SECTION 4: RESIDUE AND TRADE ASSESSMENT

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Residue Assessment

4.1 Introduction

The Pesticides and Agricultural Chemicals Committee (PACC) first considered aldicarb residues in potatoes in 1977. MRLs for sugar cane, citrus, cereal grains, strawberries, cotton seed and grapes were recommended between 1978 and 1989. A summary of the PACC proceedings is provided in Appendix 1. Although the PACC recommended various MRLs aldicarb was not cleared/registered for use on all of the commodities.

Additional uses of aldicarb (oranges, non-bearing citrus and grapevines) were cleared by the Australian Agricultural and Veterinary Chemicals Council (AAVCC) in 1992.[ϕ] The product label for Temik 150G Aldicarb Insecticide/Nematicide approved by the AAVCC in 1992 included uses on plant and ratoon cane, cotton, bearing grape vines, non-bearing citrus, oranges and wheat. A subsequent product label approved by the NRA in 1994 only included uses on cane, cotton, oranges and non-bearing citrus. The currently approved label also omits any use on grapevines or wheat. It appears then that uses on grapevines and wheat have not appeared on the approved product label since at least 1994. It is unclear if aldicarb was ever actively marketed for use on wheat or grapevines.

A separate aldicarb product was previously registered for use on ornamental plants and non-bearing citrus in commercial greenhouses, fields and nursery plantings. This product is no longer registered.

Current Relevant MRLs

Australian MRLs[Ψ] for aldicarb are listed below:

Table 1

Commodity	**MRL (mg/kg)**
Cereal grains	*0.02
Citrus fruits	0.05
Cotton seed	*0.05
Grapes	0.05
Potato	0.2
Strawberry	0.2
Sugar cane	0.02

The Australian residue definition is:

Aldicarb Sum of aldicarb, its sulfoxide and its sulfone, expressed as aldicarb

Aldicarb has an ADI of 0.001 mg/kg body weight/day (reconfirmed as part of the current review). The ADI set by the Joint Meeting of the FAO Panel of Experts on Pesticide Residues

[ϕ] Certificate of Clearance of an Agricultural Chemical Product, Variation of Conditions, Clearance No. A910023, 27 February 1992.
[Ψ] MRL Standard, as at February 2000.

in Food and the Environment and the WHO Expert Group on Pesticide Residues (JMPR) is 0.003 mg/kg body weight/day (1992).

4.2 Current Uses

In addition to the registered uses on the product labels there are currently two permits issued for the use of aldicarb.

A permit has been issued for the use of aldicarb in Tasmania for control of bulb mite in glasshouse grown freesias. Under the permit aldicarb granules are either dissolved and applied as a soil drench through overhead sprinkler systems or manually applied to the soil surface and watered in to the soil with overhead sprinklers.

As part of the Agricultural Assessment the NRA received advice that aldicarb is used off-label in vineyards in Victoria. State control-of-use legislation in Victoria allows chemicals to be used off-label provided certain conditions are met.

Maximum Treatment Regime

Maximum crop treatments, as indicated on the currently registered aldicarb product labels are shown in the table below:

Crop	Pest	Application			Application timing	WHP
		Rate	No.	Interval		
Plant and ratoon cane	Root-knot nematode, root lesion nematodes, burrowing nematodes, spiral nematodes	2.55 kg ai/ha or 3.6 g ai/10 m row	1	-	Apply no later than 3 to 5 leaf stage. Do not make more than one application per crop.	17 weeks
Cotton	Aphids, jassids, mites, thrips, wireworm, false wireworm	0.45 to 1.05 kg ai/ha	1	-	Apply into the seed furrow at seeding.	NIL
	Green mirids	0.75 kg ai/ha	1	-	Apply as above	
Non-bearing citrus	Citrus leaf miner	Area 1.05 g ai/m^2 Band 4.5 g ai/tree	-	Repeat applications may be necessary if new leaf mines are found.	Apply prior to, or as pests appear. Do not treat within 3 months of transplanting.	NIL
Oranges (non-trifoliata rootstocks	Citrus nematode, soft brown scale,	2.1 to 11.55 kg ai/ha	1	-	Apply once only each year from August to November after the	26 weeks

Crop	Pest	Application			Application timing	WHP
		Rate	No.	Interval		
only) and mandarins	mealybug				crop has been harvested and any out of season (second crop) fruit have been removed. Do not treat within 3 months of transplanting.	

The following grazing restrictions apply to all crops:

Do not allow stock to graze in treated area
Do not cut treated crop for stock food

The following general instructions also apply:

DO NOT sow any edible crops for 6 months after the last application
DO NOT sow or plant any edible crop between rows of crop treated with aldicarb for 6 months after the last application
DO NOT harvest any vegetation from treated areas for human or animal consumption for 6 months after last application
DO NOT apply aldicarb within 15 m of drinking water wells
DO NOT clean or load application equipment within 15 m of drinking water wells

4.3 Residue Monitoring Data

Aldicarb was not included as an analyte in the 1992, 1994 or 1996 Australian Market Basket Survey (now referred to as Australian Total Diet Surveys).

Between June 1997 and July 1998 the National Residue Survey tested 301 citrus fruit samples (15 lemon, 46 mandarin, 240 oranges) for aldicarb. No residues above the limit of reporting (0.05 mg/kg) were found.

In the 1997 Victorian Produce Monitoring survey[δ] 19 citrus samples were analysed for aldicarb residues. Aldicarb residues were less than the limit of detection (<0.02 mg/kg) in 15 samples. One sample contained aldicarb ≥0.02 mg/kg and <0.025 mg/kg. Three samples contained aldicarb residues ≥0.025 mg/kg but <0.05 mg/kg. Aldicarb was not included as an analyte in the 1998 Victorian Produce Monitoring survey.

Information received from the Bureau of Sugar Experiment Stations[φ] indicates that aldicarb residues have not been detected during analysis of composite raw sugar samples from Queensland. It was stated that the detection limits were set below or equal to the MRL of 0.02 mg/kg. Results are summarised below.

Year	No. of samples	No. samples with	Detection limit, mg/kg

[δ] Victorian Produce Monitoring. Results of Residue Testing 1997, Department of Natural Resources and Environment, Victoria.

[φ] Submission received from Bureau of Sugar Experiment Stations (March 1998) in response to the NRA Review of Aldicarb.

	tested	detectable aldicarb residues	
1990	12	0	0.02
1992	12	0	0.008
1994	14	0	0.008
1996	15	0	0.02

4.4 Summary of Available Data

Data were provided by Rhone-Poulenc Rural Australia (now known as Aventis CropScience following a merger of Rhone-Poulenc and AgrEvo) to support the review of aldicarb. Data submitted for the registration (minor extension of use) of aldicarb on mandarins have also been reviewed. Aldicarb was reviewed by the JMPR in 1994 as part of the Periodic Review program. Data reviewed by JMPR, which have not been submitted to NRA evaluators, have also been included where relevant.

Only one original metabolism study (Andrawes, 1986) was made available to NRA evaluators. This was accompanied by a review article (Andrawes, 1981) summarising the metabolism of aldicarb in plants and animals. The metabolism of aldicarb has been extensively characterised over the past 30 years and was thoroughly evaluated by JMPR (1994) within the CCPR Periodic Review Program. The JMPR review (1994) served as the main source of metabolism data for the NRA review.

Residue data were submitted for a range of crops including some that do not appear on the currently approved product labels. Residue data for potatoes, carrots, onions, bananas, strawberries and tomatoes have not been evaluated (see Appendix 5 for list of studies) as there is no recent history of registered use-patterns in Australia. Residue data for cereals and grapes have been evaluated although there are no use-patterns on the currently approved product labels. NRA records indicate that aldicarb has previously been cleared/registered for use on grapevines and wheat.

4.5 Metabolism Studies

4.5.1 Plant Metabolism

No original plant metabolism studies were made available to NRA evaluators. A summary of various studies (Andrawes, 1981) was provided and this was reviewed in conjunction with summaries presented in JMPR (1994). The structures of the metabolites are shown in 4.4.3.

The metabolism of [S-methyl-^{14}C]aldicarb was investigated in field grown potatoes. The test substance was applied in-furrow at planting at a rate of 3.4 kg ai/ha. The residues recovered from potato foliage and tubers are summarised in Table 4.

Radioactive residues in potato foliage and tubers following in-furrow application of [S-methyl-^{14}C]aldicarb at planting [from JMPR, 1994].

Component	^{14}C-aldicarb equivalents, mg/kg, at days after treatment [a]	
	60	90

Foliage		
Water soluble	1.81 (27.2% of TRR)	1.30 (29.8% of TRR)
Aldicarb sulfoxide	1.53 (22.9%)	0.29 (6.6%)
Aldicarb sulfone	2.92 (43.9%)	2.45 (55.9%)
Oxime sulfoxide	0.06 (0.9%)	0.05 (1.1%)
Oxime sulfone	0.10 (1.6%)	0.18 (4.0%)
Origin of TLC(polar)	0.24 (3.6%)	0.11 (2.6%)
Tubers		
Water soluble	0.42 (30.7%)	0.52 (65.7%)
Aldicarb sulfoxide	0.46 (33.4%)	0.03 (4.6%)
Aldicarb sulfone	0.42 (30.0%)	0.08 (10.1%)
Oxime sulfoxide	0.02 (1.6%)	0.09 (11.3%)
Oxime sulfone	0.06 (4.0%)	0.06 (8.0%)
Origin of TLC (polar)	0.01 (0.3%)	0.01 (0,3%)

Numbers in parentheses are the % of the total radioactive residues

The identity of radioactivity in the water soluble fraction was further investigated by treatment of immature tuber buds with radiolabelled aldicarb. The major components were found to be alcohol sulfone (5.6% of the TRR) and alcohol sulfoxide (5.2% of the TRR). Aldicarb was not detected in the organosoluble or water soluble fractions.

In sugar beet plants treated with a broadcast application of [S-methyl-^{14}C]aldicarb the major identified radioactive residues in roots and foliage were aldicarb sulfoxide and aldicarb sulfone (9.8-30.8% of total radioactive residues at 90-140 days after treatment). Parent compound was not detected. Up to 74% of the recovered radioactivity was classified as water soluble and not identified further.

In cotton plants treated with [S-methyl-^{14}C]aldicarb at planting (with or without a subsequent side dressing) the major identified radioactive residues were aldicarb sulfoxide and aldicarb sulfone. Parent compound was present in foliage up until 37 days after treatment but was not quantifiable between days 58 and 146. Unidentified water soluble metabolites were a major contributor to the total radioactive residues. The nature of the water soluble metabolites was investigated in a separate study under glasshouse conditions. The major constituent in the water soluble fraction was identified as alcohol sulfoxide, present as the glycoside conjugate.

Radioactive residues in cotton foliage following application of [S-methyl-^{14}C]aldicarb [from JMPR, 1994].

Component	Residue, mg/kg, at days after treatment									
	9	14	22	37	58	65	72	86	100 [a]	146
1.12 kg ai/ha in furrow at planting										
Aldicarb	2.2	1.1	1.0	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aldicarb sulfoxide	147.6	146.8	45.3	13.0	2.5	2.1	0.7	0.2	0.7	0.4
Aldicarb sulfone	14.8	37.7	39.2	12.9	7.3	7.5	2.5	1.1	2.0	0.6
Oxime sulfoxide	0.4	1.1	1.1	1.1	1.2	1.3	0.7	0.2	0.6	0.5
Oxime sulfone	ND [b]	1.0	1.4	0.7	0.3	0.4	0.2	<0.1	<0.1	<0.1
Nitrile sulfoxide	ND	4.8	4.7	2.0	0.1	0.2	0.1	<0.1	<0.1	<0.1
Nitrile sulfone	ND	ND	ND	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Alcohol sulfone	ND	2.7	1.1	0.4	ND	ND	ND	ND	ND	ND
Origin of TLC	2.2	3.1	0.9	1.0	0.3	<0.1	<0.1	<0.1	<0.1	0.2
Water solubles	41.8	43.6	32.1	22.0	8.3	8.7	5.0	0.9	3.8	7.2
Total	209.0	241.9	126.8	53.5	20.0	20.2	9.2	2.4	7.1	8.9
1.12 kg ai/ha in furrow at planting plus 2.24 kg ai/ha side-dress 58 days later										

Aldicarb						0.1	0.2	<0.1	<0.1	<0.1
Aldicarb sulfoxide						12.5	17.9	25.5	8.9	10.8
Aldicarb sulfone						7.2	5.7	16.2	11.7	13.1
Oxime sulfoxide						0.5	0.6	1.1	1.2	2.5
Oxime sulfone						0.1	0.2	0.7	0.5	0.5
Nitrile sulfoxide						<0.1	0.6	2.9	ND	1.1
Nitrile sulfone						<0.1	<0.1	0.7	0.5	1.4
Alcohol sulfone						0.6	0.7	0.5	0.3	0.1
Origin of TLC						0.2	0.3	0.2	0.4	1.5
Water solubles						12.1	12.9	22.5	19.3	80.8
Total						33.3	39.1	70.3	42.8	111.8

Desiccation of foliage began at approximately 90 days.
None detected

In field-grown peanut plants the major radioactive residues 98 days after application of [S-methyl-^{14}C]aldicarb were aldicarb sulfoxide and sulfone. Parent compound was not detected in foliage, roots, kernels, shells or pegs. Results are summarised in Table 5.

Radioactive residues in field grown peanut plants 98 days after application of 6.72 kg ai/ha [S-methyl-^{14}C]aldicarb [from JMPR, 1994].

Component	% of recovered radioactivity				
	Foliage	Roots	Kernels	Shells	Pegs
Aldicarb	ND	ND	ND	ND	ND
Aldicarb sulfoxide	5.3	4.0	1.7	3.2	2.6
Aldicarb sulfone	15.1	2.6	3.3	7.1	5.6
Oxime sulfoxide	0.3	0.4	0.1	0.3	0.4
Oxime sulfone	2.8	1.0	0.3	1.5	1.4
Nitrile sulfoxide	0.9	0.7	0.8	1.2	1.8
Nitrile sulfone	0.9	0.7	2.0	2.6	1.9
Alcohol sulfone	6.7	1.2	1.1	2.5	3.1
Origin of TLC	3.1	7.5	0.5	1.2	0.6
Water solubles	64.9	81.9	90.2	80.4	82.5
^{14}C aldicarb equivalents, mg/kg	3.6	1.0	0.6	0.5	0.8

4.5.2 Animal Metabolism Studies

One original animal metabolism study was made available to NRA evaluators and this study is reviewed below. Other animal metabolism information was obtained from JMPR (1994) and summaries by Andrawes (1981). The structures of metabolites are shown in 4.4.3.

Lactating goat

Reference: Andrawes, N.R. & Lee, R.E. (1986) TEMIK brand aldicarb pesticide. Aldicarb metabolism in lactating goats, Project No. 803R10, File No. 34558, 8 April 1986, Union Carbide Agricultural Products Company, North Carolina, USA.

Two lactating goats were administered [S-methyl-^{14}C]aldicarb daily for 10 days at a dose rate equivalent to 2.5 ppm in the diet (0.165 mg/kg body weight). The test substance was administered in gelatin capsules twice daily (half the daily dose in the morning and half in the evening). A third goat was administered placebo capsules and acted as the control throughout

the study. Samples of urine and feces were collected daily. Goats were milked twice daily (a.m. and p.m.) and aliquots from each milking were frozen separately for subsequent analysis. Blood samples were taken at 1, 2, 4, 6, 8 and 10 days. The goats were sacrificed 6-8 hours after the last dose and representative samples of various tissues were collected. Radioactive residues in tissues and milk were determined by liquid scintillation counting after extraction. Radioactivity in residual solids was determined by combustion and liquid scintillation counting. Metabolites were characterised and quantitated by 2-dimensional TLC with comparison against reference materials.

An average of 61.2%, 11.3% and 1.1% of the administered radioactivity was excreted in the urine, feces and milk respectively. Less than 0.1% of the administered radioactivity was present in the tissues at sacrifice.

Residues of aldicarb and metabolites in 5- and 10-day milk from goats.

Component	^{14}C aldicarb equivalents, µg/kg, at time after initial dose			
	5 days a.m.	5 days p.m.	10 days a.m.	10 days p.m.
Aldicarb sulfoxide	0.02	0.16	ND	ND
Oxime sulfoxide	0.14	1.75	0.15	0.24
Nitrile sulfoxide	0.18	0.75	0.28	0.40
Alcohol sulfoxide	0.05	0.20	0.04	0.15
Aldicarb sulfone	0.02	0.10	ND	0.01
Nitrile sulfone	34.7	37.0	50.1	53.6
Amide sulfone	1.19	1.09	1.24	1.60
Alcohol sulfone	0.04	0.08	0.04	0.04
Sulfone aldehyde	0.37	0.47	0.29	0.22
Unknown 1	0.02	0.15	0.02	0.03
Unknown 2	0.12	0.20	0.05	0.19
Origin of TLC	0.19	0.34	0.19	0.26
Water soluble	7.95	13.3	10.6	10.1
Unextracted from milk solids	13.0	12.5	12.0	12.2
Total	58.0	68.1	75.0	79.0

The highest residue found in an individual milk sample was 0.12 mg/kg aldicarb equivalents (goat A, day 11, pm). Assuming the relative contributions of individual metabolites were similar to day 5 milk (pm) then the residue is equivalent to <0.001 mg/kg carbamate residue (aldicarb sulfoxide + aldicarb sulfone). Based on milk from individual animals carbamate residues accounted for 0.01-0.59% of the total radioactivity extracted from milk.

