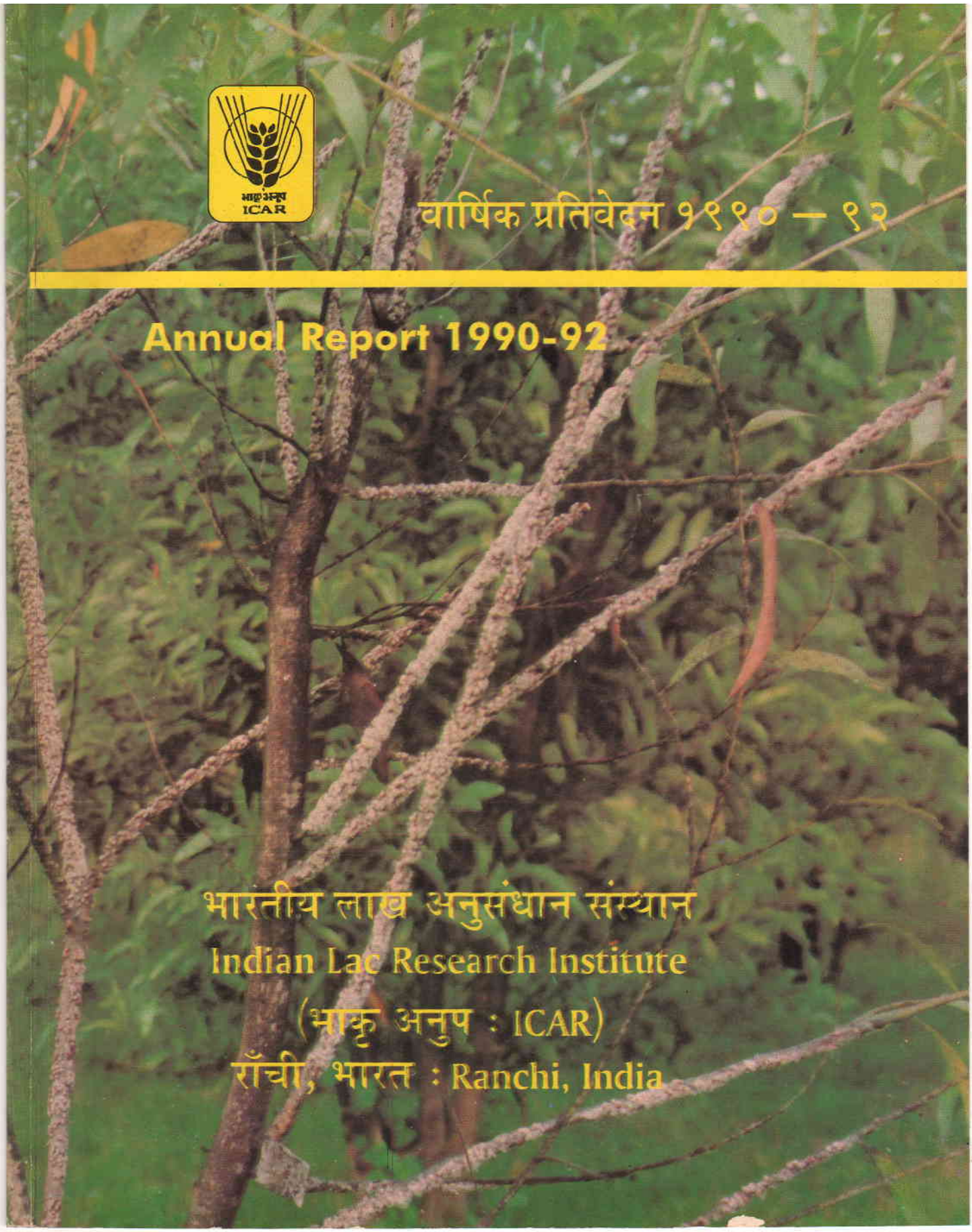


वार्षिक प्रतिवेदन १९९० — ९२

Annual Report 1990-92

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

वार्षिक प्रतिवेदन १९९० - ९२

Annual Report 1990 - 92

भारतीय लाख अनुसंधान संस्थान

Indian Lac Research Institute

(भारतीय कृषि अनुसंधान परिषद्)

(Indian Council of Agricultural Research)

नामकुम, राँची ८३४ ०१०, भारत

Namkum, Ranchi 834 010, India

Citation :

Annual Report 1990-92, Indian Lac Research Institute, Ranchi 834 010, India

(Ann. Rep. 1990-92, Indian Lac Res. Inst., Ranchi)

Published by Dr S.C. Agarwal, Director, Indian Lac Research Institute, Namkum, Ranchi 834 010, Bihar, India.

Printed at Catholic Press, Ranchi 834 001, India

This report pertains to the period : April 1990 to March 1992. The cooperation rendered by various staff members in the preparation of this manuscript is thankfully acknowledged.

Cover : Lac crop on *akashmani* (*Acacia auriculaeformis*), a new potential 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 all round improvements. 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 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, Finance and Accounts, and Mechanical Sections; the Library; besides, 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.

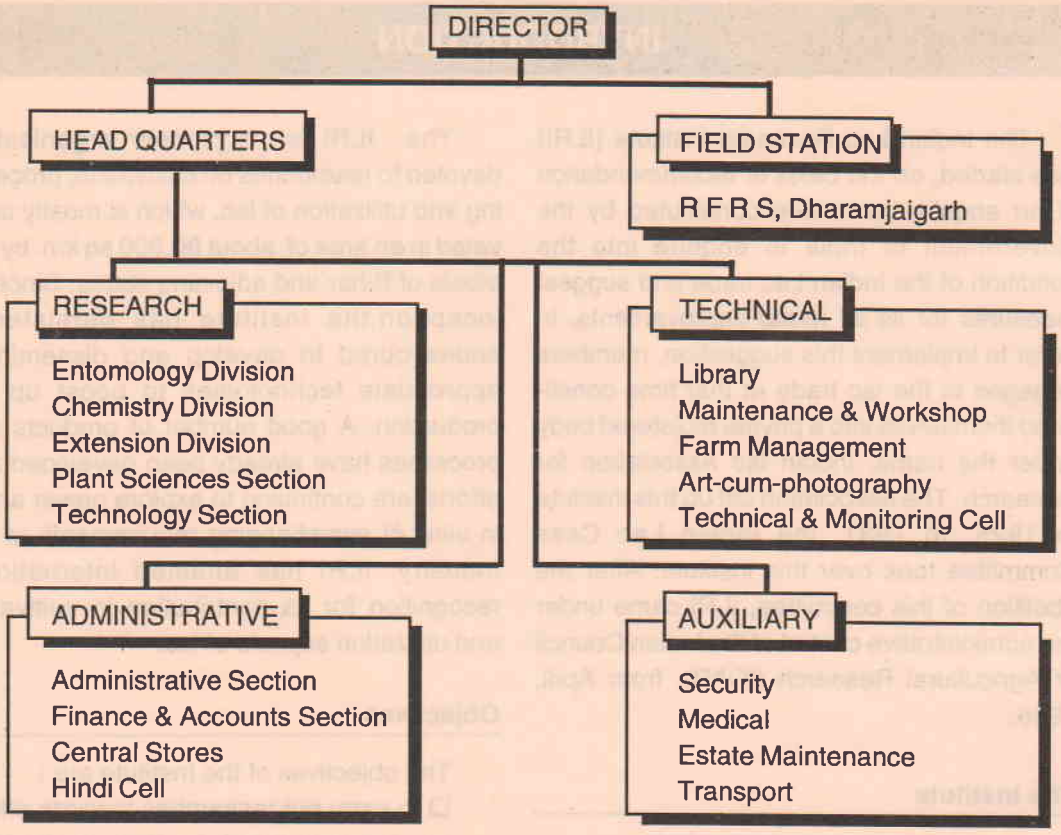
Objectives

The objectives of the Institute are :

- ❑ to carry out researches towards effecting improvement in the production, processing and standardisation of lac and study its constitution and modifications so as to intensify lac production and extend its utilisation;
- ❑ to extend the results of research through publicity, maintaining liaison with and providing technical service to the growers for improvement in lac production and indigenous industries towards increased utilisation of lac and improving the quality of their products; and
- ❑ to impart training in improved methods of lac cultivation and industrial uses of lac.

Organisational Set-up

The Institute is headed by a Director. The scientific manpower is deployed under three



Organizational set-up of ILRI

divisions: Chemistry, Entomology and Extension, and two sections: Plant Sciences and Technology. The Administrative wing comprises of Administrative Section, Finance & Accounts Section, Hindi cell and Central Stores. The auxiliary units are : 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 and Budget

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

During 1990-91 and 1991-92, the non-plan expenditures were 112.31 and 117.79 lakhs against the budget estimates of Rs. 129.50 and 130.00 lakhs respectively; the plan expenditures were Rs. 8.15 and 28.80 lakhs against the budget estimates of Rs. 35.00 and 42.00 lakhs respectively.

New Infrastructure

The Division of Extension, the Library and the Technical Cell have been shifted to a new two-storeyed building located near the main gate of the institute. The building houses the Library and the Technical Cell units in the first floor. The library has been provided with a

well-furnished reading and two stack rooms. The Extension Division is housed in the ground floor. The museum, which was hitherto located in the Administrative Block has been shifted to a capacious hall in the building. Besides, there is a lecture hall provided with modular furniture to accomodate about 100 persons.

Research Highlights

Akashmani, *a promising lac host*

Akashmani (Acacia auriculaeformis), a quick growing perennial shrub has shown potential for raising both the crops of *kusmi* strain of lac insect and the *katki* crop of the *rangeeni.* The biological attributes of the insects and the lac produced on this host were comparable to those, on the conventional hosts.

Integration of agriculture with lac culture

Efforts are being made at this institute to evolve an agroforestry system incorporating intensive lac cultivation on a mixed plantation of lac hosts. *Gora* paddy has been successfully grown as an intercrop in the spaces between the lac hosts in the second year of transplanting, without any adverse effect on the growth of the lac host plants.

Substituted coumarin derivative from jalaric acid

Jalaric acid is a constituent acid of lac resin. Substituted coumarin derivative (m.p. 114-115°C) has been synthesised with an yield of 15% (approx.) by dehydrating C-15 lactone diacid — an intermediate product obtained from jalaric acid.

Organic nitrate ester from aleuritic acid

Synthesis of organic nitrate ester, methyl (*threo*)-16-acetoxy 9(10) iodo-10(9) nitrato hexadecanoate and iodohydrins, methyl (*threo*)-16-acetoxy 9(10) iodo-10(9) hydroxy hexadecanoate has been made by the reaction of olefinic ester derivative of aleuritic acid with iodonium nitrate.

Shellac improves tracking index of polyvinyl acetate

Varnish prepared from polyvinyl acetate (PVAc, MW 45,000) possesses low tracking index value. The resistance towards tracking was found to increase when the same is blended with shellac varnish, indicating possibility for use of shellac as an extender in PVAc varnish formulation for improving tracking index of the latter.

Shellac-based out-door paint

Paint prepared from shellac-adipic acid polyester and Desmodur N remained unaffected upto 15 months in respect of colour and hardness when exposed to atmospheric conditions.

Simple method for isolation of lac dye

A simple method has been developed to isolate lac dye from the wash water obtained during processing of lac. The dye obtained is brick-red in colour and is nearly 80% soluble in hot water.

Hot-melt lac-based adhesive

A hot-melt adhesive composition based on lac and epoxy resin (M.W. 500) in the ratio of 60:40 showed a bond strength of 0.35 ton/

sq.inch as compared to that of plain shellac, 0.12 ton/sq.inch.

Forecast model for lac yield

An attempt was made, for the first time, to develop forecast models for lac yields, based on biometrical characters. The models developed explained 51 and 59 per cent variation in the lac yields of *baisakhi* and *katki* crops respectively.

Extension Highlights

Two new regular short-term courses were introduced to cater the needs of the progressive farmers, house-wives, village-level and other functionaries, and trainees/students of different organizations.

A training camp and exhibition was organised at Gopalpur in West Bengal. A roving survey-cum- post-training follow-up trip was conducted in the Deoghar and Dumka districts of Bihar by the Head, Division of Extension at the request of C.W.D.S., Bihar. On-the-spot technical guidance was provided by a team of two scientists at Shivpur (M.P.) and Jhansi (U.P.) to the "Development Alterna-tives", a voluntary organization, on the feasibility of lac cultivation in certain *palas* plantations.

PROGRESS OF RESEARCH

DIVISION OF ENTOMOLOGY

Researches Completed

1.2.9 Determination of physical and biochemical basis of lac insect host preference

A. H. Naqvi

The project was taken up to find out the basis of selection of suitable lac host plants for better performance of lac insects.

Studies were continued on the correlation between the girth, length and texture of the host plant, and the density of settlement, initial mortality and sex ratio of lac insects, as well as the yield of lac. Experiments were conducted using *kusmi* insects during *jethwi* 1990, *aghani* 1990-91, *jethwi* 1991 and *jethwi* 1992 crop seasons, and using *rangeeni* insects during *katki* 1990, *baisakhi* 1990-91, *katki* 1991, *baisakhi* 1991-92. *Kusum (Schleichera oleosa), ber (Ziziphus mauritiana), bhalia (Moghania macrophylla)* and *khair (Acacia catechu)* were used as lac hosts for the *rangeeni* insects whereas *palas (Butea monosperma), ber, bhalia* and *khair*, for the *kusmi*. No correlation was found between the physical characteristics of the host plants and the lac insect attributes studied.

The study has been concluded. Data are being analysed and the final report under compilation.

1.5.11 Studies on chromosomal behaviour of lac insect strains

S. K. Jaipuriar

Three stocks of lac insect germplasm, viz., Orissa crimson, Orissa yellow and Ludhiana were studied cytologically. A lecanoid system of chromosome behaviour, reported earlier for the local stock of *Kerria lacca* and the lac insect originating from Assam was confirmed. The diploid chromosome number was also found to be same (2N=18) in these stocks and it did not differ with sexes. The entire genome remained euchromatic in females. But in males, one haploid set of chromosomes was found facultatively heterochromatized during the early embryogeny while the other set remained euchromatic. During spermatogenesis, the first division took place equationally giving rise to two heterochromatic and two euchromatic sets of nuclei. The heterochromatic sets gave rise to heteropycnotic residues which later on degenerated. Only the euchromatic sets entered into sperm formation. The male lac insect is thus diploid but behaves as haploid transmitting only maternal genome, as observed earlier.

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. Chaudhary and M. L. Bhagat

The project aims at (i) improving the lac crop management practices for sustained production of quality broodlac and maximising the yield of sticklac on the conventional lac hosts and (ii) developing a method for estimation of broodlac requirement and expected yield.

Techniques for kusum

The study was continued in the field area at Hesal following the technical programme outlined below:

The experiment was conducted on 128 *kusum* trees. There were eight treatments with four replications of four trees each.

They were :

KA Four-coupe system; use of 10g broodlac/m shoot length; application of **Schedule I** for pest control (see below).

KB As in KA, using 20g broodlac/m.

KC Four-coupe system; use of 20g broodlac/m shoot length; no pest control measure.

KD Four-coupe system; use of 10g broodlac/m shoot length; application of **Schedule II** for pest control.

KE As in KD, using 20g broodlac/m.

KF Two-coupe system; inoculation using 10g broodlac/m shoot length on twelve-month-old shoots in Jan.-Feb. and partial harvesting in June-July; application of **Schedule II** for pest control.

KG As in KF, using 20g broodlac/m.

KH Two-coupe system; inoculation using 10g broodlac/m shoot length, self-inoculation during Jan.-Feb. (no partial harvesting); application of **Schedule II** for pest control.

Pest Control

Schedule I : Spraying of a mixture of 0.05% endosulfan (Thiodan 35 E.C.) and 0.05% BHC (50% W.P.), five weeks after inoculation, followed by another spray after eight weeks of inoculation, if necessary.

Schedule II : As in Schedule I and an additional spray of 0.05% endosulfan alone during the last week of Oct./first week of Nov. for the *aghani* crop and second week of June for the *jethwi.*

Samples were collected from the inoculated trees, after *phunki* removal, at sexual maturity and at crop maturity for assessing the population of lac insects as well as pests thereof.

The results of the above experiment have been outlined in **Table 1.**

Lac yield data obtained during the year 1991 revealed that treatment KE, i.e. four-coupe system of lac cultivation with brood rate at 20g per metre shoot length and two sprays of insecticides (once after *phunki* removal, in Feb.-Mar./July-Aug. and another in June/November, for the *jethwi* and the *aghani* crop respectively) was found the best in terms of quantity and quality of broodlac obtained. Under the treatment KE, the yield was 120 g/m shoot length as against that under control (treatment KC) which was 30 g/m). For sticklac production, the best treatment was KH, i.e. two-coupe system involving inoculation on one-year-old shoots, in June/July with brood rate at 10 g/m of shoot length, partial harvesting in Jan./Feb., followed by complete harvesting after one year with insecticidal sprays in every crop season. The treatment KH yielded 70 g sticklac per metre shoot length as against 10 g in control; the yield ratio was 1:11 as against 1:3.

In another experiment, correlation between the total shoot length of a tree and girth, height, canopy spread and the number of pruned points was studied. A positive correlation was confirmed with the number of pruned points.

Techniques for palas

During the period under report, the experiments at Kundri lac farm were repeated, as per the technical programme described in the *Ann. Rep. 1987.*

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

Treatment	Coupe	Period	Operation	Status of crop
KA, KB, KC, KD & KE.	III	July 1990	Harvesting-cum-pruning	Very good crop KE was found best for broodlac yield: 40 kg/tree (125 g/m shoot length)
	IV	-do-	Inoculation	
	IV	Feb. 1991	Harvesting-cum-pruning	Moderate crop. KE was found best for broodlac yield: 20 kg/tree (60g/m shoot length)
	I	Feb. 1991	Inoculation	Crop started dying after 2nd moult in March. High fluctuation of temperature and humidity recorded during the period
	I	July 1991	Harvesting; pruning	No crop. No broodlac obtained. No inoculation
	II	Feb. 1992	Pruning	
	III	July 1992	Pruning	
KF & KG	I	July 1990	Partial harvesting	
	I	Feb. 1991	Harvesting	
	II	Feb. 1991	Inoculation	
	II	July 1991	Inoculation	
	II	Feb. 1992	Pruning	No crop
KH	II	July 1990	Harvesting	Good crop
	I	July 1990	Inoculation	
	I	Feb. 1991	Partial harvesting	
	I	July 1991	Harvesting; pruning	No crop
	II	July 1991		
	II	Feb. 1992		

Spraying of lac crop with endosulfan and BHC and raising of trap crops were done as described in the *Ann. Rep. 1987.* The trees under the treatments at coupe II were pruned in April 1990. The *baisakhi-cum-katki* 1989-90 crop was harvested from all the trees of coupe I in Oct-Nov., 1990.

Yield data obtained from the *baisakhi-cum-katki* 1989-90 crop have been summarised below :

Parameter	Percent increase over control	
	Treatment PHA+	Treatment PHB+
Yield of broodlac	125.4	150.6
Yield of sticklac	34.2	40.3
Reduction in predator population (%)	37.0	63.7

\+ PHA: Trap cropping with 30 and 20 trees for the main and trap crops respectively; use of synthetic netting bags for crop inoculation and one spray of endosulfan in July-August on the trees carrying the main crop only.

PHB: As in PHA, with an additional spray of 0.05% endosulfan, one month prior to crop maturity.

Thus, the results of treatment, PHB which involves one additional spray of a mixture (1:1) endosulfan (0.05%) and BHC (0.05%) one month prior to crop maturity was superior confirming the previous observations.

In another experiment, to estimate the broodlac requirement per tree, *baisakhi-cum-katki* 1989-90 crop was raised on 108 *palas* trees using brood rates ranging from 5 to 30 g per metre shoot length as described in the *Ann. Rep. 1987.* It was found that the yield increased upto brood rate of 15 g/m and started declining thereafter which again confirmed the previous year's results. The *palas* trees were pruned in April 1990 for raising the *baisakhi-cum-katki* 1990-91 crop.

Correlation between the total inoculable area and height, girth, canopy, total number and length of shoots appearing from each pruned point was also studied, prior to crop inoculation. The total inoculable area as well as the total area covered under each treatment were recorded.

A positive correlation was found between total inoculable area i.e., number and length of shoots and the canopy spread confirming earlier results.

1.1.10 Evolution of cultivation schedule on *akashmani* for growing *kusmi* and *rangeeni* crops

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

This is a new project, taken up during 1990, aiming at evolving cultivation techniques on *akashmani (A. auriculaeformis)* for augumenting lac production through finding out i) suitable pruning schedule for actual time and optimum age of shoots for crop inoculation, ii) optimum brood requirement for crop inoculation for maximising yield, iii) performance of resulting brood raised either continuously on *akashmani* or alternatively with initial host trees for brood source i.e. *kusum, palas* and *ber* and finally evolving a suitable cultivation schedule based on above findings.

Pruning time and technique

For determination of appropriate method and time of pruning, two methods of pruning, i.e., apical (light and heavy) and basal (heavy) or pollarding were tried during different months of the year. Pruning operations were done during January, February, March, April, July and October. Total number of buds which appeared after pruning as well as total number

and length of primary, secondary and tertiary shoots were recorded.

This host responded excellently to all the methods of pruning tried. The most suitable months for pruning were July and February, which perfectly matches the *kusmi* cycle, followed by October which fits well with the *rangeeni* cycle.

Lac potential

For assessing the potentiality of the host for raising the *kusmi* and *rangeeni* crops, 24 plants each were inoculated for *aghani* 1990-91 and *jethwi* 1991 crops (*kusmi* strain) and *katki* 1990 crops (*rangeeni* strain) at brood rates ranging from 5-30g/m shoot length. Insect parameters viz., density of larval settlement, sex ratio, fecundity, resin secretion and crop yield were recorded.

Akashmani was found to be a highly potential host for raising both the crops of *kusmi* strain as well as the *katki* crop of *rangeeni* strain. Satisfactory *baisakhi* crop could not be obtained. The yield ratio of brood to brood and brood to total scraped lac varied in the range 1:2.1-1:3.2 and 1:2.2-1:3.4 respectively for the *katki* crop; the ranges of the above parameters for the *aghani* crop were 1:2.2-1:3.2 and 1:2.1-1:4.3 respectively **(Table 2)**.

Table 2 Lac crop yields on *akashmani* during the *katki* 1990 and *aghani* 1990-91 seasons

Treatment (Rate of broodlac in g/m shoot length)	Brood used (g)		Yield obtained (g)			Broodlac used: yield	
	Lac stick	Scraped lac	Broodlac sticks	Rejected sticks	Total scraped lac (g)	In terms of lac sticks	In terms of scraped lac
			***Katki* 1990**				
T_1 (5)	200	50	640	400	170	1:3.2	1:3.4
T_2 (10)	400	100	883	650	250	1:2.2	1:2.5
T_3 (15)	600	160	1265	600	360	1:2.1	1:2.3
T_4 (20)	800	200	1930	1250	600	1:2.4	1:3.0
T_5 (25)	1000	250	3025	1400	800	1:3.0	1:3.2
T_6 (30)	1200	310	2465	1450	790	1:2.1	1:2.2
			***Aghani* 1990-91**				
T_1 (5)	200	76	617	560	305	1:3.1	1:4.0
T_2 (10)	400	156	1290	951	681	1:3.2	1:4.3
T_3 (15)	600	218	1733	800	771	1:2.8	1:3.5
T_4 (20)	800	310	1892	1050	821	1.2.3	1:2.6
T_5 (25)	1000	394	2251	950	911	1:2.2	1:2.3
T_6 (30)	1200	474	2478	1030	1030	1:2.6	1:2.1

The mean fecundity and the lac produced per female lac insect were 321.4 (range: 278-514) and 29mg (range: 22-38) respectively, during the *aghani* 1990-91 and *jethwi* 1991 crops. The density of larval settlement, survival of insects at crop maturity and the sex ratio were found normal.

Samples of lac crops raised on *akashmani* and *kusum* were collected and analysed at the testing laboratory of the Extension Division for certain industrial parameters. The results were :

Parameter	On *kusum*	On *akashmani*
Colour index	9	8
Life	60 min	64 min
Flow	62 mm	60 mm
Wax content	4.5%	4.7%
Bleach index	80 ml	75 ml
Yield	65.5%	63.0%

The values of the above parameters of lac produced on *akashmani* were thus comparable to those of lac grown on the conventional host, *kusum.*

Optimum brood rate and age of shoot

For determining optimum brood rate and age of shoot for crop inoculation, different brood rates ranging from 10 to 30g/m were tried on 6,12, 18 and 24 month-old-shoots for raising *kusmi* and *rangeeni* crops. Density of larval settlement, sex ratio, fecundity and the crop yield were recorded. The results on crop yields are presented in **Tables 3** and **4.** No crop was obtained on six-month-old shoots. The best crop yields were obtained on 18 month-old shoots. The ratios of brood to brood yield (lac sticks) and brood to total yield (scraped lac) were higher at 10-20g/m brood rate for all ages of shoots tried.

Table 3 Analysis of lac yields from *akashmani* in relation to the brood rate and the age of shoot of host plant, during the *katki* 1991 crop season

Treatment (Rate of broodlac in g/m shoot length)	Age of shoots (month)	Brood lac used (g)		Yield obtained (g)			Broodlac used: yield	
		Lac sticks	Scraped lac	Broodlac sticks	Rejected lac sticks	Total scraped lac	In terms of lac sticks	In terms of scraped lac
T_1 (10)	12	400	100	1200	600	350	1:3.0	1:3.5
T_2 (15)		600	125	1750	600	460	1:2.9	1:3.6
T_3 (20)		800	150	2250	500	530	1:2.8	1:3.5
T_4 (25)		1000	200	2000	750	490	1:2.4	1:2.4
T_5 (30)		1200	250	2500	900	650	1:2.1	1:2.6
T_1 (10)	18	400	100	2000	450	500	1:5.0	1:5.0
T_2 (15)		600	125	2850	500	700	1:4.7	1:5.6
T_3 (20)		800	160	3275	400	780	1:4.1	1:4.8
T_4 (25)		1000	210	3050	700	760	1:3.5	1:3.6
T_5 (30)		1200	250	4250	600	960	1:3.8	1:3.8
T_1 (10)	24	400	100	1250	500	330	1:3.1	1:3.3
T_2 (15)		600	130	1830	500	425	1:3.1	1:3.2
T_3 (20)		800	160	2560	400	530	1:3.2	1:3.3
T_4 (25)		1000	200	2030	1300	500	1:2.0	1:2.5
T_5 (30)		1200	250	2330	1000	600	1:1.9	1:2.4

Table 4 Analysis of crop yields from *akashmani*, in relation to the brood rate and the age of shoot during the *aghani* 1991-92 crop season

Treatment (Rate of broodlac in g/m shoot length)	Brood lac used (g)		Yield obtained (g)			Broodlac used: yield	
	Brood lac sticks	scrapedlac	Broodlac sticks	Rejected	Total scraped lac	In terms of lac sticks	In terms of scraped lac
			Age of shoots : 12 months				
T_1 (10)	400	160	1380	450	480	1:3.4	1:3.0
T_2 (15)	600	240	1971	510	650	1:3.2	1:2.7
T_3 (20)	800	310	2466	750	860	1:3.1	1:2.7
T_4 (25)	1000	395	2560	850	898	1:2.6	1:2.2
T_5 (30)	1200	460	3130	100	1020	1:2.6	1:2.2
			Age of shoots : 18 months				
T_1 (10)	400	160	2230	500	770	1:5.5	1:4.8
T_2 (15)	600	240	2781	760	960	1:4.6	1:4.0
T_3 (20)	800	300	3550	850	1210	1:4.4	1:4.0
T_4 (25)	1000	390	3640	900	1250	1.3.6	1:3.2
T_5 (30)	1200	460	4470	1000	1630	1:3.7	1:3.3
			Age of shoots : 24 months				
T_1 (10)	400	165	1140	450	405	1:2.8	1:2.4
T_2 (15)	600	250	1760	960	650	1:2.9	1:2.6
T_3 (20)	800	320	2390	1070	880	1:2.9	1:2.7
T_4 (25)	1000	390	2460	1040	890	1:2.4	1:2.2
T_5 (30)	1200	450	2550	1200	910	1:2.1	1:2.0

Alternation of broodlac

Another experiment was carried out for evaluating the alternation of broodlac on *akashmani* and the conventional lac hosts. For this, *jethwi* and *aghani* crops were raised on *akashmani* using *kusmi* broodlac derived from *kusum* and *ber*; similarly, *baisakhi* and *katki* crops with *rangeeni* broodlac from *palas* and *ber*. The results showed a successful alternation with respect to broodlac and sticklac yields. Further, the brood obtained from the crops thus raised on *akashmani* were inoculated on *kusum* for raising *aghani* and *jethwi* crops and on *palas* for raising *katki* and *baisakhi* crops. Yields were recorded and compared. It was found that alternation of broodlac from the conventional hosts, viz., *kusum*, *palas* and *ber* with *akashmani* and *vice versa* was found successful for broodlac and sticklac yields.

