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REGIONAL NETWORK ON PESTICIDES FOR ASIA AND THE PACIFIC

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Technical report: Workshop on pesticide application technology in Serdang Selangor, Malaysia from 20-25 September 1993*

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Based on the work of the workshop organizing committee and Evan W. Thornhill, consultant in application technology

Backstopping Officer: B. Sugavanam, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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THE COURSE/WORKSHOP ON PESTICIDE APPLICATION TECHNOLOGY

Organised by

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

through the

REGIONAL NETWORK ON PESTICIDES FOR ASIA AND THE PACIFIC

in cooperation with

Universiti Pertanian Malaysia (UPM)
Malaysian Plant Protection Society (MAPPS).
The Department of Agriculture, Government of Malaysia (DOA)
Malaysian Agricultural Research and Development Institute (MARDI)

at

Agricultural Extension Training Institute
Department of Agriculture,
(ILPP)
Serdang, Selangor, Malaysia

September 20 -25, 1993

Abstract

The objective of the consultancy was to conduct a course/workshop on Pesticide Application Technology as part of a UNIDO/RENPAP project. Broadly the project's purpose is to promote within RENPAP the safe and effective production and use of agro-chemicals for sustainable agriculture. This report records the proceedings of the workshop/course, observations and recommendations as well as a meeting with the Director General and his staff on 1 October, 1993.

The main conclusion was that Malaysia is a suitable venue for Pesticide Application Technology and that such a project to support a centre of excellence in the safe and effective use of pesticide training be formally proposed. Malaysian authorities would welcome such an invitation and would consider an outlined proposal at Ministry level if appropriate project funding was made by UNIDO.

Field visits to rice, mango, rubber and cacao areas are briefly reported on.

The report was compiled by Mr. Evan Thornhill, UNIDO Consultant, International Pesticide Application Research Centre, Imperial College of Science, Technology & Medicine, Silwood Park, Buckhurst Road, Ascot, SL5 7PY, UK.

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INTRODUCTION

The Asian and the Pacific region is not only very densely populated but also the rate of growth in population is very high. Feeding the growing population has been the major challenge in this region, particularly in view of the fact that the cultivable area is gradually shrinking on account of increased encroachment of land for non-agricultural purposes needing increased output per hectare of cultivable land to feed the growing population. The role of the two major inputs, fertilizers and pesticides, cannot be over-emphasised in such a scenario. However, on account of the imperative need to protect the environment, thus the use of pesticides has come under close scrutiny world-wide. A survey conducted by UNIDO shows that the use of agro-chemicals in most of the developing countries will be on the increase. The challenge, therefore, lies in the effective management of pesticide usage to achieve the twin objectives of increasing agricultural production through adoption of the most appropriate technologies and reducing the pesticide load on the environment through adoption of target specific and efficient application technologies. There is a particular need for the implementation of integrated pest management techniques. Safe pesticide application will only become a reality through increased attention of all agencies concerned and industry to the communication of safe use practice by farmers.

Significant developments in the spheres of application technology have taken place with the development of new delivery systems, viz., ultra low volume sprayers, controlled droplet applicators and electrostatic applicators. There have been considerable developments in the control of pressure/flow rate at the spray nozzle to give the optimum controlled output. These options enable increased coverage of spray and to reduce drift onto non-target areas. Considerable economic gains and reduction of operator contamination are possible by the implementation of these new systems. Some of these developments are retro-fit items that can be fitted to any

sprayer and provide an immediate upgrade of application ability and increased safety. The benefits of improved delivery systems are yet to be fully exploited by member countries of the RENPAP network. Many undesirable techniques are currently widely used and will take some considerable time to be changed to better pesticide application practice. Several generations have been involved to develop the existing application techniques used in the field, such as the common high pressure and swinging of the lance immediately in front of the operator and the use of only one nozzle for all applications. It will be a challenge to change existing attitudes to better and safer methods.

The introduction of synthetic pyrethroids where the application rates are only a few grams per hectare has presented a situation where the requirements of measurement calibration and delivery systems are needed to be much more precise. Any improvement in spray application technology will depend on a more intimate, systematic and imaginative study of the physical and physico-chemical parameters that control not only the behaviour of sprayers but their final deposit and effect on target organisms. In the tropical environment of pesticide application considerable changes in droplet size can be experienced as the result of evaporation and the droplet's differential movement is affected by gravity, wind velocity and air turbulence. These factors can lead to significant losses of pesticide between the nozzle and the target. In order to improve pesticide application there has to be a clear understanding on how spray droplets are produced and ultimately deposited on the intended target. The method of pumping the liquid from the sprayer to the nozzle, the physics of spray droplet production, the movement of those droplets to the target, their eventually deposition and movement to the site of biological activity, are all areas that need to be clearly explained in simple terms. Engineering controls can reduce operator contamination when applied to all delivery systems, manual and motorized.

Another important area of pesticide application technology requiring priority attention is the safe handling of the equipment and the pesticide in all stages of use from storage, opening the package, filling and mixing, application parameters, as well as re-entry of farmers into treated areas. The promoting of safe protective clothing whilst spraying in the field is another important area needing attention, since under tropical climatic conditions, the use of protective clothing which is normally used in temperate climates is not possible. It must be understood that large numbers of agricultural workers resort to spraying in the field bare foot, bare handed and even bare bodied, they sweat profusely under field conditions and are usually found to be dermally contaminated with the product they are applying.

The Government of Malaysia hosting the Technical Coordinator Unit on Pesticide Application Technology, has up to date facilities and trained personnel. In collaboration with the Malaysian Plant Protection Society, Universiti Pertanian and MARDI Research Centre, the Malaysian Department of Agriculture agreed to host the course/workshop in the Department of Agriculture Officers Training Institute in Serdang, Selangor. The Principal Lecturer/Consultant for the majority of the syllabus was provided by UNIDO. The course workshop was intended to cover the following outlined 23 subject headings and a suitable syllabus for that was outlined as a Pesticide Application Technology Course Programme:-

1. Effective Pesticide Application
   - pesticide formulation
   - spray factors
   - appropriate application
   - economic machinery considerations

2. Application Equipment
   - hydraulic sprayer
   - compression sprayer
   - knapsack sprayer
   - motorised knapsack sprayers
   - tractor mounted boom sprayer and controls

3. Selection and Use of Hydraulic Nozzles
   - nozzle types
   - production of droplets
   - spray patterns

4. Calibration of Knapsack Sprayer
   - conventional method
   - use of calibottle
   - calibration of tractor mounted boom sprayer
   - measurement of flow rate
   - calculation of application rate
   - choosing correct nozzle

5. Behaviour of Spray Droplets
   - effect of environmental factors
   - spray drift

6. Spray Coverage and Sampling Technique
   - natural and artificial target
   - use of water soluble and oil soluble tracers

7. Detecting spray coverage
   - water sensitive paper
   - fluorescent tracers
   - oil sensitive paper

8. Measuring Techniques of Spray Droplets
   - sample and collection of droplets
   - use of Porton G12 Graticule and microscope
   - analysis of data to produce VMD and NMD ratios

