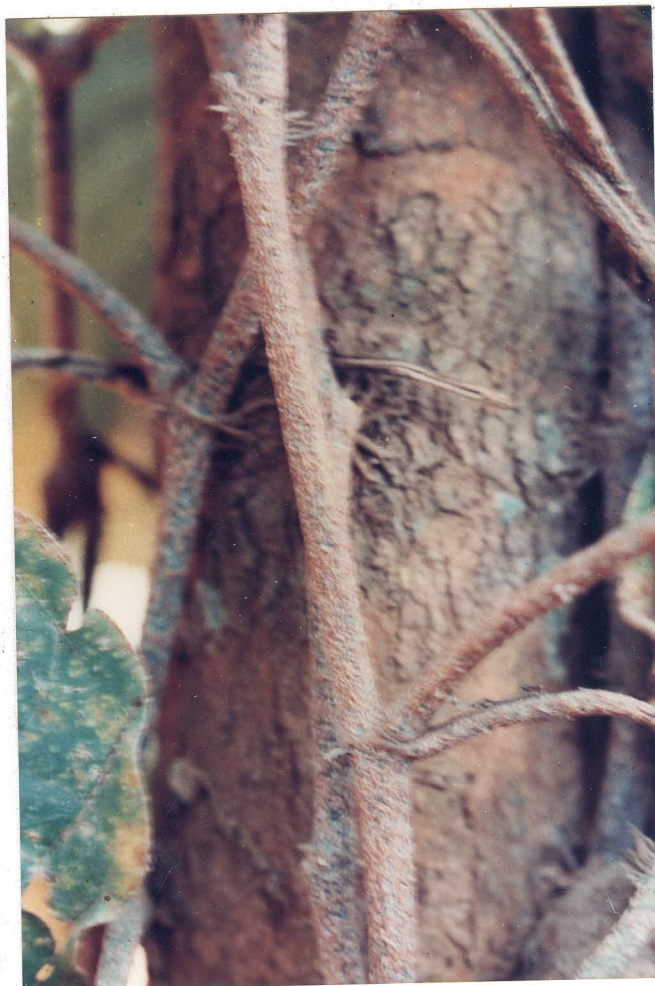


**ENT.IX : STUDIES ON COCCIDS INFESTING BLACK PEPPER**

**(1987 - 1994)**

**FINAL REPORT**



**NATIONAL RESEARCH CENTRE FOR SPICES**  
**(Indian Council of Agricultural Research)**  
**CALICUT - 673 012, KERALA**

RPF-III

FINAL REPORT

1. Institute Code No. : Ent IX (813)
2. ICAR Code No. : P1-87/13-ICI-H20/2320
3. Name and address of Research Institute/Centre : National Research Centre for Spices  
Post Box No.1701  
Marikunnu P.O.  
CALICUT-673 012, Kerala
4. Project title : Studies on coccids infesting black pepper
5. Name and designation of Project leader : K.M.Abdulla Koya  
Scientist (Senior Scale)
6. Name and designation of project leader and associate and work to be done

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| Sl. no. | Name and designation  | Time spent    | Work done |
|---------|---|---------------|-----------|
| 1.      | K.M.Abdulla Koya - Project leader<br>Scientist (Senior Scale)     | 53 man months | All items |
| 2.      | S. Devasahayam - Project associate<br>Scientist (Selection Grade) | 9 man months  | All items |

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7. Location of research project with complete address (Division/Section/Sub Centre) : Entomology Section  
National Research Centre for Spices  
Post Box No.1701  
Marikunnu P.O.  
CALICUT-673 012, Kerala
8. Date of start : January 1987
9. Date of termination : March 1994

10. a) Objectives

The project aims at identifying the various species of coccids (scale insects and mealy bugs) infesting black pepper and studying the nature of damage, life cycle, seasonal population, incidence of natural enemies and evolving suitable control measures against major species.

b) Practical utility including background information

Black pepper, the dried nature berries of Piper nigrum L., a perennial climbing vine is of considerable economic importance being a major source of foreign exchange for the country among agricultural produces. However, though India is a leading producer of black pepper in the world, the productivity of the crop is considerably low and infestation by insect pests has been identified as one of the factors responsible for the low productivity. Among the various insect pests recorded on the crop, scale insects and mealy bugs are reported to cause considerable damage to black pepper (Nair, 1975; Pillai, 1978). In recent years scale insects have become increasingly serious in many black pepper areas at higher elevations in Kerala and Karnataka. However, very little information is available on the distribution of various species of scale insects and mealy bugs in major black pepper areas, their nature of damage, life cycle and seasonal population, incidence of natural enemies and suitable control measures for their management in the field. The proposed project would provide information on the fore-mentioned aspects including formulation of effective control measures against the pest leading to increased production and productivity of the crop.

