METHOMYL (094)

EXPLANATION

A residue review for methomyl was conducted in 1975 and supervised field trial data for various crops and related data were considered in 1976-1978, 1987, 1988, 1990 and 1991. The 22nd Session of the CCPR decided to combine the MRLs for methomyl and thiodicarb (ALINORM 91/24 A, para. 126, p.21). Some aspects of the toxicology of methomyl are reviewed by the present Meeting. This review of residue aspects is within the CCPR Periodic Review Programme.

The manufacturer submitted data on product chemistry, metabolism, environmental fate, analytical methods, storage stability, animal feeding studies and survey samples. The governments of Queensland, Australia and Germany submitted information on labels.

IDENTITY

ISO common name: methomyl

Chemical name:

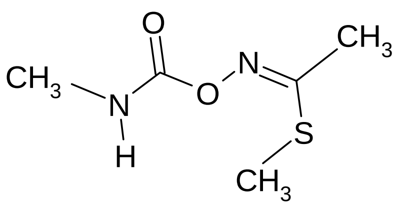
IUPAC: *S*-methyl *N*-(methylcarbamoyloxy)thioacetimidate

CA: methyl *N*-[[(methylamino)carbonyl]oxy]ethanimidothioate

CAS number: 16752-77-5

Synonyms and trade names: syn-methomyl; metomil; mesomil; OSM 1196; “Lannate”; “Nudrin”

Structural formula:



Molecular formula: $C_5H_{10}N_2O_2S$

Molecular weight: 162.20 g/mole

Physical and chemical properties

The physical and chemical properties of methomyl are summarized in Table 1. The material described is technical grade unless otherwise indicated.

Table 1. Physical and chemical properties of methomyl.

Property	**Characteristics**	**Test material purity**	**Reference**
Physical state	Crystalline solid		Silveira, 1990
Colour	White		Silveira, 1990
Odour	Slightly sulfurous		Silveira, 1990
Melting point	77°C		Silveira, 1990
Relative density	0.57 g/ml		Silveira, 1990
Solubility in water	5.48 $\pm$ 0.04 g/100 g water at 25°C	96.2%	Hoffman, 1988
Solubility in organic solvents, g/100 g at 25°C	Methanol: 100 Ethanol: 42 Isopropanol: 22 Acetone: 72 Toluene: 3 Ethyl acetate: 77.4 g/l at 20°C *n*-heptane: 0.097 1-Octanol: 24.0 *o*-xylene: 9.58 Acetonitrile: >25 at 20°C Dichloromethane: >25 Dimethylformamide: >25		Silveira, 1990. Moore, 2001
Vapour pressure	5.4 x 10^{-6} mm Hg at 25°C	>99.2%	Barefoot and Cooke, 1989
Dissociation constant	Non-ionizable		Silveira, 1990
Octanol/water partition coefficient (log)	1.24	99.3%	Singh, 1988
Hydrolysis	At pH 5 and 25°C, stable for 30 days At pH 7 and 25°C, stable for 30 days At pH 9 and 25°C, 50% loss in 30 days, with conversion to *S*-methyl *N*-hydroxythioacetimidate	95.5% radiochemical purity	Friedman, 1983

Photolysis	At a concentration of 100 mg/l in pH 5 aqueous medium at 25°C, the half-life under fluorescent UV lights (365 nm peak sensitivity, 1000 microwatts/cm^2) was 2-3 days, with acetonitrile the principal product.	95% methomyl, 3% *S*-methyl *N*-hydroxythioacetamidate, 2% unknown	Harvey, 1984
Storage stability	No significant degradation (<1%) over 9 years in ambient conditions		Silveira, 1990

Formulations

The formulations are listed in Table 2.

Table 2. Formulations of methomyl.

Registered Trademark	**Active Ingredient Content**	**Formulation Type**
Lannate Lannate SP Lannate 90	900 g/kg	Water soluble powder (SP)
Lannate 45	450 kg/kg	Water soluble powder (SP)
Lannate 40 SP	400 g/kg	Water soluble powder (SP)
Lannate 25	250 g/kg	Wettable powder (WP)
Lannate LV	290 g/l	Wettable powder (WP)
Lannate L	215 g/l	Soluble concentrate (SL)
Lannate 20L	200 g/l	Soluble concentrate (SL)
Lannate 12.5L	125 g/l	Soluble concentrate (SL)

METABOLISM AND ENVIRONMENTAL FATE

Unless otherwise noted [^{14}C]methomyl is labelled on the C doubly bound to N.

Animal metabolism

The metabolism of methomyl has been studied in various laboratory animals and livestock including rats, monkeys, goats, cows and poultry. In general, methomyl is rapidly absorbed, extensively metabolized and excreted as volatile or polar metabolites.

Rats. In a study by Harvey *et al*. (1973) two male rats were fed a diet containing 200 mg methomyl/kg bw for 8 days, followed by intragastric intubation of 1.2 mg [^{14}C]methomyl (about 5 mg/kg bw) and were killed 72 and 24 hours after treatment. A third male rat was treated similarly except that the [^{14}C]methomyl (3.5 mg/kg bw) was given after 19 days of preconditioning.

In three days the rats exhaled 50% of the administered ^{14}C (17% carbon dioxide and 33% acetonitrile, by GC-MS) and excreted 16-24% in the urine. Less than 3% of the administered dose was found in the faeces. Urinary and volatile metabolites were identified 1 or 3 days after the ^{14}C dose. Countercurrent distribution of the urine showed that almost all the radioactivity present was in polar material. Methomyl, methomyl *S*-oxide, methomyl *S,S*-dioxide and *S*-methyl *N*-hydroxythioacetimidate (MHTA) were not detected in the urine. Radioactivity was distributed among a range of tissues with about 10% of the dose in the tissues and carcase 1 or 3 days after dosing. Recovery of the total administered radioactivity did not exceed 60%.

In a second more detailed study (Hawkins *et al*., 1991) five male and five female rats were given single oral doses of syn-[^{14}C]methomyl (5 mg/kg) and held in metabolism cages for 7 days. The rats exhibited clinical signs of cholinesterase inhibition (muscle tremor and humped posture) which disappeared within 2 hours of the dose. Within 24 hours about 80% of the administered dose was eliminated in the urine and exhaled, but >90% elimination did not occur until 168 hours. No differences were found between males and females in rates of excretion or levels of residual radioactivity in tissues.

The radioactive components of the urine collected after 0-24 hours were separated by reverse-phase HPLC, ion partition chromatography (acetamide and acetate) and confirmed by TLC. The main metabolite was identified by NMR and mass spectroscopy (LC-MS-FAB) as a mercapturic acid derivative of methomyl, (L)-*N*-acetyl-*S*-[1-(methylcarbamoyloxyiminoethyl)]cysteine, equivalent to about 17% of the ^{14}C dose. There were many components, each constituting less than 5% of the administered dose, some tentatively identified as acetonitrile, acetate, MHTA sulfate and acetamide. Methomyl, MHTA, acetohydroxamic acid and the anti-isomer of methomyl were not detected.

Monkeys. Four male cynomolgus monkeys were each given a single oral dose of [^{14}C]methomyl (5 mg/kg bw). Over 24 hours about 36% of the administered dose was found in the exhaled air (4% as acetonitrile, range 2.7-5.2%; 32% carbon dioxide, range 30-36%) and about 27% in urine. A total of 32% was found in urine over 168 hours (Hawkins, 1992).

Approximately 5% of the radioactivity was still retained in the tissues after 168 hours. The highest concentrations were in the liver (0.7-0.9 mg/kg methomyl equivalents), fat (0.4-0.7 mg/kg) and kidney (0.4-0.5 mg/kg). Lower concentrations were found in other tissues but were generally higher than the blood levels of 0.1-0.2 mg/kg equivalents.

A combination of HPLC (reverse-phase, ion partition) and TLC characterized 18 radioactive metabolites in urine, with no metabolite accounting for more than 4% of the dose. Small amounts of acetonitrile (3%), acetate (0.6%), acetamide (0.5%) and MHTA sulphate (0.3%) were among the products found. The mercapturic acid derivative of methomyl accounted for about 1%. Methomyl, methomyl *S*-oxide, methomyl *S,S*-dioxide and *S*-methyl *N*-hydroxythioacetimidate (MHTA) were not detected.

Goats and cows. The metabolism of [^{14}C]methomyl has been examined in ruminants in three separate studies (two on goats and one on cows).

In the first study, (Harvey, 1980) a lactating goat was given [^{14}C]methomyl by capsule twice a day for 10 days at doses equivalent to 20 ppm in the feed. Milk, blood, urine and faeces were sampled daily and tissues within one day of the last dose. No methomyl or MHTA was detected in any of the samples. Approximately 16% and 7% of the radioactivity was excreted in the urine and faeces respectively and about 8% appeared in the milk and 17% in exhaled air. Residues in the milk reached a plateau after 3 days equivalent to approximately 2 mg/kg as methomyl, and the lactose contained about 11-13%, hexane extracts, containing the triglyceride components, 26-37% and the casein component 8-9% of the ^{14}C in the milk. This indicates that methomyl had been completely broken down and incorporated into milk constituents. [^{14}C]acetonitrile was identified as a volatile metabolite in milk and blood.

Examination of the liver samples demonstrated that the radioactivity derived from methomyl was found in glycerol, glycerol-3-phosphate, fatty acids, neutral lipids and insoluble protein, indicating a metabolic pathway via acetonitrile and acetate into the naturally occurring constituents in the liver.

In the second study, a lactating cow was dosed twice daily by capsule for 28 days with [^{14}C]methomyl at a rate equivalent to 8 ppm in the feed. Milk samples were collected each day and selected tissues were taken within 24 h of the last dose. Radioactivity appeared in the milk within one day and reached a plateau of 0.5 mg/kg equivalents within 6 days, mostly because of the reincorporation of the radiolabel into fatty acids, lactose and other acetate-derived products. No methomyl or MHTA was detected; acetonitrile accounted for about 25% of the radioactivity. The highest concentrations of radioactivity, equivalent to 9.23 mg/kg, were in the liver, with only 2.01 mg/kg in the kidneys and lower concentrations in fat and muscle. Most of the radioactivity was considered to be the result of reincorporation of the radiolabel as acetate into natural constituents. No methomyl was detected in tissues (Monson and Ryan, 1991).

A more detailed goat study (Dietrich *et al.*, 1995) confirmed the results of the earlier ruminant studies. A lactating goat was dosed orally, once daily, for three days with 160 mg of [^{14,13}C]methomyl, nominally 80 ppm in the diet based on 2 kg food consumption/day, but was actually 162 ppm based on actual food consumption during the study. The specific activity was reported as 11.0 µCi/mg and the radiochemical purity was 97.8%. Milk was collected twice daily (morning and afternoon) and pooled each day. The goat was slaughtered 24 hours after the last dose. A portion of the samples were analysed immediately and the rest were frozen. More than 30% of the administered dose was collected as exhaled volatile metabolites with 18.5% identified as [^{14}C]carbon dioxide and 12.8% as [^{14}C]acetonitrile. Urine radioactivity accounted for 16.5%, while 5.0% was found in faeces. Approximately 3% was found in milk and radiolabelled residues in muscle, liver, fat and kidneys contained approximately 6% at slaughter. Overall recovery of the administered dose including stomach and gastrointestinal tract contents was 73%.

Tissue and milk samples were homogenized with methanol and chloroform and centrifuged, and the chloroform layer was drawn off with a pipette. The remaining pellet/methanol/water mixture was extracted twice with two additional 25 ml portions of chloroform on a wrist-shaker for 5 min, centrifuged and the chloroform fraction removed and combined with the first chloroform fraction.

The remaining pellet/methanol/water mixture was further extracted with methanol followed by separation of the methanol/water fraction by centrifugation. The pellet was again extracted with 25 ml of 50/50 methanol/water, centrifuged and the methanol/water supernatant combined with the first methanol/water fraction. The total radioactivity in the chloroform and methanol/water fractions was determined by LSC.

A portion of the remaining pellet was treated with Pronase. Further extractions were made after acid and base hydrolysis, saponification of neutral lipids and fatty acids and methylation of free fatty acids. The extracts analysed by HPLC.

The TRR was highest in liver (12.1 mg/kg as methomyl) with lower levels in kidney (4.67 mg/kg), muscle (1.45 mg/kg) and fat (0.32 mg/kg), and in the milk ranged from 4.09 mg/kg during the first 0-24 h to 9.31 mg/kg in samples during the 24 h after the last dose.

Tissues and milk were extracted on the day the goat was killed and analyses completed within 48 h. Special precautions were taken to minimize loss of volatile metabolites from tissues or further metabolism of initial metabolites. Methomyl, methomyl *S*-oxide, methomyl *S,S*-dioxide, *S*-methyl *N*-

hydroxythioacetimidate (MHTA) and hydroxymethyl-methomyl were not detected (LOD 0.007-0.018 mg/kg). [^{14}C]Acetonitrile was detected in all samples, at levels of 0.438 mg/kg as methomyl (18.6% of the TRR) in 48-72 h in milk, 10.2% (0.314 mg/kg) in liver, 62.3% (0.228 mg/kg) in muscle, 30.5% (0.360 mg/kg) in kidney and 39.4% (0.032 mg/kg) in fat. Low levels of [^{14}C]acetamide were detected in all samples, ranging from 0.005 mg/kg in fat to 0.08 mg/kg in milk and kidney, as well as [^{14}C]thiocyanate at 0.58 mg/kg as thiocyanate (17% of the TRR) in 48-72 h milk, 0.30 mg/kg (7% of the TRR) in liver, 0.097 mg/kg (19% of the TRR) in muscle, 0.59 mg/kg (35% of the TRR) in kidney, and 0.057 mg/kg (50% of the TRR) in fat. ^{12}C/^{13}C ratios determined by mass spectrometry of the pentafluorobenzyl derivative indicated that the thiocyanate isolated from milk was 50% methomyl-derived (presumably resulting from acetonitrile metabolism to cyanide which is then converted to thiocyanate, a known metabolic reaction for detoxification of cyanide) and 50% from natural sources.

Further analysis of the radioactivity in tissues indicated extensive metabolism of methomyl with incorporation of the radiolabel into natural products, which is consistent with the earlier goat and cow studies. Approximately 31% of the TRR in the milk was shown to be incorporated into fatty acids by saponification, methylation and chromatography with methylated fatty acid standards, and approximately 10% as [^{14}C]lactose by co-chromatography with an authentic radiolabelled reference standard. The presence of radiolabelled glucose and amino acids was confirmed in the milk and tissue samples. Most of the solvent-extractable radioactive compounds in the tissues apart from acetonitrile were highly polar compounds unrelated to methomyl, on the basis of HPLC retention times of available standards containing the methylcarbamoyloxy moiety. It is likely that the polar residues are natural products and low molecular weight compounds originating from acetonitrile or carbon dioxide, and the main component is radiolabelled thiocyanate (Table 3).

Table 3. Identification of radiolabelled residues from a lactating goat given 3 daily doses of 160 mg of [^{13,14}C]methomyl (Dietrich *et al.*, 1995).

Compound	Sample									
	Milk		Muscle		Liver		Kidney		Fat	
	mg/kg[1]	% of TRR	mg/kg	% of TRR	mg/kg	% of TRR	mg/kg	% of TRR	mg/kg	% of TRR
Methomyl	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA
Methomyl oxime	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA
Acetonitrile	1.7	19	0.90	62	1.2	10	1.4	30	0.13	39
Acetamide	0.22	2	0.14	10	0.16	1	0.23	5	0.015	5
Thiocyanate	1.6	17	0.27	19	0.85	7	1.6	35	0.16	50
Fatty acids	2.9	31	0.02	1	0.24	2	0.06	1	0.02	7
Lactose	0.99	11	ND	NA	ND	NA	ND	NA	ND	NA
Acetate	0.28	3	0.24	16	5.7	45	0.88	19	0.03	9
Amino acids	1.2	13	0.19	13	1.6	13	0.63	13	0.03	8
Total	9.3	96	1.4	110	12.	77	4.7	98	0.32	110

[1] as methomyl
ND: not detected, LOD 0.02 mg/kg.
NA: not applicable

Poultry. Djanegara and Ryan (1994) dosed five white Leghorn laying hens orally once a day for three days with 5.1 mg [1-^{13,14}C]methomyl, equivalent to 45 ppm in the diet. The specific activity was reported as 23.3 µCi/mg and the radiochemical purity 98.5%. Eggs were collected twice daily, and samples of the whites and yolks pooled separately each day. The hens were killed 24 hours after the last dose. Exhaled acetonitrile and carbon dioxide accounted for 53% of the administered dose and the total recovery was 85% (Table 4).

Samples were analysed for methomyl, methomyl oxime, acetonitrile and acetamide (Table 5) within 48 hours. [^{14}C]Acetamide was detected in the whites and yolks at 0.02 and 0.01 mg/kg as methomyl respectively. No methomyl, methomyl oxime nor any metabolites (including methomyl sulfoxide, hydroxymethyl-methomyl and methomyl sulfone) with a retention time longer than acetonitrile were detected. [^{14}C]Acetamide was detected in the whites and yolks at 0.02 and 0.01 mg/kg as methomyl respectively.

In samples stored at -60°C for 14 months more than 98% of the TRR in egg whites was extractable with methanol/water, of which 85-89% was acetonitrile and 1.4-2.6% acetamide (Table 6).

Tissue and yolk samples sequentially extracted with methylene chloride and methanol/water (2:1) were separated into polar, non-polar and residual solids fractions, and the solids pellets were treated with Pronase E overnight at 37°C. The methylene chloride extracts were distilled to capture acetonitrile. The remaining residues were saponified and partitioned into petroleum ether, methylene chloride (after acidification) and ethanol/water extracts. The petroleum ether extracts were analysed for cholesterol and the methylene chloride extract methylated to characterize the fatty acids. Anaylses were by reverse-phase HPLC. The water/alcohol soluble fraction was not analysed further owing to low radioactivity (0.03 mg/kg). The methylated fatty acids were examined by GC-MS and palmitic, oleic, myristic and stearic acids and cholesterol were found.

The methanol/water extract and the supernatant from the Pronase E treatment of the residual solids were analysed by HPLC. Most of the radioactive residue was polar. The samples were hydrolyzed with concentrated HCl at 100° C (to liberate amino acids) and analysed by another HPLC method (Table 6).

Table 4. TRR in the tissues and eggs of hens dosed orally for three days at 5 mg/day (Djanegara and Ryan, 1994).

Sample	TRR	
	mg/kg as methomyl	% of total dose administered
Liver	2.97	1.0
Muscle	0.54	1.4
Fat	0.79	0.8

Sample	TRR	
	mg/kg as methomyl	% of total dose administered
Egg whites		
0-24 h	0.99	0.2
24-48 h	1.1	0.3
48-72 h	1.5	0.3
Egg yolks		
0-24 h	0.46	<0.05
24-48 h	0.90	0.1
48-72 h	1.9	0.2
% of total dose: acetonitrile trap, 34.1; carbon dioxide trap, 19.2; excreta, 25.8; cage wash, 1.5.		

Table 5. Metabolism by poultry - initial analyses (Djanegara and Ryan, 1994).

Compound	Sample									
	Egg white (1.53 ppm)[1]		Egg yolk (1.94 ppm)[1]		Fat (0.794 ppm)		Liver (2.97 ppm)		Muscle (0.540 ppm)	
	% of TRR	mg/kg[2]	% of TRR	mg/kg	% of TRR	mg/kg	% of TRR	mg/kg	% of TRR	mg/kg
Methomyl	ND[3]	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methomyl oxime	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetamide	1.4	0.02	ND	ND	ND	ND	ND	ND	ND	ND
Acetonitrile	89	1.4	34	0.66	12	0.09	14	0.42	33	0.18

[1] mg/kg in 48-72 h eggs
[2] As methomyl.
[3] Not detected. Limit of detection estimated at 0.007-0.015 mg/kg.

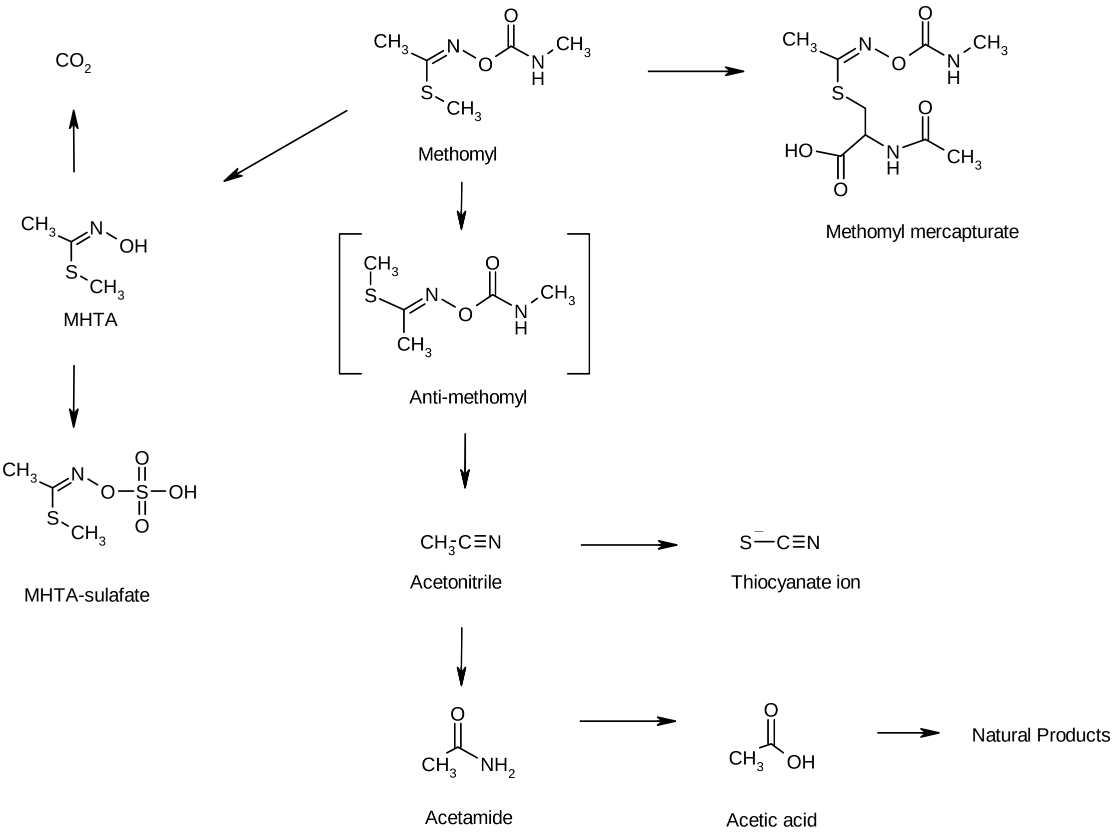
Table 6. Metabolism by poultry - additional analyses (Djanegara and Ryan, 1994).

Fraction/characterization or identification	Egg white (1.57 mg/kg)[1]		Egg yolk (1.94 mg/kg)[1]		Fat (0.794 mg/kg)		Liver (2.97 mg/kg)		Muscle (0.540 mg/kg)	
	% of TRR	mg/kg	% of TRR	mg/kg	% of TRR	mg/kg	% of TRR	mg/kg	% of TRR	mg/kg
CH_2Cl_2 extract										
Acetamide	1.4	0.02	ND[2]	ND	ND	ND	ND	ND	ND	ND
Acetonitrile	90	1.4	21	0.41	7.1	0.056	9.3	0.28	26	0.14
Lipids			60[3]	1.2	87	0.69	32	0.96	15	0.083
MeOH/Water extract[4]			3.6	0.071	1.7	0.014	11.0	0.326	12	0.066
Acetamide			0.63	0.012			0.46	0.014	1.9	0.010
Acetonitrile			0.1	0.002			0.42	0.012	ND	ND
Polar metabolites			1.4	0.028			5.2	0.15	6.8	0.037
Unidentified			0.43	0.008			2.4	0.070	ND	ND
Pronase E supernatant[5]			7.9	0.15	3.8	0.030	36	1.08	39	0.22
Acetamide			ND	ND			0.3	0.009	ND	ND
Acetonitrile			ND	ND			6.5	0.19	ND	ND
Polar metabolites			5.2	0.102			18	0.53	33	0.18
Unidentified			0.95	0.018			9.6	0.28	5.7	0.031
Unextractable	3.0	0.05	6.6	0.13	0.55	0.004	11	0.32	6.6	0.036

[1] Residue in 48-72 h eggs
[2] Not detected
[3] Palmitic and oleic acids (36%), myristic acid (3.2%), stearic acid (5.7%), cholesterol (4.5%)
[4] Acid hydrolysis reduced polar metabolites. HPLC consistent with glycine, serine, glutamate and aspartate. Acetic acid (0.25% of TRR yolk, 1.7% of TRR liver, 2.3% of TRR muscle).
[5] Acid hydrolysis reduced combination of polar and unidentified metabolites. HPLC consistent with glycine, serine, glutamate and aspartate. Acetic acid (0.85% of TRR yolk, 9.8% of TRR liver, 7.9% of TRR muscle).

The metabolic pathways in poultry, rats, monkeys and ruminants are similar. The main pathway involves conversion of methomyl to the volatile metabolites acetonitrile and carbon dioxide with further metabolism of acetonitrile followed by the incorporation of one and two carbon units into a variety of natural products. Proposed pathways are shown in Figure 1.

Figure 1. Proposed metabolic pathways of methomyl in laboratory animals and livestock.



Plant metabolism

The metabolic fate of [14C]methomyl in plants was studied in tobacco, maize and cabbage in the laboratory (Harvey, 1973a,b; Harvey and Reiser, 1973a; Harvey andYates, 1973a,b) and also under field conditions in maize, cabbage (Harvey and Reiser, 1973b) and cotton (Bull, 1974).

In the laboratory tobacco was grown from seedlings potted in sand. When the plants were 18 cm high the roots were exposed to a 10 mg/l solution of [14C]methomyl for 28 days. The foliage of 42-day old greenhouse-grown cabbage and maize plants 28 cm high was treated with [14C]methomyl in an aqueous solution containing Tween 20 surfactant, and a potted cabbage plant with 4.42 µc of radioactivity in 325 µl of solution. Four maize plants in a pot were treated with 5.44 µc of [1-C14]methomyl pipetted into the whorls at the growing point. Each pot was placed in a glass metabolism apparatus equipped with cold traps, oxidizing furnaces and sodium hydroxide traps to measure the radioactivity of volatile products. Tobacco was harvested on the last day of treatment and cabbage and maize 7 and 10 days after treatment respectively.

96-97% of the radioactivity was accounted for in the two tobacco plants which absorbed 20-25% over 4 weeks. About 6% of the TRR (25% of the absorbed) was retained in the tissues and the remainder volatilized (14-19% of the dose). The volatile components [14C]carbon dioxide and [14C]acetonitrile were found in equal proportions.

About 108% of the radioactivity applied to the maize plants was accounted for, approximately 43% of which was volatilized within 10 days. The volatile components consisted of $^{14}CO_2$ and [^{14}C]acetonitrile in the ratio of 1:4. One week after treating the cabbage leaves, 20% of the radioactivity was volatized as $^{14}CO_2$ and [^{14}C]acetonitrile in approximately equal proportions, and approximately 96% of the applied was recovered.

The plant tissues were extracted by maceration in ethyl acetate (tobacco) or methanol. In cabbage 54% of the applied radioactivity was extractable and 22% unextractable, in tobacco 5% and 0.3%, in maize 26% and 19% respectively. The extracts of cabbage plants were analysed (counter-current distribution/LSC, TLC) for methomyl, methomyl *S*-oxide, methomyl *S*,*S*-dioxide and *S*-methyl *N*-hydroxythioacetimidate (MHTA) and components were characterized as more or less polar than methomyl. The cabbage leaf extract yielded 62% polar, 7% methomyl and 30% non-polar. The only terminal residue specifically detected was methomyl, with no evidence of structurally related compounds. Saponification of the non-polar residues yielded radiolabelled fatty acids. Palmitate, stearate and/or oleate, palmitoleic and arachidate were tentatively identified by gas chromatography, and polar compounds from the cabbage extracts by TLC as glycolic and tartaric acids and compounds which gave positive ninhydrin reactions indicating the reincorporation in amino acids.

[^{14}C]methomyl was also sprayed on tobacco leaves to determine whether it was translocated to untreated parts of the plant. Two plants were covered with plastic wrap, leaving the fifth leaf from the ground exposed, then sprayed with an aqueous solution of [^{14}C]methomyl (0.5 mg, 2.70 µc) containing surfactants. Three and seven days after treatment, plants were fractionated into growing tips, stems above treated leaf, treated leaf, mature leaves, stem below the treated leaf and roots, and separately extracted with ethyl acetate. No radioactivity was detected in any extracts except of the leaf treated originally in the 3-day sample but all segments of the 7-day sample contained residues indicating limited foliar translocation of methomyl. The radioactivity in the untreated segments was <1% of the residual radioactivity on the treated leaf.

The reports of the field studies (Harvey and Reiser, 1973g; Bull, 1974) lack adequate details to validate the findings. Field-planted cabbage approximately 6 weeks old received 8 weekly treatments of [^{14}C]methomyl applied at 0.56 kg /ha, specific activity 0.428 µCi/mg, with a commercial surfactant, and the plants were harvested 8 days after the last application. The outer leaves of the cabbage contained most of the residues of which 3-4% (0.8-0.9 mg/kg) was methomyl. The edible head contained 0.03-0.09 mg/kg methomyl (approximately 2-3% of the TRR), tentatively identified by countercurrent fractionation, with the remainder characterized as polar (31-51%) and non-polar (2-13%). Between 44 and 54% of the radioactivity was unextractable. No methomyl *S*-oxide, methomyl *S*,*S*-dioxide or *S*-methyl *N*-hydroxythioacetimidate (MHTA) was found in the outer leaves or heads.

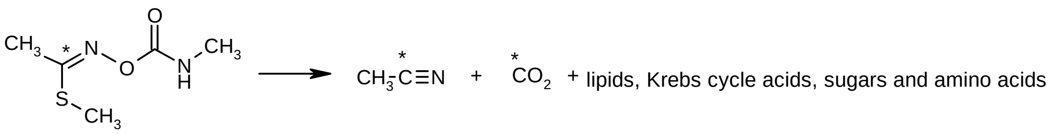
In another study sweet corn plants approximately 8 weeks old received 7 weekly treatments of [^{14}C]methomyl at 0.56 kg /ha, specific activity 0.222 µCi/mg, with a commercial surfactant. Corn ears and fodder were harvested at an early mature stage 8 days after the last harvest. No methomyl was detected in the grain by countercurrent fractionation. 63% of the TRR was in a polar fraction and 37% was unextractable. The methomyl was equivalent to 2 mg/kg in fodder and 1.5 mg/kg in cannery waste (husks and cobs), and 35-49% was unextractable. 26-35% of the extractable TRR was polar and 3-6% non-polar. No methomyl *S*-oxide, methomyl *S*,*S*-dioxide or MHTA was found in the corn fractions.

In a further study individual field-grown cotton leaves were treated with 50 µg of [^{14}C]methomyl in an aqueous solution containing a wetting agent and harvested 0, 4, 8, 24, 48, 96 and 192 hours later. About 40% of the methomyl penetrated the cotton leaves within the first four hours and 19% was on the leaf surface. Surface residues were largely lost within 48 hours (<2% remaining), presumably as $^{14}CO_2$ and [^{14}C]acetonitrile. Determination was by TLC and the parent compound was the only radioactive component on the leaf surface. [^{14}C]methomyl appeared to penetrate the leaf surface and was almost completely degraded within 8 days (<2% degraded after 48 hours). No methomyl *S*-oxide, methomyl *S*,*S*-dioxide or *S*-methyl *N*-hydroxythioacetimidate (MHTA) was found in the leaves. The unextractable residue was about 6% of that applied.

In a study on rotational crops sandy loam soil (0.73% organic matter (OM), pH 5.9) in 28-l containers was surface-treated with [^{14}C]methomyl at 4.48 kg ai/ha and aged in a greenhouse (Harvey, 1978). Thirty and 120 days after treatment, cabbage, red beets and sunflower seeds were planted in the containers. The crops were grown to maturity and analysed for total ^{14}C and methanol-extractable ^{14}C, and the methanol extracts for ethyl acetate-soluble ^{14}C. After the 30 days of ageing, 26% of the original [^{14}C]methomyl remained in the soil, but only 8% after 120 days. Mature beets and cabbage harvested from soil aged 30 days after treatment contained ^{14}C levels equivalent to 0.1-0.2 mg/kg as methomyl, and mature sunflower seeds 2 mg/kg. Beets and cabbage planted 120 days after the soil was treated had ^{14}C levels of 0.04-0.05 mg/kg, and sunflower seeds 1.5 mg/kg. However all crops sampled after either 30 or 120 days ageing had levels of intact [^{14}C]methomyl or metabolites equivalent to 0.01 mg/kg or less (in the ethyl acetate fraction from hexane/ethyl acetate partition of concentrated methanol extract). The residue in the sunflower seeds was not analysed further.

The degradation pathway of methomyl is similar in the various crops studied. It is extensively metabolized to one- and two-carbon fragments, $^{14}CO_2$ and [^{14}C]acetonitrile, which are reincorporated into natural plant constituents in maize and cabbage, such as fatty acids. No apparent conjugates were observed in any of these studies. The only terminal residue specifically detected was methomyl.

Figure 2. Metabolism of [^{14}C]methomyl in plants.



Methomyl (* denotes position of the radiolabel)

The degradation or loss of unlabelled methomyl on cotton leaves was studied in cotton-growing areas of Mississippi, Texas and California in the USA. The potential wash-off from various leaf surfaces was tested in dislodgeable foliar studies (Eble and Tomic, 1990). Single applications of 0.76 kg ai/ha of a water-soluble formulation of methomyl were sprayed on the leaves during periods of no rainfall and sampled at 9 intervals from 0 to 144 hours after application. Residues were rinsed off with water for analysis by HPLC. The foliar half-life for methomyl was estimated to be 0.6 to 2.2 days, average 1.1 days, based on first-order kinetics.

Environmental fate in soil

The aerobic degradation of [^{14}C]methomyl was studied in a microbially active loam soil from Madera, California, USA (Zwick and Malik, 1990a). The organic matter content was 0.93% and the pH 7.8. The soil was treated with [^{14}C]methomyl at a rate equivalent to approximately 9 kg ai/ha and incubated at 75% maximum water holding capacity in a flow-through system at 25°C in the dark for 90 days. Duplicate samples taken at 9 dates were analysed for total ^{14}C, [^{14}C]methomyl and potential metabolites. [^{14}C]methomyl was rapidly degraded with a half-life of approximately 11 days, on the basis of first-order kinetics. The main product was $^{14}CO_2$ (75% of applied ^{14}C) during the three months. The degradation products extractable with methanol/water, 50/50, identified by TLC and HPLC, included minor amounts of the hydrolysis product of methomyl, *S*-methyl *N*-hydroxythioacetimidate (MHTA) and two polar products, all of which were individually 3.3% or less of the applied radioactivity at any time. Unextractable radioactivity increased for the first month, reaching 24% then decreasing to 14% of the applied radioactivity at 3 months, mostly associated with soil organic matter. The soluble humin fraction, separated by sequential 0.1 N NaOH and 6N HCL treatments at 90°C, and the insoluble fraction contained about 8% each of the applied radioactivity.

[^{14}C]methomyl was added at a rate equivalent to 5.0 kg ai/ha to three moist agricultural soils and incubated in the dark in the laboratory for 42 days in a flow-through apparatus (Harvey and Pease, 1973e). Of the applied radioactivity 31-45% was found in the sodium hydroxide traps and identified as $^{14}CO_2$ and 12-14% was unextractable. The soil extracts contained 33-51% of the applied radioactivity, almost all as [^{14}C]methomyl, and degradation products and/or polar compounds represented less than 2%. Using the same experimental arrangement, a Minnesota muck soil (52% OM, pH 5.45) was treated at 4.5 kg ai/ha with [^{14}C]methomyl and incubated as described above for 42 days (Harvey, 1972). During the experiment 42% of the applied radioactive material was degraded to $^{14}CO_2$, unextractable residues accounted for 46% and 8% was extracted. The major component of the soil/water extract was [^{14}C]methomyl by TLC, representing 7.7% of the applied radioactivity. Minor degradation products were all below 0.3%.

In another laboratory study a Flanagan silt loam (8.26% OM, pH 6.5) was treated at 4 mg/kg with [^{14}C]methomyl and incubated for 45 days in a flow through system at 25°C in the dark. Soil moisture was maintained at approximately 70% of the maximum water holding capacity (Harvey, 1977b). A heat-sterilized soil replicate was also incubated in aseptic conditions. At the end of the experiment [^{14}C]methomyl was present in the active soil extracts at 47% of the applied radioactivity, $^{14}CO_2$ accounted for 22.5% and 26.2% was unextractable. 19% of the extractable fraction was methomyl and/or MHTA, equivalent to approximately 5% of the applied radioactivity. In the sterile replicate $^{14}CO_2$ was only 0.3%, and [^{14}C]methomyl was present at 89% of the applied radioactivity, indicating the importance of microbial processes for the degradation and subsequent mineralization of [^{14}C]methomyl and its transient products in soil.

Microbial transformation of methomyl was determined in Myrtleford sandy loam (2.1% OM, pH 6.1) and Ovens fine sandy clay loam (2.3% OM, pH 5.8). 10g of each soil was perfused with aqueous solutions (230 ml) containing 6 mg/l of methomyl (Fung and Uren, 1977). In one replicate, sodium azide was added to sterilize the soil. The soils were conditioned in the perfusion apparatus with polyvinyl alcohol (5%, w/v) to flocculate them to ensure adequate drainage, and equilibrated for 2 days. The solutions of 6 mg/l methomyl were then exchanged at a flow rate of 8 ml/min. at 25°C for up to 56 days. After 42 days 58% of the methomyl in the solution perfusing the Myrtleford soil and 38% in the Ovens soil solution had been degraded. The loss appeared to be about 5% in the azide-treated soil, suggesting the importance of microbial transformation.

The degradation of [^{14}C]methomyl under field conditions was studied at three US sites (Harvey and Pease, 1973) in a Keyport silt loam at Newark, Delaware; a Leon Immokalee fine sand at Bradenton, Florida; and Cecil loamy sand at Clayton, North Carolina. Stainless steel cylinders of approximately 10 cm in diameter and 38 cm in length were driven into undisturbed soil and the cylinders of soil were treated with [^{14}C]methomyl at rates equivalent to 5.04 kg ai/ha. Leachate from the more permeable Bradenton and Clayton soils was allowed to drain freely into a glass container. The cylinders were collected after 1, 3 and 12 months in Newark, after 3 months in Florida and 5 in North Carolina. The leachates contained no radioactivity. The soils were divided into four layers and the top layer was extracted with methanol and water and analysed for [^{14}C]methomyl and potential degradation products by countercurrent distribution. In all soils most of the residual radioactivity was in the top 8 cm, with less than 5% in the lower layers in Delaware, 8% in Florida and 27% in North Carolina. The results are shown in Table 7.

Table 7. Distribution of [^{14}C]methomyl (percentage of applied dose) in three soils under field conditions after application at 5 kg ai/ha (Harvey and Pease, 1973).

Fraction	% of applied ^{14}C at location/interval (months)/rainfall (cm)				
	Delaware/1/2.8	Delaware/3/28	Delaware/ 12/103	Florida/3/ 60	North Carolina/5/44
Unaccounted (volatilization assumed)	71	81	85	90	85
Unextracted (0-8 cm)	26	18	15	10	15
Methomyl (0-8 cm)	1.8	0.3	0.0	<0.005	<0.005
S-methyl *N*-hydroxy thioacetimidate (MHTA) (0-8 cm)	0.2	0.1	0.0	<0.005	<0.005
Polar (0-8 cm)	0.9	0.7	0.3	0.2	0.04

In another study [^{14}C]methomyl was added at 4.48 kg ai/ha to the surface of 1l containers filled with an agricultural sandy loam (0.73% OM, pH 5.9) and incubated in a greenhouse for 45 days (Harvey, 1977a). At the end of the experiment unextractable soil residues represented 20% of the applied radioactivity, and [^{14}C]methomyl 21%. The only degradation product, MHTA, was below 0.5% of the applied radioactivity at all 6 sampling dates. A polar fraction was found in all soil extracts, accounting for < 2% of the applied radioactivity. Most of the applied [^{14}C]methomyl was assumed to be lost through volatilization of $^{14}CO_2$. After extraction of the 45-day soil residue with hot caustic soda, about 25% of the unextractable radioactivity was recovered as MHTA, representing 3% of the applied radioactivity. The remainder was divided between all the normal soil organic matter fractions.

The anaerobic degradation of [^{14}C]methomyl in a microbially active loam soil from Madera, California, was studied by Zwick and Malik (1990b). The organic matter (OM) content of the soil was 0.93% and the pH 7.8. The soil was treated with [^{14}C]methomyl at a rate equivalent to approximately 8.97 kg ai/ha and first incubated aerobically at 75% maximum water holding capacity at 25°C in the dark for 14 days and then under anaerobic conditions for 60 days. Duplicate soil samples were taken 7, 14, 30 and 60 days later for analysis. [^{14}C]methomyl was rapidly degraded with a half-life (first order kinetics) of approximately 14 days under anaerobic conditions. The major product was $^{14}CO_2$ with approximately 35% of the applied radiolabel converted during the study period; however, 30% was formed during the aerobic phase. An additional 4% was found as volatile organic compounds during the anaerobic phase. Extractable compounds identified by HPLC and TLC included minor amounts of methomyl (0.6-5% of applied ^{14}C), MHTA (0.3-1%) and two polar products (each 0.3-7% of the applied radioactivity). Unextractable radioactivity was observed on anaerobic day 7 at 30% and decreased to 24% of the applied radioactivity at 60 days. Most of the unextractable radioactivity was associated with the soil organic matter.

Unlabelled methomyl was incubated at 10°C in soil samples from below shallow ground-water tables from four locations in The Netherlands (Smelt *et al*., 1983). The subsoils were sand 0.5% OM, pH 7.6, loamy fine sands 2.3% OM, pH 7.5 and 1.0% OM, pH 7.8, and fine sand 0.1% OM, pH 4.5. All four subsoils are anaerobic in the field, and from each 100 g of water-saturated sediment was transferred into a jar and 25 ml of groundwater added. Anaerobic conditions were established by purging the container with nitrogen. After pre-incubation for 7-11 days at 10°C in the dark, 4 ml of methomyl solution was added (50 µg/ml) and the jars incubated under the same conditions as before. Conversion of methomyl in the soil samples was very rapid. In three subsoils less than 5% of the applied material was measured after one day of incubation (half-life <5 hours), and in the fine sand the half-life was calculated to be 7 hours.

Bromilow *et al*. (1986) investigated the role of ferrous ions in the rapid degradation of methomyl in anaerobic soils. Subsoils were sampled from two locations in The Netherlands and anaerobic conditions were maintained during sampling and transport. The organic matter in the soils was 1.0 and 22.0%, the pHs were 5.7 and 6.7, and concentrations of ferrous ions (Fe^{2+}) 27 and 41 mg/l in the soil water. Suspensions of anaerobic soils (80-200 g dry basis) were incubated before the study began according to the procedure of Smelt *et al*. (1983) and 5 mg of unlabelled methomyl was added for further incubation at 20-24°C in the dark. Methomyl was very rapidly degraded in the anaerobic subsoils with half-lives of 1 and below 0.2 hours. Only methanethiol and dimethyl disulfide were detected in the headspace and soil water. Reactions of methomyl with metal ions was tested in an aqueous solution containing 250 mg/l Fe^{2+}. Solutions were deoxygenated with a gentle steam of nitrogen and incubated in sealed glass tubes under nitrogen. Methomyl was very rapidly degraded in the presence of Fe^{2+} with a half-life of 4.1 hours yielding methanethiol and presumably acetonitrile. However, the reactions in soil were about an order of magnitude faster than those in the aqueous solutions at comparable concentrations of ferrous ions in the water.

The rate of degradation was measured in three greenhouse soils in The Netherlands (Leistra *et al.*, 1984). The organic matter content of the soils ranged from 3.8-9.7% and the pH from 6.4-7.1. Methomyl was added at a rate equivalent to 3 kg ai/ha and the soils were incubated in the dark at 20°C for 60 days. Soil moisture was kept between 25 and 40% gravimetric water content. Half-lives determined using first-order kinetics were 2 to 14 days (average 6.7 days).

Methomyl, formulated as Lannate L insecticide, was applied at 4.48 kg ai/ha at a site in Greenville, Mississippi, USA (C.M. Kennedy, 1991d) to field cabbages planted in a loam and silt loam, average pH 6.4 and organic matter content 1% in the top 90 cm layer. Samples were taken down to 90 cm at 9 sampling dates up to 91 days later. The calculated half-life of methomyl was 5 days, and it remained in the top 15 cm of the soil throughout.

In another trial the same formulation was applied to cabbages at 10.09 kg ai/ha (S.M. Kennedy, 1989) at a field site in Madera, California, USA. The soil was a sandy loam with a pH of 7.9 and an organic matter content of 0.6% in the top 30 cm layer. Samples were taken down to 90 cm at 14 sampling dates up to 272 days after application. The half-life of methomyl was 54 days, owing to the low moisture content of the soil as the site bordering the California desert (2.5%-17.2% with an average of 10.7% during the study period). It was thought that the dry conditions may have adversely affected the soil microbial population, thus significantly reducing its bioactivity.

The photolysis of [^{14}C]methomyl by natural sunlight was studied at an application rate of 1.12 kg ai/ha (Swanson, 1986) with a dark control. Samples were analysed at intervals up to 30 days. A slurry of Keyport silt loam (5.0% sand, 67% silt, 28% clay, 1.4% OM, pH 6.8) was applied to glass microscope slides at 1 mm thickness and air dried. Using a water bath the temperature was maintained at 25°C during the exposure to sunlight. [^{14}C]methomyl decomposed with a half-life of 34 days to form acetonitrile, the only detected radioactive degradation product. The controls did not decompose.

The mobility of methomyl was investigated in batch equilibrium studies with [^{14}C]methomyl on two sandy loam and two silt loam soils (Priester, 1986). Aqueous solutions containing 0.2-6 mg/l [^{14}C]methomyl/l were mixed with 20 g of soil in a 1:1 ratio and shaken for 24 hours at 25°C. Radioactivity in the soil at equilibrium was determined from the change in concentration of radioactivity in the aqueous solution. For the desorption phase, the soil and water from the 6 mg/l adsorption experiment were used. The supernatant was removed and distilled water added to re-establish the initial total weight and 1:1 (w/w) soil to water ratio. The mixture was shaken for 24 hours at 25^{o}C and the concentration of radioactivity in the supernatant was determined. This procedure was repeated five times, using fresh distilled water each time. The concentration of radioactivity in the soil at each step was calculated from the change in radioactivity in the water. Results are summarized in Table 8.

The mobility of [^{14}C]methomyl was also investigated in the four soils using soil thin-layer chromatography (Priester, 1984). TLC plates were made with each soil, spotted with an acetone solution of methomyl, and developed with water. The results are shown in Table 8.

Table 8. Adsorption/desorption of methomyl on sandy loam and silt loam soils (Priester, 1984, 1986).

Sample	pH	Organic matter (%)	K_{oc}, coefficient of adsorption per unit organic matter (l/kg)	Coefficient of desorption per unit organic matter (l/kg)	R_f for TLC plates developed with water
Cecil sandy loam	6.5	2.1	34	48	0.53
Woodstown sandy loam	6.6	1.1	21	45	0.82
Keyport silt loam	5.2	7.5	14	37	0.52
Flanagan silt loam	5.4	4.3	23	37	0.46

In another adsorption study by Cox *et al.* (1993) in southern Spain, 4 soils including subsoils were treated at concentrations of 20 and 50µM and soil:solution ratios of 1:2 and 1:5, w/v. Organic matter contents were 0.54-2.5%, and clay contents 20-68%. The soil-water distribution coefficient ranged from 0.06 l/kg for a subsurface soil with 0.29% organic matter and 24% clay to 1.4 l/kg for a surface soil with 1.67% organic matter and 68% clay. Regression analysis indicated some correlation between organic matter or clay content and adsorption.

Leistra *et al.* (1984) studied the adsorption of methomyl in three greenhouse soils (3.7-9.7% organic matter, pH 6.4-7.1) in The Netherlands. The soil:solution ratio was 1:1, with two concentrations of methomyl at 0.25 and 1 mg/l. Adsorption coefficients ranged from 0.43-1.30 l/kg and calculated K_{oc} from 11 to 13 l/kg. Adsorption was weak to moderate, with highest sorption in soils with higher clay and organic contents.

In a soil-column leaching study using sand, loamy sand and sandy loam soils, [^{14}C]methomyl was applied to the surface of 30 cm soil columns at a rate equivalent to 0.5 kg ai/ha and the columns were eluted with HPLC grade water equivalent to approximately 200 mm of rainfall within 24 hours (Langford-Pollard, 1994). The major radioactive component in the leachates corresponded to methomyl, as determined by HPLC and TLC. A minor component accounting for 0.8-2% of the applied radioactivity was identified as MHTA. Other radioactive fractions represented a maximum of 0.7% of applied radioactivity. Analysis of the soil column demonstrated the presence of [^{14}C]methomyl only.

Additional trials were conducted with aged Speyer 2.1 soil. 100 g soil fractions were mixed with sufficient HPLC grade water to bring the soil to 9% moisture content, and stored for 12 days in the dark at 20^{o}C in flasks, treated with the [^{14}C]methomyl solution and placed in a gas-flow system with traps for volatiles. After ageing [^{14}C]methomyl in the sandy Speyer 2.1 soil for 13 days at 20°C (half-life as determined from separate experiments), the contents of the flasks were transferred to columns packed with Speyer 2.1 soil, which were eluted with HPLC water. Extraction of an aged soil sample yielded 53% of the applied radioactivity; some 21% was not extracted and the radioactivity in the volatile traps during ageing accounted for 20% of the applied radioactivity which was shown to be due to $^{14}CO_2$. The main radioactive component in the soil extracts before elution accounted for 48% of the applied radioactivity as [^{14}C]methomyl. MHTA was a minor component accounting for 0.8% of applied radioactivity. Column leaching of the aged soil sample showed limited mobility. [^{14}C]methomyl in the leachate represented 5% of the applied radioactivity.

The results are shown in Table 9.

Table 9. Leaching of ^{13}C-methomyl from three soils when applied at 200 g/ha and eluted with water equivalent to 20 cm of rainfall (Langford-Pollard, 1994).

Soil Organic % Sand %	% of applied radioactivity						
	Leachate	Soil 0-10 cm		Soil 10-20 cm		Soil 20-30 cm	
		Extract[1]	Residue	Extract	Residue	Extract	Residue
Unaged Speyer 2.1 1.07 90.9	52	5.1	1.6	12	2.0	27	3.3
Aged Speyer 2.1 1.07 90.9	6.7	10	22	7.6	2.0	13	2.9
Speyer 2.2 4.01 82.1	9.1	8.8	3.2	13	5.7	27	11
Speyer 2.3 2.11 64.7	8.1	9.7	3.3	22	4.1	46	7.7

[1] Methanol/water (2/1).

Environmental fate in water/sediment systems

The extent of indirect photolysis of methomyl in aqueous solutions was assessed by Armbrust and Reilly (1995). The rate constant for its reaction with hydroxyl radicals generated by direct photolysis of hydrogen peroxide, measured by competition kinetics against acetophenone as a reference, was 2.3 x 10^{12} /M-h indicating that methomyl is relatively reactive toward hydroxyl. In further experiments degradation was measured in sterile water buffered at pH 7 in the presence and absence of excess nitrate ions and in sterile natural water exposed to simulated sunlight at 25°C. Identical solutions were run as dark controls. After 360 hours (11,261 watt-hr/m^2), equivalent to about 42 summer days in Delaware, the degradation rate increased with increasing concentrations of nitrate ions, with half-lives of 45, 9.5 and 50 sunlight equivalent days for the 100 and 1000 molar excess nitrate solutions and the sterile natural water respectively. No significant degradation was observed in the controls, or in irradiated solutions that did not contain nitrate. These data suggest that methomyl would be rapidly degraded by indirect photolysis processes in shallow or near-surface natural waters.

The fate of [^{14}C]methomyl added at nominal concentrations of 0.45 µg/ml to two natural water/sediment systems was investigated by Mayo (1994). Test vessels with water/sediment samples (55-75 g) and sieved water (6 cm above sediment) were stored 28 days in the dark at 20^{o}C with a constant flow of humidified air passing over the water surface at a height of 3 cm and flow rate of 10-50 ml/min. The pH, temperature and oxygen concentration of the water and redox potential of water and sediment were measured periodically during the acclimatization period. An equilibrium in these parameters was established in 28 days as shown below, together with the characteristics of the soils.

Source of water/sediment	Auchingilsie, UK (moving water)	Hinchingbrooke, UK (pond)
pH	7.2-7.8	7.2-7.8
O_2 concentration	60%	65%
Redox potential (of sediment)	-40 to -50 mV	-40 to -50 mV
Sand %	41	44
Silt %	37	31
Clay %	22	25
Organic matter %	5.0	10.0

The mixtures in the vessels were treated with [^{14}C]methomyl at 0.45 µg/ml, and the vessels connected to a gas-flow system with traps (two vessels for each water/sediment system sampled at 0, 0.25, 1, 2, 7, 14, 29, 60 and 102 days). Samples of water taken at each interval were radio-assayed and then analysed by HPLC and TLC. Sediment samples were extracted with water/methanol. The redox potential of the sediment samples indicated that the sediment was anaerobic during the test period. The results are shown in Tables 10 and 11.

Table 10. Distribution of radioactivity after [^{14}C]methomyl was added to water/sediment systems (Mayo, 1994).

Sample	Days						
	0	0.25	1	7	14	60	102
	% of applied radioactivity[1]						
Auchingilsie							
Acetonitrile		0.98	1.1	19	23	27	27
CO_2		0.02	0.02	1.2	14	38	46
Water	85	88	88	49	15	1.4	1.7
Sediment extract	16	14	11	14	8.0	1.4	1.1
Sediment residue	0.42	0.62	0.48	8.0	14	12	10
Total recovery	101	104	101	91	74	80	86
Hinchingbrooke							
Acetonitrile		0.67	0.94	9.2	19	24	24
CO_2		<0.03	<0.07	0.48	5.9	28	32
Water	78	74	72	54	10	1.1	0.41
Sediment extract	22	25	25	19	7.8	0.94	0.67

Sample	Days						
	0	0.25	1	7	14	60	102
	% of applied radioactivity[1]						
Sediment residue	1.4	2.4	2.0	6.9	20	16	15
Total recovery	101	102	100	90	62[2]	70[2]	72[2]

[1] Average of two flasks
[2] Low recovery attributed to inefficient trapping of carbon dioxide.

Table 11. Percentage of the applied radioactivity in water and sediment after application of [^{14}C]methomyl at a nominal rate of 0.5 µg/ml (Mayo, 1994).

Day	% of applied ^{14}C in substrate[1]					
	Water		Sediment		Total	
	Hinchingbrooke	Auchingilsie	Hinchingbrooke	Auchingilsie	Hinchingbrooke	Auchingilsie
0	73	79	8.6	6.1	82	86
0.25	69	82	8.7	4.2	86	86
1	67	81	11	3.5	84	84
2	71	74	4.5	4.2	78	78
7	28	22	2.5	1.4	23	23
14	0.1	0.1	<0.4	<0.3	0.2	0.2
29	<0.1	<0.1	<0.2	<0.3	<0.4	<0.4

[1] Average of two flasks.

Methomyl was the main compound in the water and sediment. MHTA in the water fraction peaked at 7% of the applied radioactivity on day 2 in the Hinchingbrooke sample, 1% in The Auchingilsie sample. On day 7 [^{14}C]acetamide, identified by TLC and partition HPLC, accounted for up to 14% in the Auchingilsie system, and [^{14}C]acetonitrile peaked at 16% of the applied radioactivity in both systems on day 7. The total concentration of methomyl (water + sediment) decreased from 82% of the applied radioactivity on day 0 to 0.3% on day 14 in the Hinchingbrooke sample and from 86% to 0.2% in the Auchingilsie sample so assuming first-order kinetics the half-life was 3.5 days in the Auchingilsie system and 4.8 days in the Hinchingbrooke system.

HPLC and TLC analyses of water and sediment extracts confirmed the absence of *E*-methomyl, *E*-MHTA, methomyl sulfoxide, MHTA sulfoxide, acetaldehyde and acetic acid.

The degradation of methomyl in chlorinated water was investigated by Miles and Oshiro (1990). Solutions of methomyl at various pH levels stored in the dark at 24°C were treated with 1 µM hypochlorite. Methomyl disappeared rapidly from slightly alkaline solutions at a chlorine/methomyl ratio of 10. The degradation rate increased with higher hypochlorite concentrations when the pH was buffered at 9, and with decreasing pH. Half-lives ranged from about 0.4 min. at pH 7.6 to 12 min. at pH 8.9. Reaction rates of methomyl with chloramine were 100 to 1000 times slower than with free chlorine and varied little over the pH range of 7 to 9.

Mason *et al.* (1990) investigated the removal of methomyl from water by chlorination and ozonation. Methomyl reacted rapidly with excess chlorine in the pH range 6.0-8.5 in proportion to chlorine concentrations. At fixed chlorine concentrations reaction rates decreased with increasing pH. At ratios below 2:1 chlorine:methomyl, the chlorine concentration was insufficient to destroy all the methomyl. Light had no effect on the reaction rate. No reaction was observed at pH 7 within 24 h when chlorine dioxide was used as the disinfecting agent at 14-18:1 ClO_2:methomyl on a molar ratio basis. When 1 mg/l of methomyl was reacted with ozone the reaction was too rapid to be followed spectrophotometrically, preventing kinetic studies.

METHODS OF RESIDUE ANALYSIS

Analytical methods

Several analytical methods based on GLC or HPLC have been developed for the determination of methomyl in plant commodities which are suitable for data collection and some, as indicated, for enforcement (Table 12). Validation data are shown in Table 13.

Table 12. Methods for the determination of methomyl in or on plant commodities.

