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INTEGRATED PEST MANAGEMENT FOR HIGH VALUE CROPS: AN ASSESSMENT OF CURRENT STATUS AND FUTURE OPTIONS

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CONTENTS

		Page
I.	INTRODUCTION	01
II.	REVIEW OF RESEARCH REPORTS AND ANALYSIS OF CURRENT ENTOMOLOGICAL RESEARCH BEING DONE BY DEPARTMENT OF AGRICULTURE	02
	A. Summaries of the work done at Regional Agricultural Research Station, Girandurukotte and Aralaganwila	03
	B. Summaries of the work done at Regional Agricultural Research Station Maha Illuppallama	23
	C. Summaries of the work carried out at the Central Agricultural Research Institute, Gannoruwa, Peradeniya(CARI)	30
	D. Summaries of Miscellaneous publications	40
III.	REVIEW OF ENTOMOLIGICAL RESEARCH PROGRAMS FOR 1990-91	44
IV.	REVIEW THE ENTOMOLOGICAL EXTENSION RECOMMENDATIONS MADE BY MEA AOs IN SYSTEM B AND EVALUATE THE MECHANISM AND EFFECTIVENESS OF GETTING THIS INFORMATION TO THE SETTLERS	46
V.	ADVISE THE DEPARTMENT OF AGRICULTURE ON IMPROVED AND UP TO DATE PROCEDURES	49
	A & B Identification of Insect Pests And Their Natural Enemies	
	C Simplified Assessment of Population Dynamics.	
	D Determining Best Stage for Insecticide Application.	
	E Assessing Yield Losses and Economic Threshold.	
	F Determining Yield Recovery After Control Measures are Used.	
	G Developing Understanding Of Ecological Factors Responsible For Peak of Major Pests.	
	H Screening Varieties For Resistance	

Page

VI. DEVELOP IPM FOR CUCUMBEP ᐧRKIN) INSECT CONTROL..... 51

VII. UP TO DATE LISTS OF IP ᐧES REGISTERED FOR USE IN SRI LANKA, INDI VING RESTRICTED USE IN THE USA..... 52

VIII. TOPICS FOR PREPARING THE REPORT..... 64

A. Analysis Of Current Entomological Research Being Done at DOA.

B. Analysis of Current Methodologies Used By MEA Extension Relative to Insect Identification and Control In System B.

C. Recommendation for Rapid and Accurate Identification Of Harmful Insects..... 65

D. Recommendations Which Will Assist in Reducing Overuse of Pesticides..... 66

E. Recommendation Which Will Result In Proper Application Of Various Insecticides At The Proper Growth Stage And Rate.

F. Refined Methods for Measuring Yield losses from Insects..... 67

IX. ACKNOWLEDGEMENTS..... 68

X. CONTACTS VISITED IN SRI LANKA..... 69

XI. ITINERARY FOR VISIT SEPTEMBER-OCTOBER 1990..... 71

LIST OF TABLES

		Page
Table I	- List of insecticides Registered in Sri Lanka	55
Table II	- List of insecticides banned in Sri Lanka	60
Table III	- List of insecticides Registered in India	61
Table IV	- List of insecticides restricted in USA	63

APPENDICES

		Page
Appendix I	- Terms of Reference of Consultancy.....	73
Appendix II	- List of Reports examined.....	75
Appendix III	- Research Programs.....	76
Appendix IV	- List of Laboratory requirements for RARC/Aralaganwila.....	88

ACRONYMS

AO	Agriculture Officer
ARSAP	Agricultural Requisites Scheme for Asia Pacific
BPH	Brown Plant Hopper
CARI	Central Agricultural Research Institute
CIRAD	Cooperation Centre of International Research and Agriculture Development
CNLD	Chilli Narrow Leaf Disorder
DAS	Days After Spraying
DOA	Department of Agriculture
DBM	Diamond Black Moth
ETL	Economic Threshold Level
FA	Field Assistant
IIE	International Institute of Entomology
IPM	Integrated Pest Management
MARD	Mahaweli Agriculture and Rural Development
MEA	Mahaweli Economic Agency
OFC	Other Field Crops
PCM	Potato Cyst Nematodes
RARS	Regional Agiriculture Research Station
GI	Galling Index
RLF	Rice Leaf Folder
RO	Research Officer
USAID	United States Agency for International Development

I. INTRODUCTION

To diversify the paddy agriculture practiced by most settler farmers, The Mahaweli Economic Agency (MEA), Mahaweli Agriculture and Rural Development Project(MARD) are introducing and encouraging farmers to grow high value horticultural crops such as gherkins,asparagus, grape and strawberry as well traditional crops such as green gram, groundnut, cowpea onion, chillies etc;

Pests are one of the major constraint in the production of these crops. At present, the farmers depend heavily on pesticides for pest control. A lot of pesticides get dumped on these crops, often when even they are not required. These are not only expensive but they pollute the environment, and are toxic for human beings. The horticultural crops pose a special threat because the farmers may send the produce to market soon after spraying when insecticide residues are still on the crop.

A consultancy was arranged by the MARD Project to look into possibilities of developing Integrated Pest Management so that total reliance on pesticides can be avoided. The terms of reference are given in Appendix I.

During the stay the Consultant visited various Research Institutes including CARI,Aralaganwila,Girandurukotte and Maha Illuppallama. Plant protection work was discussed and information relevant for the report was collected. He visited fields of both the settler and commercial farmers as well as experimental plots of the Regional Agricultural Research Stations at Girandurukotte and Aralaganwila.

II. REVIEW OF RESEARCH REPORTS AND ANALYSIS OF CURRENT ENTOMOLOGICAL RESEARCH BEING DONE BY DEPARTMENT OF AGRICULTURE.

All the available reports for Regional Agricultural Research Stations (RARS) at Girandurukotte, Aralaganwila and Maha Illuppallama and Entomology Research Highlights issued from the Cental Agricultural Research Institute (CARI), Gannoruwa Peradeniya and some other publications were studied. The list is given in Appendix 11. Summaries of the studies carried out at the above mentioned Research Institutes are given here. Some reports from CARI were not available because they contained information on all the disciplines of agriculture and were, most probably, meant for internal use. However, Entomology Research Highlights prepared by Dr C. Kudagamage substituted well for these reports.

The research has been mainly done on screening of pesticides and varieties against various pests. The analysis shows that out of 38 experiments carried out from 1985 - 1989 at RARS Girandurukotte, 24 were on insecticide trials, three were on screening the varieties and 11 on other various aspects. None were on the bionomics of the pests or their natural enemies. Similarly out of 37 experiments made at RARS Aralaganwila during the same period 7 were on insecticide trials, 4 on varietal trials and 26 on miscellaneous studies but none on the biology as ecology of the pests was their natural enemies. Recently, there has been a change and studies on bionomics and natural enemies have been started.

To develop integrated Pest Management (IPM), lists of pests attacking various parts of the crop and their natural enemies should be prepared. Detailed studies on their taxonomy, biology, ecology, Phenology, and behaviour are required. When natural enemies that are already present have been determined, simple introduction of suitable natural enemies from elsewhere may solve the pest problem.

In IPM, the main emphasis is on biological control.Normallly a number of pests are under natural control and indiscriminate use of pesticides may kill these natural enemies, then minor pests may become major pests. Studies on biology, ecology behaviour, phenology etc, may lead to development of cultural practices for the control of the pests. Even for the judicious use of pesticides, such observation are a must. Thus these studies are needed for development of IPM.

Given the present state of knowledge about Sri lankan pests and their natural enemies, IPM cannot be developed. It is high time that such studies are started.

A. Summaries of the work done at Regional Agricultural Research Stations at Girandurukotteand Aralaganwila

Yala 1985

Girandurukotte (System C)

Ten experiments were conducted during the season. These are as follows:

1. Effectiveness of pesticides against cowpea pod borer.

Six pesticides baythroid, monocrotophos (Nevacron) bayrusil, Thuricide, Lannate L and Monitor (methamidophos were screened. Bayrusil, baythroid and Monitor gave good control followed by monocrotophos and Lannate L. The trial aims to be replaced.

II. Evaluation of pesticides agairst greengram pod berer.

The above mentioned six pesticides were screened against green gram pod borer. The pod borer population was very low and the difference between different treatments was not significant.

III. Evaluation of pesticides against brinjal pod borer.

Four pesticides carbaryl 85 WP, Thuricide, Tokuthion and IK 17899 (Atabron) were tested against the brinjal pod an shoot borer. Based on yield Thuricide and IK 17899 gave better control than other pesticides. Yield in Tokuthion treated plots and the control was the same.

IV. Observations on pests of important crops.

Survey was carried out for the pests of brinjal. Plant hoppers, brinjal shoot and pod borer, leaf eating caterpillars, Epilachna spp. were recorded as pests. Shoot and pod borer was the major pest and it damaged 50 to 100 % plants. The other major pests were Epilachna spp. and leaf-hoppers. Dragon flies, damsel flies and lady bird beetles fed on hoppers and aphids. Spiders fed on caterpillars. Thirty two species were recorded as incidental pests or as visitors.

V. Integrated pest control/economic threshold of rice pests.

Studies were made at Girandurukotte and Batalayaya. The pest incidence remained very low and the result were not conclusive. The study would the continued next season.

VI. Evaluation of granules pesticides for control of white stem borer.

Efficacy of five granular insecticides Carbofuran, Dyfonate, Solvirex, Oncol and Basudin against white stem borer was studied. The pest population was negligible in all the treatments including control and difference in different treatments was not significant.

VII. Optimum seed rate of rice variety BG 94-1 was studied

Seed of rice variety BG 94-1 at the rate of 100, 150, 200, 250 and 300 Kg/ha was used. There was no relationship between the seed rate and yield. Broad leaf weeds tended to decrease with increase in seed rate.

VIII. Optimum seed rate of rice variety - BG 276-5 was studied.

The results of the experiment were the same as described above (experiment-VII)

IX. Effectiveness of pesticides against chilli leaf curl disease

Six pesticides including monocrotophos + S, Anthio 33+S, Actellic +S, Acetellic, Folimat and Lebaycid against chilli leaf curl were tested. Out of these five pesticides gave higher yield than the control. The yield where Acetellic was applied was low. Thrips, aphids, whitefly and mites were found feeding on chillies.

X. Efficacy of insecticides against rice thrips

Six pesticides dimethoate 8 ml/4ll, fenthion 5 ml/4l, methamidophos 4 ml/4l, Bayrusil 8 ml/4l, carbaryl 15 g/4l and diazinon 8 ml/4l, was screened. The results were inconclusive because the difference in different treatments was insignificant.

Aralaganwila (System B)

One experiment was carried out during the season

I. Economic threshold level on rice with integrated pest management.

Five treatments, complete control, natural control, new ETL, old ETL and farmer's practices were tested. The difference in yield was not significant in all the five treatments.

Maha 1985 - 86

Girandurukotte

Nine experiments were conducted during the season.

I. Efficiency of pesticides against brinjal shoot borer

Efficacy of six pesticides Sevin, Padan 50 SP, Sevin XLR, Atabron (IKI 7899), Larvin 75 WP and Tokuthion on brinjal shoot and fruit borer Leucinodes orbonalis was studied. Th difference between number of damaged and undamaged fruits and their weight, in different treatments' was not significant. However, there was significant difference in marketable brinjals in different pesticide treatments. Larvin 75 WP was the best.

II. Effectiveness of pesticides against cowpea pod borer

Efficacy of six pesticides Lannate 18%, Sevin XLR, Larvin 37 S, Larvin 75 WP; Padan 50 SP and Atabron, against cowpea pod borer, Maruca testulalis was studied. The percentage pod bored and yield/ha with different treatments of pesticides was not significant.

III. Evaluation of pesticides against brown plant hopper on rice

Efficacy of six pesticides - Lorsbane 2G, Oncol 3G, Solvirex 5G, Applaued 50 WP, Furadan 3G, Zectran 25 WP for control of brown plants hopper of rice Nilaparvata lugens (BPH) was studied. The difference in mortality rate of the BPH and yield was not significant.

IV. Evaluation of granular pesticides against yellow rice stem borer

Six granular pesticides Carbofuran 3G (curator), Dyfonate 3G, Solvirex .5G, Benfuracarb Diazinon and carbofuradan were screened against yellow rice stem borer Tryporyza incertulas. The yield in different treatments was not significantly different.

V. Evaluate of insecticides against chilli leaf curl

Efficacy of seven currently recommended and some new pesticides against chilli leaf curl was studied. The insecticides tested were Actellic, monocrotophos, Folimat, Lorsban, Anthio, Orthene 75 SP, Lebaycid. All the plots treated with pesticides gave higher yield than the control. The maximum yield was with Actellic followed by monocrotophos, Folimat, Lorshan, Anthio, Lebaycid and the control in descending order.

VI. Evaluation of pesticides against okra pod borer

Five pesticides were screened for control of okra pod borer Earias vittella. The populations of both Empoasca spp. and E. Vittella were low. The difference in yield in the control and plots treated with pesticides carbaryl (Sevin), Mexacarbate, Lorsban, carbaryle (Sevin XLR) and cartap (Padan) was not significant.

VII. Evaluation of pesticides against green gram pod borer

Effectiveness of six pesticides Lannate L, cartap, monocrotophos, Larvin 75, Imidan and Atabron against green gram (Vigna radiata) and pod borer (Maruca testulalis) was tested. Bad weather adversely effected the crop and results were not conclusive.

VIII. Demonstration of Integrated Pest Management/economic threshold of rice pests.

An experiment was conducted to determine new threshold of rice pests. The experiment was repeated for the second connsective season. The results were inconclusive again.

IX. Special studies on chilli leaf curl.

Studies were made on effect of soil, weeds and mulching on chilli leaf curl. Eleven local varieties of chilli were also screened against this disease. Walpita purple and Walpita varieties showed moderate level of resistance, other varieties ADA kandy (two varieties), Kolatenna, Namaltalawa, Nawinna, Eragama- 1 & 2, Kolatenna purple and MI-2 were suscepltible. There was no effect of the soil, weeds and mulching on the disease incidence.

Aralaganwila

One experiment was conducted during the season.

1. Economic threshold for various pests on rice.

Five treatments made on plots of rice variety BG 400-1 were complete control, old economic threshold, new economic threshold, farmer's practices and natural control. The difference in various treatments was not significant therefore, results remained inconclusive.

Yala 1986

Girandurukotte

Nine studies were conducted during the season

I. Evaluation of pesticides on brinjal shoot and fruit-borer

Efficacy of six pesticides on brinjal shoot and fruit borer Leucinodes orbonalis was studied. The plants treated with Atabron gave the highest yield followed by Larvin 75 WP, carbaryl (Sevin), carbaryl (Sevin XLR), cartap. The yield from plots treated with Tokuthion was almost the same as in the control.

II. Evaluation of pesticides against chilli curl disorder

Efficacy of six pesticides was determined for control of chilli leaf curl disorder. Pesticides screened were Larvin 75 WP, Mexacarbate, Anthio, Metasystox 25 EC, Lorsban and Actellic. The narrow leaf disorder appeared even in the nursery and result were not conclusive.

III. Insecticide evaluation against rice brown leaf hopper

Six pesticides Lorsban, Oncol, Solvirex, NNI (Buprazezin), Furadan and Mexacarbate were screened for the control of brown plant hopper (BPH) (Nilaparvata lugens) on rice variety BG 94-1. Although all attempts were made to increase the BPH population, because of its low infestation results were inconclusive.

IV. Evaluation of pesticides against okra jassid

Efficacy of five pesticides Sevin XLR , Lorsban, Mexacarbate, Selecron and Unden against okra jassid (Empoasca spp.) was studied. Selecron, Sevin XLR, Mexacarbate and Unden controlled the jassid effectively.

