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Diversity of Defoliators and Natural Enemies Associated with the Mulberry Ecosystem

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A comprehensive investigation into the intricate predator-prey and host-parasitoid dynamics within the mulberry ecosystem was conducted throughout 2021-2022. The study identified five defoliator pests targeting mulberry plants and documented the presence of eight natural enemies. The defoliator pests included the Mulberry leaf roller (*Glyphodes pyloalis* Walker), Common cutworm (*Spodoptera litura* Fabricius), Tussock caterpillar (*Euproctis fraterna* Moore), Spanworm (*Hemerophillaa trilineata* Butler), and Green weevil (*Myllocerus viridanus* Fabricius). Among the natural enemies were *Apanteles obliquae* Wilkinson, *Chelonus carbonator* Marshall, Ichneumonid wasp, *Disophrys* sp., Tachinid fly, *Megaselia scalaris*, *Cheilomeness exmaculata*, and spiders. *Glyphodes pyloalis* emerged as the most prevalent defoliator pest, while *Apanteles obliquae* stood out as the predominant natural enemy. Notably, hymenopteran parasitoids such as *Apanteles obliquae*, *Chelonus carbonator*, Ichneumonid wasp, and the coccinellid predator *Cheilomeness exmaculata* were identified as potentially active natural enemies against *Glyphodes pyloalis*. The study revealed a synchronized pattern in the appearance and peak activity of *Apanteles obliquae*, *Chelonus carbonator*, *Cheilomeness exmaculata*, and Ichneumonid wasp with the population dynamics of *Glyphodes pyloalis*, highlighting their role in regulating defoliator pest populations in the mulberry ecosystem.

Introduction

Mulberry a plant from the genus *Morus* and belong to the family Moraceae is a very hardy fast growing perennial plant which hardly exceed 10-15 meters height (Ajao *et al.*, 2020). Mulberry is a very versatile plant and can be maintained for about 15-20 years and used for many purposes most important being the only food for the monophagous silkworm, *Bombyx mori* L. Mulberry plant is cultivated over

2.3 lakh hectares area (Satkthivel *et al.,* 2019). Silkworm feed mulberry leaves throughout the life of the larva and use the leaf contents, especially proteins for the silk biosynthesis (Mahadeva, 2018). Mulberry (*Morus spp.*) forms the sole food for growth and development of silkworm (*Bombyx mori* L.) leading to quality silk production (Kumar *et al.*, 2002). Mulberry being an evergreen perennial plant with luxuriant foliage, afford an unlimited source of food and shelter for a variety of insects. Insect's pests are common in mulberry ecosystems.

They are detrimental to the growth, development and productivity of mulberry (Kumar *et al.*, 2018). A total of 300 insect and non-insect pest species have so far invaded mulberry, wreaking havoc on it with various diseases and pests (Kotikal *et al.*, 1982). The insect pest attacking mulberry are grouped into sap suckers, defoliators, borers and those inhabiting in soil (Termite) (Sakthivel *et al.*, 2019).

Among the pests, defoliators are considered to be major as they cause extensive damage to the mulberry. These defoliating pests cause around 12-25% leaf yield loss either by depletion in nutritive value or defoliation. Feeding these inferior quality leaves adversely affects the silkworm growth and finally the silk industry. The production of quantity and quality mulberry leaf is often hampered by insect pests (Kumar *et al.*, 2018).

The two major groups of defoliators that cause damage to the plant through their chewing mouthparts include the caterpillars and beetles. Leaf webber, *Diaphania pulverulentalis* Hampson (Lepidoptera: Pyralidae), specially its incidence peak in the month of October to December in South India, loss due to this pest is around 30% (Kumar *et al.,* 2018). Leaf webber is considered the key pest of mulberry (Pachiappan *et al.,* 2018). The peak infestation of Bihar hairy caterpillar, Spilosoma *oblique* Walker (Lepidoptera: Arctitidae) was seen during March to April and July to November. The loss due to this pest is upto 40% (Kumar *et al.*, 2018). Mulberry leaf roller, *Glyphodes (Margaronia) pyloalis* Walker (Lepidoptera:Pyralidae) causes leafyield loss about 15-20% in entire Asia (Anon., 2010). Cutworm, *Spodoptera litura* Fabricus (Lepidoptera:Noctuidae) is a polyphagus pest which occurs sporodacilly mainly in winter season (Kumar *et al.*, 2018). Its population rose-up starting February to June with another population peak in October but slide down in December (Carasi *et al.*, 2014). Other chewing insects occasionally damaging the plants include grasshoppers, katydids and their relatives (Rajadurai *et al.*, 2005).

