but no Codex or US tolerances for EPTC in animal commodities. The Australian MRLs are all set at *0.1 mg/kg.

Note: The US EPA in its RED³⁸ reported that the only residue of toxicological concern in goats was EPTA cysteine conjugate and this was only found at low concentrations on dosing at highly exaggerated rates. The agency concluded that there is no reasonable expectation of the occurrence of finite residues in animal tissues.

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

Esfenvalerate

- is a synthetic pyrethroid insecticide used for the control of various insects in crops.

The application rates for lucerne and pasture are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (g ai/ha)	Harvest WHP (days)	Grazing WHP (days)
Pasture	3.5		7
Lucerne	25		7

Esfenvalerate residues decline with typical half-lives of 35 and 8 days for soil and foliage respectively.

There are Australian, Codex and USA MRLs for fenvalerate and esfenvalerate in animal tissues. The relevant MRLs for cattle fat are 1 (meat mammalian [in the fat]), 1 and 1.5 mg/kg for Australia, Codex and the USA respectively. The relevant MRLs for milk are 0.2 mg/kg, 0.1 F mg/kg and 0.3 mg/kg (7 mg/kg for milk fat) for Australia, Codex and the USA respectively. There is a PAFC MRL of 10 ppm and MRLs of 2 ppm for alfalfa fodder and forage (green).

Residues in alfalfa green treated at 50 g ai/ha were 0.51 ppm in green material at 7 or more days after treatment and 0.92 ppm in dry material. Residues in pasture and hay are not expected to exceed 10 ppm, the maximum level that fenvalerate should be fed at in the diet for animals to still comply with the Australian MRL³⁹. Residues of esfenvalerate from feeding these products are unlikely to present a trade risk.

³⁸ Reregistration Eligibility Decision EPTC (S-Ethyl dipropylthiocarbamate) CASE # 0064EPA 738-R-99-006 December 1999 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

³⁹ APVMA Animal Residue Data Sheet for Fenvalerate & Esfenvalerate, May 2004.

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

Ethofumesate

- is a benzofuran herbicide used for the control of various grass and weeds in rye grass pasture. The application rate is up to 2 kg ai/ha.

Do not graze or cut for stock food for 7 days after application.

There are Australian and US but no Codex MRLs for ethofumesate in animal commodities. The Australian MRLs are 0.5 mg/kg for edible offal and meat (mammalian) (fat) with parent compound as the residue definition. The MRL for milks [in the fat] is 0.2 mg/kg. The US MRLs are all 0.05 mg/kg (the sum of ethofumesate and its metabolites 2-hydroxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate and 2,3-dihydro-3,3-dimethyl-2-oxo-5-benzofuranyl methanesulfonate, both calculated as the parent compound). No MRL for milk has been set. The US also has MRLs of 5 ppm for beet tops, 1 ppm for grass straw and 0.5 ppm for sugar beet molasses.

The US EPA reported a feeding study where lactating dairy cows were dosed orally via capsules with ethofumesate at 32.5, 98.8, or 325 mg/day (equivalent to 2.2, 6.6 and 21.6 ppm in the feed) for 28 consecutive days. Cows were sacrificed within 24 hours of the final dose. Milk and tissue samples were analyzed using a GC/FPD-S method (Method B-93R-04/05) that specifically determined residues of ethofumesate and its metabolites NC 8493 and NC 9607.

Residues of ethofumesate, NC 8493, or NC 9607 were each <0.01 ppm in all milk samples taken from the highest dose group, whole milk samples taken from the two low dose groups on days 21, 24 and 28, and in cream and skim milk sample from Day 28 for all 3 dose groups. For tissues, residues of ethofumesate, NC 8493, or NC 9607 were also <0.01 ppm in all tissues samples from each dose group, with the exception of one fat sample from the highest dose group bearing residues of ethofumesate at 0.02 ppm. A storage stability study was not available to cover the storage of samples for 10-12 months prior to analysis.

Residues on the day of application at 1.5 kg ai/ha were about 20-30 ppm. The half-life of residues on turf is 2-3 days (Ping Wang, Shu R. Jiang, Jing Qiu, Qiu X. Wang, Peng Wang, Zhi Q. Zhou, Stereoselective degradation of ethofumesate in turfgrass and soil, Pesticide Biochemistry and Physiology, Volume 82, Issue 3, July 2005, Pages 197-204).

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

Fenitrothion

-is an OP insecticide used to control various pests including Australian plague locust in pasture and lucerne. The application rate is up to 1.3 kg ai/ha.

Do not graze for 7 days after application or withhold stock from slaughter for 14 days after application, whichever is appropriate.

There are Australian and Codex but no US MRLs for fenitrothion in animal tissues. The relevant Australian and Codex MRLs for cattle fat are the T*0.05 and *0.05 mg/kg respectively. The Australian MRL for milks is T*0.05 [in the fat] mg/kg and the Codex MRL is *0.1 mg/kg. The Australian MRL for alfalfa fodder [lucerne] is T5 ppm and for alfalfa forage (green) is also T5 ppm. The MRL for legume animal feeds (except alfalfa fodder and forage) is T10 ppm and also for straw, fodder (dry) and hay of cereal grass and other grass-like plants.

Residues in tissues were <0.05 mg/kg in a 28 day lactating cow feeding study conducted at a feeding level equivalent to 100 ppm in the feed⁴⁰. There is no reasonable expectation of finite residues in milk or cattle tissues as a result of the feeding of pasture or derived hay/silage.

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

Fipronil

- is a phenylpyrazole insecticide used for control of wingless grasshoppers. Application to pasture is at 2.5 g ai/ha.

Do not graze or cut for stock food for 14 days after application.

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 animal feed MRL for pasture (mixed grasses/leguminous)[fresh weight] of 0.02 ppm. Foliar residues of fipronil are reported to decline with a typical half-life of 2-4 days.

Residues in pasture at 7 days after application at 5 g ai/ha were <0.002-0.019 ppm and at 15-16 days after application at 2.5 g ai/ha <0.002-0.011 ppm (JMPR).

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.0025 kg ai/ha gives a day 0 residue of 0.41 ppm. The grazing WHP of 14 days represents 4-7 half-lives so the anticipated residue in grass at 14 days is 0.003-0.026 ppm).

If maximum residues in pasture are assumed to be 0.011 ppm and using the transfer factor for fat reported by the 2001 JMPR (TF = 1.1-1.2)⁴¹, anticipated maximum residues in cattle fat are $\approx 0.011 \times 1.2 = 0.013$ mg/kg.

The TF for milk is 0.1 giving anticipated residues in milk of $\approx 0.011 \times 0.1 = 0.0011$ mg/kg.

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

Fluazifop-p

-is an aryloxyphenoxypropionate (fop) herbicide used for the control of certain grasses in various crops. In white and subterranean clover, barrel and snail medics as well as vetches, it is applied at rates up to 106 g ai/ha.

Do not graze or cut for stock food for 21 days after application.

Animals are not to be sent to slaughter for 7 days after grazing on treated pasture.

Note: there is an APVMA permit 3757 for selective Chilean needle grass seed set suppression prior to hay cutting in lucerne and leguminous pasture with an application rate of 424 g ai/ha.

Do not graze or cut for stock food for 21 days after application.

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).

⁴⁰ The NRA Review of Fenitrothion Interim Report Volume 2, June 1999, Existing Chemicals Review Program National Registration Authority for Agricultural and Veterinary Chemicals – Residues Assessment

⁴¹ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.106 kg ai/ha gives a day 0 residue of 17 ppm.) The foliar half-life is estimated to be 14-21 days. Residues in pasture at 21 days after application are expected to be <8 ppm.

The TFs for kidney, fat and milk are 0.01, 0.05 and 0.012 respectively (12 ppm feeding level)⁴². It is not expected that residues in animal feed commodities would exceed 8 ppm. Anticipated residues in fat are $8 \times 0.05 = 0.4$ mg/kg.

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

Flumetsulam

is a triazolopyrimidine sulfoanilide herbicide used on wheat, barley, oats, triticale and cereal rye undersown with clover, medic and lucerne and on clover, medic, lucerne and vetch pastures for the control of various weeds. The application rate is up to 40 g ai/ha for lucerne and 20 g ai/ha for other crops (note in Tasmania application may be up to 32 g ai/ha).

Do not graze or cut for stock food for 3 days after application.

There are Australian but no Codex or US MRLs for flumetsulam in animal commodities. The Australian MRLs are 0.3 for edible offal and *0.1 for meat and milk. There is an animal feed MRL of 15 ppm for legume pasture.

