INDIAN LAC RESEARCH INSTITUTE

NAMKUM, RANCHI, BIHAR, INDIA

ANNUAL REPORT

FOR THE FINANCIAL YEAR 1949-50

1950

CONTENTS

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ADMINISTRATIVE SECTION

General — The research and other developmental activities of the Institute continued under the general guidance and direction of Dr. P. K. Bose, Director of the Institute.

The supply position in respect of chemicals and apparatus did not show marked improvement during the period ; if anything, the position after the rupee-devaluation has become more tight, particularly in respect of supplies from hard currency areas.

As usual, the Institute continued to attract a large number of visitors throughout the year from all over India. The more important of these deserving special mention are named below :

THE HON'BLE MR. RAMCHARITAR SINGH, Minister for Irrigation, Bihar.
MR. H. LAL, I.C.S., Secretary, Development Department, Bihar.
SANT NIHAL SINGH, Journalist on deputation by the Government of India.
PROFESSOR S. N. BOSE, Calcutta University.
DR. N. K. BASU, Director, River Research Station, West Bengal.

Roads and Buildings — No new construction was undertaken during the period. Plans and estimates of the proposed staff quarters and a trainees' hostel have been prepared by the Executive Engineer, Central P.W.D., and submitted to the Government of India for scrutiny and approval.

Except for urgent petty repairs during the monsoon, no major repair work was done. Roads also did not need any substantial repairs. The doors and windows of all the staff quarters were given a much-needed coat of paint. It is interesting to note that in view of the more or less satisfactory working of the Institute's lac-oil composition used last year in painting the doors and windows of the office and laboratories, and also as a further measure of service-test, fresh batches of lac-oil compositions were prepared in the laboratories and used for painting the wood- and iron-work of the staff quarters.

Library — With the exception of German journals, which are understood to have resumed publication in certain cases, foreign journals were being received regularly. There has been, however, an important change in the mode of procurement of these in that the Government of India has arranged for their purchase and supply through Trade Commissioners and similar agencies in foreign countries ; this arrangement has ensured better trade discount and, thus, besides being economical, effected saving in foreign currencies. In view of the obvious difficulty of making any kind of direct purchases from dollar areas, UNESCO introduced during this period a coupon system of book purchase from such areas. The Institute was allotted a number of coupons against which orders have been placed in the U.S.A.

The library registered during the year a total accession of 154 volumes including bound volumes of journals. A few cases of books and journals were received from the now defunct London Shellac Research Bureau and these took up considerable shelf-space. As the library is growing rather fast, provision may have to be made for more floor area in the near future.

Intensive Demonstration Scheme — Work was continued in the three States of Bihar, West Bengal, and Uttar Pradesh. The scheme suffered a temporary set-back in

West Bengal immediately after partition of the province, but considerable progress has been made now, so much so that the number of trees under demonstration has been increased from 35 in 1947-48 to over 500 in 1949. U.P. is also pushing ahead with the scheme in a very practical manner, and already a new centre has been opened. A new centre has also been opened in Bihar. Further details will be found in the report of the Entomological Section as also in the reports of the State Entomologists appended.

Training — Altogether there were 19 persons under training in lac cultivation. This number includes three officers of the Government of Burma deputed on one month's intensive training. Four persons from Bihar completed their training during the period and were posted in four demonstration centres.

Only two candidates, both nominees of members in shellac trade, joined the course of training in the industrial uses of lac. They did not, however, complete the course, but left the Institute some three months after joining it, by which time they had received training in subjects of immediate interest to them.

Extension of Lac Cultivation in Forest and Other Areas — This scheme, which is to supplement the provincial Intensive Demonstration Schemes in some important respects, was inaugurated in the latter part of 1948 and, as reported earlier, some progress was made towards its implementation during 1948-49. Since then, work on intensive survey of easily accessible forests and other areas rich in idle lac hosts was continued, resulting in a find of over 13,76,000 idle hosts during the year. Working plans for many of the areas have been drawn up and are still under consideration of the respective State Governments. More than 2,90,000 trees have been brought under cultivation during the year under report in collaboration with some of the Governments. Cost of brood, etc. supplied free or at concessional rates in this connection comes to about Rs. 27,000/-. Further details will be found elsewhere in the Report.

Staff — Mr. P. M. Glover, Entomologist, on leave preparatory to retirement since 15-1-48, retired from the service of the Committee with effect from 10-6-49. Mr. S. N. Sahay, Librarian, and Bandi Oraon, Lac Melter, retired on their attainment of the age of superannuation respectively on 15-12-49 and 1-3-50.

Lohra Oraon was appointed as Lac Melter *vice* Bandi Oraon on 1-3-50.

The post of Personal Assistant to the Director, Indian Lac Research Institute, created in 1942 was abolished during the period and a new post with the designation " Technical Assistant " to the Director created in its place with effect from 1-8-49 on a revised scale of pay. Mr. B. Mukhopadhyay, M.Sc., who had been the P.A., was promoted to fill this new post.

The post of Lac Information Officer (India) held by Mr. S. Ranganathan since its creation in 1945 was abolished with effect from 1-10-49, and as a result Mr. Ranganathan reverted to his substantive post of Senior Research Assistant, re-designated as Scientific Officer after revision of pay scales.

Revision of Pay Scales of Staff — The revision of the pay scales of certain Class I Research Assistants and higher officers of the Institute which had been pending for a long time was completed during the period under report. As a result of the revision, the erstwhile Class I Assistants' cadre has been split up into two groups, one group being designated as Scientific Officers and the other as Research Assistants in a selection grade.

The Staff Club and the Co-operative Stores — Following a suggestion of the President, Indian Lac Cess Committee, who visited the Institute in March 1949, a Ladies' Section has been added to the Staff Club, which naturally called for additional provision in reading materials and recreational facilities. In view of the tight financial position of the Club, the Lac Cess Committee afforded some relief to the Club by remitting its electricity and water charges with effect from 1-8-49.

A Co-operative Stores has been opened, and is being run by the members of the staff all working in an honorary capacity. The Stores has recently been registered as a Co-operative Stores with the Registrar of the Co-operative Societies, Bihar.

ENTOMOLOGICAL SECTION

Dr. H. S. Pruthi and Dr. N. C. Chatterjee, the two Inspectors appointed by the Government of India, inspected the Section.

The strength of the staff was short by two Research Assistants and one Museum Assistant throughout the period.

HOST TREES

1. Improving Crop Production on *Palas* (*Butea monosperma*, syn. *Butea frondosa*) by Artificial Partial Defoliation in Kundri Forest Area

In October 1948, 3,899 partially defoliated trees were infected with 55 maunds 5 seers of broodlac for the *Baisakhi* 1948-49 crop. The crop grew under favourable climatic conditions yielding in July 1949, 40 maunds and 25 seers of good-quality surplus broodlac, besides a good quantity left on trees for self-infection. 1,134 *palas* trees were infected with the brood obtained. The resulting *Katki* crop in October 1949 amounted in all to 159 maunds 7 seers of good broodlac, which in its turn was used to infect 5,031 trees as made up of 4,730 defoliated *palas*, 267 undefoliated *palas*, 18 *F. glomerata* and 16 *ber* trees.

It may be noted that broodlac suppliers from all over Chotanagpur could supply only 10 maunds of *palas* broodlac in July and 15 maunds in October 1949, although they had been asked to supply much higher quantities.

The performance of Kundri appears to be quite satisfactory considering that till July 1949 there was practically no lac on the trees of villagers within 15 to 20 miles of Kundri and that in October 1949 only one person in Sahad, a village adjoining Kundri, was reported to have some lac on his trees.

It should be possible to obtain still better results in Kundri with proper supervision.

2. Determination of the most Suitable Pruning Methods and Seasons for *Kusum*

As reported in the Annual Report 1948-49 'apical' as well as 'surface' pruning is being tried. Data regarding the growth of shoots as resulting from these types of pruning are given in Table I.

Lac Crops on Kusum — It was mentioned in the 1948-49 Report that owing to excessive heat, the *Jethwi* 1948 crop was poor all over Chotanagpur, but that in Hesal the crop was better than elsewhere ; this, however, led to a concentration of enemy insects from neighbouring areas into Hesal, and affected the *Aghani* 1948-49 crop badly. Since the progeny of the same enemy-infected lac is being used for successive infections in Hesal, the enemy effect is being more and more pronounced as one crop succeeds another. As a result, there has been poor swarming of lac larvae in January-February 1950.

Experiments were continued on the growing of lac on shoots of different ages and the results are given in Table II. In assessing the results, it should be noted that the six-month coupé under the *Aghani* crop is the one having the worst topography, and that, in addition, the trees undergoing 'surface' pruning have still to adapt themselves to this new type of pruning, as pointed out in previous reports.

3. Investigations into the Economics of Utilizing *Palas* for the *Baisakhi* Crop only and *Ber* for *Katki* Crop only

Investigations were completed last year.

TABLE I

Tree No.	Type of pruning	Date of pruning	Age of first primary shoots in months at the time of infection	Growth and average length of shoots up to 31st March, in inches				Remarks
				Primary	Secondary	Tertiary	Sub-tertiary	
1	2	3	4	5	6	7	8	9
180	Apical	6-7-48	18	6·0	5·6	5·3	Nil	Tips dried.* Settlement of larvae on thin primaries and 50 per cent secondaries.
14	do	28-1-49	18	4·6	3·5	...	...	Tips dried.
124	do	25-6-49	18	3·9	5·7	5·5	...	Tips dried.
134	do	17-1-50	18	7·0	3·3	...	...	Tips of secondaries damaged.* Tertiary buds did not develop into shoots.
114	do	4-7-48	12	4·0	1·4	1·6	...	Tips dried or damaged in primaries and secondaries. Larvae settled and survived on thin primaries and secondaries, but did not survive on secondaries.
161 taken in place of 224 of last year	do	26-1-49	12	3·0	3·6	5·3	5·6	Tips damaged. Hence sub-tertiaries have also appeared. Average length is 4·4. No settlement on primaries. Settlement poor on others.
36	do	23-6-49	12	6·0	9·1	...	...	Mostly dried, few damaged.
128	Surface	9-7-48	12	3·3	1·9	5·0	4·3	Tips dried or damaged. Poor settlement on primaries, on others heavy. Lac survived on tertiaries.
190	do	1-2-49	12	9·4	3·7	...	...	Tips dried or damaged. Settlement on primaries and secondaries.
42	do	24-6-49	12	4·3	3·8	...	...	Tips damaged.
70	do	26-1-49	6	11·7	2·5	...	...	Settlement on primaries and secondaries.
214	do	25-6-49	6	6·7	3·0	7·5	...	Damaged or dried. Settlement on primaries.
70	do	14-1-50	6	2·9	...	...	...	...
114	Apical	17-1-50	12	2·3	...	...	...	Damaged.
134	do	17-1-50	18	3·2	...	...	...	Damaged.
128	Surface	18-1-50	12	1·6	...	...	...	...

*Natural drying quickly follows stoppage of growth, and the damage to the tips is generally caused by insect pests.

TABLE II

BROOD TO YIELD RATIO FROM *Kusum* SHOOTS OF VARYING AGES

Ages of shoots in months and type of pruning	Ratio of brood to yield of scraped lac	
	Jethwi 1949	*Aghani* 1949-50
18 Apical	1 : 3·1	1 : 3·3
12 do	1 : 1·6	1 : 4·2
12 Surface	1 : 2·6	1 : 2·6
6 do	1 : 2·6	1 : 1·7

4. INVESTIGATIONS ON THE POSSIBILITIES OF *Albizzia lucida*, *Ficus bengalensis* AND *Ougenia dalbergioides* BEING USED AS *Baisakhi* BROOD-PRODUCING HOSTS

Baisakhi broodlac survived on *A. lucida* as well as on *O. dalbergioides* (*pandan*). The ratio of brood to yield of scraped lac in the case of the former was 1 : 2·6 and in the case of the latter 1 : 2·0.

F. bengalensis, as stated in last year's Report, is not available in Namkum. Hence an arrangement has been made in co-operation with the Forest Department, Bihar, to infect a few of these hosts in Mako, and the results will be reported in due course.

5. INSECT ENEMIES OF LAC

(*a*) *Proper Harvesting, Storage and Disposal*

In the case of *Baisakhi ari* (immature) lac, the loss due to enemy insects during storage was 0·94 per cent in two months ; the loss due to the same cause in the case of mature fresh *Aghani* was 2·6 per cent in four months, and 17·2 per cent in the case of mature fresh *Katki* crop for a storage period of three months and a half.

(*b*) *Use of Wire-gauze Baskets as Brood Containers during Infection, as Control against Enemies of Lac*

(i) *Prevention of Enemies* — Wire-gauze baskets were used as containers for *kusum* broodlac during infection and the results of catch are given below (TABLE III).

TABLE III

CATCH OF ENEMY INSECTS IN WIRE-GAUZE BASKETS

Month	Wt. of broodlac used in infection Sr. ch.	No. of baskets	Catch of		
			Eublemma	*Holcocera*	*Chalcid*
July 1949	3 12	12	59	48	379
Jan. 1950 (Namkum)	2 0	16	6	19	57
Feb. 1950 (Oreya)	6 0 about	33	254	388	Not counted

TABLE IV

PERCENTAGE OF STICKLAC (SCRAPED LAC) SAVED

Brood used	In wire-gauze baskets: *Phunki* recovered	Sticklac obtained	Sticklac per md. of brood	Without wire-gauze baskets: Brood used	*Phunki* recovered	Sticklac obtained	Sticklac per md. of brood	Sticklac saved by wire-gauze baskets
1	2	3	4	5	6	7	8	9
Sr. ch.	Sr. ch.	Sr. ch.	Sr. ch.	Sr. ch.	Sr. ch.	Sr. ch.	Sr. ch.	
At Namkum								
Lac sticks 25 0	17 0	11 6	18 3	25 8	17 0	8 8	13 5	12·3%
Dal lac 17 0	15 0	15 0	35 5	19 0 (in bamboo baskets*)	15 6	15 6	32 6	7·2%
At Oreya by Demonstration Staff								
†Lac sticks 223 8	131 8	40 8	14 5	96 0	45 4	29 4	12 1	5·5%

* Villagers do not use bamboo baskets and hence they use very rarely *Dal* broodlac to propagate crops.

† Brood sticks used in baskets were poorer in encrustation than those not enclosed in baskets.

The above are only preliminary experiments; to work out fully the economics of the process, large-scale trials in isolated areas should be undertaken on a strictly comparative basis.

6. CONTROL OF INSECT ENEMIES OF LAC

(a) *By the Use of Gammexane and DDT*

Experiments were conducted with *phunki* scraped lac in two ways:

(i) *Baisakhi* as well as *Jethwi* sticklac (scraped lac) was kept under a solution of the insecticide for 24 hours. The dose of DDT or Gammexane used was $\frac{3}{8}$ oz. in 15 gallons of water.

(ii) Sticklac (scraped lac) was sprayed. The amount of DDT or Gammexane used was $\frac{3}{8}$ oz. in $\frac{3}{16}$ gallon of water.