In nature balance is maintained by certain biotic and abiotic factors and population dynamics of an organism is regulated by their natural enemies. Natural enemies play a very significant role in regulating populations of all pest classes (Singh *et al.*, 2002). Many research and studies regarding the natural enemies of mulberry host plant pest has been made in the past years and is found successful. Inundative releases of the egg parasitoid *Trichogramma chilonis* were found to be effective in reducing the damage caused by leaf webber (Samuthiravelu *et al.*, 2010). *Apanteles obliquae*, a larval endo-parasitoid is also found effective against leaf webber with a peak of 5.6% parasitism during October (Mittal *et al.*, 2016). *Apanteles sp.* has been recorded as a predominant parasitoid on the leaf roller and leaf webber in Karnataka and Kashmir, respectively (Anonymous, 1997; Rajadurai *et al.*, 1999 and Nighat *et al.*, 2002) as cited in Mittal *et al.*, (2016). Five natural enemies, including 3 parasitoids (*Bracon sp.*, *Apanteles sp.*, *Goniozus sp.*) and 2 predator spiders (*Tetragnatha sp.* and *Philodromus sp.)* were identified as natural enemies in the sericulture farms of Tamil Nadu in a survey conducted from August 1998 to February 1999 (Sathyaseelan *et al.*, 2002). In a recent finding mulberry pyralid, *Glyphodes pyloalis* is found as a host of *Pristmerus sulci* (Hymenoptera: Ichneumonidae) (Bhat *et al.*, 2020). In another study it is found that *Eocanthecona furcellata*, a predatory bug could safely be considered as potential bio-control agent in pest management programme of lepiodopteran pest like *Spilosoma oblique and*

Maruca vitrata (Tiwari *et al.,* 2017). In another study a dipteran parasitoid, *Megaselia scalaris belonging* to Phoridae family had been found as a laboratory parasitoid of *Spodoptera frugiperda* for the first time in India (Deshmukh *et al.,* 2021). It was seen that use of pesticide is the most common method in reducing the pest population as it gives a quick effect as compared to the other means of pest control. It was seen that when mulberry silkworm are fed with the leaves having pesticide residue (Mulberry plant absorbs the pesticides that were earlier applied to the crops and are still present in the soil) it shows larval mortality specifically during spinning stage (Jyothi *et al.,* 2019). Due to hazardous and ill effect of pesticide on non-targeted insect as well as other organisms we should shift our needs of pesticide uses to other relatively less harmful and eco-friendly sources. One such approach is the use of biological control. Biological control utilizes natural enemies such as parasitoid, predators, pathogens or competitors, deriving its energy directly from pests themselves (Singh *et al.,* 2002). It is acknowledged as the best type of pest control (Lloyd, 1986; as cited in Singh *et al.,* 2002).

Literature pertaining to the studies on predator-prey and host-parasitoid relationship involving defoliators and its entomophages in mulberry ecosystem is very scarce and from this it becomes clear that very few attempts were made in this regard. Moreover, it was observed that, information related to predator-prey and host-parasitoid relationship involving defoliators and its entomophages in mulberry ecosystem were very scanty, particularly for the North eastern part of India. Keeping these views in mind the present investigation was carried out to know the natural enemy complex associated with leaf feeding insects in the mulberry ecosystem.

Materials and Methods

The study on predator-prey and host parasitoid relationship involving defoliators and its entomophages in mulberry ecosystem was carried out during 2021-2022 in the field condition of Regional Sericulture Research Station, Central Silk Board, Jamuguri, Jorhat for a period of ten month from August 2021 to July 2022. The variety of mulberry plant that was used during the research period is Kanva-2 (K_2).

The Sampling method involved the Plant inspection method (Sunil *et al.,* 2013) by counting the population of pests. Samples were taken at 15 days interval and to know the pest complex, 10 plants were selected randomly by taking 2 plants from each of the four corners and middle of the experimental field, and inspection of the leaves, stems and branches for the presence of insects was carried out. The population was estimated by counting the average number of insects/shoot, insects/leaf and insects/plant.

Regular inspection of mulberry field conditions was done and different stages of defoliators were collected in a plastic container and brought to the laboratory for ascertaining their identity.

Various predacious insect predating on the defoliator pest was also recorded and collected as well as different instars of the defoliator pest was also collected in a plastic container for the adult emergence of the parasitoid in the laboratory condition. Specimens of adult parasitoids and predators was collected from the field and dry preserved and identified from the Department of Entomology, AAU, Jorhat.

