वार्षिक प्रतिवेदन
Annual Report
2007-08

INDIAN INSTITUTE OF NATURAL RESINS AND GUMS

(Formerly Indian Lac Research Institute)

Namkum, Ranchi - 834010 (Jharkhand)

भाकृअनुप
ICAR

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Annual Report
2007-08

भा.प्रा.रा.गो.सं. IINRG

भारतीय प्राकृतिक राल एवं गोंद संस्थान
INDIAN INSTITUTE OF NATURAL RESINS AND GUMS
(भारतीय कृषि अनुसंधान परिषद्)
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
नामकुम, राँची- 834 010, झारखण्ड, भारत
Namkum, Ranchi- 834 010, Jharkhand, INDIA

ISSN : 0974-2999

Published by

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Indian Institute of Natural Resins and Gums
Namkum, Ranchi - 834 010 (Jharkhand)

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Design & Layout

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Photographs

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Hindi Translation

Dr. Anjesh Kumar

Correct Citation

IINRG Ann. Rep. 2007- 08
Indian Institute of Natural Resins and Gums
Namkum, Ranchi - 834 010 (Jharkhand)

Front Cover

Ber plantlet after root initiation in MS medium with growth hormone, Rosin, Karaya gum tree, Gum karaya, Pilot plant of aleuritic acid

Back Cover

Lac crop on ber, Administrative building of the Institute

Printed at

National Printers
Namkum Industrial Area, Ranchi, Jharkhand
Phone: 0651-2261902, 22619491
E-mail: nppranchi@yahoo.com

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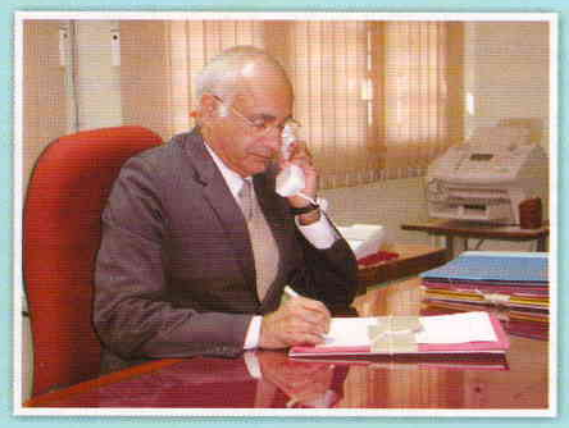


PREFACE

The year 2007- 08 was historical for expanding the Institute mandate under a new name of Indian Institute of Natural Resins and Gums from Indian Lac Research Institute (since its inception on September 20, 1924). While the research programme on lac would continue as it was, the added mandate would address processing and value addition of natural resins and gums. Keeping in view the upgradation of the Institute the core programmes were re-organized, research projects re-structured and re-grouped for effective interaction and output of scientific groups. The Institute contributed significantly for the overall development of lac production, processing and product development technologies and capacity building through various training programmes. The infrastructure development and resource generation of the Institute was also commendable. The first annual report of the upgraded and newly named Institute presents a glimpse of Institute research efforts and results.

Lac Production

Ten lac insect stocks collected from various parts of the country were characterized based on their productivity-linked attributes and three new lac insect collections from West Bengal and Orissa added to Field Gene Bank. ISSR-based molecular diversity analysis of 21 lac insect lines of Kerria spp. revealed significant genetic variation which can be used for molecular characterization and documentation of lac insect biodiversity. The Institute holds 97 collections of 47 species of potential lac hosts. The National Bureau of Plant Genetic Resources, New Delhi has designated the Institute as National Active Germplasm Site for Lac Hosts. The germplasm collection was dedicated to the country by Dr Mangala Rai, Director General, ICAR. National Lac Insect Field Gene Bank of Indian Institute of Natural Resins and Gums, Ranchi was also dedicated to the Nation with the declaration of the Institute as the National Lac Insect Germplasm Centre by Dr Mangala Rai, Director General, ICAR and Secretaty DARE. Nine each of ISSR and RAPD primers have been selected for the molecular characterization of ber germplasm. Superior genotype selections of Flemingia semialata and Albizia lucida plants have been raised in the field for evaluation. Twenty-five varieties of ber (Z. mauritiana) were planted in the field for evaluation of their lac potential. Soil fertility management studies were taken for promoting shoot growth and superior lac crop performance. Lime application resulted in better shoot growth and reduced lac insect mortality. Whereas phosphorus application increased the initial mortality of lac insect and application of potassium has improved the settlement density of lac insect. A concept project on lac production in high density ber plantation, sponsored by NABARD has been taken up.

Processing and Product Development

Bioactive compounds viz.,10-Carboxymethyl-2-decenoic acid (CMDA) and Methyl 9-methylsulphonyloxy-2-nonenoate, synthesized from aleuritic acid were found to enhance better shoot

emergence and early shoot initiation in pointed gourd (Parwal). In vitro evaluation of methyl 16-hydroxy-(E)-9-hexadecenoate, synthesized from aleuritic acid displayed considerable degree of toxicity against 2nd stage juvenile of root-knot nematode, Meloidogyne incognita infesting brinjal. Bioactive compounds (Z)-9-Hexadecenal, (Z)-9-hexadecenylacetate, (Z)-9-tetradecenyl acetate , (Z)-7-dodecenyl acetate and 16-acetoxy-(E)-9-hexadecenoic acid synthesized from aleuritic acid, have shown good sex pheromone activity against brinjal and tomato fruit borers. Jute reinforced sheets were prepared with shellac containing sheet moulding compound using jute material and fibre glass. Good mechanical properties were obtained by selecting the composition and thickness. The sheets can be applied as partition wall, door panel, window panel, ceiling and similar applications in place of particle and plywood boards. Comparative studies on drying characteristics of seedlac revealed that drying of seedlac becomes faster as drying temperature increases from 40°C to 50°C. Storage loss assessment studies revealed that the lowest hot and cold alcohol insolubles (%), the highest flow (mm), the lowest colour index, the highest heat polymerization time (min) and the highest rate of filtration (ml) was found in seedlac samples stored by spreading on cemented floor. A trial run on commercially viable pilot plant of lac dye was carried out with two batches of kusmi and one batch of rangeeni sticklac. The heavy metals such as nickel, mercury, iron, magnesium, arsenic and lead content of the dye were estimated. Except iron and lead, rest of the metals remained below detection limit. The lead content was well within the prescribed limit of 10 ppm for edible grade natural dyes. The low temperature crystallization unit of the plant has been tested for maintenance of low temperature and it is able to maintain temperature in the range of 6-8°C.

Transfer of Technology

Immense training programmes organized on and off campus for the farmers, housewives, extension cadre, NGO staff, students, entrepreneurs etc and more than ten thousand persons besides many more through orientation programmes from Jharkhand, Chhattisgarh, Orissa, Madhya Pradesh, West Bengal, Andhra Pradesh, Gujarat and Maharashtra states have been benefited under the various training activities conducted by the Institute. Ten lac based product technologies were transferred to entrepreneurs from Mumbai, Kolkata, Sikohabad, Raipur and Wardha. An exhaustive survey were carried out on lac production, marketing and processing by evolving separate schedules / questionnaires for collection of lac related information and data. The estimated national production of sticklac during 2007-08 was approximately 20,640 tons and 29,800 tons of sticklac were processed during 2006-07, which also included the amount of imported lac in India amounting to 7,366 tons. West Bengal ranked 1st (40.77 %) in processing of lac followed by Chhattisgarh (32.55 %), Jharkhand (21.31 %) and Maharashtra (5.37 %). The total export of lac and its value added products during the year 2006-07 was 7,525.46 tons valued Rs.147.72 crores. The total import of different kind of lac during the year 2006-07 was 7,365.64 tons valued Rs.56.51 crores. For the management of two key lepidopteran lac insect predators viz., Eublemma amabilis and Pseudohypatopa pulverea on lac crop, some IPM based newer chemical insecticides viz., fipronil, lambdacyhalothrin, indoxacarb, carbosulfan and spinosad and one Bt formulation (Halt) of indigenous origin were identified as promising pesticides which are safe to lac insect and found effective in reducing the incidence of lac insect predators. Laboratory bioassay studies of insecticides revealed that the pentatomid bug, Cyclopelta obscura causing damage to lac host palas can be effectively managed by the application of carbosulfan, lambdacyhalothrin, alphamethrin and ethofenprox. Linkages have been established with several Government and Non-Governmental Organizations in the states of Jharkhand, West Bengal, Maharashtra, Madhya Pradesh, Orissa and Chhattisgarh.

Infrastructure Development

A pilot plant of aleuritic acid (capacity:2 kg/batch) was erected. Installation of purification plant for the lac dye has been completed after installation of the filtration unit. A 3.5 acres farm was developed for raising natural gum yielding plants and plants of Acacia senegal, Acacia nilotica and Sterculia urens have been planted. The storage capacity of rain water pond was increased by further deepening. Organic chemistry Laboratories No. 1 and 2 situated in the divisional building and an old laboratory in Processing and Demonstration Unit were renovated. 256 Kbps broadband Internet connectivity from BSNL was established in Processing and Demonstration Unit.

I would like to express my gratitude to Dr. Mangala Rai, Director General, ICAR and Secretary, Department of Agricultural Research and Education, Dr. Nawab Ali, DDG (Engg.) and Dr. Pitam Chandra, ADG (PE) for their guidance and support. I am also thankful to the Chairman and members of various committees especially the Research Advisory Committee, chaired by Dr. N.S.L. Srivastava, Joint Director, Sardar Patel Renewable Energy Research Institute, Gujarat, Institute Research Committee, Project Monitoring and Evaluation Committee in their efforts in reviewing and suggesting new initiatives in research and their monitoring, evaluation and refinement. Sincere efforts in compiling, editing and timely bringing out this report by Dr. J.P. Singh, Sr. Scientist are thankfully acknowledged. The cooperation extended by the scientific, technical, administrative and supporting staff of the Institute for all that Institute was able to achieve during the year is duly acknowledged.

Bangali Baboo

(Bangali Baboo)

Dircetor

The mandate of the Indian Institute of Natural Resins and Gums

- **To plan conduct and promote researches on lac production technologies.**
- **To conduct basic and applied researches on processing natural resins (including lac), natural gums and gum-resins for farmers and industries.**
- **To develop value added products of commercial use from natural resins, gums and gum-resins, leading to pilot plant demonstration.**
- **To act as repository and provider of information on lac production and processing, product development, utilization of all natural resins, gums and gum-resins.**
- **To transfer the technologies to farmers, entrepreneurs and processors.**

कार्यकारी सारांश

1. कीट सुधार

लाख कीट जनन द्रव्य का संग्रह एवं मूल्यांकन

- लाख कीटों की उपलब्धता एवं लाख की खेती की स्थिति का पता लगाने के लिए पश्चिम बंगाल के तीन जिलों पुरुलिया, बांकुरा एवं मिदनापुर तथा उड़ीसा के बालेश्वर जिला के कुछ चुने हुए स्थानों का सर्वे किया गया । संग्रह किये गए तीन कीटों को जनन द्रव्य संग्रह में शामिल किया गया। दौरा किये गए सभी स्थानों में लाख कीट देखा गया परन्तु उसकी उपस्थिति के घनत्व में अलग-अलग स्थानों में अन्तर पाया गया। बांकुरा एवं पुरुलिया जिले के कुछ स्थानों पर पलास की अच्छी संख्या उपलब्ध थी। सभी तीन महत्वपूर्ण परिपालक जैसे कुसुम, पलास एवं बेर पुरुलिया में बहुतायत में उपलब्ध है तथा बांकुरा में काफी संख्या में पलास तथा कुछ बेर के वृक्ष है, जबकि मिदनापुर में रेन ट्री ज्यादा है। पुरुलिया के अतिरिक्त अन्य दो जिलों में लाख की खेती नाममात्र की है । हालांकि मिदनापुर जिले में रेन ट्री के उपर काफी संख्या में लाख कीट उपलब्ध थे लेकिन स्थानीय लोग लाख की व्यवस्थित खेती से अनभिज्ञ थे ।
- *फ्लेमेंजिया मैक्रोफाइला* पर पाले गए दस लाख कीट संचयनों (स्टॉकों) के चार पीढ़ियों से ज्यादा का मूल्यांकन किया गया एवं इन लाख कीट संचयनों (स्टॉकों) के स्थापन का प्रारम्भिक घनत्व, प्रारम्भिक मरणशीलता, नर अनुपात, फसल परिपक्वता के समय घनत्व, कोशिका का आकार, कोशिका का वजन, राल का उत्पादन एवं जनन क्षमता जैसे उत्पादकता से जुड़े गुणों के आधार पर अभिलक्षण विवरण तैयार किया गया ।

लाख कीट जनन द्रव्य का संरक्षण

- लाख कीट के 64 किस्मों के 1000 से ज्यादा लाख संवर्धो, जिसमें 14 कृषि जनित, 27 प्राकृतिक आबादी, 22 संकर/अन्तः प्रजात/चयनित, एक विदेशज एवं छः गैर संहितावद्ध किस्में शामिल है, का फिल्ड जीन बैंक में गमले में लगे *फ्लेमेंजिया मैक्रोफाइला* पर रख रखाव किया जा रहा है। *केरिया* प्रजाति के विशेष उल्लेख के साथ लाख कीटों का अंकन विकसित किया गया है ।

लाख कीटों का आण्विक लक्षण निर्धारण

- लाख कीटों की आइ.एस.एस.आर. आधारित आण्विक विभिन्नता के विश्लेषण में उपयोग के लिए आर.ए.पी.डी. चिन्हकों का उपयोग कर लाख कीटों का आण्विक लक्षण विवरण तैयार किया गया। आइ. एस.एस.आर. आधारित 21 लाख कीट वंशों के आण्विक विभिन्नता विश्लेषण से वंशों में महत्वपूर्ण आनुवंशिक अन्तर का पता चला है जिसे लाख कीट जैव विविधता के आण्विक लक्षण विवरण एवं प्रलेखीकरण में उपयोग किया जा सकता है ।

लाख कीट-परिपालक पौधा पारस्परिक किया

- लाख की अधिक उपज के लिए अत्यधिक महत्वपूर्ण उत्पादकता से जुड़े गुणों (परिपालक अनुकूलता सूचकांक) पर आधारित पाँच महत्वपूर्ण लाख परिपालकों जैसे *एकेशिया ऑरिकुलीफॉर्मिस, अल्बीजीया ल्यूसीडा, ब्यूटिया मोनोस्पर्मा, श्लेईचेरा ओलिओसा* एवं *जीजीफस मॉरिसीयाना* पर कुसमी एवं रंगीनी प्रजाति के लाख कीटों, *केरिया लैका* के आर्थिक गुणों के लिए कीट परिपालक पारस्परिक किया का विस्तृत अध्ययन किया गया। *बी. मोनोस्पर्मा* सबसे ज्यादा उपयुक्त पाया गया एवं *ए. ऑरिकुलीफॉर्मिस,* रंगीनी प्रजाति के ग्रीष्मकालीन (बैसाखी) फसल के लिए कम उपयुक्त पाया गया। जेड. *मॉरिसीयाना* पर लाख का अधिकतम उत्पादन हुआ तथा वर्षा ऋतु की फसल (कतकी) के दौरान *ए. ल्यूसीडा* पर उत्पादन कम हुआ। कुसमी प्रजाति के लिए *एस. ओलिओसा* परिपालक सर्वाधिक उपयुक्त

है एवं शरद ऋतु (अगहनी) एवं ग्रीष्म ऋतु (जेठवी) दोनों फसलों के लिए लाख कीट हेतु *एफ. सेमियालता* कम उपयुक्त परिपालक पौधा है।

- लाख कीट के साथ-साथ परिपालक पौधे का उत्पादन से जुड़े मानदंडों के अन्तर एवं आंतरिक विशिष्ट भिन्नता से पता चलता है कि लाख कीट की कुसमी प्रजाति रंगीनी से ज्यादा उत्पादक है। रंगीनी की तुलना में कुसमी प्रजाति की मादा कीट का प्रति ईकाई गंधराल उत्पादन लगभग दुगुना है । लाख कीट के विभिन्न आर्थिक गुणों पर परिपालक पौधों का विशेष प्रभाव पड़ता है । कुसमी की तुलना में रंगीनी प्रजाति का लिंग अनुपात बहुत अधिक है। उत्पादकता से जुड़े गुणों पर मौसम/पर्यावरण से जुड़े पहलूओं का महत्वपूर्ण प्रभाव पड़ता है । दोनों प्रजातियों में ग्रीष्म ऋतु की तुलना में शरद/वर्षा ऋतु के दौरान परिपालक पौधे ज्यादा उत्पादक होते हैं। राल रंजक अंश की दृष्टि से उत्पादित लाख की गुणवत्ता परिपालक पौधों से प्रभावित होती है तथा जब एक पीढ़ी के लिए लाख कीट को विभिन्न परिपालकों पर पाला जाता है तब रंगीनी की आयु, बहाव, द्रवणांक इत्यादि जैसे मानदंड प्रभावित नहीं होते हैं ।

प्रक्षेत्र में बेहतर प्रदर्शन के लिए रंगीनी लाख कीट का संग्रह, गुणण एवं मूल्यांकन

- रंगीनी लाख कीट के व्यापक प्रसार एवं मूल्यांकन हेतु संग्रह करने के लिए राजस्थान (अजमेर एवं पुष्कर) तथा जम्मु एवं साम्भा के विभिन्न स्थानों का फिल्ड सर्वे किया गया । अजमेर में *फाइकस रेलिजिओसा* (पीपल) एवं *एफ. लुसेन्स* (पाकुर) के कई वृक्षों पर लाख कीट का मध्यम प्रसार देखा गया । दो मुख्य परिपालक वृक्ष *बी. मोनोस्पर्मा* एवं *जेड. मॉरिसीयाना* जम्मु में बहुतायत में है, जहाँ बेर के ढेर सारे वृक्षों पर लाख कीटों का प्रसार देखा गया । बेर के वृक्ष से किरमिजी एवं पीले दोनों लाख कीटों का बीहनलाख एकत्र किया गया तथा गुणण एवं मूल्यांकन के लिए संस्थान लाया गया ।

कुसमी लाख कीट संचयनों का परिपालक विशेषता संबंधी जाँच

- ग्रीष्म ऋतु की फसल (जेठवी) की अवधि में गमले में लगाए गए सेमियालता एवं बेर तथा शरद ऋतु की फसल (अगहनी) के दौरान प्रक्षेत्र में पाँच कुसमी लाख कीटों के संचयनों का मूल्यांकन किया गया । बेर और सेमियालता पर कुसमी किस्मों के मूल्यांकन से पता चला कि कुसमी पछात बेर के लिए तथा कुसमी अगात सेमियालता के लिए सबसे ज्यादा उपयुक्त है । स्थापन का औसत घनत्व बेर पर 71 प्रति से.मी.^{2} (क्रम 65-77) एवं सेमियालता पर 85.2 प्रति से.मी.^{2} (क्रम 76-97) था। कुसमी किरमिजी अगात संचयन के स्थापन का घनत्व सबसे कम (बेर एवं सेमियालता पर क्रमशः 65 एवं 76 प्रति से.मी.^{2}) जबकि कुसमी किरमिजी पछात (97 प्रति से.मी.^{2}) का सेमियालता पर एवं कुसमी पीला (77 प्रति से.मी.^{2}) का बेर पर उच्चतम स्थापन रिकॉर्ड किया गया। सेमियालता पर कुसमी किरमिजी पछात की आरम्भिक मरणशीलता 12.7 प्रतिशत से 26.1 प्रतिशत रही जबकि बेर पर क्रमिक आकंड़े 24.4 प्रतिशत (कुसमी किरमिजी पछात) एवं 35 प्रतिशत (कुसमी पीला) रहे। सेमियालता की तुलना में बेर पर औसत मरणशीलता अधिक रही दोनों परिपालकों के पाँच संचयनों के लिंग अनुपात में भी बड़ा अन्तर देखा गया । सेमियालता पर औसत नर अनुपात 27.58 प्रतिशत एवं बेर पर 34.36 प्रतिशत था । यद्यपि दोनों परिपालकों पर संचयनों की कोशिकाओं के औसत आकार छोटे थे, बेर पर राल के स्राव की औसत मात्रा 26.1 प्रतिशत थी जो सेमियालता (क्रमशः 18. 36 एवं 14.56 मि.ग्रा. /मादा कोशिका) से उच्चतर थी ।

2. परिपालक सुधार

लाख परिपालक जैव विविधता का संग्रह एवं संरक्षण

- संस्थान में आशाजनक लाख परिपालकों विशेषकर पलास, कुसुम एवं बेर के 47 प्रजातियों का 97 संग्रह है। संस्थान में लाख परिपालकों के फिल्ड जीन बैंक को सुदृढ़ और व्यवस्थित किया जा रहा है ।देश में आशाजनक लाख परिपालक जैव विविधता के फिल्ड जीन बैंक की दीर्घावधि स्थापना के लिए एक मास्टर परियोजना विकसित की गई है ।इस पहल के एक भाग के रुप में वृक्ष, मध्यम एवं झाड़ीदार लाख परिपालक पौधों की 33 प्रजातियों एवं 16 जेनेरा को मिलाकर परिपालकों के संग्रह का एक फिल्ड प्लॉट

(0.5 हे.) स्थापित किया गया है । इस संग्रह में *फाईकस* की 6 प्रजातियां, *एकेशिया* और *अल्बीजीया* की चार-चार प्रजातियां, *फ्लेमेंजीया* एवं *जीजीफस* की तीन-तीन, *प्रोसोपिस* और *डलबर्जिया* की दो-दो के साथ *कैजेनस, क्रोटोन, डेस्मोडियम, गरुगा, पिथेकोलोबियम* एवं *पेल्टोफोरम* के एक-एक प्रजाति शामिल है। नये क्षेत्र में कुल मिलाकर विभिन्न कृषि जलवायु क्षेत्रों से एकत्र किये गए 33 प्रजातियों के 67 संग्रहों के पौधे लगाए गए हैं । राष्ट्रीय पौध आनुवंशिकी संसाधन ब्यूरो, नई दिल्ली ने संस्थान को लाख परिपालकों के लिए राष्ट्रीय सकिय जनन द्रव्य स्थल घोषित किया है ।

- गुजरात, महाराष्ट्र, मध्य प्रदेश, उड़ीसा एवं आन्ध्रप्रदेश में लाख परिपालकों के संग्रह के लिए विस्तृत सर्वे किया गया। उपलब्ध प्रौपग्यूल जैसे *श्लेईचेरा ओलिओसा, ब्यूटिया मोनोस्पर्मा, एकेशिया निलोटिका, प्रोसोपिस सिनेरेरिया, पेल्टोफोरम फेरुजेनियम* एवं *फाइकस* प्रजाति के नौ विभिन्न जैव प्रारुप, दो स्थानीय कृषकों से प्राप्त *कैजनस कजन* के बीज के साथ-साथ फल पैदा करने के लिए कुसुम परिवर्त के छोटे पौधों को एकत्र किया गया एवं स्थापन तथा मूल्यांकन के लिए संस्थान अनुसंधान प्रक्षेत्र में लगाया गया ।

लाख परिपालक जनन द्रव्य का अभिलक्षण वर्णन

- आण्विक उपागम के माध्यम से उपलब्ध बेर के जनन द्रव्य का अभिलक्षण वर्णन करने के उद्देश्य से सी. टी.ए.बी. पद्धति से 48 बेर के पौधे जिसमें 26 किस्म शामिल हैं, 4 प्रजाति एवं 5 भौगोलिक संग्रह से डी. एन.ए. निष्कर्षण किया गया एवं शुद्ध किया गया। आण्विक अभिलक्षण वर्णन के लिए आइ.एस.एस. आर. एवं आर.ए.पी.डी. प्रारम्भक की जाँच के लिए चार चयनित बेर पौधों के डी.एन.ए. का उपयोग किया गया । जाँच किये गए 25 आई.एस.एस.आर. एवं आर.ए.पी.डी. प्रारम्भकों में से प्रत्येक से नौ आई. एस.एस.आर. एवं आर.ए.पी.डी. प्रारम्भकों का आगे आण्विक विश्लेषण के लिए उपयोग किया जाएगा ।
- कुसुम एवं पलास जनन द्रव्य के आण्विक अभिलक्षण वर्णन के लिए तीन विभिन्न संलेखों की जाँच कर डी.एन.ए. निष्कर्षण एवं शुद्धिकरण को इष्टतम किया गया। दोनों परिपालकों के नये पत्तों से डोयल एवं डोयल उत्पादित सबसे अच्छी उपज का डी.एन.ए. से रुपान्तरित डी.एन.ए. निष्कर्षण संलेख अंगीकार किया गया । इस संलेख का कुसुम एवं पलास के संग्रहों डी.एन.ए. पृथ्यकरण कर भविष्य में आण्विक विश्लेषण के लिए उपयोग किया जाएगा ।

लाख उत्पादकता एवं गर्मी में इसे बरकरार रखने के लिए लाख परिपालक पौधों का मूल्यांकन एवं सुधार

- *फ्लेमेंजिया सेमियालता* पर ग्रीष्मकालीन लाख फसल को बनाए रखने एवं सुधार तथा मूल्यांकन के लिए प्रक्षेत्र में उगाए गए *एफ. सेमियालता* के उत्कृष्ट जीनी संरचनाओं के चयन के लिए एक चयन प्रयोग किया गया एवं उत्कृष्ट जीनी संरचनाओं वाले सेमियालता पौधो को मूल्यांकन हेतु फिल्ड में लगाया गया।
- लगातार उत्पादकता प्रदर्शित करने वाले गलवांग, *अल्बीजीया ल्यूसीडा* के चार जीनी संरचनाओं (एल. आर.जी. 501, एल.आर.जी. 502, एल.आर.जी. 508 एवं एल.आर.जी. 511) की पहचान की गई है एवं पत्ती संबंधी मानदंडों का अभिलक्षण वर्णन किया गया है । गलवांग के चार चयनित जीनी संरचनाओं में से प्रत्येक से पाँच पौधे तथा प्राकृतिक आबादी में से चुने गए पाँच पौधों को फिल्ड में लगाया गया । उच्च उत्पादकता एवं गर्मी में भी बरकरार रहने की क्षमता प्रदर्शित करने वाले पाँच अन्य जीनी संरचनाओं की हेसल, राँची में पहचान की गई है। संस्थान अनुसंधान प्रक्षेत्र में पूर्व में पहचान किये गए पौधों के साथ इन पौधों की गूंठी बांधी गई तथा इसे संस्थान अनुसंधान प्रक्षेत्र के अन्तर्गत दृढ़ बनाया जा रहा है।

उत्तक संवर्द्धन के माध्यम से कुसुम का कृन्तक (क्लोनल) प्रसार

- चूंकि कुसुम में लाख उत्पादकता की उल्लेखनीय विविधताएं हैं अत: कुसुम *(श्लेईचेरा ओलिओसा)* का उत्तम संवर्द्धन तकनीक से कृंतक प्रसार किया गया। प्रक्षेत्र से संग्रह किये गए एक्सप्लांट में सूक्ष्म जीवधारी संदूषण *इन विट्रो* परिस्थितियों में कुसुम के सहायक कोंपलों का संवर्द्धन स्थापित करने में एक प्रमुख समस्या है एवं इस जीवाणु संदूषण को *सिफोटैक्सिम* एवं *जेन्टामाइसिन* जैसे प्रतिजैविकों को मीडिया संपूरक के द्वारा संवर्द्ध को बिना नुकसान पहुँचाये कम किया

जा सकता है। *एक्सप्लांट* को प्रतिऑक्सीकारक मिश्रण घोल में डूबाने एवं एस्कॉर्बिक अम्ल तथा साइटिक अम्ल जैसे प्रतिऑक्सीकरण का माध्यम क्षतिपूर्ति भूरा होने की समस्या को कम करता है । कुसुम के अक्षीय कोंपल संवर्द्ध में कोंपल शिथिलता पर मौसमी प्रभाव एक प्रमुख समस्या है । विकल्प के रुप में गांठ के माध्यम से अप्रत्यक्ष अंगविकास कुसुम के गुणण के लिए बेहतर पाया गया । पौध पुनर्उत्पन्न मीडिया जिसमे साइटोकिनीन्स (6-बीएपी एवं कोइनेटिन) तथा सिल्वर नाइट्रेट है, के परिपक्व कुसुम पौधों से निकले *एक्सप्लांट* से कैली प्रोत्साहन संभव था, जिसे अंगविकास के लिए पुनर्उत्पन्न मीडिया पर सवंर्द्धित एवं द्विगुणित किया जा रहा है ।

3. फसल उत्पादन

लाख परिपालकों के लिए स्व-स्थाने नमी संरक्षण

- लाख परिपालक पौधों की शीघ्र वृद्धि एवं विकास के लिए मानसून के बाद की नमी को संरक्षित करने के उद्देश्य से बेर एवं कुसुम के मिश्रित बागान तैयार कर पाँच स्व-स्थाने नमी संरक्षण तरीकों का मूल्यांकन किया गया । कायिक वृद्धि एवं नमी संरक्षण की दृष्टि से अन्य उपचारों की तुलना में जमीन को घास/पत्तों से ढंकना, विशेष रुप से अर्द्धचन्द्राकार ढ़लान/अर्द्धाकार घेरा के परिणाम उल्लेखनीय रहे । घास/पत्तियों से ढ़ंकने, अर्द्धचन्द्राकार ढलान एवं क्यारी बनाना जैसे उपचार के अन्तर्गत लम्बाई की दृष्टि से बेहतर पौध वृद्धि देखी गई । जबकि कुसुम के पौध वृद्धि गुणों में विभिन्न नमी संरक्षण तरीकों के अपनाने से कोई उल्लेखनीय अन्तर नहीं देखा गया। इस व्यवस्था के अन्तर्गत उरद के अन्तर फसल से मिट्टी की स्थिति, मिट्टी के नमी की स्थिति, मिट्टी क्षरण में कमी में सुधार होगा तथा रोजगार सृजन के साथ-साथ किसानों को अतिरिक्त आय भी होगी ।

अल्वीजिया प्रोसेरा (सीरीस) पर कुसमी लाख खेती प्रौद्योगिकी

- लाख की खेती के लिए सीरीस पर छंटाई के प्रभाव का अध्ययन किया गया । लाख कीट के स्थापन की दृष्टि से 12 एवं 18 महीने पुराने प्ररोहों की तुलना मे छः माह पुराने प्ररोह उपयुक्त पाये गए ।

वाणिज्यिक लाख परिपालकों को प्रभावित करने वाली बिमारियां

- *जैन्थेमोनस बूटी* के कारण जुलाई-अगस्त के दौरान पत्तों पर धब्बे आ जाते हैं जो नवम्बर तक छिट-पुट बने रहते है। यह बिमारी झारखंड एवं पश्चिम बंगाल में दूर-दूर तक पायी जाती है तथा बड़े वृक्षों की तुलना में छोटी झाड़ियां बुरी तरह प्रभावित होती है । नवम्बर महीने में झारखंड राज्य के सिंहभूम जिले के बड़ाजामदा क्षेत्र में खेती की गई किस्म में *इरिसिफी जीजिफी* के कारण पावडरी मिल्डयू सामान्य रुप से गम्भीर रुप में पाया गया । इस रोग से पत्तियां एवं फल प्रभावित हुए । सामान्यतया लाख की खेती के लिए उपयोग में लाई जाने वाली जंगली किस्मों पर *कैप्नोडियम जीजिफी* के कारण काजल जैसे धूल में बृद्धि देखी गई । यह रोग जनवरी-फरवरी में प्रकट होता है एवं समय के साथ गम्भीर रुप से बढ़ जाता है तथा अप्रैल के महीने में काफी गम्भीर हो जाता है।

लाख की फसल पर काली फफूंदी का प्रबंधन

- मधु बूंद स्त्राव के कारण काजल जैसी धूल में वृद्धि लाख की खेती की एक समस्या है । व्यवस्थित अनुसंधानों से पता चलता है कि लाख कीटों के जमाव के पास चीटियों के जाने से लाख की खेती में काजल जैसी धूल में उल्लेखनीय कमी आती है ।

लाख उत्पादन के लिए बेर का मिट्टी उर्वरता प्रबंधन

- प्ररोह वृद्धि को गति देने तथा लाख की फसल के उत्कृष्ट उत्पादन के लिए मिट्टी उर्वरता प्रबंधन अध्ययन आरम्भ किया गया । चूना के प्रयोग के परिणामस्वरुप बेहतर प्ररोह वृद्धि एवं लाख कीट की मरणशीलता में कमी आई । फॉस्फोरस के प्रयोग में वृद्धि से लाख कीट में आरम्भिक मरणशीलता में वृद्धि हुई तथा पोटैसियम के प्रयोग से लाख कीट के स्थापन घनत्व में सुधार हुआ ।

लाख परिपालक बागान में खरपतवार प्रबंधन

- पलास, बेर, कुसुम, भालिया एवं सेमियालता के बागानों में कुल खरपतवारों में घास जैसे खरपतवार (72.07 प्रतिशत) की मात्रा सबसे अधिक पाई गई इसके बाद बड़े पत्ते (23.7 प्रतिशत) तथा दलदली

घास (4.76 प्रतिशत)पाये गये। लाख परिपालक बागानों के सभी अध्ययनों में *एगेरेटम कोनीजोआइडिस, ब्रैचिएरिया रिमोसा* एवं *इचिनोक्लोआ* जैसे खरपतवार प्रजाति सभी स्थानों पर सामान्य रुप से पाये गए । *एगेरेटम कोनीजोआइडिस* की संख्या (आर एफ) अपेक्षाकृत उच्चतम थी, जो *एफ. सेमियालता* (9.1 प्रतिशत) के बागान को छोड़कर सभी लाख बागानों में 24.9-64.2 प्रतिशत के बीच थी ।

- *एफ. सेमियालता* के प्रक्षेत्र में पौधा लगाने के 15 दिन पूर्व चयनित तथा अचयनीय तीन-तीन घासनासी का परीक्षण किया गया। पाराक्वेट का 0.4 कि.ग्रा. ए. आइ/हे. प्रयोग 62.1 प्रतिशत खरपतवार नियंत्रण क्षमता (डब्लूसीई) के साथ सर्वाधिक प्रभावी रहा तथा उसके बाद ग्लाइफोसिनेट एवं ग्लाईफोसेट का खरपतवार नियंत्रण क्षमता क्रमशः 55.2 प्रतिशत एवं 45.03 प्रतिशत पायी गयी ।

अधिक घनत्व वाले बेर के बागान में लाख उत्पादन

- *नाबार्ड* द्वारा प्रायोजित अधिक घनत्व वाले बेर के बागान में लाख उत्पादन पर एक विचार परियोजना आरम्भ की गई है । पौधों को लगाने के लगभग एक वर्ष बाद पौधों की ऊँचाई 1.9 मीटर तक हो गई । मिट्टी के संवर्द्धन, खरपतवार नियंत्रण एवं अतिरिक्त आय के लिए मटर और मूंगफली जैसे लेग्यूमिनेसी कुल की फसलें लगायी गयी ।

4. संश्लेषण एवं उत्पाद विकास

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

- भारतीय, चाइनीज, थाई, इन्डोनेशियाई चौरी एवं चपड़ा के विभिन्न भौतिक एवं रासायनिक गुणों के तुलनात्मक अध्ययन से भारतीय प्रजाति *केरिया लैका* से उत्पादित भारतीय लाख बहाव, ठंढे एवं गर्म अल्कोहल में अघुलनशीलता, रंग सूचकांक, ताप बहुलता समय, विरंजन सूचकांक एवं चिकनाई व चमक की दृष्टि से चीन, इन्डोनेशिया एवं थाईलैंड से प्राप्त लाख की तुलना में उत्कृष्ट पाया गया ।

एल्यूरिटिक अम्ल से जैव सक्रिय यौगिक

- 10-कार्बोक्सीमिथाइल-2-डिसीनोइक अम्ल (सीएमडीए) एवं मिथाइल 9-मिथाइलसल्फोनीलॉक्सी -2-नोनेनोएट जैसे पौध वृद्धि नियामकों का संश्लेषण किया गया एवं पाया गया कि इन यौगिकों से परवल में प्ररोहों का निकलना एवं उत्पत्ति में वृद्धि होती है ।
- एल्यूरिटिक अम्ल से संश्लेषित मिथाइल 16-हाइड्रॉक्सी-ई-9-हेक्साडेसेनोएट के *इन विट्रो* मूल्यांकन से बैगन के अल्प वयस्क मूल-गांठ सूत्रकृमि *(मिलाइडोगाइनी इनकॉगनिटा)* के उपर उल्लेखनीय स्तर का विषाणुता प्रदर्शित करता है ।
- (जेड)-9-हेक्साडेसेनल,(जेड)-9-हेक्साडेसोलाइलए सीटेट, (जेड)-9-टेटाडेसेनाइलएसिटेट, जेड)-7-डोडेसेनाइलएसिटेट एवं 16-एसिटॉक्सी-इ-9-हेक्साडेसेनोइक अम्ल का एल्यूरिटिक अम्ल से संश्लेषण किया गया जो बैगन एवं टमाटर फल छेदकों पर लिंग फिरोमोन सक्रियता का अच्छा प्रदर्शन करता है ।

5. सतह लेपन एवं उपयोग की विविधता

सतह लेपन सुत्रण

- कमरे के तापमान पर तरल माध्यम में चपड़ा को गंधराल में मिश्रित किया गया एवं चपड़ा तथा गंधराल के सांद्रण से अन्तरवाले विभिन्न समायोजन (चपड़ा एवं गंधराल के नियंत्रण सहित) विकसित किये गए चपड़ा को रोजीन से मिलाने के बाद ताप एवं जल प्रतिरोध, खरोंच कठोरता, लचीलापन जैसे सतहलेपन गुणों में कोई सुधार परिलक्षित नहीं होता है। लेकिन जब समायोजन को मेलामाइन फॉर्मलडिहाइड राल के साथ मिलाया गया तो यह देखा गया कि मिश्रित समायोजन, चपड़ा गंधराल मिश्रण के 50:50 तक ताप एवं जल प्रतिरोधक है ।

लाख आधारित जूट-फाइबर-कांच संबलित सीट

- जूट सामग्री, फाइबर ग्लास का उपयोग कर सीट का सांचा बनाने का यौगिक के साथ चपड़ा से जूट संबलित सीट तैयार किया गया। मोटाई एवं समायोजन के चयन से अच्छी यांत्रिक विशेषताएं प्राप्त की गई । इन सीटों को प्लाईबोर्ड एवं विभाजन बोर्ड के स्थान

पर विभाजन दीवार, दरवाजे का पैनल, छत एवं समान उपयोग में प्रयोग में लाया जा सकता है।

6. प्रसंस्करण एवं भंडारण

चौरी सूखाने का लक्षण वर्णन

- विभिन्न तापमान पर चौरी का शुस्कण उभार एवं अनुकूल तापमान के साथ मोटाई के विभिन्न स्तरों का अध्ययन किया गया । यह देखा गया कि तापमान में 40° सेंटीग्रेड से 50° सेंटिग्रेड़ वृद्धि से चौरी तेजी से सूखने लगता है। लेकिन 55° सेंटिग्रेड़ तापमान पर सुखना धीमा हो जाता है । ऐसा संभवत: 55° सेंटिग्रेड़ पर चौरी के नमूने में भारी जमाव के कारण होता है ।

भंडारण में होनेवाली क्षति का निर्धारण

- लाख व्यवसायियों एवं उद्योगों द्वारा यष्टिलाख, चौरी एवं चपड़ा के भंडारण के लिए व्यवहार में लाये जाने वाले तरीकों जैसे मिट्टी के फर्श पर फैलाना, सीमेन्ट की फर्श पर फैलाना, पटसन के बोरे में रखना, प्लास्टिक के बोरे में रखना, शीतल परिस्थियों में रखने का अनुकरण कर गुणवत्ता के मूल्यांकन के लिए अध्ययन आरम्भ किया गया है। तीन माह में भंडारण के पश्चात सीमेन्ट की फर्श पर फैला कर भंडारित किये गए नमूने में गर्म और ठंढे अल्कोहल में अघुलनशीलता न्यूनतम, वहाव उच्चतम (मि.मी.), रंग सूचकांक न्यूनतम, ताप बहुलकीकरण समय (मिनट) उच्चतम एवं छनन दर उच्चतम देखा गया ।

एल्यूरिटिक अम्ल का पाइलट संयत्र

- संस्थान के प्रसंस्करण एवं प्रदर्शन ईकाई में प्रशिक्षण तथा प्रदर्शन के लिए एल्यूरिटिक अम्ल का एक पाइलट संयत्र (क्षमता 2 कि.ग्राम प्रति बैच) स्थापित किया गया है ।

लाख रंजक का वाणिज्यिक रुप से उपयुक्त पाइलट संयत्र

- कुसमी के दो बैच तथा रंगीनी के एक बैच यष्टिलाख के साथ पाइलट संयत्र का एक परीक्षण प्रचालन किया गया तथा यष्टिलाख के वजन के 0.22 से 0.30% तक औसत प्राप्ति हुई। तकनीकी कोटि का रंजक अंस 68.5 से 71.0% के बीच, राख अंस 0.70% से 1.00% एवं द्रवणांक 230 से 238° से. के बीच पाया गया। रंजक के भारी धातु जैसे निकेल, पारा, लोहा, मैगनिसियम, आर्सेनिक एवं शीशा अंस का आकलन किया गया । लोहा और सीसा के अतिरिक्त सभी धातु अन्वेषण सीमा से कम थे। शीशा का अंस 10 पीपीएम की खाद्य कोटि प्राकृतिक रंग की निर्धारित सीमा के अन्तर्गत था ।
- छनन ईकाई की स्थापना के बाद लाख रंजक के शुद्धिकरण संयत्र की स्थापना पूरी हुई । संयंत्र का न्यून तापमान रवाकरण ईकाई का कम तापमान बनाए रखने के लिए परीक्षण किया गया एवं यह 6-8° सेंटिग्रेड़ तक तापमान बनाए रखने में सक्षम है ।

7. लाख उत्पादन, प्रसंस्करण एवं मूल्यवर्धन के क्षमता निर्माण के लिये मानव संसाधन विकास

प्रशिक्षण गतिविधियां

- संस्थान द्वारा किसानों एवं गृहिणियों के लिये एक दिवसीय अभिविन्यास कार्यक्रम, प्रक्षेत्र प्रशिक्षण, प्रक्षेत्र शिक्षण एवं प्रोत्साहन प्रशिक्षण, प्रशिक्षक प्रशिक्षण तथा प्रक्षेत्र स्तरीय प्रदर्शन जैसे नियमित प्रशिक्षण कार्यक्रम आयोजित किये गये । संस्थान द्वारा आयोजित किये गये विभिन्न प्रशिक्षण गतिविधियों से दस हजार से ज्यादा व्यक्तियों को लाभ हुआ।
- वैज्ञानिक तरीके से लाख का उत्पादन, प्रसंस्करण एवं उपयोग पर एक सप्ताह की अवधि का बत्तीस प्रशिक्षण पाठ्यक्रम आयोजित किये गये जिसमें 1186 किसान, प्रसारकर्मी एवं झारखंड, छतीसगढ़, उड़ीसा, मध्यप्रदेश, पश्चिम. बंगाल, आध्रप्रदेश एवं महाराष्ट्र के गैर सरकारी संगठनों के प्रतिनिधियों ने भाग लिया
- स्नातक कृषि के छात्रों के लिये पाँच शैक्षणिक कार्यक्रम एवं वैज्ञानिक तरीके से लाख उत्पादन, प्रसंस्करण एवं उपयोग पर कृषि प्रसार अधिकारियों के लिये एक सप्ताह की अवधि का दो प्रशिक्षक प्रशिक्षण कार्यक्रम आयोजित किया गया जिससे 130 लोग लाभान्वित हुये ।
- मुम्बई, कोलकाता, सिकोहाबाद, रायपुर एवं वर्धा के उद्यमियों को लाख आधारित दस प्रौद्योगिकी हस्तांतरित की गई ।
- झारखंड, छत्तीसगढ़, उड़ीसा, मध्यप्रदेश, गुजरात, आन्ध्रप्रदेश एवं महाराष्ट्र के किसानो गृहिणियों के

