वार्षिक प्रतिवेदन
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Annual Report
1993 - 94

भारतीय लाख अनुसंधान संस्थान
Indian Lac Research Institute
(भाकृअनुप : ICAR)
राँची, भारत : Ranchi , India

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Indian Lac Research Institute
(भारतीय कृषि अनुसंधान परिषद्)
(Indian Council of Agricultural Research)
नामकुम, राँची 834 010, भारत
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Cover photo : *Palas (Butea monosperma),* a major lac host.

Contents

INTRODUCTION

The Indian Lac Research Institute (ILRI) was started, on the basis of recommendation of an enquiry committee constituted by the Government of India to enquire into the condition of the Indian Lac trade and suggest measures for its allround improvement. In order to implement this suggestion, members engaged in the lac trade at that time constituted themselves into a private registered body under the name, Indian Lac Association for Research. The association set up this institute in 1925. In 1931, the Indian Lac Cess Committee took over this institute. After the abolition of this committee, ILRI came under the administrative control of the Indian Council of Agricultural Research (ICAR), from 1st April, 1966.

The Institute

The ILRI is situated in the peaceful suburbs, nine kilometers east of Ranchi, on the Ranchi - Tatanagar highway and is spread over an area of 49 ha. Located in the main campus are : the Entomology Division, Chemistry Division, Plant Sciences Section and Extension Division; the Administrative and Finance & Accounts Sections; the Library; the Technical and Monitoring Cell and the Mechanical Section; besides, Dispensary and the residential quarters. Adjoining this, is a small campus housing the Technology Section and the staff quarters. The Institute has playgrounds in both the campuses. Adjoining the campuses there is a 36.5 ha plantation for field experimentation. The Institute also has a Regional Field Research Station for Lac at Dharamjaigarh, M.P. and runs an Operational Research Project in a group of villages in Ranchi district. The ILRI is a pioneer organisation devoted to researches on cultivation, processing and utilization of lac, which is mostly cultivated in an area of about 80,900 sq. km., by the tribals of Bihar and adjoining states. Since its inception, the Institute has persistently endeavoured to develop and disseminate appropriate technologies to boost up lac production. A good number of products and processes have already been developed and efforts are continuing to explore newer areas in view of everchanging requirements of the industry. ILRI has attained international recognition for its contribution in cultivation and utilization aspects of lac.

Objectives

- To conduct strategic and applied research for developing strategies for improvement in the production, processing and utilization of lac.
- To provide leadership for generating location-specific technology for management of improved production and processing of lac.
- To act as a centre for training in lac production, processing and utilization technology by collaborating with State Govt. and industry.
- To act as a repository of information on the lac production, processing and utilisation.

- To collaborate with National and International agencies in achieving the above objectives.

Organisational Set-up

The Institute is headed by a Director. The scientific manpower is deployed under three divisions : Chemistry, Entomology and Extension, and two sections: Plant Sciences and Technology. The Administrative wing comprises of Director's Office, Administrative Section, Purchase Section, Finance and Accounts Section and Central Stores. The auxiliary units are: Hindi Cell, Security, Medical and Estate Maintenance Services. The technical support is provided by the following sections : Library, Farm Unit, Maintenance & Workshop and Technical & Monitoring Cell.

Staff

Sri S. Kumar continued in the capacity of Officiating Director upto 10th May 1993. Dr Nawab Ali, Project Director, C.I.A.E., Bhopal was deputed to look after the duties of Director of this Institute, who joined on 12.7.1993 and continued upto 8.10.1993 (F/N). Dr S.C. Agarwal was appointed as regular Director of this Institute who took over charge from Dr Nawab Ali on 8.10.1993.

The Institute has a sanctioned strength of 61 scientific, 86 technical, 49 administrative, 14 auxiliary and 136 supporting grade posts.

Budget

During 1993-94, the non-plan expenditure was Rs 147.72 lakhs, against a budget estimate of Rs 120.00 lakhs; the plan expenditure was Rs 30.11 lakhs against a budget estimate of Rs 44.00 lakhs.

Research Highlights

An early maturing kusmi *lac insect*

A *kusmi* lac insect obtained from Madanpur, Madhya Pradesh was found to mature about one month earlier than the local insect, after mass selection. The biological and industrial parameters of this insect were comparable to those of the local insect. The *jethwi* 1993 crop was found to almost escape the attack of *Eublemma amabilis,* a major lac predator.

Control of lac predator

Studies using the pyrethroid insecticides, cypermethrin and fenvalerate at 0.0005 and 0.001% showed that they resulted in 77-100% inhibition of hatching in 1-6-day-old eggs of *E. amabilis,* a major lac predator.

Genetic analysis of the cream variant of lac insect

Crossbreeding of cream variant of the lac insect with the wild-type and yellow insects revealed that the cream phenotype is due to a single recessive gene. The *yellow* and *cream* genes are non-allelic and are on different chromosomes.

Propagation of kusum *through air-layering*

Success has been achieved in air-layering of *kusum* through application of the hormones, IAA, NAA, IPA and IBA, individually and in combination of

two at 50/100 ppm. Upto 100% rooting was observed when the air-layers were prepared in June-July on shoots of 2-3 cm girth using *Sphagnum* moss + lanolin paste as rooting medium.

Bioactive compounds from aleuritic acid

Fifteen insect sex pheromone components have been synthesised from aleuritic acid, a major constituent acid of shellac. Of the several candidate compounds synthesised from aleuritic acid for JH activity, four were found to show slight activity on one-day-old pupae of *Corcyra cephalonica.*

Coumarin derivative from jalaric acid

The method of synthesis of 3-methyl-4(3-carboxy methyl propane) 7-carboxy methyl coumarin from jalaric acid, a constituent acid of shellac, has been standardised.

Dioxalane from butolic acid

Synthesis of 2'-hydroxy-propyl-6-(2"-methyl ethylene dioxalane) tetradecanoate was achieved using butolic acid, a constituent acid of shellac, as starting material.

Pigmented air-drying type insulating varnish

A red-pigmented shellac-based insulating varnish has been develolped for application on traction motors. The varnish was found superior to an imported varnish used for the same purpose, especially in respect of dielectric strength and resistance to tracking.

Hot-melt adhesive based on shellac and polyvinylacetate

When shellac was modified with polyvinylacetate (M.W.45000), and applied as hot-melt adhesive, a bond strength of 0.2 ton/sq inch was obtained. The result suggests the possibility of use of the product as hot-melt adhesive.

Recovery of lac dye from wash water

In order to design and install a pilot plant for recovery of lac dye from wash water, parameters such as pH, quantity of acid required to stop putrification, quantity of calcium and sodium carbonate required, have been determined.

Extension Highlights

A programme was launched in association with District Industries Centre, Purulia, Govt. of W. Bengal to train several batches of entrepreneurs in order to help them in setting up lac-based industries. Five training camps for lac growers were also organised in collaboration with Forest Department, Bihar.

The testing Laboratory of the Extension Division has gained importance as a major testing house for lac exports from the country. Test reports were issued for 146 samples drawn from export consignments aggregating 2648 tonnes of seedlac/shellac which is nearly 40% of the total lac exported during the year ❑

DIVISION OF ENTOMOLOGY

Researches in progress

1.1 Improvement in lac cultivation techniques

1.1.9 To evolve suitable management practices for brood and sticklac production in the light of recent findings

Y.D. Mishra, S.G. Choudhary and M.L. Bhagat

Techniques for kusum

During the period under report, lac crops could not be raised as per the technical programme *(Ann.Rep 1990-92)* due to shortage of broodlac. However, the experiment was restarted in December 1993, using the broodlac, obtained from Madhya Pradesh, after multiplying it to the requisite quantity. The crop was developing satisfactorily. The cultivation operations carried out are outlined in **Table 1.**

1.1.10 Evolution of cultivation schedule on *akashmani (Acacia auriculaeformis)* for growing *kusmi* and *rangeeni* crops

S.G. Choudhary, A.H. Naqvi and A.K. Sen

Field trials were continued as per the technical programme *(Ann.Rep 1990-92).* The following experiments were repeated during the period under report.

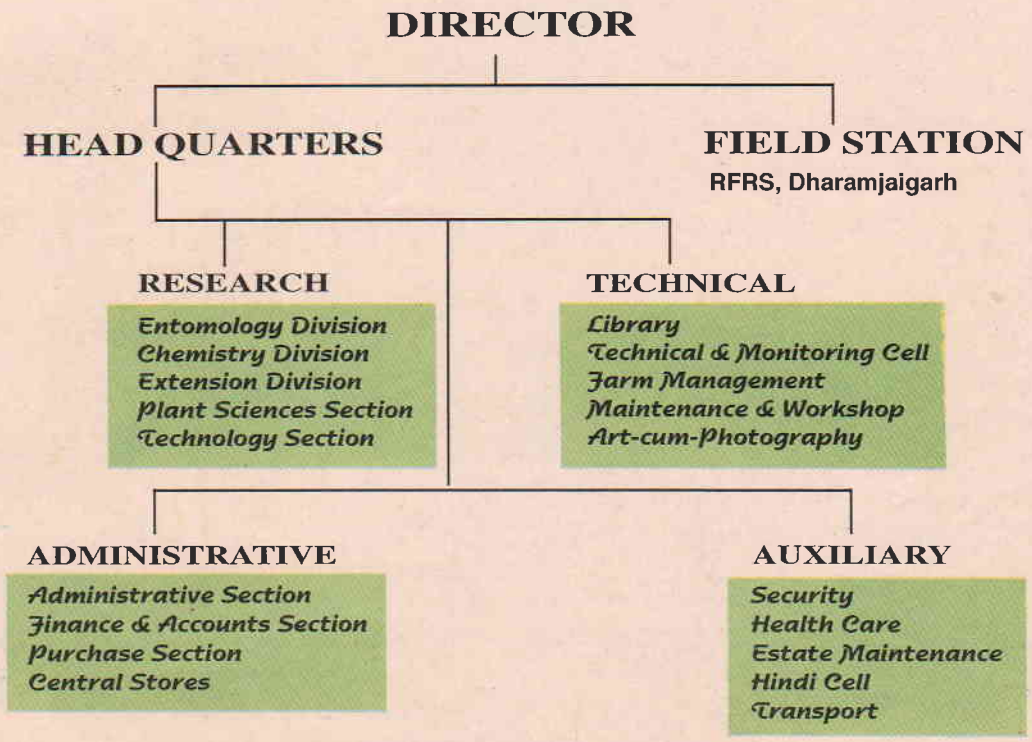
Pruning time and technique

For determining the technique and time of pruning, the common methods of pruning, i.e., apical and basal were tried during different months of the year. Total number of buds which appeared after

Table 1 Details of the lac cultivation operations, on *kusum* conducted in the field area at Hesal

Treatment	Coupe	Period	Operation	Status of crop
KA,KB,KC	I	July 1993	Pruning	—
KD & KE	II	Dec. 1993	Pruning	
	III	Dec. 1993	Inoculation	Good
KF & KB	I	Dec. 1993	Pruning	—
	II	Dec. 1993	Inoculation	Good
KH	I	July 1993	Pruning	—
	II	July 1993	Inoculation	—
	III	Dec. 1993	Partial harvesting	Good

Dr. S.C. Agarwal after taking over as Director of the Institute



Organisational set-up of I.L.R.I.

pruning were counted; total number and length of shoots appearing subsequently were also recorded.

It was found that *akashmani* responded well to both the common methods of pruning and the maximum inoculable area was obtained from the plants pruned during mid July'93 and mid February'93 followed by those pruned in October 93.

Optimum brood rate and age of shoot

For determining the suitable age of shoots for crop inoculation and optimum brood requirement, inoculations were done, 12, 18 and 24 months after pruning, at brood rates ranging from 10-40g/m shoot length, for raising the *katki* and *baisakhi* crops of *rangeeni* strain. Experiments with the *kusmi* strain could not be carried out due to shortage of broodlac. Density of larval settlement, sex ratio, fecundity and the yield per tree were recorded during *katki* 1993; the above parameters except the yield per tree were also recorded for the *baisakhi* 1993-94, during the period.

Results of repeated trials conducted during the period confirmed that the most suitable time for crop inoculation is 18 months after pruning. The yield of broodlac as well as scraped lac, in terms of the brood used, was high in general, when the brood rate was 10—20g/m (**Table 2**.)

Table 2 Effect of brood rate and shoot age on the lac yield of *akashmani* during *katki* 1993

Brood rate (g/m shoot length)	Age of shoot (months)	Broodlac used (g)		Yield obtained (g)			Brood used: Brood obtained	Brood used : total yield (in terms of scraped lac)
		Lac sticks	Scraped lac	Broodlac sticks	Rejected lac sticks	Total Scraped lac		
		1	2	3	4	5	1:3	2:5
10		600	140	980	450	225	1 : 1.63	1 : 1.6
20		1050	250	1750	400	380	1 : 1.66	1 : 1.52
25		1550	350	2260	450	420	1 : 1.45	1 : 1.2
30	12	1750	390	2300	600	430	1 : 1.31	1 : 1.1
40		2050	450	1870	650	380	1 : 0.91	1 : 0.84
10		600	130	1550	350	320	1 : 2.58	1 : 2.48
20		1050	250	2780	400	600	1 : 2.64	1 : 2.50
25		1550	340	3150	450	580	1 : 2.03	1 : 1.7
30	18	1750	380	2840	500	580	1 : 1.62	1 : 1.5
40		2050	410	3250	560	630	1 : 1.58	1 : 1.53
10		600	140	1050	450	230	1 : 1.75	1 : 1.61
20		1050	260	1850	500	350	1 : 1.76	1 : 1.34
25	24	1550	330	2540	500	540	1 : 1.63	1 : 1.63
30		1750	370	2560	600	500	1 : 1.4	1 : 1.35
40		2050	400	3050	650	500	1 : 1.48	1 : 1.25

Alternation of broodlac

The effect of alternation of brood between the conventional hosts like *palas* and *ber*, and *akashmani* for raising the *katki* crop was studied. Broodlac from *palas* and *ber* were inoculated on ten *akashmani* plants each, for raising the *katki* 1993. The biological parameters of the insects as well as industrial parameters of lac obtained were studied. Similarly, *akashmani* broodlac was inoculated on *rangeeni* host trees, i.e., *palas* and *ber* for raising *katki* and *baisakhi* crops and on *akashmani* also for the *baisakhi* 1993-94 crop. Crops were also raised on *palas* and *ber* using broodlac from *palas* and *ber* respectively. These trials indicated that transfer of broodlac from conventional hosts, viz., *palas* and *ber* to *akashmani* and vice-versa was successful with respect to brood and sticklac yields without any adverse effect on the biological and industrial parameters. Industrial parameters of lac, like colour, flow etc. obtained from *akashmani* were found superior compared to lac from conventional hosts.

