INDIAN LAC RESEARCH INSTITUTE
NAMKUM, RANCHI, BIHAR, INDIA

Annual Report
1985

INDIAN COUNCIL OF AGRICULTURAL RESEARCH
NEW DELHI
1987

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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 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 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

(1) Integration of chemical control of lac insect predators with that of trap cropping (heavy inoculation) has been found to be successful, resulting in high degree of predator control and substantial increase in lac crop yield.

(2) ' Dimilin ' a chitin inhibitor has been found to be highly effective against the lepidopterous predators.

(3) Results of experiments show that coverage of shoots (settlement of lac nymphs) increase with crowding of hosts in the case of bushy-lac host, *Moghania macrophylla.*

Agronomy Division

The most dominant weed flora recorded in *bhalia* nursery were *Echinochloa crusgalli, E. colonum, Elencine indica, Cynodon doctylon, Setaria* sp. and *Digitaria longifolia* among the grasses, *Ageratum conyzoides* and *Commelina benghalensis* among the broad leaves and *Cyprus* sp. among the grasses. However, the grassy weeds were most dominant.

Among the various herbicides tried, pendimethaline (1·5 kg ai/ha) and Oxydiazon (0·5 kg ai/ha) gave the promising results in controlling weeds.

Chemistry Division

A method for the preparation of technical grade jalaric acid from shellac in about 12 per cent yield has been standardized.

A shellac based pattern paint which possesses most of the desirable properties of a synthetic resin-based pattern paint, has been prepared.

Technology Division

The aqueous adhesive based on Rebulac has been found promising for bonding copper to copper and brass to brass surfaces. The bond strength has been found to be 5 times higher in case of copper to copper as compared to shellac.

Extension Division

The certificate course on "Industrial Uses of Lac" conducted by the Extension Division has been recognized by the Khadi and Village Industries Commission as adequate and pre-requisite for their supervisory cadre under the discipline ' Forest based industries '.

Library

The number of books and bound volumes of journals accessioned during the year 1985 was 114 which brought the total number of books and volumes of journals in the library to 18,370. One hundred sixty six periodicals were subscribed in addition to a few received in exchange of 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.

Institute Committee for Processing and Editing of Annual Reports

The Institute Technical Committee continued to function for scrutinizing the Institute Annual Report. During the period, the Member-Secretary convened 37 meetings of the committee which took up the processing and editing of Annual Report for the year 1983. The said report, after editing and compilation was sent to M/s Catholic Press for printing.

Administrative activities

Two meetings of Institute Joint Council and one meeting of the Management Committee were held. The meetings of the Grievance Cell were also held.

Some officers and staff of this Institute were deployed to work in the General Elections pertaining to Bihar Legislative Assembly as per order of the Dy. Commissioner, Ranchi in March 1985.

The staff members of the Institute also participated in the Zonal sports held at CRRI, Cuttack.

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 Government 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 five Chinese Scientists, visited this Institute during January, 1985 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, New Delhi. The revised budget estimates of the Institute for the year 1985-86 amounted to Rs 61·35 lakhs under non-plan and Rs 10 lakhs under plan respectively. The actual expenditure was Rs 58·25 lakhs under non-plan and Rs 7·47 lakhs under plan respectively.

Honours and awards

Sri S. K. Jaipuriar was awarded the degree of Doctor of Philosophy (Ph.D.) by Ranchi University for his thesis " Chromosome studies on genetic system in lac insect *Kerria lacca* kerr ".

Visitors

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

1. Wang Dingxuan, Director, Research, Institute of Chemical Processing and Utilization of Forest Products, Chinese Academy of Forestry, The P.R. of China and five others.
2. Mr S. Nonhebal, Agricultural University of Wageningen, Netherlands.
3. Mr P. B. Diwan, Conservator of Forests, Western Circle, Daltonganj.
4. Dr K. Ramasubbaiah, Prof. of Entomology, Andhra Pradesh Agriculture University.
5. Mr N. B. Krishnamurty, Prof. and Head of Zoology Dept., University of Mysore, Mysore.
6. Dr S. Krishnaswami, Former Lac Entomologist.
7. Mr Syed Mustafa Siraj, Renowned Novelist and Journalist, Calcutta.
8. Mr S. Kar, Joint Director, Directorate of Cottage and Small Scale Industries, West Bengal.
9. Mr B. D. Sharma, Manager (Insulation).
10. Mr S. S. Madan, Manager (Design) Traction.
11. Mr A. K. Basu, Manager (TS) T.S.D.
12. Mr J. R. Talwar, Dy. Manager (Q.C).
13. Mr K. D. Saxena, Executive Foreman, BHEL, Bhopal.

संस्थान में हिन्दी के बढ़ते चरण

सरकारी काम-काज में हिन्दी के प्रयोग के प्रति संस्थान के कर्मचारीगण एवं अधिकारी सतत् प्रयत्नशील रहे हैं। वर्ष १९८५ में राजभाषा कार्यान्वयन समिति की तीन बैठकों का आयोजन निदेशक जी के अध्यक्षता में सम्पन्न हुआ। अन्य मदों के अलावे निम्नांकित मदों पर निर्णय लिया गया :

१. (क) हिन्दी कार्यशाला का आयोजन किया जाना
   (ख) हिन्दी सप्ताह मनाये जाने का निर्णय
   (ग) हिन्दी में चेक लिखे जाने पर विचार
२. (क) वार्षिक रिर्पोट के सारांश का हिन्दी रूपान्तर तैयार किया जाना
३. (क) संस्थान के वाहनों पर हिन्दी में भी नामकरण
   (ख) वार्षिक कार्यक्रम १९८५-८६ के कार्यान्वयन पर विचार विमर्श

गृह मंत्रालय द्वारा संचालित हिन्दी शिक्षण योजनाधीन संस्थान के चार अहिन्दी कर्मचारियों को प्राज्ञ कक्षा में सम्मिलित होने हेतु नामित किया गया।

संस्थान के हिन्दी अनुवादक श्री लक्ष्मीकांत (टी०-II-३) को गृह मंत्रालय के केन्द्रीय अनुवाद ब्यूरो, नई दिल्ली में अनुवाद पाठ्यक्रम के त्रैमासीय प्रशिक्षण में भेजा गया, उन्होंने उक्त प्रशिक्षण में "बहुत अच्छा" परिणाम प्राप्त किया।

संस्थान के अधिकारी एवं कर्मचारी सरकारी काम-काज में हिन्दी के प्रयोग को बढ़ावा देने में सक्रिय सहयोग देते रहे हैं। भारतीय कृषि अनुसंधान परिषद् के ही इकाई "केन्द्रीय बागवानी परीक्षण केन्द्र" के सदस्यों को भी संस्थान के केन्द्रीय सचिवालय हिन्दी परिषद् में सहयोजित किया गया। राँची स्थित लाख निदेशालय द्वारा आयोजित "हिन्दी कार्यशाला" में डा० भारत भूषण खन्ना कार्यकारी निदेशक, मुख्य अतिथि, सर्वश्री श्रीकृष्णमणि त्रिपाठी एवं लक्ष्मीकांत ने वक्ता के रूप में सहयोग दिया।

संस्थान के राजभाषा कार्यान्वयन समिति एवं केन्द्रीय सचिवालय हिन्दी परिषद् के संयुक्त तत्वावधान में ६वीं फरवरी, १९८५ को "हिन्दी प्रोत्साहन दिवस" का आयोजन किया गया। मुख्य अतिथि डा० श्रवण कुमार गोस्वामी, विभागाध्यक्ष, हिन्दी विभाग, डोरण्डा महाविद्यालय, राँची ने संस्थान में हिन्दी की प्रगति पर संतोष व्यक्त किया।

२०वीं सितम्बर, १९८५ को आयोजित "हिन्दी दिवस" समारोह के मुख्य अतिथि डा० एच० आर० मिश्र, कुलपति, बिरसा कृषि विश्वविद्यालय, कांके, राँची के प्रोत्साहन से संस्थान के कर्मचारियों में हिन्दी प्रेम और जाग्रत हुआ। हिन्दी के प्रयोग को बढ़ावा देने के लिए केन्द्रीय हिन्दी निदेशालय, नई दिल्ली से संदर्भ साहित्य का उपार्जन किया गया।

संस्थान के सदस्यों के सम्मिलित प्रयास से "हिन्दी प्रगति" नामक पत्रिका का प्रकाशन प्रारंभ किया गया।

केन्द्रीय सचिवालय हिन्दी परिषद् के आहवान पर श्री कुलदीप पाण्डेय व० लिपिक ने रोकडिया का कार्य पूर्ण रूपेण हिन्दी में किया। प्रशासकीय अधिकारी श्री सत्यानन्द शर्मा परिषद् के अनुरोध पर चेक छोड़कर सभी कागजात पर सिर्फ हिन्दी में हस्ताक्षर करने लगे हैं। हिन्दी की प्रगति के प्रति संस्थान आशावान है।

2. PROGRESS OF RESEARCH

A. ENTOMOLOGY DIVISION

(a) RESEARCHES COMPLETED

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

The project was aimed for utilizing *khair* in alternation with *palas* for *rangeeni* lac cultivation, with a view to purport additional revenue to make *khair* plantation a remunerative one.

The experiment was laid out on a randomized block design with four treatments taking three trees under each treatment replicated five times. *Palas* and *khair* were utilized for raising *baisakhi* and *katki* crops respectively. Brood rates applied were the 1/2 normal, normal, 1·1/2 normal and 2 normal i.e. 250 g, 500 g, 750 g, and 1 kg per *palas* tree and 500 g, 1 kg, 1·5 kg and 2 kg per *khair* tree.

Work on the project was initiated in June, 1981 with the inoculation of *katki* 1981 crop on 50 and 27 pruned trees of *khair* and *palas* respectively with normal (N) brood rate obtained from *palas*.

The results are presented in Table 1.

TABLE 1 — SHOWING THE YIELD DATA UNDER DIFFERENT TREATMENTS

Crop	Host (Number)	Brood obtained from	Brood rate	Yield ratio		Remarks
				Lac stick	Stick lac	
Katki 1981	*Khair* (50)	Palas (P×P)	N	1:2·83	1:3·40	Only one brood rate was used for initiating the expt.
	Palas (27)	do	N	1:2·18	1:0·91	
Baisakhi 1981-82	*Palas* (15)	P×kh	1/2N	1:4·4	1:1·5	Conclusions could not be drawn due to crop failure
	Palas (15)	do	N	1:1·7		
	Palas (15)	do	1·1/2N	1:1·2	Unsatisfactory	
	Palas (15)	do	2N	1:1·2		

From the *katki* 1981 trial, it appears that *katki* crop performs better in *khair* than *palas* with brood obtained from *palas*. During *baisakhi* 1981-82, no conclusions could be drawn due to crop failure.

The crops grown during 1982-85 i.e. *katki* 1982, *baisakhi* 1982-83, *katki* 1983, *baisakhi* 1983-84, *katki* 1984 and *baisakhi* 1984-85 either totally failed or gave unsatisfactory yields on both the hosts with brood lac obtained either from *khair* or *palas*. Hence, no conclusion could be drawn. The project has been dropped.

(P. Sen and M. L. Bhagat)

1.2.8 Laccaic acid as a biological stain

The molecular structure of the laccaic acid points to its usefulness as biological stain and hence the project was taken up to find out a newer use of this dye.

Several formulations of laccaic acid in various concentrations of glacial acetic acid/propionic acid were prepared in the presence of various metallic salts such as ferric sulphate, aluminium sulphate, lithium carbonate, ammonium alum and iron alum. Out of these, the following stain solution was found to be the best. It was prepared by dissolving 2 g of lac dye in 100 ml boiling 50% aqueous solution of glacial acetic acid or propionic acid saturated with ammonium alum under reflux condenser for about 5 min. The staining solution, thus prepared was then cooled and filtered.

The growing onion root tips pretreated with *p*-dichlorobenzene and fixed in acetic-alcohol (1:3 v/v) were stained by squashing in the staining solution under a cover slip. It was observed that the stained chromosomes are reddish when ammonium alum was replaced by chrome alum, the results were satisfactory and the chromosomes were stained dark grey. Attempts were also made to use laccaic acid as a nuclear stain, but the desired intensity of the stain could not be achieved.

(R. Ramani)

1.3.3 To study the bio-ecological aspects of *Pristomerus sulci* an endoparasite of *Holcocera pulverea* a predator of lac insect

The project was aimed at a detailed ecobiological study of *P. sulci* for the control of the serious predator *Holcocera pulverea* resulting in increased lac production.

The technical programme includes the studies of (i) incidence of the parasite in all the four crops of *kusmi* and *rangeeni* grown in different seasons of the year, (ii) its ovipositional behaviour in the laboratory and (iii) effect of food and temperature on the longevity and fecundity of the insect.

To study the incidence of the parasite in different crops and seasons, 5 kg samples of lac sticks were caged in 10 parasite cages every month and their emergence was recorded. Both *kusmi* and *rangeeni* strains were collected from the Institute Plantation for all the four lac crops during the period 1974 to 1979.

It may be observed from the histogram (Fig. 1) that the incidence of this parasite is highest in *jethwi* followed by *baisakhi*, *aghani* and *katki* crops respectively. In all the crops, females out numbered the males. The average sex ratio for *kusmi* and *rangeeni* crops (♂:♀) are 1:1·75 and 1:1·48 for *aghani* and *jethwi* and 1:1·64 and 1:1·60 for *baisakhi* and *katki* respectively. As regards the seasonal incidence it has been found that the peak incidences are during Jan./February and June/July in the case of *kusmi* crops and June/July and Sept./Oct. for the *rangeeni* crops respectively, i.e. at maturity of the respective lac crops (Fig. 2).

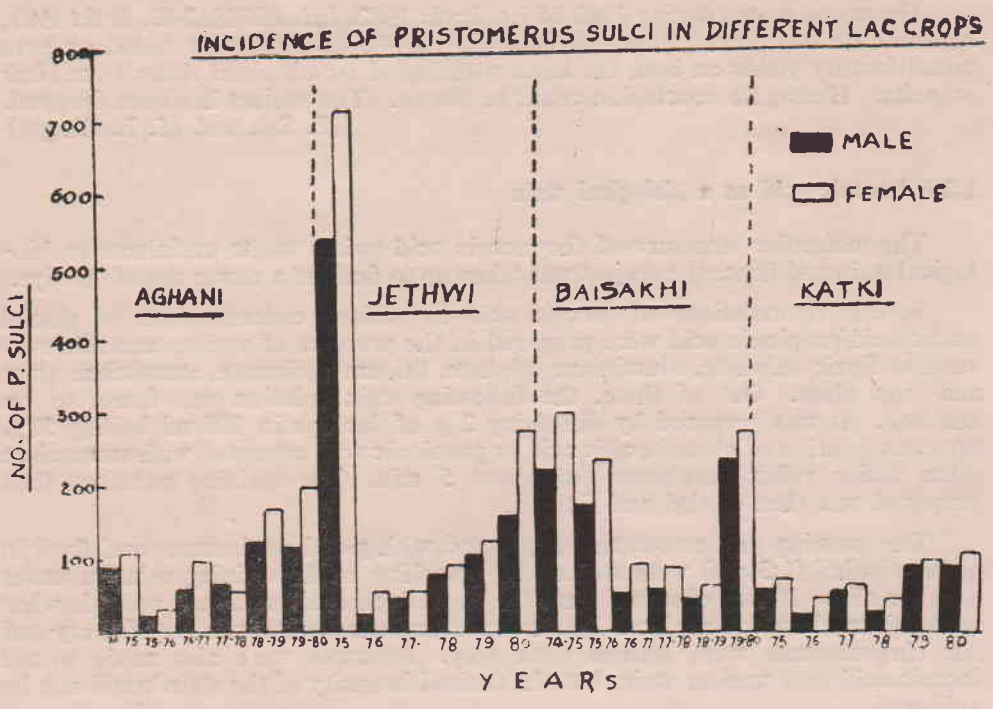

Fig. 1

To study the ovipositional behaviour, the parasites were released on the alternative host, *Corcyra cephalonica* Staint, cultured in wheat flour. One parasite was released on caged *Corcyra* larvae.

It was observed that the preovipositional period varied from 1 to 3 days. The female parasites preferred the 1st instar host larvae under covered condition and a single egg in each host was inserted through any of the 7th, 8th or 9th of the body segment. The gravid female parasite first locates the host by its antennae and then oviposits after a little probing. After laying a few eggs, the female takes some rest for smoothening its ovipositor and then again starts ovipositing.

The cocoons of this parasite are formed on the dead remains of the host. The sexes of the cocoons can be distinguised by their colour, light yellow being of the female and blackish brown of the males.

To study the effect of food on longevity, the insects were fed separately on 2 % glucose and sucrose, 50% honey and moistened raisins respectively. Maximum longevity (19 days) of the gravid female and its fecundity (21 eggs) were observed with 2 per cent sucrose solution.

To study the effect of temperature on the longevity and fecundity, the insects were kept at different temperatures ranging from 15° to 40°C. with a rise of 5°C at each step. It was observed that the insect has its highest longevity 24·2 days and fecundity (18·6 eggs) at 30°C followed by 21·0 days and 17·2 eggs at 25°C. At 40°C longevity was shortest and fecundity was least (Table 2).

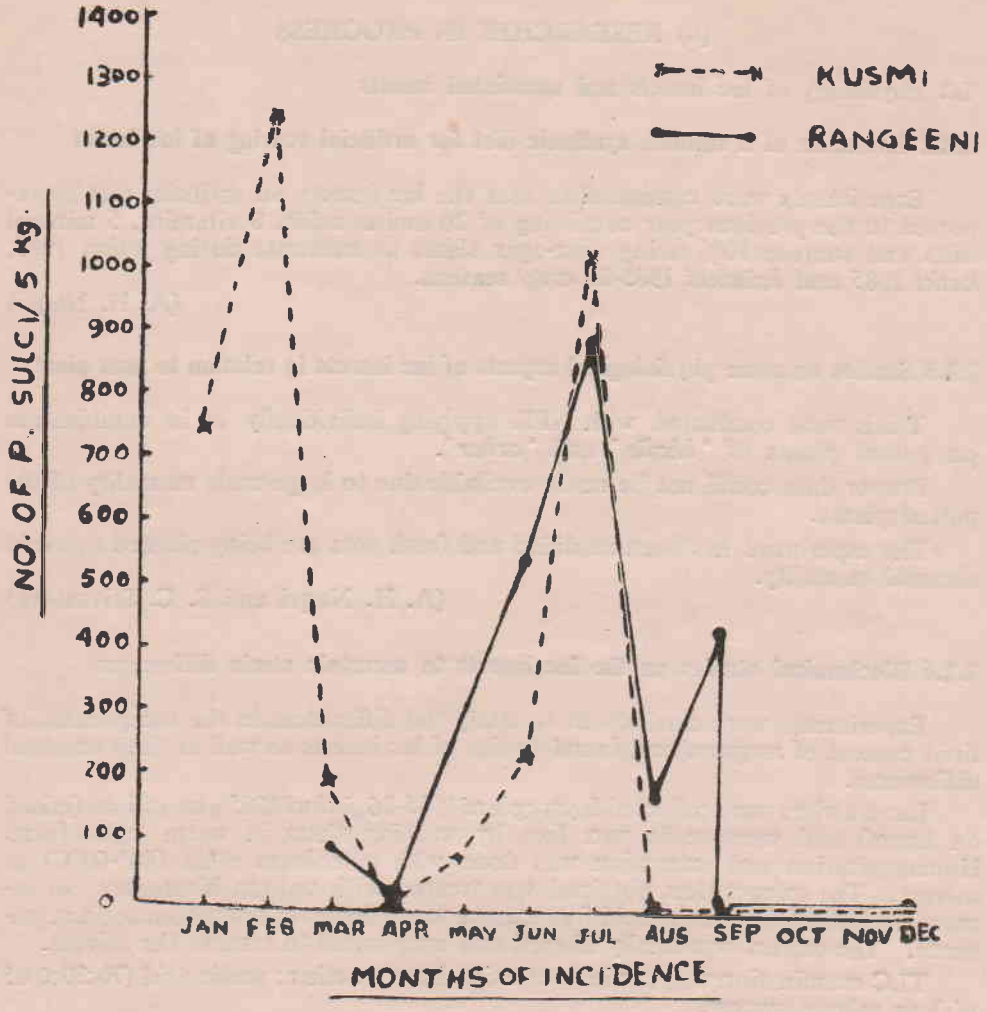

Fig. 2

TABLE 2 — LONGEVITY AND FECUNDITY OF *P. sulci* AT DIFFERENT TEMPERATURES

No. of replicates (1 No. of *P. sulci* in each)	Temperature °C											
	15		20		25		30		35		40	
	F	L	F	L	F	L	F	L	F	L	F	L
P_1	6	8	10	12	12	15	14	17	8	9	2	3
P_2	7	8	11	13	14	19	12	22	9	10	3	5
P_3	5	7	9	8	15	21	14	25	7	11	4	6
P_4	3	4	7	8	22	24	27	29	5	8	7	8
P_5	5	6	7	6	23	26	26	28	8	9	7	6
Total:	26	33	44	47	86	105	93	121	37	47	23	28
Average:	5·2	6·6	8·8	9·4	17·2	21·0	18·6	24·2	7·4	9·4	4·6	5·6

Note: L — Longevity expressed in No. of days.
F — Fecundity expressed in terms of No. of eggs.

