codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

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Agenda Item 6 **CX/PR 01/9-Add.2**

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON PESTICIDE RESIDUES

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Prepared by Australia

Post-harvest Grain Protectant Usage in Australia

1 Background

At the 30th session of CCPR 1998, the manufacturer announced that it would no longer support the use of chlorpyrifos-methyl on maize when dietary intake assessments indicated that the ADI was exceeded for some regional diets.

At 31st CCPR 1999 the CXL for maize was recommended for revocation and the draft MRLs for barley, oats and rice were returned to Step 6 for reconsideration in 2000.

At 32nd CCPR 2000 the Committee was advised that Australia had produced a paper to demonstrate that the usage of chlorpyrifos-methyl in Australia is consistent with Good Agricultural Practice. The GAP paper also contained NEDI and IEDI calculations as supporting appendices.

The Committee returned the draft MRLs for barley, oats and rice to Step 6 on the understanding that Australia would submit its intake calculations and other relevant comment to the Chairman for distribution to members in advance of the next meeting. The meeting also decided to ask that the compound be prioritised for the establishment of an ARfD.

2 Purpose of Document

The Australian MRL is 10 mg/kg for all cereal grains except rice. It is intended to demonstrate that the usage of chlorpyrifos-methyl in Australia is consistent with Good Agricultural Practice and does not result in the exceedence of the ADI in Australian dietary calculations, or in the five International Regional diets currently considered by CCPR or JMPR. The Australian MRL for cereal grains is 10 mg/kg, and a treatment rate of 10 mg/kg is used to provide effective protection of stored grain under hot conditions for periods of approximately nine months. Effective residue monitoring systems are in operation to ensure that treated grain is outturned in accordance with MRLs.

3 Australian and Codex MRLs

(a) Maximum Residue Limits are determined in Australia by the National Registration Authority and are incorporated into the Australia New Zealand Food Authority (ANZFA) Food Standards Code. MRLs listed in the code are applicable to imported foodstuffs as well as Australian produce.

Table 1 lists the Australian MRLs for chlorpyrifos-methyl on cereal grains, and compares them with those recommended by CCPR, and ratified by the Codex Alimentarius Commission (CAC). Both Australian and Codex MRLs are similar, except that Australia uses the generic term "cereal grains" and does not specify its MRLs on an individual cereal commodity basis.

Furthermore, Australia does not list specific MRLs for processed commodities such as flour, white and wholemeal bread, but records MRLs for processed fractions if there is an accumulation factor and a need to record an MRL that is higher than the parent cereal grain MRL. An Australian MRL is recorded for wheat germ, but there is no Codex MRL as this commodity is not traded internationally.

It should be noted that although Australia only records MRLs for "cereal grains", all of the necessary residue data is generated and considered for each of the cereal grains, including those listed in Codex – wheat, barley, oats and sorghum. Furthermore, residue studies are conducted on milled products of commodities such as wheat (flour, bran, germ, white/wholemeal bread, and other wheaten products to ensure that the cereal MRL is appropriate.

Table 1: Australian and Codex MRLs

Australia			Codex (23rd Session CAC 1999)		
Chemical	Commodity	MRL mg/kg	Commodity	MRL mg/kg	Step
Chlorpyrifos-methyl	Cereal grains (except rice)	10	Wheat	10	CXL
	Wheat bran (unprocessed)	20	Wheat bran (unprocessed)	20	CXL
	Wheat germ	30	Wheat flour	2	CXL
	Rice	0.1	White bread	0.5	CXL
	Lupin (dry)	10	Wholemeal bread	2	CXL
			Sorghum	10	CXL
			Rice	0.1	CXL
			Rice	10	6**
			Barley	10	6**
			Oats	10	6**

** MRLs not advanced pending further consideration of dietary intake estimates

<u>(b) Australian Use Patterns</u> – The registered labels state that the product is not to be used for malting barley and rice. The application rates for chlorpyrifos-methyl on cereal grains are:

5 g ai/t - up to three months storage period.

10 g ai/t - three to nine months storage period - an application rate of 10 g ai/t is recommended where specific resistant insect strains are present.

4 Entomology/Resistance

Combinations of two protectants are applied to grain: after the emergence of malathion resistance in the 1970s it became evident that no single protectant would be able to control all species at reasonable application rates. There have always been difficulties in controlling the lesser grain-borer, *Rhyzopertha* *dominica* with organophosphate insecticides. Currently, protectant combinations typically comprise an organophosphorus insecticide plus a synergised pyrethroid or the insect growth regulator methoprene.