1.2 Physiology of lac insect and associated insects

1.2.5 Analysis of physico-physiological factors causing lac insect preference for host plants

A. H. Naqvi

Studies were continued on the effect of soil application of N, P and K to *bhalia* and *galwang* (*Albizzia lucida*) plants, on some biological attributes of lac insects cultured on them. The methodology employed has been described in the *Ann. Rep. 1988.*

Experiment on bhalia

The observations taken under this experiment have been summarised in **Table 5.**

Table 5 Effect of soil application of N, P and K to *bhalia* bushes on lac insect attributes

Crop Season	N	P	K	N+P	N+K	P+K	N+P+K	Control
				Total larval settlement /2.5 cm shoot length				
Jethwi 1990	480	360	450	370	512	450	600	650
Aghani 1990-91	480	396	470	580	680	480	280	500
Katki 1990	320	480	480	210	410	420	510	380
Baisakhi 1990-91	600	300	380	480	585	285	430	500
Jethwi 1991	430	435	650	540	480	420	540	540
Aghani 1991-92	100	100	—	70	60	110	50	150
Katki 1991	640	420	540	720	450	580	580	429
Baisakhi 1991-92	640	545	580	195	720	453	640	406
				Mortality after settlement (%)				
Jethwi 1990	19.7	16.6	24.4	48.6	35.5	22.2	40.0	28.3
Aghani 1990-91	20.8	21.7	21.2	14.6	20.5	27.0	10.7	16.0
Katki 1990	40.6	29.0	26.6	21.4	28.0	45.2	28.4	25.0
Baisakhi 1990-91	13.3	16.6	21.0	19.7	30.7	27.7	55.8	20.0
Jethwi 1991	16.3	27.6	35.4	20.4	20.8	19.0	34.3	27.8
Aghani 1991-92	95.0	93.0	—	92.0	93.0	95.0	98.2	98.8
Katki 1991	31.9	42.9	27.9	45.8	44.4	36.2	43.1	29.8
Baisakhi 1991-92	35.8	40.2	26.3	46.3	28.6	38.3	42.1	31.8
				Proportion of males (%)				
Jethwi 1990	26.0	27.7	13.3	18.9	25.3	22.2	24.1	24.2
Aghani 1990-91	37.5	31.5	21.2	32.7	29.4	20.0	25.0	25.0
Katki 1990	18.7	25.0	23.3	25.0	18.2	30.9	15.6	26.3
Baisakhi 1990-91	30.0	33.3	26.3	20.8	21.3	23.1	16.2	20.0
Jethwi 1991	32.6	25.3	17.7	27.8	25.0	26.2	16.1	28.7
Katki 1991	25.0	23.8	25.0	23.6	32.2	24.1	17.2	32.14
Baisakhi 1991-92	29.2	29.0	26.5	27.4	34.2	33.3	33.2	35.0
				Sticklac yield/bush (g)				
Jethwi 1990	37.5	37.5	50.0	62.5	24.0	37.5	90.0	44.0
Aghani 1990-91	250.0	260.0	150.0	250.0	188.0	112.5	260.0	62.6
Katki 1990	150.0	120.0	100.0	200.0	140.0	160.0	100.0	200.0
Jethwi 1991	20.0	35.0	45.0	40.0	40.0	30.0	55.0	25.0
Katki 1991	200.0	250.0	180.0	180.0	220.0	70.0	230.0	150.0
Baisakhi 1991-92	Crop in progress							

Baisakhi 1989-90 crop : The crop which progressed well upto March'90 suffered heat mortality commencing 1st week of May and ultimately failed.

Jethwi 1990 crop : Maximum settlement of lac larvae was found under the treatment N+P+K (600 per 2.5 cm) and minimum in P (360), whereas in control it was 560. The initial larval mortality was lowest in P (16.6%) and highest in N+P (48.6%), whereas in control it was 33.7%. Male population was highest in P (27.7%), lowest in N+P (18.9%) and in control it was 24.2%. The crop yield was highest in N+P+K (90g) lowest in N+K (24g) and in control it was 44 g.

Aghani 1990-91 crop : Maximum settlement of lac larvae was in N+K (680), minimum in N+P+K (280) and in control it was 500. The initial larval mortality was lowest in N+P+K (10.7%), highest in P+K (27%) and in control, 16%. Male population was highest in N (37.5%), lowest in K (21.2%) and in control it was 25%. The yield was maximum in P (260 g) and minimum in control (62.5g).

Katki 1990 crop : Maximum settlement of lac larvae was in N+P+K (510), minimum in N+P (210) and in control it was 380. The initial larval mortality was lowest in N+P (21.4%), highest in P+K (45.2%) and in control it was 25%. Male population was highest in P+K (30.9%), lowest in N+P+K (15.6%) and in control it was 26.3%. The crop yield was highest (200g) in N+P and the control and it was lowest (100g) in N+P+K and K.

Baisakhi 1990-91 crop : Maximum settlement of lac larvae was in N (600), minimum in P+K (285) and in control it was 500. The initial larval mortality was lowest in N (13.3%), highest in N+P+K (55.8%) and in control it was 20%. Male population was highest in P (33.3%), lowest in N+P+K (16.2%) and in control it was 20%. The crop progressed very satisfactorily upto male emergence period (March '91) but thereafter it suffered total mortality towards crop maturity.

Jethwi 1991 crop : Maximum settlement of lac larvae was in K (650 larvae/2.5 cm), minimum in P+K (420) and in control it was 540. The initial mortality was lowest in N (16.2%), highest in K (33.3%) and in control it was 27.7%. Male population was highest in N (32.5%), lowest in N+P+K (16.5%) and in control it was 28.7%. Yield was maximum in N+P+K (55g), lowest in N (20 g) and in control it was 25 g.

Aghani 1991-92 crop : Maximum settlement of larvae was in control (150/2.5 cm) and minimum in N+P+K (50/2.5 cm). On account of high initial larval mortality, the crop did not progress even upto male emergence period.

Katki 1991 crop : Maximum settlement of lac larvae was in N+P (720/2.5 cm), minimum in P (420) and in control it was 429. The initial mortality was highest in N+P (45.8%), lowest in K (27.9%) and in control it was 29.7%. Male population was highest in N+K (32.3%), lowest in N+P+K (17.24%) and in control it was 32.14%. The crop yield was maximum in N (200 g), lowest in P+K (70 g) and in control it was 150g per bush.

Baisakhi 1991-92 crop : Maximum settlement of lac larvae was in N+K (720/2.5 cm), minimum in N+P (195) and in control it was 406. The initial larval mortality was lowest in K (26.3%), highest in N+P (46.3%) and in control it was 31.8%. Male population was lowest in K (26.54%) and highest (35%) in control. Development of lac insect continued to be satisfactory till the end of period under report.

Jethwi 1992 crop : Samples for examination of larval settlement and initial larval mortality were collected during the period under report.

Experiment on galwang

Galwang plants, raised simultaneously with *bhalia* through transplanting of seedlings in 1988, were put under first trial commencing with *jetwi* '91 in view of availability of suitable shoots for inoculation with lac larvae. Data presented in **Table 6** show that during *jethwi* '91 crop the maximum settlement of lac larvae was in N (700/2.5 cm) minimum in N+P (380) and in control it was 386. The initial larval mortality was lowest in N (10.14%), highest in N+P (42.1%) and in control it was 26.31%. Male population was lowest in N+K (16.93%), highest in K (33.3%) and in control it was 26.31%. The crop was harvested during July '91 and data obtained show that the yield was maximum in N+P+K (300g), lowest in K (100g) and in control it was 150 g (Table 6).

Aghani 1991-92 crop was inoculated during July '91 with the broodlac of *jethwi* '91 progeny obtained from *galwang* plants. Data presented in Table 6 show that the larval settlement was very poor in five treatments viz. N; K; N+P; N+K; and N+P+K and in the remaining there was no settlement at all, as a result of which soon after *phunki* removal complete mortality of lac insect occurred.

Adequate number of *galwang* plants having inoculable shoots were not available and hence *katki* '91 and *Baisakhi* '91-92 crops were not inoculated.

Jethwi 1992 season trial was repeated with inoculations during Feb.1992. Samples were collected by the end of period under report for assessment of larval mortality and initial settlement.

1.3 Ecology of lac insect and associated insects

1.3.12 Studies on the mortality of lac insect at different crowding levels

Y. D. Mishra and A. Bhattacharya

Table 6 Effect of soil application of N, P and K to *galwang* bushes on lac insect attributes

Crop Season	N	P	K	N+P	N+K	P+K	N+P+K	Control
Total larval settlement /2.5 cm shoot length								
Jethwi 1991	700	540	600	380	620	420	410	386
Aghani 1991-92	15	—	20	30	40	—	30	—
Mortality after settlement (%)								
Jethwi 1991	10.1	35.2	20.0	42.1	28.2	32.1	28.0	26.3
Aghani 1991-92	100.0	—	93.0	95.0	98.0	—	92.0	—
Proportion of males (%)								
Jethwi 1991	22.85	18.5	33.3	18.4	16.9	20.2	28.0	26.3
Sticklac yield/bush (g)								
Jethwi 1991	280.0	205.0	100.0	250.0	180.0	130.0	300.0	150.0

Note : *Aghani* 1991-92 — Complete mortality of the insects occurred after *phunki* removal.

Three different crowding levels of lac insects were obtained by varying the brood rates (10, 20 and 30g brood per pruned point) on the conventional host *kusum* during *aghani* 1990-91 crop season at the institute plantation. Samples were drawn at three-week intervals from the pruned points showing lac insect settlement for assessing coverage, density of settlement and the mortality of the insects. The experiment consisted of nine treatments and there were three replications. The results obtained are summarised below:

i) No correlation could be found between different levels of crowding (67 to 142 insects/ sq. cm) of lac insects and initial mortality (20.0 to 48.0%) and the percentage of male lac insect (27.8 to 73.9%) in the population.

ii) A positive correlation was found in the total available area of the shoot and number of pruned points. The latter can easily be taken as a measure of total available space of the tree for inoculation and estimation of yield.

1.4 Control of enemies of lac insects

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

A. Bhattacharya

During the period under report three experiments were conducted under randomized block design on *M. macrophylla (bhalia)* plants. In all the three experiments, spraying of insecticides was carried out after the *phunki* removal.

Experiment 1

During the *katki* 1990 crop season, some insecticide formulations of plant origin, viz., R.D.-9 Repelin, Neemark and Neemguard were evaluated for the control of lac predators. The predator population and crop yield data have been shown in **Table 7.** The experiment consisted of seven treatments with five replications.

There was no significant difference in the predator populations amongst the various treatments. The per metre lac yield under treatment Repelin 1% was highly significant (8.5 g) followed by Neemark 5% (6.86 g) when compared with control (Table 7).

Table 7 Effect of plant-origin insecticides on the predator population and lac yield of the *katki* 1990 crop

Treatment	Predator population/m lac encrustation	Yield (g/m)
R. D. - 9 Repelin[1] (1%)	1.99	8.50**
R. D. - 9 Repelin (2%)	0.95	4.64
Neemark [2] (3%)	1.41	5.87
Neemark (5%)	1.57	6.86*
Neemguard[3] (3%)	1.80	5.46
Neemguard (5%)	0.66	4.22
Control	1.60	4.31
S.Em ±	N.S.	0.99
C.D. at 5%	—	2.04
C.D. at 1%	—	2.76

* Significant
** Highly significant.

1. R. D. 9 Repelin : A botanical formulation developed by I.T.C. Limited. It contains products of *neem (Azadirachta indica), Karanja (Pongamia glabra), castor (Ricinus communis), mahua (Madhuca indica)* and *gingelly (Sesamum indicum).*
2. Neemark : A bio-derived herbal product of neem manufactured by West Coast Herbochem Pvt. Ltd., Bombay containing active azadirachtin.
3. Neemguard: Herbal concentrate of neem manufactured by Akshay Chemicals, Bombay.

Experiment 2

During the *aghani* 1990-91 crop season lac insect colonies were sprayed with the chitin inhibitor Dimilin (diflubenzuron), Thiodan (endosulfan), Dipterex (trichlorfon) and Evisect (thiocyclam) alone and in all possible combinations of two, for the control of lac predators. Samples were drawn at three-week intervals for recording the predator population. The crop yield data have been recorded at the time of harvesting. The data have been given in **Table 8**. The experiment consisted of eleven treatments replicated four times.

All the treatments (individual and combination sprays) were significantly effective in controlling the predatory population. The per metre predator population was the least in case of diflubenzuron (1.82/m) followed by endosulfan (2.51/m). In case of the combination sprays, treatment endosulfan+thiocyclam gave the best result (1.76/m) followed by treatment, diflubenzuron+thiocyclam (2.16/m). The experiment thus clearly indicated that combination sprays of selective insecticides can effectively control the lac predators in the field (Table 8).

The yield per metre of lac encrustation was found to be the highest in case of diflubenzuron (24.14 g) followed by the combination sprays of diflubenzuron+thiocyclam (19.72 g) and endosulfan+thiocyclam (16.66g) (Table 8).

Experiment 3

The above mentioned plant-origin formulated insecticides were evaluated for their safety towards the lac insect during *katki* 1991 crop season. The percent mortalities of lac insect due to various treatments have been shown in **Table 9**. The experiment consisted of seven treatments replicated four times. All the treatments (excepting Neemark 5%) were safe to one-month-old lac insects.

Table 8 Effect of various insecticides on the predator population and lac yield of the *aghani* 1990-91 crop.

Treatment	Predator population/m lac encrustation++		Yield (g/m)
Diflubenzuron (0.05%)	1.82	(2.89)**	24.14**
Endosulfan (0.05%)	2.51	(6.56)**	13.09
Trichlorfon (0.05%)	2.89	(8.12)**	7.88
Thiocyclam (0.05%)	3.47	(11.22)**	10.77
Diflubenzuron (0.05%) + Endosulfan (0.05%)	2.75	(7.79)**	13.17
Diflubenzuron (0.05%) + Trichlorfon (0.05%)	2.76	(7.42)**	9.17
Diflubenzuron (0.05%) + Thiocyclam (0.05%)	2.16	(3.79)**	19.72**
Endosulfan (0.05%) + Trichlorfon (0.05%)	2.33	(4.62)**	8.57
Endosulfan (0.05%) + Thiocyclam (0.05%)	1.76	(2.34)**	16.66**
Trichlorfon (0.05%) + Thiocyclam (0.05%)	2.69	(6.90)**	6.44
Control	6.95	(47.85)	8.94
S.Em ±	0.61		2.73
C.D. at 5%	1.24		5.69
C.D. at 1%	1.67		7.76

++ Data subjected to treatment : $\sqrt{n+1}$
The figures in parentheses indicate the original values.
** Highly significant.

Table 9 Effect of plant origin insecticides on the survival of lac insect during the *katki* 1991.

Treatment	Average percent mortality of lac insect
R.D.-9 Repelin (1%)	11.99
R.D.-9 Repelin (2%)	11.06
Neemark (3%)	15.10
Neemark (5%)	23.05*
Neemguard (3%)	4.49
Neemguard (5%)	8.92
Control	11.69
S.Em. ±	4.49
C.D. at 5%	9.43
C.D. at 1%	12.92

* Significant.

1.4.19 Fortification of pest management for the control of enemies of lac insect

S.G. Choudhary

This is a new project taken up during the period under report (1990) aiming at improving the pest management technologies, in line with continuing advancements and finding out some effective insecticides for more advantagous control measure to maximise crop yield.

The experiments were carried out under three subprojects, namely, (i) improvements in existing integrated control schedule by introducing some promising components found effective during previous years, (ii) screening of some new, less hazardous and cheaper insecticides against the lac insect and its major pests and (iii) field trials of some promising insecticides found effective under laboratory trials.

Under the subproject (i), field trials were carried out at Kundri orchard in an RBD with a 2 coupe system comprising of 16 treatments, replicated thrice with 15 *palas* trees under each replicate.

Treatment t_1: (Recommended integrated control schedule in practice) Crop inoculation on 2/3rd of the trees at normal brood rate i.e., 10-15g/m, under 60 mesh synthetic netting cages (mechanical protection measure against the pests) with heavy inoculation of remaining 1/3 of the trees for trap cropping and spraying of Thiodan at 0.05% concentration on trees inoculated at normal brood rate.

Treatment t_2: Crop inoculation with brood, treated with Thiodan (by dipping in a 0.05% solution for 5-10 min), at normal rate.

Treatment t_3: Spraying of BHC, at 0.05 percent concentration, by the end of March/or early April and again during the first fortnight of August, on trees inoculated at normal brood rate.

Treatment t_4: Combined spraying of Thiodan and BHC, at 0.05 percent each, during August and September.

Treatment t_5: Control, i.e., crop inoculation at normal brood rate but with no further treatment.

Further treatments, after integration of the above,were as follows: t_1t_2, t_1t_3, t_1t_4, t_2t_3, t_2t_4, t_3t_4, t_2t_3, t_2t_4, $t_1t_3t_4$, $t_2t_3t_4$ and $t_1t_2t_3t_4$, thus making 16 treatments in all. The field layout was in RBD with three replications. Results of these experiments have indicated that introduction of two promising components in the existing integrated control schedule has further strengthened it, resulting high degree of suppression of all the three major predators and parasites particularly *Chrysopa* species and harmful parasites for the first time and significantly increasing the yield thereby. Besides, there was a 28.8 to 66.4 percent reduction in the total pest population, resulting in 35.9 to 175.4 percent increase in yield over control. The highest being 175.4 under treatment $t_1t_2t_3$ followed by t_3, t_1, t_2 t_4 and t_2 (**Table 10**).

Table 10 Effect of various control schedules on the enemies of lac insect *vis-a-vis* lac crop yield during the *baisakhi-cum-katki* 1990-91

Treat-ment	Brood used per tree (g)	Stick lac weight of the brood used(g)	Yield obtained/tree (kg)				Percent increase in yield over control	Pest popula-tion per 100g	Percent reduction in pest population
			Brood	Rejected	Total	Total stick lac			
t_1	210	45	1.96	2.02	3.98	1.063	138.2	9.8	34.2
t_2	210	46	1.91	1.87	3.78	0.960	115.2	6.9	53.6
t_3	200	40	2.35	2.11	4.46	1.133	155.05	5.0	66.4
t_4	210	44	1.72	1.39	3.11	0.728	63.1	5.7	61.7
t_5	200	46	1.10	1.12	2.22	0.446	—	14.9	—
t_1t_2	210	42	1.71	1.71	3.42	0.787	76.3	9.4	36.9
t_1t_3	210	45	1.87	1.30	3.17	0.754	69.1	10.6	28.8
t_1t_4	200	45	2.48	1.44	3.92	0.941	110.8	8.9	40.2
t_2t_3	200	44	1.67	1.49	3.16	0.607	35.9	8.5	42.9
t_2t_4	200	40	2.41	1.97	4.38	0.986	120.9	8.6	42.2
t_3t_4	200	45	1.65	1.55	3.20	0.714	59.9	5.2	65.1
$t_1t_2t_3$	210	40	2.64	1.78	4.42	1.229	175.4	5.2	65.1
$t_2t_3t_4$	210	44	1.95	1.44	3.39	0.705	60.2	5.0	66.4
$t_1t_3t_4$	200	42	2.09	1.52	3.61	0.841	88.5	6.1	59.1
$t_1t_2t_4$	210	46	2.36	1.90	4.26	0.886	98.6	5.8	61.1
$t_1t_2t_3t_4$	200	40	1.91	1.70	3.61	0.841	88.5	7.1	52.3

1.5 Genetics and breeding of lac insects

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 ten germplasm stocks, mentioned below, were maintained during the period.

Rangeeni	*Kusmi*
1. Local yellow (Ranchi, Bihar)	1. Orissa yellow
2. Kundri, Bihar	2. Orissa crimson
3. Umaria, M.P.	3. Orissa new
4. Meghalaya (Nongpoh)	4. West Bengal
5. Maharashtra (Chopa,Bhandara)	5. Namkum (Ranchi, Bihar)

Biological attributes, such as life period, fecundity and resin secretion of six *rangeeni* and five *kusmi* lac insect germplasm stocks as well as physico-chemical characteristics of lac resin secreted by them, namely, flow, life, colour, wax content and melting point, were evaluated.

Analysis of data recorded so far showed that Orissa yellow stock had a shorter life period during the *aghani* crop season (164 days) as compared to *jethwi* (198 days) , while under normal condition the *jethwi* has shorter life period than the *aghani.*

The economic parameters of the lac obtained from various stocks are presented in **Table 11**. The values are the averages of six crop seasons over three years. Some of the stocks (Ludhiana (Punjab); Dharamjaigarh,

M.P. (early maturing); Dharamjaigarh, M.P. (late maturing); and Assam) used in this study were lost subsequently due to total mortlaity of the cultures.Among the *rangeeni* stocks, the local yellow, Ludhiana, Umaria and Kundri stocks produced lighter coloured resin compared to the Assam and Meghalaya stocks. The Assam stock yielded resin with lowest wax content. From the industrial point of view, the local yellow was found superior (among the *rangeeni* stocks) with regard to colour index, life, wax content and thermal characteristics; the Orissa yellow and Namkum stocks were found superior (among the *kusmi*) with respect to colour only. The *rangeeni* stocks thus differed significantly with respect to life, colour, wax content and melting point, the *kusmi* stocks showed marked difference with respect to colour only.

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

R. Ramani and K. Krishan Sharma

This project was taken up during the period under report with the following objectives: i) to bring about genetic improvements in lac insects with respect to colour and thermal resistance of the resin and ii) to study certain genetical perameters of the variation in resin productivity of lac insects.

All the studies were made on lac insect cultures raised on potted *bhalia (M. macrophylla)* plants, unless mentioned otherwise. The cultures were covered with cloth/ nylon netting sleeves to prevent entry of pests and periodically sprayed with Dithane M-45 (0.1%) for checking any fungal growth on the honey dew accumulation.

Table 11 Resin characteristics of different stocks of lac insect germplasm

Name of stock	Resin characteristics					
	Flow (mm)	Life (min)	Colour index	Wax (%)	Acid value	Melting point (°C)
			Rangeeni			
Ludhiana(Punjab)	52.5	52.5	11.5	4.49	67.8	77.5
Umaria (M.P.)	57.5	59.8	12.5	4.08	68.6	78.8
Local yellow (Ranchi, Bihar)	57.8	66.0	10.0	4.23	69.0	78.5
Assam	38.2	53.8	15.2	3.17	66.1	77.5
Meghalaya (Nongpoh)	45.5	49.2	15.5	4.39	67.1	77.5
			Kusmi			
Dharamjaigarh,M.P. (Late maturing)	64.0	63.8	11.0	4.48	69.6	79.2
Dharamjaigarh, M.P. (Early maturing)	60.8	69.0	11.0	4.38	69.1	79.8
Namkum (Ranchi, Bihar)	76.6	67.0	9.5	4.25	67.1	77.8
Orissa yellow	76.5	74.8	8.7	4.12	69.4	80.2
Orissa crimson	73.0	74.5	12.0	4.23	69.8	79.0

Breeding lac insects for lighter resin colour

Two sets of reciprocal crosses between *rangeeni* and *kusmi* stocks of *K. lacca* were made during the rainy season of 1989 as follows:

i) Kundri *rangeeni* crimson (KRC) x Orissa *kusmi* yellow (OKY)

ii) Kundri *rangeeni* crimson (KRC) x Ramgarh *kusmi* crimson (RKC)

The performance of the F_1 and F_2 progenies have been presented in **Tables 12** and **13**. Study of the resin dye level could not be made as the spectrophotometer went out of order. The life period of the F_1 progeny was found to be dependent on the way of cross probably due to difference in the date of inoculation. Comparison of the life period of the F_1 with that of the maternal parent showed that it was almost similar when *kusmi* insect was

Table 12 Performance of the F_1 of KRCxRKC (reciprocal) and KRCxOKY (reciprocal) and their parental lines during the summer season, 1989-90

Line	Life period (days)	Resin production/female (mg)		Fecundity (no. of larvae/female)	
	Range	Range	Mean	Range	Mean
KRC	247-274	6.1-19.8	12.0	228-1309	827
RKC	150-170	3.1-17.0	10.2	Not available	
OKY	158-197	4.6-14.0	9.3	111-578	359
F_1 of OKY♀xKRC♂	156-206	4.7-14.1	10.0	233-790	489
F_1 of KRC♀xOKY♂	222-241	Not available			
F_1 of KRC♀xKRC♂	226-259	6.5-20.7	13.1	342-1339	747
F_1 of RKC♀xKRC♂	156-195	9.3-26.6	15.7	Not available	

Table 13 Life period of F_2 females of the reciprocal crosses of KRC x OKY and KRC x RKC and their parental lines during the rainy season, 1990

Line	Life period in days (range)
KRC	100-120
RKC	198-222
OKY	168-193
F_2 (OKY♀xKRC♂)	117-135 and 191-233
F_2 (KRC♀xOKY♂)	96-126
F_2 (KRC♀xRKC♂)	102-127
F_2 (RKC♀xKRC♂)	171-184 and 232-262

used as mother, whereas it was slightly shorter when *rangeeni* insect was used. The life period of the F_2 generation was either unimodal or bimodal depending upon the way of cross, as expected. But the proportion of the female insects showing *rangeeni*-type life period was much less.

