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RESTRICTED

19425

DP/ID/SER.A/1548
29 January 1992
ORIGINAL: ENGLISH

54 p.
diagrams

STRENGTHENING OF PESTICIDE DEVELOPMENT CENTRE

DP/IND/89/128

INDIA

Technical report: Findings and recommendations*

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

Based on the work of Donald R. Johnstone,
consultant on application technology

Backstopping officer: B. Sugavanam,
Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

V.92 50714

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CONTENTS (Continued)

(Annexures)

Notes and abbreviation

25.8 Indian Rs = . US $

1 lakh = 100000

1 crore = 10000000

ADB	Asian Development Bank
ASPEE	Trade Mark of ASPW
ASPW	American Spring and Pressing Works Pty Ltd
BCPC	British Crop Protection Council, Bracknell, UK
BIS	Bureau of Indian Standards
CIAE	Central Institute for Agricultural Engineering, Bhopal
CPPTI	Central Plant Protection Training Institute, Hyderabad
DPPQS	Directorate of Plant Protection, Quarantine & Storage, New Delhi
EPPO	European & Mediterranean Plant Protection Organisation Paris
FAO	UN Food & Agriculture Organisation, Rome
FCO	UK Foreign & Commonwealth Office, London
HIL	Hindustan Insecticides Ltd., New Delhi
IARI	Indian Institute for Agricultural Research, New Delhi
IPFT	Institute for Pesticide Formulation Technology, Gurgaon (formerly PDC)
IRRI	International Rice Research Institute, Los Banos
MRC	Malaria Research Centre, New Delhi
NMEP	National Malaria Eradication Programme (for India)
NRI	Natural Resources Institute (of ODA), Chatham, UK
ODA	UK Overseas Development Administration (of FCO), London
PDC	Pesticides Development Centre, Gurgaon
PDPI	UN-assisted Pesticides Development Programme for India
RENPAP	Regional Network for Pesticides for Asia & the Pacific
UN	United Nations (Organisation)
UNDP	UN Development Programme

UNIDO	UN Industrial Development Organisation, Vienna
WHO	UN World Health Organisation, Geneva

Acknowledgements

I should like to thank all the personnel at the IPFT, Udyog Vihar, for their friendliness and cooperation during my stay. In addition, I am grateful to my contacts in the other Government institutions, and also in the commercial sector, who have readily given of their time and advice and whose views have helped shape the ideas expressed in this report.

Particular thanks are due to Dr Khawal Dhari, Director, IPFT, for his encouragement and support and to Drs Y.P.Ramdev and P.K.Ramdas, with whom I worked closely, also to Mr Sat Pal and colleagues at UNDP, for their help and support throughout my stay.

ABSTRACT

Terminal Report: Pesticide Application Technology

(DP/IND/89/128)

This report presents a follow-up of a previous visit on the same topic which took place in 1982-83 (duration three months, ref: DP/IND/80/037) and should therefore be read in conjunction with the report on that visit (Johnstone, 1983). The present visit was of two months duration, from 9 October to 5 December 1991.

The main objective was to assist and to advise the staff of IPFT, Gurgaon, on those activities in pesticide application technology which might best serve the current interests of the Institute. These activities have been examined in terms of:

1. Desk-based work
2. Laboratory-based work
3. Field-based work, and
4. Training/Marketing-related work.

The ways in which these activities are related and may be integrated with the on-going work of the existing Formulation Development, Analytical and Biosciences Laboratories have been considered.

It is emphasised that Application Technology is a multi-disciplinary science, with ideas which should contribute at various stages in the course of formulation development and that these ideas have so far been under-utilised. Although a part of the work naturally complements the current work of the Formulation Development and, in particular, the Biosciences Laboratory, there is an acute shortage of laboratory space. Very little in the way of laboratory equipment for conducting application studies has so far been acquired. Proposals for supplementing existing equipment and facilities have been put forward. These will need to be implemented before this aspect can play a full role in the work of the Institute.

RECOMMENDATIONS

1. It is recommended that more adequate provision be made within the Biosciences laboratory for pursuit of R & D in application technology. Siting of the above accommodation is important, as some of the additional equipment (outlined at Annex V) will need to be set up sufficiently remote from the insect cultures to eliminate risk of unwanted chemical contamination of these and other biological material during laboratory spraying tests with active chemicals.

Ideally this calls for new building and an indication of the required facilities is provided at Annex IV. Space exists for a suitable single storey structure on the vacant plot adjacent and to the west of the main IPFT building. If new building is not immediately possible, then interim arrangements: maybe the lease/loan of laboratory space from the adjacent HIL accommodation, needs urgent consideration.

2. It is further recommended that application considerations should feature at an early stage in the planning of new project work, as an adjunct and component of the programmes to be carried out within the Formulation Development and the Bioscience laboratories.

3. It is recommended that the contribution of Application Technology should be considered sequentially, under four basic headings:

1. Desk-based work
2. Laboratory related work
3. Field related work
4. Marketing/Training related work

as detailed at Annex VI.

4. It is recommended that practical work to evaluate the relative merits of imported and indigenously-produced ULV sprayers should form a starting point for appraisal of application equipment and technique as outlined at Annex VII. This will provide staff with 'hands-on' experience of some of the relevant field and laboratory procedures.

Efforts should also be made to procure the 1,2 and 3 bar spray management valves from Fluid Technology (Aust) Ltd., for evaluation with lever-operated knapsack sprayers.

5. It is recommended that contact/interaction with other application-oriented institutions should be fostered, both nationally and throughout the RENPAP area.. In India, appropriate bodies include: the Bureau of Indian Standards, New Delhi; the Application Engineering Department of CPPTI, Hyderabad; the Engineering Department of DPPQS, Faridabad; the Application Group at CIAE, Bhopal and the ASPEE Research Institute at Ganeshpuri, near Bombay (all involved in machinery R & D). Some overseas organisations active in the area of Application Technology, which may need to be contacted for information are listed in Annex VIII.

6. It is recommended that Mr Yashwant Singh (Dr Ramdev's assistant) spend three months in UK next Summer, 1992, to attend the eight week Pest Management Course for Overseas Officers organised by the IPARC at Imperial College Field Station, Silwood Park, Ascot, Berks, SL5 7PY, UK (contact: Dr G.A.Matthews) and, if possible, subsequently visit the Pesicide Management Resource Centre in NRI, Chatham, ME$ $TB, UK.

INTRODUCTION

UNIDO assistance (through UNDP) in the area of pesticide formulation R & D originated with the establishment in 1980 of the Pesticide Development Project for India (PDPI - IND/080/037). The writer spent three months in India as UNIDO Consultant on Pesticide Application to this initial Project (from mid-October 1982 to mid-January 1983). At this time the Pesticide Development Centre (PDC) was still in the process of construction and the advisory work was somewhat premature and was conducted from an office located in the Hindustan Insecticides HQ in the Hans Bhavan, New Delhi (Johnstone, 1983).

A five-year extension, designated 'Strengthening of Pesticide Development Centre', was commissioned in 1989 (as DP/IND/89/128), and the writer was again recruited, in May 1991, as UNIDO Consultant on Pesticide Application Technology for this phase of the Project, but was not free to undertake the mission until early October '91.

The PDC has currently been re-named the Institute for Pesticide Formulation Technology and will hereafter be referred to by the appropriate acronym (IPFT).

IPFT (as PDC) has been in commission for some seven years and most of the laboratory aspects (Formulation Development, Analytical Development and Biosciences) have been operational for several years and are functioning well, as is also the Pilot Plant. The Analytical Development laboratories are particularly well equipped, with a wide range of modern and sophisticated analytical equipment. An important remaining aspect, which has yet to be fully commissioned, is the facility for Pesticide Application R & D.

In my job description (DP/IND/89/128/11-58), the purpose of the Project is defined as: 'The development of pesticide formulation capability in the country', and the duties of the Consultant have been set out as at Annex I:

In prior discussions with Dr B.Sugavanam, IO/CHEM, UNIDO/Vienna, it was agreed that these terms of reference might not be wholly appropriate, so that limited re-drafting to meet the current situation might be in order.

The duties have duly been re-drafted, as set out at Annex II.

The author arrived in New Delhi from Vienna on 9 October and reported to UNDP Office on that day. He commenced duties at IPFT on 10 October 1991. A diary of activities is set out at Annex III.

I. BACKGROUND

The immediate objectives of the IPFT, as set out in the 1990 Project Performance Evaluation Report, are:-

1."Augmentation of the capabilities of PDPI (known as PDC) to enable it to assist the pesticide industry sector of the country by developing indigenous technology for the generation pesticide formulations, including formulation of microbiol and botanical products, integrated with development of relevant modern application technology.

2. Development of training facilities, analytical services, consultancy and dissemination of state-of-the-art information in pesticide formulation technology, to the pesticide industry in India and in the Asian and Pacific region."

Initial priority has been accorded to the main themes of chemical analysis and formulation technology, allied to product development, in which application technology has to-date played only a minor part.

