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Challenges Faced During Tasar Cocoon Grainage Under RCC Conditions

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Tasar silkworm rearing is an important component of -non-mulberry sericulture in India, particularly in Odisha, Jharkhand, Chhattisgarh and other traditional tasar-growing regions. Successful silk production depends not only on larval rearing and cocoon production but also on efficient grainage management, which ensures healthy seed cocoons, successful moth emergence, mating, oviposition and viable eggs for the next generation. Grainage in reinforced cement concrete (RCC) structures may face challenges associated with temperature fluctuations, relative humidity, ventilation, heat accumulation and uneven indoor conditions. These factors may influence cocoon preservation, pupal development, adult emergence, moth survival, mating, egg laying and hatchability. This article reviews the main challenges and practical management measures, and highlights the value of systematic environmental and biological monitoring.

Keywords: Tasar silkworm, Antheraea mylitta, Daba Trivoltine, RCC grainage, temperature, relative humidity, moth emergence, oviposition, fecundity, egg hatchability.

Introduction

Tasar sericulture is an important forest-based livelihood activity in India. The tropical tasar silkworm, Antheraea mylitta Drury, produces naturally textured tasar silk and supports the income of tribal and rural communities. Daba Trivoltine is one of the commercially important tasar silkworm eco-races, and its seed production requires careful management of cocoons and reproductive moths. Grainage is a critical stage in the tasar silkworm production cycle. It includes the handling and preservation of seed cocoons, moth emergence, sex identification, mating, oviposition, egg collection and maintenance of suitable conditions for seed production. Disturbances during these operations can reduce the number of usable eggs available for subsequent rearing. RCC buildings provide durability and protection from rain and wind, and can offer a workable grainage space. However, an RCC structure does not automatically provide a suitable microclimate. Concrete roofs and walls can absorb and store heat during the day and release it later. Depending on roof exposure, ventilation, building design, surrounding vegetation and weather, indoor temperature and relative humidity may differ from outdoor conditions. Understanding these differences is important for improving seed quality and reducing avoidable losses.



Fig: Tasar Moth emergence at PPC mangalpur, Dhenkanal

Major Challenges Faced During Grainage Under RCC Conditions

Temperature fluctuations and heat accumulation

Temperature is an important environmental factor affecting insect development and reproductive activity. Exposed RCC roofs may absorb solar heat, while poor ventilation and inadequate shading can increase indoor heat accumulation. The room may remain warm even after the outdoor temperature begins to decline. Such conditions can cause daytime heating, delayed evening cooling, uneven temperature distribution and possible heat stress during pupal development or adult activity. The effect depends on the intensity and duration of exposure and the developmental stage.

Management: Record temperature at representative points; provide suitable roof shading or insulation; improve cross-ventilation; and avoid placing cocoon trays in areas exposed to concentrated heat.

Relative humidity variation

Relative humidity (RH) affects the moisture conditions surrounding developing pupae, adult moths and eggs. In RCC rooms, RH can vary with outdoor weather, air exchange, room temperature, leakage and moisture retained by building materials. RH may fall as temperature rises even when the actual moisture content of the air changes little. Low humidity may contribute to excessive moisture loss, while persistent dampness may favour fungal growth. Both extremes can create problems depending on exposure and stage.

Management: Monitor RH with temperature, prevent roof leakage and water accumulation, maintain appropriate ventilation, and follow validated grainage guidance for the specific tasar stock and stage.

Mortality of female and male moths

Adult moth survival determines how many potential mating pairs are available. Female and male moths may respond differently to environmental stress, but it should not be assumed that one sex always experiences greater mortality without supporting data. Potential causes include unsuitable temperature or humidity, poor ventilation, handling injury, weak pupal development, infection and differences in emergence timing. Female mortality directly reduces the number of egg-laying moths; male mortality can reduce mating opportunities.

Management: Record male and female emergence separately and monitor deaths before mating, during mating and during oviposition. Define the observation period and denominator consistently when calculating mortality.

Irregular moth emergence

Successful grainage requires the emergence of healthy adult moths from selected seed cocoons. Emergence timing may be affected by environmental conditions, cocoon maturity, pupal health, storage and genetic variability. Uneven room conditions may contribute to variation in emergence timing, creating mismatches between male and female availability, additional labour for inspection and reduced utilization of available cocoons. Delayed emergence should be distinguished from failure to emerge.

