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Knowledge Level of Silkworm Rearers in Management of the Uzi Fly, *Exorista bombycis* [Louis] [Diptera: Tachinidae] in Mandya District of Karnataka, India

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Abstract

An investigation was carried out in Mandya district of Karnataka, India, to know the status of knowledge among the silkworm rearers in management of the Uzi fly, *Exorista bombycis* [Louis], a serious endo-parasitoid of the silkworm, *Bombyx mori* L. The knowledge level of silkworm rearers in respect of management of Uzi fly has been classified into full, partial and no knowledge among three categories of farmers [small, medium and big] based on their size of mulberry land holding. The silkworm rearers were assessed for their knowledge on exclusion, physical, chemical, biological and post-spinning activities. In exclusion method, full knowledge was noticed in practices such as using an ante room [44%] and manual killing of Uzi fly [100%], while partial knowledge was observed in individual tray cover with nylon net [61%] and provide doors with automatic closing mechanism [45%]. Regarding physical method, full knowledge was evident in Uzi trap [61%] and light cum sticky trap [39%], partial knowledge was observed in kerosene water trap [59%] and lack of knowledge in food bait trap [70%] and levigated China clay [65%]. In chemical method, majority of the silkworm rearers possess full knowledge on quantity of chemicals [51%], partial knowledge on the use of Uzicide [41%] and Uzi powder [50%] and no knowledge regarding the use of bleaching powder solution [38%]. In biological method, large group of silkworm rearers possess full knowledge on releasing Uzi parasitoids like *Nesolynx thymus* [40%], but there was no knowledge on the quantity of Uzi parasitoids release [44%]. In respect of post-spinning activities, all the silkworm rearers knew how to dispose silkworm litter, partial knowledge in destroying Uzi maggots/pupae [40%] and disposing of Uzi-infested cocoons [44%].

***Key words*:** *Bombyx mori, Exorista bombycis,* Knowledge, Management, *Nesolynx thymus*, Sikworm rearers

Sericulture holds a unique position as both an income-generating and employment-providing agro-based industry, supporting approximately 9.2 million individuals in India [1]. It encompasses various on-farm and off-farm activities, presenting significant employment prospects for both genders. Sericulture is a well-established, commercially sustainable, farm-based, economic enterprise supporting rural poor in the unorganized sector and also empowerment of rural folk, due to its relatively low investment of fixed capital with high returns. India is the second largest producer of silk in the world. Among the four varieties of silks produced in India, mulberry silk accounts for 70.46% (25,239 MT), eri for 20.11% (7204 MT), tasar for 8.75% (3136 MT) and Muga for 0.67% (241 MT) of the total raw silk production [1]. Sericulture is mainly a village-based industry in India, providing employment opportunities to a large section of the population. Although sericulture was considered as a subsidiary occupation, technological innovations have made it possible to take up on an intensive scale capable of generating continuous and adequate income to farmers [2].

India ranks second in silk production globally, trailing only the People's Republic of China, the country grapples with notably low average cocoon yields. This is primarily attributed to crop losses resulting from a high incidence of pests and diseases affecting mulberry and silkworm throughout the year. However, the severity of these pest and disease outbreaks varies significantly across different seasons. Annual crop loss due to pests and diseases were estimated as 30 to 40% in 2003, with a point prevalence crop loss of approximately 11.5 – 15.0 kg/100 DFLs [3].

Among the numerous factors influencing silkworm seed and commercial cocoon production, diseases and pests (both insect and non-insect) emerge as crucial contributors. The mulberry silkworm, *Bombyx mori* L., faces threats from insects such as tachinid parasitoids, dermestid beetles, ants, and earwigs [4]. Additionally, non-insect pests and parasites like mites, nematodes, wall lizards, rats, squirrels, and birds are recognized for inflicting substantial damage to silkworms and their crops [5]. Various insect and storage pests pose a significant threat to cocoon production, including the Uzi fly, earwig, dermestid beetle, praying mantis, reduviid bug, stink bug, wasps, and red ants. Among these, the Uzi fly, an endo-parasitoid, stands out for causing a yield loss of 15 to 20%. The widespread infestation of Uzi fly in sericulture has led to

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alarming circumstances and severely impacted the foundation of the industry in India, given its adaptability and ability to infest different types of silkworms [6].

