INDIAN LAC RESEARCH INSTITUTE
NAMKUM, RANCHI, BIHAR, INDIA

Annual Report
1983

INDIAN COUNCIL OF AGRICULTURAL RESEARCH
NEW DELHI
1986

COMMITTEE FOR PROCESSING AND EDITING OF ANNUAL REPORT

1. Sri Shravan Kumar	Chairman
2. Sri N. S. Chauhan	Member (Ento. Div.)
3. Dr S. K. Saha	Member (Ext. Div.)
4. Dr P. C. Gupta	Member (Tech. Div.)
5. Dr P. Kumar	Member (Agro. Div.)
6. Dr S. C. Agarwal	Member-Secretary

CONTENTS

1. DIRECTOR'S INTRODUCTION

A brief historical introduction

The Indian Lac Research Institute, Ranchi which was set up in 1925, continued to function under the Administrative control of the Indian Council of Agricultural Research, New Delhi w.e.f. April 1, 1966.

The Institute is located at Namkum, about 9 km east of Ranchi. Out of a total area of 49 ha, nearly 35 ha are being used as plantation for cultivation experiments. Areas/trees have been taken on long term lease for out station experiments.

Objectives

The objectives of the Institute are:

(i) To carry out researches towards affecting improvements in the cultivation, processing and standardization of lac and study its constitution and modifications so as to intensify lac production and extend its utilization,

(ii) To extend the results of research through publicity, maintaining liasion with and providing technical service to the growers and indigenous industries towards increased utilization of lac and improving the quality of their products, and

(iii) To impart training in improved methods of lac cultivation and industrial uses of lac.

Organizational set-up

The Institute consists of five Divisions namely, Entomology, Agronomy and Plant Genetics, Chemistry, Technology and Extension. The Institute library adjoins the Entomology Division. Besides these, the Institute has Administrative, Audit and Accounts, Artist-cum-photography and Mechanical Sections. The Institute maintains one Regional Field Research Station at Dharamjaigarh (M.P.) and also runs one Operational Research Project in a group of four villages in Ranchi District to demonstrate the package of practices for improving the production of lac on area basis.

The overall administrative and technical supervision of the Institute is done by the Director. The Divisions of Entomology and Chemistry are headed by their respective Head of Divisions, while the remaining Divisions are under the charge of their respective senior most Scientists. The Institute Plantation is maintained under the Supervision of Farm Superintendent.

Research Highlights

Entomology Division

Among the notable results particular mention may be made of: (i) the successful use of the water-soluble lac dye, laccaic acid, as a biological stain

and (ii) interesting differences recorded in the abundance of lac associated insects in different locations of Chotanagpur.

Agronomy and Plant Genetics Division

Lac cultivation trials on *arhar* varieties have shown that lac bearing plants suffered considerable mortality during summer months which could be much reduced by fortnightly irrigation.

Chemistry Division

An anticorrosive primer composition based on dewaxed lac and double-boiled linseed oil prepared earlier was tested for its film performance. The films had good adhesion, hardness, flexibility and water and solvent resistance.

The lac-2,4-D weedicide combination product has been prepared on bench scale and supplied to seven Instt./Universities for evaluation studies on problematic weed-*Parthenium* as well as other weeds of agricultural crops.

Technology Division

A cold setting adhesive composition comprising modified hydrolysed lac (rebulac) and toluene di-isocyanate (30%) gave encouraging result over wood to wood, wood to mild steel and mild steel to mild steel surfaces. The bond strength between these surfaces was 0·25, 0·24 and 0·19 ton/inch^2 respectively.

Extension Division

Comparative study of the properties of lac during storage as sticklac and seedlac showed that there is no advantage in storing as sticklac both on quality and cost consideration. It was also concluded that quality of lac can be maintained longer if the dry sticklac is stored in gunny bags. The data are expected to be helpful to the State Trading Corporation of India in formulating their buffer stock policy on lac.

Library

The number of books and bound volumes of journals accessioned during the year 1983 was 407 which brought the total number of books and volumes of journals in the library to 18,144. One hundred sixty five periodicals were subscribed in addition to a few received in exchange or as gift. Some miscellaneous publications and reports were also received.

The library also maintains an adequate stock of books and reprints of articles published by the Institute and by the erstwhile Indian Lac Cess Committee for sale/distribution to those interested.

The Institute Management Committee

The Institute Management Committee continued to function as usual and its 8th and 9th meetings were held on 12th May and 18th Nov. 1983 respectively. In the 9th meeting, the Committee emphasized that the Council may be requested

to consider the proposal for converting 6 posts of UDC to the posts of Assistants so as to remove the stagnation among the staff members who are working in the post of UDC for several years.

The Institute Grievance Cell

During the year, two meetings of the Institute Grievance Cell were held and personal grievances of the staff members were considered.

The Institute Staff Joint Council

The Institute Staff Joint Council which was reconstituted in Sept. 1982, continued to hold its meetings every quarterly. Altogether three meetings were held during the year 1983. The Institute Joint Council recommended timely assessment of technical personnel, proper water-supply, issuing identity cards to staff members, transport facility, declaring staff members permanent/quasi permanent, construction of cattle-trap at the Institute-gates, acquiring of medicines in the Institute Dispensary timely, payment of medical bills and proper distribution of work in the Administrative Section.

The Institute Committee for Processing and Editing Annual Reports

The Institute Annual Report Scrutiny Committee took up the processing and editing of Annual Reports for the years 1979 and 1980. The Member-Secretary convened nearly thirty meetings of the Committee in the course of the year for this purpose. The said reports after the editing were sent to press for publication.

Training and Advisory Services

The Institute provides two courses of training of six month duration each on: (i) Improved method of lac cultivation and (ii) Industrial uses of lac. The training is usually given to deputees of Central and State Governments and Industrial undertakings. In addition, short term training on specific lines is also arranged on request.

The Institute also provides technical assistance to all those interested in cultivation, processing, grading and utilization of lac.

ICAR Eastern Zone Sports

The ICAR Eastern Zone Sports were successfully organized by this Institute w.e.f. 24th Oct. to 29th Oct. 1983 and six ICAR Institutes of Eastern Zone participated in the sports. Sri Hira Singh, Income Tax Commissioner inaugurated the sports and Dr I. C. Mahapatra, Vice-Chancellor, Birsa Agricultural University, Ranchi delivered the valedictory address of the function and distributed the prizes to the participating players and teams.

Research Collaboration Overseas and with Other Institutions

The Institute has taken advantage of International Technical Cooperation Schemes to provide specialized knowledge to its employees as well as to exchange technical know-how with foreign delegates.

The Institute has always sought to take advantage of technical know-how and facilities available in other Institutions for the furtherance of its objectives, in particular for the evaluation of the products and process developed at this Institute.

The Institute is represented in the Lac Development Council, Shellac Export Promotion Council and Technical Committees of the Indian Standards Institution.

Finance

The Institute is being wholly financed by the Indian Council of Agricultural Research. The revised budget estimates of the Institute for the year 1983 amounted to Rs 50·37 lakhs under non-plan and Rs 20·35 lakhs under plan respectively. The actual expenditure was Rs 46·2 lakhs under non-plan and Rs 18·47 lakhs under plan respectively.

Honours and awards

Dr B. C. Srivastava Scientist S-1 (Organic Chemistry) was elected fellow of Institution of Chemists (FIC) Calcutta.

Visitors

The Institute has always been a regular attraction to most visitors to Ranchi particularly Scientists and Technologists. During the period under report also, it received the usual compliment of visitors including high officials, delegates and other distinguished persons. Some of them are listed below:

1. Dr Manohar Singh, Head, Division of Nutrition CSWRI, Avikanagar.
2. Mrs Nitin Shinde, U.S.A.
3. Sri Dilip Singh Bhuviya, M.P.
4. Ken. Kanokagi, Director, Indo-Japanese Association, Tokyo.
5. Dr A. C. Chatterjea, Asstt. Professor of Zoology, Presidency College, Calcutta.

2. PROGRESS OF RESEARCH

A. ENTOMOLOGY DIVISION

(a) RESEARCHES COMPLETED

Project No. 1.3.5(b)

Investigation on indigenous plant species for use as alternative hosts to supplement *kusmi* lac production in the region

The objective of the experiment was to find out alternative *kusmi* lac host in Madhya Pradesh to supplement *kusmi* lac production in the region.

The experiment was started in 1967 on unpruned trees found in the adjoining areas of Dharamjaigarh (M.P.). Later on, it was carried out on pruned trees and was concluded in 1983. During the period, 13 crops were raised but the crop was obtained only in 3 each of *aghani* and *jethwi*. The crop data are presented in Table 1.

The following plant species were tried:

1. Ail (*Acacia pennata* Willd.), 2. Amaltas (*Cassia fistula* Linn.), 3. Amla (*Ziziphus oxyphylla* Edgew.), 4. Bahera (*Terminaliya bellirica* Benth.), 5. Bansa

TABLE 1 — INVESTIGATION OF INDIGENOUS PLANT SPECIES FOR USE AS ALTERNATIVE *kusmi* HOST OCCURRING IN M.P.

Crop	Host	Brood used (kg)		Yield (kg)		Crop ratios
		Lac stick	Sticklac	Lac stick	Sticklac	Brood used to yield (sticklac)
Jethwi 1968	Dhoben	10·0	2·65	1·100	0·110	1:0·41
	Sarai	2·0	0·150	1·0	0·100	1:0·66
Aghani 1968-69	Khair	43·0	9·700	10·0	1·750	1:0·18
	Dumar	28·2	3·2	17·2	1·3	1:0·40
	Sarai	16·0	1·55	0·4	0·1	1:0·06
	Bansa	21·6	3·4	0·2	0·02	1:0·06
Jethwi 1969	Dhoben	5·0	0·7	4·5	0·62	1:0·90
	Sarai	10·4	0·725	1·2	0·10	1:0·13
Aghani 69-70	Khair	4·6	0·90	2·6	0·26	1:0·29
	Dumar	7·6	1·10	3·5	0·08	1:0·07
Aghani 1975-76	Jhera	3·0	0·50	1·7	0·40	1:0·80
Jethwi 1976	Dumar	4·0	0·60	2·2	0·30	1:0·50

(*Albizzia odartissima* Linn.), 6. Bargad (*Ficus bengalensis* Linn.), 7. Bhirra (*Chloroxylon swietenia* DC.), 8. Char (*Buchanania laujun* Spring.), 9. Dhaura (*Anagiessus latifolia* Loul.), 10. Dhavi, 11. Dhawa, 12. Dhoben (*Dalbergia peniculata* Roxb.), 13. Dumer (*Ficus recemosa* Linn.), 14. Ghont (*Ziziphus xylopyra* Willd.), 15. Ghui (*Ficus* sp.), 16. Ghotli, 17. Harra, 18. Jamuni, 19. Jhera (*Ficus* sp.), 20. Karai, 21. Katmouli (*Bauhimia racemosa* Lam.), 22. Khair (*Acacia catechu* Willd.), 23. Kherri, 24. Khini (*Ficus cunnia* Bunch-Ham.), 25. Mahua (*Madhuca indica* Linn.), 26. Nagur, 27. Nilgiri, 28. Pipal (*Ficus religiosa* L.), 29. Ruli-sindoor (*Mallotus philippinensis*, 30. Sarai or sal (*Shorea robusta* Gaertn.), 31. Salai or salga (*Basawallia serrata*), 32. Saja (*Terminaliya tomentossa*), 33. Sissoo (*Dalbergia sisoo* Roxb.), 34. Sendha, 35. Tendu (*Diospyrus* sp.), 36. Tevar, 37. Tilsa.

It will be seen from Table 1, that none of the plant species tried gave a satisfactory *kusmi* crop.

(B. N. Sah and J. M. Das Gupta)

(b) RESEARCHES ON HAND

1.1 Lac Cultivation Studies

1.1.8 Studies on the possibility of lac cultivation on *palas* and *khair* in alternation

Further lac cultivation trials showed that the *baisakhi* 1982-83 crop was satisfactory on those *palas* trees inoculated with *palas* brood lac and poor on those raised with *khair* brood lac. The *katki* 1982-83 crop was, in general, very poor.

(M. L. Bhagat)

1.2 Physiological Studies on Lac Insects and Associated Insects

1.2.5 Studies on some physiological aspects of lac insect in relation to host plants

Inoculations were done on 35 potted *bhalia* plants during the *baisakhi* 1983-84 season with the following treatments, each tried on five plants.

Treatment	*Fertilizer application*
A	Urea+Phosphate+Potash
B	Urea+Phosphate
C	Urea+Potash
D	Urea
E	Phosphate
F	Potash
G	Control (no fertilizer)

Lac insects in all the above treatments developed satisfactorily till the period under report showing no significant difference between the treatments in terms of growth and development.

(A. H. Naqvi)

1.2.6 Biochemical studies on lac insects to ascertain strain

Since the fractions of the lipoids extracted earlier were insufficient for further chemical analysis, these were again extracted using the method adopted earlier.

(A. K. Sen, R. Ramani and K. M. Prasad)

1.2.7 Histophysiology of lac glands

During the period under report, specimens of mated and virgin female lac insects were fixed in Little's formaldehyde, Zenker's and Duboscq-Brasil fixatives and processed for histological and histochemical investigations. Attempts were made to use methylene blue and janus green as vital dyes using the teased out tissues of the female lac insects in insect saline for studying of the secretory activities of the epidermal glands.

(R. Ramani)

1.2.8 Laccaic acid as a biological stain

Attempts were made this year to develop a stain formulation of laccaic acid for rapid and specific staining of chromosomes. Several formulations of laccaic acid in various concentrations of acetic acid in the presence of various metallic salts such as ferric sulphate, aluminium sulphate, lithium carbonate, ammonium alum and iron alum were tried. Of these, the formulation containing ammonium alum gave best results with the mitotic cells of onion root tip. This formulation contains lac dye (2%) and ammonium alum (1%) in acetic acid (50%). The staining procedure was as follows: the growing onion root tips were pretreated with a saturated aqueous solution of *p*-dichlorobenzene, fixed in aceto alcohol (1:3) and stored in ethanol (70%). The tips are then squashed in the above formulation. The staining was quite specific and the background staining was light (Fig. 1). The preparations were comparable with those of orcein and

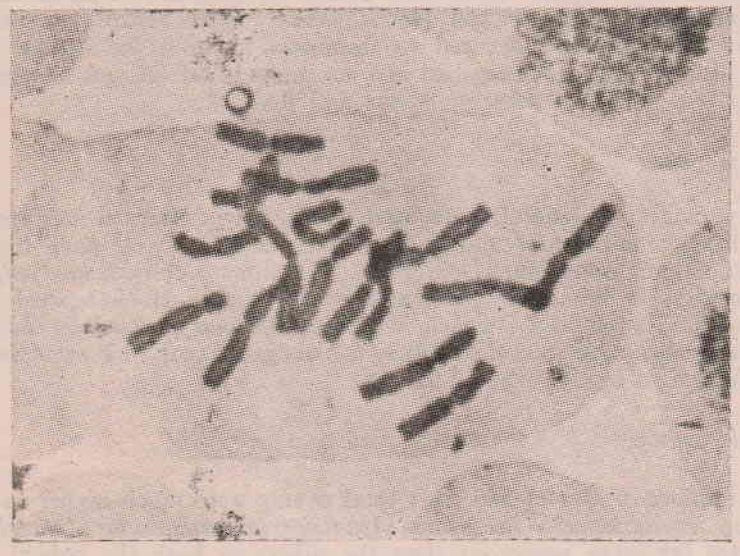

Fig. 1

carmine. Storage of this formulation up to 1-2 months showed no significant change in its staining properties.

(R. Ramani)

1.3 Ecological Studies on Lac Insects and Associated Insects

1.3.3 To study the bioecological aspects of *Pristomerus sulci*, an Endoparasite of *Holcocera pulverea*, a predator of lac insect

Nothing significant to report.

(M. L. Bhagat)

1.3.5 Ecological studies taken up at Dharamjaigarh, M.P.

1.3.5(c) Survey of inimical and beneficial insects associated with *kusmi* lac insect in the region

From the data collected, Bastar, Raigarh and Raipur can be compared for the *aghani* 1981-82 and *jethwi* 1982 crops and all the four locations, namely Bastar, Raigarh, Raipur and Hoshangabad, for the remaining *aghani* (1982-83 and 1983-84) and *jethwi* 1983 crops. The results set out in Tables 1a-1c may be summarized as follows:

Lac predators

Only *Eublemma amabilis* and *Holcocera pulverea* were recorded in all the locations. Their total counts were higher in Bastar and Raigarh than in Hoshangabad and Raipur. *E. amabilis* tended to dominate in Bastar and Raigarh and *H. pulverea* in Raipur and Hoshangabad. With regards to their relative abundance, *H. pulverea* appeared to dominate in both the *aghani* and *jethwi* crops in Raipur and Hoshangabad but no such trend has yet emerged for the remaining two locations namely, Bastar and Raigarh.

Inimical parasites

The parasites, in general, were more numerous in Raigarh and Hoshangabad than in Raipur and Bastar and their overall incidence was much higher in the *aghani* crop than in the *jethwi* excepting in Raipur. *Tetrastichus purpureus* was most numerous in both the *aghani* and *jethwi* crop in Hoshangabad and in the *jethwi* crop in Raipur and Raigarh, whereas *Euplemus tachardiae* and *Erencyrtus dewitzi* were more numerous than others in the *aghani* crop in Raipur and Raigarh, and *E. dewitzi* in *aghani* crop in Bastar.

Beneficial parasite

The number of species and their total counts were much higher in the *aghani* crops than in the *jethwi*. In general *Apanteles tachardiae* and *Apanteles fukhrul-hajiae* were far more numerous than the others in both the *aghani* and *jethwi* crops excepting in Hoshangabad, where *Brachymeria tachardiae* was the most

TABLE 1b — RELATIVE ABUNDANCE OF INIMIC

Crop	Bastar							Raigarh					
	T.p.	*E.t.*	*E.d.*	*T.t.*	*C.t.*	*M.j.*	Total	*T.p.*	*E.t.*	*E.d.*	*T.t.*	*C.t.*	*M.j*
Aghani 1981-82	3	5	1	5	0	0	14	4	37	25	23	0	0
Aghani 1982 83	3	5	1	0	0	0	9	18	15	11	3	0	0
Aghani 1983-84	5	0	30	0	0	0	35	14	0	5	0	0	0
Total	11	10	32	5	0	0	58	36	52	41	26	0	0
Total count per crop	3·7	3·3	10·7	1·7	0·0	0·0	19·3	12·0	17·3	13·7	8·7	0·0	0·
Jethwi 1982	1	0	0	5	0	0	6	2	4	0	0	0	0
Jethwi 1983	0	2	0	1	0	0	3	61	4	9	1	0	0
Total	1	2	0	6	0	0	9	63	8	9	1	0	0
Total count per crop	0·5	1·0	0·0	3·0	0·0	0·0	4·5	31·5	4·0	4·5	0·5	0·0	0·

T.p., Tetrastichus purpureus; *E.t., Eupelmus tachardiae*; *E.d., Erencyrtus*

TABLE 1c — RELATIVE ABUNDANCE OF BENEFIC

Crop	Bastar								Raigarh							
	A.t.	*A.f.*	*P.s.*	*B.g.*	*B.t.*	*E.p.*	*Bethy.*	*Chel.* Total	*A.t.*	*A.f.*	*P.s.*	*B.g.*	*B.t.*	*E.p.*	*Bethy.*	*Chel.*
Aghani 1981-82	79	24	32	0	0	0	0	0 135	71	100	5	3	0	0	0	0
Aghani 1982-83	37	12	2	6	0	5	0	0 62	71	76	3	8	46	8	0	2
Aghani 1983-84	62	17	3	2	1	0	1	0 86	37	4	0	2	1	1	1	1
Total	178	53	37	8	1	5	1	0 283	179	180	8	13	47	9	1	3
Total count per crop	59·3	17·7	12·3	2·7	0·3	1·7	0·3	0·0 94·3	59·7	60·0	2·7	4·3	15·7	3·0	0·3	1·0
Jethwi 1982	11	6	2	4	0	0	0	0 23	18	13	0	7	0	0	0	0
Jethwi	8	16	1	0	0	0	0	0 25	29	26	2	1	0	0	0	0
Total	19	22	3	4	0	0	0	0 48	47	39	2	8	0	0	0	0
Total count per crop	9·5	11·0	1·5	2·0	0·0	0·0	0·0	0·0 24·0	23·5	19·5	1·0	4·0	0·0	0·0	0·0	0·0

A.t., Apanteles tachardiae; *A.f., A. fukhrulhajiae*; *P.s., Pristomerus sulci*; *B.g., Bracon greeni*; *B.t., Brachy*

. PARASITES IN DIFFERENT LOCATIONS AND CROPS

Total	Raipur							Hoshangabad						
	T.p.	*E.t.*	*E.d.*	*T.t.*	*C.t.*	*M.j.*	Total	*T.p.*	*E.t.*	*E.d.*	*T.t.*	*C.t.*	*M.j.*	Total
89	2	10	4	5	1	0	22	—	—	—	—	—	—	—
47	8	7	0	0	0	0	15	23	4	2	2	0	0	31
19	0	4	21	0	0	0	25	71	0	29	0	0	1	101
155	10	21	25	5	1	0	62	94	4	31	2	0	1	132
51·7	3·3	7·0	8·3	1·7	0·3	0·0	20·7	47·0	2·0	15·5	1·0	0·0	0·5	66·0
6	0	0	0	0	0	0	0	—	—	—	—	—	—	—
75	110	1	1	0	0	0	112	47	0	0	1	0	0	48
81	110	1	1	0	0	0	112	47	0	0	1	0	0	48
40·5	55·0	0·5	0·5	0·0	0·0	0·0	56·0	23·0	0·0	0·0	0·5	0·0	0·0	24·0

dewitzi; *T.t.*, *Tachardiphagus tachardiae tachardiae*; *M.j.*, *Marietta javensis*.

