CAPTAN (007)

EXPLANATION

Captan has been evaluated several times since the initial evaluation in 1965. It was identified as a candidate for re-evaluation by the 1995 CCPR (ALINORM 95/24 A) and scheduled for periodic review by the 1998 JMPR at the 1997 CCPR (ALINORM 97/24 A). The 28th (1996) Session of the CCPR returned all the proposed draft MRLs to Step 3, pending the evaluation of new data by the 1997 JMPR. The 1997 JMPR recommended MRLs of 20 mg/kg for apple replacing 10 mg/kg, 40 mg/kg for cherries replacing 20 mg/kg, 25 mg/kg for grapes replacing 20 mg/kg, and 30 mg/kg for strawberry replacing 15 mg/kg. Owing to the shifting of the rights from one company to another, it was requested that the re-evaluation of captan be deferred until the 2000 JMPR, and it is now evaluated in the Periodic Review Programme.

Data to support the existing CXLs (for apple, pear, cherries, peach, plums, nectarine, blueberries, strawberry, grapes, tomato) and other critical data required for the estimation of maximum residue levels have been provided by the manufacturers.

Relevant data have also been provided in support of new residue limits for oranges, lemons, grapefruit, apricot, raspberries, cucumber, melons, potato and almonds.

The governments of Australia, Germany, Poland and Thailand have submitted information on national GAP and/or residue data.

IDENTITY

ISO common name: captan

Chemical name:

IUPAC: *N*-(trichloromethylthio)cyclohex-4-ene-1,2-dicarboximide

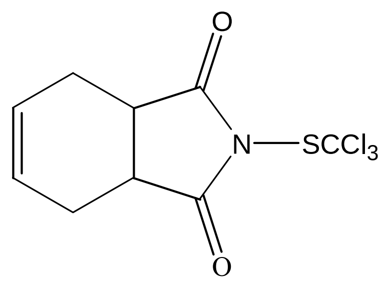
CAS: 3a,4,7,7a-tetrahydro-2-[(trichloromethyl)thio]-1*H*-isoindole-1,3(2*H*)-dione

CAS No.: 133-06-2

CIPAC No.: 40

Synonyms/trade names: SR-406, Merpan, Vanicide 89, Orthocide

Structural formula:



Molecular formula: $C_9H_8Cl_3NO_2S$

Molecular weight: 300.59

Physical and chemical properties

Pure active ingredient

Appearance: colourless crystals, white solid (Wollerton and Husband, 1995a)

Melting point: 172°C (Wollerton and Husband, 1995a)

Relative density: 1.71 (Wollerton and Husband, 1995a)

Vapour pressure: 4.2×10^{-6} Pa at 20°C (Wollerton and Husband, 1995a)

Henry's law constant (Wollerton and Husband, 1995a):

3×10^{-4} $Pa.m^3.mol^{-1}$ in purified water
3×10^{-4} $Pa.m^3.mol^{-1}$ in purified pH 5 buffered water
2×10^{-4} $Pa.m^3.mol^{-1}$ in purified pH 7 buffered water
Partition coefficient (n-octanol/water) log P_{ow} 2.5 (Wollerton and Husband, 1995a)

Solubility at 20°C, mg/kg solvent (Wollerton and Husband, 1995a,b)

Purified water	4.9
Water buffered pH 5	4.8
Water buffered pH 7	5.2

Hydrolysis (Yaron, 1985)

Half-lives at 25°C:	12 hours at pH 4
	2.6 hours at pH 7
	too fast to measure at pH 9
Half-lives at 40°C:	1.7 hours at pH 4
	0.51 hours at pH 7
	too fast to measure at pH 9

Photolysis

Not accurately measured owing to extensive hydrolysis in aqueous solution. The half-life, assuming a quantum yield of 1 and using experimental extinction values, was estimated to be about 880 days (Moffat, 1994).

Technical material (Wollerton and Husband, 1995b)

Appearance: cream solid

Melting point: 162-172°C

Solubility at 20°C (g/kg solvent):

Hexane	0.04
Octan-1-ol	1
Methanol	4
Xylenes	9
Ethyl acetate	25
Acetonitrile	31

Acetone	38
1,2-dichloroethane	41

Formulations

The following types of formulation are available: suspension concentrate (SC), wettable powder (WP), dustable powder (DP) and water dispersible granule (WG).

METABOLISM AND ENVIRONMENTAL FATE

Animal metabolism

Metabolism studies on lactating goats and laying hens with [*trichloromethyl*-^{14}C]captan, [*cyclohexene*-^{14}C]captan and [*carbonyl*-^{14}C]captan were made available to the Meeting.

Abbreviations are used for some of the metabolites:

THPI:	1,2,3,6-tetrahydrophthalimide
3-OH THPI	*cis/trans*-3-hydroxycyclohex-4-ene-1,2-dicarboximide
5-OH THPI	*cis/trans*-5-hydroxycyclohex-3-ene-1,2-dicarboximide
4,5-diOH HHPI	4,5-dihydroxycyclohexane-1,2-dicarboximide
THPAM	*cis/trans*-6-carbamoylcyclohex-3-ene-1-carboxylic acid (*cis/trans*-1,2,3,6-tetrahydrophthalamic acid)
THPI epoxide	7-oxabicyclo[4.1.0]heptane-3,4-dicarboximide

Goats. Powell and Skidmore (1993) in a material balance study dosed a lactating goat orally by gelatine capsule with [*trichloromethyl*-^{14}C]captan, once daily for two consecutive days (equivalent to 55 ppm in the feed). The recovery of ^{14}C for the period to 16 hours after the last dose was 78% with gastrointestinal tract contents and expired $^{14}CO_2$ accounting for most of the administered radioactivity at 20 and 43% respectively. Urine, faeces and milk accounted for 8.0, 4.6 and 0.2% of the radioactivity while tissue radioactivity was less than 1.4%. The low recovery of the administered radioactivity is likely to be due to the bacterial conversion of CO_2 to methane in the rumen. Samples were stored frozen and analysed within 6 weeks of slaughter.

Powell *et al.* (1994) dosed two lactating goats with [*trichloromethyl*-^{14}C]captan in gelatine capsules at a rate equivalent to 50 ppm in the diet for 7 consecutive days. Milk and excreta were collected throughout the dosing period and the animals slaughtered 16 hours after the final dose. 36% of the radioactive dose was recovered in the excreta, including cage washings. Total radioactive residues (TRR) in milk reached a plateau by day 4-5 of dosing at 2.2 mg captan/kg. The TRR in tissues were 0.46 mg captan equivalents/kg in muscle (fore- and hind-quarter), 0.11 mg/kg in subcutaneous fat, 0.09 mg/kg in perirenal fat, 0.06 mg/kg in peritoneal fat, 0.47 mg/kg in the diaphragm, 4.4 mg/kg in kidney and 4.7 mg/kg in liver. In the milk and tissues there was extensive incorporation of the radioactivity into natural products. These included fatty acids, cholesterol, glycerol, lactose, glucose, creatine, lactic acid, choline chloride, phosphatidylcholine and amino acids. (Samples were analysed within 6 months of dosing, and again 2 years later. The chemical profiles in liver and milk were the same for 6 months and 2 years storage).

A lactating goat was dosed orally with [*trichloromethyl*-^{14}C]captan at 1.4 mg/kg bw/day by capsule three times daily (3 × 0.47 mg/kg bw/day) for 3 days with an additional dose on the fourth day (Duan, 1988). Radioactivity in faeces, urine and milk collected until slaughter 4 hours after the last dose accounted for 21, 6.0 and 1.5% respectively of the administered dose. Tissue radioactivity accounted for 1.3% of the administered dose with highest residues in liver (2.0 mg/kg as captan) and kidney (1.6 mg/kg as captan). Characterization of tissue and milk radioactivity by extraction into solvents demonstrated that most of the radioactivity was incorporated into natural products. A metabolite identified in milk, liver, kidney and urine was thiazolidine-2-thione-4-carboxylic acid (TTC). TTC represented 0.4, 2.2, 4 and 24% of the TRR in milk, liver, kidney and urine respectively.

Radioactive residues were measured in the tissues, milk and excreta of a lactating goat dosed orally by capsule three times daily with [*carbonyl*-^{14}C]captan (Cheng, 1980). The daily dose was 1.4 mg/kg bw/day (equivalent to 50 ppm captan in the diet). The last dose (10th) was given after the morning milking on the 4th day and the goat slaughtered four hours later.

The major metabolites in urine, determined by derivatization with diazomethane and/or bis(trimethylsilyl)acetamide and characterization by GC-MS, were 3-OH THPI, 5-OH THPI and 4,5-diOH-HHPI. Milk samples were separated into fat, protein (casein), lactose and aqueous acetone-soluble fractions with >90% of the TRR located in the aqueous acetone fraction. The ^{14}C in milk was not incorporated into natural products. 76-87% of the TRR was extracted from the tissues with methanol/water, indicating polar metabolites. The major metabolites were tentatively identified by chromatography by comparing relative retention times with authentic standards.

Table 1. Identity and distribution of metabolites in milk and tissues from a goat dosed with [*carbonyl*-^{14}C]captan equivalent to 50 ppm in the diet for 3 days (Cheng, 1980).

	Milk	Liver	Kidney	Muscle (fq)	Muscle (hq)	Fat (peri)	Fat (subc)
TRR (mg/kg as captan)	0.13-0.63	1.7	2.3	0.65	0.66	0.35	0.36
Metabolite	% of TRR						
THPI	2.3-9.9	4.6	2.7	6.0	7.2	33	6.8
THPI epoxide	2.4-9.1	1.6	2.0	4.6	5.1	2.1	3.3
3-OH THPI	27-33	10	17	36	44	16	28
5-OH THPI	16-26	8.8	7.9	10.1	8.4	4.6	10
4,5-diOH HHPI	4.7-8.2	2.1	2.0	0.0	0.0	4.8	8.6

fq = forequarter; hq = hindquarter; peri = peritoneal; subc = subcutaneous

Minor metabolites detected in urine and milk included THPAM as well as hydroxylated THPAM derivatives (3-OH THPAM, 5-OH THPAM and 4,5-diOH HHPAM).

Hens. A single hen was dosed with [*trichloromethyl*-^{14}C]captan for two days at a rate equivalent to 10 ppm in the diet and killed 16 hours after the last dose (Mathis and Skidmore, 1993). The total radioactivity recovered in excreta, expired-air traps and the carcase was 88% with the majority either expired as $^{14}CO_2$ (33%) or eliminated in excreta (50%). Only 2.8% of the dose was recovered in the carcase with a further 1.3% recovered from cage washings and 1.3% from the contents of the gastrointestinal tract. Samples were analysed within 2 months.

Mathis and Skidmore (1994) dosed 9 hens orally with [*trichloromethyl*-^{14}C]captan at a nominal rate equivalent to 10 ppm in the diet for 10 consecutive days. Radioactive residue in eggs reached a plateau by day 8 of dosing. Mean TRRs were 0.07, 0.04, 0.06, 0.68, 0.30, 0.40 and 0.07 mg/kg as captan for skin/subcutaneous fat, peritoneal fat, muscle (leg + breast), kidney, liver, egg yolk and egg white respectively. Much of the radioactive residue was incorporated into natural products. No single metabolite was present above 0.016 mg/kg in any sample of tissue or eggs. Samples were analysed within 2 months. Liver reanalysed after 23 months showed qualitatively the same results.

A group of 10 laying hens was dosed orally, by capsule, with [cyclohexene-^{14}C]captan at a nominal rate equivalent to 10 ppm in the diet for 10 consecutive days (Renwick and Skidmore, 1993). Birds were slaughtered 16 hours after the final dose. Radioactive residues in eggs reached a plateau at 2-4 days after the start of dosing. Samples were analysed after 2-4 months. Liver reanalysed after 7 months storage showed qualitatively the same results.

Radioactivity in the excreta collected over the 10-day dosing period accounted for 86% of the administered dose, and in the tissues and eggs 3.2% of the administered dose. Identification of the residues in the excreta, tissues and eggs was by TLC and co-chromatography with authentic compounds.

Table 2. Identity and distribution of metabolites in tissues, eggs and excreta from hens dosed with [*cyclohexene*-^{14}C]captan equivalent to 10 ppm in the diet for 10 days (Renwick and Skidmore, 1993).

TRR, mg/kg as captan	Excreta	Liver	Peritoneal fat	Muscle	Egg yolk day 9	Egg white day 9
		0.66	0.13	0.55-0.63	0.83	0.84
Metabolite	%Total radioactive residue					
THPI	8.9	64	77	52	74	61
3-OH THPI	23	5.2	2.1	8.9	6.0	6.6
5-OH THPI	10	1.3	0.5	1.5	1.3	1.6
4,5-diOH HHPI	1.3	0.1	0.4	ND	ND	ND
THPAM	4.3	ND	ND	0.6	ND	ND
THPI epoxide	2.4	ND	ND	1.7	1.6	ND
Total	50	71	80	64	83	69

The metabolism of captan in goats and hens proceeds by cleavage of the N-S bond to form THPI and a derivative of the $-SCCl_3$ side chain. THPI and $-SCCl_3$ undergo further metabolism through independent pathways. The carbon of the side chain becomes incorporated into TTC and natural products. The cleavage partner THPI is oxidised to form THPI expoxide which is subsequently hydrolysed to form 4,5-diOH HHPI, or hydroxylated at the cyclohexene ring to form 3-OH and 5-OH THPI. The hydrolysis of THPI and its hydroxylated derivatives results in the formation of the corresponding THPAM derivatives. The proposed metabolic pathway in livestock is shown in Figure 1.

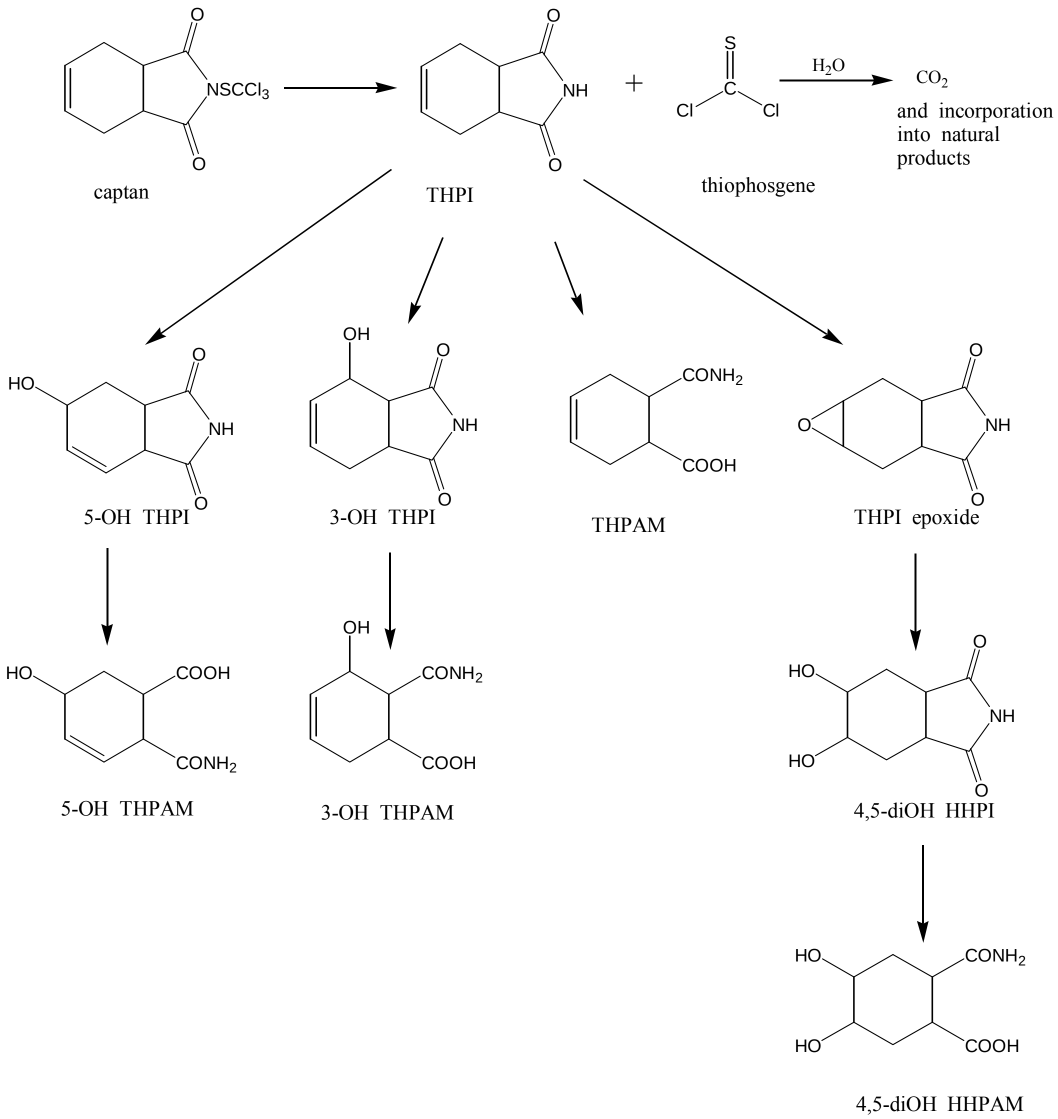


Figure 1. Proposed metabolic pathways of captan in livestock.

Plant metabolism

Metabolism studies on tomatoes, lettuce and apples were made available to the Meeting. Both [*trichloromethyl*-^{14}C]captan and [*cyclohexene*-^{14}C]captan were used to trace the fate of different parts of the captan molecule in tomatoes and lettuce while [*carbonyl*-^{14}C]captan was used in the apple study.

Lettuce and tomato plants were treated four times with [*trichloromethyl*-^{14}C]captan (Chen, 1988a) or [*cyclohexene*-^{14}C]captan (Chen, 1988b) at about 4.5 kg ai/ha (4.0 lb/acre) at 7 day intervals. The plants were harvested 3 hours after the last spray and separated into leaves, stems, roots and, in the case of tomatoes, fruit. Tomatoes were washed with acetone, blended and centrifuged to separate the juice from the pulp. Tomato pulp and other macerated plant samples were extracted with acetone, methanol and methanol/water. Tomato juice was extracted with ethyl acetate. Metabolites were characterized by TLC, HPLC and MS. Most of the radioactivity in the plants was found in the leaves and fruit of tomatoes and leaves of lettuce.

Table 3. Distribution and characterization of ^{14}C in acetone extracts of tomatoes and lettuce treated four times with [*trichloromethyl*-^{14}C]captan at 4.5 kg ai/ha (Chen, 1988a).

Characterization	Tomato leaves and stem[1]		Tomato fruit		Lettuce leaves	
	% of TRR	Residue, mg/kg[2]	% of TRR	Residue, mg/kg[2]	% of TRR	Residue, mg/kg[2]
Captan	81	93	77	5.3	76	52
Captan epoxide	0.3	0.34	0.2	0.01	0.3	0.21
Other free metabolites	6.9	7.9	9.5	0.66	5.2	3.6
Polar and conjugates	4.8	5.5	10	0.72	4.6	3.2
Unextractable	7.2	8.3	3.3	0.23	14	9.4

[1] Leaves constitute 8.0% and stems 7.0% of the total plant mass according to the reported distribution of radioactivity in leaves, stems, roots and tomatoes and on the TRR in these components. From the residues listed it appears that the plant material was 87% leaf matter
[2] Expressed as captan

Table 4. Distribution and characterization of ^{14}C in acetone extracts of tomatoes and lettuce treated four times at 4.5 kg ai/ha with [*cyclohexene*-^{14}C]captan (Chen, 1980b).

Characterization	Tomato leaves and stem[1]		Tomato fruit[2]		Lettuce leaves	
	% of TRR	Residue, mg/kg[3]	% of TRR	Residue, mg/kg[3]	% of TRR	Residue, mg/kg[3]
Captan	70	128	82	5.5	77	50
Captan epoxide	0.4	0.73	0.4	0.03	0.6	0.39
THPI	4.6	8.3	4.5	0.30	9.5	6.1
Other free metabolites	6.9	13	5.2	0.35	4.3	2.8
Polar and conjugates	8.9	16	7.5	0.50	4.5	2.9
Unextractable	8.8	16	0.9	0.06	3.0	1.9

[1] Leaves constitute 7.7% and stems 7.1% of the total plant mass according to the reported distribution of radioactivity in leaves, stems, roots and tomatoes and on the TRR. It appears plant material is 88% leaf matter.
[2] Calculated from the radioactivity in the acetone surface rinse, tomato juice and pulp using weight/volume ratios for whole fruit, pulp, juice and acetone rinse.
[3] Expressed as captan

When treated with [*cyclohexene*-^{14}C]captan, the unextractable residues accounted for less than 9% of the total radioactivity in all components except tomato pulp (not tabulated separately but included as a component of tomato fruit) in which unextractable radioactivity represented 42% of the total in the pulp. Fractionation of tomato pulp into carbohydrates, amino acids (proteins) and lignin fractions indicated that the radioactivity was distributed in all the sub-fractions with 71% associated with carbohydrates, 18% with amino acids and 3% with lignins.

With both labels most of the residue remained on the plant or fruit surface and was present as unmetabolized captan. In the plant captan was metabolized to form THPI which underwent further transformation. No specific steps were taken to avoid the hydrolysis of captan during the extraction procedure and the studies may overestimate the THPI contents.

DeBaun *et al.* (1975) treated branches of field-grown Golden Delicious apple trees with [*carbonyl*-^{14}C]captan at a rate equivalent to 0.12 kg ai/hl (1 lb ai/100 gal). The apples were washed with acetone and peeled to determine surface residues and residues in peel and pulp (peeled fruit). The residues were extracted with acetone, the extracts concentrated by rotary evaporation at 40°C, and the aqueous residue suspended in a saturated $(NH_4)_2SO_4$ solution. This was acidified and extracted with ethyl acetate before and after acidification. Residues in the combined ethyl acetate extracts were determined by TLC. Most of the residue was located on the surface of the fruit and was present as captan. THPI and THPAM represented 3.3-7.6% and 0.4-2.4% of the radioactive residue respectively. Radioactive residues in apple peel and pulp were low with captan accounting for 46 and 15% of the radioactive residue respectively. The main metabolites in peel and pulp were THPI and THPAM. The extraction procedure may lead to the hydrolysis of captan and captan expoxide, leading to an overestimation of the THPI and THPI epoxide contents.

Table 5. Distribution of radioactivity in apples after application of [*carbonyl*-^{14}C]captan at 0.12 kg ai/hl (DeBaun *et al.*, 1975).

No. of sprays (interval, days)	PHI, days	% of ^{14}C						
		Fruit					Foliage	
		Surface wash	Peel extract	Peel residue	Pulp extract	Pulp residue	Extract	Residue
1	0.13	96	3.3	0.9	0.8	0.2	99	1.5
1	20	90	4.5	2.6	2.7	0.7	85	15
2 (30)	20	81	4.8	4.4	7.7	1.7	72	29
3 (30, 31)	20	64	9.3	4.4	17	4.9	84	16

Table 6. Characterization of ^{14}C radioactivity in apples after application of [*carbonyl*-^{14}C]captan at 0.12 kg ai/hl (DeBaun *et al.*, 1975).

	% of TRR and (mg/kg as captan)							
	Fruit surface wash				Foliage extracts			
No. sprays	1	1	2	3	1	1	2	3
PHI, days	0.13	20	20	20	0.13	20	20	20
Compound								
Captan	78 (13)	79 (14)	68 (9.3)	71 (4.3)	84	74	67	71
Captan epoxide	<1 (0.17)	<1 (0.19)	<1 (0.15)	<1 (0.06)	<1	<1	<1	1.1
THPI	7.6 (0.61)	5.7 (0.50)	6.1 (0.42)	5.2 (0.16)	5.4	4.4	3.6	3.3
THPI epoxide	<1 (0.09)	<1 (0.10)	<1.2 (0.09)	<1.4 (0.05)	<1	<1	<1	<1
THPAM	1.2 (0.11)	0.4 (0.04)	1.1 (0.09)	1.3 (0.04)	2.1	2.4	2.0	0.7
	Peel				Pulp			
Captan	46 (1.6)	37 (1.4)	25 (0.74)	21 (0.72)	15 (0.02)	6.1 (0.03)	3.0 (0.03)	2.8 (0.03)
Captan epoxide	0.1 (<0.01)	0.5 (0.02)	0.2 (<0.01)	1.0 (0.04)	3.7 (0.006)	5.0 (0.03)	2.8 (0.03)	1.0 (0.01)
THPI	33 (0.59)	17 (0.31)	16 (0.24)	15 (0.26)	48 (0.04)	29 (0.07)	18 (0.09)	13 (0.07)
THPI epoxide	0.5 (0.01)	2.3 (0.05)	1.3 (0.02)	1.1 (0.02)	2.0 (0.002)	0.5 (0.001)	5.6 (0.03)	3.3 (0.02)
THPAM	8.1 (0.16)	12 (0.24)	12 (0.20)	12 (0.24)	0.5 (0.004)	2.0 (0.005)	2.4 (0.013)	1.1 (0.007)
Total	87	68	54	49	69	42	32	22

In apples, tomatoes and lettuce most of the residue was present on the surface of the leaves and fruit, mainly as unchanged captan. Metabolism in the plants includes cleavage of the thio-indole bond to form THPI and derivatives of the -$SCCl_3$ side chain. The carbon of the side chain is incorporated into natural products, and THPI is further metabolized to form THPAM. Captan is also oxidised to captan epoxide which undergoes hydrolysis to form THPI expoxide. The proposed metabolism in plants is shown in Figure 2.

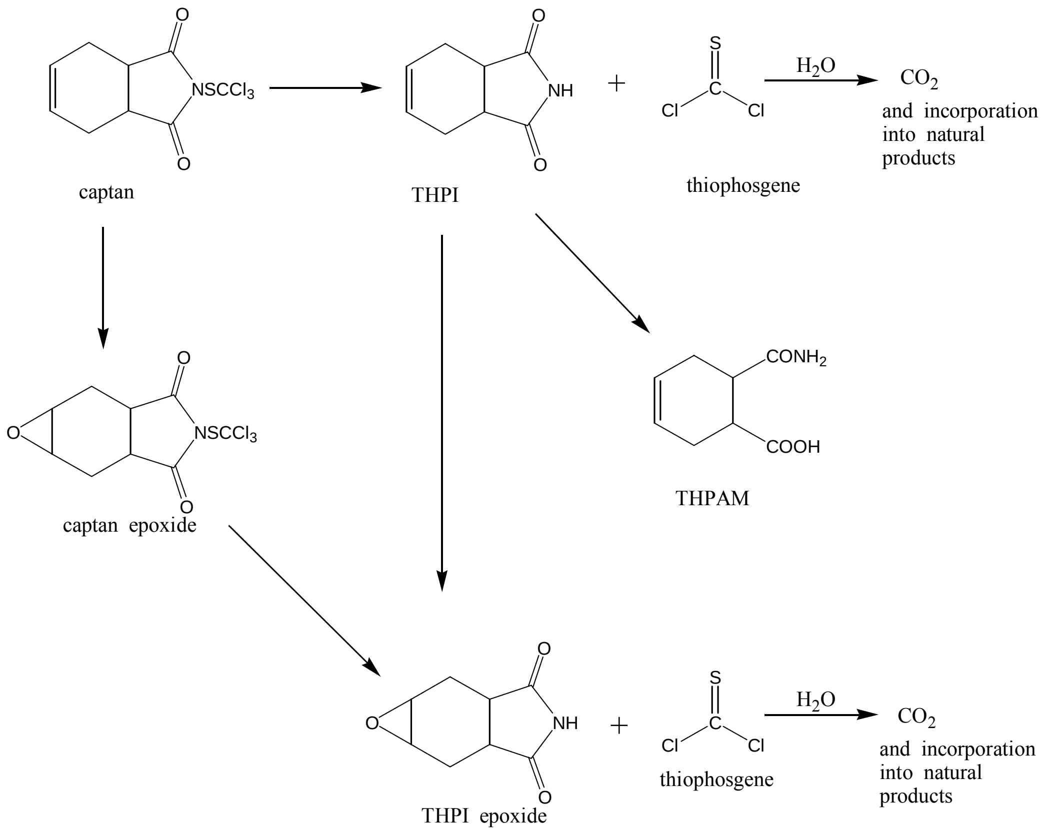


Figure 2 Proposed metabolic pathways of captan in plants.

Environmental fate in soil

Residues in rotational crops

In a confined rotational crop study (Ewing *et al.*, 1990), beets, lettuce and wheat were planted in treated soil. Nine plastic-lined wooden boxes (76 × 91 cm × 67 cm deep) were filled with Huntington series sandy loam soil (73% sand, 18% silt, 9% clay; pH 7.4, 2% organic matter, from Fayette County, Kentucky) to a depth of 61 cm. Three boxes were treated with [*cyclohexene*-^{14}C]captan at 3.9 ± 2.2 kg ai/ha and three with [*trichloromethyl*-^{14}C]captan at 6.7 ± 4.1 kg ai/ha. The variability in the application rates was due to the inhomogeneity of the application solution (acetone/water). The remaining three boxes served as controls. Beet, lettuce and wheat seeds were planted in the boxes after fallow periods of 34 and 88 days after treatment (DAT) and the boxes maintained in a greenhouse at 10-29°C.

Samples were collected as immature trimmings and at maturity. Immature plants were analysed as whole plants. Mature beet and lettuce plants were separated into leaves and roots while mature wheat plants were separated into grain, chaff, straw and roots. The ^{14}C in soil and plant components was determined by combustion and LSC. Crop samples were extracted twice with acetone followed by methanol, methanol/water and finally 1M HCl in methanol. The extracts were analysed by HPLC with a C-18 column and UV detection. Radio-chromatograms were constructed from LSC analysis of column fractions. Identification of compounds was by TLC on silica gel F_{254} plates and co-chromatography with authentic standards. The extraction procedure may result in the hydrolysis of some of the captan to THPI.

Only low levels of radioactivity were found in the crops at harvest. Radioactive residues in immature plants were highest in lettuce and beet. The radioactive residues in crops planted 88 days after application to soil were lower than those in crops planted 34 days after application.

Table 7. Radioactive residues in rotational crops after application of [*cyclohexene*-^{14}C]captan (Ewing *et al.*, 1990).

Planting DAT	Harvest DAT	^{14}C, mg/kg as captan								
		Lettuce		Beet			Wheat			
		Immature	Mature leaf	Immature	Mature		Immature	Mature		
					Leaf	Root		Straw	Chaff	Grain
34	43	1.2		1.2			0.39			
34	54	0.78/1.8		0.31/0.40			0.26/0.51			
34	61	0.18/0.35		0.06/0.16			0.14/0.23			
34	75		0.02				0.08/0.03			
34	126			0.07						
34	131				0.02	0.03				
34	186							0.09	0.05	0.04
88	105	0.06		0.05			0.03			
88	116	0.12		0.07			0.03			
88	138	0.05								
88	158		0.01	0.01						
88	186				0.005	0.02				
88	224							0.02	0.01	0.01

Table 8. Radioactive residues in rotational crops after application of [*trichloromethyl*-^{14}C]captan (Ewing *et al.*, 1990).

Planting DAT	Harvest DAT	^{14}C, mg/kg as captan								
		Lettuce		Beet			Wheat			
		Immature	Mature leaf	Immature	Mature		Immature	Mature		
					Leaf	Root		Straw	Chaff	Grain
34	43	0.11		0.09			0.08			
34	54	0.07/0.15		0.02/0.03			0.02/0.04			
34	61	0.01/0.04		0.01/0.02			0.02/0.02			
34	75		0.005				0.02/0.06			
34	126			0.02						
34	131				0.003	0.00 7				
34	186							0.05	0.03	0.02
88	105	0.03		0.01			0.009			
88	116	0.04		0.02			0.01			
88	138	0.008								
88	158		0.01	0.01						
88	186				0.003	0.01				
88	224							0.03	0.03	0.02

The radioactive residues in immature crops were characterized by HPLC and comparison with authentic standards. The major metabolites were 4,5-diOH HHPI, THPAM and THPI.

Table 9. Characterization of [^{14}C] in acetone extracts at 43 DAT by HPLC.

Compound	^{14}C residue, mg/kg as captan					
	Lettuce		Beets		Wheat	
	Ring label	CCl_3 label	Ring label	CCl_3 label	Ring label	CCl_3 label
Captan	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
THPI	0.012	<0.003	0.095	<0.003	0.088	<0.003
THPI epoxide	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
THPAM	0.012	<0.003	0.044	<0.003	0.027	<0.003
4,5-diOH HHPI	0.532	<0.003	0.174	<0.003	0.072	<0.003
THPAL	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Other	0.017	0.041	0.351	0.034	0.048	0.050
Total	0.573	0.041	0.665	0.034	0.234	0.050

Soil degradation

Aerobic. The aerobic degradation of [*trichloromethyl*-^{14}C]captan on Visalia sandy loam (sand 55%, silt 33%, clay 12%; pH 7.7; organic matter 0.7%; CEC 9.1 meq/100 g) and Greenville sandy loam (sand 58%, silt 30%, clay 12%; pH 7.2; organic matter 1.2%; CEC 7.7 meq/100 g) at 25°C in the dark has been studied by Diaz and Lay (1992) and Pack and Verrips (1988a) respectively. Captan was applied at a rate equivalent to 8.8 mg/kg to the Visalia soil and 4.6-6.1 mg/kg to the Greenville soil and incubated for periods up to 30 days. In both Visalia sandy loam and Greenville sandy loam the major product was $^{14}CO_2$, which accounted for 50-59% of the applied radioactivity after 1-3 days and reached 81-90% after 28-30 days incubation. The other compound detected was thiocarbonic acid which accounted for at most 1.1% of the applied radioactivity. Approximately 10% of the radioactivity was bound to the soil and could not be extracted. Volatile organic compounds accounted for about 0.2% of the applied radioactivity after 28 days incubation. The calculated degradation half-life for [*trichloromethyl*-^{14}C]captan was about 1-3 days at 25°C.

The aerobic degradation of [*carbonyl*-^{14}C]captan was studied on Oakley loamy sand soil (sand 67%, silt 17%, clay 16%; pH 6.8; organic matter 1.8%) at 25 °C using an initial captan concentration of 5.3 mg/kg (Pack, 1974). Approximately 20% of the applied radioactivity was evolved as $^{14}CO_2$ during the first 7 days of incubation and this accounted for 82% of the applied radioactivity at 37 days and 94% at 244 days. Captan represented less than 1% of the applied radioactivity after 7 days or more. Major compounds identified were THPI and THPAM. Residues of THPI reached a maximum of 66% of the applied radioactivity at 7 days, declining thereafter to less than 7% at 37 days and less than 0.2% at 224 days. THPAM reached a maximum of 17% of the applied radioactivity at 14 days, declining to less than 0.2% after 244 days incubation. Minor compounds identified were THPI epoxide, 4,5-diOH HHPI and THPAL.

Anaerobic. Lay (1992) studied the anaerobic degradation of [trichloromethyl-^{14}C]captan in both non-sterile and sterile Visalia sandy loam (sand 55%, silt 33%, clay 12%; pH 7.3; organic matter 0.7%; CEC 9.1 meq/100 g. In non-sterile soil, approximately 100% of the applied radioactivity was recovered as $^{14}CO_2$ after 14 days incubation. Residues of captan accounted for less than 0.1% of the radioactivity after 90 days. Bound residues accounted for 16-25% of the applied dose at all sample times. The variable recovery of radioactivity, 62-165%, was explained by problems in achieving homogeneity in soil moisture and applied captan. The recovery of radioactivity as $^{14}CO_2$ was lower for sterile soil, reaching 75% after 90 days incubation.

Pack and Verrips (1988b) investigated the anaerobic degradation of [*trichloromethyl*-^{14}C]captan in a Greenville sandy loam (sand 58%, silt 30%, clay 12%; pH 7.2; organic matter 1.2%; CEC 7.7 meq/100 g) at 25 °C. The amount of $^{14}CO_2$ evolved increased from 44-48% of the applied radioactivity after 1 day of incubation to 83-88% after 30 days. Bound residues accounted for 14-20% of the applied radioactivity.

The anaerobic soil degradation of [*carbonyl*-^{14}C]captan was studied on Oakley loamy sand soil (sand 85%, silt 6%, clay 9%; pH 7.3; organic matter 1.4%; CEC 7.5 meq/100 g) at 25°C in the dark with an initial captan concentration of 6.2 mg/kg (Pack, 1979). No captan was detected after 7 days of incubation. Compounds identified were THPI, THCY, THPAM and THPAL. The cyano acid THCY was not observed under aerobic conditions. Less than 9% of the applied radioactivity was converted to $^{14}CO_2$ over a period of 9 months. Extracts from the anaerobic soil that contained THCY were added to Oakley soil under aerobic conditions. The THCY was rapidly degraded with 98% loss occurring within 7 days.

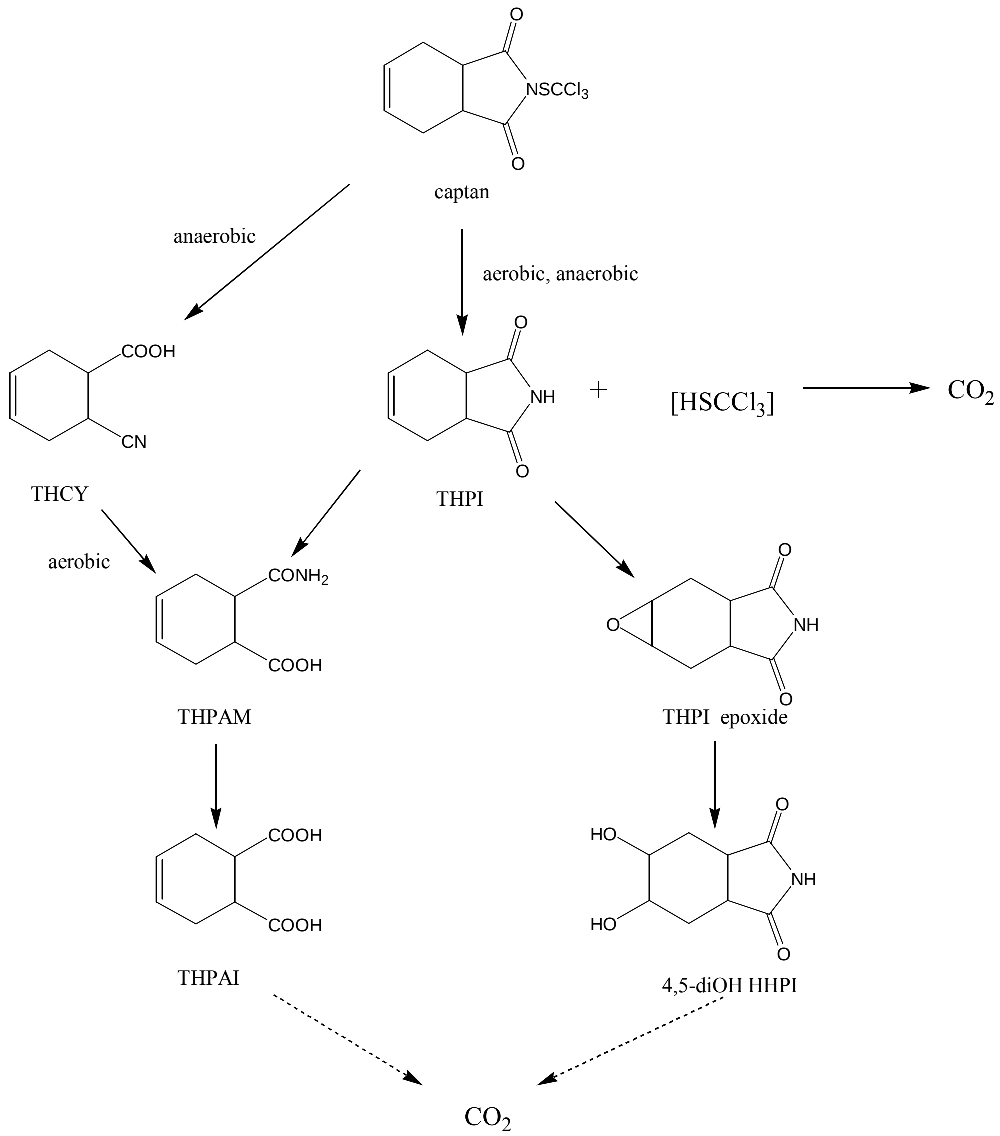


Figure 3. Proposed metabolic pathways of captan in soil.

Photolysis

The half-life of [*trichloromethyl*-[14]C]captan in Greenville sandy loam soil exposed to sunlight was 15 days while the half-life for the dark control soil was 20 days (Ruzo *et al.*, 1988a). The photochemical half-life was estimated to be 54 days. Most of the radioactivity was accounted for as captan and carbon dioxide, with the remainder present as bound residues and unidentified compounds. In irradiated samples on day 21 captan accounted for 36-40%, $^{14}CO_2$ for 49-51%, bound residues for 7%, acid-released residues for 2-5% and unidentified residues for 1.4% of the applied radioactivity. In dark control soil samples captan accounted for 50-56% and $^{14}CO_2$ for 33-40% of the applied radioactivity.

Ruzo *et al.* (1988b) studied the natural sunlight photolysis of [*cyclohexene*-[14]C]captan at 25°C on the surface of Greenville sandy loam soil treated at 4.48 kg ai/ha. The half-lives for photolysis were 130 and 236 hours for the light and dark conditions respectively, resulting in an estimated photochemical half-life of 287 hours. Products present at >3% were identified by HPLC and TLC. The major components formed under both light and dark conditions were THPI, THPI epoxide, THCY, THPAM and THPAL.

