INDIAN LAC RESEARCH INSTITUTE
NAMKUM, RANCHI, BIHAR, INDIA

Annual Report
1984

INDIAN COUNCIL OF AGRICULTURAL RESEARCH
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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 outstation experiments.

Objectives

The objectives of the Institute are:

(1) To carry out research 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.

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

(3) 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's 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 an 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.

Research Highlights

Entomology Division

Among the notable results of entomological research mention may be made of: (i) screening of new insecticides found effective against the lac predators and safe to lac insects for their possible use in pest control, (ii) improvement

in the fecundity of female lac insects with the application of insecticides and (iii) marked reduction in the emergence of lac pests from brood lac after treating it with Thiodan® thereby rendering it pest free for raising the lac crops.

Agronomy and Plant Genetics Division

Lac cultivation trials on fifteen varieties of *arhar* (*Cajanus cajan*) in the *baisakhi* 1983-84 crop have shown a normal proportion of male lac insects on eight varieties (32·7-39·4%) and a significantly higher proportion of males on the remaining seven varieties (43·6-58·3%). The lac insect sex ratio has thus varied with the varieties tried, showing clearly that the proportion of males is not higher on this host plant in general as believed earlier.

Chemistry Division

Two insect sex pheromones viz., methyl-Z(7)-hexadecenoate and E(9)-Dodecene-1-yl acetate have been synthesized from aleuritic acid. These pheromones appear to be useful in controlling beetles and cotton bollworm moth.

Gummy mass, a byproduct obtained during isolation of aleuritic acid from lac, has been found to be a suitable substitute for the hydrolysed lac in the formulation of gasket-shellac compound.

Spectrophotometric studies on the interaction between laccaic acid (lac-dye) and DNA have revealed that it binds with DNA.

Technology Division

An aqueous adhesive composition based on Rebulac was found better than plain lac for bonding steel to steel surfaces.

Extension Division

A research report on the sponsored project " Commercial feasibility studies on storage of sticklac and seedlac" was submitted to the State Trading Corporation of India. The report, which gives information on quality deterioration of sticklac and seedlac under different storage conditions, best mode of storage and criteria for quality determination, is expected to serve as a guide to S.T.C. in formulating the buffer stock policy on lac.

Library

The number of books and bound volumes of journals accessioned during the year 1984 was 112. This brought the total number of books and volumes of journals in the library to 18,256. One hundred sixty six 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 Committee for processing and editing of annual reports

The Institute Technical Committee which was functioning since 1981 was reconstituted vide office letter no. LR-A/291/84/877 dated 23 April 1984 for

scrutinizing the Annual Reports of the Institute. During the period, the Member-Secretary convened nearly 46 meetings of the committee which took up the processing and editing of Annual Reports for the years 1981 and 1982 (combined). The said reports, after editing and compilation were sent to the press for printing.

Administrative activities

The Institute Management Committee continued to function as usual and its 18th meeting was held during this period. The Committee recommended to install 5+20 lines of PBX instead of existing PBX.

The meetings of the Institute Grievance Cell were held and personal grievances of the staff members were considered for redressal.

The Institute Staff Joint Council continued to hold its meeting every quarterly. However, two meetings could be held during the period 1984. Major common issues were discussed in the meetings and decisions were taken thereon.

Some officers and staff members of the Institute were deployed to work in the General Elections pertaining to Parliament and Assembly as per the order of the Dy. Commissioner, Ranchi.

The staff members of the Institute also participated in Zonal sports of ICAR held at CIFRI, Calcutta (Barrackpur).

Training and Advisory Services

The Institute provides two courses of training of six month duration each on: (i) Improved methods 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.

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. Accordingly seven scientists of the Institute have so far been provided advanced training in various disciplines under Colombo Plan. A delegation of three Vietnamese Scientists, sponsored by F.A.O., visited this Institute during October 1984 to study lac cultivation, pest control and export promotion, etc. The delegation was shown round the Institute Plantation and Entomology Division and held discussions with the various scientists individually and in groups.

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 the 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 1984-1985 amounted to Rs 53·28 lakhs and Rs 17·15 lakhs under non-plan and plan respectively. The actual expenditure was Rs 55·61 lakhs and Rs 16·19 lakhs under non-plan and plan respectively.

Visitors

The Institute has always been a regular attraction to most visitors to Ranchi particularly, scientists and educationists. 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. Mr Bernhard Stroever and Mr Werner Bowitz Kalkhof Gmgh Petersen and Stroever Mainz (W. Germany).
2. Mrs Susan Peterson and Mr Chuck Peterson, U.S.A.
3. Mr Sermsak Pwntoomsinchai, Command Marketing Head, G.P.O. Box 1440, Bangkok (Thailand).
4. Mr P. S. Ingtn, Adviser, Forests and Wild life, Govt. of Meghalaya, Shillong.
5. Dr Bishwanath Prasad, Vice-Chancellor, Ranchi University, Ranchi.
6. Prof. Sukumar Maiti, Material Science Centre, IIT, Kharagpur.
7. Dr Indira Chakravarty, Head, Dept. of Biochemistry and Nutrition, All India Institute of Hygiene and Public Health, Calcutta.
8. Mr Pandeya Surendra, Pradhanacharya, Kala and Shilp Mahavidyalaya, Patna.
9. Dr P. K. Banerjee, Manager (R & D), Polyolefin Industries Ltd., Thane (Maharashtra).
10. A delegation from Japan led by Prof. T. Yamanobe.

2. PROGRESS OF RESEARCH

A. ENTOMOLOGY DIVISION

(a) RESEARCHES COMPLETED — Nil

(b) RESEARCHES IN PROGRESS

1.1 Lac Cultivation Studies

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

The *baisakhi* 1983-84 crop raised on 48 *palas* trees using 30 kg *palas* brood lac gave a total yield of 20 kg only. The following *katki* crop raised on 17 *khair* trees with 20 kg brood lac yielded only 5 kg. The results indicated that the alternation is not feasible.

(M. L. Bhagat)

1.2 Physiology of Lac Insects and Associated Insects

1.2.2 Evolution of a suitable synthetic diet for artificial rearing of lac insect

The project was restarted this year. Lac insects were reared with agar slant as substrate on usual synthetic diet consisting 20 amino acids, 8 vitamins, 5 mineral salts and 10 per cent sucrose during the *jethwi* 1984, *katki* 1984 and *aghani* 1984-85 crop seasons. The growth and development of the lac insects progressed satisfactorily up to 4 weeks in the *jethwi*, *aghani* crops and 2 weeks in the *katki* but did not survive thereafter due to fungal contamination in the diet. However, there was no instance of moulting during any crop season.

(A. H. Naqvi)

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

Experiments were continued to study the performance of lac insects reared on potted *bhalia* plants in relation to soil application of N, P and K individually or in their combinations under six treatments (A.R.: 1983). The cultures, however, were lost due to mortality of plants during summer.

During *baisakhi* 1984-85 crop, the experiment was modified as follows: the application of N, P and K to the soil was done on individual basis only in three doses (normal dose, half of normal dose and double of normal dose).

(A. H. Naqvi and S. C. Srivastava)

1.2.6 Biochemical studies on the lac insect to ascertain strain differences

For studying the differences in the total protein content of the *kusmi* and *rangeeni* strains of the lac insect, the bovine serum solutions at various concentrations were prepared. The biuret reagent was added to these solutions and

allowed to develop colour under appropriate conditions. The transmittance and the optical density were determined at 540 nm and the standard curve was prepared.

(A. K. Sen and R. Ramani)

1.2.7 Histophysiology of lac glands

Slides for histological investigations of female lac insects by teasing method were prepared last year for studying the secretory activities of the epidermal glands. During the period under report, attempts have been made to prepare slides by section cuttings of the adult male and female but the desired success in case of male insects could not be achieved.

(R. Ramani)

1.2.8 Laccaic acids as a biological stain

A new staining formulation similar to the one reported earlier (A.R.: 1983) was prepared replacing aluminium salt with chromium salt for chromosomal staining of onion root tip. The chromosomes, thus, stained with this formulation were dark grey.

Attempts were also made to develop a general purpose staining solution based on laccaic acid for staining nuclei in sections but satisfactory staining formulation comparable to haematoxylin could not be developed.

(R. Ramani)

1.3 Ecological Studies on Lac Insect 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.

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

The Regional Field Research Station at Dharamjaigarh (M.P.) continued to function during the period under report. The progress made under the various items of investigation is reported below:

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

Experiments were continued to study the seasonal and locational abundance of inimical and beneficial insects of lac in different locations (Bilaspur, Raigarh, Hoshangabad, Raipur and Bastar) of Madhya Pradesh. Lac stick samples weighing up to 4 kg were collected from the above locations at monthly interval from March to June in the *jethwi* crop and from October to December in the *aghani* and caged for recording the insects emerging therefrom.

The results indicated that the total number of inimical and beneficial parasites was higher in the *aghani* 1984-85 crop than in the *jethwi* 1984. *Tetrastichus purpureus* was the most dominant inimical parasite in both the crops. *Apanteles fakhrulhajiae* was the most dominant beneficial parasite in the *jethwi* 1984 and *A. tachardiae*, in the *aghani* 1984-85 crop.

Among the lac predators, *Holcocera pulverea* was most abundant in the *jethwi* 1984 crop and *Eublemma amabilis* in the *aghani* 1984-85 crop.

Location wise, *T. purpureus* was dominant in Hoshangabad in the *jethwi* 1984 crop and in Raipur in the *aghani* 1984 crop. *A. fakhrulhajiae* was dominant in Raigarh and *A. tachardiae* in Hoshangabad in the *jethwi* 1984 crop. In the *aghani* 1984-85 crop, *A. tachardiae* was dominant in Raipur and *A. fakhrulhajiae* was the most dominant in Raigarh in the *jethwi* 1984 crop and *H. pulverea* in Raipur in the *aghani* 1984-85 crop.

(B. N. Sah)

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

The experiment was continued during the *aghani* 1983-84, *jethwi* 1984 and *aghani* 1984-85 crop seasons.

Aghani 1983-84

The crop was harvested in January 1984. The crop ratios (brood lac used: yield in terms of sticklac) were 1:0·36 and 1:0·04 with the brood lacs from Madhya Pradesh (Raigarh) and Bihar (Hazaribagh) respectively. The Bihar brood lac practically failed to produce a crop while the M.P. brood lac gave a poor crop.

Jethwi 1984

The experiment was carried out with brood lacs from (i) Kanker (Bastar, Madhya Pradesh), (ii) Bachungdih (Hazaribagh, Bihar) and (iii) Tulin (Purulia, West Bengal) for raising the crop on ten *kusum* (*Schleichera oleosa*) trees each. The crop ratios (brood lac used to total yield of stick lac) were 1:0·59, 1:0·57 and 1:0·25 with Madhya Pradesh, Bihar and West Bengal brood lacs respectively. The crop was poor in general.

Aghani 1984-85

The experiment was carried out with brood lacs from (i) Institute plantation (Ranchi, Bihar) and (ii) Khadgaon (Raigarh, M.P.) for raising the crop on ten *kusum* trees each.

1.3.6 To study the population dynamics of *kusmi* strain of lac insect to ascertain the causes of *kusmi* crop failures

The experiment was taken up to evolve a sampling plan for studying the population dynamics of *kusmi* lac insects on kusum.

Kusmi lac crops were raised on kusum trees and fortnightly samples of lac bearing twigs were collected randomly from each quadrant and three canopy levels. Each sample lac sticks was divided into the basal, middle and apical portions, 8 cm each for the study.

Jethwi 1984 — It was found that the larval density differed significantly both within quadrants and canopies though there was no regular trend. In case of different portion of lac stick it was found that the larval density was highest in the middle portion. The average number of lac larvae settled per cm shoot length was 84·8, of which 13·8 died due to natural causes and 12·9 due to starvation and exhaustion.

The incidence of lac predators was higher in the lower canopy. *Chrysopa* spp. was dominant among the lac predators.

Aghani 1984-85 — The average number of larvae settled per cm shoot length was 139·0. Lac larval density differences were significant within the canopies but not within the quadrants. *Chrysopa* spp. was prominent in the lower canopy.

(B. N. Sah and M. L. Bhagat)

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

It has been found that the lac larvae suffered heavy mortality while attempting settlement. An experiment was carried out to study this mortality in relation to three hosts, namely *palas* (*Butea monosperma*), *ber* (*Ziziphus mauritiana*) and *bhalia* (*Moghania macrophylla*). Four lac bearing twigs were collected at random from each host species during the *katki* 1984 season. The number of living, starved and dead lac insects was scored at the 21-day stage. The percentage of mortality due to starvation was highest on *palas* (44·43%) followed by *bhalia* (22·92%) and *ber* (19·80%).

(D. C. Srivastava)

1.3.9 Studies on the lac larval settlement and factors affecting it

Bhalia plants raised last year to study the effect of host crowding on lac larval settlement, suffered heavy mortality during this summer. The experiment was again laid out on a randomized block design with 15 plots (5 m×5 m). The *bhalia* seedlings were transplanted in July with three treatments (levels of spacing viz., 0·1×0·1 m, 0·5×0·1 m and 0·5×0·5 m) replicated five times. Manure and fertilizers were applied at appropriate time.

Effect of rain was studied by inoculating lac insects on three *bhalia* bushes every day for ten days, allowing settlement for one day. Samples collected at random one week of inoculation were examined for the lac insects settled per sq. cm. No appreciable differences could be observed on the density of settlement, perhaps due to low rainfall (7·2 mm) during peak emergence period.

(Y. D. Mishra)

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

Lac bearing twigs were collected at male emergence and crop maturity stages during the *katki* 1983 and the *baisakhi* 1983-84 as per the programme and caged for recording the emergence of insects. The data are presented in Table 1. The results are more or less similar to those reported earlier (A.R.: 1983).

TABLE 1 — NUMBER OF ADULT PARASITOIDS AND PREDATORS RECORDED FROM LAC STICKS OF VARIOUS CLIMATIC LOCATIONS OF CHOTANAGPUR DURING *katki* 1983 and *baisakhi* 1983-84 CROPS AT MALE EMERGENCE AND CROP MATURITY STAGES

Locations	Mean number per metre of lac sticks							
	Predators				Parasitoids			
	Katki 1983		*Baisakhi* 1983-84		*Katki* 1983		*Baisakhi* 1983-84	
	Male emergence	Crop maturity	Male emergence	Crop maturity	Male emergence	Crop maturity	Male emergence	Crop maturity
Namkum	1·59	3·16	Nil	16·89	1·74	12·81	43·24	1·04
Khunti (Salga)	1·29	3·79	do	16·17	0·82	20·64	45·85	t0·62
Kundri	3·02	7·17	do	2·08	0·67	2·50	10·67	0·41
Mako (Latehar)	5·63	8·16	do	9·90	1·62	46·40	17·26	2·84
Lota	2·86	6·42	do	7·04	9·31	25·55	13·34	0·24
Malichak	3·94	1·86	do	8·90	1·68	24·85	26·77	2·32

(D. C. Srivastava)

1.4 Control of Enemies of Lac Insects

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

Field trials were continued at Kundri lac orchard as reported earlier (A.R.: 1981 and 1982). There were seven control schedules and a control. Comparison was made on the basis of: (i) incidence of predators and (ii) crop yield. The data obtained from the *baisakhi*-cum-*katki* 1983-84 crop have shown that the results were best with the integration of insecticidal control with trap cropping (Treatment AB) with maximum predator suppression (68·6 per cent) accompanied by maximum increase in lac yield (67·7 per cent) followed by treatment ABC and A with 50·7 and 44·5 per cent increase in yields respectively.

(S. G. Choudhary and C. P. Malhotra)

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

1.4.3.1 Screening of insecticides for their safety to the lac insect and toxicity to the lac predators

During *baisakhi* 1983-84 season, 25-35 days old insects reared on potted *bhalia* plants were treated with three granular insecticides, Rogor (dimethoate), Furadan (carbofuran) and Foratox (thimet). These were applied to the soil at 0·125 g/pot. All the three insecticides as applied proved safe to the lac insects. The insecticides tried in the *aghani* crop showed high degree of control of the predators.

