DISULFOTON (74)

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EXPLANATION

Disulfoton, an insecticide/acaricide, was evaluated for residues within the periodic review programme by the 1991 JMPR. Additional residue information was evaluated by the 1994 and 1998 JMPR. An ADI of 0.0003 mg/kg bw was adopted in 1991, an acute reference dose (ARfD) of 0.003 mg/kg bw in 1996. Estimations of the short term intake (IESTI) in 2002 by WHO (CCPR 34, CX/PR 02/03) resulted in IESTIs exceeding the ARfD for broccoli, cabbage, cauliflower, lettuce, potato, Japanese radish and rice. In the meantime Codex MRLs for potato, Japanese radish and rice were withdrawn.

At CCPR 36, the Committee noted that the acute intake concerns had not been resolved even with the use of a probabilistic method (ALINORM 04/27/24, paragraph 106). The Committee returned the MRLs of broccoli, cabbages (head), cauliflower, lettuce head and leaf to Step 6 awaiting refinements in the acute dietary intake probabilistic methodology (ALINORM 04/27/24, paragraph 107).

At CCPR 37 the Committee decided to return all the MRLs currently at step 7 to step 6. Since this was the third time that the proposed MRLs were returned to Step 6 for intake concerns, the Committee also decided to request the JMPR to review GAPs that may result in lower MRL recommendations (ALINORM 05/28/24, paragraph 105).

The manufacturer submitted GAP data from Canada, Mexico, Japan and the USA on broccoli, cabbage, cauliflower, and lettuce.

Residue and GAP information was also submitted by Japan on Adzuki bean, burdock, cabbage, Chinese cabbage, cucumber, eggplant, common bean (pod), mitsuba, onion, Satsuma mandarin, pineapple, potato, Japanese radish, Chinese onion (rakkyo), soybean, Welsh onion, sugar cane, sweet pepper, tomato, upland wasabi and watermelon.

Residue definition (from JMPR 1998)

Definition of the residue for compliance with MRLs and for the estimation of dietary intake: sum of disulfoton, demeton-S and their sulfoxides and sulfones expressed as disulfoton. Note that JMPR 1994 extensively discussed the inclusion of demeton-S.

USE PATTERN

Disulfoton is a systemic pre-emergent and post-emergent insecticide used for the control of a variety of insect pests such as aphids, mites, leafhoppers, leafminers, nematodes, thrips and beetles. The active ingredient is formulated as granules, EC and SC formulations, and generally applied to the soil at planting as a soil injection, or at sowing in-furrow, as a side-dressing (i.e. at the side of the furrow), or as a broadcast spray. Foliar sprays may be applied after planting (pre-emergent) or at a post-emergence stage of growth. Information on registered use patterns was provided by the manufacturer and the Japanese government. The manufacturer provided the GAP data both in summarized form, as original labels, and in an English translation.(this could mean two things, depending on where the commas go – I've assumed 'both' means the summarised form and the original labels, and that the English translation is extra. The Japanese government provided only a summary table in English.

On the US labels, the relevant soil applications are expressed as ounce (oz) of product/1000 ft of row (36 inch row spacing for broccoli, cauliflower and cabbage, 20 inch row spacing for lettuce), with a maximum in pints per acre. This maximum is given in the GAP table.

Table 1. Registered uses of disulfoton supplied by the manufacturer.

Crop	Country	Formulation (g ai/kg; g ai/L)	Application				PHI, days
			Method	Rate kg ai/ha	Spray conc, kg ai/hL	Number	
Broccoli	USA	EC 960	Soil application: Transplanting beds: soil treatment before transplanting Field: soil injection/side dressing	1.12		1	14
Broccoli	Canada	GR 15	Soil application: band on each side of the seed furrow/side dressing	1.12		1	42
Broccoli	Mexico	GR 10	Soil application: Band to each side of the row, after transplanting small plants	1			
Cabbage	USA	EC 960	Soil application: Transplanting beds: soil treatment before transplanting Field: soil injection/side dressing	2.24		1	42
Cabbage	Canada	GR15	Soil application: band on each side of the seed furrow/side dressing	1.12		1	42
Cabbage	Mexico	GR10	Soil application: Band to each side of the row, after transplanting small plants	1			
Cabbage	Japan	GR 5, GR 3	Soil application: soil incorporation row/planting hole	1.5-3		1	*
Cauliflower	USA	EC 960	Soil application: Chemigation through low pressure irrigation systems Transplanting beds: soil treatment before transplanting Field: soil injection/side dressing	1.12		1	40
Cauliflower	Canada	GR 15	Soil application: Band/side dress	1.12		2	30
Cauliflower	Mexico	GR 10	Soil application: Band to each side of the row, after transplanting small plants	1			
Lettuce	USA	EC 960	Soil application: Chemigation through low pressure irrigation systems Field application: soil	1.12; 2.24 in heavy		1	60

Crop	Country	Formulation (g ai/kg; g ai/L)	Application				PHI, days
			Method	Rate kg ai/ha	Spray conc, kg ai/hL	Number	
			injection/side dressing	organic soils			
Lettuce	Canada	GR 15	Soil application: Band application at seeding	1.12; 2.24 in heavy organic soils		1	
Lettuce	Mexico	GR 10	Soil application: Band or both sides of the sowing furrow	1			

* Application at transplanting , PHI ca. 60 days

Table 2. Registered uses of disulfoton supplied by the Japanese government.

