Bulletin No. 49

WHAT EVERY LAC CULTIVATOR OUGHT TO KNOW

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Question 1—WHAT IS LAC ?

Lac is a resinous secretion of an insect which lives on the sap of its host plant. There are several kinds of insects which produce lac, but the most common one is called *Laccifer lacca*. There is a large number of widely different kinds of plants which serve as hosts for lac insects. Lac is the only resin of animal origin of any commercial importance.

Question 2—WHERE IS LAC CULTIVATED ?

Lac is cultivated mostly in India and to a small extent in Pakistan, Burma, Indo-China, Annam, Cambodia, Federated Malaya States, Formosa and Thailand. In India the areas of major importance for lac cultivation are Chota Nagpur in Bihar, Orissa, Madhya Pradesh, West Bengal (1), the Uttar Pradesh, the Madhya Bharat and Assam.

Question 3—WHAT ARE THE USUAL HOST PLANTS OF THE LAC INSECT ?

The plants on which the lac insects thrive are called lac hosts. The lac insect can lead a healthy life only on certain plants in particular localities. The number of host plants is very large, but it is commonly grown on Ber (*Zizyphus Jujuba*), Palas (*Butea Monosperma*) and Kusum (*Schleichera trijuga*). It grows well on Ghont or Kakor (*Zizyphus Xylopyra*) in M.P., and Arhar (*Cajanus indicus*), Bolmengo (*Grewia multiflora*) and Gangma (*Lea crispa*) are good hosts in Assam. Jallari (*Shorea talura*) is a good host in Mysore and Madras, Babul (*Acacia arabica*) in Sind (Pakistan) and Enterolobium saman (*Rain tree*) in Indo-China.

Question 4—WHAT IS SWARMING ?

The process of coming out of the young (larvæ) of the lac insect one by one from the lac coat is called *swarming*.

Question 5—WHAT DO THE TERMS KUSMI AND RANGEENI LAC MEAN ?

Kusmi lac means that it has been grown either on Kusum tree or from Kusmi seed (*brood lac, vide Question 10*) on some other kind of tree. The swarming seasons for *Kusmi* lac are June-July and January-February in Northern India. Southern India has no *Kusum* brood of its own. The

Forest Utilization Department of the Madras Government imported from Ranchi *Kusum* brood in January 1932 and infected with it Kusum in the Lac Farm at Vannathiparai, Madura District. So far the brood has been swarming in different months in each crop every succeeding year and has not yet been able to fix its swarming periods. This is due to equable climate and the crop periods vary from 5 to 6 months.

Rangeeni lac means that it has not been grown on Kusum tree or from Kusumi seed (*brood lac*). The swarming seasons for *Rangeeni* lac are June-July and October-November in Northern India, and due to different climatic conditions in Southern India the swarming seasons are May-June and October-November.

Question 6—HOW MANY CROPS OF LAC ARE THERE IN A YEAR ?

There are in all four crops of lac in a year in Northern India, two crops for *Rangeeni* lac called the *Baisakhi* and the *Katki*, and two for *Kusmi* lac called the *Aghani* and the *Jethwi*. But the number of crops produced in a particular locality depends on whether both *Rangeeni* and *Kusmi* lac are cultivated in it or only one of these. Of the two *Rangeeni* crops, the *Katki* crop is infected in June-July and matures in October-November, the *Baisakhi* crop is infected in October-November and matures in June-July, and of the two *Kusumi* crops the *Aghani* is infected in June-July and matures in January-February, the *Jethwi* is infected in January-February and matures in June-July.

In Southern India, of the two *Rangeeni* crops grown on Palas (*Butea monosperma*) the *Katki* crop is infected in May-June and matures in October-November and the *Baisakhi* crop is infected in October-November and matures in May-June. Of the two *Kusumi* crops, the swarming periods vary from crop to crop.

Practically all over India, each kind of host tree gives only two crops in a year, but in Mysore and other parts of Southern India, Jallary (*Shorea talura*) gives three crops in about thirteen months. Each of these crops does not mature in the same month or months year after year as it does in any one particular year, the periods of crop maturity shift from one month to another from year to year or In a year or two; however, very broadly it may be said that the first crop grown on Jallari, corresponding to the *Katki* of Northern India, is infected in June-July and matures in October, the second crop is infected in October and matures in March, the third crop is infected in March and matures in June-July.