1.2 Physiology of lac insects and associated insects

1.2.5 Analysis of physicophysiological factors causing lac insect preference for host plants

A.H. Naqvi

Studies were continued, on some biological attributes of lac insects (no. of larvae settled per 2.5 cm shoot length; mortality after settlement; proportion of males and sticklac yield/bush) cultured on *bhalia (Flemingia macrophylla)* and *galwang* (*Albizzia lucida*) bushes with the application of N, P and K individually and in various combinations as follows: 20g urea, 40g SSP per bush were applied in two equal split doses at the time of crop inoculation and after male emergence. Muriate of potash (15g/bush) was applied in a single dose at the time of crop inoculation. Observations were taken on the *baisakhi* 1992-93, *katki* 1993, *aghani* 1993-94, *baisakhi* 1993-94 and *jethwi* 1994 crops on both the hosts. The results have been summarised in **Tables 3** and **4.**

1.4 Control of enemies of lac insect

1.4.17 Survey of pathogenic microorganisms and their effect on the development of lac insect

A.H. Naqvi, A. Bhattacharya, S.G. Choudhary and A.K. Sen

The *aghani* 1993-94 and *katki* 1993 crops were raised on 200 bushes of *bhalia* for each crop through heavy inoculation. Samples were collected at fortnightly intervals for examining the mortality of lac insect on account of pathogenic microorganisms. Sample examination did not reveal the occurrence of pathogenic microorganisms during both the crop seasons.

1.4.18 Field trials of chitin inhibitors in combination with other pesticides for the control of major lac predators

A. Bhattacharya

Screening of synthetic pyrethroid insecticides for their safety to the lac insects

Baisakhi 1993-94 : A preliminary

Table 3 Effect of N, P and K, on certain economic attributes of lac insects cultured on *bhalia* bushes

Season	N	P	K	N+P	N+K	P+K	N+P+K	Control
				Larval settlement/2.5 cm shoot length				
Katki 1993	350	560	320	180	320	475	400	465
Aghani 1993-94	260	192	232	280	262	204	280	216
Baisakhi 1993-94	540	450	500	480	365	320	480	410
Jethwi 1994	264	208	262	208	288	252	322	222
				Mortality after settlement (%)				
Katki 1993	34.28	44.64	25.00	16.66	35.93	44.21	37.30	35.48
Aghani 1993-94	38.46	31.25	29.31	30.00	30.53	29.41	21.42	22.22
Baisakhi 1993-94	35.15	23.33	29.00	37.50	31.50	15.62	30.20	34.15
Jethwi 1994	21.87	38.48	29.68	21.15	23.61	20.63	19.75	23.21
				Proportion of males (%)				
Katki 1993	25.71	19.64	28.12	33.33	28.12	26.31	25.00	21.50
Aghani 1993-94	23.00	25.00	25.86	24.00	23.60	29.41	28.50	25.92
Baisakhi 1993-94	27.27	28.28	29.00	25.00	27.39	31.85	28.12	31.70
Jethwi 1994	28.12	26.92	23.43	28.84	27.77	31.74	30.86	26.78
				Sticklac yield/bush (g)				
Baisakhi 1992-93	100	70	60	45	110	90	115	80
Katki 1993	60	50	40	80	—	50	40	75

Table 4 Effect of N, P and K, on certain economic attributes of lac insect cultured on *galwang* bushes

Season	N	P	K	N+P	N+K	P+K	N+P+K	Control
				Larval settlement/2.5 cm shoot length				
Katki 1993	410	450	370	370	280	350	400	400
Aghani 1993-94	216	192	200	180	200	204	240	192
Baisakhi 1993-94	360	450	380	320	420	400	530	480
Jethwi 1994	288	280	252	190	248	216	216	192
				Mortality after settlement (%)				
Katki 1993	26.42	40.00	18.91	41.81	32.14	31.42	35.00	17.50
Aghani 1993-94	33.33	16.66	36.00	40.00	22.00	29.21	35.00	18.75
Baisakhi 1993-94	33.55	37.77	32.87	29.68	35.71	35.00	39.62	42.70
Jethwi 1994	49.91	28.57	53.96	24.21	20.96	33.55	22.22	39.58
				Proportion of males (%)				
Katki 1993	29.26	26.66	32.43	24.32	21.42	25.71	25.00	27.50
Aghani 1993-94	27.77	29.16	30.00	26.66	30.00	25.49	21.66	25.00
Baisakhi 1993-94	27.77	26.66	27.63	34.37	23.80	27.50	24.52	23.95
Jethwi 1994	18.50	28.57	20.63	27.36	23.38	26.85	25.92	29.16
				Sticklac yield/bush (g)				
Baisakhi 1992-93	110	105	115	105	50	50	80	80
Katki 1993	130	110	60	120	110	150	115	80
Aghani 1993	150	150	145	120	130	100	160	80

experiment was conducted for screening the two synthetic pyrethroid insecticides, Bilcyp 10 E.C. (cypermethrin) and Fenval 20 E.C. (fenvalerate) for their safety to the lac insects of *baisakhi* 1993-94 crop on *bhalia* bushes at the Institute plantation. Aqueous emulsions of both the insecticides (0.001 - 0.016 per cent) were sprayed on one-month-old lac insects. The control insects were sprayed with water. The experiment consisted of eleven treatments with three replications. Mortality of lac insects due to the various insecticidal treatments was recorded 15 and 30 days after spraying.

The data have been presented in **Table 5** and it appeared that only 0.001% concentration of these insecticides appeared to be safe to lac insect. The percent mortality increased with the increase in concentration.

Jethwi 1994 : *Jethwi* 1994 crop was raised on *bhalia* bushes in the Institute plantation. The insecticides cypermethrin and fenvalerate (0.0005 and 0.001 per cent) were sprayed on 45-day-old (second instar) lac insects. The experiment consisted of five treatments and four replications. Samples were collected one, two and three weeks after insecticidal application and scored for mortality of lac insects. The results are presented in **Table 6**. Both the insecticides appeared safe to the second-instar lac insects at the concentrations tried.

Evaluation of synthetic pyrethroid insecticides against the eggs of Eublemma amabilis

The eggs of *E. amabilis* were collected by allowing the adults to lay eggs on paper strips, which were then separated out into age groups ranging from one to six days. Pieces of paper along with eggs of the various age groups were pasted on a large sheet of paper. Each such sheet was dipped for one minute in the aqueous emulsions of either 0.0005 or 0.001 percent cypermethrin or fenvalerate. The control eggs were dipped for the same period in water. These eggs were dried under the fan and kept under observation.

Table 5 Mortality of lac insects after application of pyrethroid insecticides during *baisakhi* 1993-94 crop season

Concentration (%)	Lac insect mortality (%)	
	15 DAS*	30 DAS
Cypermethrin		
0.001	23.96	25.19
0.002	32.87	36.35
0.004	59.93	62.36
0.008	85.26	89.01
0.016	92.66	96.32
Fenvalerate		
0.001	23.16	28.22
0.002	31.71	37.46
0.004	46.16	67.43
0.008	55.86	74.39
0.016	91.21	92.63
Control (water)	22.55	18.51

** DAS - Days after spraying*

The embryos were found to develop in the treated eggs; in some of the treated eggs, the larvae were unable to cut open the chorion fully and died midway. Mortality of eggs due to cypermethrin treatment varied from 77.08 to 100 percent in various age groups

whereas fenvalerate treatment caused cent percent mortality in all cases, at both the concentrations. Mortality in the case of eggs under control varied from 1.56 to 8.33%. Both the synthetic pyrethroid insecticides were thus found to exhibit strong ovicidal activity.

Table 6 Mortality of second instar lac insects after application of pyrethroid insecticides during *jethwi* 1994 crop season

Concentration (%)	Average percentage mortality		
	7 DAS	14 DAS	21 DAS
Cypermethrin			
0.0005	17.62	16.09	18.69
0.001	20.11	19.92	20.25
Fenvalerate			
0.0005	14.65	21.38	20.32
0.001	15.97	24.32	21.61
Control (Water)	14.76	18.40	16.47

Effect of synthetic pyrethroid insecticides on the pupae of Eublemma amabilis

Pupae of *E. amabilis* were collected from scraped lac and after conditioning them for a day in the laboratory, the healthy pupae were selected for the experiment. They were dipped in 0.0005 or 0.001 percent aqueous emulsion of cypermethrin and fenvalerate for 30 and 60 seconds. The control pupae were dipped in water. They were then air-dried and kept in petri dishes under observation. The experiment consisted of ten treatments and three replications.

Dipping of pupae in fenvalerate caused cent percent suppression of adult emergence, at both the concentrations and for both the timings. The average emergence of adults from cypermethrin treated eggs was 30-40% and 20% with 30 and 60 sec. dipping respectively. The emergence was very low (13.33%) even in control.

1.5 Genetics and breeding of lac insect

1.5.8 Studies on germplasm collection, conservation and characterisation of indigenous/exotic lac insects

S.K. Jaipuriar and S.K. Saha

A total of eleven germplasm stocks of lac insects, including seven *rangeeni* and four *kusmi* were maintained. These stocks were as follows :

Rangeeni	*Kusmi*
Local yellow	Orissa yellow
Kundri	Madanpur (M.P.)
Meghalaya	Taimara
Chopa, (Maharastra)	Namkum
Turhamu	
Mali Basantpur (yellow)	
Ghotari (yellow)	

The biological and physicochemical studies of the recently collected stocks, viz., Turhamu, Mali Basantpur (yellow) and Ghotari (yellow) are in progress.

1.5.13 Breeding superior lac insects for colour, thermal resistance and productivity of lac resin

R. Ramani

The F_3 generation of the cross between the local yellow female and the cream male was studied during the *katki* 1993 season. The progenies of the yellow and crimson mothers were cultured

separately; scored for colour, after sexual maturity and hence included only the females. They included crimson, yellow and cream insects. Theoretically, four classes of genotypes are expected to be produced based on the possible phenotypes they are likely to produce. It was presumed that an insect double recessive for both *cream* and *yellow* genes were indistinguishable from the cream insect. The frequencies of the phenotypes obtained was suggestive of a free recombination of the genes concerned. The results were indicative of the non-allelic nature of the *yellow* and the *cream* genes and that they are on different chromosomes.

The F_1 progenies of the reciprocal crosses between the wild-type insect and the cream variant were raised during the *katki* 1993 crop season. All the insects of both the progenies showed wild- type phenotype for both lac and body colour. The F_2 progenies were raised during the *baisakhi* 1993-94 crop season. All the progenies of the cross showed wild-type phenotype where crimson female was used as the maternal parent. But, those of the reciprocal cross showed a segregation of cream and crimson phenotypes (1:1). Scores for the phenotypes were made just prior to sexual maturity. The data obtained show that the cream phenotype is due to a single gene recessive to the gene producing wild-type body and resin colour. The *cream* gene in homozygous condition results in the cream phenotype; whereas heterozygous condition produces wild-type phenotype.

Selection for regular *rangeeeni* and *kusmi*-type life periods was continued for obtaining recombinant lines from the crosses made earlier. Cultures of a wild stock of *rangeeni* insects and an inbred line derived from it were raised on field bushes of *bhalia* during the *baisakhi* 1992-93. Cells of mature females collected are being evaluated for the lac productivity.

Ad hoc studies

* *To evolve early-maturing lac insect variant through mass selection from* kusmi *lac insect stock of Madanpur*

Y.D.Mishra

This study aims at evolving an early maturing *kusmi* lac insect which can sustain climatic fluctuations in winter, escape the attack of inimical insects due to desynchronisation of life cycles and may be grown on widely distributed conventional *rangeeni* hosts for better quality lac.

A *kusmi* stock of lac insect collected from Madanpur, M.P. was subjected to mass selection for early-maturity time in winter season. A selection pressure of seven days was applied on the base population growing on four *kusum* trees in December 1992 and selection response of 20 days was obtained in December, 1993. These selected variants were found at par with regards to biological and industrial parameters excepting the life period. The process of selection was continued for the next generation. The *jethwi* crop raised from these early maturity insects escaped attack of *E. amabilis* probably due to desynchronization of life cycles of the lac insects and the predator.

Encrustations of early maturing *Kusmi* lac insects from Madanpur, Madhya Pradesh, on *Kusum* brances

* *Finding new lac hosts for* rangeeni *and* kusmi *lac cultivation*

S.G. Choudhary

Twenty plants of *Desmodium tortuosum* and ten plants of *Desmodium* species were inoculated with *rangeeni* and *kusmi* broodlacs in July for raising the *katki* and *aghani* crops respectively. Similar inoculations were also made during Oct. and Feb. to raise *baisakhi* and *jethwi* crops respectively.

Settlement of both the strains of lac insect was found to be normal, but there was high mortality at the time of sexual maturity; the male population was found to be 54.2 and 63.6 percent respectively during *aghani* and *katki* seasons. The crops matured at the normal time, but the yields were not normal.

SECTION OF PLANT SCIENCES

Research completed

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

S.C. Srivastava, P. Kumar, B.P. Singh, B.K. Purkayastha and Moti Ram

The project was initiated with a view to develop a method for vegetative propagation of *kusum* (*Schleichera oleosa*) a major *kusmi* lac host, through air-layering so that it can be raised on plantation basis in a shorter period as well as to develop plants of true to the type and to overcome the long gestation period which acts as a serious deterrent in raising systematic plantations of proven *kusum* tree of high lac yielding capacity.