In the ruminant study, goats were fed 5-¹⁴C-pyridine-labeled flumetsulam in capsules at a dose of 21 mg/day (10 ppm in feed) for 5 consecutive days, 92% of the radioactive residues in milk and eighty-eight percent of the radioactive residues in kidney were identified as parent⁴³. Residues in muscle, fat, and liver were not characterized; however, ¹⁴C-residues in these tissues were low (less than or equal to 0.10 ppm). The maximum residues of flumetsulam observed in any matrix in the goat metabolism study were less than or equal to 0.10 ppm.

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

Flupropanate

-is a herbicide used for the control of serrated tussock and various other grass weeds (Parramatta grass, rat tailed grass etc). It is applied at up to 2.235 kg ai/ha.

Do not graze or cut for stock food for at least 4 months after spraying.

Stock is not to be grazed in flupropanate treated areas for at least 14 days prior to slaughter.

Lactating cows or goats must not be grazed in flupropanate treated areas.

Areas treated by spot spraying are not to be grazed or cut for stock food for at least 14 days after treatment.

There are Australian but no Codex or US MRLs for flupropanate in animal commodities. Australian MRLs for edible offal and meat (fat) are all set at *0.1 mg/kg.

⁴² UK PSD Evaluation of fully approved or provisionally approved products. Issue No. 10 Evaluation on: Fluazifop-P-butyl, October 1988

⁴³ Office Of Prevention, Pesticides, and Toxic Substances Memorandum Dated: 31 August 2004, Subject: Flumetsulam. Summary of Analytical Chemistry and Residue Data for the Tolerance Reassessment Eligibility Decision (TRED) Document. DP Barcode: D306242 PC Code: 129016 From: Samuel Ary, Chemist Reregistration Branch II Health Effects Division (7509C)
<http://www.fluorideaction.org/pesticides/flumetsulam.chemistry.aug04.pdf>

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 2.235 kg ai/ha gives a day 0 residue of 364 ppm).

Livestock residues may exceed international and/or domestic market standards.
Insufficient data were located to provide confident opinion on livestock residue risks.

Fluroxypyr

- is a selective herbicide used for the control of broadleaf weeds in crops such as maize, sorghum and winter cereals as well as pastures. It is applied to pastures at rates of up to 600 g ai/ha and to lucerne at up to 100 g ai/ha.

Do not graze failed crops and treated pastures or cut for stock food 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 and 0.3 mg/kg for milk. The relevant Australian MRL is 0.1 mg/kg for edible offal (mammalian except kidney), mammalian kidney *0.01 mg/kg and 0.1 mg/kg for milk. There are animal feed MRLs of 700 ppm for mixed pastures (leguminous/grasses) and 25 ppm for PAFC.

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.

Livestock residues may exceed international and/or domestic market standards.
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 prior to sowing of crops and pasture for weed control and in established pasture for improvement at application rates up to 2.16 kg ai/ha.

No harvest or grazing WHPs are required.

The relevant Australian and Codex MRLs are the same at 2 mg/kg for offal. 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.

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 acid⁴⁴. 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.

Haloxypop

-is an aryloxyphenoxypropionate (fop) herbicide used for the control of certain grasses in various crops. It is registered for weed control in lucerne, medic, clover and vetch as well as in forestry. The

⁴⁴ 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).

application rate is up to 130 g ai/ha for forestry, 78 g ai/ha for lucerne and 52 g ai/ha for clover, medic and vetch.

Do not graze or cut for stock food for 28 days for vetch, 21 days for lucerne and 7 days for clover and medic pasture.

There are Australian but no USA or Codex animal tissue MRLs for haloxyfop. 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 onions is $T \times 0.05$ mg/kg. There are Australian MRLs of 3 ppm for pasture (green), 5 ppm for alfalfa forage (green) (lucerne) and 3 ppm for vetch.

The TF for cattle fat is 0.05 and cattle kidney 0.19⁴⁵. If it is assumed residues are present at the same level as the MRL residues in cattle tissues would be $5 \times 0.05 = 0.25$ mg/kg in fat and $5 \times 0.19 = 0.95$ mg/kg in kidney. Maximum residues of haloxyfop in fat of cows dosed at the equivalent of 10 ppm in the diet were 0.53 mg/kg at the end of the 28 day feeding period and 0.21 mg/kg after 7 days on clean feed and 0.22 mg/kg after 14 days on clean feed. More information is required on the depletion of residues.

The TFs for milk and cream are 0.016 and 0.15. If it is assumed residues are present at the same level as the MRL residues in milk and cream would be $5 \times 0.016 = 0.08$ mg/kg in milk and $5 \times 0.15 = 0.75$ mg/kg in cream.

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

Hexazinone

-is used as a spot treatment for control of trees and bushes. It is not anticipated that the use pattern will lead to significant exposure of animals. There is an APVMA permit (5548) for the control of Sifton/biddy bush in pasture by hand gun. The maximum application rate is up to 0.875 kg ai/ha. Do not graze or cut for stock food for at least 28 days after application.

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 Updated Table A for Residue Chemistry RED Chapter dated 9/8/94 concluded that adequate residue data are available for alfalfa forage and hay⁴⁶. However, label amendments were required on all product labels for alfalfa, including supplemental labels, to establish a 30-day PHI for the feeding of forage and the cutting of hay. The available residue data indicate that the combined residues of hexazinone and its metabolites A, B, C, D, and E in/on treated samples were <1.87 ppm and <3.33 ppm for alfalfa forage and hay, respectively. Based on these data, the established tolerance for alfalfa forage is reassessed at its existing level of 2.0 ppm; however, the tolerance for alfalfa hay should be lowered from 8.0 ppm to 4.0 ppm.

A brief summary of the reviewed dairy cattle feeding study (MRID 43703501) is presented below. Three groups of dairy cows (3 animals/dose group) were dosed with hexazinone at 29, 87, and 290

⁴⁵ Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

⁴⁶ 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

ppm in the diet for 28 consecutive days. The maximum total hexazinone residues in milk were 0.78 ppm at the 29 ppm feeding level and 11.09 ppm at the 290 ppm level. On day-14, after total residues had reached plateaus, milk was separated into skim milk and cream. Total residues in skim milk were comparable to those in whole milk; total residues in cream were approximately half those in skim milk. In tissues, the maximum total hexazinone residues at the 290 ppm feeding level were 3.85 ppm in liver, 2.19 ppm in kidney, 0.32 ppm in muscle, and non detectable (<0.10 ppm) in fat. The maximum total residues at the 29 ppm feeding level were 0.24 ppm in liver, 0.47 ppm in kidney, and non detectable (<0.15 ppm) in muscle. Because total residues were non detectable in all fat samples from the 87 ppm and 290 ppm levels, fat samples were not analyzed at lower feeding levels.

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

Imazamox

-is a imidazolinone herbicide used for the control of broad leaf and grass weeds in lucerne and legume based pastures. It is applied at an application rate of up to 35 g ai/ha.

Do not graze or cut for stock food for 7 days after application.

There are Australian but no Codex or US MRLs for imazamox in animal commodities. In the US imazamox is exempt from the requirement of a tolerance on all food commodities when applied as a herbicide in accordance with good agricultural practices. The Australian MRLs, including milk, have all been set at *0.05 mg/kg.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.035 kg ai/ha gives a day 0 residue of 5.7 ppm).

In lactating goats imazamox derived radioactivity is rapidly eliminated without significant retention in milk or bodily tissues⁴⁷. Up to 100% of the total administered dose was recovered in the animal excrement up until sacrifice at 20 hours after the final dose. The only residue observed in any tissue was in kidney at 0.02 ppm and 0.06 ppm for the 2 ppm and 10 ppm feeding levels respectively. Characterisation of the radioactivity in the urine and kidney of the high dose goat showed that 89% (kidney) and 91% (urine) of the radioactivity was due to the presence of the intact parent compound.

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

Imazethapyr

-is a imidazolinone herbicide used for the control of weeds in lucerne, serradella and subterranean clover. It is applied at an application rate of up to 36 g ai/ha for subterranean clover and 96 g ai/ha for lucerne and serradella.

Do not graze or cut for stock food for 14 days after application.

There are no Codex MRLs for imazethapyr in animal tissues. The relevant Australian MRLs are *0.1 mg/kg for edible offal (mammalian), meat (mammalian) and milk while the US MRL for cattle meat byproducts is 0.1 mg/kg.. There is a PAFC MRL of *0.1 ppm. Feeding at this level is not expected to result in significant residues in animals (<LOQ or 0.05 mg/kg).

