FENARIMOL (191)

IDENTITY

ISO common name: fenarimol

Chemical name

IUPAC: (±)-2,4′-dichloro-Æ-(pyrimidin-5-yl)benzhydryl alcohol

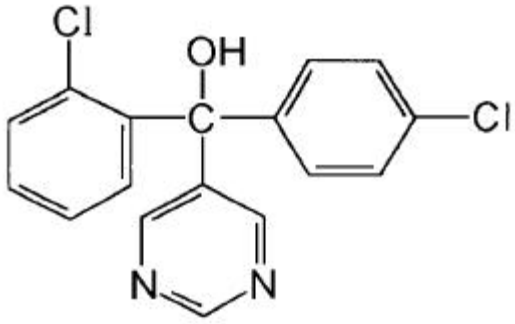
CA: (±)-Æ-(2-chlorophenyl)-Æ-(4-chlorophenyl)-5-pyrimidinemethanol

CAS registry no: 60168-88-9 (unstated stereochemistry)

CIPAC No: 380

Synonyms: compound 57322
development code EL-222

Structural formula:



Molecular formula: $C_{17}H_{12}Cl_2N_2O$

Molecular weight: 331.2

Physical and chemical properties

Pure active ingredient

Vapour pressure:	6.5×10^{-5} Pa at 25°C (99.7% pure) (A 21)	
Hydrolysis (no purity stated):	pH 3	no hydrolysis
(Dow Elanco Ltd., undated)	pH 6	no hydrolysis at 25, 37 and 52°C
	pH 9	no hydrolysis
Following 40 hours reflux at 100°C:	pH 3	30% hydrolysis
	pH 6	no hydrolysis
	pH 9	13% hydrolysis

Photolysis (no purity stated):

Sunlight or simulated sunlight

half-life in 2 mg/l water solution in summer sun: 12 hours
half-life in water in laboratory simulated sunlight: <1 hour
half-life on silica gel plates in sunlight: approx 14 hours (Day, undated)

Laboratory irradiation apparatus

half-life in distilled water: 0.6 hours
half-life in 2% acetone/water: 2.0 hours (Mosier and Saunders, 1976)

No information was submitted for the pure active ingredient on melting point, octanol/water partition coefficient, solubility or specific gravity.

Technical material

Purity:	Typically ≥97% with certified limits of 95-101% to allow for assay and production variability.
	Impurities <0.5%. except for the 2,2′-, 2,3′- and 4,4′-dichloro isomers of fenarimol (total max. 3%) (Day, 1985)
Colour:	off-white to buff (Day, 1984)
Physical state:	crystalline solid (Day, 1984)
Odour:	slightly aromatic (Day, 1984)
Melting point:	117-119°C (Day, 1984)
Octanol/water partition coefficient:	Log K_{ow} = 3.69 (Loh, 1976, Day, 1984)

Solubility
(mg/l at 25°C; purity was either 95.4% or unspecified)

water at pH 3	14.6
water at pH 7	13.7
water at pH 10	13.8
acetone	>250
acetonitrile	40-45
benzene	100-125
chloroform	>500
cyclohexanone	>500
ethyl cellosolve	>250
heavy aromatic naphtha	40-45
hexane	1.1
methanol	100-125
methyl cellosolve	>250
xylene	40-45 (Day, 1976, 1984)

Specific gravity:

Packed bulk density: 0.7 - 0.8 kg/m^3
Loose bulk density: 0.4 kg/m^3 (Hudson, 1987; Day, 1984)

Formulations

Fenarimol is formulated mainly as either WP, EC or SC products.

METABOLISM AND ENVIRONMENTAL FATE

Animal metabolism

Rats. [^{14}C]fenarimol was extensively metabolized in wistar rats with less than 3% of the dose excreted unchanged in the urine and faeces within 7 days, and with only trace amounts being detected in the bile. More than 40 metabolites, each representing only a small fraction (<10%) of the dose, were detected in the urine and faeces. Some 10 metabolites were tentatively identified by a combination of thin-layer chromatography/autoradiography, mass spectrometry, infrared spectrometry and nuclear magnetic resonance spectrometry. Many metabolites appeared to be common to both the urine and faeces. The proposed major metabolic pathways of fenarimol are oxidation of the carbinol-carbon atom, the chlorophenol rings and the pyrimidine ring, as shown in Figure 1. A proposed minor metabolic pathway involves cyclization between a chlorophenol ring and the pyrimidine ring (Goebel, 1985a; Althaus, 1985a).

Biliary metabolites existed predominantly as glucuronic acid conjugates, with similar metabolite profiles being seen at both the dose levels tested. The main metabolite present in bile after enzymatic hydrolysis was 4-[(2-chlorophenyl)(4-chlorophenyl)hydroxymethyl]-3-pyrazolone (metabolite K, Figure 1). In contrast, most of the radioactivity in the faeces was present as unconjugated compounds indicating that biliary metabolites undergo further metabolism or hydrolysis before being eliminated (Goebel, 1985a).

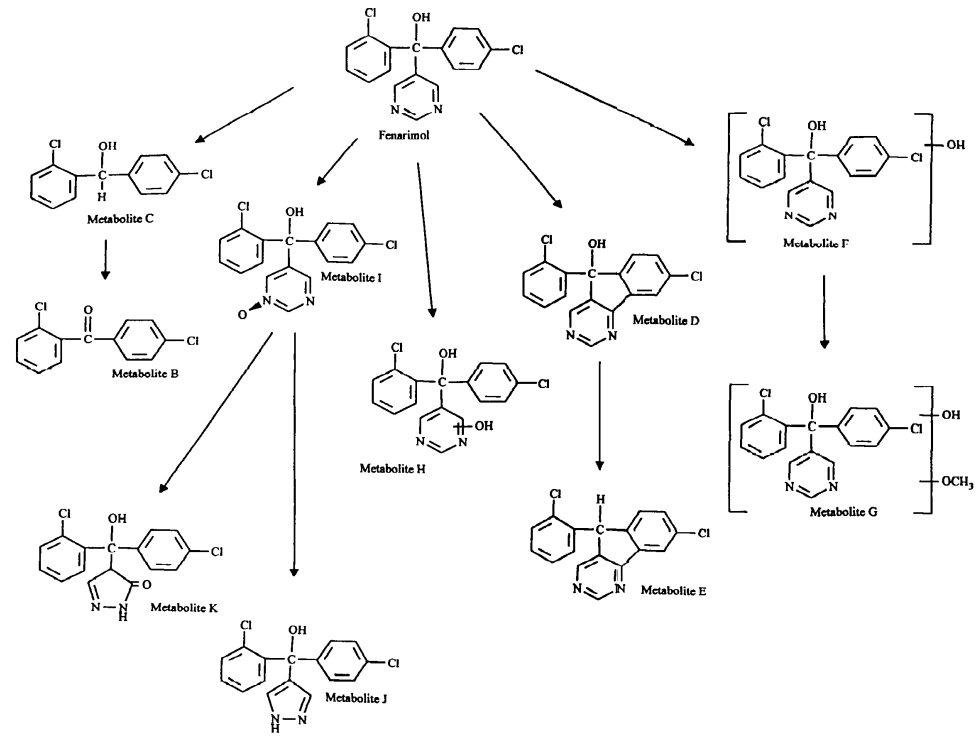
In a further study rats were dosed with a single oral dose of 1 or 13 mg/kg [^{14}C]fenarimol. The major radiolabelled constituents identified in the blood and kidneys 1 hour after dosing were unchanged fenarimol and fenarimol *N*-oxide (metabolite I); fenarimol predominated, except in the blood of low-dose males, as shown in Tables 1 and 2. Identification was by thin-layer chromatography. Fenarimol also accounted for most of the radioactivity in the liver 1 h after dosing (Table 3). In addition 3-6% of the radioactivity in the liver was tentatively identified as 4-[(2-chlorophenyl)(4-chlorophenyl)hydroxymethyl]-3-pyrazolone (metabolite K) (Althaus, 1985b).

Table 1. Major compounds in whole blood of male and female rats.

Blood	Dose, mg/kg	% of total ^{14}C	% of ^{14}C in blood		
			Fenarimol	Fenarimol *N*-oxide	Other
Male	1	0.152	19.3	41.3	39.4
Female	1	0.126	49.5	21.8	28.7
Male	13	1.154	40.4	36.7	22.9
Female	13	1.804	72.5	10.9	16.6

fenarimol

Figure 1. Proposed metabolic pathways of fenarimol in rats.



Metabolite Metabolite F: Three isomers observed. One isomer was hydroxylated in the 4-position of the 2-chlorophenyl ring and was confirmed by synthesis of the authentic model compound. The positions of the ring hydroxyl group in the other two isomers are unknown.

Metabolite G: This compound contains hydroxy and methoxy groups. Their positions are unknown.

Metabolite H: The position of the hydroxyl group on the pyrimidine ring is unknown.

Table 2. Major compounds in kidneys of male and female rats.

Kidneys	Dose, mg/kg	Fenarimol, %	Fenarimol *N*-oxide, %	Other, %
Male	1	48	19	32
Female	1	66	11	23
Male	13	64	15	21
Female	13	84	5	11

Table 3. Major compounds in liver of male and female rats.

Liver	Dose, mg/kg	Fenarimol, %	Metabolite K, %	Other, %
Male	1	67	6	27
Female	1	82	5	13
Male	13	77	6	17
Female	13	90	3	7

Goats. A lactating goat (breed unspecified) was dosed twice daily for 5 days with gelatine capsules containing [carbinol-^{14}C]fenarimol at a dose equivalent to 10 ppm in the diet and killed sixteen hours

after the final dose.

The radioactivity of tissue samples was determined by combustion/LSC. The chromatographic profiles of samples were determined by radio-TLC following preparation which generally involved an acidification and purification on a C18 column eluted with methanol. Flash chromatography was used to prepare some samples. Samples of protease-digested livers were also obtained. Further identification was carried out by HPLC with UV detection and/or GC-MS. Eighty two per cent of the total dose was excreted by the end of the study (urine 28%, faeces 53%, cage wash 0.7%, milk <0.1%). The tissues and gut contents accounted for 16% of the total dose. The maximum plasma concentration occurred 97 hours after the first dose (0.034 mg/l fenarimol equivalents) which coincided with the maximum concentration in whole blood (0.03 mg/l fenarimol equivalents) indicating that binding to red blood cells was not taking place. The maximum concentration in the milk occurred 80 hours after the first dose (0.08 mg/l fenarimol equivalents). The radioactivity in other compartments was distributed as shown in Table 4.

Table 4. Radioactivity in a goat dosed with [^{14}C]fenarimol.

Sample	mg/kg fenarimol equivalents	% of total dose
Bile	2.97	0.1
GI tract	0.18	0.82
GI tract contents	0.94	12.2
Carcase	0.02	2.0
Fat - omental	0.03	-
Fat - renal	0.03	-
Fat - subcutaneous	0.03	-
Kidneys	0.14	0.04
Liver	0.42	0.7
Muscle	0.01	0.1

At least 90% of the total radioactivity in muscle and fat samples was extractable. The compounds shown in Table 5 were identified.

Table 5. Extraction efficiency and metabolites detected in goats (% of radioactivity present).

Compounds[1]	Sample						
	Liver		Kidney		Faeces, %	Urine, %	Bile, %
	%[2]	mg/kg[3]	%	mg/kg			
Compound 1 + Compound 2	34	0.14	38	0.05	36	87	93
fenarimol	-		-		9	-	3
fenarimol + 2-chlorobenzoic acid	21	0.09	11	0.02	-	-	-
2-chlorobenzoic acid + 4-chlorobenzoic acid + dehydroxyfenarimol	-		-		9	--	
4-chlorobenzoic acid + dehydroxyfenarimol	-		4		-	-	-
Unidentified	40		43		42	0	3
Numer of unidentified compounds	4		3		3	0	1
Extractable ^{14}C as % of ^{14}C in sample	69		94		61	100	85

[1] See Figure 2
[2] Of extracted ^{14}C in sample
[3] Fenarimol equivalents

The presence of compounds 1 and 2 in liver, kidney and bile could not be confirmed with a second solvent system but was confirmed in faeces and urine.

Further characterization was attempted using protease-digested liver but no results were obtained owing to the low levels of radioactivity. GC-MS of the liver extract indicated the possible presence of a fenarimol methyl sulphone derivative (which may arise as a result of glutathione conjugation, thio-ether cleavage, methylation and oxidation) (McCorquodale & Prout, 1995).

Pigs. Three cross-bred pigs were dosed twice daily for 5 days by incorporation of labelled fenarimol (>99% radioch;emical purity) into the feed at a level of 1 ppm (dry matter). One pig was dosed with [*carbinol*-^{14}C], one with [2-*chlorophenyl*[^{14}C] and the third with [4-*chlorophenyl*-^{14}C]fenarimol. The animals were killed 6-7 hours after the final feed. The radioactivity of the samples was determined by combustion and/or LSC. Results are shown in Table 6.

Table 6. Total residues in pig tissues following dosing with [^{14}C]fenarimol (all label positions)

Sample	mg/kg fenarimol equivalents	LSC recovery from spiked samples (%)
Liver	0.19-0.24	106, 141
Kidney	0.05-0.06	114, 127
Fat	0.04-0.06	-
Muscle	0.01	105, 140

Liver samples were extracted with methanol and dichloromethane/sodium chloride solution and analysed by TLC with autoradiography following purification by column chromatography (silica gel eluted with toluene/ethyl acetate and methanol). Fat samples were extracted with "hexanes" and acetonitrile, and the ^{14}C measured by LSC. The distribution of radioactivity in various extracts was as shown in Table 7.

Table 7. Distribution of radioactivity in sample extracts.

Sample/fraction	Position of radiolabel/% of total ^{14}C in sample		
	carbinol	2-chlorophenyl	4-chlorophenyl
Liver			
unextracted	23	35	20
dichloromethane extract	65	57	68
aqueous extract	13	18	12
Fat			
acetonitrile extract	88	85	90
"hexanes" extract	12	14	10

The major compound in the dichloromethane extracts of liver and the acetonitrile extracts of fat was fenarimol, accounting for 41-43% of the total radioactivity in the liver and 90% of the total in the fat (Althaus *et al*., 1984).

Chickens. Eight chickens (Hubbard x White Mountain Cross) were fed for 5 days with a diet containing 0.7 or 7 ppm [*carbinol*-14C]fenarimol (radiochemical purity 99.8%) and killed within one hour of removing the feed. The radioactivity of the samples was determined by combustion and LSC, with the results shown in Table 8 (Athaus *et al*., 1982a).

Table 8. Radioactive residues in chicken tissues following dosing with [^{14}C]fenarimol.

Sample	Assay recovery (%)	mg/kg fenarimol equivalents	
		0.7 ppm diet	7 ppm diet
Liver	109	0.01-0.013	0.113-0.12
Kidney	126	0.005-0.006	0.06-0.07
Fat	91	0.001-0.002	0.02-0.05
Skin	90	0.001-0.002	0.02
Muscle	113	0.001	0.003-0.005

In a second study, six Leghorn hens were dosed for 7 days with a feed containing 0.6 ppm [*carbinol*-^{14}C]fenarimol (radiochemical purity >99%) and then for a further 23 days with untreated feed. Eggs were collected daily, bulked to form a composite sample and analysed by LSC. Assay recoveries were 86.0-98.6%. The highest level of radioactivity was detected in day 7 samples (0.003 mg/kg fenarimol equivalents). By day 10 (3 days after the final treated feed) the radioactivity had decreased to 0.001 mg/kg, and was equivalent to background levels by day 17 (10 days after withdrawing treated feed) (Althaus, 1982b).

Plant metabolism

Apples. [*Carbinol*-^{14}C]fenarimol (radiochemical purity >99%) was formulated as an emulsifiable concentrate and diluted to give a 40 mg/l aqueous emulsion. This was applied as a spray to apple trees (Jonathan). The location of the trials was unspecified. Applications were made to run-off (2-5 litres aqueous emulsion/tree/application) at 80% full bloom (unlabelled formulation), 80% petal fall and on nine other occasions (radiolabelled formulation) at one- to two-week intervals (equivalent to 80-200g ai/ha based on a planting density of 1000 trees/ha). The total radioactivity was determined by combustion/LSC. The distribution of radioactive residues is shown in Table 9.

Table 9. Distribution of radioactive residues in apples.

Time after spraying	Whole apple	Peel		Pulp	
	mg/kg fenarimol equivalents	% of ^{14}C in whole apple	mg/kg fenarimol equivalents	% of ^{14}C in whole apple	mg/kg fenarimol equivalents
6 hours	0.207	92	0.983	9	0.023
29 days	0.108	87	0.477	13	0.019
49 days	0.074	81	0.351	19	0.017

Samples were extracted with methanol/sodium chloride solution and dichloromethane, then analysed by TLC/LSC. The distribution of radioactivity in the extracts and the fenarimol content were as shown in Table 10.

Table 10. Distribution of radioactivity and fenarimol in apple extracts (mean of 2 trees).

Sample	% of ^{14}C in sample	[^{14}C]fenarimol in sample

fenarimol

	aqueous phase	dichloromethane extract	unextracted	% of total ^{14}C	mg/kg sample
6 hour peel	10.8	67.9	21.4	53	0.52
29 day peel	13.9	47.6	38.6	24	0.18
49 day peel	15.7	44.8	39.5	23	0.14
49 day pulp	57.7	32.5	9.9	18	0.003

The authors of the study state that radioactivity other than that from fenarimol, equivalent to 0.06 mg/kg fenarimol on a whole-apple basis in the 49-day peel samples, was "widely distributed between many compounds".

Samples of peel obtained 52 days after the final application were also taken to attempt to identify metabolites. The samples were refluxed with methanol/2N sodium hydroxide solution and then partitioned successively with dichloromethane and butanol. These extracts were analysed by LSC or purified by column chromatography (silica column eluted with methanol/water). Analysis was by TLC with detection by UV and/or autoradiography and comparison with photodegradation products. Following extraction, the radioactivity was distributed as shown in Table 11.

Table 11. Distribution of radioactive residues in peel fractions.

Fraction	% of peel radioactivity	mg/kg fenarimol equivalents
spent peel (after refluxing)	17.2	0.24
dichloromethane extract	50.9	0.70
butanol extract	26.4	0.36
aqueous phase	5.5	0.08

Several compounds were tentatively identified by comparison with photolysis products (photoproducts A, E, D and H, Figure 2), all at ≤1% of total radioactivity or ≤0.01 mg/kg fenarimol equivalents. The authors concluded that photochemical degradation occurred on the surface of the apple. Other compounds (including >40 which were very polar) were observed but not identified. They had similar chromatographic characteristics to photodegradation products (Althaus and Bewley, 1978a,b).

In a further study carried out in Chile radiolabelled fenarimol was formulated as emulsifiable concentrates, diluted to give 1000 mg/l aqueous emulsions and applied directly as a mist spray to apples (Starkrimson). Radiolabelling was either at the carbinol carbon or mixed carbinol and both chlorophenyl rings (radiochemical purity 99.5-99.9%).

Individual apples were sprayed with 1 ml of the formulation or to run-off (whichever occurred first). This rate is equivalent to 268 kg ai/ha based on an average yield of 30t/ha and a medium-sized apple weighing 112g. Samples were taken 14 days after application and separated into pulp and peel.

Peel samples were extracted with aqueous methanol and dichloromethane, then refluxed with 2-butanol/water before partitioning between dichloromethane and aqueous methanol. Analysis was by TLC with autoradiography and LSC. The distribution of radioactive residues was as shown in Table 12.

Table 12. Distribution of radioactive residues in apple peel extracts.

Sample	[^{14}C]carbinol		mixed label ^{14}C	
	% of radioactivity	mg/kg fenarimol equivalents	% of radioactivity	mg/kg fenarimol equivalents
First dichloromethane	84	3.4	86	4.2
First aqueous	3	0.1	5	0.24
Second dichloromethane	3	0.1	3	0.15
Second aqueous	1	0.04	1	0.05
Unextractable	9	0.4	5	0.24
Total	100	4.0	100	4.9

Pulp samples were found to contain *c.* 0.06 mg/kg fenarimol equivalents in both experiments. TLC and LSC of peel samples identified *c.* 65% of the ^{14}C from both labels as the parent (*c.* 3 mg/kg).

No differences were detected between the TLC autoradiographs from the two radiolabels. No major degradation product was detected. Individual degradation products accounted for 2% of the total radioactivity, and all those identified in the peel were present as photolysis products. Small amounts of the major photolysis product *o*-chlorobenzoic acid were detected (Althaus, 1984a).

Grapes. A mixture of [*carbinol*-^{14}C], [*4-chlorophenyl*-^{14}C] and [*2-chlorophenyl*-^{14}C]fenarimol was formulated as an emulsifiable concentrate and diluted to give 120 mg/l and 500 mg/l aqueous emulsions. These were applied as foliar sprays to grapes (Ribier) four times at two-week intervals (120 mg/l formulation; total dose equivalent to 0.166 kg ai/ha) or once (500 mg/l formulation; dose unspecified). Samples were collected 0, 15, 30, 45 and 60 days after the final treatment.

Samples from the multiple-treatment study were extracted with methanol and partitioned with dichoromethane. The spent grape residue was extracted with 2-butanol-water by Soxhlet. The distribution of radioactivity was as shown in Tables 13 and 14.

Tables 13 and 14. Distribution of radioactivity in grapes following multiple applications of [^{14}C]fenarimol.

Table 13.

Days after final application	Total radioactivity as mg/kg fenarimol	% of total radioactivity			
		Dichloromethane	Aqueous	Butanol	Remainder
0	0.66	67.5	l6.8	8.5	7.2
15	0.46	63.6	15.2	11.7	9.5
30	0.33	61.6	16.1	8.1	14.3
45	0.33	59.8	16.8	9.0	14.4
60	0.19	56.4	18.2	11.1	14.3

Table 14.

Days after final application	TLC of dichloromethane fraction					
	Fenarimol		"Metabolite complex"		Unidentified	
	%[1]	mg/kg	%[1]	mg/kg[2]	%[1]	mg/kg[2]
0	46.0	0.305	12.7	0.08	8.8	0.06
15	26.9	0.124	26.5	0.12	10.2	0.05
30	19.3	0.063	29.1	0.10	13.2	0.04
45	17.8	0.058	27.9	0.09	14.1	0.05
60	15.6	0.029	26.5	0.05	14.3	0.03

[1] Of total radioactivity in Table 13
[2] Fenarimol equivalents

Samples taken 60 days after the single application were extracted into acidic water, refluxed with neutral, basic or acidic aqueous methanol, combined with sodium chloride solution, partitioned with dichloromethane, and then further partitioned with neutral, basic or acidic dichloromethane.

Neutral and acidic dichloromethane extracted 61 and 67% of the total radioactivity respectively. The extracts contained fenarimol and "metabolite complex" (which was not identical in different extracts). The term "metabolite complex" was applied to a group of two major, one minor and several trace components which were "extractable in the non-polar organic solvents , but which possessed polar adsorption chromatographic properties."

After extraction under strongly basic conditions the dichloromethane phase contained 74% of the total radioactivity but did not contain significant amounts of "metabolite complex".

Three compounds were identified: fenarimol (20%), dehydroxyfenarimol (DHF, 22%) and 2,4′-dichlorobenzophenone (DCBP, 8%). The structures of these compounds are shown in Figure 2 below. The "metabolite complex" was thermally degraded when subjected to GLC or MS, degraded by aqueous hydrolysis, and bound strongly during HPLC (Althaus, 1984b).

Further studies were conducted to identify the components of the "metabolite complex". Grape samples were refluxed with methanol/water, the extract was diluted with aqeous NaCl solution and extracted with dichloromethane. After drying, the residue was reconstituted in aqueous methanol and sequentially partitioned with hexane, chloroform/trichloroethane, and dichloromethane. The distribution of radioactivity was as shown in Table 15.

Table 15. Composition of grape extracts after sequential partitioning.

Solvent	% of radioactivity extracted as				
	Fenarimol	"Metabolite complex"[1]			Total
		Zone A	Zone B	Zone C	
Hexane	1-2	0	0	0	2
80:20 Chloroform/trichloroethane	18	3	1	1	27
50:50 Chloroform/trichloroethane	0.5	6	3	2	15
Dichloromethane	<0.5	1	5	2	9
Total	*c.* 20	10	9	5	53

[1] Zones refer to retention on TLC plate. Zone C most polar, Zone A least polar.

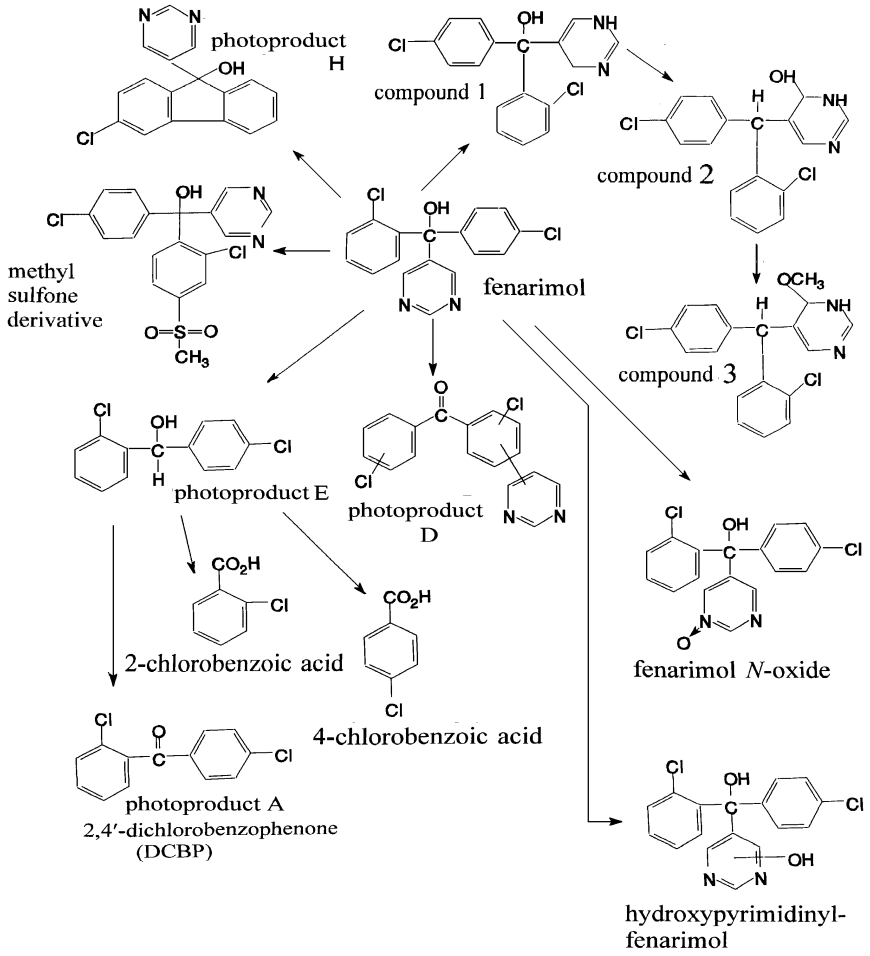
The 50:50 chloroform/trichloroethane and the dichloromethane fractions were subjected to further aqueous/methanolic sodium hydroxide hydrolysis when *c.* 50% of the extracted radioactivity was attributed to dehydroxyfenarimol (DHF) and 2,4′-dichlorobenzophenone (DCBP). The dehydroxyfenarimol was apparently produced during the hydrolysis.

Further analytical investigations of the "metabolite complex" in the basic extract were carried out using radio-HPLC, NMR and MS.

Compound 3 (Figure 2) was tentatively identified by MS but could not be confirmed by NMR, owing to the small quantity obtained. Compound 1 was tentatively identified by MS. Positions of reduction of the pyrimidine ring were investigated using NMR. Compound 2 was tentatively identified by MS but there was too little for confirmation by NMR. Three isomeric structures could exist (where -H and -OH have been added to the pyrimidine ring). The hypothesis that compound 1 could be converted to compound 2 under acidic conditions and subsequently to compound 3 by methanolysis under acidic conditions was proposed.

fenarimol

Figure 2. Proposed pathways of metabolism in livestock and plants, and of potodegradation.



In further work to characterize other metabolites in grapes, it was concluded that the unidentified radioactivity was associated with many minor components (34 "zones" were isolated). No individual component accounted for more than 2.9% of the total radioactivity (0.04 mg/kg fenarimol equivalents) (Goebel, 1985b; Rainey, 1987).

Cucumbers. [*Carbinol*-^{14}C]fenarimol was formulated as an emulsifiable concentrate and diluted to give a 26.5 mg/l aqueous emulsion. It was applied as a spray to field-grown cucumbers (Green Prolific) in the USA. One application was made to run-off at a rate equivalent to 24.7g [^{14}C]fenarimol in 934 litres water/ha. Samples were taken four days after treatment and analysed by combustion and/or LSC. The characterization of metabolites was carried out by radio-TLC.

After extraction by refluxing with methanol and further extraction with dichloromethane the total radioactivity in the crop ranged from 0.003 to 0.042 mg/kg fenarimol equivalents. Approximately 93% of this (0.04 mg/kg fenarimol equivalents) was extracted into dichloromethane and 85% of the extracted radioactivity (0.03 mg/kg fenarimol equivalents) was attributed to fenarimol and 8% (0.003

mg/kg fenarimol equivalents) remained at the origin. Three other chromatographic bands were separated, each accounting for 3% of the radioactivity (0.001 mg/kg fenarimol equivalents) (Althaus, 1986).

Environmental fate in soil and water/sediment systems

No data were submitted.

METHODS OF RESIDUE ANALYSIS

Analytical methods

Methods for the analysis of a wide range of samples were supplied. In all of these the final determination is by GLC of a toluene solution, with EC detection. Validation data are shown in Table 16.

Crops and soil. Samples were extracted with ethanol/acetone, partitioned into chloroform, dissolved in toluene and analysed by GLC with an ECD. No validation data were submitted (Dow Elanco Ltd., 1976).

Crops other than cereals. Samples were extracted with methanol, partitioned into dichloromethane and transferred to toluene for analysis. No validation data were submitted (Dow Elanco Ltd., 1977).

Fresh fruit and vegetables, pomace, raisins, juice, bananas and "other crops". Samples were extracted with methanol, methanol/water or dichloromethane, then purified by chromatography on an alumina column which was eluted with 1-chlorobutane/methanol. The extract was evaporated and the residue dissolved in toluene for analysis. The authors state that the procedure "usually gives recoveries in excess of 90%" and has a limit of detection of 0.02 mg/kg except in dry pomace and "other crops" where the limit of detection is 0.01 mg/kg. No other validation data were submitted (Griggs and Decker, 1981).

Animal feeding-stuffs (hay and straw). Samples were extracted with methanol/water then purified by chromatography on an alumina column, which was eluted with 1-chlorobutane/methanol, before transfer to toluene (Griggs and Decker, 1985).

Beer. Samples were combined with sodium hydrogen carbonate solution, and partitioned into toluene for analysis (Butcher, 1992).

Spent yeast. Samples were extracted with methanol and, after dilution with water, partitioned with toluene. The extract was concentrated to dryness and the residue dissolved in 30:70 acetonitrile/water, then cleaned up on a C18 column eluted with 50:50 acetonitrile/water, acidified and partitioned into toluene (Butcher, 1992).

Fresh, dried and spent hops. Samples were extracted with methanol and sodium hydrogen carbonate solution and partitioned into methyl isobutyl ether. The extract was treated with alkaline permanganate, partitioned into toluene, dissolved in 1-chlorobutane, and cleaned up on an alumina column eluted with methanol/1-chlorobutane and on a C18 column eluted with acetonitrile/water. After acidification, the extract was partitioned into toluene for analysis (Butcher and Perkins, 1992).

Grape must, wine, grapes, tomatoes, peaches and melons. Samples were extracted with methanol and sodium hydrogen carbonate solution, partitioned into toluene, transferred to dichloromethane and

cleaned up on a C18 column eluted with methanol/dichloromethane or on a silica extraction column eluted with methanol/dichloromethane. The solvent was evaporated and the residue dissolved in toluene for analysis by capillary GLC (Butcher and Long, 1993; Butcher, 1994a).

Soil. Samples were extracted with methanol/water and cleaned up by column chromatography on alumina. Elution was with 1-chlorobutane/methanol. The authors state that the procedure "usually gives recoveries in excess of 90%" and has a limit of detection of 0.02 mg/kg. No other validation data were submitted (Griggs and Decker, 1981,1985).

Banana and banana pulp. Samples were ground with liquid nitrogen, then refluxed in methanol/HCl. NaOH was added to the hot solution which was then allowed to cool. The extract was partitioned with hexane and the hexane fraction washed through sodium sulphate, then evaporated to dryness. The residue was redissolved in toluene and analysed on a 2% OV 17 column. The compounds I and II (Figure 2) are also be determined by this method as dehydroxyfenarimol (Turner, 1992).

In a development of this method the methanol from the reflux solution was evaporated after the addition of NaOH. The remaining aqueous solution was extracted with dichloromethane, which was evaporated and the residue reconstituted in aqueous sodium chloride solution and partitioned with diethyl ether. The ether was evaporated and toluene added. The toluene extract was cleaned up on a silica solid-phase extraction column with elution with 10% ethyl acetate in dichloromethane. After evaporation the reconstituted toluene extract was analysed as above (Catta-Preta and Matos, 1993).

Wildlife. Meat and egg samples were extracted with methanol/acetonitrile or methanol and methylene chloride. Fat was extracted with hexane/1-chlorobutane and milk with acetonitrile, which was washed with hexane and partitioned with methylene chloride. Extracts were cleaned up on a Florisil column, eluted with methylene chloride/methanol, and dissolved in toluene (Yordy and Turner, 1982).

Table 16. Validation of analytical methods (treated plants, plant products, foodstuffs and feeding-stuffs).

Substrate	Spike, mg/kg % recovery	Precision-repeatability	Limit of determination, mg/kg	Reference
Whole apple fruit	0.001-0.02 73-98	no data	0.002-0.003	OR 1B
Dried apple pomace	0.005-0.1 65-103	no data	0.01	OR 1B
Whole fresh grapes	0.001-0.02 100-110	SD + 1-10	0.002-0.003	OR 1B
Wine	0.001-0.02 101-123	SD $\pm$ 2-14	0.002-0.003	OR 1B
Wine	0.01-0.1 99-107	RSD 2.5%	0.01	OR 22
Beer	0.01-0.1 90-108	RSD 4.0%	0.01	OR 21
Spent yeast	0.01-0.1 77-105	RSD 9.7%	0.01	OR 21
Dried hops	0.1-5 78-108	RSD 10.1%	0.1	OR 20
Fresh hops	0.1-2 75-94	RSD 7.4%	0.05	OR 20
Spent hops	0.02-0.5 75-102	RSD 8.3%	0.02	OR 20

Substrate	Spike, mg/kg % recovery	Precision-repeatability	Limit of determination, mg/kg	Reference
Tomatoes	0.01-0.1 86-101	RSD 5.1%	0.01	OR 24
Peach flesh	0.01-0.1 82-117	RSD 9.3%	0.01	OR 24
Melon peel	0.01-0.1 93-109	RSD 5.0%	0.01	OR 24
Melon pulp	0.01-0.1 81-112	RSD 10.2%	0.01	OR 24
Meat	0.01 101	SD ± 16.5	0.01	OR 19
Liver	0.01 108	SD ± 11.5	0.01	OR 19
Kidney	0.01 105	SD ± 13.7	0.01	OR 19
Fat/skin	0.01 87	SD ± 9.1	0.01	OR 19
Milk	0.001 95	SD ± 16.4	0.01	OR 19
Eggs	0.01 98	SD ± 9.0	0.01	OR 19
Banana	0.005-1.0 84-114	no data	0.01	OR 27
Banana pulp	0.005-1.0 82-105	no data	0.01	OR 27
Banana	0 005-1.1 55-114	no data	0.01	OR 28
Banana pulp	0.01-0.53 54-110	no data	0.01	OR 28

Stability of pesticide residues in stored analytical samples

Samples of grapes and wine were fortified with 0.1 mg/kg or mg/l fenarimol and stored deep frozen at -10°C to -27°C up to 370 days. Residues following storage and corrected for procedural recoveries were as shown in Table 17 (Butcher, 1994b).

Table 17. Residues in grapes and wine following storage at -20°C.

Storage period (days)	Residues, mg/kg			
	Black grapes	White grapes	Red wine	White wine
0	0.10-0.11	0.10-0.11	0.09-0.10	0.10
86	0.10-0.11	0.10-0.11	0.10-0.11	0.10
370	0.09-0.10	0.09-0.10	0.09-0.10	0.08-0.11

Ground fresh grapes and grape pomace were fortified with fenarimol at 0.05 mg/kg, and ground raisins and raisin waste at 0.2 mg/kg. Following 14 days refrigeration at 4°C, the samples were stored frozen for an additional 50-119 days. Samples were analysed after 0, 1, and 14 days and at the end of the study. Residues following storage and corrected for procedural recoveries were as shown in Table

18 (Day and Saunders, 1988a).

Table 18. Residues in fresh grapes, wet pomace, raisins and raisin waste following refrigeration and freezer storage.

Storage period, days	Residues, mg/kg			
	Fresh grapes	Wet pomace	Raisins	Raisin waste
0	0.054	0.054	0.20	0.19
1	0.052	0.055	0.18	0.23
14	-	0.049	0.18	0.17
18/19	-	-	0.19	0.21
23	0.050	-	-	-
74/76	-	-	0.19	0.18
131/133	0.052	0.054	-	-

In a further study, samples of cherries were fortified with 0.1 or 1.0 mg/kg fenarimol and stored for 11 days in a chill room at 4°C, then for 93 days in the freezer at -20°C. Samples were analysed using the method of Griggs and Decker (1981). Recoveries were variable but acceptable. The results, corrected for procedural recoveries, were as shown in Table 19 (Day and Saunders, 1988b).

Table 19. Residues in cherries following storage at -20°C.

Fortification level, mg/kg	Residue, mg/kg			
	Sweet cherry		Sour cherry	
	0.1	1.0	0.1	1.0
Storage period (days)				
0	0.11, 0.11	1.1, 1.1	0.11, 0.11	1.1, 1.1
4	0.09, 0.11	1.1, 1.1	0.10, 0.11	1.1
7	0.12, 0.13	1.1, 1.10	0.13, 0.11	1.1, 1.2
11	0.12, 0.13	1.2, 1.3	0.15, 0.13	1.3, 1.3
30	0.10, 0.10	0.9, 1.0	0.11, 0.10	1.0, 1.0
68	0.10, 0.10	0.9	0.11, 0.10	0.93, 0.91
104	0.11, 0.11	1.1, 1.0	0.10, 0.10	1.2, 1.1

A new study on the stability of fenarimol in fortified peaches, tomatoes and melons under frozen storage conditions was made available, but too late for review (Butcher, 1995g).

Residue definition

The animal and plant metabolism studies indicate that fenarimol is the major residue in products of both animal and plant origin. The residue is therefore defined as fenarimol.

USE PATTERN

Fenarimol is a systemic fungicide which has protective, curative and eradicative activity. Most commonly it is applied as a foliar treatment where apoplastic movement occurs through the leaf and towards the leaf tip, but movement from treated to untreated leaves is not sufficient to provide disease control. Application via the roots and seeds leads to translocation to all the aerial parts of the plant.

Fenarimol is registered in a large number of countries. Its uses cover a wide range of fruit and vegetables, hops and wheat. Full details of registered use patterns are given in Tables 20-22. The registered uses are for treatments in the field unless otherwise indicated.

Table 20. Registered uses of fenarimol on fruits and pecans.

