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नामकुम, राँची — 834 010

INDIAN LAC RESEARCH INSTITUTE
NAMKUM, RANCHI — 834 010
BIHAR, INDIA

वार्षिक प्रतिवेदन
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1. INTRODUCTION

HISTORY AND DEVELOPMENT

The Indian Lac Research Institute came into existence in the year 1925 as a result of recommendations of an enquiry committee appointed by the Government of India to enquire into the condition of India's Lac trade and suggest measures for its all round improvement. This Institute was administered in its early years by the Indian Lac Association for Research followed by indian Lac Cess Committee. From April, 1966 onwards it is functioning under the Indian Council of Agricultural Research, as one of its Institute.

The Institute has persistently endeavoured to boost, optimise and stabilise the production of better quality lac through evolution and dissemination of appropriate technologies. It has played a significant role in serving the lac growers belonging to tribal and other weaker sections of the society, inhabiting the important lac growing States namely, Bihar, M.P. West Bengal, Orissa, U.P. etc. by popularising improved lac cultivation technologies directly as well as through other Government and voluntary agencies. A good number of products and processes have also been developed and popularised for enhancing utilisation and consumption of lac in the country. The Institute has been extending its experitise in the fields of lac cultivation, processing and utilisation to the countries like USSR, Vietnam, China etc. and thus has attained a global recognition for its researches.

Objectives

The objectives of the Institute are :

1) To carry out research towards affecting improvements in the cultivation, processing and standardisation of lac and study its constitution and modification so as to intensify lac production and extend its utilisation.

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

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

Major Missions

1) Evolving lac production technologies for improving productivity and quality of sticklac and broodlac.

2) Improving lac host plants and their management practices for increased lac production.

3) Development and upscaling of technologies for processing and diversified utilisation of lac and its bye products.

4) Dissemination of information on improved technologies in respect of lac

culture, processing and utilisation to the lac growers and the end users.

Organisational Set-up

The Institute consisted of six Divisions namely, Entomology, Plant Sciences, Chemistry, Technology, Insect Genetics & Breeding and Extension. In accordance with the policy of the ICAR, however, two Divisions namely, Plant Sciences and Technology were converted to sections from 1.7.1988. Each Research Division/Section has its own working set up. In order to support the research and extension activities the Institute also maintains a number of sections/units, namely, Technical & Monitoring Cell, Farm & Plantation, Library, Maintenance Workshop, Medical unit, Administrative section including Central Stores, Security, Estate Management and Audit & Accounts Section.

An operational Research Project for *Maximising Lac Production in Chhotanagpur area* is being implemented in two backward tribal villages of the Ranchi district and a Regional Field Research Station for Lac at Dharamjaigarh (Raigarh) is engaged in solving the regional problems of lac cultivation in Madhya Pradesh.

Staff and Budget

The Institute has a sanctioned strength of 60 scientific, 86 technical, 49 administrative,14 auxiliary and 136 supporting staff.

The budget of the Institute for the financial year 1988-89 was Rs. 101.70 lakhs for non-plan and Rs. 58.00 lakhs for plan scheme. The actual expenditure during the year was 101.59 and Rs. 18.37 lakhs under non-plan and plan respectively.

Research Achievements

Management of Lac Predators :

Diflubenzuron, a chitin inhibitor was found to be effective against the major predators of lac namely, *Eublemma amabilis* and *Holcocera pulverea* without causing any harm to the lac insects.

Vegetative Propagation of Palas :

Air layering has been found to be a successful technique for quick raising of plantations of *palas (Butea monosperma),* a major lac host.

Anti-tracking Vernish :

An air drying type anti-tracking varnish based on shellac-epoxy combination has been formulated which possesses increased resistance towards electrical tracking.

Foreign Training

Two scientists namely, Dr. D. N. Goswami and Sri R. Ramani obtained post experience training in U.K, under the British Technical Cooperation Training Programme for the year 1987-88.

Important Meetings

The tenth meeting of the ICAR Regional Committee No.IV was hosted by the Institute on June 2 and 3, 1988. There were 87 participants in the meeting.

A committee on Petition of Rajya Sabha Consisting of eight members of Rajya Sabha and 3 officials visited the Institute on 11.4.'88 and held discussions with the representatives of this Institute and Directorate of Lac Development on production, processing and marketing of lac.

Honours and Awards

Sri Bharat Prasad Singh was awarded degree of Doctor of Philosophy in Agronomy by the Birsa Agricultural University for his thesis entitle *"Growth and Yield of rice and wheat grown in sequence under resource constraints".*

2. PROGRESS OF RESEARCH

A. DIVISION OF ENTOMOLOGY

(a) RESEARCHES COMPLETED

NIL

(b) RESEARCHES IN PROGRESS

Improvement in Lac Cultivation Techniques

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

1.1.9.1 Technique for kusum

Experiments were continued as per the layout reported last year. Under four coupe system pruning of trees of coupe II & III for treatment KA, KB, KC, KD and KE was done during January, 1988; July, 1988 respectively for forthcoming inoculation.

Under 2 coupe system trees of coupe II for treatments KF and KG were pruned during February, 1988 and for KH in July, 1988.

Trees pruned last year, under treatment KH of coupe II were inoculated during July,1988 and *phunki* was recovered during August. Lac crop samples were collected at the time of *phunki* removal and sexual maturity for observations on the density of settlement, mortality, coverage, sex ratio and as pest infestation. *Endosulphan* (Thiodan 35 E.C.) and B.H.C. (W.P. 50 per cent) combination was sprayed twice on the developing crop during August and November respectively (Shedule II).

In the other experiment on 80 *kusum* trees, correlations of available shoot length as well as yield obtained with stem girth, height, canopy spread area and number of pruned points were worked out. Positive correlations were recorded between the available shoot length and canopy spread area as well as number of pruned points.

1.1.9.2 Technique for palas

Baisakhi ari (immature) 1987-88 crop was harvested during April from *heavily inoculated* sets of 10 trees each under PHA & PHB treatments of coupe I *Katki* 1988 crop was harvested during October from the sets of 10 trees each under both these treatments which were inoculated heavily using 40g broodlac/metre shoot length as per the layout reported last year.

Baisakhi 1987-88 crop on lightly inoculated sets containing 30 trees each of PHA and PHB treatments were left for self-inoculation during July, given insecticidal sprays as per layout and *baisakhi* 1987-88 cum-*katki* 1988 crop was harvested during

October. *Baisakhi* 1987-88 cum *katki* 1988 crop from trees under treatment PHC (control) were also harvesed during October.

Best yield in respect of broodlac (1.83 kg/tree) as well as sticklac (1.02 kg/tree) were obtained from the treatment PHB which included trap-cropping as well as chemical control (2 spraying).

Studies on broodlac requirement were conducted on 150 trees, divided into two coupe. The availability of shoot length for crop inoculation was found to be positively correlated with the stem girth and the canopy spread area. Out of the 6 brood rates tried, the use of 20g broodlac/metre shoot length was recorded to be optimum.

(Y.D.Mishra, S.G.Choudhary & M.L.Bhagat)

Physiology of Lac Insect and Associated Insects

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

Experiments for *katki* 1988 & *aghani* 1988-89 were laid out with 8 treatments (7 treatment + control) replicated 8 times, involving one year old 64 *Moghania macrophylla (bhalia)* plants, during each crop season. The treatments included application of N in the form urea @20g/plants; P in the form of single super phosphate @40g/plant and K in form of muriate of potash @15g/plant, individually as well as in various combinations i.e. N,P,K,NP,NK,PK,NPK along with control (No fertilizer). The plants were inoculated during July with 100g broodlac/plant.

No difference was observed in respect of colonisation per cm. shoot length, initial mortality, sex ratio and sticklac yield, in both the crops.

(A. H. Naqvi)

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

No correlation was observed between various selected parameters (described last year) on *palas, ber, bhalia, ghont (Ziziphus xylopyra)* and putri *(Croton oblongifolius)* during *baisakhi* 1987-88 and on *palas, ber, ghont* and *bhalia* during *katki* 1988 crop seasons. Studies were continued on *kusum ber, bhalia* and *khair (Acacia catechu).*

(A. H. Naqvi & A. K. Sen)

1.2.10 Studies on the factors influencing growth and development in the sexually reproducing female lac insect

Studies were undertaken as per the programme described last year. Comparative observations during *jethwi* 1988 crop season on mated and virgin female lac insects revealed that the mating enhances the size of the female cells as well as the size of the spermatheca.

(A. K. Sen, A. H. Naqvi and P. Chandrika)

Ecology of Lac Insect and Associated Insects

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

The Regional Field Research Station at Dharamjaigarh continued to carry out the following investigations.

1.3.5.1 To study the relative performance of kusum broodlac from different sources (States) at Khadgaon

The study was repeated during *aghani* 1987-88 *jethwi* 1988 and *aghani* 1988-89 crop seasons on the same lines as reported earlier.

During *aghani* 1987-88 crop season the yield of broodlac and also sticklac obtained by using original as well as locally developed broodlac from Bihar, were significantly higher as compared to that resulting from West Bengal and M.P. broodlacs. The results were not in conformity with that of last year.

During *jethwi* 1988 crop season, however, once again both the generations of local broodlac i.e. from M.P. gave higher crop yields in respect of broodlac as well as sticklac as compared to that from Bihar, Orissa and West Bengal.

1.3.5.3 To study the relative abundance of parasites and predators in different regions of M.P. and different crops on *palas*.

Samples of lac bearing shoots of palas weighing 2 kg each were collected from different localities of M.P., caged and observed as mentioned last year.

T. purpureus and *H. pulverea* were the most abundant inimical parasite and predator respectively in all the places in both the crop seasons. Among the beneficial parasites *A. tachardiae* and *Pristomerus sulci* were most abundant in the districts of Shahdol and Mandla respectively during katki crop season.

(B. N. Sah)

1.3.6 Population dynamics of kusmi strain of lac insect to ascertain the causes of kusmi crop failures (first phase)

The study was continued during the *aghani* 1987-88, *jethwi* 1988 and *aghani* 1988-89 crop seasons. *Aghani* 1987-88 : From the surviving population of 20.55 per cent reported last year only 11.25 per cent reached maturity stage.

Jethwi 1988 crop : The average no. of lac larvae settled was 80±11 per sq. cm. shoot length out of which 9.4 per cent died due to starvation and other causes respectively, during the first month after inoculation. At the second sampling stage i.e. after a forthnight, the mortality increased to 40.5 per cent of the original population. Finally at the time of crop maturity, only 12 per cent of the original population was observed surviving.

Aghani 1988-89 crop : The average settlement of lac larvae was 78.5±12.5 per sq. cm. shoot length of which 4.3 per cent and 24.6 per cent died due to starvation and other causes respectively, during the first month after inoculation. A fortnight there-after, the mortality increased to 38.5 per cent of the original population. Finally at the time of crop maturity only 18.5 per cent insects survived.

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

1.3.12 Analysis of abiotic and biotic factors causing mortality of lac insect

Studies on mortality of lac insects at different crowding levels

This is a new project taken up with a view to ascertain the key mortality factors at different crowding levels as well as to determine the optimum lac insect population per metre of shoot length for increased productivity.

The experiment was laid out in RBD on 108 *kusum* trees having 3 treatments of different rates of brood lac 10, 20 and 30g per m. shoot with 9 replications. Each replication consisted of 4 trees to be operated as per 4 coupe system of lac cultivation. During July, 1988 twenty seven trees were pruned for inoculation after 18 months.

(Y. D. Mishra, P. Chandrika, P. Rani Antony and A. Bhattacharya)

Control of Enemies of Lac Insect

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

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

Screening of insecticide was continued using the methodology reported last year.

Safety to lac insect : Two concentrations (0.05 and 0.025 per cent) of *trichlorfon* (Dipterex), *thiocylam* (evisect) and *endosulfan* (Thiodan 35 E.C.) were evaluated for their safety to the lac insects of 21-25, 30-35, 40-45 and 60-65 days stage. No adverse effect of these insecticides at the above mentioned concentrations was observed on the survival of the lac insects of any age under trial.

Effect on lac predators : The efficacy of the insecticides at 2 above mentioned concentrations was evaluated against lac predators under field conditions. Two sprayings were given 30 and 45 days after inoculation in each case and predator population was monitored by observing collected samples before and after treatment. The lac yield was also recorded.

Trichlorfon was recorded to be as effective as endosulfan in supressing the predator population as well as causing substantial increase in lac yield. *Thiocylam* was, however, not so effective in either supressing the predator population or increasing lac yield. The results were in conformity to the previous results.

1.4.3.7 Treatment of broodlac with selective insecticides

The studies were continued with BHC and endosulfan (Thiodan 35 E.C.) during *jethwi* 1988 crop season. In general, BHC was not found effective against the predators. *E. amabilis* population was not supressed at all but the *H. pulverea* population was supressed significantly (78.4 per cent).

Two more insecticides namely, *trichlorfon* (Dipterex) and *thiocylam* (Evisect) along with *endosulfan* were tried for treatment of broodlac during *katki* 1988 crop season. Data on the emergence of predators from the caging of treated broodlac sticks revealed that *thiocylam* and *trichlorfon* at 0.5 per cent concentration were significantly effective in supressing the pest population i.e. both the lac predators as well as all harmful parasites. *Endosulfan,* the well known insecticides used for the control of lac predators was observed to have no effect on the harmful parasites, although it significantly suppressed the predatory population.

(S. G. Choudhary, A. Bhattacharya)

1.4.9 Studies on application of insect growth regulators (IGR) for the control of major lac predators

1.4.9.4 Small scale field trials of diflubenzuron against lac predators

In the light of the results obtained last year the layout was modified to include *endosulfan* (Thiodan 35 E.C.) and BHC alone as well as in combination with *diflubenzuron.* Field trials with eight treatments i.e. BHC 0.05 per cent, *diflubenzuron* 0.0125 and 0.05 per cent *endosulfan* 0.05 per cent; BHC 0.025 + *diflubenzuron* 0.05 per cent; *endosulfan* 0.05 per cent + *diflubenzuron* 0.05 per cent; *endosulfan* 0.05 per cent + *diflubenzuron* 0.0125 per cent and water as control with 4 replications were conducted during the *katki* 1988 crop season on 128 *bhalia* bushes.

Results revealed significant reduction in predatory population by diflubenzuron alone (96.86 per cent by 0.05 per cent and 94.4 per cent by 0.0125 per cent concentrations). No significant difference was, however, recorded in respect of lac yield per metre shoot length.

(A. Bhattacharya)

1.4.13 Studies on the economic thresh old level of Eublemma amabilis and Holcocera pulverea

Experiment was repeated during *baisakhi* 1987-88, *katki* 1988, *jethwi* 1988 and *aghani* 1988-89 crop seasons.

The data confirmed the previous findings that the presence of 14 and more predatory larvae per metre of lac encrustation causes more than 10 per cent damage.

In other trials during *aghani* 1987-88 and *katki* 1988 crop seasons involving 0.05 per cent *endosulfan* (Thiodan 35 E.C.) spray prior to commencement of economic injury level, substantial increase of lac yield over the control was recorded.

(S. G. Choudhary)

Studies on Germplasm of Lac Insects

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

The biological attributes of 3 new stocks reported last year, namely local yellow and Meghalaya under *rangeeni* and Orissa-yellow under *kusmi* strain were studied for life period, fecundity and resin production characteristics. The results showed that performance of local yellow was quite satisfactory but it could not be compared with Meghalaya stock in respect of resin production and fecundity during *baisakhi* 1987-88 crop season, due to loss of culture on account of mortality. The *kusmi* stock (Orissa yellow) behaved differently during both the crop seasons in respect of life period. A much shorter life period i.e. 160 days during *aghani* and 208 days during *jethwi* season was observed.

The physico-chemical characteristics, namely, flow, life, colour, wax content, rate of filteration, acid value and melting point of nine germplasm stocks (five *kusmi* and four *rangeeni*) were determined. The results showed that flow, life and colour of the resin obtained from the same stock varies from season to season and year to year. Consistently high melting point (80°C), however, was recorded from Orissa yellow (*kusmi*) stock.

(S. K. Jaipuriar & S. K. Saha)

1.5.11 Studies on chromosomal behaviour of lac insect strains

Cytological studies on three stocks of lac insect namely, Ludhiana, Orissa crimson and Orissa yellow were repeated. The results reveal that hetero-chromatisation of haploid set of chromosomes during early embryogeny of males reported last year is facultative. In respect of females, it was further confirmed that both the sets of chromosomes remain euchromatic.

(S. K. Jaipuriar)

B. DIVISION OF INSECT GENETICS AND BREEDING

(a) RESEARCHES COMPLETED

6.1 Lac Insect Genetics

6.1.1. Studies on sex determination in lac insects

Lac yields vary greatly and at least part of this variability is due to the highly variable sex-ratio of lac insects. The project was undertaken in order to obtain sound knowledge of sex determination in lac insect. This will help in devising methods for improving lac yield.

Sex ratio was studied in individual progenies reared on *bhalia (M. macrophyla)* potted plants and the colonised shoot portion was covered by sleeves fabricated using muslin cloth and 80 mesh synthetic netting material, to protect the insects from the inimical insects. Sex ratio was scored at the time of sexual maturity. Following studies were carried out.

Comparision of stock

The sex ratio of single mother progenies of lac insects derived from *rangeeni*, a *kusmi* and an F_3 generation of *rangeeni* x *kusmi* were studied. The results revealed that the progeny size and sex ratio vary within wide limits in each stock (Table 1). The stocks differed significantly for the mean sex ratio, but this difference was possibly related to the difference in their rearing periods as was suggested by later evidedence.

TABLE 1 — SEX RATIO IN VARIOUS STOCKS OF *K. LACCA*

Stock	No. of pro-genies	No. of insects per progeny		Males (per cent)	
		Mean	Range	Mean	Range
Rangeeni	43	117.3	7 to 258	57.5	9.9 to 84.0
Kusmi	82	90.6	3 to 315	34.2	0.0 to 100.0
F_3 (*Rangeeni* x *Kusmi*)	63	104.2	12.417	50.7	0.0 to 79.7

The sex ratio varied independently of the progeny size, although the proportion of males was observed to increase with the increase in the progeny size when group size means were compared (Table 2).

