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वार्षिक प्रतिवेदन


**Indian Lac Research Institute**
Ranchi, India

भाकृअनुप
ICAR

# वार्षिक प्रतिवेदन
# Annual Report

2006 – 07

**2007**

भाला.अनु.सं. ILRI

**भारतीय लाख अनुसंधान संस्थान**
**INDIAN LAC RESEARCH INSTITUTE**
( भारतीय कृषि अनुसंधान परिषद् )
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***Front Cover***

- Intensive lac cultivation on semialata
- Crimson and yellow lac insects



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# Preface

*The Institute contributed immensely to the development of lac production, processing and product development technologies besides making great strides in capacity building through various training programmes. The contributions in infrastructure development and resource generation were also appreciable.*

## Lac Production

*Ten lac insect stocks collected from various parts of the country were evaluated for their economic attributes and four new lac insect stocks collected from different districts of Maharashtra were added to the Field Gene Bank. Studies using RAPD profiles of* rangeeni *lac insect revealed differentiation as a distinct group besides divergence within the group. Certain geographic races showed distinct molecular profiles as also differences in taxonomic characters. A trial on host specific screening of* kusmi *lac insect stocks showed better performance of* kusmi *early on* Flemingia semialata *and* kusmi *late stocks on* ber, *during winter season crop. Half moon terracing and mulching proved superior in terms of vegetative growth and moisture conservation in a young* ber *plantation being raised under rainfed conditions. Two formulations of bio-pesticides namely Delfin and Biolep (*Bt *sub. sp.* kurstaki*) were found effective at dose levels of 0.05% applied twice for* rangeeni *and thrice for* kusmi *lac crop. Up to 90% suppression of lepidopteran insect predators was achieved.*

## Lac Processing and Product Development

*A small scale seedlac processing unit (cap. 100 kg) comprising of four separate machines was finalized and MoU signed with one firm for commercial manufacture. Removal of excess acid remaining after bleaching, with cold water (below 20$^0$C) enhanced keeping quality of bleached lac upto 12 months at normal temperature. A pilot plant for manufacture of technical grade lac dye (cap. 2 kg per batch) was erected. The trials revealed dye yield of 0.17 – 0.31 %; dye content, ash content*

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*and melting point in the range of 70.8 - 71.1 %, 0.7-1.10 % and 230-238$^0$C, respectively were recorded. Systematic comparative studies on different physico-chemical properties of Thai, Indonesian and Indian seedlac and shellac from NEH region revealed superiority of Indian* kusmi *seedlac and shellac with regard to flow, life, colour index and gloss. A large scale trial of shellac based emulsion paint revealed to possess better anti-fungal property and liberating less smell during application when compared to commercially available formulations in market. The Quality Evaluation Laboratory was awarded ISO 9001-2000 certificate for lac and lac-based products.*

## Transfer of Technology

*A small scale lac processing unit (cap. 100 kg) designed and developed by the Institute was transferred to M/s. National Enterprises, Hatia (Ranchi). Twelve such units have been sold to the states of Chhattisgarh, Jharkhand, Bihar, Uttar Pradesh and Gujarat. An exhaustive survey carried out on lac production, marketing and processing revealed national lac production to be about 23,200 tons during the year. It is showing increasing trend for which extension and training efforts of the institute have yielded good results. Other important findings are that the ratio of* rangeeni *to* kusmi *lac was about 60:40 and Chhattisgarh emerged as leading lac producer state with about 8,875 tons. Immense training programmes organized on and off-campus, benefited about 8,000 farmers besides many more through orientation programmes. Interactions and working in project mode with Govt. of Chhattisgarh, Gujarat, Jharkhand and Madhya Pradesh have yielded good results. A new host* Albizia procera *(*Siris*) has shown promise.*

## Infrastructure Development

*A 3.5 acres Gum and Resin Farm, a rain water pond in it, a new vehicle shed and two additional rooms in* Kisan *Hostel have been constructed, renovation of labs of Lac Production Division, Chemistry Lab, Quality Evaluation Lab and some major equipments like ultracentrifuge, HPTLC, power tiller etc were procured. Library has been shifted to the renovated old Entomology Lab building.*

*We acknowledge with gratitude, the guidance and support provided by Dr. Mangla Rai, DG, Dr. Nawab Ali, DDG (Engg.), Dr. Pitam Chandra, ADG (PE) for all that Institute was able to achieve during the year.*

**(Bangali Baboo)**
*Director*

# कार्यकारी सारांश

## 1. उत्पादकता एवं गुणवत्ता में सुधार

### लाख कीट जनन द्रव्य का संग्रह एवं मूल्यांकन

- लाख कीट की उपलब्धता एवं लाख की खेती की स्थिति के बारे में जानने के लिए महाराष्ट्र एवं कर्नाटक जिले के विभिन्न जिलों के चुने हुए स्थानों का अक्टूबर 2006 में एक सर्वे किया गया। महाराष्ट्र के दस जिलों जैसे जलगाँव, नन्दरबार, धुले, औरंगाबाद, अहमदनगर, शोलापुर, उस्मानाबाद, कोल्हापुर, पूना, मुंबई तथा कर्नाटक के दो जिलों गुलबर्गा एवं बीजापुर में सर्वे किया गया। धूले, कोल्हापुर, पूना एवं मुंबई को छोड़कर दौरा किये गए सभी स्थानों में लाख कीट पाये गये। लाख कीट की आबादी *एकेशिया निलोटिका* (बबूल), *अल्बीजीया समन* (रेन ट्री), *डलबर्जिया सिसू* (शीशम), *फाईकस बेंगालेंसिस* (बरगद), *एफ. लुसेन्स* (पाकुर), *एफ. रेलिजिओसा* (पीपल), *पेल्टोफोरम फेरुजेनियम* (पीला गुलमोहर), *पिथेकोलोबियम डल्स* (जंगल जलेबी) एवं *जिजीफस मॉरीशियाना* (बेर) पर पायी गई। किरमिजी एवं पीले दोनों लाख कीट लगभग बराबर संख्या में पाये गए।
- लाख कीट के दस स्टॉकों के उत्पादकता से जुड़े मानदंडो का अध्ययन इस वर्ष भी जारी रहा। दोनों फसल ऋतुओं में अध्ययन किये गए संभारो (स्टॉक्स) में आरम्भिक स्थापन का घनत्व, नर अनुपात एवं मादा कोशिका के आकार में बहुत भिन्नता देखी गई। जबकि आरंभिक मरणशीलता तथा फसल की परिपक्वता पर जीवित मादाओं के घनत्व में कम भिन्नता पाई गई। कोशिका का वजन, राल का उत्पादन एवं जननक्षमता कोशिका के आकार से सीधे जुड़े हैं। संभारों के कटाई - पूर्व मानदंडों में निरंतरता नहीं दिखती है तथा कटाई-उपरान्त गुणों की तुलना में उनके बाहरी कारकों से प्रभावित होने की संभावना ज्यादा होती है।

### लाख कीटों का आण्विक लक्षण निर्धारण

- आर.ए.पी.डी. रूपरेखा का उपयोग कर *के. लैक्का* के रंगीनी स्टॉक से निकाले गए सात अन्त: प्रजात वंशक्रमों का अध्ययन किया गया एवं प्राकृतिक रंगीनी वंशक्रम के साथ उसकी तुलना की गई। समान स्वरूप की तुलना से उनमें विशिष्ट समूह के निर्माण की ओर अग्रसर करने वाली भिन्नता का पता चलता है।
- परिपक्व मादा लाख की आकारिकी खास भौगोलिक किस्मों की आण्विक रूपरेखा से सबंधित है, जिसे लाख कीट के वर्गीकरण में उपयोग किया गया है। यह देखा गया कि इन किस्मों में मुख्य वर्गीकरण विज्ञान अभिलक्षणों के आकृति तत्वों की दृष्टि से गुदा नलिका, *ब्रैंकिया, एन्टीरियर स्पाइरेक्ल* एवं पृष्ठ कंटक में स्पष्ट भिन्नता होती है। इस तरह इन किस्मों के वर्गीकरण विज्ञान की स्थितियां संयुक्त आकारिकी एवं आण्विक मानदंडों के आधार पर तय की जानी चाहिए।

### कुसुम एवं गलवांग का लक्षण - वर्णन

- गलवांग और कुसुम की चुनी हुई उत्पादक जीनी संरचनाओं का आकारिकी लक्षण वर्णन किया गया एवं पहचान के लिए इन जीनी संरचनाओं का नैदानिक लक्षण रिकार्ड किया गया।

### कुसमी लाख कीटों की विशिष्ट परिपालकों के लिए परख

- *एफ. सेमियालता* के साथ-साथ *जेड.मॉरीशियाना* पर ग्रीष्म ऋतु की फसल (जेठवी-2006) का गमलों में तथा शरद ऋतु की फसल (अगहनी 2006-07) का प्रक्षेत्र की परिस्थितियों में अध्ययन किया गया। पाँच कुसमी लाख कीट स्टॉक जैसे कुसमी अगात, कुसमी पछात, उड़ीसा पीला कुसमी, कुलाजंगा एवं नवाडीह का मूल्यांकन किया गया। *एफ. सेमियालता* पर प्रति मीटर टहनी की लम्बाई पर जहाँ स्थापन आच्छादन न्यूनतम (उपलब्ध-टहनी की लम्बाई का 19.64%) था वहाँ बीहन लाख की उपज अधिकतम (263.9 ग्रा./मी., कुसमी अगात स्टॉक) थी। जैसे ही स्थापन आच्छादन में वृद्धि हुई (33.26%, कुलाजंगा स्टॉक) बीहन लाख की उपज कम होकर 164.8 ग्रा./मी. रह गई लेकिन प्रति झाड़ी से लाख की कुल प्राप्ति ज्यादा थी। 33.44% से ज्यादा आच्छादन से पौधों पर प्रतिकूल प्रभाव पड़ता है तथा वे सूख भी जाते हैं। अत: प्रति पौधा तथा प्रति मीटर टहनी पर अनुकूलतम बीहन लाख की उपज के लिए आरम्भिक स्थापन आच्छादन महत्वपूर्ण है। *जेड. मॉरीशियाना* की वहन क्षमता बिना पौधों को प्रभावित किये बेहतर थी। शरद ऋतु की फसल में कुसमी अगात स्टॉक, जो फरवरी के आरम्भ में परिपक्व होता है, ने *एफ. सेमियालता* पर बेहतर प्रदर्शन किया। इसके अतिरिक्त चूँकि फसल जल्दी परिपक्व होती है, लाख की

पपड़ी तने से नहीं अलग होती जैसा कि विलम्ब से परिपक्व होने वाली किस्मों में होता है तथा जिससे उत्पादित बीहन लाख की गुणवत्ता एवं मात्रा प्रभावित होती है। बेर पर मार्च में परिपक्व होने वाले कुसमी पछात स्टॉकों का प्रदर्शन बेहतर रहा।

### *फाईकस* प्रजातियों का कायिक प्रवर्धन

- *फ्लेमेंजिया सेमियालता* एवं *फाईकस* प्रजातियों (*फाईकस कुनीया* (*एफ. सेमिकॉर्डाटा*), *एफ. रेसमोसा, एफ. इन्फेक्टोरिया* (*एफ. लैक्कर*) एवं *एफ. ल्यूसेन्स*) पर जड़ की वृद्धि के लिए आइ बी ए एवं एन ए ए के विभिन्न सांद्रणों का परीक्षण किया गया। *फाईकस* प्रजातियों में समान ग्राम आजुक संयोजन का प्रदर्शन अन्य उपचारों एवं नियंत्रण से बेहतर रहा। *एफ. इन्फेक्टोरिया* में एन ए ए और आइ बी ए के समान ग्राम द्विआजुक (100 $\mu$एम) उपचार के अन्तर्गत 60 प्रतिशत की तुलना में नियंत्रण में 15 प्रतिशत जड़ निकलती हैं। *एफ. कुनीया* में 50 $\mu$एम (आइ बी ए + एन ए ए) के साथ नियंत्रण (10 प्रतिशत) की तुलना में जड़ निकलना बेहतर (35 प्रतिशत जड़ निकलना) रहा। इसी तरह *एफ. रेसमोसा* के कटे डंठल में 100 $\mu$एम (आइ बी ए + एन ए ए) से जड़ निकलने में 53.75 प्रतिशत वृद्धि हुई तथा नियंत्रण में यह केवल 17.5 प्रतिशत थी, जबकि *एफ. सेमियालता* में 100 $\mu$एम एन ए ए घोल के साथ नियंत्रण के 10 प्रतिशत की तुलना में जड़ का निकलना उच्चतम (80 प्रतिशत) रहा।

### बेर के सूक्ष्म प्रसार के संलेख का मानकीकरण

- नोडल खंडों, जिसमें सतह विसंक्रम पद्धति, प्ररोह द्विगुणन एवं जड़ निकलने के लिए उपयुक्त संवर्द्ध माध्यम एवं हॉरमोन का प्रयोग शामिल है, का उपयोग कर बेर (*जीजीफस मॉरीशियाना*) के सूक्ष्मप्रसार संलेख के मानकीकरण के लिए कई प्रयोग किये गए। मरकरी क्लोराइड का 0.1 प्रतिशत सतह विसंक्रम के लिए सबसे अच्छा था जिसके परिणामस्वरूप कलियों का निकलना 93 प्रतिशत एवं प्ररोह निकलना 50 प्रतिशत रहा। 70 प्रतिशत इथेनॉल के पूर्व उपचार से संक्रमण में कमी आती है। एक्सप्लांट को एम एस में संवर्द्धित किया गया एवं प्ररोह निकलने पर संचारण के दो सप्ताह बाद कैलस देखा गया। चार सप्ताह के अन्दर प्ररोहों की लम्बाई 4-5 से.मी. की हो गयी तथा गाँठों की संख्या 2-3 थी एवं हर फाइटोहारमोन के समावेश के परिणाम स्वरूप चार सप्ताह में 3-4 गाँठ हो गईं। एम एस माध्यम के साथ 10 $\mu$एम बी ए पी + 3.5 $\mu$एम काइनेटीन में प्ररोह की अधिकतम वृद्धि देखी गई। हालाकि उपयोग करने योग्य अधिकतम गाँठ 10 $\mu$एम बी एपी + 45 $\mu$ एम काइनेटीन के साथ प्राप्त हुई। 10 $\mu$एम आई बी ए के साथ माध्यम के मामले में जड़ थोड़ा पहले (दस दिन के बाद) निकली तथा प्राथमिक एवं द्वितीयक जड़ों की मुख्य संख्या क्रमश: 10.0 एवं 32.4 थी। इस तरह ग्रंथिल खंडों के माध्यम से *जेड. मॉरीशियाना* के सूक्ष्म प्रसार के लिए जड़ एवं प्ररोह के द्विगुणन के लिए एम एस माध्यम के साथ बी ए पी (10 $\mu$एम), काइनेटीन (4.5 $\mu$एम) एवं आइ बी ए (10 $\mu$एम) के प्रयोग की अनुशंसा की जाती है।

### लाख कीट - पोषक वृक्ष परस्पर क्रिया

- पाँच विभिन्न लाख परिपालकों पर *केरिया लैका* की रंगीनी और कुसमी प्रजाति के कटाई-पूर्व एवं कटाई-उपरान्त आर्थिक गुणों का अध्ययन किया गया। कुसमी का स्थापन रंगीनी की तुलना में घना देखा गया। विभिन्न परिपालकों पर भिन्न ऋतुओं में आरम्भिक स्थापन घनत्व, लिंग अनुपात एवं राल के उत्पादन में महत्वपूर्ण अन्तर देखा गया। *एकेशिया ऑरिकुलीफॉर्मिस, अलबीजीया ल्युसीडा* एवं *जीजीफस मॉरीशियाना* पर ग्रीष्म ऋतु की फसल परिपक्वता तक नहीं रह पाती है। *ब्यूटिया मोनोस्पर्मा, श्लेइचेरा ओलिओसा* एवं *जेड. मॉरीशियाना* की आबादी में उल्लेखनीय आनुवंशिक भिन्नता पायी गई। हालांकि विभिन्न परिपालक पौधों से प्राप्त लाख के रासायनिक/औद्योगिक मानदंडों में उल्लेखनीय भिन्नता नहीं पाई गई।

## 2. उत्पादन में सुधार एवं फसल प्रबन्धन

### गुजरात में लाख उत्पादन में दक्षता विकास एवं क्षमता निर्माण

- लाख कीट प्रजाति के स्थान विशेष में बदलाव एवं *एफ. सेमियालता, जीजीफस मॉरीशियाना* (बेर) *श्लेइचेरा ओलिओसा* (कुसुम) एवं *प्रोसोपीस जुलीफ्लोरा* (गंदा बावल) पर लाख उत्पादन प्रौद्योगिकियों के सुझाव दिये गए। प्रदर्शन एवं प्रशिक्षण के लिए एक आदर्श लाख उत्पादन प्रक्षेत्र के विकास हेतु एक रूप रेखा सुझाई गई। आयोजित किये गए प्रशिक्षण शिविरों में किसानों तथा वन विभाग के कार्मिकों सहित 140 लोग लाभान्वित हुए। (1) *जुलीफ्लोरा*-गुजरात के एक उपेक्षित खरपतवार पर कुसमी लाख की खेती, (2) गुजरात में *मॉरीशियाना* (बोर्डी) पर कुसमी लाख की खेती से उत्तम आय नामक दो तकनीकी बुलेटिनों के गुजराती में प्रकाशन के लिए पांडुलिपि सौंपी गई।

### संघटित लाख उत्पादन प्रणाली

- भलिया की एक पंक्ति में सब्जियों अनुसूची-1 (ओकरा, लहसून एवं करैला क्रमशः खरीफ, रबी एवं जैद सीजन के दौरान) को पौध अन्तर फसल के रूप में लगाने के तरीके के अन्तर्गत लाख के संचारण के पूर्व पौध वृद्धि गुणों को रिकार्ड करने से पता चला कि इनका मान शरद ऋतु की लाख फसल (अगहनी) के दौरान अधिकतम है जबकि ग्रीष्म ऋतु में इन सब्जियों की अन्तर फसल जैसे सम्बंधित मौसम के अदरख, टमाटर एवं लौकी के साथ भलिया की दो पंक्तियों में था। अगहनी फसल में अन्तर फसल के रूप में सब्जी के साथ बीहन लाख एवं यष्टिलाख की उपज क्रमशः 60.47 - 65.41 तथा 17.54 - 19.63 कि./हे. होती है जबकि बिना सब्जी के क्रमशः 28.09 - 29.54 एवं 8.11 - 8.56 कि./हे. होती है। इसी तरह के परिणाम ग्रीष्म कालीन लाख फसल (जेठवी) में भी प्राप्त हुए परन्तु लाख की उपज कम रही।

### लाख कीट परभक्षियों का जैव-संगत प्रबंधन

- लाख फसल के दो मुख्य *लेपिडोप्टेरन* परभक्षियों जैसे *यूब्लेमा एमाबीलीस* एवं *स्यूडोहाइपोटोपा पल्वेरिया* के प्रबंन्धन के लिए *ट्राइकोग्रामा एकी, टी. ब्रैसीलेन्स, टी. इक्जीगम, टी. आस्ट्रेनी, टी. पोलाई* एवं *टी. प्रेटिओसम* नामक अंड परजीवियों का *ब्यूटीया मोनोस्पर्मा* (पलास) एवं *जीजीफस मॉरीशियाना* (बेर) पर प्रतिवृक्ष 100 अंड परजीवी, *स्लेईचेरा ओलिओसा* (कुसुम) पर 300 अंड परजीवी प्रतिवृक्ष जबकि झाड़ीदार परिपालक पौधों *फ्लेमेंजिया मैक्रोफाईला* (भालिया) एवं *अल्बीजीया ल्युसीडा* (गंलवांग) के लिए प्रतिझाड़ी 20 अंड परजीवियों की संख्या को छोड़ना प्रभावकारी है। लाख फसल के संचारण के 30 दिन के अन्तराल पर अंड परजीवियों को दो बार छोड़ना बहुत प्रभावी सिद्ध हुआ। विभिन्न परिपालक पौधों पर विभिन्न फसलों में लाख कीट परभक्षियों की संख्या में 56-90 प्रतिशत कमी देखी गई।

- *डैलफिन* और *बोयोलेप* नामक *बैसिलस थुरीनजेन्सीस* उप प्रजाति *कुर्सटकी* आधारित जैव-पीड़कनाशी के विभिन्न सुत्रणों के मूल्यांकन में रंगीन लाख फसल एवं कुसमी लाख फसल पर क्रमशः दो और तीन बार 0.05 प्रतिशत मात्रा का प्रयोग करने से *लेपिडोप्टेरन* लाख कीट परभक्षियों के विरूद्ध प्रभावी पाया गया। रंगीनी लाख फसल पर दो बार तथा कुसमी लाख फसल पर तीन बार के प्रयोग से *लेपिडोप्टेरन* लाख कीट परभक्षियों में लगभग 90 प्रतिशत कमी पायी गई।

### लाख पोषक वृक्षों हेतु स्व-स्थाने नमी संरक्षण

- बेर और कुसुम के मिश्रित बागान के लिए पाँच स्व-स्थाने नमी संरक्षण तकनीक अपनाई गई। कायिक वृद्धि एवं नमी संरक्षण के मामले में अन्य उपचारों की तुलना में अर्द्धचन्द्र वेदिका एवं पलवार बेहतर रहा। नियन्त्रण की तुलना में विभिन्न नमी संरक्षण उपायों को उपयोग में लाने से मिट्टी की नमी में सुधार हुआ, हालांकि साँख्यिकी की दृष्टि से सभी उपचार समान थे। पौधों की ऊँचाई के मामले में सभी महीनों में अर्द्ध चन्द्र वेदिका नियंत्रण की तुलना में उल्लेखनीय रूप से बेहतर रहे जब कि पलवार एवं खानेदार बांध उल्लेखनीय रूप से सभी महीनों में बेहतर रहा। पौधों की ऊँचाई का विस्तार, अर्द्ध चन्द्र वेदिका, पलवार, खानेदार बंध, आच्छादन फसल के रूप में उरद का उपयोग एवं नियन्त्रण उपचारों के अन्तर्गत क्रमशः 124.32, 146.76, 134.76, 121.09 एवं 122.53 से.मी. था। उरद दाने, डंठल एवं कुल जैव मास (डंठल + जड़ + पत्तियां) की औसत उपज क्रमशः 106.25 कि.ग्रा./हे., 580.52 कि.ग्रा./हे. एवं 1683.94 कि.ग्रा./हे. थी। विभिन्न नमी संरक्षण तकनीकों के प्रयोग करने पर भी कुसुम के पौधों के वृद्धि गुणों में कोई महत्वपूर्ण अन्तर नहीं देखा गया।

### बेर पर कुसमी लाख उत्पादन का मूल्याकंन

- कार्बेन्डाजिम एवं *बी. थुरीन्जीएन्सीस* प्रजाति *कुर्सट्की* का प्रयोग कर उन्नत विधि से लाख की खेती करने से कीट मरणशीलता एवं लाख परभक्षियों की संख्या में क्रमशः 25.3 एवं 66.6 प्रतिशत की कमी आती है। कटाई के चरण में जैव-नाशीकीट के छिड़काव से लाख पपड़ी की मोटाई में 17% कमी देखी गई। परिणाम से ऐसा लगता है कि अगहनी लाख की खेती के लिए फरवरी की छंटाई एवं बिना छंटाई के वृक्ष (वृक्ष जिनकी टहनिया 14 माह पुरानी हो) की तुलना में अप्रैल में छंटाई किया जाना समान रूप से अच्छा है। कुल मिलाकर अन्य दोनों प्रकार की तुलना में अप्रैल में छंटाई की गई शाखाओं की अनुकूलता बेहतर थी। लाख की वृद्धि एवं उपज के लिए दक्षिण-पूर्व दिशा सर्वाधिक उपयुक्त व उत्तर-पश्चिम सबसे कम अनुकूल है तथा इन दिशाओं की टहनियों पर एक वृक्ष की उपज क्रमशः 30.6% तथा 19.2% होता है।

## 3. प्रसंस्करण एवं मूल्यवर्द्धन

### पद-चालित लाख धोवन मशीन की अभिकल्पना एवं विकास

- छोटी प्रसंस्करण इकाईयों में विद्युत चालित धोवन मशीन के उपयोग की सीमाएं एवं हाथ से धोने में आने वाली

समस्याओं को ध्यान में रखते हुए, एक कम क्षमता की पद-चालित लाख धोवन मशीन की अभिकल्पना, विकास एवं परीक्षण किया गया। विकसित की गयी लाख धोवन मशीन एक बार में 35 कि.ग्रा. संदलित लाख को धोती है तथा प्रत्येक बार में 2-2.5 घंटे का समय लेती है। मशीन चलाने के लिए दो व्यक्तियों की आवश्यकता होती है। धुली हुई लाख की गुणवता को चौरी की आई. एस. : 6921-1973 विशिष्टता के अनुरूप पाया गया है।

### भण्डारण से लाख की गुणवत्ता में बदलाव

- भंडारण के आरंभिक चरण में ऑक्सीकरणरोधी के प्रयोग से कुसमी की ग्रीष्म फसल (जेठवी) एवं रंगीनी लाख की वर्षाकालीन फसल (कतकी) के मामले में चौरी एवं चपड़ा दोनों का अवक्रमण कम से कम छः महीने देर से होता है। चौरी और चपड़ा वर्षा ऋतु में नमी शोषित करते हैं तथा शरद ऋतु के दौरान इसे विमुक्त करते हैं। अगर आरम्भिक नमी की मात्रा 2% से कम हो तो यष्टि लाख/चौरी/चपड़ा को छिद्रित कागज के कार्टन में कमरे के तापमान पर चार वर्ष तक रखने से कोई जमाव नहीं होता है।

### अन्य देशों की लाख की तुलना में भारतीय लाख की गुणवत्ता

- थाइलैंड, इन्डोनेशिया एवं भारत के उत्तर पूर्वी राज्यों से प्राप्त चौरी एवं चपड़े के विभिन्न भौतिक-रासायनिक गुणों के व्यवस्थित तुलनात्मक अध्ययन से पता चलता है कि भारतीय (कुसमी) चौरी एवं चपड़ा; बहाव, आयु, रंग सूचकांक एवं चमक की दृष्टि से बेहतर है।

### लाख भण्डारण के तरीके एवं इनसे हुई क्षति का आकलन

- चौरी एवं चपड़े के भंडारण के लिए वर्त्तमान में उपयोग में लाए जाने वाले तरीकों की जानकारी प्राप्त करने के लिए विभिन्न लाख उद्योगों का सर्वे किया गया। सामान्यतः इन्हें पक्के फर्श पर हवादार ठंडी जगह में फैलाकर रखा जाता है जिससे उत्पाद से नमी को दूर करने में सहायता मिलती है। चपड़े को जूट/कागज के बोरे में बन्द कर दूसरी जगहों पर ले जाया जाता है। ग्रीष्म एवं वर्षा ऋतु के दौरान गर्म मौसम के कारण जमने से रोकने के लिए चपड़े को 14-18° से. के बीच तापमान वाले वातानुकूलित भंडार में रखा जाता है। चौरी एवं चपड़ा को सामान्यतः 60-75 कि.ग्रा. क्षमता के जूट के बोरे में पैक किया जाता है। लाख के भंडारण/परिवहन के लिए प्लास्टिक के बोरे का उपयोग नहीं किया जाता है क्योंकि ताप एवं दबाव के कारण यह प्लास्टिक से चिपक जाता है। विरंजित लाख, मोमरहित लाख एवं मोमरहित रंगहीन लाख ज्यादातर पक्के फर्श पर 15-20° सें. तापमान के बीच वातानुकूलित गोदाम में फैलाकर रखी जाती है तथा परिवहन के लिए कागज के थैले (25 कि. ग्रा. क्षमता) में पैक की जाती है। लाख आधारित उत्पादों के भंडारण, प्रबंधन एवं परिवहन के दौरान कटाई-उपरान्त क्षति का भी आकलन किया गया। क्षति मुख्य रूप से सूखने के कारण होती है। इसके अतिरिक्त उत्पाद का खुले में भंडारण करने के कारण 0.1 - 0.5% तक बिखराव से क्षति होती है।

## 4. उत्पाद विकास एवं उपयोग विविधिकरण

### लाख आधारित जूट-फाईबर ग्लास संबंलित सीट

- जूट-रेशा ग्लास संबंलित सीट (मोटाई 6-7 मि.मी.) की नमन शक्ति (82.6 - 91.5 एमपीए) केवल रेशा ग्लास का उपयोग कर तैयार की गई संबलित सीट की श्रेणी की पायी गयी जो अच्छी शक्ति का संकेत है। बड़े आकार की सीट बनाने के प्रयास के अन्तर्गत अलग-अलग रंगों व आकार की 5' × 3' एवं 6' × 3' दो जूट कपड़ा - रेशा ग्लास संबलित सीट (मोटाई 4 मि.मी.) तैयार की गयी। वाणिज्यिक रूप से उपलब्ध प्लाईवुड एवं पार्टिकल बोर्ड को जूट-रेशा ग्लास से परतबन्दी करने से मजबूती एवं नमन भार में उल्लेखनीय सुधार देखा गया।

### विरंजित लाख की भण्डारण गुणवत्ता में सुधार

- क्लोरीन के कम अंश वाले विरंजक द्रव का उपयोग कर पिण्डक की आकृति में बनायी गयी विरंजित लाख से 20° सें. से कम तापमान के ठंडे पानी से अत्याधिक अम्ल (विरंजन के बाद) को हटाने से गुणवत्ता संरक्षण (बारह महीने तक) में वृद्धि होती है। पिघले हुए विरंजित लाख से गर्म पानी में तैयार पिण्डक में 20% तक नमी रहती है जबकि सांचे द्वारा तैयार पिण्डक में आरम्भ में ज्यादा नमी होती है तथा अन्त तक 20% नमी बनी रहती है।

### लाख रंजक के लिये पॉयलट संयंत्र

- तकनीकी श्रेणी के लाख रंजक की तैयारी के लिए एक पाइलॅट संयंत्र बनाया गया है। इस पाइलॅट संयंत्र द्वारा कुसमी (*फुंकी*) यष्टिलाख के धोवन जल का उपयोग कर पाँच बैचों में रंजक (रंग) तैयार किया गया जिसका उत्पादन 0.17 - 0.31% रहा। रंजक का रंग अंश, राख अंश एवं गलन (द्रवण) बिन्दु क्रमशः 70.8 - 71.1%, 0.70 - 1.10% एवं 230-238° सें. थे।

### लाख आसंजक के साथ कम्पोजिट बोर्ड का निर्माण

- अरहर की डंडियों के साथ यष्टि लाख का बंधन सामग्री के रूप में प्रयोग कर कोलकाता की एक बोर्ड फैक्टरी में कम्पोजिट बोर्ड के परीक्षण निर्माण का सोपानीकरण किया गया। 7' × 3' एवं 8' × 4' आकार के कम्पोजिट बोर्ड तैयार किये गये। आइ.एस. 3087 - 1985 (टाईप-2) विशिष्टिकरण की आवश्यकताओं के अनुरूप जलीय माध्यम के साथ यष्टिलाख के उपयोग की तुलना में अल्कोहल माध्यम बेहतर रहा। बोर्ड को छः दिन बाहर में रखकर दीमक प्रतिरोध की जाँच की गई तथा पता चला कि यह वाणिज्यिक रूप से उपलब्ध उत्पादों की तुलना में उत्कृष्ट है। ऐसा पाया गया कि पर्याप्त यांत्रिक शक्ति वाले पार्टिकल बोर्ड के निर्माण के लिए यष्टि लाख के साथ बन्धन सामग्री के रूप में 10-15% गंधराल का उपयोग किया जा सकता है।

### एल्यूरिटीक अम्ल से जैव कारक पदार्थ

- एल्यूरिटीक अम्ल से 10-कार्बोक्सीमिथाईल-2-डेसेनोइक अम्ल (सीडीएमए) एवं मिथाईल 9-सल्फोनीलॉक्सी-2-नोनेनोएट, प्रत्येक 5.0 ग्राम का संश्लेषण किया गया एवं इसे *फ्लेमेंजिया सेमियालता*, बेर (*जीजीफस मॉरीशियाना*) एवं परवल (*ट्राइकोसेंथिस डाइवेका*) पर उपयोग की अनुकूलता के मूल्यांकन के लिए संस्थान की जैव-प्रौद्योगिकी प्रयोगशाला एवं अनुषंगी संगठन, वा.कृ.शो.का. (हार्प) पलांडु, राँची को भेजा गया।

- एल्यूरिटीक अम्ल से प्रत्येक 2.0 ग्रा., (जेड)-9-हेक्साडेसेनल, (जेड)-9-हेक्साडेसेनाइल एसीटेट, (जेड)-9-टेट्राडेसिनाइलएसीटेट, (जेड)-7-डोडेसेनाइल एसीटेट एवं 16-एसीटॉक्सी-(इ)-9-हेक्साडेसेनोइस अम्ल का संश्लेषण किया गया। संश्लेषित किये गए विभिन्न हारमोनों की क्षमता का तुलनात्मक प्रक्षेत्र परीक्षण हार्प, पलांडू (राँची) में टमाटर एवं बैंगन पर किया जा रहा है। 4.0 ग्रा. (जेड)-9-हेक्साडेसेनल एवं 2.5 ग्रा. (जेड)-11-हेक्साडेसेनल संश्लेषित किया गया एवं प्रक्षेत्र परीक्षण के लिए एन.सी.आई.पी.एम., आई.ए.आर.आई., नई दिल्ली एवं आई.आई.सी.टी. हैदराबाद भेजा गया।

### लाख आधारित नाखून पॉलिस

- पारिस्थितिकी के अनुकूल एवं किफायती रंग रहित मोम रहित लाख (डी डी एल) आधारित नाखून पॉलिस रंगरहित विरंजित लाख (डी बी एल) आधारित नाखून पॉलिस की तुलना में उत्कृष्ट पायी गयी। लाख आधारित नाखून पॉलिस लगाने के साथ सूखना, कड़ापन, चिकनाहट, चमक, टिकाऊपन एवं जल अवरोध की दृष्टि से दो प्रतिष्ठित ब्रैंड से बेहतर पायी गयी।

### चपड़ा आधारित इमल्शन पेंट

- चपड़ा आधारित इमल्शन पेंट बड़े पैमाने पर (80 ली.) तैयार किया गया एवं इसे संस्थान की विभिन्न दीवारों पर प्रयोग कर मूल्यांकन किया गया। ऐसा पाया गया कि इस पेंट में वाणिज्यिक ब्रैंड की तुलना में बेहतर कवकरोधी गुण हैं तथा प्रयोग के समय दुर्गन्ध भी नहीं आती है।

## 5. प्रौद्योगिकी मूल्यांकन, परिष्करण एवं प्रसार

### लाख बहिःस्राव का उपचार

- लाख कारखाने से प्राप्त बहिःस्राव के साथ (अ) हाइड्रोक्लोकि अम्ल (ब) हाइड्रोक्लोरिक अम्ल एवं चूना (स) अम्ल, चूना एवं हाइपोक्लोराइट घोल (द) क्लोरीन गैस (ई) क्लोरीन गैस एवं उत्प्रेरित कोयले (फ) हाइपोक्लोराइट घोल एवं उत्प्रेररित कोयला के लगातार उपचार के बाद भी बहिःस्राव का टी.डी.एस. निर्धारित सीमा 2100 मि.ग्रा. प्रति लि. से नीचे नहीं आ पाता है, अतः ये सभी उपचार अनुकूल नहीं पाये गए। एलम एवं हाइपोक्लोराइट के उपचार से टी.डी.एस. में कुछ सीमा तक कमी आई।

### लाख उत्पादन, विपणन एवं प्रसंस्करण सम्बन्धी जानकारी

- राष्ट्रीय स्तर पर लाख के उत्पादन, विपणन मूल्य, बाजार में आमद, लाख उत्पादन के अनुमान की जानकारी एकत्र करने एवं राष्ट्रीय स्तर के प्रसंस्करण केन्द्रों में प्रसंस्करण की जाने वाली लाख की मात्रा का पता लगाने के लिए एक अध्ययन किया गया। आंकड़े इकट्ठा करने हेतु लाख बाजार एवं प्रसंस्करण इकाईयों के लिए अलग से अनुसूची / प्रश्नावली विकसित की गई। विभिन्न राज्यों के लाख उत्पादक जिलों के बाजारों में किये गए सर्वे के आधार पर यह आकलन किया गया कि वर्ष 2006-07 की अवधि में यष्टिलाख का राष्ट्रीय उत्पादन लगभग 23,229 टन था। उत्पादन में छत्तीसगढ़ प्रथम एवं उसके बाद झारखंड, मध्यप्रदेश, महाराष्ट्र एवं प. बंगाल का नाम आता है। ये पाँच राज्य राष्ट्रीय लाख उत्पादन में लगभग 95 प्रतिशत योगदान करते हैं। देश के विभिन्न लाख प्रसंस्करण केन्द्रों में किये गए सर्वे के आधार पर यह आकलन किया गया कि वर्ष 2005-06 में प्रसंस्कृत की गई यष्टिलाख की मात्रा लगभग 28,890 टन थी।

## 6. लाख उत्पादन, प्रसंस्करण एवं मूल्यवर्द्धन में क्षमता निर्माण के लिए मानव संसाधन विकास

### प्रशिक्षण उपलब्धियाँ

- संस्थान ने किसानों, गृहिणियों के लिए नियमित प्रशिक्षण एक दिवसीय अभिविन्यास कार्यक्रम, प्रक्षेत्र प्रशिक्षण, क्षेत्र में शिक्षण एवं प्रोत्साहन प्रशिक्षण, प्रशिक्षक प्रशिक्षण एवं क्षेत्र स्तर पर प्रदर्शन जैसे प्रशिक्षण कार्यक्रम आयोजित किये। संस्थान के द्वारा आयोजित विभिन्न प्रसार गतिविधियों के अन्तर्गत आठ हजार से ज्यादा लोगों को लाभ हुआ।

### पुरस्कार

- लाख की खेती के क्षेत्र में उल्लेखनीय योगदान के लिए डॉ. अजय भट्टाचार्य, प्रधान वैज्ञानिक एवं अध्यक्ष, प्रौ. ह. विभाग, भा.ला.अनु.सं., राँची को का.हि.वि.वि., बनारस में आयोजित 8वीं भारतीय कृषि वैज्ञानिक एवं किसान कांग्रेस में 21 फरवरी 2006 को बायोवेद रिसर्च सोसायटी, इलाहाबाद द्वारा फेलोशिप पुरस्कार 2006 प्रदान किया गया।

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# EXECUTIVE SUMMARY

## 1. Productivity and Quality Improvement

### *Collection and evaluation of lac insect germplasm*

- A survey of selected places in different districts of Maharashtra and Karnataka was undertaken during October 2006 to know the availability of lac insects and status of lac cultivation. Ten districts in Maharashtra *viz.*, Jalgaon, Nandurbar, Dhule, Aurangabad, Ahmednagar, Solapur, Osmanabad, Kolhapur, Pune, Mumbai and two districts in Karnataka *viz.*, Gulbarga and Bijapur were surveyed. Lac insect was observed at all the places visited except in the districts of Dhule, Kolhapur, Pune and Mumbai. Lac insect populations were observed on *Acacia nilotica* (*babool*), *Albizia saman* (rain tree), *Dalbergia sissoo* (*shisham*), *Ficus bengalensis* (*bargad*), *F. luscence* (*pakur*), *F. reliogiosa* (*pipal*), *Peltophorum ferrugenium* (yellow *gulmohar*), *Pithecollobium dulce* (*jungle jalebi*) and *Ziziphus mauritiana* (*ber*). Populations of both crimson as well as yellow lac insects were encountered almost in equal frequency.
- Studies on productivity-linked parameters of the ten lac insect stocks continued this year also. Initial density of settlement, male proportion and size of the female cell showed greater range of variations among the stocks studied in both the crop seasons. Whereas, initial mortality and living female density at crop maturity showed lesser variations. Weight of the cell, resin output and fecundity are directly correlated with the size of the cell. Pre-harvest parameters with in a stock did not show consistency and are more likely to be influenced by external factors in comparison to post-harvest attributes.

### *Molecular characterization of lac insects*

- Seven inbred lines derived from a *rangeeni* stock of *Kerria lacca* have been studied using RAPD profiles and compared with natural *rangeeni* lines. Comparison of similarity indices revealed their differentiation leading to formation of a distinct group. The seven inbred lines also showed divergence within the group.
- Molecular profiles of particular geographic races were related to morphology of mature lac insect females, which is used in the taxonomy of lac insects. It was seen that these lines showed distinct differences with respect to structural features of key taxonomic characters such as anal tubercle, branchia, anterior spiracle and dorsal spine. The taxonomic status of these lines is thus, to be ascertained based on combined morphological and molecular parameters.

### *Charecterization of* kusum *and* galwang

- Morphological characterization of selected productive genotypes of *galwang* and *kusum* was done and diagnostic character for these genotypes recorded for identification.