(M. L. Bhagat)

(b) RESEARCHES IN PROGRESS

1.2 Physiology of lac insects and associated insects

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

Experiments were continued to rear the lac insects on artificial diet as reported in the previous year consisting of 20 amino acids, 8 vitamins, 5 mineral salts and sucrose 10% using agar-agar slants as substrate during *jethwi* 1985, *katki* 1985 and *baisakhi* 1985-86 crop seasons.

(A. H. Naqvi)

1.2.5 Studies on some physiological aspects of lac insects in relation to host plant

Trials were conducted with NPK applying individually or in combination on potted plants of '*bhalia*' and '*arhar*'.

Proper data could not be made available due to large scale mortality of the potted plants.

The experiment has been modified and fresh pots are being planted to avoid unusual mortality.

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

1.2.6 Biochemical studies on the lac insects to ascertain strain differences

Experiments were carried out to study the differences in the components of lipid content of *rangeeni* and *kusmi* strains of lac insects as well as their seasonal differences.

Lac crawlers were collected from *aghani* 1985-86, *jethwi* 1985 generations (raised on *kusmi*) and were made wax free by washing them in warm chloroform. Homogenization and extraction was done with petroleum ether (40°-60°C) as solvent. The extract thus obtained was treated with sodium bicarbonate to remove the free acids and the acid free extract was dried over anhydrous sodium sulphate. The extract was finally filtered and evaporated to remove the solvent.

TLC examination was carried out using hexane: ether: acetic acid (70:30:0·05 v/v) as solvent system.

The results indicated that both *aghani* and *jethwi* insects have six common fat components of Rf values 0·02, 0·10, 0·17, 0·58, 0·73 and 0·84; but the *jethwi* insects differed from the *aghani* in having one more component of Rf value 0·66. Two common components of Rf values 0·02 and 0·17 have been compared with mono- and triacetin. The results revealed that the two components are presumables mono- and triglycerides (Fig. 3 of the chromatogram).

(A. K. Sen and K. M. Prasad)

1.2.7 Histophysiology of lac glands

During the period under report, the epidermal glands of the female lac insects were studied. Observations were taken on the resinous and non resinous secretions of the glands.

It has been observed that the female lac insect possesses six lateral resinous protuberances each of which corresponds to the 'U' shaped tract of the marginal

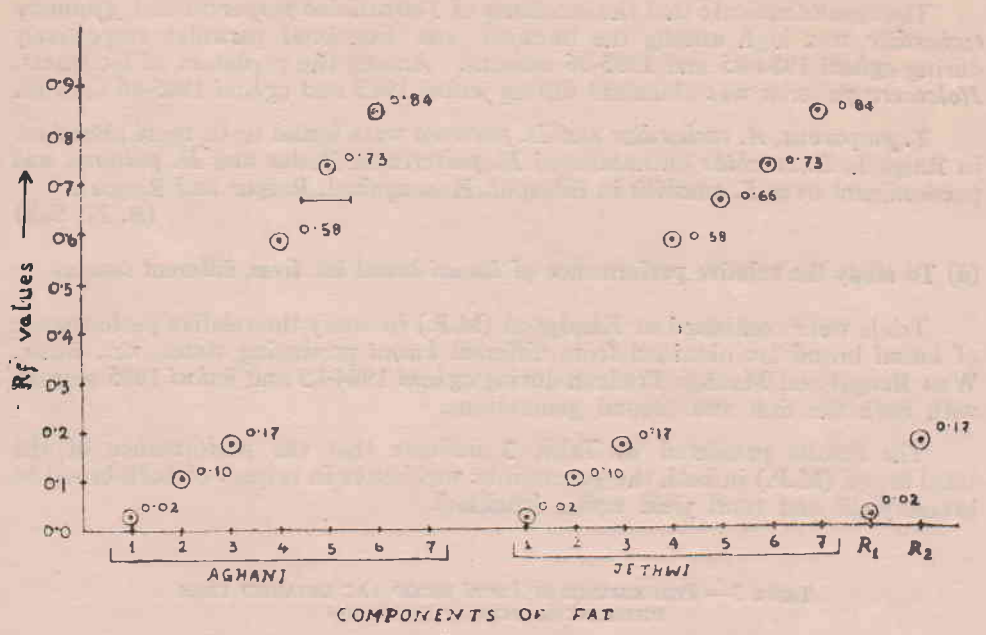

Fig. 3

pore clusters. The secretions of these glands get embedded in the secretion of the resin glands and after fertilization, the wavy outline is lost due to sharp increase in the rate of resin secretion. The secretion of the resin glands gets shifted towards aboral aspect during the post metamorphic period which is supported by the fact that the secretion of the stalked and non-stalked girdle fibre secreting cells and the perivaginal glands are located in the aboral aspects.

(R. Ramani)

1.3 Ecological Studies on Lac Insects and Associated Insects

The following research programmes were carried out during the year under report at the Regional Field Research Station, Dharamjaigarh, Madhya Pradesh.

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

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

Experiments were continued to study the relative abundance of inimical and beneficial insects during *aghani* 1984-85, 85-86 and *jethwi* 1985 seasons.

Approximately 4·0 kg fresh lac sticks were collected from five localities of the State viz. (Raipur, Bastar, Raigarh, Bilaspur and Hosangabad) from September to December and March to June respectively for *aghani* and *jethwi* crops. Emergence of insects was recorded daily from the caged samples for two consecutive months from the date of caging.

The results indicate that the incidence of *Tetrastichus purpureus* and *Apanteles tachardiae* was high among the inimical and beneficial parasites respectively during *aghani* 1984-85 and 1985-86 seasons. Among the predators of lac insect, *Holcocera pulverea* was abundant during *jethwi* 1985 and *aghani* 1985-86 seasons.

T. purpureus, *A. tachardiae* and *H. pulverea* were found to be more abundant in Raigarh, *E. amabilis* outnumbered *H. pulverea* in Bastar and *H. pulverea* was predominant over *E. amabilis* in Bilaspur, Hosangabad, Raipur and Raigarh.

(B. N. Sah)

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

Trials were continued at Khadgaon (M.P.) to study the relative performance of *kusmi* brood lac obtained from different *kusmi* producing states *viz.*, Bihar, West Bengal and Madhya Pradesh during *aghani* 1984-85 and *jethwi* 1985 seasons with both the first and second generations.

The results presented in Table 3 indicate that the performance of the local brood (M.P.) in both the generations was better in respect of both brood to brood yield and total yield ratios (sticklac).

TABLE 3 — PERFORMANCE OF *kusmi* BROOD LAC OBTAINED FROM DIFFERENT SOURCES AT KHADGAON

Sources of brood lac	Season	Generation	Ratio of brood used to yield	
			Brood used to brood obtained	Brood used to yield obtained (stick lac)
Bihar	*Aghani* 1984-85	2nd	1:0·05	1:0·36
M.P.	do	do	1:0·32	1:3·26
W.B.	do	do	1:0·07	1:1·04
Bihar	do	1st	1:0·04	1:0·84
M.P.	do	do	1:0·16	1:1·62
W.B.	Brood lac was not available			
Bihar	*Jethwi* 1985	2nd	1:0·66	1:0·61
M.P.	do	do	1:1·07	1:0·96
W.B.	Brood lac was not available			
Bihar	*Jethwi* 1985	1st	1:0·43	1:1·09
M.P.	do	do	1:1·69	1:4·74
W.B.	do	do	1:0·63	1:1·18

(B. N. Sah)

1.3.6 To study the population dynamics of the *kusmi* strain of the lac insect

Experiments were continued during *jethwi* 1985 and *aghani* 1985-86 seasons to find out the causes of mortality.

Samples were collected from twelve strata of each tree at fortnightly intervals and average number of lac nymphs settled per centimeter length of the sample as well as its density at basal, middle and apical segments of the samples were noted. Besides this, the number of dead and living lac nymphs as well as inimical insects were also recorded.

The results indicate that average settlement of lac nymphs per centimeter length of sample was 117·64, 195·18, the number of dead insects was 20·15, 6·20 and mortality due to other natural causes were 17·02 and 17·58 during *jethwi* 1985 and *aghani* 1985-86 seasons respectively. The density of the lac nymphs per centimeter length in the middle segment of the sample was found higher as compared to the basal and apical segments.

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

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

Experiments were continued on three different host plants viz., *palas*, *ber* and *bhalia* to find out the host effect on the population of *rangeeni* lac insects.

Four plants each, of the above hosts were taken and inoculation was done with mature lac cells on four shoots of each of the plants and mortality was recorded after 30 days from the date of inoculation.

The results indicate that highest mortality of the lac nymphs was on *palas* (60·20 and 47·85%) followed by *bhalia* (52·98 and 47·36%) and *ber* (31·87 and 39·25%) during *baisakhi* 84-85 and *katki* 1985 seasons respectively. During *baisakhi* 85-86 also highest mortality was recorded on *palas* (49·44%) followed by *ber* (48·84%) and *bhalia* (47·68%).

(M. L. Bhagat)

1.3.9 Studies on the lac larval settlement and factors affecting it

Experiments were continued to study the settlement pattern of lac insects in relation to host crowding. Three crowding levels viz., 1 m×1 m, 1 m×0·5 m and 0·5 m×0·5 m were taken for the experiments and ten randomly selected bushes were inoculated with normal brood rate. Covered areas of the shoots and total available space were measured and compared within and between the treatments.

The results have shown that coverage of shoot increases with the increase in the host crowding.

(Y. D. Mishra)

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

Studies were continued to assess the abundance of lac pests in relation to different places during *baisakhi* 1984-85 and *katki* 1985 seasons. Samples were collected from six different localities viz., Kundri, Mako, Salga, Lota, Malichak and Institute plantation both at the time of male emergence and crop maturity.

The results indicate that the abundance of the predators was maximum at Salga followed by Institute plantation during male emergence. With respect to the parasites highest abundance was recorded from Malichak followed by Kundri.

The abundance of the predators was found to be highest at Malichak followed by Salga, Mako and Institute plantation during crop maturity. As regards the abundance of the parasites it was highest at Institute plantation followed by Malichak, Lota and Mako.

Locationwise, maximum predator population was observed in Salga followed by Malichak and Institute plantation, whereas parasite population was maximum in Malichak followed by Institute plantation and Kundri.

(M. L. Bhagat)

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 in Randomised Block design with 3 replications and 8 treatments (seven schedules and the control). Data were collected in the same way as done earlier.

The results are presented in Table 4 and Fig. 4.

TABLE 4 — EFFECT OF VARIOUS CONTROL SCHEDULES ON THE PREDATORS POPULATION AND LAC CROP YIELD IN THE *baisakhi* 1984-85; *cum-katki* 1985 CROP ON *palas* TREES AT KUNDRI ORCHARD

Treatments	Brood used/tree in (g)		Average yield/tree in (g)		Brood to yield ratio		Average number of predators per metre lac encrustation		
	Lac stick	Stick lac	Lac stick	Stick lac	Lac stick	Stick lac	*Eublemma amabilis*	*Holcocera pulverea*	Total
A	300	47·3	2964	725·63	1 : 13·1	1 : 13·7	1·85	5·5	7·35
B	300	55·5	3958	592·8	1 : 9·8	1 : 12·8	2·025	6·4	8·42
C	300	49·3	427	64·05	1 : 1·4	1 : 1·2	3·2	9·8	13·0
AB	300	54·4	3893	843·48	1 : 12·9	1 : 15·3	1·025	4·15	5·17
AC	300	52·2	658	109·66	1 : 2·1	1 : 2·1	1·85	9·6	11·45
BC	300	52·0	697	104·55	1 : 2·3	1 : 2·1	2·6	8·7	11·3
ABC	300	55·5	2428	364·2	1 : 8·0	1 : 7·5	3·7	5·6	9·3
Control	300	48·0	890	163·16	1 : 2·4	1 : 2·4	4·5	7·9	12·4

It may be observed that there has been 58·60 per cent suppression in predator population thereby resulting in 80·60 per cent increase in the yield over control in the treatment A, B i.e. integration of insecticides application with heavy inoculation for trap cropping (cultural control) followed by treatments A, B and ABC wherein there was 40·70, 32·09 and 25·00 per cent suppression in predator population and 77·50, 72·64 and 55·20 per cent increase in lac yield respectively (Fig. 4). It is thus confirmed that integration of insecticidal application with that of heavy inoculation treatment (trap cropping) is quite successful resulting in substantial increase in lac crop yield and high degree of suppression of predator population as compared to other treatments and control.

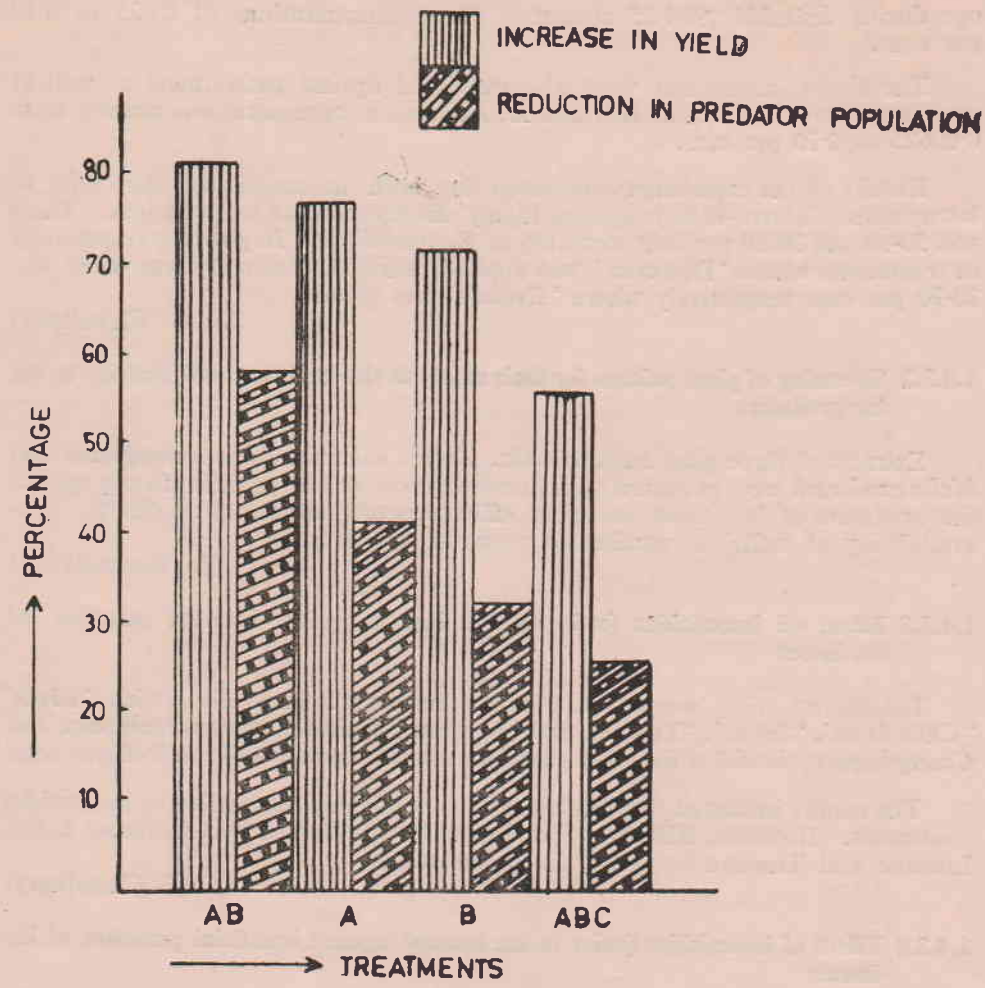

Fig. 4 — Histogram showing the effect of various control schedules on predator population and yield of lac crop

Treatment
A — Spraying of "Thiodan" at 0·05%
B — Heavy inoculation of trees (trap cropping)
AB — Integration of chemical and ultural control
ABC — Integration of chemical and two cultural practices

(S. G. Choudhary)

1.4.3 Effect of insecticides on the lac insects and associated fauna

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

The experiment was continued with certain modifications. Two insecticides namely, Dipterex and Evisect were screened against lac nymphs of above 40 days

age during *baisakhi* 1984-85 season at three concentrations of 0·025 to 0·10 per cent.

The above insecticides were also evaluated against penultimate as well as early stage larvae of *E. amabilis* and *H. Pulverea* at concentrations ranging from 0·00625 to 0·10 per cent.

Results of the experiments indicated that both the insecticides were safer to lac nymphs of above 40 days age but highly effective against lac predators. There was 50-90 and 20-80 per cent mortality of *E. amabilis* and *H. pulverea* respectively in treatments where 'Dipterex' was applied, while the mortality was 40-80 and 20-70 per cent respectively where 'Evisect' was given.

(S. G. Choudhary)

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

Extracts of three plant materials viz., *Acorus calamus*, *Butea monosperma* and *Melia azederach* were prepared as in previous years for testing their efficacy against the predators of lac insect but their efficacy could not be tested due to non-availability of sufficient number of predator population.

(A. Bhattacharya)

1.4.3.3 Effect of insecticides (safer to lac insect) against harmful parasites of lac insect

Laboratory trials were continued to evaluate 5 insecticides viz., 'BHC' 'Chlordane', 'Sevin', 'Thiodan and 'Lindane' against *Eupelmus tachardiae* and *Coccophagus tschirchii* at five concentrations ranging from 0·00625 to 0·10 per cent.

