DIAZINON (022)

EXPLANATION

The organophosphorus insecticide diazinon was evaluated by the 1993 JMPR as a periodic review for plant protection uses. The Meeting recommended an increase in the CXL for pome fruits and cabbage from 0.5 to 2 mg/kg, and the withdrawal of the CXLs for animal commodities in the absence of animal transfer studies and data from uses to control ectoparasites. The 1995 CCPR decided to retain these CXLs (milk, meat of cattle, pigs and sheep) until new data on animal feeding trials had been reviewed by the 1996 JMPR as the governments of Australia and the manufacturer had already provided the data (ALINORM 95/24A, para 76).

The 1996 JMPR considered new feeding studies with poultry and cattle, as well as new and previously submitted data from supervised trials of ectoparasite control in cattle and sheep. That Meeting was able to estimate a number of maximum residue levels for animal products, but listed modern dipping and spraying trials on sheep and cattle at maximum GAP rates and with multiple applications as desirable.

The 1998 CCPR noted that animal transfer studies would become available in 1999 (ALINORM 99/24, para 39).

The present Meeting received information on GAP and reports of new residue trials on sheep (dipping) and pigs (spraying). Additional residue data for pome fruit and cabbage were also available.

METHODS OF RESIDUE ANALYSIS

Analytical methods

Hubbard *et al.* (1990) developed analytical method AG-550A to determine residues of diazinon, diazoxon[1] and hydroxydiazinon[2] in cabbage and pome fruit. In this method 20 g samples are blended with acetone/water and filtered. The aqueous filtrate is extracted with petroleum ether and methylene chloride and the dried organic phase is concentrated. Diazinon and the metabolites are determined by gas chromatography with flame photometric detection. Untreated samples were fortified with 0.01-10 mg/kg diazinon, diazoxon and hydroxydiazinon. The average recoveries were as shown below.

Sample	Recovery, %		
	diazinon	diazoxon	hydroxydiazinon
Cabbage	94 ± 11	93 ± 12	99 ± 11
Apples	90 ± 6	83 ± 11	91 ± 10
Pears	93 ± 11	88 ± 11	95 ± 12

[1] diazoxon: diethyl 2-isopropyl-6-methylpyrimidin-4-yl phosphate
[2] hydroxydiazinon: *O*,*O*-diethyl- *O*-[2-(1-hydroxy-1-methylethyl)-6-methylpyrimidin-4-yl] phosphorothioate

Smal and Adams (1996) extended method AG-550A to determine residues of diazinon in organs and tissues of sheep by modifying the clean-up procedures and chromatography.

Before analysis, samples of fat were individually homogenised with dry ice to give a coarse powder. Muscle was analysed as a mixture of equal parts of tenderloin and hindquarter, and fat as a mixture of renal and subcutaneous samples.

Muscle, liver and kidney were extracted by maceration with aqueous acetone, the supernatant was filtered, the extract partitioned into methylene chloride and the solvent evaporated. Muscle samples were further cleaned up on a Bond Elut CN cartridge and liver and kidney on a Sep-Pak Florisil cartridge. Fats were extracted with hexane and the extract partitioned into acetonitrile. The acetonitrile was evaporated and the residue cleaned up on a Sep-Pak Florisil cartridge. Determination was by GLC with an NPD.

The LOD for the modified method was 0.01 mg/kg for all samples. The recoveries at this level were precise and accurate (Table 1).

Table 1. Recoveries of diazinon from fortified control tissues (Smal and Adams, 1996).

Sample	Fortification, mg/kg	Number	Recovery, %	Mean	SD	cv, %
Muscle	0.01	8	79-131	104	19	18
	0.02	7	78-106	95	9	10
	0.05	4	84-110	102	12	12
Kidney	0.01	6	86-118	104	11	11
	0.02	5	96-116	106	7	7
Liver	0.01	5	106-119	110	5	5
	0.02	4	81-99	94	9	9
Fat	0.01	4	92-105	98	6	6
	0.02	2	97, 99	98	-	-
	0.05	1	110	-	-	-
	0.1	3	78-93	87	8	9
	0.2	2	76, 89	82	-	-
	0.5	1	101	-	-	-
	1.0	1	92	-	-	-

Walser *et al.* (1996) used the modified method AG-550A to determine diazinon in pig tissues after spraying. Control specimens of muscle, liver and kidney were fortified with 0.005, 0.05, 0.1 or 0.5 mg/kg diazinon. The recoveries ranged from 81 to 123% (mean 96%. n = 48, SD 11.5 %). The LOD was 0.005 mg/kg.

Walser (1998) determined hydroxydiazinon and diazoxon by the modified method AG-550A. Control specimens of muscle, liver and kidney were spiked at 0.005 and 0.05 mg/kg and fat + skin at 0.01 and 0.1 mg/kg (Table 2). The mean recoveries from all substrates at all fortification levels were hydroxydiazinon 88%, SD 13.3%, n = 9; diazoxon 86%, SD 18.8%, n = 9.

Table 2. Recoveries of hydroxydiazinon and diazoxon from fortified control tissues (Walser, 1998).

Sample	Fortification, mg/kg	Recoveries, %	
		hydroxydiazinon	diazoxon
Muscle	0.005	89	81
	0.05	103	113
Kidney	0.005	84	74
	0.05	65	65
Liver	0.005	87	74
	0.05	77	77
Fat + skin	0.01	93, 96	89, 105
	0.1	99	99

Stability of pesticide residues in stored analytical samples

An interim report on the stability of diazinon, hydroxydiazinon and diazoxon in stored analytical samples of muscle, liver, fat and milk of sheep (Walser, 1999) gave the analytical results from a storage period of 9 months, summarized in Tables 3 and 4. The final report will be issued after a storage period of 24 months.

Table 3. Storage stability in of diazinon, diazoxon and hydroxydiazinon in sheep fat fortified with 0.2 mg/kg (Walser, 1999).

Months stored	Residues in stored specimen, mg/kg		
	diazinon	hydroxydiazinon	diazoxon
0	0.18	0.21	0.17
4	0.22	0.21	0.21
6.5	0.20	0.20	0.19
9	0.21	0.24	0.2

Table 4. Storage stability in of diazinon, diazoxon and hydroxydiazinon in milk, liver and muscle of sheep fortified with 0.1 mg/kg (Walser, 1999).

Months stored	Residues in stored specimen, mg/kg								
	Diazinon			hydroxydiazinon			diazoxon		
	Milk	Liver	Muscle	Milk	Liver	Muscle	Milk	Liver	Muscle
0	0.093	0.091	0.079	0.1	0.094	0.102	0.096	<0.02	0.071
4	0.084	0.086	0.131	0.11	0.097	0.102	0.067	<0.02	0.019
6.5	0.092	0.103	0.092	0.098	0.097	0.097	0.058	<0.02	<0.02
9	0.099	0.099	0.077	0.093	0.098	0.094	0.052	-	-

USE PATTERN

Diazinon is an insecticide with a broad spectrum of activity against a wide range of sucking, chewing and boring insects, including soil-living insects. It is used for plant protection as a foliar or soil spray or applied as a granule to the soil, and for the control of ectoparasites in sheep and pigs.

Table 5 shows the use patterns which have recently been approved in the USA for applications to pome fruits and cabbage. Uses on pome fruits are against aphids, maggots, crawlers and moths. The maximum single use rate is limited to 2.2 kg ai/ha with spray concentrations from 0.06 kg ai/hl in 3740 l water/ha to 0.235 kg ai/hl in 935 l water/ha, with a maximum total of 6.7 kg ai/ha per season in an unspecified number of applications at 14-day intervals. In cabbage the critical GAP on the label is one pre-plant treatment at an application rate of 4.6 kg ai/ha plus five foliar treatments with a maximum rate of 0.61 kg ai/ha at 7-day intervals.

Table 5. Registered uses of diazinon on pome fruits and cabbage in the USA.

Crop	Form.	Application				PHI, days
		Method	Rate, kg ai/ha	Spray conc., kg ai/ha	No.	
Cabbage	50 WP	Broadcast or drench transplant water treatment before planting. Incorporate into soil	0.56-1.6 or 2.2-3.3 or 2.3-4.6	0.0005-0.0022	1	21
		Ground treatments. Apply to plant beds 1-2 days before planting and incorporate into soil	1.1		1	21
		Ground treatments. Apply as insects occur, at least 7 days between applications	0.28-0.56 or 0.31- 0.61		1- 5	21
Pears[1]	50 WP	Foliar spray, apply at pre-pink stage	1.1-2.2	0.03-0.06	1-3[2]	21
		Foliar spray, first application in April	2.2	0.06	3[2]	21

Crop	Form.	Application				PHI, days
		Method	Rate, kg ai/ha	Spray conc., kg ai/ha	No.	
Pome fruit[1]	50 WP	Apply as dormant or delayed dormant spray	2.2	0.06 (+ 2 l oil)	1	21
		Apply early in season when crawlers first appear	2.2	0.06	1- 2[2]	21
		Foliar spray, apply beginning at petal fall, as infestations develop	2.2	0.06	1- 2[2]	21
		Foliar spray, beginning at pink stage	2.2	0.06	3[2]	21
		Foliar spray, apply when infestations first occur	2.2	0.06	3[2]	21
		Foliar spray, apply when flies are active and laying eggs	2.2	0.06	3[2]	21

[1] Label instruction: Maximam use rate per application = 2.2 kg ai/ha with a total of 6.7 kg ai/ha per season.
[2] Do not repeat application after less than 14 days

Table 6 shows the new information submitted to the 1999 JMPR on pending GAP for veterinary medicinal products containing diazinon (for further uses see the 1996 JMPR residue evaluation).

