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INDONESIA

Technical report: Findings and recommendations*

Prepared for the Government of Indonesia
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Brian L. Mathews,
consultant on pesticide residue analysis

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Vienna

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* This document has not been edited.

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1 Abstract

This report describes a one month consultancy carried out atthe Directorate of Food Crop Protection, Ministry of Agriculture, Jakarta, Indonesia, during the period October - November 1992. Details of the theoretical and practical training provided to course members are given. Additionally, details of instrumentation and other equipment in the laboratory are reported together with recommendations for further purchases. Information is also provided on the need for additional laboratory facilities. The report contains recommendations covering staff training and development.

2 Summary of Recommendations

The consultant proposes that the following recommendations 2.1 to 2.8 be implemented as soon as possible in order to expand and improve pesticide residue analysis at the Directorate of Food Crop Protection, Pasar Minggu, Jakarta.

2.1 Accommodation

2.1.1 Extra laboratory space should be made available for pesticide residue analysis.

2.1.2 A separate room should be designated for sample preparation work.

2.1.3 All residue analysis chromatographic and spectroscopic equipment should be located in a single room dedicated to residue analysis.

2.1.4 All residue laboratories should be fitted with adequate air conditioning equipment.

2.1.5 The sample extraction area should be ventilated.

2.1.6 A larger deep freeze is necessary to store samples awaiting analysis.

2.1.7 A dishwasher should be purchased.

2.2. Instrumentation and Equipment

2.2.1 Purchase of a gas chromatograph fitted with an electron capture detector.

2.2.2 Purchase of a High performance liquid chromatograph fitted with ultra violet detection.

2.2.3 Purchase of TLC equipment including UV lamp.

2.2.4 Purchase of an additional rotary evaporator.

2.2.5 Purchase of further supplies of reagents and GLC and HPLC

2.2.6 Purchase of a tool kit.

2.2.7 All instrumentation and equipment must be dedicated to residue analysis.

2.2.8 Instruments should be used at most-sensitive settings compatible with acceptable baseline noise.

2.3 Services

2.3.1 All fume cupboards should have adequate ventilation rates and should be equipped with cold water., nitrogen, air and vacuum facilities.

2.3.2 Hot water supply should be available in a separate wash-up facility and in the residue laboratory.

2.4 Analytical standards

2.4.1 All analytical standards held in the laboratory should be disposed of and new, validated analytical standards obtained.

2.5 Recording of residue data

2.5.1 A register of incoming residue samples should be established.

2.5.2 Laboratory notebooks and detailed calculation sheets should be used. All laboratory data should be stored securely.

2.6 Staff

2.6.1 Present trained staff should continue to work permanently on residue analysis.

2.6.2 Opportunities should be identified to continue with training to maintain and improve skills.

2.6.3 All course members should meet together at least once per annum to discuss residue analysis and exchange experiences.

2.7 Safety Matters

2.7.1 Safety equipment, e.g spectacles, laboratory coats eye wash bottles, rubber gloves, and safety screens must be used at all times in the laboratory.

2.7.2 A safety shower should be located in the laboratory or just outside the door.

2.7.3 Fire extinguishers (both powder and liquid CO_2) should be located near to exits to the laboratory.

2.7.4 Solvent bottles should be stored in metal containers with lids when not in use.

2.7.5 A waste solvent drum with flash arrester (copper gauze tray) should be used, placed under a fume cupboard.

2.7.6 Solid waste should be deposited in a metal bin with a wide tight fitting lid.

2.8 General

Following implementation of the recommendations contained in this report it is proposed that a further visit is made by a UNIDO expert to maintain the momentum for expansion and improvement of facilities and training.

3 Introduction

The organisation and administration for this pesticide analytical chemistry project under the direction of the Directorate of Agrochemicals Industry, Ministry of Industry under the control of Mr Agus Wahyudi.

The Directorate of Food Crop Protection within the Ministry of Agriculture is located at Pasar Minggu, Jakarta.

Dr M. Salta Wigenasantana is the Director of Food Crop Protection which has four sections. These are:

Section 1 Pesticides

(i) Insecticides and rodentcides

(ii) Herbicides, fungicides, bacteriocides, plant growth regulators

(iii) Pesticide control and inspection (advice and control management of farmers)

(iv) Laboratory (residue analysis and quality control)

The organisation and personnel chart of the Directorate of Food Crop Protection is given in Appendix I.
The head of the Pesticides Section is Ir Haryono Siswomihardjo and the laboratory activities are supervised by Mr Hidayat. Two members of the laboratory staff are engaged on residue analysis on a full time basis.