TABLE 2 — EFFECT OF PROGENY SIZE ON THE SEX RATIO OF *K. LACCA*

Stock	No. of pro-genies	No. of insects per progeny		Males (per cent)	
		Mean	Range	Mean	Range
Rangeeni					
Small	6	22.3	7 to 45	29.1	14.4 to 53.8
Medium	23	92.8	53 to 142	53.2	9.9 to 77.2
Large	14	198.4	152 to 258	62.3	48.1 to 84.0
Kusmi					
Small	39	25.9	3 to 50	27.9	0.0 to 100.0
Medium	25	106.6	61 to 148	29.6	0.0 to 100.0
Large	19	197.6	157 to 315	39.1	18.5 to 100.0
Small	12	30.5	12 to 50	42.2	0.0 to 75.0
F_3 (*Rangeeni* x *Kusmi*)					
Medium	40	95.6	51 to 152	49.5	27.7 to 68.5
Large	11	217.4	153 to 417	53.7	28.7 to 79.7

An interesting feature of these results has been the record of the occasional occurence of a unisexual progeny of either sex (Table 3). The all female progenies were too small to provide any meaningful information, but those of the male varied widely for the number of insects included per progeny. In fact, the largest progeny reared included only the male insects ruling out differential sexual mortality as a possible explanation.

TABLE 3 — DISTRIBUTION OF BISEXUAL AND UNISEXUAL PROGENIES IN RELATION TO PROGENY SIZE IN *K. LACCA*

Stock	Progeny size	No. of rogenies		
		Bisexual	All-male	All-female
Rangeeni	Small	6	0	0
	Medium	23	0	0
	Large	14	0	0
Kusmi	Small	34	1	4
	Medium	24	1	0
	Large	18	1	0
	Small	1010	0	2
F_3 (*Rangceni* x *kusmi*)				
	Medium	40	0	0
	Large	11	0	0

To study the occurance of unisexual male progeny, 10 female were drawn randomly from a *rangeeni* stock and their progenies were reared separately on *bhalia*. All produced a bisexual progeny with varying sex ratio as observed earlier. Each progeny was inbred by full sibmating and 10 females drawn at random from each for scoring their progeny sex ratio.

The results showed that 5 of the 10 progenies included insects which produced only a bisexual progeny, 4 progenies each included insects about 50 percent of which produced a bisexual and the remaining a unisexual male progeny and the remaining one progeny included insects which only produced a unisexual male progeny. Thus, the 10 females originally drawn from the *rangeeni* stock could be grouped into three classes namely i) breeding true for a bisexual progeny, ii) segregating for a bisexual and unisexual male progenies and iii) breeding true for the unisexual male progeny in the observed frequencies of 0.5, 0.4 and 0.1 respectively. The extreme distortion of sex ratio in favour of the male is possibly due to a recessive genetic effect.

In another experiment, a *rangeeni* stock originating from a hot region (Palamau, Bihar) was studied for the progeny size and sex ratio. The results confirm that the progeny size and sex ratio vary within wide limits and that the unisexual male progeny could vary greatly for its size (tables 4, 5 and 6). Further, the frequency (36.4 percent) of unisexual male progenies was unusually high in his stock.

TABLE 4 — SEX RATIO IN *RANGEENI* STOCK OF *K. LACCA* ORIGINATING FROM HOT REGION (PALAMAU, BIHAR)

Crop season	No. of progenies	No. of insects per progeny		Males (per cent)	
		Mean	Range	Mean	Range
Katki	40	78.5	2 to 250	43.0	9.1 to 100.0

TABLE 5 — EFFECT OF PROGENY SIZE ON THE SEX RATIO OF *K. LACCA* STOCK ORIGINATING FROM HOT REGION (PALAMAU, BIHAR)

Pro-geny size	No. of pro-genies	No. of insects per progeny		Males (per cent)	
		Mean	Range	Mean	Range
Small	16	28.2	2 to 50	37.3	9.1 to 100.0
Medium	200	95.8	52 to 145	50.1	50.1to 100.0
Large	4	193.5	160 to 250	75.8	47.0 to 100.0

TABLE 6 — DISTRIBUTION OF BISEXUAL AND UNISEXUAL PROGENIES IN RELATION TO PROGENY SIZE IN *K. LACCA* ORIGINATING FROM HOT REGION (PALAMAU, BIHAR)

Progeny	No. of progenies / (range of number of insects per progeny)		
	Bisexual	All-male	All-female
Small	13	3	0
	(6 to 50)	(2 to 46)	0
Medium	14	3	0
	(52 to 145)	(66 to 125)	0
	2	2	0
	(164 to 100)	(160 to 250)	0

Inbreeding effect

A *rangeeni* stock of lac insects was inbred by full sib-mating for five generations and eight of the inbred lines derived were compared for the progeny sex ratio.

It was observed that the progeny sex ratio varied widely within each line, but the inbred lines did not differ significantly for their mean sex ratio and the sex ratio remained unaffected by inbreeding (Table 7). No relationship was found between the parent culture and the progeny sex ratio.

TABLE 7 - EFFECT OF INBREEDING ON THE SEX RATIO OF *K. LACCA* DURING BAISAKHI 1984-85

Inbreed line	No. of progenies	Males (per cent) Mean	Range
A	8	30.6	21.2 to 55.0
B	8	38.3	22.2 to 56.5
C	9	32.1	24.8 to 47.3
D	9	36.5	27.0 to 66.0
E	8	32.2	23.4 to 53.8
F	9	35.3	25.7 to 47.6
G	8	31.5	0.0 to 67.5
H	9	35.6	24.2 to 53.4

The breeding experiment, thus, provided no evidence of genetic determination of sex in lac insects, although the sex ratio distoration in favour of the male appeared to be genetic.

Host effect

The *Meghalaya* stock of lac insects was studied in relation to *arhar (C. cajan), bhalia* and *ber (Z. mauritiana* by maintaining five cultures on each host species.

It was found that the proportion of males was unusually high in general. However, the mean male percentage differed significantly between the host species used. It was 72 percent on *bhalia*, 82 per cent on *arhar* and 98 per cent on *ber* showing that the stock sex ratio varied widely with the host species used.

Effect of shoot portion colonised, density of settlement and larval mortality

Forty progenies of a *kusmi* stock were reared separately using one *bhalia* plant for each. Twelve included only the male insects and two only the females. The others were bisexual with the sex ratio varying within these extreme limits. The progenies also differed widely for their size and larval mortality rate.

The progenies including only the female insects were not only few, but they were also too small to provide any meaningful information. Those including only the male insects varied widely for their size ranging from 7 to 269 males. The sex ratio of the bisexual progenies varied independently of their progeny size.

The proportion of female was inversely related to the mortality occuring during the

early larval period. The preponderance of males was, thus, found associated with heavy early larval mortality.

The proportion of females was observed to be significantly higher in the losely settled larvae than in those settled densely and the proportion of males tended to be higher towards the apical region of the shoot.

Similar results were obtained for *rangeeni* stock when 5 progenies were reared together on a 20 cm. shoot portion of a plant and 10 cultures were maintained using one plant for each.

The results of breeding experiments provide no evidence of genetic determination of sex, although the sex ratio distortion recorded here appears to be genetic. The breeding evidence suggested that sex determination is largely environmental and that the increase in male proportion is possibly related to the degree of nuritional inadequacy.

(N. S. Chauhan)

(B) RESEARCHES IN PROGRESS

6.1 Lac Insect Genetics

6.1.2 Survey of genetic variation in lac insects

6.1.2.1. Study of crosses

The life period, resin productivity and the fecundity were scored for the F_1 progeny of the cross between Orissa yellow *kusmi* female and Bihar (Kundri) crimson *rangeeni* male reared on *bhalia* plant. The time taken by them to complete life cycle was almost same as that of *kusmi*. The resin productivity, however, was higher than that of the maternal parent.

The life period of F_1 generation was scored (N = 125) on the basis of yellow spot which appears a few days before the beginning of crawler emergence. This appeared to show a more or less continuous distribution beginning from the second week of October to the third week of February. Two peaks were discernible coinciding with those of normal *rangeeni* and *kusmi*. Interestingly, about 74 per cent of the females completed their life period at about the normal *kusmi* time, 16 per cent at the normal *rangeeni* time and the remaining during the intervening period.

6.1.2.2 Study of inter and intra-population variation in the biological and resin characteristics

Seven maternal half-sib families of a *rangeeni* stock of lac insects were reared on *bhalia* plants during the summer season. Melting point of the lac produced by the individual females of those familes was observed to differ significantly between the families.

Studies on the density of settlement of lac insects on *bhalia* under excess and suboptimal brood-lac conditions were continued. The mean density of settlement of the *rangeeni* insects was distinctly lower than that of *kusmi* insects, under suboptimal broodlac conditions. The mean density of settlement under subopimal and excess broodlac conditions exhibited crowding effect in case of *kusmi* as well as *rangeeni* insects but it was more marked in the case of *rangeeni* insects (Table 8). The differences in the density of larval settlement were highly significant in both the cases.

(R. Ramani and K. Krishan Sharma)

TABLE 8 - DENSITY OF SETTLEMENT OF THE FIRST INSTAR LAC LARVAE ON *BHALIA* UNDER SUBOPTIMAL AND EXCESS BROOD CONDITIONS

Stock	Season	Mean no. of larvae settled per sq.cm.	C.V.
suboptimal brood			
Rangeeni	*Baisakhi* 1988-89	79.38	39.5
Kusmi	*Jethwi* 1989	136.16	33.7
Meghalaya	Summer 1988	166.50	36.9
Excess brood			
Rangeeni	*Balsakhi* 1988-89	93.84	16.7
kusmi	*Jethwi* 1989	241.70	12.4

C. DIVISION* OF PLANT SCIENCES

(a) RESEARCHES COMPLETED

2.2 Genetics and Breeding of Lac Host Plants

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

Cajanus cajan (Pigeon-pea, arhar) is an important pulse crop widely grown in India. It is also reported as a lac host in Assam. The project was taken up to explore the possibility of utilising it for pulse as well as lac production, profitably.

Baisakhi crop

Twenty lines of pigeon-pea namely, ICRISAT ICP 7197, 718, 7119, 6443, 6986, 6344, 7035, 3783, 4704, 8501; Pant-A & A; AS-29, K35/6, Basant, T-21, No. 3570, 2E, UPAS-120 and Assam Cv were evaluated for *baisakhi* crop. Observations on plant growth attributes and the linear space covered by the lac insects were recorded. It was noticed that maximum inoculable space covered by lac insects was more in ICRISAT ICP 6344. Pulse yield was found to reduce with lac cultivation except in case of No. 3570. Plants carrying lac crop started dying during summer season. Immature lac crop harvested showed comparatively better lac yield in the case of ICRISAT ICP 7188, 6986 6344. Pant — A was not found suitable for lac cultivation.

Baisakhi-cum-katki crop

Baisakhi-cum-*katki* crops were also tried. Plant survival up to lac crop maturity was better in ICP 6344, 7119 and No. 3670. The lac yield was better in case of Basant. The total shoot length and number of primary branches/plant were recorded to be maximum in case of ICP 6344.

Early/medium maturing varieties namely, UPAS-120, T-21, TT-5, TT-6 and BR-183 were evaluated for *katki* and *aghani* crops and late maturing varieties viz. *Bahar, Basant,* ICRISAT ICP Nos. 6443, 3783, 6986, 7197, 4704, 8501 and 634, AS-29, 7-S, *Laxmi,* 2E, K35, No. 3670 and Assam for *Baisakhi* and *jethwi* crops.

Katki crop with intercropping

Arhar and moong crops were grown during summer season under irrigated conditions and maximum yield of *moong* was recorded from T-2 variety. After the harvest of *moong*, groundnut was grown and maximum yield was recorded in case of UPAS-20. Meanwhile *katki* lac crop was inoculated in the month of July. It was observed that pulse yield is adversely affected due to lac cultivation and the yield of intercrops (*moong* + groundnut) were not able to compensate

*Converted to Section with effect from 1.7.1988

for the loss. Highest and lowest lac yields were obtained in case of BR-183 and UPAS-120, respectively.

Aghani crop

The *arhar* varieties tried during *katki* lac crop season were also evaluated for *aghani* crop production. TT-6 variety was however replaced by ICPL-6. Here also both *moong* and groundnut yield raised as intercrops were recorded. The lac yield was very poor in general.

It was thus concluded that both *katki* and *aghani* crops are not economical on early/medium maturing group of *arhar*.

Baisakhi crop

Eighteen varieties of *arhar* were sown in June for evaluation of their *baisakhi* (summer) lac crop potential. The *arhar* plants bearing *baisakhi* lac crop suffered heavy mortality during summer months.

Five varieties namely, *Bahar*, 2E, ICP 3783 and 7197 showed promise for lac cultivation as these varieties did not show reduction in pulse yield. The remaining varieties showed reducing trend with lac cultivation (Table 9).

Lac insect sex ratio was found to vary with the varieties.

Jethwi crop

Late maturing varieties tried during *baisakhi* crop season were also tried during Jethwi crop season and were found unsuitable for lac cultivation during this crop season. The lac crops were poor in general and pulse production was found to reduce with lac cultivation. Heavy plant mortality was observed under unirrigated condition.

TABLE 9 - VARIETAL PERFORMANCE OF *CAJANUS CAJAN* IN RESPECT OF PULSE AND LAC PRODUCTION PER PLANT

Variety	Pod bearing length (cm)		Pulse yield (g)		Reduction in pulse yield (g)	Thousand grain weight (g)		Lac yield (g)
	Inocu-lated	Unino-lated	Inocu-lated	Unino-lated		Inocu-lated	Unino-lated	
1. *Bahar*	154.2	188.2	41.3	63.8	22.5	114.3	117.2	11.1
2. *Basant*	214.4	189.4	60.8	60.1	0.7	89.1	89.8	3.71
3. T 121	61.6	63.8	7.4	7.9	0.5	—	79.0	0.83
4. ICRISAT ICP No. 6443	175.0	166.8	45.2	50.8	5.6	79.1	73.4	3.76
5. As-29	161.7	178.0	39.7	42.7	3.0	94.8	92.0	6.40
6. 7S	336.8	187.4	57.3	63.7	6.4	72.5	76.4	4.13
7. *Laxmi*	209.4	215.0	38.3	50.3	12.0	68.8	70.3	6.86
8. 2E	204.9	203.0	57.2	67.0	9.8	72.8	71.2	9.42
9. K 35/6	204.2	200.0	60.9	78.1	17.2	89.2	97.3	3.75
10. N. 3570	164.4	192.5	59.3	63.9	4.6	88.5	90.3	6.00
11. ICRISAT ICP 3783	190.6	194.2	36.9	46.6	9.7	104.4	119.3	9.33
12. ICRISAT ICP 6986	151.5	299.8	30.1	38.5	8.4	101.1	104.3	D.M.
13. ICRISAT ICP 7188	166.8	179.6	47.5	54.2	7.2	106.1	108.4	8.48
14. ICRISAT ICP 7197	197.8	184.8	49.9	44.8	5.1	107.1	111.1	7.12
15. ICRISAT ICP 4704	150.1	199.8	51.8	71.8	20.0	88.4	93.2	3.96
16. ICRISAT ICP 8501	205.6	220.4	56.1	51.4	4.7	126.5	129.4	2.05
17. ICRISAT ICP 6344	205.9	226.3	67.3	89.9	22.6	91.3	87.8	2.08
18. Assam (Local)	230.6	200.7	48.1	63.1	15.0	77.4	77.5	4.4

(P. Kumar)

(b) RESEARCHES IN PROGRESS

2.1 Propagation and Management of Lac Host Plants

2.1.2 Management of bhalia for lac cultivation

2.1.2.3 To find out a suitable method for raising bhalia seedlings

Experiments were continued as per lay-out reported last year. *Bhalia* seeds were sown at weekly intervals starting from the first week of April and continued till the last week of May in the nursery beds and polythene bags of medium and small sizes.

Observations were recorded on plant height, number of leaflets per seedlings, leaflet area and dry matter accumulation per seedlings at 60 and 105 days after sowing (DAS). Differences due to time of sowing on the plant growth attributes under study were found statistically significant at both 60 and 105 DAS in different containers except the number of leaflets per seedlings at both the times and dry matter accumulation at 105 DAS (Table 10).

TABLE 10 - EFFECT OF TIME OF SOWING ON PLANT GROWTH ATTRIBUTES OF BHALIA

Period of sowing (weeks)	60 days after sowing				105 days after sowing			
	Average plant height (cm)	Average No. of leaflets/ seedling	Average lleaflet area (sq.cm)	Average dry matter accumulation seedling (g)	Average plant height (cm)	Average No. of leaflets/ seedling	Average leaflet area (sq. cm)	Average dry matter accumulation/ seedling (g)
1	2	3	4	5	6	7	8	9
Nursery bed								
APRIL I	21.96	16.67	10.13	0.32	83.83	18.33	57.24	5.36
APRIL II	23.22	17.00	8.65	0.39	79.44	19.53	49.08	4.67
APRIL III	22.22	17.33	16.31	0.56	81.66	19.43	47.37	5.08
APRIL IV	25.10	17.43	17.10	0.54	95.01	21.33	43.82	5.45
MAY I	29.40	16.43	14.24	0.59	82.68	16.77	41.67	4.92
MAY II	28.08	16.67	21.44	0.74	81.55	21.67	84.86	6.15
MAY III	34.41	16.67	23.26	0.81	77.96	19.67	65.18	5.52
MAY IV	31.01	19.00	23.50	0.71	90.86	21.00	71.17	5.97
CD at 5 per cent	10.44	NS	6.72	0.30	NS	NS	22.89	NS
Medium size polythene bag (15 x 25 cm)								
APRIL I	13.22	15.00	3.52	0.20	37.99	20.48	43.91	3.75
APRIL II	11.13	17.43	2.88	0.22	36.39	17.23	26.43	3.38
APRIL III	18.08	16.30	6.69	0.24	42.86	18.67	28.13	3.58
APRIL IV	18.44	16.23	10.22	0.37	59.12	23.90	41.57	4.34
MAY I	25.91	17.46	18.55	0.62	79.57	22.87	50.38	5.46
MAY II	23.22	14.00	18.47	0.59	68.99	23.33	86.09	4.89
MAY III	26.08	17.00	20.78	0.61	80.43	21.77	63.26	5.91
MAY IV	25.71	18.33	25.29	0.67	64.50	17.33	59.57	3.71
CD at 5 per cent	9.23	NS	12.14	0.38	15.05	NS	22.85	NS

Contd. . . .