Pests and diseases are common in silkworm rearing and can sometimes result in total crop loss. The Uzi fly, particularly prevalent in Karnataka, Andhra Pradesh, Tamil Nadu, and West Bengal, is regarded as the most serious pest. Saratchandra [7] documented crop losses of 10 to 40% due to Uzi infestations. This endo-larval parasitoid poses a significant threat to silkworm rearing in various silk-producing nations, including India, paralyzing the sericulture industry not only domestically but also in other sericulture-dependent countries [8].

Knowledge primarily involves cognitive understanding or knowing, with individuals often driven to seek knowledge based on their predispositions. For managerial personnel, knowledge encompasses understanding the complexities involved in planning, organizing, directing, coordinating and controlling various activities to enhance well-being. In the context of managing Uzi fly infestations, the knowledge levels of silkworm rearers are categorized as full, partial, or non-existent, depending on their land holding size. Knowledge refers to the familiarity acquired through experience, contact, or association with individuals or subjects. It encompasses both theoretical and practical understanding, which can be implicit (in the form of practical skill or expertise) or explicit (in the form of theoretical comprehension). The perusal of information furnished above revealed that, though studies have been carried out on the incidence of Uzi infestation and management of Uzi fly to contain an economic loss, but, systematic approach has not been undertaken to study the knowledge levels at silkworm rearers condition.

MATERIALS AND METHODS

The current investigation has been conducted in Mandya District of Karnataka State, India. Mandya covers an area of 4962 square kilometres, predominantly agrarian, it lies between 76º 19’ and 77º 20’E longitude and 12º 13’ and 13º 04’ N latitude, with an altitude ranging from 2500 to 3000 ft. above Mean Sea Level (MSL). The district's total geographical area is 4,98,244 ha, with Srirangapatna taluk covering 35,758 ha and Nagamangala taluk covering 1,03,885 ha. Forest land ranges from 20 ha in Maddur taluk to 12,179 ha in Malavalli taluk, accounting for only 5% of the district's total area. Wasteland occupies 1,44,395 ha, constituting approximately 29% of the district's geographical area, with Malavalli taluk having the highest wasteland area and Nagamangala taluk the lowest. The net sown area is 1.89 lakh ha, representing nearly 38% of the district's geographical area, varying from 15,754 ha in Srirangapatna taluk to 36,544 ha in Krishnarajapet taluk (Department of Agriculture, Govt. of Karnataka, 2022). Mandya district experiences a semi-arid climate with three distinct seasons: rainy, winter and summer. Summers are characterized by hot and dry conditions, while winters are cool and pleasant.

The study was conducted in seven taluks of Mandya district of Karnataka state, India encompassing a total of 200 farmers. The number of silkworm rearers interviewed for data collection in each taluk depends on the mulberry area and the number of farmers engaged in sericulture. This research endeavor was formulated based on preliminary field surveys and in consultation with the Technical Staff of the State Department of Sericulture across various taluks in the Mandya district. The information on the current investigation was collected through formal discussion using pre-structured interview schedule. The silkworm rearers were asked about the knowledge in management of the Uzi fly. The response given by silkworm rearers were categorized into three namely full, partial and no knowledge. The analysis of data was carried out adopting the statistical tools like frequencies, percentages and mean. The data was analyzed using SPSS package (ver. 21.0).

