DIAZINON (022)

EXPLANATION

Diazinon was evaluated first for residues in 1967 and subsequently in 1968, 1970, 1975, and 1979. The compound was scheduled for periodic review by the 1989 CCPR (ALINORM 89/24A, para 298, Appendix V).

The general MRL for vegetables (0.5 mg/kg) was proposed for withdrawal by the 1990 CCPR, to be replaced with MRLs for individual commodities based on residue data to be provided to the 1993 JMPR (ALINORM 91/24, para 265). GAP and residue data were requested by a circular letter (CL 1990-20/PR).

Since the last evaluation the use of the compound has been extended to other crops or the recommendations have been adapted to current needs, and some uses have been discontinued. Additional residue studies have therefore been carried out, either to support existing MRLs or to justify new ones.

The Meeting received information on registered uses and residue data from the producer, several countries (Australia, New Zealand, The Netherlands, Spain, Portugal, Finland, Canada, Germany, Thailand) and the GTZ Pesticide Service Project, Germany.

USE PATTERN

Diazinon is an organophosphorus insecticide with a broad spectrum of activity against a wide range of pests: sucking, chewing and boring insects including soil-living insects. It is effective by contact and stomach action. The product has been introduced world-wide in many countries and is used on numerous crop groups or commodities. It is generally used as a foliar or soil spray or applied as a granule to the soil.

Major target crops are leafy, fruiting, stem and root vegetables, deciduous fruit, rice and maize. Minor crops include berries, cereals, citrus, grapes, mushrooms, nut trees, olives and sugar beet. It is also applied to ornamentals, grass, turf, and in nurseries.

For foliar spray treatments EC and WP formulations are used at concentrations of active ingredient between 0.01 and 0.3 kg/hl. The corresponding rates are between 0.18 and about 4.5 kg ai/ha. The number of applications varies according to local conditions and may further change depending on the degree of pest infestation during the growing season.

EC, WP and granular formulations are also recommended for single early-season soil treatment, usually before or at planting or sowing, EC and WP at rates between 2.5 and 6.0 kg ai/ha, and granules at 0.5-10 kg ai/ha.

Powder formulations are seldom recommended; the rates tend to be between 1.0 and 4.0 kg ai/ha, usually with a single application.

Diazinon is officially registered and/or approved as a plant protection agent under the trade name of "Basudin" over much of the world or as D.Z.N. in the USA. Information on

recommended uses of diazinon (GAP) in many countries is listed in Table 1.

Table 1. Summary of GAP in the use of diazinon in various countries.

Crop	Country	Form.	Application			PHI, days
			No.	Rate, kg ai/ha	Conc., kg ai/hl	
Alfalfa	Australia	EC		0.28-0.56		2
Almond	USA	EC	1-4		0.06	
		WP	1-4		0.11-0.17	
Apple	France	WP,EC			0.025-0.03	15
	Italy	EC	1-2	0.45-0.6	0.03-0.04	15
Apricots	Chile	WP,EC	1		0.04-0.042	14
	South Africa	EC		0.5-1.5	0.033-0.044	14
Artichoke	Australia	EC		0.56		14
Asparagus	Portugal				0.03	14
Banana	Australia	EC	2		0.1	14
	Costa Rica	EC		0.30-0.60	0.06	7
	Mexico	WP,EC			0.06-0.09	1
Beans	Australia	EC	3-14	0.12-0.56	0.024	14
	Canada	EC		0.55		7
	Mexico	GR	1	1.25		7
		WP,EC	>1		0.60-1.0	7
	Philippines	EC	>1		0.094-0.15	14
	Portugal	GR	1	1.20-10		
	South Africa	EC			0.044	14
	Switzerland	WP,EC	>1		0.025	21
		GR	1	0.12 g/m		
	USA	GR	1	2.2-4.4		
		WP,EC	1-3	0.42-0.84	0.021-0.90	7
Beetroot	Australia	EC		0.56		14
	Netherlands	WP,EC	1-3	0.135		10
Berries	Norway	EC	>1		0.025-0.05	14
	Switzerland	WP,EC	>1		0.025	21
Blackberries	Canada	WP,EC			0.05	
	Netherlands	WP,EC	1-3	0.135-0.16	0.0135	10
Blueberries	Australia	EC		0.056		14
	USA	WP,EC	>1	1.1-2.2	0.12	7
Cabbage	Australia	EC	>1	0.56-1.12	0.052-0.112	14
(Brassicae)	Belgium	GR	1	0.08 g/pl		
		EC,DP	1	2.5-4.86		10
	Brazil	WP,EC	>1	0.25-0.40	0.05-0.06	4
	Canada	WP,EC	>1	0.55		5-7
		GR	1	7.5 g/m		
		WP	1		0.027	

Crop	Country	Form.	Application			PHI, days
			No.	Rate, kg ai/ha	Conc., kg ai/hl	
	Denmark	GR	1	1.0		70
	Finland	GR	1	0.1-0.2 g/pl		7
		GR	1		0.05a	
	France	WP,EC	1		0.025	15
	Indonesia	EC	>1	0.60-0.80	0.12-0.16	14
	Portugal	GR	1	1.2-10		
	Sweden	GR	1	1.0		
		EC	1	3.25		70
	Switzerland	WP,EC	>1		0.025	14
	Thailand	WP,EC	>1		0.05-0.18	14
	UK	FG	1	22 g/500 pl		14
		FG	1	3.38		14
	USA	WP,EC	>1	0.28-0.56		5-7
		WP,EC,GR	1	1.1-4.4		
Caneberry	USA	WP,EC	>1	1.1-2.2	0.12	7
		WP,EC			0.12-0.24	7
Cantaloupe	Australia	EC	1-3	0.28-1.12	0.024	14
	Canada	EC	>1	0.55-1.0		10
Carrots	Australia	EC		0.52-1.12		14
	Belgium	GR	1	3.85-4.95		
		EC	1-2	3.24-4.86		10
		DP		2.5-3.0		10
	Canada	WP,EC		0.55		10
		WP,GR	1	1.1		
	Denmark	GR	1	1.0		70
	Finland	GR	1	0.2 g/m		7
	France	WG,WP,EC	1	8.0		
	Mexico	GR	1	1.25		

Carrots, contd.	Netherlands	WP,EC	1-2	3.6-5.4		60
		GR	1	3.85-5.5		60
		DP	1	3.4-5.1		
	New Zealand	GR	1	2.2		14
	Portugal	GR	1	1.2-10.4		
	Switzerland	GR	1	0.12 g/m		42
	UK	FG	1	2.8		14
	USA	GR	1	1.1-4.4		
		WP,EC	>1	0.55		10
Celery	Australia	EC		0.52-1.12		14
	Canada	WP,EC		0.55		10
Cereals	Australia	EC		0.56-0.8		14
Cereals, winter	Spain	EC			0.03-0.072	15
Cherry	Chile	WP,EC	1		0.04-0.042	14
Citrus fruit	Australia	EC			0.052	14
	New Zealand	WP	5-8	1.5	0.05	14
	Spain	WP		2.4-4.8	0.04-0.08	20
Cotton	Australia	EC		0.28-0.4		14
	Greece	EC	1	4-6		30
		EC	1		0.045-0.081	30
		EC	1	1.5 g/m		30
	Indonesia	GR	1	2.0-2.5		14
	Mexico	GR	1	1.25		14
		WP,EC	>1	0.3-0.6		14
	Philippines	EC	>1		0.095-0.15	14
	Spain	WP	1-2		0.04-0.08	15
	Thailand	WP,EC	>1		0.05-0.18	14
	USA	WP,EC	>1	0.55-1.1		14
Cranberry	USA	WP,EC	>1	1.1-1.65	0.12-0.18	7
	Canada	WP,EC		2.25-3.5	0.056-0.11	7
Cucumber	Australia	EC	1-3	0.28-1.12	0.024	14
	Brazil	WP,EC	>1		0.05-0.06	4
	Canada	WP,EC		1.12		7
	Mexico	WP,EC	>1	0.25-0.5		7
		GR	1	1.25		7

Cucumber, contd.	Netherlands	WP,EC			0.0135	3
	USA	WP,EC	>1	0.27-0.82		7
		WP,EC,GR	1	2.2-4.4		
Cucurbits	Australia	EC		0.56	0.024	14
	Chile	WP,EC	1-2	0.4-0.6		1
		EC,GR	1	2.2-2.5		45
Currants	Canada	WP,EC			0.05	
	Germany	WP	2	0.4-0.6	0.04	14
	Netherlands	WP,EC	1-3	0.135-0.16	0.0135	10
Egg plant	Australia	EC		0.52-1.12		14
Fodder beet	Canada	WP,EC		0.55		14
	Germany	WP	2	0.24	0.06-0.12	42
	Netherlands	WP,EC	1-3	0.18		
Garlic	Australia	EC		0.56	0.024	14
Gherkins	Australia	EC		0.52-1.12		14
Gooseberry	Canada	WP,EC			0.05	
Grapes	Australia	EC	2-3		0.024	14
	Canada	WP,EC	>1	1.6-3.4	0.05-0.125	16
	Chile	WP,EC	1		0.04-0.042	18
	France	EC	3	0.24		15
	Greece	WP,EC			0.03-0.081	15
	Mexico	WP,EC	>1		0.06-0.09	18
		GR	1-2	2.5-4.0		8
	Netherlands	DP	1	0.34-0.51		b
	New Zealand	WP	6-9	1.0	0.05	14
	Portugal	EC		0.5	0.05	14
					0.03	14
	Spain	WP,EC	2		0.03-0.072	15
		EC	1		0.047-0.93	15
		WP		0.24-0.48	0.04-0.08	15
	Switzerland	EC	>1		0.025	21
	Thailand	WP,EC	>1		0.045-0.18	14
	USA	WP,EC	>1	0.43-0.65	0.0225	7
		WP,EC	1	0.55-1.1	0.06	18
Herbs	Netherlands	WP,EC	1-3	0.078-0.10	0.013	10

Hops	Australia	EC			0.052	
	Canada	WP,EC		0.25-1.12		14
Kiwi fruit	New Zealand	WP,EC	6	1.0	0.05	28
Leek	Netherlands	WP,EC	1	5.4		10
		WP,EC	1-3		0.135-0.36	10
		GR	1	5.5		
		DP	1	5.1		
Lettuce	Australia	EC	1-3	0.56-1.12		14
	Canada	WP,EC		0.55		10
Lettuce	France	WP,EC	1		0.025	15
	Mexico	WP,EC	>1	0.25-0.50		10
		GR	1	1.25		10
	Switzerland	WP,EC	>1		0.025	14
		GR	1	0.12 g/m		28
	UK	FG	1	1.12		14
	USA	WP	>1	0.27-0.55		10
		WP,EC,GR	1	1.1-4.4		
Lima beans	Canada	WP,EC		0.55		3
Loganberry	Canada	WP,EC			0.05	
Macadamia nuts	Australia	EC			0.1	14
Maize/corn	Brazil	EC	>1	0.48		14
	Germany	WP	1	0.80	0.133	
	Greece	GR	1-2	1.5-2.0		15
		WP,EC	1	2.4-6.0		20-30
		WP,EC			0.045-0.08	
		WP	1	0.06-0.15 g/m		20-30
		WP	1		0.04-0.06d	
	Indonesia	EC	>1	0.6-0.8	0.12-0.16	14
	Italy	GR	1	1.0-1.5		15
	Mexico	WP,EC	>1	0.25-0.40		
	Philippines	EC	>1		0.094-0.150	14
	Portugal	GR	1	1.2-10		
	Spain	GR	1	0.50-4.50		30
		WP,EC	2		0.03-0.08	15
	Thailand	WP,EC	>1		0.045-0.18	14
	USA	WP,EC	1	0.55-4.4		
		WP,EC	>1	0.55-1.4		
Melon	Australia	EC	1-3	0.28-1.12	0.024	14
	Brazil	WP,EC	>1		0.05-0.06	14
	Canada	EC	>1	0.55-1.0		10
	Mexico	WP,EC	>1	0.25-0.5		7
		GR	1	1.25		7
	Netherlands	WP,EC			0.0135	3
	Portugal	GR	1	1.2-10		

	USA	WP,EC	>1	0.27-0.82		7
		WP,EC,GR	1	2.2-4.4		
Misc. fruits	Spain	WP		0.6-1.2	0.04-0.08	30
Mushrooms	Australia	EC		112 g/t compost		14
				24 g/t compost after casing		14
	Netherlands	WP,EC	2-3	0.36	0.036	10
		DP	2-3	0.34-0.51		10
		GR,DP	1	55 g/t compost		
		DP	1	1.7 g/t compost		
Nectarines	Chile	WP,EC	1		0.04-0.042	10
Oil seeds	Australia	EC		0.56-0.68		14
Olives	France	WP,EC	1		0.03	21
	Greece	EC			0.03-0.051	
		WP	1	1.5 g/m		
	Italy	EC	1-2	0.60-0.90	0.04-0.06	15
	Mexico	WP,EC	>1		0.06-0.09	75
	Portugal	EC	4	0.60-0.90	0.06-0.09	56
			1		0.03	21
	Spain	WP,EC	1		0.03-0.04	21
		WP		0.4-0.8	0.04-0.08	60
	Turkey	EC	1-2		0.04-0.06	15
	USA	WP,EC	1		0.045-0.06	75
Onions	Australia	EC	2-4	0.56	0.052	14
		EC	1	2.4-4.0		
	Belgium	GR	1	3.85-4.95		
		EC,DP	1	2.5-4.86		10

Onions, contd.	Brazil	EC	>1		0.06	14
	Canada	WP,EC		0.55		10
		WP,GR	1	1.1-2.2		
	Denmark	GR	1	1.0		70
	Finland	GR	1	0.2 g/m		7
	France	WG,WP,EC	1	8.0		15
	Mexico	GR	1	1.25		10
		WP,EC	>1	0.25-0.6		10
	Netherlands	WP,EC	1	5.4		10
		GR	1	1.65		
		DP	1	5.1		
	Philippines	EC	>	1	0.094-0.15	14
	Portugal	GR	1	1.2-10		
	Sweden	EC	1	3.25		
	USA	WP,EC	>1	0.55		10
		WP,EC,GR	1	2.2-4.4		
Parsley	Canada	WP,EC		0.55		7
Parsnip	Australia	EC		0.52-1.12		14
	Canada	WP,EC		0.55		10
		WP,GR	1	1.1		
Pasture	Australia	EC		0.48-1.12		2
	Canada	WP,EC		0.55		21
Peaches	France	WP,EC	1		0.025	14
	Mexico	WP,EC	>1		0.06-0.09	20
		GR	1-2	2.5-4.0		20
	Netherlands	DP	1	0.34-0.51		b
	Portugal	EC	1	0.3	0.03	14
	South Africa	EC		0.5-1.5	0.033-0.044	14
Pear	Italy	EC	1-2	0.45-0.6	0.03-0.04	15
Peas	Australia	EC		0.52-1.12		14
	France	WP,EC	1	0.25		
	Netherlands	WP,EC		0.18-0.45		
	Mexico	GR	1	1.25		4
		WP,EC	>1	0.60-1.0		4
	Philippines	EC	>1		0.094-0.15	4
	Portugal	GR	1	1.20-10		

Peas, contd.	Switzerland	WP,EC	>1		0.025	1
	USA	GR	1	2.2-4.4		
		WP,EC	1-3	0.42-0.56	0.021-0.60	
Peppers	Australia	EC	2-4	0.56-1.12		14
	Canada	WP,EC		0.25-0.55		5
	Chile	WP,EC	1-2	0.40-0.60		5
	Mexico	GR	1	1.25		
		WP,EC	>1	0.60-1.0		5
	Portugal	GR	1	1.2-10		
	USA	WP,EC	>1	0.55		5
		WP,EC,GR	1	1.1-4.4		
Persimmons	New Zealand	WP	6-7	0.75-1.0	0.05	7
Pineapple	Australia	EC			0.052	14
	Costa Rica	EC		0.3-0.6	0.06	7
	USA	WP,EC		2.2-5.8	0.12-0.23	1
Plums	Italy	EC	1-2	0.45-0.6	0.03-0.04	15
	Netherlands	DP	1	0.34-0.51		b
	South Africa	EC		0.5-0.83	0.033	14
Pome fruit	Australia	EC	3-4		0.052	14
	Brazil	EC	>1		0.06	14
	Belgium	EC			0.0012-0.002	10
	Canada	WP,EC	1-8	0.9-2.25	0.025-0.050	14
		WP,EC	1	2.5		c
	Chile	WP,EC	1		0.04	14
	Germany	WP	2-6	0.4-0.9	0.04-0.06	42
	Greece	WP,EC			0.045-0.06	20
	Mexico	GR	1-2	2.5-4.0		14
		WP,EC	>1		0.06-0.09	14
	Netherlands	WP,EC	1	0.135-0.33	0.013-0.022	10
	New Zealand	WP	7-10	1.25-1.5	0.05	14
	Norway	EC	>1		0.025-0.05	14
	Portugal	EC	4	0.36	0.036	14
					0.03-0.06	14
	South Africa	EC	>1	0.5-2.0	0.033-0.044	14
	Spain	WP,EC	4		0.03-0.08	30
		EC+oil	1		0.047-0.0093	

Pome fruit, contd.	Switzerland	WP,EC	>1		0.025	21
	Turkey	EC	1-2		0.04-0.05	21
	USA	WP	2-8		0.06	14
Potatoes	Australia	EC	2-5	0.8		14
	Brazil	EC	>1	0.48		14
	Canada	WP,EC		0.55		14
	Chile	WP,EC	1-2	0.4-0.6		35
	Finland	GR	1	0.3-0.4 g/m		
	Greece	WP,EC	1	2.4-6.0		20-30
		WP	1	0.06-0.15 g/m		20-30
		WP	1		0.04-0.06	
	Italy	EC	1-2	0.18	0.03	15
		DP	1	1.0-4.0		15
	Mexico	GR	1	1.25		35
		WP,EC	>1	0.3-0.6		35
	Norway	EC	>1		0.025-0.05	14
	Portugal	GR	1	1.2-10		
	Spain	GR	1	2.0-4.5		30
		WP		0.4-1.2	0.04-0.08	30
	Thailand	WP,EC	>1		0.05-0.18	14
	USA	GR	1	2.2-4.4		
		WP,EC	>1	0.55-1.1		35
Pumpkin	Australia	EC	1-3	0.28-1.12	0.024	14
Radish	Belgium	EC,DP	1	2.5-4.86		7-21
	Canada	WP,EC		0.55		10
		GR	1	2.2		
	Netherlands	WP,EC	1	3.6		10
		GR	1	3.85		
		DP	1	3.4		
	USA	GR	1	1.1		
		WP,EC	>1	0.28-0.55		10
Rape seed	Australia	EC		0.56		14
Raspberries	Canada	WP,EC			0.05	
	Netherlands	WP,EC	1-3	0.135-0.27	0.0135-0.022	10
Rice	Australia	EC	>1	0.06-0.28		14
	Bangladesh	GR	1	1.68		60

Rice, contd.		EC	2	1.0		30
	Columbia	GR	1-2	1.0-2.0		
		EC	1-3	0.6		15
	Greece	GR	2-3	1.0-1.5		15
		WP,EC	1	2.4-6.0		
		WP	1	0.06-0.15 g/m		
		WP	1		0.04-0.06d	
		WP,EC			0.045-0.08	
	Italy	GR	1	1.0		15
	India	GR	1	1.0-1.5		
		EC	1-3	0.15-0.6	0.03-0.24	14
	Malaysia	EC	2-4		0.10-0.133	7
	Pakistan	GR	2	1.5-2.25		14
		EC,SC	3	0.6-0.9		14
	Philippines	EC	>1		0.095-0.15	14
	Thailand	WP,EC	>1		0.045-0.18	14
Rhubarb	Australia	EC		0.52-1.12		14
Rutabaga	Canada	WP,EC		0.55		14
		WP	1	1.1		
Salsify	Canada	WP,EC		0.55		10
Sorghum	Australia	EC		0.8-1.12		14
Soya beans	Australia	EC		0.56-0.68		14
Spinach	Canada	WP,EC		0.55		10
	France	WP,EC	1		0.025	15
	Switzerland	WP,EC	>1		0.025	14
		GR	1	0.12 g/m		28
	UK	FG	1	1.12		14
	USA	WP	>1	0.27-0.55		10
		WP,EC,GR	1	1.1-4.4		
Squash	Australia	EC	1-3	0.28-1.12	0.024	14
	Canada	EC		0.55-1.0		3
	Mexico	WP,EC	>1	0.25-0.5		7
		GR	1	1.25		7
	USA	WP,EC	>1	0.27-0.82		7e
		WP,EC,GR	1	2.2-4.4		

Stone fruit	Australia	EC	3-4		0.052	14
	Brazil	EC	>1		0.06	14
	Belgium	EC			0.012-0.02	10
	Canada	WP,EC	>1		0.05-0.062	10f
	Germany	WP	3	0.4-0.6	0.04	14
	Greece	WP,EC			0.045-0.08	15
	Netherlands	WP,EC	1	0.135-0.33	0.013-0.022	10
	New Zealand	WP	5-8	0.75-1.0	0.05	14
	Norway	EC	>1		0.025-0.05	14
	Spain	WP,EC	4		0.03-0.08	30
		EC+oil	1		0.0465-0.092	
	Switzerland	WP,EC	>1		0.025	21
	Turkey	EC	1-2		0.024-0.05	21
	USA	WP,EC	>1		0.03-0.06	10f
Strawberries	Canada	WP,EC	1-2	0.5-1.12	0.05-0.1	5
	Chile	WP,EC	>1	0.4-0.6		5
	Indonesia	EC	>1		0.12-0.16	14
	Mexico	GR	1	1.25		10
		WP,EC	>1	0.6-1.0		5
	Netherlands	WP,EC	1-3	0.081-0.135	0.013	10a
	New Zealand	WP	1	0.755		
	Portugal	GR	1	1.2-10		
	Spain	WP		0.4-1.2	0.04-0.08	30
	Switzerland	WP,EC	>1		0.025	21
	USA	WP	1	1.1		
		WP,EC	>1	0.55-1.1	0.06-0.12	5
Sugar beet	Canada	WP,EC		0.55		14
	Chile	WP,EC	1-2	0.4-0.6		14
	France	WP	1	0.15		
		EC	1	1.6		
	Germany	WP	2	0.24	0.06-0.12	42
	Greece	WP,EC	1		0.04-0.081	
		WP,EC	1	4.0-6.0		
		WP,EC	1	0.06-0.15 g/m		
		WP,EC	1		0.04-0.06d	
	Hungary	GR	1	1.75		

Sugar beet, contd.	Italy	EC	1-2	0.18-0.24	0.03-0.04	15
		DP	1	1.0-4.0		15
	Netherlands	WP,EC	1-3	0.18		
	Spain	GR	1	2.0-4.5		30
	Switzerland	EC	>1		0.025	21
	USA	WP,GR	1	1.1-4.4		
		WP,EC	>1	0.82-1.1		
Sugar cane	Australia	EC		0.56-0.68		14
Swedes	Finland	GR	1	0.2 g/m		
Sweet corn	Australia	EC		0.52-1.12		14
	USA	WP,EC,GR	1	2.2-4.4		
		WP	2-3	1.1-1.4		
Swiss chard	Canada	WP,EC		0.55		14
Tomatoes	Australia	EC	3-5	0.28-1.12	0.024	14
	Brazil	EC	>1		0.06	4
	Canada	WP,EC,GR		0.55-1.1		1
	Chile	WP,EC	1-2	0.4-0.6		1
	Mexico	GR	1	1.25		1
		WP,EC	>1	0.6-1.0		1
	Netherlands	WP,EC			0.0135	3
	Portugal	EC	4	0.3	0.03-0.06	14g
	South Africa	EC	>1		0.33-0.44	14
	Switzerland	GR	1	0.12 g/m		
		WP,EC	>1		0.025	14
	USA	WP,EC	>1	0.28-0.82		1
		WP,EC,GR	1	1.1-4.4		
Tree nuts	Spain	WP		0.6-1.2	0.04-0.08	30h
Turf	Australia		>1	0.72-6.0	0.048-0.4	2
Turnips	Australia	EC		0.56		14
	Canada	WP,EC		0.55		14
		WP	1	1.1		
Vegetables	Canada	WP	1	3.4		
	Netherlands	WP,EC	1-3	0.135		10i
	(exc. parsley, celery)	DP	1-6	0.34-0.51		j
	Spain	WP		0.4-1.2	0.04-0.08	30k

Walnuts	USA	EC	1-4		0.06	
		WP	1-4		0.11-0.17	
Watermelon	Australia	EC	1-3	0.28-1.12	0.024	14
	Brazil	WP,EC	>1		0.05-0.06	14
	Canada	EC	>1	0.55-0.85		10
	Mexico	WP,EC	>1	0.25-0.5		7
		GR	1	1.25		7
	USA	WP,EC	>1	0.27-0.82		7
		WP,EC,GR	1	2.2-4.4		

a dip application
b in greenhouse: PHI 17 days in period 01.03-01.11 and 21 days in period 01.11-01.03.
c post-harvest use
d soil drenching, 150 ml solution/m
e PHI 3 days for winter squash
f PHI 20 days for peaches
g PHI 3 days for tomatoes for processing
h PHI 10 days for hazelnuts
i PHI 60 days for carrots
j greenhouse: PHI 3 days for cucumber, melons, tomatoes, and peppers; other vegetables PHI 17 days in period 01.03-01.11 and 21 days in period 01.11-01.03.
k PHI 20 days for artichokes

Diazinon is also applied to cattle against horn fly and face fly in Canada. In Australia it is mainly applied to sheep against lice, keds, and blowfly but also to goats, cattle and pigs against lice, mange, and buffalo fly.

RESIDUES RESULTING FROM SUPERVISED TRIALS

Plant commodities

Residue data from more than 380 trials or projects conducted between 1973 and 1991 are summarized in the following Tables. Trials were carried out with different formulations, mainly in Europe and North America. Trials conducted in the USA were mostly in two States. Residue data from supervised trials were presented in the 1967 monograph and repeated with additions in 1970 (FAO/WHO 1971b). Tables summarizing the results of the residue trials which have been carried out since the last evaluation are as follows.

Table 2: Residues from supervised trials on citrus fruits
Table 3: Residues from supervised trials on pome fruits
Table 4: Residues from supervised trials on stone fruits
Table 5: Residues from supervised trials on grapes
Table 6: Residues from supervised trials on strawberries
Table 7: Residues from supervised trials on other berries
Table 8: Residues from supervised trials on other fruits
Table 9: Residues from supervised trials on bulb vegetables
Table 10: Residues from supervised trials on brassica vegetables
Table 11: Residues from supervised trials on fruiting vegetables, cucurbits
Table 12: Residues from supervised trials on fruiting vegetables, other than cucurbits
Table 13: Residues from supervised trials on leafy vegetables
Table 14: Residues from supervised trials on legume vegetables
Table 15: Residues from supervised trials on root and tuber vegetables
Table 16: Residues from supervised trials on stalk and stem vegetables
Table 17: Residues from supervised trials on cereals
Table 18: Residues from supervised trials on tree nuts
Table 19: Residues from supervised trials on oil seeds

Some samples were an alysed for residues of diazoxon (G 24576) and

hydroxydiazinon (CGA 14128). In nearly all these samples residues were undetectable (<0.01 mg/kg).