This begs the question: "Is there a real role for additional work on application technology? Is it enough just to: "provide the farm worker with a sprayer and let him get on with it", which appears to be the simple answer? All too often that seems to be what happens, and surely provides one good reason why the results of spraying (or dusting) can be inconsistent, or disappointing. Sharad Patel (1987) puts it another way. He says: "The traditional spraying methods are assumed to be <u>efficient</u> because they are sometimes <u>sufficient</u>". However, the fact that they may (at times) prove sufficient, tends to conceal an underlying and real inefficiency. With the wide spectrum of droplet size

emitted by the traditional hydraulic spray nozzle, a considerable proportion of the spray volume is wasted, both in drops at the large end of the spectrum, as well as in those at the small end, so that better control of drop size offers the prospect of real economies in terms of both material and effort. I'm not suggesting that we make the spray operator's task more complicated. I do realise that the performance of the average farm worker in the field may be limited by the tools he/she has at his/her disposal. Equipment may be badly maintained, or inappropriate for the job. I have been told (J.R.Sharma, ASPEE) that lack of understanding of what is required is perhaps less the result of illiteracy in the villages, but more due to inadequate application directions available with the packaged formulation. Attention has been drawn to this, together with a full range of farmer's problems in the use of pesticides, by Mathur (1987) and also by Srivastava and Patel (1990).

Nevertheless, we should be seeking ways to ensure a measure of quality control in the field, as part of an effective, low-cost, operational performance. Low-cost means low in terms of labourer's time and effort, as well as low in terms of equipment cost. Low-cost in terms of time almost certainly implies reducing the rates of volume application - something that needs to be anticipated and planned-for when developing formulations. The real cost of equipment must depend in part on the degree of utilisation achieved (Patel, 1982). For instance, if an item of application equipment is used for just an odd day or two, then set aside until the next season's need, that equipment will almost inevitably appear costly in any economic appraisal. On the other hand, if the equipment is maybe shared, and in continual use over an extended period, the cost per unit of production, however we measure that, is likely to be small. Maybe a custom spraying

service is the answer. Mathur (1987) suggests that young men should be trained to offer such a service under the self-employment programme.

I suggest that within the remit of application we should include the need for some work-study and costings, to examine the economics of appliance use and the benefit/cost ratio of using particular formulations. That is in addition to the more usual work on physical and mechanical aspects of application, aimed at recognition of parameters required for defining a recommended operational technique. It might be appropriate to term this aspect '<u>operational research</u>'.

II. <u>LINKS BETWEEN APPLICATION, FORMULATION AND PRODUCT DEVELOPMENT</u>

Application work must be intimately linked with formulation and product development. It is my view that the form and manner in which the product is to reach the pest, or site of action, requires very early consideration and ought not be relegated to the level of an afterthought - as sometimes appears to be the case. For some while the conventional route to developing a new insecticide (for instance) has appeared to begin with the deliberate synthesis of a related series of active molecules, followed by a narrowing selection, based on screening tests of their activity, made against a range of representative target pests available as laboratory cultures. Formulation of the chosen active agent has then proceeded along a fairly standard route, taking for granted that, if the material is to be applied as a spray, then the product would be applied in water, at medium to high volume, through the traditional knapsack sprayer.

This conservative approach has, I think, been determined in part by regulatory requirements. In a number of countries the registration authorities have required that the method of application be specified, and registration has usually been simpler (and cheaper) if the conventionally accepted mode (i.e, high-volume knapsack spraying) has been adopted.

This was the routine, and if this is still the case, then perhaps the whole concept needs to be challenged, because I see it as a possible bar to progress.

An alternative approach, which brings in application considerations, might be to commence by thinking about the target pest (and it's environment) and to endeavour to predict, by simple compution and modelling, the type of practical spray coverage would be likely to achieve the most economic result. This approach should set target parameters for application and also for the required characteristics of the formulation.

III. AREAS FOR DEPLOYMENT OF PESTICIDES APPLICATION R & D

The above, analytical approach, is perhaps the first area in which the contribution of application research and development might be explored. There are obvious constraints: equipment possessed by the growers may restrict choices; developments by equipment manufacturers may not coincide with the requirements of novel formulation. Nevertheless, the options should be explored, and where possible, formulations should be tailored to meet the specific need.

The second (and perhaps major) area for development lies in the laboratory: as a branch and adjunct of both formulation

and product development studies. The Institute has not, as yet, completed full provision of means to simulate field deposition onto the target (or substrates) in the laboratory, as advocated by two previous UNIDO consultants (Price, 1986; Geering, 1987). A facility has to be provided, in the laboratory, which will allow some spray simulation and measurement of toxic response, to confirm (or challenge) the selected application parameters, in relation to formulation.

The third area concerns facilities for field examination of the efficacy of products and formulations against target pests, using nominated equipment. This may not be so readily arranged. Provision for the evaluation of herbicide formulations can be made locally on site, and I understand from Dr Bhateshwar that this is already being done. This type of trials work should be widened to include optimisation of application parameters. Field evaluation of insecticide and fungicide formulations, may, with foresight, sometimes be possible on site, but may have to be conducted collaboratively with centres in areas where the pest problems are regularly p.esent, or possibly sub-contracted to other qualified bodies. This will need further consideration.

Supplementary work by the application-oriented scientists is required to identify the best available application equipment and it's ideal mode of use. Implementation of quality control tests on equipment (including the ergonomic and durability aspects) appears to lie within the aegis of the Central Institute for Agricultural Engineering at Bhopal, so may not fall within the remit of this Institute, although such information should be available at Gurgaon. However, defining the optimum mode of use of the equipment is certainly an appropriate area of work and is a necessary aid to packaging and label development. It is imperative that a label, or

leaflet (pictorial, if necessary), forms part of the product package and provides details of the recommended application rates, the appropriate spray characteristics and, most importantly, how these are to be achieved in practise. These aspects need to be examined and validated by practical tests.

IV. FACILITIES REQUIRED FOR WORK IN PESTICIDE APPLICATION R & D

So, what sort of facilities are needed to carry out the type of work I have outlined?

i) The operational research studies which I have indicated can be carried out with the aid of reference literature, plus appropriate calculation facilities - ideally the use of a desk, or lap-top computer, equipped with spread sheet, or BASIC programming facility.

ii) Laboratory testing of candidate formulations must be related to their planned ultimate use. A report entitled: 'Preparatory assistance for the establishment of biological testing facilities' by UNIDO Consultant C.E.Price (1986) drew attention to the need for specific items of application equipment, while the review of Entomology Section conducted by the UNIDO Consultant in Crop Protection and Public Health (Geering, 1987) also pointed to this need. Busvine (1971) has detailed a wide variety of laboratory techniques. Basic equipment includes, for example: micro-applicators for topical application, the Potter spray tower, the Kearns and Marsh knockdown chamber, plus a versatile spray cabinet containing an atomiser-conveyer, such as the purpose-built Mardrive unit, developed in UK. These items of equipment all require some space for installation (especially the Mardrive,

or an equivalent device), and the use of active insecticide formulations really dictates the need for a separate laboratory, sufficiently remote from the insect cultures presently maintained in the Biosciences laboratory, in order to avoid the possibility of toxic contamination. Facilities are currently minimal and it is necessary to enquire what provision can be made to ameliorate this?

(The Mardrive unit would provide an intermediate step of testing, between topical application and subsequent work in the field. It would be used directly, or in conjunction with pot-cultured plant material. It would require housing in a separate, appropriately-isolated room, devoted solely to application and formulation studies).

iii) Laboratory facilities will also be required for dealing with samples from field trials, using either physical methods for size analysis (e.g., hot-wire technique (Mahler & Magnus, 1984), or microscopic, or image-analysis techniques); physico-chemical assessments (colorimetric, fluorimetric, chromotographic); or biological evaluation; or any combination of these methods (Matthews, 1979). While certain analytical facilities may be present in the existing laboratories and, if made available, need not be duplicated, it is important that omissions should be rectified and basic equipment be provided. A list of important equipment is given at Annex V.

iv) Appropriate application equipment will be needed for carrying out specific field studies. Some basic equipment, such as: pressurised back-pack and lever-operated knapsack sprayers, are currently available, but these require regular, supervised overhaul, maintenance, and supplementing when superceded by new designs. State-of-the-art, portable, controlled-drop-applicators have recently been imported and

these need to be compared with indigenous equipment to see where improvements can be suggested. The need for other sprayers/dusters will relate to the type of contract work to be undertaken in the future, so that the range of equipment should be increased, but possibly progressively, as the needs of contract and other work dictate.

Meteorological instrumentation (windspeed, temperature and humidity) should be acquired in order to characterise relevant field test conditions.

