



Impact Of Seasonal Variations On Silkworm Health: A Study On Diseases And Uzi Fly Infestation In Andhra Pradesh

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Abstract

A three-year survey (2021–2023) examined the prevalence of silkworm diseases—Grasserie, Flacherie, Muscardine—and the impact of Uzi fly, a significant silkworm pest, among 150 sericulture farmers in Chittoor and Anantapur districts of Andhra Pradesh. The findings indicated that Grasserie and Flacherie were most prevalent during the summer and least during the winter, while Muscardine was more common in winter and infrequent during the rainy season in both districts. Notably, cocoon production improved by 11.16 kg and 7.6 kg per 100 DFLs(disease-free laying's) ($FC1 \times FC2$) in batches reared in disinfected rearing houses using 2% bleaching powder and Ankush, a plant-based bed disinfectant, respectively. Additionally, the adoption of an integrated management package reduced Uzi fly infestation by 61.02%.

Key Words

Flacherie, Grasserie, Muscardine, Uzi fly, Bed disinfectants, Biocontrol agents

Introduction

In India, prior to the adoption of advanced silkworm rearing techniques, one in every three crops was affected by various diseases. However, the introduction of improved silkworm rearing methods, recommended practices for mulberry cultivation, and the use of specific disinfectants and chemicals for disease and pest management have led to a rise in cocoon production in recent years. Despite these advancements, silkworm crop losses due to diseases still account for approximately 15–20%. Commonly observed diseases include grasserie, flacherie, and muscardine, caused by pathogens such as the Borrelia virus, Streptococci, Staphylococci, and Beauveria bassiana, respectively. Among these, flacherie—caused by

viral and bacterial pathogens—remains the most prevalent, followed by grasserie (nuclear polyhedrosis) and muscardine.

In addition to diseases, the silkworm pest *Exorista bombycis* (Uzi fly) is a major endo-larval parasitoid of the mulberry silkworm (*Bombyx mori*), causing significant damage. The pest was inadvertently introduced in Karnataka in 1980 (Anonymous, 1980) and has since caused substantial losses to the sericulture industry. Current estimates indicate that crop losses due to Uzi fly range from 10–20% annually, with peak infestations occurring between August and October.

Continuous rearing of silkworms has led to the persistence of disease-causing microorganisms, resulting in on-going challenges for sericulturists. A recent survey in Chittoor district revealed a loss of 5–8 kg of cocoons per 100 disease-free layings (DFLs) due to silkworm diseases. Given the district's total production of 1.5 million DFLs, the annual loss in Andhra Pradesh is estimated at Rs. 0.5 crore (Kumareshan et al., 2003). Despite the significance of these losses, no comprehensive surveys on the prevalence of silkworm diseases and pests had been conducted until recently. To address this gap, a study was undertaken to assess the incidence of diseases such as grasserie, flacherie, and muscardine, as well as Uzi fly infestations across different seasons. Additionally, the study evaluated the effectiveness of disinfectants against silkworm diseases and explored integrated pest management strategies for controlling Uzi fly infestations at the farm level.

Materials and Methods

Disinfectant

Bleaching Powder: Bleaching powder (CaOCl_2) is widely used as a disinfectant and contains 30% chlorine (SBC-Chem. PVT Ltd., India). It is effective in eliminating pathogens responsible for flacherie, grasserie, and muscardine diseases. A 2% solution was prepared by dissolving 2 grams of bleaching powder in 100 ml of fresh water. Additionally, 0.3 grams of slaked lime (calcium hydroxide, Ca(OH)_2) was added to 100 ml of the solution to enhance its effectiveness.

Bed Disinfectant

Ankush: Produced by Seri-con Technologies (Bangalore, India), Ankush is a plant-based bed disinfectant designed to control the spread of silkworm diseases caused by secondary contamination. It was applied at a rate of 3 grams per square meter for young silkworms and 5 grams per square meter for late-stage silkworms. The disinfectant was dusted on silkworms 30 minutes before they resumed feeding after each moult.

Biocontrol Agent

Nesolynx thymus: An indigenous ecto-pupal parasitoid, *Nesolynx thymus* (from the Central Sericultural Research and Training Institute, Mysore, India), was released to target and kill Uzi pupae. Releases were made at sunset in the rearing house, near mountages where silkworms were spinning, and around manure pits containing leftover mulberry leaves and silkworm litter.

