Bulletin No. 76

INDIAN LAC RESEARCH INSTITUTE

IMPROVED METHODS OF LAC CULTIVATION

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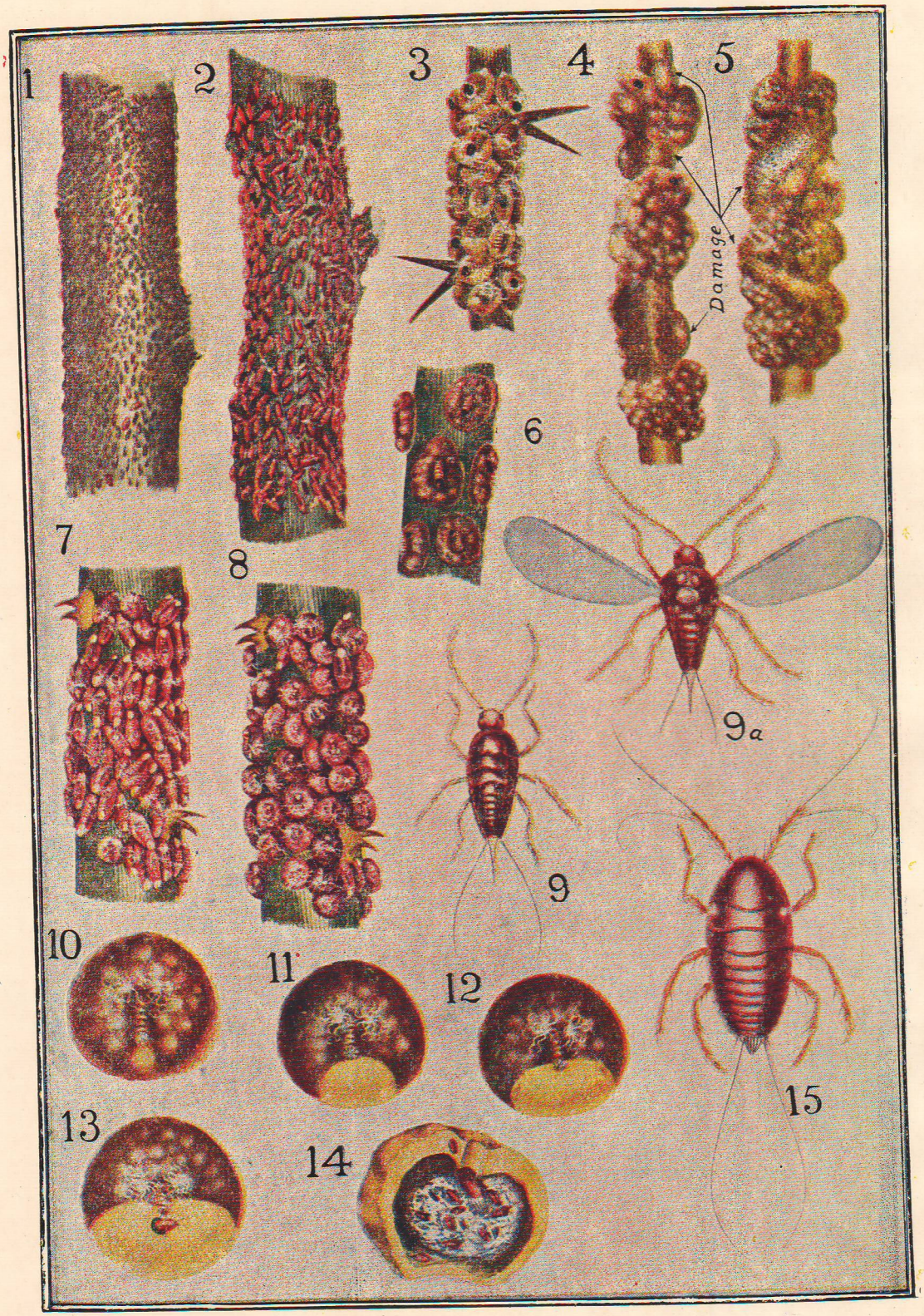
Entomologist

(FIRST REVISED EDITION.)