Section 2 Pesticides Observation and Forecasting

Section 3 Pest Control

Section 4 Diseases and weed control

This report discusses the present set-up of the residue laboratory, the training programme provided to the laboratory staff as well as recommendations for the future. The training course was also attended by a number of analytical chemists from other laboratories in the Jakarta area. A full list of participants is given in Appendix II.

3.1 Background

The Republic of Indonesia is the world's most expansive archipelago, stretching almost 5ooo km from Sabang off the northern tip of Sumatra, to a little beyond Merauke in south eastern Irian Jaya. It stretches north and south of of the equator a total of 1770 km, from the border with Sabah to the small island of Roti, off the southern tip of Timor.The archipelago contains over 10,000 islands, 6ooo of which are inhabited. Although nearly two-thirds of Indonesia is covered by tropical rain forest, agriculture is a very important activity, particularly on the most populated island of Java. Indonesia has 27 provinces.

Although Indonesia produces a range of agricultural products, including exotic introductions from Latin America, the staple product remains rice. Across the archipelago other staples including maize (corn) and sago in the extreme east are also found. Other important crops include soya bean, peanuts, mung beans, sweet potatoes, vegetables and fruits.

By the mid 1980's the use of crop protection agents had reached the level of 15-17,000 tons per annum with Diazinon being the most widely used compound. Since this time the use of crop protection agents has declined, this reduction becoming more marked with the removal of government subsidies. Increasingly, in recent years, greater reliance has been placed on the use of Integrated Pest Management techniques. This year there is evidence of an increase in use of crop protection agents although usage remains below the peak figures of the mid 1980's.

There are four other Ministry of Agriculture pesticide residue laboratories viz:

Plant Protection Centre No 2 - Badang West Sumatra
Plant Protection Centre No 6 - Surabaya East Java
Plant Protection Centre No 9 - Ujungbandang South Sulawesisea
Pesticide Laboratory for Industrial Crops - Medan N Sumatra

The facilites at Pasar Minggu, Jakarta, were opened in 1958 with laboratories introduced in 1976 and residue analysis commenced in 1982.

4 Proposed Plan for Training in Pesticide Residue Analysis

The consultant will undertake the following plan for training in residue analysis during the period from 29th October to 23rd November 1992 at the Directorate of Food Crop Protection, Jakarta.

1) General introduction to pesticide chemistry and residue and environmental analysis.

2) Discussion of the significance of residues, tolerances, Maximum Residue Limits, No observed Effect Levels and Acceptable Daily Intake.

3) To describe the procedures for carrying out field trials and demonstrate sampling methods in the field.

4) Procedures for transportation, recording and storage of residue and environmental samples. Procedures for sample preparation/reduction and quantitative extraction of residues.

5) Procedures for clean-up and where necessary derivatisation of pesticide residues.

6) Theory and practice of chromatographic techniques including information on troubleshooting.

7) Procedures for confirmation of residues.

8) Internal/external calibration and quantitation.

9) Control and recovery experiments and limits of determination.

10) Analytical standards and stability and correct use of standard solutions.

11) Validation and recording of results.

12) Good Laboratory Practice (GLP).

13) Safety in the laboratory.

14) Requirements for a residue laboratory.

15) Statistics/Accuracy and Precision/Repeatability and Reproduceability etc.

16) State-of-the-art residue analysis.

17) Multi-residue methods.

18) Nomenclature of stereoisomers.

19) Compositional analysis of pesticide technical materials.

20) Carry out practical exercises to augment tutorials.

21) To submit a report of findings and recommendations.

4.1 Residue laboratories - Present set-up

There is an increasing requirement within Indonesia for stricter controls covering the use of crop protection agents for control of pests. Concomitant with this development there is also an increasing desire to generate more residue data within the country. This will become increasingly important for crops which are grown for export.

The Residue Laboratory is a room measuring 7 x 6m with two centre benches and two double fume cupboards. The major items of equipment and instrumentation available are listed in Appendix III. At present residue analysis is limited to approximately two samples per week. If it is the intention to increase the volume of residue analysis carried out, there will need to be a commitment by the management of the Directorate of Food Crop Protection to upgrade the existing facilities. This will involve providing more space for new facilities and also additional equipment. There will be a need to continue the training of relevant laboratory staff and to cater for their motivation and career development in order to retain them. Equipment and reagents required for the residue laboratories are given in Appendix IV and V respectively.

