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# Study on effectiveness of natural enemies to suppressing the population of *Epilachna vigintioctopunctata* (Fabr.)

**Shubhendu Roy and Ankit Thakur**

**Abstract**
A study on identify the key mortality factors and effectiveness of natural enemies to suppressing the population of *Epilachna vigintioctopunctata* (Fabr.) on brinjal grown at the KVK farm at Dantewada district of Chhattisgarh during 2016-17. In this Field cum laboratory studies was found two species of parasitoids namely, *Tetrastichus* sp. and *Pediobius foveolatus*, three species of predators, i.e. lygaeid, reduviid and pentatomid bugs attacked various stages of the pest. *Tetrastichus* sp. parasitized 23.48 % of eggs whereas, the parasitoid, *P. foveolatus* parasitized 47.69 % of 4$^{th}$ instar grubs and 35.38 % of pupae. *P. foveolatus* completed its life cycle in 11.21days. The egg and larval predator *Geocoris* sp., was the most dominant causing upon 16.42% natural predation of eggs. The rate of consumption of different predators was studied. On the basis of overall performance, *Tetrastichus* sp., *P. foveolatus* and *Geocoris* sp. were recognized as key mortality factors of the pest.

**Keywords:** Parasitoid, predator, natural enemy, *E. vigintioctopunctata* & brinjal

## Introduction
The subfamily Epilachninae (Coccinellidae: Coleoptera) contains phytophagous beetles representing about one sixth of coccinellids. Most epilachnines belong to the world wide genus *Epilachna* that contains about 500 described species. In India, this subfamily is represented by 74 species (Anand *et al*., 1988) among the different species, *Epilachna vigintioctopunctata* (Fabr.) is widely distributed in South East Asia, Australia, Srilanka, America, China and India (Kapur, 1950) [4].

In India, the beetle is present in higher hills and in plains of Jammu and Kashmir, Punjab, Himachal Pradesh, Uttar Pradesh, Karnataka and West Bengal and also in the plains (Shankar *et al*., 2010) [14]. The beetle is generally considered as polyphagous and the recorded host plants include *Datura stramonium* Linn., *D. metel* Linn., *D. innoxia* Mill., *D. quercifolia* H.B.R., *Solanum aviculare* Forst., *S. surratensis* Burm., *S. nigrum* Linn. and *Withania somnifera* Dunal (Mathur and Srivastava, 1964) [8], *Physalis minima* Linn., *P. peruvIanum. P. ixocarpa* (Mohansundaram and Uthamaswamy, 1973) [9], wild species of *Amaranthus caudatus* L. (Hamed and Adlakha, 1973) [3] and *Datura fastuosa* (Edona and Soans, 1971) [2]. Pandey and Shankar (1975) [10]; Singh and Mukherjee, 1987 [15] and Mandal and Mandal, 2003 [7] considered it as oligophagus on the plants belonging to the family Solanaceae.

Both the adults and grubs feed on the leaves by scraping the surface. In case of severe infestation bark of shoots, petioles of leaves and even the skin of the fruits are scraped by them. Damage symptoms include white skeletonization of leaves which is whitish initially but gradually turn brown, yellowing and premature dropping of leaves; stunting and even drying of the plants, flower dropping and yield loss.

All the life stages of the pest viz., egg, larva, pupa and adult remain exposed on plant surface and are subjected to attack by various natural enemies such as egg and larval (larval-pupal) parasitoids; egg, larval, pupal and adult predators; and pathogens infecting egg, larva and pupa. Among the natural enemies, however, the larval - pupal parasitoid, *P. foveolatus* Crawford and the egg parasitoid, *Tetrastichus ovulorum* (*Oomyzus ovulorum*) offer considerable proportion of natural control (Krishnamurthy, 1932; Krishnamurti and Usman, 1954 and Usman *et al*. 1964; Puttarudriah and Krishnamurti, 1954 and Rajendran and Gopalan, 1997) [5, 6, 16, 11, 13].

Though the pest is widely distributed in most of the districts of Chhattisgarh, causing economic loss to the crop, the potential of natural enemies in keeping the beetle population under control was not properly evaluated, the present investigation was undertaken to study the effectiveness of natural enemies to suppressing the population and key mortality factors of *E. vigintioctopunctata* (Fabr.) under brinjal ecosystem.

