EUROPEAN COMMISSION
HEALTH & CONSUMER PROTECTION DIRECTORATE-GENERAL
Directorate F - Food and Veterinary Office
Unit 4 - Food of plant origin, plant health; processing and distribution
In cooperation with JRC Ispra, IHCP, Food Products and Consumer Goods and DG SANCO E1

SANCO/397/01-Final

Monitoring of Pesticide Residues in Products of Plant Origin in the European Union, Norway and Iceland

1999 Report

This report "Monitoring of Pesticide Residues in Products of Plant Origin in the European Union, Norway and Iceland - Report 1999" was forwarded to the Standing Committee on Plant Health for agreement on publication on 11 June 2001. The Member States, except for Spain, agreed that publication of the report was desirable. It was noted that this was also the view of Norway and Iceland.

Enquiries concerning this report should be addressed to the contact points listed in Annex 1.

June 2001

TABLE OF CONTENTS

1. INTRODUCTION

This report covers the national situations in the 15 EU Member States, Norway and Iceland for the calendar year 1999. It is evident that this document can only give an overall view on monitoring of pesticide residues. Each Member State, Norway and Iceland have been invited to contribute a short national statement (in English) for inclusion in this document. More detailed information about the situation in individual countries is available from the respective national monitoring authorities and should be requested from them. The issue of pesticide residues in foodstuffs of animal origin, as regulated in Council Directive 86/363/EEC[1], is not covered by this report.

2. LEGAL BASE

In Council Directives 86/362/EEC[2] and 90/642/EEC[3], as amended, maximum levels are fixed for pesticide residues in and on products of plant origin. Member States are asked to check regularly the compliance of foodstuffs with these levels. Inspections and monitoring should be carried out in accordance with the provisions of Council Directive 89/397/EEC[4] on the official control of foodstuffs, and Council Directive 93/99/EC[5] on additional measures concerning the official control of foodstuffs. Sampling should be carried out in accordance with Council Directive 79/700/EEC[6].

Besides national monitoring programmes, the Commission services recommended, via Commission Recommendation 1999/333/EC[7], the participation of each Member State in a specific EU coordinated monitoring programme. Those programmes have existed since 1996. Their aim is to work towards a system which makes it possible to estimate actual dietary pesticide exposure throughout Europe. The monitoring programme is designed as a rolling programme, which will have covered all major pesticide-commodity combinations by the end of 2003. The choice of commodities includes the major components of the Standard European Diet of the World Health Organisation.

Article 7 of Council Directive 86/362/EEC and Article 4 of Council Directive 90/642/EEC, as amended by Council Directive 97/41/EC[8], require Member States to report to the Commission the results of the monitoring programme for pesticide residues carried out both under their national programme and under the EU coordinated programme. A format for the reports on the Community programme was agreed (SANCO/1311/2000). The Commission is required to compile and collate this information annually.

---

[1] Official Journal No L 221, 07/08/1986 p. 0043 - 0047
[2] Official Journal No L 221, 07/08/1986 p. 0037 - 0042
[3] Official Journal No L 350, 14/12/1990 p. 0071 - 0079
[4] Official Journal No L 186, 30/06/1989 p. 0023 - 0026
[5] Official Journal No L 290, 24/11/1993 p. 0014 - 0017
[6] Official Journal No L 207, 15/08/1979 p. 0026 - 0028
[7] Official Journal No L 128, 21/05/1999 p. 0025 - 0055
[8] Official Journal No L 184, 12/07/1997 p. 0033 - 0049

Since 1 April 2000 a new Monitoring Regulation (Commission Regulation (EC) No 645/2000[9]) is in force, which provides for detailed implementing rules for the monitoring provisions of Directives 86/362/EEC and 90/642/EEC. However, for the year 1999, this regulation was not yet applicable.

3. MAXIMUM RESIDUE LIMITS (MRL), ACCEPTABLE DAILY INTAKES (ADI) AND ACUTE REFERENCE DOSES (ACUTE RFD)

Pesticide residue levels in foodstuffs are generally regulated in order to:

- minimise the exposure of consumers to the harmful or unnecessary intake of pesticides;
- control the correct use of pesticides in terms of the authorisations or registrations granted (application rates and pre-harvest intervals);
- permit the free circulation of products treated with pesticides as long as they comply with the MRLs fixed.

A maximum residue limit (MRL) for pesticide residues is the maximum concentration of a pesticide residue (expressed in mg/kg) legally permitted in or on food commodities and animal feed. MRLs are based on Good Agricultural Practice (GAP) data. Food derived from commodities that comply with the respective MRLs are intended to be toxicologically acceptable. Exceeded MRLs are indicators of violations of Good Agricultural Practice. If MRLs are exceeded, comparison of the exposure with ADIs and/or acute RfDs will then indicate whether or not there are possible chronic or acute health risks respectively.

The acceptable daily intake (ADI) is the estimate of the amount of a substance in food, expressed on a body-weight basis, that can be ingested daily over a lifetime without appreciable health risk to the consumer. The ADI is based on the no observed adverse effect levels (NOAEL) in animal testing. A safety factor (usually 100) that takes into consideration the type of effect, the severity or reversibility of the effect, and the inter- and intraspecies variability is applied to the NOAEL. The ADI therefore reflects chronic toxicity.

The acute Reference Dose (acute RfD) is the estimate of the amount of a substance in food, expressed on a body-weight basis, that can be ingested over a short period of time, usually during one meal or one day, without appreciable health risk to the consumer. It therefore reflects the acute toxicity. At present, acute Reference Doses have been fixed for certain pesticides.

[9] Commission Regulation (EC) No 645/2000 of 28 March 2000, Official Journal No. L 78, 29/03/2000, p. 0007 - 0009

4. NATIONAL MONITORING PROGRAMMES

4.1. Monitoring results for 1999

The results of the 17 national monitoring programmes are shown in Table 1. About 40 000 samples were analysed for, on average, 142 different pesticides (ranging from 38 to 323). Analysis is usually performed by multi-methods capable of detecting up to 100 or more pesticides. This means that at least an estimated 4.0 million individual determinations were carried out. 64 % of the samples contained no detectable pesticide residues. Detectable residues at or below the MRL were found in 32 % of the samples. In 4.3 % of the samples, the residues exceeded MRLs (both national or EC-MRLs). It was confirmed[10] that EC-MRLs were exceeded in 3.5 % of all samples.

The results varied significantly between the different countries. It is important to note that differences in the monitoring programmes rather than differences in the presence of pesticide residues in food could account for these differences. Several factors can be mentioned:

- The choice of pesticides investigated.
- Sampling, e.g. more random or more targeted; the proportion of domestic and imported foodstuffs; the choice of crops.
- Methods used, e.g. the addition of single methods to detect specific, often problematic pesticides.
- Analytical capabilities of the laboratories (differences in reporting levels).
- Definition of exceeded levels (e.g. including or excluding analytical uncertainties).
- Differences in national MRLs, leading to differences in exceeded levels reported.

No separation of the reporting for fruit/vegetables and cereals has been made in 1999 as it is planned to prepare a consolidation of the residue Directives, in which the different Directives for fruit, vegetables and cereals are merged. A special monitoring for methamidophos on peppers was initiated by the Junta de Andalucía, one of the Spanish Autonomous Communities. The results of this programme are not included in the data of Table 1, but the national monitoring data show in an Annex that in November and December 1999 32.4 % of the 262 samples analysed contained methamidophos residues above the MRL, which had been set to the Limit of Determination in 1999. In 67.6 % of the samples no methamidophos was found. The special monitoring programme was ongoing in the following months (January to May 2000).

[10] The definition of confirmed exceedances varies between Member States, this includes for example cases where the analytical laboratory has certified an exceedance when applying its quality assurance system, cases where official warnings have been issued or where legal or administrative consequences have followed.

Table 1: Results of the seventeen national monitoring programmes for pesticide residues (including fruit, vegetables and cereals)

	No. of samples analysed	No. of pesticides analysed for	No. of different pesticides found	% found from sought	No. of samples without detec-table residues	%	No. of samples with residues below or at MRL (national or EC MRLs)	%	No. of samples with residues above MRL (national or EC MRLs)	%	No. of samples with confir-med residues above EC-MRLs	%
B*	1035	138	61	44	562	54	396	38	77	7.4	33	3.2
DK	2287	133	67	50	1513	66	729	32	45	2.0	43	1.9
D	6617	103	61	59	4116	62	2108	32	393	5.9	375	5.7
EL	1422	123	47	38	920	65	400▲	28▲	68▲	4.8▲	64	4.5
E	3325	176	70	40	2040	61	1167	35	118	3.5	98	2.9
F	4553	228	115	50	2298	50	1878	41	377	8.3	299	6.6
IRL	232	80	39	49	122	53	97	42	13	5.6	13	5.6
I	7938	67	34	51	6372	80	1491	19	75	0.9	74	0.9
L	231	91	32	35	119	52	101	44	11	4.8	10	4.3
NL	1419**	323	97	30	748**	35	523**	37	148**	10	50**	3.5
A	597	92	52	57	298	50	235	39	64	11	51	8.5
P***	648	100	28	28	428	66	189	29	31	4.8	17	2.6
FIN	2460	182	101	55	1290	52	1035	42	135	5.5	114	4.6
S	3046	204	74	36	1894	62	1079	35	73	2.4	68	2.2
UK	1372	180	83	46	860	63	473	35	39	2.8	33	2.4
Nor-way	3091	156	73	47	2060	67	971	31	60	1.9	55	1.8
Iceland	304	38	28	74	163	54	131	43	10	3.3	10	3.3
EU + Nor-way + Iceland	**40577**	**142**	**62**	**44**	**25837**	**64**	**13003**	**32**	**1737**	**4.3**	**1407**	**3.5**

* Monitoring samples only, excluding compliance samples

** Excluding pears additionally sampled for chlormequat analysis and peppers additionally sampled for methamidophos analysis only

*** Fresh products only, excluding processed products

▲ Some samples with multiple residues have been reported more than once (as findings in different categories)

4.2. Results of the 1999 national monitoring programmes compared to the previous years

Figure 1 gives an overview of the residue situation of 1999 compared to the previous years. It shows that the percentage of samples with no detectable residues remained at about the same level over the years 1996 - 1998 (60 - 61 %) and increased in 1999 to 64 %. However, in 1999 the percentage of samples with residues above the MRL (national or EC-MRL) has also increased significantly from 3.0 - 3.4 % in 1996 - 1998 to 4.3 % in 1999. Accordingly the percentage of samples with residues at or below the MRL (national or EC-MRL) was lower (32 % in 1999, compared to 36 % - 37 % in 1996 - 1998).

As a reaction to special problems with chlormequat on pears and methamidophos on peppers, several countries took additional compliance samples directed to those problems and therefore more likely to have a higher rate of positive findings. For reasons of better comparability of different countries those samples have been excluded from the above overview where possible (where the data were reported separately).

However, a calculation including those data was performed and, as expected, this resulted in a higher rate of MRL violations (4.9 % instead of 4.3 %) and a slightly increased rate of samples with residues below or at the MRL (33 % instead of 32 %).