Question 7—IS PRUNING OF HOST TREES NECESSARY ?

The young (larvæ) of the lac insect prefer ripe but new and juicy shoots on which to settle and feed. They are unable to feed on hard shoots. A tree should, therefore, be pruned sometime prior to its being used for lac cultivation to ensure the maximum number of shoots in suitable condition for colonisation by lac larvæ. Unpruned trees, however, can be utilised for lac cultivation but they do not yield good crops.

While pruning a tree, branches more than one inch in diameter should not be cut as far as possible. Branches half an inch or less in diameter should

be cut close to the branch or trunk from which they arise. Branches more than half an inch in diameter should be cut at a distance of at least one and a half foot from the base.

Question 8—WHEN IS A TREE FIT FOR CARRYING LAC CROP AFTER PRUNING ?

The interval between pruning a tree and growing a lac crop on it depends on the host used. In the case of Palas (*B. monosperma*) and Ber (*Z. Jujuba*) to grow a *Katki* crop, trees should be pruned in February, and to grow a *Baisakhi* crop in April, *i.e.*, both Palas and Ber are fit for infection six months after pruning. But Kusum (*S. trijuga*) is generally not ready to grow a goodlac crop till about one and half years after pruning. The pruning times for Kusum are January-February and June-July.

Question 9—HOW SHOULD A CULTIVATOR GROUP HIS TREES TO GROW CONTINUOUS SUCCESSFUL LAC CROPS.

It depends on the kind of host used. To grow continuous and good crops on Palas (*B. monosperma)* and Ber (*Z. Jujuba*), the cultivator should divide his trees into three groups in the ratio of 1:3:3 As far as possible the small group i. e. group I (containing 14% of the total number of hosts) should be central, the two large groups II and III being on either side or around the smaller (group I). The group I should be used every year to grow the *Katki* (June to November) crop and it should be cropped completely in (October-November). The groups II and III should be used alternately to grow the *Baisakhi* (October-July) crop. In June-July, only shoots which are covered with dead lac should be cut and all shoots which are bearing mostly living lac should also be cut and used to infect Group I trees. The remainder of lac in these trees should be left for natural infection for the *Katki* crop, the crop being cut completely in October-November. This system gives about nine months to one years rest to each tree after yielding a crop, and after the first pruning, for each group, the crop reaping will also serve as pruning.

In the case of Kusum, the trees should be divided into four groups and each group should be used to grow every fourth crop. After the first pruning the crop reaping also serves the purpose of pruning.

Question 10—WHAT IS INFECTION (INOCULATION) OF TREES AND HOW MANY KINDS OF INFECTIONS ARE THERE ?

The process by which the young (larvæ) of the lac insect get associated with their host is called infection (inoculation). There are two kinds of infection, (i) Artificial and (ii) Natural.

Artificial infection consists in cutting branches bearing mature healthy lac from which lac larvæ are about to swarm into pieces of convenient lengths, generally from six inches to one foot. Lac in this condition is known as *brood lac*. These brood lac sticks singly or in bundles of two or three are tied to the branches of the host trees by fibres or strings, or are simply interlaced among the branches and shoots of the host, in such a way that there is maximum contact between the brood lac sticks and the new branches of the host.

Natural infection is that when instead of removing the lac from tree when it is mature and about to swarm, all or part of it is allowed to remain on

the tree uncut to swarm *in situ* and the larvæ are allowed tc infect the same host again.

The practice of natural infection in spite of its simplicity, is not recommended except under Special circumstances. Trees thus cultivated do not receive periodical rest, uniform infection is never possible and regular crops cannot be obtained. It also tends to favour multiplication of insect enemies of the lac insect. Therefore, wherever possible artificial infection should be given preference.

Question 11—HOW LONG SHOULD BROOD LAC STICKS BE KEPT ON THE TREES ?