9. Air Carrier Sprayers
   - mistblowers
   - portable air carrier sprayers
   - tractor mounted

10. Spray Coverage and Calibration
   - portable engine powered mistblowers
   - tractor mounted/trailed mistblowers

11. Aerial Application Theory

12. CDA Spinning Disc Sprayers
   - rotary atomisers
   - use of herbicide and insecticide CDA applicators

13. Electrostatic Spraying
   - various methods of charging droplets
   - electro-dynamic production of droplets
   - deposition onto targets

14. CDA/ULV Herbicide Application

   - determination of swath width
   - assessment of spray coverage
   - calibration of application

15. CDA/ULV Insecticide Application to Crops
   - determination of swath width
   - assessment of wind speed and direction
   - spray coverage

16. Trunk Injection
   - principles involved
   - practices in plantation situations

17. Assessment of Spray Coverage by Fluorescent Tracers
   - field trial

18. Thermal Fog Technology
    - cold aerosol generation
    - thermal fog applicators
    - pulsejet engine
    - heat exchanger type
    - equipment demonstration

19. Care and Maintenance of Sprayers
    - side lever knapsack sprayer
    - compression sprayers
    - two stroke engine powered units
    - wear and tear maintenance
    - tractor sprayers/pumps/controls

20. Rodent Management
    - population assessment
    - choice of rodenticide
    - bait selection
    - control techniques

21. Fumigation Slow Release Treatments
    - soil sterilization
    - stored product pest control

22. Safety Aspects of Pesticide Application
    - operator protection
    - protective clothing
    - inhalation, dermal, oral
    - safe practice and occupational hygiene

23. Pesticide Poisoning and First Aid
    - toxicology of pesticides
    - medical aspects of poisoning
    - first aid immediate actions

I. OBJECTIVES OF THE COURSE/WORKSHOP

The main objectives of the course/workshop were as follows:-

1. To lay the Foundation for a training centre of excellence in Pesticide Application Technology to serve to needs of RENPAP area.

2. To provide an opportunity for closer cooperation among countries in this region.

3. To help increase the level of knowledge on appropriate pesticide application technologies.

4. To create greater awareness on the need for safer and more efficient application of pesticides.

5. To stimulate interests and sustain efforts towards further improvement on the technologies.

6. To promote wider acceptance of user and environment friendly techniques.

It should be noted that some confusion existed as all the local arrangements had been made to conduct a training course and not a workshop. This pre-scheduled situation did not allow adequate discussion time as would be the case in a planned workshop event. I was able to initiate some adjustments, thus the resultant heading Course Workshop to the proceedings.

II. OPENING SESSION

The Chairman of the organizing committee, Dr. Mohd. Jusoh Mamat, in his speech welcomed all participants from the 13 countries to this course. He also thanked the members of the organizing committee for their efforts in arranging the course, the participating agencies involved, viz., the Department of Agricultural Research Institute (MARDI), Universiti Pertanian, Malaysia (UPM), the Malaysian Plant Protection Society (MAPPS) and the supporting role of the private sector. The keen interest and generous support from UNIDO/UNDP in making the course possible and a success was highly appreciated.

The Hon. Deputy Secretary General of the Ministry of Agriculture, in his opening remarks, emphasized the importance of safe and efficient use of pesticides and the need to protect the environment. He further stressed that the knowledge gained in this pesticide application technology training course should be disseminated to the farmers so that pesticides are used judiciously in the manner for which they are intended. It is hoped that with better application technology the agricultural production can be made more economically viable. He recommended the international course to visit the new Malaysian Agricultural Park where they could see the various cropping systems of the region and some of the processing involved of the harvested products. In his concluding remarks, he outlined the high risks involved in agricultural undertakings and commented that any improvement in the pest management situation would be welcome. The linkage between health and agriculture was emphasized and that education's role was vital in creating better situations in the area of residues on the crop or the environment.

The representative of UNIDO, mentioned about the role of UNIDO and the various projects implemented by that agency in the region. He stressed the importance of cooperation among countries in Asia

and the Pacific region. He indicated that Malaysia could play a bigger role in providing a centre of excellence in the field of pesticide application technology for this region. He suggested more active participation from related industry in supporting the project's activities that are being implemented by RENPAP/UNIDO. He clearly showed that few new products were coming on the market due the the heavy expenses involved in development. He drew to the attention of the course that more than 30% of applied pesticides usually failed to meet their intended target. He mentioned that there had been very much demand for this international course and hoped that the participants would be able to radiate out on return to their home countries what they had learnt on the course, thus contributing to an improvement on application in the region.

Dr. S.P. Dhua, Regional Co-ordinator for RENPAP/UNIDO, presented a brief overview of the various activities carried out in the region and the establishment of the technical coordinator units under the project. He also emphasised the importance of the adoption of safer and more effective application technology as these aspects had not been given serious consideration in most developing countries. He supported strongly that Malaysia be made a centre for pesticide application technology to provide for more training and consultancy services to member countries in the RENPAP region. The basic object of this project is to inculcate safety and promote the good of the environment. He acknowledged that many outdated projects and application technologies were in use in the region. The resultant pollution to the environment and to operators in application, as well as to process workers in chemical plants is of concern to all he stressed.

The conclusion of the meeting with the Director General and his staff was favourable to that enquiry and they welcome the submission to the Director General of Agriculture from UNIDO, Vienna, of a proposal outline to have a RENPAP training facility in Malaysia to serve the requirements of member countries.

III. COURSE PROGRAMME

Sunday, 19 September, 1993

Arrival and Registration of Participants

Meeting of UNIDO representatives and local coordinators.

Day 1 Monday, 20 September

0800-1000	Opening Ceremony
100-1020	Introduction and Benchmark Test Dr. Mohd. Jusoh Mamat
1020-1100	Effective Pesticide Application Dzolkhifli Omar
1100-1300	Hydraulic Sprayers Mr. Evan Thornhill
1300-1400	Lunch/Discussion
1400-1500	Selection and Use of Hydraulic Nozzles Mr. Evan Thornhill
1500-1600(P)	Calibration of Knapsack Sprayer Mr. Evan Thornhill Mr. Anas Ahmad Nasaruddin
1600-1730(P)	Calibration of tractor-mounted Boom Sprayer Mr. Anas Ahmad Nasaruddin Mr. Evan Thornhill
1730	Tea/Discussion
1900	Dinner/Discussion
1030-2130	Film on Spraying Faizal Abdullah

Day 2 Tuesday, 21 September

0800-0900	Behaviour of Spray Droplets Dr. Dzolkhifli Omar
0900-1000	Spray Coverage and Sampling Techniques Mr. Evan Thornhill
1000-1020	Tea
1020-1130(P)	Detecting Spray Coverage Mr. Evan Thornhill
1130-1300	Measuring Techniques of Spray Droplets Dr.Dzolkhifli Omar
1300-1400	Lunch/Discussion
1400-1500	Air Carrier sprayers Mr. Evan Thornhill
1500-1730(P)	Spray Coverage and Calibration of Portable Mistblower Mr. Evan Thornhill Tractor Mounted Mistblower Mr. Evan Thornhill
1730	Tea
1900	Dinner/Discussion
2030-2130	Database of Pesticide Computer Presentation and Discussion Mr. Edgar T. Dante