Early laboratory studies in Australia enabled the determination of theoretical application rates for a range of potential protectants (Desmarchelier 1977; Bengston *et al.* 1977). Two significant factors considered when choosing field application rates were length of storage period and storage temperature. As lengthy storage periods are common in Australia field trials usually involve storage periods of about 9 months (e.g. Bengston *et al.* 1980; Desmarchelier *et al.* 1987). At time of application, unaerated grain is often 30°C or greater and high temperatures continue during storage (e.g. Bengston *et al.* 1980; Desmarchelier *et al.* 1987). These factors have contributed to the need for higher application rates than might be needed in cooler countries or where storage periods are shorter.

An additional problem was the widespread resistance to organophosphorus insecticides in major species, in particular, the rice weevil, *Sitophilus oryzae.* Extensive laboratory experiments and field trials indicated that application rates of 5 mg/kg and 10 mg/kg, were required to control known resistant insects for up to 3 and 6-9 months, respectively (Bengston et al. 1980). In full scale field trials, an application rate of 10 mg/kg chlorpyrifos-methyl decayed to about 3 mg/kg 40 weeks after application (Bengston *et al.* 1980).

Since about 1980, fenitrothion was the protectant most relied on by industry to control the majority of insect pests in stored grain. However, as early as the mid-1980s, resistance to this pesticide in the sawtoothed grain beetle (Oryzaephilus surinamensis), previously a minor species, had become a serious problem (Heather and Wilson 1983). Strains of *O. surinamensis* were emerging that could survive and successfully reproduce in grain freshly treated with 12 mg/kg fenitrothion (Collins and Wilson 1986).

Chlorpyrifos-methyl was the only protectant available that would control these resistant insects, albeit, at a relatively high concentration. For example, a detailed study of a highly fenitrothion-resistant strain of *Oryzaephilus surinamensis* (Collins and Wilson 1987) showed that a dose of 2.5 mg/kg chlorpyrifos-methyl was required for 99.9% control of adult insects in freshly treated grain and 1.6 mg/kg chlorpyrifos-methyl was needed for 99.9% suppression of progeny in laboratory trials. **To maintain chlorpyrifos-methyl at these levels, an application rate of 10 mg/kg chlorpyrifos-methyl is also required to control this pest for up to 9 months storage.**

The most recent report of the level and frequency of resistance to grain protectants are the reports by Dr P J Collins to the Australian National Working Party on Grain Protection 1999. Dr Collins reported that, not only is resistance to fenitrothion very common in *Oryzaephilus surinamensis,* economically important resistance to this material appears to be developing in the flour beetle, *Tribolium castaneum*. The need to retain an alternative to fenitrothion is most important, and chlorpyrifos-methyl at the higher treatment rate of 10 mg/kg is an appropriate alternative, given the need to store grain for 6-9 months.

5 Treatment rates used in the Central Storage System

(a) Background

Australia's grain trade is export orientated, with approximately 70-80% of total production being exported. Most of the cereal crop is stored in the Central Storage System, and is handled and stored by Bulk Handling Companies (BHCs). The Central Storage System is markedly different to post-harvest storage systems in most other countries. Each of the five mainland grain growing States has a single Bulk Handling Company, which owns and operates a storage infrastructure into which most of the Australian grain crop is delivered immediately after harvest.

These five companies therefore control the storage conditions of most of the grain throughout Australia. The grain is stored on behalf of commercial marketing organisations/owners, and is outturned to consumers/customers at the request of these owners as per their sales/marketing/logistical requirements.

Almost all of the grain destined for export is stored by BHCs, who additionally handle and store a large proportion of the grain that is outturned to the Domestic Market for usage within Australia.

Australia has a warm to hot climate that is extremely suitable to rapid insect proliferation. Grain is usually harvested in hot weather (30-40^{o}C), and is usually delivered into the Central Storage System in a warm condition, which greatly favours insect reproduction. Initially, grain temperature may be in the range 30-35^{o}C, and warm conditions will persist in grain bulks for many months.

Generally grain may remain in store for up to nine months, and its storage residence time is determined by shipping logistics, the success of marketing organisations, and the delivery requirements of customers.

It is Industry practice to treat grain with grain protectants only once. It is considered that this is a safer and less costly alternative than moving and re-treating large bulks of grain.

(b) History of Chlorpyrifos-methyl use in Australia

Since it was first introduced in 1984, chlorpyrifos-methyl has been used successfully to treat large quantities of Australian grain. Grain treated with this protectant is acceptable on the Australian domestic market within the Australian MRLs.

Grain treated with chlorpyrifos-methyl has been sent to many of Australia's overseas markets during the past 15 years. It has been approved for post-harvest applications to cereal grains in many countries, and most countries that import grains from Australia have consistently accepted grain shipments that meet the Codex MRLs. In its 15 years of use in Australia many millions of tonnes of grain has been treated and delivered to various domestic and export markets without any trade difficulties or problems.