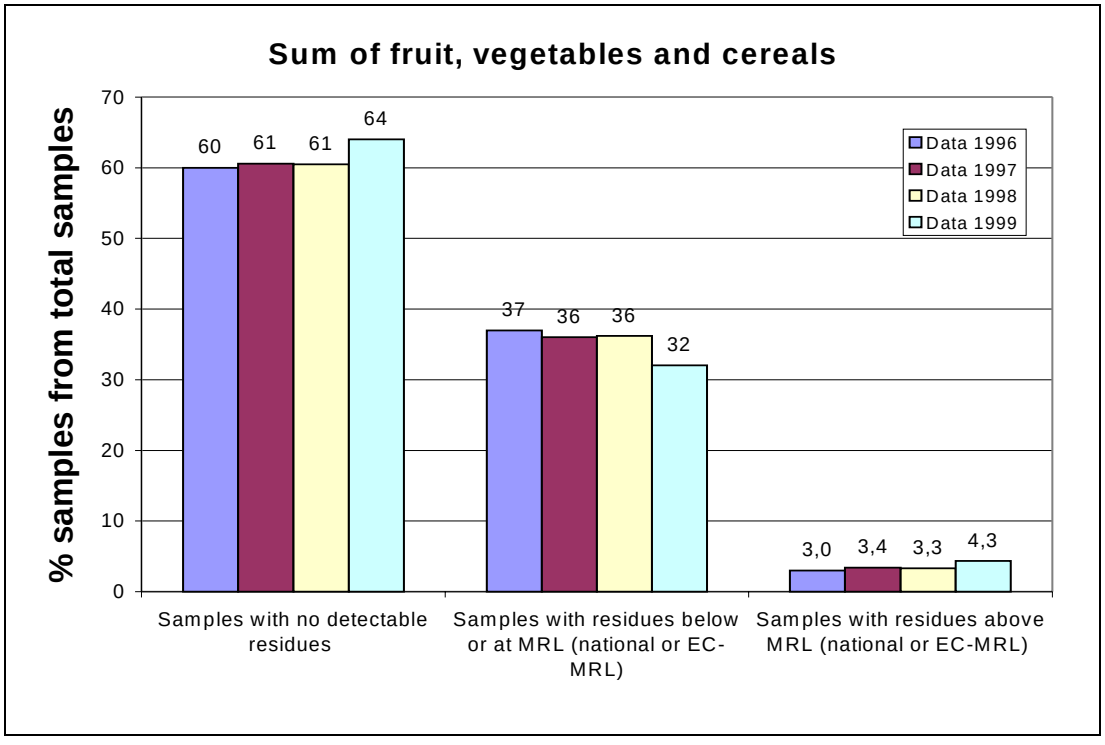

Figure 1: National monitoring results 1996 - 1999 for fruit, vegetables and cereals

4.3. Samples with multiple residues

Table 2 summarises samples in which more than one pesticide residue had been found. Residues of more than one pesticide were found in about 14 % of the analysed samples. In most of these cases (8.3 %), residues of two pesticides were found, followed by 3.6 % of samples containing three residues. In 2.2 % of the samples, residues of four or more different pesticides were found.

Table 2: Samples with residues of more than one pesticide

	No. of samples analysed	2	3	4	5	6	7	8 and more	No. of samples with multiple residues	%
B*	1587	113	60	18	9	7	3	0	210	13.2
DK	2287	206	94	44	10	4	2	0	203	12.8
D	6617	486	166	60	15	4	1	1	733	11.1
EL	1422	117	25	11	2	0	1	0	156	11.0
E**	--	--	--	--	--	--	--	--	--	--
F	4553	531	304	122	40	23	11	2	1033	22.7
IRL	232	28	12	7	2	0	0	0	49	21.1
I***	7938	327	71	22	2	2	0	0	424	5.3
L	231	27	12	9	2	0	0	0	50	21.7
NL	2110	184	116	44	27	9	1	1	382	18.1
A	597	85	34	26	1	1	1	1	149	25.0
P	757	58	9	0	0	0	0	0	67	8.9
FIN	2460	340	203	123	36	13	4	0	719	29.2
S	3046	330	129	50	13	0	1	0	523	17.2
UK	1372	119	32	14	6	1	0	0	172	12.5
Norway	3091	260	115	39	5	1	0	0	420	13.6
Iceland	304	45	13	9	7	0	1	0	75	24.7
EU + Norway+ Iceland[11]	**39295**	**3256**	**1395**	**598**	**177**	**65**	**26**	**5**	**5522**	
%		**8.3**	**3.6**	**1.5**	**0.45**	**0.17**	**0.066**	**0.013**	**14.1**	

* monitoring and compliance sampling

** Spain did not report about multiple residues

***refers to pesticides covered by Directives 86/362/EEC and 90/642/EEC

[11] Excluding Spain from the calculation as Spain did not report about multiple residues

Samples with multiple residues in the years 1996 - 1999

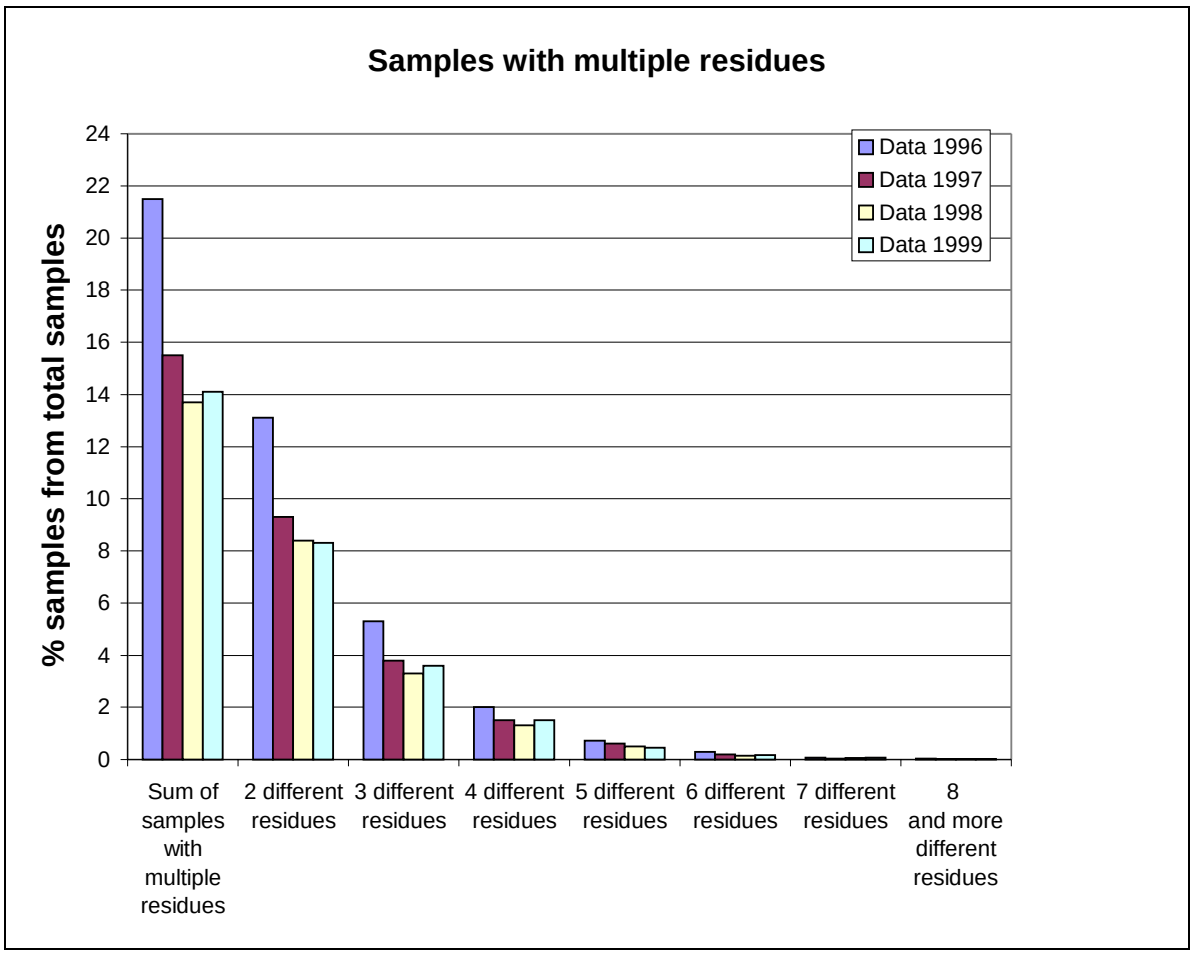

Figure 2: Samples with multiple residues - Comparison of the years 1996 - 1999

Figure 2 gives an overview over the distribution of samples with multiple residues in the years 1996 to 1999. It can be stated that the number of samples with multiple residues decreased from 1996 to 1998, which is shown throughout the different groups (e.g. samples with 2 residues, samples with 3 residues, etc.). This trend did not continue in 1999 as there is a slight increase in the total number of samples with multiple residues. However, it has to be taken into account that the 1996 results are not directly comparable with those of 1997 - 1999, as only eleven countries delivered data in 1996. In 1997 and 1998 fifteen countries out of sixteen delivered data for this overview, in 1999 sixteen countries out of seventeen (Iceland included for the first time) delivered data.

4.4. Pesticides found most often

The pesticides, which were found most often in the national monitoring programmes are shown in Table 3. Member States, Norway and Iceland were asked to prepare a list of the ten most frequently found pesticides in decreasing order of findings. The data received have been included as reported by the respective country.

Table 3: Pesticides found most often in the national monitoring programmes in the European Union, Norway and Iceland for the sum of fruit, vegetables and cereals as reported

Country	Pesticides found most often. The last row lists the pesticides mentioned most often from all Member States and Norway
B*	***Monitoring:*** Iprodione, bromide, maneb group, tolclophos-methyl, propamocarb, vinclozolin, tolylfluanid, procymidone, benomyl group, imazalil ***Compliance sampling:*** chlormequat, methamidophos, endosulfan, acephate, chlorpyriphos-methyl, imazalil, methomyl, oxamyl, pirimiphos-methyl, vinclozolin
DK	Imazalil, maneb group, benomyl group, thiabendazol, endosulfan, chlorpyriphos, ortho-phenylphenol, procymidone, methidathion, iprodione
D	Maneb group, endosulfan, procymidone, iprodione, vinclozolin, chlorpyriphos, benomyl group, thiabendazol, dicofol, bromide
EL	Chlorpyriphos, fenthion, endosulfan, benomyl group, phosalone, maneb group, chlorpyriphos methyl, methamidophos, chlorothalonil, captan
E	Chlorpyriphos, imazalil, endosulfan, procymidone, malathion, methidathion, dicofol, tetradifon, methamidophos, captan
F	Iprodione, maneb group, vinclozolin, benomyl group, imazalil, procymidone, thiabendazole, chlorpyriphos, chlorpropham, phosalone
IRL	Iprodione, thiabendazole, benomyl group, chlorpyriphos, endosulfan, captan, dicofol, chlorothalonil, chlorfenvinphos, methidathion
I	Procymidone, maneb group, chlorpyriphos, imazalil, benomyl group, thiabendazole, iprodione, chlorpyriphos-methyl, endosulfan, vinclozolin
L	Iprodione, procymidone, endosulfan, folpet, thiabendazole, chlorpyriphos, tolclophos-methyl, bromopropylate, vinclozolin, dicofol
NL**	Chlormequat, thiabendazole, methamidophos, iprodione, benomyl group, tolylfluanid, captan, procymidone, chlorpyriphos, bromopropylate, methidathion, pirimicarb
A	Endosulfan, procymidone, methamidophos, iprodione, fenvalerate, azinphos-methyl, dicofol, maneb group, acephate, lambda-cyhalothrin
P	Maneb group, methamidophos, malathion, acephate, benomyl group, captan, phosalone, dimethoate, endosulfan, phosmet
FIN	Endosulfan, thiabendazole, imazalil, chlorpyriphos, malathion, procymidone, iprodione, methidathion, pirimiphos-methyl, bromopropylate
S	Imazalil, thiabendazole, endosulfan, tolylfluanid, chlorpyriphos, captan, azinphos-methyl, maneb group, methamidopßhos, procymidone
UK	Thiabendazole, iprodione, imazalil, DDT, maleic hydrazide, chlorpyriphos, 2,4-D, bromide, pirimiphos-methyl, chlorpropham

Norway	Iprodione, thiabendazole, imazalil, tolylfluanid, methidathion, chlorpyriphos, endosulfan, prochloraz, diazinon, procymidone
Iceland	Thiabendazole, imazalil, ortho-phenylphenole, chlorpyriphos, diphenylamine, methidathion, vinclozolin, procymidone, carbaryl, iprodione
EU, Norway, Iceland	Thiabendazole, iprodione, chlorpyriphos, endosulfan, imazalil, procymidone, benomyl group, maneb group, methamidophos, vinclozolin, methidathion, tolylfluanid, captan, chlormequat

* Belgium reported separately on monitoring and the compliance sampling

** Additional samples for analysis of chlormequat/pears and methamidophos/peppers were included when reporting about the 10 most frequently found pesticides

The table shows that the pesticides found most often were mainly fungicides. These pesticides were already found most often in the 1997 and 1998 national monitoring programmes. There is no significant change from 1997 to 1999. Some Member States analysed additional samples of chlormequat and/or methamidophos in 1999. As a consequence those pesticides were found significantly more often in 1999 than in 1998.

