

- (7) It is also used in confectionary trade as antifouling, for applying on ship bottom, grinding stone industry and for ammunition and fire works.
- (8) Last but not the least used commonly as sealing wax.

Thus, it is of great use and considered to be as one of the cash crops for the cultivators and also to the Government as source of foreign exchange earners which amount to crores of rupees annually.

## IMPORTANT QUESTIONS

### » Long answer type questions

1. Give an account of the life history of lac insect.
2. Give an account of the cultivation of lac.
3. Give an account of the processing, enemies and status of lac industry in India.

### » Short answer type questions

1. Enumerate host plants of lac insects.
2. Define natural inoculation of lac insect.
3. Define artificial inoculation of lac insect.
4. Give recent plan for lac cultivation.
5. Describe processing of lac industry.
6. Economic importance of lac.

### » Very short answer type questions

1. Explain swarming of lac insect.
2. Define immature harvesting of lac.
3. Define ceupe system in lac cultivation.
4. What is seed lac ?
5. Name the predators of lac insect.

### » Objective type questions

1. *Tachardia lacca* belongs to order :  
(a) Lepidoptera (b) Hemiptera  
(c) Thysanura (d) Diptera
2. Which of the following is not a host plant of lac insect ?  
(a) *Acacia nilotica* (b) *Zizyphus mauritiana*  
(c) *Ficus religiosa* (d) *Saraca indica*
3. Which of the following is most purified form of lac ?  
(a) Seed lac (b) Pure lac  
(c) Sheet lac (d) Shell lac
4. The raw lac obtained from the twig of host plant is called :  
(a) Shell lac (b) Sheet lac  
(c) Button lac (d) Brood lac
5. Which of the following is maximum in lac ?  
(a) Wax (b) Resin (c) Water (d) Mineral
6. Which is not the constituent of lac ?  
(a) Dye (b) Wax (c) Resin (d) Gum
7. *Tachardia lacca* secretes lac for :  
(a) Protection (b) Food  
(c) Reproduction (d) Attracting the microbes
8. Which of the following is wrong ?  
(a) Lac is easily soluble in alcohol  
(b) Lac is easily fusible on heating  
(c) Lac is a bad conductor of heat  
(d) Lac is not soluble in weak alkali
9. Which is greatest producer of lac in India ?  
(a) Chhotanagpur (b) Delhi  
(c) Kashmir (d) Gorakhpur
10. Which of the following is predator of lac insect ?  
(a) *Merops orientalis* (b) *Eublema amabilis*  
(c) *Acarapis woodi* (d) *Comptonotus compressus*

### ANSWERS

1. (b), 2. (d), 3. (d), 4. (d), 5. (b),  
6. (d), 7. (a), 8. (d), 9. (a), 10. (b)

*Parenthrodryinus clavicornis*, *Erencyrtus dewitzii*, *Tachardi-aephagus tachardiae*, *Tachardiaephagus tachardiae* var. *somervilli*, *Eupelmus tachardiae*, *Coccophagustschirchii*, *Marietta javensis* and *Tetrastichus purpureus*. These parasites lay their eggs into lac insects and parasitised 4.8 to 9.9% of lac insects per year and 1/3 of the parasitised cells are males. Thus, it may be concluded that parasitization is not a major cause of the damage to the lac cultivation.

**2. Predators :** Predators cause very severe damage to lac cultivation and 35% of the lac cells are damaged by two predators viz., *Eublema amabilis* Moore (Lepidoptera : Noctuidae) and *Holocera pulvereae* Meyr (Lepidoptera : Blastobasidae). Female lays eggs near encrusted twigs from where larva emerges and feeds on lac insects.

### Precautions

- (1) Twigs for inoculation should be cut just before the swarming to get healthy brood.
- (2) Twigs used for inoculation should be free from predators and parasites.
- (3) Twigs tied for inoculation should be removed from inoculated host plants after a maximum period of 20 days.
- (4) Lac left on the host tree for swarming should be removed in October and November.
- (5) The brood lac after swarming should be destroyed along with predators and parasites on it.
- (6) The lac scraped from the tree should be taken away from the area of lac infected trees.
- (7) Fumigation and water immersion of lac, before removing from twig, should be done.

