

LAC CULTURE

Introduction

Lac insects and their products have been used in India from the time immemorial for several purposes. The lac has been referred in ancient Sanskrit works, viz., Atharva-Veda and was called as 'Luxa'. From the epic of Mahabharat; it has been recorded that 'Luxa Griha' was made up of the lac which was prepared by Kaurava for Pandavas. Abul Fozal (1590) in his famous book 'Ain-i-Akbari' has mentioned in detail about the lac industry in India. In 1709, Father Tachard discovered the insect that produced lac. The first scientific reference regarding the lac and lac insect is the report of Kerr and Gilover in 1782 who gave the insect name as *Coccus lacca*. Later the name was given as *Laccifer lacca*. Finally Chatterjee (1915) and Green (1922) called the lac insect as *Tachardia lacca*. Mahdihassan (1950-1952), has referred about the lac insect and its products in China. Subsequently, several scientists worked on the organization, distribution, taxonomy, host plants, culture, production, enemies, chemistry and technology of this insect.

Lac is a natural resin of animal origin. It is secreted by an insect, known as lac insect. In order to obtain lac, these insects are cultured and the technique is called lac culture. It involves proper care of host plants, regular pruning of host plants, propagation, collection and processing of lac.

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

Lac Insect Classification

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

Distribution

India has its monopoly on the production of lac. The production of lac has been reported from other countries like Africa, Australia, Brazil, Myanmar (Burma), China, Sri Lanka, France, W. Germany, Nepal, Spain, Japan, Malaya, Thailand, Turkey and U.S.A. But in Thailand, Malaya, Myanmar (Burma) and Nepal the lac producing industries are increasing day-by-day. Among the above countries Thailand has become the main threat to India in export of lac. In India major lac producing places are (Bengal Kolkata (Calcutta), Jangipur, Murshidabad), Jharkhand (Manbhum, Palamau, Ranchi, Santhal Pragana), Delhi, Gujarat, Assam (Kashi Hills), Kashmir, Madhya Pradesh (Damoh, Rewa, Umaria), Chhatisgarh (Bilaspur, Champa), Punjab (Hoshiarpur, Shahpur), Rajasthan (Indergarh, Kota, Jaipur, Jhallawar, Karauli), Uttar Pradesh (Ghazipur, Mirzapur, Agra), Hyderabad, Chennai, Coimbatore, Mysore and Orissa (Cuttak, Mayurbhanj) etc.

Habit and Habitat

Lac insect, *Tachardia lacca* previously known as *Laccifer lacca* is a minute, resinous and crawling scale-insect. It inserts the beak into plant tissues, sucks juices and grows, and secretes lac from the glands present in the abdomen. 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. The adult lac insect shows sexual dimorphism. The male and female insect vary in shape, size and also in the presence or absence of certain body parts.

Host Plants

The lac insects suck the sap of many host plants. The selection of suitable host plant for the cultivation of lac is of much importance. The success of lac culture depends upon the topographic and climatic conditions suitable for the growth by host plants. Brun (1958) has reported that 113 varieties of host plants are found in India. The trees which are very common in India which are as follows :

1.	Arhar	<i>Cajanus indicus</i>	9.	Putkal	<i>F. globella</i>
2.	Babul	<i>Acacia nilotica</i>	10.	Palas	<i>Butea monosperma</i>
3.	Ber	<i>Zizyphus mauritiana</i>	11.	Fig	<i>F. carica</i>
4.	Ghont	<i>Zizyphus xylopyra</i>	12.	Kusum	<i>Schleichera oleosa</i>
5.	Khair	<i>Acacia catechu</i>	13.	Mango	<i>Mangifera indica</i>
6.	Peepal	<i>Ficus religiosa</i>	14.	Sal	<i>Shorea robusta</i>
7.	Gular	<i>F. glomerata</i>	15.	Shisham	<i>Dalbergia sisso</i>
8.	Pakapi	<i>F. virens</i>			

The quality of lac is directly related with the quality of host plant. Khair, Kusum and Babul give better quality of lac when sown directly in the field. But to obtain healthy crop Palas, Ber, Ghont, may be first sown in nursery and then transplanted to the lac growing field. Palas and Ber produce a special type of the lac which is known as 'Kusumi Lac'.

