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Tiny Troupers: The Backstory of India's Illustrious Commercial Lac Insects

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Abstract

Lac is the scarlet resinous secretion of tiny insects native to India and Southeast Asia that has been harvested and used commercially for over 5000 years. This resin is cultivated on host trees by small scale farmers using the tiny lac insect *Laccifer lacca* (Kerr) or *Kerria lacca* (Kerr). These 5mm long insects feed on the sap of host trees and secrete the resinous pigment as a protective cocoon. The resin, comprising lac dye, shellac, and wax has multifaceted uses as wood finishes, fabrics dyes, food glazes, perfumes and incense due to its glossy texture, crimson hue and unique odor. India currently leads global production at over 20,000 metric tons annually with the lac insect thriving mainly in central and eastern regions facilitated by monsoonal forests and cultivated host trees. While initially extracted for fabric dying and food uses, refinement processes in the 19th century expanded Shellac's industrial applications. Today lac resin drives rural cottage industries supporting over half a million small farmers and local enterprises. Recent research has enhanced understanding of lac insect biology and ecology enabling sustainable lac cultivation. With historical significance and modern industry relevance, the ubiquitous lac insect continues to produce invaluable secretions while spurring vibrant rural economies.

Introduction

India is home to a vibrant red resin-producing insect with historical and economic importance - the tiny lac insect. Belonging to the *Laccifer* or *Kerria* genera, these rice-sized insects inhabit the branches of host trees and play a vital role in the commercial production of shellac by secreting a reddish resinous pigment that coats their bodies. Feeding on the phloem sap, thousands of these tiny insects cover entire tree boughs across central Indian forests during breeding season. This protective crimson encasement surrounding the lac insect larvae is

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harvested by skilled farmers and refined to produce shellac - a versatile natural polymer vital for wood polishes, fabrics, and sweets. Beyond shellac, derivatives from the lac insect have served as rich red dyes, varnishes and incense since ancient times. Their sustainability, cultivability and multifaceted secretions make India's prolific tiny lac insects an illuminating example of insects with commercial significance on par with luminous silkworms.

Indian Lac

Resins

Lac tubes

Here is a list of some key Indian lac insect species and their places of origin:

1. ***Kerria lacca*** (Kerr) - Originally found in assam, west bengal, some parts of uttar pradesh and madhya Pradesh
2. ***Kerria chinensis*** (Kerr) - Mainly found in manipur, meghalaya, assam and Tripura
3. ***Kerria pusana*** (Kerr) - Found in parts of west bengal and assam
4. ***Kerria sharda*** (Kerr) - Mainly seen in west Bengal
5. ***Laccifer lacca*** (Kerr) - Predominantly found in west bengal, jharkhand, chhattisgarh, odisha and Maharashtra
6. ***Paratachardina pseudolobata*** (Koningsberger) - Parts of tamil nadu, karnataka and kerala
7. ***Paratachardina decorella*** (Kerr)- Native to tamil nadu, karnataka and andhra Pradesh
8. ***Tachardiella larrea*** (Kerr) - Seen in rajasthan, gujarat, maharashtra and madhya pradesh

The key lac insect species commercially cultivated in India for lac production and processing include *Kerria lacca, Laccifer lacca* and *Paratachardina pseudolobata*. These are native species found in parts of east, west, central and southern India.

Host for Lac Insects

1. Kusum (*Schleichera oleosa*) - One of the most preferred hosts, found widely across India.
2. Palas (*Butea monosperma*) - Common host, especially in eastern and central India.
3. Ber (*Ziziphus mauritiana*) - Favored host tree in northern and western India.
4. Babul (*Acacia nilotica*) - Key host species in central and western India.

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5. Mahua (*Madhuca longifolia*) - Important lac host in central and eastern regions.
6. Babla (*Acacia arabica*) - Hosts lac insects especially in western and southern India.
7. Jamun (*Syzygium cumini*) - Used as host in some parts of central and east India.
8. Pipal (*Ficus religiosa*) - Hosts lac insects in eastern and northern regions.
9. Neem (*Azadirachta indica*) - Secondary host for certain lac insect varieties.
10. Gulmohar (*Delonix regia*) - Host tree found mainly in western India.

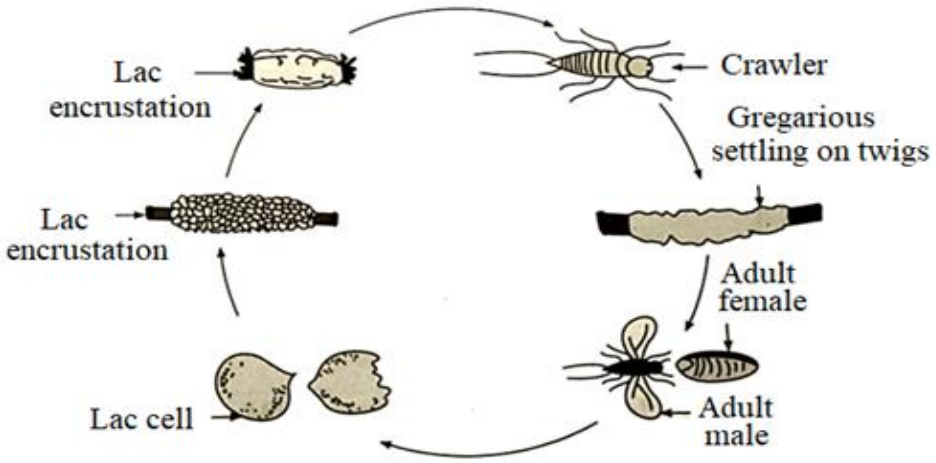
The choice of host trees depends on the region, lac insect species cultivated, climate and soil conditions. Kusum, Palas, Ber and Babul are among the most common and widely used host trees across India.

