वार्षिक प्रतिवेदन
ANNUAL REPORT
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भारतीय प्राकृतिक राल एवं गोंद संस्थान
(भारतीय कृषि अनुसंधान परिषद)
नामकुम, राँची - 834010 (झारखण्ड)

INDIAN INSTITUTE OF NATURAL RESINS AND GUMS
(Indian Council of Agricultural Research)
Namkum, Ranchi - 834010 (Jharkhand)

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(भारतीय कृषि अनुसंधान परिषद्)
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)

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CONTENTS

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.

Preface

The institute in devoted to the goal of achieving and ensuring livelihood security for the country's poorer section of the society particularly forest and sub-forest dwellers by contributing to higher lac production, productivity and value addition of natural resins and gums. With the backdrop of agriculture sector in India passing through a difficult phase and impact of global recession all over the world, further aggravated by very low and erratic monsoon rainfall, the task becomes more challenging. In the process of development, the protection of environment and natural resources also received due attention. As in the past, the Institute continued its emphasis on building the desired human resource through various training programmes. The infrastructure development and human resource development efforts of the Institute was commendable. The annual report presents a glimpse of the various activities, research efforts and accomplishments of the Institute.

LAC PRODUCTION

A promising *kusmi* yellow lac insect line from Field Gene Bank was multiplied and 20kg broodlac was harvested from *semialata* plants. New lac insect-host plant combinations are being tried for sustainable lac yield. More than 1300 cultures of 65 lac insect lines are being conserved live on potted plants of *bhalia (Flemingia macrophylla)* under protected conditions in the Field Gene Bank of National Lac Insect Germplasm Centre (NATLIGEC). Drip irrigation system has been installed in the Field Gene Bank of NATLIGEC for mechanical irrigation of the plants to save manual labour. Five *rangeeni* lac insect stocks were evaluated on *bhalia* during summer season wherein local performed best whereas during rainy season as *katki* 2009 crop Ajmer collection performed best. Fecundity of Rajasthan [one from Gene Bank and another recent collection from Ajmer] were highest and was significantly superior over others. Genetic diversity of 35 collections of *Ziziphus* spp. including 26 popular fruit cultivars, 6 geographic collections of *Z. mauritiana* as lac host and three different species (*Z. rotundifoila, Z. nummularia* and *Z. xylopyra*) were characterized through Inter Simple Sequence Repeat (ISSR) markers for prediction of genetic relatedness between the fruit cultivars and the wild type lac hosts. Four *in situ* soil moisture conservation techniques were evaluated to assess the soil moisture level and its impact on plant growth parameters of two lac hosts i.e., *ber* and *kusum*. The growth parameters included plant height, basal girth, crown spread and number of primary branches. Mulching proved to be the best treatment for enhanced soil moisture level and plant growth in *ber*. Conservation treatments didn't affect *kusum* plant growth parameters significantly. Different growth attributes of ber trees e.g., Chlorophyll content index (CCI), per cent increase in shoot length and diameter, dry matter per cent of inoculable shoots etc were found to be influenced positively by different primary nutrients (N, P_2O_5, K_2O) and liming. Shoot diameter was found to increase 7% and 26% due to liming and N application (400 g/ tree). However, potassium application reduced dry matter content of inoculable shoots by 2 per cent.

PROCESSING AND PRODUCT DEVELOPMENT

Bioactive compounds 4-chlorophenyl thiosemicarbazide, 4-methylphenylthiosemicarbazide and 2-bromophenylthiosemicarbazide of aleuritic acid were synthesized from aleuritic acid. The yield of the compound varied from 67 to 70%. Extraction of exudates for their respective resins of *Boswellia serrata, Commiphora wightii* and *Commiphora mukul* were carried out with ethyl acetate and ethyl alcohol. Acid values of *Commiphora wightii* extracted in ethyl acetate and ethanol have been found to be 15.07 and 14.65, respectively. Various combinations of shellac-novolac blends and shellac-epoxidized novolac were tried and improved surface coating properties were achieved. Lac-based fruit coating formulation technology, developed by the Institute has been protected by filing a provisional patent of the technology at the Zonal office allotted at Kolkata. Effect of shellac

based coating formulation to increase the shelf life and shining of oranges was carried out manually by dipping method at Kalamna mandi, Nagpur. The same was evaluated by the fruit dealers also, who in turn appreciated the formulation for imparting good shining to fruits after coating and expected that fruits can be sold at higher prices. The effect of time of saponification, air pressure and wax filtration through filter cloths on yield and purity of aleuritic acid (technical grade) were studied in the pilot plant with degraded *rangeeni* seedlac to assess the yield. The yield of aleuritic acid obtained was between 16 and 16.7 % from old seedlac and between 19 and 19.8% from fresh *kusmi* seedlac in different trial experiments.

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. Twenty three in campus training courses of one week duration on scientific lac production, processing and uses were organized for farmers, extension cadre and NGO staffs of Jharkhand, Chhattisgarh and Orissa states and four educational cources for B.Sc. Ag students of Allahabad Agricultural Institute and Banaras Hindu University were organized. Five lac based product technology were transferred to entrepreneurs from Mumbai, Ranchi and Chennai. Some newer insecticides viz., indoxacarb, spinosad, fipronil, bifenthrin and *Bacillus thuringiensis* var. *kurstaki* formulation (Halt and Knock WP) of indigenous origin have been identified for the management of lac insect predators. All these insecticides were also found safe to lac insect and effective against lac insect predators. Three success stories of lac growers in Kanker District of Chhattisgarh have been documented and published. Market survey on diversified uses of lac has also been made. An Institute-Industry interface meeting was organized in association with the Dhamtari Lakh Udyog Sangh, Dhamtari at Dhamtari and Chhattisgarh in which more than 50 participants consisting of lac industrialists, forest officials, traders, and progressive farmers participated. A Directory related to natural resins and gums has been prepared and published in which more than 350 addresses with their complete details i.e. name, address, phone, fax, mail, commodities handled etc. of traders, manufacturer, exporters, importers, GOs, NGOs related to natural resins and gums has been made available for ready reference.

INFRASTRUCTURE DEVELOPMENT

Pilot plant for preparation of pure lac dye has been completed and a pilot plant of bleached lac of 40 kg/batch capacity has been installed. Construction of new scooter shed in factory campus, enhancement of the height of the boundary wall, foundation stone pillar and deep bore well in factory campus were carried out. Organic chemistry laboratories, Estate Section, some staff quarters were renovated. Upgradation of internet connectivity to 512 kbps from ERNET India was initiated.

I would like to express my gratitude to Dr S Ayyappan, Director-General ICAR and Secretary, Department of Agricultural Research and Education, Dr MM Pandey, DDG (Engg) and Dr NPS Sirohi, ADG (Engg.) for their guidance and support. I am also thankful to the Chairman and members of various committees for their efforts in reviewing and suggesting new initiatives in research and their monitoring, evaluation and refinement. 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.

July, 2010
Namkum, Ranchi

R Ramani
Director

कार्यकारी सारांश

1. कीट सुधार

- महाराष्ट्र से दो तथा प. बंगाल से तीन, कुल पाँच लाख कीट स्टॉक का अनेक जैविक/आर्थिक मानदंडो के लिए लगातार मूल्यांकन किया गया। ग्रीष्म एवं वर्षा ऋतु की लाख फसल के लिए स्थापन का घनत्व, आरंभिक मरणशीलता, लिंग अनुपात, राल उत्पादन एवं प्रजनन का अध्ययन किया गया तथा स्टॉको के बीच विस्तृत विविधता पाई गई।

- फिल्ड जीन बैंक से एक कुसमी पीला आशाजनक लाख कीट का वहुगुणण किया जा रहा है। लाख समेकित कृषि पद्धति के अन्तर्गत सेमियालता पौधों से 20 कि. ग्रा. बीहनलाख की कटाई की गई एवं उसमें से ग्रीष्म ऋतु के अन्तर्गत आगे वहुगुणण के लिए सेमियालता पर 2.5 कि.ग्रा. एवं 17.5 कि.ग्रा. कुसुम पर संचारित किया गया।

- लगातार लाख उत्पादन के लिए लाखकीट-परिपालक पौधे के नये संयोजन का परीक्षण किया गया। मेघालय से अरहर (*केजेनस कजन*) पर *केरिया चाइनेन्सिस* लाख कीट की ग्रीष्मकालीन फसल के यष्टि लाख का उत्पादन : निवेश अनुपात 8:1 रहा, इससे यह पता चलता है कि सिंचित परिस्थितियों में लाख की खेती के लिए अरहर का उपयोग आशाजनक है।

- राष्ट्रीय लाख कीट जीवद्रव्य कोड (एन ए टी एल आई जी इ सी) के फिल्ड जीन बैंक में सुरक्षित स्थितियों के अन्तर्गत गमले में लगाए गए भालिया *(फ्लेमिंजीया मैक्रोफाइला)* के पौधे पर 65 लाख कीट के 1300 से अधिक संबर्द्ध का संरक्षण किया जा रहा है। एन ए टी एल आई जी इ सी के फिल्ड जीन बैंक में मानव श्रम बचाने के लिए पौधों की यांत्रिक सिंचाई हेतु बूंद-बूंद सिंचाई पद्धति लगाई गई है।

- लाख कीट प्रारंभिक कोशिका संवर्द्ध उगाने के लिए परीक्षण किये गए दो एक्सप्लान्ट में कम संदूषण की दृष्टि से नेओनेट लार्वा के स्थान पर अंडाशय को प्राथमिकता दी गई। प्रारंभिक कोशिका संवर्द्ध में सूक्ष्म जीवीय संदूषण को विलंवित करने में इथेनॉल, सोडियम हाइपोक्लोराइड एवं मरक्यूरिक क्लोराइड का उपयोग कर अंडाशय के निकालने के पूर्व मादा लाख कीट का सतह बंध्याकरण उपयोगी पाया गया।

- लाख कीट की उपलब्धता संबंधी सूचना एवं उनके संग्रह के लिए हिमाचल प्रदेश एवं मणिपुर के विभिन्न जिलों का सर्वे किया गया। मणिकरण (कुल्लू) में खुरमानी *(प्रूनस अर्मेनियाका)* पर लगभग नया/अनजान कीट (मिथ्या लाख कीट) का संग्रह किया गया। लाख कीट मणिपुर में उपलब्ध है परन्तु लोग इसके बारे में नहीं जानते हैं। लाख की *एकेशिया ऑरीकुलीफॉर्मिस, हिविस्कस चाइनेन्सिस, फाइकस रेलिजीओसा* एवं *जिजीफस मौरीसियाना* पर लाख कीट देखा गया। अनुकूल जलवायु स्थितियों के कारण उत्तर-पूर्वी राज्यों में लाख की खेती की अच्छी संभावनाएं हैं। सत्ताईस लाख कीट किस्मों को उनके जैविक गुणों जैसे स्थापन घनत्व, आरंभिक मरणशीलता, लिंग अनुपात, कोशिका का वजन/राल का श्राव एवं प्रजनन का अध्ययन किया गया।

- ग्रीष्म ऋतु की अवधि में भालिया पर पाँच रंगीनी लाख कीट स्टॉक का मूल्यांकन किया गया जिसमें स्थानीय का परिणाम सबसे अच्छा रहा, उसके बाद राजस्थान, अजमेर, कांकेर एवं पुटिडीह का स्थान रहा। इन किस्मों को वर्षा ऋतु के कतकी 2009 फसल के दौरान भालिया पर उगाया गया। अजमेर से संग्रहित का परिणाम बहुत अच्छा रहा तथा उसके बाद राजस्थान, स्थानीय, कांकेर एवं पुटिडीह का स्थान रहा। वर्षा ऋतु की फसल में एक जीन बैंक से तथा दूसरा अजमेर से हाल में लाया गया के साथ प्रजनन उच्चतर या तथा उल्लेखनीय रूप से दूसरे से बेहतर था। प्रक्षेत्र परिस्थितियों में बेहतर उत्पादकता के लिए कतकी 2009 फसल के रूप में पलास पर उगाकर उपरोक्त किस्मों का जब मूल्यांकन किया गया तो स्थानीय का परिणाम सबसे अच्छा रहा, उसके बाद कांकेर, पुटिडीह, अजमेर एवं राजस्थान का स्थान रहा। जबकि बेर वृक्ष पर राजस्थान के संग्रह

