

# **Pesticide residues in food 2013**

**Joint FAO/WHO Meeting  
on Pesticide Residues**

## **EVALUATIONS 2013**

### **PART I - RESIDUES**



**World Health  
Organization**



**Food and Agriculture  
Organization of  
the United Nations**



# Pesticide residues in food 2013

Evaluations

Part I - Residues

FAO  
PLANT  
PRODUCTION  
AND PROTECTION  
PAPER

**220**

**Sponsored jointly by FAO and WHO**

Joint meeting of the  
FAO Panel of Experts on Pesticide Residues  
in food and the Environment  
and the  
WHO Core Assessment Group  
Geneva, Switzerland 17-26 September 2013

WORLD HEALTH ORGANIZATION  
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS  
Rome, 2014

Monographs containing summaries or residue data and toxicological data considered at the 2013 JMPR, together with recommendations, are available upon request from FAO or WHO under the title:

Pesticide residues in food 2013  
Evaluations  
Part I: Residues  
FAO Plant Production and Protection Paper No. 220

#### 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).  
IPCS is a joint venture of the United Nations Environment Programme, The International Labour Organization and the World Health Organization. One of the main objectives of IPCS is to carry out and disseminate evaluations of the effects of chemicals on human health and the quality of the environment.

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) or of the World Health Organization (WHO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these are or have been endorsed or recommended by FAO or WHO in preference to others of a similar nature that are not mentioned. All reasonable precautions have been taken by FAO and WHO to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall FAO and WHO be liable for damages arising from its use.

E-ISBN 978-92-5-108245-4 (PDF)

© FAO/WHO 2014

FAO and WHO encourage the use, reproduction and dissemination of material in this information product. Except where otherwise indicated, material may be copied, downloaded and printed for private study, research and teaching purposes, or for use in non-commercial products or services, provided that appropriate acknowledgement of FAO and WHO as the source and copyright holder is given and that their endorsement of users' views, products or services is not implied in any way.

All requests for translation and adaptation rights, and for resale and other commercial use rights should be made via [www.fao.org/contact-us/licence-request](http://www.fao.org/contact-us/licence-request) or addressed to [copyright@fao.org](mailto:copyright@fao.org).

FAO information products are available on the FAO website ([www.fao.org/publications](http://www.fao.org/publications)) and can be purchased through [publications-sales@fao.org](mailto:publications-sales@fao.org).

## CONTENTS

Participants	v
Abbreviations	vii
Use of JMPR Reports and evaluations by registration authorities	ix
Introduction	xi
Monographs	
Azoxystrobin (229)	1
Bentazone (172)	37
Bixafen (262) <sup>2/</sup>	197
Chlorantraniliprole (230)	331
Chlorpyrifos-methyl (090)	357
Cyantraniliprole (263) <sup>2/</sup>	361
Cyproconazole (239)	613
Cyprodinil (207)	615
Dicamba (240)	659
Difenoconazole	673
Diquat (031) <sup>1/</sup>	725
Dithianon (028) <sup>1/</sup>	803
Fenbuconazole (197)	911
Fenpyroximate (193)	915
Fludioxonil (211)	939
Flutolanil (205)	961
Glyphosate (158)	971
Imazapic (266) <sup>2/</sup>	985
Imazapyr (267) <sup>2/</sup>	1081
Indoxacarb (216)	1163
Isoxaflutole (268) <sup>2/</sup>	1171
Malathion (49)	1325
Mandipropamid (231)	1331
Penthiopyrad (253)	1343
Propiconazole (160)	1361
Pyrimethanil (226)	1369
Spirotetramat (234)	1385
Tolfenpyrad (269) <sup>2/</sup>	1411
Triazophos (143) (	1499
Triflumizole (270) <sup>2/</sup>	1507
Trinexapac-ethyl (271) <sup>2/</sup>	1595
 Annex I, Previous FAO and WHO documents	1717

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

<sup>2/</sup> New compound



## LIST OF PARTICIPANTS

### 2013 Joint FAO/WHO Meeting on Pesticide Residues

GENEVA, 17–26 SEPTEMBER 2013

#### FAO Members

Dr Ursula Banasiak, Delegate of the Federal Institute for Risk Assessment, Max-Dohrn-Strasse 8-10, 10589 Berlin, Germany

Professor Eloisa Dutra Caldas, Pharmaceutical Sciences Department, College of Health Sciences, University of Brasilia, Campus Universitário Darci Ribeiro, 70910-900 Brasília/DF, Brazil (*FAO Rapporteur*)