This study was initiated in 1981. Air-layers of *kusum* were first prepared in 1982, at Namkum and Hesal using a mixture of IBA+IAA (100 ppm) and *Sphagnum* moss. Out of the 1000 air-layers thus prepared, 162 showed rooting. The rooted air-layers were planted in the field in September. They showed satisfactory growth during initial stage but died subsequently due to drought conditions. This project was kept in abeyance after 1982 and restarted in 1985 with a modified technical programme.

Air-layering of *kusum*, tried with the application of IAA or IBA (50, 100 ppm) during Jul.-Aug. 1985 showed 80.8% callusing with the treatment of either of the growth hormones at 100 ppm, the air-layers, however, did not survive later on.

Experiments tried during Jun.-July 1987 at Hesal Broodlac Farm and the institute plantation, using a mixture of IAA+IBA (1:1,100ppm) and lanolin paste + *Sphagnum* moss as rooting medium on shoots of 1.1-1.7 cm diameter and 35-90 cm length showed only 6.4% rooted air-layers.

In another experiment, rooted air-layers were transplanted into the following substrates : i) sand + garden soil (1:1), ii) FYM + garden soil (1:2), iii) soil from *kusum* root zone + garden soil + FYM (1:1:1). The survival of these air-layers in these substrates, upto two years, were 5.5, 18.5 and 20.3% respectively.

The experiment was further modified to improve the survival percentage in nursery beds as well as to increase the root initiation in air-layers. The hormones tried were : IBA, IPA, IAA and NAA (50 and 100 ppm) individually and in all possible combinations of two hormones, at both concentrations, using *Sphagnum* moss and lanolin paste as rooting medium, during May-July, 1988.

The treatment of hormone mixture, IBA+NAA (50 ppm) gave maximum rooted air-layers (47.6%). Mid May to mid June was found to be the best period for air-layering of *kusum*.

Subsequently, the experiment was modified as follows : The air-layering was done during May-June 1989, on 18-month-old shoots of *kusum*. The hormones tried were : IAA, IBA and NAA individually and in all possible combinations of two hormones (50 and 100 ppm). The rooting media used

were: i) *Sphagnum* moss + lanolin paste, ii) FYM + pond soil (1:1) + *Sphagnum* moss + lanolin paste and iii) FYM + pond soil (1:1) + *Saccharum* grass + lanolin paste. The highest percentage of root initiation (36.7%) was recorded under the treatment, IAA (100 ppm) + *Sphagnum* moss + lanolin paste as well as in IAA (50 ppm) + FYM + pond soil + *Sphagnum* moss + lanolin paste. The air-layers were transplanted in earthen pots, which showed heavy mortality. The survival of these air-layers were poor.

The air-layering was carried out at the institute in June, 1991 following the technical programme of 1989 with the addition of another hormone, IPA. The combination mixture, IAA + IPA (50 ppm) resulted in 20% rooted air-layers; the survival of these air-layers was, however, cent percent in field conditions. Application of IAA+NAA (50 ppm) and IBA + NAA (50 ppm) resulted in 75 and 50 per cent survival of rooted layers (during the first year) in field condition respectively. These treatments had shown rooting in 80% of the air- layers.

The experiment was repeated in 1992-93 using only one rooting medium viz., *Sphagnum* moss + lanolin paste on shoots of 3-4 cm diameter and one metre length. Cent per cent rooting was observed in the following hormonal treatments : IAA (100 ppm), IBA (100 ppm), NAA (50 ppm), IAA+NAA (100 ppm), IBA + NAA (100 ppm) and IBA + IPA (50 ppm). Maximum survival (66.6%) of the planted air-layers (during the first year) was noticed with the treatment of IAA + NAA (50 ppm) followed by (57.1%) that with IPA (50/ 100 ppm).

Air-layering of *kusum* was done again in June-July 1993 following the technical programme of the previous year. The maximum rooted air-layers (70%) was obtained with the application of IAA + IBA (100 ppm) followed by NAA (100 ppm) and IAA + IPA (100 ppm) (50%). The air-layers were planted in the field in Aug. 1993. The survival was 10-20% during the first year.

It was found that upto 100% root initiation in air-layers could be obtained using the hormones mentioned above, at both the concentrations tried, either individually or in combination of two. Application of hormones always resulted in significant improvement in root initiation. The number of planted air-layers, surviving under field conditions was found decreasing upto three years.

Researches in progress

2.1 Propagation and management of lac host plants

2.1.11 Scheduling of lac cultivation under multistoreyed system

B.P. Singh

The experiment was continued as per the technical programme described earlier (*Ann. Rep. 1990-92*) under rainfed conditon. Observations on plant growth attributes of different lac hosts raised under the system and their percentage of increase over previous year have been depicted in **Figs. 1** and **2**. It may be seen that amongst the lac hosts tried the maximum plant height (5.4m) and girth (35.4 cm) were recorded in *akashmani* (*Acacia auriculaeformis*) followed by *galwang* (*Albizzia lucida*). However, in

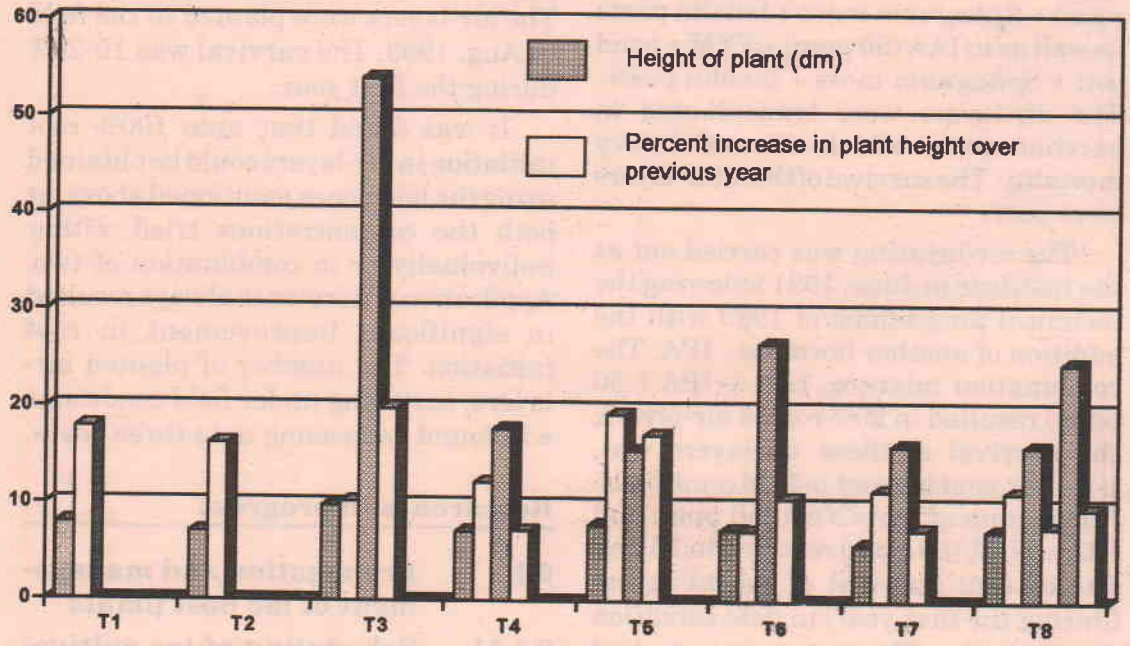


Fig. 1 Height of lac host plants raised under various treatments and the percentage increase over the previous year

T1 *Kusum*; T2 *Kusum* + Intercrop; T3 *Kusum* + *Akashmani* + Intercrop; T4 *Kusum* + *Ber* + Intercrop; T5 *Kusum* + *Bhalia* + Intercrop; T6 *Kusum* + *Galwang* + Intercrop; T7 *Kusum* + *Khair* + Intercrop; T8 *Kusum* + *Bhalia* + *Galwang* + Intercrop

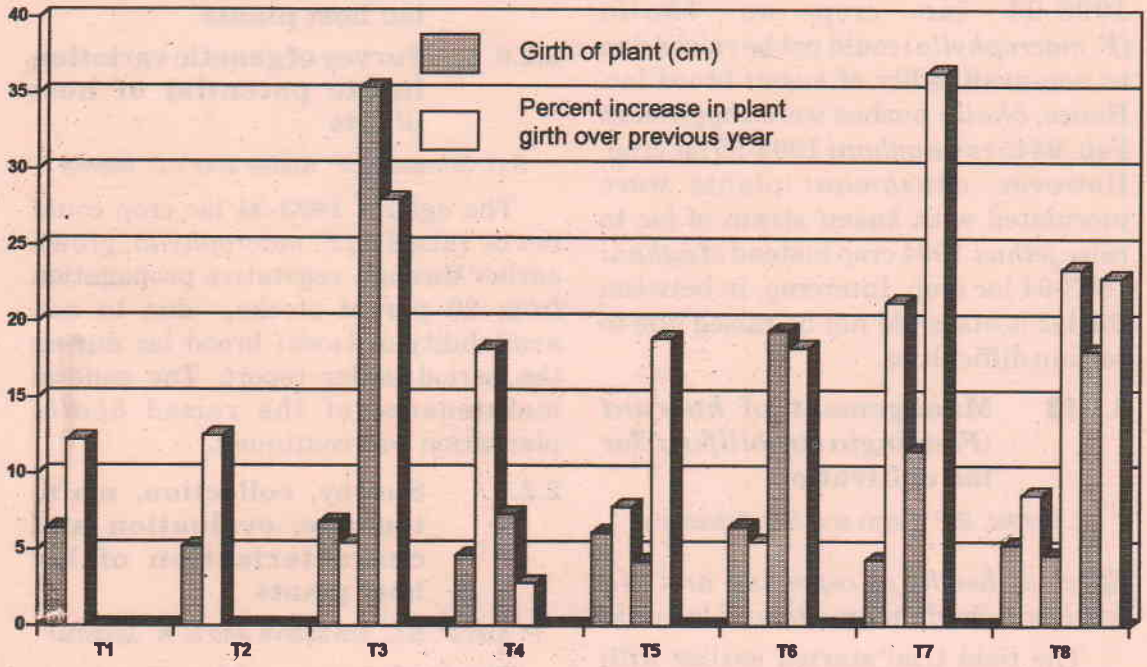


Fig. 2 Girth of lac host plants raised under various treatments and the percentage increase over the previous year.

T1 *Kusum*; T2 *Kusum* + Intercrop; T3 *Kusum* + *Akashmani* + Intercrop; T4 *Kusum* + *Ber* + Intercrop; T5 *Kusum* + *Bhalia* + Intercrop; T6 *Kusum* + *Galwang* + Intercrop; T7 *Kusum* + *Khair* + Intercrop; T8 *Kusum* + *Bhalia* + *Galwang* + Intercrop

the fourth year after raising of plantation, the percentage of increase in plant height and girth over the previous year (1992-93) were maximum in *akashmani* and *khair* (*Acacia catechu*) respectively.

Galwang plants were coppiced in Feb. 1994 to convert them into bushes. *Aghani* 1993-94 lac crop on *bhalia* (*F. macrophylla*) could not be raised due to non-availability of *kusmi* brood lac. Hence, *bhalia* bushes were coppiced in Feb.'94 to raise *aghani* 1994-95 lac crop. However, *akashmani* plants were inoculated with *kusmi* strain of lac to raise *jethwi* 1994 crop instead of *aghani* 1993-94 lac crop. Intercrop, in between the lac hosts could not be raised due to certain difficulties.

2.1.12 Management of *kusrunt* (*Flemingia strobilifera*) for lac cultivation

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

Effect of height of coppicing and NP fertilizers on plant growth and lac yield

The field trial started earlier with two heights of coppicing and two levels of N and P, alone and in combination, was continued. During the period, growth parameters, i.e., plant height and girth were recorded. The growth was luxuriant under fertilized condition when the spacing was 1.2 x 1.2m mainly due to spreading nature of the plant. However, maximum plant height (180.6 cm) and plant girth (2.83cm) were recorded in the treatment plots applied with 40 kg N + 20 kg P_2O_5/ha and 20 kgN + 40 kgP_2O_5/ha respectively, followed by the treatment with application of 40 kg N+40 kg P_2O_5/ha for both the characters. *Aghani* 1993-94 lac crop could not be raised due to non-availability of *kusmi* brood lac. *Kusrunt* bushes were coppiced at 10 and 15cm above the ground level in Jan. 1994 to see its coppicing response for raising the lac crop . Subsequently, fertilizers were also applied as per treatment plan.

2.2 Genetics and breeding of lac host plants

2.2.6 Survey of genetic variation in lac potential of host plants

S.C. Srivastava, P. Kumar and Y.D. Mishra

The *aghani* 1993-94 lac crop could not be raised on *F. macrophylla*, grown earlier through vegetative propagation from 20 parent stocks, due to non availability of *kusmi* brood lac during the period under report. The general maintenance of the raised *bhalia* plantation was continued.

2.2.7 Survey, collection, maintenance, evaluation and characterisation of lac host plants

P. Kumar, S.C. Srivastava and S. K. Jaipuriar

The performance of lac insects on four species of *Flemingia*, namely, *F. macrophylla*, *F. paniculata*, *F. semialata* and *F. macrophylla* (colchiploid) was studied. The lac insect attributes determined during *baisakhi* 1992-93 and 1993-94 and lac yield obtained during *baisakhi* 1992-93 have been shown in **Table 7.** The larval mortality was found to be higher in *baisakhi* 1993-94 as compared to *baisakhi* 1992-93. During *baisakhi* 1993-94 the lowest larval mortality (32%) was recorded on *F. paniculata* and highest (38%) on *F. semialata*. The *katki* 1993 crop could not be raised due to non-availability of broodlac. In another experiment, the

observations on plant growth attributes of different lac hosts (germplasm) as well as the economic attributes of lac insects cultured on them were recorded during *baisakhi* 1993-94 and *jethwi* 1994 crops (**Table 8**).

