



## Species diversity and seasonal abundance of fruit piercing moth complex in Tamil Nadu

J. Ramkumar<sup>1</sup>, M. Swamiappan, S. Raguraman and A. Sadasakthi

### ABSTRACT

Based on the survey made at different localities in Tamil Nadu, five species of primary fruit piercers belonging to two genera viz., *Othreis materna* (L.), *O. fullonia* (Clerck), *O. homaena* Hubner, *O. salamina* (Cram.) and *Rhytia hypermnestra* (Stoll) were found to feed on guava and citrus fruits. Among the five species, *O. materna* was the predominant piercer followed by *O. fullonia* and *O. homaena*. The species viz., *O. salamina* and *R. hypermnestra* were very less abundant in all the localities surveyed. Species richness of fruit piercing moth was higher in Periyakulam (2.173), low in Mettupalayam (1.103). The overall measure of diversity and relative abundance of fruit piercing moths was high at Periyakulam and low in Mettupalayam. Regarding seasonal abundance, the activity of *O. materna* found from the second fortnight of July to till January and *O. fullonia* and *O. homaena* was observed from the first week of September and continuing up to first fortnight of January. The larvae of *R. hypermnestra* were collected during first week of October and moth activity was recorded from the second fortnight of September.

**Key words:** Species diversity, *Othreis materna*, *O. fullonia*, *O. homaena*, *O. salamina*, *Rhytia hypermnestra*

### INTRODUCTION

There are many species of noctuid moths which normally feed on mature or ripening fruits by piercing the rind by means of specially adapted proboscis and sucking the juice of the fruit. Among the fruit piercers, the genus *Othreis* are by far the most harmful, causing widespread damage in tropical and subtropical countries. Muniappan *et al.* (1993) recorded four primary fruit piercing moths in Micronesia belonging to different genera. In India, four species of *Othreis* viz., *Othreis fullonia* (Clerck), *Othreis materna* (L.), *Othreis homaena* Hubner and *Othreis cajeta* (Cramer) were recorded as prominent fruit piercer and they are considered as very serious pest on citrus, guava, pomegranate, grapes, fig, sapota, mango, papaya and tomato in India (Hampson, 1894; Susainathan, 1924a; Ayyar, 1944; Sundara Babu and David, 1973; Nair, 1975). Swamiappan (2001) reported about the less frequently occurring fruit piercing moth's viz., *Othreis salamina* Fab. and *Rhytia hypermnestra* (Stoll). Even though these moths cause serious damage to tropical and subtropical fruits, very little research has been done in India especially on species complex and their seasonal abundance. Hence, an attempt has been made to record the species complex of fruit piercing moths and their seasonal occurrence in Tamil Nadu.

### MATERIALS AND METHODS

#### Species composition of fruit piercing moths

Field surveys were conducted in guava and citrus orchards in and around Agricultural College and Research

Institute (AC & RI), Madurai campus and in different climatic zones of Tamil Nadu, for the collection of life stages of fruit piercing moths. During the ripening season of fruits regular visits were made to guava orchards during the night hours from 7.00-10.00 p.m. to observe the moth activity. A beam of torch light was focused on the moths while they feed on the fruits and the moths were located by the reflected light from their large eyes which glisten brightly. The moths were collected by sweeping insect net and they were transferred to polythene bag containing cotton swab immersed in ethyl acetate. The moths attracted to fluorescent tube lights of college buildings and hostel premises were also collected and killed by ethyl acetate. The killed adults were pinned carefully and set on a mounting board and preserved in the laboratory for further studies. The number of male and female moths of different species of fruit piercing moths was recorded from the students' collections from Agricultural or Horticultural colleges of Tamil Nadu Agricultural University situated at Periyakulam, Trichy, Mettupalayam, Coimbatore, Karaikal and Kalavai during the year 2003-2004. Based on these, the dominant species of fruit piercing moths in that particular locality was identified.

#### Quantitative measurements of biodiversity

Quantitative estimates of species diversity, evenness and richness in different locations were made using the data derived from the field surveys.

