DISULFOTON (074)

EXPLANATION

The JMPR evaluated disulfoton for residues in 1973, 1975, 1979, 1981 and 1984, and it was completely re-evaluated by the 1991 JMPR in accordance with what was later to be designated as the CCPR periodic review programme. The ADI was revised, new MRLs were proposed, and others recommended for revision of withdrawal in the context of current GAP.

Discussion of the new or revised proposals at the CCPR in 1993 and 1994 prompted comments on various proposals (including that for milk); comments that some data supporting national limits were not included in the re-evaluation; and a proposal that the disulfoton metabolite demeton-S should be excluded from the definition of the residue. Clarification of the GAP for cabbage and sorghum forage (green) was requested.

The Meeting received and reviewed substantial additional data (280 reports); information on GAP from the manufacturer and some countries; comments from The Netherlands on the definition of the residue and written comments from countries in support of their positions at the CCPR on various commodities, including milk.

METHODS OF RESIDUE ANALYSIS

As part of the periodic re-evaluation in 1991 the JMPR estimated numerous maximum residue levels and defined the residue as the sum of disulfoton, demeton-S and their sulphoxides and sulphones, expressed as disulfoton. This is also shown in the 1991 monograph as the definition used by 15 of the 16 countries reporting national MRLs, the exceptional definition being as the sum of disulfoton and its cholinesterase-inhibiting metabolites.

At the 1993 CCPR questions were raised as to which compounds should be included in the definition of the residue: it was doubted whether residues of demeton-S and its sulphoxide and sulphone were found in practice. Written comments from The Netherlands recommended deletion of demeton-S (the oxygen analogue of disulfoton) from the definition of the residue and suggested that a limit of determination of 0.02 mg/kg was appropriate for enforcement purposes.

The structures of the compounds in the residue as currently defined are as follows.

disulfoton	$(C_2H_5O)_2PSSCH_2CH_2\text{-}S\text{-}C_2H_5$
disulfoton sulphoxide	$(C_2H_5O)_2PSSCH_2CH_2\text{-}SO\text{-}C_2H_5$
disulfoton sulphone	$(C_2H_5O)_2PSSCH_2CH_2\text{-}SO_2\text{-}C_2H_5$

disulfoton oxygen analogue (demeton-S)	$(C_2H_5O)_2POSCH_2CH_2\text{-}S\text{-}C_2H_5$
disulfoton oxygen analogue sulphoxide (demeton-S sulphoxide)	$(C_2H_5O)_2POSCH_2CH_2\text{-}SO\text{-}C_2H_5$
disulfoton oxygen analogue sulphone (demeton-S sulphone)	$(C_2H_5O)_2POSCH_2CH_2\text{-}SO_2\text{-}C_2H_5$

As stated in the 1991 JMPR monograph, individual components of the residue may be determined separately by GLC or can all be converted to the sulphones of disulfoton and its oxon by oxidation with $KMnO_4$. The total sulphone residue can be expressed as disulfoton by the use of a molecular weight conversion factor. Most of the residues submitted to the 1994 Meeting were determined by "method MR21319". The method itself was not submitted and is presumed to be one of those summarized by the 1991 JMPR.

According to the 1991 JMPR Evaluations (Part II - Toxicology) residues of disulfoton sulphone and the sulphoxide and sulphone of disulfoton oxygen analogue (i.e. the sulphoxide and sulphone of demeton-S) have been identified in the urine of rats. According to the metabolism studies summarized in the 1991 residue monograph sulphonic acids are the predominant residues in goat tissues and milk, with significant levels of the parent compound in liver and muscle. The parent compound was the predominant residue in poultry fat and gizzard, but the sulphonic acids were the main compounds in other poultry tissues.

In plant metabolism studies residues of disulfoton, disulfoton sulphoxide, disulfoton oxygen analogue sulphoxide (i.e. the sulphoxide of demeton-S), disulfoton sulphone and disulfoton oxygen analogue sulphone (i.e. the sulphone of demeton-S) are reported. No residues of the oxygen analogue of disulfoton (i.e. demeton-S) are reported in practice.

USE PATTERN

The Meeting received information on GAP for a number of commodities on which additional supervised trials data were provided, and updated information on GAP for others. The information relevant to the additional data received or to country comments is summarized in Table 1.

Table 1. Nationally approved or registered uses of disulfoton.

Crop, Country	Application	PHI (days)	Notes

	Form.	Rate, kg ai/ha (g ai/1000m row)	No.		
Asparagus Canada	GR, EC	1.1	2	6 mo.	post-harvest foliar spray
Barley USA	EC	1.1	1	60	At-plant soil injection. 60-day grazing restriction Foliar. * Aerial or ground spring or autumn application. May make in addition to at-plant, max. total of 2.2 kg ai/season
		1.1	1*	30	
	GR	1.1	1*	60	At-plant drill or broadcast or post-emergence broadcast. * Maximum 2 applications (at-plant + post-emergence) permitted/season. 30-day grazing or cut for forage restriction
Canada	GR or EC	1.1	2	60*	At-plant soil incorp. or after emergence. *30-day PHI for grazing
Beans USA	EC	(82-171) or 1.1 to 2.2 kg ai/ha at 75 cm row space	1	60	At-plant soil injection side-dress. For snap or lima beans side-dress on each side of furrow. For dry beans use the specified pre-plant treatment or a double-sided post-emergence side-dress injection at the same rate
	GR At-plant soil incorp. band	(82-163) or 1.1-2.2 at 75 cm row space	1	60	For snap or lima beans band each. side of furrow. For dry beans use the specified pre-plant treatment or a double-sided post-emergence side-dress band at the same rate
Beans, Green, Lima Canada	GR or EC	1.1-2.3	--	--	At-plant soil application
Beans, Dry Canada	GR or EC	1.1-2.3	1	60	At-plant soil or post-emergence side-dress
Broccoli USA	GR Same as cabbage*	Same as cabbage*	1	14	*Same types of use and application rates as for cabbage (below), except that the use against root aphids does not apply to broccoli and the broccoli PHI is shorter.
Canada	GR or EC	1.1	1	42	At-plant soil or established plant side-dress
Broccoli USA	EC	(100) or 1.1 at 90 cm row space	1	14	At-plant side-dress seeded furrow or transplant row. Side-dress injections each side of row or furrow. Established plant side-dress
		1.1	1 1		Pre-plant broadcast transplant seed beds, soil incorporated
Cabbage USA	EC	(100) or 1.1 at 36" (90 cm) row space	1	42	At-plant, post-plant or post-emergence side-dress. Inject each side of seed furrow or transplanted row or after plants emerge
		(154) or 1.1-2.2 at 20" (50 cm) row space			For Root aphids
		1.1 kg ai/ha	1	--	Transplant seedbed broadcast soil incorporated, broadcast prior to seeding
USA	GR	(100) or 1.1 at 36" (90cm) row space	1 +		At-plant or after plant soil incorp. side band (side bands each side of furrow) and/or post-emergence soil incorp. side-dress
			1	42	After plants are established
		(154)	1	42	For root aphids
		Same as above	1		Seed beds: pre-plant soil incorp. or post-emergence broadcast & watering broadcast
Canada	GR or EC	1.1	1	42	At-plant soil or post-emergence side-dressing
Cotton	GR	70-112 g ai/100 m row	1	--	At-plant in furrow

Crop, Country	Application			PHI (days)	Notes
	Form.	Rate, kg ai/ha (g ai/1000m row)	No.		
USA		or 0.7-1.1 kg ai/ha at 100 cm row space	1	--	Side-dress band. Band side-dress soil-incorporated each side of row
		Same	1*	28	Post-plant side-dress. Irrigated cotton only. * In addition to at plant treatment for a total of two treatments per season.
		35-45 g ai/1000 m row or 2.1-3 kg ai/ha at 100 cm row space	1	--	Hill dropped cotton: at-plant. Apply with seed
	EC	0.2-0.65	3	--	Pre-bloom foliar. Aerial or ground spray. Additional soil treatment not permitted
		70-112 g ai/1000 m row or 0.63-1.1 kg ai/ha at 100 cm row space	3	28	Soil injection. Band treatment
	Seed treatment liquid	0.25-0.5 kg ai/100 kg seed	--	--	
Spain	GR	0.6-0.75	--	--	Spreading before sowing
Greece	GR	1-1.5	1	60	Row spreading application
Egg plant - Canada	See peppers				
Lettuce (iceberg) Canada	EC	1.1	1	28	British Columbia only: 1.5 l/ha foliar spray with boom sprayer before heads begin to form with ≥500 l water/ha
LettuceCanada	EC or GR	1.1-2.2	--	--	At-plant into soil, higher rate for organic soils
Maize USA	EC	1.2	1	28	Foliar. Cutting/forage restriction within 28 days; one soil + 1 foliar treatment permitted
		1.1 (111) [112 g ai/1000 m row]	1		At-plant in furrow band over soil-covered seed or band each side of row. Rate as kg ai/ha assumes 40 in. (100cm) row space, g ai/1000 m any row space.
	or	1.1(111) [112 g ai/1000 m]	1		Post-emergence/post-plant side-dress soil injection each side of furrow
Spain	GR	0.6-0.75	--	--	Spreading before sowing
Canada	EC or GR	1.1	--	100*	At-plant into soil. *40 days for grazing or forage
Peas Canada	GR or EC	1.1-2.6	1	50	At-plant into soil or post-emergence side-dress
Peas USA	EC	1.1-2.8	1	50	At-plant in-furrow spray or post-emergence side-dress. Side-dress each side of furrow. Hay/vine feeding restriction
	GR	1.1-2.8	1	50	At-plant drill or broadcast or post-emergence side-dress. Side-dress each side of row. Hay/vine feeding restriction.
Pecans USA	EC				
	High vol. spray	0.3-0.4	1-3	30	Foliar ground; no grazing
	Low vol. spray	0.8-1.1	1-3	30	Foliar aerial, minimum 47 l water/ha; no grazing
	High vol. spray & incorporate	1.7-3.5	1	80	0.6 m band/split band soil application. South central and south western states only
	GR Spread & incorporate	1.7-3.4	1	80	Band/split band soil application. South central and south western states only
PeppersCanada	GR or EC	1.1-2.4	1	90	At-plant into soil or post-emergence side-dress.
Potato					

Crop, Country	Application			PHI (days)	Notes
	Form.	Rate, kg ai/ha (g ai/1000m row)	No.		
Canada	GR or EC	2-3.4 1.1 *	--	90	At-plant into soil and/or post-emergence side-dress. Higher rate in organic soil. * New Brunswick only
Spain	GR	1-1.3	--	--	Spreading before sowing
Sorghum Spain	GR	0.6-0.75	--	--	Spreading before sowing
USA	EC At-plant furrow	82-112 g ai/1000 m row or 0.8-1.1	1 1	-- --	At any row space At 100 cm row space
	At-plant band	112 g ai/1000 m row or 1.1	1 1	-- --	At any row space At 100 cm row space
	Post-plant side-dress	112 g ai/1000 m row	1	45*	*For forage and fodder uses. Inject both sides row up to boot stage. Can follow at-plant (Total 2 at-plant + 3 foliar).
		or 1.1	1		At 100 cm row space
	Post-plant foliar	0.28-0.56	1-2 3	7* 34** 34***	*For grain; 45 days for forage/fodder **For grain: 60 days for forage/fodder ***For grain any soil + foliar; 45 days for forage/fodder aerial ≥1 gal/A; ground ≥5 gal/A. Limitation is a total of 5 applications (2 at-plant + 3 foliar)
	GR	(84-112) or 0.84-1.1*	1	--	In-furrow above seed. Furrow ≥15 cm apart. *At 100 cm row space
		(112) or 1.1	1	--	At-plant band. 10-15 cm soil incorporated band (not on seed). Furrows ≥15 cm apart
		(112) or 1.1	1	30*	Post-plant broadcast in whorl. *Before harvest of grain. 45 days before forage or fodder use. May be made in addn. to at-plant applications.
Spinach Canada	GR or EC	1.1	--	--	At-plant into soil
Tomato Canada	GR or EC	1.1-3.4	1-2	30	At-plant into soil and (if necessary) post-emergence side-dress
USA	EC At-plant side-dress	(112-328) or 1.1-3.4 at 95 cm row space	1-2	30	Side-dress injection to seed furrow or transplanted row (not directly on seed). Maximum rate for one application. For two applications (one to established plants in addition to at-plant) 112-224 g ai/1000 m row (1.1-2.2 kg ai/ha).
	Seed beds soil-incorporation pre-plant	3.4	1	--	For Florida high alkaline soil one 985 g ai application/1000 m row (183 cm row space) or for 2 applications one at-plant at 492 g ai/1000 m row and up to that level for established plants, either at 180 cm row space
Wheat Canada (autumn wheat)	EC or GR	1.1	--		
USA Spring or Autumn wheat	EC	0.3-0.8	2	30	Foliar, aerial or ground, 30 days PHI for grain. Grazing/forage feeding treated crop prohibited. Two autumn applications, or two spring applications following the autumn application are permitted
Autumn wheat		(24) up to 1.1 kg ai/ha	--	--	At-plant soil injection. Grazing/forage cutting of treated crop prohibited. Application with liquid fertilizer also permitted

Crop, Country	Application			PHI (days)	Notes
	Form.	Rate, kg ai/ha (g ai/1000m row)	No.		
Autumn wheat	GR	1.1	1	--	At plant drill or broadcast. 75-day grazing/forage restriction for at-plant GR use

RESIDUES RESULTING FROM SUPERVISED TRIALS

During discussions of the 1991 JMPR periodic review of disulfoton at the 1993 CCPR is was noted that some data supporting national limits had not been provided for the review. The present Meeting received additional data (Bayer, 1994) on a number of commodities and in a few cases written comments from France, Germany, and The Netherlands in support of CCPR positions. Generally the new data consisted of relatively detailed summaries including most of the essential information. In most cases sample storage and handling conditions were not included and in some cases no information was provided on plot sizes. Sampling-to-analysis intervals were accessible and the 1991 JMPR had reviewed storage stability studies which indicated that the residues in various commodities were stable for long intervals under frozen conditions. The Meeting was informed that all results designated as resulting from SC formulations were actually from the application of EC formulations. "SC" had been used as a generic term for water-soluble formulations applied as a spray. The data are summarized in the following tables.

