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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 (MPPS).

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

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INTRODUCTION

The Asian and the Pacific region is not only most 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, the use of pesticides has come under close scrutiny worldwide. The 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 twin objective of increasing agricultural production through adoption of most appropriate technologies and reducing the pesticide load on the environment through adoption of target specific and efficient application technologies.

Significant development in the sphere of application technology have taken place with the development of new delivery systems, viz. ultra low volume sprayers, controlled droplet applicators and electrodyn applicators. But the benefits of improved delivery system are yet to be fully exploited by the members countries of the Network. With the introduction of synthetic pyrethroids, the application rates which are only few grams per hectare, have made the requirement of measurement, calibration and delivery routines to be more precise. Any improvement, therefore, in the spray application technology will hinge on a more intimate, systematic and imaginative study of the physical and physico-chemical parameters controlling the behavior of sprayers and their deposits on the target organisms. In the tropical environment of application, the changes in the droplet size as a result of evaporation and differential movement of the droplets due to effects of gravity, wind velocity and air turbulence leads to significant losses of pesticides between the nozzle and the target. There also has to be a clear understanding of the production of spray droplets and their ultimate deposition on the intended target including method of pumping in the sprayer to the nozzle, production of spray droplets, movement of the droplets to the target, deposition and the ultimate movement to the site of biological target activities. The other area pertaining to the application technology needing attention is the safe handling of the equipment and the pesticide in all phases of usage starting with opening the package, filling operation, application parameters, as well as reentry of the farmers into the treated areas. The use of safe and protective clothing while spraying in the field is yet another area needing particular attention since under the tropical climatic conditions, use of the protective clothing which is normally suited for the temperate climates is not possible and a large number of agricultural workers resort to spraying in the field barefoot, barehand and even bare-bodied and sweating profusely under field conditions.

The Government of Malaysia, hosting the Technical Coordinator Unit on Pesticide Application Technology, has up-to-date facilities and trained personnel and in collaboration with the Malaysian Plant

Protection Society has agreed to host the Course/Workshop in the Agricultural Extension Training Institute (ILPP) Department of Agriculture in Serdang Seiangor, where several institutions on agriculture are also located.

The Workshop is intended to cover

1. Effective Pesticide Application
 - pesticide formulation
 - spray factors.
 - appropriate application
 - economic machinery considerations
2. Application equipments
 - Hydraulic sprayer
 - compression sprayer
 - knapsack sprayer
 - motorised knapsack sprayer
 - tractor mounted boom sprayer
3. Selection and Use of Hydraulic Nozzles
 - Nozzle types
 - production of droplets
 - spray patterns
4. Calibration of knapsack sprayer
 - conventional method
 - use of cali-bottle
 - 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 tracers.
7. Detecting spray coverage
 - water sensitive paper
 - fluorescent tracers
8. Measuring Techniques of Spray Droplets
 - sampling and collection of droplets
 - using porton graticule
9. Air Carrier sprayers
 - mist blowers
 - portable
 - tractor mounted
10. Spray coverage and calibration of portable mistblower
 - tractor mounted - mist blowers
11. Aerial application theory

12. CDA-Spinning Disc sprayers
 - rotary atomiser
 - mini ULVA and micron HERBI
13. CDA-Electrostatic sprayers
 - methods of charging droplets
 - electrodyn
14. CDA/ULV - Spraying on weeds.
 - swath width
 - spray coverage
15. CDA spraying on crops
 - effective swath width
 - spray coverage
16. Trunk Injection
 - principle
 - practices in plantation
17. Examination of Flourescent Tracers
18. Fogging Technology
 - cold and thermal fogging
 - equipment and demonstration
19. Maintenance of sprayers
 - knapsack sprayer
 - small motorised sprayer
 - wear and tear
20. Rodents Management
 - population assessment
 - rodenticides
 - bait selection
21. Fumigation and Slow Release treatments
 - soil sterilization
 - stored product pests control
22. Safety aspects of Pesticide Application
 - protective clothing
 - occupational hygiene
23. Pesticide poisoning and First aid
 - toxicology of pesticides
 - medical aspects of poisoning

OBJECTIVES OF THE COURSE

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

- o To help increase the level of knowledge on appropriate pesticide application technologies.
- o To create greater awareness on the need for safer and more efficient application of pesticides.
- o To stimulate interests and sustain efforts towards further improvement on the technologies.
- o To promote wider acceptance of user and environment friendly techniques.
- o To provide an opportunity for closer cooperation among countries in this region.
- o To lay the Foundation for a training centre of excellence in Pesticide Application Technology to serve the needs of RENPAP area.