V. PROPOSALS FOR THE INITIATION OF WORK ON APPLICATION TECHNOLOGY

Some work has been carried out with a new oil-flowable formulation of cuprous oxide produced in the Formulation Development laboratory (a preliminary examination to assess the suitability for ULV application, using portable rotary atomisers). Droplet sampling and measurement have been performed directly, using the Malvern size analyser and indirectly, by sampling in the field on magnesium oxide coated slides, coupled with measurement using a projection microscope. It is proposed that experience with these basic techniques be reinforced by a series of activities which will provide background information on the relative merits of imported and indigenous ULV/CDA sprayers and which may assist in their future development (see Annex VII). This work should also provide a lead into the manner of field test for any new formulation designed for ULV application.

The use of lever-operated knapsack sprayer with the Spray Management Valve (Fluid technology) for accurate pressure control should also be evaluated.

V. WORKSHOP ON SMALL SPRAYERS: STANDARD, SAFETY AND FUTURE DIRECTIONS

This workshop, sponsored by the ADB through a grant to the IRRI, Agricultural Engineering Division, was held at the American Spring & Pressing Works factory and at the ASPEE Research Institute in Bombay from November 18-20, and was attended by myself and Dr Y.P.Ramdev, by special invitation from the convenor. The objectives of the workshop were to:

1. Develop a set of draft minimum standards specifications for lever-operated knapsack (LOK) sprayers, applicable to Asian countries.
2. Establish the current status on aspects affecting small sprayers in Asia.
3. Develop training strategies for each of the various levels associated with small sprayers, i.e., manufacturers; agrochemical organisations; government agencies; farmers.
4. Establish the content and guidelines for an appropriate project proposal to ensure all workshop recommendations are implemented and maintained.

We were able to contribute to the working group discussions and to make participants aware of plans for work in application technology at IPFT and of IPFT's role in RENPAP.

The meeting also enabled Dr Ramdev and myself to establish personal contacts with BIS and CIAE staff, with a view to future collaboration and liaison.

Dr Ramdev was able to meet Shri Sharad Patel, Technical Director of ASPW and discuss possible assistance regarding provision of sprayers and test equipment.

A full programme and preliminary delegate list is shown at Annex IX.

VI. DISCUSSION AND CONCLUSIONS

In this general survey, I've attempted to provide some insight into how I see pesticide application technology fitting into the overall programme of IPFT, but progress in application technology is, of course, partly dependent upon parallel progess on the part of the manufacturers of application equipment. As in 1982, I have been privileged to visit the factory of the American Spring and Pressing Works (ASPEE) in Bombay and enjoyed a guided tour of the factory accompanied by the quality control Engineer, Mr Patai. ASPEE are India's foremost application equipment manufacturer, employing a staff of over 400 on a 9-acre site. The firm supplies about 90% of the Indian market, and conducts some export business, chiefly to east Africa. I was impressed by the level of quality control - at least four items in their range are certified to comply with the relevant requirements of the Indian Standards Institute, following rigorous individual testing. However, it did appear that the range of equipment on offer had not materially changed since my earlier visit in 1982, and that despite of the establishment, in 1983, of the ASPEE Research Institute at Ganeshpuri, with the aim of promoting knowledge in the disciplines of agricultural engineering in general and agricultural application in particular. I was told that business was booming and that current orders covered six months of factory production.

Does this mean that the present range is considered adequate for Indian needs and that there is no incentive for change? For instance, I have been surprised at the relatively slow take up of controlled-drop-application techniques and of ULV application techniques over this intervening nine-year period and one needs to seek the reason, in view of successful adoptions elsewhere. Is it because the only officially-

registered product is malathion ULV, and that only for aerial application, so that there is no suitable product, or product guidance? Or is it because the available equipment has not proved robust, or economic to operate? Farmers and equipment manufacturers all over the World have a tendency to be cautious and conservative and the introduction of any new technique could require a considerable collaborative effort on the part of appliance manufacturers, formulators and extension personnel, in addition to sympathetic support and approval of the regulatory authorities. These questions need to be addressed by IPFT and in due course examined in relation to IPFT's training function.

If high volume application using knapsack sprayers is to give way to more economic and effective low volume application - in both field and plantation crops - then there will be need for clear guidance on choice of appropriate spray nozzle/s and on technique of spraying, related to crop and target: something which will require critical evaluation.

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Annex I

INITIAL JOB DESCRIPTION

The expert will be required to advise and assist the scientists of the Pesticide Development Centre on:

i) To design and develop a laboratory facility for undertaking work on Pesticide Application Technology,

ii) Evaluation of various application techniques for pesticidal formulation applications,

iii) To design and develop suitable techniques for Indian agro-climatic conditions for efficient and effective pest control,

iv) To design and develop suitable instruments for pesticidal application,

v) To interact with the manufacturers of pesticide application equipments in India for improvements of existing equipments and development of newer application equipments. He will also submit a report after completion of his assignment.

Annex II

REVISED JOB DESCRIPTION

The expert will be required to advise and assist the scientists of the Institute of Pesticide Formulation Technology on:

i) How work on pesticide application technology may be organised and integrated with the current work on formulation development being conducted in the Formulation Development, the Analytical Development and the Biosciences laboratories,

ii) What additional laboratory space and facilities may be required in order to undertake work on the pesticide application related aspects,

iii) What additional equipment may be required in order to examine the application aspects involved in the testing of new formulation products, both in the laboratory and in the field,

iv) The development (or choice) of suitable field application techniques, also instrumentation for evaluating the efficacy of field application, by physical, or physico-chemical means.

The expert will also:

v) interact with manufacturers of pesticides equipment in India to assess current developments, encourage improvements to existing equipment, as well as the development of newer forms of application equipment,

vi) review requirements for pesticide application inputs to packaging (labelling, directions for use, etc) and training; for instance, evolution of appropriate guidelines for application aspects in the promotion of new formulation technology,

vii) communicate the nature of his work to staff at IPFT (and other organisations) via talks, or lectures, and

viii) submit a report on completion of his assignment.

Annex III

DIARY OF ACTIVITIES

Oct 7: Depart London Heathrow 1130 hrs for Vienna. Pre-mission briefing with Dr B.Sugavanam.

Oct 8: Further briefing with Industrial Operations Support Group.
Depart Vienna 1445 hrs for Frankfurt.
Departure Frankfurt (delayed) 1945 hrs

Oct 9: Arrived Delhi - Indira Gandhi Airport, 0800 hrs
Met by Dr Kawal Dhari, Director IPFT, and reported to UNDP for local briefing with Mr Sat Pal.

Oct 10-Dec 5: (a.m.) reported for work at IPFT, Udyog Vihar, Gurgaon. Time at IPFT was split between discussions and consultation, primarily with members of the Biosciences laboratory, the Formulations Development laboratory and with other consultants, and in preparing a report, recommendations and lectures. Practical guidance has accompanied the initiation of laboratory and field work.
4 days were spent attending a specialist workshop in Bombay.

Nov 12 Lecture on Application Aspects at IPFT.
The following visits were made:

Oct 23: To American Spring and Pressing Works Pvt. Ltd., Malad, Bombay, for discussions with Sharad L. Patel, Technical Director, and colleagues.

Oct 24-25: To CPPTI, Hyderabad, for discussions with Dr P.S. Chandurkar, Director, and Dr S.N.Pathak, Engineer.

Oct 31: To IARI, New Delhi, accompanying Dr A.Woodford, at invitation of Dr B.S.Parmar where we addressed a party of IARI students at Dr Parmar's request.

Nov 7 To DPPQS, Faridabad, accompanied by Dr Y.P. Ramdev, to address senior staff and discuss areas of mutual interest for IPFT and DPPQS.

Nov 17-20: To Bombay to attend Workshop on Small Sprayers: Safety and Future Directions, sponsored by Asian Development Bank through a grant to the International Rice Research Institute.

briefing at UNIDO HQ.

Nov 27:

Return flight, Delhi - London. (urgent repatriation on medical grounds)

Annex IV

PROVISION OF ACCOMMODATION FOR WORK IN PESTICIDES APPLICATION AND EVALUATION

Idealised plans for separate accommodation for culturing biological material (primarily insect rearing) and for separate pesticide testing and and application laboratories are included here primarily as a guide. If new building has to be deferred, or does not prove possible, then it may be necessary to adapt existing accomodation, or possibly loan, or lease spare accommodation in the HIL R & D block. The aim should be to isolate any laboratory test work using active chemicals from the insect rearing activities and at the same time make provision for adequate bench space for laboratory application studies to be conducted. (A spray cabinet, such as the Mardrive unit, could take up 4 x 2 m of floor space).