The F_1 and F_2 generations of the progenies of KRCxRKC (reciprocal) and KRC♀xOKY♂ were studied. The life periods of the two lines, where the *rangeeni* insect was the maternal parent, were similar and followed a *rangeeni* pattern. The F_3 generation of KRC♀xOKY♂ showed segregation for yellow and crimson colour, as expected, but the number of yellow survivors at the end was very low (17%), the F_3's (summer generation) of RKC♀xKRC♂ and KRC♀xRKC♂ showed a maternal influence for the life period lasting 24-26 weeks and 35-39 weeks respectively. This could be due to seasonal interactions. The life period of the F_4 (rainy season generation) of RKC♀xKRC♂ was highly variable (17-32 weeks), compared to that of reciprocal cross (16-18 weeks). Lines are being developed for regular life period for evaluation with regard to resin colour.

A new colour variant was derived from one of the experimental lines of the *rangeeni* lac insect. This insect secreted very light coloured resin and the body was almost colourless. This variant wss designated as "cream" based on the overall appearance. Further studies are in progress.

Breeding lac insect for higher thermal resistance of resin

A selection programme for higher melting point of the resin produced by individual female lac insects was initiated using a *rangeeni* stock derived from Kundri, Bihar. The selection was based on the performance of the maternal parent. Thirty families were selected, in each generation, for raising the subsequent generation. Six females were picked up from each family. The selection intensity was 0.2. The number of families and individuals selected from each family was subjected to variation due to loss of insects/cultures. The lac insects were reared on potted *bhalia* plants under field conditions. The selection was initiated in *katki* 1989. In the selected line, the mean melting points were 80.9, 80.0, 78.8 and 80.7°C during the *katki* 1989, *baisakhi* 1989-90, *katki* 1990 and *baisakhi* 1990-91 seasons respectively. Thus, there was no noticeable deviation from the normal values. The selection is being continued.

Study of resin productivity

An experiment was conducted to study the variation in the amount of lac secreted by individual female lac insects during the *katki* 1991 season, under field conditions. Cultures of lac insects of Kundri *rangeeni* stock were set up on two shoots each of five randomly selected *bhalia* bushes in a lot of forty bushes. The cultures were thinned periodically to obtain isolated female insects . The cells were collected after maturity and allowed to dry under room conditions. The lac produced by individual females were weighed after removing the insect body. The lac produced varied from 2.91-16.30 mg. Study of the ANOVA revealed significant differences among the shoots. The interplant differences were not significant. The mean weight of secreted per female varied from 8.87-11.04 mg among the shoots of the plants studied.

Researches Completed

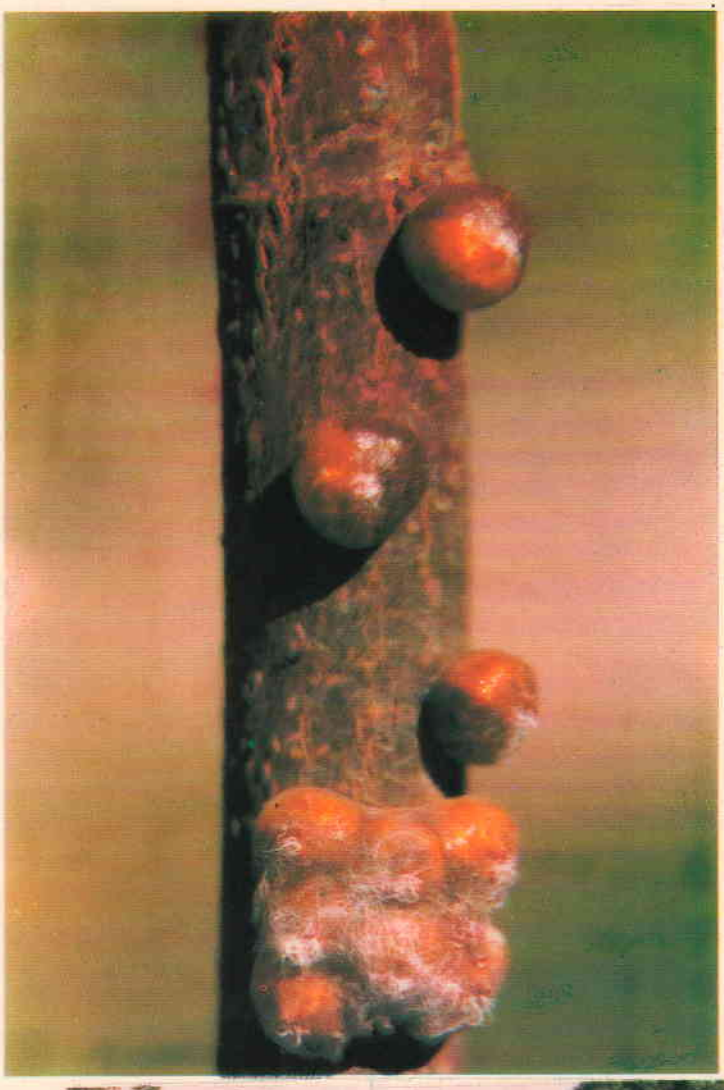
2.2.8 Vegetative propagation of *palas* through air-layering

P. Kumar

Palas (*B. monosperma*) a major lac host of *rangeeni* lac insects, not only takes a very long time to grow up to the inoculable stage when raised from seeds but also show genetic heterogenity. This study was undertaken to reduce the gestation period and to obtain true-to-type plants through vegetative propagation for intensive lac cultivation on plantation basis. Branches of different girths ranging from 10 to 40 mm were selected for the air-layering. Girdles measuring 30-35mm were prepared by removing the bark from these branches. Plant growth hormones viz., IBA, IPA, IAA and NAA were applied individually and in all possible combinations of two, at 50 and 100 ppm, alongwith a control (no hormones). These were applied on the prepared area (girdle of the branches) using lanolin paste and *Sphagnum* moss, wrapped with polythene strips and tied at both ends with plastic strings. Air-layers were prepared in each month from March to August. Further, FYM + pond soil and dried *Saccharum* grass was also tried as a medium to reduce the cost of air-layering.

Air-layers were detached after one and a half month from parent plant and transplanted in earthen pots and also in the field. Survival was better in earthen pots than in the field. The air-layers were planted in the field from the earthen pots, after one year.

The branches of 21-30 mm girth showed maximum success in rooting. Root initiation was found to occur (after one month), only when the air-layering was done during May-August, the maximum being in May (**Table 14**). Since the air-layers prepared in August and planted in October showed heavy mortality, air-layering was tried only in May, June and July during subsequent 3 years on selected branches having girth 21-30 mm. Application of NAA + IBA or NAA + IPA at 50 ppm concentration, resulted in highest percentage (93.3) of rooted air-layers followed by IAA (50/100ppm), NAA + IBA (100ppm) in May. The percentage of rooted air-layers was quite high (80%) with the use of lanoline paste+ *Sphagnum* moss without the application of growth hormones. Further, it was observed that with the use of FYM+pond soil+dried *Saccharum* grass in place of lanolin paste+*Sphagnum* moss, upto 73.3% rooted air layers could be obtained (**Table 15**). Thus, the air-layers of *palas* can be prepared, at low cost, using only FYM+pond soil+dried *Saccharum* grass. Survival after transplantation was very low during summer due to inadequate irrigation facility and thus can be improved by proper irrigation. On the basis of the above results, a large scale trial of vegetative propagation of *palas* through air-layering is suggested.



Individual and clustered mature lac insect females of Orissa *kusmi* (crimson) stock (*left*)

Gora paddy as intercrop between rows of *bhalia* bushes (*below*)

Table 14 Effect of plant growth hormones on the rooting in the air-layers of *palas* (*B. monosperma*)

Treatment	Conc. (ppm)	Percentage of rooted air-layers						
		MAY			July		August	
		Diameter of twigs (mm)			Diameter of twigs (mm)		Diameter of twigs (mm)	
		10-20	21-30	31-40	10-20	21-30	10-20	21-30
NAA	50	-	60.0	20.0	40.0	20.0	-	40.0
	100	20.0	40.0	-	40.0	-	-	10.0
IBA	50	-	-	-	20.0	40.0	-	-
	100	-	-	-	-	40.0	-	-
IAA	50	-	-	-	-	40.0	40.0	40.0
	100	20.0	-	-	-	40.0	-	40.0
IPA	50	-	-	-	-	-	20.0	-
	100	-	-	-	-	-	-	-
NAA + IBA	50	80.0	20.0	-	20.0	-	20.0	60.0
	100	40.0	60.0	-	40.0	20.0	40.0	60.0
NAA + IPA	50	60.0	40.0	-	-	-	-	-
	100	20.0	60.0	-	40.0	-	-	-
IBA + IAA	50	20.0	80.0	-	40.0	60.0	20.0	40.0
	100	-	-	-	40.0	60.0	60.0	-
IBA + IPA	50	60.0	20.0	-	80.0	20.0	-	-
	100	-	80.0	20.0	20.0	20.0	-	40.0
NAA + IAA	50	60.0	40.0	-	60.0	20.0	40.0	40.0
	100	-	40.0	-	20.0	40.0	-	60.0
IAA + IPA	50	20.0	40.0	40.0	20.0	20.0	-	40.0
	100	20.0	20.0	60.0	-	20.0	-	-
Control	-	-	20.0	-	-	20.0	-	20.0

Note : There was no rooting in the air-layers of twigs of 31—40mm diameter, in July and in August.

Table 15 Effect of application of plant growth hormones and time of air-layering of *palas* on the root characteristics and post-transplantation survival #

Treatment of hormones (ppm)	Rooted air-layers (%)			Roots(no.)			Total root length (cm)			Post transplantation survival (%)		
	May	June	July	May	June	July	May	June	July	May	June	July
NAA(50)	66.66	66.22	60.0	57.4	43.9	36.2	21.03	22.20	16.87	40.0	39.28	27.27
NAA(100)	51.11	66.66	63.33	53.3	38.5	48.3	22.62	17.69	19.02	52.17	33.33	21.05
IBA(50)	71.11	66.66	50.0	55.6	37.9	46.0	25.47	20.06	27.25	34.37	30.0	26.66
IBA(100)	77.77	62.22	56.66	45.6	43.3	47.7	20.84	11.18	18.87	34.28	25.0	35.29
IAA(50)	88.88	60.0	53.33	52.9	41.7	55.0	25.71	16.62	20.69	25.0	25.92	25.0
IAA(100)	88.88	55.55	60.0	45.1	45.9	49.2	21.08	17.64	20.01	30.0	56.0	22.22
IPA(50)	73.33	46.66	63.33	60.9	37.3	52.3	23.58	15.51	19.96	36.36	52.38	21.05
IPA(100)	73.33	60.0	60.0	50.3	43.4	39.3	21.23	17.33	19.41	33.0	33.33	22.22
NAA+IBA(50)	93.33	66.66	56.66	68.3	43.0	32.0	25.84	14.83	15.52	21.42	20.0	35.29
NAA+IBA(100)	88.88	53.33	63.33	44.9	53.5	38.8	20.16	18.79	19.04	25.0	50.0	21.05
NAA+IPA(50)	93.33	60.0	46.66	57.3	47.2	49.7	23.71	16.71	18.47	17.85	22.22	28.57
NAA+IPA(100)	73.33	73.33	43.33	62.5	47.3	60.7	26.96	14.28	23.74	27.27	27.27	46.15
IBA+IAA(50)	86.66	60.0	60.0	61.8	48.3	62.5	24.04	14.42	25.97	20.0	22.22	27.27
IBA+IAA(100)	80.0	80.0	43.33	53.5	38.7	38.3	21.22	17.16	18.10	36.11	33.33	30.76
IBA+IPA (50)	80.0	80.0	66.66	38.7	50.3	47.0	24.14	19.08	19.60	20.83	33.33	25.0
IBA+IPA(100)	66.66	60.0	90.0	45.3	41.7	71.3	18.34	16.38	23.34	0.0	22.22	14.81
NAA+IAA(50)	76.66	60.0	63.33	39.5	55.0	66.3	16.69	14.78	26.29	21.73	11.11	21.05
NAA+IAA(100)	83.33	73.33	56.66	95.0	53.0	47.8	34.18	14.36	22.59	16.0	18.18	29.41
IAA+IPA(50)	80.00	73.33	73.33	41.5	49.0	70.0	19.86	14.07	31.69	20.83	36.36	18.18
IAA+IPA(100)	76.66	73.33	46.33	66.2	36.0	39.3	42.35	10.86	17.16	21.73	18.18	18.57
Seradix	53.33	68.88	63.33	40.8	36.1	60.8	20.14	14.53	21.38	33.33	25.8	21.05
Control (only moss)	62.22	53.33	-	28.7	36.7	-	19.33	13.34	-	28.57	33.33	-
Lanolin paste+moss	80.00	73.33	70.00	41.2	46.7	45.8	23.98	21.94	21.25	58.53	50.00	19.04
FYM+pond soil+moss	73.33	63.33	-	40.3	40.5	-	20.99	10.66	-	54.54	18.18	-
FYM +pondsoil + *Saccharum* grass	73.38	53.33	-	34.3	34.5	-	14.63	13.54	-	54.54	18.33	-

Average of three years' data

2.1 Propagation and management of lac host plants.

2.1.9 Standardisation of forestry practices for raising high yielding *kusum* through air-layering.

S. C. Srivastava and P. Kumar

Studies were continued as per the technical programme outlined earlier (*Ann. Rep. 1989-90*), at the Hesal field area and institute plantation. Branches, of approximately one metre length and about 25 mm girth, were used for air-layering instead of 18 months-old shoots used in earlier experiments, in order to obtain better rooting and survival after planting.

Air-layers were prepared at the institute plantation in the June 1990 and 1991 and at the Hesal field area in July 1990, and planted in the field, during the subsequent monsoon season.

The results, in general, of air-layering done in June 1990 were not satisfactory. Maximum rooted air-layers of 63.3% was obtained with the application of IAA (50ppm).

The results of similar experiment carried out in June 1991 at the institute plantation are presented in **Table 16**. IPA was also used in addition to other hormones reported earlier (*Ann. Rep. 1989-90*) and thus there were twenty treatments. Cent percent rooting was observed with the application of NAA (100 ppm) and IAA (50 ppm). Lanolin paste and *Sphagnum* moss was used as medium in this experiment.

In another experiment, conducted in the June 1990 at Hesal, where FYM + pond soil (1:1) + *Sphagnum* moss + lanolin paste was used as medium, the results were not satisfactory. The percentages of air-layers showing rooting were 50.0, 36.7 and 53.3 with the application of IAA (50 & 100 ppm) and IBA (50 ppm) respectively. The shoots under the remaining treatments either callused or dried up. Similarly, the experiment conducted at the institute plantation in June 1991 using the above medium also did not result rooting under any of the treatments. The surviving air-layers prepared under different treatments in June 1989 and 1990 varied from 3.3 - 20.0% till the end of period under report.

2.1.11 Scheduling of lac cultivation under multistoreyed system

B. P. Singh

This study was taken up with a view to build up a lac plantation and evaluate different combinations of lac hosts for intensive lac cultivation under agroforestry system.

Kusum, will be exploited for sustained broodlac production and others such as *akashmani, ber, bhalia, galwang and khair* for sticklac. Efforts will be made to develop a system for increasing overall productivity, minimising the cost of plantation establishment and maximising the biomass production per unit area, under rainfed conditions. The experiment was laid out in 1990 in an RBD with eight treatments and four replications.

Seedlings of lac hosts, raised in nursery, were transplanted during the monsoon of 1990, in well prepared pits.

The plant growth attributes were recorded, 8 months after transplanting and one year thereafter. During 1990-91, no marked difference in growth characters was noticed among the lac hosts, under different treatments. However, the survival of different lac hosts were 100, 95.9, 90.9, 71.2, 50.0 and 40.6 per cent in *akashmani, bhalia, galwang, kusum, ber* and *khair* respectively. During 1991-92, *akashmani*

Table 16 Growth attributes of air-layers of *kusum* prepared using lanolin paste and *Sphagnum* moss as medium

Treatment of hormones (ppm)	Rooted air-layers (%)	Average no. of primary roots/	Average length of primary roots (cm)	No. of secondary roots per primary root	Average length of secondary roots (cm)	Survival of air-layers (%)
Air - layers prepared in June 1990 (n = 30)						
IAA (50)	63.3	15	10.4	9.6	4.5	10.0
IAA (100)	13.3	15	9.0	7.9	4.8	10.0
IBA (50)	23.3	12.3	9.4	10.2	3.4	20.0
IBA (100)	21.9	9.0	7.9	9.1	2.4	6.6
NAA (50)	23.3	6.7	8.0	10.8	2.7	-
NAA (100)	30.0	11.7	7.5	8.9	2.1	10.0
IAA + IBA (50)	13.3	23.3	7.0	8.5	2.0	-
IAA + IBA (100)	13.3	6.3	7.3	11.4	2.4	3.3
IAA + NAA (50)	3.3	5.0	9.0	9.0	2.3	-
IAA + NAA (100)	Nil	-	-	-	-	-
IBA + NAA (50)	Nil	-	-	-	-	-
IBA + NAA (100)	Nil	-	-	-	-	-
Control	-	-	-	-	-	-
Air - layers prepared in June 1991 (n = 5)						
IAA (50)	100	Data not available	10.8	16.2	3.9	25.0
IAA (100)	60		11.0	16.1	2.9	33.3
IBA (50)	60		9.9	16.9	3.0	33.3
IBA (100)	40		12.0	18.0	2.7	-
NAA (50)	60		11.7	9.7	2.9	-
NAA (100)	100		10.2	10.9	2.7	40.0
IPA (50)	60		10.0	10.0	2.3	-
IPA (100)	80		10.5	10.9	2.4	25.0
IAA + IBA (50)	60		14.0	19.3	4.3	33.3
IAA + IBA (100)	20		13.3	10.7	3.7	-
IAA + NAA (50)	80		9.9	13.3	3.4	75.0
IAA + NAA (100)	80		10.7	14.4	3.8	-
IBA + NAA (50)	80		12.4	17.8	3.7	50.0
IBA + NAA (100)	80		9.7	19.1	3.1	50.0
IBA + IPA (50)	70		9.8	14.2	2.8	28.6
IBA + IPA (100)	60		10.5	17.4	3.2	33.3
IPA + NAA (50)	-		-	-	-	-
IPA + NAA (100)	40		13.0	15.0	2.8	-
IAA + IPA (50)	20		13.3	10.3	3.7	100.0
IAA + IPA (100)	60		13.5	14.7	3.1	33.3
Control	-		-	-	-	-

showed maximum growth (height 273.4 cm, girth 17.8 cm) followed by *galwang*. Further, the percent increase in plant height and girth over the previous year (1990-91) was maximum in *galwang* (except for girth under treatment T8) and minimum in *bhalia* (**Fig. 1**).

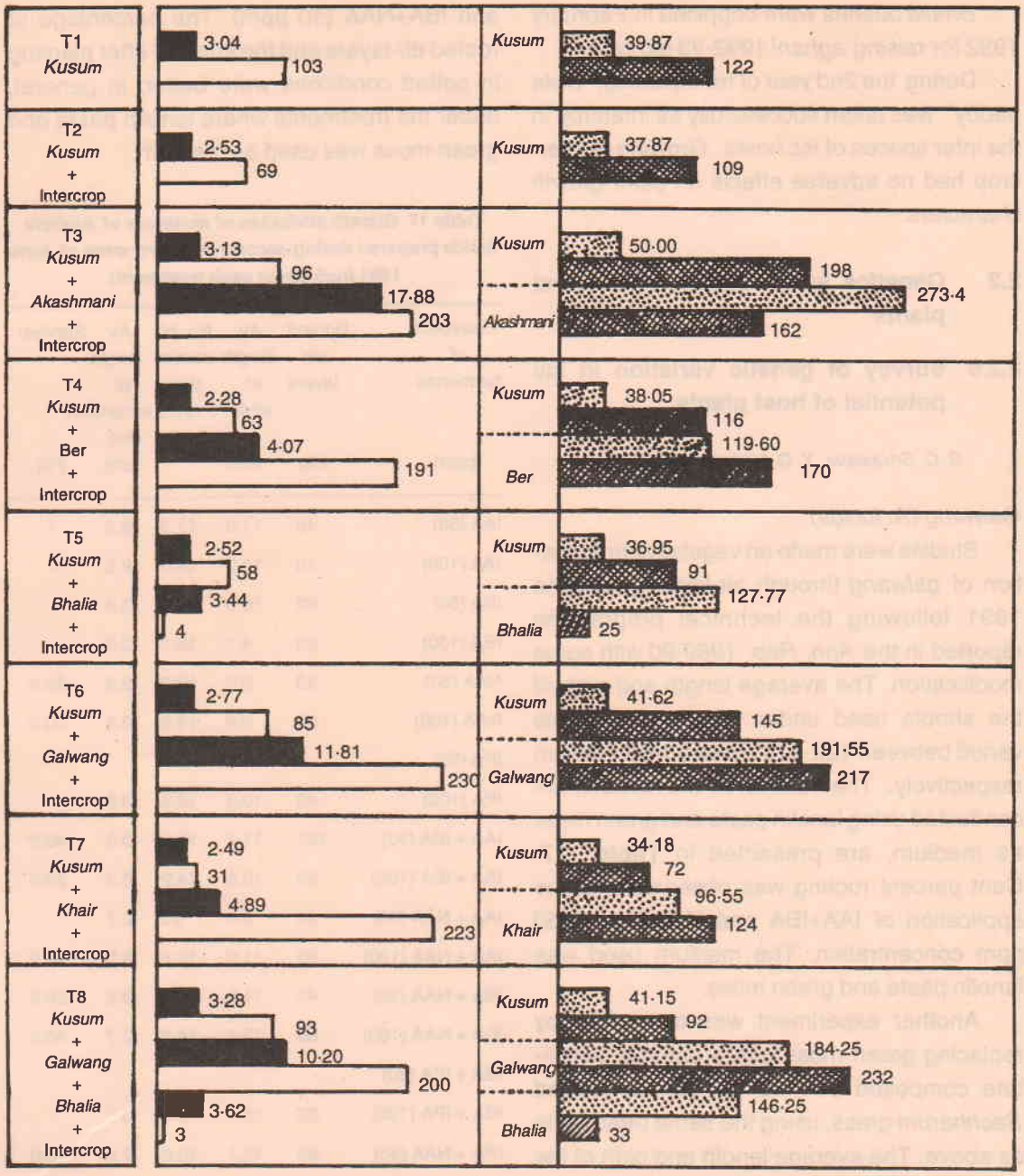


Fig. 1 The height and girth, and their per cent increase during1991-92, of the different lac host plants raised under various treatments for developing a multistoreyed system

Bhalia bushes were coppiced in February 1992 for raising *aghani* 1992-93 lac crop.

During the 2nd year of transplaning, "Gora paddy" was taken successfully as intercrop in the inter spaces of lac hosts. Growing of intercrop had no adverse effects on plant growth characters.

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, Y. D. Mishra and P. Kumar

Galwang (A. lucida)

Studies were made on vegetative propagation of *galwang* through air-layering in June 1991 following the technical programme reported in the *Ann. Rep. 1989-90* with some modification. The average length and girth of the shoots used under various treatments varied between 122-218 cm and 1.86-2.86 cm respectively. The results of the experiment conducted using lanolin paste and green moss as medium, are presented in **Table 17**. Cent percent rooting was observed with the application of IAA+IBA and IAA+IPA, at 50 ppm concentration. The medium used was lanolin paste and green moss.

Another experiment was conducted by replacing green moss with a cheaper substitute composed of mud + FYM (1:1)+dried *Sachharum* grass, using the same treatments as above. The average length and girth of the shoots used under various treatments varied between 122-212 cm and 2.04-2.90 cm respectively. The results have been shown in **Table 18**. Eighty percent rooted air-layers were obtained with the application of NAA (50 ppm) and IBA+NAA (50 ppm). The percentage of rooted air-layers and the survival after planting in potted conditions were better, in general, under the treatments where lanolin paste and green moss was used as medium.

Table 17 Growth attributes of air-layers of *Albizzia lucida* prepared during second and third week of June 1991 (n=5 under each treatment)

Treatment of hormones (ppm)	Rooted air-layers (%)	Av. length of roots (cm)	No. of secondary roots	Av. length of secondary root (cm)	Survival (%)
IAA (50)	40	11.0	21.3	3.5	-
IAA (100)	40	10.0	15.5	2.5	-
IBA (50)	60	10.8	14.1	3.8	-
IBA (100)	20	8.7	16.3	3.3	-
NAA (50)	20	9.0	16.7	3.3	20.0
NAA (100)	60	9.9	14.9	3.2	20.0
IPA (50)	-	-	-	-	-
IPA (100)	40	10.3	12.8	3.8	-
IAA + IBA (50)	100	11.7	19.9	3.5	40.0
IAA + IBA (100)	60	10.5	14.2	3.3	20.0
IAA + NAA (50)	20	9.0	6.3	2.7	-
IAA + NAA (100)	80	11.0	16.4	3.2	40.0
IBA + NAA (50)	40	11.8	10.5	3.2	20.0
IBA + NAA (100)	60	13.1	11.0	2.7	40.0
IBA + IPA (50)	-	-	-	-	-
IBA + IPA (100)	20	12.7	10.0	3.7	-
IPA + NAA (50)	80	12.1	10.8	2.9	60.0
IPA + NAA (100)	80	11.3	13.3	3.7	20.0
IAA + IPA (50)	100	10.0	14.5	3.7	-
IAA + IPA (100)	80	10.5	14.5	3.7	-
Control	60	12.1	11.8	4.0	40.0

Table 18 Growth attributes of air-layers of *Albizzia lucida* prepared during last week of June 1991 (n=5, under each treatment) (medium: *Sachharum* grass dried + FYM + pond soil (1:1)+ lanolin paste)

Treatment of hormones (ppm)	Rooted air-layers (%)	Av. length of primary roots (cm)	No. of secon-dary roots	Av. length of secondary root (cm)	Survival (%)
IAA (50)	40.0	10.7	13.7	3.2	20.0
IAA (100)	-	-	-	-	-
IBA (50)	60.0	9.7	10.0	3.0	40.0
IBA (100)	40.0	11.5	12.8	3.2	20.0
NAA (50)	80.0	12.1	13.3	3.7	40.0
NAA (100)	-	-	-	-	-
IPA (50)	40.0	11.7	13.0	3.3	-
IPA (100)	-	-	-	-	-
IAA + IBA (50)	40.0	12.5	14.7	2.7	-
IAA + IBA (100)	60.0	12.4	13.1	3.3	-
IAA + NAA (50)	40.0	10.7	14.0	2.5	-
IAA + NAA (100)	60.0	8.5	10.1	3.1	-
IBA + NAA (50)	80.0	11.8	12.2	3.7	40.0
IBA + NAA (100)	-	-	-	-	-
IBA + IPA (50)	60.0	11.0	12.1	2.3	-
IBA + IPA (100)	20.0	9.0	12.0	3.3	-
IPA + NAA (50)	-	-	-	-	-
IPA + NAA (100)	-	-	-	-	-
IAA + IPA (50)	-	-	-	-	-
IAA + IPA (100)	60.0	11.0	13.6	2.7	-
Control	60.0	10.2	13.2	4.0	20.0

Bhalia (M. macrophylla)

To study the genetic variation of *bhalia* for lac yields, plants raised through stem cuttings of 20 parents were grown in an RBD with four replications. These plants were inoculated with *kusmi* broodlac collected from Hesal brood farm during the *aghani* 1990-91 crop season. They showed 36.95 and 47.08% heritability for the scraped lac yield and shoot length colonised by lac larvae respectively.