Degradation of major products

The aerobic degradation of the captan metabolite THPI was studied on Speyer 2.1 sand (sand 90%, silt 6%, clay 4%; pH 6.3; organic matter 0.7), Speyer 2.2 loamy sand (sand 85%, silt 8%, clay 7%; pH 6.0; organic matter 3.7%) and Hyde farm sandy loam (sand 59%, silt 24%, clay 17%; pH 7.1; organic matter 3.2%) at 20°C and 40% moisture holding capacity over a period of 50 days (Freeman and Jones, 1993a). The THPI degradation half-life, calculated using the Timme and Frehse model (Timme *et al.*, 1986), was 5-6 days for loamy sand and sandy loam, and 20 days for sand. A degradation half-life of 1 day was also observed for sand during the period 33-40 days after treatment. This was thought to be due to the microbial content of the soil. The half-lives for the aerobic degradation of *cis*-tetrahydrophthalamic acid studied under the same conditions as THPI were 4-5 days for loamy sand and sandy loam and 7 days for sand (Gallagher and Jones, 1993a).

Field studies

Soil residues from the confined rotational crop study described earlier were characterized by TLC, HPLC and MS (Ewing *et al.*, 1990). The total radioactive residues in the 0-7.5 cm soil layer decreased from 2.9 and 2.7 mg/kg (as captan) immediately after application to 0.71 and 0.17 mg/kg as captan respectively for the [*cyclohexene*-^{14}C]captan and [*trichloromethyl*-^{14}C]captan after 224 days. Significantly lower levels of radioactivity were found in the 7.5-15 cm soil layer which were thought to result from contamination during sampling. Residues of captan were detected 34 days after application at levels of 0.05-0.20 mg/kg but not at later samplings. Characterization of the radioactivity in the soil after application of [*trichloromethyl*-^{14}C]captan showed that most was associated with carbon dioxide which was retained in the soil in the form of carbonates. In the case of [*cyclohexene*-^{14}C]captan a variety of degradation products was formed.

Table 10. Distribution of radioactivity in extracts of the 0-7.5 cm soil layer after application of [*cyclohexene*-^{14}C]captan (Ewing *et al.*, 1990).

DAT	^{14}C as captan, mg/kg soil									
	Ethyl acetate							Water	NaOH	Unextracted
	Total	M1	M2	M3	M4	M5	Bound			
34	0.54	0.05	0.22	0.19	0.03	0.05	0.14	0.09	0.26	0.13
88	0.16	-	0.03	0.004	0.02	0.11	0.31	0.09	0.44	0.29
224	0.06	-	0.02	0.005	0.04	0.004	0.06	0.08	0.38	0.31

M1 = captan; M2 = THPI; M3 = THPAM; M4 = 4,5-diOH HHPI: M5 = THPI epoxide

The major products at 34 and 88 DAT were THPI and THPAM, while THPI epoxide was the main product after 224 days.

Captan was applied as eight sprays at 4.5 kg ai/ha and at intervals of 7 days to an apple orchard in New York, USA (Jones, 1988a). The soil (sand 81%, silt 14%, clay 5%; pH 5.5; organic matter 2.0%; CEC 3.7 meq/100 g) was sampled to a depth of 30 cm and analysed for captan and THPI. Air temperatures were 4-14°C during the study while rainfall totalled 34 mm. Residues of captan at 0-7.5 cm soil depth were 2.1 mg/kg on the same day as the last application, decreasing to 0.53 mg/kg by 7 days and 0.02 mg/kg by 59 days after the last spray. Residues of THPI at the same sample times were 0.78, 0.12 and less than 0.01 mg/kg respectively. Using the assumption of 1st order kinetics the degradation half-life for captan in soil at 0-7.5 cm depth was calculated to be 14 days. No captan was detected at depths of 15 cm or more. At soil depths of 15-30 cm THPI was detected only on the day of the last treatment and 1 day later at levels of 0.03 and 0.02 mg/kg.

After eight applications of captan at 3.4 kg ai/ha to strawberries in California, USA, the half-life in loamy sand (sand 78%, silt 13%, clay 9%; pH 7.1; organic matter 0.5%; CEC 3.8 meq/100 g) was determined to be 2.5 days (Jones, 1988b). The total rainfall and irrigation during the study was

170 mm. Captan was detected in soil at 7.5-30 cm depth on the day of the 6th application but only at low levels, 0.03-0.05 mg/kg. No captan was detected below 30 cm and no THPI below 7.5 cm.

Six sprays of captan were applied to grapes grown in Oregon, USA, in silt loam (sand 32%, silt 54%, clay 14%; pH 5.6; organic matter 3.8%; CEC 5.7 meq/100 g) at 4.5 kg ai/ha (Jones, 1988c). The air temperatures during the course of the study were 14-26°C while the rainfall during the sampling period of 6 months was 125 mm. Neither captan nor THPI were detected in soil below 7.5 cm. The degradation half-life of captan in soil at 0-7.5 cm depth was calculated to be 24 days.

The degradation of captan was also studied in clay soil (sand 14%, silt 26%, clay 60%; pH 7.8; organic matter 2.4%; CEC 8.2 meq/100 g) in which cantaloupes were grown in Texas, USA (Jones, 1988d). Captan was found in the 7.5-15 cm soil depth samples on the days immediately after the 3rd, 4th, 5th and 6th applications at 2.2 kg ai/ha at levels between 0.01 and 0.38 mg/kg. With the exception of the sample collected the day after the 6th spray, THPI was found in the same 7.5-15 cm samples at levels 0.03-0.08 mg/kg. Captan and THPI were not detected in soil samples of 7.5-15 cm depth at any interval after the last application. The degradation half-life of captan at 0-7.5 cm soil depth was calculated to be 4 days.

Tomatoes grown in loam soil (sand 36%, silt 40%, clay 24%; pH 6.9; organic matter 1.5%; CEC 14.5 meq/100 g) in California and clay soil (sand 14%, silt 26%, clay 60%; pH 7.8; organic matter 2.4%; CEC 8.2 meq/100 g) in Florida, USA, were treated 4 times with captan at 4.5 g ai/ha (Jones, 1988e,f). The degradation half-life of captan, assuming 1st order kinetics, was 6 days for the California site and 3 days for the Florida site.

Table 11. Field studies on the dissipation of captan in soil in the USA (Jones, 1988a-f).

Crop/soil/location/year	Application, kg ai/ha /no. of sprays	Sample depth (cm)	DALA	Residues, mg/kg	
				Captan	THPI
Apples/loamy sand/New York 1988	4.5/8	0-7.5	0	2.1	0.78
			1	1.8	0.54
			7	0.53	0.12
			14	0.84	0.10
			29	0.36	0.02
			59	0.02	<0.01
			120	<0.01	<0.01
		7.5-15	0	0.01	0.06
			1	0.06	0.10
			7	<0.01	<0.01
		15-30	0	<0.01	0.03
			1	<0.01	0.02
			7	<0.01	<0.01
Cantaloupe/clay/Texas/1987	2.2/7	0-7.5	0	0.16	0.74
			1	0.02	0.59
			7	0.01	0.20
			14	<0.01	<0.01
Tomatoes/loam/California/1987	4.5/4	0-7.5	0	0.19	0.61
			1	0.24	1.2
			7	0.04	1.5
			14	0.01	1.3
			28	<0.01	0.30
			59	<0.01	0.46
			120	<0.01	<0.01
		7.5-15	0	<0.01	<0.01
			1	<0.01	0.01
			7	<0.01	<0.01
Tomatoes/sand/Florida/1987	4.5/4	0-7.5	0	5.0	0.82
			1	3.7	1.1
			7	1.3	0.86
			14	0.14	0.20

Crop/soil/location/year	Application, kg ai/ha /no. of sprays	Sample depth (cm)	DALA	Residues, mg/kg	
				Captan	THPI
			28	<0.01	0.03
			91	<0.01	<0.01
Strawberries/loamy sand/California/1987	3.4/8	0-7.5	0	0.22	0.20
			1	0.22	0.25
			7	0.06	0.12
			14	<0.01	<0.01
Grapes/silt loam/Oregon/1987	2.2/6	0-7.5	0	2.2	0.44
			1	2.0	0.45
			7	0.44	0.46
			14	0.17	0.35
			28	0.49	0.57
			63	0.05	0.19
			119	0.05	0.18
			184	<0.01	0.02

DALA: days after last application

Adsorption/desorption

Adsorption/desorption experiments with soil/water systems are not applicable to captan owing to its rapid hydrolysis (Spillner, 1988). The degradation of captan in soil-water mixtures was found to be pH-dependent, being most rapid at the highest pH studied, pH 7. The only degradation product detected was THPI. The presence of soil in the test solutions resulted in an increased rate of degradation.

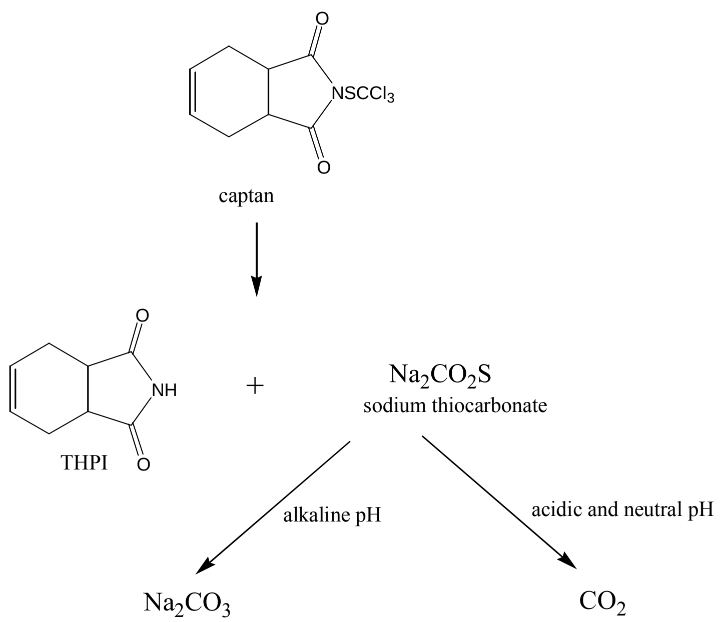


Figure 4. Proposed pathway of captan hydrolysis.

The adsorption/desorption properties of two major degradation products of captan, THPI and THPAM, were studied in six pre-sterilised soils (Rowe and Lane, 1983). Three of the soils were characterized as high pH (sandy loam pH 7.7%, 5.3 organic matter; sandy loam pH 8.1, 3.2% organic matter; loamy sand pH 7.9, 3.1% organic matter) and three as being low pH (sand pH 5.7, 0.8% organic matter; silty clay loam pH 5.0, 2.5% organic matter; sandy loam pH 4.7, 2.7% organic matter). Five rates of application were used for ^{14}C-labelled THPI and THPAM.

THPI was weakly adsorbed by each of the soils with a clear relationship observed between THPI absorbed and % organic matter. The average adsorption coefficients (Kd) ranged from 0.04 for the soil with lowest % organic matter to 0.24 for the soil with the highest % organic matter while the Freundlich adsorption coefficients (K') ranged from 0.01 to 0.17. The coefficients corrected for the organic matter contents ranged from 7.6 to 13 for Kd and 2.2 to 11 for K'. Desorption was not completely reversible with a 2-3 fold increase observed in Kd values between adsorption and desorption.

THPAM was also weakly adsorbed by soil. The Kd values increased with decreasing soil pH ranging from 0.10 for the high pH sandy loam (pH 8.1) to 1.1 for the low pH sandy loam (pH 4.7). K' values showed a similar relationship with pH, ranging from 0.14 for the high pH soil to 1.2 for the low pH soil. When corrected for organic matter contents the range of Kd values was 3.8 to 110 while for K' the range was 4.5 to 100. As with THPI the desorption of THPAM was not entirely reversible with average 2-5 fold increases in Kd.

Mobility

The mobility of aged captan residues was studied in sandy loam, sand and loamy sand. ^{14}C-ring-labelled captan was incubated in the soils in the dark at 20°C under aerobic conditions and at 40% moisture holding capacity for 30 days (Verity *et al.*, 1995). Samples were collected at intervals of 0, 1, 7, 14 and 30 days incubation. After 30 days incubation with sandy loam 21% of the radioactivity was associated with captan, 28% was converted to $^{14}CO_2$ and 30% remained unextracted. Captan constituted 59% of the radioactive residue in sand with 12% converted to $^{14}CO_2$ and 6% unextracted. In loamy sand, 51% of the radioactivity was due to captan, 21% to $^{14}CO_2$ and 11% was unextracted. THPI was the major product in the three soils representing 5, 11 and 6% of the radioactive residue in sandy loam, sand and loamy sand respectively.

The aged soils were placed on the top of duplicate 30 cm columns of the corresponding soils. The columns were leached with the equivalent of 200 mm of rain over a period of 48 hours and the soils in the columns were then analysed. The 0-5 cm layer of each of the soils contained 30-44% of the applied radioactivity. Of this radioactivity up to 25% was extractable with organic solvents. Captan was detected only in the first 0-5 cm of the sand and loamy sand. In material extractable with organic solvents, up to 12% of the radioactivity was from captan, 6% from THPI and 1% from THPAM.

No captan was found below the 0-5 cm layer and no individual compound accounted for more than 2% of the applied radioactivity. The radioactivity in the leachates from sandy loam, sand and loamy sand accounted for 1, 25 and 8% of the applied radioactivity respectively. The radioactivity in the leachates from sand and loamy sand were further characterized. THPI was the major compound, accounting for approximately 15 and 5% of the applied radioactivity from sand and loamy sand respectively. THPAM accounted for ≤3% of the applied radioactivity while no other compound accounted for more than 2%.

Biological degradation

The degradation of captan was studied in aqueous sediment systems (Travis and Simmons, 1993). The two systems studied were Old Basing (22% organic matter) and Virginia Water (5.4% organic matter). ^{14}C-ring-labelled captan was applied at an initial concentration of 1.2 µg/ml, equivalent to an application at 3.6 g ai/ha being evenly distributed over a water body to a depth of 30 cm. Both non-sterile and sterile systems were used. Each water sediment system contained 10% dry matter in stream water.

After 24 hours incubation captan was not detected in any of the systems and was determined to have been rapidly hydrolysed to THPI. Three other products identified after 24 hours incubation were THPAM, THPAL and THPI epoxide with similar levels observed in both the non-sterile systems. The levels of THPAM, THPAL and THPI epoxide reached maxima after 14 days incubation and represented up to 25% of the radioactivity for THPAM and 5 - 11% of the radioactivity for THPAL and THPI expoxide. Degradation in the non-sterile water-sediment systems was such that no THPI, THPAM, THPAL or THPI epoxide could be detected after 59 days incubation. By 90 days incubation about 50% of the ring-labelled captan had been mineralized to $^{14}CO_2$. Most of the remaining radioactivity was tightly bound to the sediment and not extracted by the solvents used.

Negligible amounts of $^{14}CO_2$ were evolved in the sterile systems. Most of the radioactivity present after 90 days incubation was associated with THPI, 64% in the Virginia Water and 36% in the Old Basing system.

Volatility (route and rate of degradation in air)

Air, 100 ml/min at 25°C, was passed over the surface of sandy soil (sand 92%, silt 6%, clay 2%; pH 7.2; organic matter 1.8%; CEC 3.6 meq/100 g) that had been treated with [*cyclohexene*-^{14}C]captan or [*trichloromethyl*-^{14}C]captan (Pack, 1987a). After 9 days, analysis of scrubber solutions revealed an average of 0.0003% and 0.4% of the radioactivity from [*cyclohexene*-^{14}C]captan and [*trichloromethyl*-^{14}C]captan respectively was trapped. There was no significant volatilization of captan from soil.

The proposed degradation pathways for captan in sediment/water systems are shown in Figure 5.

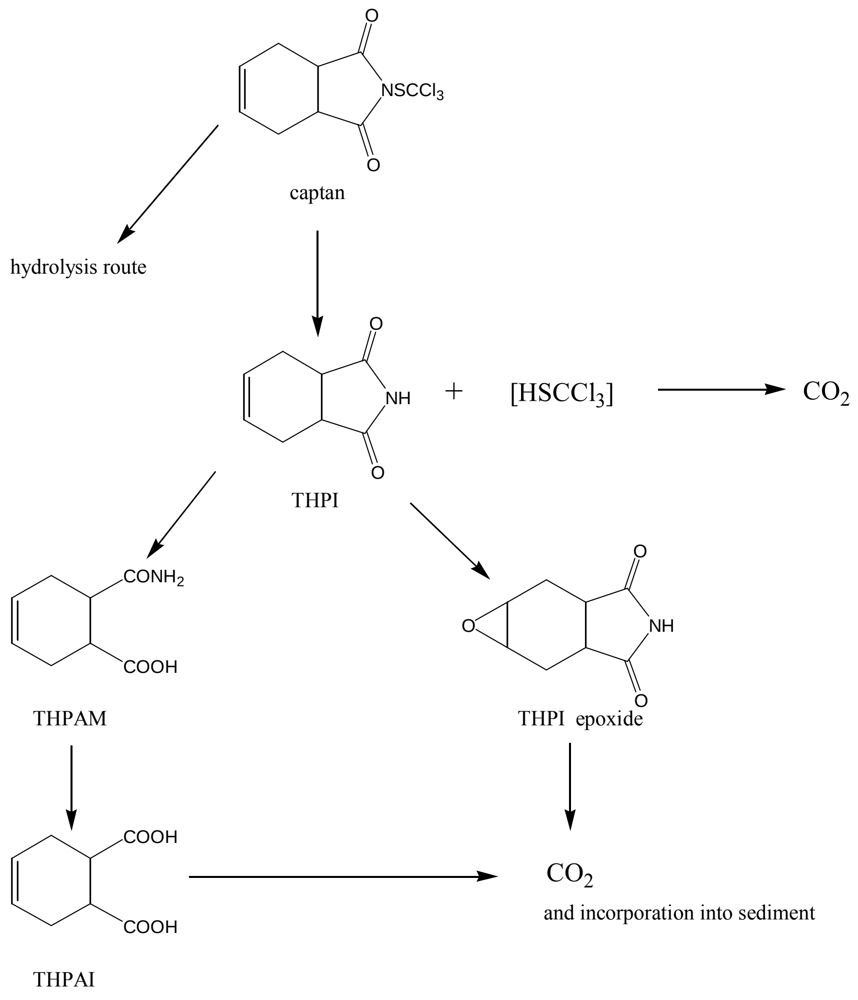


Figure 5. Degradation of captan in sediment/water systems.

METHODS OF RESIDUE ANALYSIS

The determination of captan and THPI in non-oily crops (lettuce, tomatoes, melons, apples, squash, potatoes, grapes and strawberries) was described by Schlesinger (1992a). Samples are macerated with sodium sulfate, ethyl acetate and a small quantity of phosphoric acid. For captan, the filtered extract is evaporated to dryness and the residue dissolved in n-hexane before clean-up on a Florisil solid-phase extraction cartridge. The cartridge is eluted with 1% methanol in dichloromethane and the eluate evaporated to dryness before dissolving the residue in n-hexane for determination of captan by GLC with an ECD. For THPI, the filtered ethyl acetate extracts are partitioned with pH 11.5 aqueous buffer and the aqueous phase is treated with concentrated phosphoric acid before partitioning with dichloromethane which is evaporated to dryness. The residue is dissolved in ethyl acetate for determination of THPI by GLC with a TID. The limits of quantification are 0.02 mg/kg for captan and 0.1 mg/kg for THPI. The specificity of the method was tested by analysis of untreated crops. Captan and THPI were not detected above their respective limits of quantification. The presence of 25 common pesticides did not interfere with the analytical method. Recoveries from samples fortified with captan were 93-125% from lettuce at 0.02-20 mg/kg, 72-120% from tomatoes, 88-96% from melons and 92-125% from potatoes at 0.02-2.5 mg/kg, 76-110% from apples, 92-130% from grapes and 79-130% from strawberries at 0.02-10 mg/kg, and 88-110% from squash at 0.02-5 mg/kg. Recoveries from samples fortified with THPI at 0.1-2.0 mg/kg were 69-105% from lettuce, 74-82% from tomatoes, 70-114% from melons, 71-88% from potatoes, 69-86% from apples, 70-109% from grapes, 59-78% from strawberries and 87-120% from squash.

Captan and THPI were determined in crops and processed commodities by Iwata (1989). Samples are macerated with anhydrous sodium sulfate and ethyl acetate in the presence of phosphoric acid. For non-oily crops the filtered extract is washed with phosphoric acid. The ethyl acetate is dried over anhydrous sodium sulfate, the solvent removed and the residue dissolved in dichloromethane. For oily crops the filtered extract is evaporated and partitioned with acetonitrile and hexane, the solvent is removed and the residue taken up in dichloromethane. Clean-up of extracts of both crop types is on a nuchar/silica column. The captan is eluted with 5% ethyl acetate in dichloromethane while THPI is eluted with 20% acetone in dichloromethane. Quantification is by GLC with ECD. The limit of quantification is 0.05 mg/kg for both captan and THPI. Recoveries from apple samples fortified with captan at 0.05-100 mg/kg were 82-111% while those from samples fortified with THPI at 0.05-10 mg/kg were 71-115%.

Captan residues in liver, kidney, muscle, fat, eggs and milk are extracted by blending samples with acetone and phosphoric acid (Mende, 1997). The acetone in the filtered extract is removed by evaporation and the sample purified by passage through a chromatography column containing sodium sulfate and "Extrelut". Further purification is by gel permeation chromatography. Muscle and liver samples require an additional clean-up on a silica gel solid-phase extraction cartridge. Quantification of captan residues is by GLC with an ECD. The limit of quantification is 0.005 mg/kg for milk, 0.02 mg/kg for kidney and fat and 0.03 mg/kg for muscle and liver. Mean recoveries from samples fortified at 0.005-0.5 mg/kg for milk, 0.02-0.5 mg/kg for kidney and fat and 0.03-0.5 mg/kg for liver and muscle were 93, 87, 94, 86 and 94% respectively.

THPI, *cis*- and *trans*-3-OH THPI, and *cis*- and *trans*-5-OH THPI were determined in bovine tissues and milk (Wiebe *et al.*, 1992). Samples are macerated with acetone, an aliquot of the extract diluted with ethyl acetate is filtered through anhydrous sodium sulfate and the solvent removed under a stream of nitrogen gas. The residue is dissolved in hexane and partitioned into acetonitrile and the solvent is evaporated. The residue is taken up in toluene/ethyl acetate and cleaned up on a silica column. The solvents are removed and the residue dissolved in acetonitrile for derivatization with *N*,*O*-bis(trimethylsilyl)trifluoroacetamide (BSTFA) and trimethylchlorosilane before quantification by GC-MS. The limit of quantification for each compound was 0.01 mg/kg in milk, liver, kidney, muscle and fat. Mean recoveries of the individual analytes were 84-95% for all substrates and fortification levels studied (0.01-0.5 mg/kg in tissues and milk except THPI, *trans*-3-OH THPI and *trans*-5-OH THPI which were determined at 0.005-0.5 mg/kg in milk).

Determination of captan residues in the tissues and eggs of hens dosed with [*cyclohexene*-^{14}C]captan were in good agreement when carried out by measurement of radioactivity and by the method of Wiebe *et al.* (1992). No residues of *cis*-3-OH or *cis*-5-OH THPI were detected.

Table 12 Comparison of an analytical method suitable for enforcement with ^{14}C measurement for the determination of captan metabolites in tissues and eggs of hens dosed at the equivalent of 10 ppm in the diet for 10 days with [*cyclohexene*-^{14}C]captan (Renwick and Skidmore, 1993).

Sample	Residue, mg/kg as captan					
	THPI		*trans*-3-OH THPI		*trans*-5-OH THPI	
	GC/MS	^{14}C	GC/MS	^{14}C	GC/MS	^{14}C
Liver	0.40	0.39	0.05	0.03	<0.02	ND
Peritoneal fat	0.14	0.11	<0.02	0.003	<0.02	0.001
Muscle	0.26	0.29	0.05	0.05	0.04	0.01
Eggs	0.40	0.5 egg yolk 0.5 egg white	0.05	0.04 egg yolk 0.05 egg white	<0.02	ND egg yolk ND egg white

A method was provided for the determination of residues of captan and THPI in soil (Breault and Robinson, 1987). Extraction with acetone and acidic methanol was followed by selective partitioning of captan into hexane and THPI into dichloromethane. The captan extract was cleaned up on a Florisil column while clean-up of the THPI extract was by liquid-liquid partition at pH 11. Captan was determined by GLC with an ECD, THPI by GLC with an NPD. The limit of quantification was 0.02 mg/kg for both captan and THPI.

Captan was determined in buffered aqueous solutions by extraction of the residues by shaking with toluene and analysis by GLC with an NPD (Kleinschmidt, 1983).

As captan is rapidly hydrolysed in water to produce THPI, the analytical method described for potable water determined residues of THPI (Freeman and Jones, 1993b). THPI was sorbed from water onto a C-18 solid-phase extraction cartridge and eluted with ethyl acetate. The eluate was evaporated to dryness and reconstituted in a solution of citral in acetone. Residues were determined by GLC with mass-selective detection. The limit of quantification was 0.1 µg/l. The mean recovery for THPI over the concentration range 0.1-1.0 µg/l was 89%.

Jones and Freeman (1994) determined residues of captan in air, extracting the residues by passing air through an XAD-2 sorbent tube for 6 hours at a flow rate of 2 l/min (total volume 0.72 m^3). Captan residues were eluted with acetone and determined by GLC with an ECD. The limit of quantification was 0.06 µg/m^3. The overall mean recovery for captan over the concentration range 0.06-5.6 µg/m^3 was 92%.

Stability of pesticide residues in stored analytical samples

The stability of residues in a variety of crops and processed commodities during freezer storage was studied by McKay (1990a). Both samples fortified with captan and THPI and samples with field-incurred residues were analysed. Results were not corrected for procedural recoveries. The results were presented as the means of 2-4 replicates with the initial values reported as the unadjusted analytical results and not the fortification levels. The study was divided into three parts.

In the first part macerated samples of apple, cucumber, lettuce, spinach and strawberry with field-incurred residues were stored at -20°C for 14 months. The stability of the residues varied. Acceptable stability was observed in acidic samples such as apple and strawberry. Although captan residues in spinach remained constant during freezer storage, the THPI residue level increased from 2.7 to 12 mg/kg. As captan is hydrolysed to THPI, the total residue of captan and THPI expressed in captan equivalents should not increase on storage. The total residue in spinach after 14 months storage was 55 mg/kg while the initial value was 37 mg/kg, indicating problems with the procedure. If the initial result is discarded, captan was stable in spinach samples for at least 11 months of freezer storage. There was a sharp decrease in the captan levels in cucumber and lettuce on storage for 3 months although the residue levels were stable thereafter.

Table 13. The stability of captan and THPI in macerated field-treated samples stored at -20°C (McKay, 1990a).

Storage interval, months	Mean residues, mg/kg									
	Apple		Cucumber		Lettuce		Spinach		Strawberry	
	Captan	THPI	Captan	THPI	Captan	THPI	Captan	THPI	Captan	THPI
0	2.7	0.01	1.1	0.12	13	0.22	32	2.7	8.7	0.24
3	2.8	0.11	0.43	0.22	8.8 (4)	0.43 (4)	34	9.9	6.7	0.36
6	2.8	0.12	0.55 (5)	0.28 (5)	8.1	0.72	30	7.6	6.4	0.41
14	2.9 (13)	0.13 (13)	0.39 (13)	0.34 (13)	7.4	0.58	32	12	6.4	0.50

In the second and third parts of the study samples were obtained from local markets and producers, as items of commerce (apple juice, apple sauce, tomato sauce, raisin, fruit, nut and vegetable samples) and from processing plants (dry tomato and grape pomace). Soya beans and soya bean forage, sugar beet tops and wheat forage were obtained from crops that had not been treated with captan. In the second part of the experiment samples were fortified with a mixture of captan and THPI as well as captan and THPI separately and stored in glass bottles with polyethylene-lined lids in the dark at -20 ± 10 °C. The stability of cherry and tomato samples with field-incurred residues was also studied. As in the first part of the study, residues of captan were most stable in acidic samples such as apple juice and cherries and least stable in the more basic beet tops and corn grain.

Table 14. Residues of captan and THPI in macerated fortified and field-treated samples stored at -20°C (McKay, 1990a).

Crop	Compound	Residue, mg/kg, uncorrected for recovery					
		Storage period, months					
		0	1	3	6	12	15	20
Almond	Captan THPI	0.38 0.44	<0.05 0.64	<0.05 0.36	<0.05 0.42			
Apple juice	Captan THPI	0.41 0.24	0.41 0.26	0.58 0.15	0.48 0.15		0.31 0.28	
Beet tops	Captan THPI	0.55 0.69	0.10 0.24	0.19 0.32	0.13 0.35		<0.05 0.35	
Cherry[1]	Captan THPI	21 0.26	25 0.30	19 0.35	12 0.36	16 0.30		
Maize grain	Captan THPI	0.38 0.44	0.46 0.46	0.08 0.41	0.03 0.45			
Potato tubers	Captan THPI	0.47 0.17	0.32 0.14	0.25 0.23	0.27 0.24		0.14 0.25	
Soya bean forage	Captan THPI	0.38 0.44	0.38 0.39	0.35 0.40	0.22 0.22		0.36 0.38	
Soya bean grain	Captan THPI	0.29 0.24	0.21 0.21	0.14 0.32	0.12 0.21		0.04 0.10	
Tomato[1]	Captan THPI	0.88 0.09	0.40 0.22	0.30 0.25	0.28 0.35	0.14 0.34		0.15 0.30

[1] Field-incurred residues

The third part of the experiment studied the effect of maceration on the stability of residues. Samples were fortified with captan or THPI and stored in glass bottles with polyethylene-lined lids in the dark at -20 ± 10 °C. Samples were stored whole, coarsely chopped, finely chopped or ground to determine whether greater exposure to plant enzymes would accelerate the decomposition of residues. THPI was stable in all the samples. The total residue of captan and THPI, expressed as captan equivalents, was fairly constant. Residues of captan in almond samples fortified with captan were more stable in whole nuts than in coarse ground nuts.

Table 15. Residues of captan and THPI in whole, coarsely or finely chopped or ground and homogenised samples fortified with captan or THPI and stored at -20°C (McKay, 1990).

Crop	Compound	Residue, mg/kg, uncorrected for recovery									
		Storage period, months									
		0	1	2	3	3.5	6	8	9	10	12
Almond whole	Captan (THPI)	0.41	0.27	0.42 (0)	0.38 (0)		0.33 (0.02)		0.36 (0)		
	THPI	0.44	0.36		0.31		0.35		0.45		
Almond coarse ground	Captan (THPI)	0.50	0.21	0.33 (0.07)							
	THPI	0.38	0.38								
Apples	Captan	0.52	0.41		0.39		0.38		0.43		
	THPI	0.42	0.44		0.40		0.36		0.49		
Apple sauce	Captan	0.47	0.40		0.37		0.37		0.35		
	THPI	0.43	0.37		0.36		0.42		0.38		
Maize grain, whole	Captan (THPI)	0.40	0.13	0.20 (0.08)	0.13 (0.08)	0.14 (0.09)		0.19 (0.08)			0.05 (0.21)
	THPI	0.46	0.35		0.46	0.40		0.40			0.46
Maize grain, coarse	Captan	0.44	0.05								
	THPI	0.40	0.36								
Grape pomace, dry	Captan	0.41	0.35		0.41		0.38		0.37		
	THPI	0.42	0.36		0.43		0.38		0.41		
Potato tubers	Captan	0.46	0.37		0.37		0.37		0.34		
	THPI	0.45	0.40		0.37		0.35		0.36		
Raisins	Captan	0.46	0.36		0.37		0.42			0.36	
	THPI	0.39	0.44		0.53		0.49			0.41	
Spinach, chopped coarse	Captan (THPI)	0.48	0.06	0.12 (0.10)	0.14 (0.08)			0.06 (0.14)			0.03 (0.18)
	THPI	0.44	0.39		0.47			0.36			0.47
Spinach, chopped fine	Captan	0.49	0.15								
	THPI	0.43	0.37								
Sugar beet tops	Captan (THPI)	0.48 (0)	0.43 (0.02)		0.46 (0.05)		0.42 (0)				0.32 (0.05)
	THPI	0.47	0.35		0.42		0.37				0.33
Tomato	Captan	0.46	0.38		0.38		0.38		0.40		
	THPI	0.37	0.42		0.46		0.43		0.42		
Tomato pomace, dry	Captan	0.43	0.42		0.38		0.36		0.38		
	THPI	0.43	0.38		0.40		0.39		0.38		
Tomato sauce	Captan	0.42	0.51		0.44		0.42		0.36		
	THPI	0.41	0.38		0.53		0.46		0.39		
Wheat forage	Captan (THPI)	0.41 (0)	0.39 (0.07)		0.37 (0.04)		0.10 (0.18)				0.04 (0.09)
	THPI	0.39	0.46		0.39		0.54				0.35

Samples for captan determination should be stored whole if possible and residues of captan should be determined as soon as possible after the collection of samples for analysis.

Schlesinger (1992a) studied the freezer storage stability of both captan and THPI in macerated samples of potato, tomato and melon fortified at 1 mg/kg. Recoveries of captan from samples stored for about 1 year were 65, 73 and 78% for potato, tomato and melon respectively.

Recoveries of THPI from the fortified samples stored frozen for about 1 year were 66, 87 and 72% respectively.

Meyers and Wiebe (1995) studied the freezer storage stability of captan in milk. Residues of captan decreased rapidly with a half-life of approximately 29 days. However, there was a concomitant increase in THPI concentration so that the total residue of captan + THPI expressed as captan remained fairly constant throughout the storage period. The slight variation in the total residue can be attributed to the analytical method and differences in concurrent recoveries. The hydrolysis of captan in milk is not unexpected as the pH of milk is typically 6.8 and the half-life for hydrolysis in aqueous solution at pH 7 is 2.6 hours.

Table 16. Captan and THPI residues in milk fortified at 0.4 mg/kg during freezer storage at -20 ± 10°C (Meyers and Wiebe, 1995).

Storage time, days[2]	Residue, mg/kg[1]			
	Captan	THPI	Total (mg captan equivalents/kg)	Total % remaining on storage
0	0.43	0.02	0.46	115
14	0.31	0.006	0.42	105
29	0.21	0.07	0.34	85
90	0.17	0.11	0.39	96
181	0.10	0.13	0.36	91
367	0.06	0.17	0.35	87

[1] Means of three determinations
[2] From fortification to extraction

The freezer stability of THPI and the *cis*- and *trans*-isomers of 3-OH THPI and 5-OH THPI was determined in milk and bovine tissues (Wiebe *et al.*, 1992). The compounds were stable on freezer storage at -20 °C for at least 3 years.

Table 17. The stability of THPI and hydroxylated metabolites in milk and bovine tissues fortified at 0.4 mg/kg during freezer storage at -20 ± 10°C (Wiebe *et al.*, 1992).

Sample	Storage time, days	% remaining after storage				
		THPI	*trans*-3-OH THPI	*cis*-3-OH THPI	*trans*-5-OH THPI	*cis*-5-OH THPI
Milk	0	88	96	105	93	88
	14	86	101	100	95	90
	75	89	109	106	114	100
	181	89	90	91	97	98
	362	82	104	102	102	101
	734	85	98	89	91	96
	1185	89	93	90	90	78
Fat	0	82	100	103	100	85
	14	78	76	80	76	64
	122	80	84	86	92	80
	243	94	95	85	126	90
	368	81	75	74	76	61
	734	87	94	92	95	90
	1373	90	100	100	89	77
Kidney	0	77	89	88	86	81
	14	86	98	98	128	131
	122	74	69	74	79	77
	243	67	71	76	120	84
	372	74	90	88	112	105
	938	71	72	70	78	79
	1233	88	76	70	72	73
Liver	0	65	63	73	90	94
	14	78	75	86	111	114
	120	78	67	75	107	106
	243	73	65	74	105	105

Sample	Storage time, days	% remaining after storage				
		THPI	*trans*-3-OH THPI	*cis*-3-OH THPI	*trans*-5-OH THPI	*cis*-5-OH THPI
	365	76	75	81	81	85
	932	68	72	78	71	67
	1188	74	61	70	80	77
Muscle	0	87	80	83	83	81
	14	87	93	92	89	90
	142	86	80	90	79	86
	245	78	85	82	79	77
	367	86	81	80	73	65
	902	80	76	72	65	58
	1359	80	81	84	72	68

Definition of the residue

Captan is metabolized by cleavage of the N-S bond to form THPI and derivatives of the *trichloromethyl*thio side chain followed by further degradation of the cleavage products. THPI is the major metabolite detected in plants but is generally present at much lower levels than those of captan. The definition of the residue for commodities derived from plants should be "captan" both for compliance with MRLs and the estimation of dietary intake.

USE PATTERN

Captan is registered as a fungicide in many countries. It is a broad-spectrum fungicide with activity against many diseases including scab (*Venturia spp*.), sooty blotch (*Gleodes pomigena*), leaf spot (*Alternaria mali*), fly speck (*Schizothyrium pomi*) and bitter rot (*Glomerella cingulata*) in pome fruit; brown rot/blossom blight (*Monilinia spp*.), scab (*Fusicladium carpophila*) and shot hole (*Stigmina carpophila*) in stone fruit; downy mildew (*Plasmopara viticola*), grey mould (*Botrytis cinerea*), and black rot (*Guignardia bidwellii*) in grapes; leaf spots (*Cladosporium* spp., *Mycospaerella* spp.), grey mould (*Botrytis cinerea*), anthracnose (*Colletotrichum spp*.) and damping off (*Pythium spp*., *Rhizoctonia spp*., *Penicillium spp*. and *Phythophthora spp*.) in vegetable crops.

The information available to the Meeting on registered uses is summarized in Table 18.

Table 18. Registered uses of captan.