Contd. . . TABLE 10 - EFFECT OF TIME OF SOWING ON PLANT GROWTH ATTRIBUTES OF BHALIA

	Small size polythene bag (10 x 25 cm)							
APRIL I	12.42	14.56	5.07	0.17	43.33	19.00	41.63	2.84
APRIL II	10.91	12.17	4.22	0.19	41.50	18.10	39.59	2.81
APRIL III	14.39	15.33	9.15	0.20	39.67	17.28	38.62	2.79
APRIL IV	19.48	15.90	11.01	0.30	60.02	21.33	51.50	3.96
MAY I	20.48	16.67	13.39	0.34	67.22	22.76	46.33	3.88
MAY II	22.69	16.00	15.92	0.58	76.05	24.23	90.97	3.62
MAY III	24.08	17.67	18.33	0.66	71.23	17.67	67.54	3.98
MAY IV	21.51	17.00	17.78	0.39	72.64	21.57	70.84	3.92
CD at 5 per cent	7.51	NS	8.04	0.16	14.53	NS	22.92	NS

Leaflet area = L x B x K, K = 0.746

Plant growth attributes in general were found to be better under nursery bed condition than polythene bags as observed last year.

(B. P. Singh)

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

2.1.3.2 Raising of tuber corm and rhizome crops in the mixed plantation of *bhalia* and *galwang*

Work was continued as per the lay out reported earlier (*A. Rep.*, 1987). Plant growth attributes and biomass of *bhalia* and *galwang* showed marked improvement when intercrops were grown in between and within the spaces as reported last year.

Aghani 1988-89 crop was raised on *bhalia* bushes. *Colocacia* either alone or in combination with turmeric gave best results. A gross return of Rs. 4394/hectare was obtained when *colocacia* and turmeric combination was grown as intercrop.

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

2.1.6 Agricultural utilization of lac mud as organic manure

2.1.6.3 Effect of lac mud, farm yard manure alone and in combination with NPK on rice-wheat sequence

The experiment was continued with the same technical programme as reported last year. Wheat crop (Sonalika) was sown without application of manures and fertilizers during December 1987 to study the residual effect after rice crop harvested during April' 88. Yield data of wheat failed to show any significant differences among the treatments due to subnormal yield. Paddy *(Sita)* was transplanted as super imposed during July '88 with the application of manures and ferti-lizers as per the treatments. The paddy yield along with the straw was recorded. The grain yield attributes were markedly higher with the use of lac mud, FYM, individually and in combination with commercial fertilizers than control. The yield attributes such as panicles/50 metre and grains/panicle were influenced significantly with the use of lac mud, FYM and fertilizers.

Thus the result indicated that 4.61 tonnes/hectare paddy yield was obtained by application of 10 tonnes of FYM+N P K kg/hectare Treatment J) which was almost at par with N P K kg/hectare (Treatment E) and 10 tonnes of lac mud + N P K kg/hectare (Table 11).

(B. P. Singh)

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

The experiment was continued using two new hormones namely napththalene acidic acid (NAA) and indole propionic acid (IPA) along with indole acetic acid (IAA) and indole butyric acid (IBA) used last year for root initiation in preparation of air layers. The hormones were used individually as well as in combination (IAA, NAA, IBA alone & IAA + IBA, IBA + NAA, IAA + NAA in equal proportion) in two concentrations 50 and 100 ppm.

As compared to the individual use of hormones the combinations gave better rooting performance, in general. Combination of IBA +NAA (1:1, 50 ppm) gave best performance (46.7 per cent rooting). Mid May to mid June was observed to be the best time for air layering of *kusum.*

The detached air layers were transplanted in nursery beds using the substrate consisting of F.Y.M. + garden soil+ soil from *kusum* root zone in equal proportion.

(S. C. Srivastava)

2.2 Genetics and Breeding of Lac Host Plants

2.2.6 Survey of genetic variation in lac potential of host plants

2.2.6.1 Survey of genetic variation in galwang (*Albizzia lucida*)

TABLE 11 — YIELD ATTRIBUTES OF PADDY (*SITA*) AS INFLUENCED BY DIFFERENT LEVELS AND SOURCES OF MANURES AND FERTILISER

Code	Treatment					Plant height at	panicles/ sq. metre	length of panicle	Grains/ panicle	1000 grain in weight	grain yield	Straw yield	Harvest index
	Manures tonne/ hectare		Fertiliser kg/ hectare										
	Lac mud	FYM	N	P	K	(cm)		(cm)		(g)	(o/ha)	(Q/ha)	(Percent)
A	5	—	—	—	—	77.6	320	17.6	73.3	23.36	34.1	47.1	41.9
B	10	—	—	—	—	79.6	339	17.8	78.8	23.42	36.4	50.9	41.8
C	—	5	—	—	—	82.8	334	18.0	73.7	23.40	34.7	47.9	42.0
D	—	10	—	—	—	81.5	346	18.2	80.1	23.45	37.3	51.5	42.0
E	—	—	100	22	25	82.3	365	19.1	86.4	24.36	46.0	62.9	42.2
F	—	—	50	11	12.5	81.5	337	18.3	76.8	23.46	39.9	55.5	41.9
G	5	—	50	11	12.5	81.3	351	18.5	75.5	23.53	42.2	57.8	41.4
H	10	—	50	11	12.5	80.7	360	18.7	81.2	23.60	45.6	62.3	42.3
I	—	5	50	11	12.5	82.9	349	18.6	78.5	23.51	42.6	57.6	42.5
J	—	10	50	11	12.5	84.5	367	19.4	86.0	24.80	46.1	62.8	42.3
Control	—	—	—	—	—	76.0	313	17.4	65.2	22.19	32.5	44.7	42.1
CD at 5%	—	—	—	—	—	NS	22.76	NS	7.55	NS	2.84	3.82	NS

Maximum 33 per cent success in propagation through the stem cuttings was recorded which was not adequate for multiplication of enough plants for experimentation. Attempts were, therefore, made to propagate through air layering. Hormones IAA, IBA, NAA were tried individually as well as in combination (IAA, IBA, NAA + IAA + IBA; IBA + NAA; IBA + NAA - 100 ppm). As rooting media, green moss + lanolin paste gave better results as compared to pond soil + dried grass.

Best results (93.3 per cent) were obtained when IAA + NAA was used in equal proportion (100 ppm) during June.

2.2.6.2 Survey of genetic variation in *bhalia* (*Moghania macrophylla*)

The plants raised earlier through stem cuttings under 4 replications (*A. Rep.*, 1987) were inoculated with *kusmi* broodlac to raise *aghani* 1988-89 crop. The initial larval settlement was very good. But later on the lac crop was badly damaged due to attack of *Chrysopa* spp. The data recorded on plant grwoth attributes prior to lac inoculation and sticklac yield has been presented in Table 12. The data were analysed statistically which showed 56.2 per cent genetic hereditibility for number of tillers bush and 60.8 per cent for shoot length/bush.

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

2.2.7 Surveys, collection, maintenance, evaluation and characterisation of lac hosts

Colchiploid plants of *Moghania macrophylla*, *Flemingia macrophylla*, *F. paniculata*, *F. stricta*, *F. strobilifera*, *Acacia farnesiana* and *A. auriculaeformis* inoculated during July with *rangeeni* broodlac in order to evaluate their performance in *katki* crop season. The performance of these plants in respect of lac production was very poor (average yield ranging from 7.6 g to 14.4 g per plant). However, fertile progenies of lac insects were obtained. *F. stricta*, *F. strobilifera* and *F. paniculata* have been recorded as lac host for the first time.

Plants of *F. macrophylla*, *F. stricta*, *F. strobilifera*, *F. paniculata*, *F. simialata*, *A. auriculaeformis* and *A. farnesiana* were also

TABLE 12 — ANALYSIS OF VARIANCE FOR GROWTH ATTRIBUTES IN *M. MACROPHYLLA* RAISED FROM CUTTING, 1988

Sources of variance	D.F.	Mean S. S. Value		
		Plant height (in cm)	No. of tillers/ bush	Total shoot length (in cm)
Replication	3	182**	16.57*	362.76**
Treatments	19	40*	12.75**	71.42**
Error	57	22	4.48	21.27
Total	79	33	6.93	46.30
Heritability percent		41.21	56.19	60.80

** Significant at 1 per cent level

* Significant at 5 per cent level

inoculated during November to evaluate them during baisakhi 1988-89 crop season. The insects were growing satisfactorily till the period under report.

Twenty five germlines of pigeon-pea were raised (sown in last week of June) and ten plants from each line were inoculated during November to evaluate their performance during *baisakhi* 1988-89 crop season. Plant growth attributes were recorded prior to lac inoculation during November. It was observed that the plant growth attributes varied with the lines. The lac crop developed satisfactorily till December.

(P. Kumar)

2.2.8 Vegetative propagation of *palas* through air layering

The plants of *palas* (*B. monosperma*) which is one of the major lac host species in India when propagated through seed take very long time to grow and become suitable for commercial lac production and also vary in their lac production capacity. The project was, therefore, taken up with a view to reduce the gestation period and also to get true to type plants.

Selected twigs were air layered in the village Chitir of O.R.P.area during the months of February, March, April, May, July and August. The Seradex® and hormones namely, IAA, IBA, IPA, NAA at 50 and 100 ppm concentrations individually as well as in combination (NAA+IBA, NAA+IPA, IBA+ IAA, IBA+IPA, NAA+IAA, IAA+IPA) were used.

Air layers were detached from the parent tree after one to two months of air layering and were first planted in earthen pots and later on after 2 months transferred to nursery plots.

Best results were obtained when air layering was done during the month of May in which case NAA 100 ppm resulted in 2.4 metre shoot length and exhibited 100 per cent survival of the air layers in pots as well as nursery. Seradex® also gave comparable performance.

(P. Kumar)

D. DIVISION OF CHEMISTRY

(a) RESEARCH COMPLETED

NIL

(b) RESEARCHES IN PROGRESS

3.1 Chemistry of Lac/Constituents

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

The molecular weight of the thermally polymerised seedlac was determined and found to be 3390 at the gel point. This is in conformity with the previous results.

(A. Kumar)

3.1.12 Degradation studies on lac

Experiments were carried out to standardise the conditions of oxidation reaction by selenium dioxide (SeO_2) on lac. Shellac (20 g) was taken in a round bottom flask of 500 ml capacity and dissolved in dioxan (120 ml) and SeO_2 (20 g) was added slowly with stirring for one hour. The solution was refluxed for about 24 hours, cooled and poured in cold water. The aqueous portion was extracted with ether, ethyl acetate and chloroform which on evaporation afforded three liquid compounds. These were examined by TLC (solvent system ethyl acetate: acetic acid, 100:1) and Rf values were recorded as below:

Fraction	Rf value	No. of spots
Ether fraction	0.433,0.660	2
Ethyl acetate	0.673	1
Chloroform	0.413	1

The purification of the compounds obtained is in progress

(S. C. Agarwal and N. Prasad)

3.2 Fine Chemicals from Lac

3.2.10 Synthesis of juvenile hormone analogues and pheromones from aleuritic acid

Synthesis of insect sex pheromone components namely, methyl 9(Z)-hexadecenoate and 9(Z)-hexadecen-1-al was reported last year. The former compound was again prepared this year using a modified sequence from azelaic acid aldehyde (periodate oxidation product of aleuritic acid) adopting Wittig synthesis.

In addition, insect sex pheromone compounds 9(Z)-dodecen-1-ol and its acetate; 7(Z)- etradecen-1-ol and its acetate and 7(Z)-tetradecen-1-al were synthesised from periodate oxidation products of aleuritic acid, azelaic acid aldehyde and 7-hydroxyheptanal.

The related unsaturated alcohols and their acetates were obtained by adopting Wittig synthesis and by treatment with Ac_2O/Pyridine respectively. The compound 9(Z)-tetradecen-1-al was obtained from alcohol by treatment with pyridinium chlorochromate in dichloromethane. Reduction of methyl

9(Z)-hexadecanoate with sodium borohydride/alcohol afforded 9(Z)-hexadecan-1-ol.

Some candidate compounds namely, methyl 9-10-diketohexadecane-1,16-dioate; 8-hydroxy hexadecanoic acid and methyl 8-ketohexadecanoate were prepared for possible juvenile hormone activity.

(R. N. Majee)

3.2.11 Synthesis of bis-heterocyclic compounds from aleuritic acid

Synthesis of thiadiazole from azelaic & pimelic acids and oxadiazoles from suberic, sebacic and pimelic acids were reported last year.

Hexadecane-1,16-dioic acid was prepared from aleuritic acid through potassium permanganate oxidation followed by treatment with N-bromosuccinimide/ethyl acetate and then reduction by Wolff Kishner method. The triazole, oxadiazole and thiadiazoles were then synthesised from the above dioic acid by adopting the reaction sequence eported last year.

(R. N. Majee)

3.2.12 Synthesis of substituted coumarine derivatives from jalaric acid

The project was initiated with a view to synthesise substituted coumarine derivatives from jalaric acid, a constituent acid of shellac.

Oxidation of jalaric acid with silver oxide was carried out which afforded nearly 60 per cent shellolic acid on the weight of jalaric acid. The jalaric acid used in the experiments was prepared on technical scale by adopting the method reported last year. After purification the sample of shellolic acid (melting point 205° C) was examined by TLC (Rf value 0.42; solvent system - ethyl acetate : acetic acid 100:1). Initially the shellolic acid as esterified with methanol/ sulphuric acid mixture so as to get dimethyl shellolate. The purification of the products and their characterization is in progress.

(N. Prasad)

3.2.13 Synthesis of prostaglandin analogues from aleuritic acid

The project was initiated with a view to synthesise prostaglandin analogues using aleuritic acid. Experiments were carried out to synthesise the intermediate prostanoid synthon namely, 2(w-carboxyl hexyl) cyclopene-2 en-1-one adopting the method reported by Majee and Mukherjee, (*Indian J. Chemistry,* 1983).

The sample of pure aleuritic acid was prepared from the gummy hydrolysed mass obtained after separation of jalaric acid. Oxidation of aleuritic acid by potassium periodate was carried out to prepare azelaic semialdehyde. The yield was found nearly 70 per cent of the weight of aleuritic acid. The same oxidation reaction was separately carried out by taking methyl ester of aleuritic acid so as to get directly azelaic semialdehyde methyl ester. The yield was however, only 40 per cent of the weight of aleuritic acid.

(N. Prasad and R. N. Majee)

3.2.14 Derivitisation of shellac acids-synthesis and characterisation of dioxolanes, organic nitrates and tetrazoles

The project is aimed to synthesise a variety of new chemicals from shellac acids

particularly butolic and aleuritic acids for their possible utilization in agricultural, pharmaceuticals and oleo-chemical industry.

3.2.14.1 Synthesis of dioxolanes from butolic acid

The method developed by Sukhdev *et al.* (*Tetrahedran,* 1969) yielded crude butolic acid in the following manner :

The dewaxed lac prepared from ordinary shellac was hydrolysed with NaOH and after 10 days it was neutralised with hydrochloric acid (1:1). The resultant product was extracted with ethyl acetate. The extract was concentrated to half of its volume, dispersed on celite, dried and soxhlet extracted using with petroleum ether which resulted in crude butolic acid (semi solid).

3.2.14.2 Synthesis of organic nitrates from aleuritic acid

Aleuritic acid (melting point 97-98°C) was prepared adopting standard method of alkaline hydrolysis (NaOH) of shellac. Attempts were made to convert it into unsaturated acid namely, 16 - hydroxyhexadec - 9 - enoic acid. A crude product having low melting point (45.46°C) was obtained.

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

3.3 Modification of Shellac/Constituents and their Utilisation

3.3.11 Modification of lac by ethyl cellulose

It was reported last year that the air dried films prepared from the composition obtained by mixing hand made shellac with ethyl cellulose in spirit and plasticized with dibutyl phthalate showed poor adhesion. Other surface coating properties of the air dried and baked films were studied during this year.

The touch and hard drying period of the air dried films was 5 minutes and 2 hours respectively. Air dried films were flexible but other properties such as impact resistance, hardness, acid, alkali, alcohol and acetone resistance were poor. The baked (30/45 minutes at 150°C) films were also flexible but possessed poor impact resistance and hardness. These films when observed after 24 hours dipping, showed resistance to water, acid and alkali but were not found resistant to alcohol and acetone.

(A. K. Dasgupta)

3.3.12 Modification of lac wax

Lac wax recovered from lac mud was reacted with liquor ammonia (density - 0.9) at different concentrations (10, 20 & 40 percent w/v) and the resulting ammonium salt was heated to convert into amide at different temperatures such as 100, 180 and 200°C. The physico - chemical characteristics of the modified wax were determined. The data showed that acid value decreased considerably when reacted at 200°C indicating its possible reaction with ammonia (Table 13). There was not significant improvement in penetration and solvent retention values.

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

TABLE 13 - PHYSICO-CHEMICAL CHARACTERISTICS OF LAC WAX RECOVERED FROM LAC MUD AND MODIFIED WITH AMMONIA

Sl. No	Treatment		Melting point (°C)	Penetration value	Acid value	Ash content (percent)	Saponification value	Solvent retention value
	Temperature (°C)	Ammonia concentration (percent W/V)						
1.	100	10	78-79	5	12.74	0.20	32.48	79.4
		20	79-80	5	12.74	0.15	31.36	80.1
		30	80-81	3	12.74	0.10	30.24	82.2
2.	150	10	77-78	5	10.92	0.20	26.88	80.8
		20	78-79	5	10.10	0.15	28.00	84.8
		40	79-80	5	7.28	0.10	29.12	86.0
3.	200	10	76-77	4	5.46	0.20	28.00	85.0
		20	77-78	5	6.37	0.15	30.24	86.6
		40	78-79	5	8.19	0.10	31.36	88.2
4.	—	Untreated	80-81	6	13.60	—	—	—

3.3.13 Studies on lac-based cation exchange resin as catalyst

It was reported last year that the cation exchange resin prepared from machine and hand made shellacs possessed very low cation-exchange capacity and a such were not found suitable as a catalyst in esterification process.