Among the plant growth attributes, 51.5 and 54.47% heritability were observed for the total and inoculable number of shoots per bush respectively (**Table 19**).

2.2.7 Collection, maintenance, evaluation and characterisation of lac hosts

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

The host plants, *Flemingia (=Moghania) macrophylla*, Colchiploid of *F. macrophylla, F. paniculata* and *F. semialata* raised in an RBD with three replications, were inoculated with lac for *aghani* 1990-91 and *baisakhi* 1991-92 crops. The *aghani* lac crop failed whereas the *baisakhi* crop showed initial mortality of 17-29%.

The percentage of the male population in the *baisakhi* crop ranged from 55 to 79%. The maximum larval mortality and the male proportion were recorded in *F. semialata* and *F. paniculata* respectively.

The growth attributes of the host plants raised for the *aghani* crop were studied.

F. semialata was found to be superior in respect of plant height (178.3cm) and girth (2.2cm) whereas *F. paniculata* was the best as regards the number of branches per plant, length of inoculable shoots, the length of 6th internode and the canopy size.

Another experiment was conducted for the evaluation of eleven cultivars of *Cajanus cajan* for the *baisakhi* lac crop in an R.B.D. with three replications. The lac crop was raised using *palas* broodlac (50g/plant) but it failed. Most of the *arhar* plants suffered heat mortality and from wilt disease. The length of inoculable shoots was maximum in the case of K35/6 (17 m/plants) ICRISAT-6971 gave

Table 19 Estimates of genotypic and phenotypic variances and heritability of growth attributes of *Moghania macrophylla* and lac insects during *aghani* 1990-91 crop

S.V.	Density of lac larvae/ sq. cm.	Shoot length covered by lac insects/ bush (cm)	Initial mortality of lac insects/ sq. cm.	Scraped lac yield (g/bush)	Plant height (m)	No. of shoots/ bush	No. of inocu-lable shoots/ bush	Length of shoots (m)	Girth of shoot (cm)
SEX	23.09	9.30	2.07	110.2	1.87	29.425	2.303	17.116	3.881
σ_2 gh	-0.09	-0.01	0.39	08.6	0.002	-3.641	0.004	2.387	0.746
σ_2 ph	15.49	0.82	1.78	62.7	0.052	43.560	0.149	9.018	2.492
GCV	-1.30	-1.09	30.38	83.9	2.390	-6.480	2.88	9.020	22.260
PCV	17.04	9.72	64.53	22.72	12.190	22.430	31.66	17.540	40.680
h^2%	-7.62	-11.20	47.08	36.95	19.620	-28.889	9.097	51.460	54.720

maximum grain yield (144.7g per plant). The plant attributes and the grain yield of the *arhar* plants raised for the above experiment were recorded.

Researches Contemplated

Management of *kusrunt* (*F. strobilifera*) for lac cultivation.

Researches Completed

3.1.9 Thermal polymerisation of lac. Studies on the molecular weight, shape and size

A. Kumar

Polymers of lac were prepared by thermal polymerisation of seedlac. For this purpose, dried and desiccated seedlac samples (10g each) were heated at 150°C for different periods of time, up to the gel point. The samples so obtained were powdered and kept for further use. Then, 1.0% solution of each of these samples and seedlac were prepared in alcohol, filtered and the acetal values determined. The acetal value changed linearly with the polymerisation time, upto the gel point, and then showed an upward trend. This indicated that the acetal formation is the main reaction of the pre-gelation stage.

The molecular weights of seedlac and its polymers were determined by the ebuloscopic method, using ethanol as solvent. The mol. wt. of the polymer at the gel-point was 3390 whereas that of lac was 1000. The mol.wt. data corroborated with the above results.

Intrinsic viscosities of seedlac and its polymers in ethanol were determined at the water bath temperature of 30±0.5°C. The plot of $\log_{10}[\eta]$ against $\log_{10}$ M was found to be linear. The variation in the intrinsic viscosity was found to conform with that of acetal values. The chemical constants of seedlac and its polymers upto gel-point were also determined. There was no significant change in the acid values of seedlac and its polymers. A decrease in the hydroxyl and carbonyl values of seedlac was noticed with the time of polymerisation. The decrease in the hydroxyl and carbonyl values confirmed the formation of acetals in the pre-gelation stage. The iodine values of seedlac and its polymers were determined by the Hubl's method. A decrease in the iodine value was also observed with the time of polymerisation, which may be attributed to some side reaction arising from the impurities present in seedlac.

3.3.11 Modification of lac with ethyl cellulose

A.K. Dasgupta

In this study shellac was modified with ethyl cellulose with an objective to develop a satisfactory composition with improved surface coating properties.

Varnish compositions were prepared based on dewaxed lac, different proportions of ethyl cellulose, dibutyl phthalate and denatured spirit. The best composition was obtained when 30% solution of dewaxed lac in denatured spirit was blended with a 25% solution of ethyl cellulose in denatured spirit (20:80 W/W on the solid content) and added with 5% dibutyl phthalate on the wt. of lac.

The varnish obtained was homogeneous and possessed good flow, levelling and drying characteristics. On application by brush, it produced hard, smooth and glossy films on wooden surface. The films had poor adhesion on metal surface. These became tack-free within ten minutes and acquired sufficient hardness within seven days. Air-dried films showed good gloss of 60% of standard black glass. Scratch hardness of the films was found to be 900g. The films passed the test for flexibility (1/4" mandrel). The films peeled off from the surface after one hour, when dipped in water. These were also found to peel off in dilute acids.

Solutions (25% w/w) of dewaxed lac and ethyl cellulose were prepared separately in denatured alcohol and were blended in the ratio of 20:80 (w/w) on the basis of solid content. Similarly, butylated melamine formaldehyde resin (BIOMINE 1651) was dissolved in denatured alcohol (20% w/w on the wt of lac) and to this solution, 2% PTS was added. The above solution was then mixed with a solution of shellac in (hot) ethylene glycol (20% w/w) in 5:1 ratio. The resulting solution was then finally blended with shellac-ethyl cellulose mixture.

The varnish obtained was homogeneous and exhibited good flow, levelling and drying characteristics. On application by brush, it produced hard, smooth, adherent and glossy films on wooden surface. The films became tack-free within 5 minutes and acquired sufficient hardness for rubbing and revarnishing within 15 minutes. Air-dried and baked films possessed a gloss of 60% of standard black glass. Scratch hardness of the air-dried and baked films (2h at 150°C) was found to be 1200 and 1400g respectively. Both air-dried and baked films passed the test for flexibility (1/4" mandrel) and were found to be resistant to toluene and spirit. Both the air-dried and baked films were found to peel off without blushing when the films were dipped into water for 5 minutes.

3.3.12 Modification of lac wax

K. M. Prasad and B. B. Khanna

Lac wax is an important bye-product of the lac industry and has a wide field of applications. It possesses properties similar to those of the costly and imported carnauba wax. However, it is little inferior in hardness, melting point and solvent retention power. This study was undertaken to modify lac wax and upgrade it in respect to the above mentioned properties.

The commercial grade of lac wax was modified with varying proportions of different calcium salts viz., calcium hydroxide, calcium oxide and calcium carbonate and some physico-chemical properties of the modified wax were studied (**Table 20**). No appreciable difference in m.p. was noticed, but a reduction in the penetration and acid values was observed indicating an improvement in hardness and acidity.

Table 20 Physico-chemical characteristics of commercial lac wax modified with different calcium salts at 150°C

Material	M.P. (°C)	Penetration value	Acid value	Ash content (%)	Solvent retention value
Commercial lac wax	78-79	6	8.6	0.15	33
Wax modified with					
1% calcium hydroxide	80-81	4	8.0	1.0	42
2% " "	80-81	3	2.8	2.0	35
3% " "	80-81	3	1.4	3.7	28.6
4% " "	80-81	2	0.4	4.2	20.6
5% " "	80-81	2	0.2	6.5	12.5
Wax modified with					
1% calcium oxide	78-79	5	8.0	8.0	66.0
2% " "	79-80	5	7.3	1.7	65.7
3% " "	80-81	4	4.3	1.8	64.5
4% " "	80-81	4	3.8	3.2	61.5
5% " "	80-81	2	2.8	4.0	58.0
Wax modified with					
1% calcium carbonate	78-79	3	7.5	0.8	31.0
2% " "	78-79	3	4.4	2.0	26.1
3% " "	78-79	3	3.5	2.1	24.3
4% " "	80-81	2	2.8	3.9	14.9
5% " "	80-81	2	1.5	4.2	11.9

Lac wax, obtained from lac-mud was then modified with varying proportions of (i) sodium bisulphite under carbon dioxide atmosphere, (ii) ammonia and (iii) urea at different temperatures. The physico-chemical characteristics were determined which are given in **Tables 21, 22** and **23**.

The wax obtained from the lac mud when modified with sodium bisulphite showed considerable improvement in all the above mentioned properties. Best results were obtained when lac wax was modified with 7.5% of sodium bisulphite at 200°C for 5h in the atmosphere of carbon dioxide; melting point increased from 77 to 86°C and penetration value decreased from 5 to 1. When lac wax was modified with ammonia or urea the acid value decreased, indicating the formation of amide, but other properties did not show significant improvement.

Table 21 Physico-chemical characteristics of lac wax (obtained from lac mud) modified with sodium bisulphite at different temperatures

Material	M.P. (°C)	Pene-tra-tion value	Acid value	Ash con-tent (%)
Wax from lac mud	77-78	5	15.5	0.5
Wax modified at 150°C with				
2.5% sodium bisulphite	80-81	4	13.7	1.35
5.0% " "	81-82	3	10.6	4.2
7.5% " "	82-83	2	7.7	6.1
Wax modified at 200°C with				
2.5% sodium bisulphite	82-83	3	11.6	5.2
5.0% " "	83-84	2	9.6	10.1
7.5% " "	84-85	1	6.7	12.8
Wax modified at 250°C with				
2.5% sodium bisulphite	83-84	3	7.7	6.6
5.0% " "	85-86	2	5.8	10.1
7.5% " "	85-86	1	3.9	18.1

Table 22 Physico-chemical characteristics of lac wax (obtained from lac mud) modified with ammonia of different temperatures

Material	M.P. (°C)	Pene-tra-tion value	Acid value	Ash con-tent (%)	Sol-vent reten-tion value
Wax from lac mud	80-81	6	13.6	-	-
Wax modified at 100°C with					
10% ammonia	78-79	5	12.74	0.2	79.41
20% "	79-80	5	12.74	0.15	80.18
40% "	80-81	3	12.74	0.1	82.24
Wax modified at 150°C with					
10% ammonia	77-78	5	10.92	0.2	80.80
20% "	78-79	5	10.01	0.15	84.81
40% "	79-80	5	7.28	0.1	86.91
Wax modified at 200°C with					
10% ammonia	76-77	4	5.46	0.2	85.01
20% "	77-78	5	6.37	0.15	86.65
40% "	78-79	5	8.19	0.1	88.2

Table 23 Physico-chemical characteristics of lac wax (obtained from lac mud) modified with urea at different temperatures

Material	M.P. (°C)	Pene-tra-tion value	Acid value	Ash con-tent (%)	Sol-vent reten-tion value
Wax from lac mud	79-80	6	14.5	0.2	76.0
Wax modified at 100°C with					
2% urea	79-80	5	12.0	2.0	79.9
4% "	80-81	5	12.0	2.0	80.0
6% "	80-81	5	12.0	2.0	81.5
10% "	78-80	4	12.0	1.5	80.2
Wax modified at 150°C with					
2% urea	79-80	5	10.4	2.0	80.5
4% "	79-80	5	10.4	1.5	82.2
6% "	78-79	5	10.4	1.5	82.2
10% "	78-79	4	9.1	1.5	84.5
Wax modified at 200°C with					
2% urea	78-79	5	8.6	1.5	84.0
4% "	77-78	5	7.0	1.5	85.0
6% "	77-78	4	7.0	1.5	85.0
10% "	76-77	4	7.0	1.5	85.0

3.6.4 Studies on the modification of lac for use as high thermal class insulating varnishes

M. Mukherjee, S. Kumar and D.N. Goswami

Several attempts had been made in the past by different workers to increase the thermal resistance of shellac films by reacting lac with chemicals, drying oils and other resins, etc. A few baking-type shellac-based varnishes were developed but the success in improving the thermal resistance was limited upto 130°C.

The present study was initiated with an objective to develop a high thermal resistant insulating varnish based on shellac for use in the electrical industry. In this study, shellac (BISCOLAMF, Ranchi) and a small quantity of epoxy resin (M.W 1000, CIBA-GEIGY India) was reacted with linseed oil in the presence of lime and litharge. A brief description of the process is described below:

The drying oil was first heated in a flask upto 120-150°C, lime and litharge were then added and the temperature was further raised to 250°C. The temperature was then lowered and a mixture of shellac and epoxy resin was added. The temperature was raised again to 270°C when a clear melt was obtained. It was raised further and maintained for sometime, then it was allowed to cool down to room temperature. The varnish was then diluted with toluene to the desired consistency, drier was added and filtered. All the properties of the varnish were examined following IS:10026-1982. The films of the varnish possesed very good drying characteristics and gave a smooth, uniform and non-tacky finish. The varnish could be diluted with an equal volume of thinner and no precipitate was observed. The films passed the short-duration test for thermal resistance upto 200°C. No shellac-based varnish has so far been reported to withstand such a high temperature.

The dielectric strength values of the films at room temperature (30°C), at 200°C and after immersion in water for 24h were found to be 80, 44 and 48 kV/mm respectively. These values satisfy the requirements of the above mentioned IS specification, which are 50,35 and 35 kV/mm respectively. The above properties of the varnish were observed to be superior as compared to those developed earlier.

The films of the varnish were flexible and this property did not deteriorate and no tackiness developed even when the films were kept at room temperature for more than 2 years. No greening of the copper was observed when this varnish coated copper panels were kept at 100°C for 168h. Studies were also carried out on the resistance to transformer oil. No evidence of cracks or peeling of the films was observed from the copper substrates and no change in the colour of the oil, in which the varnish coated panel was dipped, was noticed for the tests carried out upto 130°C. For tests above this temperature, colours of the control oil as well as the oil under test had changed due to the carbonisation of the oil, causing difficulty in visual comparison.

Varnish prepared using alkali-refined linseed oil also yielded good dielectric strength values and showed thermal resistance upto 200°C. The drying time of the films was found to be 30 min at 200°C. The shelf-life of the above varnishes were found to be satisfactory. No gelling, phase separation etc. in the varnish was noticed upto 18 months.

Tracking resistance of the varnish

The tracking property of the insulating varnish based on double-boiled linseed oil was

investigated following IS:10026-1982. The varnish showed increased resistance towards tracking both at 135 and 200 V and passed the test specified in the above standard. The tracking index was found to be about 266 V. This result suggested that the varnish can be used as anti-tracking insulating varnish.

Evaluation

The varnishes prepared from the reaction product of shellac-epoxy resin-double-boiled linseed oil and shellac-epoxy resin alkali-refined linseed oil, were supplied to a leading micanite manufacturer in the country. It has been reported that the micanites manufactured with the help of these varnishes, (i) did not delaminate, (ii) possessed very good dielectric strength and the property did not deteriorate upto temperature 200-220°C and (iii) the finished products were flexible. They expressed the suitability of the varnishes for the manufacture of flexible type of micanites.

The varnish based on shellac, epoxy resin and double-boiled linseed oil was supplied to a local consumer of insulating varnish for evaluation. The varnish was applied on a 25 H.P., 440 V, 3 phase electric motor and its performance was reported to be satisfactory.

Varnish prepared in presence of glycerine

The physical mixture of shellac and epoxy resin was reacted with glycerine-litharge treated double-boiled linseed oil at an elevated temperature. The product was soluble in xylene, toluene, methyl ethyl ketone and methyl-iso-butyl ketone. A 20% solution of this product in the mixed solvent of toluene: MIBK (2:1) or toluene: MEK (2:1) on treatment with 0.15% cobalt napthanate produced films, which on baking (30 min at 150°C) became tack-free, hard, smooth, glossy and flexible. Baked films possessed thermal resistance upto 180°C and dielectric strength of the order of 76 kV/mm at room temperature (30°C). Films coated on copper panels conditioned at 100°C for 168h remained flexible and no greening of copper was observed. This varnish, however, possessed low value of dielectric strength at higher temperature (28kV/mm at 110°C). The films also failed the tests of dielectric strength after immersion in water for 24h and resistance to transformer oil.

Study with silicone resin

Preliminary studies were made on the characteristics of the films prepared from the blends of shellac and silicone resin in several solvent system. The films obtained were non-uniform.

An attempt was also made to prepare films from the blends of lac-linseed oil (double-boiled) combination and silicone resin (METROARK). The films obtained were smooth, flexible and uniform having drying time of 30 min at 150°C. The drainage was found to be appreciable for varnishes with 25% solid content. The dielectric strength at 30°C was found to be 72 kV/mm. The varnish showed phase separation, when kept at room temperature. This work was hence discontinued.

Researches in Progress

3.2 Fine chemicals from lac

3.2.10 Synthesis of pheromone and juvenile hormone analogues from aleuritic acid

R.N. Majee and R. Ramani

Insect sex pheromone components 9(*Z*)-hexadecen-1-ol, its acetate; 9(*Z*)-

tetradecen-1-ol, its acetate and methyl 9(*Z*)-tetradecenoate were synthesised in quantity from azelaic acid aldehyde, one of the periodate oxidation products of aleuritic acid applying Wittig synthesis. The procedure adopted was as follows: Sodium hydride, in dry dimethyl sulphoxide, was stirred for 1h followed by addition of heptyl triphenyl phosphonium bromide in dimethyl sulphoxide. The resulting solution was treated dropwise with methyl ester of azelaic acid aldehyde to give after work-up methyl 9(*Z*)-hexadecenoate which was reduced with lithium aluminium hydride in tetrahydrofuran to give 9(*Z*)-hexadecen-1-ol. Its treatment with Ac_2O in pyridine yielded 9(*Z*)-hexadecen-1-yl acetate. Similarly, sodium hydride in dry dimethyl sulphoxide was stirred for 1h followed by addition of pentyl triphenyl phosphonium bromide in dimethyl sulphoxide. Resulting solution was treated dropwise with methyl ester of azelaic acid aldehyde to afford, after work-up, methyl 9(*Z*)-tetradecenoate. Reduction of the foregoing unsaturated ester with LAH in THF gave 9(*Z*)-tetradecen-1-ol which when treated with Ac_2O in pyridine resulted in 9(*Z*)-tetradecen-1-yl acetate.

3.2.12 Synthesis of substituted coumarin derivatives from jalaric acid

N. Prasad

Synthesis of C-15 lactone diacid by alkali fusion of dimethyl shellolate (obtained from jalaric acid by oxidation followed by esterification) was reported last year. In order to obtain a pure product, in quantity, synthesis of the compound was repeated during the period under report following the method outlined below:

Dimethyl shellolate was mixed with caustic potash (1:4) and fused in a crucible at 230-240°C till the effervesence ceased. The fused mass was cooled and dissolved in water. The solution was then acidified with dil. sulphuric acid to get the precipitate of C-15 lactone diacid (m.p. 197-198°C, yield 40%).

Experiments were then carried out to synthesise the final product i.e. substituted coumarin derivative, from C-15 lactone di-acid. C-15 lactone diacid was taken in dry methanol and to it Pd/charcoal was added and kept overnight to complete the dehydration reaction. The resulting product after filtration was esterified by refluxing with conc. hydrochloric acid for 5h. The ester, so obtained, was subjected to column chromatography and crystallisation for purification. The pure product i.e., substituted coumarin derivative, m.p. 114-115°C, was obtained in approx. yield of 15%. The spectral characterisation of the product as well as standardisation of the process of its synthesis in quantity from jalaric acid are under progress.

3.2.13 Synthesis of prostaglandin analogues from aleuritic acid

N. Prasad and R.N. Majee

Synthesis of lactone ester, by condensation reaction between the methyl ester of azelaic semialdehyde (obtained by periodic acid oxidation of aleuritic acid) and dimethyl succinate, in the presence of sodium methoxide, was reported last year. The resulting product, i.e. half-ester, was reacted with HBr/AcOH/ water (3:2:1 v/v) at reflux temperature on water bath for 15h to get the lactone ester. During the period under report, the above synthesis was repeated to prepare the lactone ester in quantity to carry out the next step of synthesis.

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

S.C. Agarwal, I. Rajendran and P.C. Sarkar

Synthesis of organic nitrates

For the preparation of organic nitrates, experiments were carried out in the following steps : Crude aleuritic acid was prepared in quantity and purified, (m.p. 99-100°C, dilute methanol) preparation of *trans*-enoic acid m.p. 66-68°C by reacting aleuritic acid with ethyl orthoformate, preparation of *erythro*-aleuritic acid by H_2O_2-HCOOH method (m.p. 125-126°C, dilute methanol). Preparation of *cis*-enoic acid (liquid, TLC single spot) and its esterification to methyl *cis*-16-hydroxy hexadec-9-enoate with MeOH-H_2SO_4 and then acetylated to obtain methyl *cis*-16-acetoxyhexadec-9-enoate.

Further, methyl (Z)-16-acetoxy hexadec-9-enoate was reacted with iodonium nitrate (generated *in situ*) which gave mixture of two isomeric products (i) isomeric iodonitrate ester in 54% yield and (ii) iodohydrin in 7% yield. The mixture of the two was separated and purified through repeated column chromatography. Eight compounds prepared during the synthesis of organic nitrate were got analysed for H'NMR, IR, mass spectra and elemental analysis from CDRI, Lucknow. The above two final products/compounds were characterised as (i) methyl (*threo*)-acetoxy 9(10) iodo-10(9) nitratohexadecanoate and (ii) methyl (*threo*)-16-acetoxy 9(10) iodo-10(9) hydroxyhexadecanoate.

The procedure of Sukh Dev *et al.* was adopted for the isolation of butolic acid from shellac but desired success could not be achieved.

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

R.N. Majee and N. Prasad

Aleuritic acid, one of the major component acids of shellac, was prepared in sufficient quantity by following the standard method. *Threo*-aleuritic acid, ethyl orthoformate and benzoic acid were mixed in a flask and heated gently so that the ethanol formed during the reaction started distilling slowly. The temperature was maintained till all the ethanol evolved was distilled. The internal temperature of the reaction mixture was slowly raised till CO_2 evolution started (170°C) and maintained for 4h. Excess of ethyl orthoformate was removed under reduced pressure, and the residue obtained was refluxed with alcoholic alkali for 5h. Most of the alcohol was then distilled off, the residue diluted with water and acidified with 10% H_2SO_4. It was then extracted with ether. The extract was washed several times with water and dried using anhy. Na_2SO_4. Removal of the solvent afforded 16-hydroxy-*trans*-hexadec-9-enoic acid as a solid (yield 90%, m.p. 68-70°C), an intermediate for the synthesis of isoambrettolide.

16-hydroxy-*trans*-hexadec-9-enoic acid was also prepared by phosphonium iodide method as described below:

A solution of aleuritic acid (10g) in acetic acid (50 ml) was treated with phosphonium iodide (10.8g) in acetic acid (40ml) on steambath for 4h, kept at room temperature for 1h, and then poured into sodium bisulphite solution. On isolation with ether an oily acetoxy acid was obtained, which was hydrolysed with methanolic KOH (10%, 200ml) on steam-bath for 3h. The product was cooled and acidified with dil. H_2SO_4 to yield 16-hydroxy-*trans*-

hexadec-9-enoic acid (5.6g). It was crystallised from ethyl acetate, m.p. 68-70°C.

The above unsaturated acid was dissolved in toluene (500 ml) containing *p*-toluene sulphonic acid (0.5g) and heated under reflux for 8h under azeotropic head. Toluene was then distilled off and the residue taken up in benzene, washed with water and dried over anhy. Na_2SO_4. Removal of the solvent yielded the polyester as residue, which was distilled with anhy. $MgCl_2$(0.5g). The distillate was dissolved in ether, washed with Na_2CO_3 solution, water and dried (Na_2SO_4). Removal of ether gave E(9)-isoambrettolide (4.5g) which was further purified by column chromatography. It gave single spot in TLC; solvent system, ethylacetate : acetic acid (100:1,v/v).

Aleuritic acid was dissolved in a mixture of dry acetone and conc. H_2SO_4 in a flask and allowed to stand for 1h. It was then neutralised with 30% KOH solution. Finely powdered $KMnO_4$ was added in small lots. The reaction was complete in 3-4h. The major portion of the reaction product found in the MnO_2 sludge from which it was removed with boiling water. On acidifying the solution, an oil separated which was boiled with mineral acid containing water for 15 min. On cooling 9,10-dihydroxy hexadecane-1,16-dioic acid (yield 80%, m.p. 122-24°C), an intermediate of exaltone, was obtained as solid.

3.4 Use of shellac and modified shellac in surface coatings

3.4.7 Modification of by-product obtained during the preparation of aleuritic acid and its use in surface coatings

A.K. Dasgupta

During the year under report, the by-product (gummy mass obtained during the preparation of aleuritic acid) was dissolved in rectified spirit and modified with 20% butylated melamine resin (Biomine 1651), 2% *p*-toluene sulphonic acid or 2% cobalt napthanate both on the wt. of the by-product. Films of the above composition were prepared and the surface coating properties of the films (air-dried and baked) were studied. It was observed that the baked films (3h at 150°C) were non-tacky, smooth, adherent and glossy. The scratch hard- ness of the films was 1000g. It passed the tests for flexibility (1/4" mandrel) and showed good resistance to water and toluene.

The by-product was then modified with 40% butylated melamine resin and 2% cobalt napthanate (both on the wt. of the by-product). The films prepared from this varnish after air-drying for ten days were found to be smooth, uniform, flexible and non-tacky. The touch-dry period of the films was however, one-and-a-half hour. Scratch hardness was 800. The resistance of the films towards impact, water, alcohol, acetone, alkali and acid was found unsatisfactory.

3.4.8 Lac based coating compositions for outdoor applications

P.M. Patil

Polyesters obtained from DL shellac, ethylene glycol and adipic acid/terephthalic acid, were pigmented with TiO_2 and ball milled. The resultant paint was thereafter reacted with TDI/Desmodur N/Desmodur VL/Desmodur Z to obtain urethane paints. The paints, thus obtained, were applied on mild steel panels and air-dried for seven days. The panels were exposed to atmospheric conditions for weather resistance test and it was observed that the paint based on adipic acid and Desmodur N remained unaffected upto 15 months in respect of colour retention and hardness.