Day 3 Wednesday 22 September

0630-1030	Aerial spraying Demonstration by Ultra Light Aircraft Pilot, Hj. Mohd. Sidek at the Rubber Research Institute, Malaysia Experimental Station in Sungai Buloh
1200-1400	Visit the National Malaysian Agricultural Park in Bukit Cahaya, Shah Alam, featuring all stages of paddy cultivation and processing industry, cocoa plantation, temperature house, orchid farm, etc.
1400-1630	Tour and Demonstration at G.P. Polymers, hosted by Lourdes Nathan, Hugh Richardson and Chris Meek on Improved Knapsack Spraying Technology, Drift Control and Sprayer Manufacturing. Dr. Mohd. Matthieu Abdullah Dr. Mohd. Jusoh Mamat Mr. Evan Thornhill
1730	Tea
2000-2200	Course Dinner at Kuala Lumpur

Day 4 Thursday 23 September

0800-0930	Safety Aspects of Pesticide Application Dr. Lee Soo Ann
0930-1000	Demonstration on Safety Dr. Lee Soo Ann
1000-1020	Tea
1020-1130	Controlled Droplet Application Mr. Evan Thornhill
1130-1300	CDA/ULV spraying on Weeds Mr. Chung Gait Fee
1300-1400	Lunch/Discussion
1400-1530	CDA Spraying on Crops Mr. Evan Thornhill
1530-1630(P)	Trunk Injection Mr. Lim Jit Ling
1630-1730(P)	Visit to Spraying Testing Equipment Laboratory MARDI Mr. Anas Ahmad Nasaruddin
1730	Tea
1900	Dinner/Discussion
2000-2100	Examination of Fluorescent Tracers Dr. Mohd. Matthieu Abdullah Mr. Evan Thornhill

Day 5 Friday, 24 September

0800-0900	Fogging Technology Mr. Ho Cheng Tuck
0900-1000	Fogging Equipment and Demonstration Principles of Operation - Pulse Jet Engines Mr. Evan Thornhill
1000-1020	Tea
1020-1230(P)	Maintenance of Sprayers - Manual and Engine Driven Mr. Evan Thornhill
1230-1430	Lunch/Discussion
1430-1600	Rodent Management Mr. Liau Siau Suan
1600-1730(P)	Fumigation and Slow Release Treatments Mr. Azmi Ab. Rahim
1730	Tea
1900	Dinner/Discussion

Day 6 Saturday, 25 September

0800-0900	Aerial Application Theory Mr. Nair Ma Lee
0900-1030	Course Evaluation Dr. Mohd. Jusoh Mamat (Course Organiser)
	Course Evaluation and Discussion Ms Zam Abdul Karim
1030-1100	Tea/Discussion
1100-1200	Pesticide Residue Mr. Cheah Uan Boh
1200-1300	Pesticide Poisoning and First Aid Dr. Zainul Abidin Md. Hussain
1300-1330	Closing Ceremony and Discussion Dr. Mohd. Jusoh Mamat Ms Zam Karin Mr. Evan Thornhill
1330-1430	Lunch

(P) = Practical

A. Lecturers/Faclitators

Mr. Anas Ahmad Nasaruddin	MARDI
Mr. Chung Gait Fee	EBOR Research
Mr. Cheah Uan Boh	MARDI
Dr. Dzolkhifli Omar	UPM
Mr. Edgar R. Dante	TPC FADIN/ARSAP
Mr. Evan Thornhill	UNIDO Principal Lecturer
Mr. Faizal Abdullah	Dept. Agric.
Mr. Ho Cheng Tuck	Golden Hope
Mr. Lim Jit Ling	Ru Farm
Dr. Lee Soo Ann	MARDI
Mr. Liau Siau Suan	GUTHRIE
Dr. Mohd. Jusoh Mamat	MARDI
Dr. Mohd. Matthieu Abdullah	UPM
Mr. Nasir Ma Lee	GUTHRIE
Mr. Yang Yew Min	ACM
Dr. Zainul Abidin Md. Hussain	Min. of Health
Ms Zam Abdul Karim	National Coordinator/UNIDO

B. Demonstrators

Mr. Hugh Richardson - Fluid Technology
Flow rate and drift control, factory visit

Mr. Lourdes Nathan - G.P. Polymers
Application techniques to reduce contamination, factory visit

Mr. Ng Yoke Foo - Dyna-Fog
Compression sprayers, public health, thermal fogger

Mr. Stephen Chan - Goizper
Hydraulic sprayers

C. List of Participants in the Course Workshop on Pesticide Application Technology September 20-25, 1993

1. Zainab Hj. Yatim
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8. G.L.M. Aponso, Assistant Registrar of Pesticide
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D. Organising Committee

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Secretary	Ms Zam Ab. Karim
Hon. Treasurer	Dr. Dzolkifli Omar

E. Committee Members

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Mr. Anas Ahmad Nararuddin
Dr. Mohd. Matthieu Abdullah
Mr. Shamsuddin Saud
Ms Nursiah Mohd. Tajul Aros
Mr. Faizal Abdullah
Mr. Mustafar Muda
Mr. Chan Tong Seng

IV. ACKNOWLEDGEMENTS

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Micron Sprayers, Bromyard, Herts., UK
Cooper Pegler, Ashington, Northumberland, UK
Goizper, Singapore
Hardi, Intan Karang Sdn. Bhd., Malaysia
Syarikat Perniagaan M/S, Malaysia
Zeneca, Fernhurst, UK
Chua Trading, Solo, Kuala Lumpur
Fluid Technology, Perth, Australia

Equipment was loaned by:-

MARDI, Malaysia
UPM, Malaysia
Dept. of Agriculture, Malaysia
IPARC, Imperial College, UK

This training could not have been held without the keen interest and commitment of the Dept. of Agriculture, Malaysia, Universiti Pertanian, Malaysia, Malaysian Agricultural Research & Development Institute, the Malaysian Plant Protection Society and the generous support from RENPAP/UNIDO and International Pesticide Application Research Centre, Silwood Park, Ascot, through Imperial College Consultants, Imperial College of Science, Technology & Medicine (London University), London, UK.

V. COUNTRY REPORTS

Each participant was requested to provide a country report on the status of pesticide application technology in their country and a one page abstract. As no abstracts were provided, the full country reports are attached as an appendix. Apologies were received from Iran who are sending their report direct to UNIDO, Vienna for the attention of Dr. Sugavanum.

Reports were received from:-

Sri Lanka
India
People's Republic of China
Philippines
Thailand
Bangladesh
Myanmar
Vietnam
Korea
Indonesia
Malaysia (2 reports)

These country reports form an annexe to this report.

