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# Natural enemies of rice caseworm and whorl maggot in mid hills of Himachal Pradesh, India

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**Abstract**
Over half of the world's population depend upon paddy as a staple food. Rice *Oryza sativa* is distributed all over the world with a high concentration in Asia. Most of this population increase will occur in developing countries of Asia and Africa, where rice is the staple food. Out of nearly 800 insect pest species recorded on paddy, only 18–20 species are major pests in tropical Asia. There is a rich complex of natural enemies in tropical Asia. These arthropod natural enemies have existed in this environment for thousands of years and have contributed to keep the pest species below damaging levels. Studies were conducted to record the abundance of natural enemies of rice caseworm and whorl maggot at the experimental farm of paddy in Rice and Wheat Research Centre, Malan, Palampur during kharif 2017. A total of nine predators belonging to three orders were found associated with both rice caseworm and whorl maggot. Amongest them damselfly, dragonfly, spiders were of more abundance. *Trichogramma chilonis* and *Tetrastichus* spp. were the egg parasitoid associated with the rice whorl maggot. While, no parasitoid was recorded associated with rice caseworm. The parasitization of *Trichogramma chilonis* initiated in the 1th week of August (31 SW) (4.0%) and reached peak of 19.0 per cent during 1st week of September (35 SW) and the parasitization of *Tetrastichus* spp. initiated in the 2nd week of August (32 SW) (5.20%) and reached peak of 12.5 per cent during 2nd week of September (36 SW).

**Keywords:** Rice, abundance, parasitization, predator and natural enemies

## Introduction
One of the oldest cereal grains, rice (*Oryza sativa*) is believed to have been grown for at least 5000 years. Rice is the seed of the grass species *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice). It is a staple food for more than half of the world's population, particularly those living in southern and eastern Asia. Rice is the most important grain with regard to human nutrition and caloric intake, providing more than one-fifth of the calories consumed worldwide by humans. Damage by insect pests is a serious challenge to rice production in India. So far, 175 species of insects have been identified on rice from seed sowing to crop harvest. On an average, the yield losses in the country due to insect pests in every year are around 30% (Prakash & Rao, 1998) [9]. The rice plant is an ideal host for a large number of insect pests-root feeders, stems borers, leaf feeders and grain feeders. Apart from these, rice caseworm and whorl maggot are also reported from different parts of country specially Himachal Pradesh. The dynamics of pests in the area is influenced by the crop management. Of the several management options available, by and large, only pesticides still dominate and serve as the primary component. The largest proportion of the world paddy market is affected by insecticides. There is a rich complex of natural enemies in tropical Asia. These arthropod natural enemies have existed in this environment for thousands of years and have contributed to keep the pest species below damaging levels. Most paddy farmers apply their first insecticide spray 40 days after crop establishment which is aimed to control early season foliage feeding insect pests. Biological control is an important component of integrated pest management programme. It exists as a naturally occurring phenomenon. A large number of biocontrol agents have been recorded on rice pests. Many minor or sporadic pests today probably are kept in check by the action of natural enemies. Biological control is primarily ecology based and therefore, ecofriendly. They are highly host specific natural enemies such as parasitoid and the general feeders like predators, Considering the above facts, the present study was undertaken to assess the abundance of natural enemies of rice caseworm and whorl maggot in rice fields.

## Material and Method

Observations were made on important larval and pupal parasitoids and predators of rice caseworm and whorl maggot. The population of natural enemies of rice caseworm and whorl maggot was assessed using following methods:

### (a) Collection of rice caseworm and whorl maggot natural enemies by sweep net method

Observations on the associated natural enemies were also recorded. The collection of predatory natural enemies was made from field of Kasturi Basmati during the study period. Regular monitoring on the occurrence and abundance of the natural enemies was made visually as well as by sweep net. This procedure was also carried in same field where sweepings were done for rice caseworm and whorl maggot. The sweepings were done on the same days when collections of adult caseworm and whorl maggot were made. These sweepings were done five times for the collection of natural enemies in a similar fashion as done for caseworm and whorl maggot through sweep net. The total natural enemies were collected twice in a week and the mean number of natural enemies was worked out. The specimens were identified with the help of available literature.

