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भारतीय लाख अनुसंधान संस्थान

राँची - 834010, झारखण्ड (भारत)

INDIAN LAC RESEARCH INSTITUTE

RANCHI-834 010, JHARKHAND (INDIA)

वार्षिक प्रतिवेदन 2005-2006

Annual Report

2006

भारतीय लाख अनुसंधान संस्थान
INDIAN LAC RESEARCH INSTITUTE
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Front Cover Page: 1. Lac crop on *Prosopis Juliflora*, 2. Shellac manufacturing in a factory, 3. Use of lac in cosmetics, 4. Hand operated lac grader

Back Cover Page : 1. *Kusum* (*Schleichera oleosa*) plantation, 2. Administration Building of ILRI 3. Lac based products.

Corrigendum : Name of Dr. K.K. Sharma was inadvertently omitted from the editorial credit line for the Annual Report 2004-2005. It should be read as Dr. D.N. Goswami, Dr. R.Ramani, Dr. K.K. Sharma and Dr. A. Bhattacharya.

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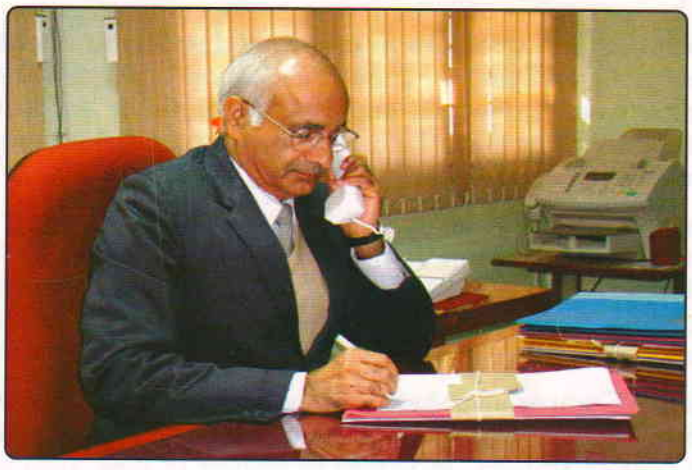
PREFACE



It was a year of fast progress and achievements in terms of research and infrastructure. Major accomplishments in the area of research, infrastructure and training are briefly stated below :

New lac host for *kusmi* lac production - *Prosopis juliflora (Ganda babool)* has been identified as potential new host for commercial *kusmi* (*aghani*) lac production. The tree was introduced in India to prevent spread of desert and has spread in large numbers in Gujarat and Rajasthan. *Aghani* crop has been raised on trees in both normal and saline soils (near coast) in Gujarat and crop was very good under both conditions. The yield ratio of 1:6 (brood lac input - output) was achieved. It is expected to increase.

Intensive lac cultivation on plantation basis on *Flemingia semialata* - *Flemingia semialata* can be successfully used for *kusmi* lac production during winter season. The plants can be exploited one year after planting and six months after coppicing for subsequent crops. The insect load is very critical and should not exceed 35% of the shoot length. The optimal density level was found to be 24,000 plants/ha., which gave sticklac yield of 27q/ha and wood biomass of 12q. The net profit per hectare is Rs 1.15 lakhs from the first crop.

***Collection and evaluation of lac insect germplasm* -** Insect-host plant relationship was studied using *rangeeni* and *kusmi* lac insects on five host species each. Host suitability index (based on four parameters) was highest for *palas* and *ber* in *baisakhi* and *katki* crop respectively. *Kusum* was best for both crop seasons (*jethwi* & *aghani*). Lac insects were collected from seven districts of eastern U.P. and added to lac insect germplasm. Twenty lines were evaluated during summer/ rainy/winter season for productivity linked attributes revealing wide variability for certain parameters.

Bio-control management of lac predators - Biorational pest control measures are being developed for lac predator control to avoid use of chemical insecticides. 48-80% lepidopterous predator suppression could be obtained using one of the following approaches: (i) Release of 3 spp. of *Trichogramma*, which is an egg parasitoid (ii) Spraying of *Bacillus thuringiensis* kurstaki and (iii) Application of extracts of odour emitting grasses, *viz.*, citronella, lemon grass and palmarosa

Characterization of lac insects and hosts - Descriptors have been developed for the three major lac hosts, *palas* (*Butea monosperma*), *kusum* (*Schleichera oleosa*) and *ber* (*Ziziphus mauritiana*) for use in characterization. Work has been initiated for characterization of lac insects through molecular fingerprinting. DNA isolation protocol from single female lac insect has been optimized. Preliminary screening of 48 lac insect lines using RAPD profiles have revealed differences both at intra and inter specific levels. This method can thus, be used for reliable characterization of lac insect species and races.

Broodlac production and revenue generation under RFS - Under revolving fund scheme, 16 q and 28q of broodlac was harvested respectively from winter and summer lac crops. 31.5q of broodlac was sold for Rs.3.83 lakh.

Enhancement of livelihood of lac growers and lac production in Jharkhand - A welfare scheme benefiting 743 lac farmers in 46 villages of Khunti sub-division of Ranchi District has been completed. Under this scheme, farmers were trained on improved methods of lac cultivation, provided with lac cultivation tools, and subsidized broodlac. Two new concepts *i.e.* lac crop insurance and broodlac entrepreneur development were introduced.

A new Centre assisted scheme for lac development has been launched to enhance the livelihood of tribal lac growers and lac production in Jharkhand. It will be implemented in nine districts of the State benefiting 20,000 farmers. The project, with a budget of Rs 9.84 crores is being implemented by Tribal Welfare Dept., under the technical guidance of ILRI. An amount of Rs 187.65 lakhs have been earmarked for the Institute for training, infrastructure development and action research.

Superiority of Indian Lac – Comparative studies on the changes in different physico-chemical properties on storage of lac of various origins viz., Thailand, Indonesia, China and India were carried out. The results obtained after one year of storage especially in respect of flow, heat polymerization time, colour index, gloss and bleach index clearly indicated the superiority of Indian lac over others.

Bleached lac with superior keeping quality – The bleached lac prepared by a new method (by optimizing the washing conditions) can be stored for around 18 months at ambient conditions without much deterioration in its qualities.

Composite board - Using sticklac as binder, medium density composite board from *arhar* (pigeon-pea) sticks has been developed for interior applications. Although the cost of the board is two times more as compared to urea-formaldehyde board, the added advantage is that it is all natural and formaldehyde free and possesses the properties as per BIS specifications. The International Agency for Research on Cancer (IARC), part of the World Health Organization has designated formaldehyde as one of the known causes of several types of throat and nasal cancer.

Development of a hand operated grader and a winnower - A hand operated lac grader with a capacity of about 60 kg/hour and a hand operated lac winnower with a capacity of about 500 kg/hour capacity has been designed and developed.

Field Demonstrations in Orissa, Madhya Pradesh and Chhattisgarh- Demonstration of scientific methods of lac cultivation were organised in remote villages in Kandhamal district of Orissa; Seoni district of MP and Raipur & Kanker district of Chhattisgarh. Institutes technical know how has revolutionized lac production in Seoni (MP) and Kanker (Chhatisgarh).

External fund mobilization for research - The institute has ten research projects with external funding from departments like Jharkhand Govt., Gujarat Govt., Technology Mission on Cotton, NABARD and DBT. Total funds received during 2005-06 were 53.50 lacs.

Major infrastructure development - Renovation of old entomology building for library and other uses, development of one deep bore well, development of a rain water pond (100×30×2.5m) and replacement of one old tractor at Institute Research Farms (IRF) were some of the major infrastructures developed.

Other major achievements - These included i) computerisation of GPF accounts and distribution of GPF annual statements within a week of yearly closing, ii) completing and updating the Asset Register and record lac production (about 60 quintals) at IRF. Besides, we were able to utilize 99.9% of Plan and 98.4% of Non-Plan budget. More than 30 lacs were earned as revenue, highest ever so far.
Overall, it was a satisfying year in all spheres.

Bangali Baboo

Dr. Bangali Baboo
Director

कार्यकारी सारांश

उत्पादकता एवं गुणवता उन्नयन

लाख कीट के जननद्रव्य का संग्रह एवं मूल्यांकन

- रंगीनी एवं कुसमी लाख कीट का उपयोग कर प्रत्येक का पाँच परिपालक प्रजातियों पर कीट-परिपालक संबंध का अध्ययन किया गया। बैसाखी एवं कतकी फसल में परिपालक उपयुक्तता सूचक (चार मानदंडों पर आधारित) क्रमशः पलास एवं बेर के लिए उच्चतम था। कुसुम दोनों फसल ऋतुओं (जेठवी एवं अगहनी) में सबसे अच्छा था।
- पूर्वी उत्तर प्रदेश के सात जिलों से लाख कीटों का संग्रह किया गया एवं लाख कीट जननद्रव्य में वृद्धि की गई। ग्रीष्म/वर्षा/शरद ऋतुओं में उत्पादकता संबंधी गुणों के लिए बीस वंशक्रमों का मूल्यांकन किया गया जिससे कुछ निश्चित मानदंडों में काफी अधिक विभिन्नता पायी गई।

लाख कीटों का आण्विक लक्षण वर्णन

- आण्विक फिंगरप्रिंटिंग द्वारा लाख कीटों के लक्षण वर्णन का कार्य आरंभ किया गया है। डी.एन.ए. पृथ्थकरण एवं पी.सी.आर. प्रोटोकॉल का अनुकूलन किया गया है। देश के विभिन्न भागों से प्राकृतिक एवं खेती किये जाने वाले लाख के 48 वंशक्रमों के आर.ए.पी.डी प्रोफाईल का उपयोग कर जाँच की गई तथा इससे पता चला कि इस तकनीक का आन्तरिक एवं अन्तर प्रजाति स्तर के लक्षण वर्णन के लिए उपयोग किया जा सकता है। इस विधि का उपयोग लाख कीट वंशक्रमों के विश्वसनीय लक्षण वर्णन के लिए किया जा सकता है।

लाख परिपालकों का लक्षण वर्णन

- तीन मुख्य लाख परिपालकों, पलास (*ब्यूटिया मोनो स्पर्मा*) कुसुम (*श्लेइचेरा ओलिओसा*) एवं बेर (*जीजीफस मौरिशियाना*) के लिए वर्णन मानक विकसित किये गए है।

लाख परिपालकों का सूक्ष्म प्रसार

- ग्रंथिल कलियों का उपयोग कर *एफ. सेमियालता* के सूक्ष्म प्रसार में सफलता प्राप्त हुई है। संलेख के मानकीकरण का कार्य प्रगति पर है। पलास और कुसुम के लिए *पॉलिफिनॉल* विक्षालन रोकने हेतु उपयुक्त उपचार विकसित कर लिया गया है। बेर में प्ररोह गुणन हेतु हारमोन एवं सतह के विसंक्रमण के लिए उपयुक्त उपचार तैयार कर लिया गया है।

उत्पादन सुधार एवं फसल प्रबन्धन

कुसमी लाख उत्पादन के लिए नया लाख परिपालक

- कुसमी लाख (अगहनी) के व्यवसायिक उत्पादन के लिए प्रासोपिस जुलीफ्लोरा (गंदा बबूल) की आशाजनक नये लाख परिपालक के रूप में पहचान की गई है। इस वृक्ष को भारत में रेगिस्तान के प्रसार को रोकने के लिए लाया गया था तथा यह अब गुजरात, राजस्थान एवं अन्य राज्यों में बड़ी संख्या में फैल गया है। आरम्भिक परीक्षण में सामान्य एवं लवणीय (समुद्र के निकट) दोनों मिट्टियों में होने वाले वृक्षों पर अगहनी फसल उगाई गई तथा दोनों स्थितियों में फसल अच्छी रही। गत वर्ष उत्पादन अनुपात 1:6 (बीहन लाख की खपत-उत्पादन) तथा इस वर्ष यह और भी अच्छा 1:25 रहा।

फ्लेमेंजिया सेमियालता के बागान स्तर पर लाख की सघन खेती

- शरद ऋतु में कुसमी लाख उत्पादन के लिए *फ्लेमेंजिया सेमियालता* का सफलतापूर्वक उपयोग किया जा सकता है। पौधों को लगाने के एक वर्ष बाद इन्हें काम में लाया जा सकता है तथा काटछांट के छः महीने बाद आगामी फसल के लिए उपयोग किया जा सकता है। पौधों पर कीटों का दाब बहुत महत्वपूर्ण होता है तथा इसे 35% प्ररोह लम्बाई से ज्यादा नहीं होना चाहिए। पौधों का अनुकूलतम घनत्व 24,000 प्रति हे. पाया गया जो प्रति हे. 27 क्विंटल यष्टि लाख तथा 12 क्विंटल लकड़ी की जैवीय सामग्री प्रदान करता है। प्रथम फसल से प्रति हे० शुद्ध आय 1.15 लाख रूपये होती है।

समेकित लाख उत्पादन पद्धति

- *एफ. सेमियालता* (8000-10000 पौधा/हे०) के बीच की जगह में अन्तर फसल (सब्जियां) उगाने से सब्जियों से अच्छी आय होती है और लाख की फसल भी अच्छी होती है। अगहनी फसल में सब्जी की फसल के साथ यष्टि लाख की उपज 20-30 क्विंटल/हे. प्राप्त हुई जबकि उसकी तुलना में बिना सब्जी के उपज 14-15 क्विंटल/हे. रही। इसी तरह का परिणाम ग्रीष्म फसल (जेठवी) का भी रहा परन्तु

लाख की उपज कम (8-12 क्विंटल/हे.) थी।

लाख परिपालकों के लिए स्वस्थाने नमी संरक्षण

- जब स्वस्थाने नमी संरक्षण की चार तकनीकों की तुलना की गई तो अगस्त-दिसम्बर में बेर की अर्द्धचन्द्राकार कगार तकनीक (*हाफ मून टेरेसिंग*) में बहुत अच्छी वृद्धि (लगभग 120%) पाई गई। इस उपचार से कुसुम की वृद्धि पर कोई खास प्रभाव नही पड़ता है।

लाख परभक्षियों का जैव नियंत्रण प्रबन्धन

- रासायनिक कीटनाशकों के उपयोग से बचने के लिए लाख परभक्षियों के नियंत्रण हेतु जैव संगत कीट नियंत्रण उपाय विकसित किये गए है। निम्नलिखित तरीकों मे से किसी एक के प्रयोग से 48-80% तक लैपिडोप्टेरस परभक्षियों का उन्मूलन किया जा सकता है : (i) *ट्राईकोग्रामा* जो कि अंड परजीवी है, की तीन प्रजातियों (टी.एच्ची, टी. इक्सीजम, टी. ओस्ट्रीनी) को छोड़ा जाना। (ii) *बैसिलस थुरींजेन्सीस* कुर्सटाकी सूत्रण का छिड़काव (iii) गंध देने वाली घांसों जैसे सिट्रोनेला, लेमन घास एवं पामा रोजा के अरक का प्रयोग।

चक्रीय निधि योजना के अन्तर्गत बीहन लाख का उत्पादन एवं राजस्व अर्जन

- चक्रीय निधि परियोजना के अन्तर्गत शरद एवं ग्रीष्म लाख फसल में क्रमशः 16 क्विंटल एवं 28 क्विंटल बीहन लाख का उत्पादन हुआ तथा 31.5 क्विं० बीहन लाख रू० 3.83 लाख में विक्रय किया गया।

प्रसार/कल्याण : झारखंड में लाख उत्पादन एवं लाख उत्पादकों की आजीविका में बढ़ोत्तरी

- राँची जिले के खूंटी अनुमण्डल स्थित 46 ग्रामों के 743 किसानों को लाभान्वित करने के लिए एक कल्याण योजना पूर्ण की गई। इस योजना के अन्तर्गत किसानों को उन्नत विधि से लाख की खेती का प्रशिक्षण, लाख की खेती के औजार एवं अनुदानित मूल्यों पर बीहन लाख दिया गया। परियोजना में लाख फसल का बीमा एवं बीहन लाख की उद्यमिता विकास जैसी दो नई अवधारणाएँ आरंभ की गई है।
- झारखंड में लाख उत्पादन एवं आदिवासी लाख उत्पादकों की आजीविका में बढ़ोतरी के लिए लाख विकास हेतु एक नयी केन्द्रीय योजना आरंभ की गई है। यह राज्य के 9 जिलों के 20,000 किसानों के लिए लाभकारी होगी। रू० 9.84 करोड़ की यह परियोजना भा.ला.अ. सं. के तकनीकी निर्देश के अन्तर्गत आदिवासी कल्याण विभाग द्वारा कार्यान्वित की जा रही है। लाख संस्थान में प्रशिक्षण, आधारभूत ढांचा विकास एवं अनुसंधान संबंधी कार्यों के लिए रू. 187.65 लाख चिन्हित किये गये है।

गुजरात मे लाख की खेती एवं प्रशिक्षण

दिये गए प्रशिक्षण :

- ❖ भा.ला.अनु.सं. में दो वन अधिकारियों का एक सप्ताह का प्रशिक्षण
- ❖ बड़ोदरा एवं गांधीनगर जिले में 90 किसानों को प्रक्षेत्र प्रशिक्षण
- ❖ गांधीनगर एवं उदयपुर में 69 वन कार्मिकों का परिसर में प्रशिक्षण

प्रदर्शन :

गोधरा जिले और बासन में दो स्थानों पर प्रदर्शन के उद्देश्य से बेर के 130 वृक्षों पर अगहनी 2005-2006 फसल उगायी गई।

प्रसंस्करण एवं मूल्य वर्द्धन

भंडारण से लाख का अवक्रमण

- विभिन्न फसलों से प्राप्त चौरी एवं चपड़ा के भौतिक रासायनिक गुणों में परिवर्त्तन संबंधी अध्ययन उपचायकरोधी की उपस्थिति एवं अनुपस्थिति में जारी है। ग्रीष्म फसल की कुसमी एवं वर्षा ऋतु की रंगीनी लाख के मामले में उपचायक के प्रयोग करने से अवक्रमण को छः महीने तक रोका जा सकता है। किसी भी फसल के चौरी एवं चपड़ा वर्षा ऋतु में अगर वातावरण के तापमान पर (आर.एच. 72-95% के बीच में) रखा जाए तो 1.8-2.25% नमी शोषित करता है। पौलीथीन के थैले में भंडारण करने से नमी को कुछ हद तक रोका जा सकता है।

अन्य देशों में उत्पादित लाख की तुलना में भारतीय लाख की गुणवता

- इन्डोनेशिया, थाइलैंड, भारत में उत्पादित चौरी एवं चपड़े के भंडारण के दौरान विभिन्न भौतिक-रासायनिक परिवर्त्तनों का तुलनात्मक अध्ययन जारी है। एक वर्ष के भंडारण के बाद प्राप्त परिणाम से पता चलता है कि भारतीय चौरी और चपड़ा विशेष रूप से बहाव, ताप बहुलकन समय, रंग सूचकांक, चमक एवं विरंजन सूचकांक की दृष्टि से अन्य देशों के चौरी और चपड़े से बेहतर है।

उत्पाद विकास एवं उपयोग विविधिकरण

यष्टि लाख से कम्पोजिट बोर्ड

- अग्नि मंदक के साथ यष्टि लाख को बंधक के रूप में उपयोग कर कम्पोजिट बोर्ड तैयार किया गया जिसमें प्रज्जवलन अवधि, उत्तरदीप्ति तथा वजन की प्रतिशत क्षति एवं जले क्षेत्र की दृष्टि से अच्छे अग्नि प्रतिरोधक गुण है। 7 मि.मी. से 26 मि.मी. की विभिन्न मोटाई के कम्पोजिट बोर्ड अरहर की यष्टि के चूर्ण के साथ यष्टि लाख को बन्धन सामग्री के रूप में उपयोग कर प्रयोग के तौर पर सफलता पूर्वक बनाया गया है।

फल एवं सब्जियों के लिए लाख आधारित लेपन सुत्रण

- लाख आधारित सूत्रण को 10% गाढ़ा कर ठोस अंश तक बनाए गए लेपन का टमाटर, बैंगन एवं परवल पर परिणाम आशाजनक रहा है।

एल्यूरिटिक अम्ल आधारित पौध वृद्धि नियामक (पी.जी. आर.) अनुरूप का मूल्यांकन

- 10-कार्बोक्सिमिथाइल-2-डेसेनोईक अम्ल (सी.एम. डी.ए.) एवं मिथाइल-9-मिथाइल-2-नोनेनोएट (पी.जी. आर.) का संश्लेषण किया गया तथा नियंत्रण एवं आई.बी.ए. की तुलना में *एफ. सेमियालता* में इस यौगिक से बेहतर जड़ उत्पत्ति पायी गई। बाद में परवल पर 0.2 पी.पी.एम. सांद्रण का प्रयोग करने पर पी.जी.आर. के परिणाम स्वरूप बहुल प्ररोह उत्पत्ति देखी गई।
- एल्यूरिटिक अम्ल से 16-हाईड्रॉक्सी-(ई)-9-हेक्साडेसेनोईक अम्ल संश्लेषित किया गया तथा उसमें द्वितीय चरण के अल्पवयस्क गोलकृमि के प्रति सन्तोषजनक विषाणुता देखी गई। 192 घंटे के बाद 5000 पी.पी.एम. पर उच्चतम मरणशीलता देखी गई।
- टोमैटो हिट (एक व्यवसायिक उत्पाद) की तुलना में (जेड)-9-टेट्राडेसिनिल एसिटेट एवं (जेड)-7-डोडेसिनिल एसिटेट का मिश्रण खेत के टमाटर की फसल में बेहतर पाया गया। सभी तीनों यौगिको का डेंगू कारक मच्छर *एडीस एजिप्टी, डी.एच.एफ* एवं *एनोफिलीस स्टीफेन्सी* के विरूद्ध मूल्यांकन किया जा रहा है।

चपड़ा सम्पूरित शीट गढ़न यौगिक से जूट फाइबर काँच संबलित शीट

- पारिस्थितिकी के ज्यादा अनुकूल शीट के निर्माण के प्रयास में जूट-फाइबर काँच संबलित शीटों के यांत्रिक एवं अन्य गुणों का अध्ययन किया गया। पहले की शीटों की मोटाई 6-7 मि.मी. बढ़ाने पर शीटों का लचीलापन सामर्थ्य (~95 एम.पी.ए.) फाईबर काँच संबलित शीटों की तरह का पाया गया। यह शीट कई रसायनों के प्रति रोधी तथा अच्छा अग्नि निरोधक है।

जल में घोलकर पतला करने योग्य पेंट

- चपड़ा आधारित जल से पतला करने योग्य संयोजन को परिष्कृत किया गया एवं उसके अभिलक्षणों का अध्ययन किया गया है। ब्रश द्वारा प्लास्टर ऑफ पेरिस लेपित सतह, कंकरीट, प्लास्टर एवं चूना की गई सतह पर प्रयोग करने से यह सख्त, मैट परिष्कृत चिकनाहट देता है इसकी फिल्म हवा में 8-12 मिनट में सूख जाती है, जल व अम्ल की बेहतरीन प्रतिरोधी है एवं क्षार की भी अच्छी प्रतिरोधी है। विकसित संयोजन के गुण उपलब्ध दो व्यवसायिक नमूनों के तुलनीय पाये गए। दो बार लेपन के लिए आच्छादन प्रति लीटर 120वर्ग फीट रिकार्ड किया गया। मूल्यांकन के लिए पेंट को संस्थान की उपयुक्त दीवारों की आन्तरिक एवं बाहरी सतहों पर प्रयोग किया गया।

प्रौद्योगिकी मूल्यांकन, परिष्करण एवं प्रसार

प्रमुख परिपालकों पर लाख की खेती की लागत

- लाख की खेती के सर्वे के आंकड़े बताते हैं कि पलास (50 परिपालक) पर लाख की खेती करने से लागत, शुद्ध आय एवं बी.सी.अनुपात क्रमशः 2566.2, 4885.80 रूपये एवं 2.9 तथा बेर (50 परिपालक) पर 4673.90, 9771.10 रूपये एवं 3.09 और कुसुम (10 परिपालक) पर खेती से क्रमशः 6880.8, 16283.70 रूपये एवं 3.37 है। लाख की वैज्ञानिक खेती के प्रशिक्षण के प्रभावस्वरूप परिपालक के उपयोग, रोजगार सृजन एवं लाख की खेती से शुद्ध आय में वृद्धि देखी गई। वर्त्तमान अध्ययन झारखंड के लाख उत्पादकों की सामाजिक आर्थिक स्थिति को मजबूत बनाने में सहायक होगा।

लाख बहिस्राव का उपचार

- लाख के कारखानें का बहिस्राव (यष्टि लाख धोवन जल) से चूना पानी, सोडियम हाइपोक्लोराइट घोल एवं सक्रिय कार्बन के लगातार उपचार के बाद गंध एवं रंग समाप्त हो जाते हैं। विद्युत चालकता, कुल धुलित ठोस, तेल एवं ग्रीस जैसे तीन अभिलक्षण/मानदंड निर्धारित सीमा से अधिक पाये गए तथा सल्फेट,

क्लोराइड, सोडियम अवशोषण अनुपात, बोरोन, सोडियम प्रतिशत, शीशा, आरसेनिक, बी.ओ.डी., फिनोलिक यौगिक, तांबा, अमोनिया एवं कुल क्रोमियम जैसे 12 अन्य मानदंड सीमा के अन्तर्गत पाये गए।

हस्तचालित लाख ग्रेडर एवं ओसाई मशीन का विकास

- लगभग 60 कि.ग्रा./घंटे की क्षमता का एक हस्तचालित लाख ग्रेडर एवं लगभग 500 कि.ग्रा./घंटे क्षमता की एक हस्तचालित लाख ओसाई मशीन अभिकल्पित एवं विकसित की गई है।

लाख: उत्पादन, प्रसंस्करण एवं मूल्यवर्द्धन में क्षमता निर्माण के लिए मानव संसाधन विकास

प्रशिक्षण उपलब्धियाँ

- झारखंड, छत्तीसगढ़, महाराष्ट्र, उड़ीसा एवं आंध्रप्रदेश के 755 किसानों के लिए भा.ला.अनु.सं. में एक सप्ताह की अवधि के बीस प्रशिक्षण पाठ्यक्रम आयोजित किये गए।
- कृषि के छात्रों, वन विभाग के अधिकारियों के लिए लाख पर चार शैक्षणिक कार्यक्रम आयोजित किये गए।
- झारखंड, छत्तीसगढ़, मध्य प्रदेश एवं गुजरात के 3649 लाभुकों के लिए 36 शिविरों में लाख की खेती पर प्रक्षेत्र प्रशिक्षण आयोजित किये गए।
- झारखंड, मध्यप्रदेश, प. बंगाल, महाराष्ट्र एवं छत्तीसगढ़ में विभिन्न जगहों पर लाख की खेती संबंधी 49 उत्प्रेरक क्षेत्रीय शिविर लगाए गए जिससे 4779 किसानों उद्यमियों को लाभ मिला।
- भा.ला.अनु.सं. में 970 लाभुकों के लिए लाख पर एक दिन के अभिविन्यास कार्यक्रम आयोजित किये गये।
- छत्तीसगढ़ पर्यावरण एवं वन मंत्रालय के उदन्ति एवं रायपुर वन प्रभाग के लिए लाख पर एक कार्ययोजना बनाई गई है।
- "लाख की वैज्ञानिक खेती" पर राँची (झारखंड), कंदमल (उड़ीसा) एवं पुरूलिया (प. बंगाल) में प्रक्षेत्र प्रदर्शन किये गये। ये प्रदर्शन बेर के वृक्ष पर कुसमी लाख के लिए किये गये।

संस्थान अनुसंधान प्रक्षेत्र में आधारभूत ढांचा विकास

- 35 हॉर्स पावर का एक नया ट्रैक्टर अन्य उपस्करों जैसे डिस्क हैरो एवं डिस्क प्लाउ के साथ पुराने ट्रैक्टर के स्थान पर क्रय किया गया।
- सिंचाई सुविधाओं में वृद्धि के लिए 100×30×25 मीटर आकार का एक नया कच्चा तालाब बनाया गया है।
- पक्के तालाब से सिंचाई हेतु पानी के प्रयोग के लिए 200 मी० लम्बाई का भूमिगत बिजली का केबल बिछाया गया।
- तीन मीटर चौड़े तथा 150 मीटर लम्बे रास्ते की मरम्मत एवं 69, 70, व 71 भूखण्डों में 100 मीटर लम्बे तथा तीन मीटर चौड़े रास्ते का निर्माण किया गया।

घटनाक्रम

लाख उत्पादन में सुधार के लिए रणनीति बनाने हेतु विचार मंथन सत्र

- संस्थान के 82वें स्थापना दिवस के अवसर पर "लाख उत्पादन में सुधार के लिए रणनीति" विषय पर एक विचार मंथन सत्र आयोजित किया गया। राज्य सरकार, राज्य वन विभाग, लाख से जुड़े संगठनों जैसे चपड़ा निर्यात संवर्धन परिषद् एवं झास्कोलैम्प, लाख उद्योग, गैर सरकारी संगठनों, वित्तीय संस्थानों के प्रतिनिधियों तथा संस्थान एवं संबद्ध संस्थानों के वैज्ञानिको समेत कुल तिरेपन प्रतिभागियों ने भाग लिया।

लाख के रसायन एवं उपयोग पर राष्ट्रीय संगोष्ठी

- लाख के रसायन एवं प्रयोग विषय पर एक राष्ट्रीय संगोष्ठी 25 नवम्बर 2005 को संस्थान के लाख प्रसंस्करण एवं उत्पाद विकास विभाग द्वारा आयोजित की गई। संगोष्ठी का उद्घाटन श्री विल्फ्रेड लकड़ा, प्रबन्ध निदेशक, ट्राइफेड, भारत सरकार ने किया। संगोष्ठी में संस्थान के 30 वैज्ञानिकों समेत, राँची विश्वविद्यालय, राँची, लाख उद्योग एवं सरकारी संगठनों के कुल 60 प्रतिनिधियों ने भाग लिया।

पुरस्कार/सम्मान

- डॉ केवल कृष्ण शर्मा, वरिष्ठ वैज्ञानिक, लाख उत्पादन विभाग को वर्ष 2004 के लिए अनुप्रयुक्त प्राणी विज्ञान में उनके बेहतरीन अनुसंधान योगदान के लिए एप्लॉयड जूलोजिस्ट रिसर्च एसोसियेशन, कटक द्वारा 14 फरवरी 2005 को अजरा युवा वैज्ञानिक पुरस्कार से सम्मानित किया गया।

EXECUTIVE SUMMARY

Productivity and Quality Improvement

Collection and evaluation of lac insect germplasm

- Insect-host plant relationship was studied using *rangeeni* and *kusmi* lac insects on five host species each. Host suitability index (based on four parameters) was highest for *palas* and *ber* in *baisakhi* and *katki* crops respectively. *Kusum* was best for both crop seasons (*jethwi* & *aghani*).
- Lac insects were collected from seven districts of eastern U.P. and added to lac insect germplasm. Twenty lines were evaluated during summer/ rainy/winter season for productivity linked attributes revealing wide variability for certain parameters.

Molecular characterization of lac insects

- Work has been initiated for characterization of lac insects through molecular fingerprinting. DNA isolation and PCR protocols have been optimized. Screening of 48 lines of cultivated as well as wild lac insect lines from different parts of the country, using RAPD profiles have shown that this technique can be used for characterization at both intra and interspecific levels. This method can thus, be used for reliable characterization of lac insect lines.

Characterization of lac hosts

- Descriptors have been developed for the three major lac hosts, *palas* (*Butea monosperma*), *kusum* (*Schleichera oleosa*) and *ber* (*Ziziphus mauritiana*) for use in characterization.

Micropropagation of lac hosts

- Success has been achieved in micropropagation of *F. semialata* using nodal buds. Standardization of the protocol is in progress. Suitable treatment to check polyphenol leaching has been worked out for *palas* and *kusum*. Suitable treatments for surface sterilization and hormones for shoot multiplication in *ber* have also been determined.

Production Improvement and Crop Management

New lac host for kusmi lac production

- *Prosopis juliflora (Ganda babool)* has been identified as potential new host for commercial *kusmi* (*aghani*) lac production. The tree was introduced in India to prevent spread of desert and has spread in large numbers in Gujarat and Rajasthan and some other states. Under preliminary trials, *aghani* crop has been raised on trees occurring in both normal and saline soils (near coast) and crop is doing well under both conditions. The yield ratio was 1:6 (brood lac input:output) last year and this year it was much better (1: 25.)

Intensive lac cultivation on plantation basis on Flemingia semialata

- *Flemingia semialata* can be successfully used for *kusmi* lac production during winter season. The plants can be exploited one year after planting and six months after coppicing for subsequent crops. The insect load is very critical and should not exceed 35% of the shoot length. The optimal density level was found to be 24,000 plants/ha., which gives a sticklac yield of 27q/ha and a wood biomass of 12q. The net profit per hectare is Rs 1.15 lakhs from the first crop.

Integrated lac production systems

- Growing of intercrops (vegetables) in the interspaces of *F. semialata* (8000-10,000 plants/ha) leads to better returns through the vegetables and also due to higher lac yields. Sticklac yields of 20-23 q/ha can be obtained from *aghani* crop with vegetable crops compared to 14-15 q/ha without them. Similar results were obtained with summer (*jethwi*) crop but the lac yields were lower (8-12 q/ha).

In-situ moisture conservation for lac hosts

- Half moon terracing led to better growth (about 120%) of *ber* during Aug.-Dec., when four *in-situ* moisture conservation techniques were compared. The treatments did not have any significant impact on growth of *kusum*.

Bio control management of lac predators

- Biorational pest control measures have been developed for lac predator control to avoid use of chemical insecticides. 48-80% lepidopterous predator suppression could be obtained using one of the following approaches: i) Release of 3 spp. of *Trichogramma*, (*T. achaeae, T. exiguum* and *T. ostrinae*) which are egg parasitoids. ii) Spraying formulation of *Bacillus thuringiensis* kurstaki. and iii) Application of extracts of odour emitting grasses, viz., citronella, lemon grass and palmarosa.

Broodlac production under RFS

- Under revolving fund scheme, 16 q and 28q of broodlac was harvested respectively from winter and summer lac crops . 31.5q of brood lac was sold for Rs.3.83 lakh.

Extension / Welfare : Enhancement of livelihood of lac growers and lac production in Jharkhand

- A welfare scheme benefiting 743 lac farmers in 46 villages of Khunti sub division of Ranchi District has been completed. Under this scheme, farmers were trained on improved methods of lac cultivation, provided with lac cultivation tools, and subsidized broodlac. Two new Concepts *i.e.* lac crop insence and broadlac intrepreneur development were introduced.
- A new Centre assisted scheme for lac development has been launched to enhance the livelihood of tribal lac growers and lac production in Jharkhand. It will be implemented in nine districts of the State benefiting 20,000 farmers. The project, with a budget of Rs 9.84 crores is being implemented by Tribal Welfare Dept., under the technical guidance of ILRI. An amount of Rs 187.65 lakhs have been earmarked for the Institute for training, infrastructure development and action research.

Lac culture training and demonstration in Gujarat

- *Training imparted:*
  - One week training : Two forest officers at ILRI
  - On-farm training to 90 farmers in Vadodera & Gandhinagar district
  - Off-campus training to 69 forest personnel in Gandhinagar & Udaipur.
- *Demonstration:*
  Aghani 2005-06 crop was raised on 130 *ber* trees at two locations in Basan & Godhra districts for demonstration purpose.

Processing and Value Addition

Degradation of lac on storage

- Studies on the changes in different physico-chemical properties of seedlac and shellac obtained from different crops were continued in presence and in absence of antioxidant. Application of an antioxidant could delay degradation at least by 6 months in the case of summer crop of *kusmi* and rainy season crop of *rangeeni* lac. Seedlac and shellac absorb moisture 1.8-2.25% from environment during rainy season when stored at room temperature (R.H. in the range 72–95%) irrespective of crop. Storage in polybag could check absorption of moisture to some extent.

Quality of Indian Lac with respect to those produced by other countries

- Comparative studies on the changes in different physico-chemical properties on storage of seedlac and shellac of various origins *viz.*, Indonesia, Thailand, China and India were continued. The results obtained after one-year storage of seedlac/shellac revealed that Indian

seedlac and shellac are better compared to other seedlac/ shellac especially in respect of flow, heat polymerization time, colour index, gloss, and bleach index.

Product Development and Use Diversification

Composite board with sticklac

- Composite board prepared using sticklac as a binder alongwith a flame retardant resulted in good fire resistance properties with regard to duration of flaming, after-glow, percentage loss in weight and charred area. Composite boards, of different thicknesses between 7 mm and 26 mm, were successfully prepared at experimental level from pulverized *arhar* sticks.

Lac based coating formulation for fruits and vegetables

- Lac based formulations optimized to 10% solid contents showed encouraging results in tomato, brinjal and pointed gourd.