का परिणाम सबसे अच्छा रहा एवं उसके बाद स्थानीय, कांकेर एवं पुटिडीह का स्थान रहा।

2. परिपालक सुधार

- लाख उत्पादकों की रिपोर्ट के अनुरूप लाख उत्पादक राज्यों के पाँच प्रमुख जिलों जैसे पुटिडीह (प. बंगाल), मयुरभंज (उड़ीसा), रायगढ़ (छतीसगढ़), राँची (झारखण्ड) एवं होशंगाबाद (मध्यप्रदेश) में लाख परिपालक वृक्षों की पहचान, प्रलेखीकरण एवं कृंतक बहुगुणण के लिए सर्वे किया गया। सर्वे के आधार पर पुटिडीह से कुसुम और पलास के दो उच्च उत्पादक तथा चकीडीह, उड़ीसा एवं बस्ती पल्ली छतीसगढ़ से एक कुसुम वृक्ष की पहचान की गई। उच्च उत्पादकता परिपालक जैसे कुसुम, पलास एवं बेर के आकारिकी का प्रलेखीकरण किया गया। संस्थान में लाख परिपालकों की फिल्ड जीन बैंक को सुदृढ़ किया गया है। फिल्ड जीन बैंक लाख परिपालकों का कुल 86 संग्रह संरक्षित किया गया है।
- फल उत्पादक एवं जंगली लाख परिपालकों के बीच आनुवंशिक संबंधों को जानने के लिए अन्तर सहज क्रम दुहराव (आई एस एस आर) मार्कर के द्वारा 26 ख्यात फल उत्पादक, 06 लाख परिपालक *जीजीफस मौरीसियाना* के भौगोलिक संग्रह एवं तीन भिन्न प्रजाति *(जेड रोटुन्डिफोलिया, जेड न्यूमुलेरिया* एवं *जेड जाइलोपाइरा)* मिलाकर *जीजीफस* प्रजाति के 35 संग्रहों के आनुवंशिक विविधता का अभिलक्षण वर्णन किया गया।
- कुसुम के *इन विट्रो* संवर्द्ध स्थापित करने में सूक्ष्मजीवीय संदूषण एक बड़ी समस्या है। कुसुम के *इन विट्रो* नोड संवर्द्ध में पाँच प्रमुख फफूंद संदूषक का पृथक्करण किया गया है एवं उनमें से चार आकारिकी एवं आण्विक विधि द्वारा *फ्यूरेशिया* प्रजाति (5 प्रतिशत संक्रमण दर), *कुर्बुलेरिया* प्रजाति (5 प्रतिशत संक्रमण दर) *अल्टरनेरिया* प्रजाति (10 प्रतिशत) एवं *पेनिशिलियम* प्रजाति (30 प्रतिशत) के रूप में पहचान की गई। पी सी आर आधारित फसल के द्वारा *लेवसेला न्युमोनी* के रूप में एक जीवाणु संदूषक की भी पहचान की गई।

3. फसल उत्पादन

- दो लाख परिपालकों बेर एवं कुसुम के मिट्टी नमी स्तर एवं पौध वृद्धि मानदंडों पर इसके प्रभाव के निर्धारण के लिए चार प्रतिस्थाने मिट्टी नमी तकनीक का मूल्यांकन किया गया। वृद्धि मानदंड में पौधे की ऊँचाई, तने का घेरा, वितान एवं प्राथमिक शाखाएं शामिल थी। बेर में मिट्टी नमी स्तर में वृद्धि एवं पौध वृद्धि के लिए पलवार सबसे अच्छा उपचार सावित हुआ। संरक्षण उपचार से कुसुम पौध वृद्धि मानदंड पर उल्लेखनीय प्रभाव नहीं देखा गया।
- विभिन्न प्रारंभिक पोषक (नाइट्रोजन, फॉस्फोरस पेंटाऑक्साइड, पोटैशियम ऑक्साइड) एवं चूना देने से बेर वृक्ष के विभिन्न वृद्धि गुणों जैसे क्लोरोफिल अंश सूचक (सी सी आई) प्ररोह की लम्बाई एवं व्यास में प्रतिशत वृद्धि, संचारित प्ररोहों में शुष्क क्षेत्र पर सकारात्मक प्रभाव देखा गया।
- चूना एवं नाइट्रोजन 400 ग्राम प्रति वृक्ष के प्रयोग से प्ररोहों के व्यास में 7 प्रतिशत से 26 प्रतिशत वृद्धि देखी गई। जबकि पोटैशियम के प्रयोग से संचारित प्ररोहों में शुष्क क्षेत्र में 2 प्रतिशत की कमी आई।
- 100 ग्राम प्रति वृक्ष की दर से नाइट्रोजन के प्रयोग से आरंभिक लाख कीट मरणशीलता में 20 प्रतिशत की कमी आई तथा पोटैशियम के प्रयोग से नर आबादी में 10 प्रतिशत कमी देखी गई। नाइट्रोजन के उच्चतम दर से बेर वृक्ष पर दीमक के प्रकोप में उल्लेखनीय वृद्धि आई। अध्ययन से पता चलता है कि पतले प्ररोह (धरातल व्यास < 1.0 से.मी.) लाख संचारण के लिए उपयुक्त नहीं है, क्योंकि ऐसे प्ररोहों पर लाख कीट मरणशीलता 72-80 प्रतिशत रिकार्ड की गई। हालांकि मोटे प्ररोहो (धरातल व्यास > 1.0 सें.मी.) पर लाख कीट मरणशीलता चूना देने से प्रभावित पाया गया।
- बेर का नया बागान उगाने के लिए प्रति पौधा क्रमशः 50, 85 एवं 40 ग्रा. नाइट्रोजन, फास्फोरस पेंटाऑक्साइड एवं पोटेशियम ऑक्साइड का प्रयोग करने पर नियंत्रण की तुलना में पौध वृद्धि में उल्लेखनीय वृद्धि देखी गई। पौधे की ऊँचाई, धरातल का व्यास एवं क्लोरोफिल अंश सूचक मान नियंत्रण की तुलना में क्रमशः 42, 48 एवं 49 प्रतिशत अधिक रहा।
- *फ्लेमिंजीया सेमियालता* (स्थापित बागान) पर संचारण पूर्व एवं संचारण के बाद के चरण में खरपतवार नियंत्रण के लिए शाकनाशी के प्रयोग के पश्चात् शरदकालीन

कुसमी लाख फसल उगाया गया एवं देखा गया कि लाख की फसल पर कोई प्रतिकूल प्रभाव नहीं पड़ता है। ग्लाईफोसेट (200.6 ग्रा./झाड़ी या 16.05 कि./हे.) से उपचारित प्लॉट में उपज उच्चतम रहा जो नियंत्रण की तुलना में 21.5 प्रतिशत अधिक है।

- *एफ सेमियालता* के बागान के शाकनाशी के प्रयोग से क्लोरोफिल अंश सूचक (सी.सी.आई.) पर कोई प्रतिकूल प्रभाव नहीं पड़ा। सबसे अधिक सी.सी.आई. ग्लाइफोसेट (20.69) उपचार पर हुए एवं उसके बाद ग्लुफोसिनेट (19.70) रहा, जो खरपतवार मुक्त उपचार एवं नियंत्रण से क्रमशः 11.6 एवं 57.10 प्रतिशत ज्यादा था।
- चक्रीय निधि-योजना के अन्तर्गत वर्ष की अवधि में 3171.5 कि.ग्रा. बीहनलाख उत्पादन किया गया, जिसमें 2012.5 कि.ग्रा. बीहनलाख, 1431.4 कि.ग्रा. यष्टिलाख एवं अन्य चीजों की विक्री से रू. 3,86,805/- का राजस्व अर्जित किया गया। वर्ष की अवधि में योजना का अन्तःशेष रू. 22,60,846 था। यह योजना कुसमी लाख कीट के उत्पादक किस्मों के वहुगुणण एवं संरक्षण में सहायक है। कुसमी लाख कीट के उत्पादक किस्म के तुलनात्मक परिणाम का मूल्यांकन किया गया।

4. संश्लेषण एवं उत्पाद विकास

- एल्यूरिटिक अम्ल से इसके जैव सक्रिय यौगिको 4-क्लोरोफिल थायोसेमिकार्वाजाइड (1.70 ग्रा.), 4-मिथाइल फिल्थियोसेमिकार्वाजाइड (1.253 ग्रा.) एवं 2-ब्रोमोफिल्थियोसेमिकार्वाजाइड (1.75852 ग्रा.) का संश्लेषण किया गया। यौगिकों का उत्पादन 67 से 70 प्रतिशत तक रहा। एल्यूरिटिक अम्ल के ब्युत्पन्न थायोसेमिकार्बाजाइड को खाद्य बिष तकनीक द्वारा 250 पी पी एम, 500 पी पी एम, 1000 पी पी एम सान्द्रण पर फ्यूसेरियम प्रजाति के प्रति परखनली में परीक्षण किया गया तथा 1000 पी पी एम के स्तर पर पैथोजेन में अवरोध देखा गया। हाइडारजाइड एवं थियोसेमिकार्वाजाइड (एल्यूरिटिक अम्ल का) को मेलिडोजीन इनकॉग्निटा (मूल गांठ कृमि) के जे2 के प्रति उनके एन्टीनिमीक सक्रियता के लिए भी परीक्षण किया गया तथा 125 पी पी एम एवं उससे ऊपर के सांद्रण में यौगिक को सक्रिय पाया गया।
- संबंधित राल (I) हैदराबाद, जबलपुर एवं बदोदरा से *बोस्वेलिया सेराटा* (II) अजमेर से *कॉमिफोरा विघटि* (III) अंजार (गुजरात) एवं ग्वालियर से *कॉम्बिफ्लोरा मुकुल* के निस्राव का इथाईल एसिटेट एवं इथाइल अलकोहल से निष्कर्षन किया गया। इथाइलएसिटेट एवं इथेनॉल में संग्रहित अजमेर के *कॉम्बिफ्लोरा विघटि* का अम्ल मान, क्रमशः 15.07 एवं 14.65 पाया गया। इथाइल एसिटेट में संग्रहित अंजार (गुजरात) एवं ग्वालियर से प्राप्त *कॉम्बिफ्लोरा मुकुल* का अम्ल मान क्रमशः 15.77 एवं 13.10 पाया गया।
- परिष्कृत एकेसिया गोन्द एवं कराया गोन्द का रासायनिक रूपान्तरण अलग-अलग किया गया। रासायनिक रूप से स्थान्तरित एकेसिया गोन्द एवं कराया गोन्द को धोया, सुखाया एवं पावडर बनाया गया। रासायनिक रूप से रूपान्तरित गोन्दों का एफ टी आई आर स्पेक्ट्रा भी रिकार्ड किया गया। रूपान्तरित गोन्द (एकेसिया गोन्द) के प्रतिविम्ब में हाइड्रोक्सिल वर्ग (3300-3600 cm^{-1}) का कोई उत्कर्ष नहीं दिखता जिससे संकेत मिलता है कि गोन्द का रूपान्तरण परिष्करण के बाद हुआ है।

5. सतह लेपन एवं उपयोग विविधता

- नोवोलैक एवं एपॉक्सीकृत नोवोलैक को संश्लेषित किया गया। चपड़ा के साथ नोवोलैक एवं एपॉक्सीकृत नोवोलैक संमिश्रण अलग-अलग किया गया। चपड़ा नोवोलैक संमिश्र एवं चपड़ा एपौक्सीकृत नोवोलैक संमिश्र के विभिन्न संयोजन का परीक्षण किया गया तथा मानक प्रक्रिया के अनुरूप उनके सतह लेपन गुणों का अध्ययन किया गया। चपड़ा एवं एपॉक्सीकृत नोवोलैक की चमक 80:20 एवं 70:30 के रूप में उच्चतर पाया गया। एपॉक्सीकृत नोवोलैक सांद्रण में वृद्धि से खरोंच कठोरता में वृद्धि हुई। एपॉक्सीकृत नोवोलैक प्रभाव प्रतिरोध में सफल नहीं रहा लेकिन, संमिश्र प्रभाव के प्रति प्रतिरोध दर्शाता है एवं परीक्षण में सफल रहा।
- विभिन्न प्राकृतिक गोंद जैसे बबूल गोन्द, खैर गोन्द, कराया गोन्द, घट्टी गोन्द, सलाई गोन्द, इमली गोन्द एवं ग्वार गोन्द के कई प्रकाशनों के विश्लेषण से यह पता चलता है कि ग्वार गोन्द के संदर्भों की संख्या उच्चतर थी एवं उपरोक्त गोन्दों के खोज संदर्भों की संख्या में उल्लेखनीय बढ़ोतरी से ऐसे संकेत मिलते हैं कि हाल के दशक में प्राकृतिक गोन्द के प्रति रूझान