INDIAN LAC RESEARCH INSTITUTE
NAMKUM, RANCHI, BIHAR, INDIA
1956

Price four annas only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INTRODUCTION

LAC IS AN IMPORTANT RESIN OF COMMERCE, mainly used in the manufacture of gramophone records, French polishes, electrical goods, sealing wax, etc. While other resins are either dug out of the earth or tapped from trees, lac is secreted by an insect which feeds on certain types of trees, and is collected from their branches. Lac production is thus an agricultural pursuit. Although ninety per cent of the world production of lac comes from India and lac cultivation has been practised for centuries in this country, it is only in comparatively recent years that attempts have been made, especially in the Indian Lac Research Institute, to understand the scientific facts underlying the operations of lac cultivation, and to apply the scientific knowledge so gained to the improvement of the existing methods of cultivation. The present pamphlet describes briefly such improved methods and it is hoped that the adoption of these by the cultivators will materially help them in bettering the quality and improving the yield of the lac crop.

1. Host trees: While the lac insect can thrive on the shoots of a large number of shurbs, plants and trees, good crops can be obtained over a continuous period of years mainly on the following trees:

Hindustani name	Botanical name	Where found in India
Kusum	*Schleichera oleosa*, syn. *S. trijuga*	In sub-mountainous tracts of greater part of India.
Ber	*Zizyphus mauritiana*, syn. *J. infectoria*	All over India.
Palas	*Butea monosperma*, syn. *Butea frondosa*	All over India.
Khair	*Acacia catechu*	All over India.
Ghont	*Zizyphus xylopyra*	Chiefly in C. P.
Bolemgo	*Grewia multiflora*	In Assam.
Gangma	*Lea crispa*	In Assam.
Arhar	*Cajanus cajan*, syn. *C. indicus* ..	In Assam.
Jallari	*Shorea talura*	In Madras and Mysore.

2. Lac crops & seasons: There are two types of lac grown in India, *Kusmi* and *Rangeeni*. *Kusmi* lac is grown on *kusum* or on some other hosts using *kusum* brood. *Rangeeni* lac is grown on all hosts other than *kusum* and the brood used is not either *kusum* or its progeny, for example, *palas* and *ber* lac are *Rangeeni*.

Kusmi as well as *Rangeeni* lac has two crops in a year. However, in Madras and Mysore *Jallari* (*Shorea talura*) produces three crops in thirteen months and the lac produced is grouped under *Rangeeni*.

Kusmi crops are called *Aghani* and *Jethwi*. The *Aghani* is propagated in June-July (*asarh-savan*) and matures in January-February (*paush-magh*). The *Jethwi* is propagated in January-February and matures in June-July. In south Madras due to equable climate the *kusum* crops do not keep the above time and every succeeding year matures in different months, each crop taking 5 to 6 months to mature.

Rangeeni crops are named *Katki* and *Baisakhi*. The *Katki* crop is propagated in June-July and matures in October-November (*aswin-katki*). The *Baisakhi* crop is propagated in October-November and matures in June-July.

3. Coupé system of cultivation: In general the same host trees are used over and over again, season after season and do not, therefore, ever recieve any rest; as a result they do not put forth the maximum number of shoots, and the maximum quantity of lac is never produced from them. In order that periodic rest may be allowed and at the same time to reduce the expenditure and trouble incurred in guarding a large number of widely scattered trees from theft, a cultivator who owns or works a large number of trees should utilize them on the coupé system.

(a) *Kusum: Kusum* trees should be divided into four equal coupés one coupé only should be used for each crop, *Aghani* and *Jethwi*. Each coupé requires 18 months' rest from the date of cropping before it is in really suitable condition again for re-infection.

(b) *Palas & Ber:* Should be divided into three coupés in the ratio of 1 : 3 : 3. As far as possible the small coupé (containing $\frac{1}{7}$ or 14% of the total number of hosts) should be central, the two large coupés being on either side or around the smaller.