Evaluation of PGR analogue based on aleuritic acid

- 10-carboxymethyl-2-decenoic acid (CMDA) and methyl-9-methyl-2-nonenoate (PGRs) were synthesized and the compound was found to yield better roots in *F. semialata* than the control and IBA. Latter PGR resulted in multiple shoot emergence in pointed gourd (*Parwal*) applied at a concentration of 0.2 ppm.
- 16-Hydroxy-(*E*)-9-hexadecenoic acid synthesized from aleuritic acid was found to display considerable degree of toxicity against the second stage juvenile nematodes. Highest mortality was noticed at 5000 ppm after 192 hrs. of exposure duration. Blend of (*Z*)-9-tetradecenyl acetate and (*Z*)-7-dodecenyl acetate was found to be superior than tomato hit (a commercial product) in tomato crops in field.
- 1,9 – Nonanediol diacetate, 1,7 heptane diol diacetate and (E)-2- undecen-1, 11 diol diacetate were synthesied) All the three compounds are under evaluation against *Aedes aegypti*, the vector mosquito for Dengue, DHF and *Anopheles stephensi*.

Jute-fibre-glass reinforced sheets with shellac filled sheet moulding compound

- Mechanical and other properties of jute-fibreglass reinforced sheets were studied in an effort to prepare a more eco-friendly sheet. The flexural strength (~95 Mpa) of the sheets was found to be in the range of fiberglass reinforced sheets when thickness of the former sheets was increased to 6-7 mm. The sheets possessed resistance to a number of chemicals and good flame retardness.

Water thinnable paint

- Refinement in the composition of shellac based water thinnable paint was made and their characteristics were studied. It can be applied by brush to produce hard, smooth and matt finish on plaster of Paris coated surface, concrete, masonry and limed surface. The films dry in 8-12 minutes in air which showed excellent resistance towards water, acid and fairly good resistance to alkali. The properties of the developed composition were found to be comparable with those of two commercial samples. Covering power was recorded to be 120 ft^2 per liter for double coat. The paint was applied on suitable wall spaces for its evaluation on exterior and interior surfaces at the Institute.

Technolgy Assessment, Refinement and Dissemination

Cost of Lac cultivation on major hosts

- Cost of cultivation, net return and BC ratio has been worked out to be Rs. 2,566.20, Rs.4,885.80 and 2.9 respectively for lac cultivation on *palas* (50 hosts); Rs. 4,673.90, Rs. 9,771.10 and 3.09 respectively for *ber* (50 hosts) and Rs. 6,880.8, Rs. 16,283.70 and 3.37 respectively for lac cultivation on *kusum* (10 hosts). Impact of scientific lac cultivation training has revealed higher host utilization, employment generation and returns in lac cultivation.

Lac effluent treatment

- Lac factory effluent (sticklac wash water) on successive treatments with limewater, sodium hypochlorite solution and activated carbon were found to remove practically all the colour and

the odour. Three characteristics / parameters such as electrical conductance, total dissolved solids and oil & grease were found to be above the prescribed limits and other 12 parameters *e.g.*, sulphate, chlorides, sodium absorption ratio, boron, percent sodium, lead, arsenic, BOD, phenolic compounds, copper, ammonia and total chromium were found to be within the limit.

Development of a lac grader and a winnower

- A hand operated lac grader, with a capacity of about 60 kg/hour and a hand operated lac winnower of about 500 kg/hour capacity have been designed and developed.

HRD for Capacity Buliding in Lac Production, Processing and Value Addition

Training highlights

- Twenty training courses of one week duration were organized at ILRI for 755 farmers of Jharkhand, Chhattisgarh, Maharastra, Orissa and Andhra Pradesh
- Four educational programmes on lac were conducted for Ag. Students and officials of Forest Deptt.
- On–Farm trainings on lac cultivation were organized in 36 camps for 3,649 beneficiaries of Jharkhand, Chhattisgarh, M.P. and Gujarat
- Organised 49 motivational field camps for lac cultivation at different places of Jharkhand, M.P., W.B., Maharastra and Chhattisgarh benefiting 4779 farmers and entrepreneurs.
- One – day orientation programmes on lac were conducted for 970 beneficiaries at ILRI
- An action plan for Development of Lac in Udanti and Raipur Forest Division was prepared for Chhattisgarh environment and Forest department.
- Field Demonstration on 'Scientific Lac Cultivation' was conducted at Ranchi (Jharkhand), Kandhmal (Orissa) and Purulia (W.B.). These demonstrations were conducted for *kusmi* lac on *ber* tree.

Infrastructure Development at Intitute Research Farm

- A new 35 HP Tractor has been purchased with other implements like Disc Harrow and Disc Plough as replacement for the old Tractor.
- A new *Kuchcha* pond of 100 x 30 x 2.5 m dimensions has been developed to augment the irrigation facilities.
- 200 m long underground electric cable was laid to provide electric connection at the *Pucca* pond site for lifting the water from the pond for irrigation.
- 150 m long and 3 m wide *Kuchcha* road was re-laid and 100 m long and 3 m wide *Kuchcha* road was constructed in plot nos. 69, 70 and 71.

Events Organized

Brainstorming Session on Strategies for Improving Lac Production

- A brainstorming session on "Strategies for improving lac production" was organized as a part of the 82nd foundation day of the Institute. Fifty-three participants from State Govt. State Forest Dept., lac related organizations like SEPC & JASCOLAMPF, lac industry, NGOs, financial institutions and the scientists of the Institute as well as sister Institutes took active part in the session.

National Seminar on Chemistry and Application of Lac

- A national seminar on "Chemistry and Application of Lac" was organized by LP & PD Division in the Institute on 25th November 2005. The seminar was inaugurated by Sri Wilfred Lakra, Managing Director, TRIFED, Govt. of India and attended by altogether 60 delegates including 30 scientists from the Institute, Ranchi University, Ranchi, Lac industries and Govt. organizations.

Awards / Honours

- Dr. K. K. Sharma, Sr. Sc., LP Division was awarded AZRA Young Scientist Award for the year 2004 by Applied Zoologist Research Association, CRRI, Cuttack on Feb. 14, 2005 for his outstanding research contribution in the field of Applied Zoology.

INTRODUCTION

Historical Development

Lac, a natural resin, is cultivated and collected by tribals inhabiting the sub-hilly tracts of Jharkhand, Chattisgarh W. Bengal, Madhya Pradesh, Maharashtra, Orissa and UP. Before the advent of synthetic plastics and resins, lac was invaluable in moulding and insulating industries, and India, then had an unparalleled global monopoly over the lac trade. Realising the strategic importance of this commodity, the then Imperial Govt. of India constituted the *Lindsay-Harlow Committee* in 1920, to look into all aspects of the country's lac trade and its development. On the suggestions of this Committee, lac merchants organized themselves into the *Indian Lac Association for Research*, under the aegis of which, the foundation stone of the Indian Lac Research Institute was laid on September 20, 1924 at Ranchi.

Initially, the Institute consisted of an Entomological Section as the principal unit supported by a Biochemical Section which started functioning from 1925. Then, in 1927, a Physico-chemical Section was added to take up applied research. Later, these two chemical sections were combined to form a Chemical Division. The scope of this Institute was thus, widened to cover both the entomological and chemical aspects. Subsequently, on the recommendations of the *Royal Commission on Agriculture, the Indian Lac Cess Committee* was constituted, which took over the reigns of the ILRI in 1931. The ILCC also organised and maintained the (1) *London Shellac Research Bureau, UK* and (2) *Shellac Research Bureau and Polytechnique Institute of Brooklyn, USA*. As a result of reorganization of agricultural research and education within the country, the ICAR took over the administrative control of the ILRI from April 1966. This Institute is thus, one of the oldest, within the ICAR system, having completed more than 82 years of fruitful service to the nation.

A Unique Institute

The ILRI is unique and only one of its kind in the world, being devoted exclusively to all aspects of lac cultivation, processing and utilization. It employs a multidisciplinary approach of researches, encompassing all areas related to lac production, refinement and utilization. The areas covered include lac insects and associated biota; their host plants (both trees and bushy species); lac insect and host management; refinement/ isolation of commercially important products from raw lac; lac based product diversification and other areas such as economics, marketing etc. It has the world's richest and the oldest books and literature on lac, a well-organised lac museum depicting all aspects of lac and a collection of a wide range of lac insects and lac host plants collected from different parts of the country.

Location and Agro-Climate

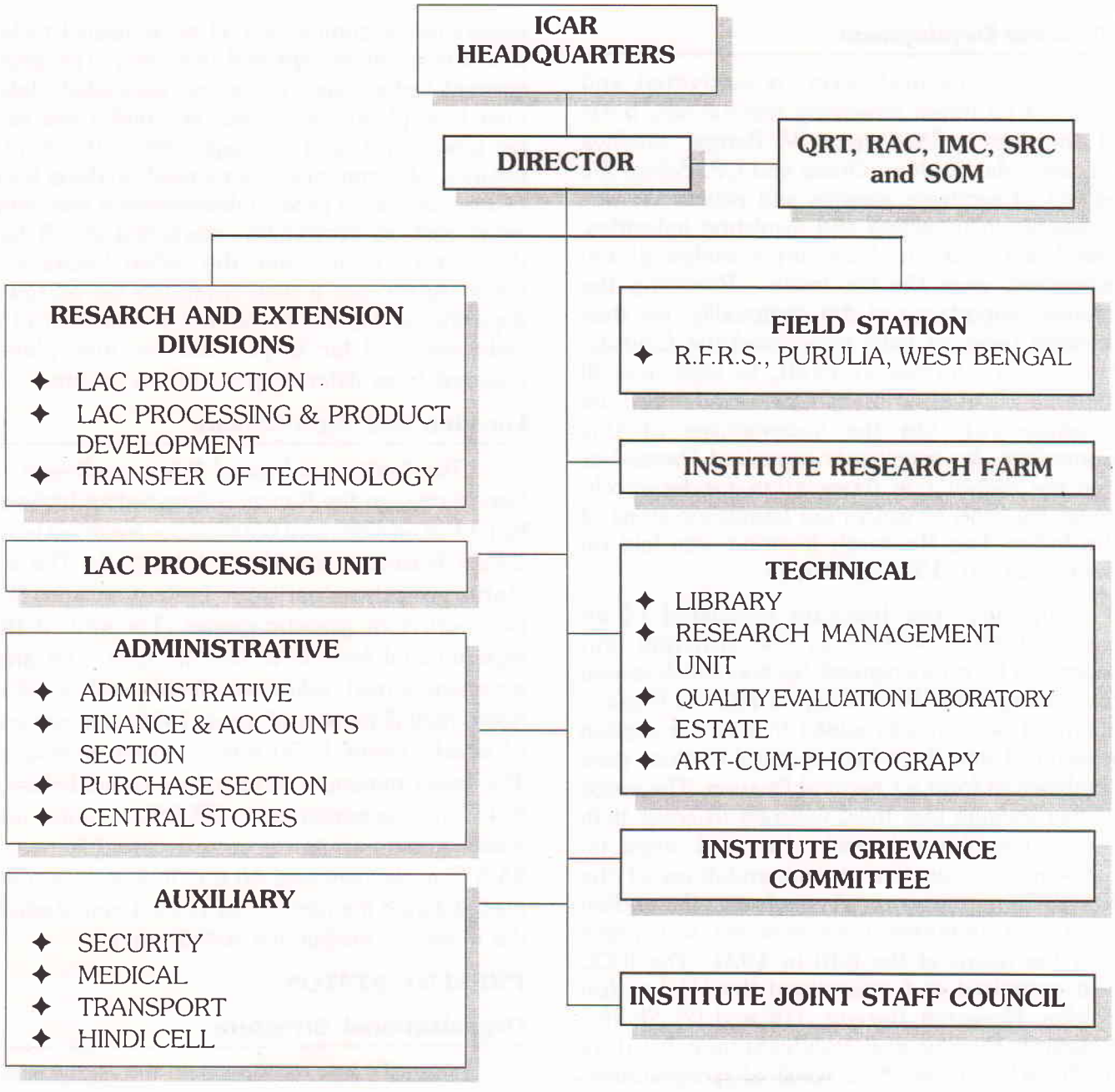
The Institute is located 9 km. south-east of Ranchi city, on the Ranchi – Jamshedpur highway NH 33, at an altitude of 650m above mean sea level, 23°23' N latitude and 85°23' E longitude. The soil status of the Institute indicates advance weathering of granitic gneiss. The soil of the experimental farm is of lateritic type. The area experiences mild, salubrious climate, with a rather heavy rainfall pattern of about 1400 mm average, of which, about 1250 mm is during monsoon. The mean minimum temperature varied between 6.4°C in December and 25.2°C in June and mean maximum temperature varied between 25.5°C in January and 40.6°C in May. The total rainfall during the period was 1029.4 mm of which the monsoon rainfall was 889.3 mm.

PRESENT STATUS

Organisational Structure

The ILRI has responded to the globalisation of industries and agricultural enterprises of the country as well as functional reorganisation of ICAR. The Institute also has undergone structural changes and the priorities have been redefined. In 1995-96, the erstwhile Divisions and Sections were abolished and the scientific manpower divided into three divisions, *viz.*, Lac Production, Lac Processing and Product Development, and Transfer of Technology. The Institute runs one Regional Field Research Station at Purulia in West Bengal. The Institute is headed by a Director.

ORGANISATIONAL SET-UP



Staff

Institute has a sanctioned strength of 1 RMP, 46 scientific, 62 technical, 36 administrative and 89 supporting grade posts, out of which 29 scientific, 58 technical, 31 administrative and 81 supporting posts are in position.

Infrastructure

Manned by a strong band of dedicated scientists from various disciplines including entomology, plant sciences, organic chemistry, physics, engineering, bio-technology, etc., the Institute has about 200 staff in scientific, technical, administrative and supporting categories. The Institute has several prestigious labs, *viz.*, High Voltage Laboratory, Bio-technology Laboratory, Bio-control Laboratory, Instrument Laboratory, Quality Evaluation Laboratory etc. Besides these, the DTP and publications facilities are also available. A number of modern and sophisticated laboratory equipment, including DSC, FT-IR, Insect

Activity Meter, Environmental Growth Chamber etc. are available for research on all aspects of lac production, processing and product development. Besides the above, a Regional Field Research Station at Purulia (WB) addresses the region-specific technology and its transfer problems. There are several well-organised and equipped service sections to support research management of the Institute. The administrative wing comprises of Director's Office, Administrative Section, Finance and Accounts Section, Purchase and Central Stores. The technical support is provided by the following sections: Institute Research Farm Section, Research Management Unit, Library and Maintenance & Workshop. The Auxiliary units are: Hindi Cell, Security, Medical and Estate Maintenance services.

The Institute Research Farm area spread over 36 ha. has all conventional and cultivated lac host plants. It has 1540 host trees of *S. oleosa* (*kusum*), 2480 trees of *Butea monosperma* (*palas*), 1351 *trees of Z. mauritiana* (*ber*) and 8695 minor host plants. The field gene bank of the Institute has collection of genotypes/species of important host plants. The Institute is responsible for the collection and maintenance of germplasm of lac insect lines as well as lac host trees. Presently, the field gene bank of lac insects is maintaining more than fifty lines of the lac insects, which includes collection from different parts of the country, inbred and crossbred lines.

The ILRI Library has holdings of more than 50,000 volumes of scientific journals, 2000 rare books, including back volumes of research periodicals in the field of lac and surface coating. Since the holdings of back volumes of certain journals date back to *circa* 1760, the library has been catering to the document supply services of INSDOC, New Delhi. Besides catering to the scientists and staff of the Institute, the library also attracts researchers of neighbouring educational and research institutions, including BIT, RU, BAU and HARP, Ranchi; IIT, Kharagpur; RAU, Samastipur; PU, Patna; NIT, Jamshedpur etc.

The Quality Evaluation Laboratory of the Institute caters to the quality control needs of the lac processing / lac product industries as well as exporters of lac / lac products. This QE lab analyses about 150 samples, on an average, per annum. The lab has facilities for carrying out testing of lac / lac products as per BIS requirements.

The Research Management Unit (RMU) provides the scientists, access to internet and e-mail facilities for communication and information retrieval. The Institute website, available at *www.icar.org.in/ilri default.htm,* is a valuable source of information on ILRI as well as lac.

The Institute has attained international recognition for its contribution in cultivation and utilisation aspects of lac.

Mandate of the Institute

For Head Quarters

- To develop lac culture technologies, adopting existing or genetically improved lac insects and lac hosts
- To develop lac processing techniques for the industry
- To conduct researches for diversification of lac utilisation leading to pilot plant demonstration
- To transfer the technologies to farmers and entrepreneurs
- To act as a repository of information on lac production, processing and utilisation

For Regional Field Research Stations

- To test the developed lac cultivation technologies under different agro-climatic conditions
- Broodlac production and exploitation of regional hosts
- Training of farmers for boosting lac production in agro-forestry system
- Entrepreneur awareness programme on regional basis

Budget

During 2005-2006, the non-plan expenditure was Rs.436.02 lakhs, against a revised estimate of Rs.443.00 lakhs, the plan expenditure was Rs.119.88 lakhs against a revised estimate of Rs. 120.00 lakhs. The detailed figures are shown in the following table on page 4.

Revenue Generation

During the period under report, a sum of Rs. 30.33 lakhs was earned as revenue through different programmes of various divisions and sections of the Institute.

Budget during 2005-06
(in Rs. Lakhs)

PLAN

Sl. No.	Sub-Head	R.E. 2005-06	Expenditure Upto 31.03.2006	Percentage
1.	Estt. Charge	0.00	0.00	
2.	Traveling allowance	5.00	5.00	
3.	Other charges including equipments	96.00	96.00	
4.	Works	14.00	13.89	
5.	Other items (Library)	5.00	5.00	
	Total : (1 to 5)	120.00	119.89	99.90

Non-Plan

1.	a) Estt. Charges including LSP & PE	352.00	346.55	
	b) Wages (Temporary status)		-	
	c) OTA	0.05	0.05	
2.	Traveling allowance	3.60	3.57	
3.	Other charges including equipments	49.00	49.00	
4.	Works			
	i) Annual Repair & maintenance		-	
	a) Office building	10.00	9.92	
	b) Residential building	10.00	9.98	
	ii) Minor works	9.75	9.70	
5.	Other items	8.60	7.26	
	Total : (1 to 5)	443.00	436.03	98.42
6.	Pension and Pensionery benefits	95.00	69.24	
7.	Loans and Advances (interest bearing)	12.00	11.54	

Note : There is no North East component sanctioned during the Xth Plan for ILRI

	Target	Actual
Net Revenue Generation	40.00	30.33

RESEARCH ACCOMPLISHMENTS

1. LAC PRODUCTION

1.1. Productivity and Quality Improvement

1.1.1. Collection, conservation and evaluation of lac insect and host germplasm

Survey and Collection

Survey of selected areas in seven districts of Eastern UP was carried out in the month of October to know the status of lac culture and availability of lac insects and host plants in nature. Though lac insects were observed at all the places visited, frequency of occurrence of lac insects in nature was very low. Lac insect populations were observed mainly on *Peepal (Ficus religiosa)*, *Pakur (Ficus lucescence)*, at various places visited and on *Shami (Prosopis cineraria)* at Varanasi. Mixed population of crimson and yellow colour forms were found at almost all the places but proportion of yellow lac insect was more. Details of places visited and collections made in respect of lac insects and host plant samples for conservation at ILRI are given in Table 1.

Though lac hosts like *palas* are available in sufficient numbers in certain pockets of Allahabad and Mirzapur districts, the villagers were found to be unaware about lac cultivation.

Table 1. Details of lac insects collected from Eastern Uttar Pradesh

District	Place	Lac insect / Host Plant collected	Remarks
Deoria	Deoria, Baitalpur, Goribazar, Chauri-Chaura, Sonu Ghat	Mixed population of yellow and crimson lac insects on *Pakur*	Immature, likely to emerge in December
Kushinagar	Hata, Kulkalamai, Padrauna	On *Pakur*	Emerging stage
Gorakhpur	Jagdishpur, Gorakhpur and nearby areas	Mixed population of Yellow and crimson lac insect on *Peepal*, collected seeds of *Kusum* also	Mature Stage
Maharajganj	Maarajganj, Chhappian Bazar, partawal, Bhathat	Crimson and yellow lac insect on *Pakur*	-
Varanasi	BHU, Varanasi, Sarnath	Lac insects on *Peepal*, *Pakur* and *Shami*	-
Mirzapur	Mirzapur, Vindhyachal and nearby areas	Crimson lac insect on *Peepal*	Only on one tree
Allahabad	Meja Road, Shringverpur, Allahabad and nearby areas	Crimson lac insect on *Peepal*	Fairly good occurence of *Palas* host on Meja Road

Maintenance and evaluation of lac insect germplasm

More than 500 lac cultures of twenty two lac insect stocks collected from different parts of the country and the existing germplasm are being maintained on potted plants of *Flemingia macrophylla*.

Evaluation of biological parameters of ten different lac insect stocks on *F. macrophylla* has been completed (Table 2). Evaluation of another ten stocks has been initiated (Table 3). Productivity linked attributes, *viz*, initial density of settlement, initial mortality, male proportion, density at crop maturity, size of cell, weight of cell, resin output and fecundity of different lac insect stocks cultured on *F. macrophylla* were recorded. Significant differences were observed for all the parameters studied among the lac insect stocks.

Table 2. Productivity - linked attributes of different lac insect stocks reared on *F. macrophylla* during summer/winter season

Lac insect stock	Initial density of Settlement (no./cm²)	Initial mortality (%)	Male (%)	Density at crop maturity (no./cm²)	Diameter of cell (mm)	Weight of cell (mg)	Resin output per cell (mg)	Fecundity (no.)
Rangeeni trivoltine	75.7	37.0	26.6	2.6	2.64	11.17	7.83	85
Rangeeni crimson	99.5	12.1	31.4	7.8	3.16	12.76	9.74	81
Rangeeni yellow	114.3	9.6	66.1	8.4	3.35	12.91	9.68	148
Rangeeni inbred	118.1	6.3	50.5	9.6	3.23	10.85	7.53	170
Kusmi early	67.7	13.6	28.7	9.3	3.60	14.99	12.06	310
Kusmi yellow	81.7	5.1	29.0	9.6	3.48	13.74	10.87	355
Kusmi late	109.6	16.4	43.0	18.2	3.47	15.85	14.07	140
Meghalaya	127.9	7.6	70.8	5.3	2.85	10.45	7.03	86
Cross (*K.sharda* × *K. lacca*, Orissa *kusmi*)	95.3	16.2	36.3	5.5	2.99	12.78	10.64	104
Ludhiana	70.2	5.3	75.3	10.6	3.40	13.48	9.78	242

Table 3. Productivity-linked attributes of different lac insect stocks reared on *F. macrophylla* during rainy season

Lac insect stock	Initial density of Settlement (no./cm²)	Initial mortality (%)	Male (%)	Density at crop maturity	Diameter of cell (mm)	Weight of cell (mg)	Resin output per cell	Fecundity (no.)
Kusmi trivoltine	104.8	11.8	27.1	8.4	2.94	9.25	7.23	153
Thrissur (Kerala)	89.7	2.9	21.3	10.1	3.19	12.03	9.57	197
Thailand	122.8	5.3	19.3	6.9	*	*	*	*
Udaipur (Rajasthan)	84.4	1.7	30.1	6.8	3.19	11.12	8.93	238
Jhalod (Rajasthan)	89.8	4.1	19.7	8.7	2.81	9.36	6.76	192
Echoda (AP)	68.2	7.4	35.3	8.7	3.48	15.59	13.18	313
Jammu (J & K)	95.9	3.3	46.9	4.0	3.05	9.69	7.29	136
Patiala (Punjab)	93.4	11.9	40.3	4.7	3.11	9.51	7.28	220
Ambaji (Gujarat)	78.6	2.0	32.9	6.3	3.12	12.32	9.42	221
Alsipur (Gujarat)	93.7	2.3	28.7	10.1	3.47	13.45	8.84	314

* Crop yet to mature

Molecular characterization of lac insects

The taxonomy of coccoids is based on the morphology of adult females, even though they are highly degenerate and undergo tremendous changes in size and shape during post-metamorphic stage. Therefore, the status of many of the described species is doubtful, due to high intra-specific variation of taxonomic characters in populations. Use of molecular approaches have been initiated for characterizing lac insect taxa with reliability and also in unraveling intraspecific variations.

The study material was mainly derived from the lac insect cultures maintained at the Institute and collected from different parts of the country like Jharkhand, West Bengal, Chhattisgarh, Uttar Pradesh, Karnataka, Kerala, Gujarat, Maharashtra, Orissa, Rajasthan, Meghalaya, Andhra Pradesh, etc. The insects studied were those that are used in lac cultivation as well as wild populations. They included economically important species, viz., *K. lacca (kusmi* and *rangeeni* infrasubspecific forms*)*, *K. chinensis* and *K. sharda*. It also included a collection from Thailand (*K. chinensis*), another major lac producing country. Besides, some experimental lines, both inbred and crossbred as well as two colour mutants of *K. lacca* were also studied.

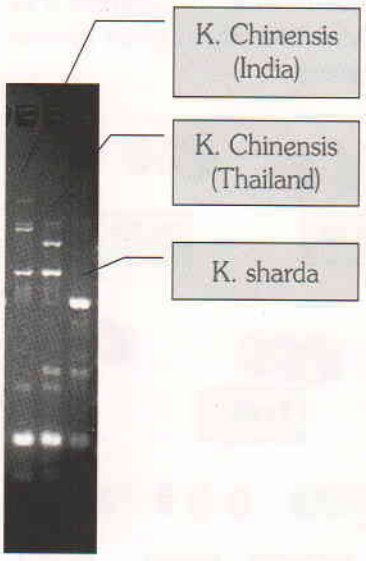


Fig. 1 Profiles of *K. chinensis* from India and Thailand and *K. sharda*.

Fig. 2 RAPD profiles of *K. chinensis*, *K. sharda* and *K. lacca*.

After screening nine protocols, lac insect DNA was extracted from mature females, adopting a procedure described by De Barro *et al.* (1995), after some modifications. The RAPD profiles of the lines were generated using selected decamer primers, after screening and standardization of PCR protocol. Analysis of the gel data was done employing UPGMA method with GeneDirectory® package.

The three species of *Kerria* examined, *K. lacca*, *K. chinensis* and *K. sharda* showed distinct RAPD profiles across the primers tested. *K. chinensis* collections from India and Thailand showed differences in banding patterns. *K. sharda*, a trivoltine insect showed banding closer to *K. lacca*. The molecular profiles could thus be used for distinguishing the species (Figs. 1 and 2).

The lines of *kusmi* and *rangeeni* forms of *Kerria lacca*, particularly from the major lac growing areas of India, displayed consistent patterns of RAPD banding (Fig. 3). Unique bands could not be found, which were common across any one of these groups. Some of the lines of these two forms tended to cluster in the dendrogram, but they were not distinctly separated.

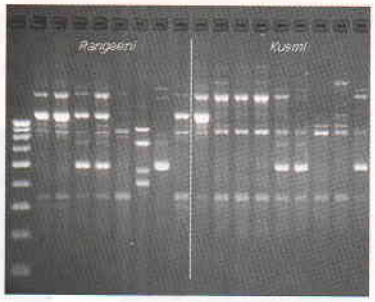


Fig. 3 Profiles of lines of *rangeeni* and *kusmi* subspecific forms of *K. lacca* from different regions.

This may be due to closeness of the taxa and gene flow. Even though these two forms remain distinct due to differences in host preferences and life cycle patterns, hybridization can be done under laboratory conditions. The *kusmi* insect is mainly restricted to lac growing regions, while the *rangeeni* form, is more widespread. Some of the *rangeeni* insects from the major lac growing

Fig. 4 Profiles of collections from different parts of the country from left to right : Gujarat, Rajasthan, Jharkhand, Maharashtra, Uttar Pradesh, Kerala, Karnataka, Andhra Pradesh

regions showed differences Geographic races of *rangeeni* form of *K. lacca*, showed distinct banding patterns.

The geographic races of *K. lacca* showed distinct profiles compared to those from major lac growing regions in the country (Fig. 4). The collections particularly from peninsular India, Kerala and Karnataka, displayed distinct RAPD profiles.

The RAPD profiles of the yellow and cream mutants of *K.lacca* showed distinct patterns compared to their wild counterparts from the same population (Fig.5). This appears to indicate larger genomic differences linked to these loci.

Two inbred lines which showed one unique amplicon each were crossed; the hybrid progeny (F_1) showed both the amplicons as well as the common one. They could serve as molecular markers (Fig. 6).

Fig. 6 Profiles of two lines (left) Marked with arrows and their cross (right)

Fig. 5 Distinct Profiles Displayed by yellow (a) and cream (b) Mutants Compared to their wild counterparts from the same population Y : yellow mutant; c:wild type

Dendrogram generated for all the lines studied indicates that commercially exploited *kusmi* and *rangeeni* forms of *K. lacca* had a common origin. Geographic races of *K. lacca* tended to form a separate group. The *K. chinensis* from India and Thailand form a distinct group; *K. sharda* was also distinct (Fig. 7).

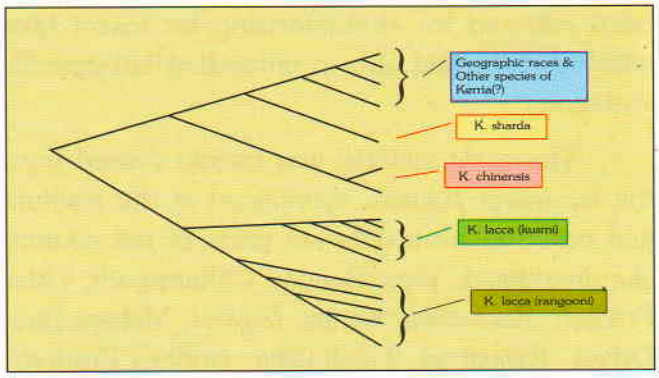


Fig. 7 Evolutionary relationship of lac insect lines studied-simplified

Descriptors for lac hosts

Descriptors of three major lac host plants viz. *Schleichera oleosa (Kusum), Ziziphus mauritiana (ber),* and *Butea monosperma (palas)* have been developed for evaluating biological diversity in plant genetic resources of the ecosystem. Characterization of lac hosts of *kusum*, *palas* and *ber* of institute farm is in progress (Fig. 8) for evaluating biological diversity in plant genetic resources of lac ecosystem.

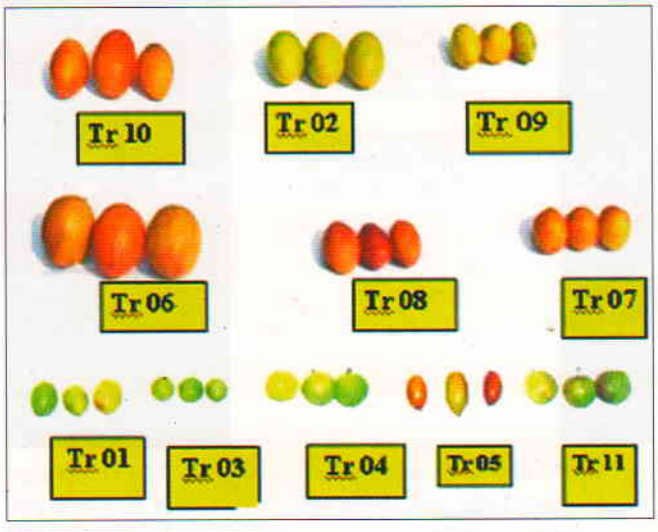


Fig. 8 Variations in the fruits of *ber*, a major lac host-plant

1.1.2 Identification and characterization of *kusum* and *galwang* genotypes for high productivity of lac

Productivity linked variability in *kusum*

The *kusum* trees were evaluated based on i) pruning response and ii) broodlac output-input ratio. For this, 100 pruned *kusum* trees in a cluster were taken randomly in the Institute Research Farm. Inoculation was conducted during February 2005 for raising *jethwi* crop with broodlac of *kusmi* lac insect LR-5316 at the rate of 20 g/m shoot length. Pest management schedules were followed as per need. After harvest, three pruned points were selected randomly for determination of number and length of shoots emerging from the pruned point. The weight of lac sticks was also taken through destructive sampling.

Yield ratio (brood lac output/input), varied widely (0.3 to 25) with an average of 4.9 (Fig. 9).

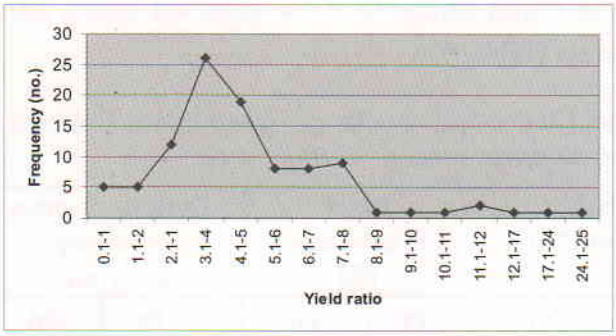


Fig. 9 Frequency distribution of yield ratio (broodlac output/input) of the study population of *kusum* trees

Mean length of shoots per pruned point measured 18 months after pruning (Fig 10), varied between

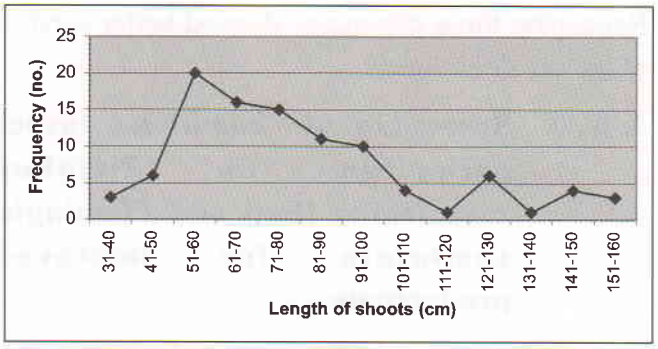


Fig. 10 Frequency distribution of length of shoots generated (cm) generated per pruned point, 18 months after pruning of *kusum* trees.

30 and180 cm with an average of 81cm. As all the *kusum* plants were nearly of similar age and located in a cluster, the variation is attributed to largely of genetic origin. Plants showing extreme higher values for yield ratio and pruning response were marked as plus trees for further multiplication and characterization on morphological basis (Table 4).

Identification of plus genotypes of *galwang*

Air layers of eight genotypes prepared last year were transplanted in larger pots. Four airlayers of each genotype were inoculated with *kusmi* broodlac during August. Observations were taken on the initial survival, male percentage and final survival at crop maturity. Three out of eight genotypes showed severe mortality and could not

Table 4 Data showing high yield ratio and pruning response of selected *kusum* trees

Broodlac Yield Ratios		Pruning Response	
Tree No	Yield ratios	Tree No.	Length of shoots (cm)/ pruned point
146	7.9	131	124
212	8.6	139	124
162	10.0	141	127
231	10.4	115	140
185	11.1	235	141
127	11.5	129	142
124	12.0	227	146
154	17.5	158	153
197	25.0	111	160
Mean	12.67	-	139.67
Population mean	4.9	-	80

produce lac at all, while two genotypes available showed variable survival among the clones. Remaining three genotypes showed better survival of lac on all air layers.

1. 1. 3 Screening of *kusmi* lac insect germplasm on *Ziziphus mauritiana* (*ber*) and *Flemingia semialata* for improved productivity

Five stocks of *kusmi* strain of lac insect *viz., kusmi early crimson, Orissa kusmi yellow, kusmi late crimson, Kulajanga and Nawadih* stocks were inoculated on one year old plant of *Flemingia semialata* and *Z. mauritiana* under potted condition during Feb-March 2005. Five plants each of both host plants for each lac insect stock were used for recording observations. Initial density of settlement, mortality after 21-days of inoculation, male proportion and density at crop maturity stage recorded are shown in Table 5.

Wide variations were observed among the stocks for all the parameters scored, but no significant differences were observed in mean values between the two hosts for density of settlement and sex ratio. However, initial mortality was 65% more on *Z. mauritiana* than *F. semialata*. Density of living females at crop maturity was high on *F. semialata*. Average weight of resin secreted by lac insect on *F. semialata* (14.03 mg) was almost twice than on *Z. mauritiana* (7.56 mg)

Observation recorded during *aghani* season for density of settlement, initial mortality and sex ratio when grown under field conditions showed the trends similar to those observed during *jethwi* crop (Table 6).

Table 5. Productivity linked attributes of different *kusmi* lac insect stocks on *F.semialata* (Fs) and *Z. mauritiana* (Zm) under potted condition during summer season (*Jethwi*) crop.