Table

2. Broccoli and cabbage
3. Beans
4. Peas
5. Barley
6. Maize
7. Sorghum
8. Sorghum rotational
9. Wheat - Granular formulations
10. Wheat - SC formulations
11. Cotton
12. Pecans

Broccoli (Table 2). The 1991 JMPR estimated a maximum residue level of 0.2 mg/kg for broccoli (14-42 days PHI), which had been covered by the 0.5 mg/kg CXL for vegetables. The estimate was based on six 1986 US trials all with 2 applications (combinations of EC and/or GR) of 1.1 + 1.7 or 1.1 + 2 kg ai/ha and residues after the 14-day GAP PHI of 0.01 (6), 0.03 (2), 0.05, 0.06, 0.09 and 0.11 mg/kg. However, the data in the monograph do not indicate the types of application (in-furrow, side-dress etc.). Summary data in the 1973 monograph (showing residues up to 0.6 mg/kg) were not used because the original reports were not available.

The proposed MRL of 0.2 mg/kg is one of several proposals for disulfoton which the 1994 CCPR requested the JMPR to reconsider. The French government provided written comments on the proposal as requested. The Meeting also received reports of ten 1972 US trials which had not been provided to the 1991 JMPR.

The new data include trials with at-plant in-furrow and at-plant band treatments. The reported GAP does not include the in-furrow applications. Residues in whole plants from at-plant band applications with a granular formulation ranged from 1.6 to 15 mg/kg after PHIs between 33 and 45 days (compared to a GAP PHI of 14 days), but these were from application rates of $\geq$1.7 times the GAP rate of 100 g ai/1000m (1.1 kg ai/ha at 90 cm row space). The exact nature of the at-plant band treatment (i.e. whether in-furrow, side-dress etc.) was not included in the reports provided. Side-dress soil-incorporated single

band applications (both sides of furrow or row) at planting, after transplant or after plant establishment are according to GAP.

The comments received from countries on the data reviewed in 1991 express doubt whether two applications reflect GAP and concern at the low ADI. An MRL of 0.1 mg/kg was proposed. Current US labels, which permit only single applications to broccoli, were also received.

Cabbage (Table 2). The 1991 JMPR estimated a 0.2 mg/kg maximum residue level for head cabbages. It was based on 9 US supervised trials with maximum residues of <0.01 (5), 0.02 (2), 0.06 and 0.17 mg/kg after the GAP 42-day PHI, from two applications of EC or EC/GR formulations at 1.1 kg ai/ha for the first and 1.3 to 3.2 kg ai/ha for the second. Data were also available from 4 Japanese trials which showed a residue of 0.07 mg/kg from 1.3 times the GAP rate and 0.06 mg/kg from a 2.6-fold rate after the Japanese 70-day PHI. Other trials results were not evaluated owing to the lack of detailed information.

At the 1993 CCPR the delegation of France requested clarification of US Gap. The 1994 CCPR requested the French government to provide written comments in support of its objections to the proposed MRL.

The requested comments from the French government, including a proposal for a 0.1 mg/kg limit, were received. The proposal was based on the observations that 2 applications had been made in the US trials reviewed by the 1991 JMPR and the doubt whether this corresponded to GAP, and that the residue of 0.17 mg/kg occurred at 39-43 days, while 0.09 mg/kg was reported after 29/32 days in the same trial.

Clarification of US GAP, supported by GR and EC labels was also received. Current GAP includes a 42-day PHI and single applications of GR or EC formulations, whereas the GAP reported to the 1991 JMPR allowed 2 applications for some uses. Current GAP includes applications at 100 g ai/1000 m row (1.1 kg ai/ha for 90 cm (36") row space), and against root aphids 159 g ai/1000 m (up to 2.2 kg ai/ha at a 50 cm row space).

Reports were also received of 13 additional 1971-2 US supervised trials with granular formulations, which were not reviewed by the 1991 JMPR. Residues were ≤0.05 mg/kg from post-emergence band-over-row, and at-plant band-over-furrow and band-over-row applications at PHIs ranging from 35 to 86 days. Residues were substantially higher from at-plant band and at-plant in-furrow applications. From the latter residues ranged from 2.4 to 5.9 mg/kg in whole plants after 35 days and 0.7 to 8.4 mg/kg after 51 to 62 days. However, at-plant in-furrow applications appear not to be GAP according to US labels for granular formulations provided to the Meeting. From "at-plant band" applications at 170 g ai/1000 m (1.7 times the GAP rate on a g/m basis or 1.9 to 11 kg ai/ha, depending on row spacing) residues ranged from 1.4 to 7.7 mg/kg after 51 days; the GAP PHI is 42 days.

Cauliflower. No new residue data were provided for cauliflower, although the Meeting received information on current US GAP for EC and GR formulations and, as requested by the 1994 CCPR, comments from the French government on the recommendation by the 1991 JMPR of 0.2 mg/kg as a partial replacement of the 0.5 mg/kg CXL for vegetables. The comments referred to the GAP reported to the 1991 JMPR (1 or 2 GR applications at 1.1 kg ai/ha and a 40-day PHI in the USA; 1 GR application at 2 kg ai/ha and a 14-day PHI in Mexico). The comments also referred to the residue trials, concluding that the 0.3 mg/kg residue was an outlier and that an MRL of 0.05 mg/kg could be supported.

Current US GAP permits two applications for EC or GR formulations, the first at 100 g ai/1000 m

(1.1 kg ai/ha at 90 cm row spacing) as an at-plant seed furrow or transplanted row side-dress (both sides), and if necessary as a side-dressing after plants are established. The PHI is 40 days.

The 8 US trials reviewed by the 1991 JMPR were with 3 applications, the 1st at the GAP rate and the 2nd and 3rd at the GAP rate in 6 trials and up to 1.5 times the GAP rate in 2 trials. The details of the applications are not given in the monograph. After 28-30 days the residues were ≤0.01 (6), 0.02 and 0.04 mg/kg, and after 38-43 days ≤0.01 (5), 0.04 and 0.31 mg/kg.

Table 2. Residues of disulfoton in broccoli and cabbage resulting from supervised trials with GR formulations in the USA. All single applications.

Crop, State, Year	Application		Residues, mg/kg, at days after last application					Mobay Report No.
	Type	Rate, kg ai/ha, (g ai/1000m row)						
Broccoli			33-35	43-45		58-63		
			9.9	10		5.9		38508
FL 1972	In furrow at-plant	1.9 (170) = 2.3 X GAP)	34	5.8		6.3		38509
		2.9 (170)	50	9.5		6.8		38510
		3.8 (170)	26	9.7		7.9		38511
		5.7	19	12		6.3		38512
		11.4	2.7	2.7		4.2		38503
FL 1972	Band at-plant	(170) 1.8 (=1.7 X GAP)	5.7	9.8		6.5		38504
		2.9 (=2.6 X GAP)	5.1	6		1.6		38505
		3.8 (=3.5 X GAP) 5.7	5.8	15		5.4		38506
		11.4	7.8	9.2		4.5		38507
			All controls <0.05					
Cabbage (whole plant)			35	42	51	62	86	31329
FL 1971	band over row post-emergence	3.1 (158) 20" row space	<0.05	<0.05				
KS 1971		1.6 (78) 40" row space	0.05	<0.05				
	at-plant band over furrow	3.1 (158) 20"					0.05	30941
KS 1971		1.6 (78) 40"					0.03	
	band over row	3.1 (158) 20"	0.04	0.05				30940
KS 1972		1.6 (78) 40"	0.02	0.05				
	at-plant band	1.9 (173) 36"row space	4		5	0.5		37831
		2.9 (173) 24"row*	1.9		3.2	0.2		37830
		3.8 (173) 18"row	1.9		1.4	2.3		37829
		5.7 (173) 12"row	3.2		2.7	1.3		37828
KS 1972		11.4 (173) 6"row	1.6		7.7	3		37827
	at-plant in furrow	1.9 (173) 36"row	5.9		3.7	3.4		37826
		2.9 (173) 24" row	5.8		2.2	8.4		37825
		3.8 (173) 18"row	2.4		3.2	0.7		37824
		5.6 (173) 12"row	2.8		3.2	1.6		37823
	GR	12 (173) 6"row	4.4		5.6	1.7		37822
		* row = row space	All cabbage controls <0.01 except report 31329 at 0.05					

Beans (Table 3) and peas (Table 4). As a result of the periodic review of disulfoton the 1991 JMPR estimated maximum residue levels of 0.01 mg/kg for dry beans, 0.2 mg/kg for common beans and 0.1 mg/kg for garden peas. Two trials on lima beans were considered insufficient to estimate a maximum level. The present Meeting received limited additional data on dry beans, common beans and lima beans as well as data on black-eyed peas (regulated as beans in the United States) and limited additional data on peas. French comments on common beans, requested by the 1994 CCPR, were also received.

The MRL recommended by the 1991 JMPR for dry beans was based on 5 trials in the USA with application rates of about 2.2-3.5 kg ai/ha compared to the reported maximum GAP rate of 2.3 kg ai/ha. Residues did not exceed 0.01 mg/kg after 45 days: the registered PHI is 60 days. The Meeting received relatively detailed summary data from two additional US trials on dry beans (the sample handling and storage conditions were missing, but plot sizes and sample storage periods before analysis were given) as well as another very summarized report which was not considered but is included in Table 3. Residues in the two reviewed studies after 86 days from treatments according to GAP were 0.03 and <0.01 mg/kg in the dry beans and 0.2 and 0.05 mg/kg in the vines, with controls in the beans and vines of <0.01 and 0.03 mg/kg respectively.

In written comments the French government doubted whether 0.01 mg/kg was a realistic limit of determination.

The 1991 estimate of 0.2 mg/kg as a maximum residue level in common beans was based on 10 US and 4 Japanese trials with residues of <0.01 (4), 0.04, 0.06, 0.11 and 0.14 mg/kg after 59-67 days in the USA and <0.07 mg/kg after 57-69 days in all the Japanese trials. The GAP PHI is 60 days. References to residues up to 0.3 mg/kg in the 1973 monograph were not considered in the absence of the actual reports. Residues in two additional US trials from which data were submitted to the Meeting did not exceed 0.05 mg/kg.

The Meeting also received written French comments on the recommended MRL of 0.2 mg/kg, as requested by the 1994 CCPR. These proposed a 0.1 mg/kg limit, since only two of the 10 trials reviewed by the 1991 JMPR (in which the residues were <0.01 mg/kg) were according to GAP, application rates in the others being up to 50% above the maximum GAP rate of 2.3 kg ai/ha.

The 1991 JMPR did not consider the two trials on Lima beans for which data were provided (maximum residue 0.02 mg/kg) sufficient to estimate a maximum residue level. The Meeting received data from one additional supervised trial in the United States (Table 3), with residues of <0.01 and 0.06 mg/kg in beans and green vines respectively after 92 days.

Data were received on residues in green and dry black-eyed peas (beans) (Table 4) from 5 US supervised trials with an SC formulation and 4 with a granular formulation in 1968, and from a 1976 rotational crop trial with an LC formulation. Little detail accompanied the summary reports, although sampling-to-analysis intervals were accessible. No information was provided on GAP for SC formulations, but the GAP for EC and GR formulations (up to 2.2 kg ai/ha, 60-day PHI) would presumably apply to these trials (see the note on SC and EC formulations at the end of the introduction to this section). All of the results were at PHIs of 28 to 46 days compared to the reported GAP PHI of 60 days.

The maximum residue level of 0.1 mg/kg for garden peas estimated by the 1991 JMPR was part of the recommended replacement of the 0.5 mg/kg CXL for vegetables. It was based on US, Canadian and

Japanese trials with maximum residues up to 0.08 mg/kg after 56 to 60 days. The Meeting received data on residues in peas (Early frosty, Venus, and Little Marvel) from trials in the United States in 1975-77. The residues were ≤ 0.04 mg/kg in the peas and 0.1 mg/kg in the pods.

Table 3. Residues of disulfoton in beans resulting from supervised trials with GR formulations in the USA in 1975. All single applications.

State, variety	Application		Residues, mg/kg, at days after last application	Mobay Report No.
	Type	Rate, kg ai/ha (g ai/1000m row)	61 75 83 86 89 92 105 126	
Dry beans				
CA 1975 Sutter Pink	Side-dress post-emergence	1.5	<0.01	50692[1]
WA 1975 Big bend	At-plant double side-dress	2	Beans 0.03 <0.01 control <0.01 vines 0.2 0.05 control <0.01	49327
WA 1975 v.Big bend		2	Beans <0.01 <0.01 vines 0.05 0.03 control <0.01	49329
Green beans				
WI 1975 Ford H. Lima	At-plant-double side-dress	2.2	Beans <0.01 Green vines 0.05 0.05 0.06 control <0.01	49287
OR 1975 Burpee str. snap beans	At-plant side-dress	0.13	beans 0.02 vines 0.04 0.02	49144
OR 1975 Snap beans, stringless		0.13	beans 0.05 vines 0.09 0.06	49147

[1] Summary data only

Table 4. Residues of disulfoton in peas resulting from supervised trials in the USA.

