

# Pesticide residues in food 2010

Evaluations

Part I - Residues

FAO  
PLANT  
PRODUCTION  
AND PROTECTION  
PAPER

**206**

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Joint Meeting of the  
FAO Panel of Experts on Pesticide Residues  
in Food and the Environment  
and the  
WHO Core Assessment Group on Pesticide Residues  
Rome, Italy, 21–30 September 2010

Monographs containing summaries or residue data and toxicological data considered at the 2010 JMPR, together with recommendations, are available upon request from FAO or WHO under the title:

Pesticide residues in food 2010  
Evaluations  
Part I: Residues  
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INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY

The preparatory work for the toxicological evaluation of pesticide residues carried out by the WHO Expert Group on Pesticide Residues for consideration by the FAO/WHO Joint Meeting on Pesticide Residues in Food and the Environment is actively supported by the International Programme on Chemical Safety (IPCS).

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## CONTENTS

|   | pages |
|---|-------|
| List of participants .....  | v     |
| Abbreviations .....   | ix    |
| Use of JMPR reports and evaluations by registration authorities ..... | xv    |
| Introduction .....  | xvii  |
| BIFENAZATE (219) .....  | 1     |
| BIFENTHRIN (178) .....  | 15    |
| BOSCALID (221) .....  | 175   |
| CADUSAFOS (174) .....   | 189   |
| CHLORANTRANILIPROLE (230) .....                                       | 223   |
| CHLOROTHALONIL (081) .....  | 269   |
| CLOTHIANIDIN (238) .....  | 495   |
| CYPROCONAZOLE (239) .....   | 766   |
| DICAMBA (240) .....   | 939   |
| DIFENOCONAZOLE (224) .....  | 1095  |
| ENDOSULFAN (032) .....  | 1121  |
| ETOXAZOLE (241) .....   | 1133  |
| FENPYROXIMATE (193) .....   | 1230  |
| FLUBENDIAMIDE (242) .....   | 1266  |
| FLUDIOXONIL (211) .....   | 1393  |
| FLUOPYRAM (243) .....   | 1415  |
| MEPTYLDINOCAP (244) .....   | 1703  |
| NOVALURON (217) .....   | 1737  |
| EVALUATION OF PESTICIDE RESIDUES IN SPICES .....                      | 1779  |
| THIAMETHOXAM (245) .....  | 1787  |
| TRIAZOPHOS (143) .....  | 2023  |
| FAO Technical papers .....  | 2031  |

<sup>1/</sup> Evaluated for the Periodic Review Programme of the Codex Committee on Pesticide Residues.

<sup>2/</sup> New compound.



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## ABBREVIATIONS

(Well-known abbreviations in general use are not included. Specific abbreviations for pesticide degradation products, etc., may be used in the monographs and these are either identified where first used or in a table within the monograph. Two-letter codes for pesticide formulations are given in the Manual on development and use of FAO and WHO specifications for pesticides, 1<sup>st</sup> Ed., FAO Plant Production and Protection Paper 173, FAO, Rome, 2002.)

|                    |  |
|--------------------|--|
| ACN                | acetonitrile   |
| ADI                | acceptable daily intake  |
| AFID               | alkali flame-ionization detection or detector (equivalent to TSD, forerunner of NPD) |
| ai                 | active ingredient = active substance   |
| APCI               | atmospheric pressure chemical ionisation (for MS detection)                          |
| AR                 | Applied radioactivity  |
| ARfD               | acute reference dose   |
| AUC                | area under the curve for concentration–time  |
| BBCH               | Biologische Bundesanstalt, Bundessortenamt and Chemical industry.                    |
| BMDL <sub>10</sub> | benchmark-dose lower 95% confidence level  |
| bw                 | body weight  |
| CA                 | Chemical Abstracts   |
| CAC                | Codex Alimentarius Commission  |
| CAS                | Chemical Abstracts Services  |
| CCN                | Codex classification number (for compounds or commodities)                           |
| CCPR               | Codex Committee on Pesticide Residues  |
| CCRVDF             | Codex Committee on Residue of Veterinary Drugs in Food                               |
| CEC                | cation exchange capacity   |
| CI                 | chemical ionization  |
| CV                 | coefficient of variation (RSD)   |
| d                  | days   |
| DAT                | days after (last) treatment  |
| DCM                | dichloromethane  |
| DFG                | Deutsche Forschungsgemeinschaft  |
| DMF                | dimethylformamide  |