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
Apples	Australia	EC	airblast	0.043-0.054	0.0029-0.0036	1-10	14	1 & 2
	Argentina	EC	mist blower broadcast	0.048-0.09	0.0024-0.003	2	20	1

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	Belgium	WP	LV overall	0.03-0.06	-------	3-4	1 month	1
	Brazil	EC	mist blower broadcast	0.038-0.14	0.0048-0.0072	2	28	1
	Chile	EC	Gun broadcast med vol	0.038-0.096	0.0036-0.0042	2	(a)	1
	Denmark	EC	HV overall	0.060	0.006-0.004	5	14	1 & 11
	Germany (Rubigan EC)	EC	L/HV row	0.0108-0.054	0.0036	max 7	21	1 & 8
	Germany (Elital)	SC	L/HV overall	0.0108-0.054	0.0036	max 14	21	1 & 8
	Germany (Rubigan SC)	SC	L/HV row	0.0108-0.054	0.0036	max 14	21	1 & 8
	Greece	WP	HV overall	0.105	0.0042	3-5	20	1
	Ireland	SC	LV overall	0.04-0.08	-------	up to 14 usually 4-6	14	1
	Italy	EC	HV overall	0.054-0.072	0.0036-0.0048	Through-out season	21	1
	Italy	SC	HV overall	0.054-0.072	0.0036-0.0048	Through-out season	21	1
	Italy	WP	HV overall	0.054-0.072	0.0036-0.0048	Through-out season	21	1
	Japan	WP	airblast	0.09-~0.14	0.003-~0.004	1-3	21	1
	Mexico	EC	mist blower	0.054-0.108	0.0027-0.0036	2	(b)	1
	Netherlands[1] (country submission)	WP	spraying of the aerial part	0.039-0.076	0.0039-0.076	3	21	6
	Netherlands (company submission)	WP	HV overall	0.039-0.076	0.0026-0.076	max 10	3 weeks	1
	New Zealand	SC	HV to run-off	0.0067-0.090	0.003	6	35	5
	Peru[1] (country submission)	-	foliar application	-	0.05	3	30	7
	Peru (company submission)	EC	gun broadcast	0.012-0.060	0.0015-0.004	2	(a)	1
	Portugal	EC	HV overall	0.024-0.054	0.0024-0.0036	5	21	1
	Spain	EC	low volume spray (500-1,500 l/ha)	-	0.0042-0.0048	7-10 days intervals	14	4
	Spain	EC	high volume spray (>1,500 l/ha)	0.060-0.096	-	7-10 days intervals	14	4
	Spain	SC	HV overall	0.063-0.072	0.0042-0.0048	1	14	1
	UK	SC	LV overall	0.04-0.08	-------	up to 14 usually 4-6	14	1
	Uruguay	EC	broadcast mist blower	0.075-0.090	0.0024-0.003	2	20	1
	USA	SC	spray	0.049-0.098	-	7-14***	30	4
	USA	EC	spray	0.067-0.101	-	7-10***	30	4

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
Bananas	Honduras[1]	EC	Aerial	0.08-0.12	0.0053-0.006	7	0 (c)	1
	Nicaragua[1]	EC	Aerial	0.08-0.12	0.533-0.6	7	0 (c)	1
Currants								
, black	Denmark	EC	HV overall	0.06	--------	3	14	1
, black	Ireland	SC	LV overall	0.04	--------	NR	14	1
	Netherlands[1] (country submission)	EC	spray	0.048-0.058	0.0048	4	21	6
	Netherlands (company submission)	EC	HV overall	0.048-0.058	0.0048	5	3 weeks	1
, black	UK	SC	LV overall	0.04	--------	NR	14	1
Cherry	Denmark	EC	HV overall	0.060	--------	5	14	1
	Japan	WP	airblast	0.16 ~0.2	0.004	1-3	3	1
	USA	EC	spray	0.051-0.101	-	4-8***	up to & after harvest	4
Gooseberries	Ireland	SC	HV overall	0.04	-------	NR	14	1
	Netherlands	EC	spray	0.048-0.058	0.0048	4	21	1
	UK	SC	HV overall	0.04	-------	NR	14	1
Grapes	Argentina	EC	gun individual plant	0.0192-0.036	0.0024	2	30	1
	Australia	EC	airblast	0.012-0.024	0.0012-0.0024	1-7	14	1
	Brazil	EC	gun individual plant	0.0108-0.024	0.0018-0.0024	4	15	1
, table	Chile	EC	gun individual plant	0.005 0.012	0.002-0.003	3	(d)	1
	France	SC	LV overall	0.018	0.0009-0.003	1 to 4	7	1
, wine	Germany[1] (Elital) (country submission)	SC	spray	0.0047-0.0125	0.00078	6	35	8
	Germany (Elital) (company submission)	SC	L/HV overall	0.0047-0.0234	0.00156	max 6*	35	1
	Germany (Rubigan SC)	SC	L/HV row	0.0047-0.0234	0.00156	max 6	35	1
	Greece	WP	HV overall	0.012-0.024	0.0012-0.0024	2-4	30	1
	Ireland	SC	LV overall	0.04	-------	NR	14	1
,table	Italy	WP	HV overall	0.03-0.06			14	1
,table	Italy	SC	HV overall	0.018-0.036	0.0018-0.0036	--------	14	1
, wine	Italy	SC	HV overall	0.014-0.054	0.0018-0.0036	--------	14	1
, wine	Italy	WP	HV overall	0.014-0.036	0.0018-0.0036		14	1
	Mexico	EC	mist blower	0.030-0.054	0.0075-0.0054	4	(e)	1
	New Zealand	SC	HV spray to run-off	0.024-0.048	0.0024	4	30	5
	Peru[1] (country	-	foliar	-	0.02	4	30	7

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	submission)		application					
	Peru (company submission)	EC	gun broadcast	0.012-0.060	0.0012-0.005	3	(d)	1
	Portugal	EC	HV overall	0.011-0.03	0.0018-0.0030	3	7	1
	Spain	EC	MV-HV overall	0.0099-0.05	0.0033-0.0036	1 (wine) 3(table)	28 (wine) 14 (table)	1
	Spain	SC	MV-HV overall	0.009-0.05	0.003-0.0036	1 (wine) 3(table)	28 (wine) 14 (table)	1
	UK	SC	spray	0.04	-------	NR	14	1 & 4
	Uruguay	EC	gun application individual plant	0.019-0.036	0.0024	2	30	1
	USA	EC	spray	0.017-0.051	_	3-9***	30	4
	USA	SC	spray	0.024-0.049	-	2-7***	30	4
Peaches	Argentina	EC	mist blower	0.048-0.072	0.0024	2	20	1
	Greece	WP	HV overall	0.12	0.0048	2-4	20	1
	Italy	EC	HV overall	0.072	0.0042-0.0048	2-3	14	1 & 12
	Italy	SC	HV overall	0.072	0.0042-0.0048	2-3	14	1 & 12
	Japan	WP	airblast	0.12-~0.2	0.004	1-3	1	1
	Spain	EC	HV overall	-	0.0042-0.0048	1	7	4
	Spain	SC	HV overall	-	0.0042-0.0048	1	7	4
	Uruguay	EC	broadcast mist blower	0.048-0.072	0.0024	2	20	1
Pears	Argentina	EC	mist blower broadcast	0.048-0.09	0.0024-0.003	2	20	1
	Australia	EC	airblast	0.043-0.054	0.029-0.0036	1-10	14	1 & 2
, Japanese	Australia	EC	airblast	0.036-0.054	0.0024-0.0036	1-10	14	1 & 2
	Belgium	WP	LV overall	0.03-0.06	--------	3-4	1 month	1
	Chile	EC	Gun broadcast med. vol	0.038-0.096	0.0036 0.0042	2	(a)	1
	Denmark	EC	HV overall	0.060	--------	5	14	1
	Germany (Elital)	SC	L/HV overall	0.0108-0.054	0.0036	max 14	21	1 & 8
	Italy	EC	HV overall	--------	0.0036-0.0048	**	14	1
	Italy	SC	HV overall	--------	0.0036-0.0048	**	14	1
	Italy	WP	HV overall	0.054-0.072	0.0036-0.0048	**	14	1

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	Japan	WP	airblast	0.09-~0.12	0.003-~0.004	1-3	21	1
	Mexico	EC	mist blower	0.054-0.108	0.0027-0.0036	2	(b)	1
	Netherlands[1] (country submission)	WP	spraying of the aerial part	0.039-0.076	0.0039-0.076	3	21	6
	Netherlands (company submission)	WP	HV overall	0.039-0.076	0.0026-0.0076	max 10	3 weeks	1
	New Zealand	SC	HV to run-off	0.0067-0.090	0.003	6	35	5
	Portugal	EC	HV overall	0.024-0.054	0.0024-0.0036	5	21	1
	Spain	EC	HV overall	0.063-0.072	0.0042-0.0048	1	14	1
	Spain	SC	HV overall	0.063-0.072	0.0042-0.0048	1	14	1
	Uruguay	EC	broadcast mist blower	0.075-0.090	0.0024-0.003	2	20	1
	USA	SC	spray	0.049-0.098	-	7-14***	30	4
	USA	EC	spray	0.067-0.101	-	7-10***	30	4
Pecans	Mexico	EC	mist blower	0.054-0.108	0.0028-0.0057	2	(f)	1
	USA	SC	applied to run-off	0.073-0.098	-	7-9***	30	4
Persimmon, Japanese	Japan	WP	airblast	0.2	0.004	1-3	21	1
Raspberry	UK	SC	LV overall	0.04	--------	3	14	1
	Ireland	SC	LV overall	0.04	--------	3	14	1
Strawberry	Denmark	EC	HV overall	0.084	--------	3	14	1
	Ireland	SC	LV overall	0.04	--------	NR	14	1
	Italy	EC	HV overall	--------	0.0042-0.0048	3	7	1
	Italy	SC	HV overall	--------	0.0042-0.0048	3	7	1
	Italy	WP	HV overall	0.034-0.038	0.0042-0.0048	3	7	1
	Japan	WP	mist spray[2]	0.03	0.003	1-3	1	1 & 10
	Netherlands[1] (country submission)	EC	spray[2]	0.036-0.084 (depend. on variety)	0.006-0.0084	4	treatment before flowering or after harvest	6
	Netherlands (company submission)	EC	HV overall	0.03-0.05	0.005-0.01	5	treatment before flowering or after harvest	1
	Spain	EC	HV overall		0.0042-0.0048	4	3	1
	Spain	SC	HV overall		0.0036-0.0048	4	3	1

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	UK	SC	LV overall	0.04	-------	NR	14	1

[1] No product label submitted
[2] Glasshouse and Field use
NR No restration restriction, typically 2-4
* max 4 between flowering and benning of ripening
** Application throughout season
*** the maximum number of treatments is controlled by a maximum total dose
Notes (a) to (f) refer to growth stage at last treatment:
(a) immature fruit (b) early fruit
(c) from disease onset (d) mature fruit
(e) fruit initiation (f) pre-flowering

Table 21. Registered uses of fenarimol on vegetables.

Crop	Country	Form	Application				PHI, days	Refer-ence
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
Artichokes	Italy	EC	HV overall	--------	0.0048	3	7	1
	Italy	SC	HV overall	--------	0.0048	3	7	1
	Italy	WP	HV overall	0.038	0.0048	3	7	1
Aubergines	Italy	EC	HV overall	--------	0.0048	3	7	1
	Italy	SC	HV overall	--------	0.0048	3	7	1
	Italy	WP	HV overall	0.038	0.0048	3	7	1
	Japan	WP	mist spray	0.024 ~0.04	0.0012 ~0.002	1-3	1	1
Courgettes	Netherlands[1] (country submission)	EC	spray[2]	0.012-0.036	0.0024	6	3	6
	Netherlands[1] (country submission)	EC	spray (field only)	0.0096-0.024	0.0024	6	3	6
Cucumbers	Brazil	EC	knapsack individ. plant	0.038-0.072	0.0048-0.0072	4	4	1
	Denmark	EC	HV overall[3]	0.024-0.036	0.0024	4-8	2	1
	Ireland	SC	LV overall	--------	0.001-0.002	NR	2	1
	Japan	WP	mist spray	0.024	0.0012	1-3	1	1
	Netherlands	EC	spray[2]	0.012-0.036	0.0024	6	3	1
	UK	SC	LV overall[3]	--------	0.001-0.002	NR	2	1
	Uruguay	EC	knapsack individ. plant	0.014-0.024	0.0012-0.0024	4	4	1
Cucurbits	Australia	EC	Boom	0.024	0.004	1-10	3	1
	Greece	WP	HV overall	0.018-0.024	0.0018-0.0024	as requir ed	1	1
	Italy	EC	HV overall	--------	0.0024-0.003	3	7	1
	Italy	SC	HV overall	--------	0.0024-0.003	3	7	1
	Italy	WP	HV overall	0.020-	0.0024-	3	7	1

Crop	Country	Form	Application				PHI, days	Refer-ence
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
				0.024	0.003			
	Spain	EC	HV overall	0.01-0.019	0.0036-0.0048	2	7	1
	Spain	SC	HV overall	0.013-0.019	0.0042-0.0048	2	7	1
Egg plants, see Aubergines								
Gherkins	Netherlands[1] (country submission)	EC	spray[2]	0.012-0.036	0.0024	6	3	6
	Netherlands[1] (country submission)	EC	spray (field only)	0.0096-0.024	0.0024	6	3	6
Melons	Japan	WP	mist spray	0.024	0.0012	1-4	1	1
	Netherlands	EC	spray[2]	0.012-0.036	0.0024	6	3	1
	Portugal	EC	HV overall	0.024-0.036	0.0024-0.0036	5	3	1
Musk-melons	Brazil	EC	knapsack individ. plant	0.014-0.024	0.0018-0.0024	4	4	1
Peas	Italy	EC	HV overall	--------	0.0024-0.003	3	7	1
	Italy	SC	HV overall	--------	0.0024-0.003	3	7	1
	Italy	WP	HV overall	0.02-0.024	0.0024-0.003	3	7	1
Peas, Immature	Japan	WP	mist spray	0.024	0.0012	1-5	1	1
Peppers	Italy	EC	HV overall	--------	0.0048	3	7	1
	Italy	SC	HV overall	--------	0.0048	3	7	1
	Italy	WP	HV overall	0.038	0.0048	3	7	1
	Netherlands[1] (country submission)	EC	spray[2]	0.012-0.036	0.0024	6	3	6
	Japan	WP	mist spray	0.024	0.0012	1-4	1	1
	Spain	EC	HV overall	0.048-0.072	0.0048-0.006	3	7	1
	Spain	SC	HV overall	0.048-0.072	0.0048-0.006	3	7	1
	UK	SC	overall spray[2]	0.054	0.002	3	7	9
Pumpkins	Brazil	EC	knapsack individ. plant	0.014-0.024	0.0018-0.0024	4	4	1
	Japan	WP	mist spray	0.012	0.0012	1-4	3	1
	Peru	EC	gun individ. plant	0.012-0.060	0.0015-0.004	4	4	1
Squash, small	Argentina	EC	gun individ. plant	0.0096-0.024	0.0012-0.0024	4	4	1
Squash	Uruguay	EC	knapsack individ. plant	0.014-0.024	0.0012-0.0024	4	4	1
Squash, summer	Netherlands	EC	spray[2]	0.012-0.036	0.0024	6	3	1
Tomatoes	Denmark	EC	HV overall[3]	0.024-0.036	0.0024	4-8	2	1
	Italy	EC	HV overall	---------	0.0048	3	7	1
	Italy	SC	HV overall	---------	0.0048	3	7	1

Crop	Country	Form	Application				PHI, days	Refer-ence
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	Italy	WP	HV overall	0.038	0.0048	3	7	1
	Japan	WP	mist spray	0.04	0.002	1-3	1	1
	Netherlands[1] (country submission)	EC	spray[2]	0.024-0.072	0.0048	3	3	6
	Netherlands (company submission)	EC	HV overall	0.024-0.072	0.0048	5	3	1
	Spain	EC	HV overall	0.028-0.057	0.0048	3	7	1
	Spain	SC	HV overall	0.028-0.057	0.0048	3	7	1
	UK	SC	overall spray[2]	0.054	0.002	3	7	9
Watermelons	Brazil	EC	knapsack individ. plant	0.014-0.024	0.0018-0.0024	4	4	1
	Japan	WP	mist spray	0.012	0.0012	1-4	3	1
	Uruguay	EC	knapsack individ. plant	0.0096-0.0024	0.0012-0.0024	4	4	1
Vegetables	Netherlands	EC	HV overall	0.012-0.036	0.0024	5	3	1

[1] No product label submitted
[2] Glasshouse use only
[3] Glasshouse and field use

Table 22. Registered uses of fenarimol on hops and cereals.

Crop	Country	Form	Application				PHI, days	Ref.
			Method	Rate, kg ai/ha	Spray conc., kg ai/hl	No.		
Hops	Germany	WP	HV row	0.06	0.0015	max 4	10	1 & 8
	Spain	EC	HV overall		0.0042-0.0048		--------	1
	Spain	SC	HV overall		0.0042-0.0048		--------	1
Wheat	Japan	WP	Boom	0.04-0.06	0.004	1-2	14	1

Uses of fenarimol were also reported in Algeria, Austria, "Belarus", Bulgaria, China, "CR/SR", Croatia, Egypt, Hungary, India, Indonesia, Iraq, Korea, Lebanon, Libya, Macedonia, Morocco, Pakistan, Poland, Romania, Russia, Slovenia, Slovakia, Switzerland, Syria, Taiwan and Tunisia, but insufficient information was submitted for inclusion in the Tables.

RESIDUES RESULTING FROM SUPERVISED TRIALS

The residue trials are summarized in the following Tables. Trials were carried out under field conditions unless stated otherwise. Unless indicated in the notes, trials were reported in sufficient detail and acceptable analytical information was supplied. Analytical recoveries outside the range 70-120% and/or storage of samples for longer than 6 months are also indicated in the notes. Analytical results have been rounded to one significant figure if <0.1 mg/kg except where processing information is given.

Apples. Informatiaon on GAP was reported for many countries world-wide. The maximum

application rates are 0.054-0.14 kg ai/ha with PHIs of 14-35 days.

Residue trials data were available from Belgium, Germany, the UK, Canada, the USA, Chile, Brazil, New Zealand and The Netherlands. Residues in 16 Northern European trials according to German GAP (0.0036 kg ai/hl, 21-day PHI) were 0.02-0.21 mg/kg. Three further trials which reflected German GAP showed residues of 0.06, 0.1 and 0.1 mg/kg but only a summary was submitted. Eight Northern European trials complied with GAP in Denmark, the UK and Ireland in which there is a shorter PHI of 14 days (maximum rates 0.06-0.08 kg ai/ha, concentration not specified) with residue levels of 0.02-0.18 mg/kg. A further 6 Dutch trials were within GAP in The Netherlands (0.0039-0.076kg ai/hl, 21-day PHI) with residues of 0.01-0.34 mg/kg in samples taken 21 days after the final treatment. However, these Dutch trials were submitted in summary form only. In 5 replicated US trials according to GAP (ca 0.1 kg ai/ha, 30-day PHI) residue levels were 0.002-0.3 mg/kg. In three New Zealand trials according to GAP (maximum 0.09 kg ai/ha, 0.003 kg ai/hl, 35-day PHI) residues were 0.008-0.03 mg/kg.

Table 23. European supervised residue trials on apples.

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
Ramecroix, Belgium, 1976[1]	EC	11	0.034	0.004	0	0.12	NF 13 B76-001
					7	0.07	
					14	0.05	
					21	0.06	
					28	0.04	
					85	0.01	
Giessen, Germany, 1977[1]	EC	10	0.036	0.003	55	<0.01	NF 15 D76-302
			0.048	0.004	55	<0.01	
Giessen, Germany, 1978[2,3,5]	EC	14	0.054	0.0036	0	0.13	NF 08 D78-311
					3	0.12	
					7	0.10	
					10	0.11	
					14	0.07	
					21	0.06	
					28	0.08	
					36	0.07	
Giessen, Germany, 1981[3,5]	SC	14	0.054	0.0036	0	0.16	NF 20 D81-302
					4	0.06	
					13	0.05	
					20	0.07	
					27	0.04	
					33	0.06	
Uberlingen, Germany, 1981[3,4,5]	SC	14	0.054	0.0036	0	0.29	NF 20 D81-353
					4	0.34	
					7	0.02	
					14	0.02	
					21	0.02	
Wulfsdorf, Germany, 1981[3,5]	SC	13	0.054	0.0036	0	0.36	NF 20 D81-350
					7	0.23	
					14	0.18	
					22	0.06	

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
					28	0.05	
					35	0.05	
Wittlich, Germany, 1981[3,4,5]	SC	10	0.06	0.00396	0	0.37	NF 20 D81-351
					7	0.19	
					14	0.15	
					21	0.15	
					28	0.09	
					63	0.01	
Kriftel, Germany, 1982[3,5]	EC	13	0.036	0.0036	0	0.06	NF 21 D82-304
					8	0.05	
					14	0.04	
					17	0.04	
	SC	13	0.036	0.0036	0	0.1	
					8	0.09	
					14	0.07	
					17	0.04	
Kriftel, Germany, 1982[3,5,6]	EC	13	0.036	0.0036	0	0.09	NF 21 D82-305
					8	0.08	
					14	0.06	
					21	0.05	
					30	0.03	
	SC	13	0.036	0.0036	0	0.21	
					8	0.17	
					14	0.04	
					21	0.11	
					30	0.05	
Marbach, Germany, 1982[3,5]	EC	14	0.036	0.0036	0	0.37	NF 21
					7	0.24	
					13	0.22	
					20	0.21	
					27	0.14	
Marbach, Germany, 1982[3,5]	EC	14	0.036	0.0036	0	0.18	NF 21 D82-307
					7	0.11	
					13	0.15	
					20	0.14	
					27	0.09	
Giessen, Germany, 1982[3,5,6]	EC	14	0.036	0.0036	0	0.17	NF 21 D82-301
					5	0.08	
					13	0.05	
					19	0.03	
					26	0.04	
					35	0.01	
	SC	14	0.036	0.0036	0	0.19	
					5	0.11	
					13	0.08	
					19	0.07	
					26	0.04	

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
					35	0.02	
Giessen, Germany, 1982[3,5]	SC	14	0.036	0.0036	0	0.10	NF 21 D82-302
					5	0.12	
					13	0.06	
					19	0.04	
					26	0.04	
					35	0.03	
	EC	14	0.036	0.0036	0	0.10	
					5	0.07	
					13	0.03	
					19	0.03	
					26	0.01	
					35	0.02	
Giessen, Germany, 1982[3,5,6]	EC	14	0.036	0.0036	0	0.06	NF 21 D82-303
					8	0.03	
					14	0.03	
					21	0.02	
					30	0.01	
	SC	14	0.036	0.0036	0	0.10	
					8	0.09	
					14	0.01	
					21	0.03	
					30	0.01	
Bonn, Germany, 1982[1]	EC	12	0.05	0.004	0	0.1	8
					7	0.1	
					14	0.1	
					21	0.1	
					28	0.04	
Dossenheim, Germany, 1982[1]	EC	14	0.05	0.004	0	0.1	8
					10	0.1	
					14	0.04	
Frankfurt, Germany, 1982[1]	EC	14	0.05	0.004	0	0.1	8
					10	0.1	
					14	0.1	
					21	0.1	
					28	0.02	
Oudenbosch, Netherlands, 1977[5,7]	WP	1		0.005	7	0.14	6
						0.14	
						0.22	
						0.17	
					14	0.1	
						0.14	
						0.15	
						0.09	
					21	0.09*	
						0.01*	

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
						0.11*	
						0.06*	
Berlicum, Netherlands, 1977[5,7]	WP	1		0.005	7	0.33	6
						0.41	
						0.3	
						0.37	
					14	0.21	
						0.46	
						0.35	
						0.24	
					21	0.28*	
						0.21*	
						0.26*	
						0.34*	
Breskens, Netherlands, 1977[5,7]	WP	1		0.005	7	0.27	6
						0.34	
						0.22	
						0.19	
					14	0.16	
						0.12	
						0.13	
						0.15	
					21	0.22*	
						0.22*	
						0.18*	
						0.14*	
Knuiningen, Netherlands, 1978[5,7]	WP	1		0.005	8	0.09	6
					15	0.11	
					22	0.06*	
Knuiningen, Netherlands, 1978[5,7]	WP	1		0.005	9	0.09	6
					15	0.06	
					22	0.03*	
Knuiningen, Netherlands, 1978[5,7]	WP	1		0.005	7	0.14	6
					14	0.11	
					21	0.13*	
Surrey, UK, 1981[3,5]	SC	13	0.06	0.003 x 11 0.002 x 2	0	0.17	NF 20 FF81-002-01
					7	0.12	
					14	0.04	
					21	0.07	
Surrey, UK, 1981[3,5]	SC	13	0.06	0.003 x 11 0.002 x 2	0	0.30	NF 20 FF81-002-02
					7	0.18	
					14	0.10	
					21	0.09	

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
Surrey, UK, 1981[3,5]	SC	13	0.06	0.003 x 11 0.002 x 2	0	0.31	NF 20 FF81-002-03
					7	0.19	
					14	<u>0.14</u>	
					21	0.13	

Underlined residues are from treatments according to GAP in Germany; those underlined twice from treatments according to GAP in Denmark, Ireland and the UK.
* According to GAP in The Netherlands.
[1] No detailed report submitted
[2] No weather data submitted
[3] Method of analysis unspecified
[4] Crops stored for 7 (NF20 D81-351) or 8 months (NF20 D81-353) before analysis
[5] No example chromatograms submitted
[6] High associated recoveries (NF21: D82-305 113-126%; D82-301 102-126%; D82-303 110-127%)
[7] Report not in English

Table 24. Non-European supervised residue trials on apples (including US processing trials).

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
Ontario, Canada, 1975[1,2,7]	EC	13	0.025	0.002	42	fruit	0.01	NF 25 MFM 5-1
			0.05	0.004		fruit	0.02	
			0.075	0.008		fruit	0.04	
Ontario, Canada, 1975[1,2,7]	EC	13	0.025	0.002	42	fruit	0.02	NF 25 MFM 6-1
			0.03	0.004		fruit	0.02	
			0.05	0.004		fruit	0.02	
			0.075	0.008		fruit	0.06	
Ontario, Canada, 1976[1,2,7]	EC	12	0.097	0.002	34	fruit	0.01	NF 25 MFM 6-3
			0.134	0.004		fruit	0.02	
			0.270	0.004		fruit	0.06	
		11	0.16 x 4 0.08 x 7	0.004 x 4 0.002 x 7		fruit	0.04	
Meaford, ONT, Canada, 1977 [1,2,7,9]	EC	6	0.016			fruit	0.007	NF 26 MFM 7-12
		6			15	fruit	0.05	
Bowmanville, ONT, Canada, 1977[1,2,7,9]	EC	5	0.016			fruit	0.17	NF 26 MFM 7-14
London, ONT, Canada, 1977[1,2,7,9]	EC	8	0.012		28	fruit	0.02	NF 26 MFM 7-28
Simcoe, ONT, Canada, 1977[1,2,7,9]	EC	8	0.012		84	fruit	0.03	NF 26 MFM 7-29
Simcoe, ONT, Canada, 1977[1,2,7,9]	EC	10	0.016 x 8 0.08 x 2			fruit	0.03	NF 26 MFM 7-31
		10	8 x 0.141 or 0.016 2 x 0.069 or			fruit	0.03	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
			0.08					
Nattawa, ONT, Canada, 1977[1,2,7,9]	EC	6	0.016		83	fruit	0.007	NF 26 MFM 7-34
		6	0.016		83	fruit	0.003	
Meaford, ONT, Canada, 1977[1,7]	EC	6	0.142		15	fruit	0.07	NF 27 MFM 7-12
		6	0.142			fruit	0.05	
Bowmanville, ONT, Canada, 1977[1,7]	EC	5	0.142		69	fruit	0.02	NF 27 MFM 7-14
London, ONT, Canada, 1977[1,7]	EC	8	0.1		28	fruit	0.02	NF 27 MFM 7-38
Simcoe, ONT, Canada, 1977[1,7]	EC	8	0.1		86	fruit	0.03	NF 27 MFM 7-29
Simcoe, ONT, Canada, 1977[1,7]	EC	8	6 x 0.142 2 x 0.071		45	fruit	0.03	NF 27 MFM 7-33
Simcoe, ONT, Canada, 1977[1,7]	EC	6	0.142		90	fruit	0.003	NF 27 MFM 7-34
Nottawa, ONT, Canada, 1977[1,7]	EC	6	0.142		90	fruit	0.007	NF 27 MFM 7-34
Oyamba, BC, Canada, 1980[1,7]	EC	3	0.101		131	fruit	0.003	NF 27 K Ellison
					95	fruit	0.004	
Kelowna, BC, Canada, 1980[1,7]	EC	3	0.101		121	fruit	<0.002	NF 27 E. Star
West Bank, BC, Canada, 1980[1,7]	EC	3	0.101		121	fruit	0.03 <0.002	NF 27 M. Janse
Campinas, Brazil, 1985[1,6,7]	EC	9		0.018	28	fruit	0.01	NB 29
				0.036		fruit	0.04	
Curico, Chile, 1980[1,3,7,12]	EC	9	0.06		100	fruit	0.09 0.09	NF 28
	SC					fruit	0.06	
San Fernando, Chile, 1980[1,3,7,12]	EC	6	0.06		113	fruit	0.08	
			0.048			fruit	0.003	
Albany, NZ, 1976[1]	EC	10	0.132	0.002-0.004	2	fruit	0.07	NF 29 NZ 75-19
					6	fruit	0.05	
					12	fruit	0.04	
			0.099	0.0015-0.003	2	fruit	0.07	
					6	fruit	0.05	
					7	fruit	0.07	
					21	fruit	0.06	
					35	fruit	0.02	
Hastings, NZ, 1979[1]	WP	12	0.061	0.0025	52	fruit	0.008	NF 29 NZ 78-2
			0.061	0.003		fruit	0.006	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
Hamilton, NZ, 1980[1]	WP	1	0.048		120	fruit	<0.002	NF 29 NZ 80-6
Hamilton, NZ, 1980[1]	WP	8	0.081		1	fruit	0.02	NF 29 NZ 80-5
					8	fruit	0.02	
					15	fruit	0.01	
					29	fruit	0.008	
Christchurch, NZ, 1981[1]	WP	14		0.003	31	fruit	0.03	NF 29 T Holland
					38	fruit	0.03	
					45	fruit	0.01	
Geneva, NY, USA, 1981[1,2,4]	EC	6	0.0445		107	fruit	<0.002	NF 18 Cornel
						juice	<0.002	
						sauce	<0.002	
						wet pomace from sauce	0.003	
						dry pomace	0.025	
		3 3	0.0445 0.0223		107	fruit	0.002	
						juice	<0.002	
						sauce	<0.002	
						wet pomace from sauce	0.002	
						dry pomace	0.014	
Biglerville, PA, USA, 1981[1,2,4,9]	EC	11	0.1038		42	fruit	0.037	NF 18 Penn. Univ.
						juice	0.003	
						sauce	0.009	
						wet pomace from sauce	0.20	
						dry pomace	0.67	
		4 7	0.1038 0.0519		42	fruit	0.017	
						juice	<0.002	
						sauce	0.004	
						wet pomace from sauce	0.079	
						dry pomace	0.20	
Winchester, VA, USA, 1981[1,2,4,9]	EC	10	0.1038		34	fruit	0.059	NF 18 Winchester
						juice	0.002	
						sauce	0.015	
						wet pomace from sauce	0.14	
						dry pomace	0.31	
		3 7	0.1038 0.0519			fruit	0.057	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
						juice	0.002	
						sauce	0.01	
						wet pomace from sauce	0.015	
						dry pomace	0.36	
Sodus, NY, USA, 1982[1,2,3,4,9,12]	EC	1 10	0.316 0.105		41	juice	0.002	NF 18 CMR 82-9
						wet pomace from juice	0.049	
						sauce	<0.002	
						dry pomace	0.11	
		1 10	0.316 0.105		41	juice	<0.002	
						wet pomace from juice	0.061	
						sauce	<0.002	
						dry pomace	0.13	
Sodus, NY, USA,1982[1,2]	EC	8	0.105		63	fruit	0.014	NF 18 CMR 8-10
						juice	0.002	
						wet pomace from juice	0.073	
						sauce	<0.002	
						dry pomace	0.12	
		8	0.105		63	fruit	0.008	
						juice	0.002	
						wet pomace from juice	0.072	
						sauce	<0.002	
						dry pomace	0.16	
Sodus, NY, USA, 1982[1,2]	EC	8	0.079		83	fruit	<0.002	NF 18 CMR 82-11
						juice	<0.002	
						wet pomace from juice	0.006	
						sauce	<0.002	
						dry pomace	0.012	
		8	0.079		83	fruit	<0.002	
						juice	0.002	
						wet pomace from juice	0.003	
						sauce	<0.002	
						dry pomace	0.013	
Sodus, NY, USA, 1982[1,2]	EC	10	0.0789		53	fruit	0.007	NF 18 CMR 82-16
						juice	<0.002	
						sauce	<0.002	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
						wet pomace from sauce	0.068	
						dry pomace	0.12	
		10	0.0789		53	fruit	0.007	
						juice	<0.002	
						sauce	<0.002	
						wet pomace from sauce	0.079	
						dry pomace	0.098	
Daleville, VA, USA, 1982[1,2,4]	EC	8	0.1052		33	fruit	0.002	NF 18 DAA 82-6
						juice	<0.002	
						wet pomace from juice	0.013	
		11	0.1052		33	fruit	0.002	
						juice	<0.002	
						wet pomace from juice	0.009	
Tehachapi, CA, USA, 1982[1,2,9]	EC	4	0.2105		118	fruit	<0.002	NF 18 DHF 82-12
						juice	<0.002	
						wet pomace from juice	0.009	
Gardners, PA, USA, 1982[1,2,11]	EC	8	0.0526		136	fruit	<0.002	NF 18 PEB 82-5
						juice	<0.002	
						sauce	<0.002	
						wet pomace from sauce	<0.002	
Thurmont, MD, USA, 1982[1,2]		10	0.1052		70	fruit	0.02	NF 18 PEB 82-6
						juice	0.002	
						sauce	0.003	
						wet pomace from sauce	0.036	
Gettysburgh, PA, USA, 1982[1,2,11]		10	0.0526		75	fruit	0.021	NF 18 PEB 82-14
						juice	0.003	
						sauce	<0.002	
						wet pomace from sauce	0.054	
Watsonville, CA, USA,1982[1,2,9]		4	0.1052		104	fruit	0.005	NF 18 RAH 82-1
						juice	0.002	
						wet pomace from juice	0.018	
		4	0.2105		104	fruit	0.013	
						juice	0.003	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
						wet pomace from juice	0.043	
Snelling, CA, USA, 1982[1,2,9]		4	0.1052		93	fruit	0.008	NF 18 RAH 82-2
						juice	0.002	
						wet pomace from juice	0.021	
		4	0.2105		93	fruit	0.011	
						juice	0.002	
						wet pomace from juice	0.029	
Moxee, WA, USA, 1982[1,2]		1 3	0.084 0.104		122	fruit	0.002	NF 18 WTC 82-4
						juice	<0.002	
						wet pomace from juice	0.005	
		1 3	0.104 0.132		122	fruit	0.002	
						juice	<0.002	
						wet pomace from juice	0.004	
Orondo, WA, USA, 1982[1,2]		2 2	0.105 0.132		147	fruit	0.007	NF 18 WTC 82-8
						juice	<0.002	
						wet pomace from juice	0.015	
Covert, MI, USA, 1982[1,2,9]		10	0.1052		147	fruit	0.019	NF 18 DG 082-10
						juice	<0.002	
						wet pomace from juice	0.14	
						sauce	0.003	
						wet pomace from sauce	0.33	
Sodus, NY, USA, 1976[1,2]		10	0.1075		62	fruit	0.004	NF 18 CDC 6-16
						juice	<0.002	
						wet pomace from juice	0.022	
						dry pomace	0.068	
Reedley, CA, USA, 1988	EC	7	0.105		30	fruit	0.03	NF 31 DHF88-02
		7	0.105		30	fruit	0.02	NF 31 DHF 88-03
Sunnyside, WA, USA, 1988	EC	7	0.105		29	fruit	0.01	NF 31 BJB88-01
		7	0.105		29	fruit	0.01	NF 31 BJB88-02
		7	0.105		29	fruit	0.02	NF 31

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
								BJB88-03

Underlined residues are from treatments according to GAP in the USA; those underlined twice from treatments according to GAP in New Zealand
[1] No weather data submitted
[2] Method of analysis unspecified. Stated to be GLC for studies NF 20, 25 & 26 but no further details
[3] No control plot data submitted
[4] Crops stored for 8-15 months before analysis
[6] No example chromatograms submitted
[7] Duration of sample storage unspecified
[9] High associated recoveries (NF26: MFM 7-12 98-140%, NF 18 dry pomace 132%; juice 121-128%
[11] Half sprayed - one side of row only
[12] System recoveries only submitted (i.e control extract or extraction solvent, not the commodity, was fortified)

Pears. GAP was reported for many countries world-wide and was generally the same as that reported for apples.

A few trials were available which complied with GAP (the same as for apples) in Germany (one trial), Italy (one trial) or the USA (4 trials with replicates), but the recoveries associated with the German (0.13 mg/kg) and Italian trials (0.09 mg/kg) were low at 67 and 63% respectively. Residues in the US trials were 0.01-0.04 mg/kg.

Table 25. Supervised residue trials on pears.

Location, year	Application				PHI, days	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl			
Australia, 1985[1,5,6]				0.0036	14	0.03	NB 30 AUS 78-314
				0.0072		0.04	
Giessen, Germany, 1978[1-4,6]	EC	14	0.054		0	0.1	NF 03 D78-312
					3	0.08	
					10	0.07	
					13	0.08	
					17	0.08	
					20	0.09*	
					24	0.03	
					31	0.06	
Baricella, Italy, 1981[1-4]	SC	17		0.004	20	0.13	NF 06 181 211
Hood River, OR, USA, 1983[1,5]	EC	3	0.143		112	0.003	NF 33 WTC83-2
Medford, OR, USA, 1983[1,5]	EC	2	0.143		120	<0.001	NF 33 830R12
					144	<0.001	
Hood River, OR, USA, 1984[1,5]	EC	3	0.092		120	<0.001	NF 33 840R4
			0.143		123	<0.001	
Medford, OR, USA, 1985[1,5]	EC	2	0.092 0.071		147	<0.001	NF 33 840R5
			0.143 0.109			<0.001	
Clayton, NC, USA, 1986[1,5]	SC	7	0.1		30	0.01	NF 33 DAA86-13
		7	0.1			0.02	
Reedley, CA, USA, 1986	SC	7	0.1		30	0.03	NF 33 DHF86-5

Location, year	Application				PHI, days	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl			
	EC					0.01	
Parlier, CA, USA, 1986[1,5]	EC	7	0.1		29	0.04	NF 33 DHF86-6
Mesa, WA, USA, 1986[1,5]	EC	7	0.1		28	0.02	NF 33 DHF86-8
	SC					0.08	

Underlined residues are from treatments according to GAP in the USA; those underlined twice from treatments according to GAP in Italy
* according to GAP in Germany
[1] No weather data submitted
[2] Method of analysis unspecified
[3] Low associated recoveries (NF03 D78-312 67%; NF06 181-211 63%
[4] No example chromatograms submitted
[5] Duration of sample storage unspecified
[6] Crop variety unspecified

Peaches. GAP was reported for Uruguay, Argentina, Japan, Greece, Italy and Spain. No GAP was reported for apricots or nectarines, although some trials data were submitted. The maximum application rates are 0.036-0.2 kg ai/ha (0.0024-0.0048 kg ai/hl) with a PHI of 1-20 days.

Residue trials were available only from Spain, Italy and France. The critical European GAP for peaches was the Spanish (0.0048 kg ai/hl, PHI 7 days) for which there were 5 trials (one of them replicated) with residues of 0.03-0.3 mg/kg. In two of these trials the volume of spray per hectare was not specified. A further Spanish trial on apricots in 1988 where the use pattern was the same as the Spanish GAP for peaches with a residue of 0.36 mg/kg at 7 days provided supporting information. A single Chilean trial on nectarines reflected the Argentinian GAP for peaches (0.072 kg ai/ha, PHI 20 days) with no residue detected. No data on supervised trials were available for Japanese GAP in which there is a 1-day PHI.