L PARASITES IN DIFFERENT LOCATIONS AND CROPS

Total	Raipur								Hosangabad								
	A.t.	*A.f.*	*P.s.*	*B.g.*	*B.t.*	*E.p.*	*Bethy.*	*Chel.*	Total	*A.t.*	*A.f.*	*P.s.*	*B.g.*	*B.t.*	*E.p.*	*Bethy.*	*Chel.*	*E.c.*	Total
179	39	21	9	7	0	1	0	0	77	—	—	—	—	—	—	—	—	—	—
214	17	13	10	5	0	0	0	0	45	8	9	1	1	19	0	0	0	0	38
47	23	9	1	0	12	0	0	0	45	22	7	0	9	28	5	0	0	1	72
440	79	43	20	12	12	1	0	0	167	30	16	1	10	47	5	0	0	1	110
146·7	26·3	14·3	6·7	4·0	4·0	0·3	0·0	0·0	55·7	10·0	5·3	0·3	3·3	15·7	1·7	0·0	0·0	0·3	36·7
38	0	0	6	0	0	0	0	0	6	—	—	—	—	—	—	—	—	—	—
58	13	10	1	0	0	0	0	0	24	5	3	0	2	0	0	0	0	0	10
96	13	10	7	0	0	0	0	0	30	5	3	0	2	0	0	0	0	0	10
48·0	6·5	5·0	3·5	0·0	0·0	0·0	0·0	0·0	15·0	2·5	1·5	0·0	1·0	0·0	0·0	0·0	0·0	0·0	5·0

neria tachardiae; *E.p.*, *Eurytoma pallidiscapus*; *Bethy.*, *Bethylidae*; *Chel.*, *Cheloneila*; *E.c.*, *Elasmus claripennis*.

TABLE 1a — RELATIVE ABUNDANCE OF PREDATORS IN DIFFERENT LOCATIONS AND CROPS

Crop	Bastar				Raigarh				Raipur				Hoshangabad			
	Eublemma amabilis	*Holcocera pulverea*	*Chrysopa*	Total	*Eublemma amabilis*	*Holcocera pulverea*	*Chrysopa*	Total	*Eublemma amabilis*	*Holcocera pulverea*	*Chrysopa*	Total	*Eublemma amabilis*	*Holcocera pulverea*	*Chrysopa*	Total
Aghani 1981-82	313	303	0	616	654	210	0	864	395	394	0	789	—	—	—	—
Aghani 1982-83	43	51	0	94	324	190	0	514	82	158	0	240	57	171	—	228
Aghani 1983-84	235	414	0	649	189	206	0	387	57	125	0	182	203	151	—	354
Total	591	768	0	1359	1159	606	0	1765	534	677	0	1211	260	322	—	582
Total count per crop	197·0	256·0	0·0	453·0	386·3	202·0	0·0	588·3	178·0	225·7	0·0	403·7	86·7	107·3	—	194·0
Jethwi 1982	127	167	0	984	228	210	0	428	133	188	0	321	—	—	—	—
Jethwi 1983	21	160	3	184	14	120	1	135	65	131	1	197	26	167	0	193
Total	148	327	3	1168	242	330	1	573	198	319	1	518	26	167	0	193
Total count per crop	427·0	155·5	1·5	584·0	121·0	165·0	0·5	286·5	99·0	159·5	0·5	259·0	13·0	83·5	0·0	96·5

numerous in the *aghani* crops and in Raipur, where only *Pristomerus sulci* was recorded in the *jethwi* 1982 crop.

(B. N. Sah and J. M. Das Gupta)

1.3.5(d) To study the relative performance of *kusumi* brood lac from different sources

The study was continued in the *aghani* 1982-83, *jethwi* 1983 and *aghani* 1983-84 crops.

Aghani 1982-83

The crop has been very poor with the Bihar and M.P. brood lac used.

Jethwi 1983

The crop was raised using brood lacs collected from (i) Gersa (Raigarh, M.P.), (ii) Bhuchungdih (Hazaribagh, Bihar) and (iii) Jaipatna (Kalahandi, Orissa).

The *kusum* trees were inoculated with brood lac of each state to raise the crop which was harvested in July 1983. The relative performance of different brood lacs was as follows:

Sources of brood lac	Crop ratio	Stick lac
	Brood lac used: Broodlac obtained	Brood lac used: total yield
Bihar	1:0·51	1:1·29
M.P.	1:0·41	1:0·52
Orissa	1:0.50	1:1·87

Aghani 1983-84

The brood lac was collected from Duwaldih (Raigarh, M.P.) and Bhuchungdih (Hazaribagh, Bihar) and the crop was raised as during the previous season.

(B. N. Sah)

1.3.8 Studies on the factors affecting *rangeeni* lac insect population

Preliminary sampling of field populations of *rangeeni* lac insects on *palas* was carried out as per programme, during *baisakhi* 1982-83 and *katki* 1983 crops. Data on apparent mortality for the two crops are presented in Table 2. The major mortality of the insects took place in the crawler stage mainly due to starvation and during the postmetamorphic stage of the female due to predation in *baisakhi* and due to parasitization and predation in *katki* crop. Only a small proportion of the original colonists survived up to the time of crop maturity, thus the population trend and the key mortality factors remained more or less the same as in the previous two *rangeeni* crops. The canopy of the host tree and

TABLE 2 — MEAN APPARENT MORTALITY OF *rangeeni* LAC INSECTS REARED ON *palas* AT NAMKUM PLANTATION

Developmental stage	Mortality factor	Mortality (%)	
		Baisakhi 1982-83	*Katki* 1983
1st instar	Starvation	49·99	54·37
	Other causes	9·13	12·96
	Total mortality	59·12	67·33
2nd instar	Parasitism	3·88	2·83
	Predation	0·83	0·45
	Fungi	Nil	2·90
	Other causes	19·68	37·83
	Total mortality	24·39	44·01
3rd instar	Parasitism	0·98	11·26
	Predation	4·29	5·74
	Fungi	Nil	0·68
	Other causes	3·08	10·49
	Total mortality	8·35	28·17
Post-metamorphic stage	Males	16·35	14·95
	Parasitism	18·15	27·27
	Predation	46·74	26·05
	Heat	4·74	Nil
	Fungi	Nil	2·50
	Other causes	12·46	16·04
	Total mortality	98·44	86·81

the portion of shoot did not appear to affect the total population and main mortalities in these insects. But inter-tree differences appeared to be significant.

(D. C. Srivastava)

1.3.9 Studies on lac larval settlement and factors affecting it

The study of the pattern of larval settlement of lac insect in relation to the inclination of the shoot was continued. The lac insects were offered a 30 cm length of shoot for settlement and the inoculation period was three days. The total number of larvae settled and the surface area of the shoot were determined. Best coverage with lac insects was observed on the shoots kept at angle 75° and 90° from the ground level from east to west. These results agreed with those reported earlier.

An experiment was planned to study the effect of host crowding on the lac larval settlement. The *bhalia* plants were raised in plots (5×5 m) at density of 1, 2 and 4 plants per sq. mt. with five replications.

(Y. D. Mishra)

1.3.10 Abundance of lac pests in relation to different climatic situations and lac insects of different places

Lac stick samples were collected at male emergence and crop maturity stages of the *katki* 1982 and the *baisakhi* 1982-83 crops from six locations of Chotanagpur and caged for the emergence of the lac insect predators and parasitoids. The data are presented in Table 3. It will be seen that the locations differed for the abundance of lac pest.

TABLE 3 — NUMBER OF ADULT PARASITOIDS AND PREDATORS RECORDED FROM LAC STICKS OF DIFFERENT AGRO-CLIMATIC LOCATIONS OF CHOTANAGPUR, DURING *katki* 1982 AND *baisakhi* 1982-83 CROPS AT MALE EMERGENCE AND CROP MATURITY STAGES

Location	Mean number per metre of lac stick							
	Predators				Parasitoids			
	Katki-1982		*Baisakhi*-1982-83		*Katki*-1982		*Baisakhi*-1982-83	
	Male emergence	Crop maturity	Male emergence	Crop maturity	Male emergence	Crop maturity	Male emergence	Crop maturity
1. Namkum	7·20	7·1	Nil	9·09	3·97	9·72	81·53	6·76
2. Khunti (Salga)	5·43	2·57	Nil	22·35	23·10	15·74	34·07	1·02
3. Kundri	5·93	2·16	Nil	3·09	3·11	9·38	49·26	7·68
4. Mako (Latehar)	10·03	4·97	Nil	10·30	25·94	10·90	40·48	11·78
5. Lota	6·88	0·79	Nil	12·25	4·00	6·47	42·14	2·89
6. Malichak	10·8	3·00	Nil	6·91	8·65	3·77	28·07	10·02

(D. C. Srivastava)

1.4 Control of Enemies of Lac Insect

1.4.1(2) Field trials of integrated control schedules against the lac predators

The experiment was carried out as per lay out reported earlier (A.R.: 1981 and 1982).

Baisakhi 1982-83-*cum-katki* 1983 *crop*: One-fifth of the *palas* trees were heavily inoculated in June-July 1983 for trap cropping. Thiodan® (0·05 per cent) was sprayed under treatments A, AB, AC and ABC during July 1983. The crop was harvested in Oct.-Nov. 1983 and the pest population determined. The results are presented in Table 4.

TABLE 4 — EFFECT OF INTEGRATED CONTROL SCHEDULE IN SUPPRESSION OF PREDATOR AND CONSEQUENT INCREASE IN YIELD

Sl No.	Treatment	Increase in lac yield (%)	Pest suppression (%)
1	A	52·6	59·5
2	B	46·6	44·3
3	C	Nil	Nil
4	AB	59·5	66·3
5	BC	11·6	0·6
6	AC	35·4	21·9
7	ABC	13·02	10·2
8	Control	—	—

(S. G. Choudhary, C. P. Malhotra and T. P. S. Teotia)

1.4.3 Effect of insecticides on the lac insect *Kerria lacca* (Kerr) and the associated fauna

The objective of this study is to find insecticides more potent than endosulfan and plant poisons possessing selective toxicity to the inimical insects of lac and hormoligatory effect on the lac insects, if any. This study also aims at finding the impact of the previously developed integrated control schedule on the fauna associated with lac insect.

(i) Screening of insecticides for their safety to the lac insect and toxicity to the lac predators

Five insecticides, namely, Padan (cartap hydrochloride), Dimecron (phosphamidon), Evisect (thiocyclam hydrogen oxalate), dipterex (trichlorophon) and methoxychlor, and the already proven Thiodan® (endosulfan) in concentrations ranging from 0·00625 to 0·1 per cent were sprayed on about 1½ to 2 month-old *jethwi* 1983 (Table 5a), *aghani* 1983-84 (Table 5b), *katki* 1983 (Table 5c) crops and about 5 month-old, *baisakhi* 1982-83 crop (Table 5d) crops on *bhalia* (*Moghania macrophylla*). All these could be considered safe to the lac insect at the stages screened at 0·025 per cent concentration.

TABLE 5a — SCREENING OF INSECTICIDES

Crop — *Jethwi* 1983
Date of inoculation — 5.2.83
Date of *phunki* removal — 26.2.83
Date of spraying — 14.4.83

Insecticides and their concentrations (%)		No. of lac insect under observation	Per cent mortality	Corrected per cent mortality
Padan	0·1	232	26·73	Nil
	0·05	255	33·73	8·75
	0·025	229	20·09	Nil
	0·0125	236	29·24	2·56
	0·00625	169	20·13	Nil
Thiodan®	0·1	212	14·16	Nil
	0·05	237	27·43	Nil
	0·025	227	20·27	Nil
	0·0125	213	24·89	Nil
	0·00625	232	32·76	7·42
Methoxychlor	0·1	189	32·81	7·49
	0·05	237	22·37	Nil
	0·025	228	20·18	Nil
	0·0125	206	16·02	Nil
	0·00625	183	32·25	6·71
Dimecron	0·1	170	25·89	Nil
	0·05	206	19·99	Nil
	0·025	286	20·63	Nil
	0·0125	197	15·23	Nil
	0·00625	273	24·18	Nil
Evisect	0·1	248	23·39	Nil
	0·05	176	24·44	Nil
	0·025	211	19·91	Nil
	0·0125	210	23·81	Nil
	0·00625	245	11·03	Nil
Dipterex	0·1	149	15·44	Nil
	0·05	248	24·20	Nil
	0·025	197	21·83	Nil
	0·0125	200	26·99	Nil
	0·00625	169	17·91	Nil
Emulsified water control	0·5	190	27·37	

TABLE 5b — SCREENING OF INSECTICIDES

Crop — *Aghani* 1983-84
Date of inoculation — 20.7.83
Date of *phunki* removal — 25.7.83
Date of spraying — 5.9.83

Insecticides and their concentrations (%)		No. of lac insects under observations	Per cent mortality	Corrected per cent mortality
Padan	0·1	305	19·02	Nil
	0·05	298	14·77	Nil
	0·025	314	18·48	Nil
	0·0125	309	21·69	Nil
	0·00625	343	20·70	Nil
Thiodan®	0·1	275	24·00	Nil
	0·05	285	15·13	Nil
	0·025	343	18·08	Nil
	0·0125	274	17·89	Nil
	0·00625	298	15·78	Nil
Methoxychlor	0·1	328	24·09	Nil
	0·05	293	24·58	Nil
	0·025	310	18·39	Nil
	0·0125	303	18·82	Nil
	0·00625	298	22·15	Nil
Dimecron	0·1	284	24·27	Nil
	0·05	293	19·22	Nil
	0·025	284	18·00	Nil
	0·0125	307	17·27	Nil
	0·00625	316	20·26	Nil
Evisect	0·1	302	13·58	Nil
	0·05	331	12·09	Nil
	0·025	270	14·45	Nil
	0·0125	339	15·90	Nil
	0·00625	309	15·86	Nil
Dipterex	0·1	289	15·23	Nil
	0·05	281	15·66	Nil
	0·025	287	12·90	Nil
	0·0125	315	18·42	Nil
	0·00625	340	18·56	Nil
Emulsified water control	0·5	307	28·02	—

TABLE 5c — SCREENING OF INSECTICICIDES

Crop — *Katki* 1983
Date of inoculation — 7.7.83
Date of *phunki* removal — 19.7.83
Date of spraying — 3.9.83

Insecticides and their concentrations (%)		No. of lac insects under observations	Per cent mortality	Corrected per cent mortality
Padan	0·1	196	14·29	Nil
	0·05	281	17·80	Nil
	0·025	277	19·50	Nil
	0·0125	243	18·94	Nil
	0·00625	236	18·65	Nil
Thiodan®	0·1	221	24·44	Nil
	0·05	238	25·22	Nil
	0·025	216	23·15	Nil
	0·0125	265	21·51	Nil
	0·00625	224	23·67	Nil
Dipterex	0·1	215	12·56	Nil
	0·05	191	11·52	Nil
	0·025	211	15·17	Nil
	0·0125	194	18·56	Nil
	0·00625	222	13·97	Nil
Evisect	0·1	246	13·42	Nil
	0·05	224	12·06	Nil
	0·025	230	15·22	Nil
	0·0125	222	17·57	Nil
	0·00625	238	14·29	Nil
Methoxychlor	0·1	241	19·92	Nil
	0·05	215	20·00	Nil
	0·025	241	27·39	Nil
	0·0125	204	23·53	Nil
	0·00625	217	25·81	Nil
Dimecron	0·1	320	26·57	Nil
	0·05	204	28·93	Nil
	0·025	360	21·67	Nil
	0·0125	280	25·36	Nil
	0·00625	203	31·53	Nil
Tween 80 (control)	0·5	187	35·30	

TABLE 5d — SCREENING OF INSECTICIDES

Crop — *Baisakhi* 1982-83
Date of inoculation — 5.11.82
Date of *phunki* removal — 26.11.82
Date of spraying — 15.4.83

Insecticides and their concentrations (%)		No. of lac insects under observations	Per cent mortality	Corrected per cent mortality
Padan	0·1	280	12·86	Nil
	0·05	140	22·15	7·05
	0·025	166	16·27	0·03
	0·0125	152	9·22	Nil
	0·00625	214	11·22	Nil
Thiodan®	0·1	160	13·13	Nil
	0·05	197	20·31	4·85
	0·025	187	16·58	0·40
	0·0125	162	18·52	2·72
	0·00625	124	20·17	4·69
Methoxychlor	0·1	185	18·38	2·55
	0·05	191	13·62	Nil
	0·025	186	13·45	Nil
	0·0125	186	20·44	5·01
	0·00625	175	21·72	6·54
Dimecron	0·1	178	20·79	5·43
	0·05	155	16·13	Nil
	0·025	177	27·12	12·98
	0·0125	203	9·86	Nil
	0·00625	208	18·75	2·99
Evisect	0·1	186	17·75	1·80
	0·05	168	19·11	3·34
	0·025	195	8·21	Nil
	0·0125	176	15·35	Nil
	0·00625	129	11·63	Nil
Dipterex	0·1	156	20·52	5·10
	0·05	150	16·67	0·05
	0·025	171	18·72	2·96
	0·0125	213	13·15	Nil
	0·00625	187	15·51	Nil
Tween 80 (control)	0·5	191	16·24	

(C. P. Malhotra)

(ii) Screening of plant poisons for their safety to the lac insect

The following plant extracts were sprayed on about one month old lac insects during different crop seasons.

Jethwi 1983 — Extracts of *Swalortia chirayita* and *Butea monosperma* were sprayed in concentrations, ranging between 0·025 and 0·1 per cent. *B. monosperma* proved safe up to a concentration of 0·05 per cent while *S. chirayita* proved toxic in all the concentrations tried (Table 6).

TABLE 6 — EFFECT OF PLANT POISONS ON LAC INSECTS

Crop	Plant poisons and their concentrations	Number of lac insects under observation	Per cent mortality	Corrected per cent mortality
Jethwi 1983	*Swalortia chirayita*			
	0·025	321	62·62	60·50
	0·05	259	52·89	27·38
	0·1	270	58·15	43·36
	Control	350	40·00	—
	Butea monosperma			
	0·025	278	50·00	Nil
	0·05	219	60·73	Nil
	0·1	247	73·28	27·24
	Control	177	63·28	—
Katki 1983	*Acorus calamus*			
	0·025	370	31·081	Nil
	0·05	87	31·034	Nil
	0·1	327	41·59	1·947
	Control	319	40·438	—
	Vitex negundo			
	0·025	426	40·61	0·302
	0·05	391	30·946	Nil
	0·1	345	46·66	10·458
	Control	319	40·438	—
Baisakhi 1983-84	*Acorus calamus*			
	0·0125	402	29·353	7·743
	0·025	366	25·136	2·232
	0·05	317	11·041	Nil
	0·1	368	37·50	18·372
	0·2	358	35·754	16·101
	Control	333	23·423	—
	Melia azederach			
	0·0125	373	19·839	3·456
	0·025	206	17·475	0·602
	0·05	344	18·023	1·264
	0·1	355	25·352	10·092
	0·2	307	22·149	6·238
	Control	330	16·969	—

Katki 1983 — Extracts of *A. calamus* (*Acorus calamus*) and *V. negundo* (*Vatex negundo*) were sprayed in concentrations ranging between 0·025 and 0·1 per cent. The former proved safe in all concentrations whereas the latter was safe up to a concentration of 0·05 per cent (Table 6).

Baisakhi 1983-84 — Extract of *A. calamus* and *Melia azederach* were sprayed in 5 concentrations ranging between 0·0125 and 0·2 per cent. Both proved safe in concentration upto 0·05 per cent (Table 6). The experiment carried out earlier (A.R.: 1981 and 82) was repeated in *katki* 1983 crop and similar results were obtained.

(A. Bhattacharya and C. P. Malhotra)

(iii) Hormoligatory effects on the lac insect with insecticide

Further trials with low concentrations of Thiodan® (0·003125 to 0·025%) resulted in marked increase in the size of both the male and female lac insects as also reported earlier (A.R.: 1981 and 82).

(A. K. Sen and C. P. Malhotra)

(iv) Effect of the recommended control schedule on the associated fauna of lac insect under field conditions

The effect of the recommended control schedule involving spraying of 0·05 per cent Thiodan® 4 weeks after inoculation followed by a spray of a mixture of 0·05 per cent Thiodan® and Thuricide® (1 : 1) has been studied in the *aghani* 1983-84 and the *baisakhi* 1983-84 crops. It has been found that a high degree of control of the inimical insects was achieved, although some detrimental effects on the beneficial parasites were also observed.

(B. N. Sah and C. P. Malhotra)

1.4.4 Laboratory evaluation of the efficacy of microbial agents for the control of Lepidopterous predators

Predatory caterpillars of lac insects were collected from samples of lac sticks obtained from different sources. These were sorted out on the basis of preliminary symptomatic diagnosis and the suspected diseased population. These were minutely observed for any change in behaviour, structure, function, pathology, etc. But no change was found.

Further, by applying contamination as well as pure inoculum techniques, the individual as well as the mixed isolates were tested for their pathogenicity against the predators. The results did not satisfy Koch's postulates. It could, therefore, be inferred that death in suspected diseased population was due to non-infectious diseases.

(S. G. Choudhary and A. H. Naqvi)

1.4.10 Chemical control of *Chrysopa* species

Field trials were continued on *bhalia* plants (75 nos) carrying *aghani* crop with *Chrysopa* infestation. There were three treatments and five replications with 5 bushes under each. BHC and Chlordane (0·05 per cent) were sprayed thrice

at fortnightly interval. The incidence of *Chrysopa* spp. was assessed before and after each treatment and the lac yield compared.

It was found that BHC (0·05 per cent) proved more effective than Chlordane suppressing the *Chrysopa* incidence by 72·08 per cent and improving the lac yield by 42·8 per cent. The *Chrysopa* suppression and lac yield improvement with chlordane were 66·5 and 36·7 per cent respectively.

(S. G. Choudhary)

1.4.13 Studies on the economic threshold of *E. amabilis* and *H. pulverea* infesting lac crop

The experiments were carried out on randomly selected lac bearing twigs in the different crops. Five levels of larval densities viz. 2, 4, 6, 8 and 10 per shoot of 30 cm length were maintained by manual infestation at two stages viz. 1-30 days and 31-60 days alongwith control. The lac bearing twigs were protected with 60 mesh synthetic netting cages throughout the crop period. The treatments having different pest densities were also kept covered. There were five lac bearing twigs under each treatment and three replications. The lac yield was compared at crop maturity. The results are furnished in Tables 7a, b, c and d. These show that larval densities above 4/30 cm lac encrustation caused 22·7 to 66·8 and 19·6 to 51·2 per cent damage to 1-30 days-old *baisakhi* 1982-83 and *jethwi* 1983 crops respectively. The same densities when maintained on 30-60 days-old crop caused damage of 13·7 to 36·3 and 19·7 to 28·2 per cent in *baisakhi* and *jethwi* crops respectively.