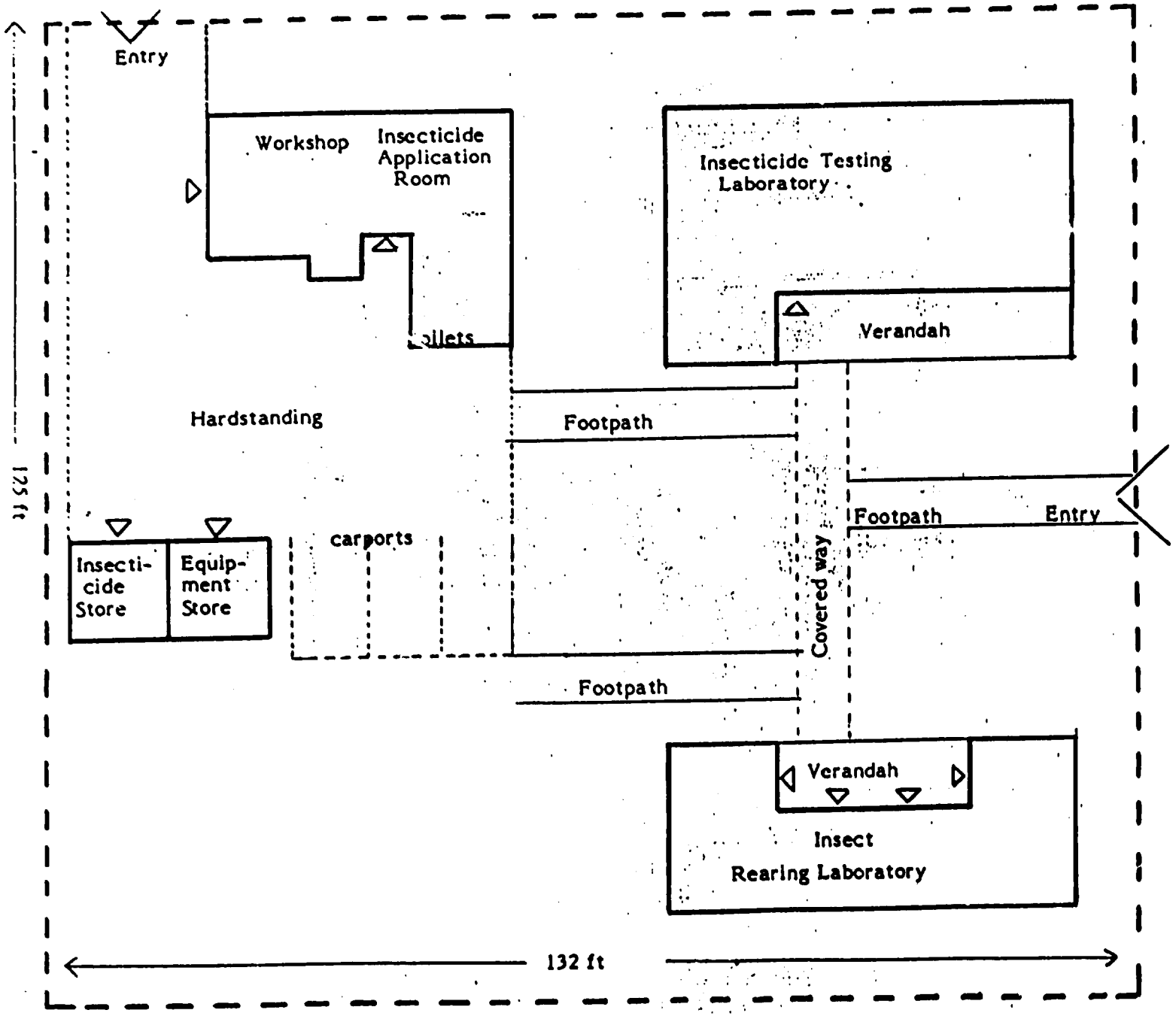
SKETCH PLANS

OF

PESTICIDE EVALUATION

AND

APPLICATION LABORATORY



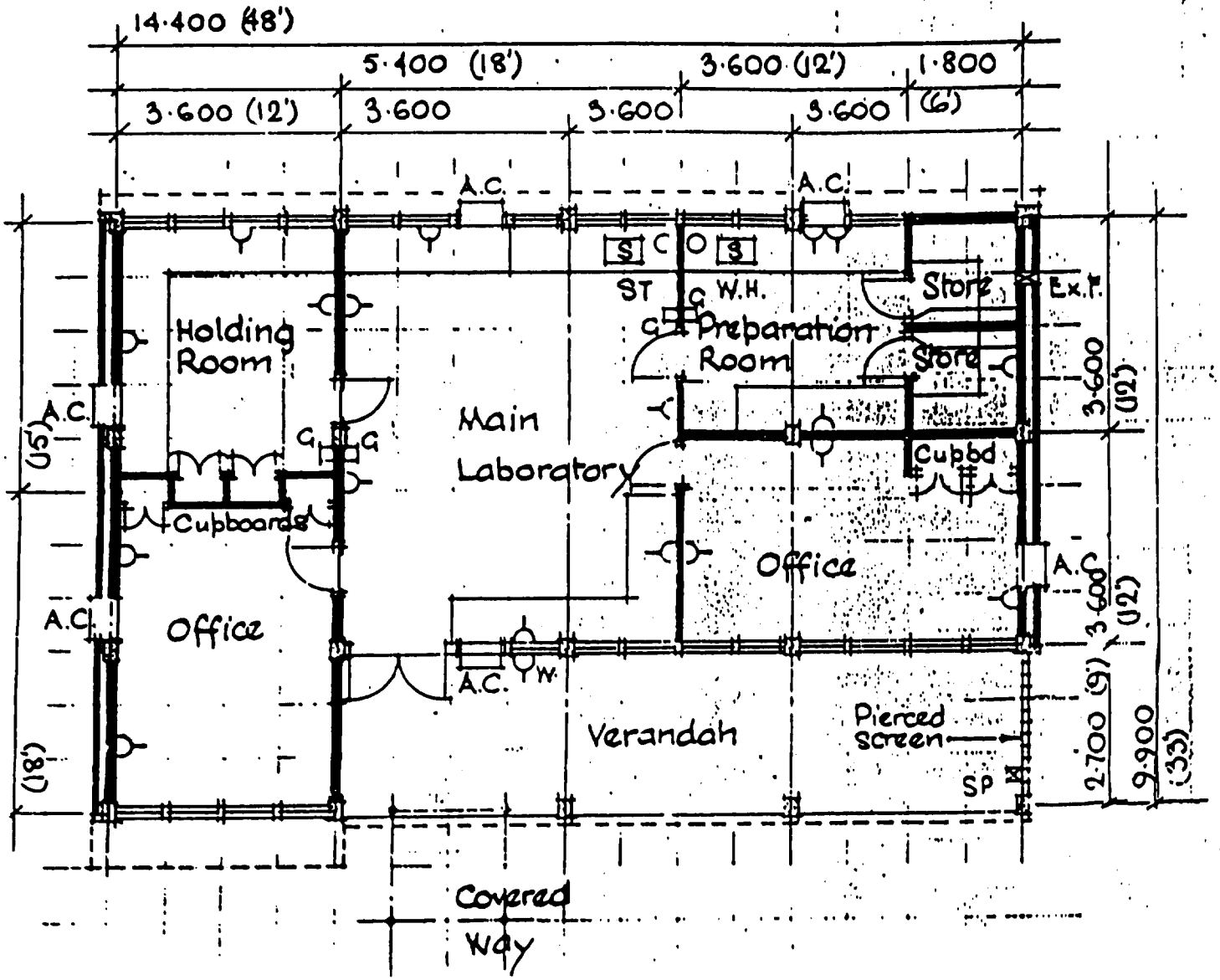
1. EXAMPLE OF

SITE LAYOUT

Area of Site: 0.378 ac (0.153 ha)

