Pesticide residues in food 2009

Evaluations
Part I – Residues

FAO
PLANT
PRODUCTION
AND PROTECTION
PAPER

198

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 on Pesticide Residues
Geneva, Switzerland, 16–25 September 2009

WORLD HEALTH ORGANIZATION
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2010

Monographs containing summaries or residue data and toxicological data considered at the 2009 JMPR, together with recommendations, are available upon request from FAO or WHO under the title:

Pesticide residues in food 2009
Evaluations
Part I: Residues
FAO Plant Production and Protection Paper

This report contains the collective views of two international groups of experts and does not necessarily represent the decisions or the stated policy of the Food and Agriculture Organization of the United Nations or of the World Health Organization.

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 Progamme, 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.

ISBN 978-92-5-106503-7

CONTENTS

[1/] Evaluated for the Periodic Review Programme of the Codex Committee on Pesticide Residues.

[2/] New compound.

LIST OF PARTICIPANTS

2009 JOINT FAO/WHO MEETING ON PESTICIDE RESIDUES

GENEVA, 16–25 SEPTEMBER 2009

FAO Members

Dr Ursula Banasiak, Federal Institute for Risk Assessment, Thielallee 88-92, D-14195 Berlin, Germany

Professor Eloisa Dutra Caldas, University of Brasilia, College of Health Sciences, Pharmaceutical Sciences Department, Campus Universitário Darci Ribeiro, 70919-970 Brasília/DF, Brazil

Mr Stephen Funk, Health Effects Division (7509P), United States Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington DC 20460, USA

Mr Denis J. Hamilton, Principal Scientific Officer Biosecurity, Department of Primary Industries and Fisheries, PO Box 46, Brisbane, QLD 4001, Australia

Mr David Lunn, Senior Programme Manager (Residues–Plants), Export Standards Group, New Zealand Food Safety Authority, PO Box 2835, Wellington, New Zealand *(FAO Rapporteur)*

Dr Dougal MacLachlan, Australian Quarantine and Inspection Service, Australian Government Department of Agriculture, Fisheries and Forestry, GPO Box 858, Canberra, ACT 2601, Australia

Dr Bernadette Ossendorp, Centre for Substances and Integrated Risk Assessment, National Institute of Public Health and the Environment (RIVM), Antonie van Leeuwenhoeklaan 9, PO Box 1, 3720 BA Bilthoven, Netherlands *(FAO Chairman)*

Dr Yukiko Yamada, Deputy Director-General, Food Safety and Consumer Affairs Bureau, Ministry of Agriculture, Forestry and Fisheries, 1-2-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8950, Japan

WHO Members

Professor Alan R. Boobis, Experimental Medicine & Toxicology, Division of Investigative Science, Faculty of Medicine, Imperial College London, Hammersmith Campus, Ducane Road, London W12 0NN, England

Dr Vicki L. Dellarco, Office of Pesticide Programs (7501P), United States Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington, DC 20460, USA (WHO Rapporteur)

Dr Helen Hakansson, Institute of Environmental Medicine, Karolinska Institutet, Unit of Environmental Health Risk Assessment, Box 210, Nobelsväg 13, S-171 77 Stockholm, Sweden

Professor Angelo Moretto, Department of Environmental and Occupational Health, University of Milan, International Centre for Pesticides and Health Risk Prevention, Luigi Sacco Hospital, Via Stephenson 94, 20157 Milan, Italy (WHO Chairman)

Dr Roland Solecki, Chemical Safety Division, Steering of Procedures and Overall Assessment, Federal Institute for Risk Assessment, Thielallee 88-92, D-14195 Berlin, Germany

Dr Maria Tasheva, Consultant, National Service for Plant Protection, Ministry of Agriculture and Food, 17 Hristo Botev Bul. 1040 Sofia, Bulgaria

Secretariat

Dr habil. Árpád Ambrus, Hungarian Food Safety Office, Gyali ut 2-6, 1097 Budapest, Hungary (FAO Temporary Adviser)

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

Dr Katie Calp, Pest Management Regulatory Agency, Health Canada, 2720 Riverside Drive, AL 6605E Ottawa, Canada (WHO Temporary Adviser)