The data on the emergence of insects from the treated and control samples are given in Table V.

The data in Table V do not indicate appreciable superiority of the insecticides (DDT and Gammexane) over plain water, as a method of controlling the enemy insects of lac.

TABLE V

EMERGENCE OF INSECTS PER POUND OF STICKLAC CAGED AFTER TREATMENT WITH DDT, GAMMEXANE, ETC.

	Description of lac		Treatment offered	Insects emerged			
				Eublemma	*Holcocera*	*Chalcid*	Beneficial and other non-enemy insects*
1.	*Rangeeni Baisakhi* 1948-49		Control to 2-5	28	47	—	19
2.	do	do	Immersed in DDT sol.	2	6	—	8
3.	do	do	Immersed in water only	—	1	—	17
4.	do	do	Sprayed with DDT sol.	7	2	2	7
5.	do	do	Sprayed with Gam. sol.	—	2	—	—
6.	*Kusmi Aghani* 1948-49		Control to 7-11	17	59	8	9
7.	do	do	Immersed in Gam. sol.	10	3	—	—
8.	do	do	Immersed in DDT sol.	11	2	1	—
9.	do	do	Immersed in water only	4	6	11	1
10.	do	do	Sprayed with Gam. sol.	9	9	—	3
11.	do	do	Sprayed with DDT sol.	19	7	7	—
12.	*Kusmi Jethwi* 1949		Control to 13 and 14	11	32	7	12
13.	do	do	Immersed in Gam. sol.	5	1	—	—
14.	do	do	Immersed in water only	4	8	1	2

* Mostly beetles emerged. All of them are scavengers.

(*b*) *By Fumigation*

Ethylene dichloride and carbon tetrachloride, singly or in combination, were tried as fumigants. Fumigation was carried out for 24 hours, the dose used being 3 oz. per 10 c.ft. The composition of the mixture was 75 parts of ethylene dichloride and 25 parts of carbon tetrachloride. The results of emergence of insects from treated lac are given in Table VI.

TABLE VI

EMERGENCE OF INSECTS FROM ONE POUND OF FUMIGATED STICKLAC

	Description of lac	Fumigants used	Number of insects emerged
1.	*Kusmi Aghani* 1948-49 mature fresh	Nil. Control to 2 and 3	98
2.	do	Ethylene dichloride and carbon tetra-chloride	100
3.	do	Ethylene trichloride	62

Ethylene trichloride was not available in June-July 1949.

However, judging by the results of experiments conducted during the last two years, fumigation shows little promise of success, and hence further investigations along the line have been stopped.

7. Biological Control

(*a*) *To Discover Suitable Alternative Hosts to Breed* Bracon (Microbracon) greeni *in the Laboratory*

With the kind co-operation of Sugarcane Specialist, Bihar, top-borer-affected cane was collected from the neighbourhood of Pusa. The main supply of other alternative hosts was obtained locally. *Crotolaria* sp. (*Junjunia*) pod- and seed-borer proved very handy.

Table VII

Living Larvae of Unnatural Alternative Hosts Collected

Month of collection	Name of the host and number	Pest of
Throughout the year except February, October and November	*Trachylepidia fructicassiella* 4985	*Amaltas* (*C. fistula*) pod-borer
January to March	*Etiella zinckenella* 553	Pea pod-borer
Throughout the year	Unidentified 9803	*Junjunia* (*Crotolaria* sp.) pod-borer.
January to March	*S. nivella* 2298	Sugarcane top-borer
February-March	*P. gossypiella* 1390	Cotton seed-borer
April to September	*Earias* sp. 242	*Bhindi* (*Hibiscus*) pod-borer
April, July	*Leucinodes orbonalis* 617	Brinjal fruit-borer
August	*Chilo zonellus* 687	Maize shoot-borer

Experiments on the use of alternative (unnatural) hosts to breed *B. greeni* in the laboratory show the following to be most suitable for the purpose, of which, with the exception of *S. nivella* and *P. gossypiella*, all are available locally and in sufficient numbers.

1. *T. fructicassiella* (*Amaltas* pod-borer).
2. Pod-borer of *Crotolaria* sp. (*Junjunia* and *Jheri*).
3. *Leucinodes orbonalis* (brinjal fruit-borer).
4. *P. gossypiella* (cotton seed-borer).
5. *S. nivella* (sugarcane top-borer).

(*b*) *Breeding of* B. greeni *on a Mass scale on Unnatural (alternative) Hosts*

During the period under report, the pod-borer of *Junjunia* was chiefly tried. However, maximum parasitization was recorded on *P. gossypiella*, and this was 73·6 per cent. The maximum number of *B. greeni* bred per host (pod-borer of *Junjunia*) was 0·9. The results of breeding are given in Table VIII. In the same table results obtained with *E. amabilis*, the natural host, are also given for comparison.

(*c*) *Cedria paradoxa*

Supplies of the braconid were received through the kindness of the Forest Entomologist, Forest Research Institute, Dehra Dun. The instalments of braconids received during the period January to August were tried on 546 larvae of ten different kinds of unnatural hosts, but of these only 9 larvae of *amaltas* pod-borer, 1 of *Junjunia* pod-borer and 1 of *toon* (*cedrela toona*) shoot-borer were parasitized. Only one adult emerged successfully from one of the parasitized *amaltas* borers.

From September to the end of March, the hosts used were the larvae of teak-defoliator, pod-borer of *Junjunia* and *Jheri*, *amaltas* pod-borer, leaf-defoliator of a flower plant, *Eublemma amabilis* and *Holcocera pulverea*. The braconid, however, could be successfully reared only on teak-defoliator, leaf-defoliator of the flower plant, *Junjunia* and *Jheri* pod-borer,

TABLE VIII

MASS-BREEDING OF *B. greeni* ON UNNATURAL HOSTS AND *E. amabilis*, THE NATURAL HOST

Host and number introduced*		Percentage parasitism	Number of *B. greeni* bred	Percentage of females	Number of adults bred per host parasitized
E. amabilis	5880	68·3	5,702	84·3	1·42
Pod-borer of *Crotolaria* sp. (*Junjunia* and *Jheri*)	14,739	40·2	5,375	76·4	0·90
T. fructicassiella (*amaltas* pod-borer)	3,711	38·4	967	66·4	0·67
S. nivella (sugarcane top-borer)	5,045	34·8	1,356	74·8	0·76
P. gossypiella (cotton seed-borer)	1,060	73·6	583	65·2	0·74
Erias sp. (*bhindi* pod-borer)	492	8·5	22	66·6	0·50
Chilo zonellus (maize stem-borer)	1,188	6·3	35	82·8	0·46
L. orbonalis (brinjal fruit-borer)	580	7·5	36	58·3	0·80
E. zinckenella (pea pod-borer)	276	29·3	22	72·7	0·27

*The number of hosts given in this table may be more in certain cases than the one given in Table VII; this is so because the unparasitized hosts from each day's breeding were re-introduced for parasitization on the following day.

and *E. amabilis*. In every case the braconid parasitized the *naked* larva of the host offered. Nine generations of the braconid were bred. The maximum percentage parasitization was 36·6, observed in the case of the leaf-defoliator of the unidentified flower ; in the case of *E. amabilis* percentage parasitization varied from 7 to 33·3.

From the preliminary experiments conducted, and judging from the bionomics, habits and structure of the braconid (*Cedria paradoxa*), it is not likely to prove efficacious in controlling either *E. amabilis* or *H. pulverea*.

8. DEMONSTRATION

(*a*) *Advice and Training*

To lac cultivators all over India advice was given through correspondence and personal contacts, as also through exhibitions. The Publicity Department of the Bihar Government was also contacted. Exhibits were sent to educational institutions and to museums and exhibitions. Help was rendered to the Government of India in their preparation of a documentary film relating to the cultivation, processing and marketing of lac.

Schemes for lac cultivation were prepared for the Forest Departments of Madras, Bhopal and Madhya Pradesh, and cultivation was actually started in Bhopal and Madhya Pradesh under the extension of lac cultivation scheme (*see* Extension of Lac Cultivation).

There were 19 persons under training. Of these 4 Demonstrators from Bihar, who completed full one year's course of training, were posted to demonstration centres ; 3 Forest

Officers from Burma had about a month's short training; 2 Inspectors, 1 Supervisor and 4 Demonstrators from Bihar, 3 Demonstrators from U.P. and 1 Forest Range Officer from Bombay are under training.

In addition, an *ad hoc* training of about a week was given to the Superintendent of Industries, Hoshiarpur, and to one Forester of Forest Division, Karnal, Punjab.

(*b*) *Supply of Pruning Instruments and Broodlac*

Pruning instruments were supplied to the trained staff engaged under the Demonstration Schemes of various States. Certain States received samples of pruning instruments while some private parties purchased a number of them.

Broodlac was supplied free under the Demonstration Schemes as also under the recently inaugurated scheme for extension of lac cultivation. Under the latter, some broodlac was also sold to those who could not procure it for themselves. The details are given in Table IX.

(*c*) *Practical Demonstration*

Practical demonstration of improved methods of cultivation using villagers' own trees was given through the Demonstration staff.

Intensive Demonstration Scheme

In Bihar — One Lac Supervisor and two Demonstrators were dismissed. One Demonstrator was transferred to the post of a clerk under the Scheme.

The Scheme provides for eight centres only. But recently, in response to persistent requests from the public, the number of centres has been increased to nine. There are only eight Supervisors and eighteen Demonstrators working in these centres. One of the Supervisors is only in an acting capacity, and excluding those under training five posts of Demonstrators remained vacant during the year.

In West Bengal — There are two centres. One centre has one Lac Supervisor and one Demonstrator only, while the other has one Supervisor and two Demonstrators only.

In Uttar Pradesh — A new centre was opened during the period so that there are now two centres (Mirzapur and Wyndhamgunj) in the State, instead of one only, as originally provided under the Scheme. Each centre is under a Lac Supervisor. The posts of five Demonstrators were not filled in.

Only two Supervisors and one Demonstrator are working in the areas.

The main objects of the Demonstration Scheme as stated in the previous reports are as follows :

(i) Systematic cultivation using regular coupés in rotation, thereby allowing rest to the trees, and facilitating supervision and guarding against theft.

(ii) Means of ensuring preservation of *Baisakhi* brood by partial pruning of *ber* and artificial defoliation of *palas*.

(iii) Exclusive use of *palas* as *Baisakhi* host and *ber* as *Katki* host in areas where both are found in sufficient numbers.

(iv) Adoption of the four-coupé system for *kusum* utilizing complete cropping and correct methods of pruning.

(v) Adoption of three-coupé system for *ber* and *palas* ; of these three, one coupé is to be for *Katki* and the other two for alternate *Baisakhi* crops. The *Katki* coupé is to contain 14 per cent of the total number of trees and the alternate *Baisakhi* coupés 43 per cent each.

From the *Baisakhi* coupé shoots bearing only thick encrustation of dead and living lac are to be cut in June-July and the rest left for self-infection. While cutting the crop it

TABLE IX

DETAILS OF BROODLAC AND PRUNING INSTRUMENTS SUPPLIED

Type of brood, pruning instruments and party		Intensive Demonstration Scheme		Extension of lac cultivation		Sold	
Broodlac		Weight Md. sr. ch.	Cost Rs. as. p.	Weight Md. sr. ch.	Cost Rs. as. p.	Weight Md. sr. ch.	Cost Rs. as. p.
Baisakhi	Bihar	18 30 0	984 6 0	0 37 8	75 0 0	9 10 0 D.F.O., Karnal Bangalore	485 10 0
„	U.P.	4 15 0	229 11 0	1 0 0 Delhi, Gurukul	80 0 0		
„	West Bengal	305 turies	699 5 0	20 0 0	1,050 0 0		
Jethwi	Bihar	8 3 0	1,235 7 9	57 32 0	8,843 6 9	3 32 0 D.F.O., Palamau	582 0 0
Katki	Bihar	17 26 0	569 1 0	17 6 0	572 1 0	4 25 0 Bapatla, Hosiarpur, Udepur, Palanpur	189 10 0
„	U.P.	2 28 0	110 11 6				
„	West Bengal*	—	—	0 26 0	20 2 6		
„	Punjab (Karnal)*	—	—	4 0 0	154 6 6		
Aghani	Bihar	13 30 0	1,925 0 0	90 30 0 Forest Dept.	15,248 13 3	0 15 0 S.I. Hoshiarpur	52 8 0
				5 10 0	577 8 0	0 0 8 Agricultural College, Delhi	1 8 0
	Bhopal			3 0 0	375 12 0		
Pruning Instruments							
To staff in Bihar		28 new 7 replaced					
„ „ in U.P.		2 new 1 replaced					
„ Punjab (I)							15 0 0

*These parties were supplied broodlac in brass wire-gauze baskets.

should be kept in view that sufficient lac is left on the trees for self-infection and only the excess is taken out. The coupés should be harvested fully in October.

(vi) To avoid self-infection in growing *Baisakhi* crop.

(vii) Co-operative and collective cultivation should be attempted and encouraged.

In Bihar

Baisakhi 1948-49 *Crop* — Demonstration was given in 107 areas on 89 *ber* and 1,225 *palas* trees.

The number of *palas* trees defoliated in 26 areas was 299 where 379 trees were kept as control to check the data accurately. The quantity of broodlac produced on defoliated trees was 11 maunds 38 seers as against 6 maunds 38 seers on the control. It will be seen that the survival of broodlac on defoliated trees was more than twice that of the control. The ratio of brood to yield of sticklac in the case of defoliated trees was 1 : 3·6 and in the case of control trees 1 : 3·0. It will be seen thus that defoliation not only effected economy in the initial requirement of broodlac, but enabled the cultivator to obtain a large yield of broodlac and sticklac.

In the case of *ber*, 20 trees were partially pruned and 24 trees served as control. The broodlac obtained from partially pruned trees was three times that from the control. The yield of sticklac from the trees partially pruned before infection was nearly twice that from the control, the yield from the trees partially pruned after infection being slightly less than that from the control. The ratio of the brood to yield of scraped lac for these trees was as follows :

Control	1 : 1·5
Partially pruned before infection	1 : 2·8
Partially pruned after infection	1 : 1·1

The results clearly show that partial pruning of *ber* and partial defoliation of *palas* tend to produce larger quantities of broodlac and hence also larger quantities of sticklac.

Owners of trees in two centres were able to produce surplus broodlac for purposes of sale.

Jethwi 1949 *Crop* — 73 *kusum* trees were infected in areas outside Singhbhum. Broodlac could be obtained from all the areas, and in one area the cultivators sold over 7 maunds of surplus broodlac.

Katki 1949 *Crop* — 99 *ber* and 1,119 *palas* trees were infected. They produced about 95 maunds of broodlac, out of which the cultivators were able to sell 32 maunds as surplus broodlac.

Aghani 1949-50 *Crop* — Climatic conditions were unfavourable during the infection period. 93 *kusum* trees were infected with about 14 maunds of broodlac, and 27 maunds of broodlac were produced. The cultivators were able to produce and sell about 6 maunds of surplus broodlac.