Stocks	Density at Initial stage (no./cm²)		Initial Mortality (%)		Male Proportion (%)		Density at crop maturity (no./cm²)	
	Fs	Zm	Fs	Zm	Fs	Zm	Fs	Zm
Kusmi early crimson	105.9	115.1	30.8	21.2	80.7	92.5	4.33	1.87
Orissa kusmi yellow	74.9	114.1	5.3	7.3	18.8	28.3	-	2.83
Kusmi late crimson	128.2	63.4	31.3	70.8	68.8	46.5	8.33	1.67
Kulajanga stock	60.3	59.3	32.5	48.5	18.7	25.4	-	5.78
Nawadih stock	68.8	61.9	13.6	39.7	43.6	37.1	1.67	-
Mean	87.6	82.8	22.7	37.5	46.1	46.0	4.78	3.04

Table 6. Productivity linked attributes of different *kusmi* lac insect stock on *F. semialata* (Fs) and *Z. mauritiana* (Zm) under field condition during winter season (*Aghani*) crop.

Stocks	Density at initial stage (no./cm²)		Initial Mortality (%)		Male proportion (%)	
	Fs	Zm	Fs	Zm	Fs	Zm
Kusmi early crimson	122.6	*	5.9	*	23.4	*
Orissa kusmi yellow	75.5	88.3	5.6	10.6	20.4	30.6
Kusmi late crimson	59.2	92.7	22.5	20.3	45.8	35.9
Kulajanga	69.6	86.8	11.1	23.6	19.6	24.7
Nawadih	111.2	52.4	13.1	40.8	18.0	34.9
Mean	87.6	80.1	11.6	23.8	25.4	31.5

* Crop not inoculated due to shortage of broodlac.

Management of insect pest of *F. semialata* for seed production

Seed production in *F. semialata* is severely affected due to infestation of a pod borer. Spraying of endosulfan (0.05%) thrice at monthly interval, starting from bud initiation stage resulted in seed yield of 25g/ bush as compared to 4 g/bush in control.

1.1.4 Lac host propagation techniques

Propagation of lac hosts through stem cuttings

Experiments were conducted for vegetative propagation from stem cuttings of four host species viz., *Flemingia semialata*, *Ficus racemosa*, *F. infectoria* and *F cunia*. The cuttings were treated with Indole Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) individually and their equimolar combinations (25, 50 and 100µM). The age of shoots was 15 to 18 months. The number of cuttings was 20-30 with four replications. Each cutting was taken from basal region and had at least five internodes. The cuttings were raised in polybags for *F semialata* and in beds in case of *Ficus* species under trench condition covered with polysheets (200µM thick) during summer.Treatments involving combination of the hormones tried resulted in better root initiation (Table.7) compared to control and hormones tried individually (Fig. 11).

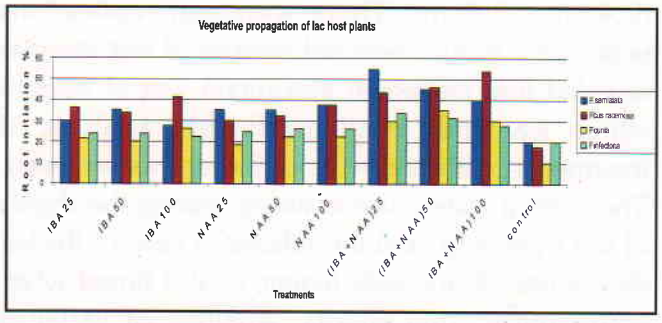


Fig. 11 Effect of hormones on root initiation in basal shoot cuttings of four host spp.

1.1.5 Development of techniques for micropropagation of lac hosts

Control of polyphenol leaching

Spectrophotometric analysis was used to study the level of polyphenol leaching in three lac hosts- *S.oleosa*, *F.semialata* and *B.monosperma*. Four antioxidants/agents *viz.*, ascorbic acid, citric acid, PVP and activated charcoal were studied

Table 7. Effect of Hormones on vegetative propagation through cuttings of host plants.

Hormone treatment /Conc.(µM)	Root Initiation %			
	Flemingia semialata	*Ficus racemosa*	*Ficus cunia*	*Ficus infectoria*
IBS-25	30.0	36.25	21.25	23.75
IBA-50	35.0	33.75	20.00	23.75
IBA-100	27.5	41.25	26.25	22.50
NAA-25	35.0	30.00	18.75	25.00
NAA-50	35.0	32.50	22.50	26.25
NAA-100	37.5	37.50	22.50	26.25
(IBA+NAA)	55.0	43.75	30.00	33.75
(IBA+NAA)	45.0	46.25	35.00	31.25
(IBA+NAA)	40.0	53.75	30.00	27.50
Control	20.0	17.50	10.00	20.00
F critical	2.210	2.211	2.211	2.211
C.D. value 5%	4.645	3.066	1.977	NS
C.D. value 1%	6.256	4.132	2.663	

for their efficacy in control of polyphenol leaching.

Uniform length (2.5cm) of nodal cuttings from above mentioned host species were collected and kept for 24hrs in distilled water. They were grouped into thick (0.8cm-1.5cm) and thin shoots (0.4cm – 0.8cm). There were ten replications under each group. Spectral analysis of test samples revealed that maximum absorption was at 385nm which was then used for further analysis of treatments with and without the agents screened. The phenol release varied widely among the shoots of the three spp. and the release in case of thicker shoots was distinctively higher (~ 2-3 times) when compared to thin shoots. Analysis of variance showed that interplant differences were not significant for thin as well as thick shoots. A highly positive relationship was found between polyphenol leaching and weight of buds in case of *B.monosperma* and a small positive yet significant relationship was seen in case of *F.semialata* (Fig.12,13). Pretreatment with different antioxidants/agents was found effective in controlling the phenol release as revealed by percentage reduction in absorbance value with increase in concentration of antioxidant/agent used. In *B. monosperma*, ascorbic acid at 0.09% and activated charcoal at 0.15% concentration was found effective while in *F.semialata* citric acid at 0.15% and activated charcoal at 0.02% were effective in controlling polyphenol leaching (Fig. 14-15).

In case of *S.oleosa* ascorbic acid at 0.08% or PVP at 0.12% was found effective. The above results were then evaluated on explants inoculated in MS media as well and satisfactory results were obtained.

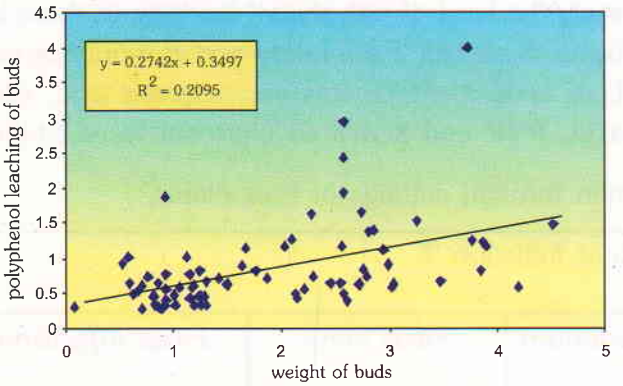


Fig. 12 Graph showing small yet positive significant relationship between polyphenol leaching and weight of buds in *F.semialata*.

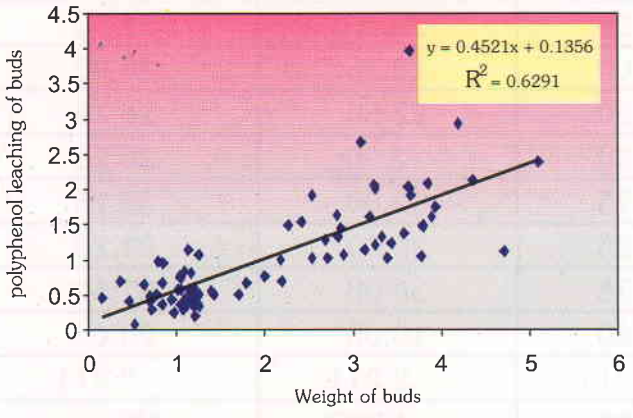


Fig. 13 Graph showing highly positive significant relationship between polyphenol leaching and weight of buds in *B. monosperma*.

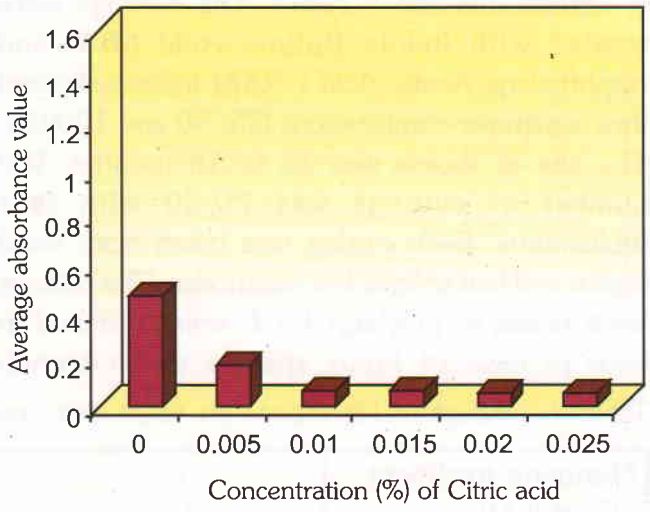


Fig. 14 Effect of citric acid on polyphenol leaching in thin shoots (0.4-0.8cm) of *F. semialata*

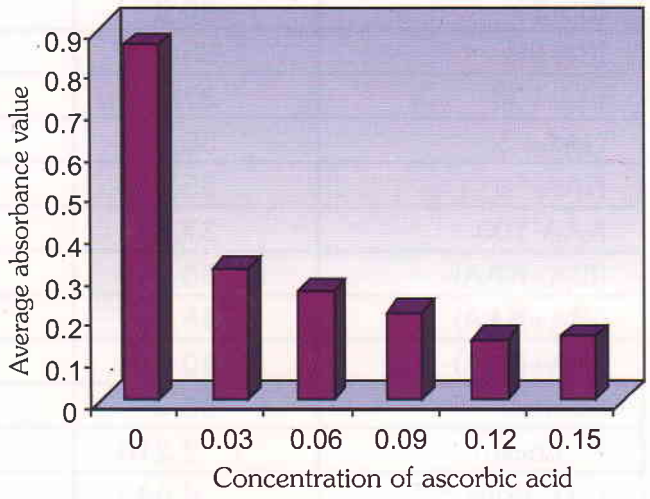


Fig. 15 Effect of ascorbic acid on polphenol leaching in thin buds (0.4-0.8cm) of *B. monosperma*.

Micropropagation of *F.semialata*

Nodal explants of *F.semialata* were subjected to six treatments (0.05%, 7 and 9 min; 0.1%, 5 and 7 min;1%, 9 and 11 min) using mercuric chloride as sterilant. Best results were obtained by immersion and continuous agitation of explants in 0.1% mercuric chloride for 9 min. Duration of treatment exceeding 9 min was found to cause irreversible damage to the explants while treatment less than 9 min was found to be relatively less efficient (Fig.16). Pre-wiping of the

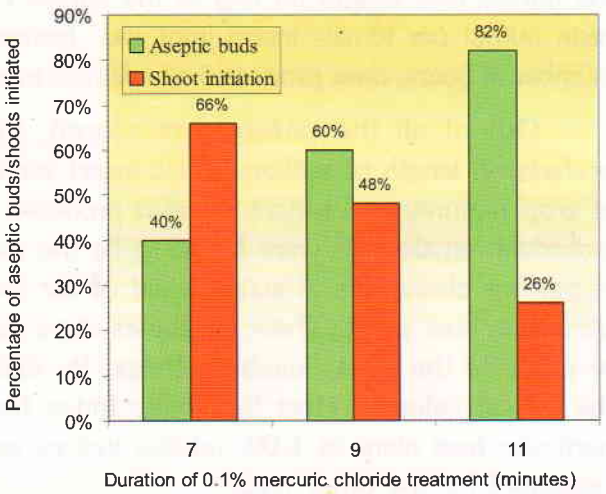


Fig. 16 Effect of mercuric chloride as surface sterilizing agent on the nodal explants of axillary buds of *F. semialata.*

shoots with 70% alcohol proved to be advantageous. Bud break was observed after 12days of inoculation and within 4 weeks, the shoots grew to 3-4 cm in length with 2-3 nodes.

Effect of cytokinins on shoot proliferation and growth was studied on the nodal cultures; varying concentrations of BAP and kinetin (0-15µM) were used in medium either singly or in combination. Multiple shoot response was found to be more effective at lower concentrations of kinetin, it was maximum at 2.5µM.

Thirty-five different combinations of BAP (0-15µM) and Kinetin (0-4µM) were tested for their synergistic effect on shoot proliferation. It was observed that raising of BAP concentration resulted in increase in mean shoot lengths at each kinetin concentration tried, in general. At kinetin concentration of 2µM and 3µM, the maximum values of shoot length were observed at 10µM and 12.5µM of BAP respectively. An analysis made to study the relationship between mean shoot length increase and ratio of BAP: Kinetin revealed that values were high at the ratio of 3-5 (highest around 4), where values of BAP were higher (Fig.17). A closer look at the data revealed

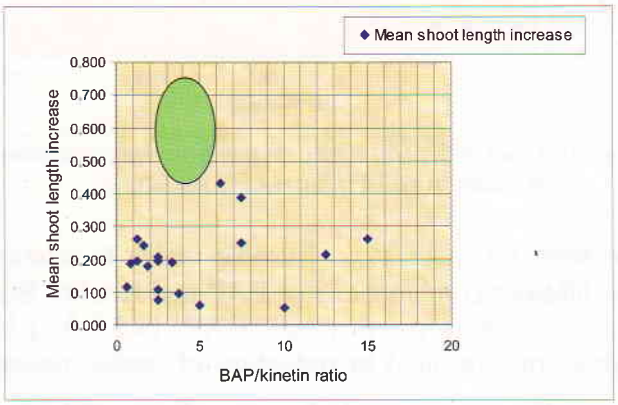


Fig. 17 Effect of BAP/KIN ratio on mean shoot length increase in nodal cultures of *F. semialata*

that maximum shoot length increase was observed at the combination containing 12.5 µM BAP and 3µM kinetin (Fig. 18). It also revealed that further

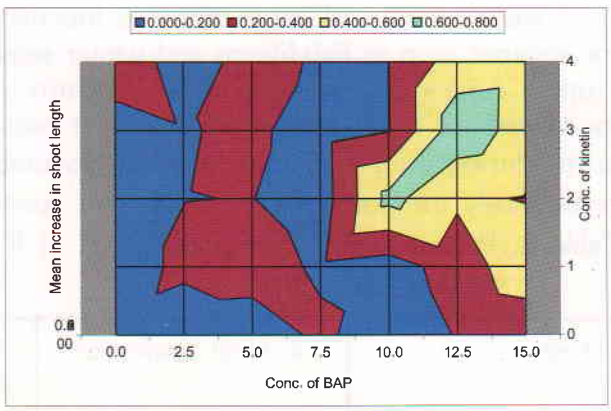


Fig. 18 Effect of combination of concentrations of BAP and kinetin on mean increase in shoot length of nodal cultures. of *F. semialata.*

increase in BAP should be combined with concomitant increase in kinetin.

Similar results were obtained in case of mean number of nodes with maximum nodal

multiplication at 15µM BAP and 4 µM kinetin and BAP: Kinetin ratios ranging between 2.5 and 5 (Fig. 19). However, no clear cut pattern could

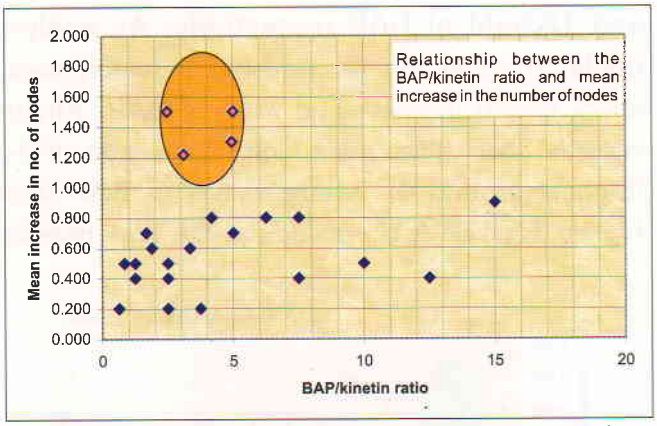


Fig. 19 Effect of BAP/KIN ratio on mean increase in number of nodes in nodal cultures of *F. semialata*

be seen for mean no. of usable nodes in relation to different combinations of BAP and kinetin. But, higher concentration of BAP (>12.5 µM) apparently resulted in reduction of usable nodes.

Thus, in view of above results, combination of 12.5µM BAP and 3µM kinetin can be regarded as the best combination for shoot proliferation and growth. Experiments for root induction of *F.semialata* using three auxins NAA, IBA and IAA are in progress.

1.1.6 Lac insect-host plant relationship

Kusmi strain of lac insect was inoculated for summer crop in Feb-March and winter season crop in June - July while *rangeeni strain* was inoculated for rainy season and summer season crops during June-July and October-November respectively on five different host-plant species *Acacia auriculiformis* (Akashmani), *Albizia lucida* (Galwang), *Flemingia semialata* (Semialata), and *Ziziphus mauritiana* (Ber) were common hosts for both the strains, while *Butea monosperma (Palas)* was used for *rangeeni* and *Schleichera oleosa (kusum)* for *kusmi*. Observations have been recorded with respect to the following productivity linked parameters of lac insects *vis-a-vis* host plants: Density of settlement (number per square cm); initial mortality (number per square cm after 21 days of inoculation); sex ratio (% of male / female insects); size (diameter in mm) of the female cell; weight (in mg) of the female cell; resin output per female insect (mg) and fecundity (number of young ones produced) by a female insect.

Out of all the parameters scored; host preference, length of settlement, lac insect survival at crop maturity and weight of resin produced by individual female cells were found to be the most important characters affecting yield of lac on a particular host plant. These attributes were used to calculate the Host Suitability Index. By taking the lowest value of Host Suitability Index for a particular host plant as 1.00, relative indices were calculated for the other hosts.

Rangeeni strain

i. Summer season (*Baisakhi* 2004-05) crop : *A. auriculiformis* was the least suitable and *B. monosperma* the most suitable hosts. Differences in the relative suitability of the host-plants were very high (Table 8).

Table 8. Performance of *rangeeni* strain of *K. lacca* during summer season (*Baisakhi*) crop, 2004-05 on five host species

Host	% Host Preference	% Length of Settlement at crop maturity	% Survival of lac insect at crop maturity	Weight of resin produced by individual female (mg)
A. auriculiformis	20	3.99	1.21	13.5
A. lucida	40	4.18	2.00	10.8
B. monosperma	100	25.74	12.28	14.6
F. semialata	60	20.00	6.99	8.3
Z.. mauritiana	40	8.03	2.34	15.8

Host Suitability Index in ascending order of lac yield was: *A. auriculiformis* < *A. lucida* < *Z. mauritiana* < *F. semialata* < *B. monosperma* (Fig. 20).

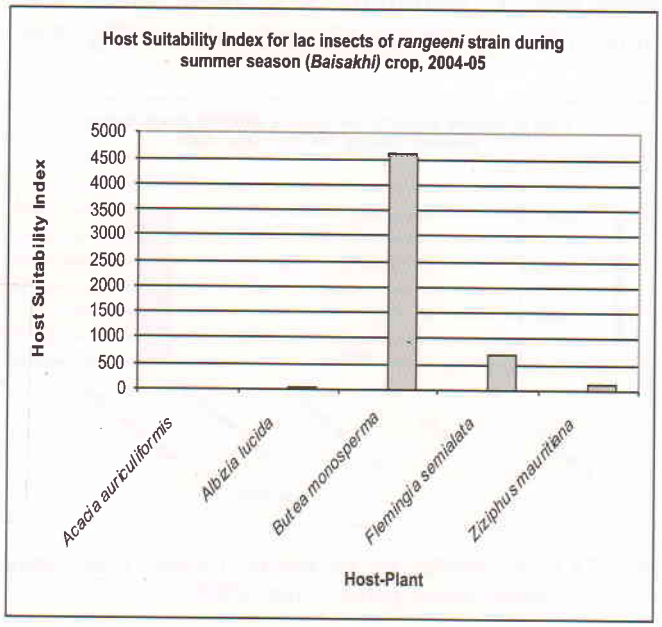


Fig. 20 Host suitablity index for lac insects of *rangeeni* strain during summer season (*baisakhi*) crop, 2004-05

ii. Rainy season (*Katki* 2005) crop: Suitability of the host plant to the lac insect changed with season. Maximum yield of lac was obtained on *Z. mauritiana* and least on *A. lucida*. All the plant-hosts performed better during rainy season crop than summer crop (Table 9).

Host suitability index in ascending order of lac yield was: *A. lucida* < *A. auriculiformis* < *F. semialata* < *B. monosperma* < *Z. mauritiana* (Fig. 21).

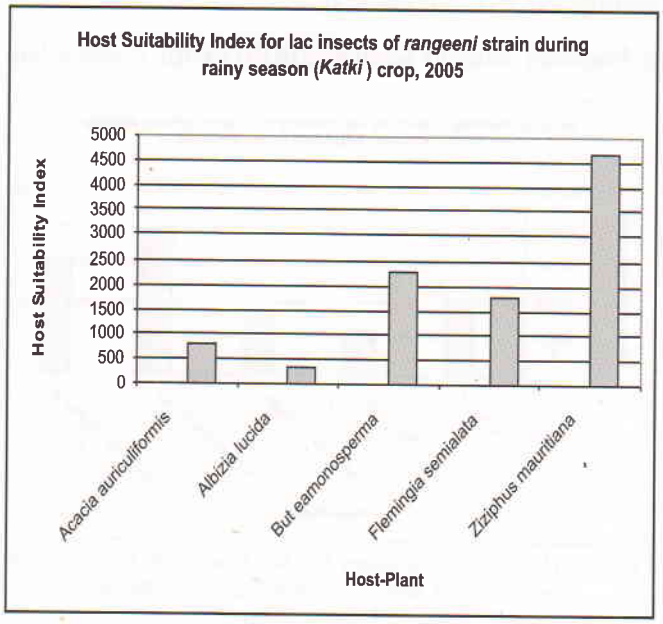


Fig. 21 Host suitablity index for lac insects of *rangeeni* during rainy season (*katki*) crop, 2005

Kusmi strain

i. Winter season (*Aghani* 2004-05) crop: Like *rangeeni* strain host plants were more suited to lac insects during winter season than summer

Table 9. Performance of *rangeeni* strain of *K. lacca* during rainy season (*Katki*) crop, 2005 on five host species

Host	% Host Preference	% Length of Settlement at crop maturity	% Survival of lac insect at crop maturity	Weight of resin produced by individual female (mg)
A. auriculiformis	100	31.33	4.67	5.70
A. lucida	80	23.11	2.38	8.12
B. monosperma	100	22.76	13.68	7.28
F. semialata	100	25.00	8.86	7.93
Z. mauritiana	100	42.26	13.04	8.45

season crop. Inter-host plant variability was also less (Table 10).

Host suitability index in ascending order of lac yield was: *A. lucida* < *F. semialata* < *A. auriculiformis* < *Z. mauritiana* < *S. oleosa* (Fig. 22)

ii Summer season (*Jethwi* 2005) crop: *F. semialata* was the lowest yielder of lac while *S. oleosa* the best yielder. Variability observed in Host-Suitability Index among the different hosts was very high (Table 11).

Host Suitability Index in ascending order of lac yield was: *F. semialata* < *Z. mauritiana* < *A. auriculiformis* <*A. lucida* < *S. oleosa* (Fig. 23).

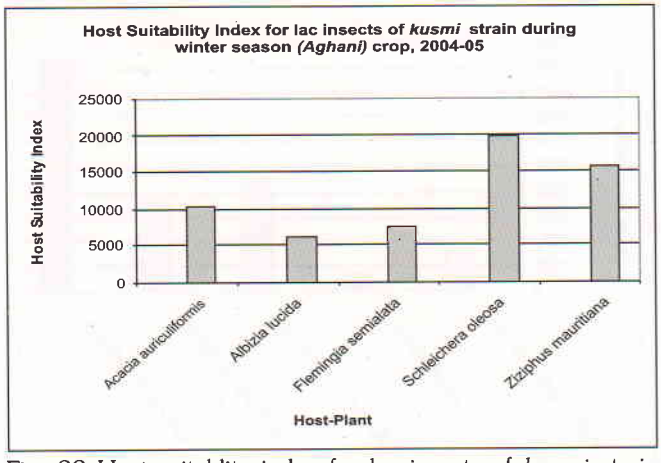


Fig. 22 Host suitablity index for lac insects of *kusmi* strain during winter season (*Aghani*) crop, 2004-05

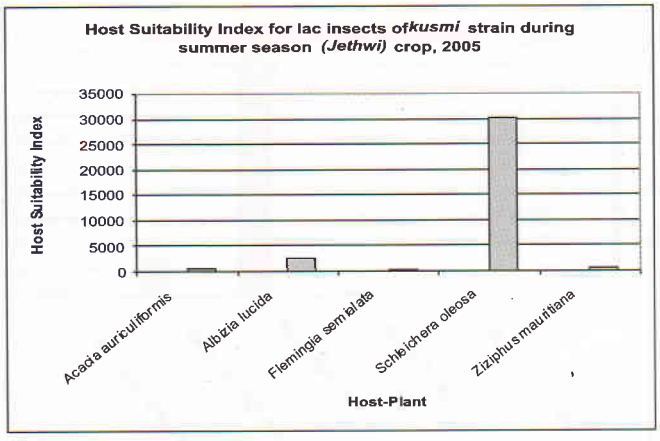


Fig. 23 Host suitability for lac insects of *kusmi* strain during summer season (*jethwi*) crop, 2005

Table 10 . Performance of *kusmi* strain of *K. lacca* during winter season (*Aghani*) crop, 2004-05 on five host species

Host	% Host Preference	% Length of Settlement at crop maturity	% Survival of lac insect of crop maturity	Weight of resin produced by individual female (mg)
A.auriculiformis	60	27.09	32.21	19.77
A. lucida	60	40.05	9.85	25.51
F. semialata	100	60.00	5.28	23.02
S. oleosa	100	79.43	10.91	22.75
Z. mauritiana	100	70.18	11.41	19.67

Table 11. Performance of *kusmi* strain of *K. lacca* during summer season (*Jethwi*) crop, 2005

Host	% Host Preference	% Length of Settlement at crop maturity	% Survival of lac insect at crop maturity	Weight of resin produced by individual female (mg)
A. auriculiformis	40	21.54	7.26	13.24
A. lucida	60	27.27	11.33	14.13
F. semialata	40	18.18	3.19	14.65
S. oleosa	100	71.75	22.06	19.01
Z. mauritiana	40	23.16	5.20	11.32

1.2 Production improvement and Crop Management

1.2.1 A new lac host for arid region

Prosopis juliflora as a kusmi lac host Prosopis juliflora (ganda baval, vilayaty babool), a native of South to Central America was introduced in India (Rajasthan) to combat desertification of Thar during early 20th century. Presently, this species has invaded several states *viz*. Rajasthan, Gujarat, Uttar Pradesh, Haryana, Madhya Pradesh, Chhatisgarh, Maharashtra and even southern States. Although this species is a reported host plant of *Kerria sindica,* no information about its utilization for production of lac is available. Exploratory trials conducted in Gujarat have revealed high potential of this host for lac cultivation (Fig 24).

The trials were conducted on five lac host species viz; *P. juliflora, A. tortilus, A. catechu, A. nilotica* and *Z. mauritiana* at Forest Research

Fig 24 *Kusmi* lac crop on *Prosopis juliflora*

Farm, Basan, Gandhi Nagar, Gujarat by inoculating three bushes of each species with productive breed of *kusmi* strain of *K.lacca*, LR-5312, during August, 2004. The crop was harvested during February, 2005.

Results clearly indicate that lac insect could be cultured on the four plant species out of five tried. However, *P. juliflora* and *Z. mauritiana* showing 1:6 and 1:20 yield ratio, respectively are worth adopting for lac cultivation in the area (Table 12) during winter crop cycle. On the other hand, continuous exploitation for lac cultivation on this species may also help reduce its unwanted spread in the region through successive pruning, harvesting every year before reproductive stage. Its identification as a good *kusmi* lac host is expected to provide an opportunity, not only for boosting quality lac production in the country, but also for providing high economic returns from this invasive species.

Table 12 Yield ratio and crop duration of *kusmi* strain of *K. lacca* grown on different lac host species in Gujarat.

Name of host	Yield ratio (Broodlac output /input)	Mean crop duration (days)
P.juliflora	6	198
Z.mauritiana	20	195
A.catechu	4	190
A.nilotica	3	200
A. tortilus	0	-

1.2.2 Soil nutrient management for *palas*

Effect of nitrogen on the growth and lac yield from *palas*

Effect of treatments on soil

Different treatments of soil application of nutrients (N_{20}-N_{80} ; ½ urea + ½ FYM) significantly affected the chemical properties of soil. There was an improvement in the soil nitrogen, phosphorus and potassium contents under different treatment over control. From the perusal of data, it is inferred that except soil pH, all other parameters improved after application of manures and fertilizers. There is marked improvement in the phosphorus content of soil at both depths (30 and 60 cm) under those treatments where FYM was applied at higher doses. Fig. 25 shows the effect of one of the treatments *i.e.*N_{80} (½ Inorganic + ½ FYM) on improvement in some chemical properties of soil compared to control.

Effect of Nitrogen on growth of *Palas*

Highest number of shoots per tree (Av=68) was recorded at nitrogen dose of 80g per tree

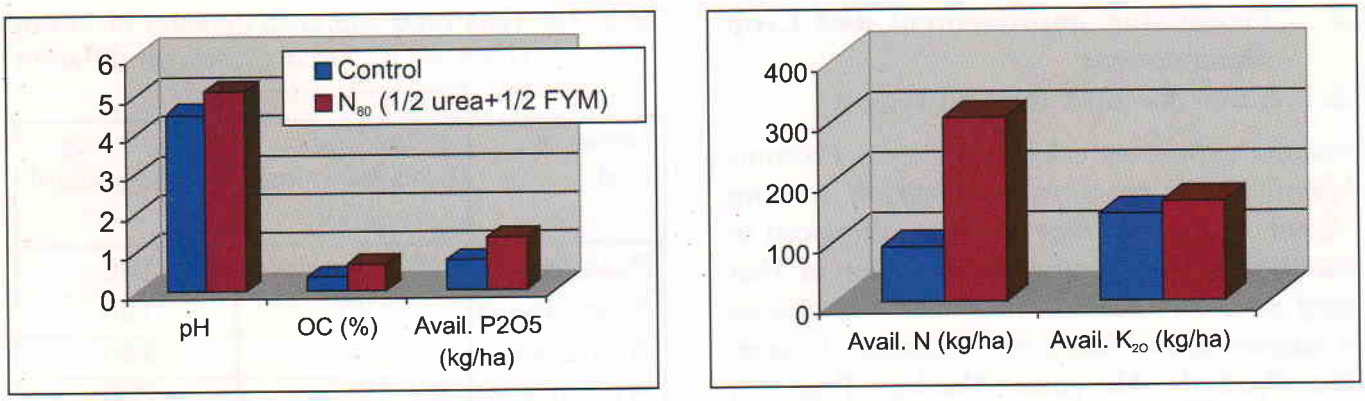


Fig. 25 Effect of application N_{80} (1/2 FYM and 1/2 urea) on chemical properties of soil compared to control

applied through urea. This treatment was at par with the doses of the nitrogen 40 and 60g N per tree applied through urea. Whereas in control the average no. of shoots was 33. The average girth of shoots per tree and total length of inoculable shoots per tree were also found best under N_{80} (urea), *i.e.*, 5.2 cm and 11.0 m respectively compared to control (3.8cm and 6.1m.). It was observed that application of urea alone had significant impact on the plant growth than conjunctive use of urea with FYM, which might be due to ready availability of nitrogen to the plant under acidic condition (pH 5.6 to 5.9). Among the treatments where nitrogen was applied through urea and FYM, dose of 80g per tree resulted significantly higher growth of *palas* in comparison to other treatments of the same category (urea + FYM). The application of FYM is beneficial for the soil health, which will have impact on the plant growth in long term.

Effect of Nitrogen on lac yield

Nitrogen applied at the rate of 80g per tree through urea alone resulted in highest broodlac, *phunki* weight and sticklac yield (~3 times) in comparison to control. Nitrogen applied at 80 g per tree through urea and FYM produced significantly more sticklac (33.5%) from broodlac in comparison to other treatments where this recovery varies between 30-31 %. Sticklac yield did not vary significantly due to application of nitrogen at 80g/tree either alone or in conjunction with F.Y.M. (½ Organic + ½ Inorganic)

Characterization of soils of lac growing areas for their macro and micro nutrient levels

Studies were made for the levels of macro and micro-nutrients in important lac growing soils of Hesal, Taimara and Putidih villages. 94 soil samples were collected from the root zone of *kusum*, *ber* and *palas* from 0-30 & 30-60 cm depth of soils. For this purpose Information of lac productivity, location wise and host wise, on *kusum*, *ber* and *palas* in selected areas was also done. Chemical analysis of soils showed variable availability of macro and micro-nutrients in different locations. Results indicated availability of nutrients play important role in lac productivity.

Hesal soils

In Hesal, the topography of the soil is undulating. The soils are deficient in organic carbon (below 0.5%) except for few soil samples in low land. Availability of phosphorus was found in low to medium range. In general, availability of potassium was low (below 140 kg/ha). Almost all soils were found rich in iron (above 2 ppm) and manganese (above 1.5 ppm) but deficiency of zinc (below 0.6 ppm) and copper (below 0.2 ppm) was noticed in soils at higher level. The yield of *kusum* and *ber* were found low where zinc and copper were found deficient. In general lac yields were dependent of the availability of nutrients on *kusum* and *ber* except one tree of

kusum which was found non-bearing, may be due to genetic factors.

Taimara soils

Almost all soils of Taimara are neutral. The cultivated soils are low in organic carbon (below 0.5 ppm) but the forest area soils are rich in organic carbon (above 0.5%). In general availability of phosphorus and potassium (81.5 and 152 kg/ha) are in medium level. Almost all soils were rich in iron (above 0.2 ppm) and manganese (above 1.5 ppm). The availability of zinc (above 0.6 ppm) and copper (above 0.2 ppm) was also sufficient, except one sample from medium land soil. In general better yields are found on *kusum*, *palas* and *ber*.

Putidih soils

The soils of Putidih were found in neutral range (near pH 7). Almost all soils of *kusum*, *palas* and *ber* were found well supplied with organic carbon (above 0.5ppm). Availability of phosphorus (24.8 kg/ha) was also found in medium level but in case of potassium it was low (below 140 kg/ha). Almost all soils of Putidih under study were found to show high level of availability of nutrients hence better crops were found. In general medium to high yields of lac are reported. Level of certain micro-nutrients appear to be critically associated with lac yields. In case of *kusum*, data collected from Hesal indicate that lac yields were low at lower levels of Zn and Cu (Fig.26).

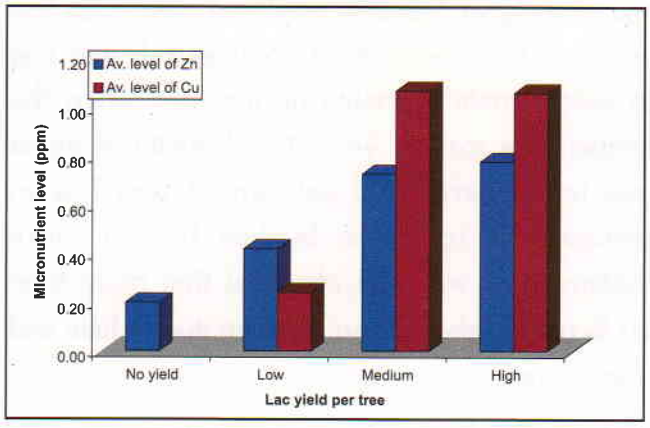


Fig. 26 Relationship between levels of micro-nutrients Zn and Cu (at 30 cm) and lac yields from *kusum* at Hesal.

1.2.3 Lac production on bushy hosts

Flemingia semialata as a bushy host

Effect of density and irrigation on summer (*jethwi*) crop

Flemingia semialata, planted in five geometries were inoculated during March 2005 to raise *jethwi* (*kusmi*) crop. The age of the bushes at the time of inoculation was 1½ years and the crop was raised under unirrigated condition. The results are furnished in Table 13. Highest number of shoots /bush was recorded at the density of 5,000 plants/ha; the differences were not significant among the remaining treatments. Plant height was maximum at the density of 40,000

Table 13 Effect of planting densities of *F. semialata* on lac production during summer (*jethwi*) crop, raised under rainfed condition

Plant density (plants/ha)	Average shoot per bush	Average shoot height (cm)	Harvested plant bio-mass (g/bush)	Broodlac weight (g/bush)	Average live encrustation per shoot at crop maturity (cm)	Average dead encru-station per shoot at crop (cm)	Average shoot girth (cm)
40,000	4	233	993	87.5	29	56.6	5.3
24,000	5	206	1246	101.7	34.5	56.5	5.9
10,000	5	203	1675	89.5	17.5	24.5	5.9
6,660	4	205	1750	164	16.2	24.5	6.4
5,000	6	183	1750	89	31.2	48.5	5.9
CD (5%)	1.13	13.1	266.5	32.4	11.67	13.39	NS

plants/ha. Highest broodlac yield (164 g/bush) and maximum shoot girth (6.4 cm) were found at the density of 6,660 plants/ha. The quality and quantity of broodlac produced, was quite low under all treatments (88-162g/bush). It was due to severe male mortality during May when the temperature rose to 44.5 °C. Mortality of insect was less where total settlement was low in comparison to those bushes having more settlement. It was also observed that more than 50 % of total shoots also dried up due to heat and insect stress.