Uzi Trap

A chemo-trap developed by the Central Sericultural Research and Training Institute (Mysore, India) was used to attract and eliminate adult Uzi flies. A tablet was dissolved in 1 litre of water and placed in light-colored trays (10 inches in diameter or 10 inches by 8 inches). These trays were positioned near windows both inside and outside the rearing house. The solution was refreshed as needed during the silkworm's third instar until the spinning stage. Each packet, containing 12 tablets, was sufficient for 100 disease-free layings (DFLs).

Seasonal Survey

Surveys were conducted over three years (2021–2023) in five villages in the Palamaner area of Chittoor district and five villages in the Penukonda area of Anantapur district. The study aimed to assess (1) seasonal disease incidence and (2) the relationship between environmental conditions and disease outbreaks. A total of 150 sericulture farmers (75 from each area) were selected. Morphological and microscopic examinations of silkworm larvae were performed during the V instar (third to fifth day) on 10% of randomly selected rearing trays. Disease incidence was calculated based on an assumption of 40,000 larvae per 100 DFLs. additionally, 1,000 V instar larvae were examined for Uzi fly scars across all trays.

Experimental Treatments

Two sets of experiments were conducted to evaluate disease and pest control measures:

1. Experiment 1 (Disease Control):

T0 (Control): Partial disinfection.

T1: Application of 2% bleaching powder with 0.3% slaked lime solution and Ankush.

2. Experiment 2 (Uzi Fly Control):

T0: No nylon net (control).

T1: Nylon net only.

T2: Nylon net with Uzi trap.

T3: Nylon net, Uzi trap, and release of *Nesolynx thymus* (8,000 parasitoids during the IV instar, 16,000 during the V instar, and 76,000 post-harvest).

Data from both experiments were statistically analysed to interpret the results.

Results and Discussion

Seasonal Incidence of Silkworm Diseases and Pests

The occurrence of silkworm diseases such as flacherie, grasserie, and muscardine was studied in the Palamaner and Penukonda areas over multiple years. During the summer of 2021-22, the prevalence of flacherie ranged between 8.0-10.0%, grasserie between 7.0-10.5%, and muscardine between 1.5-3.5%. However, during the winter of the same period, muscardine was significantly higher, reaching 20.0-23.0%. In 2022-23, flacherie dropped to 6.8-8.9%, grasserie to 4.5-8.0%, and muscardine remained between 2.0-3.7% in summer, while winter muscardine rates were between 14.0-17.0%.

The findings emphasized the higher susceptibility of silkworms to muscardine in winter, with the disease being attributed to the ease of pathogen dispersal through wind, mechanical disturbance, and contact with infected hosts. White muscardine, in particular, was noted for its rapid spread and severe impact compared to other diseases. On the other hand, flacherie and grasserie were more common in summer, likely due to fluctuating temperatures and humidity, which create favorable conditions for these infections. Poor hygiene practices, excessive rearing density, and reuse of contaminated rearing equipment further contributed to the increased incidence of grasserie in Penukonda.

Table 1: Incidence (%) of silkworm diseases and pest in the district of Anantapur and Chittoor, Andhra Pradesh

Year	Area	Rainy season				Winter season				Summer season			
		Flacherie	Grasserie	Muscardine	Uzi fly	Flacherie	Grasserie	Muscardine	Uzi fly	Flacherie	Grasserie	Muscardine	Uzi fly
2021	Palamaner	8.0-10.0	7.0-9.0	1.5-3.2	12.0-15.0	3.0-5.0	6.0-8.0	20.-23.0	10.0-13.0	8.0-10.0	7.0-10.5	--	1.0-3.0
	Penukonda	5.8-7.3	6.0-8.0	--	13.0-16.0	3.0-6.0	5.0-7.6	14.0-16.5	11.0-15.0	12.0-15.0	10.0-14.0		1.0-2.0
2022	Palamaner	6.5-8.3	4.8-6.2	2.0-3.7	10.0-12.0	2.0-3.5	3.5-5.0	14.0-17.0	7.0-10.0	6.8-8.9	5.0-8.5	--	0.5-2.5
	Penukonda	6.3-8.9	5.6-6.9	--	5.6-6.9	5.0-6.5	4.0-7.0	11.0-13.0	9.2-13.0	9.0-12.0	9.0-11.3	--	1.5-3.0
2023-2024 (jan-feb)	Palamaner	3.5-8.9	4.0-6.0	1.0-2.0	7.5-9.0	1.0-2.0	2.5-4.6	9.0-13.0	5.0-9.0	5.0-7.5	4.5-8.0	--	1.0-2.5
	Penukonda	4.0-6.3	4.5-7.8	--	10.0-14.5	3.2-5.6	2.5-4.8	6.0-9.0	7.0-12.5	7.0-10.0	7.0-10.4	--	0.5-1.6