RESULTS AND DISCUSSION

Knowledge level of silkworm rearers in management of the Uzi fly (Exorista bombycis)

Knowledge refers to awareness about facts, familiarity of practices, skills, situations, etc. The knowledge makes the farmers to organize the events more systematically for enhancing the yield and productivity of crops/animals by way of improving the production practices and reducing the losses caused by the pests and diseases. In the current study, the knowledge level of silkworm rearers in respect of management of the Uzi fly has been classified into full, partial and no knowledge among different categories of farmers (small, medium and big) based on their size of land holding. The methods that were included in management of the Uzi fly are exclusion, physical, chemical, biological and post-spinning activities (Tables 1-4).

Exclusion method

The knowledge level of silkworm rearers differs among the three categories of farmers in respect of management of Uzi fly through exclusion method. Majority of the silkworm rearers are having full knowledge when compared to partial and no knowledge in all the three categories of farmers. Notably, more number of silkworm rearers possess full knowledge on ante room (44%), use of wire mesh for windows and doors (61%), use of nylon net for partition (51%), covering of rearing stand with nylon net (41%) and keep the leaf in the verandah of the rearing house and observe for the Uzi fly before shifting leaf into the rearing house (70%) and partial knowledge on individual tray cover with nylon net (61%) and provide doors with automatic closing mechanism (45%). However, all the silkworm rearers (100%) possess knowledge on manual killing of Uzi fly. Interestingly, individual tray cover with nylon net (39%) and provide doors with automatic closing mechanism (30%) for full knowledge, covering of rearing stand with nylon net (35%) and keep the leaf in the verandah of the rearing house and observe for the Uzi fly before shifting leaf into the rearing house (30%) for partial knowledge and ante room (30%) for no knowledge were found next in the order. On the other hand, equal number of silkworm rearers (20%) possesses partial and no knowledge for use of wire mesh for windows and doors. Further, least number of silkworm rearers possess partial knowledge on ante room (26%) and use of nylon net for partition (19%) and no knowledge on covering of rearing stand with nylon net (25%) and provide doors with automatic closing mechanism (25%).

Physical method

Considerable differences were noticed with respect to knowledge level in different categories of silkworm rearers with respect to physical method of management of Uzi fly through various practices. Irrespective of the categories of farmers, large group of silkworm rearers possess full knowledge on light cum sticky trap (39%) and Uzi trap (61%), partial knowledge on kerosene water trap (59%) and no knowledge on food bait trap (70%) and levigated China clay (65%). The practices that were found next in the order were kerosene water trap (30%) for full knowledge, food bait trap (30%) and Uzi trap (30%) and levigated China clay (27%) for partial knowledge and light cum

sticky trap (35%) for no knowledge. However, levigated China clay (9%) for full knowledge, light cum sticky trap (26%) for partial knowledge and kerosene water trap (11%) and Uzi trap (10%) were found next in the order.

Table 1 Knowledge level of silkworm rearers among different categories of farmers in management of the Uzi fly through exclusion and physical methods