This depends on the amount of brood lac available and infected. If a cultivator has excess of brood lac which he is not able to sell, he should infect his trees with more brood than would normally suffice and remove it from the trees as soon as the suitable branches and shoots have been properly covered. The same should be done even when only a normal quantity of brood lac has been used. But in no case should the brood lac be left on trees for more than 3 weeks, because within 3 weeks practically the swarming is over and the larvæ get themselves established on the branches. If then brood lac is left on the trees for more than 3 weeks a few lac larvæ may still emerge from the brood, but the enemy insects of lac inhabiting the brood continue to emerge in fair number even after that time and attack the new crops.

Question 12—WHAT IS LARVAL SETTLEMENT ?

The lac larvæ come out in large numbers from brood lac and crawl on to the branches of the host trees. There they settle on suitable young shoots which have resulted from previous pruning or through natural growth and force their needle-like mouth parts (proboscis) in to the bark of the shoots and start to feed on the sap of the host. Larval settlement is very dense and once a larva settles at a place, it does not move from there and gradually grows into an adult male or female insect as the case my be.

Question 13—HOW IS ONE TO DIFFERENTIATE A MALE LAC CELL FROM A FEMALE ?

The male and the famale lac larvæ are extremely similar and can be differentiated only by experts and under high magnification with a magnifying glass or microscope. But the lac cells (coats) produced by male and female larvæ differ in shape and can be easily distinguished with the naked eye after about four weeks' growth in the case of *Katki Aghani*, and *Jethwi* crops and about 12 weeks in the case of *Baisakhi* in Northern India.

The male cell is oblong or roughly cigar-shaped and the female is more or less oval or round.

Question 14—DO THE MALE AND FEMALE LAC INSECTS PRODUCE EQUAL QUANTITIES OF LAC AND HAVE EQUAL SPAN OF LIFE ?

The male and the female larvæ take the same time to develop into adult insects; abous 6-8 weeks in the case of *Katki*, *Aghani* and *Jethwi* crops and about 14-16 weeks in the *Baisakhi* crop in Northern India. But the male insect, as soon as it becomes an adult, comes out of its lac coat and ceases to

produce any more lac. It walks over the lac encrustation and goes on mating, without feeding, with one female after another for about four days and then dies. During this period both the male and the female insects produce very little lac. Hereafter, it is the females that live on the tree and produce the entire lac crop.

Broadly speaking, the male lac insect from the larva to the adult stage lives for about two months in the case of *Katki*, *Aghani* and *Jethwi* crop and four months in the case of *Baisakhi* crop and the female insect from larva to adult lives for about four months in the case of *Katki*, six months in *Aghani* and *Jethwi* and eight months in the *Baisakhi* crop.

Question 15—WHAT IS THE RATIO OF MALES TO FEMALES IN A CROP ?

On the average there are about 20 per cent. males in the *Katki* and *Aghani*, 40 per cent in the *Baisakhi* and 30 per cent in *Jethwi*.

The males in the *Katki* and *Aghani* crop are almost hundred per cent. wingless, while in the *Baisakhi* and *Jethwi* both winged and wingless males are found. The winged males can, however, only hop and not fly, and therefore have very little advantage over the wingless males.

Question 16—DOES THE PREPONDERANCE OF MALES ADVERSELY AFFECT THE LAC CROPS ?

The male produces negligible quantity of lac and the total produce of lac is practically from the female. Therefore, if there are more than 20 per cent males in a particular *Katki* and *Aghani* crop and more than 40 per cent males in a particular *Baisakhi* and more than 30 per cent in a particular *Jethwi* crop then that crop will be poorer than the normal even if the climatic and other conditions remain normal.

Question 17—WHAT IS THAT WOOLLY WHITE SUBSTANCE OFTEN SEEN ON LAC CELLS ?

The lac larva sits naked on the shoots and afterwards covers itself all round with its resinous secretion, called lac. However, the insect throughout its life must feed, breathe and pass out *faeces* (excreta). This would not be possible inside a lac coat, if nature had not made some provision for all these processes to go on continuously without hindrance. Nature has, therefore, provided wax glands round the mouth parts, the two breathing organs and the anus; these wax glands continuously produce wax and thus prevent these parts from being covered with lac. It is this wax, produced from round the breathing organs and the anus that looks woolly and white on lac cells, if it is not disturbed.

Question 18—DOES THE ABSENCE OF WOOLLY WHITENESS ON THE LAC-CARRYING TREES INDICATE THAT THE LAC INSECTS ON THEM ARE DEAD ?