The small coupé referred to as Group I should be used annually to grow the *Katki* crop (i.e. June-November crop); it should be infected in June and cropped completely in October-November. The large coupés called Groups II and III should be used *alternately* to grow the *Baisakhi* (i.e. October-July crop). In June-July, only shoots which are covered with dead lac should be cut, and all shoots which have been sufficiently covered with living lac should also be cut and used to infect Group I trees. The remainder of the lac in these trees should be left for natural infection for the *Katki* crop, the crop being cut completely in October-November.

In this way each tree gets rest from nine months to one year.

(c) *Assam, C.P. & Madras Hosts:* Hosts such as specially referred to for Assam, C.P. and Madras should be treated much in the same way as *palas* and *ber*.

(d) *Khair*: This host must only be used once a year and then only to grow the *Katki* or *Aghani* crop. The trees should be divided into two equal coupés, which should be used in alternate years.

Khair is not suitable for use for the *Baisakhi* or *Jethwi* (January-July) crop and infection of *khair* for either of these crops will result in failure.

4. Pruning: Pruning of host tree is absolutely essential when a tree is brought under lac cultivation for the first time. Thereafter crop-cutting, if properly carried out, generally serves the purpose of pruning also. Pruning should be light, and branches or shoots of less than half an inch in diameter should be cut flush close to the place of their origin. If a stump has to be left, it should not be less than one and a half foot in length, nor should it be less than half an inch in diameter near the base. Crop-cutting as practised by the villagers is very heavy; particularly in the case of *kusum* it is so heavy that a tree does not produce sufficient shoots till 2 to 3 years after crop-cutting. Most suitable pruning times for the major lac hosts including *khair* are given below:

Host	Suitable crop	Time of pruning
Ber	*Katki*	First half of February (*magh*),
Ber	*Baisakhi*	First half of April (*Baisakh*).
Palas	*Katki*	First half of February (*magh*).
Palas	*Baisakhi*	First half of April (*Baisakh*).
Kusum	Trees fit for infection $1\frac{1}{2}$ years after pruning.	January-February (*paush-magh*).
	do ..	June-July (*asarh-savan*).
Khair	*Katki*	February (*magh*).
	Aghani	15th April to 15th May (*baisakh*)

In practice, if necessary, pruning operations may be extended to over another fortnight.

The most suitable implements for prunning and crop-cutting are shown in Fig. 19. Secateurs (Fig. 19B) and standard pruners (Fig. 19C) should be used to cut the top portion of a branch or shoot as they do not break or split off shoots. Pruning knives and axes (FIGS. 19A & 19D) should be used to cut a shoot or branch flush at the base.