Crop	Formulation (g ai/kg; g ai/L)	Application				PHI, days
		Method	Rate kg ai/ha	Spray conc, kg ai/hL	Number	
Common bean	GR 5	spreading, plant root, at development op fruit	2.0		1	60
Broad beans(dry)	GR 5	spreading, plant root, at development of fruit	2.0		1	60
Burdock	GR 5	spreading, row, at seeding	2.0		1	n.a.
Cabbage	GR 3	soil incorporation/ row, at transplanting	1.8		1	n.a.
Cabbage	GR 5	soil incorporation/ planting hole, at transplanting	1.5-3.0		1	n.a.
Chinese cabbage	GR 3	soil incorporation/ row, germination	1.8		1	n.a.
Chinese cabbage	GR 5	soil incorporation/ planting hole, at transplanting	1.5-3.0		1	n.a.
Cucumber	GR 5	spreading to planting hole, at transplanting	1.25-2.5		1	n.a.
Cucumber	GR 2	soil incorporation/ at transplanting	1.2		1	n.a.
Eggplant	GR 5	spreading, plant root, at transplanting	1.0-2.0		1	n.a.
Eggplant	GR 2	soil incorporation/ row, at leaf development	1.2		1	n.a.
Common bean(pods and/or immature seeds)	GR 5	spreading, planting hole, at seeding	2.0		1	n.a.
Kidney bean	GR 5	Spreading, at ripening of fruit and seed	2.0		1	60
Mitsuba		Spreading, at leaf development	2.5		1-3	90
Onion	GR 5	soil incorporation, at transplanting	2.0		1	n.a.
Satsuma Mandarin (Unshu orange)	GR 5	soil incorporation, at development of fruit	7.5-10		1-2	30
Field pea(dry)	GR 5	spreading, row, at leaf development	1.5-2.5		1	60

Crop	Formulation (g ai/kg; g ai/L)	Application				PHI, days
		Method	Rate kg ai/ha	Spray conc, kg ai/hL	Number	
Pineapple	GR 5	Spreading, at leaf development	2.0-2.5		1-3	120
Potato	GR 5	spreading, planting hole, at germination	2.0		1	n.a.
Potato	GR 3	soil incorporation, row, before germination (before transplanting)	1.8-2.7		1	n.a.
Radish, Japanese	GR 3	soil incorporation/ row, at seeding	1.8		1	n.a.
Radish, Japanese	GR 5	soil incorporation/ row, at transplanting	1.5-2.0		1	n.a.
Onion , Chinese (Rakkyo)	GR 5	soil incorporation/ row, at transplanting	2.0		1	n.a.
Soybean	GR 5	Spreading, at development of fruit	1.5-3.0		1	60
Soybean	GR 2	soil incorporation, at seeding	1.2		1	n.a.
Adzuki bean (dry)	GR 5		1.5-3.0		1	60
Onion , Welsh	GR 2	soil incorporation, row, at transplanting	1.2		1	n.a.
Onion , Welsh	GR 3	soil incorporation , row, at transplanting	0.9		1	n.a.
Onion , Welsh	GR 5	soil incorporation, at transplanting	1.5		1	n.a.
Sugar cane	GR 5	soil incorporation, row, at germination	3.0-4.5		1	n.a.
Sweet pepper	GR 3	spreading, plant root, at leaf development	1.8		1	45
Tomato	GR 5	spreading, plant root, at transplanting	1.5-3.0		1	n.a.
Tomato	GR 2	spreading, plant root, at transplanting	1.2		1	n.a.
Wasabi, upland	GR 3	Spreading, at development of harvestable vegetative plant parts	1.8		1-2	60
Watermelon	GR 5	spreading, planting hole, at transplanting	1.5-3.0		1	n.a.

All refer to field and glasshouse use, except for burdock, pineapple, sugar cane, and wasabi which only have a field use. ‘At transplanting’ means at leaf development

RESIDUE RESULTING FROM SUPERVISED TRIALS ON CROPS

Tables 3-24 show data from supervised trials provided by the Japanese government, on crops which have not previously been evaluated: Adzuki bean, burdock, cabbage, Chinese cabbage, cucumber, eggplant, common bean (pod), mitsuba, onion, Satsuma mandarin, pineapple, potato, Japanese radish, Chinese onion, soybean, Welsh onion, sugar cane, sweet pepper, tomato, wasabi and watermelon. Only summary data sheets were provided (ref Table XI.3), no reports on field and analytical parts of the trials were available. In all trials, it is stated that the residue definition is disulfoton-sulfon (P=S) + dimeton-thiosulfon (P=O). Residues are calculated as disulfoton. In accordance with Japanese legislation, all samples have been analyzed twice, once by an official institute and once by an in-house institute. In the tables, the mean of the duplicate analysis is given. The following summarizes information on residues resulting from supervised trials.

Commodity	Table
Adzuki bean.	Table 3
Burdock.	Table 4
Cabbage	Table 5
Chinese cabbage	Table 6
Cucumber	Table 7
Eggplant	Table 8
Common bean (pod)	Table 9
Mitsuba	Table 10
Onion	Table 11
Satsuma mandarin	Table 12
Pineapple	Table 13
Potato	Table 14
Japanese radish, root	Table 15
Japanese radish, leaves	Table 16
Chinese onion	Table 17
Soybean	Table 18
Welsh onion	Table 19
Sugar cane	Table 20
Sweet pepper	Table 21
Tomato	Table 22
Wasabi	Table 23
Watermelon	Table 24

Data on broccoli, cabbage, cauliflower and lettuce, which were reviewed in the 1991, 1994 and 1998 monographs, are interpreted in the light of current GAP in Tables 25-28.

Broccoli	Table 25
Cabbage	Table 26
Cauliflower	Table 27
Lettuce	Table 28

In conclusion, in table 29 a summary is given of broccoli, cabbage, cauliflower and lettuce data according to GAP, along with the corresponding HRs and %ARfD.