Crop, State, year	Application		PHI, days	Residues, mg/kg. (C) = Control value				Mobay Report No.
	No.	Rate, kg ai/ha (l water/ha)		Green peas[1]	Green vines	Dry peas	Dry vines	
At-plant side-dress + post-emergence with SC formulation								
Black-eye TX 1968	1 + 2	3.4	29 46	1.1	22 (0.1)	0.06	19 (0.05)	24138
Black-eye CA 1968	1 + 1	2.2	30	0.3 (<0.01)				24139
Southern pea CA 1968	1 + 1	3.4	28 39 43	1.4 (1.5)	18 (0.02)	0.04 (<0.01)	11 (0.04)	24141
Southern pea crowder MS 1968	1 + 1	2.2 (187)	28 39 43	0.2 (0.02)	4.5	0.04 (<0.01)	2.1 (0.03)	24150

Crop, State, year	Application		PHI, days	Residues, mg/kg. (C) = Control value				Mobay Report No.
	No.	Rate, kg ai/ha (l water/ha)		Green peas[1]	Green vines	Dry peas	Dry vines	
Black-eye GA 1968	1 + 1	2.2 (2806)	30 39	<0.02 (0.02)	0.07 (0.02)	 0.04	 1.9 (0.02)	24151
At-plant in-furrow with SC formulation								
Peas (Early frosty) OR 1977	1	2.8 (701)	81	<0.01				65779
At-plant side-dress + post-emergence side-dress with GR formulation								
Black-eye CA 1968	1 + 1	3.4	30	0.2 (<0.01)				24193
Black-eye CA 1968	1 + 1	2.4	30 39	<0.02 (0.02)	0.7 (0.02)	 <0.01	 0.8 (0.02)	24204
Southern pea (purple hull) MS 1968	1 + 1	2.2	28 46	0.3 (<0.01)	8.7 (0.06)	0.01 (0.01)	3.6 (0.01)	24205
In-furrow + post-emergence side-dress with GR formulation								
Black-eye GA 1968	1 + 1	3.4	30 39	<0.02 (0.02)	0.2 (0.02)	 <0.01	 4.2 (0.02)	24188
Post-emergence early side-dress with GR formulation								
Peas (Venus) NJ 1975	1	2.8	33	0.04 0.1 pods	0.2			49300

Rotational crop studies with LC formulation, soil broadcast				
Black-eye FL 1976	1	2.2-18	<0.02 mg/kg in peas & pods or green vines from 6 trials with planting 29 to 89 days after application and sampling 61 to 93 days after planting, or in peas, pods or vines from 4 trials with planting 362 days after application and sampling 65 days after planting	53594-99 67857-60
Peas (Little marvel) KS 1976	1	18	<0.01 mg/kg in green vines with planting 90 days after application and sampling 47 days after planting	67906

[1] Green peas were not further defined. Assumed to mean green pea + green hull or green pea in pod

Barley (Table 5). As part of its periodic review, the 1991 JMPR estimated a maximum residue level of 0.2 mg/kg for barley as partial replacement of the CXL at the same level for cereal grains (except rice), which was recommended for withdrawal. Although no specific questions on barley were recorded in the reports of the 1993 or 1994 CCPR, the proposed MRL was retained at step 7B in 1994.

The Meeting received information on current GAP (including labels), and reports on four 1974-75 US residue trials in addition to the trials (25 US and one Canadian) reviewed by the 1991 JMPR. Written comments were also received from the French government proposing a 0.05 mg/kg limit. These cite the GAP of 1.1 kg ai/ha with a 60-day PHI for some uses and 0.6 + 1.1 kg ai/ha with a 30-day PHI for others reported in 1991. They note that the trials reviewed were mainly with 2 applications at 1.1 kg ai/ha (GAP is 1 application) and that residues in trials which strictly followed GAP were 0.01 to 0.02 mg/kg after 60 days.

For convenience the results listed by the 1991 JMPR are repeated below (the types of application were not described in 1991).

Application			Residues, mg/kg, at interval (days)			
Form.	Rate, kg a i/ha	No.	28-37	59-63	74-83	154
EC	1.1	1			<0.01	<0.01
GR	1.1	1			<0.01, <0.01, <0.01	
EC	1.1	2	0.01, 0.02, 0.14, <0.01, <0.01, 0.04, 0.09, 0.06, <0.01, 0.1, 0.1	<0.02, <0.02, <0.02, <0.02	0.01, 0.01, 0.01, 0.01	
GR	1.1	2		0.02, <0.01, <0.01	0.03	
GR + EC	1.1 + 0.84	1 + 2	<0.01, 0.03			

The new barley trials are summarized in Table 5. The two residues in grain (0.2 and <0.01 mg/kg after 30 days) result from two foliar applications with an SC (i.e. EC) formulation at GAP rates, although GAP requires only one foliar application of EC.

Table 5. Residues of disulfoton in barley resulting from supervised trials in the USA.

State, year	Application			Residues in mg/kg at intervals (days) after last application			Mobay Report No.
	Form.	No.	Rate, kg ai/ha (g ai/hl)	30	104	114	
NY 1975	GR	2	1.1 broadcast pre- & post-emergence	green forage control	0.09 <0.01		51592
AZ 1974	SC = EC	2	0.7, 1.1 (foliar)	grain control	0.2 0.1		49261
				straw control	22 0.2		
OR 1974	SC = EC	2	1.1(foliar)	grain control straw control	<0.01 <0.01 1.3, 2 <0.01		50841
NY 1975	SC	1	1.1 (broadcast incorporated)	green forage		<0.01	51591

Maize. The 1991 JMPR recommended reductions of the CXLs of 0.5 mg/kg for maize to 0.01 mg/kg and 5 mg/kg for maize forage (included in the CXL for forage crops, green) to 1 mg/kg, and recommended a new limit for maize fodder (dry weight) of 3 mg/kg. At the 1994 CCPR one country questioned whether the limit for maize should be shown as at the limit of determination, and questions were raised (not specifically recorded in the CCPR report) as to whether all the relevant data had been submitted. The proposed MRL was retained at Step 7B. The Meeting received current information on GAP and additional data from trials in the United States which included foliar applications and trials with corn as a rotational crop (Table 6).

In the rotational crop studies residues in the grain were <0.02 mg/kg and in green forage up to 0.6 mg/kg from applications at 2-16 times the GAP rates for at-plant uses. Three trials with 3 foliar applications of an SC, i.e. EC, formulation at the registered EC rate resulted in residues of <0.01 and ≤1.1 mg/kg in kernels and forage respectively after 21 days and <0.01 and 0.7 mg/kg after 28 days. GAP allows a single application with a 28-day PHI. One trial with a topical post-emergence application of a granular formulation resulted in residues up to 0.05 mg/kg in kernels and 0.8 mg/kg in forage after 21 days, but there was no information on GAP for granular formulations.

Table 6. Residues of disulfoton in maize resulting from supervised trials in the USA.

State, year	Application			Residues, mg/kg					Mobay Report No.
	Form.	No.	Rate, kg ai/ha (g ai/1000m)	Days before planting Days planting to harvest	29 32	46	75	89-123 29-107	362 34-86	
Pre-plant broadcast (Rotational Crops)										
FL 1976	SC	2	18	green forage kernels	0.6	0.4	0.13 <0.02			53569
			9	green forage kernels	0.08	0.03	0.03 <0.02			53570
			4.5	green forage kernels	0.12	0.09	<0.02 <0.02			53571
FL 1976	SC	3	2.2-18	green forage kernels controls forage and kernels		<0.02		<0.02 8 trials <0.02 4 trials		53572--79

State, year	Application			Residues, mg/kg						Mobay Report No.
	Form.	No.	Rate, kg ai/ha (g ai/1000m)	Days before planting Days planting to harvest	29 32	46	75	89-123 29-107	362 34-86	
FL 1976	SC	3	2.2	green forage kernels (milk stage)	0.07	0.05	<0.02 <0.02			53606
FL 1977	SC	3	2.2-18	green forage kernels (milk stage) controls, forage and kernels <0.02					<0.02) 4 trials <0.02) 4 trials	67853- 56
Foliar applications				PHI (days)	21	28	35	42	Controls	
TX 1976	SC	3	1.1	green forage	1.1	0.7	0.4	0.03	0.05	53294
				kernels	<0.01 all intervals				<0.01	
				cobs	<0.01	<0.01	<0.01	0.02	<0.01	
				husks	0.3	0.2	0.1	0.05	0.04	
TX 1976	SC	3	1.1	green forage	0.8	0.6	0.3	0.05	0.09	53297
				kernels	<0.01 all intervals				<0.01	
				cobs	<0.01 all intervals				<0.01	
				husks	0.2	0.14	0.09	0.01	0.03	
NE 1976	SC	3	1.1	green forage	0.6	0.4	0.6	0.12	--	53438
				kernels	<0.01 all intervals				--	
				cobs	<0.01 all intervals				--	
				husks	0.03	0.02		0.04	<0.01 --	
Topical post-emergence application NE 1976	GR	3	1.1	green forage	0.8	0.6	0.7	0.3		53437
				kernels	0.05	<0.01		<0.01	<0.01	
				cobs	0.06	0.02		<0.01	<0.01	
				husks	0.3	0.2	0.1	0.07		

Sorghum (Tables 7 and 8). The 1991 JMPR estimated maximum residue levels of 0.5 mg/kg in sorghum grain and 20 mg/kg in sorghum forage (green). A delegation at the 1993 CCPR was concerned that 20 mg/kg in green forage might be toxic to animals; others that some of the values on which the estimate was based were aberrant. The proposal for forage was retained at Step 5 pending reconsideration by the JMPR.

The Meeting received comments from the French government proposing a 1 mg/kg limit based on the GAP PHI of 45 days; from The Netherlands expressing concern that 20 mg/kg is high in relation to the NOAEL for rats of 1 ppm in the diet and estimates of dietary intake, and from the USA expressing the view that residues of the order of 10 to 20 mg/kg in the 1991 JMPR review were aberrant. The Meeting also received substantial additional data from trials in the United States which were not reviewed by the 1991 JMPR.

The 1991 estimate for sorghum forage was based on data from 16 trials in the United States. From applications approximating GAP rates, residues in forage were <0.01-19 mg/kg 14-35 days after application and <0.01-14.2 mg/kg after 42 days. The estimate was based on a 30-day PHI. Although current GAP allows a 7- to 34-day PHI for grain depending on the use, a minimum PHI of 45 days is imposed for forage or fodder (Table 1). Residues in forage after 45 days or more are shown below as mg/kg (no. of results).

<0.01 (2), 0.07 (3), 0.08, 0.1 (3), 0.2 (2), 0.3 (3), 0.4 (3), 0.5 (3), 0.6, 0.8, 1, 1.2, 1.9, 2.1 and 14.2; mean 0.98, s.d. 2.7, 27 results.

Although extensive additional data on forage were provided, most results were at PHIs of less than 45 days. Only three trials (Table 7) with an SC (i.e. EC) formulation appear to be consistent with GAP for forage. Residues in the forage after periods of 46 days or longer were <0.01, 0.12, 0.14, 0.2 (2) and 0.6 mg/kg.

The 1991 JMPR estimated a maximum residue level of 0.5 mg/kg for sorghum grain. Although there were no outstanding questions on the grain, additional data were submitted on grain as well as forage (Table 7).

The 1991 estimate was based on the residues after 14 days or more, which were ≤0.01 (11), ≤.02 (2), 0.04, <0.05, 0.08 (2), 0.09, 0.1, 0.2 and 0.3 mg/kg (mean 0.04, s.d. 0.07, 21 results). The results at less than 14 days (0.24 and 0.15 mg/kg after 7 days; 0.87 and 2.5 mg/kg after 13 days) were too few for inclusion in the review.

Additional data available to the Meeting (Table 7) from several trials at GAP rates included GR topical with or without at-plant applications, for which the GAP PHI is 30 days. The residues were ≤0.01 (4), 0.02 (6), 0.03 (2), 0.04 (2) and 0.08 mg/kg. Data from trials with SC (i.e. EC) applications in accordance with EC GAP were also available. These included residues from 2 foliar applications at GAP rates and PHIs (7 days), and from at-plant plus foliar applications at the GAP PHI of 34 days. The residues were <0.01 (7), 0.04 (2), 0.12, 0.2 (2), 0.3 (3), 0.4 (3), 0.6 and 0.7 mg/kg.

Grain residues in rotational crops (Table 8) did not exceed 0.01 mg/kg even from exaggerated rates, except one of 0.03 and one of 0.05 mg/kg, both from the grossly exaggerated rate of 18 kg ai/ha.

Table 7. Residues of disulfoton in sorghum resulting from supervised trials.