Report (reference)	Extraction/clean-up	Method of determination
ML/PC-12 (Pease and Kirkland, 1968)	Processed crop samples were extracted three times with ethyl acetate using a homogenizer, centrifuged and the supernatant decanted. The combined organic extracts were purified by liquid-liquid partitioning and concentrated. Sodium hydroxide was added to hydrolyse methomyl to MHTA, which was then extracted with ethyl acetate.	GLC - microcoulometric sulfur detector (Column: 120 cm glass containing 10% FFAP on 80- to 100-mesh Chromosorb W, Column temperature programmed from 100° to 200°C, Vaporiser, Transfer and Furnace Temperatures: 235°, 250° and 850°C respectively, Helium Carrier Gas Flow: 100 ml/min, Helium Purge Flow: 50 ml/min, Oxygen Flow, 50 ml/min)

Report (reference)	Extraction/clean-up	Method of determination
AMR 1806-90 (Clark and Kennedy, 1990)	Processed grape samples were extracted with acetonitrile using a homogenizer and the extract filtered. Sodium chloride was then added to the filtered extract for phase separation of acetonitrile and aqueous layers and direct partitioning of methomyl to the acetonitrile layer. The acetonitrile extract was separated, partitioned with hexane and passed through a Florisil solid-phase extraction cartridge where methomyl was retained. Following elution with 50:50 acetone:hexane, the samples were evaporated to dryness and reconstituted in 15:85 acetonitrile:water.	Reversed phase HPLC-UV (Column: 5.0 µm Zorbax ODS, 250 x 4.6 mm, Column temperature: 35°C, Mobile phase: 15/85 acetonitrile/water, Flow rate: 0.8 ml/min, Detection: 233 nm)
AMR 1405-89 Protocol A. (Labare, 1990)	Samples were extracted with methanol, followed by a three step solvent partitioning clean up of extract. The partially purified extract was passed through a Celite/charcoal column, concentrated and filtered.	Reverse-phase HPLC-fluorescence (Column: 5.0 µm Zorbax C8, 250 x 4.6 mm, Column temperature: 35°C, Mobile phase: acetonitrile/water , gradient elution, Flow rate: 1.5 ml/min, Detection: post-column hydrolysis with 0.05 N sodium hydroxide forming methylamine and derivatization using *o*-phthalaldehyde and mercaptoethanol, 0.5 ml/min flow rate, 100°C reactor temperature and excitation and emission wavelengths of 340 and 455 nm respectively)
AMR 3077-94 Revision No. 1, (Grigor, 1994)	Samples were soaked with water, followed by acetonitrile homogenization and the organic extract was separated and filtered. Sodium chloride was then added to the filtered extract for phase separation and direct partitioning of methomyl into the acetonitrile layer. The acetonitrile extract was separated, partitioned with hexane to remove fats, oils and other hexane-soluble coextractives and passed through a Florisil SPE cartridge. The eluate was evaporated to dryness and reconstituted in 15:85 acetonitrile/water. Note: Revision No. 1 supersedes and stands alone from the original report.	Reverse-phase HPLC-fluorescence (Column: 5.0 µm Zorbax RX-C8, 150 x 4.6 mm, Column temperature: 40°C, Mobile phase: acetonitrile/water , gradient elution, Flow rate: 1.0 ml/min, Detection: post-column hydrolysis with 0.2N sodium hydroxide forming methylamine and derivatization *o*-phthalaldehyde and *N,N*-dimethyl-2-mercaptoethylamine, 0.13 ml/min flow rate, 100°C reactor temperature and excitation and emission wavelengths of 330 and 466 nm respectively)

Report (reference)	Extraction/clean-up	Method of determination
AMR 3015-94 Revision No. 2 (Rühl, 1998)	Processed pea seed, pea hay, sorghum forage, sorghum hay, soya bean hay, or sugar beet foliage samples were soaked with water for 10-minutes, followed by an acetonitrile extraction using a homogenizer. For processed apple or grape samples, the same extraction procedure was used, but the water soak was omitted. Purification by acetonitrile/hexane partitioning, followed by a Florisil SPE clean up of the acetonitrile layer. After elution with 50:50 acetone:hexane, the eluate was evaporated to dryness and reconstituted in 15:85 acetonitrile:water. Note that Revision No. 2 contains the original method, adds watery fruit samples and includes upgrades of Revision No. 1.	Reverse-phase HPLC-fluorescence As Grigor, 1994.
AMR 4258-96 (Weidenauer *et al*., 1998)	Processed apple, orange, grape, or cotton seed samples were extracted with acetonitrile using a homogenizer. Sodium chloride added to the extract for phase separation and direct partitioning of methomyl to the acetonitrile layer. The acetonitrile extract was purified by hexane partitioning and passed through Florisil solid-phase extraction cartridge. Following elution with 50:50 acetone:hexane, the eluate was evaporated to dryness, reconstituted in 15:85 acetonitrile:water and filtered.	Reverse-phase HPLC-fluorescence As Grigor, 1994, except final flow rate 0.2 ml/min
Literature (Multi-residue Method 2, Inspectorate for Health Protection Part 1, 1996)	Processed crop samples were extracted with acetone and subsequently 50/50 dichloromethane/light petroleum using a homogenizer. After centrifugation, the organic extract was decanted, evaporated to dryness and redissolved in dichloromethane using an ultrasonic bath. The samples were passed through an aminopropyl-bonded silica solid-phase extraction column and the eluate was collected. Following elution with 99/1 dichloromethane/methanol , the eluate was evaporated to dryness, reconstituted in 20/80 acetonitrile/water using an ultrasonic bath and filtered.	Reverse-phase HPLC-fluorescence (Column: 4.0 µm Supersphere RP-8, 250 x 4.0 mm, Column temperature: 30°C, Mobile phase : 20/80 acetonitrile-water, 20/80 methanol/water and 60/40 acetonitrile/water (gradient elution), Flow rate: 0.75 ml/min, Detection: post-column hydrolysis using a 15 µm Aminex A27 strong anion exchange resin, 0.1 ml/min flow rate, 120°C reactor temperature, and excitation and emission wavelengths of 340 and 455 nm respectively)
Literature (de Kok *et al.*, 1987)	Processed and cleaned up fruit or vegetable samples extracted as above, but finally reconstituted in 28/72 acetonitrile/water. Processed grain samples were extracted with 50/50 dichloromethane/acetone by soaking overnight. The organic extract was concentrated and purified as above.	Reverse-phase HPLC-fluorescence (Column: 5.0 µm Lichrosphere 100 RP-18, 250 x 4.0 mm, Column temperature: 30°C, Mobile phase: 28/72 acetonitrile/water , Flow rate: 1.0 ml/min, Detection: post-column hydrolysis with 0.05 N sodium hydroxide forming methylamine and derivatization with *o*-phthalaldehyde and 2-mercaptoethanol, 0.5 ml/min flow rate, 100°C reactor temperature and excitation and emission wavelengths of 340 and 455 nm respectively)

Report (reference)	Extraction/clean-up	Method of determination
Literature (de Kok and Hiemstra, 1992)	Processed fruit or vegetable samples extracted as above. The extract was purified by automated solid-phase extraction (SPE) with an aminopropyl cartridge. After elution with 99/1 dichloromethane/methanol , the collected fraction was evaporated to dryness by heating in nitrogen stream, then redissolved in 10/90 acetonitrile water and cleaned up as above.	On-line SPE-HPLC-fluorescence (Column: 4.0 µm Supersphere RP-8, 250 x 4.0 mm, Column temperature: 30°C, Mobile phase : 80/20 acetonitrile-water and 10/90 acetonitrile/water (gradient elution), Flow rate: 0.8 ml/min, Detection: post-column hydrolysis reaction using a 15 µm Aminex A27 strong anion exchange resin, 0.2 ml/min flow rate, 120°C reactor temperature, and excitation and emission wavelengths of 340 and 455 nm respectively)

Table 13. Validation of analytical methods for the determination of methomyl in plant products.

Report no. (reference)	Fortification (mg/kg)	Mean recovery (%)	Range or relative standard deviation (%) no. of samples	Sample	Control interference
ML/PC-12 (Pease and Kirkland, 1968)	0.02-4.0	98	86-110 (n=9)	Cabbage	Insignificant to none
	0.02-0.26	96	83-115 (n=11)	Sweet corn kernels	
	0.04-0.20	92	83-100 (n=3)	Sweet corn stalk	
	0.02-0.22	89	80-98 (n=7)	Soya bean leaves	
	0.02-0.20	90	84-95 (n=4)	Soya bean forage	
	0.02-0.20	81	75-86 (n=4)	Cotton seed	
	0.02-0.40	92	86-95 (n=5)	Tobacco	
	0.02-0.40	97	87-104 (n=8)	Snap beans, pods	
	0.02-0.40	90	83-104 (n=6)	Snap bean forage	
	0.02-1.0	86	80-96 (n=6)	Tomatoes	
	0.02-2.0	102	96-110 (n=7)	Celery	
	0.02-0.26	93	79-115 (n=6)	Lima beans	
	0.02-0.26	91	83-108 (n=6)	Potatoes	
	0.02-0.42	105	87-115 (n=5)	Peaches	
AMR 1806-90 (Clark and Kennedy, 1990)	0.02, 0.50 and 5.0	98	5.8 (n=6)	Grapes	Insignificant
AMR 1405-89 Protocol A (Labare, 1990)	0.05 and 5.0	89	15.7 (n=4)	Lettuce	None
		32	9.4 (n=4)	Peanuts	

Report no. (reference)	Fortification (mg/kg)	Mean recovery (%)	Range or relative standard deviation (%) no. of samples	Sample	Control interference
AMR 3077-94 Revision No. 1 (Grigor, 1994)	10 and 20	103	9.9 (n=4)	Pea hay	None
	0.20 and 0.40	94	9.0 (n=4)	Pea seed	
	1.0 and 2.0	96	20.4 (n=4)	Sorghum forage	
	1.0 and 2.0	94	6.4 (n=4)	Sorghum hay	
	2.0 and 4.0	103	3.9 (n=4)	Sugar beet foliage	
AMR 3015-94 Revision No. 2 (Rühl, 1998)	0.02, 0.20, 0.40, 1.0, 2.0, 10 and 20	83	6.0 (n=9)	Pea seed	Insignificant to none
		88	5.7 (n=9)	Pea hay	
		90	10.0 (n=9)	Sorghum forage	
		90	8.9 (n=9)	Sorghum hay	
		98	14.3 (n=16)	Soya bean hay	
		87	8.0 (n=21)	Sugar beet foliage	
		83	4.8 (n=45)	Apple	
		90	7.8 (n=33)	Grapes	
AMR 4258-96 (Weidenauer *et al*., 1998)	0.02 and 0.20	94	3.9 (n=6)	Apple	None
		94	14.1 (n=6)	Orange	
		91	9.9 (n=6)	Grapes	
		96	7.9 (n=6)	Cotton seed	

Report no. (reference)	Fortification (mg/kg)	Mean recovery (%)	Range or relative standard deviation (%) no. of samples	Sample	Control interference
Literature (De Kok, *et al.*, 1987)	0.05 and 0.50	100	1.4 (n=10)	Grain	Insignificant to none
		88	(n=2)	Apple	
		82	(n=2)	Beans	
		79	(n=2)	Carrot	
		79	(n=2)	Cauliflower	
		80	(n=2)	Celery	
	0.20	80	(n=2)	Cucumber	
	0.20	82	(n=2)	Leek	
		81	(n=2)	Onion	
		83	(n=2)	Orange	
		79	(n=2)	Potato	
		81	(n=2)	Spinach	
		84	(n=2)	Strawberry	
		87	2.8 (n=5)	Carrot	
		80	2.8 (n=5)	Cauliflower	
Literature (De Kok and Hiemstra, 1992)	0.13	79	2.4 (n=5)	Apple	
		88	1.5 (n=5)	Beans	
		79	2.1 (n=5)	Carrot	
		78	1.7 (n=5)	Cauliflower	
		83	2.3 (n=5)	Endive	
		84	1.8 (n=5)	Onion	
		77	2.0 (n=5)	Orange	
		81	2.2 (n=5)	Paprika	
		78	1.2 (n=5)	Peach	
		81	2.3 (n=5)	Potato	
		78	3.0 (n=5)	Strawberry	
		91	1.9 (n=5)	Rice	

To determine the efficacy of acetonitrile as an extraction solvent for the determination of methomyl residues in dry and watery crop samples as described by Rühl, tests were conducted on pea seed and hay, sorghum fodder and hay, and sugar beet foliage using radiolabelled methomyl (Rühl, 1998). The average extraction efficiency was 103 ± 3 % (n=10).

Methods reported for the determination of methomyl in domestic animal commodities are generally modifications of those for plant products described above and are shown in Table 14, with validation data in Table 15.

Table 14. Methods for the determination of methomyl and its metabolites in animal tissues.

Reference (Author, Year)	Extraction/clean-up	Method of determination
ML/PC-12 (Pease and Kirkland, 1968)	As for plant samples (Table 12)	GC-Microcoloumetric sulfur detector GC conditions as for plant samples
AMR 898-87 (Powley, 1991a,b)	Methomyl was extracted from milk and tissue samples on a C-18 adsorbent and eluted with methylene chloride. The eluate was concentrated and further purified by passing it through a silica solid-phase extraction cartridge. Following elution with 3% methanol in methylene chloride, the samples were concentrated and reconstituted in 10:90 acetonitrile:5mM phosphate buffer (pH 3). Principal metabolites: (1) MHTA Processed tissue samples were extracted on C-18 adsorbent with ethyl acetate as eluent. The eluate was concentrated and further purified on a silica solid-phase extraction cartridge. Following elution with 10% methanol in ethyl acetate, the samples were concentrated. For milk samples, the same procedure was followed without silica clean-up.	Reverse-phase HPLC-UV (Column: 5-µm C-18 column, 15 cm x 4.6 mm i.d., Mobile Phase: 10/90 (v/v) acetonitrile/5 mM sodium dihydrogen phosphate (pH=3), Flow rate: 2.0 ml/min, Detection: 235 nm) GC-Nitrogen phosphorus thermionic detector (Column: 15 m x 530 µm fused silica capillary wall-coated with DB-Wax, Column temperature: Programmed from 130° to 150°C for milk and cream analysis and 60° to 200°C for animal tissue analysis, Injector and detector temperature: 250° and 300°C respectively, Helium carrier gas flow: 23 ml/min, Hydrogen flow: 1.5 ml/min, Air flow: 100 ml/min)

Reference (Author, Year)	Extraction/clean-up	Method of determination
AMR 898-87 (Powley, 1991a,b)	(2) [^{14}C]acetonitrile Milk or cream samples were homogenised, mixed with saturated sodium chloride solution and placed in a purge and trap sampler, which was then heated and purged with helium. Acetonitrile and other volatile components were trapped on Tenax® adsorbent, desorbed by heating the trap, and backflushed into a GC column packed with Porapak® Q adsorbent. The acetonitrile trapped at the head of the column was separated from other volatiles by temperature programming and collected in an impinger filled with xylene, which was then mixed with scintillation cocktail. Processed tissue samples were prepared and analysed as above, but homogenized after mixing with saturated sodium chloride solution. For processed fat samples, sodium hydroxide was added with homogenization before mixing with sodium chloride. (3) Acetamide Processed milk samples were extracted with acetone using a rotating mixer and centrifuged. Supernatant decanted, concentrated, washed with hexane, then diluted with methanol. Processed tissue samples were homogenised in 95:5 acetone:water, centrifuged, supernatant separated and evaporated until only the aqueous layer remained, then partitioned with hexane and ethyl acetate using a rotary mixer and diluted with methanol.	Liquid scintillation counting (LSC) Purge and trap conditions: (Temperatures: 100°, 40°, 100° and 100°C for transfer line, mount, bottom of trap and valve oven respectively, Purge gas: Helium at 20 ml/min, Prepurge time: 0.7 min, Heating time: 0.15 min, Sample temperature: 75°C, Purge time: 20 min, Dry purge: 2 min, Desorption: 4 min at 200°C, Bake time: 8 min at 225°C GC Conditions: column: Porapak® Q 100/120, 4 ft x 2 mm i.d., Carrier/desorb gas: Helium at 15 ml/min, Injector: 100°C, Detector temperature: FID, 300°C (about 1 ml/min split flow to detector), Valve switching time: flow was diverted to impinger 8 min into the run and diverted away 4 min later) GC-Nitrogen phosphorus detector (Column: 15 m x 0.26 mm i.d. x 0.25 µm DB-Wax fused silica, Column temperature: Programmed from 75° to 210°C, Injector and Detector temperatures: 275° and 300°C respectively, Helium carrier gas and make up gas flow rates: 2 and 30 ml/min respectively, Air and hydrogen Flow rates: optimum)
	Radiolabelled acetamide Processed milk samples were extracted with acetone transferred into water, washed with hexane, then diluted with methanol. Processed tissue samples were treated as above. The final extracts were fractionated using HPLC. The collected eluate was mixed with Formula-963 scintillation cocktail.	Liquid scintillation counting

Reference (Author, Year)	Extraction/clean-up	Method of determination
AMR 2964-94 (Daun, 1995)	Milk or processed tissue samples were extracted on a solid-phase matrix. Following elution with methylene chloride, the eluate was concentrated and further purified by passing through a silica solid-phase extraction cartridge and eluting with 3% methanol in methylene chloride. The eluate was concentrated and purified by partitioning with 9:1 acetonitrile:water and hexane. The acetonitrile:water layer was separated, concentrated, reconstituted in 10% acetonitrile in water and filtered.	Reverse-phase HPLC-fluorescence (Column: 5.0 µm C-18, 4.6 x 150 mm, Column temperature: 40°C, Mobile phase: acetonitrile/water, gradient elution, Flow rate: 1.0 ml/min, Detection: post-column hydrolysis with sodium hydroxide forming methylamine and derivatization using *o*-phthalaldehyde and 2-mercaptoethanol, 0.6 ml/min flow rate, 125°C reactor temperature and excitation and emission wavelengths of 330 and 465 nm respectively)
Literature (Ali, 1989))	Processed bovine, pig, or duck liver samples were mixed with anhydrous sodium sulfate and extracted twice with methylene chloride (CH_2Cl_2) using a homogenizer. The combined organic extracts were filtered twice through anhydrous sodium sulfate. The filtered extract was concentrated and dissolved in 1:1 methylene chloride-hexane solution, filtered and passed through a GPC SX-3 gel column for clean-up. The residue fraction was collected, evaporated to dryness and reconstituted in CH_2Cl_2. This was then passed through an aminopropyl solid-phase extraction cartridge and eluted with 1.5% methanol in CH_2Cl_2. The eluate was evaporated to dryness, reconstituted in methanol and filtered.	Reverse-phase HPLC-fluorescence (Conditions as above, but excitation and emission wavelengths 340 and 418 nm respectively)

Table 15. Validation of analytical methods for the determination of methomyl and metabolites in ruminant commodities and urine.

Report no. (reference)	Fortification (mg/kg)	Mean recovery (%)	Range or relative standard deviation (%) and number of samples	Sample	Control interference
ML/PC-1	0.08-1	94	88-100 (n=2)	Liver	None
(Pease and Kirkland, 1968)	0.08-0.2	98	90-105 (n=2)	Kidney	
	0.02-0.08	92	85-96 (n=3)	Muscle	
	0.04-0.12	96	93-98 (n=2)	Fat	
	0.2-1.4	90	80-97 (n=4)	Urine	

Report no. (reference)	Fortification (mg/kg)	Mean recovery (%)	Range or relative standard deviation (%) and number of samples	Sample	Control interference
AMR 898-87 (Powley, 1991a,b)	Methomyl				None
	0.02, 0.10, 0.20	89	7.5 (n=19)	Milk (whole/skimmed)	
	and 0.50	83	5.2 (n=5)	Cream	
		87	13.9 (n=18)	Fat	
		87	10.4 (n=10)	Kidney	
		79	10.8 (n=14)	Liver	
		88	11.8 (n=13)	Muscle	
	MHTA				
	0.02, 0.10 and	95	8.0 (n=16)	Milk	
	0.50	94	12.4 (n=6)	Cream	
		58	15.3 (n=14)	Fat	
		70	14.2 (n=9)	Kidney	
		65	17.2 (n=9)	Liver	
		68	10.7 (n=9)	Muscle	
	[^{14}C]Acetamide	99	4.6 (n=6)	Milk	
	0.02, 0.10 and 0.50	68	17.3 (n=3)	Muscle	
		73	4.8 (n=3)	Liver	
AMR 2964-94 (Daun, 1995)	0.01 and 0.05	91	7.7 (n=44)	Milk (whole/skimmed)	Insignificant to none
		88	8.2 (n=8)	Cream	
		99	8.2 (n=13)	Liver	
		91	4.8 (n=11)	Kidney	
		87	10.2 (n=11)	Muscle	
		94	11.5 (n=8)	Fat	
Literature (Ali, (1989))	0.005, 0.01 and 0.02	69	24.3 (n=30)	Beef Liver	Insignificant to none
		82	15.5 (n=36)	Pork Liver	
		91	17.5 (n=36)	Duck Liver	

Extraction efficiency studies were conducted for the determination of acetonitrile and acetamide using the method described by Powley. For [^{14}C]acetonitrile the average extraction was acceptable at 73 ± 13 % for the 4 samples of liver, kidney, muscle and fat, and for acetamide was also acceptable (overall 70 ± 13 %, n=24).

Methods were also reported for the determination of methomyl in environmental samples. The methods for soils are shown in Table 16.

Table 16. Methods for the determination of methomyl in soil.

Report (reference)	Extraction/clean-up	Method of determination
ML/PC-12 (Pease and Kirkland, 1968)	As for plant samples (Table 12)	GC-microcoloumetric sulfur detector GC conditions as for plant samples
ML/PC-12 Supplement 2 (Pease, 1969)	As above.	GC-flame photometric detector GC Conditions as for plant samples
AMR 1215-88 (S.M. Kennedy, 1989)	Soil samples were wetted with deionized water and extracted three times with ethyl acetate in a wrist-action shaker. The supernatant was filtered and the combined organic extracts concentrated and passed through a silica gel column. Following elution with 10% methanol in ethyl acetate, the eluate was blown to dryness and reconstituted in 84:15:1 water:acetonitrile:acetic acid.	Reverse-phase HPLC-UV (Column: 5.0 µm Zorbax ODS, 250 x 4.6 mm, Column temperature: ambient, Mobile phase: 14/85/1 acetonitrile/water/acetic acid, Flow rate: 0.8 ml/min, Detection: 233 nm)
AMR 1921-91 (C.M. Kennedy, 1991d)	As above except silica column omitted.	Reverse-phase HPLC-UV (Column: 5.0 µm Zorbax RX, 250 x 4.6 mm, Column temperature: 35°C, Mobile phase: 15/85 acetonitrile/water, Flow rate: 0.8 ml/min, Detection: 233 nm)
Literature (Honing *et al.*, 1996))	Sediment samples were sieved, freeze-dried and extracted with acetone-methylene chloride by Soxhlet. The extract was evaporated to dryness, reconstituted in hexane and passed through an aminopropyl-bonded silica column. Following elution with 25:75 acetone-methylene chloride, the eluate was evaporated to dryness and reconstituted in 20:80 methanol:water.	LC-Ionspray MS (Column: 3.0 µm Licrosphere 60 RP-select B base-deactivated phase, 125 x 3.0 mm , Mobile phase: methanol and water, gradient elution, Flow rate: 0.3 ml/min, MS Conditions: Flow rate: 350 L/h drying gas and 15 L/h nebulizer gas, Temperature: 125°C, ion source: Cone extraction voltage 20V, Mode: selected ion monitoring , $[M+Na]^+$ ion)

Report (reference)	Extraction/clean-up	Method of determination
AMR 2396-92 (Strahan and Wilfred, 1993) AMR 2513-92 (Leva and McKelvey, 1995)	Soil samples were extracted with acetone/phosphate buffered solution (PBS), centrifuged and supernatant filtered through a 0.45-µm Durapore membrane (a polyvinylidine difluoride filter). The filtered extract was evaporated near to dryness and reconstituted in PBS.	Enzyme-linked immunosorbent assay (ELISA)-UV (Separation: Rabbit polyclonal antibody was used forming methomyl hapten, Detection:405 nm, anti-rabbit antibody-enzyme/substrate reaction to produce *p*-nitrophenyl phosphate)
AMR 2759-93 (Rühl *et al*., 1994)	Soil samples were extracted twice with methanol using a wrist-action shaker and suction. The combined filtrates were evaporated to dryness, reconstituted in deionized water and passed through a C-18 solid-phase extraction column, where methomyl was retained. Methomyl was eluted with acetone, the eluate evaporated to dryness and the residue dissolved in 10:90 acetonitrile:water.	Reverse-phase HPLC-fluorescence LC conditions as for plant samples (Rühl, 1988) except mobile phase 20:80 acetonitrile/water
AMR 2311-92 (Rühl, 1995)	Soil samples were extracted twice with methanol using a wrist-action shaker and suction filtered. The filtrate was evaporated to dryness, reconstituted in deionized water and passed through a C-18 solid-phase extraction column, where methomyl was retained. Methomyl was eluted with acetone, the eluate evaporated to dryness and the residue dissolved in 10% acetonitrile in water.	Reverse-phase HPLC-fluorescence (Column: 5.0 µm Zorbax RX or ODS 2, 150 x 4.6 mm, Column temperature: 40°C, Mobile phase: 25/75 or 20/80 acetonitrile/water, Flow rate: 1.2 ml/min, Detection: as before, 100 or 125°C reactor temperature and excitation and emission wavelengths 228 and 418 or 330 and 466 nm respectively)
Literature (Johnson *et al.*, 1997))	Soil samples were extracted with 4% methanol in deionized water using an orbital shaker and centrifuged. The extract was decanted and passed through a graphite carbon solid-phase extraction cartridge for clean-up. Following elution with methanol, the eluate was diluted with methanol and filtered.	Reverse-phase HPLC-fluorescence (Column: 5.0 µm C-18 carbamate, 100 x 4.6 mm, Column temperature: 40°C, Mobile phase: methanol/water, gradient elution, Flow rate: 1.0 ml/min, Detection: post-column hydrolysis with sodium hydroxide and derivatization with *o*-phthalaldehyde and 2-mercaptoethanol, excitation and emission wavelengths of 330 and 466 nm respectively)

Table 17. Validation of analytical methods for the determination of methomyl in soil.

Report (reference)	Fortification levels (mg/kg)	Overall Mean recovery (%)	Range or Relative standard deviation (%) and number of samples	Control Interference
Literature (Pease and Kirkland, 1968)	0.04-4.0	63	(n=12)	Insignificant to none
AMR 1215-88 (S.M. Kennedy, 1989)	0.02, 0.04, 0.05, 0.10, 0.20, 0.50, 1.0, 2.0, 3.0, 4.0 and 5.0	90	11.3 (n=124)	Insignificant to none

Report (reference)	Fortification levels (mg/kg)	Overall Mean recovery (%)	Range or Relative standard deviation (%) and number of samples	Control Interference
AMR 1921-91 (C.M. Kennedy, 1991d)	0.02, 0.10 and 0.50	86	6.4 (n=29)	Insignificant
AMR 2396-92 (Strahan and Wilfred, 1993)	0.01, 0.05 and 0.10	111	12.6 (n=18)	None
AMR 2759-93 (Rühl *et al*., 1994)	0.01, 0.20, 0.50, 1.0, 2.0, 5.0, 10.0, 15.0 and 20.0	97	12.4 (n=9)	Insignificant to none
AMR 2311-92 (Rühl, 1995)	0.001, 0.002, 0.003, 0.004, 0.005, 0.01, 0.02, 0.03, 0.040, 0.05, 0.10, 0.20, 0.50 and 1.0	99	9.1 (n=71)	Insignificant to None
AMR 2513-92 Volume 2 (Leva and McKelvey, 1995)	0.01, 0.05, 0.10, 0.20, 0.30, 0.50, 5.0 and 10.0	96	13.5 (n=40)	None

A study of extraction efficiency using radiolabelled methomyl was summarised by C.M. Kennedy (1992). Recoveries of ^{14}C were greater than 90% from treated soil extracted with methanol/water and methanol after aerobic incubation for 0, 1, 2, 4, 8, 14 and 21 days and 1, 2 and 3 months. The overall extraction efficiency was 97 ± 3% (n=10).

Analytical methods submitted for the determination of methomyl in water are summarized in Table 18.

Table 18. Analytical methods for the determination of methomyl in water.

Report (reference)	Extraction/clean-up	Method
AMR 1091-88 (McIntosh, 1988)	Groundwater samples were treated with monochloroacetic acid buffer to adjust pH to 3.0, then filtered through a 0.2-µm polyester filter. (A multianalyte method for methylcarbamoyl oximes and methylcarbamates)	Reverse-phase HPLC-fluorescence (Column: 5.0 µm Altex Ultrasphere ODS, 250 x 4.6 mm, Column temperature: 40°C, Mobile phase: 15/85 methanol/water (v/v) and methanol, gradient elution, Flow rate: 1.0 ml/min, Detection: post-column hydrolysis with 0.05 N sodium hydroxide and derivatization with *o*-phthalaldehyde and 2-mercaptoethanol, 95°C reactor temperature and excitation and emission wavelengths of 230 and 418 nm respectively)

Report (reference)	Extraction/clean-up	Method
AMR 1392-89 (Battelle, 1991)	Groundwater samples were treated with sodium chloride, followed by HCl or NaOH to adjust pH to 3.0, then passed through a C-18 SPE cartridge, where methomyl was retained. Following elution with acetonitrile, the eluate was evaporated to dryness and the residue reconstituted in 40:60 methanol:1.0 M acetate buffer solution.	Reverse-phase HPLC-UV (Column: 5.0 µm Zorbax ODS, 250 x 4.6 mm, Column temperature: ambient, Mobile phase: 15/85 acetonitrile/water, Flow rate: 1.0 ml/min, Detection: 240 nm)
AMR 2311-92 (Rühl, 1995)	Groundwater, soil-pore water, tank mix, or irrigation water samples were centrifuged to remove sand and silt, then passed through a C-18 solid-phase extraction cartridge. Following elution with acetone, the eluate was evaporated to dryness and reconstituted in 10% acetonitrile in HPLC grade water.	Reverse-phase HPLC-fluorescence (LC conditions as above for soil samples)
AMR 2396-92 (Strahan and Wilfred, 1993)	Paddy, ditch, or stream water samples filtered through a 0.45 micron Durapore membrane (a polyvinylidine difluoride filter) and then diluted with phosphate buffered solution (PBS) (1:2) (to minimise any matrix effect)	Enzyme-linked immunosorbent assay (ELISA)-UV (Separation: Rabbit polycyclonal antibody was used forming methomyl hapten, Detection:405 nm, anti-rabbit antibody-enzyme/substrate reaction to produce p-nitrophenylphosphate)
AMR 2513-92 (Leva and McKelvey, 1995)	Pond, stream, or run-off water samples filtered and diluted with PBS as above	Enzyme-linked immunosorbent assay (ELISA)-UV (Separation and detection as above)
Literature (Johnson *et al.*, 1997))	Water samples were extracted and preconcentrated on a graphite carbon solid-phase extraction cartridge. Following elution with methanol, the eluate was diluted with methanol and filtered.	Reverse-phase HPLC-fluorescence (LC conditions as for soil)
Literature (Honing *et al.*, 1996))	Surface water samples were filtered through 0.45 µm PTFE fibre-glass, then extracted and concentrated using a C-18-bonded silica disk. Following elution with acetonitrile, the eluate was evaporated nearly to dryness and the residue dissolved in methanol.	LC-Ionspray MS (LC and MS Conditions as for soil)

Report (reference)	Extraction/clean-up	Method
Literature (Chiron *et al.*, 1995))	Groundwater samples were filtered, acidified to pH 2 with sulfuric acid, then extracted and preconcentrated using an automated on-line solid-phase extraction (SPE) system. The C-18 Empore extraction disk used was conditioned with methanol followed by acidified water (pH 3, trifluoroacetic acid) at 1.0 ml/min flow rate. Sample preconcentation flow rate was at 2.0 ml/min and desorption flow rate was initially 1.1 ml/min decreasing to 0.8 ml/min.	On-line SPE/HPLC-fluorescence (Column: 4.0 µm Supersphere 60 RP-8, 250 x 4.6 mm , Mobile phase: acetonitrile-methanol-water and acetonitrile-water (gradient elution), Flow rate: 0.8 ml/min Detection as above)
USA EPA Method 531.1 (Munch (ed.), 1995)	Water samples were treated with monochloroacetic acid buffer to adjust pH to 3, then filtered through a 0.45 µm Millipore type HA filter. An aliquot was injected onto a reversed-phase HPLC column.	Reverse-phase HPLC-fluorescence (Column: 4.0 µm Novapak C-18, 150 x 3.9 mm , Mobile phase: methanol and water, gradient elution, Flow Rate: 1.0 ml/min, , Detection as before)

Table 19. Validation of analytical methods for the determination of methomyl in water.

Report (reference)	Fortification (mg/kg)	Mean recovery (%)	Relative standard deviation/no. samples	Sample	Control interference
AMR 1091-88 (McIntosh, 1988)	2.50	98 105	4.0 (n=8) 9.0 (n=8)	Artificial Ground Water (Absopure Natural Artesian Spring Water) Organic-Contaminated Artificial Ground Water	None
AMR 1392-89 (Battelle, 1991)	0.10 and 0.15	97 85	17.5 (n=21) 23.9 (n=21)	Type 1 Groundwater (Artificial recharged Groundwater) Type 2 Groundwater (From mountain clefts)	None
AMR 2396-92 (Strahan and Wilfred, 1993)	0.05, 0.10, 0.25, 0.50 and 1.0	99	10.6 (n=45)	Paddy, Ditch and Stream Water	None
AMR 2311-92 (Rühl, 1995)	0.10, 0.20, 0.30, 0.40, 0.50, 1.0 and 2.0	90	11 (n=143)	Groundwater, Soil-pore water, Tank Mix samples and Irrigation Water	Insignificant to none
AMR 2513-92 Volume 2 (Leva and McKelvey, 1995)	0.20, 0.50, 1.0, 2.0, 5.0, 10, 100, 500 and 1000	97	13.4 (n=83)	Pond, Stream and Run-off Water	None

Report (reference)	Fortification (mg/kg)	Mean recovery (%)	Relative standard deviation/no. samples	Sample	Control interference
Literature. (Johnson *et al.*, 1997))	5.0 and 50	102	5 (n=6)	Hard Water	Insignificant to none
EPA Method 531.1. (Munch (ed.), 1995)	2.5	98 105	4.0 (n=7-8) 9.0 (n=7-8)	Synthetic Water 1 (Absopure Nature Artesian Spring Water) Synthetic Water 2 (Organic-Contaminated)	Insignificant to none

Stability of residues in stored analytical samples

Methomyl stability has been determined in a variety of crops, soil, water and animal tissues.

In crops, stability has been demonstrated in homogenized and/or whole crop samples representing root, grain, watery and oily commodities (Milby, 2000; Kennedy and Devine, 1993a-c; Kennedy and Tomic, 1993a,b; Behmke, 1998). The results are shown in Table 20.

Table 20. Storage stability of methomyl in various frozen plant commodities.

Sample	Fortification	Storage (°C)	Storage (months)	Concurrent fortification recovery[1] (%)	Methomyl remaining[2] (%)	Reference/method
Soya bean hay	1.0 mg/kg	-20	0	91	87, 80 (84)	AMR2955-94
			3	88	88, 85 (87)	AMR1806-90
			6	87	79, 76 (78)	
			12	83	78, 78 (78)	
			18	87	85, 78 (82)	
			26	87	83, 79 (81)	
Maize	0.10 mg/kg	-20	0	80	72, 76 (74)	AMR1770-90
(kernels)			1	92	70, 70 (70)	AMR1806-90
			3	84	65, 59 (62)	
			6	65	75, 74 (74)	
			9	89	53, 56 (54)	
			12	81	74, 69 (72)	

Sample	Fortification	Storage (°C)	Storage (months)	Concurrent fortification recovery[1] (%)	Methomyl remaining[2] (%)	Reference/method
			18	65	66, 72 (69)	
			19.5	74	75, 79 (77)	
			24	82	75, 69 (72)	
Bean seed (whole pinto seed)	Field incurred 0.34 ± 0.04 (n=6)	-20	1	47[2] (91)	115, 129, 159 (135)	AMR3741-96 AMR1806-90 Average fresh fortification recovery
			3	42 (71)	79, 120, 91 (97)	
			6	43 (80)	102, 97, 112 (103)	
			12	41 (83)	68, 85, 97 (83)	
			18	65 (78)	109, 88, 91 (96)	
			26	41 (39)	88, 91, 94 (91)	
Potato (whole tuber)	Field incurred 0.47±0.07 (n=6)	-20	1	88[3] (90)	102, 81, 102 (95)	AMR3741-96 AMR1806-90
			3	85 (80)	87, 91, 85 (88)	
			6	81 (84)	81, 89, 96 (89)	
			12	84 (94)	104, 70, 87 (87)	
			18	85 (78)	117, 119, 119 (118)	
			26	76 (78)	94, 98, 89 (94)	
Peanut (whole kernels)	Field incurred 0.44±0.04	-20	1	76[2] (106)	109, 111, 130 (117)	AMR3741-96 AMR1806-90

Sample	Fortification	Storage (°C)	Storage (months)	Concurrent fortification recovery[1] (%)	Methomyl remaining[2] (%)	Reference/method
	(n=6)		3	68 (98)	91, 114, 111 (105)	
			8	72 (108)	70, 70, 64 (68)	
			12	64 (89)	95, 91, 111 (99)	
			18	74 (71)	141, 120, 100 (120)	
			26	61 (84)	66, 64, 73 (68)	
Sorghum forage (whole)	Field incurred 2.4±0.12	-20	1	78[3] (85)	75, 54, 110 (79)	AMR4344-97 AMR1806-90
			3	78 (82)	75, 54, 110 (110)	
			6	85 (82)	88, 92, 92 (92)	
			12	96 (96)	71, 120, 110 (100)	
			22	90 (81)	130, 110, 100 (110)	
			26	90 (107)	88, 130, 79 (96)	
Sorghum hay (whole)	Field incurred 3.2±0.36	-20	1	74[3] (78)	78, 120, 130 (110)	AMR4344-97 AMR1806-9
			3	69 (70)	110, 81, 140 (110)	
			6	120 (145)	150, 170, 150 (150)	
			12	74 (81)	100, 110,	

Sample	Fortification	Storage (°C)	Storage (months)	Concurrent fortification recovery[1] (%)	Methomyl remaining[2] (%)	Reference/method
					140 (120)	
			22	74 (82)	100, 170, 170 (150)	
			26	-[4] (96)[5]	130, 130, 110 (120)	
Sorghum fodder (stover) (homo-genized)	Field incurred 0.48±0.03	-15 to -25	1	84[6]	0.41, 0.43, 0.41, 0.42, 0.41(0.42)	AMR 3298-95 AMR 3015-94
			3	88		
Lettuce, Head	5.0 mg/kg	-15 to -25	0	88[7]	96, 96 (96)	AMR 1806-90 AMR1764-90
			1	88	88, 92 (90)	
			3	90	96, 100 (98)	
			6	70	68, 72 (70)	
			6.5	74	72, 76 (74)	
			9	94	96, 94 (96)	
			12	84	94, 84 (88)	
			18	108	98, 100 (100)	
			24	84	92, 88 (90)	
Broccoli	2.0 mg/kg	-15 to -25	0	95[8]	90, 90 (90)	AMR 1765-90
			1	85	85, 85 (85)	AMR 1806-90
			3	80	85, 85 (85)	
			6	95	90, 90 (90)	
			9	100	90, 95 (92)	
			12	100	100, 100 (100)	
			18	90	80, 80 (80)	

Sample	Fortification	Storage (°C)	Storage (months)	Concurrent fortification recovery[1] (%)	Methomyl remaining[2] (%)	Reference/method
			24	110	95, 90 (92)	
Orange	2.0 mg/kg	-15 to -25	0	95[8]	95, 95 (95)	AMR 1767-90
(finely chopped)			1	75	75, 90 (82)	AMR 1806-90
			3	100	85, 85 (85)	
			6	95	75, 70 (72)	
			9	90	55, 55 (55)	
			9.3	95	45, 49 (47)	
			12	75	46, 36 (41)	
			16	85	34, 34 (34)	
			18	90	30, 30 (30)	
			24	105	16, 18 (17)	
Orange	Field incurred	-15 to -25	24	100[9]	104	AMR 1767-90
(half)	0.96					AMR 1806-90
Apple	1.0 mg/kg	-15 to -25	0	92[9]	98, 94 (96)	AMR 1768-90
			1	93	97, 94 (96)	AMR 1806-90
			3	91	94, 93 (94)	
			6	95	91, 83 (87)	
			9	88	89, 87 (88)	
			12	94	102, 102 (103)	
			18	93	94, 91 (92)	
			24	96	97, 104 (100)	
Grape	5.0 mg/kg	-15 to -25	0	76[7]	84, 80 (82)	AMR 1768-90
			1	78	84, 78 (80)	AMR 1806-90
			3	78	76, 80 (78)	
			6	78	76, 78 (77)	
			9	88	76, 84 (80)	
			12	80	84, 80 (82)	

Sample	Fortification	Storage (°C)	Storage (months)	Concurrent fortification recovery[1] (%)	Methomyl remaining[2] (%)	Reference/method
			18	84	82, 80 (81)	
			24	78	74, 64 (69)	
			27	90	88, 80 (84)	
Onions, dry bulb (whole)	Field incurred 0.36 (0.35, 0.38)	-15 to -20	1	81[10]	106, 47 (mean 76)[11]	AMR 3746-96 AMR 1806-90
			3	87	120, 110 (115)	
			6	95	210, 140 (mean 175)[11]	
			12	84	160, 160 (160)	
			18	84	220, 220	
			24	96	230, 200 (215)	

[1] 0.10 mg/kg fortification of control samples immediately before extraction, except as otherwise noted. Results uncorrected for control sample recoveries.
[2] 0.10 mg/kg fortification of control sample homogenate, fortified at time zero and stored and analysed with the incurred residue samples. Values in parentheses are recoveries from beans or peanuts freshly fortified at 0.08 mg/kg.
[3] 0.20 mg/kg fortification of control sample homogenate, fortified at time zero and stored and analysed with the incurred residue samples. Values in parentheses are recoveries from fresh fortifications at 0.08 mg/kg for potato and 0.20 mg/kg for sorghum hay and forage.
[4] Interference in the control and 0.20 mg/kg fortification. Limit of determination 1.0 mg/kg.
[5] Fresh fortification recovery at 5.0 mg/kg.
[6] 0.5 mg/kg fortification of control samples homogenates immediately before extraction. Results uncorrected for control sample recoveries.
[7] 5.0 mg/kg fortification of control sample homogenates immediately before extraction. Results uncorrected for control sample recoveries.
[8] 2.0 mg/kg fortification of control samples immediately before extraction. Results uncorrected for control sample recoveries.
[9] 1.0 mg/kg fortification of control samples immediately before extraction. Results uncorrected for control sample recoveries.
[10] 0.08 mg/kg fortification of control samples immediately before extraction. Results uncorrected for control sample recoveries.
[11] The significant difference in replicate samples was attributed to variable concentration on the bulbs, with larger bulbs (exposed more above ground) receiving a larger dose of methomyl spray.

Methomyl was found to be unstable in beef liver fortified at 0.2 mg/kg and stored at -4°C (Ali *et al.*, 1993). 40-60% was lost when stored at room temperature for up to 8 hours, and residues decreased to 0% within two weeks. However methomyl was stable in ruminant milk, muscle and liver stored at -70°C (Daun, 1995). The results are shown in Table 21.

Table 21. Stability of residues in ruminant products fortified with methomyl and stored at –60 to -80 °C.

Sample	Fortification (mg/kg)	Storage period (days)	Methomyl remaining (%)	Method[1]
Milk, whole	0.10	0	88	Daun, 1995
		30	97	AMR 2964-94
		61	82	
		91	83	
		181	84	
Muscle	0.10	0	94	Daun, 1995
		2	93	AMR 2964-94
		9	91	
		15	88	
		33	102	
		61	88	
		91	89	
		181	86	
Liver	0.10	0	95	Daun, 1995
		11	102	AMR 2964-94
		20	93	
		31	88	
		60	94	
		90	94	
		165	94	

[1] Method validated for whole milk (0.01 mg/kg, 94% ± 6.6%, n = 16), liver (0.01 mg/kg, 106% ± 7.6%, n = 4) and muscle (0.01 mg/kg, 94% ± 8.6%, n = 3).

Rühl and Devine (1994) studied the stability of methomyl in soil samples from Madera, California, USA, fortified at 2.0, 20 and 200 µg/kg and stored frozen at -15 to -25° C, and in water from the American River, Sacramento, fortified at 0.1, 1.0 and 10 µg/kg and stored at 4°C and about -20°C. Methomyl was stable in the frozen soil and water for a minimum of 52 weeks and in cold water for a minimum of 14 weeks.

Definition of the residue

Metabolic studies on animals and plants have demonstrated that methomyl is substantially metabolized to carbon dioxide and acetonitrile. MHTA (methomyl oxime) was generally found to be absent, although its sulfate was found in some animal studies.

The older GC methods for analysis rely on conversion of methomyl to methomyl oxime, and thus, methomyl and methomyl oxime are determined. In the newer HPLC methods, only methomyl is determined, although thiodicarb may also be determined (separately) by the same method.

The Meeting noted that thiodicarb is readily metabolized to methomyl and that it is appropriate to combine the considerations for thiodicarb and methomyl. The Meeting agreed that the residue in both plant and animal commodities should be defined as methomyl for use of methomyl and as the sum of thiodicarb and methomyl, expressed as methomyl, for the use of thiodicarb. The Meeting further noted that expression of thiodicarb residue can be expressed as methomyl or thiodciarb, as the conversion factor from thiodicarb to methomyl is 0.92 and that from methomyl to thiodicarb is 1.1.

USE PATTERN

Methomyl is registered for use as a pesticide to control a large variety of chewing and sucking insects on a wide range of crops in many countries. Table 22 is a summary of the registered uses of methomyl based on labels or label translations provided by the manufacturer.

Table 22. Registered uses of methomyl.

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
Alfalfa	Argentina	F	SP	900 g/kg	Foliar-aerial/ground	0.45	0.15 gnd 2.2aer	ns	10
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	7
	Cyprus	F	SP	900 g/kg	knapsack	1.0	0.2	2-3	7
	Hungary	F	SL	200 g/l	Foliar	0.12	0.024 (0/04 stubble)	ns	14
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	7
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	7
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.16	ns	7
	Peru	F	SL	240 g/l	Foliar	0.36	0.096	ns	5
	Peru	F	SL	296 g/l	Foliar	0.52	0.09	ns	15
	Peru	F	SP	400 g/kg	Foliar	0.27	0.18	ns	7
	Peru	F	SP	900 g/kg	Foliar	0.27	0.18	ns	7
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.018	As needed	28
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	Grazing feeding-7
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10	Grazing feeding-7
Almonds	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
	Greece	F	SL	200 g/l	Foliar	1.1	0.09	1-3	20

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Greece	F	SP	900 g/kg	Foliar	1.1	0.09	1-3	20
	Greece	F	WP	250 g/kg	Foliar	1.1	0.09	1-3	20
Anise see Fennel									
Apple	Argentina		SP	900 g/kg	Foliar		0.054		14
	Australia	F	SL	225 g/l	Foliar-ground		0.045	As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground		0.048	As needed	1
	Belgium	F	WP	250 g/kg	Foliar	0.75	0.05	ns	21
	Bulgaria	F	WP	250 g/kg	Foliar		0.02	3	7
	Canada	F	SL	215 g/l	Foliar-ground	1.9	0.065	As needed	8
	Canada	F	SP	900 g/kg	Foliar-ground	1.9	0.063	As needed	8
	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
	France	F	SL	200 g/l	Foliar		0.05-0.075	3	7
	Hungary	F	SL	200 g/l	Foliar	0.80	0.053	ns	14
	Italy	F	SL	200 g/l	Foliar		0.05	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.05	ns	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	14
	Korea	F	SL	215 g/l	Foliar		0.0215	5	7
	Korea	F	SP	450 g/kg	Foliar		0.0675	2	14
	Kuwait	F	SP	900 g/kg	Foliar		0.032-0.045	ns	10-15
	Lebanon	F	SP	900 g/kg	Foliar		0.014-0.09	As needed	14
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.15-0.29	ns	8
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	0.73-1.16	ns	8
	Morocco	F	WP	250 g/kg	Foliar		0.0375	ns	7
	Oman	F	SP	900 g/kg	Foliar		0.032-0.045	As needed	10-15
	Qatar	F	SP	900 g/kg	Foliar		0.032-0.045	As needed	10-15
Apple	Romania	F	SP	900 g/kg	Foliar	0.45	0.03	3	7
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.014-0.018	As needed	15
	Syria	F	SP	900 g/kg	Foliar		.03-.06	As needed	14
	USA	F	SP	900 g/kg	Foliar-ground only	1.0	0.22	5	14 grazing-10
	USA	F	SL	290 g/l	Foliar-ground only	1.0	0.22	5	14 grazing-10
Apricot	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
	France	F	SL	200 g/l	Foliar		0.05-0.075	3	7
	Kuwait	F	SP	900 g/kg	Foliar		0.032-0.045	ns	10-15
	Morocco	F	WP	250 g/kg	Foliar		0.0375	ns	7
	Oman	F	SP	900 g/kg	Foliar		0.032-0.045	As needed	10-15
	Qatar	F	SP	900 g/kg	Foliar		0.032-0.045	As needed	10-15
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.014-0.018	As needed	15
Artichoke	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	.042-.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	7
	France	F	SL	200 g/l	Foliar	0.4		3	7
	France		SL	200 g/l	Foliar		0.04		
	Morocco	F	WP	250 g/kg	Foliar		0.0375	ns	7
	Tunisia	F	WP	250 g/kg	Foliar	0.038	0.038	3-4	7

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Venezuela	F	SL	223 g/l	traps		1.1	ns	
Asparagus	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	.042-.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	1
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.15-0.29	ns	1
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	0.73-1.16	ns	1
	Thailand	F	SL	184.5 g/l	Foliar		0.05	ns	3
	Thailand	F	SP	400 g/kg	Foliar		0.04-0.07	ns	6-14
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	8 (4.5 kg ai/ha/crop)	1
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	8 (5 kg ai/ha/crop)	1
Aubergine see Egg plant									
Avocado	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	1
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	5.4	2 (1 kg ai/ha/crop)	1
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4	2 (1 kg ai/ha/crop)	1
Banana	Philippines	F	SP	400 g/kg	Bud injection		2-3kg/ha	As needed	
Bananas, Plantains	Colombia	F	SP	400 g/kg		2% solution		ns	-
	Venezuela	F	SL	223 g/l	traps		1.1	ns	
	Venezuela	F	SP	900 g/kg	traps		0.18	ns	
Barley	Australia	F	SL	225 g/l		0.45	1.0-2.1	As needed	14
	Australia	F	SP	400 g/kg		0.48	1.1-2.2	As needed	14
	Canada	F	SL	215 g/l	Foliar-ground	0.48	0.49	As needed	20
	Canada	F	SL	215 g/l	Foliar-aerial	0.48	2.2	As needed	20
	Canada	F	SP	900 g/kg	Foliar-ground	0.49	0.49	As needed	20
	Canada	F	SP	900 g/kg	Foliar-aerial	0.49	2.2	As needed	20
	Jordan	F	SP	900 g/kg	Foliar		.02-.05	ns	7
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	0.73-1.16	ns	7
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.15-0.29	ns	7
	USA	F	SL	290 g/l	Foliar-aerial/ground	0.5	5.4	4	7 10-grazing
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.5	6.0	4	7 10-grazing
Beans	Australia	F	SL	225 g/l	Foliar-ground	0.45	0.023	As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	1
	Central America	F	SL	216 g/l	Foliar	0.54	0.14-.027	ns	7 to 14
	Central America	F	SL	290 g/l	Foliar	0.58	0.15-0.29	ns	7 to 14
	Central America	F	SP	900 g/kg	Foliar	0.45	0.11-0.23	ns	3-15
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	.25-.5	ns	3-15
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	.042-.081	2-3	3
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	3
	Ecuador	F	SL	290 g/l	Foliar	0.36		6	
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.08-0.15	6	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.08-0.15	6	14

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	15
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	0.9		1	15
	Italy	F	SL	200 g/l	Foliar		.036-.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		.036-.04	ns	10
	Kuwait	F	SP	900 g/kg	Foliar		0.032-0.045	ns	3
	Lebanon	F	SP	900 g/kg	Foliar		0.014-0.09	As needed	3
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.15-0.29	ns	21
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	0.73-1.16	ns	21
	New Zealand	F	SL	200 g/l	Foliar	0.4		As needed	2
	Oman	F	SP	900 g/kg	Foliar		0.023-0.045	As needed	3
	Peru	F	SP	400 g/kg	Foliar	0.4	0.135	ns	7
	Peru	F	SP	900 g/kg	Foliar	0.4	0.135	ns	7
	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	3
	Qatar	F	SP	900 g/kg	Foliar		0.023-0.045	As needed	3
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.014-0.032	As needed	10
	South Africa	F	SL	200 g/l	Foliar-aerial	0.225	0.75	ns	3
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	ns	3
	South Africa	F	SP	900 g/kg	Foliar-aerial	0.225	0.75	ns	3
	South Africa	F	SP	900 g/kg	Foliar-ground		0.045	ns	3
	Syria	F	SP	900 g/kg	Foliar		.03-.06	As needed	3
	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	7-14
	Venezuela	F	SL	288 g/l	Foliar	0.86		ns	7-14
	Venezuela	F	SP	900 g/kg	Foliar	0.32		ns	7-14
Beans and legume seeds	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.480		As needed	1
Beans, Adzuki	Australia	F	SP	400 g/kg	Foliar-ground	0.480		As needed	7
Beans, Black	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	7-14
	Venezuela	F	SL	288 g/l	Foliar	0.86		ns	7-14
	Venezuela	F	SP	900 g/kg	Foliar	0.32		ns	7-14
Beans, Broad	Australia	F	SL	225 g/l	Foliar-ground	0.45	0.023	As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.480			1
	Cyprus	F	SP	900 g/kg	Foliar-high volume	.42-.81	.042-.081	2-3	3
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	3
Beans, Castor	Thailand	F	SP	400 g/kg	Foliar		0.04-0.07	ns	3

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
Beans, dry	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10 (5 kg ai/ha/crop)	seed, vines, hay-14
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10 (5 kg ai/ha/crop)	seed, vines, hay-14
Beans, Fava	Lebanon	F	SP	900 g/kg	Foliar		0.014-0.09	As needed	3
	Syria	F	SP	900 g/kg	Foliar		.03-.06	As needed	3
Beans, French	Australia	F	SL	225 g/l	Foliar-ground	0.45	0.023	As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.480		As needed	1
Beans, Green	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.15-0.29	ns	1
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	0.73-1.16	ns	1
Beans, long	Australia	F	SL	225 g/l	Foliar-ground	0.34	0.023	As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	1
Beans, Mung See Mung bean									
Beans, Navy	Australia	F	SL	225 g/l	Foliar-ground	0.34	0.023	As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	1
Beans, Snap	Canada	F	SL	215 g/l	Foliar-ground	0.50	0.5	As needed	7
	Canada	F	SP	900 g/kg	Foliar-ground	0.50	0.5	As needed	7
Beans, succulent	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10 (5 kg ai/ha/crop)	≤0.5 kg ai/ha=1 >0.5=3 vines-3 hay-7
Beans, succulent	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10 (4.5 kg ai/ha/crop)	≤0.56 kg ai/ha = 1 >0.56= 3 vines-3 hay-7
Beet, red	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	.042-.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
Beets	Austria	F	WP	250 g/kg	Foliar	0.25	0.05	ns	21
Beets, table	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	6.0 (4 kg ai/ha/crop)	8	roots-0 tops-14
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	6.0 (4 kg ai/ha/crop)	8	roots-0 tops-14
Bermuda grass pasture	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	5.4	4 (0.9 kg ai/ha/crop)	forage-7 dehydrated hay-3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4	4 (0.9 kg ai/ha/crop)	forage-7 dehydrated hay-3
Binjal	India	F	SL	112 g/l	Foliar-high volume	0.04	0.08	ns	4
Blueberries	Australia	F	SL	225 g/l	Foliar-ground		0.023	ns	5
	USA	F	SL	900 g/kg	Foliar-aerial/ground	1.0	5.4	4	3
Broccoli	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	1
	Brazil	F	SL	215 g/l	Foliar		0.0215	5	3
	Canada	F	SL	215 g/l	Foliar-ground	0.48	0.19	As needed	7
	Central America	F	SL	216 g/l	Foliar	0.54	0.27	ns	3
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	3

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	6	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	6	14
	Japan	F	WP	450 g/kg	Foliar	.675-1.35	0.045	1-3	14
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	3
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.16	ns	3
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	ns	4
	South Africa	F	SL	200 g/l	Foliar-aerial	0.225	0.75	ns	4
	South Africa	F	SP	900 g/kg	Foliar-aerial	0.225	0.75	ns	4
	South Africa	F	SP	900 g/kg	Foliar-ground	0.225		ns	4
	South Africa	F	SP	900 g/kg	Foliar		0.045	ns	4
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10	3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	3
	Venezuela	F	SL	223 g/l	Foliar	0.7		ns	3
	Venezuela	F	SL	288 g/l	Foliar	0.86		ns	3
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	3
Brussels sprouts	Australia	F	SL	225 g/l	Foliar-ground	.23-.45		As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	.24-.48		As needed	1
	Canada	F	SL	215 g/l	Foliar-ground	0.48	0.19	As needed	7
	Canada	F	SP	900 g/kg	Foliar-ground	0.48	0.19	As needed	7
	Poland	F	SL	200 g/l	Foliar	0.18	0 .09	3	7
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	ns	4
	South Africa	F	SL	200 g/l	Foliar-aerial	0.225	0.75	ns	4
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10	3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	3
	South Africa	F	SP	900 g/kg	Foliar-aerial	0.225	0.75	ns	4
	South Africa	F	SP	900 g/kg	Foliar-ground	0.225		ns	4
	South Africa	F	SP	900 g/kg	Foliar		0.045	ns	4
Bush and Canefruit	New Zealand	F	SL	200 g/l	Foliar		0.024	As needed	2
Cabbage	Argentina	F	SP	900 g/kg	Foliar	0.45	0.15	ns	14
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0.045		14
	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0- .48		As needed	1
	Brazil	F	SL	215 g/l	Foliar		0.0215	5	3
	Canada	F	SL	215 g/l	Foliar-ground	0.48	0.19	As needed	1
	Canada	F	SP	900 g/kg	Foliar-ground	0.49	0.20	As needed	1
	Central America	F	SL	216 g/l	Foliar	0.54	0.27	ns	3
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	3
	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	1
	China	F	SP	900 g/kg	Foliar	0.27	0.20	1-5	7
	Colombia	F	SP	400 g/kg	Foliar-ground	0.22	0.11	ns	14
	Colombia	F	SP	400 g/kg	Foliar-aerial	0.22	0.8	ns	14
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0.50	ns	1
	Cyprus	F	SP	900 g/kg	Foliar-high volume	.42-.81	0.081	2-3	1