OPENING SESSION

The Chairman of the organising committee, Dr. Jusoh Mamat in his speech, welcome all participants from 13 countries to this course. He also thanked members of the organising committee for their efforts in organising the course, the participating agencies viz: the Department of Agriculture, Agricultural Research and Development Institute (MARDI), Universiti Pertanian Malaysia, the Malaysian Plant Protection Society (MAPPS) and the private sectors. The keen interest and generous support from UNIDO/UNDP in making this course a success was highly appreciated.

The honourable Deputy Secretary-General of the Ministry of Agriculture, Dato' Zolkpli Abdul, in his opening remarks emphasised 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 training course should be disseminated to the farmers so that pesticides are used judiciously in the manner it is intended for. Ultimately, it is hoped that with better application technology, the agricultural production can be made more economically viable.

Dr. B. Sugavanam, Senior Industrial Development officer, UNIDO, mentioned about the role of UNIDO and the various projects implemented by the agency. He stressed the importance of closer cooperation among countries in the Asia and Pacific region and he indicated that Malaysia could play a bigger role in providing a centre of excellence in the field of Pesticide Application Technology in this region. He also suggested more active participations from the industries in supporting the project activities implemented by RENDAP/UNIDO.

Dr. S.P. Dhua, Regional Co-ordinator for RENDAP/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 on the importance of the adoption of safer and more effective application technologies 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 region.

DESIGNATION OF OFFICERS

Dr. Mohd. Jusoh Mamat, Head of Entomology and Pesticide Science Programmes in the Basic Research Division of the Malaysian Agricultural Research Development Institute (MARDI) was appointed as the site Coordinator and local Consultant. Mr. Even Thornhill, Senior Research Officer/Course Organiser from International Pesticide Application Research Centre, Imperial College at Silwood Park, Ascot UK, was assigned by UNIDO as the External Adviser and principal lecturer for the course. They were assisted by the local lecturers and a team of secretariate staffs.

PROGRAMME

Sunday, 19 September, 1993

Arrival and Registration of Participants

DAY 1	Monday, 20 September, 1993
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0800 - 1000	-	Opening Ceremony
1000 - 1020	-	Introduction And Benchmark Test <i>Dr. Mohd. Jusoh Mamat</i>
1020 - 1110	-	Effective Pesticide Application <i>Dr. Dzolkhifli Omar</i>
1110 - 1300	-	Hydraulic Sprayers <i>Mr. Evan Thornhill</i>
1300 - 1400	-	Lunch
1400 - 1500	-	Selection and Use of Hydraulic Nozzles <i>Mr. Evan Thornhill</i>
1500 - 1600(P)	-	Calibration of Knapsack Sprayer <i>Mr. Anas Ahmad Nasaruddin/ Mr. Evan Thornhill</i>
1600 - 1730(P)	-	Calibration of Tractor-mounted Boom Sprayer <i>Mr. Anas Ahmad Nasaruddin/ Mr. Evan Thornhill</i>
1730	-	Tea
1900	-	Dinner
1030 - 2130	-	Film Show On Spraying <i>Faizal Abdullah</i>

DAY 2 Tuesday, 21 September, 1993

- 0800 - 0900 - Behaviour of Spray Droplets
Dr. Dzolkhifli Omar
- 0900 - 1000 - Spray Coverage And Sampling Technique
Mr. Evan Thornhill
- 1000 - 1020 - Tea Break
- 1020 - 1130(P) - Detecting Spray Coverage
Mr. Evan Thornhill
- 1130 - 1300 - Measuring Techniques Of Spray Droplets
Dr. Dzolkhifli Omar
- 1300 - 1400 - Lunch
- 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