Polyesters were also prepared from phthalic acid/maleic anhydride, ethylene glycol and ordinary shellac. These polyesters were pigmented with TiO_2 and reacted with toluene diisocyanate/Desmodur N/Desmodur VL/ Desmodur Z to obtain urethane paints and were applied on mild steel panels. After air-drying for seven days, the panels were placed on the roof of the laboratory at an angle of 45°, to test the weather resistance. The paint obtained from phthalic acid polyester and Desmodur N was unaffected, in general, upto nine months; only a slight corrosion was observed. Urethane paints based on maleic anhydride polyester were still under observation at the time of this report.

3.5 Use of lac for encapsulation and controlled release

3.5.6 Slow-release lac-based multilayered pesticidal system for roach-control

B.C. Srivastava and A.K. Jaiswal

Studies were undertaken to develop, a slow-release multi-layered pesticidal system for the roach control. The matrix envisaged to be used was lac/hydrolysed lac/by-product of lac industry/factory waste of the aleuritic acid industry (gummy hydrolysed mass).

Two test compositions for matrix purpose were prepared. The hydrolysed lac and aleuritic-acid-free gummy hydrolysed mass were prepared by adopting the standard procedures. Hydrolysed lac/aleuritic-acid-free gummy mass (100 parts) was reacted with linseed oil fatty acids (24 parts) at 150-160°C for 2h and a sample was drawn. Another product was obtained by reacting it with glycerol (20 parts) at 140-150°C for 3h. Laboratory cultures of *Blattella germanica*, maintained on baked food, were used for bioassay studies.

Hydrolysed lac, aleuritic-acid-free gummy mass and the two test compositions described above were used to prepare sticky traps. These traps were prepared by spreading the above materials over thick papers (17 cm x 8 cm), separately. The spread matrix was covered with release paper and placed in "Lac Sticky Trap" houses. Before the start of the bio-assay, the release paper was removed and two traps were placed in a glass trough.

Twenty roaches were released in the trough to test the trapping performance of each of the above matrices. It was observed that on gummy mass and hydrolysed lac, the roaches crawl easily and there was practically no trapping. However, on modified gummy mass formulations the roaches crawled with little difficulty and trapping was noticed only when dorsal side of insect comes in contact with the matrix. In the case of commercial 'Mr Sticky' trap the trapping was quite significant. It was felt that for better results lac-based matrix requires modification.

Studies were also undertaken to develop slow-release multilayered laminated pesticidal system for roach control. Solution of gummy mass in denatured alcohol and aqueous solution of gummy mass using liquor ammonia and triethanolamine were prepared and their relative performance were studied. It was found that aqueous ammoniacal solution performed better for multilayered system. A suitable composition of the solution of gummy mass and aqueous ammonia in the ratio of 1:1 was prepared and applied to six varieties of cotton cloth and its relative performance was worked out for designing the system. Preliminary studies were undertaken to evaluate the performance of the above matrix. Last instar nymphs, starved overnight, were used for the experiment. Solutions of active ingredient

(chlorpyriphos, Tech. 0.5% and 1%) as such and in combination with matrix having common solvent were prepared. Four sets of glass slides (1"x4") were coated with the compositions. There were three replications and the control slide was without any matrix coating. Each slide was put in a plastic jar (200 ml capacity) and ten insects were released in each jar. The jars were kept in the dark facilitating insects to come in contact with the treated surface. After one hour, the plate was removed from each jar and observations noted. It was found that slides having 0.5% and 1% active ingredient only, resulted in 100% mortality, whereas slides containing active ingredient mixed with the matrix resulted in 40% and 60% mortality respectively.

3.6 Electrical properties of lac and modified lacs

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

D.N. Goswami and S. Kumar

The study was initiated during the period under report with an objective to develop shellac-based insulating material, possessing improved properties, for utilization in the electrical industries.

Studies were made on the dielectric properties of films of different blends of solutions of shellac and polyvinyl acetate (PVAc) prepared separately in distilled denatured alcohol. Machine-made orange shellac (Biscolamf, Ranchi) and PVAc (MW:45,000; BDH, UK) were used.

Measurements of capacitance and Tan δ of different blends were made, in the solution stage. No appreciable change was noticed in the values of the above parameters of the blends, indicating that no curing takes place in the cold. The Tan δ values of shellac and PVAc films were found to be 0.003 and 0.0002 at 100 kHz at 30°C, respectively.

The compositions and the properties of different formulations investigated are shown in **Table 24**. The dielectric strength of both shellac and PVAc was found to be 40 kV/mm. The dielectric strength of 60:40 (parts) shellac-PVAc blend yielded a higher value of 58 kV/mm.

Tracking property of PVAc and its different blends with shellac was also studied following IS:10026 - 1982. PVAc showed increased resistance towards tracking only at 135 V and failed the test at 200 V. Its tracking index was found to be 174 V, which was lower then that of shellac films (256 V). Tracking index values of all shellac-PVAc blends were higher than that of PVAc and passed the tests both at 135

Table 24 Some characteristics of shellac - PVAc blends

Shellac-PVAc[a] solution ratio(w/w)	Dielectric strength kV/mm	Tracking Properties		
		Test at 135V	Test at 200V	Tracking index (volts)
10:90	44	P	F	-
30:70	44	P	P (Marginal)	186
40:60	49	F	P	-
50:50	42	P	P	240
60:40	58	P	P	-
70:30	52	P	P	260
80:20	44	P	P	-
Shellac	40	P	P	256
PVAc	40	P	F	174

Note : F, Fails; P, Passes

a. 25% (w/w) shellac and 10%(w/w) PVAc solution were prepared separately in distilled denatured alcohol and blended.

and 200 V. The results have been summarised in Table 24. Thus, shellac improved the tracking property of PVAc. It appears from the study that shellac may be used as an extender in PVAc formulation for improving the tracking property of the latter.

Studies were then made on the dielectric properties of blends of solutions prepared separately of shellac and polyvinyl acetal (PVA) resin in distilled denatured alcohol. Values of dielectric strength of different compositions have been summarised in **Table 25**. Dielectric strength of the polymer was found to be higher compared to that of shellac. Air-dried films of 10:90 (parts) and 30:70 (parts) shellac-PVA blends yielded dielectric strength values of the order of 80-81 kV/mm. The values were higher compared to that of PVA alone. All the blends possessed higher values of dielectric strength compared to that of shellac (Table 25).

Table 25 Some characteristics of shellac-PVA resin varnishes [Blends prepared using shellac (25%) & PVA (14%),(w/w) solutions]

Composition of shellac-PVA blends (w/w)	Dielectric strength(kV/mm)		Dissipation factor at 100 kHz at 30°C
	Air-dried films conditioned over fused $CaCl_2$ for 24h	Air-dried films conditioned over 100% RH for 24h	
10:90	81	10	-
30:70	80	18	-
40:60	64	15	-
50:50	65	16	-
60:40	58	-	0.0042
70:30	56	24	0.0065
80:20	52	25	-
Shellac	40	10	0.003
PVA	68-70	6-8	0.004

PVA possesses low resistance to humidity as compared to shellac. Air-dried films of PVA conditioned at 100% RH for 24h yielded dielectric strength values of 6-8 kV/mm. Films prepared from shellac-PVA blends, however when conditioned at 100% RH for 24h yielded dielectric strength values 15-25 kV/mm. Thus an improvement in the resistance to humidity of PVA could be achieved by blending with shellac.

The tracking property of PVA was studied. The films of PVA showed increased resistance towards tracking both at 135 and 200V. Tracking index of PVA appeared to be more than that of shellac films. The correct values for PVA and of the blends are to be determined.

Dissipation factor, measured at 100 kHz, of air-dried films of PVA was found to be 0.004 which was only a little higher than that of shellac (0.003). Dissipation factor of 70:30 and 60:40 (parts) of films of shellac-PVA blends were found to be 0.0065 and 0.0042 respectively. Values for other compositions are being determined.

3.8 Studies on biochemical aspects of insect host plant relationship

3.8.1 Studies on transformation of sap constituents and their incorporation in lac secretion so as to understand bio-chemical aspects of insect-host plant relationship

S.C. Agarwal, K.M. Prasad, P.C. Sarkar and R.C. Mishra

Methanolic extract of *kusum* bark was chromatographed over neutral alumina in bulk. A number of fractions were obtained. No pure fraction could be obtained from the extract.

AD HOC PROJECTS

Development of agro-chemical from lac fatty acids : synthesis of plant growth regulator analogue from aleuritic acid

I. Rajendran and S.C. Agarwal

Studies were made to synthesise a structurally simple compound namely, 12-hydroxy-9-dodecenoic acid using aleuritic acid as starting material.

Pure aleuritic acid was prepared in quantity from 4 kg of raw lac resin in two lots. It was subjected to periodate oxidation to get azelaic aldehydic acid. The purified hemialdehyde was ketalised with ethylene glycol to get acetal as liquid. Further work is in progress.

Exploring the possibility of utilising lac dye components to serve as intermediates in the preparation of anthracycline derivatives

K.M. Prasad, P.C. Sarkar and S.C. Agarwal

An attempt was made to obtain pure lac dye in bulk by a modified method. Different samples of sticklac were procured and pure calcium salt of lac dye was prepared.

Attempts were made to recover lac dye from its calcium salt by precipitating with different acids. Firstly, the calcium salt of dye was precipitated with mineral acids at low temperature with or without a common ion, but the dye redissolved when it was washed with water in order to make it free from mineral acids; whereas in the second case, sparingly soluble dye was obtained as usual.

Next, the dye was precipitated with weak monobasic, dibasic acids but in all the cases, precipitated dye was redissolved when washed with water to free the dye from acids and insoluble calcium salt remained as residue. Attempts are being made to overcome these difficulties.

Researches in Progress

4.2 Rubber-shellac combinations

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

R. Singh

The effect of incorporation of shellac and rosin separately into natural rubber with HAF black filler was studied last year. During the period under report, a comparative study was made on the incorporation of shellac and rosin separately into styrene butadiene rubber, in filled stocks using HAF (black) and china clay as fillers. For HAF- filled stocks, an increase was observed in the optimum time of cure with higher proportion of shellac, but in the case of rosin no appreciable change was observed. Modulus at 200% elongation was higher in the composition containing 10 and 20 phr shellac and 10 phr rosin. For HAF-filled stocks, higher values of ultimate elongation were observed with the incorporation of both shellac and rosin. Tensile strength was higher with 5 and 20 phr of shellac and 5 and 10 phr of rosin. Tear resistance and hardness increased with both shellac and rosin in HAF-filled stocks. Resilience decreased with the incorporation of both shellac and rosin but the decrease was more with rosin (**Table 26**). In china clay-filled stocks, mechanical properties were found slightly better with rosin than with shellac (**Table 27**).

Table 26 Effect of incorporation of shellac or rosin into SBR-filled stock (HAF black filler) (Base mix: SBR, 100; ZnO, 4; Stearic acid, 1; Flectol H,1; Sulphur, 2; acce.,2; HAF, 40)

Property	Shellac (phr)				Rosin (phr)		
	0	5	10	20	5	10	20
Optimum time of cure (min)	20	20	30	50	20	30	20
Modulus at 200% elongation (kg/cm^2)	25.64	25.64	35.32	31.29	24.29	32.82	17.2
Ultimate elongation %	230	300	350	350	440	350	250
Tensile strength (kg/cm^2)	32.05	35.89	20.2	41.50	44.76	46.13	20.24
Tear resistance (kg/cm)	11.99	15.64	17.61	18.88	20.95	24.84	11.99
Hardness Shore A Durometer	68	74	74	78	70	74	72
Resilience (%)	63.48	55.07	58.25	48.64	48.75	50.32	—

Table 27 Effect of incorporation of shellac or rosin into SBR-filled stocks (filler:china clay) (Base mix : SBR, 100; ZnO, 4; Stearic acid, 1; Flectol H,1; Sulphur, 2; Acc., 2; china clay, 100)

Property	Shellac (phr)			Rosin (phr)	
	0	5	10	5	10
Optimum time of cure (min)	20	30	40	20	20
Modulus at 200% elongation (kg/cm^2)	4.45	4.53	4.53	6.55	5.93
Elongation at break(%)	520	520	470	550	550
Tensile strength (kg/cm^2)	10.06	10.25	7.18	11.8	10.87
Tear resistance (kg/cm)	5.62	5.62	4.53	8.69	8.08
Hardness Shore A Durometer	64	64	68	64	64
Resilience(%)	58.25	58.25	51.9	55.1	56.7

The effect of incorporation of shellac and phenol-formaldehyde resin (2.5 and 5.0 phr) separately into natural rubber-gum stock was studied. It was found that with shellac, the properties like modulus, tensile strength, tear resistance, hardness and resilience were slightly better than with phenol-formaldenyde resin.

4.3 Use of lac in adhesives

4.3.7 Preparation of lac based hot-melt adhesive

P.C. Gupta

Hot-melt adhesives are used to join various surfaces quickly with high bond strength. Lac/modified lacs have not so far been examined as hot-melt adhesive. This project was, therefore, taken up.

Table 28 Bond strength of shellac, modified with rosin, over steel surfaces

Shellac : rosin	Bond strength (ton/sq. inch)
100:0	0.12
90:10	0.09
80:20	0.085
70:30	0.08
60:40	0.08
50:50	0.08
40:60	0.06
30:70	0.04
20:80	0.03
0:100	0.03

During the period under report, the bond strength of plain and modified shellacs over mild steel to mild steel surfaces were investigated after hot-melt appliction. The bond strength of plain shellac was studied initially. The time taken for setting was less than an hour and the bond strength was 0.12 ton/sq. inch. But, when it was applied in solution/ dispersion, a bond strength of 0.08 ton/sq. inch was obtained,after seven days of aging.

In order to increase the bond strength further, shellac was modified with different proportions of rosin. The results are shown in **Table 28**. However, all the compositions based on shellac+rosin were inferior to plain shellac with regard to bond strength, over steel surfaces. But, incorporation of rosin resulted in a better flow of the composition, which is useful for the purpose of application. Further, shellac was modified with polyvinyl acetate (PVAc, MW: 500,000), in molten condition. The maximum bond strength (0.17 ton/sq.inch) was obtained for the 80:20 (parts) shellac: PVAc composition, which was higher than that of plain shellac (0.12 ton/sq.inch) (**Table 29**).

Table 29 Bond strength of shellac modified with PVAc (MW:500,000)

Shellac : PVAc	Bond strength (ton/sq.inch)
100:0	0.12
90:10	0.15
80:20	0.17
70:30	0.14
60:40	0.13
50:50	0.12
40:60	Could not be applied due to high viscosity

Promising results were obtained when shellac was modified with epoxy resin (mol. wt. 500). The bond strength of various compositions are presented in **Table 30**. It can be seen that with the increase of epoxy resin content, the bond strength increases, upto 40/50 parts, and decreases thereafter. Thus, 60:40 (parts) shellac: epoxy resin was found to be the optimum composition for hot-melt application.

Table 30 Bond strength of shellac modified with epoxy resin (MW:500)

Shellac : Epoxy resin	Bond strength (ton/sq.inch)
100:0	0.12
90:10	0.27
80:20	0.32
70:30	0.33
60:40	0.35
50:50	0.35
40:60	0.10
30:70	(remained soft)

4.4 Pilot plant studies of lac-based products and processes

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

P.C. Gupta and A. Pandey

It has recently been reported that lac dye is used as food colouring material in certain foreign countries and therefore it has immense potential in the world market. Hence, the project has been taken up to standardise the process of recovery and set up a pilot plant for its manufacture.

During the period under report, the process developed earlier, (Sen Gupta & Ghosh, 1977) was repeated using the wash water of 1 kg. *rangeeni* sticklac per batch. The shelf-life of the dye so obtained was found satisfactory with regards to its solubility in cold water upto one year.

Since, this process is lengthy, attempts were made to shorten it. *Rangeeni* sticklac was washed with water (four times on wt. of sticklac) with or without sodium carbonate and filtered through muslin cloth. The filtrate was then acidified with 10 percent sulphuric acid. The solution was allowed to stand for an hour and then filtered through filter paper. The residue was warmed with water and filtered again. This process was repeated thrice and all the filtrate were mixed together and evaporated on water bath to dryness. The solubility of the dye was tested in hot and cold water. It was observed that the dye was partially soluble in cold water, but nearly 80 percent soluble in hot water. To improve upon the solubility of dye, hydrochloric/acetic acid was used instead of sulphuric acid for precipitation. However, no improvement in the solubility could be achieved.

In another attempt, wash water was filtered through Whatman filter paper and to this requisite amount of calcium carbonate was added and filtered. The calcium salt of lac dye

thus obtained was then treated with requisite quantity of sodium carbonate solution in order to get sodium salt of lac dye. This salt solution was then acidified with 10 percent sulphuric acid and left for 30 min. The dye obtained on evaporation was not completely soluble in water.

Further, to avoid the action of acid, if any, the wash water was filtered as mentioned above and then treated with cation exchange resin because it is believed that dye is present in the form of sodium/potassium salt. It was filtered and evaporated on water bath to dryness. The solubility of the dye in water was similar to that obtained with acid treatment. It was concluded from the above two experiments that wash water contains some other materials which during evaporation imparts insolubility.

Research Contemplated

Preparation of dewaxed decolourised lac of improved quality (wax content: 0.1%)

DIVISION OF EXTENSION

Researches Completed

5.6 Pilot studies on pre-harvest forecasting of yield of sticklac

S. K. Saha, A. K. Jaiswal and B. H. Singh (IASRI)

The objective of the project was to develop a forecast model to predict sticklac yield from the *rangeeni* strain of lac insect with the help of biometrical characters.

The experiment was carried out, on *rangeeni* lac crops (*baisakhi and katki*) grown on *palas* (*B. monosperma*) at Kundri lac orchard in the Palamau district of Bihar.

A stratified random sampling technique was adopted for the study. The first stage constituted three clusters of hosts having 33, 33 and 34 units in each cluster. The host quadrates, north, south, east and west constituted the second stage. The specified area on each stick,to be quantified for the density of lac insect, constituted the third stage. The biometrical characters included in the study were: weight of broodlac (x_1), diameter of canopy of the tree (x_2), height of the host crown (x_3), number of stumps in each tree (x_4), number of shoots encrusted with lac (x_5), length of settlement on shoots (x_6), density of lac insects settled (x_7), density of lac insect surviving after 10-30 days (x_8), percentage of male insect (x_9), density of female lac insect at the different interval of time (x_{10}) and the volume occupied by 100 female lac insects (x_{11}). The data were recorded at four stages of crop growth, namely, 10-30, 90-120, 121-150 and 151-180 days after inoculation in case of *baisakhi* crop and 10-30, 40-60, 61-90 and 91-120 days after inoculation, in the case of *katki* crop.

The regression analysis was carried out using the following linear models:

Model I : $Y = a_0 + a_1x_1 + ... + a_nx_n + e$

Model II : $Y = b_0 + b_1\log x_1 + b_2\log x_2 + ... + b_n \log x_n + e$

Model III : $Y = c_0 + c_1\sqrt{x}_1 + c_2\sqrt{x}_2 + ... + c_n\sqrt{x}_n + e$

Model IV : $Y = d_0 + d_1/x_1 + d_2/x_2 + ... + d_n/x_n + e$

Where Y denotes the yield of sticklac; x_1, x_2 etc., the biometrical characters; a_o,b_o etc. and d_1,d_2 etc., the constants and e, the error.

Baisakhi *crop*

The results of analysis of the pooled data (1987-88 to 1989-90) showed that correlation

Table 31 Mean estimates and correlation coefficients (r) of sticklac yield of *baisakhi* and *katki* crops in various parameters at different stages of crop.

No. of days after inoculation	Character	*Baisakhi* crop		*Katki* crop	
		Mean (S.E.)	'r'	Mean (S.E.)	'r'
10-30	Weight of broodlac (kg)	1.27(0.04)	0.55**	0.74(0.03)	0.43**
"	Diameter of canopy of host tree(m)	4.31(0.07)	0.29**	4.68(0.09)	0.05
"	Height of crown of host tree (m)	5.81(0.93)	0.51**	5.96(0.09)	0.30**
"	No. of stumps of each tree	7.70(0.27)	0.25**	9.00(0.29)	0.18**
"	No. of shoots with lac encrustation	66.20(2.09)	0.54**	36.41(1.60)	0.60**
"	Length of settlement of shoot (cm)	43.79(0.59)	0.42**	36.47(0.69)	0.63**
"	Density of lac insect settled (per sq cm)	47.38(2.15)	0.03	18.33(0.51)	0.26**
"	Density of living lac insects(per cm sq)	29.42(1.36)	0.02	7.11(0.24)	0.15*
40 - 60	Percentage of male insect	—	—	22.96(0.59)	-0.14*
"	Density of living female insect (per sq cm)	—	—	4.84(0.15)	0.04
61 - 90	Volume occupied by 100 lac insects (cm^3)	—	—	1.71(0.03)	0.47**
90 - 120	Percentage of male insect	28.04(0.83)	0.13	—	—
"	Desnity of living female insects (per cm sq)	7.63(0.30)	0.17	—	—
91 - 120	Volume occupied by 100 lac insects (cm^3)	—	—	2.58(0.05)	0.46**
121 - 150	- do-	0.92(0.02	0.34**	—	—
"	Density of living female lac insects (per sq cm)	4.59(0.20)	0.01	—	—
151 - 180	- do-	3.42(0.13)	0.08	—	—
"	Volume occupied by 100 lac insects(cm^3)	1.42(0.02)	0.08	—	—

*,** Significant at 5% and 1% levels

coefficient of yield with weight of the broodlac used for the inoculation of trees was highest followed by number of shoots with lac, height of crown, length of settlement on shoot, volume occupied by 100 insects and diameter of canopy of host plant (**Table 31**).

The partial regression coefficient of yield on weight of broodlac used, height of crown of host tree, length of settlement on shoot and number of shoots with lac were significant at all stages. Besides, density of lac insect at 10—30-day stage, density of female lac insect at 91-120 and 121-150-day stage and volume occupied by 100 female lac insect at 121-150-day stage were also significant (**Table 32**).

The multiple correlation coefficients were significant for all the periods and with all the four types of models (**Table 33**). The value of R^2 was either equal or relatively higher with linear model in original scale. In all the three seasons, the variation in yield due to biometrical characters was 49-53% at various stages of crop growth. Since there was no significant improvement in R^2 value at the later stages of development, the forecast of sticklac may be possible at 10-30-day stage of crop growth using the significant characters.

Table 32 Partial regression coefficients of yield of *baisakhi* sticklac on several characters recorded at different stages of crop growth

Stage (No. of days after inoculation)	Constant	Partial regression coefficient between yield and: Weight of brood lac used per tree (X_1)	Diameter of crown of host tree (X_2)	Height of crown of host tree (X_3)	No. of stumps per tree (X_4)	No. of shoots with lac per tree (X_5)	Length of settlement on shoot (X_6)	Density of lac insect settlement (X_7)	Density of living lac insect (X_8)	Percentage of male insect (X_9)	Density of living female insects (X_{10})	Volume occupied by 100 female insects (cm^3) (X_{11})	R^2
10-30	-0.906	0.199** (0.041)	-0.002 (0.021)	0.064** (0.014)	-0.006 (0.005)	0.004** (0.001)	0.012** (0.002)	-0.0001 (0.001)	0.005** (0.001)	-	-	-	0.53**
90-120	-0.763	0.158** (0.040)	0.014 (0.021)	0.063** (0.014)	-0.010 (0.006)	0.004** (0.001)	0.009** (0.002)	-	-	-	0.018** (0.004)	- -	0.51**
121-150	-1.036	0.142** (0.041)	0.009 (0.021)	0.070** (0.014)	-0.006 (0.006)	0.003** (0.001)	0.010** (0.002)	-	-	-	0.034** (0.006)	0.235** (0.065)	0.53**
151-180	-0.792	0.149** (0.041)	0.017 (0.022)	0.084 (0.014)	-0.010 (0.006)	0.003** (0.001)	0.010** (0.002)	-	-	-	0.022** (0.010)	-0.044 (0.049)	0.49**

Figures in parentheses indicate standard errors.

** Significant at 1% level.

Table 33 Percentage variation in sticklac yields of *baisakhi* and *katki* crops due to various parameters of different crop stages under different models

Crop	Stage (No. of days after inoculation)	Model			
		Linear	Log linear	Square root	Inverse
Broodlac weight included as variable					
Baisakhi	10-30	53**	50**	53**	34**
	(*Phunki* removal)				
	90-120	51**	48**	51**	34**
	(Sexual maturity)				
	121-150	53*	45**	51**	32**
	151-180	49**	43**	47**	32**
	(Crop harvesting)				
Katki	10-30	61**	50**	57**	34**
	(*Phunki* removal)				
	40-60	60**	49**	56**	32**
	(Sexual maturity)				
	61-90	62**	54**	59**	39**
	91-120	61**	52**	58**	37**
	(Crop maturity)				
Broodlac weight not included as variable					
Baisakhi	10-30	49**	44**	48**	31**
	90-120	49**	45**	48**	32**
	121 - 150	51**	44**	49**	31**
	151 - 180	47**	41**	45**	31**
Katki	10-30	57**	45**	52**	30**
	(*Phunki* removal)				
	40-60	55**	43**	50**	28**
	(Sexual maturity)				
	61-90	59**	52**	57**	38**
	91-120	59**	51**	56**	35**
	(Crop maturity)				

** Significant at 1% level

Significant characters

The weight of broodlac used was the most important character, accounting for more than 30% of the explained variation. This was followed by the number of shoots with lac encrustation, height of crown of host tree and length of settlement per shoot, in the descending order. Inclusion of density of lac insect at 10-30 days of crop growth which is also a significant parameter resulted in 53% variation in yield.

The forecast model developed for per tree yield with the help of weight of broodlac used per tree (x_1), number of shoots with lac per tree (x_5), length of settlement per shoot (x_6) and density of lac insect settled (x_7) which together accounted for 51% variation in yield, is as follows :

$$Y_b = -0.773 + 0.238^{**} x_1 + 0.004^{**} x_5 + 0.014^{**} x_6 + 0.006^{**} x_7$$
$$(0.04) \quad (0.001) \quad (0.002) \quad (0.001)$$

Figures in parentheses indicate the standard errors

Katki *crop*

The result of analysis of pooled data (1988 to 1990) showed that correlation coefficient of yield with length of settlement was highest followed by number of shoots with lac encrustation, volume occupied by 100 female lac insects, weight of broodlac used for inoculation, height of crown of host tree, density of lac insect settled after 10-30 days, number of stumps in each tree, density of living lac insects after 10-30 days and percentage of male insects (Table 31).

The partial regression coefficient of yield on weight of broodlac used, only the number of shoots with lac, length of settlement on shoots were significant parameters, at all the stages. Besides, number of insects settled at 10-30-day stage and volume (cm^3) occupied by 100 female insects were significant at 61-90-day stage of crop growth only (Table 34).