Citrus fruits (Table 2)

Six supervised trials on oranges (one variety, one location) and three on mandarins (one variety, one location) were available from Spain. One application was made at a rate of 72 g ai/hl. Two additional supervised trials on oranges with two and four applications at a rate of 60 g ai/hl were reported from Portugal.

Residues in the whole fruit varied between 0.06 and 0.20 mg/kg 14 days after the last application.

Pome fruits (Table 3)

Supervised trials were carried out in Germany (13), Switzerland (6), and the USA (7) with EC and WP formulations. The number of applications varied from two to six foliar treatments at a rate of 0.53-1.2 kg ai/ha (37.5-60 g ai/hl) with spray intervals of 1-3 weeks in the European trials. In the US trials the first application was at the dormant stage (3.36 kg ai/ha) followed by 6 foliar sprays (3.36 kg ai/ha) made at intervals of 1-2 weeks; the concentrations of the spray solutions were 0.12-0.36 kg ai/hl.

For pears supervised trials were conducted in the USA (6) and Germany (1) with the number and rate of applications the same as in the apple trials.

Residues of diazinon in fruit at harvest (PHI 14-30 days) varied between <0.02 and 0.52 mg/kg in the trials with low-concentration spray solutions and between <0.01 and 2.0 mg/kg in the US trials.

Stone fruits (Table 4)

Cherries. Supervised trials were carried out in Germany (11), Switzerland (3), and the USA (29) with EC and WP formulations. The number of applications varied from two to four foliar treatments at a rate of 0.375-0.8 kg ai/ha (25-75 g ai/hl) and spray intervals of 1-2 weeks in the European trials. In the US trials the first application was at the dormant stage (3.3 kg ai/ha) followed by 4 foliar sprays (3.3 kg ai/ha) at intervals of 1-2 weeks, the concentration of the spray solutions being 0.083-0.33 kg ai/hl. Oil was added to all applications.

Residues of diazinon in fruit at harvest (PHI 14-21 days) varied between <0.01 and 0.28 mg/kg with a rapid decrease within the pre-harvest period.

Peaches. Twenty four supervised residue trials (5 Germany, 1 Portugal, 1 Switzerland, 17 the USA) using EC and WP formulations were reported. Two to four foliar sprays were applied at 14-day intervals at a rate of 0.35-0.80 kg ai/ha (23.5-40 g ai/hl). In the US trials there was one application at the dormant stage and four foliar applications at one-week intervals, each at a rate of 3.3 kg ai/ha with added oil.

Residues of diazinon in fruit at harvest (PHI 14-21 days) varied between <0.01 and 0.13 mg/kg.

Plums, prunes. Supervised trials were carried out in Germany (11), Switzerland (1), and the USA (21 with plums, 13 with prunes) with EC and WP formulations. The number of applications varied from two to five foliar treatments at a rate of 0.35-0.94 kg ai/ha (23.5-70 g ai/hl) at intervals of 2-3 weeks in the European trials. In the US trials an application at the dormant stage was followed by 4-5 foliar applications (each 3.3 kg ai/ha) at weekly intervals with oil added to all sprays.

Residues of diazinon in plums at harvest (PHI 10-53 days) varied

between <0.01 and 0.37 mg/kg. In a set of four trials residues were between 0.53 and 0.78 mg/kg after 10 days and between 0.20 and 0.53 mg/kg after 20 days.

In prunes residues ranged from <0.01 to 0.25 mg/kg 10 -20 days after the last application, leading to corresponding residues in the dried fruits of <0.01-1.90 mg/kg.

Berries and other small fruits

Grapes (Table 5). Supervised trials with EC and WP formulations were conducted in France (9), Germany (3), Switzerland (1), and the USA (18) with 1-5 applications at 1-2 week intervals at an application rate of 0.24-1.3 kg ai/ha (24-260 g ai/hl).

Residues of diazinon in grapes at harvest (PHI 7 -49 days) varied between <0.01 and 0.72 mg/kg. In two trials results seemed to be rather high with residues from 1.2-2.6 mg/kg 7-21 days after the last treatment.

In clarified juice and wine from treated grapes no diazinon was detectable (<0.001-<0.02 mg/kg, depending on the laboratory).

Strawberries (Table 6). Thirty nine supervised residue trials, three from New Zealand and the others from the USA, using EC and WP formulations were reported. One foliar application at a rate of 0.5 -1.0 kg ai/ha or one pre-plant application followed by three foliar applications (each at 1.12 kg ai/ha) at weekly intervals were carried out.

After 5-7 days residues of diazinon ranged from <0.01 to 0.12 mg/kg.

Cranberries (Table 7). Three residue trials with granules were reported by Canada. With 1 or 2 applications rates of 3.36 or 6.72 kg ai/ha no residues of diazinon were detectable after 51-59 days.

Currants (Table 7). Supervised trials were carried out in Germany (16) and Switzerland (1) with EC and WP formulations. Trials were conducted with one application of 0.75 g ai/plant or two applications of 0.35 -0.8 kg ai/ha (24-40 g ai/hl) at an interval of 2 weeks.

Seven to 21 days after application, residues of diazinon were between <0.02 and 0.53 mg/kg.

Blackberries, boysenberries, raspberries (Table 7). Twenty residue trials with raspberries, 16 with blackberries and 4 with boysenberries were conducted in the USA using EC and WP formulations. The first application was at the dormant stage with 2.2 kg ai/ha (0.12 -0.6 kg ai/hl) followed by 5 foliar applications at 1.1 kg ai/ha (0.06 -0.3 kg ai/hl) at 2-week intervals.

Residues of diazinon in the berries at harvest (PHI 7 -21 days) were <0.01-0.18 mg/kg.

Assorted tropical and sub-tropical fruits - edible peel (Table 8)

Olives. Four Spanish and two Portugese trials were reported using 1 -2 applications at a rate of 40 or 90 g ai/hl.

Residues of diazinon in mature fruits 14, 35 -41 and about 85 days after application reached levels of 1.2-1.5 mg/kg, 0.03 -1.8 mg/kg, and <0.02-0.07 mg/kg respectively.

In preserved olives (PHI 185 days) residues of diazinon were between 0.04 and 0.09 mg/kg. Residues in crude oil (PHI 35 -41 days and about 85 days) were in the range of 2.7-6.4 mg/kg and 0.10-0.29 mg/kg respectively.

Persimmons. New Zealand reported the results of three residue trials. One

application of 1.25 kg ai/ha (50 g ai/hl) or seven applications at a rate of 0.675-0.9 kg ai/ha (45 g ai/hl) resulted in residues of diazinon of 0.16-0.36 mg/kg seven days after the last application.

Assorted tropical and sub-tropical fruits - inedible peel (Table 8)

Bananas. Seven supervised trials were conducted in Australia (1), Costa Rica (3) and Honduras (3) using GR and EC formulations. The granules were used at a rate of 4 g ai/plant at planting time. For the foliar treatments three applications at 2-5-week intervals were used at concentrations of 40-90 g ai/hl or at 0.6 kg ai/hl for spot treatment.

No residues of diazinon (<0.01/<0.02 mg/kg) were detectable in the whole fruit, pulp or peel at various days after application.

Kiwifruit. Two Italian trials and four trials from New Zealand were reported using EC formulations. Trials were with 48-60 g ai/hl applied one to seven times at 2-4-week intervals.

Residues of diazinon at harvest (PHI 28-42 days) were 0.04-0.19 mg/kg.

Pineapples. Supervised trials were carried out in Costa Rica (4), Honduras (4), and the USA (8) with EC and WP formulations. The number of applications varied from one to nine, at rates of 60-100 g ai/hl sprayed to run-off or 100 ml of spray solution per plant or amounting to a total of 9.7-13.6 kg ai/ha (US trials). Multiple treatments were at 2-5-week intervals. Additional uses involved dip treatments of seedlings at planting time, either as a single treatment (with 0.6 or 1.0% ai solutions) or prior to multiple foliar applications (US trials).

After a single treatment no residues of diazinon were detectable (<0.02 mg/kg) 558 or 574 days after application except one residue of 0.02 mg/kg. After multiple treatments residues between <0.01 and 0.08 mg/kg were detectable 7 days after the last application. Residues after 14 and 21 days were all below 0.01 mg/kg (US trials). No residues (<0.01/<0.02 mg/kg) were detectable in juice prepared from samples harvested 7 days after the last application. Residues between <0.02 and 0.05 mg/kg were detectable in bran or filter cake from the same samples.

In one case hydroxydiazinon (CGA 14128) was detectable in filter cake at a level of 0.02 mg/kg on the day of application.

Table 2. Residues in whole fruit from supervised trials on citrus fruits.

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
Orange							
Spain/1990	EC	1	2.88	0.072	0	0.58	54
					7	0.24	
					14	0.11	
					21	0.05	
					28	0.10	
	EC	1	2.88	0.072	0	0.78	54
					7	0.43	
					14	0.18	
					21	0.10	
					28	0.06	
	EC	1	2.88	0.072	0	0.32	54

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
					7	0.20	
					14	0.06	
					21	0.12	
Spain/1990 cont.					28	0.10	
Spain/1991	EC	1	3.17	0.072	0	0.39	54
					7	0.20	
					14	0.12	
					21	0.06	
					28	0.08	
					42	0.05	
					56	0.05	
	EC	1	3.17	0.072	0	0.44	54
					7	0.22	
					14	0.11	
					21	0.10	
					28	0.10	
					42	0.06	
					56	0.03	
	EC	1	3.17	0.072	0	0.43	54
					7	0.22	
					14	0.11	
					21	0.08	
					28	0.08	
					42	0.04	
					56	0.06	
Portugal/1982		2		0.06	1	0.39	47
					4	0.25	
					7	0.24	
					11	0.15	
					14	0.15	
					21	0.13	
		4		0.06	1	0.50	47
					4	0.36	
					7	0.29	
					11	0.20	
					14	0.20	
					21	0.14	
Mandarin							
Spain/1991	EC	1	2.52	0.072	0	0.45	54
					7	0.17	
					14	0.13	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
					21	0.13	
Spain 1991 cont.					28	0.14	
					42	0.07	
					56	0.06	
	EC	1	2.52	0.072	0	0.38	54
					7	0.16	
					14	0.10	
					21	0.07	
					28	0.09	
					42	0.07	
					56	0.06	
	EC	1	2.52	0.072	0	0.29	54
					7	0.18	
					14	0.09	
					21	0.13	
					28	0.10	
					42	0.07	
					56	0.06	

Table 3. Residues from supervised trials on pome fruits. Underlined residues are from treatments according to GAP.

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
Apples							
Germany/1974	EC	4	0.53	0.0375	0	0.46	58
					3	0.36	
					7	0.20	
					10	0.16	
					14	0.11	
					21	0.07	
					28	0.05	
					36	<0.02	
	EC	4	0.53	0.0375	0	0.56	58
					3	0.30	
					7	0.24	
					10	0.21	
					14	0.14	
					21	0.13	
					28	0.08	
Germany/1974 cont.					57	0.03	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
	EC	3	0.53	0.0375	0	0.48	58
					3	0.22	
					7	0.13	
					10	0.11	
					14	0.20	
					21	0.04	
					28	0.03	
					57	<0.02	
	EC	3	0.53	0.0375	0	0.90	58
					3	0.31	
					7	0.34	
					10	0.12	
					14	0.05	
					21	0.05	
					28	0.04	
					57	<0.02	
Germany/1977	WP	4	0.8	0.04	0	0.42	58
		2	1.2	0.06	3	0.40	
					7	0.45	
					14	0.07	
					21	0.10	
					28	0.04	
	WP	4	0.8	0.04	-0	0.70	58
		2	1.2	0.06	+0	0.78	
					3	0.73	
					7	0.84	
					14	0.52	
					21	0.40	
					28	0.30	
	WP	6	0.8-	0.04-	0	1.65	55
			1.2	0.06	14	1.14	
					21	0.61	
					28	0.35	
					35	0.22	
	WP	6	0.8-	0.04-	0	2	55
			1.2	0.06	14	0.44	
					21	0.28	
					28	0.29	
					35	0.22	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
	WP	6	0.6-	0.04-	7	0.95	55
			0.9	0.06	14	0.76	
					21	0.48	
					28	0.28	
					35	0.22	
	WP	6	0.8-	0.04-	0	2.64	55
			1.2	0.06	14	1.52	
					21	1.1	
					28	0.82	
					35	0.57	
Germany/1980	EC	5	0.75	0.0375	0	0.95	58
					14	0.13	
					21	0.18	
					28	0.08	
					34	<0.02	
					42	<0.02	
	EC	5	0.75	0.0375	-0	<0.02	58
					+0	0.07	
					14	0.02	
					21	0.02	
					28	<0.02	
					35	<0.02	
					42	<0.02	
					49	<0.02	
Germany/1983	WP	5	0.6-	0.04-	0	1.5	55
			0.9	0.06	14	0.31	
					21	0.14	
					28	0.1	
					35	0.1	
Switzerland/1974	EC	2		0.05	0	0.79	58
					4	0.44	
					7	0.49	
					11	0.40	
					14	0.27	
Switzerland cont.					20	0.25	
					28	0.23	
Switzerland/1976	WP	3	0.8	0.04	0	0.13	58
		2	1.2	0.06	3	0.08	
					7	0.07	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
					10	0.04	
					14	0.03	
					21	0.03	
	WP	3	0.8	0.04	0	0.10	58
		2	1.2	0.06	3	0.06	
					7	0.04	
					10	0.05	
					14	0.04	
					21	<0.02	
Switzerland/1977	WP	4	0.8	0.04	0	0.30	58
		2	1.2	0.06	4	0.09	
					7	0.11	
					14	0.11	
					21	0.07	
					28	0.08	
	WP	4	0.8	0.04	0	0.59	58
		2	1.2	0.06	2	0.15	
					7	0.33	
					14	0.25	
					21	0.08	
					28	0.09	
Switzerland/1980	EC	5	0.75	0.0375	-0	0.02	58
					+0	0.10	
					14	0.04	
					21	0.02	
					28	<0.02	
					35	<0.02	
					42	<0.02	
USA/1988	WP	1 + 6[1]	3.36[1]		14	1.32	58
					21	0.91	
					30	0.32	
	WP	1 + 6	3.36		14	0.42	58
USA/1988 cont.					21	1.13	
					30	0.25	
	WP	1 + 6	3.36		14	0.71	58
					21	1.28	
					30	0.46	
	WP	1 + 6	3.36		14	<0.01	58
					21	0.01	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
					30	0.01	
	WP	1 + 6	3.36		14	0.14	58
					21	0.10	
					30	0.03	
	WP	1 + 6	3.36		0	0.46	58
					7	0.32	
					14	0.50	
					21	0.20	
					30	0.1	
	WP	1 + 6	3.36		14	A) 0.36	31
					21	A) 0.16	
					30	A) 0.17	
		A) ground			14	B) 0.12	
		B) aerial			21	B) 0.03	
					30	B) 0.07	
					Processed fractions		
				apples	0	0.98	
				culls		2.20	
				wet pomace		1.40	
				dry pomace		0.40	
				fresh juice		0.02	
				canned juice		<0.01	
				canned slices		<0.01	
				frozen slices		<0.01	
				apple sauce		<0.01	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
Pears							
Germany/1983	WP	5	0.6-	0.04-	0	1.13	55
			0.9	0.06	14	0.04	
					21	0.06	
					28	<0.03	
					35	<0.03	
USA/1988	WP	1 + 6	3.36		14	0.12	58
					21	0.17	
					30	0.10	
	WP	1 + 6	3.36		0	2.75	58
					7	0.31	
					14	0.21	
					21	0.14	
					30	0.03	
	WP	1 + 6			14	0.55	58
					21	0.45	
					30	0.26	
	WP	1 + 6	3.36		14	0.06	58
					21	0.05	
					30	0.02	
	WP	1 + 8	3.36		14	A) 0.01	58
					21	A) <0.01	
					30	A) <0.01	
		A) ground			14	B) <0.01	
		B) aerial			21	B) <0.01	
					30	B) <0.01	
	WP	1 + 6	3.36		14	A) 0.06	58
					21	A) 0.02	
					30	A) <0.01	
		A) ground			14	B) <0.01	
		B) aerial			21	B) <0.01	
					30	B) <0.01	

[1] All US trials were with 1 application of 3.36 kg/ha + oil at the dormant stage followed by 6 (in 1 case 8) foliar sprays at 3.36 kg/ha.

Table 4. Residues from supervised trials on stone fruits. Underlined residues are from treatments according to GAP.

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
Cherries							
Germany/1975	EC	2	0.75	0.0375	0	0.16	58
			g/tree		3	<0.02	
					7	<0.02	
					11	<0.02	
					14	<0.02	
					21	<0.02	
Germany/1980	EC	4	0.5	0.025	-0	<0.02	58
					+0	0.26	
					10	0.04	
					14	0.02	
					21	<0.02	
	EC	4	0.5	0.025	-0	0.08	58
					+0	2.21	
					7	0.72	
					10	0.06	
					14	0.02	
					21	<0.02	
	WP	4	0.8	0.04	-0	0.04	58
					+0	0.53	
					10	0.08	
					14	0.03	
					21	<0.02	
	WP	4	0.8	0.04	-0	0.23	58
					+0	4.24	
					7	0.64	
					10	0.16	
					14	0.04	
					62	<0.02	
Germany/1981	WP	4	0.6	0.12	-0	<0.02	58
					+0	0.30	
					7	<0.02	
Germany/1981 cont.					11	<0.02	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
					14	<0.02	
					19	<0.02	
	EC	4	0.6	0.075	-0	0.02	58
					+0	0.36	
					7	0.02	
					11	<0.02	
					14	<0.02	
					19	<0.02	
Germany/1983	WP	4	0.6	0.04	-0	0.20	58
					+0	1.10	
					7	0.32	
					10	0.15	
					14	<0.02	
					21	<0.02	
	WP	4	0.6	0.04	-0	0.09	58
					+0	1.60	
					7	0.38	
					10	0.24	
					14	0.04	
					21	0.02	
	EC	4	0.375	0.025	-0	0.42	58
					+0	1.70	
					7	0.34	
					10	0.16	
					14	0.11	
					21	0.09	
	EC	4	0.375	0.025	-0	0.18	58
					+0	2.80	
					7	0.51	
					10	0.30	
					14	0.26	
					21	0.14	
Switzerland/1966	EC	3		0.025	-0	0.20	58
					+0	2.10	
					3	0.80	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
					5-7	0.40	
					10	0.30	
					14	0.05	
					21-27	0.02	
	EC	2		0.025	-0	0.20	58
					+0	1.50	
					3	0.50	
					5	0.30	
					7-10	0.20	
					14	0.10	
					21	0.04	
					26	0.02	
	EC	1		0.025	-0	<0.05	58
					+0	1.30	
					3	0.40	
					5	<0.05	
					10	0.09	
					13	<0.05	
USA/1988	EC	1+4[1]	3.3		10	0.18	58
	EC+WP	1+4	3.3		10	0.27	58
	WP+EC	1+4	3.3		10	0.09	58
	WP	1+4	3.3		10	0.09	58
	EC	1+4	3.3		10	0.17	58
					20	0.08	
	EC+WP	1+4	3.3		10	0.18	58
					20	0.04	
	WP+EC	1+4	3.3		10	0.29	58
					20	0.12	
	WP	1+4	3.3		10	0.36	58
					20	0.04	
USA 1988 cont.	EC	1+4	3.3		10	0.02	58
					20	<0.01	
	EC+WP	1+4	3.3		10	0.01	58
					20	<0.01	
	WP+EC	1+4	3.3		10	0.03	58

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
					20	<0.01	
	WP	1+4	3.3		10	0.03	58
					20	0.03	
	EC	1+4	3.3		0	13.0	58
					7	0.40	
					10	0.27	
					20	0.07	
					30	0.02	
	EC+WP	1+4	3.3		0	7.95	58
					7	0.77	
					10	0.52	
					20	0.19	
					30	0.04	
	WP+EC	1+4	3.3		0	10.8	58
					7	1.10	
					10	0.59	
					20	0.15	
					30	0.04	
	WP	1+4	3.3		0	6.4	58
					7	1.0	
					10	0.73	
					20	0.28	
					30	0.02	
	EC	1+4	3.3		10	0.13	58
					20	0.01	
	EC+WP	1+4	3.3		10	0.18	58
					20	0.02	
	WP+EC	1+4	3.3		10	0.12	58
USA 1988 cont.					20	0.02	
	WP	1+4	3.3		10	0.32	58
					20	0.03	
	EC+WP	1+4	3.3		10	0.05	58
		(aerial)			20	<0.01	
	EC	1+4	3.3		10	0.08	58
					20	0.01	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
	EC+WP	1+4	3.3		10	0.06	58
					20	<0.01	
	WP+EC	1+4	3.3		10	0.09	58
					20	<0.01	
	WP	1+4	3.3		10	0.06	58
					20	<0.01	
	EC	1+4	3.3		0	1.05	58
					7	0.05	
					10	0.03	
					20	<0.01	
					30	<0.01	
	EC+WP	1+4	3.3		0	0.09	58
					7	0.02	
					10	<0.01	
					20	<0.01	
					30	<0.01	
	WP+EC	1+4	3.3		0	0.16	58
					7	0.04	
					10	0.02	
					20	<0.01	
					30	<0.01	
	WP	1+4	3.3		0	0.43	58
					7	0.02	
					10	0.01	
					20	<0.01	
					30	<0.01	
Peaches							
Portugal/1976		2	0.03		1	0.82	47
					7	0.09	
					14	0.03	
Germany/1980	WP	4	0.8	0.04	0	0.55	58
					7	<0.02	
					10	<0.02	
					14	<0.02	
					21	<0.02	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
	WP	2+2	0.56	0.04	0	2.67	58
			0.8	0.04	7	0.39	
					10	0.27	
					14	0.13	
					21	0.05	
	EC	4	0.47	0.0235	0	0.76	58
					7	<0.02	
					10	<0.02	
					14	<0.02	
					21	<0.02	
Germany/1981	WP	4	0.6	0.04	0	0.90	58
					7	0.13	
					10	0.13	
					14	0.08	
	EC	4	0.35	0.0235	0	0.64	58
					7	0.22	
					10	0.14	
					14	0.09	
					21	<0.02	
Switzerland/1981	EC	4	0.47	0.0235	0	0.88	58
					7	0.15	
					10	0.12	
					14	0.06	
					21	<0.02	
USA/1988	EC	1+4	3.3		10	0.04	58
					20	<0.01	
	EC+WP	1+4	3.3		10	<0.01	58
					20	<0.01	
	WP+EC	1+4	3.3		10	<0.01	58
					20	<0.01	
	WP	1+4	3.3		10	0.11	58
					20	0.02	
	EC	1+5	3.3		10	0.11	58
					20	0.02	
	EC+WP	1+5	3.3		10	0.85	58

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
					20	0.05	
	WP+EC	1+5	3.3		10	0.15	58
					20	0.02	
	WP	1+5	3.3		10	1.18	58
					20	0.1	
	EC+WP	1+5	3.3		10	1.03	58
		(aerial)			20	0.11	
	EC	1+4	3.3		9	0.62	58
					19	0.05	
	EC+WP	1+4	3.3		9	0.42	58
					19	0.01	
	WP+EC	1+4	3.3		9	0.77	58
					19	0.05	
	WP	1+4	3.3		9	0.69	58
					19	0.07	
	EC	1+4	3.3		9	0.81	58
					19	0.03	
	EC+WP	1+4	3.3		9	0.78	58
					19	0.03	
	WP+EC	1+4	3.3		9	0.52	58
					19	0.03	
USA 1988 cont.	WP	1+4	3.3		9	0.67	58
					19	0.04	
Plums							
Germany/1974	EC	2	0.94	0.05	0	0.69	58
					7	0.05	
					15	<0.02	
					24	<0.02	
					32	<0.02	
					52	<0.02	
	EC	3	0.705	0.05	0	0.22	58
					3	0.05	
					7	<0.02	
					10	<0.02	
					14	<0.02	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
					21	<0.02	
					28	<0.02	
					46	<0.02	
Germany/1980	WP	5	0.8	0.04	0	0.33	58
					7	0.04	
					9	0.02	
					14	<0.02	
					21	<0.02	
	WP	5	0.8	0.04	0	0.15	58
					7	<0.02	
					10	<0.02	
					14	<0.02	
					21	<0.02	
					28	<0.02	
					35	<0.02	
	EC	5	0.47	0.0235	0	0.45	58
					7	<0.02	
					10	<0.02	
					14	<0.02	
Germany 1980 cont.					21	<0.02	
					28	<0.02	
Germany/1981	WP	5	0.6	0.04	0	0.15	58
					7	0.03	
					10	0.02	
					14	0.02	
					21	<0.02	
	EC	5	0.375	0.0235	0	0.07	58
					7	0.02	
					10	0.02	
					14	<0.02	
					21	<0.02	
	EC	5	0.352	0.07	0	0.11	58
					7	<0.02	
					10	<0.02	
					14	<0.02	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
Germany/1982	WP	4	0.6	0.04	0	0.26	55
					7	0.06	
					14	0.01	
					21	<0.01	
	WP	4	0.6	0.04	0	0.14	55
					7	0.02	
					14	0.01	
					21	0.01	
	WP	4	0.6	0.04	0	0.5	55
					7	0.02	
					14	0.06	
					21	0.02	
Switzerland/1974	EC	3	2.5 g	0.05	0	3.0	58
			/tree		3	0.77	
					7	0.18	
					10	0.08	
					14	0.09	
Switzerland 1974					19	0.04	
cont.					33	<0.02	
USA/1988	EC	1+4	3.3		10	0.01	58
					20	<0.01	
	EC+WP	1+4	3.3		10	<0.01	58
					20	<0.01	
	WP+EC	1+4	3.3		10	0.01	58
					20	<0.01	
	WP	1+4	3.3		10	0.01	58
					20	<0.01	
	EC	1+4	3.3		10	0.07	58
					20	<0.01	
	EC+WP	1+4	3.3		10	0.37	58
					20	0.03	
	WP+EC	1+4	3.3		10	0.09	58
					20	0.02	
	WP	1+4	3.3		10	0.10	58
					20	0.02	

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
	EC	1+4	3.3		10	0.78	58
					20	0.28	
	EC+WP	1+4	3.3		10	0.64	58
					20	0.46	
	WP+EC	1+4	3.3		10	0.58	58
					20	0.53	
	WP	1+4	3.3		10	0.53	58
					20	0.20	
	EC	1+4	3.3		10	0.10	58
					20	0.02	
	EC+WP	1+4	3.3		10	0.04	58
					20	0.02	
	WP+EC	1+4	3.3		10	0.10	58
					20	0.01	
	WP	1+4	3.3		10	0.10	58
USA 1988 cont.					20	0.02	
	EC	1+4	3.3		10	0.15	58
					20	<0.01	
	EC+WP	1+4	3.3		10	0.12	58
					20	<0.01	
	WP+EC	1+4	3.3		10	0.22	58
					20	<0.01	
	WP	1+4	3.3		10	0.20	58
					20	<0.01	
	EC+WP	1+4	3.3		10	0.07	58
		(aerial)			20	<0.01	
Prunes	Form.	No.	kg ai/ha	mg/kg fresh	PHI, days	mg/kg, dry	
USA/1988	EC	1+5	3.3	0.13	10	0.02	58
				0.02	20	<0.01	
	EC+WP	1+5	3.3	0.14	10	0.01	58
				0.02	20	<0.01	
	WP+EC	1+5	3.3	0.16	10	<0.01	58
				0.02	20	<0.01	
	WP	1+5	3.3	0.11	10	0.02	58

Crop	Application				PHI, days	Residue, mg/kg	Ref.
Country/year	Form	No.	kg ai/ha	kg ai/hl			
				0.08	20	<0.01	
	EC	1+5	3.3	0.06	10	0.09	58
				0.01	20	0.01	
	EC+WP	1+5	3.3	0.08	10	0.57	58
				0.02	20	0.01	
	WP+EC	1+5	3.3	0.14	10	0.09	58
				0.02	20	0.01	
	WP	1+5	3.3	0.25	10	1.90	58
				0.02	20	<0.01	
	EC+WP	1+5	3.3	0.07	10	0.49	58
		(aerial)		<0.01	20	0.01	
	EC	1+4	3.3	<0.01	10	<0.01	58
				<0.01	20	<0.01	
	EC+WP	1+4	3.3	<0.01	10	<0.01	58
				mg/kg fresh		mg/kg, dry	
				<0.01	20	<0.01	
	WP+EC	1+4	3.3	<0.01	10	<0.01	58
				<0.01	20	<0.01	
	WP	1+4	3.3	<0.01	10	<0.01	58
				<0.01	20	<0.01	

[1]All Us trials were with a single application at the dormant stage followed by 4 or 5 foliar, all at the same rate.

