Journal of Biological Control, 35(2): 76-81, 2021, DOI: 10.18311/jbc/2021/28583

Research Article

First record of natural enemy, *Trechnites aligharhensis* on *Trioza fletcheri minor* Crawford, a major pest on *Terminalia arjuna* and *Terminalia tomentosa*

B. THIRUPAM REDDY[1*], M. CHANDRASHEKHARAIAH[2], B. RAGHAVENDHAR[3], D. M. BAWASKAR[4], C. SELVARAJ[5], S. M. MAZUMDAR[6], G. V. VISHAKA[2], H. A. NADAF[2], M. S. RATHORE[2] and K. SATHYANARAYANA[2]

[1]*Basic Seed Multiplication and Training Centre, Kharsawan –833216, Jharkhand, India*

[2]*Basic Tasar Silkworm Seed Organization, Central Silk Board, Bilaspur – 495112, Chhattisgarh, India*

[3]*Department of Entomology, Professor Jayashankar Telangana State Agricultural University, Hyderabad - 500030, Telangana, India*

[4]*Basic Seed Multiplication and Training Centre, Balaghat – 481001, Madhya Pradesh, India*

[5]*Basic Seed Multiplication and Training Centre, Madhupur – 815353, Jharkhand, India*

[6]*Basic Seed Multiplication and Training Centre, Kathikund – 814103, Jharkhand, India*

**Corresponding author E-mail:* thirupamreddy5990@gmail.com

ABSTRACT: Studies have been carried out on exploration of natural enemies of the Psyllid bug, *Trioza flecheri minor* on *Terminalia* spp., the primary host plantations of tasar silkworm during April to November, 2020. The results of the studies indicated that among the natural enemies recorded on *T. flecheri minor,* the *Trechnites aligarhensis* Hayat, Alam and Agarwal was the major encyrtid parasitoid. The incidence of *T. f. minor* was significantly more on *T. arjuna* (22.98% galls) compared to *T. tomentosa* (12.59% galls) and peak incidence was observed during the August and September months. The parasitization of *T. aligarhensis* on *T. f. minor* was significantly more on *T. arjuna* (33.13%) as compared to *T. tomentosa* (24.92%).

KEY WORDS: Galls, parasitisation, Tasar silkworm, *Trechnites aligarhensis, Trioza flecheri minor*

(Article chronicle: Received: 07-05-2021; Revised: 28-06-2021; Accepted: 30-06-2021)

INTRODUCTION

Tropical tasar silkworm, *Antheraea mylitta* Drury rearing is a prime occupation for several tribal people in Central India. Many of these farmers depend on departmental farms for seed crop rearing and forest based *Terminalia arjuna* (L.) and *Terminalia tomentosa* Roxb (ex DC) Wight and Arn (Combretaceae) for commercial rearing of silkworm. Suitable patches have been selected for rearing of silkworms in coordination with the State Sericulture and Forest Department. Since, tasar silkworm rearing is being conducted under outdoor conditions on host plants; the success is highly influenced by both biotic and abiotic factors. In recent times, the improved production practices along with the climate change (delayed monsoon and prolonged dry spells) have drastically escalated the sucking insect-pests problem on host plants of tasar silkworm in a subtle and oblivious fashion. Due to the prevailing restrictions for spraying of synthetic chemicals within the forest areas, the management of several insect pests is becoming a serious concern.

Among the several insect pests, the sucking insect-pests are highly harmful biotic factors, posing great threats for quality leaf production. Major sucking pests are *Rhiphiphorothrips cruentatus* Hood (Thysanoptera: Thripidae), *Trioza fletcheri minor* Crawford (Hemiptera: Psyllidae), *Clovia* sp. (Hemiptera: Aphrophoridae), *Hishimonus indicus* (Sohi) and *H. viraktamathi* Knight (Hemiptera: Cicadellidae) (Chandrashekharaiah et al., 2018). Management of these sucking pests are highly cumbersome due to their specific survival behavior, reproductive adoption, resistance to chemicals, shorter life-cycle and feeding behavior (Lu et al. 2016, Chakravarthy 2015). Sap feeding pests slurp the nutrient content in the leaves of host plants prior to the rearing of silkworm and affect quality of leaf while feeding. Silkworms feed on such infested leaves during rearing and result in poor quality cocoons.

