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Biology and natural parasitization of Gall Fly *Lasioptera Falcata* Felt and *Lasioptera bryoniae* Schiner infesting bitter gourd

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Abstract
The gall midge *Lasioptera* spp belonging family Cecidomyiidae, Diptera is one of serious pest of bitter gourd causing yield loss. Recently, the occurrence of the pest in bitter gourd crop was noted in Coimbatore and Tiruppur districts of Tamil Nadu during 2015 – 16. The adult midges collected from the gall shoots of bitter gourd were identified as *L. falcata* and *L. bryoniae*. The parasitoids associated with gall midge were collected from the parasitized maggots and identified as *Aprostocetus diplosidis* and *Bracon* sp. The biology of gall fly studied in bitter gourd under laboratory condition using the variety CO1 indicated *L. falcata* had a duration of 16-25 days where as *L. bryoniae* spent 18-26 days for the development from egg to adult. The adults of *L. falcata* recorded a fecundity of 98.3 eggs as against *L. bryoniae* which had a fecundity of 104.2 eggs. The natural parasitization of *A. diplosidis* and *Bracon* sp. was high during April and May with a parasitization of more than 80 per cent whereas incidence of the gall damage in shoots during these months was low averaging 32.28 per cent. The occurrence of gall shoots was maximum in November (77.7) which recorded low level of parasitization of *A. diplosidis* (20.13) and *Bracon* sp (22.48).

Keywords: Bitter gourd, Gall midge, Biology, Parasitization and *Lasioptera falcate*

Introduction
Bitter gourd (*Momordica charantia* L.; Cucurbitacae), commonly known as balsam pear, or karela, is cultivated throughout the world, especially in the tropical areas [1]. The immature fruits and the tender leafy shoots or the ripe fruits [11] have both nutritional as well as medicinal properties [4]. In India, it is cultivated 90000 hectare with the production of 983000 MT. In Tamil Nadu it occupies 1340 hectare with the production of 26750 MT [3]. Recently due to mono-cropping and favorable weather condition gall midge *Lasioptera falcata* Felt and *Lasioptera bryoniae* Schiner assumes serious proportion in bitter gourd.
Lasioptera falcata was originally described by Felt [2] on a single female reared from a stem gall of an unidentified wild cucurbit host in Philippines. Felt, later referred this specimen to the midge reared on bitter gourd *Momordica charantia.* In South India, Ramakrishna Ayyar [8] mentioned this midge as the bitter gourd vine gall fly producing long, tubular galls at the distal end of young shoots affecting the growth of the plant. Mani [6] reported the occurrence of gall fly in Coimbatore. L. *falcata* was reported as minor pest of bitter gourd [7]. *Lasioptera bryoniae* was earlier recorded in wild gourd *Diplocyclos palmatus* (L.) Jeffrey in Amaravati and Pune districts of Maharashtra [9].
Neither the biology nor the description of the this gall fly has been made so far, hence, the research work on biology and its natural enemies was undertaken during 2015 – 16 in the Department of Agricultural Entomology, TNAU, Coimbatore.

Materials and Methods
Taxonomic identification
The samples of adult midges were collected from the galls in bitter gourd shoots and identified as *L. falcata* with the key characters available at the Department of Agricultural Entomology where as *L. bryoniae* was identified by Dr. Kumar Ghorpade, Scientist Emeritus, University of Agricultural Sciences, Dharwar. Regarding the different species of parasitoids associated with gall midge, the adults of the parasitoids were sent to Prof. TC Narendran Trust for Animal Taxonomy, Kozhikode, Kerala for identification.

Studies on Biology

The biology of L. *falcata* and *L. bryoniae* was studied in the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Tamil Nadu, India during 2015-2016 using the commonly cultivated variety CO1.

Egg period

Ten seedlings of thirty days old plants raised in plastic pots were placed inside the wooden cage (60*60*60cm) and ten pairs of L. *falcata* adults released in cage. After egg laying the stem was cut open longitudinally and number of eggs laid in each egg mass was noted. At room temperature the egg masses in galled stems were placed in a petri dish lined with filter paper and watched periodically for the emergence of maggot.