On the basis of the population density of leaf eating pests and their natural enemies, relative abundance was determined. The relationship between the population density of defoliator pests and natural enemy populations was also computed using Pearson’s correlation coefficient. The feeding potential of the predators was estimated by counting the number of prey items consumed by each predator in the field. The percent parasitization of the parasitoids was calculated using Dadang *et al.,* (2009) formula as follows:

$$\text{Percent parasitisation} = \frac{\text{Number of parasitized larvae}}{\text{Total number of larvae}} \times 100$$

Results and Discussion

A field visit was conducted to the mulberry experimental field of the Regional Sericulture Research Station, Central Silk Board, Jorhat, India, during 2021-2022 to identify the defoliator pests and natural enemies associated with mulberry cultivation. Defoliator pests associated with the mulberry ecosystem are shown in Table 1. Five species of defoliator pests were recorded: Mulberry leaf roller (*Glyphodes pyloalis* Walker) (Lepidoptera: Pyralidae), Common cutworm (*Spodoptera litura* Fabricius) (Lepidoptera: Noctuidae), Tussock caterpillar (*Euproctis fraterna* Moore) (Lepidoptera: Lymantriidae), Spanworm (*Hemerophillaa trilineata* Butler) (Lepidoptera: Geometridae), and Green weevil (*Myllocerus viridanus* Fabricius) (Coleoptera: Curculionidae). Natural enemies associated with the mulberry ecosystem are shown in Table 2. Seven species of natural enemies were found: *Apanteles obliquae* Wilkinson (Hymenoptera: Braconidae), *Chelonus carbonator* Marshall (Hymenoptera: Braconidae), Ichneumonid wasp (Hymenoptera: Ichneumonidae), *Disophrys sp.* (Hymenoptera: Braconidae), Tachinid fly (Diptera: Tachinidae), *Megaselia scalaris* (Diptera: Phoridae), *Cheilomeness exmaculata* (Coleoptera: Coccinellidae) and Spider. Our findings are in concordant with those reported by Mittal *et al.,* (2016), which identified five hymenopteran parasitoids—namely, *Apanteles obliquae* Wilkinson, *Braconhebetor* Say, *Chelonus carbonator* Marshall, *Pristomerus sulci* Mahdihassan and Kolubajiv, and *Xanthopimpla* sp.—that parasitize the larvae of *Glyphodes pyloalis*.

Relative abundance of different defoliator pest

The relative abundance of different defoliator pests in the year 2021-2022 is shown in Table 3. and Figure 1. Among the five pests, *Glyphodes pyloalis* (Lesser mulberry pyralid) had the highest relative abundance (48.16%), followed by *Spodoptera litura* (22.93%), *Euproctis fraterna* (17.43%), *Myllocerus viridians* (6.42%) and *Hemerophillaa trilineata* (5.04%). Borgohain *et al.,* (2015) identified *Glyphodes pyloalis* as a significant pest causing destruction to mulberry crops in Jorhat, Assam.

Similarly, Cetin *et al.,* (2020) recognized *Glyphodes pyloalis* as a considerable threat to mulberry production in Turkey. Since *Glyphodes pyloalis* was the most abundant pest, further studies were conducted on this species.

The population dynamics of *Glyphodes pyloalis* and its natural enemies on mulberry plants were studied in relation to weather parameters during 2021-2022. Table 4 and Figure 2 show the mean population of *Glyphodes pyloalis* and its natural enemies in this period. The population of *Glyphodes pyloalis* peaked in May (3.20 individuals per shoot) and dropped to the lowest level in January (0.10 individuals per shoot).

No *Glyphodes pyloalis* were found in February. The natural enemies of *Glyphodes pyloalis*, namely *Apanteles obliquae, Chelonus carbonator, Cheilomeness exmaculata* and Ichneumonid wasp, also reached their highest population in May (1.00, 0.60, 0.50 and 0.50 parasitized larvae per plant, respectively). The population trend of *Glyphodes pyloalis* was in sync with its natural enemies.

Samuthiravelu *et al.,* (2010) observed an increase in natural enemies, particularly the ladybird predator *Cheilomeness exmaculata*, and the braconid parasitoids *Bracon hebetor* and *Apanteles taragamae*, in response to pest infestations, especially the leaf webber in mulberry.

Additionally, Bhat *et al.,* (2020) expanded the checklist of Ichneumonid parasites and noted *Glyphodes pyloalis* as a host for the parasitoid *Pristomerus sulci* Mahd. and Kolu.

Impact of meteorological factors on *Glyphodes pyloalis* population

The outcomes of correlation studies between the population density of *Glyphodes pyloalis* and various weather parameters are documented in Table 5and illustrated in Figure 3.During the period of 2021-2022, the maximum temperature, minimum temperature, and relative humidity in the evening exhibited a significant positive impact on the population of *G. pyloalis*. Conversely, rainfall, evaporation rate, and wind speed demonstrated a non-significant positive influence on the population levels of *G. pyloalis*. Additionally, relative humidity in the morning and the duration of bright sunshine hours were found to have a non-significant negative correlation with the population of *G. pyloalis*.