## LAC INDUSTRY IN INDIA

India used to produce about 97% of the total lac output in the world but at present it has come down to 50-60%. The cultivation of lac has been good source as an earner of foreign currency. About 50% of the total lac produced in India is obtained from Chhotanagpur area. States like Orissa, Punjab, Madhya Pradesh, West Bengal,

Uttar Pradesh, Gujarat, Rajasthan, Assam etc. are increasing the production of lac now-a-days. On a very small level lac producing is also reported from Delhi and Kashmir. The average yearly yield of lac in India is about 15,000 metric tons. A lac research institute 'Indian Lac Research Institute' Namkum, Ranchi had been established in 1925 which is producing good quality of white lac. The Indian white lac is supposed to be better than red or other coloured lac because they produce stain or spots at places where they are kept. This is mostly small scale industry with around 350 factories, mostly located in Bihar. In Mirzapur district alone there are about 40 factories. Out of total lac produced in India about 85 to 95 per cent is exported specially to Britain, U.S.A., Russia and Germany.

## ECONOMIC IMPORTANCE

In 19th century lac dye was in more use than lac resin. Presently due to availability of a better and cheaper annaline dyes the use of lac as a dye has been discarded. The manifest uses of lac is one of the Nature's standing gifts. The various used to which it is put are :

- (1) It is utilized in the preparation of gramophone records. Previously this industry utilized major part of the lac produced annually. But now a days to a great extent plastic is being used in this trade.
- (2) It is of utility to Jewellers and Goldsmiths who use lac a filling material in the hollows in gold ornaments like bracelets, armlets, bangles and necklaces etc.
- (3) It is an essential gradient used extensively for making polishes, paints and varnishes for finishing wooden as well as metal furnitures and doors etc.
- (4) It is utilized for the preparation of toys, buttons, in pottery and artificial leather.
- (5) It is used in the manufacture of photographic material, lithographic ink and for stiffening felt and hat materials.
- (6) It is used as an insulating material for electrical goods.



of cultivation of lac, other groups of host plants would be under rest.

**2. Alternation of plant :** In this system the variety of host plant is changed after one crop. So, swarmed nymphs are inoculated on the tree of other variety of host plant. In this way every host plant can get enough rest resulting into better production of lac.

## PROCESSING OF THE LAC INDUSTRY

When the crop matures fully most of the lac is harvested and some part is left on the host plant. For the proper cultivation, the host plant should be pruned in January every year.

The twig bearing the lac alongwith eggs is called a BROOD LAC STICK and lac is known as BROOD or STICK LAC. The processing starts with the scraping of the stick lac from the twig. The scraped lac is subjected to removal of many impurities like dead parts of the lac insects, eggs and colouring matter and finally crushed by hand-operated mortars. Then the material is air dried and obtained in the form of granules which is known as SEED LAC. This seed lac is soaked in water, washed, dried in sun light, bleached and heated to melt on charcoal fire in cloth bag of 3 to 4 metre. At the time of heating the bag is twisted and the lac is squeezed out of the bag. The impurities of the lac are left out in the bag and are called as KIRRI LAC. The squeezed lac is now allowed to cool and solidify around the button-shaped forms which is now called BUTTON LAC or PURE LAC. This pure lac when stretched into thin sheet is called as SHEET LAC. This sheet lac when dissolved in water, produces white or orange coloured lac which is called as SHELL LAC. Shell lac is, in fact, prepared by boiling the seed lac with yellow arsenic in a certain proportion. Thus, the shell lac is most purified form of lac.

The quality of lac depends upon the host plant. Kusumi lac is said to be the best lac while Dhak is supposed to be the worst and cheapest one. The quality and colour of the lac is variable (Z-67)

according to the presence of gum and resins in the host plants.