Microplot field trials — Experiments were conducted with three insecticides, found earlier safe to lac insects, namely, Dimecron (phosphamidon), Padan (cartap) and Evisect (thiocyclam) in concentrations ranging between 0·00625 and 0·1 per cent for their effectiveness against the lac predator *E. amabilis*. All were highly effective against lac predators.

(C. P. Malhotra)

1.4.3.2 Screening of plant poisons for their safety to the lac insect and toxicity to the lac predators

Pupae of the lac predator, *E. amabilis* were dipped in the extracts of rhizomes of *vasambhu* (*Acorus calamus*), seeds of *palas* and drupes of *dhareck* (*Melia azederach*) in concentrations ranging from 0·025 to 0·1 per cent for a minute, air dried and kept for observations. *Dhareck* extract was found to be toxic only at 0·1 per cent whereas others were toxic in all the concentrations.

(A. Bhattacharya and C. P. Malhotra)

1.4.3.3 Hormoligotory effects of the insecticides on the lac insect

The experiment was repeated in *baisakhi* 1983-84 and *katki* 1984 crop seasons with same insecticides on potted *bhalia* plants. The results confirmed the earlier findings that increase in size was maximum with the lowest concentration (A.R.: 1983).

1.4.3.4 Effect of the recommended control schedule on the associated fauna of the lac insect under field conditions

Thiodan® (0·05 per cent) was sprayed on 15-36 day-old *jethwi* crop on *bhalia* bushes. Samples were collected after one, two and seven weeks of spray and examined. It was found that there was marked progressive reduction in the number of inimical and beneficial insects.

Two sprays, the first of 0·05 per cent Thiodan® followed by 0·05 per cent Thiodan®Thuricide (1 : 1) were applied on 6-41 day and 121-155-day-old *baisakhi* 1983-84 crop raised on *bhalia* bushes. Samples were collected one, sixteen and thirty-three weeks after the spray and caged for recording the emergence of lac associated insects. A very high degree of control of predators (86·6-100 per cent) and marked progressive reduction in the number of both the inimical and beneficial parasites were observed.

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

1.4.3.5 Effect of insecticides on the harmful parasites of the lac insect

Screening trials were carried out with five insecticides (BHC, Sevin, Thiodan®, Chlordane and Lindane) found earlier safe to lac insects, against the two common lac insect parasitoids, *T. purpureus* and *T. tachardiae* by releasing them on treated surface. These insecticides showed toxicity of the order of BHC>Sevin>Thiodan>Chlordane>Lindane for *T. purpureus* and BHC>Sevin>Chlordane>Thiodan® and Lindane for *T. tachardiae*.

(S. G. Choudhary and C. P. Malhotra)

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

Survey for the diseases of the lepidopterous lac predators was continued. The larvae were collected from different crops and sorted out on the basis of preliminary symptoms and kept under observation for appearance of pathogenic symptoms. Further, individual as well as mixed isolates were tested for their pathogenicity against the healthy predators. However, no disease could be established in healthy population.

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

1.4.9 Studies on the application of hormones and pheromones for the control of major lac predators

The project was restarted in 1984. The effect of Dimilin (diflubenzuron) a chitin inhibitor, was studied on the lac predator *E. amabilis* by spraying on the eggs, feeding the larvae on treated scraped lac and dipping the pupae in dimilin at concentrations ranging from 0·0125 to 0·2 per cent in all cases. Mortality and developmental abnormalities 50-100 per cent were observed only with larval treatment at all concentrations.

Mature female lac cells dipped in Dimilin (0·0125 to 0·2 per cent) for 2 min did not show any significant effect on the fecundity.

(A. Bhattacharya and C. P. Malhotra)

1.4.10 Chemical control of *Chrysopa* species

Field trials were continued on *jethwi* 1984 crop raised on *kusum* bushes as per the technical programme reported earlier (A.R.: 1983). BHC and Chlordane (0·05 per cent) were sprayed twice at fortnightly interval.

Population of *Chrysopa* spp. was assessed before and after each spray and the lac yields compared at crop maturity. Suppression of *Chrysopa* spp. was better with BHC (81·5%) compared to Chlordane (69·6 per cent) and increases in the yield were 45·3 and 38·1 per cent respectively.

(S. G. Choudhary)

1.4.13 Studies on the economic threshold of *Eublemma amabilis* and *Holcocera pulverea* infesting lac crops

The experiments were continued during the *baisakhi* 1983-84, *jethwi* 1984, *katki* 1984 and *aghani* 1984-85 seasons as per the technical programme reported earlier (A.R.: 1983).

It was observed that larval densities above 4/30 cm of lac encrustation cause economic damage 25·6 to 57·6 and 28·9 to 56·06 percent during *baisakhi* 1983-84 and *jethwi* 1984 crops respectively. The damage was maximum at 1-30 days stage of development during all the crop seasons.

(S. G. Choudhary)

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

The project was continued as per the programme reported earlier (A.R.: 1983). The brood lac of *aghani* 1983-84 crop was dipped in Thiodan® emulsions (0·1-0·4 per cent) for 30, 60 and 90 sec, dried and caged for recording emergence

of insects. The emergence of lac predators was reduced (53·6 to 83·8 per cent) with the insecticidal treatment whereas lac crawlers were not adversely affected.

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

1.5 Genetics and Breeding of Lac Insect

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

The stocks shown in Table 2, collected from different regions of the country were maintained.

TABLE 2

Rangeeni				*Kusmi*			
Sl No.	Source	No. of cultures		Sl No.	Source	No. of cultures	
		Baisakhi 1983-84	*Katki* 1984			*Jethwi* 1984	*Aghani* 1984-85
1.	Umaria	15	26	1.	Orissa (Crimson)	20	23
2.	Assam	28	26	2.	Orissa (Yellow)	23	20
3.	Ludhiana	11	19	3.	Dharamjaigarh (Old)	17	22
4.	Kundri	14	20	4.	Dharamjaigarh (New)	11	22
5.	Local Yellow	15	15	5.	Namkum Plantation	13	21
6.	Delhi	21	8				

1.5.10 Studies on sex-determination in lac insects

Analysis of inbred lines— Eight inbred lines derived from a wild *rangeeni* stock originating from a hot region (Kundri, Palamau, Bihar) after five generations of full-sib mating were used for comparison of their sex ratio. Ten females were drawn from each inbred line a few days before larviposition and their progenies reared, each on a potted *bhalia* plant under cover of 80 mesh synthetic-net cage. The experimental cultures were, however, lost due to heavy fungal growth during the unprecedented heavy and continuous rains during the *katki* 1984 season.

(N. S. Chauhan)

1.5.11 Cytotaxonomy of lac insect

Cytological studies of Assam lac insect showed that it resembles *Kerria lacca* (Kerr.) for the chromosome number and behaviour.

(S. K. Jaipuriar)

(c) RESEARCHES CONTEMPLATED — Nil

B. AGRONOMY AND PLANT GENETICS DIVISION

(a) RESEARCHES COMPLETED — Nil

(b) RESEARCHES IN PROGRESS

2.1 Propagation and Management of Lac Host Plants

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

Kept in abeyance.

2.1.4 Role of plant growth regulators on lac host plants

Kept in abeyance.

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

The experiment was continued as per the layout reported earlier. *Baisakhi* (*arị*) 1983-1984 lac crop suffered heavy mortality and thus the crop was a total failure. *Ber* bushes were pruned during May 1984. The *daba* dfl's of tasar silkworms were procured during August in two lots from the Central Tasar Research and Training Institute, Ranchi but the larvae could not survive.

(P. Kumar and N. Prasad)

2.1.10 Study and assessment of economics of the cultivation of *kusmi* lac on the bushes of *Moghania macrophylla* and *Albizzia lucida* in mixed plantation

The *bhalia* bushes were ready for inoculation but could not be inoculated during *aghani* 1984-85 crop season due to non-availability of *kusmi* brood lac. The *galwang* plants raised in July, 1983 have shown satisfactory growth during 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

Floral biology — Studies on flower anthesis during synchronized flowering period showed that the time taken by *Moghania macrophylla* from bud initiation to attainment of full bloom stage was shorter than that of *M. chappar*. It has been recorded that anthers were undehisced stage in bud length ranging from 4 to 6 mm size in both the species. In these buds, stigmas were found to be receptive 48-54 hr after this stage.

Crossing in Moghania species — The flower buds of *M. macrophylla*, delayed by pinching and topping were utilized for making reciprocal crosses with *M. chappar*. Hydrochloric acid [0·1, 0·5 and 1·0% colchicine (0·1%)] and distilled water were used separately on style shortened by sharp cutting of stigmatic zone as well as on normal emasculated flower buds of both the species. After 30-45 min of above application, these buds were pollinated with fresh pollen as well as mixed pollen separately for making reciprocal crosses. Most of these cross buds

shed off in second week after pollination-excepting few buds of *M. macrophylla* pollinated with *M. chappar* under mixed pollen and distilled water treatment. Among these, only three pods have survived and produced wrinkled black, smaller and brown coloured seeds which, however, failed to germinate.

(S. C. Srivastava)

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

Aghani 1983-84 lac yield was poor due to heavy attack of lac predators and hence no further selection was possible. The *bhalia* bushes (parent plant raised from Netrahat collections and the plants raised in progeny rows) were pruned in January and inoculated in July to raise *aghani* 1984-85 crop. The insects were developing well till the period under report.

(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

Aghani crop — Data on plant growth attributes, yield of *arhar* (*Pigeon pea*) grains and intercrops during *aghani* 1983-84 crop season have been presented in Table 3. The yield of intercrops was found to vary with the *arhar* varieties. The yield of *arhar* grains was not found to be effected with the intercrops. Lac yield data could not be obtained due to total failure of lac crop.

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

Baisakhi crop — Observations on plant growth attributes and the pulse yield of the late maturing *arhar* varieties during *baisakhi* 1983-84 crop indicate that the pulse yield reduced due to lac cultivation. Further observations on sex ratio of lac insects on these *arhar* varieties indicated a normal proportion of male on eight varieties (32·7-39·48%) and significantly higher proportion of male in the remaining varieties (43·6-58·3%). The lac insects sex ratio thus found to vary with the varieties tried. The lac insects died during summer months due to extreme heat and hence no lac yield data could be recorded.

The *arhar* varieties namely, Basant, Bahar, Laxmi, K35/6, ICP 8501, 3570, 3785, 7197, 7188, 2E, BDN-3, 7-S, T-17, SA-I, S-8 and CWL-3 were sown during June, 1984 for raising *baisakhi* 1984-85 crop.

Jethwi crop — Lac yield data in *jethwi* 1984 could not be obtained due to total crop failure during summer months. The *arhar* varieties which were raised for *baisakhi* 1984-85 crop were also raised during June 1984 for raising *jethwi* 1984 lac crop.

Fortynine lines of *arhar* were inoculated in October 1984 at the Farm of Genetics and Plant Breeding Dept. of Institute of Agricultural Sciences, BHU, Varanasi. Ten plants in each line were used for inoculation. Three plants in each line were randomly selected for recording the observation on plant height and number of primary branches. Data are presented in Table 4.

TABLE 3 — SHOWING PLANT GROWTH ATTRIBUTES, PULSE YIELD OF DIFFERENT VARIETIES OF *arhar* ALONG WITH THE YIELD OF INTERCROPS DURING *aghani* 1983-84 LAC CROP SEASON

Treatment	Plant height (cm)	Primary branches (No.)	Total shoot length (cm)	Girth of main shoot (cm)	Yield of *arhar*				Yield of intercrop (moong)	
					Wt of pods/plot (g)	Wt of grain/plot (g)	Wt of pods/plant (g)	Wt of grain/plant (g)	Wt of pods/plot (g)	Wt of grain/plot (g)
V_1 E_1 I_1	177·9	8·0	878·6	1·5	912·5	412·5	47·4	21·4	196·0	121·2
V_1 L_1 I_0	187·7	8·0	871·9	1·5	857·5	413·5	43·9	21·2	170·7	
V_1 L_0 I_1	209·1	8·5	1075·5	1·6	805·0	431·5	41·8	22·4	213·5	138·2
V_1 L_0 I_0	191·3	7·9	839·2	1·5	1082·5	217·5	57·7	11·6	193·0	
V_2 L_1 I_1	199·6	14·3	822·3	1·4	1007·5	527·5	53·0	27·7	198·0	139·0
V_2 L_1 I_0	212·0	7·7	873·3	1·6	1282·5	636·2	76·5	37·9	172·7	
V_2 L_0 I_1	210·4	9·1	1034·3	1·7	837·5	417·5	39·4	19·6	219·7	159·2
V_2 L_0 I_0	203·5	8·5	929·9	1·6	1050·0	511·2	54·8	26·5	176·5	
V_3 L_1 I_1	201·9	8·0	1335·8	1·8	1277·5	665·0	74·0	38·5	305·0	167·5
V_3 L_1 I_0	209·2	8·1	883·7	1·6	1177·5	542·5	81·2	37·4	201·7	
V_3 L_0 I_1	224·4	7·9	973·7	1·7	887·5	462·5	47·5	24·6	185·2	125·5
V_3 L_0 I_0	218·8	7·6	1035·5	1·8	1595·0	860·0	99·6	53·7	197·2	
V_4 L_1 I_1	202·1	8·2	821·8	1·5	1480·0	805·0	870·0	47·3	208·7	139·2
V_4 L_1 I_0	226·5	10·8	1187·1	1·8	1165·0	640·0	63·8	35·0	249·5	
V_4 L_0 I_1	206·0	11·5	1001·9	1·6	867·5	426·2	42·8	21·0	234·2	182·5
V_4 L_0 I_0	217·1	10·6	1145·8	1·9	797·5	367·5	43·6	20·1	138·7	
V_5 L_1 I_1	216·3	8·4	796·0	1·7	777·0	692·5	47·0	41·9	226·7	183·0
V_5 L_1 I_0	208·0	8·6	1024·4	1·7	1425·0	975·0	695·0	38·9	171·5	
V_5 L_0 I_1	218·0	9·4	1091·4	1·8	880·5	560·0	43·0	27·3	219·5	150·0
V_5 L_0 I_0	197·1	8·5	887·4	1·5	1317·5	688·7	75·2	39·3	164·2	

V_1 — UPAS 120; V_2 — T-21; V_3 — FP-5; V_4 — ICPL-6; V_5 — BR-18; L_0 — Without lac crop; L_0 — Without intercrop; L_1 — With lac crop; I_1 — With intercrop.

