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Australian Quarantine and Inspection Service

Pesticide risk profile for the grazing of pulse/legume forage/straw and/or cutting of hay and feeding to cattle and sheep

Dugald MacLachlan
Chemical Residues
Residues and Food Safety
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Abbreviations

ai	active ingredient
APVMA	Australian Pesticide and Veterinary Medicines Authority
bw	body weight
DM	dry matter
ECRP	Existing Chemical Review Program
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
g	gram
GAP	good agricultural practice
ha	hectare
HAFT	Highest average field trial
JMPR	Joint Meeting on Pesticide Residues
kg	kilogram
LOD	Limit of detection for the analytical method, sometimes also used for limit of determination which is the same as LOQ
LOQ	limit of analytical quantitation
mby	meat by products
mg	milligram = 0.001 grams
MRL	maximum residue limit
N	Negligible residue (when next to US MRL)
PAFC	primary animal feed commodity
PHI	pre-harvest interval
Pow	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.e. should be less than the LOQ.

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Potential for violative residues in cattle and sheep fed pulse forage/straw 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 pulse forage and fodder/straw/hay fed to cattle and sheep.

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

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

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

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

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

The transfer factors utilised here were calculated from residues reported in the scientific literature using the highest individual animal tissue divided by the nominal feed level. If the highest residue

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>

was not reported the average residue divided by the nominal feed level were used instead. In the case of milk the average residue was divided by the nominal feed level.

For the purposes of profiling risk conservative estimates of animal dietary burden (intake) are required. The APVMA “*Stockfeed Guideline Document 1 Primary Feed Commodities As A Proportion of Livestock Diets*” (Version 1.1 March 2002)³ lists the maximum proportion of pulse forage and fodder included in animal feed as 100% and this was used in the current evaluation. Estimates of residues in pulse forage and fodder 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. Fodder is reported to typically contain 90% dry matter and was not considered necessary to correct for dry matter content in this case. Forage contains variable amounts of dry matter, but typically 25% and this value was used to correct for dry matter content where necessary.

The estimated residue in animal commodities is:

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

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

- The pulses are 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 pulse forage and fodder/straw/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 pulses.

Most of the compounds registered for use on pulses 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, fodder and hay derived from pulses 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
2,2-DPA	Tissue	0.15	0.01	No	No
Chlorothalonil	Kidney	0.63	0.5	Yes	Yes
Chlorothalonil (HCB)	Fat	0.11 ³	0.01	No	No
Cypermethrin(s)	Fat	0.8	0.05	Yes	Yes
Deltamethrin	Fat	0.15	0.05	Yes	Yes
Dicofol	Fat	33	0.01	Yes	No
Haloxfop	Kidney	1.9	0.01	Yes	Yes
Imidacloprid	Kidney	0.1	0.01	Yes	No
Lambda-cyhalothrin	Fat	1	0.01	Yes	Yes
Linuron	Kidney/liver	1.4	0.01	No	No
Metolachlor	Kidney	0.035	0.01	No	No
Picolinafen	Kidney	0.1	0.01	No	No
Quizalofop	Kidney	0.2	0.01	Yes	No
Tetradifon	Fat	4.8	0.01	No	No

¹residue in tissue estimated using assumptions outlined above

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

³hexachlorobenzene (HCB) is an impurity present in chlorothalonil and chlorthal-dimethyl at up to 100 mg/kg. The figures reported relate to this impurity and residues arising from it accumulation in the environment and or foliar application

NOTE: the labels for chlorothalonil and dicofol contain statements advising against the feeding of forage, straw/stubble. They are included in the above table as it was felt that in some situations, especially feed shortages during droughts, it is possible that some producers may not follow these statements.

Adequate data were not located to enable an assessment to be made for the following compounds: acifluorfen, bifenthrin, diclofop-methyl, diflufenican, dimethoate, diuron, methabenzthiazuron, procymidone 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 soybeans is 3.7 kg ai/ha with application inter-row.

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 soybeans 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 beans, soybeans, beans straw and soybean straw were 1 ppm and for peas and pea vines 15 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 pulses, anticipated maximum residues in tissues are $15 \times 0.01 = 0.15$ mg/kg.

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

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 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 0.05mg/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 legume vegetables is *0.05 mg/kg, lupin (dry) *0.05 mg/kg and pulses 0.5 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

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 1.1 kg ai/ha gives a day 0 residue of 88 ppm). Anticipated residues in kidney and fat from feeding at 100% of the diet are $88 \times 0.0045 = 1.8$ mg/kg and $88 \times 0.00035 = 0.03$ 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.

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

Acifluorfen

-is a herbicide used for the control of various weeds in mung beans and soybeans at rates of up to 0.448 kg ai/ha. (A pre-emergent rate of 0.896 kg ai/ha is allowed for soybeans).

A grazing WHP is not required.

When used for crop salvage at rates of up to 0.896 kg ai/ha. Do not harvest for 50 days after application.

There are Australian but no Codex or US MRLs for animal commodities. The Australian and US residue definitions differ, parent for Australia and sum of acifluorfen and its metabolites (the corresponding acid, methyl ester, and amino analogues) for the US. The Australian MRLs are 0.1 mg/kg for edible offal and *0.01 mg/kg for meat and milk. The Australian MRL for legume vegetables is 0.1 mg/kg.

The US EPA reported⁹ a metabolism study on soybeans where two applications of sodium [¹⁴C]acifluorfen were made to soybeans at ~0.3 kg ai/ha/application for a total application of 0.6 kg ai/ha. The foliar applications were made to field grown soybeans at 21 and 81 days after planting. The whole aerial portion of the immature soybean plants (forage) were sampled 2-3 hours after the first and second applications and 13 days after the second application. Mature soybean seeds and fodder (including empty pods) were sampled 50 days after the second application.

Of the total radioactive residue (TRR), 20% and 82% was, respectively, identified and characterized in seed. Acifluorfen *per se* is the major residue identified in seed 50 days post-treatment at 8.9% of the TRR (0.043 ppm). In forage at 50 days, 27% and 53% of the TRR was identified and characterized, respectively. Similarly, in forage, acifluorfen is the major identified residue: 83% of the TRR on 0-day (28 ppm), 58% TRR on day 13 (16 ppm), and 27% TRR on day 50 (7 ppm).

In a goat metabolism study where goats were dosed at the equivalent of 10 ppm in the feed, total radioactive residues in tissues and milk ranged from 0.008 mg equiv./kg in milk to 0.40 mg equiv./kg in kidney¹⁰. The US EPA determined that there is no reasonable expectation of acifluorfen being detected in animal tissues on feeding at levels of up to 0.1 ppm in the diet (tissue LOQs of 0.01-0.02 mg/kg).

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

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

⁹ HED Metabolism Committee (MEMORANDUM: Sodium Acifluorfen (PC Code: 114402): HED Metabolism Assessment, Review Committee Decision Document (DP Barcode: D265602).

http://www.epa.gov/pesticides/reregistration/acifluorfen/metabolism_committee_report.pdf

¹⁰ SODIUM ACIFLUORFEN PC Code 114402; Case 2605 Reregistration Eligibility Decision, Residue Chemistry Considerations, March 29, 2000, Contract No. 68-W-99-053, Submitted to: U.S. Environmental Protection Agency, Arlington, VA. Submitted by: Dynamac Corporation, The Dynamac Building, 2275 Research Boulevard, Rockville, MD 20850-3268

alpha-Cypermethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. The application rates for lupins and field peas is up to 30 g ai/ha while for soybeans, mung beans and navy beans is up to 40 g ai/ha.

The harvest WHP for soybeans, mung beans and navy beans is 7 days and for lupins and field peas 4 weeks.

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 milk MRLs for the same are 1 [in the fat = 0.04 mg/kg whole milk], 0.05 mg/kg and 2.5 mg/kg respectively. 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. There are Australian MRLs for broad bean (dry) (faba bean) at 0.05 mg/kg, chickpea (dry) at 0.2 mg/kg, common bean (dry) (navy bean) at 0.05 mg/kg, field pea (dry) at 0.05 mg/kg, lupin (dry) at *0.01 mg/kg, mung bean (dry) at 0.05 mg/kg and soya bean (dry) at 0.05 mg/kg.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.04 kg ai/ha gives a day 0 residue of 3.2 ppm). The TF for fat is 0.1^{11,12}. If residues in forage are 3.2 ppm, anticipated residues in fat are $3.2 \times 0.1 = 0.32$ 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.

Amitrole

-is a herbicide used to control weeds in a variety of situations. The application rate for *field peas* and *mung beans* 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 Australian MRL for pulse grains is *0.01 mg/kg. As no residues are expected in forage items or harvest, no residues are expected in animals feeding on stubble or grain.

The JMPR have stated that¹³ “*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.

Atrazine

¹¹ 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.

¹² 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>

¹³ 1974 JMPR. Evaluations of some pesticide residues in food. FAO/AGP/1974/M/11; WHO Pesticide Residues Series No. 4, 1975

- 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 lupins at rates up to 0.5 kg ai/ha. No harvest or grazing WHP is required.

Note pre-emergent use on canola has a 15 week WHP for grazing/cutting for stock food.

There are no Codex animal tissue MRLs for atrazine. The US MRLs for animal tissues are lower (0.02 mg/kg for cattle fat, mby, meat and milk) than the Australian MRL of T*0.1 mg/kg for edible offal mammalian and T*0.01 mg/kg for milk. The MRL for lupin (dry) is *0.02 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 a residue of 80 ppm at day 0 from application at 1 kg ai/ha gives anticipated residues of 40 ppm at day 0). 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 anticipated that animal product residues will be below typical method LOQs.

Bentazone

-is a benzothiazole herbicide used for the control of certain broad leaved weeds in various crops. It may be applied to kidney beans, soya beans at 960 g ai/ha or to navy beans at 1.44 kg ai/ha with a WHP of 8 weeks or to broad beans and green beans at 1.44 kg ai/ha and a WHP of 5 weeks. Application timing is from when the unifoliate bean leaf is fully expanded onwards.

The Australian MRLs for tissues and milk are *0.05 mg/kg. The Codex MRL for milk is *0.05 mg/kg. The EU MRL for milk and cream is *0.02 mg/kg. The Australian MRL for pulses is *0.01 mg/kg. The US has MRLs of 0.05 mg/kg for peanuts and 3 ppm for peanut hay (sum of bentazone and its 6- and 8-hydroxy metabolites).

Residues of bentazone in pea hay derived from crops treated at 1.12 kg ai/ha were 0.48-2.0 ppm at 30-34 days after application (1.26-5.4 ppm for the sum of bentazone and 6-OH- and 4-OH-bentazone). Residues of bentazone in soya bean forage, fodder and hay were <0.05-0.15 ppm (PHI 28-34 days), <0.05-0.2 (PHI 78-119 days) and <0.05-0.62 ppm (PHI 36-53 days) respectively (total residues were 0.18-5.3, <0.15-0.79 and <2.2-5.9 ppm for forage, fodder and hay).

Animal metabolism studies (5 to 8 day goat study, up to 1420 ppm) and a goat feeding study (35 days) at 75 and 150 ppm suggest that no detectable residues are expected with exposure of 10 to 15 ppm¹⁵. (TF for kidney was 0.04 and fat 0.002)

Note: the US EPA indicate that a lactating cow animal transfer study exists with feeding levels of 1, 5 and 20 ppm with ¹⁴C bentazone and its 6 and 8-hydroxy metabolites.

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 *navy beans* at 20 g ai/ha, *lupins* and *chickpeas* 10 g ai/ha, *field peas* 12.5 g ai/ha and *faba beans*

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

5 g ai/ha. Cyfluthrin residues decline with typical half-lives of 60 and 3-5 days for soil and foliage respectively.

The harvest WHP is 7 days for field peas, 14 days for chickpeas, faba beans and lupins and 21 days for navy beans.