Table 6. Planned uses of diazinon in animal health (GAP pending).

Animal	Country	Application			Rate per treatment	
		Method	No.	SI/MI[1], days	mg ai/kg bw	mg ai/animal
Sheep	Registration in the EU is in progress	Dip or spray, all ages. Dip once for 1 minute with complete immersion of the animal at least once	1	35/21	Not identified	Dipping: nominal concentration in the bath 300 mg/l
		Spray	1	35/21	Approx. 24-48	2-4 l of spray per animal, nominal concentration of the spray 600 mg/l
Pigs	Registration in EU in progress	Spray, all ages	Up to three (dependent on the parasite)	28	Approx. 6	1 l of a 600 mg/l solution per animal

[1] SI: slaughter interval, MI: milking interval

RESIDUES RESULTING FROM SUPERVISED TRIALS

Uses as insecticide on plants

Pome fruit (Table 7). Supervised residue trials (12 on apples, 14 on pears) were conducted in the USA according to US GAP (max. 2.2 kg ai/ha, with 0.235 kg ai/hl, 935 l water/ha to 0.06 kg ai/hl, 3741 l water/ha per application; max. 6.7 kg ai/ha per season, PHI 21 days). The trials were on duplicate plots. Samples were analysed for diazinon, diazoxon and hydroxydiazinon. The residues of hydroxydiazinon were all below the LOD of 0.01 mg/kg.. Double-underlined residues are from treatments according to GAP and are valid for estimating maximum residue levels and STMRs. If the residues at 28 days were higher than those at the GAP PHI of 21 days, the higher values were used for evaluation. Although all trials included control plots, no control results are recorded in the Tables as the residues were all below the LOD. The samples were deep frozen before analysis for 4-7 months.

Table 7. Residues of diazinon and diazoxon from supervised trials on apples and pears in the USA (Ross and Hackett, 1992a).

Report no. Report date Location	Dates of treatment	Application rate per treatment			Growth stage at last treatment	Sample	Phi, days	Residues, mg/kg	
		kg ai/ha	water l/ha	kg ai/hl				diazinon	diazoxon
02-IR-003-91 A	19.08.91	1.5	2805	0.053	fruit 6 cm	apple	21	0.02	<0.01
28.09.92	02.09.91	1.5	2805	0.053				<0.01	<0.01
Fresno County,	16.09.91	1.5	2805	0.053			28	<0.01	<0.01
California			(3741)	(0.04) [1]				<0.01	<0.01
02-IR-003-91 B	19.08.91	2.2	2805	0.078	fruit 6 cm	apple	21	0.01	<0.01
28.09.92	02.09.91	2.2	2805	0.078				0.01	<0.01
Fresno County,	16.09.91	2.2	2805	0.078			28	<0.01	<0.01
California			(3741)	(0.058)[1]				<0.01	<0.01
05-IR-004-91 A	05.08.91	1.7	977	0.17	fruit	apple	22	0.06	<0.01
28.09.92	22.08.91	1.7	977	0.17	6-8 cm			0.03	<0.01
Columbia County,	04.09.91	1.7	977	0.17			28	0.01	<0.01
New York			(3741)	(0.044)[1]				0.02	<0.01
05-IR-004-91 B	05.08.91	2.2	977	0.23	fruit	apple	22	0.03	<0.01
28.09.92	22.08.91	2.2	977	0.23	6-8 cm			0.02	<0.01
Columbia County,	04.09.91	2.2	977	0.23			28	0.04	<0.01
New York			(3741)	(0.06)[1]				0.01	<0.01
05-IR-004-91 C	05.08.91	4.5	977	0.46	fruit	apple	22	<0.01	<0.01
28.09.92	22.08.91	4.5	977	0.46	6-8 cm				
Columbia County,	04.09.91	4.5	977	0.46			28	0.04	<0.01
New York			(3741)	(0.12)[1]					
OS-IR-602-91 A	27.06.91	1.7	1945	0.087	pre-harvest	apple	21	0.03	<0.01
28.09.92	11.07.91	1.7	1945	0.087				0.04	<0.01
Johnston County,	25.07.91	1.7	1945	0.087			28	<0.01	<0.01
N. Carolina			(3741)	(0.045)[1]				0.02	<0.01
OS-IR-602-91 B	27.06.91	2.2	1945	0.11	pre-harvest	apple	21	0.05	<0.01
28.09.92	11.07.91	2.2	1945	0.11				0.08	<0.01
Johnston County,	25.07.91	2.2	1945	0.11			28	0.01	<0.01
N. Carolina			(3741)	(0.057)[1]				<0.01	<0.01
OS-IR-602-91 C	27.06.91	4.5	1945	0.23	pre-harvest	apple	21	0.10	<0.01
28.09.92	11.07.91	4.5	1945	0.23					
Johnston County,	25.07.91	4.5	1945	0.23			28	0.07	<0.01
N. Carolina			(3741)	(0.12)[1]					
OW-IR-621-91 A	01.08.91	1.7	2151	0.079	fruit	apple	21	0.08	<0.01
28-09.92	17.08.91	1.7	2151	0.079	6-7 cm			0.06	<0.01
Yakima County,	30.08.91	1.7	2151	0.079			28	0.05	<0.01
Washington			(3741)	(0.045)[1]				0.08	<0.01
OW-IR-621-91 B	01.08.91	2.2	2151	0.10	fruit	apple	21	0.11	<0.01
28-09.92	17.08.91	2.2	2151	0.10	6-7 cm			0.13	<0.01
Yakima County,	30.08.91	2.2	2151	0.10			28	0.24	<0.01
Washington			(3741)	(0.057)[1]				0.18	<0.01
OW-IR-621-91 C	01.08.91	4.5	2151	0.21	fruit	apple	21	0.42	<0.01
28-09.92	17.08.91	4.5	2151	0.21	6-7 cm				
Yakima County,	30.08.91	4.5	2151	0.21			28	0.32	<0.01
Washington			(3741)	(0.12)[1]					
OW-IR-622-91 A	01.08.91	1.7	2151	0.079	fruit	apple	21	0.13	<0.01
28.09.92	17.08.91	1.7	2151	0.079	6-6.5 cm			0.13	<0.01
Yakima County,	30.08.91	1.7	2151	0.079			28	0.10	<0.01
Washington			(3741)	(0.045)[1]				0.07	<0.01
OW-IR-622-91 B	01.08.91	2.2	2151	0.10	fruit	apple	21	0.06	<0.01
28-09.92	17.08.91	2.2	2151	0.10	6-6.5 cm			0.10	<0.01
Yakima County,	30.08.91	2.2	2151	0.10			28	0.05	<0.01
Washington			(3741)	(0.057)[1]				0.03	<0.01
NE-IR-103-91 A	31.07.91	1.7	2806	0.061	immature	apple	21	0.04	<0.01
28.09.92	14.08.91	1.7	2806	0.061	fruit			<0.01	<0.01
Allegan County,	28.08.91	1.7	2806	0.061			28	0.02	<0.01
Michigan			(3741)	(0.046)[1]				0.04	<0.01
NE-IR-103-91 B	31.07.91	2.2	2806	0.078	immature	apple	21	0.03	<0.01
28.09.92	14.08.91	2.2	2806	0.078	fruit			0.03	<0.01
Allegan County,	28.08.91	2.2	2806	0.078			28	0.04	<0.01