⁴⁷ Public Release Summary on Evaluation of the new active IMAZAMOX in the products RAPTOR HERBICIDE & RAPTOR WG HERBICIDE National Registration Authority for Agricultural and Veterinary Chemicals January 2000 Canberra Australia

In the goat metabolism study, parent ¹⁴C-imazethapyr was dosed to lactating goats at 0.25 ppm and 1.25 ppm⁴⁸. Results showed ¹⁴C-residues of <0.01 ppm in milk, and <0.05 ppm in leg muscle, loin muscle, blood, fat, liver, and kidney. Laying hens dosed at 0.5 ppm and 2.5 ppm with ¹⁴C-imazethapyr showed ¹⁴C-residues of <0.05 ppm in eggs and all tissues (blood, muscle, skin/fat, liver, and kidney). Additional animal metabolism studies have been conducted with CL 288511 (main metabolite in treated crops fed to livestock) in both laying hens and lactating goats. These studies have been repeated to support subsequent use extensions on crops used as livestock feed items which would theoretically result in a higher dosing of imazethapyr-derived residues to livestock (i.e., corn, alfalfa). In these studies, lactating goats dosed at 42 ppm of ¹⁴C-CL 288511 showed ¹⁴C-residues of <0.01 ppm in milk, leg muscle, loin muscle, and omental fat. ¹⁴C-residues in blood were mostly <0.01 ppm but reached 0.01 ppm on 2 of the treatment days. ¹⁴C-residue levels in the liver, and kidney were 0.02 and 0.09 ppm, respectively. Laying hens dosed at 10.2 ppm of ¹⁴C-imazethapyr showed ¹⁴C-residues of <0.01 ppm in eggs and all tissues (blood, muscle, skin/fat, liver, and kidney). ¹⁴C-imazethapyr or ¹⁴C-CL 288511 ingested by either laying hens or lactating goats was excreted within 48 hours of dosing. These studies indicate that parent imazethapyr and CL 288511-related residues do not accumulate in milk or edible tissues of the ruminant.

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

Imidacloprid

- is a chloronicotinyl (pyridylmethylamine) insecticide. Application to forage and seed pasture is as a seed treatment for the control of red-legged earth mite and blue oat mite. The application rate is up to 240 g ai/100 kg seed.

Do not graze or cut for stock food within 6 weeks of sowing.

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 for milk 0.05 and 0.1 mg/kg. The Codex MRL for edible offal is 0.05 mg/kg and for milk *0.02 mg/kg. There is an animal feed MRL of 1 ppm for pastures and 1 ppm for lucerne fodder and forage.

The TF for liver is 0.01⁴⁹. Assuming residues in forage at 1 ppm and feeding at 100% of the diet, residues in liver would be $1 \times 0.01 = 0.01$ mg/kg.

The TF for milk is 0.003. Anticipated maximum residues in milk are $1 \times 0.003 = 0.003$ mg/kg.

The $t_{1/2}$ in forage/fodder is about 7 to 10 days

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

Iprodione

It is used on lucerne for the control of leaf spot with application at rates of up to 250 g ai/ha.

Do not graze or cut for stock food for 7 days after application.

There are Australian and US MRLs but no Codex MRLs for iprodione in animal tissues. The Australian MRLs have all been set at *0.1 mg/kg. The US MRLs are 3 mg/kg for cattle liver and kidney and 0.5 mg/kg for cattle fat, meat and meat by-products (except liver and kidney) and milk.

⁴⁸ Imazethapyr; Notice of Filing a Pesticide Petition to Establish a Tolerance for a Certain Pesticide Chemical in or on Food [Federal Register: January 3, 2003 (Volume 68, Number 2)] Page 370-374

⁴⁹ 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 US residue definition is the sum of iprodione + isomer (RP-30228) + metabolite (RP-32490) + metabolite (RP-36114). There is an MRL of 20 ppm for alfalfa forage (green) [Lucerne].

The TF for fat and milk (US residue definition) are 0.03 and 0.007 respectively (at 15 ppm feeding level)⁵⁰. Assuming residues in lucerne are at the MRL (20 ppm) and feeding at 100% of the diet the anticipated residues in fat are $20 \times 0.03 = 0.6$ mg/kg, below the US tolerance. Anticipated residues in milk are $20 \times 0.007 = 0.14$ mg/kg, below the US tolerance. If parent compound is monitored in tissues in other countries, as in Australia, residues in tissues and milk are expected to be below the method LOQ.

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

Lambda-cyhalothrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on lucerne, pasture and vetch for the control of various pests. The application rate is up to 10 g ai/ha. Cyhalothrin residues decline with typical half-lives of 30 and 5 days for soil and foliage respectively. Residues in cattle fat decline with a half-life of 7-9 days when animals are on "clean feed".

Do not graze or cut for stock food for 14 days (lucerne, pasture) or 7 days (vetch) after application.

There are Australian, Codex and USA MRLs for cyhalothrin in animal commodities. The relevant MRLs for cattle fat are 0.5 and 3 mg/kg for Australia and the USA respectively. The Australian MRL for milk is 0.5 [in the fat] mg/kg while the US one is 10 mg/kg for milk fat (reflecting 0.4 mg/kg in whole milk). The Codex MRLs are 3 mg/kg for fat and 0.2 mg/kg for milk. There is an Australian MRLs of 1 ppm for legume animal feeds (green) and 2 ppm for legume fodder/straw.

If residues in forage are fed to animals are assumed to be at the same level as the MRL, residues in fat (TF 0.3-0.5)⁵¹ would be $1 \times 0.5 = 0.5$ mg/kg. The TF for milk is 0.02 giving anticipated maximum residues of $1 \times 0.02 = 0.02$ mg/kg for whole milk.

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

Maldison (malathion)

- is an organophosphate insecticide used for the control of various insects and in lucerne and pasture. The application rate is up to 1.1 kg ai/ha.

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

There are Australian and but no Codex MRLs malathion in animal tissues. The relevant Australian and USA MRLs for malathion in animal tissues are 1 mg/kg in Australia and 4 mg/kg in the US. The Australian MRL for milk is 1 [in the fat] mg/kg while the US MRL is 0.5 mg/kg for milk fat (from application to dairy cows).

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 1.1 kg ai/ha gives a day 0 residue of 179 ppm).

⁵⁰ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

⁵¹ Cyhalothrin. (Environmental health criteria ; 99) 1.Pyrethrins - adverse effects 2.Pyrethrins - toxicity I. Series ISBN 92 4 154299 3 (NLM Classification: WA 240) ISSN 0250-863X

The JMPR reported residues of malathion in grass of 2-190 ppm and in hay of 1.9-260 ppm at 0 days after application at 1.0-1.4 kg ai/ha. Residues in clover at 1 day after application at 1.4 kg ai/ha were 8.9-90 ppm and in alfalfa 0.96-95 ppm.

No residues of malathion were detected in tissues in a goat metabolism study conducted at a nominal feeding level of 115 ppm⁵². However, the dose level in the goat metabolism study is too close to the anticipated exposure in cattle to draw any conclusions about the likelihood of residues in cattle tissues. There is no expectation of residues of malathion in tissues of sheep arising from the feeding of pasture or derived hay.

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

Mancozeb

Is registered for use on vetch for the control of rust and *Acsochyta* blight at a maximum rate of 1.76 kg ai/ha (APVMA permit 4783).

Do not graze or cut for stock food for 30 days after application.

There are Australian, Codex and US MRLs for mancozeb in animal commodities. The Australian MRL for edible offal is 2 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂. The USA residue definition is zinc ethylenebisdithiocarbamate and the MRL 0.5 mg/kg for liver and kidney. The MRLs for milk are *0.2 mg/kg and *0.05 mg/kg respectively.

In Australian trials residues in bean straw were 1.9 ppm at 64 days after 4 applications at 2 kg ai/ha. Residues in vetch forage and hay/straw are expected to be less than 10 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study) was 0.003⁵³ giving an anticipated maximum residue from the feeding of vetch forage and straw/hay of $10 \times 0.003 = 0.03$ mg/kg, less than the relevant international MRLs. The TF for milk was <0.008 giving rise to anticipated residues of $10 \times <0.008 = <0.08$ mg/kg.