Table 7 Lac insect attributes on different species of *Flemingia* during *baisakhi* 1992-93 and 1993-94 and lac yield during *baisakhi* 1992-93

Species	Larval mortality (%)		Male (%)		Fecundity/cell	*Baisakhi* 1992-93	
	1992-93	1993-94	1992-93	1993-94	1992-93	Broodlac yield/bush (g)	Sticklac yield/bush (g)
F. macrophylla	30.0	34	43	37	201	0.393	24.5
F. macrophylla (colchiploid)	25.0	36	44	40	257	0.152	45.5
F. paniculata	23.0	32	48	50	211	0.595	52.0
F. semialata	26.0	38	41	39	Nil	Nil	Nil

Table 8 Growth attributes of different lac hosts (germplasm) and lac insect attributes during *baisakhi* 1993-94 and *jethwi* 1994 crop seasons

Lac host	Plant attributes			Insect attributes			
				Baisakhi 1993-94		*Jethwi* 1994	
	Height (m)	Girth (cm)	Total shoot length (m)	Larval mortality (%)	Male (%)	Larval mortality (%)	Male (%)
Cajanus cajan (Vietnam collection)	2.55	2.22	9.74	24.41	32.30	—	—
D. siemaoensis (Dwarf genotype)	0.88	2.50	10.59	28.80	29.40	22.04	25.20
Desmodium pulchellum	1.72	1.64	9.02	30.40	27.90	—	—
F. macrophylla (colchiploid)	1.05	1.60	5.06	17.78	24.50	20.80	23.30
F. paniculata	1.50	1.20	12.47	—	—	24.40	27.80
F. semialata	1.21	1.30	6.16	—	—	22.90	31.80
F. stricta	1.39	1.20	8.22	31.70	31.09	—	—
F. strobilifera	1.31	2.00	15.84	17.74	31.40	—	—

DIVISION OF CHEMISTRY

Researches completed

3.2.10 Synthesis of pheromones and juvenile hormone analogues from aleuritic acid

R. N. Majee and R. Ramani

Juvenile hormone analogues

(i) Queenbee pheromone (9-oxo-*trans*-2-decenoic acid) was synthesised from aleuritic acid adopting a simple reaction sequence as follows : 7-Hydroxy heptanal, one of the periodate oxidation products of aleuritic acid when heated with malonic acid in the presence of pyridine on steam-bath for 4h resulted in unsaturated hydroxy acid. This unsaturated hydroxy acid was then treated with pyridinium chlorochromate in methylene chloride to yield the corresponding unsaturated aldehydic acid as a thick liquid. The above compound on condensation with CH_3MgI yielded 9 - hydroxy - *trans* - 2 - decenoic acid, which was then converted to 9-oxo-*trans*-2-decenoic acid, m.p. 53-55°C by aluminium-tert.butoxide.

(ii) 1,4,12-Trimethoxy dodecane, a juvenile hormone analogue was synthesised from aleuritic acid as follows :

Azelaic acid aldehyde, one of the periodate oxidation products of aleuritic acid was converted to its methyl ester with CH_2N_2. It was then condensed according to Stobbe with dimethyl succinate/NaOMe in methanol to yield half-ester as a thick liquid. The foregoing half ester when refluxed with HBr-AcOH-H_2O(3:2:1,v/v) for 13h resulted in lactone ester as a liquid. It was reduced with LAH in ether to 1,4,12-trihydroxydodecane also as a liquid. IR: presence of - OH absorption. Its treatment with CH_2N_2/BF_3. Et_2O yielded 1, 4, 12 - trimethoxy dodecane. The liquid product was purified by column chromatography. The compound showed slight JH activity on one day old pupae of *Corcyra cephanlonica*.

(iii) Methyl 9-oxodecanoate, an intermediate of JH active compound and prostanoid synthon was synthesised from azelaic acid aldehyde, one of the periodate oxidation products of aleuritic acid, by condensing it with CH_3MgI to yield carbinol, which was oxidised with Jones reagent and esterified.

(iv) Lauryl alcohol was synthesised from aleuritic acid adopting simple reaction sequences as follows :

Azelaic acid aldehyde, one of the periodate oxidation products of aleuritic acid, was converted into its methyl ester with CH_2N_2. Its condensation with propyl magnesium iodide followed by oxidation with Jones reagent yielded the oxo-compound. Reduction of the aforesaid oxo-compound by Wolff-Krishner method yielded lauryl ester, which was reduced with LAH to give lauryl alcohol as liquid. It was converted to its methyl ether by

treatment with CH_2N_2/BF_3. Et_20 reagent.

The above compounds were tested for JH activity using one-day-old pupae of *C. cephalonica*. Both of them were found to be slightly active, but the activity of lauryl ether was more than that of its alcohol.

(v) 2-(ω-carboxyhexyl) cyclopentenone was synthesised from aleuritic acid as follows for testing its JH activity:

Azelaic acid aldehyde, one of the periodate oxidation products of aleuritic acid, was converted to its methylester by treatment with ethereal solution of diazomethane. The ester, aldehyde on condensation with dimethyl succinate in the presence of sodium methoxide in methanol according to Stobbe resulted in half ester. Its treatment with HBr-AcOH-H_20 mixture afforded lactone ester. Cyclodehydration of the lactone ester with polyphosphoric acid on steam-bath gave the title compound. The compound was found to show no JH-activity on one-day-old pupae of *C. cephalonica.*

Sex pheromone components

(i) *Z*(9)-Hexadecen-1-yl acetate:

Z(9)-Hexadecen-1-yl acetate was synthesised from *threo*-aleuritic acid adopting the following sequence :

erythro-Aleuritic acid prepared from *threo*-aleuritic acid by conventional method was treated with phosphonium iodide/acetic acid followed by alkaline hydrolysis yielded 16-hydroxy-*cis*-9-hexadecenoic acid. It was then converted to corresponding tosyl derivative by tosyl chloride. Its treatment with sodium iodide-dry acetone resulted in iododerivative. Reduction of the iodo compound as its ester by LAH/THF yielded *Z*(9)-hexadecen-1-ol. It was converted into *Z*(9)-hexadecen-1-yl acetate with pyridine-acetic anhydride method.

(ii) *Z*(9)-hexadecen-1-yl acetate adopting Wittig reaction:

Azelaic acid aldehyde, one of the periodate oxidation products of aleuritic acid as its methyl ester was condensed with triphenyl salt of n-heptyl bromide in NaH using DMSO and THF as cosolvent resulted in methyl *Z*(9)-hexadecenoate, which was reduced with LAH to obtain *Z*(9)-hexadecen-1-ol. Its treatment with Ac_20/pyridine gave *Z*(9)-hexadecen-1-yl acetate.

(iii) Methyl *Z*(9)-hexadecenoate and *Z*(9)-hexadecen-1-al:

Synthesis of methyl *Z*(9)-hexadecenoate from *threo*-aleuritic acid was described in the synthesis of *Z*(9)-hexadecen-1-yl-acetate. Treatment of *Z*(9)-hexadecen-1-ol with pyridinium chlorochromate in dichloromethane yielded *Z*(9)-hexadecen-1-al, the insect sex pheromone component.

(iv) Methyl *Z*(9)-tetradecenoate, *Z*(9)-tetradecen-1-ol and its acetate, *Z*(9)-tetradecen-1-al:

The above insect sex pheromone components were synthesised from azelaic acid aldehyde, one of the periodate oxidation products of

aleuritic acid. Methyl *Z*(9)-tetradecenoate was obtained from ester of azelaic acid aldehyde adopting Wittig synthesis. *Z*(9)-tetradecen-1-ol was obtained from the ester by its reduction with LAH/THF. Its acetate was obtained by treatment of the alcohol with Ac_2O/pyridine. *Z*(9)-tetradecen-1-al was obtained from its alcohol by treatment with pyridinium chlorochromate in dichloromethane.

Besides the above, the following sex pheromone components were also synthesised from aleuritic acid adopting simple reaction sequences: methyl *Z*(7) hexadecenoate, *E*(9)-dodecen-1-yl acetate, *Z*(7)-hexadecen-1-yl acetate, *Z*(9)-dodecen-1-ol and its acetate, *Z*(7)-tetradecen-1-ol, its acetate and Z(7)-tetradecen-1-al.

Some candidate compounds, such as 16-carbonyl hexadec-9-enoic acid, methyl 9,10-diketo hexadecane-1,16-dioate, 8-hydroxy hexadecanoic acid, methyl 8-ketohexadecenoate etc. were prepared for testing juvenile hormone activity. 9(10)-epoxy-1,16-dimethylhexadecanoate, methyl *E*(2)-undecenoate were found to be inactive. Dimethyl ester of undec-2-enedioic acid resulted in ecdysial failure in 20% pupae of *C. cephalonica*.

3.2.12 Synthesis of substituted coumarin derivative from jalaric acid

N. Prasad

Coumarin and its substituted derivatives are known for their antibacterial and antifungal properties besides their use in perfumery industry and artificial flavours. The project was undertaken with an aim to synthesis substituted coumarin derivative using jalaric acid, a constituent acid of shellac, as the starting compound.

Jalaric acid was isolated in quantity from shellac by partial hydrolysis with sodium hydroxide solution and decomposing the hydrolysed product with dil. sulphuric acid. The aqueous portion was extracted with ethyl acetate and the extract after washing, drying and concentrating under reduced pressure, yielded pure jalaric acid, m.p. 168-170°C. Jalaric acid was first oxidised by silver oxide, yielding shellolic acid, m.p. 205-206°C, which was esterified by methanol/sulphuric acid mixture to obtain dimethylshellolate, m.p. 152-153°C. The latter when fused with caustic soda mixture at 230- 240°C, afforded C-15 lactone di-acid, m.p. 197-198°C. The final product was prepared in approx. 15% yield by dehydrating the C-15 lactone di-acid over palladised charcoal followed by its esterification. The product was purified by passing through silica gel column, characterised by m.p. (114-115°C) and TLC examination. The product was identified as 3-methyl-4(3-carboxymethyl propane) - 7 - carboxy methyl coumarin.

3.4.8 Lac-based coating compositions for out-door applications

P.M. Patil and B.B. Khanna

Paint compositions based on shellac were developed at this Institute for interior decoration. Poor weather

resistance of shellac restricts its use for outdoor applications. Some of the recent research work carried out at this Institute, has shown that shellac can be suitably modified to improve upon its water, acid and alkali resistance. The objective of the present work was to try a few of these compositions in formulating paints for outdoor applications and to assess the suitability for the same. Phthalic acid/teraphthalic acid/adipic acid/maleic anhydride polyesters were prepared with ordinary *kusmi* shellac by using ethylene glycol and *para*-toluene sulphonic acid as catalyst. Two step process was applied for the preparation of above mentioned polyesters.

These polyesters were pigmented with titanium dioxide (TiO_2). Further, these paints were treated with TDI/ Desmodur VL/Desmodur Z/Desmodur N and converted into polyurethane paints. These paints were applied on steel panels and tested for their weather resistance/ outdoor performance. A polyurethane paint based on shellac, adipic acid, ethylene glycol and Desmodur N showed the best performance. This paint remained unaffected during outdoor exposure upto 15 months and passed the tests for flexibility and impact resistance.

Researches in Progress

3.2 Fine chemical from lac

3.2.14 Derivatisation of shellac acids. Synthesis and characterisation of dioxalanes and organic nitrates

S.C. Agarwal and P.C. Sarkar

Preparation of 6-keto myristic acid by Jones oxidation of butolic acid was reported earlier (*Ann. Rep. 1992-93*). During the period under report, the product was esterified with diazomethane to yield methyl- 6-keto-tetradecanoate. This was treated with propane 1, 2-diol in the presence of benzene, using p-TSA to yield the target compound : 2'- hydroxy-propyl-6-(2"-methyl ethylene dioxolane) tetradecanoate, which was confirmed by FT-IR, PMR, elemental and mass spectral analysis.

16-hydroxy-hexadec-*trans*-9-enoic acid, *erythro*-aleuritic acid and 16-hydroxy-hexadec-*cis*-9-enoic acid were prepared from *threo*-aleuritic acid towards the preparation of *cis* and *trans* tetrazole derivatives of aleuritic acid. Further work is in progress.

3.2.15 Synthesis of isoambrettolide and exaltone from aleuritic acid on bench scale

R.N. Majee and N. Prasad

Synthesis of exaltone

Synthesis of hexadecane-1,16-dioic acid (thapsic acid), an intermediate for the synthesis of exaltone (a perfumery compound), was reported last year. During the period under report, the same was prepared again in quantity from 9,10-dihydroxy-dioic acid (obtained from aleuritic acid by $KMnO_4$ oxidation procedure). The reaction sequence was as follows : The above dihydroxy-dioic acid was heated with NBS (N-bromosuccinimide) in ethyl acetate/ water on steambath for 15 min. On isolation with ethylacetate 9,10-dioxo-hexadecane-1,16- dioic acid was obtained. This dioxo-dioic acid was

heated with NaOH, triethylene glycol, hydrazine hydrate (Wolff-Krishner reduction) on steam bath for 1h and then on oil bath at 180-200°C for 3h. The mixture was then diluted with water, acidified with 10% sulphuric acid. Its work up with ethylacetate afforded hexadecane-1,16-dioic acid (thapsic acid). The purity of the compound was checked by TLC.

Synthesis of isoambrettolide

16-Hydroxy-hexadec-*trans*-9-enoic acid, an intermediate for the synthesis of isoambrettolide (a compound used in perfumery industry), was synthesised in 90% yield, m.p. 68-70°C from aleuritic acid (20g,m.p. 99-100°C) by treatment with ethylorthoformate/benzoic acid followed by alc. aqueous alkali hydrolysis of the resultant product.

3.4 Use of shellac and modified shellac in surface coatings

3.4.7 Modification of by-product obtained during preparation of aleuritic acid for its use in surface coating

A.K. Das Gupta

T.N. Shellac (BISCOLAMF, Ranchi) was used to prepare aleuritic acid and the gummy mass (by-product) obtained was washed thoroughly. The gummy product could not be made totally acid free due to regeneration of acid despite repeated washing with water. The gummy mass was dissolved in absolute alcohol and panels were coated with this varnish. The panels remained tacky even after one month of air- drying.