In the *katki* 1983 and *aghani* 1982-83 crops the damage caused by the predatory larvae at densities above 4/30 cm lac encrustation was 19·8 to 57·3 per cent and 20·4 to 46·6 per cent to the 1-30 day-old crop respectively and 17·2 to 38·7 per cent and 16·3 to 42·8 per cent to the 31-60 day-old crops respectively. The

TABLE 7a — PER CENT REDUCTION IN LAC YIELD AT VARYING LEVELS OF LARVAL DENSITIES OF *E. amabilis* DURING THE *baisakhi* 1982-83 CROP

No. of *E. amabilis* larvae/30 cm	Age of crop	Yield (g)/metre		Per cent reduction in yield (sticklac)
		Lac stick	Sticklac	
2	1·30 days	86·0	13·9	5·2
4	(20 days)	68·6	12·6	13·5
6		54·6	11·3	22·7
8		40·6	8·6	40·9
10		31·3	4·8	66·8
Nil (Control)		94·3	14·6	—
2	31-60 days	81·0	13·3	9·09
4	(40 days)	70·6	13·0	11·3
6		58·6	12·6	13·6
8		45·0	10·3	29·3
10		34·0	9·3	36·3
Nil (Control)		87·6	14·6	—

TABLE 7b — PER CENT REDUCTION IN LAC YIELD AT VARYING LEVELS OF LARVAL DENSITIES OF *E. amabilis* DURING THE *Katki* 1983 CROP

No. of *E. amabilis* larvae/30 cm	Age of crop	Yield (g)/metre		Per cent reduction in yield (sticklac)
		Lac stick	Sticklac	
2	1·30 days	71·6	15·3	6·1
4	(20 days)	62·0	14·3	12·2
6		50·6	13·3	19·8
8		38·3	8·3	48·9
10		30·3	7·0	57·3
Nil (Control)		81·6	16·3	—
2	30-60 days	75·0	15·0	4·2
4	(40 days)	68·0	14·0	10·6
6		58·6	13·0	17·2
8		48·3	10·0	36·1
10		35·0	9·6	38·7
Nil (Control)		92·0	15·6	—

TABLE 7c — PER CENT REDUCTION IN LAC YIELD AT VARYING LEVELS OF LARVAL DENSITIES OF *E. amabilis* DURING THE *Jethwi* 1983 CROP

No. of *E. amabilis* larvae/30 cm	Age of crop	Yield (g)/metre		Per cent reduction in yield (sticklac)
		Lac stick	Sticklac	
2	1·30 days	74·3	12·6	7·3
4	(20 days)	64·6	12·0	12·1
6		54·0	11·0	19·5
8		47·6	7·6	43·9
10		38·3	6·6	51·2
Nil (Control)		77·0	13·3	—
2	30-60 days	78·6	13·6	10·8
4	(40 days)	69·3	13·3	13·09
6		57·6	12·3	19·7
8		42·6	11·6	23·9
10		32·3	11·0	28·2
Nil (Control)		85·3	15·3	—

TABLE 7d — PER CENT REDUCTION IN LAC YIELD AT VARYING LEVELS OF LARVAL DENSITIES OF *E. amabilis* DURING THE *Aghani* 1982-83 CROP

No. of *E. amabilis* larvae/30 cm	Age of crop	Yield (g)/metre		Per cent reduction in yield (sticklac)
		Lac stick	Sticklac	
2	1·30 days (20 days)	78·6	16·3	5·7
4		71·3	15·0	13·4
6		58·3	13·6	20·4
8		45·3	10·3	40·3
10		34·0	9·3	46·8
Nil (Control)		84·6	17·3	—
2	30-60 days (40 days)	85·3	15·3	6·1
4		71·6	14·3	12·2
6		65·0	13·6	16·3
8		52·0	10·0	38·7
10		41·3	9·3	42·8
Nil (Control)		95·0	16·3	—

damage by the predatory larvae in densities of 2 and 4 larvae per 30 cm lac encrustation at different ages of the crops was rather low.

(S. G. Choudhary)

1.5 Genetics and Breeding of Lac Insects

1.5.8 Collection, maintenance and evaluation of genetic stocks of lac insects

The following stocks, collected from different regions of the country were maintained:

Sl No.	*Rangeeni*		*Kusmi*	
	Source	No. of cultures	Source	No. of cultures
1	Umaria	12	Dharamjaigarh (old)	21
2	Ludhiana	11	Dharamjaigarh (new)	14
3	Assam	28	Orissa (Crimson)	18
4	Kundri	12	Orissa (Yellow)	11
5	Delhi	21		
6	Local yellow	12		

(P. Sen and S. K. Jaipuriar)

1.5.10 Studies on sex-determination in lac insects

During the period under report, the line derived from a stock of the *rangeeni* strain of *K. lacca* were further inbred by full-sib mating and the progenies scored for sex-ratio. The results did not show any relation between the sex-ratio of the progeny and that of the parents.

(N. S. Chauhan)

1.5.11 Cytotaxonomy of lac insects

The lac larvae collected from the Assam culture were examined cytologically. It has been observed that the nuclei of the male larvae contain the heteropycnotic body.

(S. K. Jaipuriar)

Ad-hoc Studies

(i) Treatment of brood lac/stick lac with selective insecticides and inert materials for control of inimical insects

Earlier study had revealed that dipping of brood lac in Thiodan® in concentrations ranging from 0·1 to 0·4 per cent was safe to about one-month old lac insect. This year, the brood lac from the *baisakhi* 1982-83 and *aghani* 1982-83 crops, dipped in different concentrations for 25 seconds to 2 minutes revealed that there has been a very high degree of control of both the lac predators (82.3 to 100·0%) whereas the use of water alone could control from 52·8 to 63·4 per cent.

(C. P. Malhotra and A. Bhattacharya)

(ii) Hormonal control of the lac predators

The objective of this study is to examine the various hormones and insect growth regulators for their adverse effects on the lac predators and harmlessness to the lac insect.

Preliminary study carried out during the year revealed that Dimilin (diflubenzuron) in concentrations ranging from 0·0125 to 0·2 per cent was safe to about one month old lac insects.

(C. P. Malhotra and A. Bhattacharya)

(c) RESEARCHES CONTEMPLATED — Nil

B. AGRONOMY AND PLANT GENETICS DIVISION

(a) RESEARCHES COMPLETED — Nil

(b) RESEARCHES ON HAND

2.1 Propagation and Management of Lac Host Plants

2.1.3 Integration of lac cultivation with general agriculture under dry farming condition

Expt 2 — *Raising of tuber crops and rhizomes in mixed plantation of bhalia and galwang*

The experiment was continued as per the layout reported earlier (A.R.: 1978). The intercrops viz. sweet potato, tapioca, turmeric and ginger were grown in between the spaces of *bhalia* (*Moghania macrophylla*) and *galwang* (*Albizzia lucida*)

bushes during June-July, 1983. The intercrops showed satisfactory growth at the initial stage but suffered badly due to the extreme drought. The growth of *bhalia* and *galwang* was much better in the plots where intercrops were raised. The *aghani* 1982-83 and *Jethwi* 1983 lac crops could not be raised due to non-availability of *kusmi* brood lac.

(B. K. Purkayastha)

2.1.4 Role of plant growth regulators on lac host plants

Expt 3 — *Effect of growth regulators on ber.*

The experiment was continued as per the layout reported earlier (A.R.: 1978). *Baisakhi* (*ari*) 1982-83 crop was harvested during May 1983 from the *ber* bushes treated with various concentrations of GA_3 and NAA during April/May 1982 and the data on stick lac yields and plant attributes at the time of lac harvesting have been shown in Table 8. Stick lac yield and total shoot length were maximum at GA_3 treatment against the minimum in control.

TABLE 8 — MEAN EFFECT OF GROWTH REGULATOR ON PLANT ATTRIBUTES OF *ber* AS WELL AS (*ari*) *baisakhi* LAC YIELD DURING MAY 1983

	Treatment (Growth regulator in ppm)	Plant height (in cm)	Number of primary branches per bush	Total shoot length (in cm)	Girth (in cm)	*Ari* lac stick per bush	Stick lac or scraped lac (in gm)
NAA	40	128·17	3·17	297·83	1·63	95·83	17·67
	80	106·50	3·00	239·33	1·60	173·33	21·83
	160	146·33	2·67	382·00	1·43	163·83	21·90
	320	161·77	3·33	396·00	1·87	177·50	26·07
GA_3	20	143·33	2·50	338·33	1·57	174·17	36·33
	40	152·52	3·83	448·00	1·77	166·67	37·13
	80	146·17	3·67	399·00	1·50	107·83	22·07
	160	142·17	3·33	377·50	1·53	120·83	23·00
Control		115·83	2·70	263·00	1·23	80·83	18·63
S.E.		7·18	0·58	78·93	0·20	49·66	8·94
1%		29·64	N.S.	N.S.	N.S.	N.S.	N.S.

(S. C. Srivastava)

2.1.8 Utilization of *ber* for lac, tasar and fruit

The experiment has been laid out afresh separately in two separate plots under Randomised Block Design with three replications and 7 treatments using six plants in each treatment. The *ber* bushes were pruned in May 1983 and *laria* and *daba* tasar dfls procured from Central Tasar Research Station, Ranchi during August were allowed to hatch and reared under laboratory conditions for 72 hr. These larvae were mounted on *ber* bushes. The *laria* and *daba* cocoons were harvested during October 1983. The effective rate of rearing (ERR) for

laria and *daba* cocoons was found as 41·9 and 32·03 per cent respectively. The shell weight per cocoon was 8·5 and 7·0 g for *laria* and *daba* respectively.

Ber bushes were later inoculated with *rangeeni* brood lac in November 1983 to raise *baisakhi* (*ari*) 1983-84 crop. The insects were developing well till the period under report.

(P. Kumar, B. K. Purkayastha, T. P. S. Teotia and N. Prasad)

2.1.10 Study and assessment of economics of cultivation of *kusmi* lac on bushes of *bhalia* and *galwang*

The location of the experiment was shifted from Chandwa to Institute Plantation as the *galwang* bushes could not be raised satisfactorily at Chandwa.

A suitable one hectare plot was selected and the seedlings of *bhalia* and *galwang* transplanted in July as per the lay out followed at Chandwa. These plants have shown satisfactory growth till the period under report.

(B. K. Purkayastha)

2.2 Genetics and Breeding of Lac Host Plants

2.2.1 The possibility of interspecific crossing in *Moghania* species

Crossing in Moghania Species

This year reciprocal crosses between *M. macrophylla* and *M. chappar* were made with and without the use of 0·1, 0·5 and 1·0 per cent dilute hydrochloric acid on the stigmatic surface. The pollination was carried out between 8 and 10 A.M. with fresh pollens after half an hour of HCl treatment. It was observed that few buds shed off after 8-10 days of pollination. The remaining buds (*M. chappar* ♂×*M. macrophylla* ♀) showed a little swelling at ovarian region till the period under report.

Floral biology

The pollen dehiscence of *M. chappar* was found to be more or less full at 7.30 a.m. (Table 9). The cloudy and foggy morning weather delayed the dehiscence to some extent.

TABLE 9 — TIME OF DEHISCENCE OF ANTHER IN *Moghania chappar* DURING FEB./MARCH 1983

Temperature (°C)		Relative humidity (in percentage)	Sunrise time (a.m.)	Percentage of anthesis during morning hours (a.m.)				
Max.	Min.			5.30	6.00	6.30	7.00	7.30
29·5	15·5	70	6·13	†	7·0	27·0	64·0	90·0
28·0	12·7	64	6·10	*	13·8	46·9	78·7	97·1
30·0	12·7	52	6·00	1·0	16·0	53·0	70·0	97·5
30·0	14·4	51	5·59	5·0	26·0	61·0	85·0	95·0
33·0	18·8	46	5·55	3·0	18·0	52·0	94·0	98·0

*Foggy cloudy morning.
†Slight rain with foggy cloudy morning.

(S. C. Srivastava)

2.2.2 Selection for better performance of *Moghania macrophylla* as a lac host for *kusmi* strain of lac insect

This year, *aghani* 1982-83 lac crop raised in progeny rows of *bhalia* bushes completely failed due to poor quality of brood lac. These bushes were pruned during January, 1983 and subsequently inoculated in July 1983 with *kusmi* brood lac to raise *aghani* 1983-84 crop. The lac crop was badly affected by *Chrysopa* sp. and for which, hand picking method was adopted as control measure. Two sprayings of Thiodan® were also applied to prevent the crop from the attack of lac predators, *Eublemma amabilis* and *Holcocera pulverea*.

(P. Kumar and D. C. Srivastava)

2.2.3 Evaluation and improvement of *arhar* varieties/cultivars for lac yield as well as pulse production

2.2.3.1 Evaluation of *arhar* varieties/cultivars for winter lac crop as well as pulse production

Katki crop

Five early/medium varieties of *arhar* tried for lac and pulse production during *katki* 1982 were again tried for *katki* 1983 crop except TT-6 which was replaced by var. ICPL-6. The observations were almost similar to those reported last year for pulse yield. The lac yield was very low in this crop also. Maximum lac yield per plant was however, obtained from ICPL-6 followed by varieties UPAS-120, T-21, BR-183 and TT-5.

Aghani crop

The above *arhar* varieties were also tried for raising *aghani* 1983-84 crop and pulse production. The lac crop however, again totally failed.

(P. Kumar, D. C. Srivastava and T. P. S. Teotia)

2.2.3.2 Evaluation of *arhar* varieties/cultivars for summer lac crop

Baisakhi crop

The *baisakhi* 1982-83 crop raised earlier (A.R.: 1981 and 82) on sixteen late maturing *arhar* varieties have indicated that the lac crop was very poor recording the maximum yield per plant 16·55 g in ICP No. 8501. The data have also indicated a general reducing trend in the pulse yield with lac cultivation.

The *arhar* plants suffered mortality during the summer months particularly those used for lac cultivation. This mortality was recorded in plants having girth less than 2·5 cm. The experiment was continued in 1983 with the same varieties tried during 1982. Sowing of *arhar* varieties was done during last week of June. Plant growth was badly affected due to continuous rain. The plants were inoculated in Nov. 1983 to raise *baisakhi* 1983-84 crop.

Jethwi 1983 *crop*

The *arhar* varieties tried in the *baisakhi* 1982-83 crop were also screened in this crop for lac and pulse production with and without irrigation given at fortnightly interval from April onwards. The plant mortality was found much reduced

during the summer with irrigation. The lac yield in general was poor, maximum being 14·1 g in var. Bahar. The pulse production was found reduced with lac cultivation, although varietal differences were noted in this regard.

(P. Kumar, D. C. Srivastava and T. P. S. Teotia)

2.2.4 Mutation studies on *arhar* in relation to lac and pulse production

M_3 generation plants did not provide seeds due to sterility mosaic disease. Fresh set of pure line seeds of *Assam* cv, *Basant* and *Bahar* were irradiated with gamma rays at doses ranging from 10 to 80 Kr and sown in the field alongwith the non-irradiated seeds serving as control. The germination and survival percentage were found to decrease with the increase in doses as reported earlier. The plant growth was badly affected due to continuous rains during the early growth period.

(P. Kumar)

2.2.5 Induction of polyploidy in *ber* for improved lac productivity

This year the experiment was carried out on one year old pruned *ber* bushes by treating them with different concentrations of colchicine solution. The observation made on stomata size and number per microscopic field showed that at 1·0 per cent colchicine treatment, the size was increased from 21·6×15·18 μ to 28·98×24·38 μ and the number reduced from 4·6 to 3·8.

The leaf fall was also observed to be slower with colchicine treatment as compared to control.

(S. C. Srivastava and P. Kumar)

(c) RESEARCHES CONTEMPLATED — Nil

(d) INSTITUTE PLANTATION

As usual, general upkeep of the plantation was maintained including maintenance of experimental plots, roads, paths, hedges and fencing.

Hoeing, weeding and mulching operations were carried out to the young host plants raised in the previous seasons. Hoeing operation was also carried out with the help of tractor and power tiller, in between the rows of the vacant spaces of the host plants in different plots to keep down the weeds and unwanted shrubs.

Dinanath grass and sun hemp were grown in between the rows of the *kusum*, *palas* and *khair* host trees for suppressing the weeds therein as also to improve the condition of the host trees by way of green-manuring, fertilization and cultural operations.

Seedlings of various lac hosts — namely, *palas*, *ber*, *kusum*, *bhalia*, *galwang*, were raised in the nursery-beds for filling of vacant places in the respective plots and for use in pots for laboratory experiments.

Sixteen hundred *bhalia* plants were raised within the space between thinly grown *khair* trees in plot No. 12 and another set of 2000 *bhalia* plants as pure patch in plot No. 5 i.e. south of *khair* plot. The said plants have shown satisfactory growth.

Another small pond was dug out this year in the low lying area of the *khair* plot situated towards the southern fringe of the plantation for irrigating the adjoining area.

During the year under report a fertilizer-cum-implements shed along with an extra room to be used as Farm office, was constructed at the plantation.

As in previous seasons, wheat, paddy, and other crops were grown in the plantation during this year also and the total revenue obtained through sales of these was Rs 12,154.95 P.

C. CHEMISTRY DIVISION

(a) RESEARCHES COMPLETED

3.1.6 Spectrophotometric studies on lac

The spectrophotometric studies on lac were undertaken with an objective to characterize the different absorption peaks in the UV and visible range and also to establish a correlation between the absorbance (in the visible range) and colour index.

The absorption spectra of different dewaxed varieties of shellac of varying colour indices have been studied in the complete UV and visible range at different concentrations in ethyl alcohol. These shellacs showed absorption maxima at 225, around 290 and at 425 nm while shoulders were noticed at 215 and 350 nm. For bleached lac, however, the absorption maximum and shoulder at 425 and 350 nm respectively were not found. It was concluded that the absorption maximum and shoulder observed at 425 and 350 nm were due to the colouring material erythrolaccin and the peaks observed in the UV range were due to the aldehyde group. The following relationship between colour index and optical density (noted for concentration of 10^{-3} g/ml) was obtained at 425 nm.

$$\text{Colour index} = 136.9 \times \text{optical density}$$

The above relationship can be used for an accurate determination of colour index of shellac. The absorption spectra of hard and soft resins of lac and their admixtures were then studied in the complete UV and visible range in ethyl alcohol. For hard resin, absorption maxima were obtained at 225, 255, 260, around 290 and at 425 nm. For soft resin absorption maxima were noticed at 225 nm, around 290 and at 435 nm.

The optical densities so obtained are given in Table 10.

The absorption spectra (visible range) of dewaxed lemon (DL), *bhatta*, autoclave shellacs, ammoniated lacs, bleached lac and soft resin were studied in freshly distilled commercial denatured spirit which is used in the conventional method for determination of colour index. The positions of different absorption maxima and shoulder are shown in Table 11. It was concluded that the peak at 425 nm was found unaffected in denatured alcohol (distilled) also suggesting that it can be used as an alternative solvent for the determination of colour index.

The absorption spectra of DL shellac were studied in methyl and isopropyl alcohols also. In both these solvents, absorption maxima were obtained at 230, around 290 and at 425 nm and the shoulder was noticed at 350 nm.

TABLE 10 — THE OPTICAL DENSITIES OF DL SHELLAC, HARD AND SOFT RESINS AND OF THEIR MIXTURES

Sl No.	Resin	O.D. at 425 nm	1% E_1 cm	O.D. at 225 nm (Conc. 10^{-4} g/ml)
1	DL shellac	0·057	0·54	1·65
2	Hard resin	0·04	0·5	1·7
3	Soft resin	0·076	0·8	0·91
4	70:30 Hard: soft resin mixture	0·052	0·53	1·6
5	50:50 Hard: soft resin mixture	0·062	0·63	0·62
6	20:80 Hard: soft resin mixture	0·07	0·73	0·58

TABLE 11 — POSITIONS OF ABSORPTION MAXIMA AND SHOULDER OF DIFFERENT SHELLACS IN DISTILLED COMMERCIAL DENATURED ALCOHOL

Shellac/Lac	Position of absorption maxima in nm	Position of shoulder in nm
DL	277, 425	350
Bhatta	277, 425	340
Ammoniated	277, 425	—
Autoclave	277, 440	360
Soft resin	280, 435	350
Bleached	275	—

The absorption spectra of six more natural resins, viz. benzoin, pontianac, rosin, kauri, dragon and gamboge at different concentrations in ethyl alcohol showed distinct absorption maxima in the UV range but no peak was observed in the visible range except for gamboge and dragon. It was observed that the identification of shellac in presence of above natural resins was not possible by the inspection of their absorption spectra. The absorption spectra were found to be similar to those of dewaxed shellac in the visible range but somewhat different in UV range.

(D. N. Goswami and N. Prasad)

3.2.2 Syntheses of exaltone, isoambrettolide and prostanoid synthon

Microcyclic molecules having musk like odour are in great demand because of their use in perfumery. Keeping this in view, attempts have b.en made to synthesize exaltone, iso-ambrettolide, ambrettolide, etc. and pros glandin analogues from aleuritic acid, *iso*-aleuritic acid and some of their derivatives by adopting the following reaction sequences.

Method A

Threo-isoaleuritic acid, m.p. 92-93°C, yield 56% was prepared from methyl-aleuritate following the procedure of Mathur and Bhattacharya [*JCS*, 2, 1963, 24, 77]. Identity of the compound was established by IR and elementary analysis.

Method B

Threo-16-methyl-hydrogen-7,8-isopropylidene-dioxy hexadecane dioate was reduced with LiAH/THF to afford *threo*-isoaleuritic acid as a solid, which was crystallized from ethyl acetate, m.p. 95-96°C, yield 20%.

Its *p*-phenyl phenacyl derivative melted at 124-126°C. Structure of *threo*-isoaleuritic acid was confirmed by IR, elementary analysis and its periodate oxidation.

Conversion of threo-isoaleuritic acid into its erythro-isomer and vice-versa

Threo-isoaleuritic acid on treatment with conc. HCl on a steam bath followed by aq. alkaline hydrolysis of the resultant product yielded its *erythro*-isomer, m.p. and m.m.p. 133-134°C, yield 80%. Similarly, *erythro*-isoaleuritic acid was converted into *threo*-isomer, yield 60%.