Levels and nature of residues found in goat tissues

Component	^{14}C aldicarb equivalents, µg/kg, in									
	Liver	Kidney	Lung	Heart	Brain	Mammary gland	Leg muscle	Loin muscle	Peripheral fat	Omental fat
Aldicarb oxime	ND	0.26	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb sulfoxide	1.48	0.34	0.06	0.03	ND	ND	ND	0.10	0.11	ND
Oxime sulfoxide	ND	ND	ND	ND	0.20	ND	0.06	0.09	0.06	ND
Nitrile sulfoxide	12.9	9.55	0.90	0.58	0.55	0.70	0.58	0.58	0.35	0.07
Amide sulfoxide	ND	0.33	0.09	0.02	0.04	0.20	0.10	0.08	0.14 a	ND
Alcohol sulfoxide	0.65	0.87	0.26	0.36	1.00	0.23	0.62	0.68	0.14 a	ND

Aldicarb sulfone	ND	0.12	ND	ND	ND	ND	0.04	ND	ND	ND
Oxime sulfone	ND	0.04	0.03	ND	0.12	ND	0.12	0.16	ND	ND
Nitrile sulfone	40.3	49.9	41.2	43.1	42.5	42.1	48.4	45.2	22.9	13.1
Amide sulfone	1.82	3.00	1.66	1.11	1.23	1.20	1.28	1.68	0.14	ND
Alcohol sulfone	0.10	0.54	0.16	0.13	0.28	0.09	0.19	0.17	ND	ND
Aldehyde sulfone	0.44	0.51	0.76	0.38	0.26	0.74	0.30	0.42	0.17	ND
Unknown 1	ND	ND	0.03	ND	0.05	0.05	0.04	ND	ND	0.06
Unknown 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Unknown 3	ND	ND	ND	ND	0.04	ND	ND	ND	0.03	ND
Origin of TLC	0.80	4.78	0.42	0.21	0.14	0.31	0.08	0.12	0.21	0.06
Water soluble	152	73.3	67.4	11.7	11.0	22.4	7.76	7.38	1.00	ND
Unextracted	309	49.5	201	26.4	12.5	59.3	20.4	10.3	3.93	6.67
Total	519	193	314	84	70	127	80	67	29	20

Sulfone nitrile was the predominant residue observed in all tissues. The highest carbamate residue (aldicarb sulfoxide + aldicarb sulfone) was observed in liver (1.48 µg/kg aldicarb equivalents).

Lactating cows

References: JMPR (1994) FAO Plant Production and Protection Paper, 131/1. Evaluations. Part 1-Residues. Volume 1. 19-28 September 1994, Rome, 1995; Andrawes, N.A. (1981) Section D- Nature of residues of Temik, unnumbered project report, 1 August 1981.

Three lactating cows were fed [S-methyl-^{14}C]aldicarb plus unlabelled aldicarb sulfone at total daily doses of 0.12, 0.6 or 1.2 ppm in the feed for 14 days. Radioactive residues in milk and urine were quantitatively determined after 1, 3, 5, 7, 10 and 14 days. The animals were slaughtered 18 hours after the last dose and total radioactivity in a range of tissues was determined.

The amount of the administered dose excreted in the urine, milk and feces was 91.6-93.8%, 0.9-1.3% and 2.9-3.5% respectively. Milk from the cow fed at 1.2 ppm contained, on average, 2.7 µg/kg carbamate residues (20.2% of the milk radioactivity). The liver and kidney of the same cow contained 0.163 and 0.016 mg/kg aldicarb equivalents respectively. The radioactivity in tissues was not characterised further.

In a further study lactating cows were fed a 1:1 mixture of unlabelled aldicarb sulfone and aldicarb sulfoxide. One cow was fed for a total of 32 days and the other for 46 days. Feeding levels were initially 1 ppm for 10 days, then 3 ppm for 9 days followed by 5 ppm for the remaining period (13 or 27 days). The highest residue observed in milk was 0.0075 mg/kg aldicarb equivalents after the 5 ppm feeding period. The nature of the radioactivity was not reported. There was little difference in milk residues between the cow fed for 32 days and the cow fed for 46 days. Total aldicarb residues in milk were 0.1% of the level in the feed. Aldicarb residues were not detected in liver (<0.01 mg/kg).

Laying hens

Reference: JMPR (1994) FAO Plant Production and Protection Paper, 131/1. Evaluations. Part 1-Residues. Volume 1. 19-28 September 1994, Rome, 1995.

Two groups of 10 birds were dosed twice daily with [S-methyl-^{14}C]aldicarb for 7 consecutive days at a rate equivalent to 3.5 ppm in the diet. A third group was maintained as a control.

Eggs were collected daily. At the end of the dosing period the birds were slaughtered and tissues were collected for analysis.

Residues in egg yolk, egg white and whole egg were up to 0.19, 0.16 and 0.10 mg/kg aldicarb equivalents respectively. Nitrile sulfone was the predominant residue and was present at up to 0.005 mg/kg. A full description of the nature of egg radioactivity was not provided.

Aldicarb residues in hen tissues.

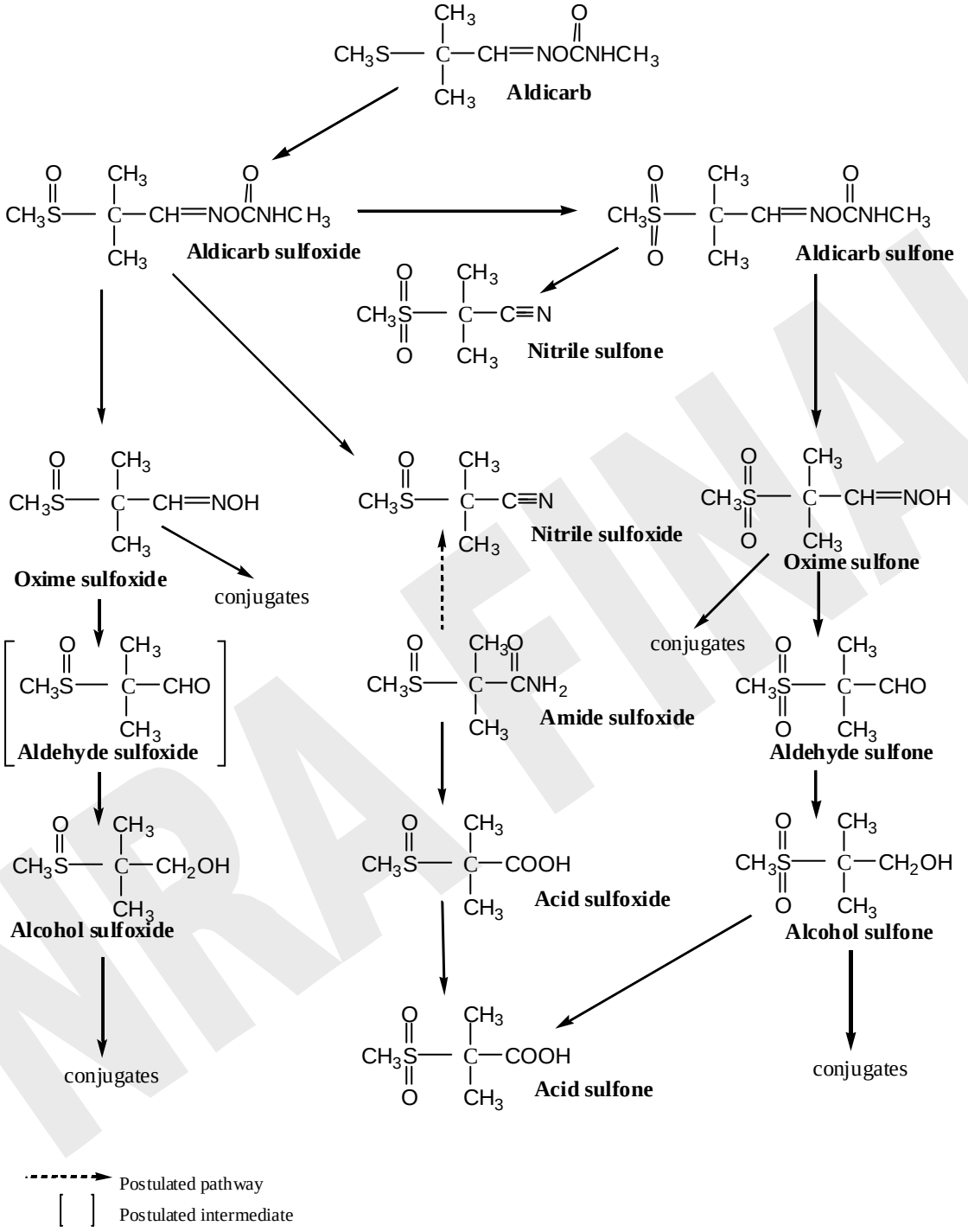
Tissue	Aldicarb equivalents, mg/kg		
	Group 1	Group 2	Average
Muscle	0.092	0.095	0.094
Fat	0.030	0.024	0.026
Skin with fat	0.082	0.084	0.084
Gastro-intestinal tissue	0.18	0.17	0.17
Kidney	0.31	0.32	0.31
Liver	0.39	0.43	0.42
Gastro-intestinal contents	0.27	0.26	0.26
Red blood cells	0.12	0.12	0.12
Plasma	0.15	0.15	0.15

The major free metabolite in liver was aldicarb acid sulfone at 0.105 mg/kg aldicarb equivalents (25.4% of the TRR). No free carbamate residues were isolated from liver.

4.5.3 Summary of Metabolism Studies

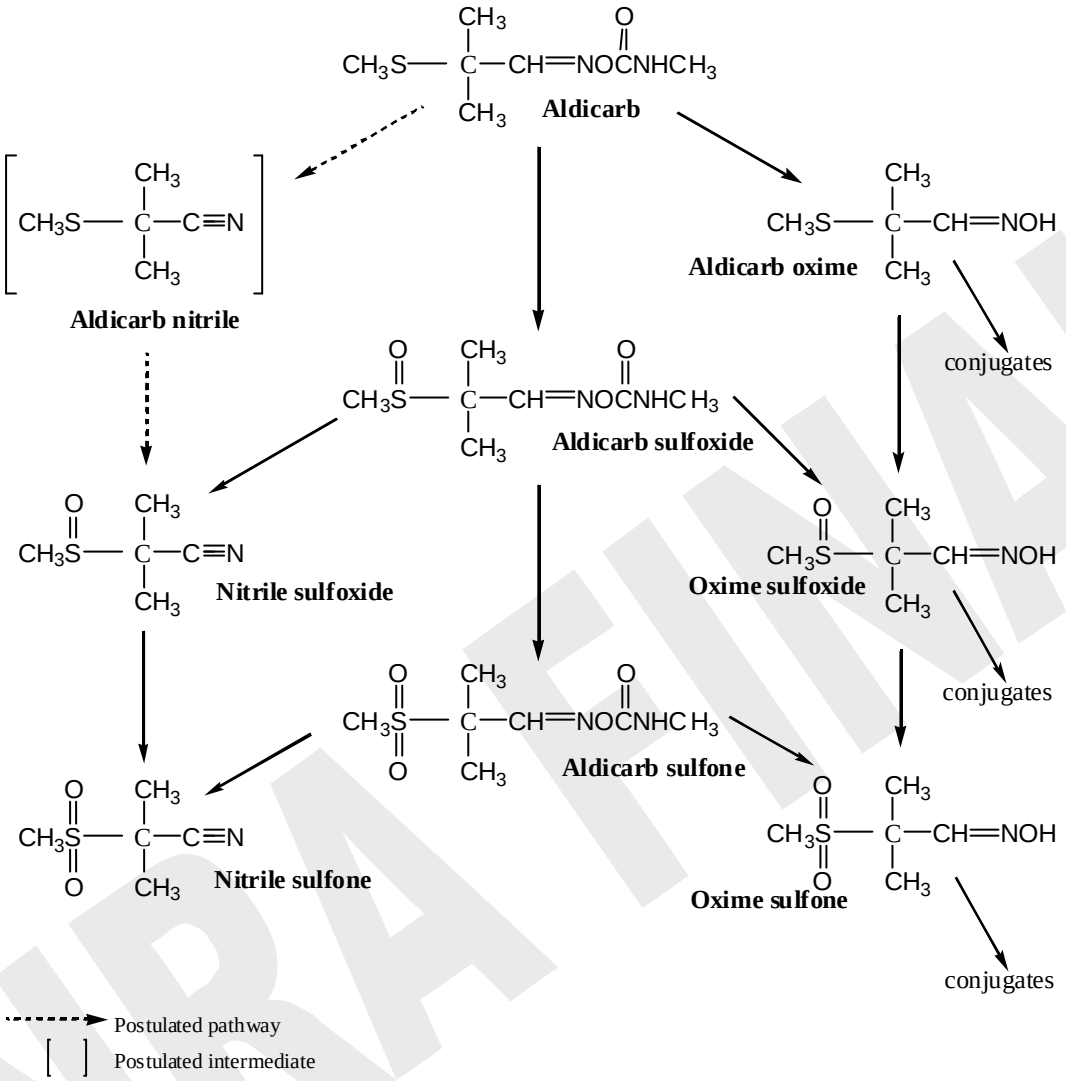
In potato, cotton, sugar beet and peanuts aldicarb was extensively metabolised. The parent compound was only detected in immature cotton foliage up to 37 days after treatment. In all plants aldicarb was rapidly metabolised to the sulfoxide which is in turn further oxidised to the sulfone. Aldicarb and its sulfoxide and sulfone analogues are converted to the corresponding nitriles and oximes which in turn may be converted to aldehyde, amide, alcohol and acid metabolites. Besides aldicarb sulfone and aldicarb sulfoxide no other metabolites with an intact carbamate moiety were identified. The metabolism pathway for aldicarb in plants was presented in JMPR (1994) and is depicted in Figure 1.

Metabolism pathway for aldicarb in plants.



In animals urinary excretion typically accounted for over 80% of the totally administered radioactive dose. Parent compound was not detected in any animal product including blood, urine, feces, meat, offal, fat, milk and eggs. Aldicarb sulfoxide and aldicarb sulfone were present at low levels in some tissues. Aldicarb nitrile sulfone was the major tissue and milk residue in lactating goats. In the studies reviewed no other metabolites with an intact carbamate moiety (besides aldicarb sulfone and sulfoxide) were identified as being present, although Andrawes (1981) suggests that minute amounts of N-hydroxymethyl aldicarb sulfone have been reported. The metabolism pathway for aldicarb in animals was presented in JMPR (1994) and is depicted in Figure 2.

Metabolism pathway for aldicarb in animals



4.6 Residue data

4.6.1 Potatoes and Strawberries

There is no history of registered uses of aldicarb in Australia for these crops. It is recommended that the current MRLs for potatoes and strawberries be deleted from the *MRL Standard*.

4.6.2 Cereals

Reference: Woodhouse, R.N. & Eden, E. (1977) Determination of residues of aldicarb in tomatoes and cereals, 18 October 1977, Report UNC/62/77758, Huntingdon Research Centre, Cambridgeshire, England.

Wheat or barley seed was drill sown with incorporation of granular aldicarb (100 g/kg or 150 g/kg) at an application rate of 0.3-2.4 kg ai/ha. Samples of straw (stem of wheat plant) were

collected prior to harvest at 42 and 90 days or at harvest. Samples of grain were collected at full maturity. Residues were determined by GC-FPD after oxidation of aldicarb residues to the sulfone. Results were expressed as aldicarb after applying a correction factor for differences in molecular weight. Recoveries from control samples fortified with aldicarb (0.2-0.5 mg/kg) were 72-100%, 77% and 72% for wheat straw, wheat grain and barley grain respectively.

Aldicarb residues in wheat straw, wheat grain and barley grain following soil application of aldicarb at seeding.

Location, year	Crop	Rate, kg ai/ha	Sample	PHI, days	Aldicarb, mg/kg
Coote, Australia, 1976	wheat	0.3	leaves, roots leaves, roots grain	42 [a] 90 164	26.02 0.44 <0.01
		0.6	leaves, roots leaves, roots grain	42 [a] 90 164	21.67 1.51 <0.01
		0.6 [b]	leaves, roots leaves, roots grain	42 [a] 90 164	21.07 0.92 <0.01
		1.2	leaves, roots leaves, roots grain	42 [a] 90 164	49.99 6.02 <0.01
		2.4	leaves, roots leaves, roots grain	42 [a] 90 164	86.54 0.66 <0.01
Jeparit, Australia, 1976	wheat	0.3	straw	188	0.02
		0.6	straw	188	0.03
		0.6 [b]	straw	188	<0.02
		1.2	straw	188	<0.02
		2.4	straw	188	0.15
Mundoora, Sth Aust., 1976	barley	0.3	grain	177	<0.01
		0.6	grain	177	<0.01
		0.6 [b]	grain	177	<0.01
		1.2	grain	177	<0.01
		2.4	grain	177	<0.01

Growth stage at 42 DAT was only 3 leaf due to drought conditions
Formulation was 150 g ai/kg. All other trials conducted with 100 g ai/kg formulation.

Reference: Anonymous (1981) Residue data for aldicarb, Reference R4-58, Union Carbide Corporation, West Virginia, USA.

The reference is a summary sheet of a residue trial in barley conducted in Massachusetts, USA. Temik 15G (15% w/w aldicarb) was applied in-furrow at a rate of 0.5 lb/A [equivalent to 0.56 kg/ha] during seeding of barley. Whole green plants were sampled at 45-120 days after planting. Samples were analysed using GC with FPD (method Aldicarb-FPD-General) and results were corrected for the recovery value of 102%. Aldicarb sulfone residues in whole plants were 0.12 mg/kg (45 DAT), 0.05 mg/kg (60 DAT), 0.10 mg/kg (90 DAT) and 0.04 mg/kg (120 DAT).

Summary Cereals

Aldicarb residues in wheat and barley grain were <0.01 mg/kg when harvested 164-177 days after at-planting applications of 0.3-2.4 kg ai/ha. Residues in wheat straw at harvest were up to 0.15 mg/kg and residues in immature plants were up to 86.5 mg/kg 42 days after an at-planting application.

There is no indication that aldicarb is currently used in any cereal crops and there is no use pattern on the currently approved product labels. It is recommended that the current entry in the *MRL Standard* (cereal grains *0.02 mg/kg) be deleted from the *MRL Standard.*

4.6.3 Citrus

Reference: Anonymous (1975b) Magnitude of the residue [citrus], Unnumbered report, 1975, Union Carbide Corporation, West Virginia, USA; Anonymous (1975a) [Various residue trial summary reports] Union Carbide Corporation, West Virginia, USA; Gunther, F.A. et al (1975) Aldicarb (Temik) residues in oranges, orange leaves, and soil after soil application in an orange grove, Unnumbered report, 3 January 1975, University of California, Riverside.