लिये 53 प्रक्षेत्र शिविर, 14 परिसर में अभिविन्यास कार्यक्रम आयोजित किये गये ।

गुजरात में लाख की खेती के लिये दक्षता विकास एवं क्षमता निर्माण

- गुजरात के डांग, बलसाड एवं केवडी क्षेत्रों में कुसमी लाख परिपालकों *जीजीफस मॉरिसीयाना* (बेर) एवं *प्रोसोपिस जूलीफ्लोरा* की भारी संख्या के साथ-साथ कुसुम के पौधो की अच्छी संख्या होने के कारण इसकी पहचान आशाजनक कुसमी लाख उत्पादक राज्य के रूप में की गई है । *जेड. मॉरिसीयाना* एवं *पी. जूलीफ्लोरा* पर प्रदर्शन के दौरान उच्च लाख उत्पादन रिकॉर्ड से राज्य में लाख की खेती की क्षमता सिद्ध हुई है। गुजरात राज्य के लिये एक विकास योजना विचारार्थ भेजी गई है ।

पुरस्कार

- डॉ. केवलकृष्ण शर्मा, वरिष्ठ वैज्ञानिक, लाख उत्पादन विभाग को प्रौद्योगिकी हस्तांतरण के क्षेत्र में उल्लेखनीय योगदान के लिये 29.31 जनवरी, 2007 को इलाहाबाद में आयोजित 9वें कृषि वैज्ञानिक एवं किसान काँग्रेस के दौरान बायोवेद रिसर्च सोसाइटी द्वारा बायोवेद फेलोसिप एवार्ड प्रदान किया गया ।

8. प्रौद्योगिकी निर्धारण, परिष्करण एवं प्रसार

लाख कीटों एवं परिपालक पौधों से जुड़े नाशकजीवों का पारिस्थितिकी के अनुकूल प्रबधंन

- लाख की फसल पर दो प्रमुख लेपिडाप्टेरन लाख परभक्षी कीट *यूब्लीमा एमाविलिस* एवं *श्यूडोहापोटोपा पल्वेरिया* के प्रबन्धन के लिये, लाख कीटों की रक्षा एवं लाख कीटों के परभक्षियों की विषाणुता के मूल्यांकन हेतु नौ आइ पी एम अनुशंसित नया रासायनिक कीटनाशी तथा एक *बैसिलस थूरिन्जिएन्सिस* आधारित स्वदेशी (हाल्ट) सूत्रण का मूल्याकंन किया गया । लाख कीटों की सुरक्षा की द्रष्टि से छरू रासायनिक कीटनाशी जैसे फिपरौनिल, लैम्डासाईहैलोथ्रीन, अल्फामेथ्रीन, इन्डोक्साकार्व, कार्बोसल्फान एवं स्पाईनोसैड तथा बीटी सुत्रण (हाल्ट) आशाजनक कीटनाशी पाये गये एवं लाख कीट परभक्षी की उपस्थिति को कम करने में प्रभावी पाया गया ।
- ग्यारह नये कीटनाशियों के प्रयोगशाला बायोएसे से पता चला है कि कार्बो सल्फान (0.02%), लैम्डासाईहैलोथ्रीन (0.007%), अल्फामेथ्रीन (0. 01%) एवं इथोफेनप्रॉक्स (0.02%) का उपचार सर्वाधिक प्रभावी है तथा इसके उपचार के 24 घंटे के अन्दर पलाश वृक्ष के नाशीजीव *साइक्लोपेल्टा* ऑव्सक्यूरा की शत प्रतिशत मरणशीलता होती है। जबकी इन्डोसल्फान (0.05%) एवं स्पाईनोसैड (0. 01%) के उपचार के 72 घटें बाद शत प्रतिशत मरणशीलता होती है।

9. संपर्क, सूचना एवं परामर्शी सेवाऐं

लाख उत्पादन, विपणन एवं प्रसंस्करण संबंधी सूचानाऐं

- लाख से जुड़ी सूचनाऐं एवं आकड़े एकत्र करने के लिये राष्ट्रीय स्तर पर प्रयास किया गया है । लाख बाजारों, व्यापारियों, निर्यातकों, आयातकों एवं प्रसंस्करण ईकाइयों के सर्वे के लिसे अलग अनुसूचीध्प्रश्नावली उपयोग में लाई गई । वर्ष 2007-08 में अनुमानित यष्टिलाख उत्पादन लगभग 20,640 टन था । वर्ष 2006-07 में कुल 29,800 टन यष्टिलाख का प्रसंस्करण किया गया जिसमें देश में आयात किया गया 7366 टन लाख भी शामिल है। लाख के प्रसंस्करण में पश्चिम बंगाल प्रथम (32. 55%), इसके बाद झारखंड (21.31%) तथा महाराष्ट्र (5.37%) राज्यों का स्थान रहा। वर्ष 2006-07 में लाख एवं इसके मूल्यवर्द्धित उत्पादों का कुल निर्यात 7525.46 टन रहा जिसका मूल्य रू. 147.72 करोड़ था । वर्ष 2006-07 के दौरान विभिन्न प्रकार के लाख का कुल आयात 7365.64 टन रहा जिसका मूल्य रू 56.51 करोड़ था ।

प्राकृतिक राल एवं गोंद संबंधी परामर्श सेवायें, संपर्क एवं सूचनाओं का सुदृढ़ीकरण

- झारखंड, पश्चिम बंगाल, महाराष्ट्र, मध्यप्रदेश, उड़ीसा एवं छत्तीसगढ़ के कई सरकारी एवं गैर.सरकारी संगठनों से संपर्क स्थापित किया गया।

EXECUTIVE SUMMARY

1. *Insect Improvement*

Collection and evaluation of lac insect germplasm

- A survey of selected places in three districts of West Bengal *viz.*, Purulia, Bankura and Midnapore and Balasore district of Orrisa were undertaken to know the availability of lac insects and status of lac cultivation. Three collections of lac insects were added to germplasm collection. Lac insects were observed in almost all the places visited but their frequency of occurrence varied from place to place. At some of the places in Bankura and Purulia districts good patches of *palas* were available. All the three major hosts *viz. kusum, palas* and *ber* were present in abundance in Purulia and plenty of *palas* and some *ber* trees were available in Bankura while in Midnapore *rain tree* out numbered. Except Purulia, cultivation of the lac was practically negligible in other two districts. Though lac insect was available in plenty on *rain trees* in Midnapore district but local people were not aware about systematic lac cultivation.
- Performance of ten lac insect stocks reared on *Flemingia macrophylla* were evaluated over four generations and these lac insect stocks have been characterized based on productivity linked attributes like initial density of settlement, initial mortality, male proportion, density at crop maturity, size of cell, weight of cell, resin output and fecundity.

Conservation of lac insect germplasm

- The Institute has been declared as *National Lac Insect Germplasm Centre*. More than 1000 lac cultures of 64 lines of lac insect which include 14 cultivated, 27 natural population, 22 cross bred /inbred/selected, one exotic and six un-coded lines are being maintained in the Field Gene Bank on potted plants of *Flemingia macrophylla*. Descriptors of lac insects with special reference to *Kerria* spp have been developed.

Molecular characterization of lac insects

- Molecular characterization of lac insects using RAPD markers were carried out for use of ISSR-based molecular diversity analysis in lac insects. ISSR-based molecular diversity analysis of 21 lac insect lines of *Kerria* spp has revealed significant genetic variation among the lines which can be used for molecular characterization and documentation of lac insect biodiversity.

Lac insect – host plant interaction

- Insect-host interactions for economic attributes were studied in detail for the *kusmi* and *rangeeni* strain of lac insect, *Kerria lacca* on five important lac hosts *viz.*, *Acacia auriculiformis, Albizia lucida, Butea monosperma, Schleichera oleosa* and *Zizyphus mauritiana* for improved lac yield based on most important productivity linked attributes (Host Suitability Index). *B. monosperma* was found to be the most suitable and *A. auriculiformis* was found to be the least suitable host during summer season (*baisakhi*) crop for *rangeeni* strain. Maximum yield of lac was obtained on *Z. mauritiana* and least on *A. lucida* during the rainy season *(katki)* crop. For *kusmi* strain, *S. oleosa* was more suited and *F. semialata* was least suited host plants to lac insect for both winter season *(aghani)* and summer season *(jethwi)* crop.
- Inter and intra specific variations in productivity linked parameters of lac insect *vis-à-vis* host plant have revealed that the *kusmi* strain of lac insect is more productive than *rangeeni*. Resin output by a single

female insect per unit of its size is almost double in *kusmi* strain than that of *rangeeni*. Host plants have pronounced effect on various economic attributes of the lac insect. Variation in sex ratio is much higher in *rangeeni* strain than *kusmi*. Productivity linked attributes are affected significantly by seasonal/environmental factors. Host plants are more productive during winter / rainy season in comparison to summer season for both the strains. Quality of lac produced in respect of resin and dye content is affected by the host plant and other quality parameters of resin like life, flow, melting point etc. are not affected when lac insect is reared on different hosts for one generation.

Collection and multiplication of rangeeni lac insect for superior field performance

- A field survey was undertaken in Rajasthan (Ajmer and Pushkar) and various places of district Jammu and Samba to collect the *rangeeni* lac insect populations for mass multiplication and evaluation. A number of *Ficus religiosa (pipal)* and few *F. luscence (pakur)* trees were found moderately infested with lac insects at Ajmer. Two major host plants namely *B. monosperma* and *Z. mauritiana* were abundant in and around the Jammu wherein many of *ber* trees were found heavily infested with lac insect. Broodlac of both crimson as well as yellow lac insects were collected from *ber* trees and brought to the Institute for multiplication and evaluation.

Host specific screening of kusmi lac insect stocks

- Five *kusmi* lac insect stocks were evaluated under potted conditions on *semialata* and *ber* during summer season *(jethwi)* crop and in the field during winter season *(aghani)* crop. Evalation of *kusmi* breeds on *ber* and *semialata* has indicated that *kusmi* late is most suitable for the *ber* and *kusmi* early for *semialata*. Average density of settlement was 71 / cm^2 (range 65-77) on *ber* and 85.2 / cm^2 (range 76-97) on *semialata*. *Kusmi* crimson early stock had the lowest density of settlement (65 and 76 / cm^2 on *ber* and *semialata,* respectively) while the highest was recorded for *kusmi* crimson late (97 / cm^2) on *semialata* and for *kusmi* yellow (77 / cm^2) on *ber*. Initial mortality ranged between 12.7 % (*kusmi* crimson late) to 26.1 % *(kulajanga)* on *semialata*, while the respective figures on *ber* were 24.4 % (*kusmi* crimson late) to 35.0 % (*kusmi* yellow). Average mortality was more on *ber* than on *semialata*. Sex ratio also showed wide variations among the five stocks on both the hosts. Average male proportion was 27.58 % on *semialata* and 34.36 % on *ber*. Though difference in average size of the cell among the stocks on both the hosts was small, average quantity of resin secreted on *ber* was 26.1 % higher than on *semialata* (18.36 and 14.56 mg/female/cell, respectively).

2. *Host Improvement*

Collection and conservation of lac host biodiversity

- The National Bureau of Plant Genetic Resources, New Delhi has designated the Institute as *National Active Germplasm Site for Lac Hosts*. The Institute holds 97 collections of 47 species of potential lac hosts especially *palas, kusum* and *ber*. The field gene bank of lac hosts at the Institute is being strengthened and systematized. A master plan has been developed for long-term establishment of field gene bank of potential lac host biodiversity in the country. As a part of this initiative, a field plot (0.5 ha) of collections of hosts has been established containing 16 genera and 33 species covering tree, medium and bushy type of lac host plants The collection include 6 species of *Ficus*, 4 species each of *Acacia* and *Albizia*, 3 each of *Flemingia* and *Zizyphus*, 2 each of *Prosopis* and *Dalbergia* along with each of *Cajanus, Croton, Desmodium, Garuga, Pithecolobium* and *Peltoforum*. Altogether 67 collections from different agro climatic regions for 33 species of lac hosts have been planted in the new area.
- Extensive surveys were undertaken covering Gujarat, Maharashtra, Madhya Pradesh,

Orissa and Andhra Pradesh for collection of lac hosts. Available propagules *viz., Schleichera oleosa, Butea monosperma, Acacia nilotica, Prosopis cineraria, Peltoforum ferrugenium* and nine different biotypes of *Ficus* species, seeds of two local cultivars of *Cajanus cajan* as well as saplings of *kusum* variants for fruit yielding have been collected and planted in Institute Research Farm for establishment and evaluation.

Molecular characterization of lac hosts germplasm

- With an objective to characterize the available *ber* germplasm through molecular approach, DNA was extracted and purified using modified CTAB method from 48 *ber* plants inclusive of 26 varieties, 4 species and 5 geographical collections. DNA from 4 representative *ber* plants were used for screening of ISSR and RAPD primers for molecular characterization. Out of 25 ISSR and 20 RAPD primers screened, nine each of ISSR and RAPD primers have been selected for further molecular analysis.
- For molecular characterization in *kusum* and *palas* germplasm, DNA extraction and purification was optimized after screening three different protocols. A modified DNA extraction protocol adapted from Doyle and Doyle produced best yield of DNA from young leaves of both the hosts. The protocol will be utilized in DNA isolation from the *kusum* and *palas* collections for further molecular analysis.

Evaluation and improvement of host plants for lac productivity and summer sustainability

- An experiment was undertaken for improving the summer sustainability of *Flemingia semialata* for bearing summer lac crop and selection of superior genotypes of *F. semialata* have been raised in the field for evaluation.
- Four genotypes of *galwang, Albizia lucida,* showing consistent lac productivity were identified (LRG501, LRG502, LRG508 and LRG511) and characterized for the leaf parameters. Five plants each of four selected genotypes of *galwang* as well as five saplings collected from the natural population were planted in the field. Five more genotypes of *kusum* showing high productivity and summer sustainability have also been identified from Hesal, Ranchi. Air layers of these plants together with those identified earlier from IRF have been prepared and are under hardening in the Institute Research Plantation.

Clonal propagation of kusum through tissue culture

- Clonal propagation of *kusum* through tissue culture techniques were under taken as *kusum* displays considerable variability for lac productivity. Microbial contamination in the field-collected explants is one of the major problem in establishing cultures of *kusum* auxiliary buds under *in vitro* conditions and this bacterial contamination problem was minimized by media supplementation of antibiotics, cefotaxime and gentamycin without affecting the cultures. Soaking of explant in antioxidant mixture solution and medium supplement of antioxidants like ascorbic acid and citric acid was found to minimize the 'browning' problem. Seasonal influence in bud dormancy was a major problem found with axillary bud cultures in *kusum*. Alternatively callus mediated indirect organogenesis is considered potential in multiplication of *kusum*. It was possible to induce calli from the explants derived from mature *kusum* plants on the plant regeneration media containing, cytokinins (6-BAP and kinetin) and silver nitrate, which are being multiplied and cultured on regeneration media for organogenesis.

3. *Crop Production*

In-situ moisture conservation for lac hosts

- Five *in-situ* moisture conservation practices for raising the mixed plantation of *ber* and *kusum* were evaluated with an objective to conserve post monsoon moisture for quick growth and development of the lac host plants. Mulching and half moon terracing/half basin ring in particular showed

significant superiority over other treatments in terms of vegetative growth and moisture conservation. Superior plant growth in terms of height was observed under treatment with mulching, half moon terracing and compartmental bunding. The intercropping with black gram in the system helped in improving soil condition, soil moisture status, reduction in soil loss and employment generation with additional income to the farmers.

Development of kusmi lac cultivation technology on Albizia procera

- The pruning response of *siris* (*A. procera*) for lac cultivation has been studied. The six month old shoots were found suitable in terms of settlement of lac insect over 12 and 18 months old shoots.

Diseases of commercial lac hosts

- Leaf spot caused by *Xanthomonas butae* appears during July-August on *palas* and remained sporadic till November. The occurrence of the disease was found widespread in Jharkhand and West Bengal and smaller bushes were more severely affected than the grown up trees. Powdery mildew caused by *Erysiphe zizyphi* was found in moderately severe form on *ber* in Barajamdah area of Singhbhum district of Jharkhand on cultivated variety in the month of November. The disease had affected leaves and fruits. Sooty mould caused by *Capnodium zizyphi* was also found growing on wild varieties of *ber* which were commonly used for lac cultivation. The disease appears during January-February and severity grows with time and becomes more severe during the month of April.

Management of sooty mould on lac crops

- Sooty mould growth due to honey dew secretion is a problem in lac culture. Systematic experiments have shown that visit of ants to lac insect colonies significantly reduced the growth of sooty mould on lac culture.

Soil fertility management of ber for lac production

- Soil fertility management studies were under taken for promoting shoot growth and superior lac crop performance. Lime application resulted in better shoot growth and reduced lac insect mortality. Whereas phosphorus application increased the initial mortality of lac insect and potassium application improved settlement density of lac insect.

Weed management in lac host plantation

- *Palas, ber, kusum, bhalia and semialata* plantations were predominated by grassy weed (72.07%) of total weeds accumulation followed by broad leaved (23.7%) and sedges (4.76%). Amongst weeds species *Ageratum conyzoides, Brachiaria remosa* and *Echinochloa* spp. were common in all the studied lac host plantations. The *Ageratum conyzoides* has the highest relative frequency (RF) value ranging between 24.9-64.2 per cent in all lac plantations except *semialata* (9.1%).
- Six herbicides, three each non-selective and selective were tested in the field of *F. semialata* 15 days before planting. The paraquat @ 0.4 kg ai/ha was found to be most effective with 62.1% weed control efficiency (WCE) followed by gluphosinate and glyphosate with 55.2 and 45.03 per cent WCE, respectively.

Lac production in high density ber plantation

- A concept project on lac production in high density *ber* plantation, sponsored by NABARD has been taken up. The plants attained a height of 1.9 m approximately one year after planting. Leguminous crops like pea and groundnut were taken for additional returns, weed suppression and enrichment of soil.

4. *Synthesis and Product Development*

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

- Comparative studies of different physico chemical properties of Chinese, Thai,

Indonesian and Indian seedlac and shellac proved superiority of Indian lac produced by the Indian species *Kerria lacca* in comparison to those obtained from other countries like China, Thailand and Indonesia in respect of flow, cold and hot alcohol insoluble, colour index, heat polymerization time, bleached index and gloss.

Bioactive compounds from aleuritic acid

- Plant growth regulators *viz.*, 10-Carboxymethyl-2-decenoic acid (CMDA) and Methyl 9-methylsulphonyloxy-2-nonenoate were synthesized and the compounds were found to enhance better shoot emergence and early shoot initiation in pointed gourd *(parwal)*.
- *In vitro* evaluation of methyl 16-hydroxy-(E)-9-hexadecenoate, synthesized from aleuritic acid displays considerable degree of toxicity against 2nd stage juvenile of root-knot nematode *(Meloidogyne incognita)* infesting brinjal.
- (Z)-9-Hexadecenal, (Z)-9-hexadecenylacetate, (Z)-9-tetradecenyl acetate, (Z)-7-dodecenyl acetate and 16-acetoxy-(E)-9-hexadecenoic acid synthesized from aleuritic acid have shown good sex pheromone activity against brinjal and tomato fruit borers.

5. *Surface Coating and Use Diversification*

Surface coating formulations

- Shellac was blended with rosin at room temperature in liquid medium and different compositions (including control of shellac and rosin) were developed by varying the concentrations of shellac and rosin. No improvement in the surface coating properties of shellac like heat and water resistance, scratch hardness and flexibility was noticed by blending with rosin. But when the compositions were treated with melamine formaldehyde resin, it was observed that blended compositions resist heat and water to the extent of 50:50 of shellac rosin blends.

Lac based jute plywood/particle board fibre-glass reinforced sheet

- Jute reinforced sheets were prepared with shellac containing sheet moulding compound using jute material and fibre glass. Good mechanical properties were obtained by selecting the composition and thickness. The sheets can be applied as partition wall, door panel, window panel, ceiling and similar applications in place of particle and plywood boards.

6. *Processing and Storage*

Drying characteristics of seedlac

- Drying curve of seedlac at various temperature and different layer thickness including ambient temperature were studied. It was observed that drying of seedlac becomes faster as drying temperature increases from 40°C to 50°C. But drying becomes slow at 55°C as compared to 50°C temperature, probably due to heavy blocking of the seedlac samples at 55 °C temperature.

Storage loss assessment

- Studies have been initiated by simulating the conditions to evaluate the qualities of sticklac, seedlac and shellac during storage under different methods as practised by lac traders and industries *viz.*, spreading on earthen floor, spreading on cemented floor, inside gunny bags, inside plastic bags and under cold storage conditions. After 3 months of storage, the lowest hot and cold alcohol insolubles, the highest flow (mm), the lowest colour index, the highest heat polymerization time (min) and the highest rate of filtration was found in case of seedlac samples stored by spreading on cemented floor.

Pilot plant of aleuritic acid

- A pilot plant of aleuritic acid (capacity: 2 kg/batch) has been erected at Processing and Demonstration Unit of the Institute for training and demonstration to entrepreneurs.

Commercially viable pilot plant of lac dye

- A trial run on pilot plant was carried out with two batches of *kusmi* and one batch of

rangeeni sticklac and an average dye yield of 0.22 to 0.30% on the wt. of sticklac were obtained. Dye content from technical grade varied from 68.5 to 71.0%, ash content varied from 0.70 to 1.10% and melting point varied from 230 to 238°C. The heavy metals such as nickel, mercury, iron, magnesium, arsenic and lead content of the dye were estimated. Except iron and lead, rest of the metals remained below detection limit. The lead content was well within the prescribed limit of 10 ppm for edible grade natural dyes.

- Installation of purification plant for the lac dye has been completed after installation of the filtration unit. The low temperature crystallization unit of the plant has been tested for maintenance of low temperature and it is able to maintain temperature in the range of 6-8°C.

7. HRD for Capacity building in Lac Production, Processing and Value Addition

Training highlights

- The Institute conducted regular training programmes for the farmers and the housewives, one day orientation progrmme, on-farm training, field educational and motivational training, trainer's training and field level demonstrations. Over ten thousand persons were benefited under the various training activities conducted by the Institute.
- Thirty two training cources on *Scientific lac production, processing and uses* of one week duration were organized for 1186 farmers, extension cadre and NGO staff of Jharkhand, Chhattisgarh, Orissa, Madhya Pradesh, West Bengal, Andhra Pradesh and Maharashtra.
- Five educational programmes for B.Sc.(Ag) students and two trainer's training programmes for Ag Extension Officers on Scientific lac production, processing and uses of one week duration were organized for 130 beneficiaries.
- Ten lac based product technology were transferred to entrepreneurs from Mumbai, Kolkata, Sikohabad, Raipur and Wardha.
- Fifty three on-farm training camps, 45 on-farm motivational / supplementary camps, 14 in-campus orientation programmes were conducted for the farmers and housewives of Jharkhand, Chhattisgarh, Orissa, Madhya Pradesh, Gujarat, Andhra Pradesh and Maharashtra.

Skill development and capacity building of lac culture in Gujarat

- High population of *kusmi* lac hosts *viz., Z. mauritiana and Prosopis juliflora* as well as good number of *kusum* plants in Dang, Balsad and Kevdi areas of Gujarat have been identified as potential *kusmi* lac producing state. Continued high lac production records of demonstrations on *Z. mauritiana and P. juliflora* have proved the potential for lac cultivation in the state. A lac development plan for Gujarat state has been submitted for consideration.

Award

- Dr. K.K. Sharma, Sr. Scientist, Lac Production Division was conferred the Bioved Fellowship Award for his outstanding contribution in the field of Transfer of Technology by Bioved Research Society on January 29, 2007 during the *9th Agricultural Scientists and Farmers Congress* held during January 29-31, 2007 at Allahabad.

8. Technology Assessment, Refinement and Dissemination

Eco-friendly management of insect pests associated with lac insect and host plants

- For the management of two key lepidopteran lac insect predators *viz., Eublemma amabilis* and *Pseudohypatopa pulverea* on lac crop, nine IPM recommended newer chemical insecticides and one *Bacillus thuringiensis* based formulation of indeginous origin (Halt) were evaluated for their safety to lac insect and toxicity to predators of lac insect. Six chemical insecticides *viz.*, fipronil, lambdacyhalothrin, alphamethrin, indoxacarb, carbosulfan and spinosad and *Bt* formulation (Halt) were identified as promising pesticides as far as safety to lac insect is concerned and found effective in

reducing the incidence of lac insect predators significantly.

- Laboratory bioassay of eleven newer insecticides revealed that carbosulfan (0.02%), lambdacyhalothrin (0.007%), alphamethrin (0.01%) and ethofenprox (0.02%) were most effective treatment causing cent per cent mortality of *Cyclopelta obscura,* a pest of *palas* trees within 24 hrs of treatment. Whereas, endosulfan (0.05%) and spinosad (0.01%) caused cent per cent mortality after 72 hrs of treatment.

9. *Liaison, Information and Advisory Services*

Informatics on lac production, marketing and processing

- Efforts were made at national level for collection of lac related information and data. Separate schedules / questionnaires were used for survey of lac markets, traders, exporters, importers and processing units. The estimated national production of sticklac during 2007-08 was approximately 20,640 tons. Total amount of sticklac processed during 2006-07 was 29,800 tons which also included 7,366 tons of imported lac in India. In processing of lac, West Bengal ranked 1st (40.77 %) followed by Chhattisgarh (32.55 %), Jharkhand (21.31 %) and Maharashtra (5.37 %). The total export of lac and its value added products during the year 2006-07 was 7,525.46 tons valued at Rs.147.72 crores. The total import of different kind of lac during the year 2006-07 was 7,365.64 tons valued Rs.56.51 crores.

Strengthening, liaison, information and advisory services on natural resins and gums

- Linkages have been established with several Government and Non-Governmental Organizations in the states of Jharkhand, West Bengal, Maharashtra, Madhya Pradesh, Orissa and Chhattisgarh for promotion of lac cultivation.

INTRODUCTION

Historical Development

Lac, a natural resin, 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 Government of India constituted the *Lindsay-Harlow Committee* in 1920, to look into all aspects of the country's lac trade and its development. On the suggestions of this Committee, lac merchants organized themselves into the *Indian Lac Association for Research*, under the aegis of which, the foundation stone of the Indian Lac Research Institute was laid on September 20, 1924 at Ranchi.

Initially, the Institute consisted of an Entomological Section as the principal unit supported by a Biochemical Section which started functioning from 1925. Then, in 1927, a Physico-chemical Section was added to take up applied research. Later, these two chemical sections were combined to form a Chemical Division. The scope of this Institute was thus, widened to cover both the entomological and chemical aspects. Subsequently, on the recommendations of the *Royal Commission on Agriculture,* the *Indian Lac Cess Committee* was constituted, which took over the reigns of the Indian Lac Research Institute in 1931. The ILCC also organized 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 84 years of fruitful service to the Nation. It has immensely contributed towards all round development of lac besides maintaining India's leadership in production, installed processing capacity and export. The Governing Body of ICAR Society in its 206th meeting held on March 19, 2007 approved revised mandate and new name of the Institute as ***Indian Institute of Natural Resins and Gums*** with effect from September 20, 2007.

A Unique Institute

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

Location and Agro-Climate

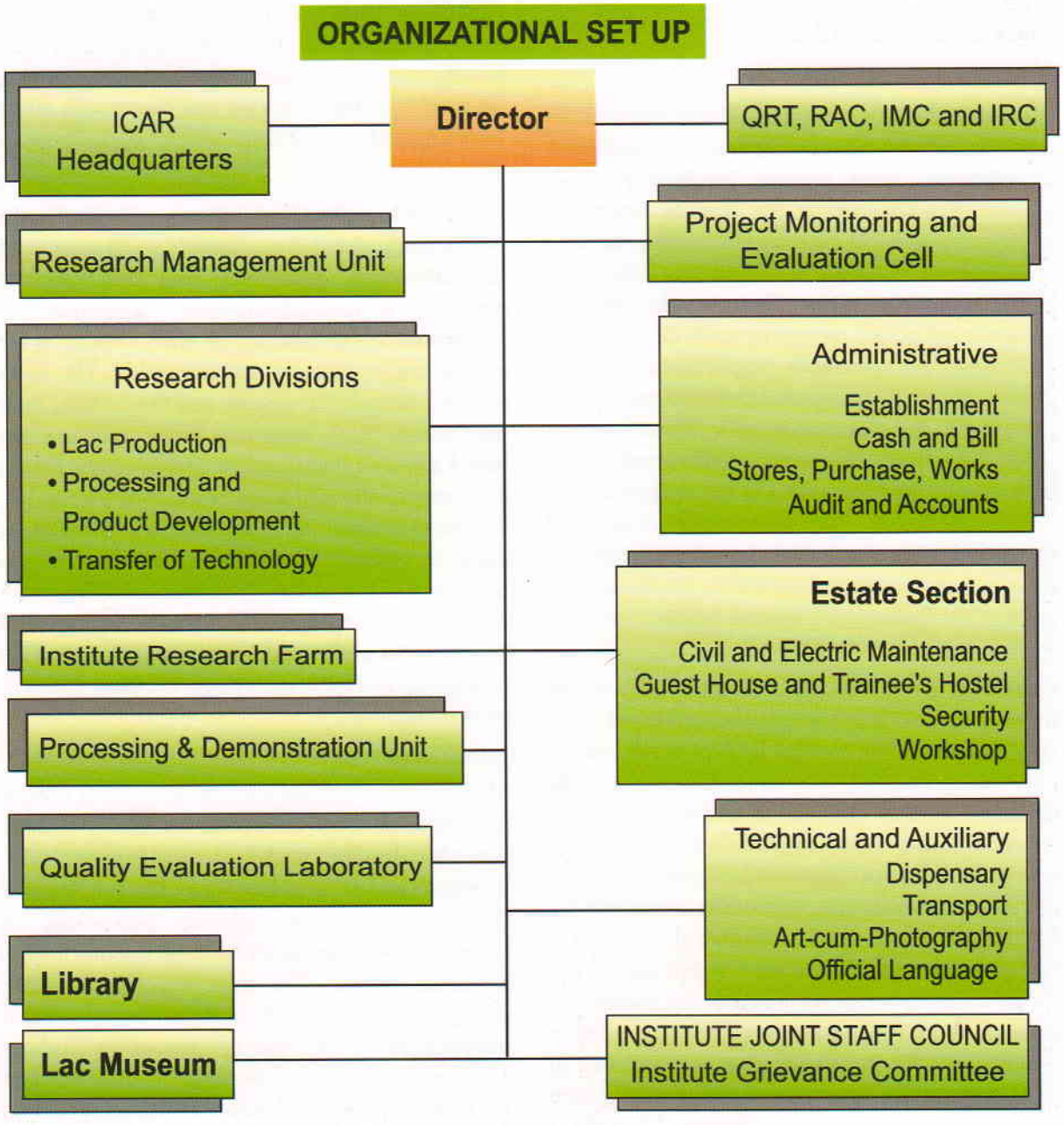
The Institute is located 9 km South-East of Ranchi city, on the Ranchi--Jamshedpur highway NH 33, at an altitude of 650 m above mean sea level, 23^{0}23' N latitude and 85^{0}23' E longitude. The soil status of the Institute indicates advance weathering on granitic gneiss. The soil of the experimental 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 highest mean maximum temperature (37.1^{0}C) was observed in the month of May and the lowest mean minimum temperature (7.0^{0}C) during

January. June 3rd and December 20th were recorded as the hottest and the coldest day of the year with a temperature of 41.7°C and 2.7°C, respectively.

Present Status

Organizational Structure

The IINRG has responded to the globalization of industries and agricultural enterprises of the country as well as functional reorganization 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, Processing and Product Development, and Transfer of Technology. The Institute is headed by a Director.



Staff

Institute has a sanctioned strength of 1 RMP, 46 scientific, 62 technical, 36 administrative and 89 supporting grade posts, out of which 28 scientific, 57 technical, 29 administrative and 76 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, Surface Coating Laboratory, Instrument Laboratory, Quality Evaluation Laboratory etc. Besides these, the DTP and publications facilities are also available. A number of modern and sophisticated laboratory equipments including DSC, FT-IR, Insect Activity Meter, Environmental Growth Chamber, Pilot plant of aleuritic acid and lac dye etc. are available for research on all aspects of lac production, processing and product development. There are several well-organized and equipped service sections to support research management of the Institute. The administrative wing comprises of Director's Office, Administrative Section, Finance and Account Section, Purchase and Central Stores. The following sections provide the technical support: Library, Research Management Unit, Institute Research Farm and Maintenance and Workshop Unit. The Auxiliary units are: Hindi Cell, Security, Medical and Estate Maintenance services.

The Institute Research Farm which 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 IINRG is maintaining more than sixty four 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 16 genera and 33 species covering tree, medium and bushy type of lac host plants. The collection include 6 species of *Ficus*, 4 species each of *Acacia* and *Albizia*, 3 each of *Flemingia* and *Zizyphus*, 2 each of *Prosopis* and *Dalbergia* along with each of *Cajanus, Croton, Desmodium, Garuga, Pithecolobium* and *Peltoforum*. Altogether 64 collections collected from different agro climatic regions for 33 species of lac hosts have been planted in the field gene bank.

The IINRG 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 neighbouring educational and research institutions, including BIT, RU, BAU and HARP, Ranchi, IIT, Kharagpur, RAU, Samastipur, PU, Patna, NIT, Jamshedpur etc.

The Quality Evaluation Laboratory of the Institute has recently been accredited IS 9001 : 2000 and it caters to the quality control needs of the lac processing 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 IINRG as well as lac.

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

Budget

During 2007-08, the non-plan expenditure was Rs. 497.97 lakhs, against a revised estimate (R.E.) of Rs. 500.00 lakhs; the plan expenditure was Rs. 100.00 lakhs against a revised estimate of Rs. 100.00 lakhs. The detailed figures are shown in the

table given below.

Revenue Generation

During the period under report, a sum of Rs. 36.65 lakhs was earned as revenue, through different programmes of various divisions and sections of the Institute.

Budget during 2007-08 (Rs. in lakh)

Sl. No.	Head	Plan		Non- Plan	
		R. E. 07-08	Expr.	R. E. 07-08	Expr.
1.	Establishment Charges	00.00	00.00	399.00	396.97
2.	Wages	00.00	00.00	00.00	00.00
3.	O.T.A.	00.00	00.00	00.10	00.10
4.	Traveling Allowances	05.00	05.00	03.60	03.60
5.	H.R.D.	02.00	02.00	00.00	00.00
6.	Other Charges	80.00	80.00	60.30	60.30
7.	O/C Information Technology	03.00	03.00	00.00	00.00
8.	Works	00.00	00.00	00.00	00.00
	Special Repairs: (a) Office	00.00	00.00	20.00	20.00
	(b) Residential	00.00	00.00	12.00	12.00
	(c) Minor Work	00.00	00.00	05.00	05.00
	(d) Major Work	00.00	00.00	00.00	00.00
9.	Other Items: Publicity (Library)	10.00	10.00	00.00	00.00
	TOTAL	**100.00**	**100.00**	**500.00**	**497.97**
(B)	Loans & Advances	00.00	00.00	04.00	03.99
(C)	Pensions	00.00	00.00	100.00	96.15
(D)	Revenue Generation	00.00	00.00	45.00	36.65

RESEARCH ACCOMPLISHMENTS

1. LAC PRODUCTION

1.1. Insect Improvement

1.1.1 *Collection, conservation, characterization and documentation of lac insect biodiversity*

Collection of lac insect biodiversity from West Bengal and Orissa

An exhaustive survey was undertaken in lac growing districts of West Bengal *viz.*, Purulia, Bankura and Midnapore and Balasore district of Orissa in the month of October to know the availability of lac insects and status of lac cultivation in these locations, the details of which are furnished in Table 1.

Table 1. Places visited and observations recorded on availability of lac insect

District	Place	Observations
A. West Bengal		
Purulia	Balarampur, Baghmundi, Ayodhya Pahar, Burda, Pagrodih, Ukada, Jhalda, Kashipur and Rangeeladih	Mature lac culture of mixed population (crimson and yellow) was recorded on *palas* in Rangeeladih village. Interaction with the farmers revealed that *rangeeni* lac crop had failed last season in the area. *Katki* crop not inoculated due to high broodlac prices (Rs. 550 per bundle of 5 kg.).
Bankura	Bankura, Indpur, Khatra, Taldungra, Simlapal and Fulkusma	About 10,000 *palas* trees was available in State Broodlac Farm at Bonkata (Indpur Block). No cultivation of lac is being done since 1997. Twelve such farms in the Bankura district are lying unexploited due to paucity of funds.
Midnapore	Bispur, Jhargram, Midnapore, Egra, Contai and Digha	A Lac Farm (Karrimouli Farm) of *ber* trees is located about 20 km from Jhargram. No lac cultivation was being practiced.
B. Orissa		
Balasore	Balasore	Crimson lac insect was found on rain tree in abundance. Emergence had already taken place about a month ago.

Mixed population of crimson and yellow on *palas* was collected from Purulia, crimson lac insect on *ber* from Bankura and crimson lac insect on rain tree from Midnapore district.

Lac insects were observed at almost all the places visited but their frequency of occurrence varied from place to place. At some of the places, especially in Bankura and Purulia districts good patches of *palas* was available. All the three major hosts *viz. kusum, palas* and *ber* were present in abundance in Purulia. Bankura has plenty of palas and some ber while in Midnapore rain trees out numbered all the other hosts. Interaction with the farmers of villages in Purulia revealed that both *rangeeni* and *kusmi* lac crops had failed last season in an area due to incessant rains. Farmers did not inoculate the next crop due to high broodlac prices. Some farmers in Purulia had bought broodlac from Jharkhand and Chhattisgarh. Except Purulia, cultivation of the lac was practically negligible in other two districts. Though lac insect was available in plenty on *rain trees* in the Midnapore district, but local people were not aware about the systematic lac cultivation.

Evaluation of lac insect germplasm collections

Performance of ten lac insect stocks, reared on *Flemingia macrophylla* were evaluated for two consecutive years *i.e.,* four crops. Productivity linked attributes *viz.*, initial density of settlement, initial mortality, male proportion, density at crop maturity, size of cell, weight of cell, resin output and fecundity of lac insect stocks *viz.*, *kusmi* trivoltine, Thrissur (Kerala), Thailand, Udaipur and Jhalod (Rajasthan), Echoda (Andhra Pradesh), Jammu (J&K), Patiala (Punjab), Ambaji and Alsipur (Gujarat) have been recorded during summer / winter season 2006-07 (Table 2).

Table 2. Productivity linked attributes of different lac insect stocks

Lac insect stock	Initial density of settlement (no./ cm^2)	Initial mortality (no./cm^2)	Sex ratio male(%)	Density at crop maturity (no./ cm^2)	Diameter of cell (mm)	Weight of cell (mg)	Resin per cell (mg)	Fecundity (no.)
Kusmi trivoltine	69	10.5	30.6	11	**2.45**	**8.08**	**6.00**	**201**
Thrissur	90	18.2	27.2	14	3.50	12.16	9.81	418
Thailand	**115**	**8.4**	**22.5**	**18**	3.62	14.11	12.08	487
Udaipur	80	12.3	34.9	9	3.51	11.99	9.76	398
Jhalod	78	15.0	26.8	**8**	3.49	12.00	9.85	414
Echoda	**68**	16.8	31.7	9	3.22	11.37	9.16	375
Jammu	75	**20.4**	**35.6**	10	**3.70**	**14.88**	11.95	**504**
Patiala	70	12.6	28.0	**8**	2.99	9.76	8.01	348
Ambaji	**68**	15.1	24.1	9	3.48	10.67	8.90	397
Alsiput	74	17.9	29.7	9	3.43	10.50	8.47	365
Average	***78.7***	***14.72***	***29.11***	***10.5***	***3.239***	***11.552***	***9.399***	***390.7***

Bold figures in a column represent the lowest and highest values

Initial density of settlement was the highest (115 / cm^2) in Thailand stock and the lowest (68 / cm^2) in lac insects collected from Echoda (A.P.) and Ambaji (Gujarat). Initial mortality varied between 8.4 % in Thailand stock to 20.4 % in Jammu stock. Proportion of males varied widely among the stocks. In Thailand stock 22.5 % males were observed in comparison to 35.6 % in Jammu stock. Density of living females varied between 8 to 18 cm^2 at crop maturity stage. Resin secreted by individual female lac insects on *kusmi* trivoltine stock was 6.00 mg whereas, the quantity of resin secreted by Jammu stock was 11.95 mg and 12.08 mg by the exotic stock (Thailand). Fecundity of different lac insect stocks was directly correlated with size / weight of the female cell.

Conservation of lac insect germplasm in the Field Gene Bank

More than 1000 lac cultures of 64 lines of lac insect which include 14 cultivated, 27 natural populations, 22 cross bred / inbred / selected, one exotic and six uncoded lines are being maintained in the Field Gene Bank on potted plants of *Flemingia macrophylla*. Descriptors of lac insects with special reference to *Kerria* spp. have been developed. Accession numbers have been assigned to the lac insect stocks maintained in the Field Gene Bank. Numbers of lac insect stocks belonging to *Kerria* and *Paratachardina* Genus collected from different states and being conserved in the Field Gene Bank are listed in Table 3.

Table 3. Number of insect lines maintained in the Field Gene Bank

Sl. No.	State	No. of Stock(s)
1.	Andhra Pradesh	1
2.	Assam	1
3.	Chhattisgarh	1
4.	Gujarat	2
5.	Jammu & Kashmir	1
6.	Jharkhand	4
7.	Karnataka	2
8.	Kerala	1
9.	Madhya Pradesh	1
10.	Meghalaya	1
11.	Orissa	2
12.	Punjab	2
13.	Rajasthan	2
14.	Uttar Pradesh	2
15.	West Bengal	4
	Total	**27**

Besides, 37 other lines are being maintained which include developed breeds, experimental crossbred, inbred and other selected lines.

Three lac insect stocks (Table 4) collected from Purulia, Bankura and Midnapore districts of West Bengal were added to the existing germplasm in the Field Gene Bank.

Lac insects collected recently from Maharashtra, Uttar Pradesh and West Bengal are being multiplied for evaluation studies.

Other activities carried out during the survey

About 4,000 *semialata* saplings were transplanted

Table 4. Lac insect stocks added this year to the Field Gene Bank

Sl. No.	Lac insect collected from	Remarks
1.	Purulia (Rangeeladih village)	Mixed population of crimson and yellow lac insects on *palas*
2.	Bankura (Dangarampur)	Crimson lac insects on *ber*
3.	Midnapore (Lodhasuli village)	Crimson lac insects on *rain tree*

at Dalpur Ashram in Bankura in collaboration with IINRG. Fifty kg of broodlac was inoculated by the Ashram on 100 trees under ATMA scheme in collaboration with the Institute. They have pruned about 2,500 *palas* trees for inoculation under other schemes. The process of broodlac bundling and inoculation was demonstrated to tribal growers at Dharra Mouli village (Khatra Block) of Bankura.

1.1.2 *Field evaluation of promising lac insect races, lines and breeds for higher productivity and superior performance*

Collection of lac insects from Rajasthan and Jammu and Kashmir for multiplication

A field survey of Rajasthan (Ajmer and Pushkar) and various places of district Jammu was undertaken to collect *rangeeni* lac insect population for mass multiplication and evaluation.

Number of *Ficus religiosa (pipal)* and a few *F. luscence (pakur)* trees were found moderately infested with lac insects at Ajmer. Almost complete emergence was noticed by 3rd week of July 07 and most of the emerged insects were found dead probably due to unavailability of suitable site/place for settlement and high heat.