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

MCPA (4-chloro-2-methylphenoxy)acetic acid or in the USA 2-methyl-4-chlorophenoxyacetic acid -is a selective herbicide used for the control of broadleaf weeds in sugarcane, cereals (barley, rye, oats, triticale, wheat) and pastures etc. It is applied at an application rate of up to 0.5 kg ai/ha for annual medic seed crops, 0.75 kg ai/ha for subterranean clover, 0.7 kg ai/ha for clover Leys and pasture (spray/graze) and 2.125 kg ai/ha for pasture.

Do not graze or cut for stock food for 7 days after application.

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.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 2.125 kg ai/ha gives a day 0 residue of 346 ppm, at 7 days residues are expected to be ca. 170 ppm).

The APVMA Stockfeed data sheet summarised some residue data for MCPA:

⁵² 1999 JMPR - Pesticide Residues in Food - 1999 Evaluations, Part I Residues FAO Plant Production and Protection Paper 157. FAO and WHO 2000

⁵³ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

A number of residue trials for MCPA in forage grasses were conducted in Canada: when MCPA is applied at 2.125 kg ai/ha, a maximum residue of 286 mg/kg is observed immediately after application (range = 94.5 to 286 mg/kg; median 164 mg/kg). Residues declined to 10.2 mg/kg at 7 days post treatment (range = 0.30 to 10.2 mg/kg; median 2.3 mg/kg). All residue levels are expressed on a wet weight basis, as no indication of the dry matter content was provided.

Cattle and sheep fed low to moderate doses of MCPA in the diet for 2 weeks showed no residues from levels less than about 18 mg/kg⁵⁴. 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 (ie. 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 level⁵⁵. 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.

Anticipated residues in kidney are $10.2/0.25 \times 0.005 = 0.2 \text{ mg/kg}$.

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

MCPB (4-(2-Methyl-4-chlorophenoxy) butyric acid)

-is a selective herbicide used for the control of broadleaf weeds in and pastures etc. It is applied at an application rate of up to 1.68 kg ai/ha for legume/grass pasture and 2.24 kg ai/ha for grass only pasture.

Do not graze or cut for stock food for 7 days after application.

There are no Codex or US MRLs for MCPB in animal tissues. The Australian MRLs for meat (mammalian) and milk are *0.05 mg/kg. No MCPB was detected in the milk of cows fed MCPB in the ration at 50 ppm for four days (LOD 0.1 ppm)⁵⁶.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 2.24 kg ai/ha gives a day 0 residue of 365 ppm). See MCPA.

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

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

Metalaxyl

- is a fungicide used on a variety of crops. It is used on lucerne and subterranean clover as a seed treatment and is applied at rates up to 70 g ai/100 kg seed.

A WHP is not required.

⁵⁴ MCPA. List A Reregistration Case 0017. ⁵⁴ Chemical No. 030501, 030502, 030516, 030564. Revised Product and Residue Chemistry Chapters for the Reregistration Eligibility Decision. DP Barcode: D299360

⁵⁵ 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.

⁵⁶ Bache, C.A., Lisk, D.J., Wagner, D.G. and Warner, R.G. 1964. Elimination of [(4-chloro-o-tolyl)oxy] butyric acid in urine from cows. J Dairy Sci. 47, 93-95.

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 MRLs for edible offal and meat are *0.05 mg/kg while the MRL for milk is *0.01 mg/kg. 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 expressed as metalaxyl equivalents. The USA MRLs are 0.4 mg/kg for fat, liver and kidney, 0.05 mg/kg for meat and meat by-products and 0.02 mg/kg for milk.

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/kg⁵⁷. It is considered unlikely that feeding of forage or hay derived from pasture grown from metalaxyl treated seed would generate tissue residues above regulatory LOQs.

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

Methabenzthiazuron

-is a urea herbicide that is used for the control of various annual broad leaved weeds in pasture and lucerne. The application rate is up to 0.6 kg ai/ha.

Do not graze or cut for stock food for 14 days after application.

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

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.6 kg ai/ha gives a day 0 residue of 97.8 ppm). The log P_{ow} for methabenzthiazuron is 2.65. Predicted TFs based on the log P_{ow} are 0.1 for offal, 0.3 for fat and 0.03 for milk.

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

Methidathion

- is an organophosphate insecticide used for the control of insects and mites in cereal and forage crops including pasture. The maximum application rate is 0.56 kg ai/ha.

Do not graze or cut for stock food for 1 day after application at 36 g ai/ha.

Do not graze or cut for stock food for 7 days after application at rates exceeding 36 g ai/ha.

There are Australian and Codex but no USA MRLs for methidathion in animal tissues. The Australian (Codex) and USA residue definitions differ: methidathion (Australia, Codex), sum of methidathion, its oxygen analogue, the sulfoxide and the sulfone (USA). The Australian and Codex that apply to animal tissues are 0.5 and *0.02 mg/kg respectively. The corresponding milk MRLs are 0.5 [in the fat] and 0.001 mg/kg.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.56 kg ai/ha gives a day 0 residue of 91 ppm and 5.9 ppm for application at 0.036 kg ai/ha. Assuming a foliar t_{1/2} of 3-4 days typical of other crops treated with methidathion, residues at 7 days after application are expected to be 23 ppm for the maximum rate). No residues of methidathion were observed in tissues of cows fed at up to 50 ppm in the diet when measured by the Australian or USA residue definitions⁵⁸. There is no expectation of residues in animal tissues.

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

⁵⁷ 1982 JMPR Pesticide Residues in Food - 1982 Evaluations, FAO Plant Production and Protection Paper 49. FAO and WHO 1983

⁵⁸ Methidathion Reregistration Eligibility Decision Residue Chemistry Considerations Shaughnessy No. 100301; Case No. 0034 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

Methiocarb

is a carbamate molluscicide and is used in pastures to control snails. The application rate is up to 0.44 kg ai/ha.

Do not graze or cut for stock food for 7 days after application.

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

The 1981 JMPR reported the results of beef and dairy cattle feeding studies where cattle were fed rations containing 10, 30 and 100 ppm methiocarb for 29 days⁵⁹. Residues were detected only in the liver (animals fed 30 and 100 ppm methiocarb) and kidney (animals fed 100 ppm methiocarb). All other tissues (brain, heart, muscle and fat) showed no detectable residues. There is no reasonable expectation for residues of methiocarb in animal tissues resulting from the feeding of pasture or hay derived from treated crops.

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

Methomyl (also thiodicarb)

- is a carbamate insecticide used for the control of heliothis in lucerne and pasture. The application rate is up to 0.45 kg ai/ha.

Do not graze or cut for stock food for 3 days after application.

Methomyl residues decline with typical half-lives of 7 and 4 days for soil and foliage respectively.

There are Australian and Codex but no USA MRLs for methomyl (as thiodicarb) in animal tissues. The MRLs have all been set at the LOQ.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.45 kg ai/ha gives a day 0 residue of 73 ppm. At 3 days after application, *ca.* 1 half-life, residues will be 37 ppm). No residues of methomyl/thiodicarb were observed in tissues (<0.01 mg/kg) of cows fed at up to 86 ppm in the diet when measured by the Australian or USA residue definitions⁶⁰. There is no expectation of residues in animal tissues.

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 pasture. It is applied at an application rate of up to 0.36 kg ai/ha.

Do not graze or cut for stock food for 13 weeks after application.

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 in milk 0.02 mg/kg. The Australian MRLs for meat (mammalian) and milk are both *0.05 mg/kg. Residues decline in soil and foliage with typical half-lives of 90 and 5 days respectively. Metolachlor has a primary animal feed commodity MRL of 5 ppm.

⁵⁹ 1981 JMPR Pesticide Residues in Food - 1981 Evaluations, FAO Plant Production and Protection Paper 42. FAO and WHO 1982

⁶⁰ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

The US EPA Metolachlor Registration Standard dated March, 1980, concluded that the qualitative nature of the residue in animals was adequately understood. Metolachlor is rapidly metabolized and almost totally eliminated in the urine and feces of ruminants (goats), non-ruminants (rats), and poultry. Metolachlor *per se* was not detected in any of the excreta or tissues. Finite residues were detected in animal transfer studies.

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)⁶¹. 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.

The US EPA reported residues in non-grass animal feeds (forage, fodder, straw and hay) of <0.54 ppm and in grass forage of 0.04-8.4 ppm and in grass hay of <0.08-0.11 ppm. Significant residues are not expected from feeding metolachlor treated pastures.

Livestock residues may exceed international and/or domestic market standards. Insufficient data were located to provide confident opinion on livestock residue risks.