V. Evaluation of pesticides against chilli narrow leaf disorder.

Effect of six pesticides Selecron, monocrotophos, Orthene, Folimat, Imidan and an antibiotic Tetracycline on chilli narrow leaf disorder (CNLD) was studied. The yields were very low because of CNLD and plants in all the treatments were affected. Therefore, no conclusion could be drawn.

VI. Demonstration of Integrated Pest Management of rice pests on farmer's field at Belaganwewa.

The population of various pests remained very law. The natural enemies were comparatively more abundant. There was no yield difference among the various treatments. No conclusion could be drawn.

VII. Evaluation of local lines of chilli against narrow leaf disorder

Twelve local lines of chilli were screened against chilli narrow leaf disorder. Two varieties showed moderate resistance. Seed of these varieties was given to the Agronomist.

VIII. Natural enemies of rice

Studies on natural enemies of rice pests were carried out. The material collected was sent to University College of Cardiff for identification.

IX. Evaluation of pesticides against cowpea pod borers

Six pesticides Lannate, Sevin XLR, Larvin 375, Larvin, cartap and Atabron were screened against cowpea pod borers (Maruca testulalis and Ettiella zinckenella). Atabron, Larvin 375 EC and Larvin 75 WP were recommended for use against cowpea pod borers.

Aralaganwila

The following three studies were made during the season

I. Studies on mosaic disease in green gram

Four varieties of green gram MI-04, MI-05, type 51 and type 77 were screened for resistance against mosaic disease. Effect of different fertilizers on this disease was also investigated. Type-77 are MI-04 were most susceptible and type 51 and MI-05 were relatively resistant. The difference in different treatment of fertilizers was not significant.

II. Studies on trap plants to control chilli narrow leaf disorder.

Unsuccessful attempt was made to determine whether tomato, capsicum could be used as trap crop for controlling narrow leaf disorder in chilli.

III. Integrated Pest control trials in rice

Economic threshold for rice pests under Integrated Pest control system using rice variety BG 34/8 on 5 July was studied. Difference in yield under complete control, old economic threshold, new economic threshold, farmer's practices and natural control was insignificant therefore experiment was inconclusive.

IV. The above experiment was done with the same rice variety on 21 June.

Yield where complete control was done was highest. The other treatments (given above) gave almost the same yield.

Maha 1986-87

Girandurukotte

The following seven experiments were done during the season

1. Evaluation of insecticides for controlling citrus leaf miner

   Efficacy of six pesticides for control of citrus leaf miner was studied. Diptrex 50 EC, Atabron, Folimat LC, Anthio, Orthane and cartap were screened. There was no significant difference between various treatments, therefore the trial would be repeated in Yala 1987.

II. Insecticidal trial against brinjal shoot and fruit borer (Leucinodes orbonalis)

   Six pesticides carbaryl (Sevin and Sevin XLR), cartap, Atabron, Larvin and Tokuthion were screened. The difference in marketable yield in all the treatments, including control, was not significant.

III. Screeing of resistant rice varieties for stem borers.

   Twenty three varieties were screened. Dead hearts and white heads were produced in small numbers, therefore no conclusion could be made.

IV. Studies on natural enemies of rice pests.

   Maximum infestation was of brown plant hopper followed by rice leaf folder. Spiders, coccinellids, Cyrtorhinus, Ophicner, unidentified Hymenoptera and Diptera were recorded as natural enemies.

V. Studies on effect of mulching on narrow leaf disorder in chilli.

   Mulching was done with yellow polythene, black polythene, aluminium painted polythene, and straw. Insecticide was sprayed after every ten days. The highest yield was obtained from the plots covered with aluminium painted polythene. Yellow and black polythene mulching was better than where no mulching was done. Use of pesticide gave less yield compared with mulching treatments. Straw mulching gave the lowest yield.

VI. Insecticide trials against sweet potato weevil cylas formicarius.

Five pesticides Mackfos, Suscon-G, Pirimicid, Oncol 3G and Hosathion were screened. The difference between different treatments was not significant. Therefore, the experiment would be repeated next season.

VII. Effect of intercropping chilli with other crops on insect pests and diseases

Chilli was intercropped with raddish, tomato, finger millet, mustared and garlic. The incidence of viral disease was almost the same in all the intercrops. There was no difference in total number of pests observed. However, there was some variation in the number of various pests in different combination of crops with chilli. Details are not given.

Aralaganwila

Four experiments were conducted during the season

I. Integrated Pest Control in rice.

The experiment was done to determine economic threshold level (ETL) of leaf roller Cnaphalocrosis medinalis and paddy bug Leptocorisa oratorius. Five treatments were applied a, biweekly insecticide application b, insecticide application according to old ETL C, insecticide application based on new ETL d, farmer's control practices and e, no pesticide application.

The highest yield was obtained with treatment a but it was very expensive and hazardous. The new ETL (treatment c) was as good as the old one (treatment b) and should be adopted for the control of leaf roller. Details of treatment c are not given in the report.

II. Evaluation of Insecticides against brown plant hopper (BPH).

Six substances including four pesticides were tested for control of BPH. These included NNI (Buprazenin) BPMC, Zectran 25 WP, Lorsban 40 EC, Soap + Kerosene + Sand and wood ash. Infestation of the BPH was not found throughout the season therefore conclusion could not be drawn.

III. Pest damage evaluation in Soyabean.

Nine varieties of soyabean PM 78-13, PM 78-15, Fitzroy, Heuites 77, Duocrop BM-2, F 73-4, Saoliz and PB-1 were screened. The pest recorded included Heliothis armigera, Ophiomyia phaseoli, Empoasca spp. Nezara viridula, Spodoptera litura, Phytomyza horticola, thrips, Plusia spp. and Maruca testulalis. Fifty four days after planting insecticides had to be used, Therefore resistance could not be determined.

IV. Evaluation of pest damage to green gram.

A number of varieties of green gram were screened. H.armigera, S. litura, P horticola, Plusia sp. Lamprosema spp., M. testulalis, Etiella zinkenella, Empoasca spp., N. viridula, thrips spp. and Epilachna spp. were recorded as pests. Because the fields were sprayed with pesticides 57 days after planting. Therefore, data for resistance were not collected.

The serious pest recorded were brown plant hopper, green leaf hopper and stem borers. Their incidence was studied.

The natural enemis recorded were dragonfly, damselflies, (Agriocnemis spp.), coccinellid Microvelia spp,spiders, carabids (Ophionea spp), water strider (Limnogonus spp. tachined (Sturmiopsis spp) and (Conocephalus spp).

II. **Population dynamics of maize pests and their natural enemies.**

Aphids, thrips, stem borers Chilo spp., caterpillars feeding on leaves especially Heliothis spp., delphacids and cicadelids were major pests . The natural enemies recorded were spiders, coccinellids and Ophionea spp. Unidentified parasitoids was reared from the above mentioned insects. Aphids, Thrips and plant hoppers were more serious than stem borers and leaf eating caterpillars.

III. **Population dynamics of beanfly Ophiomyia phaseoli on green gram.**

The lowest infestation was on the crop sown on 24 August and highest on the crops sown on 28 September. Beanfly infestation is high in Yala season.

IV. **Population dynamics of cabbage pests.**

The major pests were stem borer Hellula undalis, harlequin bugs Bagrada spp, aphid (Brevicoryne brassicae) and cabbage webworm (Crocidolomia binotaeis). These pests did serious damage resulted in almost complete destruction of the crop in 60 days. The aphid and bug were more abundant than the stem borer and webworm.

V. **Population trends of pests of chilli and their natural enemies.**

Aphids, thrips and whitefly were most important pests. Flea beetles, Spodoptera spp. and cicadelids were also recorded feeding on chilli. The aphid and whitefly were more abundant than thrips, coccinellids and spiders were recorded as natural enemies.

VI. **Population dynamics of pests of Bombay Onion and their natural enemies.**

Thrips tabaci, Spodoptera spp. and aphids were the major pests. Bagrada sp. and flea beetle were also recorded in small numbers. Spiders were recorded as the natural enemies throughout the season.

Yala 1987

Girandurukotte

During this season there experiments were carried out.

I. Evaluation of pesticides against okra jassid Empoasca spp.

Five pesticides Selecron, Savin XLR, Lorsban, Mexacarbata and Unden were screened. Because of heavy infestation of the jassid the experiment was abandoned.

II. Evaluation of three pesticides against sweat potato weevil.

Three pesticides Lorsban (chlorpyrifos), Hosathion (triazophos) and Oncol were tested against the sweat potato weevil (Cylas formicarius). Effect of some cultural practices was also studied. Because the incidence of the pest was low and the difference between different treatments was insignificant the results were inconclusive.

III. Studies on population dynamics of Empoasca sp.

Its population trends were studied on okra, cowpea and cotton by visual observations, sticky traps and yellow pan. Visual counts gave better estimate and okra was better for population estimation than cotton and cowpea because it seems to prefer okra. Maximum infestation on okra was during June and July.

IV. Some other experiments were started but were abandoned because of unavoidable circumstances. The details of these experiments are not given.

Aralaganwila

Ten experiments were carried out at this station during the season.

I. Integrated pest control in rice.

The objective was to develop Economic Threshold Level (ETL) for leaf roller Cnaphalocrosis medialis and paddy bug Leptocorisa oratorius. The population of the leaf roller and the bug did rise above ETL . Therefore, pesticides were not used.

VII. Studies on Populations of tomato pests.

The most important pests were thrips, aphids, whitefly, Spodoptera litura and Heliothis armigera. Of the five varieties of tomato screened, highest infestation of thrips was on KWR, T245, Marglobe, Beans and Roma in descending order.

Infestation of thrips and aphids was high during the dry period which coincided with 33 to 48 days after planting.

VIII. Studies on population of Sweet potato weevil Cylas formicarius on different varieties under mulching.

Five varieties Wariyapola, CARI-9, VSP 2, Cinchi and CARI-273 were sown with mulching and without mulching. The crop was heavily infested in both the treatments and difference between the treatments was not significant.

IX. Studies on varietal resistance in sweet potato to C. formicarius

Nine varieties Chinchi, Wariyapola, C-26, CARI-9, CARI-99, CARI-242, CARI 271, CARI-273 and VSP-2 were screened. The highest infestation was on VSP 2 followed by CARI-99, C-26, CARI-9, Cinchi, CARI-242, WAriyapola, CARI-273, and CARI 271, in descending order.

X. Efficacy of pesticides for control of citrus leaf miner.

Nine pesticides Diptrex, Atabron, Folimate, Anthio, Orthene, Padan, Elsan, Oncol and Methidathion were screened. Treatments were not significantly different at any rate. However, Oncol treated plants had minimum damage.

Maha 1987-88

Girandurukotte

No work on plant protection was done

Aralaganwila

The following five experiments were done during the season

I. **Survey for pests and their natural enemies of maize, chillis, onion, mungbean and cabbage was made and studies on population trends of major pests were carried out.**

Maize:

On maize major pests were aphids and planta hoppers sucking plant juices;larvae of Heliothis sp. Mythimna sp., Spodoptera spp. feeding on leaves; Chilo sp. and Sesamia sp. boring stems; flea beetles and thrips feeding on leaves. Natural enemies recorded were spiders, coccinellids and Ophionea sp.

Chilli:

Major pest on Chilli were aphids, thrips, whiteflies and plant hoppers and minor pests were Spodoptera sp;, Plusia sp. Epilachna sp. Dysdercus sp. an fleabeetles. Natural enemies recorded weere spiders, syrphids and coccinella sp.

Onion:

Main pests were Spodoptera sp., Plusia sp., thrips and fleabeetles feeding on leaves; aphid and whiteflies sucking plant juices. Spiders were found feeding on these.

Mung bean:

The important pests were thrips, aphids, whiteflies, Empoasca and Nezara viridula sucking plant juices; Heliothis sp., Spodoptera sp., Plusia sp., unidentified chrysomelid and Epilachna sp. feeding on leaves, Phytomyza sp. mining leaves; Ophiomyia phaseoli mining stems and leaves and Maruca sp,. boring pods. Spiders, Coccinella sp. and Ophionea sp. were recorded as natural enemies.

Cabbage:

Aphids, Bagrada sp., Spodoptera litura, Crocidolomia binotalis and Hellula undalis were the major pests. Plutella xylostella, Plusia sp. thrpis, mites, nettle grub flea beetle, stem fly and whiteflies were recorded as minor pests. Spiders, syrphids and Coccinella sp. were recorded as natural enemies. Population trends of most of the above mentioned pests were studied.

II. Population trends of beanfly Ophiomyia Phaseoli on green gram.

The population fluctuated from 3 to 25 plants infested by the fly. The minimum attack was in April and maximum in January.

III. Insect pests of tomato.

The major pests were aphids, whitefly, mirids, plant hoppers, thrips, S. litura, Heliothis sp., Plusia sp. Empoasca sp. Aulacophora sp. and Leucinoides orbonalis. Population trends of aphids, thrips, Whiteflies, mirids, Heloithis sp., and Spodoptera sp. were studied. Attack of thrips was severe during flowering season, that of aphids on young plants and of whitefly 46-65 days after planting. S. litura was abundant during flowering and fruiting. Spiders and Coccinella spp. were the natural enemies recorded.

IV. Evaluation of Pesticides for controlling sweet potato weevil cyclas formicarius.

Five pesticides chlopyriphos 25% WP, fenthion 50% EC, Pirimiphos methyl 20% dust and carbofuran 3% and leaves of Margosa were screened against sweet potato weevil. The application of fenthion 0.9 kg. ai/ha. at fortnightly intervals controlled the pest effectively. All other treatments showed no significant difference with the control.

V. Testing pigeonpea varieties for pest resistance.

Four pigeonpea varieties EPE 45-2, ICP- 9093, ICP 7203 and T 21 (check) were screened. On some varieties infestation of some insect pest was low. However, no definite conclusions were drawn.

Yala 1988

Girandurukotte

No work done on plant protection.

Aralaganwila

Three experiments were done during the season.

1. Evaluation of pesticides against rice leaf folder Cnaphalocrocis Medinalis (RLF).

   Four pesticides Dimilin 25 WP, Alsystin SC 480, Orthane 300 EC, and Selecron 50% EC were tried . The experiment was abandoned due to low infestation of RLF.

II. Population dynamics of pests and their natural enemies on maize, onion, chilli, mungbean, tomato and cabbage.

   This was continuation of the work of the previous season. The pests recorded from the above mentioned crops were almost the same as given above. Population trends of various species were studied.

III Population dynamics of beanfly Ophiomyia phaseolei.

   Maximum plants were infested in June (14 Out of 25) and minimum in April (3). Similarly number of larvae and pupae of the beanfly were maximum in June (18) and minimum in April (3). Maximum number of larvae and pupae per plant was 4. The beanfly population was lower during Yala than previous Maha.

Maha 1988/89

Girandurukotte

No work on plant protection was done during the season.

Aralaganwila

During the season the following four experiments were done.

1. Evaluation of insectide for the control of rice leaf folder Cnaphalocrocis medinalis.

   Five pesticides Dimilin, Alsystin, Orthane, Tokuthion, Lorsban were screened. The experiment was abundoned due to lower infestation of the pest.

II. Population dynamics of pests of maize, onion and green gram and their natural enemies.

   This was continuation of the work of the previous season. No addition pest was recorded. On maize population trends of plant and leaf hoppers, Heliothis sp., chrysomelid, Chilo sp., aphids and thrips; on onions thrips, Spodoptera litura, a chrysomelid and Lepidoptera feeding on leaves; and on mungbean that of Heliothis sp, Maruca sp. whitefly, thrips, aphids, Empoasca and mites were studied.
   No new natural enemies were recorded.

III. Population dynamics of beanfly Ophiomyia Phaseoli.

   This was continuation of the previous season. Plants were sampled from October to May. Maximum plants were infested in November with a second peak in April. 24 to 60 % plants were infested. The number of larvae and pupae per sample varied from 6 to 17. This fly has higher infestation during Maha.