Table 3. Residues in Adzuki bean (whole commodity) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues, mg/kg
Iwate, 1972, (Ohdate No. 2)	GR 5	1	1.5	Germination (at seeding)	128	< 0.02
idem	GR 5	1	3.0	Germination (at seeding)	128	< 0.02
Hokkaido, 1972, (Takaraazu)	GR 5	1	1.5	Germination (at seeding)	122	< 0.02
idem	GR 5	1	3.0	Germination (at seeding)	122	< 0.02

Table 4. Residues in burdock (whole commodity) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues, mg/kg
Hokkaido, 1989, (Yanagawariso)	GR 5	1	2.0	Germination (at seeding)	111	< 0.02
Saitama, 1989, (Isuke)	GR 5	1	2.0	Germination (at seeding)	140	< 0.02

Table 5. Residues in cabbage (whole commodity after removal of obviously decomposed or withered leaves) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues, mg/kg
Aomori, 1972, (Nagaokakohai-wase)	GR 5	1	2.0	At leaf development	57	0.074
idem	GR 5	1	4.0	At leaf development	57	0.097
Ymanashi, 1972, (Aozora)	GR 5	1	2.0	At leaf development	69	0.072
idem	GR 5	1	4.0	At leaf development	69	0.063

Table 6. Residues in Chinese cabbage (whole commodity after removal of obviously decomposed or withered leaves) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues, mg/kg
Ushiku, 1987, (Akogare)	GR 5	1	3.0	At leaf development	54	< 0.02
					64	< 0.02
Nagano, 1987, (Taibyou 60)	GR 5	1	3.0	At leaf development	49	0.08
					59	0.04

Table 7. Residues in cucumber (whole commodity after removal of stems) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues, mg/kg
Ushiku, 1987, (Tokiwahikari 3P)	GR 5	1	2.5	At leaf development	40	< 0.02
Nagano, 1987, (Nankyoku No. 1)	GR 5	1	2.5	At leaf development	26	< 0.02

Table 8. Residues in eggplant (whole commodity after removal of stems and cap) after indoor treatment in Japan.

Location, year, (variety)	Form	No	Interval (days)	g granule/plant	method, timing	DAT	residues, mg/kg
Nagasaki, 1971, (Naganasu)	GR 5	1	-	2	At leaf development	79	< 0.02
						116	< 0.02
						127	< 0.02
Idem	GR 5	2	96	2	At leaf development	20	0.018
						31	0.024
Ushiku, 1971, (Kurogishi)	GR 5	1	-	2	At leaf development	79	< 0.02
						111	< 0.02
						142	< 0.02
Idem	GR 5	2	50	2	At leaf development	29	< 0.02
						61	< 0.02
						92	0.024

Table 9. Residues in common bean (pod) (whole commodity) after indoor treatment in Japan

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues P=S, mg/kg	residues P=O, mg/kg
Okinawa	GR 5	1	1.5	At leaf development	104	0.003	< 0.008
					111	0.003	< 0.008
	GR 5	1	3.0	At leaf development	104	0.029	< 0.008
					111	0.042	< 0.008

Table 10. Residues in mitsuba (whole commodity) after indoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues P=S, mg/kg	residues P=O, mg/kg
Ibaraki	GR 5	4	2.5	At leaf development	74	0.006	0.008
	GR 5	9	2.5	At leaf development	100	0.013	0.060

Table 11. Residues in onion (whole commodity after removal of roots and adhering soil and whatever parchment skin is easily detached)) after indoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues, mg/kg*
Ushiku, 1976, (Sensyuou)	GR 5	1	1	At leaf development	209	< 0.02
	GR 5	1	2	At leaf development	209	< 0.02
					282	< 0.02
Hokkaido, 1976, (Sapporoou)	GR 5	1	1	At leaf development	125	< 0.02
	GR 5	1	2	At leaf development	125	< 0.02

* at cross-check analysis in another laboratory: all residues < 0.01 mg/kg

Table 12. Residues in Satsuma mandarin (pulp) after indoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues, mg/kg
Saga, 1971, (Wase)	GR 5	1	1	At flowering	155	< 0.02
	GR 5	2	1	Last at development of fruit	25	< 0.02
Ohsaka, 1971, (Common)	GR 5	1	1	At flowering	159	< 0.02
	GR 5	2	1	Last at development of fruit	47	< 0.02

Table 13. Residues in pineapple (pulp) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	Interval (days)	kg ai/ha	method, timing	DAT	residues, mg/kg*
Okinawa, 1976, (Smooth kaien)	GR 5	3	32-33	2.5		40	0.221
						119	0.023
	GR 5	4	32-33-26	2.5		14	0.319
						93	0.053

* Replicate samples and replicate analysis showing the mean of 2 replicate samples, each analyzed twice by two laboratories; a total of 8 numbers per mean.

Table 14. Residues in potato (whole commodity after removing tops, adhering soil removed) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues, mg/kg
Nagasaki, 1971, (Tachibana)	GR 5	1	2.0	Sprouting/germination	85	0.042
					105	0.070
	GR 5	1	4.0	Sprouting/germination	85	0.115
					105	0.098
Ushiku, 1972, (Dansyaku)	GR 5	1	2.0	Sprouting/germination	102	0.091
Idem	GR 5	1	4.0	Sprouting/germination	102	0.188

Table 15. Residues in Japanese radish (roots, whole commodity after removing tops, adhering soil removed) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Thiba, 1976, (Hayabutoriookura)	GR 5	1	1.0	germination	75	0.004	< 0.004
					82	0.004	< 0.004
Idem	GR 5	1	1.5	germination	75	0.004	< 0.004
					82	0.008	0.004
Idem	GR 5	1	2.0	germination	75	0.004	< 0.004
					82	0.005	< 0.004
Kanagawa, 1977, (Miuramiya)	GR 5	1	1.0	germination	102	0.014	< 0.004
					112	0.009	< 0.004
Idem	GR 5	1	1.5	germination	102	0.013	0.007
					112	0.011	0.008
Idem	GR 5	1	2.0	germination	102	0.019	0.008
					112	0.015	0.008

* replicate analysis showing the mean. - each sample was analyzed twice by two laboratories; a total of 4 numbers per mean. LOQ (lab 1) = 0.003 mg/kg for P=S and 0.005 or 0.01 mg/kg for P=O; LOQ (lab 2) = 0.004 mg/kg for both. The mean is calculated by assuming a residue at the LOQ when <LOQ; when all are <LOQ the lowest LOQ is stated.