(c) Amount of grain treated with chlorpyrifos-methyl

During the past three years the average cereal crop (wheat, barley, oats, sorghum, triticale) has been about 27 million tonnes annually.

The quantity of grain treated with chlorpyrifos-methyl in the central system for the past three years has been approximately 3.4 million tonnes each year, representing approximately 12.5% of the total crop. While the quantity of grain treated with chlorpyrifos-methyl at the farm level is difficult to estimate, information from chemical companies indicate that the on-farm/private sector use of chlorpyrifos-methyl is about 10% (or less) of that used in the central handling system. Grain treated on farm is often intended for use on farm, or for direct private sale domestically.

Wheat is the major commodity treated, followed by feed barley, sorghum, oats, and triticale. The Barley Industry has determined that chlorpyrifos-methyl should not be used on malting barley, as it has concerns about adverse effects on the malting process.

The use of chlorpyrifos-methyl is often rotated as a component of an integrated pest management plan aimed at controlling resistant insect strains in an efficient manner with the minimum amount of organophosphate insecticides. The alternative OP is fenitrothion, and the rotation cycle varies, but may be alternate years, or the use of chlorpyrifos-methyl two years out of every five.

(d) Treatment Rates

During the past three years approximately 1 million tonnes of grain are treated annually at 5 mg/kg for storage periods of less than three months. This lower treatment option is only utilised where aeration facilities are available, and it is possible to cool the grain bulk with ambient air.

Approximately 2.4 million tonnes of grain are treated at 10 mg/kg, and it is likely that this will become the preferred treatment option for all grain as levels of insect resistance increase.

(e) Period of protection

Chlorpyrifos-methyl levels in stored grain degrade at predictable rates, and the ½ life at a grain temperature of 30^{o}C and 50% RH is about 19 weeks. This period will be less if the grain temperature is higher – as recorded earlier grain temperatures are often in the range 30^{o}C – 40^{o}C.

In the absence of aeration, 5 mg/kg is not considered a viable option because of rapid infestation by organophosphate-resistant insect strains: 5 mg/kg is only suitable for up to three months with aeration.

It is reported by all BHCs that 10 mg/kg chlorpyrifos-methyl is effective for up to 9 months storage. The insect species causing treatment failures are normally resistant strains of *Oryzaephilus surinamensis*, and to a lesser extent *Tribolium castaneum.*

(f) Associated Pesticides

As recorded earlier, organophosphate grain protectants have not been successful in Australia in controlling the lesser grain-borer, *Rhyzopertha dominica* at reasonable application rates. They need to be used on conjunction with another insecticide: in general, the alternative insecticide is a synergised pyrethroid, such as bioresmethrin, or an insect growth regulator, such as methoprene.

6 Chlorpyrifos-methyl Residues in Grains

(a) Grains Industry Pesticide Residue Monitoring Programs

As previously stated, a large proportion of Australia's grain is destined for export and may remain in storage for a lengthy period depending on the shipping program. Almost all of this exported grain is stored in the Central Storage System.

Grain storage companies are contractually obligated by marketing authorities to outturn grain in an insect-free condition, and must undertake appropriate pest control measures: furthermore, the need to supply insect free grain is supported on the export market by Australian Government Legislation, which stipulates a "nil tolerance" for insects (as per specified Government sampling regimes at export grain terminals).

BHCs have a responsibility to store grain safely on behalf of marketing organisations – in this regard storage considerations in relation to grain protectants, and other control measures, are determined by the legislated requirements of the Domestic Market, and/or by the specific contractual and regulatory obligations required by overseas countries.

However, it should be noted that at the point of export all Australian grain must satisfy the requirements of the Australian legislation in relation to MRLs.

Pesticide residue levels are regularly checked by the Industry (in addition to Government monitoring programs) to ensure that they meet the requirements and MRLs of the importing country and Australia. Individual Bulk Handling Companies undertake quality assurance procedures, which include having grain samples analysed to ensure that pesticide residues are within appropriate levels during the storage period, and prior to outturn.

In addition, a similar quality assurance program is operated by marketing authorities to ensure that their commodity is within MRL, and meets the pesticide requirements of their customers. The amount of testing differs between the various organisations, and analyses are usually conducted by private organisations operating on their behalf. Pesticide residue certification is also required for individual shipments to some markets: this usually involves a sampling program, determination of the actual residue levels on the grain, and the provision of appropriate certification.

Samples collected by the marketing organisations are part of their Quality Assurance and/or contractual obligations, and are separate samples to those collected under the Government National Residue Survey Program, thus providing an additional check on MRL compliance. It is reiterated that this combination of Industry Quality Assurance activities, and Government Monitoring Programs has proven to be extremely efficient, and has resulted in buyers and importers of Australian grain being satisfied with the residue levels resulting from the current Industry use pattern.

