METHAMIDOPHOS (100)

[*See also* Acephate (095)]

EXPLANATION

Methamidophos was first evaluated in 1976, with further reviews of residue matters in 1979, 1981, 1984, 1989 and 1990. Extensive new residue data were reviewed by the 1990 JMPR, together with updated information on current GAP in various countries and the current national MRLs. At the 24th Session of the CCPR (1992), the proposed MRLs for some commodities were held at Step 7B pending comment from several countries for various reasons (ALINORM 93/24, paras 119-123); the commodities were broccoli, cabbages (head), cauliflower, citrus fruits, cotton seed, egg plant, peach, potato, and tomato. In addition, the MRLs for celery and melons, except watermelon, were also held at Step 7B, although the report (ALINORM 93/24) stated that they were advanced to Step 8, because several countries expressed dissatisfaction with the proposed levels and promised to send supportive data to the JMPR. Information on GAP, residue trials results and national MRLs have been received from manufacturers and additional data have been submitted by several countries. The relevant data on these crops as published in the earlier evaluations have been reassessed. This monograph is mainly concerned with the above-mentioned crops but some data on residues in hops, kale, pome fruits, rice, soya beans and yard-long beans are also included.

Attention is drawn to the fact that methamidophos residues can occur as a result of the use of acephate (see acephate monograph) as well as from its direct use.

METHODS OF RESIDUE ANALYSIS

Updated versions of methods for determining residues of methamidophos in crops, water and milk (Lai and Fowler, 1989a) and soil (Lai and Fowler, 1989b) were made available to the Meeting. The former, which also determines acephate residues, involves extraction with ethyl acetate or acetonitrile-hexane, clean-up on a silica gel column, and GLC determination with thermionic detection; an optional acetonitrile-hexane partition clean-up is also included. The method for soil is very similar. The modifications to the methods used for earlier trials are minor and aimed at consolidating the extraction procedures and improving recovery efficiency and measurement reproducibility.

Information was also provided that illustrated the validity of the method of Specht and Thier (1987) for the determination of residues of methamidophos in pome fruits, potatoes and rice. The GLC method of Leary (1978) was also shown to be suitable for beets, green vegetables, grains, husks and potatoes.

USE PATTERN

Since residues of methamidophos can arise from the use of acephate, the uses of both pesticides have to be taken into account. Use patterns of the two pesticides, in particular on the crops dealt with in this monograph, are listed in Tables 1(a) and 1(b).

Comments regarding use patterns and residue matters were received from Australia (Australia, 1994a), Canada (Canada, 1994), the EU (EU, 1994), France (France, 1994), Germany (Germany, 1994), Poland (Poland, 1994), Spain (Spain, 1994), The Netherlands (Netherlands, 1994) and the USA (USA, 1994); note has been taken of all of these as appropriate.

Table 1(a). Registered uses of methamidophos. The majority of formulations are 60% SL or EC; other concentrations of the same types of formulation ranged from 20 to 50%. Commodities are listed in the order of the Codex classification.

Crop	Country	Application		PHI, days	Comments
		kg ai/ha	No.		
Citrus fruits	El Salvador	0.84-1.3	-	7	
	France	0.5	1	21	
	Malaysia	0.5	-	28	
	Morocco	0.9	-	28	
	Spain	2.7	-	28	
Pome fruit	Greece	0.68-1.5	-	21	
	Italy	0.4 -0.75	1	21	Before flowering
	Morocco	0.9	-	28	
	Spain	0.68	-	28	In Spring
Apple	France	0.5	1-2	21	
Pear	France	0.5	1-2	21	
Stone fruit	Greece	0.68-1.5	-	21	
	Italy	0.4	1	21	Before flowering
	Spain	0.68	-	28	
Cherries	France	0.5	-	21	
Peach	Australia	0.25	1	21	
	France	0.5	-	21	
	Portugal	0.6	1	28	
	Zimbabwe	0.3	1-2	28	
Plums	France	0.5	-	21	
Grapes	France	0.5	1-2	21	
	Greece	0.23-0.9	-	21	
	Italy	0.4	1	21	
Raspberries	France	0.5	1	21	
Strawberry	Italy	0.2	1	21	

Crop	Country	Application		PHI, days	Comments
		kg ai/ha	No.		
Vegetables	Greece	0.27-0.9	-	21	
Broccoli	Brazil	0.36	1-5	21	
	Canada	0.53-1.1	2-6	14	
	Mexico	0.6 -0.9	1-2	14	
	Philippines	0.6 -0.9	1-7	28	
	USA	0.58-1.2	1-4	14	
	Venezuela	0.3 -0.6	1-7	28	
Cabbages	Australia	0.5 -0.95	1-2	7	
	Brazil	0.36	1-3	21	
	Canada	0.53-1.1	2-6	7	
	El Salvador	0.6 -0.84	1-2	7	
	Germany	0.36	1	21	
	Indonesia	0.18-0.5	1-5	14	
	Malaysia	0.66	1	14	
	Mexico	0.6 -0.9	1-2	35	
	New Zealand	0.66-0.9	2-4	7	
	Peru	0.15-0.3	1-2	35	
	S Africa	0.3	1	21	
	Taiwan	0.4	3-4	14	
	Thailand	0.6 -1.2	1-2	21	
	USA	0.58-1.2	1-4	35	
	Venezuela	0.3 -0.6	1-2	14	
Cauliflower	Australia	0.5 -0.95	1-2	7	
	Brazil	0.36	1-3	21	
	Canada	0.53-1.1	2-6	7	
	Germany	0.36	1	21	
	Greece	0.6 -1.5	1-2	21	
	Mexico	0.6 -0.9	1-2	35	
	Philippines	0.6 -0.9	1-7	-	
	USA	0.58-1.2	1-4	28	
	Venezuela	0.3 -0.6	1-2	14	
	Zimbabwe	0.15	1-2	21	7 day intervals
Kale	Brazil	0.6	1-3	21	Collards
	Chile	0.5 -1.0	-	7	
	Costa Rica	0.65-1.4	1-2	15	
	Guatemala	0.38-0.56	2-3	21	
	Uruguay	0.7 -1.0	-	20	
	Venezuela	0.38-0.75	-	21	

Crop	Country	Application		PHI, days	Comments
		kg ai/ha	No.		
Kohlrabi	Germany	0.36	1	21	
Melon	Costa Rica	0.45-0.6	-	21	7-14 day intervals
Egg plant	Greece	0.6 -0.9	1-2	21	
	Israel	0.9 -1.5	1	14	
	Mexico	0.6 -0.9	1-2	14	
	Philippines	0.6 -0.9	1-7	28	
	Thailand	0.6 -1.2	1-2	21	
	Venezuela	0.3 -0.6	1-2	14	
Tomato	Australia	0.25-0.95	2-6	4	
	Columbia	0.3 -0.9	1	10	
	Dominican Rp	0.6	1-2	15	
	Ecuador	0.36-0.6	1-3	14	
	El Salvador	0.84	2-3	7	
	Greece	0.6 -0.9	2	21	
	Guatemala	0.6 -0.84	2-6	7	
	Honduras	0.84	1-3	21	
	Indonesia	0.55	1-6	7	
	Israel	0.9 -1.5	1-2	14	
	Mexico	0.6 -0.9	1-2	7	
	New Zealand	0.66-0.9	1-2	3	
	Peru	0.6	2-3	21	
	Portugal	0.6 -1.2	1	7	
	S Africa	0.3 -0.6	1-2	3	
	Uruguay	0.19-0.38	2-4	14	
	Venezuela	0.3 -0.6	1-2	14	
	Zimbabwe	0.3 -0.6	1-4	3	
Potato	Argentina	0.48	1-3	14	
	Australia	0.14-0.18	1-3	7	
	Brazil	0.36	1-3	21	
	Canada	0.84-1.1	1-3	14	
	Chile	0.51-0.77	1-6	21	
	0.04-0.05	1-8	21		
	Columbia	0.3 -0.9	1	10	
	Costa Rica	0.45-0.6	4-6	21	
	Dominican Rp	0.45	1-2	14	
	Ecuador	0.36-0.6	1-2	14	
	El Salvador	0.84	1-2	7	
	Germany	0.48-0.72	1-7	14	

Crop	Country	Application		PHI, days	Comments
		kg ai/ha	No.		
	Greece	0.27-0.9	2	21	
	Guatemala	0.6 -0.84	1-2	21	
	Israel	0.9 -1.5	1-2	14	
	Italy	0.48	1	21	
	Mexico	0.6 -0.9	1-2	14	
	Morocco	0.5	2	21	
	Netherlands	0.56-0.8	1-3	28	
	New Zealand	0.48-0.66	2	7	
	Peru	0.25-1.2	1-3	21	
	Philippines	0.6 -0.9	1-7	28	
	Poland	0.6	1-2	35	
	Portugal	0.6	1-2	14	
	S Africa	0.15-0.3	1-2	14	
	Uruguay	0.24-0.48	2-4	14	
	USA	0.86-1.2	1-4	14	
	Venezuela	0.3 -0.6	1-2	14	
	Zimbabwe	0.15-0.3	1-4	14	10-14 day intervals
Celery	USA	0.55-1.1	1-10	21	Florida only
Maize	Greece	0.36-1.1	-	21	
	Spain	0.45	-	28	
Rice	Costa Rica	0.6 -0.9	1-2	21	
	Dominican Rp 0.45-1.2	-	-	8-10 day intervals	
	Ecuador	0.45-0.6	-	21	3-15 day intervals
	Guatemala	0.6 -1.7	-	21	8-15 day intervals
	Malaysia	0.5	-	28	
	Thailand	0.45	0-2	-	When needed
	Taiwan	0.34-0.6	-	26	
Almond	France	0.5	1	21	
	Greece	0.68-1.5	-	21	
Cotton	Colombia	0.3 -0.9	1	-	
	Costa Rica	0.45-0.9	-	-	7-14 day intervals
	Dominican Rp	0.45-1.2	-	-	8-15 day intervals
	Ecuador	0.45-0.6	-	21	3-15 day intervals
	El Salvador	0.6 -2.1	-	7	
	Greece	0.6 -1.8	-	21	
	Guatemala	0.6 -1.7	-	21	8-15 day intervals
	Israel	1.5 -1.8	-	21	

Crop	Country	Application		PHI, days	Comments
		kg ai/ha	No.		
	Morocco	0.9	-	21	
	Spain	0.45	-	28	
	Taiwan	0.5	-	-	
	USA	0.22-1.2	1-2	50	Not to open bolls
Hops	Germany	1.8 -3.6	1-5	42	

Table 1(b). Registered uses of acephate. (All formulations are 75% soluble powders except where otherwise indicated).