Following derivatives of *threo*-isoaleuritic acid were prepared:

(i) *Trans*-7,8-*epoxy*-16-*hydroxyhexadecanoic acid*

The chloro-hydroxy rubbery mass, obtained by the treatment of *threo*-isoaleuritic acid with conc. HCl on steam-bath, was hydrolysed with alcoholic alkali to yield the title compound as a solid, m.p. 80-81°C, yield 60%.

(ii) *cis*-7(8)-*Bromo*-8(7)16-*dihydroxyhexadecanoic acid*

It was obtained by the treatment of the foregoing *trans*-epoxy acid in ether with aq. HBr. The compound melted at 84-86°C, yield 100·8%.

(iii) 7(8),16-*Dihydroxyhexadecanoic acid*

trans-7,8-Epoxy-16-hydroxyhexadecanoic acid was hydrogenated with Pd/C in AcOH to afford the desired acid. Its *p*-phenyl phenacyl derivative melted at 152-154°C.

(iv) 16-*Hydroxy*-7(8)-*dioxohexadecanoic acid*

Threo-isoaleuritic acid was oxidized with N-bromosuccinimide to the title compound which was a semi solid and could not be crystallized and yielded 80%. With 2,4-dinitrophenyl hydrazine, it formed *bis*-hydrazone, m.p. 136-138°C.

Synthesis of threo-9,10-*dihydroxy palmitic acid*

16-iodo-9,10-dihydroxy palmitate obtained as a solid, m.p. 68-70°C prepared from methylaleuritate adopting the procedure of Sheshadri *et al.*, was reduced with

Na BH_4/DMF and hydrolysed to afford *threo*-9,10-dihydroxy palmitic acid as a solid, m.p. 85-87°C, yield 20%.

Threo-9,10-dihydroxy palmitic acid was converted into its *erythro*-isomer as earlier. *Erythro*-acid had m.p. 119-121°C, yield 44%. *Erythro*-isomer was similarly converted to its *threo*-isomer, m.p. 84-86°C, yield 10%.

Butolic acid (6-*hydroxytetradecanoic acid*)

Method A

Ester acid chloride of adipic acid was condensed with dioctyl cadmium to afford 6-ketotetradecanoic acid as a solid, m.p. 65-67°C.

Method B

The carbinol obtained by the condensation of cyclohexanone and octyl magnesium bromide was oxidized to 6-ketotetradecanoic acid, m.p. 65-67°C with CrO_3/AcOH. Reduction of methyl 6-ketotetradecanoate with $NaBH_4/C_2H_5OH$ followed by hydrolysis furnished butolic acid as a solid, m.p. 61-62°C.

Similarly, 7-hydroxytetradecanoic acid (m.p. 51-53°C), 5-ketotridecanoic acid (m.p. 71-72°C), 6-ketododecanoic acid (m.p. 59-60°C) and 5-ketohendecanoic acid was synthesized. The keto-acids were converted to parent acids by Wolff-Kishner reduction.

(±)Aleuritic and (±)butolic acids were resolved in (±) and (−) form using (+) cinchonine.

Synthesis of prostanoid synthon and an analogue

2-(ω-carboxyhexyl)cyclopentenone, a prostanoid synthon was prepared in quantity as follows:

Azelaic acid aldehyde as its methyl ester was condensed with dimethyl succinate in methanol in the presence of sodium methoxide to afford half-ester as an oil.

The foregoing half-ester was then refluxed with HBr AcOH-H_2O to yield lactone ester as a liquid. Treatment of the lactone-ester with polyphosphoric acid gave 2-(ω-carboxyhexyl)cyclopentenone as a thick liquid. The identity of the compound was established by spectral data and elementary analysis.

2-(ω-*Carboxypentyl*)*cyclopentenone*

Azelaic acid aldehyde was treated with malonic acid in the presence of dry pyridine to afford Δ^2-hendecene-1,11-dioic acid as a solid, m.p. 95-97°C, yield 65%.

The foregoing unsaturated dioic acid was lactonized with dil. H_2SO_4 containing catalytic amount of perchloric acid. Treatment of the lactone with polyphosphoric acid on steam-bath gave 2-(ω-carboxypentyl) cyclopentenone as a liquid, yield 40%. Adopting similar procedure, cyclopentenones were prepared from hexanal, octanal and nonanal.

All the compounds gave satisfactory elementary analysis.

Synthesis of exaltone from threo-aleuritic acid

Hexadec-*trans*-9-enedioic acid, m.p. 102-103°C (yield 50%) obtained by treatment of *threo*-9,10-dihydroxyhexadecane-1,16-dioic acid with PH_4I/AcOH was converted to corresponding acid chloride which was cyclized to cyclopentadecenone adopting high dilution principle as per the method developed by S. C. Bhattacharya. Its hydrogenation (Pd/C) afforded exaltone as a waxy solid, m.p. 60-61°C, yield 20%.

Further improvement in the yield of exaltone was brought about by the modified procedure which was as follows:

Threo-9,10-dihydroxyhexadecane-1,16-dioic acid was treated with ethyl orthoformate/benzoic acid at 170°C for 4 hr followed by alkaline hydrolysis to give unsaturated dioic acid as a solid, m.p. 102-103°C, yield 80%.

The foregoing unsaturated dioic acid in acetic acid was hydrogenated to hexadecane-1,16-dioic acid, m.p. 124-126°C, yield 80%. It was then converted to the corresponding acid chloride by $SOCl_2$. Cyclization of the acid chloride adopting high dilution principle yielded exaltone (cyclopentadecanone) as a solid, m.p. 60-62°C yield 22%. All the compounds gave satisfactory elementary analysis.

Synthesis of trans-Δ^9-isoambrettolide

Trans-Δ^9-isoambrettolide, which has a musk-like odour was synthesized from *threo*-aleuritic acid by making certain modification in the reaction sequences as reported by Prof. S. C. Bhattacharya. The details of the procedure are as follows:

16-Hydroxy-*trans*-hexadec-9-enoic acid m.p. 69-70°C, yield 60% obtained by sequential treatment of *threo*-aleuritic acid with PH_4I/AcOH and alkali, was cyclized with *p*-toluene sulphonic acid in toluene to yield polyester which was depolymerized by distilling with anhy. $MgCl_2$ to yield *trans*-Δ^9-isoambrettolide as a liquid b.p. 115-116°C/0.2 mm, yield 75%.

All the compounds gave satisfactory elementary analysis. Improvement brought about in the yield of *trans*-Δ^9-isoambrettolide was as follows:

Threo-aleuritic acid was heated with ethylorthoformate/benzoic acid at 170°C for 4 hr. After removing excess of ethylorthoforma e, the residual mass was hydrolysed with methanolic KOH to yield 16-hydroxy-*trans*-hexadec-9-enoic acid as a solid, yield 90%, m.p. 66-68°C.

The above unsaturated acid was cyclized to liquid trans-Δ^9-isoambrettolide, yield 70%. The identity of the compound was confirmed by spectral data and elementary analysis.

Synthesis of trans-Δ^9-C_{16} cyclic ether

Threo-aleuritic acid was converted to 16-hydroxy-*trans*-hexadec-9-enoic acid as a solid, m.p. 66-68°C by treatment with PH_4I/AcOH followed by alkaline hydrolysis. It was then converted to the corresponding methyl ester. Reduction of the foregoing methyl ester with $NaBH_4$ afforded unsaturated diol. Cyclization of the foregoing diol with *p*-toluene sulphonic acid gave the title compound as a liquid. Overall yield was ~35%. The same cyclic ether was obtained by the reduction of trans-Δ^9-isoambrettolide by means of $NaBH_4/BF_3$. However, the identity of the compound is to be established by spectral data.

(R. N. Majee, S. C. Agarwal, J. N. Chatterjea, S. C. Sengupta and S. N. Mukherjee)

3.7.2 To prepare a standard for lac dye for use as a food colour

There appears to be a great demand for the water-soluble lac dye for use as a food colour. It was, therefore, decided to study its characteristics so as to lay down a standard for it.

The characteristics such as melting point, acid values (by three different methods, e.g.: (i) titration method using phenolphthalein as internal and thymol blue as external indicators, (ii) using Klett Summerson photoelectric colorimeter and (iii) *p*H meter, volatile matter at 135°C, water insolubles (cold and hot), alcohol insolubles (hot) and ash content were determined. The absorption (UV spectrophotometer and Klett Summersion photoelectric colorimeter) and chromatographic studies (paper and thin layer on silica gel and cellulose coated plates) were also carried out.

The results are summarized in Tables 12, 13, 14 and 15.

TABLE 12 — CHARACTERISTICS OF LAC DYE

Sl No.	Characteristics	Values
1	M.P. (°C)	Above 230 with charing
2	Volatile matter at 135°C %	6-7
3	Acid value	
	i) Usual titration method	238-245
	ii) Using photoelectric colorimeter	240-255
	iii) *p*H meter	234-238
4	Ash content (%)	0·7
5	Solubility %	
	i) Cold water (room temp. 27±2°C)	51-52
	ii) Boiling water	98-99
	iii) Boiling alcohol	99·9

TABLE 13 — UV ABSORPTION STUDIES ON LAC DYE

Solvents	Position of absorption maxima in nm				
Ethanol	230	292	340	500	530
Methanol	230	292	340	500	530
Water	—	292	—	490	—
Acetone	—	—	—	500	—

TABLE 14 — PHOTOELECTRIC COLORIMETRIC STUDIES ON LAC DYE

Concentration % of dye	Deflections in solvent		
	Ethanol	Methanol	Acetone
0·001	64	50	40
0·002	115	90	82
0·003	160	130	125
0·004	210	165	165
0·005	235	200	205

TABLE 15 — CHROMATOGRAPHIC STUDIES ON LAC DYE

Chromatographic studies	No. of spots	Rf values
1. Paper chromatography solvent-n-butanol formic acid : water (4:1:0·5)	2 clearly separated	(i) 0·42-0·45 minor spot (ii) 0·73-0·75 major spot
2. T.L.C. silica gel coated plate solvent n-butanol : formic acid: water 4:1:0:0·5	2 spots (diffused and long tailing	do
3. T.L.C. cellulose coated plates solvent = n-butanol : acetic acid : water (20:8:9)	8 spots (clearly separated)	0·39; 0·47; 0·83; 0·93 minor spots 0·58; 0·64; 0·73; ·076 major spots

Baséd on the above findings, a specification for pure lac dye was laid out (Table 15a).

TABLE 15a — SPECIFICATIONS LAID OUT FOR PURE LAC DYE

Characteristics	Values
M.P.	Above 230 with charing
Volatile matter at 135°C (%) max	7
Acid value	234-240
Ash content (%) max	1
Solubility (%)	
(a) Cold water	50-55
(b) Hot water	98
(c) Hot alcohol	99
Paper chromatography solvent-n-butanol : formic acid : water 4:1:0·5	Two spots with Rf value (1) 0·42-0·45 (minor) (2) 0·73-0·75 (major)
UV absorption in ethanol (0·002%)	Peaks at 530, 500, 340, 292 and 230
Klett Summerson photoelectric deflection in ethanol (0·002%)	Reading between 110 and 120

(B. B. Khanna, A. K. Ghosh, K. M. Prasad and N. Prasad)

3.7.3 To prepare standards for different grades of lac wax

In order to revise the old IS specification for lac wax, the present study was undertaken.

Seven samples of lac wax were obtained from different sources (as mentioned in Table 16) and their physico-chemical properties namely, acid value, saponification value, iodine value, volatile matter (%) at 150°C, resin content (%), colour or appearance, m.p. and ash content were determined following the methods given in IS: 1699/1974. Penetration value and solvent retention power were determined according to the method described in the book "The Chemistry and Technology of Wax" by A. H. Warth, Reinhold Publishing Corporation, New York, Second Edition; pages 612 and 714.

TABLE 16

A I	Wax from lac dust	Supplied by M/s Waxpol Industries, Tatisilwai, Ranchi
A II	Wax from lac mud	
A III	Wax from lac mud and refined	
B I	Wax from lac mud precipitated with acid	Lac muds were supplied by BISCOLAMF, Ranchi and the wax was recovered at ILRI, Ranchi
B II	Wax from lac mud without acid treatment	
C	Wax obtained from Angelo Bros., Calcutta	
D	Wax obtained during the manufacture of bleached lac at ILRI	

The results are presented in Table 17.

The data revealed that the properties (Table 17) of lac wax differed widely depending on the source of wax. Thus lac wax may be classified into two grades

TABLE 17 — PHYSICO-CHEMICAL PROPERTIES OF LAC WAX OBTAINED FROM DIFFERENT SOURCES

Sample No.	Acid value	Saponification value	Iodine value	Volatile matter (%)	Resin content (%) at 150	Appearance	m.p. °C	Ash content	Penetration value	Solvent retention value				
										24 hr	48 hr	72 hr	96 hr	120 hr
A I	8·0	89·0	8·2	0·88	2·3	Straw	—	0·03	12	—	—	—	—	—
A II	47·0	144·0	11·4	0·94	11·0	Dirty green	—	1·00	27	—	—	—	—	—
A III	50·6	125·0	15·4	1·15	10·0	Light dirty green	—	1·00	25	—	—	—	—	—
B I	35·0	106·0	15·00	—	6·5	Brown	65-72	0·02	5·0	28	47·5	54·5	50·5	37·5
B II	14·3	85·1	11·5	—	4·4	Brown	64-70	0·01	7·0	24·5	41·5	47·5	57·5	47·5
C	20·7	94·1	5·3	0·6	0·9	Light brown	70-82	0·04	2·0	12	23	30	32·8	25
D	6·3	45·0	3·0	—	3·0	Straw	70-80	0·02	0·8	—	—	—	—	—

having the characteristics as summarized in Table 18. Based on these findings the revised specification for lac wax was drawn.

TABLE 18 — PHYSICO-CHEMICAL CHARACTERISTICS OF TWO GRADES OF LAC WAX

Characteristics	Grade I	Grade II
Colour	Light yellow	Light brown to greenish brown
Acid value (max)	10	35
Saponification value (max)	95	125
Iodine value (max)	8	15
Resin content % (max)	3	8
Volatile matter at 150°C (max)	1	2
Ash content % (max)	0·5	1
Penetration value (max)	3	20
Solvent retention value after 5 days % (max)	25	35

(B. B. Khanna and K. M. Prasad)

(b) RESEARCHES ON HAND

3.1 Chemistry of Lac/Constituents

3.1.1 Separation and study of components of lac wax

The fractionation of lac wax into three fractions namely, Fr-A, Fr-B and Fr-C by alcohol and isolation and identification of pure components from Fr-A and Fr-B had been reported earlier. From the alcohol soluble fraction Fr-C, the separation of free acids by sodium bicarbonate and isolation of one component (chloroform-insoluble) was also reported (A.R.: 1981 and 1982).

The T.L.C. examination of the remaining wax fraction of Fr-C showed that it is a mixture of at least ten components having Rf values 0·04, 0·08, 0·14; 0·210, 0·3; 0·42; 0·5; 0·71; 0·89 and 0·94 respectively (solvent: trichloroethylene: chloroform: acetic acid 70:8:0·2). In order to isolate pure components, the above fraction C was fractionated repeatedly on a column of neutral alumina eluting with petroleum ether (b.p. 60-80°C). Two components were isolated having Rf values 0·08 and 0·94.

The component, having Rf value 0·94 when analysed on G.L.C. (SE-30 and SE-52 columns) was found to be a mixture of three components.

(K. M. Prasad and S. C. Agarwal)

3.1.3 Correlation of the properties of seedlac and shellac with age

Seven samples of sticklac obtained from different major lac hosts and places of cultivation were procured during 1978-81 and converted into seedlac and shellac. The 14 samples thus obtained were stored under room conditions in gunny bags and analysed periodically for various properties.

As already reported, a fall in almost all the properties has been noticed on storage. Flow seemed to be the most sensitive property of seedlac and shellac

which may be correlated with age. It was found that 1, 2 and 3 year old *kusmi* seedlacs had flow values 55, 45 and 25 mm respectively. In case of *rangeeni* seedlac, corresponding figures were 35, 30 and 25 mm respectively. The figures for shellac were higher by about 15-20 mm as compared to those for seedlac.

(B. B. Khanna, S. K. Saha, A. K. Ghosh, N. Prasad, D. N. Goswami and P. M. Patil)

3.1.5 Improvement in the method of isolating aleuritic acid from lac for maximizing its recovery

Last year the optimum conditions to isolate aleuritic acid in increased yield were worked out and it was reported that its total recovery to the tune of 32-35 per cent can be made which includes the isolation of *erythro*-aleuritic acid (7-10 per cent) from the mother liquor by adopting the method of acid treatment followed by alkaline hydrolysis.

With a view to find out the utility of gummy mass in surface coating, adhesive and cement, experiments were carried out. The gummy mass was reacted with different proportions of ethylene glycol and the chemical constants viz., acid and hydroxyl values of the resultant products were determined. The drop in acid and hydroxyl values of the resultant product, nearly two-third reduction in values with 50% ethylene glycol indicated that the reaction had taken place. The esters, so formed, were then reacted with an isocyanate (Desmodur N) and the surface coating properties were studied.

Gasket-shellac compound was prepared using gummy mass and total hydrolysed lac separately. Their comparative properties as per IS specification are being determined. Samples of gummy mass from M/s Okhla Chemicals, New Delhi and M/s Ponds India Ltd., Madras were also procured for comparison.

(S. C. Agarwal, R. N. Majee and B. C. Srivastava)

3.1.8 Biophysical studies on the interaction between laccaic acid and DNA

The aluminium and iron complexes of lac-dye were prepared which were highly soluble in water. The absorption spectra of lac-dye-aluminium complex in water revealed the presence of an absorption maximum at 525 nm and a shoulder around 570 nm. The changes in the absorption spectra of sodium salt of lac-dye as well as of the above complexes due to the presence of DNA are being studied.

(D. N. Goswami, N. Prasad and K. M. Prasad)

3.1.10 Adsorption studies on lac

The study was undertaken in order to decolourize and deodorize lac for practical purposes. Seedlac solutions of different concentration (2 to 10%) were prepared in alcohol and the insolubles were discarded through filtration.

The solutions (100 ml each) were refluxed on water bath for one hr in the presence of charcoal (10 g) and filtered off. The concentration of the solutions before and after adsorption was determined. The amount of the solute adsorbed per gram of the adsorbent was calculated in each case. The experimental data were found to obey the Freundlich's equation.

(A. Kumar)

3.1.11 Isolation of jalaric acid from lac on technical scale

To evolve a suitable technical method for the isolation of jalaric acid from lac the project was taken up this year.

Jalaric acid is one of the major constituent acids of lac resin and is present to the tune of 11-13% in unhydrolysed and 33-37% in hydrolysed lac (A.R.: 1971, p. 31). The well known method of separating water-solubles and insolubles from lac resin (*bhatta* shellac) by weak hydrolysis was attempted to isolate jalaric acid.

The hydrolysed product was decomposed with aqueous phosphoric acid (1 : 1) whereupon a gummy mass along with water-soluble portion separated out. The aqueous portion was filtered and the gummy mass was washed repeatedly with distilled water to make it acid free. All the washings were collected in the filtrate and it was extracted with ethyl acetate. The extract was dried over anhydrous sodium sulphate and concentrated to one fifth of its total volume under vacuum distillation. On keeping the concentrated extract at room temperature for 2-3 hr, a crystalline product separated out which was filtered and dried. The m.p. of the solid and its 2:4 DNPH derivative were 160-162°C and 225-227°C respectively. TLC of the compound when compared with authentic samples of jalaric acid in the solvent system: chloroform : methanol : acetic acid (90: 10: 1) revealed it to be jalaric acid (Rf 0·36), Experiments were carried out with both fresh and old samples of shellac (*kusmi* and *rangeeni*) and jalaric acid in a yield of 7 per cent was obtained.

(N. Prasad and S. C. Agarwal)

3.1.12 Degradation studies on lac

In order to understand the chemical disposition of lac, a few preliminary experiments on the degradation of lac through oxidation reactions were undertaken. To standardize the optimum conditions, aleuritic acid was first oxidzed with nitric acid (70%) which yielded a pure component (m.p. 118-119°C). This reaction was extended to shellac which on oxidation with nitric acid imparted two fractions namely, ether fraction and ethyl acetate fraction. The former fraction on refractionation yielded three pure components which on recrystallization melted at 136-137°C, 113-115°C and above 200°C while the latter fraction gave a pure component (m.p. 120-121°C).

Preliminary oxidation of shellac with alkaline potassium permanganate was also carried out but the desired success could not be achieved.

(S. C. Agarwal and N. Prasad)

3.2 Fine Chemicals from Lac

3.2.8 Synthesis of civetone and cyclic ureide from aleuritic acid

Cyclic ureides

7-Hydroxy heptanal, an intermediate required for the synthesis of cyclic ureides, was prepared from aleuritic acid through potassium periodate oxidation method. It was oxidized with Jones reagent to yield pimelic acid as a solid, m.p. 102-104°C IR (KBr): 1700 cm^{-1}. It was converted to the acid chloride by treat-

ment with $SOCl_2$. The semisolid product obtained by refluxing acid chloride with urea in dry benzene for 4 hr is being identified. (i) Ureide was again prepared from Δ^9-hexadecene-1,16-dioic acid following the procedure reported last year. The pharmacological studies of the product are in progress at B.A.U., Ranchi. (ii) Azelaic acid aldehyde, the other periodate oxidation product of aleuritic acid was heated with malonic acid in the presence of pyridine on a steam-bath till CO_2 evolution ceased. Usual work-up with ether afforded Δ^9-hendecene-1,11-dioic acid as a solid, m.p. 97-98°C. IR (KBr): 1700, 970 (*trans* HC = CH) cm^{-1}. It was converted to the corresponding acid chloride by treatment with $SOCl_2$. The acid chloride, thus obtained, was refluxed with urea in dry benzene for 4 hr. The benzene layer was washed with aq. $NaHCO_3$ followed by water and dried (Na_2SO_4). Removal of the solvent afforded ureide as a solid, m.p. 220-222°C. The pharmacological studies of the product are in progress at B.A.U., Ranchi.