4.2 Programme Implementation

The organisation and administration for the training project was under the direction of the Directorate of Agrochemicals Industry, Ministry of Industry. On 29 October 1992 a meeting was held at the Ministry of Industry under the chairmanship of Mr Agus Wahyudi to discuss the programme implementation. The author was introduced to Mr H Needoddo the Director of the Department. On arrival at the Directorate of Food Crop Protection, Pasar Minggu, 30th October 1992, the director Dr M. Salta Wigenasantana gave a brief introduction concerning the organisation of the site. I was introduced to the head of the Pesticides section, Ir Haryono Sisomihardjo and to residue chemist Mr Sutripriarso.

The technical programme was divided into theoretical tutorials and practical exercises. The training course was attended by a number of analytical chemists from other laboratories in the Jakarta district. A full list of course participants is given in Appendix II.

4.3 Theoretical Tutorials

A detailed introductory lecture was given describing residue and environmental analysis. In this lecture a typical programme of work necessary in the development of a new pesticide was described. Particular attention was paid to describing metabolism studies of a candidate pesticide since the laboratory had expressed considerable

interest in the analysis for residues of metabolites as well as parent compound. The following points were highlighted during the discussions:-

1) Pesticide residue analysis is a complex and specialised area of analytical chemistry representing a significant challenge to the residue analyst.

2) The importance of striving to eliminate any contamination in the residue laboratory was stressed. The attention of course participants was directed to the need for separate facilities, and equipment and glassware in order to avoid contamination. In this context it was emphasised that there is a need to keep product and formulation analysis and residue analysis laboratories separate from one another.

3) The importance of conducting field trials in a proper manner was stressed as was the need to accurately record all details of the trials. Additionally the need to ensure that representative random samples are taken for analysis was highlighted.

4) Storage and processing of samples for residue analysis was covered in detail.

5) The importance of alwaysusing authentic reference materials as analytical standards for reside analysis was stressed. The storage and correct use of these analytical standards was described.

6) A presentation was given on the significance of residues, Maximum Residue Limit (MRL), No-Observed Effect Level (NOEL), Acceptable Daily Intake (ADI) and Risk Evaluation to humans and animals.

In addition to the above matters various lectures were given covering all aspects of analytical chemistry relevant to pesticide residue analysis. Particular emphasis was placed upon chromatographic and spectroscopic techniques.

Full details of the topics covered during theoretical sessions are given in Appendix VI.

4.4 Practical Training

Thirteen analysts attended the course and in view of this number and the somewhat limited facilities for practical exercises the principal accent was placed on theoretical lectures. Many of the practical issues such as e,g, troubleshooting were covered in lecture periods to augment the laboratory work. Eight of the course members had no previous experience of residue analysis. All course members displayed a keen interest in the practical sessions.

4.4.1 Gas-Liquid Chromatography

Training on the use of GLC with electron capture detection was carried out. Information was provided on setting up the instrument with particular attention drawn to avoidance of contamination of the ECD. Calibration of the system was explained and techniques for cleaning the detector were demonstrated.

The flame photometric detector was dismantled to aid understanding of its theory of operation.

Column packing and conditioning were demonstrated.

4.4.2 Residue Analysis

Practical training using external standard methodology was provided for acephate and dicofol in crops. The following items were covered:-

1) Logging of residue samples and procedures for storage.

2) Sample preparation and reduction for residue analysis.

3) Extraction of residues from crops.

4) Recovery experiments.

5) Solvent partition for purposes of clean-up.

6) Column chromatographic clean-up - calibration of Florisil column.

7) Measurement of residues.

8) Calculation of results.

9) Limit of detection and limit of determination.

4.4.3 Sampling

A field exercise was carried out to demonstrate taking of random samples.

5 Conclusions

Upon arrival in Jakarta the consultant found that he was required to conduct a technical course in pesticide residue analysis. Thirteen analysts attended and in view of this number and the somewhat limited facilities for practical exercises the principal accent was placed on the theoretical lectures. However, many of the practical issues such as troubleshooting were covered in lecture periods to augment the laboratory work. Eight of the course members had no previous experience of residue analysis. All course members showed a keen interest in both theoretical and practical sessions. They demonstrated great commitment to the course and appeared to be well satisfied with it. It was necessary to cover the general theory of chromatographic and spectroscopic techniques in analytical chemistry.

