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16477

DP/ID/SER.A/889
20 August 1987
ENGLISH

PESTICIDE DEVELOPMENT PROGRAMME INDIA

DP/IND/80/037

INDIA

Technical report: Strengthening of Entomology Section*

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 Quinton A. Geering,
Consultant in Entomology with specialization in insect
breeding and bio-assay of insecticides

Backstopping officer: B. Sugavanam, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

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Introduction

The writer was recruited by UNIDO for three months to assist in the development of pesticide formulation capabilities in India. The duties were set out in job Description No.DP/IND/80/037/11-02-B, as follows:

"The expert is expected to advise and assist scientists of PDPI in collaboration with the National Project Manager and is expected to suggest:

- a consolidated plan to improve existing facilities to breed insects of importance in the country for testing formulations for agriculture and public health outlets.
- additional equipment, with specifications if necessary, needed to carry out efficient, reliable and reproducible screening experiments on formulations developed in research laboratories.
- methodology for interpretation of results and proper documentation for logical comparison of results with standards.

The expert will also participate in Seminars, training programmes organised by the Project authorities. He is also expected to travel if necessary to other institutions in the country where collaborative work is carried out and recommend suitable research projects.

The expert will have to submit a report on his findings, work carried out, and recommendations".

After briefing in Vienna, the writer left for New Delhi, arriving there on 17' December 1986. He left New Delhi on 12' March 1987.

This report should be read in conjunction with DP/ID/SER, A/737, 9' December 1986, entitled "Technical Report: Preparatory assistance for the establishment of Biological testing facilities". Based on the work of Clive E. Price, Expert in biological evaluation of pesticide formulation.

8. Documentation should, henceforth, include preparation of a Technical Information Document for each experimental product sent out for evaluation by collaborators. Purchase is recommended of the essential books and subscription to key journals listed in the appendices.

9. Provision of a desk-top computer for processing of experimental data is recommended.

10. Plan and implement a programme of visits to the main ICAR Centres in India.

11. Consider the suggested list of research projects relevant to the current programme.

CHAPTER 1

Present facilities and activities of the Entomology Section which includes the Residue Laboratory.

1.1 Staffing level and expertise:

The staff consists of two PhD's, one of whom is head of section, and two MSc. graduates. One laboratory assistant is employed, and one farm assistant is also employed. One separate office is provided for the Head of Section.

1.2 Laboratories:

There is one separate laboratory for residues studies, and a group of laboratories for bioassay.

The bioassay laboratories are comprised of 4 rooms; lay-out is shown in the accompanying plan. One room is set up as a treatment (spraying) laboratory; one provides space for insect breeding; and two rooms which also provide desk-space for two people, are used as post-treatment rooms. There is one small store-room. All four laboratories are provided with wide ceramic finished benches - as also is the one office. All have a sink with cold water supply, power points, and lighting. The rooms are high 4.0m., and have windows and ceiling fans. Two rooms have a desert cooler for the hot season and a third room has an air-conditioner.

The room used for culturing mosquitoes and house-flies is heated during the winter with single-bar 1.5 kw electric fires. Stored products insects are cultured in jars in 2 incubators. Facilities for breeding insects are thus minimal, and for plant-feeding species non-existant.

Equipment for laboratory application of insecticides i.e. a Potter Tower, and a dusting apparatus are old and defunct. There is no laboratory sprayer for treating plants. There is a new Tracor—Atlas Inc. micro-applicator.

1.3 Glass-house/Green-house facilities:

There is one glass-house measuring 22' x 9' x 15' high. The superstructure is wood plus glass. There are concrete benches. The temperature in winter is close to ambient (due to open permanent ventilation) i.e. down to 6°C. In summer the temperature is reduced with 2 desert coolers. A mesh-screened green-house is under construction size 32' x 20' x 8' high.

1.4 Field-trial facilities:

Field laboratory/store: Part of a separate building provides 3 rooms:

(a) a store for implements, which contains a rudimentary cage for keeping rabbits (for feeding adult mosquitoes).

(b) a store for housing knapsack sprayers and chemicals. There is a steel cupboard, but no shelving or benching.

(c) a large store of 7m x 3m.

Water is provided in room (a) which has a toilet attached. There is no air-conditioning. Chemicals kept under these conditions are subjected to temperatures ranging from 6°C to 40+°C through the seasons of the year.

The spraying equipment consists of one ASPEE Polypropylere knapsack sprayer and 4 old brass hand pressurised knapsack sprayers, (3 of 9 litre capacity, 1 of 18 litre capacity), with lance and single nozzle. There is an unserviceable 'Motoblo' knapsack power sprayer-duster.

Land is available to the extent of 50 acres at the research centre. Crops which have been grown on 30 acres for the past 2 seasons are:

Rice (Paddy)	Mustard	Groundnuts
Cotton	Wheat	Chick-pea
Pigeon-pea	Pearl Millet	Range of vegetables.

A small plantation of vines has been established, and the intention is to provide a small orchard of citrus and other fruits.

No significant infestation of pests has occurred on any of these crops to date.

Cultivation has been by hired contractor and tractor. Plot seeding and maintenance has been done by qualified staff.

Review of facilities and staffing level

The Research Centre building was completed and occupied in 1984. During the past two years the programme of the entomology section has included work on a fungicide seed treatment for wheat based on carboxin and on a herbicide formulation for rice based on butachlor. There have been six projects on insecticides.

The major effort at the moment is spent on breeding mosquitoes and conducting bio-assays on formulations based on Bacillus sphaericus. This work has arisen following a contract Research Agreement with A.C. College of Technology, Madras. The full season's work for 1987 includes also herbicide and fungicide trials. The list of projects completed and in progress is in the appendices. The number of staff is low for the wide range of products to be tested, and they are not fully trained to evaluate herbicides and fungicides in addition to insecticides.

Herbicidal work is usually clearly separated from other disciplines. Nevertheless the staff have worked extremely well to complete the above projects and have demonstrated their skill and ability to conduct reliable small-plot field trials with scarcely adequate facilities, and to issue well structured reports with statistical analyses.

The more obvious lack is in the facilities for culturing insects and conducting bioassays. The proposals for up grading all of these are in Chapter 2.

Chapter 2

Proposals:

Facilities: In order to maintain insect cultures and provide a regular supply of insects for laboratory bioassay work, construction of a new, separate building is required.

The planning of this cannot be delayed, particularly in view of the present location of the Entomology Section viz, immediately below the Formulations laboratory, with the attendant risk of contamination of the insect cultures.

An outline plan, indicating the range of facilities that will be required in such a building has been drawn up.

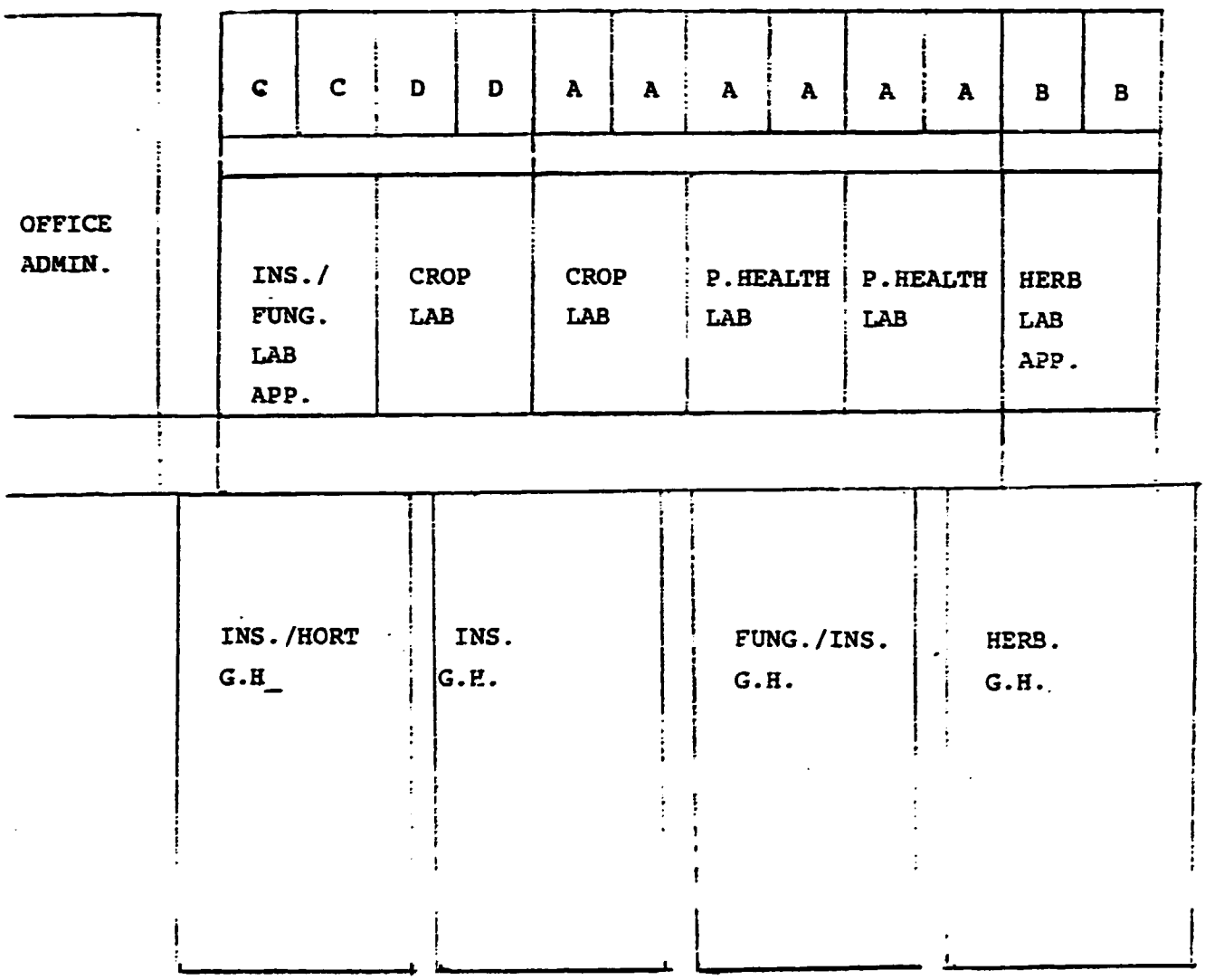
The final design need not be as shown, but could for example, be arranged around a courtyard as with the existing buildings. The glasshouses would be on the South aspect.