Table 5. Residues from supervised trials on grapes. Underlined residues are from treatments according to GAP.

Country/year	Application				Sample analysed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
France/1982	EC	1	0.24	0.024	grapes	34	<0.02	58
					wine	52	<0.02	
	EC	1	0.24	0.024	grapes	34	0.02	58
					wine	52	<0.02	
	EC	1	0.24	0.024	grapes	25	<0.02	58
					wine	50	<0.02	
	EC	1	0.24	0.024	grapes	34	0.06	58
					wine	53	<0.02	
France/1983	EC	1	0.067	0.027	grapes	69	0.05	58

Country/year	Application				Sample	PHI,	Residue,	Ref.
	Form	No	kg ai/ha	kg ai/hl	analysed	days	mg/kg	
					wine	83	<0.02	
	EC	1	0.23	0.027	grapes	32	<0.02	58
					wine	44	<0.02	
	EC	1	0.43	0.027	grapes	24	0.15	58
					wine	42	<0.02	
	EC	1	0.43	0.027	grapes	0	0.90	58
						3	0.20	
						7	0.20	
						14	0.09	
						23	0.06	
	EC	1	0.27	0.027	grapes	0	0.20	58
						3	<0.02	
						14	<0.02	
France cont.						21	<0.02	
						28	0.02	
Germany/1980	EC	4	1.04	0.26	grapes	0	0.2	58
						14	0.04	
						21	0.02	
						28	<0.02	
						35	<0.02	
					wine	35	<0.001	
	EC	3	0.98	0.13	grapes	0	1.10	58
		+ 1	1.30	0.13		14	0.16	
						21	0.10	
						28	0.05	
						39	0.07	
					wine	39	<0.001	
	EC	1	0.98	0.098	grapes	0	0.18	58
		+ 3	6.76	0.20		14	0.07	
						21	0.06	
						28	0.06	
						35	0.03	
					wine	35	<0.001	
Switzerland/1980	EC	4	1.3	0.07	grapes	0	0.52	58
						14	0.16	
						21	0.04	
						28	0.06	

Country/year	Application				Sample	PHI,	Residue,	Ref.
	Form	No	kg ai/ha	kg ai/hl	analysed	days	mg/kg	
						35	0.06	
						42	0.04	
						47	0.04	
					wine	47	<0.001	
USA/1988	EC	5	1.12		grapes	7	0.12	58
						14	0.08	
						21	0.03	
	WP	5	1.12			7	0.11	58
						14	0.03	
						21	0.02	
	EC	5	1.12			7	0.03	58
USA cont.						14	0.05	
						21	0.02	
	EC	5	1.12		grapes	7	0.03	58
						14	0.01	
						21	<0.01	
	WP	5	1.12		grapes	7	0.03	58
						14	<0.01	
						21	<0.01	
	EC	5	1.12		grapes	7	0.29	58
						14	0.27	
						21	0.39	
	WP	5	1.12		grapes	7	0.34	58
						14	0.06	
						21	0.1	
	EC	5	1.12		grapes	7	0.26	58
						14	0.13	
						21	0.17	
	WP	5	1.12		grapes	7	0.41	58
						14	0.08	
						21	0.18	
	EC	5	1.12		grapes	7	2.6	58
						14	1.3	
						21	1.3	
	WP	5	1.12		grapes	7	1.2	58
						14	1.9	
						21	1.2	

Country/year	Application				Sample	PHI,	Residue,	Ref.
	Form	No	kg ai/ha	kg ai/hl	analysed	days	mg/kg	
	EC	5	1.12		grapes	7	0.66	58
						14	0.72	
						21	0.39	
	WP	5	1.12		grapes	7	0.43	58
						14	0.57	
						21	0.32	
	EC	5	1.12		grapes	7	0.18	58
						14	0.06	
						21	0.05	
USA cont.	WP	5	1.12		grapes	7	0.13	58
						14	0.11	
						21	0.04	
	EC	5	1.12		grapes	7	0.04	58
						14	0.01	
						21	<0.01	
	WP	5	1.12		grapes	7	<0.01	58
						14	<0.01	
						21	<0.01	
	WP	5	1.12			7	0.05	45
						14	0.07	
						21	0.02	
					grapes, unwashed	7	0.06	45
					wash water		<0.01	
					stems		0.04	
					grapes, destemmed		0.06	
					juice		0.02	
					wet pomace		0.13	
					dry pomace		0.36	
					filter cake		0.01	
					Agrol settling		<0.01	
					sediment		<0.01	
					juice, clarified		<0.01	
					juice, canned		<0.01	

Table 6. Residues from supervised trials on strawberries, all ref. 58. Underlined residues are from treatments according to GAP.

Country/year	Application			PHI, days	Residue, mg/kg
	Form	No.	kg ai/ha		
New Zealand/	WP	1	0.50	0	0.06
1989				3	0.05
				5	0.03
				7	0.01
	WP	1	0.75	0	0.17
				3	0.06
				5	0.02
				7	0.02
	WP	1	1.0	0	0.81
				3	0.14
				5	0.07
				7	0.02
USA/1988	EC	1+3[1]	1.12	3	0.16
				5	0.09
	EC+WP	1+3	1.12	3	0.12
				5	0.08
	WP+EC	1+3	1.12	3	0.18
				5	0.08
	WP	1+3	1.12	3	0.16
				5	0.12
	EC	1+3	1.12	3	0.16
				5	0.08
				7	0.12
	EC+WP	1+3	1.12	3	0.10
				5	0.07
				7	0.07
	WP+EC	1+3	1.12	3	0.11
				5	0.08

Country/year	Application			PHI, days	Residue, mg/kg
	Form	No.	kg ai/ha		
USA cont.				7	0.07
	WP	1+3	1.12	3	0.09
				5	0.07
				7	0.11
	EC	1+3	1.12	3	0.14
				5	0.05
				7	0.05
	EC+WP	1+3	1.12	3	0.16
				5	0.06
				7	0.04
	WP+EC	1+3	1.12	3	0.12
				5	0.05
				7	0.04
	WP	1+3	1.12	3	0.08
				5	0.03
				7	0.05
	EC	1+3	1.12	3	0.11
				5	0.09
				7	0.04
	EC+WP	1+3	1.12	3	0.07
				5	0.07
				7	0.04
	WP+EC	1+3	1.12	3	0.07
				5	0.06
				7	0.06
	WP	1+3	1.12	3	0.07
				5	0.06
				7	0.07
	EC	1+3	1.12	3	<0.01

Country/year	Application			PHI, days	Residue, mg/kg
	Form	No.	kg ai/ha		
				5	<0.01
USA cont.				7	<0.01
	EC+WP	1+3	1.12	3	<0.01
				5	<0.01
				7	<0.01
	WP+EC	1+3	1.12	3	<0.01
				5	<0.01
				7	<0.01
	WP	1+3	1.12	3	<0.01
				5	<0.01
				7	<0.01
	EC	1+3	1.12	3	0.09
				5	0.08
				7	0.03
	EC+WP	1+3	1.12	3	0.06
				5	0.04
				7	0.01
	WP+EC	1+3	1.12	3	0.11
				5	0.06
				7	0.02
	WP	1+3	1.12	3	0.06
				5	0.04
				7	0.01
	EC	1+3	1.12	3	0.13
				5	0.06
				7	0.05
	EC+WP	1+3	1.12	3	0.03
				5	0.02
				7	0.03

Country/year	Application			PHI, days	Residue, mg/kg
	Form	No.	kg ai/ha		
	WP+EC	1+3	1.12	3	0.13
				5	0.08
USA cont.				7	0.06
	WP	1+3	1.12	3	0.08
				5	0.05
				7	0.04
	EC	1+3	1.12	3	0.44
				7	0.04
	EC+WP	1+3	1.12	3	0.09
				7	0.04
	WP+EC	1+3	1.12	3	0.07
				7	0.05
	WP	1+3	1.12	3	0.1
				7	0.05
	EC	1+3	1.12	3	0.01
				5	0.01
				7	<0.01
	EC+WP	1+3	1.12	3	0.02
				5	0.03
				7	0.02
	WP+EC	1+3	1.12	3	0.02
				5	<0.01
				7	0.01
	WP	1+3	1.12	3	0.04
				5	0.01
				7	0.02

[1] 1 pre-plant + 3 foliar

Table 7. Residues from supervised trials on other berries, all ref. 58 except cranberries, Canada, ref. 19. Underlined residues are from treatments according to GAP.

Crop Country/year	Application	PHI, days	Residue, mg/kg

	Form	No	kg ai/ha	kg ai/hl		
Blackberries						
USA/1988	EC	1	2.2	0.12	7	0.06
		+5[1]	1.1	0.06	14	0.06
	EC+WP	1	2.2	0.12	7	0.08
		+5	1.1	0.06	14	0.04
	WP+EC	1	2.2	0.12	7	0.09
			1.1	0.06	14	0.06
	WP	1	2.2	0.12	7	0.08
		+5	1.1	0.06	14	0.07
	EC	1	2.2	0.12	7	0.05
		+5	1.1	0.06	14	0.06
	EC+WP	1	2.2	0.12	7	0.05
		+5	1.1	0.06	14	0.06
	WP+EC	1	2.2	0.12	7	0.07
		+5	1.1	0.06	14	0.08
	WP	1	2.2	0.12	7	0.06
		+5	1.1	0.06	14	0.07
	EC	1	2.2	0.2	7	0.02
		+5	1.1	0.2	14	0.01
	EC+WP	1	2.2	0.2	7	0.02
		+5	1.1	0.2	14	0.01
	WP+EC	1	2.2	0.2	7	0.01
		+5	1.1	0.2	14	0.01
	WP	1	2.2	0.2	7	0.02
		+5	1.1	0.2	14	0.01
	EC	1	2.2	0.2	7	0.02
		+5	1.1	0.2	14	0.01
	EC+WP	1	2.2	0.2	7	0.02
		+5	1.1	0.2	14	0.01
	WP+EC	1	2.2	0.2	7	0.02
		+5	1.1	0.2	14	0.01
	WP	1	2.2	0.2	7	0.02
		+5	1.1	0.2	14	<0.01
Boysenberries						
USA/1988	EC	1	2.2	0.2	7	0.04
		+5	1.1	0.2	14	0.01
	EC+WP	1	2.2	0.2	7	0.03
		+5	1.1	0.2	14	<0.01
	WP+EC	1	2.2	0.2	7	0.05
		+5	1.1	0.2	14	0.02
	WP	1	2.2	0.2	7	0.06
		+5	1.1	0.2	14	0.02
Cranberries						
Canada/1987	GR	2	6.72		59	n.d.
	GR	2	3.36		59	n.d.
	GR	1	3.36		51	n.d.
Currants						
Germany/1975	EC	1	0.75 g/plant	0.0375	0	0.21
					4	0.02

Crop Country/year	Application				PHI, days	Residue, mg/kg
	Form	No	kg ai/ha	kg ai/hl		
					7	0.02
					10	<0.02
					14	<0.02
					21	<0.02
	EC	1	0.75 g/plant	0.0375	0	1.84
					3	0.30
					8	0.16
					11	0.03
					14	0.02
					21	0.05
	EC	1	0.75 g/plant	0.0375	0	2.46
					3	0.30
					6	0.23
					10	0.13
					14	0.06
					21	0.03
Germany/1980	EC	2	0.47	0.024	-0	0.06
					+0	0.39
					7	0.11
					10	0.09
					14	0.07
					21	0.03
	EC	2	0.47	0.024	-0	0.04
					+0	1.22
					7	0.14
					10	0.07
					14	0.02
					21	<0.02
	EC	2	0.47	0.024	-0	0.08
					+0	1.02
					7	0.19
					10	0.13
					14	0.08
					21	0.06
Germany cont.	WP	2	0.8	0.04	-0	0.09
					+0	0.51
					7	0.21
					10	0.13
					14	0.06
					21	0.04
	WP	2	0.8	0.04	-0	0.10
					+0	3.96
					7	0.11
					10	0.05
					14	0.04
					21	0.02
	WP	2	0.8	0.04	-0	0.06

Crop Country/year	Application				PHI, days	Residue, mg/kg
	Form	No	kg ai/ha	kg ai/hl		
					+0	2.12
					7	0.53
					10	0.34
					14	0.21
					21	0.16
	WP	2	0.8	0.04	-0	0.07
					+0	1.94
					7	0.12
					10	0.09
					14	0.06
					21	0.04
Germany/1981	EC	2	0.35	0.025	-0	<0.02
					+0	0.34
					6	0.06
					9	0.06
					13	0.05
					20	0.02
	EC	2	0.35	0.025	0	0.09
					7	0.02
					10	0.02
					15	<0.02
					21	<0.02
	EC	2	0.35	0.025	-0	0.03
					+0	0.34
					7	0.04
					10	<0.02
					14	<0.02
					21	<0.02
Germany cont.	WP	2	0.6	0.04	0	0.4
					7	0.12
					10	0.11
					15	0.08
					21	0.02
	WP	2	0.6	0.04	-0	0.04
					+0	0.46
					7	0.11
					10	0.06
					14	0.02
					21	0.03
	WP	2	0.6	0.04	-0	0.02
					+0	0.17
					6	0.05
					10	0.03
					13	0.02
					20	0.02
Switzerland/	EC	2	0.47	0.024	-0	0.04
1981					+0	0.62

Crop Country/year	Application				PHI, days	Residue, mg/kg
	Form	No	kg ai/ha	kg ai/hl		
					7	0.28
					10	0.23
					14	0.13
					21	<0.02
Raspberries						
USA/1988	EC	1	2.2	0.2	0	1.11
		+5	1.1	0.2	7	0.12
					14	0.04
					21	0.03
	EC+WP	1	2.2	0.2	0	0.76
		+5	1.1	0.2	7	0.06
					14	0.02
					21	0.04
	WP+EC	1	2.2	0.2	0	1.30
		+5	1.1	0.2	7	0.08
					14	0.04
					21	0.03
	WP	1	2.2	0.2	0	1.50
		+5	1.1	0.2	7	0.07
					14	0.02
					21	0.01
USA cont.	EC	1	2.2	0.6	0	3.10
		+5	1.1	0.3	7	0.18
					14	0.04
					21	0.01
	EC+WP	1	2.2	0.6	0	3.20
		+5	1.1	0.3	7	0.11
					14	0.02
					21	0.01
	WP+EC	1	2.2	0.6	0	2.80
		+5	1.1	0.3	7	0.17
					14	0.03
					21	0.01
	WP	1	2.2	0.6	0	3.20
		+5	1.1	0.3	7	0.12
					14	0.03
					21	0.02
	EC	1	2.2	0.2	7	0.02
		+5	1.1	0.2	14	0.02
	EC+WP	1	2.2	0.2	7	0.01
		+5	1.1	0.2	14	0.01
	WP+EC	1	2.2	0.2	7	0.03
		+5	1.1	0.2	14	0.02
	WP	1	2.2	0.2	7	0.02
		+5	1.1	0.2	14	<0.01
	EC	1	2.2	0.6	7	0.09
		+5	1.1	0.3	14	0.02

Crop Country/year	Application				PHI, days	Residue, mg/kg
	Form	No	kg ai/ha	kg ai/hl		
	EC+WP	1	2.2	0.6	7	0.08
		+5	1.1	0.3	14	0.02
	WP+EC	1	2.2	0.6	7	0.06
		+5	1.1	0.3	14	0.01
	WP	1	2.2	0.6	7	0.03
		+5	1.1	0.3	14	<0.01
	EC	1	2.2	0.12	7	0.08
		+5	1.1	0.06	14	0.02
	EC+WP	1	2.2	0.12	7	0.07
		+5	1.1	0.06	14	0.02
	WP+EC	1	2.2	0.12	7	0.07
		+5	1.1	0.06	14	0.02
	WP	1	2.2	0.12	7	0.03
		+5	1.1	0.06	14	0.01

[1] All US trials with 1 application at dormant stage and 5 foliar

Table 8. Residues from supervised trials on other fruits. Underlined residues are from treatments according to GAP.

Crop/country/year	Application				Sample analysed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
Olives								
Spain/1975		1		0.04	fruit	39	0.09	4
					preserved	39	0.09	
						185	0.09	
				0.04	fruit	39	0.03	4
					preserved	39	0.04	
						185	0.04	
Spain/1976		2		0.04	fruit	89	<0.02	5
					oil	89	0.10	
				0.04	fruit	83	0.07	5
					oil	83	0.29	
Portugal/1980		2		0.09	fruit	1	4.2	47
						7	3.3	
						14	1.5	
						21	2.6	
						28	2.3	
						35	1.8	
						41	0.91	
					oil, crude	14	6.6	
						21	8.4	
						28	9.6	

Crop/country/year	Application				Sample analysed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						35	6.4	
						41	4.9	
Portugal/1982		1		0.09	fruit	1	3.0	47
						14	1.2	
						21	1.1	
						28	0.84	
						35	0.62	
						41	0.85	
						49	0.47	
						55	0.56	
Portugal cont.					oil, crude	1	9.0	
						14	5.5	
						21	3.7	
						28	3.6	
						35	3.1	
						41	2.7	
						49	2.0	
						55	1.7	
Persimmons								
N. Zealand/1988	WP	1	1.25	0.05	fruit	1	1.40	24,
						4	0.54	59
						7	0.36	
						14	0.18	
						21	0.09	
						28	0.06	
	WP	1	1.25	0.05	fruit	1	0.88	24,
						4	0.69	59
						7	0.25	
						14	0.10	
						21	0.13	
						28	0.05	
N. Zealand/1991	WP	7	0.675-	0.045	fruit	150	0.22	
			0.900			3	0.38	
						7	0.16	
						14	0.12	
						21	0.04	
						28	<0.02	

Crop/country/year	Application				Sample analysed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						42	<0.02	
Bananas								
Australia/1988	EC	3		0.04	whole fruit	76	<0.01	58
Costa Rica/1989	EC	3	0.09	0.6	pulp	0	<0.02	58
						3	<0.02	
						7	<0.02	
						14	<0.02	
					peel	0	<0.02	
Costa Rica cont.						3	<0.02	
						7	<0.02	
						14	<0.02	
Costa Rica/1990	GR	1	4g/plant		pulp	323	<0.02	58
						337	<0.02	
					peel	323	<0.02	
						337	<0.02	
	GR	1	4g/plant		pulp	323	<0.02	58
						337	<0.02	
					peel	323	<0.02	
						337	<0.02	
Honduras/1990	EC	3	1.62	0.09	pulp	0	<0.02	58
						3	<0.02	
						7	<0.02	
						14	<0.02	
					peel	0	<0.02	
						3	<0.02	
						7	<0.02	
						14	<0.02	
	GR	1	4g/plant		whole fruit	260	<0.02	58
	GR	1	4g/plant		whole fruit	274	<0.02	58
Kiwifruit								
Italy/1988	EC	1	0.9	0.06		0	2.30	58
						13	0.34	
						27	0.12	
						34	0.09	
						41	0.04	
	EC	1	1.2	0.06		0	2.20	58
						14	0.40	

Crop/country/year	Application				Sample analysed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						28	0.06	
						35	0.04	
						42	0.04	
N. Zealand/1988	EC	5	0.768-0.864	0.05		0	0.67	58
						7	0.16	
						14	0.13	
N. Zealand cont.						21	0.07	
						28	0.05	
	EC	7	0.96-1.2	0.05		0	2.20	58
						7	1.40	
						14	0.97	
						21	0.24	
						28	0.19	
N. Zealand/1989	EC	5	to run off	0.048		0	0.96	58
						7	0.57	
						14	0.11	
						21	0.08	
						28	0.07	
	EC	6	to run off	0.048		0	0.85	58
						7	0.11	
						14	0.11	
						21	0.11	
						28	0.08	
Pineapples								
Costa Rica/1989	EC	3	0.1	0.0625	whole fruit	0	0.10	32
						1	<0.02	
						3	<0.02	
						7	<0.02	
					juice	0	<0.02	
						1	<0.02	
						3	<0.02	
						7	<0.02	
					filter cake	0	0.09	
						1	<0.02	
						3	<0.02	
						7	<0.02	
	EC	3	0.1	0.0625	whole fruit	0	0.05	33

Crop/country/year	Application				Sample analysed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						1	<0.02	
						3	<0.02	
						7	<0.02	
					juice	0	0.03	
Costa Rica cont.						1	<0.02	
						3	<0.02	
						7	<0.02	
					filter cake	0	0.59	
						1	<0.02	
						3	<0.02	
						7	<0.02	
Costa Rica/1991	EC	1	0.6% in dip solution	0.6	whole fruit	574	<0.02	58
	EC	1	0.6% in dip solution	0.6	whole fruit	574	<0.02	58
Honduras/1990	EC	3	0.1 l/plant	0.1	whole fruit	0	0.62	49
						1	0.47	
						3	0.06	
						7	0.04	
					juice	0	0.10	
						1	0.10	
						3	<0.02	
						7	<0.02	
					filter cake	0	0.38	
						1	0.38	
						3	0.05	
						7	0.03	
	EC	3	0.1 l/plant	0.1	whole fruit	0	0.24	49
						1	0.16	
						3	0.10	
						7	0.07	
					juice	0	0.10	
						1	0.04	
						3	<0.02	
						7	<0.02	
					filter cake	0	0.39	
						1	0.19	
						3	0.04	

Crop/country/year	Application				Sample analysed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						7	0.05	
Honduras/1991	EC	1	1.0% in dip solution	1.0	whole fruit	558	<0.02	58
Honduras cont.	EC	1	1.0% in dip solution	1.0	whole fruit	558	0.02	58
USA/1989	WP	1+8[1]	10.0		whole fruit	7	<0.01	58
						14	<0.01	
						21	<0.01	
					juice	7	<0.01	
					bran	7	0.03	
	WP	1+8	10.8		whole fruit	7	<0.01	58
						14	<0.01	
						21	<0.01	
	WP	1+8	13.6		whole fruit	7	0.08	58
						14	<0.01	
						21	<0.01	
	WP	1+8	13.6		whole fruit	7	0.04	58
						14	<0.01	
						21	<0.01	
	WP	1+8	13.6		whole fruit	7	0.07	58
						14	<0.01	
						21	<0.01	
	WP	1+8	10.1		whole fruit	7	0.03	58
						14	<0.01	
						20	<0.01	
	WP	1+8	9.7		whole fruit	7	0.02	58
						14	<0.01	
						21	<0.01	
	WP	1+8	9.7		whole fruit	7	0.02	58
						14	<0.01	
						21	<0.01	

[1] 1 dip + 8 foliar treatments

Bulb vegetables (Table 9)

Bulb onions. Supervised trials were conducted in Germany (5), Switzerland (6), and the USA (10) using EC, WP, and GR formulations. The result of one trial was reported by Finland. The European trials were carried out with 0.06-0.125 g ai/m row after sowing or planting, or 5.0 kg ai/ha. In US trials a granule was used pre-planting with an application rate of 4.4 kg ai/ha and followed by three foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.55 kg ai/ha.

Residues of diazinon after a single treatment never exceeded 0.1 mg/kg in the bulbs 43 -176 days after application. No residues were detectable in samples taken at normal harvest (<0.02 mg/kg). After pre-plant and foliar treatments residues of diazinon 10 -21 days after the last application varied between <0.01 and 0.04 mg/kg in the bulb.

Spring onions. Eight trials were carried out in the USA with pre-planting granules at an application rate of 4.4 kg ai/ha and three foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.55 kg ai/ha.

Residues in the whole plant 10 to 21 days afte r the last application ranged from <0.01 to 0.65 mg/kg.

Brassica vegetables (Table 10)

Broccoli. Ten trials were carried out in the USA using granules pre-planting at 4.4 kg ai/ha and five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.55 kg ai/ha.

Residues in the plant 7 to 21 days after the last application were <0.01-0.23 mg/kg.

Head cabbage. Supervised trials were conducted in Germany (4), Switzerland (3), and the USA (20) using EC, WP, and GR formulations. The European trials were carried out with one or two applications after transplanting at 0.1 g ai/m row or 0.02 g ai/plant (25 g ai/hl) at an interval of 1-20 days. In US trials a GR or EC formulation was used before planting at an application rate of 4.4 kg ai/ha followed by five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.55 kg ai/ha.

Residues of diazinon after one or two treatments ranged from <0.02 to 0.60 mg/kg 21 -86 days after the last application. After pre-plant and foliar applications residues of diazinon 7-21 days after the last treatment varied between <0.01 and 1.8 mg/kg.

Cauliflower. Six supervised trials from Germany (5) and Switzerland using EC and GR formulations were carried out with one or two applications after transplanting at 0.1 g ai/m row or 0.02 g ai/plant (25 g ai/hl) at an interval of 1-14 days.

Residues of diazinon were not detectable (<0.02 mg/kg) 36 -131 days after the last treatment.

Kohlrabi. In six supervised trials from Germany (4) and Switzerland EC or GR formulations were applied once or twice at 0.1 g ai/m row or 0.018 g ai/plant (23.5 g ai/hl) at an early growth stage.

Residues of diazinon ranged from <0.02 to 0.12 mg/kg 14 -113 days after the last treatment.

Fruiting vegetables, Cucurbits (Table 11)

Melon, cantaloupe. Fourteen trials were carried out in the USA using a granule before planting with an application rate of 4.4 kg ai/ha and five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.83 kg ai/ha.

Residues in the whole fruit 3 to 7 days after the last application ranged from 0.01 to 0.30 mg/kg.

Cucumber. Supervised trials were conducted in Japan (4), Switzerland (1), and the USA (10) with EC, WP, GR and DP formulations applied at 4.48 kg ai/ha to the soil and/or at 0.8 -0.84 kg ai/ha 3 -5 times as foliar treatments.

Residues of diazinon in the cucumbers at harvest (PHI 3 -38 days)

varied between <0.01 and 0.4 mg/kg.

Summer squash, zucchini . Eight trials with summer squash and four trials with zucchini were carried out in the USA using granules pre-planting with an application rate of 4.48 kg ai/ha and five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.83 kg ai/ha.

Residues of diazinon 3 to 14 days after the last application were <0.01-0.18 mg/kg.