Crop	Country	Form.	Application				PHI, days
			Method	Rate, kg ai/ha	Spray concentration, kg ai/hl	No.	
Alfalfa	Paraguay	TS 750	Foliar		0.35		
Almond	Argentina	WP 800	Foliar		0.12		43
Almond	Belgium	WP 830	Foliar		0.12		30
Almond	Greece	WP 830	Foliar		0.13	4	30
Almond	Portugal	WP 830	Foliar		0.15-0.2		14
Almond	Spain	SC 475	Foliar		0.13-0.15		10
Almond	USA	WP 500	Foliar	2.2-4.9			30
Apple	Argentina	WP 800	Foliar		0.12		14
Apple	Australia	WP 800	Foliar		0.1	5	7
Apple	Belgium	WG 800	Foliar		0.1-0.12		14
Apple	Brazil	WP 500	Foliar		0.11-0.12 (1-3 l/tree)		1
Apple	Canada	WP 500	Foliar	1.5-3			7
Apple	Chile	WP 800	Foliar		0.14		(1-10)[2]
Apple	Colombia	WP 500	Foliar		0.11		
Apple	Costa Rica	WP 500	Foliar	0.75	0.12		7
Apple	Ecuador	WP 800	Foliar	0.8-1.2			15
Apple	El Salvador	WP 500	Foliar	0.75	0.12		7

Crop	Country	Form.	Application				PHI, days
			Method	Rate, kg ai/ha	Spray concentration, kg ai/hl	No.	
Apple	Guatemala	WP 500	Foliar	0.75	0.12		7
Apple	Honduras	WP 500	Foliar	0.75	0.12		7
Apple	Ireland	WP 800	Foliar	2.7		12	14
Apple	Israel	WP 500	Foliar	1.3-3.8	0.13		7
Apple	Japan	WP 800	Foliar	2-8	0.07-0.13	6	14
Apple	Mexico	WP 500	Foliar		0.1-0.13	2-4	
Apple	Netherlands	WP 830	Foliar	0.5-2.1[1]	0.05-0.21		7 (0.06%)/ 21 (>0.1%)
Apple	Nicaragua	WP 500	Foliar	0.75	0.12		7
Apple	Panama	WP 500	Foliar	0.75	0.12		7
Apple	Poland	WP 500	Foliar	1.5-2.3			7
Apple	Portugal	WP 830	Foliar		0.15-0.2		21
Apple	Romania	WP 500	Foliar		0.13		14
Apple	South Africa	WP 500	Foliar		0.08-0.1		14
Apple	Syria	WP 830	Foliar		0.1		14
Apple	Turkey	WP 500	Foliar		0.08	2+	3
Apple	UK	WG 800	Foliar	2.7		10-12[1]	14
Apple	Uruguay	WP 800	Foliar		0.1-0.13	2	7
Apple	USA	WP 500	Foliar	2.2-4.4			Nil
Apple	USA	WP 500	Post-H dip		0.15		Nil
Apricot	Canada	WP 500	Foliar	3-3.6			2
Apricot	Poland	WP 500	Foliar	1.5-2.3			7
Apricot	Turkey	WP 500	Foliar		0.15	2+	3
Apricot	Uruguay	WP 800	Foliar		0.13		7
Apricot	USA	WP 500	Foliar	1.6-2.7			2
Avocado	Costa Rica	WP 500	Foliar	1.4	0.12		3-7
Avocado	El Salvador	WP 500	Foliar	1.4	0.12		3-7
Avocado	Guatemala	WP 500	Foliar	1.4	0.12		3-7
Avocado	Honduras	WP 500	Foliar	1.4	0.12		3-7
Avocado	Mexico	WP 500	Foliar		0.13		
Avocado	Nicaragua	WP 500	Foliar	1.4	0.12		3-7
Avocado	Panama	WP 500	Foliar	1.4	0.12		3-7
Avocado	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Bean	Bolivia	TS 750	Foliar		0.14		
Bean	Chile	WP 800	Foliar	1.6			1
Bean	Dominican Republic	WP 500, WP 800	Foliar	1-3			3
Bean (broad)	Ecuador	WP 800	Foliar	0.8-1.2			15
Bean	Hungary	WP 500	Foliar	0.4-1.5	0.1-0.13		14
Bean	Paraguay	TS 750	Foliar		0.14		
Bean	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Bean	Poland	WP 500	Foliar	0.6			7
Bean (broad)	Spain	SC 475	Foliar		0.13-0.15		10
Bean (French)	Spain	SC 475	Foliar		0.13-0.15		21
Bean	Venezuela	WP 500	Soil	6.0-7.0			30
Blackberry	Belgium	WG 800	Foliar		0.12		4
Blackberry	Canada	WP 500	Foliar	1.8			2
Blackberry	Netherlands	WP 830	Foliar		0.13		4
Blueberry	Canada	WP 500	Foliar	1.8			2
Blueberry	USA	WP 500	Foliar	1.1-2.7			Nil
Broccoli	Bolivia	TS 750	Foliar		0.17		
Broccoli	Paraguay	TS 750	Foliar		0.17		
Cantaloupe	Argentina	WP 800	Foliar	2.2	0.12		7
Cantaloupe (melon)	Brazil	WP 500	Foliar		0.1		1
Cantaloupe	Colombia	WP 500	Foliar		0.11		
Cantaloupe	Costa Rica	WP 500	Foliar	0.75	0.12		7
Cantaloupe (melon)	Dominican Republic	WP 500, WP 800	Foliar	2.3-3.6			3

Crop	Country	Form.	Application				PHI, days
			Method	Rate, kg ai/ha	Spray concentration, kg ai/hl	No.	
Cantaloupe	El Salvador	WP 500	Foliar	0.75-2	0.12		3-7
Cantaloupe	Guatemala	WP 500	Foliar	0.75-2	0.12		3-7
Cantaloupe	Honduras	WP 500	Foliar	0.75-2	0.12		3-7
Cantaloupe	Mexico	WP 500	Foliar	1-1.5			Nil
Cantaloupe	Nicaragua	WP 500	Foliar	0.75-2	0.12		3-7
Cantaloupe	Panama	WP 500	Foliar	0.75-2	0.12		3-7
Melon	Philippines	WP 500	Foliar		0.5-1		
Melon	Venezuela	WP 500	Foliar	2.0-2.5			30
Carrot	Costa Rica	WP 500	Foliar	0.75-2	0.12		3-7
Carrot	El Salvador	WP 500	Foliar	0.75	0.12		7
Carrot	Guatemala	WP 500	Foliar	0.75	0.12		7
Carrot	Honduras	WP 500	Foliar	0.75	0.12		7
Carrot	Mexico	WP 500	Foliar	2			Nil
Carrot	Nicaragua	WP 500	Foliar	0.75	0.12		7
Carrot	Panama	WP 500	Foliar	0.75	0.12		7
Carrot	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Cauliflower	Bolivia	TS 750	Foliar		0.17		
Cauliflower	Paraguay	TS 750	Foliar		0.17		
Celery	Argentina	WP 800			0.12		Ns
Celery	Colombia	WP 500	Foliar		0.11		
Celery	Costa Rica	WP 500	Foliar	0.5	0.12		7
Celery	El Salvador	WP 500	Foliar	0.5	0.12		7
Celery	Guatemala	WP 500	Foliar	0.5	0.12		7
Celery	Honduras	WP 500	Foliar	0.5	0.12		7
Celery	Nicaragua	WP 500	Foliar	0.5	0.12		7
Celery	Panama	WP 500	Foliar	0.5	0.12		7
Celery	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Cherry	Argentina	WP 800	Foliar		0.12		14
Cherry	Belgium	WG 800	Foliar		0.12		4
Cherry	Canada	WP 500	Foliar	3-3.6			2 (sweet) 5 (sour)
Cherry	Colombia	WP 500	Foliar		0.11		
Cherry	Greece	WP 830	Foliar		0.13	4	20
Cherry	Italy	WP 450	Foliar	1.1-2.3			20
Cherry	Japan	WP 800	Foliar	3-6	0.1	5	14
Cherry (sour)	Poland	WP 500	Foliar	1.5-2.3			7
Cherry	Romania	WP 800	Foliar		0.13		14
Cherry	USA	WP 500	Foliar	1.1-2.2			Nil
Cherry	USA	WP 500	Post-H dip		0.15		Nil
Chili	Costa Rica	WP 500	Foliar	0.75	0.12		7
Chili	El Salvador	WP 500	Foliar	0.75-2	0.12		3-7
Chili	Guatemala	WP 500	Foliar	0.75-2	0.12		3-7
Chili	Honduras	WP 500	Foliar	0.75-2	0.12		3-7
Chili	Mexico	WP 500	Foliar	1-1.5			Nil
Chili	Honduras	WP 500	Foliar	0.75-2	0.12		3-7
Chili	Nicaragua	WP 800	Foliar		0.14-0.23		14
Chili	Panama	WP 800	Foliar		0.14-0.23		14
Citrus	Argentina	WP 800	Foliar		0.14-0.23		14
Citrus	Brazil	WP 500	Foliar		0.11-0.12 (2-5 l/tree)		7
Citrus	Costa Rica	WP 500	Foliar	0.75	0.12		7
Citrus	Dominican Republic	WP 500, WP 800	Foliar	4-6.5			3
Citrus	El Salvador	WP 500	Foliar	0.75-1.4	0.12		3-7
Citrus	Guatemala	WP 500	Foliar	0.75-1.4	0.12		3-7
Citrus	Honduras	WP 500	Foliar	0.75-1.4	0.12		3-7
Citrus	Japan	WP 200	Foliar	0.67-2	0.27-0.4	5	5
Citrus	Nicaragua	WP 500	Foliar	0.75-1.4	0.12		3-7
Citrus	Panama	WP 500	Foliar	0.75-1.4	0.12		3-7
Citrus	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil

Crop	Country	Form.	Application				PHI, days
			Method	Rate, kg ai/ha	Spray concentration, kg ai/hl	No.	
Citrus	Spain	SC 475	Foliar		0.15-0.25		10
Citrus	Turkey	WP 500	Foliar		0.15	2+	3
Citrus	Venezuela	WP 500	Foliar		0.1		30
Coffee	El Salvador	WP 500	Foliar	1-1.5			3
Coffee	Guatemala	WP 500	Foliar	1-1.5			3
Coffee	Honduras	WP 500	Foliar	1-1.5			3
Coffee	Nicaragua	WP 500	Foliar	1-1.5			3
Coffee	Panama	WP 500	Foliar	1-1.5			3
Corn	Bolivia	TS 750	Foliar		0.11		
Corn	Kenya	WP 800	Seed treatment				
Corn	Paraguay	TS 750	Foliar		0.11		
Corn	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Cotton	Bolivia	TS 750	Foliar		0.11-0.16		
Cotton	Paraguay	TS 750	Foliar		0.11-0.16		
Cotton	Thailand	WP 500	Seed treatment	0.35 kg ai/100 kg seed			
Cotton	Venezuela	WP 500	Soil	6.0-7.0			30
Cucumber	Argentina	WP 800	Foliar	2.2	0.12		7
Cucumber	Brazil	WP 500	Foliar		0.1		1
Cucumber	Canada	WP 500	Foliar	1.6-3.4			2
Cucumber	Dominican Republic	WP 500, WP 800	Foliar	2.3			3
Cucumber	El Salvador	WP 500	Foliar	1-2			3
Cucumber	Guatemala	WP 500	Foliar	1-2			3
Cucumber	Honduras	WP 500	Foliar	1-2			3
Cucumber	Japan	WP 800	Foliar	1.5-4	0.1-0.13	5	1
Cucumber	Mexico	WP 500	Foliar	1-1.5			Nil
Cucumber	Nicaragua	WP 500	Foliar	1-2			3
Cucumber	Panama	WP 500	Foliar	1-2			3
Cucumber	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Cucumber	Romania	WP 800	Foliar		0.1		14
Cucumber	Venezuela	WP 500	Foliar	2.0-2.5			30
Cucurbits	Greece	WP 830	Foliar		0.13		20
Cucurbits	Venezuela	WP 500	Foliar	2.0-2.5			30
Currants	Belgium	WG 800	Foliar		0.12		10
Currants	Netherlands	WP 830	Foliar		0.13		10
Eggplant	Argentina	WP 800	Foliar	1.6	0.12		7
Eggplant	Mexico	WP 500	Foliar	1-1.5			Nil
Eggplant	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Eggplant	Spain	SC 475	Foliar		0.13-0.15		10
Endive	Netherlands	WP 830	Foliar		0.13		21
Endive	Spain	SC 475	Foliar		0.13-0.15		10
Escarole	Spain	SC 475	Foliar		0.13-0.15		10
Fruit[3]	Hungary	WP 500	Foliar	1-1.5	0.1-0.15		10
Garlic	Brazil	WP 500	Foliar		0.11		7
Garlic	Dominican Republic	WP 500, WP 800	Foliar	1.5-4.8			3
Garlic	El Salvador	WP 500	Foliar	1-2			3
Garlic	Guatemala	WP 500	Foliar	1-2			3
Garlic	Honduras	WP 500	Foliar	1-2			3
Garlic	Mexico	WP 500	Foliar	1.3-1.5			Nil
Garlic	Nicaragua	WP 500	Foliar	1-2			3
Garlic	Panama	WP 500	Foliar	1-2			3
Garlic	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Grape	Australia	WP 800	Foliar		0.1	5	7
Grape	Argentina	WP 800	Foliar		0.14		14 (table) 25 (wine)
Grape	Belgium	WG 800	Foliar		0.12		42
Grape	Brazil	WP 500	Foliar		0.11-0.12 (1-3		1

Crop	Country	Form.	Application				PHI, days
			Method	Rate, kg ai/ha	Spray concentration, kg ai/hl	No.	
					l/vine)		
Grape	Canada	WP 500	Foliar	1.6-2.8			7
Grape (table)	Chile	WP 800	Foliar	3.2		3-4[1]	(1-15)[2]
Grape (wine)	Chile	WP 800	Foliar	3.2	0.14	3-4[1]	30
Grape	Colombia	WP 500	Foliar		0.11		
Grape	France	WP 830	Foliar	1.9			(14/21)[1]
Grape	Greece	WP 830	Foliar		0.13	3-4[1]	40
Grape	Hungary	WP 500	Foliar	1-1.5	0.1-0.15	2-3[1]	10 (table) 30 (wine)
Grape	Israel	WP 500	Foliar	1.3-3.8	0.13		14
Grape	Japan	WP 800	Foliar	2-3	0.1	5	30
Grape	Mexico	WP 500	Foliar		0.01-0.013	2	Nil
Grape	Morocco	WP 500	Foliar		0.13		
Grape	Peru	WP 800	Foliar		0.16-0.2		3-7
Grape	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Grape	Portugal	WP 830	Foliar		0.16		21 (table) 42 (wine)
Grape	Romania	WP 800	Foliar		0.1		21
Grape	Spain	SC 475	Foliar		0.14-0.19		21
Grape	Thailand	WP 500	Foliar	3.1	0.13		
Grape	Turkey	WP 500	Foliar		0.15	2+	3
Grape	Uruguay	WP 800	Foliar	0.6-1.2			21
Grape	USA	WP 500	Foliar	1.1-2.2			Nil
Grape	Venezuela	WP 500	Foliar		0.5-0.62		30
Leek	Netherlands	WP 830	Foliar		0.25		14
Leek	Spain	SC 475	Foliar		0.13-0.15		21
Lettuce	Costa Rica	WP 500	Foliar	0.75-2	0.12		3-7
Lettuce	El Salvador	WP 500	Foliar	0.75	0.12		7
Lettuce	Guatemala	WP 500	Foliar	0.75	0.12		7
Lettuce	Honduras	WP 500	Foliar	0.75	0.12		7
Lettuce	Nicaragua	WP 500	Foliar	0.75	0.12		7
Lettuce	Panama	WP 500	Foliar	0.75	0.12		7
Lettuce	Spain	SC 475	Foliar		0.13-0.15		21
Lettuce	Turkey	WP 830	Foliar		0.15		7
Loganberry	Canada	WP 500	Foliar	1.2-1.8			2
Loquat	Turkey	WP 500	Foliar		0.15		3
Mango	Mexico	WP 500	Foliar		0.13-0.175		Nil
Mango	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Mango	Thailand	WP 500	Foliar	1.6-2.0	0.1-0.13		
Melon	Japan	WP 800	Foliar	2-4	0.13	5	14
Melon	Hungary	WP 500	Foliar	0.4-1.0	0.06-0.14		14
Melon	Portugal	WP 830	Foliar		0.15-0.2		28
Nectarine	Argentina	WP 800	Foliar		0.12-0.14		14
Nectarine	Greece	WP 830	Foliar		0.13	4	20
Nectarine	USA	WP 500	Foliar	1.4-4.4			Nil
Nectarine	Uruguay	WP 800	Foliar		0.13		7
Oil palm	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Olive	Spain	SC 475	Foliar		0.125-0.15		10
Onion	Argentina	WP 800			0.12		Ns
Onion	Brazil	WP 500	Foliar		0.11-0.12		7
Onion	Costa Rica	WP 500	Foliar	0.5-2	0.12		3-7
Onion	Dominican Republic	WP 500	Foliar	1.5-4.8			3
Onion	El Salvador	WP 500	Foliar	0.5-2	0.12		3-7
Onion	Guatemala	WP 500	Foliar	0.5-2	0.12		3-7
Onion	Honduras	WP 500	Foliar	0.5-2	0.12		3-7
Onion	Nicaragua	WP 500	Foliar	0.5-2	0.12		3-7
Onion	Panama	WP 500	Foliar	0.5-2	0.12		3-7
Onion	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Onion	Turkey	WP 830	Foliar		0.15		7
Orange	Peru	WP 800	Foliar		0.16-0.2		3-7

Crop	Country	Form.	Application				PHI, days
			Method	Rate, kg ai/ha	Spray concentration, kg ai/hl	No.	
Papaya	Venezuela	WP 500	Foliar	2.0-2.5			30
Parsley	Argentina	WP 800			0.12		Ns
Peas	Poland	WP	Seed treatment	0.15/100 kg seed			-
Peas	Spain	SC 475	Foliar		0.13-0.15		10
Peas (chick)	Spain	SC 475	Foliar		0.13-0.15		10
Peach	Argentina	WP 800	Foliar		0.12-0.14		14
Peach	Brazil	WP 500	Foliar		0.11-0.12 (1-3 l/tree)		1
Peach	Canada	WP 500	Foliar	3-3.6			2
Peach	Colombia	WP 500	Foliar		0.11		
Peach	France	WP 830	Foliar		0.25		14[1]
Peach	Greece	WP 830	Foliar		0.13	4	20
Peach	Poland	WP 500	Foliar	1.5-2.3			7
Peach	Portugal	WP 830	Foliar		0.15-0.2		7
Peach	Romania	WP 800	Foliar		0.13		14
Peach	Turkey	WP 500	Foliar		0.1-0.15	2+	3
Peach	Uruguay	WP 800	Foliar		0.13		7
Peach	USA	WP 500	Foliar	2.2-4.4			Nil
Peach	Venezuela	WP 500	Foliar	2.0-2.5			30
Peanut	Bolivia	TS 750	Foliar		0.15		
Peanut	Paraguay	TS 750	Foliar		0.15		
Pear	Argentina	WP 800	Foliar		0.12		14
Pear	Australia	WG 800	Foliar		0.1	5	7
Pear	Belgium	WG 800	Foliar		0.1-0.12		14
Pear	Brazil	WP 500	Foliar		0.11-0.12 (1-3 l/tree)		1
Pear	Canada	WP 500	Foliar	3			7
Pear	Chile	WP 800	Foliar		0.14		(1-10) [2]
Pear	Colombia	WP 500	Foliar		0.11		
Pear	Ecuador	WP 800	Foliar	0.8-1.2		1-2[1]	15
Pear	Ireland	WP 800	Foliar	2.7		12	14
Pear	Israel	WP 500	Foliar	1.3-3.8	0.13		7
Pear	Italy	WP 450	Foliar		0.13-0.16		15
Pear	Japan	WP 800	Foliar	2.4-8	0.08-0.13	9	7
Pear	Mexico	WP 500	Foliar		0.01-0.013	2	Nil
Pear	Netherlands	WP 830	Foliar		0.05-0.21		7 (0.06%) 21 (>0.1%)
Pear	Poland	WP 500	Foliar	1.5-2.3		10-12[1]	7
Pear	Portugal	WP 830	Foliar		0.15-0.2		21
Pear	Romania	WP 800	Foliar		0.13		14
Pear	South Africa	WP 500	Foliar		0.08-0.1		14
Pear	Syria	WP 830	Foliar		0.1		7
Pear	Turkey	WP 500	Foliar		0.08	2+	3
Pear	UK	WG 800	Foliar	2.7		12	14
Pear	Uruguay	WP 800	Foliar		0.1-0.13	2	7
Pear	USA	WP 500	Post-H dip		0.15		Nil
Pepper (bell)	Argentina	WP 800	Foliar	1.6	0.12		7
Pepper	Ecuador	WP 800	Foliar	0.8-1.2			15
Pepper	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Pepper	Venezuela	WP 500	Foliar		0.5-1.0		30
Pineapple	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Plum	Argentina	WP 800	Foliar		0.12		14
Plum/prune	Belgium	WG 800	Foliar		0.12		4
Plum/prune	Canada	WP 500	Foliar	3-3.6			2
Plum/prune	Colombia	WP 500	Foliar		0.11		
Plum	Greece	WP 830	Foliar		0.13	4	20
Plum	Italy	WP 450	Foliar	1.1-2.3			20
Plum	Japan	WP800	Foliar	2.4-8	0.08-0.13	5	14

Crop	Country	Form.	Application				PHI, days
			Method	Rate, kg ai/ha	Spray concentration, kg ai/hl	No.	
Plum/prune	Portugal	WP 830	Foliar		0.15-0.2		7
Plum	Romania	WP 800	Foliar		0.13		14
Plum	Turkey	WP 500	Foliar		0.1	2+	3
Plum	Uruguay	WP 800	Foliar		0.12		7
Plum/prune	USA	WP 500	Foliar	2.2-3.3			Nil
Pome fruit	France	WP 830	Foliar	1.5[1]	0.15		14[1]
Pome fruit	Germany	WP 830	Foliar	1.5[1]	0.1	13	21
Pome fruit	Greece	WP 830	Foliar		0.13	3+	15
Pome fruit	Morocco	WP 500	Foliar		0.15		
Pome fruit	Spain	SC 475	Foliar		0.13-0.15		10
Potato	Argentina	WP 800	Foliar	0.96-1.2	0.5		7
Potato	Brazil	WP 500	Foliar		0.11-0.12		14
Potato	Colombia	WP 500	Foliar		0.11		
Potato	Dominican Republic	WP 500	Foliar	1.5-4.8	0.17		3
Potato	Ecuador	WP 800	Foliar	0.8-1.2			15
Potato	El Salvador	WP 500	Foliar	1-2			3
Potato	Greece	WP 830	Foliar		0.13		20
Potato	Guatemala	WP 500	Foliar	1-2			3
Potato	Honduras	WP 500	Foliar	1-2			3
Potato	Mexico	WP 500	Foliar		0.1-0.2		14
Potato	Morocco	WP 500	Foliar		0.15		
Potato	Nicaragua	WP 500	Foliar	1-2			3
Potato	Panama	WP 500	Foliar	1-2			3
Potato	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Potato	Poland	WP 500	Foliar	1.5-1.8			7
Potato	Portugal	WP 830	Foliar		0.15-0.2		7
Potato	Spain	WP 475	Foliar		0.13-0.15		10
Potato	Turkey	WP 500	Foliar		0.18	2+	7
Potato	Uruguay	WP 800	Foliar	0.6-1.0			7
Potato	Venezuela	WP 500	Foliar		0.5-1.0		30
Pumpkin	Colombia	WP 500	Foliar		0.11		
Quince	Uruguay	WP 800	Foliar		0.1-0.13	2	7
Raspberry	Belgium	WG 800	Foliar		0.12		4
Raspberry	Canada	WP 500	Foliar	2			2
Raspberry	Netherlands	WP 830	Foliar		0.13		4
Rhubarb	Canada	WP 500	Foliar	1.1-1.6			2 (in forcing sheds)
Soya	Bolivia	TS 750	Foliar		0.11		
Soya	Costa Rica	WP 500	Foliar		0.12		7
Soya	El Salvador	WP 500	Foliar		0.12		7
Soya	Guatemala	WP 500	Foliar		0.12		7
Soya	Honduras	WP 500	Foliar		0.12		7
Soya	Nicaragua	WP 500	Foliar		0.12		7
Soya	Panama	WP 500	Foliar		0.12		7
Soya	Paraguay	TS 750	Foliar		0.11		
Soya	Thailand	WP 500	Foliar	0.47-0.63	0.08-0.1	3-4	
Squash	Argentina	WP 800	Foliar	2.2	0.12		7
Squash	Mexico	WP 500	Foliar	1-1.5			Nil
Squash	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Stone fruit except apricot	Australia	WP 800	Foliar		0.1	5	7
Stone fruit	Chile	WP 800	Foliar		0.14		(0-10)[2]
Stone fruit	Greece	WP 830	Foliar		0.13	4	20
Stone fruit	Israel	WP 500	Foliar	1.3-3.8	0.13		7
Stone fruit	Spain	SC 475	Foliar		0.13-0.15		10
Strawberry	Australia	WP 800	Foliar		0.10-0.16	5	1
Strawberry	Argentina	WP 800	Foliar		0.08-0.2		5
Strawberry	Belgium	WG 800	Foliar		0.12		4 (field) 14 (glass)

Crop	Country	Form.	Application				PHI, days
			Method	Rate, kg ai/ha	Spray concentration, kg ai/hl	No.	
Strawberry	Canada	WP 500	Foliar	2.3-3.4			2
Strawberry	Chile	WP 800	Foliar	1.6-3.2		1-2[1]	(2-15)[2]
Strawberry	Colombia	WP 500	Foliar		0.11		
Strawberry	Costa Rica	WP 500	Foliar	0.5	0.12		7
Strawberry	Ecuador	WP 800	Foliar	1.2-1.6			15
Strawberry	El Salvador	WP 500	Foliar	0.5	0.12		7
Strawberry	Guatemala	WP 500	Foliar	0.5	0.12		7
Strawberry	Honduras	WP 500	Foliar	0.5	0.12		7
Strawberry	Israel	WP 500	Foliar	1.3-3.8	0.13		7
Strawberry	Japan	WP 800	Foliar	1.5-3	0.1	2	30
Strawberry	Kenya	WP 800	Foliar	1			7
Strawberry	Mexico	WP 500	Foliar	1.5-2			nil
Strawberry	Netherlands	WP 830	Foliar		0.13	2-4[1]	4 field 14 glass
Strawberry	Nicaragua	WP 500	Foliar	0.5	0.12		7
Strawberry	Panama	WP 500	Foliar	0.5	0.12		7
Strawberry	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Strawberry	Spain	SC 475	Foliar		0.13-0.15		21
Strawberry	USA	WP 500	Foliar	1.6-3.3			Nil
Strawberry	Venezuela	WP 500	Foliar		0.5-0.62		30
Sunflower	Venezuela	WP 500	Foliar	1.0-1.5			30
Sweet potato	Argentina	WP 800	Foliar		0.24		7
Tomato	Argentina	WP 800	Foliar	2.2	0.12		7
Tomato	Brazil	WP 500	Foliar		0.11-0.12		1
Tomato	Canada	WP 500	Foliar	2.3-3.4	0.12		2
Tomato	Colombia	WP 500	Foliar		0.11		
Tomato	Costa Rica	WP 500	Foliar	0.75-2	0.12		3-7
Tomato	Dominican Republic	WP 500	Foliar	1.5-4.8	0.17		3
Tomato	Ecuador	WP 800	Foliar	0.8-1.2		2[1]	15
Tomato	El Salvador	WP 800	Foliar	0.75-2	0.12		3-7
Tomato	Guatemala	WP 800	Foliar	0.75-2	0.12		3-7
Tomato	Honduras	WP 800	Foliar	0.75-2	0.12		3-7
Tomato	Hungary	WP 500	Foliar	0.4-1.0	0.06-0.14		5
Tomato	Japan	WP 800	Foliar	1-3	0.07-0.1	5	1
Tomato	Mexico	WP 500	Foliar	0.75-1.5			Nil
Tomato	Morocco	WP 500	Foliar		0.15		
Tomato	Nicaragua	WP 800	Foliar	0.75-2	0.12		3-7
Tomato	Panama	WP 800	Foliar	0.75-2	0.12		3-7
Tomato	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Tomato	Portugal	WP 830	Foliar		0.15-0.2		7
Tomato	Romania	WP 800	Foliar		0.13		21
Tomato	Spain	SC 475	Foliar		0.13-0.15	4[1]	10
Tomato	Syria	WP 830	Foliar		0.17		7
Tomato	Turkey	WP 500	Foliar		0.13-0.15	2+	7
Tomato	Venezuela	WP 500	Foliar		0.5-1.0		30
Vegetables	Greece	WP 830	Foliar		0.13		20 if eaten cooked, otherwise last application at 1st flowering
Vegetables	Hungary	WP 500	Foliar	0.4-1.5	0.1-0.15		14
Watermelon	Argentina	WP 800	Foliar	2.2	0.12		7
Watermelon	Brazil	WP 500, PM 500	Foliar		0.11-0.12		1
Watermelon	Colombia	WP 500	Foliar		0.11		
Watermelon	Costa Rica	WP 500	Foliar	0.75	0.12		7
Watermelon	El Salvador	WP 500	Foliar	0.75-2	0.12		3-7
Watermelon	Guatemala	WP 500	Foliar	0.75-2	0.12		3-7
Watermelon	Honduras	WP 500	Foliar	0.75-2	0.12		3-7
Watermelon	Mexico	WP 500	Foliar	1-1.5			Nil

Crop	Country	Form.	Application				PHI, days
			Method	Rate, kg ai/ha	Spray concentration, kg ai/hl	No.	
Watermelon	Nicaragua	WP 500	Foliar	0.75-2	0.12		3-7
Watermelon	Panama	WP 500	Foliar	0.75-2	0.12		3-7
Watermelon	Philippines	WP 500	Foliar	0.75-1.5	0.19-0.38		Nil
Wheat	Bolivia	TS 750	Foliar		0.14		
Wheat	Paraguay	TS 750	Foliar		0.14		

Ns = not specified
[1] information not on label but part of GAP followed in the country
[2] PHI depends on destination for export
[3] Fruit = apple, pear, cherry, nectarine, peach, plum, strawberry

RESIDUES RESULTING FROM SUPERVISED TRIALS

Details of the residue trials are shown in tables 19-38 and are reviewed in order of the Codex Alimentarius Classification of Foods and Feeds.

Table 19. *Citrus. Lemon,* USA. *Mandarin*, Japan. *Oranges*, Brazil, Spain, USA. *Grapefruit,* USA.
Table 20. *Apple,* Argentina, Australia, Brazil, Canada, Chile, France, Germany, Hungary, Israel, Japan, Netherlands, Portugal, South Africa, UK, USA.
Table 21. *Pear,* Australia, Chile, Germany, Italy, Japan, South Africa, UK, USA.
Table 22. *Cherry,* Belgium, Germany, Japan, USA.
Table 23. *Plum,* Chile, Greece, Japan, Portugal, Spain, USA.
Table 24. *Apricots,* USA.
Table 25. *Nectarine,* Chile, Greece, Spain, USA.
Table 26. *Peach,* Australia, Canada, Chile, Italy, Japan, Spain, USA.
Table 27. *Blueberry,* USA.
Table 28. *Grape,* Australia, Brazil, Chile, France, Germany, Japan, USA.
Table 29. *Raspberry,* USA.
Table 30. *Strawberry,* Australia, Belgium, Chile, Germany, Hungary, Israel, Netherlands, Spain, USA.
Table 31. *Melon,* Japan, USA.
Table 32. *Cucumber*, Brazil, Japan, USA.
Table 33. *Squash,* USA
Table 34. *Tomato,* Brazil, Greece, Israel, Japan, Mexico, USA.
Table 35. *Soya bean,* Thailand
Table 36. *Potato,* Brazil, Canada, Mexico, Netherlands, Poland, UK, USA.
Table 37. *Radish,* Germany.
Table 38. *Almond*, USA.
Table 39. *Chive,* Germany.

Where residues were not detected the results are reported as below the limit of quantification (LOD), e.g. <0.05 mg/kg. Residues, application rates and spray concentrations have generally been rounded to 2 significant figures. Although trials included results for untreated controls, these results are not reported in the tables unless the residues in the control samples were greater than the LOD. The prefix “c” in the tables indicates samples from control plots. Where possible, residues are recorded uncorrected for analytical recoveries. It should be noted that unless stated otherwise concurrent recoveries were acceptable and any corrections would be small.

Most trials were fully reported, the exceptions being the Belgian trial on cherries, the Chilean trials on grapes (1991), the German trials on strawberries, grapes (1974-1977), radishes and chives, the Israeli tomato trial and the Polish trials on potatoes.

Captan was applied to oranges in supervised trials in Brazil, Spain and the USA by backpack, oscillating boom sprayer and mist-blower. Plot sizes ranged from 1 to 120 trees. The interval between the last two sprays in the Brazil trials was 289-292 days. In view of the long interval the residue data may be more reflective of a single spray. Mandarin trials in Japan were reported for pulp and peel separately rather than for whole fruit. Some of the trials were conducted indoors. Mandarins normally comprise 25-30% peel and 70-75% pulp, and these figures can be used to estimate the residues on a whole-fruit basis. Application of captan to lemons in Arizona was by hand gun (4 trees/plot) in California by oscillating boom spray (25 trees/plot). Grapefruit (30 trees/plot) were sprayed with a hand gun in the USA.

Plot sizes for the apple trials ranged from 1 to 16 trees. Equipment used for the application of the foliar sprays included backpack, motorised hand-gun and mist-blower. The high residues of captan and THPI detected in control samples in the 1991 Israel trials can be explained by a captan spray applied 26 days before the start of the trial. Sampling dates were not reported in one of the 1992 French trials. Captan was applied to pears by motorised knapsack and mist-blower. Plot sizes ranged from 1 to 12 trees.

Foliar sprays were applied to stone fruit by hand gun, knapsack sprayer, high-volume sprayer and mist-blower. The plot sizes were 1-4 trees for cherries, 1 tree to a plot of 4900 m^2 for nectarines and peaches and 1-64 trees for plums. For apricots most plots were 1-6 trees with the largest 93 trees.

For the aerial application of captan to blueberries plot sizes were about 2 ha. Captan was applied as a foliar spray to strawberries with backpacks, motorised sprayers and mist-blowers. The Belgian and Netherlands trials were in glasshouses while plastic tunnels were used in the Israel trials. All the other trials were in the field. Methods of irrigation included both furrow and sprinkler. Supervised grape trials were located at various sites in Australia, Brazil, Chile, France, Germany, Japan (including indoors) and the USA. Application equipment included knapsack sprayers, motorised airblast sprayers and mist-blowers. Plot sizes ranged from 3 to 300 m^2. Plot sizes for the USA raspberry trials were 39-1500 m^2 with application equipment ranging from backpack sprayers to hydraulic boom sprayers.

In cucumber, melon and squash trials captan was applied by knapsack sprayers, ground sprayers, tractor mounted boom sprays and aircraft. The plots ranged in size from a single 7.6 m row to an area of 93 m^2 for cucumbers, 11-61 m^2 for ground application to melons (0.4 ha for aerial application) and 15-23 m^2 for squash. In trials in Japan, captan was applied to both field and glasshouse cucumbers and melons.

Supervised trials were reported on tomatoes in Brazil, Greece, Israel, Japan (outdoor and glasshouse), Mexico and the USA. Plot sizes ranged from 7 to 93 m^2 for ground application (334 m^2 for aerial spraying). Ground application was by backpack sprayer or tractor mounted boom.

Plot sizes for potato trials were 13 - 100 m^2. Foliar application of captan was by knapsack sprayers, hand-held boom sprayers and motorised sprayers with hand gun. Other trials were with broadcast application to open furrows and seed treatment.

Trials were reported from Germany for the pre-emergent treatment of indoor-grown radishes and chives. Only summaries were provided.

Supervised trials on almonds grown in California, USA, were reported. Plot sizes were 41-1300 m^2 for ground applications with hand guns and airblast sprayers, and 0.8-2.2 ha for aerial applications.

Table 19. Residues of captan and THPI in citrus fruit after foliar applications of WP formulations. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application			PHI, days	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Lemons							
USA (AZ), 1986 (Lisbon)	9.0		2	0	7.0 8.5	0.18 0.16	TMN603A
USA (CA), 1986 (Eureka)	9.0		2	0	4.6 4.5	0.08 0.08	TMN603A
Mandarins							
Japan, 1983 (Miyakawa) (INDOOR) Pulp	6.7	1.3	5	1 3 7	0.76 0.96 0.60		TMN602A
Japan, 1983 (Miyakawa) (INDOOR) Peel	6.7	1.3	5	1 3 7	11 17 20 c0.44		TMN602A
Japan, 1983 (Miho-Wase) (INDOOR) Pulp	6.7	1.3	5	1 3 4	1.4 0.40 0.28 c0.02		TMN602A
Japan, 1983 (Miho-Wase) (INDOOR) Peel	6.7	1.3	5	1 3 4	32 18 14 c0.44		TMN602A
Japan, 1983 (Miyakawa) Pulp	6.7	1.3	5	1 3 7	0.39 0.16 0.11		TMN602A
Japan, 1983 (Miyakawa) Peel	6.7	1.3	5	1 3 7	9.8 15 19 c0.19		TMN602A
Japan, 1983 (Miho-Wase) Pulp	6.7	1.3	5	1 3 4	0.30 0.06 0.10 c0.006		TMN602A
Japan, 1983 (Miho-Wase) Peel	6.7	1.3	5	1 3 4	30 14 9.2 c0.31		TMN602A
Oranges							
Brazil, 1992 (Valencia)		0.12	3	7 28	<u>0.34</u> 0.16	<0.05 <0.05	RJ1478B
Brazil, 1992 (Valencia)		0.24	3	7 28	0.48 0.26	<0.05 <0.05	RJ1478B
Brazil, 1992 (Valencia)		0.12	3	7 28	<u>0.17</u> 0.14	<0.05 <0.05	RJ1478B
Brazil, 1992 (Valencia)		0.24	3	7 28	0.92 0.36	<0.05 <0.05	RJ1478B
Brazil, 1992 (Valencia)	0.5	0.12	3	7 28	0.07 <u>0.10</u>		BR-14-91-S-005-P
Brazil, 1992 (Valencia)	1.0	0.24	3	7 28	0.09 0.10		BR-14-91-S-005-P
Brazil, 1992 (Valencia)	0.5	0.12	3	7 28	<u>0.06</u> 0.02		BR-14-91-S-006-P
Brazil, 1992 (Valencia)	1.0	0.24	3	7 28	0.27 0.11		BR-14-91-S-006-P
Spain, 1991 (Valencia)	6.3	0.13	1	10 20 28	<u>0.40</u> 0.30 0.39	<0.05 <0.05 <0.05	RJ1173B
Spain, 1991 (Valencia)	7.5	0.15	1	10 20 28	<u>1.0</u> 0.56 0.44	<0.05 <0.05 <0.05	RJ1173B

Country (location), year (variety)	Application			PHI, days	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Spain, 1991 (Valencia)	6.3	0.13	1	10 20 28	2.1 1.7 1.5	<0.05 <0.05 <0.05	RJ1173B
Spain, 1991 (Valencia)	7.5	0.15	1	10 20 28	2.7 1.7 1.7	<0.05 <0.05 <0.05	RJ1173B
USA (FL), 1982 (Valencia)	6.7		1	0	0.50	0.12	TMN603B
USA (CA), 1986 (Valencia)	2×9.0 1×5.6		3	0	2.0, 1.5	0.03, 0.02	TMN603B
USA (AZ), 1986 (Valencia)	2×9.0 1×5.6		3	0	2.3, 2.3	0.04, 0.03	TMN603B
USA (CA), 1983 (Navel)	12		2	0	2.7, 2.4	1.8, 1.3	TMN603B
Grapefruit							
USA, (AZ) 1986 (Marsh/Red Blush)	9.0		2	0	2.4 4.2	0.05 0.09	TMN603C

c: control

Table 20. Residues of captan and THPI in apples after foliar applications of various captan formulations and after post-harvest dipping. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Argentina, 1984 (Red Delicious)	WP	7.0	0.16	2	14	0.0005, 0.0003, 0.0004	0.001, 0.0009, 0.0007	R-7108
Australia, 1991 (Granny Smith)	WG		0.12	7 6 5	7 14 27	3.6 3.7 1.0		S38990 91-50
Australia, 1991 (Granny Smith)	WG		0.25	7 6 5	7 14 27	8.1 7.9 2.0		S38990 91-50
Brazil, 1992 (Gala)	SC		0.06	11	1 7	0.06 <0.05	0.10 0.06	RJ1419B
Brazil, 1992 (Gala)	SC		0.12	11	1 7	0.44 0.11	0.11 0.05	RJ1419B
Brazil, 1992 (Gala)	SC		0.24	11	1 7	0.55 0.13	0.20 0.10	RJ1419B
Brazil, 1992 (Gala)	WP		0.06	11	1 7	0.15 0.12	0.11 <0.05	RJ1419B
Brazil, 1992 (Gala)	WP		0.12	11	1 7	0.68 0.38	0.18 0.13	RJ1419B
Brazil, 1992 (Gala)	WP		0.24	11	1 7	1.2 0.31	0.20 0.18	RJ1419B
Brazil, 1992 (Fuji)	SC		0.06	11	1 7	0.14 0.24 c0.08	0.07 0.05 c<0.05	RJ1419B
Brazil, 1992 (Fuji)	SC		0.12	11	1 7	1.0 0.19	0.38 0.08	RJ1419B
Brazil, 1992 (Fuji)	SC		0.24	11	1 7	2.1 0.33	0.53 0.09	RJ1419B
Brazil, 1992 (Fuji)	WP		0.06	11	1 7	1.7 0.14	0.61 <0.05	RJ1419B
Brazil, 1992 (Fuji)	WP		0.12	11	1 7	2.5 0.13	0.55 0.06	RJ1419B
Brazil, 1992 (Fuji)	WP		0.24	11	1 7	4.6 0.30	0.92 0.09	RJ1419B
Brazil, 1992 (Fuji)	SC		0.06	10	1 7	1.0 0.27 c0.13	0.12 0.09 c<0.05	RJ1419B

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Brazil, 1992 (Fuji)	SC		0.12	10	1 7	1.4 0.47	0.12 <0.05	RJ1419B
Brazil, 1992 (Fuji)	SC		0.24	10	1 7	1.7 0.54	0.15 <0.05	RJ1419B
Brazil, 1992 (Fuji)	WP		0.06	10	1 7	3.1 0.22	0.22 0.33	RJ1419B
Brazil, 1992 (Fuji)	WP		0.12	10	1 7	4.1 0.30	0.18 <0.05	RJ1419B
Brazil, 1992 (Fuji)	WP		0.24	10	1 7	5.2 0.45	0.19 0.05	RJ1419B
Canada, 1991 (Macintosh)	WP	3.0	0.13	10	6 13 20	3.2 2.1 2.6	0.08 0.05 <0.05	RJ1190B
Canada, 1991 (Macintosh)	WP	3.0	0.13	10	6 13 20	3.5 3.9 1.7	0.09 0.08 <0.05	RJ1190B
Canada, 1991 (Macintosh)	WP	6.0	0.25	10	6 13 20	4.8 4.2 3.5	0.11 0.09 0.07	RJ1190B
Canada, 1991 (Indared)	WP	3.0	0.13	10	7 14 21	2.9 2.9 1.2	0.05 <0.05 <0.05	RJ1190B
Canada, 1991 (Indared)	WP	3.0	0.13	10	7 14 21	2.9 1.1 2.7	<0.05 <0.05 <0.05	RJ1190B
Canada, 1991 (Indared)	WP	6.0	0.25	10	7 14 21	6.5 2.3 5.4	0.09 0.08 0.08	RJ1190B
Canada, 1991 (Macintosh)	WP	3.0	0.13	10	6 13	4.0 4.5	0.06 0.05	RJ1190B
Canada, 1991 (Macintosh)	WP	3.0	0.13	10	6 13 21	4.1 4.5 4.5	0.07 <0.05 <0.05	RJ1190B
Canada, 1991 (Macintosh)	WP	6.0	0.25	10	6 13 21	9.5 9.1 7.7	0.11 0.08 0.07	RJ1190B
Canada, 1991 (Red Delicious)	WP	3.0	0.13	10	7 14 21	2.8 1.5 0.99	0.05 <0.05 <0.05	RJ1190B
Canada, 1991 (Red Delicious)	WP	3.0	0.13	10	7 14 21	4.2 3.3 2.8	0.06 <0.05 <0.05	RJ1190B
Canada, 1991 (Red Delicious)	WP	6.0	0.25	10	7 7 14 14 21 21	6.9 c0.22 5.5 c0.09 4.8 c0.06	0.10 c<0.05 0.10 c<0.05 0.05 c<0.05	RJ1190B
Chile, 1992 (Granny Smith)	WP	3.6	0.15	1	29 60	0.44 0.13	<0.05 <0.05	RJ1302B
Chile, 1992 (Star King)	WP	3.6	0.15	1	28 59	0.37 0.05	0.06 <0.05	RJ1302B
Chile, 1992 (Granny Smith)	WP	3.6	0.15	1	28 59	0.46 0.15	<0.05 <0.05	RJ1302B
Chile, 1991 (Red King Oregon)	WP		0.13	3	120	0.01, 0.04, 0.02, <0.01	<0.1, <0.1, <0.1, <0.1	R-6986
France, 1997 (Royal Gala)	SC	1.5	0.15	9	0 14	2.6 0.49		R-9675
France, 1997 (Golden)	SC	1.5		9	0 14	3.2 2.1		R-9675
France, 1992 (Golden Delicious)	WDG		0.15	12	0 0	2.8, 5.5, 3.8, 4.0	<0.02 (2) <0.02 (2)	R-7149