Do not graze or cut for stock food for 7 days after application for field peas, chickpeas, faba beans and lupins and 14 days for navy beans.

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 milkfat (1 mg/kg in whole milk) for Australia, Codex and the USA respectively. There are Australian MRLs for pulses and legume vegetables at 0.5 mg/kg. There are also MRLs of 5 ppm for chickpea forage (green), faba bean forage (green), field pea forage (green), 2 ppm for lupin forage (green) and 1 ppm for navy bean forage (green) and fodder.

Residues in chick pea straw at 14 days after application at 10 g ai/ha were 0.22 ppm while those in lupin straw at 23-25 days after application were 0.11 ppm. Residues in forage/straw would not be expected to lead to exposure of greater than 0.5 ppm in the diet. TF fat = 0.05¹⁶. Estimated residues in fat are $0.5 \times 0.05 = 0.025$ mg/kg.

The TF for milk is 0.005 giving anticipated residues of $0.5 \times 0.005 = 0.0025$ mg/kg.

If residues in forage/straw are present at the same level as the MRL estimated residues in fat are $5 \times 0.05 = 0.25$ mg/kg and in milk anticipated residues would be $5 \times 0.005 = 0.025$ mg/kg.

Residues in cattle from pour-on application decline with a half-life of <14 days, a shorter half-life would be expected for tissue residues when animals are on “clean feed”.

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 *faba beans*, *field peas* and *lupins* at rates of up to 20 g ai/ha for control of mites and pasture looper. It is also registered for use on navy beans for heliothis control at 80 g ai/ha. Bifenthrin residues decline with typical half-lives of 26 and 7 days for soil and foliage respectively.

Navy beans: Do not harvest for 14 days after application.

Field peas, faba beans and lupins: 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 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 field pea (dry) is T*0.01 mg/kg, lupins (dry) T*0.02 mg/kg and other pulses *0.02 mg/kg. The animal feed commodity MRLs are 0.02 ppm for faba bean and lupin fodder (dry), 0.01 ppm for field pea fodder (dry), 1 ppm for faba bean and field pea forage (green) and 5 ppm for navy bean forage (green) and 1 ppm for navy bean fodder.

Assuming residues in navy bean forage are present at the MRL, the forage is fed at 100% of the diet and a maximum TF of 0.3¹⁷ would give anticipated residues in fat of $5 \times 0.3 = 1.5$ mg/kg, below the Australian but above the Codex and US MRLs. A correction for moisture content of the forage has not been made and residues would be expected to be even higher.

¹⁶ 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

¹⁷ 1992 JMPR - Pesticide Residues in Food – 1992 evaluations. Part II. Toxicology. WHO, WHO/PCS/93.34, Geneva, 1993

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.08 kg ai/ha gives a day 0 residue of 6.4 ppm, at 14 days or after 2 half-lives the residue would be 1.6 ppm). Feeding at this level would result in residues in fat below the relevant international MRLs ($1.6 \text{ ppm} \times 0.3 = 0.48 \text{ mg/kg}$).

Assuming residues in faba bean and field pea forage are present at the MRL, the forage is fed at 100% of the diet and a maximum TF of 0.3 would give anticipated residues in fat of $1 \times 0.3 = 0.3 \text{ mg/kg}$, below the Australian, Codex and US MRLs.

The TF for milk is 0.02 giving anticipated residues in milk of $1 \times 0.02 = 0.02 \text{ mg/kg}$.

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 *mung*, *navy* and *soya beans* 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. There is an MRL at *0.01 mg/kg for pulses.

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 *beans* and pasture for control of various pests at rates of up to 100 g ai/hL. The harvest WHP is 3 days.

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, fat 0.5 and for milk 1 mg/kg.

The Australian MRLs are 5 mg/kg for vegetables, T100 ppm for forage of cereal grains and T100 ppm for straw and fodder (dry) of cereal grains.

The JMPR reported residues in soya bean forage of 1.3-8.5 ppm at 14 days after the last of 4 applications at 1.6-1.7 kg ai/ha and in soya bean hay of <0.02-9.6 ppm at 21 days after the last application.

The TF for kidney is 0.007 for the Australian/Codex residue definition and 0.012 for the US residue definition¹⁸ giving rise to anticipated maximum residues in kidney from feeding pulse forage at 100% of the diet of $0.007 \times 10 = 0.07$ mg/kg and $0.012 \times 10 = 0.12$ mg/kg respectively for the Australian/Codex and USA residue definitions.

The TF for milk is 0.0002 for the Australian/Codex residue definition and 0.002 for the US residue definition giving rise to anticipated maximum residues in milk from feeding pulses at 100% of the diet of $0.0002 \times 10 = 0.002$ mg/kg and $0.002 \times 10 = 0.02$ mg/kg respectively for the Australian/Codex and USA residue definitions.

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

Carbendazim

- is a systemic fungicide used for the control of chocolate spot in chickpeas, faba beans, lentils and vetch. It is registered at an application rate of 250 g ai/ha.

The harvest WHP is 4 weeks.

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

There are Australian and Codex but no USA MRLs for carbendazim. The relevant MRL for cattle meat is 0.2 mg/kg for Australia. MRLs for milk are all *0.1 to 0.1 mg/kg. There is an Australian MRL for pulses at 0.5 mg/kg and one for legume animal feeds of 25 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 carbendazim 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 carbendazim¹⁹. 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.

Chlorothalonil

- is a systemic fungicide used for the control of various fungal diseases in crops. It is registered for the control of chocolate spot and rust on *faba beans* at rates of up to 1.65 kg ai/ha (Tas only) and for *peas* for downy mildew at rates of up to 115 g ai/hL.

The harvest WHP is 7 days.

Beans, peas: Do not graze treated crops.

There are Australian and US but no Codex MRLs for chlorothalonil. The Australian residue definition is the sum of chlorothalonil and 4-hydroxy-2,5,6-trichloroisophthalonitrile metabolite expressed as chlorothalonil. The Australian MRLs are 7 mg/kg for edible offal, 2 mg/kg for meat in the fat and 0.05 mg/kg for milk. The US residue definition for animal commodities is 4-hydroxy-2,5,6-trichloroisophthalonitrile. The relevant MRLs for cattle commodities are 0.1, 0.5, 0.05 and 0.03 mg/kg for fat, kidney, meat by-products (except kidney) and meat respectively. The MRL for milk is 0.1 mg/kg. The Australian MRL for pulses is 3 mg/kg and 160 mg/kg for forage and fodder of pulses.

¹⁸ 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>

¹⁹ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999.

The TF for kidney (target tissue, US residue definition) is 0.09²⁰. In trials reported by JMPR residues in bean straw at 51-71 days after application at 1 kg ai/ha were 0.18-0.33 ppm. Assuming residues of chlorothalonil are the same as the pulse grain MRL, anticipated residues in kidney would be $7 \times 0.09 = 0.63$ mg/kg if fed at 100% of the diet. Residues were not detected in tissues after a period of 32 days on clean feed (earliest clean-feed slaughter period, feed level 250 ppm chlorothalonil + 2 ppm metabolite). Other countries would be expected to utilise parent compound in any monitoring and no residues of parent compound are expected in animal tissues from feeding faba beans, peas and their wastes. The TF for milk (US def) is 0.03. Assuming residues of chlorothalonil are the same as the pulse MRL, anticipated residues in milk are $7 \times 0.03 = 0.21$ mg/kg.

Assuming residues of chlorothalonil are the same as the pulse forage and fodder MRL, anticipated residues in kidney would be $160 \times 0.09 = 14.4$ mg/kg if fed at 100% of the diet. Residues were not detected in tissues after a period of 32 days on clean feed (earliest clean-feed slaughter period, feed level 250 ppm chlorothalonil + 2 ppm metabolite). Other countries would be expected to utilise parent compound in any monitoring and no residues of parent compound are expected in animal tissues from feeding faba beans, peas and their wastes. The TF for milk (US def) is 0.03. Assuming residues of chlorothalonil are the same as the pulse forage and fodder MRL, anticipated residues in milk are $160 \times 0.03 = 4.8$ mg/kg.

Chlorothalonil can contain up to 100 mg/kg hexachlorobenzene (HCB), an application rate of 1.65 kg ai/ha corresponds to a potential application of HCB at 0.165 g/ha. Estimates of the potential for transfer of HCB residues are given below:

(a) Noting 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 crop residues ranges from 0.03 – 2.4 for aerial parts. The contribution from previous years applications (assumed 12 years of additions 1 spray per year at the maximum rate = 0.165 g HCB/ha = 1.98 g HCB/ha), distributed in the top 20 cm soil with density 1 g/mL would be $1980 \text{ mg}/2000000 \text{ kg} = 0.00098$ ppm. Residues in aerial plant parts would account for no more than 0.000098 mg/kg assuming a crop to soil ratio of 0.1.

Feeding forage/hay with residues of 0.000098 ppm at 100% diet would give rise to residues of $0.000098 \times 8 = 0.00079$ mg/kg in fat and $0.000098 \times 8.4 = 0.00083$ mg/kg in milk fat.

(b) Foliar application. If assume residues in pulse forage at day 0 from application of a pesticide at 1 kg ai/ha are 80 ppm and scale for application rate, forage residues are expected to be $0.000165 \times 80 = 0.0132$ ppm for HCB. Feeding forage/hay with residues of 0.0132 ppm at 100% diet would give rise to residues of $0.0132 \times 8 = 0.11$ mg/kg in fat and $0.0132 \times 8.4 = 0.11$ mg/kg in milk fat.

Livestock residues (chlorothalonil and HCB) may exceed international and/or domestic market standards.

Chlorpyrifos

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on *field peas*, *chickpeas*, *lupins* and *soybeans* at rates up to 0.15 kg ai/ha for the control of blue oat mite and red-legged earth mite.

A harvest WHP is not required.

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 Australian and Codex residue definition is chlorpyrifos while the USA definition includes the metabolite TCP. The MRLs for cattle fat are T0.5, 1 and 0.3 mg/kg for Australia, Codex and the USA respectively. The

²⁰ Pesticide Residues in Food - 1997 evaluations, FAO Plant Production and Protection Paper 146. FAO and WHO 1998

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). The Australian MRL for vegetables (other than those listed) is T*0.01 mg/kg.

In trials reported by the 2000 JMPR residues in beans at 4-6 days after application (scaled for the Australian rate) were 0.6-1.4 ppm in whole plants. Residues in soya bean foliage were 6.2 ppm at day 1 and 1.1-1.6 ppm at day 7 after the last application (scaled to the Australian rate). The maximum transfer factor for feeding cattle at 10 ppm in the diet was 0.016 for cattle fat²¹. Residues from feeding bean forage with residues of 6.2 ppm at 100 % of the diet $6.2 \times 0.016 = 0.1$ mg/kg, below the lowest of the Australian, Codex and USA MRLs.

Anticipated residues for milk would be $6.2 \times 0.0007 = 0.00434$ mg/kg.

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

Chlorthal dimethyl

-is a benzoic acid herbicide used for weed control in *beans* (including snap beans, *mung beans*, *soya beans* and *castor beans*) and *peas*. The application rate is up to 11.25 kg ai/ha. Application is at the 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 have all been set at *0.05 mg/kg.

The US EPA noted²² 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 0.0003. If it is assumed that the maximum exposure for animals arises from feeding at 5 ppm in the diet (vegetable MRL) maximum anticipated residues in fat are $5 \times 0.0003 = 0.0015$ mg/kg. Although more information on likely residues in animals is desirable for chlorthal-dimethyl it is considered unlikely that this pesticide would give rise to detectable residues.