In West Bengal

In Malda District, which has one centre only after the partition of Bengal, intensive demonstration started with 35 trees in 1947-48 and this number, chiefly because Institute methods of cultivation have been followed, has been increased to 525, which is indeed quite promising.

Baisakhi 1948-49 *Crop* — In the centres of Aurangabad and Malda 293 *ber* trees were infected with about 40 maunds of broodlac, but only about 34 maunds of broodlac were produced. This is so because partial pruning was carried out on a small scale, and that, too, chiefly in Malda centre. However, the brood to yield (scraped lac) ratio in the total crop was 1 : 2·9.

Katki 1949 *Crop* — In both the centres 325 trees were infected with about 52 maunds of broodlac and about 126 maunds of broodlac were obtained. Of this amount, the cultivators were able to sell about 40 maunds as surplus broodlac.

In Uttar Pradesh

As stated earlier, in U.P. there are two centres now instead of one. The Mirzapur centre has been chiefly occupied with the finding out of suitable areas for future extension of lac cultivation.

In Wyndhamganj centre, demonstration areas have been increased from 4 to 10.

In the *Baisakhi* 1948-49 crop, a start was made with 130 *palas* trees infected with about 5 maunds of broodlac and in the *Katki* 1949 crop the number of trees was raised to 175 trees which produced about 15 maunds of broodlac. The cultivators were able to sell about 9 maunds of surplus broodlac.

(*d*) *Improved Cultivation in Forest Areas*

As stated in the 1948-49 Report, sanction for continuing the scheme was received from the Bihar Government only in September 1948, when the season to propagate the *Aghani* 1948-49 crop had already passed. However, to avoid break in the continuity only 38 *kusum* trees in Oreya were infected in July for the *Aghani* 1948-49 crop which matured under adverse conditions. This adversely affected the emergence of lac larvae and hence the infection for the *Jethwi* 1949 crop, to grow which 13 maunds 33 seers and 12 chattacks of broodlac were used. 168 trees were carrying the *Jethwi* crop, but owing to unfavourable climatic conditions at the time of emergence, the growth of the lac insects was not satisfactory. This was further interfered with by the prevalence of *chalcids* which destroyed most of the crop.

At the time of infection for *Aghani* 1949-50 crop, the Forest Department could procure only 3 labourers, and the broodlac obtained from outside swarmed out at Latehar Railway Station.

In spite of all these unfortunate happenings, 5 maunds 13 seers 8 chattacks of sticklac were obtained from the *Jethwi* 1949 crop, and about 8 maunds of broodlac from the *Aghani* crop, 1949-50.

78 trees were infected for the *Jethwi* 1950 crop, using in some cases wire-gauze baskets. The crop is progressing satisfactorily and may be expected to yield surplus broodlac if there is no theft of lac.

Namkum Plantation

As desired by the Committee and under the instructions of the Inspector General of Forests of India, the plantation was inspected by Mr. J. N. Sinha, the Forest Economic Botanist to the Government of Bihar, with a view to reporting on the conditions of trees and suggesting methods of improving them. The plantation was also inspected by the Inspectors appointed by the Government of India to report on the working of the Entomological Section. The reports submitted by the Economic Botanist as well as by the Inspectors were considered by the Committee in March 1950, and the following decisions were taken :

1. Restocking of certain selected areas (in plots of one to two acres each) within the plantation, totalling to about 10 acres, be undertaken and the work be done in collaboration with the Forest Department, Bihar.

2. Manurial trials should be given in some of these new plots and also in some of the old plots in the plantation.

General upkeep of the plantation was attended to as far as available funds would permit.

Small trees and seedlings were given farmyard manure.

Green-manuring was carried out throughout the plantation with *Boga* and *Urid* (black gram). However, as the plantation is full of wild grass and regular cultivation is not being done, the growth of green-manurial plants was very poor.

Ginger and turmeric were grown as ground crops.

Hibiscus, brinjal, sugarcane, cotton, broad beans, peas, *Junjunia*, etc. were cultivated in a small area with a view to using their lepidopterous pests as alternative hosts to breed *B. greeni*. Details about the pests collected are given under item 7.

Lac cultivation was undertaken on a number of the four main groups of hosts occurring in the plantation ; the trees were ' surface-pruned ', wherever possible.

Efficiency of artificial partial defoliation of *palas* in preserving the *Baisakhi* broodlac was demonstrated this year too ; 85 trees produced over 6 maunds of broodlac, out of which 3 maunds 17 seers were sold and the rest used in departmental work. The *Katki* crop, too, yielded 3 maunds 5 seers of surplus brood for sale. In Hesel, the *Jethwi* and *Aghani* crops together yielded 23 maunds and 14 seers of broodlac.

By sale of lac, grass and miscellaneous produce, a cash revenue of Rs. 1,290-2-0 was obtained ; seeds of ginger and pea, etc. evaluated at about Rs. 680/- are in stock, and the entire crop of turmeric is in the field.

A statement of lac produced in the Institute plantations and its disposal is given in Appendix A.

Extension of Lac Cultivation

Forest areas in Bihar, Uttar Pradesh and West Bengal continued to be surveyed by the Demonstration staff every month. The Director, the Entomologist and the Liaison Officer visited forest areas in Orissa, Madras, Bhopal, Madhya Pradesh, Uttar Pradesh, and the Punjab (I).

Of the 13,70,000 trees located during this year, 6,00,000 are in U.P., 4,22,000 in Bihar, 1,50,000 in Bhopal, 1,87,000 in Orissa, about 11,000 in West Bengal and the rest in the Punjab (I) and Delhi.

While the working plan drawn up for a few areas in Orissa is under consideration of the Orissa Government, and Madras has only partially implemented the scheme drawn up for four areas in that State, Bihar and Madhya Pradesh are going ahead with the plans laid down. There are at present six areas in Bihar in which cultivation of lac has already been initiated on about 11,000 trees. Madhya Pradesh has brought about 79,000 trees under lac cultivation during the year. They have also sanctioned a scheme for opening a *kusum* brood farm in a compact forest with 4,187 trees. Lac cultivation in U.P. has also received a fresh impetus and the latest report shows that about 2,00,000 trees are now carrying lac. Lac cultivation has also been initiated in Bhopal, the Punjab (I) and West Bengal with 3,200, 400 and 1,582 trees respectively. As has been stated earlier, broodlac worth about Rs. 27,000/- was given free or at concessional rates to initiate cultivation in the above areas.

Efforts to introduce lac cultivation on co-operative lines have so far succeeded in one area in Bihar and the progress is satisfactory.

The details of broodlac etc. supplied to the areas will be found in Table IX (*vide supra*).

Steps have also been taken by some of the State Governments, on the initiative of the Institute, to check indiscriminate felling of lac hosts. Ways and means to stop the cutting of immature (*ari*) lac are under consideration.

CHEMICAL SECTION

General — Throughout the period, the Section was short of its Physical Chemist, one Organic Chemist and a junior Research Assistant.

1. Varnishes and Lacquers

Lac-Linseed Oil Paints — As mentioned in the last Annual Report, observations on the weathering properties of lac-linseed oil paints, applied to the Institute steel rafters and wooden doors and windows, were continued.

The painted surfaces were found to keep quite well indoors whereas those exposed to the sun and rain showed extensive deterioration.

Another 1·5 tons of lac-linseed oil paint (of slightly modified composition) were prepared and used in painting the iron- and wood-work of the Institute staff quarters. The wearing qualities of this *vis-à-vis* the earlier compositions are being watched.

Samples of lac-linseed oil paint vehicles and ready-mixed paints were supplied to a firm of paint manufacturers in Calcutta for exhaustive tests and report.

Oil-cloth — Twenty-five gallons of shellac-linseed oil composition for oil-cloth have been supplied to a factory in North India for their manufacturing trials, and their report is awaited.

2. Modification of Lac and Lac Derivatives

(a) Modification of Lac with Pentaerythritol and Maleic Anhydride

The results of preliminary investigations on the combination of aleuritic acid (a known constituent of lac) with pentaerythritol (PE) and maleic anhydride (MA) either singly or in combination were briefly reported in the last Annual Report. It was stated that the products of combination, made at 200°C. severally with PE and MA, were low-melting, opaque, waxy solids in the case of the former, and soft, sticky balsams in the case of the latter. In continuing these experiments, the waxy solid was examined for its solubility and other physical and chemical properties, and results are given below:

Solubility: Soluble in alcohols, alcohol-hydrocarbon mixtures; insoluble in benzene, toluene, etc.
Acid value: 15·4
M.P. : 61°-62°C.

The above work was extended to saponified lac. Bleached saponified lac (A.V. 190) 25·0 gm., PE 4·0 gm. were heated together at 150°-160°C. with mechanical stirring in a glycerine-bath for varying periods. The product obtained at the end of 30-40 minutes' heating was examined, as samples heated for a longer period gelled and became insoluble. The product had an acid value of 140·5, and was soluble in a mixture of methylated spirit, butyl alcohol and toluene. The resin as such had good adhesion for various surfaces, e.g. glass to glass, glass to metal, etc. The solution of the resin gave a clear film which on curing at 150°C. for nearly 2 hours became hard and resistant to boiling water. Further properties of this resin as also the optimum proportions of the different constituents are being examined.

Experiments on the direct combination of lac with PE and MA either *per se* or in solvent medium were also undertaken with a view to obtaining products of improved qualities for specific uses in plastic and varnish industries. As a first step, combination of lac with PE was tried. It was thought that PE being a tetrahydric alcohol with four primary hydroxyl groups, and lac, an acid resin, ester formation would easily take place if the two constituents were reacted in stoichiometric proportion. Attempts were made to conduct the reaction in this proportion at two different temperatures, viz. 150° and 200°C. At 150°C. the reaction was slow and incomplete as could be judged by the inhomogeneity of the resulting product and the low degree of esterification. At 200°C. a clear melt was obtained at the end of

10-15 minutes, but when heating was continued further so as to make the total period of heating 32 minutes, the product gelled and polymerized. The A.V. of the product, just before polymerization had set in, was found to be 59. The final product in either case was hard and brittle and showed very little change in melting point and other properties as compared with the original lac.

These experiments showed that in order to effect maximum degree of esterification such as would be indicated by a reduction in the A.V., a higher proportion of PE and longer period of heating were necessary. Another set of experiments were therefore started using 1, 2, 3 and 4 molecules of PE per molecule of lac and the reaction was carried out at 200°-205°C. The results are shown in the following tables :

TABLE I

RATE OF ESTERIFICATION OF LAC WITH PE AT 200°-205°C.

(Proportion of — 1 mol. lac : 1 mol. PE)

Time (min.)	Appearance	M.P.	A.V.	Hydroxyl No.
3	Turbid	—	68·01	—
15	,,	—	58·64	—
20	Partially clear	—	56·80	—
25	Clear	78°-88°C.	55·05	361·2

TABLE II

RATE OF ESTERIFICATION OF LAC WITH PE AT 200°-205°C.

(Lac — 1 mol. : PE — 2 mols.)

Time (min.)	Appearance	M.P.	A.V.	Hydroxyl No.
6	Turbid, PE not uniformly mixed, hard and brittle	—	51·1	—
30	Clear and uniform, hard and brittle	—	41·74	—
45	Clear, hard and brittle	70°-78°C.	37·45	404·5
50	Gelled	—	—	—

TABLE III

RATE OF ESTERIFICATION AT 200°-205°C.

(Lac — 1 mol. : PE — 3 mols.)

Time (min.)	Appearance	M.P.	A.V.	Hydroxyl No.
5	Turbid, PE not uniformly dispersed, hard and brittle	—	54·11	—
30	Partially clear, brittle but slightly soft and hygroscopic	—	56·1	—
60	Clear, fairly hard, not brittle but hygroscopic	—	33·84	—
110	Clear, soft and hygroscopic	65°-70°C.	24·79	455·8
120	Gelled	—	—	—

TABLE IV

RATE OF ESTERIFICATION AT 200°-205°C.

(Lac — 1 mol. : PE — 4 mols.)

Time (min.)	Appearance	M.P.	A.V.	Hydroxyl No.
6	Turbid, not uniformly dispersed	—	48·26	—
30	Same as above — no combination	—	42·85	—
60	Not clear, but sticky	—	31·89	—
120	Clear, sticky	—	22·42	—
240	Quite clear, sticky and soft	—	14·66	558·4

It was found that when reacting 1 mol. of lac with 4 mols. of PE, heating at 200°C. could be continued for 6 hours without gelling or polymerizing, but the resulting product was soft and extremely hygroscopic with an acid value of 11·4 and hydroxyl number 525-550.

The rate of esterification of lac with PE (1 : 4 mols.) was also studied at two higher temperatures, viz. 235°-240°C. and 260°-265°C. The lowest A.V. obtained after 4 hours' reaction at 235°-240°C. was 6·5, the corresponding figure obtained after 3 hours' reaction at 260°-265°C being 6·27. Hydroxyl numbers found for these samples were of the order of 456-458. The products were, however, very soft, sticky and extremely hygroscopic.

Judging from the results obtained so far, it would appear that the products with the lowest acid values obtained by combining lac with PE are uniformly soft, plastic, hygroscopic and, as such, not of much practical importance unless further modified to overcome their avidity for water and low softening points. Further modification is being sought through combination of these products with saturated and unsaturated acids or anhydrides. As a first step, the combination with maleic anhydride was studied.

Lac-pentaerythritol compound with an acid value of 11·4 and hydroxyl number of about 550 was at first prepared by heating the two constituents in the molecular proportion of 1 : 4 at 250°-260°C. for 1½ hours. 25 grams of this compound were heated at first with 3·5 grams maleic anhydride on an oil-bath at 200°C. The composition immediately polymerized. An attempt was, therefore, made to combine the two in a solvent medium (dioxane). The materials were mixed in a flask fitted with a Stark and Dean apparatus and a reflux condenser. The mixture was then heated for 8-10 hours using *p*-toluene sulphonic acid as catalyst. The solution was then vacuum-distilled and the residue washed with cold water and dried. A sticky soft resin with an acid value of 102·0 was obtained. The solution of this resin in alcohol air-dries to a clear film in presence of 2-5 per cent benzoyl peroxide and after baking at 130°C. for 1 hour becomes water-resistant. It has also got very good adhesion and elasticity.

Attempts are being made to obtain a hard resin by the combination of lac, PE and MA simultaneously under suitable conditions, and as a preliminary, the action of maleic anhydride on lac is being investigated. The results of this study will be reported in due course.

(b) Esterification of Lac with Unsaturated Alcohols

With a view to studying the properties and behaviour of unsaturated esters of lac, attempts were made to prepare allyl esters of lac. In course of the experiment, it was observed that depending upon the method of esterification and the type of catalyst used, soft or solid esters

could be obtained. For instance, using direct esterification method with hydrochloric acid as catalyst, a soft and sticky resinous ester was obtained. On the other hand, when the reaction was carried out in a flask fitted with a reflux condenser and a Stark and Dean apparatus for continuous removal of water, and *p*-toluene sulphonic acid used as catalyst, a hard, brittle resin was obtained. The properties of the two esters obtained under the different conditions are given below :

1. Direct esterification method ...	...	A.V.	29-32
		I.V. (Wij's)	54-58
2. Azeotropic method ...	...	A.V.	28-32
		I.V.	53-58
		M.P.	71°-73°C.