**Species diversity (H)**

To study the proportion of each species within the local community, species diversity was computed based on Shannon-Wiener formula, which is also called as Shannon Index or Shannon-Weaver Index (Humphries *et al.*, 1996).

$$H = -\sum_{i=1}^S P_i \log_e P_i$$

Where, H is the Shannon-Wiener biodiversity index,  $P_i$  is the proportion of each species in the sample (relative abundance),  $\log_e P_i$  is the natural log of  $P_i$  and S is the number of species in the community.

**Species evenness (J)**

To know the measure of how similar the abundance of different species, species evenness was calculated to estimate the equitability component of diversity (Pielou, 1969).

$$J = \frac{H}{\log_e S}$$

Where, H is the Shannon-Wiener biodiversity index and S is the number of species in the community

**Species richness (Ma) (Pielou, 1975)**

This was calculated to know how the diversity of the population distributed or organized among the particular species.

$$Ma = \frac{S-1}{\log_e N}$$

Where, S is the total number of species collected and N is the total number of individuals in all the species.

**RESULTS AND DISCUSSION****Species complex of primary fruit piercers**

Based on the survey made at different localities in Tamil Nadu, five species of primary fruit piercers belonging to

two genera viz., *O. materna*, *O. fullonia*, *O. homaena*, *O. salaminia* and *R. hypermnestra* were found to feed on guava fruits. Among the five species, *O. materna* was predominant piercer followed by *O. fullonia* and *O. homaena*. The species *O. salaminia* and *R. hypermnestra* were very less abundant in all the localities surveyed (Table 1). The species complex in descending order was *O. materna* (327 moths were collected) > *O. fullonia* (175 moths collected) > *O. homaena* (114 moths collected) > *R. hypermnestra* (38 moths collected). Susainathan (1924a, 1924b), Ayyar (1944), Sundara Babu and David (1973) were listed 17 to 20 species as fruit piercers including the secondary fruit piercers.

*O. fullonia*, *O. materna*, *O. homaena* and *Achaea janata* (L.) were the cosmopolitan species of fruit piercers mentioned by Rakshpal (1945), Mote *et al.* (1991), Bindra (1957), Bhumannavar and Viraktamath (2001a, 2001b), Mohite *et al.*, (2004) in India. In Tamil Nadu, Swamiappan (2001) listed 5 species of fruit piercing moths including *O. materna*, *O. fullonia*, *O. homaena*, *O. salaminia* and *R. hypermnestra*.

**Comparison of species abundance, diversity and richness of fruit piercing moths**

The total number of species collected from different localities ranged from 3 to 5 (Table 2). Species richness was higher in Periyakulam (2.173), low in Mettupalayam (1.103). Also, Periyakulam recorded higher values for species evenness and diversity with 0.822 and 0.495, respectively while Mettupalayam registered low values (0.362 and 0.173, respectively). The overall measure of diversity and relative abundance of fruit piercing moths was high at Periyakulam and low in Mettupalayam. Humphries *et al.* (1996) substantiated that species richness and evenness are that most popular approach to

**Table 1.** Month wise collection of fruit piercing moths at AC&RI, Madurai campus during 2003-2004

Months	2003				2004			
	<i>O. materna</i>	<i>O. fullonia</i>	<i>O. homaena</i>	<i>R. hypermnestra</i>	<i>O. materna</i>	<i>O. fullonia</i>	<i>O. homaena</i>	<i>R. hypermnestra</i>
January	-	-	-	-	-	2	2	-
February	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-
June	-	-	-	-	-	-	-	-
July	7	-	-	-	6	-	-	-
August	75	-	-	-	62	-	-	-
September	54	5	10	-	51	7	7	2
October	18	42	23	5	23	37	19	5
November	11	39	20	6	13	31	22	3
December	3	6	6	4	4	6	5	3
Total	168	92	59	15	159	83	55	13