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					22 22 44 44	1.6, 1.1, 2.2, 3.8 1.2, 1.0, 1.1, 0.95 c0.10, c<0.02, c<0.02	<0.02 (2) <0.02 (2) <0.02 (2) <0.02 (2) c<0.02 (3)	
France, 1992 (Golden Delicious)	WDG		0.15	10	0 0 ? ? ? ?	5.9, 3.4, 5.3, 3.1 3.1, 3.3, 0.08, 2.7 1.08, 0.61, 1.1, 1.1 c<0.02, c3.4, c0.04	<0.02 (2) <0.02 (2) <0.02 (2) <0.02 (2) <0.02 (2) <0.02 (2) c<0.02 (3)	R-7149
France, 1992 (Golden Delicious)	WDG		0.15	15	0 0 11 11 31 31	3.4, 13, 9.7, 6.8 5.6, 5.5, 4.8, 3.9 2.8, 4.1 3.7, 2.8 c0.11, c0.03, c0.83		R-7149
France, 1992 (Golden Delicious)	WDG		0.15	14	0 0 17 17 36 36	2.1, 4.9, 1.6, 3.3 0.71, 3.0, 1.5, 0.86 1.0, 2.1, 2.2, 0.67 c0.07, c<0.02, c<0.02		R-7149
France, 1991 (Golden)	WP	1.5		16	30 39	3.0 2.4	0.08 0.07	RJ1261B
France, 1991 (Ozark Gold)	WP	1.9		10	29 41	0.12 0.06	<0.05 <0.05	RJ1261B
France, 1991 (Ozark Gold)	WP	1×0.75 9×1.5		10	31 40	0.60 0.37	<0.05 <0.05	RJ1261B
Germany, 1994 (Elstar)	WP	1.9	0.15	15	0 2 3 7 14	5.0 4.3 3.5 4.5 2.3	<0.2 - - - 1.1	R-7784
Germany, 1994 (Cox's Orange)	WP	1.9	0.15	15	0 2 3 7 14	3.1 3.2 3.0, 2.1 2.9, 2.8 2.9, 1.0 2.6	<0.20 - - - 0.83	R-7784
Germany, 1994 (Royal Gala)	WP	1.5	0.15	12	0 2 3 7 14	2.0 2.1 1.4 0.84 0.76	<0.2 - - - 0.36	R-7784
Germany, 1994 (Indared)	WP	1.5	0.15	12	0 2 3 7 14	4.5 4.1 2.0 2.0 1.3	<0.2 - - - 0.43	R-7784
Germany, 1996 (Golden Delicious)	WDG	1.1-1.3	0.12	15	0 7 14 21	2.6 1.4 1.6 <u>1.1</u>	0.79 - 0.77 -	R-9077
Germany, 1996 (Gloster)	WDG	1.2-1.3	0.12	15	0	2.0	1.1	R-9077

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					6 13 20	1.2 1.2 1.0	- 0.63 -	
Germany, 1996 (Golden Delicious)	WDG	1-7-1.8	0.12	13	0 7 14 20 20	2.6, 4.3 3.3 1.3, 3.0 2.2 2.0, 2.4 2.7, 3.0, 2.2, 2.4	2.3 - 2.7 - -	R-9077
Germany, 1993 (Cox's Orange)	WP	1.5	0.5	10	0 3 7 14 20	7.5, 7.0 11, 6.2 9.9, 6.7 2.5 2.3	0.33, 0.35 0.36, 0.42 0.40, 0.45 0.41 0.53	RJ1592
Germany, 1993 (Elstar)	WP	1.5	0.5	10	0 0 3 3 7 13 20	6.3 c0.11 6.6 c0.11 3.2 3.1 1.8	0.25 c<0.05 0.27 c<0.05 0.29 0.28 0.30	RJ1592
Germany, 1993 (Indared)	WP	1.5	0.5	10	0 3 6 13 20	1.6 1.4 1.1 0.82 0.90	0.07 0.06 0.07 0.05 0.09	RJ1592
Germany, 1993 (Cox's Orange)	WDG	1.5	0.5	10	0 3 7 14 20	8.8, 11 10, 7.1 10, 7.9 2.8 2.4	0.31, 0.44 0.32, 0.37 0.38, 0.44 0.45 0.58	RJ1592
Germany, 1993 (Elstar)	WDG	1.5	0.5	10	0 3 7 13 20	5.5 5.3 3.8 4.0 1.7	0.26 0.27 0.27 0.36 0.43	RJ1592
Germany, 1993 (Indared)	WDG	1.5	0.5	10	0 3 6 13 20	2.7 2.6 1.7 1.4 0.99	0.11 0.08 0.08 0.09 0.14	RJ1592
Germany, 1991 (Red King)	WP	1.6		10	0 3 7 14 19	3.1 2.7 4.1 2.7 1.6	0.52 0.44 0.61 0.47 0.23	91JH045F
Germany, 1991 (Red King)	SG	1.6		10	0 3 7 14 19	3.0 4.8 4.5 2.9 2.1	0.53 0.69 0.74 0.49 0.32	91JH045F
Germany, 1991 (Red King)	WP	1.6		12	0 3 7 14 14 20	2.7 5.0 2.0 1.5 c0.03 1.7	0.30 0.42 0.14 0.12 c<0.05 0.17	91JH045F
Germany, 1991 (Red King)	SG	1.6		12	0 3 7 14 14 20	2.8 4.4 2.8 1.8 c0.03 1.4	0.31 0.31 0.17 0.21 c<0.05 0.11	91JH045F
Germany, 1991 (Red King)	WP	1.6		10	0 0	2.3 c0.03	0.24 c<0.05	91JH045F

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					3 7 14 22	2.2 2.0 1.0 0.95	0.26 0.53 0.27 0.21	
Germany, 1991 (Red King)	SG	1.6		10	0 0 3 7 14 22	3.8 c0.03 3.2 2.2 1.2 1.5	0.50 c<0.05 0.50 0.52 0.34 0.33	91JH045F
Germany, 1996 (Golden Delicious)	WP	1.3	0.15	12	0 7 14 21	2.6 1.4 1.6 1.1	0.79 - 0.77 -	R9784
Germany, 1996 (Gloster)	WP	1.3	0.15	12	0 7 14 21	2.0 1.2 1.2 1.0	1.1 - 0.63 -	R9784
Germany, 1996 (Golden Delicious)	WP	1.8	0.15	13	0 7 14 21	3.1 2.6 2.2 1.8	2.3 - 2.7 -	R9784
Hungary, 1992 (Gloster) R-7006	WG	1.6	0.16	9	10	1.2, 1.2, 1.2, 1.5, 1.2		R-7006
Israel, 1991 (Starking)[1]	WP	2.5	0.13	4	0 0 23 23 36 36 83 83	1.6, 1.6, 2.4, 2.5 0.73, 0.85, 0.90, 0.24 0.55, 0.17, 0.50, 0.23 0.89, 0.74, 0.78, 0.39	0.25, 0.36, 0.39, 0.41 0.56, 0.13, 0.10,<0.0 2 <0.02 <0.1 0.22 <0.02 <0.02 <0.02	CT/36/92
Israel, 1991 (Starking)	WP	5	0.25	4	0 0 23 23 36 36 83 83	2.0, 1.9, 2.0, 2.2 0.82, 0.91, 0.85, 0.64 0.57, 0.88, 0.64, 0.14 0.64, 2.0, 1.8, 4.9	0.50, 0.20, 0.31, 0.87 <0.1, <0.1 -, <0.02 <0.1, 0.35, <0.02 (2) <0.02 (2) <0.02 (2)	CT/36/92
Japan, 1971 (Golden)	WP		0.1	4	77	0.06		TMN-575A
Japan, 1971 (Golden)	WP		0.1	8	56	0.08		TMN-575A
Japan, 1972 (Starking)	WP		1.3	13	1 3 5 10	0.02 0.02 0.04 0.01		TMN-575A
Japan, 1992 (Fuji)	WP	8	1.3	8	3 7 14 21	1.7 1.8 1.3 1.8		TMN-575A
Japan, 1992 (Fuji)	WP	8	1.3	8	3 7 14 21	1.6 4.2 2.1 1.5		TMN-575A
Japan, 1991 (Fuji)	WP	8	0.13	8	3 7	10 13	0.23 0.28	RJ1185B

[1] Controls for days 0, 23 and 36 contained captan at >0.4-0.49 mg/kg and THPI at <0.1 to 0.33 mg/kg. It should be noted that captan was sprayed on the plots 26 days before the trial commenced.

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					14 21	4.6 3.5	0.24 0.14	
Japan, 1991 (Fuji)	WP	8	0.13	8	14 21	7.2 5.3	0.32 0.29	RJ1185B
Japan, 1991 (Tsurgaru)	WP	8	0.13	8	14 21	3.8 3.0 c0.09	0.32 0.44 c<0.05	RJ1185B
Netherlands, 1991 (Elstar)	WDG	0.96	0.5	16	0 0 0 7 7 14 14 21 21	2.7, 2.1 1.4, 2.8 c0.16 0.99, 0.59 0.93, 1.2 1.2, 0.93, 0.83, 0.90 1.0, 0.68 0.41, 0.38	0.06, 0.07 0.08, 0.08 c0.12 0.11, 0.13 0.12, 0.11 0.11, 0.09 0.13, 0.16 0.23, 0.13 0.25, 0.13	RJ1115B
Netherlands, 1991 (Elstar)	WP	1.0	0.5	16	0 0 0 7 7 14 14 21 21	1.5, 2.6 1.4, 2.6 c0.16 0.67, 1.7 1.7, 1.1 0.88, 1.1 1.8, 1.4 0.40, 0.54 0.55, 0.37	0.05, 0.05 0.05 <0.05 c0.12 0.13, 0.22 0.20, 0.14 0.12, 0.09 0.16, 0.10 0.15, 0.15 0.14, 0.15	RJ1115B
Netherlands, 1991 (Elstar)	DF	1.1	0.5	16	0 0 0 7 7 14 14 21 21	2.5, 1.3 1.3, 4.0 c0.16 2.3, 2.4 1.0, 1.4 0.85, 1.1 0.86, 1.5 0.84, 0.56 0.66, 0.58	0.06, 0.05 0.05, 0.12 c0.12 0.14, 0.14 0.13, 0.14 0.12, 0.10 0.13, 0.16 0.19, 0.11 0.17, 0.18	RJ1115B
Netherlands, 1991 (Cox)	WDG	0.96	0.5	16	0 0 0 14 14 14 21 21 21	1.8, 1.6 2.2, 1.8 c0.19 0.38, 0.57 1.1, 0.60 c0.18 0.18, 0.12 0.23, 0.26 c0.06	0.13, 0.08 0.14, 0.13 c0.35 0.08, 0.12 0.12, 0.11 c<0.05 0.09, 0.06 0.11, 0.11 c0.06	RJ1115B
Netherlands, 1991 (Cox)	WP	1.0	0.5	16	0 0 0 14 14 21 21 21	3.1, 2.7 2.9, 3.0 c0.19 1.1, 1.3 c0.18 1.0, 0.34 0.48, 0.48 c0.06	0.13, 0.11 0.09, 0.11 c0.35 0.28, 0.15 c<0.05 0.11, 0.14 0.12, 0.13 c0.06	RJ1115B
Netherlands, 1991 (Cox)	DF	1.1	0.5	16	0 0 0 14 14 14 21 21 21	1.2, 1.4 1.3, 1.3 c0.19 0.55, 0.54 1.6, 1.7 c0.18 0.31, 0.63 0.33, 0.77 c0.06	0.12, 0.11 0.12, 0.09 c0.35 0.13, 0.08 0.15, 0.16 c<0.05 0.14, 0.15 0.14, 0.22 c0.06	RJ1115B
Portugal, 1991 (Golden Delicious)	WP	2.4	0.29	10	0 0 10	6.3, 5.1, 6.7, 6.7 2.6, 2.5,	<0.1, <0.1 <0.1, <0.1 <0.1, <0.1	CT/37/92

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					10 21 21	4.4, 2.4 3.1, 2.9, 3.2, 2.5	<0.1, <0.1 <0.1, <0.1 <0.1, <0.1	
South Africa, 1992 (Starking)	SC		0.15	2	0 4 8 16 32 59	4.3 5.0 1.0 1.2 2.1 1.2	0.09 0.14 0.07 0.13 0.06 0.06	RJ1416B
South Africa, 1992 (Granny Smith)	SC		0.08	2	4 8 16 59	2.0 2.0 2.0 0.15	0.13 0.09 0.11 <0.05	RJ1416B
South Africa, 1992 (Granny Smith)	SC		0.15	2	4 8 32 59	3.4 4.0 1.2 0.45	0.14 0.19 <0.05 <0.05	RJ1416B
South Africa, 1992 (Starking)	SC		0.08	2	0 4 8 16 32 59	3.5 2.6 5.3 3.6 0.82 0.17	0.07 0.10 0.13 0.11 <0.05 <0.05	RJ1416B
UK, 1986 (Cox)	WP	2.9	0.29	3	0 14 21	1.5 0.5 0.3	0.2 0.2 0.1	197/AL/86/FF
UK, 1986 (Cox)	WP	2.9	0.29	4	0 14 21	2.5 1.2 0.4	0.2 0.2 0.1	197/AL/86/FF
UK, 1986 (Golden Delicious)	WP	2.9	0.29	4	0 14 21	3.8 1.4 0.4	0.1 0.1 0.1	197/AL/86/FF
UK, 1986 (Cox)	WP	0.66	1.3	5	0 14 21	1.1 0.2 0.3	0.2 0.2 0.1	197/AL/86/FF
UK, 1991 (Cox)	WP	2.7		9	0 14 28 42 56	7.7 2.4 1.4 1.9 1.1	0.19 0.07 0.10 0.07 0.05	RJ1134B
UK, 1991 (Cox)	WP	2.7		3	0 7 21 35	- 6.6 4.4 1.6	- 0.25 0.15 0.07	RJ1134B
UK, 1991 (Cox)	WDG	2.7		9	0 14 28 42 56	4.9 2.5 2.6 0.98 0.31	0.21 0.14 0.09 <0.05 <0.05	RJ1134B
UK, 1991 (Cox)	WP	2.7		10	0 14 28 42 56	6.3 3.1 1.4 0.51 0.38	0.23 0.14 0.07 0.05 <0.05	RJ1134B
UK, 1991 (Cox)	WP	2.7		3	0 7 14 35	- 3.1 2.4 0.42	- 0.11 0.12 0.05	RJ1134B
UK, 1991 (Cox)	WDG	2.7		10	0 14 28 42 56	1.3 0.72 0.33 0.11 0.15	0.07 <0.05 <0.05 <0.05 <0.05	RJ1134B
UK, 1991 (Cox)	WP	2.7		10	0	8.3	0.32	RJ1134B

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					14 14 28 42 42 56	3.9 c0.06 3.3 1.9 c0.07 0.81	0.15 c<0.05 0.17 0.12 <0.05 0.06	
UK, 1991 (Cox)	WP	2.7		3	0 7 14 14 35 42	- 8.7 4.2 c0.06 3.0 c0.07	0 0.46 0.36 c<0.05 0.21 c<0.05	RJ1134B
UK, 1991 (Cox)	WDG	2.7		10	0 14 14 28 42 42 56	4.6 0.91 c0.06 0.58 0.37 c0.07 0.18	0.33 <0.05 c<0.05 <0.05 <0.05 c<0.05 <0.05	RJ1134B
UK, 1990 (Cox)	WP	2.7		9	7 21	4.4 1.3	0.15 0.08	RJ1014B
UK, 1990 (Cox)	WP	2.7		8	12 26 39 53 67	0.45 1.0 0.58 0.24 0.14	<0.05 <0.05 <0.05 <0.05 <0.05	RJ1014B
UK, 1990 (Cox)	WP	2.7		3	7	4.2	0.08	RJ1014B
UK, 1990 (Cox)	WP	1×2.8 7×2.7		8	12 26 39 53 67	2.0 1.1 0.98 0.51 0.22	0.08 <0.05 0.06 <0.05 <0.05	RJ1014B
UK, 1990 (Cox)	WP	2.7		3	6 20 35	4.8 1.1 0.62	0.14 0.09 0.09	RJ1014B
UK, 1990 (Cox)	WP	2.7		8	11 38	2.5 0.68	0.07 <0.05	RJ1014B
UK, 1990 (Cox)	WP	2.7		3	6	0.98	<0.05	RJ1014B
UK, 1990 (Cox)	WDG	2.7		9	7 21	4.3 1.8	0.13 0.09	RJ1014B
UK, 1990 (Cox)	WDG	2.7		8	12 26 39 53 67	3.7 1.0 0.7 0.54 0.11	0.11 <0.05 <0.05 <0.05 <0.05	RJ1014B
UK, 1990 (Cox)	WDG	2.7		8	12 26 39 53 67	2.2 0.85 0.87 0.37 0.21	0.07 0.07 0.07 <0.05 <0.05	RJ1014B
UK, 1990 (Cox)	WDG	2.7		8	11 25 38	1.6 0.69 0.29	<0.05 <0.05 <0.05	RJ1014B
USA (MI) 1990 (Yellow Delicious)	WP	Po 1.5 g/l for 10 sec			0 30	2.2 2.9	<0.05 0.12	RR 91-028B Cold storage at 1°C for 30 days
USA (WV) 1990 (Spartan)	WP	Po 1.5 g/l for 3 min			0 30	6.6 7.8	0.06 0.08	RR 91-028B Cold storage at 1°C for 30 days
USA (MI), 1990 (Yellow Delicious)	WP	3.4		10	41 55 69	0.56 0.40 0.36	<0.05 <0.05 <0.05	RR 92-023B

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					83 97	0.15 0.06	<0.05 <0.05	
USA (WV), 1990 (Spartan)	WP	3.4		10	14 21 28 42 55	1.5 0.87 0.45 0.09 0.06	<0.05 <0.05 <0.05 <0.05 <0.05	RR 92-023B
USA (WA), 1986 (Winter Banana)	WP	13		8	0	9.1, 5.5	0.40, 0.43	051631-D
USA (WA) 1986 (Red Delicious)	WP	4.5		6 ✈	0	0.86, 0.74, 0.42	<0.05 (3)	40189803
USA (WA) 1986 (Red Delicious)	WP	4.5		6[1]	0	2.2, 2.8, 1.9	<0.05 (3)	40189803
USA (WA) 1986 (Red Delicious)	WP	4.5		8	0	5.5, 5.1	0.23, 0.21	056131-C
USA (WA) 1986 (Winter Banana)	WP	4.5		8	0	1.2, 5.2	0.37, 0.76	056131-C
USA (WA) 1986 (Red Delicious)	WP	4.5		7	7 14	5.2, 3.5 2.2, 3.3	0.21, 0.20 0.19, 0.28	056131-C
USA (MI) 1986 (Jonathan)	WP	4.5		8	0 7 14	3.4, 3.9 1.7, 1.3 2.2, 0.64	<0.05 (2) <0.05 (2) <0.05 (2)	056131-C
USA (NY) 1986 (McIntosh)	WP	4.5		8	0 7 14	4.7, 2.8 2.8, 2.5 2.8, 2.1	0.10, 0.09 0.12, 0.12 0.23, 0.10	056131-C
USA (CA), 1986 (Granny Smith)	WP	4.5		8	0	3.8, 4.9 c0.08	0.08, 0.13 c<0.05	056131-C
USA (NC), 1986 (Red Delicious)	WP	4.5		8	0	0.31, 1.5	0.06, 0.05	056131-C
USA (VA), 1986 (Golden Delicious)	WP	4.5		8	0	1.4, 0.41	0.07, ND	056131-C
USA (WA) 1986 (Red Delicious)	WP	8×4.5 + Po 1.5 g/l			0	7.7, 7.0	0.35, 0.28	056131-C
USA (WA), 1986 (Red Delicious)	WP	1.5 g/l Po/CT			0	4.0, 4.0	0.08, 0.09	056131-C
USA (NY), 1986 (McIntosh)	WP	8×4.5 + Po 1.5 g/l			0	5.7, 5.9	0.16, 0.10	056131-C
USA (NY), 1986 (McIntosh)	WP	1.5 g/l Po/CT			0	2.5, 3.3	0.07, 0.10	056131-C

✈ aerial application

[1] dilute spray

Table 21. Residues of captan and THPI in pears after foliar applications of various captan formulations and after post-harvest dipping. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Australia, 1991 (Packham's Triumph)	WG		0.13	5 4 3	6 14 27	2.5 1.9 1.4		S38990 91-48
Australia, 1991 (Packham's Triumph)	WG		0.25	5 4 3	6 14 27	7.1 5.7 1.2		S38990 91-48
Chile, 1992 (Berry Box)	WP	3.6	0.12	1	26 57	1.1 0.10	0.06 <0.05	RJ1303B

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Chile, 1992 (Packams)	WP	3.6	0.12	1	28 60	1.0 0.21	0.05 <0.05	RJ1303B
Chile, 1992 (Winter Nelly)	WP	3.6	0.12	1	30 61	1.3 0.31	<0.05 <0.05	RJ1303B
Germany, 1993 (William Christ)	WP	1.5	0.5	1	0 3 7 14 20	3.8 1.4 1.8 1.3 0.67	0.08 0.05 0.05 <0.05 <0.05	RJ1592
Germany, 1993 (William Christ)	WG	1.5	0.5	1	0 3 7 14 20	3.6 1.8 0.88 1.2 0.23	0.11 0.06 <0.05 <0.05 <0.05	RJ1592
Italy, 1997 (Conference)	WG	2.5-2.7	0.13	8	0 7 14	3.2 2.1 0.81		ERSA-DA-09.10/97
Italy, 1997 (Conference)	WG	2.5-2.7	0.13	8	0 7 14	3.6 2.6 2.0		ERSA-DA-09.10/97
Italy, 1997 (Conference)	WG	2.5-2.7	0.13	6	0 7 14	3.7 2.7 1.2		ERSA-DA-09.10/97
Italy, 1997 (Conference)	WP	2.4-2.6	0.13	8	0 7 14	3.5 2.9 1.1		ERSA-DA-09.10/97
Italy, 1997 (Abate Fetel)	WG	1.8-2.0	0.13	8	0 7 14	2.9 1.6 1.3		ERSA-DA-09.10/97
Italy, 1997 (Abate Fetel)	WG	1.8-2.0	0.13	8	0 7 14	3.1 1.8 2.0		ERSA-DA-09.10/97
Italy, 1997 (Abate Fetel)	WG	1.9-2.0	0.13	6	0 7 14	3.3 1.9 1.6		ERSA-DA-09.10/97
Italy, 1997 (Abate Fetel)	WP	1.7-2.0	0.13	6	0 7 14	3.3 2.4 1.9		ERSA-DA-09.10/97
Italy, 1997 (Abate Fetel)	WG	1.9-2.0	0.13	8	0 7 14	2.0 1.2 0.68		ERSA-DA-09.10/97
Italy, 1997 (Abate Fetel)	WG	1.8-2.1	0.13	8	0 7 14	2.1 0.67 0.59		ERSA-DA-09.10/97
Italy, 1997 (Abate Fetel)	WG	2.0-2.1	0.13	6	0 7 14	2.7 1.9 1.2		ERSA-DA-09.10/97
Italy, 1997 (Abate Fetel)	WP	1.9-2.0	0.13	8	0 7 14	2.5 1.1 0.72		ERSA-DA-09.10/97
Japan, 1988 (Kousui)	WP	6.7	0.13	5	3 7 14	0.68 0.50 0.44 c0.09		TMN-656A
Japan, 1988 (Kousui)	WP	6.7	0.13	7	3 7 14	1.0 0.77 0.62 c0.09		TMN-656A
Japan, 1988 (Kousui)	WP	6.7	0.13	9	3	1.3		TMN-656A

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					7 14	0.99 0.69 c0.09		
Japan, 1988 (Housui)	WP	6.7	0.13	5	3 7 14	6.8 1.8 2.3 c0.04		TMN-656A
Japan, 1988 (Housui)	WP	6.7	0.13	7	3 7 14	5.2 2.6 2.5 c0.04		TMN-656A
Japan, 1988 (Housui)	WP	6.7	0.13	9	3 7 14	6.2 1.8 2.6 c0.04		TMN-656A
South Africa, 1992 (Bon Chretien)	SC	2.1	0.08	2	32 40	<0.05 <0.05	<0.05 <0.05	RJ1417B
South Africa, 1992 (Bon Chretien)	SC	4.2	0.15	2	32 40	0.69 0.74	<0.05 <0.05	RJ1417B
South Africa, 1992 (Packham's Triumph)	SC/WP	2×4.2 SC, 2×4.2 WP	0.10	4	105 112	0.15 0.07	<0.05 <0.05	RJ1417B
UK, 1991 (Conference)	WDG	2.7		9	0 14 28 42 56	13 2.0 1.6 0.51 0.39	0.42 0.08 0.06 <0.05 <0.05	RJ1171B
UK, 1991 (Conference)	WP	2.7		9	0 14 28 42 56	10 2.6 1.7 0.81 0.33	0.36 0.11 0.05 <0.05 <0.05	RJ1171B
UK, 1991 (Conference)	WP	2.7		3	7 21 35	5.5 2.6 0.49	0.18 0.10 <0.05	RJ1171B
UK, 1991 (Comice)	WG	2.7		10	0 14 28 42 56	4.8 1.2 0.62 0.36 0.50	0.17 <0.05 <0.05 <0.05 <0.05	RJ1171B
UK, 1991 (Comice)	WP	2.7		10	0 14 28 42 56	6.5 1.9 1.4 0.89 0.22	0.18 <0.05 <0.05 <0.05 <0.05	RJ1171B
UK, 1991 (Comice)	WP	2.7		3	7 21 35	7.4 6.5 1.7	0.21 0.14 <0.05	RJ1171B
UK, 1990 (Conference)	WG	2.7		9	7 21 35 49 63	9.2 2.6 0.59 1.9 0.47	0.17 <0.05 <0.05 <0.05 <0.05	RJ1003B
UK, 1990 (Conference)	WP	2.7		9	7 21 35 49 63	7.3 3.1 1.4 0.73 0.18	0.14 <0.05 <0.05 <0.05 <0.05	RJ1003B
UK, 1990 (Conference)	WP	2.7		3	7 21 35	7.0 2.4 1.2	0.18 0.10 <0.05	RJ1003B
UK, 1990 (Conference)	WG	2.7		8	12 26 37 51	1.7 1.5 0.74 0.24	<0.05 <0.05 <0.05 <0.05	RJ1003B

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					65	0.12	<0.05	
UK, 1990 (Conference)	WP	2.7		8	37 51 65	1.5 0.54 0.15	<0.05 <0.05 <0.05	RJ1003B
UK, 1990 (Conference)	WP	2.7		3	7 20 34	1.5 0.94 0.23	<0.05 <0.05 <0.05	RJ1003B
USA (WA), 1986 (Bartlett)	WP	4.5		5	0 7 14	4.3, 1.3 2.9, 2.9 1.3, 2.0	<0.05 (2) <0.05 (2) <0.05 (2)	056131-O
USA (CA), 1986 (Bartlett)	WP	4.5		5	0	0.90, 1.6	<0.05 (2)	056131-O
USA (NY), 1986 (Bartlett)	WP	4.5		5	0 7 14	2.9, 1.8 1.6, 1.5 1.5, 1.4	<0.05 (2) <0.05 (2) 0.08, 0.11	056131-O
USA (MI), 1986 (Bartlett)	WP	4.5		5	0	5.4, 5.7	<0.05 (2)	056131-O
USA (WA), 1986 (Bartlett)	WP	5×4.5 + Po dip 1.5 g/l			0	11, 6.1	<0.05 (2)	056131-O
USA (CA), 1986 (Bartlett)	WP	5×4.5 + Po dip 1.5 g/l			0	2.6, 2.9	<0.05 (2)	056131-O
USA (WA), 1986 (Bartlett)	WP	Po dip 1.5 g/l			0	11, 11	0.47, 0.34	056131-O
USA (CA), 1986 (Bartlett)	WP	Po dip 1.5 g/l			0	4.7, 3.0	0.07, 0.06	056131-O
USA (WA), 1978 (Anjou)	WP	6.7	0.12	2	0 1 3 7 14	1.6 1.0 0.5 0.6 0.3	2.3 1.4 0.16 1.3 0.05	TMN-654A
USA (WA), 1978 (Bosc)	WP	6.7	0.12	2	0 1 3 7 14	1.5 1.0 0.5 0.6 0.3	<0.05 <0.05 <0.05 <0.05 <0.05	TMN-654A

Table 22. Residues of captan and THPI in cherries after foliar applications of various captan formulations and after post-harvest dipping. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and used to estimate maximum residue levels.

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Belgium, 1991 (Gorsem-Kreik)	WP	1.9	0.62	2	7	0.88, 0.39		R7025
Canada, 1982 Sweet cherry (Bing)	WP	2.4[1]		7	-0 0 1 2 3 5 7 10 14	2.8 6.7 5.2 2.8 4.6 5.0 4.4 1.9 1.8 c0.01		Northover *et al.* 1986
Canada, 1983 Sweet cherry (Bing)	WP	4.5[1]		5	-0 0 1 2 3 5	4.1 27 9.5 7.9 12 9.8		Northover *et al.* 1986

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					7 11 14	13 4.5 4.3 c0.04		
Canada, 1982 Sour cherry (Montmorency)	WP	3.0	0.1	1	0 1 3 5 8 10 14	17 15 7.6 4.9 4.8 4.3 2.3 c0.18		Northover *et al.* 1986
Canada, 1982 Sour cherry (Montmorency)	WP	3.4[1]		7	-0 0 1 2 3 5 7 10 14	10 13 8.1 6.2 7.0 9.7 8.6 5.5 4.8 c0.02		Northover *et al.* 1986
Canada, 1983 Sour cherry (Montmorency)	WP	3.4[1]		4	-0 0 1 2 3 5 7 11 14	3.5 30 32 19 11 13 8.3 3.0 2.1 c0.01		Northover *et al.* 1986
Germany, 1999 (Edelfinger)	WG	0.57-0.59	0.12	3	0 3 5 7 14	2.6 1.9 0.98 1.1, 0.38 0.69		R11155
Germany, 1999 (Schatten morelle)	WG	0.57-0.59	0.12	3	7 15	0.82 0.08		R11155
Germany, 1999 (Schatten morelle)	WG	0.59-0.64	0.12	3	0 3 5 7 14	5.2 4.0 3.2 2.9 2.5		R11155
Germany, 1999 (Johanna)	WG	0.61-0.62	0.12	3	7 14	3.7 1.7		R11155
Germany, 1975 (Frühe Ludwig)	WP	2.1		5	0 1 3 5	13 12 9.9 1.7		TMN-600B
Germany, 1975 (Schattenmorelle)	WP	2.1		5	0 1 3 5	14 15 8.4 8.4		TMN-600B
Germany, 1975 (Schattenmorelle)	WP	2.1		5	0 1 3 5	8.6 9.0 7.3 5.8		TMN-600B
Japan, 1990 (Takasago)	WP	5.6	0.08	5	14 21	1.5 0.89 c0.005		TMN-601A
Japan, 1990 (Takasago)	WP	7.0	0.1	4	14 21	1.3 0.71 c0.005		TMN-601A

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Japan, 1990 (Takasago)	WP	7.0	0.1	5	14 21	1.7 0.63 c0.005		TMN-601A
Japan, 1990 (Satonishiki)	WP	5.6	0.08	5	14 21	0.69 0.62 c0.006		TMN-601A
Japan, 1990 (Satonishiki)	WP	7.0	0.1	4	14 21	0.66 0.54 c0.006		TMN-601A
Japan, 1990 (Satonishiki)	WP	7.0	0.1	5	14 21	0.77 0.40 c0.006		TMN-601A
Japan, 1990 (Takasago)	WP	5.6	0.08	5	14 21	2.2 0.99 c0.006		TMN-601A
Japan, 1990 (Takasago)	WP	7.0	0.1	4	14 21	1.5 0.89 c0.006		TMN-601A
Japan, 1990 (Takasago)	WP	7.0	0.1	5	14 21	2.3 1.4 c0.006		TMN-601A
Japan, 1990 (Satonishiki)	WP	5.6	0.08	5	14 21	1.2 0.25 c0.01		TMN-601A
Japan, 1990 (Satonishiki)	WP	7.0	0.1	4	14 21	0.78 0.64 c0.01		TMN-601A
Japan, 1990 (Satonishiki)	WP	7.0	0.1	5	14 21	1.5 0.53 c0.01		TMN-601A
Japan, 1991 (Satonishiki)	WP		0.09	5	14 21	0.58 0.38	<0.05 <0.05	RJ1409B
Japan, 1991 (Satonishiki)	WP		0.13	5	14 21	1.3 1.3	<0.05 <0.05	RJ1409B
USA (WA), 1986	WP	Po dip 1.5 g/l			0	3.8, 14	0.09, 0.30	056131-H
USA (WA), 1986	WP	Po dip 1.5 g/l			10	7.3, 5.8	0.15, 0.17	056131-H
USA (WA), 1986	WP	Po dip 1.5 g/l			0	15, 14	0.23, 0.24	056131-H
USA (WA), 1986	WP	7×2.2 + Po dip 1.5 g/l			0	35, 13	0.45, 0.20	056131-H
USA (WA), 1986	WP	7×2.2 + Po dip 1.5 g/l			10	25, 9.2	0.44, 0.35	056131-H
USA (WA), 1986	WP	7×2.2 + Po dip 1.5 g/l			0	2.1, 23	0.15, 0.34	056131-H
USA (WA) 1986 (Lambert)	WP	2.2		7	0	17, 19 c0.61, 0.21	0.22, 0.24 c<0.05 (2)	056131-H
USA (WA) 1986 (Van)	WP	2.2		7	0	14, 14 c1.6, 5.3	0.15, 0.13 c<0.05 (2)	056131-H
USA (MI) 1986 (Montmorency)	WP	2.2		7	0	9.6, 11	0.19, 0.18	056131-H
USA (NY) 1986 (Emperor Francis)	WP	2.2		7	0	12, 10	0.17, 0.15	056131-H
USA (MI), 1976 (Montmorency)	WP	2.2		6	0 1 3 7 12	13 20 15 5.9 4.3		TMN-600C
USA (MI), 1976 (Montmorency)	WP	2.2		6	0 1 3 7	21 11 19 20		TMN-600C

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					12	8.2 c0.1		
USA (MI), 1976 (Montmorency)	WP	1.7		6	0 1 3 7 12	12 14 8.3 5.5 1.9		TMN-600C
USA (MI), 1976 (Montmorency)	WP	1.7		6	0 1 3 7 12	20 16 9.7 16 12 c0.1		TMN-600C
USA (NY), 1977 (Emperor Francis/Napolean)	WP	2.2		7	8	0.92		TMN-600C
USA (IL), 1977 (Montmorency)	WP	2.2		7	1	4.3		TMN-600C
USA (MT), 1980 (Lambert)	WP	2.2		6	1 2 3 7 14	2.4 1.6 2.4 2.2 1.4		TMN-600C
USA (MT), 1980 (Lambert)	WP	2.2		6	0 1 3	5.5 3.4 4.7		TMN-600C
USA (MT), 1980 (Lambert)	WP	2.2		8	1 8	2.3 2.8		TMN-600C

[1] application rate for last spray

Table 23. Residues of captan and THPI in plums after foliar applications of WP formulations. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application			PHI, days	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Chile, 1992 (Roy Sum)	2.9	0.14	1	26 49	0.62, 0.66 <0.05 (2)	<0.05 (4)	RJ1299B
Chile, 1992 (Angelino)	2.9	0.14	1	26 50	0.12, 0.55 0.06 <0.05	<0.05 (4)	RJ1299B
Chile, 1992 (Roy Sum)	2.9	0.14	1	27 48	0.06, 0.11 0.08, 0.05	<0.05 (4)	RJ1299B
Greece, 1999 (Angelino)	2.9-3.1	0.13	4	7 14 21	0.24 0.23 0.13	0.082 0.099 0.070	R9029
Japan, 1988 (Kojyo)	6.7	0.13	3	14 21	0.95 0.81 c0.085		TMN-664A
Japan, 1988 (Kojyo)	6.7	0.13	5	14	3.0 c0.085		TMN-664A
Japan, 1988 (Sagijyuku)	6.7	0.13	3	14 21	1.3 1.8		TMN-664A
Japan, 1988 (Sagijyuku)	6.7	0.13	5	14	3.0		TMN-664A

Country (location), year (variety)	Application			PHI, days	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Portugal, 1999 (Madley)	2.9-3.0	0.2	4	7 14 21	6.7 1.2 0.43	0.66 0.17 0.31	R9029
Spain, 1999 (Golden Japan)	3.0	0.15	4	7 10 21	1.0 0.57 0.67	0.16 0.13 0.13	R9029
Spain, 1999 (Golden Japan)	3.0	0.13	4	7 10 21	1.3 0.85 0.57	0.17 0.18 0.20	R9029
USA (CA), 1975 (Casselman)	3.4	0.12	3	13	<0.05		TMN663B
USA (NY), 1977 (Purple Plum)	3.4	0.12	13	2	0.71		TMN663B
USA (NY), 1978 (Fellenburg)	3.4	0.36	9	0 3 7 10	7.9 4.8 3.4 2.6		TMN663B
USA (CA) 1978 (Queen Anne)	6.7		1	0 1 3 7 14	0.64 0.47 0.31 0.81 0.54	0.67 0.34 0.38 0.60 0.42	TMN663B
USA (CA), 1986 (Black Amber)	3.4		9	0	0.45, 0.14	<0.05 (2)	056131-P
USA (CA), 1986 (Queen Anne)	3.4		9	0	0.42, 0.60	<0.05 (2)	056131-P
USA (MI), 1986 (Stanley)	3.4		9	0 7 14	3.5, 5.6 3.0, 3.4 2.2, 1.5	<0.05 (2) <0.05 (2) <0.05 (2)	056131-P
USA (CA) 1986 (Queen Anne)	10		9	0	4.8, 3.8	<0.05 (2)	056131-P

Table 24. Residues of captan and THPI in apricots after foliar applications of various captan formulations in the USA. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Location, year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
CA, 1986 (Improved Flaming Gold)	WP	2.8		5	0	4.4, 4.5	0.18, 0.21	056131-E
CA, 1986 (Katy)	WP	2.8		5	0	6.6, 5.3	0.10, 0.20	056131-E
CA, 1986 (Castle Bright)	WP	2.8		5	0	5.0, 6.8	0.08, 0.12	056131-E
CA, 1980 (Tilton)	WP	5.6		2	1	3.3, 2.8	0.11, 0.11	TMN-588A
CA, 1978 (Tilton)	WP	6.7		1	0 1 3 7 14	13.4 9.3 13.6 8.3 4.3	<0.05 <0.05 <0.05 0.35 0.24	TMN-588B
CA, 1978 (Golden Amber)	WP	6.7		1	0 1 3 7 14	6.6 4.0 6.0 3.6 2.0	<0.05 <0.05 <0.05 <0.05 <0.05	TMN-588B
CA, 1978	WP	3.4		1	0 1 3 7 14	2.0 2.7 3.3 2.0 1.7 c<0.05	<0.05 <0.05 <0.05 <0.05 <0.05 c0.27	TMN-588B
IL, 1978	WP	1.1		4	7	0.94		TMN-588B
CA, 1975 (Weinburger)	WP/4F	3.4		2	5	1.33		TMN-588B

Table 25. Residues of captan and THPI in nectarines after foliar applications of WP formulations. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application			PHI,	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.	days	Captan	THPI	
Chile, 1992 (Sun Sweet)	2.9	0.14	1	31 53	0.16, 0.22 0.14, 0.10	<0.05 (2) <0.05 (2)	RJ1362B
Chile, 1992 (L.316)	2.9	0.14	1	31 52	0.17, 0.30 0.16, 0.15	<0.05 (2) <0.05 (2)	RJ1362B
Chile, 1992 (Fiar Lane)	2.9	0.14	1	31 52	0.16 0.11	<0.05 <0.05	RJ1362B
Greece, 1999 (Tasty Free)	2.9-3.0	0.13	4	7 14 21	5.6 4.1 1.5	0.66 0.51 0.19	R9028
Greece, 1999 (Arm King)	2.9-3.0	0.13	4	7 14 21 7 14 21	3.1 2.3 0.90 c0.023, c<0.01, c<0.01	0.26 0.41 0.22 c<0.05 c<0.05 c<0.05	R9028
Spain, 1999 (Snow Queen)	2.8-3.0	0.15	4	7 11 21 7 11 21	2.1 1.8 0.62 c0.012, c<0.01, c<0.01	0.36 0.21 0.11 c<0.05 c<0.05 c<0.05	R9028
Spain, 1999 (Snow Queen)	3.0	0.15	4	7 11 21	2.4 1.3 0.43	0.30 0.17 0.11	R9028
Spain, 1991 (Red Globe)	1.6	0.25	1	10 20 28	0.40 0.33 0.17	<0.05 <0.05 <0.05	RJ1172B
Spain, 1991 (Red Globe)	1.9	0.3	1	10 20 28	0.77 0.47 0.18	<0.05 <0.05 <0.05	RJ1172B
USA (CA), 1986 (Spring Red)	2.8		6	0	2.2, 1.5	<0.05 (2)	056131-M
USA (CA), 1986 (Mike Grant)	2.8		6	0	1.3, 1.6	0.06, <0.05	056131-M
USA (CA), 1986 (Snow Queen)	2.8		6	0	3.9, 2.7	0.12, 0.06	056131-M
USA (CA), 1980 (LeGrande)	6.7		9	0 1 3 7 10	10 8.5 6.6 9.7 3.2 c0.03-0.05	0.28 0.32 0.21 0.26 0.20 c0.01	TMN-642