Maggot period

The maggot present in tender gall shoot was longitudinally split with cut end of the shoot covered with moist cotton swab to prevent quick desiccation. The maggots were examined every twelve hours to ascertain the growth of maggot and to fix the period of growth. The observation was continued till the maggots metamorphosed to puparia.

Pupal period

The pupariam of every maggot was taken out and kept in petri dishes lined with filter paper in cage held at room temperature. Puparia were observed every six hours for the adult emergence.

Adult period

The puparia were kept in petri dishes lined with moist filter paper in cages and provided with 30% honey solution and fresh bitter gourd flowers as adult food. Every eight hours, the adult food was changed. The freshly emerged adults were observed every six hours for their longevity.

Fecundity

Pots with one month old seedlings were placed inside the cages (100*65*65cm) and in every cage a pair of freshly emerged adults were released. The adult food described above in 1.4 was provided. After the mortality of the adults, the seedlings were dissected and examined for number of eggs laid.

Morphometrics

The developmental stages of midge from egg to adult were measured using the image analyzer (Model - LEICA M205 A, Made in Germany) available in Dept. of Agrl. Entomology.

Natural biological control

Parasitoids associated with gall midge *viz. Aprostocetus diplosidis* and *Bracon* sp. were identified at Dr. T. C. Narendran Trust for Animal Taxonomy, Kozhikode, Kerala. The level of gall midge parasitization by different parasitoids on the natural parasitization was studied for one year 2015-16 in farmer's field. The crop stand in farmers field was maintained throughout the year by staggered sowing of bitter gourd. At fortnight intervals ten shoots with galls were removed at random from the plant and confined in polythene bags for the observation on adult emergence. The number of adult midges and parasitoids emerged from the galls were counted and percent parasitization worked out. The level of parasitization of *Aprostocetus diplosidis* and *Bracon* sp. were assessed based on the number of adult parasitoids emerged from the gall. The observation was carried out for one year from December 2015 – November 2016.

Assessment of crop damage

Fortnightly observations on the number of galls per plant was recorded at random in 30 plant from 30 days old crop upto 120 days. Subsequently, the observation was continued on staggered young crop for one yaer.

$$\text{Percent incidence} = \frac{\text{Number of shoots with gall}}{\text{Total number of shoots observed}} * 100$$

Results and Discussion

Biology

The females lay the eggs by piercing the plant tissue and deposit the eggs inside the tender shoots or tender leaf petiole in patches of five. Of the 120 eggs laid by the mated female over 24 h, only 90 per cent of the eggs could hatch. The remaining 10% of the eggs did not hatch, even after 7 days of egg laying. In *L. falcata* eggs are elongate and measured 1.43 mm in length and 0.59 mm in width where as in *L. bryoniae* the eggs measured a length of 1.38mm and a width of 0.61 mm. Freshly laid eggs are transparent, which becomes yellow after 36 hours. The outline of maggot could be clearly seen externally on the chorion of the eggs which hatched within 96 hours of laying.

The neonate maggots on eclosion were transparent measuring 1mm long. The maggots have distinctly divided 11 body segments with a Y-shaped structure called the "Sternal spatula" on the ventral surface of the second segment. The maggots become white within 3 days of eclosion which attain yellow colour when fully grown. The duration of maggot was longer in *L. bryoniae* 9 to 12 days as compared to *L. falcata* which had a short duration of 7-11 days. Both the species form a separate larval cavity and remain inside. The first instar of *L. falcata* was 1.34mm long with a width of 0.28mm whereas *L. bryoniae* measured a length of 1.25mm and a width of 0.30 mm.