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

Dr Ian Dewhurst, Chemicals Regulation Directorate, Mallard House, King's Pool, 3 Peasholme Green, York YO1 7PX, England (WHO Temporary Adviser)

Dr William Donovan, United States Environmental Protection Agency, MC 7509C, Washington, DC 20460, USA (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 Debabrata Kanungo, Additional DG, Directorate General of Health Services, Ministry of Health and Family Welfare, West, Block No. 1, R.K. Puram, New Delhi, India (WHO Temporary Adviser)

Dr Katerina Mastovska, Eastern Regional Research Center (ERRC), Agricultural Research Service (ARS), United States Department of Agriculture, 600 E. Mermaid Lane, Wyndmoor, PA 19038, USA (FAO Temporary Adviser)

Dr Jeronimas Maskeliunas, Food Standards Officer, Joint FAO/WHO Food Standards Programme, Nutrition and Consumer Protection Division, Food and Agriculture Organization of the United Nations, Viale delle terme di Caracalla, 00153 Rome, Italy (Codex Secretariat)

Dr Heidi Mattock, 21 bis rue du Mont Ouest, 38230 Tignieu-Jameyzieu, France (WHO Editor)

Dr Douglas B. McGregor, Toxicity Evaluation Consultants, 38 Shore Road, Aberdour KY3 0TU, Scotland (WHO Temporary Adviser)

Dr Rudolf Pfeil, Toxicology of Pesticides and Biocides, Federal Institute for Risk Assessment, Thielallee 88-92, D-14195 Berlin, Germany (WHO Temporary Adviser)

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

Ms Jeannie Richards, 15 bis rue Georges Musy, 71100 Saint Remy, France (FAO Temprary Advisor)

Dr Prakashchandra V. Shah, United States Environmental Protection Agency, Mail Stop: 7505P, 1200 Pennsylvania Avenue NW, Washington DC 20460, USA (WHO Temporary Adviser)

Mr Christian Sieke, Federal Institute for Risk Assessment, Thielallee 88-92, D-14195 Berlin, Germany (FAO Temporary Adviser)

Dr Angelika Tritscher, Food Safety and Zoonoses (FOS), International Programme on Chemical Safety, World Health Organization, 1211 Geneva 27, Switzerland (WHO Joint Secretary)

Ms Trijntje van der Velde, National Institute of Public Health and the Environment (RIVM), Antonie van Leeuwenhoeklaan 9, PO Box 1, 3720 BA Bilthoven, Netherlands (FAO Temporary Adviser)

Dr Gerrit Wolterink, Centre for Substances & Integrated Risk Assessment, National Institute of Public Health and the Environment (RIVM), Antonie van Leeuwenhoeklaan 9, PO Box 1, 3720 BA Bilthoven, Netherlands (WHO Temporary Adviser)

Ms Yong Zhen Yang, Plant Protection Service (AGPP), Food and Agriculture Organization of the United Nations (FAO), Viale delle Terme di Caracalla, 00153 Rome, Italy (FAO Joint Secretary)

Dr Midori Yoshida, Section Chief, Division of Pathology, Biological Safety Research Center, National Institute of Health Sciences, Ministry of Health, Labor and Welfare, 1-18-1 Kamiyoga, Setagaya-ku, Tokyo 158-8501, Japan (WHO Temporary Adviser)

Dr Jürg Zarn, Swiss Federal Office of Public Health, Nutritional and Toxicological Risks Section, Stauffacherstrasse 101, CH-8004 Zurich, Switzerland (WHO 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, 1st 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
AR	Applied radioactivity
ARfD	acute reference dose
AUC	area under the curve for concentration–time
BBCH	Biologische Bundesanstalt, Bundessortenamt and Chemical industry.
$BMDL_{10}$	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
DT_{50}	time for 50% decomposition (i.e., half-life)
DT_{90}	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
F_1	first filial generation
F_2	second filial generation
FAO	Food and Agriculture Organization of the United Nations
FID	flame-ionization detection or detector
FPD	flame-photometric detection or detector
GAP	good agricultural practice(s)
GC	gas chromatography; the detector system used is usually also abbreviated as a suffix
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
HPLC	high-performance liquid chromatography
HPLC-MS	high-performance liquid chromatography – mass spectrometry
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
M	molar = mole/L
MID	multiple ion detection (mass spectrometric)
MRL	Maximum Residue Limit. MRLs include draft MRLs and Codex 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
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_{ow}	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)
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

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.