VI. EVALUATION OF THE GROUP TRAINING

The participants from the RENPAP countries were asked to complete their evaluation on the appropriate UNIDO assessment forms. The completed UNIDO assessment of training forms are being forwarded for the attention of Dr. Sugavanum in Vienna under separate cover. They do not form part of this report. In addition to that, the participants were given pre- and post- assessment of their knowledge by using a multiple course questionnaire covering some 20 questions appropriate to pesticide application technology. It was revealing to note that the pre-course evaluation results ranged from 0 - 11 marks out of 20, giving an average of 4.5 marks out of 20. This was no doubt due to few of the participants having previous experience in pesticide application technology and fewer knowing how to use associated spraying equipment or procedures. After the course exactly the same bench mark questionnaire was given to the participants, whose scores then ranged from 9-16 marks out of 20, averaging 12.8 out of 20. This showed that the training had beneficial effects and upgraded awareness and knowledge of pesticide application technology and equipment.

The course members completed their evaluation of the training on a UNIDO formatted questionnaire. In general all appreciated the course training but would have liked more time to be devoted to practical work. Some suggested that trips to crop areas to see real spraying situations and problems would have been beneficial. Few of the participants had previous knowledge or experience of spraying in the field.

All were of the opinion that the course schedule was too intense, pressured and the pace was too hectic for them. Several requested that more free time be interspersed into the course activity. Some commented that they had difficulty in assimilating some of the local lecturers sessions.

Annex 1. RECOMMENDATIONS OF THE WORKSHOP

The workshop/course participants adopted the following recommendations at the conclusion of the course workshop.

1. There is a continuing need for safe and effective application of pesticides.

2. A Centre of Excellence should be established to provide and coordinate activity in the RENPAP region.

3. Malaysia can serve such a role as a Centre of Excellence in Pesticide Application Technology. The Department of Agricuture could be the leading administrative organisation. MARDI and UPM, with the cooperation of MAPPS, could provide technical support, equipment and lecturers/trainers.

4. A venue dedicated to training could be scheduled for this activity, i.e. ILPP Agricultural Extension Training Institute, Dept. of Agriculture, Serdang, Selangor, Malaysia.

5. Existing external links with the International Pesticide Application Research Centre at the Imperial College of Science, Technology & Medicine, Silwood Park, Ascot, UK, are strong at present and would need continuing UNIDO support to be maintained.

6. Training formats need to be harmonized and standards used by all extension services involved in farmer training.

7. Industry has an important role to play in promoting safe and effective use of pesticides. Areas that need to be addressed are:-

   a) Minimum standards for application equipment should be agreed and adopted. This would involve the standardisation of areas such as nozzle interchangability, screw thread compatibility and availability of spare parts.

      Durability and safety should be major factors in equipment design standards.

   b) The present training programmes in use by industry's product stewardship schemes should be studied and included in the harmonization of standard training formats. Some existing industrial training formats could form an excellent basis for this.

   c) Some input to the training could be made by industry's support and cooperation. Industry could be invited to submit training suggestions/equipment.

8. Future workshops or courses that are planned should be attended by staff who are actively involved in pesticide application or its training and not by those in administrative roles.

9. An advisory service could be set up to that member countries of RENPAP can share new information on safe application of pesticides to ex-participants and others. Refresher courses to update users would also be beneficial for continuity.

10. External international agencies be called on to provide training expertise on the safe effective use of pesticide, i.e. GTZ, NORAID, FAO, WHO, IPARC, GIFAP, etc.

Annex 2. CONSULTANT'S FINDINGS AND RECOMMENDATIONS

A capacity for pesticide application training already exists in Malaysia and the Centre of Excellence in Pesticide Application Technology that UNIDO requires under this RENPAP project would be adequately served by the resources available and situated in Malaysia.

The Malaysian Department of Agriculture would welcome and invites a proposal from UNIDO for such a Centre if it is adequately funded and supported.

Excellent training centres exist in Malaysia for running courses. These venues are already operating effectively and efficiently. The main inputs needed for a RENPAP training centre are:-

1. Dedicated demonstration equipment and training supplies reserved for teaching/training purposes only.

2. Staff skilled in teaching, training, demonstrating and conducting discussion groups.

3. Maintenance and repair support for all equipment used in course work, practicals, demonstrations, and field work.

The existing links with the International Pesticide Application Centre at Silwood Park, Ascot, UK, were initiated over 10 years ago at the outset of the Pesticide Application Technology Courses held in Malaysia and jointly organized by the Malaysian Plant Protection Society, UPM and MARDI. IPARC has continued to provide a very strong major input to the training and would need continuing UNIDO support to be maintained at present levels.

There are several other organisations that provide some form of training in the area. The industrial companies have very good training formats, as do the Ministry of Agriculture, the

Malaysian Agricultural Chemicals Association and other services. The GIFAP organization also have internationally suitable training material available that should be available as hand-outs. It is suggested that from these and the existing course lecture notes, a training format be developed that could be used by all extension workers involved in farmer training. This would need to be done with the training target audience very much in mind. Simplified training manuals produced on plastic film would be extremely useful in communication of safe pesticide usage.

At the moment there is no interchangability of nozzles on most machines, screw threads are not compatible and safety is not a strong feature of the spraying application equipment in use. Industry could play an important role by adopting minimum standards for application equipment, in which durability and safety are major factors. The result would be an improvement in safety and durability and provide immediate benefits to farmer users.

The core lecturing staff from the Malaysian side were extremely enthusiastic for the proposal to have a Centre of Excellence for Pesticide Application Training in Malaysia. However they did mention that it is not possible to devote efforts to training projects when they have other work commitments or assignments that run concurrently with training arrangements. They emphasized the need for some labour inputs to be committed solely to such a project for the duration of any training periods.

Participative training can change attitudes to pesticide application more effectively than lecture mode presentations, so the practicals and demonstrations are of more importance probably than lecture content. In order to effectively conduct training at the level required, up to date and operational equipment with support staff is essential for success and effective use of the scheduled time.

A Centre for communicating skills in the safe and effective use of pesticides in Malaysia would complement the other efforts of UNIDO in creating other centres in regional countries to deal with associated areas of pesticide use and production.

Annex 3. SUGGESTED LIST OF EQUIPMENT FOR A TRAINING CENTRE IN PESTICIDE APPLICATION TECHNOLOGY

This list is only of equipment that would be necessary for practicals to be conducted in field spraying and for demonstrations. It does not include classroom or laboratory equipment or supplies. It is a basic list that would adequately servie a class of 20 participants. The list is not intended to be completely comprehensive and is given here for guidance.

Compression sprayers with gauges and pressure control	5
Side lever knapsack sprayers (diaphragm)	5
Side lever knapsack (piston)	5
Side lever knapsack sprayers (over-arm pump type)	5

All to be fitted with pressure indicators and spray control devices. A complementary range of spray nozzles to include flat fans, cones, deflector types, etc.