Practice	Categories of farmers																	
	Small (n=52)						Medium (n=94)						Big (n=54)					
	Full		Partial		No		Full		Partial		No		Full		Partial		No	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
I. Exclusion method																		
i. Ante Room	26	50.00	13	25.00	13	25.00	40	42.55	25	26.60	29	30.85	22	40.74	14	25.93	18	33.33
ii. Use of wire mesh for windows and doors	34	65.38	9	17.31	9	17.31	57	60.64	20	21.28	17	18.09	31	57.41	10	18.52	13	24.07
iii. Use of nylon net for partition	23	44.23	16	30.77	13	25.00	51	54.26	14	14.89	29	30.85	28	51.85	8	14.81	18	33.33
iv. Covering of rearing stand with nylon net	23	44.23	18	34.62	11	21.15	37	39.36	31	32.98	26	27.66	21	38.89	20	37.04	13	24.07
v. Individual tray cover with nylon net	23	44.23	29	55.77	0	0	34	36.17	60	63.83	0	0	21	38.89	33	61.11	0	0
vi. Provide doors with automatic closing mechanism	20	38.46	21	40.38	11	21.15	24	25.53	44	46.81	26	27.66	16	29.63	25	46.30	13	24.07
vii. Manual killing of Uzi fly	52	100.0	0	0	0	0	94	100.0	0	0	0	0	54	100.0	0	0.0	0	0
viii. Keep the leaf in the verandah of the rearing house and observe for the Uzi fly before shifting leaf into the rearing house	33	63.46	19	36.54	0	0	64	68.09	30	31.91	0	0	43	79.63	11	20.37	0	0
II. Physical method																		
i. Light cum sticky trap	24	46.15	13	25.00	15	28.85	34	36.17	24	25.53	36	38.30	20	37.04	15	27.78	19	35.19
ii. Kerosene water trap	13	25.00	35	67.31	4	7.69	29	30.85	55	58.51	10	10.64	18	33.33	28	51.85	8	14.81
iii. Food bait trap	0	0	19	36.54	33	63.46	0	0	30	31.91	64	68.09	0	0	11	20.37	43	79.63
iv. Uzi trap	33	63.46	16	30.77	3	5.77	54	57.45	29	30.85	11	11.70	34	62.96	14	25.93	6	11.11
v. Levigated China clay	8	15.38	12	23.08	32	61.54	9	9.574	27	28.72	58	61.70	0	0	14	25.93	40	74.07

Table 2 Knowledge level of silkworm rearers among different categories of farmers in management of the Uzi fly through chemical and biological methods and post spinning activities

Practice	Categories of farmers																	
	Small (n=52)						Medium (n=94)						Big (n=54)					
	Full		Partial		No		Full		Partial		No		Full		Partial		No	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
I. Chemical method																		
i. Use of uzicide	20	38.46	19	36.54	13	25.00	26	27.66	39	41.49	29	30.85	12	22.22	24	44.44	18	33.33
ii. Use of Uzi powder	19	36.54	26	50.00	7	13.46	26	27.66	45	47.87	23	24.47	16	29.63	29	53.70	9	16.67
iii. Use of bleaching powder solution	12	23.08	17	32.69	23	44.23	34	36.17	27	28.72	33	35.11	19	35.19	15	27.78	20	37.04
iv. Quantity of chemicals	27	51.92	23	44.23	2	3.85	46	48.94	39	41.49	9	9.57	29	53.70	17	31.48	8	14.81
II. Biological method																		
i. Release of Uzi parasitoid (*Nesolynx thymus*)	26	50.00	10	19.23	16	30.77	36	38.30	24	25.53	34	36.17	18	33.33	16	29.63	20	37.04
ii. Quantity of Uzi parasitoids release (1 Lakhs adults/100 DFLs)	22	42.31	9	17.31	21	40.38	33	35.11	21	22.34	40	42.55	15	27.78	12	22.22	27	50.00
III. Post-spinning activities																		
i. Destroying Uzi maggots/pupae	14	26.92	25	48.08	13	25.00	28	29.79	37	39.36	29	30.85	19	35.19	17	31.48	18	33.33
ii. Disposal of silkworm litter	52	100.0	0	0	0	0	94	100.0	0	0	0	0	54	100.0	0	0	0	0
iii. Disposal of Uzi infested cocoons	19	36.54	25	48.08	8	15.38	34	36.17	39	41.49	21	22.34	20	37.04	24	44.44	10	18.52

Chemical method

Knowledge level for management of the Uzi fly through chemical method did vary markedly among the three categories of farmers when they were classified based on the land holding. Large group of silkworm rearers are having full knowledge on quantity of chemicals (51%), partial knowledge on use of Uzicide (41%) and use of Uzi powder (50%) and no knowledge on use of bleaching powder solution (38%). The practices that stood next in the rank were use of Uzi powder (31%) and use of bleaching powder solution (33%) for full knowledge, quantity of chemicals (40%) for partial knowledge and use of Uzicide (30%) for no knowledge. On the other hand, the practices that were least in the order were use of Uzicide (29%) for full knowledge, use of bleaching powder solution (30%) for partial knowledge and use of Uzi powder (20%) and quantity of chemicals (10%) for no knowledge.