Crop	Country	Application		PHI, days	Comments
		kg ai/ha	No.		
Citrus fruit	Argentina	0.52	-	-	
	Chile	0.2 -0.6	-	21	
	Ecuador	0.38-1.1	-	15	
	Japan	5	3	30	50% wettable powder
	New Zealand	0.75	-	14	Monthly intervals
	Spain	0.38-1.1	-	21	
	Venezuela	0.6 -1.2	-	21	
Pome fruit	Germany	0.75	3	42	50% wettable powder
	S Africa	(50 g/hl)	1-2	-	Before end November
Peach	S Africa	(25-50g/hl)	1-2	14	
	Spain	0.38-1.1	-	21	
Broccoli	Australia	0.75-1.0	-	3	10-14 day intervals
	Brazil	0.5 -1.0	-	14	
	Costa Rica	0.5 -1.0	1-2	15	
	Guatemala	0.38-0.56	2-3	21	
	S Africa	0.26-0.38	-	3	7-10 day intervals
Cabbage	Australia	0.75-1.0	-	3	10-14 day intervals
	Ecuador	0.38-1.1	-	15	
	Hungary	1.0	-	30	
	Indonesia	0.2 -0.4	-	-	
	Israel	2.0	-	14	
	New Zealand	0.75-1.0	-	7	7-10 day intervals
	Peru	0.38-1.1	-	7	
	Poland	0.56-0.75	-	7	
	S Africa	0.26-0.38	-	3	7-10 day intervals
	Uruguay	0.75-1.0	-	20	
Cauliflower	Australia	0.75-1.0	-	3	10-14 day intervals

Crop	Country	Application		PHI, days	Comments
		kg ai/ha	No.		
	Brazil	0.5 -1.0	-	14	
	Chile	0.38-0.75	-	7	
	Costa Rica	0.5 -1.0	1-2	15	
	Ecuador	0.38-1.1	-	15	
	Guatemala	0.38-0.56	2-3	21	
	New Zealand	0.75-1.0	-	7	7-10 day intervals
	Paraguay	0.38-0.75	-	-	
	Peru	0.38-1.1	-	7	
	S Africa	0.26-0.38	-	3	7-10 day intervals
	Uruguay	0.75-1.0	-	20	
	USA	0.75-1.5	1-6	14	
	Venezuela	0.38-0.75	-	21	
Melon	Israel	1.0 -2.0	-	14	
	Uruguay	0.65-1.3	1-2	20	
Egg plant	Philippines	0.47-0.70	1-2	14	
	Spain	0.38-1.1	-	14	
	Uruguay	0.65-1.3	1-2	20	
Tomato	Argentina	0.075	-	-	
	Australia	0.75-1.0	-	3	7-14 day intervals
	Brazil	0.75-1.0	-	7	
	Chile	0.38-0.84	-	7	
	Costa Rica	0.5 -1.0	1-2	15	
	Cyprus	0.5 -0.75	-	15	
	Ecuador	0.38-1.1	-	15	
	Guatemala	0.38-0.75	4-6	3	
	Indonesia	0.2 -0.4	-	14	
	Israel	1.5 -2.0	-	14	
	Japan	1.5	3	7	50% wettable powder
	New Zealand	0.75	-	3	Every 14 days
	Paraguay	0.38-0.75	-	-	
	Peru	0.38-1.1	-	7	
	Philippines	0.23-0.7	1-2	14	
	Poland	0.75	-	14	
	Portugal	0.75	-	21	
	S Africa	0.75-1.5	-	3	Every 7 days
	Spain	0.38-1.1	-	14	
	Uruguay	0.75-1.0	-	7	
	Venezuela	0.38-0.75	-	21	

Crop	Country	Application		PHI, days	Comments
		kg ai/ha	No.		
Potato	Argentina	0.7	-	-	
	Australia	0.66	-	3	14-21 day intervals
	Brazil	(0.1-0.15 g/hl)	14		
	Chile	0.5 -1.0	-	15	
	Ecuador	0.5 -1.5	-	15	
	Guatemala	0.5 -1.0	-	14	
	Indonesia	(0.5-1.0 g/hl)	-		
	New Zealand	0.25-1.0	-	7	10-14 day intervals
	Peru	0.5 -1.5	-	7	
	Poland	0.5	1-2	-	
	Portugal	0.75	-	21	
	S Africa	0.5 -0.75	-	-	7-14 day intervals
	Spain	0.38-1.1	-	21	
	Uruguay	0.65-1.3	-	20	
Celery	USA	0.75-1.5	_	21	
Cotton	Argentina	0.35-0.6	-	21	
	Brazil	0.5 -1.5	-	14	
	Costa Rica	1.0 -1.4	-	22	
	Ecuador	0.5 -1.5	-	15	
	Indonesia	0.75-1.5	-	-	
	5-10 g/kg seed				
	Israel	1.5 -2.0	-	21	
	Peru	0.5 -1.5	-	28	
	USA	0.28-1.4	-	21	

Canada has no registered uses of acephate on food crops (Canada, 1994).

RESIDUES RESULTING FROM SUPERVISED TRIALS

Residue data reviewed in this monograph have been confined to methamidophos, whether derived from the use of the pesticide itself or as a metabolite from the use of acephate. Corresponding residues of acephate are dealt with in the monograph on that compound. In addition to a review of the data submitted this year, the data published in previous JMPR monographs have been reassessed as detailed for each commodity below.

(a) Residues arising from the use of methamidophos

Citrus fruits. At the 1981 JMPR, data on residues of methamidophos in citrus fruits were provided from trials in Egypt (1970-71) and the USA (1974), although no relevant GAP information was available. Crops treated included lemon, lime, orange and tangerine; residues in whole fruit ranged from 0.3 to 3.5 mg/kg at 7 days PHI and from 0.1 to 1.2 mg/kg at about 28

days PHI (FAO/WHO, 1982b). In the absence of adequate information on GAP these results must be discounted.

Summary data from two trials of methamidophos on oranges in Spain in 1988 were provided (Tomen, 1994a). On the day of application at 3.0 kg ai/ha, residues in the fruit were 0.39-0.53 and 0.13-0.85 mg/kg; at 60 days they were 0.02-0.03 and 0.01-0.05 mg/kg respectively.

Apple. Three trials of methamidophos on apples were carried out in Italy in 1992, using two applications at 0.73 kg ai/ha. Residues, all as mg/kg, were 0.51-1.3 (day 0), 0.07-0.59 (day 7), 0.05-0.64 (day 14), 0.02-0.33 (day 21) and 0.02-0.18(day 28); The Italian PHI is 21 days (Bayer, 1993a).

From three trials in France in 1992, residues were lower than those in Italy. At application rates of 0.44, 0.49 and 0.68 kg ai/ha (each applied twice), residues at 21 days PHI were 0.04, 0.01 and 0.10 mg/kg respectively (Bayer, 1993b).

Pear. Two trials of methamidophos were carried out on pears in France in 1992, using 0.42 + 0.45 kg ai/ha and 2 x 0.54 kg ai/ha; residues at 21 days were 0.15 and 0.20 mg/kg, having decreased from 0.55 and 1.0 mg/kg at day 0 respectively (Bayer, 1993b).

Peach. The 1976 JMPR reported residues of methamidophos in peaches sprayed "..under German climatic conditions", apparently at the listed GAP rate. The summarized data showed residues of 0.5 to 1.05 mg/kg at 7 days and 0.28 to 0.75 mg/kg, mean 0.45 mg/kg, at 14 days, although the GAP required a 21-day PHI. No other details were given (FAO/WHO, 1977b). These data are inadequate for assessment.

Summary data from trials of methamidophos on peaches treated with 1.2 kg ai/ha in Spain in 1992 showed residues, as mg/kg, ranging from 0.69-0.75 at day 0, through 0.05-0.09 (day 7) and 0.01-0.08 (day 14) to 0.22-0.26 at day 21 (Spain, 1994). However, Spanish GAP calls for 0.675 kg ai/ha and a 28-day PHI.

Broccoli. Data reported by the 1976 JMPR showed residues of methamidophos ranging (as mg/kg) from <0.01 to 2.84 (broccoli heads), 0.22 to 7.62 (leaves) and 0.16 to 3.74 (whole vegetable) 14 days after 3-6 applications at 0.56-1.1 kg ai/ha in the USA; at 21 days the respective maximum residues were 0.14, 0.88 and 0.57 mg/kg and at 28 days, 0.09, 0.54 and 0.44 mg/kg. However, the stated GAP gave 7-day PHI for which no data were given and these results must therefore be discounted (FAO/WHO, 1977b).

The data recorded by the 1981 JMPR are similarly not readily linked to appropriate GAP, as is noted in the text, so these also were discounted (FAO/WHO, 1982b).

Two trials on broccoli in Brazil (FAO/WHO, 1991a) showed no residues above the level of determination of 0.01 mg/kg at PHIs from 14 to 28 days.

Cabbages. Treatment of cabbages in the USA and Germany gave residues of methamidophos up to 0.11 mg/kg at 7 days and 0.07 mg/kg at 14 days. As the data were limited and summarized, and applications were not within the quoted GAP, these data are unreliable (FAO/WHO, 1977b).

The 1981 JMPR reported residues in cabbages treated in Australia of 0.05-0.61 mg/kg at 2-3 days, 0.02-0.07 mg/kg at 13-14 days and <0.02 mg/kg at 20-21 days PHI; the stated PHI

in Australia was 35 days (FAO/WHO, 1982b).

The Evaluations of the 1989 JMPR (FAO/WHO, 1990a) included an appraisal of the evaluation that was omitted from the 1982 Evaluations (FAO/WHO, 1983b); the information only appeared in summary in this appraisal and in the 1982 Report (FAO/WHO, 1983a). No data were detailed, the report merely stating that the results were in support of the existing MRL.

Data reported to the 1990 JMPR showed residues of methamidophos below 0.01 mg/kg in the USA at the recommended PHI of 35 days, apart from one apparently anomalous study giving 0.76 and 1.1 mg/kg; all trials included 6 applications at 1.1 kg ai/ha instead of the maximum of 4 allowed by GAP (FAO/WHO, 1991a).

Cauliflower. Trials on cauliflower in Germany and the USA reported at the 1976 JMPR showed residues of methamidophos in the heads up to 0.45 mg/kg at 14 days, 0.23 mg/kg at 21 days and 0.12 mg/kg at 28 days; leaves showed up to 6.28, 1.11 and 0.62 mg/kg respectively, at the same time intervals (FAO/WHO, 1977b).

Data reported by the 1981 JMPR from trials in Australia and Germany showed residues in cauliflower heads of 0.02 mg/kg or less at PHIs of 20-21 days. The Australian PHI was 28 days and the German 21 days (FAO/WHO, 1982b).

The information available to the 1990 JMPR was very varied. Two trials in Brazil showed <0.01 mg/kg at PHIs from 14 to 28 days. Results from trials in the USA in 1973 gave up to 0.48 mg/kg in the flowerheads at 15 days and 0.21 mg/kg at 21 days (the residues in the leaves were greater) but none of the data were obtained at the GAP PHI of 28 days (FAO/WHO, 1991a).

Melons. Only one of the trials reported by the 1990 JMPR (from Mexico in 1973) was within the then appropriate recommended GAP; residues ranged from 0.09 mg/kg at day 0 to 0.03 mg/kg at day 14. All USA trials in 1982 involved an excessive application rate (1.5 times the maximum) and at 14 days PHI residues ranged from 0.19 to 0.56 mg/kg; results for watermelon were similar (FAO/WHO, 1991a).

Egg plant. The 1976 JMPR recorded residues in the range 0.02 to 0.10 mg/kg at PHIs of 0 to 7 days following up to 9 applications of methamidophos at 0.45 to 0.6 kg ai/ha to egg plants in Mexico (FAO/WHO, 1977b). The treatments were outside current Mexican GAP rates.

A very limited summary of the 1976 data on residues of methamidophos in egg plant (0.05-0.06 mg/kg) was repeated in the Evaluations of the 1979 JMPR (FAO/WHO, 1980b).

The data reported to the 1984 JMPR showed very varied residues, up to 1.9 mg/kg at 3 days and up to 0.65 mg/kg at 7 days, using up to 15 applications. These treatments were not in accordance with GAP and the data must be regarded as unsuitable (FAO/WHO, 1985c).