Effect of shoot age on summer (*jethwi*) crop

During the summer season crop (*jethwi*), the performance of *F. semialata* was extremely poor in terms of lac production irrespective of shoot age and insect stress (Table 14a and 14b). Under unirrigated condition, lac insect and shoots of 6 and 12-month (with 50 & 60 % insect stress) dried completely. Six-month old shoots under irrigated condition (flood irrigation at 15 days interval during April and May) with 30 % insect stress produced highest broodlac (242 g/bush) but still mortality of shoots occurred to the tune of 30

Table 14a Effect of shoot age and insect stress on the performance of *Flemingia semialata* during summer crop (*jethwi*) under irrigated conditions

Shoot age (month)	Insect stress (% shoot height)	Broodlac Weight (g)	Shoot mortality (%)	Plant height (cm)	Live encrustation /shoot (cm)	Dried encrustation/Shoot (cm)
6	30	242	30	121	29.4	10
	50	50	70	149	11	26
	60	0	100	102	0	58
12	30	55	60	175	13.9	42.2
	50	25	90	180	6.5	65.1
	60	25	90	180	4.4	6.3.3
18	30	43	70	212	11.5	33
	50	45	85	215	8.3	84.2
	60	70	72	203	13.3	52.3

Table 14b Effect of shoot age and insect stress on the performance of *Flemingia semialata* during summer crop (*jethwi*) under unirrigated conditions

Shoot age (month)	Insect stress (% shoot height)	Broodlac Weight (g)	Shoot mortality (%)	Plant height (cm)	Live encrustation /shoot (cm)	Dried encrustation/Shoot (cm)
6	30	0	44	78	0	17
	50	0	95	78	0	31
	60	0	78	95	0	50
12	30	30	88	158	3.7	37.7
	50	0	100	176	0	52
	60	0	100	165	0	68
18	30	23	82	175	3.1	39
	50	45	57	181	10.5	35.6
	60	45	42	181	12.6	43.3

per cent. At 60% insect stress, no bush of any age could produce economical broodlac. Negligible broodlac production was observed on the shoot under unirrigated condition, under all treatments due to severe shoot mortality. The shoot age of 6 months of this host seems suitable for the broodlac production during *jethwi* crop with more frequent irrigation. Irrigation, in general, resulted in better growth and shoot survival across the treatments (Table 14a).

Integration with vegetable crops

Both winter (*Aghani* 2004-05) and summer (*Jethwi* 2005) lac crops were raised on *F. semialata* planted at single and paired - row planting pattern integrated with continuous cropping of vegetable crops, under irrigated condition. Maximum lac yield were obtained when *F. semialata* was planted at single row with vegetable crop Schedule II (ginger, tomato and bottle gourd during *kharif, rabi* and *zaid* seasons respectively). The broodlac and sticklac yields were 77.66 and 22.91 q/ha respectively during winter and 40.66 and 12.20 q/ha during summer seasons. The yields were 63-88% higher than that of control *i.e.* sole lac culture at single row.

The sticklac equivalent yield computed based on total value of main crop (lac) and inter crop (vegetable yields) was also computed during both lac crop seasons, taking into account of prevailing price of sticklac and vegetable crops. Maximum sticklac equivalent yield (27.45 q/ha) was obtained in the treatment where *F. semialata* planted at single row with vegetable crops as per Schedule I (okra, garlic and bitter gourd during three cropping seasons). Similarly, during summer, the maximum sticklac equivalent yield (15.94 q/ha) was obtained under a paired row system with vegetable crops as per Schedule II. Thus, integration showed superiority over sole lac cultivation with both planting patterns or continuous cropping of vegetable crops alone during both lac crop seasons (Fig. 27).

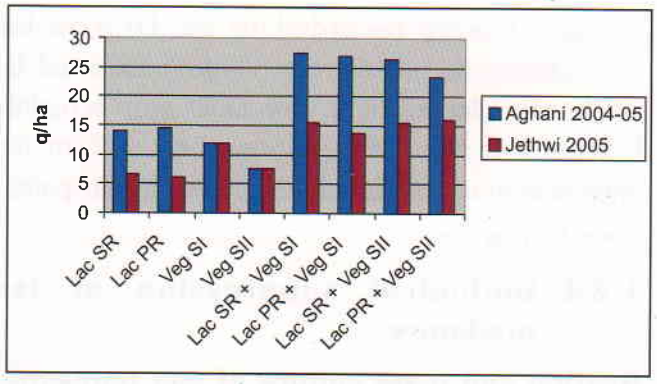


Fig. 27 Impact of integration of vegetable crops with lac cultivation on *F. semialata*

During winter season lac crop, adopting paired row planting of *F. semialata* with continuous cropping of vegetable crops as per Schedule I resulted in highest net return of Rs. 1.82 lakh/ha/annum by sale of sticklac and vegetable crops closely followed with *F. semialata* at single row + vegetable crops (Schedule I) with benefit cost ratio of 2.10 and 2.0 respectively; sole lac cultivation on *F. semialata* at single and paired rows in winter provided benefit cost ratio of 1.42 and 1.59 with economic return of Rs.0.59 and 0.74 lakh/ha/annum respectively. Like wise, cultivation of vegetable crops only during *kharif*, *rabi* and *zaid* seasons provided a net profit of Rs. 0.86 and 0.84 lakh/ha/year with benefit cost ratio of 2.51 and 2.31 at Schedule I and Schedule II respectively.

Similarly, during summer season lac crop (*Jethwi 2005*) the highest net profit of Rs.1.03 lakh/ha/annum with a benefit cost ratio 1.90 by sale of sticklac and vegetable crops was obtained with *F. semialata* planted at a paired row system integrated with Schedule II. Sole lac cultivation during summer was found to be uneconomical under both patterns of planting.

Pest incidence on lac crops was also recorded after harvesting during both seasons. During winter season the lowest incidence of predators and parasitoids was recorded in the treatment with paired row planting of *F. semialata* integrated with vegetable crops of Schedule II. However, during summer season the maximum number of

predators were recorded to be 10.8/m lac encrustation in paired row planting followed by single row planting with vegetable crop schedule I, where as the least number *i.e.*, 4.2/m lac encrustation was with sole lac cultivation at paired rows of planting.

1.2.4 Biological suppression of lac predators

Rearing and mass culture of egg parasitoid

Mass rearing and culture of *Corcyra cephalonica* and seven species of egg parasitoids namely, *Trichogramma achaeae, T. brasiliense, T. chilonis T. exiguum, T. pretiosum, T. ostrinae* and *T. poliae* were carried out in the laboratory throughout the year. The egg parasitoid *T.poliae* procured from Bio-control laboratory, IARI, New Delhi, during the year was added to the existing culture of other egg parasitoids.

Evaluation of egg parasitoids

(i) Field evaluation of three new egg parasitoids on *F. macrophylla*

***Katki* 2005 crop**

The experiment was repeated for evaluation of the three new egg parasitoids *Trichogramma achaeae, T.exiguum* and *T. ostrinae* on *rangeeni katki* (rainy season) crop raised on *F. macrophylla*. Release of egg parasitoids @ 15 and 20 per bush was done at 30 and 60 days after crop inoculation. Three bushes were used for each treatment, with replications.

The results indicate 42 - 86 percent suppression of the population of *E. amabilis* in relation to control. Percentage reduction of the population of *E. amabilis* was significantly high in case of egg parasitoids released @ 20 eggs per bush. The increase in yield was also high (245–416%) in respect to control with release of 20 egg parasitoids per bush (Table15).

The experiment in *Aghani* 2004-05 crop was conducted with same egg parasitoids. The results indicated 52 - 72% suppression of *E. amabilis* population. However, there was no significant difference between the two doses of release *i.e.* 15 and 20 eggs per bush (Table 16).

(ii) Field evaluation of the new egg parasitoid *Trichogramma poliae* on *rangeeni* lac crop raised on *Butea monosperma* (*Palas*).

The egg parasitoid *Trichogramma poliae* was evaluated for the first time on *rangeeni* lac crop raised on *B. monosperma* (*Palas*). The egg parasitoid was released twice @ 50, 75 and 100 per tree at an interval of 30 and 60 days after lac crop inoculation.

The populations of *E. amabilis* and *P. pulverea* were effectively suppressed at higher doses. The highest dose of the egg parasitoid (100

Table 15. Effect of release of egg parasitoids on the incidence of *E. amabilis* and brood lac yield in *katki* crop on *F. macrophylla*.

Parasitoid	No. released/ bush	Mean No. of *E.amabilis* per meter lac encrustation	Percentage reduction in population of *E. amabilis*	Yield ratio of brood lac (output/ input)	Percentage Increase in yield (%)
T. achaeae	15	3.21	56.55	1.90	53
	20	1.04	85.90	4.28	245
T. exiguum	15	4.27	42.29	1.40	12
	20	1.54	79.14	5.02	304
T. ostrinae	15	3.65	77.30	1.58	27
	20	1.68	57.20	6.40	416
Control		7.4	-	1.24	-
C D at 5 %		1.11	-	1.00	-

Table 16. Effect of egg parasitoids on the incidence of *E. amabilis* on the *aghani* 2004-05 lac crop raised on *F. macrophylla*

Parasitoid	No released/ bush	Mean no.of *E. amabilis* per meter lac encrustation	Reduction in the number of *E. amabilis* (%)
T. achaeae	15	2.4	52
	20	2.2	56
T. exiguum	15	1.8	64
	20	1.8	64
T. ostrinae	15	2	60
	20	1.4	72
Control		5	
C D at 5 %		2.017	

Table 17. Effect of egg parasitoid, *T. poliae* on the incidence of *E. amabilis* and *P. pulverea* in *baisakhi* 2004-05 lac crop on *palas*

No. of egg Parasitoid released per tree	Mean no. of *E. amablilis* per meter lac encrustation	Percentage reduction in the number of *E.amabilis*	Mean no. of *P.pulverea* per meter lac encrustation	Percentage reduction in the number of *P. pulverea.*
50	6.4	54.28	9.4	20.33
75	2.4	82.85	5.8	50.84
100	1.2	91.42	0.8	93:22
Control	11.4		11.8	
C D at 5 %	1.906		1.860	

eggs per tree) brought about a reduction of 91.42 % and 93.22 % in case of *E. amabilis* and *P. pulverea* respectively (Table 17).

(iii) Field evaluation of the egg parasitoids on *kusmi* lac crop raised on *Albizzia lucida*

Egg parasitoids, *T. achaeae*, *T. exiguum*, *T. poliae* and *T. ostrinae* were released on *kusmi* lac crop raised on *A. lucida*, a host plant having potential to preserve summer brood lac. The experiment was carried out during the summer season (January to June/ July 2005). Two releases were carried out at an interval of 30 and 60 days after lac crop inoculation with three doses 10, 15 and 20 egg parasitoids per plant. Each experiment was replicated five times and another five plants were kept as control. Samples were collected at the time of crop maturity and caged to quantify the incidence of *E. amabilis* and *P. pulverea*.

The two higher doses *i.e.*, 15 and 20 egg parasitoid per bush were effective in checking the population of both the lepidopteran lac insect predators. *T. achaeae* @ 20 eggs per bush produced the 100% suppression of *E. amabilis* (Table 18).

(iv) Field evaluation of some egg parasitoids on *rangeeni* lac crop raised on *B. monosperma*

In order to determine the time of application and dose of the newly acquired egg parasitoids (*Trichogramma achaeae*, *T. exiguum* and *T. ostrinae*), field evaluation was done along with the already tested egg parasitoid *T. brasiliense*. The egg parasitoids were released @ 75 and 100

Table18. Effect of release of egg parasitoids on the lepidopteran lac insect predators on summer season *jethwi* 2005 lac crop raised on *A. lucida*

Type of egg parasitoids utilized and release-dose per plant		*E.amabilis*		*P. Pulverea*	
		Average no. per meter lac encrustation	Percentage reduction in population	Average no. per meter lac encrustation	percentage reduction in population
T. achaeae	10	7.6	42.42	6.0	57.61
	15	1.0	92.42	1.8	85.48
	20	0.0	100.00	0.2	98.38
T. exiguum	10	11.0	16.66	11.2	9.68
	15	3.4	74.24	6.4	48.39
	20	3.0	77.27	1.2	90.32
T. poliae	10	17.0	0.0	9.2	25.81
	15	3.6	72.72	4.4	64.52
	20	1.6	87.87	1.2	90.32
T. ostrinae	10	5.4	59.09	7.0	43.55
	15	1.4	89.39	4.8	61.29
	20	0.4	96.96	0.8	93.55
Control	13.2		12.4		
C D at 5 %	5.63		3.89		

eggs per tree at an interval of 30 and 60 days from the date of lac crop inoculation. All the egg parasitoids were released on six trees of which three trees was exposed to double release and another group of three trees had one release. A group of three trees was kept as control far away from the site of experiment. The experiment was carried out at Institute Research Farm and farmers' field at Kharsidag village. Samples measuring one metre lac encrustation were collected from each tree at the time of crop maturity and caged in 60 mesh nylon nets to trap the emerging lac insect predators. The higher dose (100 egg parasitoids/ tree) produced better result with 93-98% suppression of *E. amabilis* and (94–100%) suppression of *P. pulverea* with two releases (Table 19).

Table 19. Effect of release of egg parasitoids on the lepidopteran lac insect predators on katki 2005 lac crop raised on *B. monosperma* at Kharsidag

Egg parasitoid and release-dose per tree		*E. amablilis*				*P. pulverea*			
		Average no. per meter lac encrustation		Percentage reduction in population		Average No. per meter lac encrustation		Percentage reduction in population	
		One release	Two release	One release	Two release	One release	Two release	One release	Two release
T. achaeae	- 75	6.66	4.33	66.12	77.97	12	7.66	35.69	58.94
	- 100	4.66	0.66	76.29	96.64	8.33	1	55.35	94.64
T. brasiliense	- 75	9.66	5.66	50.86	71.21	9.66	6	48.23	67.84
	- 100	7	1	64.39	94.91	5.66	0.33	69.66	98.23
T. exiguum	- 75	9	6	54.22	69.48	9.66	5.66	48.23	69.66
	- 100	7	1.33	64.39	93.23	5	0	73.20	100.00
T. ostrinae	- 75	7	4.66	64.39	76.29	11.33	5.66	39.28	69.66
	- 100	3.66	0.33	81.38	98.32	5	0	73.20	100.00
Control		19.66	19.66		18.66	18.66			
C D at 5 %		1.729			2.091				

The above experiment was repeated with the same egg parasitoids and same dose at ILRI Farm, Ranchi and the results recorded were similar (Table 20).

(B) Evaluation of bio-pesticides

(i) Standardization of concentration and no. of sprays

Jethwi* crop on *Albizzia lucida

The bio- pesticide Delfin (*Bacillus thuringiensis* sub sp *kurstaki*) was sprayed at 0.017, 0.034,0.05, 0.07 and 0.085% along with the three conventionally used insecticides on lac crop to evaluate their relative efficacy in the management of two lepidopteran lac insect predators. A total of six trees were selected for each treatment, of which three trees were sprayed twice (30 to 60 days after inoculation) and another three trees were sprayed only once (30 days after inoculation) to determine the frequency of application The experiment was carried out on the summer season lac crop (January to June/ July 2005) raised on *Albizzia lucida*.

Concentration of 0.05% and above produced effective control of the two major lepidopteran lac insect predators. The percentage reduction was recorded to be 98.88 to 100% in case of *E. amabilis* and 96-100% in case of *P. pulverea* (Table 21).

(ii) *Katki* crop on *B. monosperma*.

Different doses of the *Bacillus thuringiensis* sub sp. *kurstaki* based bio-pesticides were applied on lac crop raised on *Butea monosperma* at the farmers' field at Putidih and Banta villages is during the rainy season (July-October 2005). Two sprays at 0.05 % and above of bio-pesticide caused a suppression of 94.44 - 98.16% in case of *E. amabilis* at Putidih, while the suppression level for *P. pulverea* was 79.66 – 87.05%. At Banta, the suppression level for *E. amabilis* and *P. pulverea* was 72.34 to 76.62 and 61.68 to 74% respectively over control.

The results clearly indicate that two applications of *B.thuringiensis* (0.05%), 30 and 60 days after crop inoculation is sufficient to provide effective control of both the lepidopteran lac insect predators .

Table 20. Effect of release of egg parasitoids on the lepidopteran lac insect predators on *katki* lac crop raised on *B. monosperma* at ILRI Farm.

Egg parasitoid and release-dose per tree	*E. amablilis*				*P. pulverea*			
	Average no. per meter lac encrustation		Percentage reduction in population		Average No. per meter lac encrustation		Percentage reduction in population	
	One release	Two release	One release	Two release	One release	Two release	One release	Two release
T. achaeae - 75	5.33	4.33	73.35	78.35	11.33	7.00	35.84	60.36
- 100	3.66	0.33	81.7	98.35	8.66	1.00	50.96	94.33
T. brasiliense - 75	10.33	5.33	48.35	73.35	9.00	6.00	49.03	66.02
- 100	7.00	1.00	65.00	95.00	6.66	1.00	62.28	94.33
T. exiguum - 75	9.00	5.00	55.00	75.00	8.66	5.33	50.96	69.81
- 100	7.33	1.00	63.35	95.00	5.33	0.00	69.81	100.00
T. ostrinae - 75	8.00	4.33	60.00	78.35	10.00	6.00	43.33	66.02
- 100	6.33	0.66	68.35	96.70	5.00	0.66	71.68	96.26
Control 20.00	20.00		17.66	17.66				
C D at 5 %	1.74			2.674				

Table 21. Effect of bio-pesticide and chemical pesticides on the lepidopteran lac insect predators population in *jethwi* 2005 lac crop raised on *A. lucida* at Institute Farm.

Pasticide and dose percentage	*E. amablilis*				*P. pulverea*			
	Average no. per meter lac encrustation		Percentage reduction in population		Average No. per meter lac encrustation		Percentage reduction in population	
	One spray	Two spray	One spray	Two spray	One spray	Two spray	One spray	Two spray
Bt 0.017	6.33	10.00	72.86	57.13	6.00	11.66	63.98	30.01
Bt 0.034	5.33	7.66	77.15	67.16	7.66	6.33	54.02	62.00
Bt 0.05	7.33	1.66	68.58	98.88	8.00	0.66	51.98	96.00
Bt 0.07	5.33	0.66	77.15	97.17	13.00	0.66	21.96	96.00
Bt 0.085	6.00	0.00	74.28	100.00	6.00	0.00	63.98	100.00
Endosulfan 0.05	7.00	0.00	69.99	100.00	6.66	0.00	60.02	100.00
Ethofenprox 0.02	15.66	0.00	32.87	100.00	17.00	0.00	00.00	100.00
Dichlorvos 0.03	13.00	2.33	44.27	90.01	13.00	1.33	21.96	92.00
Control	23.33	23.33		16.66	16.66			
C D at 5 %	2.378			2.644				

(C) Habitat manipulation in the management of lac insect predators.

The experiment on habitat manipulation was repeated during the year 2004-05 also. The medicinal plant *Cassia occidentalis* having potential to harbour the eggs of *Catopsilia pyrenthe* was planted at a spacing of one meter on the periphery of plots with lac host plant *Flemingia macrophylla*. The host plants were inoculated with lac crop and kept under constant supervision for noticing the egg laying of *Catopsilia pyrenthe* on *Cassia occidentalis* leaves. The eggs were collected and caged in test tube for quantifying percent natural parasitisation by *Trichogramma* sp. Samples measuring one meter lac encrustation were collected from each plant at the time of crop harvest and caged in 60 mesh nylon nets. The extent of natural parasitization of *C.pyrenthe* eggs by *Trichogramma* sp was found to be 43.23 %.

The percentage reduction of *E. amabilis* was 56. 25 % in case of *kusmi* lac crop and for *rangeeni* was 64.68 %. The suppression in case of *P. pulverea* was found to be 80 % in case of *kusmi* lac crop and that for *rangeeni* lac crop was 62.50 %. Increase in lac crop yield as a result of suppression of lac insect predators was 379 % in case of *kusmi* and 191 % in case of *rangeeni* lac crop (Table 22).

(D) Essential oils in management of lac insect predators

Cotton swabs soaked in oil extracts of *Cymbopogon citratus* (lemon grass) *C.martini* (palmarosa) and *C.nardus* (citronella) and a commercial mixture (mixture of palmarosa, citronella and eucalyptus oil) were placed in perforated dispensers and made to hang among the branches of bushes. Each treatment was replicated thrice and another three were kept as control. The experiment was carried out on both *kusmi* and *rangeeni* lac crops raised on *Flemingia macrophylla* bushes. The aroma persisted for more than a month after treatment. Samples measuring 50 cm lac encrustation were collected from each plant, caged in 60 mesh nylon nets and scored after 20 days.

Table- 22. Effect of planting *Cassia occidentalis* on incidence of egg parasitoids for management of lepidopteran lac insect predators and its effect on yield on winter season *kusmi* and rainy season *rangeeni* lac crop raised on *Flemingia macrophylla*

Lac insect bioteype	Treatment	Mean no. *E. amablilis* per meter lac encrustation	Percent reduction in the number of *E. amablilis*	Mean no. *P. pulverea* per meter lac encrus-tion	Percent reduction in the number of *P. pulveria*	Yield (g)/ bush	Percent increase in yield
Kusmi	Planting of *C. occidentalis*	2.80 (0-6)	56.25	1.00 (0-2)	80.00	537 (250-1850)	379
	Control	6.40 (4-8)		5.00 (4-8)		112 (110-120)	
	C D 5 %	1.66		0.69		361	
Rangeeni	Planting of *C.occidentalis*	4.33 (2-9)	64.68	3.00 (1-6)	62.50	335 (230-450)	191
	Control	12.26 (10-15)		8.00 (5-11)		115 (100-160)	
	C D 5 %	1.245		1.27		57	

* Figures in parentheses indicate range

Reduction of population of *E. amabilis* in case of *kusmi* lac crop was 73-77 % over control with the oil extracts and that for *P. pulverea* was 22 – 66 %. In *rangeeni* lac crop the suppression level was recorded to be 22–89 % in case of *E. amabilis* and 75 to 86 % over control in case of *P. pulverea* with the oil extracts. The results clearly indicate that these oil extracts can be effectively utilized as an eco-friendly pest control strategy against these predators (Tables 23 & 24).

Field experiments have been conducted in the villages involving the farmers through participatory approach. The farmers were made aware about the advantages of biological control measures, utilization of egg parasitoids and bio-pesticides for environmental friendly management of lac insect predators. The farmers were demonstrated for release of egg parasitoids and application of bio-pesticides.

Table 23. Effect of different aromatic oil extracts on the lepidopteran lac insect predators on winter season *kusmi* lac crop raised on *F. macrophylla*

Essential oil	*E. amabilis*		*P. pulverea*	
	Average no. per 50 cm lac encrustation	Percentage reduction in population	Average no. per 50 cm lac encrustation	Percentage reduction in population
Lemon grass	1.66	77	2.33	22
Palmarosa	2.00	73	0.33	89
Citronella	1.66	77	1.00	66
Commercial Mixture	4.00	45	0.00	100
Control	7.33		3.00	
C D (5 %)	3.496		1.008	

Table 24. Effect of different aromatic oil extracts on the lepidopteran lac insect predators on rainy season *rangeeni* lac crop raised on *F. macrophylla*

Essential oil	*E. amabilis*		*P. pulverea*	
	Average no. per 50 cm lac encrustation	Percentage reduction in population	Average no. per 50 cm lac encrustation	Percentage reduction in population
Lemon grass	1.33	22	0.66	75
Palmarosa	1.66	89	0.66	75
Citronella	1.33	66	0.33	86
Commercial Mixture	0.66	100	0.33	86
Control	7.66		2.66	
C D (5 %)	2.432		1.499	

1.2.5 *In-situ* moisture conservation techniques for mixed plantation of *ber* and *kusum*

The experiment was initiated during 2005 to study the effect of *in-situ* moisture conservation techniques for raising mixed plantation of *ber* and *kusum* under rainfed condition. The experiment was laid out in RBD (Randomized Block Design) with five treatments and four replication. The treatments comprised of half moon terracing (T_1), mulching (T_2), compartmental bunding (T_3), use of cover crop (T_4) and control (T_5). To determine fertility status of the land, 40 soil samples were collected from two depths 0-30 cm & 30-60 cm. Soil was acidic in nature, low in organic carbon content and available phosphorus, and medium in available potassium. Thereafter, lime application was carried out @ 3 q/ha. FYM was also applied as per the recommended practices. The saplings of *ber* and *kusum* 160 & 20 in numbers respectively of the same age were transplanted in the month of July. The row to row and plant to plant distance was 4.0m. The geometry of planting was square and the ratio of *kusum* to *ber* was 1:8. The cover crop was Urd raised during August and Mulching was done out after cessation of rain in October. The total biomass of Urd (13.14 Kg) was incorporated equally among the replicate of the treatment T_4. The grain production of the Urd stood at 9.76 Kg. Plant growth attributes were recorded at monthly interval August onwards, whereas soil moisture measurement was taken from October onwards by gravimetric method. The maximum plant growth in *ber* was recorded under the treatment T_1 *i.e.*, half moon terracing in all the months. The soil moisture content was also found maximum under this treatment in all the months, except for December, where it was found maximum in the treatment T_3 (compartmental bunding). The moisture content in treatment T_1 for this month was at par with treatment T_3. The average height of the *ber* was 52.8 cm in August and 116.8 cm in December (posted for all treatments). Thus, there was an increase of 121.39% in terms of growth of the *ber* in January. In case of *kusum* no significant changes in the growth were found with regard to different *in-situ* soil moisture conservation techniques. (Fig 28).

Fig. 28 Half Moon Terracing for *in-situ* moisture conservation in mixed plantation of *ber* and *Kusum*

1.2.6 Broadlac and Sticklac Production

Under Revolving Fund. Scheme, (RFS) 16q broodlac was harvested from winter crop and 28q from summer season crop. 31.5q broodlac was sold for Rs. 3.83 lakhs. Balance sheet of the RFS is given below :

Income & Expenditure Statement and Balance Sheet of Revolving Fund Scheme 2005-06

INCOME	AMOUNT IN RUPEES	EXPENDITURE	AMOUNT IN RUPEES
Sale from Broodlac	506655	Labour Charges	69540
Sale of Sticklac	98220	Other Items	14492
Interest Earned on STD	46726	Institutional Charges to ILRI	40000
		Refund to ICAR	34000
Total	**651601**	**Total**	**158032**
		Gross Profit	**493569**
		Less workers Share	0
		Net Profit	**493569**
BALANCE SHEET AS ON 31-3-2006			
LIABILITIES	**AMOUNT IN RUPEES**	**ASSETS**	**AMOUNT IN RUPEES**
Capital Fund	1097437	Bank Balance	1591006
Add Net Profit transferred from Income & Exp. Statement	493569		
Total	**1591006**	**Total**	**1591006**

2. LAC PROCESSING AND PRODUCT DEVELOPMENT

2.1 Processing and Value Addition

2.1.1 Equipments for processing quality Seedlac at village level

Design and Development of Hand Operated Lac Grader

Lac encrustation separated from twigs of harvested lac crop is known as sticklac. It contains impurities and foreign matters, which are removed during primary processing of lac to a large extent. The primary processing of lac involves five major unit operations *i.e.*, crushing, washing, drying, winnowing and grading. Lac grading is an important unit operation, which is carried out at different stages *i.e.*, before crushing, after crushing and after winnowing. In small lac factories grading is mostly done by women using sieve. A woman labourer grades upto 150 kg lac in a day using a bamboo tray (*soop*) for winnowing and a sieve. In large lac processing units, grading before and after crushing is done with the help of a power operated grader. However, winnowing and grading after drying is done by women labourers. Mannual grading of lac is a slow and tedious process. In order to improve lac grading capacity and to reduce the drudgery of women labourers, a Hand operated Lac Grader has been designed and developed (Fig. 29). The developed grader consists of a feed hopper, a fluted roller type positive feeding mechanism, a cranking mechanism, set of sieves, drive mechanism and a machine frame. Only one person can operate the grader. For grading, material is fed in the feed hopper and the machine is then driven by the handle. The positive feeding mechanism draws the material from the feed hopper and discharges into the grading sieve. The agitating sieve-set, which is driven by cranking mechanism, grades the material into different grain size fractions, depending upon the sieve size. The graded material is discharged through different outlets, provided in the sieves and the pan. The developed grader was tested for *kusmi* sticklac using 10 and 30 mesh sieve-set. The capacity of the grader was found to be 60 kg/hr. The efficiencies of the 10 and 30 mesh sieves were found to be 94.8 and 86.4 per cent respectively. The grader is useful for lac grading before and after crushing and after winnowing in primary processing of lac.

Fig. 29 Hand Operated Lac grader

Design and Development of Hand Operated Lac Winnower

Winnowing of lac is an important unit operation, which is carried out before grading, in primary processing of lac. In most of the lac factories winnowing is mostly done by women using bamboo tray (*soop*). A woman labourer, winnows up to 150 kg lac in a day using a bamboo tray. The manual winnowing of lac is a slow and tedious process. In order to improve Lac Winnowing capacity and to reduce the drudgery of women labourer associated in lac winnowing, a Hand operated Lac Winnower with positive feeding mechanism has been designed and developed (Fig.30). The developed winnower consists of a feed hopper, a fluted roller type positive feeding mechanism, a cranking mechanism, a blower, a drive mechanism and a machine frame. Only one person is required to operate the winnower. Lac is fed in the feed hopper and then machine

Fig. 30 Hand Operated Lac Winnower

is driven by the handle. The positive feeding mechanism draws the material from the feed hopper and discharges it in front of the blower outlet. The light weight material present in scraped lac *i.e.* fine lac particles, fine dust and wooden chips are blown by the air and fall outside the machine. The heavier particles like lac grains which can not be blown by the air fall in the collecting hopper, which guides the winnowed lac in a bag tied to outlet. On testing with *kusmi* seedlac, the capacity of the hand operated lac winnower was found to be 500 kg/hr at 35 rpm speed of hand cranking. The separation effectiveness of the machine was 74.7 per cent. The machine is gender friendly. Both men and women labourer can operate the machine. As operation of the machine do not require either electrical or engine power, it is suitable for use in primary processing units located/planned to be located in the rural areas, where electrical and engine power are not easily available.

2.1.2 Storage studies on lac

Seedlac and shellac

Studies were continued on the changes in different physico-chemical properties of lac due to storage at room temperature (in open and in polybag). Seedlac and shellac samples were obtained from three crops of lac, viz., winter (*aghani kusmi*, stored for 42 months), summer (*jethwi kusmi*, stored for 34 months) and rainy season (*katki rangeeni*, stored for 21 months). Marked decrease was noticed in the flow (fluidity) of seedlac (87.5% for winter, 82% for summer and 58.3% for rainy season crop) and shellac (52.8% for summer and 53.8% for rainy season crop) for storage in the open. Decrease in flow was accompanied by increase in cold alcohol insolubles, decrease in acid and hydroxyl values, increase in melt-viscosity and melting temperature. The above results indicated polymerization of both seedlac and shellac with age. Flow of shellac of winter crop was reduced to zero within 30 months of storage indicating complete polymerisation of the resin, reported earlier (*Ann.Rep* 2004-05). The study also revealed that storing in polybag yielded marginal advantage.

Treatment of seedlac and shellac of both summer and rainy season crops with an antioxidant could check degradation of lac resin to some extent, especially in the early stage. Flow of seedlac reached a value of 20 [from its initial value 55] after 16 months of storage, antioxidant treated seedlac attained the value after 25 months of storage. Similarly, shellac of summer crop had attained a value of 50 [from its initial value of 70] within 4 months of storage whereas, antioxidant treated shellac attained the same value after 10 months of storage (Fig.31 and 32). The effect of antioxidant, however, was not so discernible at

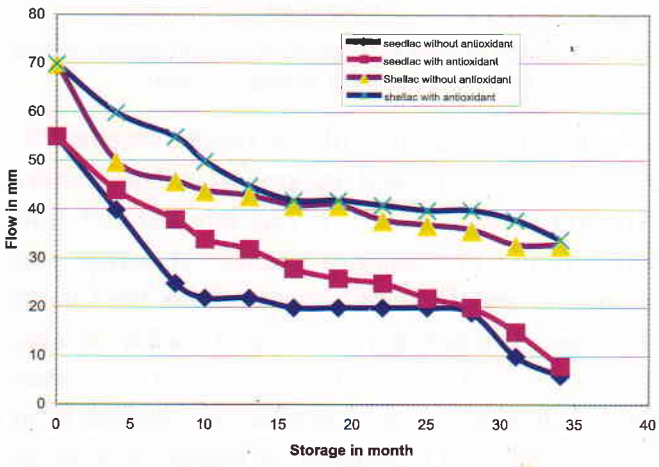


Fig. 31 Change in flow of *kusmi* summer season (*jethwi*) seedlac and shellac without and with antioxidant stored in open

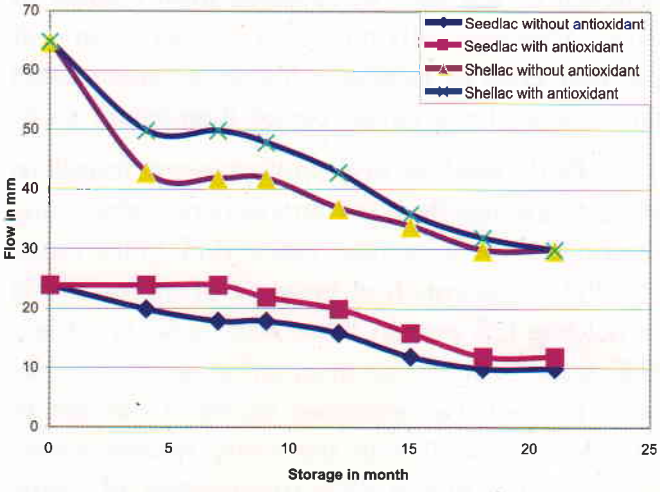


Fig. 32 Change in flow or Rangeeni *rainy season* (katki) *seedlac and shellac without and with antioxidant upon storage in open*

later stage. The effect of addition of antioxidant was also perceptible from changes in cold alcohol insolublity (Fig.33), antioxidant treated seedlac and shellac resulted in less cold alcohol insoluble compared to control.

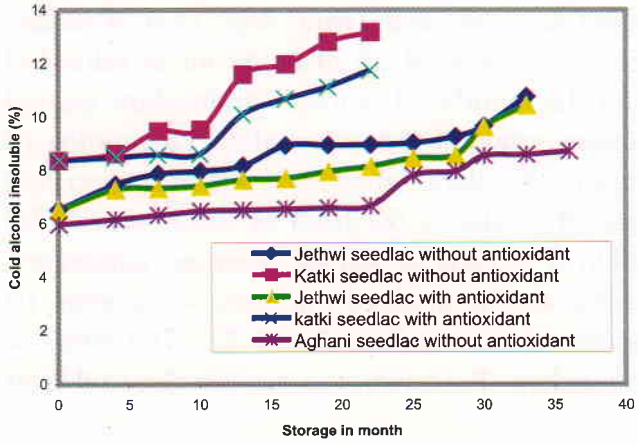


Fig. 33 Change in cold alcohol insolubles of aghani, jethwi *and* katki *seedlacs with storage in open*

From an analysis of the results obtained in the present study and by previous researchers (Khanna *et al.*, 1980), it has been found that deterioration in quality of seedlac of winter and summer crops of *kusmi* lac was quicker than those of shellac. The keeping property of shellac of rainy season crop of *rangeeni* lac was, on the other hand, better than that of seedlac, as revealed from changes in flow. Degradation of seedlac of summer crop was comparatively more rapid than that of winter crop and that of rainy season crop was in between of the two, as revealed from change in flow. This was attributed to the exposure of summer crop at relatively higher environmental temperature for a longer period than winter crop.

Both seedlac and shellac were found to absorb moisture from the atmosphere during rainy season (June – September 2005, R.H. in the range 72–95%). Absorption of moisture of shellac stored in polybag (25 micron thick) was found to be less (9%) than those stored in open. In general, it has been noticed that absorbed moisture content in seedlac and shellac in the rainy season varies between 1.8 and 2.25% irrespective of crops stored at room temperature.