5. THE EU COORDINATED MONITORING EXERCISE

As an EU coordinated monitoring exercise, the Commission recommended in 1999 via Commission Recommendation 1999/333/EC that four commodities should be tested (cauliflower, wheat grains, peppers and melons) for 20 pesticides (acephate, benomyl group, chlorpyriphos, chlorpyriphos-methyl, deltamethrin, maneb-group, imazalil, iprodione, methamidophos, permethrin, vinclozolin, lambda-cyhalothrin, metalaxyl, methidathion, pirimiphosmethyl, thiabendazol, diazinon, endosulfan, mecarbam and triazophos). The 20 pesticides analysed were the same as in 1998.

The benomyl-group comprises three different compounds (benomyl, carbendazim, thiophanate-methyl), which are analysed with the same analytical method and determined as sum, expressed as carbendazim. The maneb-group, by legal definition, comprises five different dithiocarbamates, which are also determined as sum, expressed as CS_2.

All Member States and Norway participated in the EU coordinated programme. Overall, around 4 700 samples were analysed (942 cauliflower samples, 1 159 wheat grain samples, 1 717 pepper samples and 863 melon samples). However, not all samples were analysed for all 20 pesticides.

5.1. Sampling design applied in the 1999 EU coordinated monitoring programme

5.1.1. Description of the sampling design

In order to achieve reliable information concerning the concentration of pesticides in fruit, vegetables and cereals on the European market a suitable sampling plan is required. According to Commission Recommendation 1999/333/EC, each Member State has to take the minimum number of samples specified in the Annex (cf. Table 4).

The sampling design of the coordinated programme is based on a statistical method proposed by Codex Alimentarius[12]. Based on a binomial probability distribution it can be calculated that examination of a total sample number of 459 gives a 99 % confidence of detecting one sample containing pesticides above a specific level if it is anticipated that 1 % of products of plant origin will contain residues above this specific level. This level could be the reporting level[13] or the MRL.

The minimum numbers of samples to be taken of each commodity were fixed at a different level for each country, according to their population and consumer numbers, since adjusting the sample size to the largeness of the national markets improves the precision of the sampling design. The required number of samples varied between 12 and 93, resulting in a total of 460 samples for all Member States and 484 samples for all participating countries (incl. Norway and Iceland). This procedure was the same as in the 1998 exercise. In 1999 the recommended number of samples was taken in most cases, in many cases even more samples were taken than recommended. Table 4 shows the required number of samples by Member State compared to the number of samples actually taken.

Table 4: Numbers of samples taken by Member State for each commodity

Country	Recommended number of samples (for each commodity)	Number of samples taken by commodity			
		Cauliflower	Peppers	Wheat grains	Melon
B	12	30	58	29	49
DK	12	23	32	58	30
D	93	296	345	181	257
EL	12	14	83	30	44
E	45	42	45	45	45
F	66	66	54	173	57
IRL	12	12	13	13	12
I	65	74	144	166	57
L	12	15	15	20	15
NL	17	37	283	46	23
A	12	12	12	12	12
P	12	65	97	70	68
FIN	12	44	279	13	9
S	12	48	126	140	69

[12] Codex Alimentarius, Pesticide Residues in Foodstuffs, Rome 1994, ISBN 92-5-203271-1; Vol. 2, p. 372

[13] The reporting level is the routinely achievable limit of quantification (lowest level at which residues will be reported as absolute numbers) for the monitoring laboratories and normally corresponds to the lowest calibrated level.

UK	66	71	71	62	72
Total EU	**460**	**849**	**1657**	**1058**	**819**
Norway	12	79	60	101	44
Iceland	12	14	13	0	13
Total	**484**	**942**	**1730**	**1159**	**876**

5.1.2. Statistical evaluation of the results of the coordinated exercise

As described in section 5.1.1. the statistical approach of Codex Alimentarius requires at least one sample of the whole number of samples must contain a specific concentration of a certain pesticide (e.g. above the reporting level or above the MRL) in order to assess the lowest portion of food items containing pesticides above this specific level in the whole population. In the following section this lowest portion shall be estimated on a 95 % confidence level for each of the 20 pesticides.

The portion of samples with residues below or at the MRL (grey columns) or exceeding the MRL (white columns) of the respective pesticide are shown in Figures 3 and 4. The results are presented in a logarithmic scale in order to accommodate a broad range of data in the figures. In addition, the corresponding confidence interval on the 95 % level is shown, reflecting the sampling error. The sampling error, in this context, reflects the variability of the data due to the different numbers of samples taken for the determination of the respective pesticide. Other error sources, such as the way how and when the samples were taken are not included in this estimation.

The impact of the sampling error on the final result is illustrated using the reported concentrations of the benomyl group in the food items. 2552 samples have been analysed and 29 of them showed residues below or at the MRL. The number of 2552 samples represents only a part of the whole European market, therefore the calculated fraction of samples with residues below or at the MRL (29/2552 = 1.13 %) is only an estimate for the true but unknown value. The variability of this value can be calculated and is expressed in terms of % samples shown as error bars in Figures 3 and 4. For the example of the benomyl group this means that the true value of the number of samples with residues at or below the MRL would vary between 19 and 42 samples which corresponds to a range of 0.76 % to 1.63 %.

The relative sampling error increases with decreasing numbers of samples of a certain category. For cases where no samples with exceeding MRLs have been found, those error bars reflect the actual percentage of the specific commodity in the whole population which still could contain residues above the MRL. For example no sample with residues exceeding the MRL for mecarbam was found in the coordinated monitoring exercise, but the upper limit of the error range is 0.11 %, which means that still 0.11 % of the specific commodities in the whole population (European market) could have exceeding MRLs for mecarbam. This upper limit of the error range is similar for the other pesticides, for which no residues exceeding the MRL have been found (e.g. deltamethrin, iprodione, lambda-cyhalothrin, permethrin and vinclozolin). The limit of 0.11 % is very low, because in the coordinated exercise high numbers of samples (varying from 2200 to 4200 for the individual pesticides) were taken. This ensures sufficient precision of the results and allows for subsequent risk analysis calculations to be carried out.

Statistical evaluation of the results of the coordinated exercise:
Percentage of samples with residues at or below MRL (national or EC-MRL) or exceeding the MRL (national or EC-MRL) for a specific pesticide with the respective error bars in a logarithmic scale

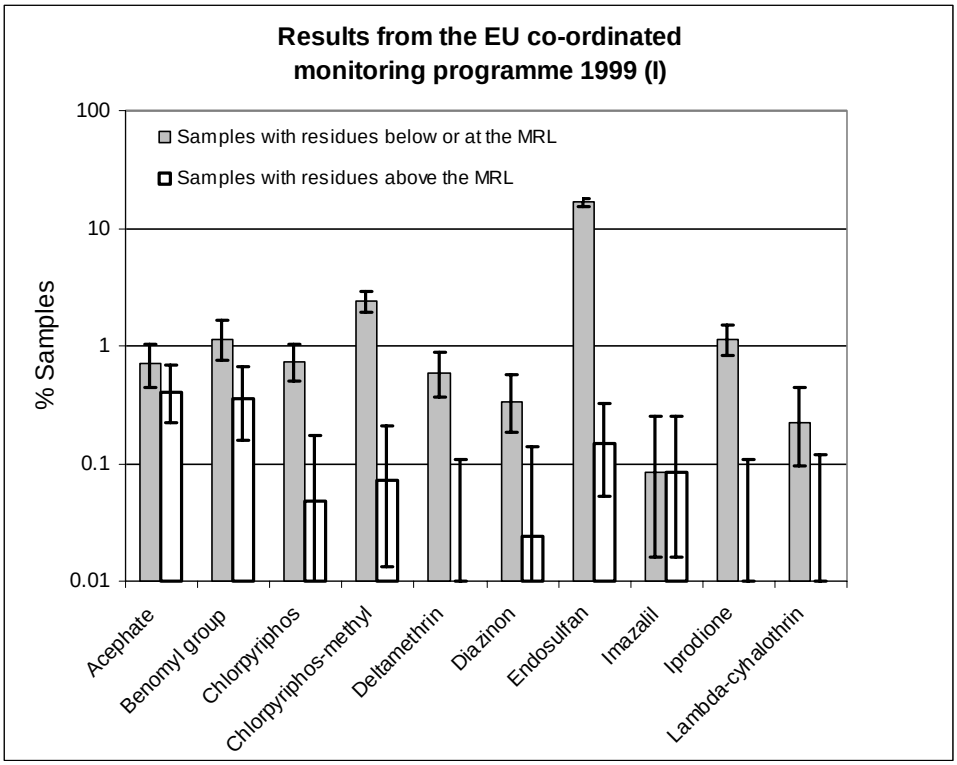

Figure 3: Results of the monitoring programme (I)

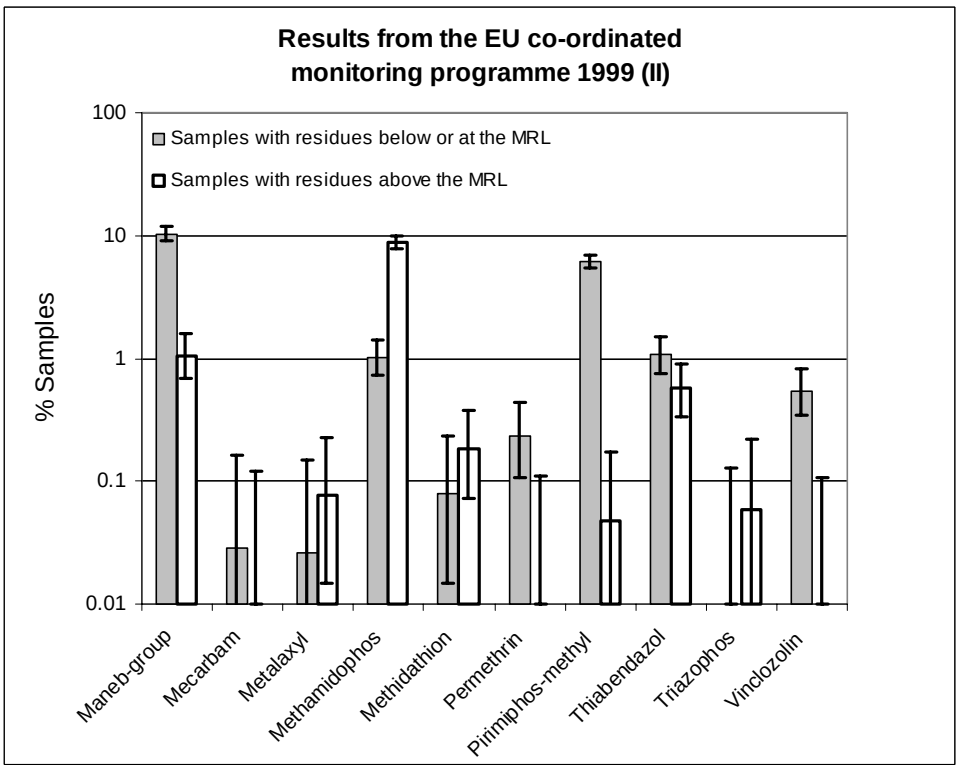

Figure 4: Results of the monitoring programme (II)

5.2. Evaluation by pesticide

The summarised results are given in Table 5 for all twenty pesticides. The table also gives information on the highest residue of a particular pesticide found in a composite sample in this monitoring exercise. Table 6 shows a selection of the most important pesticide-commodity combinations. More details can be found in Annex 2, where the complete results for all reporting countries and all commodities are given.

The results vary among the twenty different pesticides investigated. In the EU coordinated monitoring programmes, residues of endosulfan were found most often (16.9 %* of all samples), followed by the maneb group (11.5 %*), pirimiphos-methyl (6.3 %*) and chlorpyriphos-methyl (2.5 %*).

Endosulfan was found mainly in peppers and melons. 31.7 %* of all pepper samples and 27.3 %* of all melon samples contained endosulfan. Residues of the maneb group were found most often in cauliflowers with 28.9 %* of the cauliflower samples containing residues of the maneb group. When evaluating the results for the maneb group in cauliflower it has to be borne in mind that brassica vegetables generate carbon disulfide themselves, which would be analysed together with the carbon disulfide originating from dithiocarbamate residues. Some of the positive findings for the maneb group might be false positives, caused by the natural carbon disulfide content of cauliflower.

Residues of methamidophos were found most often in peppers (20.7 %* of pepper samples contained methamidophos).

Residues of pirimiphos-methyl and chlorpyriphos-methyl were found most often in wheat grains (13 %* of wheat grain samples were positive for pirimiphos-methyl and 7.2 %* were positive for chlorpyriphos-methyl).