## 11. Technical Programme

- a) Survey for distribution of scale insects and mealy bugs in major black pepper areas
- b) Nature of damage and life cycle of scale insects
- c) Seasonal population of scale insects
- d) Identification of natural enemies of scale insects
- e) Seasonal population of natural enemies of scale insects
- f) Evaluation of insecticides for the control of scale insects in the field

## 12. Final Report

### a) Distribution

Surveys were conducted in 169 locations in Thiruvananthapuram, Kottayam, Ernakulam, Palakkad, Malappuram, Kozhikode, Wynad, Kannur and Kasaragod districts in Kerala; Kodagu, Uttara Kannada and Shimoga districts in Karnataka and Kanyakumari, Salem and Nilgiris districts in Tamil Nadu to study the distribution of various species of scale insects and mealy bugs in major black pepper areas. Three gardens were surveyed in each location and 15 vines were selected at each location and 25 lateral branches were observed critically to record the incidence of scale insects and mealy bugs on them. The various species collected were identified by the International Institute of Entomology, United Kingdom.

Eleven species of scale insects and 5 species of mealy bugs were observed to infest black pepper (Table 1). Among the various species, Lepidosaphes piperis Green and Aspidiotus destructor Sign. were more common and serious. Infestations of L. piperis were relatively higher at Thiruvananthapuram, Idukki, Wynad, Kodagu and Nilgiris districts. A. destructor was more serious at Idukki, Wynad, Kodagu, North Kanara, Shimoga, Salem and Nilgiris districts (Table 2). L. piperis was also common on older rooted cuttings and laterals in nurseries.

b) Nature of damage and life cycle

i) Nature of damage

The nature of damage caused by L. piperis and A. destructor was studied in detail. Infested leaves and lateral branches of rooted laterals in the green house and vines in the field were tagged and the progress of various symptoms was observed at regular intervals.

L. piperis infested main stems (in younger vines), stems of lateral branches, leaves and berries. The pest infestation resulted in chlorotic patches, yellowing and drying of leaves. Younger vines succumbed to the pest attack during the course of 2-3 years. On older vines, the infested lateral branches wilted and dried. A. destructor generally infested leaves and rarely stems of lateral branches and berries. The pest infestation resulted in chlorotic patches on the leaves and their subsequent yellowing and drying. The other species of scale insects resulted in localised necrotic patches on the leaves. The mealy bugs generally infested tender shoots and leaves; however, infestation by Plannococcus sp. was also observed at the basal portions of stems near to the root zone under the soil.

Table 1. List of scale insects and mealy bugs recorded on black pepper

| Sl.No. | Genera/Species  | Plant parts affected                  |
|--------|---|---------------------------------------|
| 1.     | <u>Icerya aegyptiaca</u> (Douglas)<br>(Margarodidae)      | Leaves                                |
| 2.     | <u>Ferrisia virgata</u> (Cockerell)<br>(Pseudococcidae)   | Shoots, Leaves                        |
| 3.     | <u>Planococcus</u> sp.<br>(Pseudococcidae)                | Stems (basal portion), Shoots, Leaves |
| 4.     | <u>P. minor</u> (Maskell)<br>(Pseudococcidae)             | Shoots, Leaves                        |
| 5.     | <u>Pseudococcus</u> sp.<br>(Pseudococcidae)               | Shoots, Leaves                        |
| 6.     | <u>P. longispinus</u> (Targioni)<br>(Pseudococcidae)      | Shoots, Leaves                        |
| 7.     | <u>Marsipococcus marsupialis</u> (Green)<br>(Coccidae)    | Leaves                                |
| 8.     | <u>Protopulvinaria longivalvata</u> Green<br>(Coccidae)   | Leaves                                |
| 9.     | <u>Aspidiotus destructor</u> Signoret<br>(Diaspididae)    | Leaves                                |
| 10.    | <u>Lepidosaphes piperis</u> Green<br>(Diaspididae)        | Stems, Leaves, Berries                |
| 11.    | <u>Parlatoria pergandii</u> Comstock<br>(Diaspididae)     | Leaves                                |
| 12.    | <u>Pinnaspis strachani</u> (Cooley)<br>(Diaspididae)      | Stems, Leaves, Berries                |
| 13.    | <u>Pseudaulacaspis</u> sp.<br>(Diaspididae)               | Stems, Leaves                         |
| 14.    | <u>P. cockerelli</u> (Cooley)<br>(Diaspididae)            | Stems, Leaves, Berries                |
| 15.    | <u>Anomalococcus indicus</u> Ayyar<br>(Lecanodiaspididae) | Stems                                 |