Two major host plants namely *Butea monosperma (palas)* and *Zizyphus mauritiana (ber)* were abundant in and around Jammu wherein many of *ber* trees were found heavily infested with lac insect and were either emerging or about to emerge during late second fortnight of July 07. About 3.9 kg of broodlac collected from *ber* trees, which comprises both crimson as well as yellow lac insects, were brought to Institute and inoculated on *ber* and *palas* trees for multiplication at Institute Research Farm. 7.2 kg broodlac was harvested from the rainy season *(katki)* crop and was inoculated on *palas* trees as summer crop for further multiplication. During the course of survey, it was learnt that lac was abundant in the Jammu region about 50 years back and people used to collect and sell it commercially but presently it is not being practiced. The state is bestowed with ample lac host plants *viz., ber, palas, khair* and *Ficus* spp. and has favourable climatic conditions for survival and growth of lac insects. Thus, Jammu region seems to be an ideal place to explore the possibility of lac cultivation.

Field multiplication of potential rangeeni lac insect lines available in the lac insect gene bank

Five potential lac insect lines were taken up for field multiplication on *palas* during rainy season *(katki)* crop. Three of these lines including one line from Gujarat, a crossbred line of Rajasthan (Jodhpur x local *rangeeni*) and Jammu population showed good survival during rainy season *(katki)* 2007. Besides these lines one more additional line of Madhya Pradesh were inoculated on *palas* trees during summer season *(baisakhi)* crop for further multiplication.

Comparative performance of kusmi lac insect stocks on ber and semialata

Five *kusmi* lac insect stocks *viz., kusmi* crimson early, *kusmi* yellow, *kusmi* crimson late and two productive breeds namely Kulajanga and Nawadih were evaluated under potted conditions on *semialata* and *ber* during summer season *(jethwi)* crop and in the field during winter season *(aghani)* crop (Table 5).

Average density of settlement was 71 / cm^2 (range 65-77) on *ber* and 85.2 / cm^2 (range 76-97) on *semialata*. *Kusmi* crimson early stock had the lowest density of settlement (65 and 76 / cm^2 on *ber* and *semialata,* respectively) while the highest was recorded for *kusmi* crimson late (97 / cm^2) on *semialata* and for *kusmi* yellow (77 / cm^2) on *ber*. Initial mortality ranged between 12.7% for *kusmi* crimson late to 26.1% (Kulajanga) on *semialata*, while the respective figures on *ber* were 24.4 % (*kusmi* crimson late) and 35.0% (*kusmi* yellow). Average mortality was more on *ber* than on *semialata*. Sex ratio also showed wide variations among the five stocks on both the hosts. Average male proportion was 27.58 % on *semialata* and

Table 5. Productivity attributes of different kusmi lac insect stocks on F. semialata (Fs) and Z. mauritiana (Zm) under potted condition during summer season (jethwi, 2007) crop

A. Pre-harvest attributes								
***Kusmi* stocks**	**Density at initial stage (no./cm²)**		**Initial mortality (%)**		**Male proportion (no./cm²)**		**Density at crop maturity (no./cm²)**	
	Fs	**Zm**	**Fs**	**Zm**	**Fs**	**Zm**	**Fs**	**Zm**
Kusmi crimson early	76.0	65.0	18.4	26.8	22.3	40.0	8.0	10.0
Kusmi yellow	89.0	77.0	12.7	35.0	31.7	37.6	13.0	13.0
Kusmi crimson late	97.0	74.0	13.9	24.4	23.8	31.4	11.0	12.0
Kulajanga	84.0	68.0	26.1	31.9	29.5	34.5	10.0	9.0
Nawadih	80.0	71.0	20.3	33.9	30.6	28.3	10.0	8.0
Average	***85.2***	***71.0***	***18.28***	***30.4***	***27.58***	***34.36***	***10.4***	***10.4***
B. Post-harvest attributes								
***Kusmi* stocks**	**Diameter of cell (mm)**		**Weight of cell (mg)**		**Weight of resin (mg)**		**Fecundity (no.)**	
	Fs	**Zm**	**Fs**	**Zm**	**Fs**	**Zm**	**Fs**	**Zm**
Kusmi crimson early	3.00	3.13	14.9	18.1	12.0	15.2	287.0	300.0
Kusmi yellow	3.68	3.55	18.0	20.4	15.1	17.1	314.0	298.0
Kusmi crimson late	3.77	3.78	19.5	24.6	16.7	21.5	348.0	350.0
Kulajanga	3.42	3.50	17.6	22.1	14.9	19.0	311.0	327.0
Nawadih	3.33	3.41	17.5	21.9	14.1	19.0	302.0	330.0
Average	***3.44***	***3.47***	***17.5***	***21.42***	***14.56***	***18.36***	***312.4***	***321***

34.36% on *ber*. Not much differences were observed in density of living females at crop maturity among the stocks or between the hosts. Though difference in average size of the cell among the stocks on both the hosts was small, average quantity of resin secreted on *ber* was 26.1 % higher than on *semialata* (18.36 and 14.56 mg / female cell, respectively). Interestingly, no difference in average fecundity was observed on both the hosts, though weight of the cell / resin secreted was higher on *ber*.

Field studies on comparative performance of *kusmi* lac insect stocks on *ber* and *semialata* continued this year also. The observations recorded on productivity linked parameters are shown in Table 6. *Kusmi* early performed better on

Table 6. Screening of kusmi lac insect germplasm on Flemingia semialata and Zizyphus mauritiana under field condition during winter season (aghani, 2006-07) crop

A. *Flemingia semialata*					
Attributes	***Kusmi* early**	**Kulajanga**	**Nawadih**	***Kusmi* late**	***Kusmi* yellow**
Shoot length/plant (cm)	1326.0	1002.8	761.8	553.0	998.7
Encrustation length/plant (cm)	226.8 (17.94)	204.8 (20.42)	187.8 (24.65)	145 (26.22)	219.6 (21.99)
Broodlac/plant (g)	440.4	361.2	360.1	190.7	373.8
Sticklac/plant (g)	135.2	126.5	115.4	64.9	107.6
Broodlac/meter shoot length	194.2	176.4	191.81	131.5	150.34
Sticklac/ meter shoot length	59.52	61.52	61.24	44.14	68.46
B. *Zizyphus mauritiana*					
Shoot length/plant (cm)	3895.0	1030.6	2123.9	1311.0	-
Encrustation length/plant (cm)	1126.0 (28.91)	3507.1 (34.03)	737.1 (34.62)	372.0 (28.38)	-
Broodlac/plant (g)	1237.7	5391.33	1528.68	935.94	-
Sticklac/plant (g)	500.8	2360.1	785.3	538.6	-
Broodlac/ meter shoot length	109.9	153.7	207.4	251.6	-
Sticklac/ meter shoot length	44.5	67.3	106.6	144.8	-

Figures in the parentheses represent encrustation percentage of available shoot length

semialata while on *ber* late maturing varieties especially *kusmi* late and Nawadih stock gave higher yield. Lac encrustation coverage of the available shoot length at the time of crop maturity was high in *ber* (28.38 – 34.62%) in comparison to *semialata* (17.94 – 26.22%).

1.1.3 *Application of moleculer fingerprinting for genetic characterization of races and species of lac insect*

In continuation of molecular characterization of lac insects using RAPD markers, experiments were carried out for use of ISSR-based molecular diversity analysis in lac insects. Approximately 50 ISSR primers were screened with four representative lines of lac insect DNA out of which 18 primers were selected for detailed analysis of genetic diversity in 21 selected lac insect lines belonging *K. lacca, K. chinensis* and *K. sharda*. ISSR reactions were performed in 15 µl reaction mix containing optimized ingredients like *Taq* buffer, $MgCl_2$, dNTP mix, primer(s), *Taq* polymerase enzyme, sterile dd H_2O. Template DNA from the selected insect lines were separately added into each reaction and allowed for PCR amplification in a pre-optimized reaction conditions. The PCR amplified products were separated through agarose gel electrophoresis. The electrophoresed gels for all the 18 primers produced satisfactory polymorphic pattern to analyze the genetic distance between the insect lines. Representative gel images of two ISSR primers provided below, indicating the genetic variation among the lac insect lines (Fig. 1).

1.1.4 *Biological, chemical and molecular characterization of lac insect-host plant relationship*

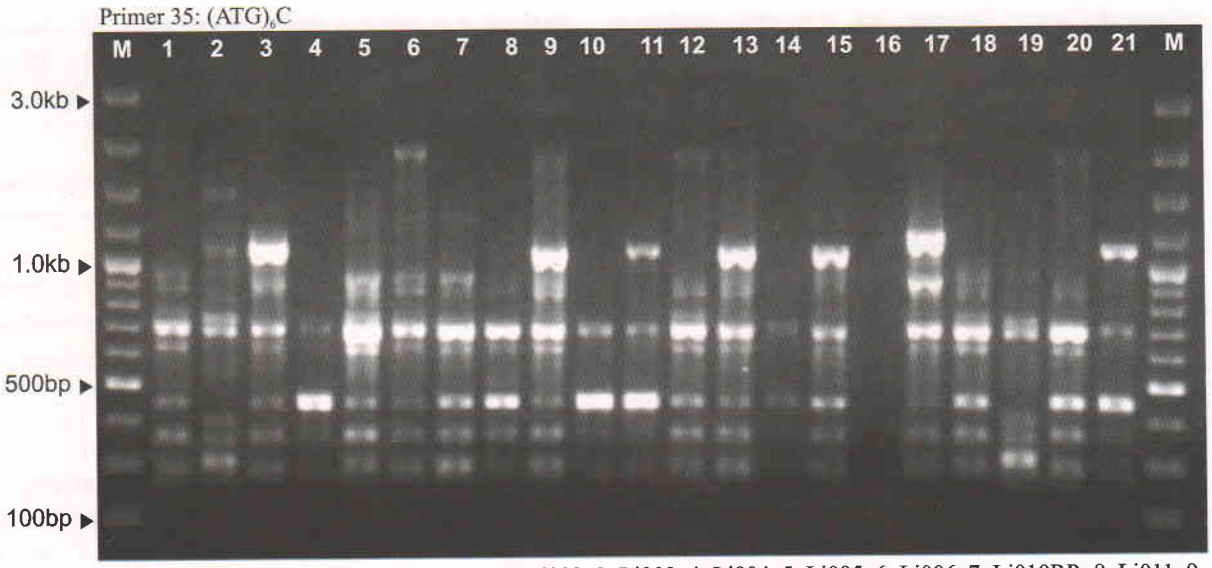
DBT sponsored project in collaboration with Delhi University and IIT, New Delhi was completed in March 2007. Significant highlights of the project are summarized below.

Biological characterization

Ideal host-plants with respect to season and strain of lac insect have been identified for their optimum exploitation. Suitable lac insect-host plant combinations have been screened out for improved lac yield. A Host Suitability Index based on most important productivity linked attributes has been developed. *Kusmi* and *rangeeni* strains of Indian lac insect, *K. lacca* (Kerr) have been evaluated on five important host plants *viz.*, *Acacia auriculiformis (akashmani)*, *Albizia lucida (galwang)*, *B. monosperma, S. oleosa* and *Z. mauritiana* for productivity linked parameters. Host suitability index has been calculated for all the five hosts for both the seasons.

A. auriculiformis was found to be the least suitable and *B. monosperma* the most suitable host during summer season *(baisakhi)* crop for *rangeeni* strain.

M: 100 bp DNA Ladder plus, 1: Li001A, 2: Li002, 3: Li003, 4: Li004, 5: Li005, 6: Li006, 7: Li010RR, 8: Li011, 9: Li013, 10: Li014, 11: Li015B, 12: Li019A, 13: Li019B, 14: Li020, 15: Li026, 16: Li031, 17: Li032, 18: Li066, 19: Li068, 20: Li073, 21: Li085



M: 100 bp DNA Ladder plus, 1: Li001A, 2: Li002, 3: Li003, 4: Li004, 5: Li005, 6: Li006, 7: Li010RR, 8: Li011, 9: Li013, 10: Li014, 11: Li015B, 12: Li019A, 13: Li019B, 14: Li020, 15: Li026, 16: Li031, 17: Li032, 18: Li066, 19: Li068, 20: Li073, 21: Li085

Fig. 1. Profiles of amplified genomic DNA of 21 lac insect lines using ISSR primers, showing the genetic variation

Host suitability index in ascending order of lac yield was: *A. auriculiformis* < *A. lucida* < *F. semialata* < *Z. mauritiana* < *B. monosperma*. Maximum yield of lac was obtained on *Z. mauritiana* and least on *A. lucida* during the rainy season *(katki)* crop. All the plant-hosts performed better during rainy season crop than summer crop. Host suitability index in ascending order of lac yield for katki crop was: *A. lucida* < *A. auriculiformis* < *F. semialata* < *B. monosperma* < *Z. mauritiana*. For *kusmi* strain host plants were more suited to lac insects during winter season than summer season crop. Host suitability index in ascending order of lac yield was: *F. semialata* < *A. auriculiformis* < *A. lucida* < *Z. mauritiana* < *S. oleosa* for winter season crop. While during summer season *(jethwi)* crop. Host suitability index in ascending order of lac yield was: *F. semialata* < *A. auriculiformis* < *Z. mauritiana* < *A. lucida* < *S. oleosa*. Techniques for studying the productivity linked parameters *viz.*, density of settlement, mortality after 21 days of inoculation, sex-ratio, living female density at crop maturity, size and weight of the female cell, resin produced by an individual insect and its fecundity have been optimized using different strains / geographic races of lac insects.

Inter and intra specific variations in productivity linked parameters of lac insect *vis-à-vis* host plant have revealed that:

(i) *kusmi* strain of lac insect is more productive than *rangeeni*. Resin output by a single female insect per unit of its size is almost double than that of *rangeeni*

(ii) host plants have pronounced effect on various economic attributes of the lac insect

(iii) productivity linked attributes are affected significantly by seasonal / environmental factors

(iv) variation in sex ratio is much higher in *rangeeni* than *kusmi* strain

(v) quality and quantity of lac produced is affected by extent of parasitization

(vi) size of the female cell and fecundity of lac insect is directly correlated

(vii) host plants are more productive during winter / rainy season in comparison to summer season for both the strains

(viii) quality of lac produced in respect of resin dye content is affected by the host plant

(ix) other parameters of quality of resin like life, flow, melting point etc. are not affected when lac insect is reared on different hosts for one generation.

Molecular characterization

Molecular profiles of the important host trees belonging to three taxa were obtained and diversity estimates were calculated. In case of *S. oleosa*, where a comparison of high, low and intermediate lac yielders could be carried out, most of the high yielders showed similarity with each other. Similarly, majority of the intermediate yielders shared high homology with each other. However, few high and intermediate yeilders did group with the selected low yielders included in the study. The per cent polymorphism was 81.4% in *S. oleosa*, 98.6% in *Z. mauritiana* and 66.3% in *B. monosperma.*

The investigations carried out to study the biochemical aspects of the taxa which are the important host plants of the lac insect in India revealed that their phloem sap composition has sucrose as the predominant sugar irrespective of the taxa. Similarly, both high as well as low yielders did not differ in terms of their sugars and amino acid composition. Most importantly, the phloem sap was found to be lacking or deficient in some of the essential amino acids. The investigations on the lac insect body extract revealed the presence of these amino acids, thus leading to investigate their source. Endosymbionts were detected and confirmed using DNA based techniques and TEM studies. These findings have immense implications in understanding the factors that contribute to the lac biosynthesis and also in the qualitative and quantitative improvement of lac production. Techniques for the phloem sap collection and characterization suitable for amino acid analysis using mass spectrometery and sugar analysis using HPLC were optimized in case of the three host taxa. The salient findings *vis-à-vis* lac insect extract were:

(i) Trehalose was the major sugar in lac insect while sucrose was the major sugar in phloem sap of all the three host taxa.

(ii) The relative percentage of essential amino acids was higher in lac insect in comparison to non-essential amino acids while these were absent or present in traces in phloem sap of its host taxa.

On the basis of the above findings, presence of the endosymbionts in *K. lacca* was suspected. Presence of endosymbionts in *K. lacca* was revealed by electron microscopic studies. Molecular evidence for the occurrence of *Wolbachia* sp. in *K. lacca* was provided by 16S rDNA gene for the first time. The preliminary evidence suggesting presence of more endosymbionts playing important role in lac insect metabolism.

Chemical characterization

Samples were analysed for their physical and chemical characteristics like solubility in different solvents, saponification values, melting behaviour, acid number and iodine numbers. FTIR, UV and NMR analysis of the samples was attempted. It was determined that while FTIR and UV analysis give very little information on the characterization, NMR method were not applicable due to difficulty in dissolution of lac in deutrated solvents. Efforts were made to develop the HPLC analytical protocols. While reverse phase HPLC was not very useful, HPLC on normal phase gave useful results on the nature of chemical components present in lac. It was determined that lac samples can be analysed by the HPLC assay developed in the project. Based upon the results achieved and HPLC profiling, parameters were determined to define best quality of lac.

1.2 Host Improvement

1.2.1 *Collection, conservation, characterization and documentation of lac host biodiversity*

IINRG as active site for host biodiversity conservation

The Institute holds 97 collections of 47 species of potential lac hosts, especially those of the major lac hosts such as *palas, kusum* and *ber.* The lac host germplasm is currently being systematically organized and documented. The National Bureau of Plant Genetic Resources, New Delhi has designated the Institute as National Active Germplasm Site for Lac Hosts. The germplasm collection was dedicated to the country by Dr. Mangala Rai, Director General, ICAR during his visit to the Institute on November 29, 2007.

Development of field gene bank of lac hosts

The field gene bank of lac hosts at the Institute is

being strengthened and systematized. A master plan has been developed for long term establishment of field gene bank of potential lac host biodiversity in the country. As a part of this initiative, a field plot of 0.5 ha has been established containing 16 genera and 33 species covering tree, medium and bushy type lac host plants. The collection include 6 species of *Ficus*, 4 species each of *Acacia* and *Albizia*, 3 each of *Flemingia* and *Zizyphus*, 2 each of *Prosopis* and *Dalbergia* along with each of *Cajanus, Croton, Desmodium, Garuga, Pithecolobium* and *Peltoforum*. Altogether 67 collections from different agro climatic regions for 33 species of lac hosts have been planted in the new area (Table 7).

Table 7. Collection under lac host gene bank at the Institute in the new area developed

Host plant	Number of collections
Tree Type	
Albizzia spp	6
Peltophorum ferrugeneum	1
Pithecolobium dulce	1
Ficus spp	4
Schleichera oleosa	7
Dalbergia spp	2
Acacia spp	5
Ziziphus spp	8
Butea spp	7
Prosopis spp	3
Grewia serrata	1
Eriolaena spp	1
Ficus spp	3
Croton oblongifolius	1
Garuga pinnata	1
Total	**51**
Bushy Type	
Dalbergia szamoensis	1
Flemingia spp	10
Cajanus spp	3
Desmodium spp	2
Total	**16**

Survey and collection of lac host from Gujarat, Maharashtra, Madhya Pradesh, Orissa and Andhra Pradesh

A survey was undertaken in nine districts of Gujarat plains and Hill zones and four districts of Maharashtra for collection of lac host plants during July 2007. *Ficus tsiela* trees were found heavily infested with lac insect population at Ranpur area of Banaskata district, Gujarat. Heavy infestation was also recorded on few trees of *Albizia saman* in Mandavi, Surat, Gujarat. *Kusum* plant in Narmada and Dang districts were smaller in size and girth as compared to Jharkhand. Variants of leaf characteristics were also observed for *kusum*, *ber* and *palas* trees. Available propagules of *S. oleosa, B. monosperma, A. nilotica, P. cineraria, P. ferrugenium* and nine different bio types of *Ficus* species were collected for evaluation at the Institute.

During the survey of Orissa and Andhra Pradesh: *Ficus benghalensis variegata* saplings; *P. ferrugeneum* sapling; *B. monosperma* yellow flower, suckers; *S. oleosa, A. saman* saplings were collected.

Another survey for lac hosts was undertaken in Anuppur district of M.P. Seeds from a wild population of *F. macrophylla (bhalia)* have been collected from Amarkantak (~3500' MSL). *Bhalia* is a quick growing host species supporting *kusmi* and *rangeeni* forms of *K. lacca* and other Indian lac insects. Besides, seeds of two local cultivars of *Cajanus cajan* as well as saplings of *kusum* variants for fruit yielding have been collected. These collections will be evaluated for lac insect performance.

New lac hosts identified

Garuga pinnata, a host reported to support both *kusmi* and *rangeeni* insects has been collected from Bandgoaon area of West Singhbhum, Jharkhand.

Molecular characterization of ber germplasm

With an objective to characterize the available *ber* germplasm through molecular approach, DNA was extracted and purified using modified CTAB method from 48 *ber* plants inclusive of 26 varieties, 4 species *(Zizyphus mauritiana, Z. rotundifoila, Z. nummularia* and *Z. xylopyra)* and 5 geographical collections. DNA from 4 representative *ber* plants were used for screening of ISSR and RAPD primers for molecular characterization. Out of 25 ISSR and 20 RAPD primers screened, nine from each, respectively produced satisfactory amplification products and variations between the 4 samples were selected for further molecular analysis (Fig. 2).

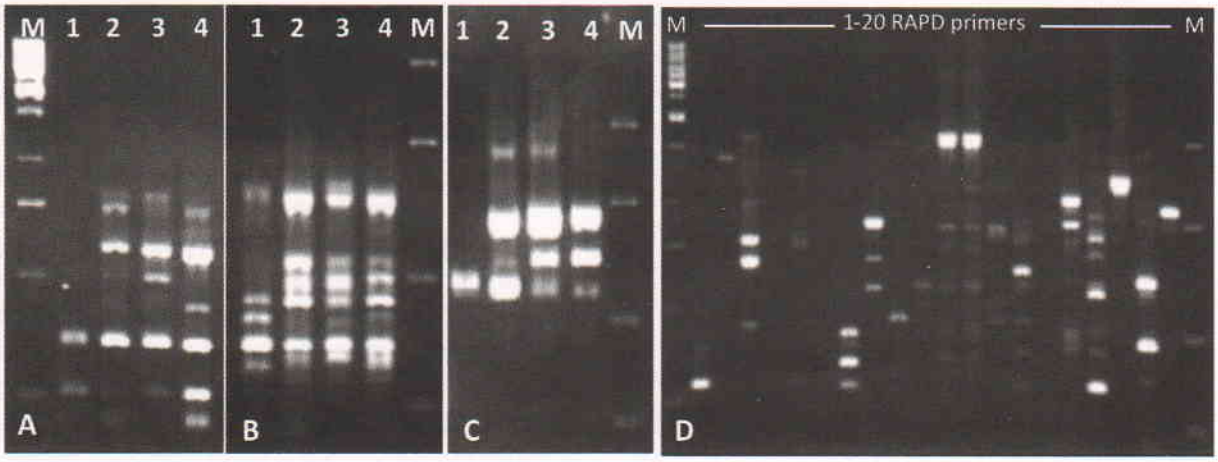


Fig. 2. Selective gel images of primer screening for ISSR in 4 representative ber samples (Z. mauritiana local (1),tikadi variety (2), Z. rotundifolia (3) and Z nummularia (4) with ISSR primer 5 (A), ISSR primer 6 (B) and ISSR primer 19 (C). Gel image of RAPD primer screening with DNA sample from tikadi variety (D). M in all the pictures represents standard DNA molecular weight markers

Molecular characterization of palas and kusum germplasm

For molecular characterization of *kusum* and *palas* germplasms, DNA extraction and purification was optimized after screening three different protocols (Fig. 3). A modified DNA extraction protocol (Method 1) adapted from Doyle and Doyle (1990) produced best yield of DNA from young leaves of both the hosts (Figure 3). The protocol will be utilized in DNA isolation from the *kusum* and *palas* collections for further molecular analysis.

1.2.2 Host plant evaluation and improvement for lac productivity and summer sustainability

Selection of Flemingia semialata for summer sustainability

F. semialata is a promising bushy host for *kusmi* lac cultivation, especially for *aghani* crop. Raising *jethwi* lac crop on this host poses problems due to high mortality of the plant as a result of summer stress, which can be largely overcome by irrigation. A selection experiment was undertaken for improving the summer sustainability of *F. semialata* bearing summer lac crop. Summer *kusmi* lac crop *(jethwi)* was raised on fifty plants, to provide a 50% insect load. The plant survival was good till May and only seven plants ultimately survived the lac insect load till maturity. Fifty seedlings raised from the seeds of surviving plants and general populations (control) were planted in August in the field for evaluation during forthcoming summer season.

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

Galwang (Albizia lucida) is a good host for summer lac production. Four genotypes, showing consistent lac productivity were earlier identified

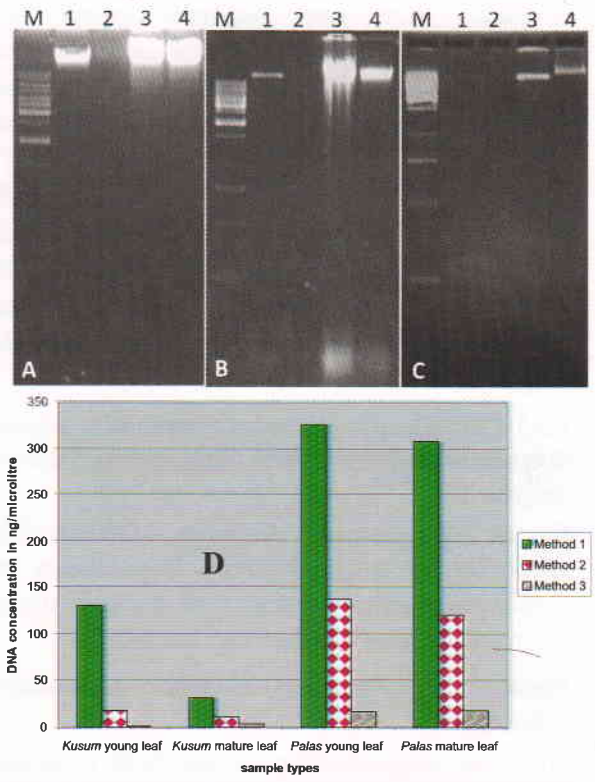


Fig. 3. Gel images of total genomic DNA extracted from kusum young (1) and mature leaf (2) and palas young (3) and mature (4) leaf by three different methods (A-C). M represents standard molecular weight marker DNA. (D) Graphical representation of DNA yield from three different methods.

(LRG501, LRG502, LRG508 and LRG511) and characterized for the leaf parameters. Five plants each of four selected genotypes of *galwang* as well as five saplings collected from the natural population were planted in the field. They will be evaluated for consistency of performance for raising summer *kusmi* lac crop *(jethwi)* after they attain proper size. One of these selected genotype (LRG501) has been added to lac host plant gene bank under the Accession No. IINRG ALU – 000003. Five more genotypes of *kusum* showing high productivity and summer sustainability have also been identified from Hesal, Ranchi. Air layers of these plants together with those identified earlier from IRF have been prepared and are under hardening in the Institute Research Plantation. They shall be planted in the field during the coming monsoon.

Screening of ber varieties for lac production

Twenty-five varieties of *ber*, including improved fruit varieties, have been planted in a field area of about 70 x 96 m in September. Ten budded plants of each variety were obtained (except two varieties, for which only 5 plants each could be obtained) from CAZRI, Jodhpur and planted. The varieties planted were: Dandan, Reshmi, Banarsi Karka, Aliganj, Katha, ZG-3, F_1 Seb x Katha, F_1 Seb x Gola, Seb, Bagwadi, BC_1 Seb x Tikadi, Gola, Illaichi, Chhuhara, Sanaur -5, Thornless, Umran, Kaithli, Maharwali, Tikadi, Banarsi Pebandi, Kali, Jogia Mundia and CAZRI Gola. They will be screened for lac potential after they attain desirable height.

1.2.3 *Clonal propagation of Schleichera oleosa (kusum) a major lac host plant through tissue culture*

Kusum (S. oleosa) displays considerable variability for lac productivity. Experiments on clonal propagation of this host through tissue culture techniques was therefore taken up.

Identification of problems in axillary bud culture of kusum

Microbial contamination in the field collected explants is one of the major problems in establishing cultures of *kusum* axillary buds under *in vitro* conditions. The endophytic bacterial contamination in the cultured axillary buds of *kusum* was minimized by media supplementation of antibiotics, cefotaxime (100 mg/l) and gentamycin (40 mg/l) without affecting the cultures (Figure 4).

Browning of culture media and explant due to phenolic secretion from the explant derived from hardwood plant is another major problem affecting the explant regeneration. Soaking of explant in antioxidant mixture solution and medium supplement of antioxidants like ascorbic acid and citric acid was found to minimize the 'browning' problem. Seasonal influence in bud dormancy was a major problem found with axillary bud cultures in *kusum*. The axillary buds were found to grow actively during the late March to July and remain dormant for the rest of the period rendering it unsuitable for axillary bud proliferation in *kusum*. Alternatively callus mediated indirect organogenesis is considered potential in multiplication of *kusum*. To test the feasibility in hardwood plants, callus was induced from explants of another hardwood plant *Albizia lucida* by addition of PGR like Thidiazuron (TDZ), and 2,4-D to the MS media. Multiple shoots of *A. lucida* were satisfactorily regenerated on the plant regeneration media containing, cytokinins (6-BAP and kinetin) and silver nitrate (Figure 5). On the same callus induction media it was possible to induce calli from the explants derived from mature *kusum* plants (Figure 5), which are being multiplied and cultured on regeneration media for organogenesis.

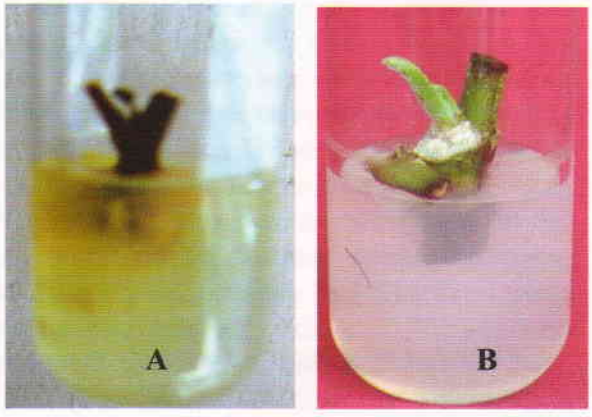


Fig. 4. Effect of antibiotics in controlling endophytic bacterial contamination in the axillary bud cultures of kusum. (A) Death of explant due to bacterial contamination. (B) Healthy shoot emergence from axillary bud of kusum cultured on medium supplemented with antibiotic.

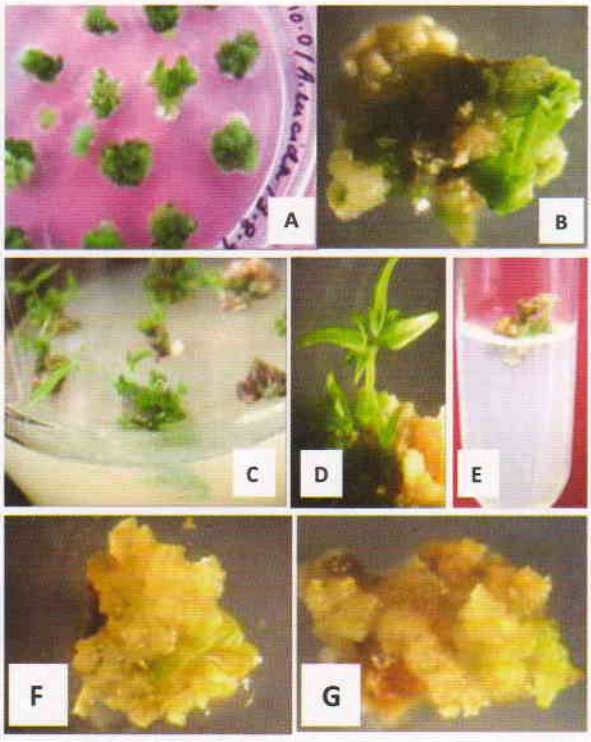


Fig. 5. Callus induction and regeneration from Albizia lucida (A-D). Callus induction and multiplication from S. oleosa (kusum) (E-G).

1.3 Crop Production

1.3.1 *Studies on in-situ moisture conservation techniques for raising mixed plantation of ber and kusum*

Study on the effect of *in-situ* moisture conservation techniques on a mixed plantation of *ber* and *kusum*, established in 2005 was continued. The soil moisture status and plant growth attributes of the plants were recorded at monthly interval (25-30 days).

Soil moisture status

During the period, the highest soil moisture content was observed under mulching treatment during all the months. The mean moisture content value under this treatment ranged from 11.3-27.9 cm/m. The soil moisture content under the mulching (T_2) and half moon terracing/half basin ring (T_1) were found significantly superior over control during January- May and October-December. During June-September (monsoon) the soil moisture level under all the treatments were at par, due to regular rains (Table 8). The half moon terracing helped in percolation of the rainwater due to longer retention period while mulching reduced the surface evaporation loss. The lowest soil moisture content (8.79–26.02 cm/m) was observed in control.

Plant height

Perusal of Table 9 shows that plant height under mulching (T_2) was significantly superior over control (T_5) in all the months. Superior plant growth in terms of height was also observed under treatment, half moon terracing (T_1) and compartmental bunding (T_3). Treatments T_1, T_2 and T_3 were found statistically at par during all the months. All treatments resulted in better vegetative growth as compared to control. The incremental increase in plant height was 30.29, 30.47, 17.72, 34.91 and 14.88 cm for treatments T_1, T_2, T_3, T_4 and T_5, respectively (Fig. 6 and 8). Better growth of the plants under treatments can be explained by moisture availability in soil during active growth

Table 8. Soil moisture content at 0-60 cm 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 '07	10.87	11.33	10.20	9.97	8.79	1.70
Feb '07	14.98	17.88	13.77	13.25	11.65	3.03
Mar '07	11.67	13.96	10.18	10.43	9.44	1.68
Apr '07	10.88	13.34	10.04	9.74	9.11	1.68
May '07	11.46	13.16	10.72	10.04	8.99	2.22
June '07	15.33	16.18	14.94	13.94	13.74	NS
July '07	27.75	27.93	27.23	26.61	26.02	NS
Aug '07	19.33	20.71	18.80	18.75	18.35	NS
Sept '07	18.32	18.37	16.97	16.91	16.54	NS
Oct '07	17.55	17.64	16.32	14.35	12.76	3.40
Nov '07	13.15	13.84	11.61	11.37	10.88	2.07
Dec '07	12.18	13.10	10.15	9.85	9.03	2.20

T_1= half moon terracing, T_2= mulching, T_3= compartmental bunding, T_4= cover corp, T_5= control

Table 9. Height of ber plants under different moisture 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 07	257.53	265.78	257.28	230.25	231.69	27.16
Feb 07	257.53	265.78	257.31	230.44	231.69	27.12
Mar 07	257.53	265.78	257.32	230.59	231.69	27.12
Apr 07	257.85	266.10	257.41	230.75	231.69	26.84
May 07	258.10	266.41	257.72	230.75	231.85	26.62
June 07	262.69	266.88	257.72	231.22	232.35	29.80
July 07	264.33	270.07	258.28	236.38	232.98	29.12
Aug 07	272.81	277.35	261.88	248.59	236.72	25.85
Sept 07	283.51	290.47	268.75	256.41	241.10	23.65
Oct 07	285.87	292.97	271.72	260.03	243.59	22.89
Nov 07	286.03	293.91	272.82	261.88	244.54	23.11
Dec 07	287.82	296.25	275.00	265.16	246.57	23.44

Table 10. Height of kusum plants under different moisture 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 07	83.75	83.50	78.25	54.75	53.00	NS
Feb 07	85.00	83.75	79.00	56.50	53.25	NS
Mar 07	85.00	83.75	79.00	56.50	53.25	NS
Apr 07	85.00	86.25	90.50	59.00	54.00	NS
May 07	86.25	97.00	92.50	59.00	58.25	NS
June 07	91.25	100.00	92.50	61.25	61.75	NS
July 07	99.50	113.00	112.50	70.00	67.75	NS
Aug 07	110.75	119.75	120.00	72.50	70.00	NS
Sept 07	112.00	123.75	146.26	103.00	77.50	NS
Oct 07	114.25	128.75	152.50	109.00	83.00	NS
Nov 07	114.25	128.75	155.00	110.75	84.25	NS
Dec 07	115.50	128.75	155.00	112.75	84.25	NS

period of the plant. The analysis of variance indicated that there was significant effect of different soil moisture conservation treatments on the growth (height) of *ber* plants. Though, the incremental magnitude in plant height of *kusum* was observed as 31.25, 45.25, 76.75, 58.0 and 31.25 in treatments T_1, T_2, T_3, T_4 and T_5, respectively (Fig. 7), no significant difference was observed due to moisture conservation techniques during the period (Tables 10).

Yield of inter-cropped urd (black gram)

Black gram was sown as intercrop @ 17.36 kg/ha (0.25 kg per plot) in the treatment T_4 in July. The

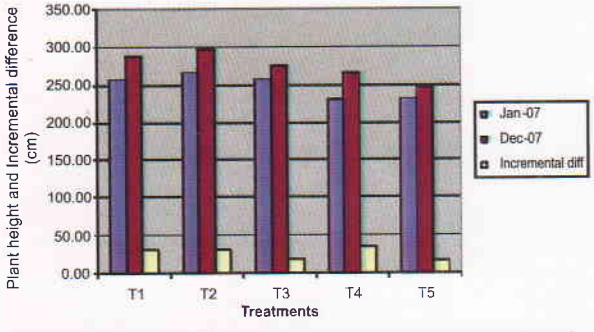


Fig. 6. Incremental growth in height of ber under the moisture conservation treatments

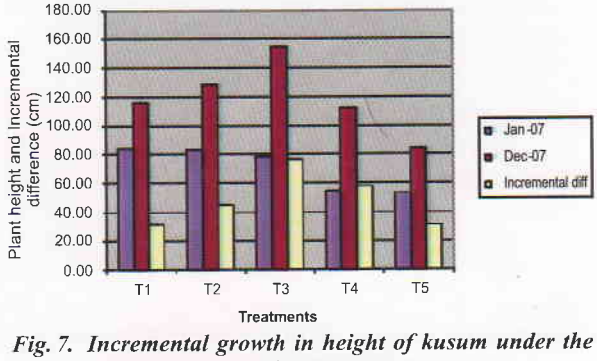


Fig. 7. Incremental growth in height of kusum under the moisture conservation treatments

Fig. 8. Growth of ber plant under mulching treatment (right) and control (left)

crop was harvested in early November and the grain yield was found to be 2.3 q/ha. Biomass (Roots + stalks + leaves) @ 23.5 q/ha was also obtained, which was used over the soil surface to act as surface mulch in the plot. The intercropping with black gram in the system will help in improving soil condition, soil moisture status, reduction in soil loss and employment generation with additional income to the farmers.

1.3.2 Development of kusmi lac cultivation technology on Albizia procera (siris)

The experiment was carried out at *Putidih* village of *Jhalda* block in *Purulia* district (West Bengal). *Jethwi* crop was inoculated on 10 *siris* and three *kusum* trees in first week of March 07. The *siris* trees were pruned eight months prior to inoculation and the average length of new shoot was 1.90 meter at the time of inoculation. The density of lac insect settlement at 35-40 days of inoculation on *siris* tree was found to be 40-78 per square cm and initial mortality was 21-75%. The density of settlement on shoots of *S. oleosa* was 28-53 per sq cm and initial mortality 39-70 %. However, due to general mortality of lac insect culture on both hosts (*siris* and *kusum*), final conclusion could not be drawn and experiment was discontinued.

Observation on length of available shoot after 6, 12 and 18 months of pruning indicate that the average length of shoot varies from 1-1.5, 2-2.5 and 4.5 meter respectively. *Siris* trees pruned six months prior to inoculation lacks secondary shoot and the insect settled on primary shoots only. Trees pruned one year before inoculation have secondary shoots also with an average length of 30 cm. The insect settled mainly on these shoots. Trees pruned 18 months prior to inoculation have very thick primary shoots which was not suitable for settlement of lac insect. However, secondary shoots with average length of 55 cm is suitable for lac insect settlement.

Aghani crop raised on 25 *siris* trees and five *ber* trees were used as a check during Aug 07. Out of 25 trees of *siris*, 10 each were pruned 6 and 12 months prior to inoculation and the remaining 5 trees pruned 18 months prior. The observations were recorded for different biological characters and given in Table 11. The settlement density of lac insect was significantly higher on *ber* shoots than *siris* but no difference was observed between different age group of shoots in case of *siris*. The observations also indicated that the initial mortality was significantly higher on *siris* as compared to *ber* trees. Similarly initial mortality was significantly higher on trees pruned 12 and 18 months prior to inoculation than that of six months before trees pruned. However, there was no difference in mortality at sexual maturity stage between *ber* and *siris* as well as between three different age group of shoot from *siris* tree. No difference was found in sex ratio between *siris* and *ber* as well as between different age group of shoots on *siris* tree.

Table 11. Biological characteristics of lac insect on siris and ber trees

Host	Age of shoot (months)	Settlement density per Sq cm	Initial mortality (%)	Sexual stage mortality (%)	Per cent male
Siris	6	32	35.6	20.3	23
	12	34	61.0	26.3	20
	18	35	66.2	27.3	19
Ber	5	42	18.3	27.1	22
S.Em±		2.27	3.60	NS	NS
CD 5%		**6.42**	**10.18**		

1.3.3 *Collection, identification and assessment of diseases of commercial lac hosts*

Diseases affecting commercial lac hosts

Palas

Leaf spot caused by *Xanthomonas butae* appears during July-August and remained sporadic till November. The severity of the disease grew further and becomes moderate in severity till December. The occurrence of the disease was found widespread in Jharkhand and West Bengal. It was also observed that smaller bushes were having more severe disease than the grown up trees. Some other leaf spots were also collected. Identification of these leaf spots is in progress.

Ber

Powdery mildew caused by *Erysiphe zizyphi* was found in moderately severe form in Barajamdah area of Singhbhum district of Jharkhand on cultivated variety in the month of November. The disease had affected leaves and fruits. Sooty mould caused by *Cladosporium zizyphi* was also found growing on wild varieties commonly used for lac cultivation. The disease appears during January-February on the lower surface of the leaves. Severity grows with time and becomes more severe during April causing even leaf fall.

1.3.4 *Management of sooty mould, causing lac insect death and failure of lac crops*

Sooty mould fungus, *Capnodium* sp. was isolated and maintained in the laboratory. To see its effect on growth of sooty mould on lac encrustation an experiment was laid out. Inoculum was collected from two sources: i) sooty mould growing on honeydew on *ber* leaves and ii) growing on culture media. In both the cases, inoculum was homogenized in sterile water. Three treatments were made, inoculum from mould growth on *ber* leaves (F), inoculum from culture media (M) and sterile water (W) as control. These were sprayed on lac encrustation. High Relative Humidity (RH) was maintained artificially for one week. Two observations were taken at fortnightly interval on 13.11.07 and 30.11.07. During experiment the average max. and min. temp. were 27.03 and 13.26^{0}C, respectively and average max. and min. RH were 77.26 and 48.83 %, respectively. Results revealed that in both the observations sooty mould growth was higher in both M and F treatments than control (Table12).

Table 12. Growth of sooty mould on lac encrustation under high humidity

Sl. No.	Treatment	Sooty mould growth (%) on 13.11.07	30.11.07
1	Inoculation from field	12.4	8.4
2	Cultured inoculation	15.2	9.4
3	Water spray	2.6	1.6

Role of ants in development of sooty mould growth

Experiment was undertaken to know the role of ants in development of sooty mould growth. Two set of *ber* trees were selected. In one set Institutes recommended plant protection measure (1 spray of endosulfan + carbendazim followed by 2 sprays of dichlorvos + carbendazim) was adopted (P-1) and in another set no plant protection measure was adopted (P-2). In both sets of trees, on some branches ants were not allowed (A-1) and on others ants moved freely (A-2). Three observations on sooty mould growth were undertaken at approximately monthly interval. The data was analyzed through 't' test in paired plot technique. Results indicate that visit of ants to lac encrustation resulted in statistically significant reduction in sooty mould growth. Under P-2 condition though there was reduction in sooty mould growth but significant reduction was observed only in observation taken on 17.11.07. But under P-1 condition the significant reduction was observed in all the three observations. Movement of ants were also recorded under both P-1 and P-2 conditions and it was observed that under P-1 condition 16 ants/10 minutes were moving on the tree trunk while under P-2 conditions 20.5 ants/ 10 minutes were observed (Tables 13, 14a, 14b).