2.1.3 Quality characterization

Comparative changes in the quality of seedlac and shellac obtained from Thai and Indian lac (Indian-I) were studied during storge for one year. Seedlac obtained especially from North East Hilly Region (Indian-II) of the country was also included in the study, to find out any similarity in the qualities of seedlac of NEH and of Thailand. Seedlac of Indonesian origin was included in the study at a later stage.

No change has been observed in the values of colour Index of both Thai and Indian seedlac and shellac (*kusmi*) even after one-year storage. Colour indices of Indian-I seedlac and shellac were observed to be lower as compared to Thai ones (Fig 34 and 35).

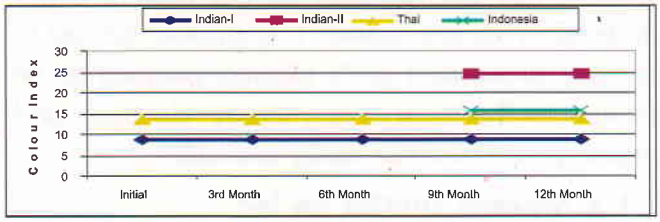


Fig. 34 Colour index of Indian-I and Thai, Indian-II and Indonesian* seedlac

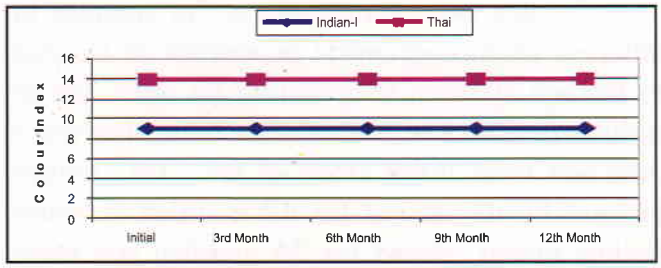


Fig. 35 Colour index of Indian I and Thai shellac

Flow of Thai seedlac and shellac was 65% and 26% lower than those of Indian origin respectively even after 12 months storage. Initially, the flow of Thai seedlac was 54% lower than Indian one (Fig. 36). Whereas, in case of shellac the

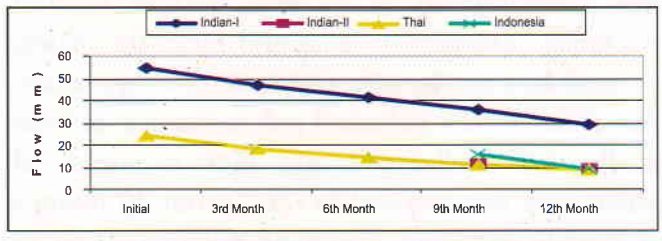


Fig. 36 Flow of Indian-I and Thai, Indian-II and Indonesian* seedlac

initial flow value of Thai lac was 36% lower than Indian shellac (Fig.37).

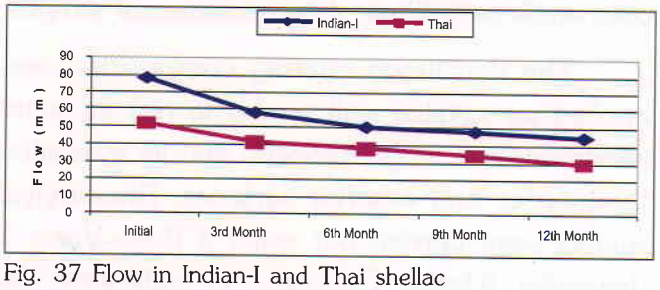


Fig. 37 Flow in Indian-I and Thai shellac

Life (heat polymerization time, HPT) of Indian-I seedlac and shellac was observed to be 8% and 11% higher than those of Thai lac (Fig 38 and 39).

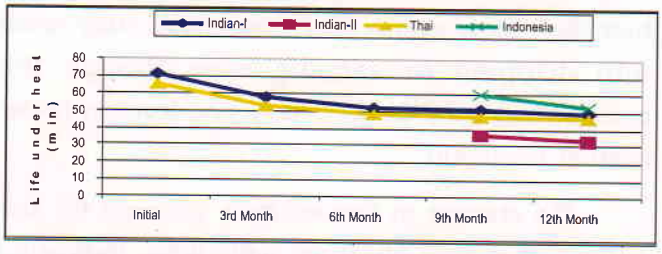


Fig 38 Life (HPT) of Indian-I & NEH (Indian-II), Thai and Indonesian

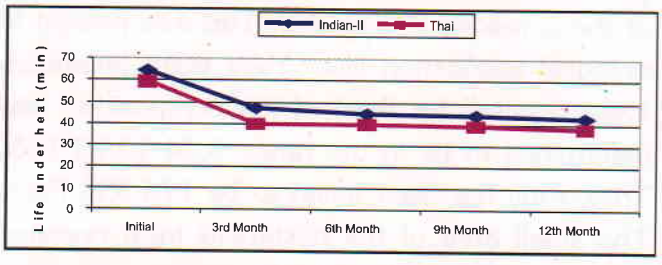


Fig 39 Life (HPT) of Indian-I and Thai shellac

Bleach index of Thai, Indonesian and Indian-II seedlac was 42%, 42% and 27% higher than that of Indian-I seedlac (Fig 40), indicating less

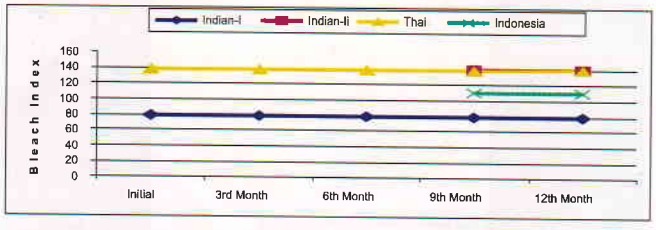


Fig. 40 Bleach Index of Indian-I, NEH (Indian-II) and Thai, and Indonesian* seedlac

expenditure to be involved in the manufacture of bleached lac from Indian-I seedlac. Both cold and hot alcohol insolubles of Indian-I seedlac were less compared to those obtained for other countries, indicating presence of low impurities in Indian-I seedlac.

Melt-viscosity of Thai seedlac was found to be 1790 PaS compared to its initial value noted 1430 PaS six months ago. Similarly, melt-viscosity of Indian-I seedlac was found to be 1100 PaS compared to its initial value of 696 PaS noted six months ago, indicating polymerization of resin. No appreciable change in the melt-viscosity of Indian-I shellac was noticed, however, for the same period of storage (30.4 PaS to 30.68 PaS).

Study of the melting profiles of waxes extracted from Indian-I, Chinese and Thai seedlac by a Differential Scanning Calorimeter, revealed that there exists at least two fractions common to all, possessing melting peaks around 49-50 and 72°C, suggesting that lac insects irrespective of species and hosts (country) secrete two similar wax fractions (Fig.41 and 42).

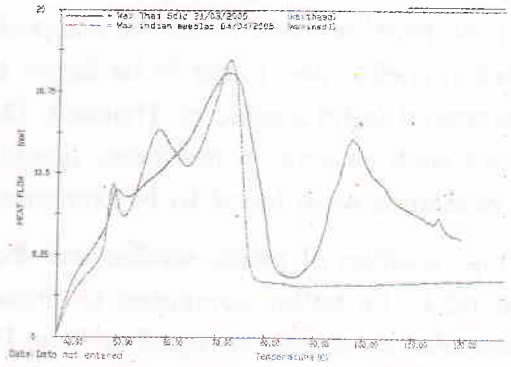


Fig. 41 Melting Profiles of waxes extracted from Thai and Indian seedlac.

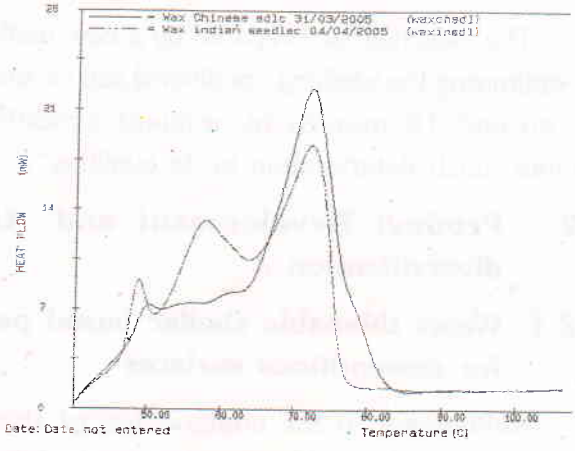


Fig 42 Melting Profiles of waxes extracted from Chinese and Indian seedlac.

Thai lac insects also secrete wax fractions having higher melting temperatures (prominent at 97.6 and peak at 115°C) compared to lac insects of other countries (Fig. 41).

A comparative study was also made on the surface coating properties of Indian and Thai shellac. Solution of Indian and Thai shellac was made in ethanol and found that Thai shellac solution was darker (dark tan) than that of Indian (brown) in appearance. Characteristics like, gloss, scratch hardness, impact resistance and flexibility were studied and found that gloss of Indian shellac was more (70%) than that of Thai shellac (54%) when compared with the standard black (100%), may be due to presence of higher percentage of wax in Thai lac. The surface coating properties of compositions developed using butylated melamine formaldehyde resin and shellac obtained from Thai and Indian origins were also studied. Gloss of the films, prepared from the composition using Indian shellac was found to be better than those prepared using shellac of Thailand. Other properties such as scratch hardness, flexibility, impact resistance were found to be comparable.

Thus, qualities of Indian seedlac and shellac were found to be better compared to those of other countries especially, in regard to flow, HPT, colour index, bleach index and gloss.

2.1.4 Bleached lac

The bleached lac prepared by a new method (by optimizing the washing conditions) can be stored for around 18 months at ambient conditions without much deterioration in its qualities.

2.2 Product Development and Use diversification

2.2.1 Water thinnable shellac based paint for cementitious surfaces

Refinement in the composition of shellac based water thinnable coating material for cementitious surfaces was made by modifying shellac with synthetic resin. The characteristics of the shellac based coating composition were found to be comparable with those of two commercial samples.

The developed coating composition was applied on suitable wall spaces to test its water resistance, anti fungal property and its evaluation for interior and exterior surfaces. Rheological studies were carried out using a Roto Visco 1 rheometer, (Haake, Germany), to understand the flow properties of the shellac-based water borne paint compositions. In water based coating system, the solid content (%) increases slowly due to slow evaporation rate of water especially, at higher humidity. Slow evaporation sometimes may result into dripping or sagging even though the composition exhibits good flow and leveling under normal condition.

No change in the solution viscosity for the composition was observed with time, indicating good leveling capability and absence of sagging of the composition (Fig. 43). This was noticed in practical application also. Yield point (minimum force required for flow) of the composition was determined to be in the range 6.24-10.92 PaS. Thixotropy has been found to be 178-330 Pa/s. The small area of the hysteresis loop revealed good recovery capability for the paint composition

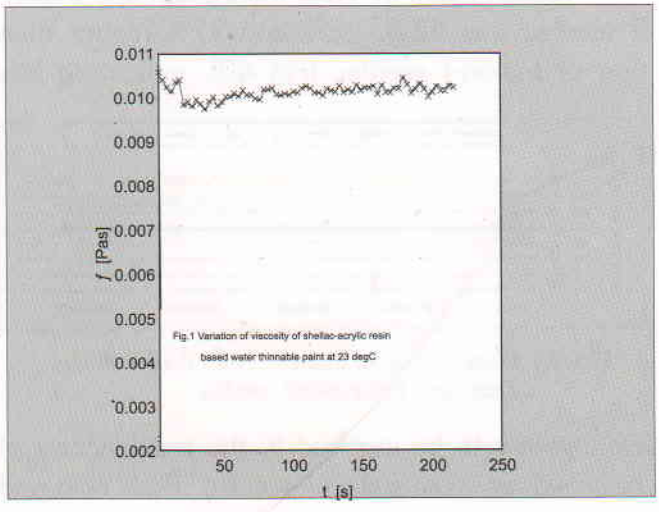


Fig 43 Variation in viscosity of shellac acrylic resin based water thinnable paint at 23°C

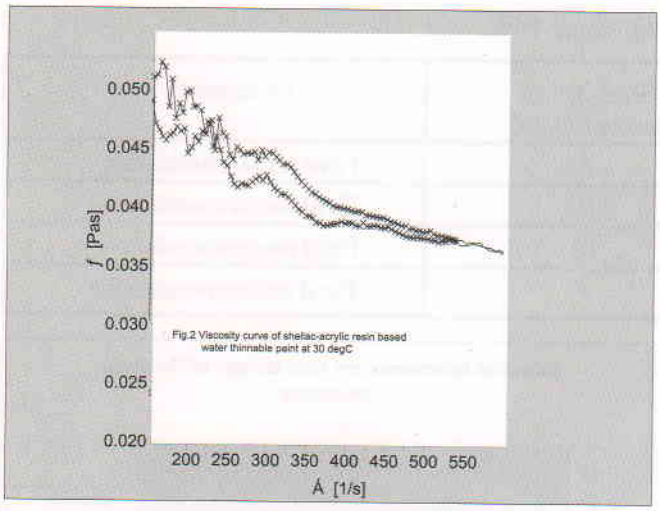


Fig. 44 Viscosity curve of shellac acrylic resim based water thinable paint at 30°C

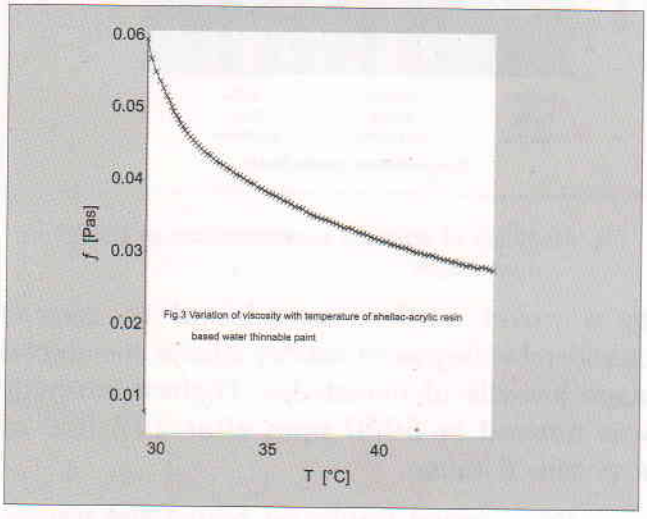


Fig. 45 Variation in viscosity with temperature of shellac acrylic resin based water thinnable paint

from deformation when shear is withdrawn (Fig.44). A small decrease in the solution viscosity with temperature was observed between 30 and 45°C, indicating increased flow with temperature (Fig.45).

The values of the parameters within the cross model relevant to this system were found out and are shown in Table 25.

The low h_o and h_∞ values indicate good compatibility of the solute molecules with the solvent. The value of n is found to be generally 2/3 (not necessarily), a little higher value is obtained in the present case.

Table: 25 Cross model parameter of shellac-acrylic paint

η_o	η_∞	n
0.052	0.024	1.0

The covering power of the shellac based coating composition was recorded to be approximately 120 ft^2 /L for two coats. The composition was found to be suitable for application on plaster of Paris treated smooth surface as well as limed surface resulting in attractive finish. The first coating on limed surface requires more paint material because of quick absorption but second coat requires less paint resulting in a pleasant finish on the wall surface.

2.2.2 Composite board

The flammability properties of sticklac composite board such as the duration of flaming, after-glow, percentage loss in weight and charred area were studied incorporating varying concentrations (0 to 15%) of a flame retardant. It was found that the duration of flaming and after-glow were reduced to zero with 8-10% of flame retardant. The percentage loss in weight and charred area were around 7% and 24% respectively. The results indicated that the composite board using sticklac can be imparted with good fire resistance properties, by addition of fire retardant.

Composite boards (density ~ 0.8g/cc) of different thicknesses (7, 12, 20 and 26 mm) were prepared from pulverized *arhar* stick and sticklac. It was observed that a press-cycle of increased duration (~ 1 hr) was required for making board of thickness 26 mm. Lower press-cycle duration even with increased contact pressure (~ 42 kg/cm^2) was found to cause debonding of layer of the board.

2.2.3 Fruits and vegetables coating formulation

Lac based formulation with 10% solid contents gave encouraging results in tomato, brinjal, pointed gourd. Parameters analysed were % acidity, lycopene content, ascarbic acid, TSS, non-enzymatic browning etc. as applicable. Out of three formulations prepared, SH03 was the best while SH01 and SH02 were at par.

Table 26 Final recommendation for various produces on their PHL

Produce	Shelf life of control (days)	Shelf live of treated (days)	Comments
Brinjal	3	7	Final recommendation
Capsicum	4	9	Final recommendation
Tomato	5	10	Final recommendation
Parval	3	7	Final recommendation

Report from SKUAST revealed that SH03 was the best for extending, shelf life of apples, (varieties: Ambri, Golden, Royal, Red Delicious), it could reduce water loss by 50% over a storage period of 100 days. The report also revealed that SH03 was best for extending shelf life of William/ Bartlett pear as it could reduce the water loss by 50% over a storage period of 15 days.

Report from CIPHET, Abohar revealed that SH01 was most suitable for extending shelf life of kinnow, to 36 days in ambient conditions as compared to 20 days in control. Further, the report revealed that lac based formulations had significant anti-microbial activity towards *P. italicum* as compared to control. Final recommendation for various produces on their Post Harvest Losses (PHL) is shown in the Table 26.

2.2.4 Bioactive compounds from lac

Effect of 10-carboxymethyl-2-decenoic acid (CMDA) / (PGRs) synthesized from aleuritic acid, the major component acid of lac was studied on *in vitro* multiplication of pointed gourd (*Parwal*). Addition of CMDA at a concentration of 0.2 ppm in MS-media resulted in auxiliary bud proliferation after 5 days of inoculation of the ex-plant, whereas it was 6 days in the case of the latter. Root emergence was noticed after 4.0 and 4.4 days respectively. Later, PGR resulted in multiple shoot emergence. CMDA was treated on *F. semialata*, a promising lac host plant. The growth performance of plants treated with CMDA (applied at different concentrations) was found to be at par with IBA (indole butyric acid, a commercial product (Fig.46). CMDA was also applied on the seeds of *F. semialata* which yielded better roots than the control and IBA.

16-Hydroxy-(*E*)-9-hexadecenoic acid, synthesized from aleuritic acid in quantitative yield

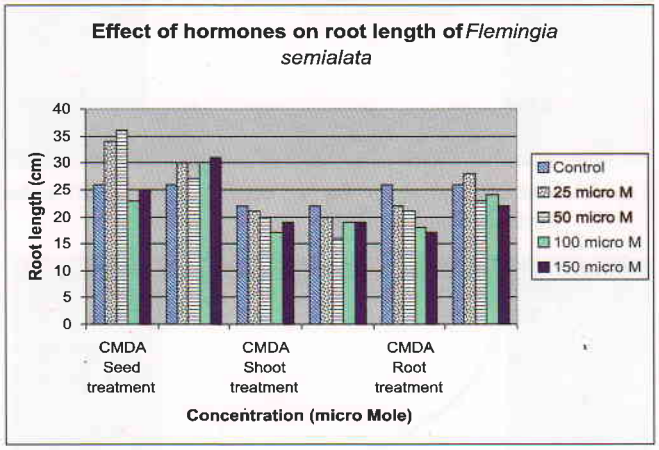


Fig. 46 Effect of different concentrations of CMDA on root length

by a novel method was found to display considerable degree of toxicity against the second stage juvenile of nematodes. Highest mortality was noticed at 5000 ppm after 192 hrs. of exposure duration.

Encouraging results on brinjal and tomato crops were obtained with insect sex pheromones, (*Z*)-9-hexadecenol, 16-acetoxy-(*E*)-9-hexadecenoic acid, blend of (*Z*)-9-tetradecenyl acetate and (*Z*)-7-dodecenyl acetate (1:1,w/w). Blend was found to be superior to tomato hit, a commercial product.

1,9-Nonanedioldiacetate,1,7-heptanediol-diacetate and (*E*)-2-undecen-1,11-dioldiacetate were synthesized from aleuritic acid and evaluated against *Aedes aegypti*, and *Anopheles stephensi*. Evaluation trials of these compounds for the activity are in progress.

2.2.5 Insect sex pheromone components

1.0g (E,E)-10,12-Hexadecadienal, a sex pheromone of spiny bollworm (*Earias insulana*), 7.0g of Z-11-hexadecenal and 6.0g of Z-9-hexadecenal were synthesized and sent for evaluation at NCIPM, New Delhi for the experiments under Technology Mission on Cotton (TMC).

2.2.6 Lac based nail polish

Lac based nail polishes prepared from seedlac, golden seedlac and dewaxed decolourised lac (DDL) were evaluated through a nail polish manufacturer. Performance of two compositions prepared from DDL were found to be comparable with that of commercial product of a well known brand.

2.2.7 Jute fibre-glass reinforced sheets

Sheets of jute fibre-glass composites were prepared with shellac-containing sheet moulding compound and tested for mechanical properties. So far, highest tensile strength and tensile modulus values obtained were 40.6 MPa and 1.7 GPa respectively (Sample No.17, Table 27). Flexural strength and flexural modulus were found to be 95.98 MPa and 4.2 GPa respectively. Flexural strength of jute fibre-glass sheets were found to be in the range of those of jute free fiberglass reinforced sheets. Impact resistance was found to be in the range 0.383 – 0.615 kgm. Preliminary study revealed that pre-treatment of jute fabric and felt with shellac varnish resulted in less soaking of sheet moulding compound.

It was observed that jute fibre-glass reinforced sheet prepared with a fire retardant chemical, do not catch fire easily and extinguishes itself when the flame is withdrawn. Sheets (5 mm thick), without fire retardant chemical, catch fire easily and continue to burn completely at the rate of 0.23 in^2/min.

Jute-fibre glass reinforced sheets were found to be resistant towards water, H_2SO_4 (50%), HCl (10%), acetone (10%), ethanol (50%), saturated NaCl solution, transformer oil, kerosene oil, acetic acid (50%) and ammonium chloride (5%), but adverse effect (within 24 hrs of immersion) was observed with NaOH (10%) solution and methanol (chemicals were chosen following Murthy, Pop. Plastic Pack., Jan.1999, p.73; Encycl. Polym. Sci. Technol., Vol.3, p. 671). Effort has been initiated for finding out bio-degradation, if any, of the jute fiber-glass reinforced sheets.

Table 27 : Mechanical properties of jute-fibreglass reinforced sheets

Composition no.	Tensile strength (MPa)	Tensile modulus (GPa)	Flexural strength (MPa)	Flexural modulus	Impact strength (kgm)
1	1.0	0.05	24.1	0.24	
2	22.4	0.634	30	0.4	
3	38	1.0	27.3	0.3	
4	34.23	1.5	52.26	1.45	
5	22	1.2	48.14	2.2	
6	-	-	67.54	1.31	
7	-	-	48.27	1.2	
8	32	1.53	82.95	1.4	
9	-		76.4	1.22	
10	20	1.03	27.4	0.32	0.268
11	16.2	0.725	22.5	0.32	
12	18.2	0.8	20.9	0.348	
13	21.4	0.67	30.5	0.544	
14	18.6	0.28	30.4	0.46	
15			33.8	0.42	
17	40.6	1.7	95.98	4.2	0.383
18	28.75	1.1	43.56	1.4	0.295
19	26.04	1.0	16.13	0.6	0.615

3. TRANSFER OF TECHNOLOGY

3.1. Technology Assessment, Refinement and Dissemination

3.1.1 Lac as a source of livelihood: Technology intervention for sustained production in Khunti Sub-Division (Financed by JHASCOLAMPF, Govt. of Jharkhand)

This project was initiated with the following objectives:

1. To provide improved implements for lac cultivation to farmers,
2. To provide training to progressive lac growers in scientific methods of lac cultivation,
3. To organize On-farm training for the beneficiaries and
4. Technology intervention in lac cultivation at the following stages:

- Pruning of lac host tree,
- Use of optimum amount of broodlac,
- Broodlac inoculation using synthetic netting,
- Pesticide spray to manage pests and diseases and
- Harvesting of lac crop at proper stage

750 (against 500 in phase I and 250 in phase II) beneficiary families from 70 SHGs in 59 Hamlets of 46 villages under two Blocks namely Khunti and Torpa have been adopted under the Project.

Implements provided for distribution among the beneficiaries:

Phase - I Each group of five farmers was provided with a Farming Kit containing: One rocking sprayer, five secateurs, five scraping knives, five pruning knives two tree pruners, 7500 nylon netting sleeves and 10 % subsidy on the broodlac purchased.

Phase – II. Each group of Ten farmers was provided with a Farming Kit containing: One rocking sprayer, ten secateurs, ten scraping knives, ten pruning knives, ten tree pruners, 15000 nylon netting sleeves.

Improved farming kits were distributed among the beneficiaries of the project (Table 28).

Following activities were undertaken for effective implementation of the project: Capacity building of PRADAN Professional, Capacity building of village level extension cadres, One Day Training of Beneficiaries, Beneficiary Selection (Primary Concept Sharing), Pruning Training (Hamlet Level), Follow-up of Scientific Pruning, Tree Selection and Brood estimation Training (Hamlet Level), Dummy Inoculation Training (Hamlet Level), Brood cutting and Packing training (Hamlet Level), Insecticide and fungicide spraying Training (Hamlet Level), Follow-up of Spraying, Growth Follow-up, Emergency Follow-up and Yield Assessment and Reporting.

Table 28. Improved implements used in lac cultivation provided to PRADAN for distribution among the adopted farmers

Sr. No.	Implement Provided	Number		Total
		Phase - I	Phase - II	
1.	Rocking Sprayers	115	25	140
2.	Secateur	575	250	825
3.	Pruning Knife	575	250	825
4.	Scraping Knife	575	250	825
5.	Tree prunner	230	250	480
6.	Nylon netting	6,000 m	5,000 m	11,000 m

Field visits were undertaken at critical stages of lac cultivation *i.e.* Pruning of lac host tree, Use of optimum amount of broodlac, Broodlac inoculation using synthetic netting, Pesticide spray to manage pests and diseases, Harvesting of lac crop at proper stage.

One week training was organized for 40 farmers at the Institute and on-farm training was organized to demonstrate to all the 750 beneficiaries the improved methods of lac cultivation., *viz.* brood lac inoculation using nylon nets, tree pruning, spraying of pesticide, harvesting of crop at right stage etc. (Table 29).

On an average 110 SHGs were covered every year under 67 hamlets/villages for imparting training in scientific methods of lac cultivation. More than 6640 trees were pruned every year and 105 quintals of broodlac was distributed along with 1,05,300 net bags for inoculation. Broodlac input to sticklac obtained ratio varied between 1.0 to 2.0 during the programme.

Two new concepts *i.e.*credit-cum-insurance for lac crop to the growers and broodlac entrepreneur development were introduced under the project.

3.1.2 Enhancement of livelihood of lac growers and lac production in Jharkhand

A new Centre assisted scheme for lac development has been launched to enhance the livelihood of tribal lac growers and lac production in Jharkhand. It will be implemented in 9 districts of the State benefiting 20,000 farmers. The project, with a budget of Rs 9.84 crores is being implemented by Tribal Welfare Dept., under the technical guidance of ILRI. An amount of Rs 187.65 lakhs have been earmarked for the Institute for training, infrastructure development and action research.

Under this scheme, one Orientation Training Programme on Lac has been conducted for the MESO / District Welfare Officers of Jharkhand State Government on February 3, 2005.

Other TOT Activities

Field Demonstration on Lac Cultivation in Orissa

The Institute successfully transferred lac cultivation technology to remote villages of *Krutibali* and *Gajinazu* blocks in *Kandhmal* district (Orissa), where about 11,000 *kusum* trees in 11 Village *Panchayats* are available. In order to initiate the work, a progressive farmer Shri J. Mahto (an ex-trainee of ILRI), now professionally involved in lac cultivation from Jhalda, Purulia dist (West Bengal) offered to supply 40 Kg of broodlac (worth about Rs. 4,000) from his surplus production free of cost. The broodlac was inoculated on eight un-pruned trees of *S. oleosa* (*kusum*) during February 2005, by the local villagers. Experts from ILRI visited the area and monitored the lac crop from time to time. This demonstration has yielded very good results. The mature lac crop harvested during July, 2005, had a yield of 176 kg broodlac, despite very high temperature during the summer (>48°C) in the area. One particular tree inoculated with 1 kg of broodlac has yielded 16.5 kg broodlac after adopting all pest management techniques. The quality of broodlac was also very good in respect of lesser incidence of predators and high fecundity of female lac insect. All the cultivation operations including watch and ward, were carried out by a group of very poor tribal villagers. To propagate the lac culture further, 150 trees of *Zizyphus mauritiana* (*ber*) and 20 trees of *kusum* in 11 villages of the same block were inoculated by 176 kg broodlac during July 2005. Around 400 families

Table 29. Training imparted to the beneficiaries during the project period

Sr. No.	Training Provided	Number		Total
		Phase - I	Phase - II	
1.	One Week	25 farmers	15 farmers	40 farmers
2.	On-Farm	15 villages	9 villages	24 villages
3.	Field Visits	12	6	18

were exposed to this demonstration and they showed enthusiasm to undertake this income generating activity. Broodlac production is expected to be around 6 quintals during this winter season crop. It is planned to further increase the number of lac cultivating families by involving unemployed rural youths and also to increase the number of villages.

Preparation of lac based product

Forty – three litres of melfolac was prepared for sale through sale-counter and exhibitions.

Researchable issues posed by lac Industry

- New washing technique for sticklac
- Effluent water treatment plant for lac industry
- Improvement of colour index of shellac made from *molamma* and *kiri*
- Anticorrosive paint for underground GI pipe
- Pilot plant for aleuritic acid and lac dye for training of entrepreneurs

3.1.3 Eco-friendly disposal of lac effluent and its possible utilization

The effluent water (obtained after washing of sticklac) from the state owned lac factory JHASCOLAMF, Ranchi was collected and calcium salt of lac dye was recovered. The effluent was further treated with lime-water (35%), which reduced its colour (optical density 0.20 at 490 nm) and pH (7.5). The lime treated water was further treated with 4%, 6% or 8% of sodium hypochlorite solution (available chlorine 3%), which practically removed the odour and further reduced the colour (optical density from 0.2 to 0.02) (Table 30).

Table30. Effect of addition of sodium hypochlorite solution on the optical density of lime treated effluent

Sodium hypochlorite (%)	Optical Density at 490 nm
0 %	0.20
4 %	0.08
6 %	0.06
8 %	0.02

Two samples of the effluent, one treated with 8% sodium hypochlorite solution and the control have been analyzed for various parameters. The results are summarized in (Table 31).

Table 31. Result of analysis of untreated and treated effluents

Sl.	Parameters	Effluent	
		Before treatment	After treatment
1.	Electrical conductance ms/cm	6.47	12.97
2	Sodium absorption ratio	0.44	1.12
3	Boron mg/l	<0.1	<0.1
4	Total dissolved solids mg/l	5,468	5,455
5	Sulphate mg/l	845	929
6	Chloride mg/l	571.3	565.7
7	Percent sodium	6.58	8.5
8	Lead mg/l	1.08	0.18
9	Arsenic mg/l	0.03	<0.03
10	BOD mg/l	370	62
11	Phenolic compounds mg/l	0.47	0.16
12	Copper mg/l	0.323	0.025
13	NH_3 mg/l	22.7	21.6
14	Total chromium mg/l	<0.05	<0.05

The values of electrical conductance, total dissolved solids and oil & grease were found to be beyond the limits, attempts are being made to reduce these values; two parameters *e.g.*, sulphate and chloride are within marginal limits and ten parameters *e.g.*, sodium absorption ratio, boron, percent sodium, lead, arsenic, BOD, phenolic compounds, copper, ammonia and total chromium are well within the limits. Treatment of the effluent with activated charcoal (1 to 5%) further reduced the colour of water (optical density decreased from 0.01 to 0.001, Table 32). Further, analyses for other parameters are under progress.

Table 32. Effect of addition of activated charcoal on optical density

% Carbon on wt. of solution	Optical density at 490 nm
1%	0.01
2%	0.003
3%	0.001
5%	0.001

3.2 HRD for Capacity Building in Lac Production, Processing and Value Addition

3.2.1 Economics and marketing of lac

Economics of Lac Cultivation in Jharkhand

A survey was made among 500 lac growers in Ranchi and West Singhbhum districts of Jharkhand during the year 2003-04 and 2004-05, including 100 lac growers who had got one week training at this Institute. Cost of cultivation and returns in lac cultivation, obtained from survey data, are presented in Table 33 and Fig. 47.

Cost of production of broodlac was Rs. 17.20, Rs. 16.20 and Rs. 38.60 per kg. for *palas*, *ber* and *kusum*, respectively. Cost of production of sticklac was Rs. 18.90, Rs. 19.40 and Rs. 28.20 per kg. for *palas*, *ber* and *kusum*, respectively. Cost of production of sticklac and broodlac was the highest in case of *kusum*.

Coefficient of determination (R^2) was 0.7646, 0.6673 and 0.6826 for *palas*, *ber* and

Table 33. Cost of cultivation and returns from lac cultivation

Particulars	*Palas* (50 hosts)	*Ber* (50 hosts)	*Kusum* (10 hosts)
Cost of cultivation (Rs.)	2,566	4,674	6,881
Net return (Rs.)	4,886	9,771	16,284
BC ratio	2.90	3.09	3.37

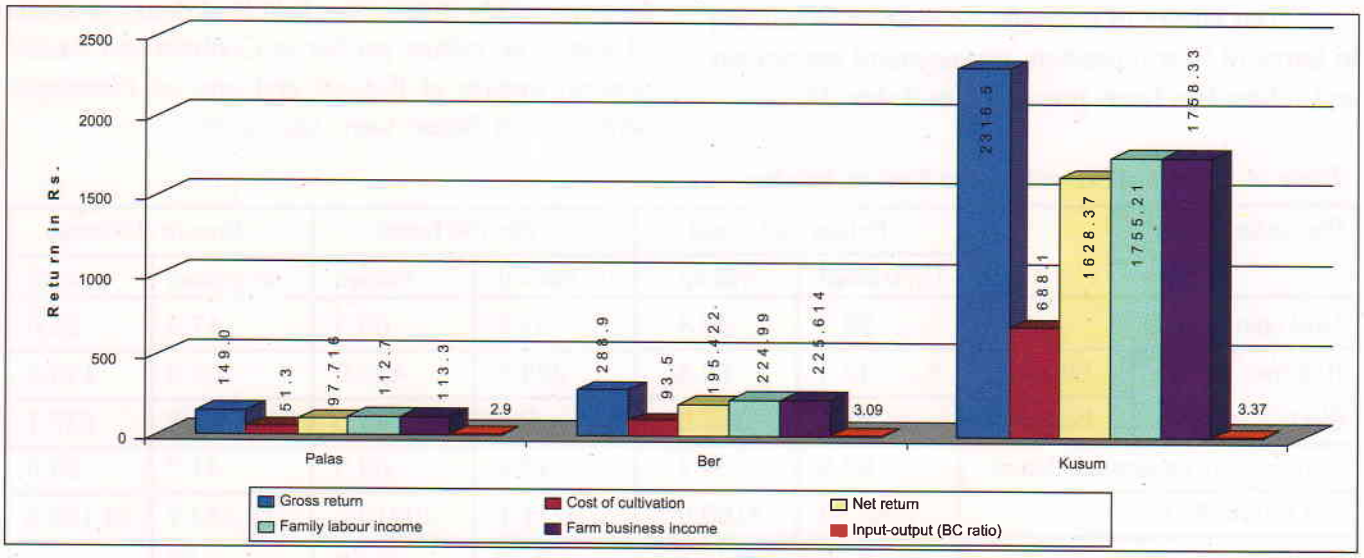


Fig. 47 Returns (Per host) from traditional lac cultivation on different hosts in Jharkhand

kusum, respectively indicating that 76.46 %, 66.73 % and 68.26 % variation in total income from lac utilizing above hosts was explained by four variable namely, number of hosts utilized, human labour day utilized, amount of broodlac inoculated and other inputs (synthetic net bag and pesticide). Human labour day utilized and amount of broodlac inoculated show significant positive effect on output while effect of number of hosts utilized and other inputs did not have any significant impact on per tree yield on all three hosts. The elasticity of production for human labour was almost equal in lac cultivation on *ber* (0.35) and *palas* (0.35) and was followed by *kusum* (0.30). It implies that one per cent increase in human labour days utilized would increase the gross return by 0.35 per cent in lac cultivation on *ber* and *palas* and 0.30 % on *kusum*. The elasticity of production for the amount of broodlac inoculated was highest in lac cultivation on *kusum* (0.6387) followed by *ber* (0.5890) and *palas* (0.4969). The marginal value product (MVP) of human labour was found to be highest in case of lac cultivation on *kusum* (Rs. 4.25) followed by *ber* (Rs. 1.25) and *palas* (Rs. 1.13). The MVP of broodlac was highest for lac cultivation on *ber* (Rs.2.45) followed by *kusum* (Rs.1.95) and *palas* (Rs.1.38). The MVP for other input was Rs.12.7 and Rs.3.9 for lac cultivation on *kusum* and *palas*, respectively.