**Materials and Method**

A roving survey was conducted for field cum laboratory studies on identify the key mortality factors of *Epilachna vigintioctopunctata* (Fabr.) on brinjal grown at the KVK farm at Dantewada district of Chhattisgarh, the egg masses, larvae and pupae were collected from the field. The egg masses were placed in small glass vials, the mouth of which was plugged tightly with cotton ball and egg masses were inspected daily for emergence of parasitoids, if any. The parasitoids were identified following literature available elsewhere. The percentage of eggs showing egg parasitisation was calculated. Similarly, the field collected grubs those showing parasitisation were separated and kept individually in glass vials for emergence of parasitoid. The parasitoids were collected, identified and there per cent parasitisation of grubs was calculated. The pupae collected from the field were kept in small glass vials and the parasitoids emerged were collected, preserved and identified.

**Identification of predators**

The field was inspected in every alternate day to observe the predators acting on the pest. Those found on the stage of the pest (egg, larva, pre pupa, pupa and adult) were collected and brought to the laboratory. These were provided with suitable stage of the pest for confirmation of predation.

The adult bugs of *Geocoris* spp. were provided with average 20 eggs /day and 20 1st instar grubs /day and adult reduviid bug were provided with average 10 grubs /day for one week to study the rate of predation of both predator. The eggs/ adults predated by the *Geocoris* spp. were counted and these were replaced by fresh eggs/grubs and same procedure is followed in case of reduviid bug here the grubs and adults predated by the bug were counted and these were replaced by fresh grubs /adults.

**Duration of life cycle of *P. faveolatus* (Crawford)**

Fourth instar grubs of *E. vigintioctopunctata* were provided to the adults of *P. faveolatus* (Crawford) for parasitisation. After 24 hours these were removed and fresh larvae were provided. The larvae removed from the parasitoids were then placed in petriplates provided with brinjal leaves. Blackening and death of the larvae indicated parasitisation. The parasitoid larvae were then removed and kept separately for emergence of adult parasitoids and duration of egg- adult was recorded after adult emergence and the sex ratio of the emerged parasitoids and calculate out the average and percentages comparing the all data found from this study.

**Result and Discussion**

Field studies were undertaken to identify the key mortality factors of *E. vigintioctopunctata* on brinjal crop. All the life stages of the pest were inspected to record the predators and parasitoids attacking the pest, if any, under field condition. During the period of study, one species of egg parasitoid *Tetrastichus* spp. and one species of larval – pupal parasitoid *P. foveolatus* (Crawford) was recorded to parasitize *E. vigintioctopunctata.* One species of Lygaeid, one species of Reduviids and two species of Pentatomids appeared as predators on various life stages of insect (Table 1).

**Table 1:** Parasitoids and Predators

| **Parsitoids** | | | |
|---|---|---|---|
| **Order** | **Scientific name** | **Family** | **Stage of the pest attacked** |
| Hymenoptera | *Tetrastichus* sp. | Eulophidae | Egg |
| Hymenoptera | *Pediobius foveolatus* Crawford | Eulophidae | 3rd and 4th instar larva and pupa |
| **Predators** | | | |
| Hemiptera | *Geocoris* sp. | Lygaeidae | Egg and 1st instar larva |
| Hemiptera | - | Reduviidae | Egg, larva and adult |
| Hemiptera | Unidentified predator | Pentatomidae | Larva |

**Natural parasitzation of eggs of *E. vigintioctopunctata* by *Tetrastichus* sp.**

The natural parasitisation of eggs of *E. vigintioctopunctata* (Fabr.) by the egg parasitoid *Tetrastichus* sp. was surveyed during February–March. The percent egg masses parasitized ranged from 61.32 % during the end of February and 42.81 % during the beginning of March. The percent of eggs parasitized per egg mass ranged from 13.47 to 100% in different observations (Table 2). However, the average percentage of eggs parasitized ranged from 18.56 during the starting of March to 23.48 during the end of February.