IV. Incidence of insects on chickpea.

   Fifteen varieties 4918, 11141,84204, 86224, 83128, 84239, 86206, 86209, 5003, 85211,84215, 83149, 83227, 86226 and 86227were planted. Data were collected from the first eight varieties; because germination of other varieties was poor.

   Unidentified chrysomelid fed on young seedlings' leaf eating caterpillars and aphids had high infestation during vegetative phase. Thrips and whiteflies infested during vegetative and flowering stage. Heliothis sp. first fed on leaves and later on pods thus causing a considerable damage to the crop.

All the varieties were equally susceptible. Spiders were observed throughout the season. No other natural enemy was recorded.

Yala 1989

Aralaganwila

Five experiments were carried out during the season. (Taken from sheets provided by Dr. Carl N. Hittle).

I. Resistance of sweet potato varieties to root weevil and stem borer

Nine varieties of sweet potato were screened against root weevil Cylas formicarius and stem borer Omphisa omastomosalis 107 days after planting. CARI 495 showed the highest resistance to both the insects. CARI 488 was more resistant to weevil but more suscepible to stem borer. CARI 352 was more susceptible to the weevil. CARI 352 and CARI 242 were moderately resistant, while CARI 426, CARI 73, CARI 9 and Wariyapola were highly susceptible to both the insects.

II. Evaluation of pesticides against sweet potato root weevil

Three insecticides were screened against root weevil C. formicarius on sweet potato variety Wariyapola. Lebayeid 50% EC gave the best control when sprayed six times at fortnightly intervals at 1,200 ml/ha from 15 days after planting.

III. Effect of pesticides on pest damage and pigeonpea yield.

The effect of pesticides from preflowering stage to pod maturity was study by spraying these at different times after germination. The pod setting was significantly higher with a production of more high quality seed in the untreated control compared to incesticides treatments. The seed loss and pod damage by podfly, pod borers Lampides sp. and Maruca sp. and Cydia sp. was higher in untreated control.

The treatment with Lannate L 18%-EC (at 3080 ml/ha) at 10 and 17 days after flowering (DAF) and carbofuran 3G (at 80 Kg/ha), at 10 days DAF gave higher yield and lower seed loss.

IV. Screeing resistance varieties of pigeonpea

Seven varieties of pigeonpea were screened without spraying pesticides. All the varieties tested showed low susceptibility to pod borers but considerable susceptibility to pod fly and Cydia sp. ICPL - 81 gave the highest yield (1.407 mt/ha) followed by ICPL-269 (1.061), ICPL 8304 (1.031) and ICPL - 187-1 (0.7923). ICPL 187-1 gave the highest yield per plant but had a poor plant stand.

V. Release of insect parasitoid for biological control

The beanfly *Ophiomyia phaseoli* is a major pest of Legumenous crops. A' parasitoid *Opius* sp. was imported by the Central Agricultural Research Institude, Peradeniya from Hawaii. Research on this parasitoid has been intiated.

B. Summaries of the work done at Regional Agricultural Research Station Maha Illuppallama.

Maha 1982/83

Four experiment was done during the season.

I. Screening of insecticides against the leaf hoppers of cowpea.

Five pesticides formothion 33 EC (Anthio), methomyl 18% EC (Lannate) omethoate 50% EC (Folimat), Endosulfan 35 EC (Thiodan), acephate 75% SP were screened against the leaf hoppers. Formathion and methomyl gave best control of the leaf hopper Empoasca sp.

II. Establishment of economic threshold levels for cowpea defoliaters.

In this experiment ten 25-day-old cowpea plots were selected in the field. Number of plants was counted in each plot. Third instar larvae of Dasichira mendosa were released on each plant after one day, two days and three days and defoliation was recorded. The results were regarded tentative.

III. Development of resistance in cowpea Weevil Callosobruchus spp. to pirimiphos methyl (Actellic)

The LD 50 came to 0.01% . It would be compared in the next season to see if the pest had developed resistance.

IV. Assessment of infestation of cowpea Weevil on cowpea pods in the field.

One hundred pods of cowpea were collected from each of five localities and number of eggs on these was counted. Two to four eggs per 100 pods were found indicating that main infestation of the weevil does not take place in the field.

Yala 1985

Eight experiments were conducted during the season.

I. Evaluation of cowpea varieties for their resistance/ tolerance to beanfly Ophiomyia phaseoli.

Eight varieties of copwea Sudu mung, Sel. 23-2, Worth more, EG-2, Arlington, MI-35, Vita-4,. All seasons and control (MI-35) were screened for resistance. Ovipositor punctures in the first two leaves and number of larvae and pupae of the beanfly were counted. Based on the total number of larvae and pupae Sudu mung, Sel 23-2 and Worth more are least susceptible.

II. Screening of green gram varieties to yellow mosaic virus.

Fifteen green gram varieties CES-ID-20, VC 2764A, Type 77, VC 2774A, VC 1973A, MI-5, TV 79-11, IPBM-7932, TV 796, 7715, CES 5S, IPBM-79-132, TV 79-3, CES-IF-1 and 7704 were evaluated for resistance to vector whitefly and yellow mosaic virus (YMV).

Although statistically not significant, CES-IF-1 and 7704 were more attractive to whitifly and YMV incidence was higher on these varieties.

III. Evaluation of green gram varieties for resistance to beanfly.

Data were collected from the trial mentioned above (no II) on all the fifteen varieties. Although statistically not significant, TV 796 and 7715 were least susceptible to beanfly compared to existing varieties such as Type -77, and MI-5.

IV. Some studies on possible cause for bulb rot in Bombay onion.

Four treatments a, use of carbofuran b, spray of Delsinext + Captan c, burning the soil with paddy husk and straw and d, covering the soil with polythene were tried. Difference between the treatments was not significant.

V. Reassessment of population of beanfly Ophiomyia Phaseoli

Studies on popullation dynomics in 1976-79 had indicated that during Yala season high population of beanfly occurred during May and June. To determine if by planting the crop early, it would escape the attack of beanfly, planting was started from 1 March at 10-day-interval. It was concluded that if the farmers sow the crop with the first Yala rains, the crop can escape damage by the beanfly and expenditure on pesticides can be avoided.

VI. Studies on damage by Legume leaf beetle to cowpea.

The important leaf eating beetles at Maha Illuppallama have been identified as Chaetocnema indica Wse. and C. basilis Baly.-In addition to these species, Luperodes sp. (Galerucinae) and Longitarsus recticollis (Jocoby) (Halticinae) have been recorded as minor pests.

At the beginning of the season in March damage was high but declined by mid May. Maximum infestation recorded was 46.3%. Because legumes can withstand considerable leaf damage without significant loss in yield. Therefore, the loss was not regarded as high.

VII. Revision of economic threshold value for rice insect pests

At Sravasstipura, four treatments were applied against the major pest of rice Spodoptera spp. caterpillars were allowed to defoliate 8% leaves, 40% leavesed 80% leaves. In the control no feeding was allowed. Percentage yield loss at 83.6% was 20% and at 39% 16.4%.

VIII. Screen Cowpea varieties for Bruchids.

Ten varieties of cowpea IT 81D - 1007, IT 81D- 1064, IT 81D-1032, IT 81D- 1157, IT 81D - 600-5, Arlington, IT 81D-703, IT 81D-985, IT 81D-1137, IT 71D-716 and control was kept on MI-35. The varieties IT 81D-703, IT 81D-985 and IT 71D-716 showed resistance to the bruchids.

Maha 1985/86

Six studies were made during the season.

1. Resistance of soybean varieties to leaf eating and leaf rolling caterpillars.

Nine soybean varieties Guntur, G 2261, 50228-2-7-66, Pb-1, BM-2, 50228-1-38-6, 30290-11-11, Bossier, Huites-77 were screened against lepidopterous pests. Guntur, G 2261 and 50228-2-7-66 were relatively more tolerant to leaf roller damage, G-2261 and 50228-2-7-66 suffered less damage to leaf eating caterpillars. However, populations of these pests were low because of rain.

II. Resistance of cowpea varieties to pod borers.

Eight cowpea varieties VITA-4, Sel. 230-2, Worth more, Arlington, All season, MI-35, EG-2, and Sudu mung were screened. Variety Sel. 230-2 had the lowest attack . This trial is to be repeated.

III. Evaluation of pesticides against Chilli leaf curl complex

Six pesticides Lorsban 40% EC, Anthio 33% EC, and Metasystox 50% EC, were screened. The difference between various treatments including the control was not significant, most probably due to low infestation of pests because of heavy rains.

IV. Screeing of green gram varieties against cowpea weevil

Seeds of fifteen green gram varieties 7704,CES. 5S, TV-79-6,EES-1F-1, IPBM-7922,CES-ID-21, TV-79-11,VC-2774-A,VE 1973-a,VC 2764-A, 7715,IPBM-79-132,Type 77, MI-5, TV 79-3 were screened against cowpea weevil. 7704 CES.5S and TV-79-6 were promising varieties.

V. The effect of moisture content of cowpea seeds on oviposition and hatching of cowpea weevil eggs (Callosobruch spp.)

Seed dried in sun for 7 days, for 3 days, soaked in water for 6 hours, for 12 hours and oven dried at 50 C for 12 hours, were exposed to females for oviposition. Seeds with lowest water contents were prefered by the weevil for oviposition. Larval mortality was higher on seeds with higher moisture content. The experiment is to be repeated.

VI. Studies on biology and bionomics of important Legume pests.

It is planned to study biology of pod borer *Maruca testulalis* Grey, beanfly *Ophiomyia phaseoli* (Tryon), bean aphid *Aphis craccivora* Koch and *Helicoverpa armigera* (Hb) because no information on their bionomic is available.

Yala 1986

Four studies were conducted during the season.

1. **Evaluation of nine soybean varieties to some major pests.**

   Nine varieties Pb-1, Bossier, G 2261, Huites 77, BM-2, 50228-2-7-66, Guntur, 50228-1-38-6, 30290-11-11 were screened. Resistance against beanfly, Spodoptera litura, Hedylepta indicata and Dasychira mendosa was studied. The beanfly infestation during the season was too low to be statistically analysed. The difference to attack of H. indicata in different varieties was not significant. Varieties 50228-1-38-6 and 302090-11-11 were susceptible to S. litura.

II. **Evaluation of resistance of cowpea varieties to pod borer - complex.**

   Eight varieties All season, EG-2,MI-35,Sudu mung, Sel. 230-2, VITA-4, Worth more Arlington were screened. Arlington and Worth more were more suceptible.

III. Evaluation of storage methods to control cowpea weevil in cowpea seeds.

   Some 250 grams of cowpea seeds were kept in different storage materials, separately including polythene, gunny and supersac bags and clay pots. Highest infestation of Callosobruchus maculatis was in gunny bags and supersacs. Polythene bags and clay pots were better for storage because infestation is these was lower.

IV. Evaluation of insecticides for controlling Chilli leaf curl complex.

   Six pesticides Lorsban, Anthio, Larvin, Zectran, Actellic and Metasystox were screened. Insecticides were sparayed at ten day intervals. Leaves were examined for mite infestation and disease incidence was assessed. The differrence in various treatments was not significantly different from the control.

Yala 1987

Three experiments were done during the season.

I. **Evaluation of Pigeon pea varieties for resistance to pod borer**

Six varieties of pigeon pea ICPL-81, ICPL-2, ICPL-269, ICPL 8304, ICPL 187-1 and MI-10 were screened. Because the pod borer population was very low, infestation of the pod borer was not significantly difference on different varieties.

II. Evaluation of insecticides against chilli pod borer (*Heliothis armigera*)

Six pesticides Tokuthion, Atabron, Sevin XLR, Larvin (thiodicrab 34 EC), Larvin (thiodicarb 75 WP) and Lannate (methomyl) was kept as control. All the insecticides gave some control which was not significantly different from the check (untreated plot). This could be attributed to low pest population.

III. Evaluation of insectidices against chilli leaf curl complex.

Five pesticides Lorsban, Anthio 33 EC, Larvin 375, Larvin 75 WP, Metasystox 50 EC and Actellic was kept as control. Anthio 33 EC, Metasystox 50 EC and Actellic were promising insecticides as far as effectiveness is concerned. It was suggested that trial should be repeated to confirm the results.

C. Summaries of work carried out at the Central Agricultural Research Institute, Gannoruwa, Peradeniya (CARI)

The reports were not available. The work summarized here has been taken from the Entomology Research Highlights and country paper on Integrated Pest Management prepared by Dr. C. Kudagamage Entomologist, CARI.

Maha 1986-87

The following three experiments were carried out.

I. Biological control

The parasitoids of diamond back moth plutella xylostella and their incidence was studied in different areas. The species of the parasitoids recorded were Apanteles plutellae (Parasitism varied from 2.63% to 33%), an unidentified ichneumonid (0.33 to 5%) and Tetrastichus sp. (2.01% to 5.5%).

II. Insecticide evaluation

Six pesticides were tried against brown plant hopper. These were Mexacarb, Lorsban, cartap, Unden, benfuracarb, and carbofuran. Unden and carbofuran gave best control.

III. Varietal evaluation

Twenty seven varieties were screened against the gall midge. Several lines from different stations were resistant.

Yala 1987

Five experiments were made during the season.

I. Insecticide evaluation

Four insecticides were evaluated for diamond back month, P. xylostella, Prodenia litura and Plusia sp. quinalphos, monocrotophos, profenophos and methomidophos were sprayed three times. All the insecticides caused significant more mortality of cabbage caterpillars (name of pest not given) compared with the control. There was no significant difference among other treatments.

II. Insecticide evaluation

Six pesticides Zectran 25% WP, Lorsban 50% EC, Unden 20 EC, Padan 50 SP, Oncol 3G and monocrotophos 60% EC were screened against rice leaf folder (RLF). Ten days after spraying (DAS) only monocrotophos and Padan were significantly toxic to larve compared with other treatments. None of the insecticides were significantly toxic 15 DAS. At present monocrotophos and chlorpyrifos are recommended for control of RLF. Padan is a potential new insecticide for RLF control.

III. Biological control

Four parasitoid specis were recorded from brinjal pod borer Leucinodes orbanalis. These were Spalangia gemina Boucek, Phanerotoma sp., Opius sp., Trathala falvoorbitalis. Two parasitoids were identified from fruitfly Dacus sp.

Survey for parasitoids of diamond back moth was continued. The ichneumonid previously reported was identified as Diadromus collaris. Percentage Parasitism of various parasitoids at different localites is geven.

IV. Varietal evaluation

Ten Pd varieties, 23 BW varieties and six Bg varieties of rice were screened against rice gall midge (RGM) under laboratory conditions. BG 276-5, M1 339-27-1, and BG 400I were resistant. BW 272-3, BW 267-3, BW-100, BW 295-5, BW 288-2, BW 293-2, BW 271-1, BW 297-2, BW 298-2, BW 271-2, BW 306-2 BW 307-3, BW 306-4, Pd 7-9-2 and pd 16-4-3 were rated R.

V. Varietal evaluation

Thirty NCRVT, 9 pd, 6 BT, 18 LD and 23 BW varieties were screened in the glass house against rice thrips. Dahanala and BG 94-1 were used as resistant and susceptible checks. None of the varieties tested were resistant.

Yala 1988

Ten studies have been reported. These are as follows

I. **Effect of organic matter on root knot nematods Meloidogyne spp.**

Five types of organic matter, poonac, poultry manure, cattle manure and coir dusts were compared with three nematicides carbofuran, benfuracarb and Phenamephos for the control of root-knot nematodes. Yields from plots treated with organic manure and chemicals were significantly higher compared with the untreated plots. The galling index was also low in treated plots. Results confirmed that organic matter can be used to control root-knot nematodes.