### Composition of Lac

Lac is a complex substance having large amount of resins, together with sugar, water and other alkaline substances. The percentage of various constituents are as given below :

(1) Resin	— 68 to 90%
(2) Dye	— 2 to 10%
(3) Wax	— 6%
(4) Albuminous matter	— 5 to 10%
(5) Mineral matter	— 3 to 7% and
(6) Water	— 3%

### Properties of Lac

- (1) Lac is not soluble in water but easily soluble in alcohol. This property of lac has great value for insulation of electrical connections.
- (2) Lac is easily fusible on heating.
- (3) Lac has adhesive quality.
- (4) It has binding property when mixed with alcohol.
- (5) Lac is also soluble in weak alkali like ammonia.
- (6) Lac is a bad conductor of heat.

## ENEMIES OF LAC CULTIVATION

Lac cultivation is destroyed by biotic and abiotic factors :

**1. Abiotic enemies :** These are high intensity of light, high temperature, high humidity, heavy rainfall and flow of wind.

**2. Biotic enemies :** The main biotic enemies of lac cultivation are mammals and insects. Krishnaswami *et al.* (1957, 59), and Gepulpure *et al.* (1963), have reported that squirrel, rats and monkeys cause great damage to the lac crop.

The insects are very powerful enemies of lac crop. Annual loss due to the insect enemies is to the tune of about four lakh maunds. The insects damage the crops in different ways.

**1. Parasites :** The lac insects are parasitised by eight species of chalcidoid parasites like,



- (4) For the uniformity of inoculation, 3 to 4 twigs should be utilised.
- (5) Host plants should be changed from time to time for the proper nutrition of the nymphs.

These insects are very small and if they move to a long distance there are chances of mortality of the nymphs. Due to maximum contact of twigs, swarming nymphs have not to move for long distance and find suitable places to establish on the host plant.

### Inoculation Period

In India two types of crops viz., Rangini and Kusumi are grown in a year. The Rangini crop is of two types called as Kartiki and Baisakhi crop which produce Kartiki and Baisakhi lac respectively. The Kusumi crop is also of two types viz., Agahani and Jethi which produce Agahani and Jethi lac respectively.

Thus, the inoculation periods of all the four types of crops are different. The inoculations of Kartiki, Baisakhi, Agahani and Jethi crops are recommended in months of June to July, October to November, July and January to February respectively. But if continuously four crops are taken, the plant would not get any rest which may cause less production of lac.

### Swarming

It is very important phase in the life history of lac insect. So one should have accurate knowledge about the actual date of the swarming. At the time of swarming, the upper surface has yellow spot on the anal region. At this stage muscle contracts and insect gets detached from the place of attachment. Thus, it leaves a hollow cavity which later on gets covered with wax also. When these eggs are to be hatched out they become orange coloured. Thus, it is an indication that swarming has taken place. Thus, by trials and learning methods *i.e.*, by practice one could know about the exact date of swarming by looking at the colour of the eggs.

### Harvesting of Lac

The process of collection of ready lac from host tree is known as harvesting. In common practice the harvesting is of two types.

**1. Immature harvesting :** The harvesting of the lac before swarming is called as immature type of harvesting and the lac thus obtained is known as 'ARI LAC'.

**2. Mature harvesting :** The collection of crop after the swarming is called as mature harvesting and the lac obtained is known as 'MATURE LAC'.

The harvesting of lac before the swarming has some drawbacks because the lac insects may be damaged at the time of harvesting which would affect the population of lac insects and ultimately result in great economic loss to the cultivators. But in case of palas lac (Rangini lac) it is found that Ari lac gives better production. Therefore, Ari lac harvesting is recommended in case of palas only. In all other cases immature harvesting should be discouraged. It is also found that in cold areas mature crop yields better quality of lac.

**Harvesting period :** The harvesting periods of different crops are quite different in accordance with the inoculation of crops. Kartiki crop is harvested in October to November whereas, Baisakhi crop in May and June. The other crops like Agahani and Jethi are harvested in January to February and June to July respectively.

## RECENT PLAN FOR LAC CULTIVATION

With the increasing number of lac industries some advanced plans have been recommended for the better cultivation of lac crops. Two types of planning are used now-a-days.