Residue analysis is a complex and highly specialised branch of analytical chemistry. It is likely that there will be an increasing requirement to carry out residue analysis at the residue laboratory of the Directorate of Food Crop Protection, Jakarta. In order to achieve this it will be necessary to improve and expand the present facilities of the residue laboratory as recommended in this report. There is a need to increase laboratory space and to purchase additional equipment and instrumentation. Implementation of the recommendations contained in this report will improve significantly the overall safety of laboratory operations.

Efforts should be made to retain the trained staff for carrying out residue analysis. There will be a need to identify further opportunities for training in order to maintain and seek to improve the level of scientific skills.

Serious consideration should be given to the provision of funds and resources required to effect the recommendations given.

On completion of laboratory improvements and purchase of the various instruments and equipment recommended in this report, a further training programme should be arranged.

A follow-up visit is recommended to maintain the momentum for expansion and improvement of facilities and training.

6 Detailed Recommendations

6.1 Accommodation

It is likely that there will be an increasing requirement to carry out residue analysis at the residue laboratory of the Directorate of Food Crop Protection, Jakarta. This will necessitate having more extensive accommodation.

The extended residue analysis facilities should include the following items:-

a) A separate room should be designated for sample preparation work.

b) All residue analysis chromatographic and spectroscopic equipment should be located in a single room dedicated to residue analysis.

c) All residue laboratories should be fitted with adequate air conditioning equipment.

d) All fume cupboards should have adequate ventilation rates and should be equipped with cold water, nitrogen, air and vacuum facilities.

e) Hot water supply should be available in a separate wash-up facility. This should be located in a separate room.

f) A dishwasher should be purchased.

g) The sample extraction area should be ventilated.

h) A larger deep freeze is necessary to store samples awaiting analysis.

6.2 Safety Matters

The following safety recommendations should be implemented:-

a) Custom made safety spectacles should be used.

b) Eye wash bottles should be located in laboratories.

c) Rubber gloves should be used.

d) A safety shower should be located in the laboratory or just outside the door.

e) Fire extinguishers (both powder and liquid CO_2) should be located near to exits to the laboratory.

f) Solvents bottles should be stored in metal containers with lids when not in use.

g) Safety screens should be purchased for use with rotary evaporators.

h) A waste solvent drum with flash arrestor (copper gauze tray) should be used, placed under a fume cupboard.

i) Solid waste should be deposited in a metal bin with a wide tight fitting lid.

j) Metal trays for sample and standard solutions.

k) Crop extracts should be stored in a cool cupboard in the absence of light.

6.3 Equipment

It is recommended that the following additional equipment is purchased.

a) Gas chromatograph fitted with an electron capture detector.

b) High performance liquid chromatograph fitted with ultra violet detection.

c) UV lamp for TLC.

d) General TLC equipment e.g. Tanks, plates etc.

e) Additional rotary evaporator.

f) Flow meters for GLC equipment.

g) Flow measuring tubes.

h) Tool kit.

Suggested lists of equipment, glassware and reagents are given in Appendices IV and V.

6.4 Analytical Standards

Pure analytical primary standards with certificates of purity, expiry dates etc, should be obtained from manufacturing companies or other suppliers. e.g. Laboratory of the Government Chemist, Teddington, U.K.

Analytical standard solutions should be stored in a refrigerator at 4°C. These solutions should have an expiry date. The standard solutions should be allowed to warm to ambient temperature before use.

6.5 Recording of residue data

a) A register of incoming residue samples should be established.

b) Laboratory note-books should be used.

c) Detailed calculation sheets should be used.

d) All data including records of field trials, laboratory note-books , calculation sheets and instrument traces should be stored.

6.6 Sampling

A comprehensive guideline for sampling for residue analysis was provided to course members.

6.7 Staff

It is recommended that the two staff currently carrying out residue analysis at the Pasar Minggu laboratory should continue to do so. This will enable them to capitalise on the training received. Opportunities should be identified to continue with training to maintain and improve their skills. It is particularly important to seek to retain the expertise gained by the residue analysts. When the recommendations contained in this report have been implemented it is recommended that a further training exercise is carried out.