Mr David Lunn, Principal Adviser (Residues), Plant Exports. Plants, Food & Environment Directorate, New Zealand Food Safety Authority, PO Box 2835, Wellington, New Zealand

Dr Dugald MacLachlan, Australian Government Department of Agriculture, Fisheries and Forestry, GPO Box 858, Canberra, ACT 2601, Australia (*FAO Chairman*)

Mr Christian Sieke, Unit Residue Assessment of Pesticides and Biocides, Department of Chemicals Safety, Federal Institute for Risk Assessment, Max-Dohrn-Strasse 8-10, 10589 Berlin, Germany

Dr Yukiko Yamada, Advisor to Vice Minister / Chief Scientific Advisor, Ministry of Agriculture, Forestry and Fisheries, 1-2-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8950, Japan

#### Secretariat

Dr Árpád Ambrus, Hungarian Food Safety Office, 1143 Budapest Tábornok u 2, Hungary (FAO Temporary Adviser)

Mr Kevin Bodnaruk, 26/12 Phillip Mall, West Pymble, NSW 2073, Australia (FAO Editor)

Ms Gracia Brisco, Food Standards Officer, Joint FAO/WHO Food Standards Programme, Food and Agriculture Organization of the United Nations (FAO), Viale delle Terme di Caracalla, 00153 Rome, Italy (Codex Secretariat)

Dr Michael Doherty, Office of Pesticide Programs, Health Effects Division, Risk Assessment Branch II, United States Environmental Protection Agency, MS 7509C, Washington, DC 20460, USA (FAO Temporary Adviser)

Dr Yi Bing He, Department of Science and Education, Ministry of Agriculture, No. 11 Nong Zhan Guan Nanli, Chaoyang District, Beijing 100125, China (FAO Temporary Adviser)

Dr Paul Humphrey, Pesticides Program, Australian Pesticides and Veterinary Medicines Authority (APVMA), PO Box 6182, Kingston, ACT 2604, Australia (FAO Temporary Adviser)

Mr Makoto Irie, Plant Product Safety Division, Food Safety and Consumer Affairs Bureau, Ministry of Agriculture, Forestry and Fisheries, 1-2-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8950, Japan (FAO Temporary Adviser)

Dr Mi-Gyung Lee, Department of Food Science and Biotechnology, College of Natural Science, Andong National University, #388 Songcheon-dong, Andong-si, Gyeongbuk, 760-749, Republic of Korea (FAO Temporary Adviser)

Dr Xiongwu Qiao, Shanxi Academy of Agricultural Sciences, 2 Changfeng Street, Taiyuan, Shanxi 030006, China (CCPR Chairman)

Ms Monique Thomas, Pest Management Regulatory Agency, Health Canada, 2720 Riverside Drive, Ottawa, ON, Canada KIA 0K9 (FAO Temporary Adviser)

Ms Trijntje van der Velde-Koerts, Centre for Nutrition, Prevention and Health Services, National Institute for Public Health and the Environment (RIVM), Antonie van Leeuwenhoeklaan 9, PO Box 1, 3720 BA Bilthoven, the Netherlands (FAO Temporary Adviser)

Ms Yong Zhen Yang, Plant Production and Protection Division, Food and Agriculture Organization of the United Nations (FAO), Viale delle Terme di Caracalla, 00153 Rome, Italy (FAO JMPR Secretariat)

Dr Guibiao Ye, Director of Pesticide Residue Evaluation, Institute for the Control of Agrochemicals, Ministry of Agriculture, Maizidian 22, Chaoyang District, Beijing 100125, China (FAO Temporary Adviser)