Studies were further undertaken to prepare cation-exchange resins using autoclave (partially dewaxed) and dewaxed decolourised lacs. The sulphonated lac an intermedidate product, was prepared following method developed by the Central Leather Research Institute, Madras from the above lacs. The sulphonated lacs were converted into cation-exchange resins and were analysed for total exchange capacity following the standard procedures (*A. Rep.* 1987). But it was found that the resins so prepared also possessed very low cation-exchange capacity.

(B. C. Srivastava)

3.4 Use of Lac and Modified Lacs in Surface Coating

3.4.6 Styrenation of lac-oil combinations

Last year, styrenation of lac-linseed oil was attempted using ordinary shellac where improvement was noticed in scratch hardness and water & acid resistance of the resultant films but alkali resistance was poor.

In order to avoid possible interference in copolymerisation process due to the presence of erythrolaccin in ordinary shellac, combination of linseed oil with dewaxed decolourised shellac was prepared. The combination was reacted with styrene 50:50 and 30:20 proportions using benzoyl peroxide (5 and 10 parts) as initiator and refluxed for 10 and 20 hours.

The films prepared from the resulted products showed increased scratch hardness and resistance to water & acid. With higher proportions of styrene, resistance to alkali also improved. It was observed that

the compositions prepared using dewaxed decolourised shellac showed better performance.

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

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

It was observed that films of the varnish prepared from the gummy mass remain tacky evenafter air drying for months together.

Attempts were, therefore, made to modify the composition with melamine resin. It was found that when the gummy mass was modified with 20 per cent (w/w) melamine resin the tackyness of the films was removed after air drying for 12 days.

(A. K. Dasgupta)

3.4.8. Lac based coating compositions for outdoor applications

Shellac is mostly used in interior applications. It has poor weather resistance which restricts its use for outdoor applications.

Shellac was therefore modified with ethylene glycol and adipic acid to get polyster by following two process:

One step process Dewaxed decolourised lac (40 mesh, 100 g), ethylene glycol (38 ml) and adipic acid (10 g) were heated together to 120°C with consant stirring until all the lac was dissolved. Temperature was thereafter lowered to 80°C and p-tolune sulphonic acid (0.5 g) was added, after which the temperature was gradually raised. The mixture was heated at 175+ 5°C till constant acid value was obtained (nearly 4 hours).

Two step process : In two step process, same proportions of dewaxed decolourised lac and ethylene glycol were heated at 175+ 5°C for one hour. The temperature, thereafter, was lowered to 100°C and adipic acid (10 g) and p-toluene sulphonic acid (0.5 g) were added and temperatue was raised to 175 + 5°C. Heating was continued till constant acid value was obtained.

The polyesters thus obtained were dissolved in methyl ethyl ketone and were pigmented with titanium dioxide (30 parts) and ball milled for 24 hours. The resultant paint was then reacted with TDI/Desmodur N/Desmodur VL/Desmodur Z to obtain urethane paints. Eight such compositions were prepared and applied on mild steel panels (20 gauge) with brush after cleaning the panels with fine sand paper and solvent to remove rust, greese etc. After air drying for 7 days, the panels were exposed to atmospheric conditions (45° towards south) for testing weather resistance. There was obsolutely no change of gloss and panels remained in perfect condition up to December (one month).

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

3.5 Use of Lac for Encapsulation and Controlled - Release

3.5.5 Slow-release lac-urea formulation for animal feed

It was reported last year that lac-urea combinations possessed slow-release characteristics. The work was further continued to study the effect of temperature and pH on the dissolution of urea from the lac-urea formulation. The standard buffer solutions having pH value 6.6 and 6.8 were prepared using citric acid and di-basic sodium phosphate. Standard buffer tablet

(BDH) was used for preparing the neutral (pH 7) buffer solution. The test temperatures viz 44°C, 48°C, 52°C (+) were maintained in a small air oven.

A lac urea combination prepared by heating shellac (90 parts) and urea (10 parts) at 150° C up to gel point was tested for dissolution behaviour at above mentioned pH and temperature at the interval of one and six days. The dissolution was observed to increase with the increase in temperature and pH.

Attempts were also made to develop a slow-release urea in granular form for the animal feed using encapsulation technique. Encapsulated urea granules were prepared using lac rosin ester as a wall material and notoxic ingredient like coaltar etc. Preliminary observations indicated that such formulation can serve as a slow - release urea for animal feed.

(B. C. Srivastava)

3.6 Electrical Properties of Lac and Modified Lacs

3.6.3 Study on the tracking resistance of shellac based varnishes

The results of the study on the tracking of varnishes prepared by curing and epoxy resin both in the cold and by fusion were prepared last year. Similar studies in bigger lots (upto 400g) were carried out this year.

Curing in the cold : Tests on tracking property were carried out following IS : 8264 - 1976 and IS : 10026 - 1982 for the air drying varnishes prepared by curing shellac and epoxy resin varnishes in the ratios of 70:30 and 50:50. Both the varnishes passed the tests satisfactorily at 135V and 200V. The tracking index values for these two compositions were found to be 270V and 300V respectively.

The results of he tracking tests carried out on baked films (2 hours, 120°C) also passed the requirements of the standards for 135 and 200V. These are conformity with the results obtained last year. The tracking index values of the baked films prepared from 70:30 and 50:50 shellac epoxy varnishes were in the same range i.e. 270V and 310V respectively. The above mentioned values were higher than that of shellac alone (256V).

Curing by fusion : The tracking experiments carried out on the air drying varnishes prepared from the cured products of 70:30 and 50:50 shellac epoxy resin prepared in 400 g lots also passed the tests at 135V and 200V satisfactorily as was reported earlier in respect of smaller lots (*A. Rep.*, 1985). All the above mentioned shellac-epoxy varnishes exhibited increased resistance towards tracking.

The results show that varnishes prepared from 70:30 and 50:50 shellac-eposy combinations can be used as air drying type antitracking varnishes.

(D. N. Goswami)

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

It was reported last year that a varnish based on lac-linseed oil combination and silicone resin was found to posses good film properties and dielectric strength.

Experiments were carried out on the modification of lac-linseed oil combinations

with the silicone resin (metroark 1974, Silicone) used last year. Satisfactory results could not be obtained due to the tendency of the silicone resin to gel under the influence of catalyst and temperature.

Studies were also undertaken on the varnishes based on lac-linseed oil epoxy resin combinations. A mixture of shellac and epoxy resin was reacted with the mixed glycerides of linseed oil at 290 ± 5°C. The product was completely soluble in xylene, toluene, methyl-ethyl ketone (MEK) and methyl-isobutyl ketone (MIBK). A suitable solution of this product in solvent mixtures namely toluene + MIBK (2:1); and toluene + MEK (2:1), produced films which on baking became tack free, smooth, glossy, flexible and showed good resistance to water, acid and alkali. Baked films of above formulations possessed improved thermal resistance upto 200-220°C and dielectric strength of the order of 1.9 kv/mil at 30°C. Films on copper panels when conditioned at 100°C for 168 hours remained flexible. No greening of copper was observed.

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

3.8 Biochemical Aspects of Insect-Host Plant Relationship

3.8.1 Transformation of sap constituents and their incorporation in lac secretion

The extraction of *kusum* bark with different solvents was reported last year. The extraction procedure was modified as follows:

Dried *kusum* bark (1.5 kg) was extracted successively with petroleum ether, methanol and water. The petroleum ether portion (F.A.) was fractionated into wax (F.A. 1) and lipid portions (F.A. 2) by keeping it in chloroform + methanol (2:1) at 0°C. The insolubles (wax) were filtered of and filterate (lipid) was kept at 0°C for further analysis. The fraction F.A. 1 was eluted on a column of silica gel with petroleum ether (40-60°C), petroleum ether + benzene (1:1); benzene alone and benzene + ethyl acetate (1:1). For fractions were obtained (F.A.1.1, F.A.1.2, F.A.1.3 and F.A.1.4). Fraction F.A.1.1 was purified repeatedly on a column of alumina and one pure fraction (Rf, 0.63) was obtained, which was crystallised and sent for IR and PMR analysis.

The fraction F.A.1.2 was again eluted repeatedly on alumina with petroleum ether + benzene C.1:1). A mixture of two components (Rf, 0.57 and 0.7) was obtained which is being separated by preparative thin layer chromatography.

The third (F.A.1.3) and fourth (F.A.1.4) fractions were found to be a mixture of three (Rf, 0.05, 0.11 and 0.2) and five (Rf, 0.05, 0.06, 0.17, 0.23 and 0.46) components respectively.

The methanol extract of *kusum* bark was concentrated under vacuum and shaken with hexane + benzene (1:1) to separate out non-polar compounds. A gummy mas was obtained after concentration of the methanol extract and was stored in inert atmosphere.

A portion of the gummy mas was chromatogaphed over alumina (Brockman, neutral) column using methanol + hexane (17:3); methanol (AR); water; methanol acetic acid (9:1): methanol acetic acid (3:2) which yielded twelve fractions. The TLC examination of the fractions exhibited good resolution.

A protion of the gummy mass was also chromatographed over silica gel (60-120 mesh) column using methanol + hexane (17:3) followed by pure methanol. The TLC examination of the above fractions however, did not exhibited good resolution.

The residual *kusum* bark was refluxed with distilled water and resultant deep red aqueous extract was concentrated under vacuum. The solid deposit was filtered off and dried to yield a dark red mass which was soluble in methanol.

(S. C. Agarwal, P. Kumar, A. K. Sen, K. M. Prasad and P. C. Sarkar)

E. DIVISION* OF TECHNOLOGY

(a) RESEARCHES COMPLETED

4.1 Improvement in the Processing Techniques

4.1.6.2 Improvement in dewaxing and decolourising techniques in solvent medium

Dewaxed and decolourised lac is very much in demand. The present project was taken up to work out the details of dewaxing and decolourising technique and making improvements therein.

Experiments were carried out to standardise the process of dewaxing and decolourising of lac.

Finely powdered (30-40 mesh) *kusmi* seedlac having colour index 8-12 and wax content 4-5% was dissolved in cold alcohol (11-14°C) in the ratio of 1:9 (w/w) by intermittent stirring. The time of dissolution was not allowed to exceed more than 3 hours at the temperature (11-14°C). The solution was then filtered using silver-sand as filter aid, washed thoroughly with cold alcohol and the washings were mixed with the filterate. After filtration, the wax-free solution was decolourised by treating with activated carbon (20 per cent on the weight of lac) at 78°C for 1 hour. Different grades of activated carbon (commercial, LR and pure and dry) were tried for decolourisation. Decolourised lac of grade D1 (IS: 16, 1956; ISO:R-56, 1957, E) was prepared from these carbons. Decolourisation of lac was most effective with pure and dry grade of activated carbon (E. Merck, Germany). By using this grade, shellac having colour index as low as 0.7 to 0.9 was prepared whereas by using commercial (Bengal Chemicals) and LR (Sarabhai Chemicals) grades of activated carbon, shellac with a comparatively higher colour index ranging from 1.2 to 1.4 was obtained. The dewaxed and decolourised lac was collected from the clear filrate by distilling off the alcohol and vigorously boiling with distilled water and was finally flaked. The average yield of dewaxed and decolurised lac was 80 per cent.

The effect of acids during decolourisation was studied. It was observed that addition of 0.2 per cent of acetic acid (on the weight of seedlac) during above decolourisation process can lower the colour index further by 0.3 unit without deteriorating the life and flow of the resulting seedlac.

Different solvents namely acetone, methanol, isopropyl alcohol and denatured spirit (distilled) were tried for dissolving shellac for dewaxing and decolourising lac by the above process. It was observed that methanol and denatured spirit (distilled) were as good as rectified spirit of dewaxing and decolourising lac.

*Converted to section with effect from 1.7.1988.

Re-use of activated carbon

In order to make the process more economic, experiments were carried out to study the feasibility or recycling the activated carbon used in the process of decolourisation. *Kusmi* seedlac (Colour Index 12.0) was decolourised by activated carbon (LR, Sarabhai Chemical) by the standardised process described earlier. The colour index of the decolourised lac obtained was 1.1. The activated carbon recovered after filtration of the alcoholic decolorised solution of lac was again used to decolourise a fresh lot of *kusmi* seedlac of the same batch. In this way the experiments regarding cycling of used activated carbon were repeated seven times. It was observed that activated carbon recycled for the seventh time could reduce the colour index of seedlac from 12.0 to 3.5 only. Decolourised shellac of D1 grade conforming to ISS: 16, 1956 can be prepared by using the recycled activated carbon up to the time (Table - 14).

TABLE 14 - DECOLOURISATION OF *KUSMI* SEEDLAC (COLOUR INDEX 12) WITH USED ACTIVATED CARBON (LR, SARABHAI CHEMICAL)

Details of carbon used	Frequency code	Colour index	Yield (per/cent)
Fresh	C0	1.1	82.5
Once used	C_1	1.5	82.2
Twice used	C_2	1.8	83.1
Thrice used	C_3	2.0	83.2
Four times used	C_4	2.5	83.4
Five times used	C_5	3.0	82.7
Six times used	C_6	3.5	82.3
Seven times used	C_7	3.5	84.1

Experiments were also carried out to utilise he used carbons by counter current system. Different batches from the same *kusmi* seedlac (Colour Index 12) were decolourised twice as usual by treating separately with the fresh and used carbons. The best result was obtained by carrying out the decolourisation first with the fresh carbon (Co) and then with the once used carbon (C_1) and in this way shellac with colour index 0.9 could be prepared. By decolourising *kusmi* seedlac solution similarly with the combinations upto five (C_5) and six (C_6) times used carbons decolourised shellac of D1 grade could be obtained (Table - 15). The addition of 0.1 per cent acetic acid during decolourisation resulted in the further reduction of colour of shellac up to 0.8. The experiments with the commercial grade of Bengal Chemicals and LR grade of Sarabhai Chemicals of activated carbon gave comparable results.

TABLE 15 - DECOLOURISATION OF *KUSMI* SEEDLAC (COLOUR INDEX 12) WITH DIFFERENT COMBINATION OF ACTIVATED CARBON (LR, SARABHANI CHEMICALS) BY COUNTERCURRENT SYSTEM.

Codes of combinations of carbon used	Colour index & shellac obtained	Yield (per/cent)
C_0	1.1	82.0
C_0+C_1	0.9	81.3
C_1+C_2	1.1	82.5
C_2+C_3	1.2	83.0
C_3+C_4	1.4	83.0
C_4+C_5	1.6	83.4
C_5+C_6	1.8	84.0
C_6+C_7	2.1	84.0

Reactivation of exhausted carbon

Experiments were carried out to reactivate the used carbon which lost its adsorptive power due to long use in the process of decolourisation of lac. The used carbon was

extracted thrice with 2 per cent alcoholic caustic soda and the residual carbon was thereafter treated with 2 per cent sulphuric acid and finally washed throughly with water till free from mineral acid. After drying, the carbon was reactivated at 500°C for 1 hour. The reactivated carbon thus obtained can be used to decolourise lac and shellac with colour index as low as 0.9 (Table - 16).

TABLE 16 - DECOLOURISATION OF *KUSMI* SEED LAC (COLOUR INDEX 12) WITH REACTIVATED CARBON (LR, SARABHAI CHEMICALS)

Details of carbon used	Shellacc obtained	
	Colour index	Yield (per/cent)
Fresh	1.1	82
Reactivated	0.9	84

(R. K. Banerjee)

4.1.8 To study the industrial parameters affecting the preparation of bleached lac

The project was undertaken to study the parameters such as life, flow and bleach index of the parent seedlac used for the preparation of bleached lac of good keeping quality.

Experiments were carried out to correlate the properties of parent seedlac with the bleached lac prepared therefrom. *Rangeeni* and *kusmi* seedlacs of different ages were converted into bleached lac by the standard method. The properties of the parent seedlacs of different ages and the bleached lac prepared therefrom were compared (Table - 17).

No difficulty was experienced in preparing bleached lac from the samples of seedlac as old as 4 years. The yield of bleached lac was, however, reduced due to the insoluble portion of seedlac. The dried samples of bleached lac stored under laboratory condition were tested for their solubility in alcohol at regular intervals. No deterioration was observed upto 14 months but thereafer slight insolubility (turbidity) appeared in the samples prepared from seedlac having life and flow less than 30 minutes and 40 mm respectively. The yield of the bleachedlac decreased with the age of the parent seedlac (Table - 17).

TABLE 17 - CORRELATION OF THE PROPERTIES OF PARENT SEEDLAC AND THE BLEACHED LAC OBTAINED

Sl. No.	Age (year)	Seedlac used Properties			Yield (per/cent	Bleached lac obtained Properties			
		Life (minutes)	Flow (mm)	Bleached Index		Colour Index	Life (minutes)	Flow (mm)	Shelf* Life (months)
					RANGEENI				
1.	0.5	61	65	95	81.5	0.30	10	10	15
2.	1.0	40	51	100	80.2	0.40	11	10	15
3.	2.0	30	40	95	74.1	0.30	11	9	15
4.	3.0	22	21	103	70.5	0.30	10	10	14
5.	4.0	11	0	115	63.5	0.35	10	8	14

KUSMI

6	0.5	70	79	70	83.5	0.30	11	12	15
7.	1.0	58	61	78	81.7	0.30	10	10	15
8.	2.0	51	48	80	75.1	0.35	11	9	15
9.	3.0	31	23	80	73.6	0.40	10	8	14
10.	4.0	24	8	80	66.1	0.40	10	8	14

*Period for which the bleached lac remains completely soluble in alcohol.

The study revealed that by strictly following the method developed at the Institute optimum yield and standard bleached lac of good keeping quality can be prepared conforming to IS: 15-1956, Standard I (life 40 minutes and flow 50 mm). In order to maximise the yield of bleached lac the parent seedlac should be completely soluble in alcohol.

(R. K. Banerjee)

4.2 Rubber Shellac Combinations

4.2.2 Electrical properties of rubber-shellac blends

The study was taken up to investigate the electrical properties of different rubber-shellac combinations and to evolve a suitable composition for electrical insulation. For this purpose, electrical properties of the compositions obtained by the incorporation of different proportions of shellac in the gumstocks of natural rubber (NR), styrene butadiene rubber (SBR) and their 1:1 blend and also in the filled stock of a blend of NR and SBR were studied. The fillers used were china clay, aluminium silicate and a combination of china clay and calcium carbonate. The curing time was varied between 10 to 50 minutes. The electrical parameters studied were dielectric constant, dielectric loss, dissipation factor (tan) and dielectric strength.