The temperature has a significant effect on the *G. pyloalis* population, influencing the pest's biology, distribution, and abundance, as highlighted by Braman *et al.*, (1984); Tobin *et al.*, (2003) and Zahiri *et al.*, (2010). The impact of rainfall, although not significant, may positively affect the population by enhancing the nutritive quality of leaves, thereby aiding reproduction. Similarly, wind's non-significant positive effect could be attributed to the dispersal of adult moths to new locations. These findings suggest that weather factors play a role in the fluctuation of *G. pyloalis* populations. Borgohain *et al.*, (2015) observed that evening relative humidity and minimum temperature significantly positively affect the occurrence of *G. pyloalis*. Conversely, Ramegowda *et al.*, (2012) reported a negative correlation with maximum temperature, minimum temperature, and the number of rainy days at a significance level of P=0.01.

Feeding potential and percent parasitization of natural enemies

Table 6. details the feeding potential of *Cheilomeness exmaculata* on *Glyphodes pyloalis* larvae. The findings indicate that the *Cheilomeness exmaculata* grub exhibited a 16% feeding efficiency, with an average consumption of 1.6±0.2 early instar larvae. The adult male *Cheilomeness exmaculata* showed a 23% feeding efficiency, consuming on average 2.3±0.3 early instar larvae. The adult female *Cheilomeness exmaculata* demonstrated the highest feeding efficiency at 29%, with an average consumption of 2.9±0.1 early instar larvae.

Singh *et al.*, (2008) investigated the biology and feeding potential of *Cheilomeness exmaculata* on mustard aphids. They discovered that the mean feeding potential for the grub stage was 26.82±0.59 aphids per day per individual, while the adult stage had a mean feeding potential of 47.13±1.75 aphids per day per individual. Furthermore, Table 7. presents the percentage of *Glyphodes pyloalis* larvae parasitized by the hymenopteran parasitoid *Apanteles obliquae*.

Table.1 Defoliator pests associated with the mulberry ecosystem

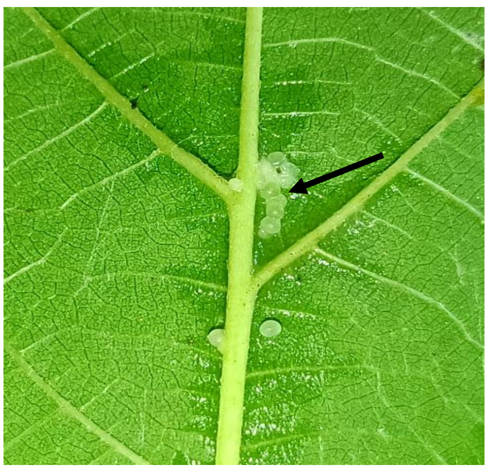
Common name	Scientific name	Order	Family
Mulberry leaf roller	*Glyphodes pyloalis* Walker	Lepidoptera	Pyralidae
Common cutworm	*Spodoptera litura* Fabricius	Lepidoptera	Noctuidae
Tussock caterpillar	*Euproctis fraterna* Moore	Lepidoptera	Lymantriidae
Spanworm	*Hemerophillaa trilineata* Butler	Lepidoptera	Geometridae
Green weevil	*Myllocerus viridanus* Fabricius	Coleoptera	Curculionidae

Table.2 Natural enemies associated with the mulberry ecosystem

Natural enemies	Order	Family
***Apanteles obliquae* Wilkinson**	Hymenoptera	Braconidae
***Chelonus carbonator* Marshall**	Hymenoptera	Braconidae
Megaselia scalaris	Diptera	Phoridae
Cheilomeness exmaculata	Coleoptera	Coccinellidae
***Disophrys*sp.**	Hymenoptera	Braconidae
Tachinid fly	Diptera	Tachinidae
Ichneumonid wasp	Hymenoptera	Ichneumonidae
Spider	Araneae	Salticidae

Plate.1 (a-d). Different stages of *Glyphodes pyloalis*

a) Egg



b) Larva

c) Pupa

d) Adult

Table.3 Relative abundance of different defoliator pests during the year 2021-22 in the mulberry field