Country, State, year	Application			Residues, mg/kg, at days after last application							Mobay Report No.
	Form.	No.	Rate, kg ai/ha (g ai/1000m)								
					15	18	29-30	32-35	45-46	Control	
USA TX 71	GR In-furrow + broadcast (topical in whorl)	1+3	1.7	grain			<0.05			0.05	33153
				forage	1.6		0.7		1.4	0.05	
KS 71	GR Pre-emerg. band over row + broadcast in whorl	1+3		grain			0.04			0.04	33157
				forage		0.2	0.2		0.1	0.05	
NE 71	GR Broadcast topical in whorl	1+3	1.7	grain			0.06			0.02	33160
				forage	1.3		0.7		0.3	0.06	
TX 68	GR	3	1.1	grain			<0.01			0.01	24048
				dry forage			0.5			0.3	
OK 68	GR	1	1.1	grain				0.02		<0.01	24049
				dry forage				0.1		0.02	
TX 68	GR	1	1.1	grain				0.04		<0.01	24052
				dry forage			<0.02		0.02		
							29-	32-	45-		

Country, State, year	Application			Residues, mg/kg, at days after last application										Mobay Report No.
	Form.	No.	Rate, kg ai/ha (g ai/1000m)											
					15		18		30		35		46	Control	
NE 68	GR	1	1.1	grain				0.01					<0.01		24052
				dry forage				0.04					--		
MS 68	GR	1	1.1	grain						0.04			<0.01		24053
				dry forage						0.09			0.02		
TX 68	GR	1	1.1	grain				0.02					--		24054
				dry forage				0.2					0.06		
NE 68	GR	1	1.1	grain				<0.01					<0.01		24055
				dry forage				0.3					--		
AZ 68	GR	1	1.1	grain						0.08			<0.01		24056
				dry forage						0.34			0.01		
					7	10	14		58		67	82		Control	
USA MO 65	GR Side-dress and topical in whorl	2	(140) [1.5oz/1000']	grain								<0.03	0.03		21753
				forage	5.1		3.4							0.08	
TX 68	GR	2	(140)	grain								<0.02	0.02		21754
				forage	4		2.8							0.02	
MO 68	GR	2	(140)	grain						<0.02			0.02		21758
				forage	4		2.8							0.02	
MO 68	GR	2	(140)	grain				<0.02					0.02		21798
				forage		0.4	14							0.01	
MO 65	GR SC (side-dress) + GR (top)	2	(140)	grain								<0.03	0.03		21743
				forage	4.3		2.4							0.08	
MS	ditto	2	(140)	grain				<0.01					0.01		21759
				forage	2.4		0.2		(49 days)					0.01	
TX	ditto	2	(140)	grain								<0.02	0.02		21760
				forage	2.1		3.2							0.04	
Canada ON 65	SC = EC	2	(140)	grain						<0.01			0.01		21777
				forage	0.8		0.15							0.02	
USA MO 65	SC (furrow) + GR (topical)	2	(140)	grain				<0.02					0.02		21799
				forage		0.5	0.7							0.01	
					0		7		14		21	28	35	Control	
USA OK 68	Foliar SC=EC (aerial)	1	0.6 [18.7 l water/ha]	grain								<0.01	<0.01		23397
TX 68	SC	2	1.1 [33.2 l water/ha]	grain		0.3				0.12	0.3	0.05			23969
				forage	101		8.3		5.1		7.6	4.1	1.4		
				straw			9.7		4.3				0.34		
MS 68	SC	2	1.1	grain		<0.01						<0.01			23970
				forage	15		2.3		0.8				0.23		
				straw			2.9						--		
NE 68	SC	2	1.1	grain				0.2		0.04	<0.01	<0.01			23972
				forage	19		0.09		0.6				0.14		

Country, State, year	Application			Residues, mg/kg, at days after last application							Mobay Report No.
	Form.	No.	Rate, kg ai/ha (g ai/1000m)								
				straw		2			0.03		
NE 68	SC	2	1.1	grain	0.2				<0.01		23973
			[93.5 l	forage	33	0.7	0.6		0.02		
			water/ha]	straw	7.9	5			0.01		
OK 68	SC	2	1.1 [74.8 l	grain	0.7		0.4	0.4	<0.01		23974
			water/ha]	forage	33	4.7	4.3	1.2	0.15		
				straw		12	3.4		0.04		
				0		7	14	21	28	Control	
USA	Foliar application										
TX 1968	SC=EC	2	1.1 [28.1 l	grain	0.4		0.3		0.01		23975
			water/ha]	forage	23	8.3	5.7	6.8	3.4	0.08	
				straw		4.5				0.1	
AZ 1968											
	SC	2	1.1 [234 l	grain	0.6		0.04	<0.01	<0.01		23976
			water/ha]	forage	17	3.8	3.4			0.06	
TX 1968				straw		2.9				0.02	
	SC	2	1.1 [28 l	forage	30	3.1	3.6			0.07	23977
			water/ha]								
USA						46-		76-			
MN 1970	In furrow+side-dress+foliar			34		49	62	77	92	Control	
	SC	5	0.6 [1 fur.+1	grain		<0.01				<0.01	29385
			side +3 foliar]	forage			0.12	0.2	0.14	0.07	
NE 1970	SC	5	ditto	grain	<0.01					<0.01	29388
				forage	<0.01	<0.01				<0.01	
TX 1970	SC	5	ditto	grain		<0.01		<0.01		<0.01	29391
				forage			0.6		0.2	<0.01	

Table 8. Residues of disulfoton in sorghum resulting from rotational crop trials, Kansas, USA, 1976. All LC formulations. All 9.35 l water/ha.

Application		Residues, mg/kg, at days after last application	Mobay Report No.
No.	Rate, kg ai/ha	Days appli. to plt. 32 32 61 32 Days plt. to harvest 29 45 57 87 116	
1 (pre-plant)	18	green forage 0.02 straw <0.01	67894
1	9	threshed grain <0.01 green forage 0.07 0.01 straw <0.01	67895
1	18	Days appli. to plt. 61 61 61 Days plt. to harvest 29 45 87 threshed grain 0.03 green forage <0.01 <0.01 straw <0.01	67896
1	9	threshed grain 0.01 green forage 0.01 <0.01 straw <0.01	67987
1	18	Days appli. to plt. 364 364 364 Days plt. to harvest 29 57 138 grain 0.05 green forage <0.01 <0.01 straw <0.01	67900
1	9	grain <0.01 green forage <0.01 straw <0.01	67901
1	4.5	grain <0.01 green forage <0.01 <0.01 straw <0.01	67902
1	2.2	grain <0.01 green forage <0.01 straw <0.01 Controls all <0.01, except grain 0.02 mg/kg	67903

Wheat, oats. No new data have been provided for oats, but data from numerous trials in addition to those reviewed by the 1991 JMPR were provided for wheat (Tables 9 and 10). The 1991 JMPR recommended an MRL of 0.01 mg/kg at the limit of determination for oat grain as partial replacement of the 0.2 mg/kg CXL for cereals (except rice and maize), an MRL of 0.5 mg/kg for oat forage (green) as partial replacement of the 5 mg/kg CXL for forage crops (green), and a new limit for oat straw and fodder, dry, of 0.05 mg/kg. The 1994 CCPR requested the JMPR to reconsider the recommendations for the forages and fodders of oats and wheat because they appeared to be inconsistent with one another.

The Meeting also received comments from the French government questioning the 1991 JMPR estimates of 0.2 mg/kg for wheat and 10 mg/kg for wheat straw. It was suggested that 0.05 mg/kg was sufficient for wheat on the grounds that the residue of 0.11 mg/kg might be an outlier and that although the GAP PHI is 75 days, most of the grain samples were taken at about 30 days. A limit of 5 mg/kg was proposed for wheat straw, again on the grounds that residues at PHIs of about 30 days should not be considered.

The recommendations of the 1991 JMPR are tabulated below.

	MRL mg/kg			
	Oats		Wheat	
	1991 JMPR	Previous	1991 JMPR	Previous
Forage (green)	0.5	5[1]	2	5[1]
Straw and fodder, dry	0.05	--	10	--
Grain	0.01*	0.2[2]	0.2	0.2[2]

* At or about the limit of determination
[1] Forage crops (green)
[2] Cereals (except rice and maize)

The recommendations were based on the following results.

Oat grain: <0.01 mg/kg at all intervals of ≥56 days.
Oat forage: 0.01-0.25 mg/kg after 30-31 days, <0.01 mg/kg after 56-62 days, except one residue of 0.02 mg/kg.
Oat straw: <0.01-0.03 mg/kg.

The trials on oats were with single applications of EC or one or two applications of GR formulations, all at the rate of 1.1 kg ai/ha. This rate is similar to that reported as GAP in Canada, where a 30-day forage/grazing restriction applies.

Wheat grain: <0.01 (26), 0.01 (3), 0.03, 0.06 and 0.11 mg/kg, with 25 results after 27-32 days and 7 after 37-50 days (mean 0.02, s.d. 0.02, n = 31). There were also 3 residues of ≤0.01 mg/kg at 231 days.
Wheat forage: <0.01-2.4 mg/kg (mean: 0.5, s.d. 0.58) after 27-100 days.
Wheat straw: ≤0.01 (5), 0.02, 0.03, 0.04 (2), 0.06, 0.09, 0.1, 0.2 (7), 0.3 (3), 0.4 (2), 0.5, 0.8, 8, 10 and 24 mg/kg (mean 1.3, s.d. 4.2).

Only three trials reported residues in straw at a pre-harvest interval of >50 days. The residues were ≤0.01 mg/kg after ≥231 days.

Residues in wheat forage were from single GR applications at 1.1 kg ai/ha. US GAP permits GR at-plant or broadcast applications at the rate used in the trials and imposes a 75-day grazing/forage feeding restriction. Residues in wheat straw were from single applications of EC at 0.84 kg ai/ha or GR at 1.1 kg ai/ha, or from a single granular application at 1.1 or 1.4 kg ai/ha followed by 2 EC applications at 0.84 kg

ai/ha. The rates are consistent with current GAP, although US GAP allows grazing/forage only after single GR at-plant applications with a PHI of 75 days (Table 1).

About 90 reports of additional US trials on wheat which were not considered by the 1991 JMPR are summarized for granular formulations in Table 9 and for SC formulations in Table 10. The GR trials included post-emergence applications, (with residues in forage determined at PHIs from 0 to 28 days) and one to 4 broadcast applications with residues reported at 0 to 31 days, whereas GAP requires a single at-plant GR application with a 75-day forage/grazing feeding restriction. Only a few of the forage samples were from trials with single applications according to GAP, and all except 2 were at PHIs of ≤31 days. After 26 to 31 days the residues in forage from single applications at GAP rates were <0.05, 0.2, 0.4, 0.05 and 0.1 mg/kg. All residues in grain and straw from this treatment were from 2 to 4 applications, not the single application permitted by GAP.

The trials with GR treatments which were closest to GAP were two in 1974 (reports 49267 and 49317) in which the only residue reported in grain was <0.01 mg/kg after 40 days, and residues in green forage were 0.5 and 0.6 mg/kg after 57 and 93 days respectively. The only residue determined in straw was 0.02 mg/kg after 291 days.

Sixty-four reports of additional US trials with foliar applications of SC formulations to winter and spring wheat and to "wheat" were available (Table 10). Information on GAP was provided for EC formulations (the same as SC in these trials) for spring and autumn wheat. Treatments included foliar air (4 trials), foliar ground (109 trials), seed + foliar (8 trials), post-emergence foliar (2 trials) and broadcast at planting (8 trials) plus two trials on wheat as a rotational crop. United States GAP does not permit grazing or cutting for forage after EC applications, although it permits EC applications up to 30 days before grain is harvested. No specific restriction applies to straw. The residues at ≥29 days, expressed as mg/kg (no. of results) were as follows.

Grain: ≤0.01 (21), ≤0.02 (12), 0.03, 0.04 (2), 0.05 (2), 0.14, 0.2 (2), 0.3. [Mean 0.04, s.d. 0.06, n = 42].

Straw: ≤0.01 (7), <0.02 (3), ≤0.03 (11), 0.05, 0.07 (2), ≤0.08 (2), 0.12-0.15 (4), 0.2, 0.5 (2), 0.6 (2), 0.9, 1.0 (3), 1.5 (2). [Mean 0.34, s.d. 0.46, n = 41].

Only two of the trials included residues in straw at ≥75 days; they were <0.02 and 0.05 mg/kg after 274 days.

Table 9. Residues of disolfoton in wheat resulting from supervised trials in the United States and Canada with granular formulations.

Country, State, Year	Application		Residues in mg/kg at intervals (days) after last application							Mobay Report No.
	Type[1] & No.	Rate, kg ai/ha		0	7	14	20/21	28	Control	
USA, Winter wheat	PEB									
KS 1974	1	0.6	forage	0.5	0.1	0.1	0.1	0.06		43144

Country, State, Year	Application		Residues in mg/kg at intervals (days) after last application					Mobay Report No.
	Type[1] & No.	Rate, kg ai/ha						
KS 1974	1	2.2	forage	1.6	1.1	1	0.7	43161
KS 1974	1	1.1	forage	0.7	0.3	0.2	0.5	43162

	B[2]		0 5-7 12-14	19-21	26-28	29-31	Controls		
NE 1973-4	4	1.1	grain					<0.05	43146
	2		forage	0.5	0.2	0.2		<0.05	
	2		straw				0.6	<0.05	
NE 1973	2	1.1	forage	0.09	1 4	0.7	0.7	<0.05	43147
1974	4		grain				<0.05	0.05	
	3		forage	2.2	1.3	3 0.8	<0.05		
	4		straw				0.3	0.1	
TX 1973	2	2.2	forage	1.8	2.2	1.3	2.2 2.1	1.9 <0.05 (1-3 days)	43148
1974	4		grain				<0.05	<0.05	
	3		forage	1.2	0.6	1.2 1.2	<0.05		
	4		straw				1.1	0.4	
NE 1973	2	2.2	forage	0.3	1.6	1.2	1.3 0.9	<0.05	43149
1974	4		grain				<0.05	0.05	
	3		forage	0.2	0.8	0.7 0.2	<0.05		
	4		straw				0.08	0.1	
Canada Ont. 1973	2	1.1	forage	23	0.5		0.3	<0.05	43150
1974	4		grain				<0.05	<0.05	
	3		forage	0.5	0.6	0.6 0.4	<0.05		
	4		straw				1.1	<0.05	
USA NE 1973	2	1.1	forage	0.05	0.3 1.3	0.3	0.3	0.06	43152
1974	4		grain				<0.05	0.06	
	3		forage	1.5	1.3	0.8	0.5	0.06	
	4		straw				0.5	0.05	
Canada Ont. 1973	2	2.2	forage	2.4			1.9	<0.05	43153
1974	4		grain				<0.05	<0.05	
	3		forage	2.7	2.9	1.6 0.6	<0.05		
	4		straw				4.1	<0.05	
USA WA 1974	2	0.6	grain				<0.05	<0.05	43154
	1		forage	0.08	0.05	0.05	<0.05	---	
	2		straw				1.7	<0.05	
WA 1974	2	1.1	grain				0.16	<0.05	43155
	1		forage	0.1	0.07	0.06	<0.05		
	2		straw				2.3	<0.05	