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 Geneva, 16–25 September 2009, 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, 2009). 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 summarized 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 2008 JMPR, for the FAO Panel of Experts on Pesticide Residues in Food and the Environment:

Dr. Á. Ambrus, Dr U. Banasiak, Dr E. Dutra Caldas, Dr W. Donovan Dr S. Funk, Mr D. J. Hamilton, Mr M. Irie, Mr D. Lunn, Dr D MacLachlan, Dr K. Mastovska, Dr B. Ossendorp, Mr C. Sieke, Dr T. van der Velde-Koerts, Dr Y. Yamada,

Note. Any comment on residues in food and their evaluation should be addressed to the:

Plant Production and Protection Division

Food and Agricultural Organization

Viale delle Terme di Caracalla

00100 Rome, Italy

Reference

JMPR, 2009. Pesticide residues in Food – 2009. 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, Geneva, Switzerland, 16-25 September 2009. WHO and FAO, Rome, 2009.

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)
45	Pocket computers in agrometeorology, 1983 (E)
46	Pesticide residues in food 1982 – Report, 1983 (E F S)
47	The sago palm, 1983 (E F)
48	Guidelines for integrated control of cotton pests, 1983 (Ar E F S)
49	Pesticide residues in food 1982 – Evaluations, 1983 (E)
50	International plant quarantine treatment manual, 1983 (C E)
51	Handbook on jute, 1983 (E)
52	The palmyrah palm: potential and perspectives, 1983 (E)
53/1	Selected medicinal plants, 1983 (E)
54	Manual of fumigation for insect control, 1984 (C E F S)
55	Breeding for durable disease and pest resistance, 1984 (C E)
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)
75 Technical guidelines for field variety trials, 1993 (E F S)
76 Guidelines for seed exchange and plant introduction in tropical crops, 1986 (E)
77 Pesticide residues in food 1986 – Report, 1986 (E F S)
78 Pesticide residues in food 1986 – Evaluations – Part I: Residues, 1986 (E)
78/2 Pesticide residues in food 1986 – Evaluations – Part II: Toxicology, 1987 (E)
79 Tissue culture of selected tropical fruit plants, 1987 (E)
80 Improved weed management in the Near East, 1987 (E)
81 Weed science and weed control in Southeast Asia, 1987 (E)
82 Hybrid seed production of selected cereal, oil and vegetable crops, 1987 (E)
83 Litchi cultivation, 1989 (E S)
84 Pesticide residues in food 1987 – Report, 1987 (E F S)
85 Manual on the development and use of FAO specifications for plant protection products, 1987 (E** F S)
86/1 Pesticide residues in food 1987 – Evaluations – Part I: Residues, 1988 (E)
86/2 Pesticide residues in food 1987 – Evaluations – Part II: Toxicology, 1988 (E)
87 Root and tuber crops, plantains and bananas in developing countries – challenges and opportunities, 1988 (E)
88 *Jessenia* and *Oenocarpus*: neotropical oil palms worthy of domestication, 1988 (E S)
89 Vegetable production under arid and semi-arid conditions in tropical Africa, 1988 (E F)
90 Protected cultivation in the Mediterranean climate, 1990 (E F S)
91 Pastures and cattle under coconuts, 1988 (E S)
92 Pesticide residues in food 1988 – Report, 1988 (E F S)
93/1 Pesticide residues in food 1988 – Evaluations – Part I: Residues, 1988 (E)
93/2 Pesticide residues in food 1988 – Evaluations – Part II: Toxicology, 1989 (E)
94 Utilization of genetic resources: suitable approaches, agronomical evaluation and use, 1989 (E)
95 Rodent pests and their control in the Near East, 1989 (E)
96 *Striga* – Improved management in Africa, 1989 (E)
97/1 Fodders for the Near East: alfalfa, 1989 (Ar E)
97/2 Fodders for the Near East: annual medic pastures, 1989 (Ar E F)
98 An annotated bibliography on rodent research in Latin America 1960-1985, 1989 (E)
99 Pesticide residues in food 1989 – Report, 1989 (E F S)
100 Pesticide residues in food 1989 – Evaluations – Part I: Residues, 1990 (E)
100/2 Pesticide residues in food 1989 – Evaluations – Part II: Toxicology, 1990 (E)
101 Soilless culture for horticultural crop production, 1990 (E)
102 Pesticide residues in food 1990 – Report, 1990 (E F S)
103/1 Pesticide residues in food 1990 – Evaluations – Part I: Residues, 1990 (E)
104 Major weeds of the Near East, 1991 (E)
105 Fundamentos teórico-prácticos del cultivo de tejidos vegetales, 1990 (S)
106 Technical guidelines for mushroom growing in the tropics, 1990 (E)
107 *Gynandropsis gynandra* (L.) Briq. – a tropical leafy vegetable – its cultivation and utilization, 1991 (E)
108 Carambola cultivation, 1993 (E S)
109 Soil solarization, 1991 (E)
110 Potato production and consumption in developing countries, 1991 (E)
111 Pesticide residues in food 1991 – Report, 1991 (E)
112 Cocoa pest and disease management in Southeast Asia and Australasia, 1992 (E)
113/1 Pesticide residues in food 1991 – Evaluations – Part I: Residues, 1991 (E)
114 Integrated pest management for protected vegetable cultivation in the Near East, 1992 (E)
115 Olive pests and their control in the Near East, 1992 (E)
116 Pesticide residues in food 1992 – Report, 1993 (E F S)
117 Quality declared seed, 1993 (E F S)
118 Pesticide residues in food 1992 – Evaluations – Part I: Residues, 1993 (E)
119 Quarantine for seed, 1993 (E)
120 Weed management for developing countries, 1993 (E S)
120/1 Weed management for developing countries, Addendum 1, 2004 (E F S)
121 Rambutan cultivation, 1993 (E)
122 Pesticide residues in food 1993 – Report, 1993 (E F S)
123 Rodent pest management in eastern Africa, 1994 (E)
124 Pesticide residues in food 1993 – Evaluations – Part I: Residues, 1994 (E)
125 Plant quarantine: theory and practice, 1994 (Ar)
126 Tropical root and tuber crops – Production, perspectives and future prospects, 1994 (E)
127 Pesticide residues in food 1994 – Report, 1994 (E)