TABLE 4 — PLANT GROWTH ATTRIBUTES OF DIFFERENT *arhar* VARIETIES USED FOR LAC AND PULSE YIELD EVALUATED AT B.H.U., VARANASI

Sl No.	Name of lines	Height/Plant (cm)			No. of primary branches		
		K^1	K^2	K^3	1	2	3
1.	ACT-3 Bahar (ch)	205	195	200	14	10	14
2.	MA97	230	260	265	14	15	17
3.	DA13	115	175	195	17	15	15
4.	ICPL-358	175	225	210	15	11	15
5.	T-7 (Ch.)	200	225	200	14	18	9
6.	PDA-1	225	215	220	13	13	11
7.	ICPL-311	225	200	215	15	11	16
8.	ICPL-366	235	225	240	12	7	14
9.	DA 11	230	235	185	12	13	6
10.	PDA-9	255	190	220	12	15	15
11.	ICPL-310	235	230	225	19	16	12
12.	Schore-367	200	190	220	16	14	14
13.	GWL-3 (Ch.)	215	235	210	11	17	14
14.	PDA-10	215	210	240	7	9	16
15.	MA-166 ST-3	215	220	240	4	9	12
16.	]1258×1348)	190	235	235	11	17	17
17.	134A×GP 300	180	215	230	9	18	11
18.	7979×Bahar	155	160	150	11	15	14
19.	126B×129	165	205	200	4	12	18
20.	129A×126	165	185	225	14	13	17
21.	1258×P 541	205	210	225	16	5	15
22.	301 F6 *ICRISAT*	230	235	180	26	18	7
23.	309 F2	200	201	235	5	17	23
24.	33 F6	185	200	180	19	15	10
25.	329 F6	250	280	255	16	13	14
26.	308 F2	185	180	220	13	8	19
27.	300 F6	200	215	185	13	17	18
28.	Sl. No. 20	215	200	195	20	18	20
29.	299 F6	220	215	235	15	18	19
30.	240 F6	205	225	220	18	9	16
31.	228 F6	215	200	210	15	10	10
32.	303 F2	225	220	240	18	19	17
33.	ICSM-AXTTB-7 *ST*-2	230	280	230	12	11	14
34.	do (B)	235	225	250	20	13	10
35.	ICSM-2×7035	225	215	220	19	17	18
36.	1258×ICSM-2	225	210	220	20	11	15
37.	M844×HY3C	199	230	225	10	21	17
38.	127 *Veg.*	200	210	220	5	5	8
39.	134 B	185	210	195	3	8	7
40.	131 A1	210	210	185	5	5	5
41.	125 A2	225	220	255	10	10	7
42.	124 C3	225	250	225	11	7	7
43.	133 B2	240	255	200	17	7	14
44.	125 D	190	185	190	10	4	4
45.	125 C	235	220	240	12	7	8
46.	MA-2	230	210	185	14	19	14
47.	MA-95-2	200	215	175	20	21	15
48.	MA-135	200	210	225	10	7	14
49.	MA-1	215	200	225	8	10	11

(P. Kumar and D. C. Srivastava)

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

Pure line seeds of *Assam* cv. and *Bahar* var. of *arhar*, irradiated with gamma rays at doses ranging between 10 and 60 kR, were kept in petridishes for germination under laboratory conditions along with control and germination percentage recorded. The seedlings at 2-leaf stage were then transferred to polythene tubes in the laboratory. After 3 weeks when the seedlings established they were transplanted in the field. Data on survival before transplanting to the field and at maturity were recorded. The plants suffered heavy mortality due to continuous heavy rain. Germination and survival data for *Assam* cv. and *Bahar* var. have been presented in Tables 5 and 6 respectively. The plant survival at maturity was found to decrease with the increase in dose. At about 40 kR dose it was drastically reduced.

TABLE 5 — GERMINATION AND SURVIVAL PERCENTAGE IN M_1 GENERATION OF ASSAM CV.

Dose	Germination (%)	Survival at seedling stage (after germination) (%)	Survival at maturity (after germination) (%)
10 KR	94·85	94·56	55·43
20 KR	73·46	94·44	75·00
30 KR	74·52	93·67	62·05
40 KR	92·15	75·53	50·00
50 KR	75·45	83·13	22·89
60 KR	72·16	69·33	4·00
Control	81·63	96·25	68·75

TABLE 6 — GERMINATION AND SURVIVAL PERCENTAGE IN M_1 GENERATION OF *Bahar* VAR.

Dose	Germination (%)	Survival to germination at seedling stage (%)	Survival to germination at maturity (%)
10 KR	82·53	83·33	76·38
20 KR	66·89	91·34	76·92
30 KR	57·14	88·65	59·79
40 KR	65·25	82·23	51·47
50 KR	67·21	97·40	28·57
60 KR	76·47	91·46	6·09
Control	71·28	95·60	81·09

(P. Kumar)

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

The current year sprouts of pruned *ber* bushes were treated with aqueous colchicine solution ranging from 0·1 to 1·5% for 6 hr.

The data recorded on plant growth attributes indicated some increase in colchicine treatments as compared to control. However, there was no definite trend.

The seedlings at 2 leaf stage were also treated with colchicine solution ranging from 0·1 to 1·5% for 6 hr.

The data presented in Table 7 showed that in 1% colchicine treatment, the stomatal size increased but number reduced as compared to control.

TABLE 7 — EFFECT OF COLCHICINE ON STOMATA OF *ber* SEEDLING

(Under potted plant condition)

Concentration (%)	Stomata	
	No.	Size (μ)
Control	35·0	22·5 ×17·25
0·1	41·7	21·37×16·12
0·2	22·7	23·6 ×12·2
0·3	28·3	22·5 ×17·62
0·5	27·25	22·5 ×16·87
1·0	18·7	27·4 ×22·5
1·5	26·0	22·5 ×18·75

(S. C. Srivastava)

(c) RESEARCHES CONTEMPLATED

1. Survey of genetic variation in lac potential of host plants.

INSTITUTE PLANTATION

The general upkeep of the plantation was attended and regular weeding and hoeing were carried out to keep down the weeds, and provide good soil in mulched condition.

The unwanted and obnoxious weeds of prolific growth, namely, *Lantana camera* and *Stachytarpheta indica* were completely uprooted from the *kusum* and *palas* plots. The growing of fodder grass (*Dinanath*) in a portion of *khair* plot suppressed the growth of the unwanted weeds in *khair* plot.

A plot comprising of all the major and minor lac hosts was developed in the nursery area as a model demonstration units for lac crop.

A large number of seedlings of various lac hosts were raised in nursery beds both for filling gaps in the plantation and for experimental purpose.

(B. K. Purkayastha)

C. CHEMISTRY DIVISION

(a) RESEARCHES COMPLETED

3.1.1 Separation and study of components of lac wax

Sticklac contains 5 to 6 per cent lac wax. Attempts have been made from time to time to study its constitution. Recently this aspect was studied by Tulloch (1971), using commercial lac wax. To avoid partial loss and changes in the constitution of lac-wax during its isolation, the present study was initiated with whole lac-wax obtained from sticklac.

A comparison of the characteristics of lac wax obtained from sticklac of different lac hosts viz. *palas*, *kusum*, *arhar* and *moghania* has also been carried out.

The wax was extracted from *palas* sticklac by adopting two different methods: (i) by dissolving sticklac in (70%) alcohol at room temperature, filtering and extracting the residue with petroleum ether (60-80°) and (ii) by directly extracting sticklac mixed with sand (1 : 1) directly with petroleum ether (60-80°). Uniform yield was obtained by adopting the first method only.

In order to isolate pure components, the fractionation of the wax was done with acetone using temperature phase separation technique. Further refractionation with absolute alcohol and chloroform was not successful. Next, the wax was fractionated with petroleum ether into soluble and insoluble fractions at room temperature. The petroleum ether-insoluble portion was refractionated by preparative layer chromatography and three pure components were isolated. IR spectral studies revealed that the components were alcohol (m.p. 83-84°C), a hydrocarbon (m.p. 84-85°C) and an ester (m.p. 93-94°C) respectively. The technique was found to be a cumbersome one and the quantities obtained were very small.

Hence, the whole wax was fractionated with alcohol into three fractions, namely: (i) fraction A: insoluble in boiling alcohol (16%), (ii) fraction B: insoluble at 40°C (44%) and (iii) fraction C: soluble at 40°C (40%).

Refractionation of fraction A

This fraction, when examined by T.L.C. was found to be a mixture of four components. One component (highly polar) was found to be present in major quantity while the remaining three were very small in quantity. The major component was purified by repeated crystallization with chloroform followed by preparative layer chromatography. The component was found to be an ester (m.p. 94-95°C) and was identical with the ester component isolated from petroleum ether-insoluble-wax fraction. It was hydrolysed to the corresponding acid and alcohol. The acid was converted into its methyl derivative (m.p. 76-78°C). The acid and alcohol components were identified as saturated straight chain C_{38} acid and C_{36} alcohol respectively by mass spectra.

Refractionation of fraction B

The fraction B was further fractionated by ether into two components: (i) ether-insoluble (B_1) and (ii) ether-soluble (B_2). The fraction B_1 was found to be again a mixture of two components. The fraction B_1 was acetylated and

refractionated again into ether-soluble (Fr. B-1-1) and ether-insoluble (Fr. B-1-2) components. The fraction B-1-1 appeared to be an acetylated alcohol (m.p. 63-65°C). This was hydrolysed to the corresponding alcohol (m.p. 81-82°C) and was identified as a C_{32} alcohol by mass spectra. The fraction B-1-2 was found to be a saturated C_{27} hydrocarbon (m.p. 79-80°C).

Refractionation of fraction C

The T.L.C. examination of the fraction C revealed that it is a complex mixture consisting of at least ten components. The free acids were separated by treating the fraction C with sodium bicarbonate. Then this acid-free fraction C was further fractionated with chloroform as chloroform-insoluble (Fr. C_1) and soluble (Fr. C_2) portions. The chloroform-insoluble fraction (Fr. C_1) was found to be pure and identical with the C_{27} hydrocarbon which was isolated from wax fraction B-1-2. The fraction C_2 was further refractionated on a column of neutral alumina, which yielded two components having Rf values 0·08 and 0·94 respectively. The first component (Rf 0·08) could not be analysed by GLC as it failed to elute through the columns of SE-30 and SE-52 at 280°C. The second component was a liquid and was found to be a mixture of three hydrocarbons of chain length C_{18}, C_{20} and C_{22}.

Comparison of wax isolated from sticklac of different lac hosts

Lac wax was also isolated from sticklacs of different lac hosts viz. *ber*, *kusum*, *palas*, *moghania* and *arhar*. Their different physico-chemical constants were determined and are given in Table 8. The results revealed that the wax content, free acid percentage and iodine value varied appreciably hostwise whereas the other properties differed little.

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

3.1.3 Correlation of the properties of seedlac and shellac with age

The project was taken up with an aim to solve the outstanding problem of lac industry regarding determination of the age of seedlac and shellac samples. Detailed studies were made on the variations of different physico-chemical properties of stored lac at different intervals of time.

Seven sticklac samples of different major lac hosts and locations were procured. These were *ber* sticklac (*baisakhi* 1977-78) from Barguttu, *palas* sticklac (*katki* 1978) from Kundri *kusum* sticklac (*jethwi* 1979 and *aghani*, 1979-80) from Hesal and Amjharia respectively, *kusum* sticklac (*aghani*, 1980-81) from Bundu, *palas* (*baisakhi*, 1980-81) from Kundri and *ber* (*baisakhi*, 1980-81) from Balrampur. These samples were then converted into seedlac and shellac. The samples of seedlac and shellac so obtained (14 in all) were stored in gunny bags at room temperature and their following physico-chemical characteristics were determined periodically: (i) moisture, (ii) colour index, (iii) life under heat, (iv) flow, (v) cold alcohol insolubles, (vi) hot alcohol insolubles, (vii) rate of filtration, (viii) intrinsic viscosity, (ix) dielectric strength, (x) dissipation factor, (xi) conductivity. In addition, studies were made on TLC, UV-visible and IR absorption spectra, acid, hydroxyl and carbonyl values were carried out only for shellac.

The variation in the properties mentioned above for seedlac and shellac samples due to storage have been reported in the Annual Reports (1978-83).

TABLE 8 — ANALYTICAL CONSTANTS OF WAX OBTAINED FROM STICKLAC OF DIFFERENT LAC HOSTS

Hosts	Wax content (%)	Free acid content (%)	Melting point °C	Acid value	Iodine value	Saponification value	Ash content (%)	Volatile matter at 150°C (%)	Resin content (%)	Penetration value
Palas	6·3	10·2	74-78·5	4·5	4·7	66·2	0·08	1·0	2·6	4
Ber	7·0	12·5	76-82	7·0	8·4	94·0	0·08	1·0	3·0	6
Kusum	6·0	9·0	75-82	3·1	4·0	68·5	0·07	0·9	2·3	6
Arhar	3·0	5·0	74-79	2·5	3·2	65·1	0·07	1·0	2·8	5
Moghania	4·5	9·8	75-79	4·3	6·5	43·1	0·08	0·8	2·8	5

A gradual lowering in life, flow, rate of filtration, dielectric strength, dissipation factor, conductivity and an increase in cold and hot alcohol insolubles and intrinsic viscosity were also noticed this year. These results indicate a deterioration in the qualities of seedlac and shellac with age. The colour index of all the samples remained almost unaffected. No significant change in the UV-visible and IR absorption spectra was noticed. TLC examination also did not reveal any change. Among the above properties, flow appeared to be the most sensitive property which is affected on storage.

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

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

Aleuritic acid, one of the major constituents of lac resin, is believed to be present to the tune of 35-40 per cent. However, only 20 per cent is usually obtained by the conventional method of alkaline hydrolysis.

The study was initiated with a view to evolve a suitable and economical method for obtaining a higher yield of aleuritic acid.

To begin with, several lots (1500 gm each) of DL-shellac, *rangeeni* seedlac, *kusmi* seedlac and refuse lacs such as *kiri*, *molamma* and *kunhi* were separately hydrolysed by adopting the conventional method of alkaline hydrolysis. The yield of crude aleuritic acid was found to vary between 19 and 22 per cent. The bulk preparation of the acid was then carried out taking 10 kg lot of each sample.

Attempts were then made to make improvement in the method of isolation of aleuritic acid so as to ensure its full recovery from lac. The effect of alkaline chemicals in different concentrations and temperature on the saponification of lac was studied and the results are given in Table 9. It was observed that the addition of sodium sulphite always increased the yield of aleuritic acid by five per cent. It was also observed that the removal of wax at the initial stage was facilitated if the seedlac and water are taken in the ratio of either 1:3 or 1:4 in presence of alkali (20%). The yield of crude aleuritic acid was thus obtained up to 25 per cent. With a view to increase the rate of filtration of sodium aleuritate, different filtering aids, namely, kiselguhr, bentonite, fuller earth, paper pulp and asbestos wool were tried. Drill and nylon cloth were used as filtering media. Nylon cloth was found to be better than drill cloth as it was comaparatively cheaper, long lasting and resistant to alkali. No improvement was however, observed by using different filtering aids. The use of nylon cloth in a filter press, however, enhanced the rate of filtration of sodium aleuritate.

In order to further increase the recovery of aleuritic acid from the mother liquor, obtained after the separation of sodium aleuritate, it was divided into two parts A and B.

Part A

Attempts were made to separate aleuritic acid from the barium and zinc salts of the mother liquor (part A), but the same could not be achieved. However, butolic acid (m.p. 56°C) an yield of 7·8% was recovered.

TABLE 9 — EFFECT OF ALKALINE CHEMICALS ON THE SAPONIFICATION OF LAC

Sl No.	Treatment	Concentration of alkali (%)	Yield of aleuritic acid (%)
1.	Simple hydrolysis of seedlac by sodium hydroxide at room temperature taking seedlac: water, 1:1 w/v	20	15
2.	(do) at reflux temperature	20	15
3.	As above + sodium sulphite (5% w/w)	20	20
4.	Simple hydrolysis of seedlac by sodium hydroxide at room temperature taking seedlac and water in the ratio of 1:3 w/v concentration of alkali added is on the volume of water and skimming out the wax	5 10 15 20 25 30 30	10 15 18 20 20 20 20
5.	As at Sl No. 4 + sodium sulphite (5% on the weight of seedlac)	20 25	25 28
6.	Dewaxing seedlac with sodium carbonate (10% w/w and taking seedlac and water in the ratio of 1:3 w/v). Hydrolysis with caustic soda	5 10 15 20 25 30	10 12 15 20 20 20
7.	As at Sl No. 6 + sodium sulphite (5% w/w)	10 20 25 30	15 25 25 25
8.	Simple hydrolysis of seedlac at room temperature by caustic soda taking seedlac and water in the ratio of 1:4 or 1:5 (w/v). Sodium sulphite added 5% w/w	20	25
9.	Effect of different interval of days on the hydrolysis of seedlac as mentioned at Sl No. 7	5 days 10 days 15 days (20% alkali)	Incomplete hydrolysis Sticky material Good result

Part B

This portion of the mother liquor was acidified and the gummy mass thus obtained was thoroughly washed with water and dried. This was then subjected to the following treatments separately: (i) the gummy mass was treated with conc. hydrochloric acid and was heated on water bath for 8-12 hr in presence and also in absence of organic solvents like pyridine, dioxane and acetic acid. The polymeric chloro-derivative, thus obtained, was hydrolysed with aqueous alkali (10%)

for 30-36 hr at 100°C to yield *erythro*-aleuritic acid (m.p. 124-126°C); (ii) the gummy mass was treated with hydrobromic acid in acetic acid (HBr-ACOH) at room temperature for 24 hr to obtain a polymeric bromo derivative, which on aqueous alkaline hydrolysis (as stated above) yielded *erythro*-aleuritic acid to the tune of 8-10%. Thus the total recovery of crude aleuritic acid from lac resin was nearly 35 per cent.