External Features

Male—Male is red in colour and 1.2 to 1.5 mm in length. It secretes bright creamy lac. The body is divided into head, thorax and abdomen. Head bears a pair of reduced eyes and a pair of 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 the largest part of the body. It terminates into a short, chitinous prominent genital sheath containing penis. A white elongated caudal seta is found on either side of this genital sheath.

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. Head bears a pair of antennae and single proboscis. The mouth-parts are piercing and sucking type. Eyes are absent. The antennae are clearly visible and degenerated. The thorax is devoid of wings and legs. The loss of eyes, wings and legs are due to the fact that the female larva after setting down once, never move again and thus these parts become useless and ultimately atrophy. The posterior end of the body has a median and two lateral processes.

Fertilization

After attaining the maturity, males emerge out from their cells and walk over the lack incrustations. The male enters the female cell through and tubular opening and inside female cell it fertilizes the female. After copulation, the male dies. One male is capable of fertilizing several females.

Life History

The fertilized female lays about 200 to 400 eggs in a cell in which she is enclosed. The oviposition takes place into the incubating chamber which is formed by the contracting of the body of the female in forward direction inside the lac cell. The eggs are laid in the months of October and November. The eggs are hatched into first instar nymphs after six weeks of laying. After hatching nymphs emerge in quite large number. This mass emergence of the nymphs is called 'Swarming' (Fig. 1).

Nymph—At the time of emergence the nymph are boat shaped, red coloured and about 0.5 mm in length. Body is divided into head, thorax and abdomen. The head bears paired antennae, a pair of simple eyes and ventrally situated piercing and sucking type of mouth-parts. The mouth-parts are provided with proboscis. The thorax is well developed, three segmented and contains two pairs of spiracles and three pairs of walking legs. The abdomen terminates into a pair of long caudal setae. Just after the emergence, the active nymphs start moving in search of food and reach young host plants having succulent shoots. 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. The nymphs suck the sap from the twig of the host plant when once they get fixed to the twig 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 an encasement over the body of nymph and is called as 'Cell' (Fig. 2). Once they are fully covered, within this cell moulting, morphological changes and lac secretion take place. The cell produced by male and female differ in shape, and can be easily distinguished. The male cell is elongated and cigar-shaped. There is a pair of branchial pores in the anterior side and a single large circular posterior operculum. Female cell is oval, having a pair of small branchial pores in anterior side and a single round and tubular opening in posterior side. Through the anal tubular opening are protruding waxy white filaments, secreted by the glands in the insects body, which is an indication that the insect inside the cell is alive and is in healthy condition. These filaments also prevent the blocking of the pore during excess secretion of lac. After six to eight weeks of stationary life the nymphs moult and metamorphosed in their respective cells 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 on the host plant in resinous mass. The males move over the lac encrustations of females and fertilize them