Date of sampling	*Glyphodes pyloalis*(no./ shoot)	*Spodoptera litura*(no./ plant)	*Euproctis fraterna*(no./ leaf)	*Hemerophillaa trilineata* (no./ plant	*Myllocerus viridians* (no./ plant)
15-Aug,2021	1.20	0.40	0.60	0.20	0.20
31-Aug	1.40	0.70	1.00	0.00	0.20
15-Sep	1.80	0.50	0.70	0.10	0.20
30-Sep	1.30	0.50	0.50	0.30	0.20
15-Oct	1.10	0.60	0.40	0.00	0.10
31-Oct	1.00	0.90	0.20	0.00	0.10
15-Nov	1.10	1.00	0.40	0.10	0.00
30-Nov	1.30	0.90	0.30	0.00	0.00
15-Dec	0.90	1.00	0.20	0.10	0.20
31-Dec	0.60	0.40	0.20	0.20	0.10
15-Jan,2022	0.10	0.00	0.30	0.10	0.00
31-Jan	0.10	0.00	0.10	0.00	0.00
15-Feb	0.00	0.00	0.00	0.00	0.10
28-Feb	0.00	0.00	0.20	0.10	0.10
15-Mar	1.10	0.00	0.20	0.00	0.10
31-Mar	0.80	0.00	0.10	0.20	0.20
15-Apr	1.30	0.30	0.60	0.30	0.10
30-Apr	1.40	0.80	0.50	0.10	0.30
15-May	3.20	1.10	0.40	0.20	0.20
31-May	2.10	1.40	0.60	0.30	0.10
15-Jun	0.90	0.80	0.30	0.10	0.30
30-Jun	0.80	0.50	0.50	0.20	0.20
15-Jul	0.70	0.10	0.30	0.10	0.10
31-Jul	1.00	0.20	0.40	0.00	0.30
Mean	1.05	0.50	0.38	0.11	0.14
Relative abundance (%)	48.16	22.93	17.43	5.04	6.42

Table.4 Population trend of *Glyphodes pyloalis* and its major natural enemies during the year 2021-22

Date of sampling	*Glyphodes pyloalis*(no./shoot)	*Apanteles obliquae* (no. of parasitized larva/ plant)	*Chelonus carbonator* (no.of parasitized larva/ plant)	Ichneumonid wasp (no. of parasitized larva/ plant)	*Cheilomeness exmaculata* (G+A) (no./ plant)
15-Aug,2021	1.20	0.60	0.10	0.30	0.20
31-Aug	1.40	0.40	0.00	0.10	0.10
15-Sep	1.80	0.60	0.10	0.00	0.20
30-Sep	1.30	0.50	0.00	0.10	0.30
15-Oct	1.10	0.30	0.20	0.20	0.00
31-Oct	1.00	0.50	0.10	0.10	0.20
15-Nov	1.10	0.20	0.00	0.10	0.10
30-Nov	1.30	0.30	0.20	0.00	0.20
15-Dec	0.90	0.40	0.10	0.20	0.10
31-Dec	0.60	0.20	0.10	0.00	0.00
15-Jan,2022	0.10	0.00	0.00	0.00	0.00
31-Jan	0.10	0.00	0.00	0.00	0.00
15-Feb	0.00	0.00	0.00	0.00	0.00
28-Feb	0.00	0.00	0.00	0.00	0.00
15-Mar	1.10	0.30	0.20	0.10	0.10
31-Mar	0.80	0.40	0.10	0.30	0.30
15-Apr	1.30	0.60	0.30	0.40	0.30
30-Apr	1.40	0.50	0.20	0.20	0.20
15-May	3.20	0.70	0.40	0.50	0.50
31-May	2.10	1.00	0.60	0.40	0.20
15-Jun	0.90	0.50	0.40	0.20	0.30
30-Jun	0.80	0.50	0.30	0.10	0.10
15-Jul	0.90	0.50	0.30	0.20	0.20
31-Jul	1.00	0.40	0.50	0.10	0.30

Table.5 Relationship of *Glyphodes pyloalis* with meteorological factors during 2021-22

Meteorological factors	Relationship statistic	*Glyphodes pyloalis* population
Max T(℃)	r	0.44*
Min T(℃)	r	0.56*
RH (morning)	r	-0.14 NS
RH (evening)	r	0.48*
RF (mm)	r	0.28 NS
EVP (mm)	r	0.21 NS
WS (kmph)	r	0.30 NS
BSSH (hr)	r	-0.12 NS

NS= Non Significant
* Significant at P= 0.05

Table.6 Feeding potential and Predatory efficiency of *Cheilomeness exmaculata* on *Glyphodes pyloalis*

Predator stage	No. of prey offered	No. of prey consumed	Percent feeding efficiency
Grub	10	1.6±0.2	16.0
Adult (Male)	10	2.3±0.3	23.0
Adult (Female)	10	2.9±0.1	29.0

Data based on 5 observations

Table.7 Per cent parasitization of *Apanteles obliquae* on *Glyphodes pyloalis*

Host stage	No. of host larvae	Per cent parasitization
1st instar	10	18.0
2nd instar	10	36.0
3rd instar	10	20.0
4th instar	10	6.0
5th instar	10	0.0