Table 2. Incidence of Lepidosaphes piperis and Aspidiotus destructor on black pepper

| State/District     | No. of locations surveyed | % vines infested (range) |                      |
|--------------------|---------------------------|--------------------------|----------------------|
|                    |                           | <u>L. piperis</u>        | <u>A. destructor</u> |
| <b>Kerala</b>      |                           |                          |                      |
| Thiruvananthapuram | 10                        | 0.0-33.3                 | 0.0-15.6             |
| Kottayam           | 10                        | 0.0-2.2                  | 0                    |
| Ernakulam          | 6                         | 0.0-6.7                  | 0                    |
| Idukki             | 14                        | 0.0-70.0                 | 0.0-73.3             |
| Palakkad           | 3                         | 0                        | 0                    |
| Malappuram         | 12                        | 0                        | 0                    |
| Kozhikode          | 20                        | 0                        | 0                    |
| Wynad              | 16                        | 0.0-46.7                 | 0.0-40.0             |
| Kannur             | 21                        | 0                        | 0                    |
| Kasaragod          | 17                        | 0.0-6.7                  | 0.0-2.2              |
| <b>Karnataka</b>   |                           |                          |                      |
| Kodagu             | 15                        | 2.2-55.6                 | 2.2-53.3             |
| Uttara Kannada     | 7                         | 0.0-11.1                 | 0.0-33.3             |
| Shimoga            | 3                         | 0.0-2.2                  | 0.0-26.7             |
| <b>Tamil Nadu</b>  |                           |                          |                      |
| Kanyakumari        | 7                         | 0.0-10.0                 | 0                    |
| Nilgiris           | 5                         | 6.7-80.0                 | 0.0-73.3             |
| Salem              | 3                         | 0                        | 23.5-60.0            |

## ii) Life cycle

The life cycle of L. piperis and A. destructor was studied in the green house. Portions of infested stems and leaves of black pepper were collected from the field and 'clipped on' to leaves of healthy rooted laterals raised in pots in the green house and the emerging crawlers were allowed to settle on them. The progress in development of settlers was observed under a stereomicroscope at daily intervals to determine the duration of various stages and life cycle.

Crawlers of L. piperis and A. destructor generally settled within 24 h of hatching and secretion of the scale covering commenced soon after. Both the species were observed to reproduce parthenogenetically. The incubation period of eggs could not be ascertained since the eggs were laid under the scale. In L. piperis, the I and II instar larval stages lasted for 9-12 and 9-10 days, respectively and the prepupal and pupal stages for 2-3 each. In A. destructor, the I and II instar larval stages lasted for 5-8 and 9-12 days, respectively and the prepupal and pupal stages for 6-7 and 4-5 days, respectively.

## c) Seasonal population

The seasonal population of L. piperis and A. destructor was recorded at monthly intervals at Kalpetta (Wynad district, Kerala). Infested leaf samples were collected from vines (var. Panniyur-I) and brought to the laboratory. The number of crawlers and scales present on them was counted under a stereomicroscope in three 1x1 cm areas from the distal, middle and basal portions of each leaf.



Fig 1. Seasonal population of *Lepidosaphes piperis* on black pepper at Kalpetta (1989-92)