7 Acknowledgements

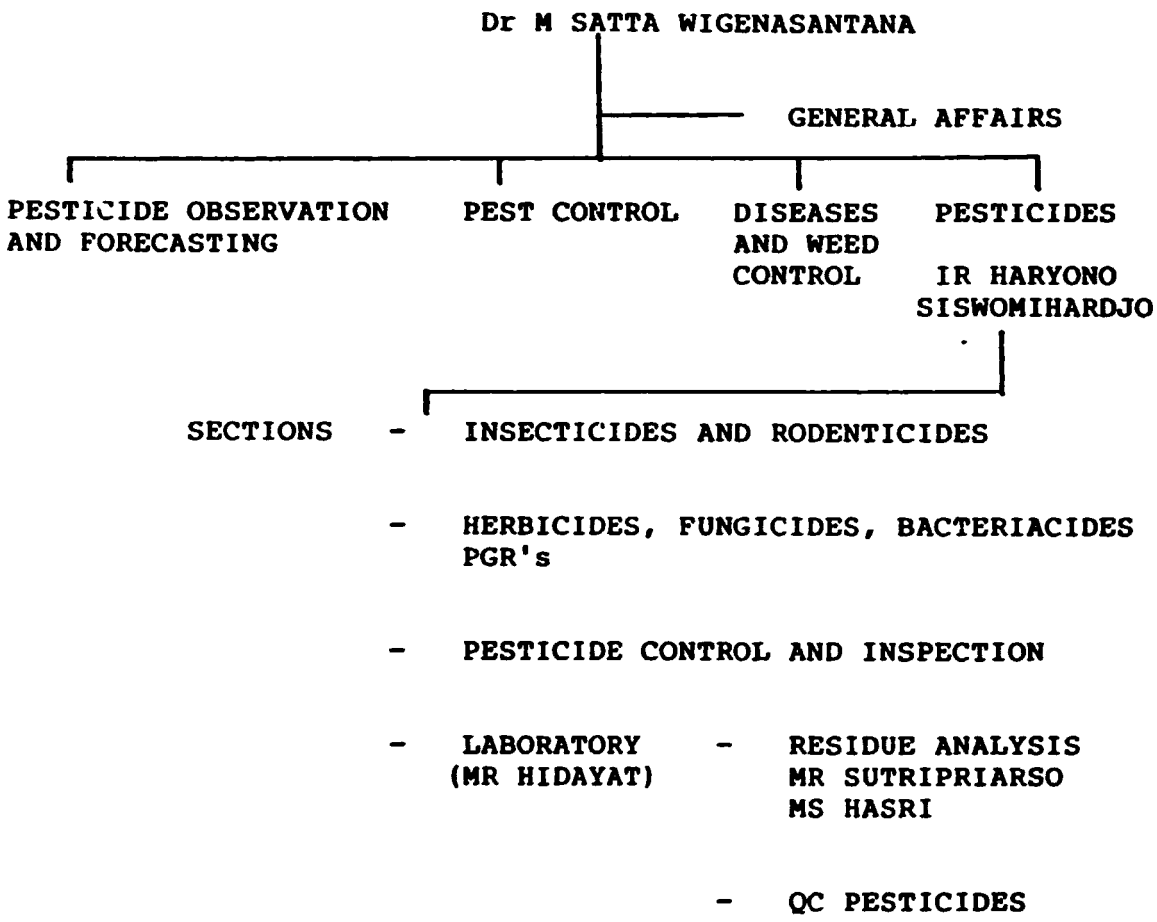
The consultant would like to thank all participants of the training course for their kindness and consideration throughout. Special thanks are due to Mr Sutripriarso for the help and assistance he provided during the training period. Thanks are also due to Mr Agus Wahyudi of the Ministry of Industry and senior staff at the Directorate of Food Crop Protection for making resources available to the consultant.

The consultant was very impressed with course members who all showed great interest and dedication throughout.

APPENDIX I

ORGANISATION AND PERSONNEL CHART FOR MINISTRY OF AGRICULTURE-

DIRECTORATE OF FOOD CROP PROTECTION, JAKARTA



APPENDIX II

LIST OF PERSONNEL CONTACTED

MINISTRY OF INDUSTRY

DR H NEEDODDO, DIRECTOR OF AGROCHEMICAL INDUSTRY,
MR AGUS WAHYUDI, DIRECTORATE OF AGROCHEMICALS INDUSTRY,
MR SUTIJONO ONTORIKOO, DIRECTORATE OF AGROCHEMICALS INDUSTRY.