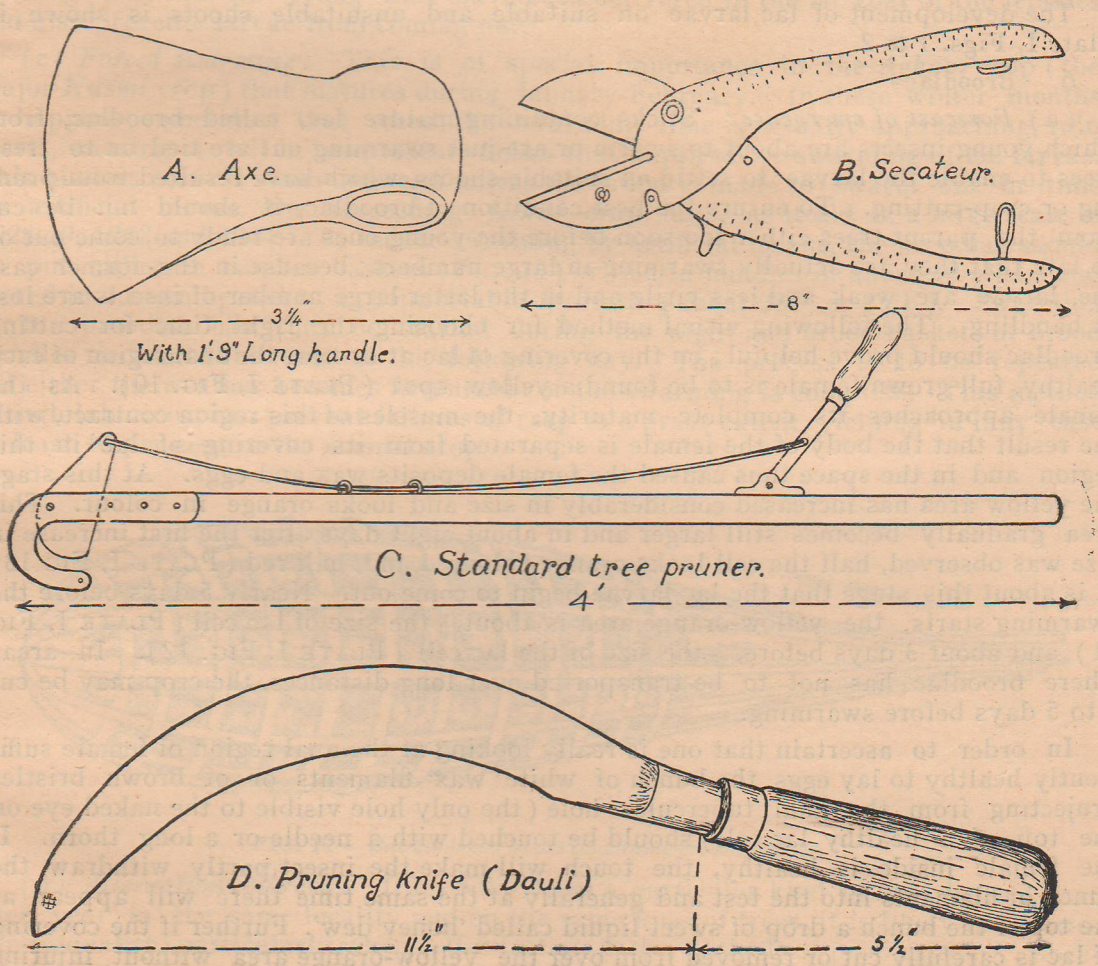

FIG. 19—*Pruning Implements*

5. The lac insect: The lac insect starts its life on the host as a tiny young bug. It chooses a place for itself and pierces the bark of the shoot with its needle-like mouth parts. Once it settles at a place, it does not move from there and simultaneously it begins to cover itself all round with the secretion called lac except at four places namely the mouth, the anus and the two breathing apertures. These four places are kept free from being covered with lac by wax glands which continuously secrete wax filaments. Day to day, the young lac insects continue to grow in size and produce more and more lac. The male as well as the female lac larva moults thrice before it becomes a grown-up male or female. The male lac insect, after the the third moult, comes out of its covering of lac and mates with a large number of females and dies some 96 hours after it has come out and started mating. On the other hand, the female remains stuck to the shoot and enclosed within its lac coat, and continues growing in size as well as producing lac till it begins to lay eggs. In the process of development from larva to grown-up female the female insect loses its legs and antennae and looks like a bag rather than an insect.

The male lac insect, from larva to the day of its coming out from its lac coat, has half the span of life of a female and hence it produces practically a negligible quantity of lac, as such it is of little economic importance.

The development of lac larvae on suitable and unsuitable shoots is shown in Plate I, Figs. 1 & 2.

6. Broodlac -

(a) *Forecast of emergence:* Sticks containing mature lac, called broodlac, from which young insects are about to swarm or are just swarming out are tied on to fresh trees to enable the larvae to settle on suitable shoots, which have resulted from pruning or crop-cutting. To ensure the best condition of broodlac, it should not be cut from the parent trees either too soon before the young ones are ready to come out or so late that they are actually swarming in large numbers; because in the former case the larvae are weak and less virile and in the latter large number of insects are lost in handling. The following visual method for choosing the right time for cutting broodlac should prove helpful; on the covering of lac at or near the anal region of each healthy, full-grown female is to be found a yellow spot (PLATE I, FIG. 10). As the female approaches its complete maturity, the muscles of this region contract, with the result that the body of the female is separated from its covering of lac in this region and in the space thus caused the female deposits wax and eggs. At this stage the yellow area has increased considerably in size and looks orange in colour. This area gradually becomes still larger and in about eight days after the first increase in size was observed, half the cell looks orange-coloured and, half red (PLATE I, FIG 13) It is about this stage that the lac larvae begin to come out. Nearly 5 days before the swarming starts, the yellow-orange area is about $\frac{1}{4}$ the size of lac cell (PLATE I, FIG 11) and about 3 days before, $\frac{1}{3}$ the size of the lac cell (PLATE I. FIG. 12). In areas where broodlac has not to be transported over long distances, the crop may be cut 3 to 5 days before swarming.