Table 13. Role of ants on the development of sooty mould without any plant protection measures

Sl. No.	Conditions	Sooty mould growth (%) on 15.10.07	17.11.07	11.12.07
1	Ants were not allowed	42.5	58.3*	58.2
2	Ants moved freely	39.2	29.2	51.0
		NS	NS	

Table 14a. Role of ants on the development of sooty mould under recommended spraying condition

Sl. No.	Conditions	Sooty mould growth (%) on		
1	Ants were not allowed	75.7**	78.6*	78.4
2	Ants moved freely	40.7	41.4	48.6

Table 14b. Movement of ants on the tree

Sl. No.	Conditions	Sooty mould growth (%) on		
1	Ants were not allowed	75.7**	78.6*	78.4*
2	Ants moved freely	40.7	41.4	48.6

Role of plant density on sooty mould growth

In another experiment to know growth of sooty mould under different planting density, two sets of treatments were selected. In one set planting was dense (D-1) and in another set it was sparse. Two observations were taken on 18.10.07 and 18.11.07 at monthly interval. Results revealed that though sooty mould growth was more in dense planting but the difference was not significant (Table 14c).

Table 14c. Sooty mould severity on lac encrustation due to plant density

Sl. No.	Treatment	Sooty mould growth (%) on 18.10.07	18.11.07
1	Dense planting	45.4	43.9
2	Sparse planting	39.4	45.0
	CD at (0.05%)	0.230	0.467

1.3.5 *Soil fertility management of ber (Z. mauritiana) for shoot growth and lac yield (aghani)*

Thirty two treatment combinations comprising of two levels each of liming (no liming and liming), phosphorus (0 and 150g/ tree), potassium (0 and 150 g/ tree) and four levels of nitrogen (0, 100, 200 and 400 g/tree) were applied to randomly selected *ber* trees in three replications. Liming was done in May and ½ dose of N and full dose of P and K was applied in July and rest N was applied in September. Four branches of different dimensions were tagged to measure growth parameters before and after fertilizer application. For the study of density of settlement and initial lac mortality, counting of respective traits were done per square centimeter. Branches of the experimental trees were sampled randomly and sorted into two categories- those with basal diameter of less than 1.0 cm and those with more than 1.0 cm. Thereafter, per cent mortality of lac insects on both the types of branches was recorded in November (Table 15).

Plant parameters

A clear cut difference in chlorophyll content index of *ber* leaves have been observed due to lime application. But other factors could not produce any significant effect on this parameter. Average performance of trees receiving no lime was found better in respect to per cent increase in shoot diameter during the period July to December. Increase in diameter of shoot could be the result of pH status of the previous season. Other parameters

Table 15. Plant growth parameters as affected by liming, N, P and K

Factors	Chlorophyll content index			Increase in shoot dia. (%)	Shoot dry matter,%	Soil pH	
	17.07.07	31.07.07	16.08.07			June	Dec.
No lime	18.2	17.5	20.3	41.7	40.3	6.5	6.6
Liming	20.1	19.8	21.9	37.1	39.1	5.9	6.7
SEM±	0.46	0.37	0.60	2.14	0.81		
$CD_{(0.05)}$	1.31*	1.05*	-	-	-	-	-
N_0	19.7	19.1	21.9	38.4	40.3	6.3	6.7
N_{100}	18.2	18.5	20.2	40.2	39.6	6.2	6.7
N_{200}	19.0	18.3	20.6	41.4	39.5	6.2	6.6
N_{400}	19.5	18.8	21.5	37.4	39.3	6.2	6.7
SEM±	0.66	0.53	0.85	3.07	1.14		
$CD_{(0.05)}$	-	-	-	-	-	-	-
P_0	19.1	19.0	21.6	39.4	38.7	6.2	6.7
P_{150}	19.2	18.3	20.5	39.4	40.7	6.2	6.7
SEM±	0.46	0.37	0.60	2.14	0.81		
$CD_{(0.05)}$	-	-	-	-	-	-	-
K_0	18.6	18.6	21.3	39.5	40.3	6.2	6.7
K_{150}	19.6	18.7	20.8	39.3	39.1	6.2	6.7
SEM±	0.46	0.37	0.60	2.14	0.81		
$CD_{(0.05)}$	-	-	-	-	-	-	-

e.g. N, P and K could not change the increase in diameter of shoot significantly. Dry matter per cent of shoots, which indirectly reduces shoot succulence, registered no significant difference due to different treatments in the month of September. Although difference is non significant but more dry matter was accumulated in phosphorus treated trees. It could be the possible reason for increased initial lac insect mortality due to phosphorous application. Results pertaining to growth parameters have been presented in Table 15.

Lac parameters

Application of lime significantly reduced the initial lac insect mortality at different portions of shoot (Table 16). Initial density of settlement was also found to be significantly affected by treatments. Male per cent of lac insect population also increased significantly due to lime application. Improvement in density of settlement and reduction in initial mortality was recorded with application of nitrogen. The highest density and least mortality were recorded in case of nitrogen application @100 g/ tree. However, the influence reduced with subsequent higher doses. Male per cent remained unaffected by nitrogen application. Phosphorus application increased initial mortality particularly in the mid portion of the shoot. Density of settlement was also significantly different at apical portion of the branch. But male proportion was not affected by phosphorus application. Higher settlement density was also observed on application of potassium and male proportion was affected.

Survival of lac

Effect of soil pH of the previous season has influenced the survival percentage of lac on branches of higher diameter. Survival of lac insect was higher after sexual maturity on trees with 100 g nitrogen application and subsequent higher doses have shown lower survival, though differences were not significant. Phosphorus application could not affect lac survival in later stages. However, potassium application was found to reduce lac survival by 7 per cent as compared to control (Table 17).

Other parameters

Termite infestation is a serious problem on *ber* trees particularly during monsoon and post monsoon period. Extent of termite infestation was visually assessed under different treatments. Phosphorus application could reduce termite infestation significantly (Table17).

1.3.6 *Production of quality kusmi broodlac at Institute Research Farm*

A total of 472 kg broodlac was harvested from *kusum* trees in July/August 2007. 425 kg broodlac has been inoculated on 500 *ber* trees / bushes and remaining broodlac was provided / sold to different projects/farmers. 510 kg of scraped lac has been sold and about 250 kg of *phunki* lac sticks are in stock.

Table 16. Lac insect growth parameters as influenced by lime, N, P and K

Factors	Initial mortality/ sq cm			Initial settlement/ sq cm			Male (%)
No lime	16.4	14.0	14.5	136.6	139.4	136.9	30.0
Liming	13.0	11.3	9.7	147.6	153.8	151.4	32.0
SEM±	1.60	1.45	1.26	4.93	4.93	5.13	0.003
$CD_{(0.05)}$	-	-	3.57*	14.00*	14.00*	14.56*	0.01*
N_0	16.4	13.6	14.6	135.0	139.3	137.9	30.6
N_{100}	12.4	11.1	10.2	159.6	155.4	153.3	29.7
N_{200}	13.6	11.9	10.9	139.2	153.1	142.2	30.8
N_{400}	16.4	14.0	12.8	134.6	138.7	143.3	31.9
SEM±	2.26	2.05	1.78	6.97	6.97	7.25	0.005
$CD_{(0.05)}$	-	-	-	19.44*	-	-	-
P_0	13.4	9.4	11.0	148.9	147.2	144.7	31.3
P_{150}	15.9	15.9	13.2	135.3	146	143.6	30.3
SEM±	1.6	1.45	1.26	4.93	4.93	5.13	0.003
$CD_{(0.05)}$	-	4.12*	-	14.00*	-	-	-
K_0	15.8	13.2	11.5	138.7	139.9	141.0	31.3
K_{150}	13.6	12.1	12.7	145.5	153.4	147.3	30.2
SEM±	1.66	1.45	1.26	4.93	4.93	5.13	0.003
$CD_{(0.05)}$	-	-	-	-	14.00*	-	0.01*

Table 17. Lac insect survival and termite infestation as affected by liming, N, P and K

Fators	Lac survival on branches of basal diameter		Termite infestation %		Transmission ratio
	<1.0 cm	>1.0 cm	September	November	
No lime	40.3	51.7	57.6	18.2	37.6
Liming	42.5	43.7	55.6	20.3	34.6
SEM±	3.40	2.55	4.9	2.73	2.11
$CD_{(0.05)}$	-	7.24*	-	-	-
N_0	37.9	50.3	44.2	20.8	32.6
N_{100}	45.3	51.8	64.9	14.6	36.0
N_{200}	42.6	46.8	64.9	20.8	40.3
N_{400}	39.6	41.9	51.3	20.8	35.3
SEM±	4.8	3.61	7.30	3.86	2.98
$CD_{(0.05)}$	-	-	-	-	-
P_0	43.3	48.3	65.6	20.8	36.3
P_{150}	39.5	47.1	46.9	17.7	35.9
SEM±	3.4	2.55	4.9	2.73	2.11
$CD_{(0.05)}$	-	-	13.9*	-	-
K_0	41.6	51.3	53.2	17.2	35.6
K_{150}	41.1	44.1	59.6	21.3	36.6
SEM±	3.40	2.55	4.9	2.73	2.11
$CD_{(0.05)}$	-	7.24*	-	-	-

Revolving Fund Scheme

Balance Sheet (April 2007 – March 2008)

Balance Sheet as on 31.03.2008 (Amount in Rupees)

Corpus/ Capital Fund & Liabilities		Current Year	Previous Year
Capital Fund			
(a) As on 01.04.2007	1672990		
(b) Net Profit/Loss from P& L A/C	54203	1727193.00	
Reserves		0.00	0.00
Earmarked/Endowment Funds		0.0	0.00
Current Liabilities & Provisions			
(a) O/S Worker's share	59714	59714.00	0.00
(b) Others	0		
TOTAL		**1786907.00**	**0.00**
Assets			
Fixed Assets		0.00	0.00
Investments		0.00	0.00
Endowment Funds		0.00	0.00
Current Assets, Loans & Advances			0.00
(a) O/S Credit Sales	74985		
(b) Loans to RFS:II	100000		
(C) Cash in Bank	1611922	1786907.00	0.00
TOTAL		**1786907.00**	**0.00**

PROFIT & LOSS ACCOUNT FOR THE YEAR ENDED AS ON 31.03.2008 (Amount in Rupees)

A. CREDIT		Current Year	Previous Year
Income from Sales/Service		0.00	0.00
(a) Cash sale of (i) Broodlac	62465		
(ii) Sticklac	51000	113465.00	
(b) Credit Sales: (i) Institute	50505		
(ii) Broodlac	6240		
(iii) Sticklac	18240	74985.00	
Income from Royalty, Publications		0.00	0.00
Interest Earned		0.00	0.00
Other Income		0.00	0.00
Prior Period Income		0.00	0.00
TOTAL		**188450.00**	**0.00**

B. DEBIT		Current Year	Previous Year
Cost of Sales			
(a) Labour Charges	68205		
(b) Contingency	6328		
(c) Travelling Allowance	0		
(d) Others	0	74533.00	0.00
O/S Worker's Share		59714.00	0.00
Miscellaneous Expenses		0.00	0.00
Depreciation		0.00	0.00
Prior Period Expenses		0.00	0.00
TOTAL		**134247.00**	**0.00**
Balance being surplus /deficit carried to Corpus/Capital Funds		***54203.00***	***0.00***

Receipts	Current Year	Previous Year	Payments	Current Year	Previous Year
1 Opening Balances			1 Expenses		
a) Cash in Hand	0	0	a) Labour Charges	68205	0
b) Cash in Bank			b) Contingency	6328	0
in current accounts	1672990	0	c) Travelling Allowance	0	0
in Deposit accounts (STD)	0	0	d) Others	0	0
in savings accounts	0	0			
			3 Investments & Deposits		
2 Cost of Sales realised	113465	0	a) Investments	0	0
			b) Loans	100000	0
			c) Advances	0	0
			8 Closing Balances		
		0	a) Cash in Hand	0	0
			b) Cash in Bank	1611922	0
			in current accounts	0	0
			in Deposit accounts	0	0
			in savings accounts	0	0
			c) in transit		
TOTAL	**1786455**	**0**	**TOTAL**	**1786455**	**0**

1.3.7 *Development of lac production system using high density ber plantation under semi protected condition*

A concept project, sponsored by NABARD, has been taken up by the Institute for production of lac, in high-density plantation.

Earlier, a suitable site was selected in the Research Farm of the Institute and a plot measuring 16 x 45m was earmarked. The layout and planting system was prepared and land developed accordingly. To know the basic status of soil of the area, 18 soil samples were collected from two depths (0-30 and

Fig. 9. Top view of high density ber plantation (about one year after planting)

Fig. 10. Close-up of high density ber plantation showing individual plant and intercrop groundnut

30-60 cm) and analyzed for pH, organic carbon and available nitrogen, phosphorus and potassium. The soil of the plot was strongly to very strongly acidic in nature. Available nitrogen and potassium were medium; nitrogen was low in lower depth. However, P_2O_5 was low at both the depths. In view of the soil acidity, lime @ 4.0 ton/ha was applied during the middle of May.

The planting area was prepared by digging four trenches measuring size of 46.0 x 2.0m. F.Y.M. was applied @ 10.0 ton/ha. *Ber* plants were raised under triple hedge system in the plot, which accommodated 536 plants. The plant to plant distance was maintained 1.0m (within) and row to row 0.75m (between); the interstrip space between two triple hedges was 2.5m. Thus, 7445 plants can be accommodated in one hectare.

The planting had been done in August 2006 by *ber* seedlings (local cultivar) raised earlier in polybags. The average height of plants by the middle of September was 0.8m (n=168) (Fig. 9). *Salad pea* (Snow P) was raised as cover crop during *kharif* the previous year in the interspaces of *ber* plants. The total number of pea plants raised was ~2500 in the planted strips, equivalent to ~69,000 plants/ha. Basal manuring was done using FYM and vermicompost. 145 kg of fresh peas and 5 kg of seeds was obtained from the crop. Groundnut (AK 12-24) has been raised as cover crop in June 2007, in the interplant spaces of *ber* plant strips for interim returns and enrichment of the soil. Vermicompost was applied at 12.5 kg per strip as basal dose. The yield was 26 kg (dry) (Fig. 10). The growth data were recorded in September 2007. The mean height of the *ber* plants was 1.9 m and mean basal diameter was 2.16 cm.

1.3.8 Weed management in lac host plantation

The study was taken up with the objective to identify, categorize and assess the weed flora in plantations of five lac hosts, *viz.*, *B. monosperma*, *Z. mauritiana*, *S. oleosa*, *F. macrophylla (bhalia)* and *F. semialata* and also to evaluate mechanical and chemical practices for weed control, so that suitable integrated weed management technology can be evolved. The planting pattern of the lac hosts was as follows: *palas* - 3.6 x 3.6 m; *ber*-3.0 x 2.5 m; *kusum*- 6.0 x 6.0 m; *bhalia*- 2.0 x 1.5 m and *F. semialata*- 0.5 x 1.0 x 2.0 m (paired row). Weed samples were collected from the plantation from two random quadrates of 50.0 x 30.0 cm during rainy season in September, 2007. The samples were identified, counted, segregated, and then oven dried at 65°C till the constant weight was obtained.

Weed dry matter accumulation (t/ha) during rainy season in five lac hosts plantations have revealed that grassy weeds were predominated in the field constituted 72.1% of total weeds accumulations followed by broad leaved (23.2%) and sedges (4.8%) (Table 18). Weeds occurring in studied lac host plantations constituted of *Eleusine indica* (L.), *Cynodon dactylon* (L.), *Digiteria sanguinalis* (L.), *Echinocloa* spp (L), *Dactylactenium aegypticum* (L.), *Brachiaria remosa* (L.), *Setaria verticellata* (L.) among grasses whereas, *Ageratum conyzoides*, *Alteranthra sessilis* (L.), *Emelia sonchyfolia*, *Spilanthes acmella*, *Stellaria media*, *Oldenlandia corymbosa*, *Commelina benghalensis*, *Phylanthus niruri* and *Desmodium trifolium* among broad leaved; *Cyperus iria*, *Cyperus rotandus* and *Cyperus deformis* among sedges. Among these three species *i.e.*, *Ageratum conyzoides*, *Brachiaria remosa* and *Echinocloa colonum* were present in all the five lac host plantations.

Relative Frequencies (RF) of different weeds species in the five lac host species studied are given in Table 19. The RF value also varied for the host species. *Ageratum conyzoides* registered the highest RF values among all the host plantation (24.0-62.3%) except *F. semialata* (9.1%).

Table 18. Dry matter of weeds accumulated in different lac host plantation

Lac hosts	Dry matter (t/ha)			Total
	Grasses	Brood leaved	Sedges	
Palas (B. Monosperma)	1.52 (53.4)*	1.07 (37.5)	0.26 (9.1)	2.85
Ber (Z. mauritiana)	0.69 (58.5)	0.46 (39.0)	0.03 (2.5)	1.18
Kusum (S. oleosa)	1.81 (86.2)	0.15 (7.1)	0.14 (6.7)	2.10
Bhalia (F. macrophylla)	0.94 (81.0)	0.20 (17.3)	0.02 (1.7)	1.16
Semialata (F. semialata)	2.91 (80.2)	0.65 (17.9)	0.07 (1.9)	3.63

** Values in parentheses are percentage of total dry matter accumulation*

During the period under report an experiment was also laid out in RBD (Randomised Block Design) with seven treatments and three replications, to screen six herbicides. The herbicides screened were paraquat @ 4.0 kg ai/ha, glyphosate @ 1.0 kg ai/ha, gluphosinate @ 1.0 kg ai/ha, oxyfluorfen @ 0.4 kg ai/ha, atrazine @ 2.0 kg ai/ha and quzalofop-p-ethyl @ 0.2 kg ai/ha. The plot size was 7.0 x 4.5 m. Three each of non-selective and selective herbicides were applied in the plots, 15 days before planting of *F. semialata*. The host plants were planted at paired row system as described above. Weed samples were collected at 40 DAS (Days after spraying). The results showed that among different herbicides tested paraquat (24SL) at 0.4 kg ai/ha was found to be most effective with 62.1 per cent weed control efficiency (WCE) followed by gluphosinate (15SL) and glyphosate (41SL) at 1.0 kg ai/ha with 55.2 and 45.03 per cent WCE, respectively. However, plant growth of *F. semialata* was better under glyphosate treatment providing 17 per cent increase in growth (height and girth) as compared to control after three months of planting of the host plants.

1.3.9 *Impact of pitcher irrigation and mulching on the summer season (jethwi) crop sustainability and new leaf initiation period on ber*

The study was initiated in April 2006 with the objective to study the effect of pitcher irrigation

Table 19. Important weed species present in different lac host plantations and their relative frequency

Name of weed species	Relative frequency (%)				
	Palas	*Ber*	*Kusum*	*Bhalia*	*Semialata*
Grasses					
Digitaria sanguinalis (L)	6.7	7.3	2.7	5.0	9.1
Brachiaria remosa	0.7	3.8	4.4	1.3	2.7
Dactyloctenium aegypticum (L.)	-	6.1	0.5	1.7	8.1
Cynodon dactylon (L.)	-	4.6	-	20.7	11.8
Echinochloa colonum (L.)	6.0	8.8	3.8	1.0	6.4
Eleusina indica	9.2	0.4	-	-	3.6
Setaria verticillata (L.)	-	-	4.9	0.7	-
Broad leaved					
Ageratum conyzoides	46.5	25.4	24.0	64.2	9.1
Alternavethra sessilis	-	16.9	4.4	3.4	11.8
Commelina benghalensis	0.7	-	16.9	-	0.5
Emelia sonchyfolia	8.1	8.8	-	-	0.5
Oldenlandia corymbosa	7.4	13.1	16.9	-	6.4
Phylanthus niruri	1.4	0.8	3.3	0.7	-
Stellaria media	2.1	-	-	0.7	3.2
Desmodium trifolium	-	0.8	-	-	0.5
Hedyotis corymbosa	-	-	3.3	-	-
Spilanthes acumella	1.4	-	-	-	1.1
Sedges					
Cyperus iria	5.6	0.8	9.8	-	28.5
Cyperus rotundus	2.1	-	3.8	2.7	1.1
Cyperus deformis	-	-	1.1	-	1.6

with mulching on lac crop mortality, leaf initiation period (unpruned trees) and number of new shoots (pruned trees). Sixteen *ber* plants of nearly uniform size were selected for the study. Thirty-two pits were dug to accommodate unglazed pitchers of 10 litre capacity each at the plant periphery in the active root zone. Eight plants were used for raising the summer crops of *kusmi* and *rangeeni*, in each season. Out of eight plants under one crop, two plants were provided with pitchers, two plants with pitcher with mulching, while four plants were not given pitcher irrigation or mulching (control). Four pitchers were provided for each plant, which were buried in the soil at 75 cm from the trunk, with their mouths above the ground. They were filled with water and covered with clay lids to minimize evaporation. Mulches were applied in form of dried *akashmani (Acacia auriculiformis)* leaves @ 15 kg/plant in the periphery (one meter radius) of plants under mulch treatments. Water was filled in the pitchers up to its neck at weekly interval and seepage rate was determined, which was found to be 0.05 lph.

Eight trees were pruned in early September, 2006 and *kusmi* broodlac was inoculated @ 5 g/m shoot length in February 2007. The lac crop was harvested in August. Since, the larvae didn't emerge even after 15 days of it's harvesting, the data of lac stick/scraped lac was taken and presented in Table 20.

Application of pitcher irrigation has improved the sticklac yield in *jethwi* crop as compared to control. The sticklac yield ratio in case of pitcher irrigation was 1:7.3 which was at par with pitcher irrigation with mulching and five times higher than the control, indicating beneficial effect of the method of irrigation, with no additional effect of mulching application (Fig. 11). This appears to be due to application of irrigation in the root zone of the plant through pitchers, which has restricted surface evaporation completely. The yield ratio in case of control was 1:1.4 only which has indicated the moisture stress and role of irrigation in growth and developzment of lac crop. No definite trend was observed for leaf initiation, as it was observed around the same time in plants under treatments as well as control.

Baisakhi crop of *rangeeni* strain was also inoculated on the remaining 8 pruned *ber* plants (pruned in April 2006) in October 2006 with the imposition of same treatments. Total mortality was observed in March 2007.

1.3.10 *Promoting early shoot growth of ber through fertility management for raising its plantation*

Soil fertility management in young plantation of ber

Two sets of experiments were conducted to determine the effect of (i) nitrogen and phosphorus and (ii) fertility levels and sources of nutrients on growth of *ber* seedlings under soil conditions of Ranchi, Jharkhand.

Effect of Nitrogen and Phosphorus as soil application

Combinations of three doses each of nitrogen (0, 50 and 100 g/ tree) and phosphorus (0, 85 and 170 g/ tree) were applied to *ber* seedlings to know the effect of each nutrient for raising plantation. Data on different growth parameters are presented in Table 21. Chlorophyll content of the leaves of *ber* seedlings was found to be markedly influenced by nitrogen application, measured five months after transplanting. Other growth parameters e.g. plant height, basal diameter, number of branches etc. remained unaffected by nitrogen application. Application of phosphorus could not affect growth within the short period. A slightly higher chlorophyll content index was noticed at the age of five months, due to phosphorus application. Effect

Table 20. Effect of pitcher irrigation on lac production during summer season (jethwi) crop

Treatment	No. of plants	Mean weight of inoculated broodlac (g)	Mean weight of harvested lac stick (g)	Yield ratio (sticklac used: obtained)
P+M (Pitcher with mulching)	2	90 (225)	658 (1645)	1: 7.3
P (Pitcher only)	2	95 (237.5)	692 (1730)	1: 7.3
Control	4	72.5 (181.25)	102.5 (256.25)	1: 1.4

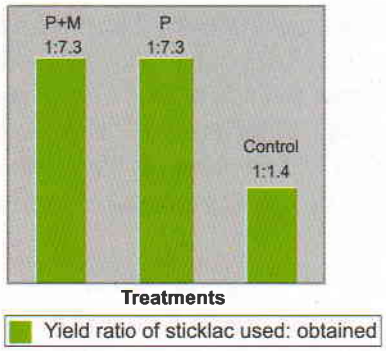


Fig. 11. Yield ratio of sticlac (used: obtained) under different treatments

of phosphorus could probably expected on other traits at later stages of development.

Effect of different NPK levels

Treatment combination of two fertility levels (NPK @ 50-85-40g and 100-170-80g per tree) and three sources of nutrients (full organic, full inorganic and ½ organic + ½ inorganic) along with control, replicated five times were allocated randomly to the *ber* seedlings to assess the effect of fertilizer levels and sources of nutrients in promoting growth of *ber* plants. Growth parameters were not influenced significantly by fertility levels, though higher numeric values were observed in the treated plants as compared to control (Table 22). Trend of plant growth due to application of nutrients ½ in organic and ½ in inorganic form was found to be better though differences were non-significant. Damage by leaf eaters was maximum when nutrient source was fully inorganic and it was minimum when it was applied ½ as organic and ½ as inorganic; the differences were significant.

1.3.10 *Promoting early shoot growth of ber through fertility management for raising its plantation*

Soil fertility management in young plantation of ber

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Effect of Nitrogen and Phosphorus as soil application

Combinations of three doses each of nitrogen (0, 50 and 100 g/ tree) and phosphorus (0, 85 and 170 g/ tree) were applied to *ber* seedlings to know the effect of each nutrient for raising plantation. Data on different growth parameters are presented in Table 21. Chlorophyll content of the leaves of *ber* seedlings was found to be markedly influenced by nitrogen application, measured five months after transplanting. Other growth parameters e.g. plant height, basal diameter, number of branches etc. remained unaffected by nitrogen application. Application of phosphorus could not affect growth within the short period. A slightly higher chlorophyll content index was noticed at the age of five months, due to phosphorus application. Effect of phosphorus could probably expected on other traits at later stages of development.

Table 21. Growth parameters of ber plants as affected by levels of nitrogen and phosphorus

Factors	Chlorophyll Content Index		Damaged leaf (%)	Height (cm)	Basal diameter (cm)	No. of branches
	60 DAT	150 DAT	60 DAT	150 DAT	150 DAT	150 DAT
Nitrogen levels						
N_0	15.7	23.8	36.1	108.6	1.03	14.6
N_{50}	20.4	31.6	35.4	121.2	1.16	15.8
N_{100}	20.3	35.6	32.2	114.3	1.20	15.4
SEm±	2.48	2.04	0.023	6.18	0.071	1.23
$CD_{(0.05)}$	NS	5.93*	NS	NS	NS	NS
Phosphorus levels						
P_0	19.6	27.6	36.1	123	1.22	14.4
P_{85}	17.9	33.6	35.4	109.9	1.11	16.4
P_{170}	18.8	29.7	33.2	111.2	1.07	15.1
SEm±	2.48	2.04	0.023	6.18	0.071	1.23
$CD_{(0.05)}$	NS	NS	NS	NS	NS	NS

DAT= Days after transplanting

Effect of different NPK levels

Treatment combination of two fertility levels (NPK @ 50-85-40g and 100-170-80g per tree) and three sources of nutrients (full organic, full inorganic and ½ organic + ½ inorganic) along with control, replicated five times were allocated randomly to the *ber* seedlings to assess the effect of fertilizer levels and sources of nutrients in promoting growth of *ber* plants. Growth parameters were not influenced significantly by fertility levels, though higher numeric values were observed in the treated plants as compared to control (Table 22). Trend of plant growth due to application of nutrients ½ in organic and ½ in inorganic form was found to be better though differences were non-significant. Damage by leaf eaters was maximum when nutrient source was fully inorganic and it was minimum when it was applied ½ as organic and ½ as inorganic; the differences were significant.

Table 22. Growth parameters of ber as affected by fertility levels and sources of nutrients

Factors	Chlorophyll Content Index	Damaged leaf (%)	Height (cm)	Basal diameter (cm)	No. of branches
	60 DAT	60 DAT	150 DAT	150 DAT	150 DAT
Fertility levels					
$N_{50}P_{85}K_{40}$	14.08	27.1	106.2	0.98	13.7
$N_{100}P_{170}K_{80}$	12.6	27.6	105.3	0.97	14.4
SEm±0.57	2.58	4.57	0.046	0.81	
$CD_{(0.05)}$	NS	NS	NS	NS	NS
Control	11.5	31.2	98.4	0.84	12.6
$SEm_{(control\ vs\ rest)}$	0.64	2.89	5.11	0.05	0.91
$CD_{(0.05)}$	NS	NS	NS	NS	NS
Mode					
Full organic	12.7	25.8	98.8	0.96	13.2
Full inorganic	12.9	33.8	105.2	0.95	14.3
½ org + ½ inorganic	14.4	22.4	113.3	1.01	14.7
SEm±	0.64	2.89	5.11	0.052	0.91
$CD_{(0.05)}$	NS	8.41*	NS	NS	NS

DAT= Days after transplanting

2. PROCESSING AND PRODUCT DEVELOPMENT

2.1 Synthesis and Product Development

2.1.1 *Comparative study on the physico-chemical properties of lac from various lac producing countries*

Different physico-chemical properties of Chinese, Thai and Indian seedlac were determined. Subsequent systematic comparative study on Thai, Indonesian and Indian (*kusmi* and *rangeeni*) seedlac and shellac with regard to moisture, flow, cold and hot alcohol insoluble, colour index, heat polymerization time, iodine value, bleach index, RF value of major spots in Thin Layer Chromatography (TLC), melting point by Differential Scanning Calorimeter (DSC), melt viscosity at ambient temperature, highlighted some very important findings. It clearly indicated that the resin produced by the species *Kerria lacca* is superior to those obtained from other countries. Final recommendations on the qualities of Indian lac in comparison to other lac producing countries, emerged after completion of the project can be summarized as follows:

Colour values of Indian *kusmi* and *rangeeni* seedlac and shellac were lower than Thai, Indonesian and Chinese seedlac and shellacs. Flow of Indian *kusmi* and *rangeeni* seedlac and shellac were higher than Thai, Indonesian and Chinese ones. The rate of filtration of the seedlac of various origins was determined by dissolving in alcohol at 25 ± 2°C. Rate of filtration of Indian *kusmi* and *rangeeni* seedlacs were remained higher than Thai and Indonesian ones. Gloss of Indian *kusmi* shellac was found better than Thai and Indonesian shellacs. Bleached index of Thai, Chinese and Indonesian seedlac were higher than Indian *kusmi* and *rangeeni* seedlac. Life of Indian *kusmi* seedlac and shellac were higher than Thai, Chinese and Indonesian ones. Cold and hot alcohol insolubles of Indian *kusmi* and *rangeeni* seedlac were found to be less than those of Indonesian, Chinese and Thai seedlacs. Aleuritic acid isolated from Indian seedlac showed a better purity and crystallinity as compared to those obtained from Thai and Indonesian ones.

The main reason for better quality of Indian *kusmi* lac can be attributed to the genetic differences in the insect used for *kusmi* lac production. *Kusmi* lac is produced by *Kerria lacca* kusmi form, which thrives well on hosts like *kusum*, *ber* and *semialata*.

2.1.2 *Field evaluation of PGRs and insect attractant/repellants derived from aleuritic acid*

Plant Growth Regulators (PGRs)

In vitro evaluation of two lac based plant growth regulators *viz.*, 10-Carboxymethyl-2-decenoic acid (CMDA) and Methyl 9 methylsulphonyloxy-2-nonenoate for multiplication of pointed gourd (*parwal*) carried out at the Tissue Culture Laboratory at Horticulture and Agro-Forestry Research Programme (HARP), Plandu, Ranchi yielded encouraging result.

The shoot emergence was recorded to be 65, 47 and 52 per cent in case of CMDA at a concentration of 1 ppm, 2 ppm and 3 ppm whereas, shoot emergence was found to be 65, 53 and 67 per cent at 1 ppm, 2 ppm and 3 ppm, respectively in case of Methyl 9-methylsulphonyloxy-2-nonenoate, in comparison to 78 per cent for Indole Acetic Acid (IAA) (0.2 ppm) + Butyl Adenine (BA) (1 ppm) and 25 per cent for control. All the treatments resulted in 4.67 to 7.17 days early shoot initiation in comparison to control (15 days). The emerged shoots were re-cultured in the rooting media after attaining sub-culturable length after 25 days of inoculation. The length was 4.12 cm for IAA + BA and comparable to 4 cm in case of CMDA (2 ppm) only.

Evaluation of Nematicides

- Nematicidal activity of methyl 16-hydroxy-(E)-9-hexadecenoate, synthesized from aleuritic acid, against the 2nd stage juvenile (J_2) was of root-knot nematode (*Meloidogyne incognita*) infesting brinjal

was tested in *in vitro* at 1000 ppm, 500 ppm, 250 ppm, 125 ppm, 62.5 ppm dose level after 24, 48 and 72 hr of incubation period at Bioved Research Centre, Allahabad. Increase in mortality of J_2 stage of *M. incognita* at 62.5 to 1000 ppm was 52 to 91 per cent after 48 and 72 hrs of exposure.

- Bioactive compounds *viz.,* Methyl 16-hydroxy-(E)-9-hexadecenoate and 16-Acetoxy-(E)-9-hexadecenoic acid, synthesized from aleuritic acid, were found to be effective and cause 100 per cent juvenile mortality of root knot nematode within 24 hr of exposure at 2500 ppm concentration. Higher degree of mortality (99%) could be noticed within 96 hr of exposure even at 62.5 ppm concentration in case of Methyl 16-hydroxy-(E)-9-hexadecenoate as tested at Central Institute of Sub-tropical Horticulture (CISH), Lucknow.

Insect sex attractants

- (Z)-9-Hexadecenal, (Z)-9-hexadecenylacetate, (Z)-9-tetradecenyl acetate, (Z)-7-dodecenyl acetate and 16-acetoxy-(E)-9-hexadecenoic acid were synthesized from aleuritic acid, adopting methods as developed earlier in improved yield (~62-70%).
- Performance of aleuritic acid derived compounds as sex pheromones against brinjal fruit and shoot borer was studied at Horticulture and Agro-forestry Research Programme (HARP), Plandu, Ranchi. Number of moths catches in traps containing different compounds and commercial formulation are given in Table 23.

Observations on number of insect catches were recorded 15 days after treatments. Significantly higher number of insect catches was recorded in all the treatments as compared to control (Table 23). Among the aleuritic acid derived compounds, the maximum number of catches were recorded in case of 16-acetoxy-(E)-hexadecenoic acid, which was at par with that of blend of (Z)-9-C_{14} acetate and (Z)-7-C_{12} acetate. The number of catches in both

Table 23. Performance of aleuritic acid derived compounds as sex pheromone against brinjal fruit and shoot

Sl. No.	Treatments	Number of insects per trap
1	Biolure (commercial formulation)	11.00
2	(Z)-9-Hexadecenyl acetate	4.00
3	(Z)-9-Hexadecenal	5.50
4	Blend of (Z)-9-C_{14} acetate and (Z)-7-C_{12} acetate (1:1, w/w)	9.50
5	16-Acetoxy-(E)-9-hexadecenoic acid	11.00
6	Control	0.75
	SEm. ±	0.722
	CD at 5%	1.539

treatments, were at par with that of Biolure, a commercial compound.

The Evaluation report of sex pheromones compounds (Code A, B & C) on brinjal and tomato borers obtained from Bidhan Chandra Krishi Viswavidyalaya, Depatment of Agricultural Entomology, Faculty of Agriculture, Mohanpur, Nadia (West Bengal) is presented in Table 24 and 25 for two crops separately. The compounds were effective for 6 days and Code B was more effective.

Field evaluation of insect sex pheromones was carried out at Bio-control Research Laboratory (BCRL), Bangalore, for the products (i) (Z)-9-Tetradecenyl acetate and (Z)-7-Dodecenyl acetate (1:1) (ii) 16-Acetoxy-(E)-9-hexadecenoic acid and (iii) (Z)-9-Hexadecenyl acetate in brinjal field, having six lures each of three types were prepared. Results reported were as follows:

i) Attracted 60 moths (0.36 moths per day per trap)

ii) Attracted 35 moths (0.21 moths per day per trap)

iii) Attracted 76 moths (0.45 moths per day per trap)

It was observed that moth attracted only for first 15 days of installation and performance of all three types are almost at par. The details of the test designs were as follows: Trap height in cm – 3 ft., Distance between traps –30 mts., Type of trap used – Wota-T, Target pest: *Leucinodes orbonalis*, Total crop area – 1 Acres, Crop age at start – Flowering and fruiting.

Table 24. Number of tomato fruit borer adult male trapped

Days after trap introduced	Code A	Code B	Code C
1	3	5	3
2	3	4	3
3	2	5	4
4	4	3	3
5	3	5	4
6	4	4	3
7	0	0	0
Mean No. per day	2.71	3.71	2.85

Table 25. Number of brinjal fruit and shoot borer adult male trapped

Days after trap introduced	Code A	Code B	Code C
1	4	4	1
2	3	4	3
3	4	6	2
4	5	5	2
5	3	4	2
6	3	5	1
7	0	0	0
Mean No. per day	3.14	4.0	1.57

Code A: 16-Acetoxy-(E)-9-hexadecenoic acids
Code B: (Z)-9-Hexadecenyl acetate
Code C: Blend of (Z)-9-tetradecenyl acetate and (Z)-7-Dodecenyl acetate (1:1 w/w)

2.1.3 *Synthesis of thiosemicarbazide and thiodiazole from aleuritic acid and testing its activity as antifungal/hypoglycemic/ antinemic*

The project was initiated in November, 2007. From aleuritic acid, 10 g of methyl ester was synthesized and chemical characterization was done by TLC. It has melting point of 68 – 69°C and IR: 1742°C, which indicate the presence of ester group in methyl aleurate. Aleuritic pyrralidineamide, aleuritic isobutyl amide, aleuritic benzyl amide, aleuritic octylamide were also synthesized from aleuritic acid.

2.2 Surface Coating and Use Diversification

2.2.1 *Development of surface coating formulations based on shellac synthetic resin/polymer blends*

Blending of shellac with rosin (natural resin of plant origin) was tried with an aim to either reduce the cost of the product or improvement in the properties of varnish. Blending of shellac with rosin was carried out at room temperature in solution medium. Five compositions including control of shellac and rosin were developed by varying the concentrations of shellac and rosin and their film properties were studied. No improvement in the surface coating properties of shellac like heat and water resistance, scratch hardness, flexibility was noticed by blending with rosin. It was observed that all the compositions blushed, when came into contact with water. Washing out of the films was observed in case of samples containing rosin. Degree of washing of the films was dependent on concentration of rosin, being higher, where rosin concentration was more. The compositions failed heat resistance test, as mark of beaker was observed on the coated panels. With regard to scratch hardness, increase in concentration of rosin, decreased the scratch hardness, and the lowest scratch resistance value was recorded in the control of rosin. This may be attributed to the brittle nature of rosin. Flexibility of the film was also reduced with addition of rosin.

Films of all the compositions including control were baked at elevated temperature to see the change in the properties, if any. However, no improvement towards resistance to water was observed, on the other hand, scratch hardness was further lowered down. All the five compositions were treated with melamine formaldehyde resin. It was observed that blended compositions resisted heat and water up to the extent of 50:50 of shellac - rosin blend. No effect of melamine formaldehyde was observed in the control of rosin. Gloss was also improved in comparison to pretreated compositions.

2.2.1.1 *Use of lac and modified lac in the manufacture of jute reinforced sheets for structural and other purposes*

The project concluded and the final report submitted. The salient findings are as follows: Jute-fibre glass reinforced sheets was prepared with shellac-containing sheet moulding compound using hand lay up technique. The sheets possess very good mechanical properties. Tensile strength and tensile modulus values in the range of 49.76–51.7 Mpa and1.84–1.85 Gpa, respectively and also flexural strength the flexural modulus in

the range of 72.97 – 95.98 Mpa and 2.7 – 4.2 Gpa, respectively can be obtained by selecting the composition and thickness. Thermal resistance of the sheets was found to be 220°C. Lamination of plywood and particle board with jute fibre glass, yielded considerable improvement in the mechanical properties as compared to those of un-laminated plywood and particle boards. The above sheet exhibited good mechanical properties in smaller thickness compared to plywood and particle board. The chances of termite attack or swelling due to water absorption during rainy season was observed to be nil. These were found to be lighter as compared to particle and plywood boards. No painting or lamination is required because it possesses better scratch resistance. Both, plywood and particle board are heavier and non resistant to water and termite attack. Sunmica even comes out with ageing, if not glued properly. Though water resistant plywood is available, but it costs more. There is no chance of de-lamination of the fibre-glass laminate (from plywood/particle board) as it is chemically bonded. Jute fibre glass composite will be cost effective in the long run, as the sheets do not require any further maintenance. Fibre glass jute lamination on plywood/particle board enhances the mechanical properties with little increase in thickness and at a slightly higher cost. It can find diversified application such as partition wall, door panel, window panel, ceiling and similar applications in place of particle and plywood boards. The thinner sheets can be used for electric switch board, tea coaster, dining table top. The cost of raw materials of the above sheets (4mm thick) may vary between Rs. 50-55 per sq. ft whereas costs of commercial 1 mm and 2 mm FRP sheets are Rs.25 and Rs. 50 per sq. ft, respectively. Cost of sunmica lamination on plywood (6 mm) is Rs. 40 per sq. ft. Cost of sunmica lamination on particle board (12 mm) is Rs. 64 per sq. ft.

2.2.2 *Documentation and characterization of physico-chemical properties of plant based gums of commercial importance*

Different natural gum samples such as babul gum (*Acacia nilotica*), khair gum (*Acacia catechu*), gum arabic (*Acacia senegal*), gum ghatti (*Anogeissus latifolia*), karaya gum (*Sterculia urens*) and Tamarind kernel power (*Tamarindus indica*) were procured from Bahubali Udyog, Bilaspur, Chattisgarh.

Babul gum is slightly dextrorotatory, whereas gum arabic is slightly laevorotatory. The colour varies from pale yellow to brown or almost black. The moisture and ash contents are reported as 13% and 1.9% respectively. The gum is known to contain galactose, L-arabinose, L-rhamnose and four aldobiouronic acids. It also contains arabinobioses. The gum from *khair* is regarded as the best substitute for true gum arabic. The colour of gum may be pale yellow to dark amber. The polysaccharide of the gum is reported to have ash (0.28%), nitrogen (0.02%), methoxyl (1.7%) and molecular weight of 40,010. Purified *khair* gum is known to contain D-galactose, L-arabinose, L-rhamnose and D-glucuronic acid in a molar ratio of ~14.4:5.4:1.5:1.

Babul gum and *khair* gum were powdered to pass through 100 mesh sieve. Powdered samples were pressed to sheets of thickness ~0.3 mm and density 1.1g/cc. The breakdown voltage (dielectric strength) was measured and found to be 11-22 kv/cm.

2.2.3 *Preparation and market evaluation of heat and water proof shellac varnish for wooden surface and air-drying type shellac based glazing varnish*

Heat and water proof shellac varnish for wooden surface and air-drying type shellac based glazing varnish was prepared under revolving fund scheme in order to assess the market response of these varnishes. Efforts were made to popularize the varnish among the faculty members, students and staff/employees of BAU, BIT, NABARD, Ranchi including our own Institute, through on-the-spot demonstration, by coating leather belts, name plates, flower vases, show pieces etc Melfolac (3.0 liters) and glazing varnish (6.25 liters) were either sold or gifted to VIPs. As a part of publicity campaign, a bamboo cottage and furnitures (17 Nos) were varnished at BAU, Kanke, Ranchi.

2.2.4 *Comparative performance of water soluble lac varnishes and their keeping quality by using different alkalies*

Water soluble lac varnishes were prepared using various alkalies, as per the method suggested by Shankar Narayanan (1977) as mentioned in Table 26.