Disease Management Using Disinfectants

Field trials conducted with farmers demonstrated the effectiveness of disinfectants in controlling silkworm diseases. Using a solution of 2% bleaching powder with 0.3% slaked lime, along with Ankush bed disinfectant, significantly improved cocoon yields. In Palamaner, yields increased by 11.16 kg per 100 disease-free layings (dfls), while Penukonda saw an improvement of 7.60 kg per 100 dfls. Cocoon yields in disinfected rearing houses ranged from 56.00 $\pm$ 2.57 kg to 65.00 $\pm$ 3.78 kg in Penukonda and 65.70 $\pm$ 3.01 kg to 70.90 $\pm$ 6.89 kg in Palamaner, showing a marked increase over the control groups. The yield improvement percentages were 12.00-17.64% in Penukonda and 15.26-26.79% in Palamaner.

The effectiveness of disinfection was more pronounced in Palamaner, likely due to better hygiene and reduced chances of secondary contamination compared to Penukonda, where the tray rearing system was more common. These results underscore the importance of maintaining cleanliness and employing effective disinfectants to suppress silkworm diseases and improve cocoon productivity.

Table-2: Schedule and quantity of application of Ankush for 100 dfls of FC1×FC2 race silkworm

Sl.no	Dusting period/Instar	g/sq. ft. bed area	Tray rearing quantity(g)	Shoot rearing quantity(g)
1	While resuming from 1 st moult	3	50	50
2	While resuming from 2 nd moult	3	150	150
3	While resuming from 3 rd moult	5	600	900
4	While resuming from 4 th moult	5	1200	1900
5	On the 4 th day of 5 th instar	5	2000	3000
	Total quantity used		4000	6000

*Dusting 30 min before feeding and ** Dusting after bed cleaning

Integrated Approach for Controlling Uzi Fly

The incidence of Uzi fly infestation was monitored across three sericulture villages over the period of 2021 - 2023. The data, also shown in Table 1, indicated that the highest infestation occurred during the rainy season (13–16%), followed by winter (11–15%) and summer (1.0–3.0%) in 2021–2023. Over the following years, the incidence of Uzi fly gradually decreased as control measures were implemented.

The increased Uzi fly infestations during the rainy season can be attributed to the favourable climatic conditions, such as higher temperature, humidity, and rainfall. Additionally, a scarcity of natural alternative hosts for the fly may have contributed to its increased prevalence during this period, as many kharif crops were harvested by the time Uzi flies reached peak activity.

By adopting integrated pest management strategies, the severity of Uzi fly infestations can be significantly reduced, as demonstrated by the gradual decrease in its incidence across the surveyed years.

The Uzi fly infestation was more prevalent in the Penukonda area than in Palamaner during 2021–2022. This was likely due to the continuous rearing of silkworms in the area, which provided a constant host for the Uzi flies. Since Uzi flies are limited to a 2 km range, they tended to remain within the villages where silkworms were consistently available. This continuous availability of hosts contributed to the higher infestation levels. Thite et al. (2003)

Table 3: Effect of disinfection and Ankush on the performance of FC1×FC2 silkworm crops at farmers level in penukonda and Palamaner area (Average of 2 crops/rainy and winter season)

village	Number of farmers Covered	Number of dfl's reared	Yield/100 dfl's (kg)		Improvement (kg)	Improvement (%)
			T0	T1		
Penukonda area						
Ragimakulapalli	5+5	6400	53.00 ±4.80	60.50 ±4.63a	7.50 ±0.98	14.15
Kanchisamudram	5+5	7000	50.00 ±3.70	56.00 ±2.57	6.00 ±0.56	12.00
Beedanapalli	5+5	6000	49.00 ±2.90	57.50 ±5.64a	8.50 ±0.72b	17.34
Kogiri	5+5	5400	56.00 ±3.95	65.00 ±3.78a	9.00 ±1.08b	17.64
Patharlapalli	5+5	5200	51.00 ±2.98	58.00 ±4.21a	7.00 ±0.82b	13.72
Total/Average	25+25	30000	51.80 ±3.05	59.40 ±4.59a	7.60 ±0.69b	14.67
Palamaner area						
Nakkapalli	5+5	4000	57.000 ±1.45	65.70 ±3.01a	8.700 ±1.76b	15.26
Ranganayakam Palli	5+5	4600	60.00 ±2.56	70.00 ±5.36a	10.00 ±2.10b	16.60
Morum	5+5	4200	56.00 ±3.37	69.00 ±3.96a	13.00 ±2.70b	23.21
RamPuram	5+5	3200	53.00 ±2.78	67.20 ±3.36a	14.20 ±3.24b	26.79
Musalimadugu	5+5	5200	61.40 ±4.68	70.90 ±6.89a	9.90 ±0.98b	16.20
Total/Average	25+25	21200	57.40 ±2.68	68.56 ±3.68a	11.16 ±1.67b	19.40