				0	7	14	18-19	20-21		26-28	29-31	Controls	
USA WA 1974	2	1.1	grain				<0.05					<0.05	43156
	1		forage		0.3	0.4		0.4	0.2		---		
	2		straw				0.3					<0.05	
WA 1974	2	0.6	grain				<0.05					<0.05	43157
	1		forage		0.13	0.4		0.2	0.1		---		
	2		straw				0.3					<0.05	
TX 1973	2	1.1	forage	0.6	1.4	1.1		0.6	0.6	0.6	<0.05 (103 days)		43158
1974	4		grain								<0.05	<0.05	
	3		forage		1.1	0.5		0.7	0.4		<0.05		
	4		straw								0.6	0.4	
TX 1973	2	2.2	forage	1.1	1.8	1.5		10		8.8		<0.05	43159
TX 1974	4		grain								<0.05	<0.05	
	3		forage		0.9	1.9		1		0.6		<0.05	
	4		straw								1.6	<0.05	
				0	7	14		20-22		26-28	29-31	Controls	
TX 1973	2	1.1	forage	0.3	1.2	0.6		3.2	4.2		<0.05		43160
TX 1974	4		grain								<0.05	<0.05	
	3		forage		1.2	0.9		0.5	0.6		<0.05		
	4		straw								0.5	<0.05	
TX 1974	2	0.6	grain							<0.05		<0.05	43613
	1		forage		0.3	0.06		<0.05		<0.05		<0.05	
	2		straw							0.4		<0.05	
TX 1974	2	2.2	grain							<0.05		<0.05	43614
	1		forage		0.8	0.2		0.08		0.07		<0.05	
	2		straw							1.4		<0.05	
TX 1974	2	1.1	grain							<0.05		<0.05	43615
	1		forage		0.5	0.2		0.4		0.4		<0.05	
	2		straw							0.5		<0.05	
TX 1974	2	2.2	grain							<0.05		<0.05	43616
	1		forage		3	0.4		0.9	2.5			<0.05	
	2		straw							0.5		<0.05	
TX 1974	2	0.6	grain							0.3		<0.05	43617
	1		forage		0.4	0.07		0.2	0.05			<0.05	
	2		straw							0.3		<0.05	
			Days, PHI	0	7	14		20-22	26-28			Controls	
TX 1974	2	1.1	grain							<0.05		<0.05	43621
	1		forage		1.2	0.3		0.2		0.1		<0.05	

	2		straw					1.4			<0.05		
Wheat USA, IL 1973	2	1.1	forage	0.5	0.2	0.2	0.3	0.2			<0.05		43741
1974	4		grain					0.07 (25 days)			<0.05		
	3		forage	2.5	2	1.6	1.6	0.9			<0.05		
	4		straw					1.4 (25 days)			<0.05		
Wheat	B[2]												
IL 1973	2	2.2	forage	1.6	0.5	1.2	1.9	0.2			<0.05		43881
1974	4		grain					0.6 (25 days)			<0.05		
	3		forage	13	5.2	8.8	10	5.9			<0.05		
	4		straw					20 (25 days)			<0.05		
	AP,B				39/40	50	57	93	291	Control			
NJ 1974	1	1.1	grain		<0.01						<0.01		49267
			green forage		1.2			0.5			0.08		
			straw							0.02	<0.01		
IN 1974	1	1.1	green forage		2.6	0.4	0.6			0.02			49317

[1] PE = post-emergence; AP = at planting; B = broadcast
[2] Not stated whether all were post-emergence; number of applications indicates at least some post-emergence applications

Table 10. Residues of disulfoton in wheat resulting from supervised trials in the United States and Canada with foliar SC formulations[1].

Crop[2], Country, State, Year (Variety)	Application	Residues, mg/kg, at days after last application	Mobay Report No.

	Type[3],No.	Rate, ai/ha (l w/ha)		
			0 1 3 29-30 45 57 Controls	
W OK 1967	A, 1	1.1 (9)	grain <0.01 <0.01	21457
			straw <0.02 0.02	
W OK 1968	A, 1	0.8 (9)	forage 5.7 1.7 0.6 0.2	23004
			forage 4 3.4 3.4 0.05	23005
	A, 2	0.8 (9)	grain <0.02 0.02	23115
			straw <0.08 0.08	
W OK 1968	A, 2	0.8 (9)	grain <0.01 0.01	23117
			straw <0.03 0.03	
			PHI 29-69 days Grain / Straw	
W 7 US States			Res. / No. trials / PHI, days (Grain) / Res. / No. trials / PHI, days (Straw)	21388,
and Canada				21412,
1967	G, 1	1.1	<0.01 8 trials / <0.01 4 -- / 0.12 1 44	21413,
		(48 to 1400)	<0.02 3 trials / <0.02 1 50 / 0.6 1 45	21414,
			<0.03 2 45 / 1.0 1 44	21415,
			0.03 1 69 / 1.5 1 46	21416
			Straw controls ≤ 0.06	
			45/46 57 69 Controls	
W OK 1967	G, 1	1.1	grain <0.01	21434
			straw 0.01	
KS 1967	G, 1	1.1	grain <0.01	21454
			straw 0.03	
TX 1967	G, 1	1.1	grain <0.01	21458
Canada				
Canada W Ontario 1967	G, 1	1.1	grain <0.01	21456
			straw 0.01	
S Manitoba 1967	G, 1	1.1	grain 0.02	21455
			straw 1.5 0.01	
			0 1 3 6/7 Controls	
U NE 1968	G, 1	0.8 (94)	Forage 31 9.6 3.5 0.9 --	23000
S TX 1968	G, 1	0.8 (9)	12 5.7 4.6 2.9 0.2	23001
S TX 1968	G, 1	0.8 (19)	2.6 2.7 1.9 -- 0.2	23002
U NE 1968	G, 2	0.8 (94)	13 7.1 1.9 1.2 0.03	23006
U NE 1968	G, 2	0.8 (94)	11 10 2.5 0.6 0.01	23007
U NE 1968	G, 3	0.3+0.3+1.1 (94)	5.6 3.3 1.5 1.3 0.03	23034
			33 43 Controls	
S TX 1968	G, 2	0.8 (19)	grain <0.02 0.02	23116
			straw 0.07 <0.03	
S TX 1968	G, 3	0.8 (19)	grain 0.14 0.02	23118
			straw 0.2 <0.03	

Crop[2], Country, State, Year (Variety)	Application		Residues, mg/kg, at days after last application					Mobay Report No.
	Type[3],No.	Rate, ai/ha (l w/ha)		7	29-30	52	Controls	
W TX 1968	G, 1	0.3 (46)	forage	2.5			0.06	26557
1968	2	0.3	forage	0.6			0.12	
1969	3	0.3+0.3+0.6	forage	2.6			0.09	
1969	4	0.3+0.3+	grain		<0.01		<0.01	
		0.6+1.1	straw		0.6		0.03	
U KS 1968	G, 1	0.3 (140)	forage	0.4			0.02	26558

(Scout)	2	0.3 (140)	forage		2.2						0.07	
	3	0.3+0.3+0.6 (140)	forage		1.1						0.05	
1969	4	0.3+0.3+0.6+1.1	grain						0.02			
		(140)	straw						0.05		0.01	
				7/8		14	21	30	Controls			
W TX 1968	G, 1	0.3 (47)	forage	2.7					0.17			26579
	2	0.3 (47)	forage	3.2					0.01			
1969	3	0.3+0.3+0.6 (47)	forage	3.1					0.09			
1969	4	0.3+0.3+	grain					0.02				
		0.6+1.1 (47)	straw					1.0				
MS 1969	G, 1	0.3 (47)	forage	4.7					0.13			26580
(GA-1123)	2	0.3 (47)	forage	9.4					0.04			
	3	0.3+0.3+0.6 (47)	forage	0.13					0.09			
	4	0.3+0.3+	grain					0.2	0.01			
		0.6+1.1 (47)	straw					1.0	0.06			
MS 1969	G, 1	0.3 (47)	forage	2.7					0.14			26581
	2	0.3+0.3 (47)	forage	4.0					0.02			
(GA-1123)	3	0.3+0.3+0.6 (47)	forage	1.1					0.07			
	4	0.3+0.3+0.6+1.1 (47)	grain straw	0.2 1.7					<0.01 0.02			
W TX 1968	G, 2	0.3 (47)	forage	24			<0.06		0.06			26582
1969	3	0.3+0.3 (47)	forage	0.7					0.12			
1969		0.3+0.3+0.6 (47)	forage	9.4		8.4	1.8		0.04			
	4	0.3+0.3+0.6+1.1 (47)	grain straw					0.02 0.5	0.01 0.02			
				0	1	3	6-7	14-15	29-30	Control		
NE 1968	G, 1	0.3 (140)	forage	10	5.3	4.4	2		0.13			26583
	2	0.3+0.3 (140)	forage	7.2	6.8		3	1.6	0.01			
1969	3	0.3+0.3+0.6 (140)	forage				0.6		0.05			
(Trapper)	4	0.3+0.3+0.6+1.1 (140)	grain straw						0.01 <0.03	<0.01 0.03		
W TX 1968	G, 1	0.8 (47)	forage	45	30	12.2	4.2	2.7	0.17			26895
	2	0.8+0.8 (47)	forage	44	40	20	5	3.9	--			
1969	3	0.8+0.8+1.1 (47)	forage					1.7	0.09			
	4	0.8+0.8+1.1+1.1 (47)	grain straw						<0.01 0.13	0.02		
NE 1968	G, 1	0.8 (140)	forage	21	12	5.9	3.9	2.2	0.05			26896
	2	0.8 (140)	forage	30	15		9.2	6.3	0.01			
(Trapper) 1969	3	0.8+0.8+1.1 (140)	forage					<0.05		0.05		
	4	0.8+0.8+1.1+1.1 (47)	grain straw						0.05 <0.03	<0.01 0.03		

				0	1	3	7	14-15	29-30	Controls	
NE 1969	G, 3	0.3+0.3+0.6 (140)	forage				1.0			0.05	26905
(Trapper)	4	0.3+0.3+0.56+1.1 (140)	grain straw						0.3 <0.03	<0.01 0.03	
MS 1969	G, 1	0.8 (47)	forage	191	84	39	5.4	0.23		0.01	26944
(GA-1123)	2	0.8 (47)	forage					3.9		0.02	
	3	0.8+0.8+1.1 (47)	forage					0.8		0.07	
	4	0.8+0.8+1.1+1.1 (47)	grain straw						0.02 0.12	<0.01 0.02	
W TX 1968	G, 1	0.8 (47)	forage	59	34	31	5.6	1.2	0.03		26945
	2	0.8 (47)	forage	46	25	6.1	3.8	1.9	0.26		
1969	3	0.8+0.8+1.1 (47)	forage					3		0.09	
	4	0.8+0.8+1.1+1.1 (47)	grain straw						0.01 <0.03	<0.01 0.03	
OR 1968	G, 1	0.3	forage					0.06		<0.02	26946
1969	2	0.3	forage					1.1 (17d.)		0.02	
(Druchamp)	3	0.3+0.3+0.6	forage					0.15		<0.02	
	4	0.3+0.3+ 0.6+0.6	grain straw						0.02 (33d.) 0.5 (33d.)	<0.01 <0.01	
OR 1968	G, 1	0.8	forage					0.2		0.06	26947
1969	2	0.8	forage					0.9		0.12	
(Druchamp)	3	0.8+0.8+1.1	forage					0.3		0.04	
	4	0.8+0.8+1.1+1.1	grain straw						0.04(33d.) 0.08(33d.)	0.01 0.02	
W TX 1968	G, 1	0.8 (47)	forage	65	50	36	21	1.6	0.06		26954
	2	0.8 (47)	forage	35	23	17	2.7	2	0.12		
1969	3	0.8+0.8+1.1 (47)	forage					5		0.04	
	4	0.8+0.8+1.1+1.1 (47)	grain straw						<0.01 0.9	0.01 0.02	
MS 1969	G, 1	0.8 (47)	forage	89	68	58	1.7	1	0.03		26956
(GA-1123)	2	0.8 (47)	forage					4.9		0.04	
	3	0.8+0.8+1.1(47)	forage					0.2		0.09	
	4	0.8+0.8+1.1+1.1 (47)	grain straw						0.2 0.15	0.01 0.06	
KS 1968	G, 1	0.8(140)	forage	11	7.2	3.2			0.01		26957
	2	0.8+0.8 (140)	forage	12	10	5.9	1.7	<0.4	0.4		
1969 (Scout)	3	0.8+0.8+1.1 (140)	forage					0.2		0.05	
	4	0.8+0.8+1.1+1.1 (140)	grain straw						<0.01 (52d.) <0.01 0.07	0.01	