II. Effect of botanicals and carbofuran on Meloidogyne spp.

Dried leaves of four plant species Azadirachta indica, Acacia caseia, merigold, Vetaveria zizanides were compared with carbofuran for control of root-knot nematodes Meloidogyne incognita in the laboratory. Weight of top growth and galling index were used to evaluate the efficacy of various treatments. Pots treated with A. caseia and merigold had highest plant height and weight of top growth, respectively. Plants treated with carbofuran did not show any galls on their root systems although their plant height and weight of top growth were low compared to other treatment.

III. Evaluation of insecticides against Luffa virus

Five insecticides were screened against suspected vectors of luffa virus in Meepitiwela Yala, Markehelwala. The trial was randomized complete block design with 3 replicates. The five insecticides were Anitraz (Mitac 20 EC) 40-60g ai/ha., Formothion (Anthio) 113-175g ai/ha, quinalphos (Ekalux 20 EC) 190-195g ai/ha, Profenophos (Selecron 50 EC) 250-500g ai/ha and carbryl (Sevin XLR) 250-2000g ai/ha. These were sprayed at 10-day- interval. None of these insecticides controlled the virus effectively.

IV. Rearing method of gall midge

A study was mde to determine the optimum number of adults, per pot, required for rearing gall midge. The optimum number of adults required, per pot containing 200 plants was around 20. Three-week-old plants were better than two-week-old plants, to obtain vigorous adults.

V. Varietal screening of rice against gall midge

Most of the varieties in the CRVT are highly resistant to the old biotypes of gall midge. All varieties, except two from Division of Botany and Ambalantota were susceptible. The mechanism of resistance in these highly resistant varieties is antibiosis. This type of resistance can be easily broken down due to the development of biotypes. This perhaps explain why new biotypes developed on BG 400-1 and BG 276-5.

VI. Insecticide trials

Six granular insecticides, carbofuran, diazinon, quinalphos, benfuracarb, isofenophos and chloropyriphos were evaluated at three times after transplanting rice in the green house. sofenophos 1.75 a.i. kg/ha, diazinon 1.00 a.i. kg/ha, quinalphos 0.875 a.i. kg/ha, benfuracarb 2.00 a.i. kg/ha and chlorpyrifos 1.00 a.i. kg/ha significantly reduced the tiller infestion when applied one week before larval penetration.

VII. Varietal screening of rice against thrips

Fifty seven progenies and varieties were screened for thrips resistance in the green house. Most of the varieties were moderately susceptible. A few entries in the CRVT and from Ambalantota showed resistant or moderately resistant reaction.

VIII. Varietal screening of rice against brown plant hopper

A few hundred varieties from CRVT, Ambalantota, Division of Botany CARI and Batalagoda were screened in the laboratory. Three varieties in the CRVT, and 7 varieties from Batalagoda were resistant whereas 5 varietis from CRVT and 11 varieties from Batalagoda were moderately resistant.

IX. Evaluation of insecticides

Buprofezin, a chitin inhibiter was tested for its efficacy for controlling brown plant hopper (BPH) carbofuran was kept as check. Buprofezin had highly delayed toxicity on BPH nymphs. The ovicidal action of buprofezin was low compared with carbofuran.

X. Evaluation of insecticides

Eight insecticides, acephate, quinalphos, carbaryl, Profenophos BPMC, cartap, chlorpyrifos and propoxur were evaluated for their efficacy on BPH adults and eggs. The persistance of acephate appeared to be high compared to other insecticides. There was a considerable ovicidal effect of insecticides carbaryl, BPMC and chlorpyrifos.

Maha 1988-89

Nine experiments were corried out during the season

I. **Effect of some insecticides and neem oil on eggs and larvae of diamond back moth plutella xylostella.**

Effect of four insecticides Diflubenzuron, Chorfluazuron, Bacillus thuringenes (B.T), Triflumuron and Methamidophos and neem oil was studied on egg and larval moratality of diamond back moth in the laboratory. The best ovicidal activity was observed with Methamidophos followed by Chorfluazuron and neem oil. The highest larval mortality was observed with BT, Chlorfluazuron followed by neem oil and Triflumuron.

II. Factors affecting parasitism of Apanteles plutellae on diamond back moth.

The effect of the age and the host plant of diamond back moth (DMB). larvae on the parasitism by Apanteles plutellae was studied in the laboratory. More ten-day-old larvae were parasitised compared with larvae of other ages. More larvae reared on raddish were parasitised than reared on cabbage.

III. Varietal screening of potato for root-knot nematode Meloidogyne incognita.

Six potato varieties were tested for resistance to root-knot nematode. Varieties Iswa and kondor had the lowest nematode density on the surface of tubers. But the root galling was heavier on the root system of kondor than Isua. Galling index for kondon was 4.76 compared with 1.8 for Isua indicating its resistance to Meloidogyne incognita.

IV. Control of root Knot nematode in beet root.

Five types of organic manure Punnack, poultry, cattle green and Coir dust and three nematicides/Carbofuran 3G, Benfuracarb 3G and Phennamiphos 5G were evaluated for the control of root-knot nematode. In all treatments galling index (GI) was less than 3 compared with 4.5 in the control plot. The yield in plots treated with green manure was significantly higher than in other plots.

V. Yield loss in vegetable cowpea by pod boring larvae.

A field experiment was carried out in RCB design with 4 replicates to assess the yield loss caused by the pod boring larvae in vegetable cowpea bushitao. Counts of all the pests of vegetative and reproductive phases of the crop were recorded weekly by visual observations.

Flowers and pods were sampled weekly for borer larvae at initial flowering, 50% flowering, 100% flowering and at each harvest. Total net plot yields and marketable yield were also recorded.

The yield loss in untreated control (45%) was significantly higher than other three untreatments which was about Rs. 17,000/-per ha. Pod boring larvae alone caused a loss of about 26% of the marketable yield. This was equivalent to Rs. 1,930 per ha.

VI. Use of plant material from Sri Lanka, for control of pests of stored grain of cowpea.

Eleven plant materials were evaluated against Callosobruchus maculatus damage of cowpea in the laboratory. Use of 'Wadakaha' (Acorus colomus) and Wal inguru rhizome (5%) protected cowpea from bruchid damage up to 3 months while Heen araththa rhizome(5%) protected cowpea from bruchid damage up to one month.

VII. Varietal resistance to brown plant hopper in rice

A laboratory experiment was conducted to study the effects of plant materials used as green manure in paddy fields on brown plant hopper. Adding plant materials increased the fecundity of BPH as a result of improvement in the plant growth.

VIII. Varietal screeing of rice against rice thrips.

One hundrede nineteen varieties were screened for thrips resistance. None of the varieties were resistant while 40 varieties were found to be moderately resistant.

Yala 1989

Nine experiments have been reported during the season.

I. Evaluation of pesticides against Lepidopterous larvae feeding on cabbage.

Three chitin inhibitors trifluamuron, diflubenauron and chlorfluazuron, one biological insecticides neem oil and root extract of Horthonia angustifolia were evaluated against lepidopterous larvae feeding on cabbage. The best protection was provided by neem oil and chlorfluazuron. Trifluamuron, Horthonia angustifolia extract and diflubenzuron also showed moderate activity. Bacillus thuringiensis and methamidophos recommended by the department failed to control effectively.

II. Effect of treatment of bean seeds with pesticides on beanfly Ophiomyia phaseoli.

Laboratory and field experiments were conducted to study the effect of seed treatment in controlling beanfly. In the laboratory five insecticides acephate, phenthoate, quinalphos, carbosulphan and oxydematon methyl) at two concentrations were used .

One set of seedlings with all treatments were artificially infested with beanfly three days after germination . The other set was infested ten days after germination. The lowest effect on germination was in seeds treated with carbosulphan, phenthoate and quinalphos. The minimum number of infested plants at both times of infestation was in seeds treated with acephate and carbosulphan. The mean number of larvae found in plants was also low in these treatments.

In field experiments four insecticides propoxur 1%D, carbofuran 3G, oxydematon methyl 25 EC and carbosulphan 25 ST were tested. Propoxur and carbosulphan were applied at 50gm/kilo of seeds and 10gm/kilo of seeds for seed teatment, respectively. Carbofuran was applied to the soil at planting while oxydematon methyl was used as a foliar spray. The lowest infested plants were in plots treated with carbofuran, oxydematon methyl and carbosulphan.

The yield differences from untreated control were significatnly high in plots treated with carbofuran and carbosulphan. Treating seeds with insecticides such as carbofuran is cheap and provides effective control of beanfly throughout the susceptible stage of the crop.

III Control of Meloidogyne spp. in bittergourd using organic matter and pesticides.

Three types of organic matter poultry, cattle and green manaure were compared with carbofuran, phenamiphos and benfuracarb to control root-knot nematodes Meloidogyne incognita associated with bittergourd. Yield and galling indicies were used to evaluate the efficacy of various treatments. All the treated plots gave fairly higher yield compared to the control . Initial nematode density of the soil was 1,400 juveniles/kg of soil. Galling indicies for all the plants in treated plots were less than 3 compared with 5 in the control.

IV Home garden pest control

The major pests of beans, beanfly was effectively controlled by the present departmental recommendations. Spraying omethoate and treating seeds with Carbosulphan (Carbosulphan 25 ST 10g/1kg. of seeds). Keppetiya, Croton luccifera mulch also reduced the beanfly attack to some extent. Brinjal shoot and pod borer was effectively controlled by spraying 2% emulsion of neem oil. In bittergourd the fruitfly attack was prevented by covering the fruits with polythene.

V. Studies on population dynamics of banana root and pseudostem weevils

Pseudostem traps were placed at the rate of 25 traps/ha. in infested banana fields. Number of insects attracted to these traps were counted weekly. There was no substantial variation of the population levels of both pests from May to October.
There was no correlation of population trends to weather conditions. The damage of pseudostem weevil was more than that of root weevil.

VI Population dynamics of fruit flies in the Central Region.

Population [illegible] of Dacus dorsalis was studied using pheromone traps. Peak popuation was from July to early September. This coincided with the fruiting season in the Kandy area. There was no correlation between weather and population levels.

VII Insecticide evaluation for whitefly control.

A new whitefly was reported to attack guave and other plants at epidemic level. Five insecticides were evaluated for its control in the field. Insecticides dimethoate 40 EC and Buprofezin were highly effective for controlling the immature stages infesting guave trees at the rate of 3 ml/l and 3.3g/l, respectively.

VIII Studies on biotype of gall midge of rice.

The difference in virulence of gall midge population from eight locations was studied in the laboratory using 10 standard rice varieties. Rice varieties CR 94-13, Ptb 18, MR 1523 and Ptb 21 were resistant to gall midge population from all the localities. Rice varieties IR 8, Siam 24 and ARC 6650 were totally susceptible to all populations tested. Bg 400-1 was moderately resistant to population from Bombuwela while for other population from Barigama, Kegalle, Yatawara, Merigama, Welligalle, Gannoruwa and Ukuwela it was susceptible.

IX Varietal resistance to brown Plant hopper (BPH) in rice.

Ninety five varieties and breeding lines were evaluated for resistance to BPH. Seven varieties were resistant while thirty six varieties were moderately resistant.

Maha 1989-90

One study was made during the season.

I. Bionomics and distribution of potato cyst nematodes.

The potato cyst nematodes (PCN) *Globodera rostochiensis* and *G. pallida* are present in most potato growing areas of the world. It was reported for the first time in 1989 in Sri Lanka. The cysts which are dead remains of female with viable eggs occur in enermons numbers in the soil. Studies on its biology have been started.

D. Summaries of miscellaneous publications

In addition to reports, a few other publications that were available are summarised below.

1. Major Crop Pests and their Control with Pesticides.

This brochure has been issued by Education and Training Division, Department of Agriculture, Peradeniya. It contains information on safe use of pesticides, an introduction to integrated Pest Management,and lists of pesticides recommended for various crops.

Pesticides have been recommended for pests of rice, maize and sorghum; general pests such as tobacco cutworms,beetles (Mylabris spp.), root eating ants (Dorylus orientalis), mites, aphids, scale insects, mealybugs, whitefly (Bemisia tabaci), snails and slugs, birds (parrots, pigeons and sparrows), Rodents, grasshoppers, Pests of vegetables (onion, cabbage, brinjal, cucurbits, potato and beans) pulses, groundnut; fruit pests (citrus, mango, banana) and pests of stored grain.

Seventy one formulations of pesticides have been recommended for use against the above mentioned pests.

This brochure was published in 1986. This is being revised for publication as Technoguide for farmer, and extension workers.

2. Paper on Integrated Pest Management for major vegetables in Sri Lanka.

Country situation Paper on Integrated Pest Management (IPM) for major vegetable crops in Sri Lanka was presenled by Dr. C.Kudagamage, Entomologist CARI, at FAO Expert Consultation on IPM of Major Vegetable Crops, Bangkok.

At present, there is a great emphasis on the export of vegetables. Crop losses due to insect pests' weeds and diseases are the major constraints in vegetable production. Insecticides are the main method of preventing crop losses due to pests. There is a growing concern over the problems associated with the over use of agrochemicals. This has led to some of the serious environmental, economic and health problems. Integrated Pest Management provides answer to some of the above mentioned problems.

The losses due to pests and diseases are very high. In spite of repeated applications of pesticides, about 50% yield is lost because of brinjal fruit and shoot borer. Over 200 pests have been recorded from vegetable crops in Sri Lanka. Out of these 20-25 are economically important. The control measure used are;

I. Biological control: A number of parasitoids from some important pests have been recorded. Some of these give a varying degree of control especially late in the season. Two parasitoids were introduced against diamond back moth Plutella Xylostella from Australia and India. One of these Thyraeella (Diadromis) collaris is established.

II. Resistant varieties. The progress in this direction has been slow. No commercial varieties resistant to pests are available.

III. Mulching: Various types of mulches are able to reduce cut-worm damage to tomato.

IV. Pesticides of botanical origin: Dried leaves of Lantana camara and Chenopodium ambrosiodes were effective for controlling tuber moth Phthorimaea opercullella in potato store houses.

V. Intercropping: In mixed cropping of cabbage, totamo and garlic, in early stages, there was a significantly less infestation of diamond back moth on cabbage than on its pure stand.

VI. Chemical: Vegetable farmers are heavily dependent on the use of pesticides to keep their crops free of pests, diseases and weeds. There is three fold increase in the import of pesticides from 1982-86.

Because of pesticide poisoning there is an increase in number of hospital admissions and fatal accidents associated with mishandling and improper use of pesticides. Although there is no experimental data on resistance in pests against pesticides, the use of higher doses clearly indicate development of resistance in pests against pesticides.

3. On-farm trials, Yala 1989. Agronomic Performance from 41 Farms, Mahaweli System B

During the On-farm trials for agronomic practices a number of insect pests and diseases were recorded and various pesticides were tried for their control. The most suitable for controlling various pests have been recommended. These are given below.

BLACKGRAM

No:	Pest	Treatment
01	Lepidopterous larvae feeding on leaves.	monocrotophos
02	Lepidopterous larvae feeding on leaves, thrips.	fenthion(Leybaycid)
03	Lepidoplerous larvae feeding on leaves, leaf hopper	diamethoate
04	Aphids	oxydemeton(Metasystox)

GREENGRAM

01	Caterpillar,beanfly,pod borer	monocrotophos
02	Leaf hopper,pod borer, caterpillar	dimethoate
03	Thrips,caterpillars	fenthion(Leybaycid)
04	Caterpillar, Pod borer	methamidophos(Tamaron)

COWPEA

01	Caterpillar, leaf hopper, Pod borer and beanfly	monocrotophos
02	Caterpillar,Pod borer, leaf hopper.	dimethoate
03	Stem borer, thrips	fenthion(Leybaycid)
04	Caterpillar feeding on leaves	oxydemeton(Metasystox)

GROUNDNUT

01	Leaf miner, caterpillar feeding on leaves,beanfly, Pod borer.	monocrotophos
02	Leaf hopper	dimethoate
03	Aphids	oxydematon(Metasystox)

BUTTERNUT SQUASH

01	Caterpillar feeding on leaves, fenthion(Lebaycid) thrips.
02.	Caterpillar feeding on leaves, dimethoate leaf hopper, aphids.
03	Caterpillar feeding on leaves, oxydemeton(Metasystox) aphids.