Scale : 1:200

2. INSECTICIDE TESTING LABORATORY



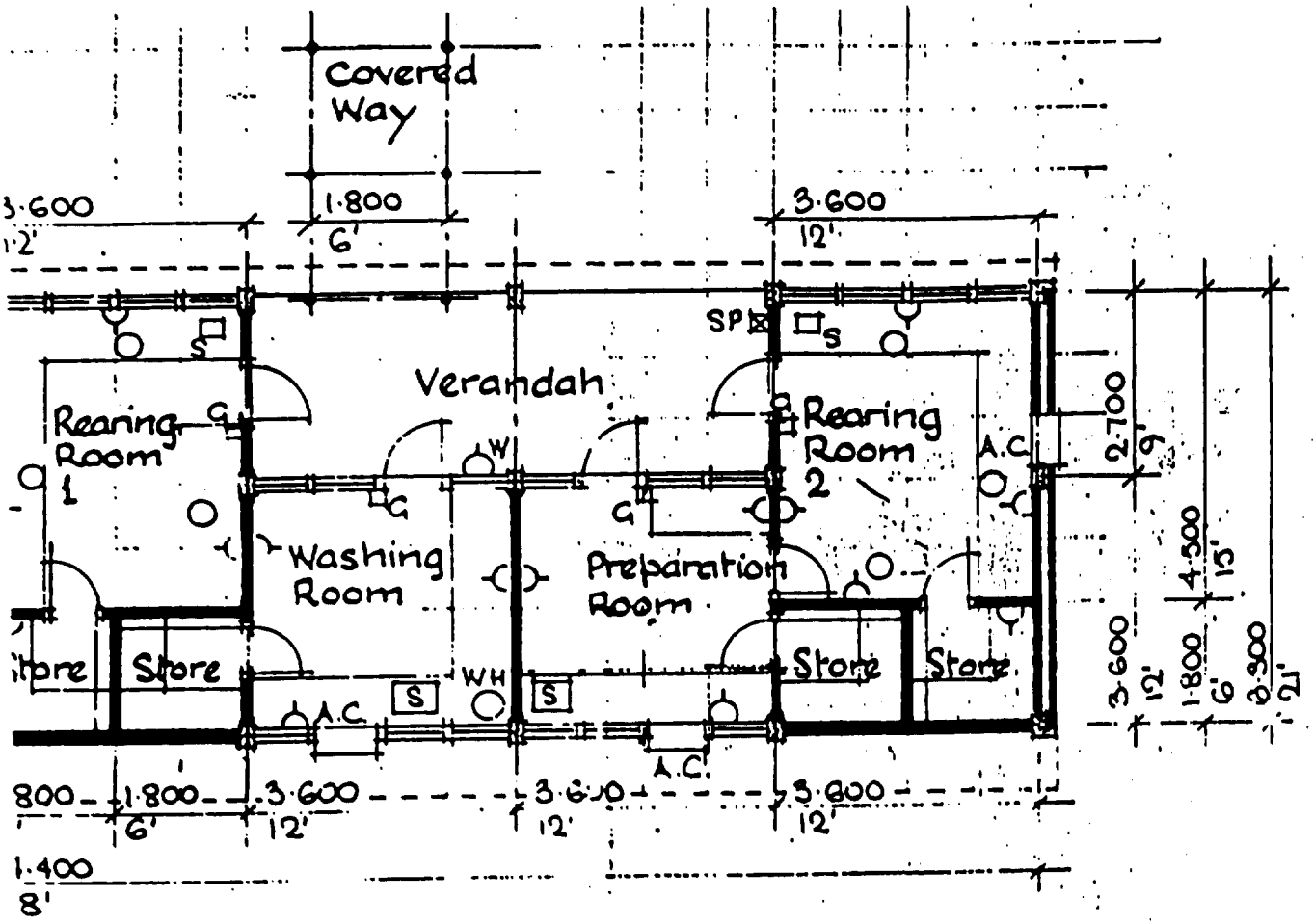
Notes:

AC Air conditioning Unit
Ex F Extract fan
S Sink
WH Waterheater, electric
ST Water still
G Wash-down gulley
W Weatherproof power point

Ceiling lights to holding room to be operated through a time switch with on/off

Scale 1 : 100

3. INSECT REARING LABORATORY



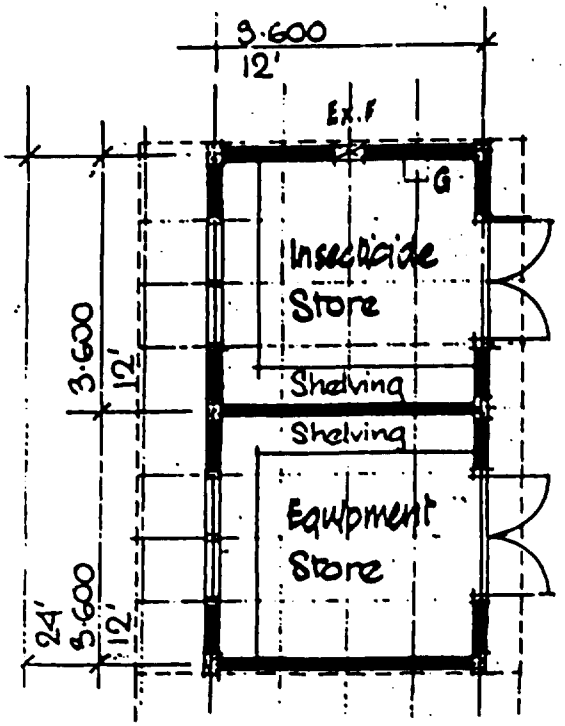
Notes:

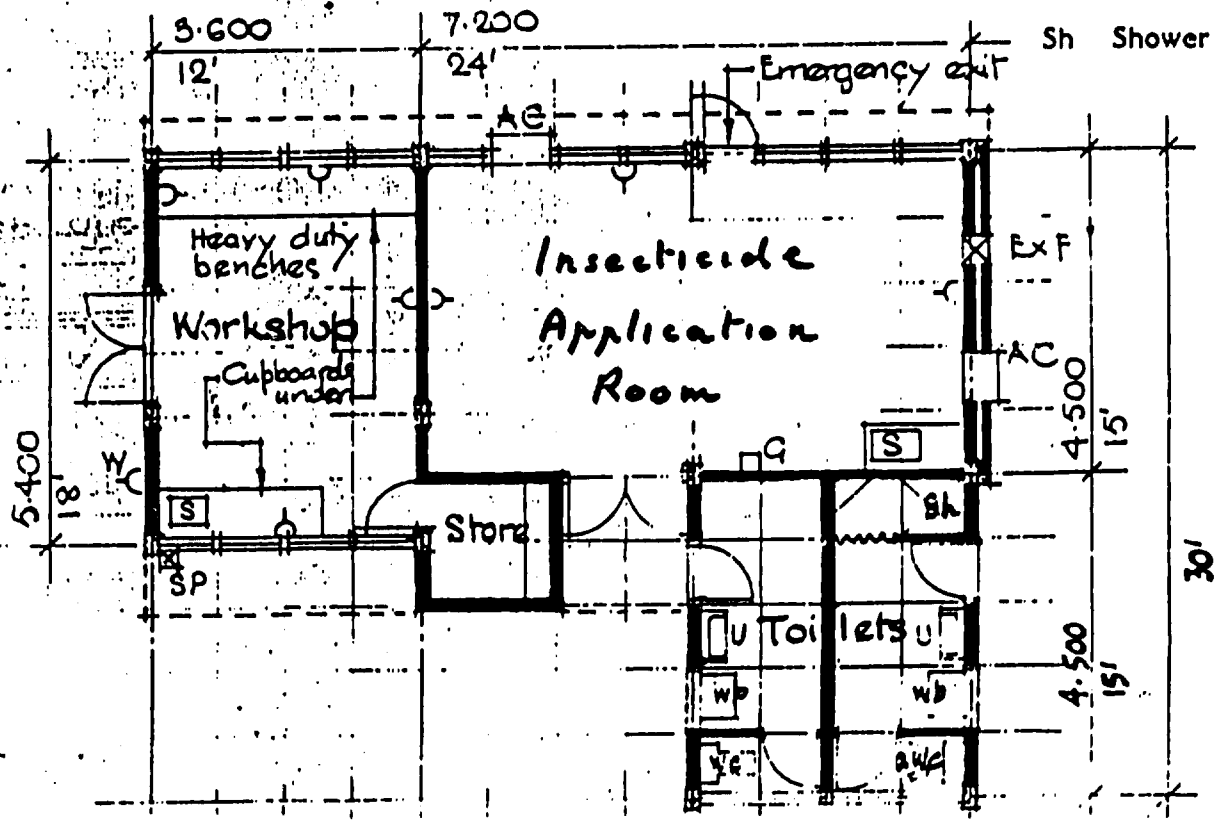
0 Spare ceiling light sockets in rearing rooms with switch outside room (required for UV sterilising lamps)

Ceiling lights in rearing rooms to be operated through time switch. with on/off

Scale 1 : 100

4. INSECTICIDE APPLICATION ROOM, WORKSHOP AND STORES





Notes:

WB Wash basin

WC Watercloset, on pedestal, one sq

U Urinal

Sh Shower

Scale 1

Annex V

PROVISION OF EQUIPMENT AND CONSUMABLES

A. Items > $US 5000

1. Quantimet image analysing computer - Cambridge Instruments Ltd., Cambridge, UK. $US 50000.

   or

   Optomax - AMS Analytical Measuring Systems, London Road, Pampisford, Cambridge, CB2 4FF, UK. Telephone: 0223 836001 Fax 0223 837 417; Telex: 817 824. $US 50000

2. Microscope, for use with above (Image analyser suppliers to specify and quote. $US 8000

3. Spray testing cabinet and conveyer: Laboratory, or portable (field model). Mardrive Engineering Co.Ltd.,Unit 15, Haigh Park, Haigh Avenue, Whitehill Industrial Estate, South Reddish, Stockport, SK4 1QR, UK. (Telephone: 061 480 2008/9 Fax: 061 474 7343; $US 125000 (lab), or 60000 (portable).

4. Model AIMS droplet measurement and analysis device KLD Labs. Inc., 300 Broadway, Huntington Sta., NY 11746, USA. Telephone: (516)549-9803, Fax: (516) 351-7190; $US 25000.