Essential features of the suggested plan are the positioning of the herbicide section, and distancing of chemical storage from insect breeding areas.

It could be built in stages, and a preliminary costing of the part required for public health insect culturing and laboratories is suggested as 1,00,000 rupees.

Outline prooosal for bioassay laboratory and glass-house facility.

Suggested basic requirements:



A = Insect breeding rooms.
B = Herbicide chemical & equipment stores
C = Insecticide Chemical & equipment stores
D = Fungicide chemical & equipment stores

Glass-houses 15' x 30' ground plan

This implies a total construction cost of 3,00,000 Rupees, plus equipment of 6,00,000 Rupees.

The glass-house costs would be additional, estimated at $ 50,000 each imported.

As a stop-gap measure, structural changes to the existing laboratories are urgently needed, and it is recommended that two of the rooms are modified to produce 4-6 insect culture rooms, with all necessary cages and equipment. These would have temperature and humidity control, enabling year-round production of the list of species contained in the appendices.

Improvements in the other two laboratories in respect of environment control and provision of essential equipment are recommended to enable standardised application of formulations, and maintenance of controlled environment in a post-treatment laboratory.

For the field trial facilities a recommended list of requirements includes a special vehicle for transporting equipment and personnel to on and off-station sites, a tractor plus implements for cultivating trial areas, and re-equiping stores and field labs, and providing a range of application equipment. All of these proposals are detailed in the appendices which include the general, (but not detailed) specification for the requirements of new and fully air conditioned glasshouses.

The major items of expenditure in these proposals are estimated as:

		Estimated cost
1.	Structural alterations	$ 5,000.00
2.	7 Air Conditioning units	$ 10,500.00
3.	1 Laboratory sprayer	$ 5,000.00
	1 Potter Tower	$ 2,000.00
4.	2 Incubators	$ 3,000.00
5.	1 Desk-top computer	$ 2,000.00
6.	4 Recording Thermohygragraphs	$ 2,000.00
7.	1 Power operated field sprayer	$ 2,000.00
8.	2 Other sprayers - 1 tractor - mounted	$ 2,000.00
9.	1 Tractor	$ 20,000.00
10.	"Jeep" type vehicle	$ 50,000.00
		$1,23,500.00

These figures need to be checked in detail - all are given in dollar values although not all will need to be imported.

Staff & Training

Ideally, specialists in fungicides and herbicides should be recruited as soon as possible.

In the meantime some basic training in these disciplines for existing staff will be necessary and beneficial. In the first instance one person should go on a training period in fungicide evaluation of an industrial research centre in U.K.

Updating knowledge and experience in machinery/ application is an important requirement and it is timely that one of the staff will be attending a course on this subject this summer at Silwood Park, Imperial College, London U.K. He is then going on to a course at an institute in Wooster, Ohio, USA, which is doing essentially similar work to PDPI/HIL.

A similar participation by an individual in a programme evaluating mosquito larvicides/biocides eg in USA is proposed. (Identification of a world expert to advise PDPI, and arrange a training programme in this aspect is an urgent requirement. The writer will undertake to advise UNIDO in this respect after his return to UK.)

Staff recruitment:

When the insect building programme is fully operative, and bioassay work in the laboratory is possible throughout the year, there will be a need to increase the number of qualified staff. This will be needed to enable field and laboratory work to continue simultaneously. It is proposed that 2 additional graduates in entomology be appointed. Candidate selection would aim at one with some experience in insecticide application systems, and the other with experience in the public health area, including mosquito control.

If fungicide formulations are to be a prominent feature of the programme recruitment of suitably qualified staff is necessary.

Based on the relative importance of products used in India, fungicides could take precedence over herbicides.

CHAPTER 3

Reporting and documentation:

As research on a new formulation progresses, the following stages in documentation can be identified:

1. Basic documentation of individual experiments.

2. Reports with conclusions and recommendations from single experiments or groups of experiments.

3. Preparation of Technical Data/information Document, for distribution with samples of formulation to collaborators. This should include clear recommendations on objectives of use, dosage ranges to test, caution/advice re-toxicology, and Code No. for identification, based on formulation details available in Formulations Section.

4. Preparation of Review of all available results from in-house and collaborator trials.

5.(a) Recommendation to Management with proposed technical content of product label. This would be supported by (4).

5.(b) Preparation of technical data supporting a submission for Registration essentially (4) with copy of draft level.

6. Publication if appropriate of results from important trials, in scientific journals.

7. An essential aid to the production of these documents is a small desk top computer.

Comments & Proposals on Reporting and Documentation

1. Basic data

Currently basic data are kept in note-books. The disadvantage when these are kept on a daily basis is that the data become disjointed. Therefore basic protocols are recommended, and these are used to devise data sheets which, when completed, are filed together for each experiment. Examples are given in the appendices.

2. Reports on experiments:

The current procedures are satisfactory for reporting and summarising results of experiments. However, it is important to distinguish clearly 'Conclusions' and 'Recommendations'.

3. Technical Information Document

These are not currently prepared. It is proposed that a start should be made eg with the Biocide product under investigation, (an example in the appendices lists the items which should be included).

4. Review of trial results

Same comments as in (2) above.

5(a) Recommendations to Management and Support for Registration:

Hopefully these are the ultimate goal of all experimental work. Management/marketing requirements must be clear when programmes are initiated.

6. No significant research work is complete until recorded in the published technical literature.

7. Computer:

The type of machine that is required, with associated software need not cost in excess of $ 2000.00, and a 'Cassio" model is probably a suitable type of machine.

Technical Literature:

A list of books for purchase is given in the appendices. These are all essential to PDPI and should be added to the library. Of equal importance is the list of journals: subscription to these is strongly advised.

CHAPTER 4

Collaboration with other Research Institutes:

Present Situation:

AT the moment no formal arrangements exist for collaborative field or laboratory evaluation of formulations originating from PDPI/HIL.

Consultation is planned with relevant institutes, appropriate to each product as it arises. Thus, there is an established relationship with the Indian Agricultural Research Institute (IARI) Headquarters in New Delhi, and the Malaria Research Centre (MRC). Contact has recently been made by the writer and Dr.Bhateshwar, with:

- International Crops Research Institute for the Semi-arid Tropics (ICRISAT): Patancheru, Andhra Pradesh.
- Central Plant Protection Training Institute: Hyderabad, Andhra Pradesh.
- Indian Council for Agricultural Research (ICAR) Directorate of Rice Research, Rajendra Nagar, Hyderabad, A.P.

The recent visits to the three institutes listed above proved most fruitful in identifying their main areas of interest, seeing the laboratory/greenhouse facilities, and ascertaining whether screening or field trial collaboration could be established. Notes on these visits are given in the appendices.

Proposals:

A programme of visits by staff of the Entomology Section should be planned. This would include the main ICAR Centres in all regions of India and cover the major crop Research Directorates.

The objective would be to establish formal contact, for collaborative evaluation of experimental formulations in their early stages of development.

At the same time these contacts would identify problem areas in crop protection, and generate ideas for new projects, or formulations where appropriate.

A definite time limit should be set on completing the programme of visits.

CHAPTER 5

Research Projects:

A list of projects is included here and comments are made under each item:

1. Investigate larvicidal action of formulation of Bacillus sphaericus under field condtions.

Comment: To date, all bioassays have been conducted with tap water under laboratory conditions before offering to collaborators. It would be wise to obtain some evidence that the formulation is effective under field conditions.

2. Determine the resistance pattern of the breeding colony of the cockroach, Blatella germanica, which has been established from specimens collected in a Delhi hotel.

3. Determine the dosage response of the B. germanica colony to cypermethrin, and obtain a susceptibility base line.

Comments on 2 & 3

It is important to know the resistance pattern in the colony being maintained. This can then be helpful in interpreting the dose-response to cypermethrin, and add weight to any label clams for controlling resistant strains.

4. Investigate the activity/particle size relationship in a product such as Malathion, where the liquid active ingred is absorbed onto a filler.

Comment: There is no published information on this subject. The results might indicate where improvements in formulation could be made.

5. Investigate the potential for a floating film formulation for control of Brown Plant Hopper (BPH) on rice, incorporating monocrotophos.

Comments : This suggestion was made by Dr. Pasalu of the ICAR Rice Research Directorate, Hyderabad. There is no satisfactory treatment for BPH which concentrates in the heart of the plants just above the water-level.

6. Survey needs for controlled release formulations (CRG).
Comments: The current programme refers to investigation of a CRG of phorate, with no specific target pests or crops indicated. It is suggested that the Institutes working on sugarcane, and forestry pest problems are consulted on preferred active ingredients. ICRISAT already has groundnut work being conducted by TDRI, UK, and contact here is recommended when the programme starts up again in the 1987 groundnut season.

7. Evaluate seed coatings, as well as seed-dressings of insecticides or fungicides.
Comments : The new technology of using a variety of materials including polymers, to firmly coat materials onto seed, is beginning to show promise, and commercialisation in Europe.

....

