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Influence of Temperature and Humidity on the Growth of Mulberry Silkworm (*Bombyx mori* L.)

*M. Parasuramudu
Post Graduate, Department of Sericulture, Sri Krishna Devaraya University, Anantapur-515003, Andhra Pradesh, India
*Corresponding Author's email: parasuram723b@gmail.com

The silkworm (*Bombyx mori* L.) is a commercially significant insect known for its role in producing silk-one of the finest natural fibers. Sericulture, or silk farming, is a meticulous process that focuses on cultivating silkworms for silk extraction. The success of this practice is greatly influenced by environmental variables, with temperature and humidity being among the most crucial. A thorough understanding of how these environmental factors influences silkworm physiology, development, and silk yield is essential to optimizing rearing conditions and improving production quality. Temperature and humidity affect every stage of the silkworm's lifecycle, including egg incubation, larval growth, cocoon spinning, and fiber quality. Deviations from the ideal range can result in developmental delays, increased vulnerability to disease, and lower silk output. This paper highlights the importance of managing temperature and humidity in sericulture, discusses their effects on various life stages of silkworms, and outlines best practices for maximizing productivity and silk quality.

Impact of Temperature Extremes on Silkworm Development

Maintaining an ideal temperature range is vital for silkworm health and silk production. Temperature fluctuations—either too high or too low—can disrupt biological functions, causing issues such as slowed growth, compromised cocoon quality, and higher mortality rates.

Low Temperatures: When silkworms are subjected to temperatures below 20°C for extended periods, their metabolic processes slow down, leading to delayed growth and reduced food intake. This results in smaller larvae and inferior cocoon size. Cold conditions may also interfere with the moulting process, causing irregularities or incomplete shedding. Moreover, low temperatures during the pupal stage can delay transformation and the emergence of adult moths.

High Temperatures: Exposure to temperatures above 30°C can induce heat stress in silkworms, resulting in accelerated breathing, dehydration, and reduced feeding efficiency. Warmer environments are also more conducive to the spread of diseases like bacterial and viral infections. These conditions can lead to irregular feeding, slower development, decreased silk production, and, in severe cases, larval or pupal mortality—posing significant economic losses for sericulturists.

Temperature Management in Rearing Units

Effective temperature control is essential for ensuring healthy silkworm growth and consistent silk yield. Farmers involved in sericulture must implement strategies to regulate temperatures across different growth stages. Key measures include:

1. Climate-Controlled Rearing Facilities: Specialized rearing houses equipped with heating and cooling mechanisms provide a stable indoor environment, independent of external climate variations.

2. Adequate Ventilation and Insulation: Good airflow prevents overheating, while insulation helps maintain thermal stability during both hot and cold seasons.
3. Use of Heating and Cooling Devices: In conventional systems, heaters can be used to warm the space during winter, while fans or coolers help to alleviate heat during summer.
4. Continuous Temperature Monitoring: Installing thermometers or digital temperature sensors helps track fluctuations and enables timely corrective actions to avoid stress on the silkworms.

Effect of Humidity Variations on Silkworm Growth

Just like temperature, humidity levels also play a significant role in silkworm development. Deviations from the optimum humidity range can influence feeding, moulting, cocoon formation, and increase disease susceptibility.
Low Humidity: Insufficient moisture in the air can lead to dehydration in larvae, causing a reduction in food consumption and stunted growth. It may also disrupt moulting, making it difficult for larvae to shed their skin. In later stages, inadequate humidity can make silk fibers brittle, leading to poor cocoon formation and lower silk recovery.
High Humidity: Excessive humidity creates a favourable environment for microbial growth. Fungal and bacterial infections thrive under such conditions, threatening the health of the silkworms. Damp rearing environments can also compromise cocoon integrity, resulting in diminished silk quality. In extreme cases, high humidity can suffocate larvae and pupae due to reduced air exchange.

Humidity Control Practices in Sericulture

Proper humidity regulation is fundamental to promoting healthy larval development and maximizing silk yield. The following techniques are recommended:
1. Humidity-Regulated Rearing Units: Modern rearing houses fitted with humidifiers and dehumidifiers offer precise control over moisture levels, regardless of seasonal changes.
2. Enhanced Ventilation and Airflow: Ensuring good ventilation helps eliminate excess moisture. Fans improve air movement, reduce fungal risks, and maintain an optimal microclimate.
3. Monitoring Devices: Hygrometers and digital sensors help track ambient humidity levels, allowing farmers to respond swiftly to any changes that could affect silkworm health.
4. Moisture Management in Feed and Bedding: Maintaining appropriate moisture in mulberry leaves and bedding is essential. Leaves should be fresh but not overly wet, and bedding should be dry and sanitized to prevent mold.
5. Use of Moisture-Control Devices: Where modern equipment is not available, traditional systems can still benefit from portable humidifiers in dry seasons or dehumidifiers during rainy spells.

Table: Optimum Temperature and Humidity for different larval stages.

S.NO.	STAGE	TEMPERATURE	HUMIDITY
1	1st Instar	28^{0}C	85%
2	2nd Instar	27^{0}C	80%
3	3rd Instar	26^{0}C	75%
4	4th Instar	25^{0}C	70%
5	5th Instar	24^{0}C	65%
6	Spinning	24^{0}C	65%

Conclusion

Environmental conditions, especially temperature and humidity, have a profound influence on the lifecycle and productivity of silkworms. These parameters determine growth rates, disease resistance, and the overall quality and quantity of silk produced. To enhance sericulture outcomes, it is critical to maintain ideal temperature and humidity ranges through practices such as using climate-controlled facilities, ensuring proper ventilation, and

conducting routine environmental monitoring. By understanding and managing these key factors effectively, sericulture practitioners can foster a healthy rearing environment, improve cocoon quality, and contribute to the long-term sustainability and profitability of the silk industry.

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