In order to ascertain that one is really looking at the anal region of female sufficiently healthy to lay eggs, the bunch of white wax filaments or of brown bristles projecting from the anal tubercular hole (the only hole visible to the naked eye on the top of a healthy lac cell) should be touched with a needle or a long thorn. If the female inside is healthy, the touch will make the insect partly withdraw the bunch of filaments into the test and generally at the same time there will appear at the top of the bunch a drop of sweet liquid called 'honey dew'. Further if the covering of lac is carefully cut or removed from over the yellow-orange area without injuring

the female, there will be found inside the cell small pieces of wax and eggs and larvae living and crawling on the wax (PLATE I, FIG. 14). An individual lac larva is shown in Plate I, Fig. 15.

(b) *Cutting & storing of broodlac:* A cultivator rarely cuts his broodlac at the proper time. He cuts it either about a month before the actual swarming of lac larvae, or when the swarming of lac larvae has actually started. The former practice which is common in Bengal and many hot districts, is usually carried out in the case of *Baisakhi* crop, the result being frequent failures of lac crops due to weakening of the brood (compare PLATE I, FIGS. 1 & 2) and lowered vitality in the lac insects. The latter practice leads to wasting of lac larvae and to self-infection of trees even when the cultivator does not so intend. Broodlac should not be cut more than 8 days before swarming, and as far as posible should be used for infecting the trees either before the swarming actually starts or when it has just started.

After broodlac has been selected from the crop cut or imported from outside, it must be stocked in well-ventilated rooms or in shade in open but covered enclosures, and must not be kept in closed baskets or sacks, because rain, moisture and heat allow growth of fungus over the anal openings. The growth of fungus over and in the anal opening weakens the young that have been delivered in the lac coat of the females and also prevents larvae from coming out.

(c) *Forced swarming:* This is of special importance in the *Aghani* crop (the major *Kusmi* crop) that matures during January-February. In these winter months it happens sometimes that when the swarming time is actually approaching, rain starts, causing a fall in temperature below that required for swarming of lac larvae. This hinders natural swarming, and unless the brood is made to swarm out in time by artificial means, the succeeding *Jethwi* crop fails, as it did on a large scale in 1928-29, 1942 and 1944. To induce swarming by artificial means, the broodlac should be put either in bamboo baskets (FIG. 16) or tied in bundles of about 10 sticks and stored in a room heated to a comfortable warmth (about 28C° or 83°F). Swarming of the broodlac can thus be started during the night and brood baskets or brood bundles tied on to the trees on the following day. The process is to be repeated till either the weather becomes favourable or the swarming is complete. This method though laborious, can prevent failures of crop to a great extent, yielding in any case at least 40 per cent of the normal crop.

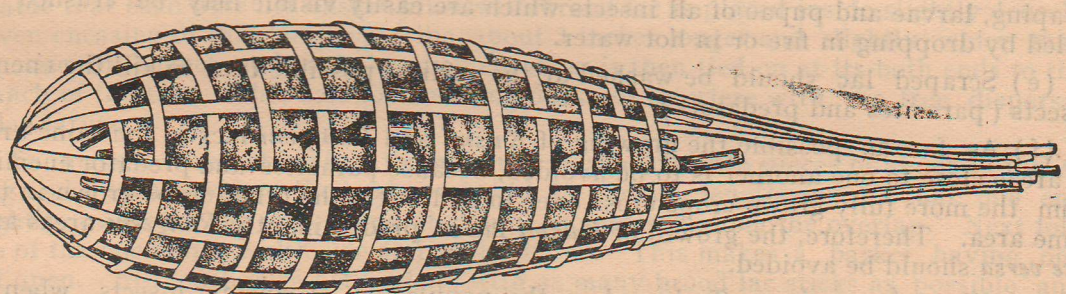

FIG. 16— *Bamboo-brood basket containing broodlac sticks.*

(d) *Alternation of brood:* If broodlac from a particular kind of host is used year after year in the same locality and on the same kind of trees, it is likely to deteriorate in quality, particularly when self-infection is the method of propagation. Moreover, if there are more than one kind of host in a locality, it is advantageous to use