The reference is a summary of ten residue trials conducted in the USA during 1974-1975. Aldicarb granules were applied by various means to orange trees at rates of 2.8-22.4 kg ai/ha. Growth stages at the time of application were not stated, however, it is apparent from the sampling descriptions that both immature and mature fruit would have been present. Samples of fruit (15-30 fruit per sample) were collected at various intervals after treatment and stored frozen until analysis. In most cases residues were determined separately in pulp and peel. No indication of the proportion of pulp to peel was given so it is not possible to calculate the results on a whole fruit basis. Residues of aldicarb (total of aldicarb, aldicarb-SO and aldicarb-SO_2, expressed as aldicarb-SO_2) were determined by method ALDICARB-FPD-GENERAL. The method measures the total of aldicarb, aldicarb sulfoxide and aldicarb sulfone, expressed as aldicarb sulfone. LOQs varied from trial to trial but were in the range 0.01-0.04 mg/kg.

Aldicarb residues in oranges grown in US trials

Location, date, variety	Application type	Rate, kg ai/ha	DALA [a]	Aldicarb sulfone, mg/kg
Citra, Florida, 1974, Pineapple	Incorporated in 2×30 inch wide bands, one on each side of tree	2.8	30, green 62, immature 94, mature 124, ripe	0.21 peel, 0.05 pulp 0.06 peel, 0.02 pulp 0.04 peel, 0.04 pulp <0.02 peel, <0.01 pulp
		5.6	30, green 62, immature 94, mature 124, ripe	0.36 peel, 0.07 pulp 0.09 peel, 0.03 pulp 0.10 peel, 0.03 pulp 0.04 peel, 0.05 pulp
		11.2	30, green 62, immature 94, mature 124, ripe	1.2 peel, 0.16 pulp 0.29 peel, 0.06 pulp 0.28 peel, 0.09 pulp 0.15 peel, 0.06 pulp

Lake Wales, Florida, 1974, Valencia	Incorporated in two 30 inch wide bands, one on each side of the trees	2.8	31, ripe 31, green 63, ripe 63, green 93, ripe 93, green 127, ripe 127, green	0.10 peel, 0.03 pulp 0.20 whole 0.11 peel, 0.03 pulp 0.18 peel, 0.06 pulp 0.04 whole 0.06 whole 0.04 whole 0.05 whole
		5.6	31, ripe 31, green 63, ripe 63, green 93, ripe 93, green 127, ripe 127, green 199, ripe 234, ripe 244, ripe 7-91 ripe [b]	0.18 peel, 0.05 pulp 0.40 whole 0.14 peel, 0.05 pulp 0.51 peel, 0.11 pulp 0.07 whole 0.23 whole 0.09 whole 0.19 whole 0.08 whole 0.04 whole 0.03 whole 0.07-0.14 whole
		11.2	31, ripe 31, green 63, ripe 63, green 93, ripe 93, green 127, ripe 127, green 199, ripe 234, ripe 244, ripe 7-91 ripe [b]	0.54 peel, 0.11 pulp 0.49 whole 0.28 peel, 0.09 pulp 1.6 peel, 0.47 pulp 0.13 whole 0.46 whole 0.19 whole 0.36 whole 0.23 whole 0.16 whole 0.11 whole 0.13-16 whole
Lake Alfred, Florida	Broadcast and incorporated in 500 sq. ft. area, around the tree	5.9	7, ripe mature 15 30 44 61	0.02 whole 0.04 0.07 0.05 0.05
		12	7, ripe mature 15 30 44 61	0.03 0.11 0.17 0.13 0.10
Tustin, California, 1975, Valencia	Incorporated in band around tree or along tree row (19 kg ai/ha treatment)	11.2	330 (approx) **c** 35 118	<0.01 (mean <0.01) 0.26-0.69 (0.52) 0.12-0.36 (0.20)
		22.4	330 (approx) 35 118	<0.01-0.14 (0.04) 0.94-1.45 (1.20) 0.46-0.52 (0.42)
		19	330 (approx) 35 118	<0.01 (<0.01) 0.27-1.16 (0.69) 0.10-0.37 (0.23)
Tustin, California, 1974, Valencias	Incorporated in 4 ft wide band around the trees	2.4	7-28 35-93 113-154	<0.03 peel, <0.02 pulp <0.03-0.04, <0.02 <0.03, <0.02
		4.7+4.7 [c]	7-28 35-93 113-154	<0.03 peel, <0.02 pulp 0.05-0.12, <0.02 <0.04-0.06, <0.02
		9.3	7-28 35-93 113-154	<0.03-0.06, <0.02 0.05-0.09, <0.02 <0.04-0.02, <0.02

		18.6	7-28 35-93 113-154 245	0.02-0.14, <0.02-0.02 0.18-0.25, 0.02-0.04 0.11-0.17, 0.04-0.05 0.13 peel, 0.05 pulp
Delano, California, 1974, Navels	Incorporated in a 2 ft wide band at the periphery of the tree	2.8 5.6 11.2 22.4 2.8+2.8 [c]	178	<0.02 peel, <0.02 pulp 0.03 peel, <0.02 pulp 0.05 peel, 0.05 pulp 0.11 peel, 0.05 pulp 0.06 peel, 0.04 pulp
Arlington, California, 1974, Navels	Applied to soil surface in a 1.5 ft band at periphery of the tree	2.8 5.6 11.2 22.4 2.8+2.8 [c]	193	<0.04 peel, <0.02 pulp <0.04 peel, <0.02 pulp <0.04 peel, 0.05 pulp <0.04 peel, 0.03 pulp <0.04 peel, 0.05 pulp
Monte Alto, Texas, 1974, Marrs Early	Spread under trees with a Cyclone spreader and incorporated	6.7-13.4	179	all <0.02 peel, all <0.01 pulp
Yuma, Arizona, 1974, Valencia	Incorporated under the trees	1.4-5.6	158-280	all <0.02-0.02 peel, all <0.01 pulp
Yuma, Arizona, 1975, Valencia	Broadcast under the trees and incorporated	5.6 11.2	7-90 7-90	0.02-0.13 0.02-0.43

Days after last application
Plot received a second treatment at 244 days after initial treatment, sampling intervals 7-91 days refer to fruit sampled after the second application
Plot received a second treatment at 24-36 days after the initial treatment. Sampling intervals relate to days after the first treatment.

References: Anonymous (1983b) Temik 15G on bearing citrus, Unnumbered report (June 1983), Union Carbide, South Africa; Anonymous (1983c) Untitled and unnumbered report [lemon residue trial] Union Carbide, South Africa.

The references contain discussions of residue trials conducted in South Africa with oranges and lemons. The trials were designed to investigate two distinct residue scenarios with regard to timing of aldicarb application. Aldicarb was applied to citrus trees bearing ripe fruit and also to trees at flowering. The rate of application was also investigated. Concerns were expressed that the South African use pattern (300 g product/tree) could result in much higher treatment rates where tree density was high. Full details of the analytical methods and sampling methodology were not provided. Results were generally presented in graphical form and interpolation of exact residue levels was not possible. It was apparent from the graphical representations that decline of residues had not always commenced at the time of the last sampling interval. This point needs to be considered when assessing the "maximum" residue results quoted in the report.

Residues of aldicarb in whole fruit following treatment of orange or lemon trees bearing ripe fruit (South Africa).

Location, date, variety	Application type	Rate, kg ai/ha	DALA	Aldicarb residues, mg/kg
Rustenburg, South Africa	To soil under the tree canopy. Treatment applied to trees bearing ripe fruit.	17.1 [a]	38, ripe 63, ripe	0.35 0.62

	To soil in a band along the tree row. Treatment applied to trees bearing ripe fruit.	10.5	63, ripe	0.18
South Africa (site 2, name not specified)	To soil under the tree canopy. Treatment applied to trees bearing ripe fruit.	16 [a]	42, ripe	0.15
Karino, South Africa	To soil under the tree canopy. Treatment applied to trees bearing ripe fruit.	8 [a]	41, ripe	<0.1
South Africa (site 4, name not specified)	To soil in a band along the tree row. Treatment applied to trees bearing ripe fruit.	10.5	44, ripe 68, ripe	0.19 0.13
Marble Hall, South Africa (lemons)	To soil under the tree canopy. Treatment applied to trees bearing ripe fruit.	22.9 [a]	21, ripe	0.74
	To soil in a band along the tree row. Treatment applied to trees bearing ripe fruit.	10.5	21, ripe	0.15

Aldicarb was applied at 45 g ai/tree. The application rates in g ai/ha were calculated from tree density at the particular site.

When trees were treated at flowering (45 g ai/tree and 10.5 kg ai/ha) aldicarb residues in developing fruit declined to <0.3 mg/kg after 17-22 weeks. In commercial crops treated at flowering (10.5 kg ai/ha) aldicarb residues declined to <0.03 mg/kg after 22-30 weeks.

Reference: Anonymous (1988) Report of analysis- Aldicarb residues in oranges, AGAL unnumbered report (1988) Australian Government Analytical Laboratories, Vic, Australia.

Residue trials on oranges were conducted in Victoria and South Australia. Aldicarb granules were applied in 1.5 m bands on both sides of tree rows at application rates of 5.7 kg ai/ha and 11.4 kg ai/ha. The granules were lightly incorporated into the soil with a disc plough and then watered in by irrigation or rain. Plot sizes were 3-4 trees with 5-6 replications per treatment (15-24 trees per treatment). Aldicarb was applied at the time of flowering. In the Cobram (Victoria) trial the trees were bearing semi-mature fruit at the time of application. In the other two trials any fruit remaining from the previous season was removed prior to application of aldicarb. The Cobram sample taken at 182 DAT was green fruit that set and developed post-treatment. Samples taken at Cobram prior to day 182 were semi-mature to mature fruit that were set pre-treatment. In the Cobram and Swan Reach (Victoria) trials all treated plots had received a previous aldicarb application 12 months prior to the commencement of the trial. Samples were collected from the Cobram plots just prior to the second treatment. Fruit were collected at various intervals after treatment and 3 replicate samples from each treatment were submitted for analysis. Fruit were separated into peel and flesh and analysed separately. The weights of peel and flesh were recorded to allow the calculation of residues on a whole fruit basis. Residues were determined as aldicarb sulfone by GC with FPD. The average recoveries of aldicarb residues from fortified samples were 75.3% (n=6, spike level 0.08 mg/kg) and 74.4% (n=6, spike level 0.15 mg/kg). The level of reporting for the analysis was set at 0.01 mg/kg as aldicarb sulfone.

Residues of aldicarb in oranges from Australian residue trials

Location, date, variety	Rate, kg ai/ha	DALA	Aldicarb sulfone, mg/kg
Cobram, Victoria, 1985/86, Valencia	5.7	365	<0.01
		15	0.08
		30	0.07
		51	0.19
		66	0.21
		92	0.13
		122	0.06
		152	0.02
		182	0.02
	11.25	365	<0.01
		15	0.18
		30	0.64
		51	0.64
		66	0.60
		92	0.43
		122	0.4
		152	0.21
		182	0.07 (pulp 0.05, peel 0.1)
Swan Reach, Victoria, 1985/86, Valencia	5.7	144	0.06
		168	0.02
		244	0.01
	11.25	144	0.09
		168	0.02 (pulp <0.01, peel 0.03)
		244	0.01
Loxton, South Australia, 1985/86, Washinton Navels	5.7	138	0.02
		162	<0.01
		238	<0.01
		300	<0.01
	11.25	138	0.04
		162	0.03 (pulp 0.04, peel 0.02)
		238	<0.01
		300	<0.01

Reference: Anonymous (undated, a) AGAL Report of analysis- Addendum to report on aldicarb residues in oranges, AGAL unnumbered report, Australian Government Analytical Laboratories, Vic, Australia.

Aldicarb granules were applied in 1.2 m bands on both sides of tree rows at application rates of 5.7 kg ai/ha and 11.4 kg ai/ha. The granules were lightly incorporated into the soil with a disc plough and then watered in by irrigation. Plot sizes were 3 trees with 5 replications (15 trees per treatment). The plots had previously been treated with aldicarb approximately 2 years prior to commencement of the trial. Aldicarb was applied at the time of flowering with the last seasons crop still on the tree. Replicate samples of mature ripe oranges were collected at various intervals after treatment. Aldicarb residues were determined in the whole fruit and in orange juice after processing with a domestic juicer. Residues were determined as aldicarb sulfone by GC with FPD. The average recovery of aldicarb residues from fortified fruit samples was 81% (n=3, spike level 0.15 mg/kg). The average recovery of aldicarb residues from fortified juice samples was 101% (n=3, spike level 0.14 mg/kg).

Aldicarb residues in oranges and orange juice from Australian residue trials

Location, date, variety	Rate, kg ai/ha	Sample	Aldicarb sulfone, mg/kg, at days after application		
			91	119	150

Cobram, 1987, Valencia	5.7	juice whole fruit [a]	0.11 0.11 (0.06-0.21)	0.10 0.03 (<0.01-0.06)	0.07 <0.01
	11.25	juice whole fruit [a]	0.23 0.22 (0.11-0.33)	0.14 0.08 (<0.01-0.14)	0.11 0.03 (<0.01-0.06)

Each result is mean of 3 replicate samples. Results <0.01 were treated as 0.01 for calculation of mean. Numbers in parentheses show range of replicates.

Reference: Clark, D.V. & Shields, R. (1988a) Residue analysis report- Determination of residues of aldicarb (Temik) in oranges, Lab ref no. 2644/87/5, 6 January 1988, Analchem Consultants Pty Ltd.

The reference is a report of the analytical phase of a residue trial in oranges. Full details of the field phase were not provided. Oranges from 3 locations that had previously been treated with aldicarb at 11.25 kg ai/ha were analysed for aldicarb residues. Oranges were peeled prior to analysis and only the pulp was tested. Residues were determined as aldicarb sulfone by GC with FPD. The recovery of aldicarb residues from a fortified fruit sample was 123% (spike level 0.2 mg/kg). Results were corrected for recovery.

Aldicarb residues in orange pulp from Australian residue trials

Location, date, variety	Rate, kg ai/ha	DALA	Aldicarb sulfone, mg/kg
Unknown	11.25	12	0.1
Nangiloc, Victoria	11.25	18	<0.05
Monak, NSW	11.25	19	<0.05

Reference: Magor, B. & Naglich, R. (Undated) AGAL Report of analysis- Aldicarb residues in oranges, AGAL unnumbered report, Australian Government Analytical Laboratories, Vic, Australia; Mitchell, L.W. (1988) Temik 150G double rate residue trial, Unnumbered report, 25 July 1988, Agrisearch Services Pty Ltd.

Aldicarb granules were applied in 1.5 m bands on both sides of tree rows at application rates of 11.25 kg ai/ha and 22.5 kg ai/ha. The granules were lightly incorporated into the soil by raking and then watered in by irrigation. Plot sizes were 3 trees with 3 replications (9 trees per treatment). Aldicarb was applied with small fruit (1-3 cm diameter) present on the trees. Replicate samples of semi-mature to mature oranges were collected at various intervals after treatment. Aldicarb residues were determined in the whole fruit as aldicarb sulfone by GC with FPD. The average recovery of aldicarb residues from fortified fruit samples was 72% (n=5, spike level 0.14 mg/kg).

Residues of aldicarb in oranges and following soil treatment with aldicarb

Location, date, variety	Rate, kg ai/ha	Aldicarb sulfone [a], mg/kg, at days after last application			
		124	150	181	210
Waikerie, Sth Australia, 1988, Navels	11.25	0.04 (<0.01-0.08)	0.02 (0.02-0.03)	0.01	<0.01
	22.5	0.38 (0.28-0.58)	0.07 (0.06-0.08)	0.04 (<0.01-0.08)	0.04 (0.03-0.07)

Each result is mean of 3 replicate samples. Results <0.01 were treated as 0.01 for calculation of mean. Numbers in parentheses show range of replicates.

Reference: Keats, A. (1996) Aldicarb and associated metabolites (aldicarb sulphoxide and aldicarb sulphone). Formulation Temik 15G- Australia 1994. Residues in mandarin., Reference: AK96053, Protocol No.: Aus 93i49aR, 12 June 1996, Rhone-Poulenc Rural Australia.

One reverse decline trial was conducted on Ellendale mandarins in South Australia. Aldicarb was applied at 11.25 kg ai/ha or 22.5 kg ai/ha with a commercial granule applicator and incorporated into the soil as a band at the base of the trees. The timing of application ranged from bud burst (180 day PHI) to green fruit present (30 day PHI). Only a single application was made to each treated plot. Plot sizes were 1 tree with 4 replications. All plots were sampled on the same day. Pairs of replicate plots were bulked to give two samples for each treatment. Aldicarb residues were determined as aldicarb sulfone by GC with TSD and results were expressed as aldicarb. Mean recoveries for control samples fortified with a single carbamate were 101%, 96.7% and 95.4% for aldicarb and its sulfoxide and sulfone metabolites respectively (spike levels 0.01-1 mg/kg).

Residues of aldicarb in mandarins following soil treatment with aldicarb

Location, date, variety	Rate, kg ai/ha	Aldicarb sulfone [a], mg/kg, at days after last application			
		30	60	90	180
Loxton, Sth Australia, 1988, Ellendale	11.25	0.374, 0.350	0.154, 0.178	0.065, 0.052	0.015, 0.011 (mean 0.013)
	22.5	0.429, 0.458	0.318, 0.276	0.086	0.019, 0.015

Reverse decline format, all plots harvested on same day, timing of application varied between plots

Reference: Maitlen, J.C. & McDonough (1967) Report of residue analysis, PCY-67-5, 31 May 1967, United States Department of Agriculture, Washington, USA.

Aldicarb was applied as a 10% granular formulation to the soil around orange trees. The application rates were equivalent to 0.45, 2.24 and 11.9 kg ai/ha. Weighed amounts of granules were sifted into the watering basins around each tree and then raked in and watered. Each treatment was applied to 8 trees from which one composite sample was collected approximately 100 days after treatment. Growth stage at the time of treatment was not specified. Peel and pulp of samples were analysed separately by GC with FPD. Sample extracts were fractionated on florisil and aldicarb, aldicarb sulfoxide and aldicarb sulfone were determined separately. Recoveries for peel spiked over the range 0.05-1.0 mg/kg were 76-93%, 78-88% and 80-99% for aldicarb, aldicarb sulfoxide and aldicarb sulfone respectively. Recoveries for pulp spiked over the range 0.05-1.0 mg/kg were 76-96%, 70-92% and 73-103% for aldicarb, aldicarb sulfoxide and aldicarb sulfone respectively. Results were corrected for recovery.