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	1
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	6	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	6	14
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	
	France	F	SL	200 g/l	Foliar	0.3		1	7
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	15
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	- 0.9		1	15
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	- 0.9		1	15
	India	F	SL	112 g/l	Foliar-high volume	0.05	0 .10	ns	3
	Indonesia	F	SL	200 g/l	Foliar		0.06	ns	14
	Indonesia	F	WP	250 g/kg	Foliar		0.075	ns	14
	Italy	F	SL	200 g/l	Foliar		0.05	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.05	ns	10
	Japan	F	GR	1.5 g/kg	granule application	0.9		3	7
	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	3
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	1
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	1-3
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	3
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	1
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.16	ns	1
	New Zealand	F	SL	200 g/l	Foliar	0.4		As needed	7
Cabbage	Oman	F	SP	900 g/kg	Foliar		0.023-0.045	As needed	1-3
	Pakistan	F	SP	400 g/kg	Foliar	0.16		ns	
	Peru	F	SP	400 g/kg	Foliar	0.4	0.14	ns	7
	Peru	F	SP	900 g/kg	Foliar	0.4	0.14	ns	7
	Poland	F	SL	200 g/l	Foliar	0.18	0.09	3	14
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	1-3
	Romania	F	SP	900 g/kg	Foliar	0.9	0.09	3	3
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.032	As needed	15
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	ns	4
	South Africa	F	SL	200 g/l	Foliar-aerial	0.225	0.75	ns	4
	South Africa	F	SP	900 g/kg	Foliar-aerial	0.225	0.75	ns	4
	South Africa	F	SP	900 g/kg	Foliar-ground	0.225		ns	4
	South Africa	F	SP	900 g/kg	Foliar		0.045	ns	4
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	1

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Taiwan	F	WP	900 g/kg	Foliar		0.03(3000x)	ns	10
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	3
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11A	15	1
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11A	15	1
	Venezuela	F	SL	223 g/l	Foliar	0.7		ns	3
	Venezuela	F	SL	288 g/l	Foliar	0.86		ns	3
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	3
Cabbage, Chinese see Chinese cabbage									
Cacao	Indonesia	F	SL	200 g/l	Foliar		0.06	ns	14
	Indonesia	F	WP	250 g/kg	Foliar		0.075	ns	14
Canola	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	7
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	7
	Canada	F	SL	215 g/l	Foliar-ground	0.27	0.11	As needed	8
	Canada	F	SL	215 g/l	Foliar-aerial	0.27	1.2	As needed	8
	Canada	F	SP	900 g/kg	Foliar-ground	0.46	0.18	As needed	8
	Canada	F	SP	900 g/kg	Foliar-aerial	0.46	2.0	As needed	8
Cantaloupe	Tunisia	F	WP	250 g/kg	Foliar	0.038	0.038	3-4	7
Carrots	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	1
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0.5	ns	1
	Cyprus	F	SP	900 g/kg	Foliar-high volume	.42-.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	Japan	F	GR	1.5 g/kg	granule application	3-4.5		1	before seeding
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	1
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10	1
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	1
Cauliflower	Argentina	F	SP	900 g/kg	Foliar	0.45	0.15	ns	14
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0.045		14
	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.36		As needed	1
	Canada	F	SL	215 g/l	Foliar-ground	0.48	0.19	As needed	7
Cauliflower	Canada	F	SP	900 g/kg	Foliar-ground	0.49	0.19	As needed	7
	Canada	F	SP	900 g/kg	Foliar-ground	0.49	0.19	As needed	7
	Central America	F	SL	216 g/l	Foliar	0.54	0.27	ns	3
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	3
	Colombia	F	SP	400 g/kg	Foliar-ground	0.22	0.11	ns	14
	Colombia	F	SP	400 g/kg	Foliar-aerial	0.22	0.8	ns	14
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	15

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	0.9		1	15
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	3
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	1-3
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	3
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.16	ns	3
	New Zealand	F	SL	200 g/l	Foliar	0.4		As needed	7
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	1-3
	Pakistan	F	SP	400 g/kg	Foliar	0.16		ns	
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	1-3
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	ns	4
	South Africa	F	SL	200 g/l	Foliar-aerial	0.225	0.75	ns	4
	South Africa	F	SP	900 g/kg	Foliar-aerial	0.225	0.75	ns	4
	South Africa	F	SP	900 g/kg	Foliar-ground	0.225		ns	4
	South Africa	F	SP	900 g/kg	Foliar		0.045	ns	4
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	3
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	3
	Turkey	F	SP	900 g/kg	Foliar	0.72		ns	3
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10	3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	3
	Venezuela	F	SL	223 g/l	Foliar	0.7		ns	3
	Venezuela	F	SL	288 g/l	Foliar	0.86		ns	3
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	3
Celery	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	7
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0.5	ns	7
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	7
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10	7
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	7
	Venezuela	F	SL	223 g/l	Foliar	0.7		ns	
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	
Cereals	Kenya	F	SP	900 g/kg	Foliar-high volume	0.27	0.06	As needed	3
	New Zealand	F	SL	200 g/l	Foliar	0.4	0.4	As needed	7

Crop	Country	F/G[1]	Form type	Concen- tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
Cetrosema, Pascuorum seed crops	Australia	F	SL	225 g/l	Foliar	0.45		ns	-
Cherry	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
	France	F	SL	200 g/l	Foliar		0.05	3	7
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	10-15
	Morocco	F	WP	250 g/kg	Foliar		0.0375	ns	7
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	10-15
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	10-15
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.018	As needed	15
Chickpea	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	7
	Australia	F	SP	400 g/kg	Foliar-ground	0 .48		As needed	1
Chicory	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	5.4	2	80
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4	2	80
Chinese cabbage	Japan	F	GR	1.5 g/kg	granule application	1.4		2	14
	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	14
	Korea	F	SP	450 g/kg	Foliar		0.068	As needed	7
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	0.43gnd 2.2aer	10 (9 kg ai/ha/crop)	10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	0.43gnd 2.2aer	10 (9 kg ai/ha/crop)	10
Citrus fruits	Algeria	F	SL	200 g/l	Foliar		0.03	ns	7
	Argentina	F	SP	900 g/kg	Foliar		0.054	ns	14
	Australia	F	SL	225 g/l	Foliar-ground		0.045	ns	2
	Australia	F	SP	400 g/kg	Foliar-ground		0.048	ns	2
	China	F	SP	900 g/kg	Foliar	300ppm	180 ppm	1-5	10
	Cyprus	F	SP	900 g/kg		0.65	0.054	1-2	1
	Greece	F	SL	200 g/l	Foliar	(1.35)	0.09	1-3	20
	Greece	F	SP	900 g/kg	Foliar	(1.35)	0.09	1-3	20
	Greece	F	WP	250 g/kg	Foliar	(1.35)	0.09	1-3	20
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	1
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	1
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	1
	Morocco	F	WP	250 g/kg	Foliar		0.038	ns	7
	South Africa	F	SL	200 g/l	Foliar		0.018	ns	2
	South Africa	F	SL	200 g/l	Foliar		0.018	ns	2
	South Africa	F	SL	200 g/l	Foliar		0.023	ns	28
	South Africa	F	SL	200 g/l	Foliar		0.09 + 3 L of Sunspray oil	1-late cultivars	28
	South Africa	F	SL	200 g/l	Foliar		0.018 + 500 ml mineral oil	ns	28
	South Africa	F	SL	200 g/l	Foliar		0.023	ns	28
	South Africa	F	SP	900 g/kg	Foliar-ground		0.018	ns	2
	South Africa	F	SP	900 g/kg	Foliar-aerial	0.225	0.45	ns	
	South Africa	F	SP	900 g/kg	Foliar		0.018	ns	2

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	South Africa	F	SP	900 g/kg	Foliar		0.0225	ns	28
	South Africa	F	SP	900 g/kg	Foliar		0.09 + 3 L of Sunspray oil	1-late cultivars	28
	South Africa	F	SP	900 g/kg	Foliar		0.018 + 500 ml mineral oil	ns	28
	South Africa	F	SP	900 g/kg	Foliar		0.022	ns	28
	Spain	F	SL	200 g/l	Foliar-high volume	0.5	0.05	1-5	7
	Spain	F	WP	250 g/kg	Foliar-high volume	0.5	0.05	1-5	7
	Taiwan	F	WP	900 g/kg	Foliar		0.03	ns	
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	3
Clover	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	7
	Greece	F	SL	200 g/l	Foliar	0.54		1-3	20
	Greece	F	WP	250 g/kg	Foliar	0.54		1-3	20
Cocoa	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	
	Venezuela	F	SP	900 g/kg	Foliar	0.18		ns	
Coffee	Kenya	F	SP	900 g/kg	Foliar-high volume	0.9	0.11	As needed	7
Cole crops	Argentina	F	SP	900 g/kg	Foliar	0.45	0.15	ns	14
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0.045		14
	Peru	F	SL	296 g/l	Foliar	0.36	0.09	ns	3
Collards, fresh market	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	8	10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	8	10
Cotton	Argentina	F	SP	900 g/kg	Foliar	0.27	0.09	ns	14
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0.027		14
	Australia	F	SL	225 g/l	Foliar-aerial	0.54	2.4	As needed	ns
	Australia	F	SP	400 g/kg	Foliar-aerial	0.56	2.5	As needed	15
	Brazil	F	SL	215 g/l	Foliar	0.33	-0.33	5	14
	Central America	F	SL	216 g/l	Foliar	0.54	0.027	ns	15
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	15
	Central America	F	SP	900 g/kg	Foliar	0.36	0.18	ns	15
	China	F	SP	900 g/kg	Foliar	0.18	0.105	1-5	ns
	Colombia	F	SL	216 g/l	Foliar-aerial	0.32	1.1	ns	7
	Colombia	F	SL	216 g/l	Foliar-ground	0.32	0.16	ns	7
	Colombia	F	SP	400 g/kg	Foliar-ground	0.44	0.22	ns	7
	Colombia	F	SP	400 g/kg	Foliar-aerial	0.44	1.6	ns	
	Costa Rica	F	SP	900 g/kg	Foliar	0.72	0.36	ns	15
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	4	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15		14
	Greece	F	SL	200 g/l	Foliar	0.7		1-3	20
	Greece	F	SP	900 g/kg	Foliar	0.7		1-3	20
	Greece	F	WP	250 g/kg	Foliar	0.7		1-3	20
	India	F	SL	112 g/l	Foliar-high volume	0.06	0.12	ns	7
	India	F	SP	400	0.45	0.09	ns	10	

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
				g/kg4Foliar-					

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
				high volume					
	Indonesia	F	SL	200 g/l	Foliar		0.06	ns	14
	Indonesia	F	WP	250 g/kg	Foliar		0.06	ns	14
	Kenya	F	SP	900 g/kg	Foliar-high volume	0.45	0.09	As needed	15
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	15
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	15
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	15
	Morocco	F	SL	200 g/l	Foliar		0.05	ns	7
	Morocco	F	WP	250 g/kg	Foliar		0.038	ns	7
	Pakistan	F	SP	400 g/kg	Foliar	0.4		ns	
	Peru	F	SP	400 g/kg	Foliar	0.4	0.18	ns	7
	Peru	F	SP	900 g/kg	Foliar	0.4	0.18	ns	7
	Spain	F	SL	200 g/l	Foliar-high volume	0.4	0.05	2-3	7
	Spain	F	WP	250 g/kg	Foliar-high volume	0.4	0.05	2-3	7
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	15
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	-
	Turkey	F	SP	900 g/kg	Foliar	0.72		ns	7
	USA	F	SL	290 g/l	Foliar-aerial/ground	0.76 west 0.50 east 0.67 Texas	8	8	15
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.76 west 0.50 east 0.67 Texas	15	8	15
	Venezuela	F	SL	223 g/l	Foliar	0.33		ns	15
	Venezuela	F	SL	288 g/l	Foliar-aerial	0.4	1.6	ns	15
	Venezuela	F	SP	900 g/kg	Foliar	0.45		ns	15
	Vietnam	F	SP	400 g/kg	Foliar	.0.72	0.12	ns	
Courgette	France	F/G	SL	200 g/l	Foliar	0.3		3	7
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	15
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	0.9		1	15
	Netherlands	F/G	SL	200 g/l	Foliar	0.4	0.025	1-3	3
	Netherlands	G	WP	250 g/kg	Foliar	0.4	0.08	1-3	3
Cowpea	Australia	F	SP	400 g/kg	Foliar-ground	0.48			7
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	3
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	3
Cucumber	Belgium	G	WP	250 g/kg	Foliar	0.5	0.031	ns	14

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Bulgaria	F	WP	250 g/kg	Foliar		0.023	3	7
	Central America	F	SL	216 g/l	Foliar	0.54	0.027	ns	3
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	3
	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	3
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0.5	ns	3
	Cyprus	F	SP	900 g/kg	Foliar-high volume	.42-.81	0.081	2-3	3
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	3
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	8	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	8	14
	France	F/G	SL	200 g/l	Foliar	0.3		3	7
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	20
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	20
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	20
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	20
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	20
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	20
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	20
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	20
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	- 0.9		1	20
	Hungary	F	SL	200 g/l	Foliar	0.4	0.07	ns	5
	Hungary	G	SL	200 g/l	Foliar	0.72	0.09	ns	5
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	3
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	3
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	3
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	3
	Netherlands	F/G	SL	200 g/l	Foliar	0.4	0.025	1-3	3
	Netherlands	G	WP	250 g/kg	Foliar	0.4	0.08	1-3	3
	New Zealand	G	SL	200 g/l	Foliar		0.024	4	2
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	3
	Pakistan	F	SP	400 g/kg	Foliar	0.16		ns	
	Peru	F	SL	296 g/l	Foliar	0.52	0.09	ns	3
	Poland	G	SL	200 g/l	Foliar		0.02	3	3
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	3
	Romania	G	SP	900 g/kg	Foliar	0.45	0.045	3	3
	Romania	F	SP	900 g/kg	Foliar	0.9	0.09	3	3
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.032	As needed	7
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	3

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	3
	Tunisia	F	WP	250 g/kg	Foliar	0.038	0.038	3-4	7
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	12	≤0.5 kg=1 >0.5 kg=3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	12	≤0.5 kg=1 >0.5 kg=3
	Venezuela	F	SL	223 g/l	Foliar	0.33		ns	3
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	3
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	3
	Canada	G	SL	215 g/l	Foliar-high volume		0.005	3	3
Duboisia	Australia	F	SL	225 g/l	Foliar-ground	0.23	0.023	As needed	ns
	Australia	F	SP	400 g/kg	Foliar-ground		0.024	As needed	2
Egg plant	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	France	F/G	SL	200 g/l	Foliar	0.45		3	7
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	15
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	15
Egg plant	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	0.9		1	15
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	5
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	6
	Netherlands	F/G	SL	200 g/l	Foliar	0.4	0.025	1-3	3
	Netherlands	G	WP	250 g/kg	Foliar	0.4	0.025-0.08	1-3	3
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	6
	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	5
	Poland	G	SL	200 g/l	Foliar		0.02	3	3
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	6
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.032	As needed	15
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	6-14
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	5.4	10 (5 kg ai/ha/crop)	3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4	10 (5 kg ai/ha/crop)	3
Endive, Escarole	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	5.4	8	10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4	8	10
Fennel	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	7

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
Fennel (anise)	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	7
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10	7
Field crops	Morocco	F	SL	200 g/l	Foliar		0.038	ns	10
Figs	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
Flax	Argentina	F	SP	900 g/kg	Foliar	0.45	0.15	ns	
	Canada	F	SL	215 g/l	Foliar-ground	0.27		As needed	8
	Canada	F	SL	215 g/l	Foliar-aerial	0.27	1.2	As needed	8
	Canada	F	SP	900 g/kg	Foliar-ground	0.24	0.24	As needed	8
	Canada	F	SP	900 g/kg	Foliar-aerial	0.24	1.1	As needed	8
	France	F	SL	200 g/l	Foliar	0.5		1	ns
	Taiwan	F	WP	900 g/kg	Foliar		0.05(2000x)	ns	
Forages	Morocco	F	SL	200 g/l	Foliar		0.05	ns	7
Fruit	Austria	F	WP	250 g/kg	Foliar	0.038	0.03	ns	21
	Macedonia	F	SL	200 g/l	Foliar		0.05	3	35
	Macedonia	F	SP	900 g/kg	Foliar		0.05	As needed	35
	Macedonia	F	WP	250 g/kg	Foliar		0.04	2	35
	Morocco	F	SL	200 g/l	Foliar		0.05	ns	7
Garlic	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	7
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	7
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	7
Garlic	USA	F	SL	290 g/l	Foliar-aerial/ground	0.5	2.7	6	7
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.5	2.7	6	7
	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	5
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	5
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	5
Gherkin	France	F/G	SL	200 g/l	Foliar	0.3		3	7
Ginger	Australia	F	SL	225 g/l	Foliar-ground	0.34		ns	ns
	Australia	F	SP	400 g/kg	Foliar-ground	0.36		ns	
	Japan	F	WP		Foliar	1.35	0.045	1-3	7
Grape	Bulgaria	F	WP	250 g/kg	Foliar		0.02	4	21
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	4
	Algeria	F	WP	250 g/kg	Foliar		0.04	3-4	7
	Australia	F	SL	225 g/l	Foliar-ground		0.034	ns	7
	Australia	F	SP	400 g/kg	Foliar-ground		0.036	ns	7
	Austria	F	WP	250 g/kg	Foliar	0.38	0.05	ns	21
	Cyprus	F	SP	900 g/kg		0.54	0.054	1-2	10
	France	F	SL	200 g/l	Foliar	0.4	0.05	3	7
	Greece	F	SL	200 g/l	Foliar	(0.81)	0.054	1-3	20
	Greece	F	SP	900 g/kg	Foliar	(0.81)	0.054	1-3	20
	Greece	F	WP	250 g/kg	Foliar	(0.81)	0.054	1-3	20
	Hungary	F	SL	200 g/l	Foliar	0.48	0.05	ns	10
	Italy	F	SL	200 g/l	Foliar		0.05	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.05	ns	10

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	1
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	1-fresh 14-wine
	Macedonia	F	SL	200 g/l	Foliar		0.05	3	35
	Macedonia	F	SP	900 g/kg	Foliar		0.05	ns	35
	Macedonia	F	WP	250 g/kg	Foliar		0.05	2	35
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	table-1 industrial-10
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	table-1 industrial-10
	Morocco	F	WP	250 g/kg	Foliar		0.0375	ns	7
	New Zealand	F	SL	200 g/l	Foliar		0.024	As needed	7
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	1
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	1
	Romania	F	SP	900 g/kg	Foliar	0.9	0.06	3	7
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.032	As needed	7
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	fresh-1 wine-14
	Turkey	F	SP	900 g/kg	Foliar		0.054	ns	7
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	0.11	5	fresh, raisin-1 wine-14
Grape	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	0.11	5	fresh, raisin-1 wine-14
	Yugoslavia	F	SP	900 g/kg	Foliar		0.05	ns	35
Grapefruit	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	0.72	4	1 grazing-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	0.72	4	1 grazing-10
Grazing and other crops	South Africa	F	SL	200 g/l	Foliar-ground	0.045	0.011	ns	-
	South Africa	F	SP	900 g/kg	Foliar-ground	0.045	0.011	ns	-
Groundnuts	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	21
Guar	Australia	F	SL	225 g/l	Foliar-ground	0.45		ns	7
Hops	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	14
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	14
	Austria	F	WP	250 g/kg	Foliar	0.25	0.03	ns	21
	Belgium	F	WP	250 g/kg	Foliar	1.2	0.031	ns	21
	Poland	F	SL	200 g/l	Foliar		0.024	3	7
	Romania	F	SP	900 g/kg	Foliar	0.45		3	
	Spain	F	SL	200 g/l	Foliar-high volume	0.5	0.05	1-5	7
	Spain	F	WP	250 g/kg	Foliar-high volume	0.5	0.05	1-5	7
Horseradish	USA	F	SL	290 g/l	Foliar-ground only	0.5		4	65
	USA	F	SP	900 g/kg	Foliar-ground only	0.5		4	65
Indian jujubes	Taiwan	F	WP	900 g/kg	Foliar		0.03(3000x)	ns	6
Jewsmallow	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	3

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	3
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	3
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.032	As needed	10
Kale	Brazil	F	SL	215 g/l	Foliar		0.0215	5	3
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	6	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	6	14
Leafy vegetables	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.24		As needed	1
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	10
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	5.4	8	10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4	8	10
Lemon	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	0.72	4	1 grazing-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	0.72	4	1 grazing-10
Lentils	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	7
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	1
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	5.4	2	21 forage-3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4	2	21 forage-3
Lettuce	Argentina	F	SP	900 g/kg	Foliar	0.45	0.15	ns	14
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0.045		14
	Australia	F	SL	225 g/l	Foliar-ground	0-0.45	0.045	As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground		0 0.048	As needed	3
	Belgium	G	WP	250 g/kg	Foliar	0.31	0.031	ns	14
	Canada	F	SL	215 g/l	Foliar-ground	0.97	0.39	As needed	7
	Canada	F	SP	900 g/kg	Foliar-ground	0.9	0.36	As needed	7
	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	7-10
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0.5	ns	7-10
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	6	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	6	14
	France	F	SL	200 g/l	Foliar	0.3		3	14
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	15
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	15

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	0.9		1	15
	Italy	F	SL	200 g/l	Foliar		0.05	ns	14
	Italy	F	WP	250 g/kg	Foliar		0.05	ns	14
	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	14
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	10
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	10
	New Zealand	F	SL	200 g/l	Foliar	0.4		As needed	7
	Peru	F	SL	296 g/l	Foliar	0.52	0.09	ns	7
	Romania	F	SP	900 g/kg	Foliar	0.9	0.09	3	7
	Venezuela	F	SL	223 g/l	Foliar	0.7		ns	
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	
Lettuce, Head & Leaf	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	15-Head 8-Leaf	≤0.5 kg ai=7 >0.5=10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	15-Head 8-Leaf	≤0.5 kg ai=7 >0.5=10
Lime	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	3
Linseed	Australia	F	SL	225 g/l	Foliar-aerial	0.45	2.0	As needed	7
	Australia	F	SP	400 g/kg	Foliar-aerial	0.48		As needed	7
Lucerne	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	3-grazing
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	3-grazing
	South Africa	F	SL	200 g/l	Foliar-aerial	0.18	0.6	ns	7
	South Africa	F	SL	200 g/l	Foliar-ground, low volume	0.18	0.18	ns	7
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	ns	7
	South Africa	F	SP	900 g/kg	Foliar-aerial	0.18	0.6	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground, low volume	0.18	0.18	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground		0.045	ns	7
Lupin	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	1
	South Africa	F	SL	200 g/l	Foliar-aerial	0.18	0.6	ns	7
	South Africa	F	SL	200 g/l	Foliar-ground, low volume	0.18	0.18	ns	7
	South Africa	F	SL	200 g/l	Foliar-ground, low volume		0.18	ns	7
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground, low volume	0.18	0.18	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground		0.045	ns	7
Maize	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	14
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	14
	Central America	F	SL	216 g/l	Foliar	0.54	0.29	ns	14
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	14
	Central America	F	SP	900 g/kg	Foliar	0.36	0.18	ns	7

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Kenya	F	SP	900 g/kg	Foliar-high volume	0.27	0.06	As needed	3
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	fresh-0 grain-3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	fresh-0 grain-3
	New Zealand	F	SL	200 g/l	Foliar	0.4		As needed	7
	South Africa	F	SP	900 g/kg	Foliar-aerial	0.18	0.6	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground, low volume		0.18	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground		0.045	ns	7
Maize	Argentina		SP	900 g/kg	Foliar	0.45	0.15	ns	10
	Brazil	F	SL	215 g/l	Foliar	0.129	0.09	5	14
	Colombia	F	SP	400 g/kg	Foliar-ground	0.33	0.17	ns	14
	Colombia	F	SP	400 g/kg	Foliar-aerial	0.33	1.2	ns	14
	Costa Rica	F	SP	900 g/kg	Foliar	0.54	0.27	ns	ns
	Ecuador	F	SL	290 g/l	Foliar	0.36		2-3	14
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	2-3	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	2-3	14
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	7
	Greece	F	SL	200 g/l	Foliar	0.54		1-3	20
	Greece	F	WP	250 g/kg	Foliar	0.54		1-3	20
	Macedonia	F	SP	900 g/kg	ground application in bands	0.9		3	42
	Peru	F	SL	240 g/l	Foliar	0.19	0.06	ns	5
	Peru	F	SL	296 g/l	Foliar	0.26	0.06	ns	0
	Peru	F	SP	400 g/kg	Foliar	0.23	0.18	ns	7
	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	0
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	6-14
	Tunisia	F	WP	250 g/kg	Foliar	0.038	0.038	3-4	7
	Turkey	F	SP	900 g/kg	Foliar	0.9		ns	3
	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	0
	Venezuela	F	SP	900 g/kg	Foliar	0.45		ns	0
	Yugoslavia	F	SP	900 g/kg	ground application in bands	0.9		3	42
Maize, field	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	21
Maize, field and popcorn	USA	F	SL	290 g/l	Foliar-aerial/ground	0.5	11	10	ears-21 forage-3 fodder-21
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.5	11	10	ears-21 forage-3 fodder-21
Mango	Taiwan	F	WP	900 g/kg	Foliar		0.05(1800x)	ns	9,8
Melon	Central America	F	SL	216 g/l	Foliar	0.54	0.027	ns	3
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	3
	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	3
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0.5	ns	7
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	.042-.081	2-3	3

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	3
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	8	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	8	14
	France	F/G	SL	200 g/l	Foliar	0.3		3	7
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	20
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	20
Melon	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	20
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	20
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	20
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	20
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	20
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	20
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	0.9		1	20
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	3
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	3
	Netherlands	F/G	SL	200 g/l	Foliar	0.4	0.025	1-3	3
	Netherlands	G	WP	250 g/kg	Foliar	0.4	0.08	1-3	3
	Pakistan	F	SP	400 g/kg	Foliar	16		ns	
	Peru	F	SL	296 g/l	Foliar	0.52	0.09	ns	3
	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	1
	Romania	F	SP	900 g/kg	Foliar	0.9	0.09	3	3
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	3
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	12	1/2 lb.-1 >1/2 lb.-3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	12	1/2 lb.-1 >1/2 lb.-3
	Venezuela	F	SL	223 g/l	Foliar	0.33		ns	3
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	3
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	3
Mint	Australia	F	SL	225 g/l	Foliar-ground	0.45		ns	14
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		ns	14
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	9.1	4	14
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	9.1	4	14
Mung bean	Indonesia	F	SL	200 g/l	Foliar		0 .02	ns	14
	Indonesia	F	WP	250 g/kg	Foliar		0.06	ns	14
	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	3
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	3
	Vietnam	F	SP	400 g/kg	Foliar	0.72		ns	
Mung bean	Australia	F	SL	225 g/l	Foliar-aerial	0.45	2.1	As needed	7

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
(seed production)									
	Australia	F	SP	400 g/kg	Foliar-aerial	0.48	2.2	As needed	7
Muskmelon	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	3
Nashi	France	F	SL	200 g/l	Foliar		0.075	3	7
Nectarine	Australia	F	SL	225 g/l	Foliar-ground		0.034	As needed	1
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	1.0	3	1 grazing-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	1.0	3	1 grazing-10
Oats	Argentina		SP	900 g/kg	Foliar	045	0.15	ns	14
	Australia	F	SL	225 g/l		00.45	02.1	As needed	14
	Australia	F	SP	400 g/kg		00.48	02.2	As needed	14
	Canada	F	SL	215 g/l	Foliar-ground	0048	0.5		20
	Canada	F	SL	215 g/l	Foliar-aerial	048	2.2		20
	Canada	F	SP	900 g/kg	Foliar-ground	0.49	0.5	As needed	20
	Canada	F	SP	900 g/kg	Foliar-aerial	0.49	2.2	As needed	20
	USA	F	SL	290 g/l	Foliar-aerial/ground	0.5	5.4	4	7 grazing-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.5	5.4	4	7 grazing-10
Okra	India	F	SL	112 g/l	Foliar-high volume	0.04	0.08	ns	4
	Thailand	F	SL	184.5 g/l	Foliar		0.05	ns	3
Olive	Greece	F	SL	200 g/l	Foliar	(0.81)	0.09	1-3	20
	Greece	F	SP	900 g/kg	Foliar	(0.81)	0.09	1-3	20
	Greece	F	WP	250 g/kg	Foliar	(0.81)	0.09	1-3	20
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Morocco	F	WP	250 g/kg	Foliar		0.038	ns	7
	Peru	F	SL	296 g/l	Foliar	-	0.06	ns	15
Onion	Argentina	F	SP	900 g/kg	Foliar	0 .45	0.15	ns	14
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0.045		14
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	6	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	6	14
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	7
	Hungary	F	SL	200 g/l	Foliar	0.4	0.07	ns	5
	Japan	F	WP	450 g/kg	Foliar	1.35	0.045	1-3	7
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	7
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	7
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	7
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	7
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	7
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	23
	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	5
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	5

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	5
Onion, dry	Romania	F	SP	900 g/kg	Foliar	0.9	0.09	3	7
Onion, green and dry bulb	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	5.4A	8 (6 kg ai/ha/crop green, 4 kg ai/ha/crop dry)	7
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4A	8(6 kg ai/ha/crop green, 4 kg ai/ha/crop dry)	7
Onion, Welsh	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	7
	Peru	F	SP	400 g/kg	Foliar		0.18	ns	7
	Peru	F	SP	900 g/kg	Foliar		0.18	ns	7
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	0.72	4	1 grazing-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.5-1.0	0.72	4	1 grazing-10
Orchards	Yugoslavia	F	SP	900 g/kg	Foliar		0.05	As needed	Fruits-35
Palm, African & Coconut	Venezuela	F	SP	900 g/kg	traps		0.9	ns	
	Colombia	F	SP	400 g/kg				ns	-
Paprika	Hungary	F	SL	200 g/l	Foliar	0.4	0.07	ns	5
	Netherlands	F/G	SL	200 g/l	Foliar	0.4	0.025	1-3	3
	Netherlands	G	WP	250 g/kg	Foliar	0.4	0.08	1-3	3
	Poland	G	SL	200 g/l	Foliar		0.02	3	3
Pasture	Australia	F	SL	225 g/l	Foliar-aerial	0.45	2.1	As needed	3-grazing
	Australia	F	SP	400 g/kg	Foliar-aerial	0.48	2.2	As needed	3-grazing
	Kenya	F	SP	900 g/kg	Foliar-high volume	0.27	0.06	As needed	3
	New Zealand	F	SL	200 g/l	Foliar	0.4		As needed	7
Pasture, legume seed crops	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	ns
Peach	Argentina	F	SP	900 g/kg	Foliar		0.054	ns	14
	Australia	F	SL	225 g/l	Foliar-ground		0.034	As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground		0.36	As needed	1
	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
	France	F	SL	200 g/l	Foliar		0.075	3	7
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	10-15
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	4
	Morocco	F	WP	250 g/kg	Foliar		0.038	ns	7
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	10-15
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	10-15
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.018	As needed	15
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	4
	USA	F	SL	290 g/l	Foliar-aerial/ground	2.0	0.06gnd 4.8aer	6	4 grazing-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	2.0	0.06gnd 4.8aer	6	4 grazing-10
Peach, early cultivars	South Africa	F	SL	200 g/l	Foliar		0.045	2	16
	South Africa	F	SP	900 g/kg	Foliar		0.045	2	16
Peach, late	South Africa	F	SL	200 g/l	Foliar		0.045	3	16

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
cultivars									
	South Africa	F	SP	900 g/kg	Foliar		0.045	3	16
Peanut	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	14
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	14
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	21
	Indonesia	F	SL	200 g/l	Foliar		0.02	ns	14
	Indonesia	F	WP	250 g/kg	Foliar		0.06	ns	14
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	21
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	21
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	8	21
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	8	21
	Venezuela	F	SL	223 g/l	Foliar	0.7		ns	
	Venezuela	F	SP	900 g/kg	Foliar	0.32		ns	7-14
Pear	Argentina	F	SP	900 g/kg	Foliar		0.054	ns	14
	Australia	F	SL	225 g/l	Foliar-ground		0.045	As needed	2
	Belgium	F	WP	250 g/kg	Foliar	0.75	0.05	ns	21
	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
	France	F	SL	200 g/l	Foliar		0.075	3	7
	Hungary	F	SL	200 g/l	Foliar	0.48	0.05	ns	10
	Italy	F	SL	200 g/l	Foliar		0.05	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.05	ns	10
	USA	F	SL	290 g/l	Foliar-ground	1.0	0.22	2	7 grazing-10
	USA	F	SP	900 g/kg	Foliar-ground	1.0	0.22	2	7 grazing-10
Peas	Argentina	F	SP	900 g/kg	Foliar	0.45	0.15	ns	14
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0.045		14
	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	1
	Canada	F	SL	215 g/l	Foliar-ground	0.484	0.48	As needed	1
	Canada	F	SP	900 g/kg	Foliar-ground	0.459	0.46	As needed	1
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	3
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	3
	France	F	SL	200 g/l	Foliar	0.3		1	7
	Hungary	F	SL	200 g/l	Foliar	0.4	0.07	ns	5
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	1
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	3
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	1
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	1
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	3
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	6 (3 kg ai/ha/crop)	1 forage-5 hay-14
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	6 (3 kg ai/ha/crop)	1 forage-5 hay-14

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
Peas, field	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	7
	Australia	F	SP	400 g/kg	Foliar-ground	0.48	2.2	As needed	7
Pecans	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	5.4	7	30 grazing-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4	7	30 grazing-10
Pepper	Bulgaria	F	WP	250 g/kg	Foliar		0.023	3	7
	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	3
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	3
	France	F/G	SL	200 g/l	Foliar	0.45		3	7
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	15
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	0.9		1	15
	Hungary	G	SL	200 g/l	Foliar	0.72	0.09	ns	5
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	7
	Mexico	F	SL	290 g/l	Foliar-ground	0.65	0.33	ns	3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.65	1.3	ns	3
	Morocco	F	WP	250 g/kg	Foliar		0.038	ns	7
	New Zealand	G	SL	200 g/l	Foliar		0.024	4	2
	Tunisia	F	WP	250 g/kg	Foliar	0.038	0.038	3-4	7
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10	3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	3
	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	1
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	1
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	1
Pepper, Chili	Costa Rica	F	SP	900 g/kg	Foliar	0.54	0.27	ns	ns
	India	F	SL	112 g/l	Foliar-high volume	0.05	0.10	ns	4
	Peru	F	SL	240 g/l	Foliar	0.24	0.096	ns	5
	Peru	F	SP	400 g/kg	Foliar	0.4	0.14	ns	7
	Peru	F	SP	900 g/kg	Foliar	0.4	0.14	ns	7
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	6-14
Pepper, Green	Romania	G	SP	900 g/kg	Foliar	0.45	0.045	3	3

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
Pepper, Green (field)	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	14
Pepper, Red	Korea	F	SL	215 g/l	Foliar		0.022	4	14
	Korea	F	SP	450 g/kg	Foliar		0.068	3	7
Pepper, Red and Green	Argentina	F	SP	900 g/kg	Foliar	0.45	1.5	ns	10
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0.045		10
Pepper, Sweet	Australia	F	SL	225 g/l	Foliar-ground		0.045	As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground		0.048	As needed	1
Pigeon pea	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	7
	Australia	F	SP	400 g/kg	Foliar-ground	0.48	2.2	As needed	1
	India	F	SP	400 g/kg	Foliar-high volume	0.45	0.09	ns	7
Pistachio	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
Plantain, see Banana									
Plum	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	10-15
	Romania	F	SP	900 g/kg	Foliar	0.45	0.03	3	14
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.018	As needed	15
	France	F	SL	200 g/l	Foliar		0.075	3	7
	Morocco	F	WP	250 g/kg	Foliar		0.038	ns	7
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	10-15
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	10-15
Pome fruit	Algeria	F	WP	250 g/kg	Foliar		0.04	3-4	7
	Greece	F	SL	200 g/l	Foliar	(1.1)	0.09	1-3	20
	Greece	F	SP	900 g/kg	Foliar	(1.1)	0.09	1-3	20
	Greece	F	WP	250 g/kg	Foliar	(1.1)	0.09	1-3	20
	Spain	F	SL	200 g/l	Foliar-high volume	0.75	0.05	1-5	7
	Spain	F	WP	250 g/kg	Foliar-high volume	00.75	0.05	1-5	7
Pomegranates	USA	F	SL	290 g/l	Foliar-aerial/ground	1	4.4	2	14
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1	4.4	2	14
Poppies	Australia	F	SL	225 g/l	Foliar-ground	0 0.45		As needed	14
	Australia	F	SP	400 g/kg	Foliar-ground	0 0.48		As needed	14
Potato	Algeria	F	SL	200 g/l	Foliar		0.04	ns	7
	Algeria	F	WP	250 g/kg	Foliar		0.04	3-4	7
	Australia	F	SL	225 g/l	0	0.34-0.45		As needed	-
	Australia	F	SP	400 g/kg	Foliar-ground	0 0.48		As needed	
	Brazil	F	SL	215 g/l	Foliar		0.0215	3	9
	Canada	F	SL	215 g/l	Foliar-ground	0.48	0.19	As needed	3
	Canada	F	SP	900 g/kg	Foliar-ground	0.49	- 0.19	As needed	3
	Central America	F	SL	216 g/l	Foliar	0.65	0.33	ns	6
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	6
	Central America	F	SP	900 g/kg	Foliar	0.45	0.11-0.23	ns	6
	Colombia	F	SL	216 g/l	Foliar		0.054	ns	14
	Colombia	F	SP	400 g/kg			0.027	ns	14
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0.5	ns	6

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0- .81	0.081	2-3	7
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	7
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	6	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	6	ns
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	6
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	15
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	15
Potato	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	15
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	15
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	15
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	- 0.9		1	15
	Indonesia	F	SL	200 g/l	Foliar		0.075	ns	14
	Japan	F	GR	1.5 g/kg	granule application	0.9		5	7
	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	7
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	6
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	6
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	6
	Mexico	F	SL	290 g/l	Foliar-ground	0.65	- 0.33	ns	6
	Mexico	F	SL	290 g/l	Foliar-aerial	0.65	1.3	ns	6
	Morocco	F	WP	250 g/kg	Foliar		0.038	ns	7
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	6
	Pakistan	F	SP	400 g/kg	Foliar	016		ns	
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	6
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.032	As needed	15
	South Africa	F	SL	200 g/l	Foliar-aerial	0.45	1.5	Repeat weekly	3
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	Repeat weekly	3
	South Africa	F	SP	900 g/kg	Foliar-aerial	0.45	1.5	Repeat weekly	3
	South Africa	F	SP	900 g/kg	Foliar-ground		0.045	Repeat weekly	3
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	6
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	3-14
	USA	F	SL	290 g/l	Foliar-aerial/ground	1.0	11	10	6
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	6
	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	6
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	6
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	6
Prunes	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	
Pumpkin	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Peru	F	SL	296 g/l	Foliar	0.52	0.09	ns	3
	Venezuela	F	SL	223 g/l	Foliar	0.33		ns	
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	
Quince	France	F	SL	200 g/l	Foliar		0.075	3	7
Radish, Japanese	Japan	F	GR	1.5 g/kg	granule application	0.9		3	7
	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	7
Rice	Central America	F	SL	216 g/l	Foliar	0.54	.027	ns	7
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	7
	Colombia	F	SL	216 g/l	Foliar-aerial	0.3	1.1	ns	14
	Colombia	F	SL	216 g/l	Foliar-ground	0.3	0.15	ns	14
	Colombia	F	SP	400 g/kg	Foliar-aerial	0.22	0.8	ns	14
	Colombia	F	SP	400 g/kg	Foliar-ground	0.22	0.11	ns	14
	Ecuador	F	SL	290 g/l	Foliar	0.23		3	14
	Ecuador	F	SP	400 g/kg	Foliar	0.22	0.11	3	14
	Ecuador	F	SP	900 g/kg	Foliar	0.22	0.11	3	14
	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	3
	Taiwan	F	WP	900 g/kg	Foliar		0.05(1800x)	ns	15
	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	
Rye	USA	F	SL	290 g/l	Foliar-aerial/ground	0.5	5.4	4	7 grazing-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.5	5.4	4	7 grazing-10
Scallion, Leek	Taiwan	F	WP	900 g/kg	Foliar		0.03(3000x)	ns	10
Sesame	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	7
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	-
	Venezuela	F	SL	223 g/l	Foliar	0.33		ns	ns
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	
Sesame seed	Australia	F	SL	225 g/l	Foliar-ground	0.45		As needed	14
	Australia	F	SP	400 g/kg	Foliar-ground	0.48	2.2	As needed	14
	Colombia	F	SP	400 g/kg	Foliar-ground	0.33	0.17	ns	14
	Colombia	F	SP	400 g/kg	Foliar-aerial	0.33	1.2	ns	
Shallot	Indonesia	F	SL	200 g/l	Foliar		0.08	ns	14
	Indonesia	F	WP	250 g/kg	Foliar		.075	ns	14
Sitao	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	3
Sorghum	Argentina	F	SP	900 g/kg	Foliar	0.45	0- .15	ns	10
	Australia	F	SL	225 g/l	Foliar-aerial	0.45	2.0	As needed	14
	Australia	F	SP	400 g/kg	Foliar-aerial	0.48	2.2	As needed	14
	Central America	F	SL	216 g/l	Foliar	0.54	.027	ns	14
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	14
	Central America	F	SP	900 g/kg	Foliar	0.36	0.18	ns	14
	Colombia	F	SL	216 g/l	Foliar-aerial	0.2	0.7	ns	14
	Colombia	F	SL	216 g/l	Foliar-ground	0.2	0.1	ns	14
	Colombia	F	SP	400 g/kg	Foliar-aerial	0.33	1.2	ns	14

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Colombia	F	SP	400 g/kg	Foliar-ground	0.33	0.17	ns	14
	Costa Rica	F	SP	900 g/kg	Foliar	0.54	0.27	ns	14
	Ecuador	F	SL	290 g/l	Foliar	0.36		2-3	14
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	2-3	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	2-3	14
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	14
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	14
	Peru	F	SL	240 g/l	Foliar	0.24	0.096	ns	5
	Peru	F	SL	296 g/l	Foliar	0.26	0.06	ns	14
	Peru	F	SP	400 g/kg	Foliar	0.23	0.14	ns	7
	Peru	F	SP	900 g/kg	Foliar	0.23	0.14	ns	7
	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	14
	South Africa	F	SL	200 g/l	Foliar-aerial	0.18	0.6	ns	7
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	ns	7
	South Africa	F	SL	200 g/l	Foliar-ground, low volume	0.18	0.18	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground		0.045	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground, low volume	0.18	0.18	ns	7
	Taiwan	F	WP	900 g/kg	Foliar		0.03(3000x)	ns	15
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	6-14
	USA	F	SL	290 g/l	Foliar-aerial/ground	0.5	2.6A 0.53T	2	14 grazing-14
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.5	2.6A 0.53T	2	14 grazing-14
	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	14
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	14
	Venezuela	F	SP	900 g/kg	Foliar	0.45		ns	14
Soya bean	Argentina	F	SP	900 g/kg	Foliar	0.45	0.15	ns	10
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0.045		10
	Australia	F	SL	225 g/l	Foliar-aerial	0.45	2.0	As needed	7
	Australia	F	SP	400 g/kg	Foliar-aerial	0.48	2.2	As needed	7
	Brazil	F	SL	215 g/l	Foliar	0.43	0.43	3	14
	Central America	F	SL	216 g/l	Foliar	0.54	0.027	ns	7 to 14
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	7 to 14
	Colombia	F	SL	216 g/l	Foliar-aerial	0.2	0.7	ns	14
	Colombia	F	SL	216 g/l	Foliar-ground	0.2	0.1	ns	14
	Colombia	F	SP	400 g/kg	Foliar-aerial	0.33	1.2	ns	14
	Colombia	F	SP	400 g/kg	Foliar-ground	0.33	0.17	ns	14
	Ecuador	F	SL	290 g/l	Foliar	0.36		3	14
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	3	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	3	14
	Indonesia	F	SL	200 g/l	Foliar		0.06	ns	14
	Indonesia	F	WP	250 g/kg	Foliar		0.06	ns	14
	Japan	F	GR	1.5 g/kg	granule application	0 .9		4	14
	Japan	F	WP	450 g/kg	Foliar	1.4	.0.045	1-3	14

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	14
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	14
	Peru	F	SP	400 g/kg	Foliar	0.23	0.14	ns	7
	Peru	F	SP	900 g/kg	Foliar	0.23	0.14	ns	7
	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	3
	Taiwan	F	WP	900 g/kg	Foliar		0.05(2000x)	ns	
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	8 -14
Soya bean	USA	F	SL	900 g/kg	Foliar-aerial/ground	0.5	10	3	14 bean <0.5 kg ai/ha: forage 3 hay 7 >0.5 kg ai/ha: forage 10 hay 12
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.5	10	3	14 bean <0.5 kg ai/ha: forage 3 hay 7 >0.5 kg ai/ha: forage 10 hay 12
	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	7-14
	Venezuela	F	SL	288 g/l	Foliar	0.86		ns	7-14
	Venezuela	F	SP	900 g/kg	Foliar	0.32		ns	7-14
Spinach	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	7
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0. 5	ns	7
	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	14
	Peru	F	SL	296 g/l	Foliar	0.52	0.09	ns	7
	Romania	F	SP	900 g/kg	Foliar	0.9	0.09	3	7
	USA	F	SL	900 g/kg	Foliar-aerial/ground	1.0	11	8	7
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	8	7
Spinach, leafy vegetables	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
Squash	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	10
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	3
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	3
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	3
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.032	As needed	7
	Tunisia	F	WP	250 g/kg	Foliar	0.038	0.038	3-4	7
Squash, Summer	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	7
	USA	F	SL	900 g/kg	Foliar-aerial/ground	1.0	4.5-9.1	12	1/2 lb.-1 > 1/2 lb.-3
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	4.5-9.1	12	1/2 lb.-1 > 1/2 lb.-3

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
Stone fruit	Algeria	F	WP	250 g/kg	Foliar		0.04	3-4	7
	Australia	F	SL	225 g/l	Foliar-ground		0.045	ns	1
	Australia	F	SP	400 g/kg	Foliar-ground		0.048	ns	1
	Greece	F	SL	200 g/l	Foliar	1.1	0.09	1-3	20
	Greece	F	SP	900 g/kg	Foliar	1.1	0.09	1-3	20
	Greece	F	WP	250 g/kg	Foliar	1.1	0.09	1-3	20
	Spain	F	SL	200 g/l	Foliar-high volume	0.75	0.05	1-5	7
	Spain	F	WP	250 g/kg	Foliar-high volume	0.75	0.05	1-5	7
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
Strawberry	Australia	F	SL	225 g/l	Foliar-ground		0.045	As needed	3
	Australia	F	SP	400 g/kg	Foliar-ground		0.048	As needed	3
	Canada	F	SL	215 g/l	Foliar-ground	0.70	0.3	1	14
	Canada	F	SP	900 g/kg	Foliar-ground	0.70	0.3	1	14
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	3
	Japan	F	WP	450 g/kg	Foliar	0.68	0.045	1-3	-
	Japan	F	WP	450 g/kg	Foliar	9.0	0.045	1-3	
	Japan	F	WP	450 g/kg	Foliar	13.5	0.045	1-3	
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	3
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	3-fresh 10-processing
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	3
	New Zealand	F	SL	200 g/l	Foliar		0.024	As needed	2
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	fresh-3 processed-10
	USA	F	SL	900 g/kg	Foliar-aerial/ground	1.0	1.1	10	fresh fruit-3 processing fruit-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	1.1	10	fresh fruit-3 processing fruit-10
Sugar beet	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	7
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0.5	ns	7
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	7
	Italy	F	SL	200 g/l	Foliar		0.05	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.05	ns	10
	Macedonia	F	SL	200 g/l	Foliar		0.08	3	42
	Macedonia	F	WP	250 g/kg	Foliar		0.06		42
	Poland	F	SL	200 g/l	Foliar	0.14	0.09	3	14
	Spain	F	SL	200 g/l	Foliar-high volume	0.3	0.05	1-5	7
	Spain	F	WP	250 g/kg	Foliar-high volume	0.3	0.05	1-5	7
	USA	F	SL	900 g/kg	Foliar-aerial/ground	1.0	11	10	7
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	11	10	7
	Yugoslavia	F	SP	900 g/kg	ground application in bands	0.9		3	42
Sugar cane	Indonesia	F	WP	250 g/kg	Foliar		0.18	4	14

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
Sunflower	Argentina	F	SP	900 g/kg	Foliar	0.45	0.15	ns	10
	Australia	F	SP	400 g/kg	Foliar-aerial	0.48	2.2	As needed	7
	Australia	F	SL	225 g/kg	Foliar-aerial	0.45	2.0	As needed	7
	South Africa	F	SP	900 g/kg	Foliar-aerial	.09 + 100 ml Sumiciden	0.3	ns	-
	Venezuela	F	SL	223 g/l	Foliar	0.33		ns	7
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	7
	Venezuela	F	SP	900 g/kg	Foliar	0.18		ns	7
Sweet corn	Australia	F	SP	400 g/kg	Foliar-ground	0.48		As needed	1
	Australia	F	SP	400 g/kg	Foliar-ground	0.45		As needed	1
	Canada	F	SL	215 g/l	Foliar-ground	0.56	0.23	4	3
	Canada	F	SP	900 g/kg	Foliar-ground	0.56	0.23	4	3
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	3
	New Zealand	F	SL	200 g/l	Foliar	0.4		As needed	7
	USA	F	SL	900 g/kg	Foliar-aerial/ground	0.5	5.4	28	ears-0 forage-3
Sweet potato	Japan	F	GR	1.5 g/kg	granule application	0.9		5	7
	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	7
	Taiwan	F	WP	900 g/kg	Foliar		0.05(1800x)	ns	
Tangelo, Tangerine	USA	F	SL	900 g/kg	Foliar-aerial/ground	1.0	0.6	4	1 grazing-10
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	0.6	4	1 grazing-10
Tea	Indonesia	F	SL	200 g/l	Foliar		0.05	3	14
	Indonesia	F	WP	250 g/kg	Foliar		0.05	3	14
	Japan	F	WP	450 g/kg	Foliar	1.8	0.045	1-3	21
	Taiwan	F	WP	900 g/kg	Foliar		0.05(2000x)	ns	21
Tea trees	Australia	F	SP	400 g/kg	Foliar-ground	0.5		ns	ns
Tomato	Argentina	F	SP	900 g/kg	Foliar	0.45	0.15	ns	10
	Argentina	F	SP	900 g/kg	Foliar-knapsack		0. 045		10
	Australia	F	SL	225 g/l	Foliar-ground		0.045	ns	1
	Australia	F	SP	400 g/kg	Foliar-ground		0.048	ns	1
	Belgium	G	WP	250 g/kg	Foliar	0.5	0.031	ns	14
	Brazil	F	SL	215 g/l	Foliar		0.02	5	3
	Bulgaria	F	WP	250 g/kg	Foliar		0.02	3	7
	Canada	F	SL	215 g/l	Foliar-ground	0.49	0.2	As needed	1
	Canada	F	SP	900 g/kg	Foliar-ground	0.49	- 0.2	As needed	1
	Central America	F	SL	216 g/l	Foliar	0.54	.027	ns	1
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	1
	Central America	F	SP	900 g/kg	Foliar	0.45	0.23	ns	1-2
	Costa Rica	F	SP	900 g/kg	Foliar	1.00	0.5	ns	1-2
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	1
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	1

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Ecuador	F	SL	290 g/l	Foliar	0.3		8	1
	Ecuador	F	SP	400 g/kg	Foliar	0.22	0.11	8	1
	Ecuador	F	SP	900 g/kg	Foliar	0.22	0.11	8	1
	Egypt	F	SP	900 g/kg	Foliar	0.64		ns	1
	France	F/G	SL	200 g/l	Foliar	0.5		3	7
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	7
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.9		1	7
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	7
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	7
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.9		1	7
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	7
Tomato	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	7
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	0.9		1	7
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	7
	Hungary	F	SL	200 g/l	Foliar	0.4	0.07	ns	5
	Hungary	G	SL	200 g/l	Foliar	0.72	0.09	ns	5
	India	F	SP	400 g/kg	Foliar-high volume	0.45	0.09	ns	5
	Indonesia	F	SL	200 g/l	Foliar		0.06	ns	14
	Indonesia	F	WP	250 g/kg	Foliar		0.038	ns	14
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	1
	Kuwait	F	SP	900 g/kg	Foliar		00.045	ns	1
	Lebanon	F	SP	900 g/kg	Foliar		0.09	As needed	3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.65	- 1.3	ns	1
	Mexico	F	SL	290 g/l	Foliar-ground	0.65	0.33	ns	1
	Morocco	F	WP	250 g/kg	Foliar		0.038	ns	1-2
	Netherlands	F/G	SL	200 g/l	Foliar	0.4	0.025	1-3	3
	Netherlands	G	WP	250 g/kg	Foliar	0.4	0.08	1-3	3
	New Zealand	G	SL	200 g/l	Foliar		0.024	4	2
	New Zealand	F	SL	200 g/l	Foliar	0.4		As needed	2
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	1
	Pakistan	F	SP	400 g/kg	Foliar	0.16		ns	
	Peru	F	SL	240 g/l	Foliar	0.36	0.096	ns	5
	Peru	F	SL	296 g/l	Foliar	0.52	0.09	ns	1
	Peru	F	SP	400 g/kg	Foliar	0.4	0.18	ns	7
	Peru	F	SP	900 g/kg	Foliar	0.4	0.18	ns	7
	Philippines	F	SP	400 g/kg	Foliar		0.09	As needed	1
	Poland	F	SL	200 g/l	Foliar	0.18	0.09	3	3
	Poland	G	SL	200 g/l	Foliar		0.02	3	3
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	1
Tomato	Romania	G	SP	900 g/kg	Foliar	0.45	0.045	3	3

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Romania	F	SP	900 g/kg	Foliar	0.90	0.09	3	3
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.032	As needed	15
	South Africa	F	SL	200 g/l	Foliar		0.045	ns	2
	South Africa	F	SP	900 g/kg	Foliar		0.045	ns	2
	Spain	F	SL	200 g/l	Foliar-high volume	0.50	0.05	1-5	3
	Spain	F	WP	250 g/kg	Foliar-high volume	0.50	0.05	1-5	3
	Syria	F	SP	900 g/kg	Foliar		0.06	As needed	1
	Taiwan	F	WP	900 g/kg	Foliar		0.03(3000x)	ns	4
	Thailand	F	SL	184.5 g/l	Foliar		0.05	ns	3
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	3
	Tunisia	F	WP	250 g/kg	Foliar	0.038	0.038	3-4	7
	Turkey	F	SP	900 g/kg	Foliar	0.72		ns	3
	USA	F	SL	900 g/kg	Foliar-aerial/ground	1.0	5.4	16	1
	USA	F	SP	900 g/kg	Foliar-aerial/ground	1.0	5.4	16	1
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	1
	Venezuela	F	SL	223 g/l		0.89		ns	1
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	1
Top fruit trees	Algeria	F	SL	200 g/l	Foliar		0.08	ns	7
Turf	USA	F	SL	900 g/kg	Foliar-aerial/ground	2.0		4	-
	USA	F	SP	900 g/kg	Foliar-aerial/ground	2.0		4	-
Vegetables	Algeria	F	SL	200 g/l	Foliar		0.04	ns	7
	Algeria	F	WP	250 g/kg	Foliar		0.04	3-4	7
	Austria	F/G	WP	250 g/kg	Foliar	0.38	0.06	ns	21
	Kenya	F	SP	900 g/kg	Foliar-high volume	0.9		As needed	5
	Macedonia	F	SL	200 g/l	Foliar		0.04	3	tomato-7 peppers, root vegetables-14 other veg-35
	Macedonia	F	SP	900 g/kg	Foliar		0.045	As needed	
	Macedonia	F	WP	250 g/kg	Foliar		0.04	2	
	Morocco	F	SL	200 g/l	Foliar		0.05	ns	7
	Yugoslavia	F	SP	900 g/kg	Foliar		0.05	As needed	14
Walnuts	Cyprus	F	SP	900 g/kg		0.82	0.041	1	8
Watermelon	Central America	F	SL	216 g/l	Foliar	0.54	0.027	ns	3
	Central America	F	SL	290 g/l	Foliar	0.58	0.29	ns	3
	Cyprus	F	SP	900 g/kg	Foliar-high volume	0.81	0.081	2-3	3
	Cyprus	F	SP	900 g/kg	knapsack	1.00	0.2	2-3	3
	Ecuador	F	SP	400 g/kg	Foliar	0.3	0.15	8	14
	Ecuador	F	SP	900 g/kg	Foliar	0.3	0.15	8	14
	Greece	F/G	SL	200 g/l	Foliar	0.45		1-3	20
	Greece	F/G	SL	200 g/l	soil spraying; incorporated	2.7		1	20
	Greece	F/G	SL	200 g/l	soil spraying followed by irrigation	0.90		1	20
	Greece	F/G	SP	900 g/kg	Foliar	0.45		1-3	20

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	Greece	F/G	SP	900 g/kg	soil spraying; incorporated	2.7		1	20
	Greece	F/G	SP	900 g/kg	soil spraying followed by irrigation	0.90		1	20
	Greece	F/G	WP	250 g/kg	Foliar	0.45		1-3	20
	Greece	F/G	WP	250 g/kg	soil spraying; incorporated	2.7		1	20
	Greece	F/G	WP	250 g/kg	soil spraying followed by irrigation	0.90		1	20
	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Kuwait	F	SP	900 g/kg	Foliar		0.045	ns	3
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	-1.2	ns	3
	Oman	F	SP	900 g/kg	Foliar		0.045	As needed	3
	Peru	F	SL	296 g/l	Foliar	0.52	0.09	ns	3
	Peru	F	SP	400 g/kg	Foliar	0.41	0.18	ns	7
	Peru	F	SP	900 g/kg	Foliar	0.41	0.18	ns	7
	Qatar	F	SP	900 g/kg	Foliar		0.045	As needed	3
	Saudi Arabia	F	SP	900 g/kg	Foliar		0.032	As needed	10
	Thailand	F	SP	400 g/kg	Foliar		0.07	ns	3
	Venezuela	F	SL	223 g/l	Foliar	0.33		ns	3
	Venezuela	F	SL	288 g/l	Foliar	0.5		ns	3
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	3
Watermelon, field	Japan	F	WP	450 g/kg	Foliar	1.4	0.045	1-3	1
Wheat	Argentina	F	SP	900 g/kg	Foliar	0.45	.15	ns	14
	Australia	F	SL	225 g/l	Foliar-aerial	0.45	2.1	As needed	14
	Australia	F	SP	400 g/kg	Foliar-aerial	0.49	2.2	As needed	14
	Brazil	F	SL	215 g/l	Foliar	0.28	0.28	4	14
	Canada	F	SL	215 g/l	Foliar-ground	0.49	- 0.5	As needed	20
	Canada	F	SL	215 g/l	Foliar-aerial	0.49	2.2	As needed	20
	Canada	F	SP	900 g/kg	Foliar-ground	0.49	0.5	As needed	20
	Canada	F	SP	900 g/kg	Foliar-aerial	0.49	2.2	As needed	20
	China	F	SP	900 g/kg	Foliar	0.202	0.10	1-5	7
	Jordan	F	SP	900 g/kg	Foliar		0.05	ns	7
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	7
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	7
	South Africa	F	SL	200 g/l	Foliar-aerial	0.18	0.6	ns	7
	South Africa	F	SL	200 g/l	Foliar-ground, low volume	0.18	0.18	ns	7
	South Africa	F	SL	200 g/l	Foliar-aerial		0.6	ns	7
	South Africa	F	SL	200 g/l	Foliar-ground		0.045	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground, low volume	0.18	0.18	ns	7
	South Africa	F	SP	900 g/kg	Foliar-ground		0.045	ns	7
Wheat	USA	F	SL	900 g/kg	Foliar-aerial/ground	0.5	5.4	4	7 grazing-10

Crop	Country	F/G[1]	Form type	Concen-tration	Application method	Rate[2] kg ai/ha	Spray conc., kg ai/hl	No. of applications	PHI (days)
	USA	F	SP	900 g/kg	Foliar-aerial/ground	0.5	5.4	4	7 grazing-10
Yucca	Venezuela	F	SL	223 g/l	Foliar	0.45		ns	
	Venezuela	F	SP	900 g/kg	Foliar	0.27		ns	
Zucchini	Italy	F	SL	200 g/l	Foliar		0.04	ns	10
	Italy	F	WP	250 g/kg	Foliar		0.04	ns	10
	Mexico	F	SL	290 g/l	Foliar-ground	0.58	0.29	ns	3
	Mexico	F	SL	290 g/l	Foliar-aerial	0.58	1.2	ns	3

[1] Outdoor or field use (F) or glasshouse application (G)
[2] The kg ai/hl value is calculated from label information, i.e., from maximum kg ai/ha and minimum spray volume per ha, except where no rate value is given or is in parenthesis.
ns: not stated

RESIDUES RESULTING FROM SUPERVISED TRIALS

Supervised field trials were reported for numerous commodities. Where results were given as ND (not detected) and a substantiated value for ND was not provided, the ND was assigned 50% of the limit of quantification. Trials are listed in the following Tables, where underlined residues are from trials according to GAP and were used to esimate maximum residue levels.