|                  |  |
|------------------|--|
| DT <sub>50</sub> | time for 50% decomposition (i.e., half-life)   |
| DT <sub>90</sub> | time for 90% decomposition   |
| 2D-TLC           | two dimensional thin layer chromatography  |
| dw               | dry weight   |
|                  |  |
| ECD              | electron capture detection or detector   |
| EI               | electron-impact (ionization), now more usually electron ionization   |
| EPA              | Environmental Protection Agency (usually US EPA)   |
| eq               | residue expressed as ai equivalent   |
| ESI              | electron spray ionisation (sample introduction/ionisation technique for MS)  |
| EtOAc            | ethyl acetate  |
|                  |  |
| F <sub>1</sub>   | first filial generation  |
| F <sub>2</sub>   | second filial generation   |
| FAO              | Food and Agriculture Organization of the United Nations  |
| FID              | flame-ionization detection or detector   |
| FPD              | flame-photometric detection or detector  |
| fw               | fresh weight (sample as received)  |
|                  |  |
| GAP              | good agricultural practice(s)  |
| GC               | gas chromatography; the detector system used is usually also abbreviated as a suffix   |
| GC-MS            | gas chromatography with mass spectrometric detection   |
| GC-NPD           | gas chromatography coupled with Nitrogen-Phosphorous detector  |
| GEMS/Food        | Global Environment Monitoring System–Food Contamination Monitoring and Assessment Programme                                    |
| GLP              | good laboratory practice (i.e. the defined system, not in the general sense)   |
| GPC              | gel-permeation chromatography  |
| GSH              | glutathione  |
|                  |  |
| Hac              | acetic acid  |
| HPLC             | high-performance liquid chromatography   |
| HPLC-DAD         | high-performance liquid chromatography with diode array detection  |
| HPLC-MS          | high-performance liquid chromatography – mass spectrometry   |
| HPLC-MS-MS       | high-performance liquid chromatography with tandem mass spectrometric detection  |
| HPLC-UV          | high-performance liquid chromatography with UV absorption detection  |
| h                | hour   |
| HR               | highest residue in the edible portion of a commodity found in trials used to estimate a maximum residue level in the commodity |

|               |  |
|---------------|--|
| HR-P          | highest residue in a processed commodity calculated by multiplying the HR of the raw commodity by the corresponding processing factor  |
| IEDI          | international estimated daily intake   |
| IESTI         | international estimate of short-term dietary intake  |
| IPCS          | International Programme on Chemical Safety   |
| IR            | infrared spectroscopy  |
| ISO           | International Organization for Standardization   |
| ITD           | ion-trap detector or detection   |
| IUPAC         | International Union of Pure and Applied Chemistry  |
| JECFA         | Joint Expert Committee on Food Additives   |
| JMPR          | Joint Meeting on Pesticide Residues  |
| JMPS          | Joint FAO/WHO Meeting on Pesticide Specifications  |
| LC            | liquid chromatography  |
| LC-MS         | liquid chromatography – mass spectrometry  |
| LOAEL         | lowest-observed-adverse-effect level   |
| LOAEC         | lowest-observed-adverse-effect concentration   |
| LOD           | limit of detection   |
| LOQ           | limit of quantification  |
| LSC           | liquid scintillation counting or counter of radioactivity  |
| M             | molar = mole/L   |
| MeOH          | methanol   |
| mg ai/kg bw/d | milligram active ingredient per kilogram bodyweight per day  |
| mg/kg eq      | milligram per kg, expressed as clothianidin equivalents  |
| MID           | multiple ion detection (mass spectrometric)  |
| MRL           | Maximum Residue Limit. MRLs include <u>draft</u> MRLs and <u>Codex</u> MRLs (CXLs). The MRLs recommended by the JMPR on the basis of its estimates of maximum residue levels enter the Codex procedure as draft MRLs. They become Codex MRLs when they have passed through the procedure and have been adopted by the Codex Alimentarius Commission. |
| MS            | mass spectrometry or mass spectrometric detector (suffix to GC- or LC-)  |
| MSD           | mass-selective detection or detector   |
| MS/MS         | tandem mass spectrometry   |
| MWHC          | maximum water holding capacity (for soil)  |
| m/z           | mass to charge ratio (mass unit for mass spectrometry)   |