Fruiting vegetables, other than cucurbits (Table 12)

Mushrooms. In four trials in the Netherlands either the compost was treated with 0.05 kg ai/t or the cells twice with 6 g ai/cell.

Residues of diazinon were not detectable (<0.02 mg /kg) 35 days after treatment of the compost. Cell treatment led to residues of 0.07 to 0.17 mg/kg on the day of the last application. Two days later residues ranged from 0.05 to 0.11 mg/kg.

Peppers. Ten trials were carried out in the USA using a granule before planting at 4.48 kg ai/ha and five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.56 kg ai/ha.

Residues of diazinon 3 to 14 days after the last application ranged from <0.01 to 0.09 mg/kg.

Sweet corn . Supervised trials were conducted in Thailand (4) and the USA (36) using EC, WP, and GR formulations. In the US trials a granule or an EC formulation was used pre-planting at 4.4 kg ai/ha followed by five foliar sprays at approximately two-week intervals with WP or EC formulations at a rate of 1.38 kg ai/ha. Thailand reported results from trials with an EC formulation applied four times at rates between 0.65 and 2.12 kg ai/ha (0.051 and 0.102 kg ai/hl).

No residues of diazinon were detectable (<0.01 mg/k g) 10 or 14 days after the last application. After seven days residues were <0.01 -0.02 mg/kg. In the forage residues were detectable at levels of 0.04 -7.95 and <0.01-4.95 mg/kg 7 and 14 days after the last application.

Tomatoes. Supervised trials were reported from Canada (1), The Netherlands (2, indoor) and the USA (38) using EC, WP, SP and GR formulations. In the US trials a pre-planting granule or EC at 4.48 kg ai/ha was followed by five foliar sprays at weekly intervals with WP or EC formulations at 0.84 kg ai/ha. Canada reported one treatment with an EC formulation at a rate of 0.8 kg ai/ha (0.1 kg ai/hl) and The Netherlands one treatment with an SP formulation at 0.19 kg ai/ha (12.7 g ai/hl).

In the indoor trials no residues were detectable (<0.04 m g/kg) three days after the application. In the other trials residues of diazinon ranged from <0.01 to 0.48 mg/kg 1 -14 days after the last application. Residues in processed fractions are discussed in "Fate of residues" below.

Leafy vegetables (Table 13)

Chinese cabbage . Supervised trials were reported by Finland (2) and Thailand (4). In Finland granules were applied at 0.1 and 0.2 g ai/plant. In Thailand four foliar EC sprays were applied at 0.373 -2.31 kg ai/ha (0.06-0.228 kg ai/hl).

After 62 days residues of 0.17 and 0.34 mg/kg were detectable in the trials with granules. Seven days after the last spray application, residues of diazinon were within a range of 0.02-0.62 mg/kg.

Endive. The Netherlands reported the result of a trial after one application of a WP formulation at a rate of 0.255 kg ai/ha (25.5 g ai/hl).

In the head a residue of 0.55 mg/kg was found two days after application, which was reduced by washing and cooking to 0.33 mg/kg and 0.02 mg/kg respectively.

Kale. Six supervised trials were reported by GTZ from Thailand using five foliar EC sprays at 1.8 and 3.6 kg ai/ha (0.18 and 0.36 kg ai/hl).

Fourteen days after the last spray residues of diazinon were within a range of <0.02 to 0.05 mg/kg.

Lettuce, head . Twenty-five supervised trials were reported from The Netherlands, Switzerland, and the USA (23) using EC, WP, and GR formulations. In the US trials 4.48 kg ai/ha (GR or EC) before planting was followed by five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.56 kg ai/ha. In Switzerland one granular application was made at a rate of 0.2 g ai/m row at the pre-plant stage, and in The Netherlands one application of a WP formulation at 0.255 kg ai/ha (25.5 g ai/hl).

Residues of diazinon in the heads ranged from <0.01 to 0.20 mg/kg 14-21 days after the last application. After the row treatment residues were detectable at 0.05 and 0.03 mg/kg at 70 and 76 days respectively. In the trial in The Netherlands a residue of 0.32 mg/kg was detectable two days after application, which was reduced by washing to 0.21 mg/kg.

Lettuce, leaf. Twenty supervised trials were reported from the the USA in which 4.48 kg ai/ha (GR or EC) was applied before planting, followed by five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.56 kg ai/ha.

Residues of diazinon in the leaves ranged from <0.01 to 0.15 mg/kg 14-21 days after the last application.

Spinach. Supervised trials were conducted in Italy (2), Switzerland (1), and the USA (8) using EC, WP, and GR formulations. The European trials were with foliar applications of 0.3 -0.8 kg ai/ha. In the US trials a granule was used pre-planting at 4.48 kg ai/ha followed by five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.56 kg ai/ha.

Residues of diazinon in the leaves ranged from <0.01 to 0.37 mg /kg 14-21 days after the last application.

Legume vegetables (Table 14)

Common beans. Supervised trials were conducted in Canada (1), Switzerland (3), Thailand (6), and the USA (20) using EC, WP, GR, and DP formulations. In the US trials a pre-plant GR or EC formulation at 4.4 kg ai/ha was followed by three foliar sprays at 5 -day intervals with WP or EC formulations at 0.83 kg ai/ha (0.11-0.46 kg ai/hl). In the Canadian trial a WP formulation was applied at 0.5 kg ai/ha (62.5 g ai/hl). The trials in Thailand, reported by the GTZ, were with an EC formulation at rates of 3.9 and 7.8 kg ai/ha (0.18 and 0.36 kg ai/hl, 5 foliar sprays).

In all cases the pods were analysed. Residues of diazinon were <0.01-0.38 mg/kg and <0.01 -0.05 mg/kg after 5 -8 and 10 -14 day s respectively.

Peas. Twenty supervised trials from the USA using EC, WP and GR formulations were reported. Trials were with 4.4 kg ai/ha as an EC or GR formulation at the pre-plant stage followed by 3 -5 foliar sprays at a rate of 0.83 kg ai/ha (0.11 -0.45 kg ai/hl) at weekly intervals with EC or WP formulations.

Residues of diazinon in peas were <0.01 -0.15 and <0.01-0.09 mg/kg at 7 and 14 days, respectively, after the last application.

Root and tuber vegetables (Table 15)

Carrots. Supervised trials were conducted in Germany (3), The Netherlands (6), Switzerland (5), and the USA (16) using EC, WP, and GR formulations. In US trials a GR or EC formulation was used pre-planting or at seeding time with an application rate of 4.4 kg ai/ha, followed by five foliar sprays at weekly intervals with WP or EC formulations at 0.55 kg ai/ha. The European trials were with single applications of either granules at 0.08 g ai/m row or 5.0 kg ai/ha, or an EC formulation at a rate of 0.125 g ai/m row or 2.7-5.4 kg ai/ha (0.1-0.54 kg ai/hl), all at stages from sowing up to a plant height of about 10 cm.

After the single treatment residues of diazinon in the roots ranged from <0.005 to 0.20 mg/kg 1-6 months after the application. In one Swiss trial a residue of 1.08 mg/kg after 57 days seemed to be unrepresentative. In trials with multiple treatments residues varied from 0.02 to 0.41 mg/kg after 7-14 days.

In some samples traces up to 0.01 mg/kg of hydroxydiazinon (CGA 14128) were detectable.

Celery. The result of one trial was available from The Netherlands. One application was made at a rate of 3.6 kg ai/ha (0.36 kg ai/hl) using an EC formulation. The residue of diazinon in the tuber reached 4.05 mg/kg 27 days after the application.

Parsley, turnip-rooted. One trial was reported by The Netherlands. An EC formulation was applied once at 3.6 kg ai/ha (0.36 kg ai/hl). The residue of diazinon in the root reached 3.49 mg/kg after 27 days.

Potatoes. Supervised trials were conducted in Canada (4), France (1), and the USA (23) using EC, WP, and GR formulations. In the US trials a GR or EC pre-planting application at 4.4 kg ai/ha was followed by five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.55 kg ai/ha. The other trials were with granules at 2.25 or 10 kg ai/ha one month after planting.

No residues of diazinon were detectable (<0.01 or <0.02 mg/kg) in any of the harvested samples except in three trials where residues of 0.01 mg/kg were found.

Residues in processed fractions only occurred in dry peel.

Radish. Seventeen supervised trials from Switzerland and the USA (16) using EC, WP and GR formulations were reported. In the US trials a GR or EC formulation was used pre-planting at 4.48 kg ai/ha followed by three or four foliar sprays at weekly intervals with WP or EC formulations at 0.56 kg ai/ha. The Swiss trial was with granules at 8.7 kg ai/ha at the 4-6 leaf stage.

Residues of diazinon in the roots ranged from <0.01 to 0.08 mg/kg 7-33 days after the last application.

Sugar beet. Supervised trials were conducted in Germany (4), Switzerland (2), and the USA (11) using EC, WP, and GR formulations. The European trials were with 2-4 applications of 0.14-0.5 kg ai/ha (0.023-0.5 kg ai/hl) at 2-4 week intervals. In the US trials a GR or EC formulation was used pre-planting at an application rate of 4.4 or 5.5 kg ai/ha followed by four or five foliar sprays at weekly intervals with WP or EC formulations at 0.55 kg ai/ha.

Residues of diazinon were not detectable (<0.01 or <0.02 mg/k g) in the roots or tops after 21 days and longer. Fourteen days after the last application residues in roots and tops were <0.01-0.10 mg/kg and <0.02-2.51 mg/kg respectively. No residues were detectable (<0.01 mg/kg) in processed

fractions, except a residue of 0.01 mg/kg in pulp.

Residues of hydroxydiazinon (CGA 14128) were detectable up to 0.02 mg/kg in some samples harvested 14 days after the last application.

Sugar beet roots containing no residues (<0.01 mg/kg) in harvest samples after treatment at the normal recommended rate were processed. The only diazinon residues detected were in pulp at 0.01 mg/kg.

Stalk and stem vegetables (Table 16)

Artichoke. Three supervised trials (one variety, one location) were available from Spain. One application was made at 1.512 kg ai/ha (72 g ai/hl) using an EC formulation. Residues in the fruit varied between 0.18 and 0.30 mg/kg 21 days after the application.

Witloof. The result of one trial was available from The Netherlands. One application was made at 3.3 g ai/cell using tablets. No residue was detectable (<0.01 mg/kg) after 14 days.

Cereal grains (Table 17)

Maize/corn. Supervised trials were conducted in Germany (4), Switzerland (2), and the USA (4) with DS, EC, and GR formulations. The European trials were with either 0.5 kg ai/100 kg seed or 0.94 -1.0 kg ai/ha (0.1 -0.164 kg ai/hl) at the 1 -3 leaf stage. In the US trials a granule was used four times with an application rate of 1.1 kg ai/ha at weekly intervals.

No residues of diazinon were detectable (<0.02 mg/kg) 58 -156 days in whole plants, grain or residual plants 58-156 days after single seed or early foliar treatments. After multiple applications residues in the grain were at the limit of determination (<0.01 mg/kg) 43 -45 days after the last application. In maize fodder residues were higher, ranging from 0.29 to 3.15 mg/kg. Maize silage harvested 10 days after the last application contained residues between 1.18 and 5.4 mg/kg.

Whole kernels from harvest samples after treatment at the normal recommended rate were processed by dry and wet milling. Residues were low in all fractions, never exceeding 0.1 mg/kg except in maize oil.

Rice. Seven supervised trials were conducted in India (5), Indonesia, and Pakistan using EC and GR formulations. One to three granular treatments at 1.0-1.68 kg ai/ha or 3-5 foliar treatments at 0.125-0.6 kg ai/ha (0.05-0.12 kg ai/hl) at 2-3-week intervals were carried out.

No residues were detectable (<0.02 or <0.03 mg/kg) in the grain or the unhusked grain 23 -59 days after the last application. Small residues were detectable in the straw, reaching levels up to 0.04 mg/kg.

Tree nuts (Table 18)

Almonds. The results of four projects (18 trials) were reported from California/USA using EC and WP formulations. Trials were with 3.3 kg ai/ha at the dormant stage followed by three foliar sprays at the same rate (0.18-1.77 kg ai/hl) at two-week intervals. Ground and aerial applications were reported.

Residues in the whole nut were small, ranging from <0.01 to 0.02 mg/kg 28 -45 days after last treatment. At the same intervals residues in the hull varied between 0.02 and 4.35 mg/kg.

In some cases diazoxon (G 24576) and hydroxydiazinon (CGA 14128) were detectable in the hulls at levels of 0.02 -0.10 and 0.01 -0.08 mg/kg respectively.

Walnuts. Twenty four supervised trials were conducted in California/USA

using EC and WP formulations. Trial conditions were similar to those for almonds, but oil was added to all applications.

No residues were detectable in the whole nuts (<0.01 mg/kg) 14 -45 days after the last application.

Oilseed (Table 19)

Cotton seed. Four supervised trials were reported from India with two or five applications of EC at 0.4 or 0.75 kg ai/ha (0.064 or 0.12 kg ai/hl).

No residues of diazinon (<0.05 mg/kg) were detectable in delinted seeds 7-93 days after the last application.

Table 9. Residues from supervised trials on bulb vegetables. Underlined residues are from treatments according to GAP.

Crop Country/year	Application	Sample analysed & maturity	PHI, days	Residue, mg/kg	Ref.

	Form	No	kg ai/ha	kg ai/hl				
Onions, bulb								
Finland/1980		1	5.0		bulbs	108	0.003	52
Germany/1975	EC	1	0.125 g/m	0.025	whole plant	0	8.0	58
					bulbs	16	0.03	
					bulbs	43	<0.02	
	GR	1	60 mg/m		bulbs	100	0.02	58
						114	0.02	
						135	<0.02	
						174	<0.02	
	GR	1	60 mg/m		bulbs	90	0.02	58
						106	0.08	
						133	<0.02	
Germany/1978	GR	1	60 mg/m		whole plant	50	0.12	58
						70	0.02	
					bulbs	134	<0.02	
	GR	1	60 mg/m		whole plant	50	0.19	58
						70	0.06	
					bulbs	104	<0.02	
Switzerl'd/1975	EC	1	0.125 g/m	0.025	bulbs	61	<0.02	58
						76	<0.02	
						91	<0.02	
						106	<0.02	
						122	<0.02	
	EC	1	0.125 g/m	0.025	bulbs	52	0.02	58
						67	<0.02	
						82	<0.02	
						98	<0.02	
						109	<0.02	
	GR	1	60 mg/m		bulbs	61	0.02	58
						76	<0.02	
						91	<0.02	
						106	<0.02	
						123	<0.02	
Switzerl'd/1977	EC	1	0.125 g/m	0.025	bulbs	70	<0.02	58
Switzerland						82	<0.02	
cont.						90	<0.02	
						103	<0.02	
	GR	1	60 mg/m		bulbs	81	<0.02	58
						91	<0.02	

Crop Country/year	Application				Sample analysed & maturity	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						103	<0.02	
						124	<0.02	
Switzerl'd/1978	GR	1	60 mg/m		whole plant	70	<0.02	58
					bulbs	90	<0.02	
						112	<0.02	
						132	<0.02	
USA/1988	GR+EC	1+3[1]	4.4+0.55		bulbs	11	<0.01	58
						14	<0.01	
	GR+WP	1+3	4.4+0.55		bulbs	11	<0.01	58
						14	<0.01	
	GR+EC	1+3	4.4+0.55		bulbs	10	<0.01	58
						14	<0.01	
	GR+WP	1+3	4.4+0.55		bulbs	10	<0.01	58
						14	<0.01	
	GR+EC	1+3	4.4+0.55		bulbs	10	0.01	58
						14	<0.01	
	GR+WP	1+3	4.4+0.55		bulbs	10	<0.01	58
						14	<0.01	
	GR+EC	1+3	4.4+0.55		bulbs	10	<0.01	58
						14	<0.01	
	GR+WP	1+3	4.4+0.55		bulbs	10	<0.01	58
						14	<0.01	
	GR+EC	1+3	4.4+0.55		bulbs	0	0.81	58
						7	0.09	
						10	0.03	
						14	0.02	
						21	<0.01	
	GR+WP	1+3	4.4+0.55		bulbs	0	1.16	58
						7	0.05	
						10	0.04	
USA cont.						14	0.02	
						21	<0.01	
Spring onions								
USA/1988	GR+EC	1+3	4.4+0.55		whole plant	0	4.80	58
						7	0.71	
					bunch	10	0.56	
						14	0.28	

Crop Country/year	Application				Sample analysed & maturity	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
					mature	21	0.16	
	GR+WP	1+3	4.4+0.55		whole plant	0	6.80	58
						7	0.62	
					bunch	10	0.65	
						14	0.40	
					mature	21	0.11	
	GR+EC	1+3	4.4+0.55		whole plant	10	<0.01	58
						14	<0.01	
	GR+WP	1+3	4.4+0.55		whole plant	10	<0.01	58
						14	<0.01	

USA cont.	GR+EC	1+3	4.4+0.55		whole plant	10	0.01	58
						14	<0.01	
	GR+WP	1+3	4.4+0.55		whole plant	10	0.02	58
						14	<0.01	
USA/1989	GR+EC	1+3	4.4+0.55		whole plant	0	0.05	58
						4	0.03	
	GR+WP	1+3	4.4+0.55		whole plant	0	0.04	58
						4	0.01	

[1] All US trials 1 pre-plant + 3 foliar.

Table 10. Residues from supervised trials on brassica vegetables, all ref. 58. Underlined residues are from treatments according to GAP.

Crop Country/year	Application	Sample analysed & maturity	Residue, mg/kg	PHI, days

	Form	No	kg ai/ha	kg ai/hl			
Broccoli							
USA/1988	GR+EC	1+5[1]	4.4+0.55		bunch[2]	3.1	0
						0.02	7
					mature	<0.01	14
						<0.01	21
	GR+WP	1+5	4.4+0.55		bunch[2]	7.4	0
						0.10	7
					mature	0.01	14
						<0.01	21
	GR+EC	1+5	4.4+0.55		bunch	0.03	3
						0.01	14
					mature	<0.01	21
	GR+WP	1+5	4.4+0.55		bunch	0.02	3
						<0.01	14
					mature	<0.01	21
	GR+EC	1+5	4.4+0.55		bunch	0.23	7
						0.05	14
						<0.01	21
	GR+WP	1+5	4.4+0.55		bunch	0.22	7
						0.1	14
						<0.01	21
	GR+EC	1+5	4.4+0.55		bunch	0.12	7
USA cont.					normal harvest	0.02	14
						0.03	21
	GR+WP	1+5	4.4+0.55		bunch	0.15	7
					normal harvest	0.06	14
						0.02	21
	GR+EC	1+5	4.4+0.55		mature	0.05	7
						<0.01	14
						<0.01	21
	GR+WP	1+5	4.4+0.55		mature	0.01	7
						<0.01	14
						<0.01	21
Cabbage, Head							
Germany/1975	EC	2		0.025	head	2.9	18
						0.6	26
						0.13	39
						0.09	51
	GR	1	0.1g/m		head	0.03	34
						0.05	42

Crop Country/year	Application				Sample analysed & maturity	Residue, mg/kg	PHI, days
	Form	No	kg ai/ha	kg ai/hl			
						<0.02	56
						<0.02	81
	GR	1	0.1g/m		head	0.1	33
						0.03	41
						<0.02	54
						<0.02	66
Germany/1980	EC	2		0.025	head	0.57	-0
						4.61	+0
						0.27	14
						0.15	21
						0.23	42
						0.18	49
Switzerl'd/1974	EC	2		0.025	head	14	0
						0.3	9
						0.05	18
						<0.02	27
						<0.02	37
						<0.02	47
						<0.02	59
Swtzlnd cont.						<0.02	66
Switzerl'd/1975	GR	1	0.1g/m	0.025	leaves	4	0
						1.74	7
						0.11	14
						0.02	21
						0.03	42
					head	<0.02	72
						<0.02	86
	EC	2		0.025	head	0.03	14
						<0.02	28
						<0.02	42
						<0.02	56
USA/1988	GR+EC	1+5	4.4+0.55		head	0.03	7
						0.01	14
						<0.01	21
	GR+WP	1+5	4.4+0.55		head	0.03	7
						0.03	14
						<0.01	21
	EC	1+5	4.4+0.55		head	0.01	7
						0.09	14

Crop Country/year	Application				Sample analysed & maturity	Residue, mg/kg	PHI, days
	Form	No	kg ai/ha	kg ai/hl			
						<0.01	21
	EC+WP	1+5	4.4+0.55		head	0.03	7
						0.04	14
						<0.01	21
	GR+EC	1+5	4.4+0.55		head	0.11	7
						0.08	14
						0.03	21
	GR+WP	1+5	4.4+0.55		head	0.05	7
						0.07	14
						<0.01	21
	EC	1+5	4.4+0.55		head	<0.01	7
						0.03	14
						0.01	21
	EC+WP	1+5	4.4+0.55		head	0.26	7
						0.03	14
						0.02	21
	GR+EC	1+5	4.4+0.55		head	0.78	7
USA cont.						0.02	14
						<0.01	21
	GR+WP	1+5	4.4+0.55		head	1.8	7
						0.02	14
						<0.01	21
	EC	1+5	4.4+0.55		head	0.48	7
						0.08	14
						<0.01	21
	EC+WP	1+5	4.4+0.55		head	0.74	7
						0.11	14
						<0.01	21
	GR+EC	1+5	4.4+0.55		head	1.7	0
						0.07	7
						0.02	13
						0.02	20
	GR+WP	1+5	4.4+0.55		head	1.35	0
						0.14	7
						0.02	13
						<0.01	20
	EC	1+5	4.4+0.55		head	1.4	0
						0.16	7
						0.03	13

Crop Country/year	Application				Sample analysed & maturity	Residue, mg/kg	PHI, days
	Form	No	kg ai/ha	kg ai/hl			
						<0.01	20
	EC+WP	1+5	4.4+0.55		head	2.90	0
						0.15	7
						0.03	13
						0.02	20
	GR+EC	1+5	4.4+0.55		head	1.34	7
						1.13	14
						0.16	21
	GR+WP	1+5	4.4+0.55		head	1.3	7
						0.45	14
						0.13	21
	EC	1+5	4.4+0.55		head	1.12	7
						0.28	14
						0.2	21
	EC+WP	1+5	4.4+0.55		head	1.07	7
USA cont.						0.26	14
						0.09	21
Cauliflower							
Germany/1977	EC	1	20 mg/pl	0.025	whole plant	1.99	0
						0.51	8
						0.05	22
					head	<0.02	36
	EC	2	20 mg/pl	0.025	whole plant	0.75	0
						0.13	14
						<0.02	28
					head	<0.02	42
Germany/1978	GR	1	0.1 g/m row		head	<0.02	111
						<0.02	125
						<0.02	131
	GR	1	0.1 g/m row		head	<0.02	47
						<0.02	61
						<0.02	68
Switzerl'd/1978	GR	4	0.1 g/m row		whole plant	<0.02	33
						<0.02	47
						<0.02	61
Kohlrabi							
Germany/1978	GR	1	0.1 g/m row		roots	<0.02	91
						<0.02	105
						<0.02	113

Crop Country/year	Application				Sample analysed & maturity	Residue, mg/kg	PHI, days
	Form	No	kg ai/ha	kg ai/hl			
	GR	1	0.1 g/m row		roots	<0.02	48
						<0.02	62
						<0.02	69
Germany/1980	EC	1	18.8 mg/pl	0.0235	roots	1.19	0
						0.06	14
						<0.02	21
						<0.02	42
						<0.02	49
						<0.02	56
	EC	2	18.8 mg/pl	0.0235	plant	15	0
						0.12	14
						<0.03	28
					roots	<0.02	42
Germany cont.						<0.03	45
Switzerl'd/1978	GR	1	0.1 g/m row		roots	<0.02	23
						<0.02	37
						<0.02	51
Switzerl'd/1980	EC	2	18.8 mg/pl	0.0235	roots	5.28	0
						<0.02	14
						<0.02	28
						<0.02	35
						<0.02	42
						<0.02	49

[1] All US treatments 1 pre-plant granule + 5 foliar.
[2] 30-50% mature

Table 11. Residues from supervised trials on fruiting vegetables, cucurbits, all ref. 58. Underlined residues are from treatments according to GAP.

Crop Country/year	Application	PHI, days	Residue, mg/kg

	Form	No	kg ai/ha	kg ai/hl		
Cantaloupe						
USA/1988	GR+EC	1	4.4		3	0.08
		+5[1]	0.83		7	0.06
	GR+WP	1	4.4		3	0.15
		+5	0.83		7	0.04
	GR+EC	1	4.4		0	0.14
		+5	0.83		3	0.04
	GR+WP	1	4.4		0	0.06
		+5	0.83		3	0.07
	GR+EC	1	4.4		0	0.01
		+5	0.83		7	0.02
	GR+WP	1	4.4		0	0.02
		+5	0.83		7	0.01
	GR+EC	1	4.4		0	0.17
		+5	0.83		3	0.10
					7	0.05
					14	0.02
	GR+WP	1	4.4		0	0.17
USA cont.		+5	0.83		3	0.11
					7	0.05
					14	0.01
	GR+EC	1	4.4		3	0.21
		+			7	0.08
	GR+WP	1	4.4		3	0.3
		+5	0.83		7	0.09
	GR+EC	1	4.4		3	0.1
		+5	0.83		7	0.02
	GR+WP	1	4.4		3	0.06
		+5	0.83		7	0.01
	GR+EC	1	4.4		3	0.09
		+5	0.83		7	0.18
	GR+WP	1	4.4		3	0.03
		+5	0.83		7	0.11

Crop Country/year	Application				PHI, days	Residue, mg/kg
	Form	No	kg ai/ha	kg ai/hl		
Cucumber						
Japan/1976	EC	3	0.8	0.04	10	0.002
					15	0.002
					20	0.002
	EC	3	0.8	0.04	10	0.012
					15	0.003
					20	0.001
	EC	3	0.8	0.04	10	0.005
					31	0.001
					38	0.001
	EC	3	0.8	0.04	10	0.007
					31	0.001
					38	0.001
Switzerl'd/1972	DP	1	0.8		0	0.38
					5	0.03
USA/1988	GR+EC	1	4.48		3	0.08
		+5	0.84		7	0.01
	GR+WP	1	4.48		3	0.06
		+5	0.84		7	0.01
USA cont.	GR+EC	1	4.48		0	0.84
		+5	0.84		3	0.16
					7	<0.01
					14	<0.01
	GR+WP	1	4.48		0	0.88
		+5	0.84		3	0.11
					7	0.01
					14	<0.01
	GR+EC	1	4.48		3	0.2
		+5	0.84		7	0.4
	GR+WP	1	4.48		3	0.16
		+5	0.84		7	0.02
	GR+EC	1	4.48		3	0.15

Crop Country/year	Application				PHI, days	Residue, mg/kg
	Form	No	kg ai/ha	kg ai/hl		
		+5	0.84		7	0.1
	GR+WP	1	4.48		3	0.06
		+5	0.84		7	0.04
	GR+EC	1	4.48		3	0.05
		+5	0.84		7	0.02
	GR+WP	1	4.48		3	0.03
		+5	0.84		7	<0.01
Summer squash						
USA/1988	GR+EC	1	4.4		0	0.09
		+5	0.83		3	0.02
					7	<0.01
					14	<0.01
	GR+WP	1	4.4		0	0.13
		+5	0.83		3	0.04
					7	0.01
					14	<0.01
	GR+EC	1	4.4		3	0.04
		+5	0.83		14	<0.01
	GR+WP	1	4.4		3	0.07
		+5	0.83		14	0.01
	GR+EC	1	4.4		3	0.04
USA cont.		+5	0.83		7	0.03
	GR+WP	1	4.4		3	0.02
		+5	0.83		7	0.01
	GR+EC	1	4.4		3	0.04
		+5	0.83		7	<0.01
	GR+WP	1	4.4		3	0.03
		+5	0.83		7	<0.01
Zucchini						
USA/1988	GR+EC	1	4.4		3	0.03
		+5	0.83		7	0.01
	GR+WP	1	4.4		3	0.01

Crop Country/year	Application				PHI, days	Residue, mg/kg
	Form	No	kg ai/ha	kg ai/hl		
		+5	0.83		7	<0.01
	GR+EC	1	4.4		3	0.18
		+5	0.83		7	0.03
	GR+WP	1	4.4		3	0.18
		+5	0.83		7	0.05

[1] All US trials with 1 pre-plant granule + 5 foliar.

