CAPTAN (007)

EXPLANATION

Captan has been evaluated several times since the initial evaluation in 1965, most recently in 1994 (residues) and 1995 (toxicology).

The 1994 JMPR recommended MRLs for apple, blueberries, cherries, grapes, nectarine, peach, pear, plums, strawberry and tomato. The 28th Session of the CCPR (ALINORM 97/24, para 31 and addendum, p 16) returned draft MRLs for apple, cherries, grapes, nectarine, pear, plums, strawberry and tomato to step 3 pending evaluation by the 1997 JMPR.

Information was made available to the Meeting on uses of captan and on supervised trials on apples, cherries, grapes, nectarines, pears, plums and strawberries in the USA, and on strawberries in Canada. Summary data from Germany were provided on trials on grapes, strawberries, radishes and chives.

METHODS OF RESIDUE ANALYSIS

Fujie (1982) described the analytical method (RM-1K-2) used in the analysis of crop samples from the Chevron trials for captan and tetrahydrophthalimide (THPI) the main metabolite of captan. The author noted the instability of captan in macerated crop mixes even when stored at -20°C. Captan-treated crops should be analysed immediately after maceration and subsampling.

Samples were extracted with ethyl acetate in the presence of phosphoric acid and sodium sulfate and the ethyl acetate extract washed with 0.5-1% phosphoric acid. The extract was evaporated and the residue dissolved in dichloromethane/acetone for clean-up by gel-permeation chromatography. Clean-up was continued with a small Nuchar/silica gel column. Part of the eluate from this column was used for the determination of THPI. The remainder was passed through a Florisil column to provide a solution ready for the determination of captan.

Captan was determined by GLC with a flame-photometric detector in the sulfur mode, while THPI required a nitrogen/phosphorus flame-ionization detector. The LOD was typically near 0.01 mg/kg.

USE PATTERN

A US registered label for a captan wettable powder was made available to the Meeting. The UK, Thailand and Germany provided lists of registered uses. These are summarized in Table 1.

Table 1. Registered uses of captan in the USA, Germany, Thailand and the UK.

Crop	Country	Form	Application			Max total	PHI, days
			method	rate per applic. kg ai/ha	spray conc. kg ai/hl	Applic kg ai/ha per crop cycle	
Almond	USA	WP	✈ foliar[1]	2.2-5.9	1.2-13	29	30

Crop	Country	Form	Application			Max total	PHI, days
			method	rate per applic. kg ai/ha	spray conc. kg ai/hl	Applic kg ai/ha per crop cycle	
Almond	USA	WP	Foliar[1]	2.2-5.9	0.08-3.1	29	30
Apple	UK	WG WP	Foliar	2.7-2.9			7
Apple	UK	WG WP	Post-harvest dip		0.1		
Apple	USA	WP	✈ foliar[2]	2.2-4.5	1.2-9.6	36	0
Apple	USA	WP	Foliar[2]	2.2-4.5	0.060-2.4	36	0
Apple	USA	WP	Post-harvest spray or dip		0.15		
Apricot	USA	WP	✈ foliar[3]	1.7-2.8	0.90-3.0	14	0
Apricot	USA	WP	Foliar[3]	1.7-2.8	0.072-1.5	14	0
Blueberries	USA (east)	WP	✈ foliar[4]	2.8	6.0 max	39	0
Blueberries	USA (east)	WP	Foliar[4]	2.8		39	0
Blueberries	USA (west)	WP	✈ foliar[5]	1.1-2.8	0.60-6.0	39	0
Blueberries	USA (west)	WP	Foliar[5]	1.1-2.8	0.060-1.5	39	0
Cherry	USA	WP	post-harvest spray or dip		0.15		
Cherry	USA (east)	WP	✈ foliar[6]	2.2	1.2-2.4	16	0
Cherry	USA (east)	WP	Foliar[6]	2.2	0.12-1.2	16	0
Cherry	USA (west)	WP	✈ foliar[6]	1.7-2.2	0.90-2.4	16	0
Cherry	USA (west)	WP	Foliar[6]	1.7-2.2	0.090-1.2	16	0
Grape	Thailand	WP	high vol.	3.1	0.13		
Grape	USA (CA)	WP	✈ foliar[7]	2.2	1.2-3.4	13	0
Grape	USA (CA)	WP	Foliar[7]	2.2	0.12-1.2	13	0
Grape	USA (except CA)	WP	✈ foliar[8]	1.1-2.2	0.60-3.4	13	0
Grape	USA (except CA)	WP	Foliar[8]	1.1-2.2	0.060-1.2	13	0
Linseed	UK	powder	seed treatment, 0.13 kg ai/ha				
Mango	Thailand	WP	high vol.	0.011-0.025 kg ai/tree	0.11-0.13		
Nectarine	USA	WP	✈ foliar[9]	2.2-4.5	1.2-4.8	27	0
Nectarine	USA	WP	Foliar[9]	2.2-4.5	0.096-2.4	27	0
Oilseed rape	UK	powder	seed treatment, 0.13 kg ai/ha				
Peach	USA	WP	✈ foliar[10]	2.2-4.5	1.2-4.8	36	0
Peach	USA	WP	Foliar[10]	2.2-4.5	0.060-2.4	36	0
Peanut	Thailand	WP	seed treat 1.5 g ai/kg seed				
Pear	UK	WG, WP	Foliar	2.7-2.9			7
Pear	UK	WG, WP	post-harvest dip		0.1		
Pear	USA	WP	post-harvest spray or dip		0.15		
Plum, prune	USA (east)	WP	✈ foliar[11]	3.4	1.8-3.6	30	0
Plum, prune	USA (east)	WP	Foliar[11]	3.4	0.12-1.8	30	0
Plum, prune	USA (west)	WP	✈ foliar[12]	2.2-3.4	1.2-3.6	30	0
Plum, prune	USA (west)	WP	Foliar[12]	2.2-3.4	0.080-1.8	30	0
Pome fruit	Germany	WP	Foliar	1.5-1.9	0.1-0.13	13[n]	14
Rice	Thailand	WP	seed treat 1.5 g ai/kg seed				
Soya bean	Thailand	WP	high vol.		0.075-0.10	4-5[n]	
Strawberry	UK	WP	Foliar	2.8-5.5			
Strawberry	USA	WP	✈ foliar[13]	1.7-3.4	0.90-3.6	27	0

Crop	Country	Form	Application			Max total	PHI, days
			method	rate per applic. kg ai/ha	spray conc. kg ai/hl	Applic kg ai/ha per crop cycle	
Strawberry	USA	WP	Foliar[13]	1.7-3.4		27	0
Sweet corn	UK	WP	seed treat 1.04 g ai/kg seed				
Tomato	UK	WP	foliar, gl[14]		0.25		

✈: aerial application n number of applications

[1]Apply at popcorn, bloom and petal fall stages and up to 5 weeks after petal fall. Hulls may be fed to livestock.
[2]USA (east). Apply at 5- to 7-day intervals as needed to maintain control in prebloom, bloom, petal fall and first cover sprays. Apply at 10 to 14 day intervals in second and later cover sprays.
USA (west). Make 1 or 2 applications with late cover sprays and 1 final spray before harvest.
[3]Apply in red bud, bloom, 75% petal fall, and cover sprays.
[4]Start spray programme when buds swell or have loose scales. Repeat at 7-day intervals through blossom period. Repeat at 7- to 10-day intervals from late bloom.
[5]Begin at mid-bloom, repeat at 7- to 10-day intervals until maturity.
[6]Apply in pre-bloom, bloom, petal fall, shuck, cover and pre-harvest sprays.
[7]Make 2 applications before bloom and 1 immediately after bloom. Repeat periodically, making 3 cover applications before the bunches close.
[8]Begin application at shoot length of ½ to 1½ inches, continue at 10- to 14-day intervals as necessary.
[9]Apply in full pink, bloom, petal fall, shuck, cover and pre-harvest sprays.
[10]Apply in full pink, bloom, petal fall, shuck stages and in cover and pre-harvest sprays. When conditions are favourable, make applications at 3- to 4-day intervals during bloom to control blossom blight. Then repeat application at 7- to 14-day intervals as needed to maintain control. Continue applications through harvest if conditions favour brown rot.
[11]Apply in full pink, bloom and petal fall sprays. Repeat applications at 7- to 14-day intervals as needed to maintain control. Continue applications through harvest if conditions favour brown rot.
[12]Apply at green bud, popcorn, bloom and petal fall stages. Repeat in cover sprays as conditions warrant.
[13] Begin applications when new growth starts in the spring and before fruit starts to form. Repeat at 7- to 14-day intervals. Under conditions favourable to fruit rot, continue applications through harvest period treating immediately after each picking.
[14]Glasshouse

RESIDUES RESULTING FROM SUPERVISED TRIALS

Details of supervised residue trials are summarized in Tables 2-6.