The 1990 JMPR reported data from the USA, from trials according to US GAP at that time, showing up to 0.17 mg/kg at 3 days and up to 0.12 mg/kg at 7 days (FAO/WHO, 1991a).

Tomato. Only one of the residues reported by the 1976 JMPR had been obtained under the quoted recommended use (GAP) conditions; the data must therefore be ignored (FAO/WHO, 1977b).

Trials data from New Zealand and South Africa were available to the 1981 JMPR, although it is stated that it could not be determined whether nationally approved GAP was represented. All residues were below 0.53 mg/kg, even at 4 hours PHI; at 7 days residues were <0.01 to 0.3 mg/kg (FAO/WHO, 1982b).

Trials in Spain and Brazil were evaluated at the 1990 JMPR. From Spanish glasshouse trials, residues were 0.18-0.25 mg/kg at 3 days, 0.27-0.35 mg/kg at 7 days and 0.20-0.34 mg/kg at 14 days. Results from Brazil were all under 0.01 mg/kg from 3 to 21 days PHI. The treatments were not in accord with the stated GAP (FAO/WHO, 1991a).

Summary data were provided from two trials of methamidophos on tomatoes in Thailand in 1993 (Thailand, 1994a). Crops were sprayed at either the maximum rate of 1.2 kg ai/ha or at twice this rate. The residues are given in Table 2.

Table 2. Residues of methamidophos in tomatoes in Thailand in 1993.

PHI (days)	0	1	3	5	7	10	15	25
Application	Methamidophos (mg/kg)							
1.2 kg ai/ha	0.81	0.42	0.34	0.37	0.27	0.25	0.13	0.10
2.4 kg ai/ha	1.14	0.94	0.88	0.68	0.65	0.52	0.36	0.08

The PHI for most crops in Thailand is 21 days but no information was available on whether this use is registered.

Kale. At the 1990 JMPR, data from one trial at two levels in Brazil were assessed. After 4 applications at 0.6 kg ai/ha, 1 mg/kg was found on the day of the last application but residues were below 0.01 mg/kg after 14 to 28 days. When a double-dose treatment was given, residues were also below 0.01 mg/kg at a 21-day PHI (FAO/WHO, 1991a).

Data on six trials carried out in Thailand over three growing seasons were provided (Thailand, 1994b). Four applications were made at either the maximum recommended rate of 1.2 kg ai/ha or a double rate, at intervals of 5 or 6 days. The residues found are detailed in Table 3.

Table 3. Residues of methamidophos in kale in Thailand.

PHI (days)	0	1	3	5	8	11	14	17	21
Year/season	Methamidophos residues (mg/kg)								
a) Maximum recommended application rate (1.2 kg ai/ha)									
1991	22	20	10	5.7	1.2	0.43	0.12	<0.05	<0.05
1991/2	28	26	12	6.0	2.9	1.1	0.31	0.05	<0.05
1992	29	25	14	8.6	2.8	1.1	0.25	0.05	<0.05
b) Double application rate (2.4 kg ai/ha)									
1991	38	35	19	12	3.9	1.2	0.26	0.07	<0.05
1991/2	46	40	25	15	5.8	2.4	0.47	0.09	<0.05
1992	50	42	24	17	6.6	2.5	0.59	0.12	<0.05

Residues decreased rapidly, from 30 to 50 mg/kg at day 0 to less than 0.05 mg/kg at the usual Thailand PHI of 21 days. Although the report states that GAP was observed in the trials, no information was available on whether the use is registered in Thailand.

Yard-long beans. Data on six trials carried out in Thailand over three growing seasons were provided (Thailand, 1994c). Four applications were made at either the maximum recommended rate of 1.2 kg ai/ha or twice this rate, at intervals of 5 or 6 days. The residues found in the succulent pods with beans (without peduncle) were as given in Table 4.

Table 4. Residues of methamidophos in yard-long beans in Thailand.

PHI (days)	0	1	3	5	8	11	14
Year/season	Methamidophos residues (mg/kg)						
a) Maximum recommended application rate (1.2 kg ai/ha)							
1991	11	9.0	2.6	0.35	0.08	<0.02	<0.02
1991/2	13	10	3.8	0.71	0.12	0.03	<0.02
1992	15	13	4.1	0.83	0.14	0.04	<0.02
b) Double application rate (2.4 kg ai/ha)							
1991	20	14	5.4	1.1	0.17	0.06	<0.02
1991/2	24	18	7.3	1.8	0.29	0.07	<0.02
1992	26	20	8.0	2.4	0.34	0.11	<0.02

Residues decreased rapidly, from 11 to 26 mg/kg at day 0 to less than 0.02 mg/kg at 14 days; no further samples were taken as the residues had then reached the limit of determination. The usual PHI in Thailand is 21 days for most crops; although the report states that GAP was observed in the trials, no information was available on whether the use is registered in Thailand.

Potato. Residues on potatoes reported by the 1976 JMPR did not exceed 0.11 mg/kg at 7-day PHI but the summary data were limited and the number of applications was twice that allowed

by GAP; the results are therefore of doubtful validity (FAO/WHO, 1977b).

The 1981 data were confined to one trial in New Zealand at twice the GAP application rate. Residues were 0.07 and 0.19 mg/kg at 7 days, and <0.01 and 0.03 mg/kg at 14 days (FAO/WHO, 1982b).

The Evaluations of the 1989 JMPR (FAO/WHO, 1990a) include the appraisal/evaluation that was omitted from the 1982 Evaluations (FAO/WHO, 1983b); the information only appeared in summary in the 1982 Report (FAO/WHO, 1983a). No details were given, but it was stated that "In 23 experiments in which potatoes were treated repeatedly with methamidophos in accordance with GAP, all residues were below the existing MRL of 0.1 mg/kg".

At the 1990 JMPR, data were presented from Brazil, Spain and the USA. All residues were below 0.01 mg/kg (FAO/WHO, 1991a).

Four trials of methamidophos (together with cyfluthrin) on potatoes were carried out in Germany in 1988, using 7 applications at 0.6 kg ai/ha. All residues were below the limit of determination (0.01 mg/kg) from day 0 to day 21; the PHI in Germany is 14 days (Bayer, 1989).

Celery. Limited data on residues of methamidophos in celery were reviewed by the 1976 JMPR. At 21-day PHI, residues were up to 1.55 mg/kg in the stalks, 0.08-6.0 mg/kg in the tops and 0.02-0.20 in the whole plant; treatments were close to USA GAP (FAO/WHO, 1977b).

Residue data from the USA, as reported by the 1990 JMPR, showed a similarly large variation. At the recommended PHI of 21 days, residues ranged from <0.01 to 1.27 mg/kg in stalks and from 0.02 to 3.14 mg/kg in the whole plant (FAO/WHO, 1991a).

Rice. In 4 trials in Thailand in 1992/93, rice was treated twice with methamidophos at 0.6 kg ai/ha. The results obtained are shown in Table 5 (Bayer, 1994).

Table 5. Residues of methamidophos in rice in Thailand.

Sample	PHI (days)	Range of residues (mg/kg)
Green plant	0	13-27
Grain, polished	50-61	<0.01
Straw	50-61	<0.01-0.02
Glume	50-61	<0.01-0.01
Bran	50-61	<0.01-0.02

Methamidophos is not registered for use on rice in Thailand, although acephate can be used. This use on rice was at a rate similar to the GAP rate for methamidophos on rice in Malaysia and several Central and South American countries.

Cotton. Data from treated cotton were summarized very briefly in the 1976 Evaluations. Residues in cotton seed were up to 0.06 mg/kg at 21 to 26 days after treatment with methamidophos at 0.26 to 2.24 kg ai/ha. As the data also covered rape seed treatments, the results cannot be interpreted with any degree of assurance (FAO/WHO, 1977b).

The Evaluations of the 1989 JMPR (FAO/WHO, 1990a) include the appraisal/evaluation that was omitted from the 1982 Evaluations (FAO/WHO, 1983b); the

information only appeared in summary in the 1982 Report (FAO/WHO, 1983a). No details were given but it was stated that ".. the residue data provided from supervised trials support the existing MRL for cotton seed".

Residue data on cotton seed, cotton forage (green) and cotton bolls were reported by the 1990 JMPR. Residues on cotton seed ranged from 0.1 to 1.6 mg/kg at 7 days and from 0.02 to 0.21 mg/kg at a 28-day PHI. No results were given at the USA recommended PHI of 50 days, and 5 applications were made instead of the maximum 2 allowed (FAO/WHO, 1991a).

Data were made available from a trial of methamidophos on cotton in the USA in 1973. Treatment at 1.1 or 2.2 kg ai/ha 5, 6 or 7 times gave the results listed in Table 6 (Tomen, 1994a).

Table 6. Residues of methamidophos in cotton seed in the USA.

Crop part		Residue (mg/kg)		
	Days after last appal.	6	17	33
	No. of appals.	7	6	5
Fuzzy seeds	(1.1 kg ai/ha)	0.03, 0.03	n, 0.01	n, n
Fuzzy seeds	(2.2 kg ai/ha)	0.04, 0.05	n, 0.01	n, n

n = below limit of determination (0.01 mg/kg).

Soya bean. Summary data were provided from a trial of methamidophos on soya beans in Thailand in 1993 (Thailand, 1994d). Following 3 applications at 0.25 or 0.5 kg ai/ha, residues after 7 days were <0.01 and 0.01 mg/kg respectively.

Hops. Residues in dry hops 59 days after treatment in Poland with methamidophos at 0.75 kg ai/ha were 0.04 mg/kg (Poland, 1994). However, it was not clear whether this treatment was within Polish GAP. German GAP requires 1.8-3.6 kg ai/ha and a 42-day PHI (EU, 1994). The present CXL is 5 mg/kg.

(b) Residues of methamidophos resulting from the application of acephate

Citrus fruits. It is not possible to correlate the limited summary data reported at the 1976 JMPR on residues of methamidophos in oranges and grapefruit in New Zealand with the current GAP. The maximum amount of methamidophos found in orange and grapefruit pulp was 0.3 mg/kg. There is no GAP in the USA to support the US data on residues in oranges, lemons and tangelos. These results (FAO/WHO, 1977b) are therefore discounted.

Residues of methamidophos in citrus fruit from trials with acephate in the USA from 1979 to 1989, reported at the 1990 JMPR, were generally below 0.1 mg/kg at a 21-day PHI. However, as the use of acephate on citrus fruit is not registered in the USA, these data (FAO/WHO, 1991a) are not relevant.

Data were also reported at the 1990 JMPR from trials on mandarin oranges in Japan in 1971 and 987 that are within their current GAP; residues of 0.03, 0.02, 0.08, and 0.09 mg/kg of methamidophos were found at the recommended PHI of 30 days. A maximum of 0.16 mg/kg appeared at a PHI of 7 days and 0.15 mg/kg at 45 days (FAO/WHO, 1991a).

Trials of acephate on mandarin and summer oranges were carried out in Japan in 1992-93. At the maximum Japanese GAP of three applications of 5 kg ai/ha and a PHI of 30 days, residues of methamidophos ranged from 0.03 to 0.33 mg/kg in the whole fruit (Tomen

Japan, 1993). Results are detailed in Table 7.

Table 7. Residues of methamidophos in some citrus fruits in Japan, 1992-93. All single trials with 3 applications of 50% WP formulation.