Table 12. Residues from supervised trials on fruiting vegetables, other than cucurbits. Underlined residues are from treatments according to GAP.

Crop Country/year	Application	Sample analyzed	PHI, days	Residue, mg/kg	Ref.

	Form	No	kg ai/ha	kg ai/hl				
Mushrooms								
Netherl'ds/1969	WP	2	6 g/cell			0	0.09	53
						2	0.07	
	WP	2	6 g/cell			0	0.07	53
						2	0.11	
	WP	2	6 g/cell			0	0.17	53
						2	0.05	
Netherl'ds/1972	GR	1	50g ai/t compost			35	<0.02	58
Pepper (green)								
USA/1988	GR+EC	1	4.48			1	0.13	58
		+5[1]	0.56			3	0.08	
USA cont.	GR+WP	1	4.48			1	0.11	58
		+5	0.56			3	0.03	
	GR+EC	1	4.48			1	<0.01	58
		+5	0.56			4	<0.01	
	GR+WP	1	4.48			1	<0.01	58
		+5	0.56			4	<0.01	
	GR+EC	1	4.48			1	0.09	58
		+5	0.56			3	0.08	
	GR+WP	1	4.48			1	0.03	58
		+5	0.56			3	0.05	
	GR+EC	1	4.48			1	0.08	58
		+5	0.56			3	0.03	
	GR+WP	1	4.48			1	0.08	58
		+5	0.56			3	0.02	
	GR+EC	1	4.48			0	0.52	58
		+5	0.56			1	0.24	
						3	0.09	
						7	0.02	
						14	0.02	
	GR+WP	1	4.48			0	0.53	58
		+5	0.56			1	0.11	
						3	0.06	
						7	0.03	
						14	0.01	
Sweet corn								
Thailand/1988	EC	4	0.647	0.051		0	0.01	51
						1	0.01	

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						3	<0.01	
						5	n.d.	
						7	n.d.	
						10	n.d.	
	EC	4	1.294	0.102		0	<0.01	51
						1	0.01	
						3	<0.01	
						5	n.d.	
						7	n.d.	
						10	n.d.	
	EC	4	1.06	0.051		0	<0.01	51
						1	n.d.	
						3	n.d.	
						5	n.d.	
						7	n.d.	
						10	n.d.	
	EC	4	2.12	0.102		0	0.01	51
						1	n.d.	
						3	n.d.	
						5	n.d.	
						7	n.d.	
						10	n.d.	
USA/1988	GR+EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	1.4	
						14	0.09	
	GR+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.94	
						14	0.06	
	EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.01	
						14	0.14	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.41	

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						14	0.04	
	GR+EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	2.25	
						14	0.6	
	GR+WP	1	4.4		ears	7	<0.01	58
USSA cont.		+5	1.38			14	<0.01	
					forage	7	1.08	
						14	0.13	
	EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	1.5	
						14	1.05	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.32	
						14	0.04	
	GR+EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.2	
						14	0.09	
	GR+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.11	
						14	0.07	
	EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.08	
						14	0.08	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.14	
						14	0.05	
	GR+EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.13	
						14	2.7	

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
	GR+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.70	
						14	0.71	
USA cont.	EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	1.43	
						14	3.95	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.8	
						14	1.8	
	GR+EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	1.03	
						14	0.38	
	GR+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.03	
						14	0.16	
	EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.46	
						14	0.22	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.33	
						14	0.12	
	GR+EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.72	
						14	0.25	
	GR+EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.23	
						14	0.01	
	EC	1	4.4		ears	7	<0.01	58

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
		+5	1.38			14	<0.01	
					forage	7	0.85	
USA cont.						14	0.39	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.29	
						14	0.07	
	GR+EC	1	4.4		ears	7	0.01	58
		+5	1.38			14	<0.01	
					forage	7	7.95	
						14	4.95	
	GR+WP	1	4.4		ears	7	0.01	58
		+5	1.38			14	<0.01	
					forage	7	2.05	
						14	0.97	
	EC	1	4.4		ears	7	0.02	58
		+5	1.38			14	<0.01	
					forage	7	6.6	
						14	2.4	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	1.7	
						14	0.45	
	GR+EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.43	
						14	0.55	
	GR+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.17	
						14	0.04	
	EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.16	
						14	0.12	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
USA cont.					forage	7	0.1	
						14	0.03	
	GR+EC	1	4.4		ears	0	0.02	58
		+5	1.38			7	<0.01	
						14	<0.01	
						21	<0.01	
					forage	0	22	
						7	1.75	
						14	0.4	
						21	0.37	
	GR+WP	1	4.4		ears	0	0.01	58
		+5	1.38			7	<0.01	
						14	<0.01	
						21	<0.01	
					forage	0	14	
						7	0.49	
						14	0.13	
						21	0.18	
	EC	1	4.4		ears	0	0.02	58
		+5	1.38			7	<0.01	
						14	<0.01	
						21	<0.01	
					forage	0	20	
						7	2.25	
						14	0.28	
						21	0.1	
	EC+WP	1	4.4		ears	0	0.03	58
		+5	1.38			7	<0.01	
						14	<0.01	
						21	<0.01	
					forage	0	13	
						7	0.57	
						14	0.12	
						21	0.05	
	GR+EC	1	4.4		ears	7	<0.01	58
USA cont.		+5	1.38			14	<0.01	
					forage	7	2.05	

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						14	0.12	
	GR+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.03	
						14	0.18	
	EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.09	
						14	0.44	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.02	
						14	0.22	
	GR+EC	1	4.4		ears	0	<0.01	58
		+5	1.38			7	<0.01	
						15	<0.01	
						21	<0.01	
					forage	0	4.45	
						7	0.08	
						15	0.03	
						21	0.03	
	GR+WP	1	4.4		ears	0	<0.01	58
		+5	1.38			7	<0.01	
						15	<0.01	
						21	<0.01	
					forage	0	48	
						7	0.18	
						15	0.05	
						21	0.01	
	EC	1	4.4		ears	0	<0.01	58
		+5	1.38			7	<0.01	
						15	<0.01	
						21	<0.01	
USA cont.					forage	0	8.8	
						7	0.25	
						15	0.1	
						21	0.01	

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
	EC+WP	1	4.4		ears	0	<0.01	58
		+5	1.38			7	<0.01	
						15	<0.01	
						21	<0.01	
					forage	0	14	
						7	0.08	
						15	0.02	
						21	0.03	
	GR+EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.29	
						14	0.33	
	GR+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	1.05	
						14	0.05	
	EC	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.47	
						14	0.97	
	EC+WP	1	4.4		ears	7	<0.01	58
		+5	1.38			14	<0.01	
					forage	7	0.22	
						14	0.12	
Tomatoes								
Canada/1989	EC	1	0.8	0.1		1	0.04	37
						3	0.03	
						7	0.03	
						14	0.07	
						21	<0.005	
						28	<0.005	
Netherl'ds/1973	SP	1	0.191	0.0127	fruit	3	<0.04	53
	SP	1	0.191	0.0127	fruit	3	<0.04	53
USA/1988	GR+EC	1	4.48			1	0.17	58
		+5	0.84			3	0.14	
	GR+WP	1	4.48			1	0.19	58
		+5	0.84			3	0.16	

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
	EC	1	4.48			1	0.18	58
		+5	0.84			3	0.15	
	EC+WP	1	4.48			1	0.18	58
		+5	0.84			3	0.13	
	GR+EC	1	4.48			1	0.03	58
		+5	0.84			3	0.02	
	GR+WP	1	4.48			1	0.03	58
		+5	0.84			3	0.01	
	EC	1	4.48			1	0.04	58
		+5	0.84			3	0.05	
	GR+EC	1	4.48			1	0.02	58
		+5	0.84			3	0.05	
	GR+WP	1	4.48			1	0.03	58
		+5	0.84			3	0.01	
	EC	1	4.48			1	0.05	58
		+5	0.84			3	0.03	
	EC+WP	1	4.48			1	0.02	58
		+5	0.84			3	0.01	
	GR+EC	1	4.48			1	0.16	58
		+5	0.84			3	0.05	
	GR+WP	1	4.48			1	0.13	58
		+5	0.84			3	0.03	
	EC	1	4.48			1	0.12	58
		+5	0.84			3	0.05	
	EC+WP	1	4.48			1	0.03	58
		+5	0.84			3	0.02	
	GR+EC	1	4.48			1	0.20	58
		+5	0.84			3	0.17	
	GR+WP	1	4.48			1	0.18	58
USA cont.		+5	0.84			3	0.04	
	EC	1	4.48			1	0.48	58
		+5	0.84			3	0.10	
	EC+WP	1	4.48			1	0.15	58
		+5	0.84			3	0.08	
	GR+EC	1	4.48			1	0.08	58
		+5	0.84			3	0.06	
	GR+WP	1	4.48			1	0.19	58

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
		+5	0.84			3	0.10	
	EC	1	4.48			1	0.02	58
		+5	0.84			3	0.01	
	EC+WP	1	4.48			1	0.03	58
		+5	0.84			3	0.01	
	GR+EC	1	4.48			1	0.22	58
		+5	0.84			3	0.11	
	GR+WP	1	4.48			1	0.15	58
		+5	0.84			3	0.16	
	EC+WP	1	4.48			1	0.12	58
		+5	0.84			3	0.22	
	GR+EC	1	4.48			1	0.05	58
		+5	0.84			2	0.03	
	GR+WP	1	4.48			1	0.04	58
		+5	0.84			2	0.02	
	EC	1	4.48			1	0.07	58
		+5	0.84			2	0.07	
	EC+WP	1	4.48			1	0.08	58
		+5	0.84			2	0.03	
	GR+EC	1	4.48			0	0.20	58
		+5	0.84			1	0.14	
						3	0.08	
						7	0.07	
						14	0.01	
USA cont.	GR+WP	1	4.48			0	0.32	58
		+5	0.84			1	0.10	
						3	0.06	
						7	0.07	
						14	<0.01	
	EC	1	4.48			0	0.30	58
		+5	0.84			1	0.15	
						3	0.10	
						7	0.04	
						14	0.01	
	EC+WP	1	4.48			0	0.22	58
		+5	0.84			1	0.08	
						3	0.07	

Crop Country/year	Application				Sample analyzed	PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl				
						7	0.04	
						14	<0.01	
	GR+WP	1	4.48			1	0.27	58
		+5	0.84			3	0.16	
	EC	1	4.48			1	0.47	58
		+5	0.84			3	0.14	
	EC+WP	1	4.48			1	0.26	58
		+5	0.84			3	0.14	
	GR+EC	1	4.48			1	0.20	36
		+5	0.84			3	0.15	
				Processed fractions:				
					unwashed	1	0.09	
					washed	1	0.15	
					canned	1	<0.01	
					wet pomace	1	2.20	
					dry pomace	1	2.60	
					juice, canned	1	0.03	
					puree	1	0.13	
					paste	1	0.11	
					juice	1	<0.01	
					ketchup	1	0.05	

[1]All US trials 1 pre-plant +5 foliar

Table 13. Residues from supervised trials on leafy vegetables. Underlined residues are from treatments according to GAP.

Crop Country/year	Application	PHI, days	Residue, mg/kg	Ref.

	Form	No	kg ai/ha	kg ai/hl			
Chinese cabbage							
Finland/1987	GR	1	0.2 g/pl		62	0.34	52
	GR	1	0.1 g/pl		62	0.17	52
Thailand/1987	EC	4	0.373	0.06	0	2.91	51
					1	1.97	
					3	1.14	
					5	0.73	
					7	0.31	
					10	0.04	
	EC	4	0.746	0.12	0	4.80	51
					1	3.75	
					3	2.44	
					5	1.34	
					7	0.62	
					10	0.08	
Thailand/1988	EC	4	1.155	0.114	0	7.98	51
					1	1.87	
					3	0.44	
					5	0.04	
					7	0.02	
	EC	4	2.31	0.228	0	16.4	51
					1	5.98	
					3	1.62	
					5	0.03	
Endive							
Netherl'ds/1971	WP	1	0.255	0.0255	2	0.55 head	53
						0.33 washed	
						0.02 cooked	
Kale							
Thailand/1991	EC	5	1.8	0.18	0	27.9	57
					1	11.1	
					3	2.4	
Thailand cont.					5	0.69	
					8	0.11	
					11	0.05	
					14	<0.02	
					17	<0.02	
					21	<0.02	

Crop Country/year	Application				PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
	EC	5	3.6	0.36	0	52.3	57
					1	16.9	
					3	5.1	
					5	1.19	
					8	0.27	
					11	0.07	
					14	0.02	
					17	<0.02	
					21	<0.02	
Thailand/1992	EC	5	1.8	0.18	0	29.6	57
					1	16.3	
					3	4.1	
					5	1.07	
					8	0.20	
					11	0.05	
					14	<0.02	
					17	<0.02	
					21	<0.02	
	EC	5	3.6	0.36	0	55.4	57
					1	20.6	
					3	5.7	
					5	1.39	
					8	0.36	
					11	0.11	
					14	0.03	
					17	<0.02	
					21	<0.02	
	EC	5	1.8	0.18	0	32.6	57
					1	14.7	
Thailand cont.					3	3.0	
					5	0.77	
					8	0.13	
					11	0.06	
					14	<0.02	
					17	<0.02	
					21	<0.02	
	EC	5	3.6	0.36	0	60	57

Crop Country/year	Application				PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
					1	22	
					3	6.1	
					5	1.7	
					8	0.28	
					11	0.14	
					14	0.05	
					17	<0.02	
					21	<0.02	
Lettuce, Head							
Netherl'ds/1971	WP	1	0.255	0.0255	2	0.32 head	53
						0.21 washed	
Switzerl'd/1973	GR	1	0.2 g/m		70	0.05	58
					76	0.03	
USA/1988	GR+EC	1	4.48		0	3.35	58
		+5[1]	0.56		7	0.23	
					14	0.08	
					21	0.02	
	GR+WP	1	4.48		0	3.2	58
		+5	0.56		7	0.38	
					14	0.15	
					21	0.01	
	EC	1	4.48		0	8.15	58
		+5	0.56		7	0.61	
					14	0.05	
					21	0.12	
	EC+WP	1	4.48		0	11.4	58
		+5	0.56		7	0.34	
USA cont.					14	0.09	
					21	0.08	
	GR+WP	1	4.48		0	26.0	58
		+5	0.56		7	0.60	
					14	0.14	
		(aerial)			21	0.20	
	GR+EC	1	4.48		7	0.12	58
		+5	0.56		14	0.02	
					21	<0.01	
	GR+WP	1	4.48		7	0.10	58

Crop Country/year	Application				PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
		+5	0.56		14	0.02	
					21	<0.01	
	EC	1	4.48		7	0.05	58
		+5	0.56		14	0.03	
					21	<0.01	
	EC+WP	1	4.48		7	0.05	58
		+5	0.56		14	0.03	
					21	0.01	
	GR+EC	1	4.48		7	0.26	58
		+5	0.56		14	0.01	
					21	<0.01	
	GR+WP	1	4.48		7	0.22	58
		+5	0.56		14	0.02	
					21	<0.01	
	EC	1	4.48		7	0.28	58
		+5	0.56		14	0.01	
					21	<0.01	
	EC+WP	1	4.48		7	0.44	58
		+5	0.56		14	0.01	
					21	<0.01	
	GR+EC	1	4.48		7	0.39	58
		+5	0.56		14	0.08	
					21	<0.01	
	GR+WP	1	4.48		7	0.05	58
		+5 (aerial)	0.56		14	<0.01	
USA cont.					21	<0.01	
	GR+EC	1	4.48		7	0.22	58
		+5	0.56		14	<0.01	
					21	<0.01	
	GR+WP	1	4.48		7	0.12	58
		+5	0.56		14	<0.01	
					21	<0.01	
	EC	1	4.48		7	0.17	58
		+5	0.56		14	0.03	
					21	<0.01	
	EC+WP	1	4.48		7	0.05	58
		+5	0.56		14	0.03	

Crop Country/year	Application				PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
					21	<0.01	
	GR+EC	1	4.48		7	<0.01	58
		+5	0.56		14	0.02	
					21	<0.01	
	GR+WP	1	4.48		7	0.02	58
		+5	0.56		14	<0.01	
					21	<0.01	
	EC	1	4.48		7	0.02	58
		+5	0.56		14	<0.01	
					21	<0.01	
	EC+WP	1	4.48		7	0.04	58
		+5	0.56		14	<0.01	
					21	0.01	
Lettuce, Leaf							
USA/1988	GR+EC	1	4.48		7	0.10	58
		+5	0.56		14	0.12	
					21	<0.01	
	GR+WP	1	4.48		7	0.07	58
		+5	0.56		14	0.08	
					21	<0.01	
	EC	1	4.48		7	0.06	58
		+5	0.56		14	0.07	
					21	<0.01	
USA cont.	EC+WP	1	4.48		7	0.11	58
		+5	0.56		14	0.04	
					21	<0.01	
	GR+EC	1	4.48		7	0.04	58
		+5	0.56		14	0.03	
					21	<0.01	
	GR+WP	1	4.48		7	0.08	58
		+5	0.56		14	0.05	
					21	<0.01	
	EC	1	4.48		7	0.04	58
		+5	0.56		14	0.05	
					21	<0.01	
	EC+WP	1	4.48		7	0.10	58
		+5	0.56		14	0.15	

Crop Country/year	Application				PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
					21	<0.01	
	GR+EC	1	4.48		0	34	58
		+5	0.56		7	0.21	
					14	0.10	
					21	0.08	

USA cont.	GR+WP	1	4.48		0	40	58
		+5	0.56		7	0.35	
					14	0.12	
					21	0.12	
	EC	1	4.48		0	42	58
		+5	0.56		7	0.20	
					14	0.11	
					21	0.08	
	EC+WP	1	4.48		0	39	58
		+5	0.56		7	0.34	
					14	0.10	
					21	0.12	
	GR+EC	1	4.48		7	0.25	58
		+5	0.56		14	0.10	
					21	0.03	
	GR+WP	1	4.48		7	0.13	58
		+5	0.56		14	0.03	
					21	0.01	
	EC	1	4.48		7	0.12	58
		+5	0.56		14	0.06	
					21	0.02	
	EC+WP	1	4.48		7	0.09	58
		+5	0.56		14	0.04	
					21	0.02	
	GR+EC	1	4.48		7	0.19	58
		+5	0.56		14	0.03	
					21	0.02	
	GR+WP	1	4.48		7	0.19	58
		+5	0.56		14	0.03	
					21	<0.01	
	EC	1	4.48		7	0.16	58
		+5	0.56		14	0.03	
					21	<0.01	
	EC+WP	1	4.48		7	0.13	58
		+5	0.56		14	0.01	
USA cont.					21	<0.01	
Spinach							
Italy/1988	EC	1	0.3	0.06	0	52	58
					7	0.14	
					14	<0.02	

					21	0.03	
	EC	1	0.36	0.06	0	11	58
					7	0.45	
					14	0.04	
					21	0.02	
					28	<0.02	
Switzerland/1972	EC	1	0.8		0	42	58
					10	0.73	
USA/1988	GR+EC	1	4.48		7	0.01	58
		+5	0.56		14	<0.01	
					21	<0.01	
	GR+WP	1	4.48		7	<0.01	58
		+5	0.56		14	0.01	
					21	<0.01	
	GR+EC	1	4.48		7	0.57	58
		+5	0.56		14	0.16	
					21	0.03	
	GR+WP	1	4.48		7	0.78	58
		+5	0.56		14	0.18	
					21	0.03	
	GR+EC	1	4.48		7	0.02	58
		+5	0.56		14	<0.01	
					21	0.01	
	GR+WP	1	4.48		7	0.02	58
		+5	0.56		14	0.01	
					21	<0.01	
	GR+EC	1	4.48		0	8.9	58
		+5	0.56		7	0.16	
					14	0.06	
					21	0.06	
USA cont.	GR+WP	1	4.48		0	29	58
		+5	0.56		7	0.52	
					14	0.37	
					21	0.02	

[1] All US trials 1 pre-plant + 5 foliar

Table 14. Residues from supervised trials on legume vegetables. Underlined residues are from treatments according to GAP.

Crop Country/year	Application	PHI, days	Residue, mg/kg	Ref.

	Form	No	kg ai/ha	kg ai/hl			
Common beans							
Switzerl'd/1972	DP	1	0.8		0	1.78	58
					10	0.05	
	DP	1	0.8		0	1.04	58
					10	0.05	
	DP	1	0.8		0	1.25	58
					10	0.05	
USA/1988	GR+EC	1	4.4		7	0.01	58
		+3[1]	0.83	0.37	14	<0.01	
	GR+EC	1	4.4		6	0.09	58
		+3	0.83	0.46	13	0.01	
	GR+EC	1	4.4		7	<0.01	58
		+3	0.83	0.11	14	<0.01	
	GR+EC	1	4.4		14	<0.01	58
		+3	0.83	0.37			
	GR+EC	1	4.4		0	0.76	58
		+3	0.83	0.18	7	0.15	
					14	0.04	
					21	0.05	
	GR+WP	1	4.4		7	<0.01	58
		+3	0.83	0.37	14	<0.01	
	GR+WP	1	4.4		6	0.04	58
		+3	0.83	0.46	13	<0.01	
	GR+WP	1	4.4		7	0.01	58
		+3	0.83	0.11	14	<0.01	
USA cont.	GR+WP	1	4.4		14	<0.01	58
		+3	0.83	0.37			
	GR+WP	1	4.4		0	0.50	58
		+3	0.83	0.18	7	0.09	
					14	0.03	
					21	0.03	
	EC	1	4.4	1.95	7	0.03	58
		+3	0.83	0.37	14	<0.01	
	EC	1	4.4	2.4	6	0.11	58
		+3	0.83	0.46	13	0.01	
	EC	1	4.4	1.6	7	0.02	58
		+3	0.83	0.11	14	<0.01	
	EC	1	4.4	0.94	14	<0.01	58

Crop Country/year	Application				PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
		+3	0.83	0.37			
	EC	1	4.4	0.96	0	0.63	58
		+3	0.83	0.18	7	0.12	
					14	0.03	
					21	0.04	
	EC	1	4.4	1.95	7	0.03	58
		+3	0.83	0.37	14	<0.01	
	EC	1	4.4	2.4	6	0.04	58
		+3	0.83	0.46	14	<0.01	
	EC	1	4.4	1.6	7	0.01	58
		+3	0.83	0.11	14	<0.01	
	EC	1	4.4	0.94	14	<0.01	58
		+3	0.83	0.37			
	EC	1	4.4	0.96	0	0.66	58
		+3	0.83	0.19	7	0.09	
					14	0.03	
					21	0.03	
Dwarf french beans							
Canada/1988	WP	1	0.5	0.0625	2	0.15 fruit	25
					9	0.02 fruit	
					2	0.75 ends	
					9	0.17 ends	
Yardlong beans							
Thailand/1991	EC	5	3.9	0.18	0	15.9	56
					1	5.2	
					3	0.58	
					5	0.16	
					8	0.05	
					11	0.02	
					14	<0.01	
	EC	5	7.8	0.36	0	23.2	56
					1	8.8	
					3	0.84	
					5	0.21	
					8	0.08	
					11	0.03	
					14	0.01	

Crop Country/year	Application				PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
	EC	5	3.9	0.18	0	16.4	56
					1	5.4	
					3	0.67	
					5	0.23	
					8	0.08	
					11	0.03	
					14	0.01	
	EC	5	7.8	0.36	0	26.9	56
					1	10.0	
					3	0.96	
					5	0.31	
					8	0.14	
					11	0.05	
					14	0.02	
Thailand/1992	EC	5	3.9	0.18	0	17.8	56
					1	6.6	
					3	0.61	
					5	0.18	
					8	0.06	
					11	0.03	
Thailand cont.					14	<0.01	
	EC	5	7.8	0.36	0	28.2	56
					1	9.3	
					3	1.11	
					5	0.38	
					8	0.10	
					11	0.04	
					14	0.01	
Peas							
USA/1988	GR+EC	1	4.4		7	0.09	58
		+5	0.83	0.45	14	0.05	
	GR+EC	1	4.4		7	0.10	58
		+5	0.83	0.45	14	0.03	
	GR+EC	1	4.4		7	0.02	58
		+3	0.83	0.11	14	<0.01	
	GR+EC	1	4.4		7	0.03	58
		+3	0.83	0.41	14	0.01	

Crop Country/year	Application				PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
	GR+EC	1	4.4		0	1.45	58
		+3	0.83	0.45	7	0.07	
					14	0.09	
					21	0.03	
	GR+WP	1	4.4		7	0.05	58
		+5	0.83	0.45	14	0.03	
	GR+WP	1	4.4		7	0.10	58
		+5	0.83	0.45	14	0.02	
	GR+WP	1	4.4		7	0.01	58
		+3	0.83	0.11	14	<0.01	
	GR+WP	1	4.4		7	0.02	58
		+3	0.83	0.41	14	0.01	
	GR+WP	1	4.4		0	0.64	58
		+3	0.83	0.45	7	0.03	
					14	0.03	
					21	0.01	
	EC	1	4.4	2.4	7	0.07	58
		+5	0.83	0.45	14	0.05	
USA cont.	EC	1	4.4	2.4	7	0.15	58
		+5	0.83	0.45	14	0.04	
	EC	1	4.4	1.6	7	0.02	58
		+3	0.83	0.11	14	<0.01	
	EC	1	4.4	2.2	7	0.03	58
		+3	0.83	0.41	14	<0.01	
	EC	1	4.4	2.2	0	1.1	58
		+3	0.83	0.45	7	0.05	
					14	0.01	
					21	0.02	
	EC+WP	1	4.4	2.4	7	0.05	58
		+5	0.83	0.45	14	0.02	
	EC+WP	1	4.4	2.4	7	0.04	58
		+5	0.83	0.45	14	0.02	
	EC+WP	1	4.4	1.6	7	<0.01	58
		+3	0.83	0.11	14	<0.01	
	EC+WP	1	4.4	2.2	7	0.02	58
		+3	0.83	0.41	14	<0.01	
	EC+WP	1	4.4	2.4	0	0.7	58

Crop Country/year	Application				PHI, days	Residue, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
		+3	0.83	0.45	7	0.02	
					14	<0.01	
					21	0.01	

[1] All US trials 1 pre-plant + 3 or 5 foliar

Table 15. Residues from supervised trials on root and tuber vegetables. Underlined residues are from treatments according to GAP.

