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The Silent Room: Why Silkworms Need Peace and Quiet

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Silkworms (*Bombyx mori*), the cornerstone of sericulture, are sensitive not only to temperature and humidity but also to auditory stimuli. Although extensively studied for their dietary, climatic and genetic needs, the impact of noise on silkworm development remains under-discussed. Recent experimental and observational studies reveal that high-intensity sounds and vibrations during rearing significantly disrupt larval physiology, feeding behaviour and cocoon spinning. Exposure to loud or sudden noises causes stress, reduced metabolic efficiency and even mortality, ultimately compromising cocoon quality and Sericultural profitability. This article explores the biology behind silkworms' auditory sensitivity, experimental findings on noise pollution effects, practical implications for commercial silk farms and future considerations for acoustic biosecurity in sericulture. We highlight the importance of “rearing silence” as an overlooked but vital factor in sustainable silk production.

Keywords: Silkworm, *Bombyx mori*, noise pollution, acoustic stress, cocoon quality, vibration, sericulture management, insect neurophysiology, environmental stressors and silent rearing

Introduction

Sericulture, the ancient practice of rearing silkworms for silk production, has traditionally focused on maintaining optimal temperature, humidity, leaf quality and also sanitation. However, there is growing recognition that auditory and vibrational stimuli, particularly noise, are critical environmental stressors affecting silkworm behaviour and productivity. While silkworms lack conventional auditory organs like those in vertebrates, they possess mechanoreceptors that detect vibrations and low-frequency sound waves. These stimuli, when intense or irregular, can trigger physiological stress, inhibit feeding, disturb spinning, or lead to mortality (Nagaraju, 2002). This makes silkworms particularly vulnerable to industrial, agricultural, or household noise near rearing facilities. In this article, we examine the biological basis of silkworm sensitivity to noise, summarize existing experimental findings, present case studies and discuss practical strategies to minimize acoustic stress in sericulture. We argue that maintaining acoustic stability is not merely an add-on practice but a crucial environmental control for successful cocoon production.

1. Silkworm Sensory Biology and Vibration Detection

Although silkworms lack true ears, they sense mechanical vibrations and low-frequency sound *via*: Sensory hairs (setae) on the cuticle and thorax, Campaniform sensilla on the legs and Chordotonal organs in the antennae and abdomen, these structures help silkworms to detect, Predator movement, Leaf substrate vibrations and Environmental disturbances. The threshold for acoustic response is generally <1000 Hz. Sounds above this level, especially sudden or continuous noises, are perceived as threats, activating stress responses.

2. Experimental Evidence of Noise-Induced Stress in Silkworms

Several scientific studies have shown the detrimental effects of noise on silkworm physiology:

2.1 Larval Behaviour and Feeding Suppression

Kumar *et al.* (2009) exposed 5th instar larvae to 90 dB industrial noise for 6 hours/day.

Result: 17% reduction in feeding activity.

Behavioral signs: Curling, twitching and movement to darker areas.

2.2 Developmental Retardation

✓ Noise-exposed groups showed delayed pupation by 1-2 days.

✓ Reduced larval weight and decreased silk gland size were observed.

2.3 Cocoon and Silk Quality Degradation

High-noise environments yielded cocoons with:

❖ Lower shell ratio

❖ Coarse filament structure

❖ Reduced silk yield (by approximately 15%)

2.4 Mortality and Lethal Acoustic Threshold

Continuous noise above 95 dB caused mortality in early-instar larvae.

Acoustic vibrations above 100 dB disrupted molting cycles and neural coordination (Selvakumar *et al.*, 2017).

3. Physiological Basis of Acoustic Stress

How does sound cause such drastic effects in silkworms?

3.1 Activation of Stress Pathways

Noise triggers the release of octopamine, the insect analog of adrenaline.

This results in:

❖ Increased metabolic rate

❖ Muscle tremors

❖ Disrupted feeding patterns

3.2 Hormonal Imbalance

Continuous stress affects the levels of ecdysone and juvenile hormone (JH), key regulators of molting and silk synthesis (Nagaraju, 2002).