Chlorthal-dimethyl can contain up to 100 mg/kg hexachlorobenzene (HCB), 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 crop residues ranges from 0.03 – 2.4 for aerial parts. The contribution from previous years applications (assumed 12 years of additions 1 spray per year at the maximum rate = 1125 g HCB/ha = 13.5 g HCB/ha), distributed in the top 20 cm soil with density 1 g/mL would be $13500 \text{ mg} / 2000000 \text{ kg} = 0.0068$ ppm. Residues in aerial plant parts including seed would account for no more than 0.00068 mg/kg assuming a crop to soil ratio of 0.1 giving rise to anticipated residues of $0.00068 \times 8 = 0.0054$ mg/kg in fat and $0.00068 \times 8.4 = 0.0057$.

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-

²¹ 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>

²² 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

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

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 cyclohexanedione herbicide used for the control of certain grass weeds in crops. It is registered for use on *chickpeas*, *faba beans*, *lupins* and *field peas* at rates of up to 120 g ai/ha, *mung beans* and *soybeans* at up to 90 g ai/ha.

No harvest WHP required.

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 sulphoxides 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 and 0.05 mg/kg for milk. The MRL for pulses (dry) is *0.1 mg/kg while for lupins (dry) it is 0.2 mg/kg.

The JMPR reported residues in plant at 13-27 days after application at 0.11 kg ai/ha of 0.47-0.53 ppm and in vines (dry) at 14 days after application at 0.28 kg ai/ha of <0.1-2.8 ppm. The TF for the US residue definition is 0.006²³ for offal giving an anticipated residue when using the highest residue in vines (dry) scaled for the Australian rate as the maximum feed level of $1.2 \times 0.006 = 0.007$ mg/kg for liver and kidney, below the US MRL.

Anticipated residues in milk (TF 0.0011) are $1.2 \times 0.0011 = 0.00132$ mg/kg.

²³ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

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

Clomazone

- is an isoxazolidinone herbicide used to control broad-leafed annual weeds in crops. The application rate for *navy beans* is 0.48 kg ai/ha and is applied post-sowing but pre-emergent. Do not graze or cut for stock food until after harvest.

There are no Australian, Codex or US MRLs for clomazone in animal commodities. The Australian MRLs for vegetables are all set at *0.05 mg/kg. No detectable residues are expected to be found in crops at harvest, following pre-emergent application of clomazone.

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

Cyanazine

- is a triazine herbicide used for the control of various weeds in *peas, chickpeas, field peas, processing peas* and *faba beans*. The application rate is up to 2 kg ai/ha. It is applied post-sowing pre-crop emergence or early crop emergence and is not expected to result in significant residues in forage or fodder.

A harvest WHP is not required.

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

Cyfluthrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. The Australian label is not clear in that the approved uses for peas and beans could be interpreted to include/cover pulse crops.

The application rates for vegetables 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)
<i>Beans</i>	3.75 g ai/hL	1	-
<i>Peas</i>	3.75 g ai/hL	7	-

Cyfluthrin residues decline with typical half-lives of 60 and 3-5 days for soil and foliage respectively. Residues in cattle from pour-on application decline with a half-life of <14 days, a shorter half-life would be expected for tissue residues when animals are on “clean feed”.

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 milkfat (1 mg/kg in whole milk) for Australia, Codex and the USA respectively. There is an Australian MRL for legume vegetables of 0.5 mg/kg as well as cereal grain and various forage MRLs (grass pasture, legume pasture, chickpea, field pea, canola, faba bean, navy bean, sorghum) of 2-5 mg/kg.

TF fat = 0.05²⁴. Estimated residues in fat from feeding forage or fodder with residues at the MRL at 100% of the diet are $5 \times 0.05 = 0.25$ mg/kg.

The TF for milk is 0.005 giving anticipated residues of $5 \times 0.005 = 0.0025$ mg/kg.

²⁴ 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

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

Cyhalothrin (lambda and gamma)

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on *Chickpeas, Faba beans, lentils, vetch, field peas, lupins, mung beans, navy beans* and *soybeans* for the control of various pests. The application rate is up to 6 g ai/ha for lupins, 9 g ai/ha for Chickpeas, Faba beans, lentils, vetch and field peas and 17.5 g ai/ha for mung beans, navy beans and soybeans..

The harvest and grazing/cut for stock food WHPs are:

7 days for chickpeas, Faba beans, lentils, vetch and field peas.

14 days for lupins

14 days for mung beans and navy beans harvested dry and 1 day if harvested green and

21 days for soybeans

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 are Australian MRLs for pulses (except soybean dry) of 0.2 and for soybean of *0.02 mg/kg. The feed MRLs are legume animal feeds [green] 1 ppm and legume fodder/straw 2 ppm.

If pulse forage is fed to animals, residues in fat (TF 0.3-0.5)²⁵ would be $1 \times 0.5 = 0.5$ mg/kg, higher if the moisture content of the forage is taken into account and be $2 \times 0.5 = 1$ mg/kg for fodder/straw. 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.

Cypermethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is used on *soybean, navy bean* and *mung bean* at 100 g ai/ha, *field peas* at 50 g ai/ha and *lupins* at 60 g ai/ha. The harvest WHP is 7 days for mung beans, navy beans and soya beans, 21 days for lupins (except WA where it is 24 days) and 28 days for field peas.

No grazing restraints.

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. There are Australian MRLs for chick-pea fodder and forage at 10 mg/kg and primary feed commodities at 5 mg/kg.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.1 kg ai/ha gives a day 0 residue of 8 ppm.). The TF for fat is 0.1^{26,27}. If residues in forage are 8 ppm, anticipated residues

²⁵ 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

²⁶ 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.

in fat are $8 \times 0.1 = 0.8$ mg/kg if fed at 100% of the diet (28 days on clean feed to be below 0.05 mg/kg). Anticipated residues in whole milk (TF 0.003-0.1) are also 0.8 mg/kg.

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

Deltamethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on *pulses* at 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

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 MRL for pulses is 0.1 mg/kg. There are Australian animal feed MRLs of 5 ppm for fodder and forage, 0.1 for oilseeds, pulses and sweet corn and 7 ppm for rice hulls.

(Scaling residues in forage at day 0 after treatment at 1 kg ai/ha of 80 ppm to an application rate of 0.01375 kg ai/ha gives an estimated forage residue of 1.1 ppm and at 7 days or one t $\frac{1}{2}$ of 0.6 ppm).

The TF for deltamethrin in fat is roughly 0.03²⁸. Feeding of forage with residues of 0.6 mg/kg at 100% of the diet could result in deltamethrin residues in fat of $0.6 \times 0.03 = 0.018$ mg/kg, this is less than the Australian, Codex and USA tolerances. Anticipated residues in milk (TF 0.009) are $0.6 \times 0.009 = 0.0054$ mg/kg.

Feeding of with residues at the APVMA MRL for forage and fodder of 5 mg/kg 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 but higher than the USA tolerance.

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 *soybeans* for the control of various pests including grasshoppers and locusts. The application rate is up to 0.68 kg ai/ha.

Do not harvest, 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. The Australian MRL for vegetables is 0.7 mg/kg. The average half-lives for residues in soil and foliage are reported to be 40 and 4 days respectively.

²⁷ 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>

²⁸ 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

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.68 kg ai/ha gives a day 0 residue of 54 ppm, and at 14 days or 3 half-lives, 6.8 ppm). The TF for fat from a dairy cow feeding study (400 ppm feed level) was 0.002²⁹. Feeding forage, fodder, hay or straw at 100% of the diet could result in fat residues of $6.8 \times 0.002 = 0.01$ mg/kg. No residues were detected in milk of cows dosed at the equivalent of 120 ppm in the diet.

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 *lupins* and *peas*. 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 mg/kg. The MRLs for lupins (dry) and peas have been set at 0.1 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 diet³⁰. 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 25.0 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.

Dicofol

- is an organochlorine miticide used for the control of various pests in a variety of crops. In *vegetables* it is used for the control of mites. The application rate is up to 55 g ai/hL.

The harvest WHP is 7 days.

Do not graze or cut for stock food.

There are no Australian or USA MRLs for animal commodities. The Australian and Codex residue definitions differ. The Australian residue definition is the sum of dicofol + 2,2,2-trichloro-1-(4-chlorophenyl)-1-(2-chlorophenyl)ethanol calculated as dicofol while the Codex residue definition for animal commodities is the sum of dicofol + 2,2-dichloro-1,1-bis(4-chlorophenyl)ethanol (p,p'-FW152) calculated as dicofol. There is a Codex MRL of 3 for cattle fat, 0.1 mg/kg for milk (F) and 1 mg/kg for cattle edible offal. The EU MRLs are 0.5 mg/kg for cattle and sheep meat, *0.05 mg/kg for cattle and sheep edible offal and 0.02 mg/kg for milk. There are Australian MRLs for vegetables [except cucumber, gherkin and tomato] of 5 mg/kg, tomato 1 mg/kg and cucumber and gherkin of 2 mg/kg.

²⁹ 1996 JMPR - Pesticide Residues in Food - 1996 Evaluations, Part I: Residues FAO Plant Production and Protection Paper 142. FAO and WHO 1997

³⁰ 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

Residues in soil and foliage decline with typical half-lives of 16- 60 days and >6 months respectively.

The TF for fat for the Australian and Codex residue definitions are 0.05-0.1 for Australia and 0.3-0.5 for the Codex residue definition³¹.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.825 kg ai/ha gives a day 0 residue of 66 ppm). Feeding forage at 100% of the diet could result in fat residues of $66 \times 0.1 = 6.6$ mg/kg for the Australian and $66 \times 0.5 = 33$ mg/kg for the Codex residue definitions. Anticipated residues in milk (TFs 0.003-0.006 and 0.02-0.04 respectively.) are $66 \times 0.04 = 2.64$ mg/kg for the Codex and $66 \times 0.006 = 0.396$ mg/kg for the Australian residue definition.

A major deficiency in the available data is information on the decline of residues in cattle. In the absence of this information it is important that the likely residues in peas/beans are better refined, perhaps through residue analyses or obtaining information on the actual use of dicofol (timing, rate, % crop treated) by the different industries.

Dicofol can contain up to 1000 mg/kg DDT and related compounds³². The TF for fat and milk fat are estimated to be 1.8 and 2.1 respectively. (Scaling maximal anticipated residues in forage at day 0 of 80 ppm for application at 0.825 g DDT/ha gives a day 0 residue of 0.066 ppm). Anticipated residues in fat and milk fat from feeding at 100% of the diet are $0.066 \times 1.8 = 0.12$ mg/kg and $0.066 \times 2.1 = 0.14$ mg/kg respectively.

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

Diflufenican

-is a nicotinanalide herbicide used to control various weeds in *field peas* and *lupins*. Application is at rates of up to 100 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 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. The MRLs for pulse, and peas have been established at 0.05 mg/kg.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.1 kg ai/ha gives a day 0 residue of 8 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

³¹ Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

³² 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>

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.

Dimethenamid-P

- is a pre-emergent herbicide used for the control of weeds in *green beans*, *navy beans* and *green peas*. It is registered on navy beans at application rates of up to 720 g ai/ha.

A harvest WHP is not required.

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

There are Australian and Codex but no USA MRLs (negligible residue) for dimethenamid in animal tissues. The Australian and Codex MRLs for animal commodities have been set at *0.01 mg/kg. There is an Australian MRL of *0.02 mg/kg for common bean, peas and pulses and for forage and fodder at *0.02 mg/kg.

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

Dimethoate

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on *beans* and *peas* at rates of up to 320 g ai/ha.

The harvest WHP is 7 days

There are Australian, Codex and USA MRLs for dimethoate in animal tissues. The Australian and Codex MRLs for animal commodities have been set at *0.05 mg/kg while the US ones are set at 0.02 mg/kg. There is an Australian MRL of 0.5 mg/kg for lupin (dry) and 1 ppm for lupin forage.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.32 kg ai/ha gives a day 0 residue of 26 ppm).