Table 2 *Apples, pears*. USA, Canada.
Table 3 *Cherries, nectarines, plums*. USA.
Table 4 *Grapes, blueberries, strawberries*. USA, Germany, Canada.
Table 5 *Radishes*. Germany.
Table 6 *Chives*. Germany.

Where residues were not detected the results are recorded in the Tables as less than the limit of determination (LOD), e.g. <0.01 mg/kg. Residues, application rates and spray concentrations have generally been rounded to 2 significant figures or, for residues near the LOD to 1 significant figure. Residues were frequently detected in samples from field control plots, but mostly at or about the LOD. The prefix “c” indicates samples from control plots. Residues are not corrected for analytical recoveries or field controls.

The trials were reported on summary sheets as well as in detailed summaries.

The 1994 JMPR reviewed extensive data on the stability of captan residues during freezer storage. They were stable as field-incurred residues in apples stored at -20°C for 14 months, the longest period tested. Samples in many of the trials had been stored for 6 to 14 months before

analysis, but the longest periods of storage were from trials 16038, 12644 and 10068 for 25, 18 and 18 months respectively.

In many of the apple trials apples from replicate plots were composited for analysis.

In trials on applies in 1973-75 in the USA, plot sizes ranged from 1 tree to 0.4 ha. A hand-gun sprayer was used in some trials but the spraying equipment was not identified in others. Captan was applied by hand-gun sprayers to plots of single, 2 or 16 apple trees in 4 trials in 1976 (trials 06081, 12057, 13628 and 16075).

Captan was applied to run-off using hand-gun single nozzle sprayers in two trials on apple trees in 1976 (trials 3513 and 3514). The trial design consisted of 2 or 4 single-tree replicates. Harvested apples were processed (Table 7).

In four of the US trials on apples in 1978 no information was available on the sprayers or the plot size. In one trial captan was applied by hand-gun sprayer to single-tree plots. The trees were planted at 69/acre (170/ha), which would accommodate large trees. Air-blast or high-pressure hand-gun sprayers were used for application in the US trials of 1980. The plot sizes varied from 1 to 5 trees. In one other 1978 trial and in a 1980 trial captan was applied by mist blowers.

Pear trees in plots of 1 tree to 0.4 ha were treated with captan using hand-gun sprayers in the Stauffer trials from 1973 to 1978. Samples in trials 21776 and 21777 were stored for 12 months before analysis. The relatively high levels of THPI in samples from trial 21776 suggested some losses of captan during storage.

No information was available on the sprayers used in the Chevron trials on pears in 1978 in the USA (Table 2). A plot consisted of 12 trees; 10 mature pears were taken as the field sample. In a set of trials in the USA in 1980 captan was applied to pear trees by tractor sprayer on a commercial scale to 2 ha blocks. Analytical recoveries of captan in theses trials were variable: 63%, 70%, 79%, 82%, 86% and 100%.

Hand-gun or air-blast-sprayers were used to apply captan in the cherry trials in the USA from 1975 to 1980 (Table 3). The plot or replicate sizes varied from one tree to a 2 ha block, but were commonly 1-4 trees. In some trials cherries from replicates were composited for analysis. In trial 5062 the sample for analysis consisted of whole fruit + stems, but in most trials the nature of the sample for analysis was not explicitly described. Samples were stored from 4 to 15 months before analysis. Freezer storage studies reviewed by the 1994 JMPR had demonstrated that incurred residues of captan in cherries were stable in storage at -20°C for 12 months, the longest time tested.

Captan was applied with fan-blower sprayers to nectarine trees in a series of trials in the USA in 1975 (Table 3). The plot sizes ranged from 4 to 125 trees. Samples were generally stored for 5-6 months before analysis but in trials 10690 and 10691 the storage periods were 24 and 14 months respectively. The conditions of storage were not explicitly stated, but 24 months storage even under ideal conditions is probably too long. The freezer storage data on cherries can be used as a guide for nectarines. An analytical problem may have occurred with trials 06474, 10693, 10698, 10707 and 10709, samples from which were all analysed on the same day, because captan was detected in the control samples at a level of 0.13 mg/kg.

A high-pressure hand-gun sprayer was used for application to single-tree plots in two nectarine trials in the USA in 1978. The levels of THPI in some samples suggest a loss of captan during sample storage for 15 months. The trial design in a nectarine trial in the USA in 1980 was 4 single-tree replicates. Field samples consisted of 10 mature fruit. No information was available on the sprayer.

Captan was applied by an air-blast sprayer to a plot of 64 trees in the US trial on plums in 1975. The plot sizes were 6 trees in the 1977 trial and one in the trials of 1978. Samples were stored

for 13 and 15 months; evidence of some breakdown of captan during sample storage was provided by the relatively high levels of THPI.

A fan duster was used to apply a captan dust formulation in a plum trial (5053) in the USA in 1980 (Table 3). A sample from the control plot in this trial was contaminated with captan (1.9 mg/kg). No information on the sprayers was available in the other 2 plum trials. The trial design was 4 single-tree replicates, and the sample size 20 mature plums or prunes.

Boom sprayers were used to treat grapes with captan in trials in the USA in 1976 (Table 4). The plot sizes were 1 or 2 rows of 90 or 120 m, 22 vines or 0.4 ha. In two trials in 1978 captan was applied by a portable mist blower or a power sprayer with a hand-gun. The plot in trial 12149 was small, consisting of 2 vines. In trial 4627 there were 4 replicate plots, each consisting of 4-5 m of row. Power-driven dusting equipment was used to apply a dust formulation to grapes in three trials in 1979 in the USA. In one of the trials the grapes were also sprayed with a WP formulation. Trials 4965 and 4967 were on a commercial scale, involving treatment of 130 and 13 ha respectively. The design for trial 4978 was 85 vines per replication and 4 replications per treatment. Captan contamination, 1.8 mg/kg, occurred in the control plot.

Grape plots consisting of 4 rows of vines 120 m long were treated with captan and the grapes harvested for processing (Tables 9 and 10) in two US trials in 1980. The grapes were stored at 10°C for 125-152 days before processing. In trial 5049 the grapes in closed plastic bags were fumigated 3 times with methyl bromide during storage. Grapes in trial 5051 were treated with a dust formulation using a tractor-mounted power-take-off duster. Grapes on 15-16 vines per plot were treated with an over-the-row hooded boom spray in trials 5162 and 5163. Grapes in trial 5164 were sprayed with a CO_2-pressurized single cone hand sprayer. The trial was very small, consisting of 4 replicates of single-vine plots.

In a series of grape trials by a captan task-force in the USA in 1986 captan was applied at a rate of 2.2 kg ai/ha and grapes were harvested on the day of the final application for residue analysis. The plot sizes ranged from 8.5 m^2 to 84 m^2 and captan was applied using CO_2-pressurized back-pack sprayers or a mist blower.

Information on grape trials in Germany in 1974 and 1977 (Table 4) was available only as summary tables. The trials were not further evaluated.

Captan was applied by power mist blower to a blueberry plot of 0.8 ha in a trial in the USA in 1976.