Table 34 Contribution to total variation in yield of *katki* sticklac by significant character and regression equation of various stages of crop growth

Stage (No. of days after inoculation)	Constant	Partial regression coefficient between yield and					R^2
		Weight of broodlac used per tree	No. of shoots with lac	Length of settlement on shoot	No. of insects settled	Volume occupied by 100 female insects(cm^3)	
10-30	-0.395	0.1536**	0.0052**	0.0141**	0.0051*	-	0.59**
		(0.035)	(0.001)	(0.001)	(0.002)		
	-0.4856	-	-	0.0217**	-	-	0.40**
				(0.002)			
	-0.4771	-	0.0060**	0.0155**	-	-	0.54**
			(0.001)	(0.002)			
40-60	-0.5406	0.1713**	0.0052**	0.0146**	-	-	0.57**
		(0.035)	(0.001)	(0.001)			
	-0.5406	0.1713**	0.0052**	0.0146**	-	-	0.57**
		(0.035)	(0.001)	(0.001)			
61-90	-0.6561	0.1352**	0.0052**	0.0119**	-	0.1403**	0.60**
		(0.035)	(0.001)	(0.002)		(0.032)	
91-120	-0.5406	0.1713**	0.0052**	0.0146**	-	-	0.57**
		(0.035)	(0.001)	(0.001)			

Figures in parentheses indicate standard errors
*,** Significant at 5% and 1% levels.

Multiple correlation coefficients were significant for all the periods and with all the four types of models (Table 33). The value of this coefficient was relatively higher with linear model in original scale. The variation in yield by the biometrical characters varied between 40 and 60% at various stages of crop growth (**Table 34**). Since 59% variation in yield could be explained at the 10—30-day stage of crop, the forecast of sticklac yield is possible at this stage by using significant characters for this crop also.

The forecast model developed for per tree yield with four characters, namely, weight of broodlac (x_1), number of shoots with lac (x_5), length of settlement on shoots (x_6) and density of lac insect (x_7) is as follows :

$$Y_k = -0.395 + 0.1536^{**} x_1 + 0.0052^{**} x_5 + 0.0141^{**} x_6 + 0.0051^{**} x_7$$
$$(0.035) \quad (0.001) \quad (0.001) \quad (0.002)$$

Figures in parentheses indicate the standard errors

Researches 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 were continued under Phase III, in the

operational area of the project covering two backward tribal villages namely, Chitir and Dundu of Namkum Development Block of Ranchi district. Demonstrations of other agricultural, horticultural crops etc. were also arranged in the area, through other organisations/agencies.

Lac culture

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

Baisakhi 1989-90 *ari* (immature) sticklac crop was harvested during May-June, 1990 from 23 *ber* trees of sticklac coupe. An average yield of 5.6 kg sticklac per tree was obtained as against 1.6kg obtained from the trees operated traditionally.

Thirty-two *ber* trees of the same coupe were incoluated for the *baisakhi* 1990-91 crop and harvested during May-June, 1991 as *ari*. This time an average yield of 2.6kg sticklac per tree was obtained as against 0.4kg obtained from the trees operated traditionally.

Broodlac from the *Baisakhi-cum-katki* 1989-90 crop was harvested during October 1990 from 112 *palas* trees of the first broodlac coupe. An average yield of 2.4 kg broodlac per tree was obtained as against 0.3 kg obtained from the trees operated traditionally.

Broodlac from the *baisakhi-cum-katki* 1990-91 crop was harvested during October 1991 from 52 *palas* trees of the second broodlac coupe . An average broodlac yield of 2.3 kg per tree was obtained by the participating farmers as against 0.3 kg recorded from the trees operated traditionally.

In order to improve the lac production in the area, the farmers were encouraged to plant seedlings of selected unconventional as well as conventional lac host plants in their backyards. Seedlings were distributed as per the details given below:

Year	*Galwang*	*Bhalia*	*Akashmani*	*Ber*	Total
1990-91	220	700	660	370	1950
1991-92	165	950	1330	170	2615

Apiculture

The farmers trained in bee-keeping were encouraged to maintain bee colonies by providing technical guidance regularly. Although sufficiently good number of bee colonies were caught by them from the nature,very high mortality and desertation rates were recorded, most probably due to the after effects of the spread of American foul disease of bees in the adjoining areas. Thus, by the end of the period under report, seven bee colonies were recorded yielding only 1 kg honey per annum .

Agriculture

During 1990, three demonstrations of potato (*Kufri Chandramukhi*) covering 0.18 ha area were conducted with the co-operation from State Agriculture Department and an average yield of 75q/ha (range 71-100 q) was recorded.

During *kharif* 1992, four crop demonstrations on paddy variety IR-36 (seeds introduced earlier under paddy exchange programme) were harvested and an average yield of 6.1 q/ha was obtained.

Horticulture

Improved varieties of vegetables namely, cowpea (*Arka Komal*), Okra (*Pusa Sawni*), radish (Japanese white) and tomato (Pusa Ruby) were popularised in the area with the co-operation from National Seed Corporation. 134 papaya seedlings (Ranchi papaya) were

also distributed for planting in the farmers backyards.

Irrigation infrastructure

Arrangements were made for construction of three dug wells in the area under Jaldhara scheme. Out of these, only two were completed by the end of the period under report.

Extension education programme

Farmers' forum meetings were organised regularly and discussions were held on the demonstrations given on new technologies, to obtain the feedback.

During 1990-91, a study tour of 29 rural housewives and one farmer was organised to Kalamati village of Khunti subdivision.They were shown various lac-based enterprises namely, lac bangle making, sealing wax manufacture and mixed plantation of *bhalia* and *galwang* and interacted with the beneficiaries.

Nine progressive farmers of the area participated in the "Udyan Mela" held at Palandu Farm of Central Horticultural Experiment Station of IIHR on 3.2.92.

Ad hoc project: Analysis of growth, variation and instability in production, export and price of lac in India

S. K. Saha and A. K. Jaiswal

The project was taken up in 1991.The growth rates, trend and instability in lac production, in various lac growing states of India and the country as a whole, during the past thirty years (1960-61—1989-90) were studied with the help of the following functions:

Linear function : $Yt = a + bt$

Exponential function : $Yt = Ae^{bt}$

Power function : $Yt = \alpha t^{b}$

where Yt denotes the production of sticklac; t, the time and a,A, α and b, the constants estimated by least squares method.

The results revealed that the country had registered a negative growth rate of 3.55% and instability to the extent of 42% during last 30 years. The simple and compound growth rates for diffrent states showed significant differences in the rate of decline in sticklac production in diffrent states. Bihar, Madhaya Pradesh and West Bengal showed significant and negative growth rate to the extent of 2.61, 4.47 and 4.93 percent respectively. Negative growth rates to the tune of 3.97, 9.44 and 4.87 percent were also recorded for Uttar Pradesh, Maharastra and other minor lac producing states, respectively. Only Bihar showed instability lower than the country. Maharashtra witnessed 107 percent instability followed by minor lac producing states,i.e., M.P., W.B. and U.P.. The lac crop from *kusmi* strain showed higher instability than the *rangeeni* crop in all the States, except M.P. where a reverse situation was observed.

The correlation and regression studies for sticklac production showed positive and significant correlation between sticklac yield from *katki* and the following *baisakhi* crop as well as between *jethwi* and the following *aghani* crop for various lac growing states and the country as a whole. In case of *rangeeni* crops the 'r' (correlation coefficient) values were 0.73, 0.81, 0.55 and 0.83 for Bihar, M.P., W.B. and the country as a whole, respectively; whereas in case of *kusmi* crops, the values were 0.65, 0.37, 0.68 for Bihar, M.P. and the country as a whole, respectively.

The prediction model developed passed the γ_m criteria indicating practical utility of the regression model.

SUMMARY

DIVISION OF ENTOMOLOGY

Researches Completed

1.2.9 Studies were made to find out any relationship between the physical characteristics of lac host plants (girth, length, texture etc. of the shoot) and some lac insect attributes. Experiments were conducted during all the crop seasons using *rangeeni* as well as *kusmi* strains of *K. lacca* cultured on various lac host species. No relationship was found between the physical characteristics of the plants and the lac insect attributes studied.

1.5.11 Cytological studies were made on lac insect stocks, Orissa yellow and Ludhiana. The chromosome number, and its behaviour in the somatic and germinal tissues were similar to those reported for the local stock of *K. lacca.*

Researches in Progress

1.1.9 Field trials of lac cultivation on *kusum* showed that for broodlac production, a four-coupe system with a brood rate of 20g per metre shoot length and two insecticidal sprays, once after *phunki* removal and another in Nov. or June for the *aghani* and the *jethwi* crops respectively, was the best. For sticklac production, a two-coupe system, involving inoculation on one-year-old shoots in June/July at 10g broodlac per metre shoot length, partial harvesting in the following Jan./Feb. and complete harvesting in subsequent June/July, was the best; insecticidal sprays were also given in each crop season.

Field trials conducted at Kundri lac orchard on *palas* showed that a two-coupe system of lac cultivation with two sprays of 0.05% endosulfan was the best for sticklac and broodlac yields.

Correlation studies were also carried out on *palas* and *kusum* for estimating the available area for lac insect settlement using other parameters. Experiment was also carried out on the effect of brood rate on lac yields.

1.1.10 Preliminary field trials on *akashmani* (*A. auriculaeformis*) showed that this host holds potential for raising both the crops of *kusmi* and the *katki* crop of *rangeeni* strains. It responded well to the various pruning techniques tried. Suitable periods of pruning and the period of rest after pruning were determined. Alternation of broodlac from the conventional hosts, *kusum, palas* and *ber* with *akashmani* and *vice versa* was also successful.

1.2.5 Studies were made on the effect of soil application of N,P and K, individually and in all possible combinations, on the economic attributes of *rangeeni* and *kusmi* lac insects cultured on *bhalia* and *galwang*.

1.3.12 No correlation was found between the three crowding levels of lac insects, on their initial mortality and male proportion. Number of pruned points appeared to be a useful measure for estimating the total available area of settlement on *kusum.*

1.4.18 Use of selective insecticides, viz., diflubenzuron, endosulfan, thiocyclam and trichlorfon alone and in combina-

tion resulted in significant control of lac predators, under field conditions. A neem-based formulation was found safe to one-month-old lac insects.

1.4.19 Integration of dipping broodlac in endosulfan (0.05%) before inoculation and spraying of BHC (0.05%) in Mar./Apr. and in Aug. with the existing integrated control schedule resulted in increased yields due to a high degree of suppression of predators and harmful parasites as well.

1.5.8 The Orissa yellow stock showed a shorter life period during the *aghani* than during the *jethwi*, although normally the converse is true. The physico-chemical properties of the lac produced by ten stocks of lac insects, were also compared. The local yellow stock was superior, among the *rangeeni* stocks. The Assam stock produced resin with lowest wax content.

1.5.13 Two sets of reciprocal crosses, between a *rangeeni* stock and two *kusmi* stocks, were made to obtain superior recombi-nant for resin colour. Biological characteristics of the F_1, F_2, F_3 and F_4 generations were studied. A new colour variant secreting very light coloured resin has been derived from a *rangeeni* stock.

A selection programme for genetic improvement of the thermal resistance of the lac produced by the lac insect was initiated, using a *rangeeni* stock.

A study of the variation in the quantity of the lac secreted by individual female lac insects during the *katki* 1991 revealed significant differences among the shoots; the interplant differences were not significant.

SECTION OF PLANT SCIENCES

Researches Completed

2.2.8 Experiments on air layering of *palas, B. monosperma*, a major lac host, showed maximum root initiation (93.3%) with the application of NAA + IBA or NAA + IPA at 50 ppm concentration, on shoots of 21-30 mm girth, during May, using lanolin paste and *Sphagnum* moss as medium. However, the percentage of rooted air layers varied between 73.3 and 80% even without application of any hormones. It was found that air layers of *palas* can be prepared at low cost, using only FYM + pond soil and dried grass, which may be undertaken on a large scale.

Researches in Progress

2.1.9 Air layering of *kusum (S. oleosa)*, a major lac host, showed cent per cent root initiation, when the air-layers were prepared during June with the treatment of NAA (100 ppm) or IAA (50 ppm) alongwith lanolin paste and green moss. The survival of air-layers under field conditions varied from 3.3 to 20 percent.

2.1.11 Among the lac hosts tried, under multistoreyed system, maximum plant height and girth were observed in *akashmani* (*A. auriculaeformis*), followd by *galwang* (*A. lucida*). During the second year, after transplanting the lac hosts, *Gora* paddy could be grown as intercrop, without any adverse effect on the lac hosts.

2.2.6 Study of the plant attributes of *bhalia (M. macrophylla)* revealed 51.5 and

54.47% heritability for the number of total and inoculable shoots per bush, respectively.

2.2.7 *F. stricta* was found to be a suitable host for raising the *rangeeni* strain of lac insect; *F. stricta* was suitable for both *rangeeni* and *kusmi* strains. Heavy mortality of plants and the lac insects grown on them were observed in different varieties of *C. cajan*.

DIVISION OF CHEMISTRY

Researches Completed

3.1.9 Seedlac was polymerised at 150°C for different periods of time. The intrinsic viscosity and mol. wt. of seedlac and its polymers were determined. The plot of $Log_{10}[\eta]$ against Log_{10} M was found to be linear. The mol. wt. of the polymer at the gel point was 3390 whereas the mol. wt. of seedlac was 1000. The chemical constants of seedlac and its polymers were also determined which confirmed the formation of acetals in the pre-gelation stage.

3.3.11 Two compositions were prepared based on ethyl cellulose, shellac and dibutyl phthalate and also on dewaxed lac, ethyl cellulose, butylated melamine formaldehyde and ethylene glycol for utilisation in surface coatings. The film properties of these compositions were studied.

3.3.12 The commercial grade lac wax was modified with varying proportions of calcium salts and the lac wax obtained from lac mud was modified with sodium bisulphite, ammonia and urea at different temperatures. The best result was obtained by treating the lac wax with 7.5% sodium bisulphite at 200°C for 5h under an atmosphere of carbon dioxide.

3.6.4 An improved baking-type insulating varnish has been developed from the reaction product of shellac, epoxy resin and double-boiled-linseed oil. The varnish possesses good drying characteristics (30 min at 175°C). It also possesses adequate dielectric strength when tested at room temperature, at 200°C and after immersion in water for 24h as required by IS:10026 - 1982. The films of the varnish passed the short duration test for thermal resistance upto 200°C. Evaluation trials revealed that the varnish can be used for coating of coil/armatures of electric motors, trans- formers etc. and also for the manufacture of flexible type of micanites etc. Study also suggests the possibility for use of the varnish as an antitracking insulating varnish.

Researches in Progress

3.2.10 Insect sex pheromone components 9(*Z*)-hexadecen-1-ol, its acetate; methyl 9(*Z*)-tetra decenoate; 9(*Z*)-tetradecen-1-ol and its acetate were synthesised in quantity from azelaic acid aldehyde, one of the periodate oxidation products of aleuritic acid applying Wittig synthesis.

3.2.12 C-15 lactone diacid, an intermediate compound in the synthesis of substituted coumarin derivative, was synthesised from jalaric acid in approx. 40% yield. The final product i.e substituted coumarin derivative, m.p. 114-115°C was also synthesised in approx 15% yield by dehydrating the C-15 lactone diacid.

3.2.13 Lactone ester was synthesised, in quantity, from aleuritic acid for the synthesis of prostanoid synthon.

3.2.14 Aleuritic acid was treated with ethylorthoformate to get *trans*-enoic acid. The enoic acid was treated with H_2O_2/ HCO_2H and hydrolysed to get *erythro* acid which was again treated with ethylorthoformate to get *cis*-enoic acid. This was further purified, esterified and subsequently acetylated. This olefinic acetoxy ester on reaction with iodonium nitrate gave methyl (*threo*)-16-acetoxy-9 (10)-iodo-10 (9)-nitrato-hexadecanoate and iodohydrin, methyl (*threo*)-16-acetoxy-9 (10)-iodo-10 (9) hydroxyhexa-decanoate.

3.2.15 (*E*)9-Isoambrettolide (4.5 g) was prepared from aleuritic acid (10 g) and purified by column chromatography. It gave single spot in the TLC (solvent system — ethyl acetate : acetic acid 100:1, v/v). 9,10-dihydroxy hexadecane-1, 16-dioic acid was also prepared for the synthesis of exaltone.

3.4.7 The bi-product obtained during the preparation of aleuritic acid was modified with BIOMINE 1651 (butylated melamine resin) and *para*-toluene sulfonic acid. A study on the film properties of air-dried as well as baked films revealed that the baked films (3h at 150°C) were suitable for use in the field of surface coating. The above product was also modified with 40% BIOMINE 1651 and 2% cobalt napthanate and the air-dried films prepared with this varnish were found smooth, non-tacky and uniform.

3.4.8 A paint composition, based on shellac, adipic acid polyester and Desmodur N remained unaffected upto 15 months in respect of colour retention and hardness. The polyurethane paint based on phthalic acid-shellac polyester and desmodur N showed slight corrosion upto 9 months of observation.

3.5.6 Studies were made to develop "Lac Sticky Traps", similar to commercial traps, for the control of roaches without use of any pesticide. Bio-trials revealed that lac based matrix need modification for use in such traps. Studies were also undertaken to develop slow release multilayered pesticidal system for roach control. It was observed that gummy waste mass, obtained during the preparation of aleuritic acid, may serve as a suitable matrix.

3.6.5 Dielectric properties of different blends of solutions of shellac and poly vinyl acetate (PVAc) and of shellac and poly vinyl acetal (PVA) resins in denatured alcohol were studied separately. Dielectric strength of 60:40 shellac-PVAc composition was found to be 58 kV/mm, which was higher than that of either of the resins. PVAc possessed low tracking index value (174 V) compared to that of shellac. Addition of shellac in PVAc solution improved tracking resistance.

Air-dried films of the blends of shellac-PVA resin (in solution stage) possessed improved dielectric strength compared to that of shellac. Films of PVA possessed low resistance to humidity. Films prepared from shellac-PVA blends showed improvement in the resistance to humidity compared to that of PVA.

3.8.1 Methanolic extract of *kusum* bark was chromatographed over alumina in bulk. No significant separation could be achieved to obtain pure fractions.

SECTION OF TECHNOLOGY

Researches in Progress

4.2.3 Better results were obtained with the shellac incorporated HAF (black)-filled SBR stock compared with that of rosin-incorporated SBR stock; whereas, converse results were obtained with chinaclay filled SBR stock. Mechanical properties were slightly better with shellac than with phenol formaldehyde resin, when incorporated into natural rubber gum stock.

4.3.7 When shellac was modified with PVAc and epoxy resin separately, the bond strength was markedly higher than that of plain shellac, on application as hot melt adhesive.

4.4.3 The old method for the preparation of lac-dye (Sengupta and Ghosh 1977) was found reproducible. Attempts made to reduce the number of steps were not successful.

EXTENSION DIVISION

Researches Completed

5.6 A pilot study was carried out for developing suitable models for pre-harvest forecast of yield of sticklac, in the Palamau district of Bihar. A multi-stage stratified random sampling technique was used for selection of host trees (*palas, B.monosperma*). Multiple regression technique was used for fitting the regression models. It was observed that four yield attributes of sticklac, namely, weight of broodlac used, number of shoots with lac, length of settlement per shoot and density of lac insect settlement may be used to forecast the sticklac yield about one month after the inoculation for both *baisakhi* and *katki* crops. The models so developed explained 51 and 59 per cent variation in yields for *baisakhi* and *katki* crops respectively.

Researches in Progress

5.5 Trial-cum-demonstrations, of the improved technologies developed at the institute, were given on the farmers' trees, using *palas* for broodlac and *ber* for sticklac production in the ORP area. Marked increase in the broodlac (about 8 times) and sticklac (about 4 to 7 times) yields were obtained over the villagers' method. Over 4,500 lac host plants were also distributed in the area.

Seeds of improved varieties of vegetables were popularised in the area. Demonstrations of improved varieties of potato and paddy were also arranged.

Ad hoc study

Studies were made on the growth rate and instability in lac production in various lac growing States of India and the country as a whole, during the past thirty years. Analysis of regression of sticklac production over the time showed significant variations in growth rate and instability between the States and the crops. Simple prediction models have been worked out for the *rangeeni* and *kusmi* lac crop yields based on those of the preceeding crops.

EXTENSION ACTIVITIES

Training

A capacious lecture room in the newly constructed Extension Division building was furnished with suitably designed modular furniture.

Regular training courses were organised as per the details given below.

Course (duration)	Session	Number of successful candidates
Improved methods of lac cultivation (six months)	October 1990 to March 1991	2
-do-	April to September 1991	2
Industrial uses of lac (three months)	October to December 1990	1
-do-	October to December 1991	1

A new regular course of one-week duration, on 'Lac cultivation, processing and utilisation' was started for the farmers, rural housewives and the functionaries working in rural areas. Apart from imparting improved skills in lac production, and establishment of lac host plantations, the trainees were also exposed to other lac-based income generation enterprises such as, use of lac for coating earthenware, wood finishing and bangle making etc. through lectures, demonstrations, participatory excercises, study tours and audiovisual aids. Three such courses were conducted for 21 candidates (17 housewives and 4 village functionaries) sponsored by the Centre of Women's Development Studies of Deogarh district, Bihar. Successful candidates were awarded certificates. Print support, seeds of lac host plants and samples of water-soluble lac, shellac etc. were also supplied to them.

Another short-term training course of one/two-day duration was introduced from March, 1991, for the batches of professional trainees/students of other organisations visiting the institute on modern lac production, processing and utilisation technologies. This course included a set of lectures, visits to the institute Museum, Plantation and film shows. Training courses for 19 batches were organised as per the details given below:

Sponsoring organisation	No. of batches	Description	No. of trainees
Birsa Agricultural University, Ranchi, Bihar	1	B.Sc. Forestry students	13
Divyayan Krishi Vigyan Kendra, R. K. Mission, Ranchi.	8	Progressive farmers	195
Xavier Institute of Social Sciences, Ranchi, Bihar	1	Students, P. G. Diploma in Rural Development	63
Institute for Rural Industrialisation Ranchi, Bihar	3	Social change agents	67
Eastern Forest Ranger's College, Khurseong West Bengal	1	Range officers	19

Contd. . .

Sponsoring organisation	No. of batches	Description	No. of trainees
Foresters' Training College, Jaipore, Orissa	1	Foresters	26
Forest Rangers' College, Angul, Orissa	1	Range officers	33
Indira Gandhi National Forest College, Dehradoon U.P.	2	IFS Probationers	48
Institute of Forestry, Pokhra, Nepal	1	B.Sc. Forestery students	40
Total	19		504

Demonstration-cum-shcrt term training for entrepreneurs was organised as per the details given below :

Subject (period)	Name of the entrepreneurs and the sponsoring organisation
Preparation of Aleuritic acid and Analysis & Testing of lac (31.5—14.6.1990)	Sri Arun Kumar Sharma M/s Tajna Shellac Factory, Khunti, Ranchi.
Preparation of Aleuritic acid (7—21.6.1990)	Mrs Alka Jaiswal M/s Samar Singh Jaiswal Ltd., 27B, Camac Street, Calcutta.
Preparation of aleuritic acid, lac dye, lac wax, & insulating varnish (22.10.1989-5.5.1990)	Sri R.P. Bhagat M/s Raj Lac Industries, Bundu, Ranchi
Preparation of aleuritic acid (11-25.3.1990)	Sri Prabhas Chandra Jaiswal, M/s Bardhan Brothers Pvt. Ltd., Murrhu, Ranchi.
Preparation of aleuritic acid (29.7-13.8.1991)	Sri Dinesh Pd. Agarwal M/s Lexportex India (P) Ltd., Purulia, W.B.

A training camp was organised at Gopalpur in West Bengal for 72 farmers sponsored by Jamgoria Sevabrata Club. Lectures were delivered in Bengali as well as in Hindi and films on lac were shown. An exhibition on lac and an interaction session were also organised. Seeds of lac host plants and printed material were distributed amongst the trainees. *Kusmi* broodlac was also supplied to them, subsequently, for lac culture trials on the pigeon pea plants raised by the some club participants with the assistance of Wasteland Development Board.

Technical Advisory Service

A large number of postal enquiries received from all over the country and abroad on the problems of reviving lac cultivation; lac host plants; availability of broodlac, publications, raw materials and machines etc. were attended to. In addition, the problems of farmers, entrepreneurs, extension workers and other functionaries of government departments as well as voluntary organisations visiting the institute were also solved.

Inspection and evaluation of a closed shellac factory of the Forest Department, Madhya Pradesh at Umaria (Shahdel) was arranged and the evaluation report alongwith the necessary recommendations was submitted.

A roving survey of the Deoghar and Dumka districts was conducted during October 1991 with the cooperation from the Centre for Women's Development Studies, Bihar. Ex-trainees of the one-week course were also contacted in their villages and on-the-spot technical guidance was provided to them. Lectures were delivered to nearly 120 farmers at Pathalgarha and Dholpathar villages on improved methods of lac cultivation. Work plans for these two villages were prepared and

explained to the participants and C.W.D.S. workers, Survey revealed a large untapped lac host plant resource (mostly *palas* and some *ber*) in these districts. It was felt that intensive drive to revive lac cultivation in these districts is necessary. Lac grown on *akashmani* by the farmers trained at our Institute, was observed at Pathalgarha. The coverage was poor and crop mortality was very high. Necessary guidance was given to the cultivators.

In response to a request from the Development Alternatives, a voluntary organisation, Dr P. Kumar, Head, Section of Plant Sciences and Shri R. C. Mishra, Head, Division of Extension conducted a survey of the *palas* plantations at Barwasagar and Orchha in the Jhansi district of U.P. and at Datia in the Shivpur district of M.P. during December 1991, to assess the suitability of the *palas* trees for lac cultivation. At Datia, the area which had been reserved and protected by the above agency was showing excellent growth of *palas* coppices.Since the rocky ground below the *palas* coppices was likely to become hot enough to kill the lac insects on these low profile tree stand, it was not advisable to begin lac cultivation before the tree canopy reaches a reasonable height. At Barwasagar and Orchha good sites and trees were available where lac cultivation can be started. Work plan for these areas was prepared and supplied to the agency.

A total of 28 crop samples received from lac growers/ organisations were examined, free of cost, and reports on likely period of larval emergence and causes of mortality issued.

Large-scale Cultivation of Lac at Kundri

Regular technical assistance to the Forest Department, Bihar in running their Kundri Lac Farm having 48,945 *palas* and some other lac host plants was continued. The operational details have been summarised in **Table 35**.

Out of the surplus broodlac obtained from the above operations, 757 kg was sold and 825kg distributed free of cost to 86 lac cultivators belonging to S.C., S.T. and backward classes.

Kisan Mela and Exhibitions

The Institute also participated in several Kisan melas and exhibitions and the details have been furnished in **Table 36**.

Exhibits were supplied to Agricultural College U.A.S., Bangalore; Govt Agricultural College and Research Institute, Tiruchi, Tamilnadu and G.B. Pant University of Agriculture and Technology, Pantnagar, U.P. and few other organisations for display in their museums.