A metabolism study with lactating goats dosed orally with dimethoate at a rate equivalent to feeding at 30 ppm in the diet suggests that residues are not expected in animal tissues³³. 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 *dry beans*, *peas*, *lupins*, *mung beans* and *soya beans* with application rates up to 0.6 kg ai/ha.

The harvest WHP is 4 days for pigeon peas and soya beans.

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 are MRLs of 1 mg/kg for pulses. There is a legume animal feed MRL of 100 ppm. No residues were detected in tissues of cows fed diquat for 28 days at 100 ppm in the diet

³³ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

and slaughtered on the last day of dosing (LOD 0.01 mg/kg)³⁴. Residues in hay/ forage would be expected to be less than 100 ppm.

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 *peas* and *beans* and is applied in-furrow at sowing. Application is at 1.05 kg ai/ha for peas and 1.4 kg ai/ha for beans.

Do not apply to edible crops later than 70 days before harvest.

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. There are Australian MRLs of 0.5 mg/kg for vegetables.

The maximum residue in tissues of dairy cattle fed at 7.2 ppm in the diet was 0.03 mg/kg³⁵. 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 milk.

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 *lupins* and *peas* prior to crop emergence with application rates up to 1 kg ai/ha.

No harvest or grazing WHP is required.

There are no Codex MRLs for diuron. The US and Australian residue definitions differ with the Australian definition including a metabolite in addition to the parent compound. The relevant US MRL for animal tissues is 1 mg/kg for cattle mbyop while the Australian MRL for edible offal of cattle is 3 mg/kg (the higher value probably reflecting the inclusion of the metabolite in the residue definition). The Australian MRL for milk is 0.1 mg/kg. Residues in soil and foliage decline with typical half-lives of 90 and 30 days respectively. Australia has a primary animal feed commodity MRL of 50 mg/kg. There is no MRL for lupins. The MRL for field pea (dry) is *0.05 mg/kg.

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

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

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

Endosulfan

³⁴ 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>

³⁵ DISULFOTON Shaughnessy No. 032501; Case 0102 Reregistration Eligibility Decision:
Product Chemistry Considerations 3 October 1997, Contract No. 68-D4-0010, Submitted to: U.S. Environmental Protection Agency by Dynamac Corporation

- is an organochlorine insecticide used for the control of mites in a variety of crops. The application is pre-emergence at 0.335 kg ai/ha.
 A harvest WHP is not required.
 DO NOT graze or cut for stock food for 7 weeks after application.

There are Australian, Codex and USA MRLs for animal commodities. The Australian and Codex MRL for cattle fat is 0.2 mg/kg while the US MRL is 13 mg/kg. The Australian MRL for milk [in the fat] is 0.2 mg/kg, USA 2 mg/kg for milk fat and Codex 0.1 F mg/kg. There is an Australian MRL for pulses set at *0.1 mg/kg and a primary animal feed commodity MRL of 0.3 ppm.

Residues in soil and foliage decline with typical half-lives of 50 and 3 days respectively although the decline of residues in senescent foliage is much slower.

Trials reported by the APVMA indicate residues in forage should be <0.3 mg/kg. The TF for fat is 0.3-0.4³⁶. Assuming residues in pulse forages are less than the animal feed commodity MRL of 0.3 ppm, residues in fat would be 0.3×0.4 = 0.12 mg/kg. The TF for milk is 0.02. Residues in milk would be 0.3×0.02 = 0.006 mg/kg. The TF for cream is 0.12. Residues in cream would be 0.3×0.12 = 0.036 mg/kg.

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

EPTC (eptam)

-is a thiocarbamate herbicide used for the pre-emergent control of certain grasses and broad-leafed weeds and is used as a pre-plant application in crops. It is used on beans (except flat podded beans such as cowpeas, soybeans and lima beans) 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. The MRL for vegetables is *0.04 mg/kg.

Note: The US EPA in its RED³⁷ 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 pulses 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)
<i>Broad bead</i>	16.5	14	7
<i>Field pea</i>	16.5	14	7

³⁶ 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>

³⁷ 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

<i>Lupins</i>	16.5	14	7
<i>Chickpeas</i>	25	14	7
<i>Soya beans</i>	25	14	7
<i>Navy beans</i>	25	14	7
<i>Pigeon pea</i>	25	14	7
<i>Mung beans</i>	25	14	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 or 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 are MRLs of 0.5 mg/kg for pulses and a PAFC MRL of 10 ppm.

Residues in forage, straw, stubble and hay are not expected to exceed 5 ppm, the maximum level that fenvalerate should be fed at in the diet for animals to still comply with the Australian MRL.

The JMPR reported residues in pea forage and fodder at 10 days after the last application at 220 g ai/ha were 4.4 ppm and at 21 days 4.9-70 ppm. Following application at 56 g ai/ha residues were 7.4 ppm at 21 days and after application at 110 g ai/ha 18 ppm at 21 days. Residues in bean hay and forage were 3.1-10 ppm at 21 days after application at 56 g ai/ha, 1.8-12 ppm for 110 g ai/ha and 2.7-22 at 220 g ai/ha. Residues in pea and bean forage at 21 days were 0.44 ppm at 56 g ai/ha, 0.82 ppm at 110 g ai/ha and 22 ppm at 220 g ai/ha.

The dairy cow feeding study with [¹⁴C]fenvalerate was designed to provide residue transfer information as well as metabolism information³⁸. The level of fenvalerate in the animal diet was 79 ppm. Approximate levels of ¹⁴C and % as fenvalerate were: fat 1-3 mg/kg (90%+), milk 0.47 mg/kg (90%+), muscle 0.25 mg/kg (90%), liver 2 mg/kg (<1%) and kidney 1.4 mg/kg (17%).

Anticipated residues in fat from feeding pulse forage with residues at the MRL are $10 \times 0.04 = 0.4$ mg/kg. Anticipated residues in milk from feeding pulses with residues at the MRL are $10 \times 0.006 = 0.06$ mg/kg.

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

Ethametsulfuron-methyl

-is a sulfonyl urea herbicide used for control of various weed. It is registered for use on narrow leaf lupins at 22.95 g ai/ha.

A harvest WHP is not required.

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

There are Australian but no Codex or US MRLs for ethametsulfuron-methyl in animal commodities. The Australian MRLs are all *0.02 mg/kg. The MRL for lupins is *0.02 mg/kg. There are animal feed MRLs of *0.02 ppm for lupin fodder (dry) and lupin forage [fresh weight].

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

³⁸ 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

Fluazifop-p

-is an aryloxyphenoxypropionate (fop) herbicide used for the control of certain grasses in various crops.

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

Crop	Rate (g ai/ha)	Harvest WHP (weeks)	Grazing WHP (days)
<i>Broad bean</i>	212	5	35
<i>Field pea</i>	63.6	7	49
<i>Lupins</i>	106	17	21
<i>Chickpeas</i>	63.6	7	49
<i>Soya beans</i>	212	17	119
<i>Navy beans</i>	212	5	35
<i>Pigeon pea</i>	212	17	119

There are Australian and USA but no Codex animal tissue MRLs for fluazifop. The relevant Australian MRLs are *0.05 for edible offal and meat and 0.1 for milk. The US tolerances for animal commodities have all been set at 0.05 mg/kg (fluazifop-butyl). The relevant Australian MRL is 0.5 mg/kg for pulses.

The relevant TFs for fluazifop are 0.01 for kidney and 0.005 for fat³⁹. It is not expected that residues in animal feed commodities would exceed 1 ppm. Anticipated maximum residues are expected to be below likely regulatory limits of detection (assumed to be 0.01 mg/kg).

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

Flumetsulam

-is a triazolopyrimidine sulfoanilide herbicide used on *chickpeas* and *field peas* at rates of up to 20 g ai/ha and up to 40 g ai/ha for *soya beans*.

A harvest WHP is not required.

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

There are Australian but no Codex or US MRLs for flumetsulam in animal commodities. The Australian MRLs are 0.3 mg/kg for edible offal and *0.1 mg/kg for meat and milk. There is an animal feed MRL of 15 ppm for legume pasture. The MRL for pulses is *0.05 mg/kg. The MRL for pulse forage and fodder is *0.05 ppm.

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

Flumioxazin

-is a phenyl ether herbicide used for knockdown and control of various grass and broadleaved weeds when mixed with glyphosate or paraquat/diquat herbicides prior to sowing wheat, barley, lupins, faba beans, field peas, chick peas and lentils. The application rate is 15 g ai/ha.

A harvest WHP is not required.

Do not graze crop or treated vegetation for 6 weeks after application.

There are Australian but no Codex or US MRLs for flumioxazin in animal commodities. The Australian MRLs are all *0.01 mg/kg for animal commodities. The MRLs for pulse grain, forage and fodder are *0.1 ppm.

³⁹ UK PSD Evaluation of fully approved or provisionally approved products. Issue No. 10 Evaluation on: Fluazifop-P-butyl, October 1988

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

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 pulses. 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 cattle 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 detected after the animals were fed with a diet containing 100 mg/kg glyphosate and aminoglyphosate acid⁴⁰. 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 *chickpeas, faba beans, field peas* and *lupins* at rates of up to 52 g ai/ha and on *navy beans soya beans* and *mung beans* at rates of up to 78 g ai/ha.

A harvest WHP is not required.

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

There are Australian but no USA or Codex animal tissue MRLs for haloxypop. The relevant Australian MRLs are 0.5 mg/kg for edible offal, 0.02 mg/kg for meat (fat) and 0.02 mg/kg for milk. There are Australian MRLs of 0.1 mg/kg for pulses and 0.5 ppm for bean fodder, chickpea fodder, lupin fodder and pea fodder and 5 ppm for bean forage (green), 5 ppm for pea vines (green) and 10 ppm for chickpea forage and lupin forage.

The TF for cattle fat is 0.05 and cattle kidney 0.19⁴¹. If it is assumed residues are present at the same level as the MRL residues in cattle tissues would be $10 \times 0.05 = 0.5$ mg/kg in fat and $10 \times 0.19 = 1.9$ mg/kg in kidney if included at 100% of the diet.

The TFs for milk and cream are 0.016 and 0.15. If it is assumed residues are present at the same level as the MRL, residues in milk and cream would be $10 \times 0.016 = 0.16$ mg/kg in milk and $10 \times 0.15 = 1.5$ mg/kg in cream.

Maximum residues of haloxypop 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.

⁴⁰ 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).

⁴¹ Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

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

Imazamox

-is a imidazolinone herbicide used for the control of broad leaf and grass weeds in *field pea, faba beans* and *soya beans*. It is applied at an application rate of up to 31.5 g ai/ha for field peas and *faba beans* and 35 g ai/ha for soya beans.

Do not graze or cut for stock food for 6 weeks for field peas and faba beans and 4 weeks for soya beans 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 have all been set at *0.05 mg/kg. The MRLs for field pea (dry), faba bean forage and fodder (dry), soya bean (dry), pea vines (green) [fresh weight] and soya bean forage (green) [fresh weight] are *0.05 ppm.

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

Imazapic

-is a imidazolinone herbicide used for the control of broad leaf and grass weeds in *fallow crops*. It is applied at an application rate of up to 48 g ai/ha.

Chickpeas: Do not graze treated stubble or weeds for 28 days after application.

There are no Codex MRLs for imazapic. The relevant US MRLs for animal tissues are 1 mg/kg for kidney and 0.1 mg/kg for meat, fat and meat bypr except kidney while the Australian MRL for edible offal (mammalian) is *0.05 mg/kg, for meat (mammalian (in the fat) *0.05 mg/kg and for milk *0.01 mg/kg.

The half-life for imazapic in soil is reported to be 106-113 days and in foliage <7 days.