Residues of methamidophos exceeded MRLs most often (8.7 % of all samples), followed by the maneb group (1.1 %), thiabendazol (0.57 %), acephate (0.41 %) and the benomyl group (0.35 %).

The MRL for methamidophos was exceeded most often on peppers and melons (18.7 % of all pepper samples and 3.7 % of all melon samples). The residues of the maneb group exceeded the MRL most often on cauliflower (3.9 % of all cauliflower samples). Residues of thiabendazol exceeded the MRL most often on melons (2.8 % of the melon samples).

Figures 5 and 6 illustrate the findings with regard to the 20 different pesticides. In Figures 5 and 6 the scale of the axis has been chosen in a way to that lower values appear clear enough, therefore the highest residues in both figures exceed the scale. However, to show the exact value, this value has been indicated as label above the column.

The highest residues found were 4.6 mg/kg imazalil on peppers (EC-MRL: 0.02 mg/kg), 3.9 mg/kg pirimiphos-methyl on wheat grains (EC-MRL: 5.0 mg/kg) and 3.8 mg/kg maneb group on melons (EC-MRL: 0.5 mg/kg).

* Percentages include sum of samples with residues at or below the MRL and exceeding the MRL

Table 5: Results from the EU coordinated monitoring programme for pesticide residues for each pesticide analysed for in cauliflower, peppers, wheat grains and melons

Pesticide	Total No. of samples	No. of samples without residues	No. of samples with residues below or at MRL	%	No. of samples with residues above MRL	%	Maximum residue found in mg/kg (commodity in which it was found and the EC-MRL in mg/kg)
Acephate	3434	3396	24	0.70	14	0.41	1.4 (melons, EC-MRL: 0.02)
Benomyl group	2552	2514	29	1.1	9	0.35	1.0 (peppers, EC-MRL: 0.1)
Chlorpyriphos	4211	4178	31	0.74	2	0.05	0.30 (peppers, EC-MRL: 0.5)
Chlorpyriphos-methyl	4215	4111	101	2.4	3	0.07	1.0 (wheat, EC-MRL: 3.0)
Deltamethrin	3963	3940	23	0.58	0	0	0.17 (wheat, EC-MRL: 1.0)
Diazinon	4166	4151	14	0.34	1	0.02	0.18 (cauliflower, EC-MRL: 0.5)
Endosulfan	4071	3387	678	16.7	6	0.15	1.5 (peppers, EC-MRL: 1.0)
Imazalil	3557	3551	3	0.08	3	0.08	4.6 (peppers, EC MRL: 0.02)
Iprodione	4034	3988	46	1.1	0	0	1.6 (peppers, EC MRL: 5.0)
Lambda-cyhalothrin	3614	3606	8	0.22	0	0	0.03 (peppers, no EC-MRL fixed[14])
Maneb-group	2265	2006	235	10.4	24	1.1	3.8 (melon, EC-MRL: 0.5)
Mecarbam	3500	3499	1	0.03	0	0	0.02 (cauliflower, EC-MRL: 0.05)
Metalaxyl	3863	3859	1	0.03	3	0.08	0.13 (peppers, no EC-MRL fixed[15])
Methamidophos	3731	3365	38	1.0	328	8.8	2.8 (peppers, EC-MRL: 0.01)
Methidathion	3805	3795	3	0.08	7	0.18	0.062 (peppers, EC-MRL: 0.02)

[14] New MRL according to Commission Directive 2000/42/EC: 0.1 mg/kg (OJ No. L 158, 30.06.2000, p. 0051 - 0075)

[15] New MRL according to Commission Directive 2000/42/EC: 0.05 mg/kg (OJ No. L 158, 30.06.2000, p. 0051 - 0075)

Pesticide	Total No. of samples	No. of samples without residues	No. of samples with residues below or at MRL	%	No. of samples with residues above MRL	%	Maximum residue found in mg/kg (commodity in which it was found and the EC-MRL in mg/kg)
Permethrin	3868	3859	9	0.23	0	0	0.47 (peppers, EC-MRL: 0.5)
Pirimiphos-methyl	4216	3954	260	6.2	2	0.05	3.9 (wheat grains, EC-MRL:5.0)
Thiabendazol	3168	3116	34	1.1	18	0.57	1.4 (melons, no EC-MRL fixed[16])
Triazophos	3372	3370	0	0	2	0.06	0.24 (peppers, EC-MRL: 0.02)
Vinclozolin	4046	4024	22	0.54	0	0	0.31 (peppers, EC-MRL:3.0)

[16] New MRL according to Commission Directive 2000/42/EC: 0.05 mg/kg (OJ No. L 158, 30.06.2000, p. 0051 - 0075)

Results of the 1999 coordinated exercise by pesticide:
Fig. 5: Percentage of samples at or below MRL (national or EC) and
Fig. 6: Percentage of samples exceeding the MRL (national or EC)

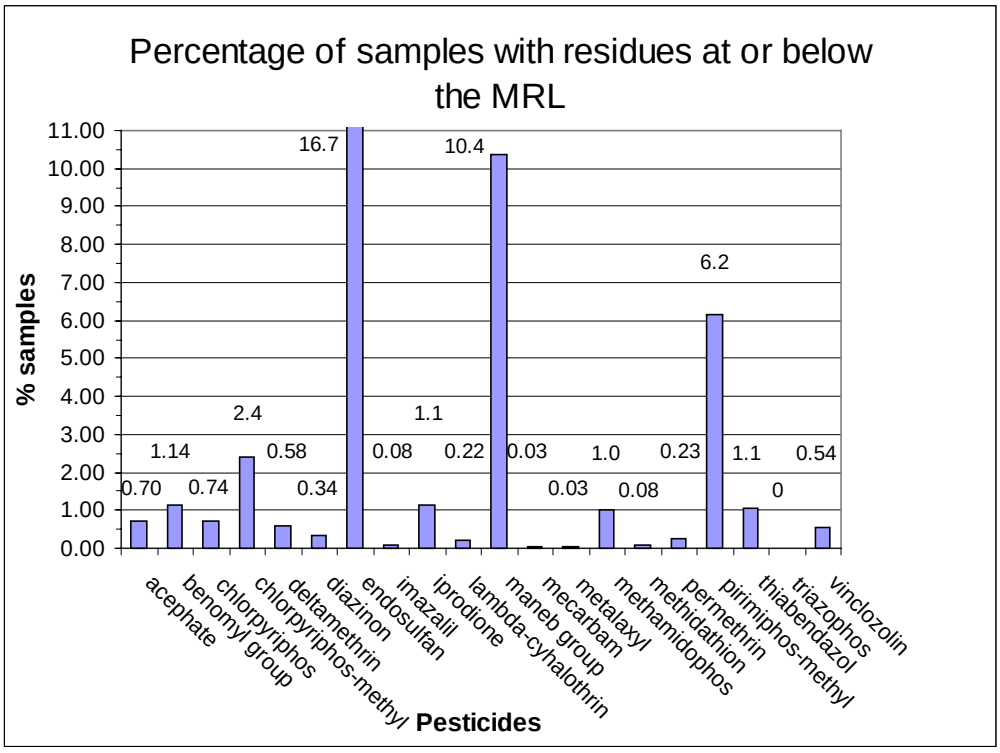

Figure 5: Samples with residues at or below MRL (national or EC-MRL)

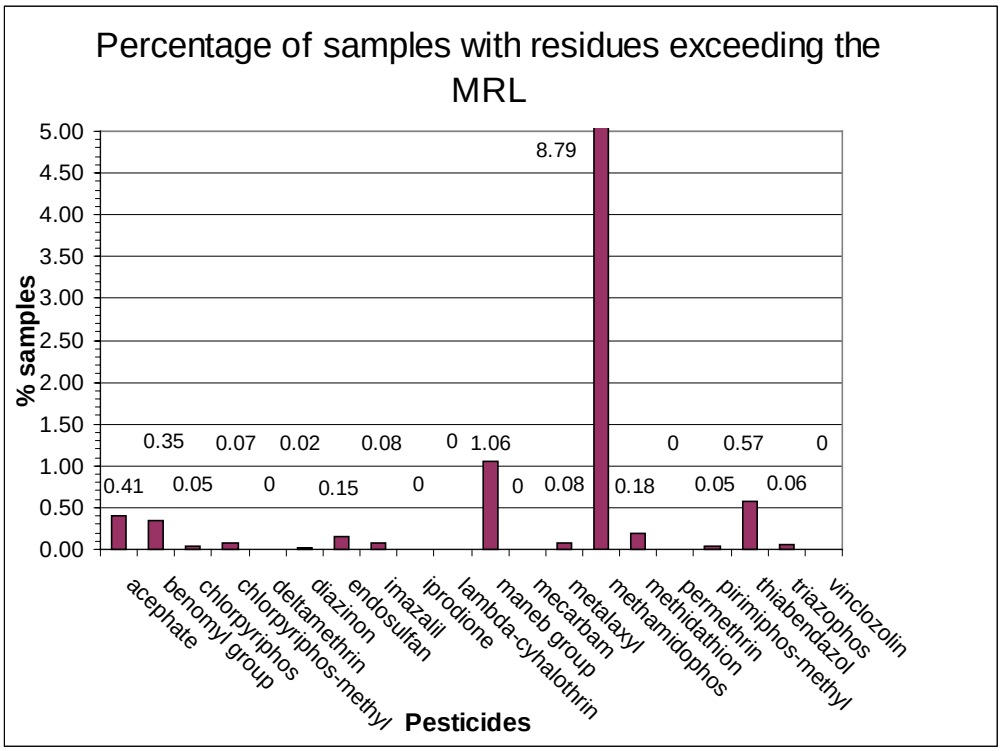

Figure 6: Samples with residues exceeding the MRL (national or EC-MRL)

Table 6: Presentation of the most important pesticide-commodity combinations where residues were found (in alphabetical order)

Pesticides	Detected most often in[17]	MRL exceeded most often in
Acephate		**Melons** (0.79 % of all melon samples, 0.17 % of total samples, respectively)
		Peppers (0.56% of all pepper samples, 0.12 % of total samples, respectively)
Benomyl group		**Cauliflower** (0.61 % of all cauliflower samples, 0.23 % of total, respectively)
		Peppers (0.55 % of all pepper samples, 0.20 % of total, respectively)
Chlorpyriphos-methyl	**Wheat grains (**7.2 % of all wheat grain samples, 1.8 % of total, respectively)	
Endosulfan	**Peppers** (31.7 % of all peppers, 11.0 % of total samples, respectively)	
	Melons (27.3 % of all melons, 5.7 % of total samples, respectively)	
Methamidophos	**Peppers** (20.7 % of all peppers; 8.8 % of total samples, respectively)	**Peppers** (18.7 % of all pepper samples, 8.0 % of total samples, respectively)
		Melons (3.7 % of all melon samples, 0.78 % of total samples, respectively)

[17] Percentages in this column include samples at or below the MRL and exceeding the MRL

Pesticide	Detected most often in	MRL exceeded most often in
Maneb group	**Cauliflower** (28.9 % of all cauliflower samples, 7.2 % of total samples, respectively)	**Cauliflower** (3.9 % of all cauliflower samples, 0.97 % of total samples,
Pirimiphos-methyl	**Wheat grains** (13 % of all wheat grain samples, 3.4 % of total samples, respectively)	
Thiabendazol	**Melons** (2.8 % of all melon samples, 0.54 % of total samples, respectively)	

The most important pesticide-commodity combinations where detectable residues were found (incl. those at or below the MRL and exceeding the MRL) were endosulfan/peppers, methamidophos/peppers, maneb group/ cauliflower and endosulfan/melons. With regard to the findings of residues of the maneb group on cauliflower some comments have been made under chapter 5.2, page 15.

With regard to MRL exceedances the most important pesticide-commodity combinations were methamidophos/ peppers and maneb group/cauliflower.

It is evident from Table 5 and 6 that the commodity where most often residues were detected and exceeded, and where the highest residues were found, was peppers.

Table 7 shows a comparative overview of pesticides found most often with residues at or below the MRL (national or EC-MRL) and pesticides exceeding MRLs (national or EC-MRLs) analysed on different commodities in 1997, 1998 and 1999.