Hand carried horizontal boom	1
Vertical tail boom	1
Extension lances to 3 m	2
Demonstration boom fitted with different nozzle types	1
Stirrup pump type sprayer	1
Motorised knapsack sprayer	3
Motorised knapsack mistblower	3
Motorised knapsack duster	3
CDA spinning disc herbicide applicator	5
CDA spinning disc insecticide applicator	5
"D" cell alkaline batteries	40
Pulsejet thermal fogger	5
Hand operated dusters	5
Cold aerosol generator	1

Tractor mounted or trailed equipment:-

Large thermal fogger for plantation use	1
Tractor mounted sprayer 3-12 m boom	1
Tractor driven piston pump unit with hose extensions to hand lances	1
Tractor driven/mounted mistblower with adjustable air ducts	1

Supporting supplies for such field work would include:-

measuring tapes
sampling poles and targes
water sensitive paper
oil sensitive paper
tracer dyes
measuring cylinders
calibration bottles
large key calculators (1 per 2 students)
plot marking poles
detergent, fuel and oil
buckets, wiping paper, cloth
ultra-violet lamps with batteries
spare parts kits for all machines
large maintenance posters as most manufacturers supply to dealers
hand lenses x 10 magnification
portable white board with magnetic indicators/clamps
small engineer's tool kit

Some reported very little pre-course briefing and that they were not prepared adequately. The participants would have appreciated much more discussion time. Several of the report forms completed by the participants had contradictory responses that clearly indicated a misunderstanding of the UNIDO questions posed.

Three organizations were involved in the organization of the course workshop and some underlapping of arrangements resulted. In future courses it is recommended that one person should be assigned to do nothing else except to help lecturers, provide physical back-up in practicals, put equipment in the right place at the right time and generally ensure continuity. This would prevent the loss of valuable teaching time.

Safe use of pesticides really should be featured at the very beginning of any training course on pesticide application and the theme of safety will then be carried through all the presentations. It is suggested that at least 20% of the course time be devoted to safety and proper cleaning and maintenance procedures. These are the areas which create most of the problems in operator and environmental contamination which this type of training is aiming to improve.

Annex 4. MEETING REPORT
1st OCTOBER, 1993
MINISTRY OF AGRICULTURE

Venue, Ministry of Agriculture, Jalan Gallagher, KL

A meeting was arranged with the Director General, Abdul Jamil Mohd. Ali, and his advisory staff on 1st October, 1993 to discuss the implementation of a proposal for a centre of excellence in training at trainer and extension level on the subject of safe and effective use of pesticides and its related technology. Among those present were:-

Dato Zaharudin b. Jaafar
Asst. Director General, Training & Farmers Development

Hamzah B. Chin
Asst. Director General, Production Development

Shamsiah Muhammad
Asst. Director, Pesticide Control Branch, Dept. of Agriculture
(New Co-ordinator for RENPAP/UNIDO)

Ms Zam Abdul Karim
(Outgoing Co-ordinator for RENPAP/UNIDO)

Kama Ruzzaman Alias
Deputy Director General, Training & Farmers Development

Chin Chen Chiang
Asst. Director, Section Technology, Dept. of Agriculture
Farm Mechanization Branch

Dato' Abdul Mutalib Ahmad
Asst. Director General, Dept. of Agriculture
Crop Protection Div.

Tan Soo Hiam
Director, Pesticides Control Branch
Dept. of Agriculture, Jalan Gallagher, Kuala Lumpur
Tel. 2983077

I asked the meeting if Malaysia would welcome a proposal for their organisations to provide the capacity to have a centre of excellence in Pesticide Application Technology. After some discussion the Director General agreed that any UNIDO proposal on this subject would be welcomed and examined. The Director General firmly stated that any project must not involve any loss financially to the Malaysian Government. Proposals must be attractive to win Government approval with costs and benefits clearly outlined.

Funding was the main area of concern from the Malaysian side. In the past some projects have been formed and the Government had resultant problems in funding staff. The workshop/course members recommendations (page 28) were discussed and agreed in principle. However, concern was expressed over the time commitment of the staff that would be involved in conducting training courses and the frequency for RENPAP training.

It should be noted that some basic equipment would need to be obtained and be dedicated to such a training project. I mentioned that the course had difficulty this time due to malfunctioning tractor mounted equipment and related matters. Some skeleton staff would need to be trained or suitable trained persons assigned to this area of work.

I clearly commented to the meeting that at this stage UNIDO had only asked that I ascertain the Malaysian response to receiving such a project outline for discussion. This was in addition to my role in the course workshop and was requested at my meeting for briefing in Vienna.

The conclusion of the meeting with the Director General and his staff was favourable to that enquiry and they invite the submission to the Director General of Agriculture from UNIDO, Vienna, of a proposal outline to have a RENPAP training facility in Malaysia to serve the requirements of member countries.

Annex 5. CONSULTANT'S ITINERARY AND FIELD VISITS SCHEDULE

13/14 September - Travel London Heathrow to Kuala Lumpur.

15 September - Preparation and contact with local coordnators.

16th September - Visit to the MARDI Research Station, Jalan Kebun, Klang and Hextar Chemicals Sdn. Bhd., Klang. Dr. Lee Soo Ann was visited to discuss the training component of Safe Use of Pesticides that was part of the course syllabus. He reported that there was still much to be done in the area of operator awareness of the dangers of pesticide application and protection when using pesticides. A resurgence of interest in CDA spinning disc sprayers for the application of herbicides was discussed and in the afternoon we both visited a company that distributes some of these units. I was able to point out that certain specific training is required to convert a knapsack operator to a safe and effective CDA/ULV spinning disc sprayer user. An awareness has to be cultivated of the effects of meteorological conditions on the final destination of the spray generated. The output of this type of sprayer has to be carefully monitored for successful calibration to be achieved. Dr. Lee Soo Ann discussed the demonstrations planned for the workshop and made an extremely effective contribution to the training given.

17th September - Transfer from accommodation in Kuala Lumpur to Universiti Pertanian, Malaysia, campus. Lecture and visual aid preparation for course workshop. Resource material.

18 September - Established contact with Dr. Dzokhifli Omar. Discussions on the preparation of lectures and practicals and demonstration materials. Phone calls to various manufacturers to arrange for demonstration equipment to be brought to site to supplement UPM spraying equipment. Selection of nozzles to demonstrate low drift and other spray situations.

19 September - Comprehensive checking of equipment on site for practicals with Dr. Dzolkhifli Omar. Preparation of lecturing facilities. No tractor mounted equipment or thermal foggers were yet available at this stage. Unpacked resource material hand carried from UK.

Afternoon meeting with Dr. Dhua, RENPAP Regional Coordinator, Representative , UNIDO, Vienna, and Dr. Jusoh Mohamed of MARDI, and Ms. Zam Karin, the local UNIDO Coordinator. The point was raised by the UNIDO representatives that somehow the course would have to be revised to include workshop type interchange of views with the participants. It was decided that Dr. Jusoh Mohamed and Ms Zam Karin would initiate some course discussions during the bench mark test time and at other appropriate opportunities in the course. They also agreed to assist the UNIDO Consultant in the preparation of the draft report of the training section of this report.

Unfortunately no course participants were available for pre-course discussions in the afternoon or evening.