(b) Australian Government Pesticide Residue Monitoring Programs

The Australian Government has an extremely comprehensive residue monitoring program which currently includes eight grain commodities and two milled products. The Australian National Residue Survey (NRS) is a program conducted by the Residues & Standards Branch of the National Office of Food Safety in Agriculture, Fisheries and Forestry – Australia (AFFA). The NRS monitors chemical residues in food and fibre produced in Australia.

Results are reported in terms of maximum residue limits (MRLs) and maximum permitted concentrations (MPCs) which define the concentrations of residues or metals which are legally permissible in food. MRLs and MPCs are those listed in the Food Standards Code published by the Australia New Zealand Food Authority (ANZFA).

NRS Grains Program

Commodities monitored in the NRS Grains Program are wheat (including the flour and bran), barley, oats, sorghum, field peas, chickpeas, lupins, and canola.

Export grain is sampled at terminals as ships are loaded. Each sample is collected, usually using automatic sampling equipment, as bulk grain is moved. Domestic grain samples are collected from bulk grain when it is received at storage facilities or moved. Samples of wheat, flour, and bran are also collected from flour mills throughout Australia.

Samples of wheat due to be milled are collected from flour mills on randomly selected dates. Milled flour and bran samples are obtained from wheat that has been sampled so that the results provide information on the relative concentration of residues in each fraction.

NRS tests for a wide range of chemicals. These include the registered grain protectants used against insect infestation in storage and also agricultural chemicals that may contaminate grain. NRS also monitors for environmental contaminants and persistent organochlorines, which are no longer used in agriculture.

Samples receive four broad-spectrum analytical tests: organophosphates, other agricultural chemicals (‘multi screen’), organochlorines, and heavy metals. The first two screens cover the possible grain protectants that may be legally used in Australia as well as possibly misused chemicals. The tests conducted are sufficiently sensitive to report levels well below MRL, usually one tenth MRL or less. The NRS Grains Program reports organophosphates to a level of 0.1 mg/kg.

NRS Residue Results – Chlorpyrifos-methyl

The consolidated information in Appendix 1 has been provided by the NRS, and records the results of 19073 samples collected and analysed for residues of chlorpyrifos-methyl between 1 January 1996 and 30 June 1999. This information in Appendix 1 is summarised in Table 2:-

Table 2: Summary of data in Appendix 1

Sample Description	Number of Samples	Percentage of Total	Percentage - Samples with residues
Total	19073		
No Chlorpyrifos-methyl detected	15177	79.57%	
Residues above LOR*	3896	20.43%	
Residues below 0.5 MRL	3849	20.18%	98.79%
Residues between 0.5 MRL and MRL	40	0.21%	1.0%
Residues above MRL	4	0.02%	0.1%
No MRL	3**		

* LOR (Level of Reporting) – 0.1 mg/kg
** Samples contained less than 0.5 mg/kg, but are technically unacceptable as there are no chlorpyrifos-methyl MRLs for canola and chick peas.

The table shows that 19073 grain samples were collected and subjected to multiple analyses during the period 1 January 1996-30 June 1999. Of these, 15177 (79.57%) did not contain residues of chlorpyrifos-methyl above the Level of Reporting (LOR) (Nil Residues column), and 3896 (20.43%) samples contained chlorpyrifos-methyl residues (Residues above LOR).

Residues were below 0.5 MRL in 98.79% of the samples containing chlorpyrifos-methyl. The table also shows that 40 samples (0.21% of total number of samples) contained residues in the range 0.5 MRL up to MRL: it is important that the MRL remain at 10 mg/kg to accommodate residue results falling within this range.

These NRS results demonstrate a very high degree of compliance with Good Agricultural

Practice within the Australian Grains Industry. They show that, as a result of good management practices, the Grains Industry is able to apply chlorpyrifos-methyl at 10 mg/kg for entomological reasons, and achieve lengthy storage periods under warm grain conditions with one initial treatment.

7 <u>Risk Assessment</u>

<u>(a) NEDI Appendix 2</u>

The Australian use pattern does not pose any national dietary intake concerns, as the National Estimated Daily Intake (NEDI) is approximately equivalent to 63% of the ADI. The calculation has been performed in accordance with the guidelines described in the Geneva Consultation 1997 and current methodology used by the JMPR.