Table 26. Supervised residue trials on peaches, apricots and nectarines.

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
Fronton, S. France, 1993[1]	EC	3	0.04	0.0078	0	pulp	0.13	NG 07 R93-46
					6		0.04	
					10		0.06	
					13		0.04	
Fronton, France, 1994	EC	5	0.04	0.008	8	pulp	0.03	NG 11 GHE-P-4062
Follonica, Italy, 1977[2-6]	WP	8		0.0042	34	fruit	<0.01	NG 01 I77-212A
Puntone, Italy, 1977[2-6]	WP	4		0.0042	20	fruit	0.02	NG 02 I77-213
Follonica, Italy, 1977[2-6]	WP	6	0.24	0.0042	16	fruit	<0.01	NG 03 I77-214
S. Biagio, Italy, 1993[1]	SC	5	0.09	0.0042	0	pulp	0.44	NG 08 R93-45
					7		0.13	
					10		0.08	
					14		0.08	
			0.1	0.0048	0	pulp	0.65	
					7		0.15	
					10		0.15	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
					14		0.16	
Francolino, Italy, 1994	SC	4	0.066 0.069 0.071 0.072	0.0048 x 4	13	pulp	0.05	NG 10 GHE-P-4014
Luchente, Spain, 1988[2,3,5,6,7]	EC	1	0.18	0.0048	0	fruit	0.41	ref. 13
					3		0.38	
					7		0.30	
					14		0.12	
					21		0.10	
Pobla del Duc, Spain, 1992[2,3,5,6,7]	EC	1		0.0036	0	fruit	0.18	ref. 13
					7		0.08	
					14		0.03	
					21		0.02	
Pobla del Duc, Spain, 1993[2,3,5,6,7]	EC	1		0.0036	0	fruit	0.07	ref. 13
					7		0.03	
					14		0.02	
					21		0.01	
NECTARINE								
Chile[2,5,7]	EC		0.072	0.0036	0	fruit	0.03	NG 09
					6		<0.01	
					16		ND	
					24		ND	
APRICOT								
Luchente, Spain, 1988[2,3,5,6,7]	EC	1	0.18	0.0048	0	fruit	0.45	ref. 13
					3		0.44	
					7		0.36	
					14		0.14	
					21		0.08	

Underlined residues are from treatments according to GAP in Spain
Results underlined twice reflect GAP in Argentina
ND - not detected
[1] Crops stored for 11 months before analysis
[2] No weather data submitted
[3] Method of analysis unspecified (reports 2, 3, 4 & 5 in Spanish
[4] Low associated recoveries (NG01 69%; NG02 68%; NG03 59%
[5] No example chromatograms submitted
[6] Duration of sample storage unspecified
[7] No English translation provided

Cherries. GAP was reported for Denmark, Japan and the USA. The maximum application rates reported were 0.06 to about 0.2 kg ai/ha with PHIs of 0-14 days.

All 15 trials submitted were from the USA with samples being taken at 0 and 1 day after the final treatment. In all these trials no account was taken of the weights of the stones. US GAP (0.101 kg ai/ha) allows treatment 'up to and after harvest' and residues in the 9 trials (3 of which were replicated) complying with it were 0.06-0.89 mg/kg.

Table 27. Supervised residue trials on cherries in the USA.

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
Traverse City, MI, 1987[1,2]	EC	6	0.053		0	fruit pulp	0.21	NG 04 87MI1
					1		0.24	
Geneva, NY, 1987[1,2]	EC	5	0.095		0	pulp	0.07	NG 04 87NY1
					1		0.10	
Biglerville, PA, 1987[1,2]	EC	5	0.089		0	pulp	0.10	NG 04 87PA1
					1		0.11	
Hart, MI, 1987[1,2]	EC	5	0.053		0	fruit	0.16	NG 04 WWH87-2
					1		0.17	
Hart, MI, 1987[1,2]	EC	5	0.053		0	pulp	0.18	NG 04 WWH87-3
					1		0.13	
Sutton Bay, MI, 1987[1,2]	EC	5	0.053		0	pulp	0.28	NG 04 WWH87-5
					1		0.26	
Sutton Bay, MI, 1987[1,2]	EC	6	0.053		0	pulp	0.20	NG 04 WWH87-6
					1		0.10	
Sutton Bay, MI, 1987[1,2]	EC	5	0.053		0	pulp	0.17	NG 04 WWH87-7
					1		0.16	
Vantage Bay, WA, 1987[1,2]	EC	4	0.105		0	pulp	0.06	NG 04 WTC87-3
					1		0.05	
Malago, WA, 1987[1,2]	EC	4	0.105		0	pulp	0.44	NG 04 WTC87-6
					1		0.41	
Othello, WA, 1987[1,2]	EC	4	0.105		0	pulp	0.17	NG 04 WTC87-7
					1		0.15	
Corvallis, MI, 1987[1,2]	EC	4	0.105		0	pulp	0.63	NG 04 WTC87-8
					1		0.64	
Linden, CA, 1989	EC	4	0.106		0	fruit	0.89	NG 05 LES89-05
					1		0.49	
			0.106	0.0056	0	fruit	0.77	
					1		0.63	
Grevais. OR, 1989	EC	4	0.106	0.0056	0	fruit	0.22	NG 05 LR89-01
					1		0.28	
	SC	4	0.106	0.0056	0	fruit	0.1	
					1		0.1	
Westley, CA,1989	EC	4	0.106	0.0056	0	fruit	0.4	NG 05 LES89-04
					1		0.88	
	SC	4	0.106	0.0056	0	fruit	0.3	
					1		0.25	

Underlined residues are from treatments according to GAP in the USA
[1] No weather data submitted
[2] Duration of sample storage unspecified

Currants. GAP for blackcurrants was reported for Denmark, Ireland and the UK, and for all currants for The Netherlands. The application rates were 0.04-0.06 kg ai/ha or 0.0048 kg ai/hl with PHIs of 14 or 21 days.

Data were available only from 5 trials in The Netherlands. Residues were 0.04-0.74 mg/kg 15 days after the final treatment but with a variety of application rates with only one trial according to the reported GAP.

Gooseberries. GAP in Ireland and The Netherlands is the same as for currants. Only one trial in The Nethlands was reported with a residue of 0.05 mg/kg at 10 days and this trial was submitted in summary form only.

Table 28. Supervised residue trials on currants and gooseberries in The Netherlands in 1980. All EC applications. All reference 6.

Crop	Application			PHI, days	Residues, mg/kg
	No.	kg ai/ha	kg ai/hl		
Blackcurrant[1,2]					
	8		40ppm	2	0.1
				10	0.07
				14	0.04
				22	0.05
				29	0.06
	1	6-	60 ppm	13	0.47
	1		80 ppm	13	0.45
	?	0.06		50	0.10
	?	0.08		13	0.74
Redcurrant[1,2]					
	3	0.048		25	0.07
					0.14
					0.06
					0.08
Gooseberry[1,2]					
	8		40ppm	2	0.07
				10	0.05

Underlined residues are from treatments according to GAP in The Netherlands
[1] No example chromatograms submitted
[2] No English translation provided

Grapes. GAP was reported for many countries world-wide. The maximum application rates were 0.012-0.06 kg ai/ha with PHIs of 7-35 days. CLICK HERE to continue

NB 20. Dow Elanco Ltd. Residue Study - Melons - France 1980 F80-729.

NB 21. Dow Elanco Ltd. Residue Study - Melons - France 1980 F80-730.

NB 22. Dow Elanco Ltd. Residue Study - Melons - France 1980 F80-730A.

NB 23. Dow Elanco Ltd. Residue Study - Melons - France 1980 F80-735.

NB 24. Dow Elanco Ltd. Residue Study - Cantaloup - Italy 1981 181-256.

NB 26. Dow Elanco Ltd. Residue Study - Squash - Italy 1981 181-254.

NB 28. Dow Elanco Ltd. Residue Study - Artichokes - Italy 1981 181-251.

NB 29. Arcas, J.B. Analises de Residuos de Fenarimol em Frutos e Cucurbitaceas 1986.

NB 30. Dow Elanco Ltd. Application for clearance of RUBIGAN systemic Fungicide to the Technical Committee on Agricultural Chemicals Section E-Residues (Australian Data Summary). Undated.

NB 30. Application for clearance of RUBIGAN systemic Fungicide to the Technical Committee on Agricultural Chemicals Section E - Residues, 1979.

NB 31. Butcher, S. Residues in Melons Spain 1994 Jan 1995 GHE-P-4011.

NB 32. Butcher, S. Residues in Melons Italy 1994 Jan 1995 GHE-P-4013.

NC 11. Dow Elanco Ltd. Residue Study - Strawberry - Italy 1979 179-252.

NC 12. Dow Elanco Ltd. Residue Study - Strawberry - Italy 1979 179-253.

NC 16. Rubigan 12 WP/Strawberry Crop Dow Elanco Ltd. Residue Study: Japan 1984 and 1988 Studies June 1988 T2R-077.

ND 01. Longhurst, C Residues of Fenarimol in Raspberries following Foliar Applications of RUBIGAN Sept 1985 FF84-006.

NE 02. Dow Elanco Ltd. Residue Study - Peppers - Spain 1977 E77-129.

NE 03. Dow Elanco Ltd. Residue Study - Tomatoes - Italy 1979 179-251.

NE 04. Dow Elanco Ltd. Residue Study - Peppers - Israel 1979 ISL79-2.

NE 05. Dow Elanco Ltd. Residue Study - Pepper - Italy 1979 179-250.

NE 06. Dow Elanco Ltd. Residue Study - Pepper - Italy 1979 179-251.

NE 07. Dow Elanco Ltd. Residue Study - Tomatoes - Italy 1979 179-250.

NE 08. Butcher, S.M. Residues of Fenarimol in Tomatoes at Intervals Following Application of RUBIGAN 12ec (EAF 457), Spain 1993 Aug 1994 GHE-P-3653.

NE 09. Dow Elanco Ltd. Residue Study - Tomatoes - Italy 1981 181-258.

NE 10. Dow Elanco Ltd. Residue Study - Pepper - Italy 1981 181-259.

NE 11. Butcher, S.M. Residues of Fenarimol in Tomatoes at Intervals Following Application of RUBIGAN 12SC (EAF 383), Netherlands 1994 Jan 1995
. GHE-P-4008.

NE 12. Butcher, S.M. Residues of Fenarimol in Tomatoes - Greece 1994 Jan 1995
. GHE-P-4012.

NF 03. Dow Elanco Ltd. Residue Study - Pears - Germany 1978 D78-312.

NF 06. Dow Elanco Ltd. Residue Study - Pears - Italy 1981 181-211.

NF 08. Dow Elanco Ltd. Residue Study - Apples - Germany 1978 D78-311.

NF 18. Decker, O.D. and Day, E.W. Fenarimol Residue Data on Apples and Apple Products from Experiments conducted in the United States in 1981 and 1982. Mar 1983. I-ODD-83-06.

NF 20. Dow Elanco Ltd. Residue Studies-Apples Germany and UK/1981 Apr 1983
. D81-302, D81-350, D81-351, D81-353, FF81-002.

NF 21. Dow Elanco Ltd. Residue Studies - Apples Germany 1982 Apr 1983. D82-301, D82-302, D82-303, D82-304, D82-305, D82-307.

NF 25. Frank, R. Fenarimol Residues in Whole Apple Fruit (Canada) May 1977 T2R-233.

NF 26. Frank, R. Fenarimol Residues in Whole Apple Fruit (Canada) July 1978 T2R-198.

NF 27. Day, E.W. Fenarimol Residue Data on Apples from Canada May 1981.

NF 28. Day, E.W. Fenarimol Residues in Apples from Chile May 1981 T2R-230.

NF 29. Day, E.W. Fenarimol Residues in Apples from New Zealand Mar 1981. NZ75-19, NZ78-2, NZ80-5, NZ80-6.

NF 31. Day, E.W. West, S.D 1988 Fenarimol Residue

Studies in Apples Nov 1988. AAC8819.

NF 33. Day, E.W. Fenarimol Residue Data on Pears March 1987 EWD8640.

NG 01. Dow Elanco Ltd. Residue Study - Peach - Italy 1977 177-212.

NG 02. Dow Elanco Ltd. Residue Study - Peach 1977 177-213.

NG 03. Dow Elanco Ltd. Residue Study - Peach - Italy 1977 177-214.

NG 04. Day, E.W and Saunders, D.G. 1987 Fenarimol Residue Studies in Cherries AAC8713 Feb 1988.

NG 05. Day, E.W. and West, S.D. 1989 Fenarimol Residue Studies in Cherries, Aug 1989 AAC8903.

NG 06. Day, E.W. and Saunders, D.G Storage Stability of Fenarimol in Cherries EWD8803 Feb 1988.

NG 07. Butcher, S. and Wood, S. Residues of Fenarimol in Peaches at intevals following Application of RUBIGAN 4 (EAF 216), - Southern France 1993 GHE-P-3652 Aug 1994.

NG 08. Butcher, S. and Wood, S. Residues of Fenarimol in Peaches at intervals following Application of RUBIGAN 12sc (EAF383), Italy - 1993 GHE-P-3626 Jun 1994.

NG 09. Dow Elanco Ltd. Residues in Nectarines in Chile, Gonzalez, R.H Degradacion de Residous de Rubigan en Nectarinos Y Fijacion de Carencias Preliminares Chile 1993.

NG 10. Butcher, S. Peaches Italy Jan 1995 GHE-P-4014.

NG 11. Butcher, S. Peaches France Jan 1995 GHE-P-4062.

NG 12. Butcher, S. The stability of fenarimol in fortified peaches, tomatoes and melons under frozen storage conditons. GHE-P-4318.

NH 01. Dow Elanco Ltd. Residue Study - Grapes AAC8714.

NH 02. Dow Elanco Ltd. Residues Study - Grapes EWD8703.

NH 04. Butcher, S. and Wood, S. Residues of Fenarimol in Grapes at Intervals following Application of TRANSFLO (EAF 383), France - 1993 GHE-P-3627 Jun 1994.

NH 05. Dow Elanco Ltd. Residue Study - Grape 1977 A77-121.

NH 06. Dow Elanco Ltd. Residue Study - Grape 1977 A77-122.

NH 07. Day, E.W. Jr. and Saunders D.G. Storage Stability of fenarimol and its Metabolites in Grapes and Grape Products. EWD8802 Apr 1988.

NH 09. Dow Elanco Ltd. Residue Study - Grape 1977 177-225.

NH 10. Butcher, S. The Stability of Fenarimol in Fortified Grapes and Wine stored under Frozen Conditions GHE-P-3741 Aug 1994.

NH 11. Butcher, S. and Wood, S. Residues of Fenarimol in Grapes, Grape Must and Wine following Application of Rubigan 12 SC (EAF 383) to Grape Vines Germany 1992/93. GHE-P-3655 Aug 1994.

NH 12. Dow Elanco Ltd. Residues Studies - Grapes - Germany and France 1981/2 Apr 1983.

NH 17. Day, E.W. Fenarimol Residue Data on Grapes and Grape Products from Experiment conducted in the United States in 1983 March 1984 I-EWD-84-03.

NH 20. Day, E.W. and West, S.D. 1988 Fenarimol Residue Trials in Grapes AAC8818 Dec 1988.

NH 22. Trevallyn-Jones, J. Further Submission to T.C.A.C - Withholding Period in Grapes treated with RUBIGAN (contains Australian Dow Elanco Ltd. Residue data) July 1984.

NH 23. Dow Elanco Ltd. Submission to T.C.A.C - Rubigan Data Supporting Reduction in Withholding Period in Grapes (contains Australian Residue data) July 1987.

NH 24. Dow Elanco Ltd. 1995. Residues of fenarimol in fresh and processed grapes after treating Cabernet Sauvignon and Sultana grapevines with Rubigan 120 EC®. March. Ref.

NI 01. Dow Elanco Ltd. Residue Study - Artichoke - Italy 1979 179-250.

NI 05. Butcher, S. Residues of Fenarimol in Globe Artichokes at Intervals following Multiple Applications of RUBIGAN 12 SC (EAF383), Italy 1995 GHE-P4010 Jan 1995.

NJ 01. Butcher, S. and Perkins, J. Residues of fenarimol in Hops and related fractions from the brewing process following application of Drawisan 6WP (EAF 219) - Germany 1990. GHE-P-2517 Oct 1991.

NL 02. Catta-Preta, R.F. and Matos, J.C. Residues of Fenarimol and its Major Metabolites in Bananas following Multiple treatments with Rubigan Ec Fungicide - Costa Rica, Honduras and Ecuador, 1992 April 1993 GHB-P 151.

NL 03. Ishikura, H. Residues of Fenarimol in Pulp, Peel and Whole Bananas Following application of Rubigan 12EC Fungicide in the Philippines - 1991 July 1991. GHF-P -1126.

NL 04. Day, E.W. Reasonable Grounds in Support of the

Petition for the Establishment of A Tolerance for Fenarimol and its Metabolites in or on Bananas. Aug 1993. ECL93073.

NM 01. Decker, O.D. Fenarimol Residues on Pecans when Rubigan 1EC or Rubigan 1AS is Foliar applied to Pecan Trees on Disease Control March 1983 I-ODD-82-02.

NM 02. Decker, O.D. Fenarimol Residues on Pecans when Rubigan is Foliar applied to Pecan Trees for Disease Control Feb 1984 I-ODD-84-01.

OR 01A. Griggs, R.D and Decker, O.D. Determination of Fenarimol in Agricultural Crops and Soil Jan 1981 AM-AACA-R039-AA-755.

OR 01B. Griggs, R.D. and Decker, O.D. Determination of Fenarimol in Agricultural Crops and Soil Jan 1985 AM-AA-CA-RO39-AB-755.

OR 10. Dow Elanco Ltd. Determination of EL-222 in Agricultural Crops and Soils by Gas-Liquid Chromatography Std An.Method No.86 Sep 1976.

OR 11. Dow Elanco Ltd. Determination of Fenarimol In Agricultural Crops (Other than Cereals) by Gas-Liquid Chromatography Nov 1977 Std.An.Method No.97.

OR 19. Yordy, D.W. and Turner, L.G Determination of Fenarimol In Meat, Milk and Eggs. AM-AA-CA-RO72-AA-755 Sep 1982.

OR 20. Butcher, S.M. and Perkins, J.M. Determination of Fenarimol Residues in Fresh, Dried and Spent Hops. ERC91-8 Jan 1992.

OR 21. Butcher, S.M. Determination of Fenarimol Residues in Beer and Spent Yeast. Jan 1992 ERC91-10.

OR 22. Butcher, S.M. and Long, T.J. Determination of Residues of Fenarimol in Grape Must, Wine and Grapes. ERC93-6 Jul 1993.

OR 24. Butcher, S.M. Determination of Residues of Fenarimol in Tomatoes, Peaches and Melons ERC 94.3 Aug 1994.

OR 27. Turner, L.G. Dow Elanco Ltd. Residue Method Development Report for Fenarimol and its Metabolites in Whole Bananas and Banana Pulp. GH-C-2840 Aug 1992.

R 28. Catta-Preta, R.F. and Matos, J.C Determination of Residues of Fenarimol, Compound 212746 and 210302 in Banana Whole Fruit and Pulp BRC 92.2 March 1993.

FENARIMOL (191)

IDENTITY

ISO common name: fenarimol

Chemical name

IUPAC: (±)-2,4′-dichloro-Æ-(pyrimidin-5-yl)benzhydryl alcohol

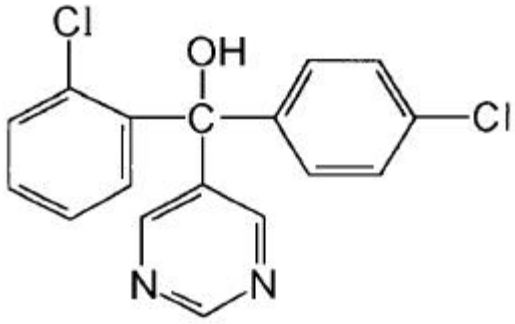
CA: (±)-Æ-(2-chlorophenyl)-Æ-(4-chlorophenyl)-5-pyrimidinemethanol

CAS registry no: 60168-88-9 (unstated stereochemistry)

CIPAC No: 380

Synonyms: compound 57322
development code EL-222

Structural formula:



Molecular formula: $C_{17}H_{12}Cl_2N_2O$

Molecular weight: 331.2

Physical and chemical properties

Pure active ingredient

Vapour pressure:	6.5×10^{-5} Pa at 25°C (99.7% pure) (A 21)	
Hydrolysis (no purity stated):	pH 3	no hydrolysis
(Dow Elanco Ltd., undated)	pH 6	no hydrolysis at 25, 37 and 52°C
	pH 9	no hydrolysis
Following 40 hours reflux at 100°C:	pH 3	30% hydrolysis
	pH 6	no hydrolysis
	pH 9	13% hydrolysis

Photolysis (no purity stated):

Sunlight or simulated sunlight

half-life in 2 mg/l water solution in summer sun: 12 hours
half-life in water in laboratory simulated sunlight: <1 hour
half-life on silica gel plates in sunlight: approx 14 hours (Day, undated)

Laboratory irradiation apparatus
half-life in distilled water: 0.6 hours
half-life in 2% acetone/water: 2.0 hours (Mosier and Saunders, 1976)

No information was submitted for the pure active ingredient on melting point, octanol/water partition coefficient, solubility or specific gravity.

Technical material

Purity:	Typically ≥97% with certified limits of 95-101% to allow for assay and production variability. Impurities <0.5%. except for the 2,2′-, 2,3′- and 4,4′-dichloro isomers of fenarimol (total max. 3%) (Day, 1985)
Colour:	off-white to buff (Day, 1984)
Physical state:	crystalline solid (Day, 1984)
Odour:	slightly aromatic (Day, 1984)
Melting point:	117-119°C (Day, 1984)
Octanol/water partition coefficient:	Log K_{ow} = 3.69 (Loh, 1976, Day, 1984)

Solubility
(mg/l at 25°C; purity was either 95.4% or unspecified)

water at pH 3	14.6
water at pH 7	13.7
water at pH 10	13.8
acetone	>250
acetonitrile	40-45
benzene	100-125
chloroform	>500
cyclohexanone	>500
ethyl cellosolve	>250
heavy aromatic naphtha	40-45
hexane	1.1
methanol	100-125
methyl cellosolve	>250
xylene	40-45 (Day, 1976, 1984)

Specific gravity:
Packed bulk density: 0.7 - 0.8 kg/m^3
Loose bulk density: 0.4 kg/m^3 (Hudson, 1987; Day, 1984)

Formulations

Fenarimol is formulated mainly as either WP, EC or SC products.

METABOLISM AND ENVIRONMENTAL FATE

Animal metabolism

Rats. [^{14}C]fenarimol was extensively metabolized in wistar rats with less than 3% of the dose excreted unchanged in the urine and faeces within 7 days, and with only trace amounts being detected in the bile. More than 40 metabolites, each representing only a small fraction (<10%) of the dose, were detected in the urine and faeces. Some 10 metabolites were tentatively identified by a combination of thin-layer chromatography/autoradiography, mass spectrometry, infrared spectrometry and nuclear magnetic resonance spectrometry. Many metabolites appeared to be common to both the urine and faeces. The proposed major metabolic pathways of fenarimol are oxidation of the carbinol-carbon atom, the chlorophenol rings and the pyrimidine ring, as shown in Figure 1. A proposed minor metabolic pathway involves cyclization between a chlorophenol ring and the pyrimidine ring (Goebel, 1985a; Althaus, 1985a).

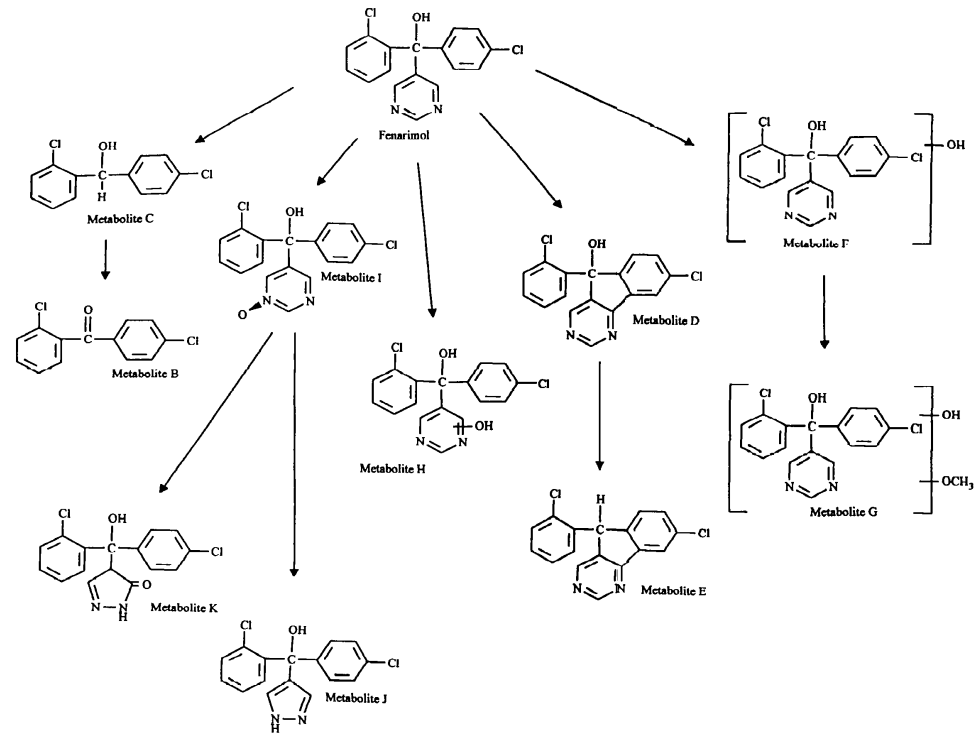
Biliary metabolites existed predominantly as glucuronic acid conjugates, with similar metabolite profiles being seen at both the dose levels tested. The main metabolite present in bile after enzymatic hydrolysis was 4-[(2-chlorophenyl)(4-chlorophenyl)hydroxymethyl]-3-pyrazolone (metabolite K, Figure 1). In contrast, most of the radioactivity in the faeces was present as unconjugated compounds indicating that biliary metabolites undergo further metabolism or hydrolysis before being eliminated (Goebel, 1985a).

In a further study rats were dosed with a single oral dose of 1 or 13 mg/kg [^{14}C]fenarimol. The major radiolabelled constituents identified in the blood and kidneys 1 hour after dosing were unchanged fenarimol and fenarimol *N*-oxide (metabolite I); fenarimol predominated, except in the blood of low-dose males, as shown in Tables 1 and 2. Identification was by thin-layer chromatography. Fenarimol also accounted for most of the radioactivity in the liver 1 h after dosing (Table 3). In addition 3-6% of the radioactivity in the liver was tentatively identified as 4-[(2-chlorophenyl)(4-chlorophenyl)hydroxymethyl]-3-pyrazolone (metabolite K) (Althaus, 1985b).

Table 1. Major compounds in whole blood of male and female rats.

Blood	Dose, mg/kg	% of total ^{14}C	% of ^{14}C in blood		
			Fenarimol	Fenarimol *N*-oxide	Other
Male	1	0.152	19.3	41.3	39.4
Female	1	0.126	49.5	21.8	28.7
Male	13	1.154	40.4	36.7	22.9
Female	13	1.804	72.5	10.9	16.6

Figure 1. Proposed metabolic pathways of fenarimol in rats.



Metabolite Metabolite F: Three isomers observed. One isomer was hydroxylated in the 4-position of the 2-chlorophenyl ring and was confirmed by synthesis of the authentic model compound. The positions of the ring hydroxyl group in the other two isomers are unknown.

Metabolite G: This compound contains hydroxy and methoxy groups. Their positions are unknown.

Metabolite H: The position of the hydroxyl group on the pyrimidine ring is unknown.

Table 2. Major compounds in kidneys of male and female rats.

Kidneys	Dose, mg/kg	Fenarimol, %	Fenarimol *N*-oxide, %	Other, %
Male	1	48	19	32
Female	1	66	11	23
Male	13	64	15	21
Female	13	84	5	11

Table 3. Major compounds in liver of male and female rats.

Liver	Dose, mg/kg	Fenarimol, %	Metabolite K, %	Other, %
Male	1	67	6	27
Female	1	82	5	13
Male	13	77	6	17
Female	13	90	3	7

Goats. A lactating goat (breed unspecified) was dosed twice daily for 5 days with gelatine capsules containing [carbinol-^{14}C]fenarimol at a dose equivalent to 10 ppm in the diet and killed sixteen hours

after the final dose.

The radioactivity of tissue samples was determined by combustion/LSC. The chromatographic profiles of samples were determined by radio-TLC following preparation which generally involved an acidification and purification on a C18 column eluted with methanol. Flash chromatography was used to prepare some samples. Samples of protease-digested livers were also obtained. Further identification was carried out by HPLC with UV detection and/or GC-MS. Eighty two per cent of the total dose was excreted by the end of the study (urine 28%, faeces 53%, cage wash 0.7%, milk <0.1%). The tissues and gut contents accounted for 16% of the total dose. The maximum plasma concentration occurred 97 hours after the first dose (0.034 mg/l fenarimol equivalents) which coincided with the maximum concentration in whole blood (0.03 mg/l fenarimol equivalents) indicating that binding to red blood cells was not taking place. The maximum concentration in the milk occurred 80 hours after the first dose (0.08 mg/l fenarimol equivalents). The radioactivity in other compartments was distributed as shown in Table 4.

Table 4. Radioactivity in a goat dosed with [^{14}C]fenarimol.

Sample	mg/kg fenarimol equivalents	% of total dose
Bile	2.97	0.1
GI tract	0.18	0.82
GI tract contents	0.94	12.2
Carcase	0.02	2.0
Fat - omental	0.03	-
Fat - renal	0.03	-
Fat - subcutaneous	0.03	-
Kidneys	0.14	0.04
Liver	0.42	0.7
Muscle	0.01	0.1

At least 90% of the total radioactivity in muscle and fat samples was extractable. The compounds shown in Table 5 were identified.

Table 5. Extraction efficiency and metabolites detected in goats (% of radioactivity present).

Compounds[1]	Sample						
	Liver		Kidney		Faeces, %	Urine, %	Bile, %
	%[2]	mg/kg[3]	%	mg/kg			
Compound 1 + Compound 2	34	0.14	38	0.05	36	87	93
fenarimol	-		-		9	-	3
fenarimol + 2-chlorobenzoic acid	21	0.09	11	0.02	-	-	-
2-chlorobenzoic acid + 4-chlorobenzoic acid + dehydroxyfenarimol	-		-		9	--	
4-chlorobenzoic acid + dehydroxyfenarimol	-		4		-	-	-
Unidentified	40		43		42	0	3
Numer of unidentified compounds	4		3		3	0	1
Extractable ^{14}C as % of ^{14}C in sample	69		94		61	100	85

[1] See Figure 2
[2] Of extracted ^{14}C in sample
[3] Fenarimol equivalents

The presence of compounds 1 and 2 in liver, kidney and bile could not be confirmed with a second solvent system but was confirmed in faeces and urine.

Further characterization was attempted using protease-digested liver but no results were obtained owing to the low levels of radioactivity. GC-MS of the liver extract indicated the possible presence of a fenarimol methyl sulphone derivative (which may arise as a result of glutathione conjugation, thio-ether cleavage, methylation and oxidation) (McCorquodale & Prout, 1995).

Pigs. Three cross-bred pigs were dosed twice daily for 5 days by incorporation of labelled fenarimol (>99% radioch;emical purity) into the feed at a level of 1 ppm (dry matter). One pig was dosed with [*carbinol*-^{14}C], one with [2-*chlorophenyl*[^{14}C] and the third with [4-*chlorophenyl*-^{14}C]fenarimol. The animals were killed 6-7 hours after the final feed. The radioactivity of the samples was determined by combustion and/or LSC. Results are shown in Table 6.

Table 6. Total residues in pig tissues following dosing with [^{14}C]fenarimol (all label positions)

Sample	mg/kg fenarimol equivalents	LSC recovery from spiked samples (%)
Liver	0.19-0.24	106, 141
Kidney	0.05-0.06	114, 127
Fat	0.04-0.06	-
Muscle	0.01	105, 140

Liver samples were extracted with methanol and dichloromethane/sodium chloride solution and analysed by TLC with autoradiography following purification by column chromatography (silica gel eluted with toluene/ethyl acetate and methanol). Fat samples were extracted with "hexanes" and acetonitrile, and the ^{14}C measured by LSC. The distribution of radioactivity in various extracts was as shown in Table 7.

Table 7. Distribution of radioactivity in sample extracts.

Sample/fraction	Position of radiolabel/% of total ^{14}C in sample		
	carbinol	2-chlorophenyl	4-chlorophenyl
Liver			
unextracted	23	35	20
dichloromethane extract	65	57	68
aqueous extract	13	18	12
Fat			
acetonitrile extract	88	85	90
"hexanes" extract	12	14	10

The major compound in the dichloromethane extracts of liver and the acetonitrile extracts of fat was fenarimol, accounting for 41-43% of the total radioactivity in the liver and 90% of the total in the fat (Althaus *et al*., 1984).

Chickens. Eight chickens (Hubbard x White Mountain Cross) were fed for 5 days with a diet containing 0.7 or 7 ppm [*carbinol*-14C]fenarimol (radiochemical purity 99.8%) and killed within one hour of removing the feed. The radioactivity of the samples was determined by combustion and LSC, with the results shown in Table 8 (Athaus *et al*., 1982a).

Table 8. Radioactive residues in chicken tissues following dosing with [^{14}C]fenarimol.

Sample	Assay recovery (%)	mg/kg fenarimol equivalents	
		0.7 ppm diet	7 ppm diet
Liver	109	0.01-0.013	0.113-0.12
Kidney	126	0.005-0.006	0.06-0.07
Fat	91	0.001-0.002	0.02-0.05
Skin	90	0.001-0.002	0.02
Muscle	113	0.001	0.003-0.005

In a second study, six Leghorn hens were dosed for 7 days with a feed containing 0.6 ppm [*carbinol*-^{14}C]fenarimol (radiochemical purity >99%) and then for a further 23 days with untreated feed. Eggs were collected daily, bulked to form a composite sample and analysed by LSC. Assay recoveries were 86.0-98.6%. The highest level of radioactivity was detected in day 7 samples (0.003 mg/kg fenarimol equivalents). By day 10 (3 days after the final treated feed) the radioactivity had decreased to 0.001 mg/kg, and was equivalent to background levels by day 17 (10 days after withdrawing treated feed) (Althaus, 1982b).

Plant metabolism

Apples. [*Carbinol*-^{14}C]fenarimol (radiochemical purity >99%) was formulated as an emulsifiable concentrate and diluted to give a 40 mg/l aqueous emulsion. This was applied as a spray to apple trees (Jonathan). The location of the trials was unspecified. Applications were made to run-off (2-5 litres aqueous emulsion/tree/application) at 80% full bloom (unlabelled formulation), 80% petal fall and on nine other occasions (radiolabelled formulation) at one- to two-week intervals (equivalent to 80-200g ai/ha based on a planting density of 1000 trees/ha). The total radioactivity was determined by combustion/LSC. The distribution of radioactive residues is shown in Table 9.

Table 9. Distribution of radioactive residues in apples.

Time after spraying	Whole apple	Peel		Pulp	
	mg/kg fenarimol equivalents	% of ^{14}C in whole apple	mg/kg fenarimol equivalents	% of ^{14}C in whole apple	mg/kg fenarimol equivalents
6 hours	0.207	92	0.983	9	0.023
29 days	0.108	87	0.477	13	0.019
49 days	0.074	81	0.351	19	0.017

Samples were extracted with methanol/sodium chloride solution and dichloromethane, then analysed by TLC/LSC. The distribution of radioactivity in the extracts and the fenarimol content were as shown in Table 10.

Table 10. Distribution of radioactivity and fenarimol in apple extracts (mean of 2 trees).

Sample	% of ^{14}C in sample	[^{14}C]fenarimol in sample

	aqueous phase	dichloromethane extract	unextracted	% of total ^{14}C	mg/kg sample
6 hour peel	10.8	67.9	21.4	53	0.52
29 day peel	13.9	47.6	38.6	24	0.18
49 day peel	15.7	44.8	39.5	23	0.14
49 day pulp	57.7	32.5	9.9	18	0.003

The authors of the study state that radioactivity other than that from fenarimol, equivalent to 0.06 mg/kg fenarimol on a whole-apple basis in the 49-day peel samples, was "widely distributed between many compounds".

Samples of peel obtained 52 days after the final application were also taken to attempt to identify metabolites. The samples were refluxed with methanol/2N sodium hydroxide solution and then partitioned successively with dichloromethane and butanol. These extracts were analysed by LSC or purified by column chromatography (silica column eluted with methanol/water). Analysis was by TLC with detection by UV and/or autoradiography and comparison with photodegradation products. Following extraction, the radioactivity was distributed as shown in Table 11.

Table 11. Distribution of radioactive residues in peel fractions.

Fraction	% of peel radioactivity	mg/kg fenarimol equivalents
spent peel (after refluxing)	17.2	0.24
dichloromethane extract	50.9	0.70
butanol extract	26.4	0.36
aqueous phase	5.5	0.08

Several compounds were tentatively identified by comparison with photolysis products (photoproducts A, E, D and H, Figure 2), all at ≤1% of total radioactivity or ≤0.01 mg/kg fenarimol equivalents. The authors concluded that photochemical degradation occurred on the surface of the apple. Other compounds (including >40 which were very polar) were observed but not identified. They had similar chromatographic characteristics to photodegradation products (Althaus and Bewley, 1978a,b).

In a further study carried out in Chile radiolabelled fenarimol was formulated as emulsifiable concentrates, diluted to give 1000 mg/l aqueous emulsions and applied directly as a mist spray to apples (Starkrimson). Radiolabelling was either at the carbinol carbon or mixed carbinol and both chlorophenyl rings (radiochemical purity 99.5-99.9%).

Individual apples were sprayed with 1 ml of the formulation or to run-off (whichever occurred first). This rate is equivalent to 268 kg ai/ha based on an average yield of 30t/ha and a medium-sized apple weighing 112g. Samples were taken 14 days after application and separated into pulp and peel.

Peel samples were extracted with aqueous methanol and dichloromethane, then refluxed with 2-butanol/water before partitioning between dichloromethane and aqueous methanol. Analysis was by TLC with autoradiography and LSC. The distribution of radioactive residues was as shown in Table 12.

Table 12. Distribution of radioactive residues in apple peel extracts.

Sample	[^{14}C]carbinol		mixed label ^{14}C	
	% of radioactivity	mg/kg fenarimol equivalents	% of radioactivity	mg/kg fenarimol equivalents
First dichloromethane	84	3.4	86	4.2
First aqueous	3	0.1	5	0.24
Second dichloromethane	3	0.1	3	0.15
Second aqueous	1	0.04	1	0.05
Unextractable	9	0.4	5	0.24
Total	100	4.0	100	4.9

Pulp samples were found to contain *c.* 0.06 mg/kg fenarimol equivalents in both experiments. TLC and LSC of peel samples identified *c.* 65% of the ^{14}C from both labels as the parent (*c.* 3 mg/kg).

No differences were detected between the TLC autoradiographs from the two radiolabels. No major degradation product was detected. Individual degradation products accounted for 2% of the total radioactivity, and all those identified in the peel were present as photolysis products. Small amounts of the major photolysis product *o*-chlorobenzoic acid were detected (Althaus, 1984a).

Grapes. A mixture of [*carbinol*-^{14}C], [*4-chlorophenyl*-^{14}C] and [*2-chlorophenyl*-^{14}C]fenarimol was formulated as an emulsifiable concentrate and diluted to give 120 mg/l and 500 mg/l aqueous emulsions. These were applied as foliar sprays to grapes (Ribier) four times at two-week intervals (120 mg/l formulation; total dose equivalent to 0.166 kg ai/ha) or once (500 mg/l formulation; dose unspecified). Samples were collected 0, 15, 30, 45 and 60 days after the final treatment.