Natural rubber gumstock

Different electric parameters of NR and SBR shellac compositions were studied. An initial decrease was noticed in the value of dielectric constant due to incorporation of shellac in gumstock. It reached a minimum and then on further addition of shellac an increase was observed. The changes in the values, however, were not appreciable.

Incorporation of shellac in the gumstock resulted in decrease in the values of dissipation factor and dielectric loss, which is an improvement in the dielectric properties of natural rubber. The values of dissipation factor and dielectric loss i.e. 0.002 and 0.0002 respectively were lowest in case of the composition containing 2.5 parts of shellac cured for 30 minutes.

No marked change in the dielectric strength was observed. The variation of dielectric constant, dissipation factor and dielectric loss was studied in the frequency range 0.1 to 100 kH at temperatures ranging from 30 to 110°C. Both the frequency and temperature profiles of dielectric loss revealed existance of many relaxation processes. Natural rubber containing 5 parts of shellac and cured for 20 minutes was observed to possess the desirable electrical properties

such as dielectric constant (2.82), dissipation factor (0.0008), dielectric loss (0.00225) and dielectric strength (345 V/mil).

Styrene-butadiene rubber gumstock

The variation in the different dielectric properties was studied in the case of shellac-SBR compositions. A general increase in the value of dielectric constant was observed due to incorporation of shellac in the gumstocks. For the gumstocks cured for 40 minutes and more, the above behaviour, however, was not observed. The maximum value (3.41) was obtained for the gumstocks containing 15 parts of shellac and cured for 20 minutes.

Most of the shellac containing SBR compositions showed higher values for both dissipation factor and dielectric loss. For some compositions a lowering in the above values was also observed. Minimum values of the dissipation factor and dielectric loss i.e. 0.0004 and 0.0011 respectively were obtained for the composition containing 5 parts of shellac cured for a period of 20 minutes.

No marked change was noticed in the dielectric strength by incorporation of shellac in the gumstocks. However, dielectric strength values of shellac free gumstocks of SBR were in general lower than those of natural rubber.

Blends of NR and SBR (1:1) in gum stock

The changes in the values of different dielectric parameters of shellac incorporated blends (50:50) were studied. There was no marked change in the dielectric constants and no significant trend was observed in the behaviour of shellac incorporated blends.

Dissipation factor and dielectric loss values of the blends were found to be lower than those of natural rubber. Dissipation factor values of the shellac incorporated gumstocks were higher as compared to those of shellac free stocks. These values for the stocks containing upto 15 parts of shellac and cured for 20 and 30 minutes were almost similar to those of shellac free blends. In general incorporation of shellac in the gumstock resulted in an increase in the value of dielectric loss. It was observed that dielectric strength values of shellac free and shellac containing blends were almost same.

Filled stocks of blend of NR and SBR (1:1)
(i) China clay filled stock

The dielectric parameters of china clay filled stocks were also studied. Dielectric constant values of shellac free filled stocks were found to be higher than those of the individual rubbers. Stocks containing shellac and cured for 30 to 50 minutes showed slightly higher values of dielectric constant. However, for other stock slight decrease in dielectric constant was observed.

No trend was observed in the changes in dissipation factor (Tan) as well as dielectric loss due to incorporation of shellac in the filled stocks. Minimum values of Tan and dielectric loss recorded were 0.0006 and 0.00194 respectively in case of the stock containing 10 parts of shellac cured for 40 minues.

Incorporation of more than 10 parts of shellac in the filled stock resulted in slight decrease in the dielectric strength.

(ii) Aluminium silicate filled stock

The values of dielectric constantof the shellac free filled stocks of the blends were higher as compared to those of NR, SBR and also of their unfilled and china clay filled blends (1:1). Incorporation of shellac in the stock increased the dielectric constant for most of the compositions.

Dielectric loss and Tan values of shellac free filled stocks were nearly 10 times higher than those of china clay filled stocks of the blends and Nr and SBR gumstocks. Most of the shellac incorporated stocks exhibited higher Tan values. The variation observed for dielectric loss was similar to that of Tan. The dielectric strength values varied from 285 to 345 V/mil.

(III) China clay: calcium carbonate (50:45) filled stock

The values of dielectric constant of the stocks containing a combination of above fillers found to be higher than of china clay filled stocks. The value of dielectric constant of filled stocks containing 5 parts of shellac when cured for 20 minutes was recorded be higher (4.22) as compared to shellac free filled stocks (3.78).

The values of Tan and dielectric loss of the filled stocks were also higher than china clay filled stocks but lower as compared to that of aluminium silicate filled stocks. The results in respect of Tan were not consistent.

Incorporation of shellac did not cause any marked change in the values of dielectric loss of the stocks cured for 20-50 minutes. No marked change was observed in the dielectric strength values. The break down strength (BDS) of these filled stocks was slightly lower than other stocks.

Conclusion

1. Incorporation of shellac in the natural rubber gumstocks causes a lowering of dielectric loss and Tan δ value. Natural rubber containing 5 parts of shellac when cured for 20 minutes was found to possess better dielectric properties compared to shellac free rubber.

2. SBR gumstocks containing 15 parts of shellac when cured for 20 minutes exhibited beter properties than shellac free stocks.

3. Incorporation of shellac in the gumstocks of blend of NR and SBR (1:1) do not reveal any marked improvement in the dielectric properties.

4. China Clay was found to be the most best white filter out of the three types of fillers studied. China Clay filled stocks of a blend of NR and SER generally exhibied higher values of dielectric constant. Stocks containing 10 parts of shellac when cured for 40 minutes were found to possess better combination of properties as compared to other stocks.

5. Aluminium silicate filled stocks exhibited comparatively very high vales of dielectric constant as compared to NR and SBR. Nearly 10 times higher values of Tan δ and dielectric loss were, however, also recrded which is not desirable.

6. Use of a combination of china clay and calcium carbonate (50:45) as filler exhibited better dielectric properties than aluminium silicate filled stocks.

(R. Singh and D. N. Goswami)

4.3 Use of Lac in Adhesives

4.3.4 Modified lac (with synthetic resins) as adhesive

The adhesive property of shellac as such is poor and finds limited use for bonding different surfaces. It was, therefore, proposed to modify it with synthetic resins in order to increase adhesive properties.

Four thermosetting resins namely epoxy (molecular weight 5000), butylated malamine (solid content 37 per cent), urea formaldehyde (U.P.) and phenol formaldehyde (P.F., Norolac) were tried alongwith shellac.

Fifty per cent solutions of shellac as well synthetic resins mentioned above were prepared in spirit and compositions were formulated and applied over mild steel to mild steel, wood to mild steel and wood to wood surfaces for testing of bond strength. Mild steel to mild steel joints were pressed under 2,000 lbs./square inch pressure at 150°C for one hour and wood to mild steel as well as wood to wood surfaces were clamped for 24 hours, cold cured for seven days after that tested for the bond strength with the help of Hounsfield Tensometer.

Among the four synthetic resins tried epoxy and butylated melamine resin were found better in regard to adhesive property. These can be used for formulating adhesives for binding all the surfaces. The other two resins deteriorate the adhesive properties of shellac in adhesive formulation (Table 18).

(P. C. Gupta)

TABLE 18 - BOND STRENGTH* OF SHELLAC (ASK) MODIFIED WITH SYNTHETIC RESINS

Type of joint	Synthetic resins	Ratio of shellac : Synthetic resins										
		100:0	90:10	80:20	70:30	60:40	50:50	40:60	30:70	20:80	10:90	0:100
Steel	P.F. resin (Norolac)	0.06	0.03	0.03	0.02	0.03	0.03	0.02	0.01	0.01	0.01	0.02
to	U.F. resin	0.06	0.06	0.05	0.02	0.04	0.05	0.06	0.05	0.05	0.02	—
	Epoxy	0.08	0.13	0.13	0.21	0.21	0.23	0.22	0.18	0.16	Shellac separated	No adhesion
Steel	Butylated melamine resin	0.08	0.08	0.07	0.07	0.14	0.12	0.11	0.08	0.04	—	—
Steel	P.F. resin	0.06	0.03	0.02	0.03	0.06	0.05	0.07	0.02	0.02	0.02	0.04
to	Butylated	0.05	—	0.20	0.17	0.17	0.11	0.12	0.11	0.09	did not	
Wood	melanine										dry	
Wood	P.F. resin (Novo lac)	0.02	0.02	0.03	0.04	0.05	0.04	0.04	0.02	0.03	0.02	0.04
to	Butyiated	0.05	—	0.08	0.12	0.12	0.06	0.07	0.07	did not	did not	
Wood	melanine resin									dry	dry	

*ton/square inch

4.3.6 Use of lac byproducts for making coal block from coal dust as domestic fuel

The project was undertaken to prepare water and impact resistant coal block using inferior quality of coal dust (E and F grades) and byproducts of lac (*kiri, mola*mma and *kunhi*) as a binder.

Coal dust F-grade obtained from north Karanpura (Bachara Coliery) and *kiri* having 50 per cent lac content were used for the preparation of coal blocks. THese ingredients were initially powdered (40 mesh) with the help of a disintegrator, mixed together thoroughly in cold and moulded in a cylindrical mould at different temperatures, pressure and time under a hydraulic press. The blocks were immediately taken out with the help of plunger. Cylinderical blocks of 7.5 cm diameter and 5 cm height with 7 holes were thus prepared. It was found that minimum quantity of binder reqired to produce block of desired properties was 3 per cent (140° C; 25 tons/inch^2 pressure for 2 minutes).

Following the same method, molamma having 70 per cent resin content and *kunhi* with 40 per cent resin content were also tried as a binding material. It was observed that 3 per cent molamma and 2 per cent *kunhi* imparted the same desired properties to the blocks as obtained with *kiri*. The properties have been summarised in (Table 19).

Attempts were also made to prepare blocks without using any binder. Under the similar moulding conditions smooth blocks were prepared. These blocks, however, failed in respect of water and impact tests showing that binder plays a vital role for making the blocks impact and water resistant.

TABLE 19 - CHARACTRISTICS AND PERFORMANCE OF COAL BLOCKS USING KIRI, MOLAMMA AND KUNHI AS BINDER

1	Appearance	:	Compact Black
2.	Weight	:	200-205 g
3.	Impact strength	:	Quite strong and does not break when falls from a height of 1 meter
4.	Hygroscopicity	:	Non-hygroscopic
5.	Water resistance	:	Does not disintegrate when immerged in water for 48 hr or even more
6.	Burning property	:	Easily catches fire when ignited with fire wood or coal-block ignitor (ILRI)
7.	Period of burning	:	About 2 hours
8.	Flame length	:	1-2 cm
9.	Nature of flame	:	Blue
10.	Heating capacity	:	200 ml water boils in 5-6 minutes in pressure cooker (1 litre capacity)
11.	Cooking performance	:	One block can cook 200 g rice in 400 ml water in 30 minutes, 50 g pulse in 150 ml water in 15 mnutes and 20 chapaatis (400 g wheat flour).

Calorific and useful heat values of the blocks

The calorific and useful heat values of the blocks were determined. No significant variation in the calorific values of the blocks prepared with *kiri, malamma, kunhi* or without any binder was observed. Useful heat value was maximum in case of block prepared with *kiri.*

TABLE 20 - THERMAL PARAMETERS OF LAC BASED COAL BLOCKS

Binder used	Concentration percent	Calorific value K.cal/kg	Useful heat value K.cal/kg
Kiri	3	3870	2772
Molamma	3	3700	2662
Kunhi	2	3730	2488
Control (No binder)	0	3870	2662

(P. C. Gupta)

(b) RESEARCHES IN PROGRESS

4.2 Rubber Shellac Combinations

4.2.3 A comparative study of shellac with rosin for use in rubber industry

The study was taken up to compare the utility of shellac vis-a-vis rosin in rubber compounding.

Rosin and shellac were incorporated in NR gumstock. It was found that optimum time of cure was increased with the use of rosin with all the concentation tried. With the use of shellac, however, it increased upto 2.5 and 5 per cent but thereafter it decreased. Ultimate elongation decreased with all the rosin concentrations whereas with 2.5 per cent it remained unaltered but it decreased with higher concentrations. Tensile strength decreased with both shellac and rosin but decrease was more with rosin. Tear resistance decreased with all the concentrations of rosin but with shellac it increased except when 10 per cent shellac was used. Hardness decreased slightly with rosin but remained constant with shellac (Table 21).

(R. Singh, P.C. Gupta and A. Pandey)

TABLE 21 - EFFECT OF INCORPORATION OF ROSIN AND SHELLAC INTO NATURAL RUBBER GUMSTOCK

Resin used	Per cent of resin in the blend	Curing time (minute)	Ultimate elongation (Per cent)	Tensile strength (2 kg/cm)	Tear Resistance (kg/cm)	Hardness (Shore-Durometer)
Rosin	0.0	30	900	73.4	4.9	36
	2.5	40	850	60.8	2.0	34
	5.0	40	730	32.7	3.2	35
	7.5	50	720	30.2	3.4	35
	10.0	50	700	24.6	4.1	36
Shellac	2.5	40	900	57.4	6.0	36
	5.0	40	850	49.2	—	36
	7.5	30	800	35.4	6.2	36
	10.0	30	700	24.6	4.9	38

Composition of base mix: NR, 100; ZnO, 4; Fletch H, 1; Stearic acid, 1; Sulphur 2.5; Accelerator, 0.5

4.5 Use of Lac in printing Ink

4.5.1 Development of printing inks based on lac/modified lacs

Last year it was reported that lac alone was not useful for making printing inks using furnace black carbon. Beside this partial butyl ester/ether and glycol ester/ether of lac were also not useful since resulting consistency, hue and flow were not up to the mark.

Lac was, therefore, modified with linseed oil (Sanakarnaryanan. Y., J. Sci. industrial Res., 1947) to be used as binder. Three printing inks formulations based on this binder were prepared (Table 22).

TABLE 22 - PRINTING INK FORMULATIONS BASED ON LAC-LINSEED OIL BINDER

Sl. No.	Ingredients	Composition (percent) A	B	C
1.	Binder	14.2	28.5	27.0
2.	Fison's channel black carbon (21752)	12.3	14.0	12.2
3.	Linseed oil			
4.	Mineral oil	73.7	56.0	19.4
5.	Cobalt naphthenate	—	traces	—

These compositions apparently showed properties comparable to that of market sample (obtained from Prabhat Khabar daily, Press, Ranchi) in respect of hue and shine etc. They also did not show any *Strike through or show through.* No livering was observed while mixing the ingredients before grinding.

Lac based alkyd formulation was also prepared (Chopra, S.S. and Sankarnaraynan, Y., *Indian J. Technol.* 1967) and used as binder in Printing ink formulations which gave results comparable to that of lac-linseed oil based ink formulations.

(A. Pandey)

4.6 Pilot Plant Studies on Lac Based Products and Process

4.6.1 Preparation of improved cation exchange resin from shellac

Cation exchange resin from shellac was prepared following the method of Rahman *et al.* (*Res.* & *Industry,* 1979) but the cation exchange capacity was found only 0.02 m. eq./g. A systematic study was, therefore, initiated by converting lac into gel using resorcinol paraformaldehyde method of Dhar *et al. (J. Sci. Industrial. Res.* 1954) then sulphonated using concentrated sulphuric acid, oleum (20 per cent) and chlorosulphonic acid separately.

The cation exchange capacities obtained were 3.80, 4.10 and 5.84 with sulphuric acid, oleum and chlorosulphonic acid respectively. The gel and acid ratio was 1;8 in case of sulphuric acid and oleum while in the case of chlorosulphonic acid it was 1:28 Oleum and chlorosulphonic acid proved better sulphonating agents.

(P. C. Gupta and K. K. Sharma)

F. DIVISION OF EXTENSION

(a) RESEARCH COMPLETED

NIL

(b) RESEARCHES IN PROGRESS

5.5 Operational research project for maximising lac production in Chotanagpur area

Last year a new operational area (phase iii) comprising of two backward tribal villages namely, *Chitir* and *Dundu* was selected in the Namkum Development Block of Ranchi district for conducting operational researches on the transfer of technology in respect of lac culture and other enterprises. Bench mark survey of the area was continued.

Bench Mark Survey

Bench mark survey revealed the following facts:

1. Geographical area of the villages totalled 291.74 hectare.
2. No forest or culturable waste existed in the villages.
3. Only 3.64 hectare cultivated land (1.25 per cent of total) was irrigated (tanks and wells).
4. 115 households including 692 individuals (349 males and 343 females) Inhabiited and villages.
5. Majority of the population (96.5 per cent) consisted of scheduled tribes (*Oraon* 58.2; *Munda*, 32.6; *Lohra*, 4.5 and *Baraik*, 1.2 per cent).
6. Religion wise Hindus dominated the scene (88.4 per cent) followed by Christians (9.1 per cent) and Muslims (2.5 per cent).
7. Age of the majority of the population (77.3 per cent) was recorded to be below 35 years.
8. Working force was recorded to be 53.5 per cent of the total and was engaged mainly in agriculture, mining and transport.
9. Extensive migration of working popula tion to Andaman and Nicobar, Assam, Gujrat, Himachal Pradesh and Punjab was noted due to paucity of profitable occupations in or near the area.
10. Literacy was observed to be very low being 9.25 per cent only. Six matriculates and one graduate only were recorded.
11. (a) Majority of the households (93.2 per cent) possessed lac host plants.
    (b) Lac cultivation on *palas* and *ber* was done by 88 per cent of the households.
12. Lac cultivable vegetative cover cosisting of 1828 *palas*, 1288 *ber*, 36 *kusum* and 64 *porrho* (Ficus spp.) totaling 3216 was enumerated.

13. The average density of lac host plants per hectare was recorded to be 11.11.
14. Average holding of lac host plants was 29.7 per household.

Lac Culture

Baisakhi 1987-88, *ari* (immature) lac crop was harvested during April to June, 1988 from 4 *ber* trees of *ari* coupe belonging to the farmers. These trees were partially pruned in traditional manner during April/ May, 1987 and were inoculated using 4.5 kg *palas* broodlac per tree during November, 1987 for demonstrating the profitability of improved techniques. An average yield of 5.8 kg sticklac per tree was obtained as against 1.09 kg recorded from the traditionally operated trees.