बढ़ा है। उपरोक्त गोन्दों का एफ टी आई आर स्पेक्ट्रा एवं विभिन्न ताप एवं ताप ग्रैमिमैट्रिक विश्लेषण (डी टी ए एवं टी जी ए) थर्मोग्राम अध्ययन किया गया। सामान्यतया ओ एच, सी एच एवं सी ओ के स्ट्रेचिंग कंपन के कारण इन्फ्रारेड स्पेक्ट्रा पॉलीसेकेराइड्स का महत्वपूर्ण बंधन दर्शाता है। सामान्यतः गोन्द 100 से. के नीचे अन्तःतापीय उभार तथा 300-500 सें. पर वाहयतापीय उभार दर्शाता है। 220-340 से. ताप के बीच वजन में सबसे अधिक कमी आती है जो संभवतः पॉलीसेकेराइड अणुओं के अवक्रमण के कारण होता है। कराया गोन्द एवं ग्वार गोन्द का जल अवशोषण तुलनात्मक रूप से उच्चतर था। ग्वार गोन्द के भौतिक रासायनिक गुणों की प्रारंभिक माप से इसका परावैद्युत सामर्थ्य (ब्रेक डाउन वोल्टेज) मान 16.8 के वी/से.मी.^{2} दर्शाता है। सतह एवं आयतन प्रतिरोधिता मान क्रमशः $1.6x10^{12}$ ओ.एच.एम. एवं $0.9x10^{11}$ ओ एच एम पाये गए। जब गोंद एवं जल के अनुपात में 1:3 से 1:20 की वृद्धि की गई तो गोन्द की आसंजकता में सुधार देखा गया।

- वुड फीन एवं टच वुड जैसे बाजार के उत्पाद के साथ लैक वुड साइन के रंग, चमक, अम्ल मान, सुखने का समय, (स्पर्श से सुखा दिखना एवं पूर्ण शुष्क), खरोंच कठोरता, लचीलापन, जल प्रतिरोध, नमक जल प्रतिरोध, फैलाव की क्षमता, चिपचिपाहट जैसे गुणों का तुलनात्मक विश्लेषण किया गया। वार्निश लेपित 6"x4"x1" के आम की लकड़ी की पट्टी पर दीमक के प्रभाव का अध्ययन चल रहा है। प्रारंभिक अध्ययन से यह संकेत मिलता है कि पट्टी के किनारे एवं नीचे की ओर दीमक का प्रभाव है।

- पाइलट संयंत्र में एल्यूरिटिक अम्ल (तकनीकी श्रेणी) के उत्पादन एवं शुद्धता पर फिल्टर कपड़े के द्वारा सावुनीकरण का समय, वायु दवाब एवं मोम छनन के प्रभाव का अध्ययन किया गया। उत्पादन का निर्धारण करने के लिए पुराने एवं अवक्रमित रंगीनी चौरी लाख (तीन वर्ष से ज्यादा पुराना) से पाइलट संयंत्र में एल्यूरिटिक अम्ल तैयार किया गया। विभिन्न परीक्षण प्रयोग से पुराने चौरी से 16 से 17 प्रतिशत के बीच तथा ताजा कुसमी चौरी से 19 से 19.8 प्रतिशत के बीच एल्यूरिटिक अम्ल प्राप्त हुआ। 95-96 से. तक द्रवणांक प्राप्त किया।

6. प्रसंस्करण एवं भंडारण

- पाइलट संयंत्र का परीक्षण प्रचालन किया गया। ट्रे फिल्टर में मोम का अंश एवं अम्लमान 0.26 प्रतिशत तथा 81.5 पाया गया जबकि स्पार्कलर प्रेशर फिल्टर के मामले में यह 0.30 प्रतिशत तथा 81.46 रहा। मोम छनन कार्य गुरूत्व फेड पद्धति के अन्तर्गत दो अलग-अलग स्थितियों (ए. समुचित तापमान 27 ± 1^0 से. बी. ठंढा घोल 15 ± 2^0C) में क्षैतिज प्लेट एवं फ्रेम फिल्टर में किया गया। यह लाख के घोल को मोमरहित करने के लिए उपयुक्त पाया गया। दोनों परिस्थितियों में तैयार विरंजित लाख में मोम का अंश 0.22-0.26 प्रतिशत (भा.मा.व्यू. अधिकतम सीमा - 0.5 प्रतिशत) तथा अम्ल मान 80-88 था। संयत्र पर उद्यमियों को प्रशिक्षण भी दिया गया।

- भा. प्रा. रा. गों. सं., राँची द्वारा विकसित लाख आधारित फल लेपन सुत्रण प्रौद्योगिकी का सुरक्षित रखने के लिए कोलकाता के क्षेत्रीय कार्यालय में प्रौद्योगिकी का औपबंधिक पेटेन्ट दाखिल कर दिया गया है। प्रौद्योगिकी को कुल बाहरी अभिकरणों जैसे एन आर डी सी के सहयोग से या पंजीकृत कंपनियों, प्रतिष्ठानों या किन्नु वैक्सिंग संयंत्रों से निविदा आमंत्रित कर वाणिज्यीकरण करने का प्रयास जारी है।

- कलमना मंडी, नागपुर में नारंगी के भंडारण काल एवं चमक की वृद्धि में चपड़ा आधारित लेपन सूत्रण के प्रभाव का अध्ययन डुवाने की विधि का प्रयोग कर किया गया। इसी तरह का मूल्यांकन फल व्यापारी के द्वारा भी किया गया। व्यापारियों ने फल की अच्छी चमक के लिए सूत्रण की सराहना की और आशा व्यक्त किया कि सूत्रण लेपिक फलों को बाजार में अच्छे मूल्य पर बेचा जा सकता है।

7. क्षमता निर्माण के लिए मानव संसाधन विकास

- संस्थान द्वारा किसानों एवं गृहणियों के लिए नियमित प्रशिक्षण कार्यक्रम आयोजित किये गए जिसमें एक दिवसीय अभिविन्यास कार्यक्रम, प्रक्षेत्र प्रशिक्षण, प्रक्षेत्र शिक्षण एवं प्रोत्साहन प्रशिक्षण, प्रशिक्षक प्रशिक्षण तथा प्रक्षेत्र स्तरीय प्रदर्शन शामिल हैं। संस्थान द्वारा चलाए गए विभिन्न प्रशिक्षण गतिविधियों के अन्तर्गत दस हजार लोग लाभान्वित हुए।

- वैज्ञानिक विधि से लाख उत्पादन, प्रसंस्करण एवं उपयोग पर एक सप्ताह अवधि के लिए परिसर के अन्तर्गत तेईस प्रशिक्षण पाठ्यक्रम आयोजित किये गए, जिसमें झारखण्ड, छतीसगढ़ एवं उड़ीसा राज्य के 500 से अधिक किसानों प्रसारकर्मियों एवं गैरसरकारी संगठनों ने भाग लिया।
- इलाहाबाद कृषि संस्थान एवं बनारस हिन्दु विश्वविद्यालय के स्नातक कृषि के विद्यार्थियों के लिए चार शैक्षणिक पाठ्यक्रम आयोजित किए गए जिसमें 100 से ज्यादा लोग लाभान्वित हुए।
- मुम्बई, राँची एवं चेन्नई के उद्यमियों को लाख आधारित पाँच उत्पाद प्रौद्योगिकी हस्तांतरित किए गए।
- झारखण्ड, छतीसगढ़, उड़ीसा, मध्यप्रदेश, गुजरात, आंध्रप्रदेश एवं महाराष्ट्र के किसानों एवं गृहणियों के लिए चार प्रक्षेत्र प्रशिक्षण शिविर, 22 प्रक्षेत्र प्रोत्साहन/पूरक शिविर, परिसर के अन्तर्गत 14 अभिविन्यास कार्यक्रम आयोजित किये गए जिसमें 4000 से ज्यादा लोग लाभान्वित हुए।
- झारखण्ड में जनजातिय परिवारों की आजीविका में वृद्धि योजना के अन्तर्गत विभिन्न गैरसरकारी संगठनों द्वारा प्रायोजित 09 प्रसार कर्मियों के लिए एक बैच में एक सप्ताह का प्रशिक्षण तथा 1995 लाभुकों के लिए 22 प्रक्षेत्र प्रशिक्षण आयोजित किये गए। खरसीदाग ग्राम में गैर सरकारी संगठन (सीड्स) के सहयोग से सेमियालता के 1200 पौधों पर शरदकालीन कुसमी लाख की खेती का प्रक्षेत्र प्रदर्शन किया गया। राँची जिले के मांगोबांध ग्राम में सीड्स के द्वारा तथा खूंटी जिले के गुटवा ग्राम में गैरसरकारी संगठन प्रदान के द्वारा तीन उत्पादक कुसमी प्रजातियों का प्रक्षेत्र प्रदर्शन किया गया।

8. प्रौद्योगिकी मूल्यांकन, परिष्करण एवं प्रसार

- संस्थान अनुसंधान प्रक्षेत्र एवं किसानों के खेतों में कुसमी एवं रंगीनी लाख की फसलों पर किये गए प्रयोगों के आधार पर लाख कीट परभक्षियों जैसे *यूब्लेमा अमैविलिस, स्यूडोहाइपोटोपा पल्वेरिया* एवं *क्राइसोपा* प्रजाति के प्रबंधन के लिए कुछ नए कीटनाशी जैसे इन्डोक्साकार्व, स्पाइनोसैड, फिप्रोनील एवं बाइफेन्थ्रीन की पहचान की गई है। सभी कीटनाशी लाख कीट के लिए सुरक्षित पाये गए तथा लाख कीट परभक्षी को कम करने में प्रभावी हैं। विजातिय उत्पत्ति का डेल्फिन के साथ देशी उत्पत्ति के दो *बैसिलस थूरीन्जिएन्सिस* वर कुर्सटाकी सूत्रण (हाल्ट एवं नॉक डब्ल्यू पी) का भी कुसमी लाख फसल पर मूल्यांकन किया गया तथा लेपिडोप्टेरन लाख कीट परभक्षी (*यूब्लेमा अमैविलिस* एवं *स्यूडोहाइपोटोपा पल्वेरिया*) के उपर प्रभावी पाया गया। लेपिडोप्टेरन परभक्षियों के नियंत्रण में हाल्ट भी डेल्फिन के समान प्रभावी पाया गया।
- किसानों के खेत में उनकी सक्रिय सहभागिता, लाख की खेती के बैज्ञानिक तरीके का समुचित अंगीकरण एवं कीट मरणशीलता के संभावित पहलूओं के विश्लेषण के लिए तीन राज्यों जैसे झारखण्ड, उड़ीसा एवं छत्तीसगढ़ के कृषि विज्ञान केन्द्रों/गैर सरकारी संगठनों/प्रगतिशील किसानों के सहयोग से लाख की वैज्ञानिक खेती का शीर्ष क्रम प्रदर्शन किया गया।
- वैज्ञानिक विधि से लाख की खेती पर छतीसगढ़ में आयोजित किये गए विभिन्न प्रकार के प्रशिक्षण कार्यक्रमों को सूचीबद्ध किया गया। पिछले नौ वर्षों में कुल 8275 व्यक्तियों को प्रशिक्षित किया गया। आंकड़े एवं सूचना एकत्र करने के लिए परियोजना के अन्तर्गत सात प्रश्नावलियां विकसित की गई। छतीसगढ़ के तीन जिलों एवं पाँच वन प्रभागों के लाख से संबंधित परियोजनाओं/गतिविधियों (पिछले पाँच वर्ष की अवधि में) का प्रलेखन किया गया। कांकेर जिले के 10 ग्रामों के 100 किसानों (लाभुकों एवं गैर लाभुकों) का सर्वे किया गया। परियोजना/प्रशिक्षण के कार्यान्वयन के बाद ज्यादातर लाख उत्पादकों ने खेती की उन्नत प्रौद्योगिकी को अपनाया। लाख उत्पादकों के स्तर पर लाख का वार्षिक उत्पादन में दो गुणा से ज्यादा वृद्धि हुई। बीहनलाख एवं यष्टिलाख के उत्पादन पर स्पष्ट प्रभाव दिख रहा है क्योंकि परियोजना के कार्यान्वयन से पूर्व कोई भी किसान बीहनलाख का उत्पादन नहीं कर रहा था। छतीसगढ़ के कांकेर जिले से सफलता के तीन कहानियों का प्रलेखीकरण व प्रकाशन किया गया है। लाख के विविध उपयोग संबंधी बाजार सर्वेक्षण भी किया गया। लाख की ज्यादातर मात्रा (>60%) पेंट एवं वार्निश उद्योग में उपयोग किया जाता है।