DAY 3 Wednesday, 22 September, 1993

- 0630 - 1030 - Aerial Spraying Demonstration by Ultra light aircraft, pilot: Hj. Mohd. Sidek at the Rubber Research Institute of 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 & processing Industry, Cocoa plantation, Temperate house, Orchid farm etc.
- 1400 - 1630 - Tour and demonstration at E.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

DAY 4 Thursday, 23 September, 1993

- 0800 - 0930 - Safety Aspects Of Pesticide Application
Dr. Lee Soon Ann
- 0930 - 1000 - Demonstration On Safety
Dr. Lee Soon Ann
- 1000 - 1020 - Tea Break
- 1020 - 1130 - Controlled Droplet Application
Mr. Evan Thornhill
- 1130 - 1300 - CDA/ULV Spraying On Weeds
Mr. Chung Gait Fee
- 1300 - 1400 - Lunch
- 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
Mr. Anas Ahmad Nasaruddin
- 1730 - Tea
- 1900 - Dinner
- 2000 - 2100 - Examination Of Flourescent Tracers
*Dr. Mohd. Matthieu Abdullah/
Mr. Evan Thornhill*

DAY 5, Friday, 24 September, 1993

- 0800 - 0900 - Fogging Technology
Mr. Ho Cheng Tuck
- 0900 - 1000 - Fogging Equipment And Demonstration
Mr. Evan Thornhill
- 1000 - 1020 - Tea Break
- 1020 - 1230(P) - Maintenance Of Sprayers
Mr. Evan Thornhill
- 1230 - 1430 - Lunch
- 1430 - 1600 - Rodent Management
Mr. Liau Siau Suan
- 1600 - 1730(P) - Fumigation And Slow Release Treatments
Mr. Azmi Ab. Rahim
- 1730 - Tea
- 1900 - Dinner

DAY 6, Saturday, 25 September, 1993

- 0800 - 0900 - Aerial Application Theory
Mr. Nasir Ma Lee
- 0900 - 1030 - Course Evaluation-Organiser
Dr. Mohd. Jusoh Mamat
- Course Evaluation-Participants
Ms Zam Abdul Karim
- 1030 - 1100 - Tea Break
- 1100 - 1200 - Pesticide Residue
Mr. Cheah Uan Boh
- 1200 - 1300 - Pesticide Poisoning And First Aid
Dr. Zainul Abidin Md. Hussain
- 1300 - 1330 - Closing Ceremony
- 1330 - 1430 - Lunch

(P) = Practical

TECHNICAL SESSION

The course was organised and conducted by a committee comprising various experts from MARDI, Universiti Pertanian Malaysia, Department of Agriculture and the private sectors which include the plantation, chemical companies and pest control equipment manufactures.

The course was divided into 3 basic sessions covering lectures, practicals, visits and discussions. Additional sessions were also conducted at night and these include, video shows on spraying and a demonstration on Pesticides Database by a representative from FADINAP/ARSAP.

Approximately, 55% of the course involved lectures, 30% practicals and 15% taken up by visits and discussion.

Before the course proper was conducted, a benchmark test was carried out to assess the baseline knowledge of the participants. Subsequently, after most of the lectures and practicals had been given, post-course benchmark test using the same questions was carried out. The results of the benchmark tests are covered under a separate topic in this report.

A discussion session was carried out towards the end of the course involving all participants and lecturers. Suggestions and recommendations were made and these are reported under the topic on recommendation.

As part of the course package, each participants was given a set of compiled lecture notes at the beginning, thus allowing them ample opportunity to read before each lecture. In addition they were also given various pamphlets, samples and gift items from the pesticide application equipment companies.

Two visits were conducted during to the duration of the course. The first visit was to the Rubber Reserch Institute of Malaysia (RRIM) Field Experiment station in Sungai Buluh. Here the participants were shown the microlight aerial spraying demonstration. They also toured the RRIM Museum where the long history of the rubber industry in Malaysia is displayed.