Both the esters, when dissolved in alcohol, gave films which dried in air in the presence of small quantities of benzoyl peroxide. Baking for a short while at 70°C. made the films hard and water-resistant. The possibility of these resins, with further modifications, for use in varnish and plastic industries is being studied.

(c) Lac Esters as Resin Plasticizers for Nitrocellulose Lacquers

The suitability of shellac esters, particularly the butyl ester, as resin plasticizers for nitrocellulose lacquers has been known for a long time. W. H. Gardner took a patent on the subject as early as 1933 (U.S. Patent No. 1,1,910,100 of May 1933). But little commercial use of this patent seems to have been made, and this, as was pointed out later, was due to the high price of shellac esters (consequent on the prices of shellac and butyl alcohol being high). It was thought, however, that esters from cheaper alcohols like fusel oil, if found nearly as good as the butyl ester, might find wider practical application. The following experiments describe the preparation and properties of such esters.

Fusel oil used in this investigation was purchased from a firm in Calcutta. It contained about 6·25 per cent water, 18·5 per cent lower boiling alcohols, about 70 per cent of the fraction distilling between 125° and 135°C. and the rest (about 5·25 per cent) a higher boiling fraction. The fraction, b.p. 125°-135°C./690-700 mm. which consisted mostly, if not entirely, of amyl alcohols, was used for this investigation.

The esterification was carried out as recommended by Gidwani and Kamath (*Paint Manufacture*, April 1945, pp. 93-7) using concentrated hydrochloric acid as catalyst. The ester was a thick syrup having the characteristic pungent odour of fusel oil. The butyl ester prepared under exactly similar conditions was free from any smell except a faint smell of lac. The fusel oil ester had an acid value of 6·8, saponification value of 200·0 and iodine value of 23·9. Surprisingly, however, the hydroxyl value of this ester was only 92-95 as against an expected value of over 200. The butyl ester also had practically the same constants as the fusel oil ester. These esters were insoluble in methylated and rectified spirits but dissolved readily in butyl alcohol, toluene, benzene, ethyl acetate, butyl acetate and acetone.

They are quite compatible with all grades of nitrocellulose giving perfectly clear and homogeneous films from suitable solvent mixtures.

Films containing about 2 parts of lac ester to one part of nitrocellulose were found to be about the most satisfactory. Films having smaller amount of the ester were brittle while those containing larger proportions were tacky and not quite hard. Generally, films containing only lac ester and nitrocellulose were not very glossy though the gloss could be considerably improved by incorporating limited quantities of dewaxed lac or dammar in the lacquers.

Samples of book-binding and leather-cloths made from compositions containing film scrap and lac ester as plasticizer have been prepared, and these have been found to be generally superior to those using castor-oil. The cost of lac ester, however, will be a serious consideration against its general adoption.

It was interesting to note that during esterification of lac with fusel oil or butyl alcohol in the presence of concentrated hydrochloric acid, as described above, there was an unexpected lowering of the hydroxyl value and that the resulting product, though an ester, was not soluble in methyl or ethyl alcohol but was completely soluble in hydrocarbons, like toluene. With a view to ascertaining whether this esterification and loss of hydroxyl occurred during the reduced-pressure distillation or earlier, the product obtained after refluxing was freed from hydrochloric acid by repeated washing with water and once with very dilute sodium bicarbonate solution. The product obtained by the distillation of this solution under reduced pressure was found to possess the same properties and hydroxyl value.

(d) Other Esters of Lac

Attempts to prepare the methyl and ethyl esters by an identical method did not succeed, as lac polymerized during the removal of the solvent under reduced pressure. When, however, the hydrochloric acid was removed from the reaction mixture by washing, the resulting ester could be freed from the alcohols under reduced pressure as usual without any polymerization taking place. The methyl ester so prepared had an acid value 14·7 and hydroxyl number 210. It was much more viscous than the fusel oil and butyl esters, contrary to the observation of Gidwani and Kamath (loc. cit.).

The ethyl ester was similar to the methyl ester as regards viscosity and physical constants. They were both readily soluble in aromatic hydrocarbons like toluene and benzene, esters like ethyl and butyl acetates and acetone. They were also fully compatible with nitrocellulose.

An easier method of preparing the methyl or ethyl ester in toluene solution avoiding vacuum distillation has been devised. In this method, lac is refluxed with dry methyl or ethyl alcohol and concentrated hydrochloric acid. The resulting product is mixed with toluene and the toluene solution freed from acid and excess alcohol by repeated washing with water and once with very dilute sodium bicarbonate solution. The toluene solution is then distilled under ordinary pressure when the last traces of water distil over along with some toluene. The residual moisture-free toluene solution of lac ester may be straightaway used for the preparation of lacquers.

(e) Shellac Esters for Coated Fabrics

About 12 lb. of lac butyl ester have been supplied for preliminary trials to a factory in Bombay engaged in the production of coated fabrics like leather-cloth, book-binding cloth, etc. Further contact is being maintained with the party to see if they could regularly use this product.

(f) Lac Ester as Plasticizer for Polyvinyl Chloride (PVC)

Experiments have been undertaken to study the utility of lac esters as plasticizers for polyvinyl chloride. A PVC-lac ester-pigment paste, spread on fabrics and " gelled " by exposure to radiant heat, has been found to give films with good gloss, hardness and flexibility and toughness. There was, however, a tendency for the ester to sweat out after some time. Further work is in progress.

3. Fundamental Researches

(a) Chemical Composition of Shellac

The total amount of violet barium salt from 2 kgm. of shellac was 565 gm. (*vide* Annual Report 1948-49, p. 17). It consisted of two fractions (77 gm. and 488 gm.) which were obtained by successive precipitation with 113 gm. and 150 gm. barium chloride respectively. These two fractions were examined for constituent acids.

These fractions were as usual extracted with petroleum ether to remove wax. They were then extracted with absolute alcohol which removed alcohol-soluble barium salt. The residues were extracted with hot water, and hot-water-soluble and hot-water-insoluble fractions were obtained. The hot-water-soluble fraction obtained from the first crop of violet barium salt (77 gm.) has already been examined (*vide* Annual Report 1948-49, p. 18).

Hot-water-soluble Barium Salt — One more acidic fraction melting at 94°-95°C. was obtained from the soft, dark mass left after separation of the acidic fraction (m.p. 92°C.), by the usual process of fractionation (loc. cit., p. 19). Further attempts to get more fractions were unsuccessful, and the soft, acidic, dark-coloured residue smelt strongly of shellac.

Hot-water-insoluble Barium Salt — The soft, brown mass, obtained from the white mass (melting range 135°-140°C.) by saponification (*vide* Annual Report 1948-49, p. 18, line 7 from bottom), was treated with boiling water and the clear solution decanted off. The decanted solution after concentration was kept in the cold and on long standing gave a slightly coloured crystalline product. This was washed with ether and an ether-soluble (0·22 gm.), coloured soft mass was obtained. The residue, on crystallization from alcohol-water mixture, weighed 0·23 gm. and melted at 90°-91°C. The water-insoluble portion was dissolved in methyl alcohol and water added to the solution till turbid. On prolonged standing in the cold there separated a crystalline substance alone with some soft material. The crystalline portion, weighing 0·4 gm., melted at 91°-92°C. Further attempts to get more crystalline products were unsuccessful.

The dark-coloured soft mass, obtained by decomposition of the alcohol-insoluble residue (*vide* Annual Report 1948-49, p. 18, line 5 from bottom) with dilute acid, was fractionated as before and two acidic fractions were obtained melting at 96°-97°C. and 95°-96°C., weighing 0·27 gm. and 0·16 gm. respectively. Attempts to get further crystalline products were unsuccessful. The residue was a dark-coloured soft mass.

Alcohol-soluble Barium Salt — Water was added to the barium salt (*vide* Annual Report 1948-49, p. 18, line 2 from top) containing traces of alcohol. Thus it could be resolved into (i) water-insoluble salt and (ii) water-soluble salt.

(i) The water-insoluble barium salt was decomposed with dilute acid in the cold. The precipitate on drying melted at 53°-54°C. (1·84 gm.). After decolourization and recrystallization it formed long, thin, needle-like crystals melting at 54°-55°C. It is soluble in methyl and ethyl alcohol, acetone, ether, chloroform, ethyl acetate, benzene, and warm petroleum ether.

The acid and hydroxyl values of this compound were found to be 210·5 and 217·0 respectively. The molecular weight on the basis of acid value (monobasic) comes to 266·5. From these values, this acid seems to be monohydroxypalmitic acid, which requires an acid value of 206, hydroxyl value of 206 and m.w. 272.

The acetyl derivative is a liquid and the methyl ester has a melting point of 27°-28°C.

Oxidation of this acid to the keto-acid and other lower acids, to ascertain the position of the hydroxyl group, is under progress. Chromic acid oxidized it to the keto-acid(?) according to the procedure adopted by Davis and Adams (*Jour. Am. Chem. Soc.*, 1928, **50**, 1753). The melting point of the once crystallized keto-acid is 65°-66°C.

The mother-liquor left after removal of the acid, m.p. 53°-54°C., gave on long standing some white crystalline precipitate with a few brown globules. The precipitate was washed with water and ether and on drying melted at 95°-96°C. It weighed 0·3 gm.

(ii) The filtrate, containing the water-soluble barium salt, on treatment with dilute hydrochloric acid and prolonged standing gave a crystalline product contaminated with brown soft globules. During filtration, most of the brown liquid passed through the filter-paper and the rest was washed away by ether. The crystalline residue (0·29 gm.), on drying,

melted at 94°-95°C. On decolourization and recrystallization, the m.p. rose to 95·5°C. The mother-liquor gave a further crop of the acid (0·13 gm.), m.p. 94°-95°C.

The acid, saponification, and hydroxyl values of this material were 183·4, 185·2 and 532·5 respectively. The calculated values for aleuritic acid are 184·2, 184·2 and 552·6 respectively. It seems therefore that this acid of m.p. 94°-95°C. is an isomer of aleuritic acid.

The ethereal extract left a soft brown mass on removal of ether (2·62 gm.). It was acidic in nature and was saponified with alkali. The mixture was fractionally decomposed with dilute acid and extracted with ether, but no crystalline material could be isolated.

Further work is in progress.

Decomposition of Violet Barium Salt (Major Fraction)

Petroleum ether-extracted barium salt (488 gm.) was extracted with alcohol. Alcohol was removed from the extract and water added. Thus (i) water-insoluble and (ii) water-soluble parts were separated.

(i) The water-insoluble salt was decomposed with hydrochloric acid. The free acid was washed with water and then with ether to remove ether-solubles. The ether-insoluble residue on fractional crystallization gave two fractions melting at 72°C. and 93°-94°C. respectively. The latter was twice crystallized from alcohol-water mixture and melted at 95°-96°C.

The ether-soluble fraction was liquid after complete evaporation of ether, and on long standing formed clusters of needles with some granulated substance. Fine needle-like crystals deposited from its alcohol-water solution in the cold, but the crystals melted during filtration. It was again cooled and the clear supernatant liquid was decanted off and immediately washed thoroughly with ice-cold water. The crystals were then extracted several times with hot petroleum ether. The extracted acid melted at about 40°C. It was then extracted with benzene. The benzene-soluble and -insoluble fractions after recrystallization melted at 54°-55°C. and 76°-78°C. respectively.

(ii) Similarly, on decomposition of the water-soluble barium salt, acidic fractions were obtained, which were made up of an ether-soluble liquid and an ether-insoluble solid.

Nothing crystallized out from the ether-soluble fraction on long standing even in the cold. It had a pleasant odour, yellow colour and constituted the major part of the total acids. The ether-insoluble fraction on recrystallization was found to have an m.p. of 65°C. It had an acid value of only 94·2 and a saponification value of 185·54. The hydroxyl value was found out to be 463·3 corresponding to 4·93 hydroxyl groups. On saponification, decomposition and crystallization it gave an acid, melting at 95°-96°C., which, on further recrystallization, gave homogeneous clusters of needles melting at 96°-97°C.

From the above, it may be assumed that the acid melting at 65°C. is an inter-ester of the trihydroxy acid melting at 95°-96°C.

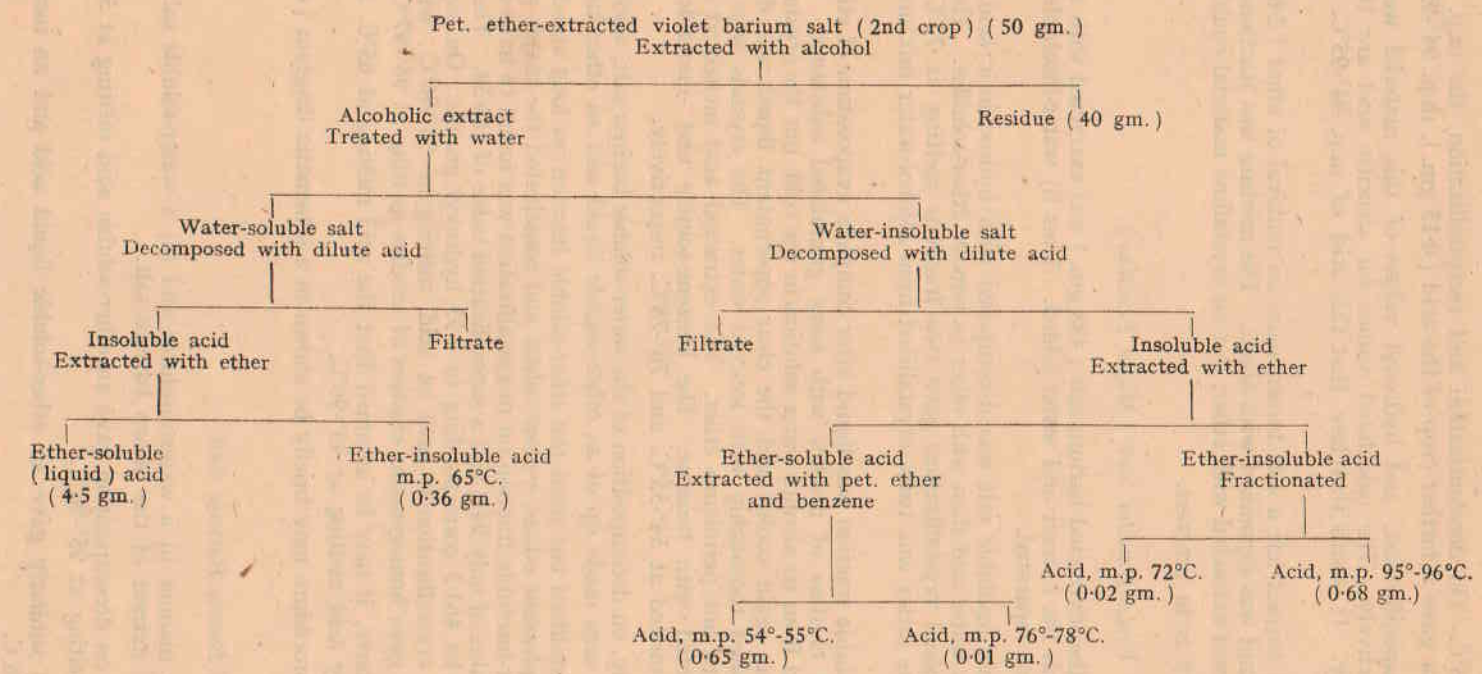
The whole procedure may briefly be shown in a schematic diagram (on the following page).