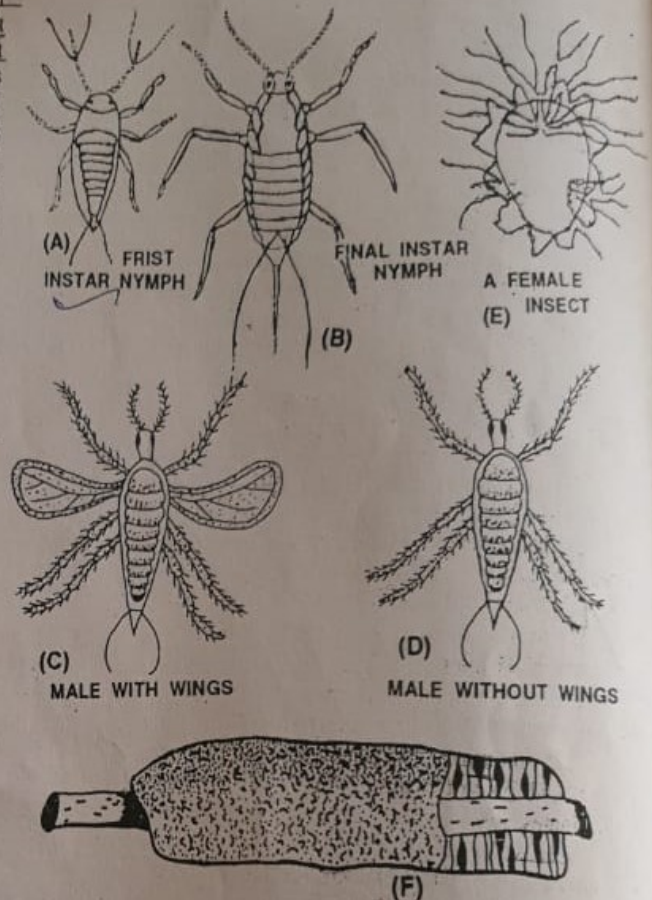


Fig. 1. Life history of *Tachardia lacca*. (A) First instar nymph, (B) Final instar nymph, (C) Male with wings, (D) Male without wings, (E) A female lac insect, (F) A twig with heavy incrustation of lac.

within their oval cells through anal opening. The males leave the parent cell after fertilizing the female. The female nymph once settled never walks and moults three times inside her cell losing its eyes and legs, and left with rudimentary antennae only. The fertilization of female is followed by a rapid growth of the female body till it starts laying eggs in October and November. The male and female emerge from these eggs in February and 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, there are two generations in one year on the same host plant.

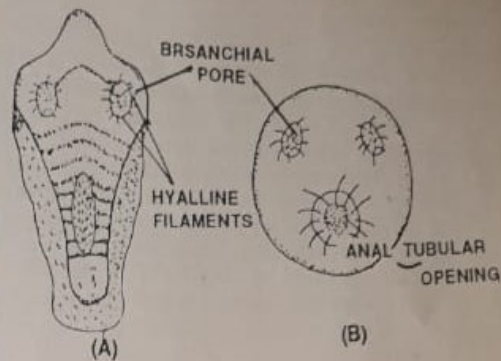


Fig. 2. Different forms of lac.
(A) Male cell, (B) Female cell.

The males do not take major part in the secretion of lac due to short life period. The female secretes lac throughout her life and its life span is longer than males. Major quantity of lac is secreted from females.

Cultivation of Lac

The cultivation of lac involves proper care and regular pruning of the host plants, propagating or inoculation of insects, and collection and processing of lac. The most important prerequisite for the cultivation of lac is to provide proper care of the host plants because lac insects complete their life-cycle on these plants. For scientific cultivation of host plants, a suitable piece of land may be taken and then host plants are systematically planted. The plants may be provided artificial manures, irrigation facilities, ploughing and protection from cattle etc. The plants may be observed regularly for their proper growth. The nymph of the insects are inoculated on the host plants only after the host plants have reached a proper height.

For lac cultivation, the cultivators should know well about the inoculation, swarming period and harvesting of lac.

Inoculation

The inoculation is the process by which young ones are introduced to the new lac host plants. Inoculation is of two types :

1. **Natural inoculation**—The infestation from one plant to another plant is called natural inoculation. It 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. This type of inoculation of swarmed nymphs has certain shortcomings which are as follows :

(a) **Incomplete nutrition**—Lac insects feed on the cell sap by inserting their mouth-parts into succulent twigs. 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 stunted. Thus lac insect may not be able to get sufficient food from the same host plant. The underfed lac insects lose their proper development, thereby affecting the production of lac also.

(b) **Irregular inoculation**—During the natural inoculation it is not confirmed that continuously inoculation takes place. If inoculation is not in a uniform fashion, a regular crop of lac may not be obtained.

(c) **Multiplication of parasites and predators**—Lac insects are attacked by parasites and predators. The multiplication of parasites and predators takes place if the crop is not harvested in time which causes decline in the population growth of lac insects.