The results indicated that these parasites are highly susceptible to insecticidal treatments. However, BHC was found most toxic followed by Chlordane, Sevin, Lindane and Thiodan for both the parasites.

(S. G. Choudhary)

1.4.3.4 Effect of insecticides (safer to lac insects) against beneficial parasites of lac insects

The experiments could not be conducted due to non-availability of beneficial parasites in adequate number.

(B. N. Sah and S. G. Choudhry)

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

Trials were continued to assess the effect of Thiodan® spray (0·05%) after four weeks of inoculation and combined spray of Thiodan® (0·05%) and Thuricide (0·05%) (1:1 v/v) after 8 weeks of inoculation on associated fauna of lac insect during *baisakhi* 1984-85, *aghani* 1984-85 and *jethwi* 1985 seasons.

Random samples of lac twigs were collected at 3 intervals i.e. one week after spray, at male emergence and finally at crop maturity and caged for recording the emergence of the associated fauna. The results are appended in Table 5.

TABLE 5 — EFFECT OF THE RECOMMENDED CONTROL SCHEDULE ON THE ASSOCIATED FAUNA

Crop	Percentage reduction in the associated insects								
	First sampling (4 weeks after inoculation)			Second sampling 8-9 weeks after inoculation)			Third sampling (at crop maturity)		
	Predator	Harmful parasites	Beneficial parasites	Predator	Harmful parasites	Beneficial parasites	Predator	Harmful parasites	Beneficial parasites
Baisakhi 1984-85	100	73·3	40·0	100	60·0	33·3	69·2	55·5	30·0
Aghani 1984-85	100	50·0	41·0	80·0	83·0	25·7	78·4	64·3	25·5
Jethwi 1985	66·6	50·0	40·0	100	50·0	33·3	50·0	33·3	25·0

The results indicate that the recommended control schedule is highly effective against the inimical insects (predators and parasites) in reducing their population. It was also observed that though there is some deterimental effect of the insecticides on the beneficial parasites, the same is much less as compared to that on the harmful parasites.

(B. N. Sah and S. G. Choudhary)

1.4.3.6 Hormoligatory effect of the insecticides on the lac insects

Experiments were continued on *jethwi* 1985 and *katki* 1985 crop seasons to confirm the earlier findings that insecticides have hormoligatory effect in regard to the size of the insects. Increase in size was found maximum at concentration (0·003125%) of Thiodan®. Further studies on fecundity and resin secretion could not be made as the culture died at an advanced stage.

(S. G. Choudhary and A. K. Sen)

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

Studies were continued to observe the effect of 'Dimilin' (a chitin inhibitor) on the eggs and larvae of *E. amabilis* and *H. pulverea* by topical application as well as by ingestion through food at concentrations ranging from 0·0125 to 0·20 per cent, with three replications. Observations were taken at the time of hatching of the eggs and adult emergence.

The results indicate (Table 6) that there was no adverse effect on hatching of the eggs but there was significantly higher mortality and malformation due to 'Dimilin' treatment in *E. amabilis* larvae but in case of *H. pulverea* larvae no significant difference (Table 7) was recorded.

TABLE 6 — EFFECT OF DIMILIN TREATMENT ON THE LARVAE OF *Eublemma amabilis*

Treatment	Average per cent mortality and malformation			
	Treated food		Topical application	
	Mortality	Malformation	Mortality	Malformation
0·0125%	48·93 (56·66)	22·41 (20·01)*	43·07 (46·66)	30·99 (26·66)**
0·025%	47·70 (53·33)	19·49 (16·67)*	43·07 (46·66)	37·22 (36·66)**
0·05%	70·77 (83·33)**	41·07 (43·33)**	54·78 (66·66)	45·00 (50·00)**
0·1%	66·14 (83·33)*	31·92 (30·00)**	70·77 (83·33)**	43·07 (46·66)**
0·2%	81·14 (93·33)**	53·07 (63·33)**	78·93 (90·00)**	48·93 (56·66)**
Control	37·14 (36·66)	0·81 (0·02)	39·14 (40·00)	0·81 (0·02)
S.E. ±	9·72	7·14	9·43	4·07
CD at 5%	21·256	16·792	21·01	9·06
CD at 1%	30·802	23·884	29·88	12·89

The figures in parentheses indicate original value: Arc. Sin. $\sqrt{\text{Percentage}}$.
*Significant.
**Highly significant.

TABLE 7 — MORTALITY IN *H. pulverea* LARVAE DUE TO DIMILIN TREATMENT

Treatment	Average per cent mortality (After Arc. Sine transformation, $P = \text{Sin}_2 O$)
0·0125%	38·07 (40·00)
0·025%	39·14 (40·00)
0·05%	42·99 (46·66)
0·1%	45·00 (50·00)
0·2%	39·23 (40·00)
Control	26·07 (20·00)

CD — N.S.
The figures in parentheses indicate original value: Arc. Sin $\sqrt{\text{Percentage}}$.

(A. Bhattacharya)

1.4.10 Chemical control of *Chrysopa* species

(A) Field trials were conducted in randomised block design to find out a control schedule against the *Chrysopa* species during *jethwi* 1985 and *aghani* 1985-86 crop seasons. Two insecticides viz., 'BHC', and 'Chlordane' were tried either alone or alternately at 0·025 and 0·05 per cent concentrations following 1, 2 and 3 spray schedules at fortnightly intervals on lac bearing twigs of *bhalia* bushes. There were 15 treatments replicated thrice. Sprayings were given before and after male emergence i.e. in August and April respectively for *aghani* and *jethwi* seasons.

Pest populations were counted before and after each treatment and yield per bush was recorded at the time of harvesting. Effectiveness of the spray schedule was compared by recording: (i) pest population under each treatment and (ii) yield of lac per plant. Results have been incorporated in Fig. 5. The results indicate that: (i) 'BHC' is more effective than 'Chlordane', (ii) three spray schedule is most effective followed by two spray and one spray schedules with respect to suppression of predators. With regard to the effect of treatments on the increase of lac crop yield, three spray schedule of BHC is most effective.

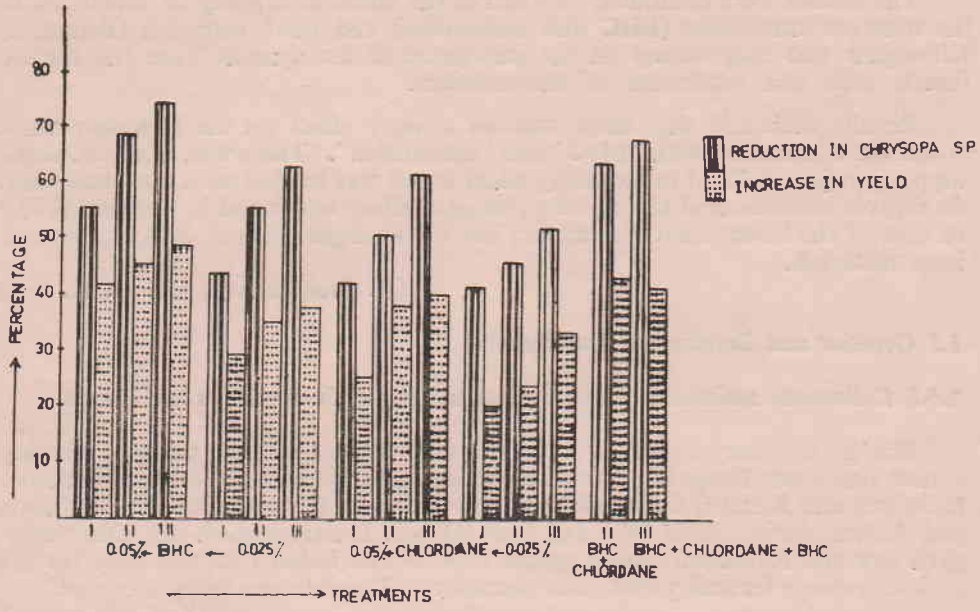

Fig. 5 — Histogram showing the effect of control schedules against *Chrysopa* sp. and lac yield
Treatment I — One spray schedule
II — Two spray schedule
III — Three spray schedule

(B) Laboratory evaluation of 3 more insecticides viz., 'Padan', 'Dipterex' and 'Evisect' (reported to be safer to lac insect) was carried out at concentrations ranging from 0·00625 to 0·1 per cent with three replications. 'BHC' and 'Chlordane' were also tested to compare the effectiveness of the above insecticides. Results indicated that 'Padan' is *at par* with BHC whereas 'Dipterex' and 'Evisect' are slightly inferior to 'BHC' but *at par* with Chlordane.

(S. G. Choudhary)

1.4.13 Studies on economic threshhold level of *E. amabilis* and *H. pulverea* infesting lac crop

Studies were continued during *baisakhi* 1984-85, *jethwi* 1985, *katki* 1985 and *aghani* 1985-86 seasons at their three developmental stages with varying pest densities as per the technical programme reported earlier (A.R.: 1983).

The results confirm the earlier findings that pest densities above 2 per 30 cm of lac bearing twig cause considerable damage to the lac crop in any stage and in all the crop seasons. However, the damage is very high when the crop is infested at an early stage.

(S. G. Choudhary)

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

The studies were continued to observe the effect of dipping of brood lac in the selective insecticides (BHC and endosulfan) and inert materials (Bentonite, Kieselguhr and soap stone) on the emergence of lac nymphs from the mature female cells and settlement of the crawlers.

Results indicated that there was no adverse effect on the fecundity when brood lac was treated with 'BHC' and 'endosulfan'. There was, however, slight suppession (about 27%) in fecundity when brood was treated with inert materials. As regards settlement of the crawlers, adverse effect was found to be slight (17%) in case of the insecticidal treatments, but it was higher (about 30%) in case of inert materials.

(A. Bhattacharya and A. K. Sen)

1.5 Genetics and Breeding of Lac Insects

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

Six germplasm stocks of *rangeeni* and five of *kusmi* strains including a new one from Bangalore were maintained and evaluation of three (Umaria, Ludhiana and Kundri) during *baisakhi* 1984-85, four (Umaria, Kundri, Ludhiana and Assam) during *katki* 1985 and four (Orissa, Dharamjaigarh old, Dharamjaigarh new and Namkum) during *aghani* 1984-85 and *jethwi* 1985 was done for life period, average fecundity and resin secretion. The data are being analysed.

(S. K. Jaipuriar)

1.5.10 Studies on sex determination in lac insects

Studies were continued on eight inbred lines (ten progenies of each inbred line) of *rangeeni* lac insect obtained from a hot region of Bihar (Palamau) reared on potted *bhalia* plants under a cover of 80 mesh synthetic net to study the effect of inbreeding by full-sib mating on sex-ratio during *baisakhi* 1984-85 season. Sex-ratio was scored at the time of sexual maturity.

The results show that inbreeding has no effect on sex-ratio.

Inbred lines maintained under this project showed four new colour forms differing distinctly for the resin and body colour. The F_1 generation obtained from crosses between *kusmi* males and *rangeeni* females when reared on *kusmi* and *bhalia* resulted in 100 and 40 per cent increase in resin secretion respectively over the *rangeeni* parent. It has also been found that these F_1 females also matured by about a fortnight earlier on each host as compared to the *rangeeni* parents. The experiments on crosses of lac insects of widely separated regions have shown that lac insect of North-Eastern region is biologically distinct.

(N. S. Chauhan)

1.5.11 Cytotaxonomy of lac insects

The lac insects collected from Assam were analysed cytologically by 'Giemsa air drying' technique for their chromosomal behaviour.

Facultative heterochromatization was observed in both somatic and germinal tissues of the males which was absent in the females. Diploid chromosome number ($2n = 18$) was also confirmed in both the sexes.

(S. K. Jaipuriar)

Ad hoc studies

Assessment of losses of lac caused by fungal and bacterial pathogen

A preliminary experiment was laid out with *rangeeni* inoculated during October 1985 for *baisakhi* 1985-86 crop season in randomized block design with 4 treatments replicated 5 times.

The treatments were as follows:

(a) Control of fungal and bacterial disease only.
(b) Control of diseases as well as predators and parasites.
(c) Control of predators and parasites only.
(d) Control — No treatment.

It was found that 30 minutes dipping of brood lac in fungicide (Bavistin 0·05%) and bactericide (Vitavux 0·01%) mixture has no harmful effect on the brood lac. Preliminary visual examination of the samples in the field revealed that brood lac subjected to fungicidal and bactericidal treatment before inoculation resulted in less initial mortality of the lac nymphs.

(B. B. Das)

(C) RESEARCHES CONTEMPLATED

(1) "Survey of the pathogenic microorganisms and their effect on the development of lac insect".
(2) Mutation breeding in lac insects.
(3) Survey of genetic variation in host preference of lac insects.
(4) Application of hybrid vigour for improved lac productivity.

B. AGRONOMY AND PLANT GENETICS DIVISION

(a) RESEARCHES COMPLETED — Nil

(b) RESEARCHES IN PROGRESS

2.1 Propagation and Management of Lac Host Plants

2.1.2 Management of *bhalia* for lac cultivation

Expt 1 — *Effect of planting systems and fertilizers on plant growth and lac yield*

The experiment was revived during the year under report as per the technical programme reported earlier (A.R: 1978). *Bhalia* bushes were coppiced in January

1985 and inoculated in July 1985 with *kusmi* brood lac to raise *aghani*, 1985-86 crop. The initial larval settlement and further growth of lac insect was satisfactory till the period under report.

Expt 2 — Weed management in bhalia nursery

The experiment was laid out in R.B.D. with 3 replications. *Bhalia* seeds were sown in April 1985 and the presowing herbicides, namely, Butachlor (2 kg ai/ha), Benthiocarb (1·5 ai/ha), Isoproturon (1 kg a.i ha), Oxadiazon (0·5 kg ai/ha), Oxyflurfen (0.1 kg ai/ha) and Pendimethalin (1·5 kg ai/ha) in 600 litres of water/ha were sprayed by hand sprayer.

Observations were recorded for weeds count and weeds dry weight at 80 and 100 days after sowing (DAS) and compared with hand weeding at 30 DAS and two hand weedings at 30 DAS and 60 DAS, weed free check and no weeding (control).

The most dominant weed flora in *bhalia* nursery during summer and rainy seasons recorded were *Echinochloa crusgalli*, *E. colonum*, *Eleusine indica*, *Cynodon dactylon*, *Setaria* sp. and *Digitaria longiflora* among the grasses, *Ageratum conyzoides* and *Commelina benghalensis* among the broad leaves and *Cyprus* sp. among the sedges.

The data presented in Table 8 revealed that grassy weeds were the most dominant (90% of the total weed population and maximum dry weight during both the stages of observations). Among the various herbicides tried, Pendimethaline (1·5 kg ai/ha) and oxadiazon (0·5 kg ai/ha) were highly effective in controlling weeds in *bhalia* nursery.

The observations recorded on *bhalia* with respect to plant height and number of leaves under different treatments indicated that the plots with severe weed infestation produced lanky plants with lower number of leaflets while the plots receiving weed control measures showed healthy plants with more number of leaflets (Table 9; ai = active ingredient; DAS = days after sowing).

TABLE 9 — EFFECT OF WEED CONTROL TREATMENTS ON PLANT HEIGHT AND NUMBER OF LEAFLETS OF *bhalia* SEEDLINGS

Treatments	80 DAS		100 DAS	
	Plant height (cm)	Number of leaflets	Plant height (cm)	Number of leaflets
Butachlor 2 kg ai/ha	16·5	14	29·4	14
Benthiocarb 1·5 kg ai/ha	15·3	14	29·5	14
Isoproturon 1 kg ai/ha	12·3	12	26·2	12
Oxadiazon 0·5 kg ai/ha	17·6	17	25·6	16
Oxyflurfen 0·1 kg ai/ha	22·6	15	32·2	14
Pendimethalin 1·5 kg ai/ha	16·8	16	25·3	16
Hand weeding (1)	22·5	16	32·0	15
Hand weeding (2)	15·0	20	24·5	19
Weed free check	13·3	18	24·2	20
Unweeded (control)	21·6	13	33·0	14
CD at 5%	3·48	2·60	6·34	3·83

(B. P. Singh)

TABLE 8 — EFFECT OF WEED CONTROL TREATMENTS ON WEED POPULATION AND DRY MATTER ACCUMULATION

Treatments	Weed population/m²						Dry matter accumulation g/m2					
	80 DAS			100 DAS			80 DAS			100 DAS		
	Grasses	Broad leaves	Sedges	Grasses	Broad leaves	Sedges	Grasses	Broad leaves	Sedges	Grasses	Broad leaves	Sedges
Butachlor 2 kg ai/ha	324	23	13	354	23	16	187·9	4·5	3·2	396·6	44·4	5·8
Benthiocarb 1·5 kg ai/ha	387	18	12	416	22	23	335·8	4·3	3·1	486·2	51·3	5·9
Isoproturon 1 kg ai/ha	470	14	17	529	20	19	332·3	6·1	3·5	487·2	53·0	7·0
Oxadiazon 0·5 kg ai/ha	204	16	13	266	11	13	140·8	2·2	2·2	268·3	22·3	4·6
Oxyflurfen 0·1 kg ai/ha	325	21	13	395	14	19	293·0	4·1	3·5	431·2	38·8	7·7
Pendimethalin 1·5 kg ai/ha	121	13	9	220	17	11	104·9	1·6	1·9	256·5	18·0	4·3
Handweeding (1)	304	26	16	329	19	14	211·1	2·5	2·5	251·1	28·8	5·6
Handweeding (2)	122	12	9	149	13	11	89·9	1·3	1·4	171·4	8·9	4·0
Weed free check	22	8	4	23	7	7	11·8	0·6	0·6	17·3	2·8	0·9
Unweeded (control)	558	28	21	637	28	26	365·8	9·2	4·1	552·9	62·2	16·1
CD at 5%	161·90	8·86	8·43	135·30	10·73	7·70	63·86	3·14	1·40	147·33	17·52	6·87

2.1.3 Integration of lac cultivation with general agricultural crops under dry farming condition

Expt 2 — *Raising of tubercrops and rhizomes as intercrops in the mixed plantation of bhalia* and *galwang*

The experiment was revived during the year under report as per the layout reported earlier (A.R. 1978), except that tapioca was replaced by *Colocacia*. The intercrops were raised during *kharif* 1985 season. *Bhalia* bushes were coppiced in January, 1985 and inoculated with *kusmi* brood lac to raise *aghani* 1985-86 crop. The larval settlement and the crop development were satisfactory till the period under report.

The results presented in Table 10 showed that the gross return per hectare was maximum (Rs 4574.00) when sweet potato+turmeric+ginger were intercropped.