III. REVIEW OF THE ENTOMOLOGICAL RESEARCH PROGRAMMES FOR 1990-91

The Entomological research programmes of the Regional Agricultural Research Stations at Girandurukotte and Aralaganwila for Maha 1990-91 were reviewed and discussed with the RO Mr. M.G. Dhanapala at Girandurukotte and Ms. Kalyanee Weerasinghe.at Aralaganwila. Because Mr.Y.Ketipearachchi was out of the country his programme was also discussed with the above mentioned Research Officers and result of our discussion were to be conveyed to Mr.Ketipearachchi on his return. The programmes that had been approved by the Technical Committee are attached (Appendix III)

There has been an improvement in the plan of work compared with the previous years. The programme at both the stations seems to be very ambitious. The result is that only superfical observations can be made rather than going into details which are required for developing the control measures. It would be nice if the programme could be reduced and instead of attempting to do a number of experiments superficially, a few well defined, in depth studies are made. This would yield better results that can be used for developing pest control measuers

At Aralaganwila, out of 5 studies two are on screening pesticides, one on insect pests and their natural enemies on gherkin; one on insects feeding on flowers and pods of chilli; and one on legumes (pigeonpea) pests.

The study on gherkin pests (Experiment No.1) should yield useful data if it is carried out properly.. It was suggested that Mr. Ketipearachchi may include some plots on which the most used pesticide should be sprayed. This will indicate the effect of pesticide on the populations of the pests and their natural enemies as well.

At Girandurukotte, the programme was discussed with Mr. Dhanapala and a numbner of changes in the programme were suggested.

He has planned seven expepriments for the season. Again this is too much. Detailed studies cannot be made on any of the experiments included in the programme. It was recommended that detailed studies should be made starting from recording all the pests and their natural enemies of a crop say banana (it is included in his programme). Biology, ecology and phenology of the important pests and their natural enemies should be studied.

For studying population dynamics sampling methodds were discussed. It was pointed out that there should be a well defined objectives for studying the population dynamics of a pest and then an effort should be made to analyse data to see whether or not that objective has been achieved. In the past population trends have been studied but no effort was made to correlate the data with any of the ecological factors.

It was felt that the staff need training in sampling and in insect rearing methods especially mass rearing of natural enemies. It is recommended that Research Officers be sent to some Biological Control Research Station where such studies are being made. PARC-CIBC Station, International Institution of Biological Control, Rawalpindi, Pakistan has facilities for training people in such methods.

It was also observed that the RARS at Aralaganwila and Girandurukotte are very poor in library facilities. If literature can be provided under the MARD Project, it is strongly recommended that literature, at least basic, may be provided to these Research Stations. I can provide a list of books and journals that will be useful for entomological work.

These stations are also deficient in equipment for working on IPM programmes. A list of the appratus needed is appended (Appendix IV).

IV. REVIEW THE ENTOMOLOGICAL EXTENSION RECOMMENDATIONS MADE BY MEA AOs IN SYSTEM B AND EVALUATE THE MECHANISM AND EFFECTIVENESS OF GETTING THIS INFORMATION TO THE SETTLERS.

At present for crops other than rice, the only extension material available to the farmers, for pest control, is on the use of pesticides. A brochure "Major Crop Pests and Their Control" has been issued by the Department of Agriculture, Education and Training Division. A summary of this information is given in this report in Chapter II "Review of Research Reports and Analysis of Current Entomological Research Being Done by Department of Agriculture". Similar information has also been produced by firms dealing with Agro-chemicals e.g., Haychem Ltd. has published "Agro chemicals Hand-Book on Crop Protection". In this hand book, use of pesticides, fungicides, weedicides etc; (Bayer products) has been explained and recommended.

Some pamphlets in the local language such as "Natural Enemies of Paddy," How to Spray Pesticides" " Pesticides" and on "Integrated Pest Control of Rice" have been produced by MEA. An Advisory Bulletin(No.1) was produced by the MARD Project in November 1989. This contains information, in addtion to preparing the land for planting, fertilizer application, etc on the pest management through cultural practices and pesticides for a number of pests on cowpea, green gram and black gram.

At present, no information on Integrated Pest Management of pests of horticultural crops, and other crops such as cowpea, green gram and black gram, etc; is available that can be transferred to the farmers.

The MEA/MARD extension programme is carried out through the Block Offices. At present, there are 8 Block offices in System B. The Block Manager is the incharge of the Block office. He is supported by a team of officers such as Marketing Officer, Community Development Officer, Civil Engineer, Laison Officer, Agricultural Officer etc;

The Agricultural Officer is responsible for the transfer of agricultural technology to the farmers through Units. He is also responsible for arranging and giving training to Field Assistants.

The number of Units in a block varies from 6 to 11. A Unit has a Unit Manager and a Field Assistant (FA). Each F.A. is responsible to transfer information to about 250 farmers covering 250 ha. of land. As more land is brought under cultivation more Units are created. At present, there are about 58 Units in the system.

In system B some of the Units have Farming Systems Extensionists (FSEE). Sometime ago there were 19 in number; ten left the job and joined other Organizations. The reason for this is temporary nature of the job. When FSEE find a permanent job, they leave the MEA Project jobs for security of service. The responsibilities of FSEE are to accomplish the tasks associated with Agricultural technology generation and dissemination to the farmers in the system. They are supposed to enlist farmer cooperators for farm trials to demonstrate the possibility and desirability of appropriate OFC production, hold field days on spepcific crops, expand the area for adapted crop cultivation, encourage group production and marketing contacts, provide critical timely production advice and assistance in mobilishing production inputs and marketing, expand the production of appropriate OFCs to more farmers, encourage farmers to cultivate higher risk and export crops, support rapid movement of varieties and research station solutions to the field, along with Irrigation Community Organizers promote Turn Out Groups consensus decision making. empahsis, to all paprties concerned, the whole-farm concept of integrated agricultural development,collect important data from the farmers which will assist in improving future cropping recommendations, work with FAs and use their knowledge of crop specific technology to improve any new cropping pattern introduced by the Farming System Extension Programme, and to establish demonstration plots for new cropping systems.

The FAs attend fornightly training classes. In these class they are given instructions to be passed on to the farmers. In addition to fortnightly classes, preseason training is also given at the beginning of Maha and Yala seasons. These classes are attended by Agricultural Officers, Field Assistants, Unit Managers and Farming Systems Extensionists. This training and information are given at Mahaweli Regional Training Centre, Aralaganwila by the Assistant Director (Agriculture). to people involved in extensionn work for transferring it to the farmers.

There seems to be a good net work of extension service in System B. There is a need to improve the service conditions of FSEE by providing them permanent tenure of service. This will help in keeping the competent people in service. The competent people are first to leave the job because they can get better jobs and conditions of service. If temporary conditions continue for a long, the department may be left with people who could not get job elsewhere, and may be they are not good and efficient workers.

As regards actual transfer of information to the farmers, I did not have the time to survey how effectively the extension service is working and how often the Field Assistants visit the farmers and how often farmers consulted the Field Assistants. I am not aware any such study has been made. In other areas such as Kandy, Matale, Nuware Eliya and Badulla districts as reported by Chandrasekera et.al (19186), only 23% farmers consulted village level extension officer when selecting pesticide for spraying the crops.

There is need to make the extension worker more mobile by providing them motorcycles rather than cycles. This would improve their performance.

The other important factor is to generate Integrated Pest Management Technology. This should be tested throughly before transferring it to the farmers. If a technology by which farmer can control the pests cheaply, they adopt it from the neighbouring farmers and spreads fa

Reference: Chandrasekera, A.I, Wettasinghe, A and Amarasiri, S.L. 1986. Pesticide usage by vegetable farmers. Proc. Annual Res. Conf. on Fruits, Vegetables and Tuber crops, Gannoruwa, Peradeniya, 4-5 September 1986,44pp.

V. ADVISE THE DEPARTMENT OF AGRICULTURE ON IMPROVED AND UP TO DATE PROCEDURES FOR IPM

The various topics suggested under this heading were explained and discussed with the Research Officers. However, these are briefly described below;

A & B Identification Of Insect Pests and Their Natural Enemies.
Given in Chapter VIII C, Topics for preparing the report.

C Simplified assessment of population dynamics.

Population dynamics can be studied by sampling the pest population at regular intervals. There are a number of sampling methods used for studying the pest populations. The field can be divided in to a number of parts or grids. From each grid a fixed number of plants is examined at random for the pest numbers.

The interval for sampling depends on the biology of the pest. If the development period is short sampling is done frequently, maybe twice weekly or once a week. If the development period is long, this interval can be increased.

A universal method for counting the pest stage and plant part can be fixed. This will be different for different pests, depending on their behavior. If possible, sedentary stage is used so that error that may occur if actively flying or moving stage is selected, can be avoided. For example for sampling whiteflies, eggs, nymph and/or pupae are counted on a fixed part of the plant each time. For lepidoptera, larvae are counted in the vicinity of the feeding. For stem borers the infested stems are counted and then they are dissected for immature stages of the pest. For thrip the part mostly attacked by the spread may be collected and brought to laboratory in plastic bags and the pest may be removed by shaking the plant on a piece of paper or by getting blowing on it to dislodge them on a paper and counted. Sampling was discussed with the Research Officers in detail.

D Determining Best Stage For Insecticide Application.
Given in Chapter VIII D & E, Topics for preparing the report.

E Assessing Yield Losses and Ecnomic Thresholds
Given in Chapter VIII F, Topics for preparing the report

F Determining Yield Recovery After Control Measures Are Used.
Given in Chapter VIII F, Topics for preparing the report.

G. Developing Understanding Of Ecological Factors Responsible For Peaks of Major Pests.

To develop an understanding ofthe effect of ecological factors on the build up of Pests and their natural enemies, their population, trends should be studied very accurately, based on a sound sampling system, for a number of years.

The population of the pest should be plotted on a graph. On the same graph trends of both antibiotic and biotic factors should be plotted. The pest population will show a correlation with the factors that are effecting its population. A correlation coefficient may be calculated, between the two to confirm if there is really a correlation between the two. Sometimes the effect of the factor may be delayed by a certain amount of time, but it should be apparent from the graph.

H Screening Varieties For Resistance

Usually two methods for screening the varieties for resistance are used.

1 By growing different varieties in rows in randomized block, and allowing the natural infestation to occur. The susceptible variety will be quite apparent from its appearance from its poor condition compared with the resistant varieties. The sampling for the pest population is to be made to determine rate of infestation on various varieties. The yield should be determined at maturity of the crop.

2. By artificially infesting the plants with laboratory reared insects. This is helpful especially when it is feared that the natural infestation may remain low. The various varieties are inoculated with equal numbers of the pest and then the survival and ultimate pest population on various varieties and condition and yield will indicate the resistance.

The resistance may be due to non-preference, antibiosis or tolerance. In case of non-preference and antibiosis the pest population should be low on resistant varieties compared with susceptible varieties. In case of tolerance the pest population may be the same on both the resistance and susceptible varieties. Because the resistant varieties can tolerate higher population the yield is not effected.

VI DEVELOP IPM FOR CUCUMBERS (GHERKIN) INSECT CONTROL

Thrips, Chrysomelid beatle Aulacophora, aphids and miles were seen attacking the crop. At Sunfrost, Ellewewa an unidentified anthocorid bug was found feeding on the thrip. At present the crop is sprayed heavily and indiscriminately. To develop IPM of pests of gherkin, exact identification of various pests and their natural enemies are needed. It may be possible to attempt biological control by introducing natural enemies from other areas or countries. To develop cultural practices, chemical control and other methods of pest control detailed observations on biology,ecology, phenology and behaviour of the pests and their natural enemies are required. There are definite possibilities of developing IPM of gherkin pests.

The above mentioned studies may be started as soon as possible. These can be carried out at the Regional Agricultural Research Station and by sponsoring a M.Sc thesis at the Post Graduate Institute of Agriculture at Peradeniya under the supervision of an IPM specialist.

VII. UP TO DATE LIST OF INSECTICIDES REGISTERED FOR USE IN SRI LANKS, INDIA AND HAVING RESTRICTED USE IN THE USA.

The insecticides, molluscides, nematicides, rodenticides and chemicals for soil treatment registered in Sri Lanka are given in Table I. Some 16 companies are importing and formulating these. Some of the insecticides have been banned or have been restricted in use (Table II). The restriction/ban is based on trials carried out in the USA. The insecticides approved for use in India are listed in Table III. In India these are manufactured in the public sector (Dr. Kawel Dhari, General Manager Research & Technology, Hindustan Insecticides Ltd, Personal Communication)1990. Therefore, brand names and name of the dealers are not available.

The list of insecticides that have been put on the restricted list in the USA is available with the MARD Project. Those insecticides which have been restricted, for use in the USA, but are still on the approved list in Sri Lanka are given in Table IV.

The pesticides are approved for use in Sri Lanka by a Committee based on the results of trials made at the Central Agricultural Research Station, Peradeniya and the Regional Agricultural Research Centres. There is no aerial spray of the pesticides. It is done by Knap sack sprayers by the farmers. There is no subsidy given on pesticides by the Government. This is useful because it prevents their misuse and overuse.

Chlorinated hydrocarbons are banned except for lindane chlorodane and aldrin which are imported in small quantities for use against coconut pests and termites. Malathion is sprayed free of cost for controlling mosquitoes. Some of it gets sprayed on crops also. About 15 insecticides can be sprayed only by trained applicators.

At present, farmers depend heavily on insecticides for controlling vegetable, fruit and other pests. There has been a tremendous increase in imports in recent years. Moreover, the farmers are over using and misusing the pesticides. According to Kudagamage(1988) 57% of farmers use doses higher than recommended by the Department of Agriculture and 64% apply pesticide before appearance of any pest. There are farmers who apply pesticides on harvested produce.

A study carried out by Dharmasena (1989) indicated that most of the famers use highly toxic broad spectrum insecticides. Some used higher and others lower doses than recommended by the Department. In both the cases they do more harm than good. His survey showed that 60% farmers at Rajanganaya used only 1/3 of the recommended dose. This, when applied to crop canopy, eliminates natural enemies rather than the pest because natural enemies are near the upper side of the crop and the pests are found near the lower side.

On rice only less than 3% had an idea of threshold. This means most of them applied pesticides when it was not necessary.

Thus it can be concluded that misuse of insecticides is causing a great loss to the farmers and their crops, polluting the environment and creating health hazards for the public. Kudagamage (1988) has reported that there is a clear increase in the number of hospital admissions and fatal accidents associated with the mishandling and improper use of insecticides.

During my stay at Aralaganwila, I visited a number of large farms and some small farmers. The pesticides are heavily used both by the big farmers as well as small farmers. One large farmer, growing gherkins, sprayed his feilds with incecticides mainly selecron 500 EC, for controllong thrips every two or three days and each plot got seven sprays in 50 days. At Sunfrost Farm, Ellewewa it seemed that the pesticides were used more judiciously probably based on pest density. Here a predator of thrips (an unidentified anthocorid) was recorded feeding on thrips.

At Kapila Farm, onion was examined. The crop had matured. The owner had sprayed it ten times in 100 days. Seven times fungicides and three times insecticides mainly monocrotophos was sprayed. It appeared that the crop was never attacked by any pest inflicting noticeable damage because there were no feeding signs of any insect. It seems that the crop was sprayed as a precaution without locking for insect attack.