Data based on 5 observations

Plate.2 (a-d). Different stages of *Spodoptera litura*

a) Egg

b) Larva

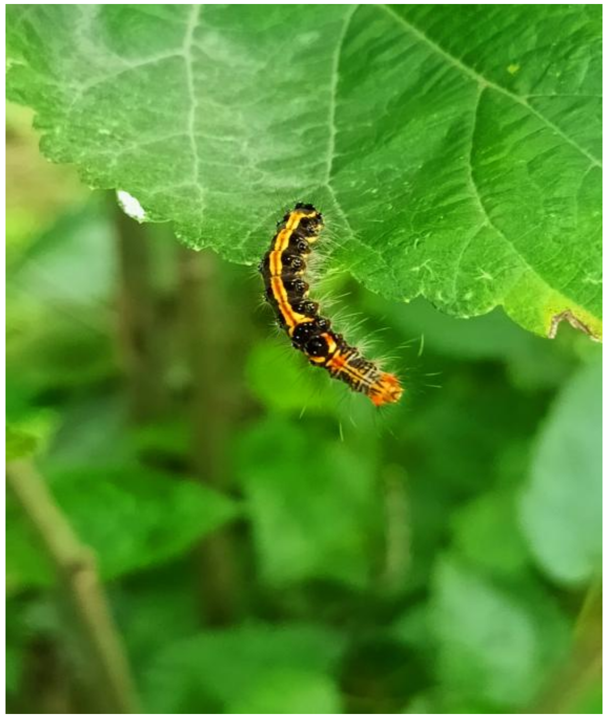
c) Pupa

d) Adult

Plate.3 (a-d). Different stages of *Euproctisfraterna*

a) Egg

b) Larva



c) Pupa

d) Adult

Plate.4 Spanworm
(***Hemerophillaa trilineata***)

Plate.5 Green Weevil
(***Myllocerus viridanus***)

Plate.6 (a-c). Different stages of *Apanteles obliquae*

a) Maggot

b) Cocoon

c) Adult

Plate.7 (a-c). Different stages of *Chelonus carbonator*

a) Maggot **b) Cocoon** **c) Adult**

Plate.8 (a, b). Different stages of Ichneumonid wasp

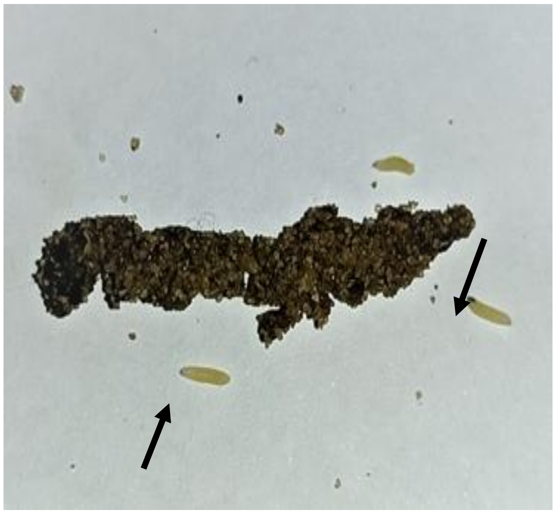
a) Cocoon **b) Adult**

Plate.9 *Disophrys*sp.

Plate.10 Tachinid fly

Plate.11 (a-c). Different stages of *Megaselia scalaris* found from *Spodoptera litura*