TABLE 10 — YIELD AND TOTAL REVENUE OF INTERCROPS WITH MIXED PLANTATION OF *Albizzia lucida* AND *Moghania macrophylla*

Treatments	Yield of inter crops (q/ha)				Total revenue (Rs/ha)
	Colocacia	Sweet potato	Turmeric	Ginger	
Control (No intercrops)					
Colocacia	24·41				3661·50
Sweet-potato		38·09			3809·00
Ginger				5·98	2990·00
Turmeric			9·59		2877·00
Colocacia + Ginger	20·84			2·14	4196·00
Colocacia + Turmeric	21·37		2·61		3988·50
Sweet-potato + Ginger		27·98		2·39	3993·00
Sweet-potato + Turmeric		26·11	2·69		3418·00
Sweet-potato + Ginger + Turmeric		27·09	3·25	1·78	4574·00

Rate : Colocacia Rs 1.50/kg
Ginger Rs 5.00/kg
Sweet-potato Rs 1.00/kg
Turmeric Rs 3.00/kg

(B. P. Singh, S. C. Srivastava and P. Kumar)

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

Baisakhi (*ari*) 1984-85 lac crop was harvested in May 1985 from the *ber* bushes. Lac crop suffered heavy mortality during the summer months and, thus, submormal lac yield was recorded. The *ber* bushes were pruned in May. The DFLS of *daba* and *sarihan* tasar worms procured from the Central Tasar Research and Training Institute, Ranchi were allowed to hatch in the laboratory and later mounted on *ber* bushes in the field. All the larvae died at a later stage and, therefore, no tasar crop could be obtained. Observations of *ber* bushes on plant

height, diameter of stem, number of shoots and the plant spreads (E-W and N-S) were recorded prior to lac inoculation in October 1985 but the attributes mentioned above showed no significant differences between the treatments. (Table 11).

TABLE 11 — SHOWING MEAN VALUES OF PLANT GROWTH ATTRIBUTES/PLANT OF *ber* AFTER THE HARVEST OF TASAR CROPS IN OCTOBER 1985

Treatment	Height/plant (m)	Diameter of main shoot/plant (cm)	Total shoots (no.)	Plant Spreads EW (m)	NS (m)
T_1	9·14	19·2	20·00	8·76	8·88
T_2	11·19	20·33	27·33	9·15	9·05
T_3	10·93	20·50	21·00	9·10	8·86
T_4	11·02	21·16	18·66	8·32	8·25
T_5	11·23	18·13	23·66	8·89	9·26
T_6	12·16	22·20	23·00	9·87	9·93
T_7	10·79	20·70	23·66	8·96	9·05

T_1 — Lac culture
T_2 — Tasar culture
T_3 — Fruit culture
T_4 — Lac culture + Tasar culture
T_5 — Lac culture + Fruit culture
T_6 — Tasar culture + Fruit culture
T_7 — Lac culture + Tasar culture + Fruit culture

(P. Kumar, B. P. Singh, N. Prasad and Y. D. Mishra)

2.1.9 Standardization of agro-forestry practices for raising high lac yielding *kusum* through air layering

Following the success of *kusum* (*Schleichera oleosa*), a major host of *kusmi* lac insects by vegetative means through air layering, this project was taken up to establish *kusum* plantation of proven value.

During the year under report *kusum* trees of proven value at Hesl Experimental Area were marked during May 1985. Due to the late procurement of *Sphagnum* moss, the air layers could not be prepared in June. However in July and August, 115 air layers were prepared out of which 93 layers induced rooting. These air layers were detached from the trees and transplanted in earthen pots during December 1985.

(S. C. Srivastava, B. P. Singh and P. Kumar)

2.1.10 Study and assessment of economics of the cultivation of *kusmi* lac on the bushes of *bhalia* and *galwang* in mixed plantation

Bhalia and *galwang* plants grown in July 1983, have shown satisfactory growth. *Bhalia* bushes were inoculated in the month of July 1985 for raising the *aghani* 1985-86 crop. The progress of the lac crop has been satisfactory in spite of damage done by predators at earlier stage. *Galwang* plants were coppiced for the first time in December 1985, to train them into suitable bushes before these are brought under lac cultivation.

(B. K. Purkayastha)

2. Genetics and Breeding of Lac Host Plants

2.2.1 Possibility of inter-specific crossing in *Moghania* sp. (kept in abeyance)

(S. C. Srivastava)

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

Aghani 1984-85 lac crop raised on *bhalia* bushes grown in progeny rows was harvested from individual plant. The plant showing higher lac yields were

TABLE 12 — *Aghani* 1984-85 LAC YIELD PERFORMANCE ON *bhalia* RAISED IN PROGENY ROWS

Lines	Lac yield (g)
PR-1/1/1/85	50·0
PR-1/1/2/85	40·0
PR-1/1/3/85	66·0
PR-1/1/4/85	24·0
PR-1/1/5/85	54·0
PR-1/2/1/85	60·0
PR-1/2/2/85	75·0
PR-1/2/3/85	48·0
PR-1/3/1/85	30·0
PR-1/3/2/85	66·0
PR-1/3/3/85	58·0
PR-1/3/4/85	45·0
PR-1/3/5/85	70·0
PR-1/3/6/85	55·0
PR-1/4/1/85	20·0
PR-1/4/2/85	85·0
PR-1/5/1/85	58·0
PR-1/5/2/85	76·0
PR-1/5/3/85	40·0
PR-1/5/4/85	65·0
PR-1/5/5/85	35·0
PR-1/5/6/85	82·0
PR-1/5/7/85	37·0
PR-1/5/8/85	68·0
PR-1/5/9/85	76·0
PR-1/6/1/85	40·0
PR-1/6/2/85	56·0
PR-1/6/3/85	88·0
PR-1/6/4/85	36·0
PR-1/6/5/85	70·0
PR-1/7/1/85	50·0
PR-1/7/2/85	65·0
PR-1/8/1/85	38·0
PR-1/8/2/85	40·0
PR-1/9/1/85	16·0
PR-1/9/2/85	44·0
PR-1/9/3/85	85·0
PR-1/9/4/85	50·0
PR-1/9/5/85	75·0
PR-1/9/6/85	48·0
PR-1/9/7/85	64·0
PR-1/10/1/85	35·0
PR-1/10/2/85	44·0
PR-1/10/3/85	20·0
PR-1/10/4/85	68·0
PR-1/10/5/85	72·0
PR-1/10/6/85	58·0
PR-1/10/7/85	36·0

reselected for further screening. In this selection maximum lac yield recorded from individual plant was 85 g (Table 12). The seeds of these plants will be collected and from them plants will be raised in progeny rows for further selection.

Similarly, *aghani* 1984-85 lac crop was harvested from the individual parent *bhalia* plants raised from Netarhat collections. Here the maximum lac yield from individual plant was recorded up to 100 g (Table 13). The seeds of the selected plants will be collected and then plants will be raised for further selection.

TABLE 13 — *Aghani* 1984-85 LAC YIELD PERFORMANCE ON PARENT *bhalia* PLANTS RAISED FROM SEEDS COLLECTED FROM NETARHAT

Plant No.	Lac yield (g)
NC-1/85	24·0
NC-2/85	25·0
NC-5/85	25·0
NC-8/85	100·0
NC-9/85	100·0
NC-10/85	30·0
NC-11/85	35·0
NC-12/85	45·0
NC-14/85	25·0
NC-15/85	30·0
NC-17/85	40·0
NC-54/85	22·0
NC-62/85	20·0
NC-63/85	50·0
NC-64/85	20·0
NC-66/85	32·0
NC-67/85	20·0
NC-69/85	48·0
NC-70/85	40·0
NC-72/85	80·0
NC-73/85	55·0
NC-79/85	50·0
NC-82/85	60·0
NC-84/85	30·0
NC-85/85	100·0
NC-86/85	20·0
NC-87/85	50·0
NC-88/85	20·0
NC-89/85	15·0

(P. Kumar and N. S. Chauhan)

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

Baisakhi 1984-85 and *jethwi* 1985 lac crops raised on *arhar* varieties suffered heavy mortality during summer months and thus subnormal lac yield was recorded.

Seeds of ten *arhar* varieties viz., *Bahar*, 2E, *Laxmi*, GWL-3, MA-2, MA-153, MA 95-2, MA-1, ICP 3783 and ICP 7197 were sown during last week of June in two separate plots under RBD for raising *baisakhi* 1985-86 and *jethwi* 1986 lac crops. One plot was inoculated with *rangeeni* brood lac during November to raise *baisakhi* 1985-86 crop and another set was inoculated in January 1986 to raise *jethwi* 1986 crop. Observations on various plant growth attributes were recorded prior to lac inoculation in November 1985 (Table 14).

TABLE 14 — PLANT GROWTH ATTRIBUTES PRIOR TO LAC INOCULATION IN NOVEMBER 1985 FOR *baisakhi* 1985-86 LAC CROP

Variety	Height/ plant (cm)	Girth per plant (cm)	Shoots per plant (No.)	Total shoot length/plant (cm)
V1	172·13	1·5	14·33	799·13
V2	179·26	1·58	12·93	860·46
V3	173·06	1·58	13·8	894·13
V4	173·8	1·51	14·73	969·46
V5	161·6	1·54	14·8	872·9
V6	149·5	1·62	15·46	825·66
V7	146·3	1·38	14·0	673·13
V8	172·4	1·55	14·66	823·2
V9	157·4	1·52	13·73	707·0
V10	153·13	1·46	14·13	731·53

V1 — Bahar
V2 — 2E
V3 — Laxmi
V4 — GWL-3
V5 — MA-2
V6 — MA-153
V7 —MA 95-2
V8 — MA-1
V9 — ICP 3783
V10 — ICP 7197

Germplasm lines collected from various sources were also raised in separate plots and inoculated with *rangeeni* brood lac during November 1985 for evaluation of *baisakhi* 1985-86 crop.

(P. Kumar, B. P. Singh and A. Bhattacharya)

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

Seeds from individual M_1 plants of *Assam* cv. and *Bahar* var. of *arhar* were collected and sown in July for raising M_2 generation. M_2 plants were inoculated with *rangeeni* broodlac in November 1985 to raise *baisakhi* 1985-86 crop. Plant growth attributes were recorded for individual M_2 plants. These plants were later on sprayed with 0·05% Thiodan® to protect the lac crop from the damage by predators, *Eublemma amabilis* and *Holcocera pulverea* and the pulse crop from the pests.

(P. Kumar)

2.2.5 Induction of polyploidy in *ber* for improved lac productivity (kept in abeyance)

2.2.6 Survey of genetic variation in lac potential of host plants

To find out the estimation of genetic variance in lac yielding potential of host plants this study was taken up. Twenty plants of *galwang* (*Albizzia lucida*) were randomly selected and 60 cuttings (22 cm long from one year old shoots) from each plant were dipped in the mixture of IBA×IPA (100 ppm) for 24 hr. These cuttings were then transplanted in the nursery beds. None of the cuttings induced rooting.

(S. C. Srivastava)

(C) RESEARCHES CONTEMPLATED — Nil

INSTITUTE PLANTATION

(1) General management and upkeep of the plantation including maintenance of roads, paths, hedges and fencing along with farm equipments were also carried out. Hoeing, weeding and mulching operations were also carried out to the young host plants raised in previous seasons under different plots.

Dinanath grass was grown in between the rows of *kusum* and *palas* host trees as inter-crop to improve the condition of lac host trees by applying fertilizers and cultural operations to the intercrops.

Seedlings of various species of lac host plants namely, *palas, ber, kusum, bhalia, galwang* and other minor hosts were raised in the nursery beds for filling up gaps in the respective plots and for use in pots for laboratory experiments.

C. CHEMISTRY DIVISION

(a) RESEARCHES COMPLETED

3.1.10 Adsorption studies on lac

The study was aimed at the preparation of decolourized and deodorized lac by the adsorption method with special reference to the kinetic parameters of the process. Charcoal was chosen as the adsorbent since it is commonly used for the removal of the dye from the industrial effluents.

The study consisted of two parts namely, (1) an examination of the applicability of the Freundlich's adsorption isotherm and (2) the determination of the heat of adsorption in the case of lac.

In the first part, the adsorption of lac from the alcoholic solution (10%, w/v) on charcoal (10% w/v) was studied at room temperature (20°C). It was found that the experimental results obeyed the Freundlich's isotherm. Further, there was a sharp decrease in the intensity of the colour of the solution after adsorption. the adsorption was found to be maximum at a *p*H value of about 4·63 (Table 15).

TABLE 15 — CHANGES IN COLOUR AND *p*H AFTER ADSORPTION

Before adsorption			After adsorption			
CO	d*	*p*H at 32°C	Ce	d*	*p*H at 32°C	X/m
7·87	475	4·81	7·90	153	4·74	0
5·10	385	4·87	4·22	68	4·63	0·088
3·32	360	4·81	2·75	23	4·70	0·057
2·54	195	4·94	2·33	6	4·98	0·021

N.B. CO-Initial concentration (g/100 ml).
d*-Colorimetric deflection.
Ce-Concentration at equilibrium (g/100 ml).
X/m-Ratio of the amount of the solute adsorbed (g) to the mass of the adsorbent (g).

In the second part, the rates of adsorption were studied for different periods of time at different temperatures. The order of the reaction was established and the heat of adsorption was determined from the experimental data which was found to be 92·12 k/cals.

The dependence of the rate of adsorption on the initial concentration of the adsorptive (lac) was studied.

The effect of different amounts of the adsorbent on adsorption was also investigated. It was observed that the adsorption increases sharply with the increasing amount of charcoal up to a given value. Thereafter, it attains a constant value.

In addition, studies were made on the effect of different solvents namely, ethyl alcohol, methyl alcohol, butyl alcohol and dioxane on the adsorption. It was observed that the adsorption was dependent on the nature of the solvent. Further, adsorption was found to be greater from the solvent having higher dielectric constant. This conformed to the general trend.

(A. Kumar)

(b) RESEARCHES IN PROGRESS

3.1 Chemistry of Lac/Constituents

3.1.8 Biophysical studies on the interesction between laccaic acid and DNA

The results of the study on the interaction between laccaic acid and DNA and between mono- and disodium salts of laccaic acid and DNA in 0·001 M NaCl and in water respectively have been reported earlier.

During the period under report, spectrophotometric studies were made on the interaction of mono- and disodium salts of laccaic acid with DNA in 0·001 M NaCl at different DNA phosphate (P) to dye (D) ratios (P/D). The spectral changes of the mono sodium salt were consisted of a bathochromic shift and hypochromism up to P/D-8, beyond which hyperchromism was obtained alongwith red shift up to P/D = 50. No isosbestic point, as obtained in water (A.R.: 1984) was observed in this case.

The number of strong binding sites available per nucleotide (n) was found to be about 0·13 (in 0·001 M NaCl) which is lower than the value of n = 0·21 obtained in water. This indicates less binding of the dye in ionic medium. The above value (0·13) was found to be higher compared to that obtained for laccaic acid (0·064) in the same medium (A.R.: 1984) suggesting that the monosodium salt possesses more affinity for binding with DNA.

For disodium salt, no hypochromism and isosbestic point were noticed. The spectral changes of the dye consisted of hyperchromism and red shift with the progressive presence of DNA.

The interaction of laccaic acid with DNA was also studied by the viscometric method in the phosphate buffer (sodium ion concentration was 0·001 M) of *p*H 6·8 at different DNA phosphate (P) to dye (D) ratios (P/D). A sharp rise in the ratio of specific viscosities of laccaic acid — DNA complexes to dye-free DNA was observed up to P/D = 10 after which a plateau was obtained (Fig. 6). The

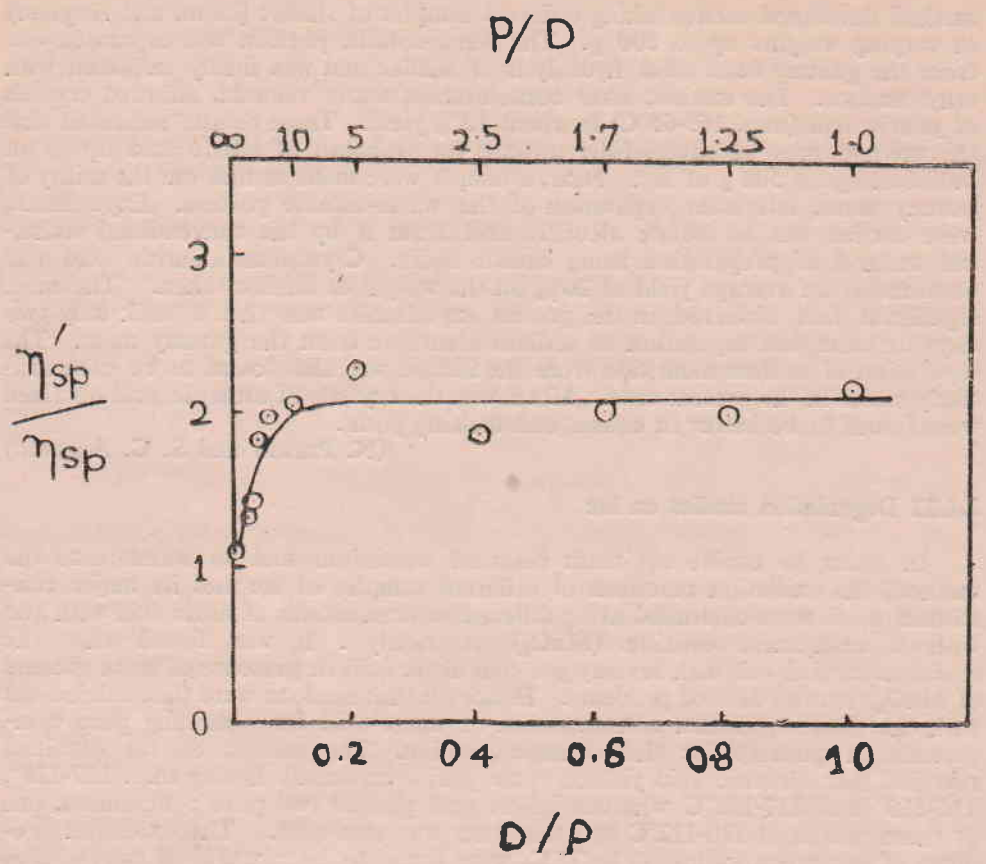

Fig. 6 — Variation of the ratio of specific viscosities of laccaic acid — DNA complexes (η_{sp}) to dye-free DNA (η_{sp}) with the dye (D) to DNA phosphate (P) ratios (D/P)

rise in viscosity indicates that the dye binds with DNA. This result corroborates the finding based on spectrophotometric measurements reported earlier (A.R.: 1984).

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

3.1.9. Thermal polymerization of lac: studies on the molecular weight, shape and size

The project was not undertaken on account of non-availability of dewaxed decolourized lac.

(A. Kumar)

3.1.11 Isolation of jalaric acid from lac on technical scale

It was reported last year that a method has been developed for isolation of jalaric acid from shellac on technical scale (10-12% yield). During the period under report, further experiments were carried out for the standardization of the

method developed earlier taking different samples of shellac (*kusmi* and *rangeeni*) in varying weights up to 500 g. The water-soluble portion was separated out from the gummy mass after hydrolysis of shellac and was finally extracted with ethyl acetate. The extract, after concentration under vacuum, afforded crystals of jalaric acid (m.p. 163-65°C) in about 12% yield. These results indicated that the method may be successfully utilized for isolation of jalaric acid up to an initial charge of 500 g of lac. Next, attempts were made to find out the utility of gummy mass, left after separation of the water-soluble portion. Experiments were carried out to isolate aleuritic acid from it by the conventional technical method of preparation using caustic sodia. Crystalline aleuritic acid was obtained at an average yield of 20% on the weight of shellac taken. The most significant fact observed in the present experiments was that it took only two days for complete separation of sodium aleuritate from the gummy mass. The separation of sodium aleuritate from the filtrate was also found to be comparatively easier in the present case. Moreover, the crystals of aleuritic acid obtained were found to be better in colour and melting point.