The impact of scientific lac cultivation training in terms of host utilization, employment generation and return has been presented in Table 34.

The important findings of the study are:

i) there is a need for more investment in broodlac in lac cultivation for higher return.

ii) there is a need to adopt scientific method of lac cultivation for more income and employment generation and overcome the various constraints faced by lac growers.

iii) there is a need for developing lac producer's organization in the form of co-operative society to protect the common interest of lac growers and

iv) there is a need to increase the cultivation of *kusmi* lac than *rangeeni* lac as it is more profitable.

3.2.2 Skill development and capacity building in lac culture through training and demonstration in Gujarat (Financed by Forest Department, Govt. of Gujarat)

Human resource development

During the period under report two forest officials, Mr. M.K.Patel, ACF and Mr. Atul Amin RFO, TRC, Gandhinagar, Gujarat, were trained at the Institute under trainers training programme. Trainer's training was also imparted to 39 forest officials in two training camps at Basan and Kewadi, Gujarat during Jan.- Feb. 2006. On-farm training was imparted to two batches of 50 farmers at Banaskantha and Kewadi in the months of April and December respectively in addition to 150 farmers in Feb. 2005. Two field level demonstrations of *kusmi* lac culture on *ber* at Godhara and Basan, one on *kusum* at Kewadi and one on *Flemingia semialata* at Basan were also given.

Table 34. Impact of Scientific lac cultivation training

Particulars		*Palsas* (50 hosts)		*Ber* (50 hosts)		*Kusum* (10 hosts)	
		Un-trained	trained	un-trained	trained	un-trained	trained
Host utilization(%)		28.7	39.8	53.8	69.3	17.2	26.0
Returns (Kg.)	Sticklac	42.4	69.3	224.5	435.0	168.3	140.5
	Broodlac	97.4	152.8	9.5	45.5	55.2	237.1
Employment generation (Days)		24.8	34.2	47.2	69.5	41.2	50.0
Net return (Rs.)		4885.80	8168.9	9771.1	20913.7	16,283.7	33,128.5
Bc ratio		2.90	3.31	3.09	3.63	3.37	4.0

Potentiality trials on local hosts

Yield data of the potentiality trial conducted last year on five lac host species *viz.*, *P. juliflora*, *Acacia tortilis, A. catechu, A. nilotica* and *Zizyphus mauritiana*, at Basan, Gandhi Nagar, Gujarat by inoculating three bushes of each was obtained after harvesting during February'2005. An experiment was conducted again during August, 2005 at Thalsar, Bhavnagar, Gujarat on 18 bushes of *P. juliflora* by inoculating five months after pruning. The output-input ratio was high (21) revealing the high potential of this host.

3.2.3 Promotional initiatives for capacity building on technical training in lac cultivation (Sponsored by NABARD)

Training programmes for 200 candidates nominated by Gram Jan Jagriti Manch, Ranchi and XISS, Ranchi and sponsored by NABARD have been conducted. The 3 day programme comprised of 2 days field farm training and one day exposure-cum-interaction programme at ILRI. NABARD made available Rocking sprayers, *rangeeni* and *kusmi* broodlac for 100 farmers nominated by Gram Jan Jagriti Manch (NGO). The training programme conducted at Bandgaon with XISS support, was attended by 106 farmers from 44 villages. Four quintals of *kusmi* broodlac were made available to 100 farmers of Sogod and Kolad villages. Around 90 families were directly involved in cultivating *kusmi* lac on *ber*. Performance of *kusmi* lac on ber tree was found to be satisfactory.

3.2.4 Human Resource Development

Training Programmes related to lac cultivation of Farmers and Housewives

The institute conducted one-week and one-day training programmes with special emphasis on lac culture. One-week programmes mainly covered lac cultivation, processing at farm level and utilization of lac at village level. 755 farmers from different states participated in this programme. Summary of different programmes and state-wise figure are given in (Tables 35) and (Fig. 48) respectively. Maximum participation was from Chhattisgarh State followed by Jharkhand, Orissa, Andhra Pradesh and Maharashtra.

Training of Govt. Officials and Students

Forest Range Officers, SDOs from State Forest Departments (Madhya Pradesh and Gujarat) and students of Zila Panchayat Krishi

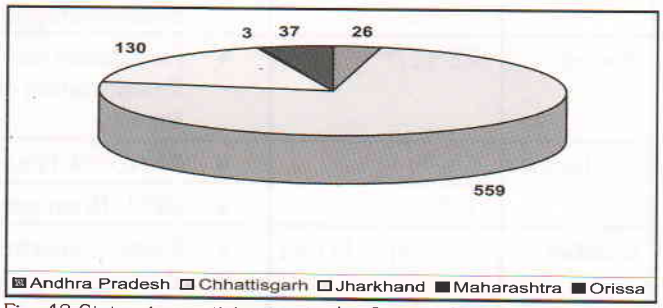


Fig. 48 State-wise participation in the One-week training programme

Table 35. One-week Training Programme on lac culture and other aspect for farmers and housewives

Month	Period	Sponsoring Organization	State	No. of participants
January	27th Dec-1st Jan. 24th-29th	State Forest Department, Dhamtari • ATMA, Chaibasa, West Sighbhum • Private Individual	Chhattisgarh Jharkhand	34 12 1
February	21st -26th	• Jharkhand Women Development Society, Ranchi • Private Individual	Jharkhand	29 1
March	7th -12th	• DFO, North Bastar, Kanker • MD, Chhattisgarh State MFP, (Trade and Development) Mahasamund	Chhattisgarh	32 25

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	14th -19th	• DFO, North Bastar, Kanker • DFO, East Bhanupratappur • Private Individual	Chhattisgarh Jharkhand	26 29 1
April	28th March - 2nd April	• DFO, North Bastar, Kanker • Private Individual	Chhattisgarh Jharkhand	28 1
	4th -9th	• DFO, North Bastar, Kanker • DFO, Bastar- Narayanpur • Private Individual	Chhattisgarh Jharkhand	30 30 1
	11th-15th	• Social Action for Rural Development (SARDA), Aamgaon, Gondia	Maharashtra	3
	25th -30th	• DFO, North Bastar, Kanker • DFO, Raipur, Udanti Garyaband	Chhattisgarh	9 30
May	2nd -7th	• DFO, North Kondagaon • DFO, Dhamtari· • Private Individual	Chhattisgarh Jharkhand	20 32 1
	16th -21st	• DFO, North Bastar, Narayanpur • TCDR- Tatisilwai, Ranchi· • ILRI-Ranchi	Chhattisgarh Jharkhand	30 13 1
	24th 28th	• DFO, Bhanupratappur • ATMA, Dumka • Private Individual	Chhattisgarh Jharkhand Jharkhand	31 16 1
June	30th -04th June	• Managing Director, DFO, North Sarguja, Ambikapur • DFO, Keshkal, Narayanpur • M D, DFO, West Bhanupratappur	Chhattisgarh	14 21 29
August	22nd-27th	• Foundation for Emancipation of Marginalised, Ranchi	Jharkhand	33
September	6th -9th	• PRADAN, Khunti, Ranchi	Jharkhand	11
	19th- 24th	• DFO, Bhanupratappur, Bastar	Chhattisgarh	49
October	26th Sept -1st Oct	• Forest Department, Dantewara, Bastar	Chhattisgarh	50
	17th -22nd	• DPIMU, Pathalgaon, Jashpur	Chhattisgarh	11
November	21st - 26th	• TRIFED, Sundergarh	Orissa	44
December	28th Nov- 3rd Dec	• Indira Kranthi, Paderu, • Vishakhapatnam	Andhra Pradesh	26
			Total	**755**

Mahavidyalaya, Banda, Uttar Pradesh, were given One- Week training in lac cultivation, processing and its uses (Table 36).

On- Farm Training

Organised 36 camps in collaboration with other organizations in Jharkhand, Chhattisgarh and Madhya Pradesh with the representation from more than 300 villages. 3,389 farmers benefited from this programme. Maximum participation was from Seoni district of M.P. followed by North Bastar, Ranchi, South Bastar, Raipur, West Singhbhum and Mahasamund and Hoshangabad. The details of training programmes conducted one given in

(Tables 37) and (Fig. 49).

Field education and Motivational Training programme

Organized 49 camps in collaboration with NGOs and GOs of different States. A total of 4,779 persons, mainly farmers were benefited from this programme. Maximum number of camps (24) were organised in Madhya Pradesh followed by Jharkhand (17), Maharashtra (4) and West Bengal (2). The details of training programme

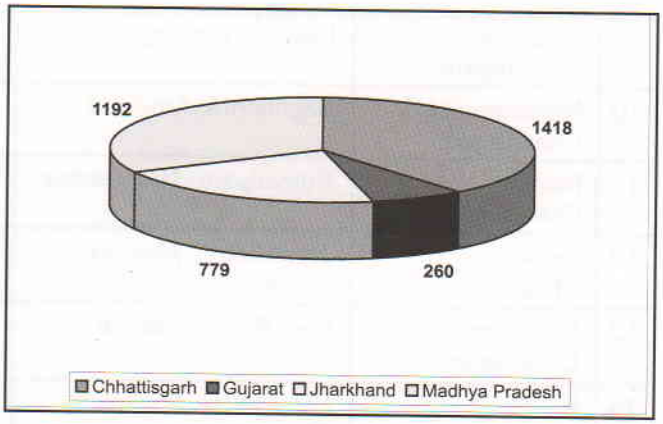

Fig. 49 State-wise participation in on-farm training programme

Table 36. Trainer's Training / Education programme

Sl. No	Month	Period	Sponsoring Organization	State	No. of participants
1	May	16th – 21st	Zila Parishad, Krishi Mahavidyalaya, Banda, UP	Uttar Pradesh	6
2		23rd to 28th	State Forest Research Institute, Poli Pathar, Jabalpur	Madhya Pradesh	3
3	June	20th to 25th	Gujarat State Forest Development Corporation	Gujarat	2
4	November	21st- 26th	Private Individual	Ranchi	1

Table 37. On-farm training Programme

Sl	District and State	Venue (Village and Block)	Sponsoring/ Nominating Agency	Date	No. of Participants
1.	Gandhinagar, Gujarat	Forest Research Centre, Godhra	Forest Department, Govt. of Gujarat	2.2.05	50
2.		Forest Research Centre, Vagai, Dang	-Do-	3.2.05	50
3.		Forest Research Centre, Basan, Gandhinagar	-Do-	5.3.05	50
4.	Vadodara, Gujarat	Kewadi, Chhotaudeypur	Gujarat State Forest Dev. Corporation Ltd	30.3.05	35
5.		Kewadi, Chhotaudeypur		31.3.05	75
6.	Ranchi, Jharkhand	Kolad, Namkum	NABARD & Gram Jan Jagriti Kendra	7.4.05 8.4.05	50 50
7.		Sogod, Namkum	-Do-	27.4.05 28.4.05	50 50
8.	West Singhbhum, Jharkhand	Church, Bandgaon	NABARD & Xavier Institute of Social Services	12.5.05 13.5.05	106 106

Cont....

9.	N. Bastar, Chhattisgarh	Keshkal, Kondagaon	Chhattisgarh State MFP (Trade & Dev.)	6.6.05 7.6.05	60 57
10.	Mahasamund, Chhattisgarh	Baghbehra, Amakoni	-Do-	6.6.05 7.6.05	56 84
11.	Bastar, Chhattisgarh	Bokhulpara, Narayanpur	-Do-	8.6.05 9.6.05	50 67
12.	Raipur, Chhattisgarh	Jhariabahra, Mainpuri, Udanti	-Do-	8.6.05 9.6.05	74 83
13.	N. Bastar, Chhattisgarh	East Bhaupratappur	-Do-	10.6.05 11.6.05	86 77
14.	Raipur, Chhattisgarh	Eco Centre, Sankra, Dhamtari	-Do-	10.6.05 11.6.05	51 31
15.	Kanker, Chhattisgarh	Sigarbhat	MD, Dist MFP (Trade & Dev.)	12.6.05 13.6.05	50 50
16.		Garpichwari	-Do-	12.6.05 13.6.05	60 45
17.		Korar	-Do-	12.6.05	90
18.		Moongbal, Korar	-Do-	13.6.05	66
19.		Selegond	-Do-	13.6.05	79
20.	Ranchi, Jharkhand	Jate, Murhu	World Vision	17.6.05	60
21.	Ranchi, Jharkhand	Kuluburu, Arki	Alternative for India Development	18.10.05	49
22.		Tingaria, Murhu	-Do-	19.10.05	50
23.		Tubil, Arki	-Do-	21.10.05	80
24.		Ulihatu, Khunti	-Do-	22.10.05	48
25.		Arki, Arki	-Do-	23.10.05	80
26.	Hoshangabad, M.P.	Panchmarhi	District Collector	15.11.05	50
27.	Bastar, Chhatisgarh	Auction Palace, South Kondagaon	DFO South Kondagaon	20.11.05 21.11.05	91 61
28.		Keskal, North Kondagaon	DFO North Kondagaon	22.11.05	50
29.	Seoni, MP	Jevnara, Barghat	Zila Panchayat, Seoni	27.11.05 28.11.05	130 136
30.		Kurai, Kurai	-Do-	27.11.05 28.11.05	50 70
31.		Janpad, Keolari	-Do-	29.11.05	116
32.		Janpad, Ghansore	-Do-	29.11.05	180
33.		Janpad , Chhapara	-Do-	30.11.05	75
34.		Janpad, Dhanora	-Do-	30.11.05	155
35.		Janpad,Seoni	-Do-	1.12.05	175
36.		Jan Panchayat, Lakhnadon	-Do-	1.12.05	55
				Total	**3,649**

conducted are given in Tables 38 and Fig. 50.

One-day Orientation programme

This programme aims at educating the existing lac farmers and suggesting remedial measures for their problems. A total of 870 farmers, students, entrepreneurs in 28 batches have received training under this programme (Table 39).

Special Training programme

A special one-month programme on 'Technology of lac insect culture and its application'

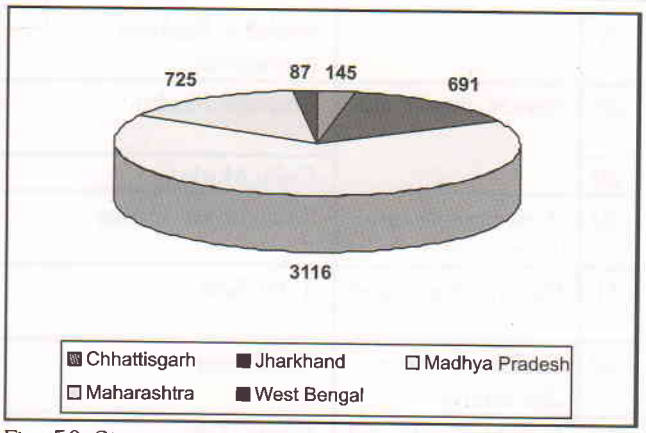

Fig. 50 State-wise participationon on-farm motivational training programme.

Table 38. Motivational training programme on scientific lac cultivation

Sl. No.	District and State	Venue (Village and Block)	Sponsoring/ Nominating Agency	Date	No. of Participants
1.	Ranchi, Jharkhand	Mangobandh, Khijri	SEED	1.1.05	45
2.		Dokad,Angara	Gram Jan Jagriti Manch	3.2.05	35
3.		Sogod		11.2.05	83
4.	Seoni, M.P.	Zila Panchayat	Zila Panchayat, Seoni	22.2.05	100
5.		Jan Panchayat, Barghat		23.2.05	45
6.		Piparia, Barghat		23.2.05	100
7.		Khami		23.2.05	63
8.		Jan Panchayat,		24.2.05	65
9.		Kanari		24.2.05	414
10.		Thanvari		24.2.05	300
11.		Jan Panchayat,Dhanora		25.2.05	56
12.		Khirkhiri, Dhanora		25.2.05	80
13.		Jan Panchayt, Ghansore		25.2.05	600
14.		Dhanpura,Ghansore		25.2.05	80
15.		Jan Panchayat,Lakhnadon		26.2.05	80
16.		Jan Panchayat ,Chhapara		26.2.05	75
17.		Chamari, Chhapara		26.2.05	34
18.		Tendini,Chhapara		26.2.05	36
19.		Mehra Piparia		27.2.05	55
20.		Chizban		27.2.05	25
21.		Partapur,Kurai		27.2.05	520
22.	Purulia, WB	Khamar,Jhalda-I		16.3.05	55
23.	Latehar, Jharkhand	Hatchery Hall	District Collector	29.3.05	116
24.	Gondia, Maharashtra	Aamgaon, Aamgaon	Central India Lac Development Society, Gondia	2.4.05	200
25.		Korhjauria, Zila School,Salekera		2.4.05	250
26.		Tiroda,Tiroda		3.4.05	75

27.		Kurhadi, Kurhadi (Goregaon)		3.4.05	200
28.	Ranchi,Jharkhand	Lowadih,Murhu	Alternative for India Development	27.4.05	43
29.		Gullu,Murhu	Nav Bharat Jagriti Kendra	16.5.05	35
30.	West Singhbhum, Jharkhand	Sabarnagar, Potka	Bharat Seva Samaj	1.6.05	40
31.	Ranchi, Jharkhand	Tubil,Arki	Alternative for India Development	12.7.05	29
32.	East Singhbhum, Jharkhand	Bandgaon	VICAS (R C Church)	30.7.05	64
33.	Ranchi, Jharkhand	Banta, Silli	A farmer	23.8.05	10
34.	Purulia, WB	Putidih,Jhalda	A farmer	23.8.05	32
35.	Ranchi, Jharkhand	Sarjamdih, Angara	KVK, RK Mission	3.9.05	25
36.		Gutidih, Angarha		3.9.05	10
37.		Namsilli		5.9.05	25
38.		Ichadih		5.9.05	20
39.		Bisaria,Silli	INDAL (Hindalco)	15.9.05	55
40.	Hazaribag, Jharkhand	Ramgarh	Agragati	18.9.05	26
41.	Seoni, M.P.	Dhobisarra, Kurai	Zila Panchayat	28.11.05	100
42.		Khirkhiri,Dhanora		30.11.05	100
43.		Zila Panchayat		2.12.05	150
44.	Chhindwara,MP	Kusumdhana, Umranala	Forest Department	3.12.05	15
45.		Chimtipur,Patalkot		4.12.05	22
46.		Sehra & Khamarpur, Patalkot		5.12.05	16
47.	Ranchi Jharkhand	Hurua, Khijri	SEED,Ranchi	15.12.05	30
48.	Raigarh,	Barra	Janmitram	23.12.05	80
49.	Chhattisgarh	Chhotegumra		24.12.05	65
				Total	**4,779**

was conducted for two students from Allahabad Agriculture Research Institute, Deemed University, Allahabad, UP.

Advisory and Consultancy services

The Institute provided information on various training programmes to be organized at the Institute to the clients. Advisory services were also provided to the farmers, NGOs and other lac related organizations for taking remedial measures with respect to pest management, harvesting of crop, forecasting of larval emergence etc. Monitoring of *kusmi* lac crop, technical guidance, remedial measures for pest attack, demonstration of spraying etc. at different locations were also carried out (Table 40).

Training on Lac Product Demonstration

Trainings were also conducted for processing of lac, preparation of gasket cement compound, *aleuritic acid*, water soluble lac and Melfolac (Table 41). Fourteen persons received training in processing of lac, preparation of aleuritic acid and gasket shellac cement compound and 20 rural women of village Chirudih were demonstrated the use of water soluble lac and Melfolac on bamboo handicrafts through an NGO Madhur Muskan.

Table 39. One-day Orientation Programme on lac culture and other aspect

Sl No.	Organization	Date	No of participants
1.	Jharkhand Women Development Society, Ranchi	22.1.05	25
2.	KVK , Divyayan, Ranchi	29.1.05	39
3.	Jharkhand Women Development Society, Ranchi	28 1.05	25
4.	AFPRO, Ranchi	3.2.05 & 4.2.05	15
5.	Gramin Vikas Trust, Ranchi	18.2.05	19
6.	CASA, Surguja, Chhattisgarh	2.3.05	32
7.	Gandhi Seva Ashram, Ambikapur	2.3.05	16
8.	NABARD, Ranchi	16.3.05	36
9.	KVK , Divyayan, Ranchi	18.3.05	36
10.	World Vision, Ranchi	15.4.05	40
11.	Institute of Forest Productivity, Ranchi	16.4.05	16
12.	KVK , Divayayan, Ranchi	29.4.05	71
13.	Gram Jan Jagriti Manch, Sogod, Ranchi	30.4.05	50
14.	Vikas Kendra, Simdega	3.5.05	55
15.	Institute of Forest Productivity, Ranchi	5.5.05	32
16.	CASA, Raipur	9.5.05	16
17.	XISS, Ranchi	14.5.05	110
18.	Institute of Forest Productivity, Ranchi	2.6.05	47
19.	KV K , Divyayan, Ranchi	10.6.05	52
20.	Tribal Welfare Department, Jharkhand	29.6.05	12
21.	Bharat Sevashram Sangh, East Singhbhum	29.6.05 & 30.6.05	27
22.	Jan Seva Parishad, Jamshedpur	30.8.05	18
23.	AFPRO, Ranchi	28.9.05 & 29.9.05	13
24.	SEED, Kharsidag, Ranchi	4.10.05	50
25.	BASIX, Ranchi	14.10.05 & 5.10.05	7
26.	Institute of Forest Productivity, Ranchi	2.12.05	12
27.	Gramin Utthan Kendra, Gumla	2.12.05	18
28.	TSRDS, Ranchi	8.12.05	13
		Total	**870**

Table 40. Other TOT Activities

Sl No.	District -State	Venue (Village-Block)	Collaborating Agency	Date	Purpose
1	Kanker-Chhattisgarh	Bayanar-Korar	Forest Department	11.6.05	*Kusmi* lac crop monitoring and technical guidance
2	Ranchi-Jharkhand	Sarjamdih, Gutiguda	R K Mission	3.9.05	Lac crop monitoring and suggested remedial measures on pest attack
3		Namsilli, Ichadih		5.9.05	-Do-
4	Ranchi-Jharkhand	Kolad		17.9.05	Demonstration on spraying
5		Sogod		18.9.05	-Do-
6	Kanker-Chhattisgarh	Kanker	Forest Department	25.9.05	Lac crop monitoring on *F.semialata*

Table 41. Lac product demonstration

Sl. No.	Subject	Sponsoring agency	Duration	Persons/ Nos.
1	Processing of Lac	Zila Panchayat Seoni	21.1.05 - 5.2.05	10 Persons
2	Preparation of Gasket Shellac Compound	Self	8.3.05 - 12.3.05	Shri Ashok Rampuria
3	Water Soluble Lac & Melfolac	Madhur Muskan, Ranchi	10.5.05	20 Women from Chirudih & Bundu, Ranchi
4	Preparation of Gasket Shellac Compound	Self	1.8.05- 4.8.05	Shri Ashok Gupta
5	Preparation of Aleuritic Acid	Self	17.10.05 - 10.11.05	Shri Mukul Budhia
6	Preparation of Gasket Shellac Compound	Self	14.11.05 - 18.11.05	Shri Suresh Kumar

3.3 Regional Field Reserch Station, Purulia (WB)

Studies on lac cultivation at farmers field in Purulia district

Aghani crop cultivation on *ber* was done on a trial basis, in collaboration with KVK, Jahajpur which supplied the inputs for the trial. The farmers were given on-farm training by ILRI on improved lac cultivation techniques. Seventeen trees were used under this trial, out of which 11 trees were pruned in February; six trees that were pruned in May were also used for comparison, Pest control schedule (spraying of endosulfan 0.05% carbendazim 0.01%, 25 dyas after inoculation) was adopted for crop raised on four trees pruned in May. Pruning response, fruit yield, lac crop yield were recorded. The results obtained have been given below:

Pruning response and fruit yield in relation to lac inoculation

The study included three variables : Time of pruning (Feb./May), ii) Lac crop inoculation (inoculated/uninoculated) and iii) Branches with and without encrustation. Fifteen pruned branches from each of these six categories were taken at random and observations were recorded one month before harvesting.

Ber fruit production was less, 60 and 78.5%, in inoculated trees pruned in Feb. and May, respectively. In an inoculated tree branches without lac encrustation also showed reduction in fruit yield. Thus, the stress due to lac crop load on the tree reflected even on the branches without lac. The effect is more prominent in May pruned trees. Similar results were found in case of length of primary branches also (Table 42).

Impact of pruning time and pesticide spraying on lac yield

The yield ratio (scraped lac output/broodlac input) was high with Feb. pruning compared to May pruning (156%). Spraying of insecticide resulted in 19% higher sticklac yield from trees pruned in Feb. (Fig. 51).

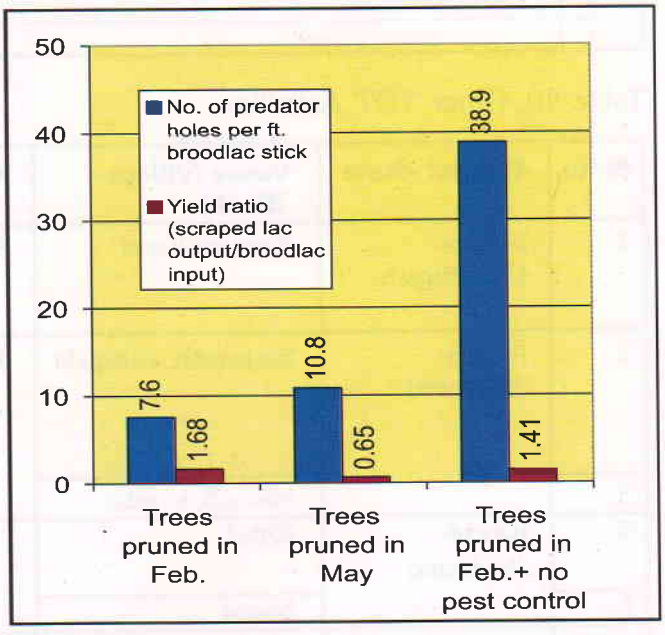

Fig.51 Relationship between the time of pruning and pest control measure on the predator emergence and crop yield ratio on *ber*, in farmers field.

Table 42. Fruit yield and tree growth attributes as affected by lac inoculation on *ber* trees

Parameter	No. of fruits /branch	length of branch	Length of encrustation	Branch dia.(cm)	No. of sec. branches
Feb. pruned,uninoculated	55.1	309.3	0	3.6	17.9
Feb. pruned, inoculated, both tree and branch	22	142.3	142.3	2.6	12
Feb. pruned, tree inoculated but branch with no lac	45.3	264.3	0	2.9	15.1
May pruned, inoculated	50.7	294.7	0	3.5	16.9
May pruned, inoculated, both tree and branch	10.9	103	103	2.4	11.1
May pruned, tree inoculated but branch with no lac	37.7	227	0	2.8	15.5
CD(.05%)	11.6*	27.6*	16.5*	0.5*	2.69*

The following Trainings/demonstrations and awareness programmes were organized in Purulia district by the station.

Date	Topic	Village	No. of participants	Sponsored by
21.6.05	Scientific methods of lac cultivation	Shimla, Dhabara	40	Dist. Purulia Dev. Cell, Purulia
29.6.05	*Kusmi* lac cultivation on *ber*	Gosaindih	19	KVK, Jahajpur
2.8.05	Tranining and demonstaton for *aghani* lac cultivation on *ber*	Gumerdih and Gosaindih	26	-D0-
6.8.05	Demonstration on spraying on lac crop on *ber*	Bamni, Ajodhya Hills	9	R.K. Mission, Narendrapur
30.12.05	Scientific approaches for lac cultivation	Joypur forest range office, Joypur	50	Forest Range Office, Joypur

Awareness lectures on importance of lac/lac cultivation

Date	Place
2.7.05	LAMPS, Chirudih and Bandwan, Purulia
20.7.05	Tribal Development Corporation Office, Purulia
16.12.05	NVK, Jahajpur on its scientific advisory meeting

4. APPROVED ONGOING RESEARCH PROJECTS

(NAME OF PI IS GIVEN WITHIN PARENTHESIS)

Productivity and Quality Improvement

- Collection, maintenance, conservation and evaluation of lac insects and host plants (Dr. P. Kumar)
- Improvement in lac host plant propagation techniques (Shri S.C. Srivastava)
- Selection of *Flemingia semialata* for summer sustainability of *kusmi* lac crop (Dr. P. Kumar)
- Identification and characterization of *kusum* and *galwang* genotypes for high productivity of lac. (Shri Y.D. Mishra)
- Screening of *kusmi* lac insect germplasm on *Ziziphus mauritiana* (*ber*) and *Flemingia semialata* for improved productivity. (Dr. K.K. Sharma)
- Characterisation and documentation of major lac host plants and the Indian lac insect (Shri S.C. Srivastava)
- Biological, chemical and molecular characterization of lac insect-host plant relationship (DBT Project) (Dr. K.K. Sharma)
- Application of molecular fingerprinting for genetic characterization of races and species of lac insect (DBT Project) (Shri R. Ramani)

Production Improvement and Crop Management

- Effect of nitrogen on growth and yield of *palas* (Shri G. Singh)
- Management of *Flemingia semialata* for sustainable lac production under different crop geometry and irrigation (Dr. S.K. Yadav)
- Integration of *Flemingia semialata* with horticultural crops for sustainable lac production under irrigated conditions (Dr. B.P. Singh)
- Delineation of promising lac growing areas and their soils for macro and micronutrients deficiency / sufficiency (Shri G. Singh)
- Studies on *in-situ* moisture conservation technique for raising mixed plantation of *ber* and *kusum* (Shri R.K. Singh)
- Production of quality broodlac on *kusum* and *palas* at different agro-climatic region (Revolving Fund Scheme) (Shri Y.D. Mishra)
- Evaluation of bio-control agents and bio-rational approaches for management of lac insect predators (DBT Project) (Dr. A. Bhattacharya)

Processing and Value Addition

- Studies on qualitative changes in lac with storage (Dr. D.N. Goswami)
- Comparative study on the physico-chemical properties of lac from various lac producing countries (Dr. S. Srivastava)
- Enhancing keeping quality of bleached Lac (Shri R. Singh)
- Establishment of commercially viable pilot plant for preparing pure / food grade lac dye (Dr. K.M. Prasad)
- Development of water-soluble lac in powder form / flakes, based on borax. (Shri P.M. Patil)

Product Development and Use Diversification

- Water-thinned shellac – synthetic resin/ polymer blends for cementitious surfaces (Shri M.F. Ansari)

- Use of sticklac in development of composite board from *arhar* stick for panel /furniture (Dr. K.P. Sao)
- Development of lac-based coating formulations for extending shelf life of fruits and perishable food products (Dr. P.C. Sarkar)
- Field Evaluation of PGR and insect attractant / repellants derived from aleuritic acid. (Dr. R.N. Majee)
- Development of lac-based nail polish. (Dr. R.N. Majee)
- Use of lac and modified lac in the manufacture of jute re-inforced sheets for structural and other purposes. (Dr. D.N. Goswami)
- Integrated pest management (IPM) at village level for cost-effective, quality production of cotton (Technology Mission on Cotton). (Dr. N. Prasad, CCPI)

Technology Assessment, Refinement and Dissemination

- Improvements in process and equipments for processing quality seedlac at village level (Dr. En. N. Prasad)
- Database on lac - basic information and technologies available (Shri R. Ramani)
- Eco-friendly disposal of lac effluents and their possible utilisation (Dr.K.M. Prasad)
- Study of lac marketing in India (AP Cess Fund) (Shri R. Ramani)
- Adoption of lac growers of Jharkhand for model upliftment through scientific lac cultivation. (Jharkhand Govt. project) (Shri R. Ramani)
- Lac as a source of livelihood; technology intervention for sustained production in Khunti Sub-Division (Dr. K.K. Sharma)

HRD for Capacity Building in Lac Production, Processing and Value Addition

- Training, demonstration, extension education and information service on lac culture,processing and product development (Dr. A.K. Jaiswal)
- Economics of lac cultivation in Jharkhand (Dr. G. Pal)
- Skill development and capacity building in lac cultivation at Gujarat (Gujarat Govt.) (Dr. P. Kumar)
- Promotional initiatives for capacity building on technical training in lac cultivation (NABARD) (Dr. A.K.Jaiswal)

5. PUBLICATIONS

Research Papers

- Bhattacharya, A., Jaiswal A.K., Kumar S. and Kumar M. 2005. Evaluation of cartap hydrochoride as a substitute of endosulfan for management of *Eublemma amabilis* Moore - a serious lepidopteran predator of lac insect. *J. Appl. Zool. Res.* **16** (1):93-94
- Ghosal S, Sharma KK and Kumar P. 2005. Effect of seedling size and irrigation on plant survival in *Flemingia semialata* - an important bushy lac host plant. *J. Applied Zoological Research,* **16** (2) : 236-237.
- Sarkar, P.C., Prasad, N. and Nandy, Sonia.2005. A novel synthesis of Z-(9) hexadecenal in improved yields, from aleuritic acid. *J. Indian Chem. Soc.*, Vol.**82**, May, pp. 475-478
- Sharma KK, Kumari Kavita and Kumar Manoj. 2005. Analysis of factors responsible for low yield of lac in India. *J. Applied Zoological Research,* **16** (1) : 95-96
- Yadav, S.K, Singh, B.P., Mishra, Y.D. and Kumar, P. 2005. Estimation of phyllode area of *Acacia auriculaeformis* A. Cunn Ex. Benth by regression analysis. *Indian J. Forestry*, **28** (1):69-70.

Papers presented in Seminars/Symposia

- Ansari, M. F. Goswami, D.N. and Prasad. N. 2005. Uses of shellac in surface coating. In : National Seminar on "Chemistry and Applications of Lac" on November 25, 2005, at ILRI, Ranchi.
- Bhattacharya A., Jaiswal A.K., and Kumar S. 2005.Evaluation of *Trichogramma* spp. for the management of lepidopteran lac insect predator *Eublemma amabilis* Moore (Noctuidae) in lac culture raised on *Flemingia macrophylla* O.Ktze, a bushy lac host plant in *National Symposium on Advances in Indian Entomology : Productivity & Health*. October 2-4, 2005, Haridwar.
- Bhattacharya A., Jaiswal A.K., Kumar S. and Kumar M. 2005. Evaluation of cartap hydrochoride as a substitute of endosulfan for management of *Eublemma amabilis* Moore - a serious lepidopteran predator of lac insect in *7th AZRA Conference*, February 14-16, 2005, Bhubaneshwar.
- Bhattacharya A., Kumar S, Srivastava S. and Jaiswal A.K. 2005, Repellent effect of different essential oils of grasses on the population of lepidopteran lac insect predators *Eublemma amabilis* Moore and *Pseudohypatopa pulverea* Meyr. In : *Proceedings of 1st Congress of Insect Science,* December 15-17, 2005, PAU, Ludhiana; pp 130-131.
- Chakravarty P.K., Mishra Y.D., Kumar S. and Bhattacharya A. 2005. Biology of trivoltine lac insect *Kerria sharda* Mishra & Sushil (Homoptera: Tachardiidae) on *Flemingia* spp. In: *Proceedings of National Symposium on Advances in Indian Entomology : Productivity & Health*. October 2-4, 2005, Haridwar. Abstact No. 82, p. 66
- Goswami, D.N. 2005. Protective coating varnishes based on shellac. In : National Seminar on "Chemistry and Applications of Lac" on November 25, 2005, at ILRI, Ranchi.2
- Jaiswal A.K. and A. Bhattacharya A. 2005. Recent advances in the management of lac insect pests. In : *Proceedings of the 7th AZRA Conference*, February 14-16, 2005, Bhubaneshwar. Abstract No. 121, p. 80.
- Jaiswal A.K. and Bhattacharya A. 2005. Pest management in lac culture through traditional approaches. In: *Proceedings of National Symposium on Advances in Indian Entomology : Productivity & Health*. October 2-4, 2005, Haridwar. Abstract No. 49, p. 46.