The income per *ber* tree was recorded to be Rs. 53.77 and in addition fuel wood worth Rs. 80.40 was available to the cultivator for domestic consumption.

Eight *palas* trees of 3 farmers which were inoculated during November, 1987 and left for self inoculation during July, 1988 were sprayed once with 0.05 per cent *endosulfan* (Thiodan 35 E.C.) during August, 1988 were harvested for broodlac. From these trees 2.25 kg broodlac per tree was obtained, whereas traditionally operated trees yielded only 0.75 kg selected broodlac (200 per cent increase).

New demonstrations were initiated by inoculating 82 *palas* and 19 *ber* trees of 13 farmers by using 120 kg *palas* broodlac.

Total 452 seedlings of lac host plant (325 *bhalia*, 115 *galwang* and 12 *ber*) were distributed amongst 22 households and were planted in their backyards.

Apiculature

Stipendary training of one month duration in bee-keeping was organised for 37 trainees of the area with the cooperation from *Khadi and Village Industries Board Bihar, Ranchi.*

One set of apicultural appliances (Beehive, catch net, viel etc) along with a cash stipend of Rs. 60/- per trainee was distributed amongst 37 trainees. Purchase of 4 honey-extracting machines was also arranged at the rate of Rs. 150/- each, separately.

Six bee colonies were captured by the trainees but only 3 colonies could be established.

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

The study was taken up last year in order to develop a suitable statistical model for forecasting yield of sticklac. Actual crop yields from *palas* trees during the *baisakhi* and *katki* crop seasons were recorded and correlated with the biometrical characters.

Baisakhi, 1987-88 crop

The size, number of shoots with lac, average length of lac encrustation per shoot, number of lac insects settled, density of surviving female lac insects, pest density etc. were recorded at 5 stages of lac crop, namely at the time of inoculation, 10-30, 90-120, 120-150 and 150-180 days after inoculation.

Positive and significant correlation was observed between the sticklac yield and size of tree as well as broodlac input. Similar

correlation was also observed between sticklac yield and the length of encrustation per shoot as well as the density of female lac insects at 120-150 day stage.

Katki, 1988 crop

During this crop the observations were recorded at inoculation stage, 10-30, 40, 60-90 days after inoculation and at crop maturity (90-120 days). The data are being analysed.

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

C. Extension Activities

4. *Training*

One Forester from Karnataka and two lac growers from West Bengal completed regular training of six month duration in *Improved Methods of Lac Cultivation* during the session October, 1987 to March, 1988. During the following April to September, 1988 session two Foresters from Orissa and one grower from West Bengal completed the same course. Three more candidates (Two Extension Officers from Industry Department West Bengal and one Forester from Orissa) were admitted to the subsequent session (October, 1988 to March, 1989) and were partially trained.

Lectures on lac culture were delivered at the Institute to the 200 farmer trainees of Divyayan K. V. K., R. K. Mission, Ranchi; 30 Forester trainees of Foresters Training School, Mahillong, Ranchi (Bihar Forest Department) and 15 farmer trainees of Agriculture Training Centre, Namkum, Ranchi.

The *Radio Krishi Pathshala Karyakarm* started last year was continued in cooperation with the All India Radio, Ranchi. Twelve more broadcasts of ten minutes each were transmitted every Sunday covering more aspects of lac cultivation (Table 23). These broadcasts attracted 110 responses from the farmers. Three more radio talks and 2 telecasts on various aspects of lac cultivation were transmitted through A.I.R. and Doordarshan Kendras, Ranchi.

TABLE 23 — RADIO KRISHI PATHSHALA KARYAKRAM (FARM SCHOOL ON AIR)

Sl No.	Date of broadcast	Name of the Scientist/specialist	Topic
1.	03.1.88	Dr. A. K. Sen	*Lakh Chhilai, Bhandaaran Evam Niptan*
2.	10.1.88	Dr. A. K. Jaiswal	*Lakh Ki Kheti Ke Unnat Upkaran Evam Unki Dekhrekh*
3.	17.1 88	Sri Y. D. Mishra	*Kusum Par Lakh Ki Kheti Kaise Karen*
4.	24.1.88	Ms. P. Chandrika	*Palas Aur Ber Par Lakh Ki Kheti Kaise Karen*
5.	31.1.88	Sri R. C. Maurya	*Bhalia Aur Galwang Ke Bagaano Men Lakh Ki Kheti Kaise Karen*
6.	07.2.88	Dr. B. P. Singh	*Lakh Poshak Vrikchhon Ke Beech Khali Bhoomi Ka Upyog*
7.	14.2.88	Sri M. L. Bhagat	*Beehan Lakh Utpadan Ki Takniken, Chunav, Bhandaaran, Paiking Evam Niptan*
8.	21.2.88	Sri R. C. Mishra	*Kharaab Mausam Men Lakh Phasal Ki Raksha Kaise Karen*
9.	28.2.88	Sri A. H. Naqvi	*Beehan Sanrakshan Ki Vishesh Vidhiyan*
10.	06.3.88	Sri A. K. Ghose	*Lakh Se Chouri Evam Chapra Banane Ki Vidhiyan*
11.	13.3.88	Dr. S. K. Saha	*Gramin Kchhetron Men Lakh Adharit Kutir Udyog*
12.	20.3.88	Sri Lakhan Ram	*Lakh Ke Upyog*

Three entrepreneurs (Two from Bihar and one from West Bengal) completed 3 months regular training in *Industrial Uses of Lac* during the session October to December, 1988.

Method demonstration-cum-short term training of 1 month duration was also organised in the manufacture of French Polish. Water Soluble Lac and Insulating Varnish for 2 nominees of *Khadi & Village Industries Commission.*

One month training on various aspects of lac was organised for 4 senior level F.A.O. nominees from Vietnam, namely, Mr. Tran Van Xuan, Hoang Xuyen, Ha Van Thi and Lanh Van Bat. The trainees were accompanied by Mr. Do Xuan Ha, the interpreter.

Technical Advisory Service

Queries (80) related to lac utilisation, availability of raw materials and machineries, schemes of various sizes for lac based industries etc. received from all over the country and abroad were attended. Consultations were provided to industrialists, entrepreneurs, extension workers and government functioneries with the help of the scientists of the Institute. Information regarding the use of shellac-epoxy combination in electrical industry was communicated to a leading micanite factory of Bihar.

Technical enquiries regarding lac cultivation from various states were attended and suitable assistance was provided. DVC authorities were helped in introducing lac cultivation in the Panchet area under their Social Obligation Programme. For this purpose survey of the lac host trees available in the area was conducted and suitable gauidance in respect of lac cultivation on nearly 50,000 *palas* tress available there was provided.

Thirty three lac crop samples received from the lac growers and various organisations were examined and forecasting of the crawler emergence as well as analysis of the causes of crop mortality was done and reports issued.

Large Scale Cultivation of Lac at Kundri

Regular technical assistance to the Forest Department, Bihar in running their Kundri Lac Farm having 40,000 *palas* trees was continued. Pruning cum *ari* harvesting operation of 26,110 *palas* trees during April-May yielded 4,980 kg dry sticklac. Partial harvesting of 386 trees during July-August yielded 302 kg broodlac. Out of this, 71 kg broodlac was distributed free to Scheduled Caste families and the remaining was used for inoculating 246 trees and 50 bushes of *palas.* During October-November, 15,800 trees were harvested yielding 12,810 kg broodlac. From this 11,274 kg broodlac was used for inoculating 24,450 *palas* trees and the rest was distributed to S.C. and S.T. farm families in the nearby area. An expenditure of Rs. 42,858 was incurred and a net return of Rs. 45,562 was recorded.

Kisan Mela and Exhibitions

Exhibition stalls were put up in *Kisan Melas* organised by the *Krishi Vigyan Kendras* at Ranchi and Hazaribagh on 30-31 January and 16-17 April respectively.

Exhibits of lac and lac based products were supplied to *Kendriya Vidyalaya,* Namkum and the Botanical Survey of India,

Calcutta for permanent display in their museums.

Testing

Facilities for testing the samples of lac and lac products were extended for the benefit of manufacturers and various organisations on payment of nominal fee. Total 104 samples of seedlac, shellac and other lac based products were received and in all 263 tests were carried out.

Museum

Total 556 visitors including seven batches of farmers, students and in-service trainees were shown round the museum. Film/slide shows were arranged for those who came in groups.

3. Publications

1. Bhagat, M. L. 1988. Field studies on the initial mortality of lac insect *Kerria lacca* Kerr. in relation to host plants. *Indian Forester* **114** (6): 339-342.
2. Malhotra, C. P. and Bhattacharya, A. 1988. Control of the lac predators, *Eublemma amabilis* Moore and *Holcocera pulveria* Meyrick by dipping broodlac in the emulsions of the insecticide, Thiodan 35 E.C. (*endosulfan*). *Pesticides* **22**: 34-35.
3. Sah, B. N. 1988. Seasonal incidence, sex-ratio and damage by pod moth (*Eublemma hemirhoda* Walker (Lepidoptera: Noctuidae) to *Moghania macrophylla* flowers and pods in the field. *Nat. Acad. Sci. letters* **2** (1): 29-30.
4. Sah, B. N. and Pathak, R. D. 1988. First record of *Mimosa pudica* Linn. as host of *kusmi* lac, *Kerria lacca* Kerr. from Namkum, Ranchi. *Indian Forester* **114** (2): 93-94.
5. Kumar, P., Sinha, S. S. N. and Chauhan, N. S. 1988. Effect of gamma rays on growth of root and shoot meristems in two cultivars of *Cajanus cajan* and two species of *Moghania*. *Indian J. Forestry* **11** (1): 47-52.
6. Agarwal, S. C., Srivastava, B. C. and Majee, R. N. 1988. An Improved method of isolating aleuritic acid for maximising its recovery from lac. *Research and Industry* **33**: 243-248.
7. Goswami, D. N., Singh, R, and Khanna, B. B. 1988. Dielectric behaviour of shellac on incorporated natural rubber gumstock. *Die Angewandte Macromoleculare Cheme* **157**: 23-30.
8. Goswami, D. N. and Prasad, N. 1988. Spectrophotometric studies on a few natural resins. *Paint and Resin* **58** (1): 24.
9. Goswami, D. N., Prasad, K. M. and Prasad, N. 1988. Spectrophotometric studies on the interaction between laccaic acid and DNA. *Curr. Sci.* **57**: 30.
10. Goswami, D. N. and Kumar, S. 1988. Studies on the curing of shellac with epoxy and phenolic resins by the measurement of dielectric strength. *Pigm. Resin Technol.* **17** (2): 4.

4. SYMPOSIA & SEMINARS ETC.

A. Attended by Institute Scientists

1. Sri A K. Dasgupta, Scientist S-1 participated in the *Seminar on High Performance Coating and Printing Inks for Plastic* organised by the Colour Society, Bombay (held at Bombay on 16th January, 1988) and presented a paper entitled *Shellac Based Pattern Paints*, on January 16th.
2. Sri P. C. Sarkar attended workshop on *Lasers in Chemical and Biological Sciences* (held at Indian Institute of Technology, New Delhi from December, 15-23).
3. Dr. S. C. Agarwal, Scientist S-3 & S. Kumar, Director, participated in Seminar on Perspective in Scientific Research in Bihar, organised by Bihar Council on Science and Technology, Department of Science and Technology, Govt. of Bihar, Patna and presented a paper entitled Perspective and Progress in Lac Research by S. C. Agarwal & S. Kumar (held at Patna from March, 27-28).
4. Sri R. C. Mishra, Scientist S-2 and Incharge ORP participated in the Technical Session of the *8th* Annual Meeting of ex-trainees of Divyayan K. V. K., Ranchi (held at Ranchi on May 6-7 and delivered a talk on *Lah Ki Upaj Barhane Kee Adhunik Takneenken.*
5. Sri R. C. Mishra, Scientist S-2 and Incharge ORP participated in *National Convention on Strategies of Horticultural Development for Tribal Regions* at Birsa Agricultural University, Ranchi (held on 11-12.3.1988).

B. Institute Seminars

Sl No.	Date	Speaker	Topic
1.	11.1.1988	Sri A. K. Das Gupta S-1	Shellac Based Patern Paint
2.	5.10.1988	Sri R. P. Tewari, Librarian	Users Motivation and their Orientation to Library
3.	14.10.1988	Dr. D. N. Goswami, S-2	Research Expences in United Kingdom
4.	16.11.1988	Sri R. Ramani, S-2	Genetic Improvement of Lac Insect

C. Important Meetings Organised

1. Tenth Meeting of the ICAR Regional Committee No. 4 was organised from 2-3 June 1988 in the Institute premises.
2. A Committee on Petition of Rajya Sabha visited the Institute on 11.4.1988 and held discussions on various aspects of Lac.

D. Training Received

Name of the Scientist	Course	Place	Period
Foreign Training			
1. Dr. D. N. Goswami Scientist S-2 (Physics)	Post experience training in the "Dielectric behaviour of polymers/Resins Possessing High Thermal Endurance" under the British Technical Cooperation Training Programme.	Department of Physical, Inorganic and Industrial Chemistry, University of Liverpool, U.K.	29.2.1988-19.8.1988
2. Sri R. Ramani Scientist S-2 (Agricultural Entomology)	Post experience training in the "Insect Genetics" under the British Technical Cooperation Training Programme.	University College of Swansea, U.K.	29.2.1988-3.8.1988
Inland Training			
1. Dr. S. C. Agarwal Scientist S-3 & Head, Division of Chemistry	Human Resource Management	National Academy of Agricultural Research and Management, Hyderabad	1.8.1988-12.8.1988
2. Sri P. C. Sarkar Scientist S-1 (Organic Chemistry)	XXVII Foundation Course in Agricultural Research Project Management.	-do-	14.10.1987-1.3.1988
3. Sri I. Rajendran Scientist S-1 (Organic Chemistry)	-do-	-do-	-do-

5. Technical Auxiliary & Supporting Services

A. LIBRARY

The library continued to provide services to the scientists and other staff members of the institute as well as visitors.

The holdings of the library grew rapidly and 612 scientific documents including 320 bound volumes and books were added. In addition 160 periodicals were subscribed. The total number of holding of books and periodicals at the end of the year was 19,120.

Classification of books and journals was continued during the year with the help of latest editions of classification schemes and cataloguing code.

In order to provide the information about the forthcoming conferences in the field of Agricultural and allied sciences and selected lists of forthcoming conferences/seminars and symposia were compiled and circulated from time to time.

A total sum of Rs. 3.57 lakhs was spent on the acquisition of scientific periodicals and purchase of books.

B. MAINTENANCE & WORKSHOP

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

C. TECHNICAL & MONITORING CELL

Salient features of the activities were as follows:

Research monitoring : The progress of 52 research projects was monitored periodically. Staff Research Council meetings were organized and the proceedings were prepared. The research accomplishment and action plans of research projects were compiled in the form of *Activity Mile-Stone* and submitted to the ICAR, New Delhi.

Reports : 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.

Other activities : Various scientific and technical meetings and institute seminars were organisesd. General information about the institute activities were supplied to various agencies including ICAR, NAARM and DST. The researach papers and articles submitted by the scientists were processed and communicated to the journals.

D. PLANTATION & LANDSCAPING

The Institute plantation covers an area of 36.5 ha and consists of separate blocks of lac host plants namely *palas, kusum, ber, khair, bhalia, galwang, ghont,* etc. besides the nursery.

General management and upkeep of the plantation including maintenance of roads, paths, hedges and fencing were continued. Effective improvements in lac host plants were brought about through proper management and adoption of modern agro-forestry practices.

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 space in respective plots, utilisation in research experiments and distribution among the farmers of O R P.

Propagation works were also done to multiplying foliage and ornamental plants, seedlings of seasonal flowers were also raised for planting under landscaping unit.

Different type of vegetables and fruit crops were grown in the nutritional garden and vacant plot near the nursery and sold to the staff members as and when harvested.

The total return from sale of farm produce namely, grass, pruned twigs, fire-wood, vegetables, foliage and ornamental plants etc. was Rs. 5170.

E. ART & PHOTOGRAPHY

Services in support of research and extension were rendered. 637 photographs (coloured and black & white), 188 coloured transparencies were taken for the various scientific works and of different functions held at Institute.

F. MEDICAL

The Institute provides day to day medical facilities to its employees. A total of 4654 consultations were provided by the part time Authorised Medical Attendant (AMA) to the institute staff and their families at the Institute Dispensary. 18 patients were also attended at their residence by AMA. In addition, 42 cases needing specialised treatment were referred to the Medical Institutions of repute.

6. Distinguished Visitors

1. Mr. Tran Van Xuan, General Director, Special Forest Export Products Company, Ministry of Forestry, Vietnam accompanied by Mr. Hoang Xuyen, Mr. Havan Thi, Mr. Lanh Van Bat and Mr. Do Xuan Ha.
2. Dr. John Berg, University College, London University.
3. Sri Ram Avdhesh Singh, Member of Parliament.
4. Sri Satya Prakash Malviya, Member of Parliament.
5. Sri Thomas Kuthiravattom, Member of Parliament.
6. Sri Dhuleshwar Meena, Member of Parliament.
7. Sri Purushottam Kakodkar, Member of Parliament.
8. Sri D. Basumatoi, Member of Parliament.
9. Dr. S. D. Tripathi, Director, Central Institute of Fisheries and Acquaculture, Bhubaneshwar.
10. Mrs. Swaran Lata Prasad, Director, Bihar Tribal Welfare Research Institute, Ranchi.
11. Dr. B. B. Mallick, Joint Director, Indian Veterinary Research Institute, Izatnagar, U.P.
12. Dr. J. N. Dwedi, Dean, Veterinary College, Mathura, U.P.
13. Prof. Bishan Singh Samendri, Ex-Vice Chancellor, Guru Nanak Dev University, Amritsar, Punjab.
14. Brig. G. P. Batra, Dy. Director, E.M.E., H.O.I. Crops, C/o 56 APO.
15. Dr. J. N. Panda, Prof. & Head, Division of Physiology, Central Avian Research Institute, Izatnagar, U.P.
16. Dr. P. K. Sinha, Prof. & Head, Deptt. of Plant Breeding & Genetics, Birsa Agricultural University, Ranchi.
17. Dr. H. S. P. Sinha, Head, Deptt. of Extension Education, Birsa Agricultural University, Ranchi.
18. Dr. J, N, Pauls, Professor & Head, Deptt. of Physiology, Birsa Agricultural University, Ranchi.
19. Prof. N. C. Das, Head, Deptt. of Agril. Botany, Birsa Agricultural University, Ranchi.