### *Host specific screening of* kusmi *lac insect stocks*

- Summer season crop (*jethwi*, 2006) on *F. semialata* as well as on *Z. mauritiana* was studied under potted conditions and winter season crop (*aghani* 2006-07) under field conditions. Five *kusmi* lac insect stocks *viz.*, *kusmi* crimson early, *kusmi* crimson late, Orissa *kusmi* yellow, Kulajanga crimson and Nawadih crimson were evaluated. On *F. semialata*, weight of broodlac per meter shoot length was the highest (263.9 g/m, *kusmi* early stock) where settlement coverage was the lowest (19.64% of the available shoot length). As the settlement coverage increased (33.26%, Kulajanga stock) weight of broodlac was reduced to 164.8 g/m but total quantity of the lac obtained per bush was higher. Above 33.44 % coverage, the plant was adversely affected leading even to its death. Initial settlement coverage is, therefore, important to obtain

optimum broodlac yield per plant as well as yield per meter shoot length. *Z. mauritiana* showed better carrying capacity without affecting the plant. During winter season crop, *kusmi* early stock, which matured in early February, performed better on *F. semialata*. Moreover, as the crop matured early, lac encrustation did not detach from the stem as is the case in late maturing varieties affecting quantity and quality of the broodlac produced. While on *ber*, performance of *kusmi* late stocks, which matured in March, was better.

*Vegetative propagation of Ficus spp.*

- Cuttings of *Flemingia semialata* and *Ficus* spp. (*Ficus cunia syn F. semicordata, F. racemosa, F. infectoria syn. F. lacor* and *F. lucescence)* were tried for rooting enhancement with different concentration of IBA and NAA. The equi-molar combinations showed better performance than other treatments and control in *Ficus* spp. Rooting in *F. infectoria* was recorded as 60 % with the treatment of equi bi-molar solution (100 µM) of NAA and IBA as compared to 15 % in control. Rooting in *F. cunia* showed better performance (35% root initiation) with 50 µM (IBA + NAA) in comparison to control (10%). Similarly, cuttings of *F. racemosa* showed 53.75% increase in initiation of rooting with 100 µM (IBA + NAA), it was 17.5% only in control. Whereas, in *F. semialata* highest root initiation (80 %) was observed in 100 µM NAA solution as compared to 10% in control.

*Standardization of protocol for micropropagation of ber*

- A series of experiments were conducted for standardization of protocol for micropropagation of *ber* (*Z. mauritiana*) using nodal segments, which included surface sterilization method, suitable culture media and hormone application for shoot multiplication and rooting. $HgCl_2$ at 0.1% was found best for surface sterilization resulting in 93% asceptic buds and 50% shoot initiation. Prior treatment with 70% ethanol minimized contamination. The explants were cultured in MS media and callusing was observed two weeks after inoculation followed by shoot initiation. The shoots attained a height of 4-5 cm with a mean number of 2-3 nodes within four weeks and resulted in 3-4 nodes in another four weeks with incorporation of any phytohormones. Maximum shoot growth was observed in MS media supplemented with 10 µM BAP + 3.5 µM kinetin. However, maximum number of usable nodes was obtained with 10 µM BAP + 4.5 µM kinetin. In case of medium supplemented with 10µM IBA the root initiation was early (after 10 days) and the mean numbers of primary roots and secondary roots were 10.0 and 32.4, respectively. Thus, MS medium with application of BAP (10 µM), kinetin (4.5 µM) and IBA (10 µM) is recommended for shoot and root multiplication for micropropagation of *Z. mauritiana* through nodal segments

*Lac insect – host plant interaction*

- Pre-harvest and post-harvest economic attributes of *rangeeni* and *kusmi* strain of *K. lacca* were studied on five different host-plants. *Kusmi* strain showed tendency of settling closer than *rangeeni*. Initial density of settlement, sex ratio and resin output varied significantly on different hosts and in different seasons. Summer crop did not survive to crop maturity on *Acacia auriculiformis, Albizia lucida* and *Z. mauritiana*. Considerable genetic variation was scored in population of *Butea monosperma*, *Schleichera oleosa* and *Z. mauritiana*. However, chemical /

industrial parameters of the lac obtained from different host-plants did not show significant variations.

## 2. Production Improvement and Crop Management

*Skill development and capacity building in lac culture in Gujarat*

- Location specific amendments for selection of lac insect strain and also in lac production technologies on *F. semialata, Z. mauritiana (ber), S. oleosa (kusum)* and *Prosopis juliflora (ganda bawal)* in Gujarat have been recommended. Layout for developing a model Lac Production Farm for demonstration and training was provided. Training camps were organized for 140 participants including farmers and forest officials. Manuscript for two technical bulletins namely i) *Kusmi* lac cultivation on *juliflora*, a derided weed in Gujarat and ii) High returns from *kusmi* lac cultivation on *mauritiana, (bordi)* in Gujarat were prepared for publication in Gujarati.

*Integrated lac production system*

- Plant growth attributes of *Flemingia semialata* recorded prior to lac inoculation showed maximum value for plant growth attributes during winter season lac crop (*aghani*) at single row planting pattern with vegetable intercrops of Schedule I (okra, garlic and bitter-gourd during *kharif, rabi* and *zaid* season, respectively) whereas, during summer season it was in paired row with vegetable intercrops *i.e.* ginger, tomato and bottle gourd in respective season. Broodlac and sticklac yields to the tune of 60.47-65.41 and 17.54-19.63 q/ha can be obtained from the *aghani* crop with vegetable inter crops as compared to 28.09-29.54 and 8.11-8.56 q/ha respectively without integration. Similar trends were obtained during summer lac crop (*jethwi*) but the lac yields were low.

*Bio-rational management of lac insect predators*

- For the management of the two key lepidopteran lac insect predators *viz.*, *Eublemma amabilis* and *Pseudohypatopa pulverea* on the lac crop, effective release doses of egg parasitoids namely *Trichogramma achaeae, T. brasiliense, T. exiguum, T. ostrinae, T. poliae* and *T. pretiosum* for *Butea monosperma* (*palas*) and *Z. mauritiana* (*ber*) were 100 egg parasitoids per tree; for *Schleichera oleosa* (*kusum*), the dose was 300 eggs parasitoids per tree while for the bushy host plants *Flemingia macrophylla* (*bhalia*) and *Albizia lucida* (*galwang*), it was 20 egg parasitoids per bush. Two releases of egg parasitoids at an interval of 30 days after lac crop inoculation have proved very effective. 56-90 percent reduction in the number of lac insect predators was observed in the different crops raised on different host plants.

- Evaluation of different formulations of *Bacillus thuringiensis* sub sp. *kurstaki* based bio- pesticide namely Delfin and Biolep were found to be effective against both the lepidopteran lac insect predators at a dose of 0.05% applied twice for *rangeeni* lac crop and thrice for *kusmi* lac crop. Per cent reduction of lepidopteran lac insect predators was found to be around 90 when applied twice for *rangeeni* lac crop and thrice for *kusmi* lac crop.

In-situ *moisture conservation for lac hosts*

- Five *in-situ* moisture conservation techniques were applied for raising mixed plantation of *ber* and *kusum*. Half moon terracing and mulching showed superiority over other treatments in terms of vegetative growth and moisture conservation. There was improvement in soil moisture status on account of adopting different moisture conservation measures over control, though all the treatments were at par statistically. In terms of plant height half moon terracing was significantly superior over control in all the months, while mulching and compartmental bunding were found significantly superior in most of the months. The magnitude of increment in plant height was 124.32, 146.76, 134.76, 121.09 and 122.53 cm for

half moon terracing, mulching, compartmental bunding, use of *urd* as cover crop treatments and the control respectively. The average yield of *urd* grain, stalk and total biomass (stalk + roots + leaves) was 106.25 kg/ha, 580.52 kg/ha and 1683.94 kg/ha, respectively. No significant difference was observed in *kusum* plants' growth attributes in different treatments.

*Evaluation of* kusmi *lac production on* ber

- Improved method of lac cultivation using carbendazim and *B. thuriengiensis* sp *kurstaki* reduced insect mortality and lac predator population by 25.3 and 66.6%, respectively. 17% reduction in thickness of lac encrustation was observed due to spray of bio-pesticide at the harvesting stage. Result suggested that April pruning is equally good for *aghani* lac cultivation as compared to Feb. pruning and un-pruned trees (trees with 14 months old shoots). Over all suitability of April pruned branches proved to be better than other two types. South-East direction proved to be the most suitable and South-West direction the least suitable site for lac growth and yield, accounting for 30.6% and 19.2%, respectively of the yield on a tree.

## 3. Processing and Value Addition

*Design and development of pedal operated lac washing machine*

- A small capacity pedal operated lac washing machine has been designed, developed and tested considering the problems faced in manual vat washing and limitations of using large power operated lac washing machine in small lac processing units. The developed lac washing machine washes 35 kg crushed lac per batch and for washing each batch 2-2.5 hours time is required. Two persons are required to operate the machine. The quality of washed lac was found to be as per the requirements of IS - 6921-1973: Specifications of seedlac.

*Changes in lac quality with storage*

- Application of an antioxidant in the early stage of storage delayed degradation of both seedlac and shellac at least by 6 months in the case of summer crop (*jethwi*) of *kusmi* and rainy season crop (*katki*) of *rangeeni* lac. Seedlac and shellac absorb moisture from environment during rainy season and releases the same during winter season. No blocking of sticklac/seedlac/shellac was observed during storage at room temperature inside perforated paper cartons for 4 years, provided initial moisture content was less than 2%.

*Quality of Indian lac with respect to that produced by other countries*

- Systematic comparative study on different physico-chemical properties of Thai, Indonesian and Indian seed lac and shellac of NEH revealed that quality of Indian (*kusmi*) seedlac and shellac is better with regard to flow, life, colour index and gloss.

*Lac storage practices and loss assessment*

- Survey of different lac industries was made to know the existing practices of storing seedlac and shellac. These are, in general, stored by spreading on concrete floors in a well-ventilated cool place, which also help in removal of moisture from the products. Shellac is packaged and transported in gunny/paper bags. During summer and rainy season, shellac is stored in air-conditioned warehouses, maintained at temperature 14-18$^0$C to prevent its blocking in hot weather. Seedlac and shellac, in general, are packed in gunny bags of 60-75 kg capacity each. Plastic bags are not used for storage/ transportation of lac as it sticks to the material under heat and pressure. Bleached lac, dewaxed shellac and dewaxed decolourized lac are, most often, stored in air conditioned godown, at around 15-20$^0$C temperature by spreading on cemented floor and packed in paper bags (25 kg packing) for transportation. Post-harvest losses of lac based products during storage, handling and transportation were also assessed. Losses were found mainly due to driage; besides loss to the extent of 0.1-0.5% occurs due to shattering of the products in loose storage.

## 4. Product Development and Use Diversification

*Lac based jute – fibre glass reinforced sheets*

- Flexural strength (82.6 –91.5 MPa) of jute-fibre glass reinforced sheets (thickness 6-7 mm) was found to be in the range of reinforced sheets prepared using fibre glass alone, indicating very good strength. Two 5' x 3' and one 6' x 3' jute fabric/cloth – fibre glass reinforced sheets (4 mm thickness) of two different colours were prepared as an attempt to produce bigger size sheets. Considerable improvement in impact strength and flexural load was obtained when commercial plywood and particle board were laminated with jute-fibre glass.

*Enhancing keeping quality of bleached lac*

- Removal of excess acid (after bleaching) with cold water below 20$^0$C enhances keeping quality of bleached lac (up to 12 months), prepared in the form of hank, using bleach liquor with less chlorine content. Hanks prepared by melting bleached lac in hot water retains moisture up to 20 %, where as hanks prepared by moulding absorbs more moisture at initial stage and finally retains moisture up to 20 %.

*Pilot-plant of lac dye*

- A pilot-plant has been erected for preparation of technical grade of lac dye. Dye was prepared in five batches with this pilot-plant using wash water of *kusmi* (*phunki*) sticklac with yield of 0.17 – 0.31%. Dye content, ash content and melting point of the dye were found to be in the range 70.8 - 71.1%, 0.70 – 1.10% and 230-238$^0$C, respectively.

*Composite board using lac as a binder*

- Scaling up trial of manufacture of composite board from *arhar* stick using sticklac as binder was carried out in a private board factory at Kolkata. Composite boards of size 7' x 3' and 8' x 4' were prepared. Use of sticklac in alcoholic medium was found to be better compared to aqueous medium as per requirement of IS: 3087 – 1985 (Type 2) specification. Termite resistance test carried out on the boards for 6 days exposure indicated its superiority over a commercial product. It has been found that 10-15% rosin can be used with sticklac as binder to make particle - board of adequate mechanical strength

*Bioactive compounds from aleuritic acid*

- 5.0g each of 10 – Carboxymethyl – 2 - decenoic acid (CMDA) and methyl-9 – methylsulphonyloxy – 2 - nonenoate were synthesized from aleuritic acid, and sent for evaluation at Bio-technology laboratory of the institute and to the sister organization, HARP, Palandu, Ranchi for their suitability in propagation of *Flemingia semialata*, *ber* (*Z. mauritiana*) and pointed gourd (*Trichosanthes diveca*).

- 2.0g each of (*Z*) - 9 - Hexadecenal, (*Z*) - 9 - hexadecenylacetate, (*Z*) - 9 - tetradecenylacetate, (*Z*) - 7 - dodecenyl acetate and 16 - acetoxy - (*E*) - 9 - hexadecenoic acid were synthesized from aleuritic acid. Field trials for comparative efficacy of different pheromones synthesized are being conducted on tomato and brinjal, at HARP Plandu (Ranchi). 4.0g of (*Z*) - 9 - hexadecenal and 2.5g of (*Z*) - 11 - hexadecenal were synthesized and supplied to NCIPM, IARI, New Delhi and IICT, Hyderabad for evaluation under field conditions.

*Lac based nail polish*

- Eco-friendly and cost effective decolourised dewaxed lac (DDL) based nail polish was found to be superior than decolorised bleached lac (DBL) based nail polish. Performance of the lac-based nail polishes was found to be superior than two well known brands with respect to touch dry time, hardness, smoothness, gloss, durability and water resistance.

*Shellac based emulsion paint*

- Shellac based emulsion paint was prepared in large scale (80 L) and evaluated by applying on different wall surfaces of the

institute. The paint was found to possess better anti-fungal property and liberate less smell during application as compared with a commercial brand.

## 5. Technology Assessment, Refinement and Dissemination

*Lac effluent treatment*

- The successive treatment of lac factory effluents with (a) hydrochloric acid (b) hydrochloric acid and lime (c) acid, lime & hypochlorite solution (d) chlorine gas (e) chlorine gas & activated charcoal (f) hypochlorite solution & activated charcoal could not reduce the TDS of the effluent below the prescribed limit of 2,100 mg/l and therefore, these treatments were found unsuitable. Treatment with alum & sodium hypochlorite solution could reduce the TDS marginally.

*Information on lac production, marketing and processing*

- A study was taken up for collection of information on production, market prices, market arrival and quantity of lac processed in different lac processing centres at national level. For collection of data, separate schedules / questionnaires for lac market and processing units were developed. On the basis of survey conducted in the markets of various lac producing districts of different states, the total national production of sticklac was estimated to be approximately 23,229 tons. Chhattisgarh ranked 1st among the states followed by Jharkhand, Madhya Pradesh, Maharashtra and West Bengal. These five states contributed around 95 per cent to the national lac production. Total quantity of sticklac processed during 2005-06 was 28,890 tons on the basis of surveys made at different lac processing centres in the country.

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

*Training highlights*

- The Institute conducted regular training programmes for the Farmers and Housewives, One-day orientation programme, On-farm training, Field educational and motivational training, Trainer's training and Field level demonstrations. Over eight thousand persons have benefited under the various training activities conducted by the Institute.

## Award

- The Bioved Research Society, Allahabad conferred Fellowship Award 2006 to Dr. A Bhattahcarya, PS and Head, TOT Division, ILRI, Ranchi for his outstanding contribution in the field of 'Lac Culitvation' during the 8th Indian Agricultural Scientists and Farmers` Congress on 21st February, 2006 at BHU, Varanasi.

■ ● ■

# INTRODUCTION

*Historical Development*

Lac, a natural resin, is a Non-Timber Forest Produce and is cultivated and collected by tribals inhabiting the sub-hilly tracts of Jharkhand, Chhattisgarh, West Bengal, Madhya Pradesh, Maharashtra, Orissa and Uttar Pradesh. Before the advent of synthetic plastics and resins, lac was invaluable in moulding and insulating industries, and India, then under British rule, 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 of 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, 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 research, encompassing all areas related to lac production, refinement and utilization. The areas covered include lac insects and their biota; 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 economic, 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*

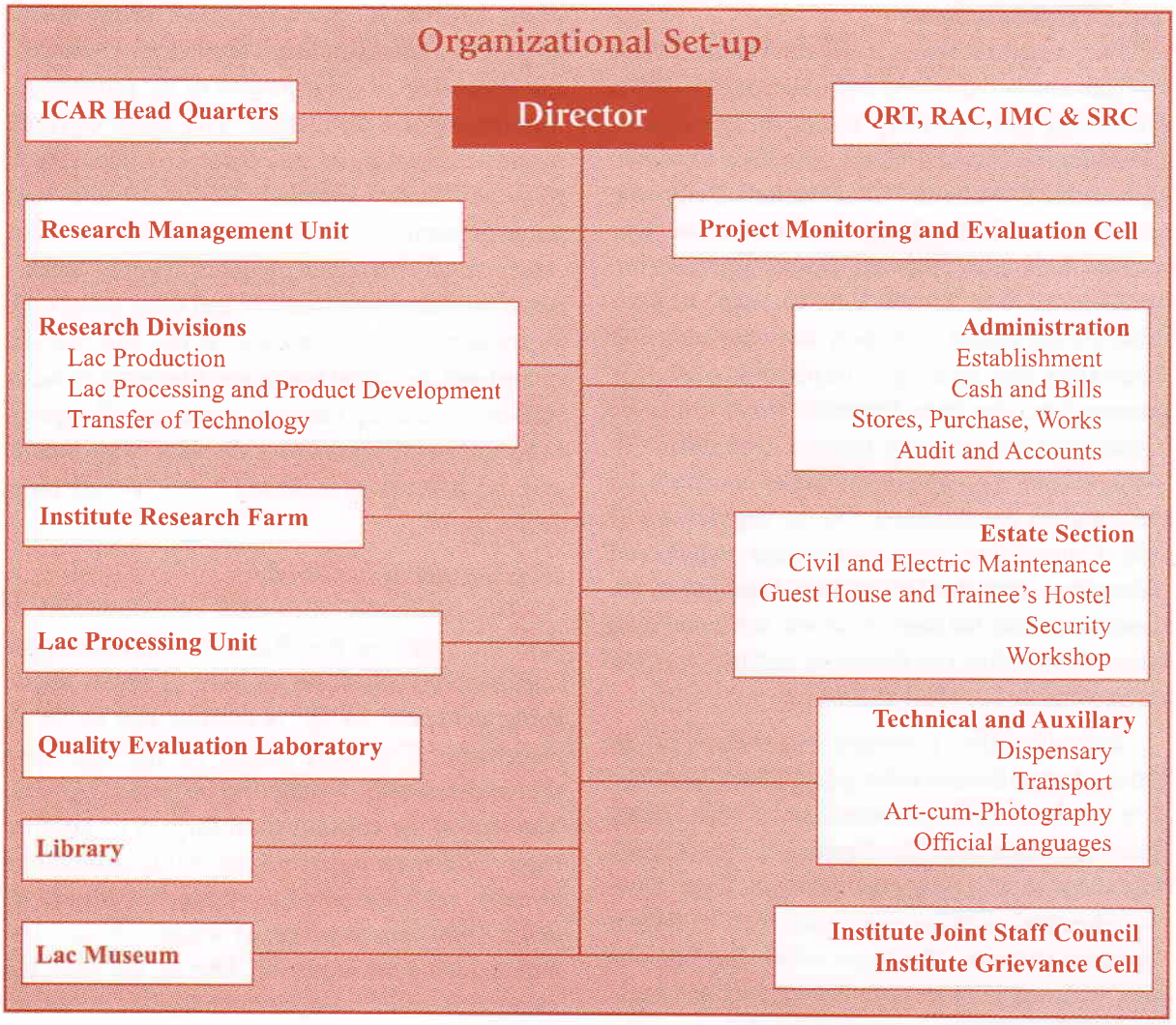
The Institute is located 9 km south-east of Ranchi city, on the Ranchi – Jamshedpur highway NH 33; at an altitude of 650m above mean sea level, 23°23' N latitude and 85°23' E longitude. The soil status of the Institute indicates advance weathering on granitic gneiss. The soil of the experimental farm 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 the monsoon. During the year, the mean minimum temperature varied between 7.9°C in January and 23.2°C in June and the mean maximum temperature varied between 25.1°C in December and 36.5°C in April. The total rainfall during the period was 1752.3 mm of which the monsoon rainfall was 1546.3 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.




*Staff*

Institute has a sanctioned strength of 1 RMP, 46 scientific, 60 technical, 36 administrative and 89 supporting grade posts, out of which 28 scientific, 58 technical, 30 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, Biotechnology, 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 following sections provide the technical support: Library, Research Management Unit, Institute Research Farm and Maintenance & Workshop Unit. The Auxiliary units are: Hindi Cell, Security, Medical and Estate Maintenance services.

The Institute Research Farm spread over 36 ha. has all conventional and cultivated lac 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 ILRI is maintaining more than fifty lines of the lac insect, which include collection from different parts of the country, inbred and crossbred lines. Similarly, the Institute Research Farm has 1540 host trees of *S. oleosa* (*kusum*), 2480 trees of *B. monosperma* (*palas*), 1351 *Z. mauritiana* (*ber*) and 8695 minor host plants. The field gene bank of the Institute has the following genotypes in stock: *palas* (13), *kusum* (4), *ber* (7), *Dalbergia szaemaoensis* (2), *Eriolaena spectabilis* (1) and *Albizia saman* (2).

The ILRI Library has holdings of more than 30,000 volumes of scientific journals, 2000 rare books, including back volumes of research periodicals in the field of lac and surface coatings. 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 neighboring 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 has recently been accredited IS /ISO 9001: 2000 and it caters to the quality control needs of the lac processing / lac product industries as well as exporters of lac / lac products. The QEL analyses, on an average, about 150 samples 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.

## The Mandate of the Institute is:

### 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 Station

- 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 2006-07, the non-plan expenditure was Rs. 406.38 lakhs, against a revised

estimate of Rs. 419.00 lakhs; the plan expenditure was Rs. 134.02 lakhs against a revised estimate of Rs. 149.00 lakhs. The detailed figures are shown in the table given below.

## Revenue Generation

During the period under report, a sum of Rs. 30.05 lakhs was earned as revenue through different programmes of various divisions and sections of the Institute.

## Budget during 2006-07

*(Rs. Lakhs)*

| Sl. No. | Head | Plan | | Non- Plan | |
|---|---|---|---|---|---|
| | | R. E. 06-07 | Expr. | R. E. 06-07 | Expr. |
| 1. | Establishment Charges | 00.00 | 00.00 | 360.00 | 347.90 |
| 2. | Wages | 00.00 | 00.00 | 00.00 | 00.00 |
| 3. | O.T.A. | 00.00 | 00.00 | 0.10 | 0.10 |
| 4. | Traveling Allowances | 4.50 | 4.22 | 3.60 | 3.27 |
| 5. | H.R.D. | 0.15 | 0.15 | 00.00 | 00.00 |
| 6. | Other Charges | 121.35 | 106.65 | 45.30 | 45.23 |
| 7. | O/C Information Technology | 3.00 | 3.00 | 00.00 | 00.00 |
| 8. | Works | | | | |
| | Special Repairs: (a) Office | 00.00 | 00.00 | 4.00 | 3.93 |
| | (b) Residential | 00.00 | 00.00 | 3.00 | 3.00 |
| | (c) Minor Work | 00.00 | 00.00 | 3.00 | 2.95 |
| | (d) Major Work (Plan) | 20.00 | 20.00 | 00.00 | 00.00 |
| 9. | Other Items: Publicity | 00.00 | 00.00 | 00.00 | 00.00 |
| | **TOTAL** | **149.00** | **134.02** | **419.00** | **406.38** |
| (B) | Loans & Advances | | | 12.00 | 11.40 |
| (C) | Pensions | | | 70.00 | 43.48 |
| (D) | Revenue Generation | | | 40.00 | 30.05 |

# RESEARCH ACCOMPLISHMENTS

## 1. LAC PRODUCTION

### 1.1 Productivity and Quality Improvement

#### 1.1.1 *Collection, maintenance, conservation and evaluation of lac insects and host plants and their genetic improvement*

**Survey of Maharashtra and Karnataka**

An extensive survey of selected places in different districts of Maharashtra and some adjoining districts of Karnataka was undertaken during October 4 -17, 2006 to know the availability of lac insects and status of lac cultivation at the different places visited. Ten districts in Maharashtra *viz*., Jalgaon, Nandurbar, Dhule, Aurangabad, Ahmednagar, Solapur, Osmanabad, Kolhapur, Pune, Mumbai and two districts in Karnataka *viz*., Gulbarga and Bijapur were surveyed (Table 1). Lac insect was observed at all the places visited except in the districts of Dhule, Kolhapur, Pune and Mumbai but their frequency of occurrence varied from place to place. Lac insect populations were observed on *Acacia nilotica* (*babool*), *Albizia saman* (rain tree), *Dalbergia sissoo* (*shisham*), *Ficus bengalensis* (*bargad*), *F. luscence* (*pakur*), *F. reliogiosa* (*pipal*), *Peltophorum ferrugenium* (yellow *gulmohar*), *Pithecollobium dulce* (*jungle jalebi*) and *Ziziphus mauritiana* (*ber*). Populations of both crimson as well as yellow lac insects were encountered almost in equal frequency.

Some lac larvae were also seen settled on an unknown bushy plant of Solanaceae family, which was growing under a *pipal* tree infected with lac insect. An unidentified tree looking like *palas* with thorns was also encountered. Photographs were taken of both these plants and leaves were collected for herbarium purpose. At some of the places especially in Nandurbar and Aurangabad districts good patches of *palas* are available. No lac cultivation was being done at present at any of the places.

**Table 1. Places visited and observations recorded on availability of lac insect during the survey**

| Sl. No. | District | Place | Observations |
|---|---|---|---|
| **A. Maharashtra** | | | |
| 1. | Jalgaon | Bhusawal, Jalgaon, Erandol and Parola | Yellow lac insect on *Pipal* at Bhusawal and mixed population of crimson and yellow lac insects on *Pakur* at Parola but yellow lac insect was dominant |
| 2. | Dhule | Dhule and Daundaicha | No lac insect was observed |
| 3. | Nandurbar | Nandurbar | Crimson lac insect on *Bargad* and Rain tree |
| | | Khand Bara | Two good patches of *Palas* having about 10,000 trees each are available in a compact area but lac insect was not observed on *Palas* |
| 4. | Aurangabad | Aurangabad, Ellora | Yellow lac insect was observed on *Pipal*, Rain tree, yellow *Gulmohar* and *Ber* trees in Aurangabad and was available in abundance |
| 5. | Ahmednagar | Vaijapur, Kopargaon and Shirdi | Crimson lac insect on *Pipal* at all the places |
| | | Ahmednagar | Crimson lac insect was observed on *Ber*, *Babool*, Rain tree, *Bargad* and *Pithecollobium dulce*. Lac insect was available in abundance |
| | | Daund | Crimson lac insect was observed on *Bargad*, *Pipal* and Rain tree. |
| 6. | Solapur | Solapur | Crimson lac insect was observed on *Pipal* and *Pakur* |
| 7. | Osmanabad | Tuljapur and Tamal Wadi | Mixed population of yellow and crimson lac insect on Rain tree, *Babool* and *Bargad* |

*Contd...*

| Sl. No. | District | Place | Observations |
|---|---|---|---|
| | Osmanabad | Naldurg, Jalkot and Yenegur | Crimson lac insect was observed on *Shisham*, *Pipal* and *Pakur* |
| 8. | Kolhapur | Kolhapur | Lac insect was not seen, though *Pipal*, Rain trees and *Babool* trees were present in abundance |
| 9. | Pune | Pune | Rain tree and *Ficus* spp. are present in plenty but lac insect could not be observed |
| 10. | Mumbai | Mumbai | *Ficus* spp. and Rain trees were in abundance along the roads but lac insect was not observed |
| **B. Karnataka** | | | |
| 11. | Gulbarga | Aland and Almel | Crimson lac insect was seen on *Pipal*, *Pakur* and Rain tree |
| 12. | Bijapur | Bijapur | Crimson lac insect was seen on Rain tree |

## Maintenance and evaluation of lac insects and host plants

Four lac insect stocks (Table 2) collected from Ahmednagar, Aurangabad, Bhusawal and Solapur districts of Maharashtra were added to the existing Field Gene Bank. Now, more than 600 lac cultures of 26 lac insect stocks collected from different parts of the country and the existing germplasm are being maintained on potted plants of *Flemingia macrophylla*.

**Table 2. Lac insect stocks added this year to the Lac Insect Field Gene Bank**

| Sl. No. | Lac insect Stock / Collected from | Remarks |
|---|---|---|
| 1. | Ahmednagar | Crimson lac insect |
| 2. | Aurangabad | Yellow lac insect |
| 3. | Bhusawal | Yellow lac insect |
| 4. | Solapur | Yellow lac insect |

Studies on productivity linked parameters of the summer season crop inoculated in 2005 and rainy season crop inoculated in June – July 2006 of the ten lac insect stocks continued this year also. Initial density of settlement, male proportion and size of the female cell showed greater range of variations among the stocks studied in both the crop seasons (lowest and the highest values are shown in bold). Whereas, initial mortality and living female density at crop maturity showed lesser variations. Weight of the cell, resin output and fecundity are directly correlated with the size of the cell. Observations recorded are presented in Tables 3 and 4. Pre-harvest parameters with in a stock did not show consistency and are more likely to be influenced by external factors in comparison to post-harvest attributes.

**Table 3. Productivity linked attributes of different lac insect stocks when reared on *Flemingia macrophylla* during summer/winter season 2005-06**

| Lac insect Stock | Initial density of settlement (no./cm²) | Initial mortality (no./cm²) | Male (%) | Density at crop maturity (no./cm²) | Diameter of cell (mm) | Weight of cell (mg) | Resin output per cell (mg) | Fecundity (no.) |
|---|---|---|---|---|---|---|---|---|
| *Kusmi* Trivoltine | **62** | 12.45 | 26.50 | 7.0 | **2.63** | **7.19** | **5.47** | **162** |
| Thrissur (Kerala) | 81 | 10.67 | 62.75 | **5.0** | 3.47 | 11.81 | 9.37 | 505 |
| Thailand | 103 | 8.48 | 20.65 | 7.0 | 3.47 | 9.60 | 7.6 | 309 |
| Udaipur (Rajasthan) | 104 | 4.53 | 81.4 | **8.0** | 3.58 | 14.80 | 11.8 | 505 |
| Jhalod (Rajasthan) | **105** | 6.00 | **93.89** | 7.0 | 3.45 | 13.80 | 11.2 | 540 |
| Echoda (AP) | 76 | 5.80 | 66.56 | 2.0 | 3.01 | 13.70 | 11.2 | 192 |
| Jammu (J & K) | 69 | 10.40 | **12.91** | **8.0** | 2.85 | 10.64 | 8.33 | 120 |
| Patiala (Punjab) | 69 | 9.33 | 23.49 | 6.0 | 3.40 | 13.89 | 10.89 | 329 |
| Ambaji (Gujarat) | 100 | **17.42** | 96.85 | 6.0 | 3.60 | 15.58 | **12.89** | **548** |
| Alsipur (Gujarat) | 94 | **2.60** | 49.43 | 7.0 | **3.64** | **15.68** | 10.85 | 539 |
| **Average** | **86.3** | **8.77** | **53.44** | **6.3** | **3.31** | **12.67** | **9.96** | **374.9** |

**Table 4. Productivity linked attributes of different lac insect stocks when reared on *Flemingia macrophylla* during rainy season 2006**

| Lac insect Stock | Initial density of settlement (no./cm²) | Initial mortality (no./cm²) | Male (%) | Density at crop maturity (no./cm²) | Diameter of cell (mm) | Weight of cell (mg) | Resin output per cell (mg) | Fecundity (no.) |
|---|---|---|---|---|---|---|---|---|
| *Kusmi* Trivoltine | **103** | 8.66 | 26.89 | 10.0 | **2.85** | **7.34** | **5.28** | 201 |
| Thrissur (Kerala) | 87 | **5.80** | 22.22 | 10.0 | **3.29** | 11.91 | 8.83 | 176 |
| Thailand | 97 | 6.69 | 22.65 | **11.0** | 2.91# | 8.53# | 6.91# | 108# |
| Udaipur (Rajasthan) | 62 | 15.04 | 28.44 | 6.0 | * | * | * | * |
| Jhalod (Rajasthan) | 73 | 9.09 | **18.41** | 6.0 | 2.97 | 8.59 | 6.74 | 183 |
| Echoda (AP) | 69 | 13.24 | 41.12 | 5.0 | 3.14 | **11.98** | **9.70** | **226** |
| Jammu (J & K) | 48 | 7.22 | **47.03** | **3.0** | 2.90 | 8.29 | 5.85 | **72** |
| Patiala (Punjab) | 74 | 8.15 | **47.03** | 5.0 | 2.90 | 8.81 | 7.29 | 192 |
| Ambaji (Gujarat) | **47** | **17.13** | 25.49 | 6.0 | * | * | * | * |
| Alsipur (Gujarat) | 50 | 13.65 | 23.65 | 9.0 | * | * | * | * |
| **Average** | **71** | **10.47** | **30.29** | **7.1** | **3.01** | **9.49** | **7.28** | **175** |

*# Data pertains to 2005-06 crop, * sufficient cells were not available*

## Collection of lac host germplasm

Following collections have been added to the existing Lac Host Field Gene Bank:

*Swadi palas:* A new germplasm collection of *palas,* known locally as *swadi palas* suitable for both the strains of lac insect *i.e., Kusmi and rangeeni has* been collected from village Putadag of Jonha, Ranchi.

Kandyor- *Garuga pinnata* (Karoe): A host plant in Kolebira areas of Simdega (Jharkhand) used for rearing mainly *rangeeni* and occasionally *kusmi* lac insects was collected from Thikpani village area. The plant flowers in June/July/ August. The leaves bear 9-11 leaflets with opposite alternate arrangement.

## Molecular characterization of lac insects

Seven inbred lines derived from a *rangeeni* stock of *K. lacca* were studied using RAPD profiles. They were compared with natural *rangeeni* lines. Comparison of similarity indices revealed their differentiation leading to formation of a distinct group. The seven inbred lines also showed divergence within the group. Fig. 1 shows the dendrogram of seven inbred lines compared with six lines parent group and also three lines of mixed nature.

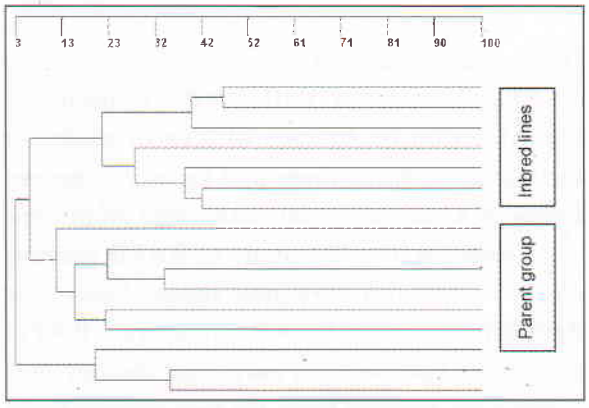



*Fig. 1. Divergence of seven rangeeni inbred lines from the parent group*

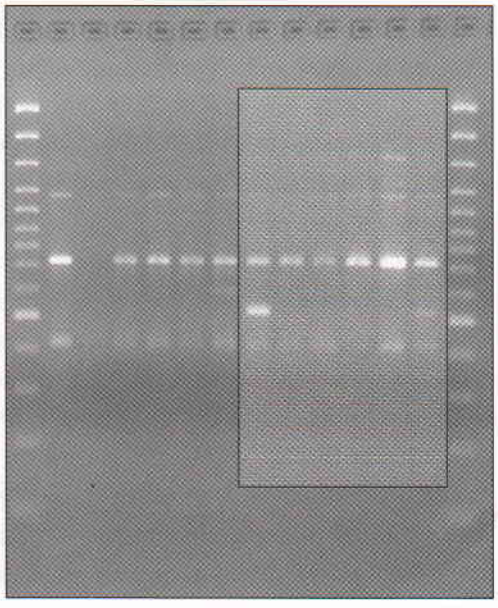


*Fig. 2. Variation in profiles of some inbred lines*

*Correlation of molecular and morphological divergence*

The picture that emerged from molecular profiles of particularly geographic races (Fig. 2) was related to morphology of mature lac insect females (Fig. 3), which is used in the taxonomy of lac insects. It was seen that these lines showed distinct differences with respect to structural features of key taxonomic characters such as anal tubercle, branchia, anterior spiracle and dorsal spine. The taxonomic status of these lines is thus, to be ascertained based on combined morphological and molecular parameters.

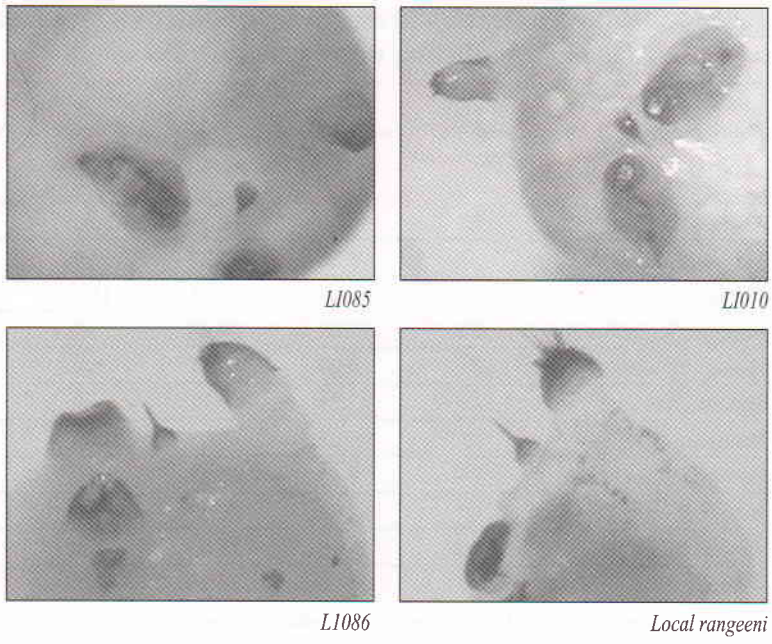



*Fig. 3. Morphologically distinct lines (LI010, LI085, LI086) and local* rangeeni *form of* K. lacca

*Development of SCARs*

SCAR primers will be developed for identification of species of *Kerria* studying distinct geographic races and *kusmi* / *rangeeni* forms of *K. lacca*. Twenty candidate amplicons were selected from the study of RAPD profiles obtained for the screened insect lines, for development of SCAR primers. RAPD amplicons specific to a particular species or a group were excised from 1% low melting point agarose gel and the fragment DNA was purified using QIAGEN mini elute gel extraction kit. The excised RAPD bands were cloned using pDrive cloning vector and introduced into competent *E.coli* DH5 cells. Recombinants were identified as white colonies on LB plates with antibiotic selection, Xgal and IPTG. Plasmid DNA was isolated from putative recombinants. An aliquot of purified plasmid DNA was digested by EcoRI restriction enzyme and the resulting products were run on 1% agarose gel along with the undigested one and photographed. Positive transformants were evaluated based on size of the amplification product and the size of plasmid insert. Master plates of the colonies screened and sent for sequencing through professional agencies.

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

## Morphological characterization of productive genotypes of *galwang*

The morphological characterization of these genotypes of *galwang* was carried out using leaf parameters such as i) colour of leaf stipule, ii) shape of leaf apex, iii) basal laminar shape, iv) margin v) apical leaf arrangement vi) number of paired leaflets vii) succession of leaflet size from base to apex viii) presence of glands on leaf laminar region were. Altogether five leaves from each clone were taken for characterization. Features, which were common to all of the four colons, were considered as characteristic feature of the genotype (Table 5). Morphometeric measurements of three genotypes were also taken and recorded in Table 6. For the sake of convenience, different productive genotypes identified earlier have been coded. The first two letters of the code are indicative of the Institute, the third letter indicates the first letter of the local name of the species and numbers indicate the agro-climatic zone and the collection number.