them for the crops and seasons they are individually best suited to. Hence alternation of brood and host is advisable. For this purpose *Acacia catechu* (*khair*) which is found more or less widely distributed but is rarely used for lac cultivation, deserves particular attention, in that it can be used to grow *Rangeeni* as well as *Kusmi* crops. It is the only host so far known which can be successfully and regularly alternated with *kusum* to grow lac crops. The stick lac produced on it with *kusum* brood is as good in quality as pure *kusum* and fetches about the same price.

The main disadvantage of *khair* is that it can be used to grow only either the *Aghani* or the *Katki* crop and not the *Jethwi* or the *Baisakhi* crop. It should, therefor, be infected only in June-July with either *kusum* or *ber* or *palas* broodlac.

Mature lac from *khair* shoots and sticks falls or breaks off easily, hence caution in collection is necessary.

7. Insect enemies of the lac insect: Notwithstanding the use of good host trees and of properly selected broodlac, crops are often found to be to a greater or less extent damaged by parasites and predators which kill the lac-producing insect. The extent of such destruction can be minimized by taking the following precautions:

(a) Use only healthy brood, which should be carefully selected. Parasitized and damaged encrustations should be discarded and *not* used as brood.

(b) Remove brood from the trees after sufficient number of lac larvae have come out and settled on the shoots; in no case should brood be on the trees for more than 3 weeks.

(c) At the time of crop-cutting, except as detailed below no portion of the crop should be left on the tree for natural infection as this facilitates the breeding and increase of insect enemies of lac.

In the case of *ber* and *palas*, in localities which have a severe hot weather natural infection should be allowed in June-July as earlier explained.

Natural infection may be allowed in the case of *kusum* in January-February, if the *Aghani* crop has been poor and continuous rains are likely to interfere with crop-cutting. This will allow better settlement of lac larvae than artificial infection under such conditions.

(d) Scrape lac from sticks as soon as possible after the cutting of crop, as this operation reduces multiplication of enemy insects (parasites and predators). During scraping, larvae and pupae of all insects which are easily visible may be crushed or killed by dropping in fire or in hot water.

(e) Scraped lac should be washed at the earliest possible time to kill the enemy insects (parasites and predators).

(f) As far as possible the growing of *Kusmi* and *Rangeeni* lacs in the same area or areas close to one another is to be avoided, because parasites and predator enemies from the more fully grown crops cross over to and infect the other crops grown in the same area. Therefore, the growth of *Kusmi* lac in predominantly *Rangeeni* areas and *vice versa* should be avoided.

(g) *Water-immersion* — To keep low the population of enemy insects, when a crop is harvested all the lac sticks not required for brood lac should be tied into bundles along with fairly heavy stones or brick and immersed under water in a fenced area. Wherever possible, running water should be preferred for immersion, but if lac bundles are to be immersed in stagnant water e.g. in ponds the water level should be over a foot high from the submerged bundles of lac. The bundles of lac should remain under water for 3 to 4 days and after that they should be removed and dried

in shade and scraped while the lac sticks are still wet. The *phunki* brood lac sticks as soon as removed from the trees should also be treated in the same manner. This simple method kills practically all the insects in lac. Operations should be carefully done so that the colour of lac does not darken.

The additional advantage of this treatment is that lac can be easily scraped from wet sticks hence the cost of scraping is considerably lowered and the quantity of dust lac being low, the quality of sticklac (*dal*) improves.

(h) Infection of brood lac on trees with wire-net baskets as brood containers (FIG. 20). In areas where lac is introduced for the first time and in areas where enemy insects have become a menace, brood lac should be packed in 60 to 30 mesh wire-net baskets about 12 inches long and 3 inches in diameter and infected on trees. The mesh allows the lac larvae to filter out and entraps all the enemy and other insects bigger in head width than the mesh of the net.