9. संपर्क, सूचना एवं परामर्शदातृ सेवाएं

- विभिन्न राज्यों के वन विभागों एवं बाजारों से गोंद उत्पादन का सर्वे किया गया एवं सूचना एकत्र की गई। वर्ष 2008-09 में सभी प्रकार के गोन्द मिलाकर राज्यों में गुजरात - 279 क्वि., आंध्र प्रदेश - 2,525 क्वि., उड़ीसा - 3000 क्वि., झारखण्ड - 1200 क्विं. उत्पादन हुआ।
- धमतरी लाख उद्योग संघ के साथ धमतरी, छतीसगढ़ में एक संस्था-उद्योग विचार विमर्श का आयोजन किया गया जिसमें लाख उद्योगपति, वन विभाग के अधिकारी, उद्यमियों एवं प्रगतिशील किसानों समेत 50 से अधिक लोगों ने भाग लिया।
- प्राकृतिक राल एवं गोंद से जुड़े 350 से अधिक व्यापारियों, निर्माताओं, निर्यातकों, आयातकों, सरकारी कार्यालयों, गैरसरकारी संगठनों का पूर्ण पता जैसे नाम, पता, दूरभाष, फैक्स, ई-मेल, संबंधित सामग्री इत्यादि के विवरण के साथ प्राकृतिक राल एवं गोन्द के लिए तुरंत संदर्भ उपलब्ध कराने हेतु निर्देशिका तैयार एवं प्रकाशित की गई है।
- जहाँ लाख परिपालक पौधे उपलब्ध हैं, उन क्षेत्रों में लाख की खेती को प्रोत्साहित करने के लिए संस्थान ने विभिन्न कृषि विज्ञान केन्द्रों, सरकारी एवं गैरसरकारी संगठनों से संपर्क स्थापित किया। लाख रंजक एवं लाख आधारित वार्निश की तैयारी से संबंधित समस्याओं के समाधान के लिए आवश्यक सलाह दिये गए। झारखंड, पश्चिम बंगाल एवं उड़ीसा राज्यों में विभिन्न परिपालक वृक्षों पर लाख फसल का पर्यवेक्षण किया गया एवं लाख की खेती के विभिन्न पहलूओं पर आवश्यक सलाह प्रदान किया गया।
- संस्थान के अधिदेश में वर्णित गतिवधियों से संबंधित सूचना के प्रसार के लिए संस्थान द्वारा प्राकृतिक राल एवं गोन्द पर कई नियमित एवं तदर्थ प्रकाशन प्रकाशित किये गए।

EXECUTIVE SUMMARY

1. INSECT IMPROVEMENT

- Five lac insect stocks – two from Maharashtra and three from West Bengal continued to be evaluated for their biological / economic parameters. Density of settlement, initial mortality, sex ratio, resin production and fecundity were studied for summer and rainy season lac crops and a wide variation within and among the stocks were recorded.
- A promising *kusmi* yellow lac insect from Field Gene Bank is being multiplied. More than 20 kg broodlac was harvested from *semialata* plants of which 2.5 kg has been inoculated on *semialata* under Lac Integrated Farming System and 17.5 kg on *kusum* during summer season for further multiplication.
- New lac insect-host plant combinations are being tried for sustainable lac yield. Summer season crop of lac insect from Meghalaya, *Kerria chinensis* on *arhar, Cajanus cajan* during summer season gave an output: input ratio of 8: 1 of sticklac showing the promise of utilizing *arhar* for lac cultivation under irrigated conditions.
- More than 1300 cultures of 65 lac insect lines are being conserved live on potted plants of *bhalia* (*Flemingia macrophylla*) under protected conditions in the Field Gene Bank of National Lac Insect Germplasm Centre (NATLIGEC). Drip irrigation system has been installed in the Field Gene Bank of NATLIGEC for mechanical irrigation of the plants to save manual labour.
- Out of two explants tried to raise primary cell culture of lac insects, ovaries were preferred to neonate larvae in terms of less contamination. The surface sterilization of female lac insects before extracting ovaries using ethanol, sodium hypochlorite and mercuric chloride was found useful in delaying the microbial contamination in primary cell culture.
- Surveys to different districts of Himachal Pradesh and Manipur were undertaken to collect information on availability of lac insect and their collection. A seemingly new / unknown scale insect (Pseudo lac insect) on *khurmani* (*Prunus armeniaca*) plant at Manikaran (Kullu) was collected. Lac insect is available in Manipur but people are not aware about it. Lac insect was observed on *Acacia auriculiformis*, *Hibiscus rosa chinensis*, *Ficus religiosa* and *Ziziphus mauritiana*. North-Eastern state has scope for lac cultivation due to favourable climatic conditions. Twenty seven lac insect lines are being studied for their biological attributes *i.e.* density of settlement, initial mortality, sex ratio, weight of cell/resin secreted and fecundity.
- Five *rangeeni* lac insect stocks were evaluated on *bhalia* during summer season wherein local performed best followed by Rajasthan, Ajmer, Kanker and Putidih These lines when raised on *bhalia* during rainy season as *katki* 2009 crop. Ajmer collection performed better followed by Rajasthan, Local, Kanker and Putidih. During rainy season crop, fecundity of Rajasthan [one from Gene Bank and another recent collection from Ajmer were higher and was significantly superior over others. Above lines when evaluated as *katki* 2009 crop for superior productivity. In field condition local performed best followed by Kanker, Putidih, Ajmer and Rajasthan when raised on *palas*. Whereas, on *ber* trees Rajasthan collection performed best followed by local, Kanker and Putidih.

2. HOST IMPROVEMENT

- Survey has been undertaken in five districts of major lac growing states *viz*, Putidih, (West Bengal), Mayurbhanj (Orissa), Raigarh (Chhattisgarh), Ranchi (Jharkhand) and Hoshangabad (Madhya

Pradesh) for identification, documentation and clonal multiplication of lac host trees as reported by lac growers. Based on the survey, two high yielding hosts of kusum and palas were identified from Putidih and one high yielding *kusum* trees from Chakidih, Orissa and Bastipali, Chhattisgarh were identified. The morphometric features of high yielding host plants *viz, kusum, palas* and *ber* have been documented. The field gene bank of lac hosts at the institute has been strengthened. All together 86 collections have been conserved in the field gene bank of lac hosts.

- Genetic diversity of 35 collections of *Ziziphus* spp. including 26 popular fruit cultivars, 6 geographic collections of *Z. mauritiana* as lac host and three different species (*Z. rotundifoila, Z. nummularia* and *Z. xylopyra*) were characterized through Inter Simple Sequence Repeat (ISSR) markers for prediction of genetic relatedness between the fruit cultivars and the wild type lac hosts.
- Microbial contamination is one of the major problems faced in establishing *in vitro kusum* cultures. Five major fungal contaminants were isolated from the *kusum in vitro* node cultures and four of them were identified through morphological and molecular methods as *Fusarium* spp. (5% infection rate), *Curvularia* spp. (5% infection rate), *Alternaria* spp. (10%) and *Penicillium* spp. (30%). A bacterial contaminant was also identified through PCR based approach as *Klebsiella pneumoniae*.

3. CROP PRODUCTION

- Four *in situ* soil moisture conservation techniques were evaluated to assess the soil moisture level and its impact on plant growth parameters of two lac hosts *i.e., ber* and *kusum*. The growth parameters included plant height, basal girth, crown spread and number of primary branches. Mulching proved to be the best treatment for enhanced soil moisture level and plant growth in *ber*. Conservation treatments didn't affect *kusum* plant growth parameters significantly.
- Different growth attributes of ber trees e.g., Chlorophyll content index (CCI), per cent increase in shoot length and diameter, dry matter per cent of inoculable shoots etc were found to be influenced positively by different primary nutrients (N, P2O5, K2O) and liming. Shoot diameter was found to increase 7% and 26% due to liming and N application (400 g/ tree). However, potassium application reduced dry matter content of inoculable shoots by 2 per cent.
- Nitrogen application @ 100 g/ tree could reduce initial lac insect mortality by 20% and male population was found to reduce 10% due to potassium application. Highest dose of nitrogen significantly increased termite infestation on *ber* trees. Study also suggested that thin shoots (basal diameter < 1.0 cm) are not suitable for lac inoculation as lac mortality on 72-80% of such shoots was recorded. However, lac mortality on thick shoots (basal diameter > 1.0 cm) was influenced by liming
- For raising new plantation of *ber*, application of 50, 85 and 40 g N, P2O5 and K2O per plant significantly increased plant growth as compared to control. Increase in plant height, basal diameter and chlorophyll content index values were 42, 48 and 49 % higher than control.
- Winter season *kusmi* lac crop raised on *Flemingia semialata* (established plantation) after application of herbicides for weed control at pre and post inoculation stages, it was observed that there was no adverse effect on lac yield. The highest sticklac yield was obtained with glyphosate (200.6 g/bush or 16.05 q/ha) treated plot which was 21.5% higher than that of control.
- Application of herbicides in established plantation of *F. semialata* showed no adverse effect on chlorophyll content index (CCI). The highest CCI was recorded with glyphosate (20.69) treatment followed by glufosinate (19.70) which was 11.6 and 57.10% higher than that of weed free treatment and control, respectively.
- During the year, 3171.5 kg broodlac was produced from which Rs. 3, 86, 805/- was earned

as revenue from the sale of 2012.5 kg broodlac, 1431.4 kg sticklac and other means. Closing balance of the scheme during the year is 22, 60, 846. The Scheme is helping in conservation and multiplication of productive breeds of *kusmi* lac insects and comparative performance of productive breeds of *kusmi* lac insects was evaluated.

4. SYNTHESIS AND PRODUCT DEVELOPMENT

- Bioactive compounds 4-chloropheyl thiosemicarbazide (1.701g), 4-methylpheylthiosemicarbazide (1.253g) and 2-bromopheylthiosemicarbazide (1.75852 g) of aleuritic acid were synthesized from aleuritic acid. The yield of the compound varied from 67 to 70%. The derivatives of thiosemicarbazide of aleuritic acid were tested *in vitro* against *Fusarium sp.* at 250 ppm, 500 ppm, 1000 ppm concentration by food poison technique and inhibition of pathogen was observed at a dose of 1000 ppm. Hydarzide and thiosemicarbazide (of aleuritic acid) were also tested for their antinimic activity against j_2 of *Meloidogyne incognita* (root knot nematode) and the compound was found active at a concentration of 125 ppm and above.
- Extraction of exudates for their respective resins of (i) *Boswellia serrata* from Hyderabad, Jabalpur and Vadodra (ii) *Commiphora wightii* from Ajmer and (iii) *Commiphora mukul* from Anjar (Gujarat) and Gwalior were carried out with ethjylacetate and ethyl alcohol. Acid values of *Commiphora wightii* from Ajmer and extracted in ethylacetate and ethanol have been found to be 15.07 and 14.65, respectively. Acid values of *Commiphora mukul,* from Anjar (Gujarat) and Gwalior and extracted in ethyl acetate, have been found to be 15.77 and 13.10, respectively.
- Chemical modifications of purified gum acacia and gum karaya have been carried out, separately. Chemically modified *gum acacia* and gum *karaya* were washed, dried and finely powdered. FTIR Spectra of the chemically modified gums were also recorded. Spectrum of the modified gum (*gum acacia*) does not show any peak of hydroxyl group (3300-3600 cm^{-1}), indicating that gum have been modified after purification.