Sample	Residues, mg/kg, at PHI (days)
Mandarin orange	
Pulp	0.07 (30), 0.05 (45), 0.04 (60)
Peel	0.09 (30), 0.05 (45), 0.02 (60)
Pulp	0.10 (30), 0.06 (45), 0.03 (60)
Peel	0.14 (30), 0.06 (45), 0.02 (60)
Whole fruit	0.11 (30), 0.06 (45), 0.03 (60)
Pulp	0.01 (30), 0.007 (45), <0.005 (60)
Peel	0.02 (30), 0.01 (45), <0.005 (60)
Whole fruit	0.13 (30), 0.008 (45),<0.005 (60)
Pulp	0.17 (30), 0.01 (45), 0.01 (60)
Peel	0.09 (30), 0.03 (45), 0.03 (60)
Whole fruit	0.03 (30), 0.01 (45), 0.02 (60)
Summer orange	
Pulp	0.05 (30), 0.03 (45), 0.02 (60)
Peel	0.97 (30), 0.53 (45), 0.53 (60)
Whole fruit	0.33 (30), 0.19 (45), 0.18 (60)
Pulp	0.03 (30), 0.05 (45), 0.05 (60)
Peel	0.68 (30), 0.78 (45), 0.92 (60)
Whole fruit	0.23 (30), 0.27 (45), 0.32 (60)

Pome fruit, Peaches. No data were available on residues of methamidophos resulting from the use of acephate on pome fruit or peaches.

Brassica crops. From the summary data provided in the evaluations of the 1976 JMPR (FAO/WHO, 1977b) it is not possible to relate the residues to the appropriate GAP for acephate on broccoli, cabbages and cauliflower and these data are therefore discounted; however, it is known that the results of some of the studies have been resubmitted this year and these are dealt with in detail below.

Broccoli. Data from supervised trials of acephate on broccoli carried out in Canada, Italy, Japan and the USA are detailed in Table 8. However, none of these countries has a registered use of acephate on this crop and the trials were therefore not in accordance with recognised GAP. A maximum residue of 2.5 mg/kg was found 3 days after the last of nine applications but most residues were less than 0.5 mg/kg.

Cabbages. The bulk of the data on residues from the use of acephate on cabbages that were reviewed at the 1981 JMPR were from trials in the USA where the use is not registered (FAO/WHO, 1982b). The data have therefore been rejected as irrelevant. The limited data on trials in France and Germany have been resubmitted and are reviewed below.

The 1984 JMPR reviewed data from trials of acephate on cabbages in New Zealand in 1972-73, at treatment rates within or close to the current New Zealand registered use. At 0.84 kg ai/ha, a residue of 0.17 mg/kg of methamidophos was found 7 days after the last of three applications and 0.2 mg/kg was found 10 days after one application at 1.1 kg ai/ha (FAO/WHO, 1985c).

The data on residues of methamidophos from the use of acephate on cabbages in the USA, already dealt with at the 1981 JMPR, were reviewed again at the 1990 Meeting (FAO/WHO, 1991A). In the absence of GAP in the USA, these cannot be considered for evaluation.

One trial with acephate in South Africa in 1972 was at an application rate (0.56 kg ai/ha) nearly twice the registered rate of 0.26 to 0.38 kg ai/ha. At 4-day PHI methamidophos residues were up to 0.20 mg/kg. Data were also presented from trials in France, Germany, Japan and The Netherlands, in none of which countries is the use on cabbages registered. The maximum residue of methamidophos was 0.14 mg/kg at 7 and 14 days PHI (Table 8).

Cauliflower. A very limited summary of the 1976 data on residues of methamidophos in cauliflower (0.5 mg/kg) was given in the 1979 monograph (FAO/WHO, 1980b). As explained under brassica crops above, these data were discounted.

Data were presented from trials using acephate in France, Germany and The Netherlands, with a maximum residue of 0.18 mg/kg methamidophos. However, in none of these countries is the use of acephate registered on cauliflower (Table 8).

Melons, Egg plant. No data were available on residues of methamidophos resulting from the use of acephate on melons or egg plant.

Tomato. From the summary data provided in the evaluations of the 1976 JMPR it is not possible to relate the residues to the appropriate GAP for acephate on tomatoes and these data are therefore discounted (FAO/WHO, 1977b).

For the 1990 JMPR, data were produced from 5 trials of the use of acephate in France in 1988, with residues of 0.31 and 0.43 mg/kg of methamidophos at 21 days after the last of two applications at 1.6 kg ai/ha; other results were below 0.1 mg/kg at 21 days (FAO/WHO, 1991a). This use is not currently registered in France and so the data are deemed to be unsuitable.

Trials of acephate on tomatoes were carried out according to the relevant GAP in Japan in 1984 and 1985 and in South Africa in 1973. In the Japanese trials, at the recommended PHI of 7 days, methamidophos residues were between 0.06 and 0.12 mg/kg. Methamidophos residues in the South African trials were 0.03 and 0.07 mg/kg at 3-day PHI (Table 8). Several trials were also carried out in Canada, which has no registered uses of acephate on food crops (maximum residues 0.15 mg/kg at 3 days and 0.21 mg/kg at 21 days.

Potato. Summary data reported by the 1976 JMPR showed that residues of methamidophos in the peel and pulp of potatoes treated with 1 to 2 kg ai/ha of acephate were 0.03-0.06 mg/kg and 0.02-0.04 mg/kg respectively, 3 and 14 days after application (FAO/WHO, 1977b).

Very limited data summarized by the 1984 JMPR showed no residues of methamidophos above 0.05 mg/kg following the treatment of potatoes in New Zealand with acephate at 0.42 to

0.84 kg ai/ha (FAO/WHO, 1985c).

Celery. No data were available on residues of methamidophos resulting from the use of acephate on celery.

Table 8. Residues of methamidophos in some vegetable crops from the use of acephate.

Crop	Country/year	Form. %	kg ai/ha	No. of trials	No. appals.	Residues, mg/kg, at PHI (days)	Ref.
Broccoli	Canada '76	75	0.75	1	3	0.04, 0.07 (14)	CH1976a
	Italy '90	42.5	1.1	1	1	0.09 (21)	Shell/ Septum 1990-1991
		42.5	2.2	1	1	0.14 (21)	
	Italy '91	42.5	1.1	1	1	0.20 (28)	
		42.5	2.2	1	1	0.46 (28)	
	Japan 93	50 WP	1.25	1	3	0.17 (7),0.04 (14),0.008 (21)	Tomen'93
		50 WP	1.25	1	3	0.96 (7),0.42 (14),0.47 (21)	Tomen'93
	USA 70	75	1.1	1	9	1.4,1.6 (3),1.2,1.3 (7), 0.75,0.76 (14)	CH1970
		75	2.2	1	9	2.3,2.5 (3),1.2,1.3 (7),1.1,1.5 (14)	CH1970
	USA 72	75	0.56	1	3	0.02,0.02 (7),<0.01 (14)	CH1972a
		75	1.1	1	3	0.04,0.06 (7),<0.01 (14)	CH1972a
	72	75	0.56	1	3	0.09,0.11 (7),<0.01 (14)	CH1972a
		75	1.1	1	3	0.19,0.25 (7),0.02,0.03 (14)	CH1972a
	USA '72	75	1.1	1	3	0.09,0.14 (7),0.07,0.12 (14)	CH1972b
		75	1.1	1	3	0.36,0.45 (7),0.32,0.36 (14)	CH1972b
	USA '72	75	0.56	1	6	0.09,0.11 (7),0.02,0.02 (14)	CH1973a
		75	1.1	6		0.18,0.20 (7),0.05,0.05 (14)	CH1973a
	USA '73	75	1.1	6		0.02,0.02 (14),<0.01 (21)	CH1973b
		75	1.1	6		0.09,0.11 (14),0.07,0.10 (21)	CH1973b
Cabbage	France '73	75	0.525	1	1	0.04 (7),0.10 (14),0.02 (21)	
	Germany '76	50	0.25x2+ 0.5x1	1	3	<0.01 (7,10,14,21)	CH1976c
	Japan '88	50 WP	1.8	3	3	0.01 (6),0.01 (13),0.02 (19)	Tomen'88
		50 WP	1.8	3	3	0.14 (7),0.14 (14),0.06 (21)	Tomen'88
	Neath. '72	75	1.0	1	1	0.04,0.05 (14)	CH1972c
	S Africa '72	75	0.56	1	3	0.24,0.26 (1),0.17,0.18 (8),0.16,0.19 (14),0.11,0.15 (21)	CH1972d
Cauliflower	France '75	75	0.5	1	1	<0.01 (14)	CH1975b
	Germany '76	50	0.25x2+ 0.5x1	1	3	0.03 (0),<0.01 (7),0.05 (10), 0.06 (14),<0.01 (21)	CH1976d
	Neath. '72	75	1.0	1	1	0.01, 0.18 (14)	CH1972e
Tomato	Canada '80	75 WP	0.55	1	3	0.06 (3),0.02 (7),0.04 (14)	Rathke 1980a
			1.1	1	3	0.05 (3),0.037),0.02 (14)	
		75 WP	0.55	1	3	0.11 (3),0.14 (7),0.01 (14)	Rathke 1980b

Crop	Country/year	Form. %	kg ai/ha	No. of trials	No. appals.	Residues, mg/kg, at PHI (days)	Ref.
			1.1	1	3	0.15 (3),0.21 (7),0.03 (14)	
	Japan 84	50 WP	1.5	1	2	0.03 (1),0.05 (3),0.06 (7)	Tomen Japan 1984 & 1985
			1.5	1	3	0.06 (1),0.08 (3),0.12 (7)	
	Japan 85	50 WP	1.5	1	2	0.04 (1),0.03 (3),0.06 (7)	
			1.5	1	3	0.08 (1),0.06 (3),0.07 (7)	
	S Africa'73	75 WP	0.38	1	5	0.03 (2),0.03 (3),0.03 (7)	Fascines 1973
			0.75	1	5	0.07 (3)	

(All CH19.. references are to Chevron trials data)
(All formulations were soluble powders except where indicated as WP)

Cotton. The data given in the Evaluations of the 1976 JMPR (FAO/WHO, 1977b) list only the "..maximum levels found in a series of experiments". No evidence of the extent of the trials or of the range of residues found is included. Fortunately, full results of all of these trials have been provided for the present Meeting, although only in tabular format (USA, 1994; Tomen, 1994b). Of the 159 results quoted, 6 were from 6 to 8 applications of acephate at 0.88 kg ai/ha, 124 from 4 to 15 applications at 1.1 kg ai/ha and 29 from 4 to 8 applications at 2.2 kg ai/ha; PHIs ranged from 6 to 69 days. Residues were below the limit of determination of 0.01 mg/kg in 129 of the samples examined; there were 8 results at 0.01 mg/kg, 15 at 0.02 mg/kg and one of each at 0.03, 0.07, 0.09, 0.13, 0.14, 0.23 and 0.26 mg/kg. All of the last four results over 0.1 mg/kg were from one trial in which the residues of acephate were also unusually high, being in the range 0.61 to 1.4 mg/kg as against the normal findings of less than 0.1 mg/kg with occasional excursions up to 0.4 mg/kg. Table 9 sets out the results obtained in these trials at the US PHI of 21 days.

Table 9. Residues of methamidophos in cotton seed from the use of acephate.