Metribuzin

- is a herbicide used on a variety of crops. It is used on vetch for the control of various weeds. The application rate is up to 278 g ai/ha with application post-sowing pre-emergence. No grazing restraints required.

There are Australian and US but no Codex tolerances for metribuzin in animal tissues. The Australian and US residue definitions differ with the Australian one being parent compound and the US one including the triazinone metabolites of metribuzin. The Australian animal commodity MRLs have all been set at *0.05 mg/kg (including milk) while the US MRLs for animal tissues have all been set at 0.7 mg/kg and 0.05 mg/kg for milk. There is a PAFC MRL of 0.2 ppm.

The US EPA reported beef and dairy cattle feeding studies where animals were fed at 3 or 10 ppm in the diet for up to 30 days⁶². Residues were less than the limit of detection in muscle. The TF for fat (10 ppm feed level) was 0.11 while at the 3 ppm feed level it was 0.02. It is unclear why the TF calculated for the 10 ppm feed level should be so much higher than the 3 ppm but may be related to saturation of an excretion pathway (also noting the octanol water partition coefficient $\log P_{ow}$ ~1.75). The transfer factor from the 3 ppm feed level was used for fat and milk (TF=0.002).

Feeding at the levels expected to arise in forage and hay from treated crops should not lead to residues of concern in animals.

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

Metsulfuron-methyl

is a sulfonylurea herbicide used for the control of various weeds in pastures. Application is at rates up to 96 g ai/ha.

A grazing/cutting WHP is not required.

⁶¹ 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

⁶² Reregistration Eligibility Decision Metribuzin LIST A CASE 0181EPA 738-R-97-006 February 1998. Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

There are Australian and US but no Codex MRLs for metsulfuron-methyl in animal commodities. The Australian MRLs for animal commodities have all been set at *0.1 mg/kg. The US MRLs are 0.5 mg/kg for kidney, 0.1 mg/kg for other meat by-products, meat and fat and 0.05 mg/kg for milk.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.096 kg ai/ha gives a day 0 residue of 16 ppm. Residues in foliage decline with a $t_{1/2}$ of <2 days).

The fate of metsulfuron methyl and its metabolite was investigated in the lactating goat. Metsulfuron methyl and the metabolite were eliminated mostly in the urine and faeces. Traces of radioactivity were found in some tissues and in milk of the parent (0.008-0.009%) and no radioactivity of the metabolite was detected in the milk or any organ or tissue sample. In a cattle feeding study, metsulfuron methyl was rapidly excreted in the urine and faeces of the treated cows. Less than 0.1% of the daily dose was excreted in the milk as metsulfuron methyl and <10% of the metsulfuron methyl residue level was found as the glucuronide conjugate. Residues (<0.1 ppm) were found in the kidney of cows slaughtered 12 hours after treatment stopped but not in cows slaughtered a week later.

A lactating cow study reported the following disposition of metsulfuron-methyl residues (dosing regime: 0, 5, 20 or 100 ppm in the diet for 4 weeks)⁶³. Fat and meat tissues were < 0.01 mg/kg (LOQ), except for one cow (100 ppm feeding study) with meat residues of 0.014 to 0.02 mg/kg. Liver and kidney tissues from cows fed 5 ppm were not greater than 0.053 mg/kg. Metsulfuron-methyl residues in milk samples from cows fed 5 ppm were less than 0.011 mg/kg; 20 ppm feeding resulted in residues that reached a plateau at day 7 post-treatment with residues at 0.016-0.033 mg/kg over the 4 week period.

The US EPA reported⁶⁴ a lactating goat metabolism study conducted at a dose level equivalent to 3.4 ppm in the feed, metsulfuron methyl was the major component in milk. Saccharin was the major component in liver and was judged not to be of concern. Levels in other tissues were ≤20 ppb.

Livestock residues may exceed international and/or domestic market standards. Insufficient data were located to provide confident opinion on livestock residue risks.

Omethoate

- is an organophosphate insecticide used for the control of mites and aphids in pastures. The maximum application rate is 58 g ai/ha.

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

There are Australian but no Codex or US MRLs for omethoate in animal tissues. The Australian MRLs for animal commodities including milk have been set at *0.05 mg/kg. There is an Australian MRL at 20 ppm for a series of miscellaneous forage and fodder crops including cereals.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.058 kg ai/ha gives a day 0 residue of 9.4 ppm). A metabolism study with lactating goats dosed orally with dimethoate suggests that residues of omethoate are not expected in animal tissues⁶⁵.

⁶³ Pest Management Regulatory Agency Decision Document E95-04 Tribenuron methyl 8 December 1995

⁶⁴ Metsulfuron methyl; Pesticide Tolerances for Emergency Exemptions [Federal Register: December 16, 1999 (Volume 64, Number 241)] [Page 70184-70191]

⁶⁵ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

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 pasture crops. The application rate is up to 0.6 kg ai/ha.

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 while in milk are *0.01 and 0.005 mg/kg, 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 Australian PAFC MRL is 500 ppm.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.6 kg ai/ha gives a day 0 residue of 98 ppm). For residues in kidney to be less than the US MRL of 0.3 mg/kg, cattle would have to be fed at less than *ca.* 80 ppm in the diet.

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

Parathion-methyl

- is an organophosphate insecticide used for the control of various insects in crops. It is used for the control of clover seed moth on clover seed crops at a rate of up to 0.4 kg ai/ha.

Do not graze or cut for stock food for 14 days after application.

There are Australian but no Codex or US MRLs for parathion methyl in animal commodities. The Australian MRLs for animal commodities have been set at T*0.05 mg/kg. There are MRLs of T5 ppm for clover, T25 ppm for clover hay and fodder and T25 ppm for legume animal feeds.

In US trials on clover reported by the JMPR residues in forage were <0.05-8.2 ppm at 15 days after application at 1.1-1.4 kg ai/ha. Scaling these results to the Australian application rate gives estimated residues in pasture at 14 days of 2.3 ppm.

A metabolism study with lactating goats dosed orally with parathion methyl at the equivalent of 6.25 ppm in the diet suggests that residues of parathion methyl are not expected in animal tissues⁶⁶. Note the dose rate in the goat metabolism study is close to the anticipated exposure for cattle and therefore may underestimate the likelihood of residues if there are significant differences in TFs for goat and cattle.

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

Pendimethalin

-is a selective herbicide used for the control of weeds in established lucerne. It is applied at an application rate of up to 1.5 kg ai/ha.

No harvest or grazing WHPs are required.

There are Australian MRLs but no Codex or US MRLs for pendimethalin in animal tissues. The Australian MRL for animal commodities all have been set at *0.01 mg/kg. Residues decline in soil

⁶⁶ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

and foliage with typical half-lives of 90 and 50 days respectively. The Australian MRL for the cereal grains listed 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 tissues⁶⁷.

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 pasture as a seed treatment for the control of seed harvesting ants with application at rates of up to 0.125 kg ai/100 kg seed. Permethrin residues decline with typical half-lives of 30 and 8 days for soil and foliage respectively.

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.

It is conservatively estimated that the level of residues occurring in pasture would be ~ 13 ppm [Pasture seed sowing rate of 125 g ai/100 kg seed; application of 20 kg seed/ha; biomass/ha at earliest grazing is 1000 kg foliage (DM)/ha; one soil half-life elapsed since application; equivalent to $125 \text{ g} \times 20 \text{ kg}/2 \times 100 \text{ kg}$ per 1000 kg DM = 12.5 ppm]. The (recently revised, APVMA Gazette May 2003) permethrin MRLs for animal commodities are based on a maximum feeding level (MFL) of 10 ppm (MRL for meat (mammalian) (in the fat) = 0.3 mg/kg). Noting that residues in fat are reported to decline with an initial half-life of < 7 days, the feeding of pasture grown from treated seed to animals is not expected to result in violative residue levels. The TF for milk is 0.002⁶⁸ and if fed at 10 ppm would give rise to residues in whole milk of 0.02 mg/kg, less than the relevant international standards.

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

Phosmet

-is an organophosphorus acaricide used for the control of red legged and blue oat mites and lucerne flea in pasture and lucerne. Application is at rates up to 52.5 g ai/ha.

Do not graze or cut for stock food for 2 days after application.

There are Australian but no Codex or US MRLs for phosmet in animal commodities (US MRLs may soon be revoked). The Australian MRLs are 1 mg/kg for cattle edible offal and meat (in the fat), *0.05 mg/kg for sheep edible offal and meat and 0.2 mg/kg for milks [in the fat].