Purification

While conducting the above experiments, it was observed that the lac dye present in seedlac causes difficulty in the removal of colour from aleuritic acid. In order to obtain colour free aleuritic acid, *rangeeni* seedlac (1 kg) was treated with washing soda solution (10% w/w, 5 litre) through stirring. The solution was then allowed to settle and the water soluble colouring material was decanted off. The process was repeated to remove the colour as far as possible. The modified method of alkaline hydrolysis was then adopted to obtain *threo*-aleuritic acid. Purification was carried out by dissolving the aleuritic acid in hot ethyl acetate and decolourizing with charcoal (5% w/w) yielding pure crystals (80%) of aleuritic acid (m.p. 97-98°C). The solubility of aleuritic acid (g/100 ml) in water (at 80°C) and ethyl acetate was 0·9% and 20% respectively.

Preparation of aleuritic acid through a new method of alkaline hydrolysis

It was observed that the above method of purification of aleuritic acid is very uneconomical as it not only reduces the yield of aleuritic acid during decolourizing step but also involved the use of costlier chemicals e.g., activated charcoal and ethyl acetate. Thus, a new and simplified method for preparing technical grade *threo*-aleuritic acid (m.p. 95-97°C) was developed. The method involved pretreatment of lac with sodium hypochlorite solution (bleach liquor) for 24 hr at room temperature followed by the modified method of alkaline hydrolysis. The usual process was adopted after the hydrolysis for 15 days. This resulted directly *threo*-aleuritic acid in the white form in an yield of approximately 25 per cent. This method minimizes the decolourizing step of purification involving the use of costlier activated charcoal and ethyl acetate solvent.

Utility of gummy mass (aleuritic acid free hydrolysed lac) in surface coatings and gasket-shellac compound

Experiments were conducted to find out the utility of the gummy mass (left after the isolation of aleuritic acid) in surface coatings and gasket shellac compound.

Surface coatings — The gummy mass was reacted with different proportions of ethylene glycol and various chemical constants of the resultant products were determined. The data are presented in Table 10. The drop in acid and hydroxyl value of the resultant products indicated that the esterification reaction has taken place. The esters, thus formed, were then reacted with an isocyanate (Desmodur N) and the surface coating properties of the reaction products were studied. The final product possessed good adhesion, hardness, flexibility and impact resistance.

TABLE 10 — PROPERTIES OF ETHERS/ESTERS PREPARED FROM GUMMY HYDROLYSED LAC AND ETHYLENE GLYCOL

(Gummy material taken in each composition : 100 *g, period of reaction* 8 *hr, temperature* 170±5°C)

Chemical constants	Gummy material (control)	Ethylene glycol (%, w/w) present in different compositions					
		Comp. 1 20	Comp. 2 30	Comp. 3 40	Comp. 4 50	Comp. 5 60	Comp. 6 80
Acid value	170·0	63·6	43·4	39·6	34·6	35·2	36·4
Hydroxyl value	270·5	133·0	91·5	81·0	75·4	77·2	76·4

NB — The acid and hydroxyl values for normal hydrolysed lac were 201·3 and 346·9 respectively.

Gasket shellac compound — The gummy mass has been found to be suitable as a cheaper substitute for normal hydrolysed lac in formulating gasket shellac compound. The samples of gasket shellac compound based on gummy mass were prepared, their properties were studied and then compared with those of the products available in the market as per ISS: 3447-1965. The above formulation of gasket shellac compound has the properties at par with those of the marketed products. The requirement (I.S.S.) for resistance to lubricating oil is not fulfilled by any of the formulations based on gummy mass and the marketed products.

These studies, are expected to open new fields for the utility of gummy mass in surface coatings and in formulating gasket-shellac compound thereby solving the problem of its disposal in the industry.

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

3.2.8 Syntheses of civetone and cyclic ureids from aleuritic acid

(i) *Dehydrocivetone having musk-like odour was synthesized from aleuritic acid adopting simple reaction sequences*

Treatment of aleuritic acid in glacial acetic acid with phosphonium iodide in acetic acid on steam-bath for 2 hr followed by alkaline hydrolysis of the resulting acetoxy acid yielded 16-hydroxy-Δ^9-hexadecenoic acid as a solid, which was crystallized from ethyl acetate, m.p. 68-70°C; yield 50% IR (KBr): 3250 (OH), 1700 (COOH), 970 cm^{-1} (*trans*-HC=CH).

However, improvement in the yield (90%) of 16-hydroxy-Δ^9-hexadecenoic acid was brought about by treatment of aleuritic acid with ethylorthoformate/benzoic acid at 170°C for 4 hr followed by aqueous alcoholic alkaline hydrolysis of the resultant product.

The foregoing unsaturated acid was treated with Jones reagent for 10 min to afford the corresponding aldehydic acid (yield 80%) as a solid, m.p. 78-80°C which formed silver mirror.

Treatment of the above aldehydic acid with malonic acid in the presence of dry pyridine gave unsaturated dioic acid, as a liquid, yield 70%, IR (neat): 1700 (COOH), 970 cm^{-1} (*trans*-HC=CH).

This was refluxed with $SOCl_2$ in dry ether to yield acid chloride as a liquid (yield 85%). Cyclization of the acid chloride in dry ether containing Et_3N adopting high dilution principle followed by alkaline hydrolysis resulted dehydrocivetone as a liquid which was purified by distillation, b.p. 220-25°C (bath)/5 mm, yield 20%. It formed 2,4-DNP derivative, m.p. 178-80°C.

Many cyclic ureides are useful as drugs. Keeping in view, attempts were made to synthesize cyclic ureides from aleuritic acid.

(ii) *Synthesis of trans-Δ^9-hexadecenyl urea*

threo-9,10-Dihydroxy hexadecane-1,16-dioic acid (prepared from *threo*-aleuritic acid following standard procedure) was heated with ethylorthoformate/benzoic acid at 170°C for 4 hr. The residue, thus obtained, was refluxed with aqueous alcoholic potassium hydroxide for 5 hr, then cooled and acidified to yield hexadec-*trans*-Δ^9-enedioic acid as a solid, yield 84%, m.p. 102-103°C. IR (KBr): 1700 (COOH), 970 cm^{-1} (*trans*-HC=CH). The foregoing unsaturated dioic acid was converted to liquid acid chloride by treatment with $SOCl_2$, yield 100%, IR (neat): 1800 (COCl), 970 cm (*trans*-HC=CH).

All the compounds gave satisfactory elemental analysis.

(iii) *Synthesis of trans-Δ^2-undecenyl urea*

Azelaic acid aldehyde, one of the periodate oxidation products of aleuritic acid was treated with malonic acid in the presence of dry pyridine to afford undec-*trans*-Δ^2-enedioic acid as a solid, yield 65%, m.p. 95-97°C. IR (KBr): 1700 (COOH), 980 cm^{-1} (*trans* HC=CH).

Treatment of the foregoing unsaturated acid in dry benzene with $SOCl_2$ gave the corresponding acid chloride as a liquid, yield 80%. IR (neat): 1800 (COCl), 970 cm^{-1} (*trans* HC=CH). The above acid chloride was heated under reflux with urea in dry benzene for 4 hr and worked up as before to yield *trans*-Δ^2-undecenyl urea as a solid. It was crystallized from methanol, yield 80%, m.p. 222-24°C. IR (KBr): 3325 (—NH), 1700 (—CONH), 970 cm^{-1} (*trans* HC=CH). All the compounds gave satisfactory elemental analysis.

(iv) *Synthesis of pimelyl urea*

7-Hydroxy heptanal, the other periodate oxidation product of aleuritic acid was oxidized with Jones reagent to yield pimelic acid as a solid, yield 80%, m.p. 102-4°. IR (KBr): 1700 cm^{-1} (COOH).

The foregoing dioic acid in dry benzene was refluxed with $SOCl_2$ for 4 hr to afford acid chloride as a liquid, yield 100·5%. IR (neat): 1800 (COCl), 970 cm^{-1} (*trans* HC=CH).

A solution of the above acid chloride in dry benzene was heated under reflux for 4 hr with urea and after usual workup gave pimelyl urea as a thick liquid, yield 80%. IR (neat): 3322 (—NH), 1700 cm^{-1} (—CONH). All the compounds gave satisfactory elemental analysis.

(v) *Synthesis of trans-Δ⁹-heptadecenyl urea*

threo-9,10-Dihydroxy-heptadecane-1,17-dioic acid was prepared from *threo*-aleuritic acid following standard procedure. Treatment of the above product with phosphonium iodide in acetic acid followed by alkaline hydrolysis yielded *trans*-Δ⁹-1,17-dioic acid. Its dimethyl ester was refluxed with ethanol in the presence of sodium ethoxide for 3 hr to yield a solid, m.p. 94-96°C, though the product gave positive test for nitrogen, spectral data revealed that cyclic ureide was not formed.

Bio-assay

Preliminary screening of *trans*-Δ⁹-hexadecenyl urea and *trans*-Δ²-undecenyl urea showed no gross behavioural effects up to dose levels of 500 mg/kg body weight when administered intraperitoneally to mice. However, these two compounds elicited the following electrocardiographic changes at 500 mg/kg body weight in these animals.

Compound	*Observations*
trans-Δ⁹-hexadecenyl urea	(i) Q. wave absent (ii) S.T. segment depressed (iii) T. wave irregular
trans-Δ²-undecenyl urea	(i) T.P. interval less than control (ii) S.T. segment depressed (iii) QRS complex irregular

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

(b) RESEARCHES IN PROGRESS

3.1 Chemistry of Lac/Constituents

3.1.8 Biophysical studies on the interaction between laccaic acid and DNA

The results of some preliminary studies on the interaction between laccaic acid and DNA have been reported earlier. During the period under report, further studies were made on the interaction of laccaic acid with DNA in 0·001 M Nacl at different DNA phosphate (P) to dye (D) ratios (P/D) by the spectrophotometric methods in the visible range evolved by Peacocke and Skerrett [*Trans. Faraday Soc.*, **52**, 261, 1956]. Laccaic acid was prepared by the method of Ghosh and Sengupta [*Res. and Indus.*, **22**, 219, 1977]. Salmon testes DNA of highly polymerized grade, obtained from Sigma Chemical Co., USA, was used in this study. A gradual hypochromism together with bathochromic shift was obtained in the spectrum of laccaic acid on addition of DNA up to P/D = 23. After further addition of DNA, a hyperchromism was obtained. The maximum bathochromic shift obtained was approximately 20 nm (490 to 510 nm, at P/D = 45). An isosbestic point was also obtained at about 507 nm.

The binding parameters i.e., the maximum number of available binding sites per nucleotide (n) and the apparent binding constant (k) were determined

following Peacocke and Skerrett using the Scatchard binding equation:

$$r/c = k\ (n-r)$$

where r is the number of dye molecules bound per nucleotide at the free dye concentration C.

Binding data r, C and r/C were determined from the changes in absorbance at 490 nm. The scatchard plot (r/C vs r) was found to be linear. The number of strong binding sites (n) available per nucleotide was found to be 0·064. The association constant (k) was of the order of $8{\cdot}3 \times 10^{-5} M^{-1}$.

Laccaic acid as such is not completely soluble in water. It was found that its mono- and disodium salts were highly soluble in water. The above study was then extended for mono- and disodium salts of laccaic acid in water. For mono-sodium salt, the spectral changes involved a gradual hypochromism and red shift (up to P/D = 10). An isosbestic point was also obtained at about 507 nm. The red shift obtained was approximately 25 nm (490 to 515 nm at P/D = 10).

Some preliminary studies made with the disodium salt of laccaic acid showed a hypochromism and red shift in the spectrum of the dye on its binding with DNA. The maximum red shift was obtained approximately 25 nm (495 to 520 nm). The study revealed that laccaic acid and its sodium salts undergo intercalative mode of binding with DNA. The process of preparation of aluminium complex of lac dye evolved earlier is being standardized.

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

3.1.10 Adsorption studies on lac

During the year under report, efforts were made to measure the rate of adsorption at various temperatures. Adsorption from an alcoholic solution of lac (10% w/w) on charcoal was studied at 20° and 60°C for different periods (1/2, 1, 1½, 2 hr). The concentration of the solution before and after adsorption was determined in each case and therefrom the rate of adsorption was calculated. It was observed that the rate of adsorption is proportional to the equilibrium concentration. Further study at 100°C is in progress.

(A. Kumar)

3.1.11 Isolation of jalaric acid from lac on technical scale

Last year, preliminary experiments were carried out to isolate jalaric acid from shellac by separating water soluble portion from it.

During the year under report, further experiments were carried out to increase the yield of jalaric acid. Samples of two different strains of shellac (*kusmi* and *rangeeni*) were taken and hydrolysed with caustic soda (1·75N) for 5 hr under constant stirring. During the process of hydrolysis, different concentrations of sodium sulphite (1 to 7%) were added. The hydrolysed product was then decomposed with aqueous phosphoric acid (1:1) whereupon a gummy mass along with the water-soluble portion separated out. The gummy mass was repeatedly washed and all the washings were collected in the filtrate and finally extracted with ethyl acetate. The extract after drying was concentrated, the crystals of jalaric acid (m.p. 160-65°C) were separated by keeping the extract at ice temperature for overnight. It was observed that addition of 5% sodium sulphite during hydrolysis was found to be optimum to yield 10-12 per cent jalaric acid.

(N. Prasad and S. C. Agarwal)

3.1.12 Degradation studies on lac

During the period under report, further experiments were carried out on the oxidation reactions using nitric acid as an oxidizing agent. In order to evolve the optimum conditions for the reaction, different concentrations (viz., 50, 60, 70 and 100%) of nitric acid were used in the presence of manganese dioxide. The samples taken for the study were: (a) aleuritic acid, (b) jalaric acid, (c) total hydrolysed lac, (d) jalaric acid free hydrolysed lac and (e) aleuritic acid free hydrolysed lac.

The reactions were carried out at reflux temperature on water bath for 12 hr. The reaction products were cooled and then poured in ice-cold water. The products from each set of experiments were recovered with ether and ethyl acetate separately. Their physical appearances were examined, melting points determined and TLC experiments were also conducted.

Three pure compounds were obtained from aleuritic acid having m.p. 127-129°C and 113-115°C in all the reaction conditions whereas the remaining samples gave two products each. The oxidation of jalaric acid did not yield any crystalline product, but on TLC they gave a single spot (Rf 0·84). A white crystalline material m.p. 96-98°C (Rf 0·62) and a semisolid product (Rf 0·56) were obtained when total hydrolysed lac was oxidized and extracted with ether and ethyl acetate respectively.

The products obtained from jalaric acid free hydrolysed lac and aleuritic acid free hydrolysed lac through ether extraction, were solid (m.p. 95-96°C) and semi solid respectively whereas the products obtained by extraction with ethyl acetate, were liquid in both the cases. It was observed that 70 per cent is the optimum concentration of nitric acid for carrying out the oxidation reactions of dewaxed shellac in presence of MnO_2. Attempts are being made to obtain the pure compounds in sufficient quantity for their proper characterization.

(S. C. Agarwal and N. Prasad)

3.2 Fine Chemicals from Lac

3.2.10 Syntheses of pheromones and juvenile hormone analogues from aleuritic acid

(i) 1,4,12-Trimethoxydodecane was again synthesized from aleuritic acid by adopting the procedure reported earlier.

This compound showed slight JH activity while 1,4,12-trihydroxydodecane did not show any juvenile mimetic activity on one-day old pupae of *Corcyra cephalonica*.

(ii) Two insect sex pheromones, viz., methyl-Z(7)-hexa-decenoate and E(9)-dodecen-1-yl acetate were synthesized from aleuritic acid following simple reaction sequences.