(d) **Unfavourable climatic conditions**—A number of factors like high intensity of sunlight, heavy rainfall, flow of wind etc. affect the proper inoculation of nymphs at the time of swarming.

These unfavourable environmental factors may also affect the host plant at the same time. This may cause a gap of inoculation resulting in irregularity of the lac crop.

Thus, to check the drawbacks the natural procedure of inoculation, artificial method of inoculation has been developed.

2. Artificial inoculation—The nymph feed on the cell sap by inserting their proboscis in the tender young shoots. For this before inoculation, 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 to the size of six inches. They are called **brood lac**. Then the cut pieces of these twigs are tied to fresh trees. Strings could be used for tying the brood lac with the host plant may be of different types (Fig. 3). In longitudinal infection the brood lac is tied in close contact with host branches. In lateral



(A) LONGITUDINAL INFECTION, (B) LATERAL INFECTION, (C) INTERLACED INFECTION.

Fig. 3. Three different ways of artificial inoculation of lac.

Infection the brood lac is tied across the gaps between two branches. In interlaced method, brood lac are tied among the branches of several new shoots 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 :

(i) The twigs, which are to be tied on fresh host plant, should have large number of nymphs or eggs in brood sacs. (ii) The eggs or nymphs present on the twigs should be ready to swarm so that one could save the time. (iii) The twigs provided with eggs or nymphs should be free any parasite and predator. (iv) For the uniformity of inoculation, 3 to 4 twigs should be utilized. (v) Host plants should be taken and changed from time to time for the proper nutrition of the nymphs. (vi) The twigs should have maximum contact with a fresh tree so that swarming nymphs have not to move for long distance and find suitable places to establish on the host plant. These insects are very small and if they move to long distance there are chances of mortality of the nymphs.

Lac Crop

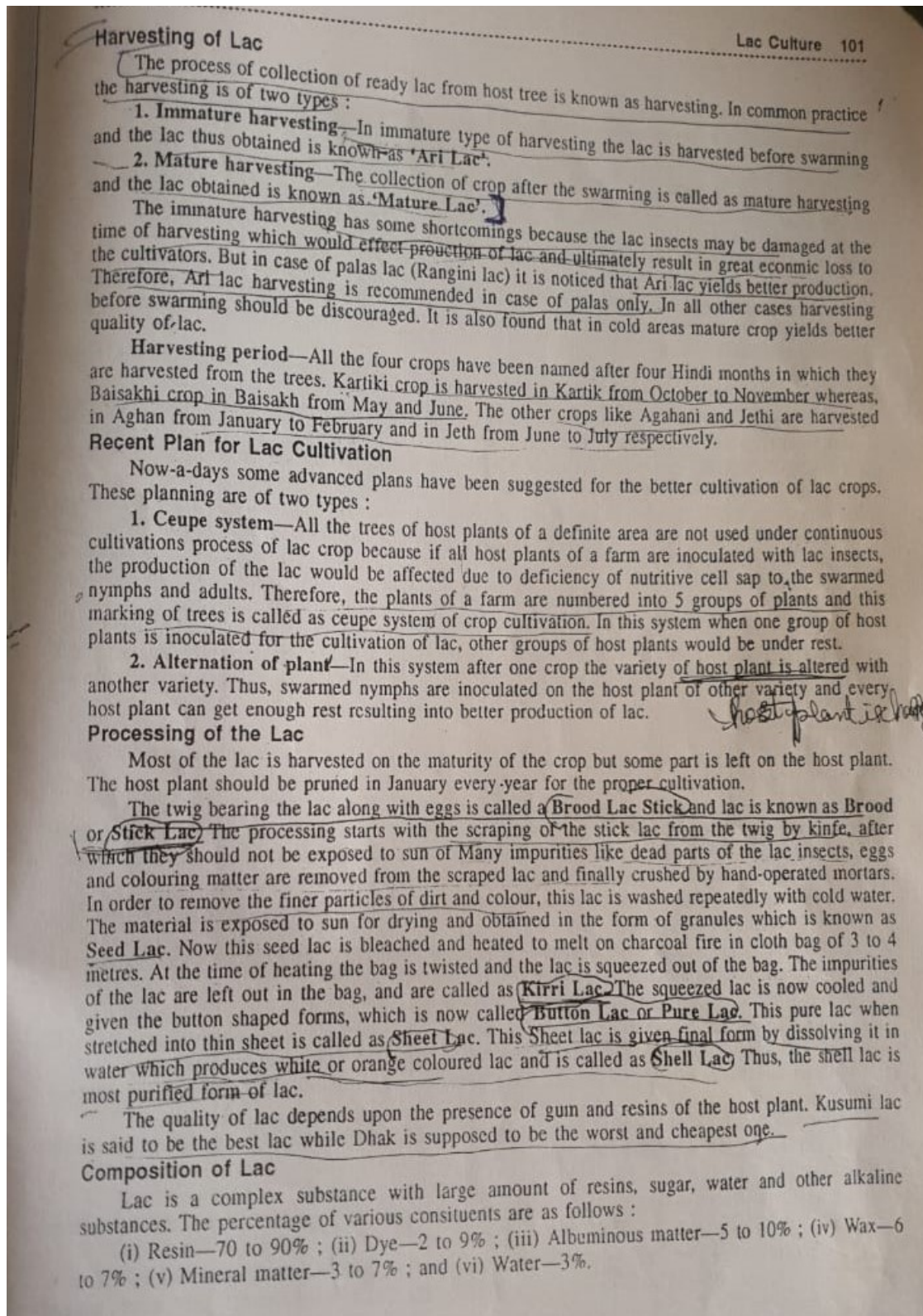
Lac insects repeats its life-cycle twice in a year. The lac insects either develop on Kusum plants or develop on plants other than Kusum. The lac which grows on Non-Kusum plants are called as **Rangini crop** and which grows on Kusum plant is called **Kusum crop**. Therefore, in India two types of crops, 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**. The lac produced by these crops is called Agahani and Jethi lac respectively.