Residues in alfalfa at 1 day after application at 1.1 kg ai/ha were 4.4-175 ppm for forage and at 0-3 days were 30-80 ppm for hay. Scaling the forage residues for application rate gives estimated residues in forage at the Australian WHP of 2 days of 8.4 ppm. (Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.0525 kg ai/ha gives a day 0 residue of 8.5 ppm).

⁶⁷ Reregistration Eligibility Decision Pendimethalin List A Case 0187, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

⁶⁸ 1981 JMPR Pesticide Residues in Food - 1981 Evaluations, FAO Plant Production and Protection Paper 42. FAO and WHO 1982

Combined residues of phosmet and its oxon in dairy cows dosed at the equivalent of 100 ppm in the feed for 21 days were 0.03-0.19 mg/kg in fat and <0.05 mg/kg in kidney, liver and muscle as well as in milk⁶⁹.

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

Picloram

- is a selective herbicide used widely for the control of weeds. It is registered on grazing pastures, rights of way and forests essentially as a spot treatment. The application rate is 0.9 g ai/m².

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. Picloram does not accumulate in fat. The TF for kidney is 0.01⁷⁰ and milk 0.0003⁷¹. 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.

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

Pirimicarb

-is a carbamate aphicide used for the control of aphids in lucerne and medic pastures. The application rate is up to 75 g ai/ha.

Do not graze or cut for stock food or feed to poultry for 3 days after application.

There are Australian and Codex but no USA MRLs for pirimicarb in animal commodities. The Australian and Codex MRLs for meat and milk are all set at *0.1 mg/kg. both set at the limit of analytical quantitation and are essentially the same. There is a PAFC MRL of 20 ppm.

The JMPR reported residues of pirimicarb in alfalfa forage at 0-3 days after application at 70 g ai/ha of 0.92-26 ppm and in hay at 0-3 days of 0.29-12 ppm. In a feeding study reported by JMPR residues of pirimicarb were <0.05 mg/kg for animals dosed at the equivalent of 200 ppm in the diet⁷², a level of exposure much greater than would be anticipated to arise from lucerne or medic pasture including hay. The TF for milk is 0.00065 indicating a little likelihood that residues would be detected in milk.

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

Prometryn

- is a triazine herbicide used for the control of certain grasses in crops such as canola, cotton, sunflower, legumes and pastures. It is used on pasture at 0.425 kg ai/ha and perennial grass seed crops at 1.1 kg ai/ha.

No grazing/cutting WHP required.

⁶⁹ 1976 JMPR. Evaluations of some pesticide residues in food. AGP:1976/M/14, 1977

⁷⁰ 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.

⁷¹ 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.

⁷² 1978 JMPR - Pesticide Residues in Food - 1978 Evaluations, FAO Plant Production and Protection Paper 15 Suppl. FAO and WHO 1979

There are Australian but no Codex or US animal commodity MRLs for prometryn. The Australian MRLs are all set at *0.05 mg/kg. It is considered unlikely that residues of prometryn would be detected in animal tissues. There is an MRL of 50 ppm for hay or fodder (dry) of grasses.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 1.1 kg ai/ha gives a day 0 residue of 179 ppm). The US EPA considered that there is no reasonable expectation of detectable residues. Animals exposed to residues at levels anticipated in pasture are not expected to have detectable residues (US EPA refer to a feeding study conducted at 50 ppm)⁷³.

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

Propaquizafop

-is a herbicide used for the control of grass weeds in various crops. It is used on legume pastures and lucerne at rates of up to 45 g ai/ha.

Do not graze or cut for stock food for 3 days after application.

There are Australian but no Codex or US MRLs for propaquizafop in animal commodities. The tissue MRLs have been set at *0.02 mg/kg while the milk MRL is *0.01 mg/kg. There is an MRL of 5 ppm for legume pastures (green).

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.045 kg ai/ha gives a day 0 residue of 7.3 ppm. Residues of propaquizafop decline with a half-life of <3 days). The relevant TFs for propaquizafop are 0.004 for both kidney and fat⁷⁴. Anticipated residues on feeding pasture with residues of 3.6 ppm at 100% of the diet are $3.6 \times 0.004 = 0.014$ mg/kg. The TF for milk is 0.001-0.002 which gives rise to anticipated residues of $3.6 \times 0.002 = 0.007$ mg/kg

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

Propyzamide (pronamide or Kerb)

-is a herbicide used for the control of various grass weeds in lucerne, clover and medics. The application rate is up to 1 kg ai/ha.

Do not graze or cut for stock food for 25 days after application.

There are Australian and US but no Codex tolerances for propyzamide in animal commodities. The Australian and US residue definitions differ. The Australian residue definition is parent compound with MRLs of *0.2 for cattle edible offal, *0.05 mg/kg for cattle meat and *0.01 mg/kg for milk.

The US residue definition is for the combined residues of propyzamide and its metabolites (containing the 3,5-dichlorobenzoyl moiety and calculated as 3,5-dichloro-N-(1,1-dimethyl-2-ropynyl)benzamide). The US MRLs are 0.4 mg/kg for kidney and liver and 0.02 mg/kg for fat and 0.02 mg/kg for other offal, meat and milk.

In an animal transfer study where dairy cattle were fed propyzamide in the diet at rates of up to 40 ppm, residues were detected in liver (target tissue), kidney, muscle and milk⁷⁵. A transfer factor of 0.04 was calculated for liver. Unmetabolized Kerb did not appear in the urine of a cow treated orally with Kerb. Traces of pronamide were found in the milk of cows given feed that contained 5

⁷³ Reregistration Eligibility Decision Prometryn List A Case 0467, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division, EPA 738-R-95-033 February 1996

⁷⁴ Evaluation of fully approved or provisionally approved products: Issue No. 94 propaquizafop February 1994

⁷⁵ Reregistration Eligibility Decision (RED) Pronamide List A Case 0082, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

ppm doses of a pronamide formulation. Pronamide has a low potential for bioaccumulation in animal tissues.

The 4/16/93 Residue Chapter recommended the establishment of a crop group tolerance for Nongrass Animal Feeds (Forage, Fodder, Straw, and Hay) Group at 10 ppm. The available residue data indicate that residues of pronamide and its metabolites containing the 3,5-dichlorobenzoyl moiety are not expected to exceed 10 ppm in/on the forage, fodder, straw, and hay of representative members of the crop group when pronamide is applied according to the maximum registered use pattern.

Residues of pronamide and its metabolites containing the 3,5-dichlorobenzoyl moiety were 6.90 and 8.68 ppm in/on two samples of alfalfa seed harvested 50 days following a single broadcast application of the 50% WP formulation at 2.2 kg ai/ha (1× the maximum registered single and seasonal rates in the US) using ground equipment.

The US EPA reported a feeding study where lactating dairy cows were fed alfalfa hay containing 20 or 40 ppm field-aged pronamide residues for three weeks. The combined residues of pronamide and its metabolites containing the 3,5-dichlorobenzoyl moiety are presented in the table below. Assuming a linear relationship between dose level and pronamide residues observed in the feeding study, the established tolerances for the kidney, liver, and meat of ruminants remain adequate. However, linear extrapolation of the maximum residues observed in fat at the 40 ppm feeding level relative to the MTDB suggest that the fat tolerance should be raised from 0.02 ppm to 0.20 ppm.

Sample	Residues (mg/kg)	
	20	40
Kidney	0.05-0.31	0.66-1.88
Liver	0.23-0.55	0.92-1.48
Diaphragm muscle	<0.01-0.02	0.05-0.06
Front leg muscle	<0.01-0.02	0.03-0.05
Hind leg muscle	<0.01-0.02	0.03-0.06
Mesentery fat	0.02-0.08	0.21-0.48
Thoracic fat	<0.01-0.09	0.18-0.34
Kidney fat	0.02-0.10	0.25-0.47

In a separate feeding study lactating dairy cows were dosed at the equivalent of 0.7, 3.5, 1.8 and 7.5 ppm for 16-30 days. Average residues in milk were <0.005, 0.005, <0.005 and 0.011 mg/kg respectively.

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

Quizalofop-P

-is used for the control of certain grass and broad leaf weeds in clover pastures, medic and lucerne. The application rate is up to 100 g ai/ha for lucerne and 38 g ai/ha for clover/subterranean clover and medic pastures.

Lucerne: Do not graze or cut for stock food for 12 weeks after application.

Clover, medic: Do not graze or cut for stock food for 14 days after application.