Table 16. Residues in Japanese radish (leaves, whole commodity as usually marketed, after removal of obviously decomposed or withered leaves) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Thiba, 1976, (Hayabutoriookura)	GR 5	1	1.0	germination	75	0.005	0.032
					82	0.004	0.020
Idem	GR 5	1	1.5	germination	75	< 0.003	0.018
					82	< 0.003	0.021
Idem	GR 5	1	2.0	germination	75	0.005	0.030
					82	0.004	0.015
Kanagawa, 1977, (Miuramiya)	GR 5	1	1.0	germination	102	0.009	0.046
					112	0.006	0.028
Idem	GR 5	1	1.5	germination	102	0.014	0.054
					112	0.022	0.083
Idem	GR 5	1	2.0	germination	102	0.026	0.114
					112	0.022	0.074

* replicate analysis showing the mean - each sample was analyzed twice by two laboratories; a total of 4 numbers per mean. LOQ (lab 1) = 0.003 mg/kg for P=S and 0.005 or 0.01 mg/kg for P=O; LOQ (lab 2) = 0.004 mg/kg for both. Mean is calculated by assuming a residue at the LOQ when <LOQ; when all are <LOQ the lowest LOQ is stated.

Table 17. Residues in Chinese onion (rakkyo) (whole commodity after removal of roots and adhering soil and whatever parchment skin is easily detached) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	Interval (days)	kg ai/ha	method, timing	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Fukui, 1985, (common)	GR 5	1	-	3.0	germination	282	< 0.005	0.006
						296	< 0.005	< 0.005
Idem	GR 5	2	196	4.5	Germination + at leaf development	86	< 0.005	0.014
Idem	GR 5	1	-	4.5	germination	282	< 0.005	0.007
						296	< 0.005	0.006

* replicate analysis showing the mean.

Table 18. Residues in soybean (dry) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues, mg/kg
Fukushima, 1987, (Suzuyutaka)	GR 5	1	3.0	flowering	60	< 0.02
Nagano, 1987, (Hourei)	GR 5	1	3.0	flowering	60	< 0.02

Table 19. Residues in Welsh onion (whole vegetable after removal of roots and adhering soil) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Nagano, 1976, (Shimonita)	GR 5	1	0.5	germination	102	< 0.003	0.006
Idem	GR 5	1	1.5	germination	102	< 0.003	< 0.005
Idem	GR 5	1	0.5	Leaf development	122	< 0.003	0.005
Idem	GR 5	1	1.5	Leaf development	122	< 0.003	0.006
Gunma, 1976, (Ishikuranebukanegi)	GR 5	1	1.5	Leaf development	161	< 0.003	0.016
Idem	GR 5	1	3.0	Leaf development	161	< 0.003	0.011
Idem	GR 5	1	1.5	germination	247	< 0.003	< 0.005
Idem	GR 5	1	3.0	germination	247	< 0.003	< 0.005

* replicate analysis showing the mean.

Table 20. Residues in sugar cane (stem after removal of skin) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Okinawa miyako, 1976, (NCO 310)	GR 5	1	3.0	germination	329	< 0.002	< 0.004
					519	< 0.002	< 0.004
Idem	GR 5	1	4.5	germination	329	< 0.002	< 0.004
					519	< 0.002	< 0.004
Okinawa yaeyama, 1976, (NCO 310)	GR 5	1	3.0	germination	200	< 0.003	0.004
					297	< 0.003	< 0.004
Idem	GR 5	1	4.5	germination	200	0.004	0.005
					297	< 0.003	< 0.004

* replicate analysis showing the mean - each sample was analyzed twice by two laboratories; a total of 4 numbers per mean. LOQ (lab 1) = 0.002 or 0.003 mg/kg for P=S and 0.004 or 0.02 mg/kg for P=O; LOQ (lab 2) = 0.004 mg/kg for both. The mean is calculated by assuming a residue at the LOQ when <LOQ; when all are <LOQ the lowest LOQ is stated.

Table 21. Residues in sweet pepper (whole commodity after removal of stems and cap) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	Interval (days)	kg ai/ha	method, timing	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Ushiku, 1982, (Tosagreen B)	GR 5	1	-	2	Maturity of fruit	1	0.004	< 0.008
						7	0.006	< 0.008
						14	< 0.004	< 0.008
						21	< 0.004	< 0.008
Idem	GR 5	1	-	2	Leaf development	59	0.016	0.014

Location, year, (variety)	Form	No	Interval (days)	kg ai/ha	method, timing	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Idem	GR 5	2	59	2	Maturity of fruit	21	0.004	< 0.008
Kochi, 1982, (Original)	GR 5	1	-	2	Maturity of fruit	1	< 0.004	< 0.008
						7	0.004	< 0.008
						14	0.009	< 0.008
						21	0.006	< 0.008
	GR 5	1	-	2	Leaf development	55	0.011	0.012
	GR 5	2	25	2	Maturity of fruit	21	0.014	0.013

* replicate analysis showing the mean.

Table 22. Residues in tomato (whole commodity after removal of stems and cap) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	Interval (days)	kg ai/ha	method, timing	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Nagano, 1976, (Kyouryokubeiju)	GR 5	1	-	1 g GR/plant	Leaf development	70	< 0.003	0.005
						100	< 0.003	< 0.005
Idem	GR 5	1	-	2 g GR/plant	Leaf development	70	< 0.003	0.006
						100	< 0.003	< 0.005
Idem	GR 5	2	42	3 kg ai/ha, and 2 g GR/plant	Development of fruit (2x); flowering	30	0.016	0.204
						41	0.003	0.071
						60	< 0.003	0.008
Koibuchi, 1976, (Hikari F1)	GR 5	1	-	1 g GR/plant	Leaf development	38	0.003	0.076
						64	< 0.003	0.005
	GR 5	1	-	2 g GR/plant	Leaf development	38	0.008	0.140
						64	< 0.003	0.018
	GR 5	2	42	3 kg ai/ha, and 2 g GR/plant	Leaf development	33	0.006	0.062

* replicate analysis showing the mean.