Table Number	Commodity
23	Oranges and mandarins
24	Apples and pears (Europe)
25	Apples (USA)
26	Pears (USA)
27	Peaches and apricots (Europe)
28	Peaches (USA)
29	Nectarines (USA)
30	Plums (Europe)
31	Grapes (USA)
32	Grapes (Europe)
33	Onions, Bulb
34	Cabbage
35	Broccoli
36	Pears (USA)
36	Broccoli and cauliflower
37	Cucumbers and courgettes (Southern Europe)
38	Cucumbers and courgettes (Northern Europe)
39	Watermelon
40	Melons
41	Egg plant, tomatoes and peppers (USA)
42	Tomatoes and peppers (Europe)
43	Spinach, Head lettuce, Leaf lettuce
44	Beans (succulent), peas (podded), soya (immature)
45	Bean forage
46	Beans (dry)
47	Bean (dry) forage

Table Number	Commodity
48	Potato
49	Asparagus
50	Celery
51	Barley, oats, wheat
52	Barley, oats, wheat forage/straw
53	Sorghum grain
54	Sweet corn and maize
55	Sweet corn and maize forage and fodder
56	Cotton seed
57	Peanuts
58	Alfalfa
59	Soya hay
60	Sorghum forage and hay
61	Sorghum fodder
62	Sorghum fodder

Citrus fruits. In field trials in Greece, Italy and Spain SL or WP formulations were applied to oranges and mandarins in the 1996 (Weidenauer *et al.*, 1998m) and 1997 (Françon, 1999) growing seasons. Three foliar spray ground applications (4 in Greece) were made at one to three month intervals at a target rate of 500-1250 g ai/ha/application and 1000-2500 l/ha at concentrations of 0.04 kg ai/hl in Italy, 0.09 kg ai/hl in Greece and 0.05 kg ai/hl in Spain. In each year some trials were residue decline studies and others were at a PHI of 7 days. Samples were collected manually in duplicate and stored frozen at -18 to -20°C for analysis by method AMR 3015-94 (Rühl, 1998). Storage was for a maximum of a year in the 1996 and 1.4 years in the 1997 trials. Samples were stored whole unhomogenized until 2 weeks or less before extraction in 1997 and until 4 months before extraction in 1996. The 1996 samples were then stored homogenized for a period that could have resulted in 30% loss of methomyl, on the basis of the storage stability studies (see above). Control samples fortified with methomyl at 0.02 mg/kg were extracted and analysed with the treated samples. For the 1996 samples recoveries were 88% ± 14%, n=13, and for 1997 96% ± 7%, n=13. The half-life, assuming first order kinetics, was 1-7 days for the former and 2-4 days for the latter. The results are shown in Table 23.

Table 23. Residues of methomyl in or on oranges and mandarins after foliar applications of WP or SL formulations in Greece, Italy and Spain in 1996 and 1997 (Trials AMR 4043-96; AMR 4500-97).

Location/Year/Variety	Spray application					PHI (days)	Methomyl (mg/kg)
	Form.	kg ai/hl	l/ha	No.	kg ai/ha		
Orange							
GAP:Spain	WP SL	0.05		5	0.6WP 0.5SL	7	
GAP:Greece	SL	0.09		3	1.35	20	
GAP:Italy	SL, WP	0.04				10	
Los Palacios, Spain/1996/Navelina	SL, 200 g/l	0.051	2131	3	1.09	-1h +1h 1 3 5 7	<0.02 0.17, 0.24 0.44, 0.29 0.24, 0.11 0.06, 0.02 <0.02, <0.02

Location/Year/Variety	Spray application					PHI (days)	Methomyl (mg/kg)
	Form.	kg ai/hl	l/ha	No.	kg ai/ha		
Los Palacios, Spain/1996/Navelina	WP, 250 g/kg	0.050	2131	3	1.06	-1h +1h 1 3 5 7	<0.02 0.37, 0.21 0.29, 0.26 0.11, 0.32 0.05, 0.15 0.03, <0.02
Los Palacios, Spain/1996/New Hall	SL, 200 g/l	0.050	2125	3	1.06	7	0.06, 0.03
Los Palacios, Spain/1996/Navelina	SL, 200 g/l	0.051	2131	3	1.09	7	<0.02, <0.02 <0.02, <0.02 (duplicate plots)
Los Palacios, Spain/1997/New Hall	SL, 200 g/l	0.051	1905	3	0.97	-1h +3h 1 3 5 7	<0.02 0.16, 0.03 0.05, 0.11 0.20, 0.04 <0.02, <0.02 0.02, <0.02
Los Pobla Llarga, Spain/1997/Salustiana	SL, 200 g/l	0.051	1003	3	0.51	7	0.43, 0.25
Los Pobla Llarga, Spain/1997/Salustiana	WP, 250 g/kg	0.051	1018	3	0.52	7	0.35, 0.15
Dalamanara-Argolis, Greece/1997/Merlin	SL, 200 g/l	0.050	2519	4	1.25	-1h +1h 1 3 5 7	0.07, 0.10 0.48, 0.78 0.69, 0.55 0.21, 0.49 0.27, 0.46 0.26, 0.30
Dalamanara-Argolis, Greece/1997/Merlin	SL, 200 g/l	0.050	2519	4	1.25	7	0.24, 0.25
Vergi Kostalii, Greece/1997 /Merlin	SL, 200 g/l	0.050	2014	3	1.0	7	0.30, 0.59
Catania, Italy/1996/Navalina	SL, 200 g/l	0.050	1500	3	0.75	7	0.06, 0.02
Catania, Italy/1996/Navalina	WP, 250 g/kg	0.050	1500	3	0.75	7	0.04, 0.09
C. da Desi, Italy/1997/Navelina	SL, 200 g/lg	0.050	2300	3	1.14	<0h +3 h 1 3 5 7	<0.02 0.66, 0.36 0.35, 0.22 0.17, 0.21 0.21, 0.17 0.14, 0.08
C. da Desi, Italy/1997/Navelina	WP, 250 g/l	0.051	2300	3	1.16	<0h +3 h 1 3 5 7	<0.02 0.79, 0.10 0.20, 0.76 0.55, 0.32 0.15, 0.17 0.07, 0.06
Mandarin							
GAP: Spain	SL, WP	0.05		5	0.5,0.6	7	
GAP: Greece	SL, WP	0.09		3	1.35	20	
GAP: Italy	SL, WP	0.04				10	

Location/Year/Variety	Spray application					PHI (days)	Methomyl (mg/kg)
	Form.	kg ai/hl	l/ha	No.	kg ai/ha		
Llira, Spain/1996/Clemenules	WP, 250 g/kg	0.050	2280	3	1.14	-1h +1h 1 3 5 7	0.03, 0.10 0.52, 0.97 0.76, 1.1 0.74, 0.50 0.61, 0.77 0.10, 0.19
Los Palacios, Spain /1996 /Clemenules	SL, 200 g/l	0.050	2111	3	1.06	7	0.05, 0.05
Lliria, Spain /1996 /Clemenules	WP, 250 g/kg	0.050	2280	3	1.14	7	0.14, 0.17
Castello de la Ribera, Spain /1997 /Clemenvilla	SL, 200 g/l	0.051	1813	3	0.93	-1h +3h 1 3 5 7	<0.02 0.44, 0.75 0.43, 0.53 0.37, 0.26 0.24, 0.15 0.17, 0.14
Los Placios, Spain /1997 /Clemenules	WP 250 g/l	0.051	1804	3	0.91	7	0.03, <0.02
Pyrgela-Argolis, Greece /1997 Clementines	SL, 200 g/l	0.050	2500	4	1.25	7	0.43, 0.16
Vergi Kostakii, Greece /1997 /Clementines	SL, 200 g/l	0.049	1930	3	0.96	-1h +3h 1 3 5 7	0.13, 0.09 1.7, 1.6 0.70, 0.80 0.42, 0.41 0.15, 0.74 0.32, 0.31
Vergi Kostakii, Greece /1997 /Clementines	WP, 250 g/kg	0.051	1944	3	0.98	-1h +3h 1 3 5 7	0.07, 0.02 1.8, 1.8 0.60, 0.59 0.48, 0.25 0.53, 0.27 0.11, 0.38
Catania, Italy/1997 /Avana	WP, 250 g/kg	0.050	2000	3	1.0	-1h +1h 1 3 5 7	<0.02 1.3, 0.98 0.74, 0.91 0.90, 0.75 0.49, 0.36 0.31, 0.30, 0.38, 0.31
C. da Campochiaro, Italy /1998 /Avana	SL, 200 g/l	0.051	2000	3	1.02	7	0.89, 0.51

Pome Fruit. Field trials on apples and pears were reported from Europe and the USA. Trials were conducted in Belgium, France and Italy in 1996 (Weidenauer *et al.*, 1998f,g) and in Belgium, France, Italy and Spain in 1997 (Françon and Larcinese, 1999d). WP or SL formulations were applied with ground equipment at a target rate of 0.60 or 0.90 kg ai/ha to pear and apple trees three times at one to two month intervals. Duplicate fruit samples were collected manually, stored frozen for a maximum of 1.9 years (-20^{o}C) and analysed by method AMR 3015-94. Control samples were fortified at 0.02 mg/kg and analysed with the treated samples. Recoveries were 84% ± 15% (n=11) for AMR 3941-96; 90% ± 12%% (n=14) for AMR 4505-97; and 88% ± 8% (n=4) for AMR 3942-96, and were similar at 0.20 mg/kg and 1.5 mg/kg fortifications. The results are shown in Table 24.

Table 24. Methomyl residues in or on apples and pears after the application of a WP or SL formulation at 0.60-0.90 kg ai/ha to trees in Europe in 1996-1997 (AMR 3941-96; AMR 3942-96; AMR 4505-97).

Location/Variety/ Year	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concentration (kg ai/hl)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
GAP: France	SL	0.075		3		7	
GAP: Italy	SL, WP	0.05				10	
GAP: Spain	SL, WP	0.05		5	0.6	7	
GAP: Belgium	WP	0.05			0.75	21	
Apple							
Fromenville-Rainecourt, France/Jomagol/1996 (AMR 3941-96)	SL, 200 g/l	0.060	1362	3	0.82	-1h +1h 1 3 5 7	<0.02 0.20, 0.24 0.11, 0.11 0.11, 0.15 0.10, 0.14 0.10, 0.13
Fromenville-Rainecourt, France/Jomagol/1996	WP, 250 g/kg	0.061	1283	3	0.78	-1h +1h 1 3 5 7	<0.02 0.17, 0.10 0.16, 0.12 <0.02, <0.02 0.08, 0.06 0.16, 0.08
Beano di Codroipo, Italy/Ozark Gold/1996	SL, 200 g/l	0.060	1500	3	0.90	-1h +1h 1 3 5 7	<0.02 0.47, 0.37 0.13, 0.22 0.18, 0.20 0.18, 0.17 0.08, 0.05
Beano di Codroipo, Italy/Ozark Gold/1996	WP, 250 g/kg	0.060	1500	3	0.90	-1h +1h 1 3 5 7	<0.02 0.53, 0.32 0.24, 0.18 0.13, 0.17 0.09, 0.12 0.09, 0.08
Sorgues, France/Golden/1996	SL, 200 g/l	0.060	994	3	0.60	-1h +1h 1 3 5 7	<0.02 0.12, 0.20 0.11, 0.09 0.10, 0.13 0.08, 0.11 0.05, 0.11
Fleurus, Belgium/Jonagold/1996	WP, 250 g/kg	0.060	1129	3	0.68	-1h +1h 1 3 5 7	<0.02 0.34, 0.18 <0.02, 0.21 0.10, 0.21 <0.02, 0.10 0.06, 0.05
St Jean de Braye, France/Golden/1996 (AMR 3942-96)	SL, 200 g/l	0.060	1152	3	0.69	7	0.03, 0.02
Montauban, France/Reine des Reinettes	SL, 200 g/l	0.060	964	3	0.58	7	0.07, 0.09
Nodebais, Belgium/Jonagold/1996	WP, 250 g/kg	0.061	1092	3	0.66	7	0.02, 0.15
Terrer-Zaragoza, Spain/Golden Delicious/1996	WP, 250 g/kg	0.060	1066	3	0.64	7	0.04, 0.06

Location/Variety/ Year	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concentration (kg ai/hl)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
St Loubes, France/Reinette/1997	WP, 250 g/kg	0.060	1611	3	0.967	<0 +3h 1 3 5 7	<0.02 0.14, 0.43 0.16, 0.22 0.17, 0.19 0.16, 0.16 0.10, 0.09
Lignieres de Tourraine, France/Granny Smith/1997	SL, 200 g/l	0.060	959	3	0.575	7	0.02, 0.09
Lignieres de Tourraine, France/Granny Smith/1997	WP, 250 g/kg	0.060	1010	3	0.606	7	0.17, 0.13
Assent, Belgium/Elstar/1997	WP, 250 g/kg	0.061	1176	3	0.714	7	0.05, 0.03
Ateca, Spain/Golden Delicious/1997	SL, 200 g/l	0.061	1032	3	0.633	7	0.07, 0.08
Pear							
Ittre, Belgium/Conference/ 1997	WP, 250 g/l	0.061	1157	3	0.702	-1h +3h 1 3 5 7	<0.02 0.58, 0.52 0.20, 0.24 0.17, 0.12 0.10, 0.10 0.09, 0.10
Chouze sur Loire, France/Williams/1997	SL, 200 g/l	0.060	1230	3	0.738	-1h +3h 1 3 5 7	<0.02 0.19, 0.18 0.18, 0.09 0.08, 0.15 0.05, <0.02 0.03, <0.02
Modena, Italy/Decana del Comizio/1997	SL, 200 g/l	0.060	1020	3	0.612	-1h +3h 1 3 5 7	<0.02 1.1, 1.6 0.14, 0.11 0.17, 0.10 0.14, 0.13 0.11, 0.11
Modena, Italy/Decana del Comizio	WP, 250 g/l	0.060	1044	3	0.626	-1h +3h 1 3 5 7	<0.02 1.9, 0.96 0.07, 0.10 0.12, 0.13 0.05, 0.10 0.18, 0.10
Sorgues, France/Guyot/1997	SL, 200 g/l	0.060	992	3	0.596	7	0.04, 0.03

Two trials on apple trees were reported from the USA. In 1992 two plots at each of ten test sites received five foliar treatments (ground, airblast) of SP, WP or SL formulations at intervals of 5-7 days at 1 kg ai/ha or 1.5 kg ai/ha per treatment (Hausman and Devine, 1993b). Samples of mature fruit were taken 8, 10, 14 and 21 days after the last treatment and stored frozen at -15 to -25°C for up to 7 months. Analyses were by HPLC method AMR 1806-90. Control apple samples were fortified with methomyl at 0.02 mg/kg and analysed with the treated samples. The mean recovery was 96% ± 11% (n=4). For 35 fortifications from 0.02 to 1 mg/kg, the mean recovery was 95% ± 10%, range 78%-111%.

In the second trial in 1997 two plots were treated at 14 locations at different times to provide multiple PHIs with five applications by airblast sprayer (ground) at 1.0 kg ai/ha at approximately 7-day intervals (McCooey, 1998a). Duplicate samples from each plot were stored at -15 to -25°C for up to 5.5 months before extraction and analysis by method AMR 3015-94. Two trials were residue decline studies and half-lives of 5.0-9.5 days were calculated. Control samples were fortified with methomyl at 0.02 mg/kg and prepared and analysed with the treated samples. The recovery was 84% ± 4.7%, n=23.

The results are shown in Table 25.

Table 25. Residues of methomyl in or on apples after five foliar application of SP, WP or SL formulations at 1.0 or 1.5 kg ai/ha in the USA in 1992 and 1997 (AMR 2291-92; AMR 4345-97).

Location/Variety/year	Application			PHI (days)	Methomyl (mg/kg)
	Form.	Rate (kg ai/ha)	Spray volume (l/ha)		
GAP: USA	SP, SL	1.0	470	14	
Newark, Delaware/McIntosh/1992	SL, 216 g/l	1.0	460-470	8 14	0.44, 0.48, 0.56 0.24, <u>0.34</u>, 0.24
	SL, 216 g/l	1.5	460-470	8 10 21	1.1, 1.1, 1.1 0.69 0.39, 0.21, 0.51
Upper Black Eddy, Pennsylvania/Cortland/1992	WP, 900 g/kg	1.0	480	8 14	0.66, 0.60, 0.68 <u>0.31</u>, 0.28, 0.26
	WP, 900 g/kg	1.5	480	8 10 21	0.96 0.94 0.42, 0.32, 0.36
Hamburg, Pennsylvania/Red Delicious/1997	SP, 900 g/kg	1.0	610-670	35 41	0.30, 0.32 0.17, 0.20
Hereford, Pennsylvania/Red Delicious/1997	SP, 900 g/kg	1.0	560	35 42	0.26, 0.27 0.33, 0.32
Alton, New York/Twenty Ounce/1992	SL, 216 g/l	1.0	470	8 14	0.43 <u>0.42</u>, 0.40, 0.33
	SL, 216 g/l	1.5	470	8 10	0.94 0.92
Sodus, New York/Monroe/1997	SL, 216 g/l	1.0	470	35 42	0.42, 0.33 0.29, 0.26
North Rose, New York/Idared/1997	SL, 216 g/l	1.0	480	35 42	0.38, 0.39 0.23, 0.31
Conklin, Michigan/Golden Delicious/1992	SL, 216 g/l	1.0	450	8 10 14 21	1.3, 1.4 0.86, 1.0, 0.89 0.43, <u>0.77,</u> 0.60 0.19, 0.55, 0.50
	SL, 216 g/l	1.5	450	8 10 14 21	1.6, 1.9 2.1 1.3 0.80, 1.1, 1.1
Fennville, Michigan/Red Delicious/1992	SL, 216 g/l	1.0	470	8 14	0.46, 0.43, 0.35 <u>0.39</u>, 0.31, 0.16
	SL, 216 g/l	1.5	470	8 10	0.64, 0.44, 0.38 0.66
Conklin, Michigan/McIntosh/1997	SP 900 g/kg	1.0	580-650	35 42	0.099, 0.14 0.12, 0.094
Fennerville, Michigan/Red Delicious/1997	SP, 900 g/kg	1.0	450-470	35 42	0.24, 0.22 0.13, 0.12
North Rose, New York/Rhode Island Greening/1992	SP, 900 g/kg	1.0	470	8 14	0.64, 0.44, 0.38 <u>0.31</u>, 0.21, 0.14
	SL, 216 g/l	1.5	470	10	0.42

Location/Variety/year	Application			PHI (days)	Methomyl (mg/kg)
	Form.	Rate (kg ai/ha)	Spray volume (l/ha)		
Hickman, California, Granny Smith/1992	SP, 900 g/kg	1.0	470	8 14	0.23, 0.20, 0.12 0.12, 0.13, <u>0.16</u>
	SP, 900 g/kg	1.5	470	10	0.20
Madera, California/Fuji/1997	SP, 900 g/kg	1.0	470	35 42	<0.02, <0.02 <0.02, <0.02
Granger, Washington/Red Delicious/1992	SL, 216 g/l	1.0	470	8 14	0.30, 0.40, 0.38 0.18, 0.22, <u>0.25</u>
		1.5	470	10	0.22
Harrrah, Washington[1]/Red Delicious/1992	SL, 216 g/l	1.0	470	8 14	0.47, 0.42, 0.34 0.16, 0.23, <u>0.24</u>
	SL, 216 g/l	1.5	470	10	0.54
Harrah, Washington[1]/Red Delicious/1992	SL, 216g/l	1.0	470	8 14	0.40, 0.71, 0.58 0.30, <u>0.48</u>, 0.34
	SL, 216 g/l	1.5	470	10	0.46
Granger, Washington/Red Delicious/1997	SL, 216 g/l	1.0	460-500	35 42	0.17, 0.19 0.15, 0.11
Granger, Washington/Red Delicious	SP, 900 g/kg	1.0	460-490	21 28 35 42	0.50, 0.05 0.42, 0.40 0.18, 0.14 0.13, 0.12
Ephrata, Washington/Red Delicious/1997	SP, 900 g/kg	1.0	480	35 42	0.20, 0.25 0.15, 0.17
Elkton, Maryland/Golden Delicious/1997	SP, 900 g/kg	1.0	500	21 28 35 42	0.57, 0.46 0.23, 0.22 0.059, 0.030 0.058, 0.022
Cana, Virginia/Red Delicious/1997	SP, 900 g/kg	1.0	490	35 42	0.12, 0.096 0.064, 0.060
Austin, Colorado/Red Delicious/1997	SP 900 g/kg	1.0	570	35 42	0.15, 0.14 0.11, 0.080
Hood River, Oregon/1997/Red Delicious	SL, 216 g/l	1.0	480-560	35 42	0.300.42 0.49, 0.32

[1] Although two sites were in Harrah, different soil types were reported: loam for the first entry and silt loam for the second.

In six trials on pear trees in the USA four applications of an SL formulation with an airblast sprayer (ground) at 0.5 kg ai/ha were made at 5-7 day intervals (Hausmann and Devine, 1992b, 1993d). One to three samples, consisting of 16 or more fruit each, were collected at maturity at each location and stored frozen for a maximum of 8.5 months until extracted and analysed by method AMR 1806-90. Control samples fortified with methomyl were extracted and analysed with the treated samples. Recoveries were 100% at 0.2 mg/kg (n=2), 73% at 0.1 mg/kg, 92% at 0.5 mg/kg (n=2), 91% at 2 mg/kg and 98% at 4 mg/kg. The results are shown in Table 26.

Table 26. Residues of methomyl in or on pears after foliar ground applications of an SL or SP formulation to pear trees in the USA (AMR 2344-92; AMR 1970-91).

Location/Variety/year	Application					Methomyl (mg/kg)
	Form.	Rate (kg ai/ha)	Spray volume (l/ha)	No.	PHI (days)	
GAP: USA	SL, SP	1.0	470	2	7	
Upper Black Eddy,	SL, 216 g/l	0.5	480	4	7	0.52, 0.62, 0.56

Location/Variety/year	Application					Methomyl (mg/kg)
	Form.	Rate (kg ai/ha)	Spray volume (l/ha)	No.	PHI (days)	
Pennsylvania/Bartlett/1992						
Romney, West Virginia/Mangus/1992	SL, 216 g/l	0.5	410	4	7	1.1, 1.1, 1.2
Orwigsburg, Pennsylvania/Bosc/1992	SL, 216 g/l	0.5	470	4	7	0.17, 0.15, 0.23
Alton, New York/Bartlett/1991	SP, 900 g/kg	0.5	940	4	7 10 14	0.41 0.28 0.25
Alton, New York/Bartlett/1991	SL, 216 g/l	0.5	940	4	7 10 14	0.48 0.28 0.23
Winchester, Virginia/Delicious/1991	SL, 216 g/l	0.5	920	4	7 10 14	0.57, 0.58 0.56, 0.46 0.31, 0.36

Stone fruits. In field trials in France, Germany, Italy and Spain SL or WP formulations were applied to peaches or apricots in the 1996 and 1997 growing season (Weidenauer *et al.*, 1998b,c; Françon and Larcinese, 1999b). Three overall foliar sprays using ground equipment were made at a target rate of 600-900 g ai/ha, approximate spray volume 1000 l/ha. The retreatment interval was about one month. Samples were collected manually in duplicate at various intervals and stored at -20^{o} C for up to 17 months (1996) or 13 months (1997). Residues of methomyl were determined by HPLC with post-column derivatization and fluorescence detection, based on method AMR 3015-94. In 1996 mean recoveries from concurrent control samples fortified at 0.02 mg/kg were 93% $\pm$ 14%, n = 8 (AMR 3886-96) and 84% $\pm$ 17%, n = 3 (AMR 3887-96), and in 1997, for samples fortified at 0.021 mg/kg, 81% $\pm$ 16%, n = 12, range 53%-110%. Even at a 0.21 mg/kg fortification, the standard deviation was still wide: 74% $\pm$ 13%, n = 7 (1996) and 72% $\pm$ 18%, n = 6 (1997). All control peach samples had methomyl concentrations below the limit of quantification (<0.02 mg/kg). Six trials were residue decline studies. The half-life ranged from 2 to 3 days for five of the trials and was 5 days for the sixth. The results are shown in Table 27.

Table 27. Residues of methomyl on peaches and apricots after three foliar applications of a WP or SL formulation at 600-900 g ai/ha, Europe, 1996 and 1997. Reference AMR 3886-96, AMR 3887-96, AMR 4499-97.

Location/Year/ Variety	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concen-tration (kg ai/hl)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
GAP:Spain	SL, WP	0.05		5	0.6	7	
GAP: Germany	SL			3	0.75	7	
GAP: Italy	WP, SL	0.04				10	
Almenar, Spain/1996/Catherine Peach	SL, 200 g/l	0.059	933	3	0.554	- 1 hr + 1 hr 1 3 5 7	<0.02, 0.02 0.75, 1.17 0.42, 0.46 0.05, 0.17 0.08, 0.05 <u>0.09,</u> 0.03
Hohnstedt, Germany/1996/ Sound Heaven Peach	WP, 250 g/kg	0.060	1000	3	0.600	- 1 hr 0 1 3 5 7	0.02, <0.02 0.43, 0.53 0.40, 0.45 0.12, 0.22 0.04, 0.07 <u>0.04</u>, 0.04

Location/Year/ Variety	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concen-tration (kg ai/hl)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
Sclaunicco di Lestizza, Italy/1996/Elegant Lady Peach	WP, 250 g/kg	0.060	1500	03	0.900	- 1 hr + 1 hr 1 3 5 7	<0.02, 0.03 0.70, 0.72 0.84, 0.33 0.43, 0.29 0.18, 0.33 0.06, 0.07
Almenar, Spain/1996/Catherine Peach	SL, 200 g/l	0.059	933	3	0.554	7	0.09, 0.03
Hohnstedt, Germany/1996/Sound Heaven Peach	WP, 250 g/kg	0.060	1000	3	0.600	7	0.04, 0.04
Scalunicco di Lestizza, Italy/1996/Elegant Lady Peach	WP, 250 g/kg	0.060	1500	3	0.900	7	0.06, 0.07
Az. Grigio Altedo, Italy/1996 Bella di Cesena Apricot	SL, 200 g/l	0.059	1228	3	0.728	7	0.15, 0.14
Az Grigio Altedo, Italy/1996 Bella di Cesena Apricot	WP, 250 g/kg	0.061	1214	3	0.737	7	0.03, 0.05
Watronville, France/1996/Early Red Haven Peach	SL, 200 g/l	0.060	989	3	0.593	7	0.17, 0.10
Watronville, France/1996/Early Red Haven Peach	WP, 250 g/kg	0.060	957	3	0.574	7	0.09, 0.05
Watronville, France/1996/Spring Lady Peach	SL, 200 g/l	0.060	1000	3	0.599	7	0.02, <0.02
Lignieres de Tourraine, France/1997/Dixired Peach	SL, 200 g/l	0.060	1025	3	0.615	- 1 hr + 3 hr 1 3 5 7	<0.02, <0.02 0.24, 0.19 0.10, 0.09 0.05, 0.11 0.02, 0.02 0.05, 0.03
Lignieres de Tourraine, France/1997/Dixired Peach	WP, 250 g/kg	0.060	1063	3	0.638	- 1 hr + 3 hr 1 3 5 7	0.02, <0.02 0.26, 0.32 0.18, 0.13 0.06, <0.02 0.03, 0.03 <0.02, 0.03
Collebeato, Italy/1997/Giulia Apricot	SL, 200 g/l	0.060	1540	3	0.924	- 1 hr + 3 hr 1 3 5 7	0.05, <0.02 0.44, 0.90 0.44, 0.25 0.08, 0.10 0.06, 0.04 0.04, 0.04
Collebeato, Italy/1997/Giulia Apricot	WP, 250 g/kg	0.060	1476	3	0.886	- 1 hr + 3 hr 1 3 5 7	0.03, 0.02 0.49, 0.46 0.32, 0.22 0.10, 0.09 0.09, 0.05 0.02,. 0.04

Location/Year/ Variety	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concen-tration (kg ai/hl)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
St-Gilles, France/1997/Royal Glory Peach	SL, 200 g/l	0.060	976	3	0.586	- 1 hr + 3 hr 1 3 5 7	<0.02, <0.02 0.11, 0.04 0.06, 0.02 0.02, <0.02 0.04, <0.02 0.04, <0.02
Hohnstedt, Germany/1997/Redhaven Peach	WP, 250 g/kg	0.060	1000	3	0.600	7	0.08, 0.05
Vigonovo, Italy/1997/2002 Peach	SL, 200 g/l	0.060	1000	3	0.600	7	<0.02, <0.02
Ateca, Spain/1997/Catherina Peach	WP, 250 g/kg	0.061	976	3	0.593	7	0.02, 0.05

Peach trees at 13 sites in the USA in 1998 were broadcast-sprayed by an airblast sprayer with an SP or SL formulation three times (Rühl, 2000). The retreatment interval was approximately 5 days. At a California site, a fourth application was made to ensure mature fruit at the desired PHI. Duplicate peach samples, each consisting of at least 24 fruits, were collected 4, 7 and 14 days after the last treatment. At two sites additional samples were collected to measure decline. Samples were stored frozen for 0.5-5 months and analysed by Method AMR 3015-94; the limit of quantification was 0.02 mg/kg. Recoveries from controls fortified with methomyl at 0.10 mg/kg were 97% ± 2%, n = 4. The results are shown in Table 28.

Table 28. Residues of methomyl on peaches after foliar applications of an SP or SL formulation in the USA in 1998 (AMR 4936-98).

Location/Variety	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concen-tration, (kg ai/hl)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
GAP: USA	Sl, SP	0.06A 4.8G		6	2.0	4	
Lyons, New York/Red Haven	SL, 288 g/l	0.11	935	3	1.0	4 7[1] 14	0.33, 0.28 0.15, 0.18 <0.02, <0.02
Elkton, Maryland/Glo Haven	SL, 288 g/l	0.16 0.17 0.18	626 589 570		1.0 1.0 1.0	0 3 7[1] 14 21	1.4, 1.2 0.32, 0.20 0.21, 0.21 0.14, 0.06 0.08, 0.08
Winterville, Georgia/Jefferson	SL, 288 g/l	0.13 0.17 0.16	767 589 617	3	1.0 1.0 0.98	4 7[1] 12 14	0.09, 0.14 0.03, 0.04 ND[2] ND
Garden Valley, Georgia/ Red Skin	SL, 288 g/l	0.18 0.15 0.16	542 654 608	3	1.0 1.0 1.0	4 7[1] 14	0.25, 0.29 0.06, 0.05 ND

Location/Variety	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concen-tration, (kg ai/hl)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
Taylorsville, North Carolina/Georgia Bell	SL, 288 g/l	0.21	468	3	1.0	4 7 14	0.60, 0.59 0.18, 0.23 0.04, 0.09
Washington, Louisiana/Tex Royal	SL, 288 g/l	0.19 0.20 0.22	524 496 505	3	1.0 1.0 1.1	4 7 14[1]	2.0, 1.5 0.36, 0.37 0.05, 0.05
Barto, Pennsylvania/ Redskin	SL, 288 g/l	0.15 0.15 0.14	682 682 692	3	1.0 1.0 1.0	4 7 14[1]	0.61, 0.62 0.20, 0.15 0.06, 0.07
Conklin, Michigan/Red Haven	SL, 288 g/l	0.16 0.16 0.16	636 645 636	3	1.0 1.0 1.0	4 7[1] 14[1]	0.38, 0.39 0.29, 0.31 0.06, 0.08
Chapel Hill, Texas/Sam Houston	SL, 288 g/l	0.11 0.11 0.11	907 898 898	3	1.0 0.97 1.0	4 7 14[1]	0.25, 0.34 0.05, 0.08 ND
Madera, California/Faye Elberta	SL, 288 g/l	0.17 0.17 0.17 0.17	561 561 561 561	4	0.96 0.96 0.97 0.97	0 4 7 14 21[1]	1.0, 1.8 0.46, 0.45 0.26, 0.27 0.13, 0.17 0.04, 0.06
Gridley, California/Loadels	SP, 900 g/kg	0.20 0.20 0.19	505 496 514	3	1.0 1.0 1.0	4[1] 7[1] 14[1]	0.70, 0.65 0.42, 0.30 0.1, 0.09
Traver, California/August Lady	SP, 900 g/kg	0.12 0.12 0.12	842 842 832	3	1.0 1.0 1.0	4 7 14[1]	0.28, 0.43 0.13, 0.18 0.02, 0.03
Woodville, California/Carson	SP, 900 g/kg	0.12 0.12 0.12	846 813 813	3	1.0 1.0 1.0	4 7 14	0.38, 0.31 0.28, 0.30 0.08, 0.18

[1] Normal harvest.
[2]The limit of detection was estimated at 0.007 mg/kg.

In field trials in the USA SP or SL formulations were applied three times to nectarines at 9 sites in 4 States in 1998 as a broadcast spray (airblast sprayer) at approximately 1.0 kg ai/ha (Rühl, 1999). The retreatment interval was 5 ± 1 days. At crop maturity (4-14 days after the last treatment), duplicate nectarine samples were collected and stored frozen for analysis by method AMR 3015-94. Control samples showed no methomyl residues, with an estimated limit of detection of 0.007 mg/kg. The storage period ranged from 21 to 135 days. Concurrent control fortifications at 0.020 mg/kg yielded a mean recovery of 94% ± 10%, n = 12, range 75%-109%. The results are shown in Table 29.

Table 29. Residues of methomyl in or on nectarines after the foliar application of SP or SL formulations (3 x 1.0 kg ai/ha) in the USA in 1998 (AMR 4935-98).

Location/Variety	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concentration (kg ai/hl, calculated)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
GAP: USA	SL, SP	1.0		3	1.0	1	
Williamson, New York/Sunglo	SL, 288 g/l	0.11	940	3	1.0	4 7[1] 14	0.20, 0.18 0.065, 0.066 0.021, 0.025
Elkton, Maryland/Sunglo	SL, 288 g/l	0.16 0.17 0.17	630 590 570	3	1.0	0 3 7[1] 14 17	1.0, 1.4 0.49, 0.63 0.69, 0.25 0.094, 0.077 0.062, 0.040
Madera, California/Flavor Top	SL, 288 g/l	0.17 0.18 0.17	570 560 580	3	0.98	0 4 7 14 21[1]	0.78, 0.62 0.10, 0.14 0.060, 0.056 ND[2] ND
Parlier, California/Summer Grand	SP, 900 g/kg	0.14 0.14 0.14	700 710 700	3	1.0	4 7 14	0.24, 0.24 0.18, 0.13 <0.020
Linden, California/Midglow	SP, 900 g/kg	0.14	710	3	1.0	4 7[1] 14	0.24, 0.42 0.17, 0.16 0.028, 0.079
Exeter, California/August Glow	SP, 900 g/kg	0.14 0.14 0.15	700 690 680	3	1.0	4 7 14	0.039, 0.072 <0.02 ND
Madera, California/Fantasia	SP, 900 g/kg	0.15 0.16 0.16	710 780 710	3	1.1-1.2	4 7 14	0.15, 0.064 0.078, 0.060 <0.020
Hughson, California/Spring Red	SP, 900 g/kg	0.13 0.13 0.15	750 750 660	3	1.0	4 7[1] 14	0.45, 0.37 0.22, 0.19 0.023, 0.034
Zillah, Washington/Persica	SP, 900 g/kg	0.097 0.097 0.097	1020 1000 980	3	0.95-0.98	4 7 14[1]	1.1, 1.1 0.56, 0.47 0.26, 0.26

[1] Normal harvest (mature fruit, ripe).
[2] ND: none detected. Limit of detection estimated as 0.007 mg/kg.

In field trials on plums in Europe in the 1996 and 1997 growing season (Weidenauer *et al.*, 1998d,e; Françon and Larcinese, 1999c) SC or WP formulations were applied three times with a ground sprayer to run-off, generally at nominal rates of 0.60 or 0.90 kg ai/ha at 20-60 day intervals. Duplicate samples were stored frozen and analysed by method AMR 3015-94. Slight modifications were made to the HPLC gradient conditions. Fortified control samples were analysed with each set of samples. At a 0.02 mg/kg fortification the recoveries were 79% ± 11% (n=4) for AMR 3894-96; 74% ± 9% (n=7) for AMR 3895-96; and 76% ± 11% (n=10) for AMR 4501-97, and did not exceed 80% at 0.2 and 1.0 mg/kg fortifications. Samples were stored frozen for up to 1.8 years. The results are shown in Table 30. The calculated half-life was 4 days (first order kinetics).

Table 30. Residues of methomyl in or on plums from foliar applications of a WP or SL formulation at 0.6-0.9 kg ai/ha in Europe in 1996 and 1997 (AMR 3894-96; AMR 3895-96; AMR 5401-97).

Location/Variety/Year	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concen-tration (kg ai/hl)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
GAP: France	SL	0.075		3		7	
GAP: Spain	SP, SL	0.05		5	0.6	7	
GAP: Germany	None						
Beaumont, France/ Mirabel de Nancy/1996	SL, 200 g/l	0.060	1263	3	0.76	7	0.17, 0.28
Terrer-Zaragoza, Spain/President/1996	SL, 200 g/l	0.060	1454	3	0.87	7	<0.02, 0.02
Durrweitzschen, Germany/Stanley/1996	WP, 250 g/kg	0.060	1500	3	0.90	7	0.03, 0.10
Thillot, France/Mirabelle de Nancy/1996	SL, 200 g/l	0.060	275	3	0.16	-1h +3h 1 3 5 7	<0.02, <0.02 0.07, 0.05 0.02, 0.05 0.04, 0.05 0.06, 0.04 0.06, 0.05
Thillot, France/Mirabelle de Nancy/1996	WP, 250 g/kg	0.06	272	3	0.16	-1h +3h 1 3 5 7	<0.02, <0.02 0.03, 0.04 0.04, 0.05 0.04, <0.02 0.05, 0.06 0.06, 0.08
Durfort Lacapelette, France/Colbus/1996	SL, 200 g/l	0.06	788	3	0.47	-1h +1h 1 3 5 7	<0.02, <0.02 0.03, 0.04 0.03, 0.02 0.02, 0.02 0.02, 0.06 0.03, 0.03
Durweitzschen, Germany/Stanley/1996	WP, 250 g/kg	0.06	1500	3	0.90	-1h 0 1 3 5 8	<0.02 0.57, 0.45 0.54, 0.47 0.15, 0.21 0.20, 0.32 0.08, 0.19
Durweitzschen, Germany/Stanley/1997	SL, 200 g/l	0.06	1500	3	0.90	<0 0 1 4 6 8	<0.02 0.30, 0.42 0.33, 0.62 0.35, 0.45 0.28, 0.51 0.28, 0.28
Durweitzschen, Germany/Stanley/1997	WP, 250 g/kg	0.06	1500	3	0.90	<0 0 1 4 6 8	<0.02 0.49, 0.27 0.73, 0.72 0.37, 0.31 0.13, 0.34 0.22, 0.34
Thillot, France/Quetsche/1997	SL, 200 g/l	0.095	650	3	0.62	<0 +1h 1 3 5 7	<0.02 0.05, 0.08 0.06, 0.06 0.06, 0.05 0.03, 0.06 0.05, 0.08

Location/Variety/Year	Application					PHI (days)	Methomyl (mg/kg)
	Form.	Spray concen-tration (kg ai/hl)	Spray volume (l/ha)	No.	Rate (kg ai/ha)		
Aznalcazar, Spain/Black Amber/1997	WP, 250 g/kg	0.061	1127	3	0.68	-1h +3h 1 3 5 7	<0.02 0.28, 0.15 0.09, 0.09 <0.02, 0.03 0.04, 0.03 0.03, <u>0.03</u>
Hohnstedt, Germany/Hauszwetsche /1997	SL, 200 g/l	0.060	1000	3	0.60	7	<u>0.11</u>, 0.10
Montauban, France/Golden Japan/1997	SL, 200 g/l	0.060	1140	3	0.68	7	0.02, <u>0.02</u>
Creue, France/Mirabelle de Nancy	SL, 200 g/l	0.18	541	3	0.98	7	0.11, 0.13
Creue, France/Mirabelle de Nancy/1997	WP, 250 g/kg	0.11	553	3	0.60	7	0.03, 0.07

<u>Berries and other small fruits</u>

<u>Grapes</u>. An SL formulation was applied five times at 7-14 day intervals at 1.0 or 2.0 kg ai/ha by airblast or backpack sprayer to thirteen sites in New York, California, Michigan, Oregon and Washington, USA, in 1989 (S.M. Kennedy, 1990c). Samples were collected 1, 7, 10 and 14 days after the last treatment and stored frozen for 10 to 12 months until analysed by HPLC Method AMR-1806-90. Concurrent recoveries (30) from grapes fortified at 0.02 to 10.0 mg/kg methomyl gave recoveries of 107% ± 6%, n = 4 at 0.02 mg/kg. The overall average recovery was 94% ± 9%. All control samples contained <0.02 mg/kg except in Santa Maria, California, where the levels ranged from <0.02 to 0.18 mg/kg (Table 31).

In a further 12 trials in 1997-1998 in New York, Pennsylvania, Washington, Idaho and California, an SL or SP formulation was applied 4 times (airblast sprayer) at a rate of 1 kg ai/ha at 5 day intervals (McCooey, 1998b). From the two plots at each location two samples were taken at each of 2 or 3 intervals. Applications were planned so that mature grapes could be harvested from plot 1 about 29 days and from plot 2 14 days after the last treatment. Samples were stored frozen 4.5-7 months before analysis by HPLC (Method AMR-3015-94). Concurrent recoveries from controls fortified at 0.02 mg/kg, n = 15, were 91% ± 8%. All control samples were reported as "ND."

The results are shown in Table 31.

Table 31. Residues of methomyl after foliar application to grapes in the USA.

Location	Application				PHI (days)	Methomyl (mg/kg)	Report no.
	Form.	Rate (kg ai/ha)	Spray volume (l/ha)	No.			
GAP: USA	Sl, SP	1.0	910	5	1 fresh 14 wine		
Phelps, NY, 1989	SL, 0.22 kg ai/l (1.8 lb ai/gal)	1.0	935	5	1 7 10 14	<u>3.5</u> 2.8 2.1 2.0	AMR-1364-89
		1.0 2.0	935 935	3 2	- 1	 5.8	

Location	Application				PHI (days)	Methomyl (mg/kg)	Report no.
	Form.	Rate (kg ai/ha)	Spray volume (l/ha)	No.			
					7 10 14	4.4 2.3 2.9	
Comstock Park, Michigan, 1989	SL, 0.22 kg ai/l	1.0	1870	5	1 7 10 14	2.9 2.8 1.6 2.1	
Vancouver, Washington, 1989	SL, 0.22 kg ai/l	1.0	374	5	1 7 10 14	2.2 1.1 1.4 1.4	
		1.0 2.0	374	3 2	- 1 7 10 14	 11 6.8 4.2 5.7	
Cornelius, Oregon, 1989	SL, 0.22 kg ai/l	1.0	374	5	1 7 10 14	0.58 0.43 0.48 0.17	
		1.0 2.0	374	3 2	- 1 7 10 14	 1.2 0.42 0.96 0.28	
Corona, California, 1989	SL, 0.22 kg ai/l	1.0	1170	5	1 7 10 14	4.1 1.2 0.95 0.95	
		1.0 2.0	1170	3 2	- 1 7 10 14	 1.9 2.4 2.4 2.5	
Santa Maria, California, 1989	SL, 0.22 kg ai/l	1.0	785-898	5	1[1] 7 10 15	5.2, 1.3 4.5, 0.84 4.5, 0.74 3.9, 0.40	
		1.0 2.0	785- 898	3 2	- 1[1] 7 10 15	 18, 3.6 8.6, 1.9 12, 1.9 9.1, 0.87	
Fresno, California, 1989	SL, 0.22 kg ai/l	1.0	935	5	1 7 10 14	0.78 0.41 0.34 0.34	
		1.0 2.0	935	3 2	- 1 7 10 14	 1.9 1.6 0.95 1.4	
Porterville, California, (Flame seedless) 1989	SL, 0.22 kg ai/l	1.0	1170	5	1 7 10 14	0.93 0.50 0.37 0.16	
		1.0 2.0	1170	3 2	- 1	 1.0	

Location	Application				PHI (days)	Methomyl (mg/kg)	Report no.
	Form.	Rate (kg ai/ha)	Spray volume (l/ha)	No.			
					7 10 14	0.50 0.30 0.15	
Porterville, California, , (Thompson seedless) 1989	SL, 0.22 kg ai/l	1.0	1170	5	1 7 10 14	<u>1.0</u> 0.32 0.19 0.12	
Terra Bella, California, 1989	SL, 0.22 kg ai/l	1.0	1170	5	1 7 10 14	<u>0.54</u> 0.21 0.12 0.40	
		1.0 2.0	1170	3 2	- 1 7 10 14	 1.6 0.64 0.67 0.39	
Biola, California, 1989	SL, 0.22 kg ai/l	1.0	748	5	1 7 10 14	<u>1.0</u> 0.53 0.52 0.28	
Dundee, New York, 1997/Aurora= wine	SL, 0.29 kg ai/l (2.4 lb ai/gal)	0.9	468	4	13 21 29	2.3, <u>2.3</u> 1.4, 1.6 0.89, 0.96	AMR 4346-97
Kempton, Pennsylvania, 1997/Cayuga= wine	SP, 900 g/kg (90%)	0.9	739-898	4	14 20 29	2.8, <u>2.8</u> 2.5, 2.7 0.96, 1.3	
Orland, California, 1997/ Zinfandel= wine	SL, 0.29 kg ai/l	0.9	387-470	4	14 30	0.54, <u>0.65</u> 0.10, 0.12	
Temecula, California, 1997/Zinfandel= wine	SP, 900 g ai/kg	0.9	688-713	4	14 29	<u>1.3</u>, 1.2 0.77, 0.67	
Porterville, California, /1997/Emperor =table	SP, 900 g ai/kg	0.9	544-574	4	14 29	0.60, 0.61 0.25, 0.22	
Orland, California, 1997/ Barbera= wine	SL, 0.29 kg ai/l	0.9	322-392	4	14 28	0.090, <u>0.15</u> 0.095, 0.11	
Hughson, California, 1997/Thompson =table	SP, 900 g ai/kg	0.9	726-764	4	14 29	1.3, 1.4 0.54, 0.53	
Madera, California, 1997/Flame =table	SP, 900 g ai/kg	0.9	483-686	7 4	14 29	0.67, 0.26 0.057, 0.085	
Fresno, California, 1997/Flame = table	SP, 900 g ai/kg	0.9	701	4	14 21 29	0.26, 0.25 0.10, 0.12 0.094, 0.098	
Poplar, California, 1997/Thomas =table	SL, 0.29 kg ai/l	0.9	560	4	14 29	0.31, 0.26 0.37, 0.30	
Granger, Washington, 1997/Riesling =wine	SL, 0.29 kg ai/l	0.9	935	4	14 21 29	0.99, <u>1.2</u> 0.63, 0.72 0.54, 0.85	
Payette, Idaho, 1997/Concord =table	SP, 500 g/kg	0.9	468	4	14 29	0.98, 0.45 0.31, 0.35	

[1] Duplicate values represent separate plots of 30 vines each at the same location. Some control samples showed methomyl concentrations of 0.02 mg/kg to 0.18 mg/kg.

In field trials on table and wine grapes during the 1997 season in France, Portugal and Italy a soluble concentrate, 200 g/l methomyl, and a wettable powder, 250 g/kg methomyl, were both applied 3 times at 30-day intervals as foliar sprays with ground equipment at a target rate of 300 g ai/ha per application (Françon and Larcinese, 1999a). The spray concentration was 0.060 kg ai/hl for both formulations The actual rate was adjusted to the foliar mass by spraying to run-off. Duplicate samples of bunches of grapes were collected 1 hour before and 3 hours and 1, 3, 5 and 7 days after the last application and stored at -18°C for approximately 2 months before analysis by an HPLC method based on AMR 3015-94. Concurrent recoveries from controls fortified at 0.021 mg/kg were 91% ± 7%, n = 14. Control samples were reported as <0.02 mg/kg The results are shown in Table 32.

Table 32. Residues of methomyl in or on grapes after three foliar sprays of SC or WP formulations at a nominal rate of 0.060 kg ai/hl, in Europe in 1997 (AMR 4498-97).

Location/Variety	Application				PHI (days)	Methomyl (mg/kg)
	Form.	Spray concen-tration (kg ai/hl)	Spray volume (l/ha)	Rate (kg ai/ha) Calculated		
GAP: France	SL	0.05		0.4	None	
GAP: Portugal	None (use Italy)					
GAP: Italy	SL, WP	0.05			10	
Avize, France/ Chardonnay	SL, 200 g/l	0.060	617	0.37	-1 h +1 h 1 3 5 7	0.03, 0.03 0.53, 0.33 0.20, 0.29 0.19, 0.22 0.14, 0.18 0.10, 0.09
	WP, 250 g/kg	0.060	597	0.358	- 1 h + 1 h 1 3 5 7	0.06, 0.06 0.32, 0.41 0.25, 0.25 0.16, 0.17 0.06, 0.13 0.14, 0.12
Rochecorbon, France/ Chenin Blanc	SL, 200 g/l	0.060	921	0.553	- 1 h + 3 h 1 3 5 7	<0.02, <0.02 0.06, 0.05 0.26, 0.15 0.16, 0.07 0.08, 0.18 0.09, 0.05
Villetelle, France/Carignan	WP, 250 g/kg	0.060	507	0.304	-1 h + 3 h 1 3 5 7	<0.02, <0.02 0.20, 0.17 0.13, 0.19 0.15, 0.11 0.06, 0.06 0.02, 0.03
C. da Biviere, Italy/ Calabrese	SL, 200 g/l	0.063	1200	0.756	-1 h + 3 h 1 3 5 7	0.03, 0.04 1.70, 1.72 1.26, 1.10 1.06, 0.38 0.79, 0.78 0.59, 0.48
C. da Biviere, Italy/ Calabrese I	WP, 250 g/kg	0.059	1200	0.710	-1 h + 3 h 1 3 5 7	0.04, 0.03 1.42, 1.31 1.30, 1.60 1.11. 0.97 0.65, 0.21 0.41, 0.38

Location/Variety	Application				PHI (days)	Methomyl (mg/kg)
	Form.	Spray concen-tration (kg ai/hl)	Spray volume (l/ha)	Rate (kg ai/ha) Calculated		
Vernou sur Brenne, France/ Chenin Blanc	SL, 200 g/l	0.060	947	0.568	7	0.09, 0.06
Hermonville, France/ Pinot Meunier	WP, 250 g/kg	0.060	600	0.360	7	0.07, 0.06
Sorgues, France/ Gros vert	SL, 200 g/l	0.060	507	0.304	7	0.12, 0.09
Sorgues, France/ Gros vert	WP, 250 g/kg	0.060	507	0.304	7	0.09, 0.06
Torres Vedras, Portugal/ Seminario	SL, 200 g/l	0.060	861	0.517	7	0.09, 0.09

Bulb vegetables

In twelve field trials on green onions in the USA from 1970-1975 1-6 applications using ground or air application equipment were made at rates of 0.28 to 2.0 kg ai/ha and 880-5100 l/ha (Ashley, 2001o). The samples were stored frozen, but no information was supplied on the storage interval nor on the analytical method and only summary results were provided. No information, except rainfall, was provided on the field conditions. Moreover, a supplement to the report states that low recoveries were found in fortified controls. The submission is deficient and was not considered.

Five field trials were reported on dry onion bulbs in the USA (S. M. Kennedy, 1990d). An SL formulation was applied 4 times with ground equipment at a rate of 1.0 kg ai/ha. Onions were harvested 7 days after the last application, stored frozen for up to one year and analysed by method AMR 1806-90. A sample consisted of at least twelve randomly collected bulbs. Control samples fortified with methomyl were extracted and analysed with the treated samples. At a fortification of 0.02 mg/kg the recovery was 87% ± 25%, n=3. The overall recovery from fortifications ranging from 0.02 to 3.0 mg/kg was 85% ± 14%, n=10 (Table 33).

Table 33. Residues of methomyl in or on bulb onions after the foliar application of an SL formulation (216 g ai/l) at 4 x 1.0 kg ai/ha, PHI 7 days, in the USA in 1989 (AMR 1365-89).

Location/Variety	Application Rate (kg ai/ha)	Spray volume (l/ha)	No. of applications	Residue (mg/kg)
GAP: USA	1.0		8	
Sodus, New York/Early Yellow Globe	1.0	240	4	0.056
Comstock Park, Michigan/Yellow Pungent Globe	1.0	140	4	0.072
Ephrata, Washington/Cima Hybrid	1.0	94	4	0.068
Irvine, California/Pecham Yellow Sweet Spanish	1.0	920	4	0.14
Porterville, California/Stockton Early Rev.	1.0	190	4	≤0.02

Brassica vegetables

In trials on cabbage in the USA (C. M. Kennedy, 1991c) multiple applications of an SL or SP formulation were made at a rate of 1.0 kg ai/ha at three sites, at one with aerial equipment. Samples were collected at crop maturity (PHI 1 day, minimum 12 heads) and stored frozen for 8-12.5 months before analysis by method AMR 1806-90. Control samples were fortified at 0.05, 0.1, 0.5, 1 and 5 mg/kg and prepared and analysed with the treated samples. The average recovery was 86% + 7%, n=5. The results are shown in Table 34.

Table 34. Residues in or on cabbage after the foliar application of SL or SP formulations of methomyl at 10-20 x 1.0 kg ai/ha, PHI 1 day, in the USA in 1991 (AMR 1606-90).