3.3 Neural Fatigue and Hypersensitivity

1. Prolonged exposure to noise may lead to overstimulation of sensory neurons, causing fatigue or malfunction in motor control.
2. The central nervous system becomes unresponsive, explaining cocoon-spinning disruption.

4. Sources of Noise Pollution in Sericulture Regions

Common noise sources affecting silkworm rearing include:

- **Agricultural machinery:** Tractors, tillers, harvesters
- **Domestic appliances:** Radios, mixers, TVs near rearing rooms
- **Urban encroachment:** Traffic, construction near village sericulture centres
- **Rearing equipment:** Poorly maintained incubators, fans, or humidifiers

Some studies in Karnataka and Tamil Nadu (India) reported cocoon losses of up to 22% in farms near highways or industrial zones (Rao *et al.*, 2019).

5. Best Practices for Acoustic Management in Silkworm Rearing

To maintain acoustic peace, sericulturists are advised to:

5.1 Construct “Silent Rooms”

- ❖ Use sound-insulated walls, mud plastering, or straw-based acoustic buffers.
- ❖ Avoid placing rearing houses near roads, mills, or schools.

5.2 Machinery and Appliance Control

- ❖ Use low-noise fans and humidifiers.
- ❖ Schedule loud chores (grinding, repairs) outside rearing times.

5.3 Rearing Staff Training:

Educate workers on maintaining silence, especially during the 4th and 5th instars, when spinning begins.

5.4 Acoustic Monitoring

- Use smartphone apps or dB meters to monitor ambient sound.
- Maintain <60 dB inside rearing houses.

5.5 Timed Disturbance Avoidance

Restrict foot traffic or discussions during molting and spinning phases.

6. Critical Stages Sensitive to Noise

Certain developmental windows are extremely sensitive to auditory disturbance:

- **Fourth Instar Onset:** Silk gland development peaks; stress reduces protein synthesis.
- **Spinning Period (5th instar end):** Noise interrupts spinning behaviour, resulting in malformed or thin cocoons.
- **Molting Phases:** Disruption may cause incomplete shedding or larval death.

Therefore, strict noise control during these phases can ensure better survival and yield.

7. Impact on Cocoon Quality and Commercial Losses

Cocoon quality is affected in several ways:

- ✓ **Lower Shell Ratio:** Stress affects sericin secretion, reducing protective shell thickness.
- ✓ **Shorter Filament Length:** Disrupted spinning results in broken, less continuous threads.
- ✓ **Colour and Uniformity Changes:** Noise-induced tremors cause irregular cocoon construction.

Economic modelling by Suresh *et al.* (2021) found that a 10 dB increase above baseline (60 dB) could result in 5-8% loss in silk yield per batch.

8. Climate Change and Acoustic Stress Synergy

Climate change not only increases temperature and humidity variability but also intensifies rural noise levels due to:

- ✓ Increased mechanization
- ✓ Migration of rural populations into peri-urban areas
- ✓ Higher energy usage (generators, fans)
- ✓ Combined environmental and acoustic stressors may synergistically affect silkworm health, making holistic rearing control necessary.

9. Policy and Extension Recommendations

9.1 Government Guidelines

- ✓ Incorporate noise thresholds in sericulture manuals.
- ✓ Provide subsidies for soundproof construction materials.

9.2 Research Gaps

Further studies needed on:

1. Specific frequency and duration thresholds for different silkworm breeds
2. Long-term epigenetic or transgenerational effects of noise

9.3 Capacity Building

Extension programs should emphasize acoustic discipline along with temperature and feeding control.

Conclusion

Silkworm rearing is an intricate art-science that requires precise environmental management. While temperature, humidity and nutrition are well-documented factors, noise remains an under-recognized stressor with serious consequences. Scientific evidence confirms that acoustic disturbances can compromise silkworm physiology, cocoon quality and survival. As sericulture modernizes, especially in rural and peri-urban zones, acoustic biosecurity must be prioritized. Promoting quiet zones, sound-insulated infrastructure and awareness among rearers will enhance productivity and animal welfare in silk farming. The silent room, once a

traditional practice, is emerging as a scientifically validated necessity for the future of sustainable sericulture.

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