Testing

Facilities for testing various forms of lac and lac products were extended to the

Table 35 Operational details of large scale lac cultivation at Kundri lac farm, Palamau

Year	No. of trees operated		Yield obtained (kg)		Revenue expected (Book value) (Rs.)	Expenditure incurred (Rs)	Expected profit (Rs)
	Harvested	Inoculated	Broodlac	Sticklac			
1990-91	36,621	17,659	11,817	9,128	1,24,005	64,767	59,238
1991-92	22,058	12,000	9,497	4,419	73,535	48,761	24,774

Table 36 Details of participatory activities of the institute in Kisan melas and exhibitions

Date(s)	Type of activity	Location	Organising institution	No. of visitors
10.7.1990	Exhibition and training camp.	Gopalpur, Purulia, W.B.	Indian Lac Research Institute	200
7-8.2.1991	Annual Kisan Mela	Getalsud, Ranchi	Divyayan Krishi Vigyan Kendra, R. K. Mission, Ranchi.	5,000
11-16.3.91	Gramodaya Mela	Jajpur, Ranchi.	Anand Jyoti Gramodaya Ashram, (Indian Farmers Service Instt.) Ranchi	3,000
29-30.1.92	Annual Kisan	Getalsud, Ranchi	Divyayan K.V.K., R.K. Mission Ranchi.	1135

manufacturers and other organisations on payment of a nominal fee. Drawal of representative samples for analysis from the premises of the manufacturers from the consignments marked for export was also arranged.

During the period under report, a total of 259 samples of seedlac, shellac, bleached lac, shellac wax, aleuritic acid, lac bye-products, sealing wax etc. were analysed and 680 tests carried out.

Quality Control

The institute continued to play a leading role in formulation of Indian Standards on Lac and Lac products by the Bureau of Indian Standards. Dr. S.K. Saha, Principal Scientist, Extension Division served as Chairman of the Lac and Lac Products Sectional Committee (CHD 22) of the Bureau of Indian Standards during the period and attended one meeting of the committee. The following Indian Standards for which necessary drafts were supplied earlier, were finalised and published by B.I.S.

IS - 12921 : 1990 — Lac Dye - Specification

IS - 868 : 1990 — Sealing Wax - Specification (first revision)

IS - 13160 : 1991 — Aleuritic Acid - Specification

IS - 16 : 1991 — Shellac specification, Part -I Hand-made shellac (third revision)

IS - 16 : 1991 — Shellac specification Part - II Machine-made Shellac (third revision)

A method developed earlier at the division for determination of pitch content in sealing wax (*Ann. Rep. 1987*, p. 57) was incorporated in the revised standard for sealing wax.

Production Unit

The unit continued to prepare and supply some selected lac-based products as per the details given below :

Product	Quantity (kg)	Supplied to
Lac-coated urea	107.00	CPCRI, Kasargod, Kerala
	5.00	Birsa Agricultural University, Ranchi.
	5.00	Indian Institute for Soil Sciences, Bhopal, Madhya Pradesh.
	147.00	Sericulture Research and Training Institute, Berhampur, West Bengal.
Water-soluble lac	20.0	M/s Kheejmad Lac Cooperative Society, Alwaye, Kerala
	1.00	M/s Chelannur Gramin M.V.S.S. Ltd., Kozikode, Kerala
	0.75	Daltonganj Lac Cooperative Society, Palamau, Bihar.

Museum

The museum was shifted from the Administrative Block to the newly constructed Extension Division Block. The show cases, specimens and the display materials were organised and rearranged in the spacious museum hall. Arrangements were made to display daily prices of raw and refined lacs in the Museum.

Some of the publications of B.I.S. specifications on lac and lac products/processes

Tribal housewives receiving training on the use of lac in surface coating

PUBLICATIONS

Research Papers

Goswami, D.N. and Kumar, S. (1991) Shellac based insulating varnishes, *Pigm. Resin Technol.*, **20**(3),10

Kumar, P and Srivastava, S.C. (1990) Record of *Acacia auriculiformis* A., *The Indian Forester*, **116** (11) 927

Majee, R.N., Agarwal, S.C., Mukherjee, S. N. and Chatterjea, J.N. (1991) Synthesis of dehydrocivetone, *Indian Perfumer*, 35(4), 239

Mishra, G.S., Gupta, P.C. and Pandey, A. (1990) Graft copolymer of shellac *Paintindia*, (May issue), 55

Prasad, N.,and Agarwal, S.C. (1990) A convenient method for isolation of jalaric and aleuritic acids from shellac, *Res. Indus.*, **35**, 164

Prasad, N. Agarwal, S.C. and Sengupta, S. C. (1991) Quantitative estimation of aleuritic acid in lac and its other fractions, *Paint and Resin*, **61**(5), 28

Ramani, R. and Sharma, K.K. (1991) A review of some genetical aspects of lac insect, *Ann. Entomol.*, **9**(2), 547

Sharma, K.K. (1991) Laboratory rearing of *Kerria lacca* (Kerr) (Homoptera : Coccoidea : Tachardiidae) on the fruits of pumpkin, *Cucurbita moschata*, *Curr. Sci.*, **61** (8), 544

Singh, B.P. (1990) Weed management studies in *Bhalia (Moghania macrophylla)* nursery, *Indian J. Weed. Sci.*, **22**(1&2), 32

Singh, B.P. (1992) Use of linear measurement in the estimation of leaf area in *Bhalia*, *Indian Forester*, **118** (6), 438

Papers Presented in Seminars, Symposia etc.

Agarwal, S.C., Srivastava, B.C. and Majee, R.N. (1991) Aleuritic acid- ILRI Processes product and industrial significance, presented in "An exposition of status and development of lac technology in India" organised by Indian Lac Research Institute, Ranchi, 5-6 July, p.IV-34

Banerjee, R.K. (1991) Improved washing technique for the manufacture of seedlac, *loc. cit.* p. III - 7

Banerjee, R.K. (1991) Bleached lac process, product and response of industry, *loc. cit.*, p. III -21

Banerjee, R.K. (1991) Hydrolysed lac-process, product and industrial significance, *loc. cit.*, p III - 24

Choudhary, S.G., and Bhattacharya, A. (1991) Management of lac insect, *Kerria lacca* (Kerr), *loc. cit.*, p I - 15

Dasgupta, A.K. and Kumar, S. (1991) Shellac based pattern paint, *loc. cit.*, p. IV-18

Goswami, D.N., Agarwal, S.C., Srivastava, B.C., Prasad, N., Majee, R.N., Prasad, K.M., Mukherjee, M and Kumar, S. (1990) Prospects of diversification of uses of lac, presented in the seminar,'Modernisation of lac industry in Bihar', organised by Bihar Industrial and Technical Consultancy Organisation Ltd., (BITCO) held at Ranchi on 26th April

Goswami, D.N. and Kumar, S. (1991) Improved air-drying type insulating varnish, presented in " An exposition of status

and development of lac technology in India" organised by Indian Lac Research Institute, Ranchi, 5-6 July, p. IV-4 (Reprinted in *Indian Shellac*, No. 1 & 2, 15)

Goswami, D.N. and Kumar, S. (1991) Improved baking-type insulating shellac varnish, *loc. cit.*, p IV - 8 (Reprinted in *Indian Shellac*, No. 1 & 2, 7)

Gupta, P.C. (1991) Hygienic disposal of lac factory effluents and recovery of dye and wax therefrom, *loc. cit.*, p III - 10.

Gupta, P.C. (1991) Shellac etch primer, *loc. cit.*, p IV - 27

Kumar, P., Singh, B. P. and Srivastava, S. C. (1991) Management of mixed plantation of *bhalia* and *galwang* for *kusmi* lac cultivation, *loc. cit.*, p. II - 4

Kumar, S. (1991) Melfolac - a heat and water proof shellac varnish for wood furniture, *loc. cit.*, p IV - 13

Majee, R.N., Prasad, N. and Agarwal, S. C. (1991) Iso-ambrettolide production from aleuritic acid, *loc. cit.*, p IV - 38

Mishra, R.C. and Lal. J. (1991) Operational research by ILRI on lac cultivation system, *loc. cit.*, p V - 7

Mishra, R.C. and Jaiswal, A.K. (1991) Training, testing services and technology transfer by ILRI, *loc. cit.*, p V - 1

Naqvi, A.H. (1991) Lac insect of India as compared to China, Thailand and other countries, *loc. cit.*, p I - 1

Pandey, A. and Gupta, P.C. (1990) " *Bihar mein lakh udyog ki samasyaein*" presented in the seminar - 'Modernisation of lac industry in Bihar', organised by Bihar Industrial and Technical Consultancy Organisation Ltd. (BITCO), held at Ranchi on 26th April.

Pandey, A. (1991) Sealing Wax, presented in "An exposition of status and development of lac technology in India " organised by Indian Lac Research Institute, Ranchi, 5-6 July, p IV - 1

Pandey, A. (1991) Autoclave process of manufacture of shellac, *loc. cit.*, p. III - 18

Prasad, K.M. (1991) Lac dye - its industrial significance, *loc. cit.*, p III -14

Ramani, R., Sharma, K.K. and Jaipuriar, S. K. (1991) Possibilities of breeding lac insects yielding pigment free or low pigment lac, *loc. cit.*, p I - 12

Saha, S. K. (1990) Lac industry - the need for a pragmatic policy, presented in the seminar - "Modernisation of lac industry in Bihar ", organised by Bihar Industrial and Technical Consultancy Organisation Ltd. (BITCO), held at Ranchi on 26th April

Saha, S. K. (1991) Studies on storage of lac, presented in " An exposition of status and development of lac technology in India" organised by Indian Lac Research Institute, Ranchi, 5-6 July, p III-28

Sen, A. K., Mishra, Y.D. and Sah, B.N. (1991) Traditional lac hosts of India-status and productivity, *loc. cit.*, p III - 1

Singh, R. (1991) Sand separation machine for separating sand from seedlac, *loc. cit.*, p III - 5

Singh, R. (1991) Dry mounting tissue paper, *loc. cit.*, p IV - 16

Srivastava, B.C. and Agarwal, S.C. (1991) Shellac gasket-cement compound, *loc. cit.*, p IV - 20

Srivastava, B.C. (1991) Slow release lac-coated urea fertiliser, *loc., cit.*, p IV - 22

Srivastava, B.C. (1991) Water thinned shellac red oxide primer, *loc. cit.*, p IV - 30

Pamphlets, Booklets etc. Published by the Institute

Lac-changing scenario (a folder) 6 pp
An exposition of status and development of lac technology in India - a booklet containing the papers presented by different authors in the " Status appraisal meeting on lac "

SEMINARS, SYMPOSIA ETC.

Organised

Status and development of lac technology in India—An exposition by ILRI

An exposition on "Status and Development of Lac Technologies in India" was organised by the ILRI on 5th and 6th July 1991 at the institute. The exposition was attended by sixty-three delegates from various organisations including ICAR; TRIFED; Directorate of Lac Development; Bihar State Co-operative Lac Marketing Federation; Shellac Export Promotion Council; Birla Institute of Technology, Ranchi; Small Industries Service Institute, Ranchi; Birsa Agricultural University, Ranchi etc. Altogether thirty-three papers on various topics related to production, processing, utilization and marketing of lac were prsented in six technical sessions. The representatives of lac-processing units and lac-based industries showed keen interest in the technologies developed by the institute. The exposition also provided an opportunity to apprise the consumers with the new technologies developed by the institute and to get the feedback from them. Important suggestions made by the delegates during the discussions were noted for incorporation into the research activities of the institute.

Attended by Scientists

Dr S. K. Saha, Pr. Sc., Dr P. Kumar, Pr. Sc., Dr P. C. Gupta, Pr. Sc., Dr S. C. Agrawal, Pr. Sc., Dr D. N. Goswami, Sr. Sc., Dr B. C. Srivastava, Sr. Sc., Dr N. Prasad, Sr. Sc., Dr R. N. Majee, Sr. Sc., and Dr A. Pandey, Sr. Sc. attended a seminar on "Modernisation of Lac Industry in Bihar" organised by the Bihar Industrial and Technical Consultancy Organisation Ltd. (BITCO) held at Ranchi on 26th April, 1990.

Dr S. K. Saha, Principal Scientist, chaired the meeting of Lac and Lac Products Sectional Committee, CHD O22 of Bureau of Indian Standards held on 21st March, 1991 in New Delhi.

An exposition on "Status and Development of Lac Technology in India organised at ILRI" — a view of the stage

Dr. Alam, A.D.G. (Engg) and other delegates discussing about lac dye at the Museum

AUXILIARY/SUPPORTING SERVICES

Library

Library extended literature search and consultation services to the scientists of the Institute as well as to scholars, professors and other research workers from other institutions like B.I.T., Mesra, University of Ranchi, B.A.U., Ranchi, I.I.T., Kharagpur, N.M.L., Jamshedpur and University of Patna.

The holdings of the institute library grew rapidly during the period. Details of the holdings are given below:

Documents	Additions during the period	Total holdings
Books, bound volumes	1150	20,182
Annual reports	267	1,506
Reprints, photocopies, pamphlets etc.	17	392

A sum of Rs. 11.2 lakhs was spent on the purchase of books, procurement of periodicals and miscellaneous forms of publications for the library during the period.

A "Selected list of forthcoming conferences/ seminars" was prepared and circulated in the institute. So far, 12 issues of this list have been circulated. The library maintained a programme of exchange of I.L.R.I. publications with many scientific libraries of the country and abroad.

Details of library acquisitions during the period are :

Particulars	National	International
No. of journals subscribed	109	53
No. of journals acquired in exchange or on gratis	26	20
No. of research institutes/ information centres with whom Institute library maintains exchange relationship	96	5

The library is 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. The library is an institutional member of British Council 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.

The library is equipped with a "GBC-Hi-Tech. Laminator" machine which has the facility for Heat-Fuse-lamination of Book covers. An automatic Cutting & Stitching machine "Donewell- 150" is also available in the unit for booklet/leaflet production.

Technical and Monitoring Cell

The cell convened meetings of the Staff Research Council to review the progress of ongoing research projects and 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. The research accomplishments and action plans of different research projects were compiled in the form of Activity Milestones, for onward transmission to ICAR, New Delhi.

Various reports namely, monthly report for the Cabinet, Quarterly reports of ORP and 20 Point Programme, Status paper for Regional Committee, DARE report, research highlights for ICAR report etc. were compiled.

Various scientific and technical meetings and seminars were organised. General information about the institute's activities were compiled for communication to various agencies including ICAR, NAARM, DST etc.

The research papers and articles submitted by the scientists were processed for forwardal to the various journals.

Farm Unit

Management and upkeep of the Institute plantation was continued. Hoeing, weeding and multching operations were also carried out in the plots of young lac host plants. The plots of lac hosts viz., *ber, putri, khair, palas* and *kusum* were frequently ploughed by a tractor, to get rid of weeds. Arrangements were also made for the ploughing of experimental plots, transportation, irrigation and guarding of the farm.

Seedlings of various species of lac host plants, namely, *kusum, palas, ber, galwang* and *bhalia* were raised in the nursery beds for filling up the vacant spaces in respective plots, utilisation in research experiments and distribution among the farmers under O R P. Foliage, ornamental and seasonal flower plants were multiplied at various locations of the institute and maintained properly.

Planting of *kusum, galwang and akashmani* seedlings were done in plot Nos. 4, 35, 36, 64, 65 and 72 and in vacant spaces of the plots of lac hosts. Plants of *ber, palas* and *khair* were inoculated with *rangeeni* broodlac in model demonstration plot.

The total income from the plantation through different farm produce, grass cutting charges and sale of pruned twigs, firewood, foliage and ornamental plants etc. was Rs. 8651.05.

Maintenance and Workshop

The workshop unit of the Institute provided its services towards maintenance of water and electricity supply lines to the laboratories, staff quarters, farm etc. Minor repairs of the laboratory and farm equipments were also undertaken. Number of different jobs done were: electrical, 1427; mechanical fabrication and plumbing, 495 and instrument repairing, 486.

Art and Photography

The unit continued to play an active role in the scientific and publicity activities of the Institute. About 590 photographs (colour and black & white) were taken, of the various research activities, Hesal broodlac farm, ORP area and also on the occasions of important meetings, seminar, Hindi day celebrations, National Science day etc. held at the institute.

Health Care

A part-time Authorised Medical Attendent visits the institute 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, 6,780 patients were attended to and 59 patients were referred to medical specialists at RMCH, Ranchi. Medical bills submitted by the staff members were also processed for reimbursement.

MISCELLANEA

Important Committees

Quinquennial Review Team

The Quinquennial Review Team (Q.R.T.) was constituted by the ICAR to review the research and other programmes of the institute during 1983—1990. The team comprised of

Prof. Lallan Rai
(Director(Retd.)
Institute of Agricultural Sciences
BHU, Varanasi 221 005)
160, Saket Nagar
Varanasi 221 005

Dr G. B. V. Subramanian
Prof. of Chemistry
University of Delhi
New Delhi 110 007

Dr P. K. Sen Sarma
(Dean (Retd.), Faculty of Forestry
BAU, Ranchi 834 006)
Flat no, 1, II Floor, West Block
302, N.S.C. Bose Road
Calcutta 700 047

Dr A. K. Vasishtha
Director
Harcourt Butler Technological Institute
Kanpur 208 002

Dr (Ms) I. K. Varma
Professor
Centre for Material Science & Technology
I.I.T., Delhi 110 016

Sri Tarun Kapur
Sr. Scientist, ICAR
Krishi Bhawan
New Delhi 110 001

The Q.R.T. visited the institute from 7 to 9.1.'91 and 20 to 23.2.'91 and held discussions with the Director, Heads of Divisions/Sections, scientists and other officials. The team submitted its report to ICAR in October, 1991.

Management committee

The Management Committee assists the Director in monitoring the progress of research under various research programmes of the institute and suggests suitable modifications, new researches etc. It helps in solving the problems related to research and administration. The Committee also helps in formulating the proposals for the Annual and Five-year Plans.

The constituent members of the Committee were as follows:

Director -Chairman
Indian Lac Research Institute
Namkum, Ranchi

Additional Chief Conservator of Forests -Member
Office of the Principal Chief Conservator of Forests
Madhya Pradesh, Bhopal

Dr. P. K. Sen Sarma -Member
Flat No. 1, 2nd Floor, West Block,
302 N. S. C. Bose Road
Calcutta 700 047

Sri Balbir Singh Bartana -Member
Ex-MLA, Flat No 329, Sector 37A
Chandigarh (Punjab)

Mrs Basanti Devi -Member
Ex-MLA, Near Bus stand
Jhejar, Dist. Rohtak, Haryana

The Assistant Director-General (Engg) ICAR, Krishi Bhawan New Delhi	-Member
Finance and Accounts Officer Central Rice Research Institute Cuttack	-Member
Dr D. N. Goswami, S-2 ILRI, Namkum, Ranchi	-Member
Dr B. C. Srivastava, S-2 ILRI, Namkum, Ranchi	-Member
Dr N. Prasad, S-2 ILRI, Namkum, Ranchi	-Member
Sri R. Ramani, S-2 ILRI, Namkum, Ranchi	-Member
Administrative Officer ILRI, Namkum, Ranchi	-Member

The 16th and 17th meetings of the committee were held on 29-30 August, 1991 and on 12th March, 1992 respectively at the institute.

Sports

The institute team, comprising of 52 participants, took part in the Inter-institutional Tournament (Zone III) of ICAR for the year 1990-91 held at the Directorate of Pulse Research, Kanpur, U.P. during 26—29 November, 1991.

In the track and field events, Sri D. W. Runda won 2nd prize in 400m race and two 3rd prizes, one each in 800 and 1500m race. In the team event, the institute's team comprising of Sarvasree N. K. Dey, D. W. Runda, A. Bhattacharya, H. S. Munda and D. K. Singh won the 2nd prize in Badminton.

The institute team, comprising of 47 participants, also took part in the Inter-institutional Tournament (Zone III) of ICAR for the year 1991-92 held at the Rice Research Institute, Cuttack during the 7—12 November, 1992.

Sri D. W. Runda won the 2nd prize in the 1500m race in the track and field events. Sri N. K. Dey became the winner in the individual badminton championship. In the team event, this institute team comprising of Sarvasree N. K. Dey, D. W. Runda, A. Bhattacharya, A. K. Sahay and H. S. Munda also became the winner in badminton.

Visitors

During the period under report, the institute received 2,704 visitors from the country as well as from abroad. The visitors included 42 batches of students and trainees from the states of Bihar, Orissa, U. P., Tamil Nadu and West Bengal and one batch of graduate forestry students from Nepal. Lectures, film shows on lac and visits to the Museum and the institute plantation were organised for these students.

Some of the distinguised visitors were:

Colonel S. S. Kahlon, 23rd Artillary, Bihar

Dr Baikunth Mishra, Professor & head of Plant Pathology, Birsa Agricultural University, Ranchi, Bihar

Mr R. M. N. Sahay, IFS, Director, Directorate of Lac Development, Ranchi, Bihar

Mr K. Rangarajan, F.A.O. Consultant, ICP Mission, Bihar

Mr J. K. Rawat, Director, Forest Research Institute, Dehradun, U. P.

Mr M. M. Sharma, ICRISAT, Hyderabad, A. P.

Mr H. R. Noomani, Asstt. Director (Training), Bihar Tribal Welfare Research Institute, Ranchi, Bihar.

Dr A. Alam, A. D. G. (Engg.) , ICAR, New Delhi

Members of the Quinquennial Review Team holding discussion with the Heads of the Divisions/Sections

Dr T. Krishna Murthy, Advisor, TRIFED, New Delhi

Mr R. Banerjee, Advisor, S.E.P.C., Calcutta, W. B.

Dr G. B. Singh, Director, I.I.S.R. (ICAR), Lucknow, U. P.

Sri Bhagwan Prasad Sharma, Director, P.D.S.V., Ranchi, Bihar.

Retd. Air-Vice Marshall S. Sahni, Development Alternatives, New Delhi.

Dr A. K. Bhatnagar, General Manager (R&D), I.O.C., Faridabad, Haryana.

Sri J. N. Prasad, Librarian, British Council Library, Ranchi, Bihar.

Dr R. L. Sagar, Head, Division of G.P.T.T., C.I.R.G., Mathura, U. P. (ICAR)

Dr J. S. Shukla, Professor of Chemistry, Lucknow University, Lucknow, U. P.

Dr N. S. L. Srivastava, Director, C.I.A.E. (ICAR), Bhopal, M.P.

Dr K. K. Nag, Head, Department of Botany, Ranchi University, Ranchi, Bihar.

Mr Han Jui, R.S.T.C. South China, Agricultural University, Gunyzhow, China

Mr Teresita A. Beltran, Philippines

Mr Sunichi Yamazaki, Tokyo, Japan

Mr A. Clarke, London, U. K.

Mr S. Tamazaki, Tokyo, Japan

Mr R. W. Willey, Angalia, U. K.

Mr M. J. Wilson, London, U. K.

Mr D. Roledi Agendf, Geisastrage, Germany

Mr Manfred Penning, M.H.P. Shellac, Germany

Mrs Suyuki Sumiko, Japan

Dr A. K. Dass, Institute of Forestry, Nepal.

Personnel

i) List of personnel as on 31.3.92

Director

Sri S. Kumar

Division of Entomology

Head of Division

Sri A. H. Naqvi

Scientist (S.G.)

Sri R. Ramani (Agric. Entomol.)

Scientist

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

Technical Officer

Sri A. K. Sahay (T-5)

Field/Farm Technician

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

Lab Technician

Sri G. M. Borkar	(T-1-3)
Sri S. K. Chatterjee	"
Sri Bhola Ram	"
Sri G. Das	"
Sri R. K. Swansi	(T-2)

Regional Field Research Station, Dharamjaigarh

Field/Farm Technician

Sri R. S. Maliya	(T-II-3)
Sri Jiwan Lal	(T-1-3)

Lab Technician

Sri A. Hussain (T-1-3)

Section of Plant Sciences

Head of Section

Dr P. Kumar

Senior Scientist

Dr B. P. Singh (Agro.)

Scientist

Sri S. C. Srivastava (Plant Breeding)

Lab Technician

Sri D. D. Prasad	(T-1-3)
Sri Mohan Singh	(T-2)

Field/Farm Technician

Sri K. A. Nagruar	(T-2)

Division of Chemistry

Head of Division

Dr S. C. Agarwal

Senior Scientist

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

Scientist (Senior Scale)

Dr K. M. Prasad (Org. Chem.)

Scientist

Sri A. K. Das Gupta (Org. Chem.)
Sri P. M. Patil (Phys. Chem.)
Sri I. Rajendran (Org. Chem.)
Sri P. C. Sarkar "

Technical Officer

Sri B. P. Banerjee	(T-5)
Sri D. D. Singh	"

Lab. Technician

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

Glass Blower

Sri B. S. Chaudhari (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

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-1-3)
Sri M. K. Singh "
Sri T. Ram "

Sr Mechanic

Sri S. K. Srivastava (T-4)

Division of Extension

Head of Division & Incharge ORP

Sri R. C. Mishra

Principal Scientist

Dr S. K. Saha (Phys. Chem.)

Scientist

Sri J. Lal (Agric. Entomol.)
Dr A. K. Jaiswal "

Technical Officer

Sri A. Rahman (T-5)
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 D. Runda (T-1-3)
Sri B. P. Ghosh "
Sri J. K. Ambuj (T-1)

Field/Farm Technician

Sri H. Bhengra (T-4)
Sri S. S. Prasad (T-1-3)
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

Driver

Sri Bandhan Runda (T-2)

Administrative and Audit & Accounts Section

Asst. Admin. Officer
Sri H. S. Munda

Finance & Accounts Officer
Sri Pradeep Kumar

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

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

Sr Stenographer
Sri R.Ravidas

Sr Clerk
Sri S. Ram
Sri D. Ram
Sri D. N.Mahto
Smt S. Guha
Sri K. L. Choudhuri
Sri R. K. Upadhyaya
Sri N. Topno

Sri Md. Mubarak
Sri V. Ram
Sri E. Gari

Sri Subhash Chand
(on deputation)

Jr Stenographer
Smt S. Prasad

Jr Clerk
Sri N. Gope
Sri T. Minz
Sri B. N. Gope
Sri A. Pandey
Sri P. Singh

Sri S. C. Lal
Sri R. N. Mahto

Sri B. Sahu
Sri W. Guria
Sri K. P. Arya

Technical and Monitoring Cell

Technical Officer

Sri S. K. M. Tripathi (T-8)
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

Sr Mechanic

Sri S. K. Bhaduri (T-4)

Instrument Mechanic

Sri H. L. Bhakta (T-1)

Medical Unit

Authorised Medical Attendent

(Part time)
Dr N. P. Sahu

Stockman-cum-Compounder

Sri C. Pandey (T-1-3)

Farm Unit

Farm Superintendent

Sri N.K. Sharma (T-6)

Field/Farm Technician

Sri Md. A. Ansari (T-1-3)
Sri R. C. Singh "
Sri V. K. Tewari (T-2)

Tractor Driver

Sri M. Surin (T-1-3)

Hindi Cell

Assistant Director (O.L.)