Location/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Application Method	No. of applications	Residue (mg/kg)
GAP: USA	SL, SP	1.0	90A	Aerial/ground	15	
Bradenton, Florida/Bravo	SL, 216 g/l	1.0	450	Ground foliar plot sprayer	20 (heads present for 7 appls)	0.10
	SL, 216 g/l	1.0	450	Ground foliar plot sprayer	20 (heads present for 7 appls)	0.46
	SP, 900 g/kg	1.0	450	Ground foliar	20 (heads present for 7 appls)	0.27
Phelps, New York/A&C #5	SL, 216 g/l	1.0	280	Over-the-row ground with 12 ft boom	10 (heads present)	0.086
	SP, 900 g/kg	1.0	280	Over-the-row ground with 12 ft boom	10 (heads present)	0.18
Uvalde, Texas/Pennant	SL, 216 g/l	1.0	47	Aerial	10 (heads present)	0.52
	SP, 900 g/kg	1.0	47	Aerial	10 (heads present)	0.63

In field trials in the USA on broccoli and cauliflower in 1990 and 1992 (C. M. Kennedy, 1991a; Kennedy and Devine, 1994a) SL, SP or WP formulations were sprayed at 1 kg ai/ha in multiple ground or aerial applications at 2-day intervals to plots of brassica vegetables in California. Samples of about 12 heads or plants were collected at maturity (in triplicate for the 1992 trial) and stored frozen for 12.5 months until analysed by method AMR 1806-90. Control samples were fortified with methomyl at concentrations of 0.02, 0.10, 0.20 and 2.0 mg/kg and extracted and analysed with the treated samples. From broccoli the overall recovery was 99% + 5.5%, n=9 and from cauliflower in 1990 87% + 5.7%, n=10. The results are shown in Table 35.

Table 35. Residues after foliar ground or aerial application of methomyl to broccoli and cauliflower in California at 1.0 kg ai/ha, 3-day PHI (AMR 1600-90; AMR 1600-90 Supplement).

Location/Year/Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	Residue (mg/kg)
GAP: USA	SL, SP	1.0	90A	Aerial/ground	10	
Broccoli						
Madera, California/1990/ Packman	SL, 216 g/l	1.0	410	Over the top, tractor sprayer	10	0.35
	SP, 900 g/kg	1.0	410	Over the top, tractor sprayer	10	0.36
Salinas, California/1990/Shogun	SL, 216 g/l	1.0	400	Foliar ground, plot sprayer	13 + 1[1]	0.45
	SP, 900 g/kg	1.0	400	Foliar ground, plot sprayer	13 + 1[1]	0.44
Salinas, California/1990/Shogun	SL, 216 g/kg	1.0	140	Broadcast Aerial	13	0.68

Location/Year/Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	Residue (mg/kg)
	WP, 900 g/kg	1.0	140	Broadcast Aerial	13	1.1
Cauliflower						
Madera, California/1990/Long Island	SL, 216 g/l	1.0	370-420	Over-the-top broadcast. Tractor ground	17	5.6
	WP, 900 g/kg	1.0	370-420	Over-the-top broadcast. Tractor ground	17	3.8
Salinas, California. 1990/Silver Star	SL, 216 g/l	1.0	210 apps 1-7 420 apps 8-10	Broadcast over crop. Plot sprayer	10	0.18
	WP, 900 g/kg	1.0	210 apps 1-7 420 apps 8-10	Broadcast over crop. Plot sprayer	10	0.20
Salinas, California/1990/Silver Star	SL, 216 g/l	1.0	140	Broadcast Aerial	10	0.24
	WP, 900 g/kg	1.0	140	Broadcast Aerial	10	0.18
Madera, California/1992/Snowball Y Improved	SL, 216 g/l	1.0	310-380	Broadcast over crop, tractor with 10 ft boom.	10	1.6, 0.70, 0.58
Madera, California/1992/Snowball Y Improved	WP, 900 g/kg	1.0	310-380	Broadcast over crop, tractor with 10 ft boom	10	1.4, 2.0, 1.6

[1] An hour after the 13th application with ground equipment, the plots were accidentally sprayed at 1.0 kg ai/ha from a helicopter with the SL formulation.

Summaries of trials in the USA from 1967 to 1972 were reported by Ashley (2001j). Multiple applications of a 900 g ai/kg WS formulation or a 216 g/l SL formulation were made to broccoli and cauliflower at rates of 0.56 to 2.2 kg ai/ha using ground or aerial equipment. Samples were collected and analysed by GLC with a flame photometric detector (ML/PC-12 Supplement). The summary information is provided in Table 36.

Table 36. Residues of methomyl in or on broccoli and cauliflower after applications of WS or SL formulations, USA, 1967-1972 (4F1448).

Location/Year	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	PHI (days)	Residue[1] (mg/kg)
Broccoli							
Albion, New York/1967	WP, 900 g/kg	0.56	940	Foliar ground	6	1 3 7 10	1.0 0.15 0.04 0.02
Geneva, New York/1967	WP, 900 g/kg	0.56	260	Foliar ground	7	0 3 7 10 14	0.48 0.48 0.05 0.02 0.03
Milpitas, California/ 1968	WP, 900 g/kg	1.1	470	Foliar ground	[3]	0 3 5	0.46 0.09 <0.02

Location/Year	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	PHI (days)	Residue[1] (mg/kg)
						7	<0.02
Salinas, California/ 1967	WS, 900 g/kg	1.1	470	Foliar ground	[3]	0 3	8.6 0.20
	WS, 900 g/kg	2.2	470	Foliar ground	3	0 3	16. 0.46
Soledad, California/ 1967	WS, 900 g/kg	0.50	94	Foliar aerial	2	1 3 5 7	0.83 0.16 <0.02 0.05
	WS, 900 g/kg	1.0	94	Foliar aerial	2	1 3 5 7	1.2 0.21 0.12 0.08
Gilroy, California/ 1972	WP, 900 g/kg	0.50	94	Foliar aerial	2	1 3 5 7	0.44 0.30 0.10 0.05
	WP, 900 g/kg	1.0	94	Foliar aerial	2	1 3 5 7	1.0 0.73 0.22 0.32
Niles, Michigan/ 1972	WP, 900 g/kg	1.0	380	Foliar ground	5	1 3 7 14	3.5 0.70 0.20 0.06
	SL, 216 g/l	1.0	380	Foliar ground	5	1 3 7 14	4.4 2.8 0.09 0.08
Bradenton, Florida/1968	WP, 900 k/kg	1.1	240	Foliar ground	6	3 7 14	0.77 0.06 <0.02
Bradenton, Florida/1968	WP, 900 g/kg	1.3	660	Foliar ground	3	3 5 7	1.8 0.39 0.35
Bradenton, Florida/1971	WP, 900 g/kg	1.1	850	Foliar ground	1	1 3	5.1 0.51
Bradenton, Florida/1971	WP, 900 g/kg	0.56	770	Foliar ground	10	1 3	0.72 0.44
Bradenton, Florida/1971	WP, 900 g//kg	1.1	770	Foliar ground	10	1 3	3.6 0.96
Cauliflower							
Geneva, New York/1967	WP, 900 g/kg	0.56	260	Foliar ground	7	0 3 7	0.05 0.12 0.02
Bradenton, Florida/1972	WP, 900 g/kg	0.56	750	Foliar ground	6	1 3	0.32 0.10
Bradenton, Florida/1972	WP, 900 g/kg	1.1	750	Foliar ground	6	1 3	0.92 0.74
Sanger, California/ 1967	WP, 900 g/kg	0.56	340	Foliar ground	6	1 3 5 8	0.12 0.05 0.07 0.04
Gonzales, California/?	SL, 216 g/l	0.50	94	Foliar aerial	2	1 3 5 7	0.30 0.02 <0.02 0.02

Location/Year	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	PHI (days)	Residue[1] (mg/kg)
Gonzales, California/?	SL, 216 g/l	1.0	94	Foliar aerial	2	1 3 5 7	0.46 0.04 0.03 <0.02
Gilroy, California/?	SL, 216 g/l	0.50	94	Foliar aerial	2	1 3 5 7	0.26 0.12 0.089 0.13
Gilroy, California/?	SL, 216 g/l	1.0	94	Foliar aerial	2	1 3 5 7	0.48 0.51 0.13 0.05

[1] Summary results only. No details of sample storage, preparation, concurrent recovery data or details of the analyses.

Cucurbits

Field trials on cucumbers and courgettes (zucchini) in Belgium, Greece, Italy and The Netherlands were reported. In Italy and Greece a WP or SL formulation was applied (3 x 1000 l/ha, 3 x 50 g ai/hl) as a foliar ground spray to cucumbers and courgettes in the 1996 growing season (Weidenauer *et al.*, 1998h). Duplicate samples were collected at intervals and stored frozen (-20°C) for 11-13 months pending analysis by method AMR 3015-94. Fortified controls were analysed with the treated samples. At 0.02 mg/kg fortification, the average recovery was 76% ± 8%, n=4; at 0.2 mg/kg, 77% ± 22%, n=3. In further trials under similar conditions in the 1997 growing season in France, Greece and Italy samples were stored 14-16 months before extraction and analysis (Françon and Larcinese, 1999g). Recoveries from fortified control cucumbers were 84% ± 18%, n=3 at 0.021 mg/kg; and 89% ± 16%, n=3, at 0.21 mg/kg. Recoveries from courgettes were 85% ± 19%, n=6 at 0.021 mg/kg and 85% ± 11%, n=7 at 0.21 mg/kg. The results are shown in Table 37.

Table 37. Residues of methomyl in or on cucumbers and courgettes after foliar applications of a WP or SL formulation in Southern Europe (AMR 3977-96; AMR 4511-97).

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	PHI (days)	Residue (mg/kg)
Cucumber							
GAP: Italy	SL, WP	0.04 kg ai/hl				10	
GAP: Greece	SL	0.45			3	20	
GAP: France	SL	0.3			3	7	
Monta-naso Lombardo, Italy/1996/Potomac F1	SL, 200 g/l	0.52	1040	Ground foliar to run-off	3	-1h +3h 1 3 5 7	<0.02 0.03, 0.07 0.03, 0.02 <0.02, <0.02 <0.02:<0.02 <0.02, <0.02
Monta-naso Lombardo, Italy/1996/Potomac F1	WP, 250 k/kg	0.52	1030	Ground foliar to run-off	3	-1h +3h 1 3 5 7	<0.02 0.07, 0.03 0.07, 0.02 <0.02, <0.02 <0.02<0.02 <0.02:<0.02
Monta-naso	WP,	0.40	810	High volume	3	-1h	<0.02

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	PHI (days)	Residue (mg/kg)
Lombardo, Italy/1997/Potomac F1	250 g/kg			ground foliar to run-off		+3h 1 3 5 7	0.04, 0.04 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02
Cadriano Bologna, Italy/1996/Carine	SL, 200 g/l	0.33	666	Ground foliar to run-off	3	7	<0.02, <0.02
Fiesso di Castenaso, Italy/1997/Darina	SL, 200 g/l	0.49	966	Direct foliar	3	7	<0.02, <0.02
Kato Souli-Attica, Greece/1996/Ferri morse	SL, 200 g/l	0.50	994	Ground foliar to run-off	3	7	<0.02, <0.02
Beaucaire, France/1997/ Emeraude	SL, 200 g/l	0.31	612	Foliar spraying	3	-1 h +3 h 1 3 5 7	<0.02 0.08, 0.05 0.04, 0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02
Beaucaire, France/1997/ Emeraude	WP, 250 g/kg	0.30	601	Foliar spraying	3	-1h +3h 1 3 5 7	<0.02 <0.02, <0.02 0.03, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02
Courgette							
GAP: Italy	None Use France						
GAP: France	SL	0.3			3	7	
GAP: Greece	WP	0.45			3	15	
Mediglia, Italy/1996/?	SL, 200 g/l	0.52	1040	Ground foliar to run-off	3	7	<0.02, <0.02
Drosia, Michaniona, Greece/1997/ Verona	WP, 250 g/kg	0.25	508	Foliar appli-cation	3	-1h +3h 1 3 5 7	<0.02 0.02, 0.03 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02

Trials on cucumbers and courgettes in Northern Europe were also reported (Weidenauer *et al.*, 1998k; Françon and Larcinese, 1999k). WP or SL formulations were applied three times at 3-7 day intervals at a rate of 300-600 g ai/ha/application in glasshouses. Duplicate samples were collected at harvest, stored frozen (-20°C) and analysed by method AMR 3015-94. Control samples were fortified and analysed with the treated samples. At 0.02 mg/kg fortification the recovery was 87% ± 14%, n=10, and at 0.2 mg/kg, 84% ± 12%, n=9. The results are shown in Table 38.

Table 38. Residues in or on cucumbers and courgettes after foliar applications of WS or SL formulations in glasshouses in Northern Europe (AMR 4017-96; AMR 4521-97).

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	PHI (days)	Residue (mg/kg)
GAP:Belgium	WP	0.5	1600			14	

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	PHI (days)	Residue (mg/kg)
GAP: Netherlands	SL WP	0.4 0.4	1600 500		3	3	
Cucumber							
Oosterhout, Netherlands/ 1996/Dugan	SL, 200 g/l	0.50	982	Overall foliar by ground sprayer to run-off	3	-1h +3h 1 3 5 7	<0.02 0.03, 0.05 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02
Oosterhout, Netherlands/ 1996/Dugan	WP, 250 g/kg	0.49	972	Overall foliar by ground sprayer to run-off	3	-1h +3h 1 3 5 7	<0.02 0.04, 0.05 0.02, 0.03 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02
Oosterhout, Netherlands/19 97/Europa	SL, 200 g/l	0.47	1591	Ground sprayer (high volume) to run-off	3	-1h +3h 1 3 5 7	0.03, <0.02 0.02, 0.02 <0.02, 0.02 0.03, <0.02 <0.02, <0.02 <0.02, <0.02
Oosterhout, Netherlands/19 97/Dugan	SL, 200 g/l	0.48	1806	Ground sprayer (high volume) to run-off	3	7	<0.02, <0.02
Oosterhout, Netherlands/19 97/Dugan	WP, 250 g/kg	0.48	1594	Ground sprayer (high volume) to run-off	3	7	<0.02, <0.02
Melsele, Belgium/1997/ Nicolas	WP, 250 g/kg	0.55	1810	Overall foliar by ground sprayer to run-off	3	7	<0.02, <0.02
Bois de Nivelles, Belgium/1997/ Recento	WP, 250 g/kg	0.44	1465	Spraying	3	-1h +3h 1 3 5 7	<0.02, 0.03 0.18, 0.18 0.06, 0.06 0.03, 0.,02 <0.02, <0.02 <0.02, <0.02
Courgette							
St Gillis-Waas, Belgium/1997/ Bengale	WP, 250 g/kg	0.54	1253	Overall foliar by ground sprayer to run-off	3	-1h +1h 1 3 5 7	<0.02 0.06 0.08 <0.02 <0.02 <0.02
Bois de Nivelles, Belgium/1997/ Pandorex	WP, 250 g/gk	0.34	1117	Spraying	3	7	<0.02, <0.02
Honselersdijk, Netherlands	SL, 200 g/l	0.51	996	Overall foliar by ground sprayer to run-off	3	7	<0.02, <0.02

Field trials in 1969-1971 on watermelons were reported from the USA (Ashley, 2001f). A WD formulation was applied at rates of 0.56 to 1.12 kg ai/ha and whole watermelons were analysed by the GLC method ML/PC-12. The method was validated at 0.04 mg/kg. Detailed information on field trial conditions, sample collection, storage, extraction and analysis was not provided. Summary results are shown in Table 39.

Table 39. Residues of methomyl in or on watermelons after the application of a WD formulation in the USA.

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of applications	PHI (days)	Residue[1] (mg/kg)
GAP: USA	SL, SP	1.0	90A	Aerial/ground	12	3	
Leesburg, Florida/1969/?	WD, 900 g/kg	0.56	940	Broadcast	7	3	<0.04
Leesburg, Florida/1969/?	WD, 900 g/kg	1.12	940	Broadcast	2	4	<0.04
Leesburg, Florida/1970/?	WD, 900 g/kg	0.56	940	Broadcast	7	3	<0.04, <0.04
Blythe, California/1970/?	WD, 900 g/kg	0.56	560	Broadcast	2	3	<0.04
Blythe, California/1970/?	WD, 900 g/kg	1.12	560	Broadcast	2	3	<0.04
Bakersfield, California/1971/?	WD, 900 g/kg	0.56	140	Aerial	2	2 4	<0.04 (0.03) <0.04
Bakersfield, California/1971/?	WD, 900 g/kg	1.12	140	Aerial	2	2 4	0.07 <0.04

[1] Values reported as <0.02 mg/kg, but method not validated below 0.04 mg/kg.

Field trials on melons were reported from Greece, Italy and The Netherlands in 1996 and 1997 (Weidenauer *et al.*, 1998i,n; Françon and Larcinese, 1999h,j). An SL or WP formulation was applied three times as a broadcast foliar spray at rates of 250-500 g ai/ha. Duplicate samples of mature fruits were collected and stored frozen for up to 16 months for analysis by method AMR 3015-94. Control samples of melons fortified with methomyl were extracted and analysed with the treated samples. At a 0.02 mg/kg fortification, the recovery was 86% ± 12%, n=18. The results are shown in Table 40.

Table 40. Residues of methomyl in or on melons after three foliar applications of a WP or SL formulation in Europe.

Location/Year/Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	PHI (days)	Residue (mg/kg)	Reference
GAP: Netherlands	SL WP	0.4 0.4	1600 500		3		
GAP: Italy	SL, WP	0.04 kg ai/hl			10		
GAP: Spain	None Use Italy						
GAP: Germany	SL	0.45		3	20		
Monster, Netherlands/ 1996/Haon	SL, 200 g/l	0.46	897	Foliar Glass-house	-1h +4h 1 3 5 7	<0.02 0.02, 0.02 <0.02, 0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	Weidenauer *et al.*, 1998n AMR 4019-96
Monster, Netherlands/ 1996/Haon	WP, 250 g/kg	0.45	880	Foliar Glass-house	-1h +4h 1 3 5 7	<0.02 <0.02, 0.02 0.02, 0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	Weidenauer *et al.*, 1998n AMR 4019-96
Gravezande,	SL, 200 g/l	0.58	1986	Foliar	-1h	<0.02	Françon and Larcinese,

Location/Year/Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	PHI (days)	Residue (mg/kg)	Reference
Netherlands/ 1997/Haon				Glass-house	+0h 1 3 5 7	0.07, 0.06 0.10, 0.07 0.03, 0.10 <0.02, <0.02 0.03, <0.02	1999j AMR 4519-97
Gravezande, Netherlands/ 1997/Haon	WP, 250 g/kg	0.61	2011	Foliar Glass-house	7	<0.02, <0.02	Françon and Larcinese, 1999j AMR 4519-97
Gavello, Italy/1997/Pamir	SL, 200 g/l	0.26	515	Foliar Broad-cast	7	<0.02, <0.02	Françon and Larcinese, 1999h AMR 4513-97
Gavello, Italy/1997/Pamir	WP, 250 g/kg	0.26	518	Foliar Glass-house	7	<0.02, <0.02	Françon and Larcinese, 1999h AMR 4513-97
Caleppio de Settala, Italy/1997/Super market	WP, 250 g/kg	0.40	805	Foliar Glass-house	1 3 5 7	0.05, 0.04 0.02, 0.02 0.02, 0.02 <0.02, <0.02	Françon and Larcinese, 1999h AMR 4513-97
Montanaso Lombardo, Italy/1996/ Vector F-1	SL, 200 g/l	0.49	984	Foliar broad-cast	-1h +1h 3 5 7	<0.02 0.02, 0.03 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	Weidenauer *et al.*, 1998i AMR 3998-96
Montanaso Lombardo, Italy/1996/ Vector F-1	WP, 250 g/kg	0.50	990	Foliar Broad-cast	-1h +1h 3 5 7	<0.02 0.02, <0.02 <0.02, 0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	Weidenauer *et al.*, 1998i AMR 3998-96
Volania Ferrar, Italy/1996/Pamir	WP, 250 g/kg	0.41	808	Foliar Broad-cast	7	<0.02, <0.02	Weidenauer *et al.*, 1998i AMR 3998-96
Volania Ferrara, Italy/1996/Pamir	SL, 200 g/l	0.50	990	Foliar Broad-cast	-1h +1h 3 5 7	<0.02 0.03, 0.04 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	Weidenauer *et al.*, 1998i AMR 3998-96
Mesimeri-Thessaloniki, Greece/1996/ Thraklotica	SL, 200 g/l	0.50	985	Foliar Broad-cast	7	0.03, 0.03	Weidenauer *et al.*, 1998i AMR 3998-96
Metohi, Greece/1997/ Galli	SL, 200 g/l	0.25	502	Foliar Glass-house	1 3 5 7	0.03, 0.03 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	Françon and Larcinese, 1999h AMR 4513-97
Umbrete, Spain/1997/ Rochet	SL, 200 g/l	0.42	829	Foliar Broad-cast	7	<0.02, <0.02	Françon and Larcinese, 1999h AMR 4513-97

Other fruiting vegetables

Summary information on egg plant, pepper and tomato trials in the USA was provided and is summarized in Table 41(Ashley, 2001p). Samples were analysed by method ML-PC12 (1968).

Table 41. Residues of methomyl in or on egg plants, tomatoes and peppers after foliar application in the USA (9F 0814).

Location/Year	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of Applications	PHI (days)	Residue (mg/kg)
GAP: USA	SL, SP	1.0	19A	Aerial/ground	10 egg plant 10 pepper 16 tomato	3 egg plant 1 tomato 3 pepper	
Egg plant							
Wilmington, Delaware/1969	?	0.56	?	Foliar	9	2 5	0.10 0.04
Bradenton, Florida/1969	?	0.56	?	Foliar	2	2 4 6	0.05 0.04 <0.02
Bristol, Maryland/1969	?	0.56	?	Foliar	5	4	0.11
Wooster, Ohio/1969	?	0.56	?	Foliar	6	2 5	0.10 <0.02
Wooster, Ohio/1969	?	1.1	?	Foliar	6	2 5	<u>0.30</u> 0.11
Tomato							
Bradenton, Florida/1967	?	0.28	?	Foliar	4	0 4 8	0.02 <0.02 <0.02
Bradenton, Florida/1967	?	0.56	?	Foliar	4	3 5 7	0.08 0.02 0.02
Homestead, Florida/1967	?	0.56	?	Foliar	8	3 5 7	0.05 0.03 <0.02
Gillette, Florida/1967	?	0.56	?	Foliar	3	3 5 7	0.03 <0.02 <0.02
Gillette, Florida/1967	?	1.1	?	Foliar	3	3 5 7	0.03 0.04 0.02
Wilmington, Delaware /1968	?	0.56	?	Foliar	3	2 5	0.03 <0.02
Yolo, California		1.1	?	Foliar	3	0 10	<u><0.1</u> <0.1
Wooster, Ohio/1968	?	0.56	?	Foliar	6	2 5	0.03 <0.02
Wooster, Ohio/1968	?	1.1	?	Foliar	6	2 5	<u>0.03</u> 0.02
Bristol, Maryland/1968	?	0.56	?	Foliar	10	3 6	<0.02 <0.02
Weslaco, Texas/1968	?	0.56	?	Foliar	8	3 5	<0.02 <0.02
Weslaco, Texas/1968	?	1.1	?	Foliar	8	3 5	<0.02 <0.02
Weslaco, Texas/1968	?	2.2	?	Foliar	8	3 5	<0.02 <0.02
Pepper							
Bristol, Maryland/1968	?	0.56	?	Foliar	5	4	0.10
Wilmington, Delaware/1968	?	0.56	?	Foliar	9	2 5	0.16 0.05
Niles, Michigan	?	0.56	?	Foliar	4	2	0.28

Location/Year	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Method	No. of Applications	PHI (days)	Residue (mg/kg)
						4 8	0.12 0.07
Niles, Michigan	?	1.1	?	Foliar	4	2 4 8	<u>0.44</u> 0.11 0.10
Bradenton, Florida/1968	?	0.56	?	Foliar	6	3 5 7	0.39 0.38 0.28
Weslaco, Texas	?	0.56	?	Foliar	8	10	0.05
Weslaco, Texas	?	2.2	?	Foliar	8	10	0.19
Weslaco, Texas	?	1.1	?	Foliar	8	10	0.03
Wooster, Ohio/1968	?	0.56	?	Foliar	6	2 5	0.02 0.03
Wooster, Ohio/1968	?	1.1	?	Foliar	6	2 5	<u>0.08</u> 0.03

In pepper and tomato trials in Europe (Weidenauer *et al.*, 1998j,l; Françon and Larcinese, 1999e,i) plants were treated with a foliar spray 3 times, at 200-500 g ai/ha per application. Samples were collected in duplicate at intervals and stored frozen (-18°C) for up to 17 months until analysed by method AMR 3015-94. Control tomatoes and peppers fortified with methomyl were extracted and analysed with the treated samples. Recoveries from peppers and tomatoes fortified at 0.02 mg/kg were 80 ± 2.0%, n=3, and 84% ± 12%, n=25 respectively. The results are shown in Table 42.

Table 42. Residues of methomyl in or on tomatoes and peppers after three foliar applications of a WP or SL formulation to plants in Europe.

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Application Method	PHI (days)	Residue (mg/kg)	Report no.
Tomato							
GAP: Netherlands	SL WP	0.4	1600 500		3 3		
GAP: Belgium	WP	0.5	1600		14		
GAP: Italy	SL, WP	0.04 kg ai/hl			10		
GAP: Spain	SL, WP	0.50	1000		3		
GAP: Portugal	None Use Spain						
Huissen, Netherlands/1996 /Jamaica	SL, 200 g/lg	0.50	975	Foliar with ground sprayer to run-off	-1h +1h 1 3 5 7	<0.02 0.02, <0.02 <0.02, <0.02 <u><0.02</u>, <0.02 <0.02, <0.02 <0.02, <0.02	AMR 4018-96
Huissen, Netherlands/1996 /Jamaica	WP, 250 g/kg	0.50	982	Foliar with ground sprayer to run-off	-1h +1h 1 3 5 7	<0.02 <0.02, 0.02 <0.02:<0.02 <u><0.02</u>, <0.02 <0.02:<0.02 <0.02, <0.02	AMR 4018-96
Bemmel, Netherlands/1997 /Jamaica	SL, 200 g/l	0.60	2020	Foliar with ground sprayer to run-off, high volume.	-1h +3h 1	<0.02 0.03, 0.03 <0.02, <0.02	AMR 4515-97

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Application Method	PHI (days)	Residue (mg/kg)	Report no.
				Glasshouse	3 5 7	<0.02, <0.02 <0.02, <0.02 <0.02, <0.02	
Huissen, Netherlands/1997 /Jamaica	WP, 250 g/kg	0.60	1980	Foliar with ground sprayer to run-off, high volume. Glasshouse	-1h +3h 1 3 5 7	<0.02 0.11, 0.07 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	AMR 4515-97
Harmelerwaard, Netherlands/1997 /Blitz	SL, 200 g/l	0.60	2006	Foliar with ground sprayer to run-off, high volume. Glasshouse	7	<0.02, <0.02	AMR 4515-97
Harmelerwaard, Netherlands/1997 /Blitz	WP, 250 g/kg	0.59	1953	Foliar with ground sprayer to run-off, high volume. Glasshouse	7	<0.02, <0.02	AMR 4515-97
Sint Katelinje Waver, Belgium/1996 /Durinta	WP, 250 g/kg	1.0	2013	Foliar with ground sprayer to run-off	7	0.06, 0.04	AMR 4018-96
Saint Amand, Belgium/1997 /Lucy	WP, 250 g/l	0.42	1384	Typical spraying. Glasshouse	-1h +3h 1 3 5 7	<0.02 0.08, 0.06 <0.02, 0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	AMR 4515-97
Bois de Nivelles, Belgium/1997 /Solar	SL, 200 g/l	0.45	1493	Typical spraying. Glasshouse	7	<0.02, <0.02	AMR 4515-97
Caleppio di Settala, Italy/1997 /Erminia	SL, 200 g/l	0.41	812	Foliar with ground sprayer to run-off, high volume.	-1h +3h 1 3 5 7	<0.02 0.07, 0.03 0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	AMR 4507-97
Caleppio di Settala, Italy/1997 /Erminia	WP, 250 g/kg	0.42	836	Foliar with ground sprayer to run-off, high volume. Glasshouse	7	<0.02, <0.02	AMR 4507-97
Montanaso Lombardo, Italy/1996/Red Setter/	SL., 200 g/l	0.50	994	Foliar with ground sprayer to run-off	-1h +1h 1 3 5 7	<0.02 0.04, 0.04 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	AMR 3999-96
Montanaso Lombardo, Italy/1996/Red Setter/	WP, 250 g/kg	0.48	960	Foliar with ground sprayer to run-off	-1h +1h 1 3 5 7	<0.02 0.04, 0.09 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	AMR 3999-96
Palacios, Spain/1997 /Empire	WP, 250 g/kg	0.45	885	Foliar spray	-1h +3h 1 3 5 7	<0.02 0.14, 0.21 0.03, 0.03 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	AMR 4507-97

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Application Method	PHI (days)	Residue (mg/kg)	Report no.
Utrera, Spain/1997/ Empire	WP, 250 g/kg	0.45	888	Foliar spray	7	<0.02, <0.02	AMR 4507-97
Ultrera, Spain/1996/ Nemared	SL, 200 g/l	0.30	607	Foliar with ground sprayer to run-off	-1h +3h 1 3 5 7	<0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	AMR 3999-96
Azambuja, Portugal/1997/ Heinz 8892	WP, 250 g/kg	0.41	813	Foliar application to run-off (atomizer)	7	<0.02, <0.02	AMR 4507-97
Azambuja, Portugal/1996/ Cannery row	SL, 200 g/l	0.48	965	Foliar with ground sprayer to run-off		No data	AMR 3999-96
Pepper							
GAP: Netherlands	None						
GAP: Belgium	None						
GAP: Italy	SL, WP	0.04 kg ai/hl			10		
Huissen, Netherlands/1996 /Spirit	SL, 200 g/lg	0.50	975	Foliar with ground sprayer to run-off	-1h +3h 1 3 5 7	<0.02 0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02 <0.02, <0.02	AMR 4018-96
Montanaso Lombardo, Italy/1996/Indalo F1	SL, 200 g/l	0.50	990	Foliar with ground sprayer to run-off	7	<u><0.02</u>, <0.02	AMR 3999-96

<u>Leafy vegetables</u>

Summary data were provided on US trials on spinach from 1968-1972, using multiple applications of an SP (900 g/kg) or an SL formulation (216 g/l) at 0.56-1.1 kg ai/ha (Ashley, 2001j). No details were provided. The results are shown in Table 43.

Trials were reported for head and leaf lettuce in California and Arizona in 1990 (C. M. Kennedy, 1991b). 10-15 applications of an SL or SP formulation were made with ground or aerial equipment at 1.0 kg ai/ha/application and samples of at least 12 heads or bunches were collected and stored at -15 to -25^{o}C for up to 14 months for analysis by method AMR 1806-90. Control samples of leaf and head lettuce were fortified with methomyl (0.02-7.0 mg/kg) and analysed with the treated samples. The recovery from leaf lettuce was 93% $\pm$ 7%, n=9 and from head lettuce, 94% $\pm$ 7%, n=11. Some control samples showed residues up to 0.5 mg/kg in head and 0.07 mg/kg in leaf lettuce, but most controls were <0.02 mg/kg. The results are shown in Table 43.

Table 43. Residues of methomyl in or on leafy vegetables after the foliar application of an SL or SP formulation in the USA.

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Application method	No. of appli-cations	PHI (days)	Residue (mg/kg)	Report no.
Spinach								
GAP: USA	SL, SP	1.0	90A	Aerial/ground	8	7		
King City, California/1970/?	SP, 900 g/kg	1.1	660	Ground foliar	4	3 7 9	9.2 1.4 0.28	4F 1448
Chualar, California/1972/?	SP, 900 g/kg	0.84 0.56	380	Ground foliar	1 1	 7	 3.0	4F 1448
Chualar, California/1972/?	SP, 900 g/kg	0.84 1.1	750	Ground foliar	1 1	 3 7	 6.5 4.1	4F 1448
Chualar, California/1972/?	SL, 216 g/l	0.84 0.56	380	Ground foliar	1 1	 7	 1.7	4F 1448
Chualar, California/1972/?	SL, 216 g/l	0.84 1.1	750	Ground foliar	1 1	 3 7	 16 4.6	4F 1448
Salinas, California/1972/?	SL, 216 g/l	0.84 0.56	380	Ground foliar	1 1	 3 7	 5.1 2.6	4F 1448
Salinas, California/1972/?	SL, 216 g/l	0.84 1.1	750	Ground foliar	1 1	 3 7	 12. 4.6	4F 1448
Salinas, California/1969/?	SP, 900 g/kg	0.56	660	Ground foliar	1	1 3 9 15	8.8 3.0 1.2 0.60	4F 1448
Salinas, California/1969/?	SP, 900 g/kg	1.1	660	Ground foliar	1	1 3 9 15	4.3 3.2 1.3 0.56	4F 1448
Van Buren, Arizona/1968/?	SP, 900 g/kg	0.56	250	Ground foliar	3	3 7 14	1.7 0.25 0.07	4F 1448
Van Buren, Arizona/1968/?	SP, 900 g/kg	1.1	250	Ground foliar	3	3 7 14	5.6 0.07 0.05	4F 1448
Albion, New York/1968/?	SP, 900 g/kg	0.56	280	Ground foliar	4	3 7	0.44 0.07	4F 1448
Albion, New York/19689/?	SP, 900 g/kg	1.1	280	Ground foliar	4	3 7	1.3 0.34	4F 1448
Crystal City, Texas/1969/?	SP, 900 g/kg	0.56	660	Ground foliar	7	3 5 7 14	7.4 3.7 1.6 0.04	4F 1448
Crystal City., Texas/1969/?	SP, 900 g/kg	1.1	660	Ground foliar	7	3 5 7 14	12 5.7 5.00 0.13	4F 1448
Alma, Arkansas/1967/?	SP, 900 g/kg	0.56	380	Ground foliar	1	5 7 10	6.9 2.3 0.68	4F 1448
Bradenton, Florida/1967/?	SP, 900 g/kg	0.56	940	Ground foliar	4	1 3 5	32. 4.0 0.40	4F 1448

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Application method	No. of appli-cations	PHI (days)	Residue (mg/kg)	Report no.
						10 14	0.04 0.03	
Bradenton, Florida/1967/?	SP, 900 g/kg	1.1	940	Ground foliar	4	1 3 5 10 14	96. 12 2.1 0.22 0.04	4F 1448
Bradenton, Florida/1967/?	SP, 900 g/kg	1.1	630	Ground foliar	9	1 3 5	0.60 0.53 0.10	4F 1448
Dyersburg, Tennessee /1971/?	SP, 900 g/kg	0.34	75	Aerial foliar	1	4	0.40	4F 1448
Dyersburg, Tennessee /1971/?	SP, 900 g/kg	0.67	75	Aerial foliar	1	4 7	0.84 0.30	4F 1448
Dyersburg, Tennessee /1971/?	SP, 900 g/kg	1.3	75	Aerial foliar	1	4 7	3.2 <u>0.74</u>	4F 1448
Lettuce, Head								
GAP: USA	SP, SL	1.0	90A	Aerial/ground		<0.5 kg ai/ha= 7 >0.5 kg ai/ha =10		
Madera, California/1990 /Great Lakes	SL, 216 g/l	1.0	400-450	Tractor sprayer over-the-top	11 12 15	10 10 10	0.23 (0.039[1]) <u>0.70</u> (<0.020[1])	AMR 1601-90
Madera, California/1990 /Great Lakes	SP, 900 g/kg	1.0	400-450	Tractor sprayer over-the-top	11 12 15	10 10 10	0.13 (0.026[1]) <u>0.18</u> (0.026[1])	AMR 1601-90
Salinas, California /Pybas-101	SL, 216 g/l	1.0	140	Helicopter foliar	15 16	10 10	1.2 (0.028[1]) <u>1.2</u> (0.13[1])	AMR 1601-90
Salinas, California/1990 /Pybas-101	SP, 900 g/kg	1.0	140	Helicopter foliar	15 16	10 10	0.54 (0.043[1]) <u>0.54</u> (0.067[1])	AMR 1601-90
Salinas, California/1990 /Pybas-101[2]	SL, 216 g/l	1.0	200 for apps 1-10 430 for apps 11-15	CO_2 plot sprayer, broadcast over crop	10 12 15	10 10 10	<u>2.2</u> (1.0[1]) 1.4 (0.62[1]) 1.8 (0.076[1])	AMR 1601-90
Salinas, California/1990 /Pybas-101[2]	SP, 900 g/kg	1.0	200 for apps 1-10 430 for apps 11-15	CO_2 plot sprayer, broadcast over crop	10 12 15	10 10 10	<u>2.3</u> (0.79[1]) 1.1 (0.21[1]) 0.74 (0.080[1])	AMR 1601-90
Litchfield, Arizona/1990 /Vanguard	SP, 900 g/lg	1.0	56	Backpack broadcast	10 12 15	10 10 10	<u>4.6</u> 1.2 2.1	AMR 1601-90
Litchfield, Arizona/1990 /Vanguard	SL, 216 g/l	1.0	56	Backpack broadcast	10 12 15	10 10 10	2.2 1.6 <u>3.3</u>	AMR 1601-90
Litchfield, Arizona/1990 /Vanguard	SP, 900 g/kg	1.0	71	Fixed-wing aircraft foliar	15	10	<u>4.8</u>	AMR 1601-90
Litchfield, Arizona/1990 /Vanguard	SL, 216 g./l	1.0	71	Fixed-wing aircraft foliar	15	10	<u>1.5</u>	AMR 1601-90

Location/Year/ Variety	Form.	Application rate (kg ai/ha)	Spray volume (l/ha)	Application method	No. of appli-cations	PHI (days)	Residue (mg/kg)	Report no.
Lettuce, Leaf								
GAP: USA	See head lettuce							
Madera, California/1990 /Prize Head[3]	SL, 216 g/l	1.0	400-450	Tractor sprayer over-the-top	11 12 15	10 10 10	1.4 2.1 1.9	AMR 1601-90
Madera, California/1990 /Prize Head[3]	SP, 900 g/kg	1.0	400-450	Tractor sprayer over-the-top	11 12 15	10 10 10	2.1 0.92 1.4	AMR 1601-90
Salinas, California/1990 /Royal Green[4]	SL, 216 g/l	1.0	140	Helicopter foliar	15	10	0.62	AMR 1601-90
Salinas, California/1990 /Royal Green[4]	SP, 900 g/kg	1.0	140	Helicopter foliar	15	10	0.31	AMR 1601-90
Salinas, California/1990 /Royal Green[5]	SL, 216 g/l	1.0	200-220 for apps 1-10 430 for apps 11-15	CO_2 plot sprayer. Broadcast over crop.	10 12 15	10 10 10	0.88 2.9 0.58	AMR 1601-90
Salinas, California/1990 /Royal Green[5]	SP, 900 g/kg	1.0	200-220 for apps 1-10 430 for apps 11-15	CO_2 plot sprayer. Broadcast over crop.	10 12 15	10 10 10	1.2 2.5 1.0	AMR 1601-90
Litchfield, Arizona/1990 /Romaine	SL, 216 g/l	1.0	56	Backpack broadcast	10 12 15	10 10 10	5.4, 6.0, 5.4 6.1, 6.4, 5.4 6.6, 6.7, 6.3	AMR 1601-90
Litchfield, Arizona/1990 /Romaine	SP, 900 g/kg	1.0	56	Backpack broadcast	10 12 15	10 10 10	3.1 5.6, 4.9, 5.7 4.0	AMR 1601-90
Litchfield, Arizona/1990 Romaine	SL, 216 g/l	1.0	71	Fixed-wing aircraft foliar	15	10	3.6	AMR 1601-90
Litchfield, Arizona/1990 /Romaine	SP, 900 g/kg	1.0	71	Fixed-wing aircraft foliar	15	10	5.5, 5.3, 5.2	AMR 1601-90

[1] Trimmed.
[2] One of four controls showed residues of 0.38 mg/kg (trimmed), and 0.50 mg/kg (untrimmed).
[3] One of three controls showed residues of 0.049 mg/kg.
[4] Control showed a residue of 0.071 mg/kg.
[5] Controls showed residues of 0.047 and 0.021 mg/kg.

Legume vegetables

Results and limited descriptions of trial conditions and analytical methods were reported for trials on succulent beans, peas and soya in the late 1960s and early 1970s (Ashley, 2001b,g). Samples were analysed by GLC method ML/PC-12 or its modification. Storage conditions and periods were not reported but some recovery data were given for fortified controls. It appears that adequate recoveries were achieved at concentrations $\geq$0.02 mg/kg. Report 2F 1247 demonstrated adequate recoveries at 0.21-2.1 mg/kg from peas plus pods ranging from 76 to 88%, n=5 (Table 44).

Ten soya trials in 1967-1968 with PHIs ranging from 12 to 62 days were reported by Ashley (2001b). None of the trials were at the GAP PHI and it was not clear whether many of the trials were for immature beans. All residues were <0.02 mg/kg.

Table 44. Residues of methomyl in or on succulent beans and podded peas after multiple foliar applications of various formulations in the USA.

Location/type/year	Form.	Application rate (kg ai/ha)	No. of applications	PHI (days)	Residue (mg/kg)	Report no/ comment
GAP: USA	SL, SP	1.0	10	<0.5 6 kg ai/ha = 1 >0.5 6 kg ai/ha= 3		11 kg ai/ha max
Beans (Bush, Pole and Lima)						
Bradenton, Florida/bush bean/1968	SL, 360 g ai/l	0.56	6	2 5	0.02 0.07	1F- 1021
Bradenton, Florida/bush bean/1968	D, 20 g ai /kg	0.56	6	2 5	0.13 0.06	1F- 1021
Bradenton, Florida/bush bean/1968	SP, 900 g/kg	1.1	6	0 7	0.06 <0.02	1F- 1021
Bradenton, Florida/bush bean/1968	SP, 900 g/kg	0.56	7	1 3	0.05 <0.02	1F- 1021
Bradenton, Florida/bush bean/?	SP, 900 g/kg	0.22	7	1 3	<0.02 <0.02	1F- 1021
Bradenton, Florida/bush bean/?	SP, 900 g/kg	0.56	7	1 3	0.05 <0.02	1F- 1021
Bradenton, Florida/pole bean/1968	SP, 900 g ai/kg	0.56	3	2 6	<0.02 <0.02	1F- 1021
Homestead, Florida/1968/bush bean	SP, 900 g ai/kg	0.45	4	5	0.28	1F- 1021
Raleigh, North Carolina/1968/bush bean	D, 20 g ai/kg	1.1	4	1 3 7	0.62 0.03 0.04	1F- 1021
Raleigh, North Carolina/1968/bush bean	SP, 900 g/kg	0.56	7	1 3 7	0.06 0.04 <0.02	1F- 1021
Newark, Delaware/1965/lima bean	SP, 900 g/kg	1.1	11	7	<0.02	1F- 1021
Newark, Delaware/1965/lima bean	SP, 900 g/kg	0.56	11	7	<0.02	1F- 1021
Niles, Michigan/?/bush bean	SP, 900 g/kg	0.56	2	3 7	0.30 0.07	1F- 1021
Niles, Michigan/?/bush bean	SP, 900 g/kg	1.1	2	3 7	0.30 0.18	1F- 1021
Wooster, Ohio/?/lima bean	SP, 900 g/kg	1.1	6	2 5 8	0.68 0.05 0.03	1F- 1021
Peas + Pods (Peas only)						
Mt. Vernon, Washington/1969	SP, 900 g/kg	0.50	3	1 2 5 7	4.0 (0.12) 1.1 <0.02 (<0.02) <0.02	1F- 1021
Mt. Vernon, Washington/1969	SP, 900 g/kg	1.0	3	1 2 5 7	4.6 (0.40) 1.4 0.11 (<0.02) 0.04	1F- 1021

Location/type/year	Form.	Application rate (kg ai/ha)	No. of applications	PHI (days)	Residue (mg/kg)	Report no/ comment
Stanwood, Washington/1969	SP, 900 g/kg	0.56	2	6	0.09	1F- 1021
Stanwood, Washington/1969	SP, 900 g/kg	1.1	2	6	0.12	1F- 1021
Stanwood, Washington/1969	SP, 900 g/kg	2.2	2	6 13	0.93 (<0.02)	1F- 1021
Burlington, Washington/1969	SP, 900 g/kg	0.56	2	5	0.17	1F- 1021
Burlington, Washington/1969	SP, 900 g/kg	1.1	2	5	0.27	1F- 1021
Burlington, Washington/1969	SP, 900 g/kg	2.2	2	5 16	0.64 0.02 (<0.02)	1F- 1021
Waseco, Minnesota/1969	SP, 900 g/kg	0.56	1	14	<0.02	1F- 1021
Waseco, Minnesota/1969	SP, 900 g/kg	2.2	1	14	<0.02	2F- 1247
Marien, Wisconsin/1970	SP, 900 g/kg	0.56	1	1	0.12 (0.03)	2F- 1247
Marien, Wisconsin/1970	SP, 900 g/kg	1.1	1	1	0.20 (0.09)	2F- 1247
Waseca, Minnesota/1970	SP, 900 g/kg	0.56	1	1	0.18 (<0.02)	2F- 1247
Waseca, Minnesota/1970	SP, 900 g/kg	1.1	1	1	1.2 (0.52)	2F- 1247
Waseca, Minnesota/1970	SP, 900 g/kg	2.2	1	1	2.2 (1.1)	2F- 1247
Walla Walla, Washington/1971	SP, 900 g/kg	0.56	1	3 5	0.07 0.04	2F- 1247
Walla Walla, Washington/1971	SP, 900 g/kg	1.1	1	3 5	0.19 0.11	2F- 1247
Waseca, Minnesota/1971	SP, 900 g/kg	0.50	1	1 2	0.60 0.28	2F- 1247
Waseca, Minnesota/1971	SP, 900 g/kg	1.0	1	1 2	1.2 0.92	2F- 1247
Forest, Wisconsin/1971	SP, 900 g/kg	1.0	1	1 2 3	0.70 0.74 0.33	2F- 1247
Owatonna, Minnesota/1971	SP, 900 g/kg	0.50	1	1 2	0.83 0.51	2F- 1247
Owatonna, Minnesota/1971	SP, 900 g/kg	1.0	1	1 2	0.88 0.74	2F- 1247

Summary data were also reported for forage (Table 45).

Table 45. Residues of methomyl in or on the forage of beans (succulent), peas and soya (immature) from multiple foliar applications of various formulations in the USA.

Location/type/year	Form.	Application Rate (kg ai/ha)	No. of applications	PHI (days)	Residue (mg/kg)	Report no./ comment
GAP: USA	SL, SP	1.0	10	Bean: Vine 3 Hay 7 Pea: Forage 5		

Location/type/year	Form.	Application Rate (kg ai/ha)	No. of applications	PHI (days)	Residue (mg/kg)	Report no./ comment
				Hay 14		
Beans (Bush, Pole and Lima) - vines						
Bradenton, Florida/bush bean/1968	SL, 360 g ai/l	0.56	6	2 5	0.77 0.31	1F1021
Bradenton, Florida/bush bean/1968	D, 20 g ai /kg	0.56	6	2 5	4.0 1.2	1F1021
Bradenton, Florida/bush bean/?	SP, 900 g/kg	0.22	7	1 3 7	0.60 0.09 <0.02	1F1021
Bradenton, Florida/bush bean/?	SP, 900 g/kg	0.56	7	1 3 7 14	8.0 3.3 1.0 0.03	1F1021
Bradenton, Florida/pole bean/1968	SP, 900 g ai/kg	0.56	3	2 6	0.40 0.20	1F1021
Homestead, Florida/1968/bush bean	SP, 900 g ai/kg	0.45	4	3 7	0.62 0.11	1F1021
Raleigh, North Carolina/1968/bush bean	D, 20 g ai/kg	1.1	4	1 3 7	12. <u>4.3</u> 1.4	1F1021
Raleigh, North Carolina/1968/bush bean	SP, 900 g/kg	0.56	7	1 3 7	6.8 3.1 0.06	1F1021
Podded pea forage						
Mt. Vernon, Washington/1969	SP, 900 g/kg	0.50	3	1 2 5 7	14 5.8 0.94 0.05	1F1021
Mt. Vernon, Washington/1969	SP, 900 g/kg	1.0	3	1 2 5 7	21 4.3 <u>0.34</u> 0.12	1F1021
Stanwood, Washington/1969	SP, 900 g/kg	0.56	2	1 6	6.0 2.7	1F1021
Stanwood, Washington/1969	SP, 900 g/kg	1.1	2	1 6	22 <u>6.5</u>	1F1021
Stanwood, Washington/1969	SP, 900 g/kg	2.2	2	1 6 13	27 14 4.9	1F1021
Burlington, Washington/1969	SP, 900 g/kg	0.56	2	1 5	15 3.1	1F1021
Burlington, Washington/1969	SP, 900 g/kg	1.1	2	1 5	33 <u>7.6</u>	1F1021
Burlington, Washington/1969	SP, 900 g/kg	2.2	2	1 5 16	48 10 0.30	1F1021
Waseco, Minnesota/1969	SP, 900 g/kg	0.56	1	14	<0.02	1F1021
Waseco, Minnesota/1969	SP, 900 g/kg	2.2	1	14	0.06	2F1247
Marien, Wisconsin/1970	SP, 900 g/kg	0.56	1	1	3.0	2F1247
Marien, Wisconsin/1970	SP, 900 g/kg	1.1	1	1	4.3	2F1247
Waseca, Minnesota/1970	SP, 900 g/kg	0.56	1	1	1.3	2F1247
Waseca, Minnesota/1970	SP, 900 g/kg	1.1	1	1	4.2	2F1247
Walla Walla, Washington/1971	SP, 900 g/kg	0.56	1	3 5 7	0.11 0.10 <0.02	2F1247
Walla Walla,	SP, 900 g/kg	1.1	1	3	3.7	2F1247

Location/type/year	Form.	Application Rate (kg ai/ha)	No. of applications	PHI (days)	Residue (mg/kg)	Report no./ comment
Washington/1971				5 7	1.3 0.08	
Soya bean forage						
Blackville, South Carolina/1967	?	1.1	2	12	0.30 (1.2 air-dried)	1F1021
Raleigh, North Carolina/1968	?	0.56	4	1 7 14	0.60 (2.4 air -dried) 0.03(0.10) 0.07(0.25)	1F1021
Raleigh, North Carolina/1968	?	1.1	4	14	0.08(0.29)	1F1021
Raleigh, North Carolina/1968	?	2.2	4	14	0.40(1.43)	1F1021
Bristol, Maryland/1968	?	0.56 (13.4 soil)	7	3 7	0.92(5.75 air-dried) 0.06(0.37)	1F1021
Quincey, Florida/1968	?	0.56	1	3	<0.02	1F1021
Quincey, Florida/1968	?	1.1	1	3	0.08(0.2 air-dried)	1F1021
Quincey, Florida/1968	?	0.56 ultralow volume	1	3	5.1(14 air-dried)	1F1021
Quincey, Florida/1968	?	1.0 ultralow volume	1	3	0.08(0.2 air-dried)	1F1021
Blackville, South Carolina/1968	?	0.56	2	3 7 10	5.1(14 air-dried) 0.80(2.2) 0.12(0.3)	1F1021
Blackville, South Carolina/1968	?	1.1	2	3 7 10	8.0(22 air-dried) 3.7(10) 0.88(2.4)	1F1021

In a succulent green bean trial in Plover, Wisconsin, USA an SL formulation, 215 g/l, was applied 5 times at 6-7 day intervals at a rate of 1.0 kg ai/ha (C.M. Kennedy and Devine, 1993d). The application was foliar with ground equipment (CO_2 tractor sprayer). Replicate samples were harvested 3 days after the last treatment and stored frozen ($-20^0 \pm 5^oC$) for 10 months before analysis by method AMR 1806-90. Control recoveries were 80, 92 and 88% at 0.01, 0.10 and 1.0 mg/kg. The residues on unwashed beans were 0.42, 0.58 and 0.36 mg/kg and on washed beans 0.13, 0.21 and 0.21 mg/kg.

Pulses

Field trials on dry beans were reported from the USA. Summary results were reported for trials in California in 1970-1972 (Ashley, 2001i). In additional trials in California in 1989 (Marxmiller and Tomic, 1991) and in Michigan, Colorado, Idaho and North Dakota in 1990 (Marxmiller and Hay, 1991d) samples stored for up to 31 months were analysed by Method AMR 1806-90. Recoveries ranged from 70% to 110% from beans fortified at 0.02-0.5 mg/kg. The results for dry beans are shown in Table 46 and for dry bean hay and forage in Table 47.

Table 46. Residues of methomyl in or on dry beans after the application of SP or SL formulations in the USA (4F1437; AMR 1465-89; AMR 1602-90).

Location/year/type	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
GAP: USA	SL, SP	1.0	10	10	Aerial/Ground	14	
San Lucas, California/1971 /Lima	SP, 900 g/kg	0.56	520	1	Ground	6	<0.02
San Lucas, California/1971 /Lima	SP, 900 g/kg	1.1	520	1	Ground	6	<0.02
Collegeville, California/1972/Kidney	SP, 900 g/kg	1.1	94	1	Aerial	3	<0.02
Newman, California/1972/Lima	SP, 900 g/kg	1.0	94	1	Aerial	14	<0.02
King City, California/1972/Lima	SP, 900 g/kg	0.50	470	1	Ground	0 4 7 13	<0.02 <0.02 <0.02 <0.02
King City, California/1972/Lima	SP, 900 g/kg	1.0	470	1	Ground	0 4 7 13	<0.02 <0.02 <0.02 <0.02
King City, California/1972/Lima	SP, 900 g/kg	0.50	49	1	Aerial	0 4 7	<0.02 <0.02 <0.02
King City, California/1972/Lima	SP, 900 g/kg	1.0	49	1	Aerial	0 4 7	<0.02 <0.02 <0.02
Dixon City, California/1972/Lima	SP, 900 g/kg	1.0	330	1	Ground	1 3 7	<0.02 <0.02 <0.02
Dixon City, California/1972/Lima	SP, 900 g/kg	1.0	94	1	Aerial	1 3 7	<0.02 <0.02 <0.02
Collegeville, California/1972/Kidney	SP, 900 g/kg	1.0	94	1	Aerial	3	<0.02
Farmington, California/1972/?	SP, 900 g/kg	1.0		1		3	<0.02
Tracey, California/1972/Pinto	SP, 900 g/kg	0.50	94	1	Aerial	5	<0.02
Tracey, California/1972/Pinto	SP, 900 g/kg	1.0	94	1	Aerial	5	<0.02
Greenfield, California/1971/Lima	SP, 900 g/kg	0.50	330	2	Ground	1 7	<0.02 <0.02
Madera, California/1989/Bush	SP, 900 g/kg	1.0	360	5	Tractor sprayer	0 3 7 14 21	<0.02 <0.02 <0.02 0.023 0.026[1]
Madera, California/1989/Bush	SP, 900 g/kg	2.0	360	5	Tractor sprayer	3 7 14	<0.02 <0.02 0.024
Madera, California/1989/Cowpea	SL, 215 g/l	1.0	390	5	Tractor sprayer	14 21	<0.02 <0.02
Madera, California/1989/Cowpea	SL, 215 g/l	2.0	390	5	Tractor sprayer	0 3 14 21	0.14 0.085 <0.02 <0.02
Tracy, California/1989/Lima	SL, 215 g/l	1.0	420	5	CO_2 plot sprayer	0 3 7	0.050 0.035 <0.02

Location/year/type	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
						14 21	<0.02 <0.02
Tracy, California/1989/Lima	SL, 215 g/l	2.0	420	5	CO_2 plot sprayer	0 3 7 14 21	0.16 0.24 0.035 <0.02 <0.02
Tracy, California/1989/Lima	SL, 215 g/l	1.0	100	5	aerial	0 3 7 14 21	<0.02 <0.02 <0.02 0.02 <0.02
Tracy, California/1989/Lima	SP, 900 g/kg	1.0	420	5	CO_2 plot sprayer	0 3 7 14 21	0.045 <0.02 <0.02 <0.02 0.026
Tracy, California/1989/Lima	SP, 900 g/kg	2.0	420	5	CO_2 plot sprayer	0 3 7 14 21	<0.02 0.070 0.050 <0.02 0.026
Conklin, Michigan/1990/Albion	SL, 215 g/l	1.0	210	5	CO_2 backpack sprayer	7	0.16, 0.17, 0.18
Eaton, Colorado/1990/Pinto	SL, 215 g/l	1.0	50	5	Aerial	7	0.045
Jerome, Idaho/1990/Pinto	SL, 215 g/l	1.0	120	5	CO_2 backpack sprayer	7	<0.02
Northwood, North Dakota/1990/Navy	SL, 215 g/l	1.0	50	5	Aerial broadcast	7	<0.02

[1] Control dry bean sample showed 0.03 mg/kg methomyl.

Table 47. Residues of methomyl in or on dry bean forage and hay after the application of SP or SL formulations in the USA (4F1437; AMR 1465-89; AMR 1602-90).