In a small-farmer's field where cowpea, beans, snake gourd, bittergourd, knolkhol, maize, onion, chilli, etc were growing, almost all the crops were heavily attacked. We were told that the farmer sprayed insecticides at least once a week. He used monocrotophos, fenthion, etc. In spite of heavy spraying of insecticides, attacks of various pests such as diamond back moth Heliothis, and a number of other unidentified lepidopterous pests, thrips, etc were heavy.

Pesticides should be used judiciously and other methods of pest control should he developed to avoid excessive misuse of pesticides. The answer to the problem is development of Integrated Pest Management.

References;

Dharmasena, C.M.D. (1989). Insecticide usage in Mahaweli H area and Rajanganaya for the pests of rice. Krushi, 2(3): 29-34

Kudagamage, C (1988). Country situation paper on integrated pest management for major vegetables in Sri Lanka. FAO Expert Consultation on Integrated Pest Management on Major Vegetable Crops. Bangkok 14-16 Nov. 29pp.(Mimeographed).

TABLE I

List of insecticides (including acricides),molluscides, nematicides, rodenticides and soil treatment chemical registered in Sri Lanka. Information is based on Regional Agro-pesticide Index jointly published by Agricultural Requisites Scheme for Asia and the Pacific (ARSAP) and International Co-operation Centre of Agricultural Research for Development (CIRAD), 1990 Edition.

Common Name:	Brand Name:	Distributors
I. INSECTICIDES		
Acephate	Orthene	Harrison & Crosfield (Colombo) Ltd.
Aldicarb	Temik	Green Farm Ltd.
Aldrin	Aldrin	Lankem Ceylon Ltd.
Aluminium Phosphide	Celphos	Anglo-Asian Fertilizers Ltd.
	Getia Gas Ex-B	Food Commissioner,Food Department.
	Gastoxin	A Baur & Co. Ltd.
	Phostoxin	Heychem Ltd.
	Phostoxin Tablet	Prima Ceylon Ltd.
	Phostoxin	Ceylon Tobacco Co.Ltd.
Bacillus thuringiensis	Phostoxin	Mackwoods Ltd.
	Bactospeine	Mackwoods Ltd.
	Thuricide	A. Baur & Co. Ltd.
Benfuracarb	Oncol 3G	Lankem Ceylon Ltd.
	Oncol 40% EC	Lankem Ceylon Ltd.
BPMC	Bassa 50	Lankem Ceylon Ltd.
	Baycarb	Heychem Ltd.
	BPMC 50% EC	Ceylon Petroleum Corp.
	BPMC 50 % EC	Uniceyl Marketing Serv.(Pvt) Ltd.
	Harcros BPMC	Harrison & Crosfield (Colombo)Ltd.
	Mackarb	Mackwoods Ltd.
	Moricarb	J.L.Morrison Son & Jones Ltd.
	Red Star BPMC	Anglo-Asian Fertilizers Ltd.
	Strike 50 EC	Chemical Industries(Colombo)Ltd.
	Strike BPMC	Union Carbide Ceylon Ltd.

Carbaryl	Carbaryl	Ceylon Petroleum Corp.
	Carbaryl	Chemical Industries (Colombo) Ltd.
	Dicarbam	Mackwoods Ltd.
	Harcros	Harrison & Crosfield
	Carbayl	(Colombo) Ltd.
	Sevin 5 D	Union Carbide Ceylon Ltd.
	Sevin 85 S	- do -
	Sevin XLR	- do -
	Sevin XLR	Chemical Industries (Colombo) Ltd.
Carbofuran	Carbofuran	Ceylon Petroleum Crop.
Carbosulfan	Marshal	Chemical Industries (Colombo)Ltd.
	Marshal 20 EC	Ceylon Petroleum Crop.
Chinomethionat	Morestan 25 WP	Haychem Ltd.
Chlorfluazuron	Atabron	Chemical Industries (Colombo) Ltd.
Chlorpyrifos	Chlorpyrifos	Ceylon Petroleum Corp.
	Lorsban 40 EC	Anglo-Asian Fertilizers Ltd.
	Macfos	Mackwoods Ltd.
Cyfluthrin	Baythroid	Haychem Ltd.
Deltamethrin	Decis	Lankem Ceylon Ltd.
Diazinon	Basudin 5G	Harrisons & Crosfield (Colombo) Ltd.
	Diazinon 50 EC	Lankem Ceylon Ltd.
	Harcros	Harrison & Crosfield
	Basudin	(Colombo) Ltd.
Dichlorvos	DDVP 48%	Lankem Ceylon Ltd.
	Harcros Nuvan 100 SC	Harrisons and crosfield (Colombo) Ltd.
Dicofol	Kelthana MF42	Chemical Industries (Colombo) Ltd.
Dimethoate	Dimethoate 40	Lankem Ceylon Ltd.
	Dimethoate 40	Uniceyl Marketing Servies (Pvt.) Ltd.
	Dimethoate 40EC	Ceylon Petroleum Corparation
	Dimethoate 40EC	Chemical Industries (Colombo) Ltd.
	Harcros Demro	Harrisons & Crosfield(Colombo) Ltd.
	Perfekthion	Mackwood Ltd.
	Red Star	
	Dimitox	Anglo-Asian Fertilisers Ltd.
	Rogor 40	J.L. Morison Son & Jones Ltd.
Endosulfan	Baurs Endosulfan 35 EC	A Baur & Co. Ltd.
	Endocel 35 EC	Kulaweera Associates
	Endocel 35 EC	Anglo-Asian fertilizers Ltd.
	Thiodan 35 EC	Hoechst (Ceylon) Ltd.
	Thiodan 35 EC	Ceylon Petroleum Corparation

Fenbutatin oxide	Torque plus	Not given
Fenthion	Lebaycid 3% Dust	Haychen Ltd.
	Lebaycid 50 EC	Haychem Ltd.
Formothion	Anthio 33	A. Baur & Co. Ltd.
Isofenphos	Oftanot 5% G	Haychem Ltd.
Isoprecarb	Mipcin	Lankem·Ceylon Ltd.
Lindane	Gammalin	Chemical Industries (Colombo) Ltd.
Magnesium phosphide	Degesch Magtoxin	Haychem Ltd.
	Degesch Plate	Haychem Ltd.
	Degesch Plate	Food Commissioner's Dept.
Methamidophos	Harcros Mathamidophos	Harisons & crosfield (Colombo) Ltd.
	Harcros Monitor 600 EC	Harisons & Crosfield (Colombo) Ltd.
	Methamidophos	Chemical Industries (Colombo) Ltd.
	Methamidophos 60 WSC	Ceylon Petroleum Corporation
	Methedrin 60	Lankem Ceylon Ltd.
	Methion	Uniceyl Marketing Services (Pvt.) Ltd.
	Morithion	J.L. Morison Sons & Jones Ltd.
	Red Star Aloran	Anglo-Asian Fertilizers Ltd.
	Tamaron 600 LC	Haychem Ltd.
Methomyl	Lannate L	Lankem Ceylon Ltd.
	Methavin 1.8 L	Union Carbide Ceylon Ltd.
	Methavin 90 SP	Union Carbide Ceylon Ltd.
	Methavin 90 SP	Chemical Industries (Colombo) Ltd.
Monocrotophos	Marcros Nuvacron	Harisons & Crosfield (Colombo) Ltd.
	Monocron	Mackwoods Ltd.
	Monochrotophos	Chemical Industries (Colombo) Ltd.
	Monochrotophos	J.L. Morison Son & Jones Ltd.
	Monochrotophos	A Baur & Co. Ltd.
	Monochrotophos	Uniceyl Marketing Servise (Pvt.) Ltd.

	Monochrotophos 60	Lankem Ceylon Ltd.
	Monochrotophos 60 WSC	Ceylon Patroleum Corparation
	Red Star Monocrotophos	Anglo-Asian Fertilizers Ltd.
Omethoate	Folimat LC 50	Haychem Ltd.
Oxydemeton-methyl	Metasystox EC	Haychem Ltd.
Permethrin	Ambush 25 EC	Chemical Industries (Colombo) Ltd.
Phenthoate	Cidial	J.L. Morison Son & Jones Ltd.
	Elsan 5% Dust	Lankem Ceylon Ltd.
	Elsan 50	Lankem Ceylon Ltd.
Pirimiphos-	Actellic 2% Dust	Chemical Industries (Colombo) Ltd.
	Actellic 50 EC	Chemical Industries (Colombo) Ltd.
Profenofos	Harcros Selecron	Harrisons & Crosfield (Colombo) Ltd.
Propoxur	Unden 1% Dust	Haychem Ltd.
	Unden 200 EC	Haychem Ltd.
Prothiofos	Tokuthion EC	Haychem Ltd
Quinalphos	Bayrusil EC 25%	Haychem Ltd.
	Ekalux 1.5% Dust	A. Baur & Co. Ltd.
	Ekalux 25 EC	A. Baur & Co. Ltd.
Thiodicarb	Larvin 375 P	Union Carbide Ceylon Ltd.
	Larvin 75 WP	Union Carbide Ceylon Ltd.
Trichlorfon	Diptrex LC 50%	Haychem Ltd.

2. MOLLUSCIDES

Metaldehyde	Meta powder	A Baur & Co. Ltd.
	Meta ready for use	A Baur & Co. Ltd.
	Metaldehyde	Chemical Industries (Colombo) Ltd.

3. NEMATICIDE

D-D(N)	DD Soil Fumigant	Lankem Ceylon Ltd.
Fenamiphos	Nemacure 5% G	Haychem Ltd.

4. RODENTICIDE

Brodifacoum	Klerat Pellets	Chemical Industries (Colombo) Ltd.
	Klerat Wax Blocks	Chemical Industries (Colombo) Ltd.
Coumatetralyl	Racumin Ready Boit	Haychem Ltd.
	Racumin Tracking powder	Haychem Ltd.

5. SOIL TREATMENT

Chloropicrin + Methyl Bromide	Baurs Melhyl Bromide	A. Baur & Co. Ltd
	Name not available	Lanken Ceylon Ltd.

TABLE II

List of Insecticide banned or restricted for use in Sri Lanka.

Name	Remarks
Aldrin	Severely restricted for termite control.
Asenate & Arsenites	Banned.
Chloradane	Severely restricted for termite and nursery pests control in coconut.
Chlorimeform	Banned.
Dibromochlorophopane	Banned
Dieldrin	Agricultural use is prohibited, used for termites.
Endrin	Banned.
Ethylene dibromide	Banned.
Heptachlora	Banned.
Leptophos	Banned.
Lindana	Severely restricted for termite control and nursery pests in coconut.
Parathion	Banned.
Parathion-Methyl	Banned.
Pentachlorophenol	Restricted to be used in Paint industry.
Thallinn	Banned.

TABLE III

List of insecticides (including acricides) molluscides, nematicides, rodenticides and soil treatment chemicals registered in India. Information is based on Regional Agro-chemicals Index jointly pulished by Agricultural Requistes Scheme for Asia and Pacific (ARSAP) and International Cooperation Centre of Agricultural Reserch for Development (CIRAD), 1990 Edition.

Because brand names and names of distributors of insecticides are not availabe. Therefore, these have been listed by common names of active ingredients.

The details for abbreviations are as follows: CB=Bait Concentrate, DP= Dustable Powder, EC= Emulsifiable Concentrate, FU= Somoke Generator, GR= Grannles, RB= Bait, SC= Suspension Concentrate, SL = Soluble Concentate, SP= Water Soluble Powder, UL= Ultra Low Volume, WP= Wettable Powder

Common name	Type of formulation
Acephate	75% SP
Aldicarb	10% GR
Aldrin	5% DP & 30% EC
Allethrin	0.5% coil
Camphechlor	10% DP, & 63% and 80% EC
Carbaryl	5% & 10% DP, 50% & 85 WP & 4% GR
Carbaryl Lindane	4+4% GR
Carbofuran	3% GR & 50 SP
Chlordane	5% DP & 20% EC
Chlorfenvinphos	10% GR
Chlorobenzilate	25% EC & 43% FU
Chlorpyrifos	20% EC
Cypermethrin	10% & 25% EC
DDT	5% & 10% DP, 50% WP & 25% EC
Deltamethrin	2.8 EC
Diazinon	40% WP, 20% EC & 5%, & 10% CR
Dichlorvos	76% & 80% EC
Dicofol	18.5% EC
Diflubenzuron	25% WP
Dimethoate	30% EC
Endosulfan	35% EC & 84% GR
Ethion	50% and 80% EC
Fenitrothion	5% DP, 40% WP, 50% & 82.5% EC & 5% GR
Fenthion	82.5% EC & 2.5% GR
Formothion	25% EC
HCH	5% & 10% DP; 20% & 50% WP; 5%, 6% & 10% GR & 0.5% coil
Lindane	0.65%, 6.5% & 13% DP, 20% EC, & 6% & 10% GR

Malathion	5% DP, 25 WP, 50% EC & 96 UL
Menazon	70% WP
Monocrotophos	36% SL
Nicotine	40% Sulphate
Oxydemeton-Methyl	
Parathion-Methyl	50% EC
Pentachlorophenol	12.5% GR
Permethrin	25 EC
Phenthoate	2% DP; 30% & 50% EC & 5% GR
Phorate	10% GR
Phosalone	4% DP & 35% EC
Phosphamidon	85% SC
Pirimiphos-Methyl	50% & 1% EC
Propoxur	20% EC
Pyrethrins	0.2% DP, & 2% EC
Quinalphos	1.5% DP, 25 EC & 5% GR
Temephos	50% EC
Tetradifon	8% EC
Thiometon	25% EC
Trichlorfon-	5% DP, 50% EC, & 5% GR

2. MOLLUSCIDES

Metaldehyde	2.5% DP

3. NEMATICIDES

D-D(N)	50 Purity
Dibromochloropropane	60% EC

4. RODENTICIDE

Bromadiolone	0.25% CB, 0.005 RB & 0.005% RB cake
Coumachlor	0.5% & 0.025%

5. SOIL TREATMENT

Ethylene Dibromide +
Methyl Bromide
Methyl Bromide

TABLE IV

List of insecticides that have been restricted is Use in the USA but are still on the approved list in Sri Lanka.

Name of Insecticide	Formulation	Use Pattern
Aldicarb	As sole active ingredient and in combination with other actives, all granular formulations	All uses
Aluminium Phosphide	As sole ingredient (no mixture registered)	All uses
Cyfluthrin	EC 25%	Agricultural
Carbofuran	All formulations	All uses
Isofenphos	65% liquid	Termite control
Lindane	All formulations	Avocados,pecans, live stock(sprays), forestry,christmas trees,ornamentals, structural treatmer , dog dust/shampoos
Magnesium Phosphide	All formulations	All uses
Methamidophos	Liquid formulation 40% and greater Dust formulations 2.5% and greater	All uses
Methomyl	As sole ingreadient in 1% to 2.5% baits (except 1% fly bait) All concentrated solution formulation and 90% wettable powder formulation (not in water soluable bags).	Non-domestic Out-door agric. crops,ornamental and turf for all formulations listed.
Monocrotophos	Liquid formulations 19% and greater Liquid formulations 50% and greater	All uses
Oxydemeton-Methyl	All formulation	All products registered.
Permethrin Methyl	All formulations	Agric crop uses(Broadcast spray)
Profenofos	Emulsifiable Concentrates 59.4%, EPA Reg.No: 100-549 and 100-669	Cotton (only registered use).

VII. TOPICS FOR PREPARING THE REPORT

A. Analysis of Current Entomological Research Being Done at DOA.

Given in Chapter II, Review of Research Reports and Analysis of Current Entomological Research Being Done by DOA.

B. Analysis Of Current Methodologies Used by MEA Extension Relative to Insect Identification and Control in System B.

Given in Chapter IV, Review the Entomological Extension. REcommendation Made by MEA AOs and in Chapter V A & B, Identification of Insect Pests and Their Natural Enemies.