Table 26. Compositions of water soluble lac varnish

Formulation	Ingredients					
	Dewaxed lac	Borax	Ammonia	Morpholine	Triethanolamine	Water
I	100 gm	24 gm	-	-	-	500 ml
II	100 gm	-	11.5 ml	-	-	500 ml
III	100 gm	-	-	11 ml	-	500 ml
IV	100 gm	-	-	-	15 ml	500 ml

A total of eight numbers of varnishes were prepared *i.e.,* four for dewaxed lemon and four for dewaxed orange shellac. The surface coating properties for above varnishes on M.S. sheet panels were tested at 20 days intervals. Panels were baked at 100 ± 2^{0}C in oven for one and half an hour. The results are given in Tables 27 and 28. It can be observed from the tables that water resistance failed for all the varnishes except ammonia based varnish. Impact resistance failed and flexibility passed for all the varnishes. Determining scratch hardness, the highest value (above 2000 g) was recorded for borax based water soluble lac while the lowest value (900 g) was observed for morpholine based varnishes (Table 27). Incase of dewaxed orange shellac (Table 28), the higher value (1700 g) of scratch hardness was noted for triethanolamine based varnish and the lower value (800 g) was recorded for ammonia based varnishes. With regard to gloss, the maximum value was noted for morpholine based varnishes for both lemon and orange shellac, while the lower value (33%) was recorded for borax based varnish in dewaxed lemon shellac (Table 27) and in case of dewaxed orange shellac, the lower value (35%) was observed for ammonia based varnish.

Table 27. Properties of dewaxed lemon shellac based varnish

Formulation	Properties				
	Water resistance	Impact resistance	Scratch hardness, gms	Flexibility	Gloss (%)
Borax	Fail upto 2 hr	FAIL	Above 2000	PASS	33.1
Ammonia	Pass upto 24 hr	FAIL	1200	PASS	58.9
Morpholine	Fail upto 2 hr	FAIL	900	PASS	78.7
Triethanolamine	Fail upto 2 hr	FAIL	1800	PASS	39.2

Table 28. Properties of dewaxed orange shellac based varnish

Formulation	Properties				
	Water resistance	Impact resistance	Scratch hardness, gms	Flexibility	Gloss (%)
Borax	Fail upto 2 hr	FAIL	1600	PASS	62.4
Ammonia	Pass upto 24 hr	FAIL	800	PASS	35.0
Morpholine	Fail upto 2 hr	FAIL	1300	PASS	73.3
Triethanolamine	Fail upto 2 hr	FAIL	1700	PASS	58.0

2.3 Processing and Storage

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

Installation of commercially viable pilot plant for production of technical grade of lac dye has been completed and a trial run on pilot plant was carried

Table 29. Physical properties of technical grade lac dye obtained from pilot plant

Item	*Kusmi* lac dye		*Rangeeni* lac dye
	Sample I	Sample II	
Yield of lac dye on the wt. of sticklac	0.22	0.25	0.30
Dye content	71.0	70.8	68.5
Ash content	0.70	0.78	1.10
Melting point °C	238	236	230

Table 30. Heavy metals in technical grade lac dye obtained from pilot plant

Metals	Sample I (ppm)	Sample II (ppm)
Cadmium	Below detection limit of 0.02.	Below detection limit of 0.02
Mercury	Below detection limit of 0.02	Below detection limit of 0.02
Arsenic	Below detection limit of 0.02	Below detection limit of 0.02
Nickel	Below detection limit of 0.5	Below detection limit of 0.5
Lead	40.6	13.3
Iron	47.3	129.0
Magnesium	1.8	2.0

out with two batches of *kusmi* and one batch of *rangeeni* sticklac. The average yield of technical grade lac dye obtained was 0.22 to 0.30%. Dye content of the products varied from 68.5 to 71.0%. Its ash content was found to be 0.70 to 1.10% and melting point 230 to 238°C with charring (Table 29).

The estimation of heavy metals present in two samples of technical grade lac dye was done at CFTRI, Mysore. The results obtained are presented in the Table 30.

The results indicated that only lead was found in excess quantity than the prescribed limit of 10 ppm (Ref: BIS IS: 1694:1994, Tartrazine Food Grade IS: 6406:1994, Brilliant Blue CFC Food Grade). Therefore, two batches of technical grade of lac dye were once again prepared with utmost care to locate the probable source of lead. The samples of lac dye and various ingredients such as water used for processing, stick lac (both kusmi and rangeeni) as well as the chemicals used, namely sodium carbonate were analysed for presence of lead content from Sri Ram Industrial Laboratory, New Delhi. The analysis report is shown in Table 31. It may be observed that the ingredients used for producing the dye, such as sticklac, chemicals and water did not show presence of lead. The samples of the lac dye showed the presence of lead but well within the permissible limit of 10 ppm for food grade and in other ingredients used for producing dye, presence of lead was not detected (Table 31). So, the problem of presence of lead content was successfully resolved.

Installation of purification plant for the dye has been completed after installation of the crystallization and filtration unit (Fig. 12 and 13). The low temperature crystallization unit of the plant has been tested for maintenance of low temperature and it is able to maintain temperature in the range of 6-8°C.

Table 31. Lead content analysed by Shri Ram Laboratory, New Delhi

Item	Lead in ppm
Kusmi lac dye techincal grade	5
Rangeeni lac dye pure grade	6
Sticklac *rangeeni*	Not detected Detection limit <0.2 ppm
Sticklac *kusmi*	-do-
Sodium carbonate	-do-
Sodium bicarbonate	-do-
Water	Not detected Detection limit < 0.2 ppm

2.3.2 *Storage loss assessment for lac and lac based products*

Visits were made to lac processing industries at Bilaspur, Shakti, Kathghora and Pendra (Chhattisgarh) Gondia (Maharashtra), Seoni and Mandla (Madhya Pradesh) for information on storage pattern, storage losses and cost of storage of different lac based products like seedlac, shellac, button lac and bleached lac.

Fig. 12. Crystallization unit *Fig. 13. Filtration unit*

Fig. 14. Pilot-Plant of Aleuritic acid

Studies have been initiated by simulating the conditions to evaluate the qualities of sticklac, seedlac and shellac during storage under different methods, as practised by lac traders and industries. Fresh baisakhi sticklac and seedlac were purchased and their initial quality paramaters viz. moisture content, hot and cold alcohol insolubles, life, flow, rate of filtration and colour index, melting point and surface coating properties (for shellac) were measured. Sticklac was stored under four different methods viz. spreading on earthen floor, spreading on cemented floor, inside gunny bags and in plastic bags. Similarly, seedlac were stored on cemented floor, inside gunny bags , inside plastic bags and inside metal containers, where as shellac was stored under five different methods viz. spreading on cemented floor, inside gunny bags, inside gunny bags (with cotton lining), in plastic bags and under cold storage in refrigerator. The quality parameters of sticklac and seedlac stored under different methods were measured after 3 months of storage (Table 32).

2.3.3 *Establishment of commercially viable pilot plant for aleuritic acid*

A pilot plant of aleuritic acid (capacity: 2 kg/batch) was installed at Processing and Demonstration Unit of the Institute for training and demonstration to entrepreneurs (Fig. 14). The performance evaluation of the plant is under progress.

2.3.4 *Design and development of seedlac dryer*

Drying characteristics of seedlac

Drying characteristics of seedlac were determined at different temperatures (40, 45, 50 and 55°C) and different drying layer thickness (1, 1.5, 2 and 2.5 cm) using electric operated tray drier. The desired temperature in the drier was maintained through

Table 32. Quality parameters after three months of storage period

Parameters	Sticklac					Seedlac				
	Initial	After 3 months of storage				Initial	After 3 months of storage			
		EF	CF	GB	PB		CF	GB	PB	MC
Hot alcohol insolubles (%)	5.05	5.48	4.96	4.37	5.23	3.72	3.64	4.06	4.67	6.21
Cold alcohol insolubles (%)	9.47	11.1	11.0	10.01	11.4	11.22	9.04	10.2	11.8	10.9
Flow (mm)	39	32	32	21	31	34	35	29	28	24
Colour index	13	11	12	10	12	14	14	15	18	19
Heat polymerization time (min)	57	55	57	56	55	55	67	66	66	63
Rate of filtration (ml.)	84	79	71	80	72	82	77	75	75	70

EF = stored on earthen floor, PB = stored inside plastic bag, CF = stored on cemented floor
MC = stored inside metal container, GB = stored inside gunny bag
The storage study is under progress and further evalution of samples will be done after 6, 9 and 12 months interval for comparison of different methods of storage.

digital temperature controller. The least count of the temperature controller was 1°C. The drying characteristics were also determined and different ambient conditions *i.e.*, drying in sun and shade with and without raking for drying layer thickness of 1 cm.

For determining the drying characteristics kusmi seedlac was taken in desired quantity based on drying layer thickness. The sample was then transferred in a plastic container. Then sufficient quantity of water was added in the container so that seedlac remained submerged in water. After 30 minutes the water was drained and sample was transferred to drying tray of size 35 x 35 x 5 cm and wet seedlac was spread uniformly. Thus prepared samples were kept in the drier for drying after measuring its initial mass. Before keeping the tray in drier, the drier was switched on and the desired temperature was set. The drier was allowed to reach the set temperature. The sample in the tray was raked at an interval of 15 minutes and mass loss due to drying was recorded by weighing the sample at an interval of 30 minutes. Drying was continued till the sample mass became constant. The moisture content on dry basis was determined and plotted in the form of graph with respect to time for different temperature and drying layer thickness (Fig. 15 to 20). The observation thus recorded and the data obtained are presented and discussed in the following section.

Drying in ambient condition

In lac processing units washed lac is dried in mild sun or in shade. Accordingly the drying characteristics of the seedlac were determined in sun and shade. In Figure 15 the drying characteristics curves have been plotted for drying without raking in sun and shade. As expected, drying in sun is faster than drying in shade. It can be observed from the Figure 15 that for drying in sun it takes about 4.5 hours to bring down moisture content of seedlac from 30% to 2%, where as for drying in shade it takes 14 hours to bring down moisture level from 30% to 2%. In case of drying in sun blocking of the seedlac was observed which is not desired. Thus drying in sun without raking is not suitable. Further drying in shade takes more time hence such drying condition is also not suitable for seedlac drying. In Figure 16 the drying characteristics curves have been plotted for drying seedlac with raking in sun and shade.

It can be observed from the Figure 16 that raking aids drying and drying becomes faster. It is evidently clear from the Figure 17 that for drying in sun it took about 4 hours to bring down moisture content of seedlac from 28% to 2%, where as for drying in shade it took 9 hrs to bring down moisture level from 30% to 2%. No blocking was observed in seedlac during drying when the samples were raked. It was observed that drying in shade even with raking takes longer duration.

Effect of drying layer thickness on drying

The drying characteristics curves were plotted between moisture content (d. b) and time for

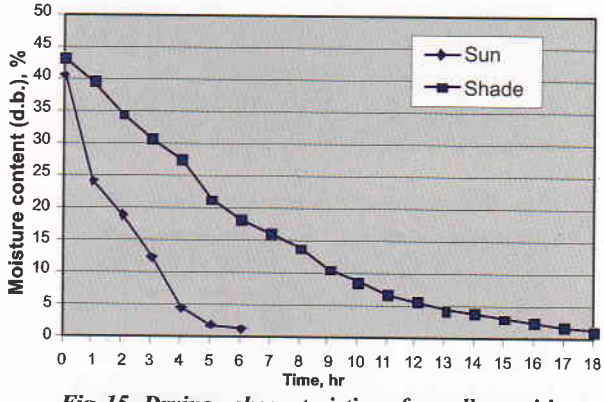

Fig. 15. Drying characteristic of seedlac without raking and drying layer thickness 1 cm

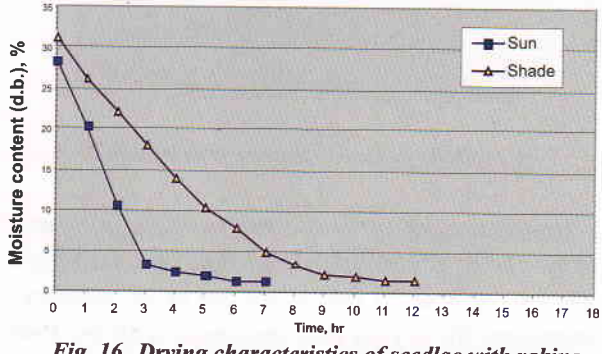

Fig. 16. Drying characteristics of seedlac with raking and drying layer thickness 1 cm

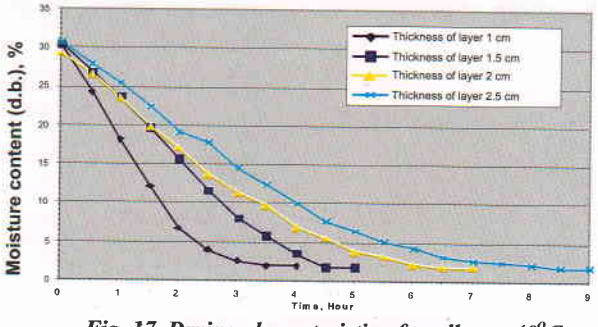

Fig. 17. Drying characteristic of seedlac at 40°C

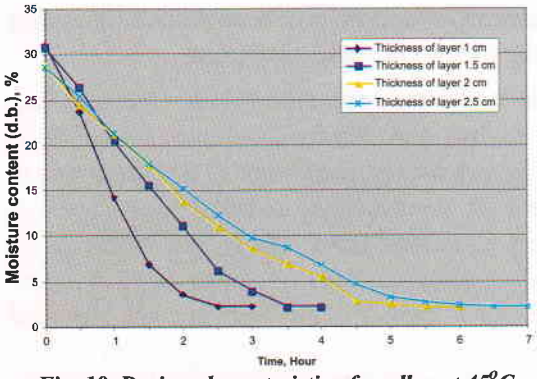

Fig. 18. Drying characteristic of seedlac at 45°C

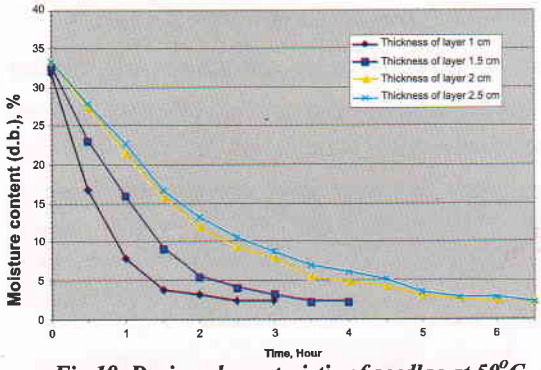

Fig.19. Drying characteristic of seedlac at 50°C

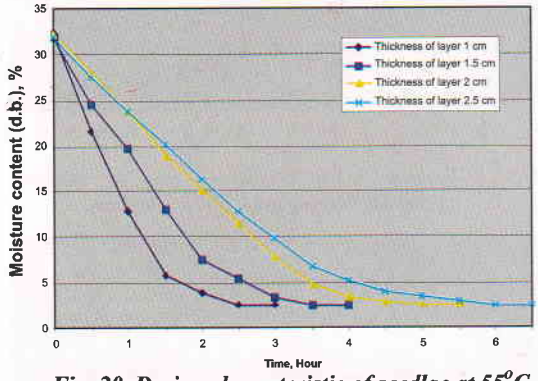

Fig. 20. Drying characteristic of seedlac at 55°C

different temperatures and drying layer thickness (Fig. 17, 18, 19 and 20). It is evident from the figure 17, 18, 19, and 20 that as drying layer thickness increases, the drying time increases at all the four temperatures. Further at 50°C temperature blocking of sample was observed for drying layer thickness 2 and 2.5 cm and at 55°C temperature heavy blocking of sample was observed for all the drying layer thickness.

Effect of temperature on drying

Seedlac drying characteristics at different temperatures for drying layer thickness 1.5 cm have been presented in figure 21. It can be observed from the figure that drying becomes faster as drying temperature increases from 40°C up to 50°C. But drying becomes slow at 55°C as compared with 50°C, probably due to heavy blocking of the samples at 55°C.

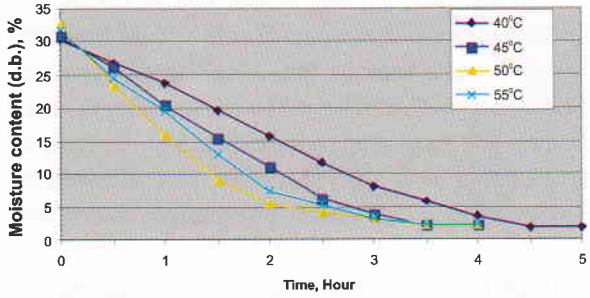

Fig. 21. Seedlac drying characteristics at different temperatures for drying layer thickness 1.5 cm

2.3.5 *Establishment of pilot plant for dewaxed bleached lac (40 kg capacity) for training demonstration and process refinement*

The process equipment required in the processing of bleached lac (from seed lac) was designed. The unit operations, and process steps involved were finalized. Two tanks namely, dissolution tank and bleached tank were made of mild steel. The bleached tank was coated iternally with minimum 3 mm thickness of poly vinyl chloride as it would handle corrosive material, chlorine. The rotary drum washer for bleached lac was fabricated. Both the tanks were installed on concrete base supported with GI pipes. Further work is in progress.

3. TRANSFER OF TECHNOLOGY

3.1 Human Resource Development

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

The Institute conducted different types of training programme as per need of the stake holders. It pertained to scientific lac cultivation, processing and utilization. The Institute continuously assessed the need of stake holders and modified the programmes accordingly. Besides many in-campus programme, many field out reach activities in terms of training, technical guidance, lac crop monitoring were also undertaken.

Farmers' and housewives' training programme

This one-week programme mainly covered lac cultivation, processing at farm level and uses of lac. A total of 1,112 farmers from 20 districts of seven states participated in this programme. A summary of different programme is given in Table 33. It is evident from the table that maximum participation was from Jharkhand followed by Chhattisgarh, Orissa, Madhya Pradesh, West Bengal, Andhra Pradesh and Maharashtra.

Educational programme on lac production, processing and uses (one week)

The agriculture graduate students from Allahabad Agricultural Institute (Deemed University), Uttar Pradesh; Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh and Polytechnic students from Latehar Polytechnic, Latehar, Jharkhand have undergone one week training in lac cultivation, processing and its uses (Table 34). A total of 114 students were educated through five courses under this programme.

Trainers training programme on scientific lac production, processing and uses

District Rural Agriculture Extension Officers and Agril Development Officers, sponsored by Chhattisgarh State Minor Forest Produce (Trade and Development Federation Ltd), Raipur have undergone Trainers training programme on scientific method of lac cultivation, production, processing and utilization. A total of 16 trainers have completed this course (Table 35).

Special training on management of broodlac farm

A total of 43 progressive farmers from Department of Forest and private entrepreneurs from Kanker district of Chhattisgarh completed special training on management of brood lac farm in two batches (Table 36).

Field out-reach programme

On-farm training on scientific cultivation of lac

A total of 27 camps were conducted in collaboration with other organizations in Jharkhand, Chhattisgarh, Madhya Pradesh, Orissa and Gujarat covering representation of more than 25 villages of 12 districts. A total of 3,100 farmers benefited from this programme. Maximum participation was from Sahadol district of Madhya Pradesh, followed by Simdega of Jharkhand and Narsinghpur district of Madhya Pradesh. The details of training programme conducted have been presented in Table 37.

Field education, motivational and supplementary training programme on lac cultivation

A total of 45 camps were organized in collaboration with NGOs and GOs of different states. A total of 5,189 persons mainly farmers representing around 45 villages of 16 districts, benefited from this programme. The details of training programme conducted have been given in Table 38.

One-day orientation programme on lac

This programme aimed to educate the existing lac farmers and suggested remedial measures for their problems. A total of 413 farmers, students, entrepreneurs in 14 batches received training

Table 33. Farmers training programme on scientific lac cultivation, processing and utilization

Month	Course No.	Sponsoring Organization	State	Period	No. of participants
January	1.	Forest Department, Chaibasa	Jhakhand	2-6 Jan.,07	10
		Forest Department, Dantewara	Chhattisgarh		49
		Janmitram, Raigarh			31
	2.	TRIFED, Sundargarh	Orissa	8-12 Jan.,07	52
		Forest Department,, Chaibasa	Jharkhand		20
		Forest Department, Rajnandgaon	Chhattisgarh	15-20 Jan.,07	44
		Private	Jharkhand		1
	3.	TRIFED, Sundargarh	Orissa	22-27 Jan.,07	46
February	4.	SUPPORT, Hazaribag	Jharkhand	29 Jan-3 Feb.,07	16
		Private			5
	5.	Forest Department, Rajnandgaon	Chhattisgarh	5-10 Feb.,07	39
		Forest Department, Hoshangabad	Madhya Pradesh		23
		Jashpur-Private	Chhattisgarh		2
March	6.	MESO project, Khunti, Ranchi	Jharkhand	12-17 March,07	31
	7.	Forest Department W. Singhbhum	Jharkhand	19 -24 March,07	18
		Tata Steel Rural Development Society, Ranchi	Jharkhand		31
	8.	Tata Steel Rural Development Society, Ranchi	Jharkhand	26-30 March,07	33
April	9.	Janamitram Kalyan Samiti, Raigarh	Chhattisgarh	16-21 April,07	37
		KGVK, Ranchi	Jharkhand		17
May	10.	Forest Dept.,West-Bhanupratappur, Bastar	Chhattisgarh	14-19 May,07	18
	11.	I.T.D.A. Nilgir, Balasore	Orissa	21-26 May,07	10
June	12.	ATMA, Bankura	W. Bengal	28 May-2 June,07	26
	13.	Tribal Development Programme, Pathalgaon, Jashpur	Chhattisgarh	11-16 June,07	32
		MESO Project, District Co-operative Dept., Ranchi	Jharkhand		20
	14.	Forest Dept. West Bhanupratapur, Bastar	Chhattisgarh	25-30 June,07	32
		Private	Jharkhand		1
July	15.	Sahyog, CCN, Vishkhapatnam	Andhra Pradesh	5-11 July,07	7
	16.	Jashpuranchal Educational Society, Jashpur	Chhattisgarh	10-13 July,07	26
	17.	TRIFED Bhubneshwar, Sundergarh	Orissa	20-25 July,07	55
		CCF, Koraput, Koenjhar & Raygada			18
September	18.	TRIFED Bhubneshwar, Sundergarh	Orissa	27 Aug -1 Sept.,07	45
		CCF, Koenjhar			10
	19.	Forest Dept., South Surguja, Ambikapur	Chhattisgarh	13-19 Sept.,07	11
	20.	TRIFED Ranchi, Gumla	Jharkhand	24-29 Sept.,07	54
		CCF Bastar	Chhattisgarh		6
		CCF Ambikapur			6
		Private			1
October	21.	Udhami Vikas Sansthan, Bhopal	Madhya Pradesh	1-6 Oct.,07	20
		CCF Surguja and Jagdalpur	Chhattisgarh		11
		TRIFED, Ranchi	Jharkhand		47
	22.	TRIFED CCF Suguja & Jagdalpur	Chhattisgarh	8-12 Oct., 07	12
		TRIFED VARDAN, Ranchi.	Jharkhand		30
	23.	Janmitram Kalyan Samiti, Raigarh	Chhattisgarh	22-27 Oct.,07	43
		MECON Ltd, Ranchi	Jharkhand		14

November	24.	TRIFED-SEEDS, Ranchi	Jharkhand	12-17 Nov., 07	29
		TRIFED-Gram Jan Jagriti Manch, Ranchi			4
		TRIFED-VARDAN, Ranchi			20
		Sahayog CCN Visakhapatnam	Andhra Pradesh		1
		Magan Sangralay Samiti, Wardha	Maharashtra		2
	25.	Magan Sangrahalay Samiti, Wardha	Maharashtra	19-24 Nov.,07	1
December	26.	Ranchi- Private	Jharkhand	3-7 Dec.07	1
	27.	SARDA, Hazaribag	Jharkhand	17-22 Dec.,07	10
		SUPPORT, Hazaribag Private			2
					1
		Total			**1112**

Table 34. Educational programme (one-week) on lac production, processing and uses

Course No.	Sponsoring Organization	State	Period	No. of participants
1.	Allahabad Agricultural Institute (Deemed University), Allahabad.	Uttar Pradesh	8 -12 Jan, 07	7
2.	Latehar Polytechnic, Latehar	Jharkhand.	12 -17 March, 07	13
3.	Institute of Agricultural Sciences, BHU, Varanasi, B.Sc. (Ag.) Students	Uttar Pradesh	7 -11 May, 07	52
	Private	Chhattisgarh		1
4.	Institute of Agricultural Sciences, BHU, Varanasi, B.Sc. (Ag.) Students	Uttar Pradesh	4 -8 June, 07	13
	Allahabad Agriculture Institute (Deemed University), Allahabad	Uttar Pradesh		6
	BIT, MESRA, Ranchi	Jharkhand		4
5.	Allahabad Agricultural Institute (Deemed University), Allahabad	Uttar Pradesh	24 -29 Dec, 07	18
	Total			**114**

Table 35. Trainer`s training programme on scientific lac production, processing and uses

Course No	Sponsoring Organization	District- State	Client	Period	No. of participants
1.	Chhattisgarh State Minor Forest Produce (Trade and Development	Dhamtari- Chhattisgarh	Rural Agricultural Extension Officer	17-22 Dec., 07	5
	Federation Ltd), Raipur	Rajnandgaon-Chhattisgarh	& Ag. Development Officers		3
2.	Chhatisgarh State Minor Forest Produce (Trade and Development	Dhamtari-Chhattisgarh	Rural Agricultural Extension Officer &	24-29 Dec., 07	5
	Federation Ltd), Raipur	Rajnandgaon-Chhattisgarh	Ag. Development Officers		3
	Total				**16**

Table 36. Special training on management of brood lac farm

Course No	Sponsoring Organization	State	Period	No. of participants
1	Forest Dept., Kanker	Chhattisgarh	14 - 22 May,07	12
	Private			1
2	Forest Department, Kanker	Chhattisgarh	18-24 June, 07	
	(a) East Bhanupratappur			10
	(b) Narayanpur			10
	(c) Keshkal			10
	Total			**43**

Table 37. On-farm training programme on scientific lac cultivation

Camp No.	District -State	Sponsoring / Nominating Agency	Venue (Village, Block)	Dated	No. of Participants
1.	Simdega-Jharkhand	B.D.O., Jaldega	TPC, Jaldega	7 - 8 Feb, 07	164
2.	Ranchi-Jharkhand	MESO, Arki	Arki, Arki	13 Feb, 07	125
3.	Narmada-Gujarat	Forest Department	Didiyapara, Narmada	12-14 March,07	113
4.	Balasore- Orissa.	I.T.D.A.	Tartari-Village	20 -21 March, 07	200
5.	Shahdol-Madhya Pradesh	Zila Panchayat	Polytechnic School	6 April, 07	421
6.	Shahdol-Madhya Pradesh	Zila Panchayat	Bhabraha	6 April, 07	107
7.	Shahdol-Madhya Pradesh	Zila Panchayat	Girwa Dham, Burhar	7 April , 07	176
8.	Shahdol-Madhya Pradesh	Zila Panchayat	Diyapiper-Gohpara	7 April, 07	240
9.	Shahdol-Madhya Pradesh	Zila Panchayat	Panchayat Bhawan, Panchgadi, Beohari	8 April, 07	36
10.	Shahdol-Madhya Pradesh	Zila Panchayat	D.R.D.A., Hall	9 April, 07	61
11.	Dongargarh-Chhattisgarh	Forest Department	Nilam Kaksh, Asholi	10 April, 07	75
12.	Latehar-Jharkhand	Gyan Tara Prakhand Saksharta Samiti Latehar	Latehar	17 April, 07	45
13.	Jashpur-Chhattisgarh	Jashpuranchal Society for Rural Education	Primary School, Korangamal, Farsabahar	2 July, 07	250
14.	Saraikela Kharsawan-Jharkhand	BASIX	Middle School, Panarol	18 July, 07	150
15.	Ambikapur- Chhattisgarh	Forest Department	Eko centre, Katkalo	8 Sept., 07	70
16.	Ambikapur-Chhattisgarh	Forest Department	Okrapara	9 Sept, 07	68
17.	Koriya-Chhattisgarh	Forest Department	Berdaon, Baikunthapur	10-11 Sept., 2007	183
19.	Jashpur-Chhattisgarh	Forest Department	Jhakkadpur	12 Sept, 07	20
20.	Jashpur-Chhattisgarh	Forest Department	Turuaamma	13 Sept, 07	25
21.	Narsinghpur-Madhya Pradesh	Zila Panchayat	Sahavan	26 Sept., 07	120
			Chotakunda	27 Sept., 07	125
22.	Narsinghpur-Madhya Pradesh	Zila Panchayat	Barheta	27 Sept., 07	15
23.	Narsinghpur-Madhya Pradesh	Zila Panchayat	Jaitpur, Narsinghpur	28 Sept., 07	22
24.	Narsinghpur-Madhya Pradesh	Zila Panchayat	Barpani, Narsinghpur	28 Sept., 07	24
25.	Simdega-Jharkhand.	Vikas Kendra Simdega	Khanjaloya, Simdega	11 Dec., 07	70
26.	Simdega-Jharkhand.	Vikas Kendra Simdega	Dhingurpani, Kurdeg	12 Dec., 07	35
27.	Simdega-Jharkhand.	Vikas Kendra Simdega	Taisar, Kurdeg	13 Dec., 07	220
	Total				**3,100**

Table 38. on-farm motivational/ supplementary training programme on lac cultivation

Camp No.	District -State	Sponsoring/ Nominating	Venue Agency	Dated	No. of Participants
1.	Ranchi-Jharkhand	MESO, Khunti	Murhu Lamps	1 Feb., 07	106
2.	Ranchi-Jharkhand	MESO, Torpa	Torpa	3 Feb., 07	275
3.	Ranchi-Jharkhand	MESO, Arki	Arki	13 Feb., 07	125
4.	Ranchi-Jharkhand	MESO, Khunti	Tamar Lamps	15 Feb., 07	168
5.	Ranchi-Jharkhand	MESO, Bundu	Bundu	16 Feb., 07	300
6.	Purulia-Jharkhand	Chakkumar Association for Social Service	Jargo	9 March, 07	45
7.	Shahdol-Madhya Pradesh	Zila Panchayat	Kubra (Jay Singnagar)	8 April, 07	990
8.	Shahdol-Madhya Pradesh	Zila Panchayat	Govt. Primary School, Raugitola, Ghongakui, Bedhani	8 April, 07	314
9.	Ranchi-Jharkhand	Mahila Vikash Kendra	Torpa main	12 April, 07	100
10.	Ranchi-Jharkhand	MESO, Project	Silli, Lamp Office	13 April, 07	100

11.	Hazaribag-Jharkhand	Srijan Foundation	Rajakiya Madhya Bidyalaya Ara,	24 May, 07	52
12.	Sundargarh-Orissa,	TRIFED	Elga, Kutra	19 June, 07	45
13.	Sundargarh-Orissa	TRIFED	Khandajhar, Lohunipada	20 June, 07	24
14.	Daltonganj-Jharkhand	KVK- Chiyanki, Palamau	KVK, Chianki	12 July, 07	50
15.	Vishakhapatnam-Andhra Pradesh	ITDA, Paderu	Ramakrishna, Arkuvalley	4 Aug., 07	55
16.	Gumla-Jharkhand	TRIFED Ranchi	Village- Kereng	18 Sep., 07	85
17.	Narsinghpur-Madhya Pradesh	Zila Panchayat	Sabhagriha-Zila Panchayat, Narsinghpur	25 Sep., 07	45
18.	Narsinghpur-Madhya Pradesh		Gadarvara,	26 Sep., 07	33
19.	Narsinghpur-Madhya Pradesh		Non-piparia, Gotegaon	27 Sep., 07	25
20.	Narsinghpur-Madhya Pradesh		Ramjharia,	28 Sep., 07	40
21.	Narsinghpur-Madhya Pradesh		Khamaria, Narsinghpur	28 Sep., 07	30
22.	West Singhbhum-Jharkhand	TRIFED, Ranchi	Goelkera, Chakradharpur	28 Sep., 07	112
23.	West Singhbhum-Jharkhand		Bharanda, Bandgaon	29 Sep., 07	60
24.	Ranchi-Jharkhand.	TRIFED, VARDAN	Huanghatu, Namkum	4 Oct., 07	150
25.	Lohardaga-Jharkhand	KVK, Lohardaga.	Kisko, KVK Training Hall	5 Oct., 07	35
26.	Ranchi- Jharkhand	TRIFED- Gram Jan Jagriti Manch	Singusoreng Namkum	7 Oct., 07	150
27.	Jashpur-Chhattisgarh	Tribal Development programme, Pathalgaon, Jaspur	Pathalgaon meeting Hall	13 Oct., 07	60
28.	Jashpur-Chhattisgarh	Tribal Development programme, Pathalgaon, Jaspur	Raghunathpur, Pathalgaon	14 Oct., 07	30
			Chaurama, Pathalgaon		50
29.	Bilaspur-Chhattisgarh	Forest Department	Korbi, Bilha	15 Oct., 07	80
30.	Bilaspur-Chhattisgarh	Forest Department	Karidongri, Khuria	16 Oct., 07	85
31.	Bilaspur-Chhattisgarh	Forest Department	Sheotarai, Kota	17 Oct., 07	15
32.	Deoghar-Jharkhand	TRIFED- Lok Jagriti . Kendra	Middle School, Jamaguri Madhupur	30 Oct., 07	83
33.	Dumka-Jharkhand	TRIFED-Chetna Vikas	Haripur, Sarayghat	31 Oct., 07	97
34.	Jamtara-Jharkhand	ATMA-Jamtara	ATMA, Office Sarkheldih	1 Nov., 07	37
35.	Jamtara-Jharkhand	TRIFED-Badlao Foundation	Kansjor, Supaidih	2 Nov., 07	47
36.	E. Singhbhum-Jharkhand	TRIFED- Kala Niketan	Narayanpur, Potka	7 Nov., 07	100
37.	Sundergarh-Orissa	TRIFED	Khandapat, Gurundia	11 Nov., 07	173
38.	Sundergarh-Orissa	TRIFED	Sewak-Office, Gurundia	12 Nov., 07	53
39.	Sundergarh-Orissa	TRIFED	do	13 Nov., 07	60
40.	Sundergarh-Orissa	TRIFED	Bijaghat, Khandadhar Lohunipada	14 Nov., 07	150
41.	Sundergarh-Orissa	TRIFED	Taldihi, Khaira	15 Nov., 07	60
42.	Sundergarh-Orissa	TRIFED	Bhaludunguri, Gurundia	16 Nov., 07	55
43.	Sundergarh-Orissa	TRIFED	Katajhar, Kutra	17 Nov., 07	250
44.	Sundergarh-Orissa	TRIFED	Chinmaya Mission Premises, Lathikata	18 Nov., 07	150
45.	Hazaribag-Jharkhand	SUPPORT	Kaluatand, Churchu	25 Nov., 07	40
	Total				**5,189**

Expert imparting training to the farmers and housewives

Participants of on farms training programme

under this programme. A summary of the programme is given in Table 39.

Other transfer of technology activities

Monitoring of *kusmi* lac crop, technical guidance, remedial measures for pest attack, demonstration of inoculation, spraying etc at different locations were carried out as mentioned in Table 40. The various activities were carried out in the states of Jharkhand, Chhattisgarh, Andhra Pradesh and Orissa.

Vocational training programme on lac processing

A total of 10 progressive farmers of different Self Help Groups (SHGs) completed training on lac processing. The programme was sponsored by Chhattisgarh Minor Forest Produce Federation Ltd, Kanker. The training was imparted through the newly developed processing units developed by the Institute, so that the trained persons start processing through the unit.

Training on product demonstration

A total of 10 trainings on different aspects of product demonstration were organized as detailed in Table 41.

Table 39. One-day in campus orientation programme on lac

Sl No.	Sponsoring Organization	Participants	Dated	No of participants
1.	SUPPORT, Hazaribag	Farmers	06 March, 07	22
2.	Sahbhagi Vikas, Simdega	Farmers	16 March, 07	22
3.	Jagriti Vikas Kendra, Kurdeg, Simdega	Farmers	16 March, 07	30
4.	KGVK, Hazaribag	Farmers	15 May, 07	8
5.	Krishi Vikash Kendra, Simdega	Farmers	17 May, 07	150
6.	Forest Department, Palkot	Farmers	24 May, 07	10
7.	District Industries Centre, Rayagada, Orissa	Farmers	28 May, 07	7
8.	R K Mission, Ranchi	Students	11 June, 07	12
9.	CCF, New Delhi	Staff	13-14 Aug., 07	12
10.	Birsa Ag University, Kanke, Ranchi	Students	16 Aug., 07	25
11.	ATMA, Sundergarh, Orissa	Farmers	8-10 Oct., 07	20
12.	Jharkhand Tribal Development Society, West Singhbhum	Farmers	11 Dec., 07	32
13.	UNDP programme	Farmers	14 Dec., 07	42
14.	SUPPORT, Hazaribag	Farmers	17 Dec., 07	21
	Total			**413**

Table 40. Demonstration and other transfer of technology activities related to lac production

Sl No.	District - State	Venue (Village, Block)	Collaborating Agency	Dated	Purpose
1.	Sundergarh - Orissa	Elga, Kutra	TRIFED	19 June, 07	*Kusmi* lac crop monitoring
2.	Sundergarh- Orissa	Khandajhar, Lohanipada	TRIFED	20 June, 07	*Kusmi* lac crop monitoring
3.	Ranchi- Jharkhand	Nagedih & Amtikra, Silli	IVLP-Birsa Ag University	19 July, 07	Demonstration of *kusmi* lac crop inoculation on *ber*
4.	Vishakhapatnam- Andhra Pradesh	Ramakrishnapuram, Arkuvalley Mandal	TPMU-IKP, Paderu	04 Aug., 07	Lac crop monitoring on *kusum* tree
5.	Jashpur- Chhattisgarh	Raghunathpur, Pathalgaon	Chhattisgarh Tribal Development Programme	14 Oct., 07	*Kusmi* lac crop monitoring on *ber* tree
6.	Jashpur- Chhattisgarh	Chaurama	Chhattisgarh Tribal Development Programme	14 Oct., 07	*Kusmi* lac crop monitoring on *ber* tree
7.	Raigarh- Chattisgarh	Sohanpur, Dharamjaigarh	Janmitram Kalyan Samiti	14 Oct., 07	Monitoring of *semialata* plantation
8.	Bilaspur- Chhattisgarh	Sheotarai, Kota	Forest Department	17 Oct., 07	Monitoring of *rangeeni* lac crop
9.	Jamtara- Jharkhand	Mojra and Rupaidih, Jamtara	ATMA	1 Nov., 07	Monitoring of *rangeeni* lac crop
10.	Jamtara- Jharkhand	Bhuiankura and Kansjor	ATMA	2 Nov., 07	Monitoring of *kusmi* lac crop on *ber* tree

Table 41. Lac Product demonstration training

Sl. No.	Subject	Sponsoring agency	Duration	Persons
1	Gasket Shellac Compound	Self	16-21 April, 07	Shri Sachin Sawant, Sujata Chemicals, Mulund (E), Mumbai-81
2	Aleuritic Acid and Bleached Lac	Self	17-24 April, 07	Shri Rajkumar Paul, Creek Lane, Kolkatta-14
4	Testing and Analysis of Lac	Self	17-21 July, 07	Shri Satya Ranjan Sharma, Aarkay Chemicals, Sikohabad
5	Iso-Ambretotolide	Self	18-28 July, 07	Shri Rajiv Gupta, RST Shellac Overseas Pvt Ltd, Tagore Nagar, Raipur
6	Dewaxed Bleached Lac	Self	2-9 Aug., 07	Shri Ritesh Agarwal, Jessore Road, Kolkatta
7	Dewaxed Bleached Lac	Self	2-9 Sept., 07	Shri Nitin Agarwal, Kolkatta
8	Aleuritic Acid	Self	13-22 Nov., 07	Shri Devendra Gandhi, Station Road, Raipur
9	Bleached Lac	Self	13-22 Nov., 07	Shri Navneet Tewari, Station Road, Raipur
10	Processing of Lac	Magan Sangrahalaya SamitiWardha	12-17 Nov., 07	Shri Timothy Nakkala, Magan Sangrahalya, Wardha, Maharashtra

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

Jharkhand Lac Development Scheme

This is a centre-assisted scheme, implemented by the Welfare Department of Jharkhand Government with technical guidance and participation by the Institute, for enhancing the livelihood options of tribal families of the State. The work done under the scheme is summarized below (Table 42, 43 and 44).

A. Training programmes conducted

Table 42. One-week in-campus training programmes

Sl. No.	Nominating NGO	No. of participants	Duration
1	PRADAN	19	13-18 Aug., 07
2	VARDAN	6	13-18 Aug., 07
3	Gramin Jan Jagriti Manch	11	19-24 Nov., 07
4	SEEDS	6	19-24 Nov., 07
5	Kara Society for Rural Action	6	19-24 Nov., 07
6	FEMALE	4	26 Nov.-1 Dec., 07
7	Alternative for India Development	5	26 Nov.-1 Dec., 07
8	Nav Bharat Jagriti Kendra	6	26 Nov.-1 Dec., 07
9	SARDA	6	26 Nov.-1 Dec., 07
10	Kolhan Mahila Sangathan	4	26 Nov.-1 Dec., 07
11	Indian Gramin Services	6	26 Nov.-1 Dec., 07
12	Chakriya Vikas	5	26 Nov.-1 Dec., 07
13	VICAS	2	26 Nov.-1 Dec., 07
14	Gramin Vikas Trust	6	03-07 Dec., 07
15	AGRAGATI	2	03-07 Dec., 07
16	Sunita Kala Niketan	3	03-07 Dec., 07
17	Kolhan Mahila Sangathan	2	03-07 Dec., 07
	Total	**99**	-

B. Action Research

1. *Intensive lac cultivation on bushy host plants like semialata, bhalia etc*

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

- A plantation of *semialata* has been raised in July / August, 2007 in area of ~ 0.2 ha with more than 2000 plants in Kharsidag village, Ranchi disticts in collaboration with SEEDS an NGO.
- In another demonstration *aghani* lac crop has been raised in July 2007 on about 500 *semialata* plants at Chitramu village, Khunti disticts in collaboration with PRADAN, an NGO. The crop is progressing well.
- More than 8763 saplings of *semialata* have been provided to the NGOs for distribution among the farmers.
- 1.5 kg seed of *semialata* was provided to different NGOs for raising nursery of *semialata* plants.
- Training on plantation raising and management of *semialata.*
- Two special one-day training programme on plantation raising and management of *Flemingia semialata* plantation and lac cultivation were organised at the Institute on 10 April, 07 for 10 farmers sponsored by SEEDS and on 23 July, 07 for 10 farmers sponsored by BASIX. 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.
- One on-farm training was organised on plantation raising and management of *Flemingia semialata* in Tunju village on 19 April, 07 in collaboration with PRADAN, an NGO.