I contacted Hugh Richardson of EP Polymers at a long evening meeting to finalise arrangements for the factory visit demonstrations that was going to be featured during the visit of the participants to a local manufacturer. I asked for the drift control of hydraulic nozzles and flow regulation to be demonstrated and Mr. Richardson kindly agreed to construct suitable demonstration application equipment in a static situation that would demonstrate the difference between hydraulic nozzles, spraying at different pressures and flow rates in a controlled and variable pressure situation. As gross operator contamination to the legs and upper thighs is very common, I asked if side booms could be demonstrated on knapsack sprayers as well as rear mounted adaptations that enable the spray to be deposited either to the side or at the rear of the operator. It was arrange that Mr. Chris Meek, who would be visiting Malaysia from the UK at that time, would also be involved in the demonstrating of various spray control

devices on a new diaphragm pump knapsack sprayer being locally produced. Mr. Richardson also agreed to arrange that a conducted tour of the manufacturing facilities and processes be given with an explanation of quality control stages.

20-25 September - Pesticide Application Technology Course Workshop, Agricultural Extension Training Institute, Dept. of Agriculture, Serdang, Malaysia.

26 September - Transfer to Kuala Lumpur Federal Hotel. Rest Day.

27 September - Compilation of report on training course/workshop.

28 September - Compilation of report on training course/workshop. Midday meeting with manufacturer.

29 September - Visit to the Agricultural Country Park to see various cropping situations and environmental conditions.

30 September - Visit to Tanjung Karang hosted by Mr. Khor Kheng Wee. This area to the north of Kuala Lumpur is a rice growing region. Several spraying situations being conducted by small holding farmers were seen.

1st October - 7.30 a.m. check out from Federal Hotel in preparation for travel to Kedar. 9 a.m. courtesy call to the Director General of Agriculture and discussions in a convened meeting with him and his staff. The purpose of this meeting was to ascertain the probable Malaysian response to a UNIDO proposal for a Centre of Excellence to be established in Malaysia for Pesticide Application Technology training. A very favourable conclusion was reached.

12 noon leave for Alor Setar, Kedar by road, accompanied by Miss L. Chen. Several cropping situations and plantation crops were visited during the 8 hour journey. Overnight in Alor Setar, Kedar.

2 October - 8 a.m. Visit MADA Agricultural Development Authority (see page 43) Briefing in control practices, followed by visits to spray areas, sprayer and pest clinics. Overnight in Kedar.

3 October - Depart Kedar to visit the Perlis Mango Project. 3 p.m. leave for Langkawi ferry. Overnight in Langkawi.

4 October - Collation of report.

5 October - Transfer to Kuala Lumpur. Overnight in Federal Hotel.

6 October - Meeting at Federal Hotel with Miss Zam Karin, UNIDO Coordinator and Ms Chen.

6/7 October - Depart Kuala Lumpur MH 002 to London Heathrow.

Annex 6. VISIT TO MADA PROJECT IN MUDA, KEDAH 1 AND 2 OCTOBER, 1993

An accompanied visit with Miss Chen of the Dept. of Agriculture was made to see the rice growing area scheme which has been initiated to improve the farmers living as well as to introduce double cropping to increase yields per hectare. There is a long record of rice growing in this area going back to the first Century AD. In order to introduce double cropping extensive irrigation systems have been developed. Farmers smallholdings of 1.6 hectares average size cover 67% of the total area of 96 thousand hectares. In a recent paper by Heong, et al, 1992, it was found that 80% of the farmers in the Muda area owned sprayers. The side lever operated knapsack sprayer is dominant in the area but the authors explain that less than 1% of the users have been exposed to any proper training.

My observations were somewhat restricted due to the short time available to visit spraying sites, but all the spraying operations seen during the conducted visits were using techniques that would result in operator contamination. I would suggest that the excellent progress made in cultural and irrigation techniques be supported by more frequent organised safe application courses to include operator protection, effective techniques and some basic knowledge on nozzle selection. Motorized mistblowers were seen to be used in the traditional swing method from side to side with the operator walking into the spray cloud. This method enables the operator to achieve an effective swath width of between 5 and 7 metres. However, if the application is made with the outlet of the mistblower directly to the side of the operator, swath widths of up to 10 metres can be achieved, with less operator contamination. The sprayer clinic at Jitra supervised by Dzulkifli Yaacob was visited and was obviously well equipped to conduct farmer training. A short talk, instruction and practical demonstration on nozzle choice, pressure/flow control and safety was given to the group present. This

included comparative swath width assessment by spraying water onto the concrete roadway and comparing the deposition of various types of nozzles and application methods. The shortcomings of the traditional swing method from side to side in front of the operator were made evident. I also gave advice on the maintenance of thermal foggers and two stroke engine powered sprayers. Hamid Darus hosted my next visit to ARUA Pest Klinik, where good pictographic training material was displayed. I suggested some additions that could be usefully made that would complement the existing well designed communication material.

Ahmed Kassin kindly received me at MADA HQ and explained the project in some detail. During the discussions it was mentioned that some Paraquat resistant variety of the weed Roettbolia sp had been reported. I was not able to see incidences of that in the available time at my disposal. At my request I was taken to see a typical sprayer retail outlet that supplied the farmers in the area. Mr. Lee Yee Hoe of Sin Hup Hin Agricultural Chemicals, Sekinchan kindly showed the new equipment that he was making available in the area. This included the plastic locally made Crossmark sprayer and several motorized pump, granule and mistblower units. Some mistblowers were reported to have had operational difficulties due to excessive vibration of the carburettor needle causing enlargement of the metering orifice and problems with the float in the fuel metering reservoir. Other new machines were reported by Mr. Lee Yee Ho to suffer from water leaks when supplied even as new items ex-works.

At MADA the training available was reported to be through the Extension Services Section. Six officers are involved and four to five day training periods are held on project related subjects during the year. Six sprayer orientated courses are run throughout the year including manual, motorized equipment and safety. I again suggested some revision of the training formats so that safety is always prominent on the first day and the theme of the training is safe and effective use.

Hollow cone spray nozzles are used for everything. 80% of the farmers owned lever operated sprayers, mostly of local manufacture, less than 10% owned motorized knapsack mistblowers. There is a rental scheme for hiring motorized sprayers, blowers, granule applicators and thermal foggers. This scheme is used by small holder farmers who would be unable to afford purchase of this range of equipment. Some 50,000 manual knapsack sprayers were said to be in use, most of them being between 3 and 5 years old. The introduction of plastic tank knapsacks was being welcomed as it was thought that the tanks would be less likely to develop the leaks that have long been experienced with the traditional sprayers. I pointed out that metal tanks can be locally repaired by soldering techniques; however was informed that the traditional tin smith repairers were gradually decreasing in number, so that the change to plastic would be more welcome than I supposed. They were light in weight and thus less tiring to use, were appealing to the farmers. Ideally when plastic sprayers are used in pesticide application programmes, it is very beneficial to have machines dedicated to herbicide use only. This eliminates the possibility of cross contamination and subsequent crop damage when changing from herbicide application to fungicide or insecticide usage. The random and indiscriminate disposal of used pesticide containers in irrigation canals, padi walkways and environments was clearly observed. This demonstrates the need for education in the safe practice of handling pesticides.