Samples from the multiple-treatment study were extracted with methanol and partitioned with dichoromethane. The spent grape residue was extracted with 2-butanol-water by Soxhlet. The distribution of radioactivity was as shown in Tables 13 and 14.

Tables 13 and 14. Distribution of radioactivity in grapes following multiple applications of [^{14}C]fenarimol.

Table 13.

Days after final application	Total radioactivity as mg/kg fenarimol	% of total radioactivity			
		Dichloromethane	Aqueous	Butanol	Remainder
0	0.66	67.5	l6.8	8.5	7.2
15	0.46	63.6	15.2	11.7	9.5
30	0.33	61.6	16.1	8.1	14.3
45	0.33	59.8	16.8	9.0	14.4
60	0.19	56.4	18.2	11.1	14.3

Table 14.

Days after final application	TLC of dichloromethane fraction					
	Fenarimol		"Metabolite complex"		Unidentified	
	%[1]	mg/kg	%[1]	mg/kg[2]	%[1]	mg/kg[2]
0	46.0	0.305	12.7	0.08	8.8	0.06
15	26.9	0.124	26.5	0.12	10.2	0.05
30	19.3	0.063	29.1	0.10	13.2	0.04
45	17.8	0.058	27.9	0.09	14.1	0.05
60	15.6	0.029	26.5	0.05	14.3	0.03

[1] Of total radioactivity in Table 13
[2] Fenarimol equivalents

Samples taken 60 days after the single application were extracted into acidic water, refluxed with neutral, basic or acidic aqueous methanol, combined with sodium chloride solution, partitioned with dichloromethane, and then further partitioned with neutral, basic or acidic dichloromethane.

Neutral and acidic dichloromethane extracted 61 and 67% of the total radioactivity respectively. The extracts contained fenarimol and "metabolite complex" (which was not identical in different extracts). The term "metabolite complex" was applied to a group of two major, one minor and several trace components which were "extractable in the non-polar organic solvents , but which possessed polar adsorption chromatographic properties."

After extraction under strongly basic conditions the dichloromethane phase contained 74% of the total radioactivity but did not contain significant amounts of "metabolite complex".

Three compounds were identified: fenarimol (20%), dehydroxyfenarimol (DHF, 22%) and 2,4′-dichlorobenzophenone (DCBP, 8%). The structures of these compounds are shown in Figure 2 below. The "metabolite complex" was thermally degraded when subjected to GLC or MS, degraded by aqueous hydrolysis, and bound strongly during HPLC (Althaus, 1984b).

Further studies were conducted to identify the components of the "metabolite complex". Grape samples were refluxed with methanol/water, the extract was diluted with aqeous NaCl solution and extracted with dichloromethane. After drying, the residue was reconstituted in aqueous methanol and sequentially partitioned with hexane, chloroform/trichloroethane, and dichloromethane. The distribution of radioactivity was as shown in Table 15.

Table 15. Composition of grape extracts after sequential partitioning.

Solvent	% of radioactivity extracted as				
	Fenarimol	"Metabolite complex"[1]			Total
		Zone A	Zone B	Zone C	
Hexane	1-2	0	0	0	2
80:20 Chloroform/trichloroethane	18	3	1	1	27
50:50 Chloroform/trichloroethane	0.5	6	3	2	15
Dichloromethane	<0.5	1	5	2	9
Total	*c.* 20	10	9	5	53

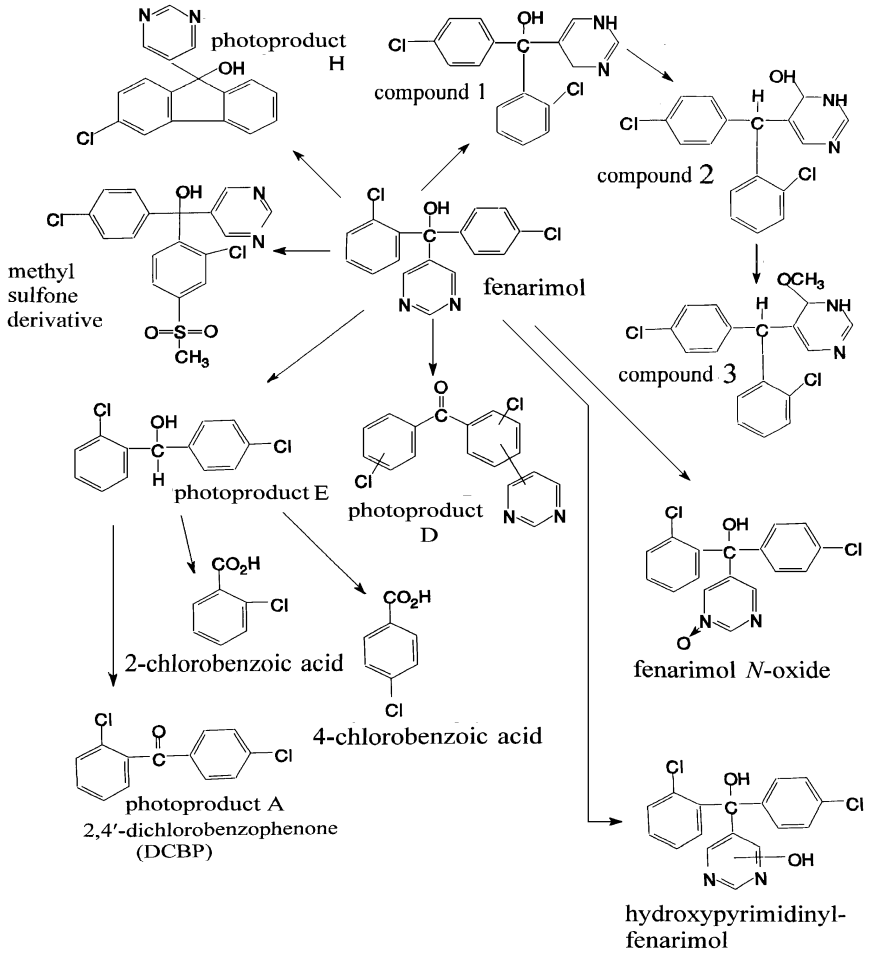
[1] Zones refer to retention on TLC plate. Zone C most polar, Zone A least polar.

The 50:50 chloroform/trichloroethane and the dichloromethane fractions were subjected to further aqueous/methanolic sodium hydroxide hydrolysis when *c.* 50% of the extracted radioactivity was attributed to dehydroxyfenarimol (DHF) and 2,4′-dichlorobenzophenone (DCBP). The dehydroxyfenarimol was apparently produced during the hydrolysis.

Further analytical investigations of the "metabolite complex" in the basic extract were carried out using radio-HPLC, NMR and MS.

Compound 3 (Figure 2) was tentatively identified by MS but could not be confirmed by NMR, owing to the small quantity obtained. Compound 1 was tentatively identified by MS. Positions of reduction of the pyrimidine ring were investigated using NMR. Compound 2 was tentatively identified by MS but there was too little for confirmation by NMR. Three isomeric structures could exist (where -H and -OH have been added to the pyrimidine ring). The hypothesis that compound 1 could be converted to compound 2 under acidic conditions and subsequently to compound 3 by methanolysis under acidic conditions was proposed.

Figure 2. Proposed pathways of metabolism in livestock and plants, and of potodegradation.



In further work to characterize other metabolites in grapes, it was concluded that the unidentified radioactivity was associated with many minor components (34 "zones" were isolated). No individual component accounted for more than 2.9% of the total radioactivity (0.04 mg/kg fenarimol equivalents) (Goebel, 1985b; Rainey, 1987).

Cucumbers. [*Carbinol*-^{14}C]fenarimol was formulated as an emulsifiable concentrate and diluted to give a 26.5 mg/l aqueous emulsion. It was applied as a spray to field-grown cucumbers (Green Prolific) in the USA. One application was made to run-off at a rate equivalent to 24.7g [^{14}C]fenarimol in 934 litres water/ha. Samples were taken four days after treatment and analysed by combustion and/or LSC. The characterization of metabolites was carried out by radio-TLC.

After extraction by refluxing with methanol and further extraction with dichloromethane the total radioactivity in the crop ranged from 0.003 to 0.042 mg/kg fenarimol equivalents. Approximately 93% of this (0.04 mg/kg fenarimol equivalents) was extracted into dichloromethane and 85% of the extracted radioactivity (0.03 mg/kg fenarimol equivalents) was attributed to fenarimol and 8% (0.003

mg/kg fenarimol equivalents) remained at the origin. Three other chromatographic bands were separated, each accounting for 3% of the radioactivity (0.001 mg/kg fenarimol equivalents) (Althaus, 1986).

Environmental fate in soil and water/sediment systems

No data were submitted.

METHODS OF RESIDUE ANALYSIS

Analytical methods

Methods for the analysis of a wide range of samples were supplied. In all of these the final determination is by GLC of a toluene solution, with EC detection. Validation data are shown in Table 16.

Crops and soil. Samples were extracted with ethanol/acetone, partitioned into chloroform, dissolved in toluene and analysed by GLC with an ECD. No validation data were submitted (Dow Elanco Ltd., 1976).

Crops other than cereals. Samples were extracted with methanol, partitioned into dichloromethane and transferred to toluene for analysis. No validation data were submitted (Dow Elanco Ltd., 1977).

Fresh fruit and vegetables, pomace, raisins, juice, bananas and "other crops". Samples were extracted with methanol, methanol/water or dichloromethane, then purified by chromatography on an alumina column which was eluted with 1-chlorobutane/methanol. The extract was evaporated and the residue dissolved in toluene for analysis. The authors state that the procedure "usually gives recoveries in excess of 90%" and has a limit of detection of 0.02 mg/kg except in dry pomace and "other crops" where the limit of detection is 0.01 mg/kg. No other validation data were submitted (Griggs and Decker, 1981).

Animal feeding-stuffs (hay and straw). Samples were extracted with methanol/water then purified by chromatography on an alumina column, which was eluted with 1-chlorobutane/methanol, before transfer to toluene (Griggs and Decker, 1985).

Beer. Samples were combined with sodium hydrogen carbonate solution, and partitioned into toluene for analysis (Butcher, 1992).

Spent yeast. Samples were extracted with methanol and, after dilution with water, partitioned with toluene. The extract was concentrated to dryness and the residue dissolved in 30:70 acetonitrile/water, then cleaned up on a C18 column eluted with 50:50 acetonitrile/water, acidified and partitioned into toluene (Butcher, 1992).

Fresh, dried and spent hops. Samples were extracted with methanol and sodium hydrogen carbonate solution and partitioned into methyl isobutyl ether. The extract was treated with alkaline permanganate, partitioned into toluene, dissolved in 1-chlorobutane, and cleaned up on an alumina column eluted with methanol/1-chlorobutane and on a C18 column eluted with acetonitrile/water. After acidification, the extract was partitioned into toluene for analysis (Butcher and Perkins, 1992).

Grape must, wine, grapes, tomatoes, peaches and melons. Samples were extracted with methanol and sodium hydrogen carbonate solution, partitioned into toluene, transferred to dichloromethane and

cleaned up on a C18 column eluted with methanol/dichloromethane or on a silica extraction column eluted with methanol/dichloromethane. The solvent was evaporated and the residue dissolved in toluene for analysis by capillary GLC (Butcher and Long, 1993; Butcher, 1994a).

Soil. Samples were extracted with methanol/water and cleaned up by column chromatography on alumina. Elution was with 1-chlorobutane/methanol. The authors state that the procedure "usually gives recoveries in excess of 90%" and has a limit of detection of 0.02 mg/kg. No other validation data were submitted (Griggs and Decker, 1981,1985).

Banana and banana pulp. Samples were ground with liquid nitrogen, then refluxed in methanol/HCl. NaOH was added to the hot solution which was then allowed to cool. The extract was partitioned with hexane and the hexane fraction washed through sodium sulphate, then evaporated to dryness. The residue was redissolved in toluene and analysed on a 2% OV 17 column. The compounds I and II (Figure 2) are also be determined by this method as dehydroxyfenarimol (Turner, 1992).

In a development of this method the methanol from the reflux solution was evaporated after the addition of NaOH. The remaining aqueous solution was extracted with dichloromethane, which was evaporated and the residue reconstituted in aqueous sodium chloride solution and partitioned with diethyl ether. The ether was evaporated and toluene added. The toluene extract was cleaned up on a silica solid-phase extraction column with elution with 10% ethyl acetate in dichloromethane. After evaporation the reconstituted toluene extract was analysed as above (Catta-Preta and Matos, 1993).

Wildlife. Meat and egg samples were extracted with methanol/acetonitrile or methanol and methylene chloride. Fat was extracted with hexane/1-chlorobutane and milk with acetonitrile, which was washed with hexane and partitioned with methylene chloride. Extracts were cleaned up on a Florisil column, eluted with methylene chloride/methanol, and dissolved in toluene (Yordy and Turner, 1982).

Table 16. Validation of analytical methods (treated plants, plant products, foodstuffs and feeding-stuffs).

Substrate	Spike, mg/kg % recovery	Precision-repeatability	Limit of determination, mg/kg	Reference
Whole apple fruit	0.001-0.02 73-98	no data	0.002-0.003	OR 1B
Dried apple pomace	0.005-0.1 65-103	no data	0.01	OR 1B
Whole fresh grapes	0.001-0.02 100-110	SD + 1-10	0.002-0.003	OR 1B
Wine	0.001-0.02 101-123	SD $\pm$ 2-14	0.002-0.003	OR 1B
Wine	0.01-0.1 99-107	RSD 2.5%	0.01	OR 22
Beer	0.01-0.1 90-108	RSD 4.0%	0.01	OR 21
Spent yeast	0.01-0.1 77-105	RSD 9.7%	0.01	OR 21
Dried hops	0.1-5 78-108	RSD 10.1%	0.1	OR 20
Fresh hops	0.1-2 75-94	RSD 7.4%	0.05	OR 20
Spent hops	0.02-0.5 75-102	RSD 8.3%	0.02	OR 20

Substrate	Spike, mg/kg % recovery	Precision-repeatability	Limit of determination, mg/kg	Reference
Tomatoes	0.01-0.1 86-101	RSD 5.1%	0.01	OR 24
Peach flesh	0.01-0.1 82-117	RSD 9.3%	0.01	OR 24
Melon peel	0.01-0.1 93-109	RSD 5.0%	0.01	OR 24
Melon pulp	0.01-0.1 81-112	RSD 10.2%	0.01	OR 24
Meat	0.01 101	SD ± 16.5	0.01	OR 19
Liver	0.01 108	SD ± 11.5	0.01	OR 19
Kidney	0.01 105	SD ± 13.7	0.01	OR 19
Fat/skin	0.01 87	SD ± 9.1	0.01	OR 19
Milk	0.001 95	SD ± 16.4	0.01	OR 19
Eggs	0.01 98	SD ± 9.0	0.01	OR 19
Banana	0.005-1.0 84-114	no data	0.01	OR 27
Banana pulp	0.005-1.0 82-105	no data	0.01	OR 27
Banana	0 005-1.1 55-114	no data	0.01	OR 28
Banana pulp	0.01-0.53 54-110	no data	0.01	OR 28

Stability of pesticide residues in stored analytical samples

Samples of grapes and wine were fortified with 0.1 mg/kg or mg/l fenarimol and stored deep frozen at -10°C to -27°C up to 370 days. Residues following storage and corrected for procedural recoveries were as shown in Table 17 (Butcher, 1994b).

Table 17. Residues in grapes and wine following storage at -20°C.

Storage period (days)	Residues, mg/kg			
	Black grapes	White grapes	Red wine	White wine
0	0.10-0.11	0.10-0.11	0.09-0.10	0.10
86	0.10-0.11	0.10-0.11	0.10-0.11	0.10
370	0.09-0.10	0.09-0.10	0.09-0.10	0.08-0.11

Ground fresh grapes and grape pomace were fortified with fenarimol at 0.05 mg/kg, and ground raisins and raisin waste at 0.2 mg/kg. Following 14 days refrigeration at 4°C, the samples were stored frozen for an additional 50-119 days. Samples were analysed after 0, 1, and 14 days and at the end of the study. Residues following storage and corrected for procedural recoveries were as shown in Table

18 (Day and Saunders, 1988a).

Table 18. Residues in fresh grapes, wet pomace, raisins and raisin waste following refrigeration and freezer storage.

Storage period, days	Residues, mg/kg			
	Fresh grapes	Wet pomace	Raisins	Raisin waste
0	0.054	0.054	0.20	0.19
1	0.052	0.055	0.18	0.23
14	-	0.049	0.18	0.17
18/19	-	-	0.19	0.21
23	0.050	-	-	-
74/76	-	-	0.19	0.18
131/133	0.052	0.054	-	-

In a further study, samples of cherries were fortified with 0.1 or 1.0 mg/kg fenarimol and stored for 11 days in a chill room at 4°C, then for 93 days in the freezer at -20°C. Samples were analysed using the method of Griggs and Decker (1981). Recoveries were variable but acceptable. The results, corrected for procedural recoveries, were as shown in Table 19 (Day and Saunders, 1988b).

Table 19. Residues in cherries following storage at -20°C.

Fortification level, mg/kg	Residue, mg/kg			
	Sweet cherry		Sour cherry	
	0.1	1.0	0.1	1.0
Storage period (days)				
0	0.11, 0.11	1.1, 1.1	0.11, 0.11	1.1, 1.1
4	0.09, 0.11	1.1, 1.1	0.10, 0.11	1.1
7	0.12, 0.13	1.1, 1.10	0.13, 0.11	1.1, 1.2
11	0.12, 0.13	1.2, 1.3	0.15, 0.13	1.3, 1.3
30	0.10, 0.10	0.9, 1.0	0.11, 0.10	1.0, 1.0
68	0.10, 0.10	0.9	0.11, 0.10	0.93, 0.91
104	0.11, 0.11	1.1, 1.0	0.10, 0.10	1.2, 1.1

A new study on the stability of fenarimol in fortified peaches, tomatoes and melons under frozen storage conditions was made available, but too late for review (Butcher, 1995g).

Residue definition

The animal and plant metabolism studies indicate that fenarimol is the major residue in products of both animal and plant origin. The residue is therefore defined as fenarimol.

USE PATTERN

Fenarimol is a systemic fungicide which has protective, curative and eradicative activity. Most commonly it is applied as a foliar treatment where apoplastic movement occurs through the leaf and towards the leaf tip, but movement from treated to untreated leaves is not sufficient to provide disease control. Application via the roots and seeds leads to translocation to all the aerial parts of the plant.

Fenarimol is registered in a large number of countries. Its uses cover a wide range of fruit and vegetables, hops and wheat. Full details of registered use patterns are given in Tables 20-22. The registered uses are for treatments in the field unless otherwise indicated.

Table 20. Registered uses of fenarimol on fruits and pecans.

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
Apples	Australia	EC	airblast	0.043-0.054	0.0029-0.0036	1-10	14	1 & 2
	Argentina	EC	mist blower broadcast	0.048-0.09	0.0024-0.003	2	20	1

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	Belgium	WP	LV overall	0.03-0.06	-------	3-4	1 month	1
	Brazil	EC	mist blower broadcast	0.038-0.14	0.0048-0.0072	2	28	1
	Chile	EC	Gun broadcast med vol	0.038-0.096	0.0036-0.0042	2	(a)	1
	Denmark	EC	HV overall	0.060	0.006-0.004	5	14	1 & 11
	Germany (Rubigan EC)	EC	L/HV row	0.0108-0.054	0.0036	max 7	21	1 & 8
	Germany (Elital)	SC	L/HV overall	0.0108-0.054	0.0036	max 14	21	1 & 8
	Germany (Rubigan SC)	SC	L/HV row	0.0108-0.054	0.0036	max 14	21	1 & 8
	Greece	WP	HV overall	0.105	0.0042	3-5	20	1
	Ireland	SC	LV overall	0.04-0.08	-------	up to 14 usually 4-6	14	1
	Italy	EC	HV overall	0.054-0.072	0.0036-0.0048	Through-out season	21	1
	Italy	SC	HV overall	0.054-0.072	0.0036-0.0048	Through-out season	21	1
	Italy	WP	HV overall	0.054-0.072	0.0036-0.0048	Through-out season	21	1
	Japan	WP	airblast	0.09-~0.14	0.003-~0.004	1-3	21	1
	Mexico	EC	mist blower	0.054-0.108	0.0027-0.0036	2	(b)	1
	Netherlands[1] (country submission)	WP	spraying of the aerial part	0.039-0.076	0.0039-0.076	3	21	6
	Netherlands (company submission)	WP	HV overall	0.039-0.076	0.0026-0.076	max 10	3 weeks	1
	New Zealand	SC	HV to run-off	0.0067-0.090	0.003	6	35	5
	Peru[1] (country submission)	-	foliar application	-	0.05	3	30	7
	Peru (company submission)	EC	gun broadcast	0.012-0.060	0.0015-0.004	2	(a)	1
	Portugal	EC	HV overall	0.024-0.054	0.0024-0.0036	5	21	1
	Spain	EC	low volume spray (500-1,500 l/ha)	-	0.0042-0.0048	7-10 days intervals	14	4
	Spain	EC	high volume spray (>1,500 l/ha)	0.060-0.096	-	7-10 days intervals	14	4
	Spain	SC	HV overall	0.063-0.072	0.0042-0.0048	1	14	1
	UK	SC	LV overall	0.04-0.08	-------	up to 14 usually 4-6	14	1
	Uruguay	EC	broadcast mist blower	0.075-0.090	0.0024-0.003	2	20	1
	USA	SC	spray	0.049-0.098	-	7-14***	30	4
	USA	EC	spray	0.067-0.101	-	7-10***	30	4

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
Bananas	Honduras[1]	EC	Aerial	0.08-0.12	0.0053-0.006	7	0 (c)	1
	Nicaragua[1]	EC	Aerial	0.08-0.12	0.533-0.6	7	0 (c)	1
Currants								
, black	Denmark	EC	HV overall	0.06	--------	3	14	1
, black	Ireland	SC	LV overall	0.04	--------	NR	14	1
	Netherlands[1] (country submission)	EC	spray	0.048-0.058	0.0048	4	21	6
	Netherlands (company submission)	EC	HV overall	0.048-0.058	0.0048	5	3 weeks	1
, black	UK	SC	LV overall	0.04	--------	NR	14	1
Cherry	Denmark	EC	HV overall	0.060	--------	5	14	1
	Japan	WP	airblast	0.16 ~0.2	0.004	1-3	3	1
	USA	EC	spray	0.051-0.101	-	4-8***	up to & after harvest	4
Gooseberries	Ireland	SC	HV overall	0.04	-------	NR	14	1
	Netherlands	EC	spray	0.048-0.058	0.0048	4	21	1
	UK	SC	HV overall	0.04	-------	NR	14	1
Grapes	Argentina	EC	gun individual plant	0.0192-0.036	0.0024	2	30	1
	Australia	EC	airblast	0.012-0.024	0.0012-0.0024	1-7	14	1
	Brazil	EC	gun individual plant	0.0108-0.024	0.0018-0.0024	4	15	1
, table	Chile	EC	gun individual plant	0.005 0.012	0.002-0.003	3	(d)	1
	France	SC	LV overall	0.018	0.0009-0.003	1 to 4	7	1
, wine	Germany[1] (Elital) (country submission)	SC	spray	0.0047-0.0125	0.00078	6	35	8
	Germany (Elital) (company submission)	SC	L/HV overall	0.0047-0.0234	0.00156	max 6*	35	1
	Germany (Rubigan SC)	SC	L/HV row	0.0047-0.0234	0.00156	max 6	35	1
	Greece	WP	HV overall	0.012-0.024	0.0012-0.0024	2-4	30	1
	Ireland	SC	LV overall	0.04	-------	NR	14	1
,table	Italy	WP	HV overall	0.03-0.06			14	1
,table	Italy	SC	HV overall	0.018-0.036	0.0018-0.0036	--------	14	1
, wine	Italy	SC	HV overall	0.014-0.054	0.0018-0.0036	--------	14	1
, wine	Italy	WP	HV overall	0.014-0.036	0.0018-0.0036		14	1
	Mexico	EC	mist blower	0.030-0.054	0.0075-0.0054	4	(e)	1
	New Zealand	SC	HV spray to run-off	0.024-0.048	0.0024	4	30	5
	Peru[1] (country	-	foliar	-	0.02	4	30	7

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	submission)		application					
	Peru (company submission)	EC	gun broadcast	0.012-0.060	0.0012-0.005	3	(d)	1
	Portugal	EC	HV overall	0.011-0.03	0.0018-0.0030	3	7	1
	Spain	EC	MV-HV overall	0.0099-0.05	0.0033-0.0036	1 (wine) 3(table)	28 (wine) 14 (table)	1
	Spain	SC	MV-HV overall	0.009-0.05	0.003-0.0036	1 (wine) 3(table)	28 (wine) 14 (table)	1
	UK	SC	spray	0.04	-------	NR	14	1 & 4
	Uruguay	EC	gun application individual plant	0.019-0.036	0.0024	2	30	1
	USA	EC	spray	0.017-0.051	_	3-9***	30	4
	USA	SC	spray	0.024-0.049	-	2-7***	30	4
Peaches	Argentina	EC	mist blower	0.048-0.072	0.0024	2	20	1
	Greece	WP	HV overall	0.12	0.0048	2-4	20	1
	Italy	EC	HV overall	0.072	0.0042-0.0048	2-3	14	1 & 12
	Italy	SC	HV overall	0.072	0.0042-0.0048	2-3	14	1 & 12
	Japan	WP	airblast	0.12-~0.2	0.004	1-3	1	1
	Spain	EC	HV overall	-	0.0042-0.0048	1	7	4
	Spain	SC	HV overall	-	0.0042-0.0048	1	7	4
	Uruguay	EC	broadcast mist blower	0.048-0.072	0.0024	2	20	1
Pears	Argentina	EC	mist blower broadcast	0.048-0.09	0.0024-0.003	2	20	1
	Australia	EC	airblast	0.043-0.054	0.029-0.0036	1-10	14	1 & 2
, Japanese	Australia	EC	airblast	0.036-0.054	0.0024-0.0036	1-10	14	1 & 2
	Belgium	WP	LV overall	0.03-0.06	--------	3-4	1 month	1
	Chile	EC	Gun broadcast med. vol	0.038-0.096	0.0036 0.0042	2	(a)	1
	Denmark	EC	HV overall	0.060	--------	5	14	1
	Germany (Elital)	SC	L/HV overall	0.0108-0.054	0.0036	max 14	21	1 & 8
	Italy	EC	HV overall	--------	0.0036-0.0048	**	14	1
	Italy	SC	HV overall	--------	0.0036-0.0048	**	14	1
	Italy	WP	HV overall	0.054-0.072	0.0036-0.0048	**	14	1

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	Japan	WP	airblast	0.09-~0.12	0.003-~0.004	1-3	21	1
	Mexico	EC	mist blower	0.054-0.108	0.0027-0.0036	2	(b)	1
	Netherlands[1] (country submission)	WP	spraying of the aerial part	0.039-0.076	0.0039-0.076	3	21	6
	Netherlands (company submission)	WP	HV overall	0.039-0.076	0.0026-0.0076	max 10	3 weeks	1
	New Zealand	SC	HV to run-off	0.0067-0.090	0.003	6	35	5
	Portugal	EC	HV overall	0.024-0.054	0.0024-0.0036	5	21	1
	Spain	EC	HV overall	0.063-0.072	0.0042-0.0048	1	14	1
	Spain	SC	HV overall	0.063-0.072	0.0042-0.0048	1	14	1
	Uruguay	EC	broadcast mist blower	0.075-0.090	0.0024-0.003	2	20	1
	USA	SC	spray	0.049-0.098	-	7-14***	30	4
	USA	EC	spray	0.067-0.101	-	7-10***	30	4
Pecans	Mexico	EC	mist blower	0.054-0.108	0.0028-0.0057	2	(f)	1
	USA	SC	applied to run-off	0.073-0.098	-	7-9***	30	4
Persimmon, Japanese	Japan	WP	airblast	0.2	0.004	1-3	21	1
Raspberry	UK	SC	LV overall	0.04	--------	3	14	1
	Ireland	SC	LV overall	0.04	--------	3	14	1
Strawberry	Denmark	EC	HV overall	0.084	--------	3	14	1
	Ireland	SC	LV overall	0.04	--------	NR	14	1
	Italy	EC	HV overall	--------	0.0042-0.0048	3	7	1
	Italy	SC	HV overall	--------	0.0042-0.0048	3	7	1
	Italy	WP	HV overall	0.034-0.038	0.0042-0.0048	3	7	1
	Japan	WP	mist spray[2]	0.03	0.003	1-3	1	1 & 10
	Netherlands[1] (country submission)	EC	spray[2]	0.036-0.084 (depend. on variety)	0.006-0.0084	4	treatment before flowering or after harvest	6
	Netherlands (company submission)	EC	HV overall	0.03-0.05	0.005-0.01	5	treatment before flowering or after harvest	1
	Spain	EC	HV overall		0.0042-0.0048	4	3	1
	Spain	SC	HV overall		0.0036-0.0048	4	3	1

Commodity	Country	Form	Application				PHI, days	Ref.
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	UK	SC	LV overall	0.04	-------	NR	14	1

[1] No product label submitted
[2] Glasshouse and Field use
NR No restration restriction, typically 2-4
* max 4 between flowering and benning of ripening
** Application throughout season
*** the maximum number of treatments is controlled by a maximum total dose
Notes (a) to (f) refer to growth stage at last treatment:
(a) immature fruit (b) early fruit
(c) from disease onset (d) mature fruit
(e) fruit initiation (f) pre-flowering

Table 21. Registered uses of fenarimol on vegetables.

Crop	Country	Form	Application				PHI, days	Refer-ence
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
Artichokes	Italy	EC	HV overall	--------	0.0048	3	7	1
	Italy	SC	HV overall	--------	0.0048	3	7	1
	Italy	WP	HV overall	0.038	0.0048	3	7	1
Aubergines	Italy	EC	HV overall	--------	0.0048	3	7	1
	Italy	SC	HV overall	--------	0.0048	3	7	1
	Italy	WP	HV overall	0.038	0.0048	3	7	1
	Japan	WP	mist spray	0.024 ~0.04	0.0012 ~0.002	1-3	1	1
Courgettes	Netherlands[1] (country submission)	EC	spray[2]	0.012-0.036	0.0024	6	3	6
	Netherlands[1] (country submission)	EC	spray (field only)	0.0096-0.024	0.0024	6	3	6
Cucumbers	Brazil	EC	knapsack individ. plant	0.038-0.072	0.0048-0.0072	4	4	1
	Denmark	EC	HV overall[3]	0.024-0.036	0.0024	4-8	2	1
	Ireland	SC	LV overall	--------	0.001-0.002	NR	2	1
	Japan	WP	mist spray	0.024	0.0012	1-3	1	1
	Netherlands	EC	spray[2]	0.012-0.036	0.0024	6	3	1
	UK	SC	LV overall[3]	--------	0.001-0.002	NR	2	1
	Uruguay	EC	knapsack individ. plant	0.014-0.024	0.0012-0.0024	4	4	1
Cucurbits	Australia	EC	Boom	0.024	0.004	1-10	3	1
	Greece	WP	HV overall	0.018-0.024	0.0018-0.0024	as requir ed	1	1
	Italy	EC	HV overall	--------	0.0024-0.003	3	7	1
	Italy	SC	HV overall	--------	0.0024-0.003	3	7	1
	Italy	WP	HV overall	0.020-	0.0024-	3	7	1

Crop	Country	Form	Application				PHI, days	Reference
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
				0.024	0.003			
	Spain	EC	HV overall	0.01-0.019	0.0036-0.0048	2	7	1
	Spain	SC	HV overall	0.013-0.019	0.0042-0.0048	2	7	1
Egg plants, see Aubergines								
Gherkins	Netherlands[1] (country submission)	EC	spray[2]	0.012-0.036	0.0024	6	3	6
	Netherlands[1] (country submission)	EC	spray (field only)	0.0096-0.024	0.0024	6	3	6
Melons	Japan	WP	mist spray	0.024	0.0012	1-4	1	1
	Netherlands	EC	spray[2]	0.012-0.036	0.0024	6	3	1
	Portugal	EC	HV overall	0.024-0.036	0.0024-0.0036	5	3	1
Musk-melons	Brazil	EC	knapsack individ. plant	0.014-0.024	0.0018-0.0024	4	4	1
Peas	Italy	EC	HV overall	--------	0.0024-0.003	3	7	1
	Italy	SC	HV overall	--------	0.0024-0.003	3	7	1
	Italy	WP	HV overall	0.02-0.024	0.0024-0.003	3	7	1
Peas, Immature	Japan	WP	mist spray	0.024	0.0012	1-5	1	1
Peppers	Italy	EC	HV overall	--------	0.0048	3	7	1
	Italy	SC	HV overall	--------	0.0048	3	7	1
	Italy	WP	HV overall	0.038	0.0048	3	7	1
	Netherlands[1] (country submission)	EC	spray[2]	0.012-0.036	0.0024	6	3	6
	Japan	WP	mist spray	0.024	0.0012	1-4	1	1
	Spain	EC	HV overall	0.048-0.072	0.0048-0.006	3	7	1
	Spain	SC	HV overall	0.048-0.072	0.0048-0.006	3	7	1
	UK	SC	overall spray[2]	0.054	0.002	3	7	9
Pumpkins	Brazil	EC	knapsack individ. plant	0.014-0.024	0.0018-0.0024	4	4	1
	Japan	WP	mist spray	0.012	0.0012	1-4	3	1
	Peru	EC	gun individ. plant	0.012-0.060	0.0015-0.004	4	4	1
Squash, small	Argentina	EC	gun individ. plant	0.0096-0.024	0.0012-0.0024	4	4	1
Squash	Uruguay	EC	knapsack individ. plant	0.014-0.024	0.0012-0.0024	4	4	1
Squash, summer	Netherlands	EC	spray[2]	0.012-0.036	0.0024	6	3	1
Tomatoes	Denmark	EC	HV overall[3]	0.024-0.036	0.0024	4-8	2	1
	Italy	EC	HV overall	---------	0.0048	3	7	1
	Italy	SC	HV overall	---------	0.0048	3	7	1

Crop	Country	Form	Application				PHI, days	Refer-ence
			Method	Rate kg ai/ha	Spray conc, kg ai/hl	No.		
	Italy	WP	HV overall	0.038	0.0048	3	7	1
	Japan	WP	mist spray	0.04	0.002	1-3	1	1
	Netherlands[1] (country submission)	EC	spray[2]	0.024-0.072	0.0048	3	3	6
	Netherlands (company submission)	EC	HV overall	0.024-0.072	0.0048	5	3	1
	Spain	EC	HV overall	0.028-0.057	0.0048	3	7	1
	Spain	SC	HV overall	0.028-0.057	0.0048	3	7	1
	UK	SC	overall spray[2]	0.054	0.002	3	7	9
Watermelons	Brazil	EC	knapsack individ. plant	0.014-0.024	0.0018-0.0024	4	4	1
	Japan	WP	mist spray	0.012	0.0012	1-4	3	1
	Uruguay	EC	knapsack individ. plant	0.0096-0.0024	0.0012-0.0024	4	4	1
Vegetables	Netherlands	EC	HV overall	0.012-0.036	0.0024	5	3	1

[1] No product label submitted
[2] Glasshouse use only
[3] Glasshouse and field use

Table 22. Registered uses of fenarimol on hops and cereals.

Crop	Country	Form	Application				PHI, days	Ref.
			Method	Rate, kg ai/ha	Spray conc., kg ai/hl	No.		
Hops	Germany	WP	HV row	0.06	0.0015	max 4	10	1 & 8
	Spain	EC	HV overall		0.0042-0.0048		--------	1
	Spain	SC	HV overall		0.0042-0.0048		--------	1
Wheat	Japan	WP	Boom	0.04-0.06	0.004	1-2	14	1

Uses of fenarimol were also reported in Algeria, Austria, "Belarus", Bulgaria, China, "CR/SR", Croatia, Egypt, Hungary, India, Indonesia, Iraq, Korea, Lebanon, Libya, Macedonia, Morocco, Pakistan, Poland, Romania, Russia, Slovenia, Slovakia, Switzerland, Syria, Taiwan and Tunisia, but insufficient information was submitted for inclusion in the Tables.

RESIDUES RESULTING FROM SUPERVISED TRIALS

The residue trials are summarized in the following Tables. Trials were carried out under field conditions unless stated otherwise. Unless indicated in the notes, trials were reported in sufficient detail and acceptable analytical information was supplied. Analytical recoveries outside the range 70-120% and/or storage of samples for longer than 6 months are also indicated in the notes. Analytical results have been rounded to one significant figure if <0.1 mg/kg except where processing information is given.

Apples. Informatiaon on GAP was reported for many countries world-wide. The maximum

application rates are 0.054-0.14 kg ai/ha with PHIs of 14-35 days.

Residue trials data were available from Belgium, Germany, the UK, Canada, the USA, Chile, Brazil, New Zealand and The Netherlands. Residues in 16 Northern European trials according to German GAP (0.0036 kg ai/hl, 21-day PHI) were 0.02-0.21 mg/kg. Three further trials which reflected German GAP showed residues of 0.06, 0.1 and 0.1 mg/kg but only a summary was submitted. Eight Northern European trials complied with GAP in Denmark, the UK and Ireland in which there is a shorter PHI of 14 days (maximum rates 0.06-0.08 kg ai/ha, concentration not specified) with residue levels of 0.02-0.18 mg/kg. A further 6 Dutch trials were within GAP in The Netherlands (0.0039-0.076kg ai/hl, 21-day PHI) with residues of 0.01-0.34 mg/kg in samples taken 21 days after the final treatment. However, these Dutch trials were submitted in summary form only. In 5 replicated US trials according to GAP (ca 0.1 kg ai/ha, 30-day PHI) residue levels were 0.002-0.3 mg/kg. In three New Zealand trials according to GAP (maximum 0.09 kg ai/ha, 0.003 kg ai/hl, 35-day PHI) residues were 0.008-0.03 mg/kg.

Table 23. European supervised residue trials on apples.