Table 23. Residues in upland wasabi (Shimane: top and root; Yamaguchi: top) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Shimane	DP 3	1	1.8	14	0.72	0.20
				30	0.14	0.05
				60	0.02	< 0.01
				122	< 0.01	< 0.01
Idem	DP 3	2	1.8	14	0.76	0.21
				30	0.31	0.10
				60	0.04	0.02
				122	< 0.01	< 0.01
Idem	DP 3	3	1.8	14	1.3	0.30
				30	0.32	0.08
				60	0.07	0.05
				122	0.02	< 0.01
Yamaguchi,	GR 3	1	1.8	14	0.265	0.28
				30	0.024	0.025
				60	< 0.004	< 0.01
				120	< 0.004	< 0.01
				180	< 0.004	< 0.01

Location, year, (variety)	Form	No	kg ai/ha	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Idem	GR 3	2	1.8	14	0.382	0.54
				30	0.070	0.095
				60	0.006	< 0.01
				120	< 0.004	< 0.01
				180	< 0.004	< 0.01
Idem	GR 3	3	1.8	14	0.349	0.50
				30	0.044	0.06
				60	0.006	< 0.01
				120	< 0.004	< 0.01
				180	< 0.004	< 0.01

* replicate analysis showing the mean.

Table 24. Residues in watermelon (whole commodity after removal of stems) after outdoor treatment in Japan.

Location, year, (variety)	Form	No	kg ai/ha	method, timing	DAT	residues* P=S, mg/kg	residues* P=O, mg/kg
Kanagawa, 1976, (Shimao)	GR 5	1	1.43	Leaf development	79	< 0.01	0.01
Idem	GR 5	1	2.86	Leaf development	79	< 0.01	0.04
Ushiku, 1976, (Kodama)	GR 5	1	1.5	Leaf development	78	< 0.01	< 0.01
	GR 5	1	3.0	Leaf development	78	< 0.01	< 0.01

* replicate analysis showing the mean.

Table 25. Residue interpretation table for disulfoton residues in broccoli. GAP and trial conditions are compared for treatments considered valid for MRL and STMR estimation.

		Use pattern					disulfoton
Crop	Country	Form.	kg ai/ha	No of appl Note	PHI days	Trial	mg/kg
Broccoli	Canadian GAP	GR	1.12	1	42		
No relevant trials							
Broccoli	US GAP	GR/EC	1.12	1	14		
Broccoli	US 1987	EC	1.12 + 1.68	1 + 1	14	M 91147[a]	< 0.02
Broccoli	US 1987	EC	1.12 + 1.68	1 + 1	14	M 91147[a]	0.05
Broccoli	US 1987	EC	1.12 + 2.04	1 + 1	15 29	M 91147[a]	0.03 0.11
Broccoli	US 1987	GR+EC	1.12 + 2.04	1 + 1	14	M 91147[a]	0.03
Broccoli	US 1987	GR+EC	1.12 + 2.04	1 + 1	15 29	M 91147[a]	0.06 0.09
Broccoli	US 1987	GR	1.12 + 2.04	1 + 1	14	M 91147[a]	<u>< 0.02</u>
Broccoli	Mexican GAP	GR	1.0	1	ns	Apply after transplant of small plants	
No relevant trials							

a One soil spray followed by one side-dress spray.

Table 26. Residue interpretation table for disulfoton residues in cabbage. GAP and trial conditions are compared for treatments considered valid for MRL and STMR estimation.

		Application					disulfoton
Crop	Country	Form.	kg ai/ha	No of appl	PHI days	Trial	mg/kg
Cabbage, head	Canadian GAP	GR	1.12	1	42		
Cabbage, head	US 1987	EC	1.12	2	42	M 91152[a]	<u>≤ 0.02</u>
Cabbage, head	US 1987	GR+EC	1.12 + 1.30	1 + 1	39	M 91152[a]	<u>≤ 0.02</u>
Cabbage, head	US 1987	GR	1.12 + 1.48	1 + 1	42	M 91152[a]	<u>≤ 0.02</u>

		Application					disulfoton
Crop	Country	Form.	kg ai/ha	No of appl	PHI days	Trial	mg/kg
Cabbage, head	US GAP	EC	1.12 – 2.24	1	42		
Cabbage, head	US 1987	EC	1.12 + 1.72	1 + 1	42	M 91152 [a]	0.17
Cabbage, head	US 1987	EC	1.12 + 1.72	1 + 1	41	M 91152 [a]	0.02
Cabbage, head	US 1987	GR	1.12 + 1.72	1 + 1	42	M 91152 [a]	0.17
Cabbage, head	US 1987	GR	1.12 + 1.72	1 + 1	41	M 91152 [a]	0.03
Cabbage, head	US 1987	EC	1.12 + 1.72	1 + 1	42	M 91152 [a]	0.06
Cabbage, head	US 1987	EC	1.12 + 1.72	1 + 1	42	M 91152 [a]	0.08
Cabbage	Mexican GAP	GR	1.0	1	ns	Apply after transplant of small plants	
No relevant GAP							
Cabbage, head	Japan GAP	GR	1.5-3.0	1	ns	Apply at seeding or transplanting	
Cabbage, head	Japan 1972	GR	2	1	57	N 27/72 (1991)	0.073
Cabbage, head	Japan 1972	GR	4	1	57	N 27/72 (1991)	0.096
Cabbage, head	Japan 1972	GR	2	1	69	N 28/72 (1991)	0.072
Cabbage, head	Japan 1972	GR	4	1	69	N 28/72 (1991)	0.063

[a] One soil broadcast followed by one side-dress spray.

Table 27. Residue interpretation table for disulfoton residues in cauliflower. GAP and trial conditions are compared for treatments considered valid for MRL and STMR estimation.