Decomposition of Brown Barium Salt

In a similar manner (i) a water-insoluble and (ii) a water-soluble salt were obtained from the alcohol extract of the brown barium salt.

Fraction (i) on decomposition gave an ether-soluble acid melting at 54°-55°C. and an insoluble acid melting at 95°-96°C.

Fraction (ii) similarly gave an ether-soluble liquid acid and an insoluble solid acid melting at 95°-96°C.


Pet. ether-extracted violet barium salt (2nd crop) (50 gm.)
Extracted with alcohol
Alcoholic extract
Treated with water
Residue (40 gm.)
Water-soluble salt
Decomposed with dilute acid
Water-insoluble salt
Decomposed with dilute acid
Insoluble acid
Extracted with ether
Filtrate
Filtrate
Insoluble acid
Extracted with ether
Ether-soluble
(liquid) acid
(4·5 gm.)
Ether-insoluble acid
m.p. 65°C.
(0·36 gm.)
Ether-soluble acid
Extracted with pet. ether
and benzene
Ether-insoluble acid
Fractionated
Acid, m.p. 72°C.
(0·02 gm.)
Acid, m.p. 95°-96°C.
(0·68 gm.)
Acid, m.p. 54°-55°C.
(0·65 gm.)
Acid, m.p. 76°-78°C.
(0·01 gm.)

To obtain these acidic fractions in large amounts for studying various properties, another batch of 4 kgm. of dewaxed shellac was saponified and various salts were prepared following the usual procedure.

Further work is in progress.

(b) Separation and Identification of Shellac Acids as Hydrazides

Crystalline hydrizide was obtained from decolourized, dewaxed shellac by refluxing with hydrazine hydrate. The hydrazide melted partially at 120°C. On recrystallization, it melted at 137°-138°C., and was found to be identical with aleurityl hydrazide. Apparently shellac molecule suffers hydrolytic fission under the influence of hydrazine hydrate.

The mother-liquor was concentrated and another crop was obtained melting at 118°-119°C. Attempts to get further solid products failed. The residue was a coloured semi-solid mass, soluble in alcohol and water.

In a similar manner, liquid hydrazide derivatives were obtained from soft resin. No solid products separated from either aqueous or alcoholic solution even on long standing in the cold.

(c) Constitution of Soft Resin

Hot-water-insoluble Zinc Salt from Soft Resin — The resinous acid softening at 60°-65°C. (*vide* Annual Report, 1948-49, p. 20) was taken in solution with amyl acetate, filtered and kept at room temperature for slow evaporation and crystallization. Gradually some coloured crystalline product separated which was filtered from the highly soluble fraction and washed well with ether. It melted between 215° and 220°C. with decomposition. It was recrystallized, yielding hexagonal plates which melted with decomposition at 225°C.

The solvents were completely removed from the filtrate and a resinous mass obtained which decomposed at 85°C.

(d) Physico-chemical Studies

(*a*) *Dielectric Properties of Kauri Gum* — The dielectric properties of *kauri* gum are being measured at various temperatures and frequencies, for comparison with the corresponding properties of lac and some other natural resins, measurements on which have already been completed. In carrying out these measurements, the filling of the experimental cell presented great difficulty and concordant results could not be obtained by following the previous practice of filling up a gold cell. As the melting point of the resin is high and its flow on melting rather poor, it is feared that the adherent gas bubbles, which it is extremely difficult to eliminate, are interfering with the success of the experiment. Measurements have therefore been started on moulded sheets of the resin.

The work is in progress.

(*b*) *Dielectric Properties of Plasticized Lac* — The effect of various pasticizers on the dielectric properties of lac is being studied. Preliminary work with tricresyl phosphate and dibutyl phthalate shows that for constant frequency these plasticizers simply shift the dielectric constant — temperature as well as the power factor — temperature curves of lac bodily towards the lower temperature side. This is probably an indication of the lowering of the inner friction of lac molecules due to the presence of these plasticizer molecules in the inter space. The greater the quantity of these plasticizers used, the more the shift towards the lower temperature side. The contribution of each of these plasticizers towards the increase of dielectric constant or the loss factor has yet to be assessed.

(*c*) *Dielectric Properties of Aleuritic Acid* — Measurements of the dielectric properties of aleuritic acid, carried out some time back with the Schering and Radio frequency

bridges, were not as satisfactory as in the case of other constituents of lac owing to the limited sensitivity of the arrangement. Hence, on receipt of a parallel capacitance bridge, measurements were made afresh on a pure sample of aleuritic acid. The results obtained were in general not very different from those previously obtained, but owing to the higher sensitivity of the set-up, the figures were much more precise as the balance points were very sharp. An analysis of these new data is likely to throw considerable light on certain aspects of the constitution of lac. Results will be incorporated in a separate paper to be published shortly.

(*d*) *High Voltage Tests* — A large number of tests was carried out during the period under review on the performance of certain improved lac insulating varnishes, empire cloth substitutes and moulding compositions. Some *ad hoc* tests were also undertaken on some moulding compositions, formulated by H.B. Technological Institute, Kanpur, at their specific request.

(*e*) *Bleaching of Lac* — It is known that to obtain white bleached lac the quantity of sodium hypochlorite solution actually used is much more than the theoretically calculated quantity required to bleach only the colouring matter present in lac. This is due to the fact that the nitrogenous matter derived from the body of the lac insect as well as orpiment which is sometimes present in some grades of shellac consumes a considerable quantity of bleach-liquor. Besides, the resin of lac is known to be affected by the chlorine-bleach, and some chlorine-consumption is traceable to this cause also. The bleaching action of chlorine on lac, therefore, appears to be somewhat complex. Investigations have been started to find out if some relation can be established between the absorption of bleach-liquor and each of these factors separately.

(*f*) *Determination of Moisture in Lac by Infra-red Heating* — It was mentioned in the last Annual Report that the results of investigation to shorten the period of heating and desiccation by means of infra-red rays in the determination of moisture in lac were very encouraging. After a series of experiments on this line, a simple and inexpensive apparatus using infra-red rays for simultaneous heating and desiccation of lac samples was designed. With this apparatus, the determination of moisture in lac could be made in about an hour's time only instead of the usual 24 hours' time as required in the current methods. The apparatus can be easily assembled in most laboratories. A paper embodying the results of this investigation is expected to come out in the March (1950) issue of the *Indian Journal of Physics*.

(*g*) *Catalytic Hydrogenation of Lac* — It has been reported before (*vide* Annual Report 1948-49) that shellac in presence of PtO_2 as catalyst absorbs hydrogen, equivalent to an iodine value (I.V.) of 7 to 8. But subsequent experiments with a few fresh samples showed that the absorbed hydrogen corresponded to I.V. of 13 to 15. By repeating the experiments with different varieties of shellac, dissolved in acetic acid in cold, it was further observed that the samples had apparently different I.V.s, but that if the samples were previously refluxed for two hours in glacial acetic acid, the absorption of hydrogen was practically constant, being equivalent to I.V. of 14 to 15. This observation indicates that while partly polymerized shellac absorbs less hydrogen, the same shellac, when depolymerized by heating with glacial acetic acid, absorbs more hydrogen. This conclusion was verified by another experiment. A sample of shellac which had become so much polymerized as to be insoluble in alcohol as well as in acetic acid *in cold*, was dissolved in warm acetic acid (at 40°C.) and its hydrogen absorption was found to correspond to I.V. 7. But this sample, when refluxed with acetic acid, showed an increased I.V. nearly equal to 15. The I.V. of the same sample of shellac was determined by Wij's solution (iodine monochloride in acetic acid) and the I.V., determined thus, was 15·6. This experiment further shows that during the process of determination of I.V. by Wij's method, lac depolymerizes first, which explains incidentally why the values obtained by this method are always in the neighbourhood of 15, while I.V. according to Hubl's method which does not necessitate dissolution of shellac in acetic acid at elevated temperatures registers a figure of 7 to 9.

Some of the results obtained with lacs of different origin and age are given below:

Specimen of shellac	Approximate age in years	I.V. calculated from H_2 absorption		I.V. by Wij's method
		In cold acetic acid	After refluxing with acetic acid	
Kusum	3	7·6	14·9	14·7
Palas	4	9·1	16·7	14·7
Ber	3	8·7	13·9	13·1
Kusum	Fresh	13·9	14·4	13·7
Machine-made (dewaxed & decolourized)	—	10·1	11·5	12·4

Hydrogenated shellac was isolated in a few cases. The pale colour of the freshly precipitated lac gradually deepened on keeping. Hydrogenated lac and the corresponding shellac had the following characteristics:

	Shellac	Hydrogenated shellac
Softening point	72°-73°C.	73°-74°C.
Melting point	82°-83°C.	82°-83°C.
Acid value	70·2	72·0
I.V. (Wij's)	14·1	13·2

Although the hydrogenated samples refused to absorb further quantities of hydrogen on re-hydrogenation under the usual conditions, they showed almost identical iodine values as the parent shellac. This apparent anomaly has yet to be reconciled by further experiments and observations.

The hydrogenation experiments were also extended to some derivatives and constituents of lac. The results are given below:

Samples	I.V. calculated from H_2 absorption	
	In cold acetic and	After refluxing in acetic acid
Soft lac resin	13·5	13·7
Soft lac methyl ester... ...	12·5	12·7
Hard resin	17·1	7·2
Methyl ester of shellac ...	10·8	11·3
Parent shellac	7·6	14·9

4. Making of Shellac by Autoclave

The pilot plant described in the previous Report has been worked with steam from boiler instead of steam generated by direct firing. The pipe with the pressure release valve was connected with the steam line. An outlet for steam and condensed water was fitted on to the wall just touching the bottom. In the experiment performed, the filtering arrangement was charged with seedlac, enclosed in the iron frame and the assembly placed inside the autoclave; this was followed by the lid being placed and tightened in position by bolts and nuts. Then the steam inlet valve was opened keeping the outlet also full open to allow the water formed by condensation of steam, to effect preliminary heating of the autoclave. When practically only steam was coming out by the outlet pipe, the autoclave was sufficiently hot. During this preliminary heating of the autoclave, the valve of the molten lac

delivery pipe was kept open only partially so that if any lac melted it might flow out. Then the outlet of steam was closed partially so that there could not be any accumulation of condensed water. After that the steam inlet valve was gradually opened more and more to have the desired pressure. A few experiments were done with fresh *kusmi* and *Baisakhi* seedlacs. It was noted that at about 20 lb. pressure lac started to melt and flow out. Gradually the pressure was increased by allowing more steam to get into the autoclave by manipulation of the inlet valve. When pressure reached about 45 lb. in 20 min., the molten lac flowed out in a sufficiently thick continuous stream. After keeping at 45-50 lb. pressure for 20 min. the pressure was further increased gradually to 60 lb. The end of the process was ascertained by noting the scanty flow of molten lac fully for one minute and then again opened. If this showed little accumulation of lac, heating was stopped by closing the steam inlet valve, and outlet valves for molten lac and condensed water were opened fully to release the pressure. The filtering assembly was now brought out to collect *kiri*, as described before. The yield of shellac was the same as in the case of heating by direct firing. In this method of melting, it was noted that the amount of water coming out with the molten lac is more than in the case of the direct firing method. Compared with the other method, the time required when boiler is used for melting the same quantity of fresh *kusmi* or *Baisakhi* seedlac is less by 30 min. The period of melting may be further reduced if the bottom of the autoclave is shaped like a funnel ; for, this will eliminate the possibility of molten lac overflowing from the funnel, attached to the outlet pipe for molten lac, as fitted in the present plant.

Comparison of shellac made by (1) indigenous process, (2) autoclave by steam by direct firing, (3) autoclave by steam heating from a boiler :

	(1)	(2)	(3)
Moisture	1·69	2·10	2·03
Hot alc. insolubles %	0·72	0·16	0·37
Cold alc. insolubles %	2·10	1·84	1·94
Flow (Westinghouse) sec. ...	86	92	78
Life at 150°C., min.	38·5	39·5	39·0
Colour index	8·2	11·7	12·7
Wax %	4·36	2·29	2·29
Acid value	70·9	70·7	72·4
Sap. value	228·4	223·5	222·2
Iodine value (Wij's)	14·1	14·1	13·7

The moisture-content of lac as obtained from the autoclave is 14 to 16 per cent. So, further processing is required to dry it to the required moisture-content of 1 to 2 per cent. This can be done by re-melting the lac in a steam-heated pan and continuing heating till the temperature of the melt reaches 105°C. Button lac can be made from this melt as reported before. Of course, if an arrangement for stretching, as in the indigenous process, is kept ready, sheets also can be made. But as the country process of stretching is rather slow, lac is likely to get polymerized in the later part of the operation. So, to make sheets quickly and continuously an apparatus has been designed. This consists of a hot-water box made of G.I. sheet, 26 in. long, 16½ in. wide and 7 in. high. At the middle of this box is fitted a conical chamber 18 in. long and of equilateral triangular cross section of 8 in. each side. At the bottom of the conical chamber there is a long slit opening of ¼ in. width. Electric heating units have been fitted at the bottom of the apparatus which are used whenever necessary. To start with, hot water is put into the box, and the temperature is maintained at 75° to 76°C. Molten lac at a temperature of 76°C. is poured into the conical chamber keeping the slit-opening closed by a horizontally placed glass rod from the bottom. When it is found that molten lac has flowed down through the opening and touched the rod at all points, the rod is gradually lowered and lac comes out in the form of a sheet. But at the edges the film shows a tendency to converge and thicken. So at those points the film

is stretched by a second man. It was found that a continuous film could be drawn fairly rapidly if the temperature of the melt were maintained at 75°-76°C. The sheet so far obtained is very thin. The thickness could be increased by raising the temperature of the melt, but this made the flow too rapid for the drawn film to get cooled by air, besides increasing the tendency to cone formation. Improvements in the plant are being tried.

5. 'Ad hoc' Researches

Carbon-Type Moulded Resistances from Lac

Moulded resistors are now in great demand in radio industry. They are considered superior to the graphite-coated glass resistors in performance, and their cost of production is also generally lower. Attempts are being made, therefore, to formulate some moulding compositions from lac for making such resistors and to standardize processes for their manufacture. Preliminary trials have been found to be successful, but no definite conclusions are possible until the effect of ageing on the constancy of values is known and the acoustic qualities of an amplifier employing such resistors are determined.