### (b) Collection of egg of rice caseworm and whorl maggot for parasitoid emergence

Averages of 100 infested leaves were collected once in a week from field of Kasturi Basmati and from these leaves, eggs of rice caseworm and whorl maggot were collected. Thereafter, eggs of both rice caseworm and whorl maggot were kept under observation for the emergence of adult parasitoids. Based on number of larvae of emerging and parasitoid emergence the per cent egg parasitism was workout.

On an average, 50 damaged tillers were collected at 15 days intervals from field and from these affected tillers, larvae of rice caseworm and whorl maggot were collected, which were reared individually in collection vials on leaves. To maintain the turgidity of leaves, moistened cotton wool covered with filter paper was used. The leaves were changed every 24 hours till the larvae pupated. The larvae and pupae were observed for the emergence of parasitoids. Observations on the parasitoids were made under laboratory conditions on the developing stages of the pest.

Based on the parasitoid emerged from eggs, larvae and pupae, the per cent parasitization was calculated using following formula:

$$\text{Parasitization (\%)} = \frac{\text{Number of parasitized eggs or larvae or pupae}}{\text{Total number of egg or larvae or pupae sampled}} \times 100$$

## Results and Discussions

Population build up of associated natural enemies of rice caseworm and whorl maggot

### a) Predators associated with rice caseworm and whorl maggot

In the present investigations as many as nine predators belonging to three orders were recorded. It comprised of dragonflies and damselflies (odonata), *Pardosa* sp., *Oxyopes* sp., *Tetragnatha* sp., *Argiope* sp., *Neoscona* sp. and *Lycosa* sp. (Araneids) which were associated with both rice caseworm and whorl maggot and Ground beetle (Coleopteran) was associated with whorl maggot only. The present study revealed that most dominant natural enemies belonged to order Odonata followed by Aranea and Coleoptera. The field collections showed that the predators started appearing in 2nd week of July (28 SW). The highest peak of adults was obtained during the 2nd week of September (36 SW) with 29.5 adults caught per five sweeps. Among the nine species of predators thus recorded, the most abundantly found were damselflies followed by spiders. Among the six species of spiders, *Tetragnatha* sp. was found to be the predominant one.

These findings corroborated the findings of Dale (1994) [1], who recorded seven species of parasitoids and five species of predators in paddy ecosystem. In the Kangra valley of Himachal Pradesh, *Argiope* spp. as the most dominant predator. Whereas, in the present study *Tetragnatha* sp. was found to be most dominant predator in the present studies. Pathak (1994) recorded *Lycosa pseudoannulata*, *Neoscona theisi*, *Oxyopes javanus* and *Ochthera brevitabialis* as the most common predators associated with whorl maggot. Also, similar observations were recorded by Garg Vidyawati (2012) [3] indicated that among the predators, spiders and mirid bugs were the most important natural enemies in rice fields. Litsinger *et al.*, (1994) [5] observed caseworm larval consumption by two common species of predatory aquatic beetles, a dytiscid *Cybister tripunctatus orientalis* Gschwendtner and a hydrophilid *Sternolophus rufipes* Fabricius. According to Nigam (1979) [6]. Frogs also preyed upon moths of rice caseworm. A nuclear polyhedrosis virus was also recorded in India (Jacob *et al.*, 1978) [4].

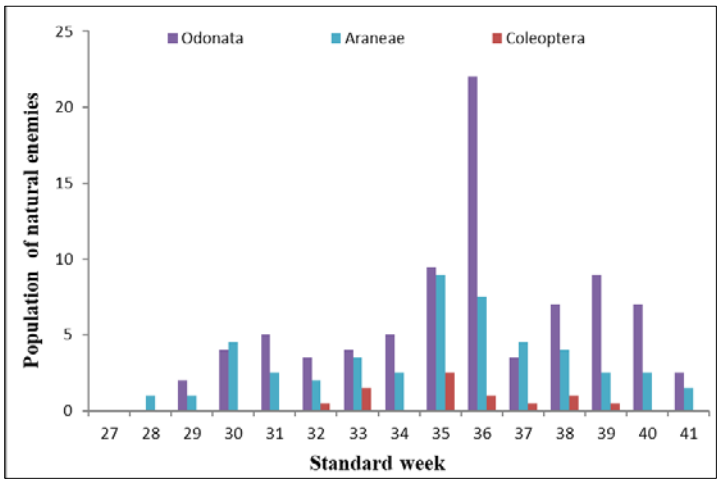


**Fig 1:** Seasonal abundance of different orders of natural enemy associated with rice caseworm and whorl maggot collected through sweep net during *kharif* 2017