Strawberry plots, each of a 5 m row, were treated with captan in a 1975 trial in the USA. Samples were stored for 10 months before analysis. In the Stauffer strawberry trials of 1976-7 captan was applied by plot sprayers or tractor-mounted boom sprayers to plots of 4 m^2, a 5 m row, 0.04 ha or 0.2 ha. Strawberry samples were stored for 4-17 months before analysis, but the storage conditions were not available. The 1994 JMPR reported that field-incurred residues of captan in strawberries had decreased by 26% during 14 months storage at -20°C, but most of the decrease had occurred in the first 3 months.

Captan was applied to strawberries by boom sprayers in two US trials in 1976. In one trial a plot was 2×15 m of bed and in the other a plot was 84 m^2. Under the growing conditions in trial 3517 the interval from blossom to ripe berries was about 25 days. Mature ripe berries with caps removed were analysed.

In a 1978 strawberry trial (4628) captan was applied by tractor-mounted boom sprayer. The control plot suffered contamination to the extent that the captan level in the strawberries was 7.7 mg/kg. In the Stauffer trials of 1978 the plot sizes were 0.1-0.4 ha and captan was applied by commercial boom sprayer or hand-gun sprayer. Samples were stored for 21 days (trial 20856) or 15-

16 months (trials 17637, 17639). The levels of THPI found in samples from trial 17637 suggest some loss of captan during storage.

Information on trials on strawberries (Table 4), radishes (Table 5) and chives (Table 6) in Germany was available only as summary tables. The trials were not further evaluated.

Table 2. Captan and THPI residues in pome fruit resulting from foliar application of captan in supervised trials in the USA and Canada. Double-underlined residues are from treatments according to GAP and were used for estimation of maximum residue levels. Single-underlined residues are from treatments according to GAP, but not close to maximum GAP.

Crop Country, year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
APPLES								
USA (WI), 1973 (Cortland)	WP	0.43	0.046	9	8	0.44		Stauffer A-10068
USA (WI), 1973 (Cortland)	WP	0.56	0.060	9	8	0.62		Stauffer A-10068
USA (WI), 1973 (McIntosh)	WP	0.43	0.046	9	8	0.29		Stauffer A-10068
USA (WI), 1973 (McIntosh)	WP	0.56	0.060	9	8	0.30		Stauffer A-10068
USA (CT), 1974 (McIntosh)	WP	2.2	0.12	10	7	3.0 1.8		Stauffer A-10208
USA (IL), 1974 (Golden Delicious)	WP	1.7	0.045	17	0	0.66		Stauffer A-10070
USA (IL), 1974 (Red Delicious)	WP	1.7	0.045	17	0	0.50		Stauffer A-10070
USA (NC), 1974 (Red and Golden Delicious)	WP	3.9	0.12	10	14	0.74		Stauffer A-10069
USA (NH), 1974 (Cortland)	WP	3.4	0.12	12	26	1.8 c 0.37		Stauffer A-10222
USA (NH), 1974 (McIntosh)	WP	0.84	0.90	8	4	3.0 c 0.22		Stauffer A-06034
USA (NH), 1974 (McIntosh)	WP	2.2	0.080	10	8	6.6		Stauffer A-10203
USA (NH), 1974 (McIntosh)	WP	3.4	0.12	12	26	1.8 c 0.31		Stauffer A-10222
Canada (NS), 1975 (McIntosh)	WP	2.5	0.075	8	7 65	0.27 0.06		Stauffer A-10259
USA (WV), 1975 (Golden Delicious)	WP	3.4	1.8	9	2	1.6		Stauffer A-12643
USA (WV), 1975 (Rome)	WP	3.4	1.8	8	24	0.24		Stauffer A-12644
USA (NY), 1976 (7 apple varieties)	WP	1.1	0.040	15	21	0.20 0.09		Stauffer A-16075
USA (CA), 1976 (Red Delicious)	WP	4.5	0.12	1	0	14 12		Stauffer A-12057
USA (MI), 1976 (Rome)	WP	2.2	0.036	12	28	0.73		Stauffer A-13628
USA (MI), 1976 (Rome)	WP	1.1	0.018	12	28	0.33		Stauffer A-13628
USA (NJ), 1976 (Red Delicious)	WP	2.8	0.12	11	0	4.8 5.4 c 0.01		Chevron 3513
USA (NY), 1976 (McIntosh)	WP	1.7	0.30	10	27	0.18		Stauffer A-16038
USA (PA), 1976 (Rome)	WP	2.2	0.12	10	0 20 43	3.2 2.3 2.8 2.8 0.74 0.96 0.96 0.74 0.16 0.15 0.26 0.48 c 0.40		Stauffer A-06081
USA (VA), 1976 (Golden Delicious)	WP	2.8	0.12	13	0	2.7 3.0 c 0.02		Chevron 3514

Crop Country, year (variety)	Application Form	kg ai/ha	kg ai/hl	No.	PHI, days	Residues, mg/kg Captan	THPI	Ref.
USA (NJ), 1978 (Golden Delicious)	WP	2.8	0.12	13	0 1 7 14 21 28	3.5 5.6 3.3 5.0 3.7 2.9 2.7 2.4 3.8 3.6 2.8 3.3 c 0.03 0.04		Chevron 4430
USA (NJ), 1978 (Red Delicious)	WP	2.8	0.12	13	0 1 7 14 21 28	7.7 5.5 6.1 4.8 4.5 6.0 5.2 6.7 6.2 7.0 3.3 3.2 c 0.01		Chevron 4429
USA (NJ), 1978 (Rome Beauty)	WP	2.4 +3.5	0.12	1 +2	0 1 7 14 21 28	2.4 2.2 3.7 2.7 2.0 1.9 1.9 2.0 1.8 1.9 1.7 1.4 c 0.02		Chevron 4431
USA (NY), 1978 (Idared)	WP	3.4	0.36	9	0 3 14	16 5.0 3.8	<0.05 0.05 0.07	Stauffer A-17648
USA (PA), 1978 (Jonathan)	WP	3.4	0.12	1	0 1 3 7 14	1.6 1.1 0.63 0.40 0.06		Stauffer A-18413
USA (WV), 1978 (Golden Delicious)	WP	2.2	0.080	1	0 1 3 7 14	0.92 0.78 0.54 0.26 0.08 c 0.13		Stauffer A-18425
USA (CA), 1980 (Jonathan)	WP	1.1	0.12	2	1 3 7 10 13	1.5 1.5 1.3 1.0 0.75		Stauffer A-23994
USA (CA), 1980 (Yellow Delicious)	WP	1.1	0.12	2	1 3 7 10 13	2.2 1.5 1.3 1.3 0.67		Stauffer A-23994
USA (MO), 1980 (Red Delicious)	WP	5.0 +5.0 +1.0 +2.0 +3.0 +4.0 +5.0 +5.0 +5.0	0.18 +0.18 +0.36 +0.72 +1.1 +1.4 +0.18 +0.18 +0.18	9	1	6.6 1.2 1.3 2.2 3.3 c 0.10	0.05 0.01 0.02 0.03 0.05	Chevron 5207
USA (NY), 1980 (McIntosh)	WP	4.5	0.12	14	1 16 31	4.8 5.1 5.7 3.2 1.8 2.4 c 0.03 0.07	0.17 0.15 0.12 0.06 0.06 0.08 c 0.01	Chevron 5066B