Management: Maintain daily emergence records, separate delayed and non-emerged cocoons in the records, and organize mating according to adult availability and established practices.

Mating and fertilization difficulties

Successful mating is essential for producing fertilized eggs. Performance depends on adult maturity, availability of both sexes, environmental conditions, handling and timing. Poor mating may be associated with an imbalance in sex ratio, differences in emergence time, handling stress, low adult vitality or inappropriate pairing arrangements. A female may lay eggs even if some or all are unfertilized, so egg number alone is not a sufficient measure of mating success.

Management: Maintain suitable mating groups, record mating success and distinguish egg production from fertilization and hatchability.

Reduced fecundity and egg-laying performance

Fecundity is the number of eggs produced by a female during her reproductive life. Environmental stress may affect egg production indirectly through adult survival, physiological condition, mating success and the duration of oviposition. Possible observations include differences in eggs laid per female, delayed oviposition, shorter egg-laying periods or females laying few or no eggs. These are possible outcomes to investigate, not inevitable consequences of RCC construction.

Management: Record total eggs laid per female, fertilized eggs per female where measurable, and hatchable eggs per female as separate indicators.

Egg viability and hatchability

Egg hatchability indicates the proportion of eggs that successfully produce larvae. Egg development can be affected by female condition, fertilization, egg handling, temperature, humidity and exposure duration. Poor hatchability can reduce larval availability even when the number of eggs laid appears satisfactory. Egg batches should therefore be evaluated for both quantity and quality.

Management: Handle eggs carefully, maintain suitable egg-preservation conditions, label batches by laying date and record the number of eggs hatched from a known total.

Ventilation and air circulation

Rooms with limited openings or blocked air passages may experience insufficient air exchange, heat accumulation and uneven humidity. Ventilation should be balanced: excessive direct airflow can cause rapid moisture loss, while uncontrolled openings can admit dust, rain, predators and other disturbances.

Management: Provide appropriately positioned ventilation openings, maintain cross-ventilation where feasible, avoid direct hot-air flow onto trays, and use suitable screens to limit pest entry.

Sanitation, fungal growth and pests

Persistently damp areas, contaminated trays, accumulated organic matter and stagnant air may create conditions favourable to some microorganisms and pests. Potential problems include fungal contamination, physical damage, contaminated equipment and additional sorting requirements. RCC walls and floors do not by themselves guarantee a hygienic grainage environment.

Management: Clean and dry equipment, inspect cocoons and work areas regularly, remove contaminated material appropriately and investigate unusual mortality or fungal growth.

Uneven microclimate within the building

A single thermometer and hygrometer may not represent the conditions throughout a grainage building. Upper areas may accumulate more heat, while shaded corners or areas near openings may have different temperature and humidity. These differences can affect interpretation of biological results if all cocoons are assumed to have experienced identical conditions.

Management: Monitor representative locations and, where practical, different heights. Link environmental readings to the positions of cocoon trays and the developmental stage.



Fig: Tasar Grainage at PPC mangalpur,Dhenkanal

Summary of Major Challenges and Possible Effects

Factor	Possible effect	Suggested management
Excessive temperature	Heat stress; altered emergence or adult performance	Roof shading, insulation and temperature monitoring
Unsuitable relative humidity	Moisture imbalance; possible effects on survival or egg quality	RH monitoring and appropriate moisture management
Poor ventilation	Heat accumulation and uneven room conditions	Cross-ventilation and suitable air exchange
Irregular emergence	Difficulty synchronizing mating	Daily emergence records and timely pairing
Adult moth mortality	Fewer available mating pairs	Sex-wise mortality records and careful handling
Poor mating success	More unmated females and fewer fertilized eggs	Balanced mating groups and mating observations
Reduced fecundity	Fewer eggs per female	Monitor female condition and oviposition
Low hatchability	Fewer larvae available for rearing	Careful egg handling and hatchability assessment
Poor sanitation	Increased risk of contamination and biological losses	Routine cleaning and inspection
Uneven microclimate	Differences in performance by room location	Multiple monitoring points

How RCC Conditions May Influence Overall Grainage Performance

Grainage performance should be evaluated as a sequence of connected biological processes. The indoor microclimate—temperature, relative humidity, ventilation and spatial variation—may influence cocoon and pupal condition, emergence timing, adult survival, mating and reproductive performance. These factors then affect egg production, fertilization, hatchability and ultimately the availability of viable larvae for subsequent rearing. If hatchability declines during a period of elevated temperature, the observation may indicate an association, but it does not establish causation. Female age, mating success, egg storage, cocoon batch and other conditions should also be considered. Monitoring should therefore link environmental records with biological observations.