**1. Ceupe system :** All the trees of host plants of a definite area are not used under continuous cultivations process of lac crop because if all host plants of a farm would be under continuous attack of lac insects, 100% plants may not get any rest and thus the production of the lac would be affected due to deficiency of nutritive cell sap to the swarmed nymphs and adults. So, the plants of a farm are numbered into 5 groups of plants. This artificial division or marking of trees is called as ceupe system of crop cultivation. In this system when one group of host plants is under the process



13. Shisham — *Dalbergia sisso*  
 14. Fig — *Ficus carica*

The quality of lac is directly related with the quality of host plant. So far, no artificial product has been able to replace the lac. Khair, Kusum and Babul give better quality of lac when sown directly in the field. But Palas, Ber and Ghont give good crop when they are first sown in nursery and then transplanted to the lac growing field. Palas and Ber produce a particular type of lac which is called as 'KUSUMI LAC'.

## CULTIVATION OF LAC

Lac cultivation is a complicated process, so the cultivators should know well about the inoculation, swarming period and harvesting of lac.

### Inoculation

The first procedure in the lac cultivation is the inoculation of lac insect. Inoculation is the process by which young ones get associated properly with the host plant. Inoculation is of two types :

**1. Natural inoculation :** The inoculation taking place in normal routine or in natural way is very simple and common process during which the swarmed nymphs infect the same host plant again and start to suck the juices from the twigs. The natural incubation of swarmed nymphs has some drawbacks which are as follows :

**(a) Incomplete nutrition :** Lac insects with their piercing and sucking mouth-parts, pierce into succulent twigs and suck the cell sap of the same host plant for nutrition. If the cell sap of the same host plant is further sucked out by the swarmed nymphs of the second crop continuously, the growth of the host plant would be retarded. In this way lac insect may not be able to get enough nutrients from the same host plant. The lac insects due to lack of sufficient nutrients lose their proper development, thereby affecting the production of lac also.

**(b) Irregular inoculation :** During the natural inoculation it is not sure that uniform sequence of inoculation takes place. If inoculation is not of

continuous fashion, a regular crop of lac may not be obtained.

**(c) Unfavourable climatic conditions :** At the time of swarming a number of factors like high intensity of sunlight, heavy rainfall, flow of wind etc. affect the proper inoculation of nymphs. These natural environmental factors may also affect the host plant at the same time and may cause a gap of inoculation resulting in irregularity of the lac crop.

**(d) Multiplication of parasites and predators :** Lac insects have certain enemies in the form of parasites and predators. If the crop is not harvested in time and lac is allowed to remain on the same twig, the multiplication of parasites and predators takes place which hampers the population growth of lac insects.

Thus, keeping in view the above drawbacks the natural procedure of inoculation is avoided and certain devices have been developed to ensure artificial method of inoculation.

**2. Artificial inoculation :** The main idea behind the artificial method of inoculation is to check all possible drawbacks of natural inoculation.

In this method first of all host plant should be pruned in January or June. The twigs bearing insect nymphs which are about to swarm or just before swarming are cut in sizes ranging between 20 to 30 cm in length. Then the cut pieces of these twigs are tied to fresh trees in such a way that each stick touches the tender branch of the tree at several places which form bridges for the migration of the nymphs. After swarming, these twigs should be removed and separated from the host plant. The following precautions should be taken in artificial inoculation :

- (1) One must ensure that the twigs, which are going to be tied on fresh host plant, are having good number of nymphs or eggs. It is also possible that from many of the twigs nymphs have swarmed out, thus inoculation would prove unsuccessful.
- (2) The twigs provided with eggs or nymphs should be without any parasite and predator.
- (3) The eggs or nymphs present on the twigs should be healthy and about to swarm so that one has not to wait for longer period and thus save time.