(N. Prasad and S. C. Agarwal)

3.1.12 Degradation studies on lac

In order to evolve optimum reaction conditions and to standardize the method, the oxidation reactions of different samples of lac and its major constituent acids were continued using different concentrations of nitric acid with and without manganese dioxide (MnO_2) as catalyst. It was found that the reactions carried out with seventy per cent nitric acid in presence of trace amount of MnO_2 resulted desired products. Hence all the reactions were then carried out with the above optimum concentration of nitric acid for obtaining pure components in quantity for their characterisation. The results, so far obtained revealed that aleuritic acid yielded three pure components having m.p. 127-128°, 115-116° and 117-118°C whereas jalaric acid yielded two pure components, one of them melted at 110-112°C and the other was semisolid. The oxidation products of lac, when examined by TLC, were found to be mixtures of two to three components. These are being refractionated to isolate pure components. The pure components obtained from aleuritic and jalaric acids are being characterized with the help of IR, mass spectra and elemental analysis, etc. The reaction conditions have been found to be satisfactory as the components could be obtained in quantity.

(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

Two insect sex pheromones viz, Z(7)-hexadecen-l-yl acetate and Z(9)-hexadecen-l-yl acetate were synthesized from aleuritic acid adopting simple reaction sequences. Their characterization was done by IR and mass spectra.

After an intensive survey of known insect sex pheromones the compounds, which could be synthesized from aleuritic acid have been selected for the present study. Few more compounds e.g., *p*-phenyl phenacyl ester of aleuritic acid, hydrazides of aleuritic, azelaic acids and S-benzyl thiouronium salt of aleuritic acid were prepared for testing their juvenile hormone activity.

(R. N. Majee and R. Ramani)

3.2.11 To synthesize bis-heterocyclic compounds from aleuritic acid

Oxadiazoles were synthesized from pimelic and azelaic acids, obtained by the oxidation of 7-hydroxy heptanal and azelaic acid aldehyde, the periodate oxidation products of aleuritic acid. The compounds were characterized by IR, PMR and elemental analysis.

(R. N. Majee)

3.3 Modification of Shellac/Constituents and Their Utilization

3.3.3 (ii) Cation exchange resin from styrenated lac

Last year, styrenated lac was sulphonated with concentrated sulphuric acid and converted into cation exchange resin which threw colour in spirit.

During the period under report, sulphonation of styrenated lac with sulphuric acid was carried out in the dry state as well as in dioxane solution in the presence of silver sulphate. The cation (0·010%) exchange resin was then prepared from this sulphonated styrenated lac using ammonium chloride as catalyst. The yield and moisture content were found to be 70 and 8·2 per cent respectively. The cation exchange capacity increased from 2·0 to 2·60 meq/g. The resin did not throw colour in spirit showing inprovement over the previous composition.

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

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

Lac-linseed oil combination was prepared by adopting the procedure developed earlier (A.R.: 1967). This was then treated separately with Desmodur® N and Desmodur® VL and the film properties of the resultant products were examined. It was observed that the air-dried films obtained from the reaction products of lac-linseed oil combination with Desmodur® N (75%) showed good alkali, acid and water resistance while in the case of Desmodur® VL (30% and 50%) all these properties were obtained only in the baked films. Lac-castor oil combination was also prepared by the method developed earlier (A.R.: 1966) and was then treated separately with Desmodur® N (75 and 100%) Desmodur® VL (30 and 50%) and Desmodur® E-21 (30 and 50%). The baked films obtained from the reaction products of castor oil lac combination with Desmodur® N and Desmodur® VL showed good alkali, acid and water resistance while those obtained with Desmodur E21 showed poor alkali resistance but good water and acid resistance.

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

3.3.10 Addition polymerization of shellac

The polymer samples were sent to the Indian Association for the Cultivation of science, Jadavpur earlier for the determination of their molecular weights. The report received from I.A.C.S. revealed that the values of the mol. wt were inconsistent with the data obtained from the viscosity measurements. The assay requires replication.

(A. Kumar)

3.3.11 Modification of lac with ethyl cellulose

It has been reported earlier that the air-dried films prepared from varnishes containing different proportions of shellac and ethyl cellulose showed good properties except impact resistance.

During the period under report, few more varnish compositions were prepared by taking different proportions of ethyl cellulose and shellac (100:15, 100:30, 100:45, 100:60, 100:75, 100:90, 100:120) in denatured spirit. The properties of the air-dried films obtained from different compositions were then investigated and compared with those of the films obtained from 20% solution of ethyl cellulose alone in denatured spirit. The properties such as, adhesion to metal surface, scratch hardness, flexibility and also water and solvent resistance of the films of the above compositions were found to be more or less similar to those obtained for the films prepared from ethyl cellulose solution. The best performance was obtained when 120% lac on the weight of ethyl cellose was used in the composition. The suitability of other solvents in place of spirit was also studied but none was found suitable.

(A. K. Dasgupta)

3.3.12 Modification of lac wax

It was reported earlier that the lac-wax (commercial grade) was modified with calcium hydroxide, calcium oxide and calcium carbonate and some physical properties of the resultant products were studied.

During the period under report, additional physicochemical constants such as acid, saponification and solvent retention values of the modified wax compositions were determined. No appreciable change in the saponification value was observed. Acid and solvent retention values were, however, found to decrease with the increase in the amount of calcium hydroxide, calcium oxide or calcium carbonate in the compositions. Lac wax was also modified with sodium bisulphite (5%) at 150°C under carbon dioxide atmosphere for 5 hr. Characterization of the modified product is under progress.

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

3.4 Use of Shellac and Modified Shellacs in Surface Coatings

3.4.3 Studies on shellac paints for wood patterns

It was reported last year that two lots of an improved compostion of pattern paint based on ordinary shellac were prepared for evaluation studies.

During the year under report, these lots (2 litres each) of pattern paint were supplied to the Foundry Forge Plant of H.E.C., Ranchi for evaluation but they desired a bigger lot (not less than 5 litres) for this purpose. Accordingly, a few more lots of the said paint composition were prepared. All the lots were mixed together and performance of the mixed lot was studied. The mixed lot was found to possess most of the desirable properties of a good pattern paint. The mixed lot (5·5 litres) was, therefore, sent to the Foundry Forge Plant for evaluation. Preliminary trials conducted by them have shown very encouraging results. The paint sample has met their requirement in respect of viscosity, drying characteristics and the film gloss.

(S. Kumar and A. K. Dasgupta)

3.4.4 Studies on shellac esters and their utilization

It was reported last year that when shellac was reacted with glycerol in 3:1 molar ratio using boron trifluoride etherate (BF_3-Et_2O) as catalyst under suitable conditions, shellac glyceryl ester was formed to the extent of 60-65 per cent.

During the period under report, experiments were carried out to characterize this ester. T.L.C. examination, using various solvent system viz. (i) ethyl acetate: glacial acetic acid (100:1, v/v), (ii) chloroform: methanol: glacial acetic acid (90:102, v/v) and (iii) petroleum ether (b.p. 40-60°C): diethyl ether:methanol (48:50:2, v/v), indicated that the product obtained was not a single substance but a mixture of mono-, di- and triglyceryl esters. Attemps were then made to separate these glyceryl esters by preparative TLC and column chromatography. One of the fractions on crystallization gave a white solid, m.p. 78-79°C. TLC examination of this compound suggested it to be a triglyceryl ester of shellac by comparing this compound with triacetin. IR spectrum showed a band for ester carbonyl at 1725 cm^{-1}. It was further confirmed through its mass spectrum.

Studies on film properties of the shellac glyceryl ester were also carried out during the period under report. It was observed that when this ester was reacted with Desmodur N (5%), it produced films which were uniform, non-tacky and glossy. Both air-dried as well as baked films showed good resistance to water and mild alkali.

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

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

An anticorrosive primer composition based on dewaxed lac double-boiled, linseed oil vehicle was prepared last year. During the year under report, this composition was tested for its film performance. This primer on application by brush produced smooth, uniform and adherent egg shell films on tin and M.S. panels. These films passed the test for flexibility and possessed a scratch hardness of 1100 g. They also showed good resistance to water. The above results showed that even when one and half year old vehicle was used the performance of the primer remained the same.

A suitable vehicle composition based on *bhatta* shellac and double boiled linseed oil was also successfully prepared during the year. Using this vehicle an anticorrosive primer was prepared which had uniform texture. This primer also possessed good drying characteristics and could be applied satisfactorily by brush to produce smooth and uniform films. Film properties of this primer are under study.

Experiments were also carried out to prepare a suitable vehicle based on lac and butylated melamine resin but uniform vehicle could not be obtained.

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

3.5 Use of Lac for Encapsulation and Controlled Release

3.5.3 Combination of lac with weedicide for slow-release

Studies were continued to use lac-mud for the preparation of slow-release 2,4-D combination product. The wax-free lac mud was combined chemically with the acid chloride of 2,4-D in 1:1 molar proportion through hetero-

geneous reaction system developed earlier (A.R.: 1981 and 1982). Studies on granular formulations of lac-2,4-D and lac-mud-2,4-D slow release combination products (1:1) were carried out. The granules/microtablets based on lac-2, 4-D (active ingredient), soap stone (carrier) and PVA (binder) in presence of urea (activator) were prepared. The bulk density of the formulation before and after compacting was 0·501 gm/ml and 0·57 gm/ml respectively. It was further observed that when lac-mud-2,4-D was used granules/microtablets could be prepared without the use of carrier thereby minimising the cost of the formulation.

These granules/microtablets did not disperse in water for weeks together showing the possibility of using it for aquatic weed control. It was also found that when wood and rubber (without filler) surfaces were coated with lac-2,4-D (1:1) they served as a slow-release material for the aquatic weed control.

Evaluation results of the samples sent to RRL, Jammu earlier revealed that the weedicides namely 2,4-D-Lac, 2,4-D-acid and 2,4-D sodium proved effective at all doses (500-4000 ppm) against dicots and annual grasses.

Herbicides did not result in any morphological abnormalities during vegetative growth of the test plants (wheat) but with the emergence of inflorescence various types of abnormalities like the formation of tubular leaves, incomplete heading, tweaked and bunched ears besides reduced number of grain/ear were seen particularly more with rise in the strength of concentration except of 500-1000 ppm of 2,4-D-lac and 2,4-D sodium salt and 500 ppm of 2,4-D acid. Moreover, the grain yield with the treatment of 2,4-D lac at 500 ppm was enhanced by 11·81% and thus, proved selective.

Soil residue studies indicated an increase of 8·33% with 2,4-D-lac (at 4000 ppm) in respect of growth of seedlings on 50 days after sowings.

The lac 2,4-D and lac mud 2,4-D combination products were found to be effective in controling the germination of *parthenium* seeds revealing that these may work as pre-emergent type of slow-release weedicide.

A few samples of lac 2,4-D (1:1) formulation were prepared and supplied to Haryana Agricultural University, Hissar for evaluation.

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

3.5.4 Studies on use of lac as adjuvant in pesticide formulations lac-based stickers

It was reported last year that the performance of lac based stickers and commercial stickers on glass surface was comparable. During the period under report, studies were continued to see the relative performance of lac-based sticker on green leaves. Six formulations in ammonia and triethanolamine developed earlier (A.R.: 1983) and three commercial sticker formulations were applied on the *palas* leaves and micro capsules of each were spread on the same area (1 sq. inch). From a comparative study on the sticking property of the capsules by the use of water spray, it was found that the lac-based stickers were comparable with the BASF stickers based on synthetics corroborating the earlier findings on glass surface.

Six samples of lac based sticker formulations based on partially hydrolysed lacs and gummy hydrolysed mass, solutions of shellac in ammonia and triethanolamine and three BASF sticker formulations (commercial) have been supplied to M/s Pest Control (India) Pvt. Ltd., Bombay for evaluation.

The effect of modifiers on the sticking property of lac based stickers was also studied. Shellac solutions (10% v/v) in aqueous ammonia (1:3) and triethanolamine were prepared separately and mixed thoroughly with the sticker formulations based on partially hydrolysed lacs as well as hydrolysed mass. From the sliding characteristics of the above compositions, it was found that the plain shellac solutions can be used as suitable modifiers to the lac based sticker formulations.

Lac-based emulsifiers

It was reported last year that the conditions of sulphonation of lac (CLRI method) were optimized. Aleuritic acid was sulphonated and the solubility parameter of aleuritic acid and its alkyl ester were determined. During the period under report, studies were continued to esterify aleuritic acid with stearic acid with a view to develop suitable emulsifiers. Both the acids were heated in 1:1 molar proportion at 200°C for 5 hr and the resultant product was analysed. This product on sulphonation showed surface active property.

Studies were also made on the mode of sulphonation of lac. From the gravimetric estimation of sulphonated lac it was found that sulphonic groups were present in the product.

(B. C. Srivastava)

(C) RESEARCHES CONTEMPLATED

(1) Study on the tracking resistance of shellac based varnishes.
(2) Styrenation of lac-oil combination.

D. TECHNOLOGY DIVISION

(a) RESEARCHES COMPLETED

4.1 Improvements in the Processing Techniques

4.1.5 Washing of sticklacs with synthetic detergents

Colour is the most important criterion for determining the price of lac. Darker seedlacs generally fetch less price. The colouring material is removed by washing sticklac with washing soda, saji-mitti etc. which also remove some lac resin thereby lowering down the yield of lac. Experiments were, therefore, carried out to study the suitability of the commercial detergents as washing aids so that colouring material of lac may be removed without affecting its yield.

Various samples of *rangeeni* and *kusmi* sticklacs were washed separately with different commercial detergents (0·1% on the weight of sticklac) namely, Biz®, Det®, Gnat®, Key®, Surf®, Genteel®, Magic®, Teepol®, Spa® and Point® and Ritha. The percentage yield, colour index and bleach index of the seedlac so obtained were compared with the seedlac obtained by washing with washing, soda (0·1% on the weight of sticklac). The results are brought out in Table 16. It was noted that Genteel® showed the best performance as washing aid. In this case, the increase in yield was 5·3 to 7·6 per cent and decrease in bleach index was 2 to 10 units with marginal improvement in colour index (1 to 2 units). Next best performance was observed when Surf® was used.

TABLE 16 — PROPERTIES OF SEEDLACS OBTAINED BY WASHING STICKLACS WITH DIFFERENT WASHING AIDS

Sl No.	Details of sticklac	Properties of seedlac obtained	Washing aids (0·1% on the weight of sticklac)											
			Washing soda (control)	Biz	Det	Gnat	Key	Surf	Genteel	Ritha	Teepol	Spa	Magic	Point
1.	*Baisakhi*, 1976-77	Yield (%)	58·1	60·6	60·7	61·2	62·1	62·8	64·3	61·6	61·7	62·0	61·8	62·3
	Palas,	Colour Index	23·0	23·0	23·0	22·0	22·0	21·0	21·0	23·0	23·0	23·0	22·0	23·0
	Daltonganj	Bleach Index	120·0	118·0	117·0	115·0	116·0	110·0	112·0	118·0	120·0	120·0	118·0	120·0
2.	*Baisakhi*, 1977-78	Yield (%)	60·2	63·3	63·5	63·3	64·1	65·4	67·5	62·2	62·4	62·9	62·7	63·8
	Palas,	Colour Index	17·0	17·0	17·0	16·0	16·5	16·0	16·0	17·0	17·0	18·0	17·0	17·0
	Namkum	Bleach Index	98·0	96·0	93·0	94·0	95·0	85·0	93·0	96·0	98·0	100·0	98·0	98·0
3.	*Baisakhi*, 1977-78	Yield (%)	62·7	65·2	65·2	65·5	66·1	68·2	70·1	66·1	66·0	66·3	66·5	66·3
	Ber,	Colour Index	18·0	18·0	18·0	17·5	17·0	17·0	16·0	18·0	18·0	18·0	18·0	18·0
	Namkum	Bleach Index	102·0	100·0	100·0	99·0	98·0	90·0	94·0	100·0	104·0	105·0	102·0	102·0
4.	*Baisakhi*, 1977-78	Yield (%)	63·2	65·4	65·8	65·7	66·7	68·7	70·3	66·4	66·2	66·8	67·0	67·1
	Palas,	Colour Index	22·0	21·5	22·0	20·5	21·5	21·0	20·0	21·0	22·0	22·0	22·0	22·0
	Daltonganj	Bleach Index	112·0	110·0	110·0	108·0	107·0	100·0	102·0	108·0	112·0	110·0	114·0	112·0
5.	*Katki*, 1978	Yield (%)	58·2	60·3	61·2	61·8	62·1	63·5	65·2	61·5	61·8	61·9	62·1	62·5
	Ber,	Colour Index	22·0	22·0	22·5	21·5	21·0	21·0	20·0	21·0	22·0	22·0	21·0	22·0
	Daltonganj	Bleach Index	116·0	114·0	114·0	113·0	113·0	106·0	108·0	116·0	116·0	116·0	114·0	114·0
6.	*Baisakhi*, 1978-79	Yield (%)	63·7	66·2	66·8	68·1	67·4	69·1	71·3	66·8	66·7	67·1	67·1	67·2
	Ber,	Colour Index	18·0	18·0	18·0	17·0	17·0	17·0	17·0	18·0	18·0	18·0	17·5	18·0
	Balarampur	Bleach Index	97·0	92·0	94·0	95·0	92·0	84·0	91·0	98·0	98·0	100·0	98·0	100·0

— *Contd*

TABLE 16 — PROPERTIES OF SEEDLACS OBTAINED BY WASHING STICKLACS WITH DIEFERENT WASHING AIDS — *Contd*

Sl No.	Details of sticklac	Properties of seedlac obtained	Washing aids (0·1% on the weight of sticklac)											
			Washing soda (control)	Biz	Det	Gnat	Key	Surf	Genteel	Ritha	Teepol	Spa	Magic	Point
7.	*Aghani*, 1976-77 *Kusum*, Namkum	Yield (%)	68·0	69·7	70·3	70·5	70·4	72·1	73·0	71·2	71·4	71·7	71·2	71·6
		Colour Index	14·0	14·0	14·0	14·0	14·0	14·0	14·0	14·0	14·0	14·0	14·0	14·0
		Bleach Index	91·0	89·0	89·0	88·0	90·0	86·0	86·0	92·0	92·0	94·0	94·0	94·0
8.	*Jethwi*, 1977 *Kusum*, Namkum	Yield (%)	69·1	70·0	70·5	71·3	71·5	73·3	76·6	72·7	72·7	72·8	72·1	72·6
		Colour Index	14·0	14·0	14·0	14·0	14·0	14·0	14·0	13·0	14·0	14·0	14·0	13·0
		Bleach Index	90·0	88·0	88·0	88·0	88·0	85·0	86·0	90·0	90·0	92·0	90·0	94·0
9.	*Aghani*, 1977-78 *Kusum*, Daltonganj	Yield (%)	68·8	71·3	71·6	73·1	73·2	73·8	74·5	71·9	72·1	72·4	72·6	72·8
		Colour Index	14·0	14·0	14·0	14·0	13·0	13·0	13·0	13·0	13·0	14·0	14·0	14·0
		Bleach Index	93·0	88·0	88·0	86·0	85·0	82·0	84·0	92·0	95·0	94·0	92·0	96·0
10.	*Jethwi*, 1978 *Kusum*, Daltonganj	Yield (%)	69·0	72·3	72·2	74·2	73·8	74·8	75·1	72·3	72·3	72·2	72·3	72·4
		Colour Index	13·0	13·0	13·0	13·0	12·0	12·0	12·0	13·0	13·0	13·0	13·0	13·0
		Bleach Index	90·0	85·0	85·0	85·0	84·0	81·0	84·0	90·0	92·0	90·0	90·0	90·0
11.	*Aghani*, 1978-79 *Kusum*, Namkum	Yield (%)	70·1	73·7	73·4	75·5	75·6	76·1	77·5	74·1	71·1	73·2	72·5	73·8
		Colour Index	12·0	12·0	12·0	12·0	11·0	11·0	10·0	13·0	12·0	13·0	12·0	12·0
		Bleach Index	86·0	83·0	84·0	83·0	83·0	80·0	82·0	87·0	86·0	88·0	86·0	86·0
12.	*Jethwi*, 1979 *Kusum*, Namkum	Yield (%)	71·5	74·0	76·1	76·8	76·8	77·3	79·0	75·0	75·1	74·9	75·2	75·1
		Colour Index	10·0	10·0	10·0	10·0	10·0	9·0	9·0	10·0	10·0	10·0	11·0	10·0
		Bleach Index	85·0	84·0	84·0	84·0	84·0	80·0	83·0	85·0	86·0	85·0	85·0	85·0

As Genteel® and Surf® showed best results, further experiments were conducted to see their effect on increased concentrations of said detergents on the properties of seedlac.