3.5 Use of lac for encapsulation and controlled release

3.5.6 Slow-release lac-based multi-layered pesticidal system for roach control

B.C. Srivastava and A.K. Jaiswal

Slow-release multi-layered pesticidal system

It was reported last year (*Ann. Rep. 1992-93*) that aleuritic acid-free waste gummy hydrolysed lac mass can serve as a suitable matrix for developing slow-release multilayered pesticidal system. With a view to bring improvement in the adhesive layer of the system, the gummy mass was modified with 10-20% dibutyl phthalate. The matrix system was prepared having 1% a.i. (chlorpyriphos) with suitable polythene sheet support, above modified adhesive layer, release paper and gummy mass. This was applied on slides and subjected to bio-assay.

Bioassay revealed that matrix having 1% a.i. was capable of killing the roaches (*Blattella germanica*) within 5h at the initial stage. The system was capable of causing sufficient mortality of roaches coming in contact with the matrix even after 10 months although the activity was reduced.

Slow-release lac based 'monolithic' devices

Studies were continued this year also for preparing lac-based 'monolith' for the control of cockroaches. Compositions on 'monolith' having 1.5% a.i. (Chlorpyriphos) and 1-3% bleached lac as matrix were prepared. Plywood panels

coated with shellac varnish, black paint and as such were treated in replication with the above composition of 'monolith' and subjected to bioassay.

Plywood panels treated with the above mentioned various lac 'monolith' showed mortality of *B. germanica* to varied extent. Initial bioassay (3-4 days after treatment) showed total mortality within two hours and this continued upto 9 months of testing. The contact treatment resulted into total mortality within 10h with the 'lac-monolith' treated plain wooden surface, shellac varnish coated surface as well as paint coated surface. The mortality of cockroaches was observed to be the same as above upto 9 months of testing.

3.6 Electrical properties of lac and modified lac

3.6.5 Development of lac based insulating material/varnishes having improved electrical properties

D.N. Goswami and S. Kumar

Studies on the electrical properties of blends of solutions of shellac and polyvinylacetal resin in (distilled) denatured alcohol were continued. Tracking property of 70:30, 50:50 and 40:60 shellac- polyvinylacetal (B-72) resin blends were studied both at 135 and 200V. All the compositions passed the tests and showed increased resistance towards tracking at both the voltages. The tracking index values were observed to be 272, 280 and 266 V respectively for the above compositions, which were higher compared to that of shellac films (256V).

Tracking property of 90:10 shellac-polyvinylacetal resin (B-30) blend was also studied. The blend passed the test for resistance to tracking at 135 and 200 V and showed increased resistance towards tracking at both these voltages. Tracking index value was found to be 258 V.

Changes in the dielectric strength of air-dried films conditioned over 100% R.H. for 24 h, were investigated for polyvinyl acetate and its blends with shellac in the solution stage (solvent : distilled denatured alcohol). The dielectric strength of polyvinyl acetate films was found to be very low (less than 8kV/mm). Correct value could not be determined as a measurable deflection could not be obtained in the voltmeter. The low value indicates the poor resistance towards humidity of the polymer. The values of dielectric strength for 50:50 and 60:40 shellac polyvinyl acetate blends were found to be 17 and 18kV/mm respectively. Thus, incorporation of shellac in the solution of polyvinyl acetate improved its resistance towards humidity.

Pigmented shellac-based insulating varnish

A pigmented insulating varnish has been developed following a suggestion made by a local manufacturer of insulating varnish for possible utilisation on traction motors. The varnish possessed very good drying characteristics. The dielectric strength of the films of the varnish at room temperature and after conditioning at 100% R.H. for 24h were found to be 66 and 20 kV/mm respectively. The varnish passed the test for resistance to transformer oil (24h at 120°C). No

greening of copper was observed. The varnish also passed the tests for resistance to tracking at 135 and 200 V and showed increased resistance towards tracking at both the voltages when tested following IS: 10026-1982.

The properties of the varnish described above were compared with those of an imported varnish reportedly being used in the Chittaranjan Locomotive works (**Table 9**). The varnish developed at this Institute was found to possess better properties compared to the imported one. A sample of the varnish was sent for evaluation at the Chittaranjan Locomotive Works.

Another sample of pigmented varnish was prepared which also possessed good drying characteristics. The dielectric strength of the films at room temperature and after conditioning at 100% R.H. for 24h were found to be 80 and 39 kV/mm respectively. The varnish showed thermal resistance upto 100°C. Further studies are in progress.

Table 9 Comparison of the properties of the pigmented varnish developed at I.L.R.I. with those of the imported one

Properties	Varnish developed at I.L.R.I.	Imported varnish
Colour	Red	Red
Non-volatile matter content (%)	42	—
Drying time on plate surface	1 h	1 h
Dielectric strength (kV/mm)		
(i) at room temp. (25°C)	66	51
(ii) After conditioning at 100% R.H. for 24h	20	16
Resistance to transformer oil (24h at 120°C)	Passes	Fails
Resistance to tracking		
at 135 V	Passes	Passes
at 200 V	Passes	Fails

Ad hoc studies

Development of plant growth regulators from aleuritic acid

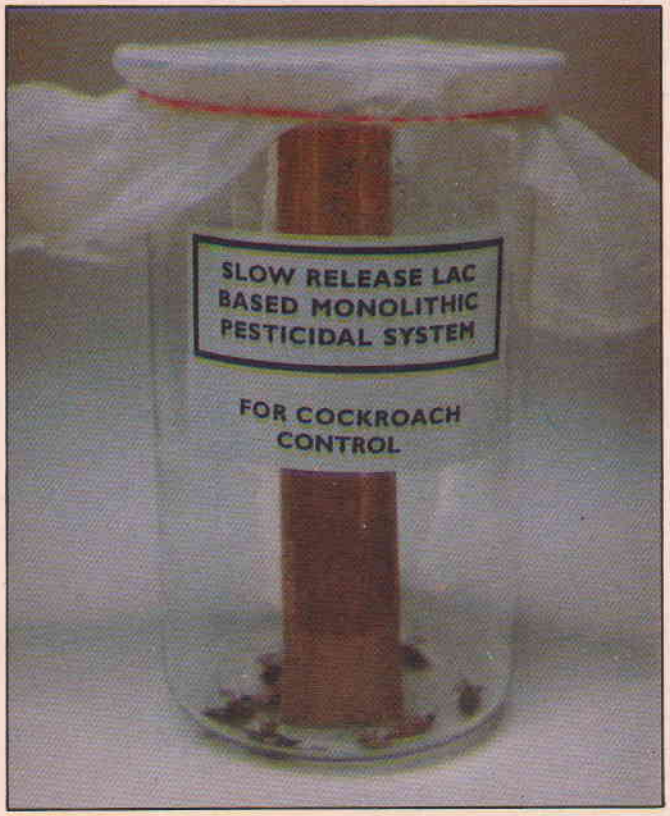
I. Rajendran and S.C. Agarwal

Aleuritic acid obtained from lac by the usual method, was crystallised to obtain pure acid, m.p. 99-100°C. The acid was subjected to periodate oxidation to get azelaic acid semialdehyde which was purified by crystallisation and derivatised as its acetal using diethylene glycol and *p*-toluene sulphonic acid. The compound obtained was purified by TLC and column chromatography. The IR and HNMR spectra of the two intermediate compounds were analysed. Bulk preparation of aleuritic acid is under progress for further work.

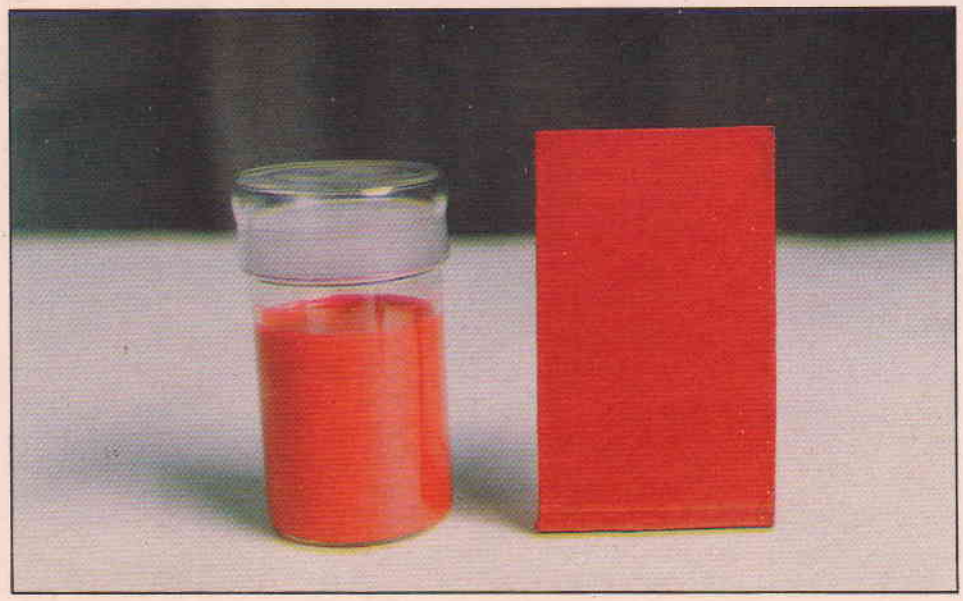
Condensation copolymerisation of shellac with synthetic monomers

K.M. Prasad

Preparation of methyl ester of shellac has been reported earlier (*Ann.Rep.*



Slow-release lac-based monolithic pesticidal system for cockroach control



Pigmented air-drying type anli-tracking shellac-based insulating varnish (Left : Varnish, Right : panel coated with the varnish)

1992-93). During the period under report, attempts were made to prepare acrylic ester of methyl ester of shellac,by reacting methyl ester of shellac and acrylic acid in different molar ratios (1:1, 1:2) for different periods of time (4 and 5 h) in various solvents (tetrahydrofuran and dioxane), at reflux temperature. The product was isolated by first distilling the unreacted monomers, solvent and then pouring the mass into water, filtering and then drying. The product so obtained was jelly-like and insoluble in tetrahydrofuran and dioxane, indicating cross-linking. Attempts to fractionate the product into soluble and insoluble portions by ether proved unsuccessfull. Since the desired product, which could be polymerised further, could not be obtained, the work was discontinued.

Research Contemplated

* Improvement in the method of preparation of lac-dye and aleuritic acid.

SECTION OF TECHNOLOGY

Researches Completed

4.2.3 A comparative study of shellac with other resins (synthetic and natural) which are used in rubber industry

R. Singh

Natural/synthetic resins are used in rubber industry as processing aid to improve the mechanical properties of rubber. The present study was taken up with a view to explore the possibility of using shellac in the place of these resins.

A comparative study was made on the incorporation of shellac and rosin separately in the filled stock of natural rubber using high abrasion furnace (HAF) black as filler. It was observed that the mechanical properties of shellac-incorporated stocks were better than those of stocks containing rosin (*Ann.Rep. 1989-90*). Similar studies were made with filled stocks of styrene-butadiene rubber using HAF black and China clay as fillers. It was observed that in the case of HAF black-filled stocks, incorporation of shellac yielded better properties than those incorporated with rosin whereas converse was observed for China clay-filled stocks (*Ann.Rep. 1990-92*). Effect of incorporation of phenol formaldehyde resin in the stocks was also investigated (*Ann. Rep. 1990-92*), the properties of which were again found inferior compared to those of shellac-incorporated stocks.

4.3.7 Preparation of lac/ modified lacs based hot melt adhesives

P.C. Gupta

Studies made earlier on the adhesive property of lac/modified lac in solution/ dispersion, in non-aqueous and aqueous media have revealed that it takes a long time for setting/curing. Use of hot-melt adhesive is a fast technique for jointing various surfaces and imparts higher bond strength also. Lac/modified lac has not yet been examined as a hot-melt adhesive. The project was taken up with a view to examine the scope of using shellac in the field.

Plain shellac in solution/dispersed form imparts bond strength of 0.08 ton/ sq.inch after aging for seven days (setting/ curing time) whereas hot-melt application yields bond strength of 0.12 ton/sq.inch in less than an hour. In order to improve the bond strength further, lac was modifed with rosin, polyvinylacetate (PVAc; Mol.wt., 5,00,000), epoxy resin (Mol.wt. 500) and hydrolysed lac. The results of these modifications have already been reported in the *Ann. Rep. 1990-92* and *1992-93*, excepting for PVAc (Mol. wt. 45,000) which is given in **Table 10.**

Table 10 Modification of lac with PVAc (Mol.wt. 45,000) at 150°C and their bond strengths over mild steel surfaces

Composition (Shellac:PVAc)	Bond strength (ton/sq.inch)
100:0	0.12
90:10	0.14
80:20	0.15
70:30	0.15
60:40	0.16
50:50	0.17
40:60	0.20
30:70	0.21
20:80	0.20
10:90	0.25
0:100	0.29

Among the different resins tried, rosin did not yield good results. A maximum bond strength of 0.17 ton/sq.inch was obtained with the composition containing shellac and 20 parts of PVAc (Mol.wt. 5,00,000). Bond strengths of 0.35 and 0.40 ton/sq.inch were obtained with the compositions, 60:40 (parts) shellac-epoxy resin and 40:60 (parts) shellac-hydrolysed lac respectively.

From the study it was concluded that the composition based on shellac and hydrolysed lac was the best as it yieled maximum bond strength and is economical.

Research in progress

4.4 Pilot plant studies of lac-based products and processes

4.4.3 Standardisation of recovery of lac dye process and its pilot plant studies

P.C. Gupta and A. Pandey

A systematic study was carried out to find out the minimum quantity of acid required to stop putrification in the wash-water obtained after washing a certain quantity of sticklac. For the purpose, 500g of sticklac was washed with 2 litres of water and the wash-water was filtered through muslin cloth. The filtrate was divided into five equal parts. To each filtrate 0.5, 1.0, 1.5, 2.2 and 2.5 ml 10% sulphuric acid was added and the observation has been indicated in the table below :

Quantity (ml) of 10% H_2SO_4 added	Putrification started	
	Yes/No	Time (h)
0.5	Yes	30
1.0	Yes	30
1.5	Yes	55
2.2	No	96
2.5	No	96

It was concluded that 2.2 ml of 10% H_2SO_4 is the minimum quantity to stop putrification in 400 ml wash-water.