128 Manual on the development and use of FAO specifications for plant protection products – Fourth edition, 1995 (E F S)
129 Mangosteen cultivation, 1995 (E)
130 Post-harvest deterioration of cassava – A biotechnology perspective, 1995 (E)
131/1 Pesticide residues in food 1994 – Evaluations – Part I: Residues, Volume 1, 1995 (E)
131/2 Pesticide residues in food 1994 – Evaluations – Part I: Residues, Volume 2, 1995 (E)
132 Agro-ecology, cultivation and uses of cactus pear, 1995 (E)
133 Pesticide residues in food 1995 – Report, 1996 (E)
134 (Number not assigned)
135 Citrus pest problems and their control in the Near East, 1996 (E)
136 El pepino dulce y su cultivo, 1996 (S)
137 Pesticide residues in food 1995 – Evaluations – Part I: Residues, 1996 (E)
138 Sunn pests and their control in the Near East, 1996 (E)
139 Weed management in rice, 1996 (E)
140 Pesticide residues in food 1996 – Report, 1997 (E)
141 Cotton pests and their control in the Near East, 1997 (E)
142 Pesticide residues in food 1996 – Evaluations – Part I Residues, 1997 (E)
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)
147 Soil solarization and integrated management of soilborne pests, 1998 (E)
148 Pesticide residues in food 1998 – Report, 1999 (E)
149 Manual on the development and use of FAO specifications for plant protection products – Fifth edition, including the new procedure, 1999 (E)
150 Restoring farmers' seed systems in disaster situations, 1999 (E)
151 Seed policy and programmes for sub-Saharan Africa, 1999 (E F)
152/1 Pesticide residues in food 1998 – Evaluations – Part I: Residues, Volume 1, 1999 (E)
152/2 Pesticide residues in food 1998 – Evaluations – Part I: Residues, Volume 2, 1999 (E)
153 Pesticide residues in food 1999 – Report, 1999 (E)
154 Greenhouses and shelter structures for tropical regions, 1999 (E)
155 Vegetable seedling production manual, 1999 (E)
156 Date palm cultivation, 1999 (E)
156 Rev.1 Date palm cultivation, 2002 (E)
157 Pesticide residues in food 1999 – Evaluations – Part I: Residues, 2000 (E)
158 Ornamental plant propagation in the tropics, 2000 (E)
159 Seed policy and programmes in the Near East and North Africa, 2000
160 Seed policy and programmes for Asia and the Pacific, 2000 (E)
161 Silage making in the tropics with particular emphasis on smallholders, 2000 (E S)
162 Grassland resource assessment for pastoral systems, 2001, (E)
163 Pesticide residues in food 2000 – Report, 2001 (E)
164 Seed policy and programmes in Latin America and the Caribbean, 2001 (E S)
165 Pesticide residues in food 2000 – Evaluations – Part I, 2001 (E)
166 Global report on validated alternatives to the use of methyl bromide for soil fumigation, 2001 (E)
167 Pesticide residues in food 2001 – Report, 2001 (E)
168 Seed policy and programmes for the Central and Eastern European countries, Commonwealth of Independent States and other countries in transition, 2001 (E)