Crop Country, year (variety)	Application Form	kg ai/ha	kg ai/hl	No.	PHI, days	Residues, mg/kg Captan	THPI	Ref.
USA (NY), 1980 (McIntosh)	WP	4.5	0.72	14 13 12	1 16 31	5.5 6.1 3.0 3.1 0.43 0.50 c 0.18 0.05	0.09 0.12 0.03 0.03 <0.01 <0.01 c 0.01	Chevron 5066C
USA (NY), 1980 (Wealthy)	WP	4.5	0.72	14 13 12	1 16 31	4.0 3.6 3.5 3.0 3.1 2.5 c 0.03 0.09	0.13 0.10 0.08 0.07 0.07 0.05	Chevron 5066A
PEARS								
USA (NH), 1973 (Bartlett)	WP	0.84 -1.2	0.90 -1.3	8	14	0.28 c 0.26		Stauffer A-06034
USA (NH), 1974 (Clapps Favorite)	WP	2.1 -3.4	0.076 -0.12	10	8	4.1 c 0.10		Stauffer A-10203
USA (NY), 1976 (Bartlett)	WP	2.5	0.090	2	41	<0.05		Stauffer A-16039
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 c 0.11	Stauffer A-21776
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	Stauffer A-21777
USA (CA), 1978 (Bartlett)	WP	2.5 +3.4 +3.8 +4.2 +4.7 +4.2 +5.1		2 +2 +2 +1 +1 +1 2	0 1 7 14 21	0.04 0.09 0.07 0.03 0.04 0.10 0.07 0.09 0.07 0.09 c 0.03 0.06 0.02 c 0.09		Chevron 4432
USA (CA), 1978	WP	2.2	0.24	1	2	0.66 0.98 0.94 0.54 0.40 0.31 0.71 0.68 c 0.04 0.05 c 0.06 0.06		Chevron 4443
USA (NY), 1980 (Bartlett)	WP	3.9	0.24	9	1 14 21	0.52 0.19 0.18 0.18 0.20 0.12 c 0.03 0.05 0.04	0.02 0.01 0.01 0.01 0.01 0.01	Chevron 5074A
USA (NY), 1980 (Seckel)	WP	3.9	0.24	9	1 14 21	1.1 1.9 2.6 1.5 0.04 1.5 c 0.06 0.06 0.09	0.05 0.07 0.07 0.05 0.04 0.04 c 0.01 0.01	Chevron 5074B
USA (NY), 1980 (Flemish Beauty)	WP	3.9	0.24	9	1 14 21	0.65 0.50 0.34 0.43 0.24 0.20 c 0.08 0.06 0.08	0.04 0.03 0.01 0.01 0.02 0.02 c 0.01 0.01	Chevron 5074C

Crop Country, year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
USA (NY), 1980 (Clapp's)	WP	3.9	0.24	9	1 14 21	0.51 0.58 0.52 0.34 0.44 0.36 c 0.05 0.05 0.04	0.02 0.03 <0.01 0.02 0.02 0.02	Chevron 5074D
USA (NY), 1980 (Bosc)	WP	3.9	0.24	9	1 14 21	0.54 0.34 0.84 0.35 0.32 0.21 c 0.04 0.05 0.03	0.03 0.03 0.03 0.01 0.02 0.01 c 0.01 0.01	Chevron 5074E

c: sample from control plot

Table 3. Captan and THPI residues in stone fruit resulting from foliar application of captan in supervised trials in the USA. Double-underlined residues are from treatments according to GAP and were used for estimation of maximum residue levels. Single-underlined residues are from treatments according to GAP, but not close to maximum GAP.

Crop, State, Year, (Variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
CHERRIES								
MI, 1975 (Sweet)	WP	3.4	0.12	5	0	0.55		Stauffer A-12730
MI, 1975 (Sour)	WP	3.4	0.12	5	0	2.6		Stauffer A-12730
MI, 1976 (Montmorency)	WP	2.2	0.080	6	0 1 3 7 12	13 20 15 5.9 4.3		Stauffer A-13621
MI, 1976 (Montmorency)	WP	2.2	0.080	6	0 1 3 7 14	21 11 19 20 8.2 c 0.1		Stauffer A-13622
MI, 1976 (Montmorency)	WP	1.7	0.060	6	0 1 3 7 12	12 14 8.3 5.5 1.9		Stauffer A-13626
MI, 1976 (Montmorency)	WP	1.7	0.060	6	0 1 3 7 14	20 16 9.7 16 12 c 0.1		Stauffer A-13627
CA, 1976 (Bing)	WP	5.6	0.24	2	1	7.9 c 0.1		Stauffer A-14005
CA, 1977 (Montmorency)	WP	3.4	0.12	7	10	8.2 7.4		Stauffer A-17615
NY, 1977 (Emperor Francis and Napoleon)	WP	2.2	0.060	7	8	0.92		Stauffer A-17616
IL, 1977 (Montmorency)	WP	2.2	0.060	7	1	4.3		Stauffer A-19931

Crop, State, Year, (Variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
NY, 1978 (Napoleon)	WP	1.1	0.12		0 1 3 7	17 5.3 11 8.3 c 0.11	1.6 0.55 1.0 1.5 c 0.19	Stauffer A-17635
NY, 1978 (Montmorency)	WP	1.1	0.12	5	0 1 3 7 10 14	16 15 9.9 7.4 7.1 2.0	1.8 3.0 1.9 2.2 1.6 0.36	Stauffer A-17638
MT, 1980 (Lambert)	WP	2.2	0.12	6	1 2 3 7 14	2.4 1.6 2.4 2.2 1.4		Stauffer A-27008
MT, 1980 (Lambert)	WP	2.2	0.96	6 8	0 1 3 1 8	5.5 3.4 4.7 2.3 2.8		Stauffer A-27013
CA, 1980	WP	14	0.24	4	1 6 7	7.9 4.9 3.3 c 0.03 0.03	0.26 0.49 0.37	Chevron 5062
NY, 1980 (Napoleon)	WP	4.5	0.12	8	1 7	3.7 7.2 7.1 4.6 c 0.03 0.26	0.52 0.49 0.30 0.35 c 0.01	Chevron 5165
NY, 1980 (Montmorency)	WP	3.9	0.71	7	1 7	17 12 6.8 11 c 0.03 0.04	0.83 0.51 0.21 0.32 c 0.02 0.01	Chevron 5166
NECTARINES								
IL, 1975 (Early Blaze)	WP	1.1	0.14	8	1	0.25 c 0.13		Stauffer A-06474
CA, 1975 (Regal)	WP	3.4	0.12	3	18	0.47 c 0.25		Stauffer A-10690
CA, 1975 (Late LeGrand)	WP	3.4	0.12	3	12	0.24		Stauffer A-10691
CA, 1975 (Late LeGrand)	WP	3.4	0.095	3	12	<0.05 c 0.13		Stauffer A-10693
CA, 1975 (Flame Kist)	SC	3.4	0.45	2	20	0.13		Stauffer A-10696
CA, 1975 (September Grand)	WP	2.2	0.24	2	18	0.20 c 0.13		Stauffer A-10698
CA, 1975 (September Grand)	WP	4.5	0.16	2	18	<0.05 c 0.13		Stauffer A-10707
CA, 1975 (Flame Kist)	WP	4.5	0.19	2	17	<0.05 c 0.13		Stauffer A-10709
CA, 1978 (Grand Prize)	WP	6.7	0.12	1	0 1 3 7 14	3.3 3.0 2.0 2.1 0.7	<0.05 <0.05 0.11 0.39 0.40 c 0.43	Stauffer A-17775

Crop, State, Year, (Variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
CA, 1978 (Arm King)	WP	6.7	0.12	1	0 1 3 7 14	2.6 2.3 1.2 1.1 0.8	1.0 0.44 0.44 0.59 <0.05	Stauffer A-17778
CA, 1980 (LeGrande)	WP	6.7	0.12	9	0 1 3 7 10	10 8.5 6.7 9.7 3.2 c 0.03-0.05	0.21 0.24 0.16 0.20 0.16 c 0.01	Chevron 5063
PLUMS, PRUNES								
CA, 1975 (Casselman)	WP	3.4	0.12	3	13	<0.05		Stauffer A-10692
NY, 1977 (Purple Plums)	WP	3.4	0.12	13	2	0.71		Stauffer A-17622
NY, 1978 (Fellenburg)	WP	3.4	0.36	9	0 3 7 10	7.9 4.8 3.4 2.6	1.0 0.16 0.17 0.22	Stauffer A-17649
CA, 1978 (Queen Anne)	WP	6.7	0.12	1	0 1 3 7 14	0.64 0.47 0.31 0.81 0.54 c 0.09	0.67 0.34 0.38 0.60 0.42	Stauffer A-17781
CA, 1980 (Santa Rosa)	WP	6.7	0.12	6	0 1 3 7 10	5.5 5.3 4.0 4.3 4.7 c 0.03 0.03 0.03 c 0.03 0.04	0.07 0.09 0.06 0.09 0.11 c 0.01	Chevron 5052
CA, 1980 (French)	WP	6.7	0.12	6	0 1 3 7 10	4.6 8.6 8.9 6.1 8.8 c 0.02 0.04 0.04 c 0.04 0.05	0.11 0.14 0.16 0.10 0.15 c 0.01	Chevron 5052A
CA, 1980 (French)	dust	5.6		3	0 1 4 8 11	7.3 5.6 4.6 5.5 5.7 6.0 6.0 4.4 5.0 7.1 c 1.9	0.08 0.07 0.05 0.07 0.03 0.03 0.06 0.04 0.12 0.12c 0.03	Chevron 5053

c: sample from control plot

Table 4. Captan and THPI residues in grapes, blueberries and strawberries resulting from foliar application of captan in supervised trials in the USA, Germany and Canada. Double-underlined residues are from treatments according to GAP and were used for estimation of maximum residue levels. Single-underlined residues are from treatments according to GAP, but not close to maximum GAP.