Subsequently, the effect of addition of 10% sulphuric acid in the wash-water, on the yield of sludge was also studied and the results were as under:

Vol. (ml) of 10% sulphuric acid added to 500 ml wash water	Weight of sludge (g)
1.5	2.633
10.0	2.585
50.0	2.675
100.0	2.678

It was observed that the amount of sludge obtained was almost same irrespective of concentration of sulphuric acid added.

Gravity filtration of wash-water takes long time. In order to reduce the time, an attempt was made to filter the wash-water using polypropylene cloth as a filtering medium in basket-type centrifuge. In this process, although filtration was quick but the filtrate was not clear. The dye obtained was also not completely soluble in water indicating presence of impurities.

Experiments were then carried out to find out the amount of calcium carbonate required to obtain calcium salt of dye. It was found that 1.5g calcium carbonate was required for 100g of *kusmi* sticklac wash water to attain pH 7 to get calcium salt of the dye. In this process, sulphuric acid was not used. Calcium salt of the dye was further converted into sodium salt by adding 10% sodium carbonate solution till pH 13 was obtained.

Pure dye was prepared with and without use of sulphuric acid i.e., two-step and one-step processes already mentioned in the previous report (*Ann. Rep. 1992-93*). The dye samples obtained by both the processes were similar. The pure dye obtained was similar in colour and was soluble in water even after storage for more than a year. Fresh sample of *kusmi* sticklac yielded 0.9% pure dye. When isolation of dye was carried out after six months, the yield of the dye was, however, found to be about 0.3% on the weight of sticklac. This has been confirmed after doing several experiments. Thus, it has been concluded that on storage of sticklac, the yield of dye diminishes significantly. In some old sticklac samples, dye content was found negligible.

Lac dye is in great demand for dyeing of wool and silk. Crude dye, for this purpose was prepared by filtering the wash water through a drill cloth and evaporating the filtrate on water bath. The yield was 30% on the weight of sticklac. The solubility of this dye was 75% in cold water.

Ad hoc study

Preparation of dewaxed decolourised lac of improved quality

R K Banerjee

It has been reported earlier (*Ann.Rep. 1992-93*) that dewaxed decolourised lac of wax content as low as 0.10% (which is better than the requirement of B.I.S. of 0.20%) and colour index 1.5 was prepared from *kusmi* seedlac. Further experiments were carried out during the year under report to confirm the above results using *kusmi* seedlac as raw material.

In order to make the process cheaper, *rangeeni* seedlac was tried in the place of *kusmi* seedlac. A sample of *rangeeni* sticklac (*baisakhi* 1991-92, *palas*, Kundri) was converted into seedlac having colour index 16 and wax content 4.65%. This seedlac was then used to prepare dewaxed decolourised lac by adopting the method standardised earlier (*Ann. Rep. 1988*) using indigenous granular activated carbon of commercial grade for decolourisation in the presence of 0 to 0.2 per cent oxalic acid. The results are brought out in the **Table 11.** Although the B.I.S. specification of the product (IS:16-1956 and ISO-R-56) was met by lowering the dissolution temperature to 11-14 °C, further improvement in the properties (colour index, 2.1 and wax content, 0.12%) could be achieved by lowering the temprature to 8-10 °C.

Researches contemplated

* Improvement in storage life of lac at various stages
* Pilot plant studies on manufacture of aleuritic acid and lac dye

Table 11 Preparation of dewaxed decolourised lac from *rangeeni* seedlac (colour index 16, wax content 4.65%)

Treatment			Properties of dewaxed decolourised lac		
Temp. of dissolution of seedlac in alcohol (°C)	Activated carbon used (%)	Oxalic acid used (%)	Yield (%)	Colour index (%)	Wax content (%)
28 - 30 (control)	—	—	84	14.00	4.50
11 - 14	20	—	82	3.20	0.18
11 - 14	20	0.05	78	2.80	0.18
11 - 14	20	0.10	78	2.60	0.14
11 - 14	20	0.15	75	2.40	0.15
11 - 14	20	0.20	78	2.10	0.16
8 - 10	20	0.20	74	2.10	0.12

DIVISION OF EXTENSION

Research in Progress

5.5 Operational Research Project for maximising lac production in Chhotanagpur area.

R.C. Mishra and J. Lal

Operational researches on the transfer of technologies in respect of lac and other crops, on area basis, were continued in the Phase III operational area covering two backward Tribal villages namely Chitir and Dundu of Namkum Development Block of Ranchi district.

Lac culture

Trial-cum-demonstrations of improved methods of lac cultivation on *ber* and *palas* were continued.

Baisakhi 1992-93 *ari* (immature) crop was harvested during May/June 1993 from 34 *ber* trees. These trees had been pruned-cum-*ari* harvested in May/June '92 and inoculated in October, the same year. An average sticklac yield of 3.3 kg per tree was obtained as against 1.1 kg/tree recorded from the set of traditionally operated trees.

Baisakhi - cum - *katki* 1992-93 broodlac crop was harvested during October 1993 from 70 *palas* trees of second broodlac coupe. These trees had been pruned during April/May 1992 and inoculated in October, the same year for raising the *baisakhi* 1992-93 crop. An average broodlac yield of 2 kg per tree was obtained by the adopted farmers trees as against 0.5 kg/tree from traditionally operated trees.

Extension education programme

Farmers' forum meetings were organized every month and discussions were held on the results of the demonstrations, need for self-sufficiency in brood lac production, profitability from new technologies and other constraints of the farmers.

Research Contemplated

* Studies on mechanism of degradation of lac on ageing ❑

SUMMARY

DIVISION OF ENTOMOLOGY

Researches in Progress

1.1.9 To evolve suitable management practice for lac production on *kusum, jethwi* 1993-94 crop was raised at the Hesal Field Area.

1.1.10 Field studies on *akashmani* (*A. auriculaeformis*) showed that February and July are the most suitable months for pruning ,followed by October. Maximum lac yields were obtained from the *katki* 1993 crop when inoculation was made eighteen months after pruning with a brood rate of 10-20g/m shoot length. Alternation of broodlac between *akashmani* and the conventional *rangeeni* lac hosts (*palas* and *ber*) was also found successful.

1.2.5 The effect of application of N,P and K to the lac hosts, *bhalia* (*F. macrophylla*) and *galwang* (*A. lucida*), on the larval density, initial mortality, sex ratio and lac yields was studied during various *rangeeni* and *kusmi* crop seasons.

1.4.17 Screening of the *aghani* 1993-94 and the *katki* 1993 crops raised on *bhalia* bushes did not reveal the occurrence of lac insect mortality due to pathogenic microorganisms.

1.4.18 Preliminary studies on the pyrethroid insecticides, Bilcyp 10EC (cypermethrin) and Fenval 20EC (fenvalerate) showed that they were safe to second instar lac insects during the *jethwi* 1994 crop season, at 0.0005 and 0.001%. The above insecticides at the same concentrations resulted in 77-100% inhibition of hatching in 1-6-day-old eggs of *Eublemma amabilis*.

1.5.8 Lac insect germplasm, consisting of seven *rangeeni* and four *kusmi* stocks, is being maintained.

1.5.13 Crossbreeding of the cream variant with the wild-type lac insect revealed that the cream phenotype is due to a single recessive gene. Crosses between the cream and yellow mutants revealed that the *yellow* and *cream* genes are non-allelic and they are on different chromosomes.

Ad hoc Studies

* An early-maturing *kusmi* lac insect was obtained from Madanpur, M.P. and subjected to mass selection. The *jethwi* 1993 raised from this insect was found to almost escape the attack of the predator, *E. amabilis*.

* *Desmodium tortuosum* and *Desmodium* sp. were screened for cutting *rangeeni* and *kusmi* strains of lac insect. The lac crops raised on them were not normal.

SECTION OF PLANT SCIENCES

Research Completed

2.1.9 Root initiation in air-layers of *kusum* was observed upto cent perent with the use of growth hormones such as IAA, NAA, IPA and IBA at 50 and 100 ppm,

either alone and in combination along with *Sphagnum* moss + lanolin paste as rooting medium. Air-layers of *kusum* may be prepared successfully from middle of May-July. The survival of air-layers in the field condition was only 20-22.2%.

Researches in Progress

2.1.11 In the fourth year of plantation raising, maximum plant height and girth were recorded in *akashmani* followed by *galwang*. However, the percentage of increase in plant height and girth over previous year were maximum in *akashmani* and *khair* respectively.

2.1.12 The growth of *kusrunt* bushes, planted at 1.2 x 1.2m, was luxuriant and overcrowded with application of N and P (alone or in combination). Maximum plant height (180.6 cm) and girth (8.89cm) were observed in the treatment plots applied with 40 kg N + 20 kg $P_2 0_5$/ha and 20 kg N + 40 kg $P_2 0_5$/ha respectively.

2.2.6 The general maintenance of *bhalia* plantation raised through vegetative propagation from 20 parent stocks was continued.

2.2.7 The biological attributes of lac insect were studied on four species of *Flemingia* during *baisakhi* 1992-93 and 1993-94. Maximum yield of broodlac as well as sticklac was obtained from *F. paniculata* during *baisakhi* 1992-93. In another experiment, growth attributes of different lac hosts (germplasm) and economic attributes of lac insects were also studied during *baisakhi* 1993-94 and *jethwi* 1994. Maximum shoot length (15.5m) was observed in *F. strobilifera*.

DIVISION OF CHEMISTRY

Researches completed

3.2.10 The following bioactive compounds were synthesised from aleuritic acid : (i) Queenbee pheromone (9-oxo-*trans*-2-decenoic acid) (ii) 1,4,12-Trimethoxydodecane, a juvenile hormone analogue. The compound showed slight JH activity on one-day-old pupae of *Corcyra cephalonica*. (iii) Lauryl alcohol and lauryl ether, both of which showed slight JH activity on one-day-old pupae of *C. cephalonica*. (iv) Insect sex pheromone components, such as, methyl *Z*(7)- hexadecenoate, *E*-(9)-dodecen-l-yl acetate, *Z*(7)-hexadecen-l-yl acetate, *Z*(9)-hexadecen-l-yl acetate, methyl *Z*(9)-hexadecenoate, *Z*(9)-hexadecen-1-al, *Z*(9)-dodecen-1-ol and its acetate, *Z*(7)-tetradecen-1-ol, its acetate, *Z*(7)-tetradecen-1-al, methyl *Z*(9)-tetradecenoate, *Z*(9)-tetradecen-1-ol and its acetate, *Z*(9)-tetradecen-1-al. (v) Several candidate compounds were also prepared for testing their JH activity.

3.2.12 A method for synthesis of substituted coumarin derivative, i.e., 3-methyl-4(3-carboxy methyl propane) 7-carboxy methyl coumarin, has been standardised using jalaric acid, a constituent acid of shellac, as the starting compound.

3.4.8 A number of shellac-based polyurethane paint compositions were prepared and tested for outdoor applications. One of them, based on shellac, adipic acid, ethylene glycol and Desmodur N remained unaffected upto 15 months of outdoor exposure.

Researches in progress

3.2.14 Esterification of methyl-6-keto tetradecanoate, and subsequent treatment of the ester with propane 1,2 diol and p-TSA yielded the target compound : 2'-hydroxy - propyl-6- (2" methyl ethylene dioxolane) tetradecanoate. *erythro* - Aleuritic acid, 16- hydroxy hexadec-*trans*-9-enoic acid and 16-hydroxy hexadec-*cis*-9-enoic acids were prepared from naturally occuring *threo*-aleuritic acid.

3.2.15 Hexadecane-1,16-dioic acid (thapsic acid), an intermediate for the synthesis of exaltone (a perfumery compound) was prepared in quantity from 9,10-dihydroxy-hexadecane-1, 16-dioic acid (obtained from aleuritic acid). 16-Hydroxy-hexadec-*trans*-9-enoic acid was obtained (yield 90%, m.p. 68-70°C) from aleuritic acid (m.p. 99-100°C, 20g) on treatment with ethyl orthoformate/benzoic acid followed by aqueous alkali hydrolysis.

3.4.7 Films from varnish prepared from the gummy-mass obtained during preparation of aleuritic acid from shellac remained tacky even after one month of air-drying.

3.5.6 Studies on development of slow-release multi-layered pesticidal system revealed that the improved system possessed bio-activity upto 10 months.

Studies on slow-release 'lac-monolith' pesticidal system revealed that the 'lac-monolith' formulation can control roach upto 9 months.

3.6.5 Electrical properties of blends of solutions of shellac and polyvinylacetal and of shellac and polyvinylacetate resins were studied. The tracking index values of blends of shellac-polyvinyl acetal resin (B-72) were found to be higher than that of shellac. Polyvinylacetate resin was found to possess low resistance towards humidity. Presence of shellac in polyvinyl acetate solution was found to improve the resistance towards humidity of the polymer.

A red-pigmented shellac-based insulating varnish has been developed. The properties of the varnish were found superior to those of an imported varnish.

Ad hoc studies

* Aleuritic acid was subjected to periodate oxidation to obtain azelaic acid semialdehyde. Further, its acetal derivative was prepared, purified and characterised by IR and ^{1}HNMR.
* Attempts were made to prepare acrylic ester of methyl ester of shellac in different solvents; but, the desired product could not be obtained.

SECTION OF TECHNOLOGY

Researches completed

4.2.3 Mechanical properties of shellac-incorporated SBR and natural rubbers both in gum and filled stocks were found better compared to those of rosin and phenol formaldehyde resin compounded stocks.

4.3.7 Performance of hot-melt adhesive composition based on epoxy resin and hydrolysed lac, was superior to those based on shellac, rosin and polyvinylacetate.

Research in progress

4.4.3 Preparation of pure water soluble lac-dye has been standardised, especially in respect of pH, quantity of calcium and sodium carbonate to be added and also quantity of acid to be added to stop putrification.