(iii) Following known compounds viz., methyl aleuritate, ethyl aleuritate, butyl aleuritate, allyl aleuritate, 1,9,10,16-tetrahydroxyhexadecane, 1,9,10,16-tetramethoxy hexadecane, *trans*-Δ^9(10)-epoxy-16-hydroxy hexadecanoic acid, *trans*-9(10)-epoxy-hexadecane-1,16-dioic acid, 9,10-dihydroxy-hexadecane-1,16-dioic acid, dimethyl ester of hexadecane-1,16-dioic acid, diethyl ester of hexadecane-1,16-dioic acid, *trans*-Δ^2-undecene-1,11-dioic acid, dimethyl ester of *trans*-Δ^2-undecene-1,11-dioic acid, dimethyl ester of *trans*-Δ^2-undecene-1,11-dioic acid, *p*-phenyl phenacyl

ester of aleuritic acid, hydrazide of aleuritic acid, dimethyl ester of pimelic acid and dimethyl ester of azelaic acid were prepared from aleuritic acid for testing their JH activity.

(R. N. Majee and R. Ramani)

3.3 Modification of Shellac/Constituents and Their Utilization

3.3.3(ii) Cation exchange resin from styrenated lac

During the period, attempts were made to remove the colour throw of the cation exchange resin from the styrenated lac. The resin was washed with 5 per cent sodium carbonate solution, and dried. Some colour throw was observed. Thereafter, the resin was equilibrated with 5 per cent sulphuric acid, washed free of acid, dried and extracted with spirit in soxhlet. It was noticed that fifty per cent styrenated resin threw more colour than that of 20 per cent.

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

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

Last year hydrolysed lac was reacted with lower proportions (up to 60%) of Desmodur L and the resultant films showed poor alkali resistance. During the year, the studies were continued to react hydrolysed lac with higher proportions of Desmodur L (75%, 100% based on the weight of hydrolysed lac). The films were prepared on glass slides and then air dried for 7 days and a set of films was baked at 150°C for 30 min. The films were tested for acid, water and alkali resistance. It was observed that baked films of polyurethane prepared from hydrolysed lac with Desmodur L (100%) showed good alkali resistance.

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

3.3.10 Addition polymerization of shellac

The intrinsic viscosities of the products, obtained by carrying out polymerization reaction of shellac at 100°C in the presence of benzoyl peroxide as the catalyst for different intervals of time viz., 30, 60, 90 and 120 min, were determined at 40°C in *n*-butanol. The values obtained were 0·16, 0·50, 0·01 and 0·11 respectively. The intrinsic viscosity of lac at 40°C in *n*-butanol was found to be 0·14. The samples have been sent to the I.A.C.S., Jadavpur for the determination of molecular weight.

Further, the solubility of the products was examined. The gel percentage varied between 10 and 46 per cent. The rate of polymerization has been found to be dependent on the percentage of the sol and gel contents present in the system as well as on the polymerization time.

(A. Kumar)

3.3.11 Modification of lac with ethyl cellulose

It was reported earlier that varnishes containing different proportions of *bhatta* shellac and ethyl cellulose were prepared. During the period under report, films were prepared, air-dried and tested for various properties. Scratch hardness was found to vary between 800 and 1400 g. The films were found to be flexible and passed the comical mandrel test. Water resistance was found to vary from 6-12 hr. These films however, did not pass the test for impact resistance.

(A. K. Dasgupta)

3.3.12 Modification of lac wax

The lac wax is an important byproduct of the lac industry. It is, however, inferior to carnauba wax in regard to hardness and melting point. Attempts were, therefore, made to modify and upgrade its properties.

Lac wax (commercial grade) was treated with calcium hydroxide, calcium oxide and calcium carbonate separately in different proportions varying from 1 to 5 per cent at 150°C. The physical characteristics such as, penetration value, melting point and ash content were determined. There was no marked difference in melting point but the penetration value was found to reduce from 6 to 3 in all cases indicating increased hardness. Little increase in the ash content was also observed.

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

3.4 Use of Shellac and Modified Shellacs in Surface Coatings

3.4.3 Shellac paints for wood patterns

It was reported last year that an improved composition of pattern paint based on ordinary shellac was prepared and tested for its film performance. During the period under report, the storage stability of the said paint composition was studied. It was observed that even after one year of storage in polythene containers, no deterioration in the paint texture as well as in its film performance had taken place indicating good storage stability of the paint. In view of its good performance and storage stability it was considered desirable to get this composition evaluated by the consumers. Accordingly, two bigger lots of this composition were prepared and tested as a measure of quality control. The performance of these lots was also found to be similar to that obtained earlier from smaller lots. The samples are being sent to NIFFT, Ranchi for their evaluation.

(S. Kumar and A. K. Dasgupta)

3.4.4 Studies on shellac esters and their utilization

It was reported earlier that glyceryl mono aleuritate (m.p. 63-65°C, yield 80%) was synthesized by reacting aleuritic acid with glycerol in 1:1 molar ratio in the presence of zinc dust as catalyst.

During the period under report, the study on the esterification of shellac with glycerol was carried out in different molar ratios under different conditions of time, temperature and also in the presence of different catalysts such as concentrated sulphuric acid, boron trifluoride etherate (BF_3-Et_2O), zinc dust. The reaction products, thus obtained, at regular interval of time (30 min) were poured into ice cold water and extracted with ethyl acetate. The products obtained in each case were monitored by TLC and confirmed by chemical analysis. It was observed that when shellac was reacted with glycerol in 3:1 molar ratio, in the presence of BF_3-Et_2O under reflux for 5 hr in a solvent mixture, benzene+dioxane (1:1), shellac ester (A.V. 16·1-17·5) was formed to the extent of 60-65%.

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

3.4.5 Studies on anticorrosive primers/paints for use on ferrous metals

It was reported last year that the primer composition based on dewaxed lac-double boiled linseed oil vehicle was tested and found to possess good film properties. During the period under report, experiments were carried out to test the anticorrosive properties of the said primer composition but consistent results could not be obtained as the salt spray cabinet went out of order during the experiments.

Experiments were also carried out to study the storage stability of the vehicle (dewaxed lac-double boiled linseed oil) prepared earlier. No gelling or thickening of the vehicle was noticed even after one and half year of storage. Using this vehicle, a fresh composition of the primer was prepared. This primer composition also produced hard, smooth and highly adherent films on ferrous metals. Film properties of this composition are under study.

Fresh lots of the primer based on ordinary shellac-double boiled linseed oil vehicle could not be prepared as the satisfactory vehicle could not be obtained.

(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.: 1983) that the lac-mud was tried to combine directly with 2,4-D. However it was not found feasible, therefore, attempts were made to combine lac-mud with 2,4-D through heterogeneous reaction system. The preparation of 2,4-D acid chloride in quantity could not be achieved by the process developed by the National Chemical Laboratory, Poona.

During the period under report, studies were made to prepare lac-2,4-D in granular formulation. Blank granules based on soap-stone as carrier and different binders, namely, shellac (95% 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 an oscillating type granulator. Disintegration test was carried out in tap and standard hard water and the time taken for dispersion of granules on continuous shaking in water (10 ml) was recorded at the room temperature (Table 11).

TABLE 11 — WATER DISPERSION CHARACTERISTICS OF GRANULES BASED ON SOAP STONE

Sl No.	Binder	Average dispersion time (sec.)	
		Tap water	Standard hard water (342 ppm as $CaCO_3$)
1.	Ammoniacal (1:3) lac solution (5% w/v)	92·0*	180·0*
2.	Casein solution (2% w/v)	15·5	14·0
3.	Sodium CMC solution (1% w/v)	11·0	13·7
4.	PVA solution (2% w/v)	No sign of disintegration up to 21 hr	No sign of disintegration up to 21 hr

*Disintegrated into lumps.

The order of disintegration for different binders was found to be PVA>Shellac >Casein>Sodium CMC. The hardness of water showed no apparent effect on the disintegration of granules.

Experiments were carried out to explore the possibility of using lac-2,4-D combination product for the control of aquatic weed. Indications were obtained that the soap-stone as carrier and PVA as binder may be used for the preparation of slow-dissolving granules based on lac-2,4-D.

Evaulation — It was reported earlier (A.R.: 1982) that formulations of lac-2,4-D combination were sent for evaluation to Agricultural Universities and Research Institutes. The reports received so far are summarized below:

The results of trials conducted at RRL, Jammu on lac 2,4-D for Barley (*Hardum vulgare*-V) and Latjera (*Achyran thesesaspara* L) indicated that Barley seeds were comparatively resistant to the formulation as compared to that of 2,4-D alone and lethal at much lower concentration. The 2,4-D sodium salt did not show any affect. The lac 2,4-D product was tried as a pre-emergent type weedicide for *Albizzia lebek* at F.R.I. and C, Dehra Dun and it was found that efficacy was at par with 2,4-D and 2,4-D sodium salt.

Preliminary experiments carried out at IARI, New Delhi for phytotoxicity/ tolerance of lac-2,4-D combination indicated that it is toxic to most of the crops namely cotton, tomato, bottle gourd, peas, gram, mustard, sawflower, oats, cow-pea and wheat.

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

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

Lac-based stickers — It was reported earlier (A.R.: 1983) that it is possible to prepare lac-based stickers possessing sticking behaviour similar to those of commercial stickers. Preliminary studies on the relative performance of lac-based and commercial sticker formulations were made in the laboratory using microcapsules. Commercially available BASF sticker (Acranol 4D) and lac-based stickers were diluted to a sprayable concentration (2·5% w/v) separately and then used. Same number of microcapsules suspended in sticker solution were applied to identical circular area, evenly spread on glass surface and dried overnight. The deposits were tested by applying a water spray through a hand sprayer from constant distance (18 cm) and angle (45°) at room temperature. The fall of microcapsules was observed. Preliminary observations indicated that lac-based stickers were comparable to those of BASF stickers.

Lac-based emulsifiers — Studies were undertaken to see the mode of sulphonation of aleuritic acid/shellac. Shellac was sulphonated in various molar proportions (1:7 to 7:5). It was observed that the preparation and handling of the material was not feasible with the above proportions except the proportions evolved by CLRI, Madras, i.e. shellac 100 part sulphuric acid, 89 part.

Aleuritic acid was also sulphonated in various (1:1 to 1:3) molar proportions with sulphuric acid. The handling of the product of higher molar proportion (7:3) was found difficult. The products were examined by TLC. Different physico-chemical characteristics of the resultant products were also determined. These have been summarized in Table 12. Considerable decrease in acid, hydroxyl values and melting point was observed as compared to control. The

TABLE 12 — CHARACTERISTICS OF SULPHONATED ALEURITIC ACID

Sl No.	Molar proportions of aleuritic acid/ sulphuric acid	Yield %	Melting point (°C)	Acid value	Hydroxyl value	Rf value	Solubility in water			pH of solution
							Cold (R. temp.)	Warm	Boiling	
1.	1:1	96	76-77	18·16	329	0·958	N.S.	S.S.	S	6
2.	1:2	94	81-82	19·46	335	0·958	N.S.	S.S.	S	6
3.	1:3	82·8	79-80	54·00	398	0·958	N.S.	S.S.	S	6
4.	Aleuritic acid (Technical)	—	97-98	177·8	526·8	0·657	N.S.	S.S.	S	4

N.S. — Not soluble; S.S. — Sparingly soluble; S — Soluble.

TABLE 13 — PHYSICAL CHARACTERISTICS OF ALEURITIC ACID AND ITS ALKYL ESTERS

Sl No.	Material	Molecular formula*	Molecular weight*	Molar volume (c.c.)	Difference in molar volume for adjacent members (c.c.)	Solubility parameter (d)		Difference in solubility parameter for adjacent members	
						Small's $(Cal/c.c.)^{\frac{1}{2}}$	Krevelen $(Cal/c.c.)^{\frac{1}{2}}$	Small's $(Cal/c.c.)^{\frac{1}{2}}$	Krevelen $(Cal/c.c.)^{\frac{1}{2}}$
1.	Aleuritic acid	$-C_{16}H_{32}O_5$	−304	278·98	— 15·03	9·40	10·09	— 0·02	— 0·05
2.	Methyl aleuritate	$-C_{17}H_{34}O_5$	316	294·01	— 15·03	9·38	10·04	— 0·03	— 0·04
3.	Ethyl aleuritate	$-C_{18}H_{36}O_5$	322	309·04	—	9·35	10·00	—	—

*Taken from literature.

products were found to be soluble in boiling water. The TLC of the reaction products showed good resolution in the solvent system, Chloroform: Methanol: Acetic acid: 90:10:2. Two distinct spots were observed. The upper spot was sulphonated aleuritic acid whereas the lower one was due to some unreacted aleuritic acid. The IR-spectra of the products obtained after sulphonation of aleuritic acid and shellac were studied.

The solubility parameters and molar volumes of aleuritic acid and its alkyl esters were calculated by Contribution techniques. These have been shown in the Table 13. The Small's value of δ was found to be almost the same for both the aleuritic acid and its alkyl esters. Similar observation was made in respect of the Krevelen value of *d*.

(B. C. Srivastava)

(c) RESEARCHES CONTEMPLATED

Synthesis of bis-heterocyclic compounds from aleuritic acid.

D. TECHNOLOGY DIVISION

(a) RESEARCHES COMPLETED — Nil

(b) RESEARCHES IN PROGRESS

4.1 Improvements in the Processing Techniques

4.1.5 Washing of sticklacs with synthetic detergents

It was reported earlier that eleven detergents were tried as washing aid for sticklac. Out of these, Genteel and Surf gave the best result. Yield was maximum with Genteel while bleach index was minimum with Surf. Other properties were almost the same.

During the year under report, *rangeeni* sticklacs were washed separately with 0·1 per cent of Genteel and Surf on semi-pilot scale in (20 kg lot). The yield was improved 2·5-4·0% with Genteel and 1·0-2·2 per cent with Surf while the bleach index was reduced to 1-3 and 2-5 units with Genteel and Surf respectively. The results were more or less similar to those obtained earlier on laboratory scale.

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

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

During the year under report, *kusmi* seedlac (colour index 12·0) was dewaxed at room temperature (28-30°C) using alcohol of various concentrations and then decolourized by the method standardized earlier. It was observed that yield of shellac and efficiency of decolourization increased with increase of concentration of alcohol, but dewaxing was more effective with dilute alcohol (Table 14).

TABLE 14 — PROPERTIES OF SHELLAC AFTER DEWAXING AND DECOLOURIZING *kusmi* SEEDLAC

Concentration yield of		Wax content (%)	Colour index
Alcohol (%)	Shellac (%)		
98	84·0	1·50	0·8
95	82·0	1·00	0·8
90	80·0	0·60	1·0
85	74·0	0·50	1·2
80	71·0	0·25	1·2
78	66·0	0·20	1·2
75	54·0	0·20	1·2
70	25·0	0·19	1·3

(R. K. Banerjee)

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

A method was standardized earlier to extract lac in aqueous alkaline medium from *kiri* (A.R.: 1983). The product had more or less the same life and flow as that of alcohol extracted product, but its acid value was high (103-105). To overcome this problem varying percentages of sodium hydroxide and sodium hydrosulphite were tried (Table 15). It was found that sodium hydroxide and sodium hydrosulphite (3% each) were found optimum to bring down the acid value to 91. The life and flow of the alkali extracted and alcohol extracted lacs were more or less the same (Table 15). The properties of the product remained unchanged when stored under laboratory conditions up to 4 months.

TABLE 15 — THE PROPERTIES OF SHELLAC OBTAINED FROM *kiri* LAC SAMPLES

Per cent of sodium hydroxide and sodium hydrosulphite	A.V.	Life (min)	Flow (mm)
1	87	Nil	Nil
2	88	12	10
3	91	15	13
4	105	16	21
Alcohol extracted	86	17	16

(A. K. Ghose)

4.2 Rubber-shellac Combination

4.2.2 Electrical properties of rubber-shellac blend

The experiments were repeated on the electrical properties of shellac compounded with natural (NR) and styrene-butadiene (SBR) rubbers-gum-stock. The value of dielectric strength of different rubber-shellac compositions at different

periods of curing are given in Table 16. Some improvement in the dielectric strength of both NR and SBR was observed with the incorporation of shellac. But little improvement in the dielectric strength was noticed in some cases with the increase in curing time. The values of dielectric strength of control and shellac containing SBR gum-stock were found to be low compared to those obtained with NR gum-stock.