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 and for edible offal (mammalian) 0.2 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 0.25 mg/kg. The US residue definition is the sum of quizalofop-ethyl, quizalofop- methyl and quizalofop expressed as quizalofop ethyl. There are MRLs of 2 ppm for clover and 10 ppm for medic pasture. .

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.038 kg ai/ha gives a day 0 residue of 6.1 ppm. For quizalofop, residues in foliage decline with a typical half life of 2 days. At 14 days or 7 foliar t $\frac{1}{2}$'s residues are expected to be 0.02 ppm).

In a feeding study, three groups of three lactating dairy cows plus a control group were fed 0.1, 0.5, and 5.0 ppm quizalofop ethyl ester (encapsulated) for 28- consecutive days⁷⁶. 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.

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

Sethoxydim

- is a cyclohexanedione herbicide used for the control of certain grass weeds in crops. It is used for the control of various weeds in common stylo, clover, medic and lucerne with application at rates of up to 0.192 kg ai/ha.

Do not graze or cut for stock food for 14 days after application.

There are Australian and US MRLs for sethoxydim but no Codex MRLs. However, the Codex residue definition for clethodim is the "sum of clethodim and its metabolites containing 5-(2-ethylthiopropyl)cyclohexene-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexene-3-one moieties and their sulphoxides and sulphones, expressed as clethodim". Comparision with the Australian residue definition indicates residues for sethoxydim will be covered by Codex MRLs for clethodim. The Codex MRLs for clethodim are *0.2 mg/kg for edible offal and meat and *0.05 mg/kg for milk. The Australian residue definition is sethoxydim and its metabolites containing 5-(2-ethylthiopropyl)cyclohexane-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexe-3-one moieties and their sulphoxides and sulphones, expressed as sethoxydim. The US residue definition is sethoxydim and its metabolites containing the 2-cyclohexen-1-one moiety. The Australian MRLs for animal commodities have been set at *0.05 mg/kg. The US MRLs for cattle tissues are 1 mg/kg for meat by-products , 0.2 mg/kg for other tissues while the milk MRL is 0.5 mg/kg. There is an MRL for legume animal feeds at 15 ppm.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.19 kg ai/ha gives a day 0 residue of 31 ppm). Note: The USA also has tolerances for several major animal feeds including alfalfa forage and hay (40 ppm), bean hay and clover hay (50 ppm). The tolerances suggest that sethoxydim may be fed at up to 50 ppm in the diet without exceeding the USA animal commodity MRLs.

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

Simazine

⁷⁶ [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)

- is a triazine herbicide used for the control of weeds in crops. It is registered for control of certain grass and broad leaf weeds in subterranean clover and established lucerne and perennial grass pastures with application rates up to 0.8 kg ai/ha.

For subterranean clover: Do not graze for 14 days after application. Do not cut for stock food for 21 days after application.

There are Australian and US but no Codex MRLS for animal commodities. The Australian MRLs for edible offal and meat are *0.05 and for milk *0.02 mg/kg. The US MRLs are 0.03 mg/kg for animal commodity MRLs.

In a ruminant feeding study⁷⁷, dairy cows were dosed with simazine at levels equivalent to 0.5, 2.5, and 5 ppm in the diet for 28 consecutive days. The combined residues of simazine, G-28279, and G-28273 in milk throughout the dosing period were <0.03 ppm (<0.01 ppm for each analyte) in milk from cows dosed at 0.5 ppm; 0.03 ppm (G-28273 was detected at 0.01 ppm) from cows dosed at 2.5 ppm; and 0.03-0.05 ppm (G-28273 detected at 0.01-0.04 ppm) from cows dosed at 5 ppm. The combined residues of simazine, G-28279 and G-28273 were <0.03 ppm (each at <0.01 ppm) in samples of meat, kidney, liver, and fat from cows in each dose group, with the exception of one cow dosed at 5 ppm and sacrificed on Day 21 which had residues of G-28273 at 0.01 ppm in tenderloin and kidney samples.

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

S-Methoprene

is used for fire ant baiting and is applied to pasture at 10 g ai/ha (APVMA permit 4886). Do not use less than 14 days before slaughter for domestic or export markets.

There are Australian and Codex but no US MRL for S-Methoprene in animal commodities. Australian MRL for edible offal, milk and meat is *0.01, 0.1 and 0.3 mg/kg respectively. Codex MRL for edible offal, milk and meat (fat) is 0.02, 0.1 and 0.2 mg/kg respectively.

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

S-metolachlor

see metolachlor

Tebuconazole

-is a DMI fungicide used for the control of leaf and stem rust in ryegrass and fescue seed crops. The application rate is up to 125 g ai/ha.

Do not graze or cut for stock food for 14 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 cattle and sheep mby and 0.1 mg/kg for milk.

The Australian PAFC MRL is 50 ppm.

⁷⁷ DATE: 26 May 2005 SUBJECT: SIMAZINE: Residue Chemistry Chapter for the RED, Revised for Errors; PC Code 080807; DP Barcode D316474 FROM: David Soderberg, TO: Diane Sherman

Residues in forage following application at the Australian rate were <2 ppm in trials reported by JMPR. 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 days⁷⁸. The residues in liver were 0.2 mg/kg. The TF for liver is 0.0008. There is no reasonable expectation of residues of tebuconazole in meat and fat arising from feeding of straw/hay/stubble from treated cereal crops.

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

Tebuthiuron

-is applied at 2-3 kg ai/ha for control of woody weeds on grazing land.
No withholding period required.

There are Australian and US but no Codex MRLs for tebuthiuron in animal commodities. The Australian MRLs are 2 mg/kg for edible offal (mammalian), 0.5 mg/kg for meat (mammalian) and 0.2 mg/kg for milk. The US MRLs for tebuthiuron are 1 mg/kg for the cattle fat and meat, 5 for meat byproducts and 0.8 mg/kg for milk. There are US MRLs of 10 ppm for grass forage and hay.

The US EPA reported the results of a lactating dairy cow feeding study conducted at a nominal 45 ppm tebuthiuron feeding level for 28 days. Based on an animal dietary burden of 28.5 ppm, the EPA recommended the tolerances for meat and fat may be lowered, but the tolerances for milk and meat byproducts must be increased:

Commodity	Revised Tolerance based on an intake of 28.5 ppm ¹
Milk	0.8
Ruminant ,fat	1.0
Ruminant , mby	5.0
Ruminant , meat	1.0

¹ The tolerance is expressed in terms of tebuthiuron and its metabolites containing the dimethylethyl thiadiazole moiety.

Assuming residues are present in grass forage at the same level as the US tolerance the predicted residues in animal commodities should also be the same.

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

Tepraloxym

-is a cyclohexanedione herbicide for early post-emergence control of various grass weeds in subclover and vetch used for seed production only. The application rate is up to 60 g ai/ha.

For seed production only.

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 pasture it is applied at rates up to 0.35 kg ai/ha.
Do not graze or cut for stock food for 7 days after application.

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

There are no Codex or US MRLs for terbutryn. The Australian MRLs for meat (mammalian) and milks are 0.1 mg/kg and for edible offal (mammalian) 3 mg/kg. Animal feed commodity MRLs of 75 ppm have been set for pastures (mixed grasses/leguminous).

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.35 kg ai/ha gives a day 0 residue of 57 ppm). Residues in milk and butter of cows dosed at the equivalent of 400 ppm in the diet were <0.01 and 0.03 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.

Livestock residues may exceed international and/or domestic market standards. Insufficient data were located to provide confident opinion on livestock residue risks.

Thiabendazole

-is used as a seed dressing in vetch for the control of Ascochyta blight and seedling rots.

Application is at 40 g ai/100 kg seed.

No grazing/cutting restraints are required.

There are Australian, Codex and US MRLs for thiabendazole in cattle tissues. The Australian MRLs for animal tissues have been set at 0.2 mg/kg while the milk MRL is 0.05 mg/kg. There is an Australian MRL for apples at 10 mg/kg. The Codex MRL for cattle kidney is 1 mg/kg while the MRL for cattle milk is 0.2 mg/kg. The US MRL for cattle meat are 0.1, and meat byproducts is 0.4 mg/kg while the milk MRL is 0.1 mg/kg.

It is considered unlikely treated seed will give rise to significant residues in pastures or in milk and tissues of livestock grazing on the pasture.

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

Thiram

- is a dithiocarbamate fungicide used on a variety of crops. It is used vetch seed at 72 g ai/100 kg seed.

No grazing/cutting restraints are required.

There are Australian and Codex but no US MRLs for thiram in animal commodities. The Australian MRL for edible offal is 2 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂.