Among these sucking pests, the gall fly/psyllid *Trioza fletcheri minor* Crawford (Hemiptera: Psyllidae) is an endemic pest in the major tasar sericulture practicing states

and inflict damage on the leaves of host plants up to 40-50% by sucking sap and forming galls on the leaves (Thangavelu and Singh, 1991). Presently, dimethoate 30 EC @ 0.09% spraying is being followed during pre-monsoon season to check the multiplication of psyllid population on *T. arjuna* and *T. tomentosa*, as a preventive measures. However, *T. f. minor* from the unprotected plants or forest/avenue trees disperse to the tasar host plants and cause severe damage during effective silkworm rearing seasons. Hence, there is much scope for management of psyllids using potential natural enemies on tasar silkworm host plants. Therefore, this study was intended to study the *T. f. minor* population during silkworm rearing seasons and identification of its major natural enemies in the major tasar sericulture practicing districts in Jharkhand state.

MATERIAL AND METHODS

Infested leaves of both *T. arjuna* and *T. tomentosa* were collected from the Departmental farm, Basic Seed Multiplication and Training Centre (BSM and TC), Kharsawan and brought to the laboratory to observe for the occurrence of parasitoids. The *T. f. minor* infested galls cut open using a sharp needle and are observed for the grubs/pupal stages of parasitoids. Predominantly occurring parasitoid pupae were collected in the 20 ml glass vials and observed for their emergence under laboratory conditions. Natural enemies after emergence were collected and preserved for identification. The specimens were sent to Dr. Ramesh, Scientist-C, Zoological Survey of India for identification.

After identification of the parasitoid (Figure 1 G and H), their occurrence on *T. f. minor* from April 2020 to September 2020 at Kharsawan was recorded at fortnightly intervals. Twenty infested leaves @ one per plant, collected from the *T. arjuna* and *T. tomentosa* plants separately, in randomly selected plants at departmental farm, BSM and TC, Kharsawan. The samples were collected at every fifteen days interval and brought to the laboratory for assessment of parasitoids incidence. Through a destructive sampling process, all the galls in the sampled leaves were ruptured using a sharp needle and observed for the occurrence of different parasitoids. The percentage parasitization was estimated using the formula, Parasitism (%) = [(No. of parasitized galls on leaf/Total No. of galls on leaf)×100].

RESULTS

The parasitoid was identified as *Trechnites aligarhensis* Hayat, Alam and Agarwal (Encyrtidae: Hymenoptera) (Figure 1 G and H). Field observations revealed that the entire body of a parasitized nymph of *T. f. minor* became bulged compared to normal (Figure 1D). Before the emergence of adult parasitoids from gall, they make an opening slit by chewing the tip of the gall and such openings are irregular (Figure 1B), however, *T. f. minor* adult emergence slits were uniform and smooth (Figure 1C). The *T. aligarhensis* matured pupae are small elliptical and black in color. Adults have black heads and have shiny greenish-yellow triangular sclerite thoracic regions. Females have small ovipositor (Figure 2).

Occurrence of *T. f. minor* was significantly more on *T. arjuna* compared to *T. tomentosa* ($t = 18.03$; $df = 13$; $p<0.01$). However, number of galls per leaf, both in the *T. arjuna* and *T. tomentosa,* increased gradually from April to September and decreased subsequently ($F = 250$; $df = 13,279$; $P<0.01$). Peak incidence was observed during the August and September months.

Highest number of *T. f. minor* parasitization was recorded on the *T. arjuna (*33.13%) compared to *T. tomentosa* (24.92%) ($t = 8.78$; $df = 11$; $p<0.01$). The percentage parasitization did not vary significantly over the entire study period on both *T. arjuna* ($P = 0.13$) and *T. tomentosa* ($P = 0.09$). However, parasitisation was slightly increased from April to July on *T. tomentosa* and April to September on *T. arjuna* and subsequently reduced on both the host plants. Similar trend was also recorded with regard to infestation of the *T. aligarhensis* on *T. arjuna* ($p = 0.18$) and *T. tomentosa* ($p = 0.106$) during the study period. However, occurrence of *T. aligarhensis* was highest on the *T. arjuna* ($t = 9.88$; $df = 11$; $p<0.01$) compared to *T. tomentosa*. About 22.98% and 12.59% galls on *T. arjuna* and *T. tomentosa* parasitised by the *T. aligarhensis,* respectively.