The second visit was to a knapsack sprayer manufacturer, the E.P. polymers, situated in Shah Alam. There the participants were briefed by the factory manager on how each component was made and assembled. A demonstration was also given on the performance of special items such as the SMV nozzle, the multinozzle and other accessories. The participants were also given the opportunity to see the production floor where the various components were made using the blow moulding and the injection moulding machines. As a token, each participant was presented with a complimentary unit of Prima-knapsack sprayer (valued at RM128). Along the way took the participants wwere also taken to the Malaysian Agricultural Park in Shah Alam where they had a four of the various attractions including the Orchid Garden, Cactus Garden and the Fishery Lakes.

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 the 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 economical 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, flamethrowers, 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 clothing while handling and applying pesticides in the fields.

INDONESIA

The major pesticide use in Indonesia are Diazinon, MIPC, BPMC, Carbofuran, Etaphon, Monocrotophos, Carbaryl, Glyphosate, NPG, Propoxur and Methomyl. The pesticide by formulation are EC, granule dust and powder. The types of equipment used for pesticides application are hand sprayer, SKID/hydraulic powder 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 MT in 1991. A total of 270 active ingredients are registered with 530 formulations available. Common formulation used are EC, WP, GR, SI, 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 of 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 used remain almost the same. About 80% of total pesticides used is herbicide, followed by insecticides 13%, fungicides 4% and other 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 maintenance and repairs, improper calibrations, 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 workshop 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, form the core group in dissemination 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 aerielly 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 manually operated pump sprayer. Some farmers use an indengineous 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 (SC), 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 at 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 sprayer are also put in use when there is an outbreak of pests or diseases on large scale. In order to help farmers apply pesticides efficiently, Plant Protection authorities at all levels had conducted training courses on pests and diseases and the effective

COURSE EVALUATION

Basically, a test was given to evaluate the level of knowledge of the participants on the pesticide application technology. These include some principles of pesticides application and the equipment. The range of score marks achieved in the pre-course benchmark test was 0-11 out of a maximum of a possible 20 marks. The overall average on this test was 4.5 out of 20.

At the end of the training a post-course benchmark test was conducted in which the same questions were posed. The range of marks achieved was between 9-16 and the average mark was 12.8 out of 20. The average percentage marks achieved by the participants was raised to 64% from an initial score of 22.5%. One participant who scored 0 in the initial test managed to attain 15 out of 20 in the final assessment. Almost all participants made substantial improvement in terms of their knowledge on pesticide application even though some of them had very little or no actual operational experience in pesticides application technology.

In conclusion, even though the course was conducted relatively in a very short time, the manner in which the course was conducted proved to be effective as seen from the results of the evaluation tests. However, effort would be made to further improve in the future courses, to enable all participants have the opportunity to actually conduct the practicals. This would provide them the first-hand experience in the handling of the equipment and enable them to gain practical knowledge on various aspects of proper usage and maintenance of the sprayers.

RECOMMENDATIONS

The workshop/course participants adopted the following recommendations.

1. There is a continuing need for training in safe and effective application of pesticides.
2. A centre of excellence should be established to provide and coordinate training activity in RENPAP
3. Malaysia can serve such a role as a centre of excellence in Pesticide Application Technology. The Department of Agriculture would be the leading administrative organisation. Mardi and UPM with the cooperation of MAPPS could provide the 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 Department of Agriculture, Serdang, Selangor, Malaysia.
5. Existing external links with International Pesticide Application Centre, Imperial College Silwood Park Ascot UK are strong and would need continuing UNIDO support to be maintained.
6. Training formats need to be harmonised 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 like nozzle inter-changeability screw thread compatibility. Durability and safety should be major factors in equipment design standard.
 - (b) The present training programmes in use by industries product stewardship schemes should be studied and included in the harmonisation of training standard formats. Some industrial training formats can provide 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.
8. Future workshops/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 so member countries of RENPAP can help to spread new information on safe application of pesticides to ex-participants. Re-fresher courses to update users would be beneficial for continuity.
10. External international agencies be called on to provide training expertise on safe, effective use of pesticide i.e. GTZ, NORAD, FAO, WHO, IPARC, etc.

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