Table 5. Characteristic feature of productive genotypes of *galwang* affecting morphological parameters of leaf

| Leaf Parameters | Plant index number of *galwang* genotypes | | | |
|---|---|---|---|---|
| | LRG501 | LRG502 | LRG508 | LRG511 |
| Colour of leaf stipule | Light Green | Light green | Light pale green | Light Yellow green |
| Apex | Beak shaped | Beaked | Beaked | Globular |
| Colour & basal laminar shape | Light green narrow cone shaped | Green, leaf slightly folded | Light green, wider base, apex flat | Green, Wider, Basal pair single |
| Apical leaf arrangement | Bipinnate | Bipinnate | Bipinnate | Bipinnate Abnormally smaller |
| No of leaflet pairs | 6-7 | 6-9 | 6-8 | 5-6 |
| Size of leaflets (from base to apex) | Smaller to bigger | Smaller to bigger | Smaller to bigger | Basal wider |
| Presence of gland* | Single gland at main and each leaflet petiolar rachis below apical leaf pairs | Single gland at main and each leaflet petiolar rachis below apical leaf | Single gland at main and each leaflet petiolar rachis below apical leaf | Single gland at main petiolar rachis only |

* *Glandular protuberances on stipules*

Table 6. Morphometeric observations on selected characteristic features of three productive genotypes of *galwang* leaves

| Sl. No. | Character | LRG501 | LRG02 | LRG508 |
|---|---|---|---|---|
| 1. | Percentage of distance of the basal glands to the total distance between glands | 8.01 | 5.75 | 3.30 |
| 2. | Length of main lamina of leaf (cm) | 16.00 | 9.60 | 14.10 |
| 3. | Number of pairs of basal leaflets | 4.00 | 4.00 | 4.00 |
| 4. | Number of pairs of middle leaflets | 1.00 | 2.00 | 2.00 |
| 5. | Number of pair of terminal leaflets | 2.00 | 2.00 | 2.00 |
| 6. | Average area (length x width) of basal leaflets ($cm^2$) | 14.79 | 13.25 | 35.86 |
| 7. | Average area of middle leaflets ($cm^2$) | 24.65 | 36.67 | 56.75 |
| 8. | Average area of terminal leaflets ($cm^2$) | 48.38 | 213.23 | 104.32 |
| 9. | Ratio of areas of middle: basal leaflets | 1.66 | 2.76 | 1.58 |
| 10. | Ratio of areas of terminal / basal leaflets | 3.27 | 16.09 | 2.9 |
| 11. | Ratio of areas of terminal/Middle leaflets | 1.96 | 5.8 | 1.84 |

Important morphological parameters identified for recording intra-species variation in *galwang* genotypes are:

LRG 501: - Leaf apex beak shaped, very long leaf lamina (longest among all the samples)

LRG 502: -Basal lamina slightly folded, terminal leaflet largest

LRG 508: - Basal laminar apex flat, leaf pale green, glands near the base

LRG511: Leaflet apex smallest, globular, 5-6 pairs

## Morphological characterization of identified productive *kusum* plants

*Kusum* plants identified in the Institute Research Farm earlier for high lac yield ratio and larger length of shoots generated per pruned point was studied for morphometric variations for their characterization. Five leaves were taken randomly from each tree and measured for stipule length. The distance from twig to basal pair of leaves was designated as S1, from basal pair to middle pair as S2 and from middle to apical pair as S3. Mean length and width of basal pair, middle pair and apical pair of leaves were also recorded and are given in Tables 7 and 8.

Table 7. Morphometeric variations in leaves of identified *Kusum* trees giving high broodlac yield ratio (output: input)

| Tree No. | Yield ratio | Basal leaf | | | Middle leaf | | | Apical leaf | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Length (cm) | Width (cm) | Ratio L : W | Length (cm) | Width (cm) | Ratio L : W | Length (cm) | Width (cm) | Ratio L : W |
| 146 | 7.9 | 14.4 | 5.6 | 2.57 | 23.0 | 7.8 | 2.95 | 26.0 | 8.1 | 3.21 |
| 212 | 8.6 | 10.7 | 5.2 | 2.06 | 16.4 | 6.5 | 2.53 | 20.8 | 7.8 | 2.67 |
| 162 | 10.0 | 8.6 | 5.2 | 1.65 | 18.2 | 7.3 | 2.49 | 22.2 | 8.1 | 2.74 |
| 231 | 10.4 | 6.9 | 3.8 | 1.81 | 12.2 | 5.9 | 2.06 | 16.5 | 7.4 | 2.23 |
| 185 | 11.1 | 9.9 | 5.1 | 1.94 | 14.4 | 6.8 | 2.11 | 20.0 | 8.7 | 2.29 |
| 127 | 11.5 | 12.4 | 6.8 | 1.82 | 17.1 | 8.3 | 2.06 | 19.9 | 9.2 | 2.16 |
| 124 | 12.0 | 9.0 | 4.9 | 1.84 | 16.1 | 6.7 | 2.40 | 16.4 | 7.8 | 2.10 |
| 154 | 17.5 | 10.8 | 5.2 | 2.07 | 18.0 | 7.5 | 2.40 | 19.5 | 7.9 | 2.46 |
| 197 | 25.0 | 9.2 | 4.8 | 1.92 | 19.4 | 7.8 | 2.49 | 22.9 | 8.7 | 2.63 |

Table 8. Morphometeric variations in leaf lamina of identified *kusum* trees giving high broodlac yield ratio (output: input)

| Tree No. | Broodlac yield ratio | S1 | S2 | S3 | S1/S2+S3 |
|---|---|---|---|---|---|
| 146 | 7.9 | 12.2 | 4.3 | 5.4 | 1.26 |
| 212 | 8.6 | 8.9 | 3.4 | 4.6 | 1.11 |
| 162 | 10.0 | 7.4 | 4.0 | 5.9 | 0.75 |
| 231 | 10.4 | 3.7 | 3.0 | 2.7 | 0.65 |
| 185 | 11.1 | 7.6 | 3.5 | 4.2 | 0.99 |
| 127 | 11.5 | 9.7 | 4.6 | 4.0 | 1.12 |
| 124 | 12.0 | 7.8 | 2.9 | 3.7 | 1.18 |
| 154 | 17.5 | 9.8 | 4.4 | 4.7 | 1.07 |
| 197 | 25.0 | 6.0 | 2.7 | 3.3 | 1.00 |

*S1= length of lamina from base to first pair leaflets, S2= length from first pair leaflets to second pair leaflets, S3= length from second to apical pair leaflets*

### 1.1.3 *Screening of lac insect germplasm on* Ziziphus mauritiana *(ber) and* Flemingia semialata *for improved productivity*

Winter season crop inoculated during July 2005 on *F. semialata* and *Z. mauritiana* was harvested. Before harvesting, living female density at crop maturity stage was studied. 50 cells each from every stock were collected for study of size and weight of the female cell, resin output and fecundity. After harvesting shoot length, length of encrustation, broodlac and sticklac yield per plant were recorded. Summer season crop (*jethwi*, 2006) on *F. semialata* as well as on *Z. mauritiana* was studied under potted conditions and winter season crop (*aghani* 2006-07) under field conditions. Six-month old unpruned shoots of *F. semialata* and six month old pruned shoots of *Z. mauritiana* were used for inoculation during *jethwi* crop under potted condition.

Initial settlement coverage on *F. semialata* varied from 12.04 % of total inoculable shoots available to 64.76% in *aghani* crop under field conditions. Some of the inoculated plants died before lac crop could attain crop maturity. Settlement coverage of dead plants ranged between 42.27 to 51.57% whereas, it was between 19.64 to 33.44% on surviving plants. Lac crop yield per meter shoot length was the highest for *kusmi* early on *F. semialata* (Table 9a) but total yield per plant was the lowest. As settlement coverage increased, yield of lac also increased but above 33.44 % it affected the plant adversely leading even to its death. Initial settlement coverage, therefore, is important to obtain optimum broodlac yield per plant as well

as yield per meter shoots length. *Z. mauritiana* showed better carrying capacity (settlement coverage 39.28 to 48.24%) without affecting the plant (Table 9b). However, quantity of broodlac / m was low (131.87 – 164.06 g) in comparison to *semialata*.

*Kusmi* early performed better on *F. semialata*. Moreover, as the crop matured early, lac encrustation did not detach from the stem as is the case in late maturing varieties affecting quantity and quality of the broodlac produced (Fig.4). While on *ber*, performance of *kusmi* late stocks was better.

**Table 9a. Screening of *kusmi* lac insect germplasm on *Flemingia semialata* under field condition during winter season (*aghani*, 2005-06) crop**

| Attributes | Kulajanga | *Kusmi* Early | Nawadih | *Kusmi* Late |
|---|---|---|---|---|
| Shoot length/plant (cm) | 1650.13 | 926.00 | 1593.88 | 1722.57 |
| Encrustation length/plant (cm) | 548.93 | 181.89 | 533.00 | 484.17 |
| Broodlac/plant (g) | 904.67 | 480.00 | 892.94 | 903.26 |
| Sticklac/plant (g) | 265.00 | 155.56 | 295.59 | 332.17 |
| Broodlac/meter shoot length (g) | 164.80 | 263.90 | 167.53 | 186.56 |
| Sticklac/ meter shoot length (g) | 48.28 | 85.52 | 55.46 | 66.90 |

**Table 9b. Screening of *kusmi* lac insect germplasm on *Ziziphus mauritiana* under field condition during winter season (*aghani*, 2005-06) crop**

| Attributes | Kulajanga | *Kusmi* Early | Nawadih | *Kusmi* Late |
|---|---|---|---|---|
| Shoot length/plant (cm) | 3842.2 | 3616.4 | 3000.6 | 4459.8 |
| Encrustation length/plant (cm) | 1554.6 | 1553.2 | 1447.6 | 1751.8 |
| Broodlac/plant (g) | 2050.0 | 2100.0 | 2375.0 | 2555.0 |
| Sticklac/plant (g) | 670.0 | 695.0 | 770.0 | 855.0 |
| Broodlac/ meter shoot length (g) | 131.87 | 135.2 | 164.06 | 145.85 |
| Sticklac/ meter shoot length (g) | 43.10 | 44.75 | 53.19 | 48.81 |

*Fig. 4. Lac encrustation detaching from the* semialata *shoot in the crop nearing maturity*

Average density of settlement was low on *Z. mauritiana* but initial mortality was high in comparison to *F. semialata* during both the crop seasons under potted as well as field conditions (Tables 10a and 10b). No discernible differences in male proportion were observed between the hosts during *aghani* crop. However, significant differences were observed among the stocks in *jethwi* as well as *aghani* crops and between the two hosts during *jethwi* crop. Amount of the resin secreted was 31.3% more on *Z. mauritiana* during summer season crop on potted plants but during winter season under field condition, resin output per female was 9.2% higher on *F. semialata* than on *Z. mauritiana*. (Tables 11a and 11b).

**Table 10a. Pre-harvest productivity attributes of different *kusmi* lac insect stocks on *F. semialata* (Fs) and *Z. mauritiana* (Zm) under potted condition during summer season (*Jethwi* 2006) crop**

| *Kusmi* 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 | 72 | 59 | 9.20 | 34.52 | 25.99 | 60.85 | 5.33 | 8.13 |
| *Orissa kusmi yellow* | 97 | 69 | 13.76 | 39.94 | 22.46 | 32.70 | 8.87 | 6.60 |
| *Kusmi late* crimson | 90 | 61 | 22.70 | 52.18 | 27.74 | 29.19 | 1.83 | 6.78 |
| *Kulajanga* | 91 | 62 | 16.11 | 68.00 | 32.47 | 30.49 | 1.67 | 3.78 |
| *Nawadih* | 106 | 53 | 16.13 | 40.45 | 39.67 | 28.32 | 0.00 | 6.11 |
| **Average** | **91.2** | **60.8** | **15.58** | **47.02** | **29.67** | **36.31** | **4.43** | **6.28** |

Table 10b. Pre-harvest productivity attributes of different *kusmi* lac insect stock on *F. semialata* (Fs) and *Z. mauritiana* (Zm) under field condition during winter season (*Aghani*, 2006-07) crop

| *Kusmi* stocks | Density at initial stage (no./cm²) | | Initial mortality (%) | | Male proportion (%) | |
|---|---|---|---|---|---|---|
| | Fs | Zm | Fs | Zm | Fs | Zm |
| *Kusmi early* crimson | 69 | 93 | 15.48 | 34.31 | 23.44 | 30.34 |
| *Orissa kusmi yellow* | 89 | * | 7.25 | * | 32.67 | * |
| *Kusmi late* crimson | 90 | 80 | 13.94 | 39.59 | 33.54 | 34.85 |
| *Kulajanga* | 102 | 82 | 12.49 | 16.21 | 25.11 | 26.36 |
| *Nawadih* | 113 | 84 | 14.56 | 21.88 | 39.63 | 27.30 |
| **Average** | **92.6** | **84.8** | **12.7** | **23.83** | **30.88** | **29.71** |

**Crop did not survive*

Table 11a. Post-harvest productivity attributes of different *kusmi* lac insect stock on *F. semialata* (Fs) and *Z. mauritiana* (Zm) under potted condition during summer season (*Jethwi*, 2006) crop

| *Kusmi* stocks | Diameter of cell (mm) | | Weight of cell (mm) | | Weight of resin (mg) | | Fecundity (no.) | |
|---|---|---|---|---|---|---|---|---|
| | Fs | Zm | Fs | Zm | Fs | Zm | Fs | Zm |
| *Kusmi early* crimson | 2.80 | 3.93 | 6.33 | 21.88 | 3.99 | 19.13 | 156.00 | 403.00 |
| *Orissa kusmi yellow* | 3.97 | * | 29.20 | * | 24.03 | * | 425.00 | * |
| *Kusmi late* crimson | * | 3.59 | * | 26.19 | * | 23.13 | * | 55.00 |
| *Kulajanga* | * | 3.37 | * | 13.97 | * | 12.01 | * | 151.00 |
| *Nawadih* | * | 3.48 | * | 22.64 | * | 19.33 | * | 57.00 |
| **Average** | **3.39** | **3.59** | **17.77** | **21.17** | **14.01** | **18.4** | **290.50** | **166.5** |

**Crop did not survive*

Table 11b. Post-harvest productivity attributes of different *kusmi* lac insect stock on *F. semialata* (Fs) and *Z. mauritiana* (Zm) under field condition during winter season (*Aghani*, 2005-06) crop

| *Kusmi* stocks | Density at crop maturity (no./cm²) | | Diameter of cell (mm) | | Weight of cell (mm) | | Weight of resin (mg) | | Fecundity (no.) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fs | Zm | Fs | Zm | Fs | Zm | Fs | Zm | Fs | Zm |
| *Kusmi early* crimson | 10.60 | * | 3.41 | * | 20.87 | * | 18.66 | * | 192 | * |
| *Orissa kusmi yellow* | 1.80 | * | * | * | * | * | * | * | * | * |
| *Kusmi late* crimson | 8.20 | 9.33 | 3.55 | 3.31 | 22.27 | 19.67 | 18.22 | 17.68 | 44 | 10 |
| *Kulajanga* | 11.73 | 10.60 | 3.72 | 3.47 | 25.13 | 21.80 | 22.28 | 18.93 | 166 | 14 |
| *Nawadih* | 8.27 | 8.07 | 3.55 | 3.37 | 18.90 | 17.96 | 16.74 | 15.38 | 133 | 39 |
| **Average** | **8.12** | **9.33** | **3.56** | **3.38** | **21.79** | **19.81** | **18.98** | **17.33** | **133.75** | **21.00** |

**Crop did not survive*

### 1.1.4 *Improvements in lac host propagation techniques*

#### Propagation of *F. semialata* through shoot cuttings

Cuttings of *F. semialata* of size ranging from 1.0 - 2.2 cm diameter and length 25-45 cm were used for the study. The cuttings were taken from basal and middle region of the shoots aged 12-18 months. Each cutting was having at least 5 internodes, among which three were kept below and two above the soil during planting. It was observed that cuttings with shorter internodes showed better performance than longer internodes for initiating rooting in cuttings. Mixture of FYM + vermi-compost

(1:1) with sand and garden soil in the ratio of 1:1:1 was found preferable to FYM + sand + soil (1:1:1).

Chloropyriphos 20% EC (Dursban TC, 0.1%) was used in soil during poly bag filling and arial spray (0.01%) at monthly interval on leafy regions to prevent termite attack. Superior performance of initiation of rooting (80%) was recorded with the treatment of NAA (Naphthalene Acetic Acid, 100 µ mole solution) during July – August (after 40 days of planting) as compared to 10 % in control (Fig. 5).

## Vegetative propagation of *Ficus* spp.

Cuttings of *Ficus cunia (syn F. semicordata)*, *F. racemosa, F. infectoria (syn. F. lacor)* and *F. lucescence* were tried for rooting enhancement with IBA and NAA having concentration 25, 50 and 100 µ mole alone and bi-molar combination during June-July to Aug.-Sept. The equi-molar combinations showed better performance than other treatments and control (Fig. 5). The diameter and length of cutting used in *Ficus* species varied between 2-3 cm and 40-50 cm, respectively of the shoots aged 12-18 months. The experiments were carried out in 3 replications with 20-30 cuttings. Rooting in *F. infectoria* and *F. lucescence (pakur)* was recorded as 60 % with the treatment of equi bi-molar solution (100 µmoles) of NAA and IBA during the month of July- August as compared to 15 % in control.

Rooting in *F. cunia* showed better performance in initiation of rooting with 50 µ mole (IBA + NAA) during July/August 2005 hence was tried during June/July 2006 which showed (35%) initiation of rooting with 50 µ mole (IBA + NAA) whereas, in control only (10%) root initiation was observed. Heavy mortality of raised plants was observed due to persistent rain. Cuttings of *F. racemosa* showed increase (53.75%) in initiation of rooting with 100 µ mole (IBA + NAA) whereas; in control it was only 17.5%. Heavy mortality of raised plants was observed due to persistent rain.

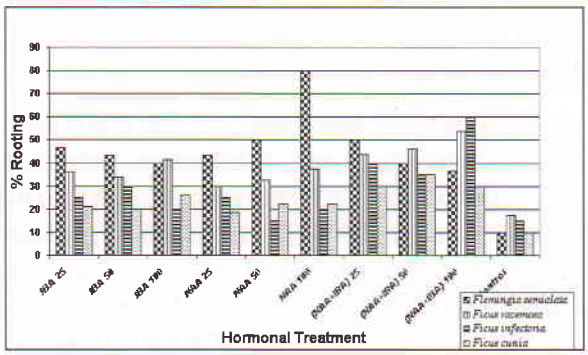



*Fig. 5 Percent rooting in shoot cuttings with individual, and combination of hormonal treatments*

## Propagation of *kusum* (*S. oleosa*) through air layering

Air layers of *kusum* developed earlier were put under hardening after rooting. Survival of the rooted air layers after hardening is given in Table 12.

**Table 12. Percent survival of *kusum* air layers after two years of planting as well as hardening of one year***

| Treatment (per pit) | No. of air layers | Rooted layers | Survival after hardening | Survival after 2 year of planting | Per cent final survival in field condition |
|---|---|---|---|---|---|
| Soil and FYM (1: 1) + SSP 50g + Mycorrhyza (VAM 10g) | 25 | 19 (76 %) | 10 (52.6%) | 5 (50%) | 20 |
| Soil + IBA 1000 ppm + Mycorrhyza (VAM 10g) | 25 | 22 (80%) | 9 (40.9%) | 4 (44.4%) | 16 |
| Vermi-compost and Soil (1: 1) + IBM 1000ppm | 25 | 16 (64%) | 7 (43.75%) | 3 (42.8%) | 12 |
| Soil and FYM (1: 1) | 25 | 20 (80%) | 8 (40%) | 3 (37.5%) | 12 |
| Soil and IBM 1000 ppm | 25 | 17 (68%) | 8 (47%) | 3 (37.5%) | 12 |
| Soil (Control) | 25 | 18 (72%) | 7 (38.8%) | 0 (0) | - |

**Hardening period 2003-04 and planting 2004-06*

### 1.1.5 *Development of techniques for micropropagation of lac hosts*

## Application of growth hormones on shooting response from pruned points of *ber*

Lac hosts are pruned at specific periods to induce development of fresh shoots for lac insect colonization. Number and length of new shoots from the pruned points are important to providing larger settlement area for the lac insects, thereby, enhancing productivity. An experiment was, therefore, taken up using *ber* plants to examine whether shoot proliferation from pruned point can be enhanced by application of growth hormones.

There were 15 treatments with one plant under each and four replications. The treatments comprised of applications of hormones BAP (6-benzylainopurine, $T_1$-$T_6$) and kinetin ($T_7$-$T_{10}$) alone and their combinations ($T_{11}$-$T_{14}$), in varying concentrations (BAP: 50-200µM; kinetin: 20-50µM; four combinations of BAP + kinetin: 100,125µM and 20, 30µM, respectively). Cotton wads loaded with the hormone solution were placed on freshly pruned points of the plant and firmly covered with polythene sheet to check evaporation and left overnight. The cotton wads were removed the next day and pruned points painted with a protective of covering shellac solution. The treatments were done in the third week of March. Periodical observations were made on the total number of primary shoots and other plant parameters.

Data recorded reveals significant effect of the application of hormones on shooting response. Fig. 6 depicts the mean number of primary shoots per pruned point under different treatments. Treatments $T_1$-$T_6$ comprise of increasing concentration of BAP and treatments $T_7$-$T_{10}$, an increasing concentration of kinetin. In both cases, the number of primary shoots per pruned point increased with increase in concentration of the hormone. Under BAP + kinetin combinations, lower concentrations of BAP (100 µM) and kinetin (20µM) provided higher number of primary branches compared to higher concentrations tried. The results indicate that BAP at 150-200µM, kinetin at 50 µM or BAP + kinetin at 100+20µM; 100+30µM resulted in 4.9 – 5.5 primary shoots per pruned point.

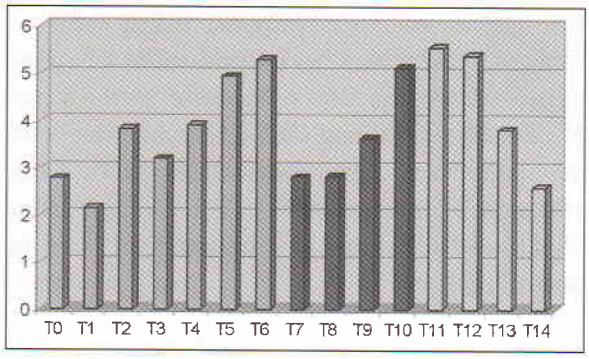



*Fig. 6. Mean no. of primary shoots per pruned point under different treatments*

## Standardization of protocol for micro-propagation of *ber*

A series of experiments were conducted for standardization of protocol for micropropagation of *ber* (*Z. mauritiana*) using nodal segments, which included surface sterilization method, suitable culture media and hormone application for shoot multiplication and rooting. The nodal segments were subjected to surface sterilization using six concentrations of $HgCl_2$ (0.05 to 2.0%). It was found that concentrations higher than 0.1% proved detrimental to the explants. Prior treatment with 70% ethanol minimized contamination. $HgCl_2$ at 0.1% was found best for surface sterilization resulting in 93% asceptic buds and 50% shoot initiation. The explants were cultured in MS under standard conditions. Callusing was observed two weeks after inoculation followed by shoot initiation. The shoots attained a height of 4-5 cm with a mean number of 2-3 nodes within four weeks. Shoots subcultured in MS medium resulted in 3-4 nodes in another four weeks with incorporation of any phytohormones.

For shoot multiplication, MS media supplemented with different concentrations of BAP (0, 10, 15 µM) and of kinetin (0, 2.5, 3.5, 4.5 µM) were evaluated using a checkerboard design. Maximum shoot growth was observed with 10 µM BAP + 3.5 µM kinetin. However, maximum number of usable nodes was obtained with 10 µM BAP + 4.5 µM kinetin (Fig. 7).

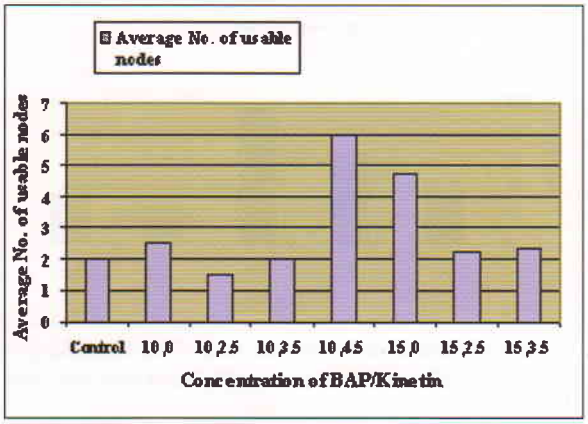



*Fig. 7. Effect of BAP and Kinetin on shoot multiplication w.r.t. number of usable nodes*

MS media supplemented with six concentrations of IBA (0 – 55 µM) and four concentrations of IAA (0 -20 µM) were used to study their effect on root multiplication. The mean number of primary shoots was maximum in media supplemented with 55µM IBA, *i.e.*, 28.7, but the mean number of secondary roots was low *i.e.*, 6.3 and the time required for root initiation was high (24 days). In case of the medium supplemented with 10µM IBA the root initiation was early (after 10 days) and the mean numbers of primary roots and secondary roots were 10.0 and 32.4, respectively (Fig. 8). The latter treatment, therefore, was considered the best.

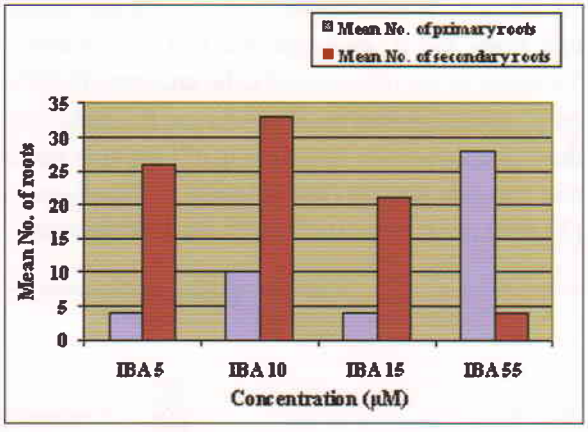



*Fig. 8. Effect of application of IBA on rooting of* ber *explants*

Thus, MS medium with application of BAP (10 µM), kinetin (4.5 µM) and IBA (10 µM) is recommended for shoot and root multiplication for micropropagation of *Z. mauritiana* through nodal segments (Fig. 9).

*Fig. 9.* Ber *plantlet after root initiation in MS medium with growth hormones*

### 1.1.6 *Biological, Chemical and Molecular Characterization of Lac Insect-Host Plant Relationship*

#### Biological charatcterization

Five different host-plant *viz.*, *Acacia auriculaeformis* (*akashmani*), *Albizia lucida* (*galwang*), *Flemingia semialata* (*semialata*), *Schleichera oleosa* (*kusum*) and *Ziziphus mauritiana* (*ber*), were inoculated during Feb. - March, 2006 for summer season (*jethwi*) crop of *kusmi* strain of the lac insect. While for *rangeeni* lac insects, *S. oleosa* was replaced with *Butea monosperma* (*palas*) other four being common hosts for raising rainy season (*katki*) crop inoculated during June – July, 2006. Studies on winter season (*aghani 2005-06*) crop of *kusmi* and summer season (*baisakhi 2005-06*) crop of *rangeeni* strain inoculated during previous year continued this year also.

Observations on the following productivity linked parameters of lac insects host plants have been recorded:

**A. Pre-harvest parameters**

1. Initial density of settlement (no. per sq. cm)

2. Initial mortality (no. per sq. cm after 21 days of inoculation)
3. Sex ratio (% of males / females)
4. Density at crop maturity (no. per sq. cm)

**B. Post-harvest parameters**

5. Size (diameter in mm) of the female cell
6. Weight (mg) of the female cell
7. Resin out put per female insect (mg) and
8. Fecundity (no. of young ones produced by.a female insect)

Results obtained are discussed as under :

### 1. Initial density of settlement (Figs. 10 & 11)

*Kusmi* strain of lac insect showed tendency of settling closer in comparison to *rangeeni* strain. Average density of settlement was 54 / $cm^2$ for *rangeeni* and 78 / $cm^2$ for *kusmi* strain. Wide intra-strain fluctuations in settlement density were observed on different host plants also.

Density of settlement in increasing order on different host plant was as follows:

*(i)* *Rangeeni* strain (rainy season, *katki* crop)

*F. semialata* < *Z. mauritiana* < *A. auriculaeformis* < *A. lucida* < *B. monosperma.*

*(ii)* *Kusmi* strain (summer season, *jethwi* crop)

*A. lucida* < *A. auriculaeformis* < *Z. mauritiana* < *S. oleosa* < *F. semialata*

Mortality of lac insect varied between 5.05% of the initial settlement on *B. monosperma* to 44.44% on *F. semialata* for *rangeeni* strain and between 7.24% on *S. oleosa* to 58.73% on *A. lucida* for *kusmi* strain. Insect mortality at initial stage is affected by the prevalent environmental conditions and varies from season to season.

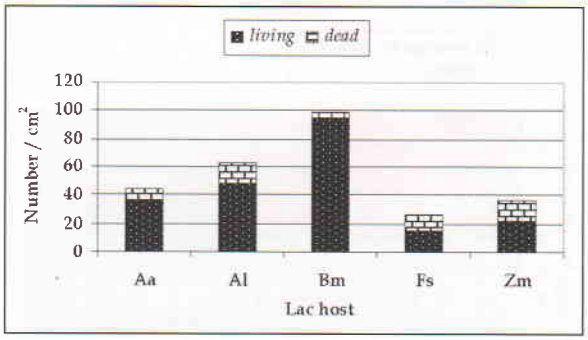



*Fig. 10. Initial mortality in* rangeeni *strain of* Kerria lacca *(Kerr) on different host-plants during rainy season (*katki *crop, 2006)*

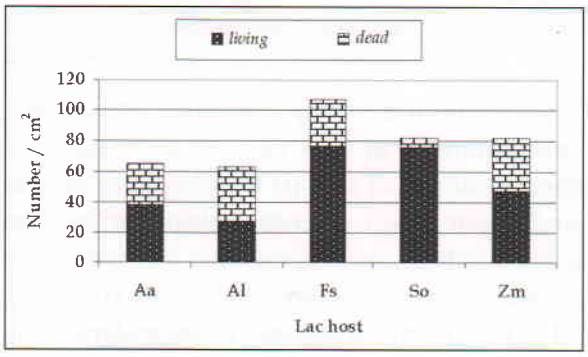



*Fig. 11. Initial mortality in* kusmi *strain of* Kerria lacca *(Kerr) on different host-plants during summer season (*jethwi *crop, 2006)*

### 2. Sex ratio (Figs. 12 & 13)

*A. auriculaeformis, A. lucida* and *Z. mauritiana* did not support the summer season (*baisakhi*) crop of the *rangeeni* strain to sexual maturity stage. Proportion of males fluctuated violently between 18.5% and 78.14% respectively on the remaining two hosts *i.e. B. monosperma* and *F. semialata.* Variation in sex ratio tended to be uniform (18.82% on *B. monosperma* to 30.83 % on *F. semialata*) during rainy season (*katki*) crop of *rangeeni* strain and summer season (*jethwi*) crop of *kusmi* strain (23.50% on *A. lucida* to 27.27% on *Z. mauritiana).*

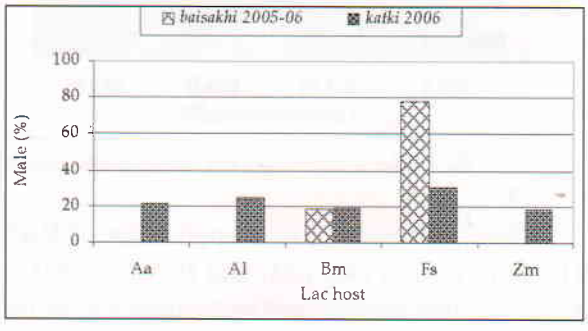



*Fig. 12. Sex ratio variation in* rangeeni *strain of* Kerria lacca *(Kerr) on different host plants*

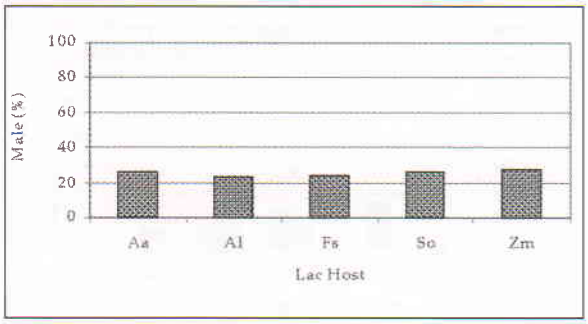



*Fig. 13. Sex ratio variation in* kusmi *strain of* Kerria lacca *(Kerr) on different host-plants during summer season (*jethwi *crop, 2006)*

## 3. Density at crop maturity (Figs. 14 & 15)

Density of living females at crop maturity is the result of interaction between host suitability and existing environmental factors. Drastic reduction in settlement density of settlement when compared to initial density of settlement is caused by (i) mortality due to non-feeding at initial stage, (ii) existing biotic / abiotic factors and (iii) death of male insects which die soon after fertilizing the females. It varied between 6-13 / cm$^2$ on different host plants for *rangeeni* strain and 6-17 / cm$^2$ for *kusmi* strain.

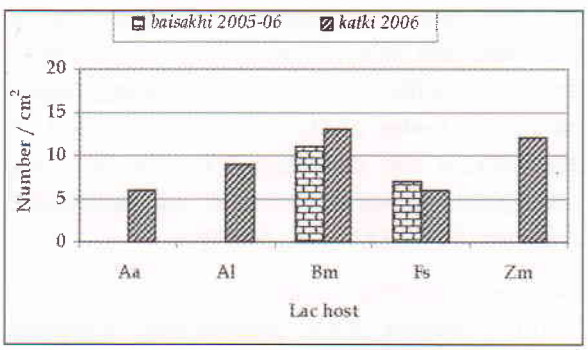



*Fig. 14. Settlement density at crop maturity of* rangeeni *strain of* Kerria lacca *(Kerr) on different host plant*

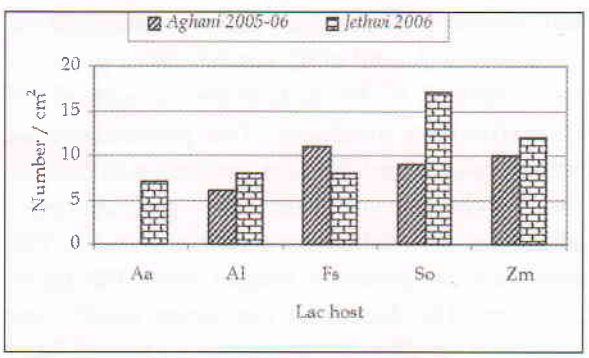



*Fig. 15. Settlement density at crop maturity ot* kusmi *strain of* Kerria lacca *(Kerr) on different host plants*

## 4. Size of the female cell (Figs. 16 & 17)

Average diameter (taking all the host plants together) of the cell varied between 3.138 mm in rainy season (*katki*) crop to 4.52 mm in summer season (*baisakhi*) crop of the *rangeeni* strain. The smallest size of the cell 2.87 mm was recorded on *F. semialata* during rainy season (*katki*) crop and the biggest size (5.13 mm) on *B. monosperma* during summer season (*baisakhi*) crop. The average size of cell for *kusmi* ranged between 3.32 mm on *F. semialata* during summer season (*jethwi*) crops to 4.03 mm on *A. lucida* during winter season (*aghani*) crop.

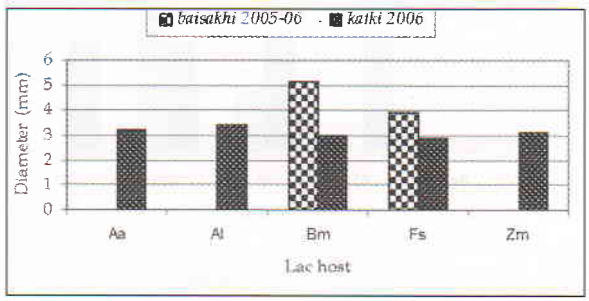



*Fig. 16. Diameter of* rangeeni *female cell of* Kerria lacca *(Kerr) on different host-plants*

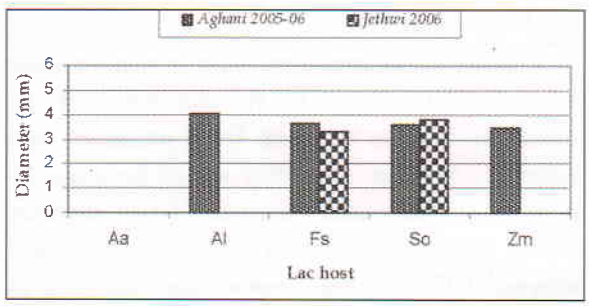



*Fig. 17. Diameter of* kusmi *female cell of* Kerria lacca *(Kerr) on different host-plants*

## 5. Resin out put per female cell (Figs. 18 & 19)

Within a strain, resin out put per female cell is directly correlated to the size of the cell, which in turn is affected by the duration of the crop. Average resin out put per female lac insect was 9.26 mg in rainy season (*katki*, 4 months duration) crop, 20.57 mg in summer season (*baisakhi*, 8 months duration) crop. Similarly resin out put was 18.17 mg in summer season (*jethwi*, 5.5 months duration) crop to 21.09 mg in winter season (*aghani*, 6.5 months duration) crop. Resin out put per mm diameter was higher in *kusmi* in comparison to *rangeeni* strain, showing it to be more productive.

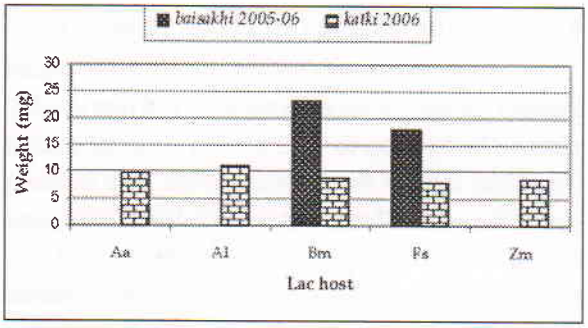



*Fig. 18. Weight of resin produced by* rangeeni *female of* Kerria lacca *(Kerr) on different host-plants*

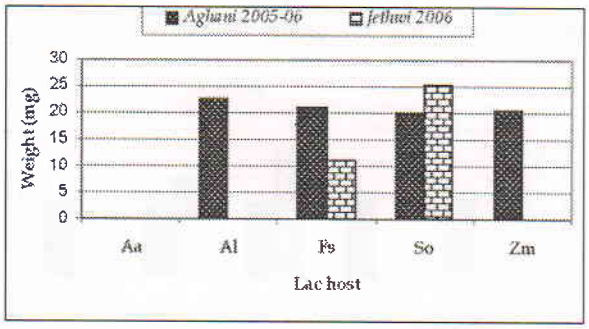



*Fig. 19. Weight of resin produced by* kusmi *female of* Kerria lacca *(Kerr) on different host-plants*

## 6. Fecundity and extent of parasitisation (Figs. 20 & 21)

Quality of the broodlac (akin to seed in other crops) is determined by the fecundity of lac insects as well as freedom from predators and parasites. Average fecundity varied between 99 in rainy season (*katki*) crop to 264 in summer season (*baisakhi*) crop of *rangeeni* strain and between 107 in winter season (*aghani)* crop to 142 in summer season *(jethwi*) crop of the *kusmi* strain.

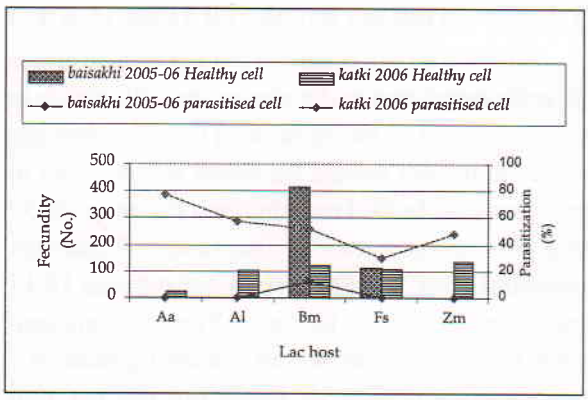



*Fig. 20. Fecundity and extent of parasitisation in* rangeeni *strain of* Kerria lacca *(Kerr) on different host-plants*

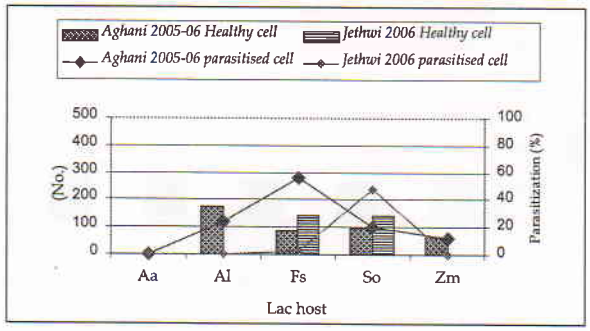



*Fig. 21. Fecundity and extent of parasitisation in* kusmi *strain of* Kerria lacca *(Kerr) on different host-plants*

Some of the collected cells were found to be parasitized which adversely affected the brood value of the crop. Either, there was no emergence or very low emergence of larvae from the parasitized cells. Extent of parasitisation varied between 7.50 in summer season (*baisakhi*) crop to 52.4% in rainy season (*katki*) crop of *rangeeni* strain. While for *kusmi* strain it was 27.69 % in winter season (*aghani*) crop and 27.78 % in summer season (*jethwi*) crop.

## Molecular characterization (at DU, Delhi)

Presence (1) or absence (0) of reproducible amplification products was scored for each analyzed elite clone generating a binary matrix. For each pair wise comparison, the Jaccard's similarity coefficient (JSC) was calculated. Based on JSCs cluster analysis was performed. A dendrogram was constructed by means of the unweighted pair-group method, with arithmetic averages (UPGMA) using NTSYS.