The Australian ADI for chlorpyrifos-methyl is 0.01 mg/kg bodyweight/day, the same as that set by JMPR in 1992. Australian milling data for wheat were used in the refinement of the NEDI and these data were submitted to the JMPR for consideration in 1991. As the registered labels in Australia specifically state that the products should not be used for malting barley and rice, intakes for beer have not been included under cereal grains. Similarly, there is a separate MRL of 0.1 mg/kg for rice, which is included in the calculation without further refinement. Explanation of the STMR and STMR-P figures is given in Appendix 2. Mean intake figures for respondents aged 2 years and above from the 1995 ANZFA National Nutrition Survey of Australia have been used in the NEDI calculation; an average bodyweight of 67 kg is used for comparison to the ADI.

It should be noted that the calculations provided with this document are extremely conservative for Australian consumption, as they have been calculated on the hypothesis that the total crop production is treated with chlorpyrifos-methyl: it is estimated that approximately 12.5% of the total Australian production is treated, and utilisation of this lower percentage would result in even lower actual dietary exposure.

Monitoring data recorded in Table 1 of this document show that 98.79% of "samples with residues" had residues present at less than 0.5 MRL – these monitoring data were not used in the calculation of the NEDI, and inclusion would result in even lower actual dietary exposure.

Australian Market Basket Surveys (total diet studies) confirm that measured intakes of chlorpyrifos-methyl for sub-populations in Australia are in the range of 1.6 to 9.7% of the ADI for diets of a mean energy intake.

(b) Australian Market Basket Survey

Chlorpyrifos-methyl was included in the suite of organophosphorus insecticides monitored in the 1996 Australian Market Basket Survey (Hardy, 1998) and in the 1994 Australian Market Basket Survey (Marro, 1996).

Total diets based on the foods analysed in each survey were developed using food consumption data from the 1983 National Dietary Survey (adult males and females aged 25-24 years) and the 1985 National Dietary Survey (boys and girls aged 12 years). The toddler and infant diets (toddlers aged 2 years, infants 9 months) were developed using data from a longitudinal study from birth to 5 years. The sum of contributions of residues from each food gave the total dietary intake of pesticide residues for each age/sex group.

Seventy-six foods were tested for pesticide residue content during the 1996 calendar year, and 77 foods were tested in 1994. Estimated dietary intakes for chlorpyrifos-methyl were in the range 1.6 to 9.7% of the ADI for diets of a mean energy intake and 2.3 to 11.4% of the ADI for diets of a 95th percentile energy intake (Table 3).

Table 3. Estimated daily dietary intake for chlorpyrifos-methyl residues in food expressed as ng/kg bodyweight (% of ADI in brackets). Chlorpyrifos-methyl ADI is 10 000 ng/kg bw (0.01 mg/kg bw), Hardy 1998 and Marro 1996.

	Adult males bodyweight 75.0 kg	**Adult females bodyweight 59.1 kg**	**Boys aged 12 bodyweight 39.8 kg**	**Girls aged 12 bodyweight 41.5 kg**	**Toddlers aged 2 bodyweight 12.3 kg**	**Infants 9 months bodyweight 9.1 kg**
Market Basket Survey 1996 (Hardy 1998)						
Diet, mean energy intake	182.8 **(1.8%)**	170.7 **(1.7%)**	200.4 **(2.0%)**	159.5 **(1.6%)**	504.3 **(5.0%)**	967.2 **(9.7%)**
Diet, 95th percentile energy intake	295.7 **(3.0%)**	283.7 **(2.8%)**	316.0 **(3.2%)**	231.2 **(2.3%)**	585.0 **(5.9%)**	1141.3 **(11.4%)**
Market Basket Survey 1994 (Marro 1996)						
Diet, mean energy intake	242.7 **(2.4%)**	210.7 **(2.1%)**	288.2 **(2.9%)**	243.7 **(2.4%)**	691.4 **(6.9%)**	309.9 **(3.1%)**
Diet, 95th percentile	392.6	350.0	454.4	353.3	808.9	368.6

	Adult males bodyweight 75.0 kg	Adult females bodyweight 59.1 kg	Boys aged 12 bodyweight 39.8 kg	Girls aged 12 bodyweight 41.5 kg	Toddlers aged 2 bodyweight 12.3 kg	Infants 9 months bodyweight 9.1 kg
energy intake	**(3.9%)**	**(3.5%)**	**(4.5%)**	**(3.5%)**	**(8.1%)**	**(3.7%)**

NOTE: In **Table 3** above 95th percentile energy diets were derived by multiplying the mean amounts of food consumed by the ratio of 95th energy intake to the mean energy intake for the population surveyed