Crop, Country, year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
GRAPES								
USA (CA), 1976 (Golden Muscat)	WP	1.1	0.060	2	0	<u>11</u>		Stauffer A-12072
USA (CA), 1976 (Thompson Seedless)	WP	1.1	0.12	5	73	<u>0.32</u> 0.35 c 0.23		Chevron 3511
USA (CA), 1976 (White Malaga)	WP	1.1	0.12	1	0	<u>11</u>		Stauffer A-12155
USA (MD), 1976 (Chancellor)	WP	1.1	0.20	9	0	<u>2.6</u>		Stauffer A-10190
USA (NY), 1976 (Concord)	WP	3.4	0.18	5	43	0.83 c 0.03		Chevron 3512
USA (FL), 1978 (F4-36)	WP	2.2	0.16	6	7 14	0.24 <u>1.6</u> 0.22 053 c 0.01		Chevron 4627
USA (CA), 1978 (Thompson)	WP	11	0.12	1	0 1 3 7	30 29 20 17	<0.05 <0.05 <0.05 <0.05	Stauffer A-12149
USA (CA), 1979 (Ruby Cabernet)	dust	3.9		4	2 4 6 10 17	1.1 0.45 0.72 1.2 2.8 1.8 0.56 0.68 0.48 1.2 c 0.07	0.03 0.01 0.03 0.03 0.05 0.03 0.02 0.03 0.03 0.02 c 0.01	Chevron 4965
USA (CA), 1979 (Ruby Cabernet)	dust	3.9		4	1 3 7 14	1.0 1.8 1.0 0.98 0.28 0.31 0.24 0.23 c 0.08	0.04 0.04 0.03 0.03 0.04 0.02 0.01 0.02 c 0.01	Chevron 4967
USA (CA), 1979 (Zinfandel)	WP + dust	2.2 +4.5	0.60 +1.2	2 + 3	63	4.1 5.5 2.3 2.4 c 1.8	0.18 0.18 0.20 0.17 c 0.14	Chevron 4978
USA (CA), 1980 (Emperor)	WP	3.4	0.36	3	1 3 7 10 13	10 10 6.9 6.4 5.5		Stauffer A-23992
USA (CA), 1980 (Grenache)	dust	4.0		10 10 9 8 3	1 7 14 28 92	1.1 4.7 5.1 6.5 1.2 c 0.05-0.09	0.03 0.38 0.31 0.16 0.03 c 0-0.01	Chevron 5051
USA (CA), 1980 (Thompson Seedless)	dust	4.0		9 9 8 7 3	1 7 14 28 86	13 9.5 13 11 5.3 7.6 11 8.0 1.7 1.6 c 0.35	0.42 0.42 0.45 0.20 0.25 0.37 0.20 0.19 0.07 0.05 c 0.02	Chevron 5049

Crop, Country, year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
USA (CA), 1980 (Thompson Seedless)	WP + dust	2.2 +4.0	0.080 +0.14	3 + 6	1 7	7.0 13 10 12	0.57 0.62 0.79 0.97	Chevron 5050
USA (CA), 1980 (Thompson Seedless)	WP + dust	2.2 +4.0	0.080 +0.14	3 + 3	14	7.1 6.4	0.49 0.55	Chevron 5050`
USA (CA), 1980 (Thompson Seedless)	WP + dust	2.2 +4.0	0.080 +0.14	3 + 4	28	3.7 4.8 c 0.43	0.39 0.33 c 0.03	Chevron 5050`
USA (CA), 1980 (Thompson Seedless)	WP	2.2	0.080	3	85	1.2 1.6	0.06 0.08	Chevron 5050`
USA (NY), 1980 (Aurora)	WP	2.2	0.16	3	13	0.77 1.1 c 0.04	0.05 0.14 c 0.01	Chevron 5162
USA (NY), 1980 (Chancellor)	WP	2.2	0.12	7	33	9.4 9.1 c 0.02	0.21 0.19 c 0.01	Chevron 5164
USA (NY), 1980 (Elvira)	WP	2.2	0.096	4	9	1.2 2.3 c 0.05	0.10 0.14	Chevron 5163
USA (CA), 1986 (Emperor)	WP	2.2	0.12	6	0	3.7 1.3	<0.05 <0.05	86256
USA (CA), 1986 (Emperor)	WP	2.2	0.12	6	0	7.4 5.8 c 8.9	<0.05 <0.05	86994
USA (CA), 1986 (Thompson Seedless)	WP	2.2	0.12	6	0	11 22	0.20 0.28	86814
USA (CA), 1986 (Thompson Seedless)	WP	6.7	0.36	6	0	179 72	1.9 0.69	86814
USA (MI), 1986 (Concord)	WP	2.2	0.12	6	0	11 8.1	0.14 0.12	86218
USA (NY), 1986 (Aurora)	WP	2.2	0.12	6	0	7.2 6.4	0.15 0.14	86719
USA (NY), 1986 (Concord)	WP	2.2	0.12	5	0	6.4 4.5	0.14 0.18	86549
USA (WA), 1986	WP	2.2		6	0	0.93 1.3	<0.05 <0.05	86080
GRAPES, WINE								
Germany, 1974 (Bacchus)	WP	1.6- 2.4	0.08	6	0 28 47 77	2.2 0.31 0.11 0.12		BBA TR1074
Germany, 1974 (Müller-Thurgau)	WP	2.0		7	3 45	1.8 0.28		BBA KH1074
Germany, 1974 (Müller-Thurgau)	WP	1.6	0.32	7	0 28 42	7.4 1.8 1.4		BBA GE1074
Germany, 1974 (Müller-Thurgau)	WP		0.08	10	0 21 41	7 2.0 0.48		BBA WU1074
Germany, 1974 (Müller-Thurgau)	WP	1.3	0.33	9	0 28 42 57	8.1 0.74 1.4 0.23		BBA OP1074
Germany, 1974 (Müller-Thurgau)	WP	4.0	0.5	7	3 45	14 2.5		BBA 1174KH
Germany, 1974 (Müller-Thurgau)	WP	5×2.5 +2×3.2	0.64	7	0 28 42	10 2.2 3.2		BBA GE1174
Germany, 1974 (Bacchus)	WP	2.5 -3.7	0.13	6	0 28 47 77	18 0.61 <0.02 0.96		BBA TR1174