In the goat metabolism study 3 goats were exposed to ¹⁴C-imazapic at doses of 0, 3.76 and 15.1 mg in gelatin capsules for seven consecutive days⁴². These levels were considered to be 0, 33×, and 197× of maximum residue that foraging animals would likely receive in the diet in the US (feeding levels of 2 and 12 ppm). The limits of detection for imazapic were 0.02 mg/kg in fat and 0.01 mg/kg for milk and tissues. Daily milk residues were below the limits of detection as were all tissue concentrations with the exception of the kidney: 0.01 mg/kg at the low dose and 0.05 mg/kg at the high dose. Residues from the kidney consisted of 30% parent compound.

NOTE: US MRLs have been established for animal feed items (including grass forage and hay at 30 and 15 ppm respectively) 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 1 ppm is estimated (30 ppm grass forage, 25% DM, 60% diet and 15 pm hay 88% DM 40% diet). An anticipated TF is the 1.0 ppm (animal commodity tolerances, kidney) ÷ 79 ppm (dietary burden) = 0.01 (crude estimate) and for fat/muscle/liver 0.1 ppm (animal commodity tolerances, tissues except kidney) ÷ 79 ppm (dietary burden) = 0.001 (crude estimate).

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

⁴² ERA TR 00-21-28-01e IMAZAPIC [Plateau and Plateau DG]-Human Health and Ecological Risk Assessment Final Report Prepared for: USDA, Forest Service Task No. 28 USDA/FS Contract No. 53-3187-5-12 USDA/FS Order No. 43-3187-0-0153 Submitted to: Leslie Rubin, COTR Animal and Plant Health Inspection Service (APHIS) Biotechnology, Biologics and Environmental Protection Environmental Analysis and Documentation United States Department of Agriculture Submitted by: Syracuse Environmental Research Associates, Inc. January 28, 2001

Imazethapyr

-is a imidazolinone herbicide used for the control of weeds in *chickpeas, faba beans, field peas, soya beans* and *mung beans*. It is applied at an application rate of up to 30 g ai/ha for chickpeas, 72 g ai/ha for faba beans and field peas and 96 g ai/ha for mung beans and soya beans.

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 and for pulses at *0.1 mg/kg.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.096 kg ai/ha gives a day 0 residue of 7.7 ppm).

In the goat metabolism study, parent ¹⁴C-imazethapyr was dosed to lactating goats at 0.25 ppm and 1.25 ppm⁴³. 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 *lupins* is as a seed treatment for the control of red-legged earth mite and blue oat mite. The application rate is up to 180 g ai/100 kg seed.

Do not graze lupin plants grown from treated seed 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 mixed pastures. The MRL for lupin (dry) is T0.2 mg/kg and for legume animal feeds 25 ppm.

⁴³ 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

The TF for liver is 0.01⁴⁴. Assuming residues in forage at 25 ppm and feeding at 100% of the diet, residues in liver would be $25 \times 0.01 = 0.25$ mg/kg. The TF for milk is 0.003. Anticipated maximum residues in milk are $25 \times 0.003 = 0.075$ mg/kg.

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

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

Indoxacarb

- is a oxadiazine insecticide. Application to pulse crops (*mungbean, soybean, chickpea, Adzuki bean*) is for control of heliothis and is at an application rate of 80 g racemate or 60 g indoxacarb (as S-isomer)/ha.

The harvest WHP is 28 days.

Do not graze or cut for stockfood for 28 days after application

There are Australian, Codex and US MRLs for indoxacarb in animal tissues. The relevant Australian, Codex and US tolerances for indoxacarb in cattle fat are 1, 1 and 1.5 mg/kg respectively and for milk 0.05, 2 F and 0.15 (4 mg/kg for milkfat) mg/kg. The Australian MRLs for the various pulses are 0.2 mg/kg. There are Australian MRLs for legume animal feeds is 10 ppm, soya bean hulls and aspirated grain fractions 2 ppm and soya bean meal 0.02 ppm.

The TF for fat is 0.03⁴⁵. Assuming that the residues in derived feeds do not exceed the MRL of 10 ppm, residues in cattle fat would be expected to be $10 \times 0.03 = 0.3$ mg/kg if fed at 100% of the diet, less than the Australian, Codex and USA MRLs. NOTE also mitigated by the short residue depletion half-life for cattle tissues, estimated to be <4 days.

The TF for milk is 0.002. Anticipated residues in milk of animals fed derived forage or fodder at 100% of the diet are $10 \times 0.002 = 0.02$ mg/kg.

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

Iprodione

- is a systemic fungicide used for the control of moulds in vegetables. It is used on *soya beans* for the control of black leaf blight with application at rates of up to 500 g ai/ha.

The harvest WHP is 7 weeks.

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. The US residue definition is the sum of iprodione + isomer (RP-30228) + metabolite (RP-32490) + metabolite (RP-36114). There is an MRL of 5 ppm for soya bean forage (green).

Residues in bean forage after application at 1.1 kg ai/ha were 27-66 ppm at 14 days after the last of 1 or two applications.

⁴⁴ 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

⁴⁵ Indoxacarb; Notice of Filing a Pesticide Petition to Establish a Tolerance for a Certain Pesticide Chemical in or on Food, Federal Register: March 17, 2004 (Volume 69, Number 52) Page 12664-12670

The TF for fat (US residue definition) is 0.03 (at 15 ppm feeding level)⁴⁶. Assuming residues in forage are at the highest residue in the trials scaled for the Australian rate ($66 \times 0.5 / 1.1 = 30$ ppm) and feeding at 100% of the diet the anticipated residues in fat are $30 \times 0.03 = 0.9$ mg/kg, below the US tolerance. Anticipated residues in milk are $30 \times 0.007 = 0.21$ mg/kg. If parent compound is monitored in tissues in other countries, as in Australia, residues in tissues are expected to be below the method LOQ.

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

Isoxaflutole

-is an isoxazole herbicide used for the control of broad leaf weeds and grasses in sugarcane and chickpeas. It is used on *chickpeas* at a maximum rate of 75 g ai/ha.

A harvest WHP is not required.

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

There are no Codex and US MRLs for isoxaflutole for animal tissue. The Australian MRLs for edible offal, meat (mammalian) (fat) and milk are *0.05 mg/kg. The MRL for chickpea fodder is 0.03 ppm and 0.3 ppm for chickpea forage (fresh weight). The MRL for chickpea (dry) is *0.03 mg/kg.

In an animal transfer study dairy cows were fed at the equivalent of 4.6, 13.8 and 46 ppm in the diet for 42 days⁴⁷. Residues in muscle and fat were <LOQ while mean residues in liver and kidney were 0.62 and 0.14 mg/kg respectively for the lowest feed level. The TF for liver is 0.13. Anticipated residues in liver are $0.3 \times 0.13 = 0.04$ mg/kg.

It is anticipated that animal product residues will be below typical method LOQs. (Assumed LOQ of 0.05 mg/kg).

Lambda-cyhalothrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on *soya beans*, *navy beans* and *mung beans* at 17.5 g ai/ha, *faba beans*, *chickpeas* and *field peas* at 9 g ai/ha and *lupins* at 6 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".

The following harvest/grazing/cutting for stock food WHPs apply.

Mung beans, navy beans: if harvested green 1 day.

Field peas, faba beans and chickpeas: 7 days

Lupins, mung beans (dry), navy beans (dry): 14 days

Soya beans: 21 days

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. The MRL for soya beans (dry) is *0.02 mg/kg and for pulses 0.2 mg/kg. There is an Australian MRLs of 2 ppm for legume fodder/straw.

⁴⁶ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

⁴⁷ Health Canada (PMRA) Proposed Regulatory Decision Document PRDD2001-03 Isoxaflutole

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.0175 kg ai/ha gives a day 0 residue of 1.4 ppm).

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)⁴⁸ would be $2 \times 0.5 = 1$ mg/kg. The TF for milk is 0.02 giving anticipated maximum residues of $2 \times 0.02 = 0.04$ mg/kg for whole milk.

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

Linuron

-is a selective urea herbicide used for the control of various weeds. It is registered for use on *soya beans* as a pre-emergent herbicide. Application is at rates up to 2.25 kg ai/ha. A harvest WHP is not required.

There are Australian and US but no Codex MRLs for linuron in animal commodities. The Australian MRLs are all *0.05 mg/kg, except for edible offal (mammalian) which is 1 mg/kg, while the US MRL for cattle fat is 0.2, liver and kidney 2 and milk is 0.05 mg/kg. . The vegetable MRL (no specific entry for soybeans) is *0.05 mg/kg.

The UK PSD and US EPA reported several animal feeding studies^{49,50}. In study were two dairy cows (Guernsey) were fed at 1 ppm for 30 days, residues were not found in milk, lean meat or fat (<0.05 mg/kg); liver and kidney residues ranged from 0.4-0.7 mg/kg (common moiety method = linuron and its metabolites convertible to 3,4-dichloroaniline, calculated as linuron). In a separate study, 2 dairy cows (Guernsey) were fed at 50 ppm for 30 days. Residues in milk were 0.3-0.35 mg/kg. Lean meat and fat contained *ca.* 0.5 mg linuron/kg and liver and kidney 13 mg/kg (common moiety method).

Anticipated residues in liver and kidney tissues using the maximum UK pasture residues at 28 days of 2.07 ppm are $2.07 \times 0.3-0.7 = 0.6-1.4$ mg/kg if measured using the common moiety residue. No residues of intact linuron are expected in any tissues and residues would be expected to be below regulatory LOQs for countries monitoring the parent compound.

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

Maldison (malathion)

- is an organophosphate insecticide used for the control of various insects in *peas*. The application rate is up to 0.625 kg ai/ha. The harvest WHP is 3 days.

There are Australian and US 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).

⁴⁸ 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

⁴⁹ Evaluation of fully approved or provisionally approved products. Issue 132: Evaluation on Linuron, May 1995, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

⁵⁰ Linuron Tolerance Reassessment Eligibility Decision Residue Chemistry Considerations PC Code 035506; Case 0047 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

The JMPR reported the results of three trials on peas with 5 applications at 2.8 kg ai/ha. Malathion residues in dry forage ranged from 2.9 to 32 mg/kg (up to 7.1 ppm when scaled for Australian application rate).

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.625 kg ai/ha gives a day 0 residue of 50 ppm).

No residues of malathion were detected in tissues in a goat metabolism study conducted at a nominal feeding level of 115 ppm⁵¹.

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

Mancozeb (also metham, metiram, propineb, thiram, zineb and ziram)

Is registered for use on *beans* and *soya beans* for the control of rust and Anthracnose at a maximum rate of 1.76 kg ai/ha. There is also a maximum registered use pattern of 2.0 kg ai/ha for the control of Chocolate Spot in beans (including faba beans and green broad beans).

The harvest WHP is 7 days.

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 Australian and Codex MRLs for milk are *0.2 mg/kg and *0.05 mg/kg respectively.

In an Australian trial residues in bean straw were 1.9 ppm at 64 days after 4 applications at 2 kg ai/ha. (Scaling anticipated residues in forage at day 0 of 80 ppm for application at 2 kg ai/ha gives a day 0 residue of 160 ppm).

Residues in bean forage and hay/straw are expected to be ca. 160 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study) was 0.003⁵² giving an anticipated maximum residue from the feeding of bean forage and straw/hay of 160×0.003 = 0.48 mg/kg, less than the relevant international MRLs. The TF for milk was <0.008.

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 0.35 kg ai/ha for *peas*.

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 80 ppm for application at 0.35 kg ai/ha gives a day 0 residue of 28 ppm). Cattle and sheep fed low to moderate doses of MCPA in the diet for 2

⁵¹ 1999 JMPR - Pesticide Residues in Food - 1999 Evaluations, Part I Residues FAO Plant Production and Protection Paper 157. FAO and WHO 2000

⁵² Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

weeks showed no residues from levels less than about 18 mg/kg⁵³. The major metabolite of MCPA is 2-methyl-4-chlorophenol in the free and conjugated form, which is formed in the liver. The US has a tolerance of 300 mg/kg for pasture indicating that feeding at this level should not result in residues in animal tissues above the US MRL (i.e. the residues would be <LOQ or 0.1 mg/kg).