Endosulfan, pirimiphos-methyl, chlorpyriphos-methyl and the maneb group were detected significantly more often with residues below or at the MRL (national or EC-MRL) on the 1999 commodities (cauliflower, peppers, wheat grains, melons) than on the 1997 commodities (mandarins, pears, bananas, potatoes) and the 1998 commodities (oranges, peaches, carrots, spinach), whereas chlorpyriphos, imazalil, mecarbam, metalaxyl, methidathion, thiabendazol and the benomyl group were detected less often on the 1999 commodities.

The pesticides most often exceeding the MRL were also different on the 1999 commodities compared to the 1997 and 1998 commodities. Methamidophos, methidathion, endosulfan and thiabendazol exceeded the MRL significantly more often on the 1999 than on the 1997 and 1998 commodities, whereas vinclozolin, diazinon and the maneb group exceeded the MRL significantly less often on the 1999 commodities.

Many of the frequently found pesticides in 1998 (e.g. imazalil, maneb-group) were not analysed on the 1997 commodities (only 11 pesticides were the same in 1997 and 1998), but in 1999 all 20 pesticides were the same as in 1998.

Table 7: Comparison of pesticides found most often and pesticides exceeding MRLs (national or EC-MRLs) analysed on different commodities in 1997, 1998 and 1999

Commodities	**Mandarins, pears, bananas, beans, potatoes (commodities analysed for in the 1997 programme)**		**Oranges, peaches, carrots, spinach (commodities analysed for in the 1998 programme)**		**Cauliflower, peppers, wheat grains, melons (commodities analysed for in the 1999 programme)**	
	% samples with residues below or at MRL	**% samples with residues above MRL**	**% samples with residues below or at MRL**	**% samples with residues above MRL**	**% samples with residues below or at MRL**	**% samples with residues above MRL**
Acephate	0.16	0	0.23	0.21	0.70	0.41
Benomyl group	4.5	0.03	3.8	0.43	1.1	0.35
Chlorothalonil	0.20	0.09	Not analysed	Not analysed	Not analysed	Not analysed
Chlorpyriphos	6.5	0.24	7.3	0.29	0.74	0.05
Chlorpyriphos-methyl	Not analysed	Not analysed	0.83	0.06	2.4	0.07

Commodities	Mandarins, pears, bananas, beans, potatoes (commodities analysed for in the 1997 programme)		Oranges, peaches, carrots, spinach (commodities analysed for in the 1998 programme)		Cauliflower, peppers, wheat grains, melons (commodities analysed for in the 1999 programme)	
	% samples with residues below or at MRL	% samples with residues above MRL	% samples with residues below or at MRL	% samples with residues above MRL	% samples with residues below or at MRL	% samples with residues above MRL
DDT	0.04	0.02	Not analysed	Not analysed	Not analysed	Not analysed
Deltamethrin	Not analysed	Not analysed	0.38	0	0.58	0
Diazinon	0.55	0	1.1	0.10	0.34	0.02
Endosulfan	1.3	0	2.0	0.02	16.7	0.15
Imazalil	Not analysed	Not analysed	19	0.10	0.08	0.08
Iprodion	1.3	0.13	4.0	0.30	1.1	0
Lambda-cyhalothrin	Not analysed	Not analysed	0.61	0	0.22	0
Maneb group	Not analysed	Not analysed	5.5	2.1	10.4	1.1
Mecarbam	Not analysed	Not analysed	0.43	0	0.03	0
Metalaxyl	0.45	0	1.4	0.02	0.03	0.08
Methamido-phos	0.48	0.18	0.52	0.36	1.0	8.8
Methidathion	5.9	0	6.6	0.02	0.08	0.18
Permethrin	Not analysed	Not analysed	0.59	0.15	0.23	0
Pirimiphos-methyl	Not analysed	Not analysed	0.89	0	6.2	0.05
Thiabendazol	18	0.08	10	0.15	1.1	0.57
Triazophos	0.04	0	0.07	0.02	0	0.06
Vinclozolin	Not analysed	Not analysed	0.81	0.41	0.54	0

5.3. Evaluation by commodity

Tables 8 and 9 give an overview over the findings in the different commodities. With regard to all four commodities investigated, about 22 % of the samples contained residues of pesticides at or below the MRL, and 8.7 % above the MRL (7.9 % for EC-MRLs, 0.8 % for national MRLs) (Table 8). Residues at or below the MRL were found most often in melons (32 %), followed by peppers (24 %), wheat grains (21 %) and cauliflower (17 %). MRLs (including national or EC-MRLs) were exceeded most often in peppers (19 %), followed by melons (6.1 %), cauliflower (3.0 %), and wheat grains (0.5 %).

In those results no differentiation is made with regard to findings of several pesticides in the same sample, that means a sample where two different pesticides were found would be counted just as one finding with detectable residues in Table 8.

Supplementary to that, Table 9 shows the residues found in individual determinations, that means the findings with regard to every single pesticide. In this table a sample where two different pesticides were found would be counted as two findings with detectable residues. In this table the order of findings is different from Table 8. Residues of a specific pesticide at or below the MRL were found most often in peppers (3.0 %), followed by melons (2.2 %), wheat grains (1.6 %) and cauliflower (1.0 %). This is different from the above result since peppers range before melons. Pesticide residues exceeding the MRL were found most often in peppers (1.2 %), followed by melons (0.37 %), cauliflower (0.17 %) and wheat grains (0.03 %). This corresponds to the results given in Table 7.

Table 8: Residues found in the four commodities analysed in the EU coordinated monitoring programme

	Number of samples analysed	**Without detectable residues**	**%**	**With residues below or at MRL (national or EC-MRL)**	**%**	**With residues above MRL (national or EC-MRL)**	**%**
Cauliflower	942	754	80.0	160	17.0	28	3.0
Peppers	1730	969	56.0	422	24.4	326	18.8
Wheat grains	1159	908	78.3	245	21.1	6	0.5
Melon	876	528	60.3	282	32.2	53	6.1
SUM	4707	3227	68.6	1043	22.2	411	8.7

Table 9: Residues found in individual determinations (ind. det.) in the four commodities analysed in the EU coordinated monitoring programme

	Total number of ind. det.	**Number of ind. det. without residues**	**Number of ind. det. with residues below or at MRL (national or EC)**	**%**	**Number of ind. det. where a residue exceeded the MRL (national or EC)**	**%**
Cauliflower	16511	16312	171	1.0	28	0.17
Peppers	27147	26004	810	3.0	333	1.2
Wheat grains	14683	14441	238	1.6	4	0.03
Melon	15310	14912	341	2.2	57	0.37
SUM	73651	71669	1560	2.1	422	0.60

5.4. Evaluation by country

With regard to the twenty pesticides and the four commodities of the coordinated programme, residues at or below the MRL (national or EC-MRL) were found in 22 % of the samples. In 7.9 % of the samples these residues exceeded MRLs (national or EC-MRLs). Differences between countries can result e.g. from different sampling approaches (relation of compliance and surveillance sampling), amounts of samples analysed for pesticides that are most likely to be found, and reporting levels (cf. chapter 4.1). Table 10 shows the results sorted by country and Figure 7 illustrates those results.

Table 10: Residues of pesticides in the four commodities as analysed in the Member States, Norway and Iceland

	Number of samples analysed	**Without detectable residues**	**%**	**With residues below or at MRL (national or EC-MRL)**	**%**	**With residues above MRL (national or EC-MRL)**	**%**
B	166	148	89	9	5.4	9	5.4
DK	143	109	76	33	23	1	0.7
D	1079	591	55	406	38	82	7.6
EL	171	147	86	17	9.9	7	4.1
E	177	147	83	12	6.8	18	10.2
F	350	208	59	125	36	17	4.9
IRL	50	40	80	7	14	3	6.0
I	441	402	91	37	8.4	2	0.5
L	65	50	77	13	20	2	3.1
NL*	389	247	64	26	6.7	116	30
A	48	27	56	11	23	10	21
P	300	232	77	51	17	17	5.7
FIN	345	113	33	151	44	81	24
S	383	270	71	77	20	36	9.4
UK	276	227	82	41	15	8	2.9
Norway	284	255	90	27	9.5	2	0.7
Iceland	40	36	90	3	7.5	1	2.5
EU+ Norway +Iceland	**4707**	**3249**	**69**	**1046**	**22**	**412**	**8.7**

* including pepper samples analysed for methamidophos only

Evaluation of the results of the 1999 coordinated exercise by country:
Percentage of samples without detectable residues, with residues at or below MRL (national or EC-MRL) and with residues exceeding the MRL (national or EC-MRL)

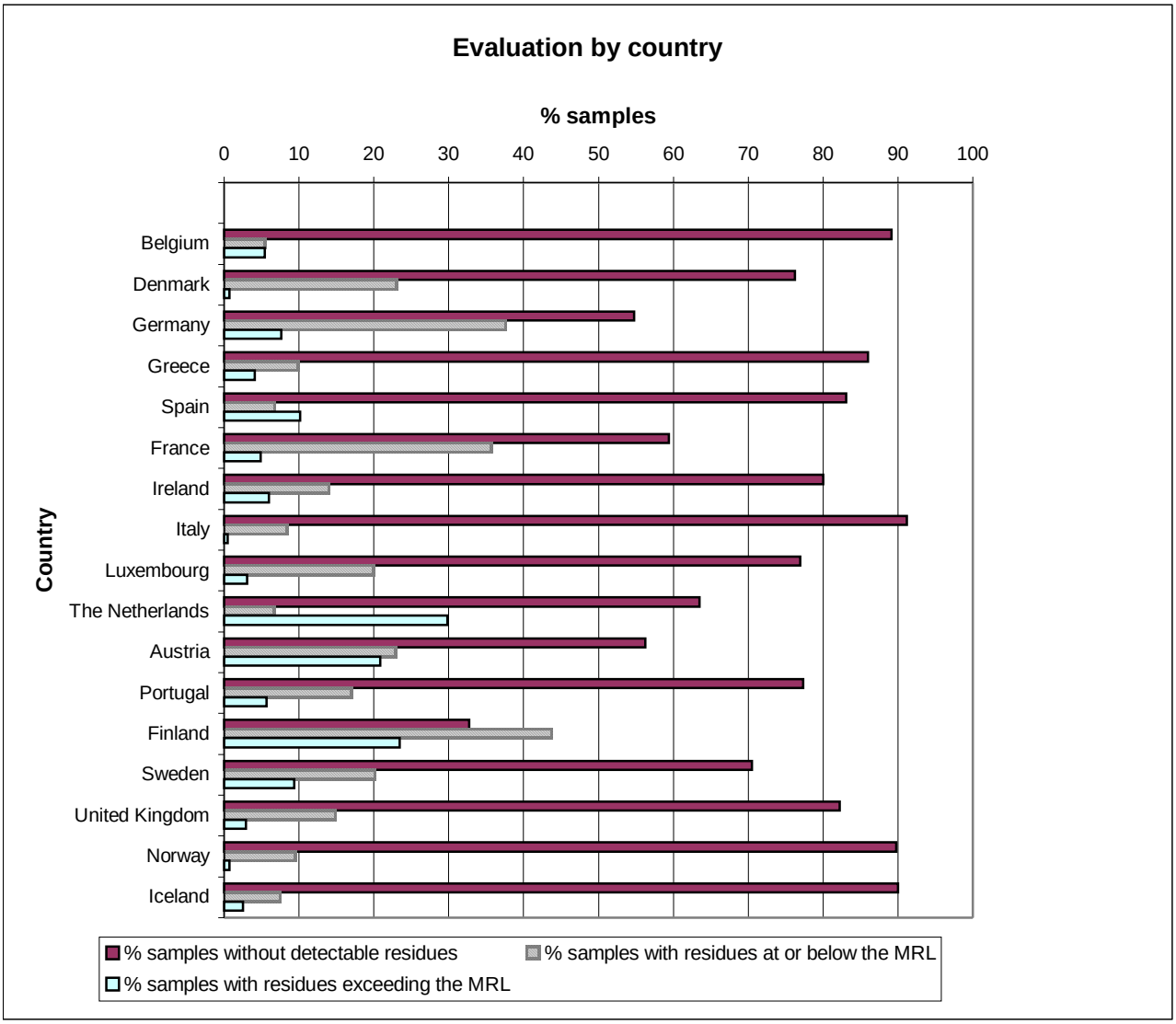

Figure 7: Percentage of samples without residues, with residues at or below the MRL and with residues exceeding the MRL sorted by country

5.5. Homogeneity exercise

In 1999 for the first time a special exercise was introduced to determine the distribution of pesticide residues in the individual sample units taken from commercial trade, which form part of the analytical sample (composite sample). As the sample units may or may not originate from the same producer and therefore may or may not have had the same sample treatment history the single items' residue content can differ. In order to get an idea of the variability of the single units (and therefore of the homogeneity of the composite monitoring sample) the participating countries were required to carry out this exercise for a pesticide, possibly posing an acute risk. In 1999 methamidophos on peppers was the recommended pesticde-commodity combination. It was recommended to take two samples of an appropriate number of items, analyse the first sample as composite sample after mixing the items and, in case of detectable residues in the composite sample, to analyse then the single items of the second sample. The participating countries were also required to give information whether the single units of a sample were taken from a single producer.