|                 |  |
|-----------------|--|
| NOAEL           | no-observed-adverse-effect level   |
| NMR             | nuclear magnetic resonance   |
| NPD             | nitrogen/phosphorus detector   |
| OECD            | Organization for Economic Co-operation and Development   |
| om              | amount of organic matter in soil   |
| PES             | post extracted solids  |
| PF              | processing factor  |
| PHI             | pre-harvest interval   |
| ppm             | parts per million (used only with reference to the concentration of a pesticide in a diet, in all other contexts the terms mg/kg or mg/l are used)       |
| P <sub>ow</sub> | octanol–water partition coefficient  |
| RAC             | raw agricultural commodity   |
| r.d.            | relative density (formerly called specific gravity)  |
| RfD             | reference dose (usually in phrase “acute RfD”)   |
| RSD             | precision under repeatability conditions (measurements within one day or one run) expressed as relative standard deviation (= coefficient of variation)  |
| SD              | standard deviation   |
| SPE             | solid-phase extraction (may also describe a post-extraction clean-up process)  |
| STMR            | supervised trials median residue   |
| STMR-P          | supervised trials median residue in a processed commodity calculated by multiplying the STMR of the raw commodity by the corresponding processing factor |
| t               | tonne (metric ton)   |
| TAR             | total applied (or administered) radioactivity  |
| TLC             | thin-layer chromatography  |
| TRR             | total radioactive residue  |
| TMDI            | theoretical maximum daily intake   |
| TSD             | thermionic specific detection or detector (equivalent to AFID, forerunners of NPD)   |
| USDA            | US Department of Agriculture   |
| US FDA          | US Food and Drug Administration  |
| UV              | ultraviolet (radiation)  |
| % v/v           | percentage volume: volume (mL/100mL)   |

|       |   |
|-------|---|
| v/v   | mixing of solvents on volume basis (e.g. 80:20 v/v = 80 mL: 20 mL = 80 ml + 20 mL)                        |
| % w/w | percentage weight: weight (g/100 g)   |
| w/w   | mixing of solvents on weight basis (e.g. 80:20 w/w = 80 g: 20 g = 80 g + 20 g)                            |
| W     | the previous recommendation is withdrawn, or withdrawal of the existing Codex or draft MRL is recommended |
| WHO   | World Health Organization   |



## **USE OF JMPR REPORTS AND EVALUATIONS BY REGISTRATION AUTHORITIES**

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## INTRODUCTION

The Report of the Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group (JMPR), held in Rome, 21–30 September 2010, contains a summary of the evaluations of residues in foods of the various pesticides considered, as well as information on the general principles followed by the Meeting (JMPR, 2010). The present document contains summaries of the residues data considered, together with the recommendations made.

The Evaluations are issued in two parts:

Part I: Residues (by FAO);

Part II: Toxicology (by WHO).

For those interested in both aspects of pesticide evaluation, both parts and the Report containing summaries of residues and toxicological considerations are available.

Some of the compounds considered at the Meeting were previously evaluated and reported on in earlier publications. In general, only new information is summarised in the relevant monographs but reference is made to previously published evaluations, which should also be consulted. In the case of older compounds which are re-evaluated as part of the periodic review programme of the CCPR, a review of all available data, including data which may have previously been submitted, is carried out. Compounds evaluated for the first time are indicated by a single asterisk and those evaluated in the CCPR periodic review programme by double asterisks in the Table of Contents.