DISCUSSION

Trioza fletcheri minor is a serious pest on the *T. arjuna* and *T. tomentosa* and its infestation has resulted in the reduction of 40-50% leaf quality (Thangavelu and Singh, 1991). The incidence of *T. f. minor* usually coincides with the emergence of new leaves and as the feeding progresses, the leaf quality deteriorates and such leaves become unsuitable for rearing of silkworm. Seed crop rearing farmers are facing severe shortage of quality leaf during August and September crops and forced them to take up silkworm rearing in an alternative patch. Due to the monoculture nature of tasar host plants, the tender leaves emerge after onset of monsoon showers and served as a breeding site for the *T. f. minor* to multiply rapidly. Chandrashekharaiah et al. (2018) reported the peak infestation of *T. f. minor* during pre-monsoon and rainy season in Chhattisgarh. Further, the incidence of *T. f. minor* was also recorded very frequently on new leaves produced after pruning, pollarding and on the twigs/ branches that were cutoff during silkworm rearing operations (transferring of larvae and harvesting of cocoons). The leaves produced during off season are also serving as breeding sites for perpetuation within the field.

Fig. 1. A - Leaf galls of *T. f. minor*, B and C - emergence holes made by the adult parasitoid, (B) and *T. f. minor* (C), D - Healthy (right) and parasitised (left) nymphs of *T.f. minor*, E and F - *T. aligarhensis* and its pupal case, G - *T. aligarhensis* male, H and I - *T. aligarhensis* female and its ovipositor.

The psyllid appeared in the severe form during March to December on both *T. arjuna* and *T. tomentosa*. The *T. f. minor* transforms mesophyll cells of leaves into galls by the action of hypertrophy and hyperplasia while feeding. Leaf gall causes distortion of leaves, reduces effective photosynthetic area and affects the leaf quality (Sunita Mukherjee et al., 2017). Hemipterans are also phloem-feeders; they absorb nutrients using piercing and sucking mouth type and secrete toxic saliva that actually interacts with plant defense mechanisms (Scott Brown et al. 2002, Steinbauer 2013, Torsten Will et al. 2013, Weintraub and Beanland 2006). Further, sap feeding insects (Hemipterans) balance their nutrition by excreting the excess sugar-water as honeydew, which is objectionably sticky and supports the growth of sooty mold. Honeydew attracts stinging wasps and ants (*Koch et al.,* 2011). Foliar spray of dimethoate @ 0.09% against gall fly is the only recommended chemical practice and due to its negative impact on other fauna in the forest ecosystem and dimethoate is not recommended under forest rearing patches. Therefore, management of gall fly through ecofriendly measures is of great concern.