Report no. Report date Location	Dates of treatment	Application rate per treatment			Growth stage at last treatment	Sample	Phi, days	Residues, mg/kg	
		kg ai/ha	water l/ha	kg ai/hl				diazinon	diazoxon
Michigan			(3741)	(0.059)[1]				0.04	<0.01
02-IR-004-91 A	17.07.91	1.7	2806	0.061	fruit	pear	21	<0.01	<0.01
28.09.92	31.07.91	1.7	2806	0.061	7.5 cm			<0.01	<0.01
Fresno County,	14.08.91	1.7	2806	0.061	diameter		28	<0.01	<0.01
California			(3741)	(0.046)[1]				<0.01	<0.01
02-IR-004-91 B	17.07.91	2.2	2806	0.078	fruit	pear	21	<0.01	<0.01
28.09.92	31.07.91	2.2	2806	0.078	7.5 cm			<0.01	<0.01
Fresno County,	14.08.91	2.2	2806	0.078	diameter		28	<0.01	<0.01
California			(3741)	(0.059)[1]				<0.01	<0.01
02-IR-004-91 C	17.07.91	4.5	2806	0.16	fruit	pear	21	0.02	<0.01
28.09.92	31.07.91	4.5	2806	0.16	7.5 cm				
Fresno County,	14.08.91	4.5	2806	0.16	diameter		28	<0.01	<0.01
California			(3741)	(0.12)[1]					
OW-IR-118-91 A	16.07.91	1.7	468	0.36	fruit	pear	21	0.04	<0.01
28.09.92	30.07.91	1.7	468	0.36	5.5-6 cm			0.02	<0.01
Washington	13.08.91	1.7	468	0.36	diameter		28	0.04	<0.01
County, Oregon			(3741)	(0.045)[1]				0.04	<0.01
OW-IR-118-91 B	16.07.91	2.2	468	0.47	fruit	pear	21	0.04	<0.01
28.09.92	30.07.91	2.2	468	0.47	5.5-6 cm			0.04	<0.01
Washington	13.08.91	2.2	468	0.47	diameter		28	<0.01	<0.01
County, Oregon			(3741)	(0.059)[1]				0.02	<0.01
OW-IR-118-91 C	16.07.91	4.5	468	0.96	fruit	pear	21	0.04	<0.01
28.09.92	30.07.91	4.5	468	0.96	5.5-6 cm				
Washington	13.08.91	4.5	468	0.96	diameter		28	0.02	<0.01
County, Oregon			(3741)	(0.12)[1]					
OW-IR-201-91 A	07.06.91	1.7	652	0.26	mature	pear	21	<0.01	<0.01
28.09.92	21.06.91	1.7	1188	0.14	fruit			<0.01	<0.01
Stanislaus	05.07.91	1.7	1291	0.13			28	<0.01	<0.01
County,			(3741)	(0.045)[1]				<0.01	<0.01
California									
OW-IR-201-91 B	07.06.91	2.2	652	0.34	mature	pear	21	<0.01	<0.01
28.09.92	21.06.91	2.2	1188	0.18	fruit			<0.01	<0.01
Stanislaus	05.07.91	2.2	1291	0.17			28	<0.01	<0.01
County,			(3741)	(0.059)[1]				<0.01	<0.01
California									
OW-IR-201-91 C	07.06.91	4.5	652	0.69	mature	pear	21	<0.01	<0.01
28.09.92	21.06.91	4.5	1188	0.38	fruit				
Stanislaus	05.07.91	4.5	1291	0.35			28	<0.01	<0.01
County,			(3741)	(0.12)[1]					
California									
OW-IR-623-91 A	02.07.91	1.7	935	0.18	green fruit	pear	21	<0.01	<0.01
28.09.92	17.07.91	1.7	935	0.18				<0.01	<0.01
Yakima County,	30.07.91	1.7	935	0.18			28	<0.01	<0.01
Washington			(3741)	(0.045) [1]				<0.01	<0.01
OW-IR-623-91 B	02.07.91	2.2	935	0.24	green fruit	pear	21	<0.01	<0.01
28.09.92	17.07.91	2.2	935	0.24				0.02	<0.01
Yakima County,	30.07.91	2.2	935	0.24			28	<0.01	<0.01
Washington			(3741)	(0.06) [1]				<0.01	<0.01
OW-IR-624-91 A	20.07.91	1.7	2151	0.079	fruit	pear	21	0.05	<0.01
28.09.92	01.08.91	1.7	2151	0.079	5-6 cm			0.11	<0.01
Yakima County,	17.08.91	1.7	2151	0.079			28	0.11	0.02
Washington			(3741)	(0.045)[1]				0.11	0.01
OW-IR-624-91 B	20.07.91	2.2	2151	0.10	fruit	pear	21	0.11	<0.01
28.09.92	01.08.91	2.2	2151	0.10	5-6 cm			0.11	0.01
Yakima County,	17.08.91	2.2	2151	0.10			28	0.07	0.01
Washington			(3741)	(0.057)[1]				0.12	0.01
OW-IR-624-91 C	20.07.91	4.5	2151	0.21	fruit	pear	21	0.43	0.02
28.09.92	01.08.91	4.5	2151	0.21	5-6 cm		28	0.26	0.02
Yakima County,	17.08.91	4.5	2151	0.21					
Washington			(3741)	(0.12)[1]					
NE-IR-104-91 A	24.06.91	1.7	2806	0.061	immature	pear	21	0.05	<0.01
28.09.92	08.07.91	1.7	2806	0.061	fruit			0.06	<0.01

Report no. Report date Location	Dates of treatment	Application rate per treatment			Growth stage at last treatment	Sample	Phi, days	Residues, mg/kg	
		kg ai/ha	water l/ha	kg ai/hl				diazinon	diazoxon
Allegan County, Michigan	22.07.91	1.7	2806 (3741)	0.061 (0.046)[1]			28	0.06 <0.01	<0.01 <0.01
NE-IR-104-91 B 28.09.92 Allegan County, Michigan	24.06.91 08.07.91 22.07.91	2.2 2.2 2.2	2806 2806 2806 (3741)	0.078 0.078 0.078 (0.059)[1]	immature fruit	pear	21 28	0.01 <u>0.11</u> <0.01 <0.01	<0.01 <0.01 <0.01 <0.01
NE-IR-401-91 A 28.09.92 Wayne County, New York	10.07.91 24.07.91 07.08.91	1.7 1.7 1.7	935 935 935 (3741)	0.18 0.18 0.18 (0.045) [1]	fruit 5.2-5.6 cm	pear	21 28	<<u>0.01</u> <0.01 <0.01 <0.01	<0.01 <0.01 <0.01 <0.01
NE-IR-401-91 B 28.09.92 Wayne County, New York	10.07.91 24.07.91 07.08.91	2.2 2.2 2.2	935 935 935 (3741)	0.24 0.24 0.24 (0.06) [1]	fruit 5.2-5.6 cm	pear	21 28	<<u>0.01</u> <0.01 <0.01 <0.01	<0.01 <0.01 <0.01 <0.01
NE-IR-401-91 C 28.09.92 Wayne County, New York	10.07.91 24.07.91 07.08.91	4.5 4.5 4.5	935 935 935 (3741)	0.48 0.48 0.48 (0.12) [1]	fruit 5.2-5.6 cm	pear	21 28	0.01 <0.01	<0.01 <0.01

[1]kg ai/hl calculated for 3741 l water/ha (water volume according to label instructions)

<u>Head cabbages</u> (Table 8). Eleven supervised residue trials on cabbage according to the current US label directions in seven states of the USA (representing 72% of the US cabbage production) were reported. The directions allow for a single pre-planting treatment of 4.4 kg ai/ha followed by five post-emergence foliar applications of 0.55 kg ai/ha at 7-day intervals using ground equipment. In general, the trials were on duplicate plots. The samples were deep frozen for 4-12 months before analysis. All samples were analysed for diazinon, diazoxon and hydroxydiazinon. Hydroxydiazinon was not found in any sample, and diazoxon was detected only in 2 samples of trimmed heads (trial 02-IR-002-91). Single- and double-underlined residues are from treatments according to GAP. Single-underlined residues are valid for estimation of the maximum residue level. Double-underlined residues (in trimmed heads) were used to estimate the STMR. Although all trials included control plots, no control results are recorded in the Tables as the residues were all below the LOD.

Table 8. Residues of diazinon from supervised trials on cabbages in the USA (Ross and Hackett, 1992b).