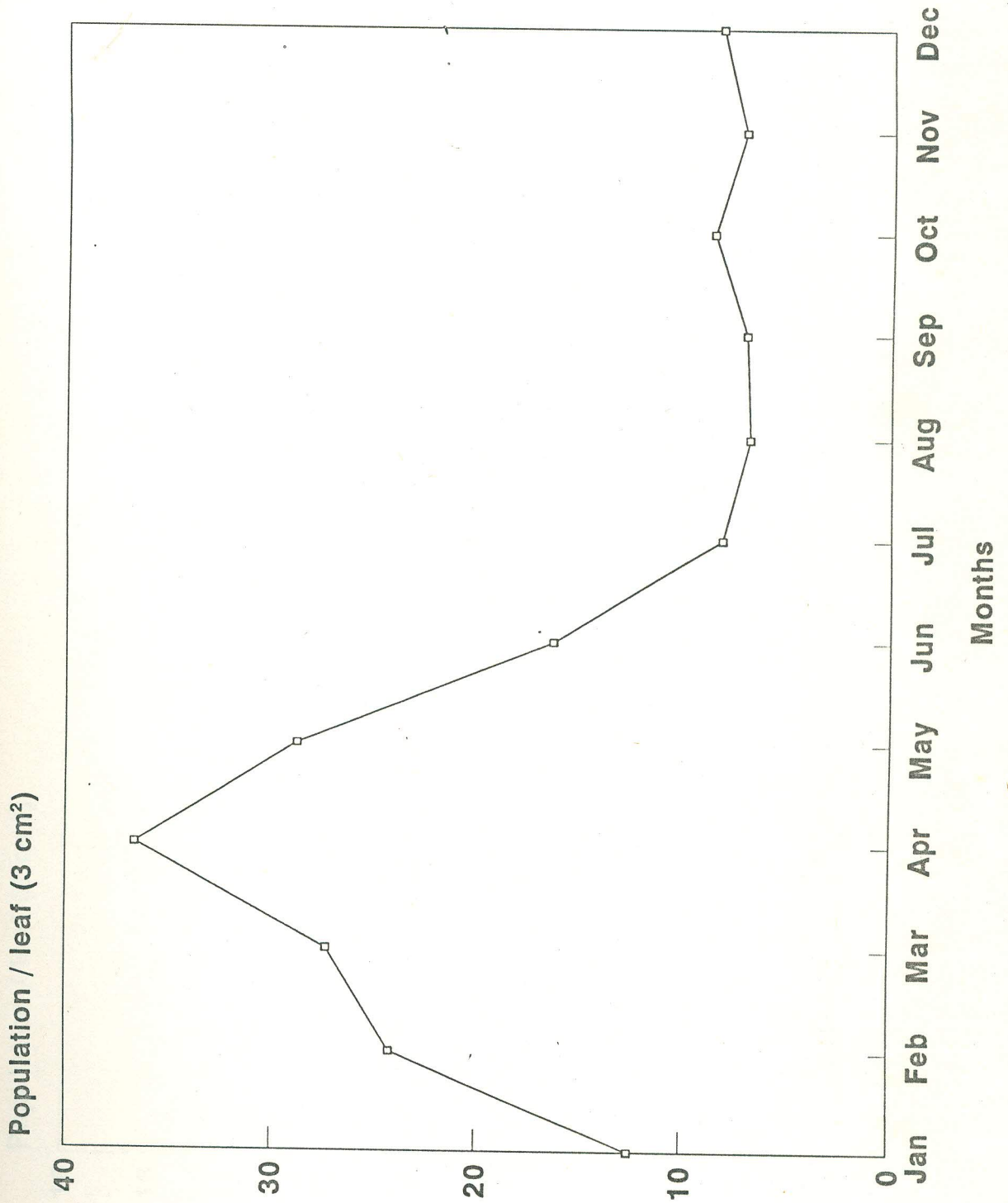


Fig 2. Seasonal population of *Aspidiotus destructor* on black pepper at Kalpetta (1990-93)



Populations of L. piperis were observed throughout the year in the field but were higher during February-May and low during July-December. Summer months were ideal for the build up of the pest population and the onset of the monsoon resulted in their drastic reduction (Fig.1). Populations of A. destructor were also observed throughout the year but were higher during the post monsoon and early summer months (September-March) (Fig.2).

d) Identification of natural enemies

Natural enemies of scale insects and mealy bugs were collected from the field during the survey for the incidence of the pest in various areas. The predatory/parasitic activity of the natural enemies was confirmed in the laboratory. The natural enemies were identified by the International Institute of Entomology, United Kingdom.

Seven species of coleopterans, 4 species of hymenopterans, 2 species of thysanopterans, and a species of neuropteran and mite were recorded as natural enemies (Table 3). All the species appear to be new records on scale insects and mealy bugs. Among the various natural enemies Chilocorus circumdatus, Pseudoscymnus sp. and Encarsia lounsburyi were more common on L. piperis and A. destructor.

e) Seasonal population of natural enemies

The seasonal population of important natural enemies of L. piperis and A. destructor was recorded at monthly intervals at Kalpetta. Leaf samples infested with scale insects were collected from vines (var. Panniyur-1) and brought to the laboratory for recording the natural enemies. The number of scales parasitised by E. lounsburyi was recorded in three 1x1 cm areas from the distal, middle and basal portions of the leaf. The number of larvae/adults of C. circumdatus and Pseudoscymnus sp. was recorded from each collected leaf.