Thus, the inoculation periods of all the four types of crops are different. The inoculation of Kartiki, Baisakhi, Agahani and Jethi crops are recommended in months of October to November, May to June, January to February and June to July respectively.

Swarming

It is very important phase in the life history of the insect. At the time of swarming, the upper surface has yellow spot on the anal region. The indication of the swarming is that the eggs which to be hatched out they become orange coloured.

Thus, one could know about the exact date of swarming by looking at the colour of the eggs. In Kartiki-crop female gives rise to swarming nymphs in October-November, Baisakhi crop swarming in June-July, Agahani crop swarming in January-February and Jethi crop swarming in June-July.



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Properties of Lac

(i) Lac is soluble in alcohol but insoluble in water. Due to this property lac has great importance for insulation of electrical connections. (ii) Lac has adhesive quality. (iii) Lac is easily fusible on heating. (iv) When mixed with alcohol it has binding property. (v) Lac is a bad conductor of heat. (vi) Lac dissolves in weak alkali like ammonia.

Enemies of Lac Cultivation

Lac enemies impose a challenge to the lac culturist, as they not only decrease the population of lac insects but also decrease the production and quality. The damage caused to lac cultivation by abiotic and biotic enemies.

1. **Abiotic enemies**—The high intensity of light, high temperature, high humidity, heavy rainfall and flow of wind adversely effect the lac cultivation.

2. **Biotic enemies**—The main biotic enemies of lac cultivation are mammals like squirrel, rats, and monkeys cause great damage to the lac crop.

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

1. **Parasites**—The common parasite of lac insect are chalcids parasites like, *Parenchthrodryinus clavicornis*, *Erencyrtus dewitzii*, *Tachardiaephagus tachardiae*, *Eupelmus tachardiae* and *Tetrastichus purpureus*. These parasites are small, winged insects which lay their eggs into lac insects. The larva which hatches from these eggs feed upon the lac insects, thereby causing mortality of their host. They parasitise 5 to 10% of lac insects per year and 1/3 of the parasitised cells are males.