Report no. Report date Location	Form. Variety	Dates of treatment	Application rate per treatment			Sample	PHI, days	Diazinon, mg/kg
			kg ai/ha	water l/ha	kg ai/hl			
NE-IR-201-91 A 23.09.92 Fayette County, Ohio	14 GR + 50 WP Prize	17.05.91 03.07.91 11.07.91 17.07.91 24.07.91 31.07.91	4.5 0.56 0.56 0.56 0.56 0.56	 213 214 229 221 232	 0.26 0.26 0.245 0.25 0.24	heads, untrimmed	7 7 14 14 21 21	0.07 0.24 0.04 0.01 <0.01 <u>0.01</u>
						heads, trimmed	7 7 14 14 21 21	<0.01 <0.01 <0.01 <0.01 <<u>0.01</u> <0.01
						wrapper leaves	7 7 14 14 21 21	0.19 0.51 0.09 0.07 0.04 0.06

Report no. Report date Location	Form. Variety	Dates of treatment	Application rate per treatment			Sample	PHI, days	Diazinon, mg/kg
			kg ai/ha	water l/ha	kg ai/hl			
NE-IR-201-91 B 23.09.92 Fayette County, Ohio	14 GR + AG 500 Prize	17.05.91 03.07.91 11.07.91 17.07.91 24.07.91 31.07.91	4.5 0.56 0.56 0.56 0.56 0.56	 213 214 229 221 232	 0.26 0.26 0.245 0.25 0.24	heads, untrimmed heads, trimmed wrapper leaves	7 7 14 14 21 21 7 7 14 14 21 21 7 7 14 14 21 21	0.11 0.30 <0.01 0.03 <0.01 <0.01 <0.01 0.01 <0.01 <0.01 <0.01 <0.01 0.35 0.34 0.09 0.21 0.05 0.10
02-IR-002-91 A 23.09.92 Fresno County, California	14 GR + 50 WP Copen- hagen MKT.	11.04.91 15.05.91 22.05.91 29.05.91 05.06.91 12.06.91	4.5 0.56 0.56 0.56 0.56 0.56	 468 468 468 468 468	 0.12 0.12 0.12 0.12 0.12	heads, untrimmed heads, trimmed wrapper leaves	8 8 14 14 21 21 8 8 14 14 21 21 8 8 14 14 21 21	0.13 (<0.01)[1] 0.09 (<0.01) 0.02 (<0.01) 0.01 (<0.01) <u>0.01</u> (<0.01) <0.01 (<0.01) <0.01 (<0.01) <0.01 (<0.01) <0.01 (0.01) <0.01 (<0.01) <<u>0.01</u> (<0.01) <0.01 (<0.01) 0.21 (<0.01) 0.10 (<0.01) 0.03 (<0.01) 0.05 (<0.01) 0.03 (<0.01) 0.04 (<0.01)
02-IR-002-91 B 23.09.92 Fresno County, California	AG 500 + 50 WP Copen- hagen MKT.	11.04.91 15.05.91 22.05.91 29.05.91 05.06.91 12.06.91	4.5 0.56 0.56 0.56 0.56 0.56	 468 468 468 468 468	 0.12 0.12 0.12 0.12 0.12	heads, untrimmed heads, trimmed wrapper leaves	8 8 14 14 21 21 8 8 14 14 21 21 8 8 14 14 21 21	0.10 (<0.01) 0.05 (<0.01) 0.05 (<0.01) 0.03 (<0.01) <<u>0.01</u> (<0.01) <0.01 (<0.01) <0.01 (<0.01) <0.01 (<0.01) <0.01 (<0.01) <0.01 (<0.01) <<u>0.01</u> (0.02) <0.01 (<0.01) 0.28 (<0.01) 0.12 (<0.01) 0.08 (<0.01) 0.04 (<0.01) 0.03 (<0.01) 0.02 (<0.01)

Report no. Report date Location	Form. Variety	Dates of treatment	Application rate per treatment			Sample	PHI, days	Diazinon, mg/kg
			kg ai/ha	water l/ha	kg ai/hl			
05-IR-002-91 A 23.09.92 Columbia County, New York	14 GR + AG 500 Market Price	06.06.91 07.08.91 14.08.91 21.08.91 28.08.91 05.09.91	4.5 0.56 0.56 0.56 0.56 0.56	 702 702 702 702 702	 0.080 0.080 0.080 0.080 0.080	heads, untrimmed	7 7 13 13 21 21	0.36 0.13 0.05 0.15 <u>0.08</u> 0.02
						heads, trimmed	7 7 13 13 21 21	<0.01 <0.01 <0.01 <0.01 <<u>0.01</u> <0.01
						wrapper leaves	7 7 13 13 21 21	0.55 0.78 0.24 0.25 0.11 0.13
05-IR-002-91 B 23.09.92 Columbia County, New York	14 GR + AG 500 Market Price	06.06.91 07.08.91 14.08.91 21.08.91 28.08.91 05.09.91	9.0 1.1 1.1 1.1 1.1 1.1	 702 702 702 702 702	 0.16 0.16 0.16 0.16 0.16	heads, untrimmed	7 13 21	1.1 0.31 0.34
						heads, trimmed	7 13 21	<0.01 <0.01 <0.01
						wrapper leaves	7 13 21	1.6 0.43 0.31
07-IR-002-91 A 23.09.92 Indian River County, Florida	14 GR + AG 500 Bravo	23.10.91 29.11.91 06.12.91 13.12.91 20.12.91 27.12.91	4.5 0.56 0.56 0.56 0.56 0.56	 468 468 468 468 468	 0.12 0.12 0.12 0.12 0.12	heads, untrimmed	7 7 14 14 21 21	0.33 0.52 0.22 0.30 <u>0.35</u> 0.24
						heads, trimmed	7 7 14 14 21 21	0.04 0.02 <0.01 <0.01 <<u>0.01</u> <0.01
						wrapper leaves	7 7 14 14 21 21	3.2 2.7 1.8 1.2 0.51 1.0

Report no. Report date Location	Form. Variety	Dates of treatment	Application rate per treatment			Sample	PHI, days	Diazinon, mg/kg
			kg ai/ha	water l/ha	kg ai/hl			
07-IR-002-91 B 23.09.92 Indian River County, Florida	AG 500 + AG 500 Bravo	23.10.91 29.11.91 06.12.91 13.12.91 20.12.91 27.12.91	4.5 0.56 0.56 0.56 0.56 0.56	 468 468 468 468 468	 0.12 0.12 0.12 0.12 0.12	heads, untrimmed	7 7 14 14 21 21	0.69 0.55 0.27 0.12 0.25 0.26
						heads, trimmed	7 7 14 14 21 21	0.09 0.03 <0.01 0.01 <0.01 <0.01
						wrapper leaves	7 7 14 14 21 21	2.8 3.6 1.4 1.1 0.65 0.91
OS-IR-303-91 A 23.09.92 Cameron County, Texas	14 GR + AG 500 Solid Blue 760/ Abbott	12.06.90 22.03.91 29.03.91 05.04.91 12.04.91 19.04.91	4.5 0.56 0.56 0.56 0.56 0.56	 203 203 203 203 203	 0.28 0.28 0.28 0.28 0.28	heads, untrimmed	7 7 15 15 21 21	0.15 0.17 0.03 0.04 0.03 0.05
						heads, trimmed	7 7 15 15 21 21	0.01 0.09 <0.01 <0.01 <0.01 <0.01
						wrapper leaves	7 7 15 15 21 21	0.47 0.42 0.23 0.24 0.07 0.07
OS-IR-303-91 B 23.09.92 Cameron County, Texas	14 GR + AG 500 Solid Blue 760/ Abbott	12.06.90 22.03.91 29.03.91 05.04.91 12.04.91 19.04.91	9.0 1.1 1.1 1.1 1.1 1.1	 203 203 203 203 203	 0.55 0.55 0.55 0.55 0.55	heads, untrimmed	7 15 21	0.54 0.12 0.16
						heads, trimmed	7 15 21	0.04 0.01 <0.01
						wrapper leaves	7 15 21	2.1 1.4 0.42

Report no. Report date Location	Form. Variety	Dates of treatment	Application rate per treatment			Sample	PHI, days	Diazinon, mg/kg
			kg ai/ha	water l/ha	kg ai/hl			
OS-IR-601-91 A 23.09.92 Franklin County, N. Carolina	14 GR + 50 WP Market Price	22.02.91 17.04.91 24.04.91 01.05.91 08.05.91 15.05.91	4.5 0.56 0.56 0.56 0.56 0.56	 359 359 359 359 359	 0.16 0.16 0.16 0.16 0.16	heads, untrimmed	7 7 14 14 21 21	0.16 0.20 <0.01 <0.01 <0.01 <0.01
						heads, trimmed	7 7 14 14 21 21	0.07 0.07 <0.01 <0.01 <0.01 <0.01
						wrapper leaves	7 7 14 14 21 21	0.41 0.59 0.02 0.03 <0.01 <0.01
OS-IR-601-91 B 23.09.92 Franklin County, N. Carolina	AG 500 + 50 WP Market Price	22.02.91 17.04.91 24.04.91 01.05.91 08.05.91 15.05.91	4.5 0.56 0.56 0.56 0.56 0.56	 359 359 359 359 359	 0.16 0.16 0.16 0.16 0.16	heads, untrimmed	7 7 14 14 21 21	0.09 0.04 0.02 0.02 <0.01 <0.01
						heads, trimmed	7 7 14 14 21 21	0.07 0.08 <0.01 <0.01 <0.01 <0.01
						wrapper leaves	7 7 14 14 21 21	0.91 0.85 0.14 0.13 0.07 0.11
MW-IR-701-91 A 23.09.92 Columbia County, Wisconsin	AG 500 + AG 500 Little Rock	21.05.91 03.07.91 10.07.91 17.07.91 24.07.91 31.07.91	4.5 0.56 0.56 0.56 0.56 0.56	 187 187 187 187 187	 0.30 0.30 0.30 0.30 0.30	heads, untrimmed	7 7 14 14 21 21	0.97 0.57 0.20 0.31 0.24 0.19
						heads, trimmed	7 7 14 14 21 21	0.01 0.09 <0.01 <0.01 <0.01 <0.01
						wrapper leaves	7 7 14 14 21 21	1.2 1.3 1.9 1.1 0.86 0.86