Pupation takes place inside the larval cavity. The puparia was transparent initially which subsequently turn yellow and become dark brown with the development of wing pad and antenna 24 hours before adult emergence. The ventral sides of the pupariam turn orange with black stripes at the distal abdominal segments. Adults emerged from the puparium leaving pupal case semi atrophied on the gall shoots. The total period of life cycle from egg to adult was 21.5 days in *L. falcata* and 22.7 days in *L. bryoniae.*

Both the species of adults *L. falcata* and *L. bryoniae* showed an adult emergence of 95 per cent. Adult was mosquito like fly and the mated female do not have the premating period which starts laying eggs in tender shoots immediately after mating. The average fecundity of gravid female was 98.3 with 90 per cent hatchability in *L. falcata* as against 87% hatchability in *L. bryoniae* which showed a fecundity of 104.2. The per cent transformation of adults from eggs was 46.7 in *L. falcata* and 51.0 in *L. bryoniae.*

Natural biological control

The major parasitoids commonly found attacking gall midge in the experimental field were *Aprostocetus diplosidis* Crawford and *Bracon* sp. The assessment of gall midge population and the level of parasitization of the two parasitoids were carried out based on the adult emergence from the sampled gall shoots.

The parasitism of gall midge by *A. diplosidis* was the lowest in December II fortnight 13.0% which increased steadily to a peak 48.28 per cent in II fortnight of April. Subsequently, the parasitization of *A. diplosidis* declined at a slower rate resulting in sigmoid curve response. On an average, adults of A. *diplosidis* emerging from single gall was 6.03 with range of 2.4 – 8. 6 adults/gall. Umeh and Joshi [10] reported the role of *Aprostecetus pachydiplosisae* in the control of African rice gall midge in Malawi where in parasitization up to 100 per cent was recorded at the end of the season. Lampo [5] also reported the parasitization of *Contrinia sorghicola* by *A. diplosidis.*

The adults of *Bracon* sp. emerged from the single gall ranged 3.0 to 6.4 averaging 5.19 adults/gall. Its population was slightly lower than A. *diplosidis*. The female parasitoid finds a gall using her ovipositor and antenna and lays a single egg. The average annual parasitization was 28.07 per cent with the maximum of 39.20% during I fortnight of May and minimum of 17.31 per cent recorded during I fortnight of December.

Crop Damage

The contribution of the two parasitoids in the natural biological suppression of the shoot gall damage of *Lasioptera* spp in bitter gourd was also observed. The crop damage due to gall fly was high during II fortnight of November 78.2% galls whereas the damage of shoot galls during II fortnight of May was least 21.7% which had the highest natural parasitization by both the parasitoids *A. diplosidis* and *Bracon* spp. The highest parasitization >80 per cent prevailed during April and May showed lowest gall damage. The inverse relationship between higher parasitoid activity during April and May and lower gall fly occurence can be attributed to the availability of alternative host harboring insect plants like sorghum which provide the host midge *C. sorghicola* for the parasitoid *A. diplosidis* [5] and other rainfed crops which provide adult food like pollen and nectar to the adult parasitoids for sustenance in the field. Further, it can also be reasoned for the stress induced production of phenols in bitter gourd which might have reduced the immunity in the maggots of gall midge which in turn succum to the parasitization of *A. diplosidis* and *Bracon* sp and hence the minimum gall damage and maximum parasitization of *A. diplosidis* and *Bracon* sp during April and May. Above two parasitoids clearly indicated their potential to check the population of gall midge in bitter gourd. The variation in the level of parasitization between species can be attributed to the behavior, fecundity and ability of the life stages of the parasitoids to tolerate the immune response of maggots of the midge. In addition, the presence of alternate midge host crops like sorghum might have influenced the occurrence of *A. diplosidis* parasitoids slightly in higher proportion than *Bracon* spp.