Civetone

Threo-aleuritic acid, on treatment with ethylorthoformate/benzoic acid at 170°C for 4 hr, followed by alkaline hydrolysis afforded 16-hydroxy-Δ^9-hexadecenoic acid as a solid, m.p. 68-70°C, yield 90%. The foregoing unsaturated acid in dry methylene chloride, on treatment with pyridinium chlorochromate for 2 hr and purification of the product on a column of neutral alumina with ether as eluent afforded unsaturated aldehydic acid, which was then heated with malonic acid in the presence of pyridine on steam-bath for 4 hr to afford 9,16-diene-octadec-1,18-dioic acid. Treatment of the above unsaturated dioic acid with $SOCl_2$ furnished the corresponding acid chloride as a liquid.

(R. N. Majee and S. C. Agarwal)

3.2.10 Synthesis of pheromones and juvenile hormone analogues from aleuritic acid

Lauryl alcohol and lauryl ether are reported to possess JH activity on meal worm. Therefore, attempts were made to synthesize compounds having similar structure from aleuritic acid.

(i) Synthesis of 1,4,12-trimethoxydodecane, a juvenile hormone analogue from aleuritic acid was repeated this year and reproducible results were obtained regarding JH activity.

(ii) 2-(ω-carboxyhexy)cyclopentenone synthesized earlier from aleuritic acid was tested for JH activity.

The compound did not show any JH-activity on one day-old pupae of *Corcyra cephalonica*.

(R. N. Majee and R. Ramani)

3.3 Modification of Lac/Constituents and Their Utilization

3.3.3(ii) Cation exchange resin from styrenated lac

Last year, the sulphonation of styrenated lac was carried out but desired results were not achieved. This year, the experiment was repeated. Both styrenated lac and ordinary lac were sulphonated with conc. sulphuric acid separately and the sulphur contents of the resultant products were determined gravimetrically. It was observed that styrenated lac has 4·28% sulphur content as against

4·18% in sulphonated lac which indicated that more than one sulphonic group is introduced.

(A. Rahman, P. C. Gupta and B. B Khanna)

3.3.6(ii) Modification of lac/hydrolysed lac with polyisocyanates

A number of polyisocyanates are commercially available which on reaction with compounds containing hydroxyl groups give polyurethanes having good weather and chemical resistance. Work has, therefore, initiated to modify the hydrolysed lac with some of these polyisocyanates and study the film properties of the resultant polyurethanes.

Reaction of hydrolysed lac with Desmodur N, Desmodur L and Desmodur VL

A (25%) solution of hydrolysed lac in dry methyl ethyl ketone was treated with different proportions by weight of Desmodur N, Desmodur L and Desmodur VL, at room temp. for 15 min and the films of the resulting product were prepared on clean glass slides. Film of one set of these was air dried for 7 days and another set was baked at 150°C for 30 min. The films were tested for acid, water and alkali resistance. It was observed that air dried films prepared from the reaction product, Desmodur N, Desmodur L and Desmodur VL showed good water and acid resistance but poor alkali resistance. However baked films prepared from Desmodur N and Desmodur L showed slight improvement in alkali resistance. Films of polyurethane prepared from Desmodur VL became dark after baking. The gelation time due to the reaction of hydrolysed lac with polyisocyanates and the resistance of the film to water, alkali and acid are given in the Table 19.

TABLE 19 — FILM PROPERTIES OF POLYURETHANES PREPARED FROM THE REACTION OF HYDROLYSED LAC WITH POLYISOCYANATES

Polyisocyanate used	Amount used on the wt of hydrolysed lac (%)	Gelation period	Resistance to		
			Water	HCl (1%) (48 hr)	NaOH (1%) (24 hr)
Desmodur N	75	40 min	A.D. 5	4	0
			B. 5	5	3
	100	35 min	A.D. 5	4	0
			B. 5	5	3
Desmodur L	45	2 hr 35 min	A.D. 4	4	0
			B. 5	5	0
	60	2 hr 20 min	A.D. 4	4	0
			B. 5	5	0
Desmodur VL	40	1 hr 45 min	A.D. 5	5	0
			B. 5	5	1
	60	45 min	A.D. 5	5	0
			B. 5	5	2

A.D. = Air dried (for 7 days).
B. = Baked (150°C for 30 min).
5, Practically unaffected; 4, Slight loss of gloss; 3, Loss of gloss and change in colour; 2, Blush; 1, Blush and lifted; 0, completely removed.

(B. B. Khanna and P. M. Patil)

3.3.10 Addition polymerization of shellac

The solubility of the products, obtained by addition polymerization of shellac using benzoyl peroxide, α,α-azo-di-iso-butyro nitrite and boron trifluoride etherate was examined in n-butanol. In each case, about 20-25% material remained insoluble. The intrinsic viscosity of the above sol. fractions was determined and found to be 0·50, 0·04 and 0·07 respectively as against 0·14 for lac. The data indicates that polymerization has taken place when benzoyl peroxide was used as an initiator.

(A. Kumar)

3.3.11 Modification of lac with ethyl cellulose

Both ethyl cellulose and *bhatta* shellac solutions (25%) were prepared in denatured spirit. These two solutions were mixed in different proportions viz., 5:95; 10:90; 15:85; 20:80; 25:75; 30:70; 35:65; 40:60; 45:55 and 50:50 respectively and films were prepared to study their properties.

(A. K. Dasgupta)

3.4 Use of Shellac and Modified Shellac in Surface Coating

3.4.3 Shellac paints for wood patterns

It was reported earlier that the air dried films of the pattern paint composition prepared by using ordinary shellac and denatured spirit as the main solvent were comparatively less glossy and showed slightly inferior resistance to water.

In view of the above, the composition of pattern paint was modified by varying the proportion of binder and pigment in the composition. Pattern paints prepared by using the modified composition were sufficiently viscous and uniform. These paints when applied by brush produced hard, smooth, uniform and glossy films. These films showed good flexibility and possessed a gloss of 68% of standard black glass. The scratch hardness of the films was found to be 1100 g. In regard to water resistance, however, no appreciable improvement was obtained. These films also showed blushing after 24 hr immersion in water.

With a view to improve the water resistance of the films, one more composition of pattern paint was prepared by further increasing the proportion of binder. This composition on application by brush produced hard, smooth and sufficiently glossy films which also did not possess the desired resistance to water.

(S. Kumar and A. K. Dasgupta)

3.4.4 Studies on shellac ester and their utilization

The reaction of aleuritic acid with glycerol in the presence of boron trifluoride as catalyst was studied earlier. During the period, aleuritic acid was heated with glycerol at 250 ± 5°C for 40 min in the presence of zinc dust as catalyst. A semi-solid product, soluble in ethyl acetate, methanol and ether was obtained. After purification, the acid value of the product was 1·35. Intensity of the spot obtained by TLC indicated that glyceryl mono aleuritate was present to the extent of 90-95 per cent in the mixture of glycerol mono-, di- and tri-aleuritates. Glyceryl mono aleuritate was separated from the said mixture by preparative

TLC. Again TLC examination of this product in different solvent systems indicated the purity of glyceryl monoaleuritate. IR spectrum showed band for ester carboxyl at 1720 cm^{-1}. Column chromatography in a silica gel column of the above mixture was also performed and almost identical results were obtained. The resultant product on crystallization from ethyl acetate gave white needles of glyceryl monoaleuritate (m.p. 62-64·5°C).

Further experiments carried out in this direction showed that when aleuritic acid and glycerol were reacted in 1:1 molar ratio at 225 ± 5°C for 1 hr 15 min in the presence of zinc dust as catalyst, only pure glyceryl monoaleuritate m.p. 63-65°C, yield, 80 per cent was obtained.

(M. Mukherjee, R. N. Majee and S. Kumar)

3.4.5 Studies on anticorrosive primers/paints for ferrous metals

A few compositions of anticorrosive primers based on dewaxed lac-double boiled linseed oil and ordinary shellac-double boiled linseed oil vehicles were prepared earlier. During the period, the primer composition based on dewaxed lac was tested for its film performance. This composition when applied by brush produced films which were hard, smooth and uniform and showed good adhesion on ferrous metals. These films did not show any cracking when bent round a $\frac{1}{8}$ inch mandrel and possessed a scratch hardness of 900 g. The water and solvent resistance of these films was also found to be good. These films showed good hold out to top coats viz., synthetic enamels. The experiments to test the anticorrosive properties of the air dried films are in progress.

The primer composition based on ordinary shellac-double boiled linseed oil vehicle, however, could not be tested for its film performance as some gel like structure had developed in it. The efforts made to prepare a fresh lot of the primer also did not succeed as the vehicle gelled during its preparation.

Attempts were also made to prepare another vehicle for anticorrosive primers by following the method developed earlier. Lac (100 g) and rosin (100 g) were mixed together and heated at 150°C till a gel-like mass was obtained. At this stage, zinc oxide (3·5 g) was added and heating continued till the mass liquified. This liquid mass was cooled, powdered and dissolved in toluene. Crepe rubber (10 g) was dissolved separately in toluene and the two solutions were mixed together. The experiment was repeated six times but satisfactory varnish could not be obtained for use as a vehicle for anticorrosive primers.

(S. Kumar, A. Rahman and M. Mukherjee)

3.5 Use of Lac for Encapsulation and Controlled Release

3.5.3 Combination of lac with weedicide for slow-release

It was reported earlier (A.R.: 1982) that samples of lac 2·4-D ester formulations were prepared by direct combination method and sent to different agricultural Universities/Institutes for evaluation studies.

During the period, studies were undertaken to explore the possibility of using byproducts of lac as suitable matrix for combining them with weedicide for preparing slow-release formulation. Lac-mud, a waste of the lac-processing industry, was first taken for the study. The physico-chemical properties namely,

acid value and hot alcohol insolubles of lac-mud (with and without wax) both acid treated and as such were determined but no difference was noted (Table 20). The lac-mud samples on the basis of lac-resin content were reacted in 1:1 and 1:2 molar proportions directly with 2,4-D.

Studies were also undertaken to prepare granular formulations of lac-2,4-D. Various carriers such as bentonite, soap-stone, fuller's earth and kieselguhr were examined. Bentonite and soap-stone were preferred due to their availability, source and economic viability. Blank granules using bentonite as carrier and binder such as shellac (5% w/v), PVA (2% w/v), sodium CMC (1% w/v) and casein (2% w/v) — all in aqueous solution were prepared with the help of a oscillating type granulator. Disintegration test was carried out in normal tap-water and also in standard hard-water with a view to select the suitable binder for the desired purpose. The time taken at room temp. for dispersion on continuous shaking of granules in water (10 ml) was recorded (Table 21). The order of disintegration for different binders was found to be PVA>sodium>CMC>casein> shellac. It was observed that granules took comparatively more time to disintegrate in tap water than the standard hard water showing that the hardness of water has an effect on the disintegration of granules.

TABLE 20 — PHYSICO-CHEMICAL PROPERTIES OF LAC-MUD

Sl No.	Lac-mud samples	Hot alcohol insolubles (%)	Acid value (average)
1.	Wax free; lac-mud (without acid treatment)	56·90	38·31
2.	Wax free lac-mud (acid treated)	64·21	37·76
3.	Lac-mud with wax (without acid treatment)	55·86	36·71
4.	Lac-mud with wax	53·68	37·22

TABLE 21 — WATER-DISPERSION CHARACTERISTICS OF BENTONITE GRANULES

Sl No.	Binder	Dispersion time (seconds)	
		Tap-water	Hard water 342 ppm as $CaCO_3$
1.	Ammoniacal (1:3) lac solution (5% w/v)	98	53·6
2.	Casein solution (2% w/v)	272	16·5
3.	Sodium CM-cellulose solution	736	54·7
4.	PVA solution (2% w/v)	No Up to 7 days	No Up to 7 days

The IR spectra of various lac-2,4-D reaction products prepared earlier by using different methods confirmed the previous findings (A.R.: 1979-1980 and 1981-82).

(B. C. Srivastava and S. C. Agarwal)

3.5.4 Studies on the use of lac as adjuvant in pesticide formulation

Lac based stickers

During the period under report, studies were undertaken to see the relative performance of lac-based stickers and commercial stickers. The gummy mass obtained after the isolation of aleuritic acid which was so far considered as waste was utilized for the preparation of sticker formulation. The acid value, hydroxyl value, life under heat and solubility of this gummy mass along with the partially hydrolysed shellacs (A.R.: 1982), were determined. It has been found that excepting life under heat, other characteristics are similar in nature as reported earlier. All these three materials can be solubilized in water in the presence of triethanolamine and ammonia.

Sticker formulations (50% w/v) based on two types of partially hydrolysed shellac and gummy mass (obtained after isolation of aleuritic acid) were prepared using ammonia (1:3) and triethanolamine (1:4) as solubilizing agents. With a view to ascertain the relative viscous nature of these formulations, glass slide test was improvized. Laboratory evaluations based on this test indicated that sticker formulations based on triethanolamine were more viscous than those obtained using ammonia (Table 22). Further, these formulations alongwith commercial formulations were applied on glass plates and their sticking nature was periodically observed. All these formulations were found to possess the desired continuing sticking nature (so far over 4 months) similar to that of commercial BASF sticker formulations based on synthetics.

TABLE 22 — SLIDING CHARACTERISTICS OF STICKER FORMULATIONS

Sl No.	Sticker formulation		Sliding time (second)
	Preparing conditions of partially hydrolysed lac etc.	Solvent	
1.	6 hrs at room temp.	Ammonia (1:3)	28·0
2.	6 hrs at room temp.	Triethanolamine (1:4)	55·5
3.	1 hr refluxing	Ammonia (1:3)	17·5
4.	1 hr refluxing	Triethanolamine (1:4)	78·0
5.	Gummy mass	Ammonia (1:3)	5·0
6.	Gummy mass	Triethanolamine (1:4)	20·0
7.	Acronol 4 D*	Not known	0·5
8.	Acronol 7 D*	do	0·7
9.	Lutanol-I 65 D*	do	197·6
10.	—	Distilled water	Time could not be recorded
11.	—	Triethanolamine	
12.	—	Ammonia	

*BASF commercial formulation.

Lac-based emulsifiers

Studies were undertaken to find the possibility of preparing lac-based emulsifiers for pesticide formulations. Sulphonation of lac was carried out

TABLE 23 — CHARACTERISTICS OF SULPHONATED LAC (CLRI METHOD)

Sl No.	Characteristics	Values (Average)
1.	*p*H	6·5
2.	Acid value	13·68
3.	Hydroxyl value	46·84
4.	Sap. value	151·81

adopting the technique of CLRI, Madras and SEPC, Calcutta. The solubility of both the sulphonated products was determined. It was found that the sulphonated lac obtained by SEPC method was insoluble in water, ammonia, triethanolamine, methanol, spirit and 1,4-dioxan, whereas the sulphonated lac prepared by CLRI method was readily dispersible in water and above solvents. The product obtained using CLRI technique was characterized (Table 23).

(B. C. Srivastava and T. P. S. Teotia)

(c) RESEARCHES CONTEMPLATED

(1) Modification of lac wax.

D. TECHNOLOGY DIVISION

(a) RESEARCHES COMPLETED — Nil

(b) RESEARCHES ON HAND

4.1 Improvements in the Processing Techniques

4.1.5 Washing of sticklacs with synthetic detergents

During the period under report, a fresh batch of detergents namely, Magic®, Spa® and Point® were also tried along with Genteel® and Surf® for washing *kusmi* sticklac on laboratory scale. In general, the yield was improved by 2-3·5 per cent but colour and bleach indices remained the same (Table 24) as compared to the control. However, these detergents did not show any improvement over Genteel® and Surf®.

TABLE 24 — PROPERTIES OF SEEDLAC OBTAINED BY WASHING *kusmi* (*aghani* 1978-79, NAMKUM) STICKLAC WITH 0·1 PER CENT OF DIFFERENT WASHING AIDS

Sl No.	Washing aids	Properties of seedlac		
		Yield (%)	Colour index	Bleach index
1.	Genteel	77·5	10·0	82·0
2.	Surf	75·1	11·0	80·0
3.	Magic	72·5	12·0	86·0
4.	Spa	73·2	13·0	88·0
5.	Point	73·7	12·0	86·0
6.	Washing soda (control)	70·1	12·0	86·0

(R. K. Banerjee and A. K. Ghosh)

4.1.6(ii) Improvements in dewaxing and decolourizing techniques in solvent medium

Four samples of *kusmi* seedlac were decolourized by the method standardized earlier (A.R.: 1981 and 1982). The yield, colour index, life and flow of the shellacs obtained were 84 to 86 per cent, 1·2 to 1·5 units, 30 to 35 min and 74 to 80 mm respectively. The wax content of the samples varied from 0·9 to 1·4 per cent indicating that dewaxing was not satisfactory.

(R. K. Banerjee)

4.1.7 Making of shellac from *kiri* without use of alcohol

During the period under report, three samples of *kiri* (2 machine made and one of *bhatta* process) were processed to shellac by adopting alcohol and alkali extraction methods as reported earlier (A.R.: 1981 and 1982). The percentage of sodium hydroxide and sodium hydrosulphite has been varied from 2 per cent to 4 per cent of each. The period of contact with hydroxide and its temperature during reaction have been studied throughly by varying the time and temperature.

Finally, it was found that the extract of *kiri* in boiling water with sodium carbonate (8%) and sodium sulphite (4%) should be reacted with sodium hydroxide (2-4%) at 90°C for 4 hr and then allowed to cool for 12-14 hr. It is then reacted with equal amount of sodium hydrosulphite for 30 min, diluted, precipitated and

washed as usual. The product, thus prepared, was kept at laboratory conditions and tested after six months. It was found that the product retained all its properties. The data so far obtained by using 2 and 4 per cent sodium hydroxide and sodium hydrosulphite, are summarized in Table 25.

It was found that in some samples of *kiri*, 2% of these chemicals gave satisfactory product while in other cases 4 per cent of both was found necessary.

TABLE 25 — PROPERTIES OF SHELLAC OBTAINED FROM DIFFERENT SAMPLES OF *kiri* USING 2 AND 4 PER CENT EACH SODIUM HYDROXIDE AND SODIUM HYDROSULPHITE

Sample	Process of extraction	Yield (%)	Life under heat (min)		Flow (mm)		Colour index	Solubility in alcohol
			(4%)	(2%)	(4%)	(2%)		
Machine	Alcohol	33·0	21·0	—	19·0	—	Very dark	Soluble in cold
	Alkali	30·0	20·0	12·0	19·0	11	28·0	do
Machine	Alcohol	35·0	20·0	—	16·0	—	Very dark	do
	Alkali	32·0	15·0	10·0	13·0	9	31·0	do
Bhatta	Alcohol	48·0	17·0	—	15·0	—	Verydark	do
	Alkali	46·0	20·0	16·0	16·0	11	30·0	do

(A. K. Ghosh)

4.2 Rubber-Shellac Combinations

4.2.1 Incorporation of modified lacs into rubber

During the period under report, the effect of incorporation of higher concentration of magnesium salt (Mg-salt) of lac into a blend of natural rubber (NR) and styrene-butadiene rubber (SBR) was studied. From the data (Table 26), it is observed that there was no effect on the optimum time of cure with the increased concentration of Mg-salt of lac while Mooney number and scorch time indicated an increase. The modulus at 200% elongation showed an increase with the incorporation of 40 parts of Mg-salt of lac per 100 parts of the blend. The tensile strength showed decrease while tear resistance showed increase up to 40 parts of Mg-salt of lac. The impact resilience was more or less constant while hardness showed a definite increase with increased concentration of Mg-salt of lac.

In the presence of filler (china clay), when 5 parts of Mg-salt of lac are incorporated into the blend, the modulus, tensile strength and hardness showed an increase (Table 26).

(R. Singh and B. B. Khanna)

TABLE 26 — THE EFFECT OF INCORPORATION OF Mg-SALT OF LAC INTO A BLEND OF NR AND SBR

(*Base mix*; *NR*-50; *SBR*, 50; *no*. 4; *PBN*, 1; *stearic acid*, 1; *sulphur*, 2 *and MBT*, 1)

Mg-salt of lac added per hundred parts of blend	Optimum time of cure at 140°C (min)	Mooney No. (MLPP4) at 120°C	Scorch time (min-sec)	Modulus elongation at 200% (kg/cm^2)	Ultimate elongation (%)	Tensile strength (kg/cm^2)	Impact resilience (%)	Tear resistance	Hardness (shore A Durometre)
30	20	44	22-10	13·2	820	57·2	60·0	21·5	48
40	30	52	17-20	17·2	600	45·0	61·7	22·5	58
50	30	38	31-02	13·5	700	37·0	48·7	17·5	50
				FILLER CHINA CLAY 100					
0	30	—	—	8·3	690	39·3	—	—	52
5	20	—	—	10·8	700	41·1	—	—	54

4.2.2 Electrical properties of rubber-shellac blend

This study was taken up with a view to observe the changes in the electrical properties of rubber-shellac combinations and to evolve a suitable composition for electrical insulation.

Preliminary studies were made on the variation of dielectric strength of natural (NR) and styrene butadiene rubbers (SBR) gumstocks on incorporation of shellac using MBT as an accelerator. The shellac content was varied from 0 to 10 parts for NR and 0 to 15 parts for SBR while the curing time was varied from 15 to 30 min for NR and 10 to 50 min, for SBR. The dielectric strength of shellac compounded gum-stock and reference gum-stock were found to increase with the increase of cure time. No substantial, improvement in dielectric strength was observed with the addition of shellac in natural and SBR gum-stocks.

Preliminary studies were also made on the variation of dielectric constant and dissipation factor (tan δ), measured at 100 Hz, of shellac compounded NR gum-stock (curing time 30 min). Dielectric constant and dissipation factor were found to increase and decrease in succession with the addition of 5 parts of shellac thereby indicating improvement in the electrical properties of shellac compounded gum-stock compared to the reference gum-stock.