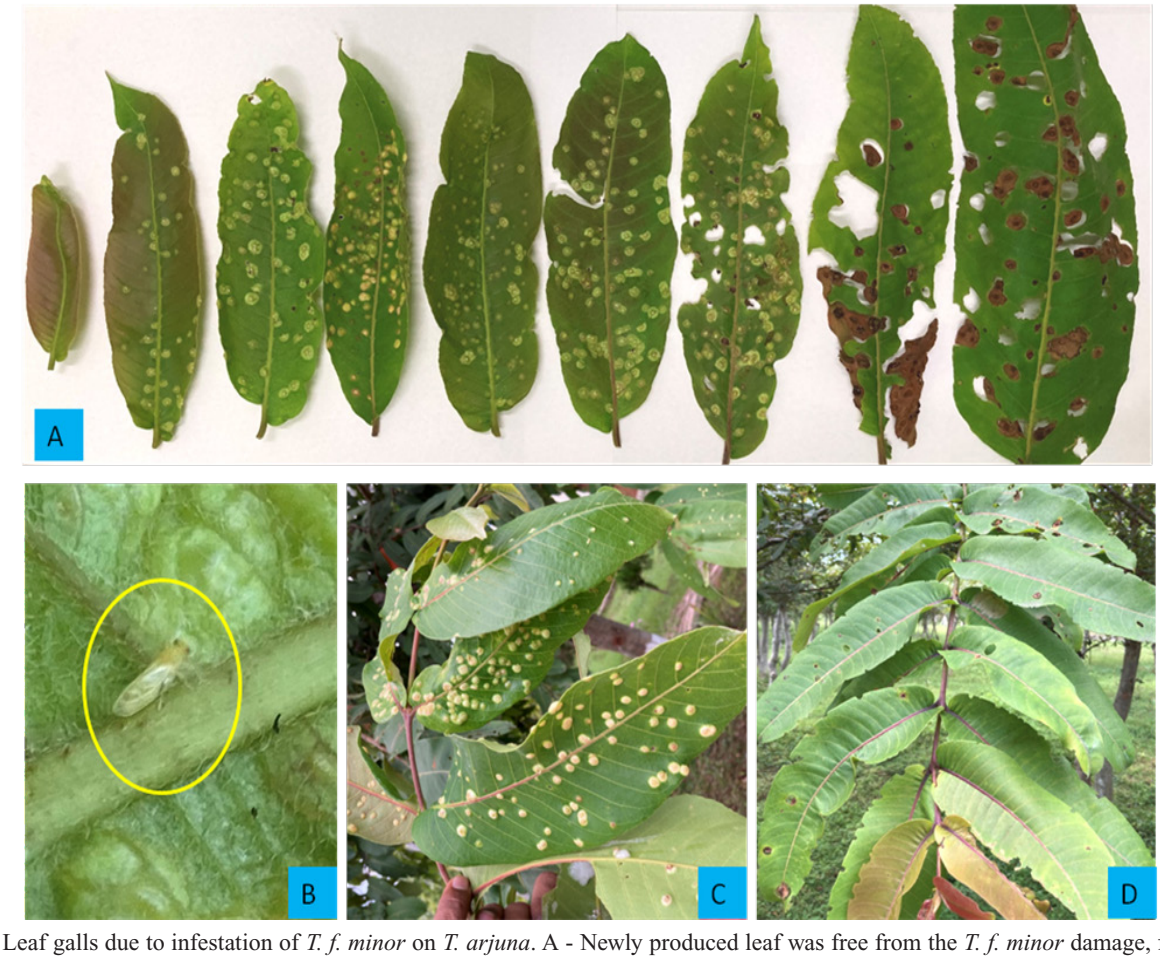

Fig. 2. Leaf galls due to infestation of *T. f. minor* on *T. arjuna*. A - Newly produced leaf was free from the *T. f. minor* damage, further, the number of galls increased gradually as the leaf matures. Mature leaves with no fresh galls symptoms but old gall markings turned into brown spots. B- Adult *T. f. minor*. C- Fresh infestation *of T. f. minor* on leaves D - Infestation free leaves due to chemical protection