Aldicarb residues in orange peel and pulp from US residue trials

Location, date, variety	Rate, kg ai/ha	Sample	Residue (mg/kg) at 100 days after application		
			aldicarb	sulfoxide	sulfone
USA (site not identified), 1965	0.45	peel	<0.01	0.06	0.01
		pulp	<0.01	0.03	<0.01
	2.24	peel	<0.01	1.39	0.36
		pulp	<0.01	0.35	0.13
	11.9	peel	<0.01	12.75	2.24
		pulp	<0.01	2.63	0.58

Reference: Myers, W.R. (1985) The determination of the anticipated residue values of aldicarb in potatoes and citrus, File No. 33917, 18 December 1985, Union Carbide Agricultural Products Company Inc., NC, USA.

The reference is a statistical evaluation of all available US residue data for aldicarb in citrus and potatoes. The purpose was to determine "anticipated residue values" to use in dietary exposure calculations. Full details of the trials were not provided. Data were presented in summary form only. Trials conducted in various US locations between 1972 and 1983 on oranges, grapefruit, lemons and limes were summarised. All crops were treated with aldicarb according to the maximum label rate (equivalent to 5.6 kg ai/ha in Florida and 11.2 kg ai/ha elsewhere). Residue levels are for whole mature fruit.

Summary of aldicarb residues in oranges from US residue trials

DALA	Aldicarb residues, mg/kg, number of results in specified range					
	<0.02	0.02-0.05	0.05-0.1	0.1-0.15	0.15-0.2	0.25-0.3
0-28	-	-	2	-	-	-
29-56	1	12	10	3	1	-
57-84	5	8	10	3	-	1
85-112	6	3	12	2	1	1
113-140	5	3	3	-	4	-
141-168	5	2	1	-	-	-
196+	35	2	2	-	-	-

References: Hunt, T.W. (1991a) In-orchard variation of the magnitude and character of aldicarb residues in oranges and grapefruit and stability of these residues in commercial storage, EC-90-093, 24 July 1991, Rhone-Poulenc Ag Company, NC, USA; Hunt, T.W. (1991b) In-orchard variation of the magnitude and character of aldicarb residues in oranges, 26 August 1991, Rhone-Poulenc Ag Company, NC, USA

A total of six trials were conducted with oranges and grapefruit in Florida, USA. In each trial approximately 2 acres of trees were treated with aldicarb at 5.6 kg ai/ha. Aldicarb granules were applied to the soil in a band down each side of the row under the drip line of the trees. Mature fruit were present on the trees at the time of application. Samples of approximately 1000 mature fruit were collected from each treated plot 60 days after application. The pulp from 100 individual fruit from each trial was analysed for aldicarb residues using a HPLC method that could separately quantify aldicarb and its sulfoxide and sulfone metabolites. The LOD of the method was 0.01 mg/kg for each analyte. In the first phase of the project (trials 90-201, 90-202, 90-203 and 90-206) the mean recoveries for control pulp fortified with aldicarb, aldicarb sulfoxide and aldicarb sulfone respectively were 85%, 90% and 96% (spike levels 0.005-0.5 mg/kg). In the second phase of the project (trials 90-225 and 90-226) the mean recoveries for control pulp fortified with aldicarb, aldicarb sulfoxide and aldicarb sulfone respectively were 85%, 80% and 92% (spike levels 0.01-1.0 mg/kg). Results were corrected for recovery.

Aldicarb residues in individual oranges and grapefruit

Residue level, mg/kg	Number of fruit with aldicarb residues in specified range					
	90-201	90-202	90-203	90-206	91-225	91-226
Aldicarb, ND [a]	100	100	100	100	99	11
Aldicarb, ND to <0.01	0	0	0	0	1	89

Aldicarb sulfone, ND	57	83	16	21	100	0
Aldicarb sulfone, ND to <0.01	43	17	84	79	0	93
Aldicarb sulfone 0.01 to 0.02	0	0	0	0	0	7
Aldicarb sulfoxide, ND	65	0	2	0	100	0
Aldicarb sulfoxide, ND to <0.01	21	90	84	60	0	8
Aldicarb sulfoxide, 0.01	6	8	10	21	0	17
Aldicarb sulfoxide, 0.02 to 0.05	7	2	4	19	0	55
Aldicarb sulfoxide, 0.06 to 0.15						19

ND = not detected The actual detection limit of the method was not specified. Presumably the detection limit was between 0.005 and 0.01 ie. between the lowest fortification level and the LOD.

References: Macdonald, I.A. et al (1985a) Certificate of analysis- The determination of concentrations of aldicarb in lemons, UNC 137/1-A, 31 January 1985, Huntingdon Research Centre, Cambridgeshire, England; Macdonald, I.A. et al (1985b) Certificate of analysis- The determination of concentrations of aldicarb in oranges, UNC 137/1-B, 31 January 1985, Huntingdon Research Centre, Cambridgeshire, England.

The references are certificates of analysis for the determination of aldicarb residues in oranges and lemons. Full details of the field phase of the trials were not provided. Residues in peel, pulp and whole fruit were determined as aldicarb sulfone by GC with FPD. It was unclear if results were expressed as the sulfone or converted to aldicarb equivalents. In lemons the mean recoveries of aldicarb residues from fortified control samples were 77%, 86% and 82% for pulp, peel and whole fruit respectively (spike levels 0.05-2.0 mg/kg). In oranges the mean recoveries of aldicarb residues from fortified control samples were 86%, 92% and 87% for pulp, peel and whole fruit respectively (spike levels 0.05-0.2 mg/kg).

In 7 trials conducted in lemons aldicarb residues were only detected in 1 trial. In the first 6 trials lemon trees were treated at 22.5-52.5 g ai/tree. All samples of pulp (n=21), peel (n=2) and whole fruit (n=2) derived from aldicarb treated trees contained aldicarb residues at <0.02 mg/kg at PHIs of 62-151 days. In the final trial samples of pulp all contained quantifiable residues of aldicarb. Aldicarb residues were 0.08-0.12 mg/kg, 0.16-0.31 mg/kg and 0.18-0.34 mg/kg for trees treated at 30, 45 and 52.5 g ai/tree (PHIs in the range 17-60 days). In 6 trials conducted in oranges the crops were treated at 22.5-52.5 g ai/tree. All samples of pulp (n=28) derived from treated oranges contained aldicarb residues at <0.02 mg/kg at PHIs of 98-232 days.

Reference: Tew, E.L. (1994) Aldicarb fresh-market orange monitoring study, EC-92-216, 1 February 1994, Rhone-Poulenc Ag Company, NC, USA.

Oranges from 20 commercial orchards that had previously been treated with aldicarb were collected during the normal harvesting period and analysed for aldicarb residues. Details of the treatment history of the orchards were not provided. Label restrictions in Florida required that aldicarb be applied in the January to April period. Sampling occurred in the period of March to May. Samples were only taken from trees where mature fruit had been present at the

time of application. Pulp samples from 869 individual oranges were analysed separately for aldicarb residues. Residues were determined as aldicarb sulfone by GC with FPD. The average recovery of aldicarb residues from fortified control samples was 89% (range 72-112%, n=96, spike levels 0.01-0.3 mg/kg). Results were corrected for recovery. Of the 869 oranges analysed, 244 contained no detectable residue of aldicarb, 467 contained detectable residues that were <0.01 mg/kg (<LOQ) and 158 contained residues >0.01 mg/kg. The highest residue observed in the pulp of an individual orange was 0.12 mg/kg.

Summary Citrus

In Australian trials conducted according to good agricultural practice at the maximum treatment rate aldicarb sulfone residues in oranges were 0.01, 0.02, 0.03 and 0.03 mg/kg 150-181 days after treatment. The label withholding period for harvest is 26 weeks (182 days). An aldicarb sulfone residue of 0.07 mg/kg observed in one trial (PHI 182 days), however, the trial was not conducted strictly in accordance with Australian good agricultural practice. In that trial trees were treated with semi-mature fruit present. The sample taken 182 days after treatment was from the following crop that set post-treatment.

It should be noted that residues in the orange trials were determined as aldicarb sulfone and were not converted back to give an apparent concentration of aldicarb, as required by the Australian (and CODEX) residue definition. The residues are equivalent to <0.01, 0.017, 0.026 and 0.026 mg/kg when expressed as aldicarb (correction factor of 0.86). The STMR for oranges is estimated to be 0.0215 mg/kg. Based on a mean depletion factor of 0.6 the STMR for the edible portion is estimated to be 0.0129 mg/kg.

Aldicarb residues (expressed as the sulfone) in oranges were <0.01-0.08 mg/kg (mean of replicate determinations 0.04 mg/kg) 182 days after trees were treated at 22.5 kg ai/ha (2× the maximum label rate).

Maximum residues of aldicarb in mandarins were 0.015 mg/kg and 0.019 mg/kg 180 days after treatment at 1× and 2× the label rate. The mandarin trial was conducted in a reverse decline format and demonstrated that single applications made 30-90 days prior to normal harvest resulted in residues of 0.052-0.374 mg/kg. Any repeat application or application inside the label withholding period is therefore likely to result in violations of the current MRL (0.05 mg/kg).

Trials conducted in the USA and South Africa generally did not closely approximate Australian GAP. In many cases aldicarb was applied to trees bearing developing or even mature fruit. It appears that most of the overseas trials conducted in the 1970s and early 1980s were to support use-patterns that were far less restrictive than the current Australian use pattern. Since adequate Australian data is available it is considered appropriate to base recommendations on the Australian data.

The variability of residues in the pulp of individual oranges was investigated in 2 US trials (Hunt, 1991a, 1991b). The data from 2 trials with oranges were used to estimate a variability factor for use in the acute dietary intake calculation. The variability factor was estimated from the ratio of the 97.5^{th} percentile residue level in an individual unit (edible portion) to the mean residue level in 50 simulated composite samples (pulp from 12 oranges). In this case the variability factor was estimated to be 4.4.

Based on the Australian data submitted the current MRL for citrus is considered to be acceptable when aldicarb is used in accordance with the label directions.

The currently approved labels also permit multiple applications of aldicarb to non-bearing citrus (4.5 g ai/tree or 1.05 g ai/m^2) for control of citrus leaf miner. The applicant indicated that product stewardship records demonstrate that treatment of non-bearing trees more than once per season is extremely rare (only 2 occurrences in 9 years). Non-bearing trees are mostly at an early age with a single treatment around the trunk. The risk of producing residues in fruit of bearing trees by treatment of nearby non-bearing trees is not considered to be significant.

4.6.4 Cotton

Reference: Anonymous (1983a) Aldicarb residues in cottonseed from Australia, Unnumbered report.

The reference is a summary table of a residue trial conducted in Emerald, Australia with cotton. Full details of the field phase of the trial were not provided. Aldicarb was applied to the soil as a band at planting (2 kg ai/ha) or as a side-dressing at some point after planting (1.5-3 kg ai/ha). Samples of cottonseed were collected at harvest, 91 days after the side-dressing treatment or 152 days after the at-planting treatment. The trial data were previously submitted to the PACSC for consideration of a cottonseed MRL in 1985[Φ]. PACSC records indicate that samples were analysed by method ALDICARB-FPD-COTS at the Institute for Research and Development Corporation, Michigan, USA.

Aldicarb residues in cotton seed from a supervised trial in Emerald, Queensland

Treatment	Rate, kg ai/ha	DALA	Aldicarb residues, mg/kg
Banded at planting	2	152	<u><0.01</u>
Side-dressed	1.5	91	<0.01
Side-dressed	3	91	<0.01-0.02

References: Dewitt, T.C. (1983) Part A- Total toxic residues of Temik in or on cottonseed obtained from plants treated with Temik 10G, 1966-1968, Part B- Dissipation of total toxic Temik residues in cotton foliage and gin trash and proof of systemic activity, Unnumbered report, 1 February 1983, Union Carbide Agricultural Products Co, West Virginia, USA.

The reference is an extract from a submission made to the US EPA and contains summary data from numerous trials conducted with aldicarb on cotton. Trials were conducted as both supervised trials and commercial grower trials. The treatment regimes applied to the crops were a) treatment at planting time of 0.56-4.5 kg ai/ha b) side-dress treatment after planting of 1.1-9 kg ai/ha c) combination of in-furrow and side-dressing treatments. The recommended method for side-dressing treatments was application at squaring in 6-8 inch bands on both sides of the row with incorporation into the soil. Samples of cottonseed were collected at harvest and analysed by a colorimetric method (LOD 0.04 mg/kg) or a GC method (LOD 0.02 mg/kg). Reasonable agreement was demonstrated between the two analytical methods. Samples of gin trash derived from treated cotton plants were taken from 3 locations and

[Φ] Pesticides and Agricultural Chemicals Committee, Sixty Ninth Meeting, 5-6 December 1985.

analysed for total aldicarb residues. Cottonseed from 4 trial locations was processed into various fractions that were analysed separately.

Aldicarb residues in cottonseed following a single application at planting in US trials

DALA	Aldicarb residues [a], mg/kg, after application at rate				
	0.56 kg ai/ha	1.1 kg ai/ha	1.7 kg ai/ha	2.2 kg ai/ha	4 kg ai/ha
111-120	<0.02	<0.02	-	-	-
121-130	<0.02 (3)	<0.02 (3)	-	<0.02	-
131-140	<0.02	<0.02 (2), 0.02, 0.03	<0.02		-
141-150	-	<0.02 (2), 0.04	-	<0.02 (3)	-
151-160	<0.02	<0.02 (2), 0.03, 0.05, 0.08	-	-	<0.02 [b]
161-170	-	<0.02	-	-	-
171-180	0.02	-	-	-	<0.02
181-190	-	-	-	0.03, 0.05	0.04 [b]

Each result is from a separate trial. Number of results in parentheses.
Banded treatment at planting. All other treatments were in-furrow at planting

Aldicarb residues in cottonseed following a single side-dress application in US trials

DALA	Aldicarb residues [a] , mg/kg, after application at rate, kg ai/ha						
	1.1	2.2	3.4	4.5	5.6	6.7	9
60	<0.02	-	<0.02	-	<0.02	0.02	-
71-80	-	0.01	0.04	0.02, 0.03	-	-	-
81-90	-	<0.02, 0.02	-	0.03, 0.04	-	-	-
91-100	0.02	<0.02 (6),	<0.02, 0.02	0.03 (3), 0.04, 0.05, 0.09	<0.02	<0.02, 0.05 (2)	<0.02, 0.04, 0.08
101-110	-	<0.02 (5), 0.02, 0.06	<0.02, 0.02 (2), 0.03, (2), 0.01	<0.02	-	0.04	0.02, 0.06
111-120	-	<0.02 (2)	0.01, 0.03	<0.02	-	<0.02	<0.02
121-130	0.01, 0.02 (2), 0.03, 0.04	0.01, 0.05, 0.06	0.07	-	-	-	-
131-140		<0.02, 0.04, 0.05	-	-	-	-	-
151-160		<0.02, 0.07	-	-	-	-	-

Each result is from a separate trial.

In cotton treated at planting (0.56-1.1 kg ai/ha) and then with a side-dressing at squaring (1.1-9 kg ai/ha) aldicarb residues were <0.02 mg/kg in 19 of 42 samples collected at harvest. Only 2 samples contained aldicarb residues at >0.05 mg/kg (both 0.08 mg/kg). The intervals between the side-band treatment and harvest were in the range 76-137 days.

In cotton treated with multiple side-dressings (with or without an at-planting treatment) aldicarb residues were in the range <0.02-0.08 mg/kg 55-137 days after the last application. The total amount of aldicarb applied was in the range 2.2-6.7 kg ai/ha.

In gin trash samples derived from cotton treated at planting (0.56-1.1 kg ai/ha) aldicarb residues were all <0.04 mg/kg 128-148 days after treatment. Aldicarb residues in gin trash from cotton that was side-dressed at 2.2-9 kg ai/ha were 0.22-0.32 mg/kg 98 days after treatment.

Summary Cotton

In the Australian trial cotton seed derived from plants treated at seeding at 2× the label rate did not contain quantifiable aldicarb residues (<0.01 mg/kg). Aldicarb residues in cotton seed from US trials were <0.02-0.08 mg/kg (n=27, Table 13) 111-190 days after single at-planting treatments of 1.1-4 kg ai/ha. Only one sample contained aldicarb residues at >0.05 mg/kg. Trials conducted with single at-planting applications of 1.1-4 kg ai/ha (US and Australian trials) were used for estimation of the STMR as the resulting residues were essentially from a single population. The STMR for cotton in trials consistent Australian GAP was estimated to be <0.02 mg/kg.

Although only limited Australian residue data were presented the current MRL for cotton seed (*0.05 mg/kg) is considered to be acceptable. The risk of detectable residues occurring in cotton seed as a result of application of aldicarb at planting is small. The period between planting and normal commercial harvest is expected to be in the range 140-200 days. A withholding period for harvest is not required when aldicarb is used as directed.

4.6.5 Sugar Cane

Reference: Union Carbide Residue Laboratory, South Charleston (1970-71) Residue data for Temik [various summary forms for analysis of sugar cane stalks, leaves and processed fractions, Louisiana, USA].

The references are summary sheets of the analysis of sugar cane commodities from residue trials conducted in Louisiana, USA. Full details of the field and analytical phases of the trials were not provided. Sugar cane was side-dressed on 2 sides with aldicarb granules at treatment rates of 2.2 kg ai/ha or 4.4 kg ai/ha. Samples of leaves and stalks were collected 35-392 days after application and tested for total aldicarb residues according to the method ALDICARB-FPD-SC. The method had a validated LOQ of 0.011 mg/kg.

Aldicarb residues in sugar cane (stalk and leaves) from US residue trials

Location, date	Rate, kg ai/ha	Sample	Aldicarb sulfone, mg/kg, at days after last application				
			35	64	89	123	378/392
Belle Rose, Louisiana, 1970 a	2.2	stalk	0.05	0.10-0.15	<0.01-0.07	<0.011-0.02	-
		leaves	0.26-0.28	0.66-1.26	0.18-1.02	0.04-0.06	-
	4.4	stalk	<0.01-0.14	<0.01-0.18	<0.01-0.03	<0.01	-

		leaves	<0.02-0.86	<0.02-1.39	0.30-0.65	0.08-0.19	-
Barton Rouge, Louisiana, 1967	2.2	stalk	-	-	-	-	<0.01
	4.4	stalk	-	-	-	-	<0.01

Each treatment was applied to duplicate plots that were sampled and harvested separately. Tabulated results show range of residues found.