Chapter 6

Lectures

Two lectures were given at the following venues:

1. Workshop on Pesticide Formulations"

Conducted by: Pesticide Development Programme India, in cooperation with the Gujarat Pesticides Formulators Association

Held at : Department of Chemistry, Sardar Patel University Vallabh Vidyanagar, Anand, Gujarat, 28-30 Jan. 1987.

Title : "Some factors affecting bio-efficacy of pesticide formulations."

Abstract .

There are many factors which influence bio-efficacy, i.e. field performance of pesticide formulations. Some are not directly due to formulation factors, but can be mitigated by special formulation proceedings. They can be broadly characterised as:

Mechanical : Application methods and volume i.e. droplet size and dilution, and particle size of active ingredient.

Climatological : Climate and weathering properties.

Biological: Persistence in relation to timing of pest attack.

Phytotoxicity and crop safety of inert ingredients.

Human error: In the production and end use.

Special reference will be made to particle size of wettable powders, and flowable formulations, illustrated in the case of a number of acaricides and insecticides, showing the close correlation between particle size and activity.

2. Regional Workshop on Pesticide Formulation Technology

Organised by: Pesticide Development Programme India, (PDPI) and Regional Network for Production, Marketing and Control of Pesticides in Asia and the Far East (RENPAF).

Sponsored by: United Nations Industrial Development Organisation (UNIDO).

Held at: India International Centre, 40-Max Muller Marg, New Delhi. March 9 - 27, 1987.

Title : "A Biological approach to Pesticide Formulation.

A full copy of the text as issued to delegates is available on request.

CHAPTER 7

Itinerary

13 Dec: Left London Heathrow 1030 for Vienna.

15 Dec: Premission briefing in Vienna

16 Dec: Departure Vienna 1020 hrs to Frankfurt
Departure Frankfurt (delayed) 1530 hrs

17Dec. Arrived Delhi-Indira Gandhi Airport 0330 hrs, AM.
Reported to UNDP, Delhi-Local briefing with
Dr. K.Hussein. Met Dr. H.Khetan, Dir.Res. PDPI.
One hour meeting with Dr. Dhua, Chairman PDPI/HIL.

18 Dec. AM reported for work at PDPI Research Centre,
Udyog Vihar, Gurgaon. A large portion of the
time on the project was spent in discussion
and consultation with members of the Entomology
Section ,Formulations Section at the Research Centre,
and with other consultants, and in preparing a
report and recommendations ,and lectures. 8 days
were spent attending 2 workshops. In addition
the following visits were made:

5 Jan. Malaria Research Centre, Delhi.

22nd Jan. Indian Agricultural Research Institute, New Delhi,
Entomology Department.

28-30 Jan. Sardar Patel University, Vallabh Vidyanagar,
Gujrat for participation in Workshop on Pesticide
Formulation.

29 Jan Dept of Entomology Gujarat Agricultural University
Anand Campus.

17-18 Feb. Visited ICRISAT, PPTI, ICAR (Rice Research) Hyderabad

8 March Technical debriefing meeting in Delhi with Dr.B.Sugavar

9-11 March Attended workshop on Pesticide Formulation
Technology, India International Centre, New Delhi
and Udyog Vihar.

12 March	Left New Delhi at 0320 hrs on flight No.LH 667 to Frankfurt and Vienna.
	P.M. Short debriefing meetings with Ms L.Taylor of Project Personnel Recruitment & Mrs Pingerra, Experts Administration.
13 March	Vienna to U.K. BA 601

Work carried out on project (17 Dec 1986 - 12 March 198

1. Study and assessment of existing bioassay facilities, staff. Lengthy discussions.

2. Recommendations to improve existing bioassay facilitie: - Lengthy consultations.

3. Visits to the following Institutes.
   3.1 Malaria Research Centre, Delhi.
   3.2 Indian Agricultural Research Institute, New Delhi
   3.3 Gujarat Agricultural University, Anand
   3.4 ICRISAT, Patanchera, Andra Pradesh.
   3.5 CPPTI - Central Plant Protection Training Institu Hyderabad.
   3.6 ICAR - Directorate of Rice Research, Rajendra Nagar, Hyderabad.

4. Lectures presented:
   4.1. "Some factors affecting bioefficacy of Pesticides. Gujarat Pesticide Formulators Association. Workshop held at Dept. of Chemistry, Sardar Patel University, Vallabh Vidyanagar. (Via Anand) Gujarat (29.1.1987)

   4.2 "A Biological approach to Pesticide Formulation" UNIDO/PDPI/RENPAF Workshop on Pesticide Formulation Technology, India International Centre, New Delhi. (11.3.87)

Acknowledgements

The writer wishes to thank all those at UNDP and at PDPI Centre, Udyog Vihar, for their generous help and assistance.

In particular thanks are due to Dr. M.Kamal Hussein, UNIDO, Senior Industrial Development Field Adviser, to Dr. S.P.Dhua, Chairman, PDPI Governing Body, and Dr. Sushil H.Khetan, PDPI R&D Director, for extending all facilities required to accomplish the programme of work.

Members of the Entomology Section under Dr.N.R. Bhateshwar have been especially helpful and encouraging.

Appendices

1. Staff of Entomology Section
2. Projects of Entomology Section
3. Plan of existing Laboratories
4. Proposed alterations to present Laboratories
5. List of equipment required for laboratories
6. Proposed list of insect species to be cultured
7. Specific insect culturing procedures
8. Protocols for laboratory bioassays and field trials.
9. Field trial facilities and proposed improvements.
10. Glass house specification
11. Technical Information Document
12. Recommended Publicationsfor purchase and Subscription Journals.
13. Visit Reports

Appendix I

Present Staff in Entomology Section

Head of Section	Dr. N.R.Bhateshwar- M.Sc in Agricultural Entomology, Ph.D in Entomology. Since specialized in insecticide activity and insecticide residues.
Junior Entomologist	Dr. Y.P.Ramdev. M.Sc in Entomology/ insect physiology. Ph.D in mode of action of insecticides - Trained in computer programming.
Field Supervisor:	Mr. S.P.Yadav - M.Sc in entomology for work on field bioassay study on insecticides for Black Gram pests.

Residue Laboratory

Senior Scientific Assistant :	Mr. M.Mukharji - M.Sc in Organic Chemistry. Work experience in Process Development and Residues analysis.
Laboratory Attendant	H.R.Pandey
Field Attendant(MALI)	Mr. Barsati

Appendix 2

Projects of Entomology Section

(a) Completed over past 2 years have included evaluation of:

1. High γ BHC 50 WDP for soil pests of peas.
2. High γ BHC 50 WDP, 50 DP, endosulfan EC for cotton pests.
3. Sesame pest complex and control.
4. Two γ BHC formulations for termites on groundnuts.
5. Fenvalerate for pigeon pea pests.
6. Soil persistence of High γ BHC in soil, and residues in pea crop from treated soil.

All above projects conducted on infested crops on farmers' land.

Since its setting up, (prior to moving to the new Centre) the Residues laboratory has conducted studies on the following active ingredients in a range of crops/situations:

Malathion
Endosulfan
Dicofol
DDT
BHC
Temephos (in rain water)

(b) Projects in progress

1. Evaluation of carboxin formulations as seed treatment for wheat and groundnuts. Assessment of residues at harvest from treated crops.
2. Evaluation of formulations of butachlor as a rice-herbicide, and assessment of residues in harvested grain.

3. Evaluation of formulations of B.Sphaericus against mosquito larvae.

4. Evaluation of "Powerpack DDT" (WDP) developed by IARI for mosquitoes "resistant" to DDT deposits on walls.

5. Rearing & maintaining insect cultures.

6. Developing improvements to laboratories, greenhouse and glass house facilities.

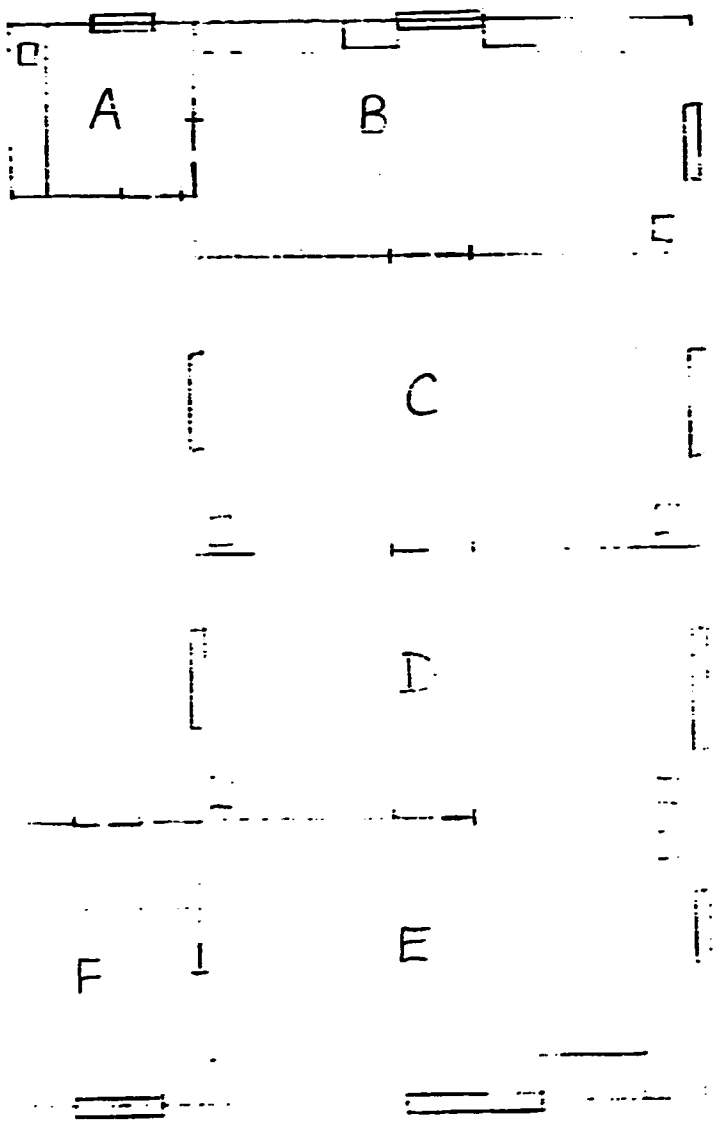
(c) Projects in the programme

1. Phorate : Micro-encapsulated formulation, and controlled release granule

2. Household Insecticide formulation development, e.g. Pyrethroid cypermethrin.

Appendix 3.0

Entomology Section : Existing laboratory accommodation.