5. SURFACE COATING AND USE DIVERSIFICATION

- Novolac and epoxidized novolac was synthesized. Blending of shellac with novolac and epoxidized novolac was done separately. Various combinations of shellac-novolac blends and shellac-epoxidized novolac were tried and their surface coating properties were studies as per standard procedure.
- Gloss of shellac and epoxidized novolac was found to be higher for 80:20 and 70:30 ratios. Scratch hardness was increased as the concentration of epoxidized novolac was increased. Epoxidized novolac did not pass impact resistance but their blends showed resistance towards impact and passed the test.
- Analysis of number of publications on different natural gums showed that the references on guar gum was higher and there was a marked increase in the number of references on the gums during the recent decades indicating an increased interest on natural gums. Fourier transform infrarted (FTIR) spectra and differential thermal and thermo gravimetric analysis (DTA and TGA) thermograms of the above gums were studied. The infrared spectra in general showed the major bands of polysaccharides due to OH, CH and CO stretching vibrations. The gums in general showed endothermic peak below 100°C and exothermic peaks in the region 300-500°C. The major weight loss occurred in the temperature range 220-340°C probably due todegradation of polysaccharide molecules. The water absorption was observed to be comparatively high for *karaya* gum and guar gum. Preliminary measurements of the physico-chemical properties of guar gum gave the dielectric strength (break down voltage) value as 16.8 kV/cm2. The surface and volume resistivity values were 1.6x1012 Ohm and 0.9x1011 Ohm cm respectively. The adhesiveness of gum

appeared to improve when gum: water ratio was increased from 1:3 to 1:20.

- Lac-based fruit coating formulation technology, which was developed at IINRG, Ranchi has been protected by filing a provisional patent of the technology at the Zonal office allotted at Kolkata. The efforts are made to commercialize the technology either through involving some external agency like NRDC or may be sold through inviting tender from registered companies, firms or kinnow waxing plant owners.
- Effect of shellac based coating formulation to increase the shelf life and shining of oranges was carried out manually by dipping method at Kalamna mandi, Nagpur. The same was evaluated by the fruit dealers also, who in turn appreciated the formulation for imparting good shining to fruits after coating and expected that fruits can be sold at higher prices.

6. PROCESSING AND STORAGE

- Trial runs of Pilot-plant were carried out. The wax content and acid value in tray filter were found 0.26 % and 81.5, whereas, it was 0.30% and 81.46 in case of sparkler pressure filter. Wax filtration was also carried out in horizontal plate and frame filter under gravity fed system at two different conditions (ambient temperature 27 ± 1^0C and cooled solution 15 ± 2^0C). It was found suitable for dewaxing of lac solution. The wax content of the prepared bleached lac in both conditions was 0.22-0.26% (BIS maximum limit-0.5%) with acid value from.80- 88. The training was also imparted to entrepreneurs on the plant.
- The effect of time of saponification, air pressure and wax filtration through filter cloths on yield and purity of aleuritic acid (technical grade) were studied in the pilot plant. Aleuritic acid was also prepared in the pilot plant from old and degraded *rangeeni* seedlac (more than 3 years old) to assess the yield. The yield of aleuritic acid obtained was between 16 and 16.7 % from old seedlac and between 19 and 19.8% from fresh *kusmi* seedlac in different trial experiments. Melting point upto 95-96°C has been achieved.

7. HRD FOR CAPACITY BUILDING IN LAC PRODUCTION, PROCESSING AND VALUE ADDITION

The Institute conducted regular training programmes for the farmers and the housewives, one day orientation programme, on-farm training, field educational and motivational training, trainer's training and field level demonstrations. Over ten thousand persons have been benefited under the various training activities conducted by the Institute.

- Twenty three in campus training courses of one week duration on *Scientific lac production, processing and uses* were organized for more than 500 farmers, extension cadre and NGO staff of Jharkhand, Chhattisgarh and Orissa states.
- Four educational cources for B.Sc. (Ag.) students of Allahabad Agricultural Institute and Banaras Hindu University were organized for more than 100 beneficiaries.
- Five lac based product technology were transferred to entrepreneurs from Mumbai, Ranchi and Chennai.
- Four On-farm training camps, 22 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 in which approx 4000 persons benefitted.
- Farmers' participatory approach is being followed in demonstration of intensive *kusmi* lac cultivation on *semialata* and of *kusmi* productive breeds on *ber*. Encouraging results of demonstrations have helped in motivating the farmers to accept intensive lac cultivation on *semialata* for enhanced returns through crop diversification.
- Some promising and fast growing lac hosts like *Albizia procera*, *Prosopis juliflora* and *Ziziphus mauritiana* have also been raised as plantation for lac cultivation under Ranchi conditions and have shown healthy and quick growth.

- Large scale pre-summer mortality has been reported for the last 3-4 years. Study has been initiated to identify causal factor for mortality. Some newer studies on (i) Ant-lac- host plant association, (ii) Development of broodlac standards have been taken up.
- Lac information Cell has been established at TOT Division. Lac data (State / district / market wise) related to production, processing, marketing etc. since 1974 has been compiled. Daily Meteorological data (Maximum temperature, Minimum temperature, Humidity, Rainfall) of the last 38 years *i.e.* since 1971 to March 2009 has been digitized.
- Training related infrastructure like Green Net House and furnishing of Lecture Hall and Training Hostel has also been completed

8. TECHNOLOGY ASSESSMENT, REFINEMENT AND DISSEMINATION

- On the basis of field experimentation undertaken at Institute Research Farm and Farmer' s field on *kusmi* and *rangeeni* lac crop, some newer insecticides *viz.*, indoxacarb, spinosad, fipronil and bifenthrin have been identified for the management of lac insect predators *viz.*, *Eublemma amabilis* Moore and *Pseudohypatopa pulverea* Meyr and *Chrysopa* spp. All the insecticides have been found safe to lac insect and effective in significantly reducing the incidence of lac insect predators. Two *Bacillus thuringiensis* var. *kurstaki* formulation (Halt and Knock WP) of indigenous origin along with Delfin of exotic origin were also evaluated on *kusmi* lac crop and found effective against lepidopteran lac insect predators (*Eublemma amabilis* and *Pseudohypatopa pulverea*). Halt was found equally effective as Delfin in reducing the incidence of lepidopteran predators.
- Front line demonstration (FLD) on scientific lac cultivation were initially taken up in three states *i.e.* Jharkhand, Orissa and Chhattisgarh with association of KVKs/NGOs/progressive farmers with a view to carry out field demonstrations in farmers field with their active participation, sensitizing adoption of scientific approaches to lac cultivation and to analyze the possible factors of insect mortality.
- Different types of training programmes conducted for Chhattisgarh on Scientific methods of lac cultivation have been have been listed. A total number of 8275 persons have been trained during last nine years. Seven questionnaires have been developed under the project for collection of data and information. Lac related projects/activities (during last five years) have been documented for 3 districts and 5 forest divisions of Chhattisgarh. 100 farmers (benefited and non-benefited) of 10 Villages of kanker district have been surveyed. After implementation of projects/ training majority of lac growers adopting improved cultivation technology. Annual production of lac at growers level have increased more than two times. The visible impact has been seen in sticklac and broodlac production as no growers producing broodlac before implementation of project. Three success stories of lac growers in Kanker District of Chhattisgarh have been documented and published. Market survey on diversified uses of lac has also been made. Majority of lac (>60%) used in paint and varnish industries.

9. LIAISON, INFORMATION AND ADVISORY SERVICES

- Information has been collected from Forest department and market survey on production of gums in different states. The production of all gums in the states during the year 2008-09 was Gujarat– 279 quintals; Andhra Pradesh – 2,525 quintals, Orissa - 3000 quintals; Jharkhand - 1200 quintals.
- An Institute-Industry interface meeting was organized in association with the Dhamtari Lakh Udyog Sangh, Dhamtari at Dhamtari, Chhattisgarh in which more than 50 participants consisting of lac industrialists, forest officials, traders, and progressive farmers participated.

Discussions were held on different related issues to find out the problems faced by lac manufacturers for its redressal.

- A Directory related to natural resins and gums has been prepared and published in which more than 350 addresses with their complete details *i.e.* name, address, phone, fax, mail, commodities handled *etc.* of traders, manufacturer, exporters, importers, GOs, NGOs related to natural resins and gums has been made available for ready reference.
- The Institute has established linkages with various KVKs and other Government and Non-governmental organizations for promotion of lac cultivation in areas where lac host plants are available. Necessary advice was provided for the solution of problems related to preparation of lac dye and lac based varnishes. Monitoring of lac crop on different host plants were carried out in the states of Jharkhand, West Bengal and Orissa and necessary advice related to different aspects of lac cultivation were provided.
- Institute brought out several regular and *ad-hoc* publications on natural resins and gums in English and Hindi, to disseminate information on the Institute's mandated activities.

IINRG : AN INTRODUCTION

HISTORICAL DEVELOPMENT

Lac, a natural resin, is a Non-Timber Forest Produce 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 19.3.2007 have 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°23′ N latitude and 85°23′ E longitude. The soil status of the Institute indicates advance weathering on granitic gneiss. The soil of the experimental farm is of lateritic type. The area experiences mild, salubrious climate, with a rather heavy rainfall pattern of about 1400 mm average, of which about 1250 mm is during the monsoon. During the year the highest mean maximum temperature (38.9°C) was observed in the month of April and the lowest mean minimum temperature

(6.1°C) during December. May 2nd and December 30th were recorded as the hottest and the coldest day of the year with a temperature of 44.0° C and 6.0° C, respectively. The total rainfall during the period was 1103.8 mm.

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.

ORGANIZATIONAL SET UP

STAFF

Institute has a sanctioned strength of 1 RMP, 46 scientific, 62 technical, 36 administrative and 81 supporting grade with Total of **226** sanctioned posts, out of which 30 scientific including RMP, 53 technical, 26 administrative and 69 supporting posts with Total of **178** staff 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 178 staff in scientific, technical, administrative and supporting categories. The Institute has several prestigious labs, *viz.*, High Voltage Laboratory, Biotechnology, Bio-control Laboratory, Instrument Laboratory, Quality Evaluation Laboratory etc. Besides these, the DTP and publications facilities are also available. A number of modern and sophisticated laboratory equipment, including DSC, FT-IR, Insect Activity Meter, Environmental Growth Chamber etc. are available for research on all aspects of lac production, processing and product development. 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 Accounts 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 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. More than 1300 cultures of 65 lac insect lines are being conserved live on potted plants of *bhalia (Flemingia macrophylla)* under protected conditions in the Field Gene Bank of National Lac Insect Germplasm Centre (NATLIGEC). Drip irrigation system has been installed in the Field Gene Bank of NATLIGEC for mechanical irrigation of the plants to save manual labour.

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

The Quality Evaluation Laboratory of the Institute has been accredited IS IISO 9001 : 2000 and it caters to the quality control needs of the lac processing / lac product industries as well as exporters of lac / lac products. The QEL analyses, on an average, about 150 samples per annum. The lab has facilities for carrying out testing of lac / lac products as per BIS requirements.

The Research Management Unit (RMU) provides the Scientists, access to Internet and e-mail facilities for communication and information retrieval. The Institute website, available at ***www.icar.org.in/ilri/default.htm***. *is* a valuable source of information on IINRG as well as natural resins and gums. The Institute has attained international recognition for its contribution in cultivation and utilization aspects of lac.

BUDGET

During 2009-10, the non-plan expenditure was Rs. 912.60 lakhs, against a revised estimate of Rs. 912.79 lakhs; the plan expenditure was Rs. 199.99 lakhs against a revised estimate of Rs. 200.00 lakhs. The detailed figures are shown in the table.