Table 1: Developmental period (days) of *Lasioptera falcata* and *L. bryoniae* on bitter gourd (CO_1)

Development stage		*Lasioptera falcate* (Days)	*Lasioptera bryoniae* (Days)
Egg	Mean ± SD	2.7 ± 0.21	2.8 ± 0.31
	Range	2 - 4	2 - 4
Maggot	Mean ± SD	9.5 ± 0.43	10.1 ± 0.29
	Range	7 - 11	9 - 12
Pupa	Mean ± SD	4.8 ± 0.29	5.2 ± 0.34
	Range	4 – 6	4– 6
Adult	Mean ± SD	3.5 ± 0.22	3.6 ± 0.20
	Range	3 – 4	3 – 4
Total developmental period	Mean ± SD	21.5 ± 0.41	22.7 ± 0.37
	Range	16 - 25	18 – 26

SD: Standard deviation

Table 2: Morphometrics of different stages of *Lasioptera falcata* and *L. bryoniae*

Stages	*Lasioptera falcata*		*Lasioptera bryoniae*	
	Length (mm) (Mean ± SD)	Width (mm) (Mean ± SD)	Length (mm) (Mean ± SD)	Width (mm) (Mean ± SD)
Egg	1.43 ± 0.21	0.59 ± 0.82	1.38 ± 0.19	0.61 ± 0.35
I instar	1.34 ± 0.28	0.28 ± 0.21	1.25 ± 0.18	0.30 ± 0.31
II instar	1.83 ± 0.18	0.33 ± 0.28	1.75 ± 0.32	0.32 ± 0.18
III instar	1.61 ± 0.33	0.75 ± 0.48	1.55 ± 0.28	0.78 ± 0.27
Pupariam	1.41 ± 0.38	0.35 ± 0.56	1.39 ± 0.43	0.31 ± 0.36
Male adult	1.43 ± 0.42	0.31 ± 0.54	1.44 ± 0.26	0.33 ± 0.24
Female adult	1.63 ± 0.11	0.36 ± 0.21	1.58 ± 0.31	0.32 ± 0.31

SD: Standard Deviation
Mean of twenty five replications

Table 3: Adult emergence, fecundity and egg hatchability of *Lasioptera falcata* and *L. bryoniae*

	Lasioptera falcata	*Lasioptera bryoniae*
Per cent adult emergence (%)	95.0	95.0
Fecundity per female (Nos.)	98.3	104.2
Per cent egg hatchability (%)	90.0	87.0
Per cent unhatched eggs (%)	10.0	13.0
Egg to adult per cent survival	46.7	51.0

Table 4: Seasonal parasitization of *Lasioptera* spp by different parasitoids

Month	Fortnight	Per cent incidence	A. *diplosidis* (%)	*Bracon* sp. (%)	Total per cent parasitization
Dec	I	74.3	17.31	17.31	34.62
Dec	II	76.2	13.04	20.79	33.83
Jan	I	70.2	25.00	17.24	42.24
Jan	II	71.3	22.45	20.83	43.28
Feb	I	67.1	23.36	23.36	46.72
Feb	II	68.4	21.62	22.32	43.94
Mar	I	53.2	36.36	29.11	65.47
Mar	II	50.2	40.45	32.91	73.36
April	I	46.2	45.24	36.11	81.35
April	II	32.6	48.28	36.62	84.9
May	I	28.6	48.05	39.20	87.25
May	II	21.7	46.24	37.50	83.74
June	I	22.4	40.48	36.50	76.98
June	II	33.8	37.5	34.20	71.7
July	I	40.6	36.84	33.10	69.94
July	II	42.2	30.00	30.69	60.69
Augest	I	51.2	32.00	30.20	62.2
Augest	II	50.2	31.51	28.40	59.91
Sept	I	60.2	31.03	29.10	60.13
Sept	II	60.4	29.70	28.20	57.9
October	I	62.4	27.19	21.70	48.89
October	II	66.9	29.51	23.21	52.72
Nov	I	77.2	20.79	20.79	41.58
Nov	II	78.2	19.47	24.17	43.64
Average		54.40	31.39	28.07	59.46