A = Office
B = Post-treatment room with desk
C = Insect breeding
D = Post-treatment room with desk
E = Treatment laboratory
F = Store

Appendix 4(1)

Alterations to existing laboratories

Room A

1. Remove existing bench and water supply.
2. Equip with necessary furniture, shelving and air conditioning to provide an office for two people.

Appendix 4(2)

Room B Post-treatment laboratory

Temperature range adjustable 25°-30°±2°C

1. No partitioning
2. Instal insulated false ceiling at 2.6m
3. Seal off passage double door
4. E Window is sealed & insulated at bottom and one air conditioner & one perspex double glazing at top.
5. N Window is sealed & insulated at the bottom and perspex double glazing & air conditioner at top.
6. Benching.

   Prcvide 1 large central working table/bench.
   Additional benching on W. wall.
7. Shelving

   Provide shelving (i) over recessed bench on E of N Wall. (ii) along S Wall across sealed doors & wall.
8. Control equipment

   Air temperature controlled by 2 units, 1 on E & I in W windows at top.
9. Humidity control provided with 1 humidifier.
10. Air vent - Provide below bench level in N wall.
11. Services: Water - retain existing supply.
    Power points - retain existing supply.

    Lighting

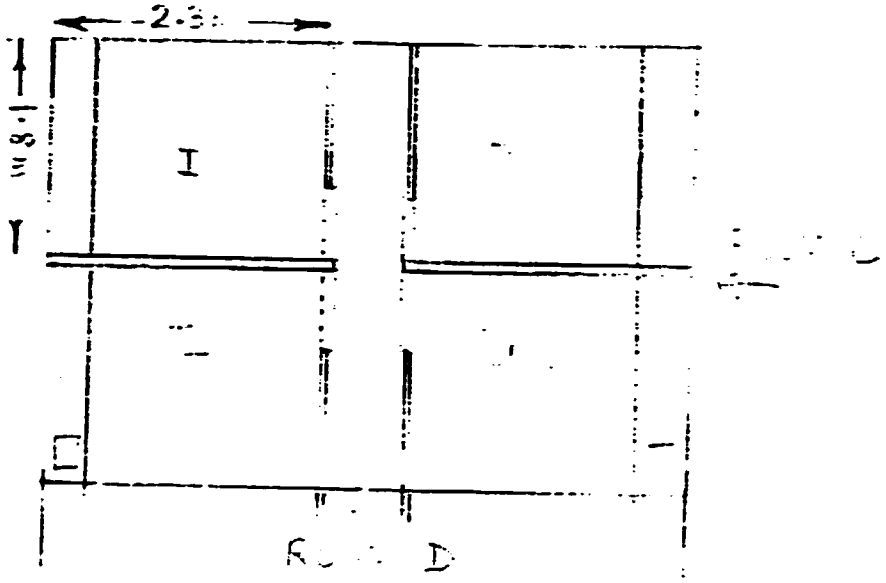
    Provide two ceiling mounted strip lights for general purposes
    Provide banks of lights - (adjustable height)

Appendix 4(3)

Insect Breeding : Proposed Modifications

Room C (4 compartments)

Room D (2 compartments)



Volume of BlocksI = II = III = IV

Dimension of block = 2.3 x 1.87 x 2.6 mt

Ceiling area at a height of 2.6 mt = 5.8 x 3.75 mt

Appendix 4(4)

Specification for Insect Breeding facility (C&D on plan)

Room C: Mosquitoes, Houseflies; Cockroaches, Stored Product pests.
Temperature 28°C±2°C. Partitioned into 4 compartments

1. Installation of insulated false ceiling throughout at 2.6m.

2. Passage way partitioned off at width of 1.2m.

3. Dimension of each culture room including thickness of new wall: 2.3m x 1.87m x 2.6m to ceiling.

4. Construct passage walls of timber framing 5.5cm x4.5cm timber, with 5.5 cm fibre glass insulation, clad both sides with chipboard panels.

5. Doorway into each room will have inner sliding door of stainless steel gauze, outer sliding door insulated with fibre-glass as per wall.

6. Interior partition wall to be contructed up to bench level of timber and panelling. Above bench level stainless steel gauze.

7. Existing windows:

   One upper pane provided with 6 mm perspex, other to accommodate air conduit. Lower portion to be insulated with triple glazing.

8. Control equipment

   8.1 Air temperature controlled by provision of 2 units, one on E + one on W side. Capacity = to produce 10 air changes/hr.

   8.2 Humidity control : In two adjacent E rooms, one humidifier in each.

9. Air vent to be provided below bench level in each compartment.

10. **Services:**

10.1 **Water** Tap & Sink supply of hot & cold water in each compartment.

10.2 **Power points** : Retain existing provision

10.3 **Lighting** : Move existing lights and fix to new ceiling at central point in each compartment.

11. **Shelving/cupboard**

Provide small unit for food storage

Appendix 4(5)

Room D : Cultures of Spodoptera and Aphids
Partitioned into 2 compartments.
Temperature 27°C

1. Installation of insulated false ceilling throughout at 2.6cm.

2. Passageway partitioned off at width of 1.2m.

3. Dimension of each culture room including wall-thickne = 2.3m x 3.75m.

4. Passage walls to be made of timber framing, 5.5cm fibre-glass insulation, and cladding of chip-board panels.

5. Two doorways into each room to act as air-trap: Inner door of steel gauze and outer sliding door as per walls.

6. Existing windows to be triple-glazed for insulation, except for section to house air-conditioning unit.

7. Control equipment
   7.1 Air temperature controlled by provision of 2 units, one each on E&W windows.
   7.2 Humidity control - In each compartment provide one humidifier.

8. Air vent. Provide below bench level in each compartment.

9. Services
   9.1 Provide sink with taps for hot & cold water.
   9.2 Retain existing power points.
   9.3 Lighting . Remove existing lights and fix to new ceiling at a central point in each compartment.
   9.4 Provide three banks of fluroscent lights to dexion racks holding aphid cultures.

Appendix 4(6)

Room E. Temperature 25°C-30°C adjustable.
Instal lower ceiling at 2.6m. Insulate windows and provide 2 air conditioners.

Make provision for the following list, located as on plan.

1. Turntable sprayer: Provide extraction cupd for installation & operation, constructing it so that the sprayed area can be washed down - i.e. water & drainage.

2. PotterTower: Remove portion of tiled bench and position tower at lower level also in extraction area, but partitioned from turntable sprayer.

3. Micro applicator

4. Balance Accommodate these on tiled recessed area. Build cupboards over.

5. Chemical store : Move sink as shown, & build ventilated chemical store of shelving, & locked door. Extractor fan, and fire-proof cup-board for inflammable solvents, & lighting.

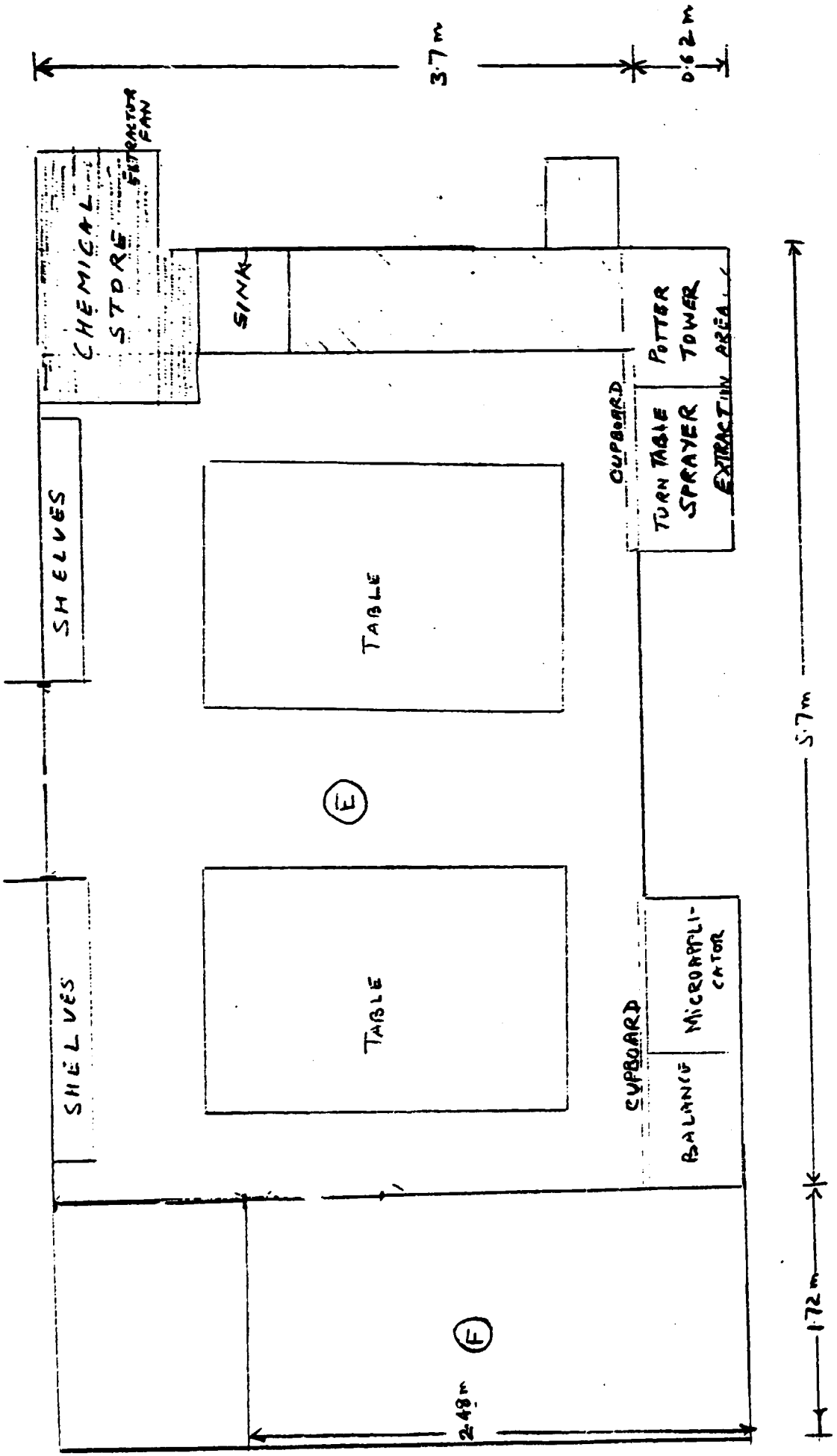
6. Area for preparing sprays will be the existing bench near sink. Block one window (lower pane) for shelving for non-toxic reagents.