### *Butea monosperma (palas)*

Fifty random 10-mer primers were surveyed, using three representative samples of *B. monosperma* for selecting informative primers. Out of the 50 primers, 18 gave good, reproducible and polymorphic patterns; and were selected for the analysis. A total of 65 amplification products were scored to be polymorphic out of 98 amplification products. The percentage of polymorphic amplification product was 66.3%. The average number of polymorphic amplification product for a primer was 3.8. The amplification products ranged from 300 bp to 2000 bp. The Jaccard's similarity coefficient values for the 28 elite clones ranged from 0.5443 to 0.89189 with a mean of 0.731.

The UPGMA dendrogram denoted three principle clusters: I, II and III. Cluster I comprised five elite clones, which could be grouped in two sub-clusters IA and IB. The cluster II was the largest one comprising thirteen elite clones, which could be further grouped into three sub-clusters: IIA, IIB and IIC. One elite clone remained an outlier within the cluster II. Third cluster comprised of six elite clones grouped in two sub-clusters: IIIA and IIIB. Four elite clones were not grouped in the three principle clusters; out of these, two were most distinct from all other elite clones.

*Ziziphus mauritiana (ber)*

Fifty random 10-mer primers were screened using three representative samples of *Z. mauritiana* for selecting informative primers. Out of these primers, fifteen were selected for the analysis. A total of 210 amplification products were scored to be polymorphic out of 213 amplification products. The percentage of polymorphic amplification product was 98.6%. The average number of polymorphic amplification product for a primer was 14. The amplification products ranged from 300 bp to 1500 bp. The Jaccard's similarity coefficient values for the 28 elite clones ranged from 0.06173 to 0.53465 with a mean of 0.232.

The UPGMA dendrogram grouped 38 elite clones of *Z. mauritiana* into three major clusters (I, II and III) along with three outliers. All the three clusters comprised eleven elite clones each. The cluster I comprised of four sub-clusters, IA, IB, IC and ID. The cluster II and III further comprised of four sub-clusters each. One remained an outlier in cluster III, while one was not grouped in any of the three major clusters. The outlier was most distinct from all other elite clones. Three elite clones were not grouped with the three major clusters.

*Schleichera oleosa (kusum)*

Twenty-one primers out of the fifty primers were selected to analysis *S. oleosa* clones. A total of 155 amplification products were scored to be polymorphic out of 190 amplification products. The percentage of polymorphic amplification product was 81.4%. The average number of polymorphic amplification product for a primer was 7.3. The amplification products ranged from 300 bp to 1500 bp. The Jaccard's similarity coefficient matrix for these 28 elite clones ranged from 0.37956 to 0.84158 with a mean of 0.529.

The UPGMA dendrogram produced with 13 good clones, 7 bad clones and 17 intermediate clones comprised of four major clusters (I, II, III and IV) and five outliers. The cluster IV was the largest one and bearing 15 out of the 17 intermediate clones. Two outliers were observed in this cluster. The sub-cluster IVA comprised of two clones; while sub-cluster consisted of IVE also of two, and were found to be the most distinct from other sub-clusters of cluster IV. The cluster I could be grouped in two sub-clusters IA and sub-cluster IB, while one clone remained as outlier within the cluster I. The cluster II also comprised of good clones, except two, which were found as an outlier. The cluster II could be grouped in three sub-clusters. The cluster III comprised of good, bad and intermediate clones and could be grouped in two sub-clusters, IIIA and IIIB. One outlier and two other clones were not grouped in the four major clusters.

## Chemical chracterization (at IIT, New Delhi)

*Kusmi* and *rangeeni* strains of the lac insect, *Kerria lacca* (Kerr) were grown on different hosts for one generation during winter season. Like wise, four different stocks of *kusmi* strain were grown on common hosts. Lac obtained from these plants /insects was analysed at Indian Lac Research Institute for yield, moisture content, wax, impurities, flow, life and colour index and at Indian Institute of Technology, New Delhi for solubility in hot alcohol, melting point, saponification number, acid value and iodine value (Table 13). Similarly, *rangeeni* and *kusmi* lac insects were cultured during summer season and lac samples obtained were analysed (Table 14). No significant differences were observed among the samples obtained from different stocks of lac insect of the same strain or from the lac obtained by culturing the same lac insect strain on different host plants. Continuous rearing of lac insect for multiple generations on the same host may help in throwing light on this aspect.

Table 13. Industrial quality parameters of sticklac obtained from different lac insect stocks grown on different host-plants during winter season (*aghani*, 2005-06)

| Industrial parameters | Lac host / stocks | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Flemingia semialata* | *Albizia lucida* | *Kulajanga (F.semia lata* | *Kulajanga (Z.mauri tiana* | *Nawadih (F.semia lata* | *Nawadih (Z.mauri tiana* | *kusmi (F.semia lata* | *kusmi (Z.mauri tiana* | *kusmi (F.semia lata* |
| **ILRI, Ranchi** | | | | | | | | | |
| Yield (%) | 70 | 72 | 60 | 67 | 60 | 64.2 | 60 | 70 | 60 |
| Moisture (%) | 2.00 | 2.04 | 2.07 | 2.24 | 2.08 | 1.98 | 2.10 | 2.00 | 2.10 |
| Wax (%) | 4.40 | 3.81 | 3.30 | 4.00 | 3.76 | 3.90 | 4.1 | 4.05 | 3.95 |
| Iinsolublity % (in hot alcohol) | 2.07 | 2.59 | 2.30 | 2.73 | 2.09 | 2.64 | 2.61 | 2.34 | 2.44 |
| Insolubility in cold alcohol (%) | 7.08 | 7.50 | 7.30 | 7.60 | 7.25 | 7.58 | 7.64 | 7.50 | 7.70 |
| Flow (mm) | 105 | 100 | 95 | 73 | 91 | 70 | 100 | 73 | 74 |
| Life (minute) | 67 | 75 | 75 | 73 | 77 | 77 | 78 | 73 | 64 |
| Colour index | 9 | 10 | 9 | 10 | 10 | 10 | 10 | 9 | 9 |
| **IIT, New Delhi** | | | | | | | | | |
| Solubility in hot alcohol (%) | 82 | 84 | 81 | 85 | 80 | 85 | 83 | 86 | 82 |
| Melting point range (°C) | 75 – 82 | 74 – 81 | 75-81 | 74-80 | 74-81 | 73-80 | 76-82 | 74-82 | 75-83 |
| Saponification Number | 177 | 178 | 176 | 180 | 178 | 179 | 175 | 181 | 177 |
| Acid Number | 54 | 56 | 55 | 58 | 54 | 60 | 56 | 57 | 55 |
| Iodine Value | 7 | 6 | 8 | 9 | 7 | 8 | 6 | 8 | 6 |

Table 14. Industrial quality parameters of sticklac obtained from different host-plants during summer season (*baisakhi and jethwi 2006*)

| Industrial parameters | Lac host / stocks | | | | |
|---|---|---|---|---|---|
| | Rangeeni *Local* (baisakhi, *2005-06)* | Kusmi *Local* (jethwi, *2006)* | Kusmi *Kaulajanga* (jethwi, *2006)* | Kusmi *Nawadih* (jethwi, *2006)* | Kusmi *Late* (jethwi, *2006)* |
| **ILRI, Ranchi** | | | | | |
| Yield (%) | 60 | 51 | 68 | 60 | 60.5 |
| Moisture content (%) | 1.98 | 2.48 | 2.04 | 2.01 | 2.10 |
| Wax (%) | 3.52 | 3.70 | 3.82 | 3.71 | 3.62 |
| Impurities (insoluble % in hot alcohol) | 2.30 | 2.80 | 2.99 | 2.20 | 2.60 |
| Insolubility in cold alcohol (%) | 7.50 | 7.20 | 7.48 | 7.89 | 7.63 |
| Flow (mm) | 46 | 41 | 48 | 46 | 47 |
| Life (minute) | 62 | 47 | 62 | 58 | 58 |
| Colour index | 9 | 10 | 9 | 9 | 9 |
| **IIT, New Delhi** | | | | | |
| Solubility in hot ethyl alcohol (% of raw lac) | 85 | 83 | 85 | 85 | 83 |
| Melting point range (°C) | 76 – 82 | 74 – 81 | 76-81 | 73-81 | 76-82 |
| Saponification Number | 178 | 176 | 177 | 179 | 175 |
| Acid Number | 54 | 55 | 54 | 57 | 56 |
| Iodine Value | 9 | 6 | 8 | 7 | 6 |

## 1.2 Production Improvement and Crop management

### 1.2.1 *Development of* kusmi *lac cultivation technology on* Albizia procera

One tree of *Albizia procera* had yielded 52 kg *kusmi* broodlac by using 1.5 kg of broodlac during winter crop 2005-06 in Udaysur village of Jhalda block in Purulia district of West Bengal. Keeping in view the potential of this tree, a project has been planned to develop technology for *kusmi* lac cultivation on this host to standardize pruning time, age of shoots suitable for inoculation, crop season, improved productivity and quality of broodlac and

lac. A well laid out experiment has been initiated in farmer's field (village- Putidih, Block- Jhalda, Dist.- Purulia) West Bengal, where required numbers of trees are available. As per schedule 20 trees of *Albizia procera* have been pruned in the month of June 2006 and will be inoculated next year.

### 1.2.2 *Development of package of practices of lac cultivation on* Prosopis juliflora

*P. juliflora,* a native of South to Central America, was introduced in India (Rajasthan) to combat desertification of *Thar* during early 20th century. Presently, this most vigorously spreading plant species in the arid zone covering neutral to alkaline and saline soil, has invaded most part of the state. Nearly one hundred million plants are present in the state in wasteland areas.

Although, this species is a reported host plant of *Laccifer* (=*Kerria*) *sindica*, no information about its utilization for production of lac was available. Since, lac cultivation is a viable proposition for economic growth of rural mass, a potentiality trial on this host plant was conducted at Gujarat for utilization of this species as a lac host bio-resource for production of lac. The trial was conducted at Forest Research Farm, Basan, Gandhi Nagar, Gujarat by inoculating one bush of this species with productive breed of *kusmi* strain of *K. lacca*, LR-5312, producing a good crop with a yield ratio of 1:6 during August 2004 as reported earlier.

Since lac is normally cultivated on normal to acidic soil, its performance in extremely alkaline (pH 9-10) and saline soil was not known. Also, lac has not been recorded to occur on this host in nature from India. Therefore, it was felt essential to take up experiments on this host in extreme conditions in Gujarat with the following objectives:

- To determine pruning response and proper age of shoot for lac inoculation
- To study performance of this host in saline/ alkaline soil in humid as well as in dry condition during winter and summer lac crop

To meet these objectives an experiment was planned on performance of *kusmi* lac insect on 5-6 month old shoots during winter and self-propagation during summer on two different locations (April 2005- July 2006)

Experiments were conducted at Victoria Garden in Bhavnagar and at Thalsar, 30 km away from Bhavnagar on the seashore with 3 treatments, each replicated 7 times and each block was represented by one tree. Seventy-two trees of 7.5-to12.5 cm DBH were pruned during April 2005 at both the sites. Shoots of *P. juliflora* were measured during 1st week of August 2005 and inoculated with *kusmi* lac insect (LR-5312) obtained from ILRI, Namkum. The crop was harvested during first week of February 2006.

#### Experiment at Thalsar

During the crop season three trees, one in each treatment, died. Data collected from rest of the trees indicated that lac insects performed well on 5-month-old shoots during winter season.

The broodlac yield: broodlac used ratios obtained under three treatments (Table 15) varied from as high as 38.52 in the lowest (13.26% coverage) insect stress ($T_1$) to 11.17 in the highest insect stress of 26.94 % coverage ($T_3$). Normally, a mean yield ratio of 22.06 is very high as compared to *kusum* and *ber*. It appears that only newly emerged tender shoots are capable in nursing the insects till maturity but not the older or thicker shoots. That's why un-pruned trees showed low yield ratio earlier. It can be inferred from the quality of lac sticks (per meter weight of lac sticks), that lac insect survival is being adversely affected when high insect stress is applied.

Since the tender shoots of *P. juliflora* are very thin in diameter (0.3-0.4 cm) about 1-1.5 g per meter of broodlac has been found to provide optimum coverage of the shoots for good quality of broodlac during winter season. It is worth mentioning that negligible pest infestation was recorded at Thalsar at crop maturity.

#### Experiment at Victoria Garden, Bhavnagar

At Victoria garden, lac crop on many trees was damaged by the fungal attack during September 2005; hence, data generated from the experiment was inadequate. However, 6.9 kg broodlac could be harvested from 13 trees. The continuous heavy rainfall that occurred between 20 to 24 September attracted fungal attack causing severe mortality of lac insects during time of male emergence.

Table 15. Performance of *kusmi* strain of lac insect on 5-month-old shoots of *P. juliflora* under humid conditions of the seashore (Thalsar)

| Treatments (Insect stress in terms of coverage) | Mean values | | | | | |
|---|---|---|---|---|---|---|
| | Shoot length generated/ tree (m) | Broodlac rate used (g/m) (range) | Percent coverage | Yield ratio (Yield:used) | Weight (g/m) lac encrustation | Broodlac yield (kg) (Used) |
| $T_1$- 10-15% | 39.4 | 1 (0.7-1.2) | 15.31 | 38.52 | 262.8 | 1.30 (0.032) |
| $T_2$-16-25% | 35 | 1.5 (1.2-1.5) | 20.14 | 18.88 | 141.6 | 0.9 (0.05) |
| $T_3$- 26-30% | 16.83 | 2 (1.6-2.2) | 26.94 | 11.17 | 96.2 | 0.47 (0.041) |
| **Grand mean** | **31.87** | | **20.11** | **22.06** | **166.87** | **0.88 (0.041)** |

Total broodlac used on 18 trees = 0.7kg, Total yield obtained = 15.16kg, Gross yield ratio=22

** *During the experimental period three plants, one in each treatment died/lost at Thalsar. Hence the data presented here was analyzed only with 6 replications.*

## Trial for summer lac production

A trial for raising summer lac crop of *kusmi* and *rangeeni* strains on *P. juliflora* was also carried out during summer 2006 at Thalsar; Victoria Garden, Bhavnagar as well as Basan, Gandhinagar on unpruned trees under 75% agro net cover. Lac crop in Bhavnagar survived only up to April 2006. The failure of summer crop at both the locations may be attributed to i) heat mortality due to sunlight falling on the lac insect and / or ii) moisture stress in the shoots. Attempts will be made again for raising summer lac crop at different places under different conditions. The *Jethwi* crop raised at Gandhinagar attended maturity with 30-40% virgin females. The crop yielded 17 kg broodlac with a 2.4 broodlac ratio.

### 1.2.3 *Integration of* F. semialata *with horticultural crops for sustainable lac production under irrigated condition.*

Winter (*aghani* 2005-06) and summer (*jethwi* 2006) season lac crops were raised on *F. semialata* planted at single and paired row planting pattern integrated with continuous cropping of vegetable crops during three cropping seasons (*kharif, rabi* and *zaid*) under irrigated condition. Observations were recorded on plant growth attributes of *F. semialata,* prior to lac inoculation for winter (*aghani* 2005-06) and summer (*jethwi* 2006) seasons. Data presented in Table 16 show the highest value of plant growth attributes *viz*; plant height, basal girth, tillers/ bush, canopy spread, total and available shoot length for lac insect settlement in treatment where *F. semialata* was planted in single row with vegetable crops schedule-I *i.e.* okra, garlic and bitter-gourd during *kharif, rabi* and *zaid* seasons, respectively during winter lac crop season. Whereas, during summer season lac crop, the plant growth characters (plant height, basal girth and total shoot length) were observed to be maximum in paired row planting pattern with vegetable crops schedule-II *i.e.* ginger, tomato and bottle-gourd during respective seasons (Table 17).

Maximum broodlac and sticklac yield were obtained to the tune of 65.41 and 13.63 q/ha when *F. semialata* was planted in paired row with vegetable crop Schedule-I (okra, garlic and bitter-gourd in respective seasons) during winter season lac crop. Similarly, 7.05 q/ha yield was obtained during summer season when the host plants were planted in single row with vegetable crops Schedule-I. The sticklac equivalent yield was computed by considering the total value of main crop (lac) and companion crop (vegetable crops yields) during both lac crop seasons taking into account of prevailing price of sticklac and vegetable crops. The highest sticklac equivalent yield, 26.55q was obtained during winter season when *F. semialata* was planted in paired row system with vegetable crops Schedule-II. Similarly, during *jethwi* crop the maximum value of sticklac equivalent yield was 15.80 q/ha with vegetable crop schedule-II

**Table 16. Plant growth attributes as influenced by different treatments prior to lac inoculation for winter lac crop (*Aghani* 2005-06)**

| Host plants planting pattern | Vegetable crops schedule | Plant height (m) | Basal plant girth (m) | Tillers/ bush (Nos.) | Canopy spread N-S | Canopy spread E-W | Total shoot length (m) | Inoculable shoot length (m) |
|---|---|---|---|---|---|---|---|---|
| Sole *F. semialata* in single row | No vegetable crops | 1.07 | 2.41 | 9.18 | 0.95 | 0.98 | 8.36 | 6.17 |
| Sole *F. semialata* in paired rows | No vegetable crops | 0.92 | 2.10 | 9.50 | 0.86 | 0.86 | 7.83 | 5.66 |
| *F. semialata* in single row | Schedule-I | 1.44 | 3.03 | 11.73 | 1.18 | 1.20 | 15.12 | 11.53 |
| *F. semialata* in single row | Schedule-II | 1.27 | 2.96 | 9.30 | 1.06 | 1.06 | 9.89 | 7.69 |
| *F. semialata* in paired rows | Schedule-I | 1.44 | 3.01 | 11.17 | 1.14 | 1.13 | 13.65 | 9.05 |
| *F. semialata* in paired rows | Schedule-II | 1.28 | 2.71 | 10.08 | 1.07 | 1.00 | 12.54 | 9.17 |
| CD at 5% | - | 0.178 | 0.688 | N.S. | N.S. | 0.188 | N.S. | N.S. |

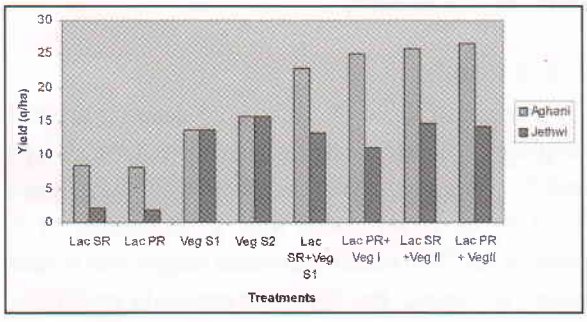
** Schedule I - Okra, Garlic and Bitter-gourd; Schedule II - Ginger, Tomato and Bottle-gourd*

**Table 17. Plant growth attributes as influenced by different treatments prior to lac inoculation for summer lac crop (*Jethwi* 2006)**

| Host plants planting pattern | Vegetable crops schedule | Plant height (m) | Basal plant girth (m) | Tillers/ bush (Nos.) | Canopy spread N-S | Canopy spread E-W | Total shoot length (m) | Inoculable shoot length (m) |
|---|---|---|---|---|---|---|---|---|
| Sole *F. semialata* in single row | No vegetable crops | 0.68 | 2.48 | 7.33 | 0.51 | 0.51 | 3.52 | 1.73 |
| Sole *F. semialata* in paired rows | No vegetable crops | 0.68 | 2.44 | 7.80 | 0.58 | 0.55 | 3.65 | 1.88 |
| *F. semialata* in single row | Schedule-I | 0.75 | 2.57 | 7.53 | 0.53 | 0.56 | 3.94 | 2.63 |
| *F. semialata* in single row | Schedule-II | 0.73 | 2.56 | 6.67 | 0.52 | 0.54 | 3.66 | 2.16 |
| *F. semialata* at paired rows | Schedule-I | 0.75 | 2.69 | 6.93 | 0.55 | 0.54 | 4.00 | 2.51 |
| *F. semialata* in paired rows | Schedule-II | 0.84 | 2.77 | 7.33 | 0.53 | 0.52 | 4.88 | 2.29 |
| CD at 5% | NS | NS | NS | NS | NS | NS | NS | |

** Schedule I - Okra, Garlic and Bitter-gourd; Schedule II - Ginger, Tomato and Bottle-gourd*

followed by *F. semialata* planted under single row (14.66 q/ha) with vegetable crop Schedule II. The integration showed superiority over sole lac cultivation under both planting patterns and continuous cropping of vegetable crops during both lac crop season (Fig. 22).




*SR – single row, PR – paired row; S1 – Schedule I, S2 – Schedule II*

*Fig. 22. Stick lac equivalent yield (q/ha) during winter and summer as influenced by different treatments*

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. 1.95 lakh/ha/ annum by sale of sticklac and vegetable crops closely followed with the same planting pattern with vegetable crops Schedule-II with benefit cost ratio of 2.40 and 2.20 respectively. Sole lac cultivation on *F. semialata* in single and paired row in winter season provided benefit cost ratio of 1.10 and 1.13 with economic return Rs.0.11 and 0.15 lakh/ha/annum respectively. Similarly, only vegetable crops cultivation during *kharif*, *rabi* and *zaid* seasons provided a net profit of Rs.1.06 and 1.10 lakh/ha/annum with benefit cost ratio of 2.77 and 2.37 at Schedule I and Schedule-II respectively. Sole lac cultivation during summer seasons on both the planting pattern was found to be uneconomical.

### 1.2.4 *Bio-rational management of lac insect predators*

The DBT funded project was completed in September 2006. Experiments were undertaken on various aspects of management of lac insect pests and the various strategies evaluated at the Institute Research Farm and under Field Level Demonstrations (FLD) in the Farmer's field through participatory approach. Following are the highlights and significant findings of the study:

- For the management of the two key lepidopteran lac insect predators *viz. Eublemma amabilis* and *Pseudohypatopa pulverea* on the lac crop, effective release doses of egg parasitoids namely *Trichogramma achaeae, T. brasiliense, T. exiguum, T. ostrinae, T. poliae* and *T. pretiosum* for *Butea monosperma* (*palas*) and *Ziziphus mauritiana* (*ber*) were 100 egg parasitoids per tree; for *Schleichera oleosa* (*kusum*), the dose was 300 eggs parasitoids per tree while for the bushy host plants *Flemingia macrophylla* (*bhalia*) and *Albizia lucida* (*galwang*), it was 20 egg parasitoids per bush.
- Two releases of egg parasitoids at an interval of 30 days after lac crop inoculation have proved very effective. 56-90 percent reduction in the number of lac insect predators was observed in the different crops raised on different host plants.
- Evaluation of different formulations of *Bacillus thuringiensis* sub sp. *kurstaki* based bio-pesticide namely Delfin and Biolep were found to be effective against both the lepidopteran lac insect predators at a dose of 0.05% applied twice for *rangeeni* lac crop and thrice for *kusmi* lac crop. Percentage reduction in lepidopteran lac insect predators was found to be around 90% when applied twice for *rangeeni* lac crop and thrice for *kusmi* lac crop.
- Planting of *Cassia occidentalis* plants along with bushy lac host plants augmented the egg parasitoid population (*T. chilonis*) in lac ecosystem. This simple strategy resulted in management of the lepidopteran lac insect predator population. Suppression of the predators was recorded to be around 56- 64% in case of *E. amabilis* while it was 62-80% in case of *P. pulverea.*
- Field evaluation of essential oils of odour emitting grasses Cymbopogon *citratus* (lemon grass) *Cymbopogon martini* (palmarosa) and *Cymbopogon nardus* (citronella) through perforated dispenser exhibited repellent activity against the two major lepidopteran predators of lac insect without any detrimental effect on the lac insects. The release resulted in 65–100% lesser incidence of lepidopteran lac insect predators.
- A light trap consisting of an emergency light and a tray (made of G I sheet) filled with detergent water placed in the field during night hours resulted in trapping of over 100 adults of *Chrysopa* sp. The *Chrysopa* pests attacking *kusmi* lac crop raised on *Schleichera oleosa* (*kusum*) were trapped in large numbers during the months of August and September.

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

Gravimetric method was used to estimate the soil moisture content at 105°C till the constant weight was obtained. Moisture content of soil was calculated on weight basis and then it was converted to volume basis. Growth attributes *i.e.*, plant height, basal girth (5 cm above the ground level), canopy spread and number of branches and soil moisture status were recorded at monthly interval (25-30 days).

#### Plant height

Perusal of Table 18 and Fig. 23 shows that plant height in $T_1$ (Half moon terracing), $T_2$ (Mulching) and $T_3$ (Compartmental bunding) was higher than $T_4$ (Use of cover crop) and $T_5$ (Control). Till September 2006 maximum mean height was in half moon terracing, but October onwards mulching treatment overtook half moon terracing. The plant heights for the treatments $T_1$ and $T_3$ were always significant in comparison to $T_4$ and $T_5$. Amongst

**Table 18. *Ber* plant height under various conservation treatments in mixed plantation of *ber* and *kusum***

| Month | Plant height (cm) | | | | | |
|---|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | CD (P=0.05) |
| Jan 06 | 133.22 | 119.03 | 122.59 | 109.19 | 106.31 | **13.25** |
| Feb 06 | 133.81 | 119.50 | 123.31 | 109.72 | 107.03 | **13.06** |
| Mar 06 | 134.78 | 119.72 | 123.75 | 110.06 | 107.87 | **13.01** |
| Apr 06 | 135.13 | 119.75 | 124.00 | 110.56 | 108.53 | **12.75** |
| May 06 | 135.28 | 120.44 | 124.16 | 110.87 | 108.68 | **12.99** |
| June 06 | 145.91 | 139.78 | 138.19 | 125.78 | 119.94 | **11.03** |
| July 06 | 173.09 | 173.03 | 171.00 | 152.03 | 150.87 | **14.41** |
| Aug 06 | 211.10 | 206.94 | 209.22 | 187.81 | 182.97 | **17.53** |
| Sept 06 | 237.03 | 231.25 | 235.06 | 215.16 | 205.62 | **23.65** |
| Oct 06 | 249.53 | 254.78 | 248.28 | 223.03 | 221.40 | **24.00** |
| Nov 06 | 256.91 | 265.34 | 256.53 | 229.53 | 231.53 | **27.71** |
| Dec 06 | 257.53 | 265.78 | 257.28 | 230.25 | 231.69 | **27.16** |

themselves, they were at par with each other, likewise $T_4$ and $T_5$, which remained at par with each other during the period. The vegetative growth of *ber* plants showed that all the treatments, except $T_4$, were effective in inducing better vegetative growth than control (Figs. 24 and 25). This might be due to more moisture conservation under different conservation measures over control. The magnitude of increment in plant height was 124.32, 146.76, 134.76, 121.09 and 122.53 cm for treatments $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$, respectively. More plant height under $T_1$, $T_2$ and $T_3$ may be due to conservation of high moisture content, which speeded up the plant growth. There was an apparent increase in the incremental growth of plant attributes during June to September for all the treatments. This may be due to more consumptive use of water by plants under increased soil moisture. The analysis of variance indicated that there was significant effect of different soil moisture conservation treatments on height of *ber* plants. Though, the incremental magnitude in plant height of *kusum* was observed as 67.75, 59.50, 57.50, 40.50 and 38.00 in treatments $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$, respectively, no significant difference was observed due to moisture conservation techniques during the period.

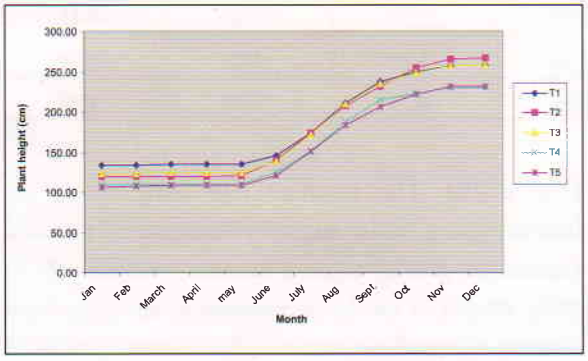



*Fig. 23. Growth of* ber *under various treatment during the year*

*Fig. 24.* Ber *and* kusum *plants under mulching treatment*

*Fig. 25.* Ber *and* kusum *plants under control*

## Soil Moisture Status

During the period, the highest soil moisture content (10.01-31.95 cm/m) was observed in half moon terracing treatment during all the months till September 2006. From October onwards, the mulching treatment showed improved moisture content over half moon terracing. It may be due to the timely application (July, 06) of mulches in the form of locally available grasses. The lowest soil moisture content was observed in control (7.13 –28.01 cm/m). The highest moisture content in half moon terracing and mulching, subsequently, was due to conservation of maximum rainwater in monsoon period. Perusal of Table 19 and Fig. 26 shows that though, there was improvement in soil moisture status on account of adopting different moisture conservation measures over control, the significant improvement in soil moisture status over control was obtained only during April-May and October-December, though all the treatments were at par statistically. No difference in the moisture content under different treatments was observed during monsoon period (June-Sept) due to uniform application of water in the form of rainfall. But during the period of October to December, the moisture content under mulching was significantly higher (25.07-53.12%) over control.

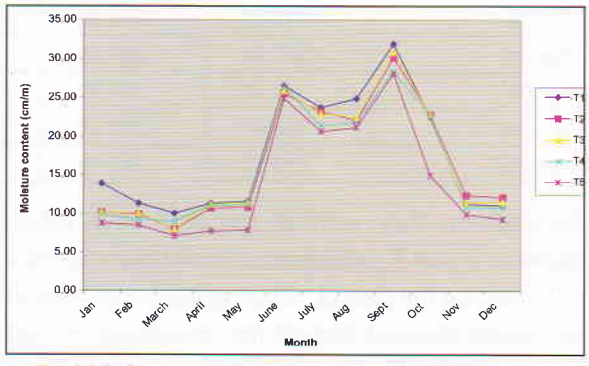



*Fig. 26. Soil moisture content under various treatments during the year*

**Table 19. Soil moisture content under various conservation treatments in mixed plantation of *ber* and *kusum***

| Month | Soil Moisture Content (cm / m) | | | | | |
|---|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | CD (P=0.05) |
| Jan 06 | 13.85 | 10.12 | 10.18 | 9.86 | 8.77 | NS |
| Feb 06 | 11.31 | 9.90 | 10.06 | 9.29 | 8.46 | NS |
| Mar 06 | 10.01 | 8.01 | 7.94 | 9.05 | 7.13 | NS |
| Apr 06 | 11.32 | 10.74 | 11.23 | 11.01 | 7.75 | **2.01** |
| May 06 | 11.58 | 10.86 | 11.42 | 11.19 | 7.85 | **1.87** |
| June 06 | 26.56 | 25.48 | 25.91 | 26.35 | 24.81 | NS |
| July 06 | 23.65 | 23.21 | 22.87 | 21.40 | 20.60 | NS |
| Aug 06 | 24.85 | 22.01 | 22.40 | 21.81 | 21.07 | NS |
| Sept 06 | 31.95 | 30.08 | 30.85 | 28.46 | 28.01 | NS |
| Oct 06 | 22.54 | 22.80 | 22.79 | 22.76 | 14.89 | **5.41** |
| Nov 06 | 11.24 | 12.32 | 11.38 | 10.85 | 9.85 | **1.40** |
| Dec 06 | 11.04 | 12.11 | 11.46 | 10.75 | 9.23 | **1.61** |

## Yield of inter-cropped *urd*

The intercrop *urd* was sown @ 250 g per plot in each replication of the treatment $T_4$. The average obtained of grain yield, stalk and total biomass (stalk + roots + leaves) was 106.25 kg/ha, 580.52 kg/ha and 1683.94 kg/ha, respectively (Table 20). The farmers can very easily do intercropping under mixed plantation of *ber* and *kusum* for getting a good income, particularly in early stages of lac hosts plantation as there is no chance of interference with the cultural practices of lac hosts.

Table 20. Yield of grain, stalks and total biomass (kg/ha) of inter-cropped *urd*

| Replications | Grain | Stalk | Incorporated biomass under the treatment |
|---|---|---|---|
| $R_1$ | 181.25 | 933.80 | 2708.00 |
| $R_2$ | 56.25 | 311.03 | 902.77 |
| $R_3$ | 100.69 | 694.13 | 2013.88 |
| $R_4$ | 86.80 | 383.10 | 1111.11 |
| **Mean** | **106.25** | **580.52** | **1683.94** |

### 1.2.6 *Broodlac and sticklac production*

## REVOLVING FUND SCHEME

Balance Sheet (April 2006 – March 2007)

| EXPENDITURE | | INCOME | |
|---|---|---|---|
| **Items** | **Amount (in Rs.)** | **Items** | **Amount (in Rs.)** |
| Labour charges | 42,977 | Sale of broodlac | 67,800 |
| Watch & Ward | - | Sale of sticklac | 59,850 |
| T.A. | - | Interest earned on STD | 28,866 |
| Other items | 9,954 | | |
| **Total** | **52,931** | **Total** | **1,56,516** |
| **Gross profit** | | | **1,03,585** |
| Less workers share and establishment charges | | | - |
| **Net profit** | | | **1,03,585** |
| **Description of Reserve growth during 2006-07** | | | |
| **Items** | **Withdrawls** | **Opening Balance** | **15,91,006** |
| Refund to ICAR (Final instalment) | 34,000 | Deposited Net Profit | 1,03,585 |
| | | Other income | - |
| **Total** | **34,000** | | **16,94,591** |
| **Closing Balance** | | | **16,60,591** |

## 1.3 Regional Field Research Station, Purulia (W. B.)

### 1.3.1 *Effect of different pruning times on* aghani *lac yield from* ber

Exploratory trial on lac cultivation in *aghani* season of 2005-06 had suggested that May pruning is not suitable for profitable lac cultivation. So, an on-farm testing in collaboration with KVK, R.K. Mission, Purulia was initiated to evaluate the performance of April pruned trees against February pruned and unpruned trees (trees with 14 months old shoots) at Gosaidih village, Purulia, West Bengal. For this purpose, nine trees pruned in February and seven each of April pruned and unpruned trees were inoculated in the month of July at uniform brood rate of 20g/m shoot length. Recommended crop protection measures were adopted *i.e.* application of 0.05% endosulfan and 0.01% carbendazim at 30 DAI (Days After Inoculation) and 0.03% DDVP along with 0.01% carbendazim at 60 DAI. Data collected were calculated in Completely Randomized Design.

Periodical observation on predator count, lac encrustation thickness and lac yield per unit length as affected by different times of pruning were recorded. However, no significant difference was observed (Tables 21 and 22).

More than 200 shoots were studied for distribution of encrustation and length of encrustation per shoot. Usually lac encrustation is found more on the base of the branch. April pruned branches are more congenial for lac growth. The fact has been reflected

in case of different yield ratio, though the figures did not touch the level of significance. The result suggested that April pruned trees are also equally good for *aghani* lac cultivation. So farmers can switch to *kusmi* lac cultivation after harvesting *ari* lac in April.

Lac insect settlement in the North - East direction was 19.2% of total of the total settlement on a tree. Whereas, it was 30.6% for the South - West direction and significantly different from the former.

**Table 21. Predator population, lac thickness and lac yield per unit length recorded at different time intervals**

| Pruning time | Predator population (No. per 10 cm) | | | | Thickness of encrustation (cm) | | | | Lac yield per 10 cm | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 DAT | 120 DAI | 150 DAI | At harvest | 100 DAT | 120 DAI | 150 DAI | At harvest | 100 DAT | 120 DAI | 150 DAI | At harvest |
| Feb. | 0.1 | 0.58 | 0.54 | 0.79 | 0.4 | 0.46 | 0.57 | 0.63 | 10.1 | 19.3 | 19.4 | 20.5 |
| April | 2.55 | 0.58 | 0.55 | 1.24 | 0.44 | 0.55 | 0.67 | 0.64 | 8.8 | 21.0 | 19.6 | 22.7 |
| Un-pruned | 1.06 | 0.32 | 0.69 | 1.12 | 0.43 | 0.47 | 0.61 | 0.67 | 8.2 | 16.6 | 23.6 | 19.5 |
| SEM± | | | | 0.22 | | | | 0.32 | | | | 1.85 |
| CD (0.05) | | | | NS | | | | NS | | | | NS |

**Table 22. Yield ratio of *aghani* lac crop on *ber* as influenced by different pruning times**

| Pruning time | Brood produced/ brood used ratio | Stick-lac/ brood used ratio | Rejected/ good brood (%) |
|---|---|---|---|
| February | 5.62 | 2.85 | 23.33 |
| April | 6.87 | 4.00 | 28.28 |
| Un-pruned | 5.65 | 3.44 | 17.71 |
| SEM ± | 1.18 | 0.73 | 5.96 |
| CD (0.05) | NS | NS | NS |

### 1.3.2 *Evaluation of* kusmi *lac (*aghani*) production technology on* ber

For evaluation of lac cultivation technology developed at ILRI, Ranchi, an experiment was conducted at farmer's field in Kenduadih village, Jhalda. Lac cultivation in farmer's method was taken as a check, where inoculation was done @ 30g/m shoot length and without pest control schedule. As per ILRI technology, brood rate was inoculated @ 20g/m and *B. thuringiensis* sp. *kurstaki* (Delfin) was applied @ 0.05% along with 0.01% carbendazim at 30 and 60 days after inoculation (DAI). Lac crop was harvested from 19 trees adopting ILRI method and 15 trees adopting farmers' method. Lac was inoculated in July and harvested in the month of November. Total rainfall received during the period was 899mm, maximum temperature range 28.9 to 31.1°C and minimum temperature range 19.7 to 25.9°C. A test of significance was done using t-test.

Mortality of lac insect before and after spray *i.e.* in August and in September was recorded. 25.3% higher mortality was recorded in case of farmers' method compared to ILRI method, where crop protection measures were adopted. This difference could be attributed to spraying of Carbendazim in August. Density of settlement was found significantly higher (15%) in farmers' method due to higher inoculation rate.

Predator population per 10cm of lac stick was recorded in different stages (Table 23). Delfin proved to be successful in controlling the predator population. At harvesting, three times higher predator population was found in the untreated lac crop than the treated ones. The difference was statistically significant.

Thickness of the lac encrustation was also measured periodically to record quantity of lac produced (Table 24). After second spray in September, lac encrustation thickness was found to be affected due to spray of pesticide. At harvest,

encrustation thickness was observed to be 0.8 mm lesser than the control condition (farmers' method) and was found to be statistically significant. Lac stick/brood used and stick lac/*phunki*-scrap ratio was not influenced significantly due to different methods of cultivation (Table 25). Yield loss due to any detrimental effect of the pesticide spray is mitigated partially by suppression of predator population in ILRI method.

**Table 23. Number of predators (No./10cm) recorded in different methods of cultivation**

| Method | 40 DAI | 60 DAI | 80 DAI | 100 DAI | At harvest |
|---|---|---|---|---|---|
| ILRI | 0.14 | 0.33 | 0.16 | 0.17 | 0.73 |
| Farmer | 1.13 | 0.14 | 0.97 | 0.56 | 2.26 |
| t-test $_{(0.05)}$ | - | - | - | - | * |

**Table 24. Thickness (mm) of lac encrustation recorded in different methods of cultivation**

| Method | At 60 DAI | At 80 DAI | At 100 DAI | At harvest |
|---|---|---|---|---|
| ILRI | 1.4 | 2.8 | 4.4 | 4.7 |
| Farmer | 1.2 | 4.1 | 5.1 | 5.5 |
| t-test $_{(0.05)}$ | - | - | - | * |

**Table 25. Different yield ratio as affected by different methods of cultivation**

| Method | Scraped lac/ *phunki* scrap ratio | Lac stick/brood used ratio |
|---|---|---|
| ILRI | 8.8 | 5.16 |
| Farmer | 8.1 | 4.60 |
| t-test $_{(0.05)}$ | NS | NS |

■ ● ■

# 2. LAC PROCESSING AND PRODUCT DEVELOPMENT

## 2.1 Processing and Value Addition

### 2.1.1 *Improvement in process and equipments for processing quality seedlac at village level*

### Design and Development of Pedal Operated Lac Washing Machine

Sticklac contains impurities and extranaceous matters, which up to a large extent are removed during primary processing. The primary processing of lac involves five major unit operations *i.e.*, crushing, washing, drying, winnowing and grading. Sticklac is converted into seedlac in primary processing. Lac washing is an important unit operation, which is carried out after crushing. Washing is done manually in small lac processing factories or mechanically in large lac processing factories. In manual washing, the feet and hands of the workers come in contact with water having lac dye and soda during washing, which adversely affect skin of feet and hands. The large lac processing factories having facilities of power and tap water carry out washing in large horizontal stationary barrel fitted with an axle on which blades are fixed. Such large size barrels, which require electric or engine power are not suitable for village level primary processing units. Therefore, a small capacity pedal operated lac washing machine (Fig. 27) was designed, developed and tested considering the problems faced in manual vat washing and limitations of using large power operated lac washing machine in small lac processing units. The developed lac washing machine washes 35 kg crushed lac per batch and for washing each batch 2-2.5 hours time is required. Two persons are required to operate the machine. The quality of washed lac was found to be as per the requirements of IS- 6921-1973: Specifications of seedlac.