				14	29	33	Controls								
NB 1968-9	G, 3	0.84x2 + 1.1	forage	<0.05			0.05								26961
(Trapper)	4	0.84x2 + 1.1X2	grain		0.05		<0.01								
		(141)	straw		<0.03		0.03								
OR 1968-9 (Druchamp)	G, 3 4	same	forage	<0.02			<0.02								26962
			grain			0.03	<0.01								
			straw			0.03	<0.01								
OR 1968-9 (Druchamp)	3 4	0.3x2 + 0.6 0.3x2 + 0.6 + 1.1	forage	0.04			<0.02								26963
			grain			0.04	<0.01								
			straw			<0.01									
				0	1	3	7	14	Controls						
NB 1968	1+1[4]	0.84 foliar (141)	forage	29	26	19	10	4	0.05						27126
W TX 1968	1+1[4]	0.3 foliar (47)	forage	55	39	39	20	2.3	0.06						27127
NB 1968 (Trapper)	1+1[4]	3 foliar (47)	forage	12	11	9	7.5	2.8	0.08						27128
MS 1969 (GA-1123)	1+1[4]	"	forage	40	23	10	3.4	<0.13	0.13						27129
MS 1969 (GA-1123)	1+1[4]	"	forage	44	23	15	1.1	<0.14	0.14						27130
TX 1968	1+1[4]	"	forage				6.3	4.3	0.06						27131
TX 1968	1+1[4]	"	forage	123	11	4.8	1.5		0.17						27132
KS 1968 (Scout)	1+1[4]	"	forage	66	46	38	7.5	3.9	0.02						27133
				0	3	7	14	21	28	Control					
Post-emergence Foliar Spray KS 1974	1	0.3(329)	forage	2.1	3	2.2	0.4	0.08	0.07	<0.05					43145
KS 1974 (Pronto)	1	1.1(329)	forage	10	10	2.9	1.5	0.2	0.1	<0.05					43151
Broadcast at planting				30	45-47	60-61	75-76	90-94	274	Controls					
KS 1975 (Eagle)	1	1.1	forage (green)				10		10						51630
NB 1975 (Centruk)		1.1(327)	forage (green)	0.02	0.9	0.4	0.3	0.4		0.01					51632
NB 1975 (Sage)	1	1.1(243)	forage (green)		0.04	0.08					--				51635
WI 1975 (Polk)	1	1.1(233)	forage (green)		0.02	0.04, 0.05					<0.01				51658
NB 1975 (Centruk)	1	1.1(243)	forage (green)		0.01	0.02	0.02				0.02				51659
IN 1975 (Genesee)	1	1.1(187)	forage (green)		0.1	0.05	0.03	0.02 (87d.)		0.02					51662
NJ 1975 (Arthur 71)	1	1.1(281)	forage (green)		0.4	0.4		0.04	<0.01						51783
			grain							<0.02					
			straw							<0.02					

OR 1977 (Yamhill)	1	1.1(374)		30	47	61	76	94	274	Controls	
			forage	0.05	0.05	0.03	0.01			<0.01	52684
			threshed grain						<0.01		
			straw						0.05	0.03	
Rotational Crop	1	18(935)	Days appl. to planting	123		123					
Soil broadcast			Days planting to sampling	28	43						
MO 1976			forage		0.1	<0.01			<0.01		67898
			forage		0.05	0.04				<0.01	67899

[1] The SC formulations were in fact EC (see introduction to this section). Since grazing and foraging after EC applications is not permitted, forage residues are not underlined as representing GAP. Residues in winter wheat are also not underlined, since GAP for EC applications applies only to spring and fall wheat. Where it was not indicated whether the wheat was spring, fall, or winter, it is assumed to be spring or fall for convenience.
[2] S = Spring wheat, W = winter wheat, U = unspecified wheat
[3] A = aerial, G = ground
[4] 1 seed treatment at 0.5 kg ai/100 kg seed + 1 foliar application

Cotton seed (Table 11). As part of its periodic review the 1991 JMPR estimated a maximum residue level of 0.1 mg/kg for cotton seed, based on 1984-86 US trials. Residues were ≤0.05 mg/kg, except one value of 0.43 mg/kg (not included in the table of results) which was assumed to be an outlier. The 1994 CCPR retained the proposed MRL at Step 7B, owing to concerns (not specifically recorded in the 1993-4 CCPR reports) that relevant older data had not been provided. The Meeting received information on current US GAP and additional data on residues from SC (= EC) and GR formulations, not reviewed by the 1991 JMPR, which are summarized in Table 11. The reported GAP includes GR and EC formulations.

Table 11. Residues of disulfoton in cotton resulting from supervised trials in the United States.

Type of applicn., State, Year	Form[1].	Application		PHI, DAYS	Residues, mg/kg. ( ) = control value			Mobay Report No.
		No.	Rate, kg ai/ha (l water/ha)					
In-furrow + side-dress at layby AL, AZ, 1973	SC or GR	1+1	2.4-3.8	51 or 99	Bolls <0.01 6 trials			42596-42600, 42606
Foliar spray					Seed	Gin trash	Foliage	
LA 1968	SC	3	1.1	99	<0.1 (0.1)	0.04 (0.01)	-	24014
TX 1968	SC	3	1.1	89	0.04 (0.04)	<0.04 (0.04)	<0.03 (0.03)	24019
LA 1968	SC	3	1.1	94	<0.05 (0.05)	<0.04 (0.04)	-	24023
MS 1968	SC	3	1.1	111	0.03	0.2	1.2 (0.01)	24029
TX 1968	SC	3	1.1	88	0.12 (0.04)	<0.09 (0.09)	0.02	24030
Seed treatment + foliar spray								
SC 1968	SC	1+3	1.1	95	0.1 (0.08)	<0.02 (0.02)		24020
NC 1968	SC	1+2	1.1	33	0.03	0.06		24021
SC 1968	SC	1+2	1.1	90	<0.06 (0.06)	<0.1 (0.1)		24022
Pre-plant broadcast incorporated MS, TX, AZ 1974 (3 trials)	SC	1	4.5 (70-187)	167-192	<0.05	<0.05	<0.05	45279 45281 45283
MS, TX 1974 (three trials)	GR	1	4.5-6.7	167-192	<0.05	<0.05	<0.05 <0.05 0.3	45278 45280 45282
In -furrow + 6" band side-dress	GR	1+1	2.2 or 1.1 [110	28	<0.19 (0.19)	<0.34 (0.34)	<0.03 (0.03)	33227*

Type of applicn., State, Year	Form[1].	Application		PHI, DAYS	Residues, mg/kg. ( ) = control value			Mobay Report No.
		No.	Rate, kg ai/ha (l water/ha)					
FL 1971			g ai/1000m]					
				28	<0.19 (0.19)	<0.34 (0.34)	<0.03 (0.03)	33228**

[1] Formulations described as SC are in fact EC
* 20 in. row space
** 40 in. row space

Pecans (Table 12). The 1991 JMPR recommended an MRL of 0.01 mg/kg (limit of determination) to replace the 0.1 mg/kg limit of determination CXL. The new estimate was based on residues after PHIs of 29-31 days in five US trials with an EC formulation at rates of 1.1 to 1.7 kg ai/ha compared to GR and EC GAP rates of 0.3 to 3.4 kg ai/ha and PHIs of 30-80 days. Residues were reported as <0.01 mg/kg (one at <0.02 mg/kg) in the kernels and up to 0.9 mg/kg in the shells. At the 1993 CCPR one delegation was concerned that the proposal did not reflect soil uses or the maximum foliar GAP rates.

The Meeting received current information on GAP for EC and GR formulations and 11 additional reports of trials in the United States with SC (i.e. EC) formulations, but none of trials with granular or soil applications. Current GAP (Table 1) allows single EC or GR soil-incorporated band applications at rates up to 3.5 kg ai/ha with an 80-day PHI. Up to 3 foliar applications may be made (0.3-0.4 kg ai/ha for ground and 0.8-1.1 kg ai/ha for aerial). A 30-day PHI applies to the foliar applications.

All of the 11 SC trials were with applications at 1.2 to 7.1 kg ai/ha compared to the maximum GAP rate of 0.4 kg ai/ha for EC ground foliar applications.

Table 12. Residues of disulfoton in pecans (nuts) resulting from supervised trials in the United States with foliar SC formulation applications.

State/Year/variety	Application		Residues, mg/kg, at days after last application. ( ) = control					Mobay Report No.
	No.	Rate, kg ai/ha (l water/ha)	22	26-28	30	41	51	
TX 1971 native	3	1.2 (935)	0.08					32683
OK 1971 native	3	[116 g ai/hl]		<0.05 (0.05)				32684
LA 1971 Koko	3	2.2 (l870)				<0.1 (0.1)		32685
TX 1971 TX Schley	3	3.6 (2993)			<0.01 (0.01)			32686
MS 1971 Stuart	3	2.2 (1870)		0.2 (0.01)				32687
TX 1971 native	3	1.7 (335)	0.2 (<0.01)					32688
LA 1971 Koko	3	3.4 (1870)				<0.1		32689

State/Year/variety	Application		Residues, mg/kg, at days after last application. ( ) = control					Mobay Report No.
	No.	Rate, kg ai/ha (l water/ha)	22	26-28	30	41	51	
					(0.1)			
TX 1971 W. Schley	3	5.4 (2993)			0.05 (0.01)			32690
MS 1971 Stuart	4	3.4 (1870)			0.43 (0.01)			32691
FL 1971 Mahan	3	6.7 (3742)					<0.08 (0.08)	32692
GA 1971 Stuart	3	5.9-7.1 (3274-3929)			<0.03 (0.03)			32693

If it is assumed that the residues are proportional to the application rate the residues found after intervals of 26-30 days, close to the GAP PHI of 30 days, from GAP applications of 0.4 kg ai/ha would be reduced as follows.

Residues found, mg/kg:	0.2	0.05	0.43
Residue from 0.4 kg/ha, mg/kg:	0.04	0.003	0.05

Tomatoes. No additional data were provided for tomatoes. The 1991 JMPR estimated a maximum residue level of 0.1 mg/kg for tomato as part of the replacement of the 0.5 mg/kg CXL for vegetables. The estimate was based primarily on three trials in the United States with reported residues of <0.01 (2) and 0.02 mg/kg after 30 days from EC applications of 1.5 to 2.1 kg ai/ha. Residues were significantly lower in Japanese trials. Residues up to 0.5 mg/kg in the 1973 monograph were not considered in the absence of the original reports.

The Meeting received written comments from the German government (as requested by the 1993 CCPR) suggesting a 0.05 mg/kg limit for tomato, if the three US trials were sufficient to warrant a recommendation, since the residues after about 30 days did not exceed 0.02 mg/kg. French government comments also pointed out that the maximum 27-31 day residue was 0.02 mg/kg.

In Animals

Milk. The 1991 JMPR estimated a maximum residue of 0.02 mg/kg for the milk of cattle, goats and sheep. It was based on residues up to 0.012 mg/kg from feeding cattle with alfalfa containing 18 mg/kg of a mixture of disulfoton sulphoxide and sulphone and the corresponding oxons, and took into account the highest maximum residue level estimated for forage of 20 mg/kg.

At the 1993 and 1994 Sessions of the CCPR France and The Netherlands called for reconsideration of the proposed MRL for milk in view of the toxicity of disulfoton. They were invited to provide written comments to the JMPR. Comments were received from The Netherlands suggesting the use of a lower dietary level as a basis for estimating a maximum residue level since the high residues of the order of 20 mg/kg were found in only a few samples of green sorghum forage and such forage was unlikely

to constitute 100% of the cattle diet. The Netherlands proposed a 0.01 mg/kg MRL, which should be limited to the milk of cattle since no data were available for other animals.

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

The Netherlands government informed the Meeting that no residues of disulfoton or its sulphoxide or sulphone were found (above the 0.05 mg/kg limit of determination) in about 30,000 samples of fruits, vegetables, cereals and potatoes analyzed for organophosphorus compounds from 1987 to 1990.

NATIONAL MAXIMUM RESIDUE LIMITS

A list of national MRLs provided by the manufacturer was supplemented by information from Australia, Canada, Spain and the USA. The following MRLs were reported.