MINISTRY OF AGRICULTURE

DR M SATTA WIGENASANTANA, DIRECTORATE OF FOOD CROP PROTECTION
IR HARYONO SISWOMIHARDJO, DIRECTORATE OF FOOD CROP PROTECTION
MR HIDAYAT, DIRECTORATE OF FOOD CROP PROTECTION

PARTICIPANTS IN TRAINING COURSE

MR SUTRIPRIARSO	DIRECTORATE OF FOOD CROP PROTECTION, JAKARTA
MS HASRI	DIRECTORATE OF FOOD CROP PROTECTION, JAKARTA
MR SADJUSI	P.T ICI PESTISIDA, INDONESIA
MR PUBUNG SETIAWAN	P.T ICI PESTISIDA, INDONESIA
MR MEMET HERMADY	P.T KARTINIA
MR NANASURYANA	P.T DHARMA ARDHA FORMA (SHELL JOINT VENTURE)
MS ROFIENDA	INSTITUTE OF R & D CHEMICAL INDUSTRY DEPT.
MS SITI NAIMAH	INSTITUTE OF R & D CHEMICAL (INDUSTRY INDUSTRY, DEPT. INDUSTRY
MR WISMO BUDIONO	P.T. PETROKIMIA GRESIK
MR SJAIFUL BASHRI	P.T. PETROSIDA GRESIK
MR ADISAM ZN	P,T, SUCOFINDA
MR ENCEP AMIN	CENTRE FOR TESTING AND Q.C, DEPARTMENT OF TRADE, JAKARTA
MR DADAYS	DEPT OF HEALTH, PHARMACY RC
MR SUTIJONO ONTORIKOO (part-time)	MINISTRY OF INDUSTRY

APPENDIX III

EQUIPMENT AVAILABLE AT THE RESIDUE LABORATORY AT PASAR, MINGGU, November 1992

1 Gas-liquid chromatograph Shimadzu Model 9A FID/FPD/ECD/FTD (six years old)

2 High Performance Liquid Chromatograph Shimadzu Model LC 5A UV/RI/RF (six years old)

3 Gas-liquid chromatograph - Mass Spectrometer Shimadzu Model QP 1000

4 U-V Spectrophotometer - Shimadzu

5 Blender - Nissei

6 Rotary Evaporator - Buchi

7 Top loading balance (0.1g)

8 6 x refrigerators, 0 - 4^{o} C

9 Deep freeze 1m x 0.5m, -18^{o} C

10 Water bath for Soxhlet extraction

11 2 x Centrifuges

12 Mechanical shaker

13 Ultrasonic bath

14 Water distillation unit

15 Vacuum aspirator

16 Vacuum filtration unit

17 Grinding Mill, Ikeda

18 Vegetable cutter

19 Analytical balance - 4 figure (in formulation laboratory)

20 Top Loading Electronic balance - 50kg

21 Soxhlet extraction equipment

22 General laboratory glassware

APPENDIX IV

EQUIPMENT REQUIRED FOR RESIDUE ANALYSIS

1 Gas-liquid chromatograph fitted with an electron capture detector.

2 Equipment for processing of samples e.g.:

a) Hobart Mincer - available from Glen Creston, Stanmore, U.K.
b) An ultra centrifugal mill, Retsch ZMI, fitted with 3mm screen (Glen Creston)

3 Range of knives (large, medium, small).

4 Trays for sample preparation 6

5 High speed macerator, e.g. laboratory mixer/emulsifier available from Silverson Machines Ltd, U.K or Sorvall Omni-Mixture homogeniser available from Du Pont UK Ltd.