### 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
ai	active ingredient
AR	applied radioactivity
ARfD	acute reference dose
asp gr fn	aspirated grain fraction
AU	Australia
BBCH	<b>B</b> iologischen Bundesanstalt, <b>B</b> undessortenamt und <b>C</b> hemische Industrie
bw	body weight
CAC	Codex Alimentarius Commission
CAS	Chemical Abstracts Service
CCN	Codex classification number (for compounds or commodities)
CCPR	Codex Committee on Pesticide Residues
CIPAC	Collaborative International Pesticides Analytical Council
$C_{\max}$	maximum concentration
CXL	Codex MRL
DALA	Days after last application
DAP	days after planting
DAT	days after treatment
DM	dry matter
DT <sub>50</sub>	time required for 50% dissipation of the initial concentration
dw	dry weight
ECD	electron capture detector
EHC	Environmental Health Criteria monograph
EHE	ethylhexyl ester
EPO	early post-emergence
ERR	Extracted radioactive residues
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
fw	fresh weight
GAP	good agricultural practice
GC	gas chromatography
GC-ECD	gas chromatography with electron capture detection
GC-FPD	gas chromatography with flame photometric detection
GC/MS	gas chromatography/mass spectrometry
GC/MSD	gas chromatography/mass selective detector
GC-NPD	gas chromatography coupled with nitrogen-phosphorus detector
GEMS/Food	Global Environment Monitoring System – Food Contamination Monitoring and Assessment Programme
GLC	gas liquid chromatography
GLP	good laboratory practice
GPC	gel permeation chromatography
HPLC	high performance liquid chromatography
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
ISO	International Organization for Standardization
IUPAC	International Union of Pure and Applied Chemistry
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
JP	Japan
LC	liquid chromatography
LOD	limit of detection
LOQ	limit of quantification
MOA	mode of action
MRL	maximum residue limit
MS	mass spectrometry
MS/MS	tandem mass spectrometry
MWHC	Maximum water holding capacity
ND	non-detect - below limit of detection
NMR	Nuclear Magnetic Resonance
NOAEC	no-observed-adverse-effect concentration
NOAEL	no-observed-adverse-effect level
OECD	Organisation for Economic Co-operation and Development
PAG3	2-(2-hydroxymethylphenyl)-2-oxoacetic acid
PBI	plant back interval
PES	Post-extraction solids
Pf	processing factor
PH	pre-harvest
PHI	pre-harvest interval
ppm	parts per million
PRE	pre-emergence
RAC	raw agricultural commodity
ROI	Region of Interest
RSD	relative standard deviation
RTI	re-treatment interval
SC	suspension concentrate
SL	soluble liquid
SPE	solid phase extraction
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
TAR	total administered radioactivity
TF	transfer factor
TLC	thin-layer chromatography
TMPA	2,2,3,3-tetramethylcyclopropane carboxylic acid
TRR	total radioactive residues
UK	United Kingdom
USA	United States of America
US/CAN	United States of America and Canada
USEPA	United States Environmental Protection Agency
US-FDA	USA – Food and Drug Administration
UV/VIS	Ultraviolet-visible spectroscopy
WG	wettable granule
WHO	World Health Organization
WP	wettable powder

**Use of JMPR Reports and Evaluations by registration authorities**

Most of the summaries and evaluations contained in this report are based on unpublished proprietary data submitted for use by JMPR in making its assessments. A registration authority should not grant a registration on the basis of an evaluation unless it has first received authorization for such use from the owner of the data submitted for the JMPR review or has received the data on which the summaries are based, either from the owner of the data or from a second party that has obtained permission from the owner of the data for this purpose.



## 1. INTRODUCTION

A 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 (JMPR) was held at World Health Organization (WHO) Headquarters, Geneva (Switzerland), from 17 to 26 September 2013. The Panel Members of the Food and Agriculture Organization of the United Nations (FAO) met in preparatory sessions on 12–16 September.

The Meeting was opened by Dr Kazuaki Miyagishima, Director, Department of Food Safety and Zoonoses, WHO. On behalf of FAO and WHO, Dr Miyagishima welcomed and thanked the participants for providing their expertise and for the significant time and effort put into such an important activity. He also expressed gratitude to the respective national authorities, institutes and organizations that have allowed their experts to contribute to this important work on pesticide residues. Dr Miyagishima said that whereas the assessment of new compounds is very important and represents the major part of the work of JMPR, it is also crucial to continue our efforts on the periodic re-evaluation of old pesticides still in use. This should allow developing countries to use old, inexpensive pesticides so that they can access international markets for their food commodities; it also should allow the removal of those compounds that are most persistent in the environment and pose the greatest risk to public health. Dr Miyagishima also noted that in order to continue using the best available science in a transparent manner, the WHO Core Assessment Group will meet during an additional day this year to update the guidance documents for experts and sponsors. Finally, JMPR is celebrating in 2013 the 50th anniversary of the first joint FAO/WHO evaluation of pesticide residues in food, and Dr Miyagishima addressed his best wishes to the Meeting on behalf of the two parent organizations.