Country/Crop	MRL (mg/kg)
Argentina	
aubergine	0.5
bean (dry)	0.4
cotton seed, cucumber, hops, lettuce, melon, potato, pumpkin, sweet peppers, tomato	0.5
Australia	
milk	0.01
edible offal (mammalian), meat (mammalian), poultry (edible offal of), poultry meat, eggs	0.02
cotton seed, hops (dry), potato, vegetables	0.5
Austria (Sum of disulfoton, disulfoton sulphone, demeton, demeton-O, demeton-S, demeton sulphoxide and demeton sulphone, expressed as disulfoton)	
cereals, potato	0.1
hops	10
Belgium	
cereals	0.2
fruit	0.4
other plant commodities	0 (0.05 limit of determination)
vegetables except carrots	0.4
Brazil	
coffee, peanut	0.1
cotton seed	0.2
bean, melon, watermelon, onion, potato, tomato	0.5

Canada	
asparagus, cereal grains (barley, oats, wheat), corn/maize, egg plant, peppers	0.1
potatoes	0.2
beans, broccoli, Brussels sprouts, cabbage, cauliflower, lettuce, peas, spinach, tomatoes	0.5
France (Sum of disulfoton, demeton-S and their sulphoxides and sulphones, expressed as disulfoton)	
pineapple	0.1
Germany (Sum of disulfoton, its sulphoxide and sulphone, demeton, demeton-O, demeton-S, demeton sulphoxide and demeton sulphone, expressed as disulfoton)	
cereals	0.1
potato	0.2
hops	10
Italy	
aubergine, bean, kidney bean, sugar beet, cabbage,	
corn, melon, watermelon, pea, potato	0.4
Kenya (temporary limits)	
coffee, peanut kernel, pecan nut, pineapple, soya (bean?) (dry)	0.1 (limit of determination)
other cereals	0.2
sugar beat, celery, corn, potato, rice, vegetables	0.5
forage crops	5
alfalfa, clover	10
Luxembourg	
all plant commodities	0.02
Malaysia	
coffee, nuts, pineapple, soya (dry)	0.1
cereals except corn	0.2
sugar beets, celery, corn, potato, rice, vegetables	0.5
Mexico	
capsicum (Chili pepper)	0.1
coffee, corn, sorghum, sugar cane	0.3
asparagus, barley, bean, broccoli, Brussels sprouts,	
cabbage, cauliflower, cotton, lettuce, oats, chick peas,	
peanuts, pecan nuts, pineapple, potato, rice, spinach,	
tomato, wheat	0.75
New Zealand	
alfalfa, bean, Brassica vegetables, carrot, cereals,	
forage crops, pea, potato	0.1*

* Not an established tolerance, general <0.1	
South Africa (Sum of disulfoton, demeton-S and their sulphoxides and sulphones, expressed as disulfoton)	
wheat	0.05
coffee	0.1
cotton seed	0.2
cruciferae, onion, potato, tomato	0.5
Spain (Sum of disulfoton, demeton, demeton sulphoxide and demeton sulphone, expressed as disulfoton)	
other plant commodities	0.02
corn, cotton seed, sorghum	0.1
potato	0.2
hops	0.5
USA	
soya forage and hay	0.25
coffee, corn grain, peanut hull, popcorn, wheat (green)	0.3
sugar beet	0.5
barley grain, bean (dry), kidney bean, lima bean, broccoli, Brussels sprouts, cabbage, cauliflower, cotton seed, lettuce, oat grain, garden pea, peanut, pecan nut, pineapple, potato, rice, sorghum grain, spinach, tomato	0.75
sugar beet leaves or tops	2
alfalfa (fresh), barley (green), barley straw, bean vines, barley fodder, corn fodder, corn forage, sweet corn fodder, sweet corn forage, oat fodder, oat (green), oat straw, garden pea vines, peanut hay, pineapple bran, pineapple foliage, popcorn fodder, popcorn forage, rice straw, sorghum fodder, sorghum forage, sugar beet pulp (dry), fresh clover, wheat fodder, wheat straw	5
clover	12

APPRAISAL

Disulfoton was completely re-evaluated by the 1991 JMPR in accordance with what was later to be designated as the CCPR periodic review programme. The ADI was revised, new MRLs were proposed and others recommended for revision or withdrawal in the context of current GAP. Discussion of the new or revised proposals at the CCPR in 1993 and 1994 prompted comments on various proposals (including that for milk); comments that some data supporting national limits were not included in the re-evaluation; and a proposal that the disulfoton metabolite demeton-S should be excluded from the definition of the residue. Clarification of the GAP for cabbage and sorghum forage (green) was requested.

The Meeting received and reviewed substantial additional data (280 reports); information on GAP from the manufacturer and some countries; comments from The Netherlands on the definition of the residue and written comments from countries in support of their positions at the CCPR on various commodities, including milk.

Barley. Although there appeared to be no outstanding questions from the CCPR on the 1991 JMPR estimate of 0.2 mg/kg for barley grain, some additional US data and comments from the French government proposing a 0.05 mg/kg limit were considered. The French comments were based on the view that residues from trials strictly according to GAP did not exceed 0.02 mg/kg. While residues were up to 0.2 mg/kg after 30 days in the additional data provided, the two foliar applications in the trials did not represent GAP, which permits only one foliar application.

The Meeting agreed that the data summarized in 1991 would support a 0.05 mg/kg limit if the trials involving two EC applications at the recorded 28-37-day PHI were not according to GAP. All other residue were $\leq$0.03 mg/kg. The Meeting re-examined the 1991 data in the light of the current information on GAP provided. Since residues were $\leq$ 0.03 mg/kg in all but the trials with 2 EC applications, it is obvious that the 1991 JMPR gave the greatest emphasis to these results. Residues after 28-37 days resulting from 2 EC applications at 1.1 kg ai/ha ranged from 0.01 to 0.14 mg/kg. Therefore, basically what is being questioned is whether these data represent GAP.

The Meeting observed that current GAP allows a single foliar autumn or spring EC application in addition to an at-plant EC application, both at 1.1 kg ai/ha. A 60-day PHI applies to at-plant applications and 30 days to foliar. The 1991 JMPR evaluation does not indicate whether the 2 EC applications were at-plant, foliar or some other. If it can be assumed that an at-plant and a foliar application were made and that the 28-37-day PHI in the trial refers to the foliar application, it would be reasonable to assume that the EC data represent GAP. That was apparently the view that the 1991 JMPR took when they had access to the original reports.

With this assumption, the residues from this application regimen are 0.01(4), 0.02, 0.04, 0.06, 0.09, 0.1(2) and 0.14 mg/kg. These would be consistent with the 0.2 mg/kg estimate of the 1991 JMPR. The Meeting concluded that the results reviewed in 1991 probably reasonably reflect GAP and confirmed the 1991 estimate.

Beans (dry). Government comments questioned the 1991 JMPR estimate for dry beans of 0.01 mg/kg (limit of determination), preferring 0.02 mg/kg and noting that most residues in the 5 trials were from applications at 1.5 times the GAP application rate. The Meeting noted that the 0.01 mg/kg proposal was not at the limit of determination according to the 1991 monograph and that according to current GAP, whether an exaggerated rate has been used can depend on the row spacings, and is not entirely defined in terms of kg ai/ha. The 1991 evaluation does not allow this to be determined.

In addition to the 5 supervised trials reviewed by the 1991 JMPR, the maximum residue in one of two additional trials was 0.03 mg/kg compared to <0.01 mg/kg in the other and in the previously reviewed trials. The "double side-dress" granular application at GAP rates was interpreted to mean a side-dress on each side of the furrow, which is GAP. Although 6 of 7 trials showed residues of <0.01 mg/kg, and although information on sample handling and storage conditions in the new trials is desirable, the Meeting saw no reason that the higher value should not represent GAP and recommended accordingly that the 1991 estimate of 0.01 mg/kg should be increased to 0.05 mg/kg. Additional data reflecting GAP are desirable.

Beans, Common. Maximum residues did not exceed 0.05 mg/kg in snap or green beans from two additional US trials not reviewed by the 1991 JMPR. The Meeting agreed that an argument could be made for a 0.1 mg/kg limit for common beans as proposed in French comments as opposed to the 0.2 mg/kg estimated by the 1991 JMPR, in view of the fact that most of the trials had been conducted at 1.4 times the GAP rate. However, owing to the relatively small number of trials, the Meeting was reluctant to recommend a 0.1

mg/kg limit. If the German 75th percentile approach summarized by the 1990 JMPR is applied to the 59-67-day results (four results at 0.01 mg/kg, one each at 0.04, 0.06, 0.11 and 0.14 mg/kg) a 0.2 mg/kg maximum residue level is suggested. Even adjusting the results to the GAP rate would lead to 0.14 mg/kg. The Meeting confirmed the 1991 JMPR estimate of 0.2 mg/kg for common beans.

Beans, Lima. The Meeting did not consider the data on two Lima bean trials reviewed by the 1991 JMPR (0.02 mg/kg maximum residue) and the one additional trial provided to the present Meeting (<0.01 mg/kg) to be sufficient for estimating a maximum residue level.

Broccoli. The Meeting received 10 additional reports on United States trials in 1972 which were not reviewed by the 1991 JMPR. Residues from possible GAP ranged from 1.6 to 15 mg/kg after 33 days compared to the 0.2 mg/kg level estimated by the 1992 JMPR for a 14-day GAP PHI. However, because (1) the data were for residues in the whole plant as distinct from the flower heads to which the MRL applies, (2) the granular at-plant applications were at exaggerated rates compared to US GAP, and (3) there was some uncertainty as to whether the field at-plant band applications were in accordance with GAP, the data were not considered suitable for estimating a maximum residue level.

The Meeting considered country comments questioning whether the trials reviewed by the 1991 JMPR (residues of 0.01 to 0.11 mg/kg) closely reflected reported GAP and proposing a 0.1 mg/kg limit. The Meeting re-examined data summarized in the 1991 monograph, taking into account country comments and current GAP labels and concluded that the 1-2 applications indicated as approved in the 1991 review were no longer GAP, which allows only one application per season for broccoli, for either EC or GR applications.

The Meeting noted that residues do not exceed 0.11 mg/kg even from two applications and that application of the 75th percentile approach to estimating MRLs described in the 1990 JMPR Report would suggest a maximum residue level of 0.1 mg/kg and concluded that residues from GAP would be unlikely to exceed 0.1 mg/kg on the basis of the data available. On the basis of previously reviewed and new information the Meeting recommended that the 1991 estimate of 0.2 mg/kg for broccoli should be lowered to 0.1 mg/kg.

Cabbage. The Meeting considered additional data not reviewed by the 1991 JMPR, clarification of current US GAP (42-day PHI and one application confirmed) and French comments questioning the GAP basis and rationale for the 1991 JMPR estimate of 0.2 mg/kg as a partial replacement of the 0.5 mg/kg CXL for vegetables. Residues were ≤0.05 mg/kg in three of the new reports provided and did not reflect GAP in 5 others. In 5 others they ranged from 1.4 to 8 mg/kg from at least 1.7 times GAP application rates after 51 days (42-day GAP PHI), but sufficient trial detail was not provided to decide whether these 5 conformed to GAP except in their maximum rate and PHI.

The GAP labels submitted confirmed the suspicion that the 2 applications in the trials reviewed in 1991 were not according to current GAP, although the 1991 information indicated that two applications were allowed for some uses. The Meeting noted French comments, including the observation that the mean residue was only 0.03 mg/kg, the doubt about the validity of the 0.17 mg/kg value and the view that a statistical analysis of the data supported 0.1 mg/kg. The Meeting did not agree that because 0.17 mg/kg was reported at a 39/43-day PHI and 0.09 mg/kg at 29/32 days in the same trial the data were necessarily invalid, especially for an at-plant application. A similar situation is also evident in another of the trials, although at lower levels.

The Meeting applied the German 75th percentile procedure for estimating maximum levels to the data. That approach would suggest that the 0.2 mg/kg recommended by the 1991 JMPR would be required if the residue of 0.17 mg/kg is included and if it could be assumed that the data represent GAP. However, according to the current information on GAP provided, none of the trials reviewed in 1991 reflect GAP, because two applications were used and some treatments exceeded GAP rates. Not only do the 1991 data not reflect GAP, but this appears also to be the case for the data submitted to the present Meeting, because GAP does not include band over-row, over-furrow or over-row post-emergence treatments (only side-dress applications are permitted). While few if any results appear to fully reflect GAP, 0.2 mg/kg would not be exceeded even from exaggerated applications. On the basis of new and previously reviewed information, the Meeting confirmed the 1991 JMPR estimate of 0.2 mg/kg.

Cattle milk. The Meeting considered the written proposal of The Netherlands that a 0.01 mg/kg limit could be supported for the milk of cattle (rather than 0.02 mg/kg), which was based on the view that feed would not contain residues at the 20 mg/kg limit proposed for sorghum forage (green) in practice since sorghum forage is unlikely to be fed at 100% of the cattle diet. It was also noted that few of the trials resulted in residues up to 20 mg/kg in green sorghum forage.

The Meeting drew attention to the new level estimated for sorghum forage (green) of 5 mg/kg (see below) and agreed that on this basis a lower feeding level could be used as a basis for estimating a limit for milk. The Meeting also agreed that sorghum forage is not likely often to amount to 100% of the diet, although it could be as much as 75% on occasion. With these considerations, and noting that none of the other feed items for which MRLs are proposed are likely to contain residues exceeding 5 mg/kg, the Meeting agreed that it would be reasonable to use another feeding trial reviewed by the 1991 JMPR as the basis for a limit for milk. With residues up to 0.004 mg/kg from a 7.2 ppm feeding level and 0.012 mg/kg from 18 ppm, and noting that residue measurements are possible down to 0.001 mg/kg, the Meeting agreed that a 0.01 mg/kg maximum residue level for the milk of cattle, goats and sheep should be recommended.

Cauliflower. No new data were available. However, the Meeting considered written comments from the French government that a 0.05 mg/kg limit could be supported as opposed to the 1991 JMPR estimate of 0.2 mg/kg, assuming that the high value of 0.31 mg/kg was an outlier. It also considered current US information on GAP, since the trials were in the USA. The Meeting observed that 3 applications had been made compared to the two that are allowed by current GAP. The first application was within GAP and the second and third were at 1 to 1.7 fold rates. Therefore, strictly speaking the trials represent exaggerated use. The Meeting observed that except for the 0.31 mg/kg value, residues were similar after 28-30 and 38-43 days. Combining these data gives a data base of 0.01(11), 0.02, 0.04(2) and 0.31 mg/kg. The Meeting agreed that the residue of 0.31 mg/kg appeared to be an outlier and concluded that 0.05 mg/kg would not be likely to be exceeded from GAP. This is supported by application of the German 75th percentile approach to estimating MRLs. The Meeting revised the maximum residue level estimated by the 1991 JMPR for cauliflower to 0.05 mg/kg.

Cotton seed. The 1991 JMPR recommended a 0.1 mg/kg limit, based on residues of $\leq$0.05 mg/kg, considering one 0.43 mg/kg value to be aberrant. In response to concerns expressed at the CCPR that all relevant data had not been submitted, the Meeting reviewed current information on GAP and additional data on disulfoton residues in cotton seed, representing several spray regimens. The trials appear to accord with GAP, since the manufacturer informed the Meeting that formulations designated as "SC" in the 1994 submission were actually EC formulations. "SC" had been used as a generic term for spray concentrates. The trials included two with in-furrow + side-dress applications with residues of <0.19 mg/kg after 28 days (control 0.19 mg/kg) and several from seed + foliar treatments (<0.06, 0.03 and 0.1 mg/kg after 33-95

days) and foliar treatments (<0.01 to 0.12 mg/kg at 88-111 days). With the exception of the 0.12 mg/kg residue where the control value was 0.04 mg/kg, the control values generally appear to contribute significantly or almost entirely to the reported residues.