**Table 2:** Natural parasitzation of eggs of *E. vigintioctopunctata* by *Tetrastichus* sp.

| S. No. | Date | % Egg Masses Parasitized | % Parasitization | Range (%) |
|---|---|---|---|---|
| 1 | 3rd February | 55.87 | 22.71 | 13.47-100.00 |
| 2 | 10th February | 53.61 | 22.67 | 16.48 - 100.00 |
| 3 | 17th February | 54.31 | 20.39 | 14.40 - 90.50 |
| 4 | 24th February | 61.32 | 23.48 | 22.06 - 84.57 |
| 5 | 3rd March | 42.81 | 18.56 | 22.73 - 76.60 |
| 6 | 10th March | 49.76 | 19.39 | 21.50 - 100.00 |
| 7 | 17th March | 51.32 | 21.41 | 13.47-100.00 |
| 8 | 24th March | 50.72 | 18.21 | 12.82 - 85.60 |
| Average | | 52.46 | 20.85 | |

**Natural parasitisation by the larval – pupal parasitoid *P. foveolatus***

Natural parasitisation of the grubs of *E. vigintioctopunctata* by the larval – pupal parasitoid, *P. foveolatus* was recorded in the field during February–March. Maximum parasitisation of the larva was recorded during the 1st week of February (52.46 %). The per cent parasitisation of grubs showed a slight decline after the 1st observation which gradually decreased to 40.43 % during the end of March (Table 3).

**Table 3:** Natural parasitization of *E. vigintioctopunctata* later instar larva by *P. foveolatus*

| Weekly Interval | No. of Larva | No. of Larva Parsitized | % Parasitization |
|---|---|---|---|
| 1st week | 284 | 149 | 52.46 |
| 2nd week | 318 | 158 | 49.68 |
| 3rd week | 294 | 147 | 50.00 |
| 4th week | 271 | 121 | 44.64 |
| 5th week | 334 | 116 | 49.70 |
| 6th week | 341 | 154 | 45.16 |
| 7th week | 299 | 148 | 49.49 |
| 8th week | 324 | 131 | 40.43 |
| Average | | | 47.69 |
| * 1st - 8th week indicates beginning of 1st week of February to last week of March | | | |

Natural parasitisation of the pupae of *E. vigintioctopunctata* by the larval – pupal parasitoid, *P. foveolatus* was recorded in the field during February – March. Maximum parasitisation of the pupa was recorded during the 1st week of February (44.44%). The per cent parasitisation of grubs gradually declined to 29.34% during the end of March (Table 4).

**Table 4:** Natural parasitisation pupa of *E. vigintictopunctata* pupa By *P. foveolatus*

| Weekly Intervals | No. of Pupa | No. of Pupa Parasitized | % Parasitization |
|---|---|---|---|
| 1st week | 108 | 48 | 44.44 |
| 2nd week | 125 | 44 | 35.20 |
| 3rd week | 104 | 40 | 38.46 |
| 4th week | 107 | 38 | 35.51 |
| 5th week | 94 | 29 | 30.85 |
| 6th week | 103 | 37 | 35.92 |
| 7th week | 78 | 26 | 33.33 |
| 8th week | 92 | 27 | 29.34 |
| Average | | | 35.38 |
| * 1st - 8th week indicates beginning of 1st week of February to last week of March | | | |

Rajagopal and Trivedi (1989) [12] reported that, *P. foveolatus* is an important parasitoid destroying fourth instar grubs and pupae during summer months. *P. foveolatus* appeared as an important parasitoid of the larvae and pupae during the present investigation also. The maximum percentage of natural parasitization recorded during the present investigation was of 52.46% in case of 4th instar larva and 44.44% in pupa of the pest. Average percentage of parasitisation recorded during February – March was 47.69% on 4th instar grub and 35.38% in pupa. This species is considered to be the most destructive natural enemy recorded by the present author.

**Rate of predation by *Geocoris* sp.**

Rate of natural predation of *E. vigintioctopunctata* eggs by *Geocoris* sp. was observed in the field for two consecutive weeks during second fortnight of March. The percent of egg masses showing predation symptoms was 38.16 % and 37.29 % during 3rd and 4th of week of March, respectively. The percentage of eggs predated ranged from 16.42 % to 16.33% during the two consecutive weeks, respectively (Table 5.1.) while under laboratory condition we observed that the predation on *E. vigintioctopunctata* eggs and 1st instar larvae by the adults of *Geocoris* sp. over a period of 7 days for each, an individual adults consumed 11-15 eggs and 4-7, 1st instar larvae per day and average of 13.02 eggs and 5.57, 1st instar larva per day consumed by a single adult (Table 5.2).