5. Fluorimeter. Hewlett Packard, UK or USA. $US 25000

Total >$US 5000 = ca. 170000

B. Items < $US 5000

1. Stroboscope, Model 432-001, Unilab Ltd, Science Park, Hutton Street, Blackburn, Lancs. BB1 3BT, UK. $US 300.

2. Variable DC Supply (Kenwood), 35V/10amp, Radio Spares No. 654-001. R.S.Components Ltd., P.O.Box 99, Corby, Northants NN17 9RS, UK. Telephone: 0536 201 201, Fax: 0536 201 501; Telex: 342 512. $US 1200.

3. Multimeter (Fluke 73), 0.4% accuracy, Radio Spares No. 204-224. R.S.Components Ltd., Address, etc., as above. $US 200.

4. Eyepiece graticule, i.e., Porton G12, Globe and circle with root two grid. To fit Olympus eyepiece, internal dia. 19mm. $US 60.

5. Stage micrometer, 0-1000 µm, in 10 and 100 µm divisions. $US 80.

6. Hand lens with measuring graticule. $US 50. (Items 4,5 and 6 from Graticules Ltd., Sovereign Way, Tonbridge, Kent TN9 1RN UK).

7. Microscope lamp, Cat. No. YSG-500-B, Fisons Scientific, Bishop Meadow Lane, Loughborough, Leics. LE11 0RG. $US 90.

8. Vibratak, high and low range devices. Micron Sprayers Ltd., Three Mills, Bromyard, Hereford, UK. $US25 each.

9. Colorimeter (spectrophotometer) 400-700nm + cuvettes Model Jenway 6050, Fisons Scientific (see above) $US 765.

10. Motorised microsyringe, Burkhard Ltd, Berkhamsted, UK $US 2000.

11. UV lamp. Blak Ray. Fisons Scientific (see above) $US 500.

12. Anemometer, Cat. No. EP 728, Eurisem, 40, High Street, Earl Shilton, Leics. LE9 7DG, UK $US 300.

13. Tachometer: Cat. No. EP611, Eurisem (see above) $US 290.

14. Fluorescent (and dye) tracers:
    UVITEX - Ciba Geigy Ind Chemicals, Tenax Road, Trafford Park, Manchester, M17 1WT, UK.
    TINOPAL - Ciba Geigy, Townsend Chemical Works, Bramley, Leeds, LS13 4ES, UK.
    Croceine Scarlet (now KENACID SCARLET 4R) - Hays Chemicals, Colur division, Union Mills, Oxford Road, West Yorkshire.

15. 'Flicker' - Uniform drop apparatus. Via Long Ashton Research Station. UK. Personnal enquiry. ca.$US 300.

16. Six rotary slide drop samplers. Via NRI, UK. Personal enquiry $US 300.

17. 1,2 and 3 bar spray management valves (to fit ASPEE Lance) Fluid Technology (Aust) Ltd., 17, Pearson Way, Osborne Park, Western Australia 6017. $US ca. 25.

Total < $US 5000 = ca. $US 6000

Annex VI

CATEGORISATION OF ACTIVITIES IN APPLICATION TECHNOLOGY OF RELEVANCE TO IPFT

1. DESK-BASED WORK

Operational research concerned with:

1.1 Modelling pathways of deposition, and the formulation requirements for specific tasks.

1.2 Work study to guide selection and to optimise efficacy of preferred method of application.

1.3 Cost/benefit analysis - will the recommended package be attractive?

1.4 Design of protocols for laboratory and field tests of formulations with respect to application

1.5 Statistical analysis and reporting of data from laboratory and field experimental work

2. LAB-RELATED WORK

2.1 Provision and use of equipment to evaluate bio-efficacy of formulations in relation to choice of application parameters (e.g., use of Potter spray tower, Mardrive unit, Kearns & Marsh knockdown chamber, etc.)

2.2 Provision and use of equipment to characterise and evaluate samples from field experiments (drop size analysis, physico-chemical, e.g., colorimetric/fluorimetric analysis, etc.)

continued over

3. FIELD-RELATED WORK	3.1 Provision of up-to-date equipment for field test of formulations
	3.2 Calibration, maintenance and use of equipment for field trials of formulations
	3.3 Provision of materials and techniques for sampling - to characterise and assess the quality of field applications
4. MARKETING/TRAINING RELATED WORK	4.1 Provision of guidance on appropriate application parameters to include in label and other marketing literature
	4.2 Inputs to training courses on application aspects of the use of various types of formulation

Annex VII

PROPOSALS FOR THE INITIATION OF WORK ON APPLICATION TECHNOLOGY

1. Provision of information on ULV/CDA sprayers

1.1. Evaluation of the performance characteristics of imported ULV/CDA sprayers in comparison with equivalent sprayers available from indigenous manufacturers.
Objective: To assess whether there is scope for improvement in design, material construction and performance of locally-manufactured sprayers and, if so, to provide documentary evidence of the nature of such improvements, in order to encourage local manufacturers to upgrade equipment on offer.
Action: Physical tests: current/voltage/rotation speed relationships versus flow rate, for comparable machines. Durability: in particular, whether plastic components distort on prolonged exposure to heat and sunlight. Drop size distibutions at standard voltage and flow rates.

1.2. Examination of effect of change of viscosity (and temperature) on flow rate through portable ULV sprayers.
Objective: Calibration of sprayers and to provide reference information for future use.
Action: Formulation Development laboratory to provide suitable range of blank aqueous, or oil formulations of graded viscosity, to facilitate such calibrations.

1.3. Examination of application technique (i.e. manner of sprayer deployment) on swath distribution.
Objective: To determine operational bandwidth and gain familiarity with the sprayer, it's mode of operation, and field performance.
Action: Replicated field tests, physically, or physico-chemically assessed, using artificial and/or natural targets, but preferably carried out in a standing field crop

2. Provision of information on spray management valves

2. Evaluation of 1, 2 and 3 bar spray management valves fitted to ASPEE lance and used with lever-operated knapsack sprayer.

Objective: To verify improved quality control in terms of flow and consistency of droplet spectrum.
Action: Flow tests and field sampling for drop measurement, with and without fitted valve.

Annex VIII

A SELECTION OF OVERSEAS ORGANISATIONS ACTIVE AND/OR PUBLISHING IN THE AREA OF APPLICATION TECHNOLOGY

1. BCPC Publication Sales, Bear Farm, Binfield, Bracknell, Berkshire RG12 5QE UK

2. EPPO, 1, Rue le Notre, Paris 7e, France

3. FAO, Via del Terme di Caracalla, Rome, Italy

4. ODA/NRI, Central Avenue, Chatham Maritime, Kent ME4 4TB, UK

5. WHO, 1211, Geneva 27, Switzerland

6. Laboratory for Pest Control Application Technology, Ohio State University, Wooster, OH 44691, USA

Annex IX

PROGRAMME OF WORKSHOP ON: SMALL SPRAYERS: STANDARDS, SAFETY AND FUTURE DIRECTIONS; HELD IN BOMBAY ON NOVEMBER 18-20

Sponsored by : The Asian Development Bank through a grant to the International Rice Research Institute, Agricultural Engineering Division

Venue/ Hosts : ASPEE Research Institute
Bombay, INDIA

Coordinators : G. R. Quick, J. J. Hastings and N. K. Awadhwal

PROGRAM

November 17
Sunday — Participants arrive and settle in Bombay. Accomodation both at ASPEE Works Guest House, Malad, Bombay and Local hotels as per prior arrangements

November 18
Monday

0830 — Registration, Local Arrangements. Ticket confirmations

0900 — Official Opening
Welcome to Bombay
on behalf of the Gov't. of India
Dr. T. P. Ojha, DDG, Indian Council Agricultural Research

0910 : Welcome to ASPEE
By the founder of ASPEE
Shri L. M. Patel
Managing Director, ASPEE

0920 : Outline of workshop objectives - Convenor

PART A - " STATE OF THE ART"

0930 : Keynote Address
"Small sprayer development, Standards and Safety" Part 1
Dr. G. A. Matthews, IPARC, England

1030 : Morning refreshments

1045 : Chairperson: Dr. T. P., Ojha
"The small sprayer market in Asia - future Trends"
Shri Sharad L. Patel
Technical Director,
ASPEE

1105	:	Ergonomics aspects of lever-operated "knapsack sprayer Mr. L. P. Gite, CIAE, Bhopal
1135	:	"Environmental & Operator Health Aspects of Pesticide application" Dr. Rashmi Mayur
1205	:	Discussion on morning session - chaired by Dr. Ojha
1315	:	Tour of ASPEE factory
1415	:	Afternoon session to be chaired by Shri Sharad L. Patel "Containers for pesticides: Handling, distribution, recycling" - Industry representative Dr. J. C. Majumdar
1500	:	Country Reports (10 min. + 5 min. questions). "The current state of small sprayer standards, safety and future directions". Each Asian nation will discuss their own situation.
1630	:	"IRRI" draft proposal for a set of minimum standards specifications for LOK sprayers in Asia" Dr. N. K. Awadhwal Mr. J. J. Hastings
1700	:	Dissemination of draft proposal Free Time
1900	:	Official Dinner Dinner Speakers: 1) Farmers Organization Representative 2) Ray Wijewardene's "Why Spray?" graphic presentation