Samples of stalk taken at harvest (216 days after treatment) from the Belle Rose site were processed at Louisiana State University to give bagasse, dilute juice, clarified juice, syrup, raw sugar and molasses. Aldicarb in the harvested cane stalk and all processed fractions were less than the LOQ of the applied method (0.01 or 0.02 mg/kg). Since the harvested cane did not contain incurred residues a processing study using fortified dilute juice was conducted. Dilute juice was fortified with aldicarb to a level of 0.24 mg/kg and then processed into various fractions. The residue levels in processed fractions were as follows: clarified juice 0.1 mg/kg; syrup 0.21 mg/kg; raw sugar <0.01 mg/kg; molasses 0.034 mg/kg.

Reference: Anonymous (1970) Residue data for Temik [various summary forms for analysis of sugar cane stalks, South Africa].

The reference consists of summary sheets for the analysis of sugar cane stalks from residue trials conducted in Eastern Transvaal, South Africa. Full details of the field and analytical phases of the trials were not provided. Aldicarb was applied by hand broadcasting and incorporated into the soil at rates of 2.8-11.2 kg ai/ha. Samples of stalk were collected 6-90 days after application and tested for aldicarb residues. No reference to the method of analysis was made. Aldicarb residues in untreated cane were <0.02-0.08 mg/kg over the duration of the trial.

Aldicarb residues in sugar cane from South African trials

Rate, kg ai/ha	Aldicarb residues, mg/kg, at days after application						
	6	14	21	27	35	56	90
2.8	0.22	0.31	0.22	0.05	0.11	<0.02	<0.02
5.6	0.34	0.90	0.29	0.15	0.23	0.03	<0.02
8.4	0.84	1.12	0.52	0.27	0.57	0.08	<0.02
11.2	1.18	1.20	0.61	0.28	0.57	0.08	<0.02

References: Anonymous (undated, c) Australian residue trials [extract from a registration submission, residue trials in sugar cane, Cairns, Australia]; Ball, I.S., Almond, R.H. & Woodhouse, R.N. (1978) Certificate of analysis- Analysis of residues of aldicarb in sugar-cane, UNC 74, 19 May 1978, Huntingdon Research Centre, Cambridgeshire, UK.

Summaries of two trials conducted in Cairns, Australia were provided along with a report of analysis generated by Huntingdon Research Centre, UK. Aldicarb was applied by hand to drill holes or open furrows. The granules were “rolled” into the soil or incorporated with a multi weeder. Application rates were in the range 2.8-5.6 kg ai/ha. Soil treatments occurred approximately 7-30 days after sowing the crop. Leaves and stalks were sampled 315-362 days after treatment and analysed for aldicarb residues by GC with FPD. Aldicarb residues were determined as aldicarb sulfone and expressed as aldicarb after applying a correction factor for differences in molecular weight. Recoveries of aldicarb from fortified control stalks were 71% and 90% (spike levels 0.05 mg/kg and 0.1 mg/kg respectively). Recoveries of aldicarb from

fortified control leaves were 83% and 81% (spike levels 0.05 mg/kg and 0.1 mg/kg respectively).

Aldicarb residues were <0.01 mg/kg in all leaves and stalks collected 315-362 days after treatment.

Reference: Ponena Chemicals (Pty) Ltd (undated) Laboratory report. Sugar cane residue analyses results. South Africa. Extract from registration submission, 1969-70, 1979-80 trials. [as cited in JMPR (1994)]

JMPR (1994) reviewed residue data from supervised trials conducted in South Africa. This study was not made available to NRA reviewers. The summary table from the JMPR report is reproduced below.

Aldicarb residues in sugar cane from South African trials

Rate, kg ai/ha	Aldicarb residues, mg/kg, at days after last application				
	60-70	119-123	170-181	187-192	320-330
Untreated	-	0.09, <0.02	-	-	0.06, 0.06
2.24	-	-	<0.02	-	<0.02
3.36	-	-	0.05, 0.33	-	<0.02, 0.11
5.67	-	-	<0.02, 0.09	-	<0.02, 0.04
11.2	-	-	<0.02, 0.13	-	0.06, 0.03
3 [a]	<0.05 (2) 0.12, 0.09	<0.05 (2) 0.03 (2)	0.02 (4)	0.02, 0.03 0.09, 0.15	-

Each result is from a separate trial. Number of results in parentheses.

Summary Sugar cane

No Australian data specifically relevant to the current withholding period of 17 weeks (119 days) were submitted. Aldicarb residues in stalks were <0.01 mg/kg 315-362 days following treatment at approximately 1× and 2× the maximum label rate.

In overseas trials considered to approximate Australian GAP (2.2-3.0 kg ai/ha, PHIs 119-123 days) aldicarb residues in stalks were <0.011, <0.05, <0.05, 0.02, 0.03 and 0.03. Two residues greater than the current MRL (0.02 mg/kg) were therefore observed at the recommended withholding period. At another trial location where plots were treated at approximately 1×-4.5× the maximum rate aldicarb residues were all <0.02 mg/kg 90 days after application.

According to the product label aldicarb must be applied no later than the 3-5 leaf stage. Under these conditions the time that would elapse between treatment and harvest of cane is 9-18 months. There appears to be no sound agricultural reason why a withholding period of 17 weeks was originally recommended. Documents submitted for review (Anon., undated) provide some insight into the original decision with the statement that "The use pattern of TEMIK in sugarcane in Australia will be such that at least a nine to twelve month period will occur between treatment and harvest (although for labelling purposes a with-holding period of 120 days is sought)." It is also noted that the original PACC decision[φ] was to recommend an MRL of *0.02 mg/kg (ie. at or about the limit of analytical quantitation) based on a

[φ] PACC decision, August 1978.

withholding period of 120 days. The current MRL entry is 0.02 mg/kg (ie. a finite value) and it seems likely that the "at or about" designation was inadvertently removed.

While there is no indication that there is any residue problem with aldicarb in sugar cane, it is considered that the withholding period on the product label should reflect good agricultural practice and be defensible in terms of the available residue data. When aldicarb is used according to the label directions (ie. application no later than the 3-5 leaf stage) it is unlikely that quantifiable residues would be present in cane stalks at normal harvest. Under these conditions the current withholding period statement is unnecessary and could lead to confusion. It is recommended that the harvest withholding period statement for sugar cane be amended to: Not required when used as directed. For correctness, it is also recommended that the sugar cane MRL be amended to *0.02 mg/kg.

4.6.6 Grapes

Reference: Magor, B, Good, J. & Lee, A. (undated) Report of analysis. Aldicarb residues in grapes (unnumbered report) Australian Government Analytical Laboratories, Victoria, Australia.

Residue trials on grapes were conducted in Victoria and South Australia. Aldicarb granules were applied in 0.6 m bands on both sides of the rows, commencing 0.2-0.3 m from the centre of the row. Application rates were 2.25-4.5 kg ai/ha. Treatment of vines occurred during shooting (2-10 cm shoots present on the vines). The granules were lightly incorporated into the soil then watered in by irrigation or rain. Plot sizes were 9-18 vines with 6 replications per treatment. Mature fruit were collected from 3 of the 6 replicate plots. Three samples (each from a separate replicate plot) were submitted for analysis. Residues were determined as aldicarb sulfone by GC with FPD. The average recovery of aldicarb residues from fortified samples was 91.5% (n=4, spike level 0.15 mg/kg). The level of reporting for the analysis was set at 0.01 mg/kg as aldicarb sulfone.

Aldicarb residues in grapes from Australian trials

Location, year, variety	Rate, kg ai/ha	PHI	Aldicarb residues, mg/kg
Robinvale, Victoria, 1985, Gordo	2.25	154	0.03
	4.5	154	0.09-0.22
Redcliffs, Victoria, 1986, Sultana	2.25	137	0.01-0.03
	4.5	137	0.03-0.08
McLarenvale, Sth Aust, 1986, Rhine Riesling	2.25	217	<0.01-0.02
	4.5	217	<0.01-0.06

Reference: Clark, D.V. & Shields, R. (1988f) Residue Analysis Report. Determination of residues of aldicarb (Temik®) in grapes, Lab Ref. No. 1276/88/5, 23 May 1988, Analchem Consultants Pty Ltd.

Two residue trials on grapes were conducted in Sunraysia, Victoria. Aldicarb granules were applied in 0.6 m bands on both sides of the rows, commencing 0.2-0.3 m from the centre of the row. Application rates were 2.25-4.5 kg ai/ha. Plots were treated in spring (prior to flowering or at budding) and were re-treated either the following spring or 2 years later. On all occasions the granules were lightly incorporated into the soil then watered in by irrigation or rain. Plot sizes were 2 rows or 18 vines with 6 replications per treatment. Approximately 5

kg of mature fruit were collected from each treatment. Residues were determined as aldicarb sulfone by GC with FPD. The recovery of aldicarb residues from a fortified sample was 107% (0.1 mg/kg). The limit of detection for the analysis stated as 0.02 mg/kg as aldicarb sulfone.

Aldicarb residues in grapes from Australian trials

Location, year, variety	Application dates	Rate, kg ai/ha	PHI, days [a]	Aldicarb residues, mg/kg
Sunraysia, Victoria, 1986/87, Gordo	10/11/86, 22/10/87	4.5	148	0.04
Sunraysia, Victoria, 1985-87, Gordo	9/10/85, 10/9/87	2.25	195	ND (<0.02) [b]
		4.5	195	0.07

PHI refers to days after the last treatment
Residue was reported as "not detected". Limit of detection was 0.02 mg/kg.

Reference: Clark, D.V. & Shields, R. (1988g) Residue Analysis Report. Determination of residues of aldicarb (Temik®) in grapes, Lab Ref. No. 651/88/5, 8 March 1988, Analchem Consultants Pty Ltd.

One trial on grapes was conducted in Riverland, South Australia. Trial details were similar to those previously described for trials in Sunraysia, Victoria. Treatments occurred with 30-40 cm shoots on the vines. Residues were determined in mature fruit as aldicarb sulfone by GC with FPD. The recovery of aldicarb residues from a fortified sample was 107% (spike level 0.1 mg/kg). The limit of detection for the analysis stated as 0.02 mg/kg as aldicarb sulfone.

Aldicarb residues in grapes from Australian trials

Location, year, variety	Application dates	Rate, kg ai/ha	PHI, days [a]	Aldicarb residues, mg/kg
Sunraysia, Victoria, 1986/87, Gordo	11/10/85, 30/10/86	4.5	98	0.17

PHI refers to days after the last treatment

Reference: Myers, W.R & Harrison, S.L (1984) Temik/Grapes. Section D- Residues, Supplement to Pesticide Petition 2F2597, 14 March 1984, Union carbide Agricultural Products Company, North Carolina.

The reference is a submission made to the US EPA seeking residue tolerances for grapes and grape products. A summary of residue data resulting from the treatment of grapevines with aldicarb during the growing seasons of 1979 through to 1983 were presented. All crops received 4.5 kg ai/ha. Fortified samples were analysed for aldicarb sulfoxide and sulfone, either individually or combined. The mean recovery was 90% (range 73-112%, n= 17, spike level 0.2 mg/kg). The maximum residue observed 0.39 mg/kg in a sample taken 110 days after treatment. All results were corrected for recovery.

Aldicarb residues in grapes (US trials 1979-1983)

PHI, days	Aldicarb residues [a], mg/kg, number of results in specified range					
	<0.02	0.02-0.05	0.06-0.1	0.11-0.2	0.21-0.3	0.31+
91-100	1	-	1	1	1	-
101-110	1	3	2	1	1	2
111-120	5	7	3	6	11	4

121-130	8	5	5	8	1	1
131-140	-	-	1	5	3	-

Corrected for recovery

Reference: Anonymous (undated, b) Aldicarb residue determinations in Temik 150G treated vines, unnumbered report, Union Carbide, South Africa.

The reference contains summary data from residue trial conducted in South Africa between 1981 and 1984. Full details of the field and analytical phases were not provided.

Aldicarb residues in grapes and vine leaves from South African trials

Variety	Rate, kg ai/ha	Sample	Aldicarb residues, mg/kg, at days after last application		
			60	120	180 [a]
Clairette Blanch	3.75	Leaves	-	<0.03	-
		Fruit	-	0.05	<0.03
	5.55	Leaves	0.75	10.8	-
		Fruit	-	0.43	0.1
	7.5	Leaves	0.69	12.9	-
		Fruit	-	0.52	0.05
	3.75 + 3.75 [b]	Leaves	0.41	4.0	-
		Fruit	-	0.06	<0.03
Cabernet Sauvignon	3.75	Leaves	6.8	0.6	-
		Fruit	-	0.03	0.06
	5.55	Leaves	8.4	1.34	-
		Fruit	-	0.09	0.04
	7.5	Leaves	10.2	4.3	-
		Fruit	-	0.26	0.09
	3.75 + 3.75 [b]	Leaves	3.1	0.74	-
		Fruit	-	0.05	0.03
Semillon	3.75	Leaves	2.4	4.4	-
		Fruit	-	0.16	-
	5.55	Leaves	4.4	9.35	-
		Fruit	-	0.87	-
	7.5	Leaves	-	14.4	-
		Fruit	-	0.65	-
	3.75 + 3.75 [b]	Leaves	1.6	3.0	-
		Fruit	-	0.15	-
Not stated	3.75	Leaves	1.84	1.94	-
		Fruit	-	0.23	0.06
	5.55	Leaves	3.22	4.43	-
		Fruit	-	0.30	0.16
	7.5	Leaves	8.82	12.2	-
		Fruit	-	0.77	0.1
	3.75 + 3.75 [b]	Leaves	4.14	1.51	-
		Fruit	-	0.17	<0.03
Cabernet Sauvignon	3.75	Fruit	-	-	<0.03 [c]
	3.75 (Autumn)		-	-	<0.03
	5.55		-	-	<0.03
	7.5		-	-	<0.03
	7.5 (Autumn)		-	-	<0.03
	3.75 + 3.75 [b]		-	-	<0.03

Samples of mature fruit were taken “at harvest”. The actual interval between application and harvest was only specified for 1 trial.

Plots were treated in autumn and then in spring. All single treatments were applied in spring (shooting to bud swell) unless otherwise stated.
The PHI for this trial was 173 days.

Summary Grapes

Aldicarb was generally applied to vines as a soil treatment during the spring flush of growth. Aldicarb residues in grapes were <0.01-0.03 mg/kg 137-217 days after treatment at 2.25 kg ai/ha. Residues were <0.01-0.17 mg/kg 98-217 days after treatment at 4.5 kg ai/ha.

In South African trials grape vines were treated at up to 7.5 kg ai/ha. Residues in grapes were 0.05-0.87 mg/kg and <0.03-0.16 mg/kg 120 days after application and at normal harvest respectively. Aldicarb residues in vine leaves sampled 120 days after treatment were typically 10-20× greater than the corresponding fruit residues.

In US trials where vines where treated at 4.5 kg ai/ha aldicarb residues were <0.02-0.39 mg/kg 92-133 days after treatment. The highest residue was observed in a sample taken 110 days after treatment.

According to information received for the Agricultural Assessment aldicarb is occasionally used off-label in Victoria on grape vines. It is not the policy of the NRA to recommend MRLs for off-label use unless that use is covered by a Minor Use Permit. It is recommended that the current entry in the *MRL Standard* (grapes 0.05 mg/kg) be deleted from the *MRL Standard* .

4.6.7 Rotational Crops

Reference: Hunt, T.W. (1992) Field accumulation study on rotational crops. Temik/plant-back residue program, Project No. EC/R-89-002, 5 February 1992, Rhone-Poulenc Ag Company.

The study was conducted at seven test sites in six states of the US. Aldicarb was applied to the primary crops (cotton, potato or sugar beet) at the US label rate. Crops received single at-planting treatments and split treatments. The primary crop was harvested at maturity and rotational crops were planted within one month of the harvest date. The plant-back dates corresponded to intervals of 6-12 months from the date of aldicarb application to the primary crop. Soil samples were collected before and after the initial aldicarb application, before planting the rotational crop and when the last rotational crop was harvested. Rotational crops were harvested at maturity. Samples of green forage and straw were taken where relevant. Soil samples were analysed by HPLC. The mean recoveries of aldicarb, aldicarb sulfoxide and aldicarb sulfone from fortified control samples were 83.4%, 85.3% and 81.1% respectively (n=84, spike level 0.02-2.0 mg/kg). Crop samples were analysed by GC with FPD. Total aldicarb residues were expressed as aldicarb sulfone. Mean recoveries were in the range 81.7-105.4%. Since aldicarb is not registered for use on potatoes or sugar beets in Australia, only the data for rotational crops following cotton have been summarised. The current plant-back (re-cropping) interval on the registered labels is 6 months. This applies to all crops.

Aldicarb residues in rotational crops planted 6-12 months after treatment of a cotton crop

Application	Rotational crop	Maximum residue, mg/kg, at plant-back interval, months			
		6	8	10	12
AP [a]	carrot	ND	0.03		
AP + SD [b]	carrot	ND	0.04		
AP	onion	ND	ND		
AP + SD	onion	ND			
AP	lettuce	<0.02	ND	ND	
AP + SD	lettuce	ND	0.03		
AP	broccoli	<0.02	<0.02	ND	
AP + SD	broccoli	<0.02			
AP	cucumbers		ND	ND	
AP + SD	cucumbers		ND		
AP	cantaloupes		ND	<0.02	
AP + SD	cantaloupes	ND	ND		
AP	wheat- grain	ND	<0.02	ND	
AP + SD	wheat- grain	ND	<0.02		
AP	wheat forage	0.11	<0.02	<0.02	
AP + SD	wheat- forage	ND	0.11		
AP	wheat- straw	<0.02	<0.02	0.04	
AP + SD	wheat- straw	ND	0.04		
AP	corn- silage			ND	ND
AP + SD	corn- silage		<0.02	ND	
AP	corn- grain			ND	ND
AP + SD	corn- grain		ND	ND	
AP	corn- stover			<0.02	ND
AP + SD	corn- stover		ND	<0.02	
AP	tomatoes		ND	<0.02	
AP + SD	tomatoes	ND	<0.02		
AP	alfalfa	ND	<0.02	<0.02	ND
AP + SD	alfalfa	ND	0.06	ND	
AP	barley- grain	<0.02	ND	ND	
AP + SD	barley- grain	ND	ND		
AP	barley- forage	<0.02	<0.02	<0.02	
AP + SD	barley- forage	ND	<0.02		
AP	barley- straw	<0.02	<0.02	0.03	
AP + SD	barley- straw	<0.02	0.02		

Application to cotton at planting only, 1.68-4.48 kg ai/ha
Split application to cotton, 1.68-3.36 kg ai/ha at planting followed by side-dressing of 3.36 kg ai/ha 45-61 days after planting.