Monitoring and Evaluation

Environmental observations

Record temperature and relative humidity at consistent, predetermined intervals. A practical schedule is four observations per day: morning, afternoon, evening and late evening. Each record should include date, observation time, indoor temperature (°C), indoor RH (%), outdoor readings where available, monitoring location, weather conditions and relevant operational notes.

Biological observations and calculations

S. NO.	PARAMETER	CALCULATION
1	Cocoon emergence (%)	Emerged moths ÷ total cocoons observed × 100
2	Non-emergence (%)	Cocoons without emergence ÷ total cocoons observed × 100
3	Male mortality (%)	Dead male moths ÷ male moths emerged × 100
4	Female mortality (%)	Dead female moths ÷ female moths emerged × 100
5	Mating success (%)	Successfully mated females ÷ females available for mating × 100
6	Mean fecundity	Total eggs laid ÷ number of females included
7	Egg hatchability (%)	Eggs hatched ÷ total eggs assessed × 100

Analysis of environmental relationships

After adequate observations have been collected, compare daily or batch-wise environmental records with biological performance. Useful analyses include mean, minimum and maximum

temperature and RH; indoor–outdoor differences; male and female mortality; eggs laid per female; hatchability by observation period; and correlation between environmental variables and reproductive outcomes. Because temperature and RH are interrelated, other factors should also be considered. A comparable reference grainage unit or building type would strengthen conclusions.

Factors for Improving Grainage Efficiency

- **Improve roof and wall thermal management.** Use suitable shading or insulation to moderate indoor temperature fluctuations.
- **Establish regular monitoring.** Use reliable instruments at representative points near cocoon and moth-handling areas.
- **Improve ventilation.** Provide appropriate air exchange without exposing biological materials to excessive direct airflow.
- **Follow validated grainage recommendations.** Use relevant technical guidance for the specific tasar stock and developmental stage rather than assuming a universal environmental range.
- **Handle cocoons and moths carefully.** Avoid unnecessary movement, overcrowding and physical injury.
- **Synchronize mating operations.** Maintain daily emergence records and organize mating groups according to adult availability and established practices.
- **Maintain sanitation.** Clean equipment and work areas, remove contaminated material and investigate unusual mortality.
- **Assess egg quality as well as quantity.** Include fertilization and hatchability measurements when evaluating performance.
- **Review performance periodically.** Compare environmental records and biological outcomes across dates, batches and locations.
- **Evaluate improvements with evidence.** Compare outcomes under consistent observation methods and, where possible, comparable batches.

Area Priorities and Scope for Further Study

A systematic study of Daba Trivoltine Tasar grainage under RCC conditions can address the following questions:

How do indoor temperature and relative humidity vary throughout the day?

Are indoor conditions associated with cocoon emergence and adult mortality?

Do male and female moths show different survival patterns under the observed conditions?

Are temperature or RH variations associated with mating success and egg production?

Does hatchability differ between batches exposed to different environmental conditions?

Which building-management practices are associated with improved grainage performance?

Conclusion

Tasar cocoon grainage is a crucial stage in maintaining the continuity and productivity of tasar sericulture. Under RCC conditions, important challenges to investigate include temperature fluctuations, relative humidity variation, insufficient ventilation, uneven microclimatic conditions, irregular moth emergence, adult mortality, mating difficulties, reduced egg production and variation in hatchability. These challenges are not necessarily inherent to RCC buildings; their severity depends on building design, local weather, management practices, cocoon and moth condition, and duration of environmental exposure. A well-managed RCC grainage unit can provide a durable and hygienic working environment when supported by appropriate microclimate management. The most effective approach combines environmental monitoring with systematic recording of cocoon emergence, sex-specific mortality, mating success, fecundity and egg hatchability. Improving grainage efficiency requires understanding how environmental conditions, biological processes and operational practices interact to determine the quantity and quality of viable tasar seed.

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4. Research publications on the biology and reproductive performance of Daba Trivoltine Tasar silkworm.