7. Provide shelving & cupboards either side of door from insectary area.

8. Provide 2 large tables for central working area.

9. Provide a Safety Station e.g. as supplied by Fisons Scientific apparatus.

ROOM E. PROPOSED MODIFICATIONS. Appendix 4(6)(ii)



Appendix 4(7)

Room F. Storage room

1. Provide office space for one person.

2. Provide shelving for books & files.

Appendix 5(1)

Equipment

The following equipment is required :

Major items
Estimated costs
US $

Room A: Office

1. 2 Desks
2. 3 chairs
3. 1 table
4. 2 3-drawer steel filing cabinets
5. Shelving for box files & books.
6. 1 desk-top computer/calculator. 2,000

Room B: Post-treatment laboratory:

1. 1 Large table
2. 2 Large incubators : 0°-50° 3,000
3. 1 Insectocutor
4. 1 Mosquito trap.

Room C

1. 6 cages for adult mosquitoes.
2. 2 cages for house-flies
3. 100 trays for mosquito larvae
   .. 1 Sq.ft:enamel ....
   50 bowls for mosquito breeding
   1 ft dia .....
4. 50 bowls for house fly larva breeding and storing mosquito eggs.
5. 50 glass droppers .....
6. 3 dozen Camel Hair brushes.
7. 1 dozen bronze sieves 8" dia
8. Dexion framing for shelving.
   ..200.... feet of angle + fittings
   ...50. ft. shelving material
9. 6 Steel Spatulas ....
   6 Steel Knives ....

Appendix 5(2)

		Cost
10.	1 Food Blender ...-	
11.	1 aspirator pumps ...	
12.	6 apirators....	
13.	4 large bins for cockroach breeding ...	
14.	4 recording thermo-hygroraphs	
15.	150 plastic jars for stored products Pests	
16.	One Insectocutor	
17/	One mosquito trap	

Room D

1.	20 plastic jars for oviposition.	
2.	20 Perspex troughs for larvae 2' x 1'	
3.	50 Plastic jars (½ litre)	
4.	Dexion Shelving	
5.	Lighting tubes + chokes + thermostats + fan + tubing	
6.	20 Breeding cages	
7.	Plastic Plant pots ½ litre size	
8.	100 Plastic Plant Propogation trays	
9.	Watering bed material	

Room E

1.	1 Turntable with motor ..... ',	5,000
2.	1 Static Sprayer	
3.	1 Air compressor ...	
4.	1 Electrical balance ...	
5.	500 plastic plant pots ½ litre ...	
6.	1000 plastic cups + lids	
7.	1 complete Potter Tower	2,000
8.	2 CO2 cylinders + reducing valves + pressure gauge.	

Appendix 5(3)

Cost

9. Glassware:
   100 Petri dishes 10 cm dia ....
   20 each of Beakers 5 ml, 50, 100,
   250, 500 ml
   10 each of measuring cylinders.
   10, 25, 50, 100, 500 ml
   20 each of Pipettes & Burets ....
   100 glass cylinders 4" x 6" & rod...

10. 2 W.H.O. test kits for mosquitoes ...

11. Stocks of tiles
    Ceramic, steel, aluminium..
    200 of each .....

12. 1 Fire-proof cabinet for solvents

13. 1 Insectocutor

14. 1 Mosquito trap.

Appendix 6(1)

Proposed insect species to be cultured at HIL/PDPI. (*are those species already in culture)

A. Laboratory cultures:

1. Crop pests:

1.1 Spodoptera littoralis:

1.2 Aphis craccivora:

1.3 Bemisia tabacci

2. Stored Product pests:

2.1 Triboleum castaneum* & T.confusum*

2.2 Rhizopertha dominica

2.3 Calosobruchus maculatus*

2.4 Cadra cautella*

3. Public Health pests:

3.1 Musca domestica*

3.2 Periplaneta americana / Blatella germanica

3.3 Culex fatigans*
Aedes aegypti*
Anopheles stephensi*

The system will be to maintain stocks of the above species, and multiply when relevant formulations become available. At the time of preparing this proposal, there is an urgent need to step up the mosquito breeding, in order to evaluate formulations of Bacillus sphaericus for control of mosquito larvae.

B. Field Cultures: One aim should be to build up infestations on a variety of host plants, grown on the research farm. The pest species to encourage are:

Earias fabiae	- cotton. okra
Heliothis armigera	- cotton & pulses
Pectinophora gossypiella	- cotton
Tetranychus telarius	- cotton + Brinjal,(egg plant

These would then be available when initial small scale field trials were required, and in the cases of Heliothis and Tetranychus for initiation of cultures in the laboratory.

In addition a range of fruit crops should be grown e.g.

Vines
Guava
Citrus
Ziziphus

Appendix 7(1)

Handling of Insect Cultures & recommended diets:

The following documents were left with the Entomology Section.

Recommended diets for:

1.1 German cockroach, and housefly, and a range of stored-product pests.

1.2 The cut-worm, Agrotis segetum.

2. Code of practice for culturing stored-product beetles and moths.

Appendix 8(1)

PROTOCOL FOR LABORATORY BIOASSAY

INSECTICIDE/ACARICIDE
Contact/Knock-down/Persistence/
Stomach/Fumigant.*

Expt.No. L ...

Date :

Time:

1. SPECIES ..... Stage (Adult, larva, nymph, giving instar No.)

2. MEDIUM TREATED
(If plant, identify and as whole or part of or surface(s), water, or soil, indicating type and origin)

3. FORMULATION
Code No. (This to be provided with the formulation)
% active Constituent (" " ")
Type : (WP/EC/Flowable etc) (" " ")
(A brief description from Formulation Section to accompany above information)

4. TREATMENTS
Rates equivalent to field use as % ai :
(Also give per acre, per square foot, per lb soil as active constituent)

Actual dosage per unit employed
(% concentration and volume)
Nos. of replications

5. APPLICATION & EXPOSURE TIME :
(Identify equipment, apparatus. Conditions at time eg in laboratory °C + % RH.)
(Indicate any limitations of exposure of species to treatment)

*Circle appropriate test.

Appendix 8(2)

6. INFESTATION LEVELS:

(Indicate numbers of individual persons involved)
- per replicate
- per treatment

7. ASSESSMENTS

Interval in days/hours/minutes

Dates ---

Assessment:

Replicates	L/D	%	L/D	%	L/D	%	L/D	%	L/D	%	L/D	%	L/D	%
1 A														
B														
C														
D														
2 A														
B														
C														
D														
3 A														
B														
C														
D														
4 A														
B														
C														
D														
5 A														
B														
C														
D														

Appendix 8(3)

Field Trial Protocol

Field Experiment : Trial No..... /year

Title : **Pest :**

The Crop

Dates : Sown ...
Flowered ...
Harvested ...
Plots marked out

Experimental Materials

List of Products	Formulation	Active ingredient	Strength	Comments
Experimental or standard	WP/EC/Fl/Gr	Common name	%ai.	

Treatments

List of Products	Application Rate	Application
As above	Standardise for all i.e. gai/ha	Number planned and volumes applied.

Date of application :

Equipment used:

Assessment dates:

Harvesting date:

Appendix 9(1)

Field trial facilities

Proposals

1. Provide more hygeinic cage facility for the rabbits. In this room some ancillary equipment could be stored.
2. Fit benching + sink + water, shelving + drawers in the field laboratory for chemical + spray equipment storage. Provide a large central table as a work-space to examine crop samples.
3. In the office provide benching, drawers and shelving.
4. Supply the following equipment.

		Est.Costs $
4.1	3 Knapsak Sprayers e.g. ASPEE-NAPSACK. Complete with range of nozzles, spray booms and rigs.	
4.2	1 Power operated sprayer, trolley mounted with long hose and set of lances & nozzle + cut off valves.	2,000
4.3	1 tractor-mounted sprayer	1,000
4.4	1 Motorised Knapsack for liquid and dust application	1,000

5. Supply mixing/measuring equipment:
   - 5.1 25 Plastic mixing tanks/cans 45 litre- 4.5 litre capacity.
   - 5.2 4 ea Plastic measuring cylinders 25 ml - 500 ml capacity
   - 5.3 4ea Plastic funnels, with & without filters. 10 cm dia - 25 cm dia.
   - 5.4 Supply of glass rod
   - 5.5 1- Stainless steel spatulas.