		Use pattern					disulfoton
Crop	Country	Form.	kg ai/ha	No of appl	PHI days	Trial	mg/kg
Cauliflower	US GAP	EC/GR	1.12	1	40		
Cauliflower	US 1987	EC	1.12	3	40	M 91154 [a]	0.31
Cauliflower	US 1987	EC	1.12 + 1.68	1 + 2	40	M 91154	< 0.01
Cauliflower	US 1987	EC	1.12 + 1.01	1 + 2	38	M 91154	< 0.01
Cauliflower	US 1987	EC	1.12	3	38-43	M 91154	< 0.01
Cauliflower	US 1987	GR	1.12	3	40	M 91154	0.04
Cauliflower	US 1987	GR	1.12 + 1.68	1 + 2	40	M 91154	< 0.01
Cauliflower	US 1987	GR	1.12	3	40	M 91154	0.01
Cauliflower	US 1987	GR	1.12 + 1.01	1 + 2	38	M 91154	0.01
Cauliflower	Canadian GAP	EC/GR	1.12	2 (i=21)	30		
Cauliflower	US 1987	EC	1.12	3	30 40	M 91154	0.01 0.31
Cauliflower	US 1987	EC	1.1 + 1.7	1 + 2	30	M 91154	< 0.01
Cauliflower	US 1987	EC	1.1 + 1.0	1 + 2	28-30	M 91154	< 0.01
Cauliflower	US 1987	EC	1.12	3	28-30	M 91154	< 0.01
Cauliflower	US 1987	GR	1.12	3	30 40	M 91154	0.02 0.04
Cauliflower	US 1987	GR	1.12	3	30 40	M 91154	< 0.01 0.01
Cauliflower	US 1987	GR	1.12 + 1.01	1 + 2	28	M 91154	0.05
Cauliflower No relevant trials	Mexican GAP	GR	1.0	1	ns	Apply after transplant of small plants	

[a] One broadcast application followed by two site-dress sprays.

Table 28. Disulfoton residues in lettuce (leaf and head), resulting from soil application in supervised trials.

Crop	Country	Form.	Use pattern				Trial	disulfoton mg/kg
			kg ai/ha	kg ai/hL	No of appl.	PHI days		
Lettuce	Canadian GAP	GR	1.12-2.25[a]		1	ns	Apply at seeding time only	
Lettuce, leaf	US 1985	EC	2.23		1	59	M 91473 (1991)	< 0.03

Crop	Country	Form.	Use pattern				Trial	disulfoton mg/kg
			kg ai/ha	kg ai/hL	No of appl.	PHI days		
Lettuce, leaf	US 1985	EC	2.44		1	50	M 91473 (1991)	0.56
Lettuce, leaf	US 1985	EC	2.9		1	59	M 91473 (1991)	0.10
Lettuce	Mexican GAP	GR	1.0		1	ns	Apply at seeding time only	
Lettuce, leaf	US 1985	EC	1.1		1	61	M 91473 (1991)	0.64
Lettuce, leaf	US 1985	EC	1.1		1	61	M 91473 (1991)	< 0.03
Lettuce, leaf	US 1995	EC	1.1	1.8	1	60	107520 (1998) FCA-DI004-95H	1.1
Lettuce, leaf	US 1995	EC	1.1	0.29	1	90	107520 (1998) 458-DI005 -95H	< 0.05
Lettuce, leaf	US 1996	EC	1.14	2.3	1	73	107520 (1998) VBL-DO006-95H	0.58
Lettuce, head	US 1995	EC	1.1	1.8	1	97	107520 (1998) FCA-DI001-95H	0.22
Lettuce, head	US 1995	EC	1.2	0.25	1	116	107520 (1998) 458-DI002 -95H	< 0.05
Lettuce, head	US 1995	EC	1.21	2.0	1	62	107520 (1998) VBL-DI003-95H	< 0.05
Lettuce	US GAP	EC	1.12-2.24		1	60		
Same as Canada GAP								

ns = not specified

[a] Use the higher rate on heavy organic soils

Table 29. Summary of disulfoton residue data according to GAP, corresponding HRs and %ARfD.

Crop	GAP	form.	kg ai/ha	No of appl	PHI days	Residue data	n	HR	% ARfD gen pop	% ARfD children
Broccoli	US	GR/EC	1.12	1	14	< 0.02, < 0.02, 0.03, 0.05, 0.09, 0.11	6	0.11	60%	120%
Cabbage	Canada	GR	1.12	1	42	< 0.02, < 0.02, < 0.02	3	0.02	10%	30%
Cabbage	US	EC	1.12-2.24	1	42	0.02, 0.03, 0.06, 0.08, 0.17, 0.17	6	0.17	110%	260%
Cabbage	Japan	GR	1.5-3.0	1		0.063, 0.072, 0.073, 0.096	4	0.096	60%	150%
Cauliflower	US	EC/GR	1.12	1	40	< 0.01, < 0.01, < 0.01, < 0.01, 0.01, 0.01, 0.04, 0.31	8	0.31	150%	380%
Cauliflower	Canada	EC/GR	1.12	2	30	< 0.01, < 0.01, < 0.01, 0.01, 0.04, 0.05, 0.31	7	0.31	150%	380%
Lettuce	Mexico	GR	1.0	1	Apply at seeding	< 0.03, < 0.05, < 0.05, < 0.05, 0.22, 0.58, 0.64, 1.1	8	1.1	380%	570%
Lettuce	Canada	GR	1.12-2.25	1	Apply at seeding	< 0.03, 0.10, 0.56	3	0.56	180%	280%

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

The results from different monitoring programs in Europe and the US are summarised in Table 30. The results show that in lettuce no residues were found in the EU. In the USDA Pesticide Data Program only low residues were detected in very few samples of broccoli or lettuce during the last eleven years. Each year from 1996–2003, many samples imported to the US or grown in the US were analysed by the FDA for residues of disulfoton. Only in three samples given in Table 30 were residues detected (Andersch, 2006).

Table 30. Monitoring data for disulfoton.