In a feeding study where calves were fed in the diet at 250 or 500 ppm for 28 days, residues were <LOQ in meat and fat at slaughter and <LOQ for liver at the 250 ppm feeding level⁵⁴. Residues in kidney at 250 ppm feed level were 1.4 mg/kg. Residues in kidney and liver at the 500 ppm feed level were 0.14 and 2.3 mg/kg respectively. Residues at 7 days on clean feed after feeding at 500 ppm were 0.1 mg/kg in kidney. The half-life for depletion in tissues is estimated to be <2 days. Estimated TF for fat is $<0.1 \text{ mg/kg} \div 500 \text{ ppm} = <0.0002$ and for offal (kidney) is $2.3 \text{ mg/kg} \div 500 \text{ ppm} = 0.005$. No residues are expected in milk of animals fed at up to 300 ppm in the diet.

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

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

-is a selective herbicide used for the control of broadleaf weeds in *peas*. It is applied at an application rate of up to 1.68 kg ai/ha.

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. The MRL for pulses is *0.02 mg/kg.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 1.68 kg ai/ha gives a day 0 residue of 134 ppm).

Glastonbury *et al.* sprayed Na-MCPB at a rate of 2.24 kg ai/ha on “Onward” peas. The half-life of the MCPB was about 3 days in peas but was not detectable after 9 days in one experiment and 14 days in another. No MCPB was detected in the milk of cows fed MCPB in the ration at 50 ppm for four days (LOD 0.1 ppm)⁵⁵.

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

Metalaxyl

- is a fungicide used on a variety of crops. It is used on *peas* and *chickpeas* at 52.5 g ai/100 kg seed and *soya beans* at 105 g ai/100 kg seed as a seed treatment.

A WHP is not required.

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 and 0.05 mg/kg for meat and meat by-products and 0.02 mg/kg for milk.

⁵³ MCPA. List A Reregistration Case 0017. Chemical No. 030501, 030502, 030516, 030564. Revised Product and Residue Chemistry Chapters for the Reregistration Eligibility Decision. DP Barcode: D299360

⁵⁴ Leng, M.L., Comparative metabolism of phenoxy herbicides in animals, in Fate of pesticides in large animals edited by Ivie, G.W. and Dorrough, H.W., Academic Press, New York 1977.

⁵⁵ 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.

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/kg⁵⁶.

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. It is registered for use on *peas* at rates of up to 1.05 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 80 ppm for application at 1.05 kg ai/ha gives a day 0 residue of 84 ppm).

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

Methamidophos

-is an organophosphate insecticide used on various crops. It is used for aphid control in *lupins*.

Application is at rates up to 319 g ai/ha.

The harvest WHP is 6 weeks.

Do not graze or cut for stock food for 6 weeks after application.

There are Australian and Codex but no US MRLs for methamidophos in animal commodities, however the residue definitions differ. The Australian residue definition is parent compound. The Australian and Codex MRLs are *0.01 mg/kg for edible offal and meat mammalian while MRL for milk *0.01 and 0.02 mg/kg respectively. The MRL for lupin forage (dry) is 0.5 ppm.

In animal transfer studies with lactating cattle fed mixtures of acephate and methamidophos the transfer factors for muscle and kidney were 0.008 and 0.017 respectively⁵⁷. The TF for methamidophos in milk is 0.004.

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

Methidathion

- is an organophosphate insecticide used for the control of insects and mites in *lupins*. The maximum application rate is 0.4 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.

⁵⁶ 1982 JMPR Pesticide Residues in Food - 1982 Evaluations, FAO Plant Production and Protection Paper 49. FAO and WHO 1983

⁵⁷ 2003 JMPR. Pesticide Residues in Food - 2003 Evaluations – Part I: Residues, FAO Plant Production and Protection Paper xxx. FAO and WHO 2004

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.4 kg ai/ha gives a day 0 residue of 32 ppm). 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.

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 *navy beans* and *broad beans*, *lupins*, *mung beans*, *peas* (including *chick peas* and *pigeon peas*), *field peas* and *soya beans* (450 g ai/ha). The harvest WHP is 7 days for pulses.

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. The Australian MRL for pulses is 1 mg/kg.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.45 kg ai/ha gives a day 0 residue of 36 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 definitions⁵⁹.

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

Metiram

- is a dithiocarbamate fungicide used on a variety of crops. It is used on vegetables for the control of various fungal diseases

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

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Beans</i>	2.45	7	-

There are Australian and Codex but no US MRLs for metiram 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.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 2.45 kg ai/ha gives a day 0 residue of 196 ppm).

The Australian PAFC MRL is 50 ppm. The target tissue is liver. The TF for liver (1000 ppm feeding study) was 0.01⁶⁰ giving an anticipated maximum residue from the feeding of bean forage/straw/hay at 100% of the diet with residues at the MRL of 50×0.01 = <0.5 mg/kg less than the relevant international MRLs.

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

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

⁵⁹ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

⁶⁰ Evaluation of fully approved or provisionally approved products. Issue 36: Evaluation on ethylenebisdithiocarbamates (2), April 1991, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

Metolachlor

-is a selective herbicide used for the control of annual grasses and broadleaf weeds in *navy beans* and *soya beans*. It is applied at an application rate of up to 2.88 kg ai/ha.

Green beans: Do not harvest, graze or cut for stock food for 10 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 0.02 mg/kg for milk. The Australian MRLs for meat (mammalian) and milk are *0.05 mg/kg. Residues decline in soil and foliage with typical half-lives of 90 and 5 days respectively. Metolachlor has a primary animal feed commodity MRL of 5 ppm.

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 TF for kidney is 0.007. Anticipated residues in kidney are $5 \times 0.007 = 0.035$ mg/kg.

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

Metosulam

-is a triazolopyrimidine sulfonanilide herbicide used for the control of broad-leafed weeds in *lupins*. It is applied at an application rate of up to 7.14 g ai/ha.

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

There are Australian but no Codex or US MRLs for metosulam in animal commodities. The Australian MRLs have all been set at *0.01 mg/kg. The MRL for lupins (dry) is *0.02 mg/kg. The MRL for lupin forage is *0.1 ppm.

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

Metribuzin

- is a herbicide used on a variety of crops. It is used on *chickpeas* and *faba beans* at 278 g ai/ha, *lupins* at 112 g ai/ha and *peas*, *pigeon peas* and *soya beans* at 360 g ai/ha with application 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 while the US MRLs for animal tissues have all been set at 0.7 mg/kg 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

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

fat (10 ppm feed level) was 0.11 while at the 3 ppm feed level it was 0.02. The TF for milk at the 10 ppm feed level was 0.0007.

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

Metsulfuron-methyl

-is a sulfonylurea herbicide used for the pre-harvest desiccation of chickpeas and control of various weeds. Application is at rates up to 3 g ai/ha.

Do not harvest for 7 days after application.

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

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 and 0.1 mg/kg for other meat by-products, meat and fat and 0.05 mg/kg for milk.

The MRL for chick-pea (dry) is *0.05 mg/kg while for feed commodities are also *0.05 ppm for forage and fodder (fresh weight) of chick-peas.

The US EPA reported that “*the results of an analyses of sorghum grain, fodder and stover (at seed maturity), forage and hay (30 days), after application of metsulfuron methyl at the maximum proposed label rate and twice the rate, show that all residues of metsulfuron methyl and its metabolites (4-hydroxy metsulfuron methyl and its glucose conjugate) were below the limit of quantitation (0.05 or 0.1 ppm).*”

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 (0.008-0.009%) of the parent 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 glucoronide 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: 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.

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

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]

Omethoate

- is an organophosphate insecticide used for the control of aphids in *lupins* and mites in *faba beans*. The maximum application rate is 200 g ai/ha for lupins and 58 g ai/ha for faba beans.

The harvest WHP is 14 days.

Faba beans: 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 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. The MRL for lupin forage is 0.5 ppm.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.2 kg ai/ha gives a day 0 residue of 16 ppm).

A metabolism study with lactating goats dosed orally with dimethoate suggests that residues of omethoate are not expected in animal tissues⁶⁵.

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

Paraquat

- is a herbicide used for the control of annual rye grass seed set in *faba bean*, *chick peas*, *lupins* and *field peas*. The application rate is up to 0.2 kg ai/ha.

The harvest WHP is 14 days.

The following grazing restraints apply:

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

The Australian and Codex MRLs for paraquat in kidney are 0.5 and 0.05 mg/kg respectively while *0.01 and 0.005 mg/kg for milk respectively. The US MRL for kidney is 0.5 mg/kg and for milk 0.01 mg/kg. Residues in soil and foliage decline with typical half-lives of *ca.* 1000 and 30 days respectively. The Australian PAFC MRL is 500 ppm.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.2 kg ai/ha gives a day 0 residue of 16 ppm).

For residues in kidney to be less than the US MRL of 0.3 mg/kg, cattle would have to 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 jassids in *beans*. The application rate is 350 g ai/ha.

The harvest WHP is 14 days.

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 T0.5 mg/kg for legume vegetables and T0.2 mg/kg for pulses.

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

Residues in bean forage and fodder (hay) at 15 days after the last of 6 applications at 1.7 kg ai/ha (5× the Australian rate) were <0.05-1.1 ppm for forage and <0.05-3.6 ppm for hay. 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.

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

Pendimethalin

-is a selective dinitroaniline herbicide used for the control of annual ryegrass and certain broadleaf weeds in cotton, cereals etc. It is registered for use on *cow peas, mung beans, navy beans, pigeon peas, chickpeas, lupins* and *soya beans* at 0.99 kg ai/ha and *broad beans* at 1.32 kg ai/ha.

Application is at the time of or soon after sowing.

No harvest WHP is required.

There are Australian 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 and foliage with typical half-lives of 90 and 50 days respectively. The MRL for pulses 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 *field peas* with application at rates of up to 0.125 kg ai/ha. Permethrin residues decline with typical half-lives of 30 and 8 days for soil and foliage respectively.

The harvest WHP is 3 days.

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.

(If assume residues at day 0 from application at 1 kg ai/ha are 80 ppm in forage, scaling for rate gives an estimated day of residue of 10 ppm). Residues in forage/hay could be as high as 10 ppm. The TF for fat is 0.04⁶⁸. Anticipated maximum residues in fat resulting from feeding pea forage or hay at 100% of the diet are $10 \times 0.04 = 0.4$ mg/kg. The TF for milk is 0.002 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.

The residues in fat were reported to decline with an initial half-life of < 7 days.

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

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

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

Picolinafen

-is an aryloxyacetic acid herbicide used for the control of certain broad leaf weeds in crops. It is registered for the control of wild radish and cape weed in *field peas* and narrow leaf *lupins* at rates of up to 37.5 g ai/ha.

A harvest WHP is not required.

Do not graze or cut for stock food for 4 weeks field peas or 6 weeks lupins after application.

There are Australian but no Codex or US MRLs for picolinafen in animal commodities. The Australian MRLs are 0.05 mg/kg for edible offal (mammalian), *0.02 mg/kg for meat (mammalian) (in the fat) and *0.01 mg/kg for milks. The MRLs for lupins (dry) and field peas (dry) are *0.02 mg/kg. The MRL for field pea forage (green) is 0.5 ppm, pea hay or pea fodder (dry) 0.05 ppm, lupin forage 2 ppm and lupin straw (dry) *0.02 ppm.

In a metabolism study, lactating goats were orally dosed with 5 ppm picolinafen in the feed for 7 consecutive days (equivalent to 0.3 mg ai/kg bw/day). Determination of TRRs showed that residues were highest in kidney and liver (i.e. target tissues). The TRRs were characterised; maximum residues (addressing the residues definition) of 0.244 mg/kg and 0.083 mg/kg were reported for kidney and liver, respectively (i.e. kidney TF = 0.05; liver TF = 0.017). The animal commodity MRLs for picolinafen were based on a feeding/exposure rate of 0.5 ppm in the diet. Noting the lupin forage MRL of 2 ppm, assuming feeding at 100% of the diet anticipated residues in kidney are $2 \times 0.05 = 0.1$ mg/kg.