November 19
Tuesday

0715	:	On board buses to travel to ASPEE RESEARCH INSTITUTE (50 kms. from Bombay)
0900	:	Assemble for working breakfast at institute
0945	:	"Small Sprayer Development, Standards and Safety" Part 2 Mr. E. W. Thornhill, IPARC, England

PART B - Development of Minimum Standards Specifications

1015 : Divide into 4 working groups, each with a chairperson and rapporteur.
Group 1 - Assignment: "Improving safety aspects of pesticide application equipment".
Group 2 - Assignment: "Improving quality aspects of pesticide application equipment".
Group 3 - Assignment: "Improving efficiency of operation and ergonomics of pesticide application equipment".
Group 4 - Assignment: "Improving inter-manufacturers compatibility of componentry"

1330 : Tour of ASPEE RESEARCH INSTITUTE facilities with working equipment demonstrations

1430 : Wrap up session for working groups
Rapporteurs to prepare summaries

1500 : Summary presentations by each of the chairpersons of the working groups

1545 : Mount buses to proceed to ASHRAM
Visit to Gurudev Siddhapeeth ashram

1700 : Buses return to Bombay
Evening free time

November 20
Wednesday

0830 : Convenors summary of presentations in the form of a set of draft recommendations from the workshop: Convenor, with Dr. G. A. Matthews.
To include discussion from the floor

PART C - FUTURE ACTION : Training & Implementation

0930 : "Assertive training strategies for organizations and small sprayer users" A panel session by:
Mr. Evan Thornhill, IPARC, England
Mr. Jeff Hastings, IRRI, Philippines
Dr. Graham Matthews, IPARC, England
Brief statements by panelists followed by parry and thrust from the floor

1030 : Brainstorming Session "The need and subject matter for a project proposal as an output from this workshop"
Chaired by Convenor

1115 : Divide into 4 working groups, each with a chairperson and rapporteur

Group 1 - Assignment: "Improving training strategies for organizations, manufacturers and farmers"
Group 2 - Assignment: "Development of a training network throughout Asia to allow rapid training of target group"
Group 3 - Assignment: "Implementation of minimum standard specification for LOK sprayers throughout Asia"
Group 4 - Assignment: "Ensuring continuity of the program and future checks"

1330 : Resume working groups

1430 : Summary presentations by group chairperson
Panel session with each group chairperson plus convenor
Develop recommendations

1530 : Discussion of a draft project proposal for consideration by a donor agency
Chaired by convenor.

1600 : Tour of C C Shraff Research Institute

1700 : End of formal program

BOMBAY WORKSHOP

CONFIRMED PARTICIPANTS

CHINA	MR. YANG XUEJUN	- CAAMS
INDONESIA	DR. EKO ANANTO	- SURIF
THAILAND	MR. S. SATIROPAS	- Dep't of Agric., Bangkok
	G. P. GUPTA	- A. I. T.
MALAYSIA	MR. JUSOH	- MARDI
	DR. DZOLKHIFLI OMAR	- UNIV. PERTANIAN MALAYSIA
SRI LANKA	FACTORY MANAGER	- AGRO TECHNICA
	RAY WIJEWARDENE	
	MR. J. M. N. F. SENEVIRATNE	- A. BAUR & CO.
	MR. G.G. WIJITHA KUMARA	- A. BAUR & CO.
INDIA	NSL SRIVASTAVA	- CIAE
	MR. GITE	- CIAE
	DR. T. P. OJHA	- ICAR
	SHRI L. M. PATEL	- ASPEE
	SHRI SHARAD PATEL	- ASPEE
	DR. RASHMI MAYUR	
	DR. J. C. MAJUMDAR	- INDUSTRY
U. K.	DR. G. MATTHEWS	- IPARC
	MR. EVAN THORNHILL	- IPARC
	MR. DONALD JOHNSTONE	
PHILIPPINES	DR. ARSENIO RESURRECCION	- U.P.L.B.

Annex X

NOTES FOR LECTURES GIVEN AT IARI ON 31 OCTOBER, AT DPPQS ON 7 NOVEMBER AND IPFT ON 12 NOVEMBER 1991

Application aspects of pesticides formulation R & D

D R Johnstone

(Basis of talks delivered to staff at IARI, New Delhi, on 31 October; and to DPPQS, Faridabad, on Thursday, 7 November 1991)

1. Introduction

When a farmer is considering the application of pesticide for the purpose of pest control there are five key questions he needs to answer, namely:-

1. WHY?
2. WHERE?
3. WHEN?
4. WHAT?
5. HOW?

1.1 WHY? Why am I using a chemical pesticide? Is there any alternative? Will it prove economic, i.e., will the benefits outweigh the costs?

1.2 WHERE? Where is the application required? Is it directly onto the pest, i.e., for effect via direct contact mode of action, or onto foliar substrate for indirect action?

e.g., for insecticides: residual pick-up, or stomach action;

e.g., for fungicides: importance of redistribution.

1.3 WHEN? When is the optimum time for application? Timing can be critical. Must ideally choose the stage in the life cycle when the pest is most accessible, or most vulnerable.

1.4 WHAT? What is the most appropriate active material - and in what form? E.g., high activity and/or selectivity; low mammalian toxicity; solution or suspension; in water or in oil; spray, dust, or granules?

1.5 HOW? How is the formulation best applied? In economic terms? By aeroplane; or by tractor gear; power sprayer; mistblower; foot sprayer; rocking sprayer; hand compression sprayer; knapsack sprayer; or by duster?

These same questions ideally need to be addressed by the formulator, both before and during the product development stage in investigating a new active agent and developing a formulation, in order that guidelines can be established (and validated) to satisfy labelling and packaging requirements.

Some of these questions imply biological investigation; some chemical investigation; but ultimately the answers involve a combination of biology, chemistry, physics and engineering: a multidisciplinary synthesis - which is rightfully the province of the application technologist.

I want to explore with you the role I visualize for an application specialist in an organisation such as the Institute for Pesticide Formulation Technology (IPFT), which has as it's principal objective the development of new pesticide formulations (and the improvement of existing formulations) for local production and use.

In the evolution and evaluation of pest control recommendations, if that is indeed one of the tasks of this organisation, then maybe the activities of the Directorate of Plant Protection, Quarantine and Storage (DPPQS) - in the plant protection field - could also benefit from the support of an application 'guru'? (Maybe 'generalist' is a more appropriate description than 'specialist', for whoever serves in this role must preserve a broad interdisciplinary outlook).

2. Background

It's perhaps all too easy to take the view that application is commonplace: 'give the farm worker a sprayer and let him get on with it' appears to be the simple answer. All too often that's just what happens, and surely provides one good reason why the results of spraying (or dusting) can be inconsistent, or disappointing. Sharad Patel (1987) puts it another way. He says: "The traditional spraying methods are assumed to be <u>efficient</u> because they are sometimes <u>sufficient</u>". However, the fact that they may (at times) prove sufficient, tends to conceal the real inefficiency. With the wide spectrum of drop size emitted by the traditional hydraulic spray nozzle, a considerable proportion of the volume is wasted in drops at the large end of the spectrum, as well as in those at the small end, so that better control of drop size is needed. Don't get me wrong - I'm not advocating that we make the spray operator's task overcomplicated. I do realise that the performance of the average farm worker in the field may be limited by the tools he/she has at his/her disposal. Equipment may be badly maintained, or inappropriate for the job. I think lack of understanding of what is required is perhaps less the result of illiteracy, but more due to inadequate application directions available with the

packaged formulation. Some of the farmers problems have been indicated by Mathur (1987) and by Srivastava and Patel (1990).

Nevertheless, we should be seeking ways to ensure a measure of quality control in the field, as part of an effective, low-cost, operational performance. Low-cost means low in terms of labourer's time as well as low in terms of equipment cost. Low-cost in terms of time almost certainly implies reducing the rates of volume application - something that needs to be anticipated and planned for when developing formulations. The real cost of equipment must depend in part on the degree of utilisation achieved (Patel, 1982). For instance, if an item of application equipment is used for just an odd day or two, then set aside until the next season's need, that equipment will almost inevitably appear costly in any economic appraisal. On the other hand, if the equipment is maybe shared, and in continual use over an extended period, the cost per unit of production, however we measure that, is likely to be small. Maybe a custom spraying service is the answer. Mathur (1987) suggests that young men should be trained to offer such a service under the self-employment programme.

I suggest that, within the remit of application, we should include the need for some work-study and costings, to examine the economics of sprayer use, and the benefit/cost ratio of particular formulations. That is in addition to the more usual work on physical and mechanical aspects of spraying, aimed at recognition of parameters required for defining a recommended operational technique. It might be appropriate to term this aspect 'operational research.