Summary Rotational Crops

Quantifiable residues (≥0.02 mg/kg) were not present in most rotational crops (onions, broccoli, cucumbers, cantaloupes, wheat grain, corn, tomatoes, barley grain and barley forage) planted 6-8 months after aldicarb was initially applied to a cotton crop. Low levels of aldicarb (0.03-0.06 mg/kg) were detected in carrots, lettuce and alfalfa with plant-back intervals of 6-8 months. It is unlikely that these crops would be used as rotational crops in cotton or sugar cane in Australia.

Residues of 0.11 mg/kg, 0.04 mg/kg and 0.03 mg/kg were observed in wheat forage, wheat straw and barley straw respectively in crops planted 6-10 months after the at-planting cotton treatment. The application rates in the trials were 1.6-4× the maximum Australian application rate. Scaling for application rate and dry matter content the maximum expected residue under Australian GAP is estimated to be 0.3 mg/kg in wheat forage [0.11 mg/kg × 100%/25% DM ×

1.05 kg ai/ha/1.68 kg ai/ha]. Animals consuming forage containing aldicarb at this level, even at 100% of the diet, are unlikely to accumulate quantifiable residues in tissues or milk.

The plant-back restriction on the current product labels (DO NOT sow any edible crops for 6 months after the last application) is considered to be adequate.

4.6.8 Animal Feed Commodities and Animal MRLs

There are currently no entries in Table 1 or Table 4 of the *MRL Standard* for animal products and animal feed commodities respectively. Based on the currently registered uses of aldicarb (ie. on the currently approved labels) animal feed commodities could potentially be derived from citrus, cotton and sugar cane. Based on the MRL in the raw agricultural commodity (RAC) and relevant processing factors the expected aldicarb residues in various feed items are shown below:

Expected residues in animal feed commodities

Crop	MRL	Feed item	% DM [a]	Processing factor	Feed level, ppm, at 100% of diet
citrus	0.05	pulp, dried	91	1.75	0.01
cotton	*0.05 (seed)	seed	90	1	0.05 [b]
		meal, hulls	90	3	0.17 [b]
sugar cane	0.02	molasses	75	0.15 [c]	<0.01

% Dry matter
Assumes that the residue in cotton seed at harvest is 0.05 mg/kg. Since the MRL is actually *0.05 mg/kg (at or about the limit of quantitation) it is unlikely that quantifiable residues would occur in the raw agricultural commodity.
Based on a processing factor obtained by processing fortified juice to molasses (rather than processing cane stalks with incurred residues).
No data for cane tops or leaves were provided

Cotton forage (in a failed crop situation), cotton stubble and cotton trash are also potential feed items through which animal transfer of aldicarb residues could occur. Limited data for cotton forage was presented (DeWitt, 1983) indicating that pre-plant applications of 2.25-4.5 kg ai/ha could result in forage residues of up to 5 mg/kg 60 days after planting. In a metabolism study with radiolabelled aldicarb residues (sum of aldicarb aldicarb sulfoxide and aldicarb sulfone) in cotton foliage were 185.6 mg/kg, 85.5 mg/kg and 26.3 mg/kg 14, 22 and 37 days after an in-furrow application of 1.12 kg ai/ha. In immature (3 leaf stage) wheat plants aldicarb residues were 86 mg/kg 42 days after treatment at an application rate that approximates the label rate for cotton.

In animal transfer studies with lactating cows the average carbamate residue (aldicarb sulfoxide + aldicarb sulfone) observed in milk during 14 days feeding at 1.2 ppm in the diet was 2.7 µg/kg aldicarb equivalents. Total radioactive residues in meat, liver and kidney at sacrifice were 0.004, 0.163 and 0.016 mg/kg aldicarb equivalents respectively. In lactating goats administered radiolabelled aldicarb (up to 2.5 ppm daily in the feed) the maximum carbamate residues in milk, meat and liver were 0.26, 0.10 and 1.48 µg/kg aldicarb equivalents respectively. The highest dietary burden would occur with the feeding of cotton meal or hulls at 100% of the diet (feeding level 0.17 ppm in diet, assumes finite residue of 0.05 mg/kg in the raw commodity). Assuming residues scale proportionately with dose the

expected residues in animal tissues from feeding at this level would be <0.002 mg/kg. The LOQs of the residue analytical methods for animal commodities are 0.01 mg/kg.

There is a risk of detectable aldicarb residues in animal commodities if cotton forage, in a failed crop situation, is fed to livestock. Cotton forage residues may potentially be well in excess of the feed levels investigated in animal transfer studies. Given the time between application and harvest the residues in cotton stubble and gin trash are unlikely to be significant, however, residue data for these items were not available.

The labels of registered aldicarb products contain the following restraint that applies to all crops: "Do not allow stock to graze in treated area. Do not cut treated crop for stock food". It is also noted that under current good agricultural practice the feeding of gin trash is not encouraged. It is considered that the current label restraints adequately cover potential feeding of cotton forage and stubble. The following additional animal feeding restraint is recommended to specifically cover potential feeding of cotton trash: "Do not feed cotton trash to animals".

Although grazing restrictions are in place the fate of treated produce cannot always be strictly controlled. However, in the case of aldicarb the overall risk of detectable residues occurring in animal commodities is small provided cotton forage is not used as a feed item. It is recommended that the grazing restraints remain in place and that MRLs be established at or about the limit of quantitation for meat, milk and offal. Residue analytical methods capable of determining aldicarb residues down to 0.01 mg/kg were provided.

A study using fortified samples of homogenised liver (Hudson & Romine, 1986) showed that aldicarb sulfoxide and sulfone were completely depleted after 1-3 days frozen storage. Residues of aldicarb sulfoxide and sulfone were, however, observed in liver samples in the goat metabolism study. The difference in the apparent stability of residues may be related to differences in the nature of the residue (fortified versus incurred) or the way tissues were stored (homogenised versus whole).

4.6.9 Fate of Residues in Processing

Citrus

Reference: Myers, W.R. (1985) The determination of the anticipated residue values of aldicarb in potatoes and citrus, File No. 33917, 18 December 1985, Union Carbide Agricultural Products Company Inc., NC, USA.

The reference included summary tables containing residue data for various citrus fractions derived from field-treated fruit. Full details of the field and analytical phases of the trials were not provided.

Aldicarb residues in processed citrus commodities

Fraction	Residue, mg/kg, in sample				Mean processing factor (range)
	A [a]	B [a]	C [b]	D [c]	
Ripe fruit	0.07	0.24 [d]	0.53	0.77	
Washed fruit	-	-	0.59	0.93	1.16 (1.1-1.2)
Finisher pulp	-	-	-	0.27	0.35

Wet pulp	-	0.13	-	-	0.54
Dried pulp	-	0.42	-	-	1.75
Chopped peel	0.08	-	-	1.87	1.79 (1.14-2.43)
Wet peel	0.04	0.57	0.69	-	1.42 (0.57-2.38)
Dry peel	0.06	-	1.10	4.95	2.78 (0.86-6.43)
Juice-dilute	0.18	0.11	0.18	0.23	0.92 (0.30-2.57)
Juice-concentrate	0.02	-	0.19	-	0.32 (0.29-0.36)
Press liquor	0.04	-	<0.01 [e]	1.25	0.74 (0.02-1.62)
Press liquor-concentrated	0.03	0.04	<0.01	-	0.20 (0.02-0.43)
Oil	0.02	0.02	<0.01	0.02	0.10 (0.02-0.29)
Oil water	-	-	0.09	-	0.17
Molasses	-	-	-	2.45	3.18
Emulsion water	-	-	-	0.27	0.35
Peel frits	-	-	-	1.55	2.01

Treatment rate 22.4 kg ai/ha
Treatment rate not specified
Treatment rate 67.3 kg ai/ha
Residue in whole fruit calculated from peel and pulp results, assuming pulp and peel account for 75% w/w and 25% w/w respectively of the whole fruit weight.
Residue levels <0.01 mg/kg were assumed to be 0.01 mg/kg for calculation of processing factors.

References: Anonymous (undated, a) AGAL Report of analysis- Addendum to report on aldicarb residues in oranges, AGAL unnumbered report, Australian Government Analytical Laboratories, Vic, Australia; Anonymous (1975b) Magnitude of the residue [citrus], Unnumbered report, 1975, Union Carbide Corporation, West Virginia, USA; Anonymous (1975a) [Various residue trial summary reports] Union Carbide Corporation, West Virginia, USA; Gunther, F.A. et al (1975) Aldicarb (Temik) residues in oranges, orange leaves, and soil after soil application in an orange grove, Unnumbered report, 3 January 1975, University of California, Riverside; Anonymous (1988) Report of analysis- Aldicarb residues in oranges, AGAL unnumbered report (1988) Australian Government Analytical Laboratories, Vic, Australia; Maitlen, J.C. & McDonough (1967) Report of residue analysis, PCY-67-5, 31 May 1967, United States Department of Agriculture, Washington, USA.

Trials in the abovementioned references were not necessarily designed as processing studies *per se*, however, information on the fate of aldicarb residues in various citrus fractions can be obtained from analysis of the results. The trials have been described fully elsewhere and results are summarised in Tables 11, 13, 14 and 18. In the US trials the mean aldicarb concentration in orange peel was 3.9× the concentration in pulp (range 0.8-11.5×). In the Australian trials the mean concentration factor for peel relative to pulp was 3.3× (range 0.5-9). The mean concentration factor pulp relative to whole fruit was 0.6 (range 0.25-1.33). The concentration of aldicarb residues in juice was 2.2× that in whole fruit (range 1.0-3.7×). [Results where peel or pulp residues were less than the LOQ of the analytical method were not included in calculations; where aldicarb and its metabolites were determined separately the concentration factors were based on the sum of components; where replicate determinations were made the concentration factors were based on the mean residue value]

Cotton

Reference: Union Carbide Corporation (1979) Temik-Cotton, USA. The amount, frequency and time of application of the pesticide chemical, Extracts from the EPA submission used for JMPR in 1979. [as cited in JMPR (1994)]

JMPR (1994) reviewed processing data for cotton commodities. The studies were not made available to NRA reviewers. Cotton seed samples from residue trials with deliberately exaggerated treatments in four States of the USA were processed to obtain oil, meal and hull fractions. Solvent extraction of the oil led to somewhat higher residues in the meal than the screw-press method. This was attributed to less severe thermal exposure with the solvent extraction technique. It was stated that residues containing the carbamate moiety are degraded by the alkaline refining process. The summary table from the JMPR report is reproduced below.

Aldicarb residues in processed cotton commodities

Fraction	Residue, mg/kg, in sample [a]					
	A	B	C	D [b]	E [b]	F
Cotton seed	0.05	0.02	0.06	<0.02	0.027	0.02
Hulls	0.15	0.03	0.17	0.018	0.024	0.005
Oil (crude extracted)	<0.003	<0.003	0.004	-	-	<0.003
Oil (refined extracted)	<0.003	<0.003	<0.003	-	-	<0.003
Oil (crude pressed)	<0.003	<0.003	0.004	<0.003	<0.003	<0.003
Oil (refined pressed)	<0.003	<0.003	<0.003	-	-	<0.003
Meal (extracted)	0.014	0.002	0.03	-	-	<0.003
Meal (pressed)	<0.003	0.002	0.006	<0.003	<0.003	<0.003

Treatment rates in field trials: A: 4.5 kg ai/ha, 91 days PHI; B: 1.12 kg ai/ha + 9 kg ai/ha, 108 days PHI; C: 2,24 + 2.24 + 4.5 kg ai/ha, 82 days PHI; D: 0.56 + 4.6 kg ai/ha, 99 days PHI; E: 0.56 + 4.5 kg ai/ha, 76 days PHI; F: 1.12 + 4.5 kg ai/ha, 104 days PHI.
Samples from D and E were pressed but not extracted. Crude oil was not refined.

Grapes

Reference: Clark, D.V. & Shields, R. (1988b) Residue Analysis Report- Determination of residues of aldicarb (Temik) in wine, Lab ref no. 331/88/5, 19 February 1988, Analchem Consultants Pty Ltd; Clark, D.V. & Shields, R. (1988c) Residue Analysis Report- Determination of residues of aldicarb (Temik) in wine, Lab ref no. 3051/87/5, 18 January 1988, Analchem Consultants Pty Ltd; Clark, D.V. & Shields, R. (1988d) Residue Analysis Report- Determination of residues of aldicarb (Temik) in wine, Lab ref no. 1575/88/5, 27 June 1988, Analchem Consultants Pty Ltd; Ewart, A.J.W. (1987) Temik trial-1987, 10 August 1987, Roseworthy Agricultural College.

One residue trial was conducted in McLaren Vale, South Australia.. Aldicarb granules were applied in 0.6 m bands on both sides of the rows, commencing 0.2-0.3 m from the centre of the row. The granules were incorporated to a depth of 5 cm and watered in by rain. Application rates were 2.25-4.5 kg ai/ha. Plots were treated on three occasions in consecutive years. The vines were shooting (10 cm shoots) at the second application and flowering at the time of last treatment. Plot sizes were 9 vines (3 panels) with 6 replications per treatment. Approximately 5 kg of mature fruit were collected from each treatment 196 days after the first treatment and 130 days after the last treatment. A composite sample of 15 kg from each treatment was submitted to Roseworthy Agricultural College for wine making. The grapes were processed using standard procedures for white wine production. The wines were fined,

cold stabilised and membrane filtered into bottles. Residues were determined as aldicarb sulfone by GC with FPD. The recoveries of aldicarb residues from fortified wine samples were 75-97% (spike level 0.025-0.1 mg/kg). The limit of detection for the analysis stated as 0.005 mg/kg (or 0.01 mg/kg) as aldicarb sulfone. Grapes were not analysed for aldicarb residues prior to wine production.

Aldicarb residues in wine (Australia)

Location, year, variety	Application dates	Rate, kg ai/ha	PHI, days [a]	Aldicarb residues, mg/kg
McLaren Vale, SA, 1988, Rhine Riesling	26/9/85 8/10/86	2.25	196	ND [b], 0.011
		4.5	196	0.012, 0.016
	26/9/85 8/10/86 8/11/87	2.25	130	ND [c]
		4.5	130	0.023

PHI refers to time between last application and harvest. Bottling of wine from samples collected after the 2nd treatment occurred 100 days after harvest. Harvest to bottling period was not specified for grapes collected after the 3rd treatment.
Limit of detection specified as 0.005 mg/kg.
Limit of detection specified as 0.01 mg/kg.

Reference: Clark, D.V. & Shields, R. (1988e) Residue Analysis Report- Determination of residues of aldicarb (Temik) in sultanas, Lab ref no. 976/88/5, 22 April 1988, Analchem Consultants Pty Ltd

One trial was conducted in Redcliffs, Victoria. Vines were treated annually over 3 consecutive years. Treatment details were similar to the McLaren Vale wine residue study. Dried berries were sampled 128 days after the last treatment. It is assumed that berries dried on the vine. No details of moisture content were provided. No detectable residues of aldicarb were observed in sultanas derived from vines that had been treated at 2.25-4.5 kg ai/ha. The recovery of aldicarb from fortified sultanas was 73% (spike level 0.12 mg/kg).

Reference: Ewart, A.J.W. (1988) Evaluation of the effect of the nematocide Temik on the fermentation rate and quality of a white table wine, June 1988, Roseworthy Agricultural College; Tromp, A. (1988) The effect of Temik 150G aldicarb pesticide on fermentation and quality Internal Oenological and Viticultural Research Institute Report-1984/85, 8 April 1988.

Studies were conducted in Australia and South Africa to determine the effect of aldicarb residues on wine production. Vines were treated at 3.75-7.5 kg ai /ha in the South African trial. Application rates were not specified for the Australian trial. Grapes harvested from the treated vines were used in wine production. It was concluded that previous treatment with aldicarb did not adversely affect the fermentation rate or wine quality.

Reference: Myers, W.R & Harrison, S.L (1984) Temik/Grapes. Section D- Residues, Supplement to Pesticide Petition 2F2597, 14 March 1984, Union carbide Agricultural Products Company, North Carolina.

The reference is a submission made to the US EPA seeking residue tolerances for grapes and grape products. A summary of residue data resulting from processing of treated grapes was presented. All trials were conducted in the USA and crops were treated at 4.5 kg ai/ha. Unless otherwise stated the residue levels presented are the mean of 3 determinations.

Aldicarb residues in dry raisins and raisin trash derived from grapes previously treated with aldicarb.

Location, year	Ripe berries, mg/kg	Dry raisins, mg/kg (conc. factor)	Raisin trash, mg/kg (conc. factor)
CA, 1981	0.10	0.08 (0.8)	0.87 (8.7)
CA, 1981	0.20	0.39 (1.95)	2.5 (12.5)
CA 1981	0.27	0.26 (0.96)	2.7 (10)
CA, 1981	0.05	0.03 (0.6)	0.15 (3)
Mean conc. factor	-	1.1	8.6

Aldicarb residues in fresh juice and dry pomace derived from vines previously treated with aldicarb.

Variety	Ripe berries, mg/kg	Fresh juice, mg/kg (conc. factor)	Dry pomace, mg/kg (conc. factor)
Tokay	0.16	0.11 (0.69)	0.10 (0.63)
French Collambard	0.17	0.10 (0.59)	0.31 (1.8)
Thompson Seedless	0.10	0.08 (0.8)	0.09 (0.9)
Cabernet Sauvignon [a]	0.16	0.13 (0.81)	0.50 (3.1)

Single determination only. Residues also determined in crushed berries 0.16 mg/kg (processing factor 1.0); wet pomace 0.17 mg/kg (1.1); new wine 0.10 mg/kg (0.63); aged wine 0.10 mg/kg (0.63).

Reference: Anonymous (1985) Aldicarb residues in grape products from simulated commercial wine processing, unnumbered report, 26 February 1985, Union Carbide Agricultural Products Company, North Carolina, USA.

Processing data for 8 varieties of grapes were presented. The studies were conducted between 1976 and 1983. Results for the 1976 study with Thompson Seedless grapes were considered invalid by the author of the report since a concentration of residues was observed in both juice and pomace. The residue material balance requires that both fractions cannot have greater residues than the starting fruit.