**Table 2.** Species diversity of fruit piercing moths in different localities

Locality	No. of species (S)	Total no. of individuals	Species evenness (J)	Species diversity (H)	Species richness (Ma)
AC & RI, Madurai	4	303	0.739	0.445	1.208
HC & RI, Periyakulam	4	24	0.822	0.495	2.173
TNAU, Coimbatore	5	269	0.506	0.854	1.646
FC & RI, Mettupalayam	3	65	0.362	0.173	1.103
AC & RI, Trichy	4	56	0.685	0.413	1.716
PAJANCOA & RI, Karaikal	3	40	0.819	0.391	1.248
Agric. College, Kalavai	3	53	0.687	0.328	1.159

AC & RI: Agricultural College and Research Institute HC & RI: Horticultural College and Research Institute, TNAU: Tamil Nadu Agricultural University FC & RI: Forestry College and Research Institute, PAJANCOA & RI: Pandit Jawaharlal Nehru College of Agriculture and Research Institute

evaluate species diversity in locality and to compare habitats on species assemblages with other locality. This relative measure of diversity is used for comparisons among different localities under same sample size to evaluate its heterogeneity (Magurran, 1988). The rich abundance in Periyakulam tract may be due to diversified fruit crop ecosystem and nearness to Kodaikanal hill ranges.

#### Seasonal abundance of fruit piercing moths

The activity of fruit piercing moths in guava orchard of AC and RI, Madurai started at 20.00 hours and then declined after 24.00 hours, while Mote *et al.* (1991) reported a slight variation that the peak moth activity was observed between 19.00 to 23.00 hours was corroborated with present findings, whereas Bhumannavar and Viraktamath (2001a) recorded same period the peak activity between 20.30 hours and 23.00 hours. Rakshpal (1945) noted the activity *A. janata* during mid night. Regarding seasonal abundance, *O. materna* began to lay eggs from the second fortnight of July and reaching a peak during August-October, after that population abundance decreased till January (Table 3). New fleshes of the *Tinospora cordifolia* (Willd.) after young sprouting during these months support the activity of *O. materna*. Similar trend was noticed in the Coimbatore condition also. In the corresponding months, more number of larvae and adult moths could be seen. On naturally growing vines of *T. cordifolia*, *O. materna* started egg laying by the end of June and more egg laying was recorded from the first week of July around Nagpur (Sontakay, 1944). Swamiappan (2001) made the collections of the larval stages of *O. materna* after rain during June-December (1997-1999) from *T. cordifolia*. Bhumannavar and Viraktamath (2001a) reported the egg laying of *O. materna* continued from end of April or early May to January. The oviposition

activity was at its peak during October to December at the Bangalore. Early occurrence before monsoon rains, in summer months at Bangalore may be due to climatic variation.

Activity of *O. fullonia* was observed from the first week of September continuing upto first fortnight of January. It reaching the peak activity during October-November (Table 3). Swamiappan (2001) made the more number of live moth collections in Coimbatore during November-December, 1997 and 1998. Baptist (1944) reported two peaks of activity of *O. fullonia* in Srilanka, a minor peak in June-July and a major peak during November-December. Similar to *O. fullonia*, the incidence of *O. homaena* started from the first week of September and continuing upto January. Its peak activity recorded during the months of October and November (Table 3). In Tamil Nadu, Swamiappan (2001) recorded the incidence of *O. homaena* on *Cocculus hirsutus* (L.) Diels. from November-December at Coimbatore. Bhumannavar and Viraktamath (2001b) collected more number of larvae during October 1999 at Raichur, Karnataka. They further reported the migrating behaviour of *O. homaena* might be appearing early in the in hilly areas (Western Ghats) during September and later migrating to plains during October.

The larvae of *R. hypermnestra* were collected on *T. cordifolia* during first week of October, 2003 and 2004, and its incidence was recorded from the second fortnight of September. Among the four species its population was very scarce. Swamiappan (2001) collected two adult moths during October-November, 1998 at Periyakulam Tamil Nadu. The present findings regarding all the species were in consonance with the view of earlier workers indicating occurrence of five prominent species of fruit piercing moths. Based on the present findings, five species of fruit piercing moths belonging to two genera *viz.*, *Othreis* and *Rhytia* were found to cause damage in the orchards. Their



incidence was noticed from July to January months during the experimental period.