Report no. Report date Location	Form. Variety	Dates of treatment	Application rate per treatment			Sample	PHI, days	Diazinon, mg/kg
			kg ai/ha	water l/ha	kg ai/hl			
MW-IR-701-91	AG 500 +	21.05.91	9.0			heads,	7	1.9
B	AG 500	03.07.91	1.1	187	0.60	untrimmed	14	0.48
23.09.92		10.07.91	1.1	187	0.60		21	0.53
Columbia	Little	17.07.91	1.1	187	0.60			
County,	Rock	24.07.91	1.1	187	0.60	heads,	7	0.05
Wisconsin		31.07.91	1.1	187	0.60	trimmed	14	<0.01
							21	<0.01
						wrapper	7	4.7
						leaves	14	2.7
							21	2.2

[1] In parentheses: diazoxon

Uses as ectoparasiticide on domestic animals

New trials on sheep and pigs were conducted according to pending GAP with the Neocidal 600 EW formulation which is not yet on the market. This formulation is a micro-emulsion of oil in water, containing 60% diazinon in the oil phase, intended to replace the former generation of EC formulations.

Smal and Adams (1996) treated sheep by dipping. Dip samples were analysed for diazinon by reversed-phase HPLC. Six replicate analyses yielded a mean concentration of 309 mg/l with a cv of 2%. The results of the trial are shown in Table 9.

No. and species: 46 sheep (25% Merino, 25% Border Leicester and 50% Dorset)
Body weight: 31.4-49.8 kg
Treatment: Plunge dipping for 1 minute in a bath containing 300 mg diazinon per litre
Slaughter intervals: 8 sheep were slaughtered 2, 4, 6, 8 or 10 weeks after treatment; 6 controls
Samples analysed: Muscle (equal weights of tenderloin and hindquarter), liver, kidney, renal and subcutaneous fat
LOD: 0.01 mg/kg in all samples

Table 9. Residues of diazinon in tissues of sheep (Smal and Adams, 1996).

Slaughter after	Animal No.	Diazinon, mg/kg			
		Muscle	Kidney	Liver	Fat
2 weeks	9397	0.05	0.03	<0.01	1.2
	9426	0.06	0.02	<0.01	1.2
	9428	0.04	0.02	<0.01	1.2
	9419	0.02	0.02	<0.01	0.6
	9388	0.05	0.03	<0.01	1.1
	9425	0.05	0.02	<0.01	1.4
	9399	0.06	0.02	<0.01	1.5
	9405	0.05	0.02	<0.01	1.1
4 weeks	9392	0.02	0.01	not analysed	0.41
	9394	0.01	<0.01		0.30
	9402	0.01	<0.01		0.32
	9391	0.02	<0.01		0.40
	9411	0.02	<0.01		0.29
	9424	<0.01	<0.01		0.16
	9400	0.01	<0.01		0.22
	9422	0.02	<0.01		0.41
6 weeks	9420	<0.01	<0.01	not analysed	0.10
	9409	<0.01	<0.01		0.11
	9417	0.01	<0.01		0.15
	9406	<0.01	<0.01		0.14

Slaughter after	Animal No.	Diazinon, mg/kg			
		Muscle	Kidney	Liver	Fat
	9423	<0.01	<0.01		0.11
	9427	<0.01	<0.01		0.08
	9396	0.01	<0.01		0.18
	9430	<0.01	<0.01		0.08
8 weeks	9401	<0.01			0.02
	9418	<0.01			0.03
	9395	<0.01			0.03
	9386	<0.01	not analysed	not analysed	0.04
	9414	<0.01			0.03
	9407	<0.01			0.03
	9421	<0.01			0.04
	9398	<0.01			0.03
10 weeks	9403				0.01
	9389				0.02
	9390				0.02
	9415	not analysed	not analysed	not analysed	0.02
	9387				0.02
	9393				0.02
	9412				0.03
	9416				0.01

Adams and Cheung (1998) analysed samples from the trial by Smal and Adams (1996) which had been deep frozen from April 1996 for diazinon, hydroxydiazinon and diazoxon in December 1997. Studies of stability in frozen storage (Tables 3 and 4) indicate that diazinon would be unstable in muscle, kidney and liver.

Table 10. Residues of diazinon, diazoxon and hydroxydiazinon in sheep tissues taken 2 weeks after dipping and analysed after prolonged frozen storage (Adams and Cheung, 1998).

Animal no.	Residues of diazinon and metabolites, mg/kg								
	Muscle			Kidney			Liver		
	diazinon	diazoxon	hydroxy-diazinon	diazinon	diazoxon	hydroxy-diazinon	diazinon	diazoxon	hydroxy-diazinon
9388	0.08 (0.05)[1]	<0.01	<0.01	0.02 (0.03)	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01
9397	0.11 (0.05)	<0.01	<0.01	0.02 (0.03)	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01
9399	0.12 (0.06)	<0.01	<0.01	0.02 (0.02)	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01
9405	0.04 (0.05)	<0.01	<0.01	0.01 (0.02)	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01
9419	0.02 (0.02)	<0.01	<0.01	<0.01 (0.02)	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01
9425	0.05 (0.05)	<0.01	<0.01	0.02 0.02	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01
9426	0.06 (0.06)	<0.01	<0.01	<0.01 (0.02)	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01
9428	0.04 (0.04)	<0.01	<0.01	0.02 (0.02)	<0.01	<0.01	<0.01 (<0.01)	<0.01	<0.01

[1]Residues in parentheses: original analyses (Table 9)

Table 11. Residues of diazinon, diazoxon and hydroxydiazinon in sheep fat analysed after prolonged storage (Adams and Cheung, 1998).

Slaughter after	Animal no.	Residues, mg/kg						
		fat[1]	renal fat			subcutaneous fat		
		diazinon	diazinon	diazoxon	hydroxydiazinon	diazinon	diazoxon	hydroxydiazinon
2 weeks	9388	1.1	1.1	<0.01	0.01	0.76	<0.01	0.02
	9397	1.2	1.2	<0.01	0.02	0.89	<0.01	0.02
	9399	1.5	1.6	<0.01	0.01	1.00	<0.01	0.02
	9405	1.1	1.2	<0.01	<0.01	0.70	<0.01	<0.01
	9419	0.6	0.71	<0.01	<0.01	0.47	<0.01	<0.01
	9425	1.4	1.4	<0.01	0.01	1.0	<0.01	0.02
	9426	1.2	1.1	<0.01	0.01	0.87	<0.01	0.01
	9428	1.2	1.4	<0.01	0.01	0.94	<0.01	0.01
4 weeks	9391	0.40	0.43	<0.01	<0.01	0.35	<0.01	<0.01
	9392	0.41	0.49	<0.01	<0.01	0.41	<0.01	<0.01
	9394	0.30	0.35	<0.01	<0.01	0.32	<0.01	<0.01
	9400	0.22	0.31	<0.01	<0.01	0.19	<0.01	<0.01
	9402	0.32	0.39	<0.01	<0.01	0.28	<0.01	<0.01
	9411	0.29	0.42	<0.01	<0.01	0.27	<0.01	<0.01
	9422	0.41	0.41	<0.01	<0.01	0.39	<0.01	<0.01
	9424	0.16	0.22	<0.01	<0.01	0.14	<0.01	<0.01

[1] Original analyses (Table 9) of combined renal and subcutaneous fat

Following a controlled drug-free period of seven days, Walser *et al.* (1996) sprayed pigs twice (Table 12) with Neocidol 600 EW.

No. and species: 42 Dutch Landrace (including 2 controls); equal numbers of females and castrated males
Body weight: 68-96.1 kg
Treatment: 2 spray applications in an interval of 7 days. Each pig was sprayed separately with 1 litre of a spray solution containing 600 mg diazinon per litre, taking care to wet the entire body
Slaughter intervals: 8 pigs slaughtered 1, 3, 7, 14 or 21 days after second treatment. 2 controls slaughtered before first treatment
Samples analysed: muscle (equal weights of tenderloin and hindquarter), liver, kidney, skin with subcutaneous fat (natural proportion)
LOD (diazinon): tissues 0.005 mg/kg, blood 0.005 mg/l, fat and skin 0.01 mg/kg

Table 12. Residues of diazinon in pigs sprayed twice (Walser *et al.*, 1996).

Days after 2nd treatment	Diazinon, mg/kg				
	Muscle	Liver	Kidney	Fat and skin	Blood
1	0.035	0.022	<0.005	0.25	<0.005
3	0.025	0.027	<0.005	0.12	<0.005
7	0.015	0.014	<0.005	0.03	<0.005
14	0.012	0.009	<0.005	<0.01	<0.005
21	0.007	0.006	<0.005	<0.01	<0.005

Samples from the trial by Walser *et al.* which were deep frozen in June/July1996 were analysed for hydroxydiazinon and diazoxon in September 1998 (Walser, 1998) .