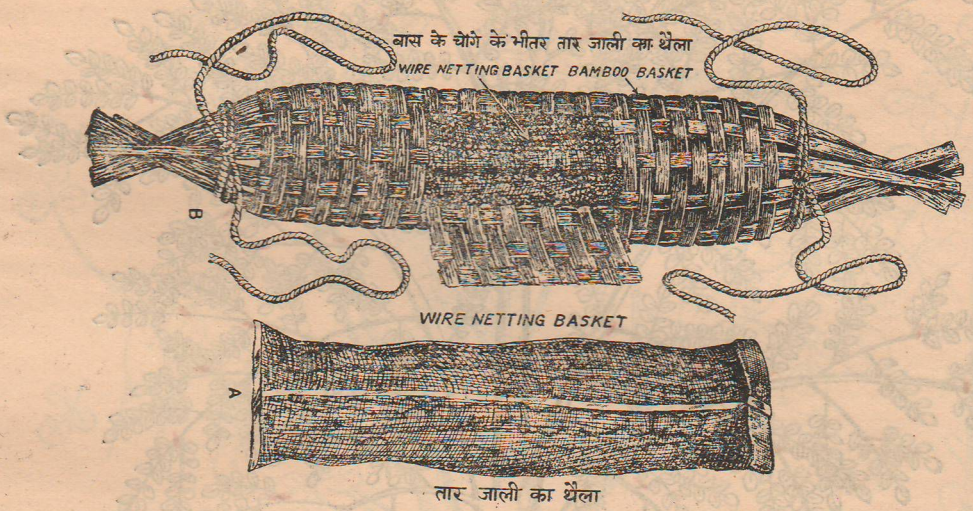

FIG. 20

To prolong life and utility of wire-net baskets and to prevent damage to them as well as to enclosed brood lac from squirrels and rats, it is economical as also advisable that each wire net basket filled with brood lac is placed inside slightly loosely woven encasing of thin bamboo strips about 3 inches longer and slightly wider than the size of basket and each bamboo encasing is then tied on at its both ends to the branch of the tree. This bamboo encasing does not interfere with the free dispersal of lac larvae.

To make a wire net basket, the wire net may be cut into pieces of about 13 inches long and 8 inches wide. Each piece should be folded lengthwise so that one end slightly overlaps the other and it should be soldered along the overlap. Next fold one of the open ends widthwise and solder it too. This makes a basket having one end open. Fill such wire net baskets with as many brood lac sticks as possible and then close the open end by folding twice. Thus brood lac is enclosed in the wire net basket.

Use of wire net baskets as brood containers has an additional advantage in that it prevents from the infected brood lac wastage of about 7 per cent stick lac which otherwise during handling and due to other causes falls off the lac sticks on the ground and thus gets lost.

FIG. 17 — *Showing how a* ber *tree should be partially pruned. Red marks show the places where the shoots have to be cut.*

FIG. 18 — *Showing how a* palas *tree should be partially defoliated*

After infection is over, bamboo encasings with wire net baskets should be removed from trees and stored as such in a safe place for about two months. By this time most of the enemy insects would have come out of brood and died of starvation inside the wire net baskets. The *phunki* brood lac should then be taken out and scraped and the wire net baskets and bamboo encasing cleaned and stored for future use. Alternatively the wire net baskets may be taken out of bamboo encasings and packed in ordinary unplastered (un-cow-dunged) baskets in household use and treated as described under water-immersion. Whichever method is adopted after lac sticks are taken out from the wire net basksts, these and the bamboo encasings should be carefully cleaned and stored for future use.

Various types of insect damage to lac crop are shown in Plate I, Figures 3 to 6.

8 **Protection of crops in summer:** *Kusum* is almost an evergreen tree and lac crops on it are not greatly exposed to the heat of the sun during April to June, while during the same period the crops on *ber* and *palas*, in the absence of new and fresh leaves, often soften due to high day temperatures resulting in premature death of lac insects.