**Table 1:** Species of natural enemies associated with caseworm and whorl maggot collected by sweep net method during *kharif* 2017

| | Mean adult catch per five sweeps in corresponding SW | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Order/ Name | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | Total |
| Odonata | | | | | | | | | | | | | | | | |
| Damsel flies | 0 | 0 | 2 | 3.0 | 5.0 | 1.0 | 3.0 | 5.0 | 6.5 | 19 | 3.0 | 5.5 | 5.0 | 7.0 | 2.5 | 67.5 |
| Dragon flies | 0 | 0 | 0 | 1.0 | 0 | 2.5 | 1.0 | 0 | 3.0 | 3.0 | 0.5 | 1.5 | 4.0 | 0 | 0 | 16.5 |
| Araneae | | | | | | | | | | | | | | | | |
| *Pardosa* sp. | 0 | 0 | 0.5 | 1.0 | 0.5 | 0.5 | 1.0 | 0.5 | 0.5 | 1.5 | 0 | 0.5 | 0.5 | 0.5 | 0 | 7.5 |
| *Oxyopes* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 2.0 | 2.5 | 0.5 | 1.0 | 0.5 | 0.5 | 0 | 7.5 |
| *Tetragnatha* sp. | 0 | 1.0 | 0.5 | 0.5 | 1.0 | 1.0 | 0.5 | 1.5 | 2.5 | 2.0 | 1.0 | 0.5 | 1.5 | 1.0 | 1.0 | 15.5 |
| *Argiope* sp. | 0 | 0 | 0 | 2.5 | 0 | 0.5 | 0 | 0 | 1.0 | 0 | 0 | 1.0 | 0 | 0 | 0 | 5.0 |
| *Neoscona* sp. | 0 | 0 | 0 | 0 | 0.5 | 0 | 0.5 | 0 | 1.0 | 1.0 | 0.5 | 0 | 0 | 0.5 | 0 | 4.0 |
| *Lycosa* sp. | 0 | 0 | 0 | 0.5 | 0.5 | 0 | 1.0 | 0.5 | 2 | 0.5 | 2.5 | 1.0 | 0 | 0 | 0.5 | 9.0 |
| Coleoptera | | | | | | | | | | | | | | | | |
| Ground Beetle | 0 | 0 | 0 | 0 | 0 | 0.5 | 1.5 | 0 | 2.5 | 1.0 | 0.5 | 1.0 | 0.5 | 0 | 0 | 7.5 |
| Total | 0 | 1 | 3 | 8.5 | 7.5 | 6 | 9 | 7.5 | 18.5 | 29.5 | 8 | 12 | 12 | 9.5 | 4 | 132.5 |

SW = Standard week

**b) Parasitoids**

Rearing of field collected eggs of rice caseworm and whorl maggot resulted in the emergence of egg parasitoids and the data on per cent parasitization by egg parasitoids recorded. No parasitoid was observed to be associated with rice caseworm. Also Perez and Cadapan, 1986 [8] recorded no egg prasitoid in nature, but in the laboratory, non submerged eggs were readily attacked by *Trichogramma japonicum* (Ashmead). While *Trichogramma chilonis* and *Tetrastichus* spp. were the egg parasitoid associated with rice whorl maggot during the study period.

- ***Trichogramma chilonis***

Parasitization by *Trichogramma chilonis* observed in 1st week of August and remained associated till 4th week of September. Parasitization reached the peak of over 19.0 per cent in the 1st week of September (35 SW) (Table 2). The egg population and per cent parasitization of rice whorl maggot egg showed positive correlation with the value of r being 0.654. Similar results were reported by Reissig *et al.*, (1985) [10], who reported that the eggs of the *Hydrellia philippina* are paratized by *Trichogramma* and *Tetrastichus* spp. and preyed upon by *Dolichopus* sp flies.