Location/year/type	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
Collegeville, California/1971/Kidney	SP, 900 g/kg	1.0	94	1	Aerial	3	4.4 forage (80% water)
Patterson, California/1971/Lima	SP, 900 g/kg	1.0	140	1	Aerial	3 7	2.5 forage 1.3 (80% water)
Collegeville, California/1970/Kidney	SP, 900 g/kg	1.0	94	1	Aerial	5	0.60 forage (84% water)
Niles, Michigan/1972/Lima	SP, 900 g/kg	1.0	380	4	Ground	3	0.13 forage (80% water)
Madera, California/1989/Bush	SP, 900 g/kg	1.0	360	5	Tractor sprayer	0 3 7 14 21	18 forage 1.5 1.1 <0.50 hay <0.50
Madera, California/1989/Bush	SP, 900 g/kg	2.0	360	5	Tractor sprayer	0 3 7 14 21	30 forage 7.0 5.3 0.70 hay <0.50

Location/year/type	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
Madera, California/1989/Cowpea	SL, 215 g/l	1.0	390	5	Tractor sprayer	0 3 7 14 21	22 forage 1.6 <0.50 <0.50 hay <0.50
Madera, California/1989/Cowpea	SL, 215 g/l	2.0	390	5	Tractor sprayer	0 3 14 21	<0.50 forage[1] 8.0 3.3 <0.50 hay <0.50
Tracy, California/1989/Lima	SL, 215 g/l	1.0	420	5	CO_2 plot sprayer	0 3 7 14 21	36 forage 6.0 4.8 9.0 hay 1.6
Tracy, California/1989/Lima	SL, 215 g/l	2.0	420	5	CO_2 plot sprayer	0 3 7 14 21	70 forage 9.2 5.3 1.8 hay <0.50
Tracy, California/1989/Lima	SL, 215 g/l	1.0	100	5	aerial	0 3 7 14 21	7.4 forage 4.6 1.8 1.1 hay <0.50
Tracy, California/1989/Lima	SP, 900 g/kg	1.0	420	5	CO_2 plot sprayer	0 3 7 14 21	36 forage 6.7 2.3 3.0 hay 1.0
Tracy, California/1989/Lima	SP, 900 g/kg	2.0	420	5	CO_2 plot sprayer	0 3 7 14 21	71 forage 8.5 2.7 10 hay 5.8

[1] Thought to be an error from mislabelling of samples.

Root and tuber vegetables

Summary results were reported for potato trials in the USA (Table 48). Samples were analysed by method ML/PC-12. Recoveries were adequate from fortified controls in the range 0.02-0.60 mg/kg.

Table 48. Methomyl residues in or on potato tubers after the foliar application of SL or SP formulations in the USA.

Location, Year	Application				mg/kg after PHI (days)		Report no.
	Form.	No.	Kg ai/hl	Kg ai/ha	6	7	
GAP:	SL, SP	8	11	1.1	6		
Hastings, FL 1968	SP, 900 g/kg	3	-	0.56	<0.02		0F 0886
Leipzig, DE 1975	SL, 215 g/l	5	0.50	1.0		<0.02	0F 0886
Smyrna, DE 1974	SL, 215 g/l	5	-	1.0		<0.02	0F 0886
Essexville, MI 1973	SL, 215 g/l	1	3.0	1.1		<0.02	0F 0886
Presque Isle, MA 1975	SL, 215 g/l	7	0.086	1.0		<0.02	0F 0886
Smyrna, DE 1974	SL, 215 g/l	5	-	0.50		<0.02	0F 0886

Location, Year	Application				mg/kg after PHI (days)		Report no.
	Form.	No.	Kg ai/hl	Kg ai/ha	6	7	
Smyrna, DE 1974	SL, 215 g/l	5	-	1.0		<0.02	
Smyrna, DE	SL, 215 g/l	1	-	0.5		<0.02	0F 0886
Smyrna, DE 1974	SL, 215 g/l	1	-	1.0		<0.02	
Smyrna, DE 1974	SL, 215 g/l	2	-	0.5		<0.02	0F 0886
Smyrna, DE 1974	SL, 215 g/l	2	-	1.0		<0.02	
Williamson, NY 1972	SP, 900 g/kg	1	-	0.56	<0.02		0F 0886
Williamson, NY 1972	SL, 215 g/l	1	-	0.56	<0.02		
Salinas, CA 1971	SP, 900 g/kg	1	-	0.56		<0.02 <0.02	0F 0886
Williamson, NY 1972	SP, 900 g/kg	1	-	1.1	<0.02		0F 0886
Williamson, NY 1972	SL, 215 g/l	1	-	4.4	<0.02		
Othello, WA 1972	SP, 900 g/kg	1	-	1.1	<0.02		0F 0886

Stalk and stem vegetables

Summary data were reported for field trials on asparagus in the USA in 1972-1973 (Ashley, 2001m). Samples were analysed by method ML/PC-12. Recoveries from fortified control asparagus samples were 150% at 0.04 mg/kg (n=1), and 90% and 105 % at 0.08 mg/kg. The results are shown in Table 49.

Table 49. Residues of methomyl in or on asparagus after the foliar application of SL or SP formulations in the USA (6F1654).

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
GAP: USA	SL, SP	1.0	10	8	Aerial Ground	1	
El Centro, California/1972	SP, 900 g/kg	1.1	94	1	Aerial	1 14	0.15 <0.02
El Centro, California/1972	Sl, 215 G/L	1.1	470	1	Ground foliar	1 3 5	0.48 0.20 0.07
Hart, Michigan/1972	SP, 900 g/kg	0.56	700	1	Ground foliar	1-5	<0.04
Hart, Michigan/1972	SP, 900 g/kg	1.1	700	1	Ground foliar	1 2 3 5	0.12 0.08 <0.04 <0.04
Buchanan, Michigan/1972	SP, 900 g/kg	0.56	380	1	Ground foliar	1 2 4	0.12 <0.04 <0.04
Buchanan, Michigan/1972	SP, 900 g/kg	1.1	380	1	Ground foliar	1 2 4	0.14 0.06 <0.04
Lathrop, California/1974	SL, 215 g/l	2.0	470	5	Ground foliar	0 1 3	2.5 1.3 0.17
Lathrop, California/1974	SL, 215 g/l	1.0	470	5	Ground foliar	0 1 3	1.2 0.26 <0.02
Lathrop, California/1974	SL, 215 g/l	0.50	470	5	Ground foliar	0 1 3	0.68 0.05 <0.02
Stockton, California/1974	SL, 215 g/l	2.0	470	5	Ground foliar	0 1 3	2.3 0.87 0.07

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
Stockton, California/1974	SL, 215 g/l	1.0	470	5	Ground foliar	0 1 3	0.70 0.40 0.07
Stockton, California/1974	SL, 215 g/l	0.50	470	5	Ground foliar	0 1 3	0.55 0.19 0.21
Bridgeton, New Jersey/1974	SL, 215 g/l	2.0	560	2	Ground foliar	1	0.81
Bridgeton, New Jersey/1974	SL, 215 g/l	1.0	560	2	Ground foliar	1	0.59
Grandview, Washington/1974	SL, 215 g/l	1.1	390	2	Ground Foliar	1 2 3 4 5	1.1 0.52 0.13 0.12 <0.02

Summary information was provided for US celery trials in Florida and California from 1968-1972 (Ashley, 2001j). Samples were analysed by method ML/PC-12. Some information on recoveries was provided for the fortification range 0.08-2.0 mg/kg. In two more recent trials in Florida and California in 1990 samples were stored up to 11 months and analysed by method AMR 1806-90 (Hay and Hausmann, 1991). Fortified control samples were analysed with the treated samples. The recovery was 110% at 0.02 mg/kg. The results are shown in Table 50.

Table 50. Residues of methomyl in or on celery after the foliar application of SP or SL formulations in the USA (4F1448; AMR 1605-90).

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue [1] (mg/kg)
GAP: USA	SL, SP	1.0	10	10		7	
Sarasota, Florida/1968	WP, 900 g/kg	0.50	940	3	Foliar	3 7	2.3(0.27) 1.4(0.25)
Sarasota, Florida/1968	WP, 900 g/kg	2.0	940	3	Foliar	3 7	7.4(0.64) 4.3(0.53)
Belle Glade, Florida/1969	WP, 900 g/kg	0.50	940	1	Foliar	3 7 14	2.7(0.8) 0.52 0.06
Belle Glade, Florida/1969	WP, 900 g/kg	1.0	940	1	Foliar	3 7 14	3.4(0.80) 2.0 0.09
Zellwood, Florida/1969	WP, 900 g/kg	0.50	940	1	Foliar	2 5 7 14	1.1(0.09) 0.68 0.06 0.03
Zellwood, Florida/1969	WP, 900 g/kg	1.0	940	1	Foliar	2 5 7 14	3.2(0.25) 1.1 0.09 0.08
Salinas, California/1971	WP, 900 g/kg	1.0	140	6	Aerial	3 5 7	6.9(3.9) 3.7(1.5) 1.8(1.0)
Sarasota, Florida/1970	WP, 900 g/kg	0.50	940	1	Foliar	7 10 14	(<0.02) (<0.02) (<0.02)
Sarasota, Florida/1970	WP, 900 g/kg	1.0	940	1	Foliar	7	(<0.02)

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue [1] (mg/kg)
						10 14	(<0.02) (<0.02)
Bradenton, Florida/1967	WP, 900 g/kg	0.84	2800	11	Foliar	1 3 7 10	(1.6) (0.92) (0.10) (0.13)
Bradenton, Florida/1967	WP, 900 g/kg	1.7	2800	11	Foliar	1 3 7 10	(2.9) (2.3) (0.28) (0.14)
Sarasota, Florida/1971	WP, 900 g/kg	1.0	28	1	Aerial	1 3 7 13	22 3.2 2.0 0.17
Belle Glade, Florida/1972	SL, 215 g/l	0.50	28	2	Aerial	1 12	7.4 <0.02
Belle Glade, Florida/1972	SL, 215 g/l	0.50	490	2	Foliar	1 12	5.5 <0.02
Belle Glade, Florida/1972	SP, 900 g/kg	0.50	28	2	Aerial	1 12	7.4 <0.02
Belle Glade, Florida/1972	SP, 900 g/kg	0.50	490	2	Foliar	1 12	7.4 <0.02
Salinas, California/1972	SP, 900 g/kg	1.0	49	2	Aerial	14	(0.04)
Salinas, California/1972	SL, 215 g/l	1.0	49	2	Aerial	14	(0.02)
Belle Glade, Florida/1990	SL, 215 g/l	1.0	47	10	Aerial	7	≤0.02
Belle Glade, Florida/1990	SP, 900 g/kg	1.0	47	10	Aerial	7	≤0.02
Irvine, California/1990	SL, 215 g/l	1.0	1000	10	Foliar. Fix wet boom with drop nozzles	7	0.72
Irvine, California/1990	SP, 900 g/kg	1.0	1000	10	Foliar. Fix wet boom with drop nozzles	7	0.59

[1] Untrimmed. Values for trimmed celery are in parenthesis.

Cereal grains

Field trial data on barley, maize, oats, sorghum and wheat were provided from the USA. Summary information was submitted for barley, oats and wheat (Ashley, 2001k). Samples were analysed by method ML/PC-12. Fortified control recoveries from grain at concentrations of 0.02-1 mg/kg were adequate. Storage periods and conditions were not detailed. Findings for grain and for forage, hay and straw are shown in Tables 51 and 52 respectively.

Table 51. Residues of methomyl in or on cereal grains after the application of SL or SP formulations in the USA (5F 1615).

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
GAP: USA	SL, SP	0.5	10	4	Aerial Ground	7	
Barley							
Stillwater, Oklahoma/1974	SP, 900 g/kg	0.50	280	4	Foliar	5	0.12

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
					ground	12	0.02
Stillwater, Oklahoma/1974	SP, 900 g/kg	1.0	280	4	Foliar ground	5 12	0.14 <0.02
Stillwater, Oklahoma/1974	SL, 215 g/l	0.50	280	4	Foliar ground	5 12	0.72 <0.02
Stillwater, Oklahoma/1974	SP, 900 g/kg	1.0	280	4	Foliar ground	5 12	1.1 0.04
Arthur, North Dakota/1974	SP, 900 g/kg	0.50	28	1	Aerial	15	<0.02
Bridgeville, Delaware/1975	SL, 215 g/l	0.50	-	1	Foliar	7 14	0.33 1.3
Oats							
Rosemont, Minnesota/1974	SP, 900 g/kg	0.50	380	2	Foliar ground	7 12	<0.02 <0.02
Rosemont, Minnesota/1974	SP, 900 g/kg	1.0	380	2	Foliar ground	7 12	<0.02 0.03
Rosemont, Minnesota/1974	SL, 215 g/l	0.50	380	2	Foliar ground	7 12	<0.02 0.02
Rosemont, Minnesota/1974	SL, 215 g/l	1.0	380	2	Foliar ground	7 12	0.02 0.03
Stillwater, Oklahoma/1974	SP, 900 g/kg	0.50	280	4	Foliar ground	5 12	<0.02 <0.02
Stillwater, Oklahoma/1974	SP, 900 g/kg	1.0	280	4	Foliar ground	5 12	<0.02 <0.02
Stillwater, Oklahoma/1974	SL, 215 g/l	0.50	280	4	Foliar ground	5 12	<0.02 <0.02
Stillwater, Oklahoma/1974	SL, 215 g/l	1.0	280	4	Foliar ground	5 12	<0.02 <0.02
Rosemont, Minnesota/1974	SP, 900 g/kg	0.50	380	2	Foliar ground	7 12	<0.02 <0.02
Rosemont, Minnesota/1974	SP, 900 g/kg	1.0	380	2	Foliar ground	7 12	<0.02 0.03
Rosemont, Minnesota/1974	SL, 215 g/l	0.50	380	2	Foliar ground	7 12	<0.02 0.02
Rosemont, Minnesota/1974	SL, 215 g/l	1.0	380	2	Foliar ground	7 12	0.02 0.03
Wheat							
Chesterfield, Missouri/1974	SP, 900 g/kg	0.50	400	2	Foliar ground	1 3 8	<0.02 <0.02 0.02
Chesterfield, Missouri/1974	SL, 215 g/l	0.50	400	2	Foliar ground	1 3 8	<0.02 0.04 <0.02
Olatho, Kansas/1974	SL, 215 g/l	0.50	360	4	Foliar ground	1 3 7	0.02 <0.02 <0.02
Buchanan, Missouri/1974	SP, 900 g/kg	0.56	360	5	Foliar ground	1 3 5 7	0.09 0.04 0.03 0.12
Buchanan, Missouri/1974	SP, 900 g/kg	1.0	360	5	Foliar ground	1	0.17
Buchanan, Missouri/1974	SL, 215 g/l	0.56	360	5	Foliar ground	1 3 5 7	0.04 0.07 0.05 0.06
Buchanan, Missouri/1974	SL, 215 g/l	1.0	360	5	Foliar ground	1 5	0.21 0.24

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
Stillwater, Oklahoma/1974	SP, 900 g/kg	0.50	280	4	Foliar ground	5 12	0.30 0.09
Stillwater, Oklahoma/1974	SP, 900 g/kg	1.0	280	4	Foliar ground	5 12	0.33 0.02
Salisbury, Maryland/1984	SL, 215 g/l	0.56	38	2	Aerial	0 1 3 7 14	0.95 1.3 1.5 0.17 0.11
Salisbury, Maryland/1984	SL, 215 g/l	1.1	75	2	Aerial	0 1 3 7 14	1.3 2.83.50.110.0 8
Delmar, Delaware/1984	SL, 215 g/l	0.56	38	2	Aerial	0 1 3 7 14	0.14 0.10 0.11 <0.02 <0.02
Delmar, Delaware/1984	SL, 215 g/l	1.1	75	2	Aerial	0 1 3 7 14	0.89 0.16 0.20 0.04 <0.02
Mt. Gilead, Ohio/1984	WS,900 g/kg	0.56	94	2	Aerial	1 3 7 18	0.62 0.57 0.17 0.06
Mt. Gilead, Ohio/1984	WS,900 g/kg	1.0	94	2	Aerial	1 3 7 18	1.1 0.57 0.91 0.36
Amsterdam, Montana/1984	SL, 215 g/l	0.56	47	2	Aerial	1 3 7 14	0.53 0.36 0.40 0.13
Amsterdam, Montana/1984	SL, 215 g/l	1.1	47	2	Aerial	1 3 7 14	1.4 1.1 1.1 0.26
Phelps, New York/1974	SL, 215 g/l	0.50	560	3	Foliar	1 3 7 14	5.8 1.8 1.1 0.28
Phelps, New York/1974	SL, 215 g/l	1.0	560	3	Foliar	1 3 7 14	9.8 4.3 1.4 0.19
Phelps, New York/1974	SP, 900 g/kg	0.50	560	3	Foliar	1 3 7 14	2.9 2.0 0.69 0.04
Phelps, New York/1974	SP, 900 g/kg	1.0	560	3	Foliar	3	7.8
Chestertown, Maryland/1974	SL, 215 g/l	0.50	340	2	Foliar	1 14	2.1 0.15
Chestertown, Maryland/1974	SL, 215 g/l	0.50	340	1	Foliar	7 14	0.14 0.05
Chestertown, Maryland/1974	SP, 900 g/kg	0.50	340	1	Foliar	7	0.17

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
						14	0.07
Florence, South Carolina/1974	SL, 215 g/l	0.50	190	1	Foliar	3 7 14	0.26 <u><0.02</u> <0.02
Belleville, Illinois/1975	SL, 215 g/l	0.50	190	1	Foliar	6 14	<u>0.02</u> <0.02
Louisville, Georgia/1974	SL, 215 g/l	0.50	130	1	?	5	0.20

Table 52. Residues of methomyl in or on cereal forage, hay and straw after the application of SL or SP formulations in the USA (5F 1615).

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
GAP: USA	SL, SP	0.5	10	4	Aerial/ Ground	7	
Barley							
Stillwater, Oklahoma/1974	SP, 900 g/kg	0.50	280	2	Foliar ground	3 6 14	16 forage <u>11</u> 0.15 (80% water)
Stillwater, Oklahoma/1974	SP, 900 g/kg	1.0	280	2	Foliar ground	3 6 14	54 forage 18 0.06 (80% water)
Stillwater, Oklahoma/1974	SL, 215 g/l	0.50	280	2	Foliar ground	3 14	14 forage 0.02 (80% water)
Stillwater, Oklahoma/1974	SP, 900 g/kg	1.0	280	2	Foliar ground	3 6 14	38 forage 14 0.47 (80% water)
Stillwater, Oklahoma/1974	SP, 900 g/kg	0.50	280	4	Foliar ground	5 12	<u>2.8</u> straw <0.02
Stillwater, Oklahoma/1974	SP, 900 g/kg	1.0	280	4	Foliar ground	5 12	4.8 straw <0.02
Stillwater, Oklahoma/1974	SL, 215 g/l	0.50	280	4	Foliar ground	5 12	<u>3.1</u> straw 0.05
Stillwater, Oklahoma/1974	SL, 215 g/l	1.0	280	4	Foliar ground	5 12	6.8 straw 0.16
Bridgeville, Delaware/1975	SL, 215 g/l	0.50	-	1	Foliar	7 14	<u>0.41</u> forage 3.1
Oats							
Stillwater, Oklahoma/1974	Sl, 215 g/l	0.50	280	2	Foliar	14	0.05 forage (78% water)
Stillwater, Oklahoma/1974	Sl, 215 g/l	1.0	280	2	Foliar	14	0.27 forage (78% water)
Stillwater, Oklahoma/1974	SP, 900 g/kg	0.50	280	2	Foliar	14	0.08 forage (78% water)
Stillwater, Oklahoma/1974	Sl, 215 g/l	1.0	280	2	Foliar	14	0.09 forage (78% water)
Stillwater, Oklahoma/1974	SL, 215 g/l	0.50	280	4	Foliar	5 12	1.7 straw <0.02
Stillwater, Oklahoma/1974	SL, 215 g/l	1.0	280	4	Foliar	5 12	7.1 straw <0.05
Stillwater,	SP, 900 g/kg	0.50	280	4	Foliar	5	2.5 straw

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
Oklahoma/1974						12	<0.05
Stillwater, Oklahoma/1974	SL, 215 g/l	1.0	280	4	Foliar	5 12	6.6 straw <0.05
Rosemont, Minnesota/1974	SL, 215 g/l	0.50	380	2	Foliar	7 12	0.16 forage 0.24
Rosemont, Minnesota/1974	SL, 215 g/l	1.0	380	2	Foliar	7 12	0.89 forage 0.14
Rosemont, Minnesota/1974	SP, 900 g/kg	0.50	380	2	Foliar	7 12	0.15 forage 0.10
Rosemont, Minnesota/1974	SP, 900 g/kg	1.0	380	2	Foliar	7 12	0.18 forage 0.24
Phelps, New York/1975	SL, 215 g/l	1.0	560	4	Foliar ground	7 21	0.65 forage <0.02
Phelps, New York/1975	SL, 215 g/l	0.50	560	4	Foliar ground	7 21	0.17 forage <0.02
Phelps, New York/1975	SL, 215 g/l	0.25	560	4	Foliar ground	7 21	0.05 forage <0.02
Wheat							
Chesterfield, Missouri/1974	SL, 215 g/l	0.50	400	2	Foliar ground	7 8 15	0.24 forage (70% water) 2.0 straw 1.0
Chesterfield, Missouri/1974	SL, 215 g/l	1.0	400	2	Foliar ground	7 14	0.87 forage 0.19 (70% water)
Chesterfield, Missouri/1974	SP, 900 g/kg	0.50	400	2	Foliar ground	8 15	2.0 straw 1.0
Chesterfield, Missouri/1974	SP, 900 g/kg	1.0	400	2	Foliar ground	7 14	0.87 forage 0.19 (70% water)
Olathe, Kansas/1974	SL, 215 g/l	0.50	360	2	Foliar ground	7 14	0.85 forage 0.03 (68% water)
Olathe, Kansas/1974	SL, 215 g/l	0.50	360	4	Foliar ground	3 7 14	0.90 straw 0.62 0.16
Buchanan, Missouri/1974	SP, 900 g/kg	0.56	380	2	Foliar ground	7 14	0.38 forage 0.03 (68% water)
Buchanan, Missouri/1974	SP, 900 g/kg	1.1	380	2	Foliar ground	7	0.52 forage (68% water)
Buchanan, Missouri/1974	SL, 215 g/l	0.56	380	2	Foliar ground	7 14	0.12 forage 0.03 (68% water)
Buchanan, Missouri/1974	SL, 215 g/l	1.1	380	2	Foliar ground	7	0.32 forage (68% water)
Buchanan, Missouri/1974	SP, 900 g/kg	0.56	380	5	Foliar ground	1 3	23 straw 12
Buchanan, Missouri/1974	SP, 900 g/kg	1.1	380	5	Foliar ground	1 7	55 15
Buchanan, Missouri/1974	SL, 215 g/l	0.56	380	5	Foliar ground	1 3 5 7	26 straw 20 11 0.43
Buchanan, Missouri/1974	SL, 215 g/l	1.1	380	5	Foliar ground	1 7	34 straw 15
Bennington, Nebraska/1974	SP, 900 g/kg	0.50	970	2	Foliar ground	8	0.59 forage (64% water)

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
Bennington, Nebraska/1974	SP, 900 g/kg	0.50	970	2	Foliar ground	7	4.6 straw
Bennington, Nebraska/1974	SL, 215 g/l	0.50	970	2	Foliar ground	8	0.37 forage (64% water)
Bennington, Nebraska/1974	SL, 215 g/l	0.50	970	2	Foliar ground	7	2.8 straw
Stillwater, Oklahoma/1974	SP, 900 g/l	0.50	280	2	Foliar ground	1 3 6 14	48 forage 18 4.9 0.16 (80% water)
Stillwater, Oklahoma/1974	SP, 900 g/l	1.0	280	2	Foliar ground	1 3 6 14	36 forage 30 6.4 0.34 (80% water)
Stillwater, Oklahoma/1974	SP, 900 g/l	0.50	280	4	Foliar ground	5 12	3.7 straw 0.09
Stillwater, Oklahoma/1974	SP, 900 g/l	1.0	280	4	Foliar ground	5 12	1.8 straw 0.08
Stillwater, Oklahoma/1974	SL, 215 g/l	0.50	280	2	Foliar ground	1 3 6 14	22 forage 12 4.9 0.14 (80% water)
Stillwater, Oklahoma/1974	SP, 900 g/l	1.0	280	2	Foliar ground	`	46 forage 34 12 0.12 (80% water)
Stillwater, Oklahoma/1974 Triticale	SP, 900 g/kg	0.50	280	2	Foliar ground	14	<0.03 forage (80% water)
Stillwater, Oklahoma/1974 Triticale	SP, 900 g/kg	1.0	280	2	Foliar ground	14	0.09 forage (80% water)
Stillwater, Oklahoma/1974 Triticale	SL, 215 g/l	0.50	280	2	Foliar ground	14	0.12 forage (80% water)
Stillwater, Oklahoma/1974 Triticale	SL, 215 g/l	0.50	280	2	Foliar ground	5 12	3.0 straw 0.09
Stillwater, Oklahoma/1974 Triticale	SL, 215 g/l	1.0	280	2	Foliar ground	5 12	4.2 straw 0.15
Stillwater, Oklahoma/1974 Triticale	SP, 900 g/kg	0.50	280	2	Foliar ground	5 12	2.1 straw 0.92
Stillwater, Oklahoma/1974 Triticale	SP, 900 g/kg	1.0	280	2	Foliar ground	5 12	2.4 straw 0.07
Salisbury, Maryland/1984	SL, 215 g/l	0.56	38	2	Aerial	0 1 3 7 14	18 straw 8.1 3.4 0.39 0.20
Salisbury, Maryland/1984	SL, 215 g/l	1.1	75	2	Aerial	0 1	54 straw 28

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
						3 7 14	12 0.82 0.32
Delmar, Delaware/1984	SL, 215 g/l	0.56	38	2	Aerial	0 1 3 7 14	2.6 straw 1.7 0.82 <0.02 <0.02
Delmar, Delaware/1984	SL, 215 g/l	1.1	75	2	Aerial	0 1 3 7 14	6.4 straw 1.9 1.7 0.50 <0.02
Mt. Gilead, Ohio/1984	WS, 900 g/kg	0.56	94	2	Aerial	1 3 7 18	23 straw 40 6.5 0.53
Mt. Gilead, Ohio/1984	WS, 900 g/kg	1.1	94	2	Aerial	1 3 7 18	28 straw 35 10 2.4
Amsterdam, Montana/1984	WL, 215 g/l	0.56	47	2	Aerial	1 3 7 14	9.7 straw 5.3 5.7 0.8
Amsterdam, Montana/1984	WL, 215 g/l	1.1	47	2	Aerial	1 3 7 14	15 straw 12 9.1 1.7
Phelps, New York/1974	Sl, 215 g/l	0.50	560	3	Foliar	1 3 7 14	2.6 forage 3.2 0.53 0.09
Phelps, New York/1974	Sl, 215 g/l	1.0	560	3	Foliar	1 3 7 14	5.3 forage 5.8 3.5 0.18
Phelps, New York/1974	SP, 900 g/kg	0.50	560	3	Foliar	1 3 7 14	1.9 forage 3.7 0.26 0.10
Phelps, New York/1974	SP, 900 g/kg	1.0	560	3	Foliar	3	9.6 forage
Chestertown, Maryland/1974	SL, 215 g/l	0.50	560	1-2	Foliar	1 7 14	8.5 forage 2.7 1.8
Chestertown, Maryland/1974	SP, 900 g/kg	0.50	560	1-2	Foliar	7 14	3.1 forage 0.99
Florence, South Carolina/1974	SL, 215 g/l	0.50	190	2	Foliar	3 7 14	4.5 forage 0.05 0.02
Belleville, Illinois/1975	SL, 215 g/l	0.50	19	1	Aerial	6 14	0.12 forage 0.05
Chesterfield, Missouri/1974	SL, 215 g/l	0.50	400	2	Foliar	4 7	1.5 forage 0.06
Chesterfield, Missouri/1974	SL, 215 g/l	1.0	400	2	Foliar	4	1.9 forage
Chesterfield,	SP, 900 g/kg	0.50	400	2	Foliar	4	2.0 forage

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
Missouri/1974							
Chesterfield, Missouri/1974	SP, 900 g/kg	1.0	400	2	Foliar	4 7	2.1 forage 1.5
Murrayville, Illinois/1974	SP, 900 g/kg	0.50	870	2	Foliar	4 7 14	1.6 forage <u>0.02</u> 0.04
Murrayville, Illinois/1974	SP, 900 g/kg	1.0	870	2	Foliar	4 7 14	0.20 forage 0.17 0.03
Murrayville, Illinois/1974	SL, 215 g/l	0.50	870	2	Foliar	4 7 14	1.5 forage <u>0.57</u> 0.07
Murrayville, Illinois/1974	SL, 215 g/l	1.0	870	2	Foliar	4 7 14	3.7 forage 2.6 0.16
Louisville, Georgia/1974	SL, 215 g/l	0.50	130	1	Aerial?	5	0.67 forage[1]
Buchanan, Michigan/1974	SL, 215 g/l	0.56	380	2	Foliar	3	2.4 forage
Buchanan, Michigan/1974	SL, 215 g/l	1.1	380	2	Foliar	3	1.2 forage
Buchanan, Michigan/1974	SP, 900 g/kg	0.56	380	2	Foliar	3	4.7 forage
Buchanan, Michigan/1974	SP, 900 g/kg	1.1	380	2	Foliar	3	3.9 forage
Bennington, Nebraska/1974	SP, 900 g/kg	0.50	970	2	Foliar	3	1.7 forage
Bennington, Nebraska/1974	SL, 215 g/l	0.50	970	2	Foliar	3	2.7 forage

[1] Control contained 0.27 mg/kg.

Sorghum field trials were conducted in the USA in 1967-1971 (Ashley, 2001h) and in 1991 (Hausmann and Devine, 1992a). Samples of grain and stover were analysed by method ML/PC-12 with the flame photometric detector modification in the early trials, with adequate recoveries from grain demonstrated from 0.02-1.0 mg/kg (0.02 mg/kg 94% and 114%). In 1991 samples of grain were collected randomly at maturity, stored frozen for a maximum of 8 months, and analysed by method AMR 1806-90. Recoveries of methomyl from fortified control grain samples at 0.02-1.0 mg/kg (at 0.02 mg/kg 115%) were adequate.

Table 53. Residues of methomyl in or on sorghum grain after the application of G, SP, or SL formulations in the USA (3F 1307; AMR 1926-91).

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
GAP: USA	SL, SP	0.5	19	2	Aerial Ground	14	
Marana, Arizona/1970	G, 5 g ai/100g	1.1	-	1	Broadcast	57	<0.02
Weslaco, Texas/1967	G, 5 g ai/100g	0.56	-	1	Band	65	<0.02
Weslaco, Texas/1967	G, 5 g ai/100g	1.1	-	1	Band	65	<0.02
Tolleson, Arizona/1971	G, 5g ai/100g	1.1	-	1	Band	48	<0.02
Tolleson, Arizona/1971	G, 5g ai/100g	2.2	-	1	Band	48	<0.02
Tolleson, Arizona/1971	G, 5g ai/100g	0.45	-	1	Band	48	<0.02
Chandler, Arizona/1971	G, 5g ai/100g	0.6	-	1	Aerial	48	<0.02

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
Buckeye, Arizona/1971	G, 5g ai/100g	0.84	-	1	Aerial	45	<0.02
Buckeye, Arizona/1971	G, 5g ai/100g	0.45	-	1	Band	45	<0.02
Harquella, Arizona/1971	G, 5g ai/100g	0.45	-	1	Aerial	39	<0.02
Tolleson, Arizona/1971	SP, 900 g/l kg	1.1	?	1	Ground broadcast	14	0.03
Tolleson, Arizona/1971	SP, 900 g/l kg	2.2	?	1	Ground broadcast	14	0.08
Clovis, New Mexico/1971	SP, 900 g/kg	0.78	?	1	Aerial	54	<0.02
Tolleson, Arizona/1971	SP, 900 g/kg	0.37	?	1	Aerial	5 15	0.09 0.07
Buckeye, Arizona/1971	G, 5g ai/ha SP, 900 g/kg	0.45 0.37	 ?	1 1	Band Aerial	 3 13	 0.36 <0.02
York, Nebraska/1991	SP, 900 g/kg	0.50	47	4	Ground. 3 pt tractor sprayer	14	0.029
Robinson, Kansas/1991	SL, 215 g/l	0.50	170	4	CO_2 backpack sprayer	14	<0.020
Eakly, Oklahoma/1991	SL, 215 g/l	0.50	140	4	CO_2 backpack sprayer	14	0.099
Oregon, Missouri/1991	SP, 900 g/kg	0.50	170	4	CO_2 backpack sprayer	14	0.12[1]

[1] Milo colouring dough stage at last treatment. At harvest, mature but still had high moisture content. Control sample contained 0.11 mg/kg.

Maize and sweet corn trials were reported from the USA (Hay, 1991b). Samples of sweet corn (kernel + cob, husk removed), maize grain, forage (entire plant, including ear) and fodder (plant without ear) were harvested at maturity and stored frozen as homogenates up to 11 months before extraction and analysis by method AMR 1806-90. Recoveries from fortified grain, fodder and forage were acceptable in the 0.02-0.20 mg/kg range for grain and 0.02-10 mg/kg range for fodder and forage. The overall recovery was 93% ± 10%, n=19. The results are shown in Tables 54 and 55.

The Tables indicate the results of earlier supervised field trials in the USA (1966-1967) (Ashley, 2001n). In most cases kernels without cobs were analysed.

Table 54. Residues of methomyl in or on sweet corn kernels and cobs and maize grain after the foliar application of SL or SP formulations in the USA (AMR 1607-90; 8F0677).

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
Sweet corn							
GAP: USA	SL	0.5	10	28		Ear 0 Forage 3	
Belle Glade, Florida/1990	SL, 215 g/l	0.50	47	24	Aerial	0	<0.02
Belle Glade, Florida/1990	SL, 290 g/l	0.50	47	24	Aerial	0	<0.02
Phelps, New York/1990	SL, 215 g/l	0.50	280	16	Pressurized canister. Ground foliar.	0	<0.02
Phelps, New York/1990	SP, 900 g/kg	0.50	280	16	Pressurized canasta. Ground foliar.	0	<0.02
Hollandale, Minnesota/1990	SL, 215 g/l	0.50	180-230	16	Off-set boom. Foliar broadcast	0	0.021
Hollandale, Minnesota/1990	SP, 900 g/kg	0.50	180-230	16	Off-set boom. Foliar broadcast	0	<0.02
Newark, Delaware/1990	SL, 215 g/l	0.50	710-730	16	High clearance CO_2 sprayer. Foliar.	0	0.052
Newark, Delaware/1990	SP, 900 g/kg	0.50	710-730	16	High clearance CO_2	0	0.043

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
					sprayer. Foliar.		
Bradenton, Florida/1967	SP, 900 g/kg	0.56		4		1 3	<0.02 <0.02 kernel only
Bradenton, Florida/1967	SP, 900 g/kg	1.1		1		1	0.03
Wesalco, Texas 1967	SP, 900 g/kg	0.56		2		0 1	<0.02 <0.02 kernel only
Newark, Delaware 1967	SP, 900 g/kg	0.42		10		1	0.03 kernel only
Arlington, Wisconsin 1967	SP, 900 g/kg	0.56		2		3	<0.02 kernel only
Guckeen, Minnesota 1967	SP, 900 g/kg	0.56		2		3	<0.02 kernel only
Niles, Michigan 1967	SP, 900 g/kg	1.1		3		3	0.04
Rochelle, Illinois 1967	SP, 900 g/kg	1.1		5		3 8	<0.02 <0.02 kernel only
Rochelle, Illinois 1967	SP, 900 g/kg	1.7		5		3 8	0.07 0.02 kernel only
Portageville, Missouri 1967	SP, 900 g/kg	0.84		14		3	0.03 kernel only
Riverside, California 1967	SP, 900 g/kg	0.56		3		1	<0.02
Springfield, Tennessee 1967	SP, 900 g/kg	0.56		3		1	<0.02
Maize (Field corn)							
GAP: USA	SL, SP	0.5	5	10		Ear 21 Forage 3 Fodder 21	
Phelps, New York/1990	SL, 215 g/l	0.50	280	16	Pressurized canister. Ground foliar.	21	<0.02
Phelps, New York/1990	SP, 900 g/kg	0.50	280	16	Pressurized canasta. Ground foliar.	21	<0.02
Hollandale, Minnesota/1990	SL, 215 g/l	0.50	180-230	16	Off-set boom. Foliar broadcast	21	<0.02
Hollandale, Minnesota/1990	SP, 900 g/kg	0.50	180-230	16	Off-set boom. Foliar broadcast	21	<0.02
Newark, Delaware/1990	SL, 215 g/l	0.50	710-730	16	High clearance CO_2 sprayer. Foliar.	21	<0.02
Newark, Delaware/1990	SP, 900 g/kg	0.50	710-730	16	High clearance CO_2 sprayer. Foliar.	21	<0.02

Table 55. Residues of methomyl in or on sweet corn and maize forage and fodder after the foliar application of SL or SP formulations in the USA (AMR 1607-90; 8F 0677).

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)[1]
Sweet corn forage							
GAP: USA	SL	0.5	10	28		Ear 0 Forage 3	
Phelps, New	SL, 215 g/l	0.50	280	16	Pressurized canister.	3	4.8

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)[1]
York/1990					Ground foliar.		
Phelps, New York/1990	SP, 900 g/kg	0.50	280	16	Pressurized canister. Ground foliar.	3	2.7
Hollandale, Minnesota/1990	SL, 215 g/l	0.50	180-230	16	Off-set boom. Foliar broadcast	3	3.2
Hollandale, Minnesota/1990	SP, 900 g/kg	0.50	180-230	16	Off-set boom. Foliar broadcast	3	3.3
Newark, Delaware/1990	SL, 215 g/l	0.50	710-730	16	High clearance CO_2 sprayer. Foliar.	3	2.5
Newark, Delaware/1990	SP, 900 g/kg	0.50	710-730	16	High clearance CO_2 sprayer. Foliar.	3	3.3
Chico, California/1990	SL, 215 g/l	0.50	94	16	Tractor mounted backpack sprayer. Foliar.	3	2.9
Chico, California/1990	SP, 900 g/kg	0.50	94	16	Tractor mounted backpack sprayer. Foliar.	3	2.3
Sweet corn fodder							
Bradenton, Florida 1966	SP, 900 g/kg	0.56		12		3 7 14	0.40 0.09 <0.02
Arlington, Wisconsin 1967	SP, 900 g/kg	0.56		2		3	0.56
Arlington, Wisconsin 1967	SP, 900 g/kg	1.1		2		3	1.0
Guckeen, Minnesota 1967	SP, 900 g/kg	0.56		3		4	0.22
Guckeen, Minnesota 1967	SP, 900 g/kg	1.1		3		4	0.26
Niles, Michigan 1967	SP, 900 g/kg	1.1		3		3	3.6 1.7
Portageville, Missouri 1967	SP, 900 g/kg	0.84		14		3	1.0
Rochelle, Illinois 1967	SP, 900 g/kg	1.1		3		3 7	7.2 1.7
Rochelle, Illinois 1967	SP, 900 g/kg	1.7		3		3 7	19 11
Maize forage and fodder							
GAP: USA	SL, SP	0.5	5	10		Forage 3 Fodder 21	
Phelps, New York/1990	SL, 215 g/l	0.50	280	16	Pressurized canister. Ground foliar.	3 21	6.9 forage 0.71 fodder
Phelps, New York/1990	SP, 900 g/kg	0.50	280	16	Pressurized canister. Ground foliar.	3 21	6.6 forage 0.30 fodder
Hollandale, Minnesota/1990	SL, 215 g/l	0.50	180-230	16	Off-set boom. Foliar broadcast	3 21	0.72 forage 0.029 fodder
Hollandale, Minnesota/1990	SP, 900 g/kg	0.50	180-230	16	Off-set boom. Foliar broadcast	3 21	1.0 forage 0.094 fodder
Newark, Delaware/1990	SL, 215 g/l	0.50	710-730	16	High clearance CO_2 sprayer. Foliar.	3 21	1.8 forage 0.094 fodder
Newark, Delaware/1990	SP, 900 g/kg	0.50	710-730	16	High clearance CO_2 sprayer. Foliar.	3 21	1.3 forage 0.053 fodder

[1] No information on moisture content.

Oilseed

Cotton seed trials were reported from the USA (Ashley, 2001e) and Europe (Weidenauer *et al.*, 1998o). Only summary information was provided for the US trials, 1966-1971, where the samples were analysed by method ML/PC-12 with a flame photometric detector. Recoveries of methomyl were adequate in the concentration range 0.02-8.0 mg/kg. In trials in Spain and Greece in 1996 duplicate samples from each plot were manually delinted, ground and frozen for up to 18 months (Greece) and 6 months (Spain) for analysis by method AMR 3015-94. The recovery of methomyl at 0.02 mg/kg was 80%, 71% and 106%. The results are shown in Table 56.

Table 56. Residues of methomyl in or on cotton seed after the foliar application of SP or SL formulations in the USA and Europe (1F 1162; AMR 4039-96).

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
GAP: USA	SL SP	0.50 east 0.76 west 0.68 Texas	8 kg/hl SL 15 kg/hl SP	8	Aerial/ Ground	15	
GAP: Spain	SL	0.4	800	3		7	
GAP: Greece	SL	0.7		3		20	
Brawley, California/1970	SP, 900 g/kg	1.1		2		28	<0.02
Somerton, Arizona/1970	SP, 900 g/kg	0.56		6		36	<0.02
San Joaquin, California/1966	SP, 900 g/kg	0.56		3		59	<0.02
Bakersfield, California/1966	SP, 900 g/kg	1.1		1		39	<0.02
Kingsburg, California/1970	SP, 900 g/kg	1.1		1		2 8 15	0.1 <0.02 0.1
Tonopah, Arizona/1970	SP, 900 g/kg	0.56		2		61	<0.02
Liberty, Arizona/1970	SP, 900 g/kg	0.56		1		44	<0.02
Peoria, Arizona/1970	SP, 900 g/kg	0.56		2		36	<0.02
Buckeye, Arizona/1970	SP, 900 g/kg	0.56		1		39	<0.02
Buckeye, Arizona/1970	SP, 900 g/kg	1.1		3		60	<0.02
Sugarland, Texas/1970	SP, 900 g/kg	1.1		3		25	<0.02
Fingsburg, California/1970	SP, 900 g/kg	1.1	94	1	Aerial	2 8 15	0.1 <0.02 0.1
Sugarland, Texas/1970	SP, 900 g/kg	1.1	75	3	Aerial	25	<0.02
Texas A&M, Texas/1971	SP, 900 g/kg	0.74	19	8	Aerial	17	<0.02
Clay, Texas/1971	SP, 900 g/kg	0.74		14	Aerial	6	<0.02
Bloy, Arizona/1971	SP, 900 g/kg	0.56	66	3	Aerial	10	0.05
Peoria, Arizona/1971	SP, 900 g/kg	0.74	47	9	Aerial	11	<0.02
Buckeye, Arizona/1971	SP, 900 g/kg	0.56	47	3	Aerial	14	<0.02
Mercedes, Texas/1970	SP, 900 g/kg	0.56	28	1	Aerial	12 14	<0.02 <0.02
Ft. Valley, Georgia/?	SP, 900 g/kg	0.56	47	3	Aerial	25	<0.02
Ft. Valley, Georgia/?	SP, 900 g/kg	1.1	47	3	Aerial	25	<0.02
Villamanrique, Spain/1996	SL, 200 g/l	0.54	604	4	Foliar by ground sprayer	-1 h +3 h 3 7 14 21	<0.02 <0.02, <0.02 <0.02, <0.02 0.02, 0.02 <0.02, <0.02 <0.02, <0.02
Korifi, Greece/1996	SL, 200 g/l	0.72	770	4	Foliar by ground	21	<0.02

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)
					sprayer		

Summary information was reported for peanut trials in 1969-1970 in the USA (Ashley, 2001c). Samples were analysed by ML/PC-12. Recoveries of 65%-100% were adequate at 0.04-2.0 mg/kg fortifications of kernels. The US label forbids the feeding of treated foliage (forage or fodder). Results are shown in Table 57.

Table 57. Residues of methomyl in or on peanut kernels, hulls and foliage after the foliar application of a WP formulation (900 g ai/kg) in the USA (1F 1158).

Location/year	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue (mg/kg)		
						Kernel	Hull	Foliage
GAP: USA	SL, SP 1.0	11 kg ai/hl 10	8	Aerial/ Ground	21			
North Carolina/1969	0.50		4	Foliar	33			<0.02
North Carolina/1969	1.0		4	Foliar	33	<0.02	<0.02	0.04
Georgia/1970	0.50	190	1	Foliar	7 14	<0.02	<0.02	0.02 <0.02
Georgia/1970	1.0	190	1	Foliar	7 14	≤0.02	<0.02	4.6 0.23
Virginia/1970	0.56	140	4	Foliar	82	<0.02	<0.02	<0.02
Alabama/1970	1.0	110	1	Foliar	8 15	<0.02	<0.09	1.4 0.34
Alabama/1970	0.56	380	1	Foliar	40	≤0.02	<0.02	<0.02
North Carolina/1970	0.50	380	3	Foliar	1 3 7 21			20 14 1.8 0.34
North Carolina/1970	1.0	380	3	Foliar	1 3 7 21			46 27 5.5 0.48
North Carolina/1970	2.0	380	3	Foliar	1 3 7 21	 <0.02	 <0.02	>100 48 16 3.8

Legume animal feeds

Alfalfa. Supervised field trials were conducted in the USA in 1992 (C. M. Kennedy and Orescan, 1995). Applications, one at each cutting, with a total of 4 cuttings at each location, were made with carbon dioxide plot, backpack, or tractor sprayers about 7 days before harvest. The cut alfalfa was air dried for 3 days (PHI for hay refers to the day samples were frozen, cutting date + 3 days) and then frozen. Replicate samples were stored frozen up to 26 months before analysis by method AMR 2137-92. Recoveries from fortified controls were adequate at 0.05 mg/kg in both forage and hay. The results are shown in Table 58.

Additional US data were reported for trials in 1967 (Ashley, 2001d). A WS formulation was applied once, and the crop cut at 0-13 day intervals. Samples were analysed by method ML/PC-12 with an FPD. Adequate recovery was demonstrated at 0.04 mg/kg (Table 58).

Table 58. Residues of methomyl in or on alfalfa forage and hay after the application of SP or SL formulations in the USA (AMR 213792, 1F 1159).

Location/year	Form.	Rate (kg ai/hg)	Spray vol. (l/ha)	Appl. no.	PHI (days)	Residue (mg/kg)
GAP: USA	SP, SL	1.0	11 kg ai/hl 10	10	7 (grazing/feeding)	
FORAGE						
Newark, Delaware 1992	SL, 215 g/l	1.0	470 .	1	7	<u>2.5</u>
				1	10	0.72 0.90 0.96
			480	2	7	<u>1.1</u>
				2	10	0.12 0.047 0.39
			460	3	7	<u>0.56</u>
				3	10	0.077 0.083 0.16
			490	4	7	12.0[1]
				4	10	0.73[1] 0.68 0.78
Newark, Delaware 1992	SP, 900 g/kg	1.0	470	1	7	<u>1.8</u>
				1	10	0.45 0.91 0.64
			480	2	7	<u>1.3</u>
				2	10	0.16 0.075 0.13
			460	3	7	<u>0.11</u>
				3	10	0.13 0.43 0.20
			490	4	7	7.3[1]
				4	10	1.8[1] 1.7 1.2
Madera, California 1992	SL, 215 g/l	1.0	.47	1	7	<u>1.9</u>
				1	10	0.47 0.46 0.46
			47	2	7	<u>3.8</u>
				2	10	2.5[2] 5.9 1.5
			47	3	7	<u>3.5</u>
				3	10	1.8 2.2 0.94
			47	4	7	<u>2.5</u> 1.0 2.2
				4	10	0.021 0.024 0.061

Location/year	Form.	Rate (kg ai/hg)	Spray vol. (l/ha)	Appl. no.	PHI (days)	Residue (mg/kg)
Madera, California 1992	SP, 900 g/kg	1.0	47	1	7	-
				1	10	7.0 6.9 5.9
			47	2	7	-
				2	10	5.3[2] 3.2 2.4
			47	3	7	-
				3	10	
			47	4	7	2.2 2.9 3.6
				4	10	1.3 1.2 1.3
Ault, Colorado 1992	SL, 215 g/l	1.0	94	1	7	4.2
				1	10	4.0 3.6 1.6
			94	2	7	2.3
				2	10	0.60 0.42 0.50
			103	3	7	2.3
				3	10	0.95 0.80 1.5
			103	4	7	6.3 3.2 4.6
				4	10	2.9 2.3 2.7
Ault, Colorado 1992	SP, 900 g/kg	1.0	94	1	7	-
				1	10	3.8 2.6 2.6
			94	2	7	-
				2	10	0.70 0.56 0.68
			103	3	7	-
				3	10	0.73 1.2 0.29
			103	4	7	6.6 7.0 5.0
				4	10	3.0 1.5 2.4
Germansville, Pennsylvania 1992	SL, 215 g/l	1.0	200	1	7	-
				1	10	0.68
			190	2	7	0.044

Location/year	Form.	Rate (kg ai/hg)	Spray vol. (l/ha)	Appl. no.	PHI (days)	Residue (mg/kg)
				2	10	0.023
			240	3	7	0.70
				3	10	0.097
Germansville, Pennsylvania 1992	SP, 900 g/kg	1.0	200	1	7	-
				1	10	0.42
			190	2	7	-
				2	10	0.032
			240	3	7	0.57
				3	10	0.066
Rocehlle, Illinois 1992	SL, 215 g/l	1.0	130	1	7	4.2
				1	10	0.060
			140	2	7	0.98
				2	10	0.17
			140	3	7	2.0
				3	10	0.21
			150	4	7	0.10
				4	10	0.031
Rocehlle, Illinois 1992	SP, 900 g/kg	1.0	130	1	7	-
				1	10	0.079
			140	2	7	-
				2	10	0.17
			140	3	7	-
				3	10	0.19
			150	4	7	0.10
				4	10	0.028
Urbandale, Iowa 1992	SL, 215 g/l	1.0	47	1	7	0.64
				1	10	0.18
			47	2	7	1.8
				2	10	0.12
			47	3	7	0.15
				3	10	0.029
			47	4	7	0.43
				4	10	0.14
Urbandale, Iowa 1992	SP, 900 k/kg	1.0	47	1	7	-
				1	10	0.23
			47	2	7	-
				2	10	0.072
			47	3	7	-
				3	10	0.043
			47	4	7	1.5
				4	10	0.14
Madera, California 1992	SL, 215 g/l	1.0	270	1	7	4.0
				1	10	0.32 5.8 4.1
			230	2	7	8.8[2]
				2	10	3.8[2] 4.1 3.2
			250	3	7	4.6
				3	10	0.94

Location/year	Form.	Rate (kg ai/hg)	Spray vol. (l/ha)	Appl. no.	PHI (days)	Residue (mg/kg)
						1.1 1.9
			260	4	7	2.6 3.4 2.8
				4	10	0.76 1.3 0.85
Madera, California 1992	SP, 900 g/kg	1.0	270	1	7	-
				1	10	5.6
			230	2	7	-
				2	10	3.4[2] 2.1 7.5
			250	3	7	-
				3	10	1.2 1.5 1.4
			260	4	7	2.1 2.6 1.9
				4	10	0.64 1.0 0.61
Plainview, Texas 1992	SL, 215 g/l	1.0	110	1	7	2.1
				1	10	2.5
			120	2	7	0.081
				2	10	<0.020
			110	3	7	0.25
				3	10	0.058
			150	4	7	1.6 1.1 1.4
				4	10	0.41
Plainview, Texas 1992	SP, 900 g/kg	1.0	110	1	7	-
				1	10	1.2
			120	2	7	-
				2	10	0.023
			110	3	7	-
				3	10	0.053
			150	4	7	1.6 1.7 0.95
				4	10	0.73
Fallon, Nevada 1967	SP, 900 g/kg	0.56	190	1	0 3 7 13	20 6.5 1.8 0.2 (80% moisture)
Fallon, Nevada 1967	SP, 900 g/kg	1.1	190	1	0 3 7	100 26 4.0 (80% moisture)
Berino, New Mexico 1967	SP, 900 g/kg	1.1	360	1	1 4 6	18 4.0 1.5

Location/year	Form.	Rate (kg ai/hg)	Spray vol. (l/ha)	Appl. no.	PHI (days)	Residue (mg/kg)
						(80% moisture)
Niles, Michigan 1967	SP, 900 g/kg	0.56	380	1	3 8	3.2 0.41 (88% moisture)
Lebanon, Pennsylvania 1967	SP, 900 g/kg	0.56	470	1	3 7	2.0 0.34 (80% moisture)
French Camp, California 1970	SP, 900 g/kg	0.28	470	1	5	0.68 (72% moisture)
	SP, 900 g/kg	1.1	470	1	5	2.7 (72% moisture)
Tracy, California	SP, 900 g/kg	0.56	-	1	1 5	7.8 0.30 (76% moisture)
Lathrop, California 1970	SP, 900 g/kg	0.56	-	1	5	0.90 (76% moisture)
	SP, 900 g/kg	1.1	-	1	5	3.7 (76% moisture)
HAY						
Newark, Delaware 1992	SL, 215 g/l	1.0	470	1	7	3.5
				1	10	0.56 0.61 0.73
			480	2	7	6.2
				2	10	0.47 1.9 0.44
			460	3	7	1.1
				3	10	0.31 0.21 0.14
			490	4	7	13. 13. 15.
				4	10	0.60[1] 0.78 0.68
Newark, Delaware 1992	SP, 900 g/kg	1.0	470	1	7	3.3
				1	10	2.1 0.88 0.68
			480	2	7	1.4
				2	10	0.52 0.48 0.35
			460	3	7	1.1
				3	10	0.12 0.38 0.40
			490	4	7	14. 14. 13.
				4	10	1.1[1] 0.93 0.92
Madera, California 1992	SL, 215 g/l	1.0	.47	1	7	4.6
				1	10	0.64

Location/year	Form.	Rate (kg ai/hg)	Spray vol. (l/ha)	Appl. no.	PHI (days)	Residue (mg/kg)
						0.76 0.60
			47	2	7	14 17
				2	10	17[2] 6.5 7.2
			47	3	7	3.4
				3	10	2.7 2.9 2.9
			47	4	7	0.49 0.81 1.8
				4	10	0.081 0.049 0.043
Madera, California 1992	SP, 900 g/kg	1.0	47	1	7	-
				1	10	7.2 8.7 6.9
			47	2	7	-
				2	10	11[2] 13 6.8
			47	3	7	-
				3	10	5.3 1.7 3.5
			47	4	7	4.0
				4	10	2.5 3.0 3.6
Ault, Colorado 1992	SL, 215 g/l	1.0	94	1	7	1.5
				1	10	3.2 4.1 4.6
			94	2	7	1.9
				2	10	0.57 0.51 0.42
			103	3	7	1.5
				3	10	0.51 0.86 1.0
			103	4	7	7.2 6.8 7.5
				4	10	4.1 3.9 4.2
Ault, Colorado 1992	SP, 900 g/kg	1.0	94	1	7	-
				1	10	2.7 2.8 2.0
			94	2	7	-
				2	10	0.74

Location/year	Form.	Rate (kg ai/hg)	Spray vol. (l/ha)	Appl. no.	PHI (days)	Residue (mg/kg)
						0.26 1.1
			103	3	7	-
				3	10	0.98 0.66 0.54
			103	4	7	7.9 5.2 7.9
				4	10	3.5 3.1 4.6
Germansville, Pennsylvania 1992	SL, 215 g/l	1.0	200	1	7	-
				1	10	0.67
			190	2	7	0.25
				2	10	0.096
			240	3	7	0.32
				3	10	0.19
Germansville, Pennsylvania 1992	SP, 900 g/kg	1.0	200	1	7	-
				1	10	0.67
			190	2	7	-
				2	10	0.10
			240	3	7	0.28
				3	10	0.20
Rocehlle, Illinois 1992	SL, 215 g/l	1.0	130	1	7	5.6
				1	10	0.30
			140	2	7	0.92
				2	10	0.30
			140	3	7	2.4
				3	10	0.68
			150	4	7	0.24
				4	10	0.22
Rocehlle, Illinois 1992	SP, 900 g/kg	1.0	130	1	7	-
				1	10	0.29
			140	2	7	-
				2	10	0.78
			140	3	7	-
				3	10	0.75
			150	4	7	0.28
				4	10	0.19
Urbandale, Iowa 1992	SL, 215 g/l	1.0	47	1	7	1.1
				1	10	0.54
			47	2	7	3.4
				2	10	0.072
			47	3	7	0.26
				3	10	0.19
			47	4	7	0.41
				4	10	0.55
Urbandale, Iowa 1992	SP, 900 k/kg	1.0	47	1	7	-
				1	10	0.48
			47	2	7	-

Location/year	Form.	Rate (kg ai/hg)	Spray vol. (l/ha)	Appl. no.	PHI (days)	Residue (mg/kg)
				2	10	0.098
			47	3	7	-
				3	10	0.14
			47	4	7	2.7
				4	10	0.36
Madera, California 1992	SL, 215 g/l	1.0	270	1	7	10
				1	10	7.0 3.0
			230	2	7	17[2]
				2	10	5.7[2] 2.4 5.9
			250	3	7	4.0
				3	10	1.2 2.7 2.5
			260	4	7	2.9 2.4 3.1
				4	10	2.6 1.5 2.1
Madera, California 1992	SP, 900 g/kg	1.0	270	1	7	-
				1	10	7.8 10 11
			230	2	7	-
				2	10	4.3[2] 4.3 3.0
			250	3	7	-
				3	10	3.2 3.8 1.9
			260	4	7	3.1 3.7 1.2
				4	10	1.7 1.6 0.82
Plainview, Texas 1992	SL, 215 g/l	1.0	110	1	7	5.5
				1	10	2.8
			120	2	7	0.12
				2	10	0.084
			110	3	7	0.46
				3	10	0.11
			150	4	7	5.6 2.4 2.4
				4	10	0.68
Plainview, Texas 1992	SP, 900 g/kg	1.0	110	1	7	-
				1	10	1.8
			120	2	7	-
				2	10	0.12
			110	3	7	-

Location/year	Form.	Rate (kg ai/hg)	Spray vol. (l/ha)	Appl. no.	PHI (days)	Residue (mg/kg)
				3	10	0.14
			150	4	7	1.7 1.3 2.2
				4	10	0.56
Phelps, New York 1966	SP,900 g/kg	1.1	470	1	2 6 14	35 3.8 0.87
	SP, 900 g/kg	2.2	470	1	2 6 14	62 6.8 2.3
Dixon, California 1967	SP, 900 g/kg	0.56	350	1	1 3 7 14	13 4.1 0.92 0.30
El Centro, California 1970	SP, 900 g/kg	0.56	210	1	4 7 13	10 4.1 0.78
				2	2 4 6	2.4 1.2 0.90

[1] Samples invalid owing to atypical practice.
[2] Excessive application rate due to tractor speed.