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

Piperonyl butoxide

- is a synergist used to increase the effectiveness of various synthetic pyrethroid (SP) insecticides. It is used for the control of green vegetable bug in organic *soya beans* when combined with pyrethrins (APVMA permit 3539). The application rate is 225 g ai/ha.

The harvest WHP is 1 day.

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

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.225 kg ai/ha gives a day 0 residue of 18 ppm).

The TF for PBO in fat is 0.004 (feeding at 100 ppm in the diet)⁶⁹ resulting in an anticipated maximum residue from feeding bean forage/fodder with residues of 18 ppm of 0.072 mg/kg, less than the relevant Australian and Codex MRLs.

The TF for PBO in milk is 0.0001 (feeding at 100 ppm in the diet) resulting in an anticipated maximum residue from feeding bean forage/fodder at 100% of the diet of $18 \times 0.0001 = 0.0018$ mg/kg, less than the relevant Australian and Codex MRLs and likely regulatory method LOQ.

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

Pirimicarb

⁶⁹ 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

-is a carbamate aphicide used for the control of aphids in *beans* and *peas*. The application rate is up to 250 g ai/ha for beans and 500 g ai/ha for peas.

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. As the MRLs are set at the limit of analytical quantitation and are essentially the same.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.5 kg ai/ha gives a day 0 residue of 40 ppm).

There is a PAFC MRL of 20 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 diet⁷⁰. The TF for milk is 0.00065.

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

Procymidone

-is a dicarboximide fungicide used on crops for control of various fungal diseases in crops. It is registered for use on *navy beans* and *adzuki beans* for sclerotinia rot (750 g ai/ha), *faba beans* for chocolate spot (250 g ai/ha) and as a seed dressing for *lupins* (100 g ai/100 kg seed). It is used on lentils for control of Grey mould at 250 g ai/ha.

A harvest WHP is not required.

Adzuki beans: Do not harvest for 21 days after application, Do not graze or cut for stock food.

Lentils: Do not harvest for 21 days after application, Do not graze or cut for stock food for 21 days after application.

There are Australian but no Codex or US MRLs for procymidone in animal tissues. The Australian MRLs are T0.2 mg/kg for fat, T0.05 mg/kg for offal and T0.02 mg/kg for milk. The MRLs for beans are 10 mg/kg and for lupins (dry) *0.01 mg/kg. The MRL for lentils is 0.5 mg/kg and for lentil forage, straw and fodder dry 5 ppm.

The Australian animal commodity MRLs were based on a dietary burden of 10 ppm (APVMA gazette, APVMA Gazette, 13th July 2004 procymidone/lentils).

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

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 *chickpeas* at 0.75 kg ai/ha applied immediately post-planting.

A harvest WHP is not required.

Do not graze or cut for stock food for 9 weeks after application

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 and 0.5 ppm for chick-pea fodder and chick-pea forage (green).

⁷⁰ 1978 JMPR - Pesticide Residues in Food - 1978 Evaluations, FAO Plant Production and Protection Paper 15 Suppl. FAO and WHO 1979

The US EPA considered that there is no reasonable expectation of detectable residues⁷¹. Animals exposed to residues at levels anticipated in forage/fodder are not expected to have detectable residues (US EPA refer to a feeding study conducted at 50 ppm).

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

Propaquizafop

-is a herbicide used for the control of grass weeds in various crops. It is used on *chickpeas, faba beans, field peas* and *lupins* at rates of up to 45 g ai/ha.

The harvest WHPs are 12 weeks for chick peas and field peas, 7 weeks for faba beans and 15 weeks for lupins

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). The MRL for pulses is *0.05 mg/kg.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.045 kg ai/ha gives a day 0 residue of 3.6 ppm). The relevant TFs for propaquizafop are 0.004 for both kidney and fat⁷². Anticipated residues on feeding pulse forage/fodder 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.

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

Pyrethrin

- is a natural pyrethroid insecticide used for the control various insect pests in *vegetables*. It is used for the control of green vegetable bug in organic *soya beans* when combined with PBO as a synergist (APVMA permit 3539). The application rate is 56.25 g ai/ha.

The harvest WHP is 1 day.

There are US but no Australian or Codex MRLs for pyrethrins in animal commodities. The MRLs applicable to cattle fat (target tissue) have all been set at 1 mg/kg. The MRL for milk fat is 0.05 mg/kg reflecting negligible residues in whole milk. There is an Australian MRL of 1 mg/kg for vegetables.

Residues in forage, vines and hay of crops treated at 56 g ai/ha and on the day of application were reported by the JMPR to be 0.24-1.6 ppm for forage, 0.08-1.6 ppm for vines and 0.03-0.48 ppm for hay. In a feeding study with lactating cows, residues in tissues of animals dosed orally at a level equivalent to 5 ppm in the feed had residues in tissues that were <LOQ (0.038 mg/kg) for muscle, liver and kidney and 0.048-0.075 mg/kg in fat⁷³. Feeding bean and pea forage and fodder with residues of 1.6 ppm should not result in tissues residues above typical LOQs for pyrethrins.

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

Pyridate

⁷¹ 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

⁷² Evaluation of fully approved or provisionally approved products: Issue No. 94 propaquizafop February 1994

⁷³ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

Is registered for use on *chickpeas* at 1.8 kg ai/ha.
A harvest WHP is not required.

There are Australian but no Codex or US MRLs for pyridate in animal commodities. The Australian MRLs have all been set at *0.2 mg/kg. The MRL for chickpea forage is *0.2 ppm and chickpea (dry) *0.1 mg/kg.

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

Quintozene

-is a fungicide used to control soil borne diseases in vegetables and crops. It is applied as a band spray to soil prior to planting beans at an application rate of 16.5 kg ai/ha.
Do not harvest for 4 weeks after application.

There are no Australian, Codex or US MRLs for animal tissues. The Australian MRL is 0.2 mg/kg for navy beans dry, 0.01 mg/kg for beans, except broad bean and soya bean and for broad bean (green pods and immature seeds).

The 1995 JMPR reported a metabolism study where peanuts were planted in soil that had been treated with [¹⁴C]quintozene at a rate of 38 kg ai/ha and grown to maturity. The vines, shells and kernels had ¹⁴C residues (expressed as quintozene) ranging from 42 mg/kg in the vines to 5.2 mg/kg in the kernels. No information was available on quintozene as a proportion of the radioactivity though it was stated that many metabolites were present. In hydroponically grown peanuts, quintozene accounted for <30% of the ¹⁴C at 4 days after application⁷⁴ confirming significant metabolism. A conservative estimate of quintozene residues in vines can be made by scaling the residues observed in the metabolism trial for application rate and adjusting for metabolism. It is estimated that quintozene residues in vines will be <5.5 ppm (16.5/38×42×<0.3).

The TF for fat is *ca.* 0.005 (10 ppm feed level, residue as parent compound)⁷⁵. Anticipated residues in fat would be <5.5×0.005 = <0.0275 mg/kg.

Quintozene can contain up to 100 mg/kg hexachlorobenzene (HCB), an application rate of 16.5 kg ai/ha corresponds to a potential application of HCB at 1.65 g/ha. Noting 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 crop residues ranges from 0.03 – 2.4 for aerial parts. The contribution from previous years applications (assumed 12 years of additions 1 spray per year at the maximum rate = 1.65 g HCB/ha = 19.8 g HCB/ha), distributed in the top 20 cm soil with density 1 g/mL would be 19800 mg/2000000 kg = 0.0099 ppm. Residues in aerial plant parts would account for no more than 0.00099 ppm, assuming a crop to soil ratio of 0.1.

Feeding forage/hay with residues of 0.00099 ppm at 100% diet would give rise to residues of 0.00099×8 = 0.0079 mg/kg in fat and 0.00099×8.4 = 0.0083 mg/kg in milk fat.

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

Quizalofop-P

⁷⁴ Rusness, D.G. and Lamoureux, G.L. (1980) Pentachloronitrobenzene metabolism in peanut. 2. Characterization of chloroform-soluble metabolites produced in vivo. *J Agric Food Chem.* 28(6) 1070-1077.

⁷⁵ 1995 JMPR - Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

-is used for the control of certain grass and broad leaf weeds in *chickpeas, faba beans, field peas, lupins, mung beans* and *navy beans*. The application rate is up to 100 g ai/ha for *soya beans, mung beans* and *navy beans* and 38 g ai/ha for the other crops.

The harvest WHP is 12 weeks for chickpeas, faba beans, soya beans, mung beans and navy beans, 9 weeks for field peas and 6 weeks for lupins.

Chickpeas, faba beans, lupins, mung beans: Do not graze or cut for stock food for 12 weeks after application.

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

Navy beans: nil

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 0.2 mg/kg for pulses and 10 ppm for forage and fodder of soybeans, chickpeas, field peas, lupins, faba beans, mung beans, navy beans, lentils, vetch and green beans.

In a feeding study, three groups of three lactating dairy cows plus a control group were fed 0.1, 0.5, and 5 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.

Feeding at 100% of the diet forage with residues at 10 ppm gives anticipated offal residues of $10 \times 0.01 = 0.1$ mg/kg.

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

Sethoxydim

- is a cyclohexanedione herbicide used for the control of certain grass weeds in crops. It is registered for control of certain grass and broad leaf weeds in *chickpeas, faba beans, field peas, soya beans* and *lupins* with application rates up to 0.192 kg ai/ha.

The harvest WHPs are 5 weeks for lupins, 10 weeks for field peas, 14 weeks for faba beans and chickpeas and 17 weeks for soya beans.

Seed crops?: 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”. Comparison 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-

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)

ethylthiopropyl)cyclohexane-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexane-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 MRLs for lupins (dry) at 0.2 mg/kg, pulses (except lupins) *0.1 mg/kg and legume animal feeds [except peanut forage and fodder] of 15 ppm.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.192 kg ai/ha gives a day 0 residue of 15 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.

The US EPA reported⁷⁷ a study where lactating goats were fed hay containing 75 ppm sethoxydim for 28 days; residues of sethoxydim and its metabolites containing the 2-cyclohexen-1-one moiety were <0.05 mg/kg in muscle and fat, <0.44 mg/kg in kidney, 0.14 mg/kg in liver, and <0.01-0.18 mg/kg in milk. The TF for kidney and milk are 0.0059 and 0.0024 respectively. Anticipated residues are $15 \times 0.0059 = 0.09$ mg/kg for kidney and $15 \times 0.0024 = 0.036$ mg/kg for milk.

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

Simazine

- is a triazine herbicide used for the control of weeds in vegetable crops. It is registered for control of certain weeds in *chickpeas*, *faba beans* and *lupins* with application rates up to 2 kg ai/ha for lupins, 1 kg ai/ha for chickpeas and 1.25 kg ai/ha for faba beans with application pre-sowing or pre-emergence.

A harvest WHP is not required.

Chickpeas: Do not graze or cut for stock food for 9 weeks after application.

Faba beans: Do not graze or cut for stock food for 8 weeks after application.

Lupins?

There are Australian and US but no Codex MRLs for animal commodities. The Australian MRLs have all been set at *0.05 except milk which is at *0.02 mg/kg. The US MRLs are 0.03 mg/kg for animal commodity MRLs.

The Australian MRL for pulses are: broad bean (dry) *0.01 mg/kg, chickpea (dry) *0.05 mg/kg, lupin (dry) *0.05 mg/kg. There are MRLs for chick-pea fodder and forage (0.5 ppm), faba bean fodder (0.1 ppm) and faba bean forage (3 ppm).