Table 43. On-farm training programmes on scientific lac cultivation

Sl. No.	Venue/Place	Nominating NGO	No. of families participated	Date
1.	Jhiripani, Ranigaon, Simdega	Chakriya Vikas Sansthan	100	12 Dec., 07
2.	Dumeria, Gumla	Gramin Jan Jagriti Manch	100	21 Jan., 07
3.	Serak, Chiro, Chatasemar	SARDA, Latehar	132	29 Jan., 07
4.	Karra Community Hall	Kara Society for Rural Action	250	02 Feb., 07
5.	Pinding	FEMALE, Erki	150	27 Feb., 07
6.	Utramit Primary School Hesala	GVT, Latehar	100	18 April, 07
7.	Sishi, Latehar (S)	GVT, Latehar	170	18 April, 07
8.	Panchayat Bhavan, Ormanjhi, Ranchi	Srijan Foundation	100	16 June, 07
9.	YMCA, Maranghata	NBJK, Khunti	250	31 Aug., 07
10.	Harbo, Torpa, Khunti	PRADAN	150	11 Sep., 07
11.	KRSA Nagar Bhavan, Karra, Ranchi	Karra Society for Rural Action	250	18 Sep., 07
12.	Kudrum, Saraipani, Phulwanagar, Simdega	Chakriya Vikas	100	04 Oct., 07
13.	Parvati Sharma, Inter Mahila Mahavidyalaya	Chakriya Vikas	200	05 Oct., 07
14.	Lumbai, Bandhgaon, West Singhbhum	VARDAN	150	05 Oct., 07
15.	Lumbai, Bandhgaon, West Singhbhum	VARDAN	150	08 Oct., 07
16.	Kadam Toli, Hardag, Namkum	VICAS	135	11 Oct., 07
17.	Chitir Ambatoli, Namkum	VICAS	67	24 Oct., 07
18.	Deogaon, Namkum	PRADAN	60	06 Nov., 07
19.	Ulhatu, Namkum	PRADAN	12	06 Nov., 07
20.	Takra, Khunti	PRADAN	60	13 Nov., 07
21.	Community Hall, Kujram	PRADAN	60	13 Nov., 07
22.	Hurlug, Khunti	PRADAN	50	14 Nov., 07
23.	Hakadua	PRADAN	55	14 Nov., 07
24.	Tati, Torpa, Khunti	PRADAN	50	21 Nov., 07
25.	Sondari, Torpa	PRADAN	60	23 Nov., 07
26.	Roda, Torpa	PRADAN	55	23 Nov., 07
27.	Banabira, Torpa	PRADAN	50	27 Nov., 07
28.	Longa, Arki	PRADAN	75	29 Nov., 07
29.	Baredih, Khunti	PRADAN	75	04 Dec., 07
	Total		**3,116**	

Table 44. On-farm training programme on scientific lac cultivation

Date	Village	Purpose
2 April, 07	Kharsidag	Field evaluation for *semialata* plantation
17 April, 07	Chitramu, Chukru, Nawadih, Hakadua	Lac crop assessment and technical guidance
19 April, 07	Tunju	On-farm training for raising *semialata* plantation
26 May, 07	Kontari	Lac crop monitoring
11 July, 07	Chitramu	Advice for broodlac inoculation on *semialata*
3 Aug., 07	Bara Salga, Gullu	Broodlac farm site selection
7 Aug., 07	Limda, Dudur, Katidari, Liangi, Potoda	Broodlac farm site selection
8 Sep., 07	Jaltanga, Rorong Kocha	*Semialata* field visit
1 Nov., 07	Kherkai, Leter, Nichipur, Sondati, Gututoli, Nachaldag, Devgain	*Semialata* field visit

Table 45. Details of lac cultivation demonstrations at various locations of Gujarat

Host plant species	Location	Number of trees/ bushes	Date of inoculation	broodlac used, (kg)	Broodlac yield in kg (yield ratio)
Flemingia semialata	Piplez	700	26 Jan., 07	9	92 (1:10.2)
	Piplez	600	5 July, 07	15	110 (1:7.3)
**Schleichera oleosa (kusum)*	Kevdi and Mithibor	760	20 Dec., 06	1000	3360 (1:3.3)
Zizyphus mauritiana (ber)	Bhavnagar	100	11 Aug., 07	9	80 #(1:9)
	Basan	100	11 Aug., 07	9	120# (1:10.3)
	Junagarh	40	7 July, 07	11	30 (1:3.3)
	Rajkot	40	7 July, 07	6	40 (1: 6.6)
	Godhara	100	7 July, 07	12	80 (1:6.6)
Prosopis juliflora (ganda bawel)	Bhavnagar	50	7 July, 07	11	No crop**

** Crop raised by Territorial Division of Forest Department, ** No settlement of lac larvae was achieved due to excessive rain during the period, # Expected yield as the lac crop yet to be harvested.*

2. *Raising plantation of alternate / high yielding host plants for evaluation at Ranchi conditions*

- Plantations of *Albizia procera* (64 plants in Plot No. 56A), *Prosopis juliflora* (132 plants in Plot Nos. 10 and 17A) and high yielding *Zizyphus mauritiana* (96 plants in Plot No. 53 part) have been raised at IRF for evaluating their potential for lac cultivation. The seedlings were raised in the nursery in poly bags in June 2006 and one year old saplings were transplanted in the field in July 2007.

3. *Field demonstration of productive breeds of lac insects in Ranchi district*

- 60 kg broodlac (30 kg each of Kulajanga and Nawadih stock) was inoculated in February 2007 on *kusum* trees in Mango Bandh area in collaboration with an NGO, SEEDS. But wide spread mortality was recorded during the month of March despite spraying the recommended pesticides.

C. *Infrastructure Development under JLDS*

- A 20m x 20m concrete floor for on-farm training has been constructed at the Institute Research Farm.
- Renovation of lodging facilities in the Kisan Hostel for trainees has been completed. New beds, mattresses, blankets etc. and two invertors for uninterrupted power supply to the boarders have been purchased.
- A motorized screen with OHP in the Training Hall and a microphone system in the Conference Hall have been installed to augment the training facility for the beneficiaries of the project.
- Proposal for construction of demonstration shed for trainees is in advanced stage of finalization.

D. *HRD Trainings conducted*

- Six students of B.Sc. (Biotechnology) from Allahabad Agricultural Institute and one student of B.Tech. (Biotechnology) from Birla Institute of Technology, Mesra, Ranchi have completed an one month summer training programme on "Principles and Techniques on Lac Biotechnology" from the Biotechnology laboratory of this Institute during 28.05.2007 to 27.06.2007.
- Three students of B. Sc. Biotechnology from Women's College, Jamshedpur have successfully completed their project work (four months) from the Biotechnology laboratory during 08.08.2007 to 18.12.2007.
- Three scientists of Central Tasar Research and Training Institute, Nagri, Ranchi have completed two weeks training programme on "Techniques in isolation, purification and analyzing DNA from bacterial isolates of lac

host plants and tasar silk insect" during 19.11.2007 to 03.12.2007.

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

During the period under report, lac cultivation trials were conducted on *F. semialata*, *Z. mauritiana*, *S. oleosa* and *P. juliflora* at various locations in Gujarat as per details in Table 45.

With a view to produce summer season *kusmi* broodlac (*jethwi*) on *F. semialata* to cater broodlac requirement for winter lac cultivation on *Z. mauritiana* and *P. juliflora* a trial was conducted on a new plantation of 600 plants (5 month old, density 2000 plants/ha) at Piplez in 2007, under irrigated conditions. Broodlac was inoculated @ 15 per plant (total 9 kg) in February and irrigation was provided weekly to the plants after inoculation. Lac pest management practices were followed as per recommendation. On crop maturity in July, the broodlac was harvested and a yield of 92 kg was obtained. The yield ratio of 1:9.2 is the indicative of a very good summer crop on this host and this technology has been recommended for Gujarat.

Regarding demonstration of *kusmi* lac cultivation technologies it can also be seen from table 46 that performance of lac crop was very good on *ber* when inoculated during August but it was not so good when inoculated during second week of July as there was heavy and continuous rain fall during the period of inoculation and settlement. The rain fall has also wiped off lac larvae from *P. juliflora*. Although *kusum* trees in Kevdi was small, these are yielding trees and a yield ratio of 1:3.3 is a good yield ratio for un-pruned trees.

Lac plantation of *F. semialata* was raised in one ha at Basan and Lakewada area in addition to the existing plantation for demonstration and training as per the layout provided. Approximately 200 naturally existing bushes of *P. juliflora* were also taken up at Lakewada area for the same purpose as suggested. A tour of Banaskanta, Saberkanta, Kachchha, Godhara, Dahod, Narmada and Dang districts of Gujarat was undertaken during June-July and September 2007 for host plant resource inventorization. Good patches of *palas* were located in Banaskanta, Saberkanta, Kachchha, Godhara whereas, *kusum* was located only in Dahod, Narmada and Dang. Another tour was undertaken in December for identification of an area for *kusmi* lac crop demonstration on *P. juliflora*. Two locations, one at Hathap, Bhavnagar district (1ha.) and another at Piplez, Chhotaudepur (0.5ha) were selected for demonstration. Trees shall be pruned during April 2008.

In order to promote value addition at village level, order has been placed for two mini lac processing units, developed by the Institute. An exhaustive plan for "Development of lac cultivation in Gujarat" has also been prepared and sent to the CCF, Gandhinagar.

3.2 Technology Assessment, Refinement and Dissemination

3.2.1 *Evaluation of some newer insecticides and bio-pesticides for eco-friendly management of insect pests associated with lac insect and host plants*

The project was initiated in July, 2007 with an aim to bring about novel and eco-friendly pest management technology for managing the insect pests associated with lac insect and host plants.

Evaluation of chemical insecticides

Field experiment was undertaken at Institute Research Farm for identification of some newer IPM recommended chemical pesticides on lac culture. For the management of two key lepidopteran predators *viz., Eublemma amabilis* Moore and *Pseudohypatopa pulverea* Meyr on the lac crop, nine IPM recommended newer chemical insecticides *viz.*, imidacloprid, fipronil, acetamiprid, thiamethoxam, lambdacyhalothrin, alphamethrin, indoxacarb, carbosulfan and spinosad were evaluated for their safety to lac insect and toxicity to predators of lac insect on rangeeni lac crop raised on *palas (Butea monosperma)*. Recommended insecticides endosulfan and ethofenprox were also sprayed for comparison of effectiveness with the newer insecticides.

Effect of insecticides on *katki* crop: Out of nine chemical insecticides evaluated, six insecticides *viz.*, fipronil (0.003 and 0.005%), lambdacyhalothrin (0.005 and 0.007%),

alphamethrin (0.005 and 0.01%), indoxacarb (0.006, 0.01 and 0.015%), carbosulfan (0.01, 0.025 and 0.05%) and spinosad (0.005, 0.007 and 0.01%) were found to be promising at recommended concentrations as far as safety to lac insect is concerned, in preliminary trials on rainy season *rangeeni* lac crop raised on *palas* trees (Table 46). Insecticides indoxacarb and carbosulfan were found safe to lac insect even at higher concentrations than the recommended one. Lac samples have been caged for quantifying the incidence of lac insect predators. The evaluation was carried out to asses whether one or two spraying of insecticide will be required to suppress the insect predators population. Significant per cent reduction in incidence of lac insect predator, *Eublemma amabilis* was recorded with the treatment of indoxacarb (71- 100 %), spinosad (53- 100 %), carbosulfan (55- 92 %), lambdacyhalothrin (97- 100%) and fipronil (63- 94 %). However in most of the treatments cent per cent reduction in incidence of *Pseudohypotopa pulverea* was observed except carbosulfan 0.01 and 0.025% where 66.67 and 83.33 per cent reduction in incidence, respectively was observed. The over all *P. pulverea* population in the crop was considerably low as compared to *E. amabilis*. It was observed that single application of insecticides was insufficient in managing the incidence of lac insect predators.

Effect of insecticides on *baisakhi* crop: The safer insecticides *viz.*, carbosulfan, indoxacarb, spinosad, fipronil, lambdacyhalothrin and alphamethrin identified on the basis of evaluation trials carried out on *katki* crop raised on *palas* trees were again evaluated with slight modification in doses of insecticides on the basis of preliminary trials for their safety to lac insect on *baisakhi* crop raised on *palas*. All the insecticides followed the similar trend as far as safety to lac insect is concerned on *baisakhi* crop also as evidenced on *katki* crop and the lac insect survival amongst different treatments at three varied doses ranged from 75 to 93 per cent as compared 94 per cent in control, clearly indicating the safety of insecticides to lac culture. In general the establishment of lac insect was relatively more in *baisakhi* crop as compared to *katki* crop.

Evaluation of insecticides on insect pest of palas tree

A pentatomid bug, *Cyclopelta obscura* was observed in large numbers during the month of October attacking the experimental *palas* trees

Fig. 22. Drying of shoots due to feeding of Cyclopelta obscura

Fig. 23. Cyclopelta obscura congregated on shoots of palas tree

Table 46. Bioefficacy of insecticides for their safety to lac insect and toxicity to lac insect predators

Sl. No.	Insecticide	Conc. (%)	Survival of lac insect (%)	Reduction in incidence of insect predators over control (%)	
				Eublemma amabilis	*Pseudohypatopa pulverea*
1.	Imidacloprid	0.003	67.50	NR	NR
		0.006	9.24		
		0.01	5.74		
2.	Acetamiprid	0.003	24.98	NR	NR
		0.006	21.84		
		0.01	7.51		
3.	Thiamethoxam	0.005	61.27	NR	NR
		0.008	53.11		
		0.01	29.15		
4.	Fipronil	0.003	83.15	2.63	100.00
		0.005	72.93	63.16	100.00
		0.01	49.66	94.74	100.00
5.	Lambdacyhalothrin	0.005	69.31	100.00	100.00
		0.007	59.93	97.37	100.00
		0.01	24.23	100.00	100.00
6.	Alphamethrin	0.005	58.70	100.00	100.00
		0.01	59.74	100.00	100.00
		0.02	49.36	100.00	100.00
7.	Indoxacarb	0.006	74.51	71.05	100.00
		0.01	59.96	84.21	100.00
		0.015	52.05	100.00	100.00
8.	Carbosulfan	0.01	63.57	55.26	66.67
		0.025	62.83	86.84	83.33
		0.05	60.92	92.10	100.00
9.	Spinosad	0.005	78.56	52.63	100.00
		0.007	72.20	89.47	100.00
		0.01	50.85	100.00	100.00
10.	Ethofenprox	0.02	61.96	94.74	100.00
11.	Endosulfan	0.05	71.14	84.21	100.00
12.	Control	(Water)	76.16	0.0	0.0
	S.Em±		6.03		
	CD (5%)		17.41		

NR = Insecticides not recommended (not safe to lac insect)

(Fig. 22 and Fig. 23). The bugs congregated and were found to feed gregariously on the tender shoots of *palas* trees and sucking the sap. As a result of continuous feeding of sap by a large number of bugs, the tender shoots dry up.

For the management of this pentatomid bug, *Cyclopelta obscura,* laboratory bioassay was carried out to evaluate eleven newer insecticides *viz.,* indoxacarb, carbosulfan, spinosad, fipronil, lambdacyhalothrin, alphamethrin, ethofenprox, endosulfan, imidacloprid, thiamethoxam and acetamiprid by a) topical application of insecticides on the insect and b) exposing the insect on residual film of insecticide (Table 47). Application of carbosulfan (0.02%), lambdacyhalothrin (0.007%), alphamethrin (0.01%) and ethofenprox (0.02%) were found to be most effective treatments resulting into cent per cent insect mortality within 24 hrs of treatment. However, endosulfan (0.05%) and topical application of spinosad (0.01%) gave cent per cent insect mortality after 72 hrs of treatment. Topical application of fipronil (0.005%) on insects and by

exposure of insect on residual film of fipronil, 76.67 and 66.67 per cent insect mortality, respectively was observed after 96 hrs of treatment and all these insecticides are also safe to lac insect, *Kerria lacca*. So it can be used effectively and safely during lac crop growth period. If lac crop is not being reared on *palas* trees, then the additional insecticides *viz.,* imidacloprid, thiamethoxam and acetamiprid may be used as these neonicotinoids are more effective as they resulted in 70 to 100 per cent insect mortality within two hrs of treatments. It was observed that the topical application and residual film of insecticides almost exerted similar effect on the bioefficacy of pentatomid bugs in most of the cases. In control no mortality of *C. obscura* was observed up to 96 hrs of treatment.

Evaluation of Bacillus thuringiensis formulation

One newer commercially available *Bacillus thuringiensis* var. kurstaki formulation (Halt 5 WP, serotype H 3a, 3b, and 3c) of indigenous origin was evaluated at four different concentrations on *kusmi* lac crop raised on *ber,* for their safety to lac insect and toxicity to lepidopteran lac insect predators *viz.*, *Eublemma amabilis* and *Pseudohypatopa pulverea*. Halt was found safe to lac insect at all the four concentrations (1g, 2g, 3g and 4g /lt) evaluated and there was no significant difference in survival of lac insect amongst different concentrations of *Bt* formulations. The survival of lac insect among different treatments varied from 79.2 to 82.3 per cent as compared to 81.8 per cent in case of control. The lac stick samples have been caged for quantification of incidence of lac insect predators. Exotic *Bt* formulation, Delfin (85 WG, serotype 3a, 3b) was also sprayed for comparison of effectiveness with this newer indigenous Bt formulation.

3.3 Liaison, Information and Advisory Service

3.3.1 *Informatics on lac production, marketing and processing*

Efforts have been made at national level for collection of lac related information and data.

Table 47. Per cent mortality of pentatomid bug, Cyclopelta obscura in different treatment of insecticides

Sl.No.	Insecticide	Conc.(%)*		Per cent mortality after 2 hrs	24 hrs	72 hrs	96 hrs
1.	Indoxacarb	0.01	TA	26.6	33.33	43.33	**100**
			RF	23.33	30.00	40.00	**100**
2.	Carbosulfan	0.02	TA	73.33	**100**		
			RF	66.67	**100**		
3.	Spinosad	0.01	TA	63.33	73.33	**100**	
			RF	6.67	20.00	46.67	73.33
4.	Fipronil	0.005	TA	23.33	33.33	50.00	76.67
			RF	6.67	23.33	43.33	66.67
5.	Lambdacyhalothrin	0.007	TA	73.33	**100**		
			RF	63.33	**100**		
6.	Alphamethrin	0.01	TA	76.67	**100**		
			RF	63.33	**100**		
7.	Ethofenprox	0.02	TA	73.33	**100**		
			RF	66.67	**100**		
8.	Endosulfan	0.05	TA	6.67	73.33	**100**	
			RF	3.33	63.33	**100**	
9.	Imidacloprid	0.006	TA	**100**			
			RF	96.67	**100**		
10.	Thiamethoxam	0.008	TA	46.67	**100**		
			RF	80.00	**100**		
11.	Acetamiprid	0.006	TA	70.00	**100**		
			RF	**100**			
12.	Untreated control	-		0.0	0.0	0.0	0.0

**** Application method; TA = Topical Application; RF = Residual Film***

Separate schedules / questionnaires were used for survey of lac markets, traders, exporters, importers and processing units. Frequent survey was made in various lac growing areas of the country for collection of data through out the year during 2007-08. The requisite data have been collected from the respondents at various lac markets and lac processing centers. For updating the information and data, regular contacts were made with the respondents through phone also. Survey has been conducted in 29 lac growing districts of 8 states with 74 lac traders, 49 lac manufacturer and 24 other key informants during 2007-08. Name of the states and districts in which survey was carried out have been presented in Table 48 and sample size surveyed during the year have been presented in Table 49.

Lac production in India during 2007-08

Efforts have been made at national level for data collection. On the basis of survey in the markets of different lac producing districts and states, the estimated national production of sticklac during 2007-08 was approximately 20,640 tons (Table 50). Chhattisgarh state ranks 1st followed by Jharkhand, Madhya Pradesh, West Bengal and Maharashtra. The above five states are contributing around 95 per cent of the national lac production. Contribution of Chhattisgarh in national lac production was 34.69 per cent followed by Jharkhand (30.94 %), Madhya Pradesh (18.19 %), West Bengal (5.52 %) and Maharashtra (5.18 %). The ratio of *rangeeni* and *kusmi* lac in national lac production was 66:34. At national level the production of lac was around 11 per cent less than the last year arrival. The major reasons for decline in lac production were shortage of broodlac and lac insect mortality after inoculation of broodlac.

Lac Processing in India

On the basis of survey of different lac processing centers in the country the total amount of sticklac processed during 2006-07 was 29,800 tons which

Table 48. States and districts surveyed

States	Districts
Assam	Karbi-Anglong
Chhattisgarh	Bilaspur, Dhamtari, Durg, Janjgir-Champa, Kanker, Korba, Koria, Mahasamund, Surguja, Raipur and Rajnandgaon
Jharkhand	Garhwa, Gumla, Latehar, Lohardaga, Palamau, Ranchi, Simdega and West Singhbhum
Madhya Pradesh	Balaghat, Dindori, Mandla and Seoni
Maharashtra	Bhandara, Gondia and Wardha
Orissa	Balasore
West Bengal	Bankura and Purulia

Table 49. Sample size during the survey

State	District	Total number of samples		
		Number of traders	Number of manufacturers	Govt. Officials/ NGOs/ Other key informants
Assam	1	2	-	1
Chhattisgarh	11	25	16	5
Gujarat	-	-	-	1
Jharkhand	7	18	13	5
Madhya Pradesh	4	18	-	4
Maharashtra	3	5	4	6
Orissa	1	-	-	1
West Bengal	2	6	16	3
Total	**29**	**74**	**49**	**26**

Table 50. Lac production in India during 2007-08 (in tons)

State	Crop				Total production
	Baisakhi	*Jethwi*	*Katki*	*Aghani*	
Andhra Pradesh	15	0	15	0	30
Assam	30	0	55	0	85
Bihar	5	0	5	0	10
Chhattisgarh	3045	1350	1475	1290	7160
Gujarat	25	5	20	5	55
Jharkhand	1370	1310	1765	1940	6385
Madhya Pradesh	2095	437	915	308	3755
Maharastra	645	0	425	0	1070
Meghalaya	5	0	10	0	15
Orissa	95	120	70	150	435
Uttar Pradesh	350	0	150	0	500
West Bengal	300	50	750	40	1140
TOTAL	**7980**	**3272**	**5655**	**3733**	**20640**

also included the amount of imported lac (7,366 tons). 26 Lac processing units in Chhattisgarh, 25 units in Jharkhand, 7 units in Maharashtra and 145 units in West Bengal were in running condition during the year 2006-07. In processing of lac West Bengal ranked 1st (40.77 %) followed by Chhattisgarh (32.55 %), Jharkhand (21.31 %) and Maharashtra (5.37 %). The information on lac processing centers in India, amount of sticklac processed at different lac processing centers in the country and share of different states in lac processing during 2006-07 has been presented in Table 51, 52 and Fig. 24, respectively. There were 12 primary and 9 secondary markets existing at national level in which annual arrival of sticklac was more than 500 tons. Name of the primary and secondary markets with annual arrival of more than 500 tons have been presented in Table 53.

Export of lac during 2006-07

Data on export of lac and its value added products from India were collected from Directorate General of Commercial Intelligence and Statistics, Kolkata. The total export of lac and its value added products during the year 2006-07 was 7,525.46 tons valued at Rs.147.72 crores. The top ten importing countries of Indian lac are Indonesia, Pakistan, USA, Egypt ARP, Bangladesh, Germany, Spain, UAE, Italy and U.K. and accounted for around 80 per cent of the total exports by quantity and 74 per cent by value.

Table 51. Lac processing centers in India

State	District (Center)	No. of processing units	Product made
Chhattisgarh	Bilaspur (Pendra)	2	Seedlac, Button lac and Hand made Shellac
	Dhamtari	11	Seedlac, Shellac, Button lac, Bleached lac
	Jajgir-Champa (Sakti)	3	Seedlac, Shellac, Bleached lac, Dewaxed Shellac, Lac dye
	Kanker	2	Seedlac, Button lac
	Korba (Kathgora)	7	Seedlac, Shellac, Bleached lac
	Rajnandgaon	1	Seedlac, Shellac
Jharkhand	Palamau & Garhwa	8	Seedlac, Button lac
	Ranchi	14	Seedlac, Button lac, Shellac, Lac dye, Bleached lac
	Simdega	1	Seedlac
	West Singhbhum	2	Seedlac, Shellac
Maharashtra	Gondia	7	Seedlac, Shellac, Gasket Shellac Compound, Bleached lac
West Bengal	Purulia (Balarampur)	95	Seedlac, Shellac, Button lac, Bleached lac, Aleuritic acid, Lac wax, Dewaxed Decolourised lac
	Purulia (Jhalda)	5	Seedlac, Shellac, Button lac
	Purulia (Tulin)	45	Seedlac, Button lac

Table 52. Amount of sticklac processed in India during 2006-07

State	Districts (Centers)	Quantity (tons)
Chhattisgarh	Bilaspur (Pendra)	200
	Dhamtari	3,500
	Janjgir-Champa (Sakti)	900
	Kanker	600
	Korba (Kathgora)	4,200
	Rajnandgaon	300
	Sub total	**9,700**
Jharkhand	Palamau & Garhwa	900
	Ranchi	4,900
	Simdega	100
	West Singhbhum	450
	Sub total	**6,350**
Maharashtra	Gondia	**1,600**
West Bengal	Purulia (Balarampur)	11,500
	Purulia (Jhalda)	250
	Purulia (Tulin)	400
	Sub total	**12,150**
	Total	**29,800***

** Include the quantity of imported lac in India*

Import of lac in India during 2006-07

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. Data on import of lac in India were collected from Directorate General of Commercial Intelligence and Statistics, Kolkata. The total import of different kind of lac during the year 2006-07 was 7,365.64 tons valued Rs.56.51 crores. Majority of lac was imported in the country was from Indonesia and Thailand. Out of the total import, around 96 per cent in terms of quantity and 95 per cent in terms of value comes from Indonesia. Details of import of lac in quantity and value during 2006-07 have been presented in the Table 56 and 57 while the trend in import of lac in quantity and value during last five years are shown in Fig. 26. Internal consumption and export of lac produced in India during 2006-07 and share of different host crops in lac production are depicted in Fig. 27 and 28, respectively.

Table 53. Markets with annual arrival more than 500 tons during 2007-08

States	Primary Markets	Secondary Markets
Chhattisgarh	Bhaisama Bazar, Bhanupratappur, Korvi, Kota, Mohala Chowki, Pali, Sambalpur	Dhamtari, Kanker, Kathgora, Sakti
Jharkhand	Bandgaon, Jaldega, Palkot	Bundu, Khunti, Daltongunj
Madhya Pradesh	Barghat, Katangi	-
Maharashtra	-	Gondia
West Bengal	-	Balarampur

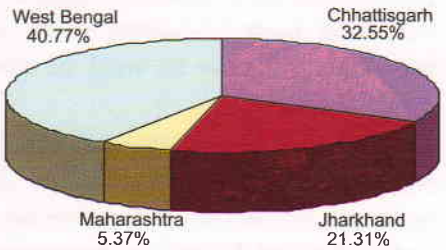

Fig. 24. Share of different states in lac processing at national level

Details of export in quantity and value during 2006-07 and list of top 15 countries importing Indian lac has been presented in the table 54 and 55 while the trend in export of lac in quantity and value during last five years are shown in figure 25.

Table 54. Export of lac and its value added products from India during 2006-07

Sl.No.	Name of product	Export in 2006-07 Quantity (tons)	Value (Rs. lakh)
1.	Shellac	4,779.91	8,899.49
2.	Seedlac	1,331.15	2,159.41
3.	Sticklac	2.67	4.74
4.	Dewaxed & Decolorized lac	128.42	320.83
5.	Bleached lac	147.55	280.14
6.	Gasket lac	28.80	31.79
7.	Button lac	571.00	1,112.93
8.	Shellac wax	19.00	52.16
9.	Aleuritic acid	259.04	1,389.95
10.	Lac dye	1.05	1.07
11.	Other lac	256.87	510.88
	Total	**7,525.46**	**14,772.39**

Table 55. Top fifteen importing countries of Indian lac

Sl. No.	Country	Quantity (tons)	Value (Rs. lakh)
1.	Indonesia	1,236.52	2,034.06
2.	Pakistan	1,121.16	1,699.48
3.	USA	803.12	1,615.77
4.	Egypt ARP	800.14	1,357.45
5.	Bangladesh	623.85	1,207.75
6.	Germany	527.50	1,120.80
7.	Spain	266.00	756.70
8.	UAE	332.31	570.54
9.	Italy	204.54	372.85
10.	UK	101.45	218.03
11.	Hong Kong	110.66	199.67
12.	Jordan	88.07	172.14
13.	South Africa	64.67	171.52
14.	Nepal	100.07	159.01
15.	Japan	59.01	112.84
16.	Other countries	1,086.39	3,003.78
	Total	**7,525.46**	**14,772.39**

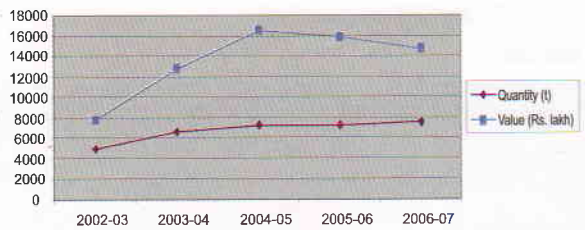

Fig. 25. Trend in export of lac from India during last five years

Table 56. Import of different kinds of lac in India during 2006-07

Sl.No.	Name of product	Export in 2006-07 Quantity (tons)	Value (Rs. lakh)
1.	Seedlac	4,861.14	4,065.61
2.	Sticklac	2,503.95	1,581.51
3.	Shellac	0.43	0.99
4.	Lac dye	0.01	2.02
5.	Other lac	0.11	0.40
	Total	**7,365.64**	**5,650.53**

Table 57. Import of lac in India from different countries during 2006-07

Sl.No.	Name of country	Quantity (tons)	Value (Rs. lakh)
1.	Indonesia	7047.56	5357.76
2.	Thailand	317.54	289.35
3.	USA	0.40	0.49
4.	UK	0.03	0.50
5.	Denmark	0.10	0.37
	Total	**7,365.64**	**5,650.53**

3.3.2 *Strengthening, liaison, information and advisory services on natural resins and gums*

- Questionnaire has been developed for collection of information from lac farmers regarding cultivation related problems, manufacturers and entrepreneurs for identifying the problems related to small scale processing and value addition and preparation of directory.
- Scientists visited Bankura (West Bengal) to explore the possibilities of promotion of lac cultivation in the District. As a follow up action the Institute has taken up lac promotion activities in association with Agricultural Technology Management Agency (ATMA) and District Industries Centre (DIC), Bankura.
- Demonstration of *rangeeni* lac cultivation technology on *palas* at State Brood Lac Farm (SBLF), Bonkata (33 plants), Dharramouli (100 plants) and at Bohra village (100 plants).
- Frontline demonstration for raising of *Flemingia semialata* plantation at Dalpur Ashram, Bankura has been taken up. About 4,000 *semialata* bushes have been raised in a 0.5 ha land.
- FLD on *rangeeni* lac cultivation in Dhenkanal in association with Krishi Vigyan Kendra (KVK) Dhenkanal. About 30 *palas* tree have been inoculated with *rangeeni* broodlac during the 1st week of November 2007.
- Technologies of preparation of gasket shellac compound, dewaxed bleached lac, aleuritic acid, Isoambrettolide, lac processing, testing and analysis of shellac have been given to 21 entrepreneurs.
- Inspection of an over burdened site (OBD) at Purnapani, Sundergarh District, Orissa was carried out for probing the possibilities of lac cultivation. The project is being sponsored by Steel Authority of Indian Limited, Department of Bio-technology, Delhi University (SAIL-DBT-DU). A proposal based on the feasibility study has been sent to the coordinator of the project.

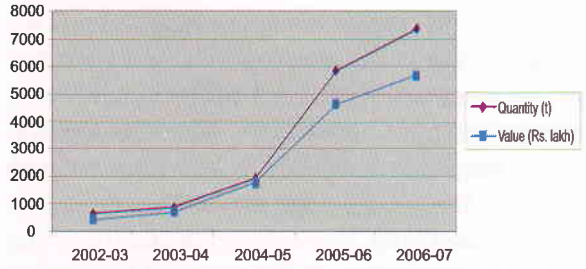

Fig. 26. Trend in import of lac in India during last five years

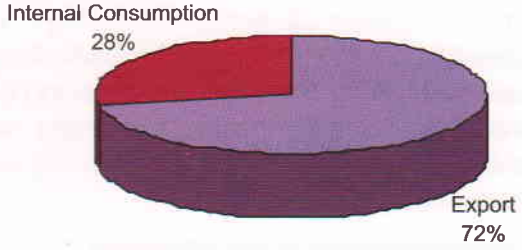

Fig. 27. Internal consumption and export of lac produced in India during 2006-07

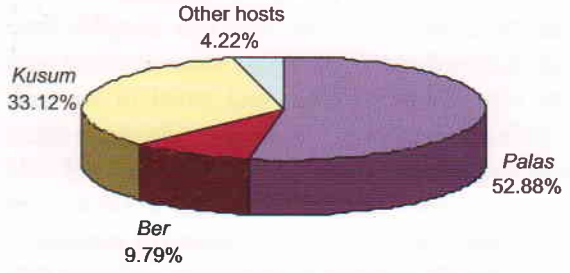

Fig. 28. Share of different hosts in lac production

- Two areas (Saruda and Gojakhas) in Palkot of Gumla District were visited for studying the feasibility of the proposed plantation of lac host plants. Assistance was provided for preparation of the proposal to be submitted by an NGO (AHEAD) for funding by the District administration. The NGO has planted lac hosts plants *i.e., kusum, ber, arhar, semialata* and *bhalia* in an around 480 acres of land in seven pockets.
- Project proposal for promotion of lac cultivation in Namkum, Angara, Silli, Chandil, Ichagarh and Nimdih Blocks has been prepared on the request of Shri Subodh Kant Sahai, Hon'ble Minister for Food Processing (Independent Charge).
- Scientists attended the meeting at All India Radio and have given proposal for inclusion of topics for recording and telecast.
- Write up has been prepared for the news paper concerning general tips for lac cultivation during the month of October.
- Survey has been conducted in Latehar, Daltonganj and Chakradharpur for identification of constraints in lac processing units. Some information on the availability of natural resins and gums have been collected and samples procured.
- An Industry-Institute Interface Meeting was organized jointly by the Institute and Balarampur Khudra Lakha Kutir Shilpa Vyavasayee Samiti, at Balarampur on November 24, 2007.
- Regular queries are being received related to lac production, processing and product development.
- A camp for motivational training on Scientific method of lac cultivation was organized in Village Navargaon, Sellu, Wardha (Maharashtra) in collaboration with Magan Sangrahalaya Samiti, Wardha. Fifty members (female) of SHGs participated in the programme. Magan Sangrahalaya Samiti, Wardha has started lac cultivation on 5000 *palas* host in four villages *i.e.,* Masada, Thomaswada, Juari and Mahakali of Wardha district. *Palas* is the major host while *kusum* and *ber* hosts are also available in Navargaon area. Necessary instructions were given for pruning of host trees for lac cultivation on *kusum* and *ber* host also.
- Samples of raw lac, seed lac, shellac, bleached lac, button lac lac dye etc were handed over to Dr. Bibha Gupta Chairperson, Magan Sangrahalaya Samiti for display in the Museum.
- Shri Ganotra, ACF (Gondia) has shown interest for providing training on lac cultivation to the Forest Guards under JFM progrmmme from the District.
- Shri D.P. Sadavate (ACF, Nagpur) showed keen interest for promotion of lac cultivation in the district and requested for some on farm trainings for the farmers.
- A team of Scientist and technical personnel

visited Chandwa, Latehar, Daltonganj areas of Jharkhand and Purulia and Bankura Districts of West Bengal for assessing the reasons of lac insect mortality and poor crop production. Among several reasons given by the farmers it seems that heavy fog during the month of November to January is responsible for insect mortality.

- Feasibility study was carried out for possibilities of lac cultivation in Barajamda, Barbil iron ore mining areas and Tengrai and adjoining villages under Rajnagar Block (East Singhbhum).

Problems of lac processing units

For identifying problems associated with lac processing units, survey of lac processing units of three areas (a) Daltonganj (b) Chakradharpur (c) Shakti, chhattisgarh were undertaken.

In Jharkhand shortage of sticklac is major constraints faced by lac manufacturer due to poor crop. Majority of lac processing units are at the verge of closer especially in Daltonganj. In Chhattisgarh some problems associated with lac industries and lac products were identified as (1) Seedlac is treated with auxiliary acid and is sun dried, then if sun is not full/intense and weather is cloudy, the colour of seedlac become dark. The dark colour is not removed even if the entire water process is repeated (2) During the washing of seedlac if it is left in vat overnight, then a white layer appears on the seedlac. However, this seedlac is soluble in spirit and there is no difficulty in marketing except the unpleasant appearance of the seedlac. (3) Shakti is located at a remote place as compared to other manufacturing units, the transportation of lac products (DL and Bleached lac) becomes costlier and difficult as these are only transported in A.C. containers. Therefore the firm would like to seek subsidy in any form on such products from Govt. for the units working in remote areas (4) the firm has suggested (a) opening of testing laboratory in the area (b) to develop mechanized process for manufacturing button lac (c) fruit coating formulation /technology (d) lac factory effluent disposal technology (e) Preparation of a turn key project for establishing a bleach lac plant for 50 tones/month capacity (f) to develop mechanized seedlac processing unit specially for winnowing, cleaning, removing sand from seedlac and grading.

Technology assessment and refinement

M/s D Manoharlal Shellac Factory at Sakti, Chhattisgarh, has posed a problem in the manufacturing of lac wax. Lac wax samples have been received and the problem was associated with high saponification value and smell of lac wax manufactured by him. The problem has been taken up as exploratory studies. The sample of lac wax was treated with calculated quantity of (a) sodium bicarbonate (b) sodium carbonate (c) potassium hydroxide (d) sodium hypochlorite solution (3% available chlorine) to bring down the saponification value to a desired level. The physico chemical characteristics of the sample and treated samples have been determined (Table 58). The results showed that the saponification value has been reduced in all the cases but not up to desired level.

Table 58. Analysis of lac wax samples

Characteristics	Required value	Untreated sample	Treated sample			
			Sodium bicarbonate	Sodium carbonate	Potassium hydroxide	Sodium hypoclorite
Acid value	2-10	7.5	8.85	7.96	8.17	8.45
Saponification value	40-50	80	74.66	67.76	67.24	69.43
Ester value	37-45	72.5	82.51	75.72	75.41	77.88
Ash content max.	1.0	0.2	-	-	-	-
Iodine value	1-3	-	-	-	-	-
Water content % (w/w)	1.0	0.17	0.17	0.16	0.16	0.16
Melting point (0°C)	77-86	79-80	80	80-81	81.0	81.0
Specific gravity Gm/cm 20°C	0.87-0.98	-	-	-	-	-

4. APPROVED ON GOING RESEARCH PROJECTS

4.1 *Insect Improvement*

- Collection, conservation, characterization and documentation of lac insect bio-diversity. (Dr. K.K. Sharma)
- Field evaluation of promising lac insect races, lines and breeds for higher productivity and superior performance. (Dr. Md. Monobrullah)
- Application of molecular fingerprinting for genetic characterization of races and species of lac insect. (Dr. R. Ramani)

4.2 *Host Improvement*

- Collection, conservation, characterization and documentation of lac host bio-diversity. (Sri S.C. Srivastava)
- Host plant evaluation and improvement for lac productivity and summer sustainability. (Dr. R. Ramani)
- Clonal propagation of *Schleichera oleosa (kusum)*, a major lac host plant through tissue culture. (Dr. D. Saha)

4.3 *Crop Production*

- Studies on *in-situ* moisture conservation techniques for raising mixed plantation of *ber* and *kusum*. (Sri R.K. Singh)
- Development of *kusmi* lac cultivation technology on *Albizia procera* (*siris*). (Dr. A.K. Jaiswal)
- Collection, identification and assessment of the diseases of commercial lac hosts. (Dr. A.K. Singh)
- Management of sooty mould, causing lac insect death and failure of lac crop. (Dr. A.K. Singh)
- Soil fertility management of *ber* (*Z. mauritiana*) for shoot growth and lac yield (*aghani*). (Dr. S. Ghosal)
- Production of quality broodlac on kusum and *palas* at different agro-climatic region. (Dr. K.K. Sharma)
- Development of lac production system using high density *ber* plantation under semi protected conditions. (NABARD sponsored) (Dr. R. Ramani)

4.4 *Synthesis and Product Development*

- Comparative study on the physico-chemical properties of lac from various lac producing countries. (Dr. S. Srivastava)
- Field evaluation of PGR and insect attractant / repellants derived from aleuritic acid. (Dr. R.N. Majee)
- Synthesis of thiosemicarbazide and thiodiazole from aleuritic acid and testing its activity as antifungal / hypoglycemic / antinemic. (Dr. Divya)

4.5 *Surface Coating and Use Diversification*

- Development of surface coating formulation based on shellac synthetic resin/polymer blends. (Sri. M.F. Ansari)
- Documentation and characterization of physico-chemical properties of plant based gums of commercial importance. (Dr. K.P. Sao)
- Preparation and market evaluation of heat and water proof shellac varnishes for wooden surfaces and air drying type shellac based glazing varnishes. (Dr. M.Z. Siddiqui)
- Comparative performance of water soluble lac varnishes and their keeping quality by using different alkalies. (Sri. P.M. Patil)

4.6 *Processing and Storage*

- Establishment of commercially viable pilot plant for preparing pure / food grade lac dye. (Dr. K.M. Prasad)
- Storage loss assessment for lac and lac based products. (Dr. S.K. Giri)

- Establishment of commercially viable plant for aleuritic acid for training demonstration and process retirement (Dr. S.K. Giri)
- Design and development of seedlac dryer. (Dr. N. Prasad)
- Establishment of pilot plant for dewaxed bleached lac (40 kg capacity) for training demonstration and process refinement. (Sri. M. Prasad)

4.7 *Human Resource Development (HRD)*

- Training, demonstration, extension education and information service on lac culture, processing and product development. (Dr. A.K. Jaiswal)
- Enhancing livelihood options for poor tribal families of the Jharkhand state through capacity building in cultivation of lac and its value addition (JLDS). (Dr. K.K. Sharma)
- Skill development and capacity building in lac culture through training and demonstration in Gujrat. (Gujarat Govt. Project) (Sri Y.D. Mishra)

4.8 *Technology Assessment, Refinement and Dissemination*

- Evaluation of some newer insecticides and bio-pesticides for eco-friendly management of insect pests associated with lac insect and host plants. (Dr. J. P. Singh)

4.9 *Liaison, Information and Advisory Service*

- Informatics on lac production, marketing and processing. (Dr. Govind Pal)
- Strengthening, liaison, information and advisory services on natural resins and gums. (Dr. A. Bhattacharya)

Exploratory Studies

- Impact of pitcher irrigation and mulching on the summer season (*jethwi*) crop sustainability and new leaf initiation period on *ber*. (Sri. R. K. Singh)
- Study on weed management in lac host plantation. (Dr. B. P. Singh)
- Promoting early shoot growth of *ber* through fertility management for raising its plantation. (Dr. S. Ghosal)

5. PUBLICATIONS AND PUBLICITY

5.1 Publications

5.1.1 *Research Papers*

- Bhattacharya, A., Jaiswal, A.K. and Kumar, K.K. 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.
- Jaiswal, A.K., Bhattacharya, A., Kumar, S. and Kumar, M. 2006. Incidence of *Tachardiaephagus tachardiae* (Hymenoptera-Encyrtidae), an important endo-parasitoid harboring lac colonies, in virgin and fertilized female lac insects. *Indian Journal of Entomology*, **68**(3): 307-308.
- Pal, G., Jaiswal, A.K. and Bhattacharya, A. 2006. An analysis of price spread in marketing of lac in Madhya Pradesh, *Indian Journal of Agricultural Marketing* **20** (3): 60.
- Prasad, N., Pandey, S.K. and Bhagat, M.L. 2007. Development of broodlac placement-cum-removal tool. *Journal of Agricultural Engineering*, **44** (1): 85-87
- Sharma, K.K., Kumari, K. and Lakhanpaul, S. 2007. Super-parasitism in Indian lac insect, *Kerria lacca* (Kerr) and its implication on fecundity and resin producing efficiency on its two strains. *Entomon*, **31** (1) : 33-39
- Yadav, S.K., Mishra, Y.D and Singh, R.K 2007. Total leaf area estimation of *Flemingia semialata* Roxb. by linear regression. *Agricultural Science Digest*, **27** (1): 44 - 46.