The homogeneity of the composite monitoring sample was expressed by calculating a factor, which was called "homogeneity factor" or "factor for the homogeneity of the sample" in order to clearly distinguish this factor from the variability factor (υ) obtained from supervised field trials. The homogeneity factor indicates the variability of the single items' results of a composite monitoring sample, taken in commercial trade. It was calculated in the same way as the variability factor for supervised field trials is usually calculated, i.e. by division of the maximum value of the single items' results by the mean value of the single items' results.

Eight out of seventeen countries delivered data for this exercise. In one case the composite sample was negative and no further single items were analysed. In the other seven cases between two and fourteen samples were taken and, within each sample, 10 - 20 single items were analysed. Table 11 shows the results obtained.

Table 11: Results of the homogeneity exercise for methamidophos on peppers obtained in eight countries

Country	Number of compo-site samples analysed	Number of single units analysed in each composite sample	Max. residue found in a single unit (mg/kg)	Average homo-geneity factor	Minimum homo-geneity factor	Maximum homo-geneity factor	Samples taken from single producer
B	9	9-12, mostly 10	0.77	3.40	1.55	7.01	Yes
DK*	--	--	--	--	--	--	
D*	--	--	--	--	--	--	
EL*	--	--	--	--	--	--	
E*	--	--	--	--	--	--	
F*	--	--	--	--	--	--	
IRL*	--	--	--	--	--	--	
I*	--	--	--	--	--	--	
L	1	None, composite sample below reporting limit	--				No
NL	6	20	7.9	5.20	2.81	7.72	No
A	5	10	1.8	3.35	2.40	4.92	No information
P	5	10	1.2	2.52	1.79	3.21	Yes
FIN	2	10	0.41	3.08	3.74	4.84	Yes
S	14	10-12, mostly 12	4.2	3.59	2.29	6.55	Unknown
UK	6	10	2.9	2.92	1.78	3.44	Yes
Norway*	--	--	--	--	--	---	
Iceland*	--	--	--	--	--	--	
All countries	Range: 1-14 Sum: 48	Range: 10-20	Max.: 7.9	Average: 3.44	Min.: 1.55	Max.: 7.72	Differs in each country

* Homogeneity exercise was not carried out

As demonstrated in Table 11 the average factor for the homogeneity of the sample obtained by the seven countries, which delivered single unit data, was 3.44. The minimum homogeneity factor was 1.55, the maximum homogeneity factor was 7.72. The highest methamidophos residue found in a single unit was 7.9 mg/kg.

The distribution of the homogeneity factors obtained in the 47 composite samples analysed unit-to-unit in seven participating countries is illustrated in Figure 8[18].

1999 Homogeneity exercise for methamidophos on peppers:

Homogeneity factors calculated for 47 composite samples, analysed unit-to-unit in seven participating countries

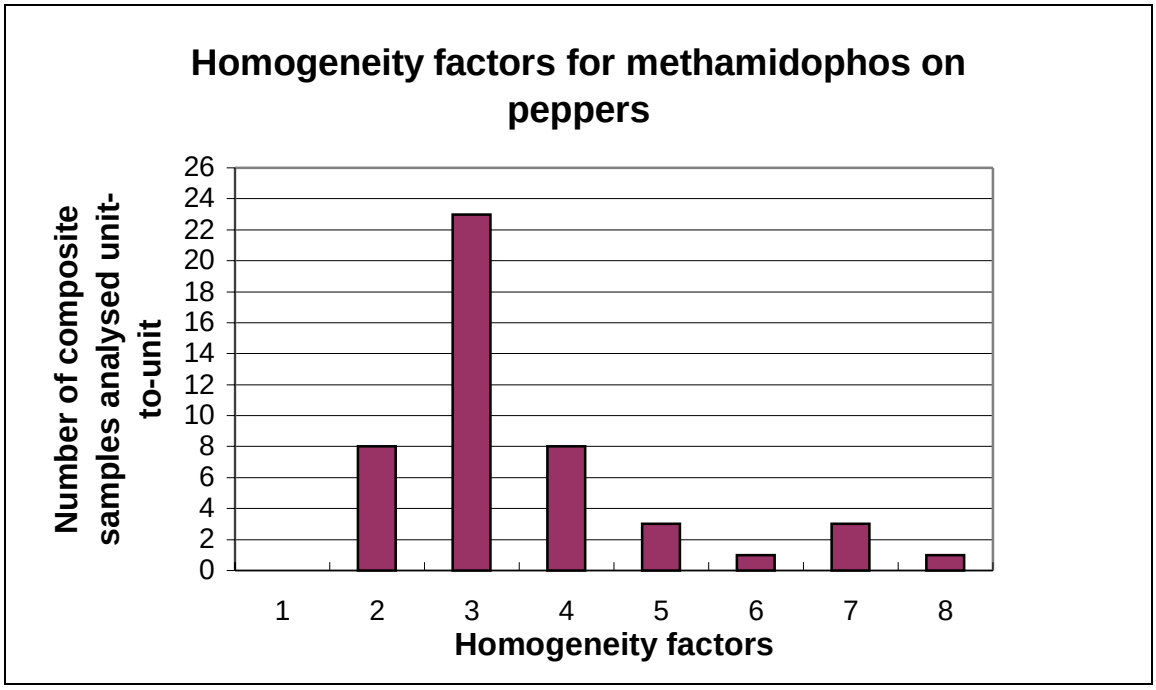

Figure 8: Homogeneity factors for methamidophos on peppers, results of 47 composite samples, analysed unit-to-unit in seven countries

[18] Luxembourg excluded, as composite sample negativ

5.6. Exposure assessment

5.6.1. Chronic risk

To estimate the chronic risk to the consumer of consuming the commodities investigated in the EU coordinated programme, calculations can be done based on consumption figures from the World Health Organisation (Standard European Diet). A realistic exposure assessment for those pesticides representing a chronic risk should not be carried out with the highest residues found, but more correctly with the average residues or, to consider worst case conditions, on basis of the 90th percentile[19]. The 90th percentile of the amount of residues found in the monitoring exercise is the value below which 90 % of the values are situated. The risk assessment was carried out for an adult with an average bodyweight of 60 kg. The intake of a specific pesticide via a specific commodity was calculated and compared with the ADI. The results (as percentage of ADI) are given in Table 12.

Table 12: Exposure assessment for the chronic risk from the dietary intake of pesticide residues (based on the 90th percentile) in those commodities of the coordinated programme in which the highest residues of the respective pesticides were found, calculated for an adult (60 kg bodyweight)

Compound	**Food item**	**90th percentile** (mg pesticide / kg commodity)	**ADI[20]** (mg pesticide / kg body weight	**Average consump-tion** (kg commodity / day)[21]	**Intake via specific commodity** (mg pesticide / day / kg body weight)[22]	**Intake in % of the ADI**
Acephate	Melon	≤ 0.01	0.03	0.0183	--	--
Benomyl group	Pepper	≤ 0.01	0.03[23]	0.0104	--	--
Chlorpyriphos	Pepper	≤ 0.01	0.01	0.0104	--	--
Chlorpyriphos-methyl	Wheat	≤ 0.01	0.01	0.178	--	--
Deltamethrin	Wheat	≤ 0.01	0.01	0.178	--	--
Diazinon	Cauliflower	≤ 0.01	0.002	0.013	--	--
Endosulfan	Pepper	≤ 0.5	0.006	0.0104	0.0000866	1.4
Imazalil	Pepper	≤ 0.01	0.03	0.0104	--	--
Iprodione	Pepper	≤ 0.01	0.06	0.0104	--	--

[19] WHO/FSF/FOS/97.7, p. 14

[20] WHO/PCS/2000.1

[21] Standard European Diet of the World Health Organization

[22] Calculated only if the 90th percentile is above the general reporting limit of 0.01 mg/kg of the agreed format

[23] ADI of carbendazim, as this pesticide has the lowest ADI of the three pesticides (carbenazim, benomyl, thiophanate-methyl) detected as carbendazim

Lambda-cyhalothrin	Pepper	≤ 0.01	--	0.0104	--	--
Maneb-group	Melon	≤ 0.01	0.03/ 0.007[24]	0.0183	--	--
Mecarbam	Cauliflower	≤ 0.01	0.002	0.013	--	--
Metalaxyl	Pepper	≤ 0.01	0.03	0.0104	--	--
Methamidophos	Pepper	≤ 0.1	0.004	0.0104	0.0000173	0.43
Methidathion	Pepper	≤ 0.01	0.001	0.0104	--	--
Permethrin	Pepper	≤ 0.01	0.05	0.0104	--	--
Pirimiphos-methyl	Wheat	≤ 0.05	0.03	0.178	0.000148	0.49
Thiabendazol	Melon	≤ 0.01	0.1	0.0183	--	--
Triazophos	Pepper	≤ 0.01	0.001	0.0104	--	--
Vinclozolin	Pepper	≤ 0.01	0.01	0.0104	--	--

As shown by the results in Table 12 the intake of pesticide residues does not exceed the ADI in any case. It is below a percentage of 1.5 % of the ADI for all pesticides. The exposure ranges from 0.43 % of the ADI for methamidophos to 1.4 % of the ADI for endosulfan.

5.6.2. Acute risk

Currently, there is no universally accepted methodology for evaluating risks from acute exposure. However, as an example, the acute risk can be evaluated by using the UK Consumer Exposure Model, where an exposure assessment is carried out based on the 97.5th percentile of consumption[25]. That means, in order to include consumers with a high consumption of specific commodities, a large portion value is used. The 97.5th percentile is the value below which the consumption of 97.5 % of all consumer is situated. For the 1999 coordinated programme, the evaluation of the acute risk was carried out for those pesticides which have acute toxicity and where acute Reference Doses (acute RfDs) have been set. The highest residue found in a composite sample was used in this calculation. In order to consider worst case conditions a default variability factor of seven[26], taking into account unit-to-unit variability of single units, was used for the medium sized crops. On the basis of those data an exposure assessment for an adult of 70.1 kg and a toddler of 14.5 kg have been carried out and the intake of the specific pesticide via a specific commodity was compared with the acute Reference Dose (acute RfD). The results are shown in Table 13.

For methamidophos on peppers additional calculations have been performed: As calculated in Table 13 under b) the average homogeneity factor of 3.4 (as determined in the homogeneity exercise, chapter 5.5) has been used for the highest residue in a composite sample (2.8 mg/kg). Additionally, under c) in Table 13 the highest residue found in a single unit (7.9 mg/kg) has been used without homogeneity factor.

[24] Group ADI for maneb, mancozeb, metiram, zineb: 0.03; ADI for propineb: 0.007

[25] UK 1998, Technical Policy on the Estimation of Acute Dietary Intakes of Pesticide Residues, AAHL/3/1998, 13 January 1998, PSD, York

[26] 1999 Joint FAO/WHO meeting on Pesticide Residues, Rome 20-29 September 1999, p.11

Table 13: Exposure assessment for the acute risk from the pesticides investigated in the 1999 coordinated programme for the products with the highest residues found in a composite sample in the European Union. The calculation was performed with the UK Consumer Exposure Model for an adult (70.1 kg) and a toddler (14.5 kg) and only those pesticides which have acute toxicity and where an acute Reference Dose has been set.