During the meeting, the FAO Panel of Experts was responsible for reviewing residue and analytical aspects of the pesticides under consideration, including data on their metabolism, fate in the environment and use patterns, and for estimating the maximum levels of residues that might occur as a result of use of the pesticides according to good agricultural practice (GAP). Maximum residue levels and supervised trials median residue (STMR) values were estimated for commodities of animal origin. The WHO Core Assessment Group was responsible for reviewing toxicological and related data in order to establish acceptable daily intakes (ADIs) and acute reference doses (ARfDs), where necessary.

The Meeting evaluated 36 pesticides, including 11 new compounds and 3 compounds that were re-evaluated within the periodic review programme of the Codex Committee on Pesticide Residues (CCPR), for toxicity or residues, or both.

The Meeting allocated ADIs and ARfDs, estimated maximum residue levels and recommended them for use by CCPR, and estimated STMR and highest residue (HR) levels as a basis for estimating dietary intake.

The Meeting also estimated the dietary intakes (both short-term and long-term) of the pesticides reviewed and, on this basis, performed dietary risk assessments in relation to their ADIs or ARfDs. Cases in which ADIs or ARfDs may be exceeded were clearly indicated in order to facilitate the decision-making process of CCPR. The rationale for methodologies for long- and short-term dietary risk assessment are described in detail in the FAO manual on the submission and evaluation of pesticide residue data for the estimation of maximum residue levels in food and feed (2009).

The Meeting considered a number of current issues related to the risk assessment of chemicals, the evaluation of pesticide residues and the procedures used to recommend maximum residue levels.



## FAO TECHNICAL PAPERS

### FAO PLANT PRODUCTION AND PROTECTION PAPERS

- 1 Horticulture: a select bibliography, 1976 (E)
- 2 Cotton specialists and research institutions in selected countries, 1976 (E)
- 3 Food legumes: distribution, adaptability and biology of yield, 1977 (E F S)
- 4 Soybean production in the tropics, 1977 (C E F S)
- 4 Rev.1 Soybean production in the tropics (first revision), 1982 (E)
- 5 Les systèmes pastoraux sahéliens, 1977 (F)
- 6 Pest resistance to pesticides and crop loss assessment – Vol. 1, 1977 (E F S)
- 6/2 Pest resistance to pesticides and crop loss assessment – Vol. 2, 1979 (E F S)
- 6/3 Pest resistance to pesticides and crop loss assessment – Vol. 3, 1981 (E F S)
- 7 Rodent pest biology and control – Bibliography 1970-74, 1977 (E)
- 8 Tropical pasture seed production, 1979 (E F\*\* S\*\*)
- 9 Food legume crops: improvement and production, 1977 (E)
- 10 Pesticide residues in food, 1977 – Report, 1978 (E F S)
- 10 Rev. Pesticide residues in food 1977 – Report, 1978 (E)
- 10 Sup. Pesticide residues in food 1977 – Evaluations, 1978 (E)
- 11 Pesticide residues in food 1965-78 – Index and summary, 1978 (E F S)
- 12 Crop calendars, 1978 (E/F/S)
- 13 The use of FAO specifications for plant protection products, 1979 (E F S)
- 14 Guidelines for integrated control of rice insect pests, 1979 (Ar C E F S)
- 15 Pesticide residues in food 1978 – Report, 1979 (E F S)
- 15 Sup. Pesticide residues in food 1978 – Evaluations, 1979 (E)
- 16 Rodenticides: analyses, specifications, formulations, 1979 (E F S)
- 17 Agrometeorological crop monitoring and forecasting, 1979 (C E F S)
- 18 Guidelines for integrated control of maize pests, 1979 (C E)
- 19 Elements of integrated control of sorghum pests, 1979 (E F S)
- 20 Pesticide residues in food 1979 – Report, 1980 (E F S)
- 20 Sup. Pesticide residues in food 1979 – Evaluations, 1980 (E)
- 21 Recommended methods for measurement of pest resistance to pesticides, 1980 (E F)
- 22 China: multiple cropping and related crop production technology, 1980 (E)
- 23 China: development of olive production, 1980 (E)
- 24/1 Improvement and production of maize, sorghum and millet – Vol. 1. General principles, 1980 (E F)
- 24/2 Improvement and production of maize, sorghum and millet – Vol. 2. Breeding, agronomy and seed production, 1980 (E F)
- 25 Prosopis tamarugo: fodder tree for arid zones, 1981 (E F S)
- 26 Pesticide residues in food 1980 – Report, 1981 (E F S)
- 26 Sup. Pesticide residues in food 1980 – Evaluations, 1981 (E)
- 27 Small-scale cash crop farming in South Asia, 1981 (E)
- 28 Second expert consultation on environmental criteria for registration of pesticides, 1981 (E F S)
- 29 Sesame: status and improvement, 1981 (E)
- 30 Palm tissue culture, 1981 (C E)
- 31 An eco-climatic classification of intertropical Africa, 1981 (E)
- 32 Weeds in tropical crops: selected abstracts, 1981 (E)
- 32 Sup.1 Weeds in tropical crops: review of abstracts, 1982 (E)
- 33 Plant collecting and herbarium development, 1981 (E)
- 34 Improvement of nutritional quality of food crops, 1981 (C E)
- 35 Date production and protection, 1982 (Ar E)
- 36 El cultivo y la utilización del tarwi – Lupinus mutabilis Sweet, 1982 (S)
- 37 Pesticide residues in food 1981 – Report, 1982 (E F S)
- 38 Winged bean production in the tropics, 1982 (E)
- 39 Seeds, 1982 (E/F/S)
- 40 Rodent control in agriculture, 1982 (Ar C E F S)
- 41 Rice development and rainfed rice production, 1982 (E)
- 42 Pesticide residues in food 1981 – Evaluations, 1982 (E)
- 43 Manual on mushroom cultivation, 1983 (E F)