Table 3. List of natural enemies recorded on scale insects and mealy bugs on black pepper

| Host/Natural enemy |  |
|--------------------|--|
| a.                 | <u>Pseudococcus</u> sp.  |
| 1.                 | Genus et sp. indet.<br>(Neuroptera : Chrysopidae)                              |
| 2.                 | <u>Leptacis</u> sp.<br>(Hymenoptera : Platygasteridae)                         |
| b.                 | <u>Protopulvinaria longivalvata</u> Green                                      |
| 1.                 | <u>Coccophagus ceroplastae</u> (Howard)<br>(Hymenoptera : Aphelinidae)         |
| c.                 | <u>Lepidosaphes piperis</u> Green and <u>Aspidiotus destructor</u> Signoret    |
| 1.                 | <u>Bdella</u> sp.<br>(Acarina : Bdellidae)                                     |
| 2.                 | Genus et sp. indet.<br>(Heteroptera : Miridae)                                 |
| 3.                 | <u>Karnyothrips melaleucus</u> (Bagnall)<br>(Thysanoptera : Phlaeothripidae)   |
| 4.                 | <u>Aleurodothrips fasciatus</u> (Franklin)<br>(Thysanoptera : Phlaeothripidae) |
| 5.                 | <u>Chilocorus circumdatus</u> (Gyllenhal)<br>(Coleoptera : Coccinellidae)      |
| 6.                 | <u>Pseudoscymnus</u> sp.(2 species)<br>(Coleoptera : Coccinellidae)            |
| 7.                 | <u>P. dwipakalpa</u> Ghorpade<br>(Coleoptera : Coccinellidae)                  |
| 8.                 | <u>Pharoscymnus horni</u> (Wiese)<br>(Coleoptera : Coccinellidae)              |
| 9.                 | <u>Sticholotis exsanguis</u> Sicard<br>(Coleoptera : Coccinellidae)            |
| 10.                | <u>Cybocephalus</u> sp.<br>(Coleoptera : Nitidulidae)                          |
| 11.                | <u>Encarsia lounsburyi</u> (Berlese & Paoli)<br>(Hymenoptera : Aphelenidae)    |

Fig 3. Seasonal population of natural enemies of *Lepidosaphes piperis* on black pepper at Kalpetta (1989-92)