Table 26. Residues of captan and THPI in peaches after foliar applications of various captan formulations and after post-harvest dipping. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application				PHI,	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.	days	Captan	THPI	
Australia, 1991 (Golden Queen)	WP		0.13	5 4 3	6 14 27	4.7 2.8 1.5		S38990-51
Australia, 1991 (Golden Queen)	WP		0.25	5 4	6 14	11 4.8		S38990-51

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
				3	27	3.7		
Canada, 1975 (Redskin)	WP	3.4		2	3	5.5		TMN-648E
Canada, 1975 (Redskin)	WP	2.1		2	1 3 7	6.1 2.6 2.3		TMN-648E
Canada, 1975 (Baby Gold)	WP	2.1		3	1 3 7	4.8 0.82 0.66		TMN-648E
Canada, 1975 (Red Haven)	WP	2.1		2	3	1.8		TMN-648E
Canada, 1975 (Red Haven)	WP	2.1		2	3	1.4		TMN-648E
Canada, 1981 (Red Haven)	WP	3.0[1]	0.1	3	-0 0 1 3 5 7 10	3.0 12 6.5 5.8 6.6 6.1 4.8 c0.06		Northover *et al.* 1986
Canada, 1981 (Garnet Beauty)	WP	3.4[1]		3	-0 0 1 4 7 12 14	1.7 9.9 7.3 2.7 2.2 2.9 1.7		Northover *et al.* 1986
Canada, 1982 (Red Haven)	WP	3.4[1]		3	-0 0 1 2 3 5 7 10 14	1.8 3.4 2.6 2.2 3.0 2.6 1.9 2.9 3.2 c0.02		Northover *et al.* 1986
Canada, 1983 (Red Haven)	WP	3.4[1]		4	-0 0 1 2 3 5 7 10 14	9.6 11 10 12 16 13 11 8.9 2.9 c0.24		Northover *et al.* 1986
Chile, 1992 (Pomona)	WP	2.9	0.14	1	27 50	2.0, 1.7 0.25, 0.27 c0.08	0.06, 0.05 <0.05 (2) c<0.05	RJ1356B
Chile, 1992 (E. Lady)	WP	2.9	0.14	1	24 24 46 46	0.44, 0.43 c0.07 0.32, 0.34 c0.22	<0.05 (2) c<0.05 <0.05 (2) c<0.05	RJ1356B
Chile, 1992 (O'Henry)	WP	2.9	0.14	1	28 50	1.0, 0.24 0.30, 0.31	<0.05 (2) <0.05 (2)	RJ1356B
Italy, 1996 (Weinbercke)	WP	3.0 + 3×1.5	0.25 + 3×0.13	4	0- 0+ 10 20 31	0.08 0.67 0.26 0.19 0.14		ERSA-DA-07/96
Italy, 1996 (Red Haven)	WP	3.7 + 3×1.8	0.25 + 3×0.13	4	0- 0+	0.08 1.1		ERSA-DA-07/96

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					10 20 31 40	1.0 0.95 0.30 0.20		
Italy, 1995 (Suncrest)	WP	3.3 + 3×1.3	0.25+4 ×0.13	5	39	0.11		ERSA-DA-08/95
Italy, 1995 (Michelini)	WP	2.5 + 3×1.3	0.25+3 ×0.13	4	0 10 20 30 40	1.7 1.5 1.0 0.52 0.17		ERSA-DA-09/95
Italy, 1997 (Spring Crest)	WDG	2.6 + 3×1.3	0.26+3 ×0.13	4	0 10 20 30	1.0 0.90 0.05 0.05		ERSA-DA-04/97
Italy, 1997 (Spring Crest)	WP	2.5 + 3×1.3	0.25+3 ×0.13	4	0 10 20 30	1.0 0.81 0.06 0.08		ERSA-DA-04/97
Italy, 1998 (Glohaven)	WG		0.25+3 ×0.13	4	0- 0+ 10 20 30	<0.01 2.1 1.0 0.49 0.23		ERSA-DA-04/98
Italy, 1998 (Glohaven)	WP		0.25+3 ×0.13	4	0- 0+ 10 20 30	<0.01 1.4 1.2 0.71 0.18		ERSA-DA-04/98
Japan, 1975 (Okubo)	WP	8	0.13	8	2 5 10	1.1 (pulp) 1.3 0.30 c0.004		TMN-650A
Japan, 1975 (Okubo)	WP	8	0.13	8	2 5 10	364 (peel) 454 209 c0.25		TMN-650A
Japan, 1975 (Okubo)	WP	4	0.13	8	1 5 10	0.89 (pulp) <0.004 <0.004		TMN-650A
Japan, 1975 (Okubo)	WP	4	0.13	8	1 5 10	82 (peel) 0.18 0.02 c0.14		TMN-650A
Japan, 1981 (Shimizu-Hakuto)	WP	8	0.13	6	1 3 7	0.21 (pulp) 0.20 0.55 c0.005		TMN-650A
Japan, 1981 (Shimizu-Hakuto)	WP	8	0.13	6	1 3 7	50 (peel) 107 97 c0.24		TMN-650A
Japan, 1981 (Hakuto)	WP	5.3	0.13	6	1 3 7	0.35 (pulp) 0.27 0.21 c0.006		TMN-650A
Japan, 1981 (Hakuto)	WP	5.3	0.13	6	1 3 7	70 (peel) 41 57 c0.56		TMN-650A
Spain, 1991 (Spring Crest)	WP	4.7	0.25	3	10 20 28	2.8 2.7 1.8 c0.08	<0.05 <0.05 <0.05 c<0.05	RJ1172B

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Spain, 1991 (Spring Crest)	WP	5.6	0.3	3	10 20 28	3.5 3.5 1.8 c0.08	<0.05 <0.05 <0.05 c<0.05	RJ1172B
USA (CA), 1978 (Red Haven)	WP	6.7	0.12	1	0 1 3 7 14	7.8 6.8 3.6 4.0 2.0	1.0 0.2 0.6 0.14 0.08	TMN-648D
USA (CA), 1986 (Fay)	WP	4.5		8	0	9.9, 14	0.08, 0.18	056131-N
USA (CA), 1986 (Fay Alberta)	WP	4.5		8	0	10, 2.9	0.29, 0.65	056131-N
USA (CA), 1986	WP	Po 1.5 g/l			0	39, 27	0.50, 0.38	056131-N
USA (CA), 1986	WP	8×4.5 + Po 1.5 g/l			0	38, 48	0.61, 0.56	056131-N
USA (GA), 1986 (Red Skin)	WP	Po 1.5 g/l			0	136, 144	1.7, 0.87	056131-N
USA (GA), 1986 (Red Skin)	WP	8×4.5 + Po 1.5 g/l			0	131, 135	2.0, 2.4	056131-N
USA (SC), 1986 (Topaz)	WP	4.5		8	0	7.4, 3.4	<0.05 (2)	056131-N
USA (GA), 1986 (Red Skin)	WP	4.5		8	0	1.4, 2.0 c0.42	<0.05 (2) c<0.05	056131-N
USA (MI), 1986 (Red Haven)	WP	4.5		8	0	5.7, 6.0	<0.05 (2)	056131-N
USA (NY), 1986 (Red Haven)	WP	2.8		8	0	7.7, 9.0	0.25, 0.42	056131-N
USA (WA), 1987 (Elberta)	WP	4.5		6 ✈	0	3.6, 2.5, 4.3	<0.05 (3)	40189814
USA (WA), 1987 (Elberta)	WP	4.5		6	0	5.8, 3.0, 2.8	0.08, 0.07, 0.07	40189814
USA (CA), 1987	WP	4.5		8 ✈	0	4.3, 0.80, 2.6	0.07, <0.05 (2)	40189814
USA (CA), 1987	WP	4.5		8[2]	0	7.8, 6.9, 6.2	0.15, 0.16, 0.16	40189814
USA (CA), 1987	WP	4.5		8[3]	0	11, 12, 12	0.50, 0.33, 0.24	40189814

✈ aerial application

[1] application rate for last spray

[2] concentrated spray

[3] dilute spray

Table 27. Residues of captan and THPI in blueberries after foliar applications of various WP formulations in the USA. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Location, year (variety)	Application			PHI, days	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Maine, 1987	2.8		4	21	0.66	0.00	IR-4 3458
Maine, 1987	2.8		10	0	8.4	0.15	IR-4 3458
WA, 1987 (Jersey)	2.8		3	64	0.67	0.00	IR-4 3458
WA, 1987 (Jersey)	2.8		4	7	3.4	<0.05	IR-4 3458
WA, 1987 (Jersey)	2.8		14	0	18	0.17	IR-4 3458
MI, 1987 (Bluecrop + Jersey)	2.8		3 ✈	0 3 5 7 10	1.7 2.0 0.50 0.31 0.50	<0.05 <0.05 <0.05 <0.05 <0.05	IR-4 3458
MI, 1987 (Bluecrop)	2.8		3 ✈	7	3.3	<0.05	IR-4 3458

Location, year (variety)	Application			PHI, days	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.		Captan	THPI	
				8	2.8	<0.05	
MI, 1987 (Bluecrop)	2.2		4	0 3 5 7 10	8.3 5.5 6.5 2.6 1.8	0.12 0.08 0.06 0.07 <0.05	IR-4 3458
MI, 1987 (Earliblue + Bluecrop)	4.5		4	0 3 5 7 10	23 16 11 8.5 7.2	0.32 0.23 0.15 0.16 0.06	IR-4 3458
MI, 1987 (Earliblue + Bluecrop)	2.8		4	0 3 5 7 10	4.0 5.4 2.4 2.0 1.3	0.07 0.08 <0.05 <0.05 <0.05	IR-4 3458
MI, 1987 (Earliblue + Bluecrop)	2.8		8	0 3 5 7 10	8.2 6.9 6.8 6.1 3.6	0.11 0.09 0.10 0.05 <0.05	IR-4 3458
NJ, 1987 (Elliot)	2.8		6 ✈	1 3 5 7	4.8 4.3 3.5 1.2	<0.05 <0.05 <0.05 <0.05	IR-4 3458
NJ, 1987 (Elliot)	2.8		6	1 3 5 7	11 15 7.1 7.1	0.09 0.14 0.06 0.21	IR-4 3458
NJ, 1984 (Bluecrop)	2.7		5 ✈	0	3.7, 4.8, 2.7, 4.0, 7.1, 5.9	<0.05 (6)	TMN-596
NJ, 1984 (Rubel)	2.7		5 ✈	0	4.2	<0.05	TMN-596
NJ, 1984 (Jersey)	2.7		5 ✈	0	4.0	<0.05	TMN-596
NJ, 1984 (Coville)	2.7		5 ✈	0	3.2	<0.05	TMN-596
NJ, 1987 (Rancocus)	2.7		5 ✈	0	6.9	<0.05	TMN-596
NJ, 1984 (Bluecrop)	2.7		4 ✈	0	3.9	<0.05	TMN-596
NJ, 1984 (Bluecrop)	2.8		3 ✈	0	6.7, 6.9, 6.3, 6.2, 6.0, 3.5, 6.3, 4.8	<0.05 (8)	TMN-596
NJ, 1984	2.7		6 ✈	1	4.0, 6.0, 4.3	<0.05 (3)	TMN-596
OR, 1976 (Highbush)	2.8		4	0	6.5 c1.2		TMN-596

✈ aerial application

Table 28. Residues of captan and THPI in grapes after foliar applications of various captan formulations. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Australia, 1994 (Malbec)	WG		0.10	8	7 14 21	3.6 1.9 1.2	0.09 <0.05 <0.05	R-11122
Australia, 1994 (Malbec)	WG		0.21	8	7 14 21	8.2 3.5 2.6	0.22 0.11 0.10	R-11122

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Australia, 1994 (Grenache)	WG		0.10	3	0 7 14 21	2.0 0.69 1.4 3.4	0.09 0.05 0.05 0.1	R-11122
Australia, 1994 (Grenache)	WG		0.21	3	0 7 14 21	5.9 7.5 4.7 5.0	0.11 0.16 0.11 0.08	R-11122
Brazil, 1995 (Italia)	WP		0.12	4	2 h 12 h 24 h	0.73 0.61 0.78		D3.2.5/62
Brazil, 1995 (Italia)	WP		0.24	4	1	1.19		D3.2.5/62
Brazil, 1994 (Niágara Rosa)	WP	0.96	0.12	5	1	2.5		D3.2.5/63
Brazil, 1994 (Niágara Rosa)	WP	1.9	0.24	5	1	4.6		D3.2.5/63
Chile, 1992 (Red Seedless)	WP	2.4	0.20	2	7 21	9.1 0.19	0.21 <0.05	RJ1374B
Chile, 1992 (Red Seedless)	WP	2.4	0.20	1	7 21	1.6 6.4 c0.10	0.13 0.36 c<0.05	RJ1374B
Chile, 1992 (Thompson Seedless)	WP	2.4	0.20	1	7 21	2.4 6.1 c0.09	0.23 0.11 c0.07	RJ1374B
Chile, 1992 (Thompson Seedless)	WP		0.12-0.13	4	15	18, 12, 25	1.5, 1.2, 1.2	R-6987
France, 1991 (Merlot Noir)	SC	1.8		14	0 0 11 11 20 20 33 33	5.6, 5.4, 2.5, 2.4 7.8, 5.5, 4.8, 2.3 4.2, 1.6 2.2, 0.96 2.9, 2.8 1.1, 0.83		R-6404
France, 1991 (Merlot Noir)	SC	3.5		11	33 33	3.1, 3.0 4.4, 2.5		R-6404
France, 1991 (Grenache)	SC	1.8		7	0 0 10 10 22 22 45 45	3.4, 1.6 3.3, 1.2 0.94, 2.1 1.9, 1.6 0.7, 1.4 1.3, 1.2 0.63, 0.53 1.3, 0.54		R-6404
France, 1991	SC	1.8		7	0 0 10 10 21 21 45 45	2.3, 2.4 2.3, 2.3 1.2, 1.2 2.4, 1.5 0.29, 0.41 0.33, 0.46 0.09, 0.06 0.06, 0.05		R-6404
Germany, 1974 (Bacchus)	WP		0.08	6	0 28 47 77	2.2 0.31 0.11 0.12		BBA TR 1074
Germany, 1974 (Müller-	WP	2.0	0.24	7	3	1.8		BBA KH

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Thurgau)					45	0.28		1074
Germany, 1974 (Müller-Thurgau)	WP	1.6	0.33	7	0 28 42	7.4 1.8 1.4		BBA GE 1074
Germany, 1974 (Müller-Thurgau)	WP		0.08	10	0 21 41	7.0 2.0 0.48		BBA WU 1074
Germany, 1974 (Müller-Thurgau)	WP	1.3	0.33	8	0 28 42 57	8.1 0.74 1.4 0.23		BBA OP 1074
Germany, 1977 (Müller-Thurgau)	WP	1.4	0.35	6	0 14 28 35 50	3.8 4.1 4.1 2.8 2.5		BBA 16684
Germany, 1977 (Müller-Thurgau)	WP		0.09	10	0 14 35 46	13 5.3 4.7 4.3		BBA 13845
Germany, 1977 (Müller-Thurgau)	WP		0.09	10	0 14 35 46	7.2 3.0 3.3 3.0		BBA 13845
Germany, 1977 (Bacchus)	WP	4×1.8 6×2.2	0.09	10	0 14 28 35 47	5.4 4.9 3.7 6.3 2.0		BBA TR 1277
Germany, 1977	WP	1.8	0.09	8	0 14 28 35 55	4.9 1.7 3.3 0.79 0.39		BBA 1377
Germany, 1977 (Müller-Thurgau)	WP	4.0	0.5	7	3 45	14 2.5		BBA 1174 KH
Germany, 1974 (Müller-Thurgau)	WP	5×2.5 2×3.2	5×0.5 2×0.64	7	0 28 42	10 2.2 3.2		BBA GE 1174
Germany, 1974 (Bacchus)	WP		0.13	6	0 28 47 77	18 0.61 <0.02 0.96		BBA TR 1174
Germany, 1990 (Bacchus)	WP	2×1.8, 5×2.7, 1×3.6		8	28	6.5	0.26	RJ1160B
Germany, 1990 (Bacchus)	WP	2×1.8, 4×2.7, 1×3.6		7	36 43	2.2 3.0	0.08 0.12	RJ1160B
Germany, 1990 (Bacchus)	WP	2×1.8, 3×2.7, 1×3.6		6	55 50	1.5 2.4	0.08 0.14	RJ1160B
Germany, 1990 (Portugieser)	WP	2×1.8, 5×2.7, 1×3.6		8	28	2.8	0.08	RJ1160B
Germany, 1990 (Portugieser)	WP	2×1.8, 4×2.7, 1×3.6		7	34 42	1.5, 1.9 1.6	0.09, 0.13 <0.05	RJ1160B
Germany, 1990 (Portugieser)	WP	2×1.8, 3×2.7, 1×3.6		6	49 55	1.6 0.85	<0.05 0.06	RJ1160B
Germany, 1990 (Bacchus)	WP	2×1.8, 5×2.7, 1×3.6		8	28	8.3	0.19	RJ1154B
Germany, 1990 (Bacchus)	WP	2×1.8, 4×2.7, 1×3.6		7	43 36	7.0 4.4	0.24 0.17	RJ1154B
Germany, 1990 (Bacchus)	WP	2×1.8, 3×2.7, 1×3.6		6	55 50	2.8 0.93	0.08 <0.05	RJ1154B
Germany, 1990 (Portugieser)	WP	2×1.8, 5×2.7, 1×3.6		8	28	1.8, 1.5	0.14, 0.13	RJ1154B

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Germany, 1990 (Portugieser)	WP	2×1.8, 4×2.7, 1×3.6		7	42 34	1.4 1.1	0.08 0.09	RJ1154B
Germany, 1990 (Portugieser)	WP	2×1.8, 3×2.7, 1×3.6		6	55 49	0.93 1.1	0.08 0.10	RJ1154B
Germany, 1990 (Riesling)	WP	2×1.8, 5×2.7, 1×3.6		8	28	15	0.35	RJ1154B
Germany, 1990 (Riesling)	WP	2×1.8, 4×2.7, 1×3.6		7	43 36	7.7 9.8	0.34 0.32	RJ1154B
Germany, 1990 (Riesling)	WP	2×1.8, 3×2.7, 1×3.6		6	57 48	7.1 7.4	0.22 0.22	RJ1154B
Germany, 1990 (Weissburgunder)	WP	2×1.8, 5×2.7, 1×3.6		8	30	3.4, 3.7	0.20, 0.25	RJ1154B
Germany, 1990 (Weissburgunder)	WP	2×1.8, 4×2.7, 1×3.6		7	38 43	1.7 1.9	0.15 0.14	RJ1154B
Germany, 1990 (Weissburgunder)	WP	2×1.8, 3×2.7, 1×3.6		6	49 56	1.3 0.79	0.10 <0.05	RJ1154B
Germany, 1991 (Kerner)	WP	7×2.3, 1×2.7		8	0 10 21 26 33	1.5 1.4 0.65 0.59 0.42	<0.05 <0.05 <0.05 <0.05 <0.05	RJ1176B
Germany, 1991 (Kerner)	WG	7×2.3, 1×2.7		8	0 10 21 26 33	2.3 1.1 0.70 0.54 0.46	<0.05 <0.05 <0.05 <0.05 <0.05	RJ1176B
Germany, 1991 (Dornfelder)	WP	7×2.3, 1×2.7		8	0 10 21 29 35	6.3 2.7 2.3 2.2 2.2	0.10 <0.05 <0.05 0.05 0.06	RJ1176B
Germany, 1991 (Dornfelder)	WG	7×2.3, 1×2.7		8	0 10 21 29 35	6.7 4.4 2.2 2.1 3.1	0.09 0.06 <0.05 <0.05 <0.05	RJ1176B
Germany, 1991 (Ortega)	WP	7×2.3, 1×2.7		8	0 10 20 27 33	2.5 1.6 2.4 3.0 1.4	0.07 <0.05 0.05 <0.05 0.06	RJ1176B
Germany, 1991 (Ortega)	WG	7×2.3, 1×2.7		8	0 10 20 27 33	2.9 3.3 2.4 2.2 2.9	0.08 0.07 0.05 0.05 0.08	RJ1176B
Germany, 1991 (Müller-Thurgau)	WP	7×2.3, 1×2.7		8	0 10 21 26 35	6.0 3.0 2.0 2.1 1.3	0.06 <0.05 <0.05 <0.05 <0.05	RJ1176B
Germany, 1991 (Müller-Thurgau)	WG	7×2.3, 1×2.7		8	0 10 21 26 35	2.9 3.1 2.2 2.6 1.8	0.07 0.06 <0.05 <0.05 <0.05	RJ1176B
Germany, 1994	WP/ WG	2.3			0 7 14 20 27	6.3 5.2 4.4 4.7 4.8	0.12 0.11 0.22 0.13 0.20	AZ26686/94
Germany, 1994	WP/ WG	2.3			0 7 14	5.4 6.8 3.6	0.20 0.19 0.13	AZ26686/94

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					21 28	2.5 4.4	0.08 0.12	
Germany, 1994 (White grapes)	WP/ WG	2.3			0 7 14 21 28	6.0 5.6 6.9 4.8 5.6	0.39 0.59 0.51 0.28 0.71	AZ27150/94
Germany, 1994 (Red grapes)	WP/ WG	2.3			0 7 14 21 28	10 7.1 8.2 8.5 8.4	0.36 0.53 0.25 0.30 0.59	AZ27150/94
Japan, 1971 (Delaware)	WP	2.5	0.1	3	23	0.43		TMN-621A
Japan, 1971 (Delaware)	WP	2.5	0.1	5	15	0.46		TMN-621A
Japan, 1973 (Delaware)	WP	3	0.1	3	27	0.65		TMN-621A
Japan, 1973 (Delaware)	WP	3	0.1	5	13	1.6		TMN-621A
Japan, 1987 (Kyoho)	WP	3	0.1	2	3 7 14 21	3.9 1.6 3.5 2.1		TMN-621A
Japan, 1987 (Kyoho)	WP	3	0.1	3	3 7 14 21	5.7 5.5 3.2 3.7		TMN-621A
Japan, 1987 (Kyoho)	WP	3	0.1	5	3 7 14 21	4.5 3.6 3.0 3.7		TMN-621A
Japan, 1987 (Kyoho)	WP	3	0.1	2	3 7 14 21	3.4 1.9 2.8 2.2 c0.04		TMN-621A
Japan, 1987 (Kyoho)	WP	3	0.1	3	3 7 14 21	5.3 3.2 3.4 3.5		TMN-621A
Japan, 1987 (Kyoho)	WP	3	0.1	5	3 7 14 21	4.7 5.3 4.3 3.0		TMN-621A
Japan, 1987 (Delaware)	WP	2.5	0.1	2	3 7 14 21	3.7 2.5 2.0 1.7 c0.02		TMN-621A
Japan, 1987 (Delaware)	WP	2.5	0.1	3	3 7 14 21	3.4 2.3 2.6 1.7		TMN-621A
Japan, 1987 (Delaware)	WP	2.5	0.1	5	3 7 14 21	5.4 4.8 3.4 3.3		TMN-621A
Japan, 1988 (Delaware) INDOOR	WP	3	0.1	2	14 21 30	3.9 2.6 2.4 c0.04		TMN-621A
Japan, 1988 (Delaware) INDOOR	WP	3	0.1	3	14 21 30	4.4 6.1 6.3		TMN-621A

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Japan, 1988 (Delaware) INDOOR	WP	3	0.1	5	14 21 30	9.2 11 7.7		TMN-621A
Japan, 1988 (Delaware)	WP	3	0.1	2	14 21 30	5.7 3.7 2.9 c0.04		TMN-621A
Japan, 1988 (Delaware)	WP	3	0.1	3	14 21 30	7.1 8.5 7.1		TMN-621A
Japan, 1988 (Delaware)	WP	3	0.1	5	14 21 30	7.8 9.4 9.7		TMN-621A
Japan, 1988 (Black Olympia) INDOOR	WP	3	0.1	2	14 21 30	3.8 2.8 1.8		TMN-621A
Japan, 1988 (Black Olympia) INDOOR	WP	3	0.1	3	14 21 30	2.5 1.2 1.9		TMN-621A
Japan, 1988 (Black Olympia) INDOOR	WP	3	0.1	5	14 21 30	3.6 2.7 2.1		TMN-621A
Japan, 1988 (Kyoho) INDOOR	WP	3	0.1	2	14 21 30	1.0 0.52 0.64 c0.13		TMN-621A
Japan, 1988 (Kyoho) INDOOR	WP	3	0.1	3	14 21 30	0.69 0.88 0.79		TMN-621A
Japan, 1988 (Kyoho) INDOOR	WP	3	0.1	5	14 21 30	2.7 2.6 1.1		TMN-621A
Japan, 1991 (Kyohou)	WP	3		5	14 21	5.8 3.8	0.08 0.08	RJ1177B
Japan, 1991 (Kyohou)	WP	3		3	14 21	1.1 3.2	<0.05 0.06	RJ1177B
Japan, 1991 (Kyohou)	WP	3		5	14 21	14 13 c0.17	0.27 0.25 c<0.05	RJ1177B
Japan, 1991 (Kyohou)	WP	3		3	14 21	12 11 c0.17	0.24 0.15 c<0.05	RJ1177B
Japan, 1991 (Kyohou)	WP	3		5	14	6.1	0.21	RJ1177B
Japan, 1991 (Kyohou)	WP	3		4	21	2.9	0.08	RJ1177B
Japan, 1991 (Kyohou)	WP	3		5	14	6.1	0.19	RJ1177B
Japan, 1991 (Kyohou)	WP	3		4	21	4.7	0.27	RJ1177B
USA (PA), 1989 (Concord)	WP	2.2		6	36	0.44	<0.05	RR 92-007B
USA (NY), 1987 (Catawba)	WP	2.2		6	0	8.0 8.4 8.0	0.21 0.22 0.25	40189811
USA (NY), 1987 (Catawba)	WP	2.2		6	0	3.5 2.2 2.1	0.07 <0.05 <0.05	40189811
USA (WA), 1989 (Concord)	WP	2.2		2 3 4	76 67 57	0.07 0.17 0.24	<0.05 <0.05 <0.05	RR 90-379B
USA (NY) 1989 (Catawba	WP	2.2		2 3 4	103 90 78	<0.05 <0.05 <0.05	<0.05 <0.05 <0.05	RR 90-379B
USA (PA) 1989 (Concord	WP	2.2		2	90	<0.05	<0.05	RR 90-379B

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
				3 4	80 73	<0.05 <0.05	<0.05 <0.05	
USA (MI) 1989 (Concord)	WP	2.2		2 3 4	116 96 84	<0.05 <0.05 <0.05	<0.05 <0.05 <0.05	RR 90-379B
USA (CA), 1989 (Thompson Seedless)	WP	2.2		2 3 4	136 118 104	0.17 0.94 0.10	<0.05 <0.05 <0.05	RR 90-379B
USA (WA), 1986	WP	2.2		6	0	0.93, 1.3	<0.05 (2)	056131-K
USA (CA), 1986 (Thompson Seedless)	WP	2.2		6	0	11, 22	0.20, 0.28	056131-K
USA (CA), 1986 (Emperor)	WP	2.2		6	0	7.4, 5.8	<0.05 (2)	056131-K
USA (CA), 1986 (Emperor)	WP	2.2		6	0	3.7, 1.3, 1.3	<0.05 (3)	056131-K
USA (NY), 1986 (Aurora)	WP	2.2		6	0	7.1, 7.2, 6.4	0.19, 0.11, 0.14	056131-K
USA (NY), 1986 (Concord)	WP	2.2		6	0	6.4, 4.8, 4.2	0.14, 0.19, 0.18	056131-K
USA (MI), 1986 (Concord)	WP	2.2		6	0	11, 8.1	0.14, 0.12	056131-K

Table 29. Residues of captan and THPI in raspberries after foliar applications of a captan WP formulation in the USA. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Location, year (variety)	Application			PHI, days	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.		Captan	THPI	
OR, 1990 (Meeker)	1.1-1.8 (last 1.1)		9	0 7	5.6 2.1	0.49 0.16	IR-4 3953
OR, 1990 (Meeker)	1.8	0.15	9	0 7	5.7 1.1	0.37 0.12	IR-4 3953
WA, 1990 (Meeker)	3.3-5.5 (last 3.3)	0.24	10	0 7	36 16	2.1 0.89	IR-4 3953
WA, 1990 (Meeker)	5.6	0.24	10	0 7	38 23	1.7 1.2	IR-4 3953
OR, 1991 (Meeker)	2.8-3.4 (last 2.8)	0.3-0.4	11	0 7	11, 11 8.3, 7.8	0.50, 0.42 0.31, 0.41	IR-4 3953b
OR, 1991 (Meeker)	2.8-3.4 (last 2.8)	0.3-0.4	10	3	6.7, 7.2	0.19, 0.23	IR-4 3953b
WA, 1991 (Willamette)	2.8	0.67	7	0 3 7	37, 24 20, 38 18, 18	1.0, 0.50 0.53, 0.55 1.0, 1.1	IR-4 3953b
WA, 1992 (Willamette)	2.3	0.54	5	3	12, 12, 13, 13	0.65, 0.42, 0.49, 0.54	IR-4 A3953
WA, 1992 (Willamette)	2.8	0.67	5	3	17, 14, 16, 13	0.38, 0.45, 0.27, 0.37	IR-4 A3953
WA, 1995 (Meeker)	2.3	0.25	6	3	8.3, 6.8	0.56, 0.42	IR-4 B3953
OR, 1995 (Meeker)	2.3	0.24	6	3	7.7, 7.4	0.43, 0.44	IR-4 B3953
PA, 1995 (Titan)	2.3	0.49	6	3	18, 13	0.86, 0.59	IR-4 B3953

Table 30. Residues of captan and THPI in strawberries after foliar applications of various captan formulations. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Australia, 1991 (Promise)	WP	3.0		5	1 2 3	6.9 6.6 7.9		S38990 91-49
Australia, 1991 (Promise)	WP	6.0		5	1 2 3	20 12 12		S38990 91-49
Belgium, 1991 (Elsanta)	WP	1.3	0.13	8	0 0 4 4 7 7	1.9, 1.7 1.8, 2.6 1.7, 1.9 2.3, 2.4 0.96, 1.3 1.1, 1.1		RIC1800
Belgium, 1999 (Elsanta) INDOOR	WG	1.2	0.12	2	14	0.18		R11136
Belgium, 1999 (Elsanta) INDOOR	WG	1.2	0.12	2	14	0.13		R11136
Chile, 1991 (Selva)	WP	3.2		1	3 7	3.8, 3.3 3.4, 4.2	0.65, 0.67 0.22, 0.23	RJ1367B
Chile, 1991 (Chandler)	WP	3.2		1	3 7	2.1, 3.0 2.9, 3.8 c<0.05	0.55, 0.73 0.39, 0.39 c0.07	RJ1367B
Chile, 1991 (Pajaro)	WP	3.2		1	3 7	3.3, 4.8 1.9, 2.7 c0.07	0.46, 0.44 0.19, 0.25 c<0.05	RJ1367B
Germany 1961 (Senga-Sengana)	WP	0.75	0.13	1	0 3 7 14	1.8 1.0 0.7 0.4		BBA
Germany 1962 (Senga-Sengana)	WP	0.75	0.13	1	0 3 7 14	2.2 2.0 1.1 0.05		BBA
Germany 1964	WP	1.3	0.13	2	-10 -1 8	0.5 <0.1 <0.1		BBA CPT 1/1964
Hungary, 1991 (Gorella)	WP	1.3		3	-0 -0 0 0 5 5 10 10 10 10	1.1, 2.9 2.3, 1.8 7.4, 6.9 5.1, 8.4 2.2, 3.2 2.2, 3.3 0.65, 0.83 0.79, 0.93 0.70, 0.88 0.86	<0.1, <0.1 <0.1, <0.1 <0.2, <0.2 <0.1, <0.2 <0.1, <0.1 <0.1, <0.1 <0.1, <0.1 <0.1, <0.1 <0.1, <0.1 <0.1	CT/42/92
Israel, 1991 (Dorit) under plastic tunnels	WP	1.3	0.18	3	0 0 17 17 24 24 31 31	3.6, 1.6 3.7, 2.8 1.5, 1.3 1.3, 2.4 0.69, 0.94 0.86, 1.2 0.48, 0.67 2.7, 0.69	<0.2, <0.2 <0.2, <0.1 <0.1, <0.1 <0.1, <0.1 <0.1, <0.2 <0.2, <0.1 <0.1, <0.1 <0.1, <0.1	CT/38/92 Control samples contaminated
Israel, 1991 (Dorit) under plastic tunnels	WP	2.5	0.18	3	0 0 17 17 24	8.0, 8.5 3.7, 4.0 2.4, 2.1 3.0, 1.6 22, 4.4	<0.2, <0.2 <0.2, <0.1 <0.1, <0.1 <0.1, <0.1 <0.1, <0.2	CT/38/92 Control samples contaminated

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					24 31 31	2.1, 2.6 1.4, 1.5 1.6, 3.0	<0.2, <0.1 <0.1, <0.1 <0.1, <0.1	
Netherlands, 1999 (Elsanta) INDOOR	WG	1.2	0.12	2	14	0.25		R11136
Netherlands, 1999 (Elsanta) INDOOR	WG	1.2	0.12	2	14	0.07		R11136
Spain, 1992 (Pájaro)	WP		0.15	4	0 0 12 12 21 21	0.17, 0.16 0.08, 0.24 0.01, 0.04 0.01 <0.01 ≤0.01 (2) <0.01 (2)	0.43, 1.5 1.2, 3.1 0.93, 0.09 0.15, 0.10 0.10 <0.01 <0.01 0.15	FRESA SP 92
USA (FL), 1993 (Oso Grande)	WP	3.4		8	2	3.9, 5.0, 4.6	0.70, 0.86, 0.79	056131-A
USA (FL), 1993 (Oso Grande)	WP	3.4		8+8	2	2.0, 2.2, 2.4	0.43, 0.32, 0.32	056131-A
USA (FL), 1993 (Oso Grande)	WP	3.4		8+8 +8	2	2.0, 1.4, 1.6	0.46, 0.38, 0.54	056131-A
USA (FL), 1993 (Sweet Charlie)	WP	3.4		8	2	6.6, 6.3, 6.1	0.59, 0.42, 0.34	056131-A
USA (FL), 1993 (Sweet Charlie)	WP	3.4		8+8	2	3.8, 3.0, 3.4	0.60, 0.54, 0.57	056131-A
USA (FL), 1993 (Sweet Charlie)	WP	3.4		8+8 +8	2	2.7, 1.8, 3.0	0.62, 0.57, 0.65	056131-A
USA (CA), 1985	WP	3.4		12	0	10, 7.2	0.34, 0.29	TMN-684A
USA (OR), 1985 (Hood)	WP	3.4		12	0	8.7, 8.6	0.23, 0.26	TMN-684A
USA (CA), 1985	WP	3.4		12	0	12, 6.7	0.90, 0.64	TMN-684A
USA (WA), 1986	WP	3.4		7	0	3.6, 4.4	0.15, 0.22	056131-V
USA (CA), 1986 (Driscoll)	WP	3.4		8	0	12, 12, 9.5	1.4, 1.4, 1.2	056131-V
USA (CA), 1986 (Tuft)	WP	3.4		8	0	5.4, 4.9, 4.8	0.53, 0.51, 0.83	056131-V
USA (FL), 1986 (Chandler)	WP	3.4		6	0	1.6, 2.0	0.14, 0.15	056131-V
USA (FL), 1986 (Chandler)	WP	3.4		7	0	1.5, 2.6	0.08, 0.19	056131-V
USA (MI), 1986 (Holiday)	WP	3.4		8	0	3.9, 3.0	0.50, 0.43	056131-V
USA (NC), 1986 (Apollo)	WP	3.4		8	0	7.2, 7.7	0.25, 0.30	056131-V
USA (CA), 1987 (Pajaro)	WP	4.5		6 ✈	0	15, 13, 8.9	0.39, 0.69, 0.22	40189822
USA (CA), 1987 (Pajaro)	WP	4.5		6[1]	0	0.84, 0.60, 1.0	0.08, 0.08, 0.09	40189822
USA (CA), 1987 (Pajaro)	WP	4.5		6[2]	0	13, 8.1, 8.9, 6.4	0.61, 0.48, 0.54, 0.42	40189822

✈ aerial application

[1] concentrated spray

[2] dilute spray

Table 31. Residues of captan and THPI in melons after foliar applications of various captan formulations. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application			PHI,	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.	days	Captan	THPI	
Japan, 1989 (Muskmelon, Andes) INDOOR	4.0	0.2	5	1 3 7 14	<0.005 <0.005 <0.005 ≤0.005		TMN-636A

Country (location), year (variety)	Application			PHI,	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.	days	Captan	THPI	
Japan, 1989 (Muskmelon, Andes) INDOOR	4.0	0.2	7	1 3 7 14	<0.005 <0.005 <0.005 <0.005		TMN-636A
Japan, 1989 (muskmelon, Sunday-Akifuyu) INDOOR	4.0	0.2	5	1 3 7 14	<0.005 0.006 <0.005 <0.005		TMN-636A
Japan, 1989 (muskmelon, Sunday-Akifuyu) INDOOR	4.0	0.2	7	1 3 7 14	0.006 0.008 <0.005 <0.005		TMN-636A
Japan, 1989 (muskmelon, Andes) INDOOR	4.0	0.2	5	1 3 7 14	<0.005 <0.005 <0.005 <0.005		TMN-636A
Japan, 1989 (muskmelon, Andes) INDOOR	4.0	0.2	7	1 3 7 14	<0.005 <0.005 <0.005 <0.005		TMN-636A
Japan, 1989 (muskmelon, Sunday-Akifuyu) INDOOR	4.0	0.2	5	1 3 7 14	<0.005 <0.005 <0.005 <0.005		TMN-636A
Japan, 1989 (muskmelon, Sunday-Akifuyu) INDOOR	4.0	0.2	7	1 3 7 14	<0.005 0.006 <0.005 <0.005		TMN-636A
Japan, 1991 (muskmelon, Andes)	4.0	0.25	5 4	14 21	4.6 3.0	0.35 0.22	RJ1427B
Japan, 1991 (muskmelon, Andes)	4.0	0.25	5 4	14 21	4.0 2.9	0.26 0.12	RJ1427B
Japan, 1991 (muskmelon, Arseinu-Natsu II)	4.0	0.25	5 4	14 21	3.6 1.8	0.32 0.23	RJ1427B
Japan, 1991 (muskmelon, Arseinu-Natsu II)	4.0	0.25	5 4	14 21	4.1 3.9	0.22 0.34	RJ1427B
USA (CA), 1986 (cantaloupe, Imperial Valley)	2.2		7	0	1.6, 2.0	0.13, 0.15	056131-G
USA (CA), 1986 (cantaloupe, Burpee Hybrid)	2.2		7	0	1.7, 2.9 c0.08	0.29, 0.22 c<0.05	056131-G
USA (FL), 1986 (cantaloupe, Asgrow-Summet)	2.2		7	0	0.25, 0.56	0.27, 0.38	056131-G
USA (MI), 1986 (cantaloupe, Star Trek)	2.2		7	0	0.52, 0.30	0.15, 0.10	056131-G
USA (TX), 1986 (cantaloupe, Aurora)	2.2		7	0	0.29, 0.17	0.10, 0.06	056131-G
USA (CA), 1987 (cantaloupe, SJ45)	2.2		7 ✈	0	1.6, 1.7, 1.8	<0.05 (3)	056131-G
USA (CA), 1987 (cantaloupe, SJ45)	2.2		7[1]	0	4.3, 6.7, 6.4	0.11, 0.16, 0.17	056131-G
USA (CA), 1985 (cantaloupe, SJ45)	2.2		6	0	0.74, 1.1	0.03, 0.05	TMN-634A
USA (FL), 1985 (cantaloupe, Gold Star)	2.2		9	0	0.35, 0.36	0.07, 0.09	TMN-634A
USA (FL), 1978 (watermelon/Dixie Lee)	2.2		6	6	<0.01, <0.01		T-4619

✈ aerial application
[1] dilute spray

Table 32. Residues of captan and THPI in cucumbers after foliar applications of captan. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Brazil, 1995 (Caipira Safira)	WP		0.11	4	1	0.16		5.214-95003719
Brazil, 1995 (Caipira Safira)	WP		0.22	4	1	0.22		5.214-95003719
Brazil, 1994 (Safira)	WP		0.11	4	0.08 0.5 1	0.06 0.04 0.06		5.214-192/95
Brazil, 1994 (Safira) 5.214-192/95	WP		0.22	4	1	0.13		5.214-192/95
Japan, 1969 (Ohtone-1) INDOOR	WP	1.5	0.13	3	1 3 7 10	1.9 1.9 1.1 0.77		TMN-609B
Japan, 1969 (Ohtone-1) INDOOR	WP	1.5	0.13	6	1 3 7 10	1.9 1.1 1.1 0.56		TMN-609B
Japan, 1969 (Yamashiro)	WP		0.13	3	1 3 7 10	0.24 0.06 <0.01 <0.01		TMN-609B
Japan, 1969 (Yamashiro)	WP		0.13	6	1 3 7 10	0.20 0.05 <0.01 <0.01		TMN-609B
Japan, 1969 (Shinko-A)	WP	5	1.3	3	1 3 7 10	1.5 0.45 0.19 0.08		TMN-609B
Japan, 1969 (Shinko-A)	WP	5	1.3	6	1 3 7 10	1.2 0.42 0.19 0.04		TMN-609B
USA (WA), 1986	WP	2.2		6	0	8.7, 10	0.60, 0.51	056131-J
USA (CA), 1986 (Marketmore)	WP	2.2		6	0	3.8, 1.7	0.15, 0.18	056131-J
USA (FL), 1986 (Surecrop)	WP	2.2		6	0	0.07, 0.06	<0.05 (2)	056131-J
USA (NJ), 1986 (Lemon cucumber)	WP	2.2		6	0	7.1, 0.11	0.08, 0.08	056131-J
USA (TX), 1986 (Sprint)	WP	2.2		6	0	0.99, 0.82	0.07, 0.07	056131-J
USA (CA), 1985	WP	2.2		6	0	0.03, 0.10	<0.01, 0.02	TMN-609A
USA (FL), 1985 (Poinsett)	WP	2.2		6	0	0.42, 0.61	0.03, 0.07	TMN-609A
USA (NY), 1985 (Marketmore 76)	WP	2.2		7	0	1.2, 0.91	0.13, 0.11	TMN-609A

Table 33. Residues of captan and THPI in squash after six foliar applications of a WP formulation in the USA. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately.