2. **Predators**—Predators cause very severe damage to lac cultivation and two predators, viz., *Eublemma amabilis* (the white moth) and *Holocera pulverea* (the blackish grey moth) damage 35% of the lac cells. Female lays eggs near encrusted twigs from where larva emerges and feeds on lac insects.

Control Measures

Damage caused by the above mentioned enemies can be reduced to a greater extent by the use of following methods :

Cultural Method

- (i) Twigs for inoculation should be cut from the host plant about one week before the swarming to get healthy brood. This will reduce the chances of parasite attack on the emerging nymphs.
- (ii) Twigs used for inoculation should be free from predators and parasites.
- (iii) After a maximum period of 20 days twigs tied for inoculation should be removed from inoculated host plant.
- (iv) The brood lac after the emergence of nymphs should be damaged along with predators and parasites on it.
- (v) The lac scraped from the tree should be taken away from the area of lac infected trees.
- (vi) The stick lac should be converted into seed lac as soon as possible because delay in processing also gives chances to the enemy insects to escape into the field.

Chemical method—Fumigation and water immersion of lac immediately after cutting from twig should be done.

Biological Method—For this purpose hyper-parasitic insects should be released in the field which kill the parasitic insects of lac crop.

Uses of Lac

Lac has been used for the welfare of human beings from the great olden days. The various uses of lac are as follows :

- (i) It is utilized in the preparation of gramophone records. Previously, this industry used to consume 30–40% of the lac produced annually. But now-a-days to a great extent used of plastic has come in this trade.
- (ii) It is utilized for making polishes, paints and varnishes for finishing wooden as well as metal furnitures and doors, etc. It is also used for silvering the back of mirrors.

- (iii) Jewellers and Goldsmiths use lac in filling hollow in gold ornaments like bracelets, armlets and necklaces, etc.
- (iv) It is used as an insulating material for encasing cable wires.
- (v) It is used in the manufacture of photographic material, lithographic ink and for stiffening felt and hat materials.
- (vi) It is an essential material used extensively in the preparation of toys, buttons, pottery and artificial leather.
- (vi) It is also used in confectionary trade, grinding stone industry and for ammunition and fire works.
- (viii) It is used commonly as sealing wax. Nail polish is a good example of the byproduct of lac.

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 it helps in earning crores of rupees as foreign exchange.

Lac Industry in India

India used to produce about 97 per cent of the total lac output in the world but at present it has come down to 50-60 per cent. The cultivation of lac provides about Rs. 12 crores of foreign exchange. About 50 per cent of the total lac produced in India is obtained from Chhotanagpur area of Bihar. The average of different states in the total quantity of stick lac produced is given below :

Bihar	— 54.5%	;	Uttar Pradesh	— 1.8%
Madhya Pradesh	— 22%	;	Assam	— 0.6%
West Bengal	— 11%	;	Orissa	— 0.1%
Maharashtra	— 7.2%	;	Gujarat	— 2.8%

Now-a-days, the production of lac is further increasing in these states. The average yearly yield of lac in India is about 24,000 metric tons. The Indian Council of Agricultural Research has established 'Indian Lac Research Institute' Namkum, Ranchi 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. About 85% of lac produced in this country is exported to about hundred countries especially to Britain, U.S.A., Russia and West Germany. This is mostly small scale industry with around 350 factories, mostly located in Bihar. In Mirzapur district alone there are about 40 factories. It has been estimated that about 3-4 million people are engaged in the lac cultivation.

QUESTIONS

Long Answer Type

1. Write an essay on lac culture in India.
2. Give an account of lac insects and cultivation of lac in India.
3. What is lac ? Describe external features and life-history of *Tachardia lacca*.
4. How many types of lac crops produced in India. Describe the processing, properties and composition of lac.
5. What is lac culture ? Give an account of external features of *Tachardia lacca* and its enemies. Write uses of lac.

Short Answer Type

1. Host plants of lac insects.
2. Natural inoculation of lac.
3. Artificial inoculation of lac.
4. Harvesting of lac.
5. Processing of lac.
6. Composition and properties of lac.
7. Uses of lac.