5.1.2 *Papers presented/contributed in conferences/symposia/seminars*

- Ansari, M.F. 2007. Commercializeable technologies of lac and lac based products. In: *Lac Industry-Institute Interface* held at Balrampur, West Bengal, 24 November, 2007.
- Ansari, M.F. and Baboo, B. 2007. Diversified uses of lac. In: *National seminar on value added products of commercial importance from natural resins and gums* held at IINRG, Ranchi, 20-21 September, 2007.
- Baboo, B., Giri, S.K. and Srivastava, S. 2007. Harvesting and processing of natural resins and gums-present status and future research needs. In: *41st Annual Convention and Symposium of ISAE* held at JAU, Junagadh, 29-31 January, 2007.
- Giri, S.K. 2007.Processing and value addition of natural resins and gums. In: *National Workshop on Identification of Appropriate Primary Processing Technologies for Value Addition of Minor Forest Produce in Tribal Areas: A Step in Rural Development* held at CIPHET, Ludhiana, 5-6 October, 2007.
- Giri, S.K. and Ansari, M.F. 2007. Processing of natural resins and gums. In: *National seminar on value added products of commercial importance from natural resins and gums* held at IINRG, Ranchi, 20-21 September, 2007.
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- Siddiqui, M.Z., Baboo, B. and Bhattacharya, A. 2007. Salai guggal – A multifunctional oleo gum-resin. In: *National Seminar on value added products of commercial importance from natural resins and gums* held at IINRG, Ranchi, 20-21 September, 2007, 27pp.
- Singh, R.K., Ramani, R. and Baboo, B. 2007. Role of Lac based Agroforestry in Watershed Management in Jharkhand. In: *South Asian Conference on Water in Agriculture: Management options for increasing crop productivity per drop of water,* held at IGKV, Raipur, Chhattisgarh. 207 pp.
- Vashishtha, A., Sharma, K.K., Chawla, H.M. and Lakhanpaul, S. 2007. Evidence for the presence of endosymbionts in *Kerria lacca:* Is lac a product of coevolution? In: *Evolution 2007 Symposium* held at Christchurch, New Zealand, 16-20 June, 2007.

5.1.3 *Books / Book Chapters/ Bulletin / Training Manual*

- Baboo, B. and Sharma, K.K. 2007. Lac in rainfed farming system. *Lecture Notes on Soil, Water and Nutrient Management for Different crops under Rainfed* Agro-ecosystem. (eds. Sarkar, A.K., Singh, R.P. and Mahapatra, P.), Birsa Agricultural University. 219-227 pp.
- Bhattacharya, A. 2007. ILRI - History, objective, set-up and its activities, In : *Advanced Lac Production, Storage and Application Technology for Employment and Income Generation* (eds. Bhattacharya, A., Jaiswal, A.K., Prasad, N. and Pal, G.), Indian Lac Research Institute, Ranchi. 1-5 pp
- Bhattacharya, A. 2007. Transfer of Technology for lac growers, entreprnerus and industries. In: *Advanced Lac Production, Storage and Application Technology for Employment and Income Generation* (eds. Bhattacharya, A., Jaiswal, A.K., Prasad, N. and Pal, G.), Indian Lac Research Institute, Ranchi. 15-18 pp.
- Bhattacharya, A. 2007 Lac insect and associated fauna. In: *Advanced Lac Production, Storage and Application Technology for Employment and Income Generation* (eds. Bhattacharya, A., Jaiswal, A.K., Prasad, N. and Pal, G.), Indian Lac Research Institute, Ranchi. 36-40 pp.
- Bhattacharya, A. and Jaiswal, A.K. 2007. Pest Management in lac culture. In: *Advanced Lac Production, Storage and Application Technology for Employment and Income Generation* (eds. Bhattacharya, A., Jaiswal, A.K., Prasad, N. and Pal, G.), Indian Lac Research Institute, Ranchi. 57-63 pp.
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- Jaiswal, A.K. and Bhattacharya, A. 2007. Conventional and scientific method of lac

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- Singh, R.K. 2007. Impact of different soil moisture conservation practices on growth and development of lac host plants. In: *Advanced Lac Production, Storage and Application Technology for Employment and Income Generation* (eds. Bhattacharya, A., Jaiswal, A.K., Prasad, N. and Pal, G.), Indian Lac Research Institute, Ranchi. 81-86 pp.
- Sharma, K.K. 2007. Lac insect – Host plant interaction : Implications on Quantity and Quality of lac. In: *Advanced Lac Production, Storage and Application Technology for Employment and Income Generation* (eds. Bhattacharya, A., Jaiswal, A.K., Prasad, N. and Pal, G.), Indian Lac Research Institute, Ranchi. 41-48 pp.
- Sharma, K.K. and Baboo, B. 2007. Plantation for lac cultivation – A potential remunerative venture for North-Eastern States. In: *Traditional Agricultural Practices with Potential for Growing Plantation Crops* (eds. Choudhary, S.L., Saxena, R.C., Nene, Y.L. and Simlot, M.M.), Asian Agri-History Foundation, Secunderabad. 108-114 pp.
- Pal, G., Jaiswal, A.K. and Bhattacharya, A. 2007. *Lac Statistics at a Glance*, India Institute of Natural Resins and Gums, Ranchi, 16 pp.
- Sharma, K.K. and Kumar, K.K. 2007. Lac – a natural heritage of India. In: *Glimpses of the Agricultural Heritage of India* (ed. Nene, Y.L.), Asian Agri-History Foundation, Secunderabad. 292-300 pp.

5.1.4 *Popular Articles*

- Ansari, M.F., Goswami, D.N. and Prasad, N. 2007. Entrepreneurial opportunities in shellac based coating compositions. In: *New Coatings for Global India*, 315-318 pp.
- Pal, G., Singh, R.K. and Bhattacharya, A. 2006. Jharkhand mein lakh ki kheti: vastusthiti, samasyaen awam nidan. *Pathari Krishi*, April-December, 2006,16-17 pp.
- Prasad, N., Baboo, B. and Pandey, S.K. 2007. Bat lakh ki. *Kheti*, **60**(5): 26-28

5.1.5 *Institute Publications*

- ILRI-*Lac Newsletter,* **11** (1) : 12 pp.
- IINRG-*Natural Resins and Gums Newsletter,* **11** (2) : 20 pp.
- ICAR and ILRI *in service of the Nation*, multicolour folder in commemoration of the foundation of ICAR : 6 pp.
- *Lac Statistics at a Glance*-2007 : 16 pp.
- IINRG-*Natural Resins and Gums Newsletter,* **11** (3) : 16 pp.
- ILRI *Annual Report* 2006-07 : 82 pp.
- *Vision 2025, perspective Plan*-IINRG : 62 pp
- IINRG *at a Glance* : 16 pp.
- Status paper on *Food application of lac dye* : 10 pp.
- IINRG-*Natural Resins and Gums Newsletter,* **11** (4) : 20 pp.

5.2 Publicity

5.2.1 *Participation in Kisan Melas and Exhibitions*

- The Institute participated in the exhibition organized by Rama Krishna Mission Ashrama, Morabadi, Ranchi, during the Seminar cum Workshop on *Integrated Rural and Tribal Development* on January 13, 2007.
- Sri M.L. Bhagat, Sc. (SG) and Sri S.B. Azad, T-4, participated in the *Exhibition in the Pratibha Darshan Mahotsav* organized at Khelgaon, Lagam, Silli on February 03, 2007.
- Sri R.N.Vaidya, T.O., Sri R.P. Srivastava, T.O. and Sri S.B. Azad, T-4, participated in the *Agro-Tech 2007 Kisan Mela* organized by Birsa Agricultural University, Ranchi during February 19-21, 2007 and put up a stall on lac.
- Sri A.K. Sinha, T.O. and Sri K. Sharan, Museum Asst. participated in *Krishi Expo 2007* organized by ICAR and held at Pragati Maidan, New Delhi during February 21-25, 2007 and put up a stall on lac.
- Sri Binod Kumar, T-4 and Sri K. Sharan, Museum Asst. participated in *Krishi Mela cum Exhibition* organized by ATMA, Hazaribagh and held at Shankarpur, Hazaribagh during March 7-8, 2007 and put up a stall on lac.
- Sri M.L. Bhagat, Sc. (SG) and Sri S.B. Azad, T-4, participated in the *Eastern Regional Agricultural Fair 2007*, organized by Rajendra Agricultural University Pusa, Samastipur, during March 9-12, 2007 and put up a stall on lac
- Sri D.D. Singh, T.O., Sri S.B. Azad, T-4 and Sri K.Sharan, Museum Asst. participated in the *Exhibition* organized at NASC, Pusa, New Delhi on July 16-17, 2007 on the occasion of the ICAR Foundation Day. Exhibits on lac based value added products and processes were displayed during the Exhibition. Hon'ble Agricultural Minister and DG, ICAR were amongst the distinguished visitors to the ILRI stall.
- Sri R.N.Vaidya and Sri R.P. Srivastava, T.O. participated in the *Exhibition* organized by NABARD, Ranchi at IICM, Kanke on October 10, 2007.
- Smt Ratna Sen, T-4 and Sri K. Sharan, Museum Asst. participated in the *Saras Mela*, organized by NABARD at Central Park, Salt Lake City, Kolkata during October 11-14, 2007 and put up a stall on lac.
- Dr. G. Pal, Sc. (SS) and Sri P. Pattamajhi, T-3 participated in the *Regional Agricultural Fair* at CRRI, Cuttack, Orissa during. October 31 to November 3, 2007 and put up a stall on lac.
- Dr. Md. Monobrullah, Sr. Scientist, Sri R.N.Vaidya, T.O. and Sri K. Sharan, Museum Asst. participated in the *Regional Agricultural* Fair at Areraj, Motihari, Bihar during November 3-5, 2007. The Institute was awarded third prize for stall display in the exhibition.

Dr. Mangala Rai, DG , ICAR releasing IINRG at a glance

Dr. Nawab Ali, DDG (Eng.) releasing booklet on lac statistics

Visitors at IINRG Exhibition stall

5.2.2 *Radio/TV talks by Subject Matter Specialists*

- *Pruning technique of lac host trees for lac production* by Dr. A.K. Jaiswal was telecast by ETV Bihar/Jharkhand on 01.04.2007.
- *Suggestion for lac crop protection in April* by Dr. A.K. Jaiswal was telecast by ETV Bihar/Jharkhand on 16.04.2007.
- *News story related to Institute activities and lac production technologies* by Dr. R. Ramani was telecast by Sahara TV on 18.04.2007.
- *Lakh ki Bazar Vyavastha* by Dr. G. Pal was broadcast by AIR on 18.06.2007.
- *Care of kusmi lac crop on kusum and ber trees* by Dr. A.K.Jaiswal was telecast by ETV Bihar/Jharkhand on 31.07.2007.
- *Lac cultivation on Flemingia semialata for income* by Dr. A.K. Jaiswal was telecast by ETV Bihar/Jharkhand on 16.09.2007.
- *Pest management in kusmi crop on ber* by Dr. J.P. Singh was telecast by ETV, Bihar/Jharkhand on 18.09.2007.
- *Tips for lac cultivation on Acacia catechu* by Dr. A.K. Jaiswal was telecast by ETV Bihar/Jharkhand on 19.09.2007.
- *Suggestions for harvesting of katki lac crop* by Dr.A.K. Jaiswal was telecast by ETV Bihar/Jharkhand on 20.09.2007.
- *A special story on IINRG and its activities* was telecast on Sahara TV with live discussion with Dr. R. Ramani, on lac cultivation on 14.10.2007.
- *Harvesting from palas trees and inoculation of rangeeni lac crop* by Dr. A.K. Jaiswal was telecast by ETV Bihar/Jharkhand on 05.11.2007.
- *Semialata per lakh ki kheti* by Dr. B.P. Singh was broadcast by AIR on 24.11.2007.
- *Tips for lac crop inoculation* by Dr. A.K. Jaiswal was telecast by ETV Bihar /Jharkhand on 0 4.12.2007.

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

6.1 Participation in Conferences / Meetings / Seminars etc.

6.1.1 *By Director*

- Meeting of State Level Committee of Lac Cell, Ministry of Forest and Environment, Govt. of Chhattisgarh, Raipur on January 3, 2007.
- 27th Meeting of Research Advisory Committee of Central Tasar Research and Training Institute, Ranchi during January 8-9, 2007.
- Seminar cum Workshop on Integrated Rural and Tribal Development, organized by Rama Krishna Mission Ashrama, Morabadi, Ranchi on January 13, 2007.
- Key note address in National Seminar on Lac in Indian Art and Culture organized by Rotary Club and Baleshwari Kala Kendra, Balasore, Orissa on January 27, 2007.
- 41st Annual Convention and Symposium, Indian Society of Agril. Engineers. Junagarh Agril. University, Junagarh during January 29-31, 2007.
- Review meeting with Principal Chief Conservator of Forests, Gujarat, Gandhinagar on February 1, 2007.
- State Level consultation meets on Agricultural Extension, Horticulture and Agro-Forestry Research Programme, Ranchi on February 7, 2007.
- Special Training Programme on Vigilance Administration and Management, CRRI, Cuttack during April 16-18, 2007.
- Third Apex Committee Meeting of Technology Vision Mission 2020 on Herbals and Natural Products Sector. TIFAC (DST, Govt. of India), New Delhi on April 27, 2007.
- NAIP Interaction Workshop of potential partners in sustainable livelihood component, BAU, Ranchi on May 3, 2007.
- Indo-US Agriculture Knowledge Workshop on contract farming: Methods and Experiences, USDA-ICAR, New Delhi during May 5-6, 2007.
- Meeting on value addition and marketing of forest products, Ministry of Environment and Forests, Govt. of India, New Delhi on July 3, 2007.
- 20th meeting of Extension Education Council, BAU, Ranchi on July 4, 2007.
- Meeting of Board of Directors of JHASCOLAMPF with Chief Secretary, Govt. of Jharkhand, Ranchi on July 10, 2007.
- ICAR Directors Conference, NASC, New Delhi during July 16-18, 2007.
- Special Interactive Workshop on Administrative and Financial Matters, CRIJAF, Barrackpore during August 2-3, 2007.
- Meeting of Food Additives and Contaminants Sub-Committee on Food Standards, Directorate General of Health Services, New Delhi on August 9, 2007.
- Meeting of Board of Studies, BAU, Ranchi on October 5, 2007.
- Symposium on Farmers Led Innovations on Sustainable Agriculture BAU, Ranchi during December 14-15, 2007.
- Indian Agricultural Universities Vice-Chancellor's Annual Convention on

Diversification in Indian Agriculture BAU, Ranchi during December 20-21, 2007.

- Second meeting of State Level Committee on Lac Cell, Govt. of Chhattisgarh, Raipur on December 27, 2007.
- Meeting at the Engineering Division of the Council to finalize the XI Plan SFC Memo of the Institute on December 30, 2007.

6.1.2 *By Others*

- Dr. A. Bhattacharya, Head, TOT Division attended the meeting of the Scientific Advisory Committee on Resource-specific network programme, organized by Department of Bio-technology, Ministry of Science and Technology, New Delhi and made a presentation of the completed DBT sponsored research project on January 9, 2007.
- Sri R.K.Singh, Sc. attended a workshop on Karyalay karya mein rajbhasha ke prayog-vyavharik kathinaiyan at IINRG, Ranchi on January 15, 2007.
- Dr. A. Bhattacharya, Pr. Sc. and Dr.A.K. Jaiswal, Sr. Sc. attended the Regional Workshop on Forestry Extension Strategy Review at Institute of Forest Productivity, Ranchi on March 23, 2007.
- Dr. A. Bhattacharya, Dr. R. Ramani and Dr. A.K. Singh, Pr. Sc. attended the 2nd Professor S.C. Mandal Memorial Lecture on Sustainability of small farm diversification with special reference to Eastern India delivered by Dr. I.C. Mahapatra, Former Vice Chancellor of BAU, Ranchi and OUAT, Bhubaneshwar at BAU, Kanke, Ranchi on April 11, 2007.
- Shri R.K. Singh, Sc. attended the Fifth Technical Advisory Committee (TAC) meeting of KGVK-ICEF Project at Ranchi on Water Resources Conservation and Conjunctive Utilization for Environmental Restoration in Tribal Area of Patratu Block, Hazaribagh District, Jharkhand during May 18-19, 2007.
- Dr. A. Bhattacharya and Dr. R. Ramani, Pr. Sc. attended the release function of BIOSPECTRA– a Biannual International Journal of Life Sciences at Central Tasar Research and Training Institute, Piska Nagri, Ranchi on June 2, 2007.
- Dr. R. Ramani, Head, Lac Production Division attended XXVII Kharif Research Council Meeting of Birsa Agricultural University, Kanke on June16, 2007.
- Dr. A.K. Jaiswal, Sr. Sc. attended a Workshop on Revision of National Forestry Plan: Research priority setting at Institute of Forest Productivity, Ranchi on June 29, 2007.
- Er. M. Prasad, Pr. Sc. and Dr. Divya, Sr. Sc. attended the International Conference on Agribusiness and Food Industry in Developing Countries at IIM, Lucknow during August 10-12, 2007.
- Dr. J.P. Singh attended a meeting at AIR, Ranchi for finalization of quarterly programme under Krishi Vani on September13, 2007.
- Dr. G. Pal, Sc. (SS) attended the one day State Level Consultation Workshop on Identification of Information Needs in Agriculture pertaining to Jharkhand at BAU, Ranchi on September 28, 2007.
- Dr. R. Ramani, Head, Lac Production Division attended XXVII Rabi Research Council meeting at BAU, Ranchi on October 26, 2007.
- Dr. A. Bhattacharya, Head, TOT Division attended a meeting organized by Jharkhand Tribal Development Society (JTDS), Ranchi for reviewing their project with the IFAD Review Team, Line Departments, other agencies and NGO representatives at Hotel Ranchi, Ashok on November 4, 2007.
- Dr R. Ramani, Head, Lac Production Division participated as a part of 11-member team in Lac Industry-Institute. Interface organized jointly by the Institute and Balarampur Khudra Lakkha Kutir Shilpa Byabasayee Samitee at Balarampur, West Bengal on November 24, 2007.
- Dr. G Pal, Sc. (SS) attended the two day workshop entitled 15th Annual Conference of Agricultural Research Statisticians held at BAU, Ranchi during December 3-4, 2007.

- Dr. R. Ramani, Head, Lac Production Division attended Regional Workshop on Forestry Statistics at IFP, Ranchi on December 7, 2007.
- Dr. R. Ramani, Head, Lac Production Division attended a seminar by Dr. Eric Meyer, Research Director, CNRS, Paris organized at BIT, Mesra on December 7, 2007.
- Dr. R. Ramani, Head, Lac Production Division and Dr. S. Ghosal, Sc. (SG) attended a meeting organized at the Office of Ms. MS Sardar, Sabhatipati, Zilla Parishad Building, Purulia to discuss about lac development in the district on December 13, 2007.
- Dr. R. Ramani, Head, Lac Production Division attended a Consortium Partners' Meeting of NAIP proposal on Utilization of under-exploited tree/shrub species for rewarding economic use for livelihood and social security of desert folk convened at CAZRI, Jodhpur on December 20, 2007.
- Shri R.K. Singh, Sc. delivered a lecture on in-situ Moisture Conservation Practices for Lac host Plants during winter school on 'System Approach for Water Resource Management' at BAU, Ranchi during December 4-24, 2007.

6.2 Human Resource Development

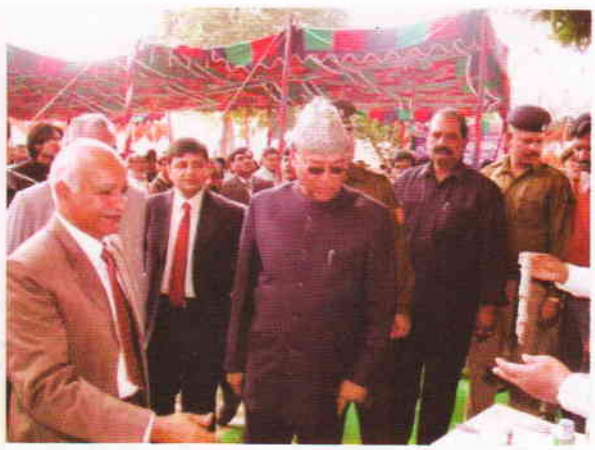
- Sri M.F. Ansari, Sc. (SS) and Sri T. K. Saha (T-6) attended a training programme on *Liquid Chromatography School* (HPLC system) organized by Waters at Kolkata during July 9-11, 2007.
- Sri S.C. Srivastava, Sr. Sc. attended a training programme on *Protection of Plant Varieties– Procedures and Methodologies* at NARRM, Hyderabad during October 3-6, 2007.
- Dr. S. Ghosal, Sc. (SG) attended a National Training Programme on *Advance Instrumental Training for the Analysis of Pollutants in the Food Commodity and Water* during during November 19-26, 2007.
- Dr. Divya, Sr. Sc. attended a training programme on *Synthetic chemistry* at IIIM, Jammu during December 3-24, 2007.
- Dr. J.P. Singh, and Dr. M.Z. Siddique, Sr. Sc. attended a training programme on Team *Building Workshop cum Training* at National Academy of Agricultural Research Management (NAARM) during December 12-15, 2007.

7. EVENTS ORGANIZED

7.1 *Annual Lac Kisan Mela*

The Annual Lac Kisan Mela was organized at the Institute on February 9, 2007. His Excellency Syed Sibte Razi, Governor of Jharkhand inaugurated the Mela. The mela began with the welcome address by Dr Bangali Baboo, Director IINRG who briefly explained the research accomplishment and various programmes being carried out by the Institute for the welfare of farmers and entrepreneurs The main objective of the mela was to expose the farmers, industrialists, entrepreneurs and government functionaries about lac based technologies developed by the Institute. The Governor, while addressing the gathering of farmers, scientists, entreprenures, representative of GOs and NGOs, emphasized to undertake lac production in a big way in the state as this is most suitable crop in rainfed condition and undulating land of Jharkhand poses limitation for better agriculture crops. He laid emphasis on planting of more lac host trees under social forestry programme. While lauding the role of the Institute under the able guidance of the Director in developing efficient and farmers friendly technologies, Governor opined that progress made by the Institute was excellent and the farmers should use the techniques developed by the Institute to augment lac production. Dr. N. N. Singh, Vice Chancellor, Birsa Agricultural University, Ranchi said that lac cultivation is the nature's gift for livelihood support to tribal farmers of Jharkhand and the wasteland in the state should be utilized for growing lac to enhance the income of poor tribal farmers. Twenty stalls from different organizations like Horticulture and Agro-Forestry Research Programme (HARP), IFFCO, Jharkhand State Cooperative Lac Marketing and Procurement Federation (JHASCOLAMPF), Institute of Forest Productivity, State Bank of India, TRIFED, JTDS, Indian Railways, Pesticide Firms, NGOs and Entrepreneurs were put in the exhibition. Nine farmers, entrepreneurs, industrialists, lac ártisan and executives from Jharkhand, West Bengal, Chhattisgarh, Madhya Pradesh, Gujarat and Maharashtra were awarded for excellence in promoting lac.

More than 500 farmers and entrepreneurs from different parts of Jharkhand, Chhattisgarh and Madhya Pradesh 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 wherein experts of the Institute, HARP and Birsa Agricultural University interacted with farmers and tried to



His Excellency Syed Sibte Razi, Governor of Jharkhand addressing the audience and one of the exhibition stall

Farmers at the IINRG stall

address the technical problems faced by the farmers in lac cultivation and other agricultural aspects. Dr. A. K. Jaiswal, Sr. Sc. was the convener of this event.

7.2 *Model Training Course*

Indian Institute of Natural Resins and Gums, Ranchi organized a Model Training Course on Advanced Lac Production, Storage and Application Technology for Employment and Income Generation, during February 19-26, 2007. The training programme was sponsored by Directorate of Extension, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India. The training was attended by twenty-two participants comprising of Sr. Scientist, SMS, ACF, ADO from KVKs, SAUs, Forest Departments, State Agriculture Department of seven different lac growing states of the country.

The training programme consisted of lectures, group discussion, demonstration, film show, field visits, visit to lac growing villages and lac processing centres, interactions etc. The participants were exposed to museum, research farm and laboratories, library, product demonstration unit, quality evaluation laboratory, research laboratories etc. within the Institute. For the benefit of participants and reference a training manual was prepared which is a compendium of all the lectures delivered by the experts during the training programme.

In the inaugural function Dr. Bangali Baboo, Director, Indian Institute of Natural Resins and Gums, Ranchi gave an overview and importance of the commodity. He expressed that the training programme will be beneficial for the participants for initiating lac related projects and extension activities in their respective states. Dr. A.K. Malhotra, Addl. PCCF, Department of Forest, Government of Jharkhand was the Chief guest during the function. In his opening remarks he stressed the need for organizing this type of training course for livelihood support to the forest and sub-forest dwellers, farmers and other people associated with cultivation and production of lac. In the Valedictory function, the Course Director Dr. A. Bhattacharya, presented a detailed report of the training programme. Dr. Bangali Baboo, Director, IINRG, stressed upon the importance of ecology and its need to be sustained and planning should be according to future needs. He requested the participants to plant at least one lac host plant in

Sl No.	Award	Name and Address
1.	Excellent Lac Farmers Award	Sri Pursotam Mandavi, Dist- Kanker, Chhattisgarh Sri Trackson Patamajhi, Dist- Phulbani (Kandhmal), Orissa Sri Rajesh Prasad, Dist- Simdega, Jharkhand
2.	Excellent Lac Production Entrepreneurship Award	Sri Sunil Pendharkar, Dist- Nagpur, Maharashtra
3.	Excellent Lac Artisan Award	Sri Om Thakur, Dist- Seoni, Madhya Pradesh Sri Zafar Ali, Balrampur, Dist- Purulia, West Bengal
4.	Excellent Lac Industrialist Award	Sri Roshan Lal, M/S Tajna Shellac Pvt Ltd, Ranchi, Jharkhand Sri Vinay Gupta, M/S Gupta Bros Shellac, Ranchi, Jharkhand Sri Subhash Jaiswal, M/S Indian Shellac Industries, Dhamtari, Chhattisgarh
5.	Excellent Lac Promotion Executive Award	Sri K K Soan, Dy. Commisioner, Ranchi, Jharkhand Sri A R thakur, SDO, (Forest), Kanker, Chhattisgarh Sri M K Patel, ACF (Forest), Gandhi Nagar, Gujarat

Inauguration function of training

Participants in techincal sessions of the interaction

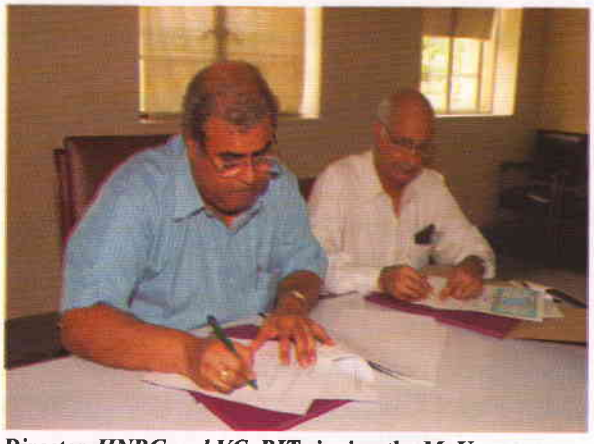
their area / locality. Dr. A.K. Sarkar, Dean, College of Agriculture, Birsa Agriculture University, Ranchi was the Chief Guest of the Valedictory function of the training programme. He congratulated the Institute for conducting this type of training course. He stressed upon the importance of lac for livelihood security of the tribal residing in various lac growing states of the country. While addressing the participants he requested the participants to formulate projects on lac as an enterprise. He opined that for entrepreneurship development, stress should be given for public - private partnership

7.3 *MoU between IINRG and other Organizations*

MoUs have been signed with two leading universities, *Birsa Agricultural University*, Kanke, Ranchi and *Birla Institute of Technology*, Mesra for co-operation in the areas of research and teaching as well as for sharing the manpower and instrumentation for mutual benefit. The scientific disciplines to be covered are biotechnology, plant pathology, entomology and agronomy with BAU; polymer engineering, applied chemistry, pharmaceutical chemistry and biotechnology will be covered with BIT. This would also enable students to undergo advance training and pursue doctoral research at the Institute.

7.4 *ILRI Rechristened as Indian Institute of Natural Resins and Gums*

Indian Lac Research Institute assumed its new name with expanded mandate as Indian Institute of Natural Resins and Gums on September 20, 2007 while celebrating its 84th foundation day. The Institute was set up in 1924 by the Indian Lac Association for Research on the recommendation of Lindsay Harlow Committee. Later on April 1, 1966 as part of rearrangement of Agricultural Research and Education under Government of India, it was integrated into Indian Council of Agricultural Research (ICAR). Indian Council of Agricultural Research noted its numerous break throughs in the field of lac production, processing and technology development and human resource



Director, IINRG and VC, BIT signing the MoU

Dr. Nawab Ali, DDG (Engg.), unveiling the stone plaque depicting the change in the name of the Institute

Dr. Nawab Ali, DDG (Engg.) addressing the participants at inaugural function of national seminar

Participants in technical session of National Seminar

development and recommended the Institute's foray into the new areas of natural resins, gums and gum resins including lac.

Speaking on this occasion, the Chief Guest, Dr. Nawab Ali, Deputy Director General (Engineering), ICAR stressed the need for more innovative research work with an objective of value addition and product development. He said that there was a need for enhancing income, generating employment opportunities for tribals living below poverty line in the state of Jharkhand, Chhattisgarh, Madhya Pradesh and Orissa. He suggested that pilot projects on production, processing for use diversification should be established in the Institute as a model for attracting entrepreneurs. However, the technology developed should be sustainable without harming the environment. Dr. Bangali Baboo, Director, IINRG, in his welcome address, spoke at length about the purpose and objective behind additional mandate given to the Institute. He said that Jharkhand is surrounded by 30 per cent of forest area and 40 per cent population thrives on forest products, so research in this area to enhance income and livelihood opportunity is very important. He listed the significant achievement such as set of equipments for primary processing of lac, development of food grade lac dye, ISO 9001-200 certification for Quality Evaluation Laboratory, varnishes and antifungal paints etc. He said MoU's have been signed with BIT, Mesra and BAU, Ranchi for strengthening research. Dr. Dhirendra Kumar, IAS, Special Secretary (Industry) Government of Jharkhand, presiding over the function outlined that unlimited potential exists in Jharkhand and neighbouring states for forest produce and suggested that the technology developed should reach to the stake-holders in time. Later, the stone plaque depicting the change in the name as Indian Institute of Natural Resins and Gums was unveiled by the Chief Guest.

7.5 National Seminar on Value added products of commercial importance from natural resins and gums

To mark the occasion on the completion of 84 years of dedicated service to the Nation and inauguration of the Foundation stone of Indian Institute of Natural Resins and Gums on September 20, 2007, a two day National Seminar on *"Value added products of commercial importance from natural resins and gums"* was organized on September 20-21, 2007 at the Indian Institute of Natural Resins and Gums. The inaugural session of seminar was chaired by Dr. Dhirendra Kumar, Special Secretary (Industries), Govt. of Jharkhand, with Dr. Nawab Ali, DDG (Engg.) ICAR, New Delhi as a Chief Guest. Total 30 delegates from various Industries, Universities and Research Institutions attended the seminar. Three sessions were held for the presentation of 18 research papers covering almost every aspects of the themes were presented by different speakers.

The thematic areas of seminar were focused on (i) Harvesting and tapping techniques for production of natural resins and gums were chaired by Dr. B.N. Singh, Dean Research, BAU, Ranchi (ii) Processing of natural resins and gums were chaired by Dr. Vineet Kumar, Scientist-E, Forest Research Institute, Dehradun and (iii) Applications of

Dr. Bangali Baboo, Director, IINRG addressing the representatives of lac industry

natural resins and gums in food and pharmaceuticals were chaired by Dr. S. Sasmal, Head, Pharmaceuticals Departments, BIT, Mesra. The technical session was followed by poster session and subsequently brain storming and plenary sessions. Brain storming session was chaired by Dr. Bangali Baboo, Director, IINRG, Ranchi to find out researchable issues on various aspects of natural resins and gums. The following recommendations emerged from the deliverations.

- Compilation and documentation of available information on the gums and resins.
- Improvement in tapping / harvesting techniques for sustainable production of natural gums and resins.
- Development of suitable storage techniques for improving self life of products.
- Identification and isolation of compounds of commercial importance from natural gums and resins for food / pharmaceutical uses.

Plenary session was chaired by Dr. Pitam Chandra, ADG (Process Engineering), ICAR, New Delhi. He stressed that a lot of works need to be done in the area of natural resins and gums. Since the world is becoming more competitive, so input / output ratio need to be optimized. Research should be taken up on global basis keeping in view the need of local people also. He also explained about the Network Project as it is more focused and programmes of project are monitorable and achievable. He opined that there is a need for a Network project on natural resins and gums.

7.6 Lac Industry- Institute Interface Meeting

The *Lac Industry- Institute Interface Meeting* was jointly organized by the Indian Institute of Natural Resins and Gums, Ranchi and Lac Industry's representatives working under the banner of *Balarampur Khudra Laksha Kutir Silpa Byabasayee Samiti* (BKLKSBS) on November 24th, 2007 at Balarampur, West Bengal. Dr. Bangali Baboo, Director, IINRG, Dr. A. Bhattacharaya, Head, TOT Division, Dr. R. Ramani, Head, Lac Production Division, Er. Murari Prasad, Incharge PPD Division, Dr. S. Srivasatava, Sr. Scientist, Dr. N. Prasad, Sr. Scientist, Dr. S.K. Giri, Scientist, Shri S.K. Pandey, Scientist (SS) and Sri M.F. Ansari, Scientist (SS) from the Institute and over 100 Samiti members from Balarampur participated in the interactions.

The Director, IINRG threw light on the importance of holding such meetings and advised them to discuss the problems faced by the industry. The agenda of the meeting was to discuss the problems faced by the industries particularly in the area of lac processing and product development as well as to apprise them the new technologies/ processing equipments/products developed by the Institute in recent times. Some industrial problems like labour cost reduction, processing and product cost reduction, storage and marketing facility, establishment of testing laboratory facility by the Institute at Balarampur were posed by the entrepreneurs for their redressal during the meeting. Products developed by the Institute, samples of natural resins and gums and gum-resins were displayed. The meeting ended with vote of thanks by Mr. Mallick, The Secretary, BKLKBS with a request for holding such interaction in future also.

7.7 Dr. Mangala Rai, Director General ICAR declares the Institute as National Active Germplasm Site for Lac Hosts and National Lac Insect Germplasm Centre

The National Bureau of Plant Genetic Resources (NBPGR), New Delhi has recently designated IINRG, Ranchi as the National Active Germplasm Site for Lac Hosts. Dr. Mangala Rai, Director General, ICAR, during his visit to Institute formally inaugurated the National Active

Inauguration of the Lac-Host Germplasm Site by the Director General, ICAR

Dr. Mangala Rai, DG, ICAR, inaugurating the Lac Insect Field Gene Bank

Germplasm Site for Lac Hosts, designated by NBPGR, New Delhi and appreciated the efforts of the Institute in this direction.

National Lac Insect Field Gene Bank of Indian Institute of Natural Resins and Gums, Ranchi was also dedicated to the Nation with declaration of the Institute as the National Lac Insect Germplasm Centre by Dr. Mangala Rai, Director General, ICAR on November 29, 2007. Dr. A.K. Singh, DDG, NRM and Heads of sister organizatios *viz.,* Horticulture and Agro-Forestry Programme, Regional Field Station of NBPGR, Ranchi were also present on this occasion.

Dr. Bangali Baboo, Director of the Institute, stressed that Indian Institute of Natural Resins and Gums is the only Institute devoted to research and development of lac and thus, has responsibility to conserve the lac biodiversity for posterity. Lac insect genetic diversity is the key component of any lac production system. More than 20% of lac insect biodiversity found in the world has been reported from India. This biodiversity is utilized either directly for lac cultivation or as a source of useful traits that can be used in breeding improved varieties. The *kusmi* form of *Kerria lacca*, known for its superior quality of lac and higher productivity is unique to India. Superior forms of this breed have been developed and exploited. In this era of IPRs, open globalization and WTO regime, characterization and documentation of lac insect biodiversity merits immediate attention for protection against bio-piracy. Further, due to large scale deforestation and dwindling active lac cultivation area, there is alarming reduction in bio-diversity of the country. Hence, it is needed to take up on priority the collection of available lac insect biodiversity in the country. Collection, conservation and sustainable use of these resources require specific attention keeping in view their importance. Conservation of lac insects is a laborious process as they have to be maintained live under protected conditions on potted plants due to their phytosuccivorous habit and associated pest complex. Sixty districts of 16 states of the country have been surveyed for collection of lac insects and information on lac cultivation. 64 lines of lac insects which include 14 cultivated, 21 natural populations, 22 cross bred / inbred / selected, one exotic and six uncoded lines are maintained in the Field Gene Bank. Dr. Mangla Rai also visited the Surface Coating Lab of Institute and saw lac-based products recently developed by the institute *viz.,* spiritless wood varnishes water-thinnable architectural paints for interiors, bulb capping cement, arhar stick-based composite boards, fibre glass/jute reinforced laminates. He desired early commercialization of wood varnished and architectural paint. He also inspected the mini lac processing unit for semi-refined lac, suitable for value addition at village level.

Dr. Bangali Baboo briefly outlined the recent achievements and initiatives of the Institute, in his welcome note during the interaction session of DG with the staff of the Institute, in which he mentioned about the two highly potential lac hosts identified, *viz., Prosopis juliflora* and *Albizia procera* as well as the pilot plants under process for aleuritic acid and bleached lac.

Dr. Rai was highly appreciative of the recent

research contributions and improvements in the Institute Research Farm during address to the staff of the Institute. He agreed upon the need for taking up research on natural resins and gums in a network mode and added favourable comments on the network project submitted by the Institute.

Earlier, in his meet with the press and media persons, Dr. Rai spoke about the rationale behind the recent expansion of the Institute mandate to include plant resins and gums. Accordingly, he said, the Institute has been renamed as Indian Institute of Natural Resins and Gums.

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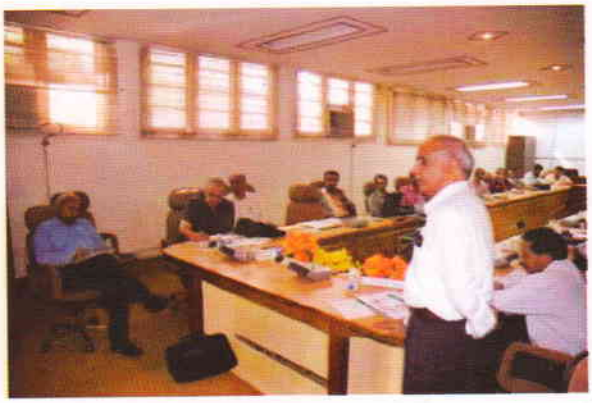
8. MEETINGS OF IMPORTANT COMMITEES

8.1 *Research Advisory Committee (RAC) Meeting*

The 13th RAC meeting of the Institute was held during April 24-25, 2007 under the Chairmanship of Dr. N.S.L. Srivastava, Joint Director, Sardar Patel Renewable Energy Research Institute (SPRERI), Vallabh Vidya Nagar, Gujarat. The members present were Dr. R.P. Kachru, Ex-ADG (PE), ICAR, New Delhi, Dr. N.K. Pal, Director (Chemical), BIS, New Delhi, Sh. Jivendra Kumar, Managing Director, JHASCOLAMPF, Ranchi, Dr. Bangali Baboo, Director, IINRG, Ranchi, Dr. A. Bhattacharya, P.S. and Head, TOT Division, IINRG, Ranchi, Member Secretary, Dr. R. Ramani, P.S. and Head, LP Division, IINRG, Ranchi, Sh. M. Prasad, PS and Head, PPD Division, IINRG, Ranchi and Dr. N. Prasad, Sr. Sc., I/c RMU, IINRG, Ranchi. At the outset, the Chairman welcomed all the participating members of the committee. The Chairman expressed satisfaction over the good work being done by the Institute. The efforts in developing and commercialization of small scale lac processing unit were appreciated but he expressed that efforts towards conducting FLDs on *Flemingia semialata*, increasing broodlac production, translating tissue culture plants to field evaluation and commercialization of aleuritic acid and nail polish technologies are not adequate. These need more vigorous efforts. Dr. R.P. Kachru commended the Institute efforts for good work being done, handling land matters, developing and improving processing unit, library, hostel, biotechnology laboratory, water management and Institute Research Farm.

The RAC made the following recommendations / oberservations.

- TOT activities for transfer of the technologies developed to be strengthened for commercialization.
- The technologies developed by the Institute need to be verified by TOT Division before their transfer.
- FLD programme should be strengthened and some target be fixed. At least two FLDs on 0.5 ha each of *F. semialata* be taken up in 5 States. More emphasis should be given on demonstration of *F. semialata* through farmers participation for propagation of the technology.
- At least 1,000 plantlets of *F. semialata* raised through tissue culture should be established and project profiles of various processes and products should be developed.
- The RAC also gave suggestions for preparing the XIth plan documents and



Dircetor , IINRG briefing to RAC members

Interaction in RAC meeting

following suggestions were given in respect of discussions on XI plan:

a) Whatever programme is being planned, the outcome should be clearly defined. Based on the outcome planning of projects be carried out.

b) Some thrust areas can be clubbed together. Major areas of research can also be clubbed and can be taken up under a mega project.

c) The deliverables may be planned as per manpower available. Modest number of projects be taken.

d) Review of the XIth Plan document is required keeping in view the available manpower. Institute should give more thrust on TOT activities. The Institute-Industry linkages be strengthened.

- RAC agreed to the proposal of network project considering its importance. It was suggested that the cooperating centers in the network project be properly identified.
- RAC recommended that the vacant posts of scientist should be filled up on priority basis as the Institute is expanding its mandate.
- Keeping in view the expanded mandate and infrastructure development, the RAC recommends a budget estimate of Rs.1,500 lakh for the XIth Plan.

8.2 *Institute Research Committee Meeting*

The Institute Research Committee (IRC) meeting for the year 2007-2008 was held during June 4-6, 2007 under the Chairmanship of Dr. Bangali Baboo, Director, IINRG in the Institute Conference Hall for scientific scrutiny of all the projects, to suggest corrective measures for successful implementation of research programmes and suitability of the new project proposals in the light of new expanded mandate of the Institute. Mr. B. Anand Babu, Deputy General Manager, Chhattisgarh State Minor Forest Produce (Trade and Development) Federation Ltd., Raipur, Chhattisgarh, Dr. Niranjan Prasad, Ex. Head, PPD Division and Dr. R.P. Singh Ratan, Director Extension, Birsa Agriculture University, Ranchi were special invitees as outside experts in the meeting.

In his opening remarks, Dr. Bangali Baboo, Chairman, IRC and Director of the Institute, welcomed the experts as well as the scientists and offered following suggestions .

- He reminded of the purpose of IRC as to consider, evaluate, recommend or reject RPF-I, II and III.
- He desired to compile and highlight the achievements/recommendations emerging out of last one year work.
- He expressed that atleast one technology/recommendation based on a scientists work of 3 years is expected and any scientist should try to achieve this.
- He desired that Institute should fix its own target for enhancing productivity of lac and for developing new products or processing techniques for natural gums and resins during XIth Plan.
- He expressed that present progress be reported in earlier core programmes but from next year all projects be re-organized in new core programmes.
- Duties of Heads of Divisions and responsibilities of programme leaders were circulated for compliance.
- Every RPF-III needs to be critically examined for output/recommendations. System followed by NAIP could be useful.

Chairman, IRC desired at least quarterly monitoring of each project should be done by HODs and proceedings alongwith comments to be sent to RMU regularly. Director would also review progress half yearly. All HODs should have strong liaison with related stakeholders to have a close touch with stakeholder's problems and need based research and transfer. The scientist to think and conceive of few high-tech science application projects on gums amd resins. During the three days deliberations in the IRC, some of the research projects were re-oriented and re-organized as per the expanded mandate of the Institute. Twenty three on-going research projects were discussed

and 12 new project proposals were approved out of the15 proposals.