Biological method

Different categories of farmers exhibit variations in knowledge level with respect to practices pertaining to biological method of management of the Uzi fly. In respect of total category of farmers, large group of silkworm rearers possess full knowledge of on day Uzi parasitoids release of *Nesolynx thymus* (40%) and no knowledge on quantity of Uzi parasitoids release (1 Lakhs adults/100 DFLs) (44%) and the next best were both day of Uzi parasitoids release of *N. thymus* and on quantity of Uzi parasitoids release for full and no knowledge (35%). Notably, least number of silkworm rearers were found with partial knowledge for both day of Uzi parasitoids release of *N. thymus* (25%) and quantity of Uzi parasitoids release (21%).

Post-spinning activities

Considerable variations were observed among the three categories of farmers in post-spinning activities with respect to management of the Uzi fly. Interestingly, all the silkworm rearers (100%) possess full knowledge on disposal of silkworm litter and large group of silkworm rearers are having partial knowledge on destroying Uzi maggots/pupae (40%) and disposal of Uzi infested cocoons (44%). On the other hand, full knowledge (31% and 37%) and no knowledge (30% and 20%) for destroying Uzi maggots/pupae and disposal of Uzi infested cocoons were found next in the order.

Table 3 Knowledge levels of silkworm rearers in management of the uzi fly through exclusion and physical methods

Practice	Full		Partial		No	
	No.	%	No.	%	No.	%
I. Exclusion method						
i. Ante room	88	44	52	26	60	30
ii. Use of wire mesh for windows and doors	122	61	39	20	39	20
iii. Use of nylon net for partition	102	51	38	19	60	30
iv. Covering of rearing stand with nylon net	81	41	69	35	50	25
v. Individual tray cover with nylon net	78	39	122	61	0	0
vi. Provide doors with automatic closing mechanism	60	30	90	45	50	25
vii. Manual killing of Uzi fly	200	100	0	0	0	0
viii. Keep the leaf in the verandah of the rearing house and observe for the Uzi fly before shifting leaf into the rearing house	140	70	60	30	0	0
II. Physical method						
i. Light cum sticky trap	78	39	52	26	70	35
ii. Kerosene water trap	60	30	118	59	22	11
iii. Food bait trap	0	0	60	30	140	70
iv. Uzi trap	121	61	59	30	20	10
v. Levigated China clay	17	9	53	27	130	65

Table 4 Knowledge levels of silkworm rearers in management of the Uzi fly through chemical and biological methods and post spinning activities

Practice	Full		Partial		No	
	No.	%	No.	%	No.	%
I. Chemical method						
i. Use of uzicide	58	29	82	41	60	30
ii. Use of Uzi powder	61	31	100	50	39	20
iii. Use of bleaching powder solution	65	33	59	30	76	38
iv. Quantity of chemicals	102	51	79	40	19	10
II. Biological method						
i. Day of Uzi parasitoids release of *Nesolynx thymus*	80	40	50	25	70	35
ii. Quantity of uzi parasitoids release [1 Lakhs adults/100 DFLs]	70	35	42	21	88	44
III. Post-spinning activities						
i. Destroying Uzi maggots /pupae	61	31	79	40	60	30
ii. Disposal of silkworm litter	200	100	0	0	0	0
iii. Disposal of Uzi infested cocoons	73	37	88	44	39	20

According to Kumar *et al.* [9], dusting of levigated China clay on spinning silkworms (@ 3 g/100 larvae) and mountage (35g/chandrike with a size of 60cm x 75cm) reduced Uzi infestation considerably (2.80%) when compared to that in the control (69.30%). Dusting of chemicals namely bleaching powder (4%), lime powder, levigated China clay and Dithane M-45 (2%) on pre-spinning silkworms (without feeding of mulberry leaves) reduces the infestation of Uzifly to an extent of 17.66, 19.00, 11.66 and 13.00%, respectively against control (81.33%). Further, Manju [10] opined that almost all the farmers possessed partial knowledge about the management of Uzi fly. Most of the farmers aware of only nylon net enclosure during rearing to control the Uzi fly attack.