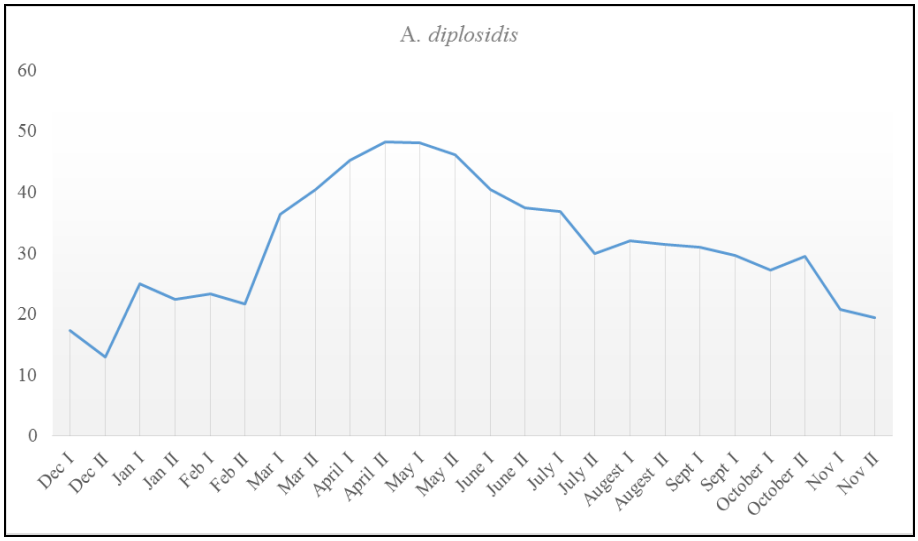


Fig 1: Natural control of gall midge by A. *diplosidis*

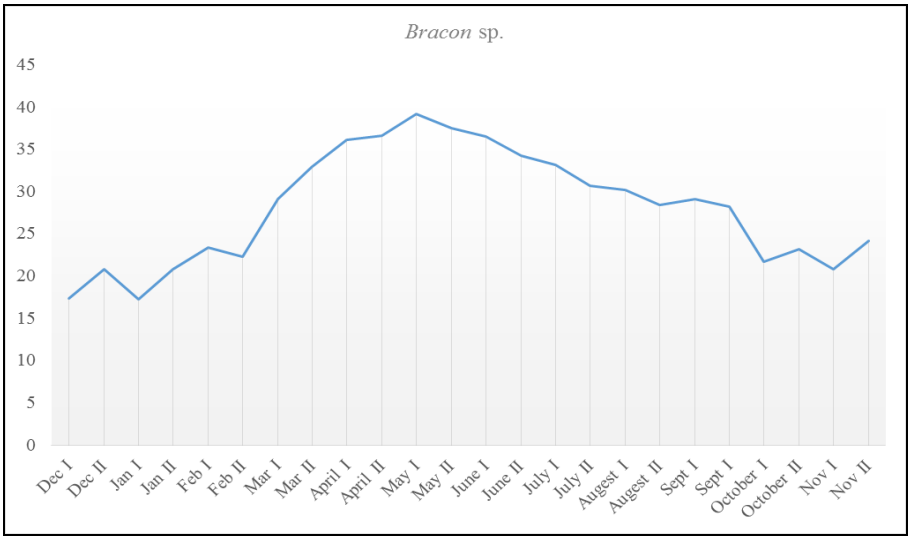
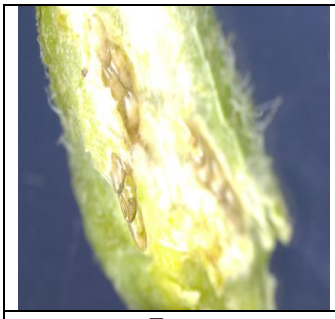


Fig 2: Natural control of gall midge by *Bracon* sp.

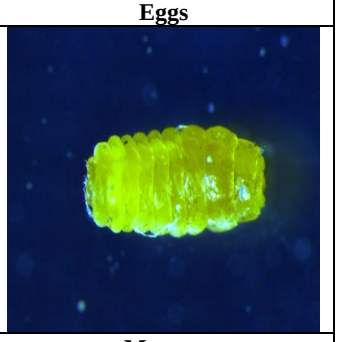
Life stages of *Lasiopera* spp.