7. PERSONNEL

A. STAFF POSITION

Class of post	No. of posts sanctioned	Total No. of employees in position	No. of SC employees	No. of ST employees
Director	1	1	Nil	Nil
Scientific				
Scientist S-0		Nil	Nil	Nil
Scientist S-1	60	24	1	Nil
Scientist S-2		9	Nil	Nil
Scientist S-3		7	2	Nil
Total	60	40	3	Nil
Technical				
Category I	46	43	5	10
Category II	36	27	1	2
Category III	4	3	Nil	Nil
Total	86	73	6	12
Administrative				
Administrative Officer	1	1	Nil	Nil
Asstt. Administrative Officer	1	1	Nil	Nil
Account Officer	1	1	Nil	Nil
Hindi Officer	1	Nil	Nil	Nil
Superintendent	3	2	NIL	1
Senior Stenographer	1	1	1	Nil
Junior Stenographer	4	3	1	1
Assistant	8	8	1	1
Senior Clerk	13	13	Nil	2
Junior Clerk	16	15	1	3
Total	49	45	4	8
Auxiliary				
Class I	2	1	1	Nil
Class II	1	Nil	Nil	Nil
Class III	11	5	Nil	3
Total	14	6	1	3
Supporting				
Supporting I	64	52	6	21
Supporting II	45	33	3	15
Supporting III	18	14	4	5
Supporting IV	9	5	Nil	1
Total	136	104	13	42

B. LIST OF STAFF MEMBERS

Sl. No.	Name of the post	Staff in position as on 31.12.88
	Director	Prof. Dr. R. P. Kapil upto 24.1.88 Sri S. Kumar from 11.2.88
	Division of Entomology	
1.	Head of the Division	Sri A. H. Naqvi
2.	Scientist S-1 (Agricultural Entomology)	1. Sri S. G. Choudhary 2. Dr. A. K. Sen 3. Sri B. N. Sah 4. Dr. S. K. Jaipuriar 5. Sri A. Bhattacharya 6. Sri Y. D. Mishra 7. Sri M. L. Bhagat 8. Miss P. Chandrika 9. Miss P. Rani George
3.	Field/Farm Technician (T-5)	Sri M. K. Chowdhary
4.	Field/Farm Technician (T-4)	1. Sri K. U. S. Sinha upto 16.9.88 2. Sri A. K. Sahay 3. Sri R. N. Vaidya
5.	Field/Farm Technician (T-I-3)	1. Sri R. D. Pathak 2. Sri K. P. Gupta 3. Sri H. N. Shukla 4. Sri R. L. Ram
6.	Laboratory Technician (T-I-3)	1. Sri G. M. Borkar 2. Sri S. K. Chatterjee 3. Sri B. Ram 4. Sri B. B. Chakravarti upto 29.2.88
7.	Field/Farm Technician (T-2)	Sri M. L. Rabidas
8.	Laboratory Technician (T-2)	Sri G. Das
9.	Field/Farm Technician (T-1)	1. Sri D. W. Runda 2. Sri D. K. Singh
10.	Laboratory Technician (T-1)	Sri R. K. Swansi

Regional Field Research Station, Dharamjaigarh (M.P.)

1. Field/Farm Technician (T-II-3)	Sri R. S. Maliya
2. Laboratory Technician (T-I-3)	Sri A. Hussain
3. Field/Farm Technician (T-2)	Sri J. Lal
4. Field/Farm Technician (T-1)	Sri P. A. Ansari Transferred to Ento. Division on 1.8.88

Insect Genetics & Breeding

1. Head of the Division	Sri N. S. Chauhan
2. Scientist S-2 (Agricultural Entomology)	Sri R. Ramani
3. Scientist S-1 (Agricultural Entomology)	Sri K. K. Sharma
4. Field/Farm Technician (T-1)	Sri A. K. Sinha

Plant Sciences

1. Head of the Division	Dr. P. Kumar
2. Scientist S-2 (Agronomy)	Dr. B. P. Singh
3. Scientist, S-1 (Plant Breeding)	Sri S. C. Srivastava
4. Laboratory Technician (T-I-3)	Sri D. D. Prasad
5. Laboratory Technician (T-1)	Sri Mohan Singh
6. Field/Farm Technician (T-1)	Sri K. A. Nagruar

Division of Chemistry

1. Head of the Division	Dr. S. C. Agarwal
2. Scientist, S-4 (Organic Chemistry)	1) Dr. B. B. Khanna 2) Sri S. Kumar Upto 10.2.88
3. Scientist, S-2 (Physical Chemistry) Scientist, S-2 (Physics) Scientist, S-2 (Organic Chemistry)	Dr. A. Kumar Dr. D. N. Goswami 1) Dr. B. C. Srivastava 2) Dr. N. Prasad 3) Dr. R. N. Majee
4. Scientist, S-1 (Organic Chemistry)	1) Sri A. K. Dasgupta 2) Dr. K. M. Prasad 3) Dr. M. Mukherjee

	4) Sri P. C. Sarkar
	5) Sri I. Rajendran
Scientist, S-1 (physical Chemistry)	Sri P. M. Patil
5. Laborataory Technician (T-5)	Sri B. P. Banerjee from 19.8.88
6. Laboratory Technician (T-4)	1) Sri T. K. Saha
	2) Sri N. K. Dey
	3) Sri D. D. Singh
	4) Sri M. Ekka
	5) Sri S. N. Sharma
7. Laboratory Technician (T-II-3)	Mrs. P. R. Ghatak upto 6.5.88
8. Laborataory Technician (T-I-3)	1) Sri U. Sahay
	2) Sri B. P. Keshry
9. Laboratoary Technician (T-2)	1) Sri P. B. Sen
	2) Sri G. Mishra Exp. on 26.11.88
	3) Smt. P. Devi
10. Glass Blower (T-1)	Sri B. S. Choudhary
11. Junior Stenographer	Sri B. K. Rajak

Division of Technology

1. Head of the Division	Dr. P. C. Gupta
2. Scientist, S-2 (Physical Chemistry)	Dr. A. Pandey
3. Scientist, S-1 (Organic Chemistry)	1) Sri R. K. Banerjee
	2) Sri K. K. Sharma
Scientist, S-1 (Physical Chemistry)	Sri Radha Singh
4. Laboratory Technician (T-5)	1) Sri M. Islam
	2) Sri B. P. Banerjee upto 18.8.88
	3) Sri Ramesh Prasad upto 18.8.88
5. Laboratory Technician (T-4)	Sri K. K. Prasad
6. Senior Mechanic (T-II-3)	Sri S. K. Bhaduri
7. Laboratory Technician (T-I-3)	1) Sri N. Minz
	2) Sri M. K. Singh
	3) Sri Tulsi Ram

Division of Extension

1. Head of the Division	Dr. S. K. Saha
2. Scientist, S-1 (Agricultural Entomology)	Dr. A. K. Jaiswal
3. Scientist, S-1 (Organic Chemistry)	Miss M. Joardar
4. Technical Officer (T-6)	Sri A. K. Ghosh
5. Lac Information Officer (T-6)	Dr. R. K. Suri
6. Publicity Officer (Auxiliary)	Sri Lakhan Ram
7. Field/Farm Technician (T-5)	Sri R. C. Maurya
8. Laboratory Technician (T-5)	Sri A. Rahman
9. Senior Artist (T-5)	Sri R. L. Singh
10. Commercial Artist (T-4)	Sri P. Das
11. Laboratory Technician (T-4)	1) Sri K. M. Sinha 2) Sri D. Ghosh 3) Sri J. Singh
12. Laboratory Technician (T-I-3)	Sri D. Runda
13. Laboratory Technician (T-2)	Sri B. P. Ghosh
14. Junior Artist-cum-Photographer	Sri R. P. Srivastava
15. Museum Assistant (T-1)	Kumari R. Dutta
16. Laboratory Technician (T-1)	Sri J. K. Ambuj
17. Junior Stenographer	Sri A. K. Sinha

Operational Research Projects

18. Scientist, S-2 (Agricultural, Entomology), Incharge)	Sri R. C. Mishra
19. Scientist, S-1 (Agricultural Entomology)	Sri Jawahir Lal
20. Field/Farm Technician (T-4)	1) Sri L. C. N. Sahdeo 2) Sri H. Bhengra
21. Field/Farm Technician (T-I-3)	Sri S. S. Prasad
22. Field/Farm Technician (T-2)	Sri K. C. Jain
23. Field/Farm Technician (T-1)	Sri S. B. Azad

Administrative & Audit & Accounts Section

1. Administrative Officer	Sri S. N. Sharma
2. Assistant Administrative Officer	Sri R. K. Singh
3. Accounts Officer	Sri Pradeep Kumar from 16.8.88
4. Superintendent	1) Sri P. K. Choudhury 2) Sri H. S. Munda
5. Assistant	1) Sri D. P. Sengupta 2) Sri R. P. Singh 3) Sri Musafir Singh 4) Sri Enemul Haque 5) Sri Md. Samiullah 6) Sri A. K. Lal 7) Sri E. Tirkey 8) Sri N. Mahto
6. Senior Stenographer	Sri R. Rabidas
7. Senior Clerk	1) Sri A. K. Choudhury 2) Sri A. Haque 3) Sri S. K. P. Keshri 4) Sri R. B. Singh 5) Sri K. D. Pandey 6) Sri K. N. Sinha 7) Sri S. Ram 8) Sri D. Ram 9) Sri D. N. Mahto 10) Smt. Sati Guha 11) Sri K. L. Choudhury 12) Sri R. K. Upadhyaya 13) Sri N. Topno
8. Junior Stenographer	Smt. S. Prasad
9. Junior Clerk	1) Sri Budhan Ram 2) Sri Md. Mobarak 3) Sri V. Ram 4) Sri E. Gari 5) Sri J. P. Srivastava 6) Sri N. Gope 7) Sri Thibu Minz

	8) Sri B. N. Gope
	9) Sri Ravi Shankar
	10) Sri Anant Pandey
	11) Sri Prahlad Singh
	12) Sri S. C. Lal
	13) Sri R. N. Mahto
	14) Sri Bihari Sahu
	15) Sri Wilson Guria
10. Hindi Translator (T-II-3)	Sri Lakshmi Kant
11. Driver (Auxiliary)	1) Sri J. Tewari
	2) Sri Arvind Kumar
	3) Sri Narayan Lakra
12. Driver (T-2)	1) Sri M. Khalkho
	2) Sri B. Runda

Technical and Monitoring Cell

1. Technical Officer (T-7)	Sri S. K. M. Tripathi
2. Senior Technical Assistant (T-5)	Sri R. Prasad from 19.8.88

Library

1. Senior Library Assistant (T-5)	Sri R. P. Tewari
2. Library Assistant (T-4)	Sri V. K. Singh

Maintenance and Workshop Unit

1. Chief Mechanical (T-II-3)	Sri S. K. Srivastava
2. Turner (T-2)	Sri A. S. Manoranjan
3. Instrument Maker (T-2)	Sri H. L. Bhakta

Medical Unit

1. Authorised Medical Attendant (Part Time)	Dr. S. S. Sahay
2. Stockman-cum-Compounder (T-I-3)	Sri C. Pandey

Institute Plantation

1. Farm Superintendent (T-6)	Sri N. K. Sharma from 3.8.88
2. Field/Farm Technician (T-1-3)	1) Sri Md. Ali Ansari
	2) Sri R. C. Singh
3. Field/Farm Technician (T-1)	Sri V. K. Tewari
	Sri Markus Surin

Promotion	Promoted to	With effect from
1. Sri Lakshmikant	Hindi Translator (T-4)	1.7.1987
Transfer		
1. Mrs. P. R. Ghatak	Laboratory Technician (T-II-3)	(Transferred to Jute Technological Research Laboratory, Calcutta on 6.5.1988 A/N)
Appointment		
1. Sri N. K. Sharma	Farm Superintendent (T-6)	3.8.1988 (F/N)
2. Sri Pradeep Kumar	Accounts Officer	16.8.1988 (F/N)
3. Sri Arvind Kumar	Driver15.1.1988 (F/N)	
4. Sri Narayan Lakra	Driver20.1.1988 (F/N)	
Retirement		
1. Sri B, B. Chakravarti	Laboratory Technician (T-I-3)	29.2.1988 (A/N)
Death		
1. Dr. R. P. Kapil	Director	24.1.1988
2. Sri G. Mishra	Laboratory Technician (T-2)	26.11.1988

8. APPENDICES

I. RESEARCH PROGRAMME — 1988

Project code No.	Project	Project Leader and Associates	Year of start	Year of completion
1	2	3	4	5
A. DIVISION OF ENTOMOLOGY				
	Improvement in Lac Cultivation Techniques			
1.1.9	To evolve suitable management practices for brood and sticklac production in the light of recent findings	Sri Y. D. Mishra, S-1 Sri S. G. Choudhary, S-1 Sri M. L. Bhagat, S-1	1987	1993
	Physiology of Lac Insect and Associated Insects			
1.2.5	Analysis of Physio-physiological factors causing lac insect preference for host plants	Sri A. H. Naqvi, S-2	1981	1989
1.2.6	Biochemical studies on the lac insect to ascertain strain differences	Dr. A. K. Sen, S-1 Dr. K. M. Prasad. S-1	1981	1988
1.2.9	Determination of physical and biochemical bases of insect host preference	Sri A. H. Naqvi, S-2 Dr. A. K. Sen, S-1	1987	1992
1.2.10	Studies on the factors influencing growth and development in the sexually reproducing female insect	Dr. A. K. Sen, S-1 Sri A. H. Naqvi, S-2 Miss Chandrika, P. S-1	1987	1992
	Ecology of Lac Insect and Associated Insects			
1.3.5.	Ecological studies taken up at Dharamjaigarn, M.P.	Sri B. N. Sah, S-1		
1.3.5.1	To study the relative performance of *kusum* broodlac from different sources (states) at Khadgaon		1981	1988
1.3.5.3	To study the relative abundance of parasites and predators in different regions of M.P. in different crops on *palas*		1986	1990
1.3.6.	Population dynamics of *kusmi* strain of lac insect to ascertain the causes of *kusmi* crop failures (First phase)	Sri B. N. Sah, S-1 Sri M. L. Bhagat, S-1	1979	1988
1.3.11	Biology, seasonal incidence, extent of damage and control of important lac parasites	Sri M. L. Bhagat, S-1 Mrs P. Rani Antony, S-1	1988	1992
1.3.12	Analysis of abiotic and biotic factors causing mortality of lac insect	Sri Y. D. Mishra, S-1 Miss P. Chandrika, S-1 Mrs. P. Ram Antony, S-1 Sri A. Bhattacharya, S-1	1988	1992

— Contd.

— *Contd.*

1	2	3	4	5
	Control of Enemies of Lac Insect			
1.4.3	Effect of insecticides on the lac insect, *Kerria lacca* (Kerr) and the associated fauna	Sri S. G. Choudhary, S-1 Sri A. Bhattacharya, S-1	1978	1989
1.4.3.1	Screening of insecticides for their safety to the lac insects and toxicity to the lac predators			
1.4.3.7	Treatment of brrodlac with selective insecticides			
1.4.9	Studies on application of insect growth regulators (IGR) for the control of major lac predators	Sri A. Bhattacharya, S-1	1984	1988
1.4.13	Studies on the economic threshold level of *Eublemma amabilis* and *holcocera pulverae Studies on Germplasm of Lac Insects*	Sri S. G. Choudhary, S-1	1982	1988
1.5.8	Studies on germplasm collection, conservation and characterisation of indigenious/ exotic lac insect	Dr. S. K. Jaipuriar, S-1 Dr. S. K. Saha, S-3	1982	1991 (Revised in 1987)
1.5.11	Studies on chromosomal behaviour of lac insect strains	Dr. S. K. Jaipuriar, S-1	1981	1991 (Revised in 1987)
	B. DIVISION OF INSECT GENETICS AND BREEDING			
	Lac Insect Genetics			
6.1.2	Survey of genetic variation in lac insects	Sri R. Ramani, S-2	1986	1990
	Lac Insect Breeding			
6.2.1	Mutation studies in lac insects	Sri N. S. Chauhan, S-3	1986	1989
	C. DIVISION OF PLANT SCIENCES			
	Propagation and Management of Lac Host plants			
2.1.2	Management of *bhalia* for lac cultivation	Dr. B. P. Singh, S-2	1975	1989
2.1.3	Integration of lac cultivation with general agriculture under dry farming conditions	Dr. B. P. Singh, S-2 Sri S. C. Srivastava, S-1	1978	1988
2.1.6	Agricultural utilization of lac mud as organic manure	Dr. B. P. Singh, S-2	1981	1992
2.1.9	Standardization of forestry practices for raising high yielding *kusum* through air-layering	Sri S. C. Srivastava, S-1	1981	1990
	Genetics and Breeding of Lac Host Plants			

— *Contd.*

— Contd.