(c) International Dietary Intake Estimate (DIE) Appendix 3

The International Dietary Intake Estimate (DIE) for the five regional diets (consumption figures published by the WHO in GEMS/FOOD Regional Diets 1998) shows that with the current Codex listing for chlorpyrifos-methyl, the dietary estimates are well below the ADI in all diets. Data for processed wheat and sorghum commodities have been based on Australian information previously reported to the JMPR in 1991 and published in *Grain Protectants*, J.T. Snelson (1987). The level of 8.5 mg/kg on wheat is the initial residue resulting from a target application rate of 10 mg/kg. Data for barley and rice have been cited from a paper presented to the 1999 CCPR by Dow AgroSciences (Codex Briefing Document). The data used reflect critical GAP for each cereal grain, *i.e.* the critical uses patterns for wheat and sorghum are Australian and the critical use patterns for barley and rice are from the US. Hence the data included in the DIE may differ from the data used by Dow AgroSciences. For cereals where no specific data were available, *i.e* barley and oats, the MRL has been used..

The dietary exposure estimate ranges from 36% of the ADI for the African diet to 90% of the ADI for the European diet. On the basis of the estimation with incorporation of valid refinements, the existing uses of chlorpyrifos-methyl (either CXLs or steps) do not pose dietary exposure concerns in any of the five regional diets. It is possible that if STMRs for all commodities currently listed by Codex were included in the calculation, further reduction of the intake estimate may occur. Notes to Appendix 3 provide further explanation regarding the figures used in the calculations.

8 CONCLUSION

Australian GAP has been developed on a sound scientific basis to provide effective protection under the required storage conditions using the lowest possible treatment rates. It is Industry practice to treat grain with grain protectants only once as this is considered a safer and less costly alternative to moving and re-treating large bulks of grain.

The current Australian MRL of 10 mg/kg is based on efficacy data for long term storage at a treatment rate of 10 g ai/t. This treatment rate is sufficient to provide effective protection under Australian conditions for approximately 9 months against a range of insect pest species that have a high level of resistance to various organophosphate insecticides, including chlorpyrifos-methyl.

A lower application rate combined with a lower MRL would reduce the storage period possible under Australian conditions. Lower application rates would preclude the use of chlorpyrifos-methyl for long term storage, which would be a significant disadvantage to the Grains Industry.

It is reiterated that the NEDI calculations provided with this document are extremely conservative for Australian consumption, as they have been calculated on the hypothesis that the total crop production is treated with chlorpyrifos-methyl. It is estimated that approximately 12.5% of the total Australian production is treated, and utilisation of this lower percentage would result in even lower actual dietary exposure.

Monitoring data recorded in Table 1 of this document show that 98.79% of "samples with residues" had residues present at less than 0.5 MRL – these monitoring data were not used in the calculation of the NEDI, and inclusion would result in even lower actual dietary exposure.

The International Dietary Intake Estimate shows that the calculated intakes for the five regional diets are below the current ADI for chlorpyrifos-methyl.

It is considered that the above information demonstrates that Australian Good Agricultural Practice is strictly followed and monitored, and is required for the lengthy storage of hot grain under warm to hot climatic conditions.

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Appendix 1

Australian National Residue Survey

Chlorpyrifos-methyl (1 January 1996 to 30 June 1999)

Commodity	Samples tested	MRL (mg/kg)	LOR	Nil Residues		Residues above LOR		LOR - 0.2 x MRL		>0.2 - 0.5 x MRL		>0.5 - 1.0 x MRL		>1.0 x MRL	
Barley	2701	10.0	0.1	2586	95.7%	115	4.3%	115	4.3%						
Canola	524	none	0.1	523	99.8%	1	0.2%							[1]	0.2%
Lupins	660	10.0	0.1	660	100.0%										
Oats	258	10.0	0.1	245	95.0%	13	5.0%	12	4.7%	1	0.4%				
Chickpeas	151	none	0.1	149	98.7%	2	1.3%							[2]	1.3%
Field Peas	305	none	0.1	305	100.0%										
Sorghum	1404	10.0	0.1	1166	83.0%	238	17.0%	197	14.0%	21	1.5%	17	1.2%	3	0.2%
Wheat	12164	10.0	0.1	9078	74.6%	3086	25.4%	2610	21.5%	464	3.8%	12	0.1%		
Flour	455	10.0	0.1	268	58.9%	187	41.1%	186	40.9%			1	0.2%		
Bran	451	20.0	0.1	197	43.7%	254	56.3%	165	36.6%	78	17.3%	10	2.2%	1	0.2%

LOR = Level of reporting (mg/kg)

[ ] indicates the presence of a chemical for which no MRL has been established

Appendix 1 records that 19073 grain samples were collected and subjected to multiple analyses during the period 1 January 1996-30 June 1999. Of these, 15177 (79.57%) did not contain residues of chlorpyrifos-methyl above LOR (Nil Residues column), and 3896 (20.43%) samples contained chlorpyrifos-methyl residues (Residues above LOR).