Supervised field trials on the foliar application of methomyl with ground equipment to soya beans to determine residues in the hay were conducted in the USA at 8 locations (Rühl and Devine, 1994c). Triplicate storage samples were air- or hot-air dried (<49°C) from 1.5-10 days to 10-15% moisture content. Hay samples were stored frozen for up to 10 months before analysis by method AMR 3015-94. Adequate recovery was demonstrated at 0.02 mg/kg fortification of control samples. The results are shown in Table 59.

Table 59. Residues of methomyl in or on soya hay after the foliar application of SL or SP formulations in the USA (Rühl and Devine, 1994c).

Location, year	Form.	Application rate (kg ai/ha)	Spray volume (l/hg)	No. of applications	PHI (days)	Residue (mg/kg)
GAP: USA	SL SP	0.5	10 kg ai/hl 5	3	<0.5 kg ai/ha/crop forage 3 hay 7 >0.5 kg ai/ha/crop forage 10 hay 12	
Lonoke, Arkansas/1993	SP, 900 g/kg	0.5	85	3	12 21	0.021 0.020 <0.020 <0.020 <0.020 <0.020
Greenville, Mississippi/1993	SL, 215 g/l	0.5	56	3	12 21	0.031[1] 0.040 0.030 <0.020[1] <0.020

Location, year	Form.	Application rate (kg ai/ha)	Spray volume (l/hg)	No. of applications	PHI (days)	Residue (mg/kg)
						<0.020
Tellico Plains, Tennessee/1993	SP, 900 g/kg	0.5	94	3	12 21	0.033 0.032 0.026 <0.020 <0.020 <0.020
Rochelle, Illinois/1993	SP, 900 g/kg	0.5	200	3	12 21	0.076 0.057 0.054 <0.020 <0.020 <0.020
Paynesville, Minnesota/1993	SP, 900 g/kg	0.5	190	3	12 21	0.059 0.075 0.13 <0.020 <0.020 <0.020
Radcliffe, Iowa/1993	SP, 900 g/kg	0.5	190	3	12 21	0.034 0.050 0.041 <0.020 <0.020 <0.020
Oregon, Missouri/1993	SP, 900 g/kg	0.5	170	3	12 21	0.056 0.048 0.056 <0.020 <0.020 <0.020
Sheridan, Indiana/1993	SP, 900 g/kg	0.5	230	3	10 21	0.081 0.076 0.099 <0.020 <0.020 <0.020

[1] Controls contained methomyl: 0.026 mg/kg for 12 day and 0.069 mg/kg for 21 day.

In eight supervised field trials on sorghum to determine residues in the forage and hay in the USA an SL formulation was applied by various ground equipment to simulate commercial practices and samples of forage and air-dried hay were frozen for up to 15 months before analysis by method AMR 1806-90 or AMR 2676-93 (S. M. Kennedy, 1990e; Hausmann and Devine, 1993c). Recoveries were adequate from both fortified forage and hay in the range 0.02-1.0 mg/kg. The results are shown in Table 60.

Table 60. Residues of methomyl in or on sorghum green forage and hay after the application of a 215 g ai/l SL formulation in the USA (AMR 1367-89; AMR 2343-92).

Location, year	Application rate (kg ai/ha)	Spray volume (l/ha)	No. of applications	PHI (days)	Residue (mg/kg)
GAP: USA	0.5	2.7 kg ai/ha 19	2	14	
Sorghum forage (green)					

Location, year	Application rate (kg ai/ha)	Spray volume (l/ha)	No. of applications	PHI (days)	Residue (mg/kg)
Snook, Texas 1989	0.50	110	2	14	0.046
York, Nebraska 1989	0.50	190	2	14	0.068
Eakly, Oklahoma 1989	0.50	140	2	14	0.22
Lucas, Texas 1989	0.50	190	2	14	0.042
Donna, Texas 1992	0.50	94	2	13	<0.020
Halfway, Texas 1992	0.50	130	2	14	0.024
York, Nebraska 1992	0.50	94	2	14	<0.020
Troy, Kansas 1992	0.50	140	2	14	0.19 0.17 0.38
Little Rock, Arkansas 1992	0.50	140	2	14	<0.020
Sorghum hay					
Snook, Texas 1989	0.50	110	2	14	<0.02
York, Nebraska 1989	0.50	190	2	14	<0.02
Eakly, Oklahoma 1989	0.50	140	2	14	0.59
Lucas, Texas 1989	0.50	190	2	14	<0.02
Donna, Texas 1992	0.50	94	2	13	0.035 0.034 0.024
Halfway, Texas 1992	0.50	130	2	14	0.035 0.029 <0.020
York, Nebraska 1992	0.50	94	2	14	0.033 0.027 0.022
Troy, Kansas 1992	0.50	140	2	14	0.078 0.068 0.096
Little Rock, Arkansas 1992	0.50	140	2	14	0.024 0.039 0.026

In supervised field trials in the USA in 1995 (C.M. Kennedy, 1995) two foliar applications of a 290 g/l SL formulation were made to maturing grain, the second at the late hard dough growth stage. Duplicate samples of stover (fodder) were collected at each site and stored frozen for up to 8 months until analysed by method AMR 3015-94. Adequate recoveries were demonstrated for the range 0.02-20 mg/kg. The results are shown in Table 61. Earlier trials are shown in Table 62 (Ashley, 2001h).

Table 61. Residues of methomyl in or on sorghum fodder (stover) after the foliar application of a 290 g/lg SL formulation in the USA in 1995 (AMR 3298-95).

Location	Application rate (kg ai/ha)	Spray volume (l/ha)	No. of Applications	PHI (days)	Residue (mg/kg)
GAP: USA	0.5	2.7 kg ai/ha 19	2	14	
Donna, Texas	0.50	210	2	2	0.025[1] 0.028
York, Nebraska	0.50	190	2	13	1.0 0.99
Little Rock Arkansas	0.50	190	2	14	0.93 0.92
Plainview, Texas	0.50	120	2	14	0.081 0.026

Location	Application rate (kg ai/ha)	Spray volume (l/ha)	No. of Applications	PHI (days)	Residue (mg/kg)
Grand Island, Nebraska	0.50	190	2	14	2.4 2.5
Garden City, Kansas	0.50	180	2	13	3.1 3.4
Oregon, Missouri	0.50	160	2	14	0.41 0.50

[1] Fodder remained in the field for 13 days before collection. Grain was collected two days after the final application.

Table 62. Residues of methomyl in or on sorghum stover after the application of G or SP formulation in the USA (3F 1307).

Location/year	Form.	Rate (kg ai/ha)	Spray (l/ha)	No.	Method	PHI (days)	Residue[1] (mg/kg)
GAP: USA	SL, SP	0.5	2.7 kg ai/hl	2		14	
Marana, Arizona/1970	G, 5 g ai/100g	1.1	-	1	Broadcast	57	<0.02
Weslaco, Texas/1967	G, 5 g ai/100g	0.56	-	1	Band	65	<0.02
Weslaco, Texas/1967	G, 5 g ai/100g	1.1	-	1	Band	65	<0.02
Tolleson, Arizona/1971	G, 5g ai/100g	1.1	-	1	Band	48	<0.05
Tolleson, Arizona/1971	G, 5g ai/100g	2.2	-	1	Band	48	<0.05
Tolleson, Arizona/1971	G, 5g ai/100g	0.45	-	1	Band	29	0.09
Chandler, Arizona/1971	G, 5g ai/100g	0.6	-	1	Aerial	48	<0.05
Buckeye, Arizona/1971	G, 5g ai/100g	0.84	-	1	Aerial	45	<0.05
Buckeye, Arizona/1971	G, 5g ai/100g	0.45	-	1	Band	45	<0.05
Harquella, Arizona/1971	G, 5g ai/100g	0.45	-	1	Aerial	39	<0.05
Tolleson, Arizona/1971	SP, 900 g/kg	1.1	?	1	Ground broadcast	14	0.09
Tolleson, Arizona/1971	SP, 900 g/kg	2.2	?	1	Ground broadcast	14	-
Clovis, New Mexico/1971	SP, 900 g/kg	0.78	?	1	Aerial	54	<0.05
Tolleson, Arizona/1971	SP, 900 g/kg	0.37	?	1	Aerial	5 15	1.4 0.59
Buckeye, Arizona/1971	G, 5g ai/100g SP, 900 g/kg	0.45 0.37	 ?	1 1	Band Aerial	 3 13	 1.8 0.38

[1] Air dried.

RESIDUES IN ANIMAL COMMODITIES

Ruminant feeding studies

In two US studies in Madison, Wisconsin, twelve lactating Holstein dairy cattle (4 groups of 3 cows) were dosed with a balling gun, twice daily, for 28 days with capsules of methomyl containing the equivalent of 0 ppm, 8.1 ppm, 33.7 ppm or 85.8 ppm based on the measured feed consumption of each animal before and during the study (Daun, 1995). Milk samples collected daily and tissues at the end of the study were stored at -70°C until analysed by an HPLC method with post-column derivatization, validated in milk and all tissues at 0.01 and 0.05 mg/kg. A concurrent storage stability study showed no significant loss of methomyl from fortified control samples stored and processed under the exact conditions of the study samples.

No samples, which included whole and skimmed milk, cream, liver, kidney, muscle and fat contained methomyl at or above the limit of quantification (0.01 mg/kg). The concentrations were in the same range as the control samples, <0.002-<0.005 mg/kg, in all samples at all feeding levels.

In a second study 4 groups of three lactating cows were dosed twice daily by balling gun after milking with a mixture of [^{14}C]methomyl and unlabelled methomyl for 28 days at feeding levels equivalent to 0, 2, 24 or 80 ppm in the diet, based on monitored feed consumption (Powley, 1991a,b). Milk and tissue samples were stored at -20^{o}C. Stability experiments conducted with the study indicated that methomyl would be stable in milk (up to two years), moderately stable in fat and muscle (up to 50% loss) and very unstable in liver and kidney. The lack of residues in liver, muscle, fat and kidney would be inconclusive for this study only.

Milk samples were analysed for methomyl by HPLC and for MHTA by capillary GLC with an NPD. The demonstrated limit of quantification of each was 0.02 mg/kg. The [^{14}C]acetonitrile in milk was determined by a purge and trap technique followed by GLC and LSC, and acetamide by acetone extraction and capillary GLC with an NPD. The [^{14}C]acetamide was extracted in the same manner, followed by HPLC fractionation and LSC.

In whole and skimmed milk and cream at the 24 ppm and 80 ppm feeding levels, methomyl and MHTA were not found (limit of quantification = 0.02 mg/kg) in any sample on days 1, 14 and 28. Methomyl was detected in one cream sample at about 0.02 mg/kg, but this sample was from a control animal. Methomyl and MHTA were also not detected in any tissue sample (<0.02 mg/kg). The results for acetonitrile and acetamide (total and labelled) are shown in Table 63.

Table 63. Residues of acetonitrile and acetamide in cow milk and tissues after dosing with methomyl for 28 days (AMR 898-87).

Sample	Residue (mg/kg) in group				Group mean (mg/kg)
	0 ppm	2 ppm	24 ppm	80 ppm	
ACETONITRILE					
Whole milk, day 1		<0.01 0.01 <0.01			0.01
Whole milk, day 7		0.07 0.07 0.08			0.07
Whole milk, day 10		0.07 0.07 0.05			0.06
Whole milk, day 18		0.07 0.08 0.05			0.07
Whole milk, day 21		0.07 0.06 0.04			0.06
Whole milk, day 24		0.09 0.06 0.08			0.08
Whole milk, day 28		0.05 0.08 0.06			0.06
Skimmed milk, day 14		0.06 0.05 0.05			0.05
Cream, day 14		0.03			0.02

Sample	Residue (mg/kg) in group				Group mean (mg/kg)
	0 ppm	2 ppm	24 ppm	80 ppm	
		0.02 0.02			
Liver		0.06 0.09 0.09			0.08
Kidney		0.04 0.03 0.04			0.04
Muscle		0.03 0.04 0.06			0.04
Subcutaneous fat		0.02 0.01 <0.01			0.01
Peritoneal fat		<0.01 <0.01 <0.01			<0.01
ACETAMIDE					
Whole milk, day 1	7.9 5.9 5.0			4.1 3.7 4.1	
Whole milk, day 4	7.5 4.9 4.2			4.5 4.3 4.3	
Whole milk, day 7	6.7 4.0 3.5			4.1 3.9 4.4	
Whole milk, day 10	6.1 3.2 3.5			6.6 4.1 5.0	
Whole milk, day 18	5.0 3.9 2.1			3.7 3.4 4.1	
Whole milk, day 21	5.2 3.4 1.6			2.8 3.4 3.6	
Whole milk, day 24	5.1 4.7 3.2			3.4 4.2 4.7	
Whole milk, day 28	5.0 4.2 2.2			3.6 4.0 4.0	
Skimmed milk, day 14	6.1 4.2 3.2			4.3 4.6 5.2	
Cream, day 14	0.5 1.6 <0.1			0.7 0.7 1.1	
Liver	14.6 16.7 14.5			13.5 14.2 13.2	
Kidney	9.6 (pooled sample)	4.9 5.8 6.7	7.3 7.3 9.2	8.8 10.2 7.6	
Muscle	7.2 6.8 7.9	9.9 8.5 8.1	8.1 8.3 8.3	9.2 8.0 9.6	
Subcutaneous fat	3.4	2.4	0.9	6.6	

Sample	Residue (mg/kg) in group				Group mean (mg/kg)
	0 ppm	2 ppm	24 ppm	80 ppm	
	3.7	2.0 1.8	1.7	1.9 4.9	
Peritoneal fat	3.8 3.1	5.0 4.8 3.7	3.6 3.7 3.5	11.6 2.4 7.8	
[^{14}C]ACETAMIDE					
Whole milk, day 1				0.006 <0.004 <0.003	0.006
Whole milk, day 4				0.068 0.033 0.019	0.040
Whole milk, day 18				0.088 0.034 0.026	0.049
Whole milk, day 28				0.053 0.050 0.037	0.047
Muscle				0.021 0.027 0.022	0.023
Liver				0.054 0.050 0.050	0.051

FATE OF RESIDUES IN STORAGE AND IN PROCESSING

In storage

No information.

In processing

Fifteen studies were reported for 13 different raw agricultural commodities processed to a total of approximately 65 fractions. Methomyl was concentrated in dried orange peel, apple peel and wheat bran. This suggests a surface residue. Methomyl is somewhat water-soluble and the octanol/water partition coefficient is low, so there would be no tendency to concentrate in oils (Table 64). All studies were conducted with RACs with field-incurred residues and processing procedures were commercially simulated unless otherwise indicated.

Table 64. Processing studies on raw agricultural commodities containing methomyl.

Commodity/sample	Methomyl (mg/kg)	Processing factor	Frozen storage, months	Reference/comment
Peanuts	0.44	---	18	Marxmiller and Hay, 1991a. AMR 1354-89. USA
Meal	<0.020	0.045	15.5	
Refined oil	<0.020	0.045	18	
Crude oil	<0.050	0.11	18	
Soapstock	0.020	0.045	18	

Commodity/sample	Methomyl (mg/kg)	Processing factor	Frozen storage, months	Reference/comment
Ginned Cotton seed	0.17	---	14.5	Kennedy and Hay, 1991a AMR 1355-89. USA
Refined oil	<0.020	<0.12	16	
Crude oil	<0.020	0.52	15.5	
Meal	0.065	0.38	16	
Soapstock	<0.020	<0.12	16	
Hulls	0.14	0.82	16	
Sorghum grain	0.17	---	3	Kennedy and Hay 1991b AMR 1356-89. USA
Flour	0.031	0.18	3	
Starch	<0.020	<0.12	3	
Soya beans	0.062	---	17	Kennedy and Hay, 1991c AMR 1357-89. USA
Refined oil	<0.020	<0.32	18	
Meal	<0.020	<0.32	18	
Crude oil	0.020	0.32	18	
Hulls	<0.020	<0.32	18	
Soapstock	<0.020	<0.32	18.5	
Wheat grain	0.13	---	13.5	Hay, 1991a AMR 1358-89. USA
Bran	0.31, 0.19 (average = 0.25)	1.9	14	
Middlings	0.026	0.20	13.5	
Shorts + germ	0.12	0.92	13.5	
Patent flour	<0.020	0.15	13.5	
Low grade flour	<0.020	0.15	13.5	
Maize	0.15, 0.060 (average = 0.11)	---	11.5	Marxmiller and Hay, 1991b, AMR 1359-89. USA
Dry mill				
Crude oil (expeller)	<0.020	0.18	11.5	
Refined oil	<0.020	0.18	10	
Medium grits	0.035	0.32	12.5	
Coarse meal	0.039	0.35	13.5	
Flour	0.11	1.0	13	
Wet mill				
Crude oil (expeller)	<0.020	0.18	10.5	
Refined oil	<0.020	0.18	10	
Starch	<0.020	0.18	12	
Succulent green beans, unwashed, untrimmed	0.36-0.58 (average = 0.45)	---	10	Kennedy and Devine, 1993d AMR 2134-91. Washing and trimming a consumer procedure. USA
Washed, trimmed	0.13-0.21 (average = 0.18)	0.4	10	
Canned	<0.020	<0.04	7.5	
Tomatoes	0.39, 0.42, 0.32 (average = 0.38)		12	Marxmiller and Hay, 1991c, AMR 1360-89. USA
Wet pomace	<0.020	0.053	12.5	
Dry pomace	<0.25	0.66	15	
Juice	<0.020	0.053	12.5	
Purée	<0.020	0.053	13	

Commodity/sample	Methomyl (mg/kg)	Processing factor	Frozen storage, months	Reference/comment
Lettuce	1.7-4.9 (average = 3.0)	---	8.5	Kennedy and Tomic, 1992 AMR 2106-91
Trimmed, unwashed	0.034-0.90 (average = 0.39)	0.13	8	Trimming as commercial process
Washed, untrimmed	0.10-0.52 (average = 0.28)	0.09	8	
Trimmed, washed	0.029-0.037 (average = 0.034)	0.01	8	Washing as consumer process. Washing of whole head.
Potatoes	0.042, <0.020, 0.050 (median = 0.042)	---	15	Kennedy and Hay, 1991e AMR 1370-89 RAC treatment = 5 x GAP. USA
Chips	<0.020	<0.48	14	
Granules	<0.020	<0.48	14	
Dry peel	<0.050	<1.0	14	
Wet peel	0.042, 0.050, <0.020 (median = 0.042)	1.0	14	
Oranges unwashed	0.96	---	19	Kennedy and Hay, 1991d AMR 1361-89. USA. Control = 0.034
Washed fruit	0.88	0.92	19	
Finisher pulp	<0.020	<0.021	20.5	
Juice	<0.020	<0.021	19.5	
Cold pressed oil	<0.020	<0.021	23	
Molasses	<0.20	<0.21	23	
Dried peel	2.8	2.9	22.5	
Oranges unwashed	0.095, 0.11 (average = 0.10)	---	10.5, 22	Hausmann and Devine, 1993a AMR 2090-91. Washed with soap and water in a commercial packing plant. Peeling is consumer practice. USA.
Washed fruit	0.038, 0.035 (average = 0.037)	0.37	10.5, 22	
Peel, unwashed fruit	0.49, 0.62 (average = 0.56)	5.6	13, 22	
Peel, washed fruit	0.29, 0.33 (average = 0.31)	3.1	13, 22	
Fruit, unwashed, peeled	<0.020, <0.020 (average = <0.020)	<0.2	12, 22	
Apples	0.77	---	7	Hausmann and Fillipone, 1993 AMR 2091-91. Washed in a commercial packing plant (brush + recycled water, then brush + fresh water, air-dried, no wax). Peeling and baking are consumer procedures. USA.
Washed fruit	0.55	0.71	7	
Peel, unwashed fruit	1.1	1.4	7	
Peel, washed fruit	1.1	1.4	7	
Fruit, unwashed, peeled	0.38	0.49	7	
Fruit, washed, peeled	0.64	0.83	7	
Baked, unwashed fruit	0.14	0.18	7	
Baked, washed fruit	0.15	0.19	7	
Apples	0.0466	---	---	Zabik *et al.*, 2000

Commodity/sample	Methomyl (mg/kg)	Processing factor	Frozen storage, months	Reference/comment
Slices	0.0102	0.22	---	
Sauce	0.0102	0.22	---	
Juice, concentrate	<0.005	0.11	---	
Juice, single	0.0133	0.29	---	
Peaches unwashed	0.21	---	4	Rühl, 2000 AMR 4936-98. Washing, peeling and baking are consumer procedures.
Washed fruit	0.030	0.14	3.5	
Fruit, peeled	0.051	0.24	3.5	
Fruit, lye-peeled	0.040	0.19	5.5	
Canned fruit	<0.007	0.03	5.5	
Baked fruit	0.025	0.12	5.5	

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

The manufacturer participated in a market basket survey study to determine the distribution and level of residues of some *N*-methylcarbamate insecticides in samples of single-unit servings of vegetables and fresh fruits such as apples and peaches, or multiple-unit servings such as grapes and strawberries available to the US population (Carringer, 2000). Carbamate insecticides are an important class of pesticides used on a variety of fruits and vegetables to control various damaging insects. The carbamate market basket study (CMBS) was conducted according to a US EPA-approved study design.

During the one-year study commodities were collected from grocery stores throughout the USA. Subsequent residue data will be used to reflect the potential dietary and cumulative exposure risks to consumers using these commodities more accurately and to provide a basis for implementation of the US Food Quality Protection Act (FQPA) risk assessment mandate.

More then 400 samples from eight different crops including apples, tomatoes, lettuce, grapes, peaches, broccoli and oranges were analysed. An EPA-approved statistical sampling design for collecting the commodities and USDA Pesticide Data Program (PDP) sample preparation procedures (washing, peeling and coring) were used that are reflective of practices used by consumers. From a cumulative risk standpoint less than 0.4% of the samples contained detectable residues, and these were well below the EPA tolerance levels. Table 65 summarizes the commodities tested and methomyl residues detected.

Table 65. Distribution of detected methomyl residues (Carringer, 2000).

Commodity	No. of analyses	Samples with no residues ≥ 0.001 mg/kg		Samples with residues ≥0.001 mg/kg		Range of residues (mg/kg)	EPA tolerance (mg/kg)
		No.	%	No.	%		
Apple	400	394	99	6	2	ND-0.020	1.0
Tomato	399	398	100	1	0	ND-0.0019	1.0
Head lettuce	399	368	92	31	8	ND-0.083	5.0
Grape	393	336	85	57	15	ND-1.0	5.0
Peach	285	263	92	22	8	ND-0.19	5.0
Broccoli	395	386	98	9	2	ND-0.0086	3.0

Commodity	No. of analyses	Samples with no residues ≥ 0.001 mg/kg		Samples with residues ≥0.001 mg/kg		Range of residues (mg/kg)	EPA tolerance (mg/kg)
		No.	%	No.	%		
Orange	399	399	100	0	0	ND	2.0

The US Department of Agriculture's Pesticide Data Program collects data on pesticide residues in or on selected food commodities in the USA. The results for methomyl from 1993 to 1998 are shown in Tables 66-71.

Table 66. Distribution of detected methomyl residues (USDA, 1993).

Commodity	No. of samples	No. of detections	% of detections	Lowest residue (mg/kg)	Highest residue (mg/kg)	US tolerance level (mg/kg)
Apples	650	13	2.0	0.15	0.15	1
Broccoli	622	3	0.5	0.015	0.065	3
Celery	620	35	5.6	0.011	0.52	3
Green beans	554	23	4.2	0.013	0.49	2
Grapefruit	624	1	0.2	0.065	0.065	2
Grapes	612	39	6.4	0.013	2.0	5
Lettuce	639	27	4.2	0.013	1.6	5
Oranges	623	6	1.0	0.065	0.28	2
Peaches	358	4	1.1	0.065	0.21	5
Potatoes	638	1	0.2	0.065	0.065	0.2

Table 67. Distribution of detected methomyl residues, 1994 (USDA, 1994).

Commodity	No. of samples	No. of detections	% of detections	Lowest residue (mg/kg)	Highest residue (mg/kg)	US tolerance level (mg/kg)
Apples	687	26	3.8	0.013	0.12	1
Broccoli	679	5	0.7	0.015	0.070	3
Celery	176	7	4.0	0.013	0.099	3
Grapes	669	58	8.7	0.013	1.3	5
Green beans	591	21	3.6	0.013	0.70	2
Lettuce	691	35	5.1	0.013	1.5	5
Peaches	395	1	0.3	0.033	0.033	5
Sweet peas	433	2	0.5	0.025	0.025	5

Table 68. Distribution of detected methomyl residues, 1995 (USDA, 1995).

Commodity	No. of samples	No. of detections	% of detections	Lowest residue (mg/kg)	Highest residue (mg/kg)	US tolerance level (mg/kg)
Apples	693	24	3.5	0.012	0.13	1
Grapes	689	48	7.0	0.012	1.3	5
Green beans	587	23	3.9	0.012	0.30	2
Peaches	367	3	0.8	0.026	0.10	5
Spinach	610	65	10.7	0.012	1.3	6

Table 69. Distribution of detected methomyl residues, 1996 (USDA, 1996).

Commodity	No. of samples	No. of detections	% of detections	Lowest residue (mg/kg)	Highest residue (mg/kg)	US tolerance level (mg/kg)
Apple juice	177	0				1
Apples	530	11	2.1	0.012	0.096	1
Carrots	500	0				0.02
Grapes	525	39	7.4	0.013	1.3	5
Green beans	531	5	0.9	0.013	0.053	2
Oranges	518	0				2
Peaches	325	4	1.2	0.093	0.22	5
Spinach	517	62	12.0	0.012	5.4	6
Sweet corn	173	0				0.1
Sweet peas	355	0				5
Sweet potatoes	507	0				0.2
Tomatoes	174	0				1

Table 70. Distribution of detected methomyl residues, 1997 (USDA, 1997).

Commodity	No. of samples	No. of detections	% of detections	Lowest residue (mg/kg)	Highest residue (mg/kg)	US tolerance level (mg/kg)
Apple juice	683	0				1
Green beans	707	7	0.9	0.012	0.10	2
Orange juice	692	0				2
Peaches	756	0				5
Pears	708	0				4
Spinach, fresh	512	51	9.9	0.020	1.5	6
Spinach, canned	168	0				6
Sweet potatoes	695	0				0.2
Tomatoes	722	0				1
Winter squash, fresh	440	0				0.2
Winter squash, frozen	221	0				0.2

Table 71. Distribution of detected methomyl residues, 1998 (USDA, 1998).

Commodity	No. of samples	No. of detections	% of detections	Lowest residue (mg/kg)	Highest residue (mg/kg)	US tolerance level (mg/kg)
Apple juice	694	1	0.1	0.012	0.012	1
Cantaloupe	408	27	6.6	0.012	0.12	0.2
Grape juice	665	0				5
Green beans, C & F	359	3	0.8	0.034	0.16	2
Orange Juice	700	1	0.1	0.071	0.071	2
Pears	712	1	0.1	0.066	0.066	4
Spinach, canned	695	0				6
Strawberries, fresh	610	164	26.9	0.013	4.4	2
Strawberries, frozen	47	5	10.6	0.028	1.0	2
Sweet potatoes	357	0				0.2
Tomatoes	717	2	0.3	0.012	0.013	1

Commodity	No. of samples	No. of detections	% of detections	Lowest residue (mg/kg)	Highest residue (mg/kg)	US tolerance level (mg/kg)
Winter squash, fresh	530	0				0.2
Winter squash, frozen	149	0				0.2

NATIONAL MAXIMUM RESIDUE LIMITS

Information on national MRLs was provided by the manufacturer and is presented below. An asterisk * indicates absence of the analyte at the limit of quantification.

Country	Commodity	MRL, mg/kg
Argentina	Alfalfa (lucerne)	0.2
	Citrus	0.02
	Corn	0.1
	Cotton	0.1
	Flax	Exempt
	Forage (Winter cereals, sorghum, corn)	1
	Leafy vegetables	0.2
	Onion	0.02
	Pea	0.1
	Pepper, tomato, sweet corn	0.1
	Pome fruits	0.02
	Sorghum	0.2
	Soya bean	0.2
	Stone fruits	0.02
	Sunflower	0.2
	Tobacco	1
	Winter Cereals	0.1
Australia	Apples	1
	Avocado	T 0.1
	Blackberries	2
	Blueberries	2
	Cabbages, head	1
	Cereal grains	0.1*
	Cherries	2
	Citrus fruits	1
	Coffee beans	T 1
	Cotton seed	0.1*
	Dried grapes	0.05*
	Edible offal (mammal)	0.05
	Eggs	0.02*
	Fruit vegetables, other than Cucurbits	1
	Ginger root	0.1*
	Grapes	2
	Guava	T 0.5
	Hops, dry	0.5
	Herbs	T 1
	Leafy vegetables	1

Country	Commodity	MRL, mg/kg
	Legume vegetables	1
	Linseed	0.1*
	Meat (mammalian)	0.05
	Milks	0.05
	Mint	0.5
	Nectarine	1
	Peach	1
	Peanuts	0.05*
	Pears	3
	Plantago ovata seed	0.1
	Poppy seed	0.05*
	Potato	1
	Poultry, edible offal of	0.02*
	Poultry meat	0.02*
	Pulses	1
	Rape seed	0.5
	Sesame seed	0.1*
	Strawberry	0.5
	Sunflower seed	0.1*
	Sweet corn	0.1
T-Temporary *-at or about the limit of quantification		
Austria	Hops	10
	Grapes	3
	Spinach	2
	Apples	1
	Cotton seed	0.5
	Radish	0.5
	Cabbage	0.2
	Pears	0.2
	Stone fruit	0.2
	Cucurbitaceae	0.2
	Soya bean	0.2
	Peas with pods	0.2
	Beans with pods	0.2
	Herbs	0.2
	Fennel	0.2
	Tea	0.1
	Others	0.05
Belgium	Apple	0.05
	Cucumber	0.05
	Hops	2
	Lettuce	0.05
	Pear	0.05
	Tomato	0.05
Brazil	Broccoli	3
	Cabbage	3
	Corn	0.1

Country	Commodity	MRL, mg/kg
	Cotton	0.1
	Kale	3
	Potatoes	0.1
	Soya bean	0.1
	Tomato	1
	Wheat	0.1
Canada	Apples	0.5
	Barley	0.1*
	Beans, snap	0.1*
	Blueberry	6
	Broccoli	0.1*
	Brussels sprouts	0.1*
	Cabbage	5
	Canola	0.1*
	Celery	0.5
	Citrus	1
	Cucumbers	0.1*
	Flax	0.1*
	Grapes	4
	Lettuce	2
	Oats	0.1*
	Peas	0.1*
	Potatoes	0.1*
	Strawberries	1
	Sweet corn	0.1*
	Tobacco	0.1*
	Tomato	0.1*
	Wheat	0.1*
*0.1 is the default MRL for those crops that have not been assigned an MRL by the Food and Drug Act.		
China	Cabbage	1
	Citrus	n/a
	Cotton	n/a
	Tobacco	5
European Union	Grapefruit	0.5
	Lemons	1
	Limes	1
	Mandarins	1
	Oranges	0.5
	Pomelos	0.5
	Citrus, other	0.05*
	Tree nuts	0.05*
	Pome fruit	0.2
	Apricot	0.2
	Cherry	0.1
	Peach	0.2
	Plum	0.5
	Stone fruit, other	0.05*
	Grapes, table	0.05*
	Grapes, wine	1

Country	Commodity	MRL, mg/kg
	Strawberry	0.05*
	Canefruit	0.05*
	Small fruit and berries, other	0.05*
	Berries, wild	0.05*
	Miscellaneous fruits	0.05*
	Radish	0.5
	Root and tuber vegetables, other	0.05*
	Bulb vegetables	0.05*
	Tomato	0.5
	Aubergine	0.5
	Other fruiting vegetables	0.05*
	Cucurbits, edible peel	0.05*
	Cucurbits, inedible peel	0.05*
	Sweet corn	0.05*
	Brassica vegetables	0.05*
	Lettuce	2
	Leafy vegetables, other	0.05*
	Spinach	2
	Water cress	0.05*
	Witloof	0.05*
	Herbs	2
	Legume vegetables, fresh	0.05*
	Stem vegetables, fresh	0.05*
	Fungi	0.05*
	Pulses	0.05*
	Peanuts	0.1
	Soya bean	0.1
	Cotton	0.1
	Oil seed, other	0.05*
	Potatoes	0.05*
	Tea	0.1*
	Hops	10
* indicates the lower limit of analytical determination		
France	Citrus, large	0.5
	Citrus, small	1
	Fruits, other	0.02
	Vegetables, other	0.5
	Cereals	0.05
	Carrots	0.05
	Cotton	0.5
	Cucurbits with edible peel	0.2
	Spinach	0.5
	Stone fruit	0.2
	Plum	0.5
	Cherry	0.1
	Pome fruit	0.2
	Hops	10
	Lettuce	2
	Potatoes	0.05

Country	Commodity	MRL, mg/kg
	Radish	0.5
	Grapes	1
	Salads	2
	Soya beans	0.2
Indonesia	Apple	2
	Asparagus	2
	Barley	0.5
	Beans	0.1
	Cabbages	5
	Cauliflower	2
	Celery	2
	Citrus	1
	Common beans	2
	Cotton (seed oil)	0.1
	Cucumber	0.2
	Eggplant	0.2
	Eggs	0.05
	Grapes	5
	Hops (dry)	10
	Lettuce	5
	Maize flour	0.05
	Meat	0.02
	Melon	0.2
	Milk	0.02
	Onion	0.5
	Peanuts	0.1
	Peas	5
	Peppers	1
	Pineapple	0.2
	Potato	0.1
	Sorghum	0.2
	Soya bean	0.1
	Spinach	5
	Sugar beet	0.1
	Sweet corn	0.1
	Water melon	0.2
	Wheat	0.5
Italy	Apples	1
	Apricots	0.05
	Beans	0.05
	Cabbage	0.05
	Cherries	0.05
	Citrus	0.05
	Cucumbers	0.05
	Eggplant	0.1
	Grapes	3
	Lettuce	0.1
	Melon	0.3
	Olives	0.05

Country	Commodity	MRL, mg/kg
	Peas	0.05
	Peach	0.2
	Pears	0.2
	Peppers	0.1
	Plums	0.05
	Pumpkin	0.2
	Sugarbeet	0.05
	Tomato	0.1
	Watermelon	0.2
	Zucchini	0.1
Japan	Bell Pepper	0.5
	Broccoli	0.5
	Cabbage	0.5
	Carrot	0.5
	Ginger	0.5
	Grains	1
	Leek	0.5
	Lettuce	0.5
	Onion	0.5
	Pakchoi	0.5
	Potato	0.5
	Radish(Root)	0.5
	Soya bean	0.1
	Spinach	0.5
	Strawberry	0.5
	Sugarbeet	0.5
	Sweet potato	0.5
	Tea	3
	Watermelon	0.5
Korea	Apples	1
	Chinese cabbage	0.5
	Peppers, red	1
Netherlands	Cucumber	0.05
	Eggplant	0.05
	Melon	0.2
	Paprika	0.05
	Tomato	0.05
New Zealand	Small fruit	0.5
	Pome fruit	1
	Cereals, vegetables	0.2
Poland	Brussels sprouts	2
	Cabbage	2
	Cucumbers	0.5
	Egg plant	0.5
	Hops	4
	Paprika	0.5
	Sugarbeet	none
	Tomato	0.5

Country	Commodity	MRL, mg/kg
Portugal	Apples	1
	Grapes	3
	Peach	1
	Pears	1
	Tomato	1
South Africa	Beans	0.10
	Broccoli	0.20
	Brussels sprouts	0.20
	Cabbage	0.20
	Cauliflower	0.20
	Citrus	0.20
	Grazing crops	none
	Lucerne	0.10
	Lupines	0.10
	Maize	0.20
	Peach	0.20
	Potatoes	0.02
	Sorghum	0.20
	Sunflower	0.10
	Tobacco	0.20
	Tomato	0.10
	Wheat	0.20
Taiwan	Bulb vegetable	1
	Citrus	2
	Cucurbit	1
	Fruit vegetable	1
	Large berry	none
	Leafy vegetable	1
	Legume vegetable	1
	Maize	1
	Melon	none
	Mushroom	none
	Pome fruit	1
	Pulse	0.5
	Rice	0.5
	Root and tuber vegetable	0.5
	Small berry	2
	Stone fruit	2
	Sugarcane	none
	Tea	2
	Wheat	none
Thailand	Asparagus	2
	Cabbage	5
	Cauliflower	2
	Celery	none
	Cucumbers	0.2
	Eggplant	0.2
	Kale	none
	Lettuce	5

Country	Commodity	MRL, mg/kg
	Onion	0.2
	Other vegetables	none
	Peas, immature	none
	Peppers	1
	Potatoes	0.1
	Scallion	0.5
	Soya bean	0.2
	Soya bean, immature	0.1
	Tomato	1
	Watermelon	0.2
	Yard long bean	5
USA	Alfalfa	10
	Apples	1
	Asparagus	2
	Avocado	2
	Barley, grain	1
	Barley, hay	10
	Barley, stray	10
	Beans, dry	0.1*
	Beans, forage	10
	Beans, succulent	2
	Beet tops	6
	Blueberries	6
	Brassica (cole) leafy vegetables	6
	Broccoli	3
	Brussels sprouts	2
	Cabbage	5
	Cauliflower	2
	Celery	3
	Chinese cabbage	5
	Collards	6
	Corn, fodder	10
	Corn, forage	10
	Corn, fresh (inc. Sweet)	0.1*
	Corn, grain (Inc. Popcorn)	0.1*
	Cotton seed	0.1*
	Cucurbits	0.2*
	Dandelions	6
	Endive (escarole)	5
	Grapefruit	2
	Grapes	5
	Grass, Bermuda	10
	Grass, Bermuda, hay	40
	Kale	6
	Leeks	3
	Lemons	2
	Lentils	0.1
	Lettuce	5
	Mint hay	2

Country	Commodity	MRL, mg/kg
	Mustard greens	6
	Nectarine	5
	Oats, forage	10
	Oats, grain	1
	Oats, hay	10
	Oats, straw	10
	Onion, green	3
	Oranges	2
	Parsley	6
	Peach	5
	Peanuts	0.1*
	Peas	5
	Peas, vines	10
	Pecans	0.1
	Peppers	2
	Pomegranates	0.2*
	Rye, forage	10
	Rye, grain	1
	Rye, hay	10
	Rye, straw	10
	Sorghum, forage	1
	Sorghum, grain	0.2*
	Soya bean	0.2*
	Soya bean, forage	10
	Spinach	6
	Strawberries	2
	Swiss chard	6
	Tangerine	2
	Tomato	1
	Turnip greens	6
	Vegetables, fruiting	0.2*
	Vegetables, leafy	0.2*
	Vegetables, root crop	0.2*
	Watercress	6
	Wheat, forage	10
	Wheat, grain	1
	Wheat, hay	10
	Wheat, straw	10

APPRAISAL

Methomyl is a carbamate insecticide. It is registered throughout the world for foliar application to numerous agricultural crops.

Metabolism

Animals

The metabolism of [^{14}C]methomyl has been studied in rats, monkeys, goats, cows and hens. The radiolabel is located on C with a double-bond to N. The main metabolite identified in rat urine was a mercapturic acid derivative; acetonitrile, acetate, methomyl oxime sulfate and acetamide were tentatively identified in urine, but methomyl (both *syn* and *anti* isomers) and methomyl oxime (*S*-methyl *N*-hydroxythioacetimidate) were absent. About 75% of orally administered radiolabelled methomyl was eliminated within 3 days of the final treatment, with 50% in expired air and 25% in urine.

The findings in monkeys were similar to those in rats: 36% of the orally administered dose was found in expired air and 25% in urine. Urine also contained acetonitrile, acetate, acetamide, methomyl oxime sulfate and a trace of the mercapturic acid derivative of methomyl. Methomyl and methomyl oxime were absent. About 5% of the administered dose was found in tissues, the liver containing the largest portion (0.9 mg/kg as equivalents).

A definitive study of metabolism in goats confirmed the results of earlier studies on metabolism in goats and cows. A lactating goat was dosed orally for 3 consecutive days with radiolabelled methomyl at a concentration of about 160 ppm determined on the basis of actual feed consumption. About 30% was collected as expired volatile compounds (18% $^{14}CO_2$ and 13% [^{14}C]acetonitrile). The concentrations of radiolabel in milk and tissues were adequate to permit isolation and identification of metabolites (12 mg/kg of liver, 5 mg/kg of kidney, 1.5 mg/kg of muscle, 0.32 mg/kg of fat, 9 mg/kg of milk). Methomyl, methomyl *S*-oxide, methomyl *S*,*S*-dioxide, methomyl oxime and hydroxymethyl methomyl were not detected in any tissue or in milk, with an LOD of 0.007–0.018 mg/kg. Radiolabelled acetamide and thiocyanate were found in all tissues and milk, the latter constituting 7–50% of the total radiolabelled residue in the matrices.

Further characterization of the residues in tissues and milk indicated extensive incorporation of the radiolabel into natural components. About 30% of the TRR in milk was shown to be associated with fatty acids, and about 10% was [^{14}C]lactose. About 13% of the TRR in muscle, liver, kidney and fat was shown to be in amino acids.

The metabolism of [^{14}C]- or [^{13}C]methomyl was studied in white Leghorn laying hens dosed orally for 3 consecutive days at a rate equivalent to 45 ppm in the diet. Respired acetonitrile and CO_2 accounted for > 50% of the administered dose. The concentrations of equivalents of radiolabelled material in eggs and tissues were: 3 mg/kg in liver, 0.5 mg/kg in muscle, 0.8 mg/kg in fat, 1.5 mg/kg in egg white and 2 mg/kg in egg yolk. Methomyl and methomyl oxime were not detected in any tissue or in egg (LOD, 0.007–0.015 mg/kg.) Acetamide was found in egg white, and acetonitrile was found in all matrices, constituting 89% of the TRR in egg white.

Further characterization of the radiolabelled residue revealed that 60% of the TRR in egg yolk was associated with lipids, 87% with fat and 32% with liver. Small amounts (3% TRR) in the eggs and tissues were characterized as radiolabelled amino acids.

The Meeting concluded that the metabolism of methomyl is adequately understood in animals, and that similar mechanisms exist in rats, monkeys, ruminants and hens. Methomyl is degraded to acetonitrile, acetamide and CO_2, and these metabolites are incorporated into natural products. The Meeting further concluded that methomyl oxime is a probable intermediate, but neither it nor methomyl showed any propensity to bioaccumulate over the duration of the studies.

Plants

The metabolism of [^{14}C]methomyl was studied in tobacco, corn, cabbage and cotton. When tobacco plant roots were exposed to a solution of radiolabelled compound for 28 days, they absorbed 25% of the available radiolabel over 4 weeks. About 25% of that absorbed was retained, and the other 75% was released as CO_2 and acetonitrile, in equal proportions.

About 45% of a dose of [^{14}C]methomyl applied to the leaves of maize plants was volatilized within 10 days. About 26% of the radiolabel was extractable with methanol.

About 20% of a dose of [^{14}C]methomyl applied to the leaves of cabbage plants volatilized within 10 days, and 54% of the radiolabel was extractable with methanol. Methomyl constituted about 4% of the radiolabelled residue; no other related metabolite, such as methomyl oxime, was detected. Saponification of a non-polar fraction yielded radiolabelled fatty acids.

The translocation of methomyl was studied in tobacco plants by applying radiolabelled compound to the fifth leaf from the ground. No translocation was found after 3 days; after 7 days, < 1% of the residual radiolabel was found in plant parts other than the fifth leaves.

The metabolism of [^{14}C]methomyl was studied in maize, cabbage, and cotton under field conditions. Plants received repeated foliar treatments, and crops of maize and cabbage were harvested 8 days after the final treatment, while cotton leaves were harvested 0–192 hours after a single treatment. The outer leaves of cabbage heads contained methomyl at 0.9 mg/kg or 4% of the TRR, and the head contained 0.09 mg/kg. Methomyl oxime was not detected in head or leaves. Maize grain contained no methomyl or methomyl oxime, and most of the extractable radiolabel was associated with polar materials. Fodder contained about 2 mg/kg methomyl, and about 50% of the radiolabel could not be extracted.

In cotton, methomyl was the only component identified on the leaf surface. Radiolabel was initially found in leaves (extract) but disappeared within 48 h of treatment. Methomyl oxime was not found at any interval.

A study of confined rotational crops was conducted in sandy loam soil with cabbage, red beet and sunflower. Seeds were planted 30 and 120 days after treatment of the soil with [^{14}C]methomyl at a rate of 4.5 kg ai/ha, and the crops were harvested at normal maturity. At the 30-day plant-back interval, beets and cabbage contained 0.1–0.2 mg/kg methomyl equivalents, and sunflower seeds contained 2 mg/kg. At 120 days, the concentrations had declined to 0.05 mg/kg and 1.5 mg/kg, respectively. The concentrations of methomyl and its immediate metabolites, as determined by methanol extraction, were $\leq$ 0.01 mg/kg at both plant-back intervals.

The Meeting concluded that the nature of the residues in and on plants is adequately understood. Methomyl is degraded to CO_2 and acetonitrile, and these metabolites may then be incorporated into natural products. The Meeting further concluded that methomyl has little tendency to translocate and does not translocate (as methomyl) into rotational crops (< 0.01 mg/kg) at 30-day or longer plant-back intervals. The Meeting also noted that methomyl oxime, if present, occurs as a minor metabolite.

Environmental fate

Soil

Under anaerobic conditions, [^{14}C]methomyl degraded rapidly, with a first-order half-time of 11 days. Over a 3-month study period, the main degradate was $^{14}CO_2$, representing 75% of the applied material; methomyl oxime represented 3% of the applied material. In experiments with various soil types, 30–45% of the applied material was isolated as $^{14}CO_2$ after 42 days. The main component in soil extracts was

[^{14}C]methomyl, representing < 10% of the applied radiolabel. In sterile soil, [^{14}C]methomyl represented 89% of the applied radiolabel after 45 days.

[^{14}C]Methomyl had a first-order half-time of < 1 day to 14 days in various experiments under anaerobic conditions. Ferrous ion accelerated degradation to methanethiol and dimethyl disulfide.

The photolysis of [^{14}C]methomyl under natural sunlight for 30 days was studied after application at a rate of 1.1 kg ai/ha to silt loam, maintained at 25 ^{o}C. The radiolabelled compound decomposed with a half-time of 34 days, and the only decomposition product detected was acetonitrile. Controls showed no decomposition.

The mobility of [^{14}C]methomyl was studied on various types of loam soil. Methomyl was highly mobile in loams with a high sand content and less mobile in loams with more organic matter. Likewise, a higher clay content decreased the mobility of methomyl. In column leaching experiments performed with Speyer 2.1, 2.1 and 2.3 soils, the percentage of radiolabel in the leachate increased from 8% to 52% as the sand content of the soil increased from 65% to 91%. The leachate contained a maximum of 2% methomyl oxime.

The Meeting concluded that methomyl degrades at a moderate rate under both aerobic and anaerobic conditions and that microbes are essential to the degradation under aerobic conditions. CO_2 is the main degradate under aerobic conditions. Methomyl on soil is also subject to photodegradation. The Meeting further concluded that methomyl has low to moderate mobility in soil, greater mobility in sandy soils and less mobility in clay and in soils with a high content of organic matter.

Water–sediment systems

The fate of [^{14}C]methomyl added at a nominal concentration of 0.45 µg/ml to two natural water–sediment systems was studied. After an equilibrium had been established in the systems, the mixtures were spiked with the [^{14}C]methomyl, and sediment and water phases were taken and analysed at intervals up to 102 days. Acetonitrile accounted for about 25% of the applied radiolabel and CO_2 for about 40% after 102 days. Sediment contained about 15% of the radiolabel and water contained about 1%. By day 29, methomyl had virtually disappeared from both water and sediment. Analysis of extracts confirmed the absence of methomyl oxime, anti-methomyl, methomyl sulfoxide, acetaldehyde and acetic acid. The first-order half-time of methomyl was about 5 days.

The Meeting concluded that methomyl degrades rapidly in water–sediment systems, with the formation of acetonitrile and CO_2.

Methods of analysis

Methods were described for the determination of methomyl in plant commodities, animal commodities and environmental samples. The original methods for plant commodities consist of extraction with an organic solvent, liquid–iquid partition and hydrolysis with sodium hydroxide. The latter converts methomyl and thiodicarb to methomyl oxime. The final extract is analysed by GC, usually with a flame photometric detector in the sulfur mode.

The more recent method is based on HPLC. The plant matrix is extracted with solvent, cleaned up on a Florisil column and analysed by HPLC with post-column reaction to convert separated thiodicarb and methomyl to methylamine. Methylamine is derivatized (on-line) and detected by fluorescence.

The GC method has been validated for numerous plant commodities at an LOQ of 0.02 mg/kg. The HPLC method and its modifications have been validated at an LOQ of 0.02 mg/kg for methomyl.

Similar GC and HPLC methods exist for the determination of methomyl in meat, milk, poultry and eggs. The LOQs for the GC method are 0.080 mg/kg for liver, 0.080 mg/kg for kidney, 0.020 mg/kg for muscle and 0.040 mg/kg for fat. Difficulties were experienced in obtaining acceptable recoveries from milk. The HPLC method has an LOQ of 0.02 mg/kg or 0.01 mg/kg, depending on the extent of sample preparation.

The Meeting concluded that adequate methods exist for the determination of methomyl in plant and animal commodities.

Stability of residues in stored analytical samples

Information on stability in storage was provided for methomyl in soya bean hay, maize (kernels), bean seed, potato, peanut (nutmeat), grain sorghum forage, grain sorghum hay, grain sorghum stover, head lettuce, broccoli, orange (chopped), orange (half), apple, grape and onion (whole) stored frozen (nominal temperature, –20 ^{o}C). Adequate stability (> 80% remaining) was demonstrated after 24 months' storage for all commodities except chopped orange and onions. The residues on onions were incurred in the field, and the variability in the recovery at different times was attributed to differences in the portion of onion bulb exposed (above ground) at the time of methomyl application. The stability on an orange half was satisfactory.

Methomyl was unstable in or on liver stored at –4 to –20 ^{o}C, declining by at least 50% on day 1. The compound was stable in milk for 24 months at –20 ^{o}C but unstable in fat, muscle and kidney. Methomyl was stable in all ruminant commodities for 6 months when stored under cryogenic conditions (–70 ^{o}C).

These studies included use of the HPLC analytical method, in which methomyl is determined as methomyl. Any hydrolysis to methomyl oxime during storage would have been reflected as loss of methomyl. This was not observed.

The Meeting concluded that methomyl is stable under frozen conditions on most plant commodities for up to 24 months, the interval studied, but that it is not stable in ruminant fat, kidney, muscle or liver under ordinary freezer conditions. Special conditions must be used to store ruminant commodities for analysis.

Definition of the residue

Studies of the nature of the residue in animals and plants showed that methomyl is substantially metabolized to CO_2 and acetonitrile. Methomyl oxime was generally absent, although its sulfate was found in some studies in animals.

The older GC methods for analysis rely on conversion of methomyl to methomyl oxime, and thus, methomyl and methomyl oxime are determined. In the newer HPLC methods, only methomyl is determined, although thiodicarb may also be determined (separately) by the same method.

The Meeting noted that thiodicarb is readily metabolized to methomyl and that it is appropriate to combine the considerations for thiodicarb and methomyl. The Meeting agreed that the residue in both plant and animal commodities should be defined as methomyl for use of methomyl and as the sum of thiodicarb and methomyl, expressed as methomyl, for the use of thiodicarb. The Meeting further noted that expression of thiodicarb residue can be expressed as methomyl or thiodicarb, as the conversion factor from thiodicarb to methomyl is 0.92 and that from methomyl to thiodicarb is 1.1.

Results of supervised trials

Supervised trials were conducted with foliar application of methomyl to numerous agricultural commodities, primarily in Europe and the USA.

Citrus

Supervised field trials were conducted on oranges and mandarin in Greece (GAP: soluble concentrate, 0.09 kg ai/hl, 1.4 kg ai/ha; one to three applications; PHI, 20 days), Italy (GAP: soluble concentrate, wettable powder; 0.04 kg ai/hl; PHI, 10 days) and Spain (GAP: wettable powder, soluble concentrate, 0.05 kg ai/hl; 0.6, 0.5 kg ai/ha; five applications; PHI, 7 days). Seven trials o oranges were conducted in Spain, three in Greece and four in Italy. Five trials on mandarin were conducted in Spain, three in Greece and two in Italy. When Spanish GAP is applied to the trials on orange, the ranked order of concentrations of residues was: < 0.02 (2), 0.02, 0.03, 0.06 (2), 0.07, 0.09, 0.14, 0.25, 0.30, 0.35, 0.43 and 0.59 mg/kg. There were five trials on mandarin in Spain, three in Greece and two in Italy. When Spanish GAP is applied to the trials on orange, the ranked order of concentrations of residues was: 0.05, 0.06, 0.17 (2), 0.19, 0.32, 0.38 (2), 0.43 and 0.89 mg/kg.

The Meeting considered the combined data sufficient for citrus. The ranked order of concentrations was therefore (median underlined): < 0.02 (2), 0.02, 0.03, 0.05, 0.06 (3), 0.07, 0.09, 0.14, 0.17 (2), 0.19, 0.25, 0.30, 0.32, 0.35, 0.38 (2), 0.43 (2), 0.59 and 0.89 mg/kg. The Meeting estimated a maximum residue level of 1 mg/kg for citrus. The Meeting agreed to maintain the current recommendation of 1 mg/kg. A study of consumer-type peeling showed that the concentration of residue on flesh is reduced by a factor of 0.2 when the peel is removed from unwashed oranges. Using this factor, the Meeting estimated an STMR value of 0.034 mg/kg and a highest residue of 0.18 mg/kg for citrus flesh.

Stone fruit

Supervised field trials were conducted on peach, apricot and nectarine. Trials on peach were conducted in Spain (GAP: soluble concentrate, wettable powder; 0.6 kg ai/ha, 0.05 kg ai/hl; one to five applications: PHI, 7 days), Germany (no GAP; uses that of France), France (GAP: 0.075 kg ai/ha; PHI, 7 days), Italy (wettable powder, soluble concentrate; 0.04 kg ai/ha; PHI, 10 days) and the USA (soluble concentrate, water-soluble powder; 2.0 kg ai/ha, 0.06 kg ai/hl terrestrial, 4.8 kg ai/hl aerial; six applications; PHI, 4 days). None of the 13 trials in the USA was conducted according to GAP. Applying the GAP of Spain for Italy, 15 trials in Europe (six in France, three in Germany, three in Italy and three in Spain) were at GAP, and the ranked order of concentrations of residues was: < 0.02, 0.02, 0.03, 0.04 (3), 0.05 (2), 0.07 (2), 0.08, 0.09 (3) and 0.10 mg/kg. The Meeting estimated an STMR value of 0.05 mg/kg and a maximum residue level of 0.2 mg/kg for peaches. The highest residue was estimated as 0.10 mg/kg. The Meeting agreed to withdraw the previous recommendation for peach (5 mg/kg).

Nine supervised trials were conducted on nectarine in the USA, two according to GAP (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.0 kg ai/hl; three applications; PHI, 1 day), resulting in concentrations of 0.78 and 1.4 mg/kg. The Meeting decided that there were insufficient data to estimate a maximum residue level or STMR value for nectarine from these data. Applying the European data for peach, the Meeting estimated a maximum residue level of 0.2 mg/kg, an STMR value of 0.05 mg/kg and a highest residue of 0.10 mg/kg for nectarine.

Four trials on apricot were conducted in Italy, all at the GAP of Spain (soluble concentrate, wettable powder; 0.05 kg ai/hl; PHI, 7 days). The ranked order of concentrations of residues was: 0.04 (2), 0.05 and 0.15 mg/kg. The Meeting considered that there were insufficient data from which to estimate a maximum residue level or an STMR value.

Supervised field trials were conducted on plums in Europe (GAP, France: soluble concentrate; 0.075 kg ai/hl; three applications; PHI, 7 days; Germany: none, uses that of France; Spain (stone fruit): soluble concentrate, wettable powder; 0.6 kg ai/ha, 0.05 kg ai/hl; one to five applications; PHI, 7 days). Of the 15 trials, 13 were conducted at GAP, and the ranked order of concentrations of residues was: 0.02 (2), 0.03 (2), 0.06, 0.08 (2), 0.10, 0.11, 0.19, 0.28, 0.34 and 0.51 mg/kg. The Meeting estimated a maximum residue level of 1 mg/kg, an STMR value of 0.08 mg/kg and a highest residue of 0.51 mg/kg for plums.

Pome fruit

Trials on apple and pear were conducted in France (soluble concentrate, 0.075 kg ai/h; three applications; PHI, 7 days), Germany (no GAP; uses that of France), Spain (soluble concentrate, wettable powder; 0.75 kg ai/ha, 0.05 kg ai/hl, one to five applications,; PHI, 7 days), Italy (soluble concentrate, wettable powder; 0.05 kg ai/hl; PHI, 10 days) and Belgium (wettable powder; 0.75 kg ai/ha, 0.05 kg ai/hl; PHI, 21 days). Of the trials on apple, 13 were at GAP (eight in France, two in Italy (GAP of Spain), two in Spain, one in Germany). The ranked order of concentrations of residues was: 0.03, 0.06, 0.08 (3), 0.09 (3), 0.11, 0.13, 0.16 and 0.17 (2) mg/kg.