(R. Singh, D. N. Goswami and B. B. Khanna)

4.3 Use of Lac in Adhesives

4.3.1 Modified lacs (with synthetic monomers) as adhesives

Bleached lac was modified with iso-butylacrylate in aqueous ammonical medium adopting the technique reported earlier in order to get improved water resistance bond. It was observed (Table 27) that 40 parts monomer and 60 parts bleached lac were optimum yielding the bond strength 0·07 ton/inch^2 over wood to wood surfaces. This value was quite low as compared to earlier compositions based on methyl and ethyl acrylates (bond strength 0·2 ton/inch^2). To further increase the bond strength, hydrolysed lac (an adhesion promoter) in different

TABLE 27 — ADHESIVE STRENGTH OF BLEACHED LAC MODIFIED WITH ISO-BUTYLACRYLATE OVER WOOD TO WOOD SURFACES

Sl No.	Bleached lac (g)	Iso-butyl acrylate (g)	Bond strength (ton/inch^2)	Remarks
1.	100	0	0·02	Solution
2.	80	20	0·03	Viscous emulsion
3.	70	30	0·05	do
4.	60	40	0·07	do
5.	50	50	0·07	do
6.	40	60	—	Gelled on storage after two days
7.	30	70	—	Gelled during preparation

TABLE 28 — EFFECT OF HYDROLYSED LAC ON ADHESIVE COMPOSITION

(*Bleached lac and monomer* 50:50)

Sl No.	Bleached lac and monomer (g)	Hydrolysed lac (g)	Bond strength (ton/inch)
1	50:50	5·0	0·06
2	50:50	10·0	0·06
3	50:50	15·0	0·05
4	50:50	20·0	Did not dry

percentage viz., 10, 20, 30 and 40 (Table 28) was incorporated in 50:50 composition at the time of reaction but no improvement was noticed. Though the bond strength was quite low but it could fix the sunmica over wooden surfaces.

(P. C. Gupta, M. Islam and R. Prasad)

4.3.4 Modified hydrolysed lac (with epoxy resins and isocyanates) as adhesives

Adhesive property of modified hydrolysed lac (*rebulac*) was studied in aqueous as well as in solvent (dioxane) media adopting the standard procedure. In aqueous medium, the bond strength for steel to steel surfaces was found to be 0·22 ton/inch^2 while shellac does not work as an adhesive for steel surfaces in aqueous medium. In solvent medium, the bond strength was 0·16 ton/inch^2 as compared to 0·08 ton/inch^2 of shellac.

Experiments were also initiated to prepare a cold setting adhesive from *rebulac* by treating it with 10, 15, 20, 25 and 30 per cent of toluene di-isocyanate (TDI). The resulting products were tried as adhesive for wood to wood, wood to steel and steel to steel surfaces. The best result was obtained when 30 per cent TDI was used (Table 29).

TABLE 29 — ADHESIVE PROPERTY OF MODIFIED HYDROLYSED LAC (*rebulac*) WITH DIFFERENT PERCENTAGE OF TOLUENE DIISOCYANATE (T.D.I.)

Sl No.	TDI (%)	Pot life (min)	Bond strength (ton/inch^2)		
			Wood to wood	Wood to steel	Steel to steel
1	10	210	0·11	0·13	0·12
2	15	200	0·16	0·16	0·12
3	20	187	0·17	0·22	0·13
4	25	120	0·18	0·22	0·15
5	30	70	0·25	0·24	0·19

(R. K. Banerjee and P. C. Gupta)

4.4 Pilot Plant Studies on Lac Based Products and Processes

4.4.2 Standardization and pilot plant studies on shellac based water thinnable red oxide primer

The preparation of lac-linseed oil fatty acid-red oxide primer was further scaled up to 50 and 100 litres per batch and no difficulty was encountered during the preparation of the primer. The scratch hardness, flexibility and impact strength of the baked films of the primer were quite satisfactory. It was resistant to water, white spirit and toluene.

(P. C. Gupta)

(c) RESEARCHES CONTEMPLATED — Nil

E. EXTENSION DIVISION

(a) RESEARCHES COMPLETED

3.3.4.1 Studies on AC-deposition of shellac based paints

Lac based varnishes and primers have been successfully deposited by DC-power supply but due to its high installation cost, the technique could not be popularized. In addition, the film is deposited only on anode by this technique.

With a view to minimize the installation as well as deposition cost, possibility of deposition by AC-power supply was investigated. The special feature of this technique is that the films are deposited on both the electrodes simultaneously.

With the above objectives aqueous dewaxed lac solution (20% solid) was mixed in various proportions with chlorinated rubber in chloroform. The mixture was taken in a battery jar and two mild steel plates connected to the two ends of AC power supply were dipped into the solution/emulsion. Deposition was carried out by using varying proportions of lac/rubber. Thin (0·3-0·4 mil) and adherent films were deposited which became hard on baking. It was also noticed that beyond 12:1 : lac: rubber ratio, preparation of vehicle as well as deposition of film was difficult because of coagulation of rubber during mixing. No deposition was noticed when aqueous lac solution alone was taken as a vehicle in place of lac/rubber composition.

Two compositions having a lac rubber ratio 6:1 and 8:1 were pigmented with titanium dioxide. In both the cases, pigment/binder ratio was kept 2:1 and deposition was tried. It was noticed that deposition was more on the surface facing outside (0·5-0·8 mil) than on the surface facing inside, but the films were uniform and smooth (0·3-0·5 mil).

To increase the thickness of the films, deposition was carried out by varying different parameters e.g. bath-concentration and *p*H, current density, voltage and pigment binder ratio but no improvement could be achieved.

(A. Pandey and S. K. Saha)

(b) SPONSORED RESEARCHES

Commercial Feasibility Studies on Storage of Sticklac and Seedlac

Sticklac storage experiments

The study on storage of sticklac and seedlac sponsored by the Ministry of Commerce, Govt. of India (State Trading Corporation of India) was taken up with the objective to ascertain as to how the important properties of lac are progressively affected on storage as sticklac (from different sources) under different conditions and to find the ideal conditions of storage at minimum operating cost. The storage experiments were conducted with samples of *katki*-1978 sticklacs one each from Palamau, Manbhum and Singhbhum areas and those of *baisakhi* 1978-79 sticklacs one each from Purulia (W.B.), M.P. and Bihar (Manbhum). The sticklacs were stored on cemented floor in layers of 30, 60 and 90 cm height and in gunny bags in stacks of five.

Representative sticklac samples were drawn from each lot at six monthly interval, converted into seedlac and tested for colour, impurities (hot alcohol insolubles), flow (method B, IS: 6921); life (at 150°C) and rate of filtration. The yield of seedlac and other byproducts were also recorded. The seedlacs obtained from the first washing were subjected to above tests at three monthly interval but those obtained from subsequent washings were tested only once immediately after washing. The experiment was continued for 30 months.

The results are given in Tables 30-34. The data were also statistically analysed by the method of analysis of variance applicable to factorial experiments. The main findings are discussed below:

(i) *Moisture content and blocking behaviour*

The *katki* sticklac having initial moisture content up to 4·5 per cent showed no serious tendency of blocking during the entire period of storage. The *baisakhi* sticklacs which had an initial moisture contents ranging between 6·5 and 17 per cent started blocking within 12 days of storage. Blocking in all cases stopped when the moisture content came down to 4·5 per cent. It took about 4 months to reach this stage under normal practice of drying (raking at frequent intervals).

(ii) *Hot alcohol-insolubles*

In case of *katki* sticklacs, all the three main effects, namely, storage period (A) storage condition (B) and source of sticklac (C) were found significant. The interactions A×B and A×C were also significant. Among the different storage conditions, storage in gunny bags recorded significantly less impurities than all other three conditions. Among the three sources, the Singhbhum sticklac showed very little increase in hot alcohol-insolubles.

In case of *baisakhi* sticklacs also, the three main effects were significant while the interaction B×C was only significant. Seedlacs from Purulia (W.B.) sticklac showed the lowest impurity followed by those of Manbhum (Bihar) and M.P. Storage in gunny bags recorded lowest impurity and proved significantly superiors to other three conditions.

TABLE 30 — EFFECT OF STORAGE ON HOT ALCOHOL INSOLUBLES (%)

Sample No.	Type of sticklac	Condition of storage	Hot alcohol insolubles (%) after storage for					
			0 month	6 months	12 months	18 months	24 months	30 months
1.	*Katki*-1978 (Palamau)	(a)	5·14	5·28	5·32	6·88	5·98	—
		(b)	—	5·00	6·59	7·98	6·24	—
		(c)	—	5·36	5·86	7·04	6·85	—
		(d)	—	4·41	5·14	5·88	6·87	6·27
2.	*Katki*-1978 (Manbhum)	(a)	3·23	3·62	4·50	5·16	5·96	—
		(b)	—	4·66	4·09	5·28	5·38	—
		(c)	—	5·05	4·67	7·42	9·10	—
		(d)	—	3·20	4·62	5·28	4·90	4·89
3.	*Katki*-1978 (Singhbhum)	(a)	4·58	4·49	4·83	6·45	6·52	—
		(b)	—	3·84	4·93	5·50	5·15	—
		(c)	—	4·42	5·35	6·08	6·41	—
		(d)	—	3·56	4·20	4·10	3·46	4·02
4.	*Baisakhi*-1978-79 (Purulia)	(a)	3·40	3·04	5·33	5·61	4·89	5·56
		(b)	—	3·60	3·43	3·43	4·98	4·00
		(c)	—	5·04	4·42	4·05	6·50	7·70
		(d)	—	3·41	3·48	3·36	3·79	3·53
5.	*Baisakhi*-1978-79 (M.P.)	(a)	3·93	4·68	4·72	4·39	5·50	6·38
		(b)	—	—	5·07	5·12	6·70	7·40
		(c)	—	—	5·53	4·92	5·90	6·63
		(d)	—	4·56	5·43	4·35	5·90	4·99
6.	*Baisakhi*-1978-79 (Manbhum)	(a)	4·00	4·56	4·74	3·86	5·50	4·50
		(b)	—	—	—	—	—	—
		(c)	—	—	4·76	5·81	5·90	5·16
		(d)	—	5·23	4·85	3·93	5·90	5·13

(a) Spread on cemented floor 30 cm deep
(b) do 60 cm deep
(c) do 90 cm deep
(d) Stored in gunny bag

(iii) *Colour index*

The main effects A, B and C and the interaction A×C were found significant for both *katki* and *baisakhi* sticklacs. The rate of increase in colour index for the sticklacs stored in gunny bags was also significantly less than that in other three conditions.

TABLE 31 — EFFECT OF STORAGE ON COLOUR INDEX

Sample No.	Type of sticklac	Condition of storage	Colour index after storage for 0 month	6 months	12 months	18 months	24 months	30 months
1.	*Katki*-1978 (Palamau)	(a)	17	16	14	15	19	—
		(b)	—	15	13	16	18	—
		(c)	—	18	13	16	17	—
		(d)	—	13	12	14	14	14
2.	*Katki*-1978 (Manbhum)	(a)	11	12	13	16	19	—
		(b)	—	12	14	14	18	—
		(c)	—	13	13	15	17	—
		(d)	—	10	13	13	13	13
3.	*Katki*-1978 (Singhbhum)	(a)	13	14	13	14	17	—
		(b)	—	13	15	15	17	—
		(c)	—	13	14	16	16	—
		(d)	—	13	13	13	15	12
4.	*Baisakhi*-1979 (Purulia)	(a)	10	15	16	16	17	15
		(b)	—	15	14	16	16	14
		(c)	—	15	17	17	17	17
		(d)	—	15	16	16	15	13
5.	*Baisakhi*-1979 (M.P.)	(a)	12	15	15	15	15	16
		(b)	—	—	16	16	15	17
		(c)	—	—	17	17	16	17
		(d)	—	15	16	16	15	15
6.	*Baisakhi*-1979 (Manbhum)	(a)	10	15	15	15	15	—
		(b)	—	—	—	—	—	—
		(c)	—	—	15	14	16	—
		(d)	—	16	14	15	15	—

(a) Spread on cemented floor 30 cm deep
(b) do 60 cm deep
(c) do 90 cm deep
(d) Stored in gunny bag

(iv) *Flow*

All the three main effects A, B and C were found significant. For *katki* sticklac, interactions A×B and A×C were significant while for *baisakhi* sticklac interaction B×C only was significant. In this case also, sticklacs stored in gunny bags retained significantly higher flow than all the other three conditions. The Purulia (W.B.) sticklac maintained a significantly higher flow than the other

TABLE 32 — EFFECT OF STORAGE ON FLOW

Sample No.	Type of sticklac	Condition of storage	Flow (mm) after storage for					
			0 month	6 months	12 months	18 months	24 months	30 months
1.	*Katki*-1978 (Palamau)	(a)	27	15	12	5	0	—
		(b)	—	15	12	0	0	—
		(c)	—	10	12	0	0	—
		(d)	—	25	22	12	12	10
2.	*Katki*-1978 (Manbhum)	(a)	38	30	24	0	0	0
		(b)	—	25	15	0	0	0
		(c)	—	22	10	0	0	0
		(d)	—	38	25	20	22	16
3.	*Katki*-1978 (Singhbhum)	(a)	33	23	17	0	0	—
		(b)	—	14	10	0	0	—
		(c)	—	20	5	0	0	—
		(d)	—	27	21	20	20	16
4.	*Baisakhi*-1979 (Purulia)	(a)	50	42	24	20	16	14
		(b)	—	28	27	25	20	22
		(c)	—	25	22	15	14	17
		(d)	—	43	38	40	38	37
5.	*Baisakhi*-1979 (M.P.)	(a)	43	30	30	25	15	10
		(b)	—	—	20	20	10	nil
		(c)	—	—	—	22	10	5
		(d)	—	32	20	24	22	12
6.	*Baisakhi*-1979 (Manbhum)	(a)	48	30	32	30	15	15
		(b)	—	—	—	—	—	—
		(c)	—	—	30	32	10	15
		(d)	—	30	30	32	22	15

(a) Spread on cemented floor 30 cm deep
(b) do 60 cm deep
(c) do 90 cm deep
(d) Stored in gunny bag

sticklacs. In case of *baisakhi* sticklacs, the rate of fall was found to be higher during the first 6 months whereafter it slowed down. Flow seemed to be the most sensitive to the effect of ageing.

(v) *Life*

The three main effects and their interactions were found significant for *katki* sticklacs whereas, for *baisakhi* sticklacs, the interactions A×B and A×C were

TABLE 33 — EFFECT OF STORAGE ON LIFE AT 150°C

Sample No.	Type of sticklac	Method of storage	Life (mm) after storage for					
			0 month	6 months	12 months	18 months	24 months	30 months
1.	*Katki*-1978 (Palamau)	(a)	53	48	43	35	30	—
		(b)	—	49	43	34	36	—
		(c)	—	48	49	36	36	—
		(d)	—	55	54	50	47	44
2.	*Katki*-1978 (Manbhum)	(a)	56	46	48	38	40	—
		(b)	—	44	41	36	34	—
		(c)	—	40	38	29	28	—
		(d)	—	50	49	42	48	42
3.	*Katki*-1978 (Singhbhum)	(a)	52	42	48	31	31	—
		(b)	—	38	41	33	33	—
		(c)	—	36	38	31	31	—
		(d)	—	45	44	42	41	40
4.	*Baisakhi*-1979 (Purulia)	(a)	57	52	45	46	43	41
		(b)	—	48	49	46	43	43
		(c)	—	48	48	45	42	40
		(d)	—	56	53	50	46	47
5.	*Baisakhi*-1979 (M.P.)	(a)	51	47	48	44	44	38
		(b)	—	40	44	42	39	34
		(c)	—	—	44	39	41	33
		(d)	—	48	45	46	46	41
6.	*Baisakhi*-1979 (Manbhum)	(a)	52	48	50	45	39	41
		(b)	—	—	—	—	—	—
		(c)	—	—	45	42	46	38
		(d)	—	48	46	44	51	42

(a) Spread on cemented floor 30 cm deep
(b) do 60 cm deep
(c) do 90 cm deep
(d) Stored in gunny bag

significant. The decrease was rapid up to 18 months whereafter rate slowed down. Sticklac stored in gunny bags recording maximum life proved significantly superior to other three conditions. The life of Purulia (W.B.) sticklac was significantly longer than those of M.P. and Manbhum (Bihar) sticklacs.

TABLE 34 — EFFECT OF STORAGE ON RATE OF FILTRATION

Sample No.	Type of sticklac	Method of storage	Rate of filtration (ml) after storage for					
			0 month	6 months	12 months	18 months	24 months	30 months
1.	*Katki*-1978 (Palamau)	(a)	63	65	59	49	49	—
		(b)	—	66	65	40	47	—
		(c)	—	65	62	44	46	—
		(d)	—	60	69	57	50	39
2.	*Katki*-1978 (Manbhum)	(a)	66	67	55	54	45	—
		(b)	—	63	67	48	37	—
		(c)	—	54	52	43	33	—
		(d)	—	69	71	66	66	48
3.	*Katki*-1978 (Singhbhum)	(a)	64	62	54	44	49	—
		(b)	—	55	45	31	28	—
		(c)	—	53	45	27	37	—
		(d)	—	64	64	53	59	47
4.	*Baisakhi*-1979 (Purulia)	(a)	72	56	65	49	54	32
		(b)	—	54	61	49	50	40
		(c)	—	50	60	44	48	47
		(d)	—	60	65	53	56	53
5.	*Baisakhi*-1979 (M.P.)	(a)	69	60	45	55	49	37
		(b)	—	—	47	46	47	34
		(c)	—	—	56	55	48	35
		(d)	—	47	66	46	50	45
6.	*Baisakhi*-1979 (Manbhum)	(a)	66	60	55	52	49	31
		(b)	—	—	—	—	—	—
		(c)	—	—	60	53	48	32
		(d)	—	59	64	51	50	38

(a) Spread on cemented floor 30 cm deep
(b) do 60 cm deep
(c) do 90 cm deep
(d) Stored in gunny bag

(vi) *Rate of filtration*

The three main effects A, B and C and their interactions were found significant for *katki* sticklac whereas interaction A × C only was significant for *baisahki* sticklac. In this case also, sticklacs stored in gunny bags recorded the highest rate of filtration and proved significantly superior to the other three conditions.

Seedlac storage experiments

The following seedlac samples were purchased and used for the storage experiment:

(i) Manbhum *baisakhi* seedlac — 1979

(ii) Manbhum *baisakhi* seedlac — 1980

The initial flow value for the two samples were 48 and 64 mm respectively. Six quintals of sample (i) were kept in 12 gunny bags (each bag containing 50 kg) in stacks of 4 bags in ordinary godown at Ranchi and another 6 quintals (in 8 double gunny bags containing 75 kg each) were stored in air-conditioned godown at Calcutta. The sample (ii) was divided into 3 parts and 3 quintals each (in 6 bags) were kept in ordinary godowns at Ranchi and Calcutta. The remaining 6 quintals (in 8 double gunny bags) were stored in air-conditioned godown at Calcutta. Samples were drawn at regular intervals and subjected to analysis for hot alcohol-insolubles (impurities), colour index, flow, life and rate of filtration. The results are reported in Tables 6 and 7. The data for impurities, colour, flow and life were statistically analysed. The main findings are discussed below:

Impurities

There has been no significant rise in the impurities during the 30 month period of storage. Storage period and conditions differences as well as their interactions were non-significant.

Colour

In this case also, all the effects were found non-significant. The colour of seedlac stored in A.C. godown was slightly less than that in ordinary godowns but the differences were non-significant.

Life

Both the main effects as also their interaction were found significant. The life of seedlac stored in A.C. godown was significantly longer than that stored in ordinary godowns. It was also found that there has been practically no change in the life of seedlac stored in A.C. godown for 30 months whereas the value dropped appreciably in case of seedlacs stored in ordinary godowns.

Flow

The two main effects and the interaction between them were found significant. The flow value progressively dropped during the 30 month period of storage in all cases but this drop was appreciably less in seedlac stored in A.C. godown than that stored in ordinary godowns.

(S. K. Saha)

(c) RESEARCHES ON HAND

5.3 Effect of Storage on Sticklac

The study which was initiated in 1978 was continued with 6 sticklac samples as reported earlier. The samples which were stored in gunny bags at room temperature were converted into seedlacs at regular intervals and tested for various physico-chemical properties. The data are given in Tables 35-37.

A declining trend was noted in values of flow, life and rate of filtration whereas in hot alcohol-insolubles and colour index due to storage, values showed increasing trend.

TABLE 35 — QUALITY DETERIORATION IN SEEDLAC DURING STORAGE

[*Seedlac — Manbhum baisakhi*-1979 (*Sample No.* 10)]

Period of storage (months)	Condition of storage	Quality of seedlac				
		Hot alcohol insoluble (%)	Colour index	Flow (mm)	Life (min)	Rate of filtration (ml)
0	—	3·12	12	48	49	—
6	A.C.	3·73	13	49	49	—
	Ordinary	3·70	13	49	49	—
9	A.C.	3·91	11	45	51	—
	Ordinary	3·20	11	45	50	68
12	A.C.	3·25	11	48	50	64
	Ordinary	3·50	13	45	55	69
15	A.C.	3·56	11	47	52	59
	Ordinary	3·85	10	42	50	70
18	A.C.	3·60	11	45	50	62
	Ordinary	3·80	11	40	50	65
21	A.C.	3·60	11	44	53	69
	Ordinary	3·85	11	35	52	61
24	A.C.	3·90	12	46	55	61
	Ordinary	4·10	11	35	50	52
30	A.C.	3·90	12	46	57	61
	Ordinary	4·68	11	35	49	47
45	A.C.	4·00	12	50	55	53
	Ordinary	4·83	11	22	45	38
55	A.C.	3·60	12	39	45	38

TABLE 36 — QUALITY DETERIORATION OF SEEDLAC DURING STORAGE

[*Seedlac — Manbhum baisakhi*-1980 (*Sample No.* 11)]

Period of storage (months)	Condition of storage	Quality of seedlac				
		Hot alcohol insoluble (%)	Colour index	Flow (mm)	Life (min)	Rate of filtration (ml)
0	—	3·9	11	64	—	—
6	Ordinary (Ranchi)	3·5	11	58	55	70
9	Ordinary (Calcutta)	3·8	12	50	55	67
	A.C.	3·6	11	62	60	73
	Ordinary (Ranchi)	3·5	11	54	48	63
12	Ordinary (Calcutta)	3·4	12	44	56	70
	A.C.	3·3	10	63	58	76
	Ordinary (Ranchi)	3·5	11	48	56	68
18	Ordinary (Calcutta)	3·64	12	30	48	54
	A.C.	3·64	12	58	58	64
	Ordinary (Ranchi)	3·83	15	35	47	—
24	Ordinary (Calcutta)	—	—	—	—	—
	A.C.	—	—	—	—	—
	Ordinary (Ranchi)	3·80	13	35	48	61
30	Ordinary (Calcutta)	5·46	13	10	39	30
	A.C.	3·84	12	58	56	58
	Ordinary (Ranchi)	3·50	13	30	44	47
42	A.C.	3·09	12	43	52	54

TABLE 37 — EFFECT OF STORAGE ON STICKLAC

Sample No.	Type of sticklac	Place of storage	Period of storage (months)	Properties of seedlac obtained from the stored sticklac				
				Impurities (%)	Colour	Flow (mm)	Life under heat (min)	Rate of filtration at 25°C (ml)
1.	*Baisakhi* 1977-78 *ari* (Palamau)	Namkum	32	—	14	18	45	—
			48	6·14	14	10	40	41
			56	—	14	10	35	—
2.	do	Kundri	30	7·98	17	nil	34	30
3.	*Baisakhi* 1977-78 *ari* (Ranchi)	Namkum	32	4·76	13	20	43	—
			48	—	—	14	37	46
			56	4·82	13	10	34	—
4.	*Baisakhi* 1978-79 *ari* (Purulia)	do	33	—	—	35	49	52
			48	5·09	14	20	39	—
			53	—	—	17	36	—
5.	*Baisakhi* 1979-80 *ari* (Palamau)	do	20	—	—	34	47	—
			30	—	—	27	47	—
			40	—	—	22	35	—
6.	*Aghani* 1979-80 (Ranchi)	do	20	—	—	51	54	—
			30	—	—	36	52	—
			40	—	—	30	49	—
7.	*Baisakhi* 1980-81 *ari* (Ranchi)	do	Nil	2·63	13	51	54	78
			12	3·61	13	38	45	58
			20	—	—	25	42	—
			26	—	—	13	34	—

(S. K. Saha and A. K. Ghosh)

(d) OPERATIONAL RESEARCH PROJECT FOR MAXIMIZING LAC PRODUCTION IN CHOTANAGPUR AREA

In the project area comprising of four backward tribal villages, namely, Hardag, Barguttu, Saheda and Koenjari of Ranchi district, operational researches on the transfer of technologies in respect of lac, honey and other agricultural crop production, animal husbandry and fisheries etc. suitable for the area were continued.