*Fig. 27. Pedal Operated Lac Washing Machine*

### 2.1.2 *Quality changes in lac with storage*

Studies were continued on the changes in different physico-chemical properties due to storage at room temperature for seedlac and shellac obtained from three crops of lac *i.e.*, winter (*aghani kusmi*), summer (*jethwi kusmi*) and rainy season (*katki rangeeni*). Significant decrease was noticed in the values of flow, cold alcohol insoluble etc. in the seedlac and shellac of both the crops namely, (*jethwi kusmi*) and (*katki rangeeni*). However, application of an antioxidant in the initial stage of storage was found to delay degradation at least by 6 months in both the crops.

Both seedlac and shellac, from *katki rangeeni* origin, were found to absorb moisture (increase in absorbed moisture content was 40% and 25.6% respectively) from the atmosphere during rainy season (July-October 2005; R.H. 72-95%) and released moisture (decrease in absorbed moisture 14.7% and 13.6%, respectively) during winter (October – January 2006).

The keeping property of seedlac of the rainy season crop of *rangeeni* lac was found to be better compared to shellac as revealed from insignificant changes observed in the melting peak of resin (59.15$^0$C) and wax (74.54$^0$C) compared to the data observed (58.13$^0$C and 76.9$^0$C) initially. A Similar observation was reported earlier based on changes in flow and cold alcohol insoluble. Analysis of DSC melting profiles of seedlac of summer crop (*baisakhi ari*) of *rangeeni* lac revealed smaller peak for resin (at 66.68$^0$C) and a more prominent peak for wax at 75.65$^0$C indicating higher wax content.

A correlation between melt-viscosity and flow (fluidity) of seedlac and shellac could be established. However, correct determination of age would be difficult due to wide variation in the initial values of physical parameters, as its (lac) origin is natural.

No uniform correlation could be established for all the crops, *e.g.*, correlation was linear for *aghani* and *katki*, while it was exponential for *jethwi*.

No blocking (coalescence) of sticklac / seedlac / shellac was observed during storage inside perforated paper cartons (at room temperature), if it is dried to the moisture content < 2%. Degradation of shellac is observed to be faster than seedlac, thus storing the latter is advantageous.

### 2.1.3 *Physico-chemical properties of lac obtained from various lac-producing countries*

Comparative changes in the qualities were studied for seedlac and shellac obtained from Thai and Indian lac stored at room temperature condition for the last two year. Seedlac obtained from North Eastern Hill Region (NEH) and Indonesia was also included in the study, which was stored only for one year. The results obtained are as follows:

*Colour Index:* No change in the values of colour indices were observed with storage. However, colour indices of Indian (*kusmi*) seedlac and shellac were observed to be lower (Figs. 28 and 29) as compared to those of Thai, Indonesian, and Indian (NEH) lac.

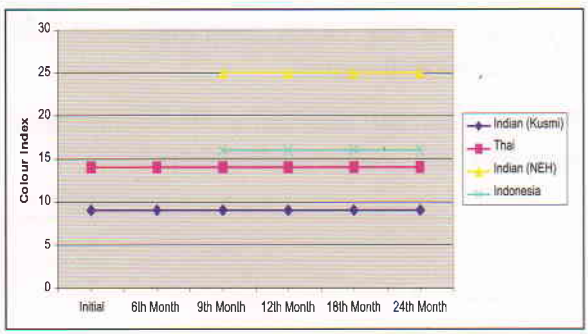



*Fig. 28. Colour Index of Indian (*Kusmi*), Indian (NEH), Thai and Indonesian Seedlac*

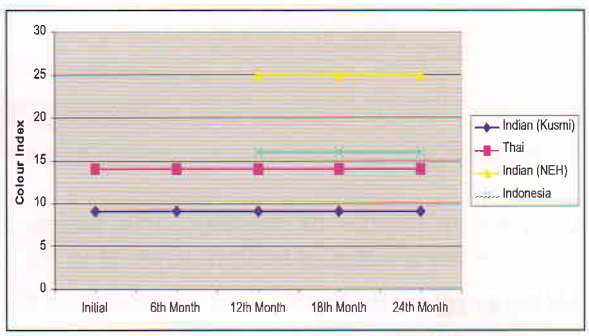



*Fig. 29. Colour Index of Indian (*Kusmi*), Indian (NEH), Thai and Indonesian Shellac*

*Flow:* After two years of storage, flow of seedlac and shellac decreased sharply (Figs. 30 and 31). Flow of Thai seedlac & shellac was 78% & 34% lower respectively than those of Indian *kusmi* respectively whereas flow of Indonesian and Indian (NEH region) seedlac and shellac were 63% & 26% and 78% & 47% lower respectively than those of Indian *kusmi* respectively (after one year of storage).

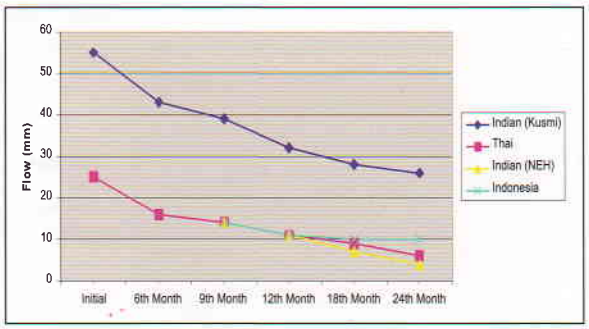



*Fig. 30. Flow of Indian (*Kusmi*), Indian (NEH), Thai and Indonesian Seedlac*

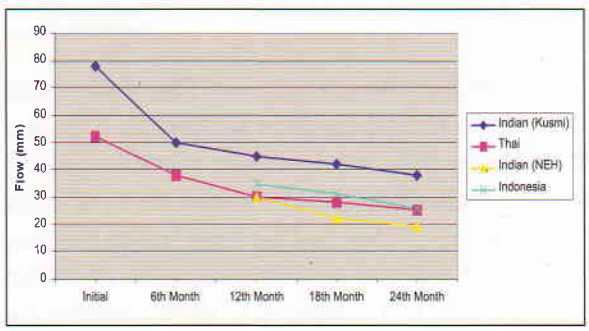



*Fig. 31. Flow of Indian (*Kusmi*), Indian (NEH), Thai and Indonesian Shellac*

Initially the flow of Thai seedlac was 54% lower than Indian (*kusmi*). Whereas, in case of shellac the initial flow value of Thai lac was 36% lower than Indian (*kusmi*) shellac.

*Heat Polymerization Time (HPT) :* Life of Indian (*kusmi*) seedlac & shellac was 5% & 18% higher than those of Thai origin (after 2 yrs of storage), whereas life of Indian (*kusmi*) seedlac & shellac was 7% & 20% and 35% & 45% higher than those of Indonesian and Indian (NEH region) respectively (after 1 yr storage). Initially also the value of HPT of Thai seedlac was 8% lower than the Indian lac (Figs. 32 & 33). Whereas, in case of shellac the initial HPT value of Thai sample was 7.8 % lower than those of Indian (*kusmi*) shellac.

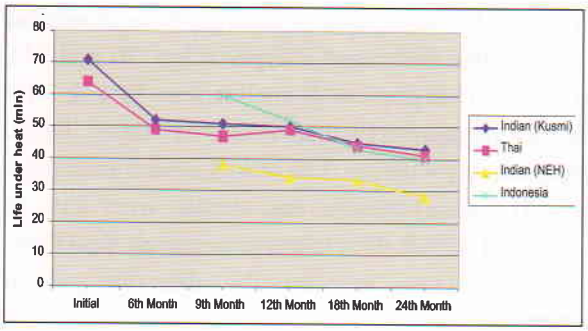



*Fig. 32. Life under heat of Indian (Kusmi), Indian (NEH), Thai and Indonesian Seedlac*

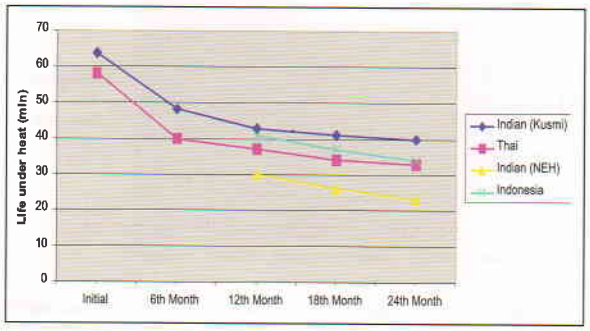



*Fig. 33. Life under heat of Indian (Kusmi), Indian (NEH), Thai and Indonesian Shellac*

*Bleach Index :* Bleach index of Thai, Indonesian and Indian (NEH) seedlacs were 42%, 42% and 27% higher (Fig. 34) than those of Indian (*kusmi*) seedlac, indicating less expenditure involved in the manufacture of bleached lac from Indian seedlac. Both cold and hot alcohol insolubles of Indian seedlac were less compared to those obtained for other countries, indicating presence of low impurities in Indian seedlac.

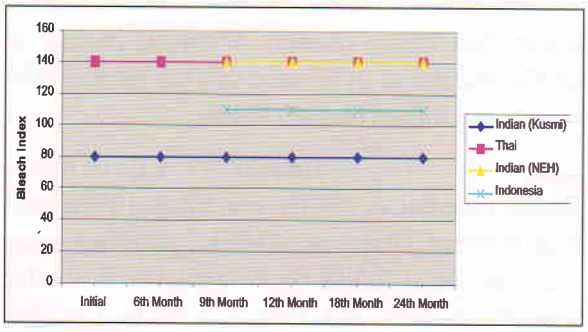



*Fig. 34. Bleach Index of Indian (Kusmi), Indian (NEH) Thai and Indonesian Seedlac*

Studies on melting profiles of aleuritic acid isolated from the seedlacs of Indian, Thai and Indonesian origin were conducted with the help of DSC. The results of DSC thermograms of aleuritic acid are as follows:

A. Melting profile of aleuritic acid isolated from the seedlac of Indonesian origin (Fig. 35)

Control: Highly impure, shoulder at 58°C, peaks at 72.22°C and 91.11°C

With 1g Charcoal: single sharp peak at 89.39°C

With 5g Charcoal: single sharp peak at 89.48°C

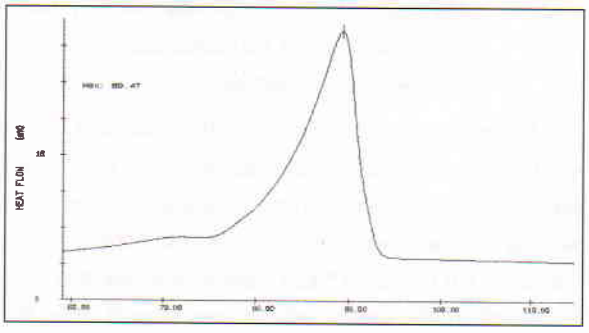



*Fig 35. DSC thermogram of aleuritic acid isolated from Indonesian seedlac*

B. Melting profile of aleuritic acid isolated from the seedlac of Thai origin (Fig. 36)

Control: Highly impure, shoulder at 58.4°C, peaks at 71.75°C and sharp peak at 90.59°C

With 1g Charcoal: single sharp peak at 91.16°C (no good crystallization)

With 5g Charcoal: shoulder at 89.39°C and peak at 90.98°C (no good crystallization).

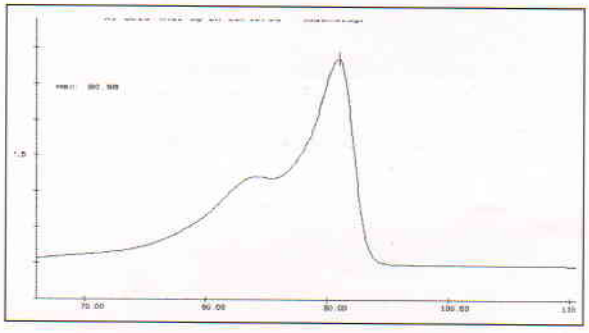


*Fig. 36. DSC thermogram of aleuritic acid isolated from Thai seedlac*

C. Melting profile of aleuritic acid isolated from the seedlac of Indian origin (Fig. 37).

Melting profile of aleuritic acid isolated from the Indian seedlac showed a single sharp peak at 95.87°C with 1g Charcoal.

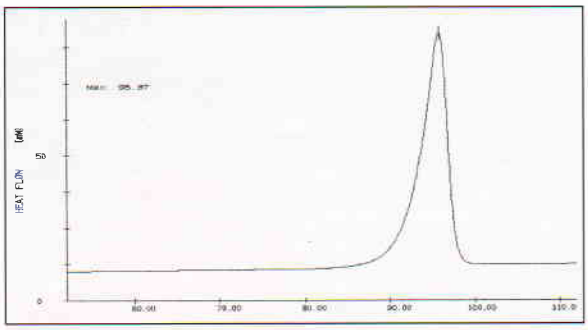


*Fig 37. DSC thermogram of aleuritic acid isolated from Indian seedlac*

Results of DSC thermograms indicate the good crystallinity and purity of aleuritic acid obtained from Indian lac as compared to the others. Aleuritic acid obtained from Indonesian seedlac showed peak at 89.48°C and Thai seedlac showed a shoulder at 84.39°C and peak at 90.98°C. This indicated better purity of aleuritic acid from Indian origin compared to those obtained from other countries.

A comparative study was also made on the surface coating properties of Indian and Thai shellac. Solution of 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 measurement, scratch hardness, impact resistance and flexibility were carried out (by its application on tin plate) and found that Indian shellac solution is glossier (70%) than that of Thai shellac solution (54%) to the standard black (100%). It 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 from Thai and Indian origins revealed better gloss of films for the latter. 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 superior to those of other countries especially, with regard to flow, HPT, colour index, bleach index and gloss.

### 2.1.4 *Storage loss assessment for lac and lac based products*

A new project was undertaken to study the existing pattern of storage, storage losses and economics of lac and lac based products (sticklac, seedlac, shellac, dewaxed decolorized lac and bleached lac) with an aim to identify suitable methods of storage for different products. Storage data were collected by surveying several lac processing and trading units at Balarampur, Purulia, Murhu, Gondia, Seoni, Sakti and Kathghora. The information collected revealed that:

Sticklac is stored on floor (Fig. 38), preferably earthen ones; turned over frequently, till dried. It is usually stored in a cool dry place in thatched sheds with proper ventilation. It is either stored in heaps (maximum height one foot) in open or packed in gunny bags of 50-60 kg capacity after drying with moisture content < 4 %.

*Fig. 38. Sticklac spread on cemented floor*

*Fig. 39. Shellac in gunny bags*

Seedlac and shellac are usually stored in open (shed) by spreading on concrete floors in a well-ventilated cool place, which also help in removal of moisture from the products. Aeration is must for storage of shellac to reduce blockage.

Shellac is normally allowed to cool off, after stretching/sheeting for a few hours and then transferred to cool-shed/ godown, where it is spread on floor for 8-10 days. The dried, shellac is packaged and transported in gunny/ paper bags (Fig. 39). During summer and rainy season, shellac is stored in air- conditioned warehouses, which are maintained at temperature 14-18°C. It helps in maintaining the quality of lac resin as well as preventing shellac from blocking in hot weather.

Sticklac, Seedlac and shellac of ordinary grades are packed in gunny bags of 60-75 kg capacity each. On the other hand, superior quality shellac is, sometimes, packed in cloth-lined gunny bags or paper bags (25 kg capacity) for export purposes (Fig. 40). Plastic bags are not used for storage/ transportation of lac as it sticks to the material under heat and pressure.

Bleached lac, dewaxed shellac and dewaxed - decolourised lac are most often stored in air-conditioned godown, at around 15-20°C temperature. Usually, storage is done in loose form by spreading on cemented floor (Fig. 41) and packed in paper bags for transportation. The size of packets/bags depends on the demands of the customers. Paper - bags of 25 kg capacity are preferred by most customers. Sometimes 10 kg packets are also used. The bags/packets used for transporting bleached lac are usually made of waterproof materials like resin treated paper bags and/or laminated paper cartons.

*Fig. 41. Bleached lac spread on cemented floor*

Assessment of losses of lac based products can be attributed mainly due to driage, which accounts for 30% (approx.) in case of *ari* lac, 5 to 10% in case of *phunki* sticklac, 0.5 to 2% in seedlac and shellac and about 5% in case of bleached lac. Further loss to the extent of 0.1 to 0.5% occurs due to shattering of the products in loose storage. Losses are also observed during handling and transportation in gunny bags, due to leakage, which is 0.1 to 0.2% and 0.2 to 0.4% for seedlac and shellac, respectively.

### 2.1.5 *Establishment of commercially viable pilot plant for preparing pure / food grade lac dye*

A pilot plant for preparation of technical grade lac dye, using wash water of sticklac, has been erected (Fig. 42) for the first time at the Institute.

*Fig. 40. Shellac in cloth-lined gunny bag*

*Fig. 42. Pilot plant of lac dye*

*Fig. 43. Technical grade lac dye*

The trial runs of the pilot-plant were carried out with a total no. of five batches of wash water of *kusmi* (*phunki*) sticklac obtained from the Institute farm. The yield of technical grade lac dye, obtained (Fig. 43) was 0.17-0.31% as shown in Table 26. It was observed that the pH and concentration determined earlier on bench scale, for precipitation of calcium salt of lac dye and its conversion to technical grade, had been found suitable in pilot scale preparations also.

**Table 26. Yield of lac dye from *kusmi* (*phunki*) sticklac obtained from different batches**

| Batch no. | Sticklac (kg) | Wash water (lt) | Wet technical grade lac dye (g) | Dry technical grade dye (g) | Yield (% by wt. of sticklac |
|---|---|---|---|---|---|
| 1 | 90 | 1000 | 360.0 | 153 | 0.170 |
| 2 | 60 | 1000 | 484.5 | 191 | 0.318 |
| 3 | 35 | 150 | 190.0 | 90 | 0.257 |
| 4 | 30 | 400 | 55.0 | 23 | 0.077 |
| 5 | 32 | 400 | 286.0 | 100 | 0.312 |

Trial of two more batches with *rangeeni* lac is under progress for comparing the variation in yield of lac dye.

Different characteristics of the lac dye *i.e.* dye content (70.8 to 71.1%); ash content (0.70 – 1.10%) and melting point (230-238°C with charring) were determined. The samples are being evaluated for presence of heavy metals, if any.

### 2.1.6 *Enhancing keeping quality of bleached lac*

Studies on effect of moisture content on keeping quality of bleached lac made from *kusmi* seedlac (3% and 1% chlorine content in bleach liquor) in the form of hank revealed that keeping quality was not affected for six months in both the cases. However, use of cold water (20°C or below) in place of ordinary water, for removal of excess acid enhances its keeping quality up to 12 months, even if the chlorine content in bleach liquor is less. It can be attributed to better removal of excess acid with cold water.

Keeping in view, the demand from the industries for retaining more moisture in the hank for better profitability, bleached lac hanks were prepared by two methods namely, melting in hot water and by moulding washed bleached lac directly in moulding press. It was observed that the former was able to retain moisture up to 20% constantly, where as in the latter case, moisture retention was higher initially, but the excess moisture was released gradually and finally retained up to 20 %.

## 2.2 Product Development and Use diversification

### 2.2.1 *Use of lac and modified lac in the manufacture of Jute re-inforced sheets*

Study on jute-fiber glass reinforced sheets was continued in order to prepare a more eco-friendly sheet for structural and other purposes using shellac containing sheet-molding compound. Mechanical properties were tested with an Instron tensil tester (Model-5567) following ASTM D 638 (tensile strength and modulus), ASTM D 790 (flexural strength and modulus) and ASTM D 256 (Impact strength) at NIRJAFT, Kolkata. Flexural strength (82.6 – 91.5 MPa) of 6-7 mm thick sheets was found to be in the range of reinforced sheets prepared using fibreglass alone, indicating very good strength. The sheets possessed resistance to

a number of chemicals, good flame retardness and thermal resistance up to temperature 220°C.

Impact strength of commercial plywood (3 mm thick) was found to be 6 kg-cm. Higher impact strength was observed, when these were laminated (Table 27), on either side (7.7 kg-cm) or on both sides (35 kg-cm) with jute and fiberglass with shellac containing sheet-molding compound. Similar higher impact strength was also observed, when commercial particle board (impact strength 11 kg-cm) was laminated on both sides with fiber glass (33.8 kg-cm) alone and with jute fabric plus fiber glass (45.3 kg-cm) respectively. Impact strength of commercially available laminated particle - board was, on the other hand, found to be only 12.3 kg-cm.

**Table 27. Mechanical properties of jute-fiberglass reinforced composite sheets prepared with shellac containing sheet-molding compound**

| Sample | Description | Impact | Maximum |
|---|---|---|---|
| 1 | Plywood (control) | 6.0 | 53.52 |
| 2 | Plywood laminated single side with jute+fiberglass | 7.7 | 157.32 |
| 3 | Plywood laminated both sides with jute + fiberglass | 35.0 | 280.78 |
| 4 | Particle board (control) | 11.0 | 279.61 |
| 5 | Particle board laminated single side with jute + fiberglass | 45.3 | 1090.94 |
| 6 | Particle board laminated single side with fibreglass mat without jute | 33.8 | 549.25 |
| 7 | Commercial laminated particle board | 12.3 | 337.96 |

Maximum flexural load of commercial plywood (3 mm thick) was observed to be 53.5 N. A considerable increase (Table 27) in maximum flexural load was observed when plywood was laminated on one side (157.3 N) and on both side (280.8 N) with a thin layer of fibreglass along with shellac filled sheet-molding compound. Similar increase was also observed with commercial particle board (max. flexural load 279.6 N) when laminated on both sides with fibre glass (549.25 N) alone and with jute plus fibre glass (1090.9 N), whereas, the maximum flexural load of commercially available laminated particleboard possessed only 338 N. Although lamination with jute-fiber glass causes an increase in thickness of 2 mm, but the above results indicated considerable improvement in the mechanical properties. Pre-soaking of jute resulted in little reduction in the consumption of synthetic resin but no appreciable advantage in the physical properties was observed.

Reinforced sheets were also prepared (Fig 44) using individually jute fiber (single layer), jute fabric (single and double layers) and jute felt (non-woven, single layer) and both sides fibre glass mats using shellac filled sheet molding compound. Good mechanical properties *i.e.*, tensile strength (25.7 MPa), tensile modulus (1.1 GPa) and flexural strength (40.61 MPa), flexural modulus (1.7 GPa), were obtained for the sheets prepared using two layers of jute fabric and both sides glass fibre mat (yielding thickness 4 mm).

Two 5' x 3' and one 6' x 3' jute fabric/cloth – fiber glass reinforced sheets (4 mm thickness) of two different colours were prepared as an attempt to produce bigger size sheets. The sheets were smooth and found to be aesthetically appealing. The sheets may be used as partition wall (in place of plywood and particle board), door and window panels, as these are resistant to water and termite attack.

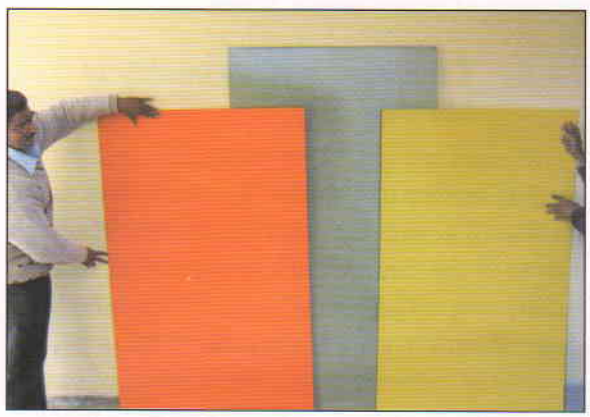


*Fig. 44. Jute-fiber glass re-inforced sheets*

### 2.2.2 *Use of sticklac in development of composite board from* arhar *stick*

The analysis of chemical constituents of pulverized *arhar* stick was carried out at NIRJAFT, Kolkata. The major constituents were found to be

as follows: - Cellulose – 42.7%, Hemicellulose - 32.8% and Lignin -20.4%.

Composite boards for panel / furniture were prepared, incorporating 2% chlorpyrifos 20% (w/w) in resin binder composition or wax emulsion, to improve the termite resistance behaviour. No appreciable change in the modulus of rupture of board was observed. The board samples of dimensions ~ 12cm x 12cm x 1.2cm were kept in open moist ground at ILRI Farm for six days. The termite survival was practically zero in the board with chlorpyrifos while in control sample termite attack was observed after three days (Fig. 45).

(a) (b)

*Fig.45. Termite resistance behaviour of sticklac composite board (a) control (b) with 2% chlorpyrifos*

Scaling up trial experiments of composite board from arhar stick using sticklac were carried out in collaboration with a private board-manufacturing factory at Kolkata. Sticklac was used both in alcoholic (methanol) and aqueous medium respectively. Binder compositions were prepared on a large scale with 25kg of sticklac per batch. Mixing of binder composition and the stick particles was carried out in Omega mixers having capacities of 22kg and 42kg respectively. The mixed material was sun and oven dried. Composite boards of size 7' x 3' and 8' x 4' (Figs. 46a and 46b) were prepared in a hydraulic press having six daylights. The use of sticklac in alcoholic medium was observed to be better compared to that in aqueous medium with regard to the requirement of IS: 3087-1985 (Type 2) specifications for Internal Grade. The control of moisture in the mat material to be hot pressed and the wood particle engineering were observed to be important in the manufacture of the board. The primary advantage is that the board is all natural and formaldehyde free.

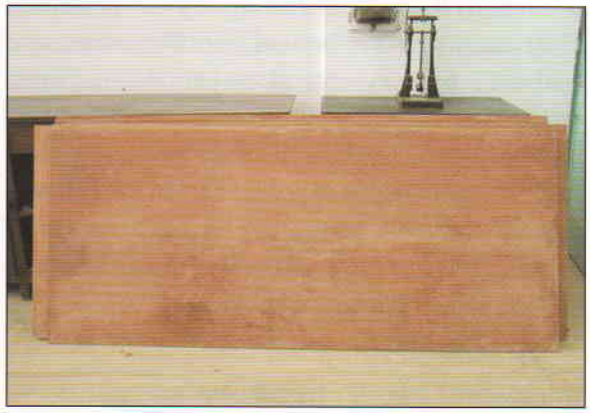


*Fig. 46a. Composite boards of size 7' X 3' from arhar stick using sticklac*

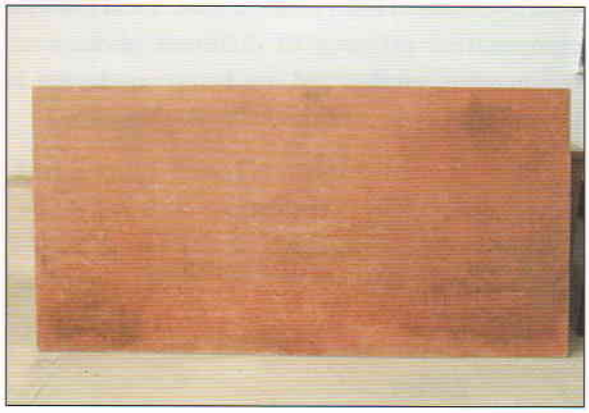


*Fig. 46b. Composite boards of size 8' x 4' from* arhar *stick using sticklac*

## Rosin and lac blend as a binder for wood particles

Rosin is a brittle, amorphous and thermoplastic natural resin. Being a cheap resin, it was considered of relevance to investigate if rosin could be used with sticklac in making particle board. Rosin sample, dark brown in colour was analyzed for its acid value and melting point, which were found to be ~171 and 100°C respectively. It was blended with sticklac in different proportions (0 to 50%) in alcoholic solution and particle boards were prepared. It was found that 10-15% rosin could be used with sticklac as partial replacement. The boards prepared with above binder showed adequate modulus of rupture values (~19.9-16.8 N/mm2).

### 2.2.3 *Field evaluation of PGRs and Insect Attractants / Repellants derived from aleuritic acid*

10 - Carboxymethyl - 2 - decenoic acid (CMDA) and methyl 9 - methylsulphonyloxy - 2 -nonenoate (5.0g each) were synthesized from 9-oxo-nonanoic acid and 7- hydroxyheptanal, the periodate oxidation products of aleuritic acid. Both the compounds are under evaluation at Biotechnology laboratory of the Institute and the sister organization, HARP, Palandu, Ranchi for their suitability in propagation of *Flemingia semialata*, *ber* (*Ziziphus mauritiana*) and pointed gourd *(Trichosanthes diveca)*.

In continuation of last year effort, (Z) - 9 - Hexadecenal, (Z) - 9 - hexadecenylacetate, (Z) - 9 - tetradecenylacetate, (Z) - 7-dodecenyl acetate and 16 - acetoxy - (E) - 9 - hexadecenoic acid (2.0g each) were synthesized from aleuritic acid. Field trials for comparative efficacy of different pheromone components synthesized are being conducted in tomato and brinjal, at HARP Plandu (Ranchi).

4.0g (Z)-9-hexadecenal and 2.5g (Z)-11-hexadecenal were synthesized and have been supplied to NCIPM, IARI, New Delhi and IICT, Hyderabad for evaluation under field conditions.

### 2.2.4 *Development of lac based nail polish*

Eco-friendly and cost effective nail polishes, prepared from decolorized dewaxed Lac (DDL), were found to be superior than decoulourised bleached lac (DBL) based nail polish. Performance of the lac based nail polishes were found to be superior than two well known brands with respect to touch dry time, hardness, smoothness, gloss, durability and water resistance.

### 2.2.5 *Development of shellac based emulsion paint*

In order to evaluate and compare the anti-fungal property of shellac based emulsion paint with commercial sample, both were applied on the boundary wall of the High Voltage Laboratory of the Institute. Water was poured equally on coated surfaces, regularly (morning and evening) for three months, till the end of monsoon to create adequate environment (prone area) for development of fungus. It was found that fungal growth was comparatively very low on shellac emulsion paint coated wall than the wall coated with commercial paint (Fig.47)

*Fig. 47. Fungal effect on shellac emulsion coated wall and commercial paint coated wall*

Comparative study was also carried out on odour emission during application of the shellac based emulsion paint and commercial paint. The Hedonic rating test revealed that commercial

*Fig. 48a. Guest house painted with shellac emulsion paint*

*Fig. 48b. Security Post painted with shellac emulsion paint*

sample had very high pungent smell, in comparison to shellac emulsion paint, which had comparatively low small. Appearance and smoothness / brush marks were found to be comparable.

In big cities, where houses/flats are in a very closed system (low air circulation), chemical substances that are used in building materials create bad effects on the human health (Sick House Syndrome). Main elements of paints such as acrylic, urethane, epoxy resin have been reported to cause allergic reactions. Studies are being made to minimise the synthetic resin content or to find alternatives for these widely used synthetic resin.

The process of manufacture of shellac emulsion paint for cementitious surfaces was upscaled and 80L of the paint was prepared in a single batch. The paint so prepared, was applied on 150 $m^2$ (approx.) area on the internal walls of the Institute's guest house (Fig 48a) and interior and exterior surfaces and of four security posts with different colors (Fig. 48b) for its large-scale evaluation. 10L of the paint has been supplied to an entrepreneur for its evaluation from outside agency.

■ ● ■

# 3. TRANSFER OF TECHNOLOGY

## 3.1 Technology Assessment, Refinement and Dissemination

### 3.1.1 *Enhancing livelihood options for poor tribal families of the Jharkhand State through capacity building in cultivation of lac and its value addition (JLDS)*

**The Project aims at:**

- Introducing scientific methods of lac cultivation through training and demonstration etc. for sustained lac production.
- Taking up Action Research and related activities through Farmers Participatory Approach.
- Create suitable infrastructure and 'Lac Network' for catering to the needs of growers, entrepreneurs and consumers of lac.

The following activities were undertaken during the year under the scheme:

**A. Training**

- Orientation training was organised for 32 personnel of different NGOs
- One-Week training has been conducted in six batches for representatives of NGOs and 116 extension cadres sponsored by the various NGOs (Table 28).
- 17 On-farm trainings have been organised for 1,908 beneficiaries of the project (Table 29).

**Table 28. One-week training programmes organized on lac culture and related aspects under JLDS**

| Sl. No. | Period | No. of participants |
|---|---|---|
| 1 | 26.06 – 1.07.06 | 2 |
| 2 | 3 -7.07.06 | 29 |
| 3 | 24 – 29.07.06 | 4 |
| 4 | 4 – 8.09.06 | 29 |
| 5 | 11 -16.09.06 | 43 |
| 6 | 18 -23.09.06 | 9 |
| TOTAL | | 116 |

**Table 29. On-farm training programme on Scientific Lac Cultivation**

| Sl. No. | District | Venue (Village-Block) | Nominating NGO | Date | No. of Participants |
|---|---|---|---|---|---|
| 1. | Ranchi | Lovadih | PRADAN | 6.10.06 | 38 |
| 2. | Ranchi | Murhu | PRADAN | 6.10.06 | 51 |
| 3. | Gumla | Lamboi Church, Gumla. | Sunita Kala Niketan | 31.10.06 | 125 |
| 4. | Ranchi | Sinjusereng-Pahantoli (Sogod) | Gram Jan Jagriti Manch | 2.11.06 | 55 |
| 5. | Ranchi | Community hall, Badri, Angarha, Ranchi | Pragati Parishad | 3.11.06 | 161 |
| 6. | Ranchi | Community hall, Hundru, Angara, Ranchi | Pragati Parishad | 3.11.06 | 100 |
| 7. | Palamau | Adivasi Kalyan Uchh Vidyalaya, Saraidih | SESA | 5.11.06 | 50 |
| 8. | Latehar | Rajkiya Utkramik Madhya Vidyalaya, Garu, Latehar | SESA | 6.11.06 | 38 |
| 9. | Ranchi | Training Hall, Arki | AID | 7.11.06 | 250 |
| 10. | Saraikela – Kharsawan | School | Indian Gramin Services | 10.11.06 | 250 |
| 11. | Hazaribagh | Bantilkala, Gola, Hazaribag. | Agragati | 15.11.06 | 110 |
| 12. | Palamau | Near Chandwa Block | Citizen Foundation | 18.11.06 | 100 |
| 13. | Ranchi | Gullu, Murhu, Ranchi. | N.B.J.K. | 18.11.06 | 150 |

| Sl. No. | District | Venue (Village-Block) | Nominating NGO | Date | No. of Participants |
|---|---|---|---|---|---|
| 14. | West Singhbhum | Koentari, Bandgaon | VARDAN | 24.11.06 | 100 |
| 15. | West Singhbhum | Goelkera | Kolhan | 9.12.06 | 50 |
| 16. | West Singhbhum | Marla | SEED | 17.12.06 | 250 |
| 17. | Ranchi | Ormanjhi | Srijan Foundation | 21.12.06 | 30 |
| | **TOTAL** | | | | **1,908** |

## B. Action Research

Field demonstration of *kusmi* lac cultivation on *Flemingia semialata*

- About 800 plants of *semialata* were raised in July 2006 and *aghani* lac crop has been raised on about 500 *semialata* plants at Chitramu village, Khunti dist. in collaboration with PRADAN, an NGO. The crop is progressing well.
- About 30,000 saplings of *F. semialata* have been provided to the NGOs for distribution among the farmers and 1.5 kg seed of *semialata* was provided to for raising nursery of *semialata* plants

Training on plantation raising and management of *semialata*

- A one-day special training programme on plantation raising and management of *Flemingia semialata* plantation and lac cultivation were organised at the Institute. 37 lac growers sponsored by different NGOs participated in the training. The participants were educated about the host plant, nursery and plantation raising practices, utilization of inter-space between the host plants for higher monitory returns etc.

## C. Infrastructure Development

- Kisan Hostel, Training laboratory and Information Cell have been extended / renovated. Building of a demonstration floor for on-farm training is in progress

### 3.1.2 *TOT activities*

Monitoring of lac crop, providing technical guidance and remedial measures for pest attack, demonstration of spraying etc. were carried out at different locations in Jharkhand, Chhattisgarh, Andhra Pradesh and Madhya Pradesh (Table 30).

**Table 30. TOT activities undertaken**

| Sl No. | District -State | Venue (Village-Block) | Collaborating Agency | Date | Purpose |
|---|---|---|---|---|---|
| 1 | Ranchi - Jharkhand | Kochang | Jharkhand Tribal Development Society | 25.2.06 | Precaution for inoculation of summer crop on *kusum* |
| 2 | Kanker-Chhattisgarh | Ichchhapur , Garhpichwari | State Forest Department | 23.2.06 | Demonstration of insecticide spray |
| 3 | Kanker- Chhattisgarh | Tirkadan (Charama) | State Forest Department | 25.2.07 | Lac crop monitoring on *Semialata* |
| 4 | Jagdalpur- Chhattisgarh | Bhaliguda (Bakawad range) | State Forest Department | 9.5.06 | Lac crop monitoring |
| 5 | Kanker- Chhattisgarh | Sigarbhat | State Forest Department | 10.5.06 | Interaction with 80 ex-trainees of 21 villages |
| 6 | Vishakhap-atnam Andhra Pradesh | Vantalamamida (Paderu) and Andiba (Hukumpeta) | TPMU-IKP, Paderu | 26.8.06 | Interaction with 11 ex-trainees, lac crop monitoring, guidance for *kusum* pruning and meeting with Project officer and APD |

| Sl No. | District -State | Venue (Village-Block) | Collaborating Agency | Date | Purpose |
|---|---|---|---|---|---|
| 7 | Shahdol Madhya Pradesh | Chakra and Kuchru (Beohari) | Zila Panchayat Shahdol | 14.9.06 | Selection of suitable spot for *rangeeni* broodlac farm |
| 8 | Kanker -Chhattisgarh | Sigarbhat | State Forest Department | 11.10.06 | Preliminary training on marketing of broodlac/ sticklac collection, quality management. |
| 9 | Kanker -Chhattisgarh | Garhpichwari | State Forest Department | 12.10.06 | Lac crop monitoring at broodlac farm |
| 10 | Kanker -Chhattisgarh | Tirkadan (Korar) Department | State Forest Department | 12.10.06 | Status of *F. semialata* planting and performance |
| 11 | Orissa | Bhubaneshwar | Agricultural University, Forest Department, TRIFED, CIFA and other Government officials | 9.10.06 | Promotion of lac cultivation in the state |
| 12 | Assam and Meghalaya | Guwahati & Shillong | Assam Agricultural Univ., Forest Dept. | 5.11.06 | Promotion of lac cultivation in the state |

## Field Level Demonstration (FLD) on Lac Cultivation

(a) *Purulia district of West Bengal:* Demonstration on *kusmi* lac cultivation on *ber* tree was conducted in Putidih village of Jhalda block in Purulia district (West Bengal). 115 trees of *ber* were inoculated with one-quintal *kusmi* broodlac by adopting recommended package of practices. Eight trees were kept as control. Performance of *kusmi* lac on *ber* trees was witnessed by (a) officials from SEPC, Kolkata along with 40 farmers of Manbazar, Raghunathpur, Ayodhya Pahad and (b) Lac Development Officer, Purulia along with 50 farmers and officers of W B Agriculture Department including BDO, ADO (c) 60 farmers from R K Mission and SEPC. They were convinced of ensured production of quality broodlac from the *ber* trees.

(b) *Ranchi district of Jharkhand:* Demonstration of *kusmi* lac cultivation on *ber* tree was conducted in Banta village of Silli block. 50 *ber* trees belonging to 7 families were inoculated with 73 kg broodlac *kusmi* broodlac on July 20, 2006 and 290 kg immature (*ari*) lac was harvested. Recommended pest control measures were adopted. Two medium sized trees that were inoculated with 8 kg broodlac produced 60kg of scraped lac. There was substantial difference in yield between pruned and unpruned trees of *ber* that convinced the farmers about importance of tender and succulent shoots for better lac cultivation. More than one thousand farmers of adjoining 19 villages visited the area to see the performance of *kusmi* lac crop on *ber* trees. The crop was harvested premature during December due to serious problem of frequent theft in view of scattered trees.

(c) *Kandhmal district of Orissa:* FLD was conducted mainly in Pajikeri, Krutibali and Gajinaju villages of Swarngiri Panchayat of Kotagarh block in Kandhmal district, for *kusmi* lac production on *kusum* tree. About 608 kg broodlac was inoculated on 26 *kusum* trees involving 15 families and about 2,500 kg broodlac were harvested. Performance of summer crop was satisfactory. The

components of lac cultivation technology included pruning, use of nylon net for inoculation and chemical control of insect pest of lac etc. The cycle could not be maintained beyond July 2006 due to heavy and widespread rains at the time of inoculation.

## Identification of lac growers' problem

**West Bengal:** Lac growers from Ayodhya Pahad, Block Baghmundi, Purulia district faced the following four major problems *viz.*, a) Mortality of lac insects during fog b) Squirrel gnawing at inoculated broodlac c) Biting by red ants while carrying out pruning and harvesting operations and d) Mortality of lac insect due to blowing of dust during summer season.

**Orissa:** *Kusmi* lac culture sample collected from *kusum* tree during the last week of October 2006 from Balasore district showed emergence of lac larvae in large numbers. The larvae re-emerged from the same crop in 2nd fortnight of January 2007.