6. Specifications for Seedlac, Shellac and Bleached Lac

The need for internationally agreed standards for different grades and types of lac had been frequently stressed by the Indian Lac Cess Committee. As a result, considerable spadework on the technical side had been done at the instance of the Committee, but for various reasons the matter remained quiescent till the Indian Standards Institution, in its capacity as the Secretariat Committee of the International Organization for Standardization (ISO) for lac, took it up. In a meeting held at Calcutta in August 1949, the ISI Sectional Committee on Shellac, with Dr. P. K. Bose as Chairman, prepared draft specifications. The Indian Lac Cess Committee was represented in this Sectional Committee by Mr. S. L. Jayaswal and Mr. B. L. Singh. Other members of the Indian Lac Cess Committee who served in this Committee are Dr. S. S. Bhatnagar, Mr. J. P. Young, Mr. G. D. Clark and Mr. G. C. Georgiades. The draft Indian Specifications with some modification were considered by the Technical Committee on Shellac of the ISO at a meeting held in New Delhi in January 1950 under the Chairmanship of Sardar Datar Singh, Additional Secretary to the Government of India. Many foreign countries sent representatives or observers to the meeting, and ISO was represented by its Secretary-General, Mr. Henry St. Leger. The Technical Committee approved the Tentative Indian Standards with minor alterations and recommended their adoption as Tentative International Standards.

7. Demonstration and Publicity

The activities under "Demonstration and Publicity" became a regular feature in the working programme of the Institute with the appointment of the Lac Information Officer in April 1945 whose main duties and functions included, among other things, (1) demonstration to interested parties of the new processes developed at the Institute, (2) collection and dissemination of information on the uses of lac, (3) giving publicity to important developments connected with lac trade, and (4) answering various enquiries of a technical nature. The post of the Lac Information Officer has been abolished since 1st October 1949, after a short existence of 4½ years, with the result that the work in this connection became limited in its scope and functions during the latter half of the year under review. The report therefore mainly deals with that part of the work done during the first six months of the year supplemented with whatever information was available in the rest of the period.

Uses of Lac in India

Plastics — Exchange of ideas and samples to evolve suitable plastic moulded components for radios with the Technical Development Establishment of the Armed Services

Wing, Dehra Dun, was continued. Samples of radio knobs made from lac moulding powder were reported to be satisfactory from all aspects and further samples are asked to be supplied for users' trials. Arrangements are being made for moulding some binocular eye-cups for them.

Samples of lac moulding powder were also sent to the Telegraph Department of the Government of India, New Delhi, and Vauman Agencies, Calcutta, for their trials.

Information regarding indigenous fillers for plastics was given to Indian Plastics Ltd., Bombay. Contact was maintained with the Gramophone Co. Ltd., Calcutta, and National Gramophone Record Manufacturing Co., Bombay, to ascertain consumption of lac.

Varnishes — Problems arising out of the uses of shellac varnishes were discussed and solutions offered to the following :

Shri G. Naik, Delhi
Hon. Organizer, Neera Scheme, Bombay
Central Palm Gur Training School, Cuddalore
Mica & Micanite Products Co., Gudur
Strawboard Manufacturing Co. Ltd., Saharanpur
Mysore Lac & Paint Works Ltd., Mysore
The Mysore Waterproofs Ltd., Bangalore

Manufacturing details for the preparation of good French Polishes and prevention of darkening of such polishes on storage were suggested to Technical Development Establishment, Kanpur, and Shroff & Co., Bombay. Information was supplied to the Ministry of Transport, Government of India, on the dry mounting of photos and light sensitive coatings containing shellac.

Bleached Lac — Numerous enquiries were received regarding the uses, preparation and sources of supply of bleached lac from various parties, and the following are some of the prominent ones who were given the desired information and advice :

Indian Museum, Calcutta
B. J. Medical College, Poona
Commercial Alcohols Ltd., Montreal
Anand Brush Works, Agra
R. D. Agarwal, Bundu, Ranchi
The Koh-i-noor (India) Ltd., Banaras
Department of Archaeology, Government of Madras

Samples of bleached lac were also supplied to a few of the above parties on request.

Adhesives and Cements — Formulation of lac adhesives and cements based on lac and hydrolysed lac and their best methods of application were given to the following for the specific purposes mentioned :

Mica and Micanite Products Co. Ltd., Gudur	— Micanite manufacture
Strawboard Mfg. Co. Ltd., Saharanpur	— Waterproof abrasive papers, grinding wheels, etc.
The Koh-i-noor (India) Ltd., Banaras	— Cementing aluminium to glass in making slide rules
Forest Utilization Officer, Bangalore	— Plywood manufacture.

Oil-cloth — The preparation of the composition on a large scale was demonstrated at the works of Sanker & Co., Calcutta, and Strawboard Mfg. Co. Ltd., Saharanpur. The use of shellac esters as plasticizers for polyvinyl chloride and film scrap coatings used in the manufacture of rexine, leather-cloth, book-binding cloth, etc. was successfully demonstrated at Dharampur Leather Cloth Co. Ltd., near Bombay. The quality of the materials prepared and the rate of production compared favourably with those made from imported

materials by the firm. Further attempts are being made to extend the use of lac in this direction.

Minor Uses of Lac — Enquiries regarding improvement in quality of lacquered toys, sealing-waxes, etc. were successfully answered and improved samples also supplied to some parties. In particular, advice regarding the minor uses of lac was given to the following:

Rajaram Walji & Sons, Poona Jain's Ink Depot, Bangalore	— Coloured sealing-wax
Director-General, Posts & Telegraphs	— Sealing-waxes
Model Industries Ltd., Agra Vigyan Kala Bhawan, Meerut Govt. Industrial School, Chennapatne	— Lacquer sticks
S. D. Khara, Ferozepore	— Lac-wax
Unichem Laboratories, Bombay	— Coating for pills
Radio & Electricals Ltd., Madras	— Insulating materials

Manufacture of Shellac — Detailed instructions for the manufacture of shellac were supplied to the following:

Department of Industries, Ceylon
Lallubhai Narottamdas, Surat
Palta General Store, Jullunder
M. Banerjee & Co., Calcutta
Stadco Stores & Laboratories Ltd., Shillong

The autoclave process of manufacturing shellac developed recently in the Institute elicited particular enquiries from interested parties who were supplied with all working details of the process.

Publicity — Exhibits of lac and lac products were sent to various exhibition organizations in India, and in particular the following may be mentioned:

Mahakhosal Provincial Conference, Raigarh
Bihar Provincial Conference, Muzaffarpur
Co-operative Shellac Factory Exhibition, Mirzapur
Forest Products Exhibition, Indore
Cottage Industries Fair, Lucknow
Bihar Exhibition, Hazaribagh
Indian Standards Institution, Delhi

As a result of taking part in the Brussels Fair, a few enquiries were received from Belgium, Holland, Switzerland and France for new trade openings.

A cinematograph film covering all aspects of lac from cultivation to manufacture of finished articles was recently taken by the Ministry of Information and Broadcasting of the Government of India, and the film translated into various Indian languages is on show in many cinema houses in India and abroad. Attempts are being made to give wide publicity to the film in the interior of the villages with the help of publicity vans and other organizations through the different State Governments.

Foreign Markets

The loss of markets for shellac in the gramophone-record industry in the U.S.A. is about complete and even in the other important field of floor varnishes, cheaper substitutes are making headway. Siam has established a firm market for seedlac in the U.S.A., and increasing exports of shellac from that country are also evident.

General

Information regarding lac markets, exports, production, prices, literature, etc. was supplied to enquirers. In addition, about 100 enquiries of a general nature were answered.

Contact was also maintained with actual and potential consumers of lac in India through correspondence and personal visits.

Articles of a descriptive nature were furnished to the *Times of India*, Bombay, the *Daily Mail*, London, and Indian Standards Institute, New Delhi.

A meeting convened at Patna by the Director-General of Industrial Statistics, Government of India, was attended to finalize questionnaires on "Lac and Plastics".

A lac conference called by the Hon'ble Minister for Development, Bihar, to evolve a lac marketing scheme was attended by the Director, the Lac Information Officer and a Senior Officer of the Institute.

A gradual expansion of the lac industry in Siam, with statistical data, was brought to the notice of the Indian Lac Cess Committee.

8. Meteorological Report

The average meteorological data for each month during the period under report are given in the following table:

Month		Wind-speed (miles/hr.)	Max. temp. (°F.)	Min. temp. (°F.)	Dry bulb temp. (°F.)	Relative humidity %	Sunshine hrs./day	Rainfall (inches)
April	1949	2·5	98·0	68·7	83·0	67·4	8·2	2·12
May	1949	2·7	99·3	75·3	83·4	66·7	7·8	5·26
June	1949	2·3	96·2	75·8	85·0	69·4	5·5	11·32
July	1949	2·2	87·6	73·0	80·0	85·0	3·3	14·46
August	1949	2·2	87·2	72·8	79·3	83·6	3·2	21·37
Sept.	1949	0·9	89·9	72·2	80·8	78·4	6·5	8·77
Oct.	1949	0·9	88·2	66·7	78·0	72·5	7·0	3·17
Nov.	1949	1·3	80·7	49·5	69·4	47·2	9·1	—
Dec.	1949	1·2	77·6	45·8	65·0	41·9	9·0	—
Jan.	1950	1·0	79·5	48·3	65·9	46·5	8·7	—
Feb.	1950	2·1	82·2	51·2	69·5	33·7	7·9	0·50
March	1950	2·0	87·7	59·7	74·7	44·1	8·3	1·62

The highest maximum temperature attained during the period was 107°F. and was recorded on April 28 and May 18, 1949. The lowest minimum temperature was 36°F. and was recorded on February 12, 1950. The monsoon rainfall was rather high being 55·92 inches as compared with the average of approximately 40 inches for the last three years.

P. K. Bose
Director
Indian Lac Research Institute, Namkum
Ranchi, Bihar

18*th July* 1950

APPENDIX I

A Statement of Lac Produced and Its Disposal

Crop & locality	Scraped or broodlac produced and its disposal																	
	Produced			Under use in Dept.			Driage			Supplied to Chemical Section			Sold			Distribution (free)		
	Md.	sr.	ch.	Md.	sr.	ch.	Md.	sr.	ch.	Md.	sr.	ch.	Md.	sr.	ch.	Md.	sr.	ch.
Baisakhi 1948-49	4	0	8†	0	3	8†	...			...			...			3	37	0†
Namkum	1	22	9*	1	6	8*	0	16	1	...			...			...		
Jethwi 1949																		
Namkum	... 0	0	6*	0	0	6*	...			...			...			...		
Hesal	... 5	17	0*	...			1	4	0	4	13	0*	...			...		
Katki 1949																		
Namkum	... 3	5	0†	...			...			...			1	1	0†	2	4	0†
	1	38	15*	1	30	10*	0	8	5	...			...			...		
Aghani 1949-50																		
Namkum	... 1	16	12*	1	6	0*	0	10	12	...			...			...		
Hesal	... 8	0	4*	6	25	0*	1	15	4	...			...			...		

RECEIPTS

	Quantity Md.	sr.	ch.	Value Rs.	as.	p.
1. By supply of broodlac for use in the department from Institute plantation	0	3	8	7	0	0
1.(a) By supply to free distribution of broodlac from Institute plantation	3	37	0	300	4	0
	2	4	0	86	1	0
By sale of broodlac from Institute plantation ...	1	1	0	42	0	6
TOTAL ...	7	2	0	428	5	6
2. By supply to Chemical Section, ILRI, of scraped lac from Institute plantation	4	13	0	346	0	0
3. By supply of scraped lac for use in the department ...	1	6	8	69	12	0
	0	0	6	0	12	0
do do	1	30	10	105	15	0
do do	1	6	0	92	0	0
do do	6	25	0	530	0	0
TOTAL ...	10	28	8	798	7	0
4. By supply of scraped lac to Chemical Section, ILRI, from purchased lac (*Rangeeni* & *Katki* 1949)	1	21	7	92	2	6
By supply of scraped lac in the Dept. (*Katki* 1949, *Rangeeni*)	0	3	10	5	7	0
By supply of scraped lac in the Dept. (*Baisakhi* 1948-49: *Ari*, *Palas*)	1	20	0	90	0	0
By supply of scraped lac in the Dept. (*Jethwi* 1949, *Kusmi*)	0	22	2	44	4	0
By supply of scraped lac in the Dept. (*Aghani* 1949-50, *Kusmi*)	0	1	2	2	4	0
TOTAL ...	3	28	5	234	1	6

* Scraped lac. † Broodlac.

APPENDIX II

Tabulated Statement of the Progress of Investigations

Item	Commd.	Progress	Future work proposed
1	2	3	4
1. Improving crop production on *palas* by artificial defoliation.	1940	Over 40 mds. of surplus broodlac were produced in *Baisakhi* crop. In *Katki* crop over 159 mds. of brood were obtained. Against 3,899 trees of last year, 5,031 have been infected this year.	Large-scale cultivation at Kundri to be continued. *Ficus* sps. to be grown.
2. Determination of most suitable pruning methods and seasons for *kusum*.	1941	In the *Jethwi* crop, best results were obtained from " apically pruned " 1½-year-old shoots ; " Surface pruned " shoots of 1 year and 6 months were close second. In the *Aghani* crop, 1-year-old " Apical " shoots gave best results.	Study of " Apical " and " Surface " pruning to be continued at least for 2 years.
3. Investigating the possibilities of *F. bengalensis* (*barh*), *O. dalbergioides* (*pandan*) and *A. lucida* as *Baisakhi* hosts.	1945-46	*Barh* was not available in Namkum. *A. lucida* and *O. dalbergioides* both gave satisfactory results.	To be continued.
4. Proper harvesting, storage and disposal of sticklac to control enemies.	1945-46	The loss in storage due to enemy insects was highest (17·2 per cent) in mature *Katki*.	Determination of loss in storage due to enemy insects to be continued.
5. Using broodlac in wire-gauze baskets with a view to controlling enemy insects.	1945	Effects satisfactory control on emergence of enemy insects from broodlac. Prevented loss in sticklac ranging from 5·5 to 12·3 per cent.	Large-scale trials on *kusum* or *palas* in isolated areas necessary.
6. Control of insect enemies by :			
(a) Gammexane	1946	Did not prove more effective than immersion in plain water.	To be discontinued till new programme is drawn up.
(b) DDT	1947		
(c) Fumigation	1947	Both ethylene dichloride and a mixture of ethylene dichloride *plus* carbon tetrachloride proved unsatisfactory.	To be discontinued.
7. Biological Control :			
(a) To discover suitable unnatural hosts to breed *B. greeni* in the laboratory.	1942	Pink boll-worm, pod-borer of *Junjunia* and *amaltas* pod-borer (*T. fructicassiella*) gave good results.	Completed.
(b) Breeding of *B. greeni* on a mass scale on natural and unnatural hosts.	...	14,098 *B. greeni* were bred. Highest parasitization was on pink boll-worm.	Field trials on a suitable scale should be undertaken.
8. Demonstration :			
(a) Advice and training.	1940	Staff from States and Burma were trained. Broodlac and pruning instruments distributed. Advice given and schemes prepared for Forest Departments.	To be continued.