Residues of hydroxydiazinon and diazoxon in all the samples were below the LOD, i.e. <0.005 mg/kg in muscle, liver and kidney and <0.01 mg/kg in skin + subcutaneous fat.

Bioequivalence of EC and EW formulations

The new residue trials on sheep and pigs were with the new EW formulation (microemulsion of 60% diazinon in water) instead of the EC formulations which were used in all previous trials (see JMPR 1996), which were based on organic solvents. The manufacturer therefore conducted comparison trials to show the bioequivalence of Neocidol 600 EW and the EC formulations Neocidol 600 EC (A-3695 J), Neocidol 250 EC (A-7182A) and Topclip Gold Shield (A-139 F).

Morrison (1994) compared the levels of diazinon in the blood and fat after spraying sheep with the 3 solvent-based formulations (Tables 13 and 14).

Animals:	18 male white sheep
Body weight:	36.5 ± 4 kg
Formulation used:	group A: Neocidol 250 EC (A-7182 A) group F: Topclip Gold Shield (A-139 F) group J: Neocidol 600 EC (A-3695 J)
Treatment:	each side of the animal sprayed for 1 min with 3 l of spray emulsion of a nominal diazinon concentration of 600 mg/l. After spraying, each animal was allowed to stand for 10-15 min. to drain excess emulsion.
Sampling:	blood samples were taken 48 and 24 hours before treatment and 1, 2, 4, 8, 12, 24 and 48 hours and 3, 5, 7, 9, 14, 21 and 28 days after treatment. fat samples of 2.5-6 g were taken by biopsy of the fat depot at the base of the tail 8 and 28 days after treatment.
LOD of diazinon:	0.005 mg/kg for both fat and blood

Table 13. Concentration of diazinon in blood of sprayed sheep (Morrison, 1994).

Time	Diazinon, mg/l, group mean ± standard deviation		
	Group A	Group F	Group J
- 48 h	<0.006	<0.006	<0.006
- 24 h	<0.006	<0.006	<0.006
+ 1 hr	0.0092 ± 0.0007	0.012 ± 0.0053	0.015 ± 0.0025
+ 2 h	0.014 ± 0.0033	0.013 ± 0.0033	0.017 ± 0.004
+ 4 h	0.019 ± 0.0065	0.025 ± 0.0064	0.024 ± 0.0072
+ 8 h	0.028 ± 0.0053	0.03 ± 0.0064	0.029 ± 0.0087
+ 12 h	0.028 ± 0.0063	0.027 ± 0.0049	0.026 ± 0.0066
+ 24 h	0.023 ± 0.0032	0.023 ± 0.0027	0.023 ± 0.0049
+ 48 h	0.024 ± 0.0042	0.024 ± 0.003	0.023 ± 0.0042
+ 3 days	0.027 ± 0.0033	0.027 ± 0.0065	0.024 ± 0.003
+ 5 days	0.017 ± 0.0023	0.016 ± 0.0049	0.016 ± 0.003
+ 7 days	0.011 ± 0.0023	0.013 ± 0.0034	0.01 ± 0.0015
+ 9 days	0.008 ± 0.0013	0.01 ± 0.0017	0.008 ± 0.0015
+ 14 days	0.0051 ± 0.0001	0.006 ± 0.0004	0.005 ± 0.0002
+ 21 days	<0.006	<0.006	<0.006
+ 28 days	<0.006	<0.006	<0.006

Table 14. Concentration of diazinon in fat of sprayed sheep (Morrison, 1994).

Days after treatment	Diazinon, mg/kg, group mean ± standard deviation		
	Group A	Group F	Group J
8	2.66 ± 0.83	2.2 ± 0.8	1.9 ± 0.25
28	0.15 ± 0.07	0.16 ± 0.05	0.12 ± 0.06

Strittmatter *et al.* (1996) determined the levels of diazinon in the blood and wool after spraying sheep with 3 different formulations including the 600 EW (Tables 15 and 16).

Species used:	21 male white sheep
Body weight:	33 ± 4 kg
Formulations:	group 1: Neocidol 600 EW (A-8265 B) group 2: Topclip Gold Shield (A-139 F) group 3: Neocidol 600 EC (A-3695 J)
Treatment:	each animal was individually plunge-dipped for 1 min in 180 l dip containing 300 mg/l of diazinon. The dip bath was prepared for each animal of each group
Sampling:	blood samples were taken 24 hours before treatment and 1, 2, 4, 8, 12, 24 and 48 hours and 3, 5, 7, 9, 14 and 20 days after treatment wool samples were taken 2, 7, 14 and 20 days after treatment from 6 different sites on each sheep and pooled within the treatment group skin samples without the fleece (3 x 3 cm) were cut and homogenised fat samples were homogenised. Subcutaneous samples were 100–250 g from the back and shoulders; omental and kidney fat samples were combined in equal portions (200-500 g)
LOD (diazinon):	0.005 mg/l in blood, 600 mg/kg in wool

The dip solutions were sampled before and after dipping each sheep and analysed for diazinon.

The results were evaluated statistically. For blood and wool the area under the concentration/time curve (AUC), the maximum concentration (C_{max}) and the time of maximum concentration (T_{max}) were determined. Table 15 shows the individual results, group geometric means and ranges of the AUC, C_{max} and T_{max} for diazinon concentrations in the blood.

Table 15. Diazinon in blood of sprayed sheep (Strittmatter *et al.*, 1996).

Formulation	Animal no.	AUC	C_{max}, mg/l	T_{max}, days
A-8265 B	1584	6.76	0.048	1
	1590	5.86	0.050	12
	1594	7.45	0.051	12
	1215	5.38	0.048	12
	1517	6.41	0.045	8
	1620	5.45	0.058	8
	1639	6.50	0.041	12
	Geom. mean	6.22	0.048	7.49
	Range	5.38-7.45	0.041-0.058	1-12
A-0139 F	1574	6.79	0.034	12
	1582	6.33	0.056	8
	1597	5.46	0.052	12
	1600	5.89	0.041	48
	1611	6.34	0.044	8
	1624	7.78	0.051	4
	1626	8.61	0.080	12
	Geom. mean	6.67	0.050	11.14
	Range	5.46-8.61	0.034-0.080	4-48
A-3695 J	1591	5.87	0.043	12
	1595	4.67	0.032	12
	1596	6.42	0.046	12
	1598	5.37	0.039	12
	1622	5.73	0.108	8
	1635	5.84	0.061	12
	1638	6.16	0.051	12
	Geom. mean	5.7	0.050	11.33
	Range	4.67-6.42	0.032-0.108	8-12

The mean ratios of C_{max} and AUC for A-8265B to the corresponding values for A-0139F and 3695J, together with the probability P that these ratios (μ) are between 0.7 and 1.3[3], are shown below.

Ratio μ for	AUC	P[0.7≤ μ≤ 1.3]	C_{max}	P[0.7≤ μ≤ 1.3]
A-8265 B/A-0139 F	0.93	0.998	0.96	0.983
A-8265 B/A-3695 J	1.09	0.994	0.96	0.933

This statistical analysis indicated that formulation A-8265 B is bioequivalent to both formulations A-0139 F and A-3695 J.

Table 16. Diazinon in wool of sprayed sheep (Strittmatter *et al.*, 1996).

Formulation	Animal no.	AUC	C_{max}, mg/l	T_{max}, days
A-8265 B	1584	111150	9920	2
	1590	103625	7730	2
	1594	108000	8260	2
	1215	87845	6420	2
	1517	87125	6540	2
	1620	91775	6960	2
	1639	104215	7530	2
	Geom. mean	98671	7546	2.0
	Range	87125-111150	6420-9920	
A-0139 F	1574	98500	9510	2
	1582	108190	7730	2
	1597	105345	8470	2
	1600	94330	7410	2
	1611	109440	8630	2
	1624	145260	10600	2
	1626	149465	10700	2
	Geom. mean	114091	8926	2.0
	Range	94330-149465	7410-10700	
A-3695 J	1591	115350	8550	2
	1595	91435	6280	2
	1596	116890	8780	2
	1598	94450	8050	2
	1622	101420	8110	2
	1635	105910	8140	2
	1638	113385	8680	2
	Geom. mean	105118	8042	2.0
	Range	91435-116890	6280-8780	

The mean ratios of C_{max} and AUC in wool for A-8265 B to the values in the other two formulations are as shown below.

Ratio μ for	AUC	P[0.7≤ μ≤ 1.3]	C_{max}	P[0.7≤ μ≤ 1.3]
A-8265B/A-0139 F	0.86	0.990	0.85	0.983
A-8265B/A-3695 J	0.94	0.999	0.94	0.999

Again the results show that formulation A-8265 B is bioequivalent to both the other formulations.