44	Improving weed management, 1984 (E F S)	71	Technical guideline on seed potato micropropagation and multiplication, 1986 (E)
45	Pocket computers in agrometeorology, 1983 (E)	72/1	Pesticide residues in food 1985 – Evaluations – Part I: Residues, 1986 (E)
46	Pesticide residues in food 1982 – Report, 1983 (E F S)	72/2	Pesticide residues in food 1985 – Evaluations – Part II: Toxicology, 1986 (E)
47	The sago palm, 1983 (E F)	73	Early agrometeorological crop yield assessment, 1986 (E F S)
48	Guidelines for integrated control of cotton pests, 1983 (Ar E F S)	74	Ecology and control of perennial weeds in Latin America, 1986 (E S)
49	Pesticide residues in food 1982 – Evaluations, 1983 (E)	75	Technical guidelines for field variety trials, 1993 (E F S)
50	International plant quarantine treatment manual, 1983 (C E)	76	Guidelines for seed exchange and plant introduction in tropical crops, 1986 (E)
51	Handbook on jute, 1983 (E)	77	Pesticide residues in food 1986 – Report, 1986 (E F S)
52	The palmyrah palm: potential and perspectives, 1983 (E)	78	Pesticide residues in food 1986 – Evaluations – Part I: Residues, 1986 (E)
53/1	Selected medicinal plants, 1983 (E)	78/2	Pesticide residues in food 1986 – Evaluations – Part II: Toxicology, 1987 (E)
54	Manual of fumigation for insect control, 1984 (C E F S)	79	Tissue culture of selected tropical fruit plants, 1987 (E)
55	Breeding for durable disease and pest resistance, 1984 (C E)	80	Improved weed management in the Near East, 1987 (E)
56	Pesticide residues in food 1983 – Report, 1984 (E F S)	81	Weed science and weed control in Southeast Asia, 1987 (E)
57	Coconut, tree of life, 1984 (E S)	82	Hybrid seed production of selected cereal, oil and vegetable crops, 1987 (E)
58	Economic guidelines for crop pest control, 1984 (E F S)	83	Litchi cultivation, 1989 (E S)
59	Micropropagation of selected rootcrops, palms, citrus and ornamental species, 1984 (E)	84	Pesticide residues in food 1987 – Report, 1987 (E F S)
60	Minimum requirements for receiving and maintaining tissue culture propagating material, 1985 (E F S)	85	Manual on the development and use of FAO specifications for plant protection products, 1987 (E** F S)
61	Pesticide residues in food 1983 – Evaluations, 1985 (E)	86/1	Pesticide residues in food 1987 – Evaluations – Part I: Residues, 1988 (E)
62	Pesticide residues in food 1984 – Report, 1985 (E F S)	86/2	Pesticide residues in food 1987 – Evaluations – Part II: Toxicology, 1988 (E)
63	Manual of pest control for food security reserve grain stocks, 1985 (C E)	87	Root and tuber crops, plantains and bananas in developing countries – challenges and opportunities, 1988 (E)
64	Contribution à l'écologie des aphides africains, 1985 (F)	88	Jessenia and Oenocarpus: neotropical oil palms worthy of domestication, 1988 (E S)
65	Amélioration de la culture irriguée du riz des petits fermiers, 1985 (F)	89	Vegetable production under arid and semi-arid conditions in tropical Africa, 1988 (E F)
66	Sesame and safflower: status and potentials, 1985 (E)	90	Protected cultivation in the Mediterranean climate, 1990 (E F S)
67	Pesticide residues in food 1984 – Evaluations, 1985 (E)	91	Pastures and cattle under coconuts, 1988 (E S)
68	Pesticide residus in food 1985 – Report, 1986 (E F S)	92	Pesticide residues in food 1988 – Report, 1988 (E F S)
69	Breeding for horizontal resistance to wheat diseases, 1986 (E)		
70	Breeding for durable resistance in perennial crops, 1986 (E)		