Compound	**Food item**	**Maximum residue found in a composite sample** (mg pesticide / kg commodity	**acute Reference Dose** (mg pesticide / kg body weight	**97.5th percentile of consumption** (kg commodity / day)[27]	**Homo-geneity factor**	**Intake via specific commodity** (mg pesticide / day / kg body weight)	**Intake in % of the acute Reference Dose**
Chlorpyri-phos	Peppers	0.30	0.1	0.089 (adult)/ 0.050 (toddler)	7	0.0027 (adult)	2.7 (adult)
						0.0072 (toddler)	7.2 (toddler)
Deltamethrin	Wheat	0.17	0.05	0.301 (adult)/ 0.128 (toddler)	none	0.0007 (adult)	1.5 (adult)
						0.0015 (toddler)	3.0 (toddler)
Endosulfan	Peppers	1.5	0.02	0.089 (adult)/ 0.050 (toddler)	7	0.0133 (adult)	67 (adult)
						0.0362 (toddler)	181 (toddler)
Methidathion	Peppers	0.062	0.01[28]	0.089 (adult)/ 0.050 (toddler)	7	0.0006 (adult)	5.5 (adult)
						0.0015 (toddler)	15 (toddler)

[27] Consumer Exposure Model, UK
[28] WHO/PCS/2000.1

Compound	Food item	Maximum residue found in a composite sample (mg pesticide / kg commodity	acute Reference Dose (mg pesticide / kg body weight	97.5th percentile of consumption (kg commodity / day)[29]	Homo-geneity factor	Intake via specific commodity (mg pesticide / day / kg body weight)	Intake in % of the acute Reference Dose
Methamido-phos	Peppers	a) 2.8 (max. residue in composite sample)	ADI: 0.004[30]	0.089 (adult)/ 0.050 (toddler)	7	0.0249 (adult)	622 (adult)
						0.0676 (toddler)	1690 (toddler)
		b) 2.8 (max. residue in composite sample)			3.4	0.0121 (adult)	302 (adult)
						0.0328 (toddler)	821 (toddler)
		c) 7.9 (max. residue in a single unit)			none	0.0100 (adult)	251 (adult)
						0.0272 (toddler)	681 (toddler)

As Table 13 shows the intakes for the highest residues in a composite sample for **chlorpyriphos, deltamethrin, endosulfan and methidathion** are all well below the acute RfD for adults. They range between 1.5 % of the acute RfD for deltamethrin and 67 % of the acute RfD for endosulfan. For toddlers the intakes range between 3.0 % of the acute RfD for deltamethrin and 181 % of the acute RfD for endosulfan. The latter case shows that for endosulfan/peppers the acute RfD is exceeded for toddlers by 81 %.

For **methamidophos** on peppers the intake has been calculated as 622 % of the ADI for adults and as 1690 % of the ADI for toddlers with the **UK consumer exposure model** when using the highest residue found in a composite sample (2.8 mg/kg) and a default homogeneity factor of 7 (Example a)). However, a more realistic calculation has been carried out using the data experimentally collected in the homogeneity exercise (chapter 5.5). When calculated with the mean homogeneity factor of 3.4 (Example b)) the intake is 302 % of the ADI for adults and 821 % of the ADI for toddlers. When calculated with the highest residue found in a single unit (7.9 mg/kg) and without homogeneity factor the intake is 251 % of the ADI for adults and 681 % for toddlers (Example c)).

[29] Consumer Exposure Model, UK

[30] The Scientific Committee on Plants, in its opinion of 14 July 1998, states that in the absence of an acute RfD for methamidophos the ADI of 0.004 mg/kg bw could be used as acute RfD based on the toxicological data summarised in the 1990 JMPR Monograph

In addition a calculation with the large portion sizes used for methamidophos/peppers in the **2000 JMPR report** (Annex IV) has been carried out, showing results for children, which are comparable with those obtained in the UK consumer exposure model. Since the large portion size for peppers for adults is significantly higher in the JMPR model (207 g instead of 89 g), the intake calculated with the JMPR figures for adults is higher than the one calculated with the UK consumer exposure model.

In all those calculations the intake of methamidophos via peppers greatly exceeds the ADI. In the opinion of the Scientific Committee on Plants of 14 July 1998[31] it was stated that the toxicologically acceptable residue level for methamidophos on peppers could be 0.1 mg/kg and that residue levels above may be toxicologically unacceptable. However, this calculation, as well as the calculations in this report, were performed with a default value of 0.004 mg/kg as acute Reference Dose (in accordance with the ADI of 0.004 mg/kg bw), since a finally established acute Reference Dose is not yet available. Furthermore, the SCP used a variability factor of 10, thus reflecting worst case conditions. Nevertheless, the data for methamidophos on peppers show that there was some reason for concern and that there might have been a health risk, especially for vulnerable groups, such as young children. In response to these concerns the Community fixed an MRL for methamidophos on peppers at the LOD and the Member States have either withdrawn authorisation of this use of methamidophos or have modified their GAP to ensure no residues of methamidophos will be present on peppers.

[31] Opinion of the Scientific Committee on Plants regarding questions relating to amending the annexes to Council Directives 86/362/EEC, 86/363/EEC and 90/642/EEC of 14 July 1998

6. SAMPLING

Commission Directive 79/700/EEC established sampling methods for the official control of pesticide residues in and on fruit and vegetables. Member States are supposed to follow these methods for their pesticide residue monitoring. Table 14 shows the information given in the summaries of the national monitoring reports of the Member States and Norway on sampling. In most cases, sampling followed national plans that were often established taking into consideration consumption, production, imported and exported products and risks (e.g. results from previous years).

Table 15 shows the distribution of domestic/imported samples and the relation of the number of samples taken to the population size. The relation of domestic and imported samples should reflect the situation in the respective Member State. The average ratio from the fourteen Member States reporting on this particular subject was about 45 % : 55 % domestic: imported produce. More detailed information can be found in the summaries of the national monitoring reports in Annex 1.

Samples were taken at different points, such as wholesalers and retailers, local and central markets, points of entry (for imported products), and processing industries.

Table 14: Summary on sampling by the national authorities (information taken from the national reports)

Country	Summary on sampling
B	Sampling was carried out mostly according to Commission Directive 79/700/EEC, at auctions, importers, wholesalers, processors and retailers. The sampling plan took account of average consumption, production figures, results of previous years, and analytical and budgetary possibilities. The sampling included monitoring samples and compliance samples (for chlormequat/ pears and methamidophos/ peppers).
DK	The sampling plan took account of dietary consumption, production, import data and results of the previous year. The samples were taken mainly at wholesalers, importers and producers.
D	Samples were taken at the level of producers, manufacturers, wholesalers, retailers and at restaurants, according to a national sampling protocol published as official legal regulation.
EL	Samples were randomly taken from points of entry, wholesalers and retailers.
E	Samples were taken from domestic crops, following Directive 79/700/EEC. Samples were taken proportional to production.

Country	Summary on sampling
F	Sampling follows Directive 79/700/EEC. Crops or processed food were sampled at production, wholesalers and retailers.
IRL	Samples are taken mainly at wholesale level. Samples are taken in accordance with the national monitoring plan and market availability of the samples at the time of sampling.
I	Samples were taken at random on the market and based on dietary consumption and production.
L	Samples were taken at central markets. Imported products were sampled at wholesaler level. The sampling plan was based on a rolling annual plan. Sampling was done mostly according to Directive 79/700/EEC.
NL	Both domestic and non-domestic products were samples, according to the situation on the market. Samples are taken at auctions, importers, wholesalers, processing industries and customs points of entry. Sampling is directed relatively more to products, where violative results were found previously. Directive 79/700/EEC (as transposed into national law) was respected.
A	Sampling was based on a nationwide sampling plan, taking into account data concerning dietary consumption, production and import of fruit and vegetables, results of former measurements and budgetary capacities.
P	Samples were mainly collected at wholesale outlets, wholesaler's warehouses and at farmgates. A small percentage of samples was taken at retail outlets.
FIN	Sampling plan took into account the proportions of the commodities in the diet and known residue problems of certain commodities. It covered domestic production and imports from EU and third countries. Imported samples were taken at wholesalers' warehouses, domestic samples directly from farms or from wholesalers' and retail shops.
S	The number of samples taken was roughly proportional to the food's consumption rate and amounted to at least 100 samples for each of the more important foods.
UK	The sampling plan was based on a main commodity rolling programme, taking into account levels of consumption and information on possible levels of residues. The range of products included is chosen to be as wide as possible. CAC guidelines were followed where practicable.
Norway	Samples were taken at wholesalers' warehouses, reflecting their share of the market, but more samples were taken of commodities suspected of retaining residues; compliance samples were taken as follow-up to violative results.
Iceland	Samples are taken at wholesaler's warehouses. Sampling is focussed on imported products mainly since fruits for commercial purposes are not grown in Iceland and a great part of vegetables are imported.

Table 15: Number and origin of the samples taken by country (monitoring samples only)

Country	Total number of samples taken	Number of inhabitants of the country[32] [x 1000]	Samples taken per capita [x 10^{-4}]	No. of domestic samples taken	% from total sample number	No. of imported samples taken (incl. samples from other EU member states)	% from total sample number
B*	1035	10213.8	1.01	681	70	298	30
DK	2287	5313.6	4.30	861	38	1426	62
D	6617	82037	0.807	2721	41	3896	59
EL	1422	10521.7	1.35	Not reported	Not reported	Not reported	Not reported
E	3225	39394.3	0.819	3325	100	0	0
F	4553	58494	0.778	Not reported	Not reported	Not reported	Not reported
IRL	232	3734.9	0.621	82	35	150	65
I	7938	57612.6	1.38	4363▲	55▲	442▲	6▲
L	231	429.2	5.38	43	19	188	81
NL**	1419	15760.2	0.90	754	53	665	47
A	597	8082.8	0.739	167	28	430	72
P***	648	9979.5	0.649	512	79	136	21
FIN	2460	5159.6	4.77	579	24	1881	76
S	3046	8854.3	3.44	922	30	2124	70
UK	1372	59391.1	0.231	651	47	591	43
Norway	3091	4445.3	6.95	1298	42	1793	58
Iceland	304	275.7	11.03	61	20	243	80
EU + Norway + Iceland	**40577 (Sum)**	**379699.6 (Sum)**	**2.66 (Average)**	**12657▲ (Sum)**	**45▲ (Average)**	**13821▲ (Sum)**	**55▲ (Average)**

* Monitoring samples only, excluding compliance samples

** Excluding pears additionally sampled for chlormequat analysis and peppers additionally sampled for methamidophos analysis

*** Fresh products only, excluding processed products

▲ Excluding Italy, as data marked with the symbol not clear

[32] Eurostat, New Cronos database, Population figures for 1 January 1999

7. QUALITY ASSURANCE

Council Directive 90/642/EEC, as amended by Council Directive 97/41/EC, requires Member States to control maximum residue levels according to Council Directives 89/397/EEC and 93/99/EEC. This also means that laboratories have to comply with the European Standard EN 45001 and that Member States are requested to assess the laboratories by applying the criteria as laid down in European Standard EN 45002. Member States shall also apply proficiency testing schemes where appropriate. In 1999, for the first time, the provisions of Council Directive 97/41/EC were fully applicable.

Commission Recommendation 1999/333/EC suggests that Member States, in the 1999 monitoring reports, provide information about the details of accreditation of the laboratories which carry out the analyses for the monitoring exercise and about the criteria applied in establishing quality assurance measures in those laboratories. It also requires the countries contributing to the monitoring to provide the accreditation certificates. Quality assurance measures have been developed and it has been recommended that these should be respected for the 1999 EU coordinated monitoring programme. Workshops on Analytical Quality Control (WAQC) are regularly held in order to review these measures. Proficiency tests, supported by the European Commission, are also regularly organised (so far three proficiency tests have been organised, the last was carried out in 1999).

The European Commission's Monitoring Regulation (cf. chapter 2), in force since April 2000, ensures the financial contribution of the European Commission to the organisation of proficiency tests and Analytical Quality Control workshops. It also confirms and further specifies the requirements for accreditation of monitoring laboratories and their participation in proficiency tests.

Table 16 and Figure 9 give an overview of the situation regarding accreditation of monitoring laboratories and participation in proficiency tests. The table is a summary of the information provided by all participating countries in their short written summaries (cf. Annex 1 for further details).

As shown in Table 16 and Figure 9, in some countries all monitoring laboratories have achieved full accreditation, but in other countries laboratories are still in the preparatory phase or only some of the laboratories are accredited. Figure 9 shows that only about 40 % of the countries (7 out of 17), participating in the monitoring exercise, have fully accredited their laboratories, 24 % (4 out of 17) have accredited some of their laboratories and there are still about 30 % of the countries (5 out of 17) being in the preparation phase for accreditation. However, from 1997 to 1999 the number of countries with full accreditation of all the monitoring laboratories has slightly increased, whereas the number of countries with accreditation of some laboratories has decreased. The number of countries with no accreditation remained at the same level in 1998 and 1999, but in 1999 Iceland was included (laboratories not yet accredited), leading to an increase of the percentage of countries with no accreditation.