Monitoring program	Origin	Year	Crop	Total samples analysed	Samples with residues	Residues (mg/kg)
EU Monitoring program	Austria	2001	Lettuce	12	0	
	Belgium			27	0	
	Finland			42	0	
	France			343	0	
	Greece			16	0	
	Italy			18	0	
	Norway			88	0	
	Spain			45	0	
USDA's Pesticide Data Program	USA	1994	Broccoli	673	0	
		1994	lettuce	691	0	
		1999	Lettuce	185	0	
		2000	Lettuce	740	1	0.015
		2001	Broccoli	720	2	0.008, 0.026
		2001	Lettuce	554	3	0.007-0.015
		2002	Broccoli	737	0	
FDA's Enforcement Monitoring Program	Mexico	1997	Broccoli	na	1	0.2 mg/kg disulfoton sulfone, 0.1 mg/kg demeton-S sulfone
	USA	1999	Cabbage	na	1	0.1 mg/kg demeton-S sulfone
	USA	2001	Lettuce	na	1	0.1 mg/kg demeton-S sulfone

na – Exact number not available

APPRAISAL

Disulfoton, an insecticide acaricide, was evaluated for residues within the periodic review programme by the 1991 JMPR. Additional residue information was evaluated by the JMPR in 1994 and 1998. An ADI of 0.0003 mg/kg bw and an acute RfD of 0.003 mg/kg bw were established in 1991 and in 1996, respectively. Estimations of the short-term intake (IESTI) in 2002 by WHO (CCPR 34, CX/PR 02/03) resulted in IESTIs exceeding the acute reference dose (ARfD) of 0.003 mg/kg bw for broccoli, cabbage, cauliflower, lettuce, potato, Japanese radish and rice. In the interim Codex MRLs for potato, Japanese radish and rice were withdrawn.

At the 36th Session of CCPR, the Committee noted that the acute intake concerns had not been resolved even with the use of a probabilistic method (ALINORM 04/27/24, paragraph 106). The Committee returned the MRLs of broccoli; cabbages, head; cauliflower; lettuce head and leaf to Step 6 awaiting refinements in the acute dietary intake probabilistic methodology (ALINORM 04/27/24, paragraph 107).

At the 37th Session of CCPR the Committee decided to return all the MRLs currently at step 7 to step 6. Since this was the third time that the proposed MRLs were returned to Step 6 for intake concerns, the Committee also decided to request the JMPR to review alternate GAPs that may result in lower MRL recommendations (ALINORM 05/28/24, paragraph 105).

The manufacturer submitted GAP information from Canada, Mexico, Japan and the USA on broccoli, cabbage, cauliflower, and lettuce.

Residue and GAP information were also submitted by Japan on Adzuki bean, burdock, cabbage, Chinese cabbage, cucumber, eggplant, common bean (pod), mitsuba, onion, Satsuma mandarin, pineapple, potato, Japanese radish, Chinese onion (rakkyo), soybean, Welsh onion, sugar cane, sweet pepper, tomato, upland wasabi and water melon.

Results of supervised residue trials on crops

Data from supervised trials which have not previously been evaluated on Azuki bean, burdock, cabbage, Chinese cabbage, cucumber, egg plant, common bean (pod), mitsuba, onion, Satuma mandarin, pineapple, potato, Japanese radish, Chinese onion, soybean, Welsh onion, sugar cane, sweet pepper, tomato, wasabi and water melon were provided by the Japanese government.

Trials from Japan were available only in summary form and could not be evaluated.

Data on broccoli, cabbage, cauliflower and lettuce which were reviewed in the 1991, 1994 and 1998 monographs were interpreted in the light of current GAP. The Meeting noted that current GAP was the same as that recorded in 1998.

Broccoli

In USA, disulfoton may be used on broccoli in the field as a soil injection or side dressing at 1.1 kg ai/ha with a PHI of 14 days.

In Canada, disulfoton may be used on broccoli in the field as a soil-application band or side dressing at 1.1 kg ai/ha with a PHI of 42 days.

In Mexico, disulfoton may be used on broccoli in the field as a soil-application band at 1 kg ai/ha after transplanting small plants.

In six US field trials where disulfoton was used as a soil spray (pre-plant) at 1.1 kg ai/ha and a side-dressing at 1.7–2.0 kg ai/ha, with PHIs of 14–29 days, residues in rank order were < 0.02, < 0.02, 0.03, 0.05, 0.09 and 0.11 mg/kg. The Meeting noted that the field trial application rates considerably exceeded the GAP rates, so the trial data could not be used.

The Meeting noted that a highest residue of 0.11 mg/kg for broccoli would be associated with IESTI values of 60% and 120% of the current ARfD (0.003 mg/kg).

None of the residue data relating to available alternative GAP suggests a lower maximum residue level to replace the current proposal of 0.1 mg/kg disulfoton on broccoli.

Cabbage

In USA, disulfoton may be used on cabbage in the field as a soil injection or side dressing at 2.2 kg ai/ha with a PHI of 42 days. In six US field trials where disulfoton was used as a soil spray (pre-plant) at 1.1 kg ai/ha and a side-dressing at 1.7 kg ai/ha, with PHIs of 41–42 days, residues in rank order were 0.02, 0.03, 0.06, 0.08, 0.17 and 0.17 mg/kg.

Six trials were insufficient for estimation of an HR. The Meeting noted that a highest residue of 0.17 mg/kg for head cabbage would be associated with IESTI values of 110% and 260% of the current ARfD (0.003 mg/kg).

In Canada, disulfoton may be used on cabbage in the field as a soil-application band or side dressing at 1.1 kg ai/ha with a PHI of 42 days. In one US field trial where disulfoton was used twice as a band at 1.1 kg ai/ha and a PHI of 42 days, the residue was < 0.02 mg/kg. In two US field trials where disulfoton was used as a soil spray (pre-plant) at 1.1 kg ai/ha and a side-dressing at 1.3–1.5 kg ai/ha, with PHIs of 39 and 42 days, residues were < 0.02 and < 0.02 mg/kg.

Three trials were insufficient for estimation of an HR.

In Japan, disulfoton may be used on cabbage in the field by soil incorporation in the row or in the planting furrow at 1.5–3 kg ai/ha. In four Japanese field trials where disulfoton was used twice at 2 or 4 kg ai/ha and with PHIs of 57–69 days, the residues in rank order were 0.063, 0.072, 0.073 and 0.096 mg/kg.