Crop, Country, year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
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 166684
Germany, 1977 (Müller-Thurgau)	WP	0.7-1.1	0.09	10	0 14 35 46	13 7.2 5.3 3.0 4.7 3.3 4.3 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 TR1277
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
BLUEBERRIES								
USA (OR), 1976 (Highbush)	WP	2.8	0.94	4	0	6.5 c1.2		Stauffer A-14201
STRAWBERRIES								
Canada (ONT), 1975	WP	3.4	0.30	5	0 1 2	27 19 11		Stauffer A-10269
Canada (ONT), 1975	WP	1.1	0.10	5	0 1 2	6.1 6.1 4.7		Stauffer A-10269
Germany, 1961 (Senga Sengana)	WP	0.75	0.13	1	0 3 7 14	1.8 1 0.7 0.4		BBA
Germany, 1962 (Senga Sengana)	WP	0.75	0.13	1	0 3 7 14	2.2 2 1.1 0.05		BBA
Germany, 1964	WP	1.3	0.13	2	8	<0.1		BBA Cpt 1/1964
USA (NY), 1975	WP	1.1	0.20	4	1 7	0.18 0.45 c 0.09		Stauffer A-12731
USA (CA), 1976 (Shasta)	WP	3.4	0.18	3	12	2.9		Stauffer A-12077
USA (CA), 1976 (Shasta)	WP	3.4	0.18	3	0	13[1]		Stauffer A-12076
USA (CA), 1976 (Heidi, G-3)	WP	3.4	0.18	11	0	7.3 6.9 c 0.03		Chevron 3517
USA (NJ), 1976 (Sparkle)	WP	3.4	0.18	10	0	3.3 3.4 c 0.02		Chevron 3518
USA (OR), 1976 (Hood)	SC	1.1	0.14	3	12	0.73		Stauffer A-14202
USA (OR), 1976 (Northwest)	SC	1.1	0.24	3	13	0.18		Stauffer A-14203
USA (VA), 1976 (Red Chief)	WP	1.7	0.18	4	0 1 3	1.5 0.66 1.0		Stauffer A-10192

Crop, Country, year (variety)	Application				PHI, days	Residues, mg/kg		Ref.
	Form	kg ai/ha	kg ai/hl	No.		Captan	THPI	
USA (VA), 1976 (Red Chief)	WP	1.7	0.18	4	0 3	1.6 1.2		Stauffer A-10192
USA (VA), 1976 (Red Chief)	WP	1.1	0.12	4	0 1 3	0.97 0.77 1.1		Stauffer A-10192
USA (WI), 1976 (Suregrow, Raritan)	WP	2.2	0.24	6	21	0.22		Stauffer A-13603
USA (VA), 1977 (Red Chief)	WP	2.2	0.24	4	0 1 3	2.8 3.0 2.3		Stauffer A-18620
USA (VA), 1977 (Red Chief)	WP	2.2	0.24	4	0 1 3	3.0 2.4 4.0		Stauffer A-18620
USA (VA), 1977 (Red Chief)	WP	3.4	0.36	4	0 1 3	5.8[2] 3.9 5.6 c 0.11[3]		Stauffer A-18620
USA (FL), 1978 (Tioga)	WP	3.4	0.36	16 20	0 3 7	8.0 8.3[4] 6.0 6.8 7.9 6. c 7.7		Chevron 4628
USA (CA), 1978 (Driscoll G-3)	WP	3.4	0.18	1	0 1 3 7 14	6.4 5.4 4.0 1.3 0.52		Stauffer A-20856
USA (NY), 1978 (Darrow)	WP	3.4	0.29	1	1 3 6 8	3.9 2.1 1.6 1.1 c 0.02	<0.05 0.07 0.54 <0.05 c 0.20	Stauffer A-17639
USA (NY), 1978 (Raritan)	WP	2.2	0.24	6	1 3 7	1.9 1.4 1.0	0.51 0.34 0.65 c 0.15	Stauffer A-17637

c: sample from control plot
[1]Sample stored 16 months before analysis
[2]Samples stored 13 months before analysis
[3]Control plot for the 3 trials in 18620
[4]Discount this trial because of control contamination

Table 5. Captan residues in small radishes (grown indoors) resulting from application of captan in supervised trials in Germany in 1976. Captan was applied pre-emergence by watering at 4 l/m^2 at a rate of 8 g product/m^2.

Year (variety)	Application				PHI, days	Captan, mg/kg	Ref.
	Form	kg ai/ha	kg ai/hl	No.			
1975 (Rota)	WP	66	0.17	1	21	<0.03	BBA 57/75
1975 (Cherry belle)	WP	66	0.17	1	112	<0.03	BBA 2553
1975 (Hilmar Treib)	WP	66	0.17	1	47	<0.03	BBA 2709
1975 (Neckar-perle)	WP	66	0.17	1	47	<0.03	BBA 2710
1975 (Cherry belle)	WP	66	0.17	1	97	<0.03	BBA 3200

Year (variety)	Application				PHI, days	Captan, mg/kg	Ref.
	Form	kg ai/ha	kg ai/hl	No.			
1976 (Cherry belle)	WP	66	0.17	1	38	<0.03	BBA 2559
1976 (Karissima GS kalibriert)	WP	66	0.17	1	48	<0.03	BBA 1482
1976 (Roky)	WP	66	0.17	1	54	<0.03	BBA 72/76 75/76

Table 6. Captan residues in chives (grown indoors) resulting from application of captan in supervised trials in Germany in 1976. Captan was applied at emergence or sprouting by watering at 4 l/m^2 at a rate of 8 g product/m^2.

Variety	Application				PHI, days	Captan, Mg/kg	Ref.
	Form	kg ai/ha	kg ai/hl	No.			
Feinstengeliger	WP	66	0.17	1	12	20 32	BBA 4/75
Hybrid Hild 68	WP	66	0.17	1	22	1.4	BBA 1480
Hybrid Hild 68	WP	66	0.17	1	15	0.62 c 0.64	BBA 1481
Feinröhriger	WP	66	0.17	1	32	0.13	BBA 2708
Feinröhriger	WP	66	0.17	1	26	0.26	BBA 2706
	WP	66	0.17	1	19	3.5	BBA 2569

c: sample from control plot

FATE OF RESIDUES IN STORAGE AND PROCESSING

In processing

The Meeting was provided with information on the fate of captan during the processing of apples and grapes.

Details were not available on the process used for producing juice and pomace from apples in trials 3513 and 3514. Heating and cooking are very influential on the fate of captan, but there is no record of the heating and cooking conditions in these two trials. Apples were quartered, ground and the juice squeezed out. The results are shown in Table 7.

Table 7. Residues of captan in apples and apple products. More details on trials 3513 and 3514 are provided in Table 2.

Sample	Captan residues, mg/kg		Processing factor	
	Trial 3513	Trial 3514	Trial 3513	Trial 3514
Apple	4.8 5.4	2.7 3.0	-	-
Juice	1.6 1.5	0.63 1.1	0.30	0.30
Wet pomace	2.9 3.6	0.77 1.0	0.64	0.31
Dry pomace	0.29 0.34	0.07 0.30	.062	0.065

Details were not available on the process used for producing pomace from grapes in trials 3511 and 3512. In trial 3511 unwashed grapes with stems removed were crushed in a colander and the juice separated, leaving wet pomace. The results are shown in Table 8 and those from other processing trials in the USA in Tables 9-11.

Table 8. Residues of captan in grapes and grape pomace. More details on trials 3511 and 3512 are provided in Table 4.

Sample	Captan residues, mg/kg		Processing factor	
	Trial 3511	Trial 3512	Trial 3511	Trial 3512
Grapes	0.32 0.35	0.83		
Wet pomace	0.30 0.22	0.56 0.40	0.78	0.58
Dry pomace	0.04 0.04	0.08 0.13	0.12	0.13

Table 9. Residues of captan and THPI in fruit and processed fractions from grapes harvested 1, 7 and 86 days after the final captan application in trial 5049 in the USA in 1980. More detail on the trial is provided in Table 4.

Sample	Residues, mg/kg					
	PHI, 1 day		PHI, 7 days		PHI, 86 days	
	Captan	THPI	Captan	THPI	Captan	THPI
Grapes	12.6 9.5	0.42 0.42	13.2 10.7	0.45 0.20	1.74 1.59	0.07 0.05
Juice	11.6 16.9	2.98 3.11	17.3 16.6	2.36 2.25	0.94 1.15	0.31 0.35
Pomace	8.00 7.31	1.24 1.02	2.70 2.85	0.57 0.60	0.27 0.30	0.11 0.09
Raisins	8.80 15.8	2.96 3.00	18.8 12.1	2.19 2.57	3.48 3.58	0.31 0.38
Raisin waste	15.7 19.5	6.01 5.36	15.8 16.3	8.58 8.42	8.77 9.69	1.00 1.17

Table 10. Residues of captan and THPI in fruit and raisins from grapes harvested 1, 7, 14 and 28 days after the final captan application in trial 5050 in the USA in 1980. More detail on the trial is provided in Table 4.