### 3.1.3 *Transfer of Technology and revenue generation*

- Technology of Heat and water- proof Spiritless Varnish (MSV 001 & 005) for wooden surfaces was transferred to an entrepreneur, Sri Suresh Babu from Bangalore (Karnataka).
- New technology (lab-scale) for the synthesis of isoambrettolide was transferred to M/s FFC Aromas Pvt. Ltd., Mumbai.
- Technology of Dewaxed bleached lac processing technology was transferred to Shri Prashant Kumar Agrawal, an entrepreneur from Kathghora (Chhattisgarh).
- Processing technology of Aleuritic acid was transferred to M/s Bardhan Brothers Pvt. Ltd., Kolkata (W.B.).
- Technology for manufacture of Jute – Fiber glass – Plywood composite sheet using shellac and multi purpose glazing varnish based on shellac was transferred to M/s Hyland Industries, Ranchi.
- A Memorandum of Understanding (MOU) for commercial production of ILRI designed machines for establishing small scale lac processing unit (capacity 100 kg/day) was signed on 01.06.2006 between ILRI and M/s National Enterprise, Ancillary Industrial Area, Hatia, Ranchi.
- Revenue of Rs.45, 000/- was earned through technology transfer, Rs. 1,155/- through sale of spirit-free varnishes and multipurpose glazing varnish and Rs.46, 808/- from testing of samples.

### 3.1.4 *Informatics on lac production, marketing and processing*

The study was taken up for collection of information on production, market prices, arrival of lac, estimation of lac production at national level and to find out quantity of lac processed in different lac processing centers. Efforts have been made for data collection at national level. For collection of data, separate schedules / questionnaires were developed for lac market and processing units. Test surveys were conducted and necessary modifications incorporated in the proforma. Frequent surveys were made in various lac-growing areas of the country for collection of data. Name of the states and districts in which surveys were made are presented in Table 31 and sample size in Table 32.

**Table 31. Name of states and districts in which survey was made**

| Name of State | Districts covered |
|---|---|
| Assam | Karbi-Anglong, Morigaon. |
| Chhattisgarh | Raipur, Dhamtari, Kanker, Mahasamund, Bastar, Rajnandgaon, Bilaspur, Janjgir-Champa and Korba. |
| Jharkhand | Ranchi, West Singhbhum, Latehar, Palamau, Garhwa, Simdega, Gumla and Lohardaga. |
| Madhya Pradesh | Balaghat, Seoni, Shahdol, Anuppur, Mandla and Dindori. |
| Maharashtra | Gondia and Bhandara. |

| Name of State | Districts covered |
|---|---|
| Meghalaya | Ribhoi, Garo Hills. |
| West Bengal | Purulia and Bankura. |

Monthly export and import data of lac and its value added products have been collected from DGCI&S, Kolkata.

**Table 32. Sample size during survey**

| State | District | Total number of samples | | |
|---|---|---|---|---|
| | | Number of traders | Number of manufacturers | Govt. Officials/ NGOs/Other key informants |
| Assam | 2 | 9 | - | 4 |
| Chhattisgarh | 9 | 22 | 15 | 4 |
| Gujarat | - | - | - | 1 |
| Jharkhand | 8 | 49 | 16 | 6 |
| Madhya Pradesh | 6 | 31 | - | 6 |
| Maharashtra | 2 | 5 | 4 | 3 |
| Orissa | - | - | - | 1 |
| West Bengal | 2 | 7 | 10 | 3 |
| **Total** | **29** | **123** | **45** | **28** |

## Lac production in India

On the basis of surveys conducted in the markets of various lac-producing districts of different states, the total national production of sticklac was estimated to be 23,229 tons during 2006-07. Chhattisgarh ranked 1st among the states followed by Jharkhand, Madhya Pradesh, Maharashtra and West Bengal. These five states contributed around 95 per cent of the national lac production. Regarding share of different crops *katki* (rainy season crop of *rangeeni*) contributed the most in national lac production followed by *baisakhi* (summer season crop of *rangeeni*), *jethwi* (summer season crop of *kusmi*) and *aghani* (winter season crop of *kusmi*), respectively (Fig. 49). The market arrival of *baisakhi* crop during the year was very poor in Jharkhand while in other states arrival was less than the previous year due to failure of crop. The market arrival of *katki* crop was comparatively better in all the states. The production of *jethwi* crop was good in Chhattisgarh and similarly in other states, therefore, market arrival of *jethwi* crop was more than last year. Market arrival pattern of *aghani* crop was similar to last year and showed a normal production year. Lac production scenario in the country is presented in Table 33 and top 10 lac-producing districts in India during 2006 in Table 34.

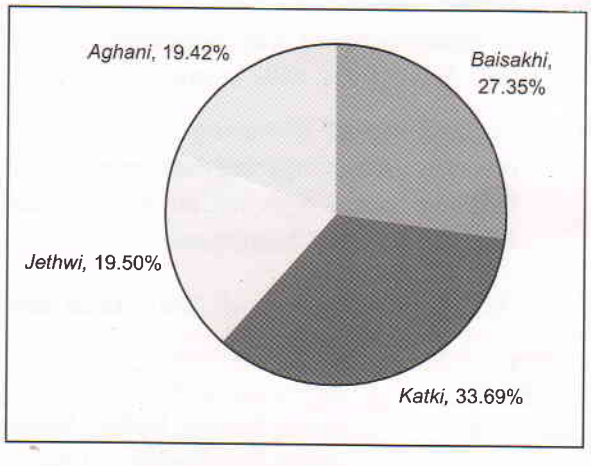



*Fig. 49. Share of different crops in national production*

Table 33. Lac production (in tons) in India during 2006-07

| Name of State | Name of crop | | | | Total production | Share in total production (%) |
|---|---|---|---|---|---|---|
| | *Baisakhi* | *Jethwi* | *Katki* | *Aghani* | | |
| Chhattisgarh | 2,685 | 2,365 | 2,185 | 1,640 | 8,875 | 38.19 |
| Jharkhand | 1,420 | 1,450 | 2,420 | 2,200 | 7,490 | 32.23 |
| Madhya Pradesh | 1,045 | 417 | 1,340 | 362 | 3,164 | 13.62 |
| Maharashtra | 285 | 0 | 1,015 | 0 | 1,300 | 5.59 |
| West Bengal | 395 | 165 | 480 | 200 | 1,240 | 5.34 |
| Uttar Pradesh | 300 | 0 | 150 | 0 | 450 | 1.94 |
| Orissa | 110 | 130 | 90 | 110 | 440 | 1.89 |
| Assam | 50 | 0 | 80 | 0 | 130 | 0.56 |
| Andhra Pradesh | 25 | 0 | 35 | 0 | 60 | 0.26 |
| Gujarat | 25 | 5 | 20 | 0 | 50 | 0.22 |
| Meghalaya | 5 | 0 | 10 | 0 | 15 | 0.06 |
| Bihar | 10 | 0 | 5 | 0 | 15 | 0.06 |
| **Total** | **6,355** | **4,532** | **7,830** | **4,512** | **23,229** | **100.00** |

Table 34. Top ten lac-producing districts in India during 2006-07

| Name of Districts | Type of lac | | Total Production (in tons) |
|---|---|---|---|
| | *Rangeeni* | *Kusmi* | |
| Ranchi | 1,800 | 1,100 | 2,900 |
| Kanker | 400 | 1,600 | 2,000 |
| Rajnandgaon | 1,150 | 500 | 1,650 |
| Simdega | 250 | 1,300 | 1,550 |
| Korba | 850 | 650 | 1,500 |
| Gondia | 1,100 | 0 | 1,100 |
| Seoni | 1,075 | 15 | 1,090 |
| Bilaspur | 700 | 350 | 1,050 |
| Balaghat | 850 | 0 | 850 |
| West Singhbhum | 170 | 650 | 820 |

## Lac processing in India

On the basis of surveys made at different lac processing centers in the country, the total quantity of sticklac processed during 2005-06 was estimated to be 28,890 tons. Maximum processing of lac was done in West Bengal followed by Chhattisgarh, Jharkhand and Maharashtra (Fig. 50). Quantity of sticklac processed at different lac processing centers in India and share of different states in lac processing during 2005-06 is presented in Table 35.

Table 35. Quantity of sticklac processed in India during 2005-06

| State | District (Place) | Quantity processed (tons) |
|---|---|---|
| West Bengal | Purulia (Balarampur) | 10,300 |
| | Purulia (Tulin) | 550 |
| | Purulia (Jhalda) | 240 |
| | **Sub total** | **11,090** |
| Chhattisgarh | Korba (Kathgora) | 3,800 |
| | Dhamtari | 2,800 |
| | Janjgir-Champa (Sakti) | 1,000 |

| State | District | Quantity processed (tons) |
|---|---|---|
| | Kanker | 550 |
| | Rajnandgaon | 300 |
| | Bilaspur (Pendra) | 200 |
| | **Sub total** | **8,650** |
| Jharkhand | Ranchi | 4,900 |
| | Palamau & Garhwa | 1,200 |
| | West Singhbhum | 450 |
| | Latehar | 400 |
| | **Sub total** | **6,950** |
| Maharashtra | Gondia | 2,200 |
| | **Grand Total** | **28,890*** |

* including the quantity of imported lac.

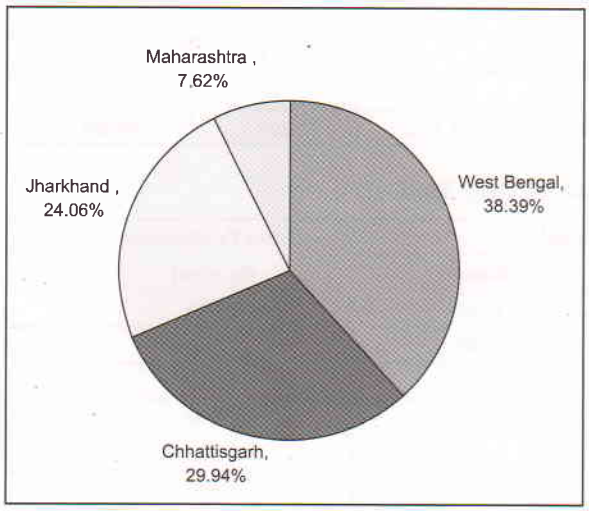



*Fig. 50. Share of different states in sticklac processing at national level*

## Export of lac and its value added products from India

The data were collected from SHEFEXIL, Kolkata for a period of 5 years spanning from 2001-02 to 2005-06 to analyse the trends in export of lac. Analysis of data show increase in export of value added products of lac (bleached lac/ dewaxed shellac/ aleuritic acid) in comparison to traditional products of lac (seedlac / shellac) (Table 36). The top ten importing countries of Indian lac *viz.*, U.S.A., Egypt ARP, Germany, Indonesia, Spain, Pakistan, Italy, Bangladesh, Japan and U.K. accounted for around 80 per cent of the total exports by quantity and value.

### Table 36. Export of lac and its value added products

| Sl. No. | Name of product | Export in 2005-06 | | % Change in last 5 years | |
|---|---|---|---|---|---|
| | | Quantity (tons) | Value (Rs. lakh) | Quantity (tons) | Value (Rs. lakh) |
| 1. | Shellac | 5,120.97 | 8,854.48 | + 11.14 | + 62.10 |
| 2. | Seedlac | 1,325.29 | 2,043.66 | + 143.26 | + 323.95 |
| 3. | Bleached Lac | 418.76 | 1,126.01 | + 403.68 | + 725.16 |
| 4. | Dewaxed Shellac | 244.17 | 731.29 | + 164.05 | + 298.68 |
| 5. | Aleuritic acid | 162.35 | 2,488.84 | + 166.15* | + 268.21* |
| 6. | Gasket Shellac | 4.54 | 6.50 | - 66.17 | - 51.78 |
| 7. | Shellac wax | 4.50 | 11.30 | + 78.57* | + 174.94* |
| 8. | 100% E.O.Us | - | 700.00 | - | - |
| 9. | Grand Total | 7,280.58 | 15,962.08 | + 30.24 | + 144.75 |

** % Change in last 4 years*

## Import of lac in India

The data on import of lac have been collected from DGCI&S, Kolkata. Due to poor lac crop production in some parts of the country and for meeting the foreign commitments, lac had to be imported from other countries. The imported lac is inferior in quality in respect to Indian lac and is procured at a cheaper rate. Out of the total import around 96 per cent in terms of quantity and value comes from Indonesia. Details of import of different forms of lac and quantity imported from different countries in 2005-06 are presented in Tables 37 and 38.

**Table 37. Import of different forms of lac in India during 2005-06**

| Sl. No. | Name of product | Import of lac | |
|---|---|---|---|
| | | Quantity (tons) | Value (Rs. lakh) |
| 10. | Seedlac | 5,655.42 | 4,494.70 |
| 11. | Shellac | 36.21 | 37.78 |
| 12. | Sticklac | 112.32 | 78.20 |
| 13. | Other lac | 9.42 | 5.94 |
| | **Grand Total** | **5,813.37** | **4,616.62** |

**Table 38. Import of lac in India from different countries during 2005-06**

| Sl. No. | Name of country | Quantity (tons) | Value (Rs. lakh) |
|---|---|---|---|
| 1. | Indonesia | 5,556.23 | 4,361.55 |
| 2. | Thailand | 245.72 | 245.92 |
| 3. | Pakistan | 9.17 | 2.47 |
| 4. | China RP | 2.00 | 3.21 |
| 5. | Other countries | 0.25 | 3.47 |

### 3.1.5 *Eco-friendly disposal of lac factory effluents and their possible utilization*

On an average 2,500 to 3,000 liters of liquid effluent is generated from processing of 800 kg of sticklac per day at Balarampur, Purulia (WB). The Pollution Control Board of West Bengal normally insists on evaluation of the parameters (shown in Table 39) from the lac-factory effluents. It was reported earlier that lac factory's effluent, on successive treatment with a) Lime water b) Hypo-chlorite solution and c) Activated carbon, removed the colour and odour from the effluent. Other parameters e.g. Sulphate, Chloride, Sodium Absorption Ratio, Boron, % Sodium, Lead, Arsenic, BOD, Phenolic compounds, Copper, Ammonia and total Chromium were found within the standard limits. However, Electrical Conductance, Total Dissolved Solids (TDS) and oil & grease were found in excess over the prescribed limits.

The study has been carried out with the main objective to reduce the TDS. Lac factory effluents from the seed lac processing unit were collected from Balrampur (WB) and treated with lime and then with 0.3 % (v/v) Sodium hypo-chlorite solution (3% available chlorine). The pH, TDS and Optical Density (OD) of the solution were found to be 7.0, 3,000mg/l and 0.5, respectively. It was further treated with activated charcoal, which reduced the OD to 0.08 and TDS to 2,500 mg/l, however, the pH remained at 7. The effluent still had the TDS in excess over the prescribed limit of the 2,100mg/l. Samples of effluent water were collected again from Balarampur and treated successively with (a) hydrochloric acid (0.1%) (b) hydrochloric acid (0.01%) & lime (0.3%) (c) acid, lime & hypochlorite solution (0.3%) (d) chlorine gas (e) chlorine gas & activated charcoal (1%) (f) hypo chlorite solution (0.3%), activated charcoal (1%). Some of the characteristics of the untreated sample are reported in Table 39. It has been observed that the TDS of the samples are increased after treatment. The pH & TDS of treated effluent have been determined which are presented in Table 40.

**Table 39. Characteristics of untreated sample**

| Parameters | Value |
|---|---|
| Hydrogen Ion Concentration (pH) | 6.5 |
| Biological Oxygen Demand (BOD) | 1,565 |
| Chemical Oxygen Demand (COD) | 3,541 |
| Total Dissolved Solids (TDS) | 940 |

The result shows that these treatments do not reduce the TDS of the effluents below the prescribed limit of 2,100 mg/l. Therefore, these treatments were found unsuitable.

## Table 40. Characteristics of treated samples

| Treatments | Sample (No.) | Colour | pH | TDS |
|---|---|---|---|---|
| Control | 1 | Violet | 6.42 | 2,670 |
| | 2 | Violet | 7.15 | 2,780 |
| | 3 | Violet | 8.10 | 1,110 |
| A. Hydrochloric acid | 1 | Light orange | 2.50 | 4,670 |
| | 2 | Light orange | 3.00 | 3,780 |
| | 3 | Light orange | 4.35 | 2,500 |
| B. Hydrochloric acid & lime | 1 | Light yellow | 5.27 | 4,490 |
| | 2 | Light yellow | 7.28 | 4,160 |
| | 3 | Light yellow | 7.61 | 2,850 |
| C. Hydrochloric acid, lime & hypochlorite solution | 1 | Colourless | 7.21 | 4,680 |
| | 2 | Colourless | 7.77 | 4,060 |
| | 3 | Colourless | 8.20 | 3,130 |
| D. Chlorine | 1 | Colourless | 4.87 | 4,340 |
| | 2 | Colourless | 6.75 | 3,570 |
| | 3 | Colourless | 6.44 | 3,970 |
| E. Chlorine & activated charcoal | 1 | Colourless | 7.55 | 3,970 |
| | 2 | Colourless | 7.50 | 2,830 |
| | 3 | Colourless | 7.52 | 2,410 |
| F. Hypochlorite solution and activated charcoal | 1 | Colourless | 6.42 | 4,040 |
| | 2 | Colourless | 7.99 | 3,340 |
| | 3 | Colourless | 2.56 | 3,760 |

Samples of lac factory effluents collected from Khunti from seedlac washing units, one being fresh wash and the other older were treated successively with (a) alum (2%) (b) alum & hypochlorite solution. The pH and TDS have been determined as shown in Table 41. The treatments have reduced the TDS marginally. The study requires to be repeated for confirmation of results.

## Table 41. Characteristics of treated samples from seedlac washing unit

| Treatment | Sample | Colour | pH | TDS |
|---|---|---|---|---|
| Control | 1 | Violet | 7.0 | 2,360 |
| | 2 | Violet | 8.5 | 1,210 |
| | 3 | Violet | 8.4 | 1,180 |
| | 4 | Violet | 7.4 | 1,800 |
| Alum (2 %) | 1 | Colourless | 7.9 | 2,350 |
| | 2 | Colourless | 8.5 | 1,060 |
| | 3 | Colourless | 7.9 | 1,160 |
| | 4 | Colourless | 7.7 | 1,780 |
| Alum + Hypochlorite solution | 1 | Colourless | 7.6 | 1,570 |
| | 2 | Colourless | 9.9 | 0,780 |
| | 3 | Colourless | 7.8 | 2,030 |
| | 4 | Colourless | 7.9 | 1,930 |

## 3.2 Human Resource Development for capacity building

### 3.2.1 *Skill development and capacity building in lac culture through training and demonstration in Gujarat*

Location specific amendments have been made for selection of lac insect strain and also in lac production technologies on *F. semialata*, *Ziziphus mauritiana* (*ber*), *Schleichera oleosa* (*kusum*) and *Prosopis juliflora* (*ganda bawal*). Layout for developing a model lac production farm for demonstration and training was provided. Two training camps were organized at Bhavnagar and Junagarh during July 2006, which were attended by 40 and 60 farmers respectively, including forest officials. Technical bulletins namely i) "*Kusmi* lac cultivation on *juliflora*, a derided weed in Gujarat" and ii) "High returns from *kusmi* lac cultivation on *mauritiana*, (*bordi*) in Gujarat" were prepared and sent to Gandhi Nagar for translation and publication in Gujarati. It was suggested for raising 0.25 ha plantation of *F. semialata* under shade and irrigation for summer broodlac production. Use of *ber* for winter in alternation with *semialata* for summer cop under irrigation was suggested and 10 kg seeds of *semialata* were sent to different stations for raising seedlings. Seedlings are ready for transplantation.

### 3.2.2 *Training, demonstration, extension education and information service on lac culture, processing and product development*

#### Farmers' and Housewives' Training Programme

The institute conducted one-week and one-day training programmes with special emphasis on lac culture. One-week programmes mainly covered lac cultivation, processing and utilization of lac at village/farm level. A total of 676 farmers from different states participated in the programme. Summary of trainings conducted under the programme and state-wise number of participants is given in Table 42 and Fig. 51 respectivily. It is evident from the table that maximum participation was from Chhattisgarh followed by Jharkhand, Madhya Pradesh (MP), West Bengal (WB), Orissa, Maharashtra and Rajasthan.

**Table 42. One-week training programme organized on lac culture and related aspects for farmers**

| Batch No. | Sponsoring Organization | State | Period | No. of participants |
|---|---|---|---|---|
| 1 | ■ State Forest Department, Kondagaon, Bastar | Chhattisgarh | 9 – 13.01.06 | 57 |
| 2 | ■ World Vision of India | Jharkhand | 13 -18 .01.06 | 13 |
| | ■ Gram Jan Jagriti Manch | Jharkhand | | 40 |
| | ■ Private | Orissa | | 7 |
| | ■ TRIFED, New Delhi. | Jharkhand | | 6 |
| 3 | ■ Private | Jharkhand | 27.02 – 4.03.06 | 15 |
| 4 | ■ Jamgoria Sevabrata, Purulia | West Bengal | 27.03 – 1.04.06 | 15 |
| | ■ ATMA, Jamtara | Jharkhand | | 12 |
| | ■ Private | Jharkhand & WB | | 2 |
| 5 | ■ Catholic charities, East Singhbhum | Jharkhand | 5 - 10.06.06 | 20 |
| 6 | ■ FEMALE, Rania, Ranchi | Jharkhand | 26.06 - 1.07.06 | 12 |
| | ■ Private | | | |

| Batch No. | Sponsoring Organization | State | Period | No. of participants |
|---|---|---|---|---|
| 7 | ■ VICAS, Bandgaon, West Singhbhum<br>■ VICAS, Goelkera, West Singhbhum | Jharkhand | 24 – 29.07.06 | 12<br>13 |
| 8 | ■ Rajasthan College of Agriculture (Maharana Pratap University of Agriculture and Technology) | Rajasthan | 14 -19.08.06 | 4 |
| 9 | ■ Gramina Samasya Mukta Trust, Jalaka, Yavatmal | Maharashtra | 21- 26.08.06 | 6 |
| 10 | ■ VICAS, Bandgaon and Goelkera, W. Singhbhum | Jharkhand | 28.08 - 2.09.06 | 5 |
| 11 | ■ Chhattisgarh Tribal Development Prog., Raipur | Chhattisgarh | 18 -23.09.06 | 29 |
| 12 | ■ State Forest Department, Kondagaon | Chhattisgarh | 9 –13.10.06 | 29 |
| 13 | ■ T.S.R.S.D., Jamshedpur<br>■ Zila Panchayat, Shahdol | Jharkhand<br>M.P. | 16 – 20.10.06 | 12<br>24 |
| 14 | ■ T.S R.S.D, Jamshedpur | Jharkhand | 30.10 – 4.11.06 | 62 |
| 15 | ■ State Forest Department, South Kondagaon | Chhattisgarh | 6 –10.11.06 | 41 |
| 16 | ■ State Forest Department, South Kondagaon | Chhattisgarh | 13 –17.11.06 | 44 |
| 17 | ■ State Forest Department, Dantewara | Chhattisgarh | 20 –25.11.06 | 35 |
| 18 | ■ State Forest Department, Sukma, South Bastar, Dantewara, | Chhattisgarh | 27.11 – 1.12.06 | 50 |
| 19 | ■ State Forest Department. Seoni | Madhya Pradesh | 5 – 8.12.06 | 33 |
| 20 | ■ State Forest Department, Sidhi<br>■ State Forest Deptt. Chhatarpur<br>■ AFPRO, Ranchi. | M. P.<br>M. P.<br>Jharkhand. | 11 –16.12.06 | 11<br>14<br>18 |
| 21 | ■ Forest dept, Saraikela- Kharsawan<br>■ Forest department-West Singhbhum<br>■ SUPPORT, Hazaribagh | Jharkhand<br>Jharkhand<br>Jharkhand | 19 – 23.12.06 | 10<br>20<br>4 |
| | **Total** | | | **676** |

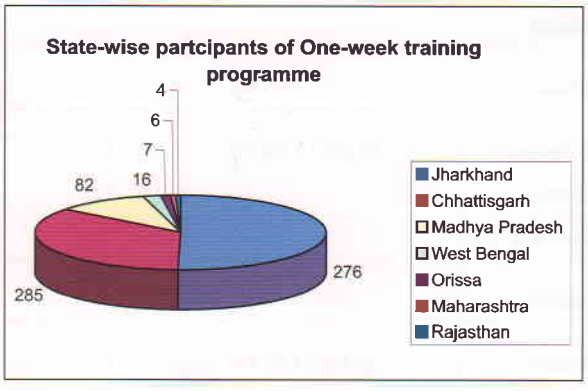



*Fig. 51. State-wise partcipants of One-week training programme*

## Trainer`s Training and Educational Programme

The agriculture graduate students from Allahabad Agricultural Institute (Deemed University); Institute of Agricultural Sciences, BHU, Varanasi; Rajasthan College of Agriculture and trainer's from State Forest Department, Kanker have been provided 6-15 days training in lac cultivation, processing and its uses (Table 43).

Table 43. Trainer`s training/ Education programme

| Sl. No | Sponsoring Organization | State | Period | No. of participants |
|---|---|---|---|---|
| 1 | Self / Private | Uttar Pradesh | 16 – 19.01.06 | 2 |
| 2 | Allahabad Agricultural Institute (Deemed University) | Uttar Pradesh | 13 – 18.02.06 | 12 |
| 3 | Institute of Agriculture Science, BHU Varanasi | Uttar Pradesh | 22 – 27.05.06 | 14 |
| 4 | Allahabad Agriculture Institute (Deemed University) | Uttar Pradesh | 29.05 – 3.06.06 | 29 |
| 5 | State Forest Department., Kanker | Chhattisgarh | 21.08 – 2.09.06 | 19 |
| 6 | Rajasthan College of Agriculture, Udaipur | Rajasthan | 14 -19.09.06 | 2 |
| 7 | State Forest Department, Kanker | Chhattisgarh | 21.09 – 2.10.06 | 10 |
| | **Total** | | | **88** |

## On- Farm Training on Scientific Cultivation of Lac

A total of 26 camps were organized in collaboration with other agencies in Jharkhand, Chhattisgarh, M.P. and Gujarat. 2,020 farmers benefited from the programme (Table 44).

Table 44. On-farm training programme on Scientific Lac Cultivation

| Sl. No. | District –State | Venue (Village-Block) | Sponsoring/ Nominating Agency | Date | No. of Participants |
|---|---|---|---|---|---|
| 1. | Gandhinagar –Gujarat | Basan | Forest Department, Govt. of Gujarat | 01.01.06 | 29 |
| 2. | Vadodora – Gujrat | Kewdi | Forest Department, Govt. of Gujarat | 3 & 4.01.06 | 40 |
| 3. | Daltonganj- Jharkhand | Eco-Center, Garu | Society for Environment and Social Awareness | 15.01.06 | 52 |
| 4. | Saraikela Kharsawan-Jharkhand | Raghunathpur, Chandil | DFO, Saraikela-Kharswan | 8.2.06 | 49 |
| 5. | Godda-Jharkhand | Community Hall, Sunder Pahari | PRADAN, Godda. | 22.2.06 | 37 |
| 6. | Simdega- Jharkhand | Jaldega | BDO, Simdega | 6 & 7.3.06 | 184 |
| 7. | Guna-M.P. | E.G.S.School, Village-Vardha, Block-Bamori | Zilla Panchayat, Guna | 22 & 23.3.06 | 69 |
| 8. | | Village-Gaura, Ruthiyai | Zilla Panchayat, Guna | 24-25.3.06 | 53 |
| 9. | | Gulwara | Zilla Panchayat, Guna | 24.3.06 | 55 |
| 10. | | Mandi Bhavan | Zilla Panchayat, Guna | 26.3.06 | 40 |
| 11. | Dhamtari-Chhattisgarh | Sakra | Forest Department Chhattisgarh | 14 & 15.5.06 | 76 |
| 12. | Dhamtari –Chhattisgarh | Dugli | Forest Department Chhattisgarh | 16 & 17.5.06 | 33 |
| 13. | Ranchi-Jharkhand | Silda (Khurd) Gullu (Murhu) | BASIX, Ranchi | 24.6.06 | 69 |
| 14. | Ranchi-Jharkhand | Patratoli, Y.M.C.A.Building, Maranghada Road. | BASIX, Ranchi. | 26.6.06 | 27 |
| 15. | Simdega- Jharkhand | Block Campus, Bano | MESO Office, Simdega | 5.7.06 | 72 |

| Sl. No. | District –State | Venue (Village-Block) | Sponsoring/ Nominating Agency | Date | No. of Participants |
|---|---|---|---|---|---|
| 16. | Shahdol- M.P. | Jan Panchayat, Jaisingh Nagar | Zila Panchayat, Shahdol | 14.9.06 | 250 |
| 17. | | Jan Panchayat, Beohari | Zila Panchayat, Shahdol | 14.9.06 | 175 |
| 18. | | Jan Panchayat, Burhar | Zila Panchayat, Shahdol | 15.9.06 | 75 |
| 19. | | Jan Panchayat, Gohparu | Zila Panchayat, Shahdol | 15.9.06 | 150 |
| 20. | West Singhbhum-Jharkhand | Manoharpur, W. Singhbhum | VICAS | 7.10.06 | 120 |
| 21. | South Bastar-Chhattisgarh | Keshkal, S. Kondagaon | Chhattisgarh State Minor Forest produce Fed. Ltd | 21.12.06 | 60 |
| 22. | | Narayanpur, Bastar | | 22.12.06 | 41 |
| 23. | | East and west Bhanupratappur | | 23.12.06 | 89 |
| 24. | Jaspur-Chhattisgarh | Jhakkarpur (Yala), Pathalgaon | State Forest Department | 27.12.06 | 30 |
| 25. | Ambikapur-Chhattisgarh | EKO Training, Centre South Sarguja | State Forest Deptt. | 28.12.06 | 75 |
| 26. | Korea- Chhattisgarh | Baikhunthpur | State Forest Deptt. | 29.12.06 | 70 |
| | | | | **Total** | **2,020** |

## Field Educational and Motivational Training Programme on Lac Cultivation

A total of 25 camps for 2,503 persons, mainly farmers were organized in collaboration with NGOs and GOs of different states. 1646 farmers of Jharkhand (Ranchi – 904, West Singhbhum – 521, Saraikela Kharsawan – 190, Hazaribagh – 31); 712 of Madhya Pradesh (Guna – 287, Shahdol – 225, Anooppur – 200); 105 of Andhra Pradesh (Vishakhapatnam) and 40 of West Bengal (Purulia) benefited from the programme.

## One-day Orientation Programme

This programme aims to educate the lac farmers and suggest on the spot remedial measures to their problems. A total of 959 farmers, students, entrepreneurs in 26 batches received training under this programme.

## Lac Product Demonstration Training

The institute organized a number of training programmes related to processing and utilization of lac (Table 45). The training programmes were mainly meant for persons from lac based industries for entrepreneurship development.

**Table 45. Lac product demonstration trainings**

| Sl No. | Subject | Sponsoring agency | Duration | Name of the participant |
|---|---|---|---|---|
| 1 | Dewaxed bleached lac | Self | 10.4.06-24.04.06 | Shri Satish Kumar |
| 2 | Fibre glass jute – plywood composite | Self | 28.8.06-318.06 | Shri B R Prasad |
| 3 | Shellac based multipurpose glazing varnish | Self | 28.8.06-318.06 | Shri B R Prasad |
| 4 | Testing and analysis of lac | Self | 20.1106- 1.12.06 | Shri Manish Kumar Goyal |
| 5 | Dewaxed bleached lac | Self | 20.11.06- 1.12.06 | Shri Prasant Kr. Agarwal |
| 7 | Aleuritic Acid | M/s Bardhan Brothers | 1.12.06-21.12.06 | Dr (Mrs) Alka Jayaswal |

# 4. APPROVED ONGOING RESEARCH PROJECTS

*(NAME OF THE PI IS GIVEN WITHIN PARENTHESIS)*

## 4.1 Productivity and Quality Improvement

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

## 4.2 Production Improvement and Crop Management

- Integration of *Flemingia semialata* with horticultural crops for sustainable lac production under irrigated condition
  (Dr. BP 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 RK Singh)
- Evaluation of *kusmi* lac (*aghani*) production technology on *ber* at farmer's field conditions at Jhalda, Purulia, W.B.
  (Dr. S Ghosal)
- Development of *kusmi* lac cultivation technology on *Albizia procera* (*Safed Siris*)
  (Dr. AK Jaiswal)
- Production of quality broodlac on *kusum* and *palas* at different agro-climatic region (Revolving Fund Scheme)
  (Shri YD Mishra; Dr. KK Sharma from November, 2006)
- Evaluation of bio-control agents and bio-rational approaches for management of lac insect predators (DBT Project)
  (Dr. A Bhattacharya)
- Development of lac production system using high density *ber* plantation under semi protected conditions (NABARD sponsored)
  (Shri R Ramani)

## 4.3 Processing and Value Addition

- 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. KM Prasad)
- Storage loss assessment for lac and lac based products
  (Dr. SK Giri)
- Establishment of commercially viable plant for aleuritic acid
  (Er. SK Pandey)

## 4.4 Product Development and Use Diversification

- Field evaluation of PGR and insect attractant /repellants derived from aleuritic acid.
  (Dr. RN Majee)
- Development of lac based nail polish
  (Dr. RN Majee)
- Use of lac and modified lac in the manufacture of jute re-inforced sheets for structural and other purposes (collaborative project with NIRJAFT, Kolkata)
  (Dr. DN Goswami)
- Integrated pest management (IPM) at village level for cost-effective, quality production (Technology Mission on Cotton)
  (Dr. N Prasad)

## 4.5 Technology Assessment, Refinement and Dissemination

- Database on lac –Basic information and technologies available
  (Shri R Ramani)
- Eco-friendly disposal of lac effluents and their possible utilization
  (Dr. KM Prasad)
- Informatics on lac production, marketing and processing
  (Dr. G Pal)
- Design and development of seedlac dryer
  (Dr. (Er.) N Prasad)
- Enhancing livelihood options for poor tribal families of the Jharkhand State through capacity building in cultivation of lac and its value addition (JLDS)
  (Dr. KK Sharma)

## 4.6 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. AK Jaiswal)
- Skill development and capacity building in lac cultivation at Gujarat (Gujarat Govt. project)
  (Shri YD Mishra)
- Promotional initiatives for capacity building on technical training in lac cultivation (NABARD project)
  (Dr. AK Jaiswal)

## Exploratory Studies

- Development of protocols for micro-propagation of *ber*, *palas* and *kusum*
  (Shri R Ramani)
- Rejuvination of old lac hosts for improved lac productivity
  (Dr. BP Singh)
- Impact of pitcher irrigation and mulching on the summer season (*jethwi*) crop sustainability and new leaf initiation period on *ber*
  (Shri RK Singh)

■ ● ■

# 5. PUBLICATIONS AND PUBLICITY

## 5.1 Publications

### 5.1.1 Research Papers

- Ansari MF and Goswami DN. 2006. Shellac-acrylic emulsion paint for cementations surfaces. *Pigm. Res. Technol.* (U.K.), **35** (4): 183-187.
- Bhattacharya A, Jaiswal AK and Kumar KK. 2006. Efficacy of the egg parasitoids, *Trichogramma* spp. for the management of *Eublemma amabilis* Moore (Lepidoptera: Noctuidae) – predator of Indian lac insect. *Entomon*, **31** (2): 121-124.
- Bhattacharya A, Jaiswal AK, Kumar S and Kumar KK. 2006. Management of lepidopteran insect predators of lac insect through habitat manipulation. *Entomon*, **31** (1): 53-56.
- Bhattacharya A, Jaiswal AK and Kumar S. 2005. Effect of treatment of broodlac with a few insecticides on the harboured inimical insects. *J. Ent. Res.*, **29** (3): 223-225.
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- Majee RN, Chatterjea JN, Sengupta SC and Agarwal SC. 2006. Facile synthesis of (E)-9-hexadecenolide (ambrettolide). *J. Indian Chem. Soc.*, **83**: 1179-1180.
- Prasad N, Kumar KK, Pandey SK and Bhagat ML. 2006. Design and development of Power operated roller type lac scraper. *Agricultural mechanization in Asia, Africa and Latin America*, **37** (1): 35-37.
- Sarkar PC, Srivastava S and Dey P. 2006. Effect of lac based post harvest tratments on storage behavior of pointed gourd (*Parwal*) at room temperature. *Bev. and Food World*, **33** (12): 24-26.
- Sharma KK, Jaiswal AK and Kumar KK 2006. Role of lac culture in biodiversity conservation: issues at stake and conservation strategy. *Current Science*, **91** (7): 894-898.
- Singh D. Sarkar PC and Srivatava S. 2006. Evaluation of lac based formulation for enhancing shelf life of *kinnow* fruits. *Food Sci. & Technol (India)*, **43** (6) : 648-650.
- Yadav SK, Mishra YD and Singh RK. 2007. Total leaf area estimation of *Flemingia semialata* Roxb. by linear regression. *Agric. Sci. Digest*, **27** (1): 44-46.

### 5.1.2 Abstracts in Proceedings

- Bhattacharya A, Jaiswal AK and Kumar S. 2006. Effect of some newly introduced egg parasitoids of *Trichogramma* spp. on the incidence of two lepidopteran lac insect predators *Eublemma amabilis* and *Pseudohypatopa pulverea*. In: 8th Indian Agrucultural Scientists and Farmers Congress held at BHU, Varanasi, 21-22 February, 2006.

- Jaiswal AK, Bhattacharya A and Kumar S. 2006. Field evaluation of *Bacillus thuringiensis* Berliner subsp. *kurstaki* commercial formulation against lepidopteran pest of lac insect. In: 8th Indian Agrucultural Scientists and Farmers Congress held at BHU, Varanasi, 21-22 February, 2006.

- Pal G, Bhagat ML and Bhattacharya A. 2006. Consumption expenditure pattern of lac growers: A study in Jharkhand, *Indian Journal of Agricultural Economics*, **61** (3), July- Sept. 2006: 429

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- Pandey RP, Srivastava DS, Dwivedi BK and Jaiswal AK. 2006. Study after post harvest operation of lac associated insect fauna in Allahabad Region. In: 8th Indian Agricultural Scientists and Farmers Congress held at BHU, Varanasi, 21-22 February, 2006.

- Prasad N, Baboo B and Pandey SK 2006. Design and development of hand operated lac winnower. In: Proceedings of 40th Annual Convention and Symposium of ISAE, held at TNAU, Coimbatore, 19-21 January 2006.

### 5.1.3 *Papers presented / contributed in conferences / symposia / seminars*

- Vashishtha Amit, Sharma KK and Lakhanpaul Suman 2006. Evidence of endosymbiont in *Kerria lacca*: A third partner in lac production? In: 5th International Symbiosis Society Congress held during August 4-10, 2006 at Vienna, Austria.

- Singh RK, Singh BP and Baboo B. 2006. Effect of different soil moisture conservation practices on growth of young *ber* and *kusum* plants. In: Proceedings of 2nd International Conference on Hydrology and watershed management organized by Centre for Water Resources, Jawaharlal Nehru Technological University during December 5-8, 2006, Vol. I, pp. 702-708.

- Ramani R, Mallick CB and Ranjan SK. 2006. Intra- and inter-specific variation in populations of *Kerria* spp. (Coccoidea: Tachardiidae) from different geographic regions of India, using RAPD profiles. In: International Conference on Insect Genomics held during January 9-11, 2006 at CDFD, Hyderabad.

- Kumari N, Kumari R, Prasad R, Singh D, Ranjan SK, Mallick CB and Ramani, R. 2006. Biochemical evaluation of antioxidants/ agents to control polyphenol leaching in explants of lac hosts, *Butea monosperma* and *Flemingia semialata*. In: National symposium on Recent Advances in Environmental Biotechnology for Forest Biodiversity Management held during March 9-10, 2006 at Ranchi Women's College, Ranchi.

- Ramani R and Baboo B. 2006. Current Scenario and Future Strategies for Rainfed Lac-based Farming Systems. In: Workshop for Eastern Region on Strategies for improving the performance of farming systems in rainfed areas organized by MANAGE at Bhubaneshwar during May 9-10, 2006.

- Ramani R. 2006. Lac insect and its hosts in phytomedicine. In: National symposium on Medicinal Plants: Role of Biotechnology and

Bioinformatics held during August 3-5, 2006 at BIT, Mesra, Ranchi.

- Ranjan SK, Mallick CB, Vidyarthi AS and Ramani R 2006. Medicinal importance of lac host plants – an overview. In: Souvenir of National symposium on Medicinal Plants: Role of Biotechnology and Bioinformatics held during August 3-5, 2006 at BIT, Mesra, Ranchi. pp 27.

### 5.1.4 *Books / Book chapters*

- Ramani R. 2006. *Unnat tareeke se lakh ki samanya prakriyayen*. pp 6-10. In: Sharma KK and Ramani R. (eds.) *Lakhon ka lakh*, ILRI, Ranchi. 72 pp.
- Sharma KK and Ramani R. 2006. '*Lakhon ka Lakh*'. Compilation of 13 Radio talks delivered by Subject Matter Specialists from 19.11.2004 to 11.02.2005 under ILRI sponsored programme, pp. 70.