Status of laboratory accreditation: Percentage of countries with full, partly or no accreditation of the monitoring laboratories

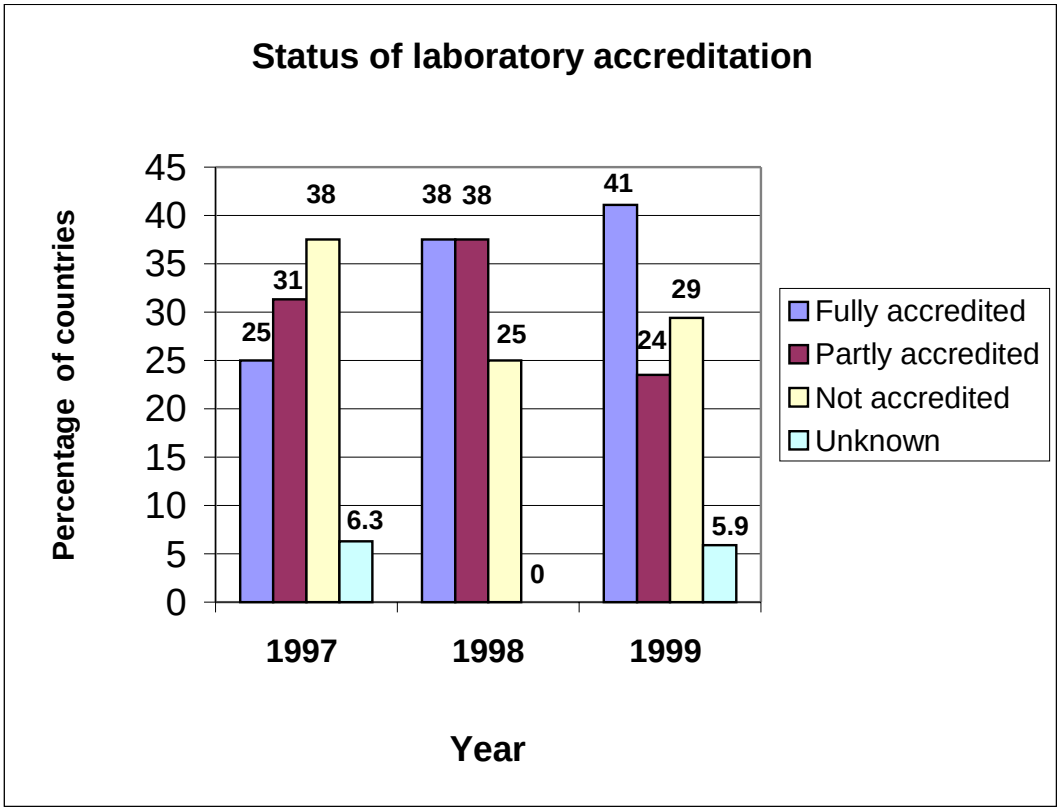

Figure 9: Number of countries with full, partly or no accreditation of monitoring laboratories

Table 16: Accreditation and participation in proficiency tests of the pesticide residue laboratories

Country	No. of laboratories	Accreditation	Accreditation certificates provided	Participation in proficiency tests	Implementation of Quality Control Procedures
B	2	Accredited for the most important analytical methods and commodities by BELTEST, accreditation was gradually extended	Yes	Both laboratories participated in the European Proficiency Test	Both laboratories take into account the Quality Control Procedures
DK	4	Accredited by DANAK	Yes**	FAPAS and EU	Quality Control Procedures have been applied to some extent for all methods, LCL concept not yet implemented for all multi methods
D	49	Accredited	No	No information	No information
EL	6	In preparatory phase	--*	Only the co-ordinated laboratory in Lycovrisi has participated in the EU Proficiency Test	EU-guidelines are followed as close as possible
E	12	3 accredited laboratories by ENAC, the others are in process of accreditation	Yes	Most of the laboratories took part in EU Proficiency Tests	Analyses were carried out mainly following the quality assurance measures proposed by the EU

* not applicable, because not yet accredited

** The Danish authorities informed that all four laboratories involved in the monitoring programmes have an accreditation of the same kind, but only for three of them the accreditation certificates were forwarded by the accreditation body

Country	No. of laboratories	Accreditation	Accreditation certificates provided	Participation in proficiency tests	Implementation of Quality Control Procedures
F	7 carried out monitoring programme, but only 6 reported in the EU format	2 laboratories, which performed around 50 % of the controls, accredited by COFRAC	Yes	All laboratories were involved in some proficiency tests with BIPEA and CHEK, at least 4 tests carried out by year	No information
IRL	1	The laboratory was not accredited during 1999	--*	Participation in EU Proficiency Test and FAPAS	EU Quality Control Procedures are taken into account
I	66	Only a part of the laboratories is accredited (take figure out of report)	No	Participation in EU Proficiency Tests I + II (9 laboratories) and III (ca. 30 laboratories)	No information
L	1	In preparatory phase for accreditation	--*	No information	Quality control procedures are taken into account as far as possible
NL	1 centralised laboratory after re-organisation in 1999	Accredited since autumn 1998	Yes	Participation in the EU proficiency test and FAPAS	EU Quality control procedures implemented
A	5	Accredited since 1998	Yes	Participation in proficiency tests, e.g. CHEK	EU Quality control procedures followed as far as possible
P	4	None of the laboratories accredited yet	--*	Participation in the EU proficiency test (2 laboratories) and in FAPAS proficiency tests (3 laboratories)	EU Quality control procedures followed as far as possible

* not applicable, because not yet accredited

Country	No. of laboratories	Accreditation	Accreditation certificates provided	Participation in proficiency tests	Implementation of Quality Control Procedures
FIN	2	Both laboratories accredited	Yes	Both laboratories took part in international proficiency tests	No information
S	1 contracted laboratory	Accredited by SWEDAC for all methods used	Yes	Participation in 2 Proficiency tests in 1999, one of them being the EU proficiency test	EU Quality control procedures implemented as far as practicable
UK	4	All of the laboratories meet the accreditation requirements of UKAS or GLP	Yes	All laboratories have taken part in proficieny tests, e.g. CHEK, FAPAS and other international proficiency tests	No information
Norway	1	Accredited since April 1997	No	Laboratory regularly participates in international proficiency tests	No information
Iceland	1	In preparatory phase	--*	Laboratory has taken part in FAPAS proficiency tests	No information

* not applicable, because not yet accredited

8. RAPID ALERT SYSTEM

The Rapid Alert System for Foodstuffs was established by Council Directive 92/59/EEC[33] on General Product Safety.

Products entailing a serious and immediate risk to the health and safety of the consumer are classified as ALERT notifications according to Article 8 of Directive 92/59/EEC. The notifying Member State informs the Commission, which then notifies this to the contact points in all Member States. After receiving an ALERT notification, Member States should take appropriate action.

Notifications which do not fulfil the requirements laid down in Article 8 of Council Directive 92/59/EEC on General Product Safety, but which are nevertheless regarded as important information, are forwarded by the Commission to the contact points in the Member States as information notifications (NON-ALERTS).

In 1999, seven ALERTs and fourteen NON-ALERTS were notified. Five of the ALERTS came from Member States and two from third countries. With regard to the NON-ALERTS two came from Member States and twelve from third countries. However, it has to be borne in mind that the notification criteria are at the discretion of the Member States and vary considerably between Member States. Discussion of these criteria is ongoing.

9. SUMMARY

9.1. National Monitoring programmes

All fifteen Member States, Norway and Iceland monitored pesticide residues in foodstuffs of plant origin. Overall, some 40 000 samples were analysed for, on average, 142 different pesticides.

In 32 % of the fruit, vegetable and cereal samples, residues of pesticides at or below the MRL (national or EC-MRL) were detected. In 4.3 % of all samples, residues above the MRL (national or EC-MRL) were found. 64 % of the samples contained no pesticide residues.

In 14 % of the samples, residues of more than one pesticide (multiple residues) were found, and in 2.2 % residues of four or more pesticides were detected. The pesticides found most often were mainly fungicides.

In 1998, pesticide residues below or at the MRL were found in about 36 % of the fruit, vegetable and cereal samples, with MRLs being exceeded in 3.3 % of cases. Multiple residues were detected in 14 % of the samples. A similar picture was received in 1997, but here the number of samples with multiple residues was higher (16 %). Pesticides found most often were very similar in the years 1997- 1999.

[33] Official Journal No. L 228, 11/08/1992 p. 0024 - 0032

A comparison of the years 1996 to 1999 shows that in 1999 there is a significant increase of the number of samples with residues exceeding the MRL, although the number of samples without residues increased as well. The increase in samples exceeding the MRL can be partly explained by the special problems encountered during 1999 with chlormequat residues in pears and methamidophos residues in peppers. However, it has to be borne in mind that sampling was sometimes more or less targeted and directed to those problems, thus increasing the number of positive findings. The trend of a decreasing number of samples with multiple residues was not continued in 1999. There was a slight increase in the number of samples with multiple residues compared to 1998.

9.2. EU coordinated monitoring programme

In a special coordinated programme, four commodities (cauliflower, peppers, wheat grains and melons) were analysed for twenty different pesticides. In this programme, about 4 700 samples were analysed. However, not every sample was analysed for all twenty pesticides. In 22 % of the samples, residues of one of the twenty pesticides were found below or at the MRL (national or EC-MRL), and in 8.7 % of the samples MRLs (national or EC-MRLs) were exceeded.

In this coordinated programme residues of one of the twenty pesticides at or below the MRL were found most often in melons (32 %), followed by peppers (24 %), wheat grains (21 %) and cauliflower (17 %). However, residues exceeding the MRL were found most often in peppers (19 %), followed by melons (6.1 %), cauliflower (3.0 %) and wheat grains (0.5 %).

Of the twenty pesticides under the coordinated programme, residues of endosulfan were found most often (16.9 %), followed by the maneb group (11.5 %), pirimiphos-methyl (6.3 %) and chlorpyriphos-methyl (2.5 %)[34].

Residues of methamidophos exceeded MRLs most often (8.7 %), followed by the maneb group (1.1 %), thiabendazol (0.57 %), acephate (0.41 %) and the benomyl group (0.35 %). The highest residue found in a composite sample in this coordinated programme was 4.6 mg imazalil/kg peppers. The most important pesticide-commodity combinations where detectable residues have been found at or below the MRL and above the MRL were endosulfan/peppers, methamidophos/peppers, maneb group/cauliflower[35] and endosulfan/melons. With regard to MRL exceedances the most important pesticide-commodity combinations were methamidophos/ peppers and maneb group/ cauliflower.

Chronic exposure assessments demonstrate that ADIs were not exceeded for these pesticide/commodity combinations. For the highest residue level found of endosulfan in a composite sample of peppers an acute risk assessment with the UK Consumer Exposure Model showed that the intake exceeded the acute RfD by 81 % for toddlers, whereas it was not exceeded for adults. For methamidophos/peppers several calculations were done using the highest residue found in a composite sample and different homogeneity factors, as well as using the highest residue found in an individual unit without homogeneity factor. In all cases the ADI was greatly exceeded for adults and for toddlers. The calculations show that for methamidophos on peppers there was some reason for concern. However, it has to be borne in mind that there is currently no scientifically established acute RfD value for methamidophos

[34] Percentages in this paragraph include sum of samples with residues at or below the MRL and exceeding the MRL

[35] this was commented under chapter 5.2, p. 15

available and that therefore worst case conditions based on the ADI have been used for calculation.

9.3. Quality assurance and sampling

Samples for the national and the EU coordinated programmes were taken at different points such as retailers, wholesalers, markets, points of entry and processing industries. National sampling plans exist in most countries, taking into consideration e.g. consumption data, production figures, import/export relation and risks (e.g. results from previous years).

Accreditation of laboratories has been fully completed only in some of the countries, whereas in other countries accreditation has been achieved only for a part of the laboratories. Only about 40 % of the countries have fully accredited their laboratories, the remaining 60 % have either accredited some but not all of their laboratories or are still in the preparation phase for accreditation. Most of the countries regularly took part in proficiency tests and have started implementation of the current Quality Control procedures for laboratories. Workshops to further develop those procedures and the organisation of new proficiency tests for laboratories will continue improving the situation.