Studies were also made on the electrical properties of blend of NR and SBR (1:1). The dielectric strength of the blend cured for 10 min, was found to be higher as compared to individual NR or SBR. The changes in the values of dielectric strength after incorporation of shellac in the blend are also shown in Table 16 and it may be seen that no marked improvement was obtained in the dielectric strength values of the blend after incorporation of shellac.

The variation of dielectric constant, dissipation factor (tan δ) and dielectric loss of NR gum-stock containing 5 parts of shellac per hundred parts of rubber was studied at 100 KHZ at temperature, between 30° and 110°C. Three sets of samples cured for 15, 20 and 30 min were tested. The variation of different dielectric parameters with curing periods at 30°C are shown in Table 17. The

TABLE 16 — DIELECTRIC STRENGTH (V/mil) OF VARIOUS RUBBER-SHELLAC COMPOSITIONS AT DIFFERENT PERIOD OF CURING

Curing time (min)	Natural rubber shellac content (%)				Styrene-butadiene rubber shellac content (%)				Blend (50:50) of natural and styrene butadiene rubber shellac content (%)		
	0	2·5	5	10	0	5	10	15	0	5	10
10	281	383	435	367	262	292	303	358	413	372	—
20	390	384	345	366	308	328	397	318	371	357	390
30	403	417	445	401	317	329	342	364	364	—	414
40	—	—	—	—	—	—	—	—	385	387	398
50	319	414	340	382	286	—	316	371	—	—	380

TABLE 17 — DIELECTRIC PROPERTIES OF NATURAL RUBBER-SHELLAC BLEND AT 30°C

Curing time (min)	Dielectric constant		Dissipation factor		Dielectric loss	
	Shellac 0	Shellac 5	Shellac 0	Shellac 5	Shellac 0	Shellac 5
15	2·68	2·30	0·0026	0·0011	0·00697	0·0025
20	3·11	2·82	0·001	0·0008	0·00311	0·00225
30	2·63	2·93	0·0024	0·0004	0·00632	0·00117

dielectric constant showed slight improvement as compared to control when cured at 30°C for 30 min only. At temperature above 30°C, a decrease in the dissipation factor and dielectric loss with the same increase in cure time was noticed.

4.3 Use of Lac in Adhesives

4.3.1 Modified lac (with synthetic monomers) as adhesives

In continuation of last years work, bleached lac solution in triethanolamine was modified with iso-butylacrylate in varying proportion in presence of hydrolysed lac (10%) and the bond strength of resulting compositions were determined. The results obtained were not encouraging.

Attempts were then made to modify bleached lac with *n*-butylacrylate in presence of hydrolysed lac (10% on the weight of bleached lac) in ammonical as well as triethanolamine solutions separately (Tables 18 and 19). This modification also however could not improve the bond strength appreciably as was in case of iso-butylacrylate, indicating the monomers are not suitable for this purpose.

TABLE 18 — ADHESIVE STRENGTH OF BLEACHED LAC (IN AMMONICAL SOLUTION) MODIFIED WITH *n*-BUTYLACRYLATE IN PRESENCE OF HYDROLYSED LAC

Sl No.	Bleached lac (g)	*n*-Butyl-acrylate (g)	Hydrolysed lac (g)	Bond strength on wood to wood (ton/inch²)
1	100	—	—	0·02
2	80	20	8	0·06
3	70	30	7	0·05
4	60	40	6	0·05
5	50	50	5	0·06
6	40	60	4	0·05

TABLE 19 — ADHESIVE STRENGTH OF BLEACHED LAC (IN TRIETHANOLAMINE) MODIFIED WITH *n*-BUTYLACRYLATE IN PRESENCE OF HYDROLYSED LAC

Sl No.	Bleached lac (g)	*n*-Butyl-acrylate (g)	Hydrolysed lac (g)	Bond strength on wood to wood (ton/inch²)
1	100	—	—	0·03
2	80	20	8	0·05
3	70	30	7	0·04
4	60	40	6	0·04
5	50	50	5	0·05
6	40	60	4	0·03

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

4.3.4 Modified hydrolysed lac (with epoxy resin and isocyanates) as adhesive

It was reported last year that Rebulac, a modified product of total hydrolysed lac, could be used to formulate cold setting adhesive (by treating it with toluene di-isocyanate) as well as pressure temperature curing type adhesive.

Since Rebulac is different from shellac, the optimum conditions for its bonding on different surfaces was worked out in detail (Tables 20-21). The optimum pressure, temperature and time for bonding mild steel to mild steel surfaces were found to be 3000 lbs/sq. in. at 200°C, for 45 min respectively for aqueous rebulac. The bond strength under these conditions was found to be 38 ton/sq. in. Corresponding bond strength of the parent shellac and total hydrolysed lac under similar conditions was found to be 0·06 and 0·15 ton/sq. in. respectively. Remarkable improvement was, thus, achieved in case of Rebulac.

TABLE 20 — BOND STRENGTH WHEN PANELS PRESSED AT 150°C FOR DIFFERENT TIME PERIODS AND PRESSURE

Sl No.	Pressure (lb/sq. in.)	Bond strength (tons/sq. in.) when the panels were pressed for the time (min)			
		30	60	90	120
1	500	0·11	0·09	0·07	0·00
2	1000	0·09	0·15	0·08	0·04
3	1500	0·12	0·14	0·11	0·09
4	2000	0·18	0·22	0·20	0·09
5	2500	0·17	0·20	0·19	0·11
6	3000	0·18	0·12	0·17	0·09
7	3500	0·12	0·10	0·09	0·08

TABLE 21 — BOND STRENGTH WHEN PANELS PRESSED AT 200°C FOR DIFFERENT TIME PERIODS AND PRESSURES

Sl No.	Pressure (lb/sq. in.)	Bond strength (tons/sq. in.) when the panels were pressed for the time (min)			
		15	30	45	60
1	500	0·09	0·18	0·21	0·08
2	1000	0·12	0·20	0·22	0·10
3	1500	0·11	0·18	0·23	0·13
4	2000	0·09	0·21	0·25	0·16
5	2500	0·12	0·23	0·28	0·14
6	3000	0·10	0·31	0·38	0·11
7	3500	0·11	0·19	0·19	0·12

Preliminary experiments were also carried out with total hydrolysed lac alone in solvent medium (dioxane) to study its suitability as adhesive for bonding the steel surfaces at 2000 lbs/sq. in. pressure for 1 hr at 150°C. The bond strength was found to be 0·17 ton/sq. in. The above product could be converted into a cold setting adhesive by treating it with toluene diisocyanate (50%) the bond strength of which on steel surfaces was 0·15 ton/sq. in.

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

4.4 Pilot Plant Studies on Lac Based Product and Processes

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

Lac-linseed oil fatty acid-red oxide primer prepared earlier was stored in polythene containers under laboratory conditions. The hardness, flexibility and water resistance tests were carried out periodically and no deterioration in these properties was noticed up to one year. It was also observed that there was no thickening of the primer. The pigment which settled could be redispersed easily.

(P. C. Gupta)

(c) RESEARCHES CONTEMPLATED

Nil

E. EXTENSION DIVISION

(a) PROJECTS COMPLETED

5.3 Effect of Storage on Sticklac

The project was taken up with the objective to study the physico-chemical changes in lac resin associated with prolonged storage of sticklac.

The experiments were conducted with the following six sticklac samples:

Sample	1	*Baisakhi*	1977-78	*ari* (Palamau)
Sample	2	*Baisakhi*	1977-78	*ari* (Ranchi)
Sample	3	*Baisakhi*	1978-79	*ari* (Purulia)
Sample	4	*Baisakhi*	1979-80	*ari* (Palamau)
Sample	5	*Aghani*	1979-80	mature (Ranchi)
Sample	6	*Baisakhi*	1980-81	*ari* (Ranchi)

All the above sticklacs had a high initial moisture content (12-15%) and showed a tendency to form hard lumps (known as blocking) if left undisturbed. The samples were, therefore, subjected to raking and the moisture contents were determined at frequent intervals. It was found that sticklacs with a moisture content, 4·5 per cent (max.) showed no blocking tendency and this may be taken as the optimum moisture content for storing sticklac. The above 6 sticklac samples were, therefore, dried up to this level and stored in hessian bags (50 kg each) under ambient conditions at Ranchi. A part of sample 1 was also stored at Kundri, Palamau district (hot area). Representative samples drawn from each lot at regular intervals, were converted into seedlac and tested for impurities, colour, flow, life and rate of filtration. For the sake of comparison, the seedlac samples were also stored and simultaneously tested for the above constants. The experiments were continued for a period of 30-65 months.

The experimental data clearly demonstrated that prolonged storage in the form of sticklac resulted in a rise in hot alcohol insolubles and colour and a fall in flow, life and rate of filtration. It was found that flow of the lac resin was most significantly affected during storage. Results of analysis of the three *baisakhi* sticklac samples, i.e., samples 1, 2 and 3 which were stored under similar conditions showed a loss in flow values to the extent of 61-75 per cent after 56 months storage. It is interesting to note that the life of all the above three samples after the same period of storage were 34-36 min irrespective of their initial life (52-60 min) and place of origin. Similar trend in change of properties was also noticed in case of sample stored as seedlac except colour which remained unaffected.

Table 22 gives a comparative picture of the rate of deterioration of the *kusmi* (*aghani*) and *rangeeni* (*baisakhi*) sticklacs collected from the same area and stored under similar conditions.

It is evident from the table below that the rate of fall in the values for flow and life of the *Baisakhi* sticklac is appreciably faster as compared to that of *kusmi* sticklac. The results indicate that the *kusmi* lac retains its properties longer than the *rangeeni* lac during storage.

The changes in the properties of lac resin during the various stages of maturity of the crop while on the tree were also studied (Table 23).

The data indicate that the resin attains maximum flow and life when the crop is 5-month old.

TABLE 22 — COMPARATIVE STUDY ON THE EFFECTS OF STORAGE ON *kusmi* AND *rangeeni* STICKLAC

Sticklac	Period of storage (months)	Properties of seedlac obtained from the stored sticklac			
		Impurities (%)	Colour	Flow (mm)	Life (min.)
Kusmi					
Aghani 1979-80	0	2·90	12	51	57
Ranchi	12	—	12	51	57
	20	2·90	15	51	54
	30	—	14	36	52
	40	—	14	30	49
Rangeeni					
Baisakhi 1980-81	0	2·63	13	51	54
(*ari*)	12	3·60	13	38	45
Ranchi	20	3·80	14	25	42
	30	—	13	16	36

TABLE 23 — PROPERTIES OF THE LAC RESIN DURING DIFFERENT DEVELOPMENT STAGES OF LAC CROP: *Baisakhi* 1983-84 (COLLECTED FROM KUNDRI)

Stage of maturity	Characteristics of the lac resin					
	Impurities (%)	Colour	Flow (mm)	Life (min)	Iodine value	Acid value
3-month old	14	Above 35	Nil	The sample gels within 20 min	8·0	77·4
4-month old	6·60	15	28	62	13·72	74·20
5-month old	3·26	14	51	70	15·23	71·00
6-month old	3·68	14	46	66	16·00	71·30
Phunki	3·20	15	35	59	15·65	70·98

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

(b) PROJECTS IN PROGRESS

Nil

(c) PROJECTS CONTEMPLATED

(i) Studies on shellac-synthetic resin polyblends.

(ii) To lay down specifications for hydrolysed lac.

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

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

A. INSECT CULTURE PROGRAMME

(a) *Lac Culture*

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

Rangeeni sticklac coupe — Baisakhi 1983-84 *ari* (immature) sticklac crop was harvested from 121 *ber* trees of the four villages and average yield of 1·005 kg per tree was obtained as against 0·360 kg recorded from the traditionally operated trees and thus an average increase of 179 per cent was demonstrated

Rangeeni brood lac coupe — Baisakhi 1983-84-cum-*katki*-84 brood lac crop was harvested from 97 *palas* trees of 37 cultivators of all the four villages during October-November 1984 and average yield of 1·385 kg/tree was obtained as against 0·460 from the traditionally operated trees. These trees were pruned during April/May 1984, inoculated during October-November of the same year with an average rate of 0·620 kg brood lac per tree and no special pest control measures were applied. On the whole 201·1 per cent increase in the brood lac yield was thus demonstrated.

Kusmi crops — Jethwi-84-cum-*Aghani* 1984-85 crop was grown on 9 *kusum* trees by equal number of farmers during January/February 1984 using 0·833 kg brood lac per tree enclosed in synthetic netting containers. Partial harvesting of one tree was done by one farmer and 8 kg sticklac was obtained. The remaining trees were left for self inoculation during July 1984 and the crop was developing satisfactorily till the end of reported period.

(b) *Apiculture*

A stipendiary training of one month duration was organized with the cooperation of Khadi and Village Industries Commission (KVIC) during February-March 1984 and 33 farmers including 11 farm women were trained in scientific bee keeping. Out of the stipend payable to the trainees, 63 bee-hives, 29 catchnets, 4 honey extracting machines and 2 capping knives were supplied. By the end of the year under report, 78 keepers owned 233 hives but only 27 keepers possessed 60 bee colonies. Only 21 keepers produced 196 kg honey from 52 colonies. The sale of the honey in clean bottles was arranged at a rate of Rs 25 per kg and a cash income of Rs 233.33 only was recorded per bee keeper.

Although 64 new colonies were captured this year, the net balance of colonies was reduced by nearly 37 per cent due to 103 desertions. The dearth of natural food during winter season was responsible for more than 40 per cent losses. Heavy build up of wax moth in the old colonies and the repelling taint of new wood in the new hives supplied this year were the other important constraints responsible for the low number of colonies and less honey production. Efforts were made to remove the above mentioned constraints by arranging planting of eucalyptus seedlings and instructing the keepers to apply wax on the inner walls of the hives, cleaning the base-boards at weekly interval and storing the empty combs in tight containers using Paradichlrobenzene as a fumigant.

B. CROP PRODUCTION PROGRAMME

(a) *Agricultural crops*

Purchase of 30 more bullocks was arranged through District Rural Development Agency (DRDA) and Kshetriya Gramin Bank (KGB) at a cost of Rs 15,794 only in order to augment the farm power.

Total 66 soil samples of 41 farmers were got analysed by the Asstt. Soil Chemist, Ranchi. The *p*H of the soils ranged from 5·0 to 6·1. Farmers were trained in the efficient use of fertilizers and lime, etc. During *Kharif* 1984 season, trials with the improved varieties of groundnut (AK 12-24), black gram (T-9), pigeon pea and soyabean (Bragg) covering 3·26 ha area were conducted. Average

yield of groundnut and black gram were 2 and 4·8 q/ha only respectively. Maximum yield of blackgram was recorded to be 8 q/ha. The trials with pigeon pea and soyabean were not encouraging. The poor yield of groundnut is probable due to theft and inadequate rainfall at the time of maturity.

(b) *Horticultural crops and agroforestry*

Seedlings of *Acacia auriculiformis* (75), arjun (20), *bakend* (10), *ber* (75), *barhal* (10), *Artocarpus* spp. (10), Eucalyptus (555), *Gamhar* (135), Guava (450), Gulmohar (33), Jackfruit (325), *Karanj* (25), *Kachnar* (10), Mango (25), Papaya (390), *Shisham* (50), *Sal* (25), totalling 2223 were procured from the Forest Department and distributed amongst the farmers of the area for planting.