Distribution

India, Pakisthan, Sri Lanka, Myamar, Malaysia, China, Thailand

Life cycle

Lac insect is a hemimetabolous i.e. it undergoes gradual metamorphosis. It has three life stage namely egg, young one and adult. The young ones are called as nymph. The nymphs are similar to adult in all aspects except their size and reproductive organs.



The life cycle of lac insects (*Kerria lacca*):

- **Eggs** - In early summer, female lac insects lay 100-400 eggs on the branches of suitable host trees. The eggs hatch in about 10-15 days.
- **Crawlers** - The tiny first instar larvae (crawlers) emerge and spread out to find spots on smaller branches and shoots to position themselves. They insert their mouth parts into the bark to begin feeding on plant sap.

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- **Settlers** - The immobile larvae harden and secrete a resinous encrustation that forms shell-like coverings known as lac cells. At this point they are known as settlers. They continue feeding and growing inside the cells, living off plant sap.
- **Lac cells** - Secretions from the settlers enlarge the lac cells over 3-4 months to form encrustations, which protect the insects as well as the twigs they are settled upon. This form of lac is known as sticklac when harvested.
- **Adults** - After 3-4 months, the larvae have undergone transformation into pupae and then into male and female adults. The males emerge first and fertilize the females. Females lay eggs and perish soon after. The males die shortly after mating. The eggs will repeat the life cycle starting the next breeding season.

Usually there are two life cycles (generations) per year. The insects thrive best in warm, tropical and subtropical climates with rainfall during breeding seasons. The lifecycle continues as new generations replace old ones. This ensures a continuous resin secretion and lac deposits on the host trees.

Favourable Conditions

- Optimum Temperature – 20 ℃ to 35 ℃
- Relative Humidity – 70%
- Moderate rainfall – 100-200 cm

Main products produced from lac insects:

1. **Shellac:** The resin secreted by the lac insects is processed and refined into shellac. Shellac has a wide variety of uses as a wood finish, protective coating, glue, food glaze, and ingredient in products like cosmetics and pharmaceuticals.
2. **Seedlac:** This is the raw, unrefined form of shellac resin with bits of lac insect bodies and twigs still in it. Seedlac can be directly processed into shellac.
3. **Lac dye:** The resin, insects, and host tree bark can be processed to produce lac dye, which has traditionally been used as a red colorant in products like textiles, food, leather goods, paints, and cosmetics.
4. **Aleuritic acid:** An acid extracted from the lac resin that is used in the production of plasticizers, resin thinners, as a lubricant ingredient, and in products like varnishes and coatings.

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5. **Lac wax:** Obtained by purifying and bleaching the aleuritic acid, lac wax has applications in leather processing, as a component in certain varnishes, and in polishes.
6. **Lac food colorants:** Both lac dye and highly purified lac colorants are used as red food color additives. These are used for purposes like coloring candy, yogurts, dessert items, sauces, and more.

Here are some areas where further research could help expand lac insect utilization and production:

1. **Breeding and hybridization:** Developing improved lac insect breeds and hybrids with higher yields through selective breeding programs and genetic research. This can increase resin output and bring down production costs.
2. **Propagation optimization:** More research into optimizing host plant propagation, lac insect inoculation methods, and farming practices to increase yields and make the process more efficient.
3. **Sustainable harvesting:** Research into developing sustainable harvesting approaches that maximize output without damaging future lac insect populations and host tree health over long periods.
4. **Resin extraction:** Improving methods of extracting and refining lac resin to increase yields and purity and reduce wastage. Developing greener, organic solvent-free extraction approaches.
5. **Resin chemistry:** Better understanding lac resin's complex chemical composition and properties to uncover new derivative compounds for applications like coatings, adhesives, plastics, varnishes etc.
6. **Value addition & products:** Innovating and developing higher value lac products like food glazes, nutraceuticals, cosmetic formulations, bio-medical materials etc. based on the unique lac resin properties.
7. **Waste utilization:** Finding uses for the lac insect and host plant waste generated during harvesting and processing to reduce ecological impact and improve production efficiency.
8. **Mechanization & automation:** Introducing mechanization and smarter automation into the very manual-labor intensive lac production process to improve productivity and quality control.

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