### 5.1.5 *Popular Article:*

- Bhagat ML, Pal G and Bhattacharya A. 2006. *Lakh poshak vriksh: Jharkhand ke kalptaru. Jharkhand-barhte kadam* No. **15** (April, 2006): 38-42.
- Sharma, KK. 2006. *Lakh ki kheti ka vaigyanik prabandhan. Prabhat Khabar*, Ranchi, March 20, 2006: 12.
- Singh RK. 2006. Drip Irrigation System-Crop per drop. *Chhotanagpur Horticulture*, **22** (1-4): 45-47.
- Singh RK 2006. Low-cost water storage and utilization system for hilly areas. Chhotanagpur Horticulture, 22 (1-4): 53-54.

### 5.1.6 *Institute Publications*

- Equipments for Lac Cultivation, in English, 9pp.
- ILRI – Lac Newsletter 9(4) – 8 pp.
- ILRI – Lac Newsletter 10(1) – 12 pp.
- ILRI – Lac Newsletter 10(2) – 8 pp.
- ILRI – Lac Newsletter 10(3) – 12 pp.
- Lac an Introduction- Coloured Booklet, 12 pp.
- *Vichar Ganga* - A Booklet of Quotations, 70 pp.
- *Lakh Ki Khati Kab: Kyon: Kaise* – A Booklet on Lac Cultivation, 20 pp. (Reprinted).

## 5.2 Publicity

### 5.2.1 *Participation in Kisan Melas & Exhibitions*

- The Institute participated in the Agricultural Fair held at Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, Nadia, West Bengal during 30th January- 2nd February 2006. Dr. S Ghosal, Sci. (SS) and Shri AK Sinha, T.O. represented the Institute.
- The Institute participated in the *Kisan Mela* organized by Rama Krishna Mission, Divyayan KVK, Ranchi at Getalsud Farm on the 6th & 7th February, 2006. Shri ML Bhagat, Sc. (SG) and Shri DK Singh, T-4 represented the Institute.
- Shri RN Vaidya and Shri LCCN Shahdeo, T. O. participated in National *Tasar Mela* at Tasar Research Institute, Nagri, Ranchi on 23-24 February 2006.
- Dr. G Pal, Sc. and Shri KK Prasad, T.O. participated in the Agri-Tech 2006 at RAU, Pusa, Samastipur held during 2-5 March 2006.
- The Institute participated in the *Krishi* Expo 2006 at Pragati Maidan, New Delhi during 8-12 March 2006. Shri RN Vaidya, T.O. and Shri LCCN Shahdeo, T.O. participated in the Expo.
- The Institute participated in the *Kisan Mela*-cum-Exhibition held at National Research Centre for Soyabean, Indore, Madhya Pradesh on 21-22 April 2006. Dr. N Prasad, Sr. Sc. and Shri RN Vaidya, T.O. represented the Institute.
- Shri KK Prasad, T.O. participated in the Appropriate Technology Exhibition for the

Handloom sector at Shamsi, Dist. Kullu, Himachal Pradesh during 20th - 24th June 2006. A stall on lac was put up during the exhibition. He also made a survey of the lac-processing unit at Kullu to collect information for the Directory of lac industries in India.

- Shri RK Singh, Sc. and Shri RN Vaidya, T.O. participated in the Centenary Function of IARI, Regional Station, Pusa, Samastipur, during October 16-17, 2006 and put up an exhibition on lac.
- The Institute participated in the *Udyog Mela* organized by Jharkhand Govt. at Ranchi during November 15-22, 2006.
- Shri LCCN Shahdeo, T.O. and Shri DD Singh, T.O. participated in the Agro-Tech 2006 Fair at Chandigarh during December 1-4, 2006, organized by Confederation of Indian Industries (CII) (Northern Region).

### 5.2.2 *Radio / TV talks by Subject Matter Specialists*

- *Lakh ki kheti ke liye unnat yantra* by Dr. N Prasad was telecast by ETV Bihar on 02.01.06
- '*Agle mahinen kya karen*: *kusmi lakh katai avam sancharan*' by Dr. KK Sharma was telecast by ETV Bihar / Jharkhand on 25.01.2006
- Success of *Bacillus thuringiensis* application for pest management by Dr. AK Jaiswal was telecast by ETV Bihar on 30.01.06
- *Rangeeni* lac cultivation by Dr. AK Jaiswal was telecast ETV Bihar on 07.02.06
- *Kusmi* lac cultivation on *ber* and *kusum* tree by Dr. AK Jaiswal was telecast by ETV Bihar on 11.02.06
- Uses of lac by Dr. AK Jaiswal was telecast by ETV Bihar on 18.02.06
- Storage of sticklac and processing by Dr. N Prasad was telecast by ETV Bihar on 27.02.06
- *Gaon ke liye lakh prasanskaran ekai* by Dr. N Prasad was telecast by ETV Bihar on 27.02.06
- *Kusmi* lac cultivation on *ber* by Shri DK Singh was telecast by ETV Bihar on 17.03.06
- *Kusmi* Lac cultivation on *Flemingia semialata* by Dr. SK Yadav was telecast by ETV Bihar on 18.03.06
- '*Lakh ki kheti ka vaigyanik prabandan*' by Dr. KK Sharma was telecast by ETV Bihar / Jharkhand on 21.03.2006.
- Precaution for harvesting *kusmi* lac and inoculation on new trees by Dr. AK Jaiswal was telecast by ETV Bihar on 23.03.06
- Care for standing *kusmi* lac crop by Dr. AK Jaiswal was telecast by ETV Bihar on 18.04.06
- *Lah utpadan mein dhyan dene yogya baatein* by Dr. KK Sharma was broadcast by AIR, Ranchi on 29.07.2006.
- Management of enemy of lac insect during rainy season by Dr. AK Jaiswal was telecast by ETV Bihar on 16.08.06
- Management of lac crop on *F. semialata* by Dr. SK Yadav was telecast by ETV Bihar on 17.08.06
- Integrated pest management for *rangeeni* lac by Dr. A Bhattacharya was telecast by ETV Bihar on 12.09.06
- Management of lac cultivation on *ber* and *kusum* tree by Shri DK Singh was telecast by ETV Bihar on 16.09.06
- Harvesting and inoculation on *palas* tree by Dr. AK Jaiswal was telecast by ETV Bihar on 03.11.06
- Problem and remedies of lac cultivation during winter lac crop by Dr. AK Jaiswal was telecast by ETV Bihar on 16.11.06
- Important suggestions for scientific lac cultivation by Dr. AK Jaiswal was telecast by ETV Bihar on 18.11.06

# 6. PARTICIPATION OF SCIENTISTS IN MEETINGS / SEMINARS / SYMPOSIA / WORKSHOPS /TRAININGS ETC.

## 6.1 Participation in Seminars/ Meetings etc.

### 6.1.1 *By Director*

- 8th Indian Agricultural Scientist and Farmers Congress organized by Bioved Research Society and hosted by BHU, Varanasi during 21-22nd February 2006.
- Meeting of all Directors and Project Coordinators of Engg. Division, ICAR on Prospects of Food Production & Productivity during XI Plan, New Delhi. March 24, 2006.
- Meeting on 'Presentation of Soil Report of Jharkhand State ' at the O/o Principal Secretary, Agriculture, Department of Agriculture and Cane Development, Nepal House, Ranchi on 30.03.06.
- 62nd Meeting of Board of Management, BAU, Ranchi. April 28, 2006.
- Training Workshop on Value Chains, NAIP, TNAU, Coimbatore. June 5-6, 2006
- ICAR Regional Committee No.IV, ICAR Res. Complex for Eastern Region, Patna. Sept.1-2, 2006
- Meeting of Engg. Division Directors & Project Coordinators on Perspective Plan 2025, ICAR, New Delhi. Sept. 7, 2006
- Sensitization Workshop on NAIP, IISR, Lucknow. Sept.11, 2006
- 2nd Meeting of Planning Commission Sub-Group on Mechanization, Post Harvest Processing and Energy Management, ICAR, New Delhi. Sept.14, 2006.
- 63rd Meeting of Board of Management, BAU, Ranchi Oct.20, 2006.
- Institute Management Committee, ILRI, Ranchi. Oct.11, 2006.
- Workshop on Protection of Plant Varieties & Farmers Rights, BAU. Oct.30-31, 2006
- Director's Conference, ICAR, New Delhi. Nov. 3-4, 2006
- Golden Jubilee Celebration, BAU. Nov.6, 2006.
- Meeting of State Level Steering Committee of Jharkhand Lac Development Scheme. Ranchi Nov.18, 2006
- Rice Technology Day, Central Rainfed Upland Rice Research Station, Hazaribagh. Dec.3, 2006.
- Inaugural Prog. of Winter School on Recent Advances of Horticulture for development of watershed, HARP, Ranchi. Nov. 15, 2006.
- Meeting of Directors of Engg. Divn. (ICAR) on NAIP proposals. ICAR, New Delhi. Nov. 28, 2006
- 26th Workshop of AICRP on PHT, OUAT, Bhubneshwar. Dec.7-9, 2006.
- XI Meeting of Lac, Lac Products and Polishes Sectional Committee CHD 23. BIS, New Delhi. Dec.20, 2006.
- Inter-media Coordination Committee Meeting, Doordarshan, Ranchi. Dec. 21, 2006

### 6.1.2 *By Others*

- Shri R Ramani, PS attended State Credit Seminar 2006-07 organized by NABARD, Ranchi on January 23, 2006.
- Dr. A Bhattacharya, PS & Head, TOT Division, attended the annual meeting of DBT at New Delhi on 13th-14th February, 2006 and presented the progress of the DBT funded project.
- Shri R Ramani, PS attended National Workshop on Planning and Management of Agric. Ext. Trg. at New Delhi on February 14, 2006.
- Dr. A Bhattacharya, PS & Head, TOT Division, attended the 24th National

Workshop on Planning and Management of Agricultural Extension Training for the year 2006-07 on 14-15th February, 2006 at National Agricultural Science Centre (NASC), Pusa, New Delhi.

- Dr. A Bhattacharya, PS & Head, TOT Division attended the 8th Indian Agricultural Scientist and Farmers Congress, organized by Bioved Research Society and hosted by BHU, Varanasi during 21-22nd February, 2006.
- Dr. Govind Pal, Sc. attended the 8th Indian Agricultural Scientist and Farmers Congress, organized by Bioved Research Society and hosted by BHU, Varanasi during 21-22nd February 2006.
- Dr. A Bhattacharya, PS & Head, TOT Division participated in one day seminar on "Promotion of lac cultivation" held at Dulmighat, Saraikela on 27.02.2006.
- Dr. AK Jaiswal, Sr. Sc. participated in one-day seminar on "Promotion of lac cultivation" held at Dulmighat, Saraikela on 27.02.2006.
- Dr. A Bhattacharya, PS & Head, TOT Division participated in the National Conference on "Recent Advances in environmental Biotechnology for biodiversity management" held at Womens College, Ranchi during 7-8 March 2006.
- Dr. A Bhattacharya, PS & Head, TOT Division, attended the meeting on National Agricultural Innovation Project (NAIP) at BAU, Kanke, Ranchi on 24.03.2006.
- Er. M. Prasad, PS and Sri M.F. Ansari, Scientist participated in the National Convention on "Knowledge-Driven Agricultural Development: Management of Change" organized by Agricultural Research Service Scientists (ARSSF), sponsored by Indian Council of Agricultural Research during March 24-26, 2006 at New Delhi.
- Dr. SK Yadav, attended a meeting on 'Presentation of Soil Report of Jharkhand State ' at the O/o Principal Secretary, Agriculture, Department of Agriculture and Cane Development, Nepal House, Ranchi on 30.03.06.
- Dr. A Bhattacharya, PS & Head, TOT Division participated in the Research Council Meeting at Zonal Research Station, Chianki, Daltongunj of Birsa Agricultural University, Ranchi on 20th May, 2006.
- Shri Murari Prasad, PS and Dr. KM Prasad, PS attended the presentation on "Enviro Health & Safety (EHS) and Water Technology Single Source with world class Monitoring Instruments" at Hotel Capitol Hill, Ranchi on 02.06.2006.
- Dr. A Bhattacharya, PS & Head, TOT attended the Workshop on "Livelihood Promotion" organized under ICEF-KGVK Project on 20.06.2006 at Hotel Capitol Hill, Ranchi.
- Dr. N Prasad, Sr. Sc. attended the Workshop on "Livelihood Promotion" organized under ICEF-KGVK Project on 20.06.2006 at Hotel Capitol Hill, Ranchi.
- Dr. AK Jaiswal, Sr. Sc. attended the Scientific Advisory Committee meeting of Divyayan KVK at R.K.Mission Ashrama, Ranchi on 20.06.2006.
- Dr. A Bhattacharya, PS & Head, TOT and Dr. R Ramani, PS attended the National Farmer's Commission Meeting held at BAU, Kanke, Ranchi on 13.07.2006.
- Dr. A Bhattacharya, PS & Head, TOT attended the Krishi Karyakram Salahkar Samiti meeting at Doordarshan Kendra, Ranchi on 18.07.2006.
- Dr. A Bhattacharya, PS & Head, TOT and Dr. AK Jaiswal, Sr. Sc. attended the programme on Radio Krishi Club organized by AIR Ranchi. The book entitled "Lakhon ka lakh" was distributed to the farmers by Smt. Grace Kujur, DDG, Prasar Bharti, New Delhi on the occasion.
- Dr. N Prasad, Sr. Sc. attended the Training programme on IPR Issues at NAARM, Hyderabad, during 1st to 3rd August, 2006

- Dr. SK Giri, Scientist attended a one-day Satellite Workshop on NAIP at ICAR Research Complex for Eastern Region, Patna on 25.09.2006.
- Dr. N Prasad, Sr. Sc. attended aone day Workshop on IPR Issues at ICAR Research Complex for Eastern Region, Phulwarisharif, Patna on 25.09.2006
- Dr. A Bhattacharya, PS & Head, TOT attended the Agricultural Summit 2006 at Vigyan Bhawan, New Delhi held during October 18-19, 2006 organized jointly by FICCI and Ministry of Agriculture, Govt. of India.
- Dr. A Bhattacharya, PS & Head, TOT attended the 66th Annual Conference of Indian Society of Agricultural Economics at ICAR Research Complex for NEH Region, Umiam, Meghalaya held during November 8-10, 2006.
- Dr. G Pal, Sc. attended the 66th Annual Conference of Indian Society of Agricultural Economics at ICAR Research Complex for NEH Region, Umiam, Meghalaya held during November 8-10, 2006.
- Dr. DN Goswami, PS presented a paper entitled 'Protective coating varnishes based on shellac' in the National seminar on Chemistry and applications of lac held at ILRI, Ranchi on 25th November, 2006.
- Dr. A Bhattacharya, PS & Head, TOT attended the meeting of the Scientific Advisory Committee of R. K. Mission Divyayan KVK on 20.12.2006

## 6.2 HRD

- Dr. N Prasad, Sr. Sc. attended a programme on Intellectual Property Rights and WTO Related Issues during July 31- August 4, 2006 at ASCI, Hyderabad
- Dr. AK Jaiswal, Sr. Sc. attended training programme on Participatory Methodologies for Agricultural Extension Management at National Institute of Agricultural Extension Management (MANAGE), Hyderabad during 21st -25th August, 2006.
- Shri MF Ansari, Sc. attended a training programme on "Use of ICT tools for improving access to agricultural information at grass root level" during Oct. 30 - Nov. 3, 2006 at National Institute of Agriculture Extension Management (MANAGE), Hyderabad.
- Sri LCCN Shahdeo, T.O. attended the training on Management development programme on managerial skills for extension personnel at MANAGE, Hyderabad held during November 6-10, 2006.
- Dr. SK Giri, Sc. attended a training programme on "Design and development of web based application using dot net technology" during Nov. 22 to Dec. 12, 2006 at IASRI, New Delhi.
- Shri R Ramani, PS attended BCIL workshop on Critical issues affecting biotech commercialization and emerging opportunities in biotechnology at New Delhi on March 3, 2006.

# 7. EVENTS ORGANIZED

## 7.1 Annual Lac *Kisan Mela*

The Institute organized the Annual Lac *Kisan Mela* on February 10, 2006. Shri MK Mandal, IAS, Chief Secretary, Jharkhand Government inaugurated the *mela*. Shri Saryu Rai, Vice-Chairman of State Planning Commission of Jharkhand presided over the function. Inauguration of the *Mela* began with the welcome address by Dr. Bangali Baboo, Director who threw light on research achievements and various programmes being carried out by the Institute for the welfare of lac farmers.


*Mr. Mandal addressing the farmers*

Addressing the gathering of farmers, scientists, entrepreneurs, representatives of GOs and NGOs; Chief Secretary, Shri Mandal said that lac is an important forest product and it contributes significantly to the livelihood of tribal farmers of the State. He expressed the need of better marketing system and minimum support price for the product. Shri Mandal appreciated the contribution of the Institute and stressed that the State Govt. will render all support to the institute in its endeavor.

Shri Saryu Rai, Vice-Chairman, State Planning Commission said that this product has tremendous capacity for improving economic condition of the farmers. He expressed the need to exploit the natural infrastructure available in the State for lac cultivation. He asserted that the efforts made by the Institute to generate awareness among the farmers for undertaking scientific cultivation of lac will yield good results. Earlier, the Chief Secretary and the Vice-Chairman were shown around the Institute Research Farm where the former planted a *kusum* sampling.

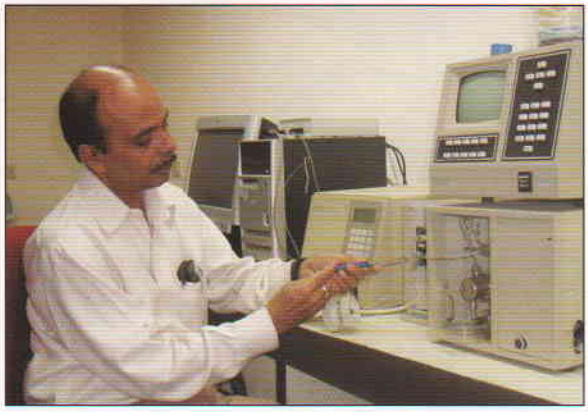
750 farmers sponsored by NGOs from different parts of the State participated in the *Kisan Mela*, who were shown around the Institute Research Farm. They were apprised of the various lac production technologies; new lac-host plants introduced for lac cultivation and pest management methods. A *Kisan Gosthi* was also organized in the afternoon session where in experts of the Institute, Birsa Agricultural University (BAU) and Horticulture and Agro-Forestry Research Programme (HARP) directly interacted with farmers and tried to solve, on the spot, the problems faced by farmers in lac cultivation and other agricultural aspects.

The Chief Secretary inaugurated an exhibition comprising of 18 stalls from different organizations. Besides ILRI, organizations like HARP, IFFCO, Jharkhand State Cooperative Lac Marketing and Procurement Federation (JHASCOLAMPF), Institute of Forest Productivity (IFP), State Bank of India, TRIFED, JTDS, Indian Railways, several pesticide firms, NGOs etc. participated in the exhibition.

*Mr. Mandal and Mr. Rai at one of the exhibition stalls*

## 7.2 IS / ISO 9001: 2000 Certification to Quality Evaluation Laboratory of ILRI

The Quality Evaluation Laboratory (QEL) of the Institute has recently been awarded IS/ISO 9001-2000 quality management systems certification. The license has been granted for rendering laboratory services for collection, analysis, testing and reporting of lac and lac based product samples. The laboratory facilities, scientific and technical expertise, services and the efforts of Director, ILRI and Head, Lac Processing and Product Development Division could lead to this recognition.



*Inside view of the QEL*

ILRI is a nodal institute at national level for research and development on all aspects of lac, such as production, processing, product development, training, information repository, technology dissemination and national/ international cooperation. Since 70-80% of lac produced in the country is exported in different forms, the recognition would be helpful to the industry, exporters, importers and researchers for getting reliable test reports on lac and lac-based products.

## 7.3 Inauguration of Pilot-Plant of Lac Dye

The pilot plant of lac dye was inaugurated by Dr. Mangla Rai, Secretary, DARE and D.G., ICAR on 6th July 2006 during his visit to the Institute. The plant has been designed and developed in the Institute for preparation of lac dye upto technical grade from wash water of sticklac. Since lac dye is non-toxic and of natural origin, it can be used as food coloruing material besides dyeing wool and silk. The dye is already being used in some of the countries like Japan, China *etc.* as food additives.

The plant can produce 2 kg of technical grade lac dye from washing of 400 kg sticklac. The different wetted parts of the plant like tanks, pipes, valves, pumps and filtration unit are made of synthetic material (HDPE, HDPP, PVC) and stainless steel to avoid the contaminations in the final product (pure/food grade lac dye).

The technical grade lac dye is further purified for making it pure/food grade. The lac processing industries presently disposing off the wash water as effluent, can recover this by-product, as pure lac dye, which can further enhance economy of the lac processing units. The pure/food grade lac dye has present market price of Rs.5,000-6,000/kg.

India, at present, produces about 20,000 tons of lac annually. Considering this annual production, nearly 200 tons lac dye is lost in effluents during washing. Thus, an enormous potential exists for recovery of the dye as by-product of lac industry. Even if half of the potential is exploited, it will be possible to turn trade of lac dye into highly profitable business, as an exportable item with an assured foreign market.

*Inauguration of the plant by the Secretary DARE & D.G., ICAR*

## 7.4 Lac Research – Industry Partnership: An Interaction

On completion of 82 years of dedicated service to the nation, Indian Lac Research Institute celebrated anniversary of its foundation on September 20, 2006. To mark the occasion, Lac Research – Industry Partnership: An Interaction was organized. The objective of the interaction was to provide an opportunity as also a platform to share the researchable problems of the industry and the technological developments at ILRI. Prof. (Mrs.) M. Mukherjee, Head, Department of Polymer Engineering, BIT Mesra, Ranchi, delivered Key Note address on the occasion. She envisaged that variety of products can be developed by blending of lac with synthetic resins. The products may prove to be useful for surface coating, adhesives, packaging and electronic industries. Emphasizing the coordination and cooperation between the institute and ILRI in the field of technology, she said that research taken up by the ILRI in tandem with the BIT would not only boost the consumption of lac, but also help variegated utilities of its products and by-products. She stressed that both the institutes ILRI and BIT could work jointly for the benefit of the people.

Earlier, in his welcome address, Dr. Bangali Baboo, Director, ILRI highlighted the achievements made by the institute. He further elaborated that Quality Evaluation Laboratory (QEL) of the Institute has received ISO 9001-2000 certification for quality testing of lac and lac based products. Pilot-plant of lac dye has been designed and developed in the Institute for production of lac dye. It can produce upto 2 kg of technical grade lac dye in one batch. Besides, equipments for lac processing, wood varnish, insulating varnish, multipurpose glazing varnish etc. have been developed. Efforts are being made for approval of food color of lac dye from Ministry of Health, Govt. of India. Lac produced in India is better than those produced in other countries, he added. He stressed on cultivation of lac on plantation basis to increase the grower's income. He expressed the need of coordination to bring industry, research organizations at one platform.

Representing industry, Shri RL Sharma, MD, Tajna Shellac Industry talked about issues related to lac industry. Dr. DN Goswami presented the commercializeable technologies on lac and lac based products from ILRI. Several representatives of industries, institutes expressed their views on augmenting the use of lac in newer areas and stressed on the need for improvement in the old technologies based on the demand of lac industries.

*Participants in technical session of the interaction. (inset) Dr. (Mrs.) Mukherjee*

## 7.5 Interaction meeting for taking up lac-related activities by KVKs in West Bengal in partnership with ILRI

**Participants Present:**

1. Dr. Bangali Baboo, Director
2. Dr. Niranjan Prasad, Head, LP&PD Division
3. Dr. DN Goswami, In-charge, RMU
4. Dr. R Ramani, Head, Lac Production Division
5. Dr. AK Jaiswal, Sr. Sc. and Training Coordinator
6. Dr. KK Sharma, Sr. Sc. and I/c, Institute Research Farm
7. Dr. N Prasad, Sr. Sc. and Trg. Co-coordinator
8. Dr. S Ghosal, I/c, RFRS, Purulia
9. Dr. PP Pal, Sr. Sc., ZC unit, Zone II, Kolkata
10. Dr. S Mukherjee, Prog. Coordinator, Seva Bharati KVK, West Medinipur
11. Mr. AK Patra, Prog. Coordinator, WBCADC KVK, Bankura
12. Mr. SK Bhattacharya, Prog. Coordinator-in-charge, Kalyan KVK, Purulia

The meeting was held on November 6, 2006 under the chairmanship of Dr. Bangali Baboo, Director of the Institute. The meeting began with self-introduction of all the participants in the meet. Dr Ramani welcomed the members and outlined the purpose of the meet. He also informed that the team from West Bengal was taken around the Museum, Research Farm, Quality Evaluation Lab. and Lac Processing Unit of the Institute; the film on lac was also shown.

Dr. Baboo in his address described the lac production and processing scenario in West Bengal and the activities of the field station of the Institute in Purulia. He expressed his desire to augment and sustain lac related activities in West Bengal with active partnership between ILRI and KVKs of three lac-producing districts through ZC Unit, Kolkata. He spelt out the envisaged roles of ILRI and KVKs in the proposed partnership. He said that the activities to be taken under this initiative and modalities may be finalized in the light of the infrastructure and other considerations.

*Programme Co-ordinators of the KVKs with Head, LPD*

Dr. Pal informed the members that the KVKs in lac growing districts of West Bengal will be glad to be associated with this initiative of ILRI. He briefed about the infrastructure and financial status of the KVKs. He pointed out the KVKs can take up FLDs only if adequate financial support is given. The representatives from the three KVKs also described the scope and support required for taking up proposed activities under the partnership. In Purulia, the KVK is already engaged in some lac production demonstrations, and there is scope for expansion. In Midnapur, lac cultivation on *ber* is popular but technology intervention is needed. In Bankura, the area of activity of the KVK is about 50-70kms, which poses accessibility problems.

The members actively deliberated on different activities that may be taken up, their modalities and limiting factors. Lac Development Officers of respective districts may be associated by KVKs in taking up the work. Inputs needed for FLDs can be provided as per KVK norms. The attitude and psychology of the farmer beneficiaries toward such developmental efforts were also discussed. After critical analysis of the activities envisaged in the light of infrastructural and financial framework of KVKs, following recommendations emerged :

- Lac-related activities in Purulia, Midnapur and Bankura districts will be taken up with active partnership of ILRI, ZC Unit and KVKs concerned in a collaborative mode.
- Lac Demonstration Units will be developed at the farms of the KVKs with the guidance of ILRI
- Subject Matter Specialists from KVKs (two from each KVK) will undergo a two-day HRD programme on lac production and primary processing at ILRI

## 7.6 National Meet on Strengthening Lac Production through Technological and Policy Intervention

The meet was convened at the institute on November 27, 2006 in which 40 representatives from central and state government; lac industrialists, policy makers, financial institutions, NGOs, researchers and farmer took part.

The inaugural session was chaired by Shri NN Sinha, IAS, Secretary (Welfare), Jharkhand Govt. with Shri Wilfred Lakra, IAS, Managing Director, TRIFED, New Delhi as Chief Guest.

Welcoming the participants Dr. Bangali Baboo, Director, ILRI explained the objectives of the meet. He shared his concern on low pace of increase in lac production and said that non-availability of broodlac particularly of *kusmi* strain, summer

mortality of crop and not cultivating lac on plantation basis posed major problems to increasing lac production. He emphasized the need to introduce systematic plantations by the forest dept., buffer stock of at least 3000- 4000 tons of lac and creation of Directorate of Lac Development at the Central level.

Chairman of the session, Shri NN Sinha told that cultivation of lac is an important activity for income and food security for the poor especially tribals. He informed that State govt. has launched a welfare project for 20,000 lac growers of the State. He added that forest dept. is intending to hand over the broodlac farms to prospective entrepreneurs and raising commercial plantations of lac host plants. He underscored the need for a national apex body on lac to remove the irritants in improving lac production.

Chief Guest, Shri Wilfred Lakra felt that different stakeholders of lac are working in isolation and there is a need for team effort for strengthening lac industry in the country. He underlined the need for a national policy on lac to bring out uniformity in the policies practiced by different state govts. He further said that production; collection, movement and price of lac are urgently required to be streamlined. He informed that TRIFED will take initiative to convene a high level meeting at Central level, of the departments concerned to address the above issues.

*Shri Wilfred Lakra addressing the participants of the Meet*

*Dr. Bangali Baboo, Director welcoming the Chairman Mr. NN Sinha*

There were two technical sessions on the two focus areas of the meet, *viz.*, i) strengthening lac production through technology intervention and ii) policy intervention for better marketing environment, chaired by Dr AK Malhotra, APCCF, Jharkhand Forest Dept. and Dr Bangali Baboo, respectively.

## Strengthening lac production through technology intervention

Non-availability of timely and quality broodlac was identified as one of the major constraints for strengthening lac production. It was also found that there was surplus broodlac production in certain areas and shortage in others. Development of information network on availability / demand of broodlac was, therefore, considered necessary to overcome this ironical situation. It was also felt that broodlac farms be promoted in different lac growing areas to meet the local demand.

Scattered lac hosts, away from village settlements also make lac cultivation difficult and vulnerable to theft, due to high lac prices. Lac production should thus, be gradually shifted to plantation scale to enable better management and protection from theft.

The following information was also provided to the participants:

- Government of Chhattisgarh has constituted a 'Lac Cell' to frame policies and implement developmental activities related to lac.
- NABARD also sponsors skill up-gradation programme (up to Rs 20,000), which can cover lac production enterprise also.

## Policy intervention for better marketing environment

Highly fluctuating price is the foremost problem affecting the consumption of lac in the country and overseas. It is important that prices are kept at levels economic to both grower and consumer to maintain a favourable marketing environment and sustained demand. Exhaustive deliberations were held on various mechanisms for price control, but a consensus could not be reached. In view of the complexity of the issue, it was decided that it may be addressed separately through a committee.

The current policies governing collection/ production of lac as well as intra and inter-state movement were reviewed in Jharkhand, Chhattisgarh, Orissa, Madhya Pradesh, Andhra Pradesh and Gujarat. It was found that lac was free from govt. royalty and free for collection in all the above States. Transit permit is not needed in States like Jharkhand, West Bengal and Madhya Pradesh whereas; it is required in Andhra Pradesh, Chhattisgarh and Gujarat. It was pointed out that transit regulations in Orissa have adversely affecting lac production in the State, which was an important *kusmi* lac producing state in the past. Shri AK Malhotra, informed that he would take up transit restriction affecting lac production in Orissa with State PCCF at his level also.

## Decisions taken for follow up action, based on deliberations:

- A committee was constituted, consisting of Dr AK Malhotra, APCCF, Jharkhand Forest Dept.; Mr Srinivas Rao, CF, Kanker, Chhattisgarh; NABARD; Shri Roshan Lal Sharma, Tajna Shellac PVT. Ltd., Khunti; and ILRI, Ranchi to suggest a pricing mechanism for lac.
- ILRI may work out cost of unit lac production for determining economic price level for the grower.
- It was expressed by some participants that transit pass system appears to be in practice in Simdedga dist. of Jharkhand even though no transit pass is required in the State. It was decided that a letter may be written to PCCF, Jharkhand for suitable action. A copy may be endorsed to Dr AK Malhotra, APCCF, Jharkhand for follow up.
- Transit permit restriction also appears to affect lac production in Orissa, a highly potential state for *kusmi* lac production. A letter may be written by TRIFED to PCCF, Orissa to look into the matter.
- The Jharkhand State Forest Dept. would initiate action for revival of existing broodlac farms in the state to meet the broodlac shortage in the state. Similarly, other state forest depts. should also establish broodlac production centres. Copies of proceedings may be endorsed to Secretary, Forests and Environment, Jharkhand govt. and MD, Jharkhand Forest Dev. Corporation, Ranchi.

## Recommendations:

- India is world leader in production, processing and export of lac and lac products. Lac is a major source of livelihood for tribal people in several States. Thus, there is need for a national policy on lac for its sustained development.
- A high level national meet, preferably at New Delhi, may be convened by TRIFED with secretaries of M/o Forests and Environment, DARE, Rural Development, Tribal Affairs, Commerce, PCCFs of lac growing states.
- No royalty or tax of any kind be levied for collection/production of lac. Transit permits, if imposed; be only for the purpose of maintaining data on quantum of production and movement of lac. This may be considered while formulating national policy on lac.
- Forest Deptts. of lac growing states need to raise compact lac host plantations in their states so that lac growers can exploit them for lac production. If all lac producing States could raise even 500-1000 ha plantation each, production can be doubled and India's leadership strengthened.

- There is need for a closer linkage between ILRI and State Forest Depts. and MFPFs for strengthening technology dissemination.
- Import of raw lac from other lac producing countries needs to be discouraged. This be considered while formulating policy on lac.
- Efforts be made for listing lac in NCDX and MCX.
- With a view to assist and apprise of recent trends and demand of lac, an industrialist may be co-opted by JHASCOLAMPF on their Board of Directors.

The meeting ended with a vote of thanks by the convenor of the meet Dr. R Ramani, ILRI. Dr. KK Sharma, Sr. Sc. and Dr. G Pal, Sc. were the Co-Convenors of the meet.

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# 8. MEETINGS OF IMPORTANT COMMITTEES

## 8.1 The XII Research Advisory Committee (RAC)

The XII Research Advisory Committee (RAC) meeting was held in the Institute on the March 27 - 28, 2006. The meeting was held under the Chairmanship of Dr. NSL Shrivastava, Ex DDG, ICAR. The other members attending the meeting were Dr. RP Kachru, Ex ADG, ICAR and Dr. NK Pal, Director (Chemicals), BIS, Kolkata.

*RAC Members are all ears during the deliberations*

Following recommendations/observations were made by the RAC:

- RAC observed that good work is being done in the Institute in developing technologies on production, processing and value addition of lac and a number of promising products like aleuritic acid, lacquer, varnishes etc have been developed, their potential need to be verified and technology commercialized at a faster pace. Business Meets on specific products be organized with the manufacturers, processors, entrepreneurs and other related officials to demonstrate the new technologies and have direct interaction with them for commercialization.
- Lac production is going down. In consumption, the share of export is more than the domestic consumption. In view of this, the ILRI expertise be utilized to increase production and increase, both, domestic consumption and export. The Institute should not divert its R&D efforts from lac. Good work is being done in identifying many new hosts like *Prosopis juliflora* (*Ganda bawal*) and a number of new States are showing interest in lac production. Therefore, there should not be much difficulty in increasing the production of lac. The Institute should develop technologies for organised lac-based farming system incorporating *Flemingia semialata* and other short duration host crops, which can yield lac within a short period.
- The tribal farmers are likely to face difficulty in adopting lac-based farming system unless they get higher and regular returns. For this, growing of intercrops, medicinal and aromatic plants, vegetable etc. along with lac may also be tried. This arrangement can widen the scope of intercrops along with lac-based farming system.
- Presently about 80-85% of lac is being exported, efforts should be made to develop products and technologies to increase domestic consumption of lac.
- The Institute is having strength in the fields of Chemistry and Engineering. As a diversification programme, ILRI should consider taking up R&D work on bio-colours/natural dyes, waxes, gums, resins, pigments, perfumery compounds, non-essential oils, bio-pesticides and minor forest product processing and value addition etc., other than lac. Filling of the vacant posts of scientists in specific fields is essential and ICAR may be approached to give priority to filling the vacant posts.
- More emphasis should be given on pilot plant demonstrations for which good and appropriate equipment may be procured and pilot plants established.
- Farmers/entrepreneurs are showing great interest in *F. Semialata* as a cultivated field crop. More field demonstrations of this crop should be conducted in farmers fields. It was agreed that ILRI will try to conduct

demonstrations of this host crop in about 200 ha area with the help of State Govts.

- New areas like Chhattisgarh, Orissa, Gujarat States have shown interst in lac cultivation. Institute should provide technological backup support to these areas by organizing training programmes, laying out demonstrations, visits of scientists to those areas and by supply of brood lac.
- Serious efforts should be made to create awareness about new products amongst the consumers.

The following suggestions emerged related to widening the R&D mandate of ILRI :

1. Need for organized and integrated lac based farming system.
2. Natural resins, pigments, wax, colouring agents are the major products of lac and these should be exploited further.
3. Evolve strategy for increasing production and utilization for consumers /traders so that they are not able to find other alternative products than using lac.
4. Non-conventional applications of lac in agriculture, cosmetics & medicines can compete with the synthetic resin. These areas should be exploited.
5. Mandate of the Institute may be expanded to work on bio-colours/natural dyes, waxes, gums, resins, pigments, perfumery compounds, non-essential oils, bio-pesticides and minor forest product processing and their value addition.
6. Growing of horticultural crops and medicinal plants as intercrop in lac based farming system.

## 8.2 40th meeting of Institute Management Committee

The meeting was held on October 11, 2006 at ILRI, Ranchi.

The following members were present:

1. Dr. Bangali Baboo, Director, ILRI - Chairman
2. Dr. S Kumar, I/c.& Head, HARP, Ranchi
3. Dr. JB Tomar, I/c. & Head, NBPGR, Ranchi
4. Dr. N Prasad, I/c. Head, LPPD, ILRI - Invitee
5. Dr. A Bhattacharya, Head, TOT, ILRI - Invitee
6. Dr. R Ramani, I/c. Head, LPD, ILRI - Invitee
7. Sh. Devesh Nigam, FAO, ILRI - Invitee
8. Sh. Ashok Mallick, Admin. Officer, ILRI - Member-Secretary

*IMC meeting in progress*

The meeting started with a welcome by Sh. Ashok Mallick, A.O. & Member-Secretary. The Chairman also welcomed all the members for attending the first meeting during the year. The progress report for the period (Dec., 05 to Sept., 06), mandate, research achievements, closure of RFRS, various core programmes and constraints *etc.* were presented by the Director. He informed the IMC that very good progress has been made in lac cultivation on *Prosopis juliflora* in Gujarat. He also outlined the various training programmes conducted during the period by TOT Division of the Institute. It was informed that good response from the NGOs / State Govts, such as Jharkhand, Chhattisgarh, Andhra Pradesh, Orissa & Madhya Pradesh was received.

He told that large scale programme was going on in Chhattisgarh; *Flemingia semialata* for raising

winter crop (*Aghani*) of *Kusmi* strain; field demonstrations at Seoni, Raipur, Kanker & Kandhmal; ISO 9001 accreditation certification for Quality Evaluation Lab received by the Institute; descriptors of lac hosts & insects and characterization of lac insect germplasm using molecular profiles; bio-control of lac insect predators to avoid use of chemical insecticides; development of technical grade lac dye, multi-purpose shellac based glazing varnish, deep bore well (200 m) through CGWB, rain water pond in IRF; establishment of Resins and Gums Farm near Technology Block and organization of BIS CHD-23 meeting at ILRI were some of the major achievements during the period. About Rs.30.33 lakhs resource generation was done during the last financial year.

The committee reviewed the progress and actions taken report on the recommendation of the 39th IMC meeting and confirmered the proceedings of the last meeting. The committee also discussed and recommended the following new agenda:

1. Creation of Product Development Lab. by renovating the lab in old building of LP&PD Division – The amount may be met out from the Non-Plan head of the Institute.
2. Closure of RFRS, Purulia (West Bengal) - The Chairman apprised the house about the present situation of the Station. He told that the West Bengal Govt. also wanted to take back the land. Based on detailed justification *i.e.* shortage of manpower, mandate expansion of the Institute, the house unanimously agreed & recommended to close the station. It was suggested that the activities of the Station could be addressed through respective KVKs in lac producing districts.
3. Demolition of eleven old buildings - It was brought to the notice of the IMC members that the aforesaid buildings are very old and are in dilapidated condition. The CPWD have also declared the buildings as unfit for living or any other use. A certificate has also been obtained to this effect from CPWD. The IMC agreed and recommended to demolish the above-identified buildings.

The meeting concluded with a vote of thanks by Member Secretary to the Chair and all the members.

## 8.3 Staff Research Council Meeting

The Staff Research council Meeting of the year 2006-07 was held during 15th to 17th June, 2006 under the chairmanship of Dr. Bangali Baboo, Director, ILRI, Ranchi for scientific scrutiny of all the projects, suggest corrective measures in the methodology, technical programme of all the projects and closer analysis on the suitability of the new project proposals. The meeting was attended by two outside experts namely Dr. K. Krishnamurti, Director, IFP, Ranchi and Dr. P. Kaushal, Dean Forestry, BAU, Ranchi alongwith all scientists of the Institute. In the SRC, 35 on-going research projects were discussed and nine new projects were approved out of the 10 proposals.