Adhoc study

* Dewaxed decolourised lac was prepared, having properties better than those required by B.I.S. specifications.

DIVISION OF EXTENSION

Research in Progress

5.5 Operational researches (Phase III) were continued in the two tribal villages, Chitir and Dundu of Ranchi District. By applying improved methods, higher yields of broodlac and sticklac were obtained in *palas* and *ber* respectively than those obtained through villagers' method.

PUBLICATIONS

Research Papers

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Papers presented in Seminar, Symposium etc.

Gupta, P.C. and Prasad, K.M. (1993) Lac dye, a potential material for colouring food and proteinous fibres, in Inter-Regional Workshop on Natural Dyes (Insects and animals) organised by NHDC & UNDP at New Delhi (1-4 November 1993), p.2.

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EXTENSION ACTIVITIES

The major extension activities carried out by the Extension Division of the Institute included transfer of the technologies developed at ILRI through its various programmes in collaboration with different Divisions and Sections of the Institute. The details are given below:

Training

The division conducts two certificate courses on 'Improved Methods of Lac Cultivation' and 'Industrial Uses of Lac' of 6 and 3 months durations respectively. These courses are suitably designed to make trained manpower available for the development of lac industry. These training programmes cover the following: theoretical and practical training, job work, final examination and award of certificates. Training courses of shorter durations have also been designed and introduced to fulfil the need of the industry. The Institute responded positively to the initiative taken by the Govt. of West Bengal to set up lac-based units in small-scale sector at Purulia. A programme was launched in association with the District Industries Centre, Purulia, to train several batches of entrepreneurs from the district in the manufacture of selected lac based products. Besides theoretical and practical courses, these trainees were provided course materials, schemes and guidelines for enabling them to prepare project reports for bank financing. The Institute also collaborated with Forest Department, Govt. of Bihar in organising training camps at five nuclear broodlac farms of the department situated at Pitaki and Saharabeda in Singhbhum district, Patratoli in Gumla district and Taimara and Kita in Ranchi district. Scientists from this Institute were deputed to these farms to impart training to lac growers and acquaint them with the latest improved technologies in lac culture. Farmers' difficulties in adopting new method were discussed and solved on the spot whereever possible. Exhibition stalls were also put up featuring various technololgies with the help of products, charts, photographs etc. This gave the farmers a good opportunity to acquaint themselves with the technological innovations in lac available for profitable exploitation. Altogether 318 lac growers participated in these programmes. The training programmes conducted during the year are summarised in **Table 12.**

Lecture - demonstration - cum - visit was organised for 253 farmer trainees from Divyayan K.V.K., Ranchi, 11 trainees from Institute for Rural Industrialisation, Ranchi, 10 farmer trainees from Indian Farmer Service Institute, Ranchi, 20 farmer trainees from Adim Jati Seva Mandal, Ranchi, 41 Range Officers from Forest Ranger College, Balaghat (M.P.) and 141 students from various educational institutions.

Technical Advisory Service

During the year, 134 queries received from all over the country and abroad regarding lac farming, manufacture of lac and lac-based products and schemes on lac-based industries were attended. Advisory services were provided to the visiting industrialists, entrepreneurs,

Table 12 Details of training programmes

Name of the course	No. of batches	Sponsoring organisation/ beneficiary	No. of trainees
Six-month certificate course on 'Improved Methods of Lac Cultivation'	1	Forest Deptt., Bihar and private candidates from W. Bengal	5
One-week course in 'Lac Cultivation Processing and Utilization.	5	i) CASA (Tribal Development Project) Sahibganj, Bihar. ii) Parbatiya Durgam Siksha Vikas, Ranchi. iii) Alternate for India Development, Bihar.	57
Entrepreneurs Training programme on the manufacture of			
i) Aleuritic acid	1	District Industries Centre, Purulia, W. Bengal and a nominee from a lac industry.	11
ii) Bleached lac	1	District Industries Centre, Purulia and a nominee from lac industry.	10
iii) Hydrolysed lac	1	District Industries Centre, Purulia, W. Bengal	5
iv) Gasket Shellac compound	1	— do —	5
		Total	**93**

extension workers and government functionaries.

Information was provided to Indian Farmers Service Institute, Ranchi regarding manurial value of lac factory waste. Information pertaining to lac farming and technologies for lac-based products were supplied to Directorate of Cottage and Small Scale Industries, Govt. of W. Bengal. A query related to lac dye from M/s Gistelivok Theo Laboratory, Belgium was attended. Dewaxed lac, lac-coated urea and water-soluble lac were sent on request to Rubber Technology Centre, IIT, Kharagpur, National Research Centre for Cashew (ICAR), Karnataka and Khadi & Village Industries Board, Assam respectively. Lac crop samples (50 no.) received from growers were examined for forecast of larval emergence and ascertaining reason for insect mortality.

Testing

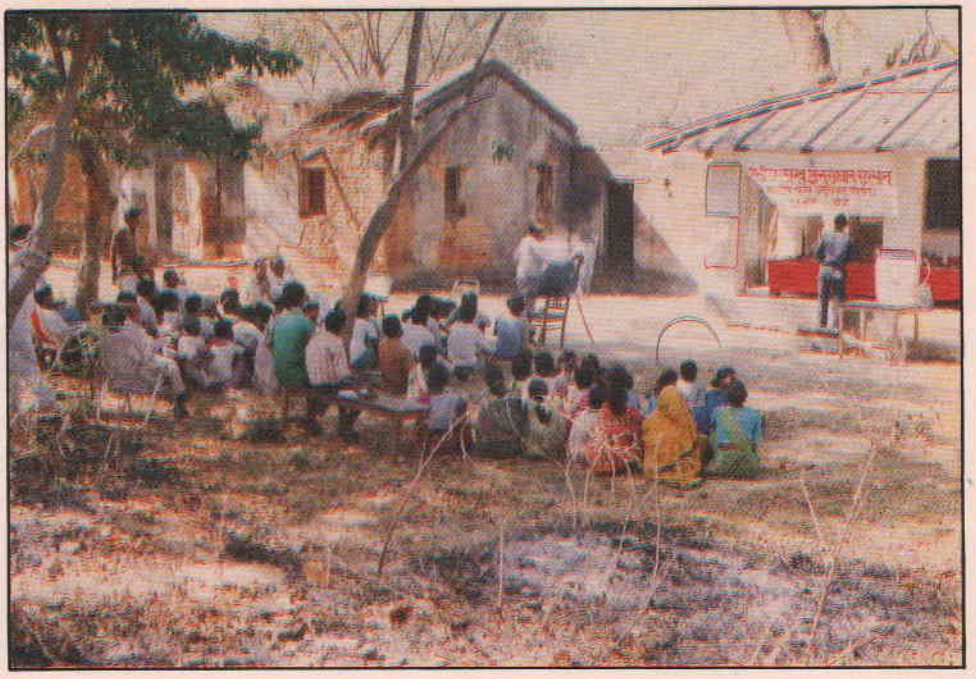
Drawing of samples of seedlac, shellac etc. from export packages and issuance of test reports for facilitating exports and quality control by the indigenous manufacturers/exporters are important functions of the Extension Division. During the year, special attention was paid to simplification and streamlining the procedural aspects and testing charges were revised, keeping in view the expenses involved. Guidelines were also drawn for the test methods to be followed and areas of testing facilities were broadened. Quick and efficient service for drawal and testing of lac samples for export were extended fully to the exporters and disputes between buyer and seller over quality were attended whenever referred to the Institute.

During the year, the testing laboratory of the Extension Division carried out 574 tests for 319 samples of seedlac and shellac which included 146 samples drawn from export consignments aggregating 2648.20 tonnes. A revenue of Rs. 22,684 towards testing and collection charges was earned.

Publicity

During the period under report, the Institute organised exhibitions and participated in *kisan melas* as shown in **Table 13.**

Exhibit materials related to lac were also supplied to (i) National Handloom Development Corporation, Lucknow, (ii) Tribal Lac Development Project, Ranchi, (iii) Department of Chemical Technology, University of Bombay and (iv) Bishop's School, Ranchi.



Training camps for the lac farmers organised by the Institute at Kita, Ranchi District (above) and at Taimara, Ranchi District (below)

Table 13 Details of exhibitions organised and participation in *kisan melas* by the Institute

Period	Organiser	Location	Visitors (No.)
1-4 Nov. 1993	National Handloom Development Corpn. Ltd., Govt. of India, Min. of Textiles, Lucknow (Inter-regional workshop on natural dye)	Raj Hans Hotel, Suraj Kund, New Delhi	Industrialists & trainees (141)
11-12 Feb. 1994	R. K. Mission, Morabadi, Ranchi	Getalsud Farm, Angara Block, Ranchi	Trainees, industrialists and businessmen (2394)
22-23 Feb. 1994	ILRI, Ranchi	Broodlac farm, Pitaki, Singhbhum, Bihar	Lac growers (44)
1-3 Mar. 1994	- do -	Broodlac farm, Saharabeda, Singhbhum, Bihar	- do -(128)
7-8 Mar. 1994	- do -	Broodlac farm, Patratoli, Gumla, Bihar	-do- (52)
11 Mar. 1994	- do -	Broodlac farm, Taimara, Ranchi.	- do - (34)
19 Mar. 1994	- do -	Broodlac farm, Kita, Silli Block, Ranchi.	- do - (60)

MISCELLANEA

SEMINARS, SYMPOSIA ETC.

Attended by Dr S. C. Agarwal, Director

* Lac Development and Co-ordination Committee Meeting at Udyog Bhavan, New Delhi on Oct. 22, 1993.
* XII Rabi Research Council Meeting at B.A.U., Ranchi on Nov. 2, 1993.
* Annual Meeting of Shellac Export Promotion Council, Calcutta on Nov. 3, 1993.
* XIII Meeting of the I.C.A.R. Regional Committee No. IV, at I.I.S.R., Lucknow, Nov. 9-10, 1993.

  A paper entitled "Problems and Prospects of Lac Research and Achievements" was submitted.
* Meeting of the District-Level Advisory Committee on Lac at Purulia, on Dec. 17, 1993.
* VI Meeting of the Chemical Division Council of B.I.S. (CHD 22-Lac and Lac Products) on Feb. 11, 1994. This Committee holds the responsibility of Secretariat of ISO/TC50, the International Standard Body for the formulation of standards on Lac and Lac Products.
* Attended, as a special invitee, a broodlac distribution programme organised by the Bihar Forest Department on Jan. 27, 1994.

Attended by the Scientists

Dr P. Kumar, Pr. Sc. and Head, Section of Plant Sciences and Shri R. Ramani, Scientist (SG), Division of Entomology, participated in a "Seminar on Forest Produce" held on 15-16 October 1993 at the Forest Genetics and Tree Breeding Institute, Coimbatore under Indian Council of Forestry Research and Education, Dehradun and presented a paper entitled "Problems and prospects of management and genetic improvement of lac insects and their host plants for lac productivity and quality" authored by P. Kumar and R. Ramani.

Dr. P.C. Gupta Pr. Sc. and Head, Section of Technology and Dr. K.M. Prasad, Sc. (Sr. Scale), Division of Chemistry participated in Inter-Regional Workshop on Natural Dyes (Insects and animals) organised by NHDC and UNDP at New Delhi from 1-4 November 1993 and presented a paper entitled "Lac Dye a potential material for colouring food and proteinous fibres" authored by P.C. Gupta and K.M. Prasad.

TECHNICAL SERVICES

Library

Library continued to provide literature search and consultation services to the scientists of the institute as well as to a number of scholars, professors and research workers from other institutions viz., B.I.T., Ranchi; Ranchi University, Ranchi; IIT., Kharagpur; N.M.L., Jamshedpur; Patna University, Patna and Bihar University, Muzaffarpur.

Details of the library holdings are described below :

Documents	Additions during the period	Total
Books, bound volumes	351	21,170
Annual Reports	127	2,067
Reprints, photocopies etc.	7	227
Bulletins, Research notes etc.	—	501

A sum of Rs 7.5 lakhs was spent on the acquisition of periodicals and other forms of publications during the year.

Purchase of books and periodicals was made on the basis of the guidelines received from Good Offices Committee, New Delhi and I.C.A.R. Most of the periodicals/books have been purchased directly from the publishers.

To apprise the scientists working in the institute, "Selected list of forthcoming conferences/seminars" was prepared and circulated.

The library continued to maintain exchange of I.L.R.I. publications with many scientific libraries of the country and abroad.

Details of the library acquisions are:

Particulars	National	International
Number of journals subscribed	61	31
Number of journals acquired in exchange or *on gratis*	46	14
Number of research institutes/ information centres with whom Institute library maintains exchange relationship	17	17

The Institute library continued as a contributing member of NUCSSI (National Union Catalogue of Scientific Serials in India), a project sponsored by INSDOC, New Delhi for National Holdings Network in science and technology in India.

The library continued to be an institutional memeber of British library services through I.C.C.R. (Indian Council for Cultural Relations) and utilizes their lending services for the benefit of scientists of the Institute.

A new catalogue cabinet of 60 drawers was purchased for the library keeping in view of the growing number of volumes on the shelves. Eight periodical display stands were also added to the library during the period. One Safex-Halon fire extinguisher assembly was also acquired.

Technical and Monitoring Cell

The Cell continued to provide services for the research activities of the institute. The Cell convened meetings of the Staff Research Council for reviewing the progress of ongoing research projects, to examine the new research projects to be

undertaken and also prepared the proceedings of the meetings for circulation. Besides, the Cell maintained research project files. Activity milestones of different research projects were also compiled for onward transmission to the Council. Various reports, such as monthly report for the Cabinet, Quarterly report for the O.R.P., twenty point programme, material for DARE report and Research Highlights of ICAR were also compiled. The Cell also processed the research papers for forwardal to scientific and popular journals.

Farm Unit

Management and general maintenance of the institute plantation area and the campus were continued. Hoeing, weeding, mulching and ploughing operations were carried out in different plots of lac hosts. The gaps in the plots of the various lac host species were filled with appropriate seedlings. Necessary arrangements were made for irrigation and transportation, related to research work and also for the security of the farm. Seedlings of lac host plants were raised for ditribution in the ORP area.