APPENDIX II (*contd.*)

Item	Commd.	Progress	Future work proposed
1	2	3	4
(b) Practical demonstration.	1940	Cultivators in Bihar, U.P., and West Bengal have begun to appreciate improved methods of cultivation. Two new centres were opened, one in U.P., and one in Bihar.	To be continued.
(c) Improved cultivation in forest areas.	1943	1949 *Jethwi* crop was badly attacked by *Chalcids*.	To be continued.
9. Namkum Plantation.	...	Defoliation of *palas* continued to give good results.	New planting in 10 acres to be undertaken.
10. Extension of lac cultivation.	1948	Actual cultivation was undertaken and/or extended in forests of Bihar, Madhya Pradesh, U.P., Madras, and the Punjab (I) and collective cultivation under Co-operative Dept. was organized in Khunti area of Ranchi circle.	To be continued.
11. Varnishes and lacquers :			
(a) Lac-linseed oil paints.	...	Compositions used to paint doors, etc. inside the buildings observed to prove satisfactory except for a slight loss in gloss. Erosion noticed in outdoor uses.	Sample supplied to a firm for test and report.
12. Modification of lac :			
(a) Combination with maleic anhydride and pentaerythritol	1948	Combination of shellac with pentaerythritol and maleic acid : esters with unsaturated alcohols, etc. Reaction products studied.	To be continued.
(b) Lac esters as plasticizers in nitrocellulose lacquers.	1949	Ester prepared with a fusel oil fraction given commercial trial as plasticizer.	To be continued.
(c) Lac ester as plasticizer for Polyvinyl chloride.	1949	Experiments started.	To be continued.
(d) Lac esters	1949	Soft or solid allyl esters obtained. Method of preparation of methyl and ethyl esters modified.	To be continued.
13. Fundamental Researches :			
(a) Constitution of hard lac resin.	1947	Degradation products are being isolated ; monohydroxy-palmitic acid isolated from lac, also other crystalline compounds.	To be continued.
(b) Constitution of soft lac resin.	1947	Attempts are continuing to isolate degradation products.	To be continued.
(c) Hydrogenation of shellac.	1947	Absorption of hydrogen studied and correlated with I.V.	To be continued.
(d) Dielectric properties of aleuritic acid, *kauri* gum and plasticized lac.	...	Experiments conducted with a parallel capacitance bridge.	Experiments to be continued with *kauri* gum and plasticized lac.

APPENDIX II (*contd.*)

Item	Commd.	Progress	Future work proposed
1	2	3	4
(e) High voltage experiments on lac insulating varnishes.	...	A large number of tests were performed.	...
(f) Bleaching of lac.	1950	Factors responsible for bleach consumption studied.	To be continued.
(g) Determination of moisture in lac by infra-red heating.	...	About one hour's time is sufficient to determine moisture by this method.	Concluded.
14. Improvements in the manufacture of shellac, seedlac, etc.			
Making shellac by autoclave method.	1947	A boiler was used for generation of steam to melt lac. Design of a suitable commercial plant for large-scale trials is nearing completion.	To be continued.
15. *Ad hoc* Researches :			
Carbon-type moulded resistances from lac.	1950	Resistances moulded and their ageing properties are being tested.	To be continued.

APPENDIX III

Papers Published During the Year April 1949 to March 1950

1. *Bulletin No. 78. Lac-linseed Oil Varnishes, Part III : Lac-linseed Oil-lime,* by Y. Sankaranarayanan (*J. Sci. & Ind. Res.*, Vol. 8B, 1949).
2. *Indian Lac Cess Committee : Review of Activities and Achievements,* 1949.
3. *Specifications for Lac,* by P. K. Bose (*Indian Standards Institution Bulletin,* Vol. 2, No. 1, 1950).

IN THE PRESS

1. *Bulletin No. 79. Determination of Moisture in Lac by Infra-red Heating,* by G. N. Bhattacharya & S. C. Mukherji (*Ind. J. Phys.*).

APPENDIX IV

Statistics of Lac Production in India (in maunds)

Year	*Baisakhi*	*Jethwi*	*Katki*	*Kusmi*	*Total*
1949-50	6,03,500	1,02,750	2,70,300	1,24,000	11,00,550
1948-49	5,40,000	10,000	1,73,000	82,000	8,05,600
1947-48	6,16,000	30,250	2,31,500	94,000	9,71,750

APPENDIX V

The Annual Report of the Intensive Lac Demonstration Scheme in Bihar for the Year 1949-50, *as Submitted by the Entomologist, Government of Bihar*

Introduction — The scheme on intensive demonstration of lac has, now, completed 5 years of its life in Bihar and this period, at any rate, cannot be said to be long enough to bring about an all-round improvement in the indigenous lac cultivation. But the results so far achieved are very encouraging and it is recorded with the greatest satisfaction that the scheme is making headway, in spite of so many hurdles put in its way. The lac growers are now realizing the advantages and superiority of the improved methods of lac cultivation advocated by us over their own indigenous and crude methods, and their extremely conservative and suspicious outlook has undergone a complete change during these years. Encouraging reports of offers of co-operation, interest and adoption of our improved methods of cultivation are now coming in from almost all the centres. A brief review of work done by our demonstration staff is given below.

Staff — There was no change in the personnel of the staff except the appointment of two Lac-Inspectors and a few more staff in places of some discharged hands and also a few transfers which were considered necessary in the interest of work. The following newly appointed persons remained on training at the Indian Lac Research Institute, Namkum, Ranchi :

1. Sri Antaryami Jha, Demonstrator, joined in May 1949.
2. Sri Baidya Nath Singh, Demonstrator, joined in November 1949.
3. Sri Shyam Singh, Demonstrator, joined in November 1949.
4. Sri Dip Narain Roy, Demonstrator, joined in November 1949.
5. Sri Ganesh Pd. Sinha, Lac Supervisor, joined in January 1950.

The appointment of two Lac-Inspectors was made during the year under report and they are undergoing short-course training at the Indian Lac Research Institute, Namkum, Ranchi, before they take up their duties at their respective centres in accordance with the provision laid down in the scheme.

The Demonstrators, on completion of their training, were posted as detailed below :

1. Sri M. M. Mishra was posted at Dantar under Lac Supervisor, Chatra, Hazaribagh.
2. Sri Dhuma Kujur was posted at Chandil under Lac Supervisor, Chandil, Manbhum.
3. Sri Gaya Datta Mishra was posted at Panki under Lac Supervisor, Panki, Palamau.
4. Sri Tarni Prasad Mandal was posted at Satbarwa under Lac Supervisor, Latehar, Palamau, and has been appointed as a Clerk under Lac Scheme.
5. Sri Suresh Ekka joined at Latehar but was discharged later on.

There is already shortage of demonstration staff consequent upon the opening of a new centre at Chatra, and a proposal for expansion of the scheme has been submitted and is under the consideration of the Government.

Survey — For carrying on intensive demonstration work successfully, it is essential to make a preliminary survey of the area so as to get an idea about the different lac host-trees. With this aim in view, survey of new areas is undertaken every year. It serves twofold purposes inasmuch as the demonstration staff comes in contact with the cultivators where aims and objects of the schemes as also the facilities extended by the Government are brought home to them. A special feature of this work, during the year under report, has been to make a survey of a number of jungles in the forest areas, besides the villages.

Propaganda — Attempts are also made by the demonstration staff to explain to the public the aims and objects of the demonstration work by availing opportunities in *hats*, bazaars, fairs and schools. At a number of places, demonstrations on pruning and artificial

method of infection, wherever considered necessary, were also given by way of casual demonstration. The number of villages and jungles surveyed during the year and casual demonstrations made, if any, are shown in Table I *vide* Enclosure 1 (p. 37).

Intensive Demonstration — The whole idea behind the intensive demonstration is to bring out the benefits and utility of the improved methods of cultivation in contrast to the defective and faulty methods hitherto followed by the cultivators and thereby to persuade them to take up the cultivation of lac in a better and systematic way with the ultimate aim of pushing up the production of lac more and more. In new area, the broodlac was continued to be supplied free of cost in the initial stage partly from the area products, which had attained self-sufficiency and partly from the Institute.

The yield-returns, as usual, were given to the growers for disposal in whatever way they liked.

The actual progress of work, giving the total number of demonstration sites, number of different host-trees operated upon, the total quantity of broodlac used and the total yield obtained at the respective centres, is shown in Table II *vide* Enclosure 2 (p. 38).

It will be found that accurate data on the yield-return at some places are not given. This is because of the fact that the produce had either been stolen away or the cultivator refused to give the exact figures.

The yield-return of *Baisakhi* and *Jethwi* crops is not included in the report under review.

New Line of Work — The Ministry of Agriculture, Government of India, has been stressing on the necessity of extending the cultivation of lac and thereby increasing the volume of exports in order to compete with the synthetic substitutes, capturing the foreign markets. The Indian lac industry has been hit hard with the devaluation of Indian currencies and it is of utmost necessity to push up the production of shellac in India. The cultivation of lac on an extensive scale is extremely essential and steps have already been taken by the Institute authorities and myself to extend the work into the forest areas, where the lac hosts still remain unexploited. Accordingly, large number of forest areas — reserved forests, Khalsa forests and zemindari forests — have been surveyed during the year under report (details as per Table I). Work has already been initiated in the reserved forest areas in Palamau District with the co-operation of the Forest Department. (The progress of work shown in Table II.)

Difficulties — The lac host trees in majority of cases are under the possession of the zemindars who are the least interested persons for taking up lac cultivation by themselves. They generally lease out their trees either on a very high rental or on share-system and they usurp the lion's share ($\frac{2}{3}$ of the total yield).

(ii) There is no safeguard against thefts which are frequently committed on the cultivators' trees.

(iii) Inconveniences in the transport of broodlac in the rainy season to the interior.

(iv) There is lack of proper marketing facilities for the disposal of sticklac, with the result that the middlemen make a huge profit, depriving the poor cultivators of their legitimate share.

(v) The present strength of the demonstration staff is too meagre to carry on the work in an extensive scale. A proposal for expansion and extenstion of the scheme has already been submitted to the Government.

Suggestions — For extensive cultivation of lac, the cultivators need encouragement in the shape of some sort of concessions, for example, facilities for obtaining broodlac at reasonable price, reduction in the rental of host-trees in case they do not own them and prevention of random thefts.

It is felt that the departmental cultivation in the entire forest areas is not practical nor economical particularly where the lac hosts are widely scattered. The Forest Department should lease out the trees on a nominal rental to the cultivators of the adjoining villages.

The necessity of lac-growers' co-operative society is felt for more than one reason and the society should be organized so as to function on the same line as that of cane-growers' co-operative societies in Bihar.

A scheme has already been submitted to the Government.

TABLE I (Enclosure 1)

Statement Showing the Number of Forests and Villages Surveyed and Casual Demonstration Areas

District	Centres	No. of jungles or villages surveyed		No. of casual demonstration areas
		Forests	Villages	
Ranchi	Palkot and Bundu	6	125	22
Manbhum	Jhalda and Chandil	20	11	1 extensive area
Palamau	Panki, Latehar and Chandwa	16	38	43
Hazaribagh	Chatra	5	31	7 extensive areas
Singhbhum	Jaraikela	—	—	—

Progress Report of the Work Done under the Scheme for Intensive Demonstration of Improved Methods of Lac Cultivation in the Uttar Pradesh for the Period 1st April 1949 to 31st March 1950, as Submitted by the Entomologist, Uttar Pradesh

STAFF

The sanctioned strength of the staff under the scheme included two Lac Supervisors and six Lac Demonstrators, of which the posts of one Lac Supervisor and three Lac Demonstrators were created with effect from 1st April 1949. The actual strength of the staff in the scheme, however, consisted of one Lac Supervisor and two Lac Demonstrators during the greater part of the year. One post of Lac Demonstrator was filled up in February 1950 and a Lac Demonstrator from the existing staff was promoted to the post of Lac Supervisor in March 1950, thus bringing the actual strength of the staff, towards the close of the year, to two Lac Supervisors and two Lac Demonstrators. The newly recruited Lac Demonstrator was, however, sent to the Indian Lac Research Institute, Namkum, Ranchi, for one year's training.

The main reason for the four posts of Lac Demonstrators remaining vacant was the low scale of pay (Rs. 25-1-40) which the posts carried.

AREAS UNDER INTENSIVE DEMONSTRATION

The intensive demonstration areas were confined to Mirzapur and Dudhi subdivisions of the Mirzapur District, with headquarters at Mirzapur and Wyndhamganj respectively. The details of the work done in the two subdivisions follow.

TABLE II (Enclosure 2)

Consolidated Statement Showing the Number of Demonstration Areas Worked, Different Host-trees Operated, Amount of Brood Used and Yield so far Received in various Lac Centres during the Period April 1949 to March 1950, under Intensive Demonstration Scheme, Bihar

Name of centre	Total No. of demonstration sites	Total amount of brood used Md. sr. ch.	Name & number of tree operated during the period						Total yield obtained Md. sr. ch.	Brood to yield ratio obtained	Brood used during *Baisakhi* 1949-50 & *Jethwi* 1950		Remarks
			Kusum	*Khair*	*Palas*	*Ber*	*Pan.*	*Barh*			*Baisakhi* Md. sr. ch.	*Jethwi* Md. sr. ch.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Latehar	13	31 30 0	20	...	1008	117	...	...	79 28 0	1 : 2·5	16 33 0	1 25 0	*Baisakhi* 1949-50 & *Jethwi* 1950 are in progress and to be reaped in July 1950.
Chandwa	12	8 2 0	27	...	492	...	...	...	14 12 8	1 : 1·8	9 23 0	3 26 0	Do
Reserve Forest under Latehar jurisdiction	2	37 18 0	245	1329	89	468	102	5	16 28 0	1 : 2·5	10 0 0	12 6 8	This brood to yield ratio is of *Aghani* 1949-50 crop only. 31 mds. 20 srs. of broodlac were used for *Katki* crop and only 2 mds. of healthy broodlac were reaped, remaining left for self-infection for *Baisakhi* 1949-50.
Chandil	37	26 37 0	21	...	704	13	...	...	14 8 0	1 : 0·502	13 12 0	3 11 0	*Aghani* 1949-50 & *Jethwi* 1949 crops failed.
Panki	12	5 17 8	...	...	371	...	...	...	9 24 0	1 : 1·76	5 15 8	...	*Baisakhi* 1949-50 in progress.
Jhalda	13	24 35 0	67	...	675	85	...	...	50 5 8	1 : 2·015	5 8 4	5 30 0	Due to total failure of *Jethwi* 1949, brood to yield ratio has fallen short.
Palkot	16	6 7 8	57	...	2	3	...	...	9 15 0	1 : 1·51	0 6 8	3 2 0	*Baisakhi* 1949-50 & *Jethwi* 1949-50 still in progress, to be reaped in July 1950.
Bundu	21	16 4 0	24	...	320	...	...	...	52 13 0	1 : 3·25	10 10 0	2 34 0	*Baisakhi* 1949-50 & *Jethwi* 1950 still in progress.
Chatra	7	8 0 0	...	...	938	...	...	...	4 19 6	1 : 1·4	9 19 6	...	3 mds. brood supplied in June-July 1949 for *Katki* crop 1949. *Katki* brood received 4 mds. 19 srs. 6 ch. only in Oct.-Nov. 1949. 5 mds. brood supplied in Oct.-Nov. 1949.
Jaraikela	14	73 23 4	1263	...	...	...	...	...	43 38 0	...	...	14 6 12	

Mirzapur Subdivision — Intensive Demonstrations of various operations of lac cultivation on improved lines, as recommended by the Indian Lac Research Institute, Namkum, Ranchi, were carried out in three villages, viz. Jhelumpur, Kakrood and Malua. In the beginning, intensive demonstration work was carried out also in the villages Banaki, Deorikalan and Basohi ; later, it was given up in Banaki due to the non-co-peration of the owner of lac host-trees and in Deorikalan and Basohi chiefly due to the failure of the heat-affected broodlac in June 1949.