1	2	3	4	5
2.2.3	Evaluation and improvement of *arhar* varieties for lac yield as well as pulse production	Dr. P. Kumar, S-2	1978	1988
2.2.6	Survey of genetic variation in lac potential of host plant	Sri S. C. Srivastava, S-1 Sri Y. D. Misra, S-1 Dr. P. Kumar, S-2	1985	1990
2.2.7	Collection, maintenance, evaluation and characterisation of lac hosts	Dr. P. Kumar, S-2	1987	1992
2.2.8	Vegetative propagation in *palas* through air-layering	Dr. P. Kumar, S-2	1988	1990
	D. DIVISION OF CHEMISTRY			
	Chemistry of Lac Constituents			
3.1.9	Thermal polymerization of lac studies on the molecular weight, shape and size	Dr. A. Kumar, S-2	1983	1988
3.1.12	Degradation studies on lac	Dr. S. C. Agarwal, S-3 Dr. N. Prasad. S-2	1983	1989
	Fine Chemicals from Lac			
3.2.10	Synthesis of pheromone and juvenile hormone analogues from aleuritic acid	Dr. R. N. Majee, S-2 Sri R. Ramani, S-2	1982	1988
3.2.11	Synthesis of bis-heterocyclic compounds from aleuritic acid	Dr. R. N. Majee, S-2	1885	1989
3.2.12	Synthesis of substituted coumarine derivatives from jalaric acid	Dr. N. Prasad, S-2	1988	1991
3.2.13	Synthesis of prostaglandin analogues from aleuritic acid	Dr. N. Prasad, S-2 Dr. R. N. Majee, S-2	1988	1992
3.2.14	Derivatisation of shellac acids-Synthesis and characterization of dioxolanes, organic nitrates and tetrazoles	Dr. S. C. Agarwal, S-3 Sri I. Rajendran, S-1 P.C.Sarkar, S-1	1988	1992
	Modifications of Shellac/Constituents and Their Utilization			
3.3.11	Modification of lac with ethyl cellulose	Sri A. K. Dasgupta, S-1	1983	1988
3.3.12	Modification of lac wax	Dr. K. M. Prasad, S-1 Dr. B. B. Khanna, S-4	1984	1988
3.3.13	Studies on lac based cation exchange resin as catalyst	Dr. B. C. Srivastava, S-2	1987	1989
	Use of Shellac and Modified Shellac in Surface Coating			
3.4.5	Studies on anticorrosive primers/paints for use on ferrous metals	Sri Shravan Kumar, S-4 Dr. M. Mukherjee, S-1	1981	1988

— Contd.

— Contd.

1	2	3	4	5
3.4.6	Styrenation of lac-oil combinations	Dr. B. B. Khanna, S-4 Sri P. M. Patil, S-1	1986	1988
3.4.7	Modification of byproduct obtained during the preparation of aleuritic acid and its use in surface coating	Sri A. K. dasgupta, S-1	1987	1990
3.4.8	Lac based coating compositions for out door applications	Dr. B. B. Khanna, S-4	1988	1990
	Use of Lac for Encapsulation and Controlled-Release			
3.5.5	Slow-release lac urea formulation for animal feed	Dr. B. C. Srivastava, S-2	1987	1989
	Electrical Properties of Lac and Modified Lacs			
3.6.3	Study on the tracking resistance of shellac based varnishes	Dr. D. N. Goswami, S-2	1986	1989
3.6.4	Studies on the modification of lac for use as high thermal class insulating varnishes	Dr. M. Mukherjee, S-1 Sri Shravan Kumar, S-4 Dr. D. N. Goswami, S-2	1987	1991
	Studies on Biochemical Aspects of Insect Host Plant Relationship			
3.8.1	Transformation of sap constituents and its incorporation in lac secretion	Dr. S. C. Agarwal, S-3 Dr. P. Kumar, S-2 Dr. A. K. Sen, S-1 Dr. K. M. Prasad, S-1 Sri P. C. Sarkar, S-1	1987	1992
	E. DIVISION OF TECHNOLOGY			
	Improvement in the Processing Techniques			
4.1.6.2	Improvements in dewaxing and decolourising technique in solvent medium	Sri R. K. Banerjee, S-1	1980	1988
4.1.8	To study the industrial parameters affecting the preparation of bleached lac	Sri R. K. Banerjee, S-1	1987	1988
	Rubber-Shellac Combinations			
4.2.2.	Electrical properties of rubber-shellac blends	Sri R. Singh, S-1 Dr. D. N. Goswami, S-2 Dr. B. B. Khanna, S-4	1983	1988
4.2.3	A comparative study of shellac with other resins (synthetic and natural) which are used in Rubber Industry	Sri R. Singh, S-1 Dr.. P. C. Gupta, S-3 Dr. A. Pandey, S-1	1988	1990

— Contd.

— *Contd.*

1	2	3	4	5
4.2.3.1	Composition of wood resin with shellac into natural rubber gum stock and filled stock			
	Use of Lac in Adhesives			
4.3.4	Modified lac (with synthetic resins) as adhesives	Dr. P. C. Gupta, S-2	1987	1990
4.3.5	Use of lac byproducts for making coal block from coal dust as domestic fuel	Dr. P. C. Gupta, S-2	1987	1990
	Use of Lac in Printing Inks			
4.5.1	Development of printing inks based on lac/ modified lac	Dr. A. Pandey, S-1	1987	1992
	Use of Lac in Ion-Exchange Resin			
4.6.1	Preparation of improved cation exchange resin from shellac on large scale	Dr. P. C. Gupta, S-3 Sri K. K. Sharma, S-1	1988	1990
	F. DIVISION OF EXTENSION			
5.5.	Operational Research Project for Maximising lac production in Chhotanagpur area	Sri R. C. Mishra, S-2 Sri J. Lal, S-1		
5.6	Pilot studies on pre-harvest forecasting of yield of sticklac	Dr. S. K. Saha, S-3	1988	1991

II. METEOROLOGICAL DATA - 1988

Month	Mean baro-metric pres-sure (mm)	Mean Maxi-mum tempera-ture (°C)	Mean Mini-mum tempera-ture (°C)	Highest Maxi-mum tempera-ture (°C)	Lowest Mini-mum t empera-ture (°C)	Mean dry bulb bulb tempera-ture (°C)	Mean Wet bulb tempera-ture (°c)	Mean Humi-dity (percent)	Total rain-fall (mm)
January	709.19	25.09	9.23	27.5	7.2	16.78	14.30	76.45	6.0
February	707.30	27.51	11.47	31.0	7.7	18,51	16.27	79.12	11.8
March	705.55	30.79	15.62	35.0	11.6	24.56	20.37	67.80	38.2
April	703.66	35.55	19.80	39.5	13.3	30.23	25.0	65.06	83.0
May	701.06	38.24	23.75	43.5	18.8	34.03	27.72	61.58	8.6
June	698.78	31.68	22.68	39.0	18.8	28.71	26.10	81.96	441.0
July	698.80	29.65	22.58	33.0	21.1	27.58	25.35	83.09	370.3
August	699.32	30.27	22.44	33.0	21.1	28.82	25.93	80.74	284.0
September	701.80	30.51	21.63	32.5	20.0	25.51	22.91	79.70	218.4
October	704.50	29.79	16.73	31.5	11.1	26.91	23.27	68.35	22.8
November	708.66	27.00	11.57	29.5	8.8	22.78	18.31	66.43	0.6
December	709.77	24.58	9.20	27.5	6.6	20.80	16.22	61.64	0.0

Highest maximum temperature	:	43.5°C on 30th May
Lowest minimum temperature	:	6.6°C on 16th December
Total rain fall	:	1484.7 (135.7 mm more than 1987)
Monsoon rain fall (June-September)	:	1313.7 mm
Hailstorm	:	1st March, 19th April and 1st June

III. PRODUCTION & EXPORT OF LAC

1. Production of sticklac during 1988-89

(metric tonne)

Statewise		Cropwise	
Bihar	9,075	*Baisakhi*	9,400
Madhya Pradesh	3,860	*Katki*	3,650
West Bengal	1,390	*Jethwi*	0.550
Maharashtra	0,075	*Aghani*	1.400
Uttar Pradesh	0,390		
Other States	0,210		
Total	15,000		15,000

Source : Directorate of Lac Development, Ranchi

2. Gradewise export of lac during 1988-89

	Quantity (tonne)	Value (rupees)
Seedlac	1,439	2,86,78,000
Shellac	5,607	15,17,49,000
Other lac	114	1,03,97,000
Total	7,170	19,08,24,000

Source : Shellac Export Promotion Council, Calcutta

परिचय

इतिहास एवं विकास

भारत में लाख उद्योग की स्थिति की जाँच एवं इसके बहुमुखी सुधार के लिए भारत सरकार द्वारा गठित जाँच समिति की अनुशंसा के फलस्वरूप भारतीय लाख अनुसंधान संस्थान की स्थापना की गई। उक्त समिति के सुझावों के कार्यान्वयन हेतु लाख उद्योग से जुड़े लोगों ने "इन्डियन लैक एसोशिएसन फॉर रिसर्च" नामक एक गैर सरकारी संस्थान का गठन किया तथा उसे पंजीकृत कराया। इस एसोशिएसन ने 1925 में भारतीय लाख अनुसंधान संस्थान 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 प्रशासनिक नियन्त्रण में आ गया। यह संस्थान कुल 49 हे० क्षेत्र में फैला हुआ है जिसमें संस्थान के दो परिसर तथा 36.5 हे० क्षेत्र का एक बागान शामिल है। मुख्य परिसर में कीट विज्ञान विभाग, रसायन विभाग, पादप विज्ञान अनुभाग, प्रसार विभाग के प्रयोगशालाओं के अतिरिक्त प्रशासकीय, वित्त व लेखा, पुस्तकालय, यांत्रिकी अनुभाग एवं आवास गृह के भवन स्थित हैं। प्रौद्योगिकी परिसर में प्रौद्योगिकी अनुभाग की प्रयोगशालाएँ, प्रशिक्षु छात्रावास तथा आवसीय भवन हैं।

संस्थान के अन्तर्गत एक क्षेत्रीय लाख अनुसंधान केन्द्र भी कार्य कर रहा है जो मध्य प्रदेश के धर्मजयगढ़ नामक स्थान पर स्थित है। राँची 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 अंग्रणी संस्थान 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 प्रौद्योगिकी के विकास एवं प्रसार में सतत प्रयत्नशील रहा है। तथा अनेक प्रविधियों एवं उत्पाद विकसित किये गए हैं। उद्योगों 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 भारतीय लाख अनुसंधान संस्थान अन्तर्राष्ट्रीय ख्याति अर्जित कर चुका है।

उद्देश्य

संस्थान के मुख्य उद्देश्य निम्नवत हैं :

* लाख के उत्पादन शुद्धिकरण एवं माकीकरण 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 करना तथा लाख उत्पादकों एवं उद्योगों 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 औद्योगिक उपयोगों के संबंध में प्रशिक्षण प्रदान करना।

मुख्य लक्ष्य

1. लाख एवं बीहन लाख की उत्पादकता एवं गुणवता में सुधार के लिए लाख उत्पादन की प्रौद्योगिकी विकसित करना।
2. लाख उत्पादन में बढ़ोत्तरी के लिए लाख परिपालक-पौधों के प्रवन्धन के तरीके में सुधार लाना।
3. लाख एवं इसके उत्पाकों के विविध उपयोग एवं संसाधान के लिए प्रौद्योगिकी का विकास एवं उसका परिवर्धन करना।
4. लाख की खेती संसाधन एवं उपयोग से संबंधित उन्नत प्रौद्योगिकी के बारे में लाख उत्पादकों एवं लाख उपभोक्ताओं के बीच सूचना का प्रचार प्रसार।

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 हैं। तकनीकी सहयोग हेतु पुस्तकालय, अनुरक्षण एवं कर्मशाला अनुभाग, बागान प्रबन्धन और तकनीकी

एवं मॉनीटरींग इकाई कार्यरत हैं। प्रशासनिक खण्ड में प्रशासकीय अनुभाग, वित्त व लेखा अनुभाग, और केन्द्रीय भण्डार है। सहायक इकाईयों के अन्तर्गत सुरक्षा, चिकित्सा और संपदा अनुरक्षण सेवाएँ हैं।

स्टाफ एवं बजट

संस्थान में 60 वैज्ञानिक 86 तकनीकी, 49 प्रशासकीय, 14 सहायक एवं 136 चतुर्थ वर्गीय स्वीकृत पद हैं। वर्ष 1988-89 के लिए संस्थान का गैरयोजना बजट 101.70 लाख रुपये तथा योजना बजट 58.00 लाख रुपये का था एवं गैरयोजना तथा योजना खर्च क्रमशः 101.59 लाख रुपये तथा 18.37 लाख रुपये था।

अनुसंधान की मुख्य उपलब्धियाँ

लाख परभक्षियों का प्रबन्धन

डाइफ्लूबेंजोरान, काइटीन निरोधक लाख कीटों को बिना नुकसान पहुँचाए मुख्य लाख परभक्षियों यूब्लीमा एमाबिलीस एवं होल्कोसेरा पलवेरिया के विरुद्ध प्रभावी पाया गया।

पलास का वानस्पतिक (वेजीटेटीव) प्रबन्धन

मुख्य लाख परिपालक पलास (ब्यूटीया मोनोस्पर्मा) के बागान को जल्दी तैयार करने के लिए गूटी (एयरलेयरिंग) बाँधने की तकनीक सफल पाई गई।

एंटीट्रैकिंग वार्निश

चमड़ा एवं रपौक्सी रेजीन के संयोग से हवा में सुखने वाली एक एंटी ट्रैकिंग वार्निश बनायी गयी है जिसमें विद्युतीय ट्रैकिंग के प्रति प्रतिरोधन क्षमता अधिक है।

विदेशी प्रशिक्षण

ब्रिटीश तकनीकी सहयोग प्रशिक्षण कार्यक्रम के अन्तर्गत वर्ष 1987-88 के लिए संस्थान के दो वैज्ञानिकों डॉ० डी० एन० गोस्वामी एवं श्री आर० रमणि ने इंगलैण्ड में अनुभवेत्तर प्रशिक्षण प्राप्त किया।

महत्त्वपूर्ण बैठकें

★ भारतीय कृषि अनुसंधान परिषद् क्षेत्रीय समिति, संख्या- IV की दसवीं बैठक 2-3 जून 1988 को संस्थान में आयोजित की गई जिसमें 87 लोगों ने भाग लिया।

★ राज्य सभा की याचिका संबंधी समिति के आठ राज्यसभा सदस्यों तथा तीन अधिकारियों ने दिनांक 11.4.88 को संस्थान का दौरा किया और लाख के उत्पादन परिष्करण एवं विपणण के बारे में संस्थान एवं लाख निदेशालय के प्रतिनिधियों के साथ विचार विमर्श किया।

सम्मान एवं पुरस्कार

श्री भरत प्रसाद सिंह को उनके शोध प्रबन्ध "ग्रोथ एंड इल्ड ऑफ राइस एंड ह्वीट ग्रोन की सिक्वेंस अन्डर रिसोर्स कन्सट्रैन्ट्स" पर बिरसा कृषि विश्वविद्यालय द्वारा शस्य विज्ञान में पी०एच०डी० की उपाधि प्रदान की गई।

राज्यभाषा कार्यान्वयन समिति

हिन्दी के प्रगामी प्रयोग की समीक्षा, राजभाषा अधिनियम 1963 और उसके अंतर्गत बने राजभाषा नियम 1976 तथा समय समय पर राज्भाषा विभाग द्वारा निर्गत अन्य आदेशों के अनुपालन को सुनिश्चित करने तथा हिन्दी में काम-काज को बढ़ावा देने के उद्देश्य से संस्थान में गत दस वर्षों से राजभाषा कार्यान्वयन समिति कार्य कर रही है। वर्ष 1988 में समिति में निम्नांकित सदस्य थे :

1. श्री श्रवण कुमार, निदेशक — अध्यक्ष
2. डा० शिशिर कुमार साहा, विभागाध्यक्ष — सदस्य
3. डा० सतीश चन्द्र अग्रवाल, — "
4. डा० प्रणय कुमार, विभागाध्यक्ष — "
5. डा० प्रेम चन्द्र गुप्ता, " — "
6. श्री नरेन्द्र सिंह चौहान " — "
7. श्री अन्जार हुसैन नक्वी, " — "
8. श्री सत्यानन्द शर्मा, प्रशासकीय अधिकारी — "
9. श्री नरेन्द्र कुमार शर्मा, फार्म अधीक्षक — "
10. श्री राम प्रताप तिवारी, पुस्तकालयाध्यक्ष — "

11. श्री रामकरण सिंह,
सहायक प्रशासकीय अधिकारी — "
12. श्री लक्ष्मी कान्त वरिष्ठ
हिन्दी अनुवादक — "
13. श्री कृष्मणि त्रिपाठी,
प्रभारी हिन्दी कार्यक्रम — सदस्य सचिव

समिति के कार्य कलाप

वर्ष 1988 में समिति की तीन बैठकों का आयोजन किया गया जिनमें निम्नलिखित महत्त्वपूर्ण निर्णय लिये गए :

(क) संस्थान के चेक एवं तार हिन्दी में तैयार किया जाना
(ख) राजभाषा अधिनियम की धारा 3(3) के अनुपालन हेतु कारगर उपाय करना
(ग) रोकड़ बही पुनः हिन्दी में लिखा जाना
(घ) अनुदित सामग्री का मुद्रण किया जाना
(ङ) वार्षिक प्रतिवेदन का सारांश एवं निदेशक के प्राक्कथन का हिन्दी रूपान्तर किया जाना

संस्थान के कार्य में हिन्दी की प्रगति

वर्ष भर में "क" क्षेत्र में हिन्दी में 4322 पत्र एवं अंग्रेजी में 4814 पत्र तथा "ख" और "ग" क्षेत्र में अंग्रेजी में क्रमशः 107 और 186 पत्र निर्गत हुए। संस्थान में प्राप्त होने वाले पत्रों में से हिन्दी के 2535 तथा अंग्रेजी के 4928 पत्र थे।

हिन्दी शिक्षण योजना

हिन्दी शिक्षण योजनाधीन प्रवोध परीक्षा में कुल 200 में से 159 अंक प्राप्त करने पर नियमानुसार इस संस्थान के वैज्ञानिक श्री इरूदय राजेन्द्रण को रु० 200/= दो सौ रुपये मात्र का नकद पुरस्कार प्रदान किया गया।

हिन्दी दिवस समारोह

अन्य वर्षों की भाँति इस वर्ष भी हिन्दी दिवस समारोह का उपयोजन दिनांक 14 सितम्बर को किया गया। इस अवसर पर हिन्दी कविता हास्य व्यंग तथा संगीत आदि के रोचक कार्यक्रम आयोजित किये गये तथा संस्थान के 41 कर्मचारियों को हिन्दी में प्रशंसनीय कार्य हेतु प्रशस्ति-पत्र प्रदान किया गया।

समारोह के मुख्य अतिथि जानी-मानी लेखिका डा० (श्रीमती) ऋता शुक्ला ने हिन्दी की महत्ता तथा सरकारी काम-काज में इसके उपयोग के सेंबध में प्रकाश डाल्रा। समारोह की अध्यक्षता संस्थान के निदेशक श्री श्रवण कुमार ने किया।