In addition, improved plant materials as per the details given below were purchased on behalf of the farmers for raising gardens:

IMPROVED PLANT MATERIALS

Plant	Varieties	Type of material	Number	Source	Cost Rs
Banana	Dwarf Cavendish, *Alpan*, *Nendrakanan*, *Kaliban* Nos. 13 and 73-2	Suckers	181	Central Hort. Exper. Station, Ranchi (CHES)	144.80
Coconut Palm	East Coast	Seedlings	40	Agriculture Deptt., Ranchi	40.00
Custard Apple		do	02	Kanke Block Nursery, Ranchi	02.00
Guava	L-49 and *Allahabad Safeda*	Gootie	24	CHES, Ranchi	72.00
Guava	*Allahabad Safeda*	Seedlings	10	Kanke Block Nursery, Ranchi	07.50
Lemon	*Kagji*	Seedlings	19	do	19.00
do	do	Gootie	05	Mullick Nursery, Ranchi	22.50
Litchi	China	—	05	do	25.00
	Muzaffarpur Green Seedless	Gootie	07	CHES, Ranchi	38.50
Mango	*Banarsi Langra*	Graft	04	Mullick Nursery, Ranchi	30.00
Mulberry		Cuttings	50	Private gardner	Free
Papaya		Seedlings	337	CHES, Ranchi	84.25
Passion Fruit		Rooted cutting	01	CHES, Ranchi	01.00
Phalsa		Cuttings	53	I.L.R.I. Campus	Free
					486.55

C. ANIMAL HUSBANDRY PROGRAMME

General animal healthcare was ensured with the cooperation of the Animal Husbandry Department by arranging timely vaccination, guest lectures and supply of medicines.

(a) *Poultry Keeping*

Three surviving white leghorn hens laid at the rate of 60 eggs/bird/stroke year prior to their death during the month of April, May and July. Out of the 8 cocks of 'Pebcock' strain released last year for improvement of the local stock, only one survived till October and crossed progeny was observed.

(b) *Swine Husbandry*

White Yorkshire piglets (19♀ and 6♂) to five farmers was arranged at a nominal price of Rs 5 each from the A.H. Department under 'fattener scheme' during January. Heavy mortality (88%) was recorded by the end of May. Two survivors were disposed off by two farmers for a cash income of Rs 260 and Rs 150 respectively during August-September. Only one male attained the age of 12 months and was retained by the keeper for improving his own local stock.

One crossbred sow farrowed six piglets during February, out of which three died during July due to pox and two were slaughtered and consumed. One farmer disposed off his old stock (crossbred) of 5 pigs for Rs 775. By the end of the year, two pigs of over one year old and one male aged 10 months survived. One crossbred female was pregnant.

Improper and inadequate feeding especially to the young stock without a nursing mother and supply of underweight weaners were the important constraints in raising the fattener stock by the tribals.

(c) *Dairy*

Out of the six crossbred cow units started earlier, three original cows survived during the year having death and birth. Four males of the first delivery attained maturity which were utilized for ploughing, etc. One of the beneficiaries purchased the bullock from the other beneficiary of the scheme at a price of Rs 375 in order to complete his pair of crossbred bullocks. One female each of the first and second delivery from the same mother attained the age of 44 and 21 months respectively but no pregnancy was observed in any case. As reported earlier, malnutrition and indifferent management of cows were responsible for almost negligible milk yield and infertility.

(d) *Goat Keeping*

Outright mortality amongst 20 Black Bengal goats supplied during November 1983 under IRD Programme was recorded without giving any economic return to the beneficiaries. Thirty per cent mortality was recorded during January-February and the remaining seventy per cent during August-September mainly due to parasitic mange infection. During 1981 also, a batch of 48 goats died due to mange without giving any economic return. Thus the mange infection has emerged as the most serious constraint in this area.

One 'Black Bengal' goat (non-IRDP) started during 1983 and comprising of one male and one female gave birth to one kid during May but the same was lifted by hyena during July. The buck was reported stolen during June and only one pregnant goat survived till the end of the year. Apart from the parasitic mange, wild animals and theft were the other important constraints.

D. FISHERIES

Stocking of the tanks with composite fishery could not be done due to the strike of the State Govt. staff, including the Fisheries Department.

E. EXTENSION EDUCATION PROGRAMME

Regular Farmers forum meetings were conducted every month in all the four villages and discussions were held on the new technologies, constraints and the felt-needs of the farmers.

One field day on soil testing and *Kharif* crop production was organized during May. Fortysix soil samples of 23 farmers were tested on the spot by the mobile soil testing Laboratory and the report of the other 20 soil samples of the 18 farmers in the test Laboratory of the Agriculture Department were communicated to all the 41 farmers. Lectures on the method of collection of soil samples and efficient use of fertilizers based on the soil test report were delivered. Farmers saw the soil testing equipment and the testing operations. Films on the Paddy and Soyabean cultivation were also shown to a large gathering.

A '*Krishi Vikas Club*' was started and the members were encouraged to raise gardens of improved varieties of fruit and other plants and also the use of improved seeds and inputs. The members visited *Kisan* and *Udyan Melas* at Kanke and Polandu respectively and the printed extension material including *Divyayan Samachar*, a publication of Krishi Vigyan Kendra, Ramakrishna Mission, Ranchi were supplied to them.

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 continued to be rendered to the Forest Department, Bihar in running their Lac Farm at Kundri (Palamau), consisting of nearly 40,000 *palas* trees. Various seasonal operations were carried out in the Farm under the supervision of this Division. A total of 20,437 *palas* trees were pruned/ari harvested during April/May yielding 20·79 quintals of sticklac. The total broodlac yield was 92·53 quintals which was used for inoculating 17,655 trees. On scraping, *phunki* lac sticks 5·28 quintal of scraped lac was obtained. The operations involved an expenditure of Rs 22,281.00 and a net profit of Rs 16,906·00 only.

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 the Government officials and representative of the industries on various aspects of lac development.

The Division also 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 and schemes were sent whenever asked for. Some of the important activities are listed below:

(i) Two entrepreneurs were demonstrated the process for manufacturing bleached lac.

(ii) Representative of a local Chemical Industry and two other entrepreneurs were demonstrated the process for manufacturing Gasket Shellac Compound.

(iii) The process for manufacturing hydrolysed lac was demonstrated to a nominee of Dr. Vineet & Co. and three other entrepreneurs.

(iv) M/s Jagannath Jwala Prasad, Daltonganj were assisted in overcoming the difficulties while manufacturing quality bleached lac.

(v) M/s Veena Enterprise, Bombay were advised regarding the use of solvents and quality of shellac for the manufacture of Gasket Shellac Compound.

(vi) A composition for general purpose cement was sent to a firm at Delhi.

(vii) Technical assistances were continued to be given to the interested lac growers and agencies 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) Kisan Mela organized by R. K. Mission at Getalsud during January. The Institute's stall was adjudged to be the best and awarded a trophy by the organizer.

4. *Testing of lac and lac products*

Eightytwo samples of seedlac, shellac and other lac based products were received from Govt. organizations and private industries and in all 238 tests were carried out.

5. *Training*

Two in-service and three private candidates who were admitted to the course on "Improved Methods of Lac Cultivation" during the session October 1983 to March 1984, completed their training successfully.

Three in-service and one private candidate admitted to the above course during the session April 1984 to September 1984 also completed their training successfully.

Only one private candidate was admitted to this course for the session October 1984 to March 1985.

One candidate sponsored by the Directorate of Lac Development, Ranchi and three candidates sponsored by Shellac Export Promotion Council, Calcutta were given introductory training in lac cultivation.

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

Three private candidates who were admitted to the course on "Industrial Use of Lac" in the month of October completed their training successfully.

The Division also arranged the training of four F.A.O. Fellows from Vietnam for a period of 2 months only.

6. *Production Unit*

During the period under report, only 3 kg DXO-grade water-soluble lac could be prepared and sold for Rs 129 only. More quantities could not be prepared because of non-availability of raw materials in the market.

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 1984 is given below:

1. *Bulletins*	
(i) Chemical	164
(ii) Entomological	103
2. *Technical notes*	30
3. *Research notes*	
(i) Chemical	85
(ii) Entomological	52
4. *Miscellaneous technical publications*	
(i) Physico-chemical	14
(ii) Entomological	48
5. *Books and Monographs*	15
6. *Pamphlets and Leaflets*	35

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

List of papers published during the year 1984

Sl No.	Authors	Title of paper	Name of Journal
		A. ENTOMOLOGY DIVISION	
1.	Srivastava, D. C., Chauhan, N. S. and Teotia, T. P. S.	Seasonal abundance of insects associated with the Indian lac insect, *Kerria lacca* (Kerr.)	*Indian Jr. Ecol.*, 11(1), 37-42
2.	Srivastava, D. C. & Chauhan, N. S.	A critical appraisal of parasitic losses	*Indian Shellac No. 9d, No.* 2, p. 24
		B. AGRONOMY AND PLANT GENETICS DIVISION	
1.	Kumar, P., Srivastava, D. C. and Teotia, T. P. S.	Pigeon pea for lac cultivation	International Pigeon pea Newsletter (IPN), No. 3

C. CHEMISTRY DIVISION

1.	Goswami, D. N. and Kumar, S.	Study on the curing of shellac with epoxy resins by dielectric measurements	*Angew, Makramol. Chem.*, 126, 145
2.	Goswami, D. N. and Kumar, S.	Study on the curing between shellac and melamine resin by dielectric measurements	*Angew. Makromol. Chem.*, 127, 211
3.	Banerjee, P. K., Srivastava, B. C. and Kumar S.	Some studies on dialysed shellac	*J. Oil Col. Chem. Assoc.*, 67, 6, 146
4.	Banerjee, P. K., Srivastava, B. C. and Kumar, S.	Electrophoretic mobility of shellac and encapsulation	*J. Oil Col. Chem. Assoc.*, 67, 8, 217
5.	Prasad, N., Prasad, K. M. Ghosh, A. K. and Khanna, B. B.	Spectrophotometric studies on laccaic acid,	*J. Oil Col. Chem. Assoc.*, 67, 5, 117
6.	Majee, R. N., Agarwal, S. C., Mukuerjee, S. N. and Chatterjea, J. N.	Syntheses and biological activities of *trans*-Δ^9-hexadecenyl urea and *trans*-Δ^2-undecenyl urea	*Curr. Sci.*, 53(8), 256-258

D. TECHNOLOGY DIVISION

Nil

E. EXTENSION DIVISION

1.	Saha, S. K. and Banerjee, B. P.	Shellac Bond Powder for the Laminated micanite sheets and moulding micanite	Indian Shellac, 1984 (1), 5-8

5. CONFERENCES AND SYMPOSIA

The Institute has been deputing scientists to attend conferences/symposia/seminar and training held at various Institutions/organizations/universities in India. The details for the period under report are as follows:

1. Sri S. C. Srivastava, S-1, January 1984	Attended 71st session of the Indian Science Congress Association held at Ranchi
2. Dr S. K. Saha, S-3, February 1984	Chaired to ISI meeting held at Calcutta on 21st and 22nd February 1984 for Lac and Lac Products Sectional Committee (Cd c9)
3. Ibid, September 1984	Attended a workshop on Agricultural Research Management held at NAARM, Hyderabad
4. Sri R. C. Misra, S-2, January 1984	Attended a National workshop on Science, Technology and Rural Development in Rural Context held at Bishnupur, Ranchi
5. Ibid, January 1984	Attended 71st session of Indian Science Congress Association held at Ranchi
6. Ibid, October 1984	Attended Agricultural Research Management Workshop on Operational Research Projects of ICAR held at NAARM, Hyderabad

6. SUMMARY

A. ENTOMOLOGY DIVISION

(a) RESEARCHES COMPLETED

Nil

(b) RESEARCHES IN PROGRESS

1.1.8 Alternation of *khair* with *palas*, for raising the *katki* and *baisakhi* crops respectively proved unsuccessful.

1.2.2 The lac larvae could be reared on synthetic diet for two to four weeks only in the different crops.

1.2.5 The effect of soil application of fertilizers to the host plant on lac insects could not be studied due to mortality of host plants.

1.2.6 Standard curve has been prepared to initiate the estimation of the total protein content of lac insects.

1.2.7 Histophysiological studies on the epidermal glands of the male and female lac insects were attempted but satisfactory sections of male lac insect could not be obtained.

1.2.8 A new staining formulation for the staining of chromosomes with laccaic acid has been developed. Attempts for nuclear staining have given somewhat satisfactory results.

1.3.5 The *aghani* and *jethwi* lac crops were raised with brood lacs obtained from different States. These crops were rather poor in general.

The seasonal and locational abundance of the inimical and beneficial insects of lac of different districts of Madhya Pradesh is studied.

1.3.6 Study of the lac insect larval settlement on *kusum* has shown that their density of settlement varies with the canopy and quadrant of the tree. The predator incidence was higher in the lower canopy and *Chrysopa* spp. was prominent.

1.3.8 Experiments were carried out to determine the sampling unit for the study of the first instar and sexually differentiated *rangeeni* lac insects.

The crawler mortality in *rangeeni* lac insects was studied in relation to three host plant species.

1.3.9 Natural rain was not found to affect the lac larval settlement on *bhalia* bushes.

1.3.10 Relative abundance of the lac associated insects of the *rangeeni* strain was studied in six different climatic regions of Chotanagpur. The results were similar to those of the previous year.

1.4.1 (2) Field trials for the integration of chemical and cultural methods of pest control showed that the pest suppression and lac yield was maximum with the integration of insecticidal control and trap cropping.

1.4.3 Further screening trials with insecticides have shown three systemic insecticides to be effective against the lac predators remaining safe to lac insects.

Microplot field trials with Dimecron, Padan and Evisect which were earlier found safe to lac insect were effective against the lac predators.

The recommended control schedules for the control of lac predators were also found to result in marked reduction of inimical parasites. The size of lac insects increased with the application of low concentrations of Thiodan®. The application of insecticides was found to improve the fecundity of lac insects which was maximum with Thiodan® (0·05 per cent).

1.4.4 Pure and mixed isolates of pathogenic microorganisms obtained from the diseased predators were not found to be virulent.

1.4.9 Dimilin, was effective against the larvae of *E. amabilis* without showing adverse effect on the one-month old lac insect.

1.4.10 Screening trials with insecticides against *Chrysopa* spp. showed BHC to be more effective than Chlordane.

1.4.13 Lac predator larval densities above 4 per 30 cm lac encrustation caused economic damage to the lac crop.

1.4.14 Encouraging results were obtained with a new method for destroying the pests harboured by brood lac.

1.5.8 The *rangeeni* and *kusmi* stocks of lac insect collected from different regions were maintained.

1.5.10 Comparison of sex ratio of inbred lines of lac insects could not be made due to loss of experimental cultures.

1.5.11 Cytological studies were carried out with the Assam lac insect.

B. DIVISION OF AGRONOMY AND PLANT GENETICS

(a) RESEARCHES COMPLETED

Nil

(b) RESEARCHES IN PROGRESS

2.1.8 *Baisakhi* (*ari*) 1983-84 lac crop suffered heavy mortality during summer months. Tasar larvae could not survive up to the maturity stage.

Baisakhi (1984-85) lac crop developed satisfactorily till the end of the period under report.

2.2.1 Under the floral biology studies, the stigmas of *Moghania macrophylla* and *Moghania chappar* were found to be receptive 48 to 54 hr after emasculation in flower bud, ranging from 4 to 6 mm size.

2.2.2 *Aghani* 1983-84 lac crop on *bhalia* was very poor due to heavy attack of lac predators. *Aghani* 1984-85 crop developed satisfactorily till the period under report.

2.2.3 The yield of intercrops was found to vary with the *arhar* varieties during *aghani* 1983-84 lac crop season.

2.2.3.2 During *baisakhi* 1983-84 and *jethwi* 1984 lac crop season, *arhar* grain yield was reduced due to lac inoculation and the lac insects died due to excessive heat, during summer months.

2.2.4 Pure line seeds of *Assam* cv and *Bahar* var. irradiated with gamma rays at doses ranging between 10 and 60 kR showed that the germination and survival percentage decreased with the increase in dose.

2.2.5 The *ber* seedlings treated with one per cent colchicine showed a decrease in number and increase in size of stomata as compared to control.

C. CHEMISTRY DIVISION

(a) RESEARCHES COMPLETED

3.1.1 The constituents of lac-wax which have so far been identified are a saturated C_{33} acid, a C_{36} alcohol, a C_{32} saturated alcohol and a C_{27} hydrocarbon. A liquid fraction, which is a mixture of C_{13}, C_{20} and C_{22} hydrocarbons, has also been isolated from lac wax.

3.1.3 The periodic determination of different physico-chemical properties of 14 samples of seedlac and shellac has indicated that the flow is the most sensitive property which is affected on ageing and it is possible to correlate it with the age.