#### REFERENCES

- Ayyar, T. V. R. 1944. Notes on some fruit sucking moths of the Deccan. *Indian Journal of Entomology*, **5** (I & II): 29-33.
- Baptist, B. A. 1944. The fruit-piercing moth (*Othreis fullonica* L.) with special reference to its economic importance. *Indian Journal of Entomology*, **6**: 1-13.
- Bhumannavar, B. S. and Viraktamath, C. A. 2001a. Biology, adult feeding, oviposition preference and seasonal incidence of *Othreis materna* (L.) (Lepidoptera: Noctuidae). *Entomon*, **27** (1): 63-77P.
- Bhumannavar, B. S. and Viraktamath, C. A. 2001b. Larval host specificity, adult feeding oviposition preference of the fruit piercing moth, *Othreis homaena* Hubner (Lepidoptera:Noctuidae) on different Menispermaceae host plants. *Journal of Entomological Research*, **25** (3): 165-181.
- Bindra, O. S. 1957. Insect pests of citrus and their control. *Indian Journal of Horticulture*, **14**(2): 89-98.
- Hampson, G. F. 1894. *The Fauna of British India Including Ceylon and Burma*, Moths. **11**: 558-563.
- Humphries, C. J., Williams, P. H. and Vane –Wright, R. K. 1996. Measuring biodiversity value for conservation. *Animal Ecology and Systematics*, **26**: 93-111.
- Magurran, A. E. 1988. *Ecological Diversity and Its Measurement*. Princeton University Press, Princeton.
- Mohite, A. S., Tembhare, D. B. and Umkar, S. P. 2004. Biology and behaviour of developing stages of fruit sucking moth, *Othreis materna* Linn. (Lepidoptera: Noctuidae). *Journal of Entomological Research*, **28**(1): 37-45.
- Mote, U. N., Tambe, A. B. and Patil, C. S. 1991. Observation on incidence and extent of damage of fruit sucking moths on pomegranate fruits. *Journal of Maharashtra Agriculture University*, **16** (3): 438-439.
- Muniappan, R., Denton, G. R. W., Marutani, M., Lali, T. S. and Kimmons, C. A. 1993. Fruit piercing moths in Micronesia and their natural enemies. *Micronesia Suppl.*, **4**: 33-39.
- Nair, M. R. G. K. 1975. *Insect and mites of crops in India*. ICAR, New Delhi, 408 P.
- Pielou, E. C. 1969. *An introduction of mathematical ecology*. Wiley interscience, New York. 105 P.
- Pielou, E. C. 1975. *Ecological diversity*. Wiley publishing Corp., New York. 136 P.
- Rakshpal, R. 1945. Citrus fruit-sucking moths and their control. *Indian Farming*, **6**: 441-443.
- Sontakay, K. R. 1944. Short note on the life and seasonal history of *Othreis materna* L. and *Othreis fullonica* L. *Indian Journal of Entomology*, **5**: 247-248.
- Sundara Babu, P. and David, B. V. 1973. A note on unprecedented occurrence of fruit-piercing moths on grapevine. *South Indian Horticulture*, **21**: 134-136.
- Susainathan, P. 1924a. Fruit-sucking moths of South India. Proc. 5<sup>th</sup> Entomol. Mtg. Pusa, 23-27.
- Susainathan, P. 1924b. The fruit moth problem in the Northern Circars. *Agriculture Journal of India*, **19**: 402-404.
- Swamiappan, M. 2001. Fruit piercing moths as emerging pests of fruit crops in India. Paper presented in national seminar on emerging trends in pests and diseases and their management held on October, 11-13, 2001 at TNAU, Coimbatore. Abs.9-10 P.

**J. Ramkumar\*<sup>1</sup>, M. Swamiappan, S. Raguraman and A. Sadasakthi**

<sup>1</sup>Department of Agricultural Entomology and Nematology, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal-609 603. U.T. of Puducherry. India, E-mail: rammuthu2000@yahoo.com

\*Department of Agricultural Entomology, ARS, TNAU, Kovilpatti - 628 501, Tamil Nadu, India.