A. INSECT CULTURE PROGRAMME

(i) LAC CULTURE

Trials-cum-demonstrations of improved methods of lac cultivation on *palas* and *ber* trees belonging to the cultivators were continued. Necessary inputs were supplied where needed and improved instruments/equipments were loaned to the beneficiaries for seasonal use.

Rangeeni Sticklac Coupe

The *Baisakhi* 1982-83 *ari* (immature) sticklac crop was harvested from *ber* trees of all the four villages and an average per tree yield of 4·9 kg was obtained as against 1·20 kg recorded from the traditional method showing an average increase of 315 per cent.

Rangeeni Broodlac Coupe

The *Baisakhi* 1982-1983 cum *katki* 1983 crop was harvested from *palas* trees of 43 cultivators of all the four villages, during October-November 1983 and an average per tree yield of 0·8 kg was obtained as against 0·3 kg from the traditional method. No special pest control measures were applied and on the whole 180·7 per cent increase in the broodlac yield was achieved.

(ii) APICULTURE

Scientific bee keeping was encouraged by providing technical guidance through guest lectures, demonstrations and regular contacts. A Bee Keepers' Summer Training Camp of seven day duration was organized during February with the cooperation of Khadi and Village Industries Commission and supply of 18 new bee-hives was arranged. By the end of the period under report, 54 keepers owned 160 bee-hives of which 45 keepers acquired and maintained 99 bee colonies. A record yield of 347 kg honey was obtained by 31 keepers from 80 productive beehives fetching an average income of Rs 280.00 per bee keeper.

B. CROP PRODUCTION PROGRAMMES

(i) AGRICULTURAL CROPS

In order to promote double cropping in the area, purchase of 6 more agricultural pumping sets was arranged through District Rural Development Agency (DRDA) and Kshetriya Gramin Bank (KGB) at a cost of Rs 31,000 and a field day on the maintenance of pumping sets was organized. Similarily purchase of 26 more bullocks was arranged through DRDA and KGB at a cost of Rs 12,640 only. Farmers were encouraged to grow improved varieties of crops as follows:

During *rabi* 1982-83 season *Sonalika* variety of wheat and *Varuna* mustard were grown by farmers on 3 ha area and the maximum yield of wheat recorded was 16·7 q/ha (average 6·5 q/ha). Grazing by the cattle and wild elephant menace were the two major constraints in the expansion of the wheat cultivation in the area. Late sowing in the fields after paddy harvesting, limited irrigation facilities and low inputs were some of the important reasons for the low yields.

During *Kharif* 1983 season, 3 paddy varieties namely, *Sita*, *Mansuri* and *Saket* were tried on 0·6 ha area. *Sita* variety gave the best yield of 40 q/ha followed by *Mansuri* (10 q/ha). The yield of *Saket* was below normal.

Ragi A-404 was sown in a limited area and the results were encouraging. A new maize variety namely, Super-1 was tried by 13 farmers and maximum yield of 62·5 q/ha (average 41·7 q/ha) was recorded.

Soyabean was grown on 6·5 ha area by 27 farmers but the results were not at all encouraging.

Nearly 100 trials involving 1 kg each seed kits of *Jowar*, moth bean (*Phaseolus aconitifolius*) and cowpea as fodder crops were conducted covering 7 ha area. As the farmers depend solely on grazing the crops were used as fodder grass only at a very small scale and the harvested seeds were used for home consumption. The yield of groundnut var. AK 12-24 grown on 0·012 ha area due to theft could not be recorded.

(ii) HORTICULTURAL CROPS AND AGRO-FORESTRY

Seedlings of *Eucalyptus* (861), *Ficus* (12), *Gamhar* (497), *Jackfruit* (545), *Jamun* (75), *Karanj* (2), *Kusum* (31), *Mango* (152), *Papaya* (55), *Shisham* (229) totalling 2479 were procured from the Forest Department and distributed among the farmers of the area. In additions, 10 seedlings of *Coconut Palm* were obtained from the Department of Agriculture, Bihar and the planting of the same using appropriate fertilizer mixture was arranged. Few *tapioca* cuttings were also supplied from the Institute Plantation.

A three day training camp on *ber* budding and tree planting was organized with the cooperation of Birsa Agricultural University, Ranchi and pruning of 32 *ber* bushes belonging to 11 farmers was done for improvement through budding.

C. ANIMAL HUSBANDRY PROGRAMMES

General animal health was taken care of with the cooperation of the Animal Husbandry Department by arranging timely vaccination, lectures and supplying drugs free of cost.

(i) POULTRY KEEPING

Observations on the three small egg laying units started during 1982 revealed that out of the seven white Leghorn hens in the beginning of the year only three survived till the end. The annual egg production was 160 per bird per year. The birds were kept under open system instead of deep litter system in which they were reared and maintained earlier resulting heavy mortality due to coccidiosis and predatory wild animals.

In order to improve the local stock through hybridization, 8 improved cocks of *pebcock* strain were supplied to 8 poultry keepers. Heavy mortality was observed due to reasons described above and only one survived till the end of the year.

Four improved duckery units were started in March with a free supply of 20 ducklings of *Khaki Campbell* strain obtained from the Animal Husbandry Department. Heavy mortality was observed due to non-availability of proper covering hatch and faulty sheltering in night. The surviving birds developed satisfactorily utilizing the fishes from the nearby tank but reported lost during August, 1983 due to theft.

(ii) SWINE HUSBANDRY

Out of the 14 exotic pig breeding units started during 1980 and 1981, only 2 boars of white Yorkshire breed survived. One boar of Hardag which attained 100 kg body weight in twelve months was slaughtered and 70 kg meat was sold in the local market fetching an income of Rs 700 to the farmer. The other boar of Barguttu village which attained 112 kg weight in fifteen months was sold alive to the Govt. Bacon Factory, Ranchi fetching an income of Rs 828.80 only.

Pure Yorkshire boars were mated with the indigenous pigs and the resulting hybrid progeny having improved traits like higher body weight, bigger litter size and longevity were found more acceptable to the farmers as compared to the hefty but delicate and unmanageable pure bred animals. In the beginning of the year, 7 hybrids (6♀+1♂) were available. Out of 6 females, 2 died and one was sold at a price of Rs 190 leaving 3 swines which farrowed 21 piglets during March and June. Seven young ones died, one reported to be stolen and three were slaughtered for home consumption leaving 10 animals (5♀+5♂) at the end of the year.

(iii) MILCH CATTLE

Out of the four surviving cross bred (Haryana) cows, one died on 14th January. One cow gave birth to a female calf on 5th March (second delivery) but the other 2 remained dry. Six calves (5♂+1♀) of the previous deliveries which attained the age of 32 months survived till the end of the year along with the 9 month old female calf. Very low level of feeding, almost complete dependence on grazing and indifferent management were found to be the major constraints in the milk production. The cows were maintained by the tribal farmers not so much to provide milk but to produce bullocks for ploughing their fields. In order to improve the level of feeding, attempts were made to encourage growing of fodder crops like sorghum, moth-bean and cowpea as reported in the crop production sections.

(iv) GOAT KEEPING

One goat breeding unit consisting of 2 she-goats and one buck of *Black Bengal* breed was started during April with the cooperation of the Animal Husbandry Department and 4 more goat units consisting of 20 she-goats were started in November with the help of *Kshetriya Gramin Bank* and DRDA costing Rs 2780 only. At the end of the year, 1 buck and 21 she-goats were surviving.

D. FISHERIES

Three tanks in the area were stocked with 2000 fish fry of major carps like *Rohu, Katla, Mrigal,* etc. obtained free from the Fisheries Department during September. Technical inspection of one tank of Saheda village was arranged prior to stocking and necessary advice was given to the farmer.

E. EXTENSION EDUCATION PROGRAMMES

Meetings of Farmers Forum were conducted every month in all the four villages and discussions on the new technologies, constraints, etc. were held and lectures on various topics were also arranged. One day training in managing cooperatives through establishment of KVIC Sanstha was also organized with the cooperation of Khadi and Village Industries Commission Ranchi.

(R. C. Mishra, S. P. Bharadwaj and J. Lal)

(c) RESEARCHES CONTEMPLATED — Nil

3. EXTENSION

The principal activities carried out by the Extension Division were as follows:

(1) *Large scale cultivation of lac at Kundri*

Technical guidance was rendered to the Forest Department, Bihar, in running their Lac Farm at Kundri (Palamau district), consisting of nearly 40,000 *palas* trees. Various seasonal operations were carried out on 33,420 trees in the farm. A total of 12,880 *palas* trees were pruned during April/May yielding 31·7 quintals of *ari* sticklac. The broodlac yield was 7882·5 kg which was used for inoculating 20,966 trees. On scraping *phunki* lac sticks, 655 kg scraped lac was obtained. The operations involved an expenditure of Rs 17,680.00 approximately. A net profit of Rs 13,000 only is expected.

(2) *Technical service and development work*

The Division continued to maintain close touch with the various development agencies interested in lac. The Scientists of the Division attended several meetings and held discussions with Govt. officials and representatives of the industries on various aspects of lac development.

A meeting of the Industrial Liaison Committee of the Institute was held at Calcutta in the month of February. Nine members and four invitees attended the meeting. Items discussed in the meeting included some current problems facing the lac industry like non-availability of dewaxed lac in the market. A sub-committee was constituted to identify the technologies which may be adopted by the industry.

The Division attended all technical/non-technical enquiries from various Government organizations, private institutions and individuals interested in shellac, shellac based compositions and lac cultivation. Technical notes, schemes and samples of lac-based products were sent whenever asked for. Some of the important activities are listed below:

(1) A leading manufacturer of cosmetics in India was assisted last year by providing technical know-how and market informations and arranging in training of technical personnel in respect of aleuritic acid — an important constituent of lac. It has been reported that the firm has successfully produced and exported 1·2 tonnes of the material during last year. The development, thus, would help earning sizeable foreign exchange for the country.

(2) The product 'lac based glue' attracted the attention of several entrepreneurs as a result of the publicity it received through news papers and trade journals. Samples were sent to several interested parties earlier and one party reported that the product suffers from wetting and colouration.

(3) Two compositions for road paints and their method of preparation were supplied to M/s Bharat Builders, Pune.

(4) Arrangement was made for testing of electrical properties of insulating varnishes samples as requested by an entrepreneur.

(5) Representative of M/s Jagannath Jawala Prasad, Daltonganj was trained in the manufacture of bleached lac.

(6) A sample of red-oxide primer (based on lac-linseed oil fatty acids) sent earlier to a leading paint manufacturer for evaluation was reported to suffer from premature gelling, lack of required film hardness at room temperature within the prescribed period, and throw out of paint on addition of more than equal parts of water.

(7) Technical assistance was given to the interested lac growers and parties for the forecast of the time of larval emergence.

(3) *Publicity*

The Institute participated in the following exhibitions:

(i) *Rabi* and *Kharif* Kisan Melas held at Birsa Agricultural University, Ranchi during February and September respectively.

(ii) An exhibition held in the month of June, at Putida organized by Birsa Agricultural University, on the occasion of opening of a Krishi Vigyan Kendra.

Samples of Lac and Lac Products, photographs and charts were sent to ICAR, New Delhi for display in the India International Trade Fair held during November.

(4) *Testing of Lac and Lac Products*

A total number of 85 samples of Lac and Lac Products were received from Government Organizations and private industries and in all 259 tests were carried out.

(5) *Training*

Three in-service candidates who were admitted to the course in "Improved Methods of Lac Cultivation" during the session October 1982 to March 1983 completed their training successfully.

Another batch of five candidates was admitted to the above course during the session October 1983-March 1984 and their training is in progress.

Two candidates sponsored by the Directorate of Lac Development, Ranchi, were given short term introductory training in Lac Cultivation.

The Institute also collaborated with Divyayan Krishi Vigyan Kendra, Ramakrishna Mission, Ranchi by arranging 22 lectures on Improved Methods of Lac Cultivation for the motivational training of the grass root level.

A two day training camp was organized in collaboration with the Centre for Agrarian Research Training and Education for the training of the villagers in Arki Block, Khunti (Bihar) in "Improved Methods of Lac Cultivation".

(6) *Production Unit*

During the period under report 25 kg of special shellacs valued at Rs 725 only were prepared and sold to the interested parties.

4. PAPERS PUBLISHED

(a) Publications

The Institute publishes its research findings in leading Scientific and Technical Journals. In addition, a few books and one monograph have also been published. The total number of publications as on 31st December 1983 are given below:

1. *Bulletins*	
(i) Chemical	162
(ii) Entomological	101
2. *Technical notes*	30
3. *Research notes*	
(i) Chemical	85
(ii) Entomological	52
4. *Miscellaneous technical publications*	
(i) Chemical	14
(ii) Entomological	48
5. *Books and Monographs*	15
6. *Pamphlets and Leaflets*	35

A complete list of Institute's publications together with those of a sister organization, the erstwhile London Shellac Bureau is supplied free on request.

List of papers published during the year 1983

Sl No.	Authors	Title of the paper	Name of periodical
		AGRONOMY AND PLANT GENETICS DIVISION	
1.	Kumar, P. and Sinha, S. S. N.	Meiotic analysis in thirteen varieties of *Cajanus cajan* Linn. (Mill sp.)	*Genetica Iberica*, **35**, 1983, pp. 39-48
2.	Srivastava, S. C.	Floral biology of *Butea monosperma* (Lam.) Taub.	*Indian Jr. Forestry*, 6(1), 1983, pp. 57-62
		CHEMISTRY DIVISION	
1.	Kumar, A.	Fractional precipitation of lac: Part I — Fractionation by the integrated method	*JOCCA*, April issue, 1983
2.	Ibid	Fractional precipitation of lac: Part II — Characterisation	*JOCCA*, May issue, 1983

Sl No.	Authors	Title of the paper	Name of periodical
3.	Ibid	Fractional precipitation of lac: Part III. Heat and Water resistance	*JOCCA*, June issue, 1983
4.	Khanna, B. B. and Tripathi, S. K. M.	Shellac based paint/primer for the gas holder of gobar gas plant	*Indian Shellac*, Jan.-March 1983, pp. 26-28
5.	Patil, P. M., Mohan, K. and Khanna, B. B.	Hydrolysed lac based polyurethane coatings	*JOCCA*, **66**(7), 1983, pp. 1983
6.	Prasad, K. M., Agarwal, S. C. and Khanna, B. B.	Lac wax — A versatile material	*Paint India*, **23**, 85-88, pp. 19-21
7.	Majee, R. N., Chatterjea, J. N., Sengupta, S. C. and Mukherjee, S. N.	Synthesis of trans-Δ^2-isoambrettolide	*Chem. and Ind.* (London), 1983, page 43
8.	Majee, R. N., Ramani, R. and Mukherjee, S. N.	Synthesis of queen bee pheromone	*Curr. Sci.*, **52**(7), 1983, pp. 320-321
9.	Majee, R. N. and Mukherjee, S. N.	Synthesis of methyl-9-oxodecanoate	*Chem. and Ind.* (London), 1983, page 167

TECHNOLOGY DIVISION

1.	Gupta, P. C., Islam, M. and Prasad, R.	The adhesive property of shellac on wood to wood surfaces	*JOCCA*, **5**, 1983, pp. 141-142

5. CONFERENCES AND SYMPOSIA

The Institute has been deputing scientists to attend Conferences/Symposia/ Seminars and training held at various institutions/Organizations/Universities in India. The details for the period under report are as follows:

1. Sri S. K. Jaipuriar, S-1, August 1983	Underwent training at B.H.U., Varanasi on recent technologies of chromosomes preparation
2. Sri S. C. Srivastava, S-1, April-May 1983	Participated in 12th Orientation Centre of Agricultural Research Management at NDRM, Hyderabad
3. Dr B. B. Khanna, S-3, January 1983	Presented a paper entitled " Lac, a versatile resin for small scale industries " in the seminar " Chemicals and Chemical Intermediate " held at I.I.T., New Delhi
4. Dr S. C. Agarwal, S-2, January 1983	Presented a paper entitled " Aleuritic acid, a potential raw material for perfumery and pharmaceutical industries in the seminar held at I.I.T., New Delhi on " Chemicals and Chemical Intermediates"
5. Sri Shravan Kumar, S-3, October 1983	Presented a paper entitled " Shellac — some new developments in surface coatings " in a seminar held at Lucknow on " Problems and Prospectives of paint industry "
6. Sri R. C. Mishra, S-2 September 1983	Participated in the Annual Workshop of "Operational Research Projects of ICAR", held at Sukhadia University, Udaipur
7. Sri R. C. Mishra, S-2 December 1983	Participated in the seminar on *Adarsh Gram Vikas Yojna*, held at Birsa Agricultural University, Kanke, Ranchi

6. SUMMARY

A. ENTOMOLOGY DIVISION

(a) RESEARCHES COMPLETED

1.3.5(b) Thirtyseven plant species were tried to find out as alternative *kusmi* lac host in Madhya Pradesh for supplementing *kusmi* lac production in the region but none of those plant species gave satisfactory crop.

(b) RESEARCHES ON HAND

1.1.8 The lac yield with the alternation of *palas* and *khair*, has not been satisfactory.

1.2.5 The lac insects were reared during the *baisakhi* 1983-84 season on potted *bhalia* plants with and without the application of N, P and K, individually and in their combinations but no significant differences were observed.

1.2.6 The lipoidal substances of lac insects were again extracted and the same fractions were obtained as reported earlier.

1.2.7 Preliminary investigation of the activities of epidermal glands of lac insects using vital dyes has been made.

1.2.8 Formulation based on water-soluble lac dye, laccaic acid has been developed for staining chromosomes.

1.3.5(c) A survey made on the abundance of inimical and beneficial parasites associated with *kusmi* lac insects in four locations of M.P. is reported.

1.3.5(d) The field experiments to compare the crop performance with brood lacs originating from different states were continued.

1.3.8 Studies on population dynamics of *rangeeni* lac insects on *palas* gave more or less similar results as reported earlier.

1.3.9 The experiments carried out earlier to study lac larval settlement in relation to shoot inclination were repeated. The results were similar to those reported earlier.

1.3.10 The abundance of lac associated insects in six locations of Chotanagpur in the *katki* 1982, *baisakhi* 1982-83 crops has differed with the locations.

1.4.1 Results for the integration of three pest control measures have shown that the lac yield was highest with the integration of chemical control and a cultural method of trap cropping.

1.4.3 Screening trials with Padan, Dimecron, Evisect, Dipterex and Methoxychlor in concentrations up to 0·1 per cent have shown that others were safe to the lac insects of the stages screened in each crop, excepting 0·025 per cent Dimecron

in the *baisakhi* crop. Trials for the screening of plant poisons for their safety to lac insects were continued in different crops.

The use of low concentration of Thiodan® has again resulted in a marked increase in the size of lac insects.

The use of recommended control schedules has shown a high degree of control of the inimical insects with some deterimental effects on the beneficial parasites also.

1.4.4 Further examination of the larvae of the major lac predators has again failed to show the occurrence of any infectious disease in these insects.

1.4.10 Field trials for the control of *Chrysopa* spp. with BHC and chlordane showed that the former was more effective than the latter resulting in higher lac yield.

1.4.13 Further studies have showed that densities lower than 4 larvae of *E. amabilis*/30 cm lac encrustation do not cause any economic injury.

1.5.8 Six *rangeeni* and four *kusmi* stocks of lac insects were maintained.

1.5.10 The lines derived from a *rangeeni* stock of lac insect were further inbred by full sib mating.

The sex-ratio did not show any relation with that of the parent.

1.5.11 Cytological studies of the Assam lac insect have shown that the lac larvae contain heteropycnotic body in the nucleus.

Ad-hoc studies

(i) Dipping of brood lac in 0·1 to 0·4 per cent Thiodan® or water, up to 2 min, resulted in a high degree of control of the lac pests.

(ii) Dimilin up to 0·2 per cent concentration has been found to be safe to the one-month-old lac larvae.

B. AGRONOMY AND PLANT GENETICS DIVISION

(a) RESEARCHES COMPLETED — Nil

(b) RESEARCHES ON HAND

2.1.3 Raising of sweet potato, tapioca, ginger and turmeric as intercrop in between the spaces of *bhalia* and *galwang* showed that the growth of these lac hosts was better where the intercrops were raised.

2.1.4 Use of plant growth regulators on *ber* bushes showed that the total shoot and stick lac yield were maximum with GA_3 (40 ppm) treatment.