The Australian PAFC MRL is 50 ppm. Residues in straw/hay/stubble would be expected to be much less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study with mancozeb) was 0.003⁷⁹ giving an anticipated maximum residue from the feeding of pasture, straw/hay at 100% of the diet of $<50 \times 0.003 = <0.15$ mg/kg, less than the relevant international MRLs.

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

Tribenuron-methyl

⁷⁹ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

-is a sulfonylurea herbicide used for the control of various weeds in fallow fields and pre-crop situations. The maximum application rate is 22.5 g ai/ha.

A harvest WHP is not required.

It is recommended that weeds are grazed 2-3 days after application.

There are Australian but no Codex or US MRLs for animal commodities. The Australian MRLs have all been set at *0.01 mg/kg.

The PAFC MRL (fresh weight) is *0.05 ppm.

In a lactating goat study with labelled tribenuron methyl at a level of 6.7 ppm there was a total of 0.5% of the administered dose found in the assayed tissues and organs⁸⁰.

The Canadian PMRA noted in their evaluation of tribenuron-methyl that *“large animal metabolism studies were not performed for tribenuron methyl, however metsulfuron-methyl (¹⁴C-phenyl labeled) animal metabolism studies can be used as a faithful model; structurally the herbicides are identical except for the absence of a methyl group at the 2-N of the urea”*⁸¹.

While this approach is not ideal it can serve as a starting point in the risk assessment.

A lactating cow study reported the following disposition of metsulfuron-methyl residues (dosing regime: 0, 5, 20 or 100 ppm in the diet for 4 weeks). Fat and meat tissues were < 0.01 mg/kg (LOQ), except for one cow (100 ppm feeding study) with meat residues of 0.014 to 0.02 mg/kg. Liver and kidney tissues from cows fed 5 ppm were not greater than 0.053 mg/kg. Metsulfuron-methyl residues in milk samples from cows fed 5 ppm were less than 0.011 mg/kg; 20 ppm feeding resulted in residues that reached a plateau at day 7 post-treatment with residues at 0.016-0.033 mg/kg over the 4 week period.

Tribenuron methyl residues (by analogy with metsulfuron-methyl) of up to 5 ppm in total diet may be fed to cattle with residues in meat and dairy products expected to be less than 0.01 mg/kg in milk, meat, and liver, and less than 0.05 mg/kg in kidney.

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 pastures for the control of various pests. The application rate is up to 0.65 kg ai/ha.

Do not graze or cut for stock food for 2 days after application.

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. 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 period⁸².

⁸⁰ PMRA Decision Document E95-04 Tribenuron methyl

⁸¹ PMRA Decision Document E95-04 Tribenuron methyl

⁸² 1971 JMPR. Evaluations of some pesticide residues in food. AGP/1971/M/9/1; WHO Pesticide Residues Series No. 1, 1972

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 0.65 kg ai/ha gives a day 0 residue of 106 ppm). Residues in pastures and hay are expected to be less than 20 ppm within 9 days of application. No detectable residues are expected in tissues of animals fed pasture or derived hay.

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

Triclopyr

-is a herbicide used for the control of various weeds, including woody weeds in fallow crops, stubble, sorghum, forestry and pastures. The application rate is up to 2.88 kg ai/ha. No grazing restraints are required.

There are Australian and US but no Codex MRLs for triclopyr in animal commodities. The Australian and US residue definitions differ. The Australian definition is parent compound. The US definition is the sum of triclopyr and its metabolite 3,5,6-trichloro-2-pyridinol (NOTE the later is also in the US residue definition for chlorpyrifos and chlorpyrifos-methyl). The Australian MRLs are 5 mg/kg for edible offal of sheep and cattle, 0.2 mg/kg for meat (in the fat) and 0.1 mg/kg for milk [in the fat]. The US MRLs are 0.5 mg/kg for liver and kidney, 0.05 mg/kg for meat, fat and meat by-products (except liver and kidney) and 0.01 mg/kg for milk.

(Scaling anticipated residues in forage at day 0 of 163 ppm for application at 2.88 kg ai/ha gives a day 0 residue of 469 ppm).

Utilising data reported in the US EPA RED⁸³ and scaling for application rate, residues in grass foliage are expected to be *ca.* 950 ppm and are reported to decline slowly. Residues in hay harvested 14 days after application are not expected to exceed 520 ppm.

The European Food Safety Authority (EFSA) Draft Application Report for triclopyr⁸⁴ reported a study where cattle were dosed with triclopyr at the equivalent of 1000 ppm in the diet for 28 days. Residues of triclopyr in kidney were up to 10 mg/kg and 3,5,6-trichloro-2-pyridinol 22 mg/kg. After three days on clean feed residues were <0.05 mg/kg for both analytes. Maximum triclopyr residues in milk during the dosing period were 0.04 mg/kg (0.28 mg/kg for cream) while those for 3,5,6-trichloro-2-pyridinol were 0.21 mg/kg (0.20 mg/kg cream).

Livestock residues may exceed international and/or domestic market standards. Insufficient data were located to provide confident opinion on livestock residue risks.

Trifluralin

-is a selective dinitroaniline herbicide used for the control of certain grasses and annual broad-leaved weeds in legume seed crops and vetch. Application is at a maximum rate of 0.816 kg ai/ha. Application is pre crop emergence. No grazing WHP is required.

There are no Codex or US MRLs for trifluralin in animal tissues although there are registrations in the US including on vegetables (except carrot) MRL 0.05 mg/kg and carrot (MRL 1 mg/kg). The Australian MRLs for meat (mammalian) and for milk are 0.05 mg/kg.

⁸³ Reregistration Eligibility Decision Triclopyr List B CASE 2710 EPA 738-R-98-011 October 1998 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

⁸⁴ Draft Assessment Report (DAR) – public version- Initial risk assessment provided by the rapporteur Member State Ireland for the existing active substance Triclopyr of the second stage of the review programme referred to in Article 8(2) of Council Directive 91/414/EEC, Volume 3, Annex B, B.7, March 2005.

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 tissues⁸⁵. Therefore no residues are expected to result from the feeding of cereal straw/hay/stubble to animals. Residues decline in soil and foliage with typical half-lives of 60 and 3 days respectively.

Residue data reported by the EPA⁸⁶ from alfalfa field trials indicate that there may be significant residues in/on alfalfa forage and hay following foliar application. In the recent alfalfa field trials, maximum trifluralin residues at 21-day PHI were 2.2 ppm in/on alfalfa forage and 1.6 ppm in/on alfalfa hay, and the highest average field trial (HAFT) residues were 2.0 ppm in/on alfalfa forage and 1.3 ppm in/on alfalfa hay. It is assumed applications were made at the US rate of 2.24 kg ai/ha. In Australia the use is as a soil application made pre-crop emergence and residues are not expected to exceed 0.05 mg/kg.

The US EPA also report a ruminant metabolism study in which two steers were dosed with [¹⁴C]trifluralin at the equivalent of 0.88 ppm and 8.8 ppm in the diet for 5 and 3 days, respectively. In addition, two dairy cows were dosed with [¹⁴C]trifluralin at 1.7 ppm and 17 ppm in the diet for 5 and 3 consecutive days, respectively.

For the steer dosed with [¹⁴C]trifluralin at levels equivalent to 0.88 ppm for 5 days, total radioactive residues (TRR) were <0.001 ppm in muscle, 0.004 ppm in fat and kidney, and 0.014 ppm in liver. For the steer dosed with [¹⁴C]trifluralin at levels equivalent to 8.8 ppm for 3 days, TRR were 0.003 ppm in muscle, 0.015 ppm in fat, 0.048 ppm in kidney, and 0.145 ppm in liver. Average TRR values in milk were 0.0016 ppm from the cow dosed at 0.88 ppm and 0.011 ppm in milk from the cow dosed at 8.8 ppm.

It should be noted that the US EPA Metabolism committee concluded that all trifluralin metabolites must be considered toxicologically similar to trifluralin *per se*.

Residues in forage are not expected to exceed 0.2 ppm. No residues are expected in animal commodities.

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

⁸⁵ 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

⁸⁶ MEMORANDUM DATE: March 4, 2004, SUBJECT: Trifluralin: Residue Chemistry Chapter for the Tolerance Reassessment Evaluation Decision (TRED) Document, DP Barcode: D296627, Case No.: 0179, PC Code: 036101, 40 CFR: §180.207, FROM: Richard Griffin THROUGH: Sheila Piper and Alan Nielsen To: Richard Griffin