Wax is produced continuously by every living lac insect, but the continuous production of wax results in long drawn filaments of wax only when the formation of filaments is not disturbed by external agencies such as walking of ants over the lac incrusation, rain, wind, etc. This is why on some trees or in certain parts of a tree where external disturbances are absent, the

lac looks woolly white, whereas it does not look so where they are present.

The absence of woolly white appearance of lac, therefore, does not necessarily mean that the lac insects on those twigs or trees are all dead, as is often believed by the cultivator.

Queston 19—WHAT ARE ARI AND PHUNKI LACS ?

Lac is used for manufacture in two conditons. If it is cut immature, *i.e.*, before the lac larvæ have swarmed from it and, used as such, it is known as *Ari*. If it has been cut after swarming or has been cut and allowed to swarm before use, it is known as *Phunki*.

Question 20—WHEN SHOULD A LAC CROP BE REAPED ?

The female lac insect continues producing lac almost to the last day of its life. On the average each healthy female insect in its full life in *Rangeeni* crops produces about $2\frac{1}{2}$ *ratee* (0·029 grammes) of lac and in *Kusmi* about 6 *ratee* (0·069 grammes). To produce half a seer (1 lb.) *Rangeeni* and *Kusm* lac about 15,655 and 6,580 healthy lac females are respectively required.

It follows, therefore, that to get the maximum amount of lac from his crop, the cultivator should allow the crop to remain on trees nearly up to the swarming time of lac larvae and should not cut the crop *ari*.

But in practice more than two-thirds of the *Baisakhi* crop from Palas and practically the entire crop from Ber is removed as *ari* in April-May. This practice is prevalent because the lac insects die in large numbers on these plants in the summer months due to hot winds, leaflessness of host trees and shortage of food supply both to the host plant and to the lac insect thriving on its sap.

It is, therefore, suggested that *ari* (immature) crop cutting must not be resorted to in the case of Kusum (*S. trijuga*) either in *Aghani* or *Jethwi* crop. In the case of *Rangeeni* hosts, *Katki* crop must not be cut *ari*, and in the case of *Baisakhi* crop, from the middle of April onwards only those branches should be cut *ari* on which the lac insects are actually found dead due to drought and heat.

Question 21—HOW TO FORECAST THE DATES OF SWARMING OF LAC LARVÆ ?

To get the maximum amount of lac from a crop and to avoid weakening or wasting the progeny by premature or late cutting of brood lac, the following simple method of forecasting the swarming of lac larvæ should be followed as far as possible:

There is to be found a yellow spot on the lac covering of each healthy full-grown female insect on its anal region. As the insect approaches its complete maturity, the muscles of the 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. The yellow spot now covers a considerably large area and looks yellowish orange in colour. This area gradually increases in size and in about eight days, half the insect looks orange coloured and half red. It is at about this stage that the lac larvae begin to come out. Thse changes can be observed with the naked eye.

With this knowledge, a cultivator can cut his crop from 24 hours to 8 days before the swarming of lac larvæ. In fairly large areas, the *Katki, Baisakhi, Jethwi* and *Aghani* crop should preferably be reaped five days before swarming of the lac larvæ, and brood lac should be put on the trees before swarming of lac larvæ starts. For details of this method see the pamphlet *A Simple Method of the Forecast of Emergence of Lac Larvæ* issued by the Indian Lac Research Institute, Namkum, Ranchi, or *J. Agric. Sci.*, No. 3, Part IX, 1933.

uestion 22—CAN THE BROOD LAC BE TRANSPORTED OVER A LONG JOURNEY AND SWARMING OF LAC LARVÆ CONTROLLED IN UNFAVOURABLE SEASONS ?

The delivery of eggs by the female is controlled by climatic conditions. Temperature plays a very important part both in the delivery of eggs and swarming of lac larvæ. The larvæ inside the lac encrustation are inactive, below a temperature of 20°C. (68°F.) and egg laying practically ceases below 17°C. (63°F.) in summer and 15°C. (59°F) in winter. The females subjected to temperatures lower than 17°C. (63°F.) in summer and 15°C. (59°F.) in winter retain egg-laying vitality for 4-12 days depending on the delivery stage at the time of subjection to lowered temperature and the season. The yield of lac and percentage of female in the progeny are not adversely effected as a result of subjecting the brood to lower temperatures for short periods.