C. RECOMMENDATION FOR RAPID AND ACCURATE IDENTIFICATION OF INSECTS.

The Central Agricultural Research Institute, Gannoruwa, Peradeniya (CARI) has a good reference collection of identified species. If the specimens are received from the Regional Agricultural Research Stations, identification is supplied by CARI, if the species is available in the reference collection. There is a need to improve maintenance of the reference collection, but very few of natural enemies were in it. There is no reference collection at the Regional Agricultural Research Stations (RARC) at Aralaganwila and Girandurukotte. Some identified specimens of pests and natural enemies were found at RARS Maha Illuppallama.

There are no taxonomists at CARI except Mr. Anura Wijesekera who has started working on parasitic wasps of family Eulophidae. The identification is most probably supplied by comparing with specimens already present inthe collection.

The International Institute of Entomology (IIE) (formerly known as the Commonwealth Institute of Entomology) is the best source for obtaining identifications of both the pests and their natural enemies from this Region becuase very large collection of identified species from Asia are available at IIE.

Sri Lanka is a member of the Commonwealth and CAB International (CABI). At the last CABI Review Conference 1990 it was decided that IIE will supply identifications to the member countries free of charge for another three years. So this is a good opportunity for the Regional Agricultural Research Stations and CARI to obtain identifications of pests and their natural enemies from IIE.

Copies of the brochure containing instructions for preparing and sending the specimens for identification to IIE were given to Mr. M.G. Dhanapala, Research Officer (RO) Entomology, RARS Girandurukotte. At the same time how to prepare and send the specimens for identification was demonstrated.

Because Mr. Ketipearachchi, RO, RARS Aralaganwila was out of country, the brochure and instructions were left with Ms. Kalyanee Weerasinghe, RO Agronomy who explained Mr. Ketipearachchi's plan of work. It was pointed out to both the ROs and is stronglyecommended that specimens that are sent to IIE for identification should be the ones reared in the laboratory from the immature stages collected in the field and not collected as adults by netting. For IPM, for the pests, hose plant association, and for the natural enemies, insect host association are a must.

Fruitfly specimens were received from Mr. Dhanapala for confirmation of their identity. These are being carried to Pakistan and their identification will be supplied in due course of time.

D. Recommendations which will assist in reducing overuse of pesticides.

E. Recommendations which will result in proper application of various insecticides at proper growth stage and rate.

Because answer to the above two problems is the same therefore these are treated together.

During my visits to the field, it was apparent that the pesticides are overused and misused. To reduce their use and to apply them at the proper time studies are need on the Economic Threshold Levels of various pests and incidence of the natural enemies.

For proper use of the pesticides biology and phenology of the pests and their natural enemies should be studied. In cases where the activitiy of natural enemies lags behind that of the pest and when pest attacks are becoming serious a spray, before the natural enemies start attacking the pest. mau reduce or prevent build up of the pest population. Later on when the natural enemies become active, they may suppress and keep the pest population under control.

Because vegetables are high value crop, arbitrary recommendations cannot be made. These have to be based on results of well planned and well conducted trials. At present there is not information available to make recommendation for reducing the use of pesticides and using them at the proper time.

However, the farmers should be advised not to do prophylactic or preventive spraying. They should be advised to keep an eye on the pest population and to spray when the pest appears to be building up its population. At present this is going to be based on good guess work till economic thresholds for various pests have been worked out.

F.REFINE METHOD FOR MEASURING YIELD LOSSES FROM INSECT

To assess yield loss, the basic principal is to compare the yield in plots where the pest was completing eliminated with the plots where pest was allowed. This has to be done in replicated trials. At least three replicate of each treatment should be made.

All the plots should be of the same size, receive identical treatments. The seed should be of the same variety, sown at the same time, should have the same agronomic practices

The pest population can be eliminated from the control plots with pesticides. If possible the pest may be remove manually without using pesticides depending on the type of pest for which loss is to be determined. We study loss in maize yield by removing eggs of the maize borer Chilo partellus manually. A reprint of this paper was given to the Research Officers at Girandurukotte and Aralaganwila. A reprint is also attached with the report.

The insect populations are to be studied in all the plots very accurately. Proper quantitative estimates are to be made by sampling at very short intervals. If possible every day and no infestation is to be allowed in the control plots.

After the crop has matured, the quantity in all the plots is to be measured accurately both from the plots where infestation was allowed and in the control plots where infestation was not allowed. The difference of the two will give the loss in yield.

The loss can be determined in the money by calculating the price of yields at the current market price of the commodity. In certain cases, depending on biology of the pest, the loss can be determined by allowing infestation rate at different levels. The procedure will be the same as described above but infestation will have to be allowed at different levels by removing a certain part of the population.

Another method of estimating loss in yield is by infesting the plants artificially with laboratory reared pest in cages. The cages are covered with Nylon mosquito netting. Plants are grown in small plots as for the above described method The plants can be manually infested at different population levels of the pest. The most important precaution requir d would be that the condition on cages with regard to growing of the plants, starting infestation of insect and other conditions should be as close to the natural field condition as possible. By carrying out the above experiments at different rates of pest infestation, economic threshold level can be worked out.

IX. ACKNOWLEDGEMENTS

I wish to express my sincerest thanks and gratitude to Dr. Max D. Goldensohn, Chief of Party of MARD Project and Dr. Carl N. Hittle for their hospitability and help during my stay in Sri Lanka. My thanks are also due to Dr. S.T.W. Kirinde for going with me to various Institutes and fields and arranging discussion with people. Help of Ms.H.L. Nilanthi de Silva and Mr. K.A. Upali Chandra for typing the report is gratefully acknowledged.

CONTACTS VISITED IN SRI LANKA
5TH SEPTEMBER - 4TH OCTOBER 1990

01. Development Alternatives Inc. (MARD/MDS Projects)

Dr. Max D.Goldensohn	Chief of Party
Dr. Carl N.Hittle	Research Agronomist
Dr. S.T.W.Kirinde	Research Agronomist
Dr. Chris Seubert	Agronomist
Mr. Martin West	Horticulturist
Dr. Jane Gleason	Agricultural Economist
Mr. I.K. Weerawardena	Marketing Specialist
Dr. G.W. Selleck	Chief of Party,Diversified Agricultural Research Project, Peradeniya.

02. US Agency for International Development, Colombo

Dr. Glenn Anders	Head,Agriculture Development
Mr. Gary Alex	Project Officer
Ms. Allison Brown	Project Officer
Mr. Nelson Vithanage	Agricultural Economist
Mr. Nimal Jayasuriya	Agricultural Specialist

03. Mahaweli Economic Agency (System B)

Mr. G.G.W. Gunathilake	Resident Project Manager
Mr. W.K.P. Christy Perera	Agricultural Officer

04. Mahaweli Economic Agency (Colombo)

Mr. Ananda Herath	Actg. Managing Director
Mr.P.H.K.Dayaratne	Project Coordinator

05. Department of Agriculture, Sri Lanka

Dr. Sarath Amarasiri	Deputy Director(Research)

06. Central Agricultural Research Institute, Gannoruwa, Peradeniya.

Dr. M.H.J.P. Fernando	Deputy Director(Research)
Dr. C. Kudagamage	Entomologist
Mr. Anura Wijesekera	Entomologist
Dr. M. Sikurajapathy	Botanist
Mr. R.S.Y.de Silva	Research Officer(Plant-Quarantine Division)

07. Plant Protection Service, Peradeniya

Mr. H.B. Senerath	Assistant Director

08. Faculty of Agriculture, Department of Agricultural Biology, University of Peradeniya.

Dr. Daya Ahaugama	Professor

09. Registrar of Pesticides Office, Peradeniya.

Dr. N. de Alwis	Registrar

10. Institute of Fundamental Studies, Kandy

Dr. Ivan Silva	Ecologist

11. Regional Agricultural Research Station, Aralaganwila.

Mr. A. Lecamwasam	Deputy Director (Research)
Ms. S.W.K. Weerasinghe	RO, Agronomy
Mr. L.L. Ranasinghe	RO, Agronomy Weed Science
Mr. S.H.S.A de Silva	RO, Water Management
Dr. M.A.Lathiff	RO, Soil Chemistry & fertility

12. Regional Agricultural Research Station, Girandurukotte.

Mr. M.G. Dhanapala	RO, Entomology
Mr. A.P. Bentota	RO, Agronomy
Mr. K.M.C. Bandara	RO, Farming systems

13. Regional Agricultural Research Station, Maha Illuppallama.

Dr. A.P. Ariyaratne	Deputy Director(Research)
Mr. C.M.D. Dharmasena	RO, Entomology

14. Farmers:

Mr. D.S. Karunasekera, Project Manager, Sun Frost Ltd.
Mr. M.Perera, Sun Frost Ltd.
Mr. F. Paproth, Fritzpickles(Pte) Ltd.
Small farmers.

XI. ITINERARY FOR VISIT September - October 1990.

5 September	Depart Rawalpindi 2100 hours, arrive Karachi 2300 hours
6 September	Depart Karachi 0200 hours, arrive Colombo 0700 hours. Met by Dr. S.T.W.Kirinde. Visited Mahaweli Economic Agency and USAID Office. Left Colomno 1600 hours, arrived Kandy 1830 hours.
7 September	Went to Central Agricultural Research Institute. Gannoruwa, Peradeniya(CARI), Department of Plant Protection, Development Alternatives Inc. Diversified Agricultural Research Project and Institute of Fundamental Research, Kandy,
8 September	Saturday, at Kandy
9 September	Sunday, at Kandy
10 September	Visited Agriculture Department, Peradeniya,Sri Lanka; CARI, Faculty of Agriculture, University of Peradeniya. Office of the Registrar of Pesticides. Left Kandy at 1500 hours arrive Aralaganwila camp 1830 hours.
11 September	Met Mr. F. Paproth a commercial farmer, discussed Pest control on gherkins. Went to Regional Agricultural Research Station, Aralaganwila(RARS). Went to Welikanda MEA Headquarters.
12 September	Visited fields. Went to commercial Gherkin and onion growers and a small farmer
13 September	Visited RARS Girndurukotte.
14 September	Visited RARS Maha Illuppallama.
15 September.	Saturday, at Aralaganwila
16 September	Sunday, at Aralaganwila
17 September	At Aralaganwila
18 September	Visited RARC Aralaganwila
19 September	Went to RARS Girandurukotte. Discussion with Mr. Dhanapala
20 September	Went to RARC Girandurukotte. Discussed Plan of work with Mr. Dhanapala.

21 September	At Aralaganwila
22 September	Saturday
23 September	Sunday
24 September	Went to Regional Agricultural Research Station, Aralaganwila.
25 September	Went to Welikanda to attend MARD Project Review Committee Meeting.
26 September	Discussion with Mr. W.K.P. Christy Perera, Agriculture Officer, Resident Project Manager's Office, Welikanda, on extension programme in System B.
27 September	Morning, gave seminar at RARS, Aralaganwila, Evening Left Aralaganwila at 1500 hours arrive Colombo 2000 hours.
28 September	Debriefing seminars at MEA Office and USAID Office. Left Colombo 1700 hours, arrive Kandy 1930 hours.
29 September	At Kandy - report writing.
30 September	At Kandy - report writing.
01 October	At Kandy, Gave a seminar at CARI, report writing
02 October	At Kandy, report writing
03 October	Left Kandy 0830 hours, arrive Colombo 1100 hours.
04 October	Left Colombo 1505, arrive Karachi 1600 hours, left Karachi 1800 hours, reached Rawalpindi 2000 hours.

Appendix I

TERMS OF REFERENCE OF CONSULTANCY

1. Review all Yala and Maha entomological research reports which detail, by crop season, the results of research conducted at Girandurukotte, Aralaganwila, Maha Illuppallama, CARI and other research stations.

2. Review the entomological research programs for 1990-91

3. Review the entomological extension recommendations made by the MEA AOs in system B and evaluate the mechanism and effectiveness of getting this information to the settlers.

4. Advise the DOA entomological on improved and up-todate procedure for:

   a. Identifying insect pests.
   b. Identifying natural enemies.
   c. Simplified assessment of population dynamics.
   d. Determining best stage for insecticides application.
   e. Assessing yield losses and economic thresholds.
   f. Determining yield recovery after control measures are used.
   g. Developing understanding of ecological factors responsible for peaks of major pests.
   h. Screening varieties for resistance to various insects.

5. Develop IPM for cucumber (gherkin) insects control.

6. Provide up-todate listings of insecticides which are recommended by and available from the US, Sri Lanka, India and other countries. These listings will include insecticides which have been banned.

7. The consultant will visit and work with both the settlers (who have one hectare of irrigable land plus a homestead) and the commercial farmers (who usually have 50 acres of land).

Appendix 1(Contd.)

8. Prepare a report based on the study which should include;

   a. Analysis of current entomological research being conducted by the DOA.

   b. Analysis of current methodologies used by MEA Extension relative to insect identification and control in system B.

   c. Recommendations for more rapid and accurate identification of harmful insects.

   d. Recommendations which will assist in reducing overuse of insecticides.

   e. Recommendations which will result in proper application of various insecticides at the proper growth stage and rate.

   f. Refined methods for measuring yield losses from insects.

9. The consultant will work closely with and call on the support of staff from MEA,MARD,DOA and USAID.

Appendix 11

List of reports, papers and other documents that were examined and have been summerised to review the research work done at various Research Stations.

Agricultural Research Station Girandurukotte and Aralaganwila

Agricultural Research Report		Maha 1983-84(no work on Entomology)
Agricultural Research Report		Yala 1985
- do -	- do -	Maha 1985-86
- do -	- do -	Yala 1986
- do -	- do -	Maha 1986-87
- do -	- do -	Yala 1987
- do -	- do -	Maha 1987-88
- do -	- do -	Yala 1988
- do -	- do -	Maha 1988-89
Summary of work at Aralaganwila		Yala 1989

Agricultural Research Station Maha Illuppallama

Half yearly report	Maha 1982 -83
- do - - do -	Yala 1985
Research Report	Maha 1985-86
- do - - do -	Yala 1986
- do - - do -	Yala 1987

Entamology Research Highlights

(Compiled by Dr.C. Kumagamage, Chairman, Entamology Working Group of Department of Agriculture, CARI, Peradeniya).

Maha	1986 - 87
Yala	1987
Yala	1988
Maha	1988 - 89
Yala	1989
Maha	1989 - 90

Department of Agriculture, Education and Training Division (1986). Major crop Pests and their control with pesticides.49pp.

Hittle, C.N. & Kirinde, S.T.W. (1990) On-farm trials Yala 1989. MARD/MDS projects report Development Alternatives Inc. 55pp.

Kudagamage, C. (1988) Country situation paper on Integrated Pest Management for major vegetables in Sri Lanka. Presented at FAO Expert Consultation on Integrated Pest Management on Major Vegetable Crops. 14-16 Nov. 1988, Bangkok,29pp (Mimeographed).

APPENDIX III

Research programmes for Maha 1990-91 of Regional Agricultural Research Stations at Aralaganwila and Girndurukotte.

A. RESEARCH PROGRAM MAHA 1990-91 - DIVISION OF ENTOMOLOGY RARS, ARALAGANWILA

1. Population dynamics of insects on gherkin Cucumis sativa.

Objectives:

1. To identify the major pests and their natural enemies on the crop.
2. To understand the population dynamics of major pests and their natural enemies throughout the crop and season.
3. To find out ecological factors responsible for the population peaks of major pests.

Cucumber variety; Calipso will be planted in an observational plot of 100 m2 monthly so that a continuous crop could be maintained in the field throughout the year.

No chemical will be applied to the crop for pest control. Other agronomic practices will be followed according to the raised bed method of the advisory leaflet for gherkin cultivation issued by MARD project on 09.05.1989.