93/1	Pesticide residues in food 1988 – Evaluations – Part I: Residues, 1988 (E)	118	Pesticide residues in food 1992 – Evaluations – Part I: Residues, 1993 (E)
93/2	Pesticide residues in food 1988 – Evaluations – Part II: Toxicology, 1989 (E)	119	Quarantine for seed, 1993 (E)
94	Utilization of genetic resources: suitable approaches, agronomical evaluation and use, 1989 (E)	120	Weed management for developing countries, 1993 (E S)
95	Rodent pests and their control in the Near East, 1989 (E)	120/1	Weed management for developing countries, Addendum 1, 2004 (E F S)
96	Striga – Improved management in Africa, 1989 (E)	121	Rambutan cultivation, 1993 (E)
97/1	Fodders for the Near East: alfalfa, 1989 (Ar E)	122	Pesticide residues in food 1993 – Report, 1993 (E F S)
97/2	Fodders for the Near East: annual medic pastures, 1989 (Ar E F)	123	Rodent pest management in eastern Africa, 1994 (E)
98	An annotated bibliography on rodent research in Latin America 1960-1985, 1989 (E)	124	Pesticide residues in food 1993 – Evaluations – Part I: Residues, 1994 (E)
99	Pesticide residues in food 1989 – Report, 1989 (E F S)	125	Plant quarantine: theory and practice, 1994 (Ar)
100	Pesticide residues in food 1989 – Evaluations – Part I: Residues, 1990 (E)	126	Tropical root and tuber crops – Production, perspectives and future prospects, 1994 (E)
100/2	Pesticide residues in food 1989 – Evaluations – Part II: Toxicology, 1990 (E)	127	Pesticide residues in food 1994 – Report, 1994 (E)
101	Soilless culture for horticultural crop production, 1990 (E)	128	Manual on the development and use of FAO specifications for plant protection products – Fourth edition, 1995 (E F S)
102	Pesticide residues in food 1990 – Report, 1990 (E F S)	129	Mangosteen cultivation, 1995 (E)
103/1	Pesticide residues in food 1990 – Evaluations – Part I: Residues, 1990 (E)	130	Post-harvest deterioration of cassava – A biotechnology perspective, 1995 (E)
104	Major weeds of the Near East, 1991 (E)	131/1	Pesticide residues in food 1994 – Evaluations – Part I: Residues, Volume 1, 1995 (E)
105	Fundamentos teórico-prácticos del cultivo de tejidos vegetales, 1990 (S)	131/2	Pesticide residues in food 1994 – Evaluations – Part I: Residues, Volume 2, 1995 (E)
106	Technical guidelines for mushroom growing in the tropics, 1990 (E)	132	Agro-ecology, cultivation and uses of cactus pear, 1995 (E)
107	Gynandropsis gynandra (L.) Briq. – a tropical leafy vegetable – its cultivation and utilization, 1991 (E)	133	Pesticide residues in food 1995 – Report, 1996 (E)
108	Carambola cultivation, 1993 (E S)	134	(Number not assigned)
109	Soil solarization, 1991 (E)	135	Citrus pest problems and their control in the Near East, 1996 (E)
110	Potato production and consumption in developing countries, 1991 (E)	136	El pepino dulce y su cultivo, 1996 (S)
111	Pesticide residues in food 1991 – Report, 1991 (E)	137	Pesticide residues in food 1995 – Evaluations – Part I: Residues, 1996 (E)
112	Cocoa pest and disease management in Southeast Asia and Australasia, 1992 (E)	138	Sunn pests and their control in the Near East, 1996 (E)
113/1	Pesticide residues in food 1991 – Evaluations – Part I: Residues, 1991 (E)	139	Weed management in rice, 1996 (E)
114	Integrated pest management for protected vegetable cultivation in the Near East, 1992 (E)	140	Pesticide residues in food 1996 – Report, 1997 (E)
115	Olive pests and their control in the Near East, 1992 (E)	141	Cotton pests and their control in the Near East, 1997 (E)
116	Pesticide residues in food 1992 – Report, 1993 (E F S)	142	Pesticide residues in food 1996 – Evaluations – Part I Residues, 1997 (E)
117	Quality declared seed, 1993 (E F S)	143	Management of the whitefly-virus complex, 1997 (E)
		144	Plant nematode problems and their control in the Near East region, 1997 (E)
		145	Pesticide residues in food 1997 – Report, 1998 (E)
		146	Pesticide residues in food 1997 – Evaluations – Part