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
Ramecroix, Belgium, 1976[1]	EC	11	0.034	0.004	0	0.12	NF 13 B76-001
					7	0.07	
					14	0.05	
					21	0.06	
					28	0.04	
					85	0.01	
Giessen, Germany, 1977[1]	EC	10	0.036	0.003	55	<0.01	NF 15 D76-302
			0.048	0.004	55	<0.01	
Giessen, Germany, 1978[2,3,5]	EC	14	0.054	0.0036	0	0.13	NF 08 D78-311
					3	0.12	
					7	0.10	
					10	0.11	
					14	0.07	
					21	0.06	
					28	0.08	
					36	0.07	
Giessen, Germany, 1981[3,5]	SC	14	0.054	0.0036	0	0.16	NF 20 D81-302
					4	0.06	
					13	0.05	
					20	0.07	
					27	0.04	
					33	0.06	
Uberlingen, Germany, 1981[3,4,5]	SC	14	0.054	0.0036	0	0.29	NF 20 D81-353
					4	0.34	
					7	0.02	
					14	0.02	
					21	0.02	
Wulfsdorf, Germany, 1981[3,5]	SC	13	0.054	0.0036	0	0.36	NF 20 D81-350
					7	0.23	
					14	0.18	
					22	0.06	

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
					28	0.05	
					35	0.05	
Wittlich, Germany, 1981[3,4,5]	SC	10	0.06	0.00396	0	0.37	NF 20 D81-351
					7	0.19	
					14	0.15	
					21	0.15	
					28	0.09	
					63	0.01	
Kriftel, Germany, 1982[3,5]	EC	13	0.036	0.0036	0	0.06	NF 21 D82-304
					8	0.05	
					14	0.04	
					17	0.04	
	SC	13	0.036	0.0036	0	0.1	
					8	0.09	
					14	0.07	
					17	0.04	
Kriftel, Germany, 1982[3,5,6]	EC	13	0.036	0.0036	0	0.09	NF 21 D82-305
					8	0.08	
					14	0.06	
					21	0.05	
					30	0.03	
	SC	13	0.036	0.0036	0	0.21	
					8	0.17	
					14	0.04	
					21	0.11	
					30	0.05	
Marbach, Germany, 1982[3,5]	EC	14	0.036	0.0036	0	0.37	NF 21
					7	0.24	
					13	0.22	
					20	0.21	
					27	0.14	
Marbach, Germany, 1982[3,5]	EC	14	0.036	0.0036	0	0.18	NF 21 D82-307
					7	0.11	
					13	0.15	
					20	0.14	
					27	0.09	
Giessen, Germany, 1982[3,5,6]	EC	14	0.036	0.0036	0	0.17	NF 21 D82-301
					5	0.08	
					13	0.05	
					19	0.03	
					26	0.04	
					35	0.01	
	SC	14	0.036	0.0036	0	0.19	
					5	0.11	
					13	0.08	
					19	0.07	
					26	0.04	

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
					35	0.02	
Giessen, Germany, 1982[3,5]	SC	14	0.036	0.0036	0	0.10	NF 21 D82-302
					5	0.12	
					13	0.06	
					19	0.04	
					26	0.04	
					35	0.03	
	EC	14	0.036	0.0036	0	0.10	
					5	0.07	
					13	0.03	
					19	0.03	
					26	0.01	
					35	0.02	
Giessen, Germany, 1982[3,5,6]	EC	14	0.036	0.0036	0	0.06	NF 21 D82-303
					8	0.03	
					14	0.03	
					21	0.02	
					30	0.01	
	SC	14	0.036	0.0036	0	0.10	
					8	0.09	
					14	0.01	
					21	0.03	
					30	0.01	
Bonn, Germany, 1982[1]	EC	12	0.05	0.004	0	0.1	8
					7	0.1	
					14	0.1	
					21	0.1	
					28	0.04	
Dossenheim, Germany, 1982[1]	EC	14	0.05	0.004	0	0.1	8
					10	0.1	
					14	0.04	
Frankfurt, Germany, 1982[1]	EC	14	0.05	0.004	0	0.1	8
					10	0.1	
					14	0.1	
					21	0.1	
					28	0.02	
Oudenbosch, Netherlands, 1977[5,7]	WP	1		0.005	7	0.14	6
						0.14	
						0.22	
						0.17	
					14	0.1	
						0.14	
						0.15	
						0.09	
					21	0.09*	
						0.01*	

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
						0.11*	
						0.06*	
Berlicum, Netherlands, 1977[5,7]	WP	1		0.005	7	0.33	6
						0.41	
						0.3	
						0.37	
					14	0.21	
						0.46	
						0.35	
						0.24	
					21	0.28*	
						0.21*	
						0.26*	
						0.34*	
Breskens, Netherlands, 1977[5,7]	WP	1		0.005	7	0.27	6
						0.34	
						0.22	
						0.19	
					14	0.16	
						0.12	
						0.13	
						0.15	
					21	0.22*	
						0.22*	
						0.18*	
						0.14*	
Knuiningen, Netherlands, 1978[5,7]	WP	1		0.005	8	0.09	6
					15	0.11	
					22	0.06*	
Knuiningen, Netherlands, 1978[5,7]	WP	1		0.005	9	0.09	6
					15	0.06	
					22	0.03*	
Knuiningen, Netherlands, 1978[5,7]	WP	1		0.005	7	0.14	6
					14	0.11	
					21	0.13*	
Surrey, UK, 1981[3,5]	SC	13	0.06	0.003 x 11 0.002 x 2	0	0.17	NF 20 FF81-002-01
					7	0.12	
					14	0.04	
					21	0.07	
Surrey, UK, 1981[3,5]	SC	13	0.06	0.003 x 11 0.002 x 2	0	0.30	NF 20 FF81-002-02
					7	0.18	
					14	0.10	
					21	0.09	

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
Surrey, UK, 1981[3,5]	SC	13	0.06	0.003 x 11 0.002 x 2	0	0.31	NF 20 FF81-002-03
					7	0.19	
					14	0.14	
					21	0.13	

Underlined residues are from treatments according to GAP in Germany; those underlined twice from treatments according to GAP in Denmark, Ireland and the UK.
* According to GAP in The Netherlands.
[1] No detailed report submitted
[2] No weather data submitted
[3] Method of analysis unspecified
[4] Crops stored for 7 (NF20 D81-351) or 8 months (NF20 D81-353) before analysis
[5] No example chromatograms submitted
[6] High associated recoveries (NF21: D82-305 113-126%; D82-301 102-126%; D82-303 110-127%)
[7] Report not in English

Table 24. Non-European supervised residue trials on apples (including US processing trials).

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
Ontario, Canada, 1975[1,2,7]	EC	13	0.025	0.002	42	fruit	0.01	NF 25 MFM 5-1
			0.05	0.004		fruit	0.02	
			0.075	0.008		fruit	0.04	
Ontario, Canada, 1975[1,2,7]	EC	13	0.025	0.002	42	fruit	0.02	NF 25 MFM 6-1
			0.03	0.004		fruit	0.02	
			0.05	0.004		fruit	0.02	
			0.075	0.008		fruit	0.06	
Ontario, Canada, 1976[1,2,7]	EC	12	0.097	0.002	34	fruit	0.01	NF 25 MFM 6-3
			0.134	0.004		fruit	0.02	
			0.270	0.004		fruit	0.06	
		11	0.16 x 4 0.08 x 7	0.004 x 4 0.002 x 7		fruit	0.04	
Meaford, ONT, Canada, 1977 [1,2,7,9]	EC	6	0.016			fruit	0.007	NF 26 MFM 7-12
		6			15	fruit	0.05	
Bowmanville, ONT, Canada, 1977[1,2,7,9]	EC	5	0.016			fruit	0.17	NF 26 MFM 7-14
London, ONT, Canada, 1977[1,2,7,9]	EC	8	0.012		28	fruit	0.02	NF 26 MFM 7-28
Simcoe, ONT, Canada, 1977[1,2,7,9]	EC	8	0.012		84	fruit	0.03	NF 26 MFM 7-29
Simcoe, ONT, Canada, 1977[1,2,7,9]	EC	10	0.016 x 8 0.08 x 2			fruit	0.03	NF 26 MFM 7-31
		10	8 x 0.141 or 0.016 2 x 0.069 or			fruit	0.03	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
			0.08					
Nattawa, ONT, Canada, 1977[1,2,7,9]	EC	6	0.016		83	fruit	0.007	NF 26 MFM 7-34
		6	0.016		83	fruit	0.003	
Meaford, ONT, Canada, 1977[1,7]	EC	6	0.142		15	fruit	0.07	NF 27 MFM 7-12
		6	0.142			fruit	0.05	
Bowmanville, ONT, Canada, 1977[1,7]	EC	5	0.142		69	fruit	0.02	NF 27 MFM 7-14
London, ONT, Canada, 1977[1,7]	EC	8	0.1		28	fruit	0.02	NF 27 MFM 7-38
Simcoe, ONT, Canada, 1977[1,7]	EC	8	0.1		86	fruit	0.03	NF 27 MFM 7-29
Simcoe, ONT, Canada, 1977[1,7]	EC	8	6 x 0.142 2 x 0.071		45	fruit	0.03	NF 27 MFM 7-33
Simcoe, ONT, Canada, 1977[1,7]	EC	6	0.142		90	fruit	0.003	NF 27 MFM 7-34
Nottawa, ONT, Canada, 1977[1,7]	EC	6	0.142		90	fruit	0.007	NF 27 MFM 7-34
Oyamba, BC, Canada, 1980[1,7]	EC	3	0.101		131	fruit	0.003	NF 27 K Ellison
					95	fruit	0.004	
Kelowna, BC, Canada, 1980[1,7]	EC	3	0.101		121	fruit	<0.002	NF 27 E. Star
West Bank, BC, Canada, 1980[1,7]	EC	3	0.101		121	fruit	0.03 <0.002	NF 27 M. Janse
Campinas, Brazil, 1985[1,6,7]	EC	9		0.018	28	fruit	0.01	NB 29
				0.036		fruit	0.04	
Curico, Chile, 1980[1,3,7,12]	EC	9	0.06		100	fruit	0.09 0.09	NF 28
	SC					fruit	0.06	
San Fernando, Chile, 1980[1,3,7,12]	EC	6	0.06		113	fruit	0.08	
			0.048			fruit	0.003	
Albany, NZ, 1976[1]	EC	10	0.132	0.002-0.004	2	fruit	0.07	NF 29 NZ 75-19
					6	fruit	0.05	
					12	fruit	0.04	
			0.099	0.0015-0.003	2	fruit	0.07	
					6	fruit	0.05	
					7	fruit	0.07	
					21	fruit	0.06	
					35	fruit	0.02	
Hastings, NZ, 1979[1]	WP	12	0.061	0.0025	52	fruit	0.008	NF 29 NZ 78-2
			0.061	0.003		fruit	0.006	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
Hamilton, NZ, 1980[1]	WP	1	0.048		120	fruit	<0.002	NF 29 NZ 80-6
Hamilton, NZ, 1980[1]	WP	8	0.081		1	fruit	0.02	NF 29 NZ 80-5
					8	fruit	0.02	
					15	fruit	0.01	
					29	fruit	0.008	
Christchurch, NZ, 1981[1]	WP	14		0.003	31	fruit	0.03	NF 29 T Holland
					38	fruit	0.03	
					45	fruit	0.01	
Geneva, NY, USA, 1981[1,2,4]	EC	6	0.0445		107	fruit	<0.002	NF 18 Cornel
						juice	<0.002	
						sauce	<0.002	
						wet pomace from sauce	0.003	
						dry pomace	0.025	
		3 3	0.0445 0.0223		107	fruit	0.002	
						juice	<0.002	
						sauce	<0.002	
						wet pomace from sauce	0.002	
						dry pomace	0.014	
Biglerville, PA, USA, 1981[1,2,4,9]	EC	11	0.1038		42	fruit	0.037	NF 18 Penn. Univ.
						juice	0.003	
						sauce	0.009	
						wet pomace from sauce	0.20	
						dry pomace	0.67	
		4 7	0.1038 0.0519		42	fruit	0.017	
						juice	<0.002	
						sauce	0.004	
						wet pomace from sauce	0.079	
						dry pomace	0.20	
Winchester, VA, USA, 1981[1,2,4,9]	EC	10	0.1038		34	fruit	0.059	NF 18 Winchester
						juice	0.002	
						sauce	0.015	
						wet pomace from sauce	0.14	
						dry pomace	0.31	
		3 7	0.1038 0.0519			fruit	0.057	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
						juice	0.002	
						sauce	0.01	
						wet pomace from sauce	0.015	
						dry pomace	0.36	
Sodus, NY, USA, 1982[1,2,3,4,9,12]	EC	1 10	0.316 0.105		41	juice	0.002	NF 18 CMR 82-9
						wet pomace from juice	0.049	
						sauce	<0.002	
						dry pomace	0.11	
		1 10	0.316 0.105		41	juice	<0.002	
						wet pomace from juice	0.061	
						sauce	<0.002	
						dry pomace	0.13	
Sodus, NY, USA,1982[1,2]	EC	8	0.105		63	fruit	0.014	NF 18 CMR 8-10
						juice	0.002	
						wet pomace from juice	0.073	
						sauce	<0.002	
						dry pomace	0.12	
		8	0.105		63	fruit	0.008	
						juice	0.002	
						wet pomace from juice	0.072	
						sauce	<0.002	
						dry pomace	0.16	
Sodus, NY, USA, 1982[1,2]	EC	8	0.079		83	fruit	<0.002	NF 18 CMR 82-11
						juice	<0.002	
						wet pomace from juice	0.006	
						sauce	<0.002	
						dry pomace	0.012	
		8	0.079		83	fruit	<0.002	
						juice	0.002	
						wet pomace from juice	0.003	
						sauce	<0.002	
						dry pomace	0.013	
Sodus, NY, USA, 1982[1,2]	EC	10	0.0789		53	fruit	0.007	NF 18 CMR 82-16
						juice	<0.002	
						sauce	<0.002	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
						wet pomace from sauce	0.068	
						dry pomace	0.12	
		10	0.0789		53	fruit	0.007	
						juice	<0.002	
						sauce	<0.002	
						wet pomace from sauce	0.079	
						dry pomace	0.098	
Daleville, VA, USA, 1982[1,2,4]	EC	8	0.1052		33	fruit	0.002	NF 18 DAA 82-6
						juice	<0.002	
						wet pomace from juice	0.013	
		11	0.1052		33	fruit	0.002	
						juice	<0.002	
						wet pomace from juice	0.009	
Tehachapi, CA, USA, 1982[1,2,9]	EC	4	0.2105		118	fruit	<0.002	NF 18 DHF 82-12
						juice	<0.002	
						wet pomace from juice	0.009	
Gardners, PA, USA, 1982[1,2,11]	EC	8	0.0526		136	fruit	<0.002	NF 18 PEB 82-5
						juice	<0.002	
						sauce	<0.002	
						wet pomace from sauce	<0.002	
Thurmont, MD, USA, 1982[1,2]		10	0.1052		70	fruit	0.02	NF 18 PEB 82-6
						juice	0.002	
						sauce	0.003	
						wet pomace from sauce	0.036	
Gettysburgh, PA, USA, 1982[1,2,11]		10	0.0526		75	fruit	0.021	NF 18 PEB 82-14
						juice	0.003	
						sauce	<0.002	
						wet pomace from sauce	0.054	
Watsonville, CA, USA,1982[1,2,9]		4	0.1052		104	fruit	0.005	NF 18 RAH 82-1
						juice	0.002	
						wet pomace from juice	0.018	
		4	0.2105		104	fruit	0.013	
						juice	0.003	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
						wet pomace from juice	0.043	
Snelling, CA, USA, 1982[1,2,9]		4	0.1052		93	fruit	0.008	NF 18 RAH 82-2
						juice	0.002	
						wet pomace from juice	0.021	
		4	0.2105		93	fruit	0.011	
						juice	0.002	
						wet pomace from juice	0.029	
Moxee, WA, USA, 1982[1,2]		1 3	0.084 0.104		122	fruit	0.002	NF 18 WTC 82-4
						juice	<0.002	
						wet pomace from juice	0.005	
		1 3	0.104 0.132		122	fruit	0.002	
						juice	<0.002	
						wet pomace from juice	0.004	
Orondo, WA, USA, 1982[1,2]		2 2	0.105 0.132		147	fruit	0.007	NF 18 WTC 82-8
						juice	<0.002	
						wet pomace from juice	0.015	
Covert, MI, USA, 1982[1,2,9]		10	0.1052		147	fruit	0.019	NF 18 DG 082-10
						juice	<0.002	
						wet pomace from juice	0.14	
						sauce	0.003	
						wet pomace from sauce	0.33	
Sodus, NY, USA, 1976[1,2]		10	0.1075		62	fruit	0.004	NF 18 CDC 6-16
						juice	<0.002	
						wet pomace from juice	0.022	
						dry pomace	0.068	
Reedley, CA, USA, 1988	EC	7	0.105		30	fruit	0.03	NF 31 DHF88-02
		7	0.105		30	fruit	0.02	NF 31 DHF 88-03
Sunnyside, WA, USA, 1988	EC	7	0.105		29	fruit	0.01	NF 31 BJB88-01
		7	0.105		29	fruit	0.01	NF 31 BJB88-02
		7	0.105		29	fruit	0.02	NF 31

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
								BJB88-03

Underlined residues are from treatments according to GAP in the USA; those underlined twice from treatments according to GAP in New Zealand
[1] No weather data submitted
[2] Method of analysis unspecified. Stated to be GLC for studies NF 20, 25 & 26 but no further details
[3] No control plot data submitted
[4] Crops stored for 8-15 months before analysis
[6] No example chromatograms submitted
[7] Duration of sample storage unspecified
[9] High associated recoveries (NF26: MFM 7-12 98-140%, NF 18 dry pomace 132%; juice 121-128%
[11] Half sprayed - one side of row only
[12] System recoveries only submitted (i.e control extract or extraction solvent, not the commodity, was fortified)

Pears. GAP was reported for many countries world-wide and was generally the same as that reported for apples.

A few trials were available which complied with GAP (the same as for apples) in Germany (one trial), Italy (one trial) or the USA (4 trials with replicates), but the recoveries associated with the German (0.13 mg/kg) and Italian trials (0.09 mg/kg) were low at 67 and 63% respectively. Residues in the US trials were 0.01-0.04 mg/kg.

Table 25. Supervised residue trials on pears.

Location, year	Application				PHI, days	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl			
Australia, 1985[1,5,6]				0.0036	14	0.03	NB 30 AUS 78-314
				0.0072		0.04	
Giessen, Germany, 1978[1-4,6]	EC	14	0.054		0	0.1	NF 03 D78-312
					3	0.08	
					10	0.07	
					13	0.08	
					17	0.08	
					20	0.09*	
					24	0.03	
					31	0.06	
Baricella, Italy, 1981[1-4]	SC	17		0.004	20	0.13	NF 06 181 211
Hood River, OR, USA, 1983[1,5]	EC	3	0.143		112	0.003	NF 33 WTC83-2
Medford, OR, USA, 1983[1,5]	EC	2	0.143		120	<0.001	NF 33 830R12
					144	<0.001	
Hood River, OR, USA, 1984[1,5]	EC	3	0.092		120	<0.001	NF 33 840R4
			0.143		123	<0.001	
Medford, OR, USA, 1985[1,5]	EC	2	0.092 0.071		147	<0.001	NF 33 840R5
			0.143 0.109			<0.001	
Clayton, NC, USA, 1986[1,5]	SC	7	0.1		30	0.01	NF 33 DAA86-13
		7	0.1			0.02	
Reedley, CA, USA, 1986	SC	7	0.1		30	0.03	NF 33 DHF86-5

Location, year	Application				PHI, days	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl			
	EC					0.01	
Parlier, CA, USA, 1986[1,5]	EC	7	0.1		29	0.04	NF 33 DHF86-6
Mesa, WA, USA, 1986[1,5]	EC	7	0.1		28	0.02	NF 33 DHF86-8
	SC					0.08	

Underlined residues are from treatments according to GAP in the USA; those underlined twice from treatments according to GAP in Italy
* according to GAP in Germany
[1] No weather data submitted
[2] Method of analysis unspecified
[3] Low associated recoveries (NF03 D78-312 67%; NF06 181-211 63%
[4] No example chromatograms submitted
[5] Duration of sample storage unspecified
[6] Crop variety unspecified

Peaches. GAP was reported for Uruguay, Argentina, Japan, Greece, Italy and Spain. No GAP was reported for apricots or nectarines, although some trials data were submitted. The maximum application rates are 0.036-0.2 kg ai/ha (0.0024-0.0048 kg ai/hl) with a PHI of 1-20 days.

Residue trials were available only from Spain, Italy and France. The critical European GAP for peaches was the Spanish (0.0048 kg ai/hl, PHI 7 days) for which there were 5 trials (one of them replicated) with residues of 0.03-0.3 mg/kg. In two of these trials the volume of spray per hectare was not specified. A further Spanish trial on apricots in 1988 where the use pattern was the same as the Spanish GAP for peaches with a residue of 0.36 mg/kg at 7 days provided supporting information. A single Chilean trial on nectarines reflected the Argentinian GAP for peaches (0.072 kg ai/ha, PHI 20 days) with no residue detected. No data on supervised trials were available for Japanese GAP in which there is a 1-day PHI.

Table 26. Supervised residue trials on peaches, apricots and nectarines.

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
Fronton, S. France, 1993[1]	EC	3	0.04	0.0078	0	pulp	0.13	NG 07 R93-46
					6		0.04	
					10		0.06	
					13		0.04	
Fronton, France, 1994	EC	5	0.04	0.008	8	pulp	0.03	NG 11 GHE-P-4062
Follonica, Italy, 1977[2-6]	WP	8		0.0042	34	fruit	<0.01	NG 01 I77-212A
Puntone, Italy, 1977[2-6]	WP	4		0.0042	20	fruit	0.02	NG 02 I77-213
Follonica, Italy, 1977[2-6]	WP	6	0.24	0.0042	16	fruit	<0.01	NG 03 I77-214
S. Biagio, Italy, 1993[1]	SC	5	0.09	0.0042	0	pulp	0.44	NG 08 R93-45
					7		0.13	
					10		0.08	
					14		0.08	
			0.1	0.0048	0	pulp	0.65	
					7		0.15	
					10		0.15	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
					14		0.16	
Francolino, Italy, 1994	SC	4	0.066 0.069 0.071 0.072	0.0048 x 4	13	pulp	0.05	NG 10 GHE-P-4014
Luchente, Spain, 1988[2,3,5,6,7]	EC	1	0.18	0.0048	0	fruit	0.41	ref. 13
					3		0.38	
					7		0.30	
					14		0.12	
					21		0.10	
Pobla del Duc, Spain, 1992[2,3,5,6,7]	EC	1		0.0036	0	fruit	0.18	ref. 13
					7		0.08	
					14		0.03	
					21		0.02	
Pobla del Duc, Spain, 1993[2,3,5,6,7]	EC	1		0.0036	0	fruit	0.07	ref. 13
					7		0.03	
					14		0.02	
					21		0.01	
NECTARINE								
Chile[2,5,7]	EC		0.072	0.0036	0	fruit	0.03	NG 09
					6		<0.01	
					16		ND	
					24		ND	
APRICOT								
Luchente, Spain, 1988[2,3,5,6,7]	EC	1	0.18	0.0048	0	fruit	0.45	ref. 13
					3		0.44	
					7		0.36	
					14		0.14	
					21		0.08	

Underlined residues are from treatments according to GAP in Spain
Results underlined twice reflect GAP in Argentina
ND - not detected
[1] Crops stored for 11 months before analysis
[2] No weather data submitted
[3] Method of analysis unspecified (reports 2, 3, 4 & 5 in Spanish
[4] Low associated recoveries (NG01 69%; NG02 68%; NG03 59%
[5] No example chromatograms submitted
[6] Duration of sample storage unspecified
[7] No English translation provided

Cherries. GAP was reported for Denmark, Japan and the USA. The maximum application rates reported were 0.06 to about 0.2 kg ai/ha with PHIs of 0-14 days.

All 15 trials submitted were from the USA with samples being taken at 0 and 1 day after the final treatment. In all these trials no account was taken of the weights of the stones. US GAP (0.101 kg ai/ha) allows treatment 'up to and after harvest' and residues in the 9 trials (3 of which were replicated) complying with it were 0.06-0.89 mg/kg.

Table 27. Supervised residue trials on cherries in the USA.

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
Traverse City, MI, 1987[1,2]	EC	6	0.053		0	fruit pulp	0.21	NG 04 87MI1
					1		0.24	
Geneva, NY, 1987[1,2]	EC	5	0.095		0	pulp	0.07	NG 04 87NY1
					1		0.10	
Biglerville, PA, 1987[1,2]	EC	5	0.089		0	pulp	0.10	NG 04 87PA1
					1		0.11	
Hart, MI, 1987[1,2]	EC	5	0.053		0	fruit	0.16	NG 04 WWH87-2
					1		0.17	
Hart, MI, 1987[1,2]	EC	5	0.053		0	pulp	0.18	NG 04 WWH87-3
					1		0.13	
Sutton Bay, MI, 1987[1,2]	EC	5	0.053		0	pulp	0.28	NG 04 WWH87-5
					1		0.26	
Sutton Bay, MI, 1987[1,2]	EC	6	0.053		0	pulp	0.20	NG 04 WWH87-6
					1		0.10	
Sutton Bay, MI, 1987[1,2]	EC	5	0.053		0	pulp	0.17	NG 04 WWH87-7
					1		0.16	
Vantage Bay, WA, 1987[1,2]	EC	4	0.105		0	pulp	0.06	NG 04 WTC87-3
					1		0.05	
Malago, WA, 1987[1,2]	EC	4	0.105		0	pulp	0.44	NG 04 WTC87-6
					1		0.41	
Othello, WA, 1987[1,2]	EC	4	0.105		0	pulp	0.17	NG 04 WTC87-7
					1		0.15	
Corvallis, MI, 1987[1,2]	EC	4	0.105		0	pulp	0.63	NG 04 WTC87-8
					1		0.64	
Linden, CA, 1989	EC	4	0.106		0	fruit	0.89	NG 05 LES89-05
					1		0.49	
			0.106	0.0056	0	fruit	0.77	
					1		0.63	
Grevais. OR, 1989	EC	4	0.106	0.0056	0	fruit	0.22	NG 05 LR89-01
					1		0.28	
	SC	4	0.106	0.0056	0	fruit	0.1	
					1		0.1	
Westley, CA,1989	EC	4	0.106	0.0056	0	fruit	0.4	NG 05 LES89-04
					1		0.88	
	SC	4	0.106	0.0056	0	fruit	0.3	
					1		0.25	

Underlined residues are from treatments according to GAP in the USA
[1] No weather data submitted
[2] Duration of sample storage unspecified

Currants. GAP for blackcurrants was reported for Denmark, Ireland and the UK, and for all currants for The Netherlands. The application rates were 0.04-0.06 kg ai/ha or 0.0048 kg ai/hl with PHIs of 14 or 21 days.

Data were available only from 5 trials in The Netherlands. Residues were 0.04-0.74 mg/kg 15 days after the final treatment but with a variety of application rates with only one trial according to the reported GAP.

Gooseberries. GAP in Ireland and The Netherlands is the same as for currants. Only one trial in The Nethlands was reported with a residue of 0.05 mg/kg at 10 days and this trial was submitted in summary form only.

Table 28. Supervised residue trials on currants and gooseberries in The Netherlands in 1980. All EC applications. All reference 6.

Crop	Application			PHI, days	Residues, mg/kg
	No.	kg ai/ha	kg ai/hl		
Blackcurrant[1,2]					
	8		40ppm	2	0.1
				10	0.07
				14	0.04
				22	0.05
				29	0.06
	1	6-	60 ppm	13	0.47
	1		80 ppm	13	0.45
	?	0.06		50	0.10
	?	0.08		13	0.74
Redcurrant[1,2]					
	3	0.048		25	0.07
					0.14
					0.06
					0.08
Gooseberry[1,2]					
	8		40ppm	2	0.07
				10	0.05

Underlined residues are from treatments according to GAP in The Netherlands
[1] No example chromatograms submitted
[2] No English translation provided

Grapes. GAP was reported for many countries world-wide. The maximum application rates were 0.012-0.06 kg ai/ha with PHIs of 7-35 days.

Residue trials were available from Germany, France, Austria, Italy, the USA, Brazil and Australia. A number of German trials were submitted of which six (2 with replicates) were according to German GAP (0.0234 kg ai/ha, 35-day PHI). The residues in these were 0.01-0.15 mg/kg in samples taken 35 days after the final treatment. Seven of the German trials (two with replicates) were at or within the UK GAP (0.04 kg ai/ha, PHI of 14 days) with residues of 0.02-0.24 mg/kg in samples taken 14 days after the final treatment. In a single French trial conducted in accordance with GAP in France (0.018 kg ai/ha, PHI 7 days) a residue of 0.02 mg/kg was found after 9 days.

Residues in trials according to US GAP (0.051 kg ai/ha, 30-day PHI) were low (0.003-0.06 mg/kg) in 17 US trials, several of which were replicated, in samples taken 28-32 days after the final treatment. Australian GAP (0.024 kg ai/ha or 0.0024 kg ai/hl, 14-day PHI) was also supported by 5 trials with either the maximum spray concentration or application rate per hectare (both are stated on the product label). Residues were 0.01-0.08 mg/kg 13 or 14 days after the final treatment.

None of the Southern European trials according to GAP conformed to Italian (0.06kg ai/ha or 0.0036 kg ai/hl, 14-day PHI) or Portuguese GAP (0.03kg ai/ha or 0.003 kg ai/hl, 7-day PHI) which have the highest dose rate and the shortest PHI respectively.

Table 29. European supervised residue trials on grapes.

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
Rohrendorf, Austria, 1977[1,2,5,6]	EC	4	0.036	0.0036	58	fruit	<0.01	NH 05
Rohrendorf, Austria, 1977[1,2,5,6]	WP	4	0.036	0.0036	58	fruit	0.01	NH 05
Grosshofflein, Austria, 1977[1,2,5,6]	EC	4	0.024	not reported	66	fruit	0.02	NH 06
		4	0.036	0.0036	66	fruit	<0.01	
Pau, France, 1981[5]	SC	4	0.024	0.024 Low vol.	0	fruit	0.18	NH 12
					7	fruit	0.12	
					14	fruit	0.05	
		4	0.036	0.036 Low vol.	0	fruit	0.27	
					7	fruit	0.18	
					14	fruit	0.04	
Sistels, France, 1993[3]	SC	3	0.018	0.075 Low vol.	0	fruit	0.04	NH 04
					4	fruit	0.03	
					9	fruit	0.02	
					15	fruit	0.02	
Godramstein, Germany, 1992[3]	SC	6	0.003+ 0.005+ 0.014+ 0.018+ 0.020+ 0.025	0.0008+ 0.0008+ 0.0026+ 0.0031+ 0.0036+ 0.0042	28	fruit	0.02	NH 11
					35	fruit	0.03	
					42	fruit	0.01	
					35	must	<0.01	
					35	wine	<0.01	
Londau, Germany, 1992[3]	SC	6	0.003+ 0.005+ 0.014+ 0.018+ 0.020+ 0.025	0.0008+ 0.0008+ 0.0026+ 0.0031+ 0.0036+ 0.0042	28	fruit	0.04	NH 11

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
					35	fruit	0.04	
					42	fruit	0.02	
					35	must	<0.01	
					35	wine	<0.01	
Neustadt, Germany, 1993[3]	SC	6	0.003+ 0.005+ 0.014+ 0.018+ 0.020+ 0.025	0.0008+ 0.0008+ 0.0026+ 0.0031+ 0.0036+ 0.0042	28	fruit	0.02	NH 11
					35	fruit	0.01	
					42	fruit	0.02	
					35	must	<0.01	
					35	wine	<0.01	
Neustadt, Germany, 1993[3]	SC	6	0.003+ 0.005+ 0.014+ 0.018+ 0.020+ 0.025	0.0008+ 0.0008+ 0.0026+ 0.0031+ 0.0036+ 0.0042	28	fruit	0.02	NH 11
					35	fruit	0.02	
					42	fruit	0.01	
					35	must	<0.01	
					35	wine	<0.01	
Bad Kreuznach, Germany, 1982 [5]	SC	8	0.005-0.033	2X0.0016 6X0.0031	0	fruit	0.23	NH 12
					7	fruit	0.14	
					14	fruit	0.14*	
					21	fruit	0.10	
					28	fruit	0.11	
					35	fruit	0.07	
					42	fruit	0.08	
Ortsweil Wolf, Germany, 1982 [5]	EC	6	0.014-0.04	2X0.0008 4X0.0016	0	fruit	0.56	NH 12
					7	fruit	0.22	
					14	fruit	0.20*	
					21	fruit	0.10	
					28	fruit	0.07	
					35	fruit	0.06	
					42	fruit	0.05	
Ortsweil Wolf, Germany, 1982 [5]	SC	6	0.014-0.04	2X0.0008 4X0.0016	0	fruit	0.44	NH 12
					7	fruit	0.28	
					14	fruit	0.18*	
					21	fruit	0.10	
					28	fruit	0.07	
					35	fruit	0.05	
					42	fruit	0.05	
Trier, Germany, 1982 [5]	SC	6	2X0.012 4X0.024	2X0.0008 4X0.0016	0	fruit	0.02	NH 12

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
					7	fruit	0.03	
					14	fruit	0.02*	
					21	fruit	0.01	
					28	fruit	0.01	
					35	fruit	0.01	
					42	fruit	0.01	
		8	1X0.014 7X0.028	1X0.0008 7X0.0016	0	fruit	0.33	
					7	fruit	0.24	
					14	fruit	0.24*	
					21	fruit	0.23	
					28	fruit	0.19	
					35	fruit	0.15	
					42	fruit	0.14	
Trier, Germany, 1982 [5]	EC	6	2X0.012 4X0.024	2X0.0008 4X0.0016	0	fruit	0.03	NH 12
					7	fruit	0.02	
					14	fruit	0.02*	
					21	fruit	0.01	
					28	fruit	0.01	
					35	fruit	0.01	
					42	fruit	0.01	
		8	1X0.014 7X0.028	1X0.0008 7X0.0016	0	fruit	0.17	
					7	fruit	0.16	
					14	fruit	0.10*	
					21	fruit	0.09	
					28	fruit	0.09	
					35	fruit	0.10	
					42	fruit	0.11	
Thringen, Germany, 1982[5]		8	2X0.015 6X0.039	1X0.0008 7X0.0020	0	fruit	0.20	NH 12
					7	fruit	0.14	
					14	fruit	0.18*	
					21	fruit	0.11	
					28	fruit	0.08	
					35	fruit	0.08	
					42	fruit	0.08	
Bad Kreuznach, Germany, 1982[5]	EC	8	2X0.015 6X0.039	1X0.0008 7X0.0020	0	fruit	0.08	NH 12
					7	fruit	0.06	
					14	fruit	0.07*	
					21	fruit	0.05	
					28	fruit	0.03	
					42	fruit	0.05	
					35	fruit	0.03	
Calderara, Italy, 1977[1,2,4-6]	WP	7	0.024	not reported	22	fruit	0.02	NH 09

Underlined residues are from treatments according to GAP in Germany; the residue underlined twice was from treatment according to GAP in France
* according to UK GAP.
[1] No weather data submitted
[2] Method of analysis unspecified
[3] Crops stored for more than 6 months before analysis (8-9 months except wine samples)
[4] Low associated recoveries (63%)
[5] No example chromatograms submitted
[6] Duration of sample storage unspecified

Table 30. Non-European supervised residue trials on grapes (including US processing trials).

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
Sungarden, Australia, 1976[1,2]	EC	2	0.015	0.003	71	fruit	--	NH 22 AUS 76-237
		2	0.01	0.002	71	fruit	0.001	
		2	0.02	0.004	71	fruit	0.005	
Victoria, Australia, 1976[1,2,4]	EC	2	0.01	0.002	89	fruit	0.001	NH 22 AUS 76-238
		2	0.015	0.003	89	fruit	0.001	
		3	0.03	0.02	66	fruit	0.001	
		3	0.045	0.003	66	fruit	0.001	
		3	0.06	0.004	66	fruit	0.002	
Mclaren Vale, S. Australia, 1978[1,2]	EC	4	0.09	0.0036	90	fruit	0.009	NH 22 AUS 78-263
Pokolbin, NSW, Australia, 1980[1,2]	EC	7	0.01	0.001	8	fruit	0.05	NH 22 AUS 79-339
		7	0.024		8	fruit	0.06	
Mclaren Vale, S. Australia, 1981 (1,7)	EC	4		0.0024	0	fruit	0.34	NH 23 AUS 80-223
					1	fruit	0.19	
					5	fruit	0.09	
					29	fruit	0.02	
		4		0.0036	0	fruit	0.72	
					1	fruit	0.43	
					5	fruit	0.27	
					29	fruit	0.10	
Lyndoch, S. Australia, 1981[1,2]	EC	4	0.047	0.0024	0	fruit	0.28	NH 22 AUS 83-201
					7	fruit	0.22	
					14	fruit	<u>0.06</u>	
					28	fruit	0.02	
		4	0.094	0.0048	0	fruit	0.45	
					7	fruit	0.37	
					14	fruit	0.19	
					28	fruit	0.10	
Pokolbin, NSW, Australia, 1985[1,3]	EC	4		0.0024	7	fruit	0.02	NH 23 F/H01/85
					13	fruit	<u>0.01</u>	
					20	fruit	0.001	
					27	fruit	0.01	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
		4		0.0048	7	fruit	0.06	
Irymple, Australia, 1992[1,2,4]	EC	1	0.037	0.0024	0	fruit	1.01	NH 24 S93 FEN1
					1		0.84	
					3		0.46	
					7		0.11	
					14		0.06	
					22		0.03	
					35		<0.2	
Irymple, Australia, 1993[1,2,4]	EC	1	0.037	0.0024	0	fruit	0.23	NH 24 S93 FEN3
					1		0.2	
					3		0.16	
					7		0.08	
					14		0.05	
					21		0.03	
					14	wine	0.008	
					14	dried fruit	0.03	
Nuriootpa, Australia, 1993[1,2,4]	EC	1	0.024	0.040-0.074	0		0.06	NH 24 A93 FEN2
					1		0.06	
					3		0.18	
					5		0.05	
					7		0.05	
					14		0.08	
					21		0.05	
					28		0.04	
					28	wine	0.008	
Nuriootpa, Australia, 1993[1,2,4]	EC	6	0.048	0.080- 0.148	28	fruit	0.57	NH 24 A93 FEN4
Brazil, 1985[1,2,4,7]	EC	11	0.024	0.0024	28	fruit	0.03	NB 29
Fresno, CA, USA, 1981[1,2]	EC	4	0.019 0.028 0.037 0.037		62	fruit	0.008	NH 21 DHF81-3
Fresno, CA, USA, 1981[1,2]	EC	3	0.025 0.025 0.025		70	fruit	<0.002	NH 21 DHF81-4
		4	0.037 0.056 0.074		70	fruit	0.006	
		3	0.025 0.025 0.025		70	fruit	0.002	
		3	0.012 0.025 0.037		70	fruit	0.003	
Fresno, CA, USA, 1981[1,2]	SC	3	0.019 0.028 0.037		70	fruit	0.005	NH 21 DHF81-4
		3	0.037		70	fruit	0.005	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
			0.037 0.037					
		3	0.037 0.037 0.037		70	fruit	0.002	
			0.012 0.025 0.037		70	fruit		
Fresno, CA, USA, 1981[1,2]	SC	3	0.074 0.111 0.148		70	fruit	0.02	NH 21 DHF81-5
	EC	3	0.037 0.056 0.074		70	fruit	0.007	
Fresno, CA, USA, 1981[1,2]	EC	3	0.025 0.025 0.025		15	fruit	<0.002	NH 21 DHF81-6
	SC	3	0.05 0.05 0.05		15	fruit	0.008	
Fresno, CA, USA, 1981[1,2]	SC	3	0.05 0.05 0.05		119	fruit	<0.002	NH 21 LGT81-7
	EC	3	0.05 0.05 0.05		119	fruit	0.03	
Grandview, WA, USA, 1982[1,2]	EC	3	0.026		106	fruit	0.002	NH 17 82WA3
						juice/wine	<0.002	
						wet pomace	0.008	
						dried pomace	0.030	
Grandview, WA, USA, 1982[1,2]	EC	3	0.035		106	fruit	0.004	NH 17 82WA3
						juice/wine	<0.002	
						wet pomace	0.012	
						dried pomace	0.047	
Paw Paw, MI, USA, 1982[1,2]	EC	3	0.018 0.026 0.035		50	fruit	<0.002	NH 17 DE-082-31
						juice/wine	<0.002	
						wet pomace	0.003	
						dried pomace	0.012	
Paicines, CA, USA, 1983[1,2,5]	EC	2	0.044		94	fruit	0.006	NH 17 DF-83-62
						juice/wine	<0.002	
						wet pomace	0.011	
					94	fruit	0.005	
						juice/wine	<0.002	
						wet pomace	0.006	
					96	fruit	0.005	
						juice/wine	<0.002	
						wet pomace	0.005	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
					96	fruit	0.006	
						juice/wine	<0.002	
						wet pomace	0.007	
Thermal, CA, USA, 1983[1,2,5]	EC	3	0.026 0.035 0.052		40	fruit	0.005	
						juice/wine	<0.002	
Thermal, CA, USA, 1983[1,2]	EC	3	0.026 0.035 0.052		40	fruit	0.005	NH 17 DHF-83-16
						juice/wine	<0.002	
						fruit	0.008	
		2	0.035 0.044		40	fruit	0.001	
Thermal, CA, USA, 1983[1,2]	EC	3	0.026 0.035 0.052		32	fruit	0.006	NH 17 DHF-83-17
	EC	3	0.026 0.035 0.052		32	fruit	0.007	
	SC	3	0.035 0.044 0.061		32	fruit	0.009	
Thermal, CA, USA, 1983[1,2]	EC	3	0.026 0.035 0.052		32	fruit	0.007	NH 17 DHF-83-18
	EC	3	0.026 0.035 0.052		32	fruit	0.003	
	SC	3	0.035 0.044 0.061		32	fruit	0.010	
Thermal, CA, USA, 1984	EC	3	0.025+ 0.033+ 0.05		47	fruit	<0.001	NH 02
		3	0.025+ 0.033+ 0.05		27	fruit	0.001	
		3	0.025+ 0.033+ 0.05		0	fruit	0.33	
					3	fruit	0.18	
					7	fruit	0.072	
					15	fruit	0.033	
					30	fruit	0.005	
Biola, CA, USA, 1984[1]	EC	2	0.033 0.05		82	fruit	0.004	NH 02 845-A
						juice	0.006	
						pomace	0.47	
						raisins	0.005	
						raisin waste	0.34	
Biola, CA, USA, 1984[1]	EC	3	0.025 0.033		82	fruit	0.004	NH 02 845-B