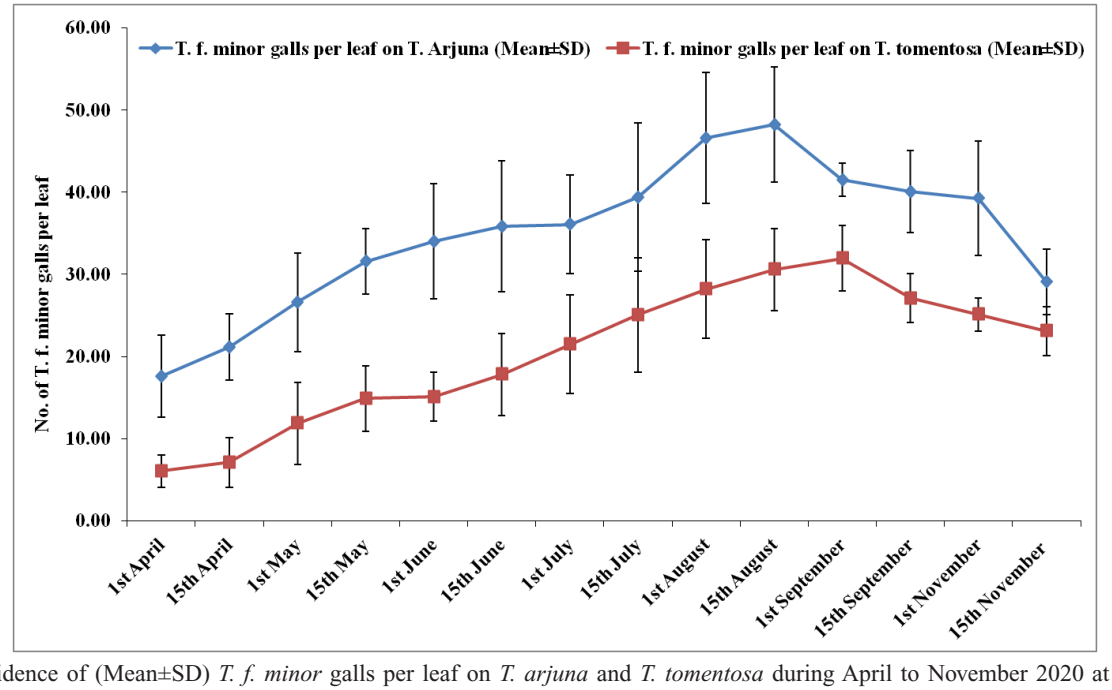

Fig. 3. Incidence of (Mean±SD) *T. f. minor* galls per leaf on *T. arjuna* and *T. tomentosa* during April to November 2020 at Kharsawan, Jharkhand

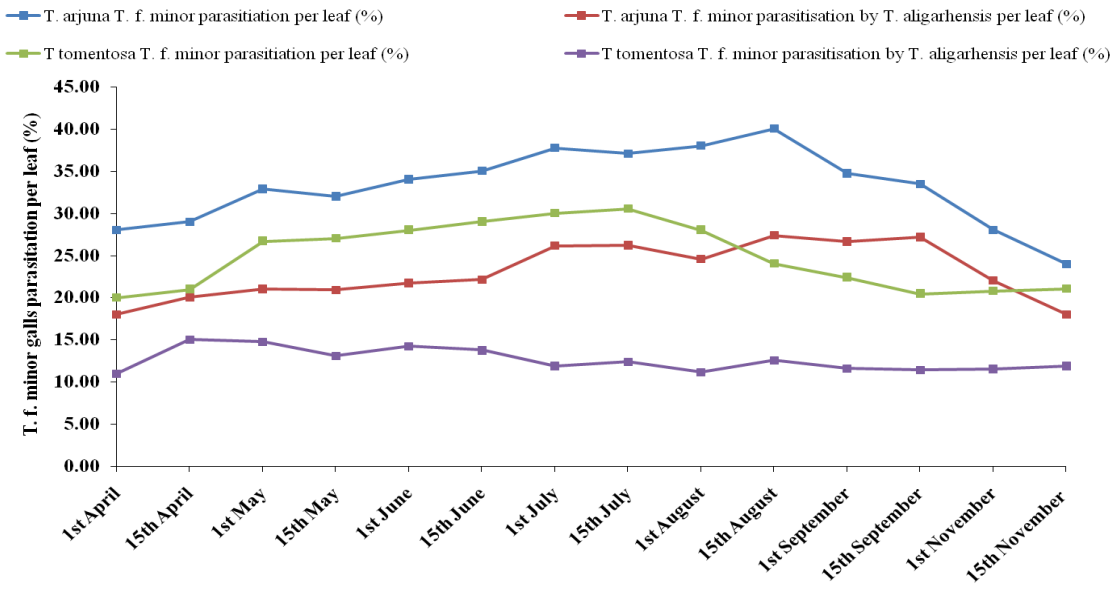

Fig. 4. Per cent infestation of *T. f. minor* on *T. arjuna* and *T. tomentosa* during the major tasar silkworm rearing season and the Per cent parasitisation of *T. f. minor* by *T. aligarhensis* on respective host plants from April to November at Kharsawan, Jharkhand state

Occurrence of the *T. aligarhensis* has been recorded for the first time on *T. f. minor.* The *T. aligarhensis* was previously reported on psyllid galls from Kerala and Uttar Pradesh (Hayat, 2004). In this study, *T. aligarhensis* parasitization was recorded on the *T. f. minor* infested on *T. arjuna* and *T. tomentosa* from the Jharkhand state. A study on etiology of the gall insect was conducted at Ranchi (India) and two hymenopterous parasitoids (nymph stage) viz. *Trechnites secundus* and *Aprostocetus niger* were identified during July- August, 1994 (Singh et al., 1995). Similarly, *Psyllaephagus arjuna (Hymenoptera:Encyrtidae)* (Singh, 2016), *Aprostocetus arjuna* (Hymenoptera:Eulophidae) (Kumar and Kumar, 2020) were also recorded on *T. f. minor*. The ants *Camponotus compressus* and *Lepisiota frauenfeldi* were also found associated with *T. f. minor* (Bodlah et al., 2017).