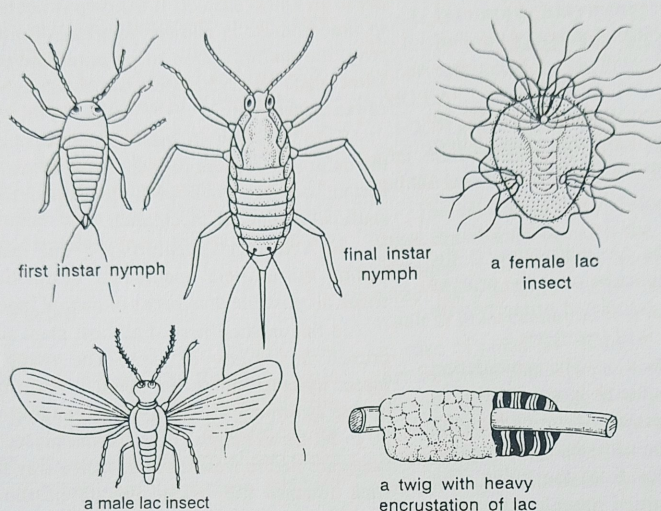


Fig. 1. Life history of *Tachardia lacca*.

on the host plant in resinous mass. The males walk over the encrustations of females and fertilize them within their oval cells through anal opening. The males leave the parent cell after fertilizing the female. One male is capable to fertilize many females. The female nymph once settled never moves but undergoes 3 moults inside her cell losing its eyes and legs and with rudimentary antennae only. The fertilization of female is followed by a rapid growth of the female body till it begins to lay eggs in October and November. From these eggs male and female emerge in February to March. The male fertilizes the females of this generation and the fertilized female lays eggs in months of June to July and dies secreting lac all the time. Thus, the life cycle reoccurs twice in one year on the same host plant.

Due to short life period males do not take major part in the secretion of lac but female secretes lac throughout her life and its life span is longer than males. Major quantity of lac is secreted from females. The life cycle period depends mainly on ecological factors of the region.

## HOST PLANTS

The lac insects have more than one host plant. The selection of suitable host plant for the cultivation of lac is of much importance. To establish the lac industry one should know well about the topographic and climatic conditions for the growth of host plants suitable for that particular region. Brun (1958) has mentioned that 113 varieties of host plants are found in the geographical Indian regions including Pakistan and Myanmar. Out of these 113 host plants only 14 are very common in India which are as follows :

- |            |   |                            |
|------------|---|----------------------------|
| 1. Kusum   | — | <i>Schleichera oleosa</i>  |
| 2. Babul   | — | <i>Acacia nilotica</i>     |
| 3. Ber     | — | <i>Zizyphus mauritiana</i> |
| 4. Palas   | — | <i>Butea monosperma</i>    |
| 5. Ghont   | — | <i>Zizyphus xylopyra</i>   |
| 6. Khair   | — | <i>Acacia catechu</i>      |
| 7. Peepal  | — | <i>Ficus religiosa</i>     |
| 8. Gular   | — | <i>F. glomerata</i>        |
| 9. Pakapi  | — | <i>F. virens</i>           |
| 10. Putkal | — | <i>F. globella</i>         |
| 11. Mango  | — | <i>Mangifera indica</i>    |
| 12. Sal    | — | <i>Shorea robusta</i>      |



### Lac Insect (Lakh ka-kira)

Phylum .....	Arthropoda
Class .....	Insecta
Order .....	Hemiptera
Sub-order .....	Homoptera
Super-family .....	Coccidae
Family .....	Leciferidae
Genus .....	<i>Tachardia</i>
Species .....	<i>lacca</i>

Lac insect (*Tachardia lacca*) previously known as *Laccifer lacca* is a minute, resinous, crawling scale-insect which inserts its beak into plant tissues, sucks juices and grows and secretes lac from the hind end of the body. Its own body ultimately gets covered with lac in the 'CELL'. Lac is actually secreted for its protection and not for the food of the insect. The commercial lac is produced in large quantities by female as a protective covering of its body which is injurious to the host plants.

**Male :** Male is red in colour and 1.2 to 1.5 mm in length. It secretes bright creamy lac. It has reduced eyes and ten segmented antennae. The mouth-parts are of piercing and sucking type. Thorax bears three pairs of legs and one pair of hyaline wings. The abdomen is eight segmented and terminates into a short, chitinous prominent general sheath containing penis. On either side of this genital sheath a white elongated caudal seta is found.