Budget allocation and utilization during 2009-10 : At a Glance

(Rs. in lakhs)

(A)	Plan & Non- Plan	Non-Plan			Plan		
	Head of Account	**BE 2009-10**	**RE 2009-10**	**Expr 2009-10**	**BE 2009-10**	**RE 2009-10**	**Expr 2009-10**
1.(i)	**Establishment charges**	700.00	840.30	840.30	0.00	0.00	0.00
(ii)	Wages	0.00	0.00	0.00	0.00	0.00	0.00
(iii)	O.T.A.	0.20	0.13	0.13	0.00	0.00	0.00
2.	**Traveling allowances**	3.60	1.39	1.39	5.00	5.00	5.00
3.(i)	**Other charges:** Contigency	39.75	53.22	53.20	53.00	47.00	47.01
(ii)	Information Technology	0.00	0.00	0.00	2.00	4.25	4.24
(iii)	Equipments, Furniture & Office equipments	0.00	1.29	1.29	50.00	80.00	79.99
(iv)	Library Books & Journals	0.00	0.13	0.13	13.00	13.00	13.00
4.	**Works**						
(i)	AR&MO of Non-Res Buildings	8.00	6.04	5.95	0.00	0.00	0.00
(ii)	AR&MO of Research Building	4.00	10.29	10.21	0.00	0.00	0.00
(iii)	Minor works	2.00	0.00	0.00	0.00	0.00	0.00
(iv)	Major original works (Plan)	0.00	0.00	0.00	75.00	49.75	49.75
5.	**Other items (HRD)**	0.00	0.00	0.00	2.00	1.00	1.00
	Total	**757.55**	**912.79**	**912.60**	**200.00**	**200.00**	**199.99**

(B)	Network Project	BE 2009-10	RE 2009-10	Expr 2009-10
1.	Recurring contingency	20.00	37.00	37.00
2.	Travelling Allowance	5.00	5.00	5.00
3.	Non-Recurring contingency	75.00	58.00	58.00
	Total	**100.00**	**100.00**	**100.00**
(C)	Pension & Other retirement benefits	75.00	246.20	244.67
(D)	Loans & Advances	4.00	5.28	5.22
(E)	**Revenue Realization**	**Target 2009-10**	**Revised**	**Realization**
(i)	Revenue Receipts	38.00	32.03	27.30
(ii)	Interest on TDR	0.00	8.00	4.48
(iii)	Recoveries on loans	0.00	9.00	8.42
	Total	**38.00**	**49.03**	**40.20**
	*Rs 8.99 lakhs realized towards sale of asset not accounted under revenue.			

REVENUE GENERATION

During the period under report, a sum of Rs. 33.68 lakhs was earned as revenue, through different programmes of various divisions and sections of the Institute.

RESEARCH ACCOMPLISHMENTS

1. LAC PRODUCTION

1.1. Insect improvement

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

Evaluation of lac insect stocks

Five lac insect stocks – 2 from Maharashtra and 3 from West Bengal continued to be evaluated for their biological / economic parameters: Sex ratio during *baisakhi* (summer) season crop 2008-09 showed wide variations. It differed from 66.94% in Purulia to 93.37% in Bankura stock in favour of males. Within stocks also variation was very high. Highest resin secreted by individual female cell was 13.07mg from Bankura stock whereas the lowest 10.61mg by Midnapore stock (Fig. 1). Fecundity varied from 421 in Midnapore stock to 638 in Purulia stock (Fig. 2).

During rainy (*katki*) season crop, 2009, initial density ranged from 77 in Ahmednagar to 112 in Midnapore stock. There was no significant difference in initial mortality that ranged from 44.98 - 48.6%. While male proportion was the lowest (34%) in Ahmednagar stock and the highest (58%) in Bankura stock (Fig. 3); average resin produced ranged between 6.46mg in Purulia stock to 10.19mg in Ahmednagar stock (Fig.4). Average fecundity differed from 313 in Midnapore stock to 419 in Purulia stock (Fig. 5).

Similarly, during *baisakhi* (summer) season crop 2009-10 initial density of settlement showed wide variations; it varied from 82 per sq. cm. in Bankura stock to 175 in Ahmednagar line. Initial mortality during this season, in general, was low (2.4 to 16.7%). Sex ratio differed from 43% in Bankura to 92% in Ahmednagar stock in favour of males. Within stocks also variation was very high (Fig. 6).

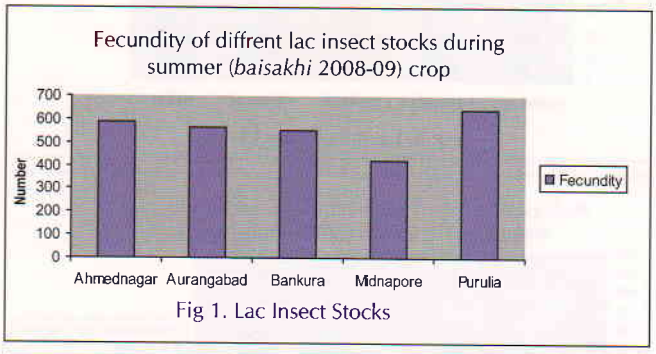


Fig 1. Lac Insect Stocks

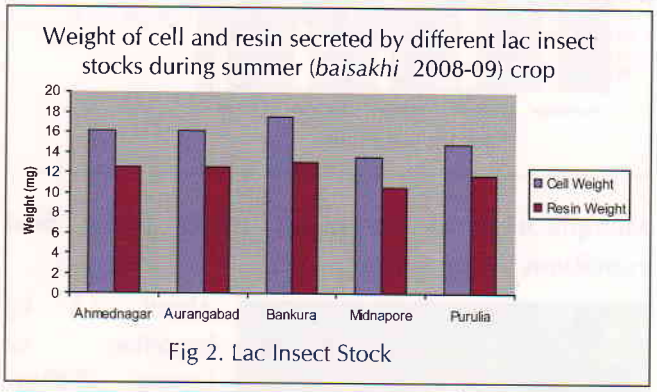


Fig 2. Lac Insect Stock

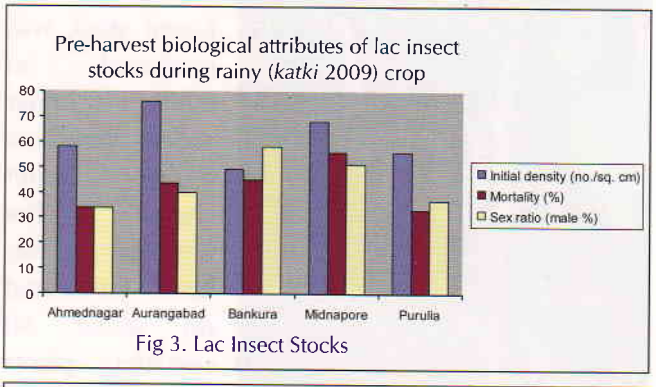


Fig 3. Lac Insect Stocks

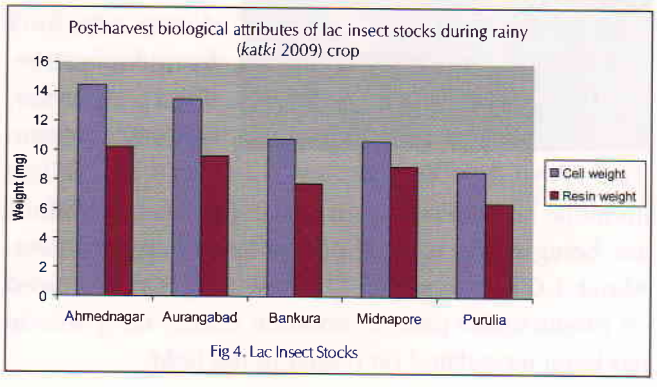


Fig 4. Lac Insect Stocks

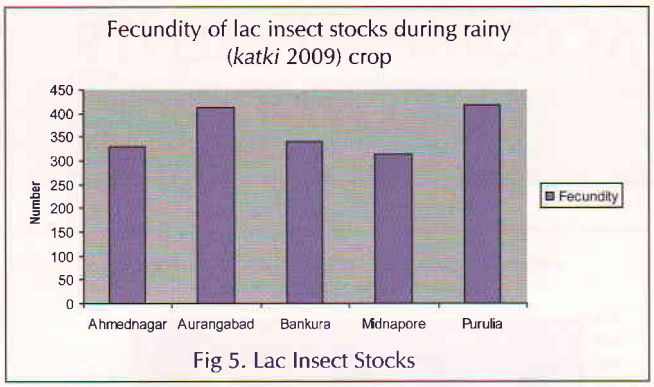


Fig 5. Lac Insect Stocks

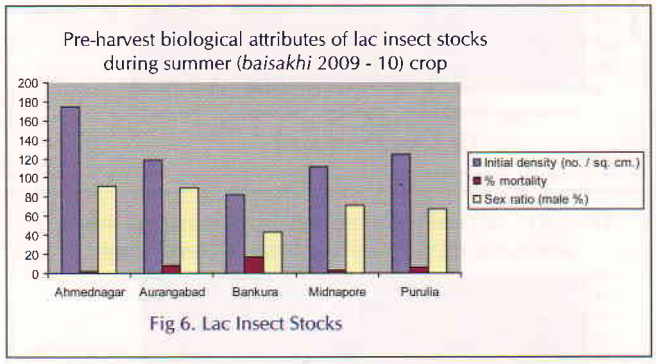


Fig 6. Lac Insect Stocks

Multiplication of lac insect stocks under field conditions


Fig. 7 : Orissa Yellow lac on semialata

About 2.5 kg broodlac of Orissa Yellow *kusmi* stock was produced on *bhalia* under potted condition during summer season. The broodlac has been inoculated on about 50 *semialata* plants during July 2009 for multiplication. (Fig.7). However, summer season crop of yellow trivoltine line did not survive on *ber* and *kusum*. Efforts are being made to multiply Yellow *rangeeni* insect. About 1.0 kg broodlac of Yellow *rangeeni* produced on *bhalia* under potted condition during rainy season has been inoculated on *bhalia* in the field.

New lac insect-host plant combination


Fig. 8 : *Kerria chinensis* on *arhar*

Summer season crop of lac insect from Meghalaya, *Kerria chinensis* was inoculated on *galwang, Albizia lucida* and *arhar, Cajanus cajan* during January, 2009. The crop on *arhar* was provided irrigation at 10 days interval. While heat mortality was observed during April-May on *galwang* after male emergence, crop on *arhar* under irrigation gave an output : input ratio of 8 : 1 of sticklac showing the promise of utilizing *arhar* for lac cultivation under irrigation (Fig.8). However, its broodlac quality suffered adversely (negligible emergence of larvae) as irrigation could not be provided as per schedule during months of May and June due to paucity of water in Institute Research Farm (IRF).

National Lac Insect Germplasm Centre

Conservation of lac insect stocks

More than 1300 cultures of 65 lac insect lines are being conserved live on potted plants of *bhalia* (*Flemingia macrophylla*) under protected conditions in the Field Gene Bank of National Lac Insect Germplasm Centre (NATLIGEC).


Fig. 9 : Drip irrigation system at NATLIGEC

Drip irrigation system (Fig. 9) has been installed in the Field Gene Bank of NATLIGEC for mechanical irrigation of the plants to save manual labour.

Ant-lac insect interaction

Fig. 10 : Damage to lac by Ants

Some cultures in the Field Gene Bank of NATLIGEC were observed to be damaged by ants (Fig. 10). Therefore, different types of ants have been collected from the IRF for identification. Further observations are being recorded to ascertain the exact nature of ant-lac insect host association

Forecasting of larval emergence

Different stages of embryonic development of lac larvae corresponding to the period of their emergence for advanced forecasting have been have been documented in the form of photographs for preparation of pictorial guide. Representative photographs of Ovariole and the mature fertilized egg of lac insect (Fig 11a &b) are provided.