Appendix 2

Australian National Estimated Daily Intake (NEDI)

Chlorpyrifos-methyl

(ADI for chlorpyrifos-methyl = 0.01mg/kg of body weight)

Commodity	Food Consumption g/kg bw/day	Food Consumption kg food/kg bw/day	MRL/STMR/ STMR-P mg/kg	NEDI mg/kg bw intake
Cereal grains (except rice and wheat)	0.3467	0.0003	10	0.0035 !
Edible offal (mammalian)	0.0151	0.0000	0.05*	0.0000 !
Eggs	0.2228	0.0002	0.05*	0.0000 !
Lupin (dry)	0.0001	0.0000	10	0.0000#
Meat (mammalian)[in the fat]	0.1756	0.0002	0.05*	0.0000 !
Milks [in the fat]	0.3597	0.0004	0.05*	0.0000 !
Poultry, edible offal of	0.0024	0.0000	0.05*	0.0000 !
Poultry meat [in the fat]	0.0560	0.0001	0.05*	0.0000 !
Rice	0.2478	0.0002	0.1	0.0000 !
Wheat flour	1.5482	0.0015	1.6575	0.0026^
Wheat bran, unprocessed	0.0075	0.0000	16.15	0.0001^
Wheat germ	0.0039	0.0000	17.85	0.0001^
Cotton seed	0.0001	0.0000	0.01*	0.0000 #
Cotton seed oil	0.0001	0.0000	0.01*	0.0000 #
Total		**** 0.0063 mg/kg bodyweight**		

**** Equivalent to 63% of the Australian ADI**

These calculations have been made in accordance with 'Guidelines for Predicting Dietary Intake of Pesticide Residues (World Health Organization, 1997)

Mean consumption figures derived from the ANZFA 1995 National Nutrition Survey of Australia; mean bodyweight of 67 kg used for all respondents 2 years and above.

* At or about the limit of determination

! MRL or Maximum Residue Limit used.

^ STMR-P used with a STMR of 4.25 mg/kg for wheat. PF = 0.39 for flour; PF = 3.8 for bran; PF = 4.2 for germ. The median level of 4.25 mg/kg for wheat resulted from an application target of 10 mg/kg, and a highest residue of 5.7 mg/kg after a storage interval of approximately 5-6 weeks.

STMR-Ps: Derived from milling data provided to JMPR 1991, using an STMR of 4.25 mg/kg for wheat.

Default minimum intake used where non consumed reported in dietary survey.

Appendix 3

International Dietary Intake Estimate (DIE) ADI is expressed as 0.01 mg/kg bodyweight/day or 0.6 mg/day assuming an average bodyweight of 60 kg.

Chlorpyrifos-methyl

Commodity							DIET, g/day					DIE, micrograms/day				
Code	Name	MRL mg/kg	STMR (or MRL) mg/kg	Proc factor	Notes	Adj STMR mg/kg	ME	FE	Afr	Lat Am	Eur	ME	FE	Afr	Lat Am	Eur
FP 0226	Apple	0.5	0.5	1		0.5	7.5	4.7	0.3	5.5	40	3.8	2.4	0.2	2.8	20.0
VS 0620	Artichoke, globe	0.1	0.1	1		0.1	2.3	0	0	0	5.5	0.2	0.0	0.0	0.0	0.6
GC 0640	Barley	10	10	1		10	1	3.5	1.8	6.5	19.8	10.0	35.0	18.0	65.0	198.0
VB 0041	Cabbages, head	0.1	0.1	1		0.1	5	9.7	0	10.5	26.8	0.5	1.0	0.0	1.1	2.7
MF 0812	Cattle fat	0.05	0.05	1		0.05	0.3	0.3	0.3	1.5	0	0.0	0.0	0.0	0.1	0.0
MM 0812	Cattle meat	0.05	0.05	1		0.05	18.5	3.5	10.4	30	63.3	0.9	0.2	0.5	1.5	3.2
MO 0812	Cattle, edible offal of	0.05	0.05	1		0.05	2.5	0.3	1.8	5	6	0.1	0.0	0.1	0.3	0.3
PF 0840	Chicken fat	0.05	0.05	1		0.05	0	0	0	0.1	0.3	0.0	0.0	0.0	0.0	0.0
PM 0840	Chicken meat	0.05	0.05	1		0.05	30.5	11.5	5.5	25.3	44	1.5	0.6	0.3	1.3	2.2
PO 0840	Chicken, edible offal of	0.05	0.05	1		0.05	0	0	0	0.3	0.3	0.0	0.0	0.0	0.0	0.0
VL 0467	Chinese cabbage	0.1	0.1	1		0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
VP 0526	Common bean	0.1	0.1	1		0.1	3.5	0.8	0	4	12	0.4	0.1	0.0	0.4	1.2
FT 0295	Date	0.05	0.05	1		0.05	41.8	0.3	0	0	0.3	2.1	0.0	0.0	0.0	0.0
VO 0440	Eggplant	0.1	0.1	1		0.1	6.3	3	0.7	6	2.3	0.6	0.3	0.1	0.6	0.2