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# 9. DISTINGUISHED VISITORS

1. Shri Ujjwal Shankar Mukhopadhyay, General Manager, Oriflame Industries (India) on 1.01.2006 and delivered a lecture on utilization of wax in cosmetic industry.
2. Dr. Mangla Rai, DG and Dr. N.Ali, DDG (Engg.), ICAR paid a visit to the Institute on 13.01.2006 and inaugurated the renovated library building.
3. Brig. Sukhbir Singh, Central Command, Gaya, Bihar visited on 6.03.2006.
4. Dr. Ashok Seth and Shri G Thapa, International Scientists from IFAD on 25.03.2006.
5. Dr. NSL Srivastava, Ex DDG, ICAR and Chairman RAC on 27.03.2006.
6. Dr. RP Kachru, Ex ADG, ICAR and Member RAC on 27.03.2006.
7. Dr. NK Pal, Director (Chemicals), BIS, Member RAC on 27.03.2006.
8. Dr. Pradyun Kumar, Pr. Sc., Directorate of Maize Research, IARI, New Delhi on 6.04.2006.
9. Mr. B Volbert and Mr. C Groeger (Scientists) from SSB Strover Industry, Germany on 17.04.2006.
10. A delegation of four consisting of Osamu Furuta, Chieko Rokunohe, Masaki Shibato and Masuru Ogi from lac industry, Japan on 24.04.2006.
11. Brigadier RN Nair on 25.04.2006.
12. Dr. NK Tyagi, Member, ASRB visited ILRI on 27.05.2006.
13. Dr. Mangla Rai, DG, ICAR and Secretary on 31.05.2006 and 5.07.2006.
14. Dr. SD Sharma, Director, IASRI, New Delhi visited the Institute on 17.07.2006.
15. Shri RP Singh, CEO and Shri PK Bose, Resident Engineer of Jindal Steel Ltd. on 26.09.2006.
16. Dr. VP Singh, Ex Director, CCSHAU, Hissar on 4.11.2006.
17. Dr. RB Deshmukh, V.C., MPKV, Rahuri on 4.11.2006.
18. Dr. P Chandra, ADG (PE), ICAR on 1.12.2006.
19. Dr. Ramesh Chandra, ICAR National Professor on 2.12.2006.
20. Brig. P Krishnamurthy on 28.12.2006.

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# 10. SUPPORT SERVICES

## 10.1 Institute Research Farm (IRF)

The following activities were undertaken during the period under report :

### Research Farm Management

Research Farm was managed and maintained in proper condition. Roads, path, channels, hedges and edges were maintained in good and scientific conditions. Weeds were managed by ploughing at regular intervals. All scientific cultural practices were used in experimental as well as in general farm. Trees were pasted with lime mixed with insecticides to manage termites. The trees in plots with unhealthy conditions and not in condition of being rejuvenated were removed. Sparsely populated plots were cleaned for new plantations and gaps were filled with suitable species. About 800 *ber* and 200 *palas* saplings were transplanted in gaps. Vacant plots were utilized by cultivating crops for resource generation.

### Lac Cultivation and Nursery Management

Lac hosts like *kusum*, *ber* and *khair*, which were not under experiment or Revolving Fund Scheme, were used for *kusmi* lac cultivation. A record 1151 kg *kusmi* broodlac was produced. Scrapping of *phunki* and low quality broodlac yielded 393 kg sticklac. Harvesting-cum-pruning of *khair* and *ber* was done. Pruning of *kusum* trees was also done. About two quintals of *rangeeni* broodlac was inoculated on *palas* in October.

A separate plot was prepared and developed as nursery for raising lac host plants. About 1500 *ber* seedlings, 100 *palas* seedlings, 50 *khair* seedlings and 50 *kusum* seedlings have been raised. About 30,000 *Flemingia semialata* seedlings were provided to JLDS project for distribution amongst farmers.

### Infrastructure Development

A part of the wasteland was developed and leveled into three subplots, which are being used for resource generation. A path of 400m length has been re-laid and strengthened. Another small farm adjacent to IRF with an area of about 3.03 acres has been developed for raising natural gum yielding plants. A pond measuring 34 x 34 x 25 x 4m has been dug in this farm, paths have been constructed and plots leveled for raising resin/gum-yielding trees.

A power tiller was purchased and is being used effectively in the farm. 100m long irrigation channel was laid down and necessary repairing of the existing pipeline was also done. Hume pipes were purchased to put at adequate places to check soil erosion. A water tanker of 3000 l capacity and a power sprayer have also been purchased.

### Resource Generation

An amount of Rs. 3,81,172/- has been generated as revenue from sale of the farm produce:

**Revenue generated by IRF**

| Sl. No. | Items | Amount (Rs.) |
|---|---|---|
| 1 | Lac (Brood lac, scrapped lac* etc.) | 2,37,153 |
| 2 | Wood (Pruned twigs, bamboo etc.) | 27,379 |
| 3 | Other Farm produce (Lac host seeds, seedlings, Paddy, wheat, ornamental plants etc.) | 1,09,540 |
| 4 | Others (Water Tanker, Fuel charges etc.) | 7,100 |
| | **Total** | **3,81,172** |

* *50 kg* kusmi *sticklac (worth Rs. 5500) has been provided to TOT for experiment.*

## 10.2 Quality Evaluation Laboratory

### BIS Accreditation of Quality Evaluation Laboratory

The Bureau of Indian Standards (BIS) has granted License (No. QSC/L-5001996) for the Quality Management Systems Certification to the Quality Evaluation Laboratory in accordance with IS/ISO 9001:2000 *w.e.f.* 30th May, 2006 to render laboratory services for collection, analysis, testing and reporting of lac and lac based products samples.

During the period, 201 samples of seedlac/ shellac/bleached lac/lac dye/aleuritic acid/ by products of lac were received from Govt. organization/Private Industries/various divisions of ILRI and in all 860 tests were carried out.

## 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 reports of the scientists and DARE report to the Council, information related to SMD meetings etc.
- Management of HRD programme of scientists and other staff of the Institute. Maintenance of research project files of the Institute.
- Processing of research/routine activities 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 computer system and Local Area Networking (LAN) of the Institute.
- Power point presentation during meetings, seminars etc.
- Maintenance of Conference Hall.
- 256 Kbps Internet connectivity from BSNL was established in Director`s bunglow
- Maintenance of RAC, QRT and SRC files
- Maintenance of database for Personal Information Management System Network (PERMISNET)
- Right to Information

The RMU presently maintains three servers namely Proxy Server for providing Internet connectivity to various Divisions/Sections, Mail Server providing e-mail facilities and Apache Web Server for hosting web site.

## 10.4 Library and Documentation Centre

The library of the Institute plays an important role in meeting the information needs of its users. Library is a repository of scientific and technical information on lac. Besides catering to the needs of scientists of the Institute it also provides services to the researchers, academicians, students and lac industrialists from other parts of the country.

The library maintains adequate linkages with leading reference libraries like National Library-Kolkata, NISCAIR- New Delhi for strengthening the information resources. It also supplies photocopies of rare research articles to NISCAIR, New Delhi from time to time against payment.

Rs. 15,424 was earned from sale of publications and reprographic services. The library continued the exchange ILRI publications with the scientific institutions in and outside the country.

### Services Provided by the Library to its Users

1. Online 'Todays Arrival'
2. Reprographic Services
3. C D searches
4. E-journals access
5. Bibliographic Services
6. Current Awareness Services
7. Inter Library Loan Services for resources sharing
8. Sale of ILRI publications

### Library Holdings as on 31.12.2006

| Documents | Addition | Total Holdings |
|---|---|---|
| Books | 22 | 7584 |
| Bound Journals | 1453 | 20764 |
| Annual Reports | 45 | 4494 |
| C D Rom | 22 | 120 |
| Maps | -- | 37 |
| Patents (Foreign) | -- | 327 |
| Patents (Indian) | -- | 17 |
| I S I Specifications | 04 | 124 |
| Thesis | 01 | 07 |

**Journals subscribed and received**

Foreign Journals : Subscribed - 22, Gratis/ Exchange - 07

Indian Journals : Subscribed - 59, Gratis/ Exchange - 24

E-Journals : 06

## 10.5 Estate Section

Estate Section of the Institute takes care of essential services such as security of the Institute premises, water and power supply as well as infrastructure development work of the Institute including the engineering research work. Services provided by the Section during the year are as follows:

### Civil and Water Supply

### A. Completion of work through C.P.W.D. /Other agencies

1. *Renovation of old official buildings & electrical lines*

   Renovation of QEL Lab, Old Chemistry building (Civil & Electrical), Canteen, *Kisan* Hostel, toilets in LPU, two Labs in Lac Production Division, Security Post in LPU, Water supply station near river bed (floor & room) and street lighting system in LPU campus was carried out.

2. *New Construction in the Institute Premises*

   Boundary wall and PCC approach road of National Resin & Gums Farm, Vehicle shed in main campus vermi-composting shed in IRF, *Kisan* Hostel (One wing of two floors), toilets in estate section and approach road in Bungalow No. 3.

3. *AR & MO of Office and Residential Buildings*

   Administrative Building, Type-II & III quarters in LPU Campus; Type - III double storey and Type - IV quarters in the main campus.

4. *Roof Grading of Residential Buildings*

   Type - II, Type - III, Type - V and several other quarters of both the campuses.

### B. Work carried out Departmentally

1. 626 job were entered in the plumber's job register and most of them have been attended to.
2. Pipe line laying from submersible pump near mist propagation chamber to nursery in IRF.
3. Installation of water coolers in various Divisions/Sections of the Institute
4. Iron scrap old iron tanks near Estate Section & discarded wooden materials worth more than one lakh Rupees were auctioned.

### Electrical & Genset

1. Maintenance of electrical connections in the Institute premises. A total of 1565 jobs related to electric work were entered in the job register and most of them have been attended to.
2. CFL light fittings were done in place of tube lights in Museum, Lecture Hall, Guest House and TOT rooms.
3. Removal of Electric Panel in front of the office and laying of underground wiring.
4. New electrical connection to pumps at both ponds of IRF
5. Electrical rewiring of QEL and Canteen.

### Workshop Unit

1. Fabrications and erection of structures, fitting of Pilot Plant of technical grade lac dye in LPU.
2. Fabrication of Pump House near IRF pond.
3. Renovation of Sale Counter of TOT and Canteen.

### Security and Land Scaping

1. No major security lapse occurred on the part of security during the year.
2. Pruning of trees, cleaning of campus, removal of weeds, ploughing and leveling of ground were done in both the campuses.
3. New hedges & saplings were planted in both campuses to give better look to the Institute premises.

4. A total of 66 jobs were entered in the job register of sweeper and cleaning work and most of them have been attended to.

### Guest House and *Kisan* Hostel

About 200 guests stayed in the Guest House and nearly 750 Trainee guests stayed in the *Kisan* Hostel during the year. Resource generation from Guest House was Rs.28, 800 and from *Kisan* Hostel it was Rs.1, 43,075 during the year.

## 10.6 Health Care

Dr. Anil Kumar and Dr. (Ms.) Sudakshina Sharma worked as AMAs on contractual basis on alternate days (each for 3 days/week).

1. 8, 500 patients were attended by the AMAs at ILRI dispensary.
2. 160 patients were examined for blood sugar by Glucometer.
3. Most of the medicines as advised by AMAs were made available to the patients from the dispensary itself.

## 10.7 Agro-meteorology

Agro-meteorology Unit of the Institute is situated at 23°23' N latitude, 85°23'E longitude and 650 m altitude. Different weather parameters recorded by the unit during the year are presented in the Table given below. Total rainfall recorded was 1752.3 mm, which was 41.3% higher than the previous year. The highest rainfall was recorded during July month and the lowest in the month of November. January, February and December months did not experience any rainfall. During September, 417.1 mm rainfall was recorded, but about 90% of it occurred during a span of three-four consecutive days. Monsoon months (June to September) alone accounted for 88.24% of the total yearly rainfall. The highest mean maximum temperature (36.5°C) was observed in the month of April and the lowest mean minimum temperature (7.9°C) during January. During the year, May 7th and January 10th were recorded as the hottest & the coldest day of the year with a temperature of 39.6°C and 5.0°C, respectively.

### Meteorological data recorded during January to December 2006

| Month | Mean Temperature (°C) | | Mean Relative Humidity(%) | | Total Rainfall |
|---|---|---|---|---|---|
| | Maximum | Minimum | 7.00 a.m. | 2.00 p.m. | (mm) |
| January | 27.1 | 7.9 | 64 | 41 | 0.0 |
| February | 30.9 | 12.2 | 57 | 37 | 0.0 |
| March | 30.7 | 15.6 | 62 | 45 | 52.0 |
| April | 36.5 | 19.9 | 55 | 39 | 14.1 |
| May | 36.4 | 21.3 | 73 | 53 | 110.8 |
| June | 33.5 | 23.2 | 82 | 74 | 300.8 |
| July | 29.5 | 22.6 | 93 | 87 | 466.5 |
| August | 29.8 | 21.3 | 93 | 88 | 361.9 |
| September | 29.3 | 20.9 | 88 | 83 | 417.1 |
| October | 30.4 | 16.9 | 77 | 64 | 25.4 |
| November | 27.6 | 13.4 | 76 | 65 | 3.7 |
| December | 25.1 | 8.7 | 71 | 52 | 0.0 |
| **Total Rainfall (mm)** | | | | | **1752.3** |

# 11. PERSONNEL

Sanctioned strength of Scientific, Technical, Administrative and Supporting Staff as on 31.12.2006 :

## Scientific

| | |
|---|---|
| R.M.P. | 01 |
| Principal Scientists | 04 |
| Senior Scientists | 11 |
| Scientists | 31 |
| **Total** | **47** |

## Technical

| | |
|---|---|
| Category-I | 39 |
| Category-II | 21 |
| **Total** | **60** |

## Administrative

| | |
|---|---|
| A. O. | 01 |
| F & A O | 01 |
| A.A.O. | 02 |
| A.D. (OL) | 01 |
| Sr. P.A. | 01 |
| Security Officer | 01 |
| P.A. | 02 |
| Assistant | 09 |
| Sr. Clerk | 13 |
| Jr. Clerk | 03 |
| Steno Gr. III | 01 |
| J.A.O. | 01 |
| **Total** | **36** |

## Supporting

| | |
|---|---|
| SSG-IV | 10 |
| SSG-III | 20 |
| SSG-II | 34 |
| SSG-I | 25 |
| **Total** | **89** |

| Cadre | Sanctioned | In-Position |
|---|---|---|
| Scientific | 47* | 28* |
| Technical | 60 | 58 |
| Administrative | 36 | 30 |
| Supporting | 89 | 81 |
| **Total** | **232** | **197** |

**Including RMP post.*

**Dr. Bangali Baboo — Director**

## Division of Lac Production

| | |
|---|---|
| Dr. R Ramani, PS & Acting- Head | Agril. Entomol. |
| Dr. BP Singh, PS | Agronomy |
| Dr. AK Singh, PS | Plant Pathol. |
| Shri G Singh, Sr. Sc. | Soil Science |
| Shri SC Shrivastava, Sr. Sc. | Plant Breeding |
| Dr. KK Sharma, Sr. Sc. | Agril. Entomol. |
| Shri YD Mishra, Sc. (SG) | Agril. Entomol. |
| Shri D Saha, Sc. | Biotechnology |
| Shri RK Singh, Sc. | SWCE |
| Shri M Ekka, T-6 | F/F Tech. |
| Shri ML Rabidas | F/F Tech. |
| Shri KP Gupta | F/F Tech |
| Shri Binod Kumar, T-4 | F/F Tech. |
| Shri RK Swansi, T-4 | Lab. Tech. |
| Shri DW Runda, T-4 | Lab. Tech. |
| Shri SK Tripathi, T-2 | F/F Tech. |
| Shri Bhupal Kumar, T-1 | Lab. Tech. |
| Smt. Sushanti Prasad, P.A. | Admin. |

## Division of Lac Processing and Product Development

| | |
|---|---|
| Dr. N Prasad, PS & Actg. Head | Org. Chem. |
| Shri Murari Prasad, PS | Chem. Engg. |
| Dr. DN Goswami, PS | Physics |
| Dr. RN Majee, PS | Org. Chem. |
| Dr. KP Sao, PS | Physics |
| Dr. S Srivastava, Sc. | Org. Chem. |
| Shri SK Pandey | Mech. Engg. |
| Shri SK Giri, Sc. | A.S. & P.E |
| Shri SKS Yadav, Sc. | Org. Chem. |
| Shri MF Ansari, Sc. | Org. Chem. |
| Shri DD Singh, T-6 | Lab. Tech. |
| Shri TK Saha, T-6 | Lab. Tech. |
| Shri Bhola Ram, T-5 | Lab. Tech. |
| Shri BP Gosh, T-5 | Lab. Tech. |
| Smt. P Devi, T-4 | Lab. Tech. |
| Shri B Kumar, T-2 | Lab. Tech. |
| Shri SK Tirkey, T-2 | Lab. Tech. |
| Shri Ajay Kumar, T-2 | Lab. Tech. |
| Shri Arjun K. Sinha, PA | Admin. |

## Division of Transfer of Technology

| | |
|---|---|
| Dr. A Bhattacharya, PS & Head | Agril. Entomol. |
| Dr. KM Prasad, PS | Org. Chem. |
| Dr. AK Jaiswal, Sr. Sc. | Agril. Entomol. |
| Shri ML Bhagat, Sc. (SG) | Agril. Entomol. |
| Shri PM Patil, Sc. (SS) | Phys. Chem. |
| Dr. N Prasad, Sr. Sc. | A.S. & P.E. |
| Dr. G Pal, Sc. | Agric. Eco. |
| Shri LCCN Shahdeo, T-6 | F/F Tech. |
| Shri RN Vaidya, T-6 | F/F Tech. |
| Shri RP Shrivastava, T-5 | Photographer |
| Shri AK Sinha, T-5 | F/F Tech. |
| Smt. R Sen, T-4 | Lab. Tech. |
| Shri PA Ansari, T-4 | F/F Tech. |
| Shri KK Prasad, T-6 | Lab. Tech. |
| Shri J Singh, T-6 | Lab. Tech. |
| Shri DK Singh, T-5 | F/F Tech. |
| Shri SB Azad, T-4 | F/F Tech. |
| Shri P Patamajhi, T-3 | Lab. Tech. |
| Shri RK Rai, T-2 | Lab. Tech. |
| Shri SK Yadav, Steno Gr. III | Admin. |
| Shri Anup Kumar, T-2 | Lab. Tech. |

## R.F.R.S., Purulia (Under L.P. Division)

| | |
|---|---|
| Dr. R Ramani, PS & Actg. Head Incharge | Agril. Entomol. |
| Dr. S Ghosal, Sc. (SS) | Agronomy |
| Shri KA Nagruar, T-1-3 | F/F Tech. |

## Research Management Unit

| | |
|---|---|
| Dr. DN Goswami, PS, Incharge | Physics |
| Dr. AK Sahay, T-6 | F/F Tech. |
| Shri D Ganguly, T-6 | Lab. Tech. |
| Shri SK Yadav, Steno Gr. III | Admin. |

## Quality Evaluation Lab. (Under L.P. & P.D. Division)

| | |
|---|---|
| Dr. N Prasad | A.S. & P.E. |
| Shri D Ghosh, T-6 | Lab. Tech. |
| Shri KM Sinha, T-6 | Lab. Tech. |
| Shri BK Singh, T-2 | Lab. Tech |

## Library

| | |
|---|---|
| Dr. A Bhattacharya, P.S., Incharge | Agril. Entomol. |
| Shri VK Singh, T-6 | Lib. Inf. & Doc. |
| Shri Binod Kumar, T-4 | Lib. Inf. & Doc. |
| Shri Madan Mohan, T-2 | F/F Tech. |

## Institute Research Farm

| | |
|---|---|
| Dr. AK Singh, PS from Dec. 2006 | Plant Pathology |
| Dr. KK Sharma, Sr. Sc. till Nov., 2006 | Agril. Entomol. |
| Shri RL Ram, T-5 | F/F Tech. |
| Shri M Surin, T-1-3 | F/F Tech. |
| Shri Satish Kumar, T-2 | F/F Tech. |
| Shri SK Mukherjee, T-2 | F/F Tech. |

## Estate

| | |
|---|---|
| Shri AK Yadav | Sec. Officer |
| Shri SK Shrivastava, T-6 | Chief Mechanic |
| Shri Hiralal Bhakta, T-4 | Workshop Tech. |
| Shri ID Das, T-2 | Workshop Tech. |
| Shri Arjun Sharma, T-2 | Workshop Tech. |
| Shri RK Rabi, T-2 | Workshop Tech |
| Shri K Tirkey, T-2 | Workshop Tech. |
| Shri BS Choudhury, T-2 | Workshop Tech. |
| Shri PVD Tirkey, T-2 | Workshop Tech |
| Shri Ramakant Singh, T-1 | Workshop Tech |
| Shri Anil Kr. Sharma, T-1 | Workshop Tech. |
| Shri KK Deonath, Sr. Clerk | Admin. |

## Hindi Cell

| | |
|---|---|
| Shri Laxmikant | Asstt. Director (OL) |
| Dr. Anjesh Kumar, T-4 | Sr. Translator |

## Dispensary

| | |
|---|---|
| Dr. AK Jaiswal, Sr. Sc., Incharge | Agril. Entomol. |
| Dr. Anil Kumar | A.M.A. (Part time) |
| Shri KM Singha, T-6 | Part time |
| Shri P Patmajhee, T-3 | Part time |

## Admin. Section – I

| | |
|---|---|
| Shri A Mallick | A.O. |
| Shri R Rabidas | Sr. P.A. |
| Shri Budhan Ram | AAO I/c. A-I |
| Shri BK Rajak | Assistant |
| Shri Prahlad Singh | Assistant |
| Shri RN Mahto | Sr. Clerk |

| | |
|---|---|
| Shri P Kumar | Sr. Clerk |
| Shri Samal Kumar | Sr. Clerk |
| Shri KP Kashi | Jr. Clerk |

## Admin. Section - II

| | |
|---|---|
| Shri KN Sinha | AAO & DDO |
| Shri Md. Mobark | Assistant |
| Shri W Guria | Assistant |
| Shri N Gope | Sr. Clerk |
| Shri B Sahu | Sr. Clerk (Cashier) |
| Shri AK Tripathi | Sr. Clerk |
| Shri RK Toppo | Sr. Clerk |

## Admin. Section – III

| | |
|---|---|
| Shri KK Prasad, T-6 | In-charge (Pur. & Store) |
| Shri Rabishankar | Assistant |
| Shri Thibu Minz | Assistant |
| Shri BN Gope | Sr. Clerk |

## Finance & Accounts Section

| | |
|---|---|
| Shri Budhan Ram | Acting F & A O |
| Shri V Ram | Assistant |
| Shri A Pandey | Sr. Clerk |
| Shri SC Lal | Sr. Clerk |
| Shri K Oraon | Sr. Clerk |
| Shri A Gope | Sr. Clerk |

## Transport

| | |
|---|---|
| Shri J Tiwari, T-2 | Driver |
| Shri A Kumar, T-2 | Driver |
| Shri M Singh, T-2 | Driver |
| Shri RK Yadav, T-2 | Driver |

## Promotions

| Name | Promoted to | w.e.f. |
|---|---|---|
| Dr. N Prasad, Sc. | Sr.Sc. | 21.1.2006 |
| Shri AK Sinha | T-5 | 1.1.2005 |
| Shri BP Ghosh | T-5 | 1.1.2005 |
| Shri C Pandey | T-5 | 1.1.2005 |
| Shri DK Singh | T-5 | 1.1.2005 |
| Shri KP Gupta | T-5 | 1.1.2005 |
| Shri RL Ram | T-5 | 1.1.2005 |
| Shri RP Shrivastava | T-5 | 1.1.2005 |
| Shri P Devi | T-4 | 3.2.2005 |
| Shri RK Swansi | T-4 | 3.2.2005 |
| Shri DW Runda | T-4 | 1.7.2005 |
| Shri SB Azad | T-4 | 1.7.2005 |

## Up-gradation under ACP

Shri Anant Pandey, Sr. Clerk in the scale of Rs. 5,500-9,000/

## Transfers to the Institute

1. Dr. AK Singh, PS (Plant Pathology) joined on 2.9.06 on transfer basis from ICAR NEH Research Complex, Barapani.
2. Shri Binod Kumar, T-4 (Lib. Asstt.) joined on 31.7.06 on transfer basis from CIPHET, Ludhiana.

## Transfers from the Institute

1. Dr. SK Yadav, Sc. (SS) technically resigned from ICAR Service and relieved from ILRI on 24.06.06.
2. Shri Devesh Nigam, F & A O, relieved from ILRI on 9.11.06 to join his new assignment on *lien* as Dy. Registrar, at LNIPE, Gwalior.

## Retirements

1. Shri C Pandey, TO on 30.04.06
2. Shri Radha Singh, Sc. (SG) on 30.1106

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# 12. संस्थान राजभाषा प्रकोष्ठ की गतिविधियाँ

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

संस्थान 'क' क्षेत्र में है, इसे राजभाषा अधिनियम की धारा 10(4) के अन्तर्गत केन्द्रीय गजट में प्रकाशित किया जा चुका है। संस्थान के चार अनुभागों को शत प्रतिशत कार्य हिन्दी में करने हेतु विनिर्दिष्ट किया गया है, एवं सभी को अपना-अपना कार्य हिन्दी में करने हेतु व्यक्तिशः निर्देश दिया गया है। राजभाषा नियम के प्रावधानों के अनुपालन एवं दैनिक कार्य में हिन्दी के प्रयोग में प्रगति लाने तथा इसे सर्वग्राह्य बनाने के लिए राजभाषा प्रकोष्ठ द्वारा निम्नलिखित कार्य सम्पादित होते हैं:-

राजभाषा कार्यान्वयन समिति की तिमाही बैठकों का आयोजन, कार्यसूची एवं कार्यवृत की तैयारी तथा बैठकों में लिए गये निर्णयों पर अनुवर्ती कार्रवाई। वार्षिक रिपोर्ट का सारांश, कार्यालय आदेश, परिपत्र, ज्ञापन, निविदा, सूचना एवं पत्राचार हेतु विभिन्न सामग्रियों का अनुदान। हिन्दीतर अधिकारियों और कर्मचारियों को हिन्दी शिक्षण योजना द्वारा आयोजित प्रशिक्षण एवं नगर राजभाषा कार्यान्वयन समिति के सदस्य कार्यालयों द्वारा आयोजित विभिन्न हिन्दी प्रतियोगिताओं एवं कार्यशालाओं में सहभागिता हेतु प्रेरित करना।

## समारोहों का आयोजन

### स्वतंत्रता दिवस समारोह

15 अगस्त 2006 को स्वतंत्रता दिवस का आयोजन हर्षोल्लास के साथ किया गया। संस्थान के निदेशक डॉ. बंगाली बाबू ने झंडोत्तोलन किया। इस अवसर पर संस्थान के वैज्ञानिक, तकनीकी एवं प्रशासनिक वर्ग के अधिकारी एवं कर्मचारीगण सपरिवार उपस्थित हुए।

डॉ. बंगाली बाबू ने कहा कि भारतीय इतिहास में 15 अगस्त 1947 स्वर्णाक्षरों में अंकित एक महत्वपूर्ण दिवस है। इसी दिन देश स्वतंत्र हुआ, अतः इस ऐतिहासिक तिथि को अविस्मरणीय बनाये रखने के लिए सम्पूर्ण देश में स्वतंत्रता दिवस मनाया जाता है। वर्तमान परिप्रेक्ष्य में उन्होंने भारत ही नहीं दुनियाँ के अन्य देशों में बढ़ती हिंसा और आतंकवादी क्रिया-कलापों पर चिन्ता प्रकट करते हुए इनका डट कर सामना करने एवं अपने-अपने कार्य को पूर्ण मनायोग से करने की अपील करते हुए कहा कि इस तिथि को राष्ट्रीय त्योहार के रूप में ही नहीं अपितु संकल्प दिवस के रूप में मनाया जाना चाहिए ताकि अगले वर्ष तक हम अपने संस्थान एवं देश को और आगे ले जाने में सक्षम हो पायें।

गत वर्ष की उपलब्धियों की संक्षिप्त चर्चा करते हुए उन्होंने कहा कि संस्थान की गुणवत्ता नियंत्रण प्रयोगशाला को इस वर्ष बी.आई.एस. द्वारा आई.एस.ओ. 9001 का प्रमाण पत्र प्राप्त हुआ है, जिससे संस्थान की गरिमा में और वृद्धि हुई है। संस्थान के कीट विज्ञान विभाग के बहुत पुराने भवन का जीर्णोधार करवाकर उसमें पुस्तकालय अनुभाग एवं राजभाषा प्रकोष्ठ को स्थानांतरित किया गया है जिससे पुस्तकालय में पुस्तकों के उचित रखरखाव में सुविधा हो सकेगी। भारतीय कृषि अनुसंधान परिषद् के अनुसंधान संस्थानों में से सर्वश्रेष्ठ संस्थान पुरस्कार हेतु संस्थान प्रयासरत् है और आशा है कि दृढ़ संकल्प से कार्य करते रहने से यह पुरस्कार हमें आगामी वर्ष तक अवश्य प्राप्त हो सकेगा। उन्होंने गुजरात में बहुतायत मात्रा में पाये जाने वाले पौधे गंदा बावल पर लाख की खेती का एक नया कार्यक्रम चलाये जाने एवं उसमें प्रारंभिक सफलता सबंधी सूचना दी तथा संस्थान द्वारा किये गये प्रयासों एवं परिणामों पर प्रकाश डाला और उन्होंने ऐसे कार्य करने पर बल दिया ताकि सम्पूर्ण संस्थान को बी.आई.एस. द्वारा आई.एस.ओ. 9001 का प्रमाण पत्र मिल सके। इस अवसर पर अधिकारियों एवं कर्मचारियों के परिजनों के लिए विभिन्न खेल एवं अंताक्षरी प्रतियोगिताओं का आयोजन कर पुरस्कार वितरण किये गये।

*डॉ. बंगाली बाबू, निदेशक, झण्डोत्तोलन करते हुए*

### सांप्रदायिक सद्भावना पखवाड़ा

संस्थान द्वारा 20 अगस्त से 5 सितंबर, 2006 तक सांप्रदायिक सद्भावना पखवाड़ा आयोजित किया गया।

डॉ. बंगाली बाबू ने संस्थान के वैज्ञानिकों, तकनीकी एवं प्रशासनिक वर्ग के अधिकारियों एवं कर्मचारियों को सद्भावना-शपथ दिलाई और कहा कि इस कार्यक्रम का उद्देश्य देश के सभी क्षेत्रों, धर्मावलंबियों एवं भाषा-भाषी व्यक्तियों के बीच बिना भेद-भाव के राष्ट्रीय एकता एवं साम्प्रदायिक सद्भावना को बढ़ावा देना तथा हिंसा से दूर रहना है। उन्होंने कहा कि आज भारत ही नहीं अपितु दुनियाँ के अन्य देशों में हिंसा और आतंकवादी क्रिया-कलाप बढ़ रहे हैं, हम सब को मिल कर इनका मुहतोड़ जबाब देना है एवं देश हित के लिए पूर्ण मनायोग एवं सतत् प्रयास से एक अच्छा माहौल तैयार करना है। इस कार्य हेतु हम सभी की अपने-अपने स्तंर से बराबर की भागीदारी होनी चाहिए। इसके लिए एक दूसरे की उन्नति एवं समानाधिकार के लिए सतत् प्रत्यनशील रहने की आवश्यकता है। आपसी सौहार्द्र एवं एकजूट हो कर कार्य करने से ही हम अपने संस्थान एवं देश को और आगे ले जाने में सक्षम हो पायेंगे।

### हिन्दी दिवस समारोह

संस्थान में 14 सितंबर 2006 को हिन्दी पखवाड़ा समापन एवं हिन्दी दिवस समारोह का आयोजन किया गया। मुख्य अतिथि, राँची दूरदर्शन के केन्द्र निदेशक श्री विमल चन्द्र गुप्त ने राजभाषा हिन्दी की विशाल क्षमता का परिचय देते हुए कहा कि हम हिन्दुस्तानी हो कर भी हिन्दी दिवस मना रहे हैं, यह एक विरोधाभाष है। इसके लिए आत्मचिंतन की आवश्यकता है। हिन्दी विश्व में सबसे अधिक बोली जाने वाली भाषा है। यह हमारे समाज की अनेक बोलियों में विद्यमान है, हिन्दी आगे बढ़ रही है। साथ-साथ इसे विदेशों में भी उचित स्थान मिला है।

विशिष्ट अतिथि, राँची विश्वविद्यालय के हिन्दी स्नातकोत्तर विभाग के अध्यक्ष डॉ. रवि भूषण ने कहा कि भाषा व्यक्ति को व्यक्ति से, राष्ट्र को राष्ट्र से, क्षेत्र को क्षेत्र से व समाज को समाज से जोड़ने का कार्य करती है। हिन्दी भाषा बहुत सारी भाषाओं को अपने में समाहित किए हुए है। 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 कार्यकारी निदेशक डॉ. अजय भट्टाचार्य ने अपने स्वागत भाषण में कहा कि हिन्दी हमारी राष्ट्र एवं राजभाषा होने 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 पर हिन्दी की प्रगति के लिए उन्होंने आत्म चिंतन करने और दिनानुदिन संस्थान के कार्य में हिन्दी के प्रयोग को बढ़ाने की अपील की।


*श्री विमल चन्द्र गुप्त, केन्द्र निदेशक, राँची दूरदर्शन द्वारा सम्बोधन*

श्री लक्ष्मी कान्त, सहायक निदेशक (रा.भा.) ने हिन्दी का प्रगति प्रतिवेदन प्रस्तुत करते हुए 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 बढ़ावा 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 टिप्पण, प्रारूप लेखन, निबंध, अंताक्षरी, पर्याय, एवं हिन्दी सुलेख प्रतियोगिताओं का आयोजन किया गया, जिसमें सर्वश्री विनोद कुमार, रंजय कुमार सिंह, मुहम्मद फहिम अंसारी, बिहारी साहु एवं कवल किशोर प्रसाद को प्रथम एवं सर्वश्री रघुनाथ महतो, प्रहलाद सिंह, मुन्ना लाल रविदास, शरत चन्द्र लाल को द्वितीय तथा अरूण कुमार त्रिपाठी, अनिल कुमार सिन्हा एवं मदन मोहन को तृतीय पुरस्कार प्रदान किये गये। हिन्दी अन्ताक्षरी प्रतियोगिता के विजयी दल के नौ प्रतिभागियों को भी पारितोषिक दिया गया।

भारतीय कृषि अनुसंधान परिषद् नई दिल्ली के प्रकाशनों 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 डॉ. कन्हैया प्रसाद साव, प्रधान वैज्ञानिक ने किया।

## अन्य गतिविधियाँ

### सतर्कता जागरूकता सप्ताह

संस्थान में दिनांक 6.11.2006 से 10.11.2006 तक सतर्कता जागरूकता सप्ताह का आयोजन किया गया। 6.11.2006 को शपथ ग्रहण के साथ सप्ताह का प्रारंभ हुआ एवं दिनांक 10.11.2006 का डॉ. बंगाली बाबू, निदेशक की अध्यक्षता में सतर्कता जागरूकता

समापन समारोह का आयोजन किया गया। इस अवसर पर संस्थान के सभी विभागाध्यक्ष, प्रभारी अधिकारी, वैज्ञानिक, तकनीकी तथा प्रशासनिक वर्ग के अधिकारी एवं कर्मचारी उपस्थित थे।

समारोह के संयोजक एवं संस्थान के सहायक निदेशक (रा.भा.) श्री लक्ष्मीकान्त ने उपस्थित अधिकारियों/कर्मचारियों का स्वागत किया और इस आयोजन से जनजागृति की संभावनायें प्रकट की।

मुख्य अतिथि श्री विनय कुमार पाण्डेय, भारतीय पुलिस सेवा आरक्षी अधीक्षक, सतर्कता, राँची ने सतर्कता जागरूकता सप्ताह के आयोजन के औचित्य की चर्चा की और सरकारी

### प्रतियोगिता के विजयी प्रतिभागी

| प्रतियोगिता में स्थान | नाम | कार्यालय का नाम |
|---|---|---|
| प्रथम | श्री रमाकान्त सिंह | भारतीय लाख अनुसंधान संस्थान, नामकुम, राँची |
| द्वितीय (संयुक्त रूप से) | श्री प्रहलाद सिंह | भारतीय लाख अनुसंधान संस्थान, नामकुम, राँची |
| | श्री ललन कुमार | आकाशवाणी, रातु रोड, राँची |
| तृतीय | श्री आदर्श कुमार लाल | केन्द्रीय तसर अनुसंधान एवं प्रशिक्षण केन्द्र, नगड़ी, राँची |
| सांत्वना | श्री रंजित भट्टाचार्य | भारतीय सर्वेक्षण विभाग, राँची |

कर्मियों के उत्तरदायित्व एवं जागरूकता के संदर्भ में बोधगम्य भाषा में व्याख्यान दिया। भ्रष्टाचार के प्रति सजग रहने तथा उसे रोकने के लिए सतत् प्रयास करने की अपील की, क्योंकि भ्रष्टाचार देश के आर्थिक विकास, आंतरिक सुरक्षा, कमजोर वर्गों के उत्थान, एवं उनके लाभ के विपरीत होता है। भ्रष्टाचार के निवारण हेतु न्यायालयों, स्वंयसेवी संस्थायों, राष्ट्रीय सर्तकता आयोग, राज्य सतर्कता आयोग, केन्द्रीय अन्वेषण ब्यूरो, भ्रष्टाचार विरोधी विभाग (*एन्टी करपशन डिपार्टमेंट*), भ्रष्टाचार निरोधी नियम (*प्रिवेन्शन आफ करपशन एक्ट*) 1947/1988 प्रेस, दूरदर्शन, सूचना का अधिकार 2005 जैसे अभिकरणों से सम्पर्क करने की सलाह दी।

उन्होंने यह भी जानकारी दी कि व्यथित व्यक्ति (*एग्रिव्ड पर्सन*) को न्याय हेतु धारा 256 के अधीन सीधे उच्च न्यायालय तक गुहार लगाने का अधिकार प्राप्त है।

संस्थान के निदेशक डॉ बंगाली बाबू ने ईमानदारी और कर्तव्य-परायणता की महत्ता पर प्रकाश डालते हुए पुरातन अवधारणा 'पूत सपूत तो क्यों धन संचय, पूत कपूत तो क्यों धन संचय' को उद्धरित किया और धन अर्जन के लिए व्यर्थ ही अनर्थ करने से परहेज करने की सलाह दी। उन्होंने महामहिम राष्ट्रपति के संदेश को पढ़ा और आचरण नियम में वर्णित प्रावधानों के अधीन सरकारी कर्मचारियों को आचरण करने की अपील की। डॉ अंजेश कुमार, वरिष्ठ हिन्दी अनुवादक ने सभा संचालन किया एवं श्री अशोक मल्लिक, प्रशासनिक अधिकारी ने धन्यवाद ज्ञापन किया।

### नगर स्तर हिन्दी अन्ताक्षरी प्रतियोगिता

हिन्दी के प्रयोग को प्रोत्साहित करने के लिए समय-समय पर विभिन्न प्रकार की हिन्दी प्रतियोगिताओं का आयोजन किया गया। नगर राजभाषा कार्यान्वयन समिति के तत्वावधान में संस्थान में हिन्दी अन्ताक्षरी प्रतियोगिता का आयोजन किया गया। जिसमें मेकॉन लिमिटेड, मुख्य डाक महाध्यक्ष कार्यालय, दूरदर्शन केन्द्र, आकशवाणी, इस्पात अस्पताल राँची, भारतीय स्टेट बैंक आंचलिक कार्यालय, नाबार्ड, सेन्ट्रल बैंक ऑफ इंडिया क्षेत्रीय कार्यालय, सेन्ट्रल बैंक आफ इंडिया अपर बाजार शाखा, गार्डेन रीच शिप बिल्डर्स एण्ड इंजिनियर्स लि. प्लांट प्लाजा, युनाईटेड इंडिया ईश्योरंश कम्पनी लिमिटेड, भारतीय सर्वेक्षण विभाग, अखिल भारतीय मृदा एवं भूमि उपयोग सर्वेक्षण, कृषि एवं सहकारिता विभाग, जूलोजिकल सर्वे आफ इंडिया, आयकर विभाग, केन्द्रीय तसर अनुसंधान एवं प्रशिक्षण संस्थान, नगड़ी एवं महालेखाकार कार्यालय झारखण्ड सरकार के प्रतिभागियों ने हिस्सा लिया। कार्यक्रम संचालन डॉ. अंजेश कुमार एवं धन्यवाद ज्ञापन श्री लक्ष्मी कान्त, सहायक निदेशक (रा.भा.) ने किया।

### राष्ट्रीय सतर की हिन्दी कार्यशाला में आलेख प्रस्तुतीकरण

- श्री लक्ष्मी कान्त, सहायक (रा.भा.) ने दिनांक 5-6 सितंबर, 2006 को राष्ट्रीय पशु आनुवंशिकी संसाधन ब्यूरो करनाल द्वारा आयोजित राष्ट्रीय स्तर की हिन्दी कार्यशाला में 'राजभाषा हिन्दी के प्रचार-प्रसार में हिन्दी अनुभागों की प्रासंगिकता' विषय पर आलेख प्रस्तुत किया।
- डॉ. अंजेश कुमार, वरिष्ठ हिन्दी अनुवादक ने गोआ में 8-10 मई, 2007 को आयोजित हिन्दी सम्मेलन एवं राष्ट्रीय कार्यशाला में संस्थान का प्रतिनिधित्व किया एवं व्याख्यान दिया।

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