**Table 5.1:** Natural predation of *E. vigintioctopunctata* eggs by *Geocoris* sp.

| Egg predation | 3rd week -March | 4th week- March |
|---|---|---|
| Predation of egg mass | 40.13 | 39.19 |
| Predation % | 16.42 | 16.33 |
| Range | 15.94-41.47 | 23.24-49.38 |

**Table 5.2:** Predation on *E. vigintioctopunctata* eggs & 1st instar larva by *Geocoris* sp. in laboratory condition

| Stage of Predation | Egg | 1st instar larva |
|---|---|---|
| Range | 11-15 | 4-7 |
| Average | 13.02 | 5.57 |

**Rate of predation by Reduviid bugs**

The rate of predation on *E. vigintioctopunctata* 3rd instar grubs by the adults of Reduviid bug was observed over a period of 7 days in laboratory. During this period individual adults consumed 5-7 3rd instar larvae per day. The average number of 3rd instar larvae consumed per day by a single adult

was 5.87 and predation rate on *E. vigintioctopunctata* Adults by the adults of Reduviid bug observed over a period of 7 days in laboratory. During the period of study individual adult predators consumed 5.87epilachna adults per day. The average number of adults consumed per day by a single adult was 4.42 (Table 6).

The rate of predation of *E. vigintioctopunctata* 3rd instar larva by the adults of unidentified Pentatomid was studied over a period of 7 days in the laboratory. During the period of study, individual adults consumed 3-7 3rd instar larvae per day. The average number of 3rd instar larvae consumed per day by a single adult was 3.46 (Table 7).

**Table 6:** Rate of predation of 3rd instar grubs and adults by the adults of Reduviid bugs

| Stage of Predation | Range | Average |
|---|---|---|
| Larva | 5-7 | 5.87 |
| Adult | 5.87 | 4.42 |

**Table 7:** Rate of predation of *Epilachna* grubs by the adults of Unidentified pentatomid bugs

| Stage of Predation | Range | Average |
|---|---|---|
| Adult | 3-7 | 3.46 |

The duration of life-cycle, number of individuals developing per grub and sex ratio of *P. foveolatus* was studied in the laboratory. The duration of life cycle (Egg to adult) was 10-13 days, with an average of 11.21 days. 24-30 numbers of P. *foveolatus* adults developed in a single grub of *E. vigintioctopunctata*. The average no. of parasitoids developed per grub was 16.37. The female: male ratio recorded in the population was to 2:1(Table 8.).

**Table 8:** Duration of life cycle and sex ratio of *P. foveolatus*

| S. No. | Life cycle (Days) | No. of parasitoids emerged |
|---|---|---|
| Range | 10-13 | 24-30 |
| Average | 11.21 | 16.37 |

## Conclusion

Several species of predators and parasitoids have been reported to attack different stages of *E. vigintioctopunctata,* of which a few are known to play appreciable role in the natural suppression of pest population. During the present investigation, *Tetrastichus* sp. was found to parasitize the eggs of *E. vigintioctopunctata.* The parasitoid could not be identified up to the species level. The rate of parasitism by this wasp was quite higher; 23.48 % during February – March. Similar results were obtained by Varma and Anandhi, 2008. Patnaik and Mohapatra, 2004 observed up to 57.20 % parasitisation of the eggs of *E. vigintioctopunctata* by *Omphale* sp., which could not be recorded during the present investigation.

Among the parasitoids and predatory fauna recorded *Tetrastichus* sp. parasitized 23.48 % of eggs whereas, the parasitoid, *P. foveolatus* parasitized 47.69 % of 4th instar grubs and 35.38 % of pupae. *P. foveolatus* completed its life cycle in 11.21days. The egg and larval predator *Geocoris* sp., was the most dominant causing upon 16.42% natural predation of eggs during February – March. The rate of consumption of different parasitoids and predators was studied. On the basis of the results obtained during the present investigation, the egg parasitoid, *Tetrastichus* sp., larval – pupal parasitoid, *P. foveolatus,* egg and 1st instar larval predator, *Geocoris* sp. are considered as key mortality factors of *E. vigintioctopunctata* on brinjal. Attempt should be made for their conservation and possible augmentation for effective management of this pest.

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