3. Links beteen application, formulation and product development

Application work must be intimately linked with formulation and product development. It is my view that the form and manner in which the product is to reach the pest, or site of action, requires very early consideration and ought not be relegated to the level of an afterthought. - as sometimes appears to be the case. For some while the conventional route to developing a new insecticide (for instance) has appeared to start with the deliberate synthesis of a related series of active molecules, followed by a narrowing selection, based on screening tests of their activity, made against a range of characteristic target pests available as laboratory cultures. Formulation of the chosen active agent has then proceeded along a fairly standard route, taking for granted that, if the material is to be applied as a spray, then the product would be applied in water, at medium to high volume, through the traditional knapsack sprayer.

This conservatism in approach has, I think, been determined in part by regulatory requirements. In a number of countries the registration authorities have required the method of application to be specified, and registration has usually been simpler (and cheaper) if the conventionally accepted mode has been adopted.

This was the routine, and if this is still the case, then perhaps the whole approach needs to he challenged, because I see it as a possible bar to progress.

An alternative approach, which brings in application considerations, might be to commence by thinking about the target pest (and it's environment) and to endeavour to predict, by simple compution and modelling, the type of practical spray coverage would be likely to achieve the most economic result. This approach should set target parameters for application and also for the required characteristics of the formulation.

4. Areas for development of pesticide application R & D

The above, analytical approach, is perhaps the first area in which the contribution of application research and development might be explored. There are obvious constraints. Equipment availability on the part of growers may restrict choices, but at least the options should be explored, and where possible, formulations tailored to match the need.

The second (and perhaps major) area for development lies in the laboratory: as a branch and adjunct of both formulation and product development studies. The Institute has not, as yet, completed full provision of means to simulate field deposition onto the target (or substrates) in the laboratory, as advocated by the two previous UNIDO consultants (Price, 1986; Geering, 1987). A facility has to be provided, in the laboratory, which will allow some spray simulation and measurement of toxic effects, to confirm (or challenge) the selected application parameters.

The third area concerns facilities for field examination of the efficacy of products and formulations against target pests, using nominated equipment. This may not be so readily arranged. Provision for the evaluation of herbicide formulations can be made locally on site, and I understand from Dr Bhateshwar that this is already being done. If necessary, this type of trials work could be widened to include application aspects. Field evaluation of insecticide and fungicide formulations, may sometimes be possible on site, but may have to be conducted collaboratively with centres in areas where the pest problems are regularly present, or possibly sub-contracted to other qualified bodies. This will need further consideration.

Supplementary work by application-oriented scientists may be needed to identify the best available application equipment and it's ideal mode of use. Implementation of quality control tests on equipment (including the ergonomic and durability aspects) appears to lie within the remit of the Central Plant Protection Training Institute at Hyderabad, so may not fall within the remit of IPFT, although such information should be available on site. However, defining the optimum mode of use of the equipment is certainly an appropriate area of work and is a necessary aid to packaging and label development. It is imperative that a label, or leaflet (pictorial, if necessary), forms part of the product package and provides details of the recommended application rates, the appropriate spray characteristics and, most importantly, how these are to be achieved in practise. These aspects need to be examined and validated by practical tests.

5. Facilities require for work in pesticide application R & D

So, what sort of facilities are needed to carry out the type of work I have outlined?

i) The operational research studies I have indicated can be carried out with the aid of reference literature, plus appropriate calculation facilities - ideally the use of a desk computer, with spread sheet, or BASIC programming facility.

ii) Laboratory testing of candidate formulations must be related to their planned ultimate use. A report on 'Preparatory assistance for the establishment of biological testing facilities' by UNIDO Consultant C.E.Price (1986) drew attention to the need for specific items of application equipment, while the review of Entomology Section conducted by the UNIDO Consultant in Crop Protection and Public Health (Geering, 1987) also pointed to this need. Busvine (1971) has detailed a wide variety of laboratory techniques. Basic equipment includes, for example: micro-applicators for topical application, the Potter spray tower, the Kearns and Marsh knockdown chamber, plus a versatile spray cabinet containing an atomiser-conveyer, such as the Mardrive unit, developed in UK. These items of equipment all require some space for installation (especially the Mardrive, or an equivalent device), while the use of active insecticide formulations almost cerainly dictates the need for a separate laboratory, sufficiently remote from the insect cultures presently maintained in the Biosciences laboratory, in order to avoid the possibility of toxic contamination. Facilities are currently minimal and it is necessary to enquire what provision can be made to ameliorate this?

(The Mardrive unit would provide an intermediate step of testing, between topical application and work in the field, to be used directly, or in conjunction with pot-cultured plant

material. It would require to be housed in a separate room, devoted solely to application and formulation studies).

iii) Laboratory facilities will also required for dealing with samples from field trials, using either physical methods for size analysis (e.g., hot wire technique (Mahler & Magnus, 1984), or microscopic or image-analysis techniques); physico-chemical assessments (colorimetric, fluorimetric, chromotographic); or biological evaluation; or any combination of these methods (Matthews, 1979). Some, but not all, of these facilities may already available in the currently existing laboratories and if so, need not be duplicated, but important omissions should be rectified. For instance, there is need now for a monodisperse drop generator, both for calibration and experimental work.

iv) Appropriate application equipment will be needed for carrying out specific field studies. Some basic equipment, such as: pressurised back-pack and lever-operated knapsack sprayers are currently available, but these require regular, supervised overhaul, maintenance, and supplement when superceded by new designs. Portable, controlled drop applicators have recently been acquired. The need for other sprayers/dusters will relate to the type of contract work to be undertaken in the future, so that the range of equipment should be supplemented, but possibly progressively, as the needs of contract and other work dictate.

Meteorological instrumentation (windspeed, temperature and humidity) may be needed to characterise relevant test conditions.

6. Conclusion

I've attempted, in this general survey, to provide you with some insight into how I see pesticide application technology fitting into the overall programme of IPFT. Any feedback from yourselves, relating to what I have suggested, would naturally be welcome.

References

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CLASSIFICATION OF SPRAYING TECHNIQUES

TABLE 1.
(ON THE BASIS OF SPRAY VOLUME USED)

CLASSIFICATION	RANGE OF APPLIED VOLUME (LITRES/HA)
HIGH VOLUME	> 600
MEDIUM VOLUME	> 200 - 600
LOW VOLUME	> 50 - 200
VERY LOW VOLUME	> 5 - 50
ULTRA-LOW VOLUME	< 5

TABLE 2.
(ON THE BASIS OF DROP SIZE)

CLASSIFICATION	VOLUME MEDIAN DIAMETER (µm)
COARSE SPRAY	> 400
MEDIUM SPRAY	> 200 - 400
FINE SPRAY	> 100 - 200
MIST	> 50 - 100
AEROSOL	< 50

PESTICIDE APPLICATION TECHNOLOGY
REVIEW/SURVEY OF ACTIVITIES

1. DESK-BASED WORK

Operational research concerned with:

1.1 Modelling pathways of deposition, and the formulation requirements for specific tasks.

1.2 Work study to guide selection and to optimise efficacy of preferred method of application.

1.3 Cost/benefit analysis - will the recommended package be attractive?

1.4 Design of protocols for laboratory and field tests of formulations with respect to application

1.5 Statistical analysis and reporting of data from laboratory and field experimental work

2. LAB-RELATED WORK

2.1 Provision and use of equipment to evaluate bio-efficacy of formulations in relation to choice of application parameters (e.g., use of Potter spray tower, Mardrive unit, Kearns & Marsh knockdown chamber, etc.)

2.2 Provision and use of equipment to characterise and evaluate samples from field experiments (drop size analysis, physico-chemical, e.g., colorimetric/fluorimetric analysis, etc.)

3. FIELD-RELATED WORK

3.1 Provision of up-to date equipment for field test of formulations

3.2 Calibration, maintenance and use of equipment for field trials of formulations

3.3 Provision of materials and techniques for sampling - to characterise and assess the quality of field applications

4. MARKETING/TRAINING RELATED WORK

4.1 Provision of guidance on appropriate application parameters to include in label and other marketing literature

4.2 Inputs to training courses on application aspects of the use of various types of formulation

Annex XI

Strengthening of Pesticide Development Centre
DP/IND/89/128

UNIDO COMMENTS

The report gives an in-depth assessment of the 'pros' and 'cons' of having an application technology unit attached to IFTC. The report elaborates the actual problems experienced by the farmers or applicators in the field to use both traditional sprayers and any modern application techniques. The report also indicates that the facilities are not adequate in IFTC for application technology and recommends collaboration work with other institutions especially for testing fungicides and insecticides.

While recommending additional equipment and space for starting application technology work, the experts recommend to pursue the work that has been carried out with new oil-flowable formulation of cuprous oxide for ULV/CDA applications.

The author along with his counterpart attended a workshop on small sprayers organized by the American Spring and Pressing Works (ASPEE), Bombay which is a well known for its work on application technology. Linking IFTC with the Bombay Institute would avoid duplication and also would provide an ideal opportunity for collaborative work making use of the facilities at ASPEE. This way IFTC can set up a small laboratory with basic facilities and link their work with ASPEE, Bombay for further development.