Sri Lakshmi Kant

Transport

Driver

Sri J. Tiwari
Sri N. Lakra

Sri A. Kumar

ii) Category-wise breakup of number of employees and the number of Scheduled Castes and Scheduled Tribes amongst them as on 31.3.1992

Class of post	No. of posts Sanctioned	No. of Employees in position	No. of SC Employees	No. of ST Employees
Scientific				
R.M.P. Scientist	1	-	-	-
Principal Scientist	4	5	1	-
Senior Scientist	12	10	-	-
Scientist	44	17	1	-
	61	32	2	-
Technical				
Category III	4	2	-	-
Category II	36	22	-	2
Category I	46	41	5	6
	86	65	5	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	11	-	3
Jr. Clerk	16	10	-	3
	49	39	4	8
Supporting				
Grade IV	11	6	2	-
Grade III	18	17	5	6
Grade II	36	35	5	16
Grade I	71	50	4	24
	136	108	16	46
Auxiliary				
Class I	2	1	1	—
Class II	1	—	—	—
Class III	11	5	—	3
	14	6	1	3
Grand Total	346	250	28	65

iii) Promotions, appointments, transfers etc. during the period under report.

Promotion

	Promoted to	*w.e.f.*
Sri Ramesh Prasad	T-4 to T-5	1.7.82
" M. Islam	T-4 to T-5	1.7.82
" B. P. Banerjee	T-4 to T-5	1.7.82
" M. L. Ravidas	T-1 to T-2	1.7.82
" N. K. Dey	T-II-3 to T-4	1.7.83
" A. K. Sahay	T-II-3 to T-4	1.7.83
" Dipak Ghosh	T-4 to T-5	1.1.88
" Markus Surin	T-2 to T-1-3	1.1.88
" M. L. Ravidas	T-2 to T-1-3	1.1.88
" S. K. M. Tripathi	T-7 to T-8	1.1.89
" A. K. Sahay	T-4 to T-5	1.1.89
" P. B. Sen	T-2 to T-1-3	1.1.89
" D. D. Singh	T-4 to T-5	1.7.89
" L. C. N. Sahdeo	T-4 to T-5	1.7.89
" S. K. P. Keshry	Sr. Clerk to Asst.	10.11.89
" Vijay Ram	Jr. Clerk to Sr.Clerk	18.2.91
" R. B. Singh	Sr. Clerk to Asst.	18.2.91
" K. D. Pandey	Sr. Clerk to Asst.	18.2.91
" Md. Mubarak	Jr. Clerk to Sr Clerk	18.2.91
" H. S. Munda	Supdt. to A.A.O.	28.6.91
" A. K. Lal	Asst. to Supdt.	28.6.91
" Md. Samiullah	Asst. to Supdt.	28.6.91
" N. Mahto	Asst. to Supdt.	28.6.91
" Budhan Ram	Sr. Clerk to Asst.	28.6.91
" K. N. Sinha	Sr. Clerk to Asst.	28.6.91
" J. P. Srivastava	Jr. Clerk to Sr. Clerk	28.6.91
" Emil Gari	Jr. Clerk to Sr. Clerk	28.6.91
" Ravi Shankar	Sr. Clerk to Asst.	23.12.91

Appointments

	Designation	*w.e.f.*
Sri Debia Oraon	Beldar	10.8.90
Smt Santoshi Lakra	-do-	10.8.90
Sri Dinu Ranjan Gorait	-do-	10.8.90
Smt Mariyam Lakra	-do-	10.8.90

Contd. . .

Appointments ***(Contd. . .)***

	Designation	*w.e.f.*
Sri Banful Lakra	-do-	10.8.90
Smt Phulmani Kachhap	Lab. Attdt.	10.8.90
" Janki Devi	-do-	10.8.90
Sri Raj Kumar Naik	-do	10.8.90
" Binay Kr. Singh	-do-	10.8.90
" Nageshwar Mishra	-do-	10.8.90
" Dhiraj Pd. Singh	-do-	10.8.90
" Bandi Lakra	Beldar	10.8.90

Transfers

	Transfered to	*Date*
Sri S. N. Sharma, A.O.	CIAE, Bhopal as Sr. A.O.	15.5.90
" K. P. Arya	Jr Clerk transferred from IVRI, Izatnagar to this Institute	26.6.91

Retirements

Dr B. B. Khanna	Pr. Scientist	30.4.90
Sri R. L. Singh	T-5	31.7.90
Sri Chutur Oraon,	Chowkidar	30.9.90
Sri M. K. Choudhury	T-5	31.12.90
Sri D. P. Sengupta	Supdt.	31.12.90
Sri Mangta Oraon	Lab. Attdt.	31.12.90
Sri S. K. P. Keshri	Asstt.	31.1.91
Sri S. N. Sharma	T-4	31.5.91
Sri A. K. Ghosh	T-6	31.10.91
Sri Jamun Jha	Armed Guard	31.10.91
Sri R. K. Singh	A.O.	31.1.92
Sri J. P. Srivastava	Sr. Clerk	31.1.92
Sri A. S. Manoranjan	T-2	31.1.92
Sri Md. Ghaseet	Lab. Attdt.	29.2.92

Deaths

Dr M. Mukherjee	Scientist	26.11.90
Sri Mangu Khalkho	T-2	18.3.91
Dr S.S. Sahay	A.M.A.	3.6.91
Dr A. Kumar	Sr. Scientist	14.11.91

Meteorological data : April 1990 - March 1992

Month	Mean barometric pressure (mm)	Mean Maximum temp (°C)	Mean Minimum temp. (°C)	Mean Dry bulb temp. (°C)	Mean Wet bulb temp. (°C)	Mean Humidity (%)	Total rainfall (mm)	Highest Maximum temp. (°C)	Lowest Minimum temp. (°C)
1990									
April	704.78	37.91	19.21	28.99	22.15	55.70	Nil	40.5	17.2
May	699.90	35.47	22.24	28.94	25.09	72.03	69.5	41.0	17.2
June	696.60	33.60	22.73	28.44	25.88	82.10	151.7	40.0	21.1
July	697.25	29.77	22.32	26.01	24.94	91.70	468.1	32.0	21.6
August	699.19	31.09	22.15	24.92	23.94	92.16	283.5	32.5	21.1
September	700.62	31.23	22.04	26.22	24.65	87.83	232.4	34.0	20.5
October	704.02	29.09	17.02	25.08	22.93	83.35	71.4	30.0	13.3
November	707.00	27.31	11.71	23.10	19.41	70.40	27.0	31.0	7.7
December	708.51	26.27	8.62	21.08	17.38	68.54	Nil	28.0	5.0
1991									
January	708.24	23.51	7.95	17.68	15.14	77.00	28.1	28.0	1.9
February	707.63	30.51	12.44	24.94	20.42	66.14	41.8	34.0	7.7
March	705.61	33.20	16.08	24.70	21.10	72.87	47.6	36.5	12.7
April	705.08	37.65	19.37	28.15	22.34	61.50	8.6	41.0	17.2
May	702.28	39.62	22.78	31.87	25.07	57.70	2.7	43.0	22.2
June	699.08	33.10	22.90	26.29	24.67	86.46	113.6	38.0	22.2
July	698.62	31.06	22.69	25.41	24.49	92.12	196.6	35.5	22.2
August	699.19	30.19	22.50	24.43	23.69	93.83	503.4	33.0	21.6
September	702.00	31.13	22.32	24.11	23.11	91.86	254.1	32.5	20.0
October	702.62	31.43	19.03	25.67	23.10	80.29	27.0	34.0	15.0
November	704.21	26.65	12.32	18.88	16.60	79.16	Nil	30.0	8.8
December	704.48	24.20	7.92	14.43	13.41	80.83	55.4	27.0	5.0
1992									
January	704.60	23.04	6.75	14.90	13.03	77.87	Nil	27.0	4.4
February	704.60	26.63	8.98	17.58	14.04	67.34	2.2	32.0	6.6
March	704.64	33.51	14.94	25.80	19.94	57.12	1.4	38.5	7.7

	1990 - 91	1991 - 92
The highest temperature	: 41.0°C (28.5.'90)	43.0°C(3.5.'91)
The lowest temperature	: 1.9°C(3.1.'91)	4.4°C(4.1.'92)
Total rainfall	: 1421.1 mm	1165.0 mm
Monsoon rainfall (June-September)	: 1135.7 mm	1067.7 mm
Hailstorm	: 13.3.'91	—

भारतीय लाख अनुसंधान संस्थान, नामकुम : राँची

वार्षिक प्रतिवेदन - 1990-91 एवं 1991-92

परिचय

भारत में लाख उघोग की स्थिति की जांच एवं इसके बहुमुखी सुधार के लिए भारत सरकार द्वारा गठित जांच समिति की अनुशंसा के फलस्वरूप भारतीय लाख अनुसंधान संथान की स्थापना की गई। उक्त समिति के सुझावों के कार्यान्वयन हेतु लाख उधोग से जुड़े लोगों ने "इन्डियन लैक एसोशिएसन फॉर रिसर्च" नामक एक गैरसरकारी संस्था का गठन किया तथा उसे पंजीकृत कराया। इस एसोशिएसन ने 1925 में भा० ला० अनुसंधान संस्थन की स्थापना की। सन् 1931 में भारत सरकार ने भारतीय लाख कर समिति का गठन किया जिसने इस संस्थान का अधिग्रहण कर लिया। अप्रैल 1966 से भारतीय लाख कर समिति समाप्त कर दी गई तथा भारतीय लाख अनुसंधान संस्थान, भारतीय कृषि अनुसंधान परिषद् के प्रशासकीय नियंत्रण में आ गया। यह संस्थान कुल 49 हे० क्षेत्र में फैला हुआ है जिसमें संस्थान के दो परिसर तथा 36.5 है० क्षेत्र का एक बागान शामिल है। मुख्य परिसर में कीट विज्ञान विभाग, रसायन विभाग, पादप विज्ञान अनुभाग, प्रसार विभाग की प्रयोगशालाओं के अतिरिक्त प्रशासकीय, वित्त एवं लेखा, पुस्तकालय, यान्त्रिकी अनुभाग तथा आवासगृह के भवन स्थित हैं। प्रौद्यौगिकी परिसर में प्रौद्यौगिकी अनुभाग की प्रयोगशालाएँ, प्रशिक्षु छात्रावास तथा आवासीय भवन हैं।

संस्थान के अर्न्तगत एक क्षेत्रीय लाख अनुसंधान केन्द्र भी कार्य कर रहा है जो मध्य प्रदेश के धर्मजयगढ़ नामक स्थान पर स्थित है तथा रांची जिले के कुछ ग्रामों में एक संक्रियात्मक अनुसंधान परियोजना भी चलायी जा रही है।

भारतीय लाख अनुसंधान संस्थान लाख की खेती, परिष्करण एवं उपयोग संबंधी अनुसंधान में कार्यरत एक अग्रणी संस्था है। लाख की खेती अधिकांशतः बिहार एवं इसके निकटवर्ती राज्यों के जनजातियों द्वारा लगभग 80,900 वर्ग कि०मी० क्षेत्र में की जाती है। अपने स्थापना काल से ही संस्थान लाख के उत्पादन तथा उपयोगिता में वृद्धि हेतु उपयुक्त प्रौधोगिकी के विकास एवं प्रसार में सतत प्रयत्नशील रहा है तथा अनेक प्रविधियों एवं उत्पाद विकसित किये गये हैं। उधोगों की बदलती आवश्यकताओं को ध्यान में रखते हुए नये क्षेत्रों की खोज के लिए प्रयास जारी हैं। लाख की खेती एवं उपयोग के क्षेत्र में अनुसंधान कार्य के लिए भा० ला० अनु० सं० अन्तर्राष्ट्रीय ख्याति अर्जित कर चुका है।

उद्देश्य

संस्थान के मुख्य उद्देश्य निम्नवत हैं :-

★ लाख के उत्पादन, शुद्धिकरण एवं मानकीकरण के क्षेत्र में सुधार लाने हेतु अनुसंधान कार्य करना तथा लाख की रासायनिक संरचना का अध्ययन एवं इसके गुणों में आवश्यक सुधार लाना ताकि लाख के उत्पादन एवं उपयोगिता के क्षेत्रों में वृद्धि की जा सके। अनुसंधान की उपलब्धियों का प्रचार एवं प्रसार करना तथा लाख उत्पादकों एवं उधोगों से संपर्क रखते हुए उन्हें तकनीकी सेवा उपलब्ध कराना जिससे कि लाख के उत्पादन एवं उपयोगिता में सुधार लाया जा सके।

★ लाख की खेती के उन्नत विधियों तथा लाख के औधोगिक उपयोगों के संबंध में प्रशिक्षण प्रदान करना।

संगठनात्मक व्यवस्था

संस्थान के शीर्ष अधिकारी निदेशक होते हैं। अनुसंधान कार्य के लिए संस्थान में तीन विभाग-कीट विज्ञान विभाग, रसायन विभाग तथा प्रसार विभाग एवं दो अनुभाग प्रौद्योगिकी अनुभाग तथा पादप विज्ञान अनुभाग है। तकनीकी सहयोग हेतु पुस्तकालय,अनुरक्षण एवं कर्मशाला अनुभाग, बागान प्रबन्धन और तकनीकी एवं मॉनीटरिंग ईकाई कार्यरत हैं। प्रशासनिक खण्ड में प्रशासकीय (अनुभाग), वित्त व लेखा अनुभाग और केन्द्रीय भण्डार हैं। सहायक इकाईयों के अर्न्तगत सुरक्षा, चिकित्सा और सम्पदा अनुरक्षण सेवाएँ हैं।

स्टाफ एवं बजट

संस्थान में 61 वैज्ञानिक, 86 तकनीकी, 49 प्रशासकीय, 14 सहायक तथा 136 चतुर्थवर्गीय स्वीकृत पद हैं।

वर्ष 1990-91 एवं वर्ष 1991-92 की अवधि में गैरयोजना मद में बजट अनुमान क्रमशः रू० 129.50 लाख तथा रू० 130.00 लाख था जबकि खर्च रू० 112.31 लाख तथा रू० 117.79 लाख हुआ एवं योजना मद में बजट अनुमान क्रमशः रू० 35.00 लाख तथा रू० 42.00 लाख के अर्न्तगत रू० 8.15 लाख तथा रू० 28.00 लाख खर्च हुआ।

अनुसंधान की मुख्य उपलब्धियाँ

एक आशाजनक लाख परिपालक - आकाशमणि

आकाशमणि (एकेसिया औरी कूलीफॉर्मिस) एक जल्दी बढ़ने वाला बहुवर्षीय झाड़ी है जिसमें कुसमी लाख की दोनों फसलें तथा रंगीनी लाख की कतकी फसल उगाने की क्षमता है। इस परिपालक पर लाख कीटों के जैविक गुण तथा उनके द्वारा उत्पादित लाख पारम्परिक परिपालकों के समतुल्य पाये गए।

लाख की खेती के साथ अन्य फसलें उगाना

इस संस्थान में लाख की सघन खेती हेतु लाख परिपालकों के मिश्रित बागान तैयार करने के लिए कृषि वानिकी पद्धति विकसित की जा रही है। दूसरे वर्ष के प्रतिरोपण में लाख परिपालकों के बीच की जगह में मिलवां फसल (इन्टरक्रॉप) के रूप में गोड़ा धान सफलतापूर्वक उपजाया गया। इससे लाख परिपालक पौधों की वृद्धि पर कोई विपरीत प्रभाव नहीं देखा गया।

जलारिक अम्ल से प्रतिस्थापित कुमेरिन डेरिवेटीव का संश्लेषण

जलारिक अम्ल लाख रेजीन का एक संघटक है। जलारिक अम्ल से मध्यवर्ती उत्पाद के रूप में प्राप्त सी-15 लैक्टोन डाइएसीड के निर्जलीकरण द्वारा प्रतिस्थापित कुमेरिन डेरिवेटीव (द्रवणांक - 114- 115 से.) का संश्लेषण किया गया है जिसकी प्राप्ति लगभग 15% हुई है।

एल्यूरिटीक अम्ल से कार्बनिक नाइट्रेट इस्टर का संश्लेषण

एल्यूरिटीक अम्ल के ओलेफिनीक इस्टर डेरिवेटीव को आयोडोनियम नाइट्रेट से प्रतिक्रिया कराकर मिथाइल (थ्रिओ) —16 एसीटौक्सी 9 (10) आयोडो —10 (9) नाइट्रेट हेक्साडेकानोएट तथा आयोडो हाइड्रीन्स एवं मिथाइल (थ्रिओ) —16-एसीटोक्सी (आयोडो —10 (9) हाइड्रौक्सी हेक्साडेकानोएट नामक कार्बनिक नाइट्रेट इस्टरों का संश्लेषण किया गया है।

चपड़े से पौलीविनाइल एसीटेट के अनुर्वतन सूचक में सुधार

पौलीविनाइल एसीटेट (पी वी ए, एम डब्ल्यू 45,000) से बनाई गई वार्निश का ट्रैकिंग इंडेक्स बहुत कम होता है। पौली विनाइलएसीटेट वार्निश को चपड़ा की वार्निश से मिला देने से ट्रैकिंग प्रतिरोधक क्षमता में वृद्धि पाई गई, जिससे यह संभावना होती है कि चपड़े को पौली विनाइल एसीटेट वार्निश के ट्रेकिंग इन्डेक्स में सुधार हेतु उपयोग किया जा सकता है।

चपड़ा - आधारित बाहरी पेंट

चपड़ा के एडिपिक अम्ल पौलिएस्टर और डेस्मोडूर एन से बनाए गए पेंट को खुले वातावरण में परीक्षण करने पर यह देखा गया कि 15 महीने तक इसके रंग और कठोरता पर किसी प्रकार का प्रभाव नहीं पड़ा।

लाख रंजक (लैक डाई) के पृथक्करण की साधारण विधि

लाख के शुद्धिकरण के समय प्राप्त जल से लाख रंजक (लैक डाई) को प्राप्त करने की एक साधारण विधि विकसित की गई है। इससे प्राप्त रंजक (डाई) ईंट जैसी लाल रंग का होता है तथा यह गर्म पानी में लगभग 80% घुलनशील है।

लाख-आधारित उष्मागलित आसंजक (एढ़ेसीव)

लाख और एपौक्सी रेजीन (अणुभार 500) को 60:40 में मिलाकर तैयार किये गए उष्मागलित आसंजक की बंधनशक्ति 0.35 टन/वर्ग ईन्च पाई गई। इसकी तुलना में केवल लाख से बने हुए आसंजक की बंधन शक्ति 0.12 टन/वर्ग ईन्च थी।

संस्थान द्वारा आयोजित हिन्दी दिवस समारोह 1990 का एक दृश्य

संस्थान द्वारा आयोजित हिन्दी दिवस समारोह 1991 का एक दृश्य

संस्थान राजभाषा कार्यान्वयन समिति
(1990-1991 एवं 1991-1992)

भारत सरकार के राजभाषा नीति के अनुपालन, समय-समय पर राजभाषा विभाग द्वारा निर्गत नियमों विनियमों एवं प्रावधानों के अनुसार कार्यक्रम की तैयारी तथा संस्थान के कार्य में हिन्दी के प्रयोग में वृद्धि के लिए तथा इस संबंध में आनेवाली समस्याओं के निराकरण के लिए राजभाषा कार्यान्वयन समिति का गठन किया गया है। उपरोक्त समिति के सदस्य निम्नांकित थे :-

क्रमसंख्या नाम एवं पदनाम

1. श्री श्रवण कुमार, निदेशक - अध्यक्ष
2. डॉ० सतीश चन्द्र अग्रवाल, विभागाध्यक्ष - सदस्य
3. " प्रणय कुमार, अनुभागाध्यक्ष - "
4. " प्रेम चन्द्र गुप्ता, " - "
5. श्री अन्जार हुसैन नक्वी, विभागाध्यक्ष - "
6. " रमेश चन्द्र मिश्र, " - "
7. " श्रीकृष्णमणि त्रिपाठी, वरिष्ठ तकनीकी अधिकारी - सदस्य सचिव (90-91) तक
8. " नरेन्द्र कुमार शर्मा, फार्म अधीक्षक - सदस्य
9. " रामकरण सिंह, प्रशासकीय अधिकारी - " (91-92) से
10. " प्रदीप कुमार, वित्त एवं लेखा अधिकारी - "
11. " राम प्रताप तिवारी, पुस्तकालयाध्यक्ष - "
12. " हरिहर सिंह मुण्डा, सहायक प्रशासकीय अधिकारी - " (91-92) से
13. " लक्ष्मी कान्त, हिन्दी अधिकारी, - सदस्य सचिव (91-92) से

(श्री हरिहर सिंह मुण्डा के अतिरिक्त सभी सदस्य वर्ष 1990-91 में भी सदस्य थे)

राजभाषा कार्यान्वयन समिति की बैठकों में संस्थान में हिन्दी के प्रयोग में आनेवाली संभावित कठिनाईयों के निराकरण तथा संस्थान से हिन्दी में तार भेजने हेतु निर्णय लिया गया तथा कमयूटरों के द्विभाषीकरण हेतु विचार विमर्श किया गया। वर्ष 1991-92 की अवधि में हिन्दी शिक्षण योजना के अर्न्तगत प्रशिक्षित किए गए अधिकारियों/कर्मचारियों के लिए कार्यशाला आयोजित करने, हिन्दी टंककों तथा हिन्दी आशुलिपिकों के प्रशिक्षण की व्यवस्था, कम से कम 40% तार देवनागरी लिपि में भेजने संबंधी मुद्दों पर विचार विमर्श किया गया। संस्थान में दोनों वर्षों में "हिन्दी दिवस" एवं "हिन्दी सप्ताह" का आयोजन किया गया।

राँची नगर राजभाषा कार्यान्वयन समिति के तत्वावधान में दिनांक 20-8-91 को आयोजित बैठक में संस्थान का प्रतिनिधित्व श्री लक्ष्मी कान्त, हिन्दी अधिकारी ने किया तथा दिनांक 10-2-92 की बैठक में संस्थान के निदेशक, श्री श्रवण कुमार तथा वरिष्ठ तकनीकी अधिकारी-सह-प्रभारी हिन्दी कार्यक्रम, श्री श्रीकृष्णमणि त्रिपाठी ने भाग लिया।

हिन्दी दिवस एवं हिन्दी सप्ताह के आयोजन 1990-91

सितम्बर 1990 की पहली तिथि से प्रारंभ होनेवाली सप्ताह को "हिन्दी सप्ताह के रूप में मनाया गया। इस अवधि में हिन्दी में सर्वाधिक कार्य करने हेतु बल दिया गया। "हिन्दी दिवस" का आयोजन 14 सितम्बर को किया गया। इस समारोह के अवसर पर संस्थान के सदस्यों ने हिन्दी-गीत, भजन एवं कविता पाठ में रूचिपूर्वक भाग लिया। राजभाषा से संबंधित प्रचार सामग्रियों जिनमें पारिभाषिक शब्दावलियां, संस्थान एवं केन्द्रीय सचिवालय हिन्दी परिषद् से प्रकाशित संदर्भ साहित्य का एक मनोरम एवं प्रेरणादायक प्रदर्शनी का भी आयोजन किया गया।

14 सितम्बर को हिन्दी सप्ताह का समापन तथा हिन्दी दिवस समारोह के आयोजन के अवसर पर मुख्य अतिथि के रूप में बिहार के लब्ध-प्रतिष्ठित हिन्दी दैनिक "राँची एक्सप्रेस" के सम्पादक श्री बलबीर दत्त ने हिन्दी भाषियों द्वारा हिन्दी को उचित महत्व नहीं देने पर खेद व्यक्त करते हुए अंग्रेजी का मोह त्यागने तथा हिन्दी का प्रयोग स्वाभिमान एवं राष्ट्राभिमान के साथ करने की सलाह दी।

संस्थान के निदेशक श्री श्रवण कुमार ने हिन्दी सप्ताह की अवधि में अधिक से अधिक काम हिन्दी में करने हेतु अपील की तथा हिन्दी को राष्ट्र का पहचान बतलाते हुए हिन्दी में ही कार्य करने हेतु अनुरोध किया।

हिन्दी में सराहनीय कार्य हेतु प्रशासकीय अनुभाग के श्री दुधेश्वर राम एवं वित्त एवं लेखा अनुभाग के श्री बिहारी साहु प्रशस्ति पत्र से सम्मानित किया गया। संस्थान में आयोजित निबंध प्रतियोगिता में सर्वश्री महेश्वर लालभगत,

मदन मोहन, शरत चन्द्र लाल एवं रघुनाथ महतो को प्रशस्ति पत्र एवं पुरस्कार प्रदान किया गया।

1991-1992

संस्थान में 24 सितम्बर 1991 को हिन्दी दिवस समारोह का आयोजन किया गया। संस्थान के सदस्यों ने हिन्दी गीत, भजन प्रहसन एवं कविता-पाठ में रूचिपूर्वक भाग लिया। इस अवसर पर राँची विश्वविद्यालय के हिन्दी विभाग के प्राध्यापक आचार्य श्रवण कुमार गोस्वामी ने मुख्य अतिथि पद से बोलते हुए हिन्दी भाषा में तकनीकी विषयों पर अधिक पुस्तकें एवं पत्रिकायें प्रकाशित कराने पर बल दिया तथा हिन्दी माध्यम से उभरते प्रतिभाओं को आगे आने का मौका दिए जाने हेतु अनुशंसा की। उन्होंने संस्थान के कर्मचारियों केअपने दैनिक काम-काज में हिन्दी के प्रयोग हेतु संकल्प लेने का आहवान किया।

संस्थान के निदेशक श्री श्रवण कुमार ने अपने अध्यक्षीय भाषण में हिन्दी में काम-काज करने हेतु बल देते हुए इसकी अनिवार्याता पर प्रकाश डाला।

उनकी अवधारणा थी कि हिन्दी हमेशा से संपर्क भाषा रही है और रहेगी। हिन्दी ने सभी भारतीय भाषाओं के सहयोग से राष्ट्रीय चेतना को जागृत किया है। हिन्दी जनता की भाषा है और जनता का कार्य जनता की भाषा में होना ही चाहिए संस्थान के अधिकारियों एवं कर्म चारियों को हिन्दी के प्रयोग हेतु प्रोत्साहित करते हुए उन्होंने कहा कि अपने लेखन त्रुटियों की परवाह न करते हुए राजभाषा का प्रयोग करना भी राष्ट्र प्रेम का प्रतीक है। उन्होंने सरकारी काम-काज में सरल हिन्दी के प्रयोग की हिमायत की।

संस्थान के वरिष्ठ तकनीकी अधिकारी श्री श्रीकृष्णमणि त्रिपाठी" ने तकनीकी क्षेत्र में हिन्दी के प्रयोग की संभावना पर एक रोचक व्याख्यान दिया।

हिन्दी अधिकारी श्री लक्ष्मी कान्त ने संस्थान में हिन्दी की प्रगति का रिपोर्ट प्रस्तुत करते हुए कहा कि संस्थान में प्रसार साहित्य का हिन्दी में प्रकाशन होता रहा है तथा कुछ के अनुवाद भी हुए हैं।

इस अवसर पर सांस्कृतिक कार्यक्रम में डॉ० निरंजन प्रसाद सर्वश्री आशीष कुमार दास गुप्ता, कवल किशोर प्रसाद, शिव वचन आजाद, अनिल कुमार सिन्हा तथा इरूदय राजेन्द्रण ने भाग लिया। धन्यवाद ज्ञापन डॉ० सतीश चन्द्र अग्रवाल ने किया।