Jhelumpur — There were 250 *palas* trees, divided into three coupés, under lac cultivation. The 1948-49 *Baisakhi* crop was only partially cropped ; part of it was left over for self-infection. In April, 100 *palas* trees were pruned for 1949-50 *Baisakhi* crop. In June, 50 *palas* trees were infected with 42 seers of broodlac received from Namkum for 1949 *Katki* crop, but due to intense heat all emerging larvae died and the infection was a failure. In October, with 10 seers of locally produced broodlac, 10 *palas* trees were infected for 1949-50 *Baisakhi* crop which developed normally. In February, 50 *palas* trees were pruned for 1950 *Katki* crop.

Kakrood — There were 250 *palas* trees, divided into three coupés, under lac cultivation. The cropping of 1948-49 *Baisakhi* crop was partial ; part of it was left over for self-infection. In April, 100 *palas* trees were pruned for 1949-50 *Baisakhi* crop. In June, 30 *palas* trees were infected with 10 seers of broodlac received from Namkum for 1949 *Katki* crop, but the infection was a failure as all the emerging larvae died due to intense heat. In October, with 24 seers of broodlac received from Namkum and with 8 seers locally produced broodlac 21 *palas* trees were infected for 1949-50 *Baisakhi* crop which was developing normally. 50 *palas* trees were pruned in February for 1950 *Katki* crop.

Malua — In this village also there were 250 *palas* trees, divided into three coupés, under lac cultivation. The cropping of 1948-49 *Baisakhi* crop was partial ; part of it was left over for self-infection. 100 *palas* trees were pruned in April for 1949-50 *Baisakhi* crop. 30 *palas* trees were infected with 14 seers of broodlac received from Namkum in June for 1949 *Katki* crop, but the infection was a failure. In October, 31 *palas* trees were infected with 46 seers of broodlac, 36 seers received from Namkum and 10 seers produced locally, for 1949-50 *Baisakhi* crop which was developing normally. 50 *palas* trees were pruned in February for 1950 *Katki* crop.

Dudhi Subdivision — The intensive demonstration areas in this subdivision were Mundisemar, Kewal, Harnakachar, Berkher, Jantajua, Jorookhar, Kolinduba, Patariha, Bome, Jampani, Mahuli and Magardah. The villages of Jantajua, Jorookhar, Kolinduba and Patariha were taken under intensive demonstration from May 1949, and those of Bome, Jampani, Mahuli and Magardah from October 1949.

Mundisemar — There were 150 *palas* trees under lac cultivation, divided into three coupés. The entire 1948-49 *Baisakhi* crop was left over for self-infection. 30 *palas* trees were infected in June with 11 seers of broodlac received from Namkum, and the development of 1949 *Katki* crop was normal. In October, 50 *palas* trees were infected with 1 maund 33 seers of broodlac received from Namkum and 17½ seers of locally produced lac for 1949-50 *Baisakhi* crop which developed normally. 60 *palas* trees were pruned in February for 1950 *Katki* crop.

Kewal — There were 140 *palas* trees under lac cultivation. 25 seers of broodlac were cropped from 1948-49 *Baisakhi* crop, out of which 35 seers were used in infecting 15 *palas* trees in July for 1949 *Katki* crop which developed normally. 60 *palas* trees were infected with 3 maunds 5 seers of broodlac, produced locally, in October for 1949-50 *Baisakhi* crop, the development of which was normal.

Harnakachar — There were 56 *palas* trees under lac cultivation. There was partial cropping of 1948-49 *Baisakhi* crop in July. With 2½ seers of broodlac so cropped, 2 *palas* trees were infected for 1949 *Katki* crop which developed normally. 10 *palas* trees were pruned in April for 1949-50 *Baisakhi* crop. In October, with 30 seers of broodlac produced

locally, 24 *palas* trees were infected for 1949-50 *Baisakhi* crop which developed satisfactorily. 5 *palas* trees were pruned in February for 1950 *Katki* crop.

Berkher — There were 105 *palas* trees under lac cultivation. 1948-49 *Baisakhi* crop was only partially cropped in July. One *palas* tree was infected with 2 seers of broodlac so cropped for 1949 *Katki* crop. 30 *palas* trees were pruned in April for 1949-50 *Baisakhi* crop. In October, 20 *palas* trees were infected with 20 seers of broodlac, 10 seers of local produce, for 1949-50 *Baisakhi* crop which developed normally. 15 *palas* trees were pruned in February for 1950 *Katki* crop.

Jantajua, Jorookhar, Kolinduba and Patariha — These areas were taken under intensive demonstration since May 1949. There were 221 *palas* trees, as made up of 75 in Kolinduba, 35 in Jantajua, 56 in Jorookhar and 35 in Patariha, for lac cultivation. One *palas* tree in each of these villages was infected with $2\frac{1}{2}$ seers of broodlac received from Namkum in June for 1949 *Katki* crop, the development of which was normal. In Jorookhar, 5 more *palas* trees were infected in July with 9 seers of broodlac, produced locally, for 1949 *Katki* crop. A total of 50 *palas* trees in these villages were pruned in April for 1949-50 *Baisakhi* crop. In Kolinduba, Jorookhar and Patariha, a total of 61 trees were infected in October with 2 maunds 37 seers of broodlac, 15 seers of which were received from Namkum, for 1949-50 *Baisakhi* crop, the development of which was satisfactory. 25 *palas* trees in all in these villages were pruned in February for 1950 *Katki* crop.

Bome, Jampani, Mahuli and Magardah — These areas were taken under intensive demonstration in October 1949. A total of 161 *palas* trees were infected with 1 maund 31 seers of broodlac produced locally in October for 1949-50 *Baisakhi* crop which developed normally.

Casual Demonstration Areas

Casual demonstrations of improved methods of lac cultivation on *palas* trees were carried out in villages Rampur, Dinari, Dharan, Samada, Palhari, Bodaha, Rajdhan, Patwadh, Salkhan, Kawaljhar, Gorgi, Bohuti, Kotwa, Vodarhava, Cheeroi, Gashwan, Baijnath, Mao and Chhapka in Mirzapur circle and Sagobadh, Ferrypan, Baina, Randah, Tehri Bandah, Sagsoti, Lambi, Ahirpurwa, Ikdari, Fanakpur, Jeevedeh, Chainpur, Kogan and Dhankhor in Wyndhamganj circle.

Propaganda

Besides intensive and casual demonstration of lac operations in the areas mentioned above, the lac staff visited about 70 villages all over the district wherein lectures on the improved methods of coupéing, pruning, infection, and collection of lac were delivered. At places, demonstrations of pruning and *ari*-cutting were also given.

Help Given to Cultivators

8 maunds 3 seers of *rangeeni* broodlac received from the Indian Lac Research Institute, Ranchi, and 13 maunds 4 seers of locally produced broodlac were supplied free to cultivators in the intensive demonstration areas. Pruning instruments were given on loan to deserving cultivators for the time of pruning operations only.

Crop Yields

There was only partial cropping of the 1948-49 *Baisakhi* crop, most of which was left over for self-infection. The amount of broodlac cropped in July was 3 maunds 25 seers and that of the seraped lac 25 seers.

The 1949 *Katki* crop on most of the *palas* trees, infected with broodlac received from Namkum in June, in the Mirzapur centre, was a failure due to intense heat. The development of *Katki* crop on self-infected trees and on trees infected with locally produced lac was, however, satisfactory. The amount of broodlac cropped in October was 9 maunds 19 seers and that of scraped lac about 46 seers.

The development of 1949-50 *Baisakhi* crop was satisfactory.

Progress Report of the Work done under the Scheme of Intensive Demonstration of Improved Methods of Lac Cultivation in West Bengal for the Period 1st April 1949 to 31st March 1950, as Submitted by the Entomologist, West Bengal

1. *Object of the Scheme* — To demonstrate improved methods of lac cultivation as advocated by Indian Lac Research Institute, Namkum, Ranchi, in the lac-growing areas of West Bengal.

2. *Area of Operation — District*: Murshidabad. *Subdivision*: Jangipur. *Thana*: Samsergunj, Suti & Farakka. *Union*: Kanchantola, Nawpara, Moharial, Nimtita, Arjunpur, Bonigram, Imamnagar.

District: Malda. *Thana*: Manikchack, Ratua and Kalichak. *Union*: Mathurapur, Kahala, Debipur, Manikchakdiar, Panchanandapur, Bedrabad, Birnagar, Golapgunj.

3. *Staff* — The sanctioned strength of the staff under the scheme consists of 2 Lac Supervisors and 6 Lac Demonstrators of which at present two Lac Supervisors and 2 Lac Demonstrators are working and the rest are under training in the Indian Lac Research Institute.

4. *Host Plant — Ber* is the only tree utilized as lac host in this State and the approximate number of trees present in each area is as follows:

District: Murshidabad			
Subdivision: Jangipur ...		... 70,000	
District: Malda: ...			
	Manikchack P.S. ...	... 5,568	54,531
	Ratua P.S. ...	... 17,593	
	Kalichak P.S. ...	... 31,370	

Number of Trees Pruned by Scientific Method for Different Crops:

Murshidabad: 1,000
Malda : 2,525 pruned in February.

Number of Trees Infected for Different Crops:

Murshidabad: 1,500
Malda : 1,465

Names of Villages where Cultivators were given Advice about the Scientific Methods of Lac Cultivation:

Malda — 1. Haripur. 2. Kahala. 3. Kamolpur. 4. Khoni. 5. Balarampur. 6. Atgona. 7. Surjapur. 8. Debipur. 9. Bholpara. 10. Konohichalk. 11. Bahirpur. 12. Puleadha. 13. Karbona. 14. Faridpur. 15. Bhado. 16. Charkilehi. 17. Kumaria. 18. Kheria. 29. Gunipukur. 20. Hanripara. 21. Chandipur. 22. Bhagleanpur. 23. Chandmoni. 24. Bahlabona. 25. Bahasal. 26. Sahapur. 27. Bhakhara. 28. Paranpur. 29. Nimondhi. 30. Radhanagar. 31. Chikkatala. 32. Gorakha. 33. Lokrigola. 34. Chunara. 35. Dangrigheet. 36. Tangaria. 37. Bhagban Dighi. 38. Nurallyaganj. 39. Turukdihi. 40. Kokolamari. 41. Gopalpur.

42. Balutola. 43. Parktola. 44. Haddatola. 45. Godhpatta. 46. Radhutola. 47. Prosaditola. 48. Shibontola. 49. Rabinpur. 50. Krishnanagar. 51. Torapditola. 52. Panchanandapur. 53. Hazarbighi. 54. Sultantola. 55. Islampur. 56. Tofi. 57. Rajnagar. 58. Birnagar. 59. Golapganj. 60. Sasani. 61. Sukpara. 62. Sahabazar. 63. Mashavari. 64. Chainpara. 65. Chauri-anantapur. 66. Anantapur. 67. Chardaha. 68. Dasbighai. 69. Khejuria. 70. Baisamtanagar. 71. Krishnapur.

Murshidabad — (a) 1. Gobindapur. 2. Babupur. 3. Joforebad. 4. Ratanpur. 5. Joneshpore. 6. Tinpakuria. 7. Chaksapur. 8. Betbona. 9. Paharghati. 10. Krishnapur. 11. Jaganathpur. 12. Kankuri. 13. Radhunathpur. 14. Parkartola. 15. Malanch. 16. Chabbghati. 17. Faridpur. 18. Protapganj. 19. Khidirpur. 20. Bhasaipikar.

(b) 1. Aurangabad. 2. Nimtita. 3. Dofobat. 4. Durgapur. 5. Kamalpur. 6. Dhusripara. 7. Chachauda. 8. Hoghalbari. 9. Jairampur. 10. Tofapur. 11. Rajipur. 12. Amtola. 13. Bortola. 14. Kanchantola. 15. Muskinagar. 16. Paranpara. 17. Arjunpur. 18. Faridpur. 19. Pratapganj. 20. Khidirpur. 21. Bhasaipikur. 22. Nayansuk. 23. Benigram. 24. Imamnagar.

Intensive Demonstration Centres

Malda — There are 17 Intensive Demonstration Centres with 3,095 trees of which 525 trees are bearing the standing *Baisakhi* crop and 405 trees have been pruned in February 1950 for June infection and 635 have been pruned for October infection.

Murshidabad — There are two Intensive Demonstration Centres of which 40 trees (coupé A) in Chabbghati and 16 trees in Bhowanipur are bearing the standing crop.

Condition of the Present Crop

The crop condition is not good as abnormal early emergence took place from the month of March 1950. The out-turn of lac will be very small as due to early emergence the cultivators became perplexed and did not further infect the trees and thus at present only 2 per cent of the trees are bearing the standing crop and the rest are lying idle. Over and above, a major portion of the present crop has been much affected by extreme heat which has resulted in 50 per cent destruction. So we shall have to face an acute scarcity of broodlac this year. The crop condition in the case of the trees in which special operation, i.e. partial pruning, was carried out is not very different.

Material Help Given to Cultivators

Forty maunds and thirty-six seers of broodlac were supplied by the Indian Lac Research Institute for distribution in intensive demonstration centres.

Probable Causes of Failure

Excessive heat and draught may be regarded as primary factors in the destruction of the crop. Excessive draught caused defoliation which resulted in direct exposure of the lac encrustation to the scorching rays of the sun. Probable cause for early emergence can be found out only by constant observation and maintenance of climatological records of the area concerned.

Plan for the Coming Season

It has been decided to start an experimental farm on cultivators' land with the existing trees where only scientific methods of cultivation as recommended by the Institute will be followed from the very beginning. One of the local lac staff will remain in charge of the experimental station who will keep record of all data including the meteorological data. The Liaison Officer, the Entomologist of the Institute as well as officers of this section will visit the farm often for keeping first-hand information about the condition of the crop. In this way we hope to find out the causes of early swarming and other factors responsible for the destruction of the crop.

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