Summaries of recommended MRLs, STMR and HR levels and assessments of dietary intake, are published as Annexes 1, 3 and 4 in the Report, and reference is made to this report.

The name of the compound appearing as the title of each monograph is followed by its Codex Classification Number in parentheses.

References to previous Reports and Evaluations of Joint Meetings are listed in Annex I.

### Acknowledgements

The monographs in these Evaluations were prepared by the following participants in the 2010 JMPR, for the FAO Panel of Experts on Pesticide Residues in Food and the Environment:

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JMPR, 2010. Pesticide residues in Food – 2010. Report of the Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group on Pesticide Residues, Rome, Italy, 21-30 September 2010. WHO and FAO, Rome, 2010.



**CORRIGENDUM TO THE 2009 RESIDUE EVALUATIONS OF JMPR**

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## FAO TECHNICAL PAPERS

- |         |  |          |  |
|---------|--|----------|--|
| 1       | Horticulture: a select bibliography, 1976 (E)  | 26       | Pesticide residues in food 1980 – Report, 1981 (E F S)   |
| 2       | Cotton specialists and research institutions in selected countries, 1976 (E)   | 26 Sup.  | Pesticide residues in food 1980 – Evaluations, 1981 (E)  |
| 3       | Food legumes: distribution, adaptability and biology of yield, 1977 (E F S)  | 27       | Small-scale cash crop farming in South Asia, 1981 (E)  |
| 4       | Soybean production in the tropics, 1977 (C E F S)  | 28       | Second expert consultation on environmental criteria for registration of pesticides, 1981 (E F S)    |
| 4 Rev.1 | Soybean production in the tropics (first revision), 1982 (E)   | 29       | Sesame: status and improvement, 1981 (E)   |
| 5       | Les systèmes pastoraux sahéliens, 1977 (F)   | 30       | Palm tissue culture, 1981 (C E)  |
| 6       | Pest resistance to pesticides and crop loss assessment – Vol. 1, 1977 (E F S)  | 31       | An eco-climatic classification of intertropical Africa, 1981 (E)                                     |
| 6/2     | Pest resistance to pesticides and crop loss assessment – Vol. 2, 1979 (E F S)  | 32       | Weeds in tropical crops: selected abstracts, 1981 (E)  |
| 6/3     | Pest resistance to pesticides and crop loss assessment – Vol. 3, 1981 (E F S)  | 32 Sup.1 | Weeds in tropical crops: review of abstracts, 1982 (E)   |
| 7       | Rodent pest biology and control – Bibliography 1970-74, 1977 (E)   | 33       | Plant collecting and herbarium development, 1981 (E)   |
| 8       | Tropical pasture seed production, 1979 (E F** S**)   | 34       | Improvement of nutritional quality of food crops, 1981 (C E)   |
| 9       | Food legume crops: improvement and production, 1977 (E)  | 35       | Date production and protection, 1982 (Ar E)  |
| 10      | Pesticide residues in food, 1977 – Report, 1978 (E F S)  | 36       | El cultivo y la utilización del tarwi – Lupinus mutabilis Sweet, 1982 (S)                            |
| 10 Rev. | Pesticide residues in food 1977 – Report, 1978 (E)   | 37       | Pesticide residues in food 1981 – Report, 1982 (E F S)   |
| 10 Sup. | Pesticide residues in food 1977 – Evaluations, 1978 (E)  | 38       | Winged bean production in the tropics, 1982 (E)  |
| 11      | Pesticide residues in food 1965-78 – Index and summary, 1978 (E F S)   | 39       | Seeds, 1982 (E/F/S)  |
| 12      | Crop calendars, 1978 (E/F/S)   | 40       | Rodent control in agriculture, 1982 (Ar C E F S)   |
| 13      | The use of FAO specifications for plant protection products, 1979 (E F S)  | 41       | Rice development and rainfed rice production, 1982 (E)   |