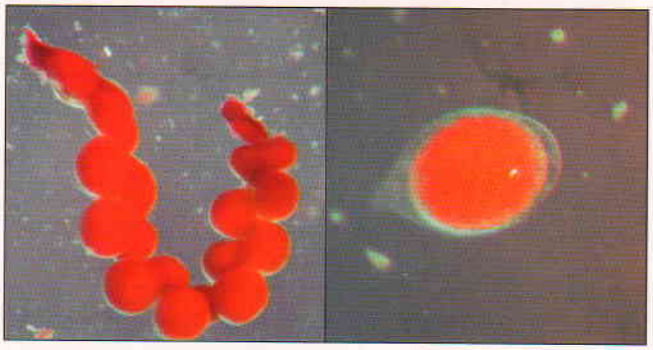


Fig. 11a : Lac insect ovariole

Fig. 11b : Fertilized egg of lac

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

Multiplication and evaluation of potential *rangeeni* lac insect lines: Five (5) *rangeeni* lac insect lines one from Kanker (Chhattisgarh), one from Putidih (W.B.), one collection from Ajmer & Pushkar (Rajasthan), another collection from Rajasthan (maintained in Institute Field Gene Bank) and one local line from IRF (Jharkhand) that survived *baisakhi* 2007-08 crop were multiplied and evaluated on *bhalia* for broodlac productivity point of view during summer season (2008-09) and were simultaneously raised on *palas* trees for multiplication (Table-1). Among five collections of *rangeeni* lac insects evaluated on *bhalia* Local performed best (1: 8.1) followed by Rajasthan (1: 7.5), Ajmer (1: 7.4), Kanker (1: 6.2) and Putidih (1: 5.8). When these lines when raised on *bhalia* as *katki* 2009 crop it was observed that the Ajmer collection performed best (1: 5.8) followed by Rajasthan (1: 5.6), Local (1: 5.5), Kanker (1: 4.7) and Putidih (1: 4.3). Biological attributes *viz.*, initial density of settlement, sex ratio, fecundity etc. were also studied during rainy season crop and was fond that the fecundity of Rajasthan [one from Gene Bank (541.2) and another recent collection from Ajmer (557.6)] were highest and was significantly superior over others (Table 2). The calculated fecundity was least for Kanker (314.2) and Putidih (315.5) and both were at par to each other whereas, local produced intermediate (420.6) and was significantly higher over Kanker and Putidih but lower in both collections of Rajasthan.

Field evaluation for superior productivity and summer sustainability on *ber* and *palas*: Above mentioned lac insect lines when evaluated as *katki* 2009 crop. In field condition it was found that the local performed best (1:2.4) followed by Kanker (1:2.3), Putidih (1: 2.2), Ajmer (1: 2.1) and Rajasthan (1: 2.1) when raised on *palas*. Whereas, on *ber* trees Rajasthan collection performed best (1: 4.7) followed by local (1: 4.1), Kanker (1: 3.8) and Putidih (1: 3.4) (Table-3). Comparative field performance of *rangeeni* lac insect originated from Jammu and Jhaldah/Putidih stock produced (1: 8.3) and (1: 9.6) when raised on *ber* whereas it was (1:5.7) and (1: 4.2) on *palas*, respectively at Jammu during rainy season (*katki* 2009). Due to large-scale pre-summer mortality it was not possible to evaluate these lines for broodlac productivity point of view on *ber* and *palas* under field condition during *baisakhi* (2008-09).

Quantification of parasitoids in *rangeeni* lac crop raised during *baisakhi* 2009-10: *Rangeeni* lac insects samples raised on *Butea monosperma* were collected from IRF, Namkum, and Latehar block (Jharkhand); Bagmundi and Jhaldah block of district Purulia (WB) in the month of January and March for the assessment

of parasitization. The data recorded showed that the lac insects were heavily parasitized by *Aprostocetus (Tetrastichus) purpureus* wherein its number varies from 248 to 364 in the month of January; it varied from 416 to 573 in the month of March while caging 10 cm length of lac encrustations.

Table 1. Details of *baisakhi* crop raised during 2008-09

Source/Place of Broodlac	Broodlac used	Date of inoculation	No. of Plant inoculated	Date of Harvesting	Broodlac produced	Remarks
Kanker	13.5 kg	31.10.08	1-*ber*	-	-	Crop failed
			9- *palas*	06.07.09	300 g	This harvest was made from 2-*palas* trees which were covered with muslin cloth (protected condition); otherwise crop did not survived upto broodlac.
	20g		10- *bhalia*	22.06.09	124 g	Under nylon mesh (protected condition)
Ajmer & Pushkar	8.74 kg	30.10.08	3-*ber*	-	-	Crop failed
			7- *palas*	06.07.09	170 g	This harvest was made from 2-palas trees which were covered with muslin cloth (protected condition); otherwise crop could not survive upto broodlac.
	20g		10-*bhalia*	27.06.09	148 g	Under nylon mesh (protected condition)
Local (IRF)	0.3 kg	18.10.08	4- *palas*	06.07.09	190 g	This harvest was made from 2- palas trees (un-protected/un-covered conditions)
	20g		10- *bhalia*	22.06.09	162 g	Under nylon mesh (protected condition)
Rajasthan (From Gene Bank)	4.25 kg	13.10.08	4- *palas*	06.07.09	150 g	This harvest was made from 2-palas trees which were covered with muslin cloth (protected condition); otherwise crop could not survived upto broodlac.
	30g		15- *bhalia*	16.06.09	226 g	Under nylon mesh (protected condition)
Putidih (W.B.)	30g	13.10.08	15- *bhalia*	27.06.09	174 g	Under nylon mesh (protected condition)

Table 2. Productivity linked attributes of different lac insect stocks raised on *bhalia* during *katki* 2009

Strain	Wt. of matured female (mg.)	Wt. of cell after crawler emergence (mg.)	Fecundity	Density at initial stage (No./cm²)	Initial mortality (%)	Sex ratio (Male %)	Density at crop maturity (No./cm²)
Rajasthan (Gene Bank)	31.87	14.75	541.2	79	39.2	39.6	11
Ajmer & Pushkar	38.02	17.27	557.6	83	43.4	38.3	10
Kanker	19.87	8.87	314.2	67	23.9	29.4	19
Putidih	24.10	11.94	315.5	63	20.6	28.0	14
Local	33.11	16.39	420.6	71	19.7	29.8	11

Table 3. Details of *katki* crop raised during 2009

Source/Place of Broodlac	Broodlac used	Date of inoculation	No. of Plant inoculated	Date of Harvesting	Broodlac produced (Input: output)	Remarks
Kanker	104g	22.06.09	1- *palas*	15.10.09	581g **(1: 2.3)**	365g good broodlac + 216g rejected
	150g	06.07.09				
	150g	06.07.09	1- *ber*	15.10.09	563g **(1: 3.8)**	236g good broodlac + 327g rejected
	20g	22.06.09	10-*bhalia*	15.10.09	94g **(1: 4.7)**	-
Ajmer & Pushkar	170g	06.07.09	1-*palas*	15.10.09	364g **(1: 2.1)**	96g good broodlac + 268g rejected
	124g	27.06.09	1-*khair*	15.10.09	675g **(1: 5.4)**	-
	20g	27.06.09	10-*bhalia*	15.10.09	116g **(1: 5.8)**	-
Local (IRF)	150g	06.07.09	1-*ber*	03.10.09	614g **(1: 4.1)**	476g good broodlac + 138g rejected
	206g	16.06.09	2-*palas*	03.10.09	485g **(1: 2.4)**	-
	20g	16.06.09	10-*bhalia*	03.10.09	110g **(1: 5.5)**	-
Rajasthan (From Gene Bank)	190g	06.07.09	2-*palas*	12.10.09	391g **(1: 2.1)**	212g good broodlac + 179g rejected
	142g	22.06.09	1-*ber*	12.10.09	670g **(1: 4.7)**	196g good broodlac + 374g rejected
	20g	22.06.09	10-*bhalia*	12.10.09	112g **(1: 5.6)**	-
Putidih (W.B.)	750g	27.06.09	1-*palas*	15.10.09	1630g **(1: 2.2)**	753g good broodlac + 947g rejected
	750g	27.06.09	1-*ber*	15.10.09	2560g **(1: 3.4)**	1326g good broodlac + 1574g
	20g	27.06.09	10-*bhalia*	15.10.09	86g **(1: 4.3)**	-

Large scale mortality of *rangeeni* lac insects (*baisakhi* crop)

Experiments were conducted at IRF to identify the factor(s) responsible for large scale mortality of *rangeeni* lac insects (*baisakhi* crop) during February-March to narrow down the possible reason(s) to overcome this problem.

All experiments were conducted both under irrigated (15 day interval) and un-irrigated conditions to nullify the moisture stress.

Experiment 1: Assessment of role of parasites and predators

Set- A: Raising of crop on palas as per the recommendation of IINRG

Under open condition: Large scale mortality but scattered survival with good development on few trees.

Under synthetic nets: Insects are surviving.

Experiment 2: Assessment of role of parasites and predators

Set- B: Raising of crop on *palas* and application of fungicides at weekly interval

Under open condition: Large scale mortality but scattered survival with good development on few trees.

Under synthetic nets: Insects are surviving.

Set- C: Raising of crop on *bhalia* as per the recommendation of IINRG

In field condition: Complete mortality.

In potted and protected condition: Insects are surviving.

In field with additional application of fungicides at weekly interval: Complete mortality.

Experiment 3: Detection of pathogens in lac insects through conventional tests:

Surviving and dead lac insects were regularly collected and examined under microscope and culture under media for fungal pathogens.

Observations of examination of samples received from various sources and through visits during the period of mortality have been mentioned below in Table 4. On the basis of observations made the temperature and host stress did not seem to be responsible for the mortality. However, the actual reasons is yet to be ascertained.

Table 4. Observations after examination of samples

Sl. No.	Location	Host	Date of collection	Date of caging	Crop Condition	Per cent mortality
1	Latehar	*Palas*	16.02.09	16.02.09	Mortality	55-60
2	N.B. Farm, Chandwa	*Palas*	01.03.09	06.03.09	Almost complete mortality	90-95
3	Khunti	*Ber*	03.03.09	04.03.09	Very good	15-20
4	Dugila, Upperloto and Negai village (Latehar)	*Palas*	05.03.09	06.03.09	No insects were found surviving on about 80% trees High mortality on remaining trees, but surviving insects were well developed	100 75-80
5	Chitramu, Barudih and Irud villages (Khunti/Ranchi)	*Ber*	04.03.09	05.03.09	Complete mortality in Chitramu, moderate in Barudih and good crop in Irud	2-100
6	Jammu	*Palas*	05.03.09	—	High mortality	70-75
7	Jammu (Photographs and through telephonic information)	*Ber*	05.03.09	—	Good crop	20-25

Sl. No.	Location	Host	Date of collection	Date of caging	Crop Condition	Per cent mortality
8	Loandih, Kotna, Lobodag, Ruitola, Gassar, Otongora, Dewo, Dabgana and Kajurdag villages (Khunti/Ranchi)	*Ber*	06.03.09	07.03.09	High mortality on majority of trees	75-100
9	Putidih, W.B.	*Palas*	07.03.09	09.03.09	High mortality on majority of trees. Some plants showed good survival	70-75 25-30

Following observations were made during the experimentations

1. Most noticeable point was that majority of mortality started at the stage of third instar.
2. Non-emergence of male was observed in field condition, even in those cultures, were lac was surviving in the month of March.
3. This year mortality started at least about 15 days later in comparison to last year.
4. Male populations were about 60-70 per cent (Kanker and Rajasthan) whereas; it was 35-40 per cent in local population.

1.1.3 *In vitro* culturing of lac insect cells

Experiments with rangeeni lac insects: Preliminary experiments done in bacterial medium revealed that the treatment with ethanol for 15 minutes followed by 0.1% or 0.2% mercuric chloride for 10 minutes eliminated surface contamination from lac insects. However, when the same experiment was repeated with *rangeeni* lac insects ovaries in insect cell culture medium (MM medium – Mitsuhashi and Maramorosch medium) contamination was observed in 2-3 days. The medium was also supplemented with 200 units of penicillin and 200 µg of streptomycin and 5 µg of amphotericin per ml of culture medium in all the following experiments unless specified. The contamination was delayed for a week when the medium was supplemented with the antibiotics.

Neonate larvae were used as explants after sterilizing them with sterile water containing antibiotics (800 units of penicillin, 800 µg of streptomycin and 20 µg of amphotericin/ml of water). The contamination was observed in less than a week after seeding.

Experiments with kusmi lac insects: The fungal contamination was observed after a week when the *kusmi* lac insects ovaries were seeded after surface sterilizing the whole insects with ethanol for 10 minutes followed by 0.1% mercuric chloride treatment for 5 minutes. Even when the anti fungal agent (amphotericin) concentration was increased to 10 µg/ml of medium along with ethanol and mercuric chloride treatment there is no change in the contamination pattern.

The surface sterilization treatment (15 minutes in ethanol and 10 minutes in 0.1% $HgCl_2$) was supplemented with sodium hypochlorite (0.8%) for 10 minutes. In this experiment, the fungal contamination was delayed for about 20 days.