Local requests were made for training courses to be arranged at venues in the area. Local agricultural officers remarked that several who were actively involved in crop protection would welcome the opportunity to participate in pesticide application technology training. They would then be more effective in communicating safe principles of use to the farmers. It is very apparent that high level training is not required and that it is not enough just to supply the technology information input. Communication skills should feature strongly in any presentations to enable extension

staff to effectively communicate basic information such as safe use, nozzle choice, the effects of pressure on inhalable droplet production, etc. to farmers.

Annex 7. VISIT TO PERLIS MANGO PROJECT
3 OCTOBER, 1993

The Mango Project involves about 600 hectares occupied by 800 farm families. Aims of the project are to raise farmers standards of living by cultivating a high value fruit crop and also aims for the farmers eventually to become self-sufficient and independent units. The project's target yields are 8 tons of fruit per hectare, based on the rates of 54 fruits per tree on an average weight of 2.5 kilos per mango.

This September the Project Leader reported an imperata reduction from 86% to 15% in a four month period. Other control situations that they have involve leaf hopper, leaf cutter, stem borer and it was reported that last year thrips affected 200 ha. Last season reported the first incidence of powdery mildew. This year Integrated Pest Management has been adopted to provide some regulation of the frequency of calendar spraying. Daily scouting inspections provide data that is communicated to all concerned within 5 days. When 5% infestation level is reached, spraying is activated.

A visit was kindly arranged to a mango plantation to see how crop protection was carried out. It was interesting to see the adaptations of spray equipment that reflected innovation in making the best economic use of the low cost equipment available. A motorized knapsack mistblower had been mounted in a small turntable pivot fixed to a trailer at a height of 1.5 metres from the trailer base. This arrangement was towed behind a small motorized tractor cultivator unit. This gave the height required for spraying the present height of the existing mango trees and gave access in between plantings. The operator rode on the trailer and manually directed the discharge hose of the knapsack sprayer at the spray target. This situation gave a higher vertical projection of spray than would normally be possible and was less tiring for the operator to use. I was able to roughly monitor the spray coverage using water sensitive paper and found that they were

achieving good deposition on the upper and lower leaf surfaces throughout the canopy. I was concerned that the trial demonstrated that an equally good coverage and deposition was being achieved both on the spray operator and the tractor driver. Woollen gloves were seen to be in general use when spraying. These are absorbent and act as a reservoir for pesticide and results in contamination to the operator. At this site lever operated knapsacks have been practically phased out of use in favour of hydraulic spraying from tractor driven pumps feeding hoses to manual operators.

It should be noted that this practice is referred to in many areas as "boom" spraying. Therefore the concept of a boom sprayer is not one of tractor mounted horizontal booms with nozzles situated at 50 cm spaces. I found all involved in this project to be extremely enthusiastic and receptive. They all again raised the question that they would like pesticide application technology courses to be organized in the north area. Judging by the interest shown, any candidates for training are more likely to be those actually involved in organizing spray operations or in related information transfer.

Azahim Abidin, the Project Director, gave an illustrated briefing before the meeting at the project HQ in Perlis.

Other staff seen were:-

Seti Eshah B. Lafis, M.E. Chief
Abd. Razale Nordin, Crop Protection Chief
Hamid Hashin, Project Coordinator
Ishmail Bahari, Project Coordinator
Hakim Md Noor, Project Manager
Azarhan Abidin, Director of Integrated Agricultural Development Project (IADP) affiliated to the Mango Project

Annex 8. JOB DESCRIPTION

DP/RAS/88/031/11-76

Title: Consultant in Application Technology

Duration: 28 days

Dates required: 31 August - 1st September, Vienna briefing
13 September - 6th October, Kuala Lumpur, Malaysia
Remainder, UK, procurement and report

Purpose of the Project:

To promote on a regional basis safe and effective ways of production and use of agrochemicals for sustainable agriculture.

Duties:

The consultant, in collaboration with project counterparts in the Department of Agriculture, Malaysia, is expected to make all the necessary arrangements to organize a workshop on Application Technology related to pesticides. He will be one of the resource persons in making all the necessary preparations for the workshop according to the tentative programme given in the Aide Memoire (copy attached). He will assist in setting up demonstrations, key lectures and group discussions on the subject. He will be helped by national experts and also any other expert coming from outside Malaysia. He will participate in discussions and help in preparing the final draft report with recommendations.

Qualifications:

Engineer/biologist with extensive experience in safe pesticide use and application. He must be familiar with the recent advances in pesticide application techniques and their adaptation to developing countries, the problems and the prospects. Experience in developing countries would be an advantage.

COUNTRY REPORTS

The country reports are summarized as follows:

BANGLADESH

Pesticide use during the last seven years in Bangladesh has been going up at the rate of about 20%. The major types of formulations of pesticides used by the growers in Bangladesh are granular, emulsifiable concentrate, water soluble powder, bait, etc.

Bangladesh produces some hand sprayers locally but for power sprayers it depends entirely on imports. At present the government has a stock of about 20,000 hand sprayers and 6000 power sprayers and maintenance are being done at Unit level offices. The types of sprayers includes hand sprayer, foot pump sprayers, lance type sprayer and power sprayer. Generally, most of the farmers do not wear any standard protective clothing while spraying and a large number of them are not aware of the risks associated with the application of pesticides in the field.

CHINA

In 1992, China produced about 220,000 tons of pesticide active ingredients and 880,000 tons of formulation. In addition, China also imported about 20,000 tons of pesticide formulations. Since 1985, the number of pesticide formulations registered in China has reached 639.

There are 20 kinds and more than 40 models of pest control equipment in China. Up to 1990, the number of hand operated equipment is about 50 million, 82% of which are knapsack type hand sprayer, 450,000 power operated machines, 80% of which are knapsack type duster-sprayer. Most of the equipment are out of date and do not meet the requirement for safe, effective, and

ecomonical use of pesticide. The development of pesticide application equipment falls behind that of pesticide and standard of the product quality and testing facilities are still low. For the majority of small farmers in China, there is an urgent need for the authority to extend and promote safer techniques of pesticide application. Farmers in big centralised farms however, seems to have more access to new information and technology.

INDIA

The major demand of pesticides in India is met through indigenous production. At present 133 pesticides have been registered on regular basis for control of different crop pests while 18 pesticides have been provisionally registered. The plant protection machines used can be classified as sprayers, dusters, sprayer-cum-dusters, seed dressing machines, fumigators, flame throwers, and bird scarers. Different kinds of sprayers and dusters used are hand-sprayers or atomisers, compressed air sprayers, knapsack sprayers, bucket sprayers, rocking type sprayers, foot sprayers and rotary dusters. The power-operated sprayers includes motorised knapsack sprayer-cum-dusters, tractor mounted sprayers & dusters and exhaust nozzle sprayers. In addition to ground application of pesticides, aerial application is undertaken to cover bigger area. Farmers are advised to wear protective clothings while handling and applying pesticides in the fields.