Location, year (variety)	Application, kg ai/ha	PHI, days	Residues, mg/kg		Ref.
			Captan	THPI	
CA,1985	2.2	0	0.12, 0.14	0.11, 0.07	TMN-683

Location, year (variety)	Application, kg ai/ha	PHI, days	Residues, mg/kg		Ref.
			Captan	THPI	
FL, 1985 (summer squash, Seneca zucchini)	2.2	0	0.26, 0.68	0.07, 0.10	TMN-683
NY, 1985 (squash, Ambassador)	2.2	0	1.1, 1.4	0.11, 0.14	TMN-683
USA, 1985	2.2	6	<0.01		TMN-683

Table 34. Residues of captan and THPI in tomatoes after foliar applications of various WP formulations. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application			PHI days	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.		Captan	THPI	
Brazil, 1991 (Santa Clara)		0.12	8	1 7	0.46 0.34	0.27 0.12	RJ1435B
Brazil, 1991 (Santa Clara),		0.24	8	1 7	0.81 0.57	0.31 0.21	RJ1435B
Brazil, 1991 (Santa Clara)		0.12	8	1 7	0.12 0.08	0.09 0.07	RJ1435B
Brazil, 1991 (Santa Clara)		0.24	8	1 7	0.27 0.18	0.16 0.10	RJ1435B
Brazil, 1991 (Santa Clara)		0.12	8	1 7	0.18 0.13	0.08 0.06	RJ1435B
Brazil, 1991 (Santa Clara)		0.24	8	1 7	0.64 0.29	0.13 0.08	RJ1435B
Brazil, 1993 (Santa Clara)		0.12	10	1 2	<0.01 0.02		
Brazil, 1993 (Santa Clara)		0.24	10	1 2	0.05 0.03		
Greece, 1991 (Star Pack)	0.5		1	1 7 15 22 28	0.38, 0.26 <0.05 <0.05 <0.05 1.9, <0.05 c0.59, c<0.05	0.07, 0.07 0.08, 0.07 <0.05 <0.05 0.47 <0.05 c0.27, c<0.05	RJ1189B
Greece, 1991 (Rio Grande)	0.5		1	1 7 15 22 28	0.11, 0.43 0.07, 0.09 <0.05 <0.05 1.4, 2.2 c0.78, 1.6	<0.05 <0.05 <0.05 <0.05 0.21, 0.30 c0.29, 0.46	RJ1189B
Greece, 1991 (Troyan)	1.0		1	1 7 14 21 28	0.61 0.21 0.17 <0.05 0.13	<0.05 <0.05 <0.05 <0.05 <0.05	RJ1189B
Greece, 1991 (Troyan)	1.0		1	1 7 14 21 28	0.15 <0.05 <0.05 <0.05 <0.05	<0.05 <0.05 <0.05 <0.05 <0.05	RJ1189B
Israel, 1991	1.3		8	0 4 11	0.21 0.11 0.07		CT/40/92
Israel, 1991	2.5		8	0 4 11	0.32 0.20 0.07		CT/40/92
Japan, 1969 (Fukujyu) INDOOR	2.3	0.13	3	1 3 7 14	0.40 0.34 0.20 0.17		TMN-649A
Japan, 1969 (Fukujyu) INDOOR	2.3	0.13	6	1	1.1		TMN-649A

Country (location), year (variety)	Application			PHI	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.	days	Captan	THPI	
				3 7 14	0.81 0.25 0.20		
Japan, 1969 (Hikari) INDOOR	3.8	0.13	3	1 3 7 14	0.28 0.45 0.23 0.19		TMN-649A
Japan, 1969 (Hikari) INDOOR	3.8	0.13	6	1 3 7 14	0.78 0.52 0.53 0.27		TMN-649A
Japan, 1969 (Hokan-2)		0.13	3	1 3 7 14	0.22 0.13 0.07 <0.01		TMN-649A
Japan, 1969 (Hokan-2)		0.13	6	1 3 7 14	0.29 0.16 0.07 0.01		TMN-649A
Japan, 1969 (Hikari)	2.5	0.13	3	1 3 7 14	0.41 0.76 0.36 0.21		TMN-649A
Japan, 1969 (Hikari)	2.5	0.13	6	1 3 7 14	0.21 0.79 0.27 0.31		TMN-649A
Japan, 1969 (Super Hokan)		0.13	3	1 3 7 14	0.28 0.11 0.02 0.01		TMN-649A
Japan, 1969 (Super Hokan)		0.13	6	1 3 7 14	0.45 0.13 0.07 0.03		TMN-649A
Japan, 1969 (Fukujyu)		0.13	3	1 3 7 14	2.3 1.1 0.28 0.39		TMN-649A
Japan, 1969 (Fukujyu)		0.13	6	1 3 7 14	1.7 0.87 0.62 0.49		TMN-649A
Japan, 1969 (Fukujyu)	2.3	0.13	3	1 3 7 14	0.40 0.61 0.30 0.20		TMN-649A
Japan, 1969 (Fukujyu)	2.3	0.13	6	1 3 7 14	0.50 0.29 0.22 0.38		TMN-649A
Japan, 1969 (Hikari)	1.9	0.13	3	3 7 14	1.0 0.42 0.27		TMN-649A
Japan, 1969 (Hikari)	1.9	0.13	6	3 7 14	0.66 0.41 0.21		TMN-649A
Mexico, 1992 (Peto 2)	1.5		3	7 14	0.37 <0.05	0.18 <0.05	RJ1431
Mexico, 1992 (Rio Grande), 92JH139, RJ1431	1.5		3	7 14	0.12 0.13	<0.05 0.13	RJ1431
USA (CA), 1986, (Peto 19)	4.2		4	0	0.55, 0.48	0.06, 0.13	056131-W
USA (CA), 1986, (Peto 19)	13		4	0	0.87, 1.8	0.12, 0.15	056131-W
USA (FL), 1986, (Better Boy)	4.2		4	0	0.28, 0.43	0.09, 0.07	056131-W

Country (location), year (variety)	Application			PHI	Residue, mg/kg		Ref.
	kg ai/ha	kg ai/hl	No.	days	Captan	THPI	
USA (NY), 1986, (Heintz 1350)	4.2		4	0	1.5, 2.2 c0.40	0.08, 0.08 c<0.05	056131-W
USA (MI), 1986, (H7814)	4.2		4	0 7 14	1.4, 1.4 0.88, 0.52 0.18, 0.16	0.10, 0.11 0.09, 0.08 0.08, 0.07	056131-W
USA (TX), 1986, (Flori Americana)	4.2		4	0	1.4, 0.25	0.11, 0.10	056131-W
USA (TX), 1987, (Flori Americana)	4.2		4 ✈	0	0.38, 0.53	0.08, 0.11	40189823
USA (TX), 1987, (Flori Americana)	4.2		4[1]	0	2.1, 0.51	0.32, 0.27	40189823

✈ aerial application

[1] dilute spray

Table 35. Residues of captan and THPI in soya beans after foliar application in Thailand.

Country, year (variety)	Application				PHI,	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.	days	Captan	THPI	
Thailand, 1989 (Sukhothai 1)	WP	0.5	0.1		39	<0.001		
	WP	1.0	0.2		39	<0.001		

Table 36. Residues of captan and THPI in potatoes after foliar, soil and seed applications of various captan formulations. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Country (location), year (variety)	Application				PHI,	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.	days	Captan	THPI	
Foliar application								
Brazil, 1992 (Monalisa)	WP		0.12	8	14	<0.01		D3.2.1/07
Brazil, 1992 (Monalisa)	WP		0.24	8	14	<0.01		D3.2.1/07
Brazil, 1994 (Monalisa)	WP		0.12	7	7	<0.05		D3.2.1/07
Brazil, 1994 (Monalisa)	WP		0.24	7	7	<0.05		D3.2.1/07
Canada, 1993 (Russet Burbank)	WP	3		3	6	<0.05	<0.05	RJ1602B
Canada, 1993 (Russet Burbank)	WP	3		3	6	<0.05	<0.05	RJ1602B
Canada, 1993 (Russet Burbank)	WP	6		3	6	<0.05	<0.05	RJ1602B
Canada, 1993 (Chieftain)	WP	3		5	7	<0.05	<0.05	RJ1602B
Canada, 1993 (Chieftain)	WP	3		5	7	<0.05	<0.05	RJ1602B
Canada, 1993 (Chieftain)	WP	6		5	7	<0.05	0.06	RJ1602B
Canada, 1993 (Chieftain)	WP	3		5	6	<0.05	<0.05	RJ1602B
Canada, 1993 (Chieftain)	WP	3		5	6	<0.05	<0.05	RJ1602B
Canada, 1993 (Chieftain)	WP	6		5	6	<0.05	0.05	RJ1602B
Canada, 1994 (Russet Burbank)	DF	3.6		7	5	<0.05	0.11	RJ1840B
Canada, 1994 (Russet Burbank)	DF	3.6		7	5	<0.05	0.07	RJ1840B
Canada, 1994 (Russet Burbank)	DF	7.2		7	5	0.06	0.16	RJ1840B
Canada, 1994 (Russet Burbank)	DF	3.6		7	7	<0.05	<0.05	RJ1840B
Canada, 1994 (Russet Burbank)	DF	3.6		7	7	<0.05	<0.05	RJ1840B
Canada, 1994 (Russet Burbank)	DF	7.2		7	7	<0.05	<0.05	RJ1840B
Mexico, 1991 (Alpha)	WP	1.0	0.33	4	7	<0.05	<0.05	RJ1432B
Mexico, 1991 (Alpha)	WP	0.83	0.33	4	14	<0.05	<0.05	RJ1432B
Mexico, 1991 (Alpha)	WP	0.83	0.33	4	6 13	<0.05 <0.05	<0.05 <0.05	RJ1432B
Mexico, 1991 (Alpha)	WP	0.83	0.33	4	7 14	<0.05 <0.05	<0.05 <0.05	RJ1432B
Netherlands, 1992 (Maritiema)	FL	1.9		11	0 0 13	<0.02 (2) <0.02 (2) <0.02 (2)	<0.1, <0.1 <0.1,	R-6596

Country (location), year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
					13	<0.02 (2)	<0.1 <0.1, <0.1 <0.1, <0.1	
Netherlands, 1992 (Maritiema)	FL	3.8		11	0 0 13 13	<0.02, (2) <0.02 (2) <0.02 (2) <0.02 (2)	<0.1, <0.1 <0.1, <0.1 <0.1, <0.1 <0.1, <0.1	R-6596
Poland 1994 (Bogna)	WP	1.5	0.5	1	16	<0.05		
Poland 1995 (Atos, Cisa, Tarpan)	WP	1.8		9	32	<0.05		
UK, 1992 (Maris Piper)	FL	1.2		6	20	<0.01 <0.01	<0.01 <0.01	R-6917
UK, 1992 (Maris Piper)	FL	2.4		6	20	<0.01 <0.01	<0.01 <0.01	R-6917
UK, 1992 (King Edward)	FL	1.2		5	47	<0.01 <0.01	<0.01 <0.01	R-6917
UK, 1992 (King Edward)	FL	2.4		5	47	<0.01 <0.01	<0.01 <0.01	R-6917
Broadcast application to open furrow at planting								
Mexico, 1996 (Alpha)	SC	9.1		1	103	<0.01, <0.01		AA96030 2
Mexico, 1996 (Alpha)	SC	20		1	103	<0.01, <0.01		AA96030 2
Mexico, 1996 (Alpha)	SC	11		1	141	<0.01, <0.01		AA96030 2
Mexico, 1996 (Alpha)	SC	23		1	141	<0.01, <0.01		AA96030 2
Seed treatment								
USA (CA), 1986 (White Rose), seed Tx	WP		0.75/10 0 kg seed	1	74 116	<0.05 <0.05	<0.05 <0.05	056131-R
USA (MA), 1986 (Superior) seed Tx	WP		1.4/100 kg seed	1	61 105	<0.05 <0.05	<0.05 <0.05	056131-R
USA, 1978 (seed Tx)	WP		0.75- 1.2/100 kg seed	1	135	0.00		TMN- 665A

Table 37. Residues of captan and THPI in indoor grown radishes after pre-emergent application of a captan WP formulation in Germany.

Year (variety)	Application			PHI, days	Residue, mg/kg	Ref.
	kg ai/ha	kg ai/hl	No.			
1975 (Rota)	66[1]	0.17	1	21	<0.03	BBA57/75
1976 (Cherry Belle)	66[1]	0.17	1	38	<0.03	BBA 2559
1976 (Cherry Belle)	66[1]	0.17	1	112	<0.03	BBA 2553
1975 (Hilmar Treib)	66[1]	0.17	1	47	<0.03	BBA 2709
1975 (Neckar-perle)	66[1]	0.17	1	47	<0.03	BBA 2710
1976 (Karissma GS kalibriert)	66[1]	0.17	1	48	<0.03	BBA 1482
1975 (Cherry Belle)	66[1]	0.17	1	97	<0.03	BBA 3200
1976 (Roky)	66[1]	0.17	1	54	<0.03	BBA 72/76 75/76

[1]watering pre-emergence at 8 g ai/m^2, 4 l water/m^2

Table 38. Residues of captan and THPI in almonds after application of a captan WP formulation in the USA. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately. Doubly underlined residues are from treatments according to GAP and were used to estimate maximum residue levels.

Location, year (variety)	Application		PHI, days	Sample	Residue, mg/kg		Ref.
	kg ai/ha	No.			Captan	THPI	
CA, 1986 (Price)	5.0	4	130	Nut	<0.05, 0.20 c0.06	0.09, <0.05 c<0.05	056131-B
				Hull	40, 27	0.33, 0.23	
				Shell	3.0, 0.77	0.31 <0.05	
CA, 1986	5.0	5	30	Nut	0.10, 0.09	0.05 <0.05	056131-B
				Hull	48, 13	0.21, 0.05	
				Shell	1.2, 3.8	<0.05 0.43	
CA, 1986 (Non-Pareil)	5.0	4	102	Nut	≤0.05 (2)	<0.05 (2)	056131-B
				Hull	25, 16	0.30, 0.54	
				Shell	1.6, 1.1	0.16, 0.05	
CA, 1986 (Non-Pareil)	5.0	5	30	Nut	≤0.05 (2)	<0.05 (2)	056131-B
				Hull	13, 13	0.36, 0.25	
				Shell	1.3, 2.2	0.14, 0.23	
CA, 1986 (Mission)	5.0	4	124	Nut	≤0.05 (2)	<0.05 (2)	056131-B
				Hull	20, 16 c0.63	0.28, 0.35 c<0.05	
				Shell	0.42, 0.54	<0.05 (2)	
CA, 1986 (Non-Pareil)	5.0	5	30	Nut	≤0.05 (2)	0.15, 0.11	056131-B
				Hull	40, 54	2.07, 1.31	
				Shell	1.1, 0.81	0.49, 0.27	
CA, 1987 (Non-Pareil)	5.0	4 ✈	142	Nut	≤0.05	<0.05	40189802
				Shell	0.15, 0.14, 0.09	<0.05 (3)	
				Hull	3.8, 3.6, 4.5 c0.11	0.08, 0.11, 0.17 c0.07	
CA, 1987 (Non-Pareil)	5.0	4[1]		Nut	≤0.05	<0.05	40189802
				Shell	0.17, 0.16, 0.07	<0.05 (3)	
				Hull	6.7, 4.5, 5.3 c0.11	0.15, 0.13, 0.17 c0.07	
CA, 1987 (Non-Pareil)	5.0	4[2]		Nut	≤0.05	<0.05	40189802
				Shell	0.19, 0.18, 0.07	<0.05 (3)	
				Hull	6.7, 7.7, 6.8 c0.11	0.28, 0.21, 0.22 c0.07	
CA, 1980 (Non-Pareil)	4.5	2	195	Kernel	≤0.03	<0.01	TMN-562A
				Hulls	0.05	<0.01	
				Shells	<0.03	<0.01	
CA, 1982 (Mission)	4.5	8	160	Kernel	0.01, <0.01 c0.02	<0.01, <0.01 c<0.01	TMN-562A
				Hulls	5.6, 8.4 c0.13	0.10, 0.17 c0.01	
				Shells	0.13, 0.44 c0.01	0.02, 0.03 c<0.01	
CA, 1985 (Non-Pareil)	5.6	4	128	Kernel	0.04, 0.03	<0.01, <0.01	TMN-562A
				Hulls	6.4, 4.3	0.05, 0.08	
				Shells	0.09, 0.06 c0.01	<0.01 (2) c<0.01	
CA, 1985 (Non-Pareil)	5.6	4 ✈	152	Kernel	≤0.01 (2)	<0.01 (2)	TMN-562A
				Hulls	0.28, 0.19	<0.01 (2)	
				Shells	0.01 (2)	<0.01 (2)	

✈ aerial application

[1] concentrated spray

[2] dilute spray

Table 39. Residues of captan and THPI in indoor-grown chives after pre-emergent application of a captan WP formulation in Germany. Analyses of replicate field samples from one plot or from duplicate plots in one trial are shown separately.

Year (variety)	Application			PHI, days	Residue, mg/kg	Ref.
	kg ai/ha	kg ai/hl	No.			
1976 (Fein-stengeliger)	66[1]	0.17	1	12	20, 32	BBA 4/75 MZ
1976 (Hild 68)	66[1]	0.17	1	22	1.4	BBA 1480
1976 (Hild 68)	66[1]	0.17	1	15	0.62	BBA 1481
1976 (Feinröhriger)	66[1]	0.17	1	32	0.13	BBA 2708
1976 (Feinröhriger)	66[1]	0.17	1	26	0.26	BBA 2706
1976	66[1]	0.17	1	19	3.5	BBA 2569

[1]watering at 8 g ai/m^2, 4 l water/m^2

Animal feeding studies

Groups of 4 lactating Holstein dairy cattle (487-737 kg bw) were dosed with captan at levels nominally equivalent to 0, 10, 30 and 100 ppm in the diet for 29 days (Wiebe, 1991). Doses were administered by gelatin capsule. Milk was collected from each of the cows before dosing and on days 1, 4, 7, 10, 14, 21 and 28 of dosing. Three cows from each group were slaughtered on day 29, three hours after receiving the final dose. The remaining cow from each group was placed on a captan-free diet, milked at intervals, and slaughtered 7 days after receiving the last dose. Samples of muscle, liver, kidney, fat and milk were analysed for five captan metabolites: THPI, *trans*-3-OH THPI, *trans*-5-OH THPI, *cis*-3-OH THPI and *cis*-5-OH THPI. Ground samples of tissue were prepared within 35 hours of slaughter and stored at -20°.

Neither of the *cis* isomers was detected in the milk or tissue samples. Residues of THPI and the *trans* isomers reached a plateau in milk by 1-4 days of dosing. Residue levels of the individual isomers were >400 times less than the corresponding captan feeding levels. No residues of the metabolites were detectable in milk by three days after the cessation of dosing or in tissues seven days after administration of the last dose.

Table 40. Mean residues of captan metabolites in milk of dairy cows dosed with captan at levels nominally equivalent to 10, 30 and 100 ppm in the diet for 29 days (Wiebe, 1991).

Day	Residue, mg/kg								
	10 ppm feed level			30 ppm feed level			100 ppm feed level		
	THPI	*trans*-3-OH THPI	*trans*-5-OH THPI	THPI	*trans*-3-OH THPI	*trans*-5-OH THPI	THPI	*trans*-3-OH THPI	*trans*-5-OH THPI
1	<0.01	0.02	<0.01	0.03	0.08	0.01	0.15	0.31	0.06
4	<0.01	0.02	<0.01	0.02	0.06	<0.01	0.16	0.25	0.04
7	<0.01	0.02	<0.01	0.03	0.06	<0.01	0.30	0.28	0.04
10	<0.01	0.02	<0.01	0.02	0.06	<0.01	0.19	0.18	0.03
14	<0.01	0.02	<0.01	0.03	0.06	<0.01	0.17	0.20	0.03
21	<0.01	0.02	<0.01	0.03	0.06	<0.01	0.20	0.21	0.03
28	<0.01	0.02	<0.01	0.03	0.06	<0.01	0.21	0.23	0.04
30	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.02	0.10	<0.01
32	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
35	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 41. Residues of captan metabolites in tissues of dairy cows dosed with captan at levels nominally equivalent to 10, 30 and 100 ppm in the diet for 29 days (Wiebe, 1991). Maximum sampling to co-extraction intervals were 159 days for milk, 317 days for fat, 311 days for kidneys, 316 days for liver and 315 days for muscle.

Sample	Residue, mg/kg								
	10 ppm feed level			30 ppm feed level			100 ppm feed level		
	THPI	*trans*-3-OH THPI	*trans*-5-OH THPI	THPI	*trans*-3-OH THPI	*trans*-5-OH THPI	THPI	*trans*-3-OH THPI	*trans*-5-OH THPI
Muscle	0.02 (2), 0.01	0.02 (2), 0.01	<0.01 (3)	0.04, 0.05, 0.13	0.04, 0.05, 0.08	0.01 (3)	0.36, 0.26, 0.10	0.21 (2), 0.13	0.04, 0.06, 0.02
Liver	0.02 (2), 0.03	0.01, <0.01 (2)	<0.01 (3)	0.08 (2), 0.20	0.03 (2), 0.07	<0.01 (3)	0.49, 0.28, 0.15	0.13, 0.12, 0.09	<0.01 (3)
Kidney	0.02 (2), 0.01	0.02 (3)	<0.01 (3)	0.06 (2), 0.15	0.07, 0.08, 0.13	0.02 (3)	0.38, 0.27, 0.11	0.34, 0.30, 0.18	0.08, 0.10, 0.03
Fat	<0.01 (3)	<0.01 (3)	<0.01 (3)	0.01, 0.02, 0.05	<0.01 (3)	<0.01 (3)	0.12, 0.08, 0.03	0.04, 0.02, 0.01	<0.01 (3)

FATE OF RESIDUES IN STORAGE AND PROCESSING

In processing

Processing studies on apples, cherries, citrus fruit, cucumbers, melons, grapes, plums and tomatoes were reported to the Meeting. Captan is susceptible to hydrolysis with cleavage of the N-S bond, resulting in the formation of THPI. Processing can result in increased conversion of captan to THPI. The 1994 and 1997 evaluations of captan introduced the use of processing yields for THPI.

Processing yield = (THPI residues in processed commodity) ÷ (RAC captan residues × 0.503 + RAC THPI residues).

The factor 0.503 is the ratio of the molecular weight of THPI (151.2) to that of captan (300.6).

Residues and, where practicable, processing factors for captan and processing yields for THPI are shown in Tables 42-59.

<u>Citrus fruit</u>. Captan was applied to oranges at 5.7-12 kg ai/ha by hand sprayers and tractor-driven sprayers in the USA. Fruit harvested on the day of the last spray were processed according to Kesterson and Braddock (1979). Oranges were washed, juice and peel separated, oil extracted from a portion of the peel, the remaining peel shredded and lime added, and the shredded peel pressed and dried.

Table 42. Captan residues in citrus processing fractions in the USA.

Location, year (variety)	Rate, kg ai/ha	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield	Ref.
Oranges							
FL, 1981 (Hamlin)	5.7	Fruit	<0.03		<0.01		TMN-603B
		Dried pulp	<0.03		<0.01		
FL, 1981 (Valencia)	5.7	Fruit	<0.03		<0.01		TMN-603B
		Dried pulp	<0.03		0.28	28	
FL, 1982 (Valencia)	6.7	Fruit	0.50		0.12		TMN-603B
		Dry pulp	<0.03	<0.06	0.04	0.1	
CA, 1983 (Navel)	2×12	Fruit	2.7, 2.4		1.8, 1.3		TMN-603B

Location, year (variety)	Rate, kg ai/ha	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield	Ref.
		Juice	<0.01	<0.01	<0.01	<0.01	
		Peel oil	0.42	0.2	0.02	<0.01	
		Dried peel	<0.01	<0.01	0.10	0.04	
CA, 1986 (Valencia)	2×9.0 + 1×5.6	Fruit	2.0, 1.5	-	0.03, 0.02	-	TMN-603B
		Washed	0.08	0.05	0.02	0.02	
		Washed peel	0.02	0.01	0.08	0.09	
		Peeled fruit	<0.01	<0.01	0.01	0.01	
		CH_2Cl_2 washed fruit	<0.01	<0.01	0.02	0.02	
		Commercially washed fruit	0.19	0.1	<0.01	<0.01	
		Wet peel	0.01	<0.01	0.12	0.1	
		Dried peel	<0.01	<0.01	<0.01	<0.01	
		Dried fines of peel	<0.01	<0.01	0.02	0.02	
		Juice	<0.01	<0.01	<0.01	<0.01	
		Molasses	<0.01	<0.01	<0.01	<0.01	
		Peel oil	<0.01	<0.01	<0.01	<0.01	
AZ, 1986 (Valencia)	2×9.0 + 1×5.6	Fruit	2.3, 2.3		0.03, 0.04	-	TMN-603B
		Washed peel	0.23	0.1	0.47	0.4	
		Peeled fruit	0.01	<0.01	0.01	0.01	
		Washed fruit	0.40	0.2	0.09	0.08	
		CH_2Cl_2 washed fruit	0.26	0.1	0.02	0.02	
Lemons							
AZ, 1986 (Lisbon)	2×9.0	Fruit	7.0, 8.5 c0.13	-	<0.01	-	TMN-603A
		Peeled fruit	0.02	0.003	0.11	0.01	
		Peel	0.51	0.07	1.7	0.2	
		Washed fruit	1.3	0.2	0.08	0.01	
		Solvent washed	0.92	0.1	0.16	0.02	
CA, 1986 (Eureka)	2×9.0	Fruit	4.6, 4.5 c0.05	-	0.08 (2) <0.01	-	TMN-603A
		Washed peel	0.89	0.2	0.12	0.05	
		Juice	0.11	0.02	0.08	0.03	
		Washed fruit	0.26	0.06	0.05	0.02	
		Solvent washed	0.86	0.2	0.10	0.04	
Grapefruit							
AZ, 1986 (Marsh/Red Blush)	2×9.0	Fruit	2.4, 4.2 c0.64	-	0.05, 0.09 <0.01	0.01	TMN-603C
		Peeled fruit	<0.01	<0.01	0.01	0.01	
		Washed peel	0.32	0.1	0.52	0.3	
		Washed fruit	0.59	0.2	0.04	0.02	
		Solvent washed fruit	0.17	0.05	0.04	0.02	
		Dried peel	0.14, 0.11	0.04	0.16, 0.16	0.09	
		Dried fines of peel	0.13, 0.12	0.04	0.51, 0.12	0.2	
		Wet peel	0.07, 0.06	0.02	0.17, 0.13	0.09	
		Peel oil	0.54, 1.1	0.24	0.16, 0.12	0.08	
		Molasses	<0.01 (2)	<0.01	0.14, 0.06	0.06	
		Juice	<0.01	<0.01	<0.01	<0.01	

Apples. Processing studies on apples were carried out in Germany in 1991, 1994 and 1996 and in the USA in 1986 and 1990.

The fate of captan in processed apple commodities was studied by Specht (1992) using Golden Delicious apples that had been sprayed 12 times with captan (WP or SG formulations) at 1.6 kg ai/ha. The apples, harvested 14 days after the last application, were processed according to normal domestic procedures. Apple sauce was made by cooking apples, cut into small pieces, in water until soft and passing through a sieve. For apple juice (warm), apples were cut into small pieces and placed in a steam juice extractor. The residue after removal of the juice was pomace (juice warm). Apple juice (cold) was produced by a juice extractor. The centrifuged juice was collected and the residue taken as pomace (juice cold). Dried apples were prepared by desiccation of cored apples.

Table 43. Captan residues in Golden Delicious apples and processed apple commodities in Germany, 1991 (Specht, 1992).

Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
Apples, washed	2.2 c0.01	-	0.14 c0.05	-
Sauce	<0.01	<0.01	0.92	0.7
Juice (warm)	<0.01	<0.01	1.3	1.0
Pomace (juice warm)	0.03	0.01	1.5	1.2
Juice (cold)	0.10 c0.01	0.05	0.07 c<0.01	0.06
Pomace (juice cold)	3.8 c0.09	1.7	0.99 c<0.01	0.8
Dried apples	2.8 c0.02	1.3	3.2 c0.05	2.6
Apples, washed	1.8 c0.01	-	0.18 c0.05	-
Sauce	<0.01	<0.01	1.2	1.1
Juice (warm)	<0.01	<0.01	1.1	1.1
Pomace (juice warm)	0.01	<0.01	1.2	1.1
Juice (cold)	0.25 c0.01	0.1	0.13 c<0.01	0.1
Pomace (juice cold)	5.2 c0.09	2.9	0.84 c<0.01	0.8
Dried apples	1.4 c0.02	0.8	2.7 c0.05	2.5
Apples, washed	1.1	-	0.21	-
Sauce	<0.01	<0.01	1.0	1.3
Juice (warm)	<0.01	<0.01	0.88	1.1
Pomace (juice warm)	0.02	0.02	0.87	1.1
Dried apples	2.2 c0.03	1.9	2.1 c<0.01	2.7
Apples, washed	1.8	-	0.36	-
Sauce	<0.01	<0.01	0.77	0.6
Juice (warm)	<0.01	<0.01	1.1	0.9
Pomace (juice warm)	0.03	0.02	1.1	0.9
Dried apples	2.0 c0.03	1.1	1.8 c<0.01	1.4

Fuchsbichler (1995) studied the effect of processing on captan residues in apples. Apple sauce and apple juice (warm and cold) were produced as described above.

Table 44. Captan residues in apples and processed apple commodities in Germany, 1994 (Fuchsbichler, 1995).

Variety	Rate, kg ai/ha	PHI, days	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
Indared	12×1.5	3	Fruit	2.0	-	-	
		3	Juice cold	0.06	0.03	-	
		3	Juice heated	<0.05	<0.03	-	
		3	Apple sauce	<0.05	<0.03	-	
		7	Fruit	2.0	-	-	
		7	Juice cold	0.08	0.04	-	
		7	Juice heated	<0.05	<0.03	-	
		7	Apple sauce	<0.05	<0.03	-	
		14	Fruit	1.3	-	0.43	-
		14	Juice cold	0.07	0.05	<0.02	<0.02
		14	Juice heated	<0.05	<0.04	0.58	0.5
		14	Apple sauce	<0.05	<0.04	0.51	0.5
Elstar	12×1.9	3	Fruit	3.5	-	-	
		3	Juice cold	0.51	0.15	-	
		3	Juice heated	<0.05	<0.02	-	
		3	Apple sauce	<0.05	<0.02	-	
		14	Fruit	2.3	-	1.1	-
		14	Juice cold	0.11	0.05	0.43	0.2
		14	Juice heated	<0.05	<0.03	2.8	1.2
		14	Apple sauce	<0.05	<0.03	1.7	0.8
Cox's Orange	12×1.9	3	Fruit	2.5	-	-	
		3	Juice cold	0.27	0.1	-	
		3	Juice heated	<0.05	<0.03	-	
		3	Apple sauce	<0.05	<0.03	-	
		14	Fruit	2.2	-	0.83	-
		14	Juice cold	0.15	0.07	0.68	0.4
		14	Juice heated	<0.05	<0.03	2.2	1.1
		14	Apple sauce	<0.05	<0.03	1.4	0.7

Apples were processed by washing and pressing twice at 50-60 bar for 2 minutes to produce unclarified juice and pomace (Fuchsbichler, 1997). Pasteurized juice was prepared by heating unclarified juice at 93-95°C for 1 minute. Apple quarters were boiled (98°C) for 45 min and then sieved to give apple purée (sauce). Dried apples were prepared by drying apple slices at 60-61°C for 8.5 hours to a moisture content of about 20%.

Table 45 Captan residues in apples and processed apple commodities in Germany, 1996 (Fuchsbichler, 1997).

Variety	Rate , kg ai/ha	PHI, days	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
Golden Delicious	12×1.3	14	Fruit	1.6	-	0.77	-
		14	Washed	0.43	0.3	0.22	0.1
		14	Unclarified juice	0.08	0.05	-	-
		14	Pasteurized unclarified juice	<0.05	<0.03	-	-
		14	Apple purée	<0.05	<0.03	-	-
		14	Dried apples	<0.05	<0.03	<0.20	<0.1
Gloster	12×1.3	13	Fruit	1.2	-	0.63	-
		13	Washed	0.37	0.3	<0.20	<0.2
		13	Unclarified juice	0.12	0.1	-	-
		13	Pasteurized unclarified juice	<0.05	<0.04	-	-
		13	Apple purée	<0.05	<0.04	-	-
		13	Dried apples	<0.05	<0.04	<0.20	<0.2
Golden Delicious	13×1.8	14	Fruit	2.2	-	2.7	-
		14	Washed	1.2	0.5	0.59	0.2
		14	Unclarified juice	0.19	0.09	-	-
		14	Pasteurized unclarified juice	<0.05	<0.02	-	-
		14	Dried apples	<0.05	<0.02	<0.20	<0.05

Smith (1987p) treated apple trees 8 times with captan (WP formulation) with a foliar spray. Apples were harvested on the day of the last application and processed. They were graded, peeled, cored and trimmed, crushed and pulped. A sample of the pulp was collected and peels, cores and trimmings added to produce wet pomace. A sample of wet pomace was dried at 53°C to produce dry pomace. Processing of the pulp was continued by straining, enzyme clarification and filtration. The juice was heated to 88°C and canned.

Table 46. Captan residues in Red Delicious apples, pomace and juice after processing in Washington, USA, 1986 (Smith, 1987p).

Rate, kg ai/ha	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
8×4.5	Apples	5.5, 5.1	-	0.23, 0.21	-
	Dry pomace	10	1.9	12	4.2
	Wet pomace	2.1 c0.1	0.4	1.9 c<0.05	0.7
	Juice	<0.05	<0.01	0.10	0.03
8×13	Apples	9.1, 5.5	-	0.40, 0.43	-
	Dry pomace	7.9	1.1	42	10
	Wet pomace	7.8 c0.1	1.1	3.5 c<0.05	0.9
	Juice	<0.05	<0.01	2.2	0.5

Iwata (1992a) applied captan to apples at two different locations in the USA as 10 foliar sprays at 3.4 kg ai/ha. The spray intervals were 14 days at the Michigan site (Yellow Delicious) and 7-17 days at the West Virginia site (Spartan). Apples were harvested 14-97 days after the last spray and processed according to normal commercial practices as shown in Figure 6.

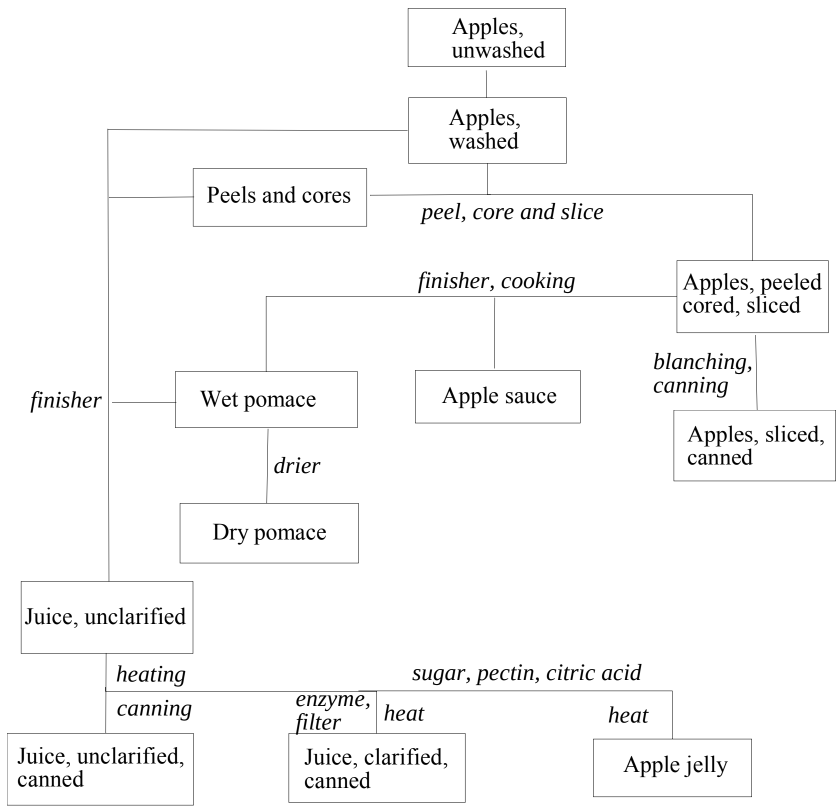


Figure 6. Apple processing (Iwata, 1992a).

Table 47. Residues of captan and THPI in apples and processed apple commodities after foliar applications of captan in Michigan, USA. Captan WP was applied to Yellow Delicious apples at 10×3.4 kg ai/ha at 14-day intervals (Iwata, 1992a).

Commodity	Residues, mg/kg									
	PHI 97 days		PHI 83 days		PHI 69 days		PHI 55 days		PHI 41 days	
	Captan	THPI	Captan	THPI	Captan	THPI	Captan	THPI	Captan	THPI
Apples, field	0.06	<0.05	0.15	<0.05	0.36	<0.05	0.40	<0.05	0.56	<0.05
Unwashed	0.06	<0.05	0.10	<0.05	0.19	<0.05	0.36	<0.05	0.44	<0.05
Washed + rinsed	<0.05	<0.05	<0.05	<0.05	0.10	<0.05	0.29	<0.05	0.17	<0.05
Peeled, cored, sliced	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Apple sauce	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Baby food apple sauce	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Canned apple slices	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Unclarified juice	<0.05	<0.05	<0.05	<0.05	0.13	0.05	0.19	0.08	0.29	0.10
Canned, unclarified juice	<0.05	<0.05	<0.05	<0.05	<0.05	0.11	<0.05	0.18	<0.05	0.27
Filter cake	<0.05	<0.05	<0.05	<0.05	<0.05	0.10	<0.05	0.13	0.06	0.19
Canned clarified juice	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	0.12	<0.05	0.18
Apple jelly	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	0.11
Wet pomace	<0.05	<0.05	<0.05	<0.05	0.06	0.09	<0.05	0.15	0.07	0.21
Dry pomace	0.05	0.08	<0.05	0.10	0.11	0.33	0.13	0.59	0.13	0.84

Table 48. Residues of captan and THPI in apples and processed apple commodities after foliar applications of captan in West Virginia, USA. Captan WP was applied to Spartan apples at 10×3.4 kg ai/ha at 7-17 day intervals (Iwata, 1992a).

Commodity	Residues, mg/kg									
	PHI, 55 days		PHI, 42 days		PHI, 28 days		PHI, 21 days		PHI, 14 days	
	Captan	THPI	Captan	THPI	Captan	THPI	Captan	THPI	Captan	THPI
Apples, field	0.06	<0.05	0.09	<0.05	0.45	<0.05	0.87	<0.05	1.5	<0.05
Unwashed	<0.05	<0.05	0.22	<0.05	0.89	<0.05	1.7	<0.05	2.2	<0.05
Washed + rinsed	<0.05	<0.05	0.12	<0.05	0.55	<0.05	0.81	<0.05	1.5	<0.05
Peeled, cored, sliced	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	<0.05	<0.05
Apple sauce	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07
Baby food apple sauce	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07
Canned apple slices	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Unclarified juice	<0.05	<0.05	0.06	0.09	0.28	0.11	1.1	0.27	2.3	0.26
Canned, unclarified juice	<0.05	<0.05	<0.05	0.13	<0.05	0.36	<0.05	0.98	<0.05	1.6
Filter cake	<0.05	<0.05	<0.05	0.09	0.10	0.27	0.37	0.70	0.56	0.97
Canned clarified juice	<0.05	<0.05	<0.05	0.07	<0.05	0.38	<0.05	1.0	<0.05	1.3
Apple jelly	<0.05	<0.05	<0.05	0.05	<0.05	0.15	<0.05	0.42	<0.05	0.58
Wet pomace	<0.05	<0.05	0.06	0.10	0.21	0.27	0.77	0.60	0.72	0.85
Dry pomace	<0.05	<0.05	0.12	0.34	0.41	1.0	1.4	2.1	2.0	2.6

Cherries. In three trials in Germany cherries were treated 3 times with captan at 0.12 kg ai/hl and harvested 7 days after the last application (Pollmann, 2000). Residues were measured in washed fruit and in fruit prepared for canning, simulated by adding 10 g sugar/100 g fruit and 200 ml water, then heating to 94-95°C at 3°C/min, and holding at that temperature for 5 min before cooling to room temperature and freezing.

Table 49. Captan residues in cherries processed in Germany in 1999 (Pollmann 2000).