To reduce such loss, *ber* trees should be lightly pruned, just before infection in October, or infected trees should be similarly treated in December, it being a matter of experience as to which of these two practices should give better results in a particular locality. Branches, which at their base are thinner than a man's thumb, and small shoots thinner than the little finger of a man should be pruned off close to their base. The result of such pruning is to promote early growth of leaves which shade the lac crop in summer The type of pruning is illustrated in figure 17. If a *ber* tree is partially pruned after infection, then chiefly branches or shoots not carrying lac or only sparsely covered with lac, and also shoots having preponderance of males (PLATE I, FIGS. 7 & 8) should be cut.

Similarly in the case of *palas* trees just before infection in October, the leaves should be removed by hand or with a long stick, allowing only 3 leaves to remain at the the top of each shoot. This ensures larval settlement only on shoots and not on leaf stalks and proves helpful for two reasons. First, without defoliation a considerable amount of brood is wasted by the settlement of larvae on leaf stalks which fall in spring; this is avoided by the leaf stalks being already removed. Secondly, as the trees normally remain bare throughout the greater part of summer, the insects that settle on the branches also die inside the encrustation owing to the strong sun and very little brood survives till July. But artificial removal of leaves induces fresh leaves to appear in the early part of summer, which by providing necessary shade protect the lac crop from the sun.

9. **General:** The criterion of successful cultivation is to produce the maximum possible amount of lac from a certain group of trees with minimum possible fluctuations in the yield from year to year.

In lac cultivation, production of enough good broodlac is the *key point*; a cultivator, who cannot produce broodlac at least to cover his own requirements, can never be successful. Purchase of broodlac is always expensive. Broodlac may even be unobtainable if the season has been very adverse. The necessity of purchasing broodlac more often than not will swallow any profit a cultivator might have made. The sale of broodlac on the other hand is remunerative. Therefore, the object of a cultivator should be:

(i) To produce broodlac in excess of his own requirements in each season [i.e. June-July (*asarh-savan*), October-November (*katik*) and January-February (*paush-magh*)].

(ii) To divide and group his trees in such a way that the largest possible number

of trees are always in use and that it is convenient to guard and cultivate lac on them at the minimum possible expense.

(iii) To have ready for infection properly pruned or cropped trees and infect them at the right time.

(iv) To produce the largest possible quantity of healthy lac free from enemy insects.

(v) To adopt methods of cultivation that will mitigate effects of adverse climatic conditions and facilitate production of continuous and regular crops.

(vi) To alternate brood and hosts wherever convenient.

EXPLANATION OF PLATE I

FIG. 1. High mortality in developing lac larvae due to unsuitable shoots or weak brood or over-infection, X 5.

FIG. 2. Healthy and normally developing lac larvae, X 5.

FIG. 3. Lac cells attacked by parasites, X 6.

FIG. 4. Lac sticks damaged by predator *Eublemma amabilis*, natural size.

FIG. 5. Lac stick damaged by predator *Holcocera pulverea*, natural size.

FIG. 6. Lac cells damaged by predator *Chrysopa* sp., X 9.

FIG. 7. Lac stick showing preponderance of males, X 6.

FIG. 8. Lac stick showing less males than females, X 6.

FIG. 9. Wingless male, X 24.

FIG. 9a. Winged male, X 24.

FIG. 10. Full-grown female lac test, yellow spot on the posterior side below the anal tubercular opening, highly magnified.

FIG. 11. Full-grown famale lac test showing yellow area about 5 days before emergence of lac larvae in *Rangeeni* and *Jethwi* crops and 9 days in *Aghani* crop, highly magnified.

FIG. 12. Full-grown female test showing yellow area about 3 days before emergence in *Rangeeni* and *Jethwi* crops and 5 days in *Aghani*, highly magnified.

FIG. 13. Full-grown female lac test showing yellow area when emergence of lac larvae actually begins, highly magnified.

FIG. 14. Female lac test of Fig. 13 stage opened from the hind end and showing lac larvae, with wax filaments and contracted mother lac insect, highly magnified.

FIG. 15. A lac larva, X 60.

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