a) Maggot



b) Cocoon

c) Adult

Plate.12 *Cheilomeness exmaculata*

Plate.13 Spider

Plate.14 (a, b). Percent parasitization

a) Bottle containing *Glyphodes pyloalis* larvae and*Apanteles obliquae* adult

b) Larvae after parasitization

Plate.15 Feeding potential and predatory efficiency

Fig.1 Relative abundance of different defoliator pests during 2021-2022

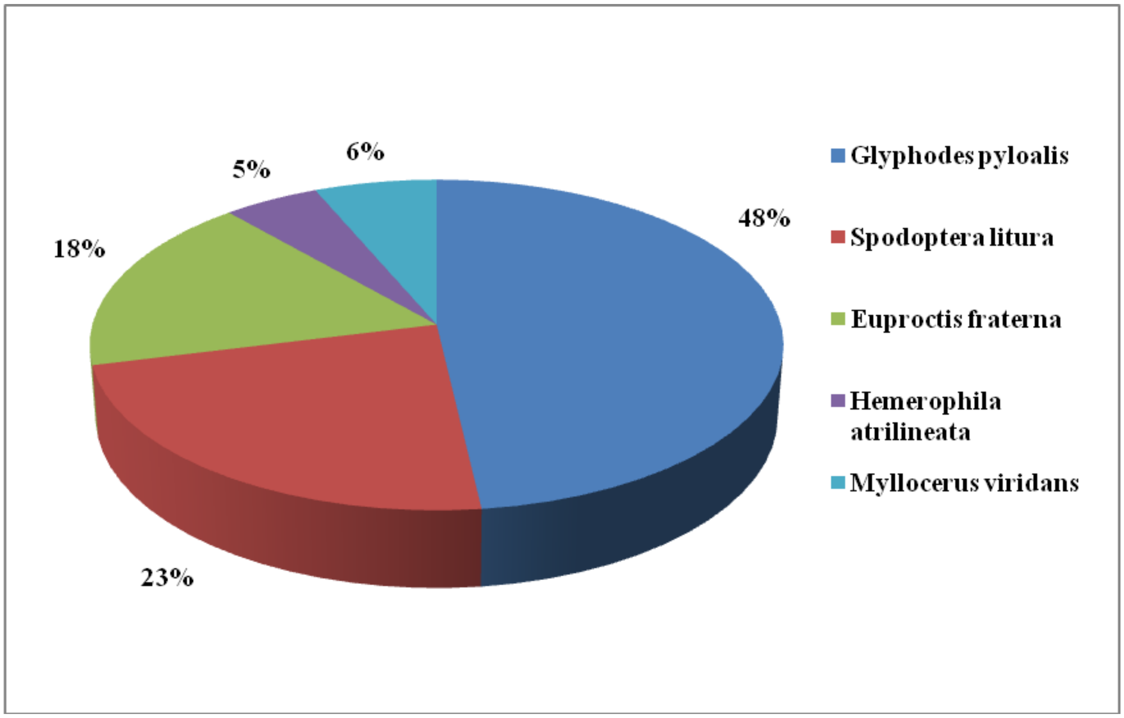


Fig.2 Population trend of *Glyphodes pyloalis* with natural enemies

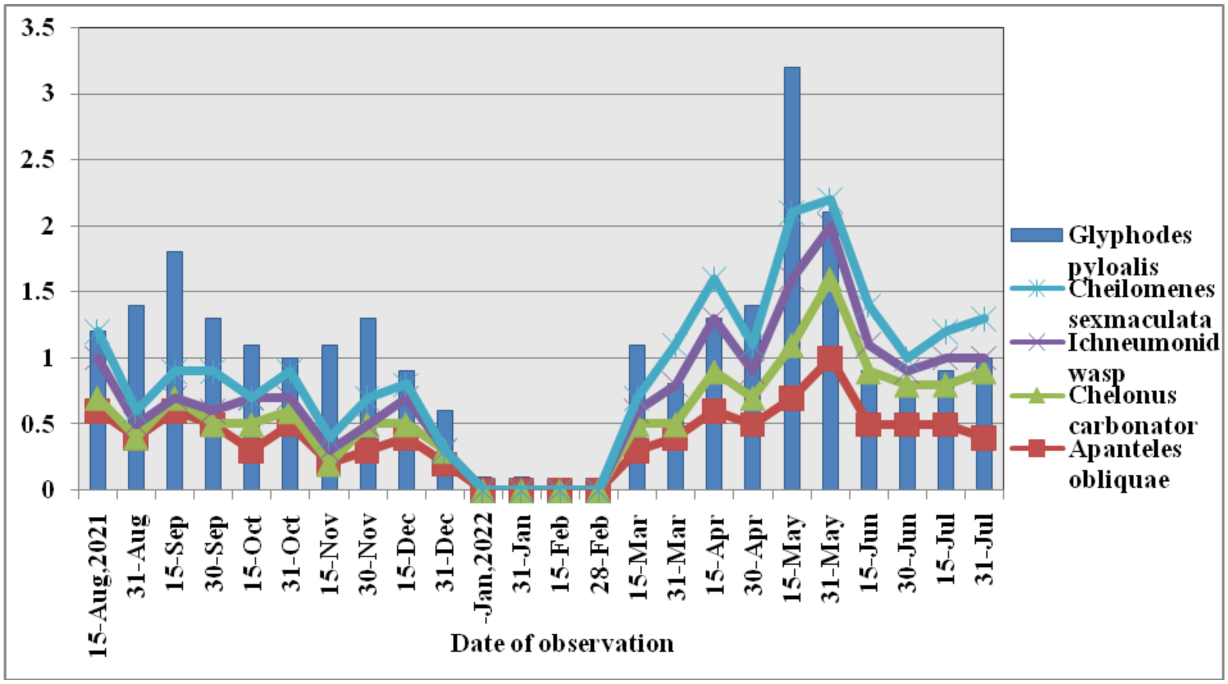
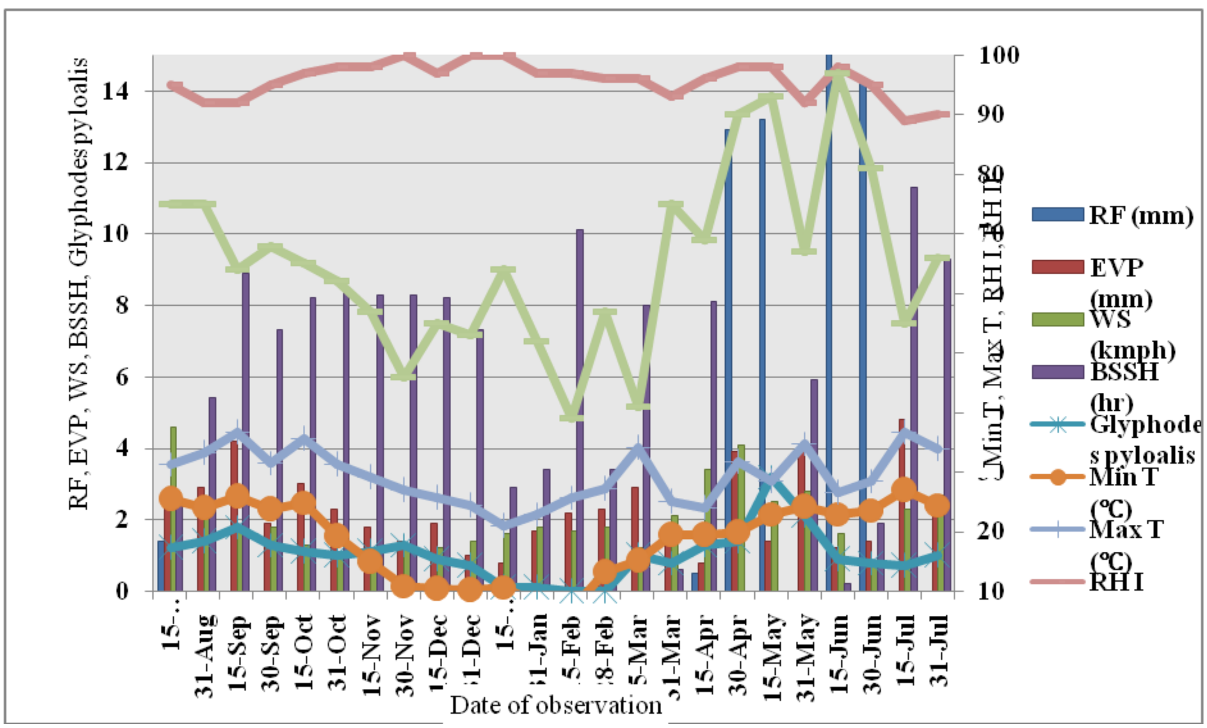