Rangeeni as well as *kusmi* sticklacs were washed separately by 0·1, 0·2, 0·3, 0·4 and 0·5 per cent of Genteel and Surf. No improvement was observed with the increased concentration of these detergents.

The process of washing sticklac with Genteel and Surf was scaled up to semi-pilot scale. Bigger lots (10 kg and 20 kg) of *rangeeni* and *kusmi* sticklacs were repeatedly washed by Genteel® and Surf® to get reproducible results. The trials confirmed that use of Genteel® (0·1% on the weight of sticklac) increased the yield of seedlac by 3 to 5 per cent and decreased the bleach index by 2 to 5 units. But the use of Surf decreased the bleach index by 3 to 10 units and increased the yield by 2 to 4 per cent. The results are given in Table 17. The colour index of seedlacs was more or less the same, and no appreciable change in other properties (e.g. life, flow and alcohol impurities) was noticed.

TABLE 17 — PROPERTIES OF SEEDLAC OBTAINED BY WASHING STICKLAC (20 KG LOT) WITH 0·1 PER CENT OF GENTEEL® AND SURF®

Sl No.	Type of sticklac	Washing aid (0·1%)	Properties of seedlac		
			Yield (%)	Colour index	Bleach index
1.	*Baisakhi*, 1981-82 *palas*, Namkum	Washing soda (control)	61.3	18.0	110·0
		Genteel	64·3	18·0	108·0
		Surf	63·6	17·5	107·0
2.	*Katki*, 1982 *ber*, Daltonganj	Washing soda (control)	60·7	20·0	115·0
		Genteel	65·6	20·0	110·0
		Surf	64·7	20·0	109·0
3.	*Aghani*, 1981-82 *palas*, Namkum	Washing soda (control)	68·8	14·0	98·0
		Genteel	73·8	13·5	94·0
		Surf	71·9	14·0	90·0
4.	*Jethwi*, 1982 *kusum*, Namkum	Washing soda (control)	70·2	12·0	95·0
		Genteel	74·3	12·0	90·0
		Surf	73·5	12·0	85·0

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

(b) RESEARCHES IN PROGRESS

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

During the period, further experiments were carried out to dewax lac with alcohol of different concentrations (70-98%) at room temperature (23-26°C) and at lower temperatures 15-18°C, 11-14°C. The results are brought out in Table 18.

TABLE 18 — PROPERTIES OF SHELLACS OBTAINED AFTER DEWAXING AND DECOLOURIZING *kusmi* SEEDLAC

Sl No.	Concentration of alcohol (%)	Yield of shellac (%)			Colour index			Wax content (%)		
		I*	II*	III*	I*	II*	III*	I*	II*	III*
1	98	82	85	85	0·70	0·70	0·70	0·18	0·20	0·80
2	95	82	85	85	0·80	0·70	0·80	0·18	0·18	0·60
3	90	81	81	82	0·75	0·80	0·80	0·16	0·18	0·60
4	85	74	75	75	0·80	0·80	0·90	0·14	0·16	0·40
5	80	70	70	72	0·90	0·90	0·90	0·14	0·16	0·20
6	78	63	65	70	1·00	1·00	1·00	0·15	0·16	0·18
7	75	51	52	55	1·20	1·20	1·20	0·15	0·15	0·18
8	70	22	25	28	1·30	1·30	1·30	0·14	0·14	0·16

*Dewaxing carried out at: I = 11-14°C
II = 15-18°C
III = 23-26°C (room temperature)

Dewaxing and decolourizing at room temperature was optimum with 78-80 per cent alcohol when yield, colour index and wax content of the shellacs were 70-72 per cent, 0·90-1·00 unit and 0·18-0·20 per cent respectively, but below 18°C, 95-98 per cent alcohol was found to be the most suitable when the yield, colour index and wax content of the shellacs were 82-85 per cent, 0·70-0·80 unit and 0·18-0·20 per cent respectively.

Experiments were also carried out with acetone, methanol, isopropyl alcohol, rectified and denatured spirits to find out their comparative suitability for dewaxing (15°-18°C) and decolourizing. The results are brought out in Table 19. Methanol was found to be as good as rectified or denatured spirit (distilled) for dewaxing and decolourizing. Acetone and isopropyl alcohol were found unsuitable as yield of shellac was only 50 and 66 per cent respectively.

TABLE 19 — PROPERTIES OF SHELLAC DEWAXED AND DECOLOURIZED PREPARED FROM *kusmi* SEEDLAC (C.I.: 11·0) BY DIFFERENT SOLVENTS

Sl No.	Solvent	Yield of shellac (%)	Properties of shellac	
			Colour index	Wax content (%)
1	Rectified spirit	85	0·75	0·18
2	Denatured spirit (distilled)	84	0·70	0·19
3	Methanol	85	0·75	0·19
4	Isopropyl alcohol	66	0·80	0·25
5	Acetone	50	0·80	0·20

(R. K. Banerjee)

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

During the period under report, three sets of each (*bhatta* and machine made) *kiri* were processed into shellac by adopting the method standardized earlier (A.R.: 1984) using sodium hydroxide and sodium hydrosulphite 3% each with a view to adjudge the reproducibility of the results obtained last year. The data (average) are presented in Table 20.

TABLE 20 — THE PROPERTIES OF SHELLAC OBTAINED FROM *kiri* LAC SAMPLES

Sl No.	Sample	Life (min)	Flow (mm)	A.V.	Colour
1.	*Bhatta kiri* (alkali extracted)	17	13	86	31
	do (alcohol extracted)	17	14	84	Very dark
2.	Machine made *kiri* (alkali extracted)	12	10	93	Very dark
	do (alcohol extracted)	12	10	90	Very dark

4.2 Rubber-Shellac Combinations

4.2.1 Incorporation of modified lac into rubber

The effect of incorporation of Mg-salt of lac into the blend of natural (NR) and styrene-butadiene rubbers (SBR) was continued with white and black fillers. It was reported (A.R.: 1983) that 5 parts of Mg-salt of lac when incorporated into the above blend in presence of white filler (china clay), the modulus, tensile strength and hardness increased. During the period, the effect of higher percentage of Mg-salt of lac (10 to 20 parts) was examined. It was found that except hardness other mechanical properties decreased considerably (Table 21).

When Mg-salt of lac was incorporated into the above blend in presence of black filler (EPC) it was found that the mooney number, elongation at break, resilience and hardness increased. While other properties such as scorchtime, modulus at 200 per cent, tensile strength, tear resistance and abrasion index decreased (Table 21). The results obtained indicate that Mg-salt does not influence the properties of the rubber blend in uniform manner.

(R. Singh and B. B. Khanna)

4.2.2 Electrical properties of the rubber-shellac blends

The variation of dielectric strength of natural and styrene-butadiene rubber due to the incorporation of different proportion of shellac in the gum stocks at different periods of curing has been reported last year. Some studies were also carried out on the variation of dielectric constant, dielectric loss and dissipation factor measured at 100 kHz of natural rubber gumstocks containing 5 parts of shellac at different periods of curing.

During the period under report, studies were made on the variation of dielectric constant, dissipation factor (tan δ) and dielectric loss of NR, SBR, filled (china clay) and unfilled blends (50:50) of NR and SBR due to incorporation

TABLE 21 — EFFECT OF INCORPORATION OF Mg-SALT OF LAC INTO A BLEND OF 50 PARTS EACH OF NR AND SBR WITH FILTERS

(Base mix: NR, 50; SBR, 50; ZnO, 4; PBN, 1; stearic acid, 1; sulphur, 2 and MBT, 1)

Mg-salt of lac added per hundred parts of the blend	Optimum time of cure at 140°C (min)	Mooney No. ML_1+4 at (120°C)	Scorch time (min-sec.)	Modulus at 200% elongation (kg/cm^2)	Elongation at break (%)	Tensile strength (kg/cm^2)	Tear resistance (kg/cm)	Hardness shore A durometer	Impart resilience (%)	Abrasion resistance index
				FILLER CHINA CLAY (100 PARTS PER 100 PARTS OF THE BLEND)						
0	30	—	—	8·3	690	39·3	—	52	—	—
5	20	—	—	10·8	750	41·1	—	54	—	—
10	20	—	—	1·7	600	8·8	6·4	58	—	—
15	30	—	—	1·6	550	11·7	5·4	60	48·75	—
20	30	38	31-02	1·7	620	16·6	6·2	64	48·75	—
				FILLER EPC (70 PARTS PER 100 PARTS OF THE BLEND)						
0	20	21·0	30-33	7·3	550	43·8	—	55	48·75	100
5	20	38·0	15-49	5·2	620	39·1	13·7	56	65·10	80·1
10	30	38·5	21-10	4·2	600	27·4	9·9	59	51·80	93·2
15	30	42·5	17-20	3·9	700	34·2	5·9	60	50-30	73·7
20	20	43·0	20-04	3·9	500	20·1	6·7	60	48·70	70·1

of different proportions of shellac in the stocks. The measurements were made at 100 kHz and curing time was varied from 10 to 50 min. The results are shown in the Figs. 7 and 8. For natural rubber, the maximum value of dielectric constant was obtained for the gumstock containing 5 parts of shellac and cured for 40 min. For SBR, the maximum value was obtained for the gumstock containing 15 parts of shellac and cured for 20 min. Dielectric constant values of the blends of NR and SBR cured for 10 and 30 min were higher compared to those for individual rubbers. Incorporation of shellac into the stocks cured for 20 and 50 min lead to an increase in the dielectric constant. For other compositions a decrease was observed. Incorporation of filled (china clay) in the blends of NR and SBR resulted a general rise in dielectric constant. Maximum value of dielectric constant was noticed for the filled blends containing 20 parts of shellac cured for 20 min.

The dissipation factor and dielectric loss values were lowest for the NR composition containing 2·5 parts of shellac cured for 30 min. For SBR, the above values were found to be minimum for the composition containing 5 parts of shellac cured for 20 min. For the unfilled blends, the minimum values were noticed for the composition containing 10 parts of shellac cured for 10 min. For the filled stocks, the minimum values were observed for the compositions containing 10 parts of shellac cured for 40 min.

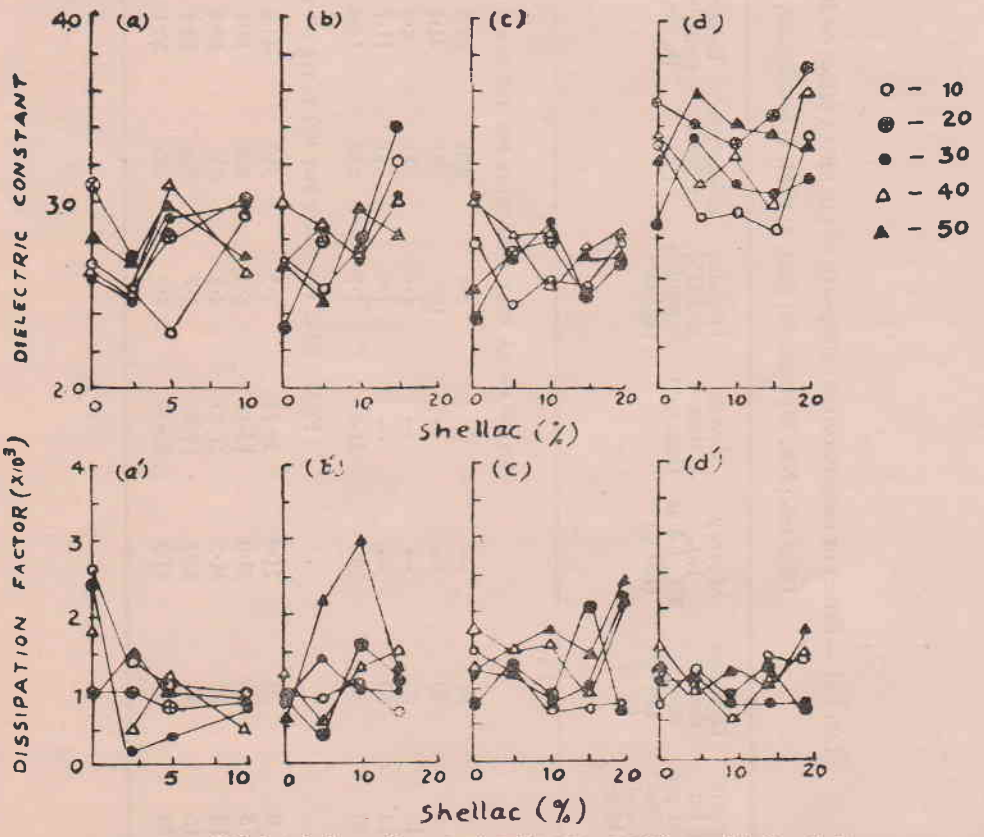

Fig. 7 — Variation of dielectric loss of different rubber compositions with the shellac content in the stocks at 100 kHz,NR(a), SBR(b), blends of NR and SBR(c), Filled (china clay) blends of NR and SBR(d). The notations used for different curing periods are same as in Fig. 1

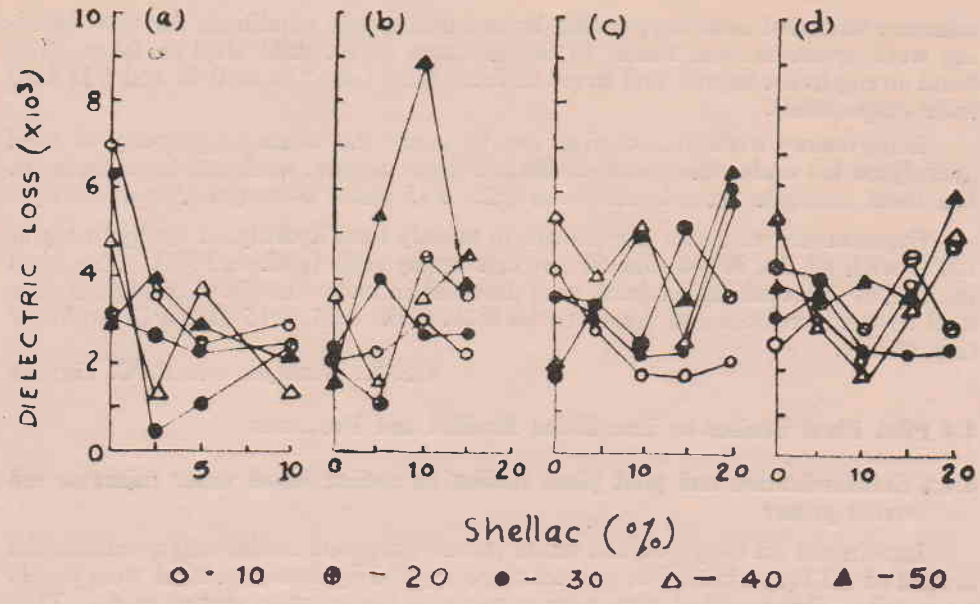

Fig. 8 — Variation of dielectric constant, dissipation factor of different rubber compositions with the shellac content in the stocks at 100 kHz. (a, a′) NR; (b, b′) SBR; (c, c′) unfilled blends (50: 50) of NR and SBR; (d, d′) Filled (china clay) blends of NR and SBR. Curing time 10 min (—○—○—), 20 min (—⊗—⊗—), 30 min (—●—●—), 40 min (—△—△—), 50 min (—▲—▲—). For NR compositions curing time was of 15 min

Further studies viz. the variation of the above parameters with frequency and temperature are to be carried out for SBR, filled and unfilled blends of NR and SBR in order to select a composition possessing desirable properties. From a similar study as stated above, natural rubber containing 5 parts of shellac cured for 20 min was observed to possess the desirable properties.

4.3 Use of Lac in Adhesives

4.3.1 Modified lac (with synthetic monomers) as adhesives

During the period under report, experiments were repeated by reacting bleached lac with iso-butylacrylate and *n*-butylacrylate in presence of hydrolysed lac (10% on the weight of bleached lac) in ammonical solution in order to get improved bond strength and water resistance but the desired success was not achieved.

A bench scale preparation (1l lot) of the best composition obtained so far based on bleached lac and ethylacrylate (1:1) was carried out and no difficulty was experienced. The resulting product was tested and found satisfactory. The adhesive has been stored in a plastic container for storage stability.

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

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

It was reported last year that the optimum conditions for aqueous Rebulac adhesive to get maximum bond strength on steel to steel surfaces were found to be 3000 lb/inch², 200°C and 45 min. During the period under report, the same

adhesive was tried over copper and brass surfaces and conditions for their bonding were optimized and found to be the same as on mild steel surfaces. The bond strengths on copper and brass surfaces were found to be 0·40 and 0·11 ton/inch^2 respectively.

Experiments were also carried out to study the adhesive property of *total* hydrolysed lac under the above conditions over copper, steel and brass surfaces. The bond strengths were found to be 0·23, 0·15 and 0·04 ton/inch^2 respectively.

Experiments were also carried out to modify *total* hydrolysed lac by fusing at 150°C with 10, 20, 30, 40 and 50 per cent epoxy resin (epikote 1001). The bond strength of the resulting products were determined under the above conditions over steel to steel surfaces and found to be 0·21, 0.18, 0·16, 0·15 and 0·12 ton/inch^2 respectively.

(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 and a commercial sample of oil based red oxide primer were applied by brush on mild steel panels separately. One panel of each primer was also coated with enamel paint. They were tested for corrosion resistance in a salt spray cabinet. After exposure for 18 hr it was observed that blister formation took place in all the panels, but the blistering was more in case of uncoated enamel panel.

(P. C. Gupta)

Ad hoc Project

Shellac is losing importance in several industries e.g. micanite, insulating varnishes, etc. due to its low melting point. It was, therefore, proposed to elevate its melting point by reacting with trimethyl chlorosilane, zinc acetate, cobalt acetate and copper acetate separately. Preliminary experiments have been carried out with these chemicals and melting point of the end products were found to be in the range of 80-85°C, 90-95°C, 80-85°C and 90-95°C respectively against control 75-80°C.