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
			0.05					
						juice	0.006	
						pomace	0.071	
						raisins	0.005	
						raisin waste	0.31	
Sanger, CA, USA, 1984[1]	EC	2	0.033 0.05	0.007 0.0107	86	fruit	0.006	NH 02 846-A
						juice	0.022	
						pomace	0.042	
						raisins	0.011	
						raisin waste	0.29	
Sanger, CA, USA, 1984[1,5]	EC	3	0.025 0.033 0.05	0.0053 0.007 0.0107	86	fruit	0.004	NH 02 846-B
						juice	0.008	
						pomace	0.035	
						raisins	0.004	
						raisin waste	0.52	
Biola, CA, USA, 1984[1]	EC	2	0.033 0.05	0.007 0.0107	92	fruit	0.004	NH 02 847-A
						juice	0.003	
						pomace	0.052	
Biola, CA, USA, 1984[1]	EC	3	0.025 0.033 0.05	0.0053 0.007 0.0107	92	fruit	0.003	NH 02 847-B
						juice	0.001	
						pomace	0.026	
Fresno, CA, USA, 1987	EC	4	0.025+ 0.033+ 0.05+ 0.05	0.0053+ 0.0071+ 0.0106+ 0.0106	30	fruit	0.03	NH 01
						juice	0.08	
						pomace	0.21	
		4	0.025+ 0.033+ 0.05+ 0.05	0.0053+ 0.0071+ 0.0106+ 0.0106	30	fruit	0.02	NH 01
						juice	0.07	
						pomace	0.19	
						raisin waste	0.48	
						raisins	0.04	
Biola, CA, USA, 1987[1]	EC	4	0.025 0.033 0.05 0.05	0.0053 0.0071 0.0106 0.0106	30	fruit	0.026	NH 01 87-13
						raisins	0.04	
						raisin waste	0.30	
Kerman, CA, USA, 1987[1]	EC	4	0.025 0.033 0.05 0.05		30	fruit	0.019	NH 01 87-14

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
						juice	0.047	
						pomace	0.09	
						raisins	0.04	
						raisin waste	0.26	
Bethlehem, PA, USA, 1988	EC	4	0.025 0.033 0.05 0.05		30	fruit	<0.042	NH 20 8804R
Phelps, NY, USA, 1988	EC	4	0.025 0.033 0.05 0.05		30	fruit	<0.006	NH 20 88060
Dundee, NY, USA, 1988	EC	4	0.025 0.033 0.05 0.05		30	fruit	<0.010	NH 20 88061
Sunnyside, WA, USA, 1988	EC	4	0.025 0.033 0.05 0.05		30	fruit	<0.033	NH 20 BJB88-05
Sunnyside, WA, USA, 1988	EC	4	0.025 0.033 0.05 0.05		30	fruit	<0.017	NH 20 BJB88-06
Fresno, CA, USA, 1988	EC	3	0.025 0.033 0.050		30	fruit	<0.007	NH 20 LE388-17
Biola, CA, USA, 1993[1,2]	EC	3	0.026 0.035 0.052		13	fruit	0.04	NH 17 DHF-83-56
					21	fruit	0.03	
					28	fruit	<0.016	
					45	fruit	0.009	
					61	fruit	0.01	
					13	juice	0.018	
					21	juice	0.011	
					28	juice	0.014	
					45	juice	0.012	
					61	juice	0.008	
					13	wet pomace	0.037	
					21	wet pomace	0.021	
					28	wet pomace	0.028	
					45	wet pomace	0.015	
					61	wet pomace	0.016	
		4	0.026 0.035 0.052 0.052		13	fruit	0.005	
					21	fruit	0.039	
					28	fruit	<0.032	
					45	fruit	0.015	
					61	fruit	0.017	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
					13	juice	0.023	
					21	juice	0.013	
					28	juice	0.023	
					45	juice	0.016	
					61	juice	0.013	
					13	wet pomace	0.036	
					21	wet pomace	0.032	
					28	wet pomace	0.029	
					45	wet pomace	0.027	
					61	wet pomace	0.029	
Biola, CA, USA, 1993[1,2,5]	EC	3	0.026 0.035 0.052		14	fruit	0.023	NH 17 DHF-83-57
					21	fruit	0.024	
					28	fruit	0.019	
					45	fruit	0.021	
					59	fruit	0.009	
					14	juice	0.008	
					21	juice	0.012	
					28	juice	0.005	
					45	juice	0.003	
					59	juice	0.006	
					14	wet pomace	0.031	
					21	wet pomace	0.018	
					28	wet pomace	0.016	
					45	wet pomace	0.016	
					59	wet pomace	0.018	
					14	raisins	0.011	
					21	raisins	0.015	
					28	raisins	0.010	
					45	raisins	0.009	
					59	raisins	0.005	
					14	raisin waste	0.105	
					21	raisin waste	0.105	
					28	raisin waste	0.099	
					45	raisin waste	0.101	
					59	raisin waste	0.095	
		4	0.026 0.035 0.052 0.052		14	fruit	0.046	
					21	fruit	0.029	
					28	fruit	0.025	
					45	fruit	0.026	
					59	fruit	0.029	
					14	juice	0.008	
					21	juice	0.019	
					28	juice	0.008	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
					45	juice	0.007	
					59	juice	0.009	
					14	wet pomace	0.027	
					21	wet pomace	0.026	
					28	wet pomace	0.027	
					45	wet pomace	0.019	
					59	wet pomace	0.019	
					14	raisins	0.017	
					21	raisins	0.019	
					28	raisins	0.014	
					45	raisins	0.010	
					59	raisins	0.012	
					14	raisin waste	0.171	
					21	raisin waste	0.191	
					28	raisin waste	0.179	
					45	raisin waste	0.131	
					59	raisin waste	0.206	
Sanger, CA, USA, 1993[1,2]	EC	4	0.026 0.035 0.052 0.052		16	fruit	0.053	NH 17 DHF-83-58
					21	fruit	0.053	
					30	fruit	0.043	
					48	fruit	0.081	
					63	fruit	0.032	
					16	raisin waste	0.347	
					21	raisin waste	0.401	
					30	raisin waste	0.216	
					48	raisin waste	0.332	
					63	raisin waste	0.271	
					16	juice	0.022	
					21	juice	0.025	
					30	juice	0.009	
					48	juice	0.017	
					63	juice	0.014	
					16	wet pomace	0.04	
					21	wet pomace	0.04	
					30	wet pomace	0.037	
					48	wet pomace	0.06	
					63	wet pomace	0.044	
					16	raisins	0.026	
					21	raisins	0.021	
					30	raisins	0.016	
					48	raisins	0.020	
					63	raisins	0.014	
Sanger, CA, USA, 1993[1,2]	EC	3	0.026 0.035 0.052		16	fruit	0.023	NH 17 DHF-83-58

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
					21	fruit	0.024	
					30	fruit	0.016	
					48	fruit	0.024	
					63	fruit	0.024	
					16	raisin waste	0.178	
					21	raisin waste	0.157	
					30	raisin waste	0.111	
					48	raisin waste	0.177	
					63	raisin waste	0.124	
					16	juice	0.021	
					21	juice	0.019	
					30	juice	0.016	
					48	juice	0.015	
					63	juice	0.006	
					16	wet pomace	0.067	
					21	wet pomace	0.023	
					30	wet pomace	0.052	
					48	wet pomace	0.045	
					63	wet pomace	0.024	
					16	raisins	0.009	
					21	raisins	0.007	
					30	raisins	0.011	
					48	raisins	0.007	
					63	raisins	0.009	
Biola, CA, USA, 1993[1,2,5]	SC	3	0.035 0.052 0.061		14	fruit	0.024	NH 17 DHF-83-57
					21	fruit	0.028	
					28	fruit	0.040	
					45	fruit	0.020	
					59	fruit	0.009	
					14	juice	0.036	
					21	juice	0.023	
					28	juice	0.027	
					45	juice	0.014	
					59	juice	0.014	
					14	wet pomace	0.042	
					21	wet pomace	0.023	
					28	wet pomace	0.035	
					45	wet pomace	0.023	
					59	wet pomace	0.035	
					14	raisins	0.020	
					21	raisins	0.019	
					28	raisins	0.013	
					45	raisins	0.012	
					59	raisins	0.012	
					14	raisin waste	0.242	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
					21	raisin waste	0.195	
					28	raisin waste	0.174	
					45	raisin waste	0.152	
					59	raisin waste	0.163	
Biola, CA, USA, 1993[1,2,5]	SC	4	0.035 0.052 0.061 0.070		14	fruit	0.068	NH 17
					21	fruit	0.052	
					28	fruit	0.044	
					45	fruit	0.040	
					59	fruit	0.044	
					14	juice	0.037	
					21	juice	0.038	
					28	juice	0.050	
					45	juice	0.021	
					59	juice	0.021	
					14	wet pomace	0.050	
					21	wet pomace	0.033	
					28	wet pomace	0.067	
					45	wet pomace	0.047	
					59	wet pomace	0.038	
					14	raisins	0.042	
					21	raisins	0.050	
					28	raisins	0.026	
					45	raisins	0.023	
					59	raisins	0.022	
					14	raisin waste	0.330	
					21	raisin waste	0.406	
					28	raisin waste	0.361	
					45	raisin waste	0.284	
					59	raisin waste	0.290	
Biola, CA, USA, 1993[1,2]	SC	3	0.035 0.052 0.061		13	fruit	0.061	NH 17 DHF-83-56
					21	fruit	0.024	
					28	fruit	0.029	
					45	fruit	0.041	
					61	fruit	0.019	
					13	juice	0.044	
					21	juice	0.015	
					28	juice	0.027	
					45	juice	0.028	
					61	juice	0.023	
					13	wet pomace	0.039	
					21	wet pomace	0.033	
					28	wet pomace	0.031	
					45	wet pomace	0.030	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
					61	wet pomace	0.028	
Biola, CA, USA, 1993[1,2]	SC	4	0.035 0.052 0.061 0.070		13	fruit	0.061	NH 17 DHF-83-56
					21	fruit	0.038	
					28	fruit	0.053	
					45	fruit	0.060	
					61	fruit	0.039	
					13	juice	0.043	
					21	juice	0.032	
					28	juice	0.094	
					45	juice	0.064	
					61	juice	0.053	
					13	wet pomace	0.052	
					21	wet pomace	0.037	
					28	wet pomace	0.053	
					45	wet pomace	0.055	
					61	wet pomace	0.057	
Sanger, CA, USA, 1993[1,2]	SC	3	0.035 0.052 0.061		16	fruit	0.067	NH 17 DHF-83-58
					21	fruit	0.032	
					30	fruit	0.061	
					48	fruit	0.061	
					63	fruit	0.021	
					16	juice	0.040	
					21	juice	0.039	
					30	juice	0.032	
					48	juice	0.031	
					63	juice	0.016	
					16	wet pomace	0.048	
					21	wet pomace	0.042	
					30	wet pomace	0.030	
					48	wet pomace	0.036	
					63	wet pomace	0.041	
					16	raisins	0.024	
					21	raisins	0.050	
					30	raisins	0.019	
					48	raisins	0.015	
					63	raisins	0.012	
					16	raisin waste	0.384	
					21	raisin waste	0.492	
					30	raisin waste	0.337	
					48	raisin waste	0.362	
					63	raisin waste	0.312	
Sanger, CA, USA, 1993[1,2]	SC	4	0.035 0.052		16	fruit	0.100	NH 17 DHF-83-58

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Reference
	Form	No.	kg ai/ha	kg ai/hl				
			0.061 0.070					
					21	fruit	0.053	
					30	fruit	0.085	
					48	fruit	0.060	
					63	fruit	0.034	
					16	juice	0.076	
					21	juice	0.034	
					30	juice	0.045	
					48	juice	0.044	
					63	juice	0.034	
					16	wet pomace	0.053	
					21	wet pomace	0.039	
					30	wet pomace	0.049	
					48	wet pomace	0.051	
					63	wet pomace	0.046	
					16	raisins	0.064	
					21	raisins	0.059	
					30	raisins	0.034	
					48	raisins	0.036	
					63	raisins	0.042	
					16	raisin waste	1.18	
					21	raisin waste	0.88	
					30	raisin waste	0.74	
					48	raisin waste	1.07	
					63	raisin waste	0.62	

Underlined residues are from treatments according to GAP in the USA; those underlined twice from treatments according to GAP in Australia

[1] No weather data submitted

[2] Duration of sample storage unspecified (Californian trials: 11 months maximum by calculation)

[3] NH23 F/H01/85 samples stored for 15 months

[4] No example chromatograms submitted

[5] Some high associated recoveries (NH 02 fruit, 122%; DHF 83-57 pomace, 123%, 136%; DHF 83-62 pomace 125%), but mean recoveries acceptable

[6] No detailed report submitted

[7] No English translation provided

Strawberries. GAP was reported for Denmark, Ireland, Italy, Japan (indoor and outdoor), The Netherlands, Spain and the UK. The maximum application rates are 0.03-0.084 kg ai/ha with PHIs of 1-14 days.

Data were available from Italy, Japan, Spain and The Netherlands. Two Italian trials and one Spanish trial were according to Italian GAP (0.048 kg ai/hl, 7-day PHI), with residues of 0.12-0.18 mg/kg. Spanish GAP has a PHI of 3 days (0.0048 kg ai/hl) and was only represented by the single Spanish trial with a residue of 0.25 mg/kg. at 3 days. Three Dutch trials were according to GAP (0.084 kg ai/ha, treatment before flowering) with residues of <0.01-0.02 mg/kg, but all the Dutch trials were submitted in summary form only. Japanese indoor GAP (0.003 kg ai/hl, 1-day PHI) was represented by 7 trials in which the crops were all protected by what was described as "vinyl housing cultivation with plastic mulch on bed". Residue levels in the trials were 0.04-0.56 mg/kg in samples taken 1 day after the final treatment.

Raspberries. Information on GAP was reported for Ireland and the UK. The application rate is 0.04 kg ai/ha with a PHI of 14 days. Only one trial was available from the UK, and this was at an exaggerated application rate.

Table 31. Supervised residue trials on strawberries and raspberries.

Location, year	Application					PHI, days	Residues, mg/kg	Ref.
	Sample	Form	No.	kg ai/ha	kg ai/hl			
STRAWBERRY								
Grosseto, Italy, 1979[1,2,3,5]	Field	WP	3	0.042	0.0042	7	0.12	NC 11
						16	0.09	
						22	0.07	
Grosseto, Italy, 1979[1,2,3,5]	Field	WP	3	0.042	0.0042	7	0.14	NC 12
						16	0.10	
						22	0.05	
Nara Pref., Japan, 1984[1,3]	Protected	WP	3	0.045	0.003	1	0.32**	NC16
						3	0.17	
						8	0.29	
Chiba Pref., Japan, 1984[1,3]	Protected	WP	3	0.045	0.003	1	0.43**	NC 16
						3	0.48	
						6	0.44	
Saitama Pref, Japan, 1987[1,3]	Protected	WP	3	0.06	0.003	1	0.04**	NC 16
Wakayama, Japan, 1988[1,3]	Protected	WP	3	0.045	0.003	1	0.13**	NC 16
Hyogo, Japan, 1988[1,3]	Protected	WP	3	0.045	0.003	1	0.56**	NC 16
Osaka, Japan, 1988[1,3]	Protected	WP	3	0.045	0.003	1	0.20**	NC 16
Shiga Pref, Japan, 1988[1,3]	Protected	WP	3	0.045	0.003	1	0.21**	NC 16
Ophensden, Netherlands, 1979[6]	Field	EC	1	0.084		238	0.02	6
Zaltbommel, Netherlands, 1979[6]	Field	EC	1	0.084		239	<0.01	6
Zundert, Netherlands, 1979[6]	Field	EC	1	0.084		238	<0.01	6
Breda, Netherlands, 1982[6]	Field	EC	1	0.07		15	<0.01	6
Vilanova de Castello, Spain, 1986[1,3,4,7]	Field	EC	3	0.096	0.0048	0	0.3	13
						3	0.25*	
						7	0.18	
						14	0.1	
						21	0.07	
RASPBERRY								
Earl Wood, Windlesham, UK, 1994[1,2,4]	Field	SC	3	0.075	0.0036	11	0.05	ND 01

Underlined residues are from treatments according to GAP in Italy; those underlined twice from treatments according to GAP in The Netherlands

* According to GAP in Spain
** According to Japanese indoor GAP
[1] No weather data submitted
[2] Method of analysis unspecified
[3] No example chromatograms submitted
[4] Duration of sample storage unspecified
[5] Crop variety unspecified
[6] No detailed report submitted
[7] No English translation provided

Bananas. GAP was reported for Honduras and Nicaragua. The application rates in both countries are 0.08-0.12 kg ai/ha with a PHI of 0 days.

Data were available from Ecuador, Costa Rica, Honduras and the Philippines. In all trials a low-volume application (20-48 l/ha) was made using a motorized backpack sprayer. Six trials reflected the use in Honduras and Nicaragua with residues 0 or 1 day after the final treatment of <0.01-0.19 mg/kg in unbagged bananas and <0.01-0.12 mg/kg in bagged bananas. Six further trials at twice the maximum application rate (i.e. 0.24 kg ai/ha) were also available with residues of 0.03-0.3 mg/kg in unbagged bananas and <0.01-0.12 mg/kg in bagged bananas.

Table 32. Supervised residue trials on bananas in 1992. All with 7 applications of EC.

Location, year	Application		Sample	Bagged/Un-bagged	PHI, days	Residues, mg/kg	Ref.
	kg ai/ha	kg ai/hl					
Limon, Costa Rica -East	0.12	0.55	whole	unbagged	0	0.02	NL 02
			pulp	unbagged	0	0.02	
			whole	unbagged	1	0.02	
			pulp	unbagged	1	0.01	
			whole	bagged	0	<0.01	
			pulp	bagged	0	<0.01	
			whole	bagged	1	<0.01	
			pulp	bagged	1	<0.01	
Limon, Costa Rica -East	0.24	1.1	whole	unbagged	0	0.03	NL 02
			pulp	unbagged	0	0.03	
			whole	unbagged	1	0.03	
			pulp	unbagged	1	0.05	
			whole	bagged	0	<0.01	
			pulp	bagged	0	<0.01	
			whole	bagged	1	0.01	
			pulp	bagged	1	<0.01	
Limon, Costa Rica -West	control		whole	bagged	-	<0.01 0.01	NL 02
	0.12	0.55	whole	unbagged	0	0.03	
			pulp	unbagged	0	0.01	
			whole	unbagged	1	0.03	
			pulp	unbagged	1	<0.01	
			whole	bagged	0	<0.01	
			pulp	bagged	0	<0.01	
			whole	bagged	1	<0.01	
			pulp	bagged	1	<0.01	
Limon, Costa Rica -West	control	control	whole	bagged	-	<0.01 0.01	NL 02

Location, year	Application		Sample	Bagged/Un-bagged	PHI, days	Residues, mg/kg	Ref.
	kg ai/ha	kg ai/hl					
	0.24	1.1	whole	unbagged	0	0.05	
			pulp	unbagged	0	-	
			whole	unbagged	1	0.05	
			pulp	unbagged	1	0.01	
			whole	bagged	0	0.01	
			pulp	bagged	0	<0.01	
			whole	bagged	1	<0.01	
			pulp	bagged	1	<0.01	
Guayas, Ecuador Site 1	0.12	0.6	whole	unbagged	0	0.09	NL 02
			pulp	unbagged	0	0.05	
			whole	unbagged	1	0.19	
			pulp	unbagged	1	0.02	
			whole	bagged	0	0.12	
			pulp	bagged	0	0.01	
			whole	bagged	1	0.02	
			pulp	bagged	1	0.12	
Guayas, Ecuador Site 1	0.24	1.2	whole	unbagged	0	0.25	NL 02
			pulp	unbagged	0	0.12	
			whole	unbagged	1	0.22	
			pulp	unbagged	1	0.11	
			whole	bagged	0	0.02	
			pulp	bagged	0	0.01	
			whole	bagged	1	0.03	
			pulp	bagged	1	0.01	
Guayas, Ecuador Site 2	0.12	0.6	whole	unbagged	0	0.12	NL 02
			pulp	unbagged	0	0.11	
			whole	unbagged	1	0.16	
			pulp	unbagged	1	0.04	
			whole	bagged	0	<0.01	
			pulp	bagged	0	<0.01	
			whole	bagged	1	0.01	
			pulp	bagged	1	0.02	
Guayas, Ecuador Site 2	0.24	1.2	whole	unbagged	0	0.05	NL 02
			pulp	unbagged	0	0.07	
			whole	unbagged	1	0.3	
			pulp	unbagged	1	0.12	
			whole	bagged	0	0.04	
			pulp	bagged	0	0.03	
			whole	bagged	1	0.04	
			pulp	bagged	1	0.04	
La Lima, Honduras Site 1	0.12	0.00025	whole	unbagged	0	0.01	NL 02
			pulp	unbagged	0	<0.01	
			whole	unbagged	1	<0.01	
			pulp	unbagged	1	<0.01	
			whole	bagged	0	<0.01	
			pulp	bagged	0	<0.01	
			whole	bagged	1	<0.01	

Location, year	Application		Sample	Bagged/Un-bagged	PHI, days	Residues, mg/kg	Ref.
	kg ai/ha	kg ai/hl					
			pulp	bagged	1	<0.01	
La Lima, Honduras Site 1	0.24	0.5	whole	unbagged	0	0.02	NL 02
			pulp	unbagged	0	0.02	
			whole	unbagged	1	0.02	
			pulp	unbagged	1	0.02	
			whole	bagged	0	<0.01	
			pulp	bagged	0	<0.01	
			whole	bagged	1	<0.01	
			pulp	bagged	1	<0.01	
La Lima, Honduras Site 2	0.12	0.25	whole	unbagged	0	<0.01	NL 02
			pulp	unbagged	0	<0.01	
			whole	unbagged	1	0.01	
			pulp	unbagged	1	0.01	
			whole	bagged	0	<0.01	
			pulp	bagged	0	ND	
			whole	bagged	1	<0.01	
			pulp	bagged	1	ND	
La Lima, Honduras -Site 2	0.24	0.5	whole	unbagged	0	0.02	NL 02
			pulp	unbagged	0	<0.01	
			whole	unbagged	1	0.02	
			pulp	unbagged	1	0.02	
			whole	bagged	0	<0.01	
			pulp	bagged	0	0.02	
			whole	bagged	1	<0.01	
			pulp	bagged	1	<0.01	
Philippines[1]	0.15	0.11	pulp	NR	8	0.02	NL 03
			peel	NR	8	0.07	
			whole	NR	8	0.04	

Underlined residues are from treatments according to GAP in Honduras and Nicaragua
ND none detected
NR not recorded
[1] 1991

Cucumbers. GAP was reported for Brazil, Denmark, Ireland, Japan, The Netherlands, Uruguay and the UK. Several other countries reported GAP for the group "cucurbits". The maximum application rates are 0.019-0.072 kg ai/ha or 0.0012-0.0072 kg ai/hl with PHIs of 1-7 days.

Residue trials data were available from Austria, Italy, Brazil and the UK. One trial with a residue of 0.03 mg /kg was according to UK and Irish GAP (0.002 kg ai/hl, 2-day PHI) and a Brazilian trial with a residue at 4 days of 0.003 mg/kg complied with GAP in Uruguay. Residues in the Italian trials were at PHIs of 10-15 days, although this is longer than any reported GAP. There were no results at the Japanese GAP PHI of 1 day.

Gherkins. GAP was reported for The Netherlands (0.0024 kg ai/hl, 3-day PHI) for both protected and field use. Other countries had GAP for the group "cucurbits".

Two replicated Dutch trials were submitted in summary form in which a high application concentration of 0.24 kg ai/hl was reported, with the rate per hectare unspecified. Residues in samples taken 3 days after the final treatment were 0.02-0.06 mg/kg.

Table 33. Supervised residue trials on cucumbers and gherkins.

Location, year	Field protected	Application				PHI, days	Residues, mg/kg	Ref.
		Form	No.	kg ai/ha	kg ai/hl			
CUCUMBER								
Tadten, Austria, 1976[1,2,3,5]	Field	EC	1	0.012	0.0006	2	0.03	NB 01
		EC	1	0.024	0.0012	2	0.02	
Campinas, Brazil, 1986[1,3-5]	Field	EC	3	0.018		4	0.003	NB 29
			3	0.036		4	0.01	
Bellaria, Italy, 1977 [1-5]	Field	WP	8		0.003 high vol.	10	<0.01	NB 08
Borghesi, Italy, 1977 [1-5]	Field	WP	7		0.003 high vol.	22	<0.01	NB 09
Parma, Italy, 1981[1-3]	Field	SC	1	0.024	0.0024	15	<0.01	NB 15
Windlesham, Surrey, UK, 1976[1-3]	Protected	EC	6	250 ml/plant	0.002	2	0.03	NB 04
						4	0.05	
			6	250 ml/plant	0.004	2	0.09	
						4	0.07	
			6	250 ml/plant	0.008	2	0.03	
						4	0.16	
GHERKINS								
Denne, Netherlands, 1977[7]	Field?	EC	1		0.24	1	0.1	6
						3	0.03	
			1		0.24	1	0.07	
							0.05	
							0.1	
							0.08	
						3	0.06	
							0.03	

Location, year	Field protected	Application				PHI, days	Residues, mg/kg	Ref.
		Form	No.	kg ai/ha	kg ai/hl			
							0.05	
							0.02	
Wernhout, Netherlands, 1977[7]	Field?	EC	1		0.24	1	0.08	6
							0.06	
							0.1	
							0.05	
						3	0.06	
							0.04	
							0.03	
							0.02	

Underlined residues are from treatments according to GAP in UK and Ireland; those underlined twice from treatments according to GAP in Uruguay
[1] No weather data provided
[2] Method of analysis unspecified
[3] No example chromatograms submitted
[4] Duration of sample storage unspecified
[5] Crop variety unspecified
[6] No English translation provided
[7] No detailed report submitted

Melons (including cantaloupes) and watermelons. Indoor GAP for melons was reported for The Netherlands (0.0024 kg ai/hl, 3-day PHI), and outdoor GAP for melons for Japan, Portugal and Brazil and for watermelons for Japan, Brazil and Uruguay, as well as GAP for "cucurbits" in other countries. The maximum application rates are 0.012-0.036 kg ai/ha with PHIs of 1-7 days.

The only relevant indoor data were from two Spanish trials on melons but these were with a higher spray concentration than in Dutch GAP.

Outdoor trials were carried out on melons in France, Italy, Brazil and Spain, on watermelons in Italy and Brazil and on cantaloupes in Italy. In four French trials according to Greek GAP for cucurbits (0.024 kg ai/ha, 1-day PHI) residues were <0.01 and <0.01-0.11 mg/kg in the pulp and peel, respectively, 2 days after the final treatment. Residues at 4 days were <0.01 and 0.01-0.07 mg/kg in the pulp and peel respectively. When a double rate was applied (0.048 kg ai/ha) residues were only <0.01-0.02 and 0.04-0.09 mg/kg in the pulp and peel at 2 days. In these French trials the actual weights of pulp and peel were not recorded.

A number of other trials on melons in Brazil, Italy and Spain were at higher application rates than GAP at 0.036-0.048 kg ai/ha but residues were low (0.01-0.04 mg/kg) at 3-4 days. In a further three outdoor trials on watermelons in Italy and Brazil and two Italian trials on cantaloupes residues were all below the LOD (<0.01 mg/kg or ND) 4-14 days after the final treatment. Brazilian GAP (0.024 kg ai/ha, 4-day PHI) was represented by two trials; residues were 0.005 mg/kg in melons and "not detected" in watermelons, but in both trials the duration of sample storage was unspecified.

Table 34. Supervised residue trials on melons, watermelons and canteloupe melons.

Location, year	Field/ protected	Application				PHI, days	Sample	Residues, mg/kg	Ref.
		Form	No.	kg ai/ha	kg ai/hl				

Location, year	Field/ protected	Application				PHI, days	Sample	Res-idues, mg/kg	Ref.
		Form	No.	kg ai/ha	kg ai/hl				
MELON									
Campinas, Brazil, 1986[1,4-6]	Field	EC	3	0.018		4	whole	0.005	NB 29
			3	0.036		4	whole	0.04	
Savonieries, France, 1976[1,2,4]	Field	EC	3	0.01	0.0017	10	whole	<0.01	NB 02
			3	0.015	0.0025	10	whole	<0.01	
St Nicholas, France, 1980[1,2,4]		EC	1	0.024	0.0024	0	pulp	<0.01	NB 20
						0	pulp	<0.01	
						2	peel	0.03	
						2	peel	0.11	
						4	peel	0.06	
						4	peel	0.04	
Moissac, France, 1980 [1,2,4]	Field	EC	1	0.024	0.0025	0	pulp	<0.01	NB 21
						0	peel	0.09	
						2	pulp	<0.01	
						2	peel	0.03	
						4	pulp	<0.01	
						4	peel	0.01	
			1	0.048	0.0048	0	pulp	<0.01	
						0	peel	0.08	
						2	pulp	<0.01	
						2	peel	0.04	
						4	pulp	<0.01	
						4	peel	0.04	
St Nicola de la Grave, France, 1980[1,2,4]	Field	EC	1	0.024	0.0024	0	pulp	<0.01	NB 22
						0	peel	0.19	
						2	pulp	<0.01	
						2	peel	0.09	
						4	pulp	<0.01	
						4	peel	0.07	
			1	0.048	0.0048	0	pulp	0.01	
						0	peel	0.22	
						2	pulp	<0.01	
						2	peel	0.09	
						4	pulp	0.01	
						4	peel	0.08	
Moissac, France, 1980[1,2,4]	Field	EC	1	0.024	0.0022	0	pulp	<0.01	NB 23
						0	peel	<0.01	
						2	pulp	<0.01	
						2	peel	<0.01	
						4	pulp	<0.01	
						4	peel	0.04	
			1	0.048	0.0048	0	pulp	0.02	
						0	peel	013	
						2	pulp	0.02	
						2	peel	0.07	

Location, year	Field/ protected	Application				PHI, days	Sample	Res-idues, mg/kg	Ref.
		Form	No.	kg ai/ha	kg ai/hl				
						4	pulp	<0.01	
						4	peel	0.04	
Volania, Ferrara, Italy, 1994	Field	SC	3	0.018+ 0.018+ 0.036	0.0036	7	peel	0.01	NB 32
						7	pulp	ND	
						7	whole	<0.01	
			3	0.024+ 0.024+ 0.048	0.0048	7	peel	0.01	
						7	pulp	ND	
						7	whole	<0.01	
Gavello, Italy, 1994	Field	SC	3	0.018+ 0.018+ 0.036	0.0036	7	peel	0.03	NB 32
						7	pulp	ND	
						7	whole	0.01	
			3	0.024+ 0.024+ 0.048	0.0048	7	peel	0.02	
						7	pulp	ND	
						7	whole	<0.01	
Los Alcazares, Spain, 1994	Protected	SC	3	0.037	0.0048	-1	whole	<0.01	NB 31
						0	whole	0.02	
						3	whole	0.02	
						5	whole	0.02	
						7	whole	<0.01	
Sevilla, Spain, 1994	Protected	SC	3	0.048	0.0048	-1	whole	<0.01	NB 31
						0	whole	0.01	
						3	whole	0.01	
						5	whole	<0.01	
						7	whole	0.01	
Romani, Spain, 1986[1,2,4,5,7]	Field	EC	2	0.096	0.0048	0	whole	0.1	13
						4	whole	0.07	
						7	whole	0.02	
						14	whole	ND	
CANTALOUPE MELONS									
Parma, Italy, 1977[1-6]	Field	WP	1	0.012	0.003	10	whole	<0.01	NB 11
Parma, Italy, 1981[1,2,4]	Field	SC	3	0.024	0.0024	14	whole	<0.01	NB 24
WATERMELONS									
Parma, Italy, 1976[1,2,4]	Field	EC	3	0.020	0.002	11	whole	<0.01	NB 03
Parma, Italy, 1977[1-4]	Field	WP	3		0.0018+ 0.0024+ 0.003	10	whole	<0.01	NB 12
Campinas, Brazil, 1986[1,4,6]	Field	EC	4	0.018	not reported	4	whole	ND	NB 29
			4	0.036	not reported	4	whole	ND	

Underlined residues are from treatments according to GAP in Greece; those underlined twice from treatments according to GAP in Brazil.

ND - not detected
[1] No weather data submitted
[2] Method of analysis unspecified
[3] Low associated recoveries (65% for cantaloupe trial, 68% for watermelon trial)
[4] No example chromatograms submitted
[5] Duration of sample storage unspecified
[6] Crop variety unspecified
[7] No English tranlation provided

Pumpkins, courgettes and squashes. GAP was reported for pumpkins for The Netherlands (indoor only), Brazil, Japan and Peru, for squash for Argentina (summer) and Uruguay, for courgettes for The Netherlands, and for "cucurbits" in other countries. The maximum application rates are 0.012-0.06 kg ai/ha with PHIs of 1-7days.

No data on indoor trials were submitted. One trial on squash in Brazil, complying with GAP for Argentina and Uruguay (0.024 kg ai/ha, 4 days PHI), showed a residue of 0.005 mg/kg. One Australian replicated trial on zucchini courgettes and one on pumpkins accorded with Australian GAP for curcurbits (0.024 kg ai/ha, 3-day PHI). Residues were very low; 0.001-0.01 mg/kg three days after the final treatment. The duration of laboratory sample storage was not given in the Australian trials considered to be according to GAP.

Table 35. Supervised residue trials on squash, zucchini, courgettes and pumpkins (whole commodities analysed).

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
SQUASH							
Campinas, Brazil, 1986[1,4,6]	EC	4	0.018	not reported	4	0.005	NB 29
		4	0.036	not reported	4	0.008	
Parma, Italy, 1977[1,2,3-6]	WP	3	0.12	0.003	15	<0.01	NB 10
Parma, Italy, 1981[1,2,4]	WP	4	0.024	0.0024	15	<0.01	NB 26
ZUCCHINI COURGETTES							
Pokolbin, NSW, Australia, 1985[1,5,6]			control	control	-	0.005	NB 30
	EC	4	0.01	not reported	3	0.01	
		4	0.02	not reported	3	0.01	
		4	0.03	not reported	3	0.02	
PUMPKINS							
Pokolbin, NSW, Australia, 1985[1,5,6]			control	control	-	0.001	NB 30
	EC	4	0.01	not reported	3	0.001	
		4	0.02	not reported	3	0.003	
		4	0.03	not reported	3	0.001	

Underlined residues are from treatments according to GAP for squash in Argentina and Uruguay; those underlined twice from treatments according to GAP for cucurbits in Australia
[1] No weather data provided
[2] Method of analysis unspecified
[3] Low associated recoveries (69%)
[4] No chromatograms submitted
[5] Duration of sample storage unspecified
[6] Crop variety unspecified

Tomatoes. GAP was reported for Denmark (glasshouse and field use), Italy, Japan, The Netherlands (glasshouse and field use), Spain and the UK. The maximum application rates are 0.036-0.072 kg ai/ha or 0.002-0.0048 kg ai/hl with PHIs of 1-7days.

Data were available from Italy, Spain, The Netherlands and Greece. Treatments in two Netherlands indoor trials were comparable to Danish GAP (0.036 kg ai/ha or 0.0048 kg ai/hl, 2-day PHI). Residues in both were 0.03 mg/kg at 2 days. Italian GAP (0.0048 kg ai/hl, 7-day PHI) and Spanish GAP (0.006 kg ai/hl, 7-day PHI) were reflected in one Spanish and two Italian trials with residues of 0.03, 0.03 and 0.05 mg/kg at 7days.

Peppers. GAP for peppers is the same as for tomatoes except that Denmark has no registered use.

Trials data were available from Italy, Spain and Israel. Spanish and Italian GAP (0.0048 or 0.006 kg ai/hl with a PHI of 7days) were represented by 6 trials in Italy and Spain. Residues were 0.03-0.07 mg/kg and 0.07-0.5 mg/kg respectively in samples taken 7 days after the final treatment. The duration of sample storage was not specified in the Spanish trials.

Egg plants (aubergines). Outdoor GAP was reported for Italy and Japan. The maximum application rates are about 0.04 kg ai/ha or about 0.002-0.0048 kg ai/hl with a PHI of 1 day in Japan and 7 days in Italy.

Only one Italian trial was reported, in which the residue was <0.01 mg/kg 15 days after harvest.

Table 36. Supervised residue trials on tomatoes, peppers and egg plants.

Location, year	Field/ protected	Application				PHI, days	Res, mg/kg	Ref.
		Form	No.	kg ai/ha	kg ai/hl			
TOMATOES								
Thessaloniki, Greece, 1994	Protected	EC	3	0.026 2 x 0.048	3 x 0.004	31	0.03	NE 12 GHE-P-4012
Grosetto, Italy, 1979[1-3]	Field	WP	3	0.084	0.0042	7	0.03	NE 03 I79-251
						14	0.06	
						21	<0.01	
Grosetto, Italy, 1979[1-3,5]	Field	WP	3	0.084	0.0042	7	0.03	NE 07 I79-250
						14	<0.01	
						21	<0.01	
Parma, Italy, 1981[1-3]	Field	SC	3	0.048	0.0042-0.0048	15	<0.01	NE 09 I81-258
Huissen, Netherlands, 1994	Protected	SC	3	0.048	0.0024	0	0.04	NE 11 R94-062-01
						1	0.04	
						2	0.03	
						3	0.03	
Bemmel, Netherlands, 1994	Protected	SC	3	0.048	0.0024	0	0.03	NE 11 R94-062-02
						1	0.03	
						2	0.03	
						3	0.02	
Marzarron, Spain, 1993[1]	Field	EC	3	*c.*0.06-0.08	0.0048	0	0.08	NE 08 GHE-P-3653
						2	0.06	
						7	0.05	
PEPPERS								

Location, year	Field/ protected	Application				PHI, days	Res, mg/kg	Ref.
		Form	No.	kg ai/ha	kg ai/hl			
Yad Natan, Israel, 1977[1-3]	Field	EC	2	0.036		30	0.03	NE 04 ISL79-2
						16	0.04	
						14	0.04	
						7	0.08	
						0	0.13	
			2	0.072		30	0.02	
						16	0.03	
						14	0.09	
						7	0.01	
						0	0.32	
Grosetto, Italy, 1979[1-3]	Field	WP	3		0.0042	7	0.07	NE 05 I79-250
						14	0.12	
						21	0.02	
Grosetto, Italy, 1979[1-3]	Field	WP	3		0.0042	7	0.03	NE 06 I79-251
						14	0.01	
						21	0.03	
Parma, Italy, 1981[1-3]	Field	SC	3	0.048	0.0048	15	<0.01	NE 10 I81-259
Cartagena, Spain, 1977[1-3,7]	Field		3		0.0024	30	0.03	NE 02 E77-129
					0.003		0.03	
Benifaio, Spain, 1986[1,3,6,7]	Field	EC	3	0.108	0.006	0	0.3	Ref. 13
						4	0.15	
						7	0.07	
						14	ND	
						21	ND	
Sollana, Spain, 1987[1,3,4,6,7]	Field	EC	1	0.126	0.006	0	0.27	Ref. 13
						3	0.23	
						7	0.12	
						14	0.05	
						21	0.03	
Benifaio, Spain, 1992[1,3,4,6,7]	Field	EC	1	0.15	0.006	0	0.6	Ref. 13
						3	0.56	
						7	0.5	
						14	0.2	
						21	0.1	
Benifaio, Spain, 1993[1,3,4,6,7]	Field	EC	1	0.12	0.006	0	0.21	Ref. 13
						3	0.26	
						7	0.08	
						14	0.05	
						21	0.03	
EGG PLANTS (AUBERGINES)								
Parma, Italy, 1981[1-3,5]	Field	SC	3		0.008	15	<0.01	NB 27 I81-260

Underlined residues are from treatments according to GAP in Spain and Italy
[1] No weather data submitted
[2] Method of analysis unspecified
[3] No example chromatograms submitted

[4] Duration of sample storage unspecified
[5] Crop variety unspecified
[6] No English translation provided
[7] The meeting was informed that samples were analysed within 24 hours of receipt at the laboratory.