Variety	Rate, kg ai/hl	PHI, days	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg
Edelfinger	3×0.12	7	Fruit	1.1	-	-
		7	Washed	0.38	0.3	-
		14	Canned	<0.002	<0.001	0.03
Schatten-morelle	3×0.12	7	Fruit	2.9	-	
		7	Washed	0.89	0.3	-
		7	Canned	<0.002	<0.001	0.10
Johanna	3×0.12	7	Fruit	3.7	-	-
		7	Washed	1.8	0.5	
		7	Canned	<0.002	<0.001	0.05

Northover *et al.* (1986) studied the effect of temperature on the residues of captan in stored whole cherries and the effect of washing on residues of captan in cherries and peaches. The residues of captan in whole sweet cherries (Bing variety) did not decrease on storage at 4 and 20°C for 14 days. Tumble washing sweet cherries for as little as 15 sec reduced captan residues by 70-74%. (1 kg lots were dropped into 3 l distilled water within a 34 l container and tumbled manually every 2.5 sec to resemble domestic washing for 15, 30, 60 or 120 sec. Fruit were then drained and dried on absorbent paper (without rubbing) for 1-2 h at 20°C). The addition of the surfactant Tween 20 or $NaHCO_3$ to the wash solution did not remove any more residue than tap or distilled water alone. Residues of captan in peaches were reduced by 56% when hand-washed and by 70% when washed with brushing.

Table 50. Captan residues in cherries and peaches before and after washing (Northover *et al.*, 1986).

Country, year (variety)	Sample	Residue, mg/kg	Processing factor
Canada, 1982, Sweet cherry (Bing)	Fruit Washed distilled water 15 s Washed distilled water 30 s Washed distilled water 60 s Washed distilled water 120 s	2.7 0.8 0.6 0.3 0.2	- 0.3 0.2 0.1 0.07
Canada, 1983, Sweet cherry (Bing)	Fruit Washed distilled water 15 s Washed distilled water 30 s Washed distilled water 60 s Washed distilled water 120 s 0.1% Tween 20, 120 s, rinse 4.2 g $NaHCO_3$/l, 120 s, no rinse 4.2 g $NaHCO_3$/l, 120 s, rinse Tap water, 120 s, rinse	6.8 1.8 1.9 0.3 0.2 0.2 0.2 0.3 0.6	- 0.3 0.3 0.04 0.03 0.03 0.03 0.04 0.09
Canada, 1983, Peach (Red Haven)	Fruit Hand wash 5 s Hand wash 10 s Brush wash 10 s	11 4.9 4.6 3.3	- 0.4 0.4 0.3

<u>Prunes</u>. Plums in the USA were sprayed 9 times with captan at 3.4 kg ai/ha with harvest on the day of the final application. Samples were washed and graded and dried in a bin dryer at 74°C for 16 hours to produce prunes (Smith, 1987q).

Table 51. Captan residues in Stanley plums and dried prunes in Michigan, USA, 1986 (Smith, 1986q).

Rate, kg ai/ha	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
9×3.4	Fruit	3.5, 5.6	-	<0.05, <0.05	-
	Dry prunes	0.59	0.1	5.2	2.3

Grapes. In three trials in Germany in 1991 red and white grapes were treated with eight sprays of captan (SG and WP formulations) at 2.3 kg ai/ha and fruit harvested 26-29 days after the final application. Grapes were processed into must and wine and residues measured in must, young wine and mature wine (Jones, 1992g). The grapes were mashed, destemmed and 50 mg SO_2/l added. The mash was heated to 60°C, cooled, drained and pressed. The turbid must was separated, appropriate quantities of sugar and yeast added and the solution fermented in bottles for 12-15 days. Samples of young wine were collected and SO_2 and bentonite added. Samples of mature wine were collected 6 months later.

Table 52. Captan residues in grapes before and after processing in Germany in 1991 (Jones, 1992g).

Variety	Form	Rate, kg ai/ha	PHI, days	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
Kerner	WP	8×2.3	26	Grapes	0.59	-	<0.05	-
			27	Must	0.08	0.1	0.44	1.3
			53	Young wine	<0.05	<0.08	0.43	1.2
			192	Mature wine	<0.05	<0.08	0.81	2.3
Kerner	SG	8×2.3	26	Grapes	0.54	-	<0.05	-
			27	Must	0.08	0.1	0.36	1.1
			53	Young wine	<0.05	<0.09	0.44	1.4
			192	Mature wine	<0.05	<0.09	0.71	2.2
Dornfelder	WP	8×2.3	29	Grapes	2.2	-	0.05	-
			31	Must	<0.05	<0.02	1.4	1.2
			50	Young wine	<0.05	<0.02	1.3	1.1
			189	Mature wine	<0.05	<0.02	1.8	1.6
Dornfelder	SG	8×2.3	29	Grapes	2.1	-	0.05	-
			31	Must	<0.05	<0.02	1.3	1.2
			50	Young wine	<0.05	<0.02	1.5	1.4
			189	Mature wine	<0.05	<0.02	1.9	1.7

The fate of captan residues during the processing of grapes from trials in Germany in 1994 was reported by Specht (1995c). No details were provided of either the field or processing parts of the trial.

Table 53. Captan residues in grapes before and after processing in Germany, 1994 (Specht, 1995).

Grapes	PHI, days	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
White grapes	26	Fruit	5.6	-	0.71	-
		Must	0.57	0.1	2.0	0.6
		Must unpasteurized	0.26	0.05	1.9	0.5
		Young wine (unpasteurized must)	0.03	0.005	0.75	0.2
		Wine (after storage)	<0.01	<0.002	1.1	0.3
Red grapes	28	Grapes	8.4 c0.59	-	0.59 c0.06	
		Must unpasteurized	0.47 c0.08	0.06	1.6 c0.49	0.3
		Must pasteurized	<0.01 c<0.01	<0.001	5.0 c0.71	1.0
		Young wine (must after mash heating)	<0.01 c<0.01	<0.001	3.3 c0.58	0.7
		Young wine (grapes after mash fermentation)	<0.01 c<0.01	<0.001	2.7 c0.56	0.6
		Wine (must after mash heating) after storage	<0.01	<0.001	3.5	0.7
		Wine (grapes after mash fermentation) after storage	<0.01	<0.001	3.4	0.7

Grenache grapes in Australia 1994 were treated with 8 foliar sprays of captan at 0.1 or 0.2 kg ai/hl and harvested 7, 14 or 21 days after the last spray. The grapes were processed into juice and wine (Brown *et al.*, 1995). No details were provided.

Table 54. Captan residues in grapes before and after processing in Australia in 1994 (Brown *et al.*, 1995).

Rate, kg ai/hl	PHI, days	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
8×0.10	7	Fruit	0.69	-	0.05	-
	7	Juice	0.46	0.7	1.0	1.3
	7	Wine	<0.05	<0.07	0.69	0.9
	14	Fruit	1.4	-	0.05	-
	14	Juice	0.22	0.2	0.96	0.6
	14	Wine	<0.05	<0.04	0.46	0.3
	21	Fruit	3.4	-	0.1	-
	21	Juice	0.27	0.08	1.3	0.2
	21	Wine	<0.05	<0.01	0.38	0.1
8×0.21	7	Fruit	7.5	-	0.16	-
	7	Juice	0.14	0.02	1.6	0.2
	7	Wine	<0.05	<0.007	0.95	0.1
	14	Fruit	4.7	-	0.11	-
	14	Juice	2.5	0.5	2.2	0.4
	14	Wine	<0.05	<0.01	1.4	0.3
	21	Fruit	5.0	-	0.08	-
	21	Juice	1.6	0.3	1.5	0.3
	21	Wine	<0.05	<0.01	1.4	0.3

Iwata (1992b) studied the effect of processing on Concord grapes treated in Pennsylvania, USA, with 6 foliar applications of a WP formulation at 2.2 kg ai/ha. Grapes were harvested 36 days after the final application and processed by simulated commercial procedures (Figure 7) into juice, jelly and pomace.

Table 55. Captan residues in Concord grapes before and after processing in the USA (Iwata, 1992b).

Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
Fruit (field)	0.4	-	<0.05	-
Fruit (Processor)	0.39	-	0.08	-
Table grapes (home washed)	0.30	0.8	0.07	0.3
Destemmed crushed grapes	0.06	0.2	0.18	0.7
Depectinised mash	<0.05	<0.1	0.17	0.6
185-degree juice	<0.05	<0.1	0.21	0.8
Clear juice	<0.05	<0.1	0.14	0.5
Thick juice	<0.05	<0.1	0.19	0.7
Filtered juice	<0.05	<0.1	0.16	0.6
Filter cake	<0.05	<0.1	0.18	0.7
Grape jelly	<0.05	<0.1	0.08	0.3
Canned juice	<0.05	<0.1	0.20	0.7
Wet pomace	<0.05	<0.1	0.07	0.3
Dry pomace	<0.05 c<0.05	<0.1	0.27 c0.14	1.0

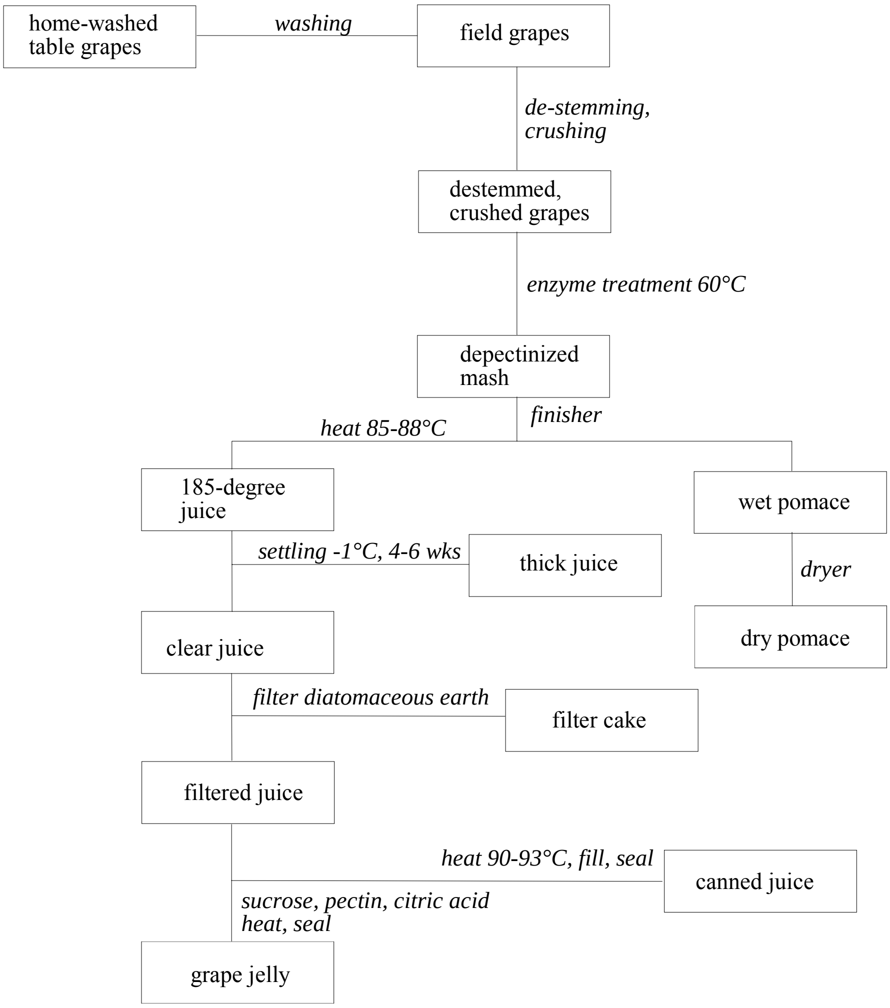


Figure 7. Grape processing (Iwata, 1992b).

Riggle (1991) studied the fate of captan residues in grapes during processing. Three field trials were conducted in the USA states California and New York. For the production of juice and pomace, grapes were mashed, the stems removed and the mashed grapes pressed to produce juice and wet pomace. The wet pomace was dried in a forced air oven at 77-88°C to produce dry pomace (less than 10% moisture content). Raisins were produced by destemming grapes and drying the whole grapes in a forced air oven at 49-63°C to achieve a moisture content of 15-18%. The process is shown in Figure 8.

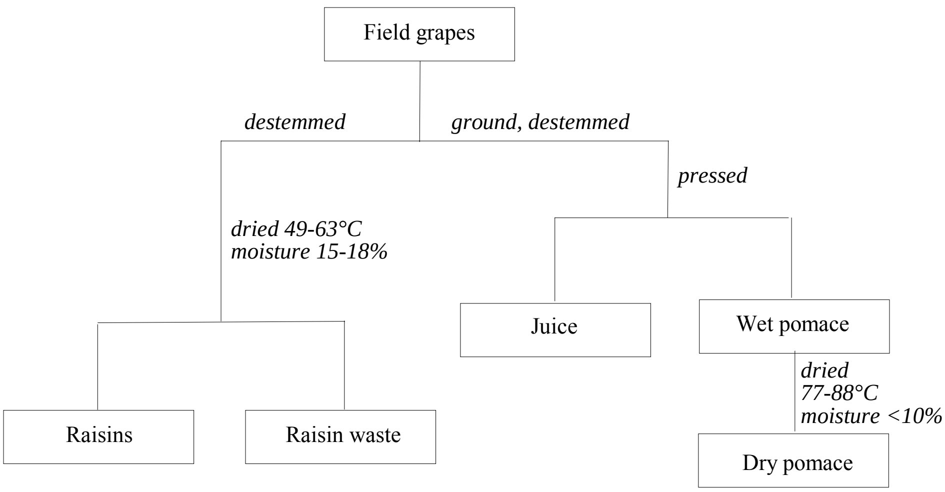


Figure 8. Grape processing (Riggle, 1991).

Table 56. Captan residues in grapes before and after processing in the USA, 1989 (Riggle, 1991).

Location (variety)	Rate, kg ai/ha	PHI, days	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg
CA (Thompson Seedless)	2×2.2	119	Grapes	0.08, 0.07	-	<0.05, <0.05
			Juice	<0.05	<0.6	<0.05
			Wet pomace	0.09	1.1	<0.05
			Dry pomace	0.11	1.4	<0.05
			Raisins	0.08	1	<0.05
			Raisin waste	0.62	7.8	<0.05
CA (Thompson Seedless)	3×2.2	91	Grapes	0.64, 0.38	-	<0.05, <0.05
			Juice	0.51	1	0.12
			Wet pomace	0.46	0.9	0.06
			Dry pomace	0.22	0.4	0.12
			Raisins	0.61	1.2	0.06
			Raisin waste	13	26	0.20
CA (Thompson Seedless)	4×2.2	77	Grapes	0.17, <0.05	-	<0.05, <0.05
			Juice	0.10	0.9	0.07
			Wet pomace	0.17	1.5	<0.05
			Dry pomace	0.09	0.8	0.09
			Raisins	0.29	2.6	<0.05
			Raisin waste	5.8	52	0.10
CA (Thompson Seedless)	2×2.2	118	Grapes	<0.05, <0.05		<0.05, <0.05
			Juice	<0.05		<0.05
			Wet pomace	<0.05		<0.05
			Dry pomace	<0.05		<0.05
			Raisins	<0.05 c0.08		<0.05 c<0.05
			Raisin waste	0.09		<0.05
CA (Thompson Seedless)	3×2.2	98	Grapes	0.07, <0.05	-	<0.05, <0.05
			Juice	0.05	0.8	<0.05
			Wet pomace	0.09	1.5	<0.05
			Dry pomace	<0.05	<0.8	<0.05
			Raisins	0.08 c0.08	1.3	<0.05 c<0.05
			Raisin waste	0.30	5	<0.05
CA (Thompson Seedless)	4×2.2	84	Grapes	0.11, 0.22	-	<0.05, <0.05
			Juice	<0.05	<0.3	0.09
			Wet pomace	0.12	0.7	<0.05
			Dry pomace	0.09	0.5	<0.05
			Raisins	0.19 c0.08	1.2	<0.05 c<0.05
			Raisin waste	0.52	3.2	<0.05
NY (Aurora)	2×2.2	85	Grapes	<0.05, <0.05		<0.05, <0.05
			Juice	<0.05		<0.05
			Wet pomace	<0.05		<0.05
			Dry pomace	<0.05		0.07
NY (Aurora)	3×2.2	62	Grapes	0.20, 0.08	-	<0.05, <0.05
			Juice	<0.05	<0.4	<0.05
			Wet pomace	0.19	1.4	<0.05
			Dry pomace	0.09	0.6	0.09
NY (Aurora)	4×2.2	50	Grapes	0.32, 0.29	-	<0.05, <0.05
			Juice	0.07	0.2	<0.05
			Wet pomace	0.31	1	0.09
			Dry pomace	0.29	1	0.39

Strawberries. Strawberries were treated with twelve foliar sprays of captan WP at 3.4 kg ai/ha and harvested on the day of the final spray. Processing was by washing and cooking the berries (TMN-684A).

Table 57. Captan residues in strawberries before and after processing in the USA, 1985 (Tomen, 1985).

Location (variety)	Rate, kg ai/ha	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
CA	12×3.4	Berries	7.2, 10	-	0.29, 0.34	-
		Washed	1.2	0.1	0.42	0.1
		Washed + cooked	<0.01	<0.01	0.54	0.1
OR (Hood)	12×3.4	Berries	8.7, 8.6	-	0.23, 0.26	-
		Washed	1.1	0.1	0.04	0.01
		Washed + cooked	<0.01	<0.01	0.55	0.1
CA	12×3.4	Berries	12, 6.7	-	0.90, 0.64	-
		Washed	0.27	0.03	0.37	0.07
		Washed + cooked	<0.01	<0.01	0.45	0.08

Tomatoes. Captan was applied as 4 foliar sprays to Peto 19 tomatoes at 4.2 or 13 kg ai/ha. Fruit were collected on the same day as the last spray and delivered overnight to the processing facility. The tomatoes were washed, sorted and trimmed. Some tomatoes were crushed and frozen as wet pomace, some crushed and dried as dry pomace. The remaining tomatoes were peeled and then subjected to hot breaking and pulping. Some of the sample was processed into purée, paste, ketchup and juice (Figure 9).

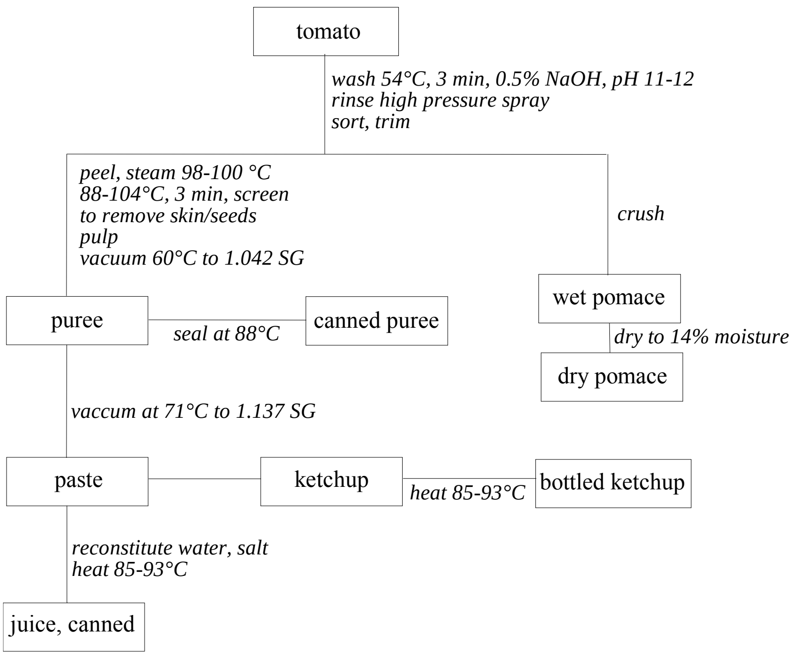


Figure 9. Tomato processing (Smith, 1987m).

Table 58. Captan residues in Peto 19 tomatoes before and after processing in California, USA, 1986 (Smith, 1987m).

Rate, kg ai/ha	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
4×4.2	Fruit	0.55, 0.48	-	0.06, 0.13	-
	Wet pomace	0.10	0.2	0.09	0.3
	Dry pomace	0.06	0.1	2.1	5.9
	Purée	<0.05	<0.1	0.23	0.6

Rate, kg ai/ha	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Processing yield
	Juice	<0.05	<0.1	0.09	0.3
	Ketchup	<0.05	<0.1	0.46	1.3
4×13	Fruit	0.87, 1.8		0.12, 0.15	-
	Wet pomace	<0.05	<0.04	0.14	0.1
	Dry pomace	0.11	0.08	2.3	1.6
	Purée	<0.05	<0.04	0.38	0.3
	Juice	<0.05	<0.04	0.12	0.08
	Ketchup	<0.05	<0.04	0.73	0.5

Cucurbits (Cucumber, melon, squash). Cucurbits were treated with 6-9 sprays of a captan WP formulation at 2.2 kg ai/ha and harvested on the day of the final application. Fruit were processed by washing, peeling and cooking.

Table 59. Captan residues in cucurbits before and after processing in the USA, 1985.

Location (commodity)	Rate, kg ai/ha	Sample	Captan, mg/kg	Processing factor	THPI, mg/kg	Ref.
CA (cucumber)	6×2.2	Fruit	0.03, 0.10	-	<0.01, 0.02	TMN-609A
		Washed fruit	0.01	0.2	0.01	
		Washed peel	0.02	0.3	0.05	
		Peeled fruit	<0.01	<0.2	<0.01	
		Washed, sliced, cooked	<0.01	<0.2	<0.01	
NY (cucumber, Marketmore 76)	6×2.2	Fruit	1.2, 0.91	-	0.13, 0.11	TMN-609A
		Washed fruit	0.05	0.05	0.06	
		Washed peel	0.15	0.1	0.57	
		Peeled fruit	<0.01	<0.01	0.05	
		Washed, sliced, cooked fruit	<0.01	<0.01	0.05	
CA (cantaloupe, 45SJ)	6×2.2	Fruit	0.74, 1.1	-	0.03, 0.05	TMN-634A
		Peel	1.0	1.1	0.13	
		Peeled fruit	<0.01	<0.01	<0.01	
FL (cantaloupe, Gold Star)	9×2.2	Fruit	0.35, 0.36	-	0.07, 0.09	TMN-634A
		Peel	0.16	0.4	0.30	
		Peeled fruit	0.01	0.03	0.02	
CA (squash)	6×2.2	Fruit	0.12, 0.14	-	0.11, 0.07	TMN-634A
		Washed	0.01	0.08	0.03	
		Washed, peeled fruit	<0.01	<0.08	0.01	
		Washed peel	0.05	0.4	0.07	
		Sliced cooked fruit	<0.01	<0.08	0.02	
NY (squash, Ambassador)	6×2.2	Fruit	1.1, 1.4	-	0.11, 0.14	TMN-634A
		Washed fruit	0.05	0.04	0.09	
		Washed, peeled fruit	<0.01	<0.01	0.02	
		Washed peel	0.12	0.1	0.20	
		Washed peeled, cooked	<0.01	<0.01	0.04	

Residues in the edible portions of food commodities

No additional information. The distribution and nature of captan residues greatly influence the residues in edible portions of food commodities. In general, captan is a surface residue. Processing to products that do not include the skin generally provides significant reductions in residues. Heating, as part of normal processing or cooking, increases the rate of hydrolysis of captan, converting most of the residue to THPI.

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

The Meeting was provided with the results of a 1991 USA nationwide survey in which whole milk samples were collected from randomly selected retail stores. Residues of captan and the metabolites THPI, 3-OH THPI and 5-OH THPI were determined by a validated method with limits of quantification of 0.005 mg/kg. The residues of captan and metabolites were below the limit of quantification in all of the 224 samples analysed. Captan was determined in foods prepared for consumption in the 1997, 1998 and 1999 USA Food and Drug Administration Pesticide Program Residue Monitoring Total Diet Studies. The number of samples analysed was 1036 in 1997, 1036 in 1998 and 1040 in 1999. Although residues of captan were detected in each of the surveys the incidence of detections was less than 2% and did not trigger specific mention in the reports. Gilvydis *et al.* (1986) reported a survey of captan residues in strawberries and grapes grown in Michigan and Indiana, USA, in the 1984 growing season. Captan was applied by overhead irrigation, tractor sprayer or aerial application at rates ranging from 0.6 to 6.7 kg ai/ha. Residues of captan were found in all 28 strawberry samples analysed with residue levels ranging from less than 0.01 to 1.5 mg/kg at 2 to 38 days after the last spray. Only six of 15 grape samples (Concord variety) treated with captan contained residues. The grape samples were harvested >54 days after the last spray with residues in the range less than 0.01 to 0.08 mg/kg. The government of Poland provided summary information on the residues of captan in apples, cherries and plums

Table 60. Residues of captan in apples, cherries and plums in Poland.

Year	No. of Samples	No. of Detections	No. of samples in residue range, mg/kg							
			<0.01[1]	>0.01-≤0.02	>0.02-≤0.05	>0.05-≤0.1	>0.1-≤0.5	>0.2-≤0.5	>0.5-≤1	>1-≤2
Apples										
1997	294	35	259	2	6	6	11	7	3	
1998	290	20	170		1	1	2	3	9	4
Cherries										
1997	81	2	79			2				
1998	114	14	100		2	2	3	5		1
Plums										
1997	53	0								
1998	61	0								

[1] LOQ

NATIONAL MAXIMUM RESIDUE LIMITS

The residue is defined as captan *per se* in Australia, the countries of the EU, and the USA, the only countries for which information was provided. The Meeting was informed that the following national MRLs had been established.

Country	Commodity	MRL, mg/kg
Argentina	Potato	10
	Tomato, pimento, aubergine, water melon, pumpkin, melon	15
Austria	Pome fruit, berries and small fruit, grapes and tomatoes	3
	Beans, broad-leaved endives, endives, leeks, stone fruit, lettuce and peas	2
	Other fruit and vegetable	0.1
Australia	Pome fruit, grape, strawberry, apple pomace, dry	10
	Stone fruit	15
	Edible offal (mammalian)	0.05
	Meat (mammalian)	0.05
	Milks	0.01

Country	Commodity	MRL, mg/kg
	Treatment of seed rice and vegetable seeds, fungicidal seed dressing	No MRL required
Belgium	Apples/pears, small fruit, tomatoes	3
	Berries	10
	Stone fruit (cherries/prunes), beans, endive, leeks, lettuce	2
	others	0.1[1]
Brazil	Garlic, apple, pear	25
	Citrus, peach, tomato	15
	Onion, cucumber	10
	Melon, watermelon, grapes	2
	Potato	1
Canada	Apples, apricots, blueberries, cranberries, cherries, grapes, peaches, pears, plums, raspberries, strawberries, tomatoes and potatoes.	5
EU (Directive 76/895/EEC)	Pome fruit, berries and small fruit, grapes and tomatoes	3
	Beans, broad-leaved endives, endives, leeks, stone fruit, lettuce and peas.	2
	Other fruits and vegetables	0.1
France	Pome fruits (apples, pears) berries, grapes, small fruits, tomatoes, stone fruits	3
	Chicory - salads, beans, leek, peas, endive	2
	Other fruits and vegetables	0.1
Germany	Pome fruit, berry fruit, tomatoes, grapes	3
	Beans, chicory, endive, peas, lettuce, leeks, stone fruit	2
	Hops, others	0.1
Greece	Pome fruit, berries, small fruit, grapes, tomatoes	3
Hungary	Paprika, tomato	5
	Melon, cucumber	2
	Other vegetables	5
	Fruit	5
	Wine/grape	2
Italy	Pome fruit, berries, grapes, tomatoes	3
	Stone fruit, leaf greens, lettuce, beans, peas, leeks	2
	Other vegetables	0.1
Japan	Tomato, eggplant, cucumber, apple, pear, grape, cherry, plum, peach, strawberry, melon	5
Kenya	Apples, cherries	40
	Pears	30
	Apricots	20
	Citrus fruits, peaches, plums, rhubarb, tomatoes	15
	Strawberries, raspberries, cranberries, cucumbers	10
	Green beans, lettuce, marrow, peppers, raisins	5
Malaysia	Leafy vegetables, non-leafy vegetables	10
	Tea, coffee	15
	Onions, potatoes	20
Mexico	Grape	50
	Apple/pear, avocado, garlic, carrots, melon, cucumber, watermelon, strawberry, tomato	25
	Mango	50
	Other crops (not listed here)	2-100
Netherlands	Berries and small fruit (including currants and strawberries), top fruit (apple, pear), tomato	3
	Leaf vegetables (including lettuce and endive), stone fruit, leeks, pulse crops	2
	Other fruit and nuts, other vegetables (including spinach), cereals	0.1
Poland	Berries and other small fruits, pome fruit, tomato	3
	Leek, legume vegetables, lettuce (head), stone fruits	2
	Other products of plant origin	0.1
Spain	Pome fruits, grapes, berries, small fruits, tomato, aubergine	3
	Stone fruit, beans, pea, lettuce, leek	2
	Citrus	0.5
	All other vegetables	0.1
Sweden	Fruit and vegetables (except those listed below)	0.1
	Apples, pear, berries, grapes, tomatoes	3
	Stone fruits, salads, beans, peas	2
Switzerland	Pome, berries, small fruit, tomatoes, aubergine	3

Country	Commodity	MRL, mg/kg
	Stone fruit, salads, beans, peas, leek	2
Turkey	Peaches, apples, pears, citrus fruits	5
	Raisins, tomatoes, peppers	3
	Grape	2
	Milk	0.05
	Cucumber, lettuce	1
USA	Almond hulls, beet (greens), cherries, lettuce, plums (fresh prunes), spinach	100
	Almonds, beet (roots), broccoli, Brussels sprouts, cabbage, carrots, cauliflower, collards, sweet corn (husk removed), kale, mustard greens, peas (dry), peas (succulent), rutabagas (roots), soybeans (dry), soybeans (succulent), turnip (greens), turnip (roots)	2
	Apples, beans (dry), beans (succulent), blackberries, blueberries (huckleberries), cantaloupes, cucumbers, dewberries, eggplants, honeydew melons, muskmelons, onions (dry bulb), pears, peppers, potatoes, pumpkins, raspberries, squash (summer), squash (winter), strawberries, tomatoes, watermelons	25
	Apricots, celery, grapes, mangoes, nectarines, onions (green), peaches	50
	Cattle fat, cattle meat, cattle meat-byproducts, hog fat, hog meat, hog meat-byproducts	0.05

APPRAISAL

Captan was first evaluated in 1965. It was listed by the 1995 CCPR (ALINORM 95/24 A) for periodic re-evaluation, and the 1997 CCPR scheduled it for consideration by the FAO Panel of the 1998 JMPR (ALINORM 97/24 A). As the rights on this compound were being shifted from one company to another, a request was made that re-evaluation of captan be deferred until 2000. The Meeting received information on the physicochemical properties, metabolism, environmental fate, analytical methods, stability under storage, registered uses, residues found in supervised trials, and processing.

Metabolism

Captan is susceptible to cleavage of the N-S bond to produce 1,2,3,6-tetrahydrophthalimide (THPI) and derivatives of the trichloromethylthio side-chain. The Meeting received reports of studies of the distribution and metabolism of captan in animals and plants in which captan was radiolabelled at the cyclohexene ring, the indole ring, or the carbon of the trichloromethylthio side-chain.

Animals and birds

In a material balance study, [trichloromethyl-^{14}C]captan was administered to lactating goats by gelatine capsule (at a dose equivalent to 55 ppm) for 2 days, and the animals were slaughtered 16 h after the last dose. Most of the radiolabel was recovered in the gastrointestinal tract (20%) and as expired CO_2 (43%) and most of the remainder in urine (8%), faeces (4.6%), and milk (0.2%). When a lactating goat was given [trichloromethyl-^{14}C]captan at a dose equivalent to 50 ppm for 7 days, 36% of the radiolabel was recovered in the excreta. The concentration of total radiolabelled residues in milk reached a plateau at 2.2 mg/kg (expressed as captan) on days 4-5. The highest concentrations were observed in kidney (4.4 mg/kg) and liver (4.7 mg/kg) (as captan). The low recovery of the administered dose is probably due to bacterial conversion of $^{14}CO_2$ to methane in the rumen.

The radiolabel in tissues at sacrifice accounted for 1.3% of a dose of [trichloromethyl-^{14}C]captan administered to a lactating goat orally at 1.4 mg/kg bw per day for 3 days. The highest concentrations were found in liver (2.0 mg/kg) and kidney (1.6 mg/kg) (as captan). Most of the radiolabel in tissues and milk was incorporated into natural products.

When a lactating goat was given a capsule containing [carbonyl-^{14}C]captan at 1.4 mg/kg bw per day three times daily (equivalent to 50 ppm), the major metabolites in urine were *cis*- or *trans*-3-hydroxy-1,2,3,6-tetrahydrophthalimide (3-OH THPI), *cis*- or *trans*-5-hydroxy-1,2,5,6-

trihydrophthalimide (5-OH THPI), and 4,5-dihydroxyhexahydrophthalimide (4,5-diOH HHPI). The major metabolites in tissues and milk were 1,2,3,6-tetrahydrophthalimide (THPI), *cis*- or *trans*-3-OH THPI), and *cis*- or *trans*-5-OH THPI. The concentrations of total radioactive residues (in rank order) were 2.3 mg/kg in kidney, 1.7 mg/kg in liver, 0.66 mg/kg in muscle, and 0.36 mg/kg in fat, as captan.

More than 88% of a dose of [trichloromethyl-^{14}C]captan administered to a hen by capsule for 2 days at a rate equivalent to 10 ppm was recovered in excreta and as $^{14}CO_2$. Only 2.8% of the dose was recovered in the carcase.

When hens were dosed orally with [trichloromethyl-^{14}C]captan at a nominal rate equivalent to 10 ppm for 10 days, the concentrations of radiolabelled residues in eggs reached a plateau by day 8 of dosing. The concentrations were highest in kidney, liver, and egg yolk. Much of the radiolabelled residue was incorporated into natural products.

When a group of laying hens was dosed orally with [cyclohexene-^{14}C]captan at a nominal rate equivalent to 10 ppm for 10 days, the concentrations of radiolabelled residues in eggs reached a plateau 2-4 days after the start of dosing. Most of the dose was excreted. The radiolabel in tissues and eggs represented 3.2% of the administered dose. The major metabolites identified in tissues and eggs were THPI, 3-OH THPI, 5-OH THPI, THPI expoxide, *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid, and 4,5-dihydroxyhexahydrophthalimide.

The studies of metabolism show that captan is rapidly degraded in goats and hens and is not detectable in tissues, milk, or eggs. The N-S bond is cleaved to form THPI and derivatives of the trichloromethylthio side-chain. THPI undergoes a variety of oxidations and hydroxylations to yield THPI epoxide, 4,5-dihydroxyhexa-hydrophthalimide, 3-OH THPI, 5-OH THPI, and *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid as the major metabolites. The tetrachloromethylthio derivatives are metabolized with incorporation of the trichloromethyl carbon into natural products, including CO_2 and CH_4.

Plants

When lettuce and tomato plants were treated four times with [trichloromethyl-^{14}C]-captan or [cyclohexene-^{14}C]captan at 4.5 kg ai/ha at 7-day intervals, most of the radiolabel was found in the leaves and fruit of tomatoes and the leaves of lettuce 3 h after the last spray.

When tomatoes were treated with [cyclohexene-^{14}C]captan, unextractable residues represented less than 9% of the total radiolabel in all components except tomato pulp, in which unextractable residues represented 42% of the total radiolabel. When tomato pulp was fractionated, 71% of the radiolabel was associated with carbohydrates, 18% with amino acids, and 3% with lignins.

With both labels, most of the residue remained on the surface of the plant or fruit as unmetabolized captan. In the plants, captan was metabolized to THPI, which undergoes further transformation.

Most the radiolabel in field-grown Golden Delicious apples on trees treated with [carbonyl-^{14}C]captan and harvested 3 h and 20 days after treatment was located on the surface of the fruit and was present as captan. Residues of THPI and *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid represented 3.3-7.6% and 0.4-2.4% of the radioactive residue, respectively. The concentrations of residues in apple peel and pulp were low, captan representing 46 and 15%, respectively, of the radiolabel. The main metabolites in peel and pulp were THPI and *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid.

In apples, tomatoes, and lettuce, most residue was present on the surface of the leaves and fruit, mainly as unchanged captan. Metabolism in these plants included cleavage of the thio-indole bond with incorporation of the carbon of the trichloromethylthio side-chain into natural products. The other major product after cleavage, THPI, is further metabolized to *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid and THPI expoxide. Captan is also oxidized to captan epoxide, which may undergo hydrolysis to form THPI epoxide.

Environmental fate

Confined rotational crops

In a study of confined crop rotation, beet, lettuce, and wheat seeds were planted in soil treated with [cyclohexene-^{14}C]captan or [trichloromethyl-^{14}C]captan 34 and 88 days after treatment and grown to maturity. Little radiolabel was found in the crops at harvest. The concentrations of radiolabelled residues in immature plants were highest in lettuce and beet. The concentrations in crops planted 88 days after application of captan to the soil were lower than those in crops planted 34 days after application. No residues of captan were detected. Most of the residue consisted of THPI and a variety of more polar metabolites, the most significant being *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid and 4,5-dihydroxyhexahydrophthalimide. The Meeting concluded that the concentrations of residues of captan inadvertently introduced into rotational crops would not be significant and that the carryover of captan under field conditions would be <0.01 mg/kg, a typical lower limit of quantification (LOQ).

Degradation in soil

The aerobic and anaerobic degradation of [trichloromethyl-^{14}C]captan was studied on sandy loam soils. Under aerobic conditions, most of the radiolabel was recovered as $^{14}CO_2$. The calculated degradation half-life of [trichloromethyl-^{14}C]captan was 1-3 days at 25°C. Under aerobic conditions in sterile soil, 75% of the radiolabel was recovered as $^{14}CO_2$ within 90 days of incubation. When non-sterile soil was used, 100% of the radiolabel was recovered as $^{14}CO_2$ within ^{14} days of incubation. The radiolabel recovered as $^{14}CO_2$ after aerobic incubation at 25 °C of [carbonyl-^{14}C]-captan on loamy sand represented 20% by 7 days and reached 94% by 244 days of incubation. No captan was detected after 7 days of anaerobic incubation of [carbonyl-^{14}C]captan on loamy sand. Less than 9% of the radiolabel was recovered as $^{14}CO_2$ after 9 months of incubation. The major metabolites identified were THPI, *cis*-6-cyano-3-cyclohexenecarboxylic acid, *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid, and *cis*-4-cyclohexene1,2-dicarboxylic acid. The half-life for aerobic degradation of THPI at 20°C in the dark was 5-6 days in loamy sand or sandy loam and 20 days in sand. The half-lives for aerobic degradation of *cis*-4-cyclohexene1,2-dicarboxylic acid were 4-5 days in loamy sand or sandy loam and 7 days in sand.

Captan is not susceptible to photolytic degradation, as the loss after irradiation of [trichloromethyl-^{14}C]captan or [cyclohexene-^{14}C]captan on sandy loam soil was minor when compared with hydrolysis and metabolic degradation.

Studies of the dissipation of captan in loamy sand, sand, clay, loam, and silt loam soils showed that it did not migrate below the top 15 cm of soil, except in a single sample of loamy sand (strawberry plot). The half-lives for captan in the 0-7.5-cm soil horizon were 14 days in an apple orchard, 2.5 days in a strawberry plot, 24 days in a grape plot, 4 days in a cantaloupe plot, and 3-6 days in tomato plots.

Captan is not amenable to adsorption or desorption from soil or water systems owing to its rapid hydrolysis. The degradation of captan in soil-water mixtures was dependent on pH, being most rapid at pH 7, the highest pH studied. The only degradate detected was THPI. The presence of soil in the test solutions resulted in an increased rate of degradation.

In studies of leaching in three soil types, captan was not readily leached, none being found below the 0-5-cm horizon. The degradation half-lives for captan in aged soil samples were 10-35 days.

Fate in water and sediment systems

The half-life of captan in two non-sterile water and sediment systems was <24 h, no captan being detected after 24 h of incubation. Captan is rapidly hydrolysed to THPI. Other products identified after the incubation were *cis*- or *trans*-6-carbamoyl-3-cyclohexene-1-carboxylic acid, *cis*-4-cyclohexene-1,2-dicarboxy-lic acid, and THPI epoxide. The products were degraded, such that none could be detected after 59 days of incubation. Negligible amounts of $^{14}CO_2$ evolved in the sterile systems. Most of the radiolabel present after 90 days of incubation was found in THPI. There was no significant volatilization of captan from soil.

Methods of analysis

Adequate methods have been developed for the determination of residues of captan and THPI on crops and for THPI and the hydroxylated metabolites 3-OH THPI and 5-OH THPI in animal commodities. The methods typically involve maceration of the sample with a solvent, which is usually ethyl acetate or acetone. As captan is readily hydrolysed at high pH, a small quantity of phosphoric acid is often added at the extraction step in order to lower the pH. Different procedures are required for the clean-up of captan and THPI: extracts of captan are cleaned-up on a silica column, while THPI must be partitioned with basic aqueous buffer and then with dichloromethane. The final extracts are analysed on a gas chromatograph equipped with an electron capture detector for captan and a thermionic detector for THPI. Typical LOQs are 0.01 mg/kg for captan and 0.02 mg/kg for THPI. The hydroxylated metabolites 3-OH THPI and 5-OH THPI must be silylated before determination by gas chromatography. Extensive data on recovery were presented for the most common methods.

Stability of residues in stored analytical samples

The possibility that captan on agricultural commodities might be hydrolysed must be considered when conducting analyses. Samples for analysis should be stored whole, and the extraction step should be completed as soon as possible after maceration. The stability of captan and THPI during frozen storage of field and fortified samples of almonds, almond nuts (whole, coarsely ground), apples, apple juice, apple sauce, beet tops, cherries, corn grain, cucumbers, dry grape pomace, lettuce, maize grain (whole, coarsely ground), melons, potato tubers, raisins, soya bean forage, soya beans, spinach (leaves, coarsely chopped, finely chopped), strawberries, sugar-beet tops, tomatoes, tomato pomace, tomato sauce, and wheat forage were determined.