To review the half yearly progress of the research projects, Half Yearly IRC meeting was held under the Chairmanship of Dr. Bangali Baboo, Director, IINRG during October 10-11, 2007 in the Institute Conference Hall. Chairman suggested that two IRC will be held, one in April and other in October. The purpose of October IRC would be to review the half yearly progress and ATR on RAC recommendations. PME cell should meet at least quarterly to review progress and advise on specific projects/programmes. During two days deliverations the progress of on-going research projects were reviewed. In his concluding remarks the Chairman desires that :

- The HODs should carry out quarterly review of projects and proceeding of the review meeting sent to RMU. The purpose is to monitor progress for effective output and address constraints, if any, besides mid –course corrections.
- Every scientist must undertake at least two tours related to research during a year.
- Progress of the project should always be reported objective-wise. The technical programme should also be worked out objective-wise. It would facilitate effective evaluation of progress.

9. DISTINGUISHED VISITORS

- His Excellency Shri Syed Sibte Razi, Governor of Jharkhand on February 9, 2007.
- Shri Bijoy B. Mathur a Scholar on March 2, 2007.
- Mrs Shalini and Shri Alexander Sahoo from Germany on March 2, 2007
- Dr. K. A. Singh, Director, IGFRI, Jhansi on April 12, 2007
- Dr. N. S. L. Srivastava, Chairman, RAC on April 24, 2007.
- Dr. R. P. Kachru, Member, RAC on April 24, 2007
- Dr. N. K. Pal, Member, RAC on April 24, 2007
- Shri A. K. Upadhyay, Addl. Secy DARE and Secretary ICAR, New Delhi on May 15, 2007.
- Dr. R. P. Sharma, NRC Biotechnology, New Delhi on June 25, 2007.
- Shri K.C. Shashidhar, Chief General Manager of NABARD on July 5, 2007
- Dr. Anwar Alam, Vice-Chancellor, Sher-e-Kashmir University of Agricultural Science & Technology, Srinagar on July 14, 2007.
- Dr. S.N. Mukherjee, Sr. Scientist, NCL Pune on July 18, 2007.
- Dr. H. P. Singh, DDG (Hort), ICAR, New Delhi on August 12, 2007.
- Major General A.K. Singh, GOC, Ranchi on September 3, 2007.
- Dr. T. P. Rajendran, ADG (PP), ICAR, New Delhi on September 10, 2007.
- Dr. Nawab Ali, DDG (Engg.), ICAR, New Delhi on September 20, 2007.
- Dr. P. Chandra, ADG (PE), ICAR, New Delhi on September 21, 2007.
- Dr. Steven Walker and Dr. Michael Widderick of Queensland, Dept. of Primary Industries and Fisheries, Toowamba, Australia on October 5, 2007.
- Dr S. K. Ambasth, HOD (NRM), CARI, Port Blair on October 25, 2007.
- Dr. S. R. Singh, Ex. Vice-Chancellor, RAU, Pusa, Samastipur on November 23, 2007.
- Dr. Mangala Rai, Director General, ICAR and Secretary DARE on November 29, 2007.
- Dr. H.V.L. Bathla, Head, Division of Sample Survey, IASRI, New Delhi on December 1, 2007.
- Mrs Manju Singh w/o Major General A. K. Singh, 23 Inf. Div. along with several army officer's wives on December 10, 2007.
- Sri A.K. Chatterejee, Dy. GM (HR), ITDC, New Delhi on December 29, 2007.

Commission for Agricultural Policy of Jharkhand visited the Institute

A team of members, under the chairmanship of Dr. K.V. Raman of Agricultural Commission for Agricultural Policy for Jharkhand visited the Institute on November 14, 2007. The team members addressed a gathering of the scientists of the Institute. The chairman in his address underscored the importance of lac sector as it supports a large section of people in the State. He said that lac is a low volume-high value commodity and a separate chapter on lac has been earmarked in the agricultural policy document for Jharkhand. He felt that primary value-addition of lac should be done at farmers' level and further value-addition at subsequent levels. Citing the example of palm oil for supplementing edible oil requirement, he emphasized on the need for anticipatory research. Other members of the Commission who addressed were Dr. RM Pandey, Dr. Jalali and Dr. Sirohi. Some important

suggestions given by them are as follows:

- Intensification of germplasm collection
- Addressing IPR issues related to lac
- Reducing the juvenile phase of lac host plants so that crop inoculation can be made early.
- Application of latest technological advancements in lac processing to compete in export market.

Chief General Manager, NABARD visited the Institute

Shri K.C. Shashidhar, Chief General Manager of NABARD visited the Institute on July 5, 2007. He was shown around the Institute and explained about the activities of the Institute. He also visited the field area to review the progress made under NABARD sponsored project on lac cultivation on high density plantation of *ber*. He was impressed about the progress made under the project and a certificate of appreciation has been given to the Institute. He also interacted with the scientists of the Institute and stressed increasing the income of economically backward farmers through lac cultivation. He pointed out that the world is prepared to pay higher price for natural products and thus, lac hold a great potential.

Members of Commission for Agricultural Policy of Jharkhand visiting Institute Research Farm

Sri K.C. Sashidhar, CGM, NABARD at the Institute Research Farm

10. SUPPORT SERVICES

10.1 Institute Research Farm (IRF)

Institute Research Farm is field laboratory. Keeping this in mind, the farm was managed and maintained to result in minimum experimental error due to farm condition. The following activities were undertaken during the period under report.

Management of Research Farm

Research Farm was managed and maintained in such a way that it gives a scientific look. Roads, path, channels, hedges and edges were maintained in good and scientific conditions. All scientific cultural practices were undertaken in experimental as well as in general farm. Trees were pasted with lime mixed with insecticides (chlorpyriphos) to manage termites. The trees in plots with very unhealthy conditions and not in condition to rejuvenate were removed. Sparsely populated plots were cleaned for new plantations and wherever possible the gaps were filled with suitable species. About 400 seedlings of *ber*, 200 seedlings and 500 air-layered saplings of *palas* and 100 seedlings of *khair* were transplanted in gaps.

Filling and utilization of vacant plots

Two plots of 50 x 50 m area each and part of plot No. 65 (0.2 ha) are planted with *Flemingia semialata*. One plot of 50 x 20 m was planted with *Flemingia macrophylla*. Sixty four plants of *siris*, 96 plants of *ber* from Jhaldah origin and 120 plants of *Prosopis* have been planted.

Three hundred *teak* plants and 50 *gamhar* plants are planted in main farm and 150 in Gum and Resin Farm around boundary.

Vacant plots were utilized for cultivation of field crops *viz.*, wheat, paddy, soybean and urd for resource generation.

Lac cultivation and nursery management

Lac hosts like *kusum, ber* and *khair,* which were not under experiment or under Revolving Fund Scheme were used for *kusmi* lac cultivation. Harvesting cum pruning of *khair* and *ber* trees and pruning of *kusum* trees were done.

A separate plot was prepared and developed as nursery for raising lac host plants. About 150 *ber* seedlings, 200 *palas* seedlings, 250 *khair* seedlings and 50 *kusum* seedlings has been raised. About 30,000 *Flemingia semialata* seedlings were either sold or distributed amongst farmers through JLDS programme.

Infrastructure development

Kacha pond in main farm was further deepened to one meter more for increasing the water storage capacity to the tune of 10,200 liters.

A small farm with an area of about 3.03 acres has been developed for raising natural gum yielding plants. Path was improved, plots were leveled and hume pipes were placed at adequate places. Seventy seven plants of *Acacia senegal*, 70 plants of *A. nilotica* and 30 plants of *Sterculia urens* were planted. Some seedlings of the above species are kept in reserve for replanting, if, require. Fourty plants of *Commiphora wightii* are ready to be planted in next season. *Boswellia serrata* and *Anogiessus latifolia* will be planted next year.

A security post was erected in the new farm of gum yielding plants.

Resource generation

An amount of Rs. 3, 11,632/- has been generated as revenue from sale of the farm produce

10.2 Quality Evaluation Laboratory

The Quality Evaluation Laboratory (QEL) of the Institute has been awarded IS/ISO 9001-2000 quality management systems certification. The licence has been granted for rendering laboratory services for collection, analysis, testing and reporting of lac and lac based product samples. During the period 186 samples of seedlac/ shellac/ bleached lac/ aleuritic acid/ lac dye/ by-products of lac were received from Govternment

Revenue generated by IRF

Sl. No.	Item	Amount
1	Lac (Brood lac, scrapped lac etc.)	Rs. 46256/-
2	Wood (Pruned twigs, bamboo etc.)	Rs. 29936/-
3	Other Farm produces (Lac host seeds, seedlings, paddy, wheat, ornamental plants etc.)	Rs. 214190/-
4	Others (Water Tanker, Fuel charges etc.)	Rs. 21250/-
	Total	**Rs. 3,11,632/-**

organizations/ private industries/ various Division of the Institute and in all 755 tests were carried out. In addition to this one trainee was trained in the analysis and testing of lac and lac based products, two trainees were trained in the preparation of dewaxed shellac and five trainees were trained in the determination of Bleach Index and one trainee in testing of Gasket Shellac Cement Compound.

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 for cabinet secretariat, quarterly progress report, six monthly report of the scientists and DARE report to the Council, information related to SMD meetings, etc.
- Management of HRD programmes of scientists and other staff of the Institute. Maintenance of research project files of the Institute.
- Processing of research/routine activities submitted for publication in journals, etc.

Inside view of QEL

- 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 broadband Internet connectivity from BSNL was established in PD Unit.
- Maintenance of RAC, QRT and SRC files.
- Maintenance of database for Personnel 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 for providing e-mail facilities and Apache Web Server for hosting web site.

10.4 Library and Documentation Center

The library of the Institute plays an important role in meeting the information needs of its users. Library of the Institute is a repository of scientific and technical information on Natural Resins and Gums. Besides catering to the needs of scientists it also renders services to other researchers, academicians and students as well as lac industrialists from all 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 INSCAIR, New Delhi from time to time against payment.

Study room of Institute Library

Revenue of Rs. 24, 256.00 was generated from the sale of publication and reprographic services. The library continued to exchange the Institutes publications with the scientific institutions in and out side the country.

Services provided by the Library to its users

- Online 'Today's Arrival'.
- Reprographic Services.
- E-Journals access.
- CD searches.
- Bibliographic Services.
- Current Awareness Services.
- Inter Library Loan Services for resource sharing.
- Sale of Institute Publications.

Journals and periodicals subscribed and received

- Foreign Periodicals (Subscribed) - 15
- Foreign Periodicals (Gratis/Exchange) - 03
- Indian Periodicals (Subscribed) - 49
- Indian Periodicals (Gratis/Exchange) - 38
- E-Journals - 05

Documents	Additions	Total Holdings
Books	11	7595
Bound Journals	175	20939
Annual Report	47	4541
CD- Rom	03	123
ISI-Specification	08	132
Maps	-	37
Patents (Foreign)	-	327
Patents (Indian)	-	17
Thesis	01	08

10.5 Estate Section

The Estate 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 Various services provided by the sections during the year are as follows:

10.5.1 *Civil and Water supply*

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

I) Renovation of Official building / Residential building

a) Lab of old PD Unit
b) Grill of ARIS cell
c) Biotechnology lab in LP Division.
d) Instrument lab of microbiology.
e) Trainee's lab and information cell floor.
f) Toilet room of LP Unit.
g) Surface coating laboratory.
h) Laboratories of PPD Division (2 Nos)

II) New construction in the Institute Premises

a) Threshing floor of IRF.
b) Enhancement of the height of the boundary wall in main campus.
c) Change of name plate at the Institute main gate / different sections and Divisions.
d) Construction of security guard post in Gums and Resin farm.

III) AR/ MO of Official and Residential building

a) Painting of old lab Building of LP Unit.
b) RMU/Account /old chemistry building.
c) Snowcem at the boundary wall and seed store room at IRF departmentally
d) Minor repair and distempering of office room of Estate section.
e) External ARMO of PPD building.

IV) Roof Grading of Residential/ Official building

a) Asbestos roof of new technical block.
b) Roof grading of all the residential quarters have been completed.

B. Work carried out department wise

I) Total No. of jobs entered in various units of Estate section are

a) Pipe line work- 400 jobs
b) Carpentry works- 450 jobs

c) Welding work- 350 jobs
d) Mechanical works- 750 jobs
e) Turner work- 376 jobs

II) Others activities

a) Total 100 No. of memento piece were made.
b) Iron scrap worth more than Rs. 1 lakh were auctioned.

C. Electrical and Genset

- Maintenance of electrical system in the Institute premises. A total of 1500 job related to electrical work were entered in the job register and all of them have been attended.
- Rewiring of Surface Coating Lab, Account Section, Samaj Sadan, Kishan Hostel and Residential quarter type II 13 and 14 carried out departmentally.
- CFL light fittings were done in place of tube lights in Surface Coating Lab, Account Section, Organic lab- I and II of TOT and Samaj Sadan.
- Restoration of power supply in the main campus after major breakdown of power supply system on September 24, 2007 within 5 days.
- Relaying of under ground power cable for Directors office, TOT, Guesthouse, Riverbed pump house and Biotechnology section of LP Division.
- Removal of overhead LT wire and Electrical poles from Estate section premises.

10.6 Health Care

The Institute is running its own Dispensary in the Campus. Dr. Anil Kumar and Dr. (Mrs.) Rashmi Dwivedi work as a part time Medical Officer on contractual basis on alternate days. The complicated cases are referred to authorized hospitals in the city for expertise treatment. Around 9,000 patients were attended by both AMAs at IINRG dispensary and 225 patients were examined for blood sugar by Glucometer. Most of the medicines advised by AMAs were made available to the patients from the dispensary itself.

10.7 Agrometeorology

Agro-meteorology Unit of the Institute is situated at 23°23' N latitude, 85°23'E longitude and 650 m altitude. During the year, different weather parameters recorded by the unit are presented in Table 1. Total rainfall recorded was 1489.7 mm, which was 14.9 % less than the previous year. The highest rainfall was recorded during September month and the lowest in the month of November. During January and December no rainfall was witnessed. Monsoon months (June to September) alone accounted for 1274.3 mm (85.5 %) of the total yearly rainfall. The highest mean maximum temperature (37.1°C) was observed in the month of May and the lowest mean minimum temperature (7.0°C) during January. June 3rd and December 20th were recorded as the hottest and the coldest day of the year with a temperature of 41.7° C and 2.7° C, respectively.

Month	Mean Temperature (°C)		Mean Relative Humidity (%)		Total Rainfall (mm)
	Maximum	Minimum	7.00 A.M.	2.00 P.M.	
January	24.6	7.3	65	47	0.0
February	26.4	11.7	77	56	56.8
March	30.7	13.9	62	52	37.2
April	33.8	20.4	60	44	33.2
May	37.1	21.9	63	45	58.9
June	35.2	23.3	70	61	176.6
July	32.0	22.9	87	76	365.7
August	30.5	22.7	90	81	362.6
September	29.6	22.3	87	81	369.4
October	29.3	16.4	74	54	29.3
November	27.1	13.3	77	49	Traces
December	25.2	7.0	66	37	0.0
				Total Rainfall (mm)	1489.7

11. PERSONNEL

Sanctioned strength of Scientific, Technical, Administrative and Supporting staff as on 31.12.2007	
Scientific	
R.M.P.	01
Principal Scientist	04
Senior Scientist	11
Scientist	31
Total	**47**
Technical	
Category-1	41
Category-II	21
Total	**62**
Administrative	
A.O.	01
F. & A. O.	01
A.A.O.	02
A.D. (O.L.)	01
Sr. P.A.	01
Security Officer	01
P.A.	02
Assistant	09
St. 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**
Grand Total	**234**

Dr. Bangali Baboo — **Director**

Lac Production Division	Disciplines
Dr. R. Ramani, P.S. & Head	Agril. Entomology
Dr. B.P. Singh, P.S.	Agronomy
Dr. A.K. Singh, P.S.	Plant Pathology
Sri S.C. Srivastava, Sr. Sc.	Plant Breeding
Dr. K.K. Sharma, Sr. Sc.	Agril. Entomology
Dr. Soumen Ghosal, Sc. (SS)	Agronomy
Dr. Md. Monobrullah, Sr. Sc.	Agril. Entomology
Sri Y.D. Mishra, Sc. (SG)	Agril. Entomology
Sri D. Saha, Sc.	Biotechnology
Sri R.K. Singh, Sc.	SWCE
Sri R.L. Ram, T-5	F/F Tech.
Sri M.L. Ravidas, T-5	F/F Tech.
Sri Binod Kumar, T-4	F/F Tech.
Sri R.K. Swansi, T-4	F/F Tech.
Sri D.W. Runda, T-4	F/F Tech.
Sri S.K. Tripathi, T-2	F/F Tech.
Sri Bhupal Kumar, T-1	Lab. Tech.
Smt. Sushanti Prasad, P.A.	Admin.

Processing & Product Development	Disciplines
Sri Murari Prasad, P.S.	Chemical Engg.
Dr. R.N. Majee, P.S.	Org. Chem.
Dr. K.P. Sao, P.S.	Physics
Dr. Divya, Sr. Sc.	Org. Chem.
Dr. M.Z. Siddique, Sr. Sc.	Org. Chem.
Dr. S. Srivastava, Sr. Sc.	Org. Chem.
Sri S.K. Pandey, Sc. (SS)	Mech. Engg.
Sri M.F. Ansari, Sc. (SS)	Org. Chem.
Dr. S.K. Giri, Sc.	A.S. & P.E.
Sri S.K.S. Yadav, Sc.	Org. Chem.
Sri T.K.Saha, T-6	Lab. Tech.
Sri D.D. Singh, T-6	Lab. Tech.
Sri Bhola Ram, T-5	Lab Tech.
Sri B.P. Ghosh, T-5	Lab. Tech.
Smt. Prabha Devi, T-4	Lab. Tech.
Sri Binod Kumar, T-2	Lab. Tech.
Sri S.K. Tirkey, T-2	Lab. Tech.
Sri Ajay Kumar, T-2	Lab.Tech.
Sri Arjun Sinha, P.A	Admin.

Transfer of Technology Division	
Dr. A. Bhattacharya, P.S. & Head	Agril. Entomology
Dr. K.M. Prasad, P.S.	Org. Chemistry
Dr. A.K. Jaiswal, Sr. Sc.	Agril Entomology
Sri P.M. Patil, Sc. (SS)	Physical. Chem.
Dr. N. Prasad, Sr. Sc.	A.S.&P.E.
Dr. J.P. Singh, Sr. Sc.	Agri. Entomology
Dr. G. Pal, Sc. (SS)	Agril. Economics
Sri R.N. Vaidya, T-6	F/F Tech.
Sri R.P. Srivastava, T-5	Photographer
Sri A.K. Sinha, T-5	F/F Tech.
Smt Ratna Sen, T-4	Lab. Tech.
Sri P.A. Ansari, T -4	F/F Tech.
Sri K.K. Prasad, T-6	Lab. Tech.
Sri D.K. Singh, T-5	F/F Tech.
Sri P. Patamajhi, T-3	F/F Tech.
Sri R.K. Rai, T-2	Lab. Tech.
Sri Anup kumar, T-2	Lab. Tech.
Sri Madan Mohan, T-2	Lab. Tech.

Sri S. K. Yadav, Steno, Gr. III	Admin.

Research Management Unit

Dr. N. Prasad, Sr. Sc.	I/c RMU
Sri A.K. Sahay, T-6	F/F Tech.
Sri D. Ganguly, T-6	Lab. Tech.
Sri K.M. Sinha, T-6	Lab. Tech.
Shri Sunil Kumar, T-4	Lab. Tech.
Sri S.K. Yadav, Steno (Gr. III)	Admin.

Quality Evaluation Lab (Under PPD Division)

Dr. S. Srivastava, Sr. Sc.	I/c QEL
Sri D. Ghosh, T-6	Lab. Tech.
Sri B.K. Singh, T-2	Lab. Tech.

Library

Sri V. K. Singh, T-6, I/C Lib.	Lib & Documentations
Sri Binod Kumar, T-4	Lib. & Documentations.

Institute Research Farm

Dr. A.K. Singh, P.S.	I/c Farm
Sri L.C.N. Shahdeo, T-6	F/F Tech.
Sri M. Surin, T-1-3	F/F Tech.
Sri Satish Kumar, T-2	F/F Tech.
Sri S.K. Mukherjee, T-2	F/F Tech.

Estate

Sri A.K. Yadav,	Security Officer
Sri H.L. Bhakta, T-4	Sec. Officer
Sri I.D. Das, T-2	Workshop Tech.
Sri Arjun Sharma, T-2	Workshop Tech.
Sri R.K. Ravi, T-2	Workshop Tech.
Sri K. Tirkey, T-2	Workshop Tech.
Sri B.S. Choudhary, T-2	Workshop Tech.
Sri P.V.D. Tirkey, T-2	Workshop Tech.
Sri Rama K. Singh, T-1	Workshop Tech.
Sri Anil K. Sharma, T-1	Workshop Tech.
Sri K.K. Deonath, Jr. Clerk	Admin.

Hindi Cell

Sri Laxmi Kant, A.D. (OL)	Admin.
Dr. Anjesh Kumar, T-4	Sr. Traslator

Dispensary

Dr. A. K. Jaiswal	I/c Dispensary
Dr. Anil Kumar	A.M.A. (Part time)
Dr. R. Dwivedi	A.M.A. (Part Time)
Sri S. Mahta	Pharmacist (T-3)

Admin. I

Sri T. Gurumoorthy	A.O.
Sri R. Ravidas	Sr. P.A.
Sri P. Singh	AAO
Sri S.C. Lal	Asstt.
Sri R. N. Mahto	Asstt.
Sri A.K. Tripathi	Sr. Clerk
Sri R. K. Toppo	Sr. Clerk
Sri K. Murari Kumar	Jr. Clerk

Admin. II

Sri Laxmi Kant	I/c D.D.O.
Sri W. Guria	Asstt.
Sri B.K. Rajak	Asstt.
Sri Bihari Sahu	Sr. Clerk
Sri Samal Kumar	Sr. Clerck (Cashier)
Sri B.N. Gope	Sr. Clerk

Admin III

Sri K.K. Prasad, T-6	Incharge(Purchase Sec.)
Sri Ravishanker	Asstt.
Sri Thibu Minz	Asstt.
Sri Kameshwar Oraon	Asstt.

Finance and Accounts Section

Sri Rajesh Sahay	F & A O
Sri C.L. Meena	J.A.O
Sri Vijay Ram	Asstt.
Sri Anant Pandey	Asstt.
Sri Arjun Gope	Sr. Clerk
Sri K.P. Kashi	Jr. Clerk

Transport

Sri J. Tewari, T-2	Driver
Sri Arbind Kumar, T-2	Driver
Sri Mandeswar Singh, T-2	Driver
Sri Rajesh Yadav, T-2	Driver

Promotions

Sl. No.	Name and Designation	Promoted to the post	Date of Promotion
1.	Sri. S.K. Pandey, Sc.	Scientist (SS)	7.1.2004
2.	Dr. Sanjay Srivastava, Sc.	Scientist (SS)	1.5.2004
3.	Sri M. Ansari, Sc.	Scientist (SS)	1.6.2005
4.	Dr. Govind Pal Sc.	Scientist (SS)	13.9.2005
5.	Sri Prahlad Singh, Asst.	AAO	11.6.2007
6.	Smt Fulmani Kachhap, SG.II	SG. III	14.9.2007
7.	Sri Bandi Lakra, S.G. II	SG. III	14.9.2007

8.	Smt Janki Devi, S.G.II	SG. III	14.9.2007
9.	Sri Gopal Mahto, S.G.I	S.G. II	14.9.2007
10.	Sri Sankar Mahto, S.G.I	S.G.II	14.9.2007
11.	Sri Sanchu Mahto, S.G.I	S.G. II	14.9.2007
12.	Sri Mantosh Linda, S.G.I	S.G. II	14.9.2007
13.	Sri Sukra Lakra, S.G. I	S.G. II	14.9.2007
14.	Sri A. Pandey, Sr. Clerk	Asst.	19.11.2007
15.	Sri S.C. Lal, Sr. Clerk	Asstt.	19.11.2007
16.	Sri R. N. Mahto Sr. Clerk	Asstt.	19.11.2007
17.	Sri K. Oraon, Sr. Clerk	Asstt.	19.11.2007

Up-gradation under ACP

Sl. No.	Name and Designation	Date of Promotion
1.	Sri B.S. Baraaik, S.G. II	23.11.2005
2.	Sri Dukha Toppo, S.G.II	23.11.2005
3.	Sri Bandhu Mahto, S.G. II	7.9.2006

Transfers from the Institute

Sl. No.	Name and Designation	Date of Transfer
1.	Sri Ashok Malick, A.O. relieved to Join at DWR, Karnal	13.4.2007
2.	Dr. Govind Pal, Scientist (SS) relieved to join at Jaisalmer as Sr. Sc.	27.6.2007

Transfer to the Institute		Date of Joining
1.	Sri Rajesh Sahay, Joined as F. & A. O. on	20.4.2007
2.	Sri Sunil Kumar, T-4 (Computer) joined on	19.6.2007
3.	Sri C.L. Meena, appointed as J.A.O. on	2.7.2007
4.	Dr. G. Pal, again Joined this Institute to his previous post i.e. Sc. (SS) on	21.8.2007

Appointments

Sl. No.	Name and Designation	Date of Appointment
1.	Dr. Divya, Sr. Sc. (Org. Chem)	23.3.2007
2.	Dr. Sanjay Srivastava, Sr. Sc. (Org. Chem)	23.3.2007
3.	Dr. M.Z. Siddiqui, Sr. Sc. (Org. Chem)	28.3.2007
4.	Sri Jhirga Oraon, SG.I	4.4.2007
5.	Dr. Md. Monobrullah, Sr. Sc. (Agril. Entomology)	10.4.2007
6.	Dr. J.P. Singh, Sr. Sc. (Agril. Entomology)	16.4.2007
7.	Sri Binoy Kr. , Jr. Engg. (T-3)	16.4.2007
8.	Sri S. Mahata Pharmasist (T-3)	16.4.2007
9.	Sri K. M. Kumar, Jr. Clerk	5.6.2007

C.R.S.

1.	Sri Jaleshwer Mahto, S.G.I	7.3.2007

V.R.S.

1.	Sri Budhram Oraon, S.G.	13.3.2007
2.	Dr. D.N. Goswami, P.S.	31.3.2007

Retirements

Sl. No.	Name and Designation	Date of Retirement
1.	Dr. N. Prasad, P.S.	31.1.2007
2.	Sri Md. Mobarak, Asstt.	31.1.2007
3.	Sri Budhan Ram, AAO	31.1.2007
4.	Sri K.N. Sinha, AAO	31.1.2007
5.	Sri G. Singh, Sr. Sci.	31.5.2007
6.	Sri Maurice Ekka, T-6	31.7.2007
7.	Sri Mahadeo Oraon, S.G. III	31.7.2007
8.	Sri K.P. Gupta, T-5	31.7.2007
9.	Sri Dukha Toppo, S.G. II	30.9.2007
10.	Smt Balo Devi, S.G. II	30.9.2007
11.	Sri M.L. Bhagat. Sc.	31.10.2007
12.	Sri S.K. Srivastava, T-6	30.11.2007

Death

1.	Late N. Lakra, T-2	15.2.2007
2.	Late Dheeraj Pd. Singh	12.5.2007
3.	Late N. Gope, Sr. Clerk	26.4.2007

12. संस्थान राजभाषा प्रकोष्ठ की गतिविधियाँ

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

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

संस्थान के दैनिक कार्य में हिन्दी के प्रयोग में प्रगति एवं इसे सर्वग्राह्य बनाने के लिए राजभाषा प्रकोष्ठ द्वारा निम्नलिखित कार्य सम्पादित किये जाते हैं:

- संस्थान राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन, कार्यसूची एवं कार्यवृत की तैयारी एवं बैठकों में लिए गये निर्णयों पर अनुवर्ती कार्रवाई ।
- वार्षिक रिपोर्ट का सारांश, न्युजलेटर, कार्यालय आदेश, परिपत्र, ज्ञापन, निविदा, सूचना एवं पत्राचार हेतु विभिन्न सामग्रियों का अनुवाद।
- 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 ।
- हिन्दी दिवस, हिन्दी सप्ताह, हिन्दी पखवाडा, हिन्दी मास एवं योजनानुसार नगर स्तरीय राजभाषा संबंधी प्रतियोगिता एवं कार्यशाला का आयोजन करना ।
- संदर्भ साहित्य, हिन्दी पत्रिका, शब्दकोश एवं तकनीकी शब्दावली के उपार्जन हेतु कार्य द्विभाषी मुहरों, नामपट्ट, पत्रशीर्ष (लेटरहेड) के निर्माण में सक्रिय सहयोग करना।
- प्रचार सामग्रियों के हिन्दी रूपान्तरण एवं समारोहों के समाचार संकलन का कार्य।
- विभागीय विषय पर तकनीकी शब्दावली का निर्माण।
- हिन्दी में वैज्ञानिक गोष्ठी के साथ साथ प्रशासनिक तथा तकनीकी वर्ग के लिए कार्यशाला का आयोजन ।

वर्ष 2007 में संस्थान राजभाषा कार्यान्वयन समिति की चारो तिमाही बैठकों का आयोजन (क) दिनांक-16.02.2007 (ख) दिनांक-17.05.2007 (ग) दिनांक-07.09.2007 एवं (घ) दिनांक-27.12.2007 को किया गया तथा प्रगति की समीक्षा की गई । बैठकों का कार्यवृत एवं तिमाही रिपोर्ट परिषद सहित अन्य संबंधित कार्यालयों में प्रेषित की गई जिसके अन्तर्गत निम्नलिखित प्रमुख चर्चायें हुई तथा अधोलिखित निर्णय लिए गए -

- वार्षिक कार्यक्रम 2007-08 के प्रस्ताव पर चर्चा ।
- गुणवत्ता मूल्यांकन प्रयोगशाला की नीति का हिन्दी अनुवाद करना ।
- संस्थान के परिवर्तित नाम के अनुरूप साइनबोर्ड, पत्र शीर्ष एवं मुहरों का निर्माण करना।
- संस्थान के वेबसाइट का हिन्दी रूपान्तरण करना ।

- संस्थान की गृह पत्रिका लाक्षा का प्रकाशन
- राष्ट्रीय हिन्दी कार्यशाला का आयोजन करना ।
- संस्थान परिसर में स्थित वृक्षों के वानस्पतिक नाम का द्विभाषी नाम पट्ट तैयार कर लगवाना ।

राजभाषा प्रकोष्ठ की उपलब्धियाँ

- सरकारी काम काज मूल रूप से हिन्दी में करने हेतु संस्थान में नकद पुरस्कार योजना लागू की गई, इसमें वैज्ञानिक, तकनीकी एवं प्रशासकीय वर्ग के कुल 41 अधिकारियों /कर्मचारियों ने भाग लिया।
- हिन्दी में श्रुतिलेखन (डिक्टेशन) देने के लिए संस्थान में पुरस्कार योजना लागू की गई ।
- समय-समय पर हिन्दी के प्रयोग को प्रोत्साहित करने के लिए विभिन्न प्रकार की हिन्दी प्रतियोगिताओं का आयोजन किया गया ।
- "राष्ट्र की सेवा में भारतीय कृषि अनुसंधान परिषद एवं भारतीय लाख अनुसंधान संस्थान" फोल्डर का हिन्दी रूपान्तर किया गया ।
- लाख समाचार एवं वार्षिक प्रतिवेदन की सामग्री का हिन्दी अनुवाद किया गया ।
- गुणवत्ता मूल्यांकन प्रयोगशाला की नीति का हिन्दी अनुवाद किया गया ।
- संस्थान परिसर में स्थित वृक्षों के वानस्पतिक नाम का हिन्दी में नाम पट्ट तैयार कर लगवाने का कार्य किया गया ।
- संस्थान के गृह पत्रिका लाक्षा का प्रकाशन एवं राष्ट्रीय हिन्दी कार्यशाला के आयोजन के प्रयास किये जा रहे है ।

हिन्दी दिवस समारोह-2007

भारतीय प्राकृतिक राल एवं गोंद अनुसंधान संस्थान में 29 सितंबर 2007 को हिन्दी चेतना मास समापन एवं "हिन्दी दिवस"समारोह का आयोजन किया गया ।

मुख्य अतिथि के रूप मे बोलते हुए सुप्रसिद्व कथाकार एवं उपन्यासकार डॉ महुआ मांजी ने राजभाषा हिन्दी की विशालतम क्षमता का परिचय देते हुए कहा कि हम हिन्दुस्तानी होकर भी हिन्दी दिवस मना रहे है, यह एक विरोधाभास 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 विदेशों में भी उचित स्थान मिला है।

राँची एक्सप्रेस के वरिष्ठ पत्रकार एवं विशिष्ट अतिथि श्री पूरन चन्द 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 प्रभारी निदेशक डॉ अजय भटटाचार्य ने अपने स्वागत भाषण में कहा कि हिन्दी हमारी राष्ट्र एवं राजभाषा के साथ-साथ सम्पर्क भाषा भी है। सरकारी काम काज में हिन्दी का सर्वाधिक प्रयोग करना हमारा नैतिक एवं संवैधानिक कर्तब्य 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 ।

संस्थान के सहायक निदेशक (रा.भा) श्री लक्ष्मी कान्त ने हिन्दी की प्रगति रिपोर्ट प्रस्तुत करने के क्रम में सूचित किया कि प्रशासकीय कार्यो के साथ-साथ तकनीकी एवं वैज्ञानिक कार्यो में भी राजभाषा हिन्दी के प्रयोग में सतत प्रगति हो रही है। संस्थान में हिन्दी को बढ़ावा देने के लिए संस्थान के कार्मिकों का प्रशिक्षण, आधारभूत संरचनाओं का विकास, संदर्भ साहित्य का उपार्जन तथा हिन्दी प्रतियोगिताओं का लगातार आयोजन किया जाता है ।

हिन्दी चेतना मास की अवधि में हिन्दी टिप्पण, प्रारूप लेखन, निबंध, अंताक्षरी, पर्याय एवं हिन्दी सुलेख प्रतियोगिताओं का आयोजन किया गया। जिसमें सर्वश्री विनोद कुमार, मुहम्मद फहिम अंसारी, कवल किशोर प्रसाद, रघुनाथ महतो, प्रहलाद सिंह, मुन्ना लाल रविदास, शरत चन्द्र लाल, अनिल कुमार सिन्हा, मदन मोहन, अनिल कुमार शर्मा, कृष्णमुरारी कुमार, छुट्टन लाल मीणा, कामेश्वर उराव, संजय श्रीवास्तव, रामानन्द बैद्य, गोबिन्द पाल,

सुप्रसिद्ध कथाकार एवं उपन्यासकार डॉ महुआ मांजी पुरस्कार प्रदान करते हुए।

अजय कुमार, अर्जुन शर्मा, वीरेन्द्र कुमार सिंह, अर्जुन गोप, रमाकान्त सिंह, कृष्णा प्रसाद काशी, विनोद कुमार सिंह, मानदेश्वर सिंह, कृष्ण कान्याल देवनाथ, शिववचन आजाद, हीरा लाल भक्त एवं विनय कुमार को पुरस्कार प्रदान किया गया ।

भारतीय कृषि अनुसंधान परिषद, नई दिल्ली के साथ-साथ संस्थान के हिन्दी प्रकाशनों की एक मनोरम प्रदर्शनी लगाई गई। सभा संचालन डॉ अंजेश कुमार एवं धन्यवाद ज्ञापन समारोह के अध्यक्षता श्री यज्ञदत्त मिश्र ने किया ।

नगर स्तरीय हिन्दी कार्यशाला का आयोजन

राँची नगर राजभाषा कार्यान्वयन समिति के तत्वावधान में 15 जनवरी 2007 को भारतीय लाख अनुसंधान संस्थान, नामकुम, राँची में "कार्यालय कार्य में राजभाषा का प्रयोग-व्यवहारिक कठिनाइयाँ" विषय पर एक दिवसीय नगर स्तरीय हिन्दी कार्यशाला का आयोजन किया गया।
उद्घाटन समारोह के मुख्य अतिथि डॉ दिनेश्वर प्रसाद (पूर्व विभागाध्यक्ष, स्नातकोत्तर हिन्दी विभाग, राँची विश्वविद्यालय) ने कहा कि हिन्दी का प्रयोग कर जब हम गौरवान्वित अनुभव करेंगे तब ही हिन्दी का प्रयोग बढ़ेगा ।

विशिष्ट अतिथि डॉ शिवेन्द्र कुमार, प्र.वै. एवं प्रमुख बागवानी एवं कृषि वानिकी शोध कार्यक्रम, पलांडू, राँची ने कहा कि हिन्दी का प्रयोग दिनानुदिन प्रगति के पथ पर है। 200 वर्षों के अंग्रेजी शासन का प्रभाव अब घटता जा रहा है और हिन्दी सभी क्षेत्रों में उल्लेखनीय प्रगति कर रही है। हमें इसके प्रयोग के लिए सदैव तत्पर रहना चाहिए ।

संस्थान के निदेशक, डॉ बंगाली बाबू ने कहा कि राजभाषा हिन्दी की लिपि देवनागरी लिपि है। सम्पूर्ण विश्व में मान्य है कि सबसे पुराना ग्रंथ ऋगवेद है जो संस्कृत भाषा एवं देवनागरी लिपि में है। इसकी रचना ईसा पूर्व 4500 वर्ष हुई। संस्कृत भाषा से ही अन्य भारतीय भाषाओं का विकास हुआ। उस समय विश्व में हम भारतीय सबसे बुद्धिमान रहे होंगे। उन्होंने हिन्दी के प्रयोग के प्रति अगाध प्रेम दर्शाते हुए कहा कि आज हिन्दी को राजभाषा का दर्जा भले ही मिला है परन्तु व्यवहारिक रूप से इसे राष्ट्रभाषा नही बनाया जा सका है। हिन्दी भाषा के प्रयोग में अवरोध खड़ा करने वाले हिन्दी भाषी ही होते हैं। उन्होंने अपील किया कि सभी कार्यालयों के अधिकारियों एवं कर्मचारियों को हिन्दी का अच्छा ज्ञान है, वे हिन्दी में काम करने का संकल्प लें और राजभाषा के कार्य को और आगे बढायें ।

संस्थान के सहायक निदेशक (राजभाषा) श्री लक्ष्मी कान्त ने कार्यशाला के उदेश्य पर चर्चा करते हुए कहा कि जिस स्थान पर आज हिन्दी को होना चाहिए वहाँ वह नहीं पहुँच सकी है। इसमें विफलता के मूल व्यवधान के कारण पर विचार विमर्श करने तथा उसके निदान हेतु समाधान खोजने के लिए संस्थान ने नगर स्तरीय हिन्दी कार्यशाला का आयोजन किया गया है।

मेकन, राँची के पूर्व महाप्रबंधक एवं नराकास के पूर्व सचिव श्री ओमेश्वर प्रसाद ने हिन्दी की प्रगति में संस्था/कार्यालय प्रधान एवं राजभाषा विभाग के कर्मियों की भूमिका पर प्रकाश डालते हुए कहा कि संस्था/कार्यालय प्रधान राजभाषा के प्रयोग के प्रति सजग होंगे तो निश्चित ही इसमें आशातीत सफलता मिलेगी। जिस तरह पानी का बहाव उपर से नीचे की ओर होता है उसी प्रकार हिन्दी के प्रयोग संबंधी कार्य अगर उच्चाधिकारी द्वारा होगा तो उसमे सफलता कई गुणा बढ़ेगी। ऐसी स्थिति में उन्होंने सलाह दिया कि कम से कम अपना कार्य हिन्दी में करने में कोई रोक नहीं सकता उससे दूसरों को भी प्रेरणा मिलती है।

डॉ रमापति तिवारी, वरिष्ठ राजभाषा अधिकारी मेकॉन, राँची ने राजभाषा की प्रगति में आनेवाली कठिनाइयों एवं उसके निदान के लिए आवश्यक कदम विषय पर प्रकाश डालते हुए राजभाषा के प्रावधानों की जानकारी दी तथा उसके अनुरूप अनुपालन के व्यवहारिक पक्ष के बारे में बताया।

"राजभाषा के प्रयोग में वांछित सफलता हेतु अधिकारियों एवं कर्मचारियों का योगदान" विषय पर श्री मिथिला शर्मा, पूर्व सहायक निदेशक (राजभाषा) मुख्य आयकर आयुक्त

कार्यालय, राँची ने इसके व्यवहारिक पक्ष पर विचार व्यक्त किए ।

संस्थान के प्रतिभागियों के साथ-साथ राँची नगर राजभाषा कार्यान्वयन समिति के सदस्य कार्यालयों के 81 प्रतिनिधियों ने कार्यशाला में भाग लिया, जिनमें सहायक डाक अधीक्षक, डाक अधीक्षक, डाक महाध्यक्ष, भारत संचार निगम लि0, हिन्दुस्तान पेट्रोलियम, इंडियन ऑयल कॉरपोरेशन, कर्मचारी राज्य बीमा निगम अस्पताल, नेशनल इंश्योरेंश कम्पनी, राँची टेलिफोन्स, स्टेट बैक आफ इंडिया, केन्द्रीय विद्यालय, नामकुम एवं दीपा टोली, आकाशवाणी एवं दूरदर्शन, ई टीवी, स्थानीय समाचार पत्रों के प्रतिनिधिगण, मंडल रेल प्रबन्धक, रेलवे विद्युतीकरण विभाग, भारतीय सर्वेक्षण विभाग, भारतीय खाद्य निगम के प्रतिनिधि शामिल थे।

कार्यक्रम संचालन डॉ अंजेश कुमार एवं धन्यवाद ज्ञापन श्री लक्ष्मी कान्त ने किया ।

- ''मधुमेह के कारण, परहेज, औषधि एवं प्राकृतिक उपचार विषय पर दिनांक 08.06.2007 को डॉ रश्मि द्विवेदी, प्राधिकृत चिकित्सक ने व्याख्यान दिया तथा संस्थान के अधिकारियों एवं कर्मचारियों द्वारा पूछे गए प्रश्नों के उत्तर दिए।

- राष्ट्रीय कृषि अनुसंधान प्रबंध अकादमी (नार्म, हैदराबाद) द्वारा 17-27 जुलाई 2007 को आयोजित ''गहन हिन्दी प्रशिक्षण कार्यशाला में सर्वश्री तरूण कुमार साहा, तकनीकी अधिकारी एवं कामेश्वर उराँव, वरीय लिपिक ने भाग लिया ।

- भारतीय कृषि अनुसंधान परिषद के प्रतिनिधि श्री मनोज कुमार, तकनीकी अधिकारी ने दिनांक 27.09.2007 को संसदीय राजभाषा समिति की प्रश्नावली से संबंधित निरीक्षण किया ।

- स्टील ऑथरिटी आफ इंडिया लिमिटेड, नई दिल्ली द्वारा कार्मिक अभिप्रेरणा एवं अनुशासन विषय पर 19-20 नवम्बर 2007 को दिल्ली में आयोजित राष्ट्रीय हिन्दी संगोष्ठी में डॉ अंजेश कुमार, वरिष्ठ हिन्दी अनुवादक ने संस्थान का प्रतिनिधित्व किया एवं व्याख्यान दिया ।

- राष्ट्रीय कृषि अनुसंधान प्रबंध अकादमी (नार्म हैदराबाद) द्वारा दिनांक 04.12.2007 से 06.12.2007 तक आयोजित 'राजभाषा अधिकारियों की समस्यायें' विषयक हिन्दी कार्यशाला में सहायक निदेशक (रा. भा), श्री लक्ष्मी कान्त ने व्यवहारिक पक्ष की चर्चा सत्र में भाग लिया ।

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