Beetroots and carrots. Only Dutch GAP for "vegetables" was reported (0.036 kg ai/ha or 0.0024 kg ai/hl, 3-day PHI). There was one Netherlands trial on each of these crops in which residues were <0.01-0.02 mg/kg in samples taken 27 days after treatment.

Table 37. Supervised residue trials on beetroots and carrots at Slootdorp, The Netherlands, in 1984. 2 x 0.06 kg ai/ha EC applied in both trials (No example chromatograms submitted and no English translation provided for either trial).

PHI, days	Sample	Residues, mg/kg	Ref.
27	Beetroots, whole, roots and soil removed	0.01	KVW267/CTB/PD
		0.01	
		0.01	
		0.02	
		0.02	
27	Carrots, whole, soil removed	<0.01	KVW268/CTB/PD
		<0.01	
		<0.01	
		<0.01	

Globe artichokes. GAP was reported only for Italy (0.0048 kg ai/hl or 0.038 kg ai/ha, 7-day PHI). Six Italian trials with residues of <0.01-0.06 mg/kg were considered to reflect GAP. In two of these (1979) the analytical recovery was low (61%). In a Spanish trial a higher residue of 0.26 mg/kg was found at 7 days, but a high volume of water (2,500 l/ha) was applied and the spray concentration was higher (0.006 kg ai/hl) than that registered in Italy.

Table 38. Supervised residue trials on globe artichokes.

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
Grosseto, Italy, 1979[1,24,5,7]		2	0.084	0.0042	7	<0.01	NI 01
					14	<0.01	
					21	<0.01	
Grosseto, Italy, 1979[1,2,4,5]	WP	3	0.084	0.0042	7	0.03	NI 02
					14	<0.01	
					21	<0.01	
Grosseto, Italy, 1981[1,2,6]	SC	3	0.048	0.0048	14	0.03	NB 28
			control	control	-	0.02	
Del Gardinia, Italy, 1994	SC	3	0.035-0.036	0.0036	-1	0.04	NI 05
					1	0.07	
					7	0.04	
					14	<0.01	
					21	<0.01	
Del Gardinia, Italy, 1994	SC	3	0.046-0.048	0.0048	-1	0.03	NI 05

Location, year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl			
					1	0.10	
					7	0.06	
					14	0.02	
					21	<0.01	
Sezze, Italy, 1994	SC	3	0.031-0.035	0.0036	-1	0.02	NI 05
					1	0.11	
					7	0.05	
					14	0.02	
					21	<0.01	
Sezze, Italy, 1994	SC	3	0.042-0.047	0.0048	-1	0.05	NI 05
					1	0.19	
					7	0.06	
					14	0.04	
					21	0.02	
L'Alcudia, Spain, 1987[1,6,8]	EC	1	0.153	0.006	0	0.42	Ref. 13
					3	0.33	
					7	0.26	
					14	0.14	
					21	0.09	

Underlined residues are from treatments according to GAP in Italy
[1] No weather data submitted
[2] Method of analysis unspecified
[3] No control plot data
[4] Crops stored for 19 months before analysis
[5] Low recoveries (61%)
[6] No example chromatograms submitted
[7] Crop variety not specified
[8] No English translation provided

Witloof chicory. Only Dutch GAP for "vegetables" was reported (0.036 kg ai/ha or 0.0024 kg ai/hl, 3-day PHI). In a single trial residues were <0.01 mg/kg in samples taken 60 days after harvest.

Table 39. Supervised residue trials on witloof chicory at Slootdorp, The Netherlands, in 1984. 2 x 0.06 kg ai/ha of EC. No example chromatograms submitted and no English translation provided.

Sample	PHI, days	Residues, mg/kg	Reference
Crop	60	<0.01	KVW266/CTB/PD
Roots, soil removed	60	<0.01	

Pecans. GAP was reported for the USA and Mexico. The maximum application rates are 0.098 and 0.108 kg ai/ha with a PHI of 30 days in the USA and pre-flowering application in Mexico.

Twelve trials were carried out in the USA in four of which (one replicated) the final applications (0.074-0.12 kg ai/ha) were comparable to the registered rate in the USA (0.098 kg ai/ha). Residues were <0.002 and <0.002-0.02 mg/kg in the kernels and shells respectively after 35-153 days. In a further series of trials in which an exaggerated application rate was used (0.15-0.32 kg ai/ha) residues were <0.002-0.02 and <0.002-0.16 in the kernels and shells in samples taken 17-55 days after treatment. In one of these trials the laboratory samples were stored for 11 months before analysis.

Table 40. Supervised residue trials (field) on pecans in the USA.

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
Byron, GA, 1981[1]	EC	10	0.148*	0.003	30	kernel	<0.002	NM 01
Albany, GA, 1981[1,2,3]	SC	14	0.197*		35-39	kernel	<0.002	NM 01 RBC 81-25
						shell	0.164	
	EC	14	0.197*		35-39	kernel	0.02	
					55	shell	0.155	
Byron, GA, 1982[1]	EC	9	0.158*		55	kernel	<0.002	NM 01 USDA
						shell	<0.002	
Albany, GA, 1982[1]	EC	17	0.149*		29	kernel	<0.002	NM 01 RBC 82-1
						shell	<0.002	
					43	kernel	<0.002	
						shell	<0.002	
Albany, GA, 1982[1]	EC	17	0.149*		17	kernel	<0.002	NM 01 RBC 1, 2-5
						shell	<0.002	
Fitzpatrick, AL, 1982[1]	EC	14	0.149*		43	kernel	<0.002	NM 01 RDH 82-3
						shell	0.01	
Blakely, GA, 1982[1]	EC	11	0.12		38	kernel	<0.002	NM 02 RBC 83-12
					84	kernel	<0.002	
					107	kernel	<0.002	
					155	kernel	<0.002	
			0.12		38	shell	<0.002	
					84	shell	<0.002	
					107	shell	<0.002	
					155	shell	<0.002	
Artesia, MS, 1983[1]	EC	6	0.14		124	kernel	<0.002	NM 02 MS UNI
						shell	0.008	
		6	0.094		124	kernel	<0.002	
						shell	0.002	
Albany, GA, 1983[1]	EC	5	0.14		171	kernel	<0.002	NM 02 RBC 83-15
						shell	<0.002	
			0.32*		171	kernel	<0.002	
						shell	<0.002	
Albany, GA, 1983[1]	EC	11	0.12		25	kernel	<0.002	NM 02 RBC 83-16
			0.08		71	kernel	<0.002	
			0.063		94	kernel	<0.002	
			0.045		142	kernel	<0.002	
			0.12		25	shell	<0.002	
			0.08		71	shell	<0.002	
			0.063		94	shell	<0.002	
			0.045		142	shell	<0.002	
Fitzpatrick, GA, 1983[1]	EC	7	0.074		153	kernel	<0.002	NM 02 RDH 83-10
			0.10			kernel	<0.002	
			0.14			kernel	<0.002	
			0.11			kernel	<0.002	
			0.074		153	shell	0.02	

Location, year	Application				PHI, days	Sample	Residues, mg/kg	Ref.
	Form	No.	kg ai/ha	kg ai/hl				
			0.10			shell	0.004	
			0.14			shell	0.007	
			0.11			shell	<0.002	
Montgomery, AL, 1983[1]	EC	7	0.074		136	kernel	<0.002	NM 02 RDH 83-11
			0.10			kernel	<0.002	
			0.14			kernel	<0.002	
			0.11			kernel	<0.002	
			0.074		136	shell	0.014	
			0.10			shell	0.013	
			0.14			shell	0.023	
			0.11			shell	<0.002	

Underlined results are according to the registered application rate in the USA but are at longer PHIs; those underlined twice are from treatments according to GAP in the USA including the PHI.
* exaggerated application rate
[1] No weather data submitted
[2] Crops stored for 11 months before analysis
[3] Low associated recoveries (shells 44%)

Hops. GAP was reported for Germany and Spain. The maximum application rate was either 0.06 kg ai/ha or 0.0015 kg ai/hl with a 10-day PHI in Germany and 0.0048 kg ai/hl with an unspecified PHIs in Spain.

Four trials in Germany were all conducted according to German GAP. Residues in dried hops harvested 10 days after the final treatment were 2.22-3.55 mg/kg. Samples were stored for 13 months before analysis. The results are shown in Table 41.

Table 41. Supervised residue trials on hops, beer and spent yeast in Germany, 1990. All trials with 4 x 0.06 kg ai/ha (0.0015 kg ai/hl) of WP.

Location, year	PHI, days	Sample	Residues, mg/kg	Ref.
Rohr[1,2]	10	fresh hops	0.65	NJ 01 R90-616
		dried hops	3.15	
		spent hops	0.12	
		beer	<0.01	
		spent yeast	0.02	
Rohr[1,2]	10	fresh hops	1.12	NJ 01 R90-61B
		dried hops	3.55	
		spent hops	0.23	
		beer	<0.01	
		spent yeast	0.02	
Steinbach[1,2]	10	fresh hops	0.63	NJ 01 R90-61A
		dried hops	2.34	
		spent hops	0.14	
		beer	<0.01	
		spent yeast	0.02	
Rohr[1,2]	10	fresh hops	0.72	NJ 01 R90-61D
		dried hops	2.22	

Location, year	PHI, days	Sample	Residues, mg/kg	Ref.
		spent hops	0.12	
		beer	<0.01	
		spent yeast	0.02	

Underlined residues are from treatments according to GAP in Germany
[1] No weather data submitted
[2] Crops stored up to 13 months before analysis

Other commodites. GAP was also reported for peas in Japan and Italy and wheat in Japan, but no trials data were submitted.

Feeding trials on cattle and pigs

Twelve cattle (White Face) and twelve crossbred pigs were fed for 28 days on a diet containing nominally 0.1, 0.3 or 1.0 ppm fenarimol. The actual levels of the active ingredient in the treated feed were lower, apparently owing to the extraction procedures in which dichloromethane was used. The animals were killed 6 hours after the final feed. Tissues samples were extracted with methanol-acetonitrile, and the filtered extract partitioned with dichloromethane/aqeous NaCl. A cleaned up dichloromethane extract was then analysed by GLC with an ECD. Average procedural recoveries were 78-95% and 86-109% from cattle and pigs respectively. The residue distribution in tissues, corrected for recoveries, were as shown in Table 42 (Koons *et al*., 1984).

Table 42. Fenarimol residues in cattle and pigs.

Animal feeding level, ppm	Residue, mg/kg				
	Liver	Kidney	Muscle, loin	Muscle, round	Fat
Cattle					
0.1	0.005- 0.006	0.01	0.01	0.01	0.01
0.3	0.005-0.03	0.01	0.01	0.01	0.01
1.0	0.04-0.05	0.006-0.007	0.01	0.01	0.01
Pigs					
0.1	0.003-0.007	0.01	0.01	0.01	0.003-0.004
0.3	0.007-0.01	0.01	0.01	0.01	0.007-0.01
1.0	0.01-0.03	0.005-0.01	0.01	0.01	0.01-0.03

FATE OF RESIDUES IN STORAGE AND PROCESSING

In storage

No data were submitted.

In processing

Apples. Samples of apples with incurred residues of fenarimol were processed into juice, wet pomace following juice extraction, apple sauce, wet pomace following sauce production, and dry pomace. Samples were analysed by the method of Griggs and Decker (1981). Recoveries were variable but acceptable. Individual results are shown in Table 24 and a summary is given in Table 43.

Table 43. Summary of the distribution of fenarimol residues in apple and processed products.

Residues, mg/kg					
Whole fruit	Juice	Wet pomace from juice	Sauce	Wet pomace from sauce	Dry pomace
<0.002-0.04	<0.002-0.003	0.009-0.14	<0.002-0.009	<0.002-0.2	0.01-0.7

The residues in the wet pomace suggest that the residues were originally mainly in the peel. The individual results show that residues were generally concentrated about 2-fold from wet pomace to dry pomace during juice production, about 1-8-fold from wet pomace from sauce to dry pomace, and roughly 2-8-fold from whole fruit to wet pomace from juice (Decker and Day, 1983).

The concentration of residues between whole fruit and dry pomace is shown in detail in Table 44. Samples from the Cornel, Penn Univ and Winchester trials were soak-washed before analysis of the whole apples. The mean analytical recovery associated with the dry pomace results in these trials was high at 132%.

Table 44. Effect on residues of the production of dry pomace from whole apples.

Residues, mg/kg		Concentration factor	Ref.
Whole apple	Dry pomace		
<0.002	0.014	>7	NF 18 Cornel
0.037	0.67	18	NF 18 Penn Univ
0.017	0.20	12	NF 18 Penn Univ
0.059	0.31	5	NF 18 Winchester
0.057	0.36	6	NF 18 Winchester
0.014	0.12	9	NF 18 CMR 82-10
0.008	0.16	20	NF 18 CMR 82-10
<0.002	0.012	>6	NF 18 CMR 82-11
<0.002	0.013	>7	NF 18 CMR 82-11
0.007	0.12	17	NF 18 CMR 82-16
0.007	0.098	14	NF 18 CMR 82-16
0.004	0.068	17	NF 18 CDR 6-16
Median concentration factor		14	
Mean concentration factor		11.5	
Concentration factors excluding the trials from Cornel,		median 14	

Residues, mg/kg		Concentration factor	Ref.
Whole apple	Dry pomace		
Penn. Univ. and Winchester		mean 12.9	

Grapes. Grapes with incurred residues of fenarimol were processed into must and wine. Samples were analysed by the methods of Butcher and Perkins (1992) and Butcher (1994a). Recoveries from all substrates were acceptable. Individual results are are shown in Table 29. A summary is given in Table 45 (Butcher and Wood, 1994c).

Table 45. Distribution of fenarimol residues in grapes and processed products.

Residue, mg/kg		
Grapes	Wine	Must
0.01-0.03	<0.01	<0.01
0.02-0.04	<0.01	<0.01
0.01-0.02	<0.01	<0.01

The US residue trials on grapes included processing. Juice, pomace, raisin waste and raisins were all analysed. Most of the residue after processing was associated with the raisin waste. Further details including the individual results are shown in Table 30 (Dow Elanco Ltd., undated refs. NHO1, NHO2; Day, 1984a).

The concentration of residues from grapes to raisins is shown in Table 46 and from grapes to dry pomace in Table 47.

Table 46. Effect on residues of the production of raisins.

Residues, mg/kg		Concentration factor	Reference
Grapes	Raisins		
0.02	0.040	2.0	NH 01
0.004	0.005	1.3	NH 02
0.006	0.011	1.8	NH 02
0.004	0.004	1.0	NH 02
0.026	0.040	1.5	NH 02
0.019	0.040	2.1	NH 02
0.023	0.011	0.5	NH 17
0.024	0.015	0.6	NH 17
0.019	0.010	0.5	NH 17
0.021	0.009	0.4	NH 17
0.009	0.005	0.6	NH 17
0.046	0.017	0.4	NH 17
0.029	0.019	0.7	NH 17
0.025	0.014	0.6	NH 17
0.026	0.010	0.4	NH 17
0.029	0.012	0.4	NH 17
0.053	0.026	0.5	NH 17
0.053	0.021	0.4	NH 17
0.043	0.016	0.4	NH 17

Residues, mg/kg		Concentration factor	Reference
Grapes	Raisins		
0.081	0.020	0.2	NH 17
0.032	0.014	0.4	NH 17
0.023	0.009	0.4	NH 17
0.024	0.007	0.3	NH 17
0.016	0.011	0.7	NH 17
0.024	0.007	0.3	NH 17
0.024	0.009	0.4	NH 17
0.024	0.020	0.8	NH 17
0.028	0.019	0.7	NH 17
0.040	0.013	0.3	NH 17
0.020	0.012	0.6	NH 17
0.009	0.012	1.3	NH 17
0.068	0.042	0.6	NH 17
0.052	0.050	1.0	NH 17
0.044	0.026	0.6	NH 17
0.040	0.023	0.6	NH 17
0.044	0.022	0.5	NH 17
0.067	0.024	0.4	NH 17
0.032	0.050	1.7	NH 17
.061	0.019	0.3	NH 17
0.061	0.015	0.2	NH 17
0.021	0.012	0.6	NH 17
0.100	0.064	0.6	NH 17
0.053	0.059	1.1	NH 17
0.085	0.034	0.4	NH 17
0.060	0.036	0.6	NH 17
0.034	0.042	1.2	NH 17
median concentration factor		0.6	

Table 47. Effect on residues of the production of dry grape pomace.

Residues, mg/kg		Concentration factor	Reference
Grapes	Dry grape pomace		
0.002	0.030	15	NH 17
0.004	0.047	12	
<0.002	0.012	>6	

In two Australian residue trials grapes were fermented into wine. The results are shown in Table 30 (NH 24). The residues in the wine were very low.

Hops. Samples of hops with incurred residues of fenarimol were processed into dried hops, beer and spent hops. Spent yeast following brewing was also analysed. Analyses were by the method of Butcher and Perkins (1992). Recoveries from all substrates were acceptable. The residues were as shown in Table 48.

Table 48. Distribution of fenarimol residues in hops and brewing products.

Residue, mg/kg				
Fresh hops	Dried hops	Spent hops	Beer	Spent yeast
0.63-1.12	2.22-3.55	0.12-0.23	0.01	0.02

Individual results (given in Table 41) showed a 3-5-fold increase in residues between fresh and dried hops and a roughly 15-25-fold decrease between dried hops and spent hops (Butcher and Perkins, 1991).

Residues in the edible portion of food commodities

Bananas. Several residue trials were carried out in which the residues in the pulp and whole bananas were determined separately. In one trial the peel was also analysed separately. Residues of fenarimol were found in the edible pulp, but were generally lower than in the peel. The results are given in Table 32 (Catta-Preta and Matos, 1993; Ishikura, 1991).

Melons. Several residue trials were carried out in which the pulp and peel were analysed separately. Residues in the pulp were low (≤0.02 mg/kg), although in most of the trials samples were taken up to 4 days after a single treatment. Details are given in Table 34.

Pecans. In thirteen US trials residues in the kernels and shells were determined separately. Residues in the edible kernels were all <0.002 mg/kg whereas residues in the shells were 0.002-0.164 mg/kg from trials at a variety of application rates. Individual results are given in Table 40 (Decker, 1983a, 1984).

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

Results of random monitoring analyses undertaken by the Australian Department of Primary Industries and Energy from 1st January 1989 to 30th June 1992 are shown below. Sampling of fruit and vegetables was of the whole commodity excluding stones, stems, crowns etc.

Table 49. Australian monitoring data for fenarimol.

Commodity	Residue, mg/kg	Number of samples
Apple	<0.01	45
	0.01-0.04	2
	0.05-0.1	1
	TOTAL	48
Fresh grapes	<0.01	165
	trace only	1
	0.01-0.02	10
	0.02-0.05	1

	TOTAL	177
Pears	<0.01	17
	0.01-0.04	2
	TOTAL	19

NATIONAL MAXIMUM RESIDUE LIMITS

The national MRLs listed below were reported to the Meeting.

Country	Crop	MRL, mg/kg	Ref.
Argentina	apples	0.01	ref. 1
	grapes	0.1	
	peach	0.1	
	pear	0.01	
	squash, small	0.1	
Australia	pome fruit	0.2	ref. 2
	fruiting vegetables/cucurbits	0.2	
	grapes	0.1	
Brazil	apple	0.05	ref. 1
	cucumber	0.05	
	grapes	0.05	
	muskmelon	0.05	
	pumpkin	0.05	
	watermelon	0.05	
European Union[1]	citrus fruit	0.02*	ref. 3
	tree nuts	0.02*	
	pome fruit	0.3	
	stone fruit	(A)[2]	
	grapes, table & wine	0.3	
	strawberries	0.3	
	raspberries	0.3	
	currants	1	
	gooseberries	1	
	all other berries and small fruit	0.02*	
	root and tuber vegetables	0.02*	
	bulb vegetables	0.02*	
	fruiting vegetables	(A)	
	brassica vegetables	0.02*	
	leaf vegetables	0.02*	
	peas with & without pods	(A)	
	other legumes	0.02*	
	artichokes	(A)	
	other stem vegetables	0.02*	
	fungi	0.02*	
	pulses	0.02*	
	oil seeds	0.02*	
	potatoes	0.02*	
	tea	0.01*	
	hops	5	
	wheat/barley	(A)	
	other cereals	0.02*	

Country	Crop	MRL, mg/kg	Ref.
	liver/kidney	(A)	
	other meat, milk or dairy	0.02*	
Hungary	apple	0.2	ref. 1
	blueberry/gooseberry	0.2	
	cherry	0.2	
	cucurbits	0.2	
	parsley	0.2	
	vineyards	0.2	
Japan	apple	1	
	aubergine	0.5	ref. 1
	cucumber	0.5	
	melon	1	
	pea, immature	0.5	
	peach	1	
	Japanese pear	1	
	pepper, sweet	0.5	
	persimmon	1	
	pumpkin	0.5	
	strawberries	1	
	tomato	0.5	
	watermelon	1	
	wheat	0.1	
Mexico	apples	0.1	ref. 1
	grapes	0.2	
	peas	0.1	
	pecan	0.1	
USA	apple	0.1	ref. 1
	cherry	1	
	grape	0.2	
	pear	0.1	
	pecan	0.1	
	cattle, fat	0.1	
	cattle, kidney	0.1	
	cattle, liver	0.1	
	cattle, meat by-products	0.01	
	cattle, meat	0.01	
	eggs	0.01	
	goats, fat	0.1	
	goats, kidney	0.1	
	goats, liver	0.1	
	goats, meat by-products	0.01	
	goats, meat	0.01	
	hog, fat	0.1	
	hog, kidney	0.1	
	hog, liver	0.1	
	hog, meat by-products	0.01	
	hog, meat	0.01	
	horse, fat	0.1	

Country	Crop	MRL, mg/kg	Ref.
	horse, kidney	0.1	
	horse, liver	0.1	
	horse, meat by-products	0.01	
	horse, meat	0.01	
	milk	0.003	
	poultry, fat	0.01	
	poultry, meat by-products	0.01	
	poultry, meat	0.01	
	sheep, fat	0.1	
	sheep, kidney	0.1	
	sheep, liver	0.1	
	sheep, meat by-products	0.01	
	sheep, meat	0.01	

[1] Applicable to Austria, Belgium, Denmark, Germany, Greece, Finland, France, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and the UK
[2] To be set at 0.02* mg/kg (analytical limit of determination) unless further residue trials data are supplied

APPRAISAL

Fenarimol is a pyrimidin-5-ylbenzhydrol systemic fungicide, which is available in several formulations, the most important being emulsifiable concentrates, suspension concentrates, and wettable powders. It is registered for use on many crops world-wide. It was considered for the first time by the present Meeting.

Fenarimol is a crystalline solid of moderately low melting point and volatility. It has low solubility in water and is soluble in medium polarity solvents. The octanol/water partition coefficient indicates that the compound has the potential to accumulate to a moderate extent. It is photolabile in air and water and is not flammable, autoflammable, explosive or oxidizing.

In rats the major metabolic routes are oxidation of the carbinol, the chlorophenyl rings and the pyrimidine ring.

In goats a number of metabolites were formed, but they occurred at very low levels and would be unlikely to exceed 0.01 mg/kg following the feeding of crops (e.g apple pomace) which had been treated according to current GAP. The metabolites included *o*-chlorobenzoic acid and the methyl sulfone derivative of fenarimol, neither of which were identified as rat metabolites. Fenarimol was also detected in liver and kidney samples at low levels, and was the major component of the residue in pigs. In a poultry metabolism study the highest total residue occurred in the liver and kidneys. No identification of the residue was attempted although intakes by chickens from treated crops are likely to low (<0.1 ppm in the diet).

In apples and grapes fenarimol was degraded to numerous unidentified compounds at very low levels. These are likely to be photo-degradation products as they generally show very similar chromatographic characteristics. They do not occur in rats. The major component of the radioactive residue in apples, grapes and cucumbers was fenarimol. Six hours, 29 days and 49 days after spraying apples with [Æ-14C]fenarimol, the majority of the radioactive residue (81-92%) was associated with the peel.

A number of analytical methods were reported for a variety of substrates. Although these used different extraction and clean-up techniques, the determination in all was by GLC with an ECD, achieving LODs of 0.002-0.05 mg/kg.

Since the studies of metabolism by plants and livestock indicated that unchanged fenarimol was the major component of the residue, the Meeting concluded that the residue should be defined as fenarimol.

Residues in wine, grapes and cherries were found to be stable for at least 370, 370 and 104 days, respectively, following storage at *c.* -20°C. Additional data on the storage stability of residues were available for fortified peaches, tomatoes and melons, but were submitted too late for consideration by the Meeting: they will be evaluated by a future Meeting.

Important experimental details were missing from several of the residue trials. In cases where weather data, example chromatograms, crop variety or full details of the method of analysis for the particular trial were not provided the trials data were used, where applicable, to estimate maximum residue levels, since these omissions were not considered critical. However, where analytical recoveries associated with a trial were outside the range 70-120% the results were generally ignored. Similarly, if laboratory samples were stored frozen for more than 6 months or the duration and conditions of storage were unspecified the analytical results were not considered reliable. The exception to this was fruit crops for which data on the storage stability of residues were available. Finally in all cases a study report was considered necessary; a simple trial sheet was not considered to give sufficient information and such submissions as were not used in the estimation of maximum residue levels.

Apples. The results of a large number of trials were available from several countries around the world. The highest residues were found in trials according to Dutch GAP, but since the Dutch data were submitted only in summary form they were not used to estimate maximum residue levels. 16 Northern European trials reflected German GAP (0.0036 kg ai/hl, 21-day PHI) with residues of 0.02-0.21 mg/kg. A number of other German trials were reported but only summary sheets were submitted. US GAP was followed in eight trials in the USA, several of which were replicated, with residues 29-42 days after the final treatment of 0.002-0.059 mg/kg.

Eight trials according to GAP reported for Denmark, the UK and Ireland showed residues of 0.02-0.18 mg/kg. In further trials according to GAP in New Zealand, Brazil and Chile residues were 0.002-0.09 mg/kg. The Meeting estimated a maximum residue level of 0.3 mg/kg.

Pears. Four trials according to GAP were reported from the USA with residues of 0.01-0.04 mg/kg. Two trials were available with residues up to 0.13 mg/kg reflecting Italian and German GAP: the analytical recoveries associated with these trials were low at 63 and 67% respectively. The Meeting took into account the large number of trials on apples and the similar use patterns on the two crops, and estimated a maximum residue level of 0.3 mg/kg for pome fruits.

Peaches. Five peach trials in Spain and Italy according to Spanish GAP gave residues of 0.03-0.3 mg/kg at 7 days. In two of these trials the volume of spray per hectare was not clear and the results can therefore only be used as supplementary information. A further 1988 Spanish trial on apricots according to Spanish GAP for peaches with a residue of 0.36 mg/kg at 7 days provides support. The highest residues were from trials in which high water volumes were used but these complied with GAP. In a single Chilean nectarine trial according to Argentinian GAP residues were below the LOD at 2 days. No trials were available with results at the Japanese GAP PHI of one day. The Meeting estimated a maximum residue level of 0.5 mg/kg for peaches.

Cherries. Nine trials (3 with replicates) according to US GAP showed residues of 0.06-0.89 mg/kg at a 0- or 1-day PHI. It was recognised that no account was taken of the weights of the stones and the residues in the whole cherries would have been somewhat lower. The Meeting estimated a maximum residue level of 1 mg/kg for cherries.

Currants. Only 5 trials were available from The Netherlands and only one of these was according to GAP in Denmark, Ireland, The Netherlands or the UK. Furthermore, since the Dutch data were submitted only in summary form they could not be used. The Meeting concluded that there were insufficient data to estimate a maximum residue level for currants.

Gooseberries. Only one Dutch trial, reported in summary form only, was available: it complied with GAP reported for Ireland, The Netherlands and the UK. The Meeting concluded that there were insufficient data to estimate a maximum residue level.

Grapes. Residues in grapes treated according to GAP in the USA, Australia and France were generally low with residues of 0.003-0.06 mg/kg, 0.01-0.08 mg/kg and 0.02 mg/kg, respectively. A number of German trials were submitted of which six (2 with replicates) reflected German GAP (0.023 kg ai/ha, 35-day PHI). The residues were 0.01-0.15 mg/kg in samples taken 35 days after the final treatment. Seven of the German trials (two with replicates) which accorded with UK GAP (0.04 kg ai/ha, PHI 14 days) gave residues of 0.02-0.24 mg/kg in samples taken 14 days after the final treatment. There were no southern European trials at the highest GAP rate (0.06 kg ai/ha) or the shortest PHI (7 days). The Meeting estimated a maximum residue level of 0.3 mg/kg for grapes.

Strawberries. Residue trials data were available from Italy, Japan, Spain and The Netherlands. Three Italian trials were according to GAP (0.048 kg ai/hl, 7-day PHI), with residues of 0.12-0.18 mg/kg. Dutch trials reflecting GAP (0.084 kg ai/ha, treatment before flowering) showed residues of <0.01-0.02 mg/kg, but the data were submitted in summary form only and were therefore not considered further. Higher residues would result from Spanish GAP which has the shorter PHI of 3 days (0.0048 kg ai/hl) and which was represented by one trial with a residue of 0.25 mg/kg. Seven field trials were according to Japanese indoor GAP with a PHI of 1 day (0.03 kg ai/ha or 0.003 kg ai/hl). Residues in crops sampled one day after the final treatment were 0.04-0.56 mg/kg. The Meeting estimated a maximum residue level of 1 mg/kg for strawberries.

Raspberries. Only one residues trial was available from the UK and this was at a higher application rate than the GAP reported for Ireland and the UK. There were insufficient data to estimate a maximum residue level.

Bananas. Residue trials in Ecuador, Costa Rica and Honduras demonstrated that residues in unbagged bananas were generally higher than in bagged bananas. Six trials according to GAP in Honduras and Nicaragua (0.12 kg ai/ha, PHI 0 days) showed residues in unbagged bananas 0 or 1 day after the final treatment of <0.01-0.19 mg/kg. Six further trials at twice the registered application rate led to residues of 0.03-0.3 mg/kg in unbagged fruit. Residues were determined in the edible pulp. Although these were generally lower than those in the peel some were higher. The Meeting concluded that there was no consistent partition factor between the pulp and peel. It estimated a maximum residue level of 0.2 mg/kg.

Cucumbers. Only very limited data were available with one trial according to UK and Irish GAP (0.002 kg ai/hl, 2-day PHI) and one according to GAP in Uruguay. Residues were 0.03 mg/kg after 2 days and 0.003 mg/kg after 4 days respectively. The Meeting concluded that there were insufficient data to estimate a maximum residue level for cucumber.

Gherkins. Information on GAP gherkins in The Netherlands was reported as 0.0024 kg ai/hl, 6-day PHI, for both protected and field use. Two Dutch trials were reported with the high application concentration of 0.24 kg ai/hl but with the rate per hectare unspecified. However, since the data were submitted in summary form only they were unsuitable. The Meeting concluded that there were insufficient data to estimate a maximum residue level.

Melons (including cantaloupe) and watermelons. Data were available from two Spanish indoor trials but these were with a higher spray concentration than the reported Dutch GAP. Two trials were according to Brazilian GAP (0.024 kg ai/ha, 4-day PHI); the residues were 0.005 mg/kg in melons and "not detected" in watermelons.

Four French trials on melons were according to Greek GAP for "cucurbits" (0.024 kg ai/ha, 1-day PHI) with residues of <0.01 mg/kg in the pulp and up to 0.11 mg/kg in the peel of samples taken 2 days after the final treatment. However, no information was available on the weight ratio of the peel to the pulp. The manufacturer suggested a 30% peel to fruit weight ratio based on melon samples taken from other trials. Whilst the Meeting would not normally consider it appropriate to use an assumed weight ratio, this was considered an exceptional case since the residues were very low and calculations of the residues in whole melons from the trial with the highest residue level in the peel, based on an assumed peel:fruit weight ratio of 20-40%, would lead to values of 0.03-0.05 mg/kg if the residues in the pulp were at the limit of determination. Other trials were available which, although they did not correspond exactly to reported GAP (usually they were with exaggerated doses), indicated that residues were generally low. The Meeting estimated a maximum residue level of 0.05 mg/kg for melons. Since there were relatively few results the Meeting did not consider it appropriate to extrapolate this estimate to other cucurbits.

Pumpkins, courgettes and squashes. Only limited data were available, with no indoor trials according to Dutch indoor GAP.

Only one trial in Brazil, with a residue of 0.005 mg/kg, conformed to outdoor GAP in Argentina and Uruguay. Single Australian replicated trials on zucchini and pumpkins were according to Australian GAP for cucurbits. Residues were very low: 0.001-0.01 mg/kg three days after the final treatment. The Meeting concluded that there were insufficient data to estimate a maximum residue level for pumpkins, courgettes or squashes.

Tomatoes. Two indoor trials in The Netherlands were comparable to Danish GAP (0.036 kg ai/ha or 0.0048 kg ai/hl, 2-day PHI). Residues in both were 0.03 mg/kg at 2 days. Italian and Spanish outdoor GAP (0.0048 and 0.006 kg ai/hl, 7-day PHI) was reflected in two Italian trials and one Spanish trial with residues of 0.03, 0.03 and 0.05 mg/kg at 7 days. There were no outdoor trials according to Japanese GAP, which has a PHI of 1 day. Should submissions be made in the future, processing data will be required. There were insufficient data to estimate a maximum residue level.

Peppers. There were 6 trials in Italy and Spain according to Italian and Spanish GAP (the same as for tomatoes). The residues were 0.03 and 0.07 mg/kg in the Italian trials and 0.07, 0.08, 0.12 and 0.5 mg/kg in the Spanish trials, in samples taken 7 days after the final treatment. The Meeting estimated a maximum residue level of 0.5 mg/kg for peppers.

Aubergines. Only one Italian trial was available in which the residue was <0.01 mg/kg 15 days after treatment. This was insufficient to estimate a maximum residue level.

Beetroots and carrots. The only GAP reported for beetroots and carrots was the Dutch GAP for "vegetables" (0.036 kg ai/ha or 0.0024 kg ai/hl, 3-day PHI). Although one Netherlands trial was available for each of these crops, neither reflected GAP since samples were taken 27 days after treatment. No maximum residue level could be estimated.

Artichoke, Globe. Six Italian trials were considered to reflect Italian GAP (0.0048 kg ai/hl or 0.038 kg ai/ha, 7-day PHI) with residues of <0.01-0.06 mg/kg. Two of these trials (in 1979 with residues of <0.01 and 0.03 mg/kg) had a low associated analytical recovery (61%) and were therefore not considered reliable. A further Spanish trial gave a higher residue of 0.26 mg/kg at 7 days but a high volume of water (2,500 l/ha) was applied and the spray concentration (0.006 kg ai/hl) was higher than that registered in Italy. The Meeting estimated a maximum residue level of 0.1 mg/kg for globe artichokes.

Witloof chicory. Only one replicated trial in The Netherlands was available which complied with Dutch GAP for "vegetables". Residues were <0.01 mg/kg in samples taken 60 days after treatment. The Meeting concluded that there were insufficient data to estimate a maximum residue level for witloof chicory.

Pecans. Twelve trials were carried out in the USA of which four (one replicated) had application rates of 0.074-0.12 kg ai/ha, close to the registered rate in the USA (0.098 kg ai/ha). Residues in the kernels, to which the MRL applies, were <0.002 mg/kg at 35-153 days. In a further series of trials, residues in the kernels were all <0.002 mg/kg except in one trial with 0.02 mg/kg, at an exaggerated application rate (0.14-0.197 kg ai/ha). The residue of 0.02 mg/kg may have resulted from physical transfer from the shell. Recognising the need to establish MRLs at levels suitable for routine analysis by monitoring and enforcement laboratories, the Meeting estimated a maximum residue level of 0.02* mg/kg for pecans.

Hops. Four trials in Germany were all according to German GAP (0.06 kg ai/ha or 0.0015 kg ai/hl, 10-day PHI). The residues in dry hops harvested 10 days after the final treatment were 2.22-3.55 mg/kg, but in all the trials the hop samples were stored for 13 months before analysis. Brewing with these hops gave residues in the beer of <0.01 mg/kg. The results appeared very consistent and would suggest a maximum residue level of 5 mg/kg in dry hops, but in the absence of data confirming the stability of fenarimol in stored samples of a leafy crop the Meeting decided not to recommend an MRL: it was informed that a storage stability study on hops was now available.

Apple pomace. Processing data on apples indicated a concentration of residues from whole apples to dry pomace of 5-20-fold, with a median concentration factor of 14. Apple samples in several of the trials were "soak-washed" before analysis of the whole apples. The Meeting considered the data from these samples unsatisfactory. In the seven remaining trials with unwashed apples the median and mean concentration factors were 15 and 17 respectively. Although it was noted that the analytical recoveries from dry apple pomace were variable (68, 68, 76, 83, 108, 132 and 132%) the Meeting estimated a maximum residue level of 5 mg/kg for apple pomace, dry.

Dried grapes. Processing data on grapes indicated concentration factors for residues in whole grapes to those in raisins of 0.2-2.1. By applying the median concentration factor of 0.6 to the estimated maximum residue level of 0.3 mg/kg for grapes, the Meeting estimated a maximum residue level of 0.2 mg/kg for dried grapes.

Grape pomace, dry. Processing grapes to dry grape pomace increased the residues about 12-15 times, but as there were only two suitable results and residues in the grapes were low the Meeting could not establish a reliable concentration factor and therefore did not estimate a maximum residue level.

In a livestock feeding study beef cattle and pigs were fed for 28 days with fenarimol at various rates up to 1 ppm in the diet. At this dose residues of fenarimol in all tissue except liver were ≤0.01 mg/kg. Residues in the liver reached a maximum level of 0.03 mg/kg in pigs and 0.05 mg/kg in cattle. At rates of 0.1 and 0.3 ppm all tissue residues were <0.01 mg/kg.

Livestock will obtain fenarimol from wheat grain and straw, peas and pea straw, and fruit pomace. Of these items sufficient data on residues were available only for dry apple pomace (estimated maximum residue level 5 mg/kg). Dairy and beef cattle consume a maximum of 30% of their dietary dry matter as fruit pomace, whereas it is not generally fed to pigs. The maximum intake of fenarimol by beef cattle from fruit pomace would therefore be approximately 1 ppm in the diet. The Meeting recognized the need to establish MRLs at levels suitable for routine analysis by monitoring and enforcement laboratories, and estimated maximum residue levels of 0.02* mg/kg for cattle meat and kidney and 0.05 mg/kg for cattle liver.

There were insufficient data on pig feed items to estimate a maximum residue level for the meat or edible offal of pigs.