According to Krishnamurthy *et al.* [11], in the traditional area of Gowribidanur and Sidlaghatta taluks of Kolar district in Karnataka, 70% of the sericulture farmers had medium to high level of knowledge on recommended sericulture technologies. As per Thiagarajan [12] majority of the farmers in rainfed areas had poor knowledge on the technologies. Most of the farmers had partial knowledge on IPM of Uzi fly and the similar trend was observed in adoption of technologies.

The knowledge level of sericulture farmers in Malavalli and Srirangapatna taluks of Mandya district in Karnataka was high regarding high yielding mulberry varieties, shoot harvesting method and separate rearing house as the majority of the farmers gain knowledge about the improved technologies under Japanese International Cooperation Agency [13].

According to Goswami *et al.* [14], Uzi fly is a serious pest of silkworm causing a considerable damage to the cocoon crop during winter crops. Nearly, 35.45% of the respondents followed traditional methods for the control of Uzi fly infestation, while 58.18 % respondents do not take any control measures and 6.36 % respondents adopted biological control measures on trial basis. Bheemireddy and Anjana Reddy [15] opined that the knowledge levels of the sericultural farmers of Gudibanda Mandal, Anantapur district on all components and sub-components of IPM against Uzi fly infestation on commercial silkworm cocoon crop is 100%, except for the chemical component of IPM. The components of mechanical/physical, Uzitrap and biological control recorded 100% knowledge levels. Even the knowledge on all sub-components of mechanical/physical components *viz.*, anteroom, wire mesh and nylon net registered 100% level.

As per Hadimani *et al.* [16], very few of the respondents (9.0%) possessed knowledge about biological control of Uzi fly in Bidar district of north Karnataka. According to Raju [17], in

rainfed condition of Chamarajanagar district, the small, medium and big farmers had full knowledge on the control of Uzi fly (62.50, 72.53, and 76.19%, respectively). In irrigated condition, more number of the small farmers did not possess knowledge on control of Uzi fly (58.33%). Medium category of farmers had full knowledge (81.33%) and all the big farmers (100.0%) had full knowledge about control of Uzi fly.

According to Elumalai and Murugesh [18], 40% of the farmers had no knowledge with partial adoption of 74% in small farmer's category. In marginal farmers, 35% of farmers had full and no knowledge with 66% of partial adoption and large farmers possess 38% comes under no knowledge with partial adoption of 72% on IPM against Uzi fly. While, Sivaranjani and Murugesh [19] reported sericulture farmers in Krishnagiri district of Tamil Nadu revealed that all the farmers (n=90) adopted IPM for Uzi fly. Harishkumar *et al.* [20] sated that majority of the silkworm rearers (81.67%) knew about IPM, but only 35% of them adopted it fully. Surprisingly, even some who knew less (58.33%) still tried IPM, but there were still a few (6.67%) who didn't use it at all. Hence, knowing about IPM and adopting it makes a big difference in Uzi fly management.

CONCLUSION

The investigation inferred that, though majority of the silkworm rearers have good knowledge in some methods/practices for the management of Uzi fly, but few of the silkworm rearers possess partial knowledge and very few of them did not have knowledge on different practices. Hence, knowledge level of silkworm rearers in management of the Uzi fly can be enhanced through education and training to reduce the infestation caused to the silkworm cocoon crops.

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