Crop	Application				No. of trials if >1	Residue, mg/kg	PHI, days	Ref.
Country/year	Form	No	kg ai/ha	kg ai/hl				
Carrots								
Germany/1974	GR	1	0.08 g/m			<0.005	117	55
	GR	1	0.08 g/m			0.02	164	55
Germany/1975	GR	1	0.08 g/m			0.20	90	58
						0.04	106	
						0.03	133	
						<0.02	174	
Netherl'ds/1977	EC	1	3.6	0.72	2	0.07, 0.07	84	53
Netherl'ds/1986	EC	1	5.4	0.54		0.04	98	53
	EC	1	2.7	0.27		0.03	98	53
	EC	1	5.4	0.54		0.06	67	53
	EC	1	2.7	0.27		0.02	67	53
Switzerl'd/1973	GR	1	5.0			0.17	70	58
Switzerl'd/1974	GR	1	5.0		2	0.06, 0.07	110	58
Switzerl'd/1975	GR	1	0.08 g/m			1.08	57	58
						0.10	72	
						<0.02	87	
						<0.02	102	
						<0.02	119	
	EC	1	0.125 g/m			0.13	64	58
						0.03	79	
						<0.02	94	
						<0.02	108	
	EC	1	5.0	0.1		0.10	34	58
USA/1988	GR+EC	1	4.4		4	0.03, 0.41, 0.03, 0.19	7	58
		+5[1]	0.55			0.06, 0.17, 0.07, 0.11	14	
	GR+WP	1	4.4		4	0.03, 0.28, 0.05, 0.11	7	58

Crop	Application				No. of trials if >1	Residue, mg/kg	PHI, days	Ref.
Country/year	Form	No	kg ai/ha	kg ai/hl				
		+5	0.55			0.03, 0.25, 0.06, 0.09	14	
	EC	1	4.4		4	0.02, 0.20, 0.04, 0.13	7	58
		+5	0.55			0.07, 0.25, 0.04, 0.07	14	
	EC+WP	1	4.4		4	0.02, 0.29, 0.05, 0.11	7	58
		+5	0.55			0.03, 0.12, 0.04, 0.04	14	
Celery, tuber analysed								
Netherl'ds/1969	EC	1	3.6	0.36		4.05	27	53
Parsley, turnip rooted, root analysed								
Netherl'ds/1972	EC	1	3.6	0.36		3.49	27	53
Potatoes								
Canada/1975	GR	1	2.25			<0.02	119	58
	GR	1	2.25			<0.02	86	58
Canada/1976	GR	1	2.25			<0.02	129	58
	GR	1	2.25			<0.02	96	58
France/1972	GR	1	10			<0.02	101	58
	GR	1	10			<0.02	122	
USA/1988	GR+EC	1	4.4			<0.01	0	58
		+5	0.55			<0.01	7	
						<0.01	14	
						<0.01	21	
	GR+WP	1	4.4			<0.01	0	58
		+5	0.55			<0.01	7	
						<0.01	14	
						0.01	21	
	EC	1	4.4			<0.01	0	58
		+5	0.55			0.01	7	
						<0.01	14	
						0.01	21	
	EC+WP	1	4.4			<0.01	0	58
		+5	0.55			0.01	7	
						<0.01	14	
						<0.01	21	
	GR+EC	1	4.4		4	<0.01	7	58
		+5	0.55			<0.01	14	
	GR+WP	1	4.4		5	<0.01	7	58

Crop	Application				No. of trials if >1	Residue, mg/kg	PHI, days	Ref.
Country/year	Form	No	kg ai/ha	kg ai/hl				
		+5	0.55			<0.01	14	
	EC	1	4.4		4	<0.01	7	58
	EC+WP	1	4.4		5	<0.01	7	58
		+5	0.55			<0.01	14	

Crop	Application				No. of trials if >1	Residue, mg/kg	PHI, days	Ref.
Country/year	Form	No	kg ai/ha	kg ai/hl				
					Processing:			
	GR+EC	1	4.4		tubers	<0.01	7	34
					" before processing	<0.01	7	
					culls	<0.01	7	
	Processing for chips:				wet peel	<0.01	7	
					dry peel	0.02	7	
					sliced/peeled potato	<0.01	7	
					wash water	<0.01	7	
					potato chips	<0.01	7	
	Processing for flakes:				wet peel	<0.01	7	
					dry peel	0.03	7	
					sliced/peeled potato	<0.01	7	
					wash water	<0.01	7	
					potato flakes	<0.01	7	
Radish, roots analysed								
					No. of trials, if >1			
Switzerl'd/1974	GR	1	8.7			<0.02	33	58
USA/1988	GR+EC	1	4.48		2	<0.01, 0.08	7	58
		+3	0.56			<0.01, 0.03	14	
	GR+WP	1	4.48		2	<0.01, 0.08	7	58
		+3	0.56			<0.01, 0.04	14	
	EC	1	4.48		2	<0.01, 0.04	7	58
		+3	0.56			<0.01, 0.03	14	
	EC+WP	1	4.48		2	<0.01, 0.04	7	58
		+3	0.56			<0.01, 0.07	14	
	GR+EC	1	4.48			0.21	0	58
		+3	0.56			<0.01	7	
						<0.01	14	
						<0.01	21	
	GR+WP	1	4.48			0.08	0	58
		+3	0.56			<0.01	7	
						<0.01	14	
						<0.01	21	
USA cont.	EC	1	4.48			0.12	0	58
		+3	0.56			<0.01	7	

Crop	Application				No. of trials if >1	Residue, mg/kg	PHI, days	Ref.
Country/year	Form	No	kg ai/ha	kg ai/hl				
						<0.01	14	
						<0.01	21	
	EC+WP	1	4.48			0.06	0	58
		+3	0.56			<0.01	7	
						<0.01	14	
						<0.01	21	
	GR+EC	1	4.48			<0.01	7	58
		+4	0.56			<0.01	14	
	GR+WP	1	4.48			<0.01	7	58
		+4	0.56			<0.01	14	
	EC	1	4.48			<0.01	7	58
		+4	0.56			<0.01	14	
	EC+WP	1	4.48			0.01	7	58
		+4				<0.01	14	
Sugar beet					No. of trials if >1 & sample analysed			
Germany/1980	WP	4	0.24	0.04	leaves	3.06	0	58
						<0.02	14-68	
					tubers	<0.02	0	
						<0.02	14	
						<0.02	28-68	
	WP	4	0.24	0.06	leaves	1.78	0	58
						<0.02	14-76	
					tubers	<0.02	0	
						<0.02	14	
						<0.02	28-76	
	EC	4	0.14	0.023	leaves	0.03	0	58
						<0.02	14-68	
					tubers	<0.02	0	
						<0.02	14	
						<0.02	28-68	
	EC	4	0.14	0.035	leaves	1.35	0	58
						<0.02	14-76	
Germany cont.					tubers	0.02	0	
						<0.02	14	
						<0.02	28-76	
Switzerl'd/1975	EC	2	0.5	0.5	whole plant	5.70	0	58

Crop	Application				No. of trials if >1	Residue, mg/kg	PHI, days	Ref.
Country/year	Form	No	kg ai/ha	kg ai/hl				
						0.19	7	
					leaves	0.03	14	
						<0.01	21-113	
					tubers	0.04	14	
						<0.01	21-113	
	EC	2	0.5	0.5	whole plant	6.70	0	58
						0.56	7	
					leaves	0.09	14	
						<0.02	21-105	
					tubers	0.07	14	
						<0.02	21-85	
USA/1988	GR+EC	1	4.4		tops	0.96	7	58
		+4	0.55			0.20	14	
					root	0.02	7	
						0.02	14	
	GR+WP	1	4.4		2 trials	1.49, 0.80	7	58
		+5	0.55			0.41, 0.40	14	
					root	0.03, <0.01	7	
						0.02, <0.01	14	
	EC	1	4.4		3 trials tops	1.60, 1.85, 4.00	7	58
		+5	0.55			0.52, 0.31, 2.51	14	
					root	0.01, 0.01, <0.01	7	
						0.10, <0.01, <0.01	14	
	EC+WP	1	4.4		3 trials tops	1.12, 1.10, 2.05	7	58
		+5	0.55			0.17, 0.40, 0.51	14	
					root	<0.01, 0.02, <0.01	7	
						0.04, <0.01, <0.01	14	
USA cont.	GR+EC	1	5.5		tops	4.40	7	58
		+4	0.55			1.20	14	
					root	0.01	7	
						<0.01	14	
	GR+WP	1	5.5		tops	2.45	7	58
		+5	0.55			0.57	14	
					root	0.01	7	

Crop	Application				No. of trials if >1	Residue, mg/kg	PHI, days	Ref.
Country/year	Form	No	kg ai/ha	kg ai/hl				
						<0.01	14	
				Processed fractions:				
					root	<0.01	7	
					cossettes	<0.01	7	
					molasses	<0.01	7	
					sugar	<0.01	7	
					pulp	0.01	7	

[1] All US trials 1 pre-plant + 3, 4 or 5 foliar

Table 16. Residues from supervised trials on stalk and stesm vegetables.

Crop Country/year	Application				Sample analysed	Residue, mg/kg	PHI, days	Ref.
	Form	No	kg ai/ha	kg ai/hl				
Artichoke								
Spain/1987	EC	1	1.512	0.072	fruit	3.40	0	54
						1.70	3	
						0.96	7	
						0.50	14	
						0.30	21	
	EC	1	1.512	0.072	fruit	3.05	0	54
						1.70	3	
						1.02	7	
						0.76	14	
						0.21	21	
	EC	1	1.512	0.072	fruit	3.40	0	54
						2.70	3	
						1.28	7	
						0.48	14	
						0.18	21	
Witloof Nthlds/1983	TB	1	3.3 g/cell (glass)			<0.01	14	53

Table 17. Residues from supervised trials on cereals.

Crop Country/year	Application				Sample analysed	Residue, mg/kg	PHI, days	Ref.
	Form	No	kg ai/ha	kg ai/hl				
Maize/field corn								
Germany/1974	EC	1	0.94	0.164	plant	<0.02	66	58
						<0.02	97	
					grain	<0.02	142	
					plant	<0.02	142	

Crop Country/year	Application				Sample analysed	Residue, mg/kg	PHI, days	Ref.
	Form	No	kg ai/ha	kg ai/hl				
Germany/1975	DS	1	0.5 kg/		plant	<0.02	85	58
			100 kg		cobs	<0.02	119	
			seed		stems	<0.02	119	
					grain	<0.02	146	
	DS	1	0.5 kg/		plant	<0.02	99	58
			100 kg			<0.02	127	
			seed		grain	<0.02	156	
	DS	1	0.5 kg/		plant	<0.02	80	58
			100 kg		cobs	<0.02	114	
			seed		stems	<0.02	114	
					grain	<0.02	140	
Switzerl'd/1974	EC	1	1	0.1	plant	<0.02	58-120	58
					grain	<0.02	154	
					plant	<0.02	154	
	EC	1	1	0.1	plant	<0.02	58-120	58
					grain	<0.02	148	
					plant	<0.02	148	
USA/1988	GR	4	1.1		forage	3.95	7	58
					silage	5.3	10	
					fodder	3.15	45	
					grain	<0.01	45	
	GR	4	1.1		forage	2.5	7	58
					silage	2.7	10	
					fodder	0.29	43	
					grain	<0.01	43	
	GR	4	1.1		forage	1.07	6	58
					silage	1.18	10	
					fodder	0.39	45	
					grain	<0.01	45	
	GR	4	1.1		forage	1.8	7	46
					silage	5.4	10	
					fodder	1.12	45	
USA cont.					grain	<0.01	45	
				Processed fractions				
				dry milled:				
				kernel, whole		0.01	45	46
				broken		0.04		
				grits, small		0.01		
				meal		0.01		
				flour		<0.01		
				hulls		0.01		
				crude oil expeller		0.01		

Crop Country/year	Application				Sample analysed	Residue, mg/kg	PHI, days	Ref.
	Form	No	kg ai/ha	kg ai/hl				
				presscake solvent		<0.01		
				crude oil solvent		0.02		
				refined oil		<0.01		
				refined oil, bleached		<0.01		
				refined oil, bleached & deodorized		<0.01		
				wet milled:				
				kernel, whole		0.08		
				steepwater concentrate		<0.01		
				hulls		0.05		
				gluten		<0.01		
				starch		<0.01		
				gluten starch		<0.01		
				crude oil expeller		0.08		
				presscake solvent		0.01		
				refined oil		0.14		
				refined oil, bleached		0.06		
				refined oil, bleached & deodorized		<0.01		
Rice								
India/1974	GR	3	1.5		grain	<0.02	59	58
					straw	0.04	59	
India/1975	GR	3	1.0		unhusked grain	<0.02	44	58
					husks	<0.02	44	
	GR	1	1.0		unhusked grain	<0.02	44	58
		+2	1.5		husks	<0.02	44	
	EC	3	0.375	0.075	grain	<0.02	23	58
					straw	0.04	23	
	EC	1	0.125	0.05	grain	<0.02	54	58
		+2	0.15	0.05	straw	0.04	54	
Indonesia/1979	EC	5	0.6	0.12	unhusked grain	<0.02	33	58
Pakistan/1971	GR	1	1.68		unhusked grain	<0.03	45	58

Table 18. Residues from supervised trials on tree nuts in California (USA), 1988. All trials with 1 application at dormant stage + 3 foliar, all at 3.3 kg ai/ha. Underlined residues are from treatments according to GAP. All ref. 58.

Crop Country/year	Application	Sample analysed	Residue, mg/kg	PHI, days

	Form	No	kg ai/hl			
Almonds						
	EC	4	0.35	nuts	<0.01	45
				hulls	0.05	45
	EC+WP	4	0.35	nuts	<0.01	45
				hulls	0.05	45
	WP+EC	4	0.35	nuts	<0.01	45
				hulls	0.05	45
	WP	4	0.35	nuts	<0.01	45
				hulls	0.06	45
	*EC+WP	4	1.77	nuts	<0.01	45
				hulls	0.05	45
	EC	4	0.18	nuts	0.08	0
					0.01	14
					0.01	28
				hulls	16	0
					3.8	14
					4.35	28
	EC+WP	4	0.18	nuts	0.04	0
					0.01	14
					<0.01	28
				hulls	17	0
					3.8	14
					3.5	28
	WP+EC	4	0.18	nuts	0.04	0
					0.03	14
					0.01	28
				hulls	17	0
					5.0	14
					4.35	28
	WP	4	0.18	nuts	0.03	0
					<0.01	14
				hulls	8.5	0
					2.0	14
	EC	4	0.24	nuts	<0.01	45
				hulls	0.09	45
	EC+WP	4	0.24	nuts	<0.01	45
				hulls	0.06	45
	WP+EC	4	0.24	nuts	<0.01	45

Crop Country/year	Application			Sample analysed	Residue, mg/kg	PHI, days
	Form	No	kg ai/hl			
				hulls	0.04	45
	WP	4	0.24	nuts	<0.01	45
				hulls	0.04	45
	*EC+WP	4	1.77	nuts	<0.01	45
				hulls	0.02	45
	EC	1+3	0.33	nuts	<0.01	45
			0.75	hulls	1.05	45
	EC+WP	1+3	0.33	nuts	<0.01	45
			0.75	hulls	0.1	45
	WP+EC	1+3	0.33	nuts	0.01	45
			0.75	hulls	3.10	45
	WP	1+3	0.33	nuts	0.02	45
			0.75	hulls	3.2	45
Walnuts						
	EC	4	0.18	nuts	<0.01	0, 14, 28
					<0.01	45
	EC+WP	4	0.18	nuts	<0.01	0, 14, 28
					<0.01	45
	WP+EC	4	0.18	nuts	<0.01	0, 14, 28
					<0.01	45
	WP	4	0.18	nuts	<0.01	0, 14, 28
					<0.01	45
	*EC	1+3	0.35+1.77	nuts	<0.01	45
	*EC+WP	1+3	0.35+1.77	nuts	<0.01	45
	*WP+EC	1+3	0.35+1.77	nuts	<0.01	45
	*WP	1+3	0.35+1.77	nuts	<0.01	45
	*EC	1+3	0.24+1.77	nuts	<0.01	45
	*EC+WP	1+3	0.24+1.77	nuts	<0.01	45
	*WP+EC	1+3	0.24+1.77	nuts	<0.01	45
	*WP	1+3	0.24+1.77	nuts	<0.01	45
	EC	4	0.24+1.77	nuts	<0.01	45
	EC+WP	4	0.24+1.77	nuts	<0.01	45
	WP+EC	4	0.24+1.77	nuts	<0.01	45
	WP	4	0.24+1.77	nuts	<0.01	45
	EC	1+3	0.15+0.14	nuts	<0.01	45
	EC+WP	1+3	0.15+0.14	nuts	<0.01	45
	WP+EC	1+3	0.15+0.14	nuts	<0.01	45

Crop Country/year	Application			Sample analysed	Residue, mg/kg	PHI, days
	Form	No	kg ai/hl			
	WP	1+3	0.15+0.14	nuts	<0.01	45
	EC	1+3	0.12+1.05	nuts	<0.01	45
	EC+WP	1+3	0.12+1.05	nuts	<0.01	45
	WP+EC	1+3	0.12+1.05	nuts	<0.01	45
	WP	1+3	0.12+1.05	nuts	<0.01	45

*First treatment ground, others aerial

Table 19. Residues from supervised trials on cotton seed in India, 1975. All EC. All ref. 58.

Application			Residue, mg/kg	PHI, days
No	kg ai/ha	kg ai/hl		
2	0.75	0.12	<0.05	7
			<0.05	21
5	0.75		<0.05	93
2	0.40	0.064	<0.05	7
			<0.05	21
5	0.40		<0.05	93

Animal commodities

Cattle. The Canadian government reported the residues in milk and tissues of cattle resulting from applying ear tags to the animals.

Two tags (6% cypermethrin, 11% diazinon), one per ear, were attached to each of three Holstein dairy cows. The animals were maintained on a total mixed ration of corn silage, haylage, high moisture corn, soya bean meal, and mineral supplement. Daily milk production ranged from 12 to 15 kg/cow. Milk samples were taken five hours before application, and five hours, one day, 3, 7, 14, 21, and 28 days after application.

Residues of diazinon were not detectable (<0.0005 mg/kg) in milk samples until three days after tag application. The diazinon residues remaind consistently less than 0.002 mg/kg for the entire residue study. Animals were in good health and no apparent ill effects were observed throughout the trial (Surgeoner ***et al.***, 1987a).

Three Hereford ste ers treated with two ear tags (6% cypermethrin, 9.6% diazinon) were maintained in an indoor/outdoor pen under normal feedlot conditions. After 14 days, one animal was slaughtered and samples of blood, liver, muscle, tongue, omental fat and perirenal fat were taken for analysis; after 100 days the remaining two treated animals were killed and sampled similarly.

Diazinon was found on the hair of the coat, but in the tissues it was detectable only in the omental and perirenal fat of the animal killed days after tag attachement. The levels in the fat were low at 0.032 and 0.035 mg/kg respectively. No residues (< 0.01 mg/kg) were found in the tissues of animals 100 days after treatment, indicating that there was no

accumulation. Analysis of hair samples showed that the concentrations were approximately equal on the neck and side at the end of the season, while slightly less diazinon was found on the face. (Surgeoner ***et al.***, 1987b)

Four Hereford steers were treated with two ear tags (20% diazinon) and maintained in an indoor/outdoor pen under normal feedlot conditions. The steers were slaughtered after 7, 14 and 28 days, (2 at 28 days) and samples of blood, liver, muscle tongue, subcutaneous fat and perirenal fat were taken for analysis.

Diazinon residues were found on the hair of the neck at levels from 11 to 55 mg/kg on all three sample dates, and on the tongue of two animals (less than 0.02 mg/kg) presumably owing to licking. Residues were found in the subcutaneous and perirenal fat of all animals. The highest levels were 0.045 and 0.041 mg/kg respectively on day 14. There were still detectable residues in the subcutaneous and perirenal fat on day 28 at approximately 0.02-0.03 mg/kg. No residues were dectectable (< 0.01 mg/kg) in any other samples. Cholinesterase levels were not affected by the tags. (Surgeoner ***et al.***, 1989)

FATE OF RESIDUES

In animals

Several studies with radiolabelled material on farm animals are now available. Studies with unlabelled active ingredient were also carried out in connection with the registration of diazinon as an animal health product, giving information on residues in animal tissues upon dermal exposure.

The fate of diazinon was studied after oral and t opical administration of unlabelled and radiolabelled diazinon in various mammalian species including the rat, mouse, guinea pig, dog, goat, sheep and cow. Additional ***in vitro*** experiments were conducted using tissue slices or cell fractions from various species.

Absorption. In all species studied, diazinon was rapidly and almost completely absorbed from the intestinal tract. Dermal absorption was also high: in rats, 73 to 81% of a dermally administered dose was recovered in the urine within 72 hours.

Elimination. In rats dosed with [2 -^{14}C]pyrimidine-diazinon, 50% of the label was eliminated within 12 hours. Within 168 hours 69-80% was excreted with the urine and 18-25% with the faeces. 48 hours after the last of ten successive daily oral doses no residual activity could be detected in any of the examined tissues.

Metabolism. Diazinon was readily degraded in all species examined. Various metabolites were identified. In mammals the cleavage of the pyrimidinyl ester bond leading to 4-hydroxy-2 -isopropyl-6-methylpyrimidine (G 27550) was found to be the main primary pathway of metabolism. Subsequent oxidation of the isopropyl substituent yields secondary and tertiary alcohols which may form glucuronide conjugates. It has been demonstrated in the rat that the pyrimidine ring is not cleaved.

Newer studies in rats (Brown and Lai, 1989), goats (Brown and Lai, 1988a), sheep (Barr and Carlin, 1990) and chickens (Brown and Lai, 1988b), which were conducted according to the latest standards, basically confirm these results. Residues of diazinon deposited in tissues were mostly insignificant: if found at all they were present in fat-containing fractions, as were traces of diazoxon (G 24576).

The radioactivity excreted with the milk was low: goats given 4 consecutive doses corresponding to an exaggerated feeding level of 100 mg/kg excreted only 0.31% of the total dose with the milk, with daily

values of approximately 0.3 to 0.5 mg/kg (Brown and Lai, 1988a).

The proposed metabolic pathway in rats, goats and hens is pres ented in Figure 1.

In recent studies diazinon residues were determined in milk, fat and tissues of cattle after exaggerated dermal exposure (spraying with 10 l of a 600 g ai/l solution) to the diazinon animal health product Neocidol 250EC.

Residues had decreased to undetectable (<0.01 mg/kg) in muscle, liver and kidney on day 14 after the treatment, while residues in omental and kidney fat decreased from levels on day 1 of 2.0 and 2.1 mg/kg respectively to 0.16 and 0.06 mg/kg on day 14. After 21 days the corresponding values were <0.01/0.05 and <0.01/0.01 mg/kg (Strong ***et al.***, 1986).

The data indicate a clear decrease of parent residues transported into fatty deposits, thus excluding a potential bioaccumulation of diazinon in these tissues. In another study, residues in milk from animals treated with the same dosage of Neocidol (spraying with 10 l of a 600 g ai/l solution) decreased from an initial average level of 0.22 mg/l measured 7 h after treatment to undetectable (<0.01 mg/l) 80 h after treatment (Bull ***et al.***, 1986).

In plants

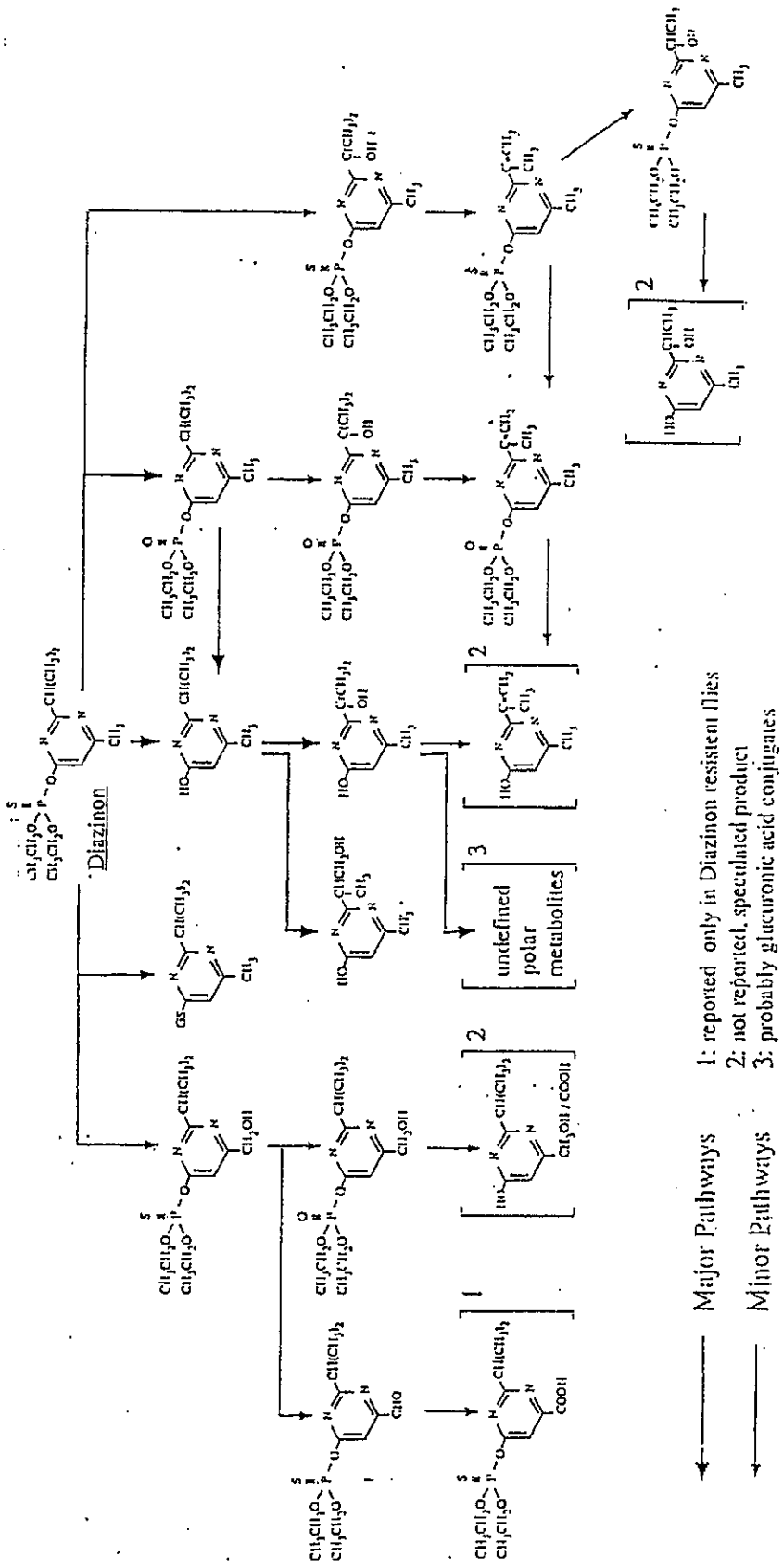
At the time of the FAO evaluation of 1973 little was known of the metabolism of diazinon in plants on the basis of available ^{14}C studies. Since then many plant metabolism and crop rotational studies have successfully addressed the characterization and identification of metabolites owing mainly to advance in methods and instruments. Details of these studies are given below.