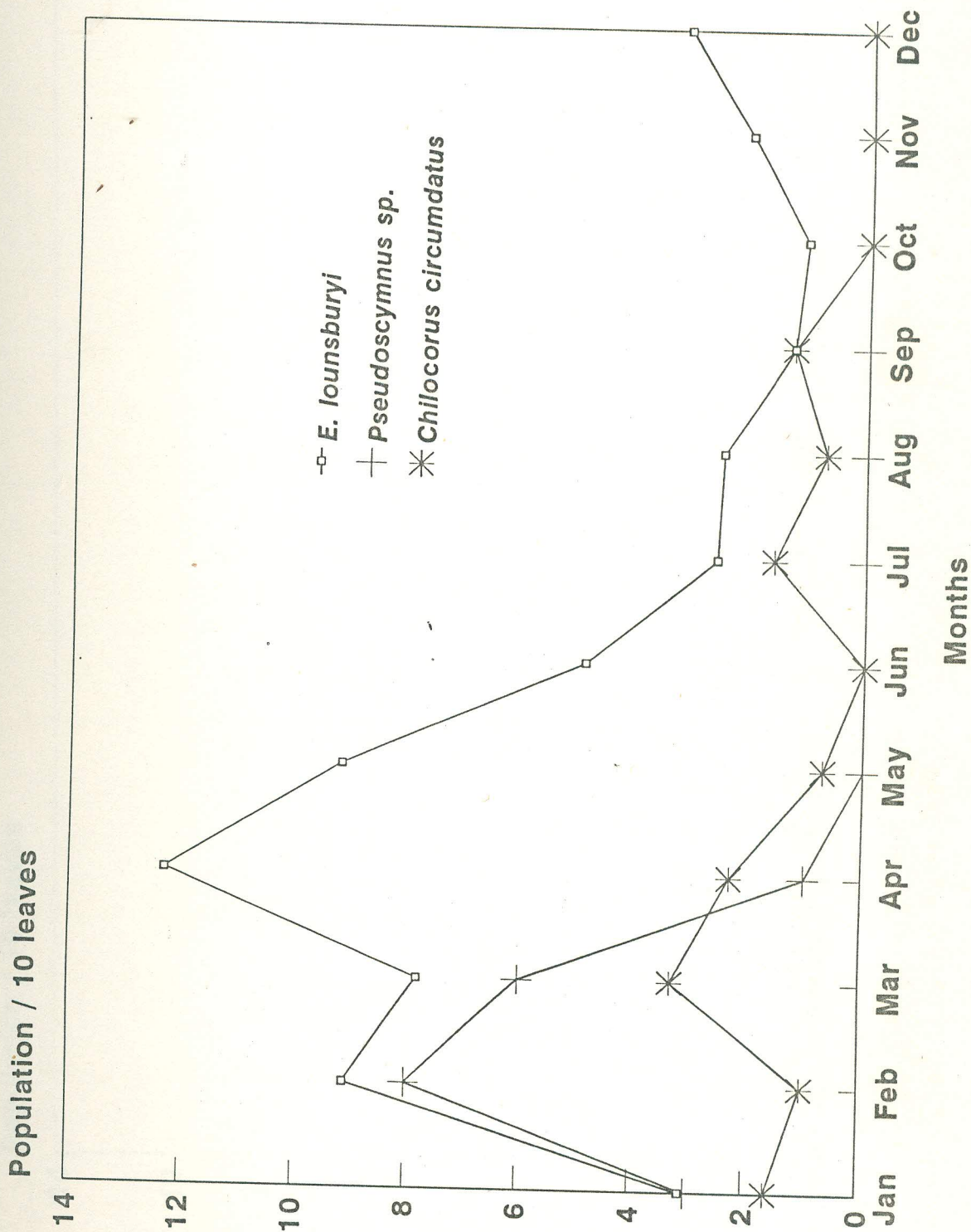
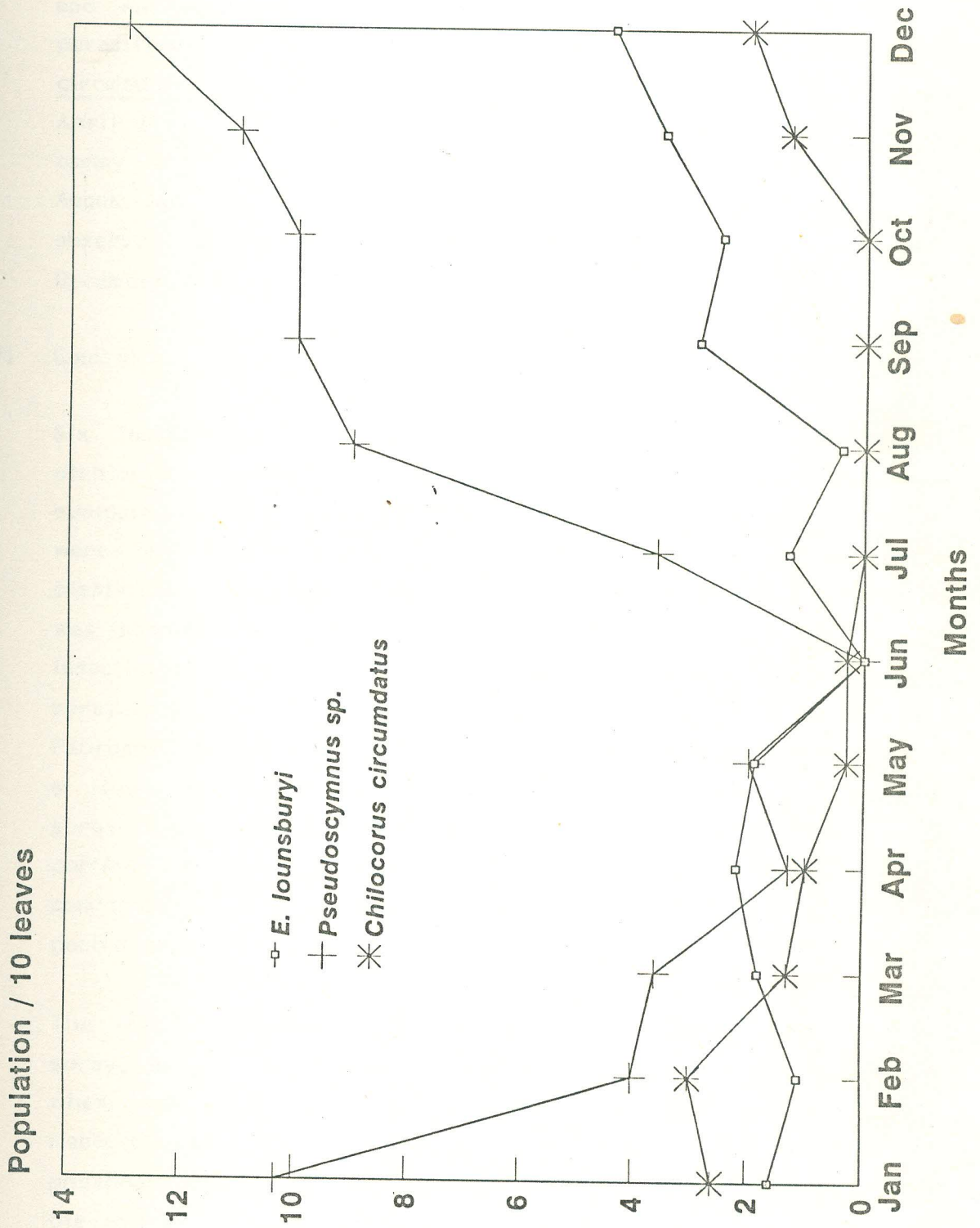