Four trials were insufficient for estimation of an HR.

In Mexico, disulfoton may be used on cabbage in the field as a soil-application band at 1 kg ai/ha after transplanting small plants. No residue data were available at this GAP.

None of the residue data relating to available alternative GAP suggests a lower maximum residue level to replace the current proposal of 0.2 mg/kg disulfoton on head cabbage.

Cauliflower

In Canada, disulfoton may be used twice on cauliflower in the field as a soil injection or side dressing at 1.1 kg ai/ha with a PHI of 30 days.

In four US field trials on cabbage where disulfoton was used three times as a side-dressing at 1.1 kg ai/ha, with PHIs of 28-40 days, residues in rank order were < 0.01, 0.01, 0.04 and 0.31 mg/kg.

In three US field trials on cabbage where disulfoton was used as a soil spray (pre-plant) at 1.1 kg ai/ha and with 2 side-dressings at 1.0 or 1.7 kg ai/ha, with PHIs of 28–30 days, residues in rank order were < 0.01, < 0.01, and 0.05 mg/kg. Residues in rank order for the seven trials were: < 0.01, < 0.01, < 0.01, 0.01, 0.04, 0.05 and 0.31 mg/kg.

The 1991 JMPR assumed that the value of 0.31 mg/kg 40 days after the last application was an outlier (JMPR Residue Evaluations, 1991, page 325). On re-examination of the study report (Di-Syston - Magnitude of residue on cauliflower, Report M 91154, 1987), the Meeting noted that there was no documented reason for classifying the residue value of 0.31 mg/kg as invalid. The Meeting therefore included the value in the evaluation.

From this use, the Meeting estimated an HR of 0.31 mg/kg for disulfoton on cauliflower. The Meeting noted that an HR of 0.31 mg/kg for cauliflower would be associated with IESTI values of 150% and 380% of the current ARfD (0.003 mg/kg).

In Mexico, disulfoton may be used on cauliflower in the field as a soil-application band at 1 kg ai/ha after transplanting small plants. No residue data were available at this GAP.

In USA, disulfoton may be used on cauliflower in the field as a soil injection or side dressing at 1.1 kg ai/ha with a PHI of 40 days.

In four US field trials where disulfoton was used three times as a side-dressing at 1.1 kg ai/ha, with PHIs of 38–43 days, residues in rank order were < 0.01, 0.01, 0.04 and 0.31 mg/kg. In four US field trials where disulfoton was used as a soil spray (pre-plant) at 1.1 kg ai/ha and two side-dressings at 1.0 or 1.7 kg ai/ha, with PHIs of 38 and 40 days, residues in rank order were < 0.01, < 0.01, < 0.01 and 0.01 mg/kg. Residues in rank order for the eight trials were: < 0.01, < 0.01, < 0.01, < 0.01, 0.01, 0.01, 0.04 and 0.31 mg/kg.

None of the residue data relating to available alternative GAP suggests a lower maximum residue level to replace the current proposal of 0.05 mg/kg disulfoton on cauliflower. On the contrary, the inclusion of 0.31 mg/kg as a valid residue for disulfoton use on cauliflower suggests that the recommended maximum residue level on cauliflower should be adjusted to a higher level.

From this use, the Meeting estimated HR and STMR values of 0.31 and 0.01 mg/kg respectively for disulfoton on cauliflower.

The Meeting estimated a maximum residue level of 0.5 mg/kg for disulfoton on cauliflower to replace the current recommendation of 0.05 mg/kg.

Lettuce

In Canada, disulfoton may be used on lettuce as a band application at seeding at 1.1–2.2 kg ai/ha. In three US leaf lettuce trials where disulfoton was used at 2.2–2.9 kg ai/ha and the lettuce were harvested 50–59 days later, disulfoton residues were < 0.03, 0.10 and 0.56 mg/kg.

Three trials were insufficient for estimation of an HR.

In USA, disulfoton may be used on lettuce in the field as a soil injection or side dressing at 2.2 kg ai/ha with a PHI of 60 days. The US and Canadian GAPs were accepted as essentially equivalent.

In Mexico, disulfoton may be used on lettuce as a band or furrow application at seeding at 1 kg ai/ha. In eight US lettuce trials where disulfoton was used at 1.1–1.2 kg ai/ha and the lettuce were harvested 60–116 days later, disulfoton residues were < 0.03, < 0.05, < 0.05, < 0.05, 0.22, 0.58, 0.64 and 1.1 mg/kg.

From this use, the Meeting estimated an HR of 1.1 mg/kg for disulfoton on lettuce. The Meeting noted that an HR of 1.1 mg/kg for lettuce would be associated with IESTI values of 180% and 280% of the current ARfD (0.003 mg/kg).

None of the residue data relating to available alternative GAP suggests a lower maximum residue level to replace the current proposal of 1 mg/kg disulfoton on head and leaf lettuce.

RECOMMENDATIONS

On the basis of the data from supervised trials, the Meeting concluded that the residue concentrations listed below are suitable for establishing MRLs and for assessing intakes.

Residue definition: *Sum of disulfoton, demeton-S and their sulphoxides and sulphones, expressed as disulfoton.*

CCN	Commodity	MRL, mg/kg	Previous MRL mg/kg	STMR mg/kg	HR mg/kg
VB 0404	Cauliflower	0.5	0.05	0.01	0.31

DIETARY RISK ASSESSMENT

Long-term intake

The estimates of long-term intake for disulfoton (ADI 0-0.0003 mg/kg bw) in 2002 for the five regional diets were 10–120% of the ADI[1]. The STMR of 0.01 mg/kg for cauliflower is unchanged, as a result the estimates of long-term intake are unchanged.

Short-term intake

The International Estimated Short-Term Intakes (IESTI) was calculated for cauliflowers. An ARfD of 0.003 mg/kg bw has been established by the JMPR. The IESTI represented 180% and 280% of the ARfD for the general population and children respectively. The information provided to the JMPR precludes an estimate that the dietary intakes calculated for cauliflowers would be below the acute reference dose.

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