Supervised field trials on apple were conducted in the USA (water-soluble powder, soluble concentrate; 1.0 kg ai/ha, 2.2 kg ai/hl; five applications; PHI, 14 days). Ten of 34 trials were at GAP, and the ranked order of concentrations of residues was: 0.16, 0.24, 0.25, 0.29, 0.31 (2), 0.34, 0.42, 0.48 and 0.77 mg/kg. The Meeting decided that the European and USA residues were from different populations and could not be combined. Supervised trials on apples were also conducted with thiodicarb, and the ranked order of concentrations of residues was: 0.30, 0.32, 0.40, 0.43, 0.48, 0.61, 0.68, 0.91 (2) and 1.6 mg/kg. The Meeting considered that the data on thiodicarb were from the same population as the data for methomyl and combined them, with a ranked order of concentrations of: 0.16, 0.24, 0.25, 0.30, 0.31(2), 0.32, 0.34, 0.39, 0.40, 0.42, 0.43, 0.48 (2), 0.61, 0.68 (2), 0.77, 0.91 (2), 1.5 and 1.6 mg/kg. The Meeting estimated a maximum residue level of 2 mg/kg, an STMR value of 0.41 mg/kg and a highest residue of 1.6 mg/kg for apple.

Supervised field trials were conducted on pear in Europe. Two trials were conducted in France, two in Belgium and one in Italy. GAP was applied in the trials in France (soluble concentrate; 0.075 kg ai/h; three applications; PHI, 7 days) and Italy (GAP of Spain: soluble concentrate, wettable powder; 0.05 kg ai/hl; five applications,; PHI, 7 days); the ranked order of concentrations of residues was: 0.03, 0.04, 0.11 and 0.18 mg/kg. Six field trials were conducted on pears in the USA, but none was at GAP. The Meeting decided that four trials were insufficient to estimate a maximum residue level or an STMR value for pears but agreed that the data on apple from Europe, with similar GAP and residue values, could be used to support the limited data set for pear. The concentrations in the combined data set, in ranked order, were: 0.03 (2), 0.04, 0.06, 0.08 (3), 0.09 (3), 0.11 (2), 0.13, 0.16, 0.17 (2) and 0.18 mg/kg. The Meeting estimated a maximum residue level of 0.3 mg/kg, an STMR value of 0.09 mg/kg and a highest residue of 0.18 mg/kg for pears.

The Meeting agreed to recommend the withdrawal of the draft MRL for pome fruit (2 mg/kg) and to replace it with the recommendations for apple (2 mg/kg) and pear (0.3 mg/kg).

Berries and small fruit

Supervised field trials on grapes were reported from the USA (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.1 kg ai/hl; five applications; PHI, 1 day for fresh table grapes, 14 days for wine grapes). Seventeen trials were conducted at GAP. When the grape type (table or wine) was not specified, use on table grapes, with the shorter PHI, was assumed.

Supervised field trials on grapes were reported from France (GAP: soluble concentrate; 0.4 kg ai/ha, 0.05 kg ai/hl; three applications; no PHI), Italy (soluble concentrate, wettable powder; 0.05 kg ai/hl; PHI, 10 days) and Portugal (no GAP; uses that of Italy). Four trials from France were at GAP, with residue concentrations of 0.19, 0.25, 0.26 and 0.29 mg/kg. The results of these trials were combined with those of trials in the USA (foliar), and the ranked order of concentrations of residues was: 0.15, 0.19, 0.25, 0.26, 0.29, 0.54, 0.58, 0.65, 0.78, 0.93, 1.0 (2), 1.2, 1.3, 2.2, 2.3, 2.8, 2.9, 3.5, 4.1 and 5.2 mg/kg. Supervised field trials were also conducted with thiodicarb, giving a ranked order of concentrations of thiodicarb residues of: 0.59 and 0.7 (2) mg/kg. The combined values for methomyl and thiodicarb residues yields a ranked order of: 0.15, 0.19, 0.25, 0.26, 0.29, 0.54, 0.58, 0.59, 0.65, 0.7 (2), 0.78, 0.93, 1.0 (2), 1.2, 1.3, 2.2, 2.3, 2.8, 2.9, 3.5, 4.1 and 5.2 mg/kg. The Meeting estimated an STMR value of 0.86 mg/kg, a highest residue of 5.2 mg/kg and a maximum residue level of 7 mg/kg, which replaces the previous estimate (5 mg/kg).

Bulb vegetables

Five supervised trials were conducted on onions, bulb in the USA (GAP: 1.0 kg ai/ha, 5.4 kg ai/hl; eight applications; PHI, 7 days). All the trials were at GAP, and the ranked order of concentrations of residues was: < 0.02, 0.056, 0.068, 0.072 and 0.14 mg/kg. The Meeting estimated an STMR value of 0.068 mg/kg, a highest residue of 0.14 mg/kg and a maximum residue level of 0.2 mg/kg, which confirms the existing MRL.

Brassica vegetables

The GAP for cabbage in the USA is soluble concentrate or water-soluble powder formulation at 1.0 kg ai/ha, 1.1 kg ai/hl; 15 applications and a 1-day PHI. Seven trials were conducted at GAP, and the ranked order of concentrations of residues was: 0.086, 0.10, 0.18, 0.27, 0.46, 0.52 and 0.63 mg/kg. Supervised field trials on cabbage with thiodicarb yielded higher values: 0.08 (2), 0.12, 0.53, 0.76, 0.97, 1.2, 1.3, 2.1, 2.7, 2.8, 3.0, 3.1, 3.5, 3.8, 4.3, 4.8, 5.0 and 5.3 mg/kg. The Meeting considered the two sets of data to be from different populations and agreed to use the results for thiodicarb (higher values) for making estimates.

Supervised field trials were conducted on broccoli in the USA, where the GAP is use of the soluble concentrate or water-soluble powder formulation at 1.0 kg ai/ha, 1.1 kg ai/hl; 10 applications and a 3-day PHI. The ranked order of concentrations of residues in the 16 trials at GAP was: 0.09, 0.20, 0.21, 0.35, 0.36, 0.44, 0.45, 0.51, 0.68, 0.70, 0.73, 0.77, 0.96, 1.1, 1.8 and 2.8 mg/kg. Supervised field trials were also conducted on broccoli with thiodicarb, resulting in concentrations of: 1.1, 1.3, 1.6, 1.9, 2.6, 5.0 and 5.6 mg/kg. The Meeting considered the two data sets to be from different populations and agreed to use those for thiodicarb (higher values) for making estimates.

Supervised field trials were conducted on cauliflower in the USA, where the GAP is use of the soluble concentrate or water-soluble powder formulation at 1.0 kg ai/ha, 1.1 kg ai/hl; 10 applications and a PHI of 3 days. Eleven trials were conducted at GAP, and the ranked order of concentrations of residues was: 0.04, 0.18 (2), 0.20, 0.24, 0.51, 0.74, 1.6, 2.0, 3.8 and 5.6 mg/kg. Supervised field trials were also conducted with thiodicarb, resulting in concentrations of: 0.09, 0.16, 0.27, 0.45, 0.64, 0.71 and 2.3 (2) mg/kg. The Meeting considered the two sets of data to correspond to the same population and agreed to combine them for making estimates.

The Meeting noted that GAP for broccoli, cabbage and cauliflower is similar and that the residue concentrations were similar. It therefore decided to combine the values for thiodicarb on cabbage, thiodicarb on broccoli and thiodicarb and methomyl on cauliflower (*n* = 45), as follows: 0.04, 0.08 (2), 0.09, 0.12, 0.16, 0.18 (2), 0.20, 0.24, 0.27, 0.45, 0.51, 0.53, 0.64, 0.71, 0.74, 0.76, 0.97, 1.1, 1.2, 1.3 (2), 1.6 (2), 1.9, 2.0, 2.1, 2.3 (2), 2.6, 2.7, 2.8, 3.0, 3.1, 3.5, 3.8 (2), 4.3, 4.8, 5.0 (2), 5.3 and 5.6 (2) mg/kg. The Meeting estimated a maximum residue level of 7 mg/kg, an STMR value of 1.3 mg/kg and a highest residue of 5.6 mg/kg for brassica vegetables.

The Meeting agreed to withdraw the previous recommendations for cabbages, head (5 mg/kg) and cauliflower (2 mg/kg), and to replace them by the recommendation for brassica vegetables (7 mg/kg).

Cucurbits

Supervised field trials on cucumbers were conducted in Belgium (wettable powder; 0.5 kg ai/ha, 0.031 kg ai/hl; PHI, 14 days), France (soluble concentrate; 0.3 kg ai/ha; three applications; PHI, 7 days), Greece (soluble concentrate; 0.45 kg ai/ha; one to three applications; PHI, 20 days), Italy (soluble concentrate, wettable powder; 0.04 kg ai/hl; PHI, 10 days) and The Netherlands (soluble concentrate, wettable powder; 0.4 kg ai/ha, 0.025 or 0.008 kg ai/hl; one to three applications; PHI, 3 days). The trials in Belgium and The Netherlands were conducted in glasshouses. The ranked order of concentrations of residues in the four trials conducted at GAP was: < 0.02 (2) and 0.03 (2) mg/kg. Eight trials on cucumber conducted outdoors (two in France, one in Greece and five in Italy) were at the respective GAP, and the ranked order of concentrations of residues was: < 0.02 (8) mg/kg. The Meeting considered that the data from the indoor and outdoor trials were from the same pool and combined them, resulting in a ranked order of concentrations in the 12 trials of: < 0.02 (10) and 0.03 (2) mg/kg.

Field trials on squash, summer were conducted in Belgium (no GAP; uses that of The Netherlands), Greece (wettable powder; 0.45 kg ai/ha; one to three applications; PHI, 15 day s), Italy (no GAP; uses that of France: 0.3 kg ai/ha; three applications; PHI, 7 days) and The Netherlands (soluble concentrate, wettable powder; 0.4 kg ai/hl, 0.025 kg ai/hl [0.08 kg ai/hl for wettable powder]; one to three applications; PHI, 3 days). The trials in Belgium and The Netherlands were conducted in glasshouses. Only one trial, in Belgium, was conducted at GAP, resulting in a residue concentration of < 0.02 mg/kg.

Supervised trials were conducted on watermelon in the USA (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.1 kg ai/hl; 12 applications; PHI, 3 days). The ranked order of concentrations in the three trials conducted at GAP was < 0.04 (2) and 0.07 mg/kg.

Supervised trials on melons were conducted in Greece (soluble concentrate; 0.45 kg ai/ha; one to three applications; PHI, 20 days), Italy (soluble concentrate, wettable powder; 0.04 kg ai/hl; PHI, 10 days), The Netherlands (soluble concentrate, wettable powder; 0.4 kg ai/ha, 0.025 or 0.08 kg ai/hl; one to three applications; PHI, 3 days) and Spain (no GAP; uses that of Italy). Ten trials (seven in Italy, two in The Netherlands and one in Spain) were at GAP, and the ranked order of concentrations of residues was: < 0.02 (10) mg/kg.

The Meeting noted that the trials on melons, watermelon, summer squash and cucumbers yielded similar results, < 0.02– 0.07 mg/kg, and therefore decided to combine the values and estimate a maximum residue level for the cucurbit group. The ranked order of concentrations was: < 0.02 (21), 0.03 (2), < 0.04 (2) and 0.07 mg/kg. The Meeting estimated a maximum residue level of 0.1 mg/kg, a highest residue of 0.07 mg/kg and an STMR value of 0.02 mg/kg for the cucurbit vegetable group.

The Meeting agreed to withdraw the previous recommendations for cucumber (0.2 mg/kg), melon (0.2 mg/kg), summer squash (0.2 mg/kg) and watermelon (0.2 mg/kg) and to replace them by the recommendation for the cucurbit vegetable group (0.1 mg/kg).

Fruiting vegetables

Supervised trials were conducted on egg plant, tomato and peppers in the USA (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 5.4 kg ai/hl; PHI, 3 days for egg plant, 1 day for tomato, 3 days for peppers). One of the trials on egg plant (residue concentration of 0.30 mg/kg), two on tomato (< 0.03 and 0.03 mg/kg) and two on peppers (0.08 and 0.44 mg/kg) were conducted at GAP.

Supervised trials on peppers and tomatoes were conducted in Europe. Trials on tomato were conducted in Belgium (wettable powder; 0.5 kg ai/ha, 0.031 kg ai/hl; PHI, 14 days), Italy (soluble concentrate, wettable powder; 0.04 kg ai/hl; PHI, 10 days), The Netherlands (soluble concentrate, wettable powder; 0.4 kg ai/ha, 0.025 or 0.08 kg ai/hl; one to three applications; PHI, 3 days), Portugal (no GAP; uses that of Spain), and Spain (soluble concentrate, wettable powder; 0.50 kg ai/ha, 0.05 kg ai/hl; one to five applications; PHI, 3 days). Two trials on pepper were reported, one from Italy (soluble concentrate, wettable powder; 0.04 kg ai/hl; PHI, 10 days) and one from The Netherlands (no GAP). The former was conducted at GAP, with a residue concentration of < 0.02 mg/kg. Nine trials on tomato (two in Belgium, four in Italy, two in The Netherlands and one in Spain) and one on peppers were conducted at GAP. The concentration of residues in tomato was < 0.02 (9). Supervised field trials on tomatoes were also conducted with thiodicarb, and the ranked order of concentrations was: 0.05, 0.06, 0.08, 0.09, 0.13, 0.16, 0.18, 0.23 (2), 0.33 and 0.73 mg/kg. The data on methomyl and thiodicarb were considered to represent different populations. Using only the data on thiodicarb (higher values), the Meeting estimated a maximum residue level of 1 mg/kg, an STMR value of 0.16 mg/kg and a highest residue of 0.73 mg/kg. The Meeting estimated a maximum residue level of 1 mg/kg for tomato, confirming the existing CXL.

The Meeting declined to estimate a maximum residue level or an STMR value for peppers, as there were only three trials at GAP, with concentrations of < 0.02, 0.08 and 0.44 mg/kg.

Sweet corn

Supervised trials were reported from the USA (GAP: soluble concentrate; 0.5 kg ai/ha, 5.4 kg ai/hl; 28 applications; no PHI for maize, 3 days for forage). Fourteen trials were at GAP, and the ranked order of concentrations of residues was: < 0.02 (9), 0.021, 0.03(2), 0.043 and 0.052. Supervised field trials were also conducted with thiodicarb, and the ranked order was: < 0.02, 0.02, < 0.03 (6), < 0.04, 0.04, 0.06, 0.07 (2), 0.08, 0.11, 0.13, 0.22, 0.28, 0.43, 0.54, 0.82 and 1.5 mg/kg. The Meeting ascertained that the two sets of data did not represent the same population and made estimates from the data on thiodicarb (higher values). The Meeting estimated a maximum residue level of 2 mg/kg, an STMR value of 0.065 mg/kg and a highest residue of 1.5 mg/kg. The Meeting agreed to maintain the current recommendation of 2 mg/kg (see report item on thiodicarb).

Leafy vegetables

Supervised field trials were conducted on lettuce, head in the USA (GAP: water-soluble powder, soluble concentrate; 1.0 kg ai/ha, 1.1 kg ai/hl; 15 applications; PHI, 7 days for rates < 0.5 kg ai/ha and 10 days for rates > 0.5 kg ai/ha). All the trials were conducted at the maximum rate with a 10-day PHI. The ranked order of concentrations in the 10 trials at GAP was: 0.18, 0.54, 0.70, 1.2, 1.5, 2.2, 2.3, 3.3, 4.6 and 4.8 mg/kg. The results of supervised trials with thiodicarb on head lettuce resulted in values of : < 0.04 (3), < 0.05, 0.07 (2), 0.09 (2), 0.12, 0.14, 0.19, 0.21, 0.25, 0.34, 0.35, 0.36, 0.42, 0.44, 0.48, 0.49, 0.71, 0.96, 1.1, 1.2, 1.5, 1.7 (2). 1.8, 1.9, 2.2, 2.6, 3.0, 3.2, 6.2, 6.3, 7.7, 10, 13, 17 and 18 mg/kg. The Meeting considered that the two data sets represented different populations and agreed to use those for thiodicarb data (higher concentrations but lower STMR value).

Supervised field trials were conducted on lettuce, leaf in the USA (GAP: water-soluble powder, soluble concentrate; 1.0 kg ai/ha, 1.1 kg ai/hl; eight applications; PHI, 7 days for rates < 0.5 kg ai/ha and 10 days for rates > 0.5 kg ai/ha). All the trials were conducted at the maximum rate, and the ranked order of concentrations of residues in the 10 trials at GAP was: 0.31, 0.62, 1.4, 2.1, 2.5, 2.9, 3.6, 5.5, 5.7 and 6.7 mg/kg.

Supervised field trials were conducted on spinach in the USA (GAP: water-soluble powder, soluble concentrate; 1.0 kg ai/ha, 1.1 kg ai/hl; eight applications; PHI, 7 days). Eight trials were at GAP, and the ranked order of concentrations of residues was: 0.07, 0.34, 0.74, 1.4, 4.1, 4.6 (2) and 5.0 mg/kg. Supervised trials also were conducted with thiodicarb, resulting in concentrations of : 0.04 (2), 0.21, 1.0, 3.2, 3.5, 4.1, 12 and 25 mg/kg. The Meeting considered the two data sets to represent the same population and combined them, resulting in a ranked order of: 0.04 (2), 0.07, 0.21, 0.34, 0.74, 1.0, 1.4, 3.2, 3.5, 4.1 (2), 4.6 (2), 5.0, 12 and 25 mg/kg. The existing MRL is 5 mg/kg.

Supervised trials were conducted on collards with thiodicarb (see report item). The ranked order of concentrations of residues was: 1.5 and 1.8 mg/kg.

The Meeting noted that the ranges of concentrations were similar for leaf lettuce (thiodicarb), spinach (methomyl and thiodicarb), collards (thiodicarb) and head lettuce (thiodicarb) and decided to pool the 69 values to estimate a maximum residue level for leafy vegetables. The ranked order of concentrations was: < 0.04 (3), 0.04 (2), < 0.05, 0.07 (3), 0.09 (2), 0.12, 0.14, 0.19, 0.21 (2), 0.25, 0.31, 0.34 (2), 0.35, 0.36, 0.42, 0.44, 0.48, 0.49, 0.62, 0.71, 0.74, 0.96, 1.0, 1.1, 1.2, 1.4 (2), 1.5 (2), 1.7 (2), 1.8 (2), 1.9, 2.1, 2.2, 2.5, 2.6, 2.9, 3.0, 3.2 (2), 3.5, 3.6, 4.1 (2), 4.6 (2), 5.0, 5.5, 5.7, 6.2, 6.3, 6.7, 7.7, 10, 12, 13, 17, 18 and 25 mg/kg. The Meeting estimated a maximum residue level of 30 mg/kg, an STMR value of 1.4 mg/kg and a highest residue of 25 mg/kg for leafy vegetables.

The Meeting agreed to withdraw the previous recommendations for kale (5 mg/kg), lettuce, head (5 mg/kg), and spinach (5 mg/kg) and to replace them by the recommendation for leafy vegetables (30 mg/kg).

Legume vegetables

Supervised trials were conducted on succulent beans in the USA (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.1 kg ai/hl; 10 applications; PHI, 1 day for single use at < 0.56 kg ai/ha and 3 days for single use at > 0.56 kg ai/ha). Six trials were at GAP, and the ranked order of concentrations of residues was: 0.03, 0.05 (2), 0.06, 0.30 and 0.68 mg/kg. The Meeting estimated a maximum residue level of 1 mg/kg, an STMR value of 0.055 mg/kg and a highest residue of 0.68 mg/kg for beans (succulent) or common bean.

Supervised trials were conducted on soya bean (immature seeds) in the USA (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.1 kg ai/hl; 10 applications; PHI, 1 day). None of the trials was conducted at GAP. The Meeting agreed to withdraw the recommendation for soya bean (immature seed) (0.1 mg/kg).

Supervised trials were conducted on peas (pods and succulent seeds) in the USA (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.1 kg ai/hl; 10 applications; PHI, 1 day for single use at < 0.56 kg ai/ha and 3 days for single use at > 0.56 kg ai/ha). Eight trials were at GAP, and the ranked order of concentrations of residues was: 0.12, 0.18, 0.19, 0.33, 0.60, 0.83, 1.4 and 4.0. The Meeting estimated a maximum residue level of 5 mg/kg, an STMR value of 0.46 mg/kg and a highest residue of 4.0 mg/kg for peas (pods and succulent seeds). The Meeting agreed to maintain the current recommendation of 5 mg/kg.

Supervised trials were conducted in the USA on beans (dry) (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.1 kg ai/hl; 10 applications; PHI, 14 days). In the 17 trials at GAP, the ranked order of concentrations of residues was: < 0.02 (15), 0.02 and 0.023 mg/kg. The Meeting estimated an maximum residue level of 0.05 mg/kg, an STMR value of 0.02 mg/kg and a highest residue of 0.023 mg/kg. The Meeting agreed to withdraw the previous recommendation (0.1 mg/kg) and to replaced it with the recommendation for beans (dry) (0.05 mg/kg).

Root and tuber vegetables

Supervised trials were conducted on potato in the USA (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha; 10 applications; PHI, 6 days). In the nine trials at GAP, the ranked order of concentrations of residues was < 0.02 (9). Supervised field trials were also conducted with thiodicarb; the ranked order of concentrations of residues after foliar application was < 0.007 (2) and < 0.008 (2) mg/kg; and that after granular bait application was < 0.04 mg/kg (11). In all trials, neither thiodicarb nor methomyl was found at the LOQ (0.02 or 0.04 mg/kg). The Meeting therefore estimated a maximum residue level of 0.02(*) mg/kg, an STMR value of 0.00 mg/kg and a highest residue of 0.00 mg/kg. The Meeting agreed to withdraw the previous recommendation of 0.1 mg/kg and to replace it by the recommendation for potato (0.02(*) mg/kg).

Stalk and stem vegetables

Supervised field trials on asparagus were conducted in the USA (GAP: water-soluble powder, soluble concentrate; 1.0 kg ai/ha, 1.1 kg ai/hl; eight applications; PHI, 1 day). In the eight trials at GAP, the rank order of concentrations of residues was: 0.12, 0.14, 0.15, 0.26, 0.40, 0.48, 0.59 and 1.1 mg/kg. The Meeting estimated a maximum residue level of 2 mg/kg, an STMR value of 0.33 mg/kg and a highest residue of 1.1 mg/kg. The Meeting agreed to maintain the current recommendation of 2 mg/kg for asparagus.

Supervised field trials on celery were conducted in the USA (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.1 kg ai/hl; 10 applications; PHI, 7 days). In the eight trials at GAP, the ranked order of concentrations of residues in untrimmed celery was: < 0.02 (2), 0.09, 0.59, 0.72, 1.8 and 2.0 (2) mg/kg. The Meeting estimated a maximum residue level of 3 mg/kg, an STMR value of 0.66 mg/kg and a highest residue of 2 mg/kg. The Meeting agreed to withdraw the previous recommendation for celery (2 mg/kg) and to replace it by the recommendation for celery (3 mg/kg).

Cereal grains

Supervised field trials were conducted on barley in the USA (GAP: soluble concentrate, water-soluble powder; 0.5 kg ai/ha, 5.4 (soluble concentrate) or 6.0 (water-soluble powder) kg ai/hl; four applications; PHI, 7 days). In the three trials at GAP, the ranked order of concentrations of residues on grain was: 0.12, 0.72 and 1.3 mg/kg (see below).

Supervised field trials were conducted on wheat in the USA (GAP: soluble concentrate, water-soluble powder; 0.5 kg ai/ha, 5.4 kg ai/hl; four applications; PHI, 7 days). In the 15 trials at GAP, the ranked order of concentrations of residues was: < 0.02 (4), 0.02 (2), 0.06, 0.12, 0.14, 0.17 (3), 0.40, 0.69 and 1.1 mg/kg. Supervised field trials were also conducted with application of thiodicarb to barley and wheat, but the GAP was for granular bait use. The concentrations of residues ranged from < 0.02 to 0.06 mg/kg. Foliar application of methomyl was considered the critical use. The Meeting concluded that data on methomyl residues in barley and wheat resulting from identical foliar use were mutually supportive and pooled the data, with the ranked order: < 0.02 (4), 0.02 (2), 0.06, 0.12 (2), 0.14, 0.17 (3), 0.40, 0.69, 0.72, 1.1 and 1.3 mg/kg. The Meeting estimated a maximum residue level of 2 mg/kg, an STMR value of 0.14 mg/kg and a highest residue of 1.3 mg/kg for wheat grain and for barley grain. The Meeting agreed to withdraw the previous recommendations for wheat grain (0.5 mg/kg) and barley grain (0.5 mg/kg) and to replace them with the recommendations for wheat grain (2 mg/kg) and barley grain (2 mg/kg).

Supervised field trials were conducted on oats in the USA (GAP: soluble concentrate, water-soluble powder; 0.5 kg ai/ha, 5.4 kg ai/hl; four applications; PHI, 7 days). In the six trials at GAP, the ranked order of concentrations of residues was < 0.02 (6). The Meeting estimated a maximum residue level of 0.02(*) mg/kg, an STMR value of 0.02 mg/kg and a highest residue of 0.02 mg/kg for oat grain. The Meeting agreed to withdraw the previous recommendation for oat grain (0.5 mg/kg) and to replace it with the recommendation for oats (0.02(*) mg/kg).

Field trials on sorghum were conducted in the USA (GAP: water-soluble powder, soluble concentrate; 0.5 kg ai/ha, 0,53 kg ai/hl terrestrial, 2.6 kg ai/hl aerial; two applications; PHI, 14 days). In the five trials at GAP, the ranked order of concentrations of residues was: < 0.02 (2), 0.03, 0.07 and 0.1 mg/kg. The Meeting decided that five trials was insufficient to permit estimation of a maximum residue level or an STMR value and agreed to withdraw the recommendation for sorghum (0.2 mg/kg).

Supervised trials were conducted on maize in the USA (GAP: 0.5 kg ai/ha, 1.1 kg ai/hl; 10 applications; PHI, 21 days for ears). In the six trials at GAP, the ranked order of concentrations of residues was < 0.02 (6). The results for sweet corn support the finding of a maximum residue level of 0.05 mg/kg for maize with no PHI. Supervised field trials were also conducted with thiodicarb; all six trials yielded a residue concentration of < 0.1 mg/kg. Estimations were made on the basis of the data for methomyl, at the lower LOQ. The Meeting estimated an STMR value of 0.02 mg/kg and a maximum residue level of 0.02(*) mg/kg for maize grain to replace the previous recommendation (0.05(*) mg/kg).

Oilseed

Supervised trials of cotton seed were conducted in the USA (soluble concentrate, water-soluble powder; 0.5 kg ai/ha east of the Rocky Mountains, 0.67 kg ai/ha in Texas, 0.76 kg ai/ha west of the Rocky Mountains; 8 kg ai/hl (soluble concentrate), 15 kg ai/hl (water-soluble powder); PHI, 15 days for seed). Supervised trials were also conducted in Greece (soluble concentrate; 0.7 kg ai/ha; one to three applications; PHI, 20 days) and Spain (soluble concentrate; 0.4 kg ai/ha, 0.05 kg ai/hl; two to three applications,; PHI, 7 days). One trial from Spain (with a residue concentration of 0.02 mg/kg), one trial from Greece (< 0.02 mg/kg)and six from the USA were conducted at GAP. The ranked order of concentrations of residues was: ≤ 0.02 (5), 0.02 and 0.1 (2) mg/kg. In supervised field trials conducted with thiodicarb, the ranked order of concentrations of residues was: ≤ 0.04 mg/kg (12), < 0.05, 0.05, 0.09 and 0.10 (3) mg/kg. The Meeting considered that the data sets represented the same populations and combined them, with a ranked order of: < 0.02 (5), 0.02, < 0.04 (12), < 0.05, 0.05, 0.09 and 0.1 (5) mg/kg. The Meeting estimated an STMR value of 0.04 mg/kg, a highest residue of 0.1 mg/kg and a maximum residue level of 0.2 mg/kg for cotton seed to replace the previous recommendation (0.5 mg/kg).

Trials on peanut were conducted in the USA (soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.1 kg ai/hl; eight applications; PHI, 21 days). The two trials at GAP gave a concentration of < 0.02 (2) mg/kg. The Meeting concluded that two trials were insufficient to estimate a maximum residue level or STMR value and agreed to withdraw the recommendation for peanut (0.1 mg/kg).

Legume animal feeds

Supervised trials were conducted on alfalfa forage (green) in the USA (water-soluble powder, soluble concentrate; 1.0 kg ai/ha, 1.1 kg ai/hl; 10 applications; PHI, 7 days). In the 41 trials at GAP, the ranked order of concentrations of residues in forage was: 0.044, 0.081, 0.10 (2), 0.11, 0.15, 0.25, 0.43, 0.56, 0.57, 0.64, 0.70, 0.98, 1.1, 1.3, 1.5 (2), 1.6, 1.7, 1.8 (2), 1.9, 2.0, 2.1, 2.3 (2), 2.5 (2), 2.6, 3.4, 3.5, 3.6, 3.8, 4.0 (2), 4.2 (2), 4.6, 6.3 and 7.0 (2) mg/kg. Using the default value for dry matter for alfalfa forage (35%), the Meeting estimated an STMR value of 5.1 mg/kg for alfalfa forage and a maximum residue level of 25 mg/kg for alfalfa forage (green) on a dry weight basis. The current MRL is 10 mg/kg for alfalfa forage (green) on a fresh weight basis. The Meeting agreed to withdraw the previous recommendation and to replace it with the recommendation for alfalfa forage (green) (25 mg/kg, dry weight).

For alfalfa hay, 41 trials were at GAP; the ranked order of concentrations of residues was: 0.12, 0.24, 0.25, 0.26, 0.28 (2), 0.32, 0.41, 0.46, 0.92, 1.1 (3), 1.4, 1.5 (2), 1.8, 1.9, 2.2, 2.4, 2.7, 2.9, 3.3, 3.4 (2), 3.5, 3.7, 3.8, 4.0 (2), 4.6, 5.5, 5.6 (2), 6.2, 7.5, 7.9, 10,14, 15 and 17 mg/kg. The Meeting estimated a maximum residue level of 20 mg/kg, an STMR value of 3.0 mg/kg and a highest residue of 19 mg/kg for alfalfa hay on a dry weight basis from the default value for dry matter of 89%.

Supervised trials on bean, pea and soya bean forage were conducted in the USA, where the GAP for bean (succulent) is use of the water-soluble powder or soluble concentrate formulation at 1.0 kg ai/ha, 1.1 kg ai/hl, and a maximum of 10 applications. The PHI is 3 days for vines, 7 days for bean hay, 5 days for forage and 14 days for pea hay. One trial on succulent bean forage was at GAP, resulting in a concentration of 4.3 mg/kg. In four trials on pea vines at GAP, the ranked order of concentrations of residues was: 0.34, 1.3, 6.5 and 7.6 mg/kg. In three trials on soya bean (immature) forage at GAP, the concentrations were: 0.08 (2) and 8 mg/kg. The Meeting determined that the values for forage commodities represented the same population and could be combined to yield, in ranked order, concentrations of: 0.08 (2), 0.34, 1.3, 4.3, 6.5, 7.6 and 8 mg/kg. The default value for dry matter of 25% was used. The Meeting estimated a maximum residue level of 40 mg/kg, an STMR value of 11 and a highest residue of 32 mg/kg for pea vines and for soya bean forage. The Meeting agreed to withdraw the recommendations for pea vines (10 mg/kg fresh weight) and soya bean forage (green) and to replace them with the recommendations for pea vines (green) (40 mg/kg, dry weight) and soya bean forage (green) (40 mg/kg, dry weight).

Supervised trials were conducted in the USA on beans (dry) (GAP: soluble concentrate, water-soluble powder; 1.0 kg ai/ha, 1.1 kg ai/hl; 10 applications; PHI, 14 days). None of the trials for residues in forage was at GAP. In five trials for hay at GAP, the ranked order of concentrations of residues was: < 0.5 (2), 1.1, 3 and 9 mg/kg. The Meeting estimated a maximum residue level of 10 mg/kg, an STMR value of 1.1 mg/kg and a highest residue of 9 mg/kg for bean hay.

Supervised trials were conducted in the USA for soya bean hay (GAP: soluble concentrate, water-soluble powder; 0.5 kg ai/ha; three applications; PHI, 7 days at < 0.5 kg ai/ha, 12 days at > 0.5 kg ai/ha). In eight trials at GAP, the ranked order of concentrations of residues was: 0.021, 0.033, 0.040, 0.050, 0.056, 0.076, 0.099 and 0.13 mg/kg. The Meeting estimated a maximum residue level of 0.2 mg/kg, an STMR value of 0.06 mg/kg and a highest residue of 0.15 mg/kg for soya bean hay, using the default value for dry matter value of 85%.

Fodder and straw of cereal grains

Supervised field trials on barley were conducted in the USA (GAP: soluble concentrate, water-soluble powder; 0.5 kg ai/ha, 5.4 kg ai/hla (soluble concentrate), 6.0 kg ai/hl (water-soluble powder); four applications; PHI, 7 days). In two trials at GAP, the concentrations of residues in straw were 2.8 and

3.1 mg/kg. Trials were conducted with thiodicarb used as a granular bait, but the concentrations were lower (< 0.04 (6), < 0.2 (2) and 0.24 mg/kg). The values for thiodicarb and methomyl thus appear to represent different populations.

Supervised field trials on wheat were conducted in the USA (GAP: soluble concentrate, water-soluble powder; 0.5 kg ai/ha, 5.4 kg ai/hl; four applications; PHI, 7 days). In the 11 trials for wheat straw conducted at GAP, the ranked order of concentrations of residues was: < 0.02, 0.39, 0.43, 0.69, 2.0 (2), 2.8, 3.7, 4.6, 5.7 and 6.5 mg/kg. In trials conducted with thiodicarb as a granular bait, the concentrations of residues were < 0.02 mg/kg, a different population.

Supervised field trials on oats were conducted in the USA (GAP: soluble concentrate, water-soluble powder; 0.5 kg ai/ha, 5.4 kg ai/hl; four applications; PHI, 7 days). No trials on straw were conducted at GAP.

Supervised field trials were conducted in the USA for sorghum stover (GAP: water-soluble powder, soluble concentrate; 0.5 kg ai/ha, 0.53 kg ai/hl terrestrial, 2.6 kg ai/hl aerial; two applications; PHI, 14 days). In eight trials at GAP, the ranked order of concentrations of residues was: 0.38, 0.50, 0.59, 0.81, 0.93, 1.0, 2.5 and 3.4 mg/kg.

Supervised trials were conducted in the USA for maize fodder (GAP: 0.5 kg ai/ha, 1.1 kg ai/hl; 10 applications; PHI, 3 days for forage, 21 days for fodder). In six trials at GAP for fodder, the ranked order of concentrations of residues was: 0.029, 0.053, 0.094 (2), 0.30, and 0.71 mg/kg.

Supervised field trials were conducted in Japan with thiodicarb on rice straw (GAP: 1.2 kg ai/ha; PHI, 30 days). In four trials at GAP, the ranked order of concentrations of residues was: < 0.5, 0.62, and < 1 (2) mg/kg.

Supervised field trials were conducted in the USA on sorghum (GAP: water-soluble powder, soluble concentrate; 0.5 kg ai/ha, 0.53 kg ai/hl terrestrial, 2.6 kg ai/hl aerial; two applications; PHI, 14 days). In nine trials for sorghum hay at GAP, the ranked order of concentrations of residues was: < 0.02 (3), 0.033, 0.035 (2), 0.039, 0.096 and 0.59 mg/kg

The Meeting considered that the values for residues in cereal grain commodities (fodder, stover, straw) represented the same population (except for use of thiodicarb as granular bait on wheat and barley) and combined the values, which, in ranked order, were: < 0.02 (4), 0.029, 0.033, 0.035 (2), 0.039, 0.053, 0.094 (2), 0.096, 0.30, 0.38, 0.39, 0.43, < 0.5, 0.50, 0.59 (2), 0.62, 0.69, 0.71, 0.81, 0.93, < 1 (2), 1.0, 2.0 (2), 2.5, 2.8 (2), 3.1, 3.4, 3.7, 4.6, 5.7 and 6.5 mg/kg. Using a default value for dry matter of 88%, the Meeting estimated a maximum residue level of 10 mg/kg, an STMR value of 0.67 mg/kg and a highest residue of 7.4 mg/kg for cereal grain fodder and straw. The Meeting agreed to withdraw the recommendations for barley straw and fodder, dry (5 mg/kg), maize fodder (50 mg/kg fresh weight), and oats straw and fodder, dry (5 mg/kg), and to replace them with the recommendation for cereal grain, straw, fodder (dry), hay (10 mg/kg).

Supervised field trials were conducted on sorghum forage (green) in the USA (GAP: water-soluble powder, soluble concentrate; 0.5 kg ai/ha, 0.53 kg ai/hl terrestrial, 2.6 kg ai/hl aerial; two applications; PHI, 14 days). In nine forage trials at GAP, the ranked order of concentrations of residues was: < 0.02 (3), 0.024, 0.042, 0.046, 0.068, 0.19 and 0.22 mg/kg. Using the default value for dry matter of 35%, the Meeting estimated a maximum residue level of 1 mg/kg, an STMR value of 0.12 mg/kg and a highest residue of 0.63. The Meeting agreed to maintain the current recommendation for sorghum forage (green) (1 mg/kg).

Supervised trials were conducted on sweet corn forage in the USA (GAP: soluble concentrate, 0.5 kg ai/ha, 5.4 kg ai/hl; 28 applications; no PHI for maize or fodder, 3 days for forage). In eight trials for forage at GAP, the ranked order of concentrations of residues was: 2.3, 2.5, 2.7, 2.9, 3.2, 3.3 (2) and 4.8. Supervised field trials were also conducted with thiodicarb; the ranked order of concentrations of residues in forage was: < 0.02, < 0.05, 0.06, 0.16, 0.21, 0.56, 1.1, 2.3, 5.2, 6.9, 11 and 18 mg/kg. The Meeting considered that the two sets of values represented the same population and combined them. They were, in ranked order: < 0.02, < 0.05, 0.06, 0.16, 0.21, 0.56, 1.1, 2.3 (2), 2.5, 2.7, 2.9, 3.2, 3.3 (2), 4.8, 5.2, 6.9, 11 and 18 mg/kg.

Supervised trials were also conducted in the USA on maize forage (GAP: 0.5 kg ai/ha, 1.1 kg ai/; 10 applications; PHI, 3 days for forage, 21 days for fodder). In six trials at GAP for forage, the ranked order of values was: 0.72, 1.0, 1.3, 1.8, 6.6 and 6.9 mg/kg.

The Meeting considered that the data for maize forage were part of the set for sweet corn forage and combined them. The ranked order of concentrations of residues was: < 0.02, < 0.05, 0.06, 0.16, 0.21, 0.56, 0.72, 1.0, 1.1, 1.3, 1.8, 2.3 (2), 2.5, 2.7, 2.9, 3.2, 3.3 (2), 4.8, 5.2, 6.6, 6.9 (2), 11 and 18 mg/kg. Using the default value for dry matter value of 40%, the Meeting estimated a maximum residue level of 50 mg/kg, an STMR value of 6.0 mg/kg and a highest residue of 45 mg/kg for maize forage on a dry weight basis. The Meeting agreed to withdraw the recommendation for maize forage (50 mg/kg, fresh weight) and to replace it with the recommendation for maize forage (50 mg/kg, dry weight).

Supervised field trials were conducted on wheat forage in the USA (GAP: soluble concentrate, water-soluble powder; 0.5 kg ai/ha, 5.4 kg ai/hl; four applications; PHI, 7 days). In 17 trials at GAP for forage, the ranked order of concentrations of residues was: 0.02, 0.05, 0.06, 0.12 (2), 0.24, 0.26, 0.37, 0.38, 0.53, 0.57, 0.59, 0.85, 2.7, 3.1 and 4.9 (2)mg/kg. Using the default value for dry matter of 25%, the Meeting estimated an STMR value of 1.5 mg/kg and a highest residue of 20 mg/kg. The Meeting did not estimate a maximum residue limit, as wheat forage is not a recognized commodity.

Unsupported uses

No supervised trials were reported for hops, dry, mint hay, onion, Welsh, peanut forage (green) or pineapple. The Meeting agreed to withdraw the previous recommendations for hops, dry (10 mg/kg), mint hay (2 mg/kg), onion, Welsh (0.5 mg/kg), peanut forage (5 mg/kg) and pineapple (0.2 mg/kg).

Fate of residues during processing

Fifteen studies were reported on processing of 13 raw agricultural commodities. In all the studies, the commodities contained field-incurred residues of methomyl, typically after application rates in excess of GAP. The studies simulated commercial practices, except where consumer practices were indicated. Methomyl occurred in only three matrices: dried orange peel, apple peel and wheat bran, supporting the observation that methomyl has little tendency to translocate. Furthermore, methomyl did not concentrate in oily fractions. Similarly, thiodicarb concentrated in soya bean hulls and sweet corn cannery waste.

The maximum residue levels, STMR values and highest residues given above were multiplied by the relevant processing factor to obtain the maximum residue level (where appropriate), the STMR-P value and the HR-P value for processed commodities of raw agricultural commodities. The results of similar studies with thiodicarb are also included, as appropriate (see the report item on thiodicarb). The calculations are summarized below.

Commodity	STMR	HR	MRL	Processed	Processin	STMR-	HR-P	MRL

(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	commodity	g factor	P (mg/kg)	(mg/kg)	(mg/kg)
Apple	0.41	1.6	2	Apple juice	0.29[a]	0.12	0.46	
				Apple pomace, wet	0.30[b]	0.12	0.48	
Citrus (orange)	0.17	0.89	1	Citrus juice	0.021	0.004	0.019	
				Citrus pulp, dry	2.9	0.49	2.6	3
Cotton seed	0.04	0.1	0.2	Cotton seed, edible oil	0.16[c]	0.006	0.016	0.04
				Cotton seed, hulls	0.96[d]	0.038	0.096	0.2
				Cotton seed, meal	0.32[e]	0.013	0.032	0.05
Grape	0.86	5.2	7	Wine	0.3[b]	0.26	1.6	
Maize	0.02	0.02	0.02 (*)	Maize, edible oil	0.18	0.004	0.004	0.02 (*)
Soya bean	0.04	0.15	0.2	Soya bean, hulls	3.6[b]	0.14	0.54	1
				Soya bean, meal	1	0.04	0.15	0.2
				Soya bean, oil crude	1	0.04	0.15	0.2
				Soya bean, oil refined	1	0.04	0.15	0.2
Sweet corn	0.065	1.5	2	Cannery waste	78[b]	5.1	120	
Tomato	0.16	0.73	1	Tomato paste	0.04[f]	0.006	0.030	
Wheat grain	0.14	1.3	2	Wheat flour	0.02	0.003	0.026	0.03
				Wheat bran	1.9	0.27	2.5	3
				Wheat germ	0.92	0.13	1.2	2

[a]Thiodicarb factor (0.014 for canned juice) and methomyl factor (0.29 for fresh juice)
[b]Thiodicarb processing study
[c]Average of thiodicarb factor (0.2) and methomyl factor (< 0.12)
[d]Average of thiodicarb factor (1.1) and methomyl factor (0.82)
[e]Average of thiodicarb factor (0.26) and methomyl factor (0.38)
[f]Average of thiodicarb factor (0.03) and methomyl factor (0.053)

A study of the results of peeling in a manner similar to that of consumers was conducted with unwashed oranges. The residue reduction factor was 0.2, and this factor was applied to the results of the field trial with citrus (see above) to give an STMR-P of 0.034 mg/kg.

Residues in animal commodities

Two feeding studies were conducted with lactating dairy cattle, one of which involved radiolabelled methomyl.

Lactating Holstein dairy cows were fed diets containing methomyl for 28 consecutive days at concentrations corresponding to 0, 8.1, 34, or 86 ppm. Milk was collected daily, and tissues were harvested immediately after the last day of treatment. The samples were stored at –70 °C to preclude degradation of methomyl. The compound was not found at the LOQ (0.01 mg/kg) in any tissue or milk sample from cows at any feeding level. The apparent concentrations were similar to those in control samples, < 0.002 – < 0.005 mg/mg, for all samples.

A mixture of methomyl and [^{14}C]methomyl was given orally for 28 consecutive days to lactating dairy cows at a rate of 0, 2, 24 or 80 ppm, as ascertained from actual feed consumption. Milk and tissue samples were stored at –20 °C for up to 2 months before analysis. Studies of stability in storage showed that methomyl was stable in milk and muscle, variably stable in fat (up to 50% loss) and unstable in kidney and liver (> 90% loss over 24 months). Methomyl and methomyl oxime were not found at the LOQ of 0.02 mg/kg in whole milk, cream or skim milk from cows at 24 or 80 ppm. Methomyl was detected in only one sample, a sample of cream from a control animal, at about 0.02 mg/kg. Likewise, neither methomyl nor methomyl oxime was found in tissue samples. However, the storage conditions would have led to degradation of residues in fat, liver and kidney.

Acetonitrile and acetamide were determined in the milk and tissue samples. The maximum concentration of acetonitrile was 0.08 mg/kg in whole milk, while the concentrations in tissues were 0.08 mg/kg in liver, 0.04 mg/kg in kidney, 0.04 mg/kg in muscle and < 0.01–0.01 mg/kg in fat. Studies of stability in storage indicated that as much as 50% of the acetonitrile may have been lost during storage. The concentrations of acetamide in samples of whole milk from cows at 80 ppm contained 2.8–6.6 mg/kg, whereas the concentrations in tissues were 14 mg/kg in liver, 9 mg/kg in kidney, 9 mg/kg in muscle and 5 mg/kg ins subcutaneous fat. Acetamide is endogenous. Determinations of [^{14} C]acetamide showed concentrations attributable to methomyl of < 0.003–0.09 mg/kg in milk, 0.03 mg/kg in muscle and 0.05 mg/kg in liver.

The Meeting concluded that methomyl and methomyl oxime do not bioaccumulate. No residues were detectable in milk or tissues at the concentrations in feed that were studied.

The Meeting estimated the dietary burden of dairy and beef cattle (and poultry) from the diets listed in Appendix IX of the *FAO Manual*. Calculation from maximum residue levels yields the maximum theoretical dietary intake or the level of residues in feed suitable for estimating MRLs for animal commodities. Calculation from STMR values for feed yields estimated STMR values for animal commodities. The diets described are designed to maximize dietary exposure to thiodicarb, and nutritional requirements are not taken into account. The maximum residue levels for processed commodities were derived from the maximum or highest residue values estimated above for raw agricultural commodities, multiplied by the appropriate concentration or reduction factor from the processing studies. An exception is processed commodities that are considered to be blended, such as sweet corn cannery waste. For these, the STMR value of the raw agricultural commodity is multiplied by the processing factor to obtain the maximum residue level in the processed feed commodity.

Calculation of maximum theoretical dietary burden for animals

Commodity	Maximum or highest residue level (mg/kg)	STMR or STMR-P (mg/kg)	Group	Dry mat-ter (%)	Per cent of diet				Residue contribution (mg/kg)			
					Beef cattle	Dairy cows	Poul -try	Pig	Beef cattle	Dairy cows	Poul- try	Pig
Alfalfa forage	25	0.12	AL	–	70	60	–	–				
Alfalfa hay	20		AL	–	70	60	–	–				
Apple pomace, wet			AB	40	40	20						
Barley grain	2	0.49	GC	88	50	40	75	80				
Cereal grain fodder	10		AS	–	10	10						
Citrus dry pulp		0.013	AB	91	20	20	–	–				
Cotton seed	0.2	0.038	SO	88	25	25	–	–				

Commodity	Maximum or highest residue level (mg/kg)	STMR or STMR-P (mg/kg)	Group	Dry mat-ter (%)	Per cent of diet				Residue contribution (mg/kg)			
					Beef cattle	Dairy cows	Poul -try	Pig	Beef cattle	Dairy cows	Poul-try	Pig
Cotton seed meal			SO	89	15	15	20	15				
Cotton seed hulls				90	20	15	–	–				
Maize grain	0.02		GC	88	80	40	80	80				
Maize forage	50		AF	–	40	50	–	–	20	25		
Pea vine	40		AL	–	25	50						
Rape seed forage	0.2	0.04	SO	–	30	30						
Sorghum forage (green)	1	0.14	AF	–	40	50	–	–				
Soya bean meal			VD	92	15	15	40	25				
Soya bean hulls				90	20	20	20				0.03	
Soya bean hay	0.2	0.27	AL	–	30	30	–	–				
Sweet corn cannery waste	5.1			30	35	20	–	–	6.0	3.4		
Wheat bran			CF		59	40						
Wheat grain	2		GC	89	~~50~~ 25	~~40~~ 30	80	80	0.56	0.67	1.8	
Wheat forage	20			–	25	60	–	–				
Wheat straw	10		AS	88	10	10	–	–				
Total					100	100	100		27	29	2.0	

The average daily dietary burden of methomyl for ruminants is a fraction of the maximum daily burden, about 28 mg/kg. The maximum daily burden is expected to yield no quantifiable residues of methomyl in meat, meat by-products or milk, in view of the absence of residues in cows fed at 86 ppm and the absence of methomyl in the study of the nature of the residue in ruminants. Thus, the STMR values for milk, meat and meat by-products are estimated to be 0.000 mg/kg. The highest residue values for meat, edible offal and milk are also estimated to be 0.000 mg/kg; as there is no reasonable expectation that residues will occur. The maximum residue levels for meat, edible offal and milk are estimated to be 0.02(*) mg/kg, the typical LOQ. The Meeting agreed to maintain the current recommendations of 0.02(*) mg/kg for milks and for meat (from mammals other than marine mammals).

No study of poultry feeding was provided, but the study of the nature of the residue in poultry, conducted at a concentration equivalent to 45 ppm in feed, showed no methomyl or methomyl oxime in tissues or eggs at an LOQ of 0.015 mg/kg. As the study lasted only 3 days, the concentrations of residues may not have reached a plateau in eggs or tissues. A 21-day study with thiodicarb fed at 102 ppm also showed no accumulation of methomyl or thiodicarb. Thus, at a projected dietary intake of 2 mg/kg, no methomyl is anticipated to occur in the tissues or eggs.

The Meeting estimated a maximum residue level of 0.02(*) mg/kg for thiodicarb plus methomyl in eggs, in poultry meat and in edible offal of poultry. The Meeting also estimated highest residues and STMR values for these commodities, each at 0.00 mg/kg.

RECOMMENDATIONS

On the basis of the consideration of data from supervised trials and processing studies for methomyl and thiodicarb, the Meeting concluded that the values given in the report item on methomyl are suitable for establishing MRLs and for assessing long-term and short-term dietary intake.

Definition of residue (for compliance with the MRL and for estimation of dietary intake): sum of thiodicarb and methomyl, expressed as methomyl

CCN	Commodity	MRL (mg/kg)		STMR, STMR-P (mg/kg)	HR (mg/kg)
		New	Previous		
AL 1021	Alfalfa forage (green)	25[a]	10 (fresh weight)		
AL 1020	Alfalfa fodder (hay)	20[a]	–		
FP 0226	Apple	2[b, c]	–	0.41	1.6
JF 0226	Apple juice	–	–	0.12	
VS 0621	Asparagus	2[a]	2	0.33	1.1
GC 0640	Barley	2[a]	0.5		
AS 0640	Barley straw and fodder, dry	W	5		
VD 0071	Beans (dry)	0.05[a]	0.1	0.02	0.023
AL 0061	Bean fodder (hay)	10[a]	–		
VP 0061	Beans (except broad and soya)	1[a]	–	0.005	0.68
VB 0040	Brassica (cole or cabbage) vegetables	7 [c, d]	–	1.3	5.6
VB 0041	Cabbages, Head	W	5		
VB 0404	Cauliflower	W	2		
VS 0624	Celery	3[a,c]	2	0.66	2
AS 0161	Cereal grain, straw, fodder (dry), hay	10[d]	–		
FC 0001	Citrus fruits	1[a]	1	0.034 pulp	0.18 pulp
AB 0001	Citrus pulp, dry	3	–		
JF 0001	Citrus juice	–		0.004	
VP 0526	Common bean (pods and/or immature seeds)	1[a]	2	0.055	0.68
SO 0691	Cotton seed	0.2[d]	0.5		
OR 0691	Cotton seed, edible oil	0.04		0.006	
	Cotton seed, meal	0.05	–		
	Cotton seed, hulls	0.2	–		
VC 0424	Cucumber	W	0.2		
MO 0105	Edible offal (from mammals other than marine mammals)	0.02(*)[d]	–	0.00	0.00
VO 0440	Egg plant	W	0.2		
PE 0112	Eggs	0.02 (*)[d]	–	0.00	0.00
VC 0045	Fruiting vegetables, cucurbits	0.1[a,e]		0.02	0.07
FB 0269	Grapes	7[a,c]	5	0.86	5.2
DH 1100	Hops, dry	W	10		
VL 0480	Kale	W	5		
VL 0482	Lettuce, Head	W	5		
VL 0053	Leafy vegetables	30[c,d]	–	1.4	25
GC 0645	Maize	0.02 (*)[a]	0.05(*)	0.02	0.02
AS 0645	Maize fodder	W	50 fresh weight		
AF 0645	Maize forage	50 [d]	50 fresh weight		
OR 0645	Maize, edible oil	0.02 (*)	–	0.004	
MM 0095	Meat (from mammals other than marine mammals)	0.02 (*)[d]	0.02 (*)	0.000	0.000
VC 0046	Melons, except watermelon	W	0.2		
ML 0106	Milks	0.02 (*)[d]	0.02 (*)	0.000	
AM 0738	Mint hay	W	2		
FS 0245	Nectarines	0.2[a]	5	0.05	0.10
AS 0647	Oat straw and fodder, dry	W	5		
GC 0647	Oats	0.02 (*)[a]	0.5		
VA 0385	Onion, Bulb	0.2[a]	0.2	0.068	0.14
VA 0387	Onion, Welsh	W	0.5		
AL 0528	Pea vines (green)	40[a]	10 fresh weight		

CCN	Commodity	MRL (mg/kg)		STMR, STMR-P (mg/kg)	HR (mg/kg)
		New	Previous		
FS 0247	Peach	0.2[a]	5	0.05	0.10
SO 0697	Peanut	W	0.1		
AL1270	Peanut forage (green)	W	5		
FP 0230	Pear	0.3[a]	–	0.09	0.18
VP 0063	Peas (pods and succulent or immature seeds)	5[a]	5	0.46	4.0
VP 0064	Peas, shelled (succulent seeds)	W	0.5		
VO 0051	Peppers	W	1		
Fl 0353	Pineapple	W	0.2		
FS 0014	Plums	1[a]	–	0.08	0.51
FP 0009	Pome fruits	W	2		
VR 0589	Potato	0.02 (*)[d]	0.1	0.00	0.00
PM 0110	Poultry meat	0.02 (*)[d]	–	0.00	0.00
PO 0111	Poultry, edible offal of	0.02 (*)[d]	–	0.00	0.00
SO 0495	Rape seed	0.05[b]	–		
	Rape seed forage	0.2	–		
GC 0651	Sorghum	W	0.2		
AF 0651	Sorghum forage (green)	1[a]	1		
VD 0541	Soya bean (dry)	0.2[b]	0.2		
VP 0541	Soya bean (immature seed)	W	0.1		
AL 1265	Soya bean forage (green)	40[a]	10		
AL 0541	Soya bean hay	0.2[a]	–		
	Soya bean hulls	1	–		
	Soya bean meal	0.2			
OC 0541	Soya bean oil, crude	0.2	–	0.04	
OR 0541	Soya bean oil, refined	0.2	–	0.04	
VL 0502	Spinach	W	5		
VC 0431	Squash, Summer	W	0.2		
VR 0596	Sugar beet	W	0.1		
VO 0447	Sweet corn (corn-on-the-cob)	2[b,c]	2	0.065	1.5
VO 0448	Tomato	1[b,c]	1	0.16	0.73
VJ 0448	Tomato paste	–	–	0.007	
VC 0432	Watermelon	W	0.2		
GC 0654	Wheat	2[a]	0.5	0.14	1.3
CF 0121	Wheat flour	0.03	–	0.003	
CF 0654	Wheat bran	3	–	0.27	
CF 1210	Wheat germ	2	–	0.13	
–	Wine, of grape	–	–	0.26	

W, withdrawn
[a]Resulting from data on supervised field trials with methomyl
[b]Resulting from data on supervised field trials with thiodicarb
[c]The information provided to the JMPR precluded an estimate that the dietary intake would be below the acute RfD.
[d]Resulting from data on supervised field trials with methomyl plus thiodicarb
[e]The information provided to the JMPR precluded an estimate that the dietary intake of methomyl from watermelon would be below the acute RfD.

Dietary risk assessment

Long-term intake

STMR or STMR-P values were estimated by the present Meeting for 39 commodities. When data on consumption were available, these values were used in the estimates of dietary intake.

The dietary intakes in the five GEMS/Food regional diets, on the basis of the new STMR values, represented 1–20% of the ADI (Annex 3-Report 2001)). The Meeting concluded that the intake of residues of thiodicarb and methomyl resulting from the uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The IESTI for thiodicarb plus methomyl was calculated for the commodities for which maximum residue levels, STMR values and highest residues were established and for which data on consumption (of large portions and unit weight) were available. The results are shown in Annex 4.

The acute RfD for methomyl is 0.02 mg/kg bw. The IESTI represented 0–7200% of the acute RfD for children and 0–2800 % of the acute RfD for the general population. For children, the 100% of acute RfD was exceeded in: apples (770%), broccoli (1500%), Brussels sprouts (450%), head cabbage (1200%), cauliflower (1700%), celery (150%), watermelon (140%), grapes (1600%), kale (1100%), head lettuce (3000%), leaf lettuce (3800%), spinach (7200%), sweet corn (420%) and tomato (190%). For the general population, the acute RfD was exceeded in: apples (260%), broccoli (810%), Brussels sprouts (200%), head cabbage (320%), cauliflower (590%), grapes (470%), kale (670%), head lettuce (2000%), leaf lettuce (1500%), spinach (2800%) and sweet corn (140%).

The information provided to the Meeting precluded an estimate that the acute dietary intake of methomyl plus thiodicarb from the consumption of apples, broccoli, Brussels sprouts, head cabbage, cauliflower, celery (children only), watermelon (children only), grapes, kale, head lettuce, leaf lettuce, spinach, sweet corn and tomato (children only) would be below the acute RfD. The Meeting concluded that the short-term intake of residues of methomyl plus thiodicarb from uses, other than on these 14 commodities, that have been considered by the JMPR is unlikely to present a public health concern.

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