INDONESIA

The major pesticide use in Indonesia are Diazinon, MIPC, BPMC, Carbofuran, Etophon, Monocrotophos, Carbaryl, Glyphosate, NPG, Propoxur and Methomyl. The pesticide by formulation are EC, granule dust and powder. The types of equipment used for pesticides appplication are hand sprayer, SKID/hydraulic power sprayer, mist blower/motor sprayer, micronizer and micronizer by

aerial spraying. In addition, dusting, fogging, fumigation and soil treatment technics are also used. The type of safety equipments used by farmers are hat, goggles, aprons, gloves, boots, respirator and face mask. Pesticide application equipment produced locally follows the National and international standards.

IRAN

In 1988 insecticide made up 50% of the total pesticide use followed by fungicides 30% and herbicide 20%. At present the use of herbicides have registered the highest growth rate in Iran, followed by fungicides and insecticides. Most of the pesticides used in Iran are formulated locally using imported technical grade materials. Agricultural Research Department is responsible for tests on application and usage of pesticides to determine its effects and safety.

REPUBLIC OF KOREA

The amounts of pesticides used on the basis of active ingredient (a.i) was recorded as 27,476 M/T in 1991. A total of 270 active ingredients are registered with 530 formulations available. Common formulation used are EC, WP, GR, SL, and SP.

In the early 1970's, application of pesticides are carried out using knapsack sprayer. Presently pesticides are being applied mainly by power sprayer, mister or speed sprayer. Personal protective equipments for pesticide application practices like clothings, gloves, boots and face-shields are available in the market with reasonable price. However most operators dislike to wear them during application practice because of hot and humid weather.

Research and development on safer pesticide formulation are being carried out in Rep. of Korea. In addition to that, research on polyethylene sheet formulation incorporated with herbicide for vinyl mulching of crops is being undertaken to eradicate pesticide application practice. Several pesticide application techniques without mixing or spraying were also established and disseminated to the farmers. In paddy field, a specially formulated SC can be introduced dropwise from the pesticide container at the inlet of irrigation water. The herbicide droplets are uniformly dispersed throughout the field along with irrigated water.

MALAYSIA

In Malaysia, the pattern of pesticides use ramain almost the same. About 80% of total pesticides used is herbicide, followed by insecticides 13%, fungicides 4% and others 3%. Most of the herbicides used are in the plantation sector.

The most common types of equipment used in the country are hand operated but with a gradual decline in the availability of manpower, mechanisation is on the increase in most of the farm operations. The types of sprayer used includes hand operated (compressed air type), motorised sprayer, dusters and others. The common problems faced by farmers in the usage of pesticides and the application equipment are: lack of safety measures, lack of knowledge in carrying out maintanence and repairs, inproper caiiberations, and poor storage of equipments.

There is a need for the Department of Agriculture to strengthen its training programmes for the field staff in pesticide application technology.

MYANMAR

The major types of pesticide formulations used in Myanmar are emulsifiable concentrates (EC), water soluble concentrate (SCW), ultra low volume (UVL), granules (G), dust (D), and water dispersable powder (WDP). Knapsack sprayer are the most common application equipment while hand-held dusters are used for dust formulation. Locally, the Myanmar Heavy Industries manufactured most of the knapsack sprayers used in the country. Others are imported from the neighbouring countries. For protection during spraying activities, the applicators are advised to wear long sleeves and at least a handkerchief to protect the mouth and nose. Rubber aprons and gloves are also available to the farmers. Through workshops and training courses farmers are more aware about the risk associated with pesticide. Myanmar Agricultural Service extension workers, trained in safe and effective use of pesticide, from the core group in dessimination of information on safer pesticide application techniques.

PHILIPPINES

There are at present 474 pesticides constituting 279 active ingredients registered in the Philippines. Of these formulated number, 379 are agricultural and the rest (95) are household pesticides. The emulsifiable concentrate (EC) is the most widely used formulation with wettable/soluble powders and granules, ranking second and third. Flowables are also familiar especially in the banana plantations in Mindanao.

The 16-liter knapsack sprayer is the most common application equipment. About 70 percent of the estimated 1 million Filipino rice farmers today own a knapsack sprayer. In the pineapple plantations in Southern Philippines, machine-driven 1,6000-gallon boom sprayers are employed. Fungicidal application in the banana plantation are aerially done. Injection with

fumigants, and spray gun with some nematicides are practiced in the banana plantations as well. The fruits and nuts crop segment utilize power sprayer, or manualy operated pump sprayer. Some farmers use an indegineous manual spray gun with a suction pump that can launch a 20 feet high solution jet.

Sixty six percent of those using pesticides in the rice farm wear some forms of personal protective clothing (PPE). Personal protective equipment like cover-alls are extensively used by big banana and pineapple plantation applicators, where there is tighter control.

THAILAND

Generally, the crops using large amount of pesticides in Thailand are rice, vegetable and cotton accounting for about 60 per of total consumption. Insecticides form 48% of the total insecticide used in rice and vegetable. In the plantation sector, rubber, oil palm and sugar cane are large users of herbicides while fruits orchards dominate the fungicide market.

The major types of formulations in use are emulsifiable concentrate (EC), wettable powder (WP), water soluble concentrate (WSC), suspension concentrate (SG), granules (G), dustable powder (D) and bait.

Important types of equipment used by farmers are: hand-operated (manually) sprayers with hydraulic pump, motorised knapsack sprayers and high power-operated hydraulic types. Practically, farmers use some kinds of material while handling or applying pesticide for self protection. But in some areas, due to lack of education and information no protective gears of any kind are used al all.

VIETNAM

Approximately 10,000 tons of chemicals (equivalent to 4,000 tons of active ingredients) are imported into Vietnam every year, of which 52.26% are insecticides, 17.12% are fungicides, 18.38% are herbicides, and 12.24% other chemicals. The most suitable type of sprayer for the vietnamese farmers are the knapsack sprayer (hand operated). Motorized sprayers are also put in use when there is an outbreak of pests or diseases on large scale. In order to help famers apply pesticides efficiently, Plant Protection authorities at all levels had conducted training courses on pests and diseases and the effective control measures.

UNIDO Comments

The report of the consultant gives a comprehensive information on the proceedings of the workshop carried out in Malaysia mainly with the help of local counterparts acting as resource persons while UNIDO consultant gave all the required elements to make it come upto international standards. As the workshop was fully supported by the local industry and organizations many field experiments could be organized.

The application technology is now well accepted as an important means to take the pesticides to the target and preventing unncessary damage to the enviornment. In addition, safety of the applicator is an essential factor that should be taken into account. Efficient use of pesticides will automatically bring down the volume of pesticides used and also in getting maximum benefit from the expensive chemicals.

The workshop paved the way for bringing Malaysia as the Centre of Excellence for the Asia region in application technology for safe development of pesticides. The evaluation of the course conducted clearly indicates that the training/workshop had the desired effect on the participants in their learning process.