Application		No. of results in the range (mg/kg)				
kg ai/ha	No.	<0.01	0.01	0.02	0.03	over 0.1 (value)
1.1	4	8	1	1	-	-
2.2	4	2	-	-	-	-
1.1	5	3	-	1	-	-
1.1	6	14	-	6	-	-
2.2	6	2	-	1	1	-
1.1	8	5	-	1	-	2 (0.13, 0.26)
2.2	8	1	-	1	-	2 (0.14, 0.23)
1.1	9	7	7	-	-	-
2.2	9	-	1	-	-	-

Information was provided that, although no maximum number of applications was prescribed, it was extremely unlikely that more than 5 per season would ever be used under the USA label directions for insect control and current GAP (Tomen, 1994b). Therefore, disregarding the four apparently anomalous results all of which were from eight applications with two at double the maximum dosage rate, it is clear residues of methamidophos at a 21-day

PHI will generally be well below the Step 7B draft MRL of 0.1 mg/kg.

FATE OF RESIDUES IN STORAGE AND PROCESSING

In processing

(a) Residues arising from the use of methamidophos

Cotton. Summary data were made available from a trial of methamidophos on cotton in the USA in 1973. Treatment at 1.1 kg ai/ha 5, 6 or 7 times gave the results listed in Table 10 (Tomen, 1994a).

Table 10. Fate of residues of methamidophos in cotton seed processing.

Days after last appal.	6	17	33
No. of appals.	7	6	5
Sample Fuzzy seeds	0.03, 0.03	n, 0.01	n, n
Lint		3.53, 5.07	1.0, 1.01
Field trash	2.39, 2.64	1.19, 1.84	0.37, 0.45
Hulls	-	0.25, 0.28	n, n
Meals	-	n, n	n, n
Crude oil		n, n	n, n
Refined oil		n, n	n, n

n = below the limit of determination (0.01 mg/kg)

(b) Residues of methamidophos arising from the use of acephate

Green beans. The total methamidophos found in canned beans was between 23 and 55% of the original residue in the fresh beans; the canning water contained 40 to 50% of the total residue. The summary data provided gave no information on the residue levels found (Lai, 1987a).

Dried beans. Pinto beans were treated six times with acephate at 1.1 kg ai/ha in the USA, allowed to dry naturally and separately boiled and canned. The cooking fluid and beans were analysed both before and after processing. No residues of methamidophos were detectable in the dried beans or in any of the processed fractions (Lai, 1987a).

Soya beans. In 1978, soya beans were treated with acephate in the USA at twice the normal rate, when maximum residues of 0.09 mg/kg of methamidophos were found in the shelled beans. Processing studies showed that residues were concentrated in the hulls but were reduced by at least 70% in the meal and by 100% in the oil. No residues of methamidophos could be detected in the crude oil, refined oil, protein flour, or mature soya beans; <0.01 to 0.14 mg/kg were found in the mill feed (Lai, 1987a).

Mint. Four trials of acephate on mint in the USA in 1987 gave maximum residues of 1.7 mg/kg of methamidophos in the fresh mint hay, after treatment at the maximum label rate, at 14-day

PHI. In the spent mint hay, residues were down to 0.77 mg/kg and no residues could be detected in the oil produced therefrom (Lai, 1987b).

Maize. After ten applications of acephate at 2.2 kg ai/ha, twice the maximum label rate, residues of methamidophos at a 21-day PHI were grain 0.04, forage 0.64, silage 0.91 and fodder 0.35 mg/kg. Processing this maize led to no residues being found in the crude oil, refined oil, soapstock, reclaimed solvent, starch, gluten, bleached oil, deodorized oil, steepwater distillate or processed water. When grain, silage, meal, flour, press cake and germ were reanalysed after a storage interval approximating to, or longer than, the interval between collection and initial analysis no loss of the low-level methamidophos residues was observed (Lai, 1988).

Cotton. The tabular residue data referred to above (USA, 1994) also included some summary information on the fate of methamidophos residues during the processing of cotton seed. Table 11 lists the results of the studies.

Table 11. Residues of methamidophos in cotton products from the use of acephate.

Commodity	Application		Residue range (mg/kg)
	kg ai/ha	Number	at 21-day PHI
Fuzzy seed	1.1	4-8	<0.01 - 0.26
Fuzzy seed	2.2	5-8	<0.01 - 0.23
Meal	1.1	5-8	0.02 - 0.31
Meal	2.2	5-8	0.06 - 0.34
Hulls	1.1	5-7	<0.01 - 0.02
Crude oil	1.1	5-8	<0.01
Crude oil	2.2	5-8	<0.01 - 0.01
Refined oil	1.1	5-8	<0.01
Refined oil	2.2	5-8	<0.01
Soapstock	1.1	5-8	<0.01
Soapstock	2.2	5-8	0.01
Field trash	1.1	5-8	0.51 - 8.2
Field trash	2.2	5-8	0.51 -16

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

Citrus fruit. Residue data given in Table 7 show the distribution of methamidophos between the peel and pulp of treated mandarin and summer oranges. Residues of methamidophos in the pulp of mandarins did not exceed 0.10 mg/kg, the maximum amount in the whole fruit was 0.11 mg/kg. In four trials of 50% acephate wettable powder on oranges, residues of methamidophos in the peel reached 0.68 and 0.97 mg/kg while the respective pulps contained 0.03 and 0.05 mg/kg at a 30-day PHI, the maximum in the whole fruit was 0.33 mg/kg (Tomen Japan, 1993).

Farm gate to consumer studies

Methamidophos residues in crops treated with acephate at the maximum label rates were monitored from harvest through typical commercial processes to the consumer. Bell peppers showed the least loss, 3 to 17%, from the farm gate to the consumer. In Brussels sprouts, residues decreased by about 33% after sorting, while blanching plus freezing lost 34% more. Cauliflower residues were reduced by about 60% after trimming and processing. In lettuce, levels were reduced by 10% by removing wrapper and outer leaves. Residues in snap beans decreased by about 64% during handling from the field to the market shelf and as a result of

canning (Lai, 1989a).

Bell peppers. Residues found at various stages, in mg/kg, were field 0.52, packing shed 0.43, distributor 0.45, supermarket 0.57, i.e. 83 to 97% was retained.

Brussels sprouts. Residues found at various stages, in mg/kg, were field 0.03, after sorting 0.02, sorting waste 0.02, after blanching and freezing 0.01, processing waste 0.15, i.e. loss on fresh sprouts 33% and on frozen sprouts 67%.

Cauliflower. Residues found at various stages, in mg/kg, were field cut head 0.10, trimmed head 0.04, cored head 0.04, after processing and freezing 0.04, processing waste 0.10, i.e. loss on trimming and freezing 60%.

Lettuce. Residues found at various stages, in mg/kg, were field cut head 0.02, trimmed head <0.01, at market <0.01, on shelf <0.01, i.e. the loss from field to supermarket shelf appeared to be total but was from a very low level.

Snap beans. Residues found at various stages, in mg/kg, were fresh beans in the field 0.06, fresh beans at market 0.02, fresh beans at the processing plant 0.03, canned beans 0.02, frozen beans in butter sauce <0.01, i.e. loss from field to processing plant 45% to canned beans 64%, to frozen beans 100%.

Market basket surveys

Eight market basket surveys were carried out quarterly in 1984 and 1985, each consisting of the collection of samples from three different geographical locations within the USA. From 26 to 62 commodities were collected in each of the surveys, the edible portions of each commodity from each location being combined and stored frozen until analysed (Lai, 1989b).

Residues of methamidophos were found in only 7 of the 62 commodities sampled, namely cantaloupe, celery (fresh), cucumbers, lettuce (crisphead), sweet peppers (green), tomatoes, and canned snap beans. All residues were less than 0.3 mg/kg. Methamidophos was not consistently found in any commodity in every survey. The results are detailed in Table 12.

Table 12. Residues of methamidophos found in market basket surveys in the USA, 1984-85.

Commodity	Residues, mg/kg	
Cantaloupe	0.10	
Celery		0.04
Cucumbers	0.06	
Lettuce (crisphead)	0.02	
Sweet peppers (Green)	0.26	
Tomato		0.17
Canned snap beans	0.01	

The limit of determination was 0.01 mg/kg

Residues of methamidophos were found in five groups in the 1992 Australian Market Basket Survey (Australia, 1994). These results are shown in Table 13.

Table 13. Methamidophos in market basket surveys in Australia in 1992.

Commodity	No. of samples	Residues (mg/kg) Range	Mean
Chicken nuggets	24	n-0.03	0.005
Lettuce	32	n-0.27	0.014
Oranges	32	n-trace	0.0002
Pears	24	n-0.003	0.0012
Spring rolls	24	n-0.1	0.04

n = not detected, taken as zero in calculating means
'trace' was taken as 0.0037 mg/kg in calculating means

From the same Market Basket study, the daily intakes by various age/sex groups were calculated to be as given in Table 14.

Table 14. Intake of methamidophos by various groups from the Australian market basket survey. Methamidophos intake in ì g/kg bw.

	Adult male	Adult female	Boy 12 years	Girl 12 years	Child 2 years	Infant 9 months
Average	0.0403	0.0226	0.0655	0.0450	0.0747	0.0028
95% decile	0.0712	0.0410	0.1150	0.0716	0.0966	0.0032

(The ADI for methamidophos is 4 ì g/kg bw.)

NATIONAL MAXIMUM RESIDUE LIMITS

The following national MRLs were brought to the attention of the Meeting.

Residue: methamidophos

Country	Commodity	MRL, mg/kg	Remarks
Argentina	Alfalfa forage	0.1	
	Alfalfa seed	0.1	
	Almond	0.1	
	Bean	0.1	
	Cereals	0.05	
	Citrus fruit	0.5	
	Clover forage	2	
	Cotton seed	0.1	
	Garlic	0.1	
	Grape	0.1	
	Leafy + other stem vegetables	0.2	
	Melon	0.5	
	Olive, oil	0.1	
	Pepper, Sweet	0.5	

Country	Commodity	MRL, mg/kg	Remarks
	Pome fruit	0.1	
	Potato	0.1	
	Rice	0.05	
	Soya	0.1	
	Stone fruit	0.1	
	Sunflower	0.1	
	Tomato	0.5	
Australia	Aubergine	1	
	Beet, Sugar	0.05	
	Brussels sprouts	1	
	Cabbage	1	
	Cattle fat	0.01*	
	Cattle meat	0.01*	
	Cattle meat by-products	0.01*	
	Cattle milk	0.01*	
	Cauliflower	1	
	Celery	2	
	Citrus fruit	0.5	
	Cotton seed	0.1	
	Cucumber	0.5	
	Goat fat	0.01*	
	Goat meat	0.01*	
	Goat meat by-products	0.01*	
	Goat milk	0.01*	
	Hop, dry	5	
	Lettuce	1	
	Peach	1	
	Peanut	0.02*	
	Peanut fodder	10	
	Peanut forage	10	
	Pepper, Sweet	2	
	Potato	0.25	
	Rape seed	0.1	
	Sheep meat	0.01*	
	Sheep meat by-products	0.01*	
	Sheep milk	0.01*	
	Soya	0.1	
	Tomato	2	
	Tree tomato	0.01*	