169 Cactus (*Opuntia* spp.) as forage, 2003 (E S)
170 Submission and evaluation of pesticide residues data for the estimation of maximum residue levels in food and feed, 2002 (E)
171 Pesticide residues in food 2001 – Evaluations – Part I, 2002 (E)
172 Pesticide residues in food, 2002 – Report, 2002 (E)
173 Manual on development and use of FAO and WHO specifications for pesticides, 2002 (E S)
174 Genotype x environment interaction – Challenges and opportunities for plant breeding and cultivar recommendations, 2002 (E)
175/1 Pesticide residues in food 2002 – Evaluations – Part 1: Residues – Volume 1 (E)
175/2 Pesticide residues in food 2002 – Evaluations – Part 1: Residues – Volume 2 (E)
176 Pesticide residues in food 2003 – Report, 2004 (E)
177 Pesticide residues in food 2003 – Evaluations – Part 1: Residues, 2004 (E)
178 Pesticide residues in food 2004 – Report, 2004 (E)
179 Triticale improvement and production, 2004 (E)
180 Seed multiplication by resource-limited farmers - Proceedings of the Latin American workshop, 2004 (E)
181 Towards effective and sustainable seed-relief activities, 2004 (E)
182/1 Pesticide residues in food 2004 – Evaluations – Part 1: Residues, Volume 1 (E)
182/2 Pesticide residues in food 2004 – Evaluations – Part 1: Residues, Volume 2 (E)
183 Pesticide residues in food 2005 – Report, 2005 (E)
184/1 Pesticide residues in food 2005 – Evaluations – Part 1: Residues, Volume 1 (E)
184/2 Pesticide residues in food 2005 – Evaluations – Part 1: Residues, Volume 2 (E)
185 Quality declared seed system, 2006 (E F S)
186 Calendario de cultivos – América Latina y el Caribe, 2006 (S)
187 Pesticide residues in food 2006 – Report, 2006 (E)
188 Weedy rices – origin, biology, ecology and control, 2006 (E S)\
189/1 Pesticide residues in food 2006 – Evaluations – Part 1: Residues, Volume 1 (E)
189/2 Pesticide residues in food 2006 – Evaluations – Part 1: Residues, Volume 2 (E)
190 Guidance for packing, shipping, holding and release of sterile flies in area-wide fruit fly control programmes, 2007 (E)

191 Pesticide residues in food 2007 – Report, 2007 (E)
192 Pesticide residues in food 2007 – Evaluations – Part 1: Residues, 2008 (E)
193 Pesticide residues in food 2008 – Report, 2008 (E)
194 Pesticide residues in food 2008 – Evaluations, 2008 (E)
195 Quality declared planting material – Protocols and standards for vegetatively propagated crops, 2009 (E)
196 Pesticide residues in food 2009 – Report, 2009 (E)
197 Submission and evaluation of pesticide residues data for the estimation of maximum residue levels in food and feed, 2009 (E)
198 Pesticide residues in food 2009 – Evaluations – Part 1: Residues, 2010 (E)

Availability: November 2010

Ar – Arabic
C – Chinese
E – English
F – French
P – Portuguese
S – Spanish

Multil – Multilingual
* Out of print
** In preparation

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.