In taking the new information into account together with the data reviewed by the 1991 JMPR, it was concluded that there might be a possibility of residues exceeding 0.1 mg/kg, but that there was insufficient evidence to recommend revision of the 1991 estimate of 0.1 mg/kg, which the Meeting therefore confirmed.

Maize. The Meeting received additional data from disulfoton trials in the United States, none of which reflected reported GAP and were therefore considered unsuitable as a basis for revising the 1991 JMPR 0.01 mg/kg estimate.

The Meeting also considered an inquiry from a delegation to the 1994 CCPR as to whether the 0.01 mg/kg proposal for maize grain was at the limit of determination. The Meeting observed that the 1991 JMPR considered the limit of determination for maize (dry grain) to be 0.01 mg/kg and recorded maize grain residues as ≤0.01 mg/kg. Because some residues were observed at the 0.01 mg/kg level, the Meeting concluded that it should not be designated as at the limit of determination.

Oats, wheat. The Meeting considered the 1994 CCPR request to re-examine limits for the green forages and straws of oats and wheat as there appeared to be inconsistencies between the two, as well as additional data not reviewed by the 1991 JMPR. The 1991 JMPR estimated 0.5 and 2 mg/kg respectively for oat and wheat green forages and 0.05 and 10 mg/kg respectively for their straws. No new data on oats were provided. The Meeting re-examined the summarized data and GAP for oats, noting that grain residues did not exceed the 0.01 mg/kg limit of determination, straw residues did not exceed 0.03 mg/kg and green forage residues were up to 0.25 mg/kg after 30 days. The Meeting confirmed the 1991 JMPR estimates of 0.01 mg/kg (limit of determination) for oat grain, 0.5 mg/kg for oat forage (green) and 0.05 mg/kg for oat straw.

In the case of wheat the 1991 monograph refers to 30 trials with GR and EC formulations, 1-3 applications and PHIs of 27 to 100 days. Residues in Wheat green forage from single GR applications, which are GAP, are reported as <0.01 to 2.4 mg/kg (mean 0.5, s.d. 0.58) in Table 2 of the 1991 monograph. However, in view of information that a 75-day forage grazing restriction applies to the single GR application at planting, the only forage residues tabulated in 1991 which correspond to the GAP reported to the present Meeting range from 0.06 to 1 mg/kg (mean 0.36, s.d. 0.27 at PHIs of ≥66 days).

In addition to the data on wheat forage reviewed by the 1991 JMPR, substantial additional data were provided to the Meeting, although most of it did not reflect GAP, because either multiple granular applications were made (GAP allows 1), SC (=EC) formulations were applied (for EC GAP grazing or cutting for forage is prohibited) or harvest intervals were less than the 75-day grazing/feeding restriction for granular at-plant applications. Green forage residues did not exceed 0.6 mg/kg in the single trial conforming to GAP, which is in line with the maximum 1 mg/kg GAP residue reported in the 1991 monograph. On the basis of current information on GAP and relevant data, the Meeting recommended lowering the 1991 estimate of 2 mg/kg for wheat forage (green) to 1 mg/kg.

In the case of wheat straw, the data in the 1991 monograph showed residues ranging between <0.01 and 24 mg/kg (n = 29, mean 1.6, s.d. 4.9). Obviously the 1991 JMPR considered 24 mg/kg to be an outlier, since it recommended a 10 mg/kg limit. All of the residues, except 3 of ≤0.01 mg/kg not included

above, were at 27 to 50 days and most of them at 27-32 days. Residues were ≤0.8 mg/kg, except three results of 8, 10 and 24 mg/kg. Substantial new data were also provided to the Meeting, again mostly for PHIs around 30 days. Residues in 30 samples ranged from <0.01 to 1.5 mg/kg, with a mean of 0.34 mg/kg and s.d. 0.5.

The Meeting noted that few results were available for PHIs greater than 30 days, that a 30-day PHI applies to grain from EC foliar applications, that straw might be fed if grain is harvested within 30 days after EC uses, even with label restrictions on foraging/grazing, and that of approximately 60 results at intervals around or greater than the 30-day PHI (including new results not previously reviewed) residues did not exceed 2 mg/kg (except for values of 8, 10 and 24 mg/kg). Having some reservation about giving no weight at all to the three high values, and taking into account government technical arguments, the Meeting lowered the 1991 estimate of 10 mg/kg for wheat straw to 5 mg/kg.

The Meeting took note of country comments that the residue of 0.11 mg/kg in wheat grain in the 1991 review was an outlier, and observed that all of the 31 results (27-50-day PHIs, mostly 27-32 days) in the 1991 data were ≤0.06 mg/kg (mean 0.02, s.d. 0.02), except the single 0.11 mg/kg value. In 42 results in the substantial data provided to the present Meeting, residues ranged from <0.01 mg/kg to 0.3 mg/kg (mean 0.04, s.d. 0.06) with a relatively continuous distribution of values up to the 0.3 mg/kg residue, but weighted to the lowest values. In both cases most of the data were for PHIs around 30 days for foliar SC (i.e. EC) applications at rates approximating GAP for EC formulations, which includes a 30-day PHI.

A case might be made that the 0.11 mg/kg value in the 1991 data base was an outlier. However, noting that residues were ≤0.2 mg/kg, except one of 0.3 mg/kg, the Meeting concluded that the 1991 JMPR estimate of 0.2 mg/kg for wheat grain could not be lowered. Because a residue occurred at 0.3 mg/kg the Meeting considered recommending an increase to 0.3 mg/kg, but since in the combined 1991 and 1994 data a total of 73 results included only one value exceeding 0.2 mg/kg the Meeting confirmed the 0.2 mg/kg estimate for wheat grain.

Peas, Black eye. Substantial data were received from 1968 US supervised trials on black-eyed peas (green and dry). These "peas" are regulated as beans in the USA. The Meeting was unable to review these data in conjunction with the 1991 JMPR data on beans, because PHI intervals for the additional trials were 28 to 46 days compared to US GAP for beans of 60 days.

Peas, Garden. Although no outstanding questions remained after the 1991 JMPR 0.1 mg/kg estimate for garden peas, limited additional information on peas (0.04 and 0.1 mg/kg in peas and pods respectively) did not require revision of the previous estimate.

Pecans. The Meeting reviewed additional data and current GAP provided in response to concerns expressed at the 1993 CCPR that the 1991 JMPR recommendation to lower the 0.1 mg/kg CXL to 0.01 mg/kg (both limits of determination) did not accommodate GAP soil uses or even the maximum foliar GAP rates. All of the additional data from SC (= EC) formulations (GAP includes either EC or GR) were at 3 to 18 times the reported GAP for foliar ground EC applications of 0.4 kg ai/ha (aerial applications can be 0.8 kg ai/ha, but no aerial data were included). When adjusted to EC GAP rates residues after 26-28 days, compared to the GAP of 30 days for foliar applications, would be up to approximately 0.05 mg/kg. However, control values were often of the order of 0.03 to 0.1 mg/kg.

One of the difficulties, as is often the case for older compounds, is that many of the results were obtained by methods for which limits of determination were not as low as are currently attainable, and there

were more old than new data. In this case the additional data do not strictly reflect GAP, but even so in a significant number of cases even control values are above the 0.01 mg/kg level that the method is capable of determining. The 1991 evaluation does not include control values, although the residue in one case is reported as <0.02 mg/kg, presumably a control value.

Although it is clear that new and older methods are capable of determining residues of 0.01 mg/kg, in practice control values can exceed that level. Primarily for this reason the Meeting agreed to withdraw the 1991 JMPR proposal of 0.01 mg/kg, retaining the current 0.1 mg/kg CXL. The Meeting agreed that additional data reflecting the higher aerial foliar applications and soil applications are desirable.

Sorghum forage. The Meeting considered written country comments expressing concern that the 1991 JMPR estimate of 20 mg/kg for sorghum forage (green) was too high for animal safety, and views that the high values leading to that estimate were aberrant. The Meeting also reviewed current information on GAP that a 45-day forage/grazing PHI applies, and additional data with maximum residues from GAP applications up to 0.6 mg/kg. It noted maximum residues of 2.1 mg/kg after a GAP 45-day PHI in the 1991 JMPR review (with the exception of one residue of 14.2 mg/kg in a total of 27 values) and residues of <0.01, 3.8, 5.1 and 19 mg/kg after 33-35 days. Noting that a case can be made that the 14.2 mg/kg is an outlier, noting that residues were up to 5 to 19 mg/kg after 33-35 days compared to a 45-day foraging restriction and that other 45-day residues slightly exceeded 2 mg/kg, the Meeting replaced the recommendation of 20 mg/kg for sorghum forage (green) by one of 5 mg/kg.

Sorghum grain. Although no outstanding questions remained on the 1991 JMPR estimate of 0.5 mg/kg for sorghum grain, the Meeting received substantial additional data from trials with granular formulation in which residues did not exceed 0.08 mg/kg from GAP applications and data from trials in accordance with EC GAP but with SC applications, again confirmed as being EC formulations. In these latter residues were relatively evenly distributed up to 0.7 mg/kg. Taking all the data reviewed by the present Meeting and by the 1991 JMPR into account, only 2 of 52 values reflecting GAP exceeded 0.5 mg/kg (0.6 and 0.7 mg/kg from SC applications). While percentage-wise the number of values exceeding the 1991 JMPR 0.5 mg/kg level is low, noting that there is a continuous distribution of GAP residues up to the maximum of 0.7 mg/kg level, the Meeting recommended increasing the 1991 estimate from 0.5 to mg/kg on sorghum grain to 1 mg/kg.

Tomato. The Meeting considered country comments from Germany and France questioning whether the three relevant US tomato trials (Japanese trials appeared not to include relevant metabolites) were a sufficient basis for a limit, and if so suggesting that the recommended 0.1 mg/kg as partial replacement of the current 0.5 mg/kg CXL for vegetables is not needed since the reported residues after 30 days in the three trials were <0.01(2) and 0.02 mg/kg. On reconsideration of the data base which is small for such a major crop, and taking into account the country comments, the Meeting decided to withdraw the 1991 recommendation.

Definition of the residue. The Meeting considered a written Netherlands government comment proposing deletion of demeton-S (the oxygen analogue of disulfoton) from the definition of the residue which currently includes the sum of disulfoton, demeton-S and their sulphoxides and sulphones, expressed as disulfoton.

The Meeting took note that none of the animal or plant metabolism studies reported in the 1991 JMPR periodic re-evaluation listed demeton-S as a residue, although its sulphoxide and sulphone were so listed. The Meeting also noted that analytical methods can separate and measure the other oxidative metabolites separately or they can be oxidized to the common sulphone. None of the field trials reviewed in

the 1991 monograph were presented in such a way as to reveal the levels of the individual compounds. The review leaves a level of uncertainty as to how many of the analyses (if any) included determinations of demeton-S. Therefore, while available evidence suggests that residues of demeton-S are not likely to occur in practice, the data summaries do not allow that to be confirmed with confidence.

As a practical matter, it is probable that many of the current results are based on methods which oxidize residues to the disulfoton oxygen analogue sulphone. This will have taken into account the more toxic metabolites. The fact that there may not have been residues of demeton-S would not appear to be of practical significance. Because of uncertainties remaining on the possible occurrence of residues of demeton-S, the lack of any practical significance in having it included in the definition, the fact that most national MRLs appear to include demeton-S in the residue, and the lack of national monitoring data which include analyses for demeton-S to show whether or not it is a significant component of the residue (suggested at the 1993 CCPR), the Meeting recommended that the definition of the residue should not be changed at present.

RECOMMENDATIONS

The Meeting estimated the maximum residue levels listed below, which are recommended as MRLs.

Definition of the residue: sum of disulfoton, demeton-S and their sulphoxides and sulphones, expressed as disulfoton.

Commodity		Recommended MRL or ERL (mg/kg)		PHI on which MRL is based (days)
CNN	Name	New	Previous	
VD 0071	Beans (dry)	0.05	0.01	40-75
VB 0400	Broccoli	0.1	0.2 [2,3]	14-42
VB 0404	Cauliflower	0.05	0.2 [2,3]	40
ML 0107	Milk of cattle, goats and sheep	0.01	0.02[2]	
TN 0672	Pecan	0.1[5]	0.01 * [2]	30
GC 0651	Sorghum	1	0.5	7
AF 0651	Sorghum forage (green)	5	20 [2,4]	45[6]
VO 0448	Tomato	W[1]	0.1 [2,3]	
AF 0654	Wheat forage (green)	1	2 [2,4]	75
AS 0654	Wheat straw and fodder (dry)	5	10[2]	30

[1] Withdrawal recommended [2] 1991 JMPR proposal
[3] The 1991 JMPR recommended withdrawal of the current 0.5 mg/kg CXL for vegetables.
[4] The 1991 JMPR recommended withdrawal of 5 mg/kg for forage crops (green).
[5] The current CXL
[6] 45 or 60 for forage depending on the use. 7 or 34 for grain, depending on the use.

FURTHER WORK OR INFORMATION

Desirable

1. Additional residue data on pecans reflecting the higher aerial foliar application rates, and data from soil applications according to GAP.

2. Additional residue data from trials on dry beans reflecting GAP.

REFERENCES

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