5.6 1 Open pan balance

5.7 1 set Avery Scales,
with weights upto 20 Kg.

5.8 5,000 Aluminium tags.

5.8 1,000 ca. Metal stakes
60 cm ± 120 cm long

5.9 10 1-metre rules.

5.10 2 ea 15m steel tapes
2 ea 50 m cloth tapes..

5.11 10 tally counters ...

5.12 1000 ca. paper
polythene } Bags 100g
cloth } - 1 Kg size

5.13 Insect collecting equipment

5.14 1 Camera (eg 'Minolta' or
'Canon' A-1 type) 1,000

5.15 2 Two-Wheel, hand operated trolleys

5.16 1 Tractor with cultivation implements 20,000

5,17 For off-station trials a suitable
vehicle eg "Jeep". 20,000

5.18 8 Plot Screens

5.19 Protective clothing
10 Face-masks
100 gloves(disposable)
10 Overalls
10 Boots/Shoes

5.20 6 Prs.Scissors
6 Knives
6 Secateurs

5.21 200 Waxed Cartons 500 ml

5.22 50 Plastic trays
30 cm x 40 cm

5.23 1000 Plastic cups 100 ml

5.24 1 x 500 gal galvanised tank for disposal of liquid waste.

5.25 10 Hand lenses
1 Table magnifier + illumination eg Burkard "Cold Light" viewer.

Appendix 10

Green house/Glass house facilites:

One Greenhouse is currently under construction, dimensions 32' x 20' x 7' height. It will be enclosed with wire gauze of 30 x 32 gauge.

The existing glass-house should be modified to have controlled ventilation.

At a suitably selected site, i.e. in relation to where a Phase II Biology Building would be situated, a new glass-house facility is proposed, with the following guideline specification.

1.	Total area	1800 Sq.ft.
2.	Height to eaves	7' Solid wall to 3' from ground.
3.	Height to ridges	: 12'
4.	Number of houses	: 4, each 15' x 30'.
5.	Accessibility	: Individual doors from header corridors.
6.	Temperature Control	: Provide for both hot and cold seasons: 4 desert coolers/compa ment.
7.	Provide for additional lighting	
8.	Floors - Concrete + drainage	
9.	Staging. To be locally assembled steel constructic	
10.	Shading : Provided for summer period	
11.	Ventilators : To be screened from insects. Import Cost/Green-house estimated at $ 50,(	

Appendix 11

Heading: Pesticide Development Programme, India

(Specimen Example: This sort of document should accompany all samples sent to collaborating laboratories).

Technical Information

Title : Biocide for control of mosquito larvae

Description

A suspension of spores of Bacillus sphaericus in a rapidly spreading base for application to breeding sites of mosquitoes, particularly anophelines.

Mode of action

The product spreads on the water surface to form a monomolecular layer including bacterial spores. The anopheline mosquito larvae being surface feeders ingest the spores, and die within 3 days.

Summary of experimental results

One or two short tables indicating conditions under which experiments were conducted, method of application, test species etc.etc.

Trial Recommendations

Indicate clearly: recommended rates of application; time interval between repeat treatments; Method of application in laboratory or field; Frequency and Timing of sample assessments.

Precautions

Any special precautions for storage, use and handling re safety to operator and environment.

Further information: Obtainable from ...-

Appendix 12(1)

Recommended Publications

1. 'Handbook of Insect Rearing' - 1985
   Vol. I & II

   Edited by Pritam Singh & R.F. Moore.

   Published by Elsevier Science Publishers
   P.O. Box 211, 1000 AE Amsterdam
   The Netherlands.
   ISBN 0-444-42465-2

   Each Volume Price US $77.75c

   Price Both volumes US $155.50c

2. 'Pesticide Application Methods' 1984 (2nd Imp)
   by G.A. Mathews
   Published by Longman, London
   ISBN 0-582-46351-2 (paper back) Price £25.00

3. 'Pesticide Application: Principles & Practice' 1985
   Edited by P.T. Haskell
   Published by: Clarendon Press, Oxford
   ISBN 0-19-854542-8. Price £ 50=00

4. "Pest & Disease Control Hand book" 1983
   Edited by: Nigel Scopes & Michael Ledieu
   Published by : The British Crop Protection Council, U.K.
   ISBN 0-901436-78-x
   (Chapter 4 of this book is entitled "The principles of insecticide and fungicide evaluation" by D.G.Ashby, and it is worth obtaining the book for this chapter.)

   Price" ?

5. Statistics and Experimental Design 1984 (2nd edn)
by Geoffrey M. Clarke
Published by Edward Arnold, London
ISBN 0 7131 2797 x (Paper back) Price £ 9.00
(Chapters 12,13, 16 particularly useful)

6. Statistical Methods in Biology 1985 (2nd edn.)
By Norman T.J. Bailey
Published by: Hodder & Stoughton London
ISBN 0 340 24756 8 (Paper back)
Price : £ 4:50
(Chapter 11 "Simple experimental design and the analysis of variance" gives worked examples of experiments.)

7. The Pesticide Manual 8th edn. 1986
Edited by Charles R. Worthing
Published by : The British Crop Protection Council, U.K
ISBN 0-901436-77-1

8. Pesticide Resistance : Strategies and Tactics for Management. 1986
Editor/Author ?
Published by: National Academy Press, Washington D.C. USA
ISBN: 0-309 03627-5.

9. Seed Treatment - 2nd Edition 1986
Edited by K.A. Jeffs
Published by: British Crop Protection Council, U.K.
ISBN: 0 948404 00 0

10. Crop Protection Agents - Their biological evaluation 1977
Editor Mc Farlane N.R.
Published by Academic Press, London
This book is638 pages. It includes both insecticide and fungicide evaluation.

11. Analysis of Specialised Pesticide Problems
Invertebrate Control Agents - Efficacy Test
Methods,1978.
Vol. IX Baculoviruses& Entomogenous Bacteria
Prepared by : Environment Protection Agency,
Washington D.C., U.S.A.
Printed/Published by: U.S.Dept. of Commerce,
National Technical Information Service
Ref PB-281 884
Earlier and later volumes should be sought.

12. "The Cockroach" 1968
Vol.1 "A Laboratory insect and Industrial Pest"
Author: P.B. Cornwell
Published by: Hutchinson, London.
Vol.II "Insecticides & Cockroach Control" 1976
Author: P.B. Cornwell
Published by: Associated Business Programmes, London.

13. "Insect Colonisation and Mass Production" 1966
Edited by: Caroll N. Smith
Published by: Academic Press, London

14. "Crop Loss Assessment Methods" FAO Manual
Sections I, II, III.
Published by: Commonwealth Agricultural Bureaux
Farnham Roval, Slough,
Bucks, SLZ 3 BW
England.

15. Recommended Journals for PDPI Library

1. Journal of Economic Entomology
   Published by: Entomological Society of America
2. Indian Journal of Entomology
3. Indian Journal of Agricultural Science
4. "Pesticides"
5. Pesticide Information
6. Indian Cotton Journal
7. Indian Journal of Weed Sciences
8. Pest Control
9. 'Pest Control'
   Publ: Harvest Publishing Co., 9800 Detroit ave.,
   Cleveland, Ohio 44102 USA

Appendix 13(1)

Visit Report . 22nd Jan. 1987

Department of Entomology, Indian Agricultural Research Institute, New Delhi.

Subject: Cotton Whitefly (Bemisia Tabaci)

The present status as a pest in Indian cotton.

This report is based on discussions held with Dr.Katyar, Entomology Division, Indian Agricultural Research Institute, New Delhi on 22nd January 1987 by the writer and Dr. N.R. Bhateshwar of HIL/PDPI.

The cotton areas where white-fly has been increasing as a problem, are centred on the following 3 areas.

Guntu in Andhra Pradesh State
Coimbatore in Tamil Nadu State
Vidarbha in Maharastra State

The severity of white fly attack is partly dependent on climatic conditions during December/January. This is usually hot and dry, and under these conditions white fly infestations build up. If, however, there is rain during this period, white fly infestations are much less serious.

The causes of the increase in whitefly infestations over the past 3 years were discussed at a recent symposium held at Guntu. This was organised by Dr. S.Jairaj, Director. Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore. Tamil Nadu, and a report on this symposium would be available to Government Organisations, on request to Dr. Jairaj.

Main points made at the symposium.

1. Synthetic pyrethroids, mainly for control of bollworms, viz, Spotted bollworms Earias spp and pink bollworm, Pectinophora gossypiella have been increasingly used over the past 3 years. These include the following active ingredients:

   Permethrin
   Fenvalerate
   Cypermethrin
   Deltamethrin

2. Numbers of sprays applied are reported to be as high as 14 in a season. It is suggested this is too many.

3. With very good yields, inspite of increased whitefly attack, farmers are unlikely to stop using pyrethroids, They will however have to reconsider the number of sprays of different products. The stimulus for this now is that some of the crop has been rejected on account of high honey-dew contamination caused by white fly attack.

4. Timing of spraying and good application to provide underleaf cover are emphasised. Lack of under leaf spraying could be a main cause of the high levels of attack.

Appendix 13(3)

Insecticide Recommendations

The latest of these are contained in the 'National Plan for Management of Whitefly on cotton" from Coimbatore, and include:

1. Early season spraying should include only the following products:

   Methyl demeton
   Monocrotophos
   Quinalphos
   Phosalone
   Ethion

2. Synthetic pyrethroids should only be used during peak flowering and boll formation.

3. Mid/late season sprays could include
   Triazophos
   Acephate

Other publications:

"Cotton Whitefly"
Author Dr. A.K. Bassu, Central Institute for Cotton Research, Regional Station, Coimbatore.