**Table 2:** Per cent parasitization of whorl maggot eggs by egg parasitoid *Trichogramma chilonis*

| Month | SW | No. of eggs/ 100 damaged leaves | Number of parasitoids emerged | Per cent parasitization |
|---|---|---|---|---|
| July | 27 | 0.0 | 0.0 | 0.0 |
| | 28 | 4.0 | 0.0 | 0.0 |
| | 29 | 8.0 | 0.0 | 0.0 |
| | 30 | 12.0 | 0.0 | 0.0 |
| August | 31 | 49.0 | 2.0 | 4.0 |
| | 32 | 76.0 | 9.0 | 11.8 |
| | 33 | 69.0 | 10.0 | 14.4 |
| | 34 | 63.0 | 10.0 | 15.8 |
| September | 35 | 42.0 | 8.0 | 19.0 |
| | 36 | 24.0 | 4.0 | 16.6 |
| | 37 | 14.0 | 2.0 | 14.2 |
| | 38 | 8.0 | 1.0 | 12.5 |
| | 39 | 0.0 | 0.0 | 0.0 |

SW= Standard week

- ***Tetrastichus* spp.**

Parasitization by *Tetrastichus* spp. initiated in 2nd week of August and remained associated till 3rd week of September. Parasitization reached the peak of over 12.5 per cent in the 2nd week of September (36 SW) (Table 3). The egg population and per cent parasitization of rice whorl maggot egg showed positive correlation with the value of r being 0.612. Ferino (1968) [2] studied the biology of rice whorl maggot and reported hymenopterous parasitoid, *Tetrastichus* spp., from the egg of pest and stated that total parasitism of whorl maggot fluctuated between 14.4 and 71.4%.

**Table 3:** Per cent parasitization of rice whorl maggot egg by egg parasitoid *Tetrastichus* spp.

| Month | SW | No. of eggs/ 100 damaged leaves | Number of parasitoids emerged | Per cent parasitization |
|---|---|---|---|---|
| July | 27 | 0.0 | 0.0 | 0.0 |
| | 28 | 4.0 | 0.0 | 0.0 |
| | 29 | 8.0 | 0.0 | 0.0 |
| | 30 | 12.0 | 0.0 | 0.0 |
| August | 31 | 49.0 | 0.0 | 0.0 |
| | 32 | 76.0 | 4.0 | 5.2 |
| | 33 | 69.0 | 6.0 | 8.6 |
| | 34 | 63.0 | 10.0 | 11.1 |
| September | 35 | 42.0 | 5.0 | 11.9 |
| | 36 | 24.0 | 5.0 | 12.5 |
| | 37 | 14.0 | 1.0 | 7.1 |
| | 38 | 8.0 | 0.0 | 0.0 |
| | 39 | 0.0 | 0.0 | 0.0 |

SW= Standard week

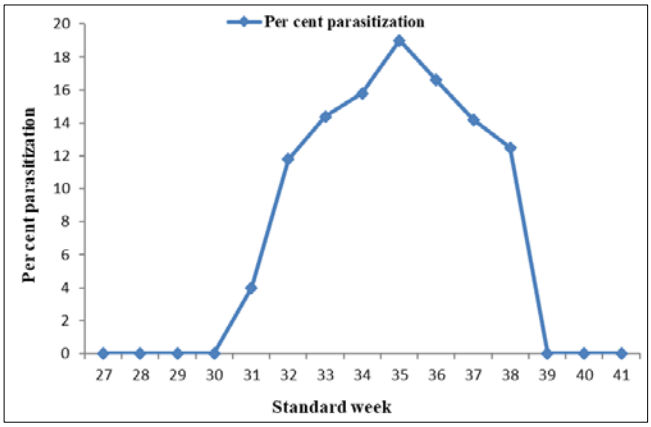


**Fig 2:** Per cent parasitization of whorl maggot eggs by egg parasitoid *Trichogramma chilonis*

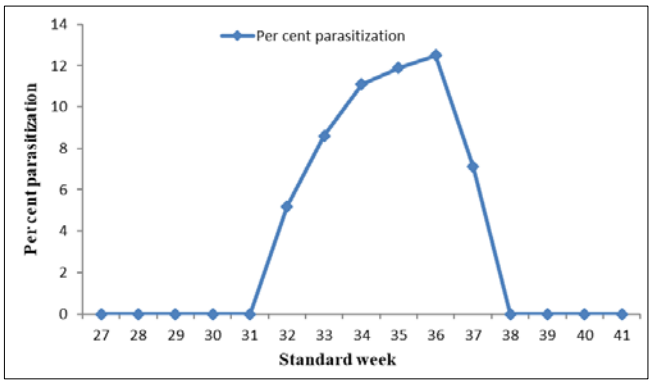


**Fig 3:** Per cent parasitization of whorl maggot eggs by egg parasitoid *Tetrastichus* spp.

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