2.1.8 Raising of tasar worms on *ber* showed that the ERR for *Laria* and *Daba* was 41·9 and 32·03 per cent respectively. *Baisakhi* 1983-84 lac crop was raised.

2.1.10 A fresh mixed plantation of *bhalia* and *galwang* was raised at Namkum plantation in an area of 1 ha after discontinuation from Chandwa.

2.2.1 The studies on Floral biology of *M. chappar* showed that the maximum pollen dehiscence occurs at 7.30 a.m.

Reciprocal crosses were attempted between *M. chappar* and *M. macrophylla* using dilute hydrochloric acid on stigmatic surface, but met with little success.

2.2.2 Selection of *Moghania macrophylla* for raising lac crop was not possible due to total failure of *aghani* crop.

2.2.3.1 Screening of early maturing *arhar* varieties for raising *katki* and *aghani* lac crops showed that the lac yield was in general poor.

2.2.3.2 Similar trials with late maturing *arhar* varieties for raising the *baisakhi* and *jethwi* lac crops also showed that the lac yield was in general poor and the pulse production is reduced with lac cultivation. This reduction in pulse production however differed with the varieties.

Further, the lac bearing plants suffered considerable mortality during the summer months without irrigation.

2.2.4 Pure line seeds of three *arhar* varieties were irradiated with gamma rays at doses ranging between 10 and 80 kR. The germination and survival was reduced with the increase in dose.

2.2.5 Attempts made to induce polyploidy in *ber* using colchicine showed that the stomata size was increased but the number was reduced at 1 per cent treatment.

C. CHEMISTRY DIVISION

(a) RESEARCHES COMPLETED

3.1.6 A relationship between colour index and optical density was established using UV Spectrophotometer for shellac solution of concentration 10^{-3} g/ml (solvent: ethyl alcohol) at a wavelength of 425 nm.

Colour index = 136·9 × optical density. This relationship can be used for quick, convenient and accurate determination of colour index of shellac.

3.2.2 A number of compounds namely, exaltone, trans-Δ^9-iso-ambrettolide, cyclic ether (perfumery compound), prostanoid synthon and its analogues have been synthesized from *threo*-aleuritic acid using simple reaction sequences. Butolic acid was synthesized adopting two different methods.

3.7.2 Samples of lac dye were prepared by different methods and their physico-chemical characteristics were studied. Based on these findings, a specification for pure lac dye has been recommended.

3.7.3 With a view to lay standards for different grades of lac wax, physico-chemical constant of different samples of wax were determined according to the methods described in IS: 5467. These findings suggested that there should be two grades of lac wax.

(b) RESEARCHES ON HAND

3.1.1 The isolation of pure component from Fr-C (left after separation of free acid and isolation of one component as chloroform insoluble) was carried out and two components having Rf values 0·08 and 0·94 were obtained.

3.1.3 The physical properties of 14 samples of seedlac and shellac on storage have been studied. Flow appears to be the most sensitive property which is affected on storage.

3.1.5 An improvement in the method of isolating aleuritic acid has been made and the cost of production of Commercial grade of aleuritic acid has been worked out. The gummy mass, obtained after isolation of aleuritic acid has been studied for the preparation of surface coating and adhesive compositions.

3.1.8 The complexes of lac-dye with aluminium and iron were prepared and found to be soluble in water.

3.1.10 In order to decolorize and deodorize lac for practical purposes, the adsorption studies on lac with activated charcoal were undertaken and the experimental data were found to obey the Freundlich's equation.

3.1.11 Preliminary experiments have been carried out to isolate jalaric acid from old and fresh samples of shellac by hydrolysis with weak alkali. An yield of approx. 7 per cent of jalaric acid was obtained.

3.1.12 Preliminary experiments on the degradation of aleuritic acid and lac through nitric acid oxidation reactions were carried out. The former yielded a pure compound (m.p. 118-119°C).

3.2.8 Ureides have been prepared from —Δ^{9}-hexadecane-1,1-dioic acid, Δ^{-2}-hendecene-1,11-dioic acid and pimelic acid by refluxing their acid chlorides in dry benzene with urea.

3.2.10 Lauryl alcohol was synthesized from aleuritic acid adopting simple reaction sequences. Treatment of lauryl alcohol with CH_2N_2/BF_2O gave lauryl ether. Both the compounds showed slight JH activity on one-day-old pupae of *Corcyra cephalonica* but the activity of lauryl ether was more than its alcohol.

1,4,12-Trimethoxydodecane was again synthesized from aleuritic acid and its JH activity was tested. 2-(ω-carboxyhexyl)-cyclopentenone synthesized from aleuritic acid was tested for its JH activity.

3.3.3(ii) It has been found that one sulphonic group is introduced in styrenated lac/lac on treatment with sulphuric acid.

3.3.6(ii) Baked films of the polyurethanes prepared by reacting hydrolysed lac with Desmodur VL, Desmodur N and Desmodur L separately showed good water and acid resistance but poor alkali resistance.

3.3.10 The addition polymerization of shellac was studied in the presence of benzoyl peroxide, αα'-azo-di-iso-butyronitrile and borontrifluoride etherate as initiators. Only in the case of benzoyl peroxide, the occurrence of the polymerization was indicated.

3.3.11 Bhatta shellac and ethyl cellulose solutions were prepared in denatured spirit separately. These two solutions were then mixed in different proportions and their films were prepared to study their properties.

3.4.3 A modified composition of pattern paint based on ordinary shellac and denatured spirit as the main solvent was prepared and tested for its film performance. Air dried films of this composition were found to be better especially in respect of hardness and gloss as compared to the films obtained by the earlier composition based on ordinary shellac. In respect of water resistance, however, no appreciable improvement was noticed.

3.4.4 Glyceryl monoaleuritate was prepared by reacting aleuritic acid with glycerol in 1: 1 molar ratio at 225 ± 5°C for 1 hr 15 min in the presence of zinc dust as catalyst. Pure monoaleuritate could be separated from the mixture of glyceryl aleuritates by preparative TLC.

3.4.5 An anticorrosive primer composition based on dewaxed lac and double-boiled linseed oil vehicle was tested for its film performance. This composition produced hard, smooth and adherent films on ferrous metals. These films showed adequate flexibility and good resistance to water and solvents.

3.5.3 The lac-mud, has been characterized for preparing slow-release 2,4-D combination product. Various carriers and binders have been screened for preparing granular formulations of 2,4-D reaction product. The IR-spectral analysis has confirmed that the combination of lac with 2,4-D takes place through ester formation.

3.5.4 Studies have indicated that it is possible to prepare sticker formulations based on partially hydrolysed lac as well as gummy mass obtained during the preparation of aleuritic acid.

Sulphonated lac has been prepared by adopting both CLRI, Madras and SEPC, Calcutta method. The resultant products were characterized.

D. TECHNOLOGY DIVISION

(a) RESEARCHES COMPLETED — Nil

(b) RESEARCHES ON HAND

4.1.5 The effect of some systematic detergents namely, Magic®, Spa® and Point® was studied on the washing of sticklac. These detergents did not show any improvement over Genteel® and Surf®.

4.1.6(ii) The standardization of the method of decolorizing and dewaxing of lac in solvent medium was studied.

4.1.7 Extraction of *kiri* in aqueous alkaline medium was carried out and optimum amount of reactants were found.

4.2.1 Incorporation of higher percentage of Mg-salt in the natural and styrene-butadiene rubber blend revealed that the mechanical properties were not improved. However, in presence of filler slight improvement was noticed.

4.2.2 An improvement in dielectric strength was noticed when shellac was added in NR and SBR.

4.3.1 Adhesive compositions based on bleached lac and isobutylacrylate resulted in inferior bond strength as compared to earlier compositions.

4.3.4 Based on rebulac and toluene di-isocyanate, a cold setting adhesive composition was prepared which gave encouraging result over wood to wood, wood to steel and steel to steel surfaces.

4.4.2 Lac-linseed oil fatty acid-red oxide primer was scaled up to 100 litres per batch.

E. EXTENSION DIVISION

(a) RESEARCHES COMPLETED

3.3.4.1 Aqueous lac solution in combination with chlorinated rubber was used as a vehicle for electrodeposition by A.C. technique. Thin (0·3 to 0·8 mil), uniform and smooth films could be deposited on both the electrodes simultaneously.

(b) RESEARCHES ON HAND

5.3 Experiments carried out with 6 sticklac samples established that the quality of lac deteriorates significantly on storage as sticklac.

Sponsored research

The effect of storage on the important properties of sticklac and seedlac was studied under a scheme sponsored by the Commerce Ministry. It was observed that blocking of sticklac stopped when the moisture content came down to 4·5%. Among the different conditions tried, storage of dry sticklac in gunny bag gave the best result. Flow was found to be the most sensitive to the effect of ageing. Flow, life and rate of filtration of seedlacs were considerably affected on storage under ordinary conditions both as sticklac and seedlac. However, impurities and colour index remained unaffected when stored as seedlac. Based on the experimental data, storage in seedlac form is recommended in preference to storage in sticklac form.

7. METEOROLOGICAL REPORT FOR THE YEAR 1983

Month	Mean barometric pressure mm	Mean maximum temp. 0°C	Mean minimum temp. 0°C	Mean humidity per month %	Total rainfall per month mm	Highest maximum temp. 0°C	Lowest minimum temp. 0°C
January	710·13	24·3	8·5	74·67	2·6	27·5	5·0
February	708·76	25·5	11·73	71·21	42·3	30·0	5·0
March	706·58	32·56	16·28	50·29	10·4	36·5	10·0
April	704·40	34·53	20·13	55·7	79·4	39·5	17·7
May	701·70	36·6	22·23	63·5	120·1	40·0	19·4
June	698·88	36·45	24·65	72·03	232·2	42·5	21·1
July	698·86	31·18	23·7	83·77	248·6	35·0	23·3
August	698·96	29·88	23·15	88·4	284·8	32·0	21·6
September	701·15	30·05	22·66	89·3	362·4	32·0	20·0
October	707·77	29·58	18·63	79·22	55·2	31·5	12·2
November	755·65	26·61	12·39	64·13	—	30·0	9·4
December	710·83	23·95	8·63	65·74	20·4	27·5	5·5
					Av. 71·49 Total 1428·4	Av. 33·6	Av. 14·18

The highest maximum temperature recorded was 42·5°C on 9th June and the lowest minimum temperature 5°C on 4th January and 5th February. The total rainfall during the year amounted to 1428·4 mm of which the monsoon (June to September) rainfall was 1128·0 mm. The rainfall during the year was lower than that of 1982 (1466·1 mm). There were hail storms on 17th May and 11th June.

8. PERSONNEL

Sl No.	Name of the Posts	Staff position as on 31-12-1983
1.	Director	Dr T. P. S. Teotia
	Entomology Division	
1.	Head, Division of Entomology	Shri N. S. Chauhan
2.	Scientist S-3 (Agricultural Entomology)	Dr C. P. Malhotra
3.	Scientist S-2 (Agricultural Entomology)	(1) Sri A. H. Naqvi (2) Dr D. C. Srivastava
4.	Scientist S-1 (Agricultural Entomology)	(1) Sri S. G. Choudhary (2) Dr A. K. Sen (3) Sri B. N. Sah (4) Sri S. K. Jaipuriar (5) Sri A. Bhattacharya (6) Sri R. Ramani (7) Sri Y. D. Mishra
5.	Scientist-S (Agricultural Entomology)	Sri M. L. Bhagat
6.	Senior Technical Assistant (T-4)	Sri M. K. Chowdhary
7.	Technical Assistant (T-II-3)	(1) Sri A. K. Sahay (2) Sri K. U. S. Sinha (3) Sri R. N. Vaidya
8.	Senior Artist (T-5)	Sri R. L. Singh
9.	Junior Artist-cum-Photographer (T-1)	Sri R. P. Srivastava
10.	Laboratory Technician (T-I-3)	Sri B. B. Chakravorty
	Laboratory Technician (T-2)	(1) Sri G. M. Borkar (2) Sri Bhola Ram (3) Sri S. K. Chatterjee (4) Sri Ghan Shyam Das
11.	Field Technician (T-I-3)	Sri R. D. Pathak
	Field Technician (T-II)	(1) Sri H. N. Shukla (2) Sri K. P. Gupta
12.	Insect Collection Tender (T-2)	Sri Ram Lochan Ram
13.	Laboratory Technician (T-1)	Sri R. K. Swansi
14.	Field Farm Technician (T-1)	(1) Sri A. K. Sinha (2) Sri Dilip Kumar Singh
15.	Field Plantation and Store Asst. (T-2)	Sri Munna Lal Ravidas
16.	Junior Stenographer	Sri Sant Kumar
	Operational Research Project	
1.	Scientist S-2	Sri R. C. Mishra
2.	Scientist-S	Sri Jawahir Lal
3.	Field Technician T-II-3	(1) Sri H. Bhengra (2) Sri L. C. Nath Sahdeo
4.	do T-2	(1) Sri K. C. Jain (2) Sri S. S. Prasad
5.	do T-1	(1) Sri S. B. Azad (2) Sri B. Runda (Driver)

Regional Field Research Station for Lac: Dharamjaigarh (M.P.)

1.	T-II-3	Sri R. S. Maliya
2.	T-I-3	Sri Azmeer Hussain
3.	T-2	Sri Jiwan Lal

Agronomy and Plant Genetics Division

1.	Scientist S-2 (Plant Genetics)	Dr P. Kumar
2.	Scientist S-1 (Plant Breeding)	Sri S. C. Srivastava
3.	Scientist S-1 (Horticulture)	Dr Moti Ram (on deputation to Birsa Agriculture Univ., Ranchi)
4.	Scientist S-1 (Agronomy)	Sri B. P. Singh (on study leave)
5.	Laboratory Technician (T-I-3)	Sri D. D. Prasad
	Laboratory Technician (T-1)	Sri Mohan Singh
6.	Field Technician (T-1)	(1) Sri Jagarnath Oraon (2) Sri K. A. Naguraur

Chemistry Division

1.	Head, Division of Chemistry	Dr B. B. Khanna
2.	Scientist S-3 (Organic Chemistry)	Sri Shravan Kumar
3.	Scientist S-2 (Organic Chemistry)	Dr S. C. Agarwal
	Scientist S-2 (Physical Chemistry)	Dr A. Kumar
	Scientist S-2 (Physics)	Dr D. N. Goswami
4.	Scientist S-1 (Organic Chemistry)	(1) Sri A. K. Dasgupta (2) Dr B. C. Srivastava (3) Dr N. Prasad (4) Dr R. N. Majee (5) Sri K. M. Prasad (6) Sri M. Mukherjee
5.	Scientist S-1 (Physical Chemistry)	Sri P. M. Patil
6.	Senior Technical Assistant (T-5)	Sri A. Rahman
7.	Technical Assistant (T-II-3)	(1) Sri N. K. Dey (2) Sri M. K. Mishra (3) Sri T. K. Saha (4) Sri M. Ekka (5) Sri D. D. Singh (6) Sri S. N. Sharma (7) Miss P. R. Chatterjee
8.	Laboratory Technician (T-I-3)	(1) Sri U. Sahay (2) Sri B. P. Keshri
	Laboratory Technician (T-2)	(1) Sri P. B. Sen (2) Sri G. Mishra
9.	Laboratory Technician (T-2)	Smt. Prabha Devi
10.	Glass Blower	Sri B. S. Chowdhary
11.	Junior Stenographer	Sri B. K. Rajak

Technology Division

1.	Scientist S-2 (Organic Chemistry)	Dr P. C. Gupta
2.	Junior Technologist (Processing S-1)	Sri A. K. Ghosh
3.	Scientist S-1 (Organic Chemistry)	Sri R. K. Banerjee
	Scientist S-1 (Physical Chemistry)	Sri Radha Singh
4.	Senior Mechanic (T-II-3)	Sri S. K. Bhaduri
5.	Senior Technical Assistant (T-5)	(1) Sri M. Islam (2) Sri B. P. Banerjee
	Senior Technical Assistant (T-4)	Sri R. Prasad
6.	Technical Assistant (T-II-3)	Sri K. K. Prasad
7.	Laboratory Technician (T-I-3)	(1) Sri N. Minz (2) Sri M. K. Singh
8.	Laboratory Technician (T-2)	Sri Tulsi Ram

Extension Division

1.	Scientist S-3 (Physical Chemistry)	Dr S. K. Saha
2.	Scientist S-1 (Physical Chemistry)	Dr A. Pandey
3.	Senior Analyst (T-5)	Sri L. C. Mishra
4.	Senior Technical Assistant (T-5)	Sri R. C. Maurya
5.	Senior Technical Assistant (T-4)	Sri Dipak Ghosh
6.	Technical Assistant (T-II-3)	(1) Sri K. M. Sinha (2) Sri Jagdish Singh
7.	Commercial Artist (T-4)	Sri Pyare Das
8.	Laboratory Technician (T-I-3)	Sri D. Runda
9.	Laboratory Technician (T-2)	Sri B. P. Ghosh
10.	Junior Stenographer	Sri A. K. Sinha

Administrative, Audit and Accounts Section

1.	Administrative Officer	Sri S. N. Sharma
2.	Assistant Administrative Officer	Sri R. K. Singh
3.	Assistant Accounts Officer	Sri A. C. Hazari
4.	Superintendent	(1) Sri P. K. Choudhary (2) Sri H. S. Munda
5.	Assistants	(1) Sri D. P. Sengupta (2) Sri R. P. Singh (3) Sri Musafir Singh (4) Sri Enamul Haque (5) Md. Shamiullah (6) Sri A. K. Lal (7) Sri N. Mahto (8) Sri Elias Tirkey
6.	Senior Stenographer	Sri R. Rabidas
7.	Senior Clerk	(1) Sri A. K. Choudhury (2) Sri S. K. P. Keshri (3) Sri A. Haque (4) Sri R. B. Singh (5) Smt. Sati Guha (6) Sri K. N. Sinha (7) Sri K. D. Pandey (8) Sri S. Ram (9) Sri D. Ram (10) Sri N. Topno
8.	Senior Clerk (Estate)	Sri D. N. Mahto
9.	Junior Stenographer	Smt. Sushanti Minz
10.	Junior Clerk	(1) Sri K. L. Choudhary (2) Sri Budhan Ram (3) Md. Mubarak (4) Sri V. Ram (5) Sri E. Gari (6) Sri J. P. Srivastava (7) Sri N. Gope (8) Sri Thibu Minz (9) Sri B. N. Gope (10) Sri Ravi Shankar (11) Sri Shambhu Chanda (12) Sri Anant Pandey
11.	Stockman-cum-Compounder (T-I-3)	Sri Chandreswar Pandey
12.	Hindi Translator (T-II-3)	Sri Lakshmi Kant

Project File and Technical Cell

1.	Technical Officer (T-7)	Sri S. K. M. Tripathi
2.	Senior Technical Assistant (T-5)	Sri P. Sen

Library

1.	Senior Library Assistant (T-5)	Sri R. P. Tiwari
2.	Library Assistant (T-II-3)	Sri V. K. Singh

Maintenance and Workshop Unit

1.	Chief Mechanic (T-II-3)	Sri S. K. Srivastava
2.	Assistant Mechanic	(Vacant)
3.	Instrument Maker	Sri Baiju Mistri
4.	Turner (T-2)	Sri A. S. Manoranjan
5.	Driver for vehicle	(1) Sri J. Ram (2) Sri M. Khalko (3) Sri Jaswant Tiwari

Institute Plantation

1.	Farm Superintendent (T-7)	Sri B. K. Purkayastha
2.	Field Farm Technician (T-2) Field Farm Technician (T-I-3)	(1) Sri G. Lakra (1) Md. Ali Ansari (2) Sri R. C. Singh
3.	Tractor Driver (T-2)	Sri Markus Surin

Fresh Appointments

1.	Driver	Sri Jaswant Tewari
2.	T-1 (F.F.)	Sri S. B. Azad
3.	T-1 (Glass Blower)	Sri B. S. Choudhury
4.	T-1 (Museum Assistant)	Miss Ratna Dutta
5.	T-1 (Assistant Mechanic)	Sri Paulus Jujo
6.	T-II-3 (Field Farm Technician)	Sri P. P. Gokulpure
7.	T-1 (Laboratory Technician)	Sri J. K. Ambuj
8.	T-II-3 (Lib. Inf. and Doc.)	Sri Sudeb Chatterjee

Promotion

1.	Dr B. B. Khanna, S-3	Promoted to the next higher grade i.e. Rs 1800-2250
2.	Dr C. P. Malhotra, S-2	Promoted to S-3
3.	Sri M. Mukherjee	do S-1
4.	Sri P. M. Patil	do S-1
5.	Sri S. N. Sharma	Promoted to the post of A.O.
6.	Sri R. K. Singh	Superintendent to A.A.O.
7.	Sri P. Sen	T-4 to T-5
8.	Sri B. P. Banerjee	do
9.	Sri M. Islam	do
10.	Sri P. K. Choudhury	Assistant to Superintendent
11.	Sri H. S. Munda	do
12.	Sri N. Mahto	Junior Clerk to Senior Clerk
13.	Sri Elias Tirkey	Senior Clerk to Assistant
14.	Sri R. K. Upadhyaya	Junior Clerk to Senior Clerk
15.	Sri N. Topno	do
16.	Sri M. L. Rabidas	T-1 to T-2
17.	Sri M. K. Singh	T-2 to T-I-3
18.	Sri U. Sahay	do
19.	Sri B. P. Kesri	do
20.	Sri Ram Lakhan Singh	T-4 to T-5
21.	Sri A. Rahman	do
22.	Sri N. Minz	T-2 to T-I-3
23.	Sri G. Mishra	T-1 to T-2
24.	Sri M. K. Singh	T-2 to T-I-3
25.	Sri Pyare Das	T-II-3 to T-4
26.	Sri K. M. Sinha	do

Resignation

1.	Sri Paulus Jojo	Assistant Mechanic, T-1
2.	Sri Bimal Ram	Driver, T-1
3.	Sri Baiju Mishtri	Instrument maker, T-1
4.	Dr A. Arya	S-1
5.	Smt. S. Minz	Laboratory Assistant, T-1

Retirement

Shri S. N. Prasad	Superintendent

INDIAN LAC RESEARCH INSTITUTE
NAMKUM, RANCHI, BIHAR, INDIA

Annual Report
1983

PRINTED AT THE CATHOLIC PRESS, RANCHI, INDIA