	I: Residues, 1998 (E)		Part I, 2002 (E)
147	Soil solarization and integrated management of soilborne pests, 1998 (E)	172	Pesticide residues in food, 2002 – Report, 2002 (E)
148	Pesticide residues in food 1998 – Report, 1999 (E)	173	Manual on development and use of FAO and WHO specifications for pesticides, 2002 (E S)
149	Manual on the development and use of FAO specifications for plant protection products – Fifth edition, including the new procedure, 1999 (E)	174	Genotype x environment interaction – Challenges and opportunities for plant breeding and cultivar recommendations, 2002 (E)
150	Restoring farmers' seed systems in disaster situations, 1999 (E)	175/1	Pesticide residues in food 2002 – Evaluations – Part 1: Residues – Volume 1 (E)
151	Seed policy and programmes for sub-Saharan Africa, 1999 (E F)	175/2	Pesticide residues in food 2002 – Evaluations – Part 1: Residues – Volume 2 (E)
152/1	Pesticide residues in food 1998 – Evaluations – Part I: Residues, Volume 1, 1999 (E)	176	Pesticide residues in food 2003 – Report, 2004 (E)
152/2	Pesticide residues in food 1998 – Evaluations – Part I: Residues, Volume 2, 1999 (E)	177	Pesticide residues in food 2003 – Evaluations – Part 1: Residues, 2004 (E)
153	Pesticide residues in food 1999 – Report, 1999 (E)	178	Pesticide residues in food 2004 – Report, 2004 (E)
154	Greenhouses and shelter structures for tropical regions, 1999 (E)	179	Triticale improvement and production, 2004 (E)
155	Vegetable seedling production manual, 1999 (E)	180	Seed multiplication by resource-limited farmers - Proceedings of the Latin American workshop, 2004 (E)
156	Date palm cultivation, 1999 (E)	181	Towards effective and sustainable seed-relief activities, 2004 (E)
156 Rev.1	Date palm cultivation, 2002 (E)	182/1	Pesticide residues in food 2004 – Evaluations – Part 1: Residues, Volume 1 (E)
157	Pesticide residues in food 1999 – Evaluations – Part I: Residues, 2000 (E)	182/2	Pesticide residues in food 2004 – Evaluations – Part 1: Residues, Volume 2 (E)
158	Ornamental plant propagation in the tropics, 2000 (E)	183	Pesticide residues in food 2005 – Report, 2005 (E)
159	Seed policy and programmes in the Near East and North Africa, 2000	184/1	Pesticide residues in food 2005 – Evaluations – Part 1: Residues, Volume 1 (E)
160	Seed policy and programmes for Asia and the Pacific, 2000 (E)	184/2	Pesticide residues in food 2005 – Evaluations – Part 1: Residues, Volume 2 (E)
161	Silage making in the tropics with particular emphasis on smallholders, 2000 (E S)	185	Quality declared seed system, 2006 (E F S)
162	Grassland resource assessment for pastoral systems, 2001, (E)	186	Calendario de cultivos – América Latina y el Caribe, 2006 (S)
163	Pesticide residues in food 2000 – Report, 2001 (E)	187	Pesticide residues in food 2006 – Report, 2006 (E)
164	Seed policy and programmes in Latin America and the Caribbean, 2001 (E S)	188	Weedy rices – origin, biology, ecology and control, 2006 (E S)
165	Pesticide residues in food 2000 – Evaluations – Part I, 2001 (E)	189/1	Pesticide residues in food 2006 – Evaluations – Part 1: Residues, Volume 1 (E)
166	Global report on validated alternatives to the use of methyl bromide for soil fumigation, 2001 (E)	189/2	Pesticide residues in food 2006 – Evaluations – Part 1: Residues, Volume 2 (E)
167	Pesticide residues in food 2001 – Report, 2001 (E)	190	Guidance for packing, shipping, holding and release of sterile flies in area-wide fruit fly control programmes, 2007 (E)
168	Seed policy and programmes for the Central and Eastern European countries, Commonwealth of Independent States and other countries in transition, 2001 (E)	191	Pesticide residues in food 2007 – Report, 2007 (E)
169	Cactus ( <i>Opuntia</i> spp.) as forage, 2003 (E S)	192	Pesticide residues in food 2007 – Evaluations – Part 1: Residues, 2008 (E)
170	Submission and evaluation of pesticide residues data for the estimation of maximum residue levels in food and feed, 2002 (E)	193	Pesticide residues in food 2008 – Report, 2008 (E)
171	Pesticide residues in food 2001 – Evaluations –	194	Pesticide residues in food 2008 – Evaluations, 2008 (E)