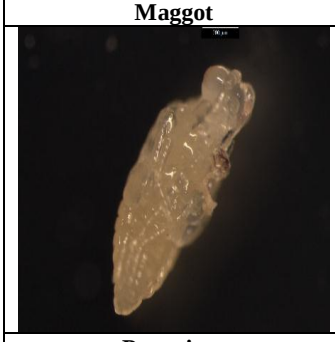
Eggs

Eggs

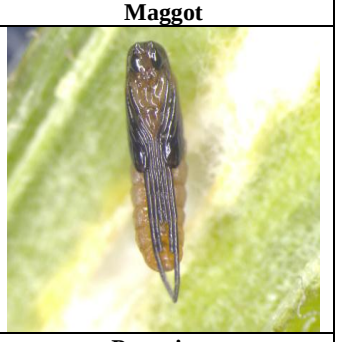
Maggot



Maggot



Puparium



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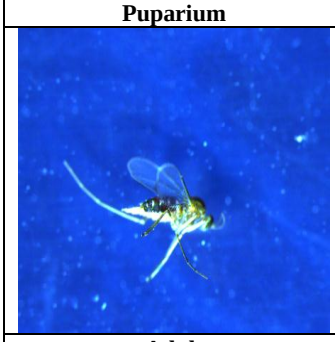
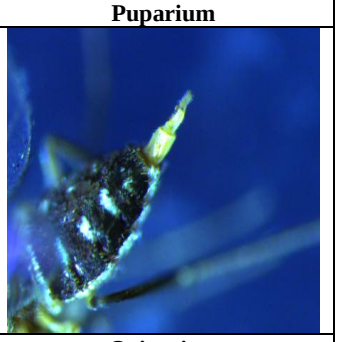


Adult



Ovipositor

Parasitoids attacking gall midge

***Aprostocetus diplosidis* Crawford**

***Bracon* sp.**

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Reference

1. El-Batran SAES, El-Gengaihi SE, El-Shabrawya OA. Some toxicological studies of *Momordica charantia* L. on albino rats in normal and alloxan diabetic rats. J. Ethnopharm. 2006; 108:236-242
2. Felt EP. New Philippine Gall Midge, Philipp. J Sci. 1919; 14:287-94
3. https://www.indiastat.com. 12 May, 2017
4. Khan A, Anderson RA. Insulin Potentiating Factor (IPF) present in foods, species and natural products. Pakistan J. Nutrit. 2003; 2:254-257
5. Lampo M. The importance of refuges in the interaction between *Contarinia sorghicola* and its parasitic wasp *Aprostocetus diplosidis*. Journal of Animal Ecology. 1994; 63:176-186.
6. Mani MS. Studies on Indian Itonididae (Cecidomyidae: Diptera), *Rec. Indian Mus*. 1934; 36:371-451
7. Ramakrishna Ayyar TV. Handbook of economic entomology for South India. Government of Madras, Madras. 1963, 516.
8. Ramakrishna Ayyar TV. Some Insects recently noted as Injurious in South India, Proc. 3rd Ent. Mtg. Pusa 1919, 1920; I:3I4-28.
9. Sharma RM. New Records of Lasiopterine Midge Galls (Diptera: Cecidomyiidae: Cecidomyiinae: Lasiopteridi) From Maharashtra. Zoos' print journal. 2003; 18(1):993.
10. Umeh EDN, Joshi RC. Aspects of the biology, ecology and natural biological control of the African rice gall midge, *Orseolia oryzivora* Harris and Gagne (Dipt., Cecidomyiidae) in south east Nigeria. J Appl. Ent. 1993; 116:391-398
11. Yamaguchi M. World Vegetables. AVI (Van No strand Reinhold Co.), New York, London, 1983.