Sample	Residues, mg/kg							
	PHI, 1 day		PHI, 7 days		PHI, 14 days		PHI, 28 days	
	Captan	THPI	Captan	THPI	Captan	THPI	Captan	THPI
Grapes	7.02 13.1	0.57 0.62	10.1 12.2	0.79 0.97	7.12 6.42	0.49 0.55	3.66 4.78	0.39 0.33
Raisins	6.00 8.77	2.60 2.66	21.3 16.1	3.08 3.06	16.1 17.2	2.48 2.16	15.1 12.7	1.91 1.62

Grapes were treated at the label rate (2.2 kg ai/ha) and at an exaggerated rate before harvest and processing into raisins, pomace and juice (Table 11, Smith, 1987). There was no statement about washing the grapes before processing, so it is likely that there was no washing step. Raisins were washed by vigorous shaking in deionised water for 2 minutes. The water wash was discarded and the procedure was repeated 3 times. No information was provided on the conditions of production of the raisins, drying of the pomace, or production of the juice, but it is unlikely that the juice was heated or most of the captan would have been converted to THPI.

Table 11. Residues of captan and THPI in fruit and processed fractions from grapes harvested on the day of the final captan application (Smith 1987, trial 86814). More detail is provided on the trial in Table 4.

Sample	Residues, mg/kg			
	Treatment 2.2 kg ai/ha		Treatment 6.7 kg ai/ha	
	Captan	THPI	Captan	THPI
Grapes	10.9 22.4	0.198 0.276	179 72	1.93 0.69
Raisins	79.5	7.67	188	11.1
Raisin waste	316	5.55	1080	14.3
Washed raisins	13.3	9.43	13.8	10.0
Wet pomace	21.0	0.40	24.2	0.30
Dry pomace	20.4	10.4	55.2	6.41
Juice	82.4	0.654	51.2	0.892

THPI residues in the juice, pomace and raisins arise from the THPI originally in the grapes and by conversion of captan to THPI during the process. Processing yields for THPI can be calculated from the following formula.

$$\text{Processing yield} = \frac{\text{THPI residues in juice, pomace or raisins}}{\text{captan residues in grapes X 0.503 + THPI residues in grapes}}$$

The factor 0.503 is the ratio of the molecular weight of THPI (151.16) to that of captan (300.6).

Processing factors for captan and processing yields for THPI calculated from the data in Tables 9-11 are shown in Table 12.

Table 12. Processing factors for captan and processing yields for THPI calculated from the data in Tables 9-11.

Process	Captan processing factor	THPI processing yield	Trial
Grapes → juice	1.29 1.42 0.63	0.51 0.36 0.37	5049
Grapes → juice	4.9 0.41	0.076 0.014	86814
Grapes → raisins	1.11 1.29 2.12	0.50 0.38 0.39	5049
Grapes → raisins	0.73 1.68 2.46 3.29	0.47 0.47 0.59 0.71	5050
Grapes → raisins	4.8 1.5	0.89 0.17	86814
Grapes → washed raisins	0.80 0.11	1.1 0.16	86814
Grapes → wet pomace	1.3 0.19	0.046 0.0047	86814
Grapes → dry pomace	1.2 0.44	1.2 0.010	86814
Grapes → pomace	0.69 0.23 0.17	0.19 0.09 0.11	5049

Residues in the edible portion of food commodities

The calculated processing factor for apple juice was 0.30, but no information was available on the heating and cooking processes. More detailed studies were available to the 1994 Meeting, which concluded that captan is not present in commodities such as canned juice because it is destroyed by cooking and other processing.

The processing factors for captan in the production of juice and raisins from grapes were highly variable, probably reflecting the sensitivity of captan residues to degradation when food is heated or cooked. The mean processing factors and ranges from the grape processing studies available to the present and the 1994 Meeting are grapes to juice 1.2 (range 0.23-4.9) and grapes to raisins 1.66 (range 0.11-4.8).

NATIONAL MAXIMUM RESIDUE LIMITS

The Meeting was informed of the US tolerances for the following five commodities.

Commodity	MRL, mg/kg
Cherries	100
Grapes	50
Nectarines	50
Plums	100
Strawberries	25

APPRAISAL

Captan was extensively reviewed in 1994 and recommendations were made for new and revised MRLs for a number of fruits, and for tomatoes. Information was made available to the present Meeting on GAP and supervised trials in the USA on apples, cherries, grapes, nectarines, pears, plums and strawberries. The residue data were evaluated together with the relevant data evaluated in 1994 to produce revised recommendations.

MRLs for captan are for residues defined as captan. Captan breaks down under some conditions to form THPI (1,2,3,6-tetrahydrophthalimide) and when a raw agricultural commodity is found to contain captan and THPI it is likely that some captan was converted to THPI during storage of the sample. In most cases the THPI residue is a negligible or minor part of the residue and its inclusion or exclusion makes little difference. The Meeting agreed that the definition of the residue for the estimation of STMR levels should also be captan alone.

Captan is registered for use on apples in the USA at 2.2-4.5 kg ai/ha with up to 36 kg ai/ha applied in a crop cycle, equivalent to 8 applications at the maximum rate. Harvest is permitted on the day of the final application. The decline of captan residues was measured in 7 trials on apples with sampling on at least 5 occasions after the final application. The median half-life of captan from the 7 trials was 11.9 days, which suggested that an increased number of applications would not influence the final residue levels because the contribution from applications more than 40-50 days before harvest would be negligible in comparison with that from the final application. A trial with only one application at the GAP rate was also included (captan residue 14 mg/kg on the day of application).

The residues from the US trials at GAP application rates (3.4-5.0 kg ai/ha) and PHI (0-1 days) but with 1-14 applications were 3.7, 4.0, 5.7, 6.1, 6.6, 14 and 16 mg/kg.

US GAP also permits a post-harvest spray or dip for apples at 0.15 kg ai/hl, which may be used in combination with the pre-harvest treatment. In 13 US trials reported in the 1994 evaluation where

captan had been used before, after, or both before and after harvest, the captan residues were 0.86, 1.4, 1.5, 2.3, 3.3, 3.9, 4.0, 4.7, 4.9, 5.2, 5.5, 5.9 and 7.7 mg/kg.

Captan trials on apples in Argentina, Brazil, Canada, Japan and the UK were evaluated against the relevant GAP for these countries in 1994. The residues from 22 trials according to GAP were 0.005, 0.44, 0.68, 0.98, 1.0, 1.4, 2.5, 2.8, 2.9, 2.9, 3.5, 3.8, 4.1, 4.2, 4.2, 4.3, 4.4, 4.5, 4.5, 4.8, 7.2 and 13 mg/kg.

The residues in rank order (median underlined) from the total of 42 trials were 0.005, 0.44, 0.68, 0.86, 0.98, 1.0, 1.4, 1.4, 1.5, 2.3, 2.5, 2.8, 2.9, 2.9, 3.3, 3.5, 3.7, 3.8, 3.9, 4.0, 4.0, 4.1, 4.2, 4.2, 4.3, 4.4, 4.5, 4.5, 4.7, 4.8, 4.9, 5.2, 5.5, 5.7, 5.9, 6.1, 6.6, 7.2, 7.7, 13, 14 and 16 mg/kg.

The Meeting estimated a maximum residue level of 20 mg/kg for captan on apples to replace the 1994 recommendation of 10 mg/kg, and an STMR level of 4.05 mg/kg.

Information from US supervised trials on pears was made available but could not be evaluated because there was no corresponding GAP.

Captan may be applied in the USA at 2.2 kg ai/ha up to 7 times to cherries, which may be harvested on the day of the final application. It may also be used as a post-harvest spray or dip at a concentration of 0.15 kg ai/hl, and the two treatments may be used in combination. Details of 7 trials according to GAP were available to the Meeting. The captan residues were 2.4, 4.3, 5.5 14, 20, 20 and 21 mg/kg. Two trials where the application rate was 1.1 kg ai/ha (half the label rate) should also be included because residues were 16 and 17 mg/kg. In most of the trials there was no explicit description of the sample for analysis (e.g. whole fruit + stems).