It is , therefore, possible under cold storage to send mature brood lac over long distances involving a journey of even 9-10 days without any detriment to the present or future crop.

Larvæ hatching from the eggs and remaining in the covering of the mother die after 4-5 days. If the atmospheric temperature during egg lying period is unfavourable to egg lying and emergence, i.e, if it is below 18° to 20°C. (64° to 68° F.), emergence of larvæ from the brood will naturally be delayed. Such a situation may arise during January-February, the maturing time of the *Aghani* crops, as it actually did happen in the *Aghani* crop season of 1928-29 and during the infection season of the *Jethwi* 1942 and 1949 crop. Swarming of brood lac under these circumstances can be induced as follows :

(i) If the day temperature rises above 20°C. (68°F.), tying the brood to the hosts to be infected, when there is bright sunshine, will cause swarming to occur.

(ii) Keeping the brood in a warm room at a temperature of 24°-28°C. (75° to 85°F.) will cause emergence to occur. If the brood is then taken and tied to the host plants, swarming will cease, unless the day temperature exceeds 20°C., and only those larvæ which have already emerged will crawl on to the host plant. Continuous emergence will not occur. But emergence can be re-started by returning the brood to the higher temperature once again. The process should be repeated till the day temperature is above 20°C, and there is continuous swarming in the brood. Under these conditions, brood lac should be kept in bamboo baskets and not handled in single sticks or in bundles of one or two.

(iii) Subjecting the brood to a temperature of 6°-13°C. (43°-55°F.) for a period of 1-4 days will cause continuous swarming to occur in 2-3 days after

return of the brood to an atmospheric temperature above 13°C.

The importance of the above methods of forcing the swarming of lac larvæ could be realised from the fact that the average number of young produced by the lac insects in the *Aghani* crops is the lowest, and leaving the brood lac to ordinary conditions in unfavourable seasons might mean practically a total failure of the *Jethwi* crop which mainly serves as a brood crop for next *Aghani* crop.

(For details see *Bulletin No. 6, Ind. Lac Res. Inst., 1932*).

Question 23—HOW SHOULD THE BROOD LAC BE STOCKED ?

After the brood lac 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 and weakening of young that have been delivered in the lac-coat of the females.

Question 24—WHAT IS MEANT BY PURE AND CROSS STRAINS IN LAC CULTIVATION AND WHAT ARE THE ADVANTAGES OF CROSS STRAINS ?

Lac can be grown in two ways. It may be grown from crop to crop on the same kind of host, and if so, it is called a pure strain. For example if Palas (*B. monosperma*) brood lac is grown on Palas continuously from crop to crop, it is a pure strain *Palas* lac. But if it is grown alternately on two different kinds of host trees, it is called a cross strain e.g., suppose an area contains Kusum (*S. trijuga*) and Khair (*A. Katechu*) trees. In such a case Kusum is infected for the *Jethwi* (January to June) crop and the brood, produced on it in July, is transferred to Khair for the *Aghani* crop (June to January) and so on. This is known as a Kusum and Khair alternation.

Both pure and cross strains are valuable methods of cultivation, but where pure strains are grown, it is advisable to introduce fresh brood from elsewhere at intervals of three to four years to prevent deterioration, particularly in localities where natural infection cannot be avoided; and in areas where several kinds of host are available, the use of alternation regularly or occasionally is strongly advised.

A cultivator, who owns both Palas (*B. monosperma*) and Ber (*Z. Jujuba*) trees, should use Ber to grow the *Katki* crop only and Palas to grow the *Baisakhi* crop. Ber and Palas should be divided into two equal groups and one group of Ber should be used to grow one year's *Kathi* crop and the second group to grow another year's *Kathi* crop. In the same way one group of Palas should be used to grow one year's *Baisakhi* crop and the second group to grow the second year's *Baisakhi* crop. By doing so, the cultivator will get more crop than he gets at present, and he will have his own good brood. Under this system each group of Ber will get 21 months' rest before it is used for infection and each group of Palas 16 months' rest. If pruning is found necessary Ber should be pruned in February before infecting in June-July and Palas in April before infecting in October.