Recommendations

PDPI could fulfill an important role by initiating /participating in a collaborative programme of research with the Central Cotton Research Institute. The main objective would be improved control of Whitefly and Cotton Quality. This would require the research programme to include:

1. Identification of best whitefly products.
2. Development/Evaluation of improved application equipment eg. Tail boom knapsack sprayer.
3. A training programme in spray application, especially to cotton.

Appendix 13(4)

Visit Report : 29th Jan 1987

Department of Entomology
Gujarat Agricultural University
Anand Campus, Anand

Personnel: Visitor: Dr. Q.A. Geering Staff: Professor:
Staff: Prof. R.C. Patel Entamology Deptt.

Professor : R.C. Patel:

Prof. Patel showed the writer around his department and some of his staff demonstrated current work on insect and bird pest control.

In the training curriculum, a good grounding on correct insecticide application is given. A wide range of application equipment is held for teaching purposes. Most was of the knapsack back-pack variety. There was, however, no example of the "Tail-boom" type of sprayer, which could be particularly helpful in improving control of cotton whitefly. The writer undertook to see that information on this is supplied to the Department.

For cotton, a great deal of advice is given to farmers on correct timing of sprays in relation to threshold levels of pests. But because of the apparently unsatisfactory situation arising from relying only on large number of insecticide sprays e.g. worsening whitefly problem, additional/alternative measures are now receiving attention. These include studies on:

1. Use of sex pheromone traps for Heliothis and Spodoptera to reduce population pressure. On a field experimental scale this led to the number of sprays required for these pests being reduced from 6 to 3. The cost was 30 rupees/ha.

2. Investigating the value of indigenous parasites and predators, advising on ways to conserve these.

3. Studying effects of mass release of exotic parasites for reduction of bollowrms in cotton, and stem borers in sugar cane.

4. Studying virus, bacterial and fungal diseases for pest control.

Two independent commercial companies have been established in India selling pheromones and parasites and predators.

Pheromones India in Andra Pradesh (i)
Biocontrol Research Laboratories (a subsidiary of Pest Control, India) in Bangalore. (ii)

Prof. Patel's rational approach to use of pesticides and other factors in insect control, suggests he could be of immense value in advising on the better use of pesticide Products . PDPI should be aware of this situation, and keep the Department informed of PDPI activities.

i) Dr. K.N. Rao, Pheromones India. 20-46-39 Chinaravur Tenali 522201, Andra Pradesh

(ii) Dr.Manjunath, Biocontrol Research Laboratories: P.O. Box 3228, Bangalore 560 - 032 Karnataka.

Appendix13(6)

Visit Report: 17 Feb 1987

Institute: International Crop Research Institute for the Semi-Arid Tropics (ICRISAT). Pantancheru, Andra Pradesh.

Personnel: Visitors: Dr.Q.A. Geering - UNIDO
Dr. N.R.Bhateshwar - PDPI/HIL

Staff: Dr.W.Reed - Principal Entomologist (Puls
Dr. N.K.Awadhawal-Agric.Engineer
Mr. Gupta- Officer I/C Glass House
Dr. A.B.S.King- TDRI, London
Mr. T.Robinson - Oxford University (Temp)

1. Dr.W.Reed.

Dr.Reed outlined the policy and objectives of ICRISAT. It is to restrict work to "improving the quantity and reliability of food production in semi-arid regions of Africa, Asia, Latin America, and the Middle East, with emphasis on Sorghum, pearl millet groundnut, chickpea, and pigeon pea".

No insecticide work as such is undertaken. A large and already successful breeding programme has begun to produce varieties with resistance to several insect pests eg sorghum resistant to midge, chickpea, resistant to Heliothis, Sorghum resistant to Striga (parasitic weed).

2. Dr. N.K.Awadhawal

In the Farming Systems Research Programme Dr. Awadhawal has designed improved farming equipment.

Included in this is designing improved spray equipment for the small-scale and largerscale application of pesticides. In this programme a prototype 'tail-boom' sprayer has been produced, but with a horizontal spray boom. This is being produced with low volume water-based sprays, through conventional hollow-cone nozzles, and also with boom mounted spinning disc 'ULVA' application. The latter causes concern through the high toxicity of the concentrate formulations required. This is the only pesticide work undertaken at ICRISAT. Protection of some breeding lines is however undertaken. A cooperative project with Dr. Mac. Caffery, Univ. of Reading, U.K. is established. He is monitoring the insecticide resistance pattern in Heliothis from cotton. The ICRISAT Heliothis is showing x70 resistance to DDT, yet endosulphan is the only insecticide ever used on the farm to control Heliothis.

Mr.Gupta

Some 20 glass houses 100' x 30' 15' height have been erected. All but one were imported from Cambridge Glass houses, Comberton, U.K. Each is divided into 5 compartments of 30' x 20' requiring 4 coolers each. The main problem is lowering the temperature in the peak summer heat when the outside is 45°C. Desert coolers only get this down to 38°C and if a lower temperature is required e.g. for chick-pea, refrigeration units are added. The outline specification for PDPI green houses was drawn up after seeing these.

Dr. G.S. King

Dr. King is on the staff of TDRI, London, and is seconded to ICRISAT to co-ordinate work on Heliothis He outlined the programmes in Heliothis research and indicated all work on insecticide control was left to the chemical companies and national research centres.

Appendix 13(8)

Mr. T.Robinson

A Cecil Pilkington Scholar from Faculty of Pure and Applied Biology, Oxford University, Mr. Robinson is working at ICRISAT for one year as part of his degree course. He assisted Mr. J.Logan,TDRI, U.K., in the termite control work, which included evaluation of a range of granule formulation applied to groundnuts, The main trials,with heavy infestations were carried out at Bangalore, and, all detailed results are at TDRI,UK. (The writer will be seeing the results of these tests on his return to UK.) The trials included a number of controlled release granular formulations. It seems these were the most promising treatments in the trials, and. TDRI work in 1987 will probably concentrate on these, when trials will again be conducted at ICRISAT, and in Bangalore.

The TDRI work in India is part of an International Programme, co-ordinated in U.K. by

Dr. R.H. Cowie
Tropical Development&Research Institute,
College House,
Wrights Lane,
London W 8 5SJ, UK.

Any submission of experimental formulations from PDPI should be directed to Dr.Cowie in U.K.

Note: Dr. Reed will be retiring to UK in October 1987. His successor has not been appointed, but Entomology Section (PDPI) should request this information in order to maintain contact with the programme on controlled release formulations which are being conducted on groundnuts.

Appendix 13(9)

Visit Report : 18 Feb 1987

-Institute: Central Plant Protection Training Institute, (CPPTI) Hyderabad)

Personnel

Visitors: Dr. Q.A. Geering - UNIDO
Dr. N.R. Bhateshwar - PDPI/HIL

Staff: Dr. B.J. Dhiwakar - Head of Entomology
Dr. R.B. Bhaskar - Head of Pathology
Dr. S.N. Parthak - Head of Application
Dr. Chandulkar - Head of Chemistry

Dr. B.J. Dhiwakar:

The courses available were outlined and, are given in the attached copy of the 'Training Programmes'. Of particular interest to PDPI will be those on:

Pesticide Formulation Analysis
Pesticide Residue analysis
Pesticide Handling, Storage and Safe Use.
Application Techniques and Equipment Maintenance.

Dr. R.B. Bhaskar

Indicated that all aerial application of pesticides is evaluated by CPPTI, on all relevant crops, throughout India. In practice this means on cotton and sugar cane. Any formulations designed specifically for aerial application would be submitted to this Institute.

Dr. S.N. Parthak

Dr. Parthak had just returned from a 3-month course at Silwood Park, UK.

He too is testing a horizontal tail-boom with 3 fan-jet nozzles, of his own construction. He demonstrated the range of dusters and sprayers produced in India. In his opinion, the best are produced by the American Spring and Pressing Works (P) Ltd in Bombay. He advised PDPI to contact the Development Director,ASPEE, Bombay for supply of a vertical tail boom as developed for use on cotton in Africa.

Dr. Chandulkar

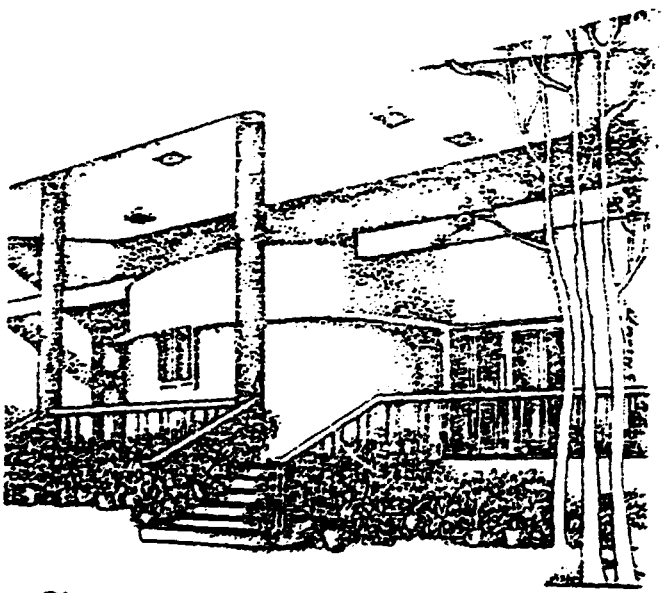
Dr. Chandulkar showed the range of analytical instruments used in his department. These included GLC, HPLC, infra-red spectra, and a polarograph. The latter is only used for gamma HCH analysis, and an alternative method is being researched. Training is given in the use of these instruments for analysis of formulations, and of residues in crops, soil, water, wild-life (fish). Monitoring in the past 3 years has been done for endosulfan, monocrotophos, and Cypermethrin. For these additional tests are carried out on milk & meat from cows kept in fields during and after spraying, and similarly in eggs and meat from chickens. Field workers i.e. spray mixers and tank fillers, and flagmen for aerial spraying undergo blood tests.