Country	Commodity	MRL, mg/kg	Remarks
Austria	All food of animal origin	0.01	
	Hop	5	
	Other plant commodities	0.05	
Belgium	Cabbage	0.1	
	Hop	5	
	Other plant commodities	0	Below LOD (0.01 mg/kg)
Brazil	Bean	0.01	
	Broccoli	1	
	Cabbage	1	
	Cabbage, White	1	
	Cauliflower	1	
	Cotton seed	0.1	
	Peanut	0.1	
	Pepper, Sweet	0.4	
	Potato	0.1	
	Soya	0.01	
	Tomato	0.3	
Canada	Aubergine	0.5	
	Broccoli	1	
	Brussels sprouts	1	
	Cabbage	0.5	
	Cauliflower	0.5	
	Cucumber	0.5	
	Lettuce	1	
	Melon	0.1	negligible residue tolerance
	Pepper, Sweet	1	
	Potato	0.1	negligible residue tolerance
	Rape seed	0.1	negligible residue tolerance
	Tomato	0.5	
Chile	Beet, sugar	0.1	
	Cattle fat	0.01*	
	Cattle meat	0.01*	
	Goat fat	0.01*	
	Goat meat	0.01*	
	Lettuce, Head	2	
	Milk	0.01*	
	Peach	1	
	Potato	0.1	
	Rape	0.1	

Country	Commodity	MRL, mg/kg	Remarks
	Sheep fat	0.01*	
	Sheep meat	0.01*	
	Tomato	2	
Cyprus	Aubergine	1	
	Beets (Beta vulgaris), leaf	1	
	Beets (Beta vulgaris), root	0.1	
	Cabbage	1	
	Cauliflower	2	
	Celery	2	
	Citrus fruit	0.5	
	Cucumber	1	
	Lettuce	1	
	Meat	0.01	
	Milk	0.01	
	Peach	1	
	Pepper, Cayenne	1	
	Pepper, Sweet	1	
	Potato	0.1	
	Tomato	2	
Denmark	Artichoke	0.01 T*	
	Aubergine	0.2	
	Bean, dry	0.01 T*	
	Berries and small fruits	0.01*	
	Berry, wild	0.01*	
	Bulb vegetables	0.01*	
	Cabbage, Head	0.5	
	Cereals	0.01*	
	Chicory, Witloof	0.01*	
	Citrus fruit	0.2	
	Corn, Sweet	0.01*	
	Cotton	0.1	
	Cucurbits, edible peel	1	
	Cucurbits, inedible peel	0.01	
	Eggs without shell	0.01*	
	Escarole	0.2	
	Flowering brassicas	0.01 T*	
	Grape	0.01 T*	
	Herbs	0.01*	
	Hop	2	

Country	Commodity	MRL, mg/kg	Remarks
	Kohlrabi	0.01*	
	Leafy brassicas	0.01 T*	
	Leek	0.01 T*	
	Legume vegetables	0.01 T*	
	Lentil dry	0.01*	
	Mammalian fat	0.01*	
	Mammalian meat	0.01*	
	Mammalian meat by-products	0.01*	
	Milk	0.01*	
	Milk products	0.01*	
	Mushroom	0.01*	
	Nuts	0.01*	
	Other cucurbits	0.01*	
	Other leafy vegetables	0.01*	
	Other oilseed	0.01	
	Other pulses	0.01	
	Other solanaceae	0.01*	
	Other stem vegetables	0.01*	
	Other tropical/subtropical fruits	0.01*	
	Pea, dry	0.01 T*	
	Pepper, Sweet	0.01 T*	
	Pome fruit	0.01 T*	
	Potato	0.01*	
	Poultry fat	0.01*	
	Poultry meat	0.01*	
	Poultry meat by-products	0.01*	
	Root and tuber vegetables	0.01*	
	Rubus species (Cane fruits)	0.01*	
	Sausage	0.01*	
	Spinach & similar	0.01*	
	Stone fruit	0.01 T*	
	Strawberry	0.01 T*	
	Tea	0.1*	
	Tomato	0.5	
	Watercress	0.01*	
European Union	Artichoke	0.01 T*	
	Aubergine	0.2	
	Bean, dry	0.01 T*	
	Berries and small fruits	0.01*	

Country	Commodity	MRL, mg/kg	Remarks
	Berry, wild	0.01*	
	Bulb vegetables	0.01*	
	Cabbage, Head	0.5	
	Cereals	0.01*	
	Chicory, Witloof	0.01*	
	Citrus fruit	0.2	
	Corn, Sweet	0.01*	
	Cotton	0.1	
	Cucumber	1	
	Cucurbits with inedible peel	0.01*	
	Eggs without shell	0.01*	
	Flowering brassicas	0.01 T*	
	Grape	0.01 T*	
	Herbs	0.01*	
	Hop	2	
	Kohlrabi	0.01*	
	Leafy brassicas	0.01 T*	
	Leek	0.01 T*	
	Legume vegetables	0.01 T*	
	Lentil, dry	0.01*	
	Lettuce	0.2	
	Mammalian fat	0.01*	
	Mammalian meat	0.01*	
	Mammalian meat by-products	0.01*	
	Milk	0.01*	
	Milk products	0.01*	
	Mushroom	0.01*	
	Nuts	0.01*	
	Other cucurbits	0.01*	
	Other leafy vegetables	0.01*	
	Other oilseed	0.01*	
	Other pulses	0.01*	
	Other solanaceae	0.01*	
	Other stem vegetables	0.01*	
	Other tropical/subtropical fruits	0.01*	
	Pea, dry	0.01 T*	
	Pepper, Sweet	0.01 T*	
	Pome fruit	0.01 T*	
	Potato	0.01*	

Country	Commodity	MRL, mg/kg	Remarks
	Poultry fat	0.01*	
	Poultry meat	0.01*	
	Poultry meat by-products	0.01*	
	Root and tuber vegetables	0.01*	
	Rubus species (Cane fruit)	0.01*	
	Sausage	0.01*	
	Spinach & similar	0.01*	
	Stone fruit	0.01 T*	
	Strawberry	0.01 T*	
	Tea	0.1*	
	Tomato	0.5	
	Watercress	0.01*	
Finland	Fruit	0.2	
	Vegetables	0.2	
France	Citrus fruit	0.30	
	Grape	0.30	
	Pome fruit	0.30	
	Stone fruit	0.30	
Germany	Animal fat	0.01	
	Aubergine	0.2	
	Cabbage, Head	0.5	
	Cauliflower	0.2	
	Citrus fruit	0.2	
	Cotton seed	0.1	
	Cucumber	1	
	Egg products	0.01	whole product
	Eggs	0.01	
	Hop	2	
	Leafy brassicas	0.2	
	Lettuce, head	0.2	
	Meat	0.01	
	Meat, preparations of	0.01	
	Milk	0.01	
	Milk products	0.01	whole product
	Other plant commodities	0.01	
	Peach	1	
	Pepper, Sweet	1	
	Pome fruit	0.2	
	Tea	0.1	

Country	Commodity	MRL, mg/kg	Remarks
	Tomato	0.5	
India	Cotton seed	0.1	
	Safflower seed	0.1	
Israel	Aubergine	1	
	Beet, Sugar	0.05	
	Brassica vegetables	1	
	Celery	2	
	Cotton seed	0.1	
	Cucumber	0.5	
	Garlic	0.1	
	Melon	1	
	Onion, Bulb	0.1	
	Pepper, Sweet	1	
	Potato	0.1	
	Tomato	2	
Italy	Beet, Sugar	0.15	
	Corn	0.15	
	Grape	0.15	
	Pome fruit	0.15	
	Potato	0.15	
	Soya seed	0.2	
	Stone fruit	0.15	
	Strawberry	0.15	
Japan	Beet, Sugar	0.05 T	
	Broccoli	1 T	
	Cabbage	1 T	
	Cauliflower	1 T	
	Cotton seed	0.1 T	
	Hop	5 T	
	Lettuce	1 T	
	Other fruits	0.1 T	
	Peach	1 T	
	Potato	0.25 T	
	Rape seed	0.1 T	
	Soya	0.05 T	
Kenya	Cattle fat	0.01 T*	
	Cattle meat	0.01 T*	
	Goat fat	0.01 T*	
	Goat meat	0.01 T*	

Country	Commodity	MRL, mg/kg	Remarks
	Milk	0.01 T*	
	Sheep fat	0.01 T*	
	Sheep meat	0.01 T*	
Luxembourg	Cabbage	0.1	
	Potato	0.01	
Malaysia	Aubergine	1	
	Citrus fruit	0.5	
	Cucumber	1	
	Fat and oil, edible	0.1	
	Peach	0.25	
	Pepper, Cayenne	1	
	Pepper, Sweet	1	
	Potato	0.1	
	Tomato	1	
	Watermelon	0.5	
Mexico	Alfalfa	2	
	Aubergine	1	
	Broccoli	1	
	Brussels sprouts	1	
	Cabbage	1	
	Capsicum (Pepper/Chilli)	1	
	Cauliflower	1	
	Celery	1	
	Cotton	0.1	
	Cucumber	1	
	Lettuce, Head	1	
	Melon	0.5	
	Potato	0.1	
	Soya	0.05	
	Tomato	1	
Netherlands	Cabbage	0.1	
	Other plant commodities	0.00*	(0.01 mg/kg)
	Potato	0.01*	
New Zealand	Brassica vegetables	1	
	Citrus fruit	0.5	
	Fruiting vegetables excluding tomato	0.2	
	Leafy vegetables	0.5	
	Potato	0.1	
	Tomato	0.1	

Country	Commodity	MRL, mg/kg	Remarks
Portugal	Potato	0.01	
South Africa	Citrus fruit	0.2	
	Cruciferae	1	
	Nectarine	1	Export
	Peach	1	
	Peach	1	Export
	Potato	0.2	
	Tomato	0.5	
Spain[1]	Artichoke	0.2	
	Aubergine	0.2	
	Bean, dry	0.01	
	Bean, pods and/or immature seeds	0.1	
	Beet, Sugar	0.05	
	Berry, wild	0.01	
	Bulb vegetables	0.01	
	Cabbage	0.5	
	Cereals	0.01	
	Chicory, Witloof	0.01	
	Citrus fruit	0.2	
	Corn, Sweet	0.01	
	Cotton seed	0.1	
	Cucumber	1	
	Flowering brassicas	0.01	
	Food, dry	0.01	
	Forage crops	0.01	
	Forage crops, straw	0.01	
	Grape	0.01	
	Herbs	0.01	
	Hop	2	
	Kohlrabi	0.01	
	Leafy brassicas	0.01	
	Leek	0.05	
	Lettuce	0.2	
	Mushroom	0.01	
	Nuts	0.01	
	Other berries and small fruits	0.01	
	Other cucurbits with inedible peel	0.01	
	Other leafy vegetables	0.01	
	Other legume vegetables	0.01	

Country	Commodity	MRL, mg/kg	Remarks
	Other oilseed	0.01	
	Other pulses	0.01	
	Other solanaceae	0.01	
	Other stem vegetables	0.01	
	Pea, dry	0.01	
	Pea, pods and/or immature seeds	0.2	
	Pepper, Sweet	1	
	Pome fruit	0.2	
	Potato	0.01	
	Root and tuber vegetables	0.01	
	Rubus species (Cane fruit)	0.01	
	Spices	0.01	
	Spinach & similar	0.01	
	Stimulant plants	0.01	
	Stone fruit	0.2	
	Strawberry	0.01	
	Sugar cane	0.01	
	Tea	0.1	
	Tea, Infusion plants	0.1	
	Tobacco	0.01	
	Tomato	0.5	
	Tropical fruit	0.01	
	Watercress	0.01	
Sri Lanka	Bean	1	
	Beets (Beta vulgaris)	1	
	Cabbage	1	
	Cowpea	1	
	Potato	0.1	
Sweden	Fruit	0.2	
	Potato	0.02*	
	Vegetables	0.2	
Taiwan	Asparagus	0.1	
	Bamboo	0.1	
	Bean, Mung	0.03	
	Bean, Adzuki	0.03	
	Cabbage	0.5	
	Cabbage, Chinese	0.5	
	Carrot	0.1	
	Cauliflower	0.5	