Data collection: Data will be collected at fortnight intervals from different sampling units as follows.

1. Population of lepidopteran, coleopteron and dipteran and other important insects per 20 vines.
2. Population of thrips, aphids and mites on 10 leaves.
3. Degree of pest damage and the population of insects on of harvested pods.

2. Field evaluation of insecticides for the control of pests on Gherkin.

Objectives:

1. To test the efficacy of insecticides for the control of the pest (D. indica. thrips, aphids, mites etc..
2. To develop pest control recommendation on cucumber.

Treatments

Insecticides	Rate/ha ai(g)	Rate/ha Product ml.	Rate/plot ml
Tokuthion(prothiofos) 500 EC	750	1500	3.75
Carbaryl(carbaryl) 48% EC	1200	2500	6.25
Actalic(pirimphos methyl)50%	750	1500	3.75
Trebon(ethofanprox) 20% EC	500	2500	6.25
NTN 33893 imedachloprid 200SL	40	200	0.5
Anthio(formothion)24.5% EC	343	1400	3.5
Control	-	-	

Design RCBD with 4 replicates

Plot size 25 m2 Variety Calipso Spacing 82.5 x 20 mm

Other agronomic practices follow the ridge and furrow system of the advisory leaflet issued by MARD project on 09.05.1989.

Experimental procedure

Treatments are applied by a Knapsack sprayer when there is a severe pest infestation. Data will be taken at 1 day before 1,3,7 and 14 days after treatment. Data include insect populations visible to the naked eye on 10 random vines and visible through microscope (10x1) on 10 random leaves per plot.

3. Population dynamics of pests and associated insects on flowers and pods of chili.

Objectives:
1. To identify the pests on flowers and immature pods.
2. To understand the degree of their damage.
3. To identify the natural enemies associated with them.
4. To study the population of these insects throughout the year.

An observational plot of chili variety MI-2 will be planted monthly so that a continuous crop could be maintained throughout the year. Recommended agronomic practices will be followed without any pest control measures.

Data collection

Fifty plants will be randomly selected and tagged from each plot at 40 days after planting. Flowers and immature pods will be picked biweekly from these plants to obtain two random samples of flowers and pods for data collection. Of these 100 of flowers and pods will be kept separately in two plastic bottles for several days so that any emerging adults could be collected. Another 100 flowers and pods will be dissected in order to observe any larvae, pupae or adult within them. Any immature stages will be reared up to adult stage in the laboratory. These insects will be identified and their accounts will be maintained.

4. Monitoring the population of important insects associated with legumes.

Objectives:
1. To identify the major pests and their damages.
2. To identify the natural enemies associated with them.
3. To understand the population dynamics of major natural enemies.

Two pigeonpea varieties; ICPL-87 and ICPL-312 will be planted monthly each in 50 m2 so that a continuous crop could be maintained in the field throughout the year. The agronomic practices will be followed as that have been recommended for cowpea NCVT, but without pests control practices.

Data collection

Data will be collected biweekly from each plot since the on set of flowering. at and the sampling units will be as follows.

Sampling unit	Observation of data
01. 20 Plants	Population of Maruca sp., Lampides sp, Heliothis sp, Spodoptera sp and Etiella sp.
02. 50 flower buds	Population of thrips, Maruca sp, Lampides sp, Heliothis sp, Spodoptera sp, and Medythia spp beatles.
03. 50 immature pods	(a) Population of above insects, podfly and any other species notices. (b) Percentage of pod damage due to pod borers and podfly.
04. 50 ripened pods	(a) - do - (b) Weight of undamaged seeds.

Any parasitized insect will be reared in the lab up to the emergence of adult. The population of parasitized insects and parasitoids will be recorded.

5. Field evaluation of insecticides for the control of pod borers and podfly on legumes.

Objectives:
1. To test the efficacy of insecticides on legumes podborers and podfly.
2. To understand the degree of pest damage under each treatments.
3. To develop pest control recommendation on legumes.

Treatments

Insecticides	Rate of application ml/ha	ml/l*
1. Marshal(carbosulfan) 20% EC	1500	3
2. Pyrenex(chlorpyrefos) 20% EC	3000	6
3. Atabron(chlorfluazuron) 05%EC	5000	10
4. Trebron (ethofenprox) 20% EC	750	1.5
5. Lebaycid (fenthion) 50% EC	3750	7.5
6. Endosulfan 35% EC	2000	4
7. Anthio (formothion) 24.9% EC	1400	2.8
8. Control		

* Application discharge by knapsack sprayer was considered as 500 l/ha.

Design RCBD with 4 replicates

Crop Pigeonpea

Plot size 5 xx 5 m2

Variety ICPL 87

Spacing 30 x 10 cm.

Other agronomic practices are as recommended by the Department of Agriculture.

Treatments will be applied by a knapsack sprayer after on set of flowers and when there is severe podborer and podfly infestation.

Data collection:

Data will be collected 1 day before 1,3,7,14 and 21 days after treatments data include sampling of pest populations as follows;

Sampling units/plot	Insects observed
a) 6 flower clusters	Eggs and larvae of podborers
b) 30 flowers	Thrips and podborers
c) 30 immature pods	Podborers and podfly.

Following data will be taken from 3 successive pickings of each plot.

a) Population of pests from a random sample of 100 pods.

b) No of pod and seed yield of randomly selected 10 plants.

c) Turn out of quality seeds from random sample of 100 pods.

d) Net plot yield from 4 middle rows.

B. RESEARCH PROGRAMME FOR MAHA 1990-91 DIVISION OF ENTOMOLOGY, RARC GIRANDURUKOTTE

Experiment: Studies on population dynamics and control of Banana weevil cosmopolitus Sordidus using pseudostems.

Background information:

Banana weevil is the major pest of Banana which is a important fruit crop in the area. There is no attempt taken to control the pest. Inspite of present recommendations. Crop sanitation is not practiced properly as most of Banana cultivation is done as a home garden crop. As a potential fruit crop for the future population dynamics of Banana weevil is prerequisite.

Objectives: To understand varieties in weevil populations throughout the year.

To study the possibility of using treated pseudostems as a control practice.

Experimental Procedure: Pieces of Banana pseudostems (5cm thick cut pieces will be kept in the established Banana crop in the field. There will be ten pieces which is covered with straw to avoid drying at each site. Pseudostems has to be replenished weekly.

Treatments: Amount to be applied to 5cm piece of pseudostem.

1. Untreated check
2. Carbofuran 3 g.
3. Carbofuran 6 g.
4. Carbofuran 9 g.
5. Benfuracarb 3 g.
6. Benfuracarb 6 g.
7. Benfuracarb 9 g.
8. Isofenphos 3 g.
9. Isofenphos 6 g.
10. Isofenphos 9 g.

Expeprimental design: 10 pieces for each treatment placed in different places.

Observations: Number of weevil present on 1,2,3 and 7 days after placement.

Experiment 2 & 3: Studies on population dynamics of fruit fly (Dacus dorselis) and melon fly (Dacus Cucurbital) using pheramones.

Background information: Fruit flies are key pest on fruits such as Mango Guava etc; and melonfly is a Key pest on cucurbits. Knowledge on population dynamics of these key pests will be very useful.

Objective: To determine the population variation throughout the year.

Experimental Procedure: Established guava trees in the orchard and Snakeguard in the experiment 6 will be used in this study. Trap used in previous seasons be placed in the field and replenish every week. Counts will be taken daily or weekly depending on the insect populations.

Observation and Sampling days:

1. Insect counts.
2. Collect infected fruits and rear till adult stage to collect parasitoid.

Experiment 4: Studies on natural enemies of rice leaffolders with emphasis on identification, population dynamics and manipulation.

Objectives:

(1) Collection of parasitoids and predators from different sites.

(2) Study the variations in natural enemy population throughout the season.

Background information:

Rice leaffolders (Cnaphalocrocis medinalis & Marasmiapatnalis) are major pest of rice in Sri Lanka. Distribution of these two species vary from location to location as well as from season to season and so are the natural enemies. Therefore it is necessary to continue this study for few more seasons.

Location: Agricultural Research Station, Girndurukotte, sampling will be done in many locations if possible.

Materials: Sweep net, Petridishes, Yellow pan, Filter papers,Plastic bottles, Wooden cages, Agralon cages, Seed paddy Fertilizer.

Experimental Procedure:

(a) Plants for culture:

Rice plot of 10m x 20m should be planted every other week beginning from November 1989. (variety Bg. 94-1). These plants will be uprooted, placed in plots and will be used for the culture and other plant needs.

Insects on these plots will be sampled using a sweep net and yellow pan everry week.

Cover some plants with Agralon or wooden cages and use for natural enemy studies.

(b) Insect culture maintenance:

Moths and larvae should be collected from the field frrom many sites.

Maintain a culture in the green house in Agralon cages. If temperature rises too high leave the cages in shade. Plants should be kept in galvanized trays filled with water to avoid migration.

Opening of Agralon cages (oviposition) should be covered with polythene whenever humidity is low.

Leave 25% Bee honey solution for feeding and renew it daily.

Larvae collecting from the field, need to be reared in petridishes.

Collection Identification and evaluation of natural enemies:

Collect larvae & pupae from the field and rear till adult or parasitoid emergence. Specimen may be discarded 15 days after pupation, emerging parasitoid should be identified using the available records. Identified specimen should be sent to CARI or CIE.

Insect predators caught from sweep net samples in RLF abundant field should be isolated with relevant life stage of the RLF to study their predating ability and to identify potential predators.

Isolation can be done in petridishes, plastic boxes or in cages.

Place plants oviposited overnight by RLF in the field for 2 days and rear from for emerging adults or parasitoids.

Experimental design: Observational plots of 10m x 20m planted in biweekly intervals.

Agronomic Practices:

Variety: Bg 94-1
Transplanting Plant 14 day old dapog seedlings.
Spacing 25 x 10 cm.

Fertilizer (g/plot)

	Urea	CSP	MP	VI	TDM
Basal	-	-	-	3740	-
1st.TD(2 WAT)	1870	-	-	-	-
2nd.TD(5 WAT)	-	-	-	-	2500

Weeding: Rotary weeding followed by manual weeding.

Special instructions:

This experiment needs to reviewed throughout the season depending on circumstantial results. Evaluation methods are to be changed as necessary.

Experiments 5: Insect sampling on rice, snake-guard okra and orange.

Objective: To collect pest and natural enemies on these crops.

Experimental Procedure: Plot of each crop will be planted in different time internals (Rice - 2 weeks, Snake-guard and Okra monthly interval, Orange - established crop in the orchard) starting from May. Visual observations and sweep net counts will be taken to record insect inhabitants. Various stages of lepidopterous pests will be reared in the laboratory to identify parasitoid species and percentage parasitism.

Agronomic Practices:

Crop	Variety	Plot size	Spacing	Fertilizer application Basal(kg)			Topdressing(kg)		
				Urea	CSP	MP	Urea	CSP	MP
1. Rice	Bg-94-1	10mx10m	25x15cm	-	-	-	*	*	*
2. Snake-guard	MI-short	10mx10m	1mx1m	2.2	2.8	1.25	.65	.83	.37
3. Okra	MI - 5	10mx10m	60x60cm	"	"	"	"	"	"

Observation and sampling days:

(1) Collecction of insects and inhabitants once in every week.
(2) Records on losses caused by pests and diseases.
(3) Preservation and identification of collected specimen.

*V mixture: 1.87 Kg/plot. Basal, 0.935 Urea 2 WAP.
1.25 Kg TDM 6 WAP.

Experiment 6: Studies on the extent of loss and economics of pest management in Bushitao/Gerkins.

Background information: Bushitao is a popular and potential vegetable in the area. Many pests such as Aphids,thrips,Empoasca and pod borers use serious damage to the crop. However in past no attempts have been made to estimate losses caused by sucking and boring pests at different seasons. This study concerns the extent of losses caused by sucking pests and fruits borers. New schedule of insecticide application would be tested, taking into consideration the occurance and intensity of pests present, so that a grower can increase his net income.

Objective: To estimate crop losses caused by pests and economics of pest control.

Experimental Procedure: Bushitao will be planted in May. NUmber of insect pests and natural enemies present on 10 plants from each plot will be counted weekly. Sweep net counts also will be taken with 5 sweep in each plot weekly. Captured insects should be released after counting, yield will be recorded.

Water filled yellow tray and a stick trap should be kept in each plot and counts on trapping insects should be taken weekly.

Treatments:

1. Untreated check
2. Carbofuran 1kg. a.i/ha at time of planting.
3. Dimethoate 40% EC based on sucking pest incidence
4. Carbofuran 1kg a.i/ha at time of plating and chlorpyrifos 60%EC at flowering.
5. Dimethoate 40% EC based on sucking pest incidence and chlorpyrifos 60% EC at flowering.
6. Chlorpyrifos 40% EC at time of flowering.
7. Chlorpyrifos 40% EC at time of flowering.

Experimental design: R.C.B. with 04 replicates.

5	4	2	1	6	3
6	2	4	5	1	3
3	6	1	2	5	4
2	5	6	3	4	1

Plot size: 6m x 5m

Agronomic practices:

Variety:
Planting: Plant 3 seeds per a hole.
Spacing : 60cm x 150 cm 2 rows each ridge(size of the ridge 80cm) size of the furrow 40cm.

Fertilizer:	Urea(g)	CSP(g)	MP(g)
Basal	120	405	225
1st TD (with the on set of flowering).	90	-	-

Weeding: Hand weeding.

Observations and sampling days:

(1) Pest and natural enemy counts in weekly intervals.
(2) Records on diseases
(3) Record yields without the border plot.222

Appendix IV.

List of laboratory requirements for Regional Agricultural Research Stations Aralaganwila and Girandurukotte. Both the stations need some type of apparatus. This list has been prepared for one station. The quantities indicated can be doubled for the two stations. Where only one station needs a particular item, it has been indicated so.

Green house	01 Nos
Air Conditioner (Complete)	02 "
Cabinets with temperature control	02 "
Binocular Microscope	01 "
Incubators	02 "
Stereomicroscope	01 "
Micro cover glasses	02 Boxes
Micro cover slips	01 "
Magnifying lense 10x	05 Nos
Magnifying lense 20x	05 "
Electric balance	01 "
Electonic stop watch	01 "
Pinning foreceps	02 "
Paper cutting shears scissors 200mm	01 "
Thermometer (Maximum and minimum Temperature)	02 "
- do - Dry and Wet Bulb	02 "
Hygrometer	02 "
Rotatable specimen holder	02 "
Insect spreading boards of different sizes	04 "
Hand sprayers	02 "
Graduated cylinders of various capacity	02 each cap.
Test tubes racks (80 tubes)	03 Nos.
Tube Lights (Complete)	12
Methyl Eugenol, Cuelore(for Girandurukotte)	05 kg.
Dessicators of two different sizes	06 of
Autoclave	06 Nos
Forceps(with fine ends/curved tip/blunt tip)	06 "
Entomological pins (different size)	12 pcks.
Thermonydrograph recorder	02 Nos
Insect collection cabinets	12 Nos
Display cabinets	06 "
Rubber gloves	12 "
Standard jars 1 lb. capacity	100 "
Test tubes a) 20x150mm	150 "
b) 22x175mm	200 "
c) 25x200mm	150 "
d) 10x75mm	02 pcks.

Appendix IV (Contd.)

Pyrex beakers, measuring 250 ml,600ml,1000ml	05 each
Graduated cylinders of various capacities	05 each
Preservation vials 1.5ml,2ml,8ml,32ml,40ml	01 gross of each size
Petri dishes	200 sets
Watch glasses 50mm dia,80mm dia	01 Doz.each
Carty blocr	02 doz.
Slides(glass)	02 Doz
Laboratory rack	06
Mylor (Agralan Sheets)	10
Wood Cages for Insect rearing	12single space