Although data on the environmental fate of fenarimol in soil were submitted to the Environmental Core Assessment Group at the present Meeting they were not, as would normally be expected, submitted for the consideration of the FAO Panel. The manufacturer agreed to submit the data to the FAO, for future consideration by the FAO Panel, as soon as possible. The Meeting concluded that in these circumstances temporary MRLs should be recommended, with a requirement for the studies on environmental fate.

RECOMMENDATIONS

The Meeting estimated the temporary maximum residue levels shown below, which are recommended for use as TMRLs.

Definition of the residue: fenarimol

CNN	Commodity	Recommended MRL, mg/kg	PHI on which based, days
AB 0266	Apple pomace, dry	5T	-
VS 620	Artichoke, Globe	0.1T	7
FI 327	Banana	0.2T	0
MM 812	Cattle meat	0.02*T	-
MO 1280	Cattle kidney	0.02*T	-
MO 1281	Cattle liver	0.05T	-
FS 13	Cherry	1T	0
DF 269	Dried grape	0.1T	-
FB 269	Grape	0.3T	14
VC 46	Melons, except Watermelon	0.05T	1
FS 247	Peach	0.5T	7
TN 672	Pecan	0.02*T	30
VO 445	Peppers, Sweet	0.5T	7
FP 9	Pome fruits	0.3T	14-28
FB 275	Strawberry	1T	1

FURTHER WORK OR INFORMATION

Required (by 1996)

Data on the environmental fate of fenarimol in soil.

Desirable

1. Full details of the methods of analysis used in all the residue studies where this information was not given. Validation of the methods of analysis for which validation data were not submitted.

2. A study to assess the likely residues in relevant succeeding or rotational crops or an explanation of why residues would not be expected.

3. Information on the melting point, octanol/water partition coefficient, solubility and specific gravity of pure fenarimol.

4. Submission of the study reports supporting the trials on apples, gooseberries, currants, gherkins and strawberries conducted in The Netherlands.

REFERENCES

Althaus, W.A. 1982a. ^{14}C Fenarimol Chicken Tissue Residue Study. Sept ABC-0186. Ref. NA 06.

Althaus, W.A. 1982b. ^{14}C Fenarimol Chicken Egg Residue Study. Sept ABC-0147. Ref. NA 07.

Althaus, W.A. 1984a. A Comparative Apple Residue Study Conducted with Carbinol-labelled and mixed-labelled ^{14}C Fenarimol. Mar ABC-0199. Ref. L 02.

Althaus, W.A. 1984b. ^{14}C Fenarimol Grape Residue Study. Apr ABC-0237, ABC-0239. Ref. L 03.

Althaus, W.A. 1985a. Characterization and Identification of Radioactivity in Urine and Feces of Wistar Rates given single oral doses of mixed-labelled ^{14}C Fenarimol. Dec ABC-0310. Ref. H 10.

Althaus, W.A. 1985b. Characterization and Identification of Radioactivity in Blood, Liver, and Kidney of Wistar Rats given single oral doses of mixed-labelled ^{14}C Fenarimol. Dec ABC-0321. Ref. H 11.

Althaus, W.A. 1986. ^{14}C Fenarimol Residue Study in Cucumbers. Oct ABC-0307. Ref. L 08.

Althaus, W.A. and Bewley, G.W. 1978a. ^{14}C Fenarimol Apple Residue Study Jan Ref. L 09.

Althaus, W.A. and Bewley, G.W. 1978b. Separation and Identification of Degradation Products formed from ^{14}C Fenarimol Applied to Apples. Jan Ref. L 01.

Althaus, W.A. *et al.* 1984. ^{14}C Fenarimol Swine Tissue Residue Study. Apr ABC-0202. Ref. NA 09.

Arcas, J.B. 1986. Analises de Residuos de Fenarimol em Frutos e Cucurbitaceas Ref. NB 29.

Arnold, M. 1995. Dow Elanco Europe. Spanish residue trials data for apricots, peaches, melons, artichoke, peppers and strawberry submitted with letter dated 17th July Unpublished. Ref. 13.

Arnold, M. 1995. Dow Elanco Europe. Personal Communication. 16th August Ref. 10.

Butcher, S.M. 1992. Determination of Fenarimol Residues in Beer and Spent Yeast. Jan ERC91-10. Ref. OR 21.

Butcher, S.M. 1993. Residues of Fenarimol in Tomatoes at Intervals Following Application of RUBIGAN 12ec (EAF 457), Spain Aug 1994 GHE-P-3653. Ref. NE 08.

Butcher, S.M. 1994a. Determination of Residues of Fenarimol in Tomatoes, Peaches and Melons ERC 94.3 Aug Ref. OR 24.

Butcher, S.M. 1994b. The Stability of Fenarimol in Fortified Grapes and Wine stored under Frozen Conditions GHE-P-3741 Aug Ref. NH 10.

Butcher, S.M. 1995a. Residues of Fenarimol in Tomatoes at Intervals Following Application of RUBIGAN 12SC (EAF 383), Netherlands Jan 1995. GHE-P-4008. Ref. NE 11.

Butcher, S.M. 1995b. Residues in Melons Spain Jan 1995 GHE-P-4011. Ref. NB 31.

Butcher, S.M. 1995c. Residues of Fenarimol in Tomatoes - Greece Jan 1995. GHE-P-4012. Ref. NE 12.

Butcher, S.M. 1995d. Residues in Melons Italy Jan 1995 GHE-P-4013. Ref. NB 32.

Butcher, S.M. 1995e. Peaches Italy Jan GHE-P-4014. Ref. NG 10.

Butcher, S.M. 1995f. Peaches France Jan GHE-P-4062. Ref. NG 11.

Butcher, S.M. 1995g. The stability of fenarimol in fortified peaches, tomatoes and melons under frozen storage conditons. GHE-P-4318. Ref. NG 12.

Butcher, S.M. 1995h. Residues of Fenarimol in Globe Artichokes at Intervals following Multiple Applications of RUBIGAN 12 SC (EAF383), Italy GHE-P4010 Jan 1995. Ref. NI 05.

Butcher, S.M. and Long, T.J. 1993. Determination of Residues of Fenarimol in Grape Must, Wine and Grapes. ERC93-6 Jul Ref. OR 22.

Butcher, S.M. and Perkins, J. 1991. Residues of fenarimol in Hops and related fractions from the brewing process following application of Drawisan 6WP (EAF 219) - Germany 1990. GHE-P-2517 Oct Ref. NJ 01.

Butcher, S.M. and Perkins, J.M. 1992. Determination of Fenarimol Residues in Fresh, Dried and Spent Hops. ERC91-8 Jan Ref. OR 20.

Butcher, S.M. and Wood, S. 1994a. Residues of Fenarimol in Grapes at Intervals following Application of TRANSFLO (EAF 383), France - GHE-P-3627 Jun 1994. Ref. NH 04.

Butcher, S.M. and Wood, S. 1994b. Residues of Fenarimol in Peaches at intervals following Application of RUBIGAN 12sc (EAF383), Italy - GHE-P-3626 Jun 1994. Ref. NG 08.

Butcher, S.M. and Wood, S. 1994c. Residues of Fenarimol in Grapes, Grape Must and Wine following Application of Rubigan 12 SC (EAF 383) to Grape Vines Germany GHE-P-3655 Aug 1994. Ref. NH 11.

Butcher, S.M. and Wood, S. 1994d. Residues of Fenarimol in Peaches at intevals following Application of RUBIGAN 4 (EAF 216), - Southern France GHE-P-3652 Aug 1994. Ref. NG 07.

Catta-Preta, R.F. and Matos, J.C. 1992 Residues of Fenarimol and its Major Metabolites in Bananas following Multiple treatments with Rubigan Ec Fungicide - Costa Rica, Honduras and Ecuador, April 1993 GHB-P 151. Ref. NL 02.

Catta-Preta, R.F. and Matos, J.C. 1993. Determination of

Residues of Fenarimol, Compound 212746 and 210302 in Banana Whole Fruit and Pulp BRC 92.2 March Ref. R 28.

Coleman, I. 1995. Commonwealth Department of Primary Industries and Energy, Australia. Personal Communication. 12th April Ref. 2.

Cowlyn, T.C. 1992. Fenarimol (pure): Determination of Physico-Chemical Properties (Vapour Pressure) Sept 93/DES080/0411. Ref. A 21.

Cowlyn, T.C. 1992. Fenarimol (technical): Determination of Physico-Chemical Properties (Flammability, Auto-flammability, Explosive and Oxidising Properties) Oct 92/DES081/0866. Ref. A 22.

Crossley, S.J. 1994. Pesticides Safety Directorate, UK. Personal Communication. 31st November Ref. 9.

Day, E.W. 1976. Solubility of Fenarimol in Organic Solvents. Sept FLP V-131. Ref. A 09.
Day, E.W. 1981. Fenarimol Residue Data on Apples from Canada May Ref. NF 27.

Day, E.W. 1981. Fenarimol Residues in Apples from New Zealand Mar NZ75-19, 1988 NZ78-2, NZ80-5, NZ80-6. Ref. NF 29.

Day, E.W. 1981. Fenarimol Residues in Apples from Chile May T2R-230. Ref. NF 28.

Day, E.W. 1983. Fenarimol Residue Data on Grapes and Grape Products from Experiment conducted in the United States in March 1984 I-EWD-84-03. Ref. NH 17.

Day, E.W. 1985. Fenarimol Technical Product Chemistry Data. Ref. A 08.

Day, E.W. 1987. Fenarimol Residue Data on Pears March EWD8640. Ref. NF 33.

Day, E.W. 1993. Reasonable Grounds in Support of the Petition for the Establishment of A Tolerance for Fenarimol and its Metabolites in or on Bananas. Aug ECL93073. Ref. NL

Day, E.W. Undated. Preliminary Photochemical Studies with the Fungicide EL-222. Ref. K 26.

Day, E.W and Saunders, D.G. 1987. Fenarimol Residue Studies in Cherries AAC8713 Feb 1988. Ref. NG 04.

Day, E.W. and Saunders, D.G. 1988. Storage Stability of Fenarimol in Cherries EWD8803 Feb Ref. NG 06.

Day, E.W. Jr. and Saunders D.G. 1988. Storage Stability of Fenarimol and its Metabolites in Grapes and Grape Products. EWD8802 Apr Ref. NH 07.

Day, E.W. and West, S.D. 1988. Fenarimol Residue Studies in Apples Nov 1988. AAC8819. Ref. NF 31.

Day, E.W. and West, S.D. 1988 Fenarimol Residue Trials in Grapes AAC8818 Dec 1988. Ref. NH 20.

Day, E.W. and West, S.D. 1989. Fenarimol Residue Studies in Cherries, Aug 1989 AAC8903. Ref. NG 05.

Day, E.W. *et al.* 1984. Physical and Chemical Characteristics of Technical Fenarimol Nov EWD8450. Ref. A 14.

Decker, O.D. 1983. Fenarimol Residues on Pecans when Rubigan 1EC or Rubigan 1AS is Foliar applied to Pecan Trees on Disease Control March I-ODD-82-02. Ref. NM 01.

Decker, O.D. 1984. Fenarimol Residues on Pecans when Rubigan is Foliar applied to Pecan Trees for Disease Control Feb I-ODD-84-01. Ref. NM 02.

Decker, O.D. and Day, E.W. 1981. Fenarimol Residue Data on Apples and Apple Products from Experiments conducted in the United States in and 1982. Mar 1983. I-ODD-83-06. Ref. NF 18.

Dow Elanco Ltd. 1976. Determination of EL-222 in Agricultural Crops and Soils by Gas-Liquid Chromatography Std An.Method No.86 Sep Ref. OR 10.

Dow Elanco Ltd. 1976. Residue Study - Cucumber - Austria A76-106. Ref. NB 01.

Dow Elanco Ltd. 1976. Residue Study - Melon- France F76-04. Ref. NB 02.

Dow Elanco Ltd. 1976. Residue Study-Cucumber-Italy 176-33. Ref. NB 03.

Dow Elanco Ltd. 1976. Residue Study - Cucumber - UK FG76-016. Ref. NB 04.

Dow Elanco Ltd. 1977. Determination of Fenarimol In Agricultural Crops (Other than Cereals) by Gas-Liquid Chromatography Nov Std.An.Method No.97. Ref. OR 11.

Dow Elanco Ltd. 1977. Residue Study - Cucumber - Italy 177-234. Ref. NB 08.

Dow Elanco Ltd. 1977. Residue Study - Cucumber - Italy 177-235. Ref. NB 09.

Dow Elanco Ltd. 1977. Residue Study - Squash - Italy 177-236. Ref. NB 10.

Dow Elanco Ltd. 1977. Residue Study - Cantaloupe - Italy 177-251. Ref. NB 11.

Dow Elanco Ltd. 1977. Residue Study - Watermelon - Italy 177-253. Ref. NB 12.

Dow Elanco Ltd. 1977. Residue Study - Peppers - Spain E77-129. Ref. NE 02.

Dow Elanco Ltd. 1977. Residue Study - Peach - Italy 177-212. Ref. NG 01.

Dow Elanco Ltd. 1977. Residue Study - Peach 177-213. Ref. NG 02.

Dow Elanco Ltd. 1977. Residue Study - Peach - Italy 177-214. Ref. NG 03.

Dow Elanco Ltd. 1977. Residue Study - Grape A77-121. Ref. NH 05.

Dow Elanco Ltd. 1977. Residue Study - Grape A77-122. Ref. NH 06.

Dow Elanco Ltd. 1977. Residue Study - Grape 177-225. Ref. NH 09.

Dow Elanco Ltd. 1978. Residue Study - Pears - Germany D78-312. Ref. NF 03.

Dow Elanco Ltd. 1978. Residue Study - Apples - Germany D78-311. Ref. NF 08.

Dow Elanco Ltd. 1979. Residue Study - Artichoke - Italy 179-251. Ref. N1 02.

Dow Elanco Ltd. 1979. Residue Study - Strawberry - Italy 179-252. Ref. NC 11.

Dow Elanco Ltd. 1979. Residue Study - Strawberry - Italy 179-253. Ref. NC 12.

Dow Elanco Ltd. 1979. Residue Study - Tomatoes - Italy 179-251. Ref. NE 03.

Dow Elanco Ltd. 1979. Residue Study - Peppers - Israel ISL79-2. Ref. NE 04.

Dow Elanco Ltd. 1979 Residue Study - Pepper - Italy 179-250. Ref. NE 05.

Dow Elanco Ltd. 1979 Residue Study - Pepper - Italy 179-251. Ref. NE 06.

Dow Elanco Ltd. 1979. Residue Study - Tomatoes - Italy 179-250. Ref. NE 07.

Dow Elanco Ltd. 1979. Residue Study - Artichoke - Italy 179-250. Ref. NI 01.

Dow Elanco Ltd. 1980. Residue Study - Melons - France F80-729. Ref. NB 20.

Dow Elanco Ltd. 1980. Residue Study - Melons - France F80-730. Ref. NB 21.

Dow Elanco Ltd. 1980. Residue Study - Melons - France F80-730A. Ref. NB 22.

Dow Elanco Ltd. 1980. Residue Study - Melons - France F80-735. Ref. NB 23.

Dow Elanco Ltd. 1981/2. Residues Studies - Grapes - Germany and France Apr 1983. Ref. NH 12.

Dow Elanco Ltd. 1981. Residue Studies-Apples Germany and UK/Apr 1983. D81-302, D81-350, D81-351, D81-353, FF81-002. Ref. NF 20.

Dow Elanco Ltd. 1981. Residue Study - Cucumbers - Italy 181-255. Ref. NB 15.

Dow Elanco Ltd. 1981. Residue Study - Cantaloup - Italy 181-256. Ref. NB 24.

Dow Elanco Ltd. 1981. Residue Study - Squash - Italy 181-254. Ref. NB 26.

Dow Elanco Ltd. 1981. Residue Study - Artichokes - Italy 181-251. Ref. NB 28.

Dow Elanco Ltd. 1981. Residue Study - Tomatoes - Italy 181-258. Ref. NE 09.

Dow Elanco Ltd. 1981. Residue Study - Pepper - Italy 181-259. Ref. NE 10.

Dow Elanco Ltd. 1981. Residue Study - Pears - Italy 181-211. Ref. NF 06.

Dow Elanco Ltd. 1982. Residue Studies - Apples Germany Apr 1983. D82-301, D82-302, D82-303, D82-304, D82-305, D82-307. Ref. NF 21.

Dow Elanco Ltd. 1987. Submission to T.C.A.C - Rubigan Data Supporting Reduction in Withholding Period in Grapes (contains Australian Residue data) July Ref. NH 23.

Dow Elanco Ltd. 1993. Residues in Nectarines in Chile, Gonzalez, R.H Degradacion de Residous de Rubigan en Nectarinos Y Fijacion de Carencias Preliminares Chile Ref. NG 09.

Dow Elanco Ltd. 1994. Europe. Italian GAP for peaches. 17th July Unpublished. Ref. 12.

Dow Elanco Ltd. 1995. Summary of Data, Fenarimol JMPR, March Unpublished. Ref. 1.

Dow Elanco Ltd. 1995. Product Labels, Fenarimol JMPR, March Unpublished. Ref. 4.

Dow Elanco Ltd. 1995. Residues of fenarimol in fresh and processed grapes after treating Cabernet Sauvignon and Sultana grapevines with Rubigan 120 EC®. March. Ref. NH 24.

Dow Elanco Ltd. Undated. Residue Study - Grapes AAC8714. Ref. NH 01.

Dow Elanco Ltd. Undated. Residues Study - Grapes EWD8703. Ref. NH 02.

Dow Elanco Ltd. Undated. Application for clearance of RUBIGAN systemic Fungicide to the Technical Committee on Agricultural Chemicals Section E-Residues (Australian Data Summary). Ref. NB 30.

Dow Elanco Ltd. Undated. Rate of Hydrolysis of EL-222. Ref. K 25.

European Union. 1994. Council Directives 94/29/EEC and 94/30/EEC. July Ref. 3.

Frank, R. 1977. Fenarimol Residues in Whole Apple Fruit

(Canada) May T2R-233. Ref. NF 25.

Frank, R. 1978. Fenarimol Residues in Whole Apple Fruit (Canada) July T2R-198. Ref. NF 26.

Germany. 1994. Submission made by the Federal Biological Research Centre for Agriculture and Forestry, July 1994. Unpublished. Ref. 8.

Goebel, G.V. 1985a. Characterization of Radioacativity in bile from rats dosed orally with ^{14}C Fenarimol. May ABC-0312. Ref. H 04.

Goebel, G.V. 1985b. Isolation and Identification of "Metabolite Complex" from 14C Fenarimol-Treated Grapes Mar ABC-0316. Ref. L 04.

Griggs, R.D and Decker, O.D. 1981. Determination of Fenarimol in Agricultural Crops and Soil Jan AM-AACA-R039-AA-755. Ref. OR 01A.

Griggs, R.D. and Decker, O.D. 1985. Determination of Fenarimol in Agricultural Crops and Soil Jan AM-AA-CA-RO39-AB-755. Ref. OR 01B.

Hudson, J.L. 1987. Fenarimol Technical, Bulk Density, Part 158 Product Chemistry Requirement. Nov T2R908703. Ref. A 10.

Ishikura, H. 1991. Residues of Fenarimol in Pulp, Peel and Whole Bananas Following application of Rubigan 12EC Fungicide in the Philippines - July 1991. GHF-P -1126. Ref. NL 03.

Koons, J.R. *et al*. 1984. Determination of Tissue Residues in Swine and Beef Cattle Fed Diets Containing Fenarimol. Mar S-AAC-83-04. Ref. NA 10.

Loh, A. 1976. n-Octanol-To-Water Partition Coefficient of Fenarimol. Dec EWD 8742. Ref. A 17.
Longhurst, C. 1985. Residues of Fenarimol in Raspberries following Foliar Applications of RUBIGAN Sept FF84-006. Ref. ND 01.

Lunn, D.W. 1995. Ministry of Agriculture and Fisheries, New Zealand. Personal Communication. 25th May Ref. 5.

Mason, R. 1995. Pesticides Safety Division, MAFF, UK. Personal Communication. 9th September Ref. 11.

McCorquodale, G.Y. and Prout, M.S. 1994. The disposition of [^{14}C]-fenarimol in the lactating goat. DowElanco Ltd., Report No. 10422. Ref. H 17.

Mosier, J.W. and Saunders, D.G. 1976. Photochemical Studies with Fenarimol. Aug Ref. K 28.

Netherlands, Ministry of Welfare, Health and Cultural Affairs, 1994. Netherlands. Personal Communication. September 1994. Ref. 6.

Pastor Talledo, C. 1994. Direccion de hygiene, Alimentarius y Control de Zoonosis, Peru. Personal communication. 23th November Ref. 7.

Rainey, D.P. 1987. Supplementary Information on Metabolism of ^{14}C Fenarimol in Grapes. Nov ABC-0239S. Ref. L 05.

Dow Elanco Ltd. 1988. Rubigan 12 WP/Strawberry Crop Residue Study: Japan 1984 and 1988 Studies 1994. June 1988 T2R-077. Ref. NC 16.

Trevallyn-Jones, J. 1984. Further Submission to T.C.A.C. - Withholding Period in Grapes treated with RUBIGAN (contains Australian Dow Elanco Ltd. Residue data) July Ref. NH 22.

Turner, L.G. 1992. [where has the DL come from?] Dow Elanco 1982. Ltd. Residue Method Development Report for Fenarimol and its Metabolites in Whole Bananas and Banana Pulp. GH-C-2840 Aug

Yordy, D.W. and Turner, L.G. Determination of Fenarimol In Meat, Milk and Eggs. AM-AA-CA-RO72-AA-755 Sep Ref. OR 27. Ref. OR 19.

NUMERICAL REFERENCES

1. Dow Elanco Ltd. Summary of Data, Fenarimol JMPR, March 1995. Unpublished.

2. Coleman, I. Commonwealth Department of Primary Industries and Energy, Australia. Personal Communication. 12th April 1995.

3. European Union Council Directives 94/29/EEC and 94/30/EEC. July 1994.

4. Dow Elanco Ltd. Product Labels, Fenarimol JMPR, March 1995. Unpublished.

5. Lunn, D.W. Ministry of Agriculture and Fisheries, New Zealand. Personal Communication. 25th May 1995.

6. Netherlands, 1994. Ministry of Welfare, Health and Cultural Affairs, Netherlands. Personal Communication. September 1994.

7. Pastor Talledo, C. 1994. Direccion de hygiene, Alimentarius y Control de Zoonosis, Peru. Personal communication. 23th November 1994.

8. Germany, 1994. Submission made by the Federal Biological Research Centre for Agriculture and Forestry, July 1994. Unpublished.

9. Crossley, S.J. Pesticides Safety Directorate, UK. Personal Communication. 31st November 1994.

10. Arnold, M. Dow Elanco Europe. Personal Communication. 16th August 1995.

11. Mason. R. Pesticides Safety Division, MAFF, UK. Personal Communication. 9th September 1995.

12. Dow Elanco Europe. Italian GAP for peaches. 17th July 1994. Unpublished.

13. Arnold, M. Dow Elanco Europe. Spanish residue trials data for apricots, peaches, melons, artichoke, peppers and strawberry submitted with letter dated 17th July 1995. Unpublished.

A 03. Decker, O.D. Solubility of Fenarimol in Water Oct 1987 ODD8711.

A 08. Day, E.W. Fenarimol Technical Product Chemistry Data. 1985.

A 09. Day, E.W. Solubility of Fenarimol in Organic Solvents. Sept 1976 FLP V-131.

A 10. Hudson, J.L. Fenarimol Technical, Bulk Density, Part 158 Product Chemistry Requirement. Nov 1987 T2R908703.

A 14. Day, E.W. *et al*. Physical and Chemical Characteristics of Technical Fenarimol Nov 1984 EWD8450.

A 17. Loh, A. n-Octanol-To-Water Partition Coefficient of Fenarimol. Dec 1976. EWD 8742.

A 21. Cowlyn, T.C. Fenarimol (pure): Determination of Physico-Chemical Properties (Vapour Pressure) Sept 1992 93/DES080/0411.

A 22. Cowlyn, T.C. Fenarimol (technical): Determination of Physico-Chemical Properties (Flammability, Auto-flammability, Explosive and Oxidising Properties) Oct 1992 92/DES081/0866.

H 04. Goebel, G.V. 1985a. Characterization of Radioacativity in bile from rats dosed orally with ^{14}C Fenarimol. May ABC-0312.

H 10. Althaus, W.A. 1985a. Characterization and Identification of Radioactivity in Urine and Feces of Wistar Rates given single oral doses of mixed-labelled ^{14}C Fenarimol. Dec ABC-0310.

H 11. Althaus, W.A. 1985b. Characterization and Identification of Radioactivity in Blood, Liver, and Kidney of Wistar Rats given single oral doses of mixed-labelled ^{14}C Fenarimol. Dec ABC-0321.

H 17. McCorquodale, G.Y. and Prout, M.S. 1994. The disposition of [^{14}C]-fenarimol in the lactating goat. DowElanco Ltd., Report No. 10422.

K 25. Dow Elanco Ltd. Rate of Hydrolysis of EL-222.

K 26. Day, E.W. Preliminary Photochemical Studies with the Fungicide EL-222.

K 28. Mosier, J.W. and Saunders, D.G. Photochemical Studies with Fenarimol. Aug 1976.

L 01. Althaus, W.A. Bewley, G.W. Separation and Identification of Degradation Products formed from ^{14}C Fenarimol Applied to Apples. Jan 1978b.

L 02. Althaus, W.A. A Comparative Apple Residue Study Conducted with Carbinol-labelled and mixed-labelled ^{14}C Fenarimol. Mar 1984b ABC-0199.

L 03. Althaus, W.A. ^{14}C Fenarimol Grape Residue Study. Apr 1984 ABC-0237, ABC-0239.

L 04. Goebel, G.V. Isolation and Identification of "Metabolite Complex" from ^{14}C Fenarimol-Treated Grapes Mar 1985 ABC-0316.

L 05. Rainey, D.P. Supplementary Information on Metabolism of ^{14}C Fenarimol in Grapes. Nov 1987 ABC-0239S.

L 08. Althaus, W.A. ^{14}C Fenarimol Residue Study in Cucumbers. Oct 1986. ABC-0307.

L 09. Althaus, W.A. Bewley, G.W14C Fenarimol Apple Residue Study Jan 1978a.

N1 02. Dow Elanco Ltd. Residue Study - Artichoke - Italy 1979 179-251.

NA 06. Althaus, W.A. ^{14}C Fenarimol Chicken Tissue Residue Study. Sept 1982. ABC-0186.

NA 07. Althaus, W.A.^{14}C Fenarimol Chicken Egg Residue Study. Sept 1982 ABC-0147.

NA 09. Althaus, W.A. *et al*. ^{14}C Fenarimol Swine Tissue Residue Study. Apr 1984a. ABC-0202.

NA 10. Koons, J.R. *et al*. Determination of Tissue Residues in Swine and Beef Cattle Fed Diets Containing Fenarimol. Mar 1984 S-AAC-83-04.

NB 01. Dow Elanco Ltd. Residue Study - Cucumber - Austria 1976 A76-106.

NB 02. Dow Elanco Ltd. Residue Study - Melon- France 1976 F76-04.

NB 03. Dow Elanco Ltd. Residue Study-Cucumber-Italy 1976 176-33.

NB 04. Dow Elanco Ltd. Residue Study - Cucumber - UK 1976 FG76-016.

NB 08. Dow Elanco Ltd. Residue Study - Cucumber - Italy 1977 177-234.

NB 09. Dow Elanco Ltd. Residue Study - Cucumber - Italy 1977 177-235.

NB 10. Dow Elanco Ltd. Residue Study - Squash - Italy 1977 177-236.

NB 11. Dow Elanco Ltd. Residue Study - Cantaloupe - Italy 1977 177-251.

NB 12. Dow Elanco Ltd. Residue Study - Watermelon - Italy 1977 177-253.

NB 15. Dow Elanco Ltd. Residue Study - Cucumbers - Italy 1981 181-255.

NB 20. Dow Elanco Ltd. Residue Study - Melons - France 1980 F80-729.

NB 21. Dow Elanco Ltd. Residue Study - Melons - France 1980 F80-730.

NB 22. Dow Elanco Ltd. Residue Study - Melons - France 1980 F80-730A.

NB 23. Dow Elanco Ltd. Residue Study - Melons - France 1980 F80-735.

NB 24. Dow Elanco Ltd. Residue Study - Cantaloup - Italy 1981 181-256.

NB 26. Dow Elanco Ltd. Residue Study - Squash - Italy 1981 181-254.

NB 28. Dow Elanco Ltd. Residue Study - Artichokes - Italy 1981 181-251.

NB 29. Arcas, J.B. Analises de Residuos de Fenarimol em Frutos e Cucurbitaceas 1986.

NB 30. Dow Elanco Ltd. Application for clearance of RUBIGAN systemic Fungicide to the Technical Committee on Agricultural Chemicals Section E-Residues (Australian Data Summary). Undated.

NB 30. Application for clearance of RUBIGAN systemic Fungicide to the Technical Committee on Agricultural Chemicals Section E - Residues, 1979.

NB 31. Butcher, S. Residues in Melons Spain 1994 Jan 1995 GHE-P-4011.

NB 32. Butcher, S. Residues in Melons Italy 1994 Jan 1995 GHE-P-4013.

NC 11. Dow Elanco Ltd. Residue Study - Strawberry - Italy 1979 179-252.

NC 12. Dow Elanco Ltd. Residue Study - Strawberry - Italy 1979 179-253.

NC 16. Rubigan 12 WP/Strawberry Crop Dow Elanco Ltd. Residue Study: Japan 1984 and 1988 Studies June 1988 T2R-077.

ND 01. Longhurst, C Residues of Fenarimol in Raspberries following Foliar Applications of RUBIGAN Sept 1985 FF84-006.

NE 02. Dow Elanco Ltd. Residue Study - Peppers - Spain 1977 E77-129.

NE 03. Dow Elanco Ltd. Residue Study - Tomatoes - Italy 1979 179-251.

NE 04. Dow Elanco Ltd. Residue Study - Peppers - Israel 1979 ISL79-2.

NE 05. Dow Elanco Ltd. Residue Study - Pepper - Italy 1979 179-250.

NE 06. Dow Elanco Ltd. Residue Study - Pepper - Italy 1979 179-251.

NE 07. Dow Elanco Ltd. Residue Study - Tomatoes - Italy 1979 179-250.

NE 08. Butcher, S.M. Residues of Fenarimol in Tomatoes at Intervals Following Application of RUBIGAN 12ec (EAF 457), Spain 1993 Aug 1994 GHE-P-3653.

NE 09. Dow Elanco Ltd. Residue Study - Tomatoes - Italy 1981 181-258.

NE 10. Dow Elanco Ltd. Residue Study - Pepper - Italy 1981 181-259.

NE 11. Butcher, S.M. Residues of Fenarimol in Tomatoes at Intervals Following Application of RUBIGAN 12SC (EAF 383), Netherlands 1994 Jan 1995
. GHE-P-4008.

NE 12. Butcher, S.M. Residues of Fenarimol in Tomatoes - Greece 1994 Jan 1995
. GHE-P-4012.

NF 03. Dow Elanco Ltd. Residue Study - Pears - Germany 1978 D78-312.

NF 06. Dow Elanco Ltd. Residue Study - Pears - Italy 1981 181-211.

NF 08. Dow Elanco Ltd. Residue Study - Apples - Germany 1978 D78-311.

NF 18. Decker, O.D. and Day, E.W. Fenarimol Residue Data on Apples and Apple Products from Experiments conducted in the United States in 1981 and 1982. Mar 1983. I-ODD-83-06.

NF 20. Dow Elanco Ltd. Residue Studies-Apples Germany and UK/1981 Apr 1983
. D81-302, D81-350, D81-351, D81-353, FF81-002.

NF 21. Dow Elanco Ltd. Residue Studies - Apples Germany 1982 Apr 1983. D82-301, D82-302, D82-303, D82-304, D82-305, D82-307.

NF 25. Frank, R. Fenarimol Residues in Whole Apple Fruit (Canada) May 1977 T2R-233.

NF 26. Frank, R. Fenarimol Residues in Whole Apple Fruit (Canada) July 1978 T2R-198.

NF 27. Day, E.W. Fenarimol Residue Data on Apples from Canada May 1981.

NF 28. Day, E.W. Fenarimol Residues in Apples from Chile May 1981 T2R-230.

NF 29. Day, E.W. Fenarimol Residues in Apples from New Zealand Mar 1981. NZ75-19, NZ78-2, NZ80-5, NZ80-6.

NF 31. Day, E.W. West, S.D 1988 Fenarimol Residue

Studies in Apples Nov 1988. AAC8819.

NF 33. Day, E.W. Fenarimol Residue Data on Pears March 1987 EWD8640.

NG 01. Dow Elanco Ltd. Residue Study - Peach - Italy 1977 177-212.

NG 02. Dow Elanco Ltd. Residue Study - Peach 1977 177-213.

NG 03. Dow Elanco Ltd. Residue Study - Peach - Italy 1977 177-214.

NG 04. Day, E.W and Saunders, D.G. 1987 Fenarimol Residue Studies in Cherries AAC8713 Feb 1988.

NG 05. Day, E.W. and West, S.D. 1989 Fenarimol Residue Studies in Cherries, Aug 1989 AAC8903.

NG 06. Day, E.W. and Saunders, D.G Storage Stability of Fenarimol in Cherries EWD8803 Feb 1988.

NG 07. Butcher, S. and Wood, S. Residues of Fenarimol in Peaches at intevals following Application of RUBIGAN 4 (EAF 216), - Southern France 1993 GHE-P-3652 Aug 1994.

NG 08. Butcher, S. and Wood, S. Residues of Fenarimol in Peaches at intervals following Application of RUBIGAN 12sc (EAF383), Italy - 1993 GHE-P-3626 Jun 1994.

NG 09. Dow Elanco Ltd. Residues in Nectarines in Chile, Gonzalez, R.H Degradacion de Residous de Rubigan en Nectarinos Y Fijacion de Carencias Preliminares Chile 1993.

NG 10. Butcher, S. Peaches Italy Jan 1995 GHE-P-4014.

NG 11. Butcher, S. Peaches France Jan 1995 GHE-P-4062.

NG 12. Butcher, S. The stability of fenarimol in fortified peaches, tomatoes and melons under frozen storage conditons. GHE-P-4318.

NH 01. Dow Elanco Ltd. Residue Study - Grapes AAC8714.

NH 02. Dow Elanco Ltd. Residues Study - Grapes EWD8703.

NH 04. Butcher, S. and Wood, S. Residues of Fenarimol in Grapes at Intervals following Application of TRANSFLO (EAF 383), France - 1993 GHE-P-3627 Jun 1994.

NH 05. Dow Elanco Ltd. Residue Study - Grape 1977 A77-121.

NH 06. Dow Elanco Ltd. Residue Study - Grape 1977 A77-122.

NH 07. Day, E.W. Jr. and Saunders D.G. Storage Stability of fenarimol and its Metabolites in Grapes and Grape Products. EWD8802 Apr 1988.

NH 09. Dow Elanco Ltd. Residue Study - Grape 1977 177-225.

NH 10. Butcher, S. The Stability of Fenarimol in Fortified Grapes and Wine stored under Frozen Conditions GHE-P-3741 Aug 1994.

NH 11. Butcher, S. and Wood, S. Residues of Fenarimol in Grapes, Grape Must and Wine following Application of Rubigan 12 SC (EAF 383) to Grape Vines Germany 1992/93. GHE-P-3655 Aug 1994.

NH 12. Dow Elanco Ltd. Residues Studies - Grapes - Germany and France 1981/2 Apr 1983.

NH 17. Day, E.W. Fenarimol Residue Data on Grapes and Grape Products from Experiment conducted in the United States in 1983 March 1984 I-EWD-84-03.

NH 20. Day, E.W. and West, S.D. 1988 Fenarimol Residue Trials in Grapes AAC8818 Dec 1988.

NH 22. Trevallyn-Jones, J. Further Submission to T.C.A.C - Withholding Period in Grapes treated with RUBIGAN (contains Australian Dow Elanco Ltd. Residue data) July 1984.

NH 23. Dow Elanco Ltd. Submission to T.C.A.C - Rubigan Data Supporting Reduction in Withholding Period in Grapes (contains Australian Residue data) July 1987.

NH 24. Dow Elanco Ltd. 1995. Residues of fenarimol in fresh and processed grapes after treating Cabernet Sauvignon and Sultana grapevines with Rubigan 120 EC®. March. Ref.

NI 01. Dow Elanco Ltd. Residue Study - Artichoke - Italy 1979 179-250.

NI 05. Butcher, S. Residues of Fenarimol in Globe Artichokes at Intervals following Multiple Applications of RUBIGAN 12 SC (EAF383), Italy 1995 GHE-P4010 Jan 1995.

NJ 01. Butcher, S. and Perkins, J. Residues of fenarimol in Hops and related fractions from the brewing process following application of Drawisan 6WP (EAF 219) - Germany 1990. GHE-P-2517 Oct 1991.

NL 02. Catta-Preta, R.F. and Matos, J.C. Residues of Fenarimol and its Major Metabolites in Bananas following Multiple treatments with Rubigan Ec Fungicide - Costa Rica, Honduras and Ecuador, 1992 April 1993 GHB-P 151.

NL 03. Ishikura, H. Residues of Fenarimol in Pulp, Peel and Whole Bananas Following application of Rubigan 12EC Fungicide in the Philippines - 1991 July 1991. GHF-P -1126.

NL 04. Day, E.W. Reasonable Grounds in Support of the

Petition for the Establishment of A Tolerance for Fenarimol and its Metabolites in or on Bananas. Aug 1993. ECL93073.

NM 01. Decker, O.D. Fenarimol Residues on Pecans when Rubigan 1EC or Rubigan 1AS is Foliar applied to Pecan Trees on Disease Control March 1983 I-ODD-82-02.

NM 02. Decker, O.D. Fenarimol Residues on Pecans when Rubigan is Foliar applied to Pecan Trees for Disease Control Feb 1984 I-ODD-84-01.

OR 01A. Griggs, R.D and Decker, O.D. Determination of Fenarimol in Agricultural Crops and Soil Jan 1981 AM-AACA-R039-AA-755.

OR 01B. Griggs, R.D. and Decker, O.D. Determination of Fenarimol in Agricultural Crops and Soil Jan 1985 AM-AA-CA-RO39-AB-755.

OR 10. Dow Elanco Ltd. Determination of EL-222 in Agricultural Crops and Soils by Gas-Liquid Chromatography Std An.Method No.86 Sep 1976.

OR 11. Dow Elanco Ltd. Determination of Fenarimol In Agricultural Crops (Other than Cereals) by Gas-Liquid Chromatography Nov 1977 Std.An.Method No.97.

OR 19. Yordy, D.W. and Turner, L.G Determination of Fenarimol In Meat, Milk and Eggs. AM-AA-CA-RO72-AA-755 Sep 1982.

OR 20. Butcher, S.M. and Perkins, J.M. Determination of Fenarimol Residues in Fresh, Dried and Spent Hops. ERC91-8 Jan 1992.

OR 21. Butcher, S.M. Determination of Fenarimol Residues in Beer and Spent Yeast. Jan 1992 ERC91-10.

OR 22. Butcher, S.M. and Long, T.J. Determination of Residues of Fenarimol in Grape Must, Wine and Grapes. ERC93-6 Jul 1993.

OR 24. Butcher, S.M. Determination of Residues of Fenarimol in Tomatoes, Peaches and Melons ERC 94.3 Aug 1994.

OR 27. Turner, L.G. Dow Elanco Ltd. Residue Method Development Report for Fenarimol and its Metabolites in Whole Bananas and Banana Pulp. GH-C-2840 Aug 1992.

R 28. Catta-Preta, R.F. and Matos, J.C Determination of Residues of Fenarimol, Compound 212746 and 210302 in Banana Whole Fruit and Pulp BRC 92.2 March 1993.