Since infestation of *T. f. minor* on *T. tomentosa* and *T. arjuna* occur throughout the year, potential parasitoid like *T. aligarhensis is* most essential for its management on both the natural and cultivated plantations. Standardization of mass rearing technique of *T. aligarhensis* for large scale multiplication and field release is required.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. Ramesh, Scientist-C, Zoological Survey of India for identification up to species level and also grateful to Dr. C. Srinivas, former Scientist-D and Director in-charge of BTSSO, Bilaspur (Chhattisgarh) for his kind support.

REFERENCES

Bodlah I, Bodlah MA, Rasheed MT, Akhter T, Aihetasham A and Yousaf M. 2017. New distributional records of psyllid, *Trioza fletcheri minor* Crawford, 1912 and record of its first association with two ant's species in Pothwar. *Asian J Agri and Biol.* **5**(1):1–6.

Chakravarthy AK. ed., 2015. New horizons in insect science: Towards sustainable pest management. *Springer.* https://doi.org/10.1007/978-81-322-2089-3

Chandrashekharaiah M, Rathore MS, Sinha RB and Sahay A. 2018. Status of sucking pests on *Terminalia arjuna*: An indication of changes in pest status and implication for tasar sericulture. *Res J Agri Sci.* **9**(5):1163–1165.

Hayat M. 2004. Taxonomic studies on the Indian Encyrtidae (Hymenoptera: Chalcidoidea). [Ph.D Dissertation]. Aligarh Muslim University.

Koch H, Corcoran C and Jonker M. 2011. Honeydew collecting in Malagasy stingless bees (Hymenoptera: Apidae: Meliponini) and observations on competition with invasive ants. *African Entomol.* **19**(1):36–41. https://doi.org/10.4001/003.019.0111

Kumar V and Kumar S. 2020. New species of *Aprostocetus* (Hymenoptera: Eulophidae) associated with pit galls on *Terminalia arjuna* leaves from Uttarakhand, India. *J Bombay Nat Hist Soc.* **117**:120–127.

Lu H, Yang P, Xu Y, Luo L, Zhu J, Cui N, Kang L and Cui F. 2016. Performances of survival, feeding behavior and gene expression in aphids reveal their different fitness to host alteration. *Sci Rep*. **6**(1):1–11. PMid: 26758247 PMCid: PMC4725932. https://doi.org/10.1038/srep19344

Noyes JS and Hayat M. 1984. A review of the genera of Indo-Pacific Encyrtidae (Hymenoptera: Chalcidoidea). Biodiversity Heritage Library. **48**(3):131–395.

Singh S. 2016. Description of a new species of *Psyllaephagus* Ashmead (Hymenoptera: Encyrtidae) parasitizing pit gall forming psyllid *Trioza fletcheri* (Hemiptera: Psylloidea: Triozidae) on *Terminalia arjuna* from India. *Ann Zool.* **66**(3):393–402. https://doi.org/10.3161/00034541ANZ2016.66.3.005

Singh RN, Karnan P and Sinha SS. 1995. Records of new hymenopterous parasitoids of gall insect, *Trioza fletcheri minor*. *Indian For.* **121**(8):266–267.

Singh S. 2017. Two new species of *Aprostocetus* (Hymenoptera: Eulophidae) parasitizing leaf gall forming psylloids (Hemiptera: Triozidae) on two economically important trees in India. *Ann Zool.* **67**(4):795–810. https://doi.org/10.3161/00034541ANZ2017.67.4.014

Mukherjee S, Kumari D, Singh J, Lokesh G and Sinha A. 2017. Morphology of gall insect, *Trioza fletcheri minor* Crawford and gall infected leaves of tasar food plants. *J Entomol Zool Stud.* **5**(3):261–263.

Thangavelu K and Singh RN. 1991. Integrated pest management in tasar culture. *Ann Entomol.* **9**(2):52–65.