[3] The formulation F_2 is considered to be bioequivalent to the formulation F_1 if the function f (F_2) = f (F_1) ± 30% (Fühler, H., *et al.*, 1983).

FATE OF RESIDUES IN STORAGE AND PROCESSING

In storage

No information.

In processing

Apples and pears (Table 17). Apples from the North Carolina field trial OS-IR-602-91 and pears from the New York field trial NE-IR-401-91 harvested at a PHI of 21 days were processed in the laboratory using typical household procedures. Samples were analysed for diazinon, hydroxydiazinon and diazoxon. Hydroxydiazinon and diazoxon were not detected. Processing factors were also derived from the processing study reported by the 1993 JMPR (trial OW-IR-618-88).

Table 17. Diazinon residues in apples and pears and their processed fractions.

Crop Trial Treatment	Sample	PHI, days	Diazinon, mg/kg	Processing factor	Report no. Reference
Apples OW-IR-618-88 7 x 3.36 kg ai/ha	Fruit	0	0.98		JMPR 1993
	Culls		2.2	2.24	
	Pomace, wet		1.4	1.43	Ross and Gold, 1989
	Pomace, dry		0.02	0.02	
	Juice, fresh		<0.01	<0.01	
	Juice, canned		<0.01	<0.01	
	Slices, canned		<0.01	<0.01	
	Slices, frozen		<0.01	<0.01	
	Apple sauce		<0.01	<0.01	
Apples, OS-IR-602-91 3 x 2.2 kg ai/ha	Fruit, unwashed (RAC)	21	0.04		ABR-92017
	Fruit, washed		0.02	0.5	
	Wash water		<0.01	<0.25	Ross and Hackett, 1992a
	Fruit cores		0.02	0.5	
	Peel, washed		0.32	8	
	Fruit, peeled and washed		<0.01	<0.25	
	Fruit, sliced and baked		<0.01	<0.25	
	Whole fruit, baked		0.05	1.25	
Apples OS-IR-602-91 3 x 4.4 kg ai/ha	Fruit, unwashed (RAC)	21	0.07		
	Fruit, washed		0.1	1.4	
	Wash water		<0.01	<0.14	
	Fruit cores		0.02	0.29	
	Peel, washed		0.43	6.1	
	Fruit, peeled and washed		<0.01	<0.14	
	Fruit, sliced and baked		<0.01	<0.14	
	Whole fruit, baked		0.08	1.1	
Pears NE-IR-401-91 3 x 2.2 kg ai/ha	Fruit, unwashed (RAC)	21	<0.01		ABR-92017
	Fruit, washed		<0.01		Ross and Hackett, 1992a
	Wash water		<0.01		
	Fruit cores		<0.01		
	Peel, washed		0.01		
	Fruit, peeled and washed		<0.01		
	Fruit, sliced and baked		<0.01		
	Whole fruit, baked		<0.01		
Pears NE-IR-401-91 3 x 4.4 kg ai/ha	Fruit, unwashed (RAC)	21	<0.01		
	Fruit, washed		0.02		
	Wash water		<0.01		
	Fruit cores		<0.01		
	Peel, washed		0.07		

Crop Trial Treatment	Sample	PHI, days	Diazinon, mg/kg	Processing factor	Report no. Reference
	Fruit, peeled and washed		<0.01		
	Fruit, sliced and baked		<0.01		
	Whole fruit, baked		<0.01		

Residues in the edible portion of food commodities

Diazinon residues in peeled and washed, and in sliced and baked apples were below the LOD of 0.01 mg/kg (Table 17).

Diazinon residues were below the LOD (<0.01 mg/kg) in trimmed heads of cabbages treated with 4.6 kg ai/ha pre-planting followed by 5 post-emergence foliar applications of 0.56 kg ai/ha after a PHI of 21 days (Table 8).

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

The 1996 JMPR asked for monitoring data on fat of sheep. The current Meeting received the 1998 UK statutory surveillance results for kidney fat (231 samples of cattle, 330 of pig, 610 of sheep). Only one sample of sheep kidney fat contained residues of diazinon, at 2.3 mg/kg (Anon., 1998).

APPRAISAL

Diazinon was evaluated by the 1993 JMPR as a periodic review for plant protection uses. The 1993 Meeting recommended an increase in the CXL for pome fruits and cabbages from 0.5 to 2 mg/kg and the withdrawal of the CXLs for animal commodities in the absence of animal processing studies and data from uses to control ectoparasites.

The 1996 Meeting considered new feeding studies with poultry and cattle, and new and previously reported data from supervised trials of ectoparasite control in cattle and sheep. That Meeting was able to estimate a number of maximum residue levels but considered additional information on GAP and modern trials at maximum GAP rates to be highly desirable.

The Meeting received reports of new residue trials on sheep (dipping) and pigs (spraying). Additional results for pome fruit and cabbage were also available.

The analytical methods that determine the parent compound as well as the metabolites diazoxon and hydroxydiazinon rely on acetone/water extraction and liquid-liquid partition, followed in extracts of animal products by clean-up on various cartridges, with determination by GLC with an FPD or NPD. The LODs of the three compounds were 0.005 mg/kg in pig blood, muscle, liver and kidney and 0.01 mg/kg in cabbage, apples, pears, pig skin and fat, and sheep tissues.

The 1993 JMPR noted that residues of diazinon *per se* are generally stable in crop samples (except strawberries) and processed commodities for a minimum of 26 months under freezer conditions (-27° to -12°C). Hydroxydiazinon was stable in crops except strawberries and apples. Residues of diazoxon however were unstable in all substrates tested except maize oil.

Residues of diazinon and hydroxydiazinon are stable in animal tissues and milk under deep frozen conditions ($\leq$-18°C) for at least 9 months, but diazoxon is only stable in fat, of limited stability in milk and highly unstable in liver and muscle

Definition of the residue

The residue was defined by the 1993 JMPR as diazinon *per se*. The current Meeting discussed the relevance of metabolites to the dietary intake. Metabolism in plants progresses, as in animals, primarily by hydrolysis of the ester linkage, yielding 4-hydroxy-2-isopropyl-6-methylpyrimidine, followed by oxidation of the isopropyl group to primary and tertiary alcohols and/or oxidation of the methyl group to the alcohol. Diazoxon and hydroxydiazinon were not reported as significant plant metabolites by the 1993 JMPR but could play an intermediary role in the degradation of diazinon and so could be of concern for the assessment of acute dietary risk.

In all, 120 samples of pome fruit and 225 samples of cabbage were analysed with freezer storage of pome fruit for 4-7 months and cabbage for 4-12 months. Diazoxon was found in 8 samples of pome fruit (5.7%) and in 2 of cabbage (0.89%) with a maximum value of 0.02 mg/kg in both commodities. Hydroxydiazinon could not be determined in any sample. The disappearance of the metabolites under freezer conditions indicates that they will also be unstable under field conditions. Furthermore, the Meeting was informed that 19 trials with snap beans, apples, plums and carrots had been conducted to investigate the occurrence of diazoxon and hydroxydiazinon at harvest, without storage of the samples before analysis. The first results showed residues of the metabolites well below 10% of the parent. The Meeting therefore concluded that diazoxon and hydroxydiazinon would not be of concern for consumer exposure and that the residue in plants for dietary intake estimations should be defined as diazinon.

In animal products, residues of diazoxon and hydroxydiazinon were below the LODs in muscle, kidney, liver and blood samples at all periods after dosing. In the 32 sheep fat samples analysed no diazoxon could be determined, but hydroxydiazinon was found in 12 samples (37.5%) at two weeks after treatment (max. 0.02 mg/kg). At the slaughtering interval according to GAP of four weeks, no residues of either metabolite were found. The absence of diazoxon in samples of animal tissues (except fat) stored deep frozen could be due to its absence at slaughter or to its rapid degradation. However, no diazoxon residues were found in sheep fat (where it is stable), whereas diazinon and hydroxydiazinon were detected. Although the determination of diazoxon is limited by its instability in certain tissues, it can be assumed that it occurs at much lower levels than diazinon, and any remaining small amounts of diazoxon at the time of slaughter can reasonably be expected to be rapidly hydrolysed. The Meeting concluded that there is no need to include diazoxon or hydroxydiazinon in the residue definition for the assessment of dietary risk of animal products.

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

The residue is fat-soluble.

The Meeting received data from supervised trials on apples, pears and head cabbages. New dipping and spraying studies were carried out on sheep and pigs.

Pome fruit. The 2 mg/kg MRL proposed by the 1993 JMPR was based on older US results and former US GAP (2–8 x 0.06 kg ai/hl, PHI 14 days). Recently US GAP for diazinon on pome fruit was changed to a maximum of 2.2 kg ai/ha, 0.235 kg ai/hl per application, and a maximum of 6.7 kg ai/ha per season, PHI 21 days. No other information on GAP was reported (obsolete uses reported by the 1993 JMPR were not considered).