Aldicarb residues in processed grape products derived from vines previously treated with aldicarb.

Variety, year	Residue in fresh berries, mg/kg	Concentration factor (relative to mature berries)			
		fresh juice	Pomace	new wine	aged wine
Cabernet sauvignon	0.16	0.81	1.1	0.63	0.63
French Colombard	1.5	0.87	1.4	0.73	0.44
Tokay	0.17	0.53	0.94	0.35	0.29
Carignane	1.2	0.60	0.73	0.64	0.30
Ruby Cabernet	2.5	0.60	0.96	0.34	0.19
Emperor	0.04	0.75	0.75	ND	ND
Pinot Chardonnay	3.3	0.79	0.94	0.70	-
Thompson Seedless	0.72	2.5	1.9	3.2	-
Mean (range) [a]	-	0.71 (0.53-	0.97 (0.73-	0.57 (0.35-	0.37 (0.19-

		0.87)	1.4)	0.73)	0.63)

Results for Thompson Seedless trial not included. Results of ND not included in calculation of mean.

4.6.10 Fate of residues in Storage

Citrus

Reference: Tew, E.L. (1994) Aldicarb fresh-market orange monitoring study, EC-92-216, 1 February 1994, Rhone-Poulenc Ag Company, NC, USA.

Full details of this study have been reported elsewhere (see 4.7.2). As an adduct to the main study the orange pulp samples that were found to contain the highest aldicarb residues were reanalysed after a period of frozen storage at –20°C. Initial residue levels were in the range 0.04-0.12 mg/kg. The average change in aldicarb residues was +3% (range –10 to +24%) following 49-168 days frozen storage. The wide range observed in the results for percentage change is most likely due to the relatively low residue levels being determined. The precision of the analytical method at such levels would not be optimal and apparent changes in residue level would be heavily influenced by the inherent variability in the test procedure.

Reference: Union Carbide Corporation (1973a) A method for determination of total toxic aldicarb residues in peanut foliage and peanut hay by gas chromatography, ALDICARB-FPD-PNUT FOL, February 1973, Union Carbide Corporation, West Virginia, USA; Union Carbide USA (undated) Part II. Description of analytical methods, unnumbered report.

The stability of aldicarb residues in potato tubers and bananas was reported as an adduct to the analytical methodology. Banana samples containing aldicarb residues were analysed and then stored frozen (-10°F) for up to 3 months before re-analysis. Residue values after storage were 76-117% of the initial values. Potato tuber samples containing aldicarb residues were analysed and then stored frozen (-10°F) for up to 29 months before re-analysis. Residue values after storage were 65-107% of the initial values.

Animal Commodities

Reference: Hudson, J.R. & Romine, R.R. (1986) Temik aldicarb pesticide, Stability of residues in frozen milk and beef liver, Project number 803R12, File number 34626, 25 April 1986, Union Carbide Agricultural Products Company, Inc., North Carolina, USA.

Experiment: Bulk samples of raw (unpasteurised) milk were fortified with aldicarb sulfoxide or aldicarb sulfone at a level of 0.1 mg/kg. The bulk samples were mixed well and then divided into 15 subsamples of 200 g each. Three subsamples from each lot (sulfoxide or sulfone fortification) were analysed immediately and the remainder stored at –20°C. Three subsamples from each lot were analysed after 0.5, 1, 3 and 6 months storage. At each sampling time, one untreated control sample was fortified at 0.1 mg/kg with aldicarb sulfoxide and another at 0.1 mg/kg with aldicarb sulfone. The freshly fortified samples, the stored fortified samples and one unfortified sample were analysed for aldicarb residues using GC-FPD (method UC 21149-III-Milk). A bulk portion of homogenised beef liver was divided into 50 gram subsamples. The subsamples were fortified with 0.1 mg/kg of aldicarb sulfoxide or 0.1 mg/kg of aldicarb sulfone. Three subsamples from each lot (sulfoxide or sulfone fortification) and three untreated control samples were analysed immediately and the

remainder stored at –20°C. Three subsamples from each lot were analysed after 1 and 3 days frozen storage. At each sampling time, one untreated control sample was fortified at 0.1 mg/kg with aldicarb sulfoxide and another at 0.1 mg/kg with aldicarb sulfone. The freshly fortified samples, the stored fortified samples and one unfortified sample were analysed for aldicarb residues using GC-FPD (method Aldicarb-FPD-General).

Results: In milk aldicarb sulfoxide recoveries were in the range 75-107% (relative to freshly fortified samples) over 0-3 months frozen storage. No result for the fresh fortification solution at the 6 month analysis point was reported. Aldicarb sulfone recoveries were in the range 82-107% (relative to freshly fortified samples) over 0-6 months frozen storage. In liver aldicarb sulfoxide was extensively degraded after 1 days storage (15% recovery relative to fresh fortification) and completely degraded after 3 days storage (no residue detected in aged sample). Aldicarb sulfoxide was completely degraded after 3 days storage (no aldicarb residue detected in aged sample).

JMPR Summary

Reference: JMPR (1994) FAO Plant Production and Protection Paper, 131/1. Evaluations. Part 1-Residues. Volume 1. 19-28 September 1994, Rome, 1995. [aldicarb monograph]

In its appraisal of the submitted data the Meeting concluded that aldicarb sulfoxide and aldicarb sulfone were shown to be stable under deep-frozen storage for at least nine months in oranges, six months in milk, six weeks in potato processing products (chips, flakes, granules, wet and dry peel) and in soya bean processing products except soapstock. It was stated that in frozen beef liver 85% of aldicarb sulfoxide and >99% of the aldicarb sulfone were lost within one day.

4.7 Analytical Methodology

Numerous residue analytical methods for the determination of aldicarb residues in a range of agricultural commodities were submitted. These can be found in the reference list.

4.7.1 Gas Chromatographic Methods

The methods utilising gas chromatography are based on the ALDICARB-FPD-GENERAL method (Union Carbide Corporation, 1973). The generic procedure has been varied slightly to accommodate different sample matrices. Residues are extracted from non-oily matrices by blending with an acetone/water or acetone/chloroform mixture. Aldicarb residues are simultaneously oxidised to the sulfone form by the addition of peracetic acid. The extract is neutralised, filtered and the residues are extracted into chloroform. The chloroform extract is concentrated and then cleaned up on a florisil column. Residues are determined as aldicarb sulfone [φ] by GC with FPD in the sulfur mode. Quantification is by comparison with a calibration curve derived from the injection of standard solutions containing aldicarb sulfone. The validated LOQs for various matrices were in the range 0.01-0.3 mg/kg (total aldicarb residues).

[φ] Carey and Helrich (1970) indicate that aldicarb sulfone is degraded to aldicarb sulfone nitrile in the hot GC injector port. It is the thermal degradation product that is actually detected.

In oily matrices the oil is dissolved in hexane and then partitioned with acetonitrile to give a relatively oil-free extract. Residues in the acetonitrile extract are oxidised with peracetic acid and cleaned up on a florisil column. Quantification is the same as that described for non-oily matrices.

In the methods for potato and potato products (Union Carbide Corporation, 1966 & 1969) the extract is fractionated on the florisil column to give separate extracts containing aldicarb, aldicarb sulfoxide and aldicarb sulfone. The fractions are analysed separately following oxidation with peracetic acid. The original residue levels of the individual components are then calculated using correction factors to allow for differences in molecular weight. The determination of aldicarb in milk requires precipitation of milk-solids with phosphoric acid prior to extraction with chloroform. Clean up and quantification procedures for milk are the same as for other matrices described earlier.

Recovery of aldicarb from fortified samples (GC method)

Matrix	Fortification range [a]	Mean recovery, % [b]
Sugar cane stalk	0.011-4.4	89 (71-114, n=38)
Cottonseed	0.011-0.488	97 (75-120, n=47)
Potato tubers	0.01-1.1	92 (77-127, n=32)
Potato products (chips, flakes, fries, canned, boiled, baked)	0.02-1.8	97 (82-123, n=12)
Peanuts (whole, kernels, shells)	0.02-0.18	106 (85-127, n=19)
Peanut foliage and hay	0.09-44	82 (68-119, n=16)
Peanut oil (crude and refined)	0.02-0.09	105 (89-118, n=11)
Peanut meal	0.01-0.04	118 (109-136, n=11)
Orange	0.02-0.44	87 (72.8-109, n=16)
Lemon, lime, grapefruit	0.09-0.5	91 (72-106, n=11)
Banana	0.02-1.1	96 (73.3-127, n=25)
Tomato	0.04-0.5	86 (70-98, n=14)
Grapes	0.04-0.89	87 (73-106, n=13)
Wheat forage	0.3-0.6	92 (78-108, n=10)
Wheat grain	0.15-0.3	97 (80-110, n=11)
Wheat straw	0.25-0.75	84 (71-123, n=13)
Barley forage	0.3-0.6	89 (74-99, n=8)
Barley grain	0.15-0.3	97 (85-114, n=8)
Barley straw	0.15-0.25	92 (88-97, n=6)
Oat forage	0.3-0.4	95 (82-103, n=8)
Oat grain	0.15-0.3	94 (89-97, n=4)
Oat straw	0.25	90 (88-92, n=3)
Cucumbers	0.3-0.4	91 (80-97, n=5)
Cantaloupes	0.3-0.4	86 (78-96, n=6)
Watermelon	0.3-0.4	86 (84-88, n=5)
Broccoli	0.15-0.3	106 (72-124, n=6)
Alfalfa	0.2-0.6	91 (79-100, n=11)
Milk	0.002-0.04	90 (67-121, n=30)

Samples were fortified with a single component or a mixture of aldicarb sulfoxide + aldicarb sulfone. Fortification levels refer to the total amount of carbamate added, whether it was a single component or a mixture.
Mean of all recovery experiments at all fortification levels. Numbers in parentheses are the ranges of results.

4.7.2 HPLC methods

In the HPLC procedure samples are extracted by stirring with a dichloromethane/acetone solvent mixture. Animal commodities are further cleaned up by solvent partitioning with hexane and acetonitrile. The extract is filtered, concentrated and then cleaned up on a florisil or charcoal column. The residue components are detected separately by reverse phase HPLC with post-column derivitisation and fluorescence detection. Each residue component is quantified separately based on individual calibration curves derived from injection of mixed carbamate standards.

Recovery of aldicarb from fortified samples (HPLC method)

Matrix	Fortification range [a]	Mean recovery, %		
		Aldicarb	Aldicarb-SO	Aldicarb-SO_2
Banana	0.01-2.5	86 (72-104, n=25)	90 (76-110, n=25)	95 (84-110, n=25)
Potato	0.05-1.0	78 (70-88, n=12)	83 (78-90, n=12)	90 (82-100, n=12)
Whole egg	0.01-0.1	89 (70-93, n=10)	87 (78-104, n=10)	97 (84-107, n=10)
Beef meat	0.01-0.1	86 (79-92, n=9)	101 (93-109, n=10)	104 (98-110, n=10)
Fat	0.01-0.1	83 (74-89, n=10)	103 (91-109, n=10)	96 (90-100, n=10)
Poultry meat	0.01-0.1	88 (79-94, n=9)	93 (88-100, n=10)	101 (90-106, n=10)
Liver	0.01-0.1	82 (71-92, n=10)	84 (75-89, n=10)	88 (77-92 (n=10)
Kidney	0.01-0.1	84 (75-91, n=10)	88 (79-96, n=10)	98 (87-103, n=10)

Fortification level of each component

Comment: Recoveries for animal products were very good, however, no indication of extraction efficiency was provided. In the goat metabolism study the radioactivity in tissues and milk was generally well extracted using acetonitrile and acetonitrile/water mixtures.

4.8 Dietary Exposure Assessment

4.8.1 Chronic Dietary Exposure

The chronic dietary risk is estimated by the National Estimated Daily Intake calculation encompassing all registered/temporary uses of the chemical and dietary intake data from the 1995 National Nutrition Survey of Australia. The NEDI calculation is made in accordance with accepted guidelines. [Φ]

The NEDI for aldicarb is equivalent to 13% of the ADI. It is concluded that the chronic dietary exposure is small and the risk is acceptable.

4.8.2 Acute Dietary Exposure

Using the currently accepted deterministic methodology the acute dietary risk is estimated by the National Estimated Short Term Intake Calculation (NESTI).

The use on citrus was the only use considered relevant in assessing the acute dietary risk of aldicarb. The NESTI for aldicarb in oranges and mandarins is equivalent to 17% and 6% of the acute RfD respectively (whole population). The NESTI for children 2-6 years old is 56% and 20% of the acutr RfD for oranges and mandarins respectively.

[Φ] Guidelines for predicting dietary intake of pesticide residues (revised), World Health Organisation, 1997.

4.9 Residue Conclusions

Adequate Australian residue data were provided to support all currently registered use patterns of aldicarb. There are currently a number of MRLs listed in the MRL Standard that do not have a corresponding registered use pattern. The MRLs for these commodities will be recommended for deletion.

In the case of cereal grains and grape vines there is some history of registered use patterns, however, these crops are not listed on the labels of currently registered products. The MRLs for cereal grains and grapes will initially be made temporary. Unless there is a clear commitment from Registrants or States to redefine use patterns and pursue registered uses then the MRLs will be deleted 12 months after the finalisation of the review.

In cases where quantifiable residues are unlikely to occur in animal commodities it is usual practice to recommend MRLs "at or about the limit of analytical determination". Suitable residue analytical methods have been provided and the MRL Standard will be revised to include appropriate animal commodity MRLs.

In respect of residues aspects the continued registration of aldicarb is supported.

It is recommended that:

the following changes be made to the *MRL Standard*

Table 1

Compound		Food	MRL (mg/kg)
Aldicarb			
Delete:	GC 0080	Cereal grains	*0.02
	FB 0269	Grapes	0.05
	VR 0589	Potatoes	0.2
	FB 0275	Strawberry	0.2
	GS 0659	Sugar cane	0.02
Add:	GS 0659	Sugar cane	*0.02
	ML 0106	Milks	*0.01
	MM 095	Meat [mammalian]	*0.01
	MO 0105	Edible offal (mammalian)	*0.01

- the harvest withholding period for plant and ratoon cane be amended to : "Not required when used as directed".

- the following additional feeding restriction be incorporated into the product labels: "Do not feed cotton trash to animals".

Residue Definition
The current residue definition for aldicarb is:

Aldicarb Sum of aldicarb, its sulfoxide and its sulfone, expressed as aldicarb

The Australian residue definition is the same as the CODEX residue definition and is considered adequate based on the review of aldicarb metabolism in plants and animals.

4.10 Trade

4.10.1 Summary of Trade

The information available on the potential effects of the withdrawal of aldicarb, or modification of its availability, on the export of agricultural commodities has been examined and an estimate made of the impact on Australian trade with other countries. It is emphasised that this report focuses only on the export market and does not draw any conclusions on the impact of regulatory activity in relation to on the domestic market. Because the domestic market is, in most cases, larger than the export market, the impacts will be greater.

Aldicarb is registered for use in three of Australia's most significant export crops. These are citrus (oranges and mandarins), cotton and sugar cane. However, the potential for residues or any other aspect of aldicarb use to adversely affect trade is considered to be minimal.

In both sugar cane and cotton, the chemical is soil applied in granular form either at planting or, in the case of ratoon cane, very early in the growth of the next crop. Because of this use pattern it is expected that residues in both of these crops would be very low and in fact the MRLs for raw sugar and cottonseed bear out this expectation.

The sugar industry has commissioned residue testing to ensure that residues in raw sugar meet the required MRL and to date residues of aldicarb have not been detected.

A number of detections have occurred in oranges. Although none of these have been above the MRL (which is lower than the MRLs set by most of Australia' trading partners), the occurrence of these residues may support suggestions from State agricultural authorities that Good Agricultural Practice as defined on the labels of aldicarb products is not always followed. For example, it may be that a full 26 week withholding period may not be observed in all cases.

There is some incompatibility between Australian MRLs and those of some trading partners in that there are some cases where there is an Australian MRL set and there are no MRLs set in the importing country. As an example the EEC nor Codex have an MRL set for aldicarb in sugarcane.

It is noted however, that Australian MRLs are set at or very close to the limits of analytical quantitation. Violative residues of aldicarb have not been detected in Australia in any of the commodities traded and the use patterns now in place for crop protection are unlikely to result in residues which could adversely affect trade.

4.10.2 Use patterns in relevant countries overseas

In the USA, aldicarb is only used as a granular formulation to control certain insects, mites and nematodes on citrus (grapefruit, lemons, limes, oranges only), cotton, dry beans, ornamentals, peanuts, sorghum, soybeans, sugar beets, sweet potatoes, pecans (Southeast and state labels in Arizona, New Mexico, Texas); sugarcane (Louisiana only); tobacco (North Carolina and Virginia only).

The insects for which control is claimed include aphids, mites, Colorado potato beetle, thrips, lygus, fleahoppers, boll weevils, fleabeetles, wireworms, leafminers, webworms, mealy bugs, and leafhoppers. The nematodes for which control is claimed include spiral, ring, lesion, dagger, root-knot and stubby species.

The use rates approved vary between 0.5 and 10 lb ai/acre (0.6-12 kg ai/ha). Comparative Australian rates are 0.45 to 2.5 kg ai/ha. It is applied as an in-furrow treatment at planting time. Also broadcast and side-dress treatments may be utilised.

4.10.3 Registered uses

The registered uses which could have an impact on Australia's trade with other countries involve control of early insect pests in cotton, and control of nematodes in oranges (non-trifoliata rootstocks) and sugar cane. There is an off-label use which was advised by the Victorian Department of Natural Resources for control of nematodes in vineyards. Clearly, this use may also have implications for both wine and table grape exports.

4.10.4 Food Commodities

The only crops which may have some significance in relation to food consumption are oranges and sugar cane and the off-label use in vineyards. Although cotton is a source of cottonseed oil, use of aldicarb is in the first six weeks of the crop and aldicarb residues above the limit of detection in cottonseed oil would be unlikely. In any case, the Australian MRL for cotton is set at the limit of analytical quantitation and therefore compliance with Australian Good Agricultural Practice will ensure compliance with overseas MRLs. Nevertheless, there do not appear to have been any residue surveys conducted on cottonseed and it may be useful to include such a programme in one of the existing surveys.