Fig.3 Population trend of *Glyphodes pyloalis* with meteorolgical factors



The highest level of parasitization occurred in the 2nd instar *G. pyloalis* larvae, with a 36% parasitization rate. This was followed by the 3rd instar larvae at 20%, the 1st instar larvae at 18%, and the 4th instar larvae at 6%. Notably, no parasitism was observed in the 5th instar larvae, which may be attributed to the host's defensive behavior observed during the experiment.

Sarikaya *et al.,* (2020) observed that the lifespan of both male and female *Bracon hebetor* was extended when they were provided with honey, in contrast to individuals that were only given water. Additionally, Islam *et al.,* (2002) reported a preference by *Apanteles obliqua* for parasitizing the second instar larvae of *Spilosoma obliqua*, followed by the third instar larvae.

The insect pests that attack mulberry plants can be categorized into four main groups: sap suckers, defoliators, borers, and soil inhabitants such as termites. Defoliators are identified as the most significant threat among these pests due to their extensive damage to mulberry foliage. The impact of these defoliating pests is substantial, resulting in an estimated leaf yield loss of 12-25%, which can be attributed to either a reduction in the nutritive value of the leaves or outright defoliation.

During the study period 2021-22 in the field condition of Regional Sericulture Research Station, Central Silk Board, Jamuguri, Jorhat, five defoliator pests were identified attacking mulberry plants, with the Mulberry leaf roller (*Glyphodes pyloalis* Walker) being the most prevalent, alongside eight natural enemies, *Apanteles obliquae*, *Chelonus carbonator* and Ichneumonid wasp, along with the coccinellid predator *Cheilomeness exmaculata*, have been identified as active natural enemies of *Glyphodes pyloalis* among which *Apanteles obliquae* Wilkinson was the most abundant. These species are considered effective biocontrol agents for managing *G. pyloalis* infestations due to their consistently high populations, synchronization with prey populations, shorter life cycles, and a high female-to-male ratio, as observed under laboratory conditions.

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Conflict of interest

None

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