Based on all these evidences, ovaries are preferred explants to neonate larvae, in terms of delaying contamination. Surface sterilization of mature female insects with ethanol, 0.1% mercuric chloride and 0.8% sodium hypochlorite may be helpful in eliminating contamination from the primary cell culture.

1.1.4 To understand the nature of diversity in lac insect of *Kerria* spp in India and the nature of insect x host interaction

Diversity analysis of lac insects of *Kerria* spp. in India (NAIP project)

This work has been done under Component 4 of NAIP with IINRG as the consortium leader and IARI, New Delhi; BIT, Mesra and University of Delhi, Delhi as partners. The contribution of the Institute under the project has been summarized below:

Molecular characterization of lac insect lines

Genomic DNA from females of 40 lac insect lines was isolated. Approximately 4 µg of DNA was

obtained from approximately 50 mg of lac insect tissue. Screening of primers for housekeeping genes for DNA polymorphism was carried out through PCR using DNA samples of nine representative lac insect lines from different groups. The primers screened were for genes of 28S rRNA, 18S rRNA, ITS2, NADH 4 dehydrogenase, NADH 5 dehydrogenase, COI, EF-α, nuclear SSU rDNA and LSU rDNA D1-D2. Primers screened for COI, EF-α, nuclear SSU rDNA, LSU rDNA D1-D2 produced satisfactory amplified products in the lines screened. The PCR products were gel purified and was sent for sequencing for further analysis.

The universal primers recommended by Folmer *et al.* (1994) generally used for amplification of the target region of gene coding for COI (cytochrome oxidase I) did not produce satisfactory amplification, which has been found to be due to mutations in the primer binding region. A new set of primers have been designed based on the conserved regions of the target gene and 650 bp region of COI has been amplified. The sequences of amplified products COI gene of seven lines were aligned for an insight into variation present in the lac insect lines. Blast analysis revealed similarity of sequence (~75%) with phytosuccivorous hemipterans, esp. aphids and phylloxeroids.

Body pigment analysis of lac insect lines

Sample preparation for analysis of body colour pigment from lac insect, through spectral data and HPTLC has been standardized. The spectral characteristics of three lines have been presented in Table 5. Line-specific variation in absorption maxima and minima were observed.

Table 5. Spectral characteristics of body colour pigments of three lac insect lines indicating wavelengths and absorbance values at absorption maxima and minima

Insect line	Attribute	Wavelength (nm)	Absorbance value
LIK0003	Peak	434	0.383
		314	2.474
	Valley	392	0.351
		264	1.601
LIK0039	Peak	520	0.466
		283	2.033
	Valley	426	0.41
		267	1.845
LIK0047	Peak	526	0.61
		291	2.65
	Valley	418	0.34
		282	1.82

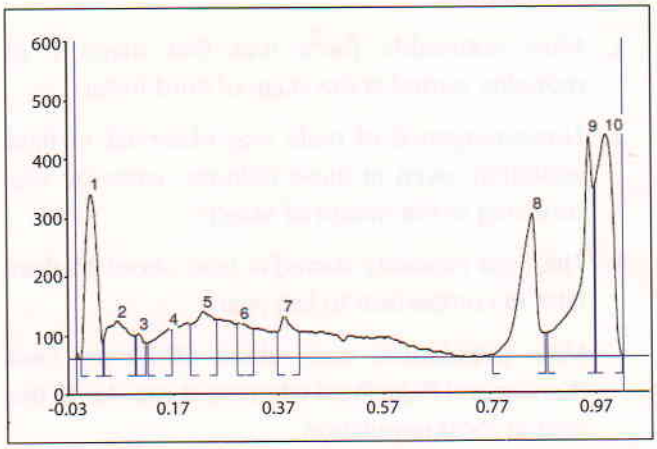


Fig. 12 : HPTLC chromatogram of LIK0047 at 0 = 350nm showing various peaks

Analysis of biological parameters of lac insect lines

Recording of density of settlement, initial mortality, sex ratio, life period, size and weight of female lac cell and fecundity of the lac insects with respect to season was done in 27 lac insect lines. Fig. 13 depicts the variation in initial mortality, settlement density and proportion males.

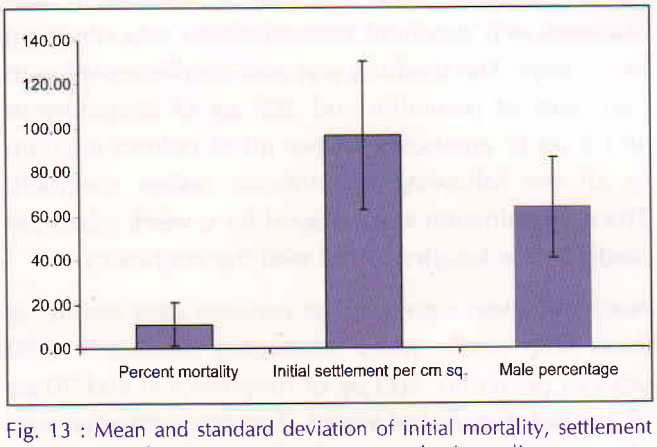


Fig. 13 : Mean and standard deviation of initial mortality, settlement density and male proportion in twenty-seven lac insect lines

Survey of north-eastern and northern states for wild populations of lac insects

Surveys were undertaken in Himachal Pradesh, Haryana, Punjab and Manipur states for occurrence of natural populations of lac insects. Survey done in nine districts of Himachal Pradesh (HP) (Sirmaur, Solan, Shimla, Bilaspur, Hamirpur, Mandi, Kullu, Kangra and Una) and border area of Haryana in July, '09. One collection was made from Ropar from *Ber*. Except one pseudo lac insect collection, on *Prunus arminica* , Manikaran (Kullu), no population of *Kerria* was found in HP.

Nine districts (Bishnupur, Chandel, Churachandpur, Imphal (E), Imphal (W), Senapati, Tamenglong, Thoubal and Ukhrul) of Manipur were surveyed in Nov., '09. Lac insects were recorded on *Acacia auriculiformis*, *Hibiscus chinensis*, *Ficus religiosa* and *Ziziphus mauritiana* plants in Imphal (W), Bishnupur, Senapati and Ukhrul districts and collections were made . Lac insect was found almost invariably associated with ants forming nest around the lac encrustation. The ant species associated with lac insects from Manipur were identified as : *Crematogaster flava, Crematogaster rogenhoferi, Crematogaster rothneyi* and *Technomyrmex albipes*.

Fig. 14 : Lac insects on *Hibiscus chinensis*, from Chingkangphai, Manipur

Fig. 15 : Pseudo lac insects on *Prunus arminica* at Manikaran, HP

Fig. 16 : A view of the new area developed for lac insect field gene bank at the Institute

A new area (2 plots measuring 10x50m and 10x20m) has been developed for raising and maintaining potted plants of *F. macrophylla* and lac insect cultures in the Field Gene Bank of the Institute. Over 500 new lac insect cultures and >1000 potted host plants have added for various studies under the project (Fig. 16).

1. 2 Host Improvement

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

Identification and documentation of high yielding lac host plants:

A survey has been undertaken in five districts of major lac growing states viz, Purulia, (W.B), Mayurbhanj (Orissa), Raigarh (Chhattisgarh), Ranchi (Jharkhand) and Hoshangabad (M.P.). These areas were surveyed during May-August, 2009 for identification, documentation and clonal multiplication of lac host trees as reported by lac growers. All together 86 collections are being conserved in the field gene bank of lac hosts. The broodlac yield ratio of identified high yielding lac host plants reported is mentioned in the Table 6.

Table 6. Broodlac yield ratio of identified lac host plants

Place	Host	Broodlac yield ratio
Putidih	Palas	1:48
West Bengal	Kusum	1:15
Chakidih, Orissa	Kusum	1:10
Bankhedi,Madhya Pradesh		1:13
Bastipali, Chhattisgarh		1:12

Morphological characterization of host plants

The morphometric features of host plants and potential features reported are as follows:

Sl.No	Source area	Host	Morphological features	Locally reported lac potential
1	Mangobandh, Jharkhand	Kusum	H-19.2m, G- 4.4m, NS- 23.6m, EW-26m, Semi spreading habit	1:8.5
2.	Putidih, W.B	Palas	H-15m, G-2m, NS- 11m, EW-9m Upright growing habit	1:48
3	Putidih, W.B	Ber	H-10.9m, G-1.85m NS- 13m, EW-14m Spreading habit	1.5: 52
4	Putidih, W.B	Kusum	H-22.6m, G-3.7m, NS-20.5m, EW- 23m, Upright spreading habi	1:15
5	Chakidih, Orissa	Kusum	H-24m, G-5.5m, NS-22m, EW-27m, Spreading habit	1:10
6	Hosangabad (M.P)	Kusum	H- 17.8m, G-4.6m, NS- 23.3m, EW- 25.6m, Semi spreading,	1:13
7	Raigarh (C.G)	Kusum	H-19.6m, G- 5.03m, NS-27m, EW- 8.5m, Spreading habit	1:12.7

Molecular characterization of host plants

Ber (*Ziziphus mauritiana* Lam.) apart from being horticultural fruit tree, the wild populations of *ber* is also an important host plant for lac insects; both *kusmi* and *rangeeni* strains. Wild *Ber* is conventionally used for summer crop of *rangeeni* insect; but the use of *ber* for winter crop of *kusmi* insect is gaining popularity these days. In general the fruit cultivars of *ber* are not recommended for lac cultivation possibly due to the poor fruit production due to lac insect infestation. It would be therefore important for a farmer to have suitable *ber* tree that would produce good quality fruits as well as support lac production. Keeping in view the above objective in mind molecular genetic characterization of 26 popular fruit cultivars, 6 geographic collections of *Z. mauritiana* as lac host and three different species (*Z. rotundifoila*, *Z. nummularia* and *Z. xylopyra*) (Table 7) were characterized through Inter Simple Sequence Repeat (ISSR) markers for prediction of genetic relatedness between the fruit cultivars and the wild type lac hosts.

Table 7. List of *ber* collections used under molecular characterization study

Fruit varieties (collected from CAZRI, Jodhpur, Rajasthan)	**B1**: Sandan; **B2**: Aliganj; **B3**: Seb X Katha; **B4**: Bagwadi; **B5**: Illaichi; **B6**: Thornless; **B7**: Maharwali; **B8**: Kali; **B9**: CAZRI Gola; **B10**: Reshmi; **B11**: Katha; **B12**: F1 Seb X Gola; **B13**: BC1 Seb X Tikadi; **B14**: Chhuahara; **B15**: Umran; **B16**: Tikadi (CAZRI collection); **B17**: Jogia; **B18**: Banarsi Karka; **B19**: ZG3; **B20**: Seb; **B21**: Gola; **B22**: Sanaur-5; **B23**: Kaithli; **B24**: Banarsi pebandi; **B25**: Mundia; **B26**: Tikadi (IINRG collection)
Geographic collections of *Ziziphus mauritiana* used as lac host	**B27**: randomly seleceted plant from IINRG research farm, Ranchi; **B28**: Rania collection; **B29**: Simdega (Jharkhand) collection; **B30**: Gumla (Jharkhand) collection; **B31**: Banaskanta (Gujarat) collection, **B32**: Purulia (WB) collection;
Species	**B33**: *Ziziphus rotundifolia*; **B34**: *Z. nummularia*; **B35**: *Z. xylopyra*

ISSR analysis of *ber* collection

Eleven selected ISSR primers produced a total of 88 scorable bands with 8 bands per primer. The size of scorable bands for ISSR primers obtained was from 200 bp to 2500 bp. The primer ISSR12 produced the maximum number of 11 scorable bands. The total polymorphism percentage was 98.86%. The high polymorphism range again confirms about its wide genetic base. The PIC and MI values of the ISSR primers range from 0.11 to 0.36 and 1.34 to 3.61, respectively. The range of resolving power (Rp) of the ISSR primers was from 1.77 to 5.77. Only one primer, ISSR 26 produced a resolving power of over 5.0 indicating it is suitable to distinguish among the collections studied (Fig. 12). Out of the 11 primers used a total of 9 primers (81.8%) produced 15 unique products which are suitable for converting into specific SCAR markers. The genetic relationship analysis between the collections was also ascertained from the similarity coefficient study. The analysis revealed Jogia and Kaithili fruit cultivars showed maximum genetic relatedness (68%) with wild host *ber*. Thus these two ber fruit cultivars can be exploited