Ornamental and seasonal plants were raised and planted in different places for beautification. Seedlings of *kusum, galwang, palas, ber* and *akashmani* were planted in the vacant plots and also in vacant spaces of the above hosts. Broodlac of *kusmi* and *rangeeni* strains were inoculated on *kusum, palas, ber* and *khair* plants in the model demonstration plot. The total return from the Farm through the sale of different farm produce, grass cutting charges, pruned twigs, firewood, foliage and ornamental plants etc. was Rs 2649.50.

Maintenance and Workshop

The workshop unit of the institute undertook the maintenance of water and electricity supply lines to the laboratories and the campus, including staff quarters, farm etc. Minor repairs of laboratory and farm equipments and fabrication of parts were also undertaken. Number of different jobs undertaken were :

Electrical, 1018; plumbing, 320; welding, 111; carpentry, 237 and instrument repairing, 281.

Art and Photography

The art and photography unit provided services in support of research and extension activities. Pictures were taken of lac insects and associated insects, lac hosts and other research materials and also for different functions held at the Institute, for International Trade Fair, for training-cum-demonstration at Kita and Taimara. This included 163 colour photographs, 35 black & white photographs and 72 colour slides❑

AUXILIARY SERVICES

Official Language Unit

The unit continued to provide the following services :

* Holding meeting of the Official Language Implementaion Committee, preparation of agenda, minutes, proceedings and taking follow-up actions.
* Translation of office orders, circulars, memos, tenders, notices, quotations, Summary of Annual Report of the Institute etc.
* Nomination of non-Hindi speaking staff for Hindi-training organised by the Hindi Teaching Scheme.
* Celebration of Hindi Day, Hindi week; organising competitions in Hindi.
* Procurement of reference literature in Hindi.

Health Care

A part-time Authorised Medical Attendant visits the Institute's Dispensary to attend to the medical needs of the staff and their dependants, on all working days. He is supported by one Stockman-cum-Compounder, one Junior Clerk and an attendant. During the period, 3609 patients were attended to, 57 patients were referred to medical specialists at R.M.C.H., Ranchi.

Medical bills submitted by the Staff-members were also processed for reimbursement ❑

VISITORS

The Museum of the Institute is a specialised museum propagating knowledge of common and special interests in all aspects of lac. During the year, the museum attracted 1,490 visitors from all walks of life. A list of distinguished visitors is given below :

Distinguished Visitors

Smt Saroj Ghose, Director (Fin.), ICAR, Krishi Bhavan, New Delhi.

Lt. Col. A.K. Basu Chaudhuri, OC-Military Dental Centre, Namkum, Ranchi.

Mr R.C. Sodhi, Major, H.Q. 23, Arm Bde., Dipatoli, Ranchi.

Sri S. M. Singh, General Manager, TRIFED, New Delhi.

Dr R.B. Mandal, Prof. of Geography, R.D. & D.V. College, Munger, Bihar.

Mr Layeeque Ahmed, Co-ordinator, CASA, Tribal Development Programme, Amrapara, Sahibganj, Bihar.

Dr D. Singh, Asstt. Technical Advisor, Community Food & Nutrition Extension, Ranchi.

Dr Girish Tilak, Technical Manager, Pidilite Industry Ltd., Bombay.

Sri C.P. Nigam, D.G.M., H.E.C., Ranchi.

Col. K.K. Arora, 323-Field Ambulance, 99 APO, Ranchi.

Brig. S.S. Sidhu, 99 APO, Namkum, Ranchi.

Mrs S.P.S. Vains, W/o GOC - 23 Inf. Division, Dipatoli, Ranchi.

Lt. Col. R.C. Sharma, Gorkha Rgt. 99 APO, Ranchi.

Dr S.S. Sinha, Director, Central Tasar Research & Training Institute, Nagri, Ranchi.

Mr Philippe Moreau, Lecturer P. I. T. O. St obeock - Autoweep, Belgium ❑

PERSONNEL

i) List of personnel as on 31.3.94

Director

Dr S. C. Agarwal

Division of Entomology

Head of Division
Sri A. H. Naqvi

Scientist (S.G.)
Sri R. Ramani (Agric. Entomol.)

Scientist (Sr. Scale)

Sri S. G. Choudhary	(Agric. Entomol.)
Dr A. K. Sen	"
Dr S. K. Jaipuriar	"
Dr A. Bhattacharya	"
Sri Y. D. Mishra	"
Sri M. L. Bhagat	"

Scientist

Sri K. K. Sharma	"
Dr B. Subbarayudu	"

Technical Officer

Sri A. K. Sahay	(T-5)

Field/Farm Technician

Sri R. N. Vaidya	(T-4)
Sri M. L. Rabidas	(T-II-3)
Sri R. D. Pathak	(T-I-3)
Sri R. L. Ram	(T-I-3)
Sri H. N. Shukla	"
Sri K. P. Gupta	(T-I-3)
Sri K. C. Jain	(T-2)
Sri D. K. Singh	"
Sri A. K. Sinha	"
Sri D. W. Runda	(T-1)
Sri P. A. Ansari	"
Sri R. G. Singh	"
Sri Binod Kumar	(T-1)

Lab Technician

Sri Bhola Ram	(T-II-3)
Sri G. M. Borkar	(T-1-3)
Sri S. K. Chatterjee	"
Sri G. Das	"
Sri R. K. Swansi	"

Jr. Stenographer
Smt. S. Prasad

Regional Field Research Station, Dharamjaigarh

Field/Farm Technician

Sri R. S. Maliya	(T-II-3)
Sri Jiwan Lal	(T-I-3)

Lab Technician

Sri A. Hussain	(T-I-3)

Section of Plant Sciences

Head of Section
Dr P. Kumar

Senior Scientist
Dr B. P. Singh (Agron.)

Scientist (Sr. Scale)
Sri S. C. Srivastava (Plant Breeding)

Lab Technician

Sri D. D. Prasad	(T-I-3)
Sri Mohan Singh	(T-2)

Field/Farm Technician

Sri K. A. Nagruar	(T-2)

Division of Chemistry

Head of Division
Sri S. Kumar

Senior Scientist

Dr D. N. Goswami	(Physics)
Dr B. C. Srivastava	(Org. Chem.)
Dr N. Prasad	"
Dr R. N. Majee	"

Scientist (Sr. Scale)

Dr K. M. Prasad	(Org. Chem.)
Sri A. K. Das Gupta	(Org. Chem.)
Sri P. M. Patil	(Phys. Chem.)

Scientist

Sri I. Rajendran	(Org. Chem.)
Sri P. C. Sarkar	"

Technical Officer

Sri D. D. Singh	(T-5)

Lab. Technician

Sri N. K. Dey	(T-4)
Sri T. K. Saha	"
Sri M. Ekka	(T-4)
Sri U. Sahay	(T-I-3)
Sri B. P. Keshry	"
Sri P. B. Sen	"
Smt. P. Devi	(T-2)
Sri H. Das	(T-1)

Glass Blower

Sri B. S. Chaudhary	(T-1)

Jr Stenographer
Sri B. K. Rajak

Section of Technology

Head of Section
Dr P. C. Gupta

Senior Scientist

Dr A. Pandey	(Phys. Chem.)

Scientist (Sr. Scale)

Sri R. K. Banerjee	(Org. Chem.)
Sri Radha Singh	(Phys. Chem.)

Technical Officer

Sri M. Islam	(T-5)

Lab Technician

Sri K. K. Prasad	(T-4)
Sri N. Minz	(T-I-3)
Sri M. K. Singh	"
Sri T. Ram	"

Division of Extension

Head of Division
Dr S. K. Saha

Scientist (S.G.)
Sri R. C. Mishra (Agric. Entomol.)

Scientist (Sr Scale)
Sri J. Lal (Agric. Entomol.)
Dr A. K. Jaiswal

Technical Officer
Sri A. Rahman (T-5)
Sri B. P. Banerjee "
Sri R. C. Maurya "
Sri D. Ghosh "
Sri L. C. N. Sahdeo "

Publicity Officer (Auxiliary)
Sri Lakhan Ram

Lab Technician
Sri K. M. Sinha (T-4)
Sri J. Singh "
Sri B. P. Ghosh (T-I-3)
Sri J. K. Ambuj (T-1)

Field/Farm Technician
Sri H. Bhengra (T-4)
Sri S. S. Prasad (T-I-3)
Sri S. B. Azad (T-1)

Jr Artist-cum-Photographer
Sri R. P. Srivastava (T-2)

Museum Assistant
Smt. R. Sen (T-1)

Jr Stenographer
Sri A. K. Sinha

Administrative and Audit & Accounts Section

Admin. Officer
Vacant

Asst Admin. Officer
Sri H. S. Munda

Finance & Accounts Officer
Sri Pradeep Kumar

Superintendent
Sri Md. Samiullah
Sri N. Mahto
Sri A. K. Lal

Sr Stenographer
Sri R. Ravidas

Assistant
Sri A. K. Choudhuri
Sri A. Haque
Sri R. B. Singh
Sri K. D. Pandey
Sri K. N. Sinha
Sri B. Ram
Sri Ravi Shankar
Sri D. Ram

Sr Clerk
Sri S. Ram
Sri D. N. Mahto
Smt. S. Guha
Sri K. L. Choudhuri
Sri R. K. Upadhyaya
Sri N. Topno
Sri V. Ram
Sri Md. Mubarak
Sri T. Minz
Sri E. Gari
Sri B. N. Gope
Sri A. Pandey

Jr Clerk
Sri N. Gope
Sri P. Singh
Sri S. C. Lal
Sri R. N. Mahto
Sri B. Sahu
Sri W. Guria
Sri K. P. Arya
Sri P. Kumar
Sri A. K. Tripathi
Sri R. K. Toppo
Sri A. Gope
Sri K. K. Deonath

Farm Unit

Farm Superintendent
Sri N. K. Sharma (T-6)

Field/Farm Technician
Md. A. Ansari (T-II-3)
Sri R. C. Singh (T-I-3)
Sri V. K. Tewari (T-2)

Tractor Driver
Sri M. Surin (T-I-3)

Technical and Monitoring Cell
Sr Technical Officer
Sri S. K. M. Tripathi (T-8)

Technical Officer
Sri R. Prasad (T-5)

Library
Technical Officer
Sri R. P. Tewari (T-5)

Library Assistant
Sri V. K. Singh (T-4)

Maintenance and Workshop Unit
Maintenance Engineer
Sri Hans Raj (T-6)

Chief Mechanic
Sri S. K. Srivastava (T-4)

Sr Mechanic
Sri S. K. Bhaduri (T-4)

Instrument Mechanic
Sri H. L. Bhakta (T-2)

Medical Unit
Authorised Medical Attendant
(Part Time)
Dr N. P. Sahu, M. D.

Stockman-cum-Compounder
Sri C. Pandey (T-I-3)

Hindi Cell
Assistant Director (O.L.)

Sri Lakshmi Kant

Hindi Translator
(Auxiliary)
Dr Anjesh Kumar

Transport
Driver
Sri Bandhan Runda (T-2)
Sri J. Tewari (Aux.)
Sri N. Lakra "
Sri A. Kumar "

(ii) Promotions etc. during the period

Promotions	*Promoted to*	*w.e.f.*
Sri S. G. Chaudhari	Scientist (Sr. Scale)	1.1.1986
Dr A. K. Sen	"	"
Sri A. K. Dasgupta	"	"
Sri S. C. Srivastava	"	"
Sri B. N. Sah (Retired)	"	"
Dr S. K. Jaipuriar	"	"
Dr A. Bhattacharya	"	28.8.1986
Sri Y. D. Mishra	"	1.7.1987
Sri R. K. Banerjee	"	1.7.1987
Sri R. Singh	"	1.7.1987
Sri P. M. Patil	"	1.7.1991
Sri M. L. Bhagat	"	1.7.1992
Dr A. K. Jaiswal	"	12.3.1991
Sri J. Lal	"	1.7.1992
Sri H. L. Bhakta	T-2	14.10.1993
Sri D. Ram	Assistant	25.3.1994
Sri B. N. Gope	Sr Clerk	25.3.1994
Sri A. Pandey	Sr Clerk	25.3.1994

Retirement	*Designation*	*w.e.f.*
Sri E. Haque	Assistant	31.1.1994

Transfers	*Transferred to*	*Date*
Sri Shyam Narayan, A.O.	N. R. C. G., Junagarh	20.3.1994
Sri Binod Kumar, T-1, from N. E. H., Shillong	I L R I	25.6.1993

Deaths	*Designation*	*Date*
Sri Tota Ram	Peon	6.11.1993
Sri Ram Brich Ram	*Safaiwala*	1.2.1994

(iii) Category-wise breakup of number of employees and the number of Scheduled Castes and Scheduled Tribes amongst them as on 31.3.1994

Class of post	No. of posts Sanctioned	No. of Employees in position	No. of SC Employees	No. of ST Employees
Scientific				
R.M.P. Scientiest	1	1	—	—
Principal Scientist Sr Scientist/Scientist (SG) Scientist (Sr Scale) Scientist	60	31	2	—
	61	**32**	**2**	**—**
Technical				
Category III	4	3	—	—
Category II	36	25	2	2
Category I	46	39	4	6
	86	**67**	**6**	**8**
Administrative				
Administrative Officer	1	—	—	—
Finance & Accounts Officer	1	1	—	—
Asst. Admin. Officer	1	1	—	1
Asst. Director (O.L.)	1	1	—	—
Superintendent	3	3	1	—
Sr Stenographer	1	1	1	—
Jr Stenographer	4	3	1	1
Assistant	8	8	1	- -
Sr Clerk	13	13	1	4
Jr Clerk	16	12	1	3
	49	**43**	**6**	**9**
Supporting				
Grade IV	11	6	2	1
Grade III	18	15	3	8
Grade II	36	30	4	13
Grade I	71	48	5	22
	136	**99**	**14**	**44**
Auxiliary	**14**	**7**	**1**	**3**
Grand Total	**346**	**248**	**29**	**64**