The concentrations of residues of captan represented more than 70% of the initial concentration for at least 15 months in apple juice and soya bean forage; 14 months in strawberries; 13 months in apples; 12 months in cherries; 10 months in raisins; 9 months in whole almond nuts, apple sauce, dry grape pomace, potatoes, tomatoes, dry tomato pomace, and tomato sauce; and 6 months in sugar-beet tops. Generally, when captan was degraded the concentration of THPI increased concomitantly. THPI was stable for at least 14 months when stored frozen in a variety of matrices.

Captan residues were more stable when stored in whole commodities than in homogenized samples. Maceration may increase exposure of captan residues to plant enzymes and water. As the main route of decomposition appears to be hydrolysis to THPI, the finding of lower concentrations of THPI residues than of captan residues is a good indication that the residue is stable in storage. With the exception of homogenized cucumbers (and presumably other cucurbits), the stability of captan in the commodities for which maximum residue levels are recommended is acceptable. The stability of captan in cucurbits might be acceptable if the samples are stored whole.

Captan is not expected to be detected in milk, eggs, or animal tissues. THPI, 3-OH THPI, and 5-OH THPI were stable in frozen fortified bovine milk and tissue samples for 3.2-3.7 years.

Definition of the residue

Captan is the major component of the residue in plants but may be hydrolysed to THPI during preparation of samples for analysis, frozen storage (especially of homogenized samples), and processing of the raw agricultural commodity. A separate analysis would be required if THPI were included in the residue definition, but it usually represents only a minor part of the residue and its inclusion in the residue definition for captan would make little difference. On the basis of the metabolism of captan in plants, the conclusions of the 1995 JMPR on the toxicity of residues of captan, and the available analytical methods, the Meeting concluded that the residue for compliance with MRLs and for estimation of dietary intake should continue to be captan.

Results of supervised trials

Captan is registered for use as a fungicide with foliar, soil, and post-harvest applications. The results of supervised trials were reported for citrus (oranges, mandarins, lemons, grapefruit), apples, pears, cherries, peaches, nectarines, plums, apricots, blueberries, strawberries, grapes, raspberries, cucumbers, melons, tomatoes, potatoes, radishes, chives, and almonds.

Trials with mandarin were presented from Japan, but the application rates were exaggerated and did not comply with GAP; furthermore, residues in pulp and peel were analysed separately. Although data were made available for lemon and grapefruit in the USA, the data were not evaluated as there was no matching GAP.

The results of trials with orange in Brazil and Spain were available. In four trials in Brazil that complied with GAP (0.11-0.12 kg ai/hl; PHI, 7 days), the concentrations of residues were 0.06, 0.10, 0.17, and 0.34 mg/kg. THPI was not detected in the two trials in which it was measured (<0.05 mg/kg). The concentrations of residues of captan in four trials conducted in Spain according to GAP (0.15-0.25 kg ai/hl; PHI, 10 days) were 0.4, 1.0, 2.1, and 2.7 mg/kg. No residues of THPI were detected (<0.05 mg/kg). The Meeting concluded that the results of the studies in Brazil and Spain could not be combined for the purposes of estimating a maximum residue level as they represented two different populations. A trial reported from the USA was not conducted according to GAP and was not considered further. Insufficient information was available to recommend a maximum residue level for oranges.

Supervised field trials on apple were reported from Argentina, Australia, Brazil, Canada, Germany, Hungary, Japan, The Netherlands, South Africa, the UK, and the USA. Trials in Chile, France, Israel, and Portugal did not correspond to GAP in those countries and were not evaluated.

The registered use pattern in Argentina is 0.12 kg ai/hl with a 14-day PHI. The concentration of residues in apples in a single trial with a spray concentration of 0.16 kg ai/hl was 0.0005 mg/kg.

In Australia, seven sprays at 0.13 kg ai/hl were used, and apples were sampled 7 days after the last spray. GAP in Australia is sufficiently close: five applications of 0.1 kg ai/hl with a 7-day PHI. The concentration of captan was 3.7 mg/kg. THPI was not measured.

In the six trials in Brazil, apples were sprayed 10-11 times at 0.12 kg ai/hl. The GAP rate is 0.11-0.12 kg ai/hl with a 1-day PHI. The concentrations of captan residues after 1 were 0.44, 0.68, 1.0, 1.4, 2.5, and 4.1 mg/kg and those of THPI were 0.11, 0.12, 0.18, 0.18, 0.38, and 0.55 mg/kg.

Eight trials on apples in Canada, in which the conditions corresponded to GAP (3 kg ai/ha; PHI, 7 days) resulted in concentrations of captan of 2.8, 2.9, 2.9, 3.2, 3.9, 4.2, 4.5, and 4.5 mg/kg and residues of THPI of <0.05, <0.05, 0.05, 0.05, 0.05, 0.06, 0.07, and 0.08 mg/kg.

The concentrations of captan in three German trials conducted according to GAP (0.1 kg ai/hl; PHI, 21 days) were 1.0, 1.1, and 3.0 mg/kg.

In a single trial in Hungary that complied with its GAP (1-1.5 kg ai/ha or 0.1-0.15 kg ai/hl; PHI, 10 days), the concentration of residues of captan was 1.5 mg/kg.

In Japan, captan is registered for use on apples at 2-8 kg ai/ha or 0.07-0.13 kg ai/hl with harvesting 14 days after the last spray. The concentrations of residues in five trials were 1.3, 2.1, 3.8, 4.6, and 7.2 mg/kg.

The GAP in The Netherlands is 0.05-0.21 kg ai/hl with a PHI of 7 days when application is at 0.06 kg ai/hl and 21 days when the application rate exceeds 0.1 kg ai/hl. The concentrations of residues of captan in six trials were 0.26, 0.55, 0.77, 0.84, and 1.0 (2 trials) mg/kg, and those of THPI residues were 0.11 (2 trials), 0.14, 0.19, 0.22, and 0.23 mg/kg.

The application rate in two trials conducted in South Africa was sufficiently close to GAP in that country (0.08-0.1 kg ai/hl; PHI, 14 days). The concentrations of residues in apples treated twice at 0.08 kg ai/hl with a 16-day PHI were 2.0 and 3.6 mg/kg, while that of THPI was 0.11 mg/kg for both trials.

GAP in the UK is 2.7 kg ai/ha with a PHI of 14 days. In 15 trials in which apples were given 3-16 applications at 2.7-2.9 kg ai/ha with a PHI of 12-14 days, the concentrations of captan were 0.5, 0.72, 0.91, 1.0, 1.2, 1.4, 2.0, 2.2, 2.4, 2.4, 2.6, 3.1, 3.7, 3.9, and 4.2 mg/kg. Those of THPI residues were <0.05 (3 trials), 0.07 (2 trials), 0.08, 0.09, 0.10, 0.11, 0.12, 0.14, 0.15, 0.2 (2 trials), and 0.36 mg/kg.

Two trials in the USA met GAP in that country, which includes both pre-harvest application (2.2-4.5 kg ai/ha; PHI, 0 day) and post-harvest application (dipping at 1.5 g ai/l; withholding interval, 0 day). After eight foliar sprays at 4.5 kg ai/ha and post-harvest dipping at 1.5 g ai/l, the concentrations of residues of captan were 5.9 and 7.7 mg/kg, and those of THPI were 0.09 and 0.35 mg/kg. Post-harvest dipping alone resulted in concentrations of similar magnitude: 2.9, 3.3, 4.0, and 7.8 mg/kg. The concentrations of THPI residues were 0.12, 0.10, 0.09, and 0.08 mg/kg in the same trials. The residues of captan after pre-harvest application alone at 4.5 kg ai/ha in nine trials were 0.86, 1.4, 1.5, 2.8, 3.9, 4.7, 4.9, 5.2, and 5.5 mg/kg, and those of THPI were <0.05, 0.07, 0.05, <0.05, <0.05, 0.10, 0.13, 0.76, and 0.21 mg/kg 0 days after the last spray.

The Meeting concluded that the results of trials of captan in apples by foliar and post-harvest applications should not be combined for the purposes of estimating a maximum residue level or STMR value, as they represent different residue populations. Rather, the results of trials of post-harvest application, the critical use pattern, should be used. The concentrations of residues of captan in apples in the six post-harvest trials in the USA, in rank order (median in italics), were 2.9, 3.3, **4.0**, **5.9**, 7.7, and 7.8 mg/kg. The Meeting decided to combine the data on apples with that on pears (see below) to estimate a maximum residue level for pome fruit. The STMR and HR values for captan in apples were estimated to be 4.95 and 7.8 mg/kg, respectively.

Supervised trials on pear conducted according to GAP were provided from Australia, Italy, Japan, the UK, and the USA. Trials in Chile, Germany, and South Africa did not correspond to GAP in those countries and were not evaluated.

The concentration of captan residues in a single trial in Australia after five applications of 0.13 kg ai/hl was 2.5 mg/kg 6 days after the last spray. GAP in Australia is five applications of 0.1 kg ai/hl with a PHI of 7 days. THPI residues were not measured.

In 12 trials in Italy, pears were given six to eight applications of 0.13 kg ai/hl with a PHI of 14 days. This rate compares well with the Italian GAP of 0.13-0.16 kg ai/hl and a PHI of 15 days. The concentrations of residues of captan 14 days after the last spray were 0.59, 0.68, 0.72, 0.81, 1.1, 1.2, 1.2, 1.3, 1.6, 1.9, 2.0, and 2.0 mg/kg. THPI residues were not determined.

The registered application rate in Japan is seven sprays at 0.08-0.13 kg ai/hl (2.4-8 kg ai/ha) with a 7-day PHI. In six trials, pears were treated with five to nine applications of 0.13 kg ai/hl. Seven days after the last spray, the concentrations of captan were 0.50, 0.77, 0.99, 2.3, and 2.6 (2 trials) mg/kg. THPI residues were not measured.

The results of five trials were provided by the UK in which treatment comprised eight to 10 sprays at 2.7 kg ai/ha and sampling 12-14 days after the last spray. GAP in that country is 12 sprays at 2.7 kg ai/ha with a 14-day PHI. The concentrations of residues of captan were 1.2, 1.7, 1.9, 2.0, and 2.6 mg/kg, and those of THPI were <0.05, <0.05, <0.05, 0.08, and 0.11 mg/kg.

In the USA, captan is registered for post-harvest dipping at 1.5 g ai/l. The concentrations of residues of captan in pears dipped at 1.5 g ai/l were 11 and 4.7 mg/kg, and those of THPI were 0.47 and 0.07 mg/kg, respectively.

The Meeting considered that the post-harvest trials in the USA represent a different population from that in the other trials and that the results should not be combined for the purposes of estimating a maximum residue level or STMR value. However, it considered that similar residues would occur after post-harvest dipping of apples and pears and that the results for pears could be combined with those for apples to estimate a maximum residue level and STMR value for pome fruit. The concentrations of residues of captan in apples and pears in the eight trials of post-harvest treatment, in rank order, were 2.9, 3.3, 4.0, **4.7**, **5.9**, 7.7, 7.8, and 11 mg/kg. The Meeting estimated a maximum residue level of 15 mg/kg, an STMR value of 5.3 mg/kg, and a HR value for captan in pome fruit of 11 mg/kg. The estimated maximum residue level replaces the current recommendations of 20 mg/kg for apples and 10 mg/kg for pears.

Supervised trials on cherry were provided from Canada, Germany, Japan, and the USA. A trial in Belgium did not correspond to GAP in that country and was not evaluated.

In five trials in Canada approximating GAP (3-3.6 kg ai/ha; PHI, 2 days for sweet cherries and 5 days for sour cherries), the concentrations of residues of captan were 5.0 and 13 mg/kg in sweet cherries and 4.9, 9.7, and 13 mg/kg in sour cherries.

Two trials in Germany were evaluated on the basis of Belgian GAP (spray concentration, 0.12 kg ai/hl; PHI, 4 days), as details of GAP in Germany were not provided. The concentrations of residues of captan were 1.9 and 4.0 mg/kg 3 days after the last spray.

When captan was applied according to GAP in Japan (five sprays at 3-6 kg ai/ha or 0.1 kg ai/hl; PHI, 14 days), the concentrations of residues of captan in two trials were 0.58 and 1.3 mg/kg. Those in 12 trials of treatment with four to five sprays at 5.6-7 kg ai/ha (0.08-0.1 kg ai/hl) were 0.66, 0.69, 0.77, 0.78, 1.2, 1.3, 1.5 (3 trials), 1.7, 2.2, and 2.3 mg/kg at a PHI of 14 days.

In the USA, captan is registered for both pre-harvest use (1.1-2.2 kg ai/ha; PHI, 0 days) and post-harvest use (1.5 g ai/l). In two trials in which cherries were treated before harvest with seven sprays at 2.2 kg ai/ha and after harvest at 1.5 g ai/l, the concentrations of residues of captan were 23 and 35 mg/kg and those of THPI were 0.34 and 0.45 mg/kg. When captan was used as a post-harvest dip only in two trials, the concentrations of captan were 14 and 15 mg/kg and those of THPI were 0.23 and 0.30 mg/kg. Pre-harvest use of captan in 12 trials of six to seven sprays at 1.7-2.2 kg ai/ha resulted in residue concentrations of 2.4, 2.8, 4.3, 5.5, 11, 12, 14 (2 trials), 19, 20 (2 trials), and 21 mg/kg. In the trials in which THPI residues were measured, the concentrations were 0.13, 0.17, 0.18, and 0.24 mg/kg.

The Meeting concluded that the residues of captan in cherries in the post-harvest trials in the USA and in the trials in Japan (indoor and outdoor) represented different populations from those in the other trials, and the results could not be combined for the purposes of estimating a maximum residue level or STMR value. The concentrations of residues of captan in cherries in the remaining 19 trials, in rank order, were 1.9, 2.4, 2.8, 4.0, 4.3, 4.9, 5.0, 5.5, 9.7, **11**, 12, 13 (2 trials), 14 (2 trials), 19, 20 (2 trials), and 21 mg/kg. The Meeting estimated a maximum residue level of 25 mg/kg, an STMR value of 11 mg/kg, and a HR value for captan in cherries (whole fruit basis) of 21 mg/kg. The estimated maximum residue level replaces the current recommendation of 40 mg/kg for cherries.

Supervised trials on plum conducted according to GAP were provided from Greece, Japan, Portugal, Spain, and the USA. Trials from Chile did not correspond to GAP in that country and were not evaluated.

The concentration of captan in a trial conducted according GAP in Greece for stone fruit (0.13 kg ai/hl; PHI, 20 days) was 0.13 mg/kg, and that of THPI was 0.07 mg/kg.

In Japan, captan is registered for use at 2.4-8 kg ai/ha (0.08-0.13 kg ai/hl) on plums, with the last application at least 14 days before harvest. The concentrations of residues of captan in plums in four trials that complied with GAP were 0.95, 1.8, and 3.0 (2 trials) mg/kg.

The concentration of captan in a trial conducted according GAP in Portugal (0.15-0.2 kg ai/hl; PHI, 7 days) was 6.7 mg/kg, and that of THPI was 0.67 mg/kg.

In two trials conducted according to GAP in Spain for stone fruit (0.13-0.15 kg ai/ha; PHI, 10 days), the concentrations of captan were 0.67 and 0.85 mg/kg, and those of THPI were 0.13 and 0.18 mg/kg.

Captan is registered in the USA for use on plums at 2.2-3.4 kg ai/ha with a PHI of 0 days. The concentrations of captan in four trials approximating GAP were 0.45, 0.60, 5.6, and 7.9 mg/kg, and the corresponding values for THPI residues were <0.05 mg/kg, although this compound was not measured in the trial in which 7.9 mg/kg of captan were found.

The concentrations of residues of captan in plums in the 12 trials, in rank order, were 0.13, 0.45, 0.60, 0.67, 0.85, **0.95**, **1.8**, 3.0 (2 trials), 5.6, 6.7, and 7.9 mg/kg. The Meeting estimated a maximum residue level of 10 mg/kg, an STMR value of 1.4 mg/kg, and a HR value for captan in plums (whole fruit basis, including prunes) of 7.9 mg/kg. The estimated maximum residue level replaces the current recommendation of 5 mg/kg for plums including prunes.

The concentrations of captan in apricot in four trials in the USA that complied with GAP (1.7-2.7 kg ai/ha; PHI, 0 day) were 3.3, 4.5, 6.0, and 6.8 mg/kg, and those of THPI were <0.05-0.21 mg/kg. There was insufficient information to estimate a maximum residue level for apricots.

Supervised trials on nectarine conducted according to GAP were provided from Greece and Spain. Trials from Chile and the USA did not correspond to the maximum GAPs in those countries and were not evaluated.

The concentrations of captan in two trials conducted according to GAP in Greece for stone fruit (0.13 kg ai/hl; PHI 20 days) were 0.90 and 1.5 mg/kg, and those of residues of THPI were 0.19 and 0.22 mg/kg.

In two trials conducted according to GAP in Spain for stone fruit (0.13-0.15 kg ai/ha; PHI, 10 days), the concentrations of captan were 1.3 and 1.8 mg/kg and those of THPI were 0.17 and 0.21 mg/kg.

An inadequate number of trials of use of captan on nectarines was available to estimate a maximum residue level, but the Meeting agreed that the results of trials in comparable countries on peaches and nectarines treated at the same rates and harvested at the same PHI could be combined for the purposes of estimating a maximum residue level and STMR value. Application of captan to peaches in seven trials in Italy at rates that corresponded to the Spanish GAP for nectarines resulted in concentrations of captan residues in peaches of 0.26, 0.81, 0.90, 1.0 (2 trials), 1.2, and 1.5 mg/kg.

The concentrations of captan in the four trials on nectarines and seven on peaches, in rank order, were 0.26, 0.81, 0.90 (2 trials), **1.0** (2 trials), 1.2, 1.3, 1.5 (2 trials), and 1.8 mg/kg. The Meeting estimated a maximum residue level of 3 mg/kg, an STMR value of 1 mg/kg, and a HR value in nectarines (whole fruit) of 1.8 mg/kg. The estimated maximum residue level replaces the current recommendation of 5 mg/kg for nectarines.

Supervised trials on *peach* conducted according to GAP were provided from Australia, Canada, Italy, and the USA. Trials from Chile, Japan, and Spain did not correspond to GAP in those countries and were not evaluated.

The concentration of captan in a trial in Australia was 4.7 mg/kg 6 days after treatment with five sprays of 0.13 kg ai/hl. GAP for stone fruit is five applications at 0.1 kg ai/hl with a 7-day PHI.

In Canada, GAP permits application of captan to peaches as two sprays of 3.4 kg ai/ha with a 2-day PHI. In five trials, the concentrations of captan were 3.2, 5.5, 6.6, 7.3, and 16 mg/kg 1 or more days after the last spray. Residues of THPI were not measured.

As described above, seven trials in Italy were evaluated on the basis of the Spanish GAP for stone fruit (0.13-0.15 kg ai/hl; PHI, 10 days), as Italian GAP was not provided The concentrations of captan were 0.26, 0.81, 0.90, 1.0 (2 trials), 1.2, and 1.5 mg/kg. THPI residues were not measured.

In the USA, GAP for peaches is 2.2-4.5 kg ai/ha with a PHI of 0 days. The concentrations of captan in 10 trials were 2.0, 4.3 (2 trials), 5.8, 6.0, 7.4, 7.8, 10, 12, and 14 mg/kg, and those of THPI were <0.05 (4 trials), 0.07, 0.08, 0.15, 0.18, 0.29, and 0.33 mg/kg.

The concentrations of captan in the 23 trials in peaches, in rank order, were 0.26, 0.81, 0.90, 1.0, 1.0, 1.2, 1.5, 2.0, 3.2, 4.3, 4.3, ***4.7***, 5.5, 5.8, 6.0, 6.6, 7.3, 7.4, 7.8, 10, 12, 14, and 16 mg/kg. The Meeting estimated a maximum residue level of 20 mg/kg, an STMR value of 4.7 mg/kg, and a HR value for captan in peaches (whole fruit basis) of 16 mg/kg. The estimated maximum residue level replaces the current recommendation of 15 mg/kg for peaches.

In the USA, captan is registered for use on *blueberry* at a rate of 1.1-2.7 kg ai/ha with a 0-day PHI. The concentrations of captan in 16 trials that complied with GAP were 2.0-18 mg/kg, and those of THPI were <0.05-0.17 mg/kg.

The concentrations of captan in the 16 trials in blueberries, in rank order, were 2.0, 3.2, 3.9, 4.0, 4.2, 4.8, 5.4, 6.5, ***6.9*** (2 trials), 7.1, 8.2, 8.3, 8.4, 15, and 18 mg/kg. The Meeting estimated a maximum residue level of 20 mg/kg, an STMR value of 6.9 mg/kg, and a HR value for captan in blueberries of 18 mg/kg. The estimated maximum residue level confirms the current recommendation of 20 mg/kg for blueberries.

Data were available from supervised trials on *grape* conducted according to GAP in Australia, Brazil, Germany, Japan, and the USA. Trials from Chile and France did not correspond to GAP and were not evaluated.

GAP in Australia allows a maximum of five applications at 0.1 kg ai/hl with harvesting 7 days after the final spray. In two trials, the concentrations of captan were 3.6 and 3.4 mg/kg, and those of THPI were 0.09 and 0.10 mg/kg.

The concentrations of captan in grapes in two trials conducted according to GAP in Brazil (0.11-0.12 kg ai/hl; PHI, 1 day) were 0.78 and 2.5 mg/kg.

Four trials in Germany were evaluated with the GAP for Belgium (0.12 kg ai/hl; PHI, 42 days), as GAP in Germany was not provided. The concentrations of captan were 0.79, 3.3, 4.7, and 6.3 mg/kg 35 days after the last of 10 sprays at 0.09 kg ai/hl.

In Japan, captan is registered for use on grapes at a maximum of five sprays at 0.1 kg ai/hl (2-3 kg ai/ha) with a PHI of 30 days. The concentrations of captan in nine indoor trials were 0.64, 0.79, 1.1, 1.8, 1.9, 2.1, 2.2, 6.3, and 7.7 mg/kg. When captan was applied to grapes in four outdoor trials, the concentrations were 0.7, 2.9, 7.1, and 9.7 mg/kg.

In nine trials conducted according to GAP in the USA (1.1-2.2 kg ai/ha; PHI, 0 day), the concentrations of captan in grapes were 1.3, 3.5, 3.7, 6.4, 7.2, 7.4, 8.4, 11, and 22 mg/kg, and those of THPI were <0.05 (3 trials), 0.07, 0.11, 0.14 (2 trials), 0.22, and 0.28 mg/kg.

The concentrations of captan in grapes in 23 trials, in rank order, were 0.65, 0.78, 0.79, 1.3, 2.4, 2.5, 2.9, 3.3, 3.4, 3.5, 3.6, ***3.7***, 4.7, 6.3 (2 trials), 6.4, 7.1, 7.2, 7.4, 7.7, 8.4, 11, and 22 mg/kg. The Meeting estimated a maximum residue level of 25 mg/kg, an STMR value of 3.7 mg/kg, and a HR value for captan in grapes of 22 mg/kg. The estimated maximum residue level confirms the current recommendation of 25 mg/kg for grapes.

Supervised trials on *raspberry* carried out in the USA were evaluated according to Canadian GAP (2 kg ai/ha; PHI, 2 days). The Meeting considered that the decrease in residues of captan was slow and that the concentrations in raspberries 0 and 3 days after the last spray could be used to estimate a maximum residue level and an STMR value. The concentrations of captan in five trials in the USA in which raspberries were treated at 1.8-2.3 kg ai/ha and harvested 0-3 days after the last spray were, in rank order, 5.7, 7.7, ***8.3***, 13, and 18 mg/kg. The Meeting estimated a maximum residue level of 20 mg/kg, an STMR value of 8.3 mg/kg, and a HR value for captan in raspberries of 18 mg/kg.

Data were available from supervised trials on *strawberry* conducted according to GAP in Belgium, Hungary, The Netherlands, Spain, and the USA.

In Belgium and The Netherlands, GAP permits application of captan at 0.12 kg ai/hl with a 4-day PHI for field-grown strawberries and a 14-day PHI for strawberries grown in a glasshouse. The concentrations of captan were 2.4 mg/kg in field-grown strawberries after 4 days in Belgium and 0.18, 0.13, 0.25, and 0.07 mg/kg in glasshouse-grown strawberries after 14 days in Belgium and The Netherlands. Trials conducted in Germany were evaluated with the GAP for Belgium, as thar for Germany was not reported. The concentrations in two field trials were 1 and 2 mg/kg 3 days after a single spray at 0.13 kg ai/hl.

GAP in Hungary permits application of three sprays of captan at 1-1.5 kg ai/ha (0.1-0.15 kg ai/hl) with a 10-day PHI. The concentration in a single trial was 0.93 mg/kg, while that of THPI was <0.1 mg/kg.

The concentration of captan in strawberries in a single Spanish trial that complied with GAP (0.13-0.15 kg ai/hl; PHI, 21 days) was <0.01 mg/kg, and that of THPI was 0.15 mg/kg.

Use of captan on strawberries in the USA is permitted at a rate of 1.6-3.4 kg ai/ha with harvesting on the day of the last application. The concentrations of captan in 10 trials were 2.0, 2.6, 3.9, 4.4, 5.4, 7.7, 8.7, 10, and 12 (2 trials) mg/kg, and those of THPI were 0.15, 0.19, 0.22, 0.23, 0.3, 0.34, 0.5, 0.53, 0.9, and 1.4 mg/kg.

The Meeting considered that the indoor trials in Belgium and The Netherlands and the field trial in Spain represented different populations of residues and could not be used to estimate an STMR value. The concentrations of captan in strawberries in 14 trials, in rank order, were 0.93, 1.0, 2.0, 2.0, 2.4, 2.6, ***3.9***, ***4.4***, 5.4, 7.7, 8.7, 10, and 12 (2 trials) mg/kg. The Meeting estimated a maximum residue level of 15 mg/kg, an STMR value of 4.2 mg/kg, and a HR value for captan in strawberries of 12 mg/kg. The estimated maximum residue level replaces the current recommendation of 30 mg/kg for strawberries.

Data were available from supervised trials on *melon* conducted according to GAP in Japan and the USA.

In four field trials in Japan, where GAP is 0.13 kg ai/hl or 2-4 kg ai/ha with a PHI of 14 days, the concentrations of captan were 3.6, 4.0, 4.1, and 4.6 mg/kg. Values <0.005 mg/kg were found in eight indoor trials.

Trials conducted in the USA were evaluated with Mexican GAP (1-1.5 kg ai/ha, with no specification of the interval between the last spray and harvesting, implying that harvesting on the day of the last spray is permitted), as GAP was not specified for the USA. The concentrations of captan in nine trials conducted at 2.2 kg ai/ha with harvesting on the day of the last of seven applications were 0.29, 0.36, 0.52, 0.56, 1.1, 1.8, 2.0, 2.9, and 6.7 mg/kg.

The Meeting decided that the residues in the indoor trials in Japan represented a different population from the others and discounted them for the purposes of estimating the STMR value. The concentrations of captan in melons in 13 trials, in rank order, were 0.29, 0.36, 0.52, 0.56, 1.1, 1.8, ***2.0***, 2.9, 3.6, 4.0, 4.1, 4.6, and 6.7 mg/kg. For the purposes of estimating the STMR and HR values for use in assessing dietary intake, it was noted that peeling reduced the concentration of captan in cantaloupe by 98% in a processing study in the USA (TMN-634A). The Meeting estimated a maximum residue level of 10 mg/kg, an STMR value of 0.04 (2.0-0.02), and a HR value for captan in melons excluding watermelon of 0.13 (6.7-0.02) mg/kg.

Data were available from supervised trials on *cucumber* conducted according to GAP in Brazil and Japan.

Captan is registered for use on cucumbers in Brazil at a spray concentration of 0.1 kg ai/hl with a 1-day PHI. The concentrations of captan in two trials were 0.06 and 0.16 mg/kg.

In six trials conducted according to GAP in Japan (0.1-0.13 kg ai/hl or 1.5-4 kg ai/ha; PHI, 1 day), the concentrations was 1.9 mg/kg in two indoor trials and 0.20, 0.24, 1.2, and 1.5 mg/kg in four outdoor trials.

The Meeting decided that the residues in the Japanese trials conducted indoors represented a different population from the others and discounted them for the purposes of estimating the maximum residue level and STMR value. The concentrations of captan in six trials in cucumbers, in rank order, were 0.06, 0.16, 0.20, ***0.24***, 1.2, and 1.5 mg/kg. The Meeting estimated a maximum residue level of 3 mg/kg, an STMR value of 0.22 mg/kg, and a HR value for captan in cucumbers of 1.5 mg/kg.

Although four trials on *squash* were reported from the USA, they could not be evaluated because the trial conditions did not correspond to GAP. There was insufficient information to recommend a maximum residue level for squash.

Data were available from supervised trials in Brazil and Japan on *tomato* conducted according to GAP.

In four trials conducted according to GAP in Brazil (0.11-0.12 kg ai/hl; PHI, 1 day), the concentrations of captan were 0.02, 0.12, 0.18, and 0.46 mg/kg. THPI was not measured in one of the trials, but the concentrations in the other three were 0.08, 0.09, and 0.27 mg/kg.

Captan is registered for use on tomatoes in Japan at 0.007-0.1 kg ai/hl (1-3 kg ai/ha) with a 1-day PHI. The concentrations of captan in tomatoes in four indoor trials were 0.40, 0.45, 0.78, and 1.1 mg/kg, and those in 12 outdoor trials were 0.22, 0.28, 0.29, 0.45, 0.50, 0.61, 0.66, 0.76, 0.79, 1.0, 1.7, and 2.3 mg/kg. Residues of THPI were not measured.

The Meeting decided that the residues in the Brazilian trials represented a different population from the others and discounted them for the purposes of estimating the STMR value. The concentrations of captan in tomatoes in the 16 trials in Japan, in rank order, were 0.22, 0.28, 0.29, 0.40, 0.45 (2 trials), 0.50, ***0.61***, ***0.66***, 0.76, 0.78, 0.79, 1.0, 1.1, 1.7, and 2.3 mg/kg. The Meeting estimated a maximum residue level of 5 mg/kg, an STMR value of 0.64 mg/kg, and a HR value for captan in tomatoes of 2.3 mg/kg. The estimated maximum residue level replaces the current recommendation of 2 mg/kg for tomatoes.

The single trial from Thailand on *soya bean* could not be evaluated because the information on GAP in Thailand did not specify a PHI. There was insufficient information to recommend a maximum residue level for soya beans.

Data were available from supervised trials on *potato* conducted according to GAP in Brazil and Mexico.

The concentration of captan in a single trial in Brazil conducted according to GAP (0.11-0.12 kg ai/hl; PHI, 14 days) was <0.01 mg/kg; THPI was not measured. In a separate trial, with harvesting 7 days after the last application, no residues of captan were detected (<0.05 mg/kg).

In Mexico, captan is registered for application to potatoes at a spray concentration of 0.1-0.2 kg ai/hl with a 7-day PHI. The concentrations of captan and THPI were <0.05 mg/kg in four trials conducted at 1.5 times the Mexican GAP.

The concentrations of captan in potatoes in the six trials, in rank order, were <0.01 and ***<0.05*** (5 trials) mg/kg. The maximum residue level, the STMR value, and the HR value for captan in potatoes were all estimated by the Meeting to be 0.05 mg/kg. The results of many trials in which the GAP was not reported but in which the PHIs and application rates were similar to or greater than those in Brazil and Mexico support the conclusion that the concentration of residues will be <0.05 mg/kg.

Although eight trials on *radish* were reported from Germany, GAP was not provided, and they could not be evaluated. There was insufficient information to recommend a maximum residue level for radishes.

Data were available from supervised trials on *almond* conducted according to GAP in the USA. Captan is registered in the USA for use on almonds at a rate of 2.2-4.9 kg ai/ha with a 30-day PHI. The Meeting considered that captan is a surface residue but that shelling gives rise to residues in the nut. In 13 trials, the concentrations of captan were <0.01, 0.01, <0.03, 0.04, ***<0.05*** (7 trials), 0.10, and 0.20 mg/kg in the nut. The Meeting estimated a maximum residue level of 0.3 mg/kg, an STMR value of 0.05 mg/kg, and a HR value for captan in almonds of 0.2 mg/kg. The concentrations of captan in almond hulls 30 days after the last of five sprays at 5 kg ai/ha were 13, 48, and 53 mg/kg. The Meeting estimated a HR for almond hulls of 53 mg/kg.

Although six trials on *chives* were reported from Germany, GAP was not provided, and they could not be evaluated. There was insufficient information to recommend a maximum residue level for chives.

Fate of residues during processing

Information was provided to the Meeting on the fate of captan and THPI during the processing of lemons, oranges, grapefruit, apples, cherries, plums, grapes, strawberries, tomatoes, melons, cucumbers, and squash, and processing factors were calculated for processed commodities derived from these raw agricultural commodities. As maximum residue levels were not estimated for lemons, mandarins, grapefruit, oranges, and squash, the effect of processing is not discussed further.

Processing factors were calculated for captan only when it was the residue of concern for surveillance and estimation of dietary intake. When the concentration in the processed commodity does not exceed the LOQ, the processing factor is calculated from the LOQ and is prefixed with ‘<’. In all the studies of processing, heating and cooking had dramatic effects on the concentrations of captan residues.

The processing factors for apples and apple pomace (dry) were <0.3, <0.8, 0.23, 0.31, 0.33, 0.8, 0.9, 1.1, 1.3, 1.4, 1.6, and 1.9. When the two factors calculated for residues that are <LOQ are excluded, the mean processing factor is 1.0 ($\nu = 10$). Application of the mean processing factor to the STMR and HR values for apples provides STMR-P and HR-P values for apple pomace (dry) of 4.95 and 7.8 mg/kg, respectively. The Meeting recommended withdrawal of the current recommendation (2 mg/kg) for dry apple pomace.

The processing factors for apples and apple juice (cold pressed) were <0.3, <0.8, <0.8, 0.03, 0.04, 0.05 (4 studies), 0.07, 0.09, 0.1 (3 studies), 0.15, 0.4, 0.5 (2 studies), 0.6, 0.7, 1.2, and 1.6. The mean processing factor, after exclusion of factors for residues in the processed commodity <LOQ, is 0.3 ($\nu = 19$). Application of the mean processing factor to the STMR and HR values for apples provides STMR-P and HR-P values for juice of 1.5 and 2.3 mg/kg, respectively.

Washing apples removed approximately 50% of the captan residues, and negligible amounts remained after peeling. Captan is readily degraded on heating, such that the processing factors for pasteurized juice, apple sauce, apple jelly, and canned slices are essentially 0. The mean processing factor for dried apples, after exclusion of factors for residues in the processed commodity <LOQ, is 0.85.

A processing factor of 0.3 was obtained for washed cherries. As canning of cherries involves heating, no residues of captan were detectable. Washing peaches reduced the concentration of captan by 60%.

A processing factor of 0.1 was obtained for plums and prunes. Application of the processing factor to the STMR and HR values for plums results in STMR-P and HR-P values for dried plums (prunes) of 0.14 and 0.79 mg/kg, respectively.

The processing factors for raisins were 1, 1.2, 1.2, 1.3, and 2.6 (mean, 1.5). Application of the mean processing factor to the STMR and HR values for grapes results in an STMR-P value of 5.6 mg/kg and a HR-P value of 33 mg/kg for raisins. The Meeting estimated a maximum residue level for captan in dried grapes (currants, raisins, and sultanas) of 50 mg/kg, which confirms the current recommendation.

Captan did not concentrate in wine, pasteurized juice, depectinized juice, or grape jelly. For these commodities, the mean processing factors were <0.05. The processing factors for washed fruit, destemmed crushed grapes, cold pressed juice, wet pomace (cold pressed), and dry pomace were 0.8, 0.2, 0.4, 1, and 0.6, respectively.

A processing factor of 0.1 was obtained for washed strawberries. Cooking strawberries resulted in no detectable residues of captan.

The processing factors for both tomato juice and purée were <0.04 and <0.1. Application of a processing factor of 0.1 to the STMR and HR values for tomatoes provides STMR-P and HR-P values for juice and purée of 0.06 and 0.23 mg/kg.

Washing cucumbers reduced the concentration of captan by 80%, while peeling or cooking reduced it to <LOQ. Most of the captan residue in melons was removed by peeling, with processing factors of <0.01 and 0.3 obtained in the samples reported.

Residues in animal commodities

When captan is fed to animals, it is rapidly hydrolysed and metabolized to THPI, which is the residue of interest. The concentrations of THPI in milk reached a plateau after 1-4 days when dairy cattle were dosed with gelatine capsules at nominal rates equivalent to 10, 30 and 100 ppm. The plateau concentrations of THPI were <0.01, 0.03, and 0.2 mg/kg after these doses, respectively. The only other metabolite of which significant residues were detected was 3-OH THPI, for which plateau concentrations of 0.02, 0.06, and 0.2 mg/kg were found at the three doses,. After 29 days of dosing, the mean concentrations of residues were similar in liver, kidney, and muscle but were much lower in fat. There was an approximately linear trend with dose: the concentrations of the two metabolites in kidney, muscle, and liver were 0.11-0.31 mg/kg at 100 ppm, 0.04-0.12 mg/kg at 30 ppm, and 0.01-0.02 mg/kg at 10 ppm. No residues were detected in fat after administration of the lowest dose. The concentrations declined rapidly when dosing was stopped. The studies indicate that the residues of THPI resulting from feeding of captan at concentrations ≤ 10 ppm will not exceed 0.01 mg/kg in milk or 0.05 mg/kg in tissues. If it is assumed that the concentration increases linearly with dose, the residues of THPI resulting from feeding captan at concentrations ≤ 5 ppm will not exceed 0.01 mg/kg in milk or tissues, the LOQ in these media of the analytical method provided.

The dietary burden of captan residues in farm animals was estimated by the Meeting on the basis of the diets listed in Appendix IX to the FAO Manual on the Submission and Evaluation of Pesticide Residues Data for the Estimation of Maximum Residue Levels in Food and Feed (FAO, 1997). Ruminants may be fed apple pomace (dry) and potato culls. Although no information was available on residues of captan in potato waste and culls, captan is applied to potatoes as a seed and a foliar treatment. Neither use pattern would be expected to result in detectable residues, and it can be assumed that those in potato culls and processing waste are <LOQ (0.05 mg/kg).

The estimated intakes of captan by beef and dairy cattle are:

Feed item	HR or HR-P, mg/kg	% dry matter	% of diet		Intake, ppm of diet	
			Beef cattle	Dairy cows	Beef cattle	Dairy cows
Apple pomace (dry)	7.8	-	20	40	1.6	3.1
Potato culls	0.05	20	70	40	0.2	0.1
Almond hulls	53	90	10	10	5.9	5.9
Total			100	80	7.7	9.1

The dietary burdens of captan in beef and dairy cattle are 7.7 and 9.1 ppm, respectively. The dietary burden of cattle is dominated by intake of residues in almond hulls. If almond hulls are not included in the calculation, the estimated dietary burden of beef and dairy cattle is <5 ppm, which would not result in residues in excess of the LOQ for THPI and its hydroxy metabolites in milk and bovine tissues. The Meeting decided that it was inappropriate to estimate maximum residue levels for animal commodities on the basis of such a minor animal feed commodity. Should future uses result in residues of captan in significant animal feeds, this study provides a good basis for setting maximum residue levels in animal commodities.

RECOMMENDATIONS

The Meeting estimated the maximum residue and STMR levels shown below. The maximum residue levels are recommended for use as MRLs.

Definition of the residue for compliance with MRLs and for estimation of dietary intake: captan

Commodity		MRL, mg/kg		STMR, mg/kg	HR, mg/kg
CCN	Name	New	Previous		
TN 0660	Almonds	0.3	-	0.05	0.2
FP 0226	Apple	W[1]	20	-	-
AB 0226	Apple pomace, dry	W	2	4.95	7.8
FB 0020	Blueberries	20	20	6.9	18
FS 0013	Cherries	25	40	11	21
VC 0424	Cucumber	3	-	0.22	1.5
DF 0269	Dried grapes (= Currants, Raisins and Sultanas)	50	50	5.6	33
FB 0269	Grapes	25	25	3.7	22
VC 0046	Melons, except Watermelon	10	-	0.04	0.13
FS 0245	Nectarine	3	5	1.0	1.8
FS 0247	Peach	20	15	4.7	16
FP 0230	Pear	W[1]	10	-	-
FS 0014	Plums (including Prunes)	10	5	1.4	7.9
FP0009	Pome fruits	15 Po	-	5.3	11
VR 0589	Potato	0.05	-	0.05	0.05
DF 0014	Prunes			0.15	0.84
FB 0272	Raspberries, Red, Black	20	-	8.3	18
FB 0275	Strawberry	15	30	4.15	12
VO 0448	Tomato	5	2	0.64	2.3
VJ 0448	Tomato juice			0.06	0.23
	Tomato purée			0.06	0.23

[1] Now included in recommendation for Pome fruits

Dietary risk assessment

Chronic intake

The periodic review of captan resulted in recommendations for new and revised MRLs and new STMR values for raw and processed commodities. Data on consumption were available for 19 food commodities and were used in calculating dietary intake. The results are shown in Annex 3 (JMPR 2000 Report). The IEDIs for the five GEMS/Food regional diets, based on the estimated STMR values, represented 0-8% of the ADI. The Meeting concluded that long-term intake of residues of captan from uses that have been considered by the JMPR is unlikely to present a public health concern.

Short-term intake

The 2000 JMPR concluded that it was unnecessary to establish an acute RfD for captan. This conclusion was based on the considerations that the pesticide is unlikely to present an acute toxicological hazard, and its residues are therefore unlikely to present an acute risk to consumers.

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