PE 0112	Eggs	0.05	0.05	1		0.05	14.5	13	3.6	11.8	37.5	0.7	0.7	0.2	0.6	1.9
FB 0269	Grapes	0.2	0.2	1		0.2	15.8	1	0	1.3	13.8	3.2	0.2	0.0	0.3	2.8
VL 0482	Lettuce, head	0.1	0.1	1		0.1	2.3	0	0	5.8	22.5	0.2	0.0	0.0	0.6	2.3
ML 0106	Milks	0.01	0.01	1		0.01	116.8	32	41.8	160	294	1.2	0.3	0.4	1.6	2.9
VO 0450	Mushrooms	0.01	0.01	1		0.01	0.3	0.5	0	0	4	0.0	0.0	0.0	0.0	0.0
GC 0647	Oats	10	10	1		10	0	0	0.2	0.8	2	0.0	0.0	2.0	8.0	20.0
FC 0004	Oranges, sweet, sour	0.5	0.5	1		0.5	31.5	4	4.8	31	29.8	15.8	2.0	2.4	15.5	14.9
FS 0247	Peach	0.5	0.5	1		0.5	1.2	0.2	0	0.4	6.2	0.6	0.1	0.0	0.2	3.1
VO 0051	Peppers	0.5	0.5	1		0.5	3.3	2	5.3	2.3	10.3	1.7	1.0	2.7	1.2	5.2
VR 0494	Radish	0.1	0.1	1		0.1	0.5	0	0	0.3	2	0.1	0.0	0.0	0.0	0.2
GC 0649	Rice	10					48.8	279.3	103.4	86.5	11.8	0.0	0.0	0.0	0.0	0.0
	polished		6	0.07		0.42	48.8	277.5	68.8	65.5	9.3	20.5	116.6	28.9	27.5	3.9
	husked		6	0.28		1.68	0	1.8	34.7	21	2.5	0.0	3.0	58.3	35.3	4.2
GC 0651	Sorghum (flour)	10	10	0.2683		2.683	2	9.7	26.6	0	0	5.4	26.0	71.4	0.0	0.0
DT 1114	Tea	0.1	0.1	1		0.1	2.3	1.2	0.5	0.5	2.3	0.2	0.1	0.1	0.1	0.2
VO 0448	Tomato	0.5	0.5	1		0.5	81.5	7	16.5	25.5	66	40.8	3.5	8.3	12.8	33.0
GC 0654	Wheat	10	8.5	1		8.5	3.5	0.0	0.0	4.8	0.0	29.8	0.0	0.0	40.8	0.0
CM 0654	Wheat, bran	20	20	1		20	0.8	1.3	0	0	4.3	16.0	26.0	0.0	0.0	86.0
CF 1211	Wheat flour	2	8.5	0.39		0	323	114	28.3	112	175.8	0.0	0.0	0.0	0.0	0.0

CF 1210	Wheat germ		8.5	4.2		35.7	0.1	0.1	0	0.1	0.1	3.6	3.6	0.0	3.6	3.6
CP 1212	Wholemeal bread	2	8.5	0.17		1.445	107.7	38	9.4	74.7	58.6	155.6	54.9	13.6	107.9	84.7
CP 1211	White bread	0.5	8.5	0.04		0.34	215.3	76	18.9	37.3	117.2	73.2	25.8	6.4	12.7	39.8

TOTAL =	**388**	**303**	**214**	**341**	**537**
% ADI =	**65**	**51**	**36**	**57**	**90**

STMR: Supervised Trial Median Residues. Maximum application rate is used for rice, barley and oats on the basis of Dow AgroSciences paper presented to 1999 CCPR.

Wheat: The level of 8.5 mg/kg on wheat is the initial residue resulting from a target application rate of 10 mg/kg.

Processing factor: Processing factors used for rice, sorghum and wheat. Rice processing data obtained from Dow AgroSciences paper presented to 1999 CCPR.

: Processing data for wheat obtained from Australian data submitted to 1991 JMPR; data for sorghum flour and bread (white and wholemeal) obtained from Snelson (1987).

Wheat bran: Intake figure for cereal preparations used.

Wheat flour: Expressed in GEMS/FOOD Regional Diets as sum of white bread and wholemeal bread, therefore 0 is used in the adjustment column for wheat flour, as the intake is calculated from the sum of white and wholemeal bread.