Fig 4. Seasonal population of natural enemies of *Aspidiotus destructor* on black pepper at Kalpetta (1990-93)



E. lounsburyi was the most important natural enemy of L. piperis and was observed throughout the year; however, the incidence of parasitism was higher during February-May. Populations of C. circumdatus and Pseudoscymnus sp. were higher during January-April (Fig.3). Pseudoscymnus sp. was the most important natural enemy of A. destructor and its population was higher during August-January. The incidence of parasitism by E. lounsburyi was observed throughout the year but was higher during September-December (Fig.4).

f) Control

Six insecticides viz., monocrotophos, phosphamidon, dimethoate, dichlorvos, methyl parathion and malathion (0.1% each) were evaluated in the field for the control of L. piperis. The trials were laid out in a 15 year old black pepper (cv. Karimunda) plantation at Kuppadi (Wynad district). A Randomised Block Design was adopted and each treatment was replicated four times. The insecticides were sprayed twice at 30 days interval with a rocker sprayer to run off level after harvest of the crop during early February. An untreated control was also maintained. The population of live scale insects was determined 15 and 30 days after the first spray and 15 days after the second spray by sampling stem portions of laterals from various treatments. The trials were conducted for 2 years consecutively and the data were subjected to pooled analysis.

The trials indicated that at the end of 15 days after the first spray, all the insecticides caused significant mortality of the pest when compared to control. Among the various treatments, monocrotophos and dimethoate were significantly superior to phosphamidon and dichlorvos and were on par with malathion. At the end of 30 days, dimethoate, monocrotophos and malathion were significantly superior to other treatments and were on par with each other. At the end of 15 days after the second spray, dimethoate, monocrotophos and malathion were significantly superior

Table 4. Evaluation of insecticides for the control of *Lepidosaphes piperis* on black pepper (combined analysis of two years)

| Insecticide<br>(0.1%) | Per cent mortality  |                     |                     |
|-----------------------|---------------------|---------------------|---------------------|
|                       | 15 DAS <sub>1</sub> | 30 DAS <sub>1</sub> | 15 DAS <sub>2</sub> |
| Monocrotophos         | 96.0 (78.4)         | 99.7 (86.7)         | 100.0 (90.0)        |
| Phosphamidon          | 84.3 (66.7)         | 83.8 (66.2)         | 91.2 (72.7)         |
| Dimethoate            | 95.5 (77.8)         | 99.9 (88.2)         | 100.0 (90.0)        |
| Dichlorvos            | 77.5 (61.7)         | 58.1 (49.7)         | 66.2 (54.5)         |
| Methyl parathion      | 84.2 (66.7)         | 91.9 (73.5)         | 95.1 (77.3)         |
| Malathion             | 92.0 (73.6)         | 99.5 (85.9)         | 100.0 (90.0)        |
| Control               | 4.8 (12.7)          | 2.5 (9.1)           | 5.7 (4.3)           |
| CD at 5%              | 7.4                 | 6.1                 | 6.9                 |

DAS<sub>1</sub> = Days after first spray

DAS<sub>2</sub> = Days after second spray

Figures in parentheses are transformed values



to other treatments causing 100 per cent mortality of the pest population and were on par with methyl parathion. The trials thus indicated that spraying of dimethoate, monocrotophos or malathion 0.1% was effective for the control of L. piperis on black pepper (Table 4).