Metabolism

Apple. One branch of an Empire hybrid apple tree (10 years old) was sprayed three times with formulated [2 -^{14}C]pyrimidine-diazinon. The initial application was a combined foliar and soil treatment, when the apple buds were in the early tight cluster stage, at a rate equivalent to 3.36 kg ai/ha. The second and third treatments were with foliar sprays when the apples were between 5 and 7.5 cm in diameter, each at a rate equivalent to 10.08 kg ai/ha. Mature apples and apple leaves were harvested 14 days after the last treatment.

Radioactive residues in mature apples and leaves at harvest were 1.29 mg/kg and 51.1 mg/kg diazinon equivalents respectively. The majority of the residue in the fruit was located in the peel (3.44 mg/kg) while the mature pulp contained 0.13 mg/kg diazinon equivalents.

Figure 1. Proposed metabolic pathways of diazinon in mammals.



By harvest, diazinon had been metabolized to a complex mixture of apolar and polar metabolites. Quantitatively, diazinon and G -27550 (4-hydroxy-2-isopropyl-6-methylpyrimidine) constituted the major residues in apples with a combined total of 85% and 77% in the peel and pulp, respectively.

The metabolism of diazinon progressed via hydrolysis of the phosphate ester linkage followed by oxidation steps to primary and tertiary alcohols. Three dihydroxy pyrimidines (C, D, E1; Figure 2) were identified in apple peel and pulp in amounts less than 3% of the total radioactive residues. Further metabolism occurred with the formation of small amounts (<4%) of five conjugates. Less than 15% of the total radioactivity in apple peel and pulp was present as bound non-extractable residues (Wong ***et al.***, 1989b).

A metabolic pathway for diazinon in plants is presented on the basis of the nine metabolites identified (Figure 2). Identical metabolites were also found in beans, maize, lettuce, potatoes and rice.

Beans. Field-grown green beans were treated with a pre -emergent soil application of [2 -^{14}C]pyrimidine-diazinon at 4.48 kg ai/ha and a further two foliar sprays, each at 1.4 kg ai/ha. The half-mature vines were sampled 32 days after planting. An intermediate harvest of vines and beans was taken 7 days after the first foliar spray (42 days after planting) and mature vine and bean samples were taken 14 days after the last application (64 days after planting).

Radioactive residues were 0.425 mg/kg diazinon equivalents in half-mature vines, increased to 4.45 mg/kg 7 days after the first foliar spray, and decreased to 3.53 mg/kg at the mature harvest. Radioactive residues in mature beans (14 days PHI) were 0.46 mg/kg. The extracted radioactivity from mature beans contained 0.01 mg/kg diazinon, while G -27550, GS -31144 and JAK -III-57 (see Figure 2) accounted for 0.12, 0.03 and 0.02 mg/kg respectively. A mixture of an additional dihydroxy metabolite, CL -XIX-29, and a glucose conjugate of GS -31144 represented 7.0% of the total radioactivity (0.03 mg/kg).

The half-mature samples and mature vines contained a mixture of metabolites qualitatively similar to those found in mature beans.

The metabolic pathway of diazinon in green beans is identical to that in apples (Wong and McFarland, 1990a).

Maize. Sweet corn grown in a greenhouse was treated with [2-^{14}C]pyrimidine-diazinon, once with pre -emergent (4.48 kg ai/ha) and twice with foliar sprays (3.5 kg ai/ha). Plant samples were taken at 50% maturity, just before the second foliar spray, and at 100% maturity.

The total radioactive residue increased from 0.810 mg/kg expressed as diazinon in 50% mature stalks to 2.07 mg/kg in immature forage and 3.89 mg/kg in mature forage. Mature cobs and grain contained 0.25 mg/kg and 0.45 mg/kg. Only 20% of the radioactivity was extractable from 50% mature stalks, and 74% from mature forage of which 77% partitioned into the aqueous phase and 23% into the organic phase. The mature grain was 26% extractable, of which 95% partitioned into the aqueous phase and 5% into the organic phase.

Diazinon accounted for 1.8% (0.07 mg/kg), G -27550 for 14.5% (0.56 mg/kg), GS-31144 for 3.0% (0.12 mg/kg) and JAK-III-57 for 5.6% (0.22 mg/kg) of the total radioactivity in mature corn forage. A mixture of an additional dihydroxy metabolite, CL -XIX-29, and a glucose conjugate of GS-31144 represented 4.0% (0.16 mg/kg) in mature forage. Diazinon was metabolized to a complex mixture of apolar and polar metabolites. The metabolism progressed via hydrolysis of the phosphate ester linkage followed by oxidation steps to primary and secondary alcohols. The metabolites in sweet corn were qualitatively the same as those in apples and potatoes (Rezaaiyan ***et al.***, 1989).

Lettuce. A field plot planted with lettuce was treated with a pre -emergent soil application of [2 -^{14}C]pyrimidine-diazinon at 4.48 kg ai/ha and two foliar sprays, each at 1.4 kg ai/ha. Immature leaves were harvested prior to the second foliar spray and mature leaves 14 days after the last application.

Radioactive residues in immature and mature leaves were 1.89 mg/kg and 0.66 mg/kg, respectively. The extractable proportions in the two samples were 87% and 78%, of which 54% and 70% respectively partitioned into the aqueous phase and 46% and 30% into the organic phase. In the mature leaves diazinon accounted for 11.8% (0.08 mg/kg), G -27550 for 17.5% (0.12 mg/kg), GS -31144 for 11.7% (0.08 mg/kg), and JAK -III-57 for 1.3% (0.01 mg/kg) of the total radioactivity. A mixture of the dihydroxy metabolite CL-XIX-29 and a glucose conjugate of GS -31144 represented 3.0% (0.02 mg/kg), while an additional dihydroxy and two resolved trihydroxy glucose conjugates represented 9.4% (0.06 mg/kg), 6.7% (0.04 mg/kg) and 2.1% (0.01 mg/kg) of the total radioactivity in mature leaves respectively. The metabolic pathway of diazinon in lettuce leaves is similar to that in apples (Wong and McFarland, 1990b).

Potatoes. Field-grown potatoes were treated in a similar manner to lettuce with [2 -^{14}C]pyrimidine-diazinon. Immature foliage and tubers were sampled before the first foliar spray and mature foliage and tubers were harvested 15 days after the last application.

Radioactive residues in foliage increased to 1.93 mg/kg at harvest while mature tuber residues reached 0.275 mg/kg. 82% of the mature foliage residue was extractable, with 25% partitioning into the organic phase and 75% into the aqueous phase. The mature tuber residue was 16% extractable with only 8% partitioning into the organic phase and 95% into the acqueous phase. Obviously the residues which were translocated into the tubers were extensively metabolized.

In mature potato foliage diazinon accounted for 14.2% (0.27 mg/kg), G-27550 for 1.3% (0.03 mg/kg), GS -31144 for 2.1% (0.04 mg/kg), JAK -III-57 for 4.3% (0.08 mg/kg), and a mixture of CL -XIX-29 and a glucose conj ugate of GS-31144 for 11.5% (0.22 mg/kg) of the total radioactivity. A mixture of additional dihydroxy and trihydroxy glucose conjugates represented 20.8% (0.4 mg/kg) and 14.1% (0.27 mg/kg) respectively.

Unextractable residues accounted for 84.2% (0.23 m g/kg) of the total radioactivity in mature tubers. These bound (unextractable with neutral solvents) residues were combined with those from maize grain (73.6% unextractable, 0.33 mg/kg) for characterization. Acetylation and acid hydrolysis indicated that these unextractable residues were also a complex mixture of sugar conjugates (Wong ***et al.***, 1989a).

Rice. The uptake of radioactivity and its distribution within the rice plant were followed after one and two applications of [2-^{14}C]pyrimidine-diazinon to th e paddy water. The results demonstrated that diazinon was rapidly absorbed by and translocated in rice plants. Less than 10% of the radioactivity remaining in the plants after 9 days was from the parent compound. About 50% of the applied radioactivity was lost within 5 days owing to volatilization from paddy water and transpiration from the leaves. A parallel experiment was also run with pea plants. The types of metabolites and the metabolic pathways in rice and peas were similar to those shown in all other crops examined (apples, beans, maize, lettuce). (Laanio ***et al.***, 1972).

Rotational crops. A total of five studies on apples, green beans, maize, lettuce and potatoes were conducted to determine the similarity of metabolites and metabolic pathways of diazinon in the target crops and to facilitate the identification of specific metabolites common to all of them. The soil from the maize study was subsequently used in a greenhouse rotational crop study while the green bean, lettuce and potato field plots

were subsequently used in a field rotational crop study.

In the greenhouse rotational crop study, rotational crops spring wheat, lettuce, sugar beet and soya beans were grown in soil which had been previously used for growing maize. The radioactive residues in mature rotational plant samples corresponded to 0.24 mg/kg in wheat grain, 0.038 mg/kg in lettuce, 0.016 mg/kg in sugar beet and 0.19 mg/kg in soya beans. The highest residues in the rotational crops were detected in mature spring wheat stalks (0.62 mg/kg). Diazinon was rapidly metabolized by the rotational crops in a similar manner as in the target crop (Rezaaiyan and McFarland, 1990).

In the field rotational study, winter wheat, lettuce, sugar beet and soya beans were grown as rotational crops in soil which had been previously used for growing green beans, lettuce and potato as target crops. Radioactive residues in the rotational crops were <0.001–0.027 mg/kg, about 1/10 of the residues in the greenhouse rotational crops (Sobralske ***et al.***, 1990).

In soil

Degradation. The degradation of diazinon in soil was investigated under laboratory conditions using ^{14}C-ring-labelled diazinon. The parent compound is very rapidly degraded under laboratory conditions (25 °C), with a half-life of approximately 11 days, to the major (transient) product 4-hydroxy-2-isopropyl-6-methylpyrimidine (G 27550) and a series of related compounds oxidized at the alkyl groups. The products are further degraded by breakdown of the pyrimidine ring with the formation of $^{14}CO_2$ in quantities >55% of the activity after 166 days (Keller, 1981).

In a study conducted at 10 °C diazinon was degraded with a half-life of 3–5 and 16 weeks in a loam soil and a humic sandy soil, respectively (Vonk and de Jong, 1987).

Mobility. Diazinon is fairly strongly adsorbed to soil particles, as shown by a laboratory study. An average adsorption constant K_{om} = 332 mg/g organic matter was determined. The value indicates the relatively low mobility of the insecticide in soil (Laanio ***et al.***, 1972; Guth, 1972). This was confirmed in leaching studies using soil columns. After 200 mm of simulated rainfall within 48 hours the compound penetrated 2, 4, 8 and 16 cm into a sandy loam, silty loam, loamy sand and sandy soil, respectively. On the basis of these results a relative mobility factor RMF = 0.28 was determined (monuron as standard compound with RMF = 1.0), indicating that diazinon has a low mobility (Guth, 1978).

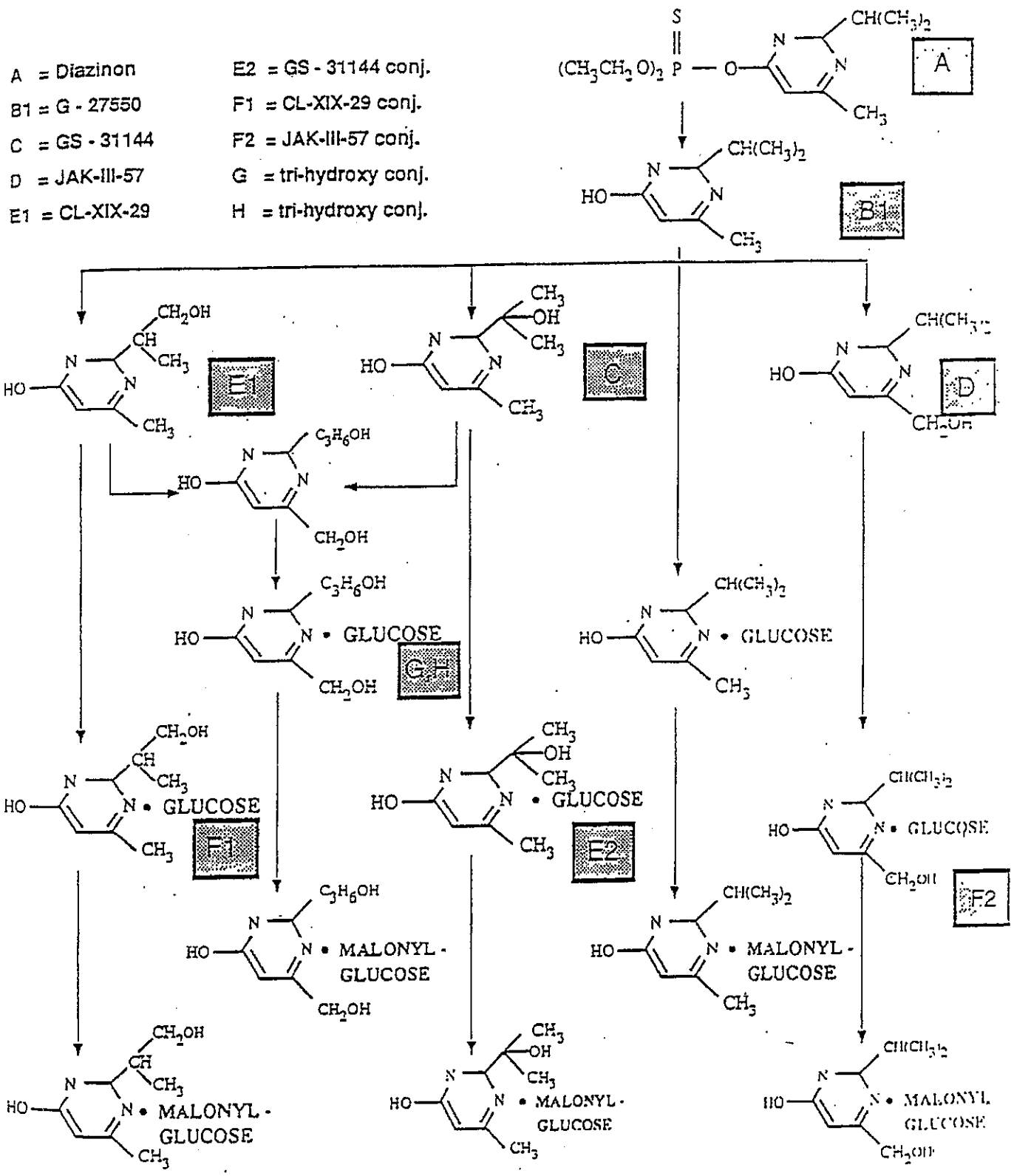
In a similar study using extreme rain conditions (508 mm within approximately 24 hours), 6, 16, 18 and 81% of the applied radioactivity was found in the leachate of silt loam, clay, sandy loam and sand soils respectively. Characterization showed that 83–94% of the radioactivity in the eluate was the pyrimidinol G 27550. The majority of radioactivity in the silt loam remained in the top 5, 7.5 and 22.5 cm of the soil column, respectively (Spare, 1987).

Leaching. The leaching characteristics of aged residues of ^{14}C-labelled diazinon were studied in a sandy loam, silty loam and sandy soil. After 30 days ageing followed by a period of 45 days with 571 mm artificial rain the leachates and soil layers were analysed. Approximately 32 and 25% of the applied radioactivity were found in the eluates of the sand and silty loam soil columns with approximately one third being the major soil degradation product G 27550 and half tentatively identified as the 2-ethyl derivative. No parent was detectable (Burkhard, 1980).

After a longer ageing period of 84 days in sandy loam and a raining period of 16 days (200 mm rain) approximately 31% of the applied radioactivity was found in the eluate, consisting almost exclusively of the major soil product G 27550 (Keller, 1983).

Photodegradation. The photodegradation of diazinon was investigated under natural and artificial sunlight. Half-lives corresponding to 17.3 hours and 5.5 days respectively were determined for these light conditions at temperatures ranging between 16 and 31 °C (Mortison, 1985). In an earlier study 72% and 77% breakdown of diazinon was found within 24 h in moist and dry soil respectively. The major breakdown product was identified as G 27550 (Burkhard, 1978).

Figure 2 . Metabolic pathways of diazinon in plants.



Volatilization. The volatilization of diazinon from soil surfaces is moderate. During the first 24 hours after application, 3.0 -10.4% of the applied product was calculated to be volatilized in various soil types (Burkhard, 1977).

Field dissipation . Field dissipation studies on different soil types confirmed the rapid degradation observed in the laboratory tests. The field half-life was approximately one week. No carry-over of residues was found in repeated treatments (Spare, 1987).

In processing

Processed fractions were prepared from a number of crops: apples, grapes, maize, pineapples, potatoes, sugar beet and tomatoes. Most of the samples were analyzed for diazinon and the two metabolites diazoxon (G -24576) and hydroxydiazinon (CGA 14128). Wine was prepared in some cases from harvest grapes and olive oil (crude) was prepared from olives in one trial. No measurable metabolite residues were found in these fractions.

Apples. Apples containing 0.98 mg diazinon/kg immediately after treatment at the normal recommended rate were processed into culls, wet pomace, dry pomace, fresh juice, canned juice, canned slices, frozen slices, and apple sauce. The results are shown in Table 3 (Ross and Gold, 1989a).

No residues were detectable in canned juice, canned slices, frozen slices or apple sauce, and only a low residue in the fresh juice (0.02 mg/kg). While residues were reduced by a factor of about 2.5 in dry pomace (0.4 mg/kg), an accumulation was observed in culls (2.2 mg/kg) and wet pomace (1.4 mg/kg).

Grapes. Grapes containing 0.06 mg diazinon/kg at harvest 7 days after treatment at the normal recommended rate were processed into wash water, stems, destemmed grapes, wet pomace, dry pomace, unclarified juice, filter cake, "Agrol" settling, clarified juice and canned juice (Gold, 1990a). See Table 5.

With the exception of pomace, residues in the processed fractions did not exceed the residues in grapes (wash water <0.01 mg/kg; stems 0.04 mg/kg; destemmed grapes 0.06 mg/kg; unclarified juice 0.02 mg/kg; filter cake <0.01 mg/kg; "Agrol" settling <0.01 mg/kg; clarified juice <0.01 mg/kg; canned juice <0.01 mg/kg). In wet pomace residues accumulated to a level of 0.13 mg/kg with further accumulation by drying up to 0.36 mg/kg in dry pomace.

In several cases wine was produced from harvest grapes (Table 5). Diazinon residues were not detectable in any of the analysed samples (<0.02 or <0.001 mg/l).

Leafy vegetables . The Netherlands government reported the results of washing head lettuce and endive (Table 13). Residues of 0.32 mg/kg in lettuce and 0.55 mg/kg in endive two days after application were reduced by washing by one third to 0.21 and 0.33 mg/kg respectively. Cooking reduced the residue further to 0.02 mg/kg (Ministry of Welfare, Health, and Cultural Affairs, 1993).

Maize/corn. Whole kernels from harvest samples after treatment at the normal recommended rate were processed by dry and wet milling. Whole kernels, broken kernels, grits, meal, flour, hulls, presscake solvent, oil (crude, refined, and refined, bleached and deodorized) and starch were analysed (Gold, 1990b, Table 17).

In the dry milling process residues in most fractions were at about the limit of determination (whole kernel 0.01 mg/kg; grits 0.01 mg/kg; meal 0.01 mg/kg; flour <0.01 mg/kg; hulls 0.01 mg/kg; presscake solvent <0.01 mg/kg) with a higher value in the broken kernels (0.04 mg/kg). Residues in oil were reduced from 0.02 to <0.01 mg/kg in the course of processing from

crude to refined, to refined and bleached, to refined, bleached and deodorized.

In the wet milling process the residue in the whole kernels was somewhat higher, reaching a level of 0.08 mg/kg. In hulls the residue was 0.05 mg/kg, in starch <0.01 mg/kg, and in presscake solvent 0.01 mg/kg. Residues in oil decreased from 0.14 to <0.01 mg/kg in the course of processing as above.

Commercial grade oil fit for human consumption contained no measurable residues.

Olives (Table 8). The government of Portugal reported that residues in whole fruit of 0.56 -3.0 mg/kg were increased by processing into crude oil to 1.7-9.0 mg/kg (Ministério dos Negócios Estrangeiros, 1990).

Whole olive fruit at harvest with little or no residue (<0.02 and 0.07 mg/kg) were in one case processed into crude oil containing 0.10 and 0.29 mg/kg respectively (Altenburger, 1976b).

Evidently processing olives into crude oil results in an accumulation of diazinon by a factor of 3-5.

Residues of 0.03 and 0.09 mg/kg in olives showed no decline after preservation (0.04 and 0.09 mg/kg) (Altenburger, 1976a).

Pineapples. Pineapples containing undetectable or trace residues (<0.02-0.07 mg/kg) in whole fruit harvest samples after treatment at the normal recommended rate were processed into juice and filter cake/bran (Kühne-Thu, 1989b,c, 1991, Table 8). Residues were undetectable in the juice (<0.02 or <0.03 mg/kg) and low in the filter cake/bran (<0.02 -0.03 mg/kg).

Potatoes. Tubers containing no residues (<0.01 mg/kg) at harvest after treatment at the normal recommended rate were processed into culls, wet peel, potato sliced and peeled, wash water, chips, and flakes, all with no detectable residues (<0.01 mg/kg). The only diazinon residues detected were in dry peel: 0.02 mg/kg (chips) and 0.03 mg/kg (flakes) (Ross and Gold, 1989b, Table 15).

Sugar beet . Sugar beet roots containing no residues (<0.01 mg/kg) in harvest samples after treatment at the normal recommended rate were processed (Table 15). Cossettes, molasses, and sugar contained no detectable residues (<0.01 mg/kg). The only diazinon residues detected were in pulp at 0.01 mg/kg (Ross and Gold, 1989c).

Tomatoes. Tomatoes containing 0.09 mg diazinon/kg in unwashed harvest samples after treatment at the normal recommended rate were processed (Table 12). Residues of the same order or lower were found in washed tomatoes (0.15 mg/kg), canned tomatoes (<0.01 mg/kg), canned juice (0.03 mg/kg), puree (0.13 mg/kg), paste (0.11 mg/kg), juice (<0.01 mg/kg), and ketchup (0.05 mg/kg). Residues were higher in pomace, reaching levels of 2.2 mg/kg in wet pomace and 2.6 mg/kg in dry pomace mg/kg (Ross and Gold, 1989d).

Generally residues of diazinon are reduced or not detectable in processed commodities of importance for human consumption, namely flour, juices, sugar, commercial grade oils and wine.

A concentration of residues was observed in crude olive oil and in pomace-type fractions, the latter having a potential use for animal feed.

Stability of pesticide residues in stored analytical samples

The stability of residues of diazinon and the metabolites diazoxon (G-24576) and hydroxydiazinon (CGA 14128) under freezer storage conditions was checked in a variety of crop substrates and processed commodities , namely maize grain, tomatoes, potatoes, apples, strawberries, lettuce, soya beans (dry), refined corn oil, tomato paste and sugar beet molasses.

Residues of diazinon are generally stable in crops and processed commodities for a minimum of 26 months of freezer storage. A slight decline was observed in strawberries after three months. This decline continued at a much slower rate through 26 months.

Residues of G -24576 are unstable in crop and processed fraction substrates, but are stable in corn oil.

Residues of CGA -14128 are generally stable in crop substrates and processed fractions. A decline in residues was observed in apples and strawberries after three months of storage and the decline continued at a much slower rate through twenty-six months (Beidler and Moore, 1991).

The stablity of diazinon under freezer storage conditions was further tested in the muscle, liver, kidney and fat of sheep. It was found to be stable for at least 8 months of storage (Schnabel, 1981).

Residues in the edible portion of food commodities

No data about the partition of residues between pulp and peel were available for citrus fruit, pineapple, or cantaloupe. No residues were detectable in the whole fruit, pulp or peel after applying diazinon to bananas.

When diazinon was applied to walnuts only the whole nuts were analysed. For almonds residues in the whole nuts and the hulls but not in the meal were available. Residues in the whole nuts were low, <0.01 -0.01 mg/kg, while the residues in the hulls were 0.02 -4.35 mg/kg 28 -45 days after the last application. From these results it seemed rather unlikely that residues could occur in the meal.

METHODS OF RESIDUE ANALYSIS

Methods for the determination of diazinon residues were described in the 1967 and 1970 monographs. Since then, basically all methods developed for diazinon employ gas chromatography using the very sensitive phosphorus/nitrogen-specific thermionic detector or in some cases the phosphorus-specific flame-photometric detector. Devices used during the early 1970s such as conductivity (microcoulometric) detectors or the Coulson detector were abandoned.

With t he advent of microbore and capillary columns for gas chromatography it became possible to co-determine the metabolites diazoxon (G 24576) and hydroxydiazinon (CGA 14128) by this technique, and the formerly used thin-layer chromatography with detection by cholinesterase inhibition for the determination of diazoxon was no longer applied. More recent improvements in laboratory equipment (e.g. cartridges for clean-up purposes) led to miniaturization of the methods used.

Methods for diazinon with sufficiently low limits of determination (0.02 mg/kg or lower) are available for practically all crops, processed commodities, animal tissues, human and animal body fluids, water and soil. Many are published in the literature. Diazinon is also generally determined by most of the available and published multi-residue methods.

In the older non-US trials reported here analyses were mostly by the

CIBA-GEIGY internal methods REM 7a/73 (Blass, 1973) and REM 15/82 Appendix 2 (Hohl, 1983), while more recently the method REM 119.01 (Kühne -Thu, 1989a) was used. In trials conducted in the USA samples were generally analyzed by method AG-550A (Hubbard and Todt, 1990).

Method REM 7a/73 (Blass, 1973) employs gas chromatography with a flame-ionization detector. Recoveries from apples, lettuce, and leaves of beans at levels of 0.2 and 1.0 mg/kg were 88-102% and 84-105% respectively. The limit of determination was assessed to be 0.02 mg/kg.

Method REM 15/82 Appendix 2 (Hohl, 1983) used an NP detector instead of a flame-ionization detector. The method was validated for cherries, lettuce and whole cacao seeds. When adding 0.05 and 0.5 mg/kg recoveries were 82 -98% and 91 -113% respectively. The limit of determination was assessed to be 0.02 mg/kg.

Method REM 119.01 (Kühne -Thu, 1989a) described the determination of several active ingredients using gas chromatography with either an NP or an electron-capture detector. Reported recoveries for kiwifruit and maize (whole plant) were:

kiwi/NPD: 77% (4.0 mg/kg), 80% (0.4 mg/kg), 77% (0.04 mg/kg),
kiwi/ECD: 89% (4.0 mg/kg), 110% (0.4 mg/kg), and
maize/NPD: 97% (4.0 mg/kg), 107% (0.4 mg/kg), 103% (0.04 mg/kg).

The limit of determination was assessed to be 0.01 mg/kg.

With method AG-550A (Hubbard and Todt, 1990) residues of diaz oxon (G 24576) and hydroxydiazinon (CGA 14128) as well as diazinon were determined using capillary column gas chromatography with a flame-photometric detector. The method was validated for 21 crops, almond meat and hulls, and corn oil products at levels of 0.01 and 0.05 mg/kg, for hops at 0.05 mg/kg, and for five animal tissue substrates at the US tolerance level or 1.0 mg/kg. Reported recoveries were in the range of 70 -120% for each of the substances in crops and animal tissues except diazinon in maize (128.2%) and lettuce (124.7%), diazoxon in hops (53.5%), beef liver (68.2%), beef fat (124.7%) and poultry eggs (123.2%), and hydroxydiazinon in lettuce (121.2%). With the exception of hops a limit of determination of 0.01 mg/kg was estimated for diazinon.