Ten US trials on cherries reported in 1994 included pre-harvest, post-harvest and combined applications according to GAP. The captan residues were 7.3, 10, 11, 14, 14, 15, 19, 23, 25 and 35 mg/kg.

In summary, the captan residues in rank order (median underlined) from the 19 trials on cherries were 2.4, 4.3, 5.5, 7.3, 10, 11, 14, 14, 14, 15, 16, 17, 19, 20, 20, 21, 23, 25 and 35 mg/kg.

The Meeting estimated a maximum residue level of 40 mg/kg for captan on cherries to replace the 1994 estimate of 20 mg/kg, and an STMR of 15 mg/kg.

Data from 11 US supervised trials on nectarines could not be evaluated because the trial conditions were not sufficiently close to GAP.

US GAP permits the use of captan on plums at 3.4 kg ai/ha with harvest on the day of the final application. The total application permitted per season is 30 kg ai/ha, which corresponds to 9 applications. Data from 2 US trials on plums were reported to the Meeting and the use pattern in one of them exactly complied with GAP while in the other the application rate was correct but there were 13 applications and the PHI was 2 days. The use pattern in the 3 trials reported in the 1994 monograph complied with US GAP. The captan residues in the 5 valid trials (median underlined) were 0.45, 0.60, 0.71, 5.6 and 7.9 mg/kg.

The Meeting concluded that the results suggest that a higher limit than the present draft MRL of 5 mg/kg is required, but the database is limited. The Meeting agreed not to estimate a revised maximum residue level, but to await the periodic review of captan in 1998 when complete information on GAP and residues resulting from supervised trials should be available.

In the USA captan may be applied to grapes at 1.1-2.2 kg ai/ha with no more than 13 kg ai/ha used in a growing season, equivalent to 6 applications at the higher rate. Harvest is permitted on the day of the last application. The conditions in 9 US trials closely matched the maximum conditions of US GAP. Seven of the trials were reported to the present Meeting and 2 had been reported in 1994. The residues in the 9 trials were 1.3, 3.5, 3.7, 6.4, 7.2, 7.4, 8.4, 11 and 22 mg/kg.

Trials on grapes in Argentina, France, Germany and Japan were evaluated in 1994. The residue was 0.74 mg/kg in an Argentinian trial according to Argentinian GAP (1.3 kg ai/ha, 3 applications, 25 days PHI). A French trial and 12 German trials were evaluated against French GAP (10 applications of 3.5 kg ai/ha with a PHI of 33 days). Pre-harvest intervals of 28-38 days in these trials were accepted. The residues in the 13 trials were 1.4, 1.7, 1.7, 1.9, 2.8, 3.0, 3.6, 4.4, 6.5, 7.0, 8.3, 9.8 and 15 mg/kg. In Japan captan may be sprayed 5 times on grapes at a concentration of 0.10 kg ai/hl, with harvest 14 days after the final application. The residues on grapes from 6 Japanese trials complying with GAP were 3.2, 5.8, 6.1, 6.1, 12 and 14 mg/kg.

In summary, the residues in rank order (median underlined) from the 29 trials were 0.74, 1.3, 1.4, 1.7, 1.7, 1.9, 2.8, 3.0, 3.2, 3.5, 3.6, 3.7, 4.4, 5.8, 6.1, 6.1, 6.4, 6.5, 7.0, 7.2, 7.4, 8.3, 8.4, 9.8, 11, 12, 14, 15 and 22 mg/kg.

The Meeting estimated a maximum residue level of 25 mg/kg for captan on grapes to replace the current draft MRL of 20 mg/kg, and an STMR of 6.1 mg/kg.

US GAP permits application rates for captan on strawberries of 1.7-3.4 kg ai/ha and a PHI of 0 days, with a total application for the growing season of 27 kg ai/ha, equivalent to 8 applications at the highest rate. Six US and one Canadian trial according to the US application rate and PHI were reported to the Meeting. The number of applications varied from one to 11 but apparently the number had little effect on the residue levels. The residues in the 7 trials were 3.4, 3.9, 5.8, 6.4, 7.3, 13 and 27 mg/kg.

Trials in the USA, Canada, Chile and Hungary were recorded in the 1994 evaluations. In nine US trials complying with US GAP the residues were 1.0, 2.6, 3.9, 4.4, 5.2, 7.7, 12, 13 and 15 mg/kg. The residue was 3.0 mg/kg in a Canadian trial according to Canadian GAP (3.4 kg ai/ha, PHI 2 days). Chilean GAP allows 2 applications of 3.2 kg ai/ha and a PHI of 2 days. In trials at this rate but with 1 application and a 3-day PHI the residues were 3.8, 4.2 and 4.8 mg/kg. The residue in a Hungarian trial according to GAP (1.3 kg ai/ha, 3 applications, 10-day PHI) was 0.93 mg/kg.

In summary, captan residues in strawberries from the 21 trials (median underlined) were 0.93, 1.0, 2.6, 3.0, 3.4, 3.8, 3.9, 3.9, 4.2, 4.4, 4.8, 5.2, 5.8, 6.4, 7.3, 7.7, 12, 13, 13, 15 and 27 mg/kg.

The Meeting estimated a maximum residue level of 30 mg/kg for captan on strawberries to replace the 1994 estimate of 15 mg/kg, and an STMR of 4.8 mg/kg.

Information was provided to the Meeting on the fate of captan during the processing of apples and grapes.

Details of the processes for producing juice and pomace from apples were very limited. Heating and cooking are very influential on the fate of captan but no information on these operations was provided. Calculated processing factors for the production of juice, wet pomace and dry pomace from apples were 0.30, 0.48 and 0.064 respectively.

More detailed studies were provided to the 1994 JMPR, and that Meeting concluded that captan is not present in processed commodities such as apple sauce, canned apple slices, apple jelly or canned juice because it is destroyed by cooking and heating.

The supervised trials median residues for the processed commodities (STMR-Ps) calculated from the processing factors and the STMR for apples (4.05 mg/kg) were apple juice (unheated) 1.2 mg/kg, apple juice (heated) 0 mg/kg, apple sauce 0 mg/kg and dry apple pomace 0.26 mg/kg.

The Meeting also used the processing factor to estimate a maximum residue level for dry apple pomace of 2 mg/kg after rounding (maximum residue level in apples 20 × processing factor 0.064).

The processing factors for captan in the production of grape products were highly variable from one experiment to another, probably reflecting the sensitivity of captan to degradation under some heating conditions. The processing factors (mean and range) from grape processing studies supplied to the current Meeting and to the 1994 JMPR were grapes to juice 1.2 (range 0.23-4.9), grapes to wet pomace 0.94 (range 0.19-1.4), grapes to dry pomace 0.67 (range 0.12-1.7) and grapes to raisins 1.66 (range 0.11-4.8).

The STMR-Ps calculated from the processing factors and the STMR for grapes (6.1 mg/kg) were grape juice 7.3 mg/kg, dry grape pomace 4.1 mg/kg and raisins 10.4 mg/kg.

The Meeting also used the processing factor for raisins to estimate a maximum residue level for dried grapes of 50 mg/kg after rounding (maximum residue level in grapes 25 mg/kg × processing factor 1.66).

RECOMMENDATIONS

On the basis of the data from supervised trials the Meeting concluded that the residue levels listed below are suitable for establishing maximum residue limits.

Definition of the residue (for compliance with MRL and for estimation of dietary intake): captan.

Commodity		Recommended MRL, mg/kg		PHI, days	STMR, mg/kg	STMR-P, mg/kg
CCN	Name	New	Current			
FP 0226	Apple	20	10	0	4.05	
AB 0226	Apple pomace, dry	2				0.26
FS 0013	Cherries	40	20	0	15	
DF 0269	Dried grapes (currants, raisins and sultanas)	50				10.4
FB 0269	Grapes	25	20	0	6.1	
FB 0275	Strawberry	30	15	0	4.8	
	Apple juice (unheated)					1.2
	Apple juice (heated)					0
	Apple sauce					0
	Grape juice					7.3

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