NOTE: US MRLs have been established for animal feed items (alfalfa and grass forages and fodder/hay at 15 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. 10.5 ppm is estimated (15 ppm for forage fed at 70% of the diet, the contribution of other potential feed items is low due to the low residue levels). An anticipated TF is the 0.02 (N) ppm (animal commodity tolerances, meat, mby, fat) \div 10.5 ppm (dietary burden) = 0.002 (crude estimate). Anticipated residues are $3 \times 0.002 = 0.006$ mg/kg for offal.

⁷⁷ MEMORANDUM Date: 22-JUN-2005 Subject: Revised as per 30-day Error Only Registrant Comments. Sethoxydim. HED Chemistry Chapter of the Reregistration Eligibility Decision (RED). Summary of Analytical Chemistry and Residue Data. Case No. 2600 DP Number: D318169 PC Code: 121001 Chemical Class: Cyclohexenone From: William H. Donovan To: James Parker

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

S-metolachlor

see metolachlor

Spinosad

- is an antibiotic insecticide used for the control of heliothis and various other pests in pulse crops.

The application rate is up to 72 g ai/ha.

The relevant withholding periods are:

Do not harvest for 14 days after application.

Do not graze or cut for stockfood for 14 days after application.

There are Australian, Codex and USA MRLs for spinosad in animal commodities. The Australian and US MRLs applicable to cattle meat (fat) are 2 and 50 mg/kg respectively. The respective milk MRLs are 0.1 and 7 (85 mg/kg for whole milk fat) mg/kg. The Codex MRL is 3 mg/kg for cattle fat and 2 mg/kg for fat of other mammals and 1 mg/kg for cattle milk (5 mg/kg for milk fat). There are Australian MRLs of 0.01 mg/kg for pulses and 1 mg/kg for legume animal feeds.

The TF for cattle fat is 0.5-0.6⁷⁸. Assuming pulse forage/fodder is fed at a maximum of 100% of the diet, residues in the treated crop are at the same level as the MRL anticipated residues in fat are $1 \times 0.6 = 0.6$ mg/kg.

The TF for milk is 0.05 giving an anticipated maximum residue in cattle milk from feeding of pomace at 30% of the diet of $1 \times 0.05 = 0.05$ mg/kg.

The half-life for the decline of residues in fat is of the order of 7 days.

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

Tebuconazole

-is a DMI fungicide used for the control of powdery mildew in peas. The application rate is up to 62 g ai/ha.

The harvest WHP is 3 days.

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

There are Australian, Codex and US MRLs for tebuconazole in animal tissues. The Australian and Codex residue definition is tebuconazole while the USA residue definition is the sum of tebuconazole and its 1-(4-chlorophenyl)-4,4-dimethyl-3-(1H-1,2,4-triazole-1-yl-methyl)-pentane-3,5-diol metabolite. The Australian MRLs 0.5 mg/kg for edible offal mammalian, 0.1 mg/kg for meat (mammalian) and 0.05 mg/kg for milk. The Codex MRLs are *0.05 mg/kg for both cattle meat and cattle edible offal and *0.01 mg/kg for milk. The US MRLs are 0.2 mg/kg for meat byp and 0.1 mg/kg for milk. Australian MRL for legume vegetables is 0.5 mg/kg, for broad beans dry 0.5 mg/kg and for soybeans dry 0.1 mg/kg. The primary animal feed commodity MRL is 50 ppm.

In Australian trials reported by JMPR residues in foliage were 6.3-9.2 ppm at 20 days after application at 0.25 kg ai/ha and 8.7-19 ppm after application at 0.5 kg ai/ha. 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 days⁷⁹. The residues in liver were 0.2 mg/kg. The TF for

⁷⁸ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

⁷⁹ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

liver is 0.0008. There is no reasonable expectation of residues of tebuconazole in meat and fat arising from feeding of grain, forage/fodder/hay.

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

Tepraloxymid

-is a cyclohexanedione herbicide for early post-emergence control of various grass weeds in chickpeas, faba beans, field peas, lentils and lupins. The application rate is up to 60 g ai/ha. The harvest WHP is 12 weeks after application.

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

The Australian MRLs for animal commodities are all *0.1 mg/kg except milk which is *0.02 mg/kg. The US MRLs are 0.5 mg/kg for kidney, 0.2 mg/kg for other meat by-products and meat, 0.15 mg/kg for fat and 0.1 mg/kg for milk. The MRL for pulses is *0.1 mg/kg and for legume animal feeds 3 ppm.

The APVMA PRS reported⁸⁰ an animal transfer study. In an animal transfer study, cattle were dosed for 28 consecutive days at 6.3, 19 or 63 ppm in the feed. At the 6.3 ppm feed level residues in all tissues and milk were below quantifiable levels (<0.02 mg/kg milk and <0.1 mg/kg tissues). At the 19 ppm feed level residues were below LOQ in all tissues except muscle, which contained residues of 0.15 mg/kg. At the highest feeding level (63 ppm) quantifiable residues were detected in milk and all tissues of animals slaughtered at the end of the dosing period, except fat. Highest residues were present in kidney (0.39 mg/kg). After 2 days depuration residue in all tissues and milk had fallen below LOQ.

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 *field peas* and is applied at rates up to 0.425 kg ai/ha.

The harvest WHP is 4 weeks

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

But no restraint for field peas!

There are no Codex or US MRLs for terbutryn. The Australian MRLs for meat (mammalian) (fat) and milk are both 0.1 mg/kg while the MRL for edible offal is 3 mg/kg. Animal feed commodity MRLs of 30 mg/kg have been set for field pea fodder and forage.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.425 kg ai/ha gives a day 0 residue of 34 ppm).

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.

Tetradifon

⁸⁰ Public Release Summary on Evaluation of the new active TEPRALOXYDIM in the product Aramo Herbicide Australian Pesticides and Veterinary Medicines Authority May 2003 Canberra Australia

-is a miticide used for the control of various mites on vegetables and fruit crops. The application rate is 0.2 kg ai/ha *for beans* combined with a 7 day harvest WHP.

There are no Australian, Codex or US MRLs for tetradifon in animal commodities. The Australian MRL for vegetables is 5 mg/kg.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.2 kg ai/ha gives a day 0 residue of 16 ppm).

On feeding cattle apple pomace with tetradifon residues in the range 0.07-0.53 ppm, residues after 160 days of feeding were 0.17 mg/kg in fat⁸¹. Assuming a TF for fat of 0.3 and residue of tetradifon at the same level as estimated for day 0 residues would give an estimated residue in fat from feeding bean forage and fodder at 100% of the diet of $0.3 \times 16 = 4.8$ mg/kg.

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

Thiabendazole

-is used as a seed dressing in various *pulses* with an application rate of 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. 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 and milk are 0.1 mg/kg. No MRLs are established in Australia for pulses. The TF for kidney (target tissue) is 0.004⁸² and the TF for milk is 0.001.

It is considered unlikely that treated pulse seed would give rise to residues in crops fed to animals.

Thiodicarb

Is registered for use on *pulses* for control of heliothis at a maximum rate of 281 g ai/ha. The harvest WHP is 21 days. Do not graze or cut for stock food for 21 days after application.

The MRL for pulses is *0.1 mg/kg and for PAFC 30 ppm.

See methomyl.

Thiram

- is a dithiocarbamate fungicide used on a variety of crops. It is used *lupin* seed at 100 g ai/100 kg seed and at 72 g ai/100 kg seed for *chickpeas*, *field peas* and *faba beans*. 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 0.5 mg/kg, both as CS₂. The Australian PAFC MRL is 50 ppm.

⁸¹ Rumsey, T.S., Bovarel, K.P., Fontenot, J.P., Oltjen, R.R., & Priode, B.M. (1977) Supplementation of apple pomace with non-protein nitrogen for gestating beef cows. IV. Pesticide accumulation in cows. J. Anim. Sci., 46: 543-550

⁸² 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

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 for mancozeb) was 0.003⁸³ giving an anticipated maximum residue from the feeding of straw/hay/stubble 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.

Triallate

-is a thiocarbamate herbicide used for the control of certain grass weeds (wild oats, annual rye grass) prior to crop emergence in *chickpeas*, *faba beans*, *lupins* and *peas*. The maximum application rate is 0.8 kg ai/ha.

A harvest WHP is not required.

There are Australian but no Codex or US MRLs for triallate in animal commodities. The Australian MRLs are *0.1 for edible offal (except kidney), 0.2 mg/kg for kidney, 0.2 mg/kg for fat and *0.1 mg/kg for meat and milk.

The MRL for pulses is *0.05 mg/kg.

In a dairy cattle feeding study conducted at dose levels equivalent to 3 and 10 ppm in the diet, residues in tissues at slaughter were <0.01 mg/kg for muscle, kidney and liver for both dose groups and were 0.01 and 0.03 mg/kg in fat for the 3 and 10 ppm dose groups respectively⁸⁴. Residues in milk were <0.01 mg/kg.

The US EPA RED suggests residue in pea hay may require a tolerance of 1 ppm. Assuming feeding at 1 ppm in the diet, residues of triallate would be less than typical regulatory method LOQs.

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

Tribenuron-methyl

-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 Australian MRLs for chickpea, mung bean and soybean are *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 organs. Based on this low potential for transfer of residues to tissues, it is concluded that feeding forage, straw, hay and stubble will not result in detectable residues in animal commodities.

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*

⁸³ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

⁸⁴ Reregistration Eligibility Decision for Triallate List B Case 2695EPA 738-R-00-021 March 2001. Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

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”⁸⁵.

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.

The log P_{ow} for tribenuron-methyl at pH 7 is -0.44 suggesting little propensity for residues to accumulate in fat. Using empirical relations between log P_{ow} and TF, the predicted maximum TF for offal is 0.02 and for fat and milk 0.01.

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 *legumes*. The application rate is up to 0.625 kg ai/ha for *soya beans* and 0.6 kg ai/ha for other *legumes*. 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. (Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.625 kg ai/ha gives a day 0 residue of 50 ppm, and at 3 days of 25 ppm). 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 period⁸⁶.

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

Trifluralin

-is a selective dinitroaniline herbicide used for the control of certain grasses and annual broad-leafed weeds in *pulses* (chickpeas, Adzuki beans, lab lab beans, cowpeas, mung beans, Borlotti beans, Red kidney beans, faba beans, pigeon peas, peas, lupins, navy beans and soya beans). Application is at a maximum rate of 1.1 kg ai/ha for soya beans, 0.72 kg ai/ha for faba beans and 0.816 kg ai/ha for the other crops. No grazing WHP is required.

⁸⁵ PMRA Decision Document E95-04 Tribenuron methyl

⁸⁶ 1971 JMPR. Evaluations of some pesticide residues in food. AGP/1971/M/9/1; WHO Pesticide Residues Series No. 1, 1972

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 MRL for meat (mammalian) and milk are *0.05 mg/kg. The MRLs for individual pulses are all 0.05 mg/kg. Residues decline in soil and foliage with typical half-lives of 60 and 3 days respectively.

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 tissues⁸⁷.

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

Zeta-cypermethrin

see cypermethrin

Zineb

- is a dithiocarbamate fungicide used on a variety of crops. It is used on *vegetables* for the control of downy mildew, early and late blight, anthracnose and Septoria leaf spot etc at a maximum application rate of 140 g ai/hL for *beans* and 100 g ai/ha for *peas*.

The harvest WHP is 7 days.

There are Australian and Codex but no US MRLs for zineb 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. MRLs for beans and peas are both 2 mg/kg.

(Scaling anticipated residues in forage at day 0 of 80 ppm for application at 0.14 kg ai/ha gives a day 0 residue of 11 ppm).

Residues in forage and fodder would be expected to be much less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study for mancozeb) was 0.003⁸⁸ giving an anticipated maximum residue from the feeding of forage and fodder at 100% of the diet of $<50 \times 0.003 = <0.15$ mg/kg,

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

⁸⁷ 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

⁸⁸ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994