3.1.5 A modified method has been developed for the isolation of aleuritic acid from lac to the tune of 35% which involves minimum use of costlier chemicals as compared to the conventional method.

It has been found that *kiri* lac, which is cheaper and contains a good amount of resin, can be utilized for the isolation of aleuritic acid on large scale by the conventional method of alkaline hydrolysis.

The gummy mass, a waste obtained during isolation of aleuritic acid, has been found to be a suitable substitute for the normal hydrolysed lac in the formulation of gasket-shellac compound.

3.2.8 Dehydrocivetone, having must-like odour was synthesized from aleuritic acid adopting simple reaction sequence. Cyclic ureides e.g., *trans*-Δ^9-hexadecenyl urea, *trans*-Δ^2-undecenyl urea and pimelyl urea were also synthesized from aleuritic acid.

Preliminary screening of *trans*-Δ^9-hexadecenyl urea and *trans*-Δ^2-undecenyl urea showed no gross behavioural effects up to dose levels of 500 mg/kg body weight when administered intraperitoneally to mice. However, these two compounds at the same dose level of 500 mg/kg body weight when administered intraperitoneally elicited electrocardiographic changes in mice.

(b) RESEARCHES IN PROGRESS

3.1.8 Spectrophotometric studies were made on the interaction of laccaic acid, its sodium salts with DNA at different DNA-phosphate to dye-ratios. The spectral changes of laccaic acid and its sodium salts, due to progressive addition of DNA, consisted essentially of a bathochromic shift and hypochromicity. The study indicated that laccaic acid and its sodium salts bind with DNA.

3.1.10 The rate of adsorption of lac on charcoal studied at 20°C and 60°C is proportional to the equilibrium concentration.

3.1.11 The addition of 5% sodium sulphite during hydrolysis of shellac increased the yield of jalaric acid from 6 to 10-12%.

3.1.12 A few pure compounds were obtained by carrying out oxidation reaction of aleuritic acid, jalaric acid, total hydrolysed lac and jalaric acid free hydrolysed lac with nitric acid.

3.2.10 1,4,12-Trimethoxy dodecane, prepared from aleuritic acid showed light JH activity on one-day-old pupae of *Corcyra cephalonica* while it was not so with 1,4,12-trihydroxydodecane, viz., methyl-Z(7)-hexadecenoate and E(9)-dodecene-1-yl acetate synthesized from aleuritic acid. Several known compounds were also prepared for testing their JH activity.

3.3.3 (ii) Colour throw of cation exchanges resins from styrenated lac was minimized by extraction with sodium carbonate and spirit. It was observed that 50% styrenated resin threw more colour than 20%.

3.3.6 (ii) The baked films of the reaction product of hydrolysed lac and Desmodur L (100%) showed good alkali resistance. The air-dried films of the above reaction product and both air-dried and baked films of the reaction product of hydrolysed lac and Desmodur L® (75%) showed good water and acid resistance but possessed poor alkali resistance.

3.3.10 The rate of polymerization of lac was studied by the viscometric method in the alcoholic phase in the presence of benzoyl peroxide at 100°C. The estimation of the gel content also gave information about the rate of polymerization.

3.3.11 The air-dried films obtained from shellac-ethyl cellulose solution showed improved surface coating properties such as scratch hardness, flexibility and water resistance compared to those of plain shellac.

3.3.12 Lac wax modified with different calcium salts showed increased hardness and ash content. There was, however, no change in the melting point.

3.4.3 Storage stability test of the pattern paint composition based on ordinary shellac showed no deterioration in the paint texture as well as in its film performance even after one year storage in air tight containers. Two fresh lots of this composition were prepared for evaluation by the consumers.

3.4.4 Esterification of shellac with glycerol in different molar ratio has been studied under different conditions of time and temperature at different stages of reaction monitored with the help of TLC. The best results were obtained when shellac was reacted with glycerol in 3:1 molar ratio in the presence of BF_3, EtO_2 at reflux temperature for 5 hr.

3.4.5 Study on the anticorrosive properties of the primer composition based on dewaxed lac double boiled linseed oil vehicle did not give consistent results. The varnish based on dewaxed lac-double boiled linseed oil showed no gelling or thickening even after 1½ year of storage. The primer prepared with this varnish also produced hard, smooth and adherent films on ferrous metals.

3.5.3 Granules of 2,4-D based on soap-stone as carrier and different binders were prepared. The disintegration test indicated the order of binding power to be PVA>shellac>casein>sodium CMC. The hardness of water had no apparent

effect on the disintegration of granules. Indications were obtained that soap-stone as carrier and PVA as binder may be used for the preparation of lac-2,4-D based slow-dissolving granules for the aquatic weed control.

3.5.4 Preliminary studies on the relative performance of lac-based stickers and commercially available stickers indicated that both are comparable.

Aleuritic acid was sulphonated and the physico-chemical properties of the resultant product were studied.

D. TECHNOLOGY DIVISION

(a) RESEARCHES IN PROGRESS

4.1.5 *Rangeeni* sticklacs in 20 kg lots were washed separately with Genteel and Surf. The results obtained were more or less similar to those obtained earlier.

4.1.6 (ii) The yield of shellac and efficiency of decolourization increased with the increase in concentration of alcohol.

4.1.7 By reducing the percentage of sodium hydroxide and sodium hydrosulphite from 4 to 3 per cent in aqueous alkaline medium, a product was obtained which was more or less similar to that obtained from alcohol extracted *kiri* lac

4.2.2 Dielectric strength of control and shellac containing NR compositions were found to be better as compared to that of SBR compositions. Incorporation of shellac into NR gum-stock was also found to show improvement in dissipation factor and dielectric loss.

4.3.1 Adhesive compositions based on bleached lac and *n*-butylacrylate could not show improvement over the composition based on iso-butylacrylate indicating thereby the monomers are not suitable.

4.3.4 Optimum conditions have been found for aqueous rebulac for bonding steel surfaces.

4.4.2 Lac-linseed oil fatty acid-red oxide primer stored in polythene containers up to one year showed no detorioration in respect of hardness, flexibility and water resistance.

E. EXTENSION DIVISION

(a) RESEARCHES COMPLETED

5.3 It was found that prolonged storage in the form of sticklac resulted in a rise in hot alcohol insolubles and colour and a fall in flow, life and rate of filtration. *Kusmi* (*aghani*) lac was found to retain its properties longer than the *rangeeni* (*baisakhi*) lac during storage. It was also observed that the lac resin attained maximum flow and life when the crop is 5-month old.

7. METEOROLOGICAL REPORT FOR THE YEAR 1984

The average meteorological data for each month/year were as follows:

Month	Mean barometric pressure mm per month/year		Mean maximum temp. °C per month/year		Mean minimum temp. °C per month/year		Mean dry bulb temp. °C per month/year		Mean wet bulb temp. °C per month/year		Mean humidity % per month/year		Total rainfall mm	Highest maximum temp. °C	Lowest minimum temp. °C
January	708·71		22·53		10·67		15·22		14·19		78·29		41·2	26·5	5·5
February	706·94		25·39		11·94		17·39		13·44		66·55		5·0	30·5	7·6
March	706·14		33·32		15·52		25·67		17·70		43·90		Nil	38·0	8·8
April	703·21		37·20		21·70		29·63		22·16		52·23		22·0	42·0	16·6
		703·56		30·08		17·52		23·92		19·92		66·46			
May	699·64		39·72		23·90		32·38		24·96		56·19		41·4	44·0	20·0
June	699·66		30·4		23·05		26·5		24·31		86·53		406·2	38·5	21·1
July	698·2		29·72		22·76		25·75		24·43		89·99		314·6	31·0	21·6
August	697·38		28·49		22·34		24·82		23·72		90·67		486·6	31·5	21·6
September	701·95		29·96		21·08		25·65		23·05		80·4		204·4	32·5	17·2
October	704·51		30·37		18·06		25·35		21·45		70·87		84·0	33·5	13·3
November	708·68		27·26		11·00		20·9		16·13		60·73		Nil	29·0	7·2
December	707·67		27·06		8·22		17·80		13·50		61·25		Nil	30·0	5·0

The highest maximum temperature recorded was 44·0°C on 25th May and the lowest minimum temperature 5·5°C on 1st, 18th January. The total rainfall during the year amounted to 1605·4 mm of which the monsoon (June to September) rainfall was 1411·8 mm. The rainfall during the year was higher than that of 1983 (1428·4 mm).

8. PERSONNEL

Sl No.	Name of the Post	Staff position as on 31-12-1984
1.	Director	Dr T. P. S. Teotia up to 5-2-84 Dr B. B. Khanna w.e.f. 6-2-84
	Entomology Division	
1.	Head, Division of Entomology	Sri 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 (3) Sri R. Ramani
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 Y. D. Mishra (7) Sri M. L. Bhagat
5.	Technical Assistant (T-5)	Sri M. K. Chowdhury
6.	do (T-4)	Sri K. U. Shankar S. Sinha
7.	do (T-II-3)	(1) Sri A. K. Sahay (2) 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)	(1) Sri B. B. Chakravorty (2) Sri G. M. Borkar
	do (T-2)	(1) Sri Bhola Ram (2) Sri S. K. Chatterjee (3) Sri Ghanshyam Das
11.	Field Technician (T-I-3)	Sri R. D. Pathak
	do (T-2)	(1) Sri H. N. Sukhla (2) Sri K. P. Gupta
12.	Insect Collection Tender (T-2)	Sri R. L. 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 Assistant (T-2)	Sri Munna Lal Ravidas
16.	Junior Stenographer	Sri A. K. Sinha
	Regional Field Research Station, Dharamjaigarh (M.P.)	
1.	T-II-3	Sri R. S. Maliya
2.	T-I-3	Sri A. 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 B.A.U. Ranchi)
4.	Scientist S-1 (Agronomy)	Sri B. P. Singh (on study leave)
5.	Laboratory Technician (T-I-3)	Sri D. D. Prasad
	do (T-1)	Sri Mohan Singh
6.	Field Technician (T-1)	(1) Sri Jagarnath Oraon (2) Sri K. A. Nagruar

Chemistry Division

1.	Head, Division of Chemistry	Dr B. B. Khanna, S-4 up to 23-11-84 Sri S. Kumar, S-4 w.e.f. 24-11-84
2.	Scientist S-3 (Organic Chemistry)	Dr S. C. Agarwal
3.	Scientist S-2 (Physical Chemistry)	Dr A. Kumar
4.	Scientist S-2 (Organic Chemistry)	(1) Dr N. Prasad (2) Dr R. N. Majee
5.	Scientist S-2 (Physics)	Dr D. N. Goswami
6.	Scientist S-1 (Organic Chemistry)	(1) Sri A. K. Dasgupta (2) Dr B. C. Srivastava (3) Sri K. M. Prasad (4) Sri M. Mukherjee
7.	Scientist S-1 (Physical Chemistry)	Sri P. M. Patil
8.	Senior Technical Assistant (T-5)	Sri A. Rahman
	(T-4)	(1) Dr M. K. Mishra (2) Sri T. K. Saha (3) Sri M. Ekka (4) Sri D. D. Singh (5) Sri N. K. Dey
	do (T-II-3)	(1) Sri S. N. Sharma (2) Miss P. R. Chatterjee
9.	Laboratory Technician (T-I-3)	(1) Sri U. Sahay (2) Sri B. P. Keshri
	(T-2)	(1) Sri P. B. Sen (2) Sri G. Mishra
	(T-1)	Smt. Prabha Devi
10.	Glass Blower (T-1)	Sri B. S. Choudhary
11.	Junior Stenographer	Sri B. K. Rajak

Technology Division

1.	Scientist S-2 (Organic Chemistry)	Dr P. C. Gupta
2.	Scientist S-1 (Organic Chemistry)	Sri R. K. Banerjee
3.	Junior Technologist (Processing)	Sri A. K. Ghosh
4.	Scientist S-1 (Physical Chemistry)	Sri Radha Singh
5.	Senior Technical Assistant (T-5)	(1) Sri M. Islam (2) Sri B. P. Banerjee (3) Sri R. Prasad
	do (T-4)	Sri K. K. Prasad
6.	Senior Mechanic (T-II-3)	Sri S. K. Bhaduri
7.	Laboratory Technician (T-I-3)	(1) Sri N. Minz (2) Sri M. K. Sinha
	do (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
	do (T-4)	(1) Sri Dipak Ghosh (2) Sri K. M. Sinha (3) Sri Jagdish Singh
5.	Commercial Artist (T-4)	Sri Pyare Das
6.	Laboratory Technician (T-I-3)	Sri D. Runda
	do (T-2)	Sri B. P. Ghosh
7.	Junior Stenographer	Sri Sant Kumar

Operational Research Project

1.	Scientist S-2 (Agricultural Entomology)	Sri R. C. Mishra
2.	Scientist S-1 (Agricultural Entomology)	Sri Jawahir Lal
3.	Scientist S-1 (Agricultural Economics)	Sri S. P. Bhardwaj
4.	Technical Assistant (T-4)	Sri L. C. N. Sahdeo
	do (T-II-3)	Sri H. Bhengra
	do (T-I-3)	Sri S. S. Prasad
	do (T-2)	Sri K. C. Jain
	do (T-1)	Sri S. B. Azad

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. Choudhury
		(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) Sri Md. Samiullah
		(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 A. Haque
		(3) Sri S. K. P. Keshri
		(4) Sri R. B. Singh
		(5) Sri K. D. Pandey
		(6) Sri K. N. Sinha
		(7) Sri S. Ram
		(8) Sri D. Ram
		(9) Sri D. N. Mahto
		(10) Smt. Sati Guha
		(11) Sri K. L. Choudhury
		(12) Sri R. K. Upadhyaya
		(13) Sri N. Topno
8.	Junior Stenographer	Smt. S. Prasad
9.	Junior Clerk	(1) Sri Budhan Ram
		(2) Sri Md. Mubarak
		(3) Sri V. Ram
		(4) Sri E. Gari
		(5) Sri J. P. Srivastava
		(6) Sri N. Gope
		(7) Sri Thibu Minz
		(8) Sri B. N. Gope
		(9) Sri Ravi Shankar
		(10) Sri Anant Pandey
		(11) to (15) Vacant
10.	Stockman-cum-compounder (T-I-3)	Sri C. Pandey
11.	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 (T-1)	Sri Paulus Jojo
3.	Instrument Maker (T-1)	Sri H. L. Bhakta
4.	Turner (T-2)	Sri A. S. Manoranjan
5.	Drivers for vehicle	(1) Sri J. Ram (2) Sri M. Khalkho (3) Sri B. Runda (4) Sri Jaswant Tewari

Institute Plantation

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

Promotion

1.	Sri Shravan Kumar (S-4)	Promoted from S-3 to S-4 w.e.f. 1-1-1984
2.	Dr S. C. Agarwal (S-3)	Promoted from S-2 to S-3 w.e.f. 1-1-1984
3.	Dr N. Prasad (S-2)	Promoted from S-1 to S-2 w.e.f. 1-1-1984
4.	Dr R. N. Majee (S-2)	do
5.	Sri R. Ramani (S-2)	do
6.	Sri B. K. Purkayastha (T-7)	Promoted from T-6 to T-7
7.	Sri K. K. Prasad (T-4)	Promoted from T-II-3 to T-4
8.	Sri T. K. Saha (T-4)	do
9.	Dr M. K. Mishra (T-4)	do
10.	Sri L. C. N. Sahdeo (T-4)	do
11.	Sri K. U. Sinha (T-4)	do
12.	Sri N. K. Dey	do
13.	Sri D. D. Singh	do
14.	Sri Jagdish Singh	do

Resignation/Transfer

1.	Dr T. P. S. Teotia	Consequent upon the expiry of his deputation, Dr T. P. S. Teotia reverted back to his parent Dept. i.e. C. S. Azad Agricultural University, Kanpur
2.	Dr D. C. Srivastava	Transferred from this Institute to IISR, Lucknow
3.	Sri Sudeb Chatterjee (T-II-3)	Resigned

Appointment

Sri A. C. Hazari	Appointed to the post of Assistant Accounts Officer (on deputation)

Retirement

Sri G. Lakra (T-2)	Retired

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