Dr. Chandulkar admitted that physical tests should also be carried out on formulations, but there is no serious examination of particle size in WP formulations.

Appendix 13(10) (i)

TRAINING PROGRAMMES 1987

CENTRAL PLANT PROTECTION TRAINING INSTITUTE, HYDERABAD.



Directorate of Plant Protection, Quarantine & Storage
Ministry of Agriculture
(Department of Agriculture and Cooperation)
Government of India

BACKGROUND

Pest Management is a scientific approach to control of organisms which damage crops. Most of the activities incorporated, are the established practices organized into a comprehensive programme. Emphasis is placed on the need based, rather than indiscriminate use of pesticides, in controlling pests and at the same time protecting the environment. Keeping this in view, the pest management approach attempts to integrate all forms of control measures to keep pest population at a less injurious level. For popularising this approach among the farmers, trained contingent of qualified pest management specialists are necessary.

The Central Plant Protection Training Institute, Hyderabad, is engaged in the task of training the plant protection workers in the modern concepts of pest management. The Institute is functioning in a spacious 17 ha. campus in the out-skirts of the city with major disciplines namely: 1. Plant Pathology, 2.Entomology, 3.Pesticide Chemistry, 4.Weed Science, 5. Agricultural Engineering and 6. Extension/Communication.

COURSES :

Basically the courses organized by the institute are broadly of two types: 1. Regular and 2. Short Courses.

REGULAR COURSES :

1) Post Graduate Diploma Course (PGDC): This is an integrated course, leading towards the award of a diploma in plant protection in which a crop wise approach to pest management has been adopted. This course is designed for officers having a bachelor's or master's degree in agriculture, serving in the department of agriculture of the States as well as Foreign Countries. Apart from the inservice candidates the course also admits a few fresh Agricultural Graduates who wish to take up plant protection as a career.

2) Advanced Plant Protection Course (APP): This course, emphasizing the integrated approach to pest management, is meant for senior officer's in the department of agriculture of the State Government as well as Foreign Countries.

3) Pesticide Formulation Analysis Course(PFA): This course is organized for those who are/ will be manning the pesticide formulation analysis laboratories, set up under the Insecticides Act. Training is given on the latest techniques of analysis of commonly available formulations of pesticides.

4) Pesticide Residue Analysis Course (PRA): This course aims at training personnel who will be required to undertake the residue analysis work in different pesticide testing laboratories.

ADMISSION TO THE COURSES :

For both Indian & Foreign National's the qualification for all regular and short courses in B.Sc.(Ag.)/B.Sc.Biology, Chemistry /B.E. Automobile Engineer/B.Tech./B.Sc.(Agri. Eng.) & atleast 3-4 years experience in Plant Protection/Agriculture/Chemical Analysis.

Indian Government officials are to be sponsored by the State / Union Territory Department of Agriculture, Agril. Universities, Agril., Organizations of Central Government. The nominations should reach (three months in advance) the Director, Central Plant Protection Training Institute Rajendranagar, Hyderabad-30, under intimation to Plant Protection Adviser, to Government of India, Directorate of Plant Protection, Quarantine and Storage, NH.IV., Faridabad-121 001, (Haryana). The expenditure towards boarding and travelling is to be met by sponsors.

Foreign Governments may also sponsor their officials and send the nominations for any course atleast six months in advance. The nominations and requests addressed to the Plant Protection Adviser to Government of India, should be sent to Ministry of External Affairs, Government of India, through their embassies. Foreign Governments have to bear all the expenditure of their officials either by themselves or through FAO / UNDP of UN's or Colombo plan or SCAAP or any other Bilateral Agreement with Government of India.

Private Pesticides Manufacturing Companies can also sponsor their candidates for any of the courses by bearing the expenditure on tution fees, boarding and lodging. The companies should request to the Plant Protection Adviser to Government of India, for approval atleast three months in advance.

Fresh Agricultural Graduates can only apply on plain paper by giving bio-data for admission to the Post Graduate Diploma Course in Plant Protection in response to the local news paper advertisement in the month of May and June, of every year.

FACILITIES :

Accommodation : The participants of various courses are provided with free furnished accommodation in the hostel located in the campus. Residence in the hostel is compulsory for all the participants. Families are not allowed in the hostel.

Library : Library of this institute provides free access to the trainees and staff members for consulting current references in plant protection subjects.

Communication Centre : The Communication Centre, equipped with modern photographic and printing facilities, is instrumental in bringing out publications in the form of mimeographs, manuals, leaflets, folders, bulletins etc., related to Integrated Pest Management. The Institute has a large collection of 5100 coloured slides on different aspects of Plant Protection, which are used in all training programmes.

Audio - Visual Aids : Classroom training is assisted through audio-visual aids. Trainees are also trained in the planning, preparation presentation, preservation of all such aids & they are required to use them in their seminar/teaching plan presentations which form a part of their training course activities.

Developing countries specially in the South East Asia have already taken advantage of this training facility by sending officers for various courses. 107 Officials have already been trained from different countries viz., Afghanisthan, Bangladesh, Burma, Ethiopia, Iran, Iraq, Kuwait, Laos, Malaysia, Mauritius, Nepal, Nigeria, Philippines, South Korea, Sri Lanka, Tanzania, Thailand, Vietnam, Yemen and South Yemen, till December, 1986.

Appendix 13(10) (iii)

CENTRAL PLANT PROTECTION TRAINING INSTITUTE

TRAINING SCHEDULE FOR 1987

REGULAR COURSES :

Course Title	Commencing from
1. Post Graduate Diploma Duration : 10 months	7.7.1987
2. Advanced Plant Protection Duration : 3 months	1.6.1987 1.10.1987
3. Pesticide Formulation Analysis Duration : 3 months	2.2.1987 1.6.1987 1.10.1987
4. Pesticide Residue Analysis Duration : 3 months	2.2.1987 1.6.1987 1.10.1987

SHORT COURSES :

1. Pesticides their handling, storage and safe use - 4 days	6.1.1987
2. Application Techniques and maintenance of Plant Protection Equipment - 7 days	13.1.1987
Seminar-cum-Workshop on Plant Protection Technology for Subject Matter Specialists - 21 days	7.1.1987*
4. .do. .do. - 21 days	7.2.1987*
5. .do. .do. - 21 days	7.3.1987*
6. Rodent Management - 7 days	9.6.1987
7. Audio Visual Aids and Communication Techniques for Plant Protection Workers - 9 working days	16.6.1987
8. Testing methods for Pesticide Application Equipment - 3 days	18.8.1987
9. Seminar-cum-Workshop on Plant Protection Technology for Subject Matter Specialists - 21 days	7.9.1987*
10. Weed Management for Extension Officers - 7 days	9.9.1987
11. Instrumental Analysis of Pesticide Formulation - 10 working days	7.9.1987
12. Disease Management in Crop Plants - 3 working days	22.9.1987
13. Integrated Pest Management in Rice - 7 days	28.9.1987
14. Seminar-cum-Workshop on Plant Protection Technology for Subject Matter Specialists - 21 days	7.10.1987*
15. Biological Control of Crop Pests and Weeds - 7 days	3.11.1987
16. Aerial Spraying Techniques for Agricultural Officers/Engineers - 6 days	17.11.1987
17. Audio Visual Aids and Communication Techniques for Plant Protection Workers - 9 working days	1.12.1987

* Courses conducted on behalf of Directorate of Extension. Participants are to be nominated by Director of Agriculture from various State Government and Union Territories.

For further information please write to Director, Central Plant Protection Training Institute, Rajendranagar, Hyderabad-500 030. Tels.48346, 48328, 48329, 48330, 48374,48378, 48347 & 48379 and Director's Resd. No.237324. Telegram - KRISHIRAKSHA, HYDERABAD - 500 030, Andhra Pradesh, India.

DECEMBER, 1986.

Produced, Designed & Printed by
Communication Centre,
Central Plant Protection Training Institute,
Rajendranagar, Hyderabad - 500 030.

Annexure 13.(11)

Visit Report : 18th Feb 1987

Institute : Indian Council for Agricultural Research
Directorate of Rice Research
Rajendra Nagar, Hyderabad 500030 (A.P.)

Personnel Visitors Dr. Q.A. Geering UNIDO

Dr. N.R. Bhateshwar PDPI/HIL

Staff Dr. I.C. Pasalu - Senior Entomologist.

Dr. Pasalu

The objective of the department/directorate is to identify rice problems of national importance, to formulate research projects on these problems, and implement them through collaborating centres in India. There are a total of 60 collaborating centres for all programmes, and 40 of these are involved in the entomology programme.

The directorate does not evaluate products/ formulations of pesticides from private companies, but it would test HIL products. In the first instance this would involve lab/glass house bioassay, and local field trials, before passing out to collaborating centres.

Brown Plant Hopper (Nilaparvata lugans) can now be largely controlled by a resistant variety as also can gall midge.

The national recommendations for rice pest control are made at this research centre.

The glass-house complex was inspected. This is used for culturing insects, i.e., Brown Plant Hopper, and Gall midge. In separate units varietal resistance is tested for both of these pests. In other units bioassays of insecticides are conducted.

Major target pests for insecticide control are lepidopterous stem borers and rice Hispa (Dichladispa armigera).

Some of the features observed in the glass houses have been incorporated in the specification for PDPI new glass houses. The total complex was locally manufactured, the framework being well-maintained painted steel.