Question 25—HOW TO PRESERVE BROOD LAC AND OBTAIN BETTER YIELDS IN BAISAKHI (OCTOBER-JUNE) CROP ON BER (Z. JUJUBA) AND ON PALAS (B. MONOSPERMA).

Though Ber (plum) is an important host and is used extensively for cultivating both the *Katki* and *Baisakhi* crops, most of the crop on it in the *Baisakhi* season has to be cut as *ari* (see *Question 20*) between middle of April and middle of May, by which time, the female lac insect has produced only half the quantity of resin it is capable of producing in its full life.

To avoid *ari* cutting of lac and to obtain better yields in summer from Ber, partial pruning of Ber trees carrying *Baisakhi* crop in early January is recommended. It provides the plant with new leaves in hot weather.

In partial pruning of Ber, branches and shoots under 3/4 inch diameter which do not bear lac, every sparsely covered branch and those mainly covered with male lac insects are to be cut close to the base; and so also about a third of the shoots thinner than the little finger of a man should be removed from branches mainly covered with male insects. Partial pruning towards the top of the branches is more important than towards the base.

Removal of most of the crop *ari* at a time should be avoided and in its stead only those branches on which the lac insects are all actually dead, i.e., which have pitted and dry appearance should be removed at fortnightly intervals from 15th April onwards.

In the case of Palas trees, just before infection in October, the leaves should be removed by hand or with a long stick, allowing as far as possible only one leaf (each leaf has 3 leaflets) to remain at the top of each shoot. This prevents larval settlement on leaf stalks and ensures settlement on shoots only and proves beneficial in two ways. First, without defoliation a considerable amount of brood is wasted by settlement of larvæ on leaf stalks which fall in spring; this is avoided by leaf stalks being already removed. Secondly, as the trees normally remain bare throughout the greater part of summer, the insects that settle on the shoots also die inside the incrustation owing to heat and draught 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.

Question 26—ARE ANTS HARMFUL TO LAC CROPS ?

Ants are not generally harmful to lac crops as is believed by the cultivator, though some species undoubtedly pick up the crawling lac larvæ and the males at the time of their respective swarming, but the amount of damage is negligible. On the other hand, all ants, generally associated with lac insect are useful as they remove the fæces of the lac insect called 'honey dew' which is sweet and sticky, and which, otherwise mixed with dust in the absence of rains, is likely to block up the breathing organs and anal openings of the lac insects, and thus cause death by suffocation. In addition, some of them, especially the big black ant named *Camponotus compressus* and the small red ant *Solenopsis geminata*, help the lac insect by feeding on the caterpillars of the enemy moths and also picking up enemies from the scraped lac in godowns.

Question 27—WHAT ARE THE CHIEF INSECT ENEMIES OF LAC ?

There are two groups of enemy insects which attack lac crops, termed parasites and predators. The parasites are small winged insects resembling wasps and are called *Chalcids*; they lay their eggs inside the lac coat either in or on the body of the lac insect, and the young ones of these feed on the lac insect only and not on lac produced by it. The normal damage done by this class of enemies varies from 5 to 10 per cent only.

Damage by predators is far more serious, the two insects mainly responsible being *Eublemma amabilis* (the white moth) and *Holcocera pulverea* (the blackish-grey moth). The damage done by the predatory caterpillars amounts to about 35 per cent of the lac cells. The larvæ feed both on the lac insect and the lac produced by it.

Question 28—HOW TO DISTINGUISH AN UNHEALTHY LAC AND LAC DAMAGED BY ENEMY INSECTS ?

Pitted and dry yellow apperance of lac indicates that the lac is dead due to heat and drought; this condition is generally met with in the *Baisakhi* and *Jethwi* lac after the middle of April.

If at the time of crop maturity, the individual lac cells in general and the lac cells which coalesce to make up continuous encrustation of lac are less thick in growth than an average sized dry black gram (*urid*) seed, the lac should be considered unhealthy and it should not be used as brood lac as far as possible.