In addition there is a plant back period of 6 months specified for all food crops. This period ensures that residues will not occur in food crops planted subsequently to, for example, sugar cane or cotton. There is also a prohibition against planting food crops between rows treated with aldicarb or harvesting vegetation for human or animal consumption for 6 months after the last application of aldicarb.

In relation to citrus, there is a recommendation for use in non-bearing citrus and a prohibition on using it less than 26 weeks before harvest in oranges. Once again, the presence of residues is unlikely. In relation to sugar cane, there is a prohibition against applying this chemical less than 17 weeks before harvest.

4.10.5 Exports to other countries

Sugar Cane

Australia is one of the worlds largest exporters of raw sugar with approximately 80% of its raw sugar production sold to overseas buyers. Sales of Queensland raw sugar outside Australia are negotiated by CSR on behalf of the Queensland Sugar Corporation. Between 1997 and 1999 the value of exports of sugar varied between $1660 m and $1166 m.

Queensland is the major exporter of sugar, with significant potential for development in the Ord River Irrigation Area of Western Australia.

Major importers of Australian sugar are Canada, China, Korea, Japan, Malaysia, New Zealand, Singapore, Taiwan and the USA.

The sugar industry is sensitive to the possibility of residues in their product affecting trade and has commissioned residue studies over a number of years to investigate the presence of residues in raw sugar. To date, residues of aldicarb have not been discovered in raw sugar which is the major commodity of the industry traded.

Cotton

The Australian cotton industry has undergone considerable expansion in recent years and exports of cotton are now valued at more than $1.5 billion. The crop is produce mainly in New South Wales and Queensland, with investigations continuing into the establishment of an industry in the Ord River Irrigation Area of Western Australia.

As aldicarb is used at the time of planting of cotton, it is unlikely that any residues of aldicarb would therefore persist through to the cotton seed after harvest. The Australian MRL for aldicarb in cotton seed which is set at the limit of analytical quantitation, confirms this expectation that residues will be very low.

Oranges

As indicated above, oranges are a very significant horticultural export for Australia with a value of $108.8 million in 1997-98, up 33.5% over 1995-96. There were 116,300 tonnes of oranges exported, an increase of 31.3% for the same period.

The major export market sector is South East Asia which currently takes about 75% of the total citrus exports. Other important market areas include New Zealand, the US, Canada and the Middle East. The achievement of entry into the US market in 1992-93 was a major development after more than a decade of negotiations on quarantine issues. Further development of South East Asian markets such as Thailand, The Philippines, Korea and Taiwan is continuing.

Grapes

In 1996-97, fresh and dried grapes were the principal fruit exports in terms of value. The combined value rose by 47.1% to $119.9 million while the quantity exported increased 43.6% to 52.0 million tonnes.

4.10.6 Potential Trade Problems

Australian MRLs for aldicarb in the crops affected are mostly set at levels below or equal to those for the respective export markets. Therefore if Australian use patterns are observed there should be no difficulties with residues in export produce.

An exception to this situation may occur where MRLs have not been set in the respective country. In these instances, a zero MRL is operative and therefore any residue detections are considered to be illegal.

Since all major export destinations for oranges have MRLs/tolerances above the Australian MRL, compliance with Australian GAP will ensure that residues above those set by importers of Australian oranges will not occur. It is noted however, that residues of aldicarb were detected in oranges in a recent Victorian residue survey. Although none of these residues was above the MRL, a number of them were between the MRL and half MRL. Given that the product should only be used for non-trifoliata rootstocks, that only a proportion of the citrus growing area is treated with nematicides, that aldicarb is not the only nematicide used and that there is a 26 week withholding period for oranges, the occurrence of residues may signify that Good Agricultural Practice is not always being observed in this crop.

With respect to sugar cane, a zero MRL would be operative for the EEC and any countries which apply Codex MRLs. Since Australia exports raw sugar to a variety of countries in which these MRLs apply, any residues of aldicarb would constitute a breach of residue standards for those countries. The sugar industry is well aware of this possibility and has been conducting residue testing on raw sugar for some time. To date, residues of aldicarb have not been detected in raw sugar. These results are an indication that the use pattern defined for aldicarb in sugar cane is being observed by producers. It is also commented that the relative amount of sugar cane which would be exposed to aldicarb is comparatively small – of the order of 1%.

Aldicarb is registered in a number of countries in the world including those listed in the following table.

Table 4 – Overseas Registration Status for aldicarb

Japan	Germany
USA	France
Korea	Italy
India	Netherlands
Singapore	Ireland
United Kingdom	Belgium

Although there does not appear to have been any regulatory action to remove uses of aldicarb in overseas countries, it is significant that the primary world wide registrant, Rhone Poulenc, has withdrawn use of aldicarb in potatoes and bananas in all countries where it was registered for these uses. The former use was withdrawn because of concerns regarding contamination of ground water, while the latter use was withdrawn because of concerns in relation to the potential for occurrence of harmful residues to result from Good Agricultural Practice in banana cultivation. The US EPA withdrew the tolerances for these commodities as a result of Rhone-Poulenc's action.

In addition, this chemical is classed as a Restricted Use Pesticide (RUP) in some or all of its currently approved uses in the USA. This categorisation in the USA means that this chemical is intended for professional application only.

4.10.7 MRLs in overseas countries

The following table shows some comparisons between overseas MRLs/tolerances and Australian values. It is clear that difficulties could arise where MRLs are not set in the respective overseas countries. However, as also indicated above Australian MRLs are set at low levels and the only residues which have been detected are in oranges and these have been below the Australian MRL which is below most of those listed. It is nevertheless possible for there to be unacceptable levels of aldicarb residues in oranges exported to Japan, for example, after following Good Agricultural Practice in Australia.

Crop/ Commodity	Country (all in mg/kg)						
	Codex	**Australia**	**EEC**	**USA**	**Japan**	**Singapore**	**India**
Citrus	0.2	0.05	0.2	0.3 (oranges)	None set	0.2	None set
Sugar cane	0.1	0.02	None set	0.02	None set	0.02	None set
Cottonseed	0.1	0.05	None set	0.1	None set	0.05	None set

4.10.8 Codex MRLs

Codex MRLs for the relevant commodities are listed in the above table. It is clear that the only difficulty which could arise is related to the fact that an MRL has not been set for sugar cane. As previously indicated, the industry has conducted surveys over the last decade during which indicate that residues are below the limit of detection. It is thus expected that aldicarb residues would be unlikely to cause a problem with trade in raw sugar where Codex MRLs are observed.

4.10.9 Export Slaughter Intervals

Export slaughter intervals are not considered necessary for this chemical since use of aldicarb has little implication for stockfood from any of the crops upon which it is used, and in any case, aldicarb does not accumulate in animal tissues.

4.10.10 Labelling related to trade

Labelling specifically related to trade concerns are not considered necessary for this chemical. Compliance with Australian Good Agricultural Practice will ensure compliance with overseas requirements, except where a zero MRL applies because a level has not actually been set.

4.10.11 Data submitted to support compliance with overseas MRLs

Data have not been submitted to support compliance with overseas MRLs. However, it is noted in this context that the sugar industry monitors raw sugar for this and other chemicals to ensure that violative residues are not present in Australian sugar. To date residues of aldicarb have not been detected.

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Union Carbide Corporation (1982) A method for determination of aldicarb residues in citrus juice, ALDICARB-FPD-CITRUS, October 1982, Union Carbide Corporation, West Virginia, USA.

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PACC decisions concerning aldicarb (residue implications)

November 1977	recommend potato MRL (0.02 mg/kg)
August 1978	recommend sugar cane MRL (*0.02 mg/kg)
March 1979	recommend provisional MRL for strawberries (P0.2 mg/kg)
December 1978	recommend citrus MRL (*0.05 mg/kg)
November 1981	recommend cereal grains MRL (*0.02 mg/kg)
February 1982	confirm MRL for strawberries (0.2 mg/kg)
December 1985	recommend MRL for cotton seed (*0.05 mg/kg) and experimental MRL for grapes (0.05 mg/kg)
August 1989	confirm MRL for grapes (0.05 mg/kg)

Dietary Exposure Assessment (chronic intake)

National Estimated Dietary Intake for aldicarb

Food consumption data from 1995 National Nutrition Survey of Australia (all respondents, 2 years and above)

(ADI for aldicarb = 0.001 mg/kg of body weight)

Commodity	Food Consumption g/kg bw/day		STMR mg/kg	Processing Factor	Daily intake mg/kg bw/day	
citrus fruits	0.7651		0.0172	0.6	7.89583E-06	
cotton seed	0.0001	*	0.05	1	0.000000005	
meat, mammalian	1.7276	*	0.01	1	0.000017276	
milk	8.9933	*	0.01	1	0.000089933	
offal, mammalian	0.0151	*	0.01	1	0.000000151	
sugarcane	0.7328	*	0.02	1	0.000014656	
Total					0.000129917	mg/kg bw/day
				Equivalent to	**12.99**	**% of the ADI**

*- denotes residue level "at or about the limit of analytical determination"
ADI - Acceptable Daily Intake
MRL - Maximum Residue Limit

Notes

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

Uses on grapes, potatoes, cereal grains and strawberries were not considered. Not on currently registered labels.

Cotton seed was not consumed in the dietary survey. Default figure used in calculation.

Consumption data for sugar cane molasses was used in calculation. Detectable residues are not expected in sugar cane at harvest or any processed fraction derived from sugar cane.

Processing factor represents the proportion of the residue present in the edible portion (pulp for oranges)

Citrus was only commodity where finite residue was expected, STMR corrected for parent compound (determined as aldicarb sulfone in analysis)

Dietary Exposure Assessment (acute intake)

National Estimated Short Term Intake (NESTI)

Pesticide: aldicarb
Acute RfD: 0.001 mg/kg bw

Commodity	MRL mg/kg	STMR mg/kg	STMR-P mg/kg	HR (edible) mg/kg	L (edible) g	U (edible) g	Variability factor	Mean bw, kg	Case 1, 2a, 2b or 3	NESTI mg/kg bw/day	% acute RfD
whole population											
orange	0.05	0.013		0.015	278	136.8	4.4	67	2a	0.000166	16.6
mandarin	0.05	0.0077		0.0077	251	72	4.4	67	2a	0.000057	5.7
children 2-6 years old											
orange	0.05	0.013		0.015	243	136.8	4.4	19	2a	0.000563	56.3
mandarin	0.05	0.0077		0.0077	256	72	4.4	19	2a	0.000203	20.3

MRL: maximum residue limit
STMR: supervised trials median residue, in the edible portion
STMR-P: supervised trials median residue-processing
HR: highest residue in composite sample (edible portion) from supervised trial data supporting the MRL and STMR
bw: body weight
L: large portion, 97.5th percentile, from 1995 National Nutrition Survey of Australia, consumers only, corrected for edible portion
U: unit weight (edible portion used in this calculation)
Case: defines which formula is used to calculate the NESTI, based on formulae recommended by JMPR.

Case 2a: NESTI = [U x HR x V + (LP-U) x STMR]/bw
Composite residue data don't reflect residue level in a meal size portion, the unit weight is >25 g and smaller than the large portion size. A large eater would consume multiple units in one sitting, eg orange, apple, banana

Variability factor (V) was estimated from actual residue trials where pulp from 196 individual oranges was analysed.
Variability factor is 97.5th percentile residue in individual pulp sample divided by mean residue in simulated composite samples of pulp from 12 oranges.

Unit weights based on 190 g orange and 100 g mandarin, each with 72% edible portion

Calculations are based on Australian residue data for oranges and mandarins. Residue in edible portion based on mean processing factor of 0.6 for whole fruit to pulp. Residue corrected for parent compound.

Only 1 mandarin trial was presented therefore STMR was not estimated. HR was used in calculation rather than STMR

The following studies were submitted by Aventis CropScience but were not referenced in the review. The studies did not include sufficient detail (eg. no details of field phase of a residue trial) to allow meaningful interpretation of the data.

Reference: Almond, R.H. & Woodhouse, R.N. (1978) Analysis of residues of aldicarb in oranges, Report No. UNC 85, 29 March 1978, Huntingdon Research Centre, UK.

The reference is a Certificate of Analysis for residue testing of oranges that had previously been treated with aldicarb at 4 or 8 kg ai/ha. Details of the field phase of the trial were not provided. Residues of aldicarb (total of aldicarb, aldicarb-SO and aldicarb-SO_2, expressed as aldicarb) were <0.01 mg/kg in all samples of orange pulp and orange juice however no indication of the pre-harvest interval was given.

References: Christopher, D.H., Dawson, J. & Bliss, G.W. (1977) Determination of residues of aldicarb in citrus fruit (from Israel), UNC 45/77315, 6 May 1977, Huntingdon Research Centre, Cambridgeshire, England; Christopher, D.H., Dawson, J. & Bliss, G.W. (1977) Determination of residues of aldicarb in citrus fruit (Turkey 1976), UNC 55/77344, 27 May 1977, Huntingdon Research Centre, Cambridgeshire, England

The references are reports of analysis for oranges that had previously been treated with aldicarb. Insufficient details of the field phase of the trials were provided to allow meaningful interpretation of the data.

References: Macdonald, I.A., Richardson, R. & Taylor, G.A. (1985) Certificate of anaylsis- The determination of concentrations of aldicarb in mandarins, UNC 142, 12 November 1985, Huntingdon Research Centre, Cambridgshire, England; Macdonald, I.A., Richardson, R. & Taylor, G.A. (1985) Certificate of anaylsis- The determination of concentrations of aldicarb in lemons, UNC 144, 12 March 1986, Huntingdon Research Centre, Cambridgshire, England; Parsons, A.H. (1986) Determination of residues of aldicarb and its sulfoxide and sulfone metabolites in clementines, peel and flesh, J 5197/5216/5227, 10 February 1986, GC Laboratories Ltd.

The references are reports of analysis for lemons and mandarins that had previously been treated with aldicarb. Insufficient details of the field phase of the trials were provided to allow meaningful interpretation of the data.

The following studies were submitted by Aventis CropScience but were not referenced in the review. The studies were not considered relevant to the registered Australian uses of aldicarb.

Banana

Woodhouse, R.N., Almond, R.N. & Tipler, A. (1979) The determination of residual concentrations of aldicarb in bananas. Report UNC 101/1, Huntingdon Research Centre, Cambridgeshire, UK.

Anonymous (1975) Magnitude of the residue, Unnumbered report (1975), Union Carbide, USA

Anonymous (1976) Aldicarb residues in bananas from Central America, Unnumbered report (1976), Union Carbide Agricultural Products Co Inc, West Virginia, USA.

Anonymous, (1974) Untitled and unnumbered report, Union Carbide, USA.

Potato

Anonymous (1977) [Various reports of residue trials in potatoes from the USA, 1964-1972], Unnumbered report, 1977, Union Carbide Corporation, West Virginia, USA.

Christopher, D.H. & Dawson J. (1976) Determination of residues of aldicarb in potatoes from Australia, UNC42/76502, 6 July 1976, Huntingdon Research Centre, Cambridgeshire, UK.

Christopher, D.H. & Dawson J. (1975) The determination of residues in English tomatoes and main crop potatoes, UNC23A/75395, 13 June 1975, Huntingdon Research Centre, Cambridgeshire, UK.

Brockelsby, C.H., Roohi, A., Maycey, P.A. and Savage E.A. (1990) Insecticide: Aldicarb. Decline studies on potatoes after overapplication, United Kingdom, 1990, Report file No. D. AG. 1691, 30 October 1991, Rhone Poulenc Ag Company.

Tew, E.L. (1996) Temik: magnitude of residues in Pacific-Northwest potatoes harvested 120 days after an at-planting, in-furrow application of Temik 15G at 3 lb ai/acre, RPAC Study No. 96T10525, File No. 45187, 6 December 1996, Rhone Poulenc Ag Company.

Tew, E.L. (1997) Temik: Pacific-Northwest potato farmgate study, RPAC Study No. 96T11379, File No. 45217, 29 January 1997, Rhone Poulenc Ag Company.

Tew, E.L. (1997) Temik: magnitude of residues in potatoes from regions V and IV harvested 120 days after an at-planting application of Temik 15G at 3 lb ai/acre, RPAC Study No. 96T11218, File No. 45257, 21 February 1997, Rhone Poulenc Ag Company.

Maycey, P.A., Roohi, A. & Savage E.A. (1991) Insecticide: Aldicarb. Residue studies on potatoes United Kingdom, 1990, Report file No. D. AG. 1597, February 1991, Rhone Poulenc Ag Company.

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Hunt, T.W. (1990) Characterisation of aldicarb residues in potatoes following cooking, Report No. 40791, 15 June 1990, Rhone Poulenc Ag Co., Research Triangle Park, NC.

Strawberries

Almond R.H. & Woodhouse R.N. (1978) Analysis of residues in strawberries- Australian residue trials, UNC75, 29 March 1978, Huntingdon Research Centre, UK.

Tomatoes

Woodhouse, R.N. & Eden A. (1977) Determination of residues of aldicarb in tomatoes and cereals, UNC/62/77758, 18 October 1977, Huntingdon Research Centre, Huntingdon, UK. [Φ]
Myers, W.R. (1982) Section D-Residues: Temik/tomatoes, UCAP 813C50 (29948), 4 March 1982, Union Carbide Agricultural Products Co Inc, West Virginia, USA.
Christopher, D.H. & Dawson J. (1975) The determination of residues in English tomatoes and main crop potatoes, UNC23A/75395, 13 June 1975, Huntingdon Research Centre, Cambridgeshire, UK.

Onions
Maycey P.A. (1993) Insecticides: Aldicarb: Residue studies in Spring sown bulb onions, Report file No. 200201, March 1993, Rhone Poulenc.

Carrots
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Bird, S.J. (1995) Aldicarb: Study to determine the residues in carrots grown in beds treated with Temik 10G, 1993, ORS study No. RES/93/009, 26 October 1995, Rhone Poulenc Agrochimie.
Bird, S.J. (1996) Aldicarb: Study to determine the residues in carrots grown in beds treated with Temik 10G, 1994, ORS study No. RES/94/002, 19 January 1996, Rhone Poulenc Agrochimie.
Bird, S.J. (1995) Aldicarb: Study to determine the residues in carrots grown in beds treated with Temik 10G, 1994, Report file No. RP 20095, April 1995, Rhone Poulenc.

[Φ] Residue data for cereals were evaluated in 4.7.1. Tomato residue data were not reviewed.