## References

- NAIR, M.R.G.K. 1975. Insects and Mites of Crops in India. Indian Council of Agricultural Research, New Delhi. 404 pp.
- PILLAI, G.B. 1978. Pests of pepper. pp.15-17. In. Proc., National Seminar on Pepper Eds. NAIR, M.K. and HARIDASAN, M. Central Plantation Crops Research Institute, Kasaragod.

13. Approximate expenditure incurred in the project (give reasons for variation if any, from original estimated cost)

|                   |               |
|-------------------|---------------|
| Original estimate | : Rs.1,05,000 |
| Revised estimate  | : Rs.1,75,000 |

The project which was originally proposed for three years, was extended for four more years. There was escalation in the salary of scientific and other staff also.

14. Publications and material (one copy each to be supplied with this proforma) developed

a) Research papers

- i) DEVASAHAYAM, S. and ABDULLA KOYA, K.M. 1994. Natural enemies of major insect pests of black pepper (Piper nigrum L.) in India. J. Spices & Aromatic Crops 3 : 50-55.

- ii) DEVASAHAYAM, S. and ABDULLA KOYA, K.M. 1994. Field evaluation of insecticides for the control of mussel scale (Lepidosaphes piperis Gr.) on black pepper (Piper nigrum L.). J. ent. Res. 18 : 00-00 (in press).
- iii) DEVASAHAYAM, S., PREMKUMAR, T. and ABDULLA KOYA, K.M. 1988. Insect pests of black pepper Piper nigrum L. in India - a review. J. Plant. Crops 16 : 1-11.
- iv) VENKATESAN, S., ABDULLA KOYA, K.M., LETCHOUMANANE, S., PRAKASAM, V., EDISON, S., THAMBURAJ, S. and KUMAR, N. 1992. Preliminary survey on the natural occurrence of coccids on black pepper at Shevroys. Pestology 16 (9) : 20-21.
- b) Popular articles
- i) DEVASAHAYAM, S. 1992. Management of insect pests of black pepper - problems and prospects. pp.48-50. In : Black Pepper and Cardamom - Problems and Propects. Eds. SARMA, Y.R., DEVASAHAYAM, S. and ANANDARAJ, M. Indian Society for Spices, Calicut.
- ii) DEVASAHAYAM, S. 1992. Insect pests of black pepper and their control. Planters Chronicle 87(3):153 & 155.
- c) Reports
- Nil
- d) Seminars and workshops (relevant to the project) in which the scientist has participated
- i) National Symposium on Integrated Pest Control - Progress and Perspectives, 15-17 October 1987, Thiruvananthapuram (S. Devasahayam)

- ii) National Seminar on Biological Control in Plantation Crops, 27-28 June 1991, Kottayam (S. Devasahayam).
  - iii) Seminar on Intercropping Pepper in Coffee Plantations, 24 February 1992, Mysore (S. Devasahayam).
  - iv) National Seminar on Black Pepper and Cardamom, 17-18 May 1992, Calicut (S. Devasahayam).
  - v) Seminar on Production and Productivity of Black Pepper and Cardamom, 6-8 August 1993, Polibetta (S. Devasahayam).
- e) Material developed such as new varieties of crops or breeds of farm animals, implements, products, etc.

The recommendation for the control of scale insect (L. piperis) on black pepper was developed. The recommendation involves spraying of monocrotophos or dimethoate or malathionn (0.1% each) during initial stages of infestation during January/February and repeating it after 30 days.

15. Details of field/laboratory note books and final material and their location

|                      |      |
|----------------------|------|
| Project file         | -1   |
| Log book             | -1   |
| Survey proforma file | -1   |
| Data file            | -1   |
| Laboratory note book | -1+1 |

(Available at Entomology Section, NRCS, Calicut)

16. Comments/suggestions of project leader regarding possible future lines of work that may be taken up arising out of this project

A number of natural enemies were recorded on the two major species of scale insects viz., L. piperis and A. destructor infesting black pepper.