| 14      | Guidelines for integrated control of rice insect pests, 1979 (Ar C E F S)  | 42       | Pesticide residues in food 1981 – Evaluations, 1982 (E)  |
| 15      | Pesticide residues in food 1978 – Report, 1979 (E F S)   | 43       | Manual on mushroom cultivation, 1983 (E F)   |
| 15 Sup. | Pesticide residues in food 1978 – Evaluations, 1979 (E)  | 44       | Improving weed management, 1984 (E F S)  |
| 16      | Rodenticides: analyses, specifications, formulations, 1979 (E F S)   | 45       | Pocket computers in agrometeorology, 1983 (E)  |
| 17      | Agrometeorological crop monitoring and forecasting, 1979 (C E F S)   | 46       | Pesticide residues in food 1982 – Report, 1983 (E F S)   |
| 18      | Guidelines for integrated control of maize pests, 1979 (C E)   | 47       | The sago palm, 1983 (E F)  |
| 19      | Elements of integrated control of sorghum pests, 1979 (E F S)  | 48       | Guidelines for integrated control of cotton pests, 1983 (Ar E F S)                                   |
| 20      | Pesticide residues in food 1979 – Report, 1980 (E F S)   | 49       | Pesticide residues in food 1982 – Evaluations, 1983 (E)  |
| 20 Sup. | Pesticide residues in food 1979 – Evaluations, 1980 (E)  | 50       | International plant quarantine treatment manual, 1983 (C E)  |
| 21      | Recommended methods for measurement of pest resistance to pesticides, 1980 (E F)                                     | 51       | Handbook on jute, 1983 (E)   |
| 22      | China: multiple cropping and related crop production technology, 1980 (E)  | 52       | The palmyrah palm: potential and perspectives, 1983 (E)  |
| 23      | China: development of olive production, 1980 (E)   | 53/1     | Selected medicinal plants, 1983 (E)  |
| 24/1    | Improvement and production of maize, sorghum and millet – Vol. 1. General principles, 1980 (E F)                     | 54       | Manual of fumigation for insect control, 1984 (C E F S)  |
| 24/2    | Improvement and production of maize, sorghum and millet – Vol. 2. Breeding, agronomy and seed production, 1980 (E F) | 55       | Breeding for durable disease and pest resistance, 1984 (C E)   |
| 25      | Prosopis tamarugo: fodder tree for arid zones, 1981 (E F S)  | 56       | Pesticide residues in food 1983 – Report, 1984 (E F S)   |
|         |  | 57       | Coconut, tree of life, 1984 (E S)  |
|         |  | 58       | Economic guidelines for crop pest control, 1984 (E F S)  |
|         |  | 59       | Micropropagation of selected rootcrops, palms, citrus and ornamental species, 1984 (E)               |
|         |  | 60       | Minimum requirements for receiving and maintaining tissue culture propagating material, 1985 (E F S) |
|         |  | 61       | Pesticide residues in food 1983 – Evaluations, 1985 (E)  |

- 62 Pesticide residues in food 1984 – Report, 1985 (E F S)
- 63 Manual of pest control for food security reserve grain stocks, 1985 (C E)
- 64 Contribution à l'écologie des aphides africains, 1985 (F)
- 65 Amélioration de la culture irriguée du riz des petits fermiers, 1985 (F)
- 66 Sesame and safflower: status and potentials, 1985 (E)
- 67 Pesticide residues in food 1984 – Evaluations, 1985 (E)
- 68 Pesticide residues in food 1985 – Report, 1986 (E F S)
- 69 Breeding for horizontal resistance to wheat diseases, 1986 (E)
- 70 Breeding for durable resistance in perennial crops, 1986 (E)
- 71 Technical guideline on seed potato micropropagation and multiplication, 1986 (E)
- 72/1 Pesticide residues in food 1985 – Evaluations – Part I: Residues, 1986 (E)
- 72/2 Pesticide residues in food 1985 – Evaluations – Part II: Toxicology, 1986 (E)
- 73 Early agrometeorological crop yield assessment, 1986 (E F S)
- 74 Ecology and control of perennial weeds in Latin America, 1986 (E S)
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