- Jaiswal A.K., Bhattacharya A. and Kumar S. 2005. Evaluation of *Bacillus thuringiensis* var. *kurstaki* (Berliner) for management of lepidopteran pests of lac insect In : *Proceedings of 1st Congress of Insect Science*, December 15-16, 2005, PAU, Ludhiana, p. 131-132.
- Kumar S., Sharma A.K., Kumari K. and Bhattacharya A. 2005. Incidence of lac associated ant fauna in some selected localities of Ranchi district. In: *Proceedings of National Symposium on Advances in Indian Entomology : Productivity & Health*. October 2-4, 2005, Haridwar. Abstract No. 54, p. 49.
- Majee R.N., Bhattacharya A. Jaiswal A.K and Prakash A. 2005. Mosquito repellent from Aleuritic acid. In: *Proceedings of National Seminar on Chemistry & Applications of lac*, November 25, 2005, ILRI, Ranchi (Abstract) p. 15
- Majee R.N., Bhattacharya A., Srivastava S.C. and Das B. 2005. Syntheses and performance evaluation of 10-carboxymethyl-2-decenoic acid and methyl 9-methyl sulphonyloxy-2-nonenoate. In: *Proceedings of National Seminar on Chemistry & Applications of lac,* November 25, 2005, ILRI, Ranchi (Abstract) p. 16
- Mishra Y.D., Chakravarty P.K., Sushil S.N. and Bhattacharya A. 2005 Effect of host plant interaction on sex determination of the Genus *Kerria* Targoini-Tozzeti (Homoptera: Tachardiidae.In: *Proceedings of National Symposium on Advances in Indian Entomology : Productivity & Health*. October 2-4, 2005, Haridwar. Abs. No. 94, p. 74
- Pal, G. and Bhagat, M.L.2005. Socio-economic Status of Lac Growers in Ranchi District of Jharkhand. In :*7th Agricultural Science Congress*, February 16-18, 2005 at MPKV, College of Agriculture, Pune - 411005.
- Pal, G. and Bhagat, M.L. 2005. Economic Analysis of Lac Cultivation by Trained and Untrained Lac Growers in Ranchi District of Jharkhand. In :*7th Agricultural Science Congress,* February16-18, 2005 at MPKV, College of Agriculture, Pune - 411005.
- Prasad, K.M. and Prasad , M. 2005. Isolation of lac dye and lac wax from lac factory effluents In:*National Seminar on Chemistry & Applications of lac*, organized by Indian Lac Research Institute, Ranchi, 25th Nov., 2005.
- Prasad K.M. and Prasad, M. 2005 Upgradation in processing technology of sticklac. *In:National Seminar on Chemistry & Applications of lac*, organized by Indian Lac Research Institute, Ranchi, 25th Nov., 2005.
- Prasad, N. 2005. An Up-to date picture of chemistry of lac resin. In : National Seminar on "Chemistry and Applications of Lac" on November 25, 2005, at ILRI, Ranchi.
- Prasad, N. 2005. Mechanization of lac cultivation – A challenge. *Agricultural Engineering* Today Vol. **29** (3-4), pp. 18-23
- Prasad, N., Kumar, K.K., Pandey, S.K. and Bhagat, M.L. 2005. Development of modified power operated lac scraper. *Journal of Agricultural Engineering (ISAE)* Vol. **42** No. 2
- Sao, K. P. and Pandey, S. K. 2005. Formaldehyde free composite board-A promising route to diversify the use of raw lac/stcklac. In: National Seminar on "Chemistry and Applications of Lac" on November 25, 2005, at ILRI, Ranchi.
- Sarkar, P. C. 2005. Modern drug development and lac. In : National Seminar on "Chemistry and Applications of Lac" on November 25, 2005, at ILRI, Ranchi.
- Sharma, K. K., Kumari Kavita and Kumar Manoj. 2005. Yield gap and potential study in Indian lac insect, *Kerria lacca* (Kerr) and analysis of factors responsible for low yield of lac. In : 7th AZRA Conference of

Recent Trends in Applied Zoological Researches Towards Food and Nutritional Security and Their Impact on Environment : Challenges a head at OUA & T Bhubaneshwar, Orissa on February 14-16, 2005. Abstract No. 130 at pp. 85-86

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- Srivastava S., Saha D.Yadav S.K.S. and Majee R. N., 2005. Lac resin as a potential source of plant growth regulators. In : National Seminar on "Chemistry and Applications of Lac" on November 25, 2005, at ILRI, Ranchi.
- Yadav, S.K., Baboo, B. and Singh, R.K. 2005. Studies on feasibility of micro-irrigation in lac production. In: *National Conference on Micro-irrigation* held at G.B. Pant University of Agriculture and Technology, Pantnagar from 3-5th June 2005, p. 48

Book Chapters/Technical Bulletins

- Krishan Sharma K and Ramani R 2004. Variations in Productivity linked parameters of lac insects of *Kerria* spp. *(Tachardiidae: Homoptera)* : Opportunities and Challenges. Pp 159-166. *In.* Pandey BN, Natrajan P, Arumugam N and Premjith S (Eds.) *New Horizon of Animal Sciences.* Zoological Society of India, Magadh University, Bodh Gaya, Bihar. 794 Pp.
- Yadav S.K., Mishra Y.D., Singh B.P. Kumar P. & Singh R.K. 2005. *Kusmi* lac production on *Flemingia semialata*; Tech. Bull.No.**5**, ILRI, Ranchi

Popular Articles

- Ramani, R., Pal, G. and Bhattacharya, A. 2005. *Lah Ki Kheti Sabhayata Ka Pratik*. In: *Jharkhand Badhate Kadam*, No. **8**, September 2005.
- Ramani, R., Pal, G. and Bhattacharya, A. 2005. Scope of lac cultivation and lac-based enterprises for the development of Jharkhand. In :*Jharkhand on the fast track*. No. **3**, Sept, 2005:40-44
- Sharma Kewal Krishan. 2006. 'Lakh ki kheti ka vaigyanik prabandhan' *Prabhat Khabar*, March 20 : p. 12
- Singh, R.K. & Mishra Y.D. 2006. 'Lac – A boon to rural economy' *Intensive Agriculture* (Jan- Feb, 2006).
- Lac cultivation in rainy season" (in Bengali) is Darpan, Purulia July 07,2005.

Publicity Through Mass Media

Following talks were delivered on Radio / TV Ranchi during the period under report:

- *Kusmi lakh ka vaigyanik vidhi se utpadan* by AIR, Ranchi on 14.1.2005 by Dr KK Sharma, Sr. Sc., LP Division
- *Lakh keet palan mein dhyhan dene wali batein* by AIR, Ranchi on 23.7.2005 by Dr KK Sharma, Sr. Sc., LP Division
- Short story on lac produced by TARA News with the help of RFRS, Purulia was telecast on 30.10.05.

Institute Publications

- ILRI at a glance, 6pp. in Hindi.
- ILRI Annual Report 2004-2005, 100pp.; in English and Hindi.
- ILRI-Tech. Bull. No. 5 - *Kusmi* lac production on *Flemingia semialata*, 16 pp; in English.
- ILRI-Lac Newsletter, issues : 9 (1), 9(2), 9(3), and 9(4), 8 pp. each.

6. PARTICIPATION OF SCIENTISTS IN SEMINARS, SYMPOSIA, WORKSHOPS, TRAININGS ETC.

Participation of scientists in:

(i) Seminars/Symposia etc.

1. Dr. A. Bhattacharya, PS & Head, TOT participated in 7th Azra Conference on "Recent Trends in Applied Zoological Researches towards food and Nutrition Security and Their Impact on Environment: Challenges Ahead" at OUAT, Bhubaneshwar during 14-16 February, 2005.
2. Dr. A. Bhattacharya, PS & Head, TOT attended the 7th National Symposium on Indian Entomology: Productivity and Health organized by UP Zoological Society, Haridwar, on 2-4th Oct, 2005.
3. Dr. A. Bhattacharya, PS & Head, TOT attended the 1st Congress on Insect Science organized by Indian Society for Advancement of Insect Science, at PAU, Ludhiana on 15-17, Dec. 2005.
4. Dr. A.K. Jaiswal, Sr. Sc. participated in Export awareness seminar on minor forest product at Raipur, Chhattisgarh on 24th Sept., 2005.
5. Dr. A.K. Jaiswal, Sr. Sc. participated in 1st Congress on Insect Science organized by Indian Society for Advancement of Insect Science at PAU, Ludhiana on 15-17, Dec. 2005.
6. Dr. G. Pal, Sc. attended Water resource conservation and conjunctive utilization for environmental restoration in tribal area of Patratu Block, Hazaribag district. (Jharkhand state) at Ramgarh, Hazaribagh, on 2nd June, 2005).
7. Dr. G. Pal, Sc. attended Export awareness seminar on minor forest product at Raipur, Chhattisgarh on 24th Sept., 2005.
8. Dr. K. K. Sharma, Sr. Sc., LP Division participated in 7th AZRA Conference on Recent Trends in Applied Zoological Research towards Food and Nutritional Security and their Impact on Environment: Challenges Ahead on 14-16 Feb., 2005 at OUA & T, Bhubaneshwar, Orissa.
9. Dr. K. K. Sharma, Sr. Sc., LP Division participated in Ist Congress on Insect Science on 15-17 December, 2005 at PAU, Ludhiana.
10. Dr. N. Prasad, Sc. (SS) participated in 39th Annual convention, Symposium of ISAE - "Engineering technologies for efficient water management in agriculture" at ANGRAU, Hyderabad, on 9-11 March, 2005.
11. Dr. N. Prasad, Sc. (SS) participated in 12th Vasant Rao Naik Memorial National Agriculture Seminar in "Value addition to Agro-Horti-Medical produce and its marketing at College of Agriculture, Nagpur on17-19 October, 2005.
12. Yadav, S.K. participated in National conference on 'Micro-irrigation 2005' at Govind Ballabh Pant University of Agriculture & Technology 3-5 June, 2005.

(ii) In Summer Schools, Training Programmes etc.

1. Dr. A. Bhhatacharya, PS & Head, TOT attended a training programme on Networking Essential during 3-11th Aug, 2005 at NAARM, Hyderabad.
2. Dr. A.K. Jaiswal, Sr. Sci attended a programme on Training Skills for Master Trainers during 25-29th July, 2005 at MANAGE, Hyderabad.
3. Sri D. Ganguly, T.O. attended a training programme on Networking Essential during 3-11th Aug, 2005 at NAARM, Hyderabad.
4. Dr. G. Pal, Sci. attended a programme on Training Skills for Master Trainers during 25-29th July, 2005 at MANAGE, Hyderabad.

5. Dr. K. K. Sharma, Sr. Sc, LP Division participated in 'Direct Trainer Skills' at Sri Krishna Institute of Public Administration, Ranchi from 1st to 5th August 2005.
6. Dr. K. K. Sharma, Sr. Sc, LP Division participated in training on, 'Strategies for Stress Management' at National Academy of Agricultural Research Management from 15th to 25th November, 2005.
7. Sri L.C.N. Shahdeo, T.O. attended a training programme on Digital Imaging during 5-14th Sept., 2005 at CIFE, Mumbai.
8. Sh. R.K.Singh attended a training programme on 'Blending of modern and traditional technologies for watershed management' at WTCER, Bhubaneswar from Sept 5-10, 2005
9. Sh. R.K.Singh attended a short course training programme on 'Watershed planning and project formulation' at DVC, Hazaribag during Dec 12-17, 2005
10. Sri R.P. Srivastava, T-4 attended a training programme on Digital Imaging during 5-14th Sept., 2005 at CIFE, Mumbai.
11. Dr. S.K. Yadav attended a Summer School on Soil, water and nutrient management for different crops under rainfed Agro-ecosystem at Birsa Agricultural University, Kanke, Ranchi from 23rd August to 12th September 2005.

7. EVENTS ORGANIZED

Events / Important meetings organized and their recommendations

Brainstorming Session on Strategies for Improving Lac Production

A brainstorming session on "Strategies for improving lac production" was organized as a part of the 82nd foundation day of the Institute. Fifty-three participants from State Govt. State Forest Dept., lac related organizations like SEPC & JASCOLAMPF, lac industry, NGOs, financial institutions and the scientists of the Institute as well as sister Institutes took active part in the session.

Notable participants included Special Secretary, Jharkhand Welfare Dept., Chief General Manager, NABARD and Shri R.L. Sharma, lac industrialist. The participants were also provided with response sheet for giving their suggestions, which were also used while formulating the recommendations. The session was chaired by Dr. Bangali Baboo, Director, ILRI. The discussions were held under five major points related to lac production which were co-ordinated by Dr. A. Bhattacharya, Dr. KK Sharma, Dr. R Ramani, Dr DN Goswami and Dr PC Sarkar.

The following five well-structured and direct questions were posed to the participants to enable focussed approach for achieving the objective:

i) What could be, in your view, the possible reasons for this scenario and how can we increase the production ?

ii) What steps should be taken to a) improve the quality of the lac produced and b) to increase the production of good quality lac ?

iii) Should we introduce some alternate system of marketing or are there any means to improve the existing system ?

iv) What are the various ways which can help increase the domestic consumption of lac ?

v) Though, there are several applications of lac, do you think there are other areas where lac can be introduced ? Which are those areas where usage of lac should be pushed more vigorously?

Some useful recommendations / points have emerged out of the deliberations held which will prove to be of immense help in formulating the future programme on lac. The brainstorming session was convened by Dr KK Sharma and Dr R Ramani.

National Seminar on Chemistry and Application of Lac

A national seminar on " Chemistry and Application of Lac" was organized by LP & PD Division in the Institute on 25th November 2005.

The thematic areas of seminar were (i) Chemistry of lac and its constituents (ii) processing of lac (iii) Lac in surface coatings and food technology (iv) Lac in cosmeceuticals (v) Novel application of lac and (vi) Quality and standardization of lac/lac products.

The seminar was inaugurated by Sri Wilfred Lakra, Managing Director, TRIFED, Govt. of India and attended by altogether 60 delegates including 30 scientists from the Institute. Ranchi University, Ranchi. Lac industries and Govt. organizations.

Three technical sessions were held for the presentation of 13 research papers covering almost all the thematic areas of the seminar by different speakers.

The major recommendations of the seminar was that keeping in view the present status of lac specially liking of the people for natural products, more sincere efforts need to be made for the development of value added products from lac, its by-products and constituent acids for the application in the areas like medicine, cosmetics, pharmaceuticals, food and agriculture.

Bureau of Indian Standards Audit Team Visits ILRI

The audit team from Bureau of Indian Standards, Kolkata visited the Institute on 11th and 12th May, 2005 to audit the application from the Institute for BIS/ISO: 9001-2000 accreditation of Quality Evaluation Laboratory. The committee in its report has recommended the proposal.

In-house Seminars / Invited Talks Convened

- 'Semio-chemical interaction in insects' by Dr. AVN Paul, PS and National Fellow, Entomology Division, IARI, New Delhi on January 12, 2005.
- 'Efficiency factors of beneficial insect parasites' by Shri ML Bhagat, Sc. (SG) on March 5, 2005.
- 'Characterization of major lac host plants and Indian lac insect' by Shri SC Srivastava, Sr. Sc. on April 9, 2005.
- 'To evolve lac based agro forestry system for maximizing land productivity' by Dr. BP Singh, Pr. Sc. on April 23, 2005.
- 'Studies on *in-situ* moisture conservation for raising mixed plantation of *ber* and *kusum*' by Shri RK Singh, Sc. on April 23, 2005.
- 'Science Citation Index – an introduction' by Dr SK Yadav, Sc. (SS) on May 7, 2005.
- 'Bio-Polymers and resins – an exposition' by Dr PC Sarkar, Sr. Sc. on June 4, 2005.
- 'Status paper on Food applications of lac dye' by Dr. N Prasad, PS and Head LPPD Division on June 16, 2005.
- 'Mapping of lac producing and potential areas of West Bengal' by Dr S Ghosal, Sc. (SS) on August 12, 2005.
- 'Water thinned shellac / synthetic polymer blends for cementitious surfaces' by Shri MF Ansari, Sc. on October 7, 2005.
- 'Economics of lac cultivation in Jharkhand' by Shri Govind Pal, Sc. on December 12, 2005.

8. MEETINGS OF IMPORTANT COMMITTEES

XI Meeting of Research Advisory Committee

The Meeting was held on 21st and 22nd March, 2005 at ILRI, Ranchi. The following members were present :

1. Dr. N. S. L. Srivastava, Joint Director, Sardar Patel Renewable Energy Research Institute (SPRERI) Vallabh Vidya Nagar, Guiarat. (Chairman)
2. Dr. Bangali Baboo Director, ILRI, Ranchi (Member)
3. Shri Jivendra Kumar Managing Director, JHASCOLAMPF, Ranchi (Member)
4. Sh. R.L. Sharma Industrialist, Ms. Tajna River Industries, Khunti, Dist. Ranchi (Member)
5. Dr. A. Bhattacharya, Pr. Sc. ILRI, Ranchi (Member-Secretary)

Invitee Members

1. Dr. P. Kumar, Head, LPD., ILRI, Ranchi
2. Dr. N. Prasad, Head, LPPD ILRI, Ranchi
3. Dr. R. Ramani, Head, TOT ILRI, Ranchi

HODs presented the mandate, progress of research core programme-wise, staff, infra-structure development, initiatives, HRD etc. in respect of each Division.

Some valuable suggestions were given by the Chairman and members of RAC on the presentation and are listed below:

- For increasing lac production good quality broodlac is needed by the farmers in large quantities. Multiplication of lac insects through non-conventional approaches should also be looked in.
- Lac cultivation should not be considered only as a poor tribal man's crop/ activity. The technology should be developed and so demonstrated that it is taken as a commercial crop.
- *Flemingia semialata* appears to have good future for cultivation as host for lac insect Tissue culture work on this plant should be initiated for mass multiplication.
- Transfer of cultivation technologies to the farmers by adopting farmers' participatory research, involving NGOs, SAUs etc. should be taken up.
- Linkages should be strengthened with other States and particularly in NEH region for increasing lac production.
- ILRI should demonstrate, at least in 4-5 ha of land, raising of plantation of *F. semialata* in the adopted villages to demonstrate. the technology developed at the Institute. Initially, it may be started in one or two villages with proper fencing irrigation etc.
- Greater emphasis be given for transfer of the technologies in respect of products from the laboratory to field and to outside agencies/entrepreneurs.
- One or two Business Meets with the industries and entrepreneurs may be organized every year on 2-3 products developed by the Institute for commercialization of technologies and signing MoUs with the industries.
- Contact big and multi national companies for commercialization of the eco-friendly and organic materials like growth regulators, nail polish, sex attractants etc., developed by the Institute.
- Greater stress need to be given for patenting and commercialization of products & processes already developed by the Institute.
- Extensive field trials for testing and evaluation of the bio-active compounds by establishing linkages with Coordinated Projects on PGRs (if any) for evaluation of the PGRs synthesized from aleuritic acid.
- The Chairman stressed on the need of giving greater attention and focus to extension activities. The Institute should telecast programme on the 24 hour "Krishi Channel" of Doordarshan. About two to three write ups and a documentary should be prepared for the channel for mass publicity regarding lac production and utilization.

- Publicity of the equipments/implements developed and distributed by ILRI be made. A success story can be prepared regarding equipment developed and a set of literature of the equipment developed by ILRI may be sent to ICAR, HQs for display.
- Broodlac placement tool may be distributed to 10-20 farmers, free of cost, for multi location trials and for getting feed back from them about the usefulness of the equipment.
- Effort made to prepare data base on lac production, processing and utilization was appreciated. It was suggested that the institute should have close linkage with IASRI New Delhi. Updating of information should be carried out in association with State departments.

Recommendations

Based on suggestions and discussions, following recommendations emerged on priority areas:

1. RAC observed that good work is being done in the Institute in developing technologies on production and processing and a number of promising products like aleuritic acid, lacquer, varnishes etc have been developed, their potential need to be verified and technology commercialized in a time bound manner.
2. One of the limitations in lac production is that all major host plants like *palas*, *ber*. and *kusum*, take a long time to grow and can be exploited for lac cultivation after a certain period of time. *Flemingia semialata* is a promising bushy host plant and can be raised within a short period, for lac production. The data generated at the Institute on the cost economics of growing this host is very encouraging. It was suggested that growing of this host plant and raising of lac insect on such plants be demonstrated in at least 1 0 farmer's field. This work should be started during 2005-06.
3. Availability of good quality brood lac is one of the major limitations for farmers, broodlac production should be multiplied on large scale at the Institute Research Farm. Training programme should be organised for entrepreneurs and NGOs and they should be encouraged to go for broodlac production on large scale. This will help in easy availability of good quality broodlac to farmers.
4. Tissue culture of *F. semialata* should be tried for quick and mass multiplication of the busy host plant.
5. Institute has developed a number of value added products like aleuritic acid, lac dye, insulating varnish, spirit based and spiritless varnishes, insect sex pheromone, multipurpose varnish etc. Patents should be taken on these products, confirmatory trials in the field be conducted and product be commercialized. This will help in resource generation for the Institute.
6. Revised Vision 2020 document was presented. RAC members gave some valuable suggestions which have been incorporated. Issues related to R&D, lac production, processing and product development have been well identified. Specific R&D projects and strategy should be worked out to fill up the gaps identified.
7. Institute should develop close linkage with industries for commercialization of its technologies. ILRI should also have close linkage with State Govt, SEPC, JHASCOLAMPF and other similar organizations.
8. Institute should prepare 2 or 3 video films on the technologies developed for telecast by the Krishi Channel of Doordarshan for creating awareness in lac production and its products.
9. Institute has developed a number of good agricultural equipment like tree pruner, Broodlac placement tool, scraping machine etc. These should be evaluated in farmers' field for their usefulness and feed back information. Institute should make efforts to distribute the implements to at least 10-20 farmers for multi location trials. This should be followed by front-line demonstrations on a larger scale.

10. Lac cultivation be popularized as a plantation crop with scientific management.
11. Project profile for processing seedlac be developed and this activity of primary processing be demonstrated as a small scale industry.
12. Different State Govts. have different policies about the trading & movement of forest produce, these may be studied and a meeting of concerned State Officers be organized on uniform policy which may be suggested to the Govt. for consideration.
13. For exchange of knowledge, visit of Scientists to other lac growing countries should be encouraged.
14. ILRI may consider closing down of RFRS, Purulia Center, in view of the shortage of manpower, and start collaborative R&D programme with the concerned SAU of the region.

38th Meeting of Institute Management Committee.

The meeting was held on 19th March, 2005 at ILRI, Ranchi. The following members were present:

1. Dr. Bangali Baboo, Director, ILRI - Chairman
2. Dr. A. Dey, Pr. Scientist & Head, NIRJAFT, Kolkata - Member
3. Dr. S. Kumar, P.S. & Head, HARP, Ranchi - Member
4. Dr. J.B. Tomar, P.S. & Head, NBPGR, Ranchi - Member
5. Dr. P. Kumar, Head, LPD, ILRI - Invitee
6. Dr. N. Prasad, Head, LPPD, ILRI - Invitee
7. Dr. R. Ramani, I/c.Head, TOT, ILRI - Invitee
8. Shri. Devesh Nigam, FAO, ILRI - Invitee
9. Sh. Ashok Mailick, A.O., ILRI - Member-Secretary

The Chairman welcomed all the members in the first meeting of newly constituted IMC. He presented in brief the progress report for the last year. The Chairman also requested the Members to extend their valuable guidance and suggestions for better planning /implementation of research programmes as well as management. He informed that during last year the Institute could utilize about 97% of its budget & this is a great achievement.

The Director informed the house that two scientists namely Dr. K.K. Sharma, Sr. Scientist and Dr. N. Prasad, Sc. (SS) received awards besides he, himself was awarded with Fellowship of ISAE, at Hyderabad this month. About 16 quintals of brood lac production under Revolving Fund Scheme is another achievement of the Institute. He further informed that three meetings were organized by the Institute for lac developmnent:-

1. Group meeting of lac -related organizations to identify researchable issues (Aug. 24, 2004)
2. National Symposium on "Advantages of natural resin of lac"(July 2-3, 2004)
3. National symposium on 11 Lac Industry - Convergence for Resurgence" (Sept 20-21, 2004)

After that, all Heads of Divisions presented the progress of research and infrastructures of their divisions.

Remarks by the Members

- All the members expressed appreciation and satisfaction on all round development and pogress during last one year.
- It was suggested that institute take immediate steps for commercialization of technologies and registering available bio-diversity including identification of elite genotypes of lac hosts. For this, farmers input may also be collected.
- Resource generation need to be augmented. The plan for this may be presented in the next meeting.
- Training needs of the region be addressed adequately and if required the available infrastructure and manpower be strengthened for the purpose.

- Since lac involves women in processing and production, the gender related issues be addressed and if required ICAR may be requested for additional budget.
- Possibility of mixing Aloevera (wonder plant) in lac based cosmetic preparations be explored.
- Food applications of lac dye as also in jute dying need to be explored.
- The institute website should be upgraded.

Action Taken Report

(a) Extension of deputation of Medical Officer (AMA)- IMC felt that this facility should also be extended to other sister institutes employees and their family members by AMA, ILRI. The Chairman also apprised the members about the appointment of AMA and all developments relating to previous AMA.

4. Closure of RFRS, Dhiaramjaigarh - Matter was settled, since all pending dues are paid.
5. RFRS, Purulia- The Chairman apprised the house about the position of the Station. The members unanimously agreed with the views of the Director and suggested that detailed Report of the Committee be enclosed with the proceedings of the IMC for consideration of the Council with the remarks that there was no separate budget provision to run the station.

   The Committee favoured closure of the Station due to following points in view:

   i) There is no separate budget provision to run the Station,

   ii) 10th Plan EFC document also states closure in a phased manner,

   iii) The Station's mandate could be addressed through state deptts/NG0s/ KVK under collaborative mode with ILRI.
6. Utilization of unused land behind the Technology Block- The Director apprised the position and IMC recommended that boundary wall be constructed in order to avoid encroachment.
7. Converting Bunglow No. 3 into Community Centre - The proposal regarding conversion of Bunglow No.3 into Community Centre has been referred to the Council. Approval of Council is still awaited.
8. Removing encroachment from boundary wall - The IMC was apprised of the present situation and it was decided that a letter may be written to NHAI in this regard.
9. Construction of Boundary wall of River Bed Pump House - IMC recommended for construction of boundary wall to avoid encroachment and territorial security of assured water supply to the institute.
10. Carpeting of road of Institute Main Campus - Some portion of road has been carpeted. IMC agreed and recommended for the remaining work.
11. Allotment of vacant quarters - The IMC agreed to allot vacant quarters of ILRI in favour of Kendriya Vidyalaya, Namkum, Ranchi.
12. One old vehicle of the Institute (BR-14A-0841) needs to be replaced since it has covered prescribed mileage- Agreed after completing all codal formalities.

New Agenda items

- Microbiology lab, Replacement of existing wooden frame windows with aluminium frame door and windows, Vinyl flooring and false ceiling - IMC agreed & recommended. The amount may be met out from sanctioned Non-Plan Head of the Institute.
- Renovation of Pilot Plant for Processing of lac and bleached lac through the approved agencies- Recommended in principle but more funds may be demanded if possible the request may be made to the Council for one time catch up grant.
- Replacement of Old Tractor (Res. Farm) - IMC agreed to replace the tractor, after completing all codal formalities.

39th meeting of Institute Management Committee.

The Meeting was held on 29th Nov., 2005 at ILRI, Ranchi. The following members were present:

1. Dr. Bangali Baboo, Director, ILRI - Chairman
2. Dr. S. Kumar, P.S., & Head, HARP, Ranchi - Member
3. Dr. J.B. Tomar, P.S. & Head, NBPGR, Ranchi - Member
4. Dr. A. K. Singh, Sr. Scientist, ICAR Res.Complex for Eastern Region, Patna - Member
5. Dr. N. Prasad, I/c Head, LPPD, ILRI - Invitee
6. Dr. A. Bhattacharya, Head, TOT, ILRI
7. Dr. R. Ramani, I/c Head, LPD, ILRI - Invitee
8. Sh. Devesh Nigam, FAO, ILRI - Invitee
9. Sh. Ashok Mallick, Adm. Officer, ILRI - Member-Secretory

Director presented in brief the progress report and functioning as also a good number of constraints to the institute which were solved administratively. He also outlined about various training programmes conducted by TOT Division of the Institute. It was informed that good response from the NGOs/State Govts, such as Jharkhand, Chhattisgarh, Andhra Pradesh, Orissa & M.P, was made. The training impact at Raipur, Gandhinagar, Badodara are good, he added.

While discussing about research & developmental work the Director stated that very good achievements were noticed - more than 6 tonnes lac is expected to be produced in our plantation which is a record; village level seed distribution to farmers., pilot plant for lac dye; composite board using sticklac, lac based insect sex pheromone compounds from aleuritic acid, 3 ICAR exams successfully conducted by ILRI, an advance planning for good resource generation & achieving administrative & financial targets; organized on-the-spot trainings, transfer of technologies, etc.

The Chairman expressed serious concern on a number of scientists transferred without substitute. He informed that some of the projects may have to be closed. A- National Seminar was organized during 24-25th Nov. 2005 at ILRI on "Chemistry and Application of Lac". Collaborative Project on Lac Development in Jharkhand, Orissa & West Bengal was discussed.

- The Chairman apprised that new electric supply line has been renovated in the Main Campus and work is under process in Factory Campus; old entomology building has also been renovated and it is now ready to shift, a Quarter from an unauthorized occupant was got evicted by the Institute; we restored normal working successfully after damage caused by 'a severe storm in July,05. However, significant achievements were made during 8 months & further work is in progress.
- The- Chairman expressed concern that a number of synthesized compounds have not been evaluated due to poor industrial liaison of the Instt. Hence, Scientists of LPPD should move out to the places as required.
- The Director apprised about wonderful training response to the TOT Division and further informed that we are getting trainees from 6-7 States regularly.

  He further added that a Project (Rs.9.84 Crs.) from Govt. of Jharkhand has been approved. The State Welfare Deptt would be the nodeal implementing agency together with ILRI and one NGO. We shall be able to start the work soon.
- Kisan Call Centre will be started soon.

Remarks by the Members

- All the members expressed appreciation and satisfaction on all round development and progress.
- Dr. S. Kumar pointed out to maintain database to monitor the work of transfer of technology to the farmers. He was informed about the database project being

handled/analyzed by Dr. R. Ramani.

- Training needs of the region be addressed adequately and if required the available infrastructure and manpower be strengthened for the purpose.
- Dr. Tomar also desired that *Flemingia* species with potential for lac production may also be registered.
- While screening lac host (*Palas, Ber, Kusum*) genetic variability, resistance to diseases may be considered.
- Lac dye is known for food applications whereas lac resin for processing food application be explored further.
- Dr. A. K. Singh suggested that progress report of research achievements be supported with some pictures. It was noted.
- As regards Jute and lac composite board, more evaluation is needed.
- Head, TOT proposed that some pathological labs be identified for benefit of the staff & their family members residing in the campus and out side as no required facility is available in our Dispensary. After discussion, IMC agreed that laboratories recognized in CGHS list may be considered.
- Dr. A. K. Singh pointed out about soil water conservation. As this is a rainfed area, he suggested to take help of Dr. Bhatnagar, HARP, Ranchi in this direction.

9. DISTINGUISHED VISITORS

Name	Designation	Date of Visit
Sri R. Narayan	Chief GM, NABARD	2.2.2005
Sri Rajat Kumar Mishra	MD, RSMUL, Udaypur, Rajasthan	14.2.2005
Sri Ujjwal Uke, IAS	Commissioner, ICDS, Mumbai	19.2.2005
Sri C.K. Viswanathan, IAS	Commissioner for Entrance Examination, Thiruvanantapuram, Kerala	19.2.2005
Dr. S. Ayyappan	DDG, Fy and Engg., ICAR, New Delhi	19.2.2005
Sri M.K. Gupta	Member, CAT, Bangalore	21.2.2005
Sri S.K. Malhotra	Member, CAT, New Delhi	21.2.2005
Sri P.K. Chowdhary	Director, Institute of Forest Productivity, Ranchi	1.4.2005
Sri A.K. Mishra	IFS, RCCF, Dumka	11.4.2005
Sri Hukumdeo Narayan Yadav	Former State Agriculture Minister, New Delhi	6.5.2005
Sri T.N.C.Vaidya	Centre for Ecological Science, Indian Institue of Science, Bangalore	8.6.2005
Mr. Takashi 0gi	Gifu Shellac Mfg., Gifu, Japan	8.6.2005
Sri V.M. Sharma	Zonal Manager, Punjab National Bank	18.6.2005
Sri P.S. Sarkar	Dy. Gen. Manager, NABARD, Ranchi	18.6.2005
Sri R.M. Prasad	Chairman, Ranchi Kshetriya Gramin Bank, Ranchi	18.6.2005
Sri Partha Mitra	Manager, NABARD, Reg.Off., Ranchi	18.6.2005
Sri R.S. Nair	DGM, Bank of India, Ranchi Zone	18.6.2005
Smt. Neeta Singh	Nodal Officer, Bank of Baroda, Regional Office, Jamshedpur	18.6.2005
Maj. Gen. Pradeep Mittal	H.Q., Central Command	8.7.2005
Maj. Gen. Dalip Bhardwaj	GOC, 23 Inf. Div.	5.8.2005
Brig. B.M. Ghungesh	Commander 61 Inf. Brigade.	5.8.2005
Dr. J.S. Samra	DDG (NRM), ICAR, New Delhi	19.8.2005
Dr. K..P. Gore	Head Agroforestry, MAU, Parbhani	20.8.2005
Dr. N.P.S. Sirohi	IARI, New Delhi	20.8.2005
Dr. N. K. Pal	Director (Chemicals), BIS, New Delhi	20.8.2005
Dr. B.S.R. Reddy	Head and Deputy Director, Central Leather Research Institute Chennai	31.8.2005
Sri Harinarayan Singh	Editor, Hindustan, Ranchi	14.9.2005
Sri E.M. Koshy	Chairman, AOFG- India	15.9.2005
Mr.H.Judith	Industrialist, Germany	15.9.2005
Mr. Kevim Kosgoron	Industrialist, Indonesia	29.9.2005
Dr. A.S. Vidyarthi	Prof. & Head, Deptt. of Biotech, BIT, Mesra, Ranchi	15.10.2005
Dr. Gautam Kalloo	DDG (Hort.), ICAR	21.10.2005
Dr. S.G. Sharma	Director, CRRI, Cuttack	21.10.2005
Sri Arvind Netam	Former Union Agril. Minister	24.10.2005
Mr. Frans Geilfus	Monitor, European Commission, Belgium	24.10.2005
Sri R.C. Chowdhary	S.P., CBI, Ranchi	27.10.2005
Dr. N.N. Singh	Vice Chancellor, BAU, Ranchi	16.12.2005
Mr. Takashi Ogi, Masaru Ogi and Masaki Shibata	Gifu Shellac Mfg., Gifu, Japan	21.12.2005

10. SUPPORT SERVICES

10.1 Institute Research Farm (IRF)

The following activities were under taken during the period under report:

Research Farm Management

Management and maintenance of Farm including roads, paths, channels, hedges and edges was done. Hoeing, weeding and mulching of various plots, removal of termites from lac host tree plots and roads and spraying of insecticides to control the termites wherever and whenever necessary were carried out. Unwanted and obnoxious weeds were eradicated from *ber, khair, kusum, putri, sisam, galwang, akashmani* plots manually as well as by ploughing. More than 5,000 trees were pasted with lime mixed with termiticide to prevent damage by the termites.

Akashmani trees which had outlived their utility were removed from plot nos. 35, 37 and 53. for raising fresh *ber* plantation. 2,000 saplings of *Flemingia semialata* were transplanted in plot no. 4, 27, 39 and 66 for seed collection and demonstration of technology developed.

Lac Cultivation and Nursery Management

Harvesting-cum-pruning of 150 trees of *ber* (*Ziziphus mauritiana*), 100 trees of *khair* (*Acacia catechu*) and 10 trees of *kusum* (*Schleichera oleosa*) was done in February 2005. More than 500 kg of broodlac was produced. Harvesting of *jethwi* 2005 (summer season) crop, *phunki* removal and scraping of lac was done. Inoculation of *aghani* 2004-05 (winter season) crop on about 250 trees of *ber* and *khair* was carried out. About 600 trees of *ber* and *kusum* were transplanted to fill the gaps in the existing plots.

Seedlings of various host plants *viz*: *kusum, ber, galwang, palas, akashmani, khair, Flemingia semialata* were raised in polythene bags as well as in nursery beds for filling up the vacant spaces in respective plots for research and experimental use as well as for sale to the farmers. More than 15, 000 seedlings of different lac-host plants were sold. Other agricultural crops like soybean, maize, ginger, wheat and paddy were raised in vacant plots / spaces under the lac hosts.

Infrastructure Development

A new 35 HP Tractor has been purchased with other implements like Disc Harrow and Disc Plough as replacement for the old Tractor.

A new *Kuchcha* pond of 100 x 30 x 2.5 m dimensions has been developed to augment the irrigation facilities.

200 m long underground electric cable was laid to provide electric connection at the *Pucca* pond site for lifting the water from the pond for irrigation.

150 m long and 3 m wide *Kuchcha* road was re-laid and 100 m long and 3 m wide *Kuchcha* road was constructed in plot nos. 69, 70 and 71.

Landscaping and Beautification

Seasonal flowers, shrubs and ornamental foliage plants and hedges were planted on various spots in the office premises including Administrative block, Lac Processing & Product Development Division, Lac Production Division and Lac processing Unit for beautification and landscaping of the area. Vacant area in the main campus was ploughed and leveled. *Kusum* saplings were transplanted in the Lac Processing Unit to develop the vacant land.