Lac sticks attacked by predators may bear closely spun domes or loosely spun webs by their caterpillars. The webs are generally interspersed with minute gnawed bits of lac, and white or black granular or yellow oval flat discs of the fæces of the caterpillars. In places where the predatory caterpillar is seated deep or the grub of the parasites have fully developed, the patches of lac encrustation or the individual lac cells look deep yellow instead of dark red or made up of partly deep red and partly yellow individual cells depending on the developmental stage of the lac insects. When the predator and parasite damage is in advanced stage and fairly heavy, the lac encrustation may show a number of small and big holes, all of which are bigger than the head of a pin, caused by adult parasites while coming out or by predatory caterpillars when they stop feeding and enter into a quiescent stage to develop and come out as adults.

Question 29—ARE THRE ANY SIMPLE MEASURES TO CONTROL THE INSECT ENEMIES OF LAC ?

The damage to lac crops can be considerably reduced if the following measures are regularly adopted.

CULTURAL METHODS.

1. Lac intended for use as brood lac should be cut as near to the swarming time as possible, never more than a week before.

2. In choosing lac for use as brood, healthy lac and lac showing the minimum of enemy attack should be selected.

3. Lac tied to the trees as brood should be removed as soon as the tree is sufficiently covered by the lac larvæ and in no case should it be allowed to remain on the trees for more than 3 weeks.

4. Natural infection (e. g., leaving a certain amount of brood lac called *Chanti* on the tree to swarm in *situ*) should be abandoned particularly in October-November. Exception to this rule may be necessitated in certain localities.

In the case of Ber and Palas in hot areas natural infection should be allowed in June-July to grow the *Katki* crop.

Natural infection my be allowed in the case of Kusum in January-February, if the *Aghani* crop has been poor and continuous rains during the swarming period are likely to interfere with crop cutting.

5. All lac cut from the trees not required for brood and all brood lac after use should be scraped from the sticks at once. This action alone destroys many of the larvæ and pupæ (young ones) of the enemy insects and exposes others to climatic factors and to the attack of ants. Larvæ and pupæ of all insects which are easily visible may be crushed or killed by dropping in fire or hot water.

6. If possible, the manufacturers, soon after purchasing the stick lac, should convert it into *Chauri* (seed lac). This eliminates the enemy insects which after emerging as adults try to escape into fields. Predators also breed on the stored lac.

7. In general, it is unwise to grow Kusmi lac in areas which are predominantly Rangeeni (where Kusum is found in very small number compared to other hosts) or *Rangeeni* lac in areas which are predominantly Kusmi (where Kusum is found in very large numbers compared to other hosts). Because the enemy insects, inhabiting the half mature *Aghani* crop from November to January, become a regular source of infection to the *Baisakhi* crop which start in October-November; and in the same way, the immature *Baisakhi* becomes a source of infesting with enemies the *Jethwi* crop which starts in January-February. In the same area, infection by brood lacs of the same strain *Rangeeni* or *Kusumi*), having a difference of more than 14 days in swarming dates should also be avoided.

ARTIFICIAL METHODS.

When a crop is cut, all the lac sticks not required for brood lac should be tied into bundles of convenient sizes with a fairly heavy stone or bricks and immersed under water in a fenced area in a river or stream or in a pond; wherever possible running water should be preferred for immersion, but if lac bundles are immersed in ponds, the water level should be over a foot high from the submerged bundles of lac sticks. The lac bundles should be kept under water for 3-4 days and after that removed and dried in shade and scraped. This simple method kills practically all the insects on the stick as they are not water inhabiting insects and therefore die of suffocation. The same method should be applied to the *Phunki* brood stick after they have been removed from the trees.

This process also makes scraping of lac easy and reduces the quantity of dust lac and thus improves the quality of stick lac (*Dal*).

If the above treatment is not applied then all the enemy insects, which emerge from lac not used as brood as well as from the *phunki* brood lac, fly to the fields and lay eggs in the future crop.

Question 30—FROM WHERE CAN FURTHER ADVICE AND INFORMATION BE OBTAINED ?

The Director, Indian Lac Research Institute, Namkum, Bihar, will be glad to furnish any information and help in the matter of lac cultivation. *Lac cultivation in India*, 1937, published by Indian Lac Reaserch Institute, Namkum, Ranchi, also gives some detailed information.

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