Country	Commodity	MRL, mg/kg	Remarks
	Celery	0.5	
	Dasheen	0.1	
	Garlic	0.5	
	Ginger	0.1	
	Leek	0.5	
	Litchi	0.2	
	Longan	0.2	
	Mango	0.2	
	Mustard	0.1	
	Onion	0.1	
	Pe-tsai	0.1	
	Peanut	0.03	
	Potato	0.1	
	Radish	0.1	
	Rape	0.5	
	Rice	0.5	
	Shallot	0.5	
	Soya	0.03	
	Spinach	0.5	
	Water spinach	0.5	
Uruguay	Tomato	0.1	
USA	Aubergine	1	
	Beet, Sugar, root	0.02	
	Beet, Sugar, top or leaves	0.5	
	Broccoli	1	
	Brussels sprouts	1	
	Cabbage	1	
	Cauliflower	1	
	Celery	1 R	Florida
	Cotton seed	0.1	negligible residue tolerance
	Cucumber	1	
	Lettuce	1	
	Melon	0.5	
	Pepper, Cayenne	1	
	Pepper, Sweet	1	
	Potato	0.1	negligible residue tolerance
	Tomato	1	

[1] MRLs refer to methamidophos resulting from uses of methamidophos or acephate
R = Regional

T = Temporary

APPRAISAL

Methamidophos is a widely used organophosphorus insecticide with systemic properties; its residues may also occur as a metabolite of acephate. It was first evaluated in 1976, with further reviews of residue aspects in 1979, 1981, 1984, 1989 and 1990. Extensive new residue data were reviewed by the 1990 JMPR, together with updated information on current GAP and national MRLs. At the 24th Session of the CCPR (1992), the proposed MRLs for some commodities were held at Step 7B pending comment from several countries for various reasons (ALINORM 93/24, para: 119-123); the commodities were broccoli, head cabbages, cauliflower, celery, citrus fruits, cotton seed, egg plant, melons except watermelon, peaches, potatoes and tomatoes. Information on GAP, results of residue trials and national MRLs have been received from manufacturers and additional data and comments have been submitted by several countries. The relevant data on these crops published in the earlier Evaluations have been reassessed. The present review is mainly concerned with the above mentioned crops but some data on residues in hops, kale, pome fruits, rice, soya beans and yard-long beans are also included.

Information on minor modifications that had been made to the method of residue analysis was made available. These were aimed at consolidating the extraction procedures and improving the recovery and reproducibility. Information was also provided that illustrated the validity of a method for the determination of residues of methamidophos in pome fruits, potatoes and rice, and of a GLC method that was suitable for beets, green vegetables, grains, husks and potatoes.

Since residues of methamidophos can also arise from the use of acephate, the uses of both pesticides have to be taken into account. Extensive information on the use patterns of the two pesticides on the Step 7B crops referred to above was made available from various sources, together with information on GAP for some additional crops.

A review of the data on residues of methamidophos arising from the use of acephate on citrus fruits and brassica crops that had been published in the Evaluations of earlier JMPRs showed that very few results had been obtained under current GAP conditions. Fortunately, some had been resubmitted this year and these could be evaluated. Results of the relevant supervised trials are summarized on a commodity basis below.

Citrus fruits. Data on residues from the use of methamidophos on citrus fruits in Egypt and the USA, reported by the 1981 JMPR, were not supported by GAP information. In trials in Spain in 1988 residues were up to 0.85 mg/kg at day 0 but declined to 0.05 mg/kg by day 60; the Spanish GAP PHI, however, is 28 days. Trials with acephate on mandarin oranges in Japan at GAP rates were reported by the 1990 JMPR, showing up to 0.09 mg/kg of methamidophos at 30 days PHI but 0.15 mg/kg at 45 days. Further trials on mandarin and summer oranges in Japan in 1992-93 gave residues ranging from 0.03 to 0.33 mg/kg in the whole fruit at 30 days; the majority of the residue was in the peel. The Meeting agreed to withdraw the current recommendation of 0.5 mg/kg for citrus fruits.

Pome fruits. Trials of methamidophos on apples in Italy in 1992, according to Italian GAP, gave residues up to 0.33 mg/kg at 21 days PHI. In similar trials in France in 1992 residues were somewhat lower, reaching 0.1 mg/kg at 21 days. Pears treated with methamidophos in France in 1992 showed up to 0.2 mg/kg at 21 days, declining from 1 mg/kg at day 0. No data were available on residues arising from the use of acephate on pome fruit. Although the data under

GAP conditions were rather limited (7 trials) the Meeting agreed to recommend an MRL of 0.5 mg/kg for pome fruits.

Peach. Trials with methamidophos on peaches reported by the 1976 JMPR were not according to GAP. Summary data from trials on peaches in Spain showed up to 0.26 mg/kg at 21 days; however, this was a double-dose treatment and Spanish GAP requires a 28-day PHI. No data were available on residues arising from the use of acephate on peaches. The Meeting agreed to withdraw the previous recommendation for peach (1 mg/kg).

Broccoli. The trials with methamidophos on broccoli reported by the 1976 and 1981 Meetings were not according to GAP. Two trials in Brazil, recorded by the 1990 JMPR, showed no residues above the limit of determination. Trials of acephate on broccoli were carried out in five countries in which this use is not registered, and thus GAP was not observed. The Meeting agreed to withdraw the previous recommendation for broccoli (1 mg/kg).

Cabbages, Head. Summary data reported by the 1976 JMPR from the treatment of cabbages in the USA and Germany gave residues of methamidophos up to 0.11 mg/kg at 7 days and 0.07 mg/kg at 14 days but the applications were not according to the quoted GAP. Data on residues in cabbages treated in Australia were reviewed at the 1981 JMPR. Residues were 0.02-0.07 mg/kg at 13-14 days and <0.02 mg/kg at 20-21 days PHI; the stated PHI in Australia was 35 days. Data reported to the 1990 JMPR showed that residues of methamidophos were generally below 0.01 mg/kg in the USA at the recommended PHI of 35 days, apart from one apparently anomalous study giving 0.76 and 1.1 mg/kg; all trials included 6 applications at 1.1 kg ai/ha instead of the maximum of 4 allowed under GAP. Residue data from the use of acephate on cabbages in New Zealand were reviewed by the 1984 JMPR from two trials that were according to their GAP and gave 0.17 and 0.2 mg/kg at 7 and 10 days PHI respectively. No other valid data on residues in cabbages from acephate uses were available. The Meeting agreed to withdraw the previous recommendation for head cabbages (1 mg/kg).

Cauliflower. Trials on cauliflower in Germany and the USA reported at the 1976 JMPR showed residues of methamidophos in the heads up to 0.45 mg/kg at 14 days, 0.23 mg/kg at 21 days and 0.12 mg/kg at 28 days; leaves showed up to 6.28, 1.11 and 0.62 mg/kg respectively, at the same time intervals. Data reported by the 1981 JMPR from trials in Australia and Germany showed residues in cauliflower heads of 0.02 mg/kg or less at 20-21 days PHI; the GAP PHI is 28 days in Australia and 21 days in Germany. The information available to the 1990 JMPR was very variable. Two trials in Brazil showed <0.01 mg/kg at PHIs from 14 to 28 days. Results from trials in the USA in 1973 gave up to 0.48 mg/kg in the flowerheads at 15 days and 0.21 mg/kg at 21 days (the residues in the leaves were higher) but none of these results were obtained at the GAP PHI of 28 days. No valid data were presented on residues of methamidophos from the use of acephate on cauliflowers. In the absence of adequate data either to support the existing recommendation or to suggest a new one, the Meeting agreed to withdraw the previous recommendation for cauliflower (1 mg/kg).

Melons, except Watermelon. Only one of the trials reported by the 1990 JMPR (from Mexico in 1973) was according to the then appropriate recommended GAP; residues were below 0.1 mg/kg from day 0 to day 14. All US trials in 1982 involved an excessive application rate (1.5 times the maximum); at 14 days PHI residues ranged from 0.19 to 0.56 mg/kg. No data were available on residues of methamidophos from trials according to current GAP or resulting from the use of acephate on melons. The Meeting agreed to withdraw the previous recommendation for melons, except watermelon (0.5 mg/kg).

Egg plant. The 1976 JMPR recorded residues in the range 0.02 to 0.10 mg/kg for PHIs of 0 to 7

days after applications of methamidophos to egg plants in Mexico; the treatments were outside current Mexican GAP rates. The data reported to the 1984 JMPR showed very variable residues, with maxima of 1.9 mg/kg at 3 days and 0.65 mg/kg at 7 days, using up to 15 applications; but, again, these treatments were not in accordance with GAP. The 1990 JMPR reported results from the USA which were then, but are not now, according to US GAP, showing residues up to 0.17 mg/kg at 3 days and up to 0.12 mg/kg at 7 days PHI. No data were available on residues of methamidophos resulting from the use of acephate on egg plants. The Meeting agreed to withdraw the previous recommendation (1 mg/kg).

Tomato. Only one result from the residue trials reported by the 1976 JMPR had been obtained under the quoted recommended use (GAP) conditions. Trials data from New Zealand and South Africa were available to the 1981 JMPR. Although it is stated that it could not be determined whether nationally approved GAP had been followed, the highest residue was 0.53 mg/kg at 4 hours PHI; at 7 days residues were <0.01 to 0.3 mg/kg. Trials data from Spain and Brazil were recorded at the 1990 JMPR. In the Spanish glasshouse trials, residues were 0.18-0.25 mg/kg at 3 days, 0.27-0.35 mg/kg at 7 days and 0.20-0.34 mg/kg at 14 days. Results from Brazil were all under 0.01 mg/kg from 3 or 2 days PHI. However, neither treatment was in accord with the stated GAP. Summary data were provided from two trials of methamidophos on tomatoes in Thailand in 1993. Crops were sprayed at either the maximum rate or at double rate; in either case residues were about 0.1 mg/kg at 25 days PHI. The PHI for most crops in Thailand is 21 days but no information was available as to whether this use is registered.

Data on residues of methamidophos from the use of acephate on tomatoes, as presented in the 1976 JMPR Evaluations, are inadequate to relate the residues to the appropriate GAP. For the 1990 JMPR, data were produced from 5 trials of the use of acephate on tomatoes in France in 1988, with residues of 0.31 and 0.43 mg/kg of methamidophos at 21 days after the last of two applications; other results were below 0.1 mg/kg at 21 days. This use is not currently registered in France.

Data from 4 trials of acephate on tomatoes which were carried out according to the relevant GAP in Japan in 1984 and 1985 and from one trial in South Africa in 1973 were provided to the present Meeting. In the Japanese trials, at the recommended PHI of 3 days, residues of methamidophos were between 0.03 and 0.08 mg/kg. Residues in the South African trials were 0.03 and 0.07 mg/kg at 3 days. Several trials were also carried out in Canada, which has no registered uses of acephate on food crops (maximum residues 0.15 mg/kg at 3 days and 0.21 mg/kg at 21 days).