NATIONAL MAXIMUM RESIDUE LIMITS

The national MRLs reported below have been established on the basis of local conditions and requirements. Most of them were adopted some time ago. They all refer to the active ingredient diazinon. The Table may not completely cover all countries or commodities with officially approved MRLs.

Country	Commodity	MRL	Remarks
		mg/kg	
Australia	eggs	0.05	
	edible offal	0.7	
	meat	0.7	residues in fat
	poultry meat	0.05	
	milk	0.5	fat basis
	milk products	0.5	fat basis
	cereals	0.1	

Country	Commodity	MRL	Remarks
		mg/kg	
	citrus fruit	0.7	
	sweet corn	0.7	
	all other fruits	0.5	
	kiwi-fruit	0.5	
	nuts	0.1	
	olives, olive oil	2	
	peaches	0.7	
	sugar cane	0.5	
	vegetables	0.7	
	vegetable oil	0.1	except olive oil
Belgium	cereals	0.05	
	fruit	0.5	
	vegetables	0.5	
Brazil	beans	0.5	
	citrus fruit	0.5	
	coffee	0.05	
Brazil cont.	corn/maize	0.7	
	cotton seed	0.5	
	cucurbits	0.5	
	fruit	0.5	
	onion	0.5	
	peas	0.5	
	peanuts	0.5	
	pecan	0.5	
	rice	0.1	
	soya beans	0.5	
	sugar cane	0.7	
	tomatoes	0.5	
	vegetables, root/tuber	0.5	
	vegetables,leafy	0.7	
	wheat	0.1	
Canada	beans	0.5	
	broccoli	0.75	
	Brussels sprouts	0.5	

Country	Commodity	MRL	Remarks
		mg/kg	
	cabbage	0.75	
	carrot	0.75	
	cauliflower	0.75	
	celery	0.75	
	chard	0.25	
	collards	0.25	
	cranberry	0.25	
	cucumber	0.5	
	grapes	0.75	
	hops	0.25	
	parsley	0.25	
	kale	0.75	
	kohlrabi	0.75	
	lettuce	0.75	
	lima bean	0.25	
	onion	0.75	
	parsley	0.25	
	parsnip	0.25	
Canada cont.	peaches	0.7	
	peppers	0.75	
	pome fruit	0.75	
	radish	0.25	
	salsify	0.75	
	spinach	0.75	
	squash	0.25	
	stone fruit	0.75	except peaches
	strawberry	0.75	
	sugar beet	0.75	
	tomatoes	0.75	
	turnip	0.5	
	vegetables, root/tuber	0.5	except parsnips, radish
	vegetables, leafy	0.75	except chard
Denmark	carrots	0.5	
	cereals	0.05	

Country	Commodity	MRL	Remarks
		mg/kg	
	fruit	0.5	
	nuts	0.1	
	vegetables	0.5	
	olive oil	2	
France	asparagus	0.5	
	cabbage	0.5	
	carrots	0.5	
	cherry	0.5	
	corn (maize)	0.5	
	grapes	0.5	
	leek	0.5	
	lettuce	0.5	
	nuts	0.05	
	olives	0.5	
	onions	0.5	
	peaches	0.5	
	pome fruit	0.5	
Germany	fruits	0.5	
	vegetables	0.5	
	other plant products	0.05	
Israel	meat	0.7	
	apple	0.5	
	avocado	0.5	
	banana	0.5	
	citrus fruits	0.7	
	cole crops	0.5	
	corn/maize	0.7	
	eggplant	0.5	
	grapes	0.7	
	olives/olive oil	2	
	peanut	0.5	
	peppers	0.5	
	potatoes	0.5	
	safflower seed	0.5	

Country	Commodity	MRL	Remarks
		mg/kg	
	stone fruit	0.5	
	sugar beet	0.5	
	sunflower seeds	0.5	
	tomatoes	0.5	
	vegetable	0.5	
Italy	cereals	0.05	
	citrus fruit	0.5	
	corn (maize)	0.05	
	fruit	0.5	
	grapes	0.5	
	nuts	0.05	
	olives	0.5	
	potatoes	0.1	
	rice	0.05	
	sorghum	0.1	
	strawberries	0.5	
	sugar beet	0.1	
	sunflowers	0.5	
	tobacco	0.5	
Japan	cereals	0.1	
	fruit	0.1	
	pulses	0.1	
Japan cont.	sugar cane	0.1	
	vegetables	0.1	
Netherlands	meat	0.7	fat basis
	milk	0.02	
	cereals	0.05	
	corn (sweet)	0.7	
	other fruits	0.5	
	nuts	0.1	
	oil seeds	0.1	
	other vegetables	0.5	
	potatoes	0.02*	
	tea	0.1	

Country	Commodity	MRL	Remarks
		mg/kg	
	other food commodities	0.02*	
New Zealand	meat	0.7	
	cereals	0.1	
	fruit	0.5	
	nuts	0.1	
	oil seeds	0.1	
	tomatoes	0.5	
	vegetables	0.5	
Spain	artichokes	0.5	
	cotton seed	0.05	
	grapes	0.5	
	other fruits	0.5	
	maize	0.05	
	nuts	0.05	
	olives	1	
	olive oil	1	
	vegetables	0.5	
	other plant products	0.05	
Sweden	meat, milk	0.02	
	cereals	0.1	
	citrus fruit	0.5	
	fruit	0.3	
	potatoes	0.1	
	vegetables	0.3	
Switzerland	meat	0.2	
	milk	0.05	
	citrus fruit	0.7	
	cole crops	0.7	
	fruit	0.5	
	vegetables	0.5	except cole crops
UK	brassicae	0.5	
	carrot	0.5	
	celery	0.5	
	cucumber	0.5	

Country	Commodity	MRL	Remarks
		mg/kg	
	lettuce	0.5	
	mushroom	0.5	
	onions	0.5	
	tomatoes	0.5	
USA	meat	0.7	
	almonds	0.5	
	apple	0.5	
	apricots	0.5	
	banana	0.2	
	beans	0.5	
	beets	0.75	
	blackberry	0.5	
	blueberry	0.5	
	boysenberry	0.5	
	broccoli	0.7	
	Brussels sprouts	0.7	
	cabbage	0.7	
	carrots	0.75	
	cauliflower	0.7	
	celery	0.75	
	cherry	0.75	
	chicory	0.7	
	citrus fruit	0.7	
	coffee	0.2	
	collard	0.7	
	corn/maize	0.7	
USA cont.	cotton seed	0.2	
	cranberry	0.5	
	cucumber	0.75	
	dandelions	0.7	
	dewberry	0.5	
	endive	0.7	
	figs	0.5	
	ginseng	0.75	

Country	Commodity	MRL	Remarks
		mg/kg	
	grapes	0.75	
	hazelnuts	0.5	
	hops	0.75	
	kale	0.7	
	kiwifruit	0.75	
	lettuce	0.7	
	loganberry	0.75	
	melons	0.75	
	mushrooms	0.75	
	nectarines	0.5	
	olives	1	
	onion	0.75	
	parsley	0.75	
	parsnip	0.5	
	peaches	0.7	
	peanut	0.75	
	pears	0.5	
	peas	0.5	
	pecan	0.5	
	peppers	0.5	
	pineapple	0.5	
	plum	0.5	
	potato	0.1	
	radish	0.5	
	raspberry	0.5	
	sorghum	0.75	
	soya beans	0.1	
	spinach	0.7	
USA cont.	squash, summer	0.5	
	squash, winter	0.75	
	strawberry	0.5	
	sugarbeet	0.5	
	sugar cane	0.7	
	Swiss chard	0.7	

Country	Commodity	MRL	Remarks
		mg/kg	
	tomatoes	0.1	
	turnips	0.5	
	walnut	0.5	
	watercress	0.75	
	wheat	0.05	
	zucchini	0.5	

APPRAISAL

Diazinon, originally evaluated by the JMPR in 1967 and re-evaluated for residues several times up to 1979, is included in the CCPR periodic review programme.

The general CXLs for fruits and vegetables (0.5 mg/kg) were retained by the 1990 CCPR, to await review by the 1993 JMPR.

Information on current world-wide GAP and extensive residue data were provided by one manufacturer and several countries.

Diazinon is an organophosphorus insecticide with a broad spectrum of activity against a wide range of pests: sucking, chewing and boring insects, including soil-living insects. It is effective mainly by contact and stomach action. The product has been introduced world-wide in many countries and is used on numerous crop groups or commodities. It is generally used as a foliar or soil spray or applied as a granule to the soil.

Major target crops are leafy, fruiting, stem and root vegetables, deciduous fruit, rice and maize. Minor crops include berries, cereals, citrus, grapes, mushrooms, nut trees, olives and sugar beet. Additional uses for non-food crops are on ornamentals, grass and turf, and in nurseries.

Citrus fruits

Only limited data were available for oranges and mandarins which the Meeting felt were not sufficient to estimate a maximum residue level. Evidently the PHI (14-21 days) does not much influence residue levels. The Meeting recommended withdrawal of the CXL (0.7 mg/kg).

Pome fruits

The Meeting estimated a maximum residue level of 2 mg/kg (PHI 14 days), based on available trials from Germany, Switzerland and the USA on apples and pears.

Stone fruits

Cherries. Trials at dosage rates of 3.3 kg ai/ha applied 5 times showed residues up to 0.73 mg/kg 10 days after the last application. The Meeting recommended an MRL of 1 mg/kg.

Peaches. Taking into account data from Germany (PHI 14 days) and the USA (PHI 20 days), the Meeting estimated a maximum residue level of 0.2 mg/kg.

Plums (including Prunes). Trials at dosage rates of 3.3 kg ai/ha applied 5 times showed residues up to 0.78 mg/kg 10 days after the last application. The Meeting proposed an MRL of 1 mg/kg.

Prunes [dry]. US trials with dried prunes showed residues up to 1.9 mg/kg. The Meeting estimated a maximum residue level of 2 mg/kg.

Berries

Grapes. On the basis of the data available the Meeting felt unable to estimate a maximum residue level because the data do not match relevant GAP.

Strawberry. After observing the recommended PHI of 5 days the residues were below 0.1 mg/kg except one of 35 results, at 0.12 mg/kg. A maximum residue level of 0.1 mg/kg was estimated.

Cranberry. No results were reported within the reported GAP.

Currants, Black, Red, White. Results of trials in Germany and Switzerland showed residues up to 0.21 mg/kg at the recommended PHI of 14 days. The Meeting estimated a maximum residue level of 0.2 mg/kg.

Blackberries, Boysenberry, Raspberries. On the basis of US data and GAP for caneberries (PHI 7 days) the Meeting recommended an MRL of 0.1 mg/kg for blackberries and boysenberry, and 0.2 mg/kg for raspberries.

Olives. Because too few of the available residue data reflect current GAP the Meeting felt unable to estimate a maximum residue level on olives or olive oil although processing studies are available which indicate an accumulation of diazinon in crude oil by a factor of 3-5. The Meeting recommended withdrawal of the CXLs for olives (2 mg/kg) and olive oil, virgin (2 mg/kg).

Tropical fruits

Persimmons. Only one trial reflected the reported GAP in New Zealand.

Banana. Only two trials reflected the current GAP in Costa Rica. Although no residues were found the Meeting felt unable to estimate a maximum residue level on such limited data.

Kiwifruit. On the basis of 6 new trials from New Zealand (PHI 28 days) the Meeting estimated a maximum residue level of 0.2 mg/kg.

Pineapple. Seven days after application (the PHI in Costa Rica) trials in Honduras and Costa Rica showed residues up to 0.07 mg/kg. Reported results from the USA were not taken into account because exaggerated application rates were used. The Meeting estimated a maximum residue level of 0.1 mg/kg.

Bulb vegetables

Onion, Bulb. At the recommended rate of application and the recommended PHI of 10 days residues were below 0.05 mg/kg, which was estimated as the maximum residue level.

Spring onion. The range of residue levels found in a series of trials was wide, between <0.01 and 0.65 mg/kg. A maximum residue level of 1 mg/kg, after the recommended PHI of 10 days, was estimated.

Brassica vegetables

Broccoli. Results of 10 trials from the USA within recommended GAP (PHI 7 days) showed residues up to 0.23 mg/kg. The Meeting estimated a maximum residue level of 0.5 mg/kg.

Cabbages, Head . On the basis of several trials from the USA within the recommended GAP (PHI 7 days) the Meeting estimated a maximum residue level of 2 mg/kg.

Cauliflower. The Meeting concluded that the reported data were insufficient to estimate a maximum residue level. Most of the trials were in Germany where there is no GAP. These results could be related to GAP in Switzerland (PHI 14 days), but only three trials included this PHI.

Kohlrabi. On the basis of the available trials and GAP in Switzerland (14 days PHI) the Meeting estimated a maximum residue level of 0.2 mg/kg.

Fruiting vegetables

Cucumber. On the basis of a PHI of 7 days (GAP in the USA) the Meeting estimated an MRL of 0.1 mg/kg. One value of 0.4 mg/kg was assumed to be an outlier because in that trial only 0.2 mg/kg was found 3 days after application.

Cantaloupe. Seven days after application (GAP in he USA) residues up to 0.18 mg/kg were found in the reported USA trials. The Meeting estimated a maximum residue level of 0.2 mg/kg.

Squash, Summer. In US trials residues up to 0.05 mg/kg were found 7 days after application. An MRL of 0.05 mg/kg was recommended by the Meeting.

Mushrooms. Limited data from The Netherlands do not reflect the current PHI. The Meeting felt unable to estimate a maximum residue level.

Peppers, Sweet. Although no data were available for the recommended PHI of 5 days in the USA, the data from USA trials at PHIs of 3-7 days clearly show that 5 days after application residues would not exceed 0.05 mg/kg. The Meeting estimated a maximum residue level of 0.05 mg/kg for sweet peppers.

Sweet corn (corn-on-the-cob) . No residues of diazinon were detectable (<0.01 mg/kg) 10-14 days after the last application. Seven days after the last application residues were small, <0.01-0.02 mg/kg. The Meeting proposed an MRL of 0.02 mg/kg.

Maize forage . Residues were detectable at levels of 0.04-7.95 and <0.01-4.95 mg/kg 7 and 14 days after the last application. The Meeting estimated a maximum residue level of 10 mg/kg.

Leafy vegetables

Tomato. On the basis of reported US data and a PHI of 1 day, the Meeting estimated a maximum residue level of 0.5 mg/kg.

Chinese cabbage; Kale, Chinese . Reported trials from Thailand on Chinese cabbage did not include the national PHI of 14 days but data from Thailand on Chinese kale showed residues below 0.02 mg/kg 14 days after application. Taking all the data on both commodities into account, the Meeting felt able to estimate a maximum residue level of 0.05 mg/kg for both Chinese cabbage and kale.

Lettuce, Head; Lettuce, Leaf. No data were available covering the PHI of 10 days registered in the USA where most of the trials were done. However, the great number of results at sampling intervals of 7-14 days clearly show that 10 days after application residues will be below 0.5 mg/kg. The Meeting estimated a maximum residue level of 0.5 mg/kg for both head and leaf lettuce.

Spinach. The Meeting concluded that the residue situation is comparable to that of lettuce and proposed an MRL of 0.5 mg/kg (PHI 10 days).

Legume vegetables

Common beans (pods and/or immature seeds). At a PHI of 7 days residues were at levels up to 0.2 mg/kg, which was estimated as a maximum residue level.

Garden pea, shelled . Residue results from the USA showed a comparable situation to that of common beans. The Meeting estimated a maximum residue level of 0.2 mg/kg (PHI 7 days).

Root vegetables

Carrot. After PHIs of 7 and 14 days residues were below 0.5 and 0.3 mg/kg, respectively. A maximum residue level of 0.5 mg/kg was estimated, covering the recommended PHI of 7 days.

Celeriac; Parsley, Turnip rooted . The results of only one trial were reported for each commodity. The Meeting therefore did not propose an MRL.

Potatoes. After the recommended PHI of 14 days residues were below the reported limit of determination. A maximum residue level of 0.01* mg/kg was estimated.

Radish. After PHIs of 7 and 14 days residues were below 0.1 mg/kg. A maximum residue level of 0.1 mg/kg was estimated, covering the recommended PHI of 10 days.

Sugar beet. At a PHI of 14 days residues were at levels up to 0.1 mg/kg, which was estimated as a maximum residue level.

Sugar beet leaves or tops . On the basis of the reported data and a PHI of 14 days a maximum residue level of 5 mg/kg was estimated.

Stalk and stem vegetables

Artichoke. Limited data available from Spain (3 results, one location) were insufficient to recommend an MRL.

Witloof chicory (sprouts) . In the one trial reported no residues were detectable (<0.01 mg/kg) 14 days after application. No MRL was proposed.

Cereal grains

Maize. In all reported trials there were no detectable residues (<0.02 mg/kg) in the grain. Taking into account the reported results on sweet corn, the Meeting estimated a maximum residue level of 0.02* mg/kg.

Rice. Seven trials were conducted in India, Indonesia and Pakistan. No residues were detectable (<0.02 or <0.03 mg/kg) in the grain or the unhusked grain 23-59 days after the last application. Low residues were detectable in the straw, up to 0.04 mg/kg. Because the data did not match GAP in most of the countries the Meeting agreed not to recommend an MRL. The Meeting recommended withdrawal of the CXL for polished rice (0.1 mg/kg).

Tree nuts

Almonds. All results from the USA clearly show that normally there will be no residues in the nuts (<0.01 mg/kg). However in several cases residues up to 0.03 mg/kg occurred owing to contamination. The Meeting proposed an MRL of 0.05 mg/kg.

Almonds, hull. The available data were at PHIs of 14-45 days (and some at 0 days). The Meeting estimated a maximum residue level of 5 mg/kg (PHI 14-45 days).

Walnuts. On the basis of the available results of 24 supervised trials it is clear that no residues occur in nuts. The Meeting proposed the limit of determination as the MRL (0.01* mg/kg).

Oilseed

Cotton seed. On the basis of only four trials from one year and one country the Meeting felt unable to estimate a maximum residue level and recommended withdrawal of the CXL for cotton seed (0.1 mg/kg).

Animal products

Meat and milks . Residues in the milk and tissues of cattle were reported after applying ear tags to the animals (registered use in Canada).

Two ear tags (6% cypermethrin, 11% diazinon), one per ear, were attached to each of three Holstein dairy cows. Milk samples were taken five hours before application, and 5 h and 1, 3, 7, 14, 21, and 28 days after application.

Residues of diazinon in milk samples were not detectable (<0.0005 mg/kg) until three days after tag application. The residues remained consistently less than 0.002 mg/kg for the entire residue study.

Three Hereford steers were treated with two ear tags (6% cypermethrin, 9.6% diazinon), one per ear. After 14 days, one animal was slaughtered and samples of blood, liver, tongue, muscle, back fat, and kidney fat were analysed; after 100 days the remaining two treated animals were killed and similar samples were analysed.

Diazinon was found on the hair, but in the analysed tissues it was detectable only in the back fat and kidney fat of the animal killed 14 days after tag attachment. The levels were low, 0.032 and 0.035 mg/kg respectively. No residues (<0.01 mg/kg) were found in the back fat, kidney fat, liver, muscle and tongue 100 days after treatment, indicating that there was no accumulation.

Four Hereford steers were treated with two ear tags (20% diazinon) - one per ear. After 7 days, one animal was killed and samples of blood, liver, tongue, muscle, centre back fat, and kidney fat were analysed; a second steer was killed after 14 days and the remaining two after 28 days, all animals being sampled in the same fashion.

Residues were detectable in the centre back and kidney fat of all the animals. The highest levels were 0.045 and 0.041 mg/kg, respectively, on day 14. There were still detectable residue levels of diazinon in the centre back and kidney fat on day 28 at 0.02-0.03 mg/kg.

Data from planned animal transfer studies are not yet available. The Meeting recommended withdrawal of the established MRLs.

Withdrawal of the CXLS for Barley, Fruits (except ...), Hazelnuts, Leafy vegetables, Meat of cattle, pigs and sheep, Milks, Peanut, Pecan, Safflower seed, Sunflower seed, Vegetables (except ...), and Wheat is recommended because available residue data are insufficient although GAP is reported.

Metabolism in plants

Metabolism studies have been carried out on apples, beans, sweet corn, lettuce, potatoes and rice.

In processing

Processed fractions were prepared from apples, grapes, lettuce, endive, maize, pineapples, potatoes, sugar beet and tomatoes. Wine was made in some cases from harvest grapes and olive oil (crude) was prepared from olives in one trial. Generally residues of diazinon are reduced or not detectable in processed commodities with importance for human consumption: juice, sugar, and wine.

A concentration of residues was observed in crude olive oil and in pomace-type fractions, wi th the latter having a potential use as animal feed.

Residues in the edible portion of food commodities

No information was available about the partition of residues between the pulp and peel in citrus fruit, pineapple or cantaloupe.

No residues were detectable in the whole fruit or in separate samples of pulp and peel when diazinon was applied to bananas.

Residues in almonds (kernels) were low, ranging from <0.01 to 0.03 mg/kg 28-45 days after the last application.

Stability of pesticide residues in stored analytical samples

The stability of diazinon and the metabolites diazoxon (G-24576) and hydroxydiazinon (CGA 14128) under freezer storage conditions was determined in maize, tomatoes, potatoes, apples, strawberries, lettuce, soya beans (dry), refined corn oil, tomato paste and sugar beet molasses.

Residues of diazinon are generally stable in crops and processed commodities for a minimum of twenty-six months of freezer storage. A slight decline was observed in strawberries after three months storage, which continued at a much slower rate through twenty-six months.

Residues of diazoxon are unstable in crop and processed fraction substrates, but are stable in maize oil.

Residues of hydroxydiazinon are generally stable in crop substrates and processed fractions. A decline in residues was observed in apples and strawberries after three months of storage and continued at a much slower rate through twenty-six months.

The stability of diazinon under freezer storage conditions was further tested in some animal tissues, namely muscle, liver, kidney and fat of sheep. Diazinon was found to be stable for at least 8 months of storage.

Methods of residue analysis have been described for commodities of plant and animal origin with a limit of determination of 0.01 mg/kg in most commodities. Diazinon is classified as fat-soluble (octanol/water partition coefficient 3.95). In a large number of studies residues of the potential metabolites diazoxon (G 24576) and hydroxydiazinon (CGA 14128) were determined besides parent diazinon. Since these two compounds were practically not found in crops at harvest or in processed commodities it can be concluded that the use of the product according to GAP may be reliably monitored by determining the parent compound alone.

The data now available from the various metabolism studies show that

major metabolites identified in plant and soil metabolism, namely 4-hydroxy-2-isopropyl-6-methylpyrimidine (G 27550), 4-hydroxy-2-(2-hydroxyprop-2-yl)-6-methylpyrimidine (GS 31144), and diazoxon (G 24576), also occur in animal metabolism (rat). Thus there is no need to include compounds other than diazinon in the residue definition.

RECOMMENDATIONS

On the basis of the data on residues from supervised trials the Meeting concluded that the residue levels listed below (next page) are suitable for establishing maximum residue limits.

Definition of the residue: diazinon (fat-soluble)

Commodity		Recommended MRL (mg/kg)		PHI, days
CCN	Name	New	Previous	
	Almond, hull	5	-	14-45
TN 0660	Almonds	0.05	0.1	14
GC 0640	Barley	W	0.1	
FB 0264	Blackberries	0.1	0.5[1]	7
FB 4079	Boysenberry	0.1	0.5[1]	7
VB 0400	Broccoli	0.5	0.5[2]	7
VB 0041	Cabbages, Head	2	0.5[2]	7
VC 4199	Cantaloupe	0.2	0.5[2]	7
VR 0577	Carrot	0.5	0.5[2]	7
TS 0013	Cherries	1	0.5[1]	10
VL 0467	Chinese cabbage	0.05	0.7[3]	14
FC 0001	Citrus fruits	W	0.7	
VP 0526	Common bean (pods and/or immature seeds)	0.2	0.5[2]	7
SO 0691	Cotton seed	W	0.1	
VC 0424	Cucumber	0.1	0.5[2]	7
FB 0021	Currants, Black, Red, White	0.2	0.5[1]	14
A02 0002	Fruits (except as otherwise listed)	W	0.5	
VP 0529	Garden pea, shelled	0.2	0.5[2]	7
TN 0666	Hazelnuts	W	0.1	
VL 0480	Kale	0.05	0.7[3]	14
FT 0341	Kiwifruit	0.2	0.5[1]	28
VB 0405	Kohlrabi	0.2	0.5[2]	14
VL 0053	Leafy vegetables	W	0.7	
VL 0482	Lettuce, Head	0.5	0.7[3]	10
VL 0483	Lettuce, Leaf	0.5	0.7[3]	10
AF 0645	Maize forage	10	-	7-14
GC 0645	Maize	0.02*	-	45-150
MM 0097	Meat of cattle, pigs and sheep	W	0.7 (fat)V	
ML 0106	Milks	W	0.02 FV	
OC 0305	Olive oil, virgin	W	2	
FT 0305	Olives	W	2	

Commodity		Recommended MRL (mg/kg)		PHI, days
CCN	Name	New	Previous	
VA 0385	Onion, Bulb	0.05	0.5[2]	10
FS 0247	Peach	0.2	0.7	14-20
SO 0697	Peanut	W	0.1	
TN 0672	Pecan	W	0.1	
VO 0445	Peppers, Sweet	0.05	0.5[2]	5
FT 0353	Pineapple	0.1	0.5[1]	7
FS 0014	Plums (including Prunes)	1	0.5[1]	10
FP 0009	Pome fruits	2	0.5[1]	14
VR 0589	Potato	0.01*	0.5[2]	14
DF 0014	Prunes	2	0.5[1]	10
VR 0494	Radish	0.1	0.5[2]	10
FB 0272	Raspberries, Red and Black	0.2	0.5[1]	7
CM 1205	Rice, polished	W	0.1	
SO 0699	Safflower seed	W	0.1	
VL 0502	Spinach	0.5	0.7[3]	10
VA 0389	Spring onion	1	0.5[2]	10
VC 0431	Squash, Summer	0.05	0.5[2]	7
FB 0275	Strawberry	0.1	0.5[1]	5
AV 0596	Sugar beet leaves or tops	5	-	14
VR 0596	Sugar beet	0.1	0.5[2]	14
SO 0702	Sunflower seed	W	0.1	
VO 0447	Sweet corn (corn-on-the-cob)	0.02	0.7	7-14
VO 0448	Tomato	0.5	0.5[2]	1
A01 0002	Vegetables (except as otherwise listed)	W	0.5	
TN 0678	Walnuts	0.01*	0.1	14-45
GC 0654	Wheat	W	0.1	

W: The previous recommendation is withdrawn
[1] Fruits (except as otherwise listed)
[2] Vegetables (except as otherwise listed)
[3] Leafy vegetables

FURTHER WORK OR INFORMATION

Desirable

1. Results of ongoing residue studies on citrus fruits, hazelnuts, hops, pecans and peanuts.

2. Data from dairy cattle transfer studies reported to be completed.

3. Additional information on registered veterinary use including residue data.

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