6 Deep freeze for storage of residue samples (-18°C)

7 UV lamp

8 TLC tanks (at least 3) and TLC plate preparation equipment.

9 Various HPLC columns 20cm x 4.6mm ID; reverse phase and normal phase columns.

10 Glass columns for GLC, 1m x 3mm ID,

11 Syringes for GLC, TLC, HPLC e.g Hamilton 10,25,50,100µl.

12 Graduated glass centrifuge tubes of 10ml capacity calibrated down to 1.0ml in 0.1ml units.

13 Measuring cylinders stoppered - 250ml, 100ml, 50ml (at least 24 of each size)

14 Separating funnels - 500ml, 250ml, 100ml (at least 24 of each size).

15 Rotary evaporator with good vacuum system.

16 Round bottomed flasks - 250ml, 100ml, 50ml (at least 12 of each size).

17 Pasteur pipettes - 10-12 boxes to transfer liquid aliquots.

18 Facility for washing of glassware.

19 Chromatographic clean-up columns - short.

20 Septa, '0' -rings etc.

21 Hair Dryer

22 Safety spectacles - lightweight.

23 Safety shields for rotary evaporator.

24 Fume cupboard.

25 Exhaust system for solvent extraction area.

26 Laboratory coats.

27 Eye-wash bottles.

28 Nitrogen or air supply for evaporating small volumes of organic solvents.

APPENDIX V

REAGENTS REQUIRED FOR RESIDUE ANALYSIS

1 Solvents - Redistilled acetone, methanol, n-hexane, diethyl ether, dichloromethane, chloroform, acetonitrile, ethylacetate.

2 Granular anhydrous sodium sulphate - BDH Chemicals Ltd, Poole, UK.
Heat in an oven at 140 degrees C for 24 hours before use.

3 Silica or glass wool.

4 Florisil (100-120 mesh), alumina (neutral and basic) and silica gel.

5 Anti foam emulsion M30 - available from Hopkin and Williams, UK.

6 BOND ELUT™ disposable colums (2.8cm³) containing 500mg adsorbent - Jones Chromatography, UK.

7 Celite 545, 595 filter aids.

8 Acids Conc. Hcl, H_2SO_4 and glacial CH_3COOH.

APPENDIX VI

THEORETICAL TUTORIALS

1 Introduction to Pesticide Chemistry, Residue and Environmental Analysis.

2 Significance of residues in foodstuffs, Maximum Residue Limit (MRL), Residue No Observed Effect Level (NOEL), Acceptable Daily Intake (ADI). Explanation of Tolerances.

3 Development studies for pesticides including metabolism studies.

4 Field Trials and sampling for residue analysis, including transportation and storage of samples.

5 Sample preparation /reduction and techniques for quantitative extraction of residues.

6 Clean-up of extracts.

7 Derivatisation techniques.

8 Theory of chromatography.

Column
GLC
HPLC
TLC

9 Other methods of determination.

10 Analytical troubleshooting.

11 Confirmation of residues.

12 Internal/external calibration and quantitation.

13 Control and recovery experiments and limits of determination.

14 Analytical standards and stability of standard solutions.

15 Validation and recording of results.

16 GLP (Good Laboratory Practice).

17 Safety in the Laboratory.

18 Requirements for a residue laboratory.

19 Statistics/Accuracy and Precision/Repeatability and Reproduceability etc.

20 Sate-of-the-art residue analysis.

21 Multi-residue methods.

22 Nomenclature of stereoisomers.

23 Compositional analysis of pesticide technical materials.

APPENDIX VII

PRACTICAL TRAINING

1 Topics covered in gas-liquid chromatography.

a) Packing of GLC column.
b) Injection.
c) Measurement of carrier gas flow rate and influence of flow rate.
d) Measurement of retention time, retention volume and column efficiency.
e) Troubleshooting.
f) Decontamination of electron capture detector.
g) Decontamination of flame photometric detector.

2 Field sampling methods.

3 Procedures of logging residue samples, storage and sample preparation.

4 Sample extraction, solvent partition, column chromatographic clean-up and calculation of residue levels.

5 External standard methodology.

6 Criteria for validation of residue results.

7 Limit of detection and limit of determination.

UNIDO COMMENTS

The report gives a complete run-down of the various requirements for up-grading of the laboratory of the Food Crop Protection, Ministry of Agriculture, Indonesia. The requirements clearly indicate that the laboratory and the staff need complete overhaul to meet the international requirements. This is vital for a country like Indonesia which not only exports food and fruit commodities but also imports varieties of food products.For this they should develop greater awareness to the requirements of good laboratory practice and have a good control of pesticides used in the country.

With UNIDO's assistance they could link themselves more with RENPAP and also request assistance for a national programme to improve the laboratory standards.

The report is a very good eye opener for Indonesia to assess its requirements to be fully involved in the high-tech area for the protection of public and the environment from the use of agro-chemicals.