(P. C. Gupta)

(C) RESEARCHES CONTEMPLATED — Nil

E. EXTENSION DIVISION

(a) Programme/projects completed	Nil
(b) Projects in progress	Nil
(c) Projects contemplated	Nil

OPERATIONAL RESEARCH PROJECT FOR MAXIMIZING LAC PRODUCTION IN CHOTANAGPUR AREA

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

A. INSECT CULTURE PROGRAMME

(a) LAC CULTURE

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

Rangeeni sticklac coupe

Baisakhi 1984-85 *ari* crop was harvested from 144 *ber* trees which were inoculated at the rate of 2·5 kg broodlac per tree in Oct./Nov. 1984 by 32 farmers and on an average yield of 1·390 kg sticklac per tree was obtained as against 0·309 kg recorded from the traditionally operated trees.

Rangeeni broodlac coupe

Baisakhi 1984-85-cum-*katki* 1985 crop was harvested from 68 *palas* trees of 33 farmers and an average yield of 1·483 kg broodlac/tree was obtained as against 0·250 kg/tree recorded 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 0·850 kg broodlac/tree and no special pest control measures were applied on them.

Kusmi crop

Out of 9 *kusum* trees of 9 farmers which were inoculated using 6·83 kg broodlac/tree enclosed in synthetic net containers during February 1984, crop on 5 trees continued to develop satisfactorily. Partial *ari* harvesting from one tree and complete mature harvesting from 3 trees during *aghani* 1984-85 season and partial *ari* as well as mature crop harvesting from one tree during *jethwi* 1985 season gave on the whole an average annual yield of 5·00 kg broodlac and 4·05 kg sticklac/tree. An average annual income of Rs 284.25/tree was recorded. Another set of 8 *kusum* trees was inoculated using 2·5 kg brood lac/tree enclosed in synthetic net containers during February 1985. Complete harvesting of one tree during July 1985 gave an yield of 12·00 kg sticklac fetching an income of Rs 240 only. Remaining 7 trees were left for self inoculation.

Raising of lac host plants

Total 229 seedlings of lac host plants (*ber* = 33, *galwang* = 160 and *kusum* = 36) were supplied to 50 farmers from the Institute Plantation for planting in the area.

(b) APICULTURE

Out of the total 78 bee keepers owning 223 modern beehives in the area, only 26 keepers were recorded to maintain 60 bee colonies in the beginning of the year. Sixty-five more colonies were caught by 30 keepers and the colony losses were minimized to only 34. As a consequence, total number of colonies in the area

were increased by 50 per cent i.e. 91 by the end of the year. Out of 26, 25 keepers produced 294·0 kg honey through 179 extractions from 75 colonies only. Average annual income of Rs 350.80 per keeper was generated through the sale of 11·76 kg honey at the rate of Rs 30 per kg. Maximum production of 71 kg honey by a single keeper was recorded from 10 colones owned by him which fetched an annual income of Rs 2130.

B. CROP PRODUCTION PROGRAMME

(a) AGRICULTURAL CROPS

General availability of inputs was facilitated by organizing 'Vikas Club' and arranging inputs as per the demand of the farmers. Improved seeds of Ragi (*Manua*) A-404, Niger (*Surguja*) N-5, *Gondli* (B-1, B-2) were procured from Birsa Agricultural University, Ramakrishna Mission and other reliable sources and supplied. In addition to fertilizers like D.A.P., Urea, T.S.P., etc. *Rhizobium* cultures for pigeon-pea, blackgram and green gram were also supplied for augmenting fertilizer effectiveness. Insecticide like B.H.C. (10% dust) for general termite control, phorate (10 g) for paddy pest control and malathion and Thiodan 35 E.C. for vegetable pest control were supplied on a limited scale. Farmers were encouraged to purchase one Knap-sack sprayer on collective basis.

Ragi — Seven farmers were encouraged to grow A-404 variety on a total of 1·22 ha area and 6·75 quintal grain was produced fetching a gross income of Rs 1106 per farmer. The technology of brood casting mixture of seed and D.A.P. in the ratio of 1:8 gave yield up to 25 g/ha in the fields treated with rock phosphate in previous years.

Wheat — Eleven farmers took up wheat cultivation on var. (Sonalika). Most of them raised the crop late after harvesting paddy and an average yield of 12·45 q/ha was recorded fetching a gross income of Rs 453 per cultivators. However, maximum yield of 29·4 q/ha was recorded when the crop was sown in time. Availability of inputs, water, cattle grazing and wild elephants were the major constrains experienced. Repair facilities for the irrigation pumps were not available as and when required causing delays in irrigation.

Horticultural crops — Vegetables growing was also encouraged by supplying improved seeds of tomato (Punjals chhuhara, Pusa Ruby, etc.) chillie *Pusa jwala*, and japanese lawanga), Brinzal (Bandham), cauliflower and cow pea after procuring them from the sources mentioned under agricultural crops, use of malathion and endosulfan (Thiodan 35 EC) for vegetable pest control was also popularized and encouraged. The grafts of litchi (19), mango (15) and citrus (5) were procured from various sources and distributed to farmer for planting along with the appropriate technology.

C. ANIMAL HUSBANDRY PROGRAMME

General animal health care was ensured with the cooperation from the animal husbandry department by arranging vaccination, guest lectures and supply of medicines.

(a) POULTRY KEEPING

One dozen fertilized egges of a hybrid strain (broiler) were procured from Ramakrishna Mission Ashrama (K.V.K.) and the chicks were raised by the *Deshi* foster hen.

(b) SWINE HUSBANDRY

The only surviving pure Yorkshire boar fetched an income of Rs 600 to owner through sale in the local market. Two keepers continued to maintain hybrid (Yorkshire × Local stock and four far rowings were recorded during January, April, June and November yielding total 23 piglets (Average No. 5·75, Maximum 9). Ten piglets and one sow died during the period and thus by the end of the year one hybrid sow, 8 grower (4 ♀ and 4♂) and 4 piglets (2♀ and 2♂) were surviving in the area.

Inadequate feeding and improper housing were the main constraints.

(c) DAIRYING

Out of the six crossbred cows supplied earlier only 3 were surviving in the beginning of the year. These were disposed off by the keeper at an average rate of Rs 533 per cow. Two heifers and 4 bullocks were surviving till the end of the year.

Two local cows along with 2 male calves were purchased by one farmer through the bank loan. One cow delivered a calf during September. Record of milk yield was not available. The cows are being kept by the farmers merely for obtaining bullocks.

(d) GOAT KEEPING

The only surviving Black-Bengal goat gave birth to a kid during May. The 7 months old kid survived till the end of the year. The goat was recorded to be pregnant again. No economic return was recorded this year.

D. 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 needs of the farmers.

One day off-Campus training course in *kharif* crop production technologies was organized with the cooperation from the Ramakrishna Mission Ashrama (K.V.K.) in the village Hardag during June.

Krishi Vikas Club — Started last year was continued to serve progressive farmers in obtaining required inputs in time and raising fruit trees in their backyards.

(R. C. Mishra and J. Lal)

3. EXTENSION

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

The division continued to provide technical guidance to the Forest Department, Bihar in running their Lac Farm at Kundri (Palamau) consisting of nearly 40,000 *palas* trees. A meeting with the Conservator of Forests (Western Circle, Daltonganj), Conservator of Forests (State Trading) and the concerned D.F.O. was arranged at the Institute to decide various steps necessary for the improvement in the working of the Farm. Various seasonal operations in the Farm were carried out under the direct supervision and guidance of the division. During the year the trees were divided into 3 coupes to include a new *ari* coupe, namely, coupe C comprising 2500 trees. A total of 21,000 trees in coupe B were pruned/*ari* harvested during April/May 1985 yielding 45·50 quintals of sticklac. Partial harvesting from 300 trees during July/August, 1985 yielded 1·20 quintals of broodlac which was used for inoculating 150 trees. The seasonal operations during October-December 1985 on 3941 trees in coupe A yielded 89·13 quintals of broodlac of which 2·6 quintals were sold (by the Forest Department) and the remaining was utilized to inoculate 14,782 trees of coupe B and C. On scraping *phunki* lac sticks 5·19 quintals of sticklac was obtained. The farm, thus yielded a total 50·69 quintals of sticklac which is almost twice that obtained last year.

The entire operation involved an expenditure of Rs 32,145.00 only and a net profit of Rs 1,24,000.00 is expected.

(2) *Technical advisory services*

The division attended 202 querries related to lac farming, manufacture of lac and lac products, schemes of various sizes on lac based industries, availability of raw materials and machineries, materials for research and publicity etc. received from all over the country and abroad. Besides, consultancy services were provided to 31 parties consisting of industrialists, entrepreneurs, farmers, scientists and extension workers. Technical assistance was also continued to be given to the lac growers and agencies for the forecast of the time of larval emergence and during the year 28 crop samples were examined for the above purpose. A leading lac manufacturer was assisted in manufacturing lac dye by way of testing facilities and suggestions to improve the quality. Plan for establishing small processing units for the benefit of lac growers was supplied to the Deputy Development Commissioner, Chotanagpur Division, Bihar. Suggestions were also given to representatives of Bharat Heavy Electricals Ltd., Bhopal on various problems faced by them in the manufacture of commutator micanite with lac as the bonding material. Demonstration of the process for manufacture of sealing wax and hydrolysed lac was arranged for the benefit of two entrepreneurs. The technology transfer programme, however, suffered a set back due to short supply and consequent rise in price of lac in the local market.

(3) *Publicity*

Exhibition stalls were put up in the Kisan Melas organized by Divyayan Krishi Vigyan Kendra at their Getalsud Farm (19-20 January) and at Birsa Agricultural University, Ranchi (10-12 February 1985).

The Institute also participated by putting up exhibits in the India International Trade Fair held at New Delhi from 4-27 November 1985. A scientist of the division was deputed for briefing the visitors.

A technical bulletin entitled "Slow release lac coated urea fertilizer for improved nitrogen use efficiency" and a 6-page folder on salient research findings of the Institute were published during the year. The head of Division represented the Institute in the advisory committee for Rural Programmes of the Local Doordarshan Kendra. Two T.V. programmes on 'uses of lac' and 'lac cultivation' were got prepared for telecast. Publicity was achieved through newspaper coverage and a special feature on "Lac Institute breaks new grounds" was published in Amrita Bazar Patrika on 2nd August 1985.

(4) *Testing of lac and lac products*

The division provides testing facilities for lac products for the benefit of manufacturers and Government organizations on payment of a nominal fee. During the year, 59 samples of seedlac, shellac and other lac based products were received at the testing laboratory and in all 145 tests were carried out.

(5) *Training*

The division continued to be responsible for offering training courses, developing currircula and providing technical expertise for different levels of extension functioneries. Four regular certificate courses were organized during the year. Out of these, three trainings were on 'Improved Methods of Lac Cultivation' and one on 'Industrial Uses of Lac' and a total of eleven trainees who completed the course successfully were awarded certificates. At the request of Shellac Export Promotion Council, Calcutta, four of their technical personnels were trained for 6 weeks at this Institute on various aspect of lac culture. A short course training of 8 days was also arranged for a personnel deputed by the Directorate of Lac Development, Ranchi. The division continued to extend its support to the educational activities of the Divyayan Krishi Vigyan Kendra, Ranchi and during the year 33 lectures on lac culture were arranged for 7 batches of their grass root level trainees. Besides, on farm training for 25 farmers of Gutigarha and Dowgarha villages was organized on 19 September 1985 in collaboration with the above K.V.K.

For all the above training programmes the division contributed by developing course schedules, selecting candidates, developing instructional resources, standardization of courses and evaluation of candidates.

The certificate course on "Industrial Uses of Lac" conducted by the Institute has been recognized by the Khadi and Village Industries Commission as adequate and pre-requisite for their supervisory cadre under the discipline "Forest Based Industries" (vide Commission's letter No. FBI/Trng/85-86/12/716 dated 3 June 1985).

(6) *Visitor's Programme*

The division attended 610 visitors including 7 batches of farmers, 2 batches of I.F.S. probationers, 3 batches of school/college students and a batch of Opinion Leaders. Film/slide shows were arranged for those who came in a group.

All necessary arrangements for the visit of a five member delegation of research scientists and Forest officials from the People's Republic of China on 2-3 January 1985 were also made. A list of important visitors is given on page 4.

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 1985 is given below:

1. *Bulletins*	
(i) Chemical	165
(ii) Entomological	105
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 1985

Sl No.	Authors	Title of paper	Name of Journal
		A. ENTOMOLOGY DIVISION	
1.	Jaipuriar, S. K., Teotia, T. P. S., Lakhotia, S. C. and Chauhan, N. S.	"A reinvestigation of the lecanoid chromosome system in *Kerria lacca* Kerr"	*Cytobios*, **42**: 263-270, 1985
2.	Bhagat, M. L. and Bose, K. C.	"Role of foods on the longevity and fecundity of *Pristomerus sulci* Mahd. and Kolu (Hymenoptera: Ichneumonidae)"	Uttar Pradesh, *J. Zool.*, **5**: 210-212; 1985
3.	A. Bhattacharya and A. K. Sen	"New host record of *Megalorothrips distalis* Karny (Thripidae: Thysanoptera) and *Haplothrips ganglbaueri* Schmutz (Phlaeothripidae: Thysanoptera)"	*Science and culture*, **51**: 61; 1985

Sl No.	Authors	Title of the paper	Name of Journal
4.	C. P. Malhotra, P. Sen and A. Bhattacharya	"*Anastatoidea* sp. (Hymenoptera: Eupelmidae) a new pupal endoparasitoid of the lac predator *Eublemma amabilis* Moore (Lepidoptera: Noctuidae)"	*Entomon*, **10**: 239-240; 1985
5.	M. L. Bhagat	"बीहन लाह संरक्षण: समस्या एवं समाधान"	राँची एक्सप्रेस, p. 12, Oct. 5, 1985

B. AGRONOMY AND PLANT GENETICS DIVISION

1.	Singh, B. P., Purkayastha, B. K. and Singh, K. P.	"A preliminary study on the effect of lac mud application on growth and yield of 'Sonalika'"	*Seeds and Farms*, Nov. 1985, 63-64

C. CHEMISTRY DIVISION

1.	Majee, R. N. and Ramani, R.	"Synthesis of 1,4,12-trimethoxy dodecane, a juvenile hormone	*Indian J. Chem.*, 1985, **24B**, 230
2.	Mukherjee, M., Majee, R. N., Kumar, Shravan and Mukherjee, S. N.	"Synthesis of glyceryl monoaleuritate"	*J. Oil Col. Chem. Assoc.*, 1985, **68**(2), 46
3.	Prasad, N., Agarwal S. C., Dasgupta, A. K. and Gupta, P. C.	"Modification of shellac with some unsaturated acids"	*J. Oil Colour Chem Assoc.*, 1985, **68**(5), 120
4.	Goswami, D. N.	"The Dielectric Behaviour of Shellac - Urea - Formaldehyde Resins"	*Angewandt. Makromol. Chem.* (W. Germany), 1985, **135**, 33
5.	Banerjee, P. K., Srivastava, B. C. and Kumar, Shravan	"Physico-chemical characterization of aqueous shellac solutions and hydrosols for encapsulation"	*J. Oil Col. Chem. Assoc.*, 1985, **68**(1), 14-17
6.	Srivastava, B. C. and Saha, S. K.	"Slow-release lac-coated urea fertilizer for improved N-use efficiency"	*Technical Bulletin*, ILRI,, Namkum, 1985, 1-22
7.	Agarwal, S. C., Kumar, Shravan and Khanna, B. B.	"Development of lac based industries in Bihar"	Presented at the workshop on "Prospects of Industrialization in Bihar" organized by RIADA at Ranchi, 1985
8.	Srivastava, B. C., Agarwal, S. C. and Kumar, Shravan	"Lac and lac based chemicals"	Presented in a seminar on "Scope of Agro-based Chemicals and Allied Industries in Eastern India" held at Jadavpur University, Calcutta 1985

D. TECHNOLOGY DIVISION

1.	R. Singh and B. B. Khanna	"Zinc salt of lac as a compounding ingredient for natural and butadiene rubbers"	*Res. and Ind.*, **30**, 1985, 199-203

Sl No.	Authors	Title of the paper	Name of Journal
		E. EXTENSION DIVISION	
1.	Saha, S. K. and Bharadwaj, S. P.	"Lac cultivation A socio-economic study"	*Indian Shellac* (1 and 2), 3-6, 1985
2.	Srivastava, B. C. and Saha, S. K.	"Slow Release Lac Coated Urea Fertilizer for Improved Nitrogen Use efficiancy"	*Technical Bulletin*, ILRI, 1985
3.	Saha, S. K.	'ILRI-Salient Research Findings"	Six-page Folder, ILRI, 1985

5. CONFERENCES AND SYMPOSIA

Agarwal, S. C., 26-27 April 1985	Presented a paper entitled " Development of lac based industries in Bihar in the workshop on prospects of Industrialization in Bihar " organized by Regional Industrial Area Development Authority (RIADA) at Ranchi
Agarwal, S. C., 24 August 1985	Attended a seminar on " Scope of agro-based chemical and allied industries in Eastern India and a paper entitled " Lac and lac based chemicals " was presented. The seminar was organized by the Institute of Chemical Engineers (India), Eastern Region at Calcutta
Khanna, B. B., 26 April 1985	Attended the workshop on " Prospects of Industrialization in Bihar " held at Ranchi
Majee, R. N., 30 October 1985	Attended Dr P. K. Bose Memorial National seminar on " Chemistry of natural products " held at Bose Research Institute, Calcutta
Prasad, N., 29-30 October 1985	Attended Dr P. K. Bose Memorial National seminar on " Chemistry of natural products " and presented a paper entitled " Lac resin and its constituent acids "
Srivastava, B. C., 24 August 1985	Attended the seminar on " Scope of agro-based chemicals and allied industries in Eastern India " and presented a paper entitled " Lac and lac based chemicals "
Saha, S. K., 26-27 April 1985	Attended the workshop on " Prospects of Industrialization in Bihar " held at Ranchi
Gupta, P. C., 26-27 April 1985	— do —
Gupta, P. C., 15-22 January 1985	Attended a short term course on adhesion and failure held at I.I.T., Kharagpur

6. SUMMARY

ENTOMOLOGY DIVISION

(a) RESEARCHES COMPLETED

1.1.8 Lac cultivation trials on *khair* and *palas* in alternation to make *khair* plantation a remunerative one proved unsatisfactory.

1.2.8 The experiments on the use of lac dye as a biological stain showed satisfactory staining of chromosomes but as a nuclear stain it was not up to the mark.

1.3.3 Bio-ecological studies on *Pristomerus sulci* indicated the peak incidences during the maturity period of all the four crops. The first instar host larvae were preferred by the female parasite for egg laying and eggs were laid singly in 7th, 8th or 9th segments. Longevity and fecundity of gravid females were maximum when fed with 2% sucrose solution at 30°C.

(b) RESEARCHES IN PROGRESS

1.2.2 Synthetic diets containing amino acids, vitamins, mineral salts and sucrose on agar slants as substrate supported the crawlers of *jethwi*, *katki* and *baisakhi* seasons for 39, 16 and 50 days respectively.

1.2.5 The effect of soil application of N, P and K was studied individually as well as in combination on potted plants. Response of NPK differed in *bhalia* and *arhar* during *baisakhi* crop. Growth and development of the lac insects under different NPK doses could not be ascertained.