For such a major crop, adequate residue data obtained under GAP conditions were limited and not sufficient either to support the existing recommendation or to suggest a new one. The Meeting agreed to withdraw the previous recommendation (1 mg/kg).

Kale. Data from one trial at two levels in Brazil were assessed at the 1990 JMPR. After 4 applications at 0.6 kg ai/ha, 1 mg/kg was found on the day of the last application but residues were below 0.01 mg/kg after 14 to 28 days. When a double-dose treatment was given, residues were also below 0.01 mg/kg at 21 days PHI. Six trials were carried out in Thailand over three growing seasons using four applications at either the maximum recommended rate of 1.2 kg ai/ha or double this amount, at intervals of 5 to 6 days. Residues declined rapidly, from 30-50 mg/kg at day 0 to less than 0.05 mg/kg at the usual Thailand PHI of 21 days. Although it is stated that GAP was observed in the trials, no information was available on whether the use is registered in Thailand. No maximum residue level could be estimated.

Yard-long beans. Data on six trials carried out in Thailand over three growing seasons on yard-long beans were provided. Four applications were made at either the maximum recommended rate of 1.2 kg ai/ha or double this amount, at intervals of 5 to 6 days. The residues found in the succulent pods with beans (without peduncle) declined rapidly, from 11 to 26 mg/kg at day 0 to less than 0.02 mg/kg at 14 days; no further sampling was done as the residues had then reached the limit of determination. The usual PHI in Thailand is 21 days for most crops; although the report states that GAP was observed in the trials, no information was available on whether the use is registered in Thailand. No maximum residue level could be estimated.

Potato. Residues from trials of methamidophos on potatoes reported by the 1976 JMPR did not exceed 0.11 mg/kg at 7 days PHI but the summary data are limited and the number of applications was twice the number allowed by GAP. Data reported at the 1981 JMPR were confined to one trial in New Zealand at double the GAP application rate; residues were 0.07 and 0.19 mg/kg at 7 days and <0.01 and 0.03 mg/kg at 14 days. At the 1982 JMPR no data were detailed, but it was stated in the 1982 evaluation, which was published with the 1989 Evaluations, that "In 23 experiments in which potatoes were treated repeatedly with methamidophos in accordance with GAP, all residues were below the existing MRL of 0.1 mg/kg". At the 1990 JMPR data were presented from Brazil, Spain and the USA, all results being below 0.01 mg/kg. Four trials of methamidophos on potatoes were carried out in Germany in 1988, using 7 applications at 0.6 kg ai/ha. All residues were below the limit of determination (0.01 mg/kg) from day 0 to day 21; the PHI in Germany is 14 days.

Summary data reported by the 1976 JMPR showed that residues of methamidophos in the peel and pulp of potatoes treated with 1 to 2 kg ai/ha of acephate were 0.03-0.06 mg/kg and 0.02-0.04 mg/kg respectively, 3 and 14 days after application. Very limited data summarized by the 1984 JMPR showed no residues of methamidophos above 0.05 mg/kg following treatment of potatoes in New Zealand with acephate at 0.42 to 0.84 kg ai/ha.

The Meeting estimated a maximum residue level of 0.05 mg/kg for potato to replace the previous recommendation of 0.1 mg/kg.

Celery. Limited data on residues of methamidophos in celery were recorded by the 1976 JMPR. At 21 days PHI, residues were up to 1.55 mg/kg in the stalks, 0.08-6.0 mg/kg in the tops and 0.02-0.20 in the whole plant; treatments were close to US GAP. Residue data from the USA, as reported by the 1990 JMPR, showed a similarly large variation. At the recommended PHI of 21 days, residues ranged from <0.01 to 1.27 mg/kg in the stalks and from 0.02 to 3.14 mg/kg in the whole plant. No data were available on residues of methamidophos resulting from the use of acephate on celery. From the review of existing data, the Meeting agreed to confirm the recommendation for celery (1 mg/kg).

Rice. In 4 trials in Thailand in 1992/93, rice was treated twice with methamidophos at 0.6 kg ai/ha. The residues were about the limit of determination (0.01 mg/kg) in polished grain, straw, glume and bran at 50 to 61 days PHI after being 27 mg/kg in the green plant at day 0. Methamidophos is not registered for use on rice in Thailand, although acephate can be used. This use on rice is at a rate similar to the GAP for methamidophos on rice in Malaysia and several Central and South American countries. No maximum residue level could be estimated.

Cotton seed. Data from treated cotton were summarized very briefly in the 1976 Evaluations. Residues in cotton seed were up to 0.06 mg/kg at 21 to 26 days after treatment with methamidophos at 0.26-2.24 kg ai/ha. As the data also covered rape seed treatments, the results could not be interpreted with any degree of assurance. In the report of the 1982 JMPR, although

no data were given, it was stated that the residue data provided from supervised trials supported the existing MRL for cotton seed. Residue data on cotton seed, cotton forage (green) and cotton bolls were reported by the 1990 JMPR. Residues on cotton seed ranged from 0.1 to 1.6 mg/kg at 7 days and from 0.02 to 0.21 mg/kg at 28 days. No data were given at the USA recommended PHI of 50 days and 5 applications were made instead of the allowed maximum of 2. Data were made available from trials of methamidophos on cotton in the USA in 1973 using 5, 6 or 7 applications of 1.1 or 2.2 kg ai/ha. Six days after the last of 7 treatments the highest residue in the fuzzy seeds was 0.05 mg/kg, all other treatments giving 0.01 mg/kg or less.

The data in the Evaluations of the 1976 JMPR for residues of methamidophos derived from the use of acephate on cotton list only the "..maximum levels found in a series of experiments". No evidence of the extent of the trials or of the range of residues found is included. Fortunately, full results of all of these trials have been provided for the present Meeting, although only in tabular format. Of the 159 results quoted, 6 were from 6 to 8 applications of acephate at 0.88 kg ai/ha, 124 from 4 to 15 applications at 1.1 kg ai/ha and 29 from 4 to 8 applications at 2.2 kg ai/ha; PHIs ranged from 6 to 69 days. Residues were below the limit of determination of 0.01 mg/kg in 129 of the samples examined; there were 8 results at 0.01 mg/kg, 15 at 0.02 mg/kg and one each at 0.03, 0.07, 0.09, 0.13, 0.14, 0.23 and 0.26 mg/kg. All of the last four results over 0.1 mg/kg were from one trial in which the residues of acephate were also unusually high, being in the range 0.61 to 1.4 mg/kg as against the normal findings of less than 0.1 mg/kg with occasional excursions up to 0.4 mg/kg. Information was provided that, although no maximum number of applications was prescribed, it was extremely unlikely that more than 5 per season would ever be used under the USA label directions for insect control and current GAP. Therefore, disregarding the four apparently anomalous results which all involved eight applications and two of which at double the maximum rate, it is clear that at 21 days PHI residues of methamidophos will generally be well below the proposed Step 7B MRL of 0.1 mg/kg. The Meeting agreed to maintain the current recommendation of 0.1 mg/kg for cotton seed.

Soya bean. Summary data were provided from a trial of methamidophos on soya beans in Thailand in 1993; residues from 3 applications at 0.25 or 0.5 kg ai/ha after 7 days were <0.01 and 0.01 mg/kg respectively. These are well within the current CXL of 0.05 mg/kg.

Hops. Residues in dry hops 59 days after treatment in Poland with methamidophos at 0.75 kg ai/ha were 0.04 mg/kg, but it was not clear whether this treatment was according to Polish GAP. German GAP has 1.8-3.6 kg ai/ha and a 42-day PHI. The residues are well within the present CXL for hops, dry, of 5 mg/kg.

Data were provided on the effects of various forms of processing on the residues of methamidophos in several commodities. Residues in crude and refined oils from treated cotton seed, soya beans and corn were below the limit of determination (0.01 mg/kg); nor could residues be detected in mint oil. Canning green beans caused residue losses up to 55 % of the original value and no residues could be detected in dried pinto beans.

Information was also provided on residues of methamidophos occurring in food in commerce and in market basket studies. Residue data showed the distribution of methamidophos between the peel and pulp of treated mandarin and summer oranges. Residues of methamidophos in the pulp of mandarins did not exceed 0.10 mg/kg, while 0.14 mg/kg was on the peel; the maximum level in the whole fruit was 0.11 mg/kg. In four trials with 50% acephate wettable powder on oranges, residues of methamidophos on the peel reached 0.68 and 0.97 mg/kg while the respective pulps contained 0.03 and 0.05 mg/kg at 30 days PHI; the maximum in the whole

fruit was 0.33 mg/kg.

Methamidophos residues in crops treated with acephate at the maximum label rates were monitored from harvest through typical commercial processes to the consumer. Bell peppers showed the least loss, 3 to 17%, from the farm gate to the consumer. In Brussels sprouts, residues decreased by about 33% after sorting, while blanching plus freezing lost a further 34%. Cauliflower residues were reduced by about 60% after trimming and processing. In lettuce, levels were reduced by 10% by removing wrapper and outer leaves. Snap bean levels decreased by about 64% during handling from the field to the market shelf and by canning.

Eight market basket surveys were carried out quarterly in 1984 and 1985, each involving the collection of samples from three different geographical locations within the USA. From 26 to 62 commodities were collected in each of the surveys, the edible portions of each commodity from each location being combined and stored frozen until analysed. Residues of methamidophos were found in only 7 of the 62 commodities sampled, namely cantaloupe (0.1 mg/kg), celery (0.04 mg/kg), cucumbers (0.06 mg/kg), lettuce (0.02 mg/kg), sweet green peppers (0.26 mg/kg), tomatoes (0.17 mg/kg), and canned snap beans (0.01 mg/kg). Methamidophos was not consistently found in any commodity in every survey.

Residues of methamidophos were found in only five groups in the 1992 Australian Market Basket Survey, 24 or 32 samples in each group. The residues (mg/kg) were lettuce max. 0.27, mean 0.014; spring rolls max 0.1, mean 0.040; chicken nuggets max 0.03, mean 0.005; pears max. 0.003, mean 0.0012; oranges max trace, mean 0.0002.

From the same market basket study, the daily intakes by various age/sex groups were calculated to be, as ì g/kg bw for an average energy intake, adult male, 0.0403; adult female, 0.0226; boy 12 years, 0.0655; girl 12 years, 0.0450; child 2 years, 0.0747; infant 9 months, 0.0028. Results for the 95% decile energy intake were about 1.8 times greater.

RECOMMENDATIONS

After reconsidering the evaluations of earlier JMPRs and reviewing additional data the Meeting estimated the two residue levels shown below, which are recommended for use as MRLs, and recommends the withdrawals shown.

Definition of the residue: methamidophos

Commodity		Recommended MRL (mg/kg)		PHI on which based, days
CCN	Name	New	Previous	
VB 0400	Broccoli	W	1	-
VB 0041	Cabbages, Head	W	1	-
VB 0404	Cauliflower	W	1	-
FC 0001	Citrus fruits	W	0.5	30
VO 0440	Egg plant	W	1	-
VC 0046	Melons, except Watermelon	W	0.5	-

Commodity		Recommended MRL (mg/kg)		PHI on which based, days
CCN	Name	New	Previous	
FS 0247	Peach	W	1	-
FP 0009	Pome fruits	0.5	-	21
VR 0589	Potato	0.05	0.1	14
VO 0448	Tomato	W	1	7

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