**Female :** Female is larger than males and measures about 4 to 5 mm in length. The pyriform body of the female is enclosed in a resinous cell. The head, thorax and abdomen are not clearly distinct. The mouth-parts are of piercing and sucking type. The antennae are clearly visible and degenerated. The posterior end of the body has a median and two lateral processes. The legs are in degenerated form.

### LIFE HISTORY

Each mature female just after fertilization lays about 200 to 500 eggs in a cell in which she is enclosed. The oviposition takes place into the incubating chamber which is formed by the

contraction of the body of the female in forward direction inside the lac cell. The eggs are laid in the months of October and November. After six weeks of laying, the eggs are hatched into first instar nymphs in the months of November and December. When nymphs emerge they are in quite large number. This mass emergence of the nymph is known as 'SWARMING' (Fig. 1).

**Nymph :** At the time of emergence the nymphs are about 0.5 mm in length, red coloured and boat-shaped. The head bears paired antennae, ocelli and ventrally situated piercing and sucking type of mouth-parts. The mouth-parts are provided with proboscis. The three segmented well developed thorax contains two pairs of spiracles and only one pair of walking legs. The abdomen contains two pairs of legs and terminates into a pair of long caudal setae. The active nymphs can crawl to a considerable distance so, just after emergence they start moving in search of food and reach their host plants, preferably on young and succulent shoots because the young nymphs are unable to settle and feed on hard twigs. These nymphs settle very close to each other on the twig of the host plant which further collapses completely and forms a continuous covering even on the lower surface of the twig. The number of nymphs that settle per square inch area is about 150 to 200. Settled nymphs suck the sap from the twig of the host plant and start to secrete the resinous substance by special dermal glands which are located all over the body. As the resinous secretion comes in contact with air, it soon becomes hard and forms a coating over the body of nymph and is called as 'CELL'. Within this cell various life processes like growth of the nymph, morphological changes and lac secretion take place.

The male 'Cell' is elongated and cigar-shaped having two holes i.e., anterior and posterior. From the posterior hole which is covered by a flap or operculum, the male insect comes out by pushing open the operculum. After six to eight weeks of stationary life the nymphs are metamorphosed as a result of which some (30%) active winged males and maximum (70%) emerge in the form of females which are wingless. The females get fixed



## Lac Culture

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Lac insects and their products have been known to naturalists since very early times. The lac has been referred in ancient Sanskrit works viz., Atharva-Veda (Dave, 1950; Hora, 1952) and was called as 'Luxa'. It is mentioned in Mahabharat that 'Luxa Griha' was made up of lac which was prepared by Kaurava for Pandavas. Abul Fazal (1590) in his famous book 'Ain-i-Akbari' has mentioned in detail about the lac industry in India. Mahdihassan (1950, 1952), has referred about the lac insect and its products in China. The first scientific reference regarding the lac and lac insect is the report of Kerr and Glover in 1782. Subsequently, much work has been done by various workers on the organization, distribution, taxonomy, host plants, culture, production, enemies, chemistry and technology.

Three products from lac insects, viz., the lac-dye, lac-wax and lac (resin) have been items of trade and commerce.

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### DISTRIBUTION

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India has its monopoly on the production of lac. Other countries like Africa, Australia, Brazil, Myanmar, Sri Lanka, China, Formosa, France, Germany, Japan, Malaya, Nepal, Spain, Thailand, Turkey, U.S.A. and some others also produce lac. But in Thailand, Malaya, Myanmar and Nepal the lac producing industries are increasing day-by-day. Thailand has become the main competitor of India in export of lac. In India major lac producing places are Assam (Kashi Hills), Bengal (Kolkata, Jangipur, Murshidabad, Mathrapur, Malda), Bihar (Manbhum, Palamau, Ranchi, Santhal Pragana), Delhi, Gujarat, Hyderabad, Kashmir, Madhya Pradesh (Damoh, Champa, Bilaspur, Rewa, Umaria), Chennai, Coimbatore, Mysore, Orissa (Cuttak, Mayurbhanj), Punjab (Hoshiarpur, Shahpur), Rajasthan (Indergarh, Kota, Jaipur, Jhallawar, Karauli), and Uttar Pradesh (Ghazipur, Mirzapur, Agra) etc.