Each value is mean± SE of 5 individual farmers. Significant differences with in rows are indicated in different superscripts from control (P < 0.05)

also noted that Uzi fly infestations were lower between November and February, but increased with rising temperatures, humidity, and rainfall, peaking from June to August. This pattern was consistent with the findings of Sathe and Jadhav (2001).

In the field trials conducted at the farmer level, an Integrated Pest Management (IPM) package was used to control Uzi fly infestation. The combination of a nylon net, Uzi trap, and the biological agent *Nesolynx thymus* (Treatment 3) demonstrated the highest effectiveness in suppressing Uzi fly populations across three villages, with reductions of 54.46%, 61.02%, and 58.72%, respectively. This result indicates that integrating a biological control agent with other physical measures in the IPM package proved to be highly effective in controlling Uzi fly infestation.

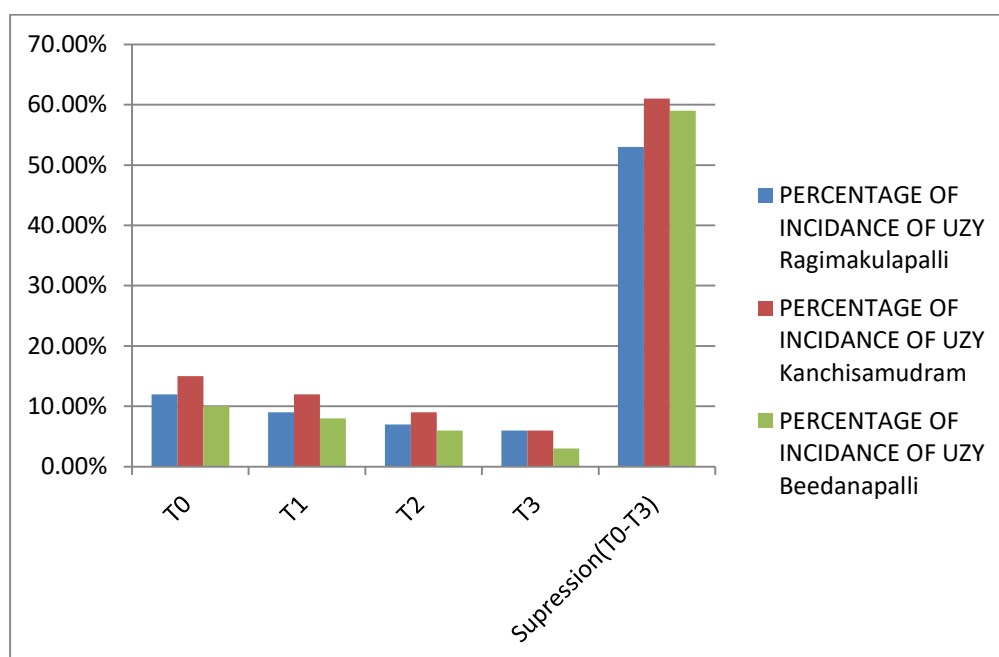


Fig. 1. Impact of integrated packages on the incidence of uzi fly at farmers level. T0 = without nylon net, T1 = with nylon net only, T2 = nylon net and uzi trap and T3 = nylon net, uzi trap and 1.0 lakh of *nysolynx thymus*, a biocontrol agent and T0-T3 is the suppression of Uzi incidence in 3 villages.

Overall, the study concluded that effective control of silkworm diseases and Uzi fly infestations can be achieved through proper disinfection of rearing houses using a 2.0% bleaching powder solution with 0.3% slaked lime, the recommended application of Ankush (a plant-based disinfectant), and the use of the IPM package for Uzi fly management. These measures not only reduce disease and pest damage but also enhance cocoon production, improving the economic outcomes for sericulturists.

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