1.2.6 The TLC examination of the lipids revealed that there are seasonal difference in the crawlers of the two *kusmi* generations i.e. *aghani* and *jethwi* with respect to the number of components of lipids.

1.2.7 Histophysiological observations on female lac insects revealed that six lateral resinous protuberance correspond to the marginal pore clusters. The wavy out lines are lost after fertilization and the resin glands get shifted towards the aboral region during post metamorphic period.

1.3.5(c) From the record of emergence from the caged lac sticks collected from different localities of M.P., it was found that the incidence of *Tetrastichus purpureus* (inimical parasite) and *Apanteles tachardiae* (beneficial parasite) was high during *aghani* season while *Holcocera pulverea* during both *jethwi* and *aghani* seasons. Locationwise variation in the incidence of the parasites and predators has also been observed.

1.3.5(d) The relative performance of *kusmi* brood obtained from different *kusmi* producing states were tried at Khadgaon (M.P.) and the performance of local brood was found to be best.

1.3.6 Experiments on two *kusmi* crops to find out the causes of mortality indicated that the density of lac nymphs per centimetre length of sample was more in the middle segment than the apical and basal segments. The average settlement was 117·64 and 195·18.

1.3.8 The studies to explore the host plant effect on the population of *rangeeni* lac insects indicated that highest mortality of the lac nymphs was on *palas* followed by *bhalia* and *ber* during *baisakhi* 1984-85 and *katki* 1985 seasons. During *baisakhi* 1985-86 highest mortality was recorded on *palas* followed by *ber* and *bhalia*.

1.3.9 Experiments on the settlement pattern of the lac insects in relation to host plant crowding revealed that coverage of the shoots is directly proportional to the host plant crowding.

1.3.10 Studies to assess the abundance of lac pests in different places showed that there were differences in the population of predators and parasites during both male emergence and maturity stages.

1.4.1(2) Out of 8 schedules tried under "field trials of integrated control schedule", it was confirmed that integration of insecticidal application with that of trap cropping (heavy inoculation) resulted in substantial increase in lac crop with a high degree of suppression of predator population.

1.4.3.1 Two insecticides viz., 'Dipterex' and 'Evisect' were evaluated for their safety to lac insects and their effectiveness against the predators. It was found that both the insecticides were safer to lac insects of above 40 days age and were highly effective against the predators. "Dipterex" was slightly more effective than "Evisect".

1.4.3.2 Extracts of three plant materials viz., *Acorus calamus*, *Butea monosperma* and *Melia azederach* could not be tested due to non-availability of sufficient number of predator population.

1.4.3.3 Laboratory trials of 'BHC', 'Chlordane', 'Sevin', 'Thiodan' and 'Lindane' against *Eupelmus tachardiae* and *Coccophagus tschirchii* indicated that they are highly susceptible to insecticidal treatments.

1.4.3.5 Trials with recommended control schedule on the associated fauna by using 'Thiodan' alone and 'Thiodan' and 'Thuricide' in combination revealed that a combined spray of 'Thiodan' and 'Thuricide' is highly effective against the inimical insects for reduction of their population.

1.0.4.6 Experiments to find out the hormoligatory effect of recommended insecticides on lac insects showed that maximum increase in size of lac cells was with lowest concentration (0·003125%) of the insecticide.

1.4.9 Experiments with chitin inhibitor 'Dimilin' against *Eublemma amabilis* eggs and larvae revealed that there was significantly high mortality and malformation in larvae due to 'Dimilin' treatment.

1.4.10 Field trials conducted to find out a control schedule against *Chrysopa* species with 'BHC' and 'Chlordane' indicated that the three spray schedule of BHC has been found to be most effective. Laboratory evaluation of three more insecticides viz., 'Padan', 'Dipterex' and 'Evisect' indicated that the effectiveness of 'Padan' is *at par* with BHC but the others are found slightly inferior.

1.4.13 Pest densities above 2 per 30 cm of lac bearing twig cause considerable damage to the lac crop, and the damage is even higher when the infestation is at an early stage.

1.4.14 Results of treatment of brood lac with selective insecticides and inert materials showed that there was no adverse effect on the lac nymphs but settlement was slightly affected. Slight suppression in emergence was, however, noted when the brood was treated with inert materials.

1.5.8 Six germplasm stocks of *rangeeni* and 5 of *kusmi* strain were maintained and evaluated for economic qualities.

1.5.10 Results of full-sib mating of *rangeeni* lac insect obtained from hot region of Bihar showed that inbreeding has no effect on sex ratio.

Inbred lines so far maintained showed a few new colour forms differing distinctly for the insect and resin colour.

The F_1 generation obtained from crosses between *kusmi* males and *rangeeni* females when reared on *kusum* and *bhalia* resulted in 40 to 100 per cent increase in resin yield respectively. It has also been found that these F_1 females also matured earlier by about a fortnight as compared to the *rangeeni* parents.

The experiments on crosses of lac insects of widely separated regions have shown that lac insect of North Eastern region is biologically distinct.

AGRONOMY AND PLANT GENETICS DIVISION

2.1.2 Among the weed categories, grassy weeds were the most dominant. Pre-sowing applications of Pendimethaline (1·5 kg ai/ha) and Oxadiazon (0·5 kg ai/ha) were found highly effective in controlling weeds in *bhalia* nursery.

2.1.3 The gross return per hectare was maximum when sweet potato + turmeric + ginger were intercropped in the mixed plantation of *Albizia lucida* and *Moghania macrophylla*.

2.1.8 The *baisakhi* (1984-85) lac crop suffered heavy mortality during summer month and subnormal lac yield was obtained. Plant attributes did not show significant differences between the treatments on *ber* bushes.

2.1.9 *Kusum* trees of proven value at Hesal field area were marked and 115 air layers prepared, out of which rooting was induced in 93 layers which were subsequently detached and transplanted in earthen pots.

2.1.10 *Aghani* 1985-86 lac crop was raised on *bhalia* bushes and *galwang* plants were coppiced for the first time to train them into suitable bushes.

2.2.2 *Aghani* 1984-85 lac crop harvested from individual *bhalia* plant, raised in progeny rows showed maximum lac yield up to 88 g.

Similarly *aghani* 1984-85 lac crop harvested from individual *bhalia* plant raised from Netrahat collections showed maximum lac yield up to 100 g.

2.2.3 *Baisakhi* 1984-85 and *jethwi* 1985 lac crop raised on *arhar* varieties suffered heavy mortality during summer months.

Ten *arhar* varieties were again raised for *baisakhi* 1985-86 and *jethwi* 1986 lac crops and plant growth attributes were recorded prior to lac inoculation (i.e. in November).

2.2.4 M_2 plants of *Assam* cv. and *Bahar* var. were raised in July 1985 and subsequently inoculated in November for raising *baisakhi* 1985-86 crop and plant growth attributes were recorded prior to lac inoculation.

2.2.6 Sixty cuttings from each of 20 randomly selected *galwang* plants were raised separately after treating them with the mixtures of IBA×IPA (100 ppm) for 24 hr.

CHEMISTRY DIVISION

(a) RESEARCHES COMPLETED

3.1.10 Studies were made on the adsorption of lac on charcoal at different temperatures to prepare decolourized lac.

(b) RESEARCHES IN PROGRESS

3.1.8 Spectrophotometric studies revealed that the affinity for binding of monosodium salt of lac-dye with DNA was higher compared to that of lac-dye alone in 0·001M sodium chloride solution. Viscometric studies revealed that lac-dye binds with DNA corroborating the earlier finding based on spectrophotometric measurements.

3.1.11 A method has been standardized for the technical preparation of jalaric acid from shellac in about 12% yield. The gummy mass, left after separation of jalaric acid, can be conveniently utilized for the technical preparation of aleuritic acid.

3.1.12 Optimum conditions have been found out for carrying out the oxidation reactions of different samples of lac and its major constituent acids with nitric acid.

3.2.10 Two insect sex pheromones, viz., Z(7)-hexadecen-1-yl acetate and Z(9)-hexadecen-1-yl acetate were synthesised from aleuritic acid. Few compounds were also prepared from aleuritic acid for testing their JH activity.

3.2.11 Oxadiazoles were prepared from pimelic and azelaic acids and characterized.

3.3.3(ii) The cation exchange capacity of the resin prepared from styrenated lac resin increased from 2·0 to 2·60 meq/g. This resin did not throw colour in spirit showing improvement over the previous composition.

3.3.6(ii) Lac was reacted with linseed and castor oils separately. The reaction products were then treated separately with Desmodur N, Desmodur VL and Desmodur E21. The films obtained from some of the compositions showed good water, acid and alkali resistance.

3.3.10 The molecular weights of the polymer samples obtained using the vapour phase osmometer were found to be inconsistent with the data obtained from the viscosity measurements.

3.3.11 The film properties of varnishes containing increased proportions of shellac in ethyl cellulose were found to be better than those obtained from ethyl cellulose alone in respect of hardness, flexibility and resistance to water and solvents.

3.3.12 Various characteristics such as acid, saponification and solvent retention values have been determined for some modified lac-wax compositions.

3.4.3 A few lots of pattern paint based on ordinary shellac were prepared and tested for their film performance. Evaluation trial of the above paint composition, carried out in the pattern shop of the Foundry Forge Plant of H.E.C. has revealed that the paint sample met the requirement in respect of viscosity, drying characteristics and film gloss.

3.4.4 TLC examination of shellac glyceryl ester, obtained earlier, showed it to be a mixture of mono-, di- and triglyceryl esters. A white crystalline compound could be isolated from this mixture and identified as a triglyceryl ester of shellac.

3.4.5 Film performance of the primer composition based on one and half year old vehicle was tested and found to be more or less same as obtained earlier from the primer composition based on freshly prepared vehicles. A primer composition based on ordinary shellac-double boiled linseed oil vehicle was also successfully prepared.

3.5.3 Lac-mud was combined chemically with the acid chloride of 2,4-D through heterogeneous reaction system. The granular formulations of lac 2,4-D and lac-mud 2,4-D combinations were prepared. Their possible use for the aquatic weed control has been envisaged. The lac 2,4-D and lac-mud 2,4-D combination products were found to be effective in controlling the germination of *Parthenium* seeds.

3.5.4 It has been found that aqueous shellac solutions can be used as modifiers for lac-based sticker formulations. The performance of lac-based stickers on leaves was comparable to that of commercial BASF stickers.

Aleuritic-stearic acids ester was prepared and subsequently sulphonated which showed surface active property for use as emulsifier.

TECHNOLOGY DIVISION

(a) RESEARCHES COMPLETED

4.1.5 Experiments were carried out to study the suitability of commercial detergents as washing aids for lac. Genteel® showed the best performance increasing the yield of seedlac by 3 to 5 per cent and decreasing the bleach index by 2 to 5 units.

(b) RESEARCHES ON HAND

4.1.6(ii) Dewaxing of seedlac at different temperatures with varying concentrations of alcohol was studied. Dewaxing of seed lac with 95-98 per cent alcohol below 18°C was found most suitable.

4.1.7 Two samples of *kiri* were processed into shellac by the method standardized last year and similar quality of products were obtained.

4.2.1 Incorporation of higher percentage of Mg-salt of lac into a blend of NR and SBR in presence of fillers decreased all the mechanical properties except the hardness.

4.2.2 Studies were made on the different dielectric parameters of SBR and filled blends of NR and SBR after incorporation of different proportions of shellac in the compositions at different period of curing. It was observed that there was improvement in the values of dielectric constant, dielectric loss and dissipation factor.

4.3.1 An adhesive composition based on bleached lac and ethylacrylate was prepared on bench scale. Its properties were found satisfactory in respect of storage stability.

4.3.4 The aqueous adhesive from Rebulac was found suitable for bonding copper to copper and brass to brass surfaces.

Total hydrolysed lac was modified with varying proportions of epoxy resin. The bond strength of the resulting products was found to decrease with the increase in the percentage of epoxy resin.

4.4.2 The films of both lac-linseed oil fatty acid-red oxide primer and a commercial red oxide primer when subjected to salt spray cabinet test showed blister formation.

Ad hoc project

Melting point of shellac could be increased 5 to 15°C by reacting it separately with trimethyl chlorosilane, cobalt acetate, copper acetate and zinc acetate.

7. METEOROLOGICAL REPORT FOR THE YEAR 1985

The average meteorological data for each month were as follows:

Months	Mean barometric pressure (mm)	Mean maximum temp. (°C)	Mean minimum temp. (°C)	Mean dry bulb temp. (°C)	Mean wet bulb temp. (°C)	Mean humidity (%)	Total rainfall (mm)	Highest maximum temp. (°C)	Lowest minimum temp. (°C)
January	708·77	24·8	10·6	19·5	14·19	79·6	31·2	28·5	6·6
February	705·27	26·6	10·13	18·35	14·0	61·8	15·2	31·5	7·2
March	704·1	34·2	14·15	27·0	20·2	52·0	—	38·0	8·8
April	702·18	37·58	20·58	27·9	24·55	55·8	38·5	41·0	16·1
May	700·00	37·43	20·07	30·37	25·72	69·03	68·4	41·5	16·1
June	696·54	35·9	21·56	29·28	26·38	78·63	129·5	40·0	15·5
July	698·89	29·30	22·13	25·22	24·17	91·67	257·5	31·0	20·5
August	698·38	29·53	22·62	25·59	24·64	92·25	424·1	32·0	21·1
September	700·69	29·61	20·28	25·65	24·18	88·73	306·4	32·0	15·0
October	705·67	29·17	12·94	24·20	21·77	80·48	202·4	32·0	7·7
November	708·11	27·21	8·89	21·2	18·06	74·06	—	30·0	7·2
December	709·22	25·20	7·34	18·45	15·38	71·54	—	29·0	3·8

The highest maximum temperature recorded was 41·5°C on 30th May and lowest minimum temperature 3·8°C on 7th December. The total rainfall during the year amounted 1473·2 mm of which the monsoon (June-September) rainfall was 1117·5 mm. The rainfall during the year was lower than that of 1984 (1984-1411·8 mm). There was no hail storm during the year.

8. PERSONNEL

Sl No.	Name of the Post	Staff position as on 31.12.1985
	Director (Officiating)	Dr B. B. Khanna
	Entomology Division	
1.	Head, Division of Entomology	Sri N. S. Chauhan
2.	Scientist S-3 (Agricultural-Entomology)	Sri B. B. Das
3.	Scientist S-2 (Agricultural-Entomology)	Sri A. H. Naqvi 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.	Senior Technical Assistant (T-5)	(1) Sri M. K. Choudhury
6.	Technical Assistant (T-4)	(2) Sri K. U. Sinha
7.	Technical Assistant (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-2)	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
	do (T-1)	Sri R. K. Swanshi
11.	Field Farm Technician (T-I-3)	Sri R. D. Pathak
	do (T-2) (T-1)	(1) Sri H. N. Sukla (2) Sri K. P. Gupta (3) Sri A. K. Sinha (4) Sri Dilip Kumar Singh
12.	Insect Collection (Tech. T-I-3) Tender	Sri R. L. Ram
13.	Field (Plantation and Stores) Asstt. (T-2)	Sri Munna Lal Ravidas
14.	Junior Stenographer	Sri Sant Kumar
	Regional Field Research Station, Dharamjaigarh (M.P.)	
1.	Field Farm Technician (T-II-3)	Sri R. S. Maliya
2.	do (T-I-3)	Sri A. Hussain
3.	do (T-2)	Sri Jiwan Lal
	Agronomy and Plant Genetics Division	
1.	Scientist S-2 (Plant Genetics)	Dr P. Kumar
2.	Scientist S-2 (Agronomy)	Sri B. P. Singh
3.	Scientist S-1 (Plant Breeding)	Sri S. C. Srivastava
4.	Scientist S-1 (Plant Physiology)	Sri R. P. Singh
5.	Laboratory Technician (T-I-3)	Sri D. D. Prasad
	do (T-1)	Sri Mohan Singh
6.	Field Farm Technician (T-1)	(1) Sri Jagarnath Oraon (2) Sri K. A. Nagruar

Chemistry Division

1.	Head, Division of Chemistry	Sri S. Kumar
2.	Scientist S-3 (Organic Chemistry)	Dr S. C. Agarwal
3.	Scientist S-2 (Physical Chemistry)	Dr A. Kumar
	do Physicist	Dr D. N. Goswami
4.	Scientist S-2 (Organic Chemistry)	(1) Dr N. Prasad (2) Dr R. N. Majee
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
	do (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) Mrs. P. R. Ghatak
9.	Laboratory Technician (T-I-3)	(1) Sri U. Sahay (2) Sri B. P. Keshri
	do (T-2)	(1) Sri P. B. Sen (2) Sri G. Mishra
10.	Laboratory Technician (T-1)	Smt Prabha Devi
11.	Glass Blower (T-1)	Sri B. S. Choudhary
12.	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. Ghose
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. Singh
	do (T-2)	Sri Tulsi Ram

Extension Division

1.	Scientist S-3 (Physical Chemistry)	Dr S. K. Saha
2.	Scientist S-1 (do)	Dr A. Pandey
3.	Senior Analyst (T-5)	Retired and Vacant
4.	Technical Assistant (T-5)	Sri R. C. Maurya
	do (T-4)	(1) Sri Deepak Ghosh (2) Sri K. M. Sinha (3) Sri Jagdish Singh
5.	Commercial Artist (T-4)	Sri Pyare Das
6.	Laboratory Technician (T-I-3)	(1) Sri D. Runda (2) Sri B. P. Ghosh
7.	Junior Stenographer	Sri A. K. Sinha
8.	Museum Assistant (T-1)	Miss Ratna Dutta

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-Entomology)	Sri S. P. Bharadwaj
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-2)	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 Clerks	(1) Sri Budhan Ram (2) Sri Md Mobarak (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 Sankar (10) Sri Anant Pandey (11) Sri Prahlad Singh (12) Sri S. C. Lal (13) Sri R. N. Mahto (14) Sri Bihari Sahu (15) Sri Erik Vijay Kujur
10.	Stockman-cum-Compounder (T-I-3)	Sri C. Pandey
11.	Hindi Translator (T-II-3)	Sri Lakshmi Kant

Technical and Monitoring 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. Tewari
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)	Vacant
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.	do (T-1)	Sri V. K. Tewari
4.	Tractor Driver (T-2)	Sri Markus Surin

Promotion

1.	Sri B. P. Ghosh	Promoted to next higher grade (T-I-3)
2.	Sri R. P. Srivastava	do (T-2)
3.	Smt Prabha Devi	do (T-2)

Resignation/Transfer

1.	Sri Erik Vijay Kujur (Junior Clerk)	Resigned
2.	Sri B. B. Das, S-3	Transferred from CPRI, Patna to ILRI, Ranchi
3.	Sri V. K. Tewari	Transferred from NEH, Shillong to ILRI, Ranchi
4.	Sri S. P. Bharadwaj, S-1	Transferred to IASRI, New Delhi
5.	Sri A. C. Hazari	Returned back to his parent department

Appointment

1.	Sri R. P. Singh, S-1	(Plant Physiologist)

Retirement

1.	Dr C. P. Malhotra, S-3 (Agricultural Entomology)	Retired on 31.3.1985
2.	Sri L. C. Mishra, Senior Analyst (T-5)	Retired on 31.8.1985

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