Twelve supervised trials on apples and 14 on pears in the USA complied with the new US GAP. Samples were analysed for residues of diazinon, diazoxon and hydroxydiazinon.

The residues in apples and pears from trials according to current US GAP in rank order (median underlined) were <0.01 (7), 0.01, 0.02 (2), 0.04 (6), 0.06 (2), 0.08 (2), 0.10, 0.11 (2), 0,12, 0.13 and 0.24 mg/kg.

Hydroxydiazinon was not found in any of the samples. Diazoxon was detected in pears from two trials according to GAP at 0.01 and 0.02 mg/kg.

On the basis of the combined apple and pear data, the Meeting estimated an STMR of 0.04 mg/kg and a maximum residue level of 0.3 mg/kg for pome fruit to replace the existing CXL (2 mg/kg).

Diazinon residues were below the LOD of 0.01 mg/kg in washed, peeled and sliced apples. Processing factors of 1.43, <0.01, <0.01 and <0.01 for wet apple pomace, juice, canned slices and apple sauce respectively, were derived from a processing study reported by the 1993 JMPR. From the STMR of 0.04 mg/kg, the Meeting estimated STMRs of 0.0572 mg/kg for wet apple pomace, and 0.0004 mg/kg for apple juice, sauce and canned slices.

Head cabbages. The 2 mg/kg MRL for cabbages proposed by the 1993 JMPR was based on US data and former US GAP (4.4 kg ai/ha followed by >1 x 0.56 kg ai/ha, PHI 5–7 days). The US GAP was recently changed to an increased PHI of 21 days.

Eleven supervised trials on cabbages according to current US label use directions were reported. These directions allow for a single pre-plant treatment of 4.4 kg ai/ha followed by five post-emergence foliar applications of 0.55 kg ai/ha at 7-day intervals using ground equipment.

The samples analysed were described in the report as follows: “Untrimmed and trimmed cabbage heads were obtained from separate plants, ... in order to avoid contamination. Trimmed cabbage heads were obtained by removing the wrapper leaves consisting of the obviously decomposed outer leaves.” The Meeting noted that the term “trimmed heads” should be in accordance to the Codex definition for the commodity, but concluded that maximum residue levels should not be based on cabbages with outer leaves removed as there is so much uncertainty as to how many leaves would be removed in practice.

The diazinon residues in rank order were <0.01, <0.01, 0.01, 0.01, 0.05, 0.08, 0.24 and 0.35 mg/kg for untrimmed heads, <0.01 (11) mg/kg for trimmed heads and 0.04, 0.07, 0.1, 0.1, 0.11, 0.13, 0.86 and 1.0 mg/kg for wrapper leaves.

Diazoxon was detected (0.02 mg/kg) in only one trial, in trimmed heads at a PHI of 21 days. Hydroxydiazinon was not found at or above the LOD.

The Meeting estimated a maximum residue level of 0.5 mg/kg for diazinon in head cabbages, to replace the existing CXL (2 mg/kg). An STMR of 0.01 mg/kg was estimated on the basis of the results for trimmed heads,.

Animal products. An EW formulation of diazinon, which is planned to replace the former EC-type formulations, was used in new trials on sheep dipping and pig spraying, but GAP is only pending. However, bioequivalence studies have shown that the water-based EW formulation used in the new studies is equivalent to the EC formulations used in earlier studies.

Sheep. According to the use pattern reported by the 1996 JMPR, the most important treatment rates recommended are 250 mg ai/l for sheep dipping (uses range from100 to 600 mg ai/l). The new dipping trial was conducted according to New Zealand GAP (200-400 mg ai/l) using a bath concentration of 300 mg/l.

The highest residues of diazinon occurred at the earliest slaughtering interval of two weeks. Fat contained the highest residues (maximum 1.5, median 1.2, mean 1.16 mg/kg). Low residues were found in muscle (maximum 0.06, median 0.05, mean 0.0475 mg/kg) and kidney (maximum 0.03, median 0.02, mean 0.0225 mg/kg). No residues were detected in the liver. The residues in muscle and kidney dissipated quickly, with all samples being below the LOD of 0.01 mg/kg by 8 and 6 weeks

respectively. In fat diazinon was more persistent, with low residues up to 0.03 mg/kg present 10 weeks after treatment. The data confirm the findings reported by the 1996 JMPR (evaluation p. 216) for sheep: muscle maximum 0.03, median 0.02; liver maximum 0.01, median <0.01; kidney maximum 0.02, median 0.02; omental fat maximum 1.3, median1.1; subcutaneous fat maximum 1.4, median 1.4 mg/kg.

Residues of diazoxon were not found in any of the sheep tissues tested. Low levels of hydroxydiazinon were found in four of eight animals in subcutaneous fat and in one of eight animals in renal fat from sheep slaughtered 2 weeks after treatment (maximum 0.02 mg/kg). The residues were below the LOD of 0.01 mg/kg by 4 weeks after treatment.

Pigs. Diazinon residues in the muscle of pigs sprayed twice decreased from 0.035 mg/kg one day after the 2nd treatment to 0.007 mg/kg after 21 days. In liver, a maximum of 0.027 mg/kg was found after 3 days which decreased to 0.006 mg/kg at day 21. The highest residues of 0.25 mg/kg in the fat and skin were found on day 1 and decreased to <0.01 mg/kg on day 14. In kidney and blood, residues were below the LOD of 0.005 mg/kg in all samples. Neither diazoxon nor hydroxydiazinon was detected in any samples.

No new studies were reported on cattle or goats.

The new data on dipped sheep and sprayed pigs reported to the Meeting do not differ from the data provided in earlier submissions.

The 1996 JMPR had noted that in practice some animals might be exposed to more than one type of treatment (e.g. spraying and dipping as well as ear tags or wound dressing), but the present Meeting was informed that multiple treatments are unlikely in practice.

The 1996 JMPR requested monitoring data on subcutaneous fat of sheep. The Meeting received the 1998 UK statutory surveillance results for kidney fat (231 samples from cattle, 330 from pigs, 610 from sheep). Only one sample of sheep kidney fat contained residues of diazinon (2.3 mg/kg).

The Meeting agreed to maintain the previous maximum residue level estimates for the liver, kidney and meat of cattle, goats, pigs and sheep of 0.03, 0.03 and 2 mg/kg in the fat respectively. The STMRs estimated on the basis of different uses (dip, ear tag, spray) on goats, pigs, cattle and sheep by the 1996 JMPR were confirmed.

RECOMMENDATIONS

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

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

The residue is fat-soluble.

Commodity		Recommendation		
		MRL, mg/kg		STMR
CCN	Name	New	Previous	mg/kg
JF 0226	Apple juice			0.0004
	Apple pomace, wet			0.057
	Apple sauce			0.0004
	Apple slices, canned			0.0004
VB 0041	Cabbages, Head	0.5	2	0.01

Commodity		Recommendation		
		MRL, mg/kg		STMR
CCN	Name	New	Previous	mg/kg
MM 0814	Goat meat	2 (fat) V	2 (fat) V	0.3 (fat) [1] 0.02 (whole muscle) [1]
MO 0098	Kidney of cattle, goats, pigs and sheep	0.03 V	0.03 V	0.01[1]
MO 0099	Liver of cattle, goats, pigs and sheep	0.03 V	0.03 V	0.01[1]
MM 0097	Meat of cattle, pigs and sheep	2 (fat) V	2 (fat) V	0.3 (fat) [1] 0.02 (whole muscle) [1]
ML 0106	Milks	0.02 F V	0.02 F V	0.02[1]
FP 0009	Pome fruits	0.3	2	0.04

[1]Estimated by the 1996 JMPR

FURTHER WORK OR INFORMATION

Studies on fruits and vegetables to investigate the occurrence of diazoxon and hydroxydiazinon at harvest, without storage of samples before analysis.

DIETARY RISK ASSESSMENT

Chronic intake

STMRs have been estimated by the current Meeting for pome fruit and head cabbages as well as by the 1996 JMPR for tomatoes and animal products. Where consumption data were available these STMRs were used in the estimates of dietary intake together with the existing MRLs and draft MRLs for 38 other food commodities.

The dietary intakes for the five GEMS/Food regional diets, based on new and existing STMRs and MRLs, were in the range of 20% to 180% of the ADI. The Meeting concluded that the dietary intake of diazinon residues may exceed the ADI for two GEMS/Food regional diets (Annex III). Further refinements of dietary intake estimates will be undertaken during the next periodic review of residues.

Acute intake

The international estimate of short-term intake (IESTI) for diazinon was calculated for the commodities for which MRLs and STMRs were established and for which consumption data (large portion consumption and unit weight) were available. The results are shown in Annex IV. The IESTI varied from 0.004 to 0.008 mg/kg bw in the general population and from 0.016 to 0.028 mg/kg in children. As no acute reference dose has been established the acute risk assessment for diazinon was not finalized.

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