Visitors at Institute Research Farm

More than 2,000 persons visited Institute plantation which included Trainees under short and long term training programmes organized by the Institute besides other farmers, students, officials etc. Proper arrangements were made to acquaint them with the lac insect, host plants, improved methods of lac cultivation and management of host plants etc.

Resource Generation

An amount of Rs.2, 72, 843 /= (Rupees Two lakh seventy two thousand eight hundred forty

Table 43. Revenue generated by IRF

Sr. No.	Item	Amount (Rs.)
1	Lac* (Broodlac, Scraped lac etc.)	1,06, 476
2	Wood (Pruned twigs, Bamboos etc.)	77, 124
3	Other Farm Produce (Lac-host seeds, seedlings, Soy bean, Wheat, Ornamental plants etc.)	50, 226
4	Others (Water Tanker, Fuel charges etc.)	39, 017
	Total	2, 72, 843

* In addition, 200.0 kg *kusmi* lac sticks were provided to other Divisions for research work.

three) has been generated as revenue through sale of farm produce. (Table 43).

10.2 Quality Evaluation Laboratory

During the period, 285 samples of seedlac/ shellac / bleached lac / lac dye/ aleuritic acid/ by-products of lac were received from Govt. organizations / Private Industries/ various Divisions of I.L.R.I. and 1087 tests were carried out. In addition to this, three trainees were given practical demonstration on Gasket Shellac Compound and a sum of Rs.63,314/= was earned. Application for BIS 9001-2000 accreditation of the lab has been submitted and it is in active process.

10.3 Research Management Unit

The Unit performed the following activities during the period under report :

- Correspondence and sending important reports to the Council.
- Compilation and preparation of various reports to the Council like monthly report, monthly report for cabinet secretariat, quarterly progress report, six monthly report of the scientists, DARE report to the Council, information related to SMD meetings, etc.
- Management of HRD programmes of scientists and other staff of the Institute. Maintenance of research project files of the Institute.
- Co-ordinating correspondence related to patents etc.
- Processing of papers submitted for publication in journals, etc.
- Providing LAN and Internet connectivity to the Divisions and Sections of the Institute.
- Providing E-mail services to the scientists.
- Annual Maintenance of the computer system & Local Area Networking (LAN) of the Institute.
- Assistance in Power point presentation during meetings, seminars etc.
- Maintenance of RAC, QRT and SRC files
- Maintenance of database for Personnel Information Management system Network (PERMISNET).
- Right to Information.

A 128/38.4 kbps broadband VSAT link was established from ERNET during the month of November, 2004. The RMU presently maintains three servers namely, proxy server for providing internet connectivity to all the Divisions/Sections of the Institute, Mail Server for providing e-mail facilities and Apache Web server, for hosting web sites.

10.4 Library and Documentation Center

The library of the Institute plays an important role in meeting the information needs of its user. Library is a repository of scientific and technical information on lac. Besides catering to the needs of Institute scientist's and technologist's the library renders services to other researchers, academicians and students as well as lac industrialists from all parts of the country.

The library maintains adequate linkage with leading reference libraries like National Library, Kolkata; NISCOM, New Delhi & INSAA for strengthening the information resources. The library also supplies photocopies of rare research articles to INSDOC, New Delhi from time to time against payment.

The library continued to exchange ILRI publications with the scientific institutions in and out side the country.

During the year library provided following services to its users:

- Today's Arrival (On line).
- Reprographic Services.
- Current Content Services.
- CD Searches.
- Bibliographic Services.
- Current Awareness Services.
- Inter Library Loan Services for resource sharing.
- Sale of ILRI Publications.

Table 44. Library holdings (as on 31/12/2005)

Documents	Additions	Total Holdings
Books	76	7562
Bound Journals	230	19311
Annual Report	105	4449
CD- Rom	20	98
IS-Specification	3	120
Maps	-	37
Patents (Foreign)	-	327
Patents (Indian)	-	15

Journals subscribed & Periodicals Received.

- Foreign Periodicals (Subscribed) - 23
- Foreign Periodicals (Gratis/Exchange) - 09
- Indian Periodicals (Subscribed) - 64
- Indian Periodicals (Gratis/Exchange) - 33

10.5 Estate

The Estate Section of the Institute consists of five units i.e. Guest House & Kisan Hostel, Civil, Electrical, Security and Workshop. The progress made in these units during 2005 is as follows :

Guest House & Kisan Hostel

- During period 2005, 180 guests stayed in the Guest House and an amount of Rs. 21,330/- was realized. Similarly 100 trainees/guests stayed in the Kisan Hostel and an amount of Rs. 1,21,265/- was collected.
- One Inverter was purchased and installed in the Guest House.

Civil Including Water supply and Sewerage work carried out departmentally

- A Submersible pump was purchased and installed in the new tube well in the Institute Main Campus
- A new pipe line connecting tube well and drinking water pump was installed.
- About 369 nos. of jobs have been entered in the Plumber's Job Register and Jobs were attended.

Work carried out by CPWD

- Polymer based roof treatment of Old Chemistry Building, Samaj Sadan, Purchase Section and Security post at Main Gate was carried out.
- AR&MO of Guest House, Samaj Sadan was done
- Road carpeting in PDU and in Institute Main Campus.
- Boundary Wall height was raised at vital point in Institute Main Campus.
- Renovation of old Entomology Building
- Renovation of old PDU Building
- AR&MO of boundary walls of Institute Main Campus and PDU
- White washing of old PDU Building
- Renovation of Toilet in Director Bungalow
- CC pavement for Double Storey Type III and IV quarters in Institute Main Campus and Purchase Section.
- Repair of boundary wall of IRF damaged due to cyclone

Electrical including Genset

- In absence of electric supply from JSEB, Genset Backup have been provided
- About 1023 job were entered in the Electrical job Register and 468 nos. of jobs were entered in the Instrument Mechanic's job Register and jobs were attended
- Laying of cable in plantation from old tube well to the water harvesting pond completed
- Laying of cable in Technology Block Campus to connect Genset Room to water pumping station completed
- Electric wiring in old Entomology Building and Bungalow No. 2

- Repair of electric overhead line damaged due to cyclone

Security, Landscaping & cleaning

- The two campus of the Institute have been cleaned by removing grasses, small bushes and by pruning the low hanging branches of the trees. New hedges have been planted in the Institute Main Campus and PDU
- About 88 no. of jobs we entered in the Job Register of the Sweepers & Landscaping work and jobs were attended.
- For security of the Institute services of a private security agency were engaged. No case of theft or security lapse was reported during the 2005.

Workshop

- Sale Counter in TOT Division was modified
- Lac Grader and Lac Winnower machines were fabricated for Institute Research Project.
- Structure for Lac Dye Pilot Plant were fabricated in PDU.
- About 544 nos. of jobs were entered in the Carpenter's Register, 409 jobs were entered in Turner's Register, 329 jobs were entered in Assistant Mechanic's Job Register and 32 nos. of jobs in the Welder cum Black Smith's Job Register and jobs were attended.
- Power Hacksaw has been procured for Workshop.

10.6 Health Care

2. No. of patient attended by ILRI dispensary - 480
3. No. of patients checked for blood sugar by Glucometer - 236
4. No. of patients referred to consult specialist, authorized hospital, pathology and x-ray labs - 48

10.7 Agrometeorology

Agro-meteorology unit of the Institute is situated at 23^0 23' N latitude, 85^0 23' E longitude and 650 m altitude. During year 2005-06, the status of different weather parameters as recorded at this unit are presented in the Table 45. Rainfall occurred in every month and the total rainfall of the year was 1029.4 mm. Highest rainfall was recorded during July month and the lowest in the month of April. Similarly, the highest maximum temperature (40.6^{0}C) was observed in the month of May and the lowest minimum temperature to the level of 6.4^{07} C during December. During the year, the hottest day with temperature of 44.5 ^{0}C was recorded on May 24th and the coldest day was recorded on 21st January with 4.4^{0}C temperature.

Table 45. Meteorological data recorded at Agro-Met Unit of the Institute during 2005

Month	Mean Temperature (^{0}C)		Mean Relative Humidity (%)		Total Rainfall (mm)
	Maximum	Minimum	7 am	2 pm	
January	25.5	9.0	74	79	18.0
February	28.9	12.2	73	71	56.0
March	34.2	17.1	71	65	14.6
April	38.0	20.0	54	44	1.8
May	40.6	21.8	52	34	10.7
June	38.4	25.2	63	52	153.4
July	30.3	22.6	92	84	362.8
August	30.3	22.1	89	79	181.1
September	30.3	21.8	89	77	192.0
October	28.7	19.3	87	73	26.0
November	27.3	10.4	69	50	10.0
December	26.0	6.4	75	52	3.0
			Total rainfall (mm)	:	1029.4

11. PERSONNEL

Present sanctioned strength of Scientific, Technical, Administrative and Supporting Staff in position as on 31.12.2005.

Scientific

R.M.P.	1
Principal Scientist	4
Senior Scientist	11
Scientist	31
Total	**47**

Technical

Category - II	21
Category – I	41
Total	**62**

Administrative

A.O.	1
F.& A.O.	1
A.A.O.	2
A.D. (OL)	1
Sr. P.A.	1
Security Officer	1
P.A.	2
Assistant	9
Sr. Clerk	13
Jr. Clerk	3
Steno Gr.-III	1
J.A.O.	1
Total	**36**

Supporting

SG.IV	10
SG.III	20
SG.II	34
SG.I	25
Total	**89**

Cadre	Sanctioned	In Position
Scientific	47*	29*
Technical	62	58
Administrative	36	31
Supporting	89	81
Total	**234**	**199**

* Including RMP Post

Dr.Bangali Baboo - Director

Division of Lac Production

Dr. R. Ramani, P.S. & Actg. Head	Agric.Entomol.
Dr. B.P. Singh, P.S.	Agronomy
Shri G. Singh, Sr. Sc.	Soil Chem./Soil Fert./Soil Micro. Bio.
Shri S.C. Srivastava, Sr. Sc.	Plant Breeding.
Dr. K.K. Sharma, Sr. Sc.	Agric. Entomol.
Shri Y.D. Mishra, Sc. (SG)	Agric. Entomol.
Dr. S. Ghosal, Sc. (Sr. Scale)	Agronomy
Dr. S.K. Yadav, Sc. (Sr. Scale)	Agronomy
Shri D. Saha, Sc.	Bio. Technol.
Shri R.K. Singh, Sc.	SWCE
Shri M. Ekka, T-6	F/F Tech.
Shri M.L. Rabidas, T-5	F/F Tech.
Shri K.P. Gupta, T-4	F/F Tech.
Shri Binod Kumar, T-4	F/F Tech.
Shri R.K. Swansi, T-3	Lab. Tech.
Shri D. Runda, T-3	Lab. Tech.
Shri S.K. Tripathi, T-2	F/F Tech.
Smt. S. Prasad, P.A.	

Division of Lac Processing and Product Development

Dr. N. Prasad, P.S. & Head	Org. Chem.
Dr. D.N.Goswami, P.S.	Physics
Dr. R.N. Majee, P.S.	Org. Chem.
Dr. K.P.Sao, P.S.	Physics.
Shri Murari Prasad, P.S.	Chem. Engg.
Dr. S. Srivastava, Sc.	Org. Chem.
Shri S.K. Pandey, Sc.	Mech. Engg.
Shri S.K.Giri, Sc.	AS & PE
Shri S.K.S.Yadav, Sc.	Org. Chem
Shri M.F.Ansari, Sc.	Org. Chem.
Shri D.D. Singh, T-6	Lab. Tech.
Shri T.K.Saha , T-6	Lab. Tech.
Shri B. Ram, T-5	Lab. Tech.
Shri B.P.Ghosh, T-4	Lab. Tech.
Smt. P. Devi, T-3	Lab. Tech.

Shri B. Kumar, T-2	Lab. Tech.
Shri S.K. Tirkey, T-2	Lab. Tech.
Shri A. Kumar , T-2	Lab. Tech.
Shri Arjun Kumar Sinha, P.A.	

Division of Transfer of Technology

Dr. A. Bhattacharya, P.S.	Agric.Entomol.
Dr. K.M. Prasad, P.S.	Org. Chem.
Dr. A.K.Jaiswal, Sr. Sc.	Agric. Entomol.
Shri R. Singh, Sc. (SG)	Phys. Chem.
Shri M.L. Bhagat, Sc. (SG)	Agric. Entomol
Shri P.M.Patil, Sc. (Sr. Scale)	Phys.Chems.
Dr. N.Prasad, Sci. (Sr. Scale)	Farm Mach. & Power.
Dr. G. Pal, Sc.	Agric. Econ.
Shri L.C.C.N. Shahdeo, T-6	F/F Tech.
Shri R.N.Vaidya, T-6	F/F Tech.
Shri R.P. Srivastava, T-4	Photographer
Shri A.K. Sinha ,T-4	F/F Tech.
Smt. R. Sen, T-4	Lab. Tech.
Shri P.A. Ansari, T-4	F/F Tech.
Shri D.K. Singh, T-4	F/F Tech.
Shri S.B. Azad, T-3	F/F Tech.
Shri P. Patamajhi, T-3	Lab. Tech.
Shri R. K. Rai, T-2	Lab. Tech.
Shri S.K. Yadav, Steno Gr.III	

Lac Processing Unit (Under LP & PD Div.)

Shri M. Prasad. P.S.	Chem Engg. O/I
Dr. K.M. Prasad, P.S. (TOT)	Org. Chem.
Shri R. Singh, Sc. (SG) (TOT)	Phys. Chem.
Shri P.M. Patil Sc (Sr. Scale)(TOT)	Phys. Chem.
Shri K.K. Prasad, T-6	Lab. Tech.
Shri J. Singh, T-6	Lab. Tech.
Shri Anup Kumar, T-2	Lab. Tech.

R.F.R.S. Purulia (Under LP Division)

Dr. S.Ghosal, Sc. (Sr. Scale)	Agronomy
Shri K.A. Nagruar, T-I-3	F/F Tech.

Institute Research Farm Section

Dr. K.K. Sharma, Sr. Sc.	O/Ic.
Shri R.L. Ram.,T-4	F/F Tech.
Shri M. Surin, T-1-3	F/F Tech.
Shri S.Kumar, T-2	F/F Tech.
Shri S.K.Mukherjee, T-2	F/F Tech.

Research Management Unit

Shri R.Ramani, P.S.	O/Ic.
Shri A.K. Sahay, T-6	Lab. Tech.
Shri D.Ganguly, T-6	Lab. Tech.

Quality Evaluation Lab. (Under LP & PD Division)

Shri D.Ghosh, T-6	Lab. Tech.
Shri K.M. Sinha, T-6	Lab. Tech.
Shri B.K. Singh, T-2	Lab Tech.

Library

Shri V.K. Singh, T-6	Lab. Tech.
Shri M. Mohan, T-2	F/F Tech.

Mechanical Section

Dr. N. Prasad, (Sr.Scale)	O/ Ic.
Shri A.K. Yadav	Security. Officer
Shri S.K. Srivastava, T-6	Chief Mechanic
Shri H. Bhakta,T-4	Workshop Tech.
Shri I.D. Das, T-2	Workshop Tech.
Shri A. Sharma, T-2	Workshop Tech.
Shri R.K. Ravi, T-2	Workshop Tech.
Shri K. Tirkey, T-2	Workshop Tech.
Shri B.S. Choudhury, T-2	Workshop Tech.
Shri R. Singh, T-1	Workshop Tech.
Shri Anil Kr. Sharma, T-1	Workshop Tech.
Shri K.K. Deonath	Sr. Clerk

Hindi Cell

Shri Lakshmikant,	Asstt.Dir. (O.L.)
Dr. Anjesh Kumar, T-4	Sr. Translator

Dispensary

Dr. A.K. Jaiswal, Sr. Sc.	O/ Ic.
Dr. Anil Kumar,	A.M.A. (Part time)
Shri C. Pandey, T-4	Pharmacist

Admin – I Section

Shri A. Mallick	A.O
Shri B.K. Rajak	Asstt.
Shri Prahlad Singh	Asstt.
Shri B. Sahu	Sr. Clerk.
Shri P. Kumar	Sr. Clerk

Shri S. Kumar	Sr. Clerk
Shri K.P. Kashi	Jr. Clerk
Sri R. Rabidas	Sr. PA

Admin.II Section

Shri K.N. Sinha	A.A.O & D.D.O
Shri R. Shanker	Asstt.
Shri W. Guria	Asstt.
Shri N. Gope	Sr.Clerk
Shri R.N. Mahto	Sr.Clerk (Cashier)
Shri A.K. Tripathi	Sr.Clerk
Shri R.K. Toppo	Sr. Clerk

Admin.III Section (Purchase)

Shri B.Ram	A.A.O. (Pur. & Store)
Shri Md. Mobarak	Asstt.
Shri T. Minz	Asstt.
Shri B.N.Gope	Sr. Clerk

Accounts Section

Shri D. Nigam	F.& A.O
Shri V. Ram	Asstt.
Shri A. Pandey	Sr. Clerk
Shri S.C. Lal	Sr. Clerk
Shri K Oraon	Sr. Clerk
Shri A. Gope	Sr. Clerk

Central Store

Shri B.Ram, A.A.O (Pur.)	O/Ic.
Shri Md. Mobarak,	Asstt.

Transport

Shri J. Tiwari, T-2	Driver
Shri N. Lakra, T-2	Driver
Shri A. Kumar, T-2	Driver
Shri M. Singh, T-2	Driver
Shri R.K. Yadav, T-2	Driver

Retirements

Shri S.K. Bhaduri, T.O.	31.1.05
Shri R.K. Upadhyaya, Asstt.	31.1.05
Shri B.P. Keshri, T-4	31.1.05
Shri B.L. Dey, T-4	31.3.05
Shri D. Ram, Asstt.	31.5.05
Shri E. Gari, Asstt.	31.5.05
Shri B. Runda, T-I-3 (Driver)	30.6.05
Shri H. Das, T-2	30.6.05

Promotions

Name and designation of employee	Promoted to the post of	w.e.f.
Shri E. Gari, Sr. Clerk	Asstt.	25.5.2005
Shri W. Guria, Sr. Clerk	Asstt.	15.9.2005
Shri Thibu Minz, Sr. Clerk	Asstt.	15.9.2005
Shri Arjun Gope, Jr. Clerk	Sr. Clerk	15.9.2005
Shri R.K. Toppo, Jr. Clerk	Sr. Clerk	15.9.2005
Shri Samal Kumar, Jr. Clerk	Sr. Clerk	15.9.2005
Shri Mandeshwar Singh, T-1 (Driver)	T-2 (Driver)	19.6.2004
Shri Rajesh Kumar Yadav, T-1 (Driver)	T-2 (Driver)	22.6.2004
Shri Mahabir Mahto, SSG-II	SSG-III	27.4.2005
Shri Madi Toppo, SSG-I	SSG-II	27.4.2005
Shri Chandradeep Mahto, SSG-I	SSG-II	27.4.2005
Shri A.K. Sharma, SSG – IV	T-1 (Welder)	30.12.2005

Appointment

Dr.Anil Kumar, as part time A.M.A.19.10.2005

Transferred to ILRI

Shri P.B.D. Tirkey, T-2 joined the Institute on 2.4.05 on transfer basis from IISR Lucknow

Shri Bhupal Kumar, T1 joined the Institute on 2.5.05 on transfer basis from NDRI, Karnal

Transferred from ILRI

1. Dr. P. Kumar, P.S. relieved from ILRI on 22.10.05 to join his new assignment at NRC Pomegranate, Sholapur (Maharashtra)
2. Dr. P.C. Sarkar, Sr. Sc. transferred from ILRI to ICAR New Delhi and relieved on 29.11.05
3. Dr. K.K. Kumar, P.S. transferred from ILRI to NRC, Lichi, Muzaffarpur on 28.2.2005

Removal/Dismissal from Service

Shri Jairam Naik, SSG - I dismissed from service on 5.11.05

Obituary

Shri Mangal Mahto, SGG - I	8.11.05
Shri Essaiya Ekka, SSG - I	17.11.05

संस्थान राजभाषा प्रकोष्ठ की गतिविधियाँ

भारत सरकार के राजभाषा विभाग (गृह मंत्रालय) द्वारा तैयार किए गए वार्षिक कार्यक्रम एवं राजभाषा अधिनियम व नियमों के संबंध में भारतीय कृषि अनुसंधान परिषद्, नई दिल्ली से समय-समय पर प्राप्त निर्देशों पर अनुवर्ती कार्रवाई तथा सरकारी कार्य में हिन्दी को और गति प्रदान करने के लिए संस्थान में राजभाषा प्रकोष्ठ की स्थापना की गई है। इसमें एक सहायक निदेशक (रा.भा.), एक वरीय हिन्दी अनुवादक (टी-4), एक अंशकालीन वरीय लिपिक तथा एक पदचर कार्यरत हैं। संस्थान में राजभाषा संबंधी क्रिया-कलापों की समीक्षा के लिए संस्थान के निदेशक की अध्यक्षता में राजभाषा कार्यान्वयन समिति गठित की गई है जिसमें विभागों/अनुभागों के प्रधानों को सदस्य तथा सहायक निदेशक (रा.भा) को सदस्य सचिव मनोनित किया गया है ।

संस्थान 'क' क्षेत्र में स्थित है। संस्थान को राजभाषा अधिनियम की धारा 10(4) के अर्न्तगत केन्द्रीय गजट में अधिसूचित किया जा चुका है। संस्थान में चार अनुभागों को शत प्रतिशत कार्य हिन्दी में करने हेतु निदेशक द्वारा विनिर्दिष्ट किया जा चुका है। संस्थान के हिन्दी में प्रवीणता प्राप्त सभी सदस्यों को अपना कार्य हिन्दी में करने हेतु व्यक्तिशः आदेश निर्गत किया जा चुका है।

संस्थान के दैनिक कार्य में हिन्दी के प्रयोग में प्रगति एवं इसे सर्वग्राह्य बनाने के लिए राजभाषा प्रकोष्ठ द्वारा निम्नलिखित कार्य सम्पादित होते है:

- संस्थान राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन, कार्यसूची एवं कार्यवृत की तैयारी एवं बैठकों में लिए गये निर्णयों पर अनुवर्ती कार्रवाई ।
- वार्षिक रिपोर्ट का सारांश, भा.ला.अनु.सं. लाख समाचार पत्रिका, कार्यालय आदेश, परिपत्र, ज्ञापन, निविदा, सूचना एवं पत्राचार हेतु विभिन्न सामग्रियों का अनुवाद।
- नगर राजभाषा कार्यान्वयन समिति, राँची के सदस्य कार्यालयों द्वारा आयोजित विभिन्न हिन्दी प्रतियोगिताओं एवं कार्यशालाओं में सहभागिता हेतु प्रेरित करना।
- हिन्दी दिवस, हिन्दी सप्ताह, हिन्दी पखवाड़ा, हिन्दी मास एवं योजनानुसार नगर स्तरीय राजभाषा संबंधी प्रतियोगिता एवं कार्यशाला का आयोजन करना।
- संदर्भ साहित्य, हिन्दी पत्रिका, शब्दकोश एवं तकनीकी शब्दावली के उपार्जन हेतु कार्य
- द्विभाषी मुहरों, नामपटट, पत्रशीर्ष (लेटरहैड) के निर्माण में सक्रिय सहयोग करना।
- प्रचार सामग्रियों के हिन्दी रूपान्तर एवं समारोहों के समाचार संकलन का कार्य
- विभागीय विषय पर तकनीकी शब्दावली का निर्माण
- हिन्दी में वैज्ञानिक गोष्ठी, के साथ साथ प्रशासनिक तथा तकनीकी वर्ग के लिए कार्यशाला का आयोजन ।

डॉ बंगाली बाबू, निदेशक की अध्यक्षता में वर्ष 2005 में संस्थान राजभाषा कार्यान्वयन समिति की चारों तिमाही बैठकों का आयोजन निम्नलिखित तिथियों को किया गया तथा प्रगति की समीक्षा की गई। तिमाही रिपोर्ट एवं कार्यवृत परिषद सहित् अन्य संबंधित कार्यालयों में प्रेषित की गई :

(क) दिनांक **26.2.2005**

(ख) दिनांक **16.5.2005**

(ग) दिनांक **23.8.2005** एवं

(घ) दिनांक **31.10.2005** जिनके अर्न्तगत निम्नलिखित प्रमुख चर्चायें हुई तथा सर्वसम्मति से निर्णय लिए गए :-

- वार्षिक कार्यक्रम-2005 के प्रस्ताव पर चर्चा ।
- संस्थान में हिन्दी में मूल रूप से पत्राचार बढाने के लिए :-

(क) हिन्दी में प्रवीणता प्राप्त सभी अधिकारियों एवं कर्मचारियों को शत प्रतिशत हिन्दी में कार्य करने हेतु व्यक्तिशः आदेश जारी किए गए ।

(ख) सरकारी काम काज मूल रूप से हिन्दी में करने हेतु संस्थान में नकद पुरस्कार योजना लागू की गई, इसमें वैज्ञानिक, तकनीकी एवं प्रशासकीय वर्ग के कुल 48 अधिकारियों / कर्मचारियों ने भाग लिया ।

(ग) हिन्दी में श्रुतिलेखन (डिक्टेशन) देने के लिए पुरस्कार योजना संस्थान में लागू की गई ।

(घ) समय-समय पर हिन्दी के प्रयोग को प्रोत्साहित करने के लिए विभिन्न प्रकार की हिन्दी प्रतियोगिताओं का आयोजन किया गया ।

राजभाषा प्रकोष्ठ की उपलब्धियाँ-2005

- ''लाख शब्दावली'' का संशोधित एवं वृहत रूप तैयार किया गया ।
- ''आवासों के आबंटन नियम'', तथा ''एक दृष्टि में :-भारतीय लाख अनुसंधान संस्थान'' का हिन्दी रूपान्तर ।
- लाख समाचार पत्रिका एवं वार्षिक प्रतिवेदन की सामग्री का हिन्दी अनुवाद किया गया ।
- नगर स्तरीय ''हिन्दी अन्ताक्षरी प्रतियोगिता'' का आयोजन

राँची नगर राजभाषा कार्यान्वयन समिति के तत्वावधान में संस्थान में प्रत्येक वर्ष की भाँति वर्ष 2005 में भी राँची स्थित केन्दीय सरकार के कार्यालयों के अधिकारियों एवं कर्मचारियों के लिए दिनांक 10.8.2005 को संस्थान परिसर में हिन्दी अन्ताक्षरी प्रतियोगिता का आयोजन किया गया जिसमें डॉ अनिल कुमार जायसवाल, वरिष्ठ वैज्ञानिक; डॉ केवल कृष्ण शर्मा, वरिष्ठ वैज्ञानिक; श्री लक्ष्मी कान्त, सहायक निदेशक (रा.भा.) तथा डॉ अंजेश कुमार, वरिष्ठ हिन्दी अनुवादक को निर्णायक मंडल का सदस्य मनोनित किया गया। प्रतियोगिता में प्रथम, द्वितीय एवं तृतीय स्थान प्राप्त करने वाले प्रतिभागियों को संस्थान द्वारा पुरस्कृत किया गया ।

हिन्दी दिवस समारोह

संस्थान में 14 सितंबर 2005 को हिन्दी पखवाड़ा समापन एवं हिन्दी दिवस समारोह का आयोजन किया गया।

मुख्य अतिथि पद से बोलते हुए दैनिक हिन्दी समाचारपत्र हिन्दुस्तान के संपादक श्री हरिनारायण सिंह ने राजभाषा हिन्दी की विशालतम क्षमता का परिचय देते हुए कहा कि यह देश के सर्वाधिक भागों में बोली और समझी जाने वाली भाषा है। इसका प्रचार प्रसार देश में ही नहीं अपितु विदेशों में भी हो रहा है। हमें अपने-अपने दैनिक कार्य में हिन्दी का प्रयोग कर गौरवान्वित होना चाहिए ।

संस्थान के निदेशक डॉ बंगाली बाबू ने अपने स्वागत भाषण में कहा कि हिन्दी हमारी राष्ट्र एवं राजभाषा के साथ-साथ सम्पर्क भाषा भी है। सरकारी काम काज में हिन्दी का सर्वाधिक प्रयोग करना हमारा नैतिक एवं संवैधानिक कर्तव्य है। हिन्दी दिवस के अवसर हिन्दी की प्रगति के लिए हमें आत्म-चिंतन करना होगा और दिनानुदिन संस्थान के कार्य में हिन्दी के प्रयोग को बढाना होगा। वर्तमान स्थिति में देश की अखंडता को बचाये रखने के लिए हिन्दी को व्यवहारिक रूप में राजभाषा बनाना होगा। हिन्दी की सरलता पर प्रकाश डालते हुए उन्होंने कहा कि वैसे भी अंग्रेजी की अपेक्षा हिन्दी सीखना ज्यादा आसान है। उन्होंने सरकारी कार्य में हिन्दी का सर्वाधिक प्रयोग करने की अपील की ।

सहायक निदेशक (रा.भा.), श्री लक्ष्मी कान्त ने संस्थान में हिन्दी की प्रगति विवरण (रिपोर्ट) प्रस्तुत करने के क्रम में सूचित किया कि प्रशासकीय कार्यों के साथ-साथ तकनीकी एवं वैज्ञानिक कार्यों में भी राजभाषा हिन्दी के प्रयोग में सतत् प्रगति हो रही है।

संस्थान में हिन्दी को बढावा देने के लिए संस्थान के कार्मिकों का प्रशिक्षण, आधारभूत संरचनाओं का विकास, संदर्भ साहित्य का उर्पाजन तथा हिन्दी प्रतियोगिताओं का लगातार आयोजन किया जाता है ।

हिन्दी पखवाड़े की अवधि में हिन्दी की विभिन्न प्रतियोगिताओं का आयोजन किया गया जिसमें सर्वश्री प्रहलाद सिंह, मदन मोहन, मो. फहिम अंसारी एवं अनिल कुमार सिन्हा को प्रथम तथा सर्वश्री शरत चन्द्र लाल, विनोद कुमार, कवल किशोर प्रसाद, मुन्ना लाल रविदास को द्वितीय पुरस्कार तथा हिन्दी अन्ताक्षरी में संयुक्त रूप से सर्वश्री अर्जुन शर्मा, कृष्णा प्रसाद काशी, मानदेश्वर सिंह एवं अन्य को पुरस्कार प्रदान किए गए। सांस्कृतिक कार्यक्रम में गीत, कविता, भजन, संस्मरण एवं राष्ट्रगीत द्वारा सुश्री कृषा डे, सर्वश्री कवल किशोर प्रसाद, अंजेश कुमार, रंजय कुमार सिंह, संजय श्रीवास्तव, मानदेश्वर सिंह एवं अनिकेत सिन्हा ने अपने मधुर स्वर से समारोह में समां बांधे रखा ।

इस अवसर पर भारतीय कृषि अनुसंधान परिषद, नई दिल्ली के साथ-साथ संस्थान के हिन्दी प्रकाशनों की एक मनोरम प्रदर्शनी लगाई गई। सभा संचालन डॉ अंजेश कुमार, वरिष्ठ हिन्दी अनुवादक एवं धन्यवाद ज्ञापन समारोह के अध्यक्ष एवं वरिष्ठ वैज्ञानिक श्री सतीश चन्द्र श्रीवास्तव ने किया ।

अन्तर माध्यम प्रचार समन्वय समिति, राँची की बैठकों में सहभागिता

- भारतीय लाख अनुसंधान संस्थान नामकुम, राँची में दिनाक 30.8.05 की बैठक में डॉ निरंजन

प्रसाद, अध्यक्ष, लाख प्रसंस्करण एवं उत्पाद विकास विभाग; डॉ प्रणय कुमार, अध्यक्ष, लाख उत्पादन विभाग; डॉ रंगनादन रमणि, प्रधान वैज्ञानिक एवं श्री लक्ष्मी कान्त, सहायक निदेशक (रा.भा.) ने भाग लिया।

- ❖ भारत सरकार के गीत एवं नाटक प्रभाग, अशोक नगर, राँची में दिनांक 30.11.2005 की बैठक में श्री लक्ष्मी कान्त, सहायक निदेशक (रा.भा) एवं डॉ अंजेश कुमार, वरिष्ठ हिन्दी अनुवादक ने भाग लिया
- ❖ आकाशवाणी, राँची में दिनांक 22.12.2005 को तथा बिरसा कृषि विश्वविद्यालय, कांके, राँची की अन्तर माध्यम प्रचार समन्वय समिति की बैठक में संस्थान का प्रतिनिधित्व श्री लक्ष्मी कान्त, सहायक निदेशक (रा.भा.) ने किया।
- ❖ दक्षिण पूर्व रेलवे, राँची द्वारा आयोजित बैठक में डॉ अंजेश कुमार, वरिष्ठ हिन्दी अनुवादक ने भाग लिया ।

नगर राजभाषा कार्यान्वयन समिति (नराकास) की बैठकों में सहभागिता

- ❖ 28 फरवरी एवं 31 अगस्त 2005 को आयोजित 'नराकास' की बैठक में श्री लक्ष्मी कान्त, सहायक निदेशक (रा.भा.) एवं डॉ अंजेश कुमार, वरिष्ठ हिन्दी अनुवादक ने भाग लिया ।

पुरस्कार

- ❖ राँची नगर राजभाषा कार्यान्वयन समिति के तत्वावधान में आयोजित हिन्दी अंताक्षरी प्रतियोगिता में श्री प्रहलाद सिंह, सहायक को प्रथम, श्री शरत चन्द्र लाल, वरिष्ठ लिपिक को द्वितीय तथा श्री कवल किशोर प्रसाद, तकनीकी अधिकारी को तृतीय पुरस्कार से सम्मानित किया गया।

हिन्दी कार्यशाला में सहभागिता

- ❖ स्टील आथॉरिटी आफ इंडिया लिमिटेड (इस्पात अनुसंधान एवं विकास केन्द्र) राँची में 30.3.05 को आयोजित हिन्दी कार्यशाला में श्री लक्ष्मी कान्त सहायक निदेशक (रा.भा.) की सहभागिता।
- ❖ श्री कामेश्वर उरॉव, वरिष्ठ लिपिक एवं श्री मदन मोहन, टी-2 को 'हार्प' पलांडू मे दिनांक 8.9.2005 को आयोजित ''हिन्दी कार्यशाला'' हेतु नामांकन ।

समारोहों का आयोजन

- ❖ दिनांक 29.6.05 को भारत सरकार के गीत एवं नाटक प्रभाग राँची के तत्वाधान में ''भाषाई समरसता में राष्ट्रीय एकता'' विषयक कार्यक्रम आयोजित किया गया ।
- ❖ दिनांक 14 सितंबर 2005 को ''हिन्दी दिवस'' हिन्दी पखवाड़ा'', ''हिन्दी चेतना मास'' के अर्न्तगत विभिन्न हिन्दी प्रतियोगिताओं का आयोजन तथा विजयी प्रतिभागियों को पुरस्कृत किया गया ।

आधारभूत संरचनाओं में वृद्धि

- ❖ हिन्दी में सहायक ग्रंथों का उपार्जन ।
- ❖ कम्प्यूटरों में हिन्दी फोन्ट लगवाया जाना ।

मानव संसाधन विकास -प्रशिक्षण

- ❖ केन्द्रीय अनुवाद ब्यूरो, नई दिल्ली के तत्वावधान मे राँची में श्री शरत चन्द्र लाल, वरिष्ठ लिपिक को पाँच दिवसीय ''हिन्दी अनुवाद प्रशिक्षण'' कार्यक्रम में प्रशिक्षण दिलवाया गया।

कौमी एकता सप्ताह

9.12.2005 को 'कौमी एकता सप्ताह'' का समापन समारोह झंडा दिवस के रूप में किया गया।

इस अवसर पर संस्थान के निदेशक, डॉ बंगाली बाबू ने अपने अध्यक्षीय भाषण में कौमी एकता अर्थात राष्ट्रीय एकता दिवस मनाये जाने के उद्देश्य पर प्रकाश डालते हुए अल्प संख्यक कल्याण, भाषाई सदभावना, कमजोर वर्ग के उत्थान, सांस्कृतिक एकता, महिला एवं पर्यावरण सुरक्षा दिवस की उपयोगिता पर प्रकाश डाला ।

डॉ रंगनादन रमणि, अध्यक्ष, लाख उत्पादन विभाग ने पर्यावरण सुरक्षा की आवश्यकता पर बल देते हुए अपने विचार रखे। श्री लक्ष्मी कान्त, सहायक निदेशक (रा.भा) ने झंडा दिवस एक विवेचन एवं ''भारतीय नारी, कल आज और कल और उनकी सहभागिता'' विषयक आलेख प्रस्तुत किया। सभा संचालन डॉ अंजेश कुमार, वरिष्ठ हिन्दी अनुवादक एवं धन्यवाद ज्ञापन श्री अशोक मल्लिक, प्रशासनिक अधिकारी ने किया।

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