195	Quality declared planting material – Protocols and standards for vegetatively propagated crops, 2010 (E)		for facilitators in sub-Saharan Africa
196	Pesticide residues in food 2009 – Report, 2009 (E)	Availability: July 2013	
197	Submission and evaluation of pesticide residues data for the estimation of maximum residue levels in food and feed, 2009 (E)	Ar – Arabic	Multil – Multilingual
		C – Chinese	* Out of print
198	Pesticide residues in food 2009 – Evaluations – Part 1: Residues, 2010 (E)	E – English	** In preparation
		F – French	
199	Rearing codling moth for the sterile insect technique, 2010 (E)	P – Portuguese	
		S – Spanish	
200	Pesticide residues in food 2010 – Report, 2011 (E)		
201	Promoting the Growth and Development of Smallholder Seed Enterprises for Food Security Crops Case Studies from Brazil, Côte d’Ivoire and India (E) 2010		The FAO Technical Papers are available through the authorized FAO Sales Agents or directly from Sales and Marketing Group, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy.
202	Seeds in Emergencies: a technical handbook (E) 2011		
203	Sustainable wheat rust resistance – Learning from history		
204	State of knowledge on breeding for durable resistance to soybean rust disease in the developing world		
205	The FAO/IAEA Spreadsheet for Designing and Operation of Insect Mass Rearing Facilities		
206	Pesticide Residues in food 2010 – Evaluations – Part 1		
207	Plant breeding and seed systems for rice, vegetables, maize and pulses in Bangladesh		
208	The dynamic tension between public and private plant breeding in Thailand		
209	The strategic role of plant breeding in Uruguay: analysis through an agricultural innovation system framework		
210	Evolving a plant breeding and seed system in sub-Saharan Africa in an era of donor dependence		
211	Pesticide residues in food 2011 – Report, 2011 (E)		
212	Pesticide Residues in food 2011 – Evaluations – Part 1		
213	Evaluation of pesticide residues - Training Manual		
214	Agricultural handtools; Guidelines for Field Officers and Procurement		
215	Pesticide residues in food 2012 – Report, 2011 (E)		
216	Pesticide residues in Food 2011 – Evaluations – Part 1 (E)		
217	Good Agricultural Practices for greenhouse vegetable crops: Principles for Mediterranean climate areas (E)		
218	Cassava Farmer Field Schools – Resource material		





The annual 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 was held in Geneva, Switzerland, from 17 to 26 September 2013. The FAO Panel of Experts had met in preparatory sessions from 6 to 10 September. The Meeting was held in pursuance of recommendations made by previous Meetings and accepted by the governing bodies of FAO and WHO that studies should be undertaken jointly by experts to evaluate possible hazards to humans arising from the occurrence of pesticide residues in foods. During the meeting the FAO Panel of Experts was responsible for reviewing pesticide use patterns (use of good agricultural practices), data on the chemistry and composition of the pesticides and methods of analysis for pesticide residues and for estimating the maximum residue levels that might occur as a result of the use of the pesticides according to good agricultural use practices. The WHO Core Assessment Group was responsible for reviewing toxicological and related data and for estimating, where possible and appropriate, acceptable daily intakes (ADIs) and acute reference doses (ARfDs) of the pesticides for humans. This report contains information on ADIs, ARfDs, maximum residue levels, and general principles for the evaluation of pesticides. The recommendations of the Joint Meeting, including further research and information, are proposed for use by Member governments of the respective agencies and other interested parties.

E-ISBN 978-92-5-108245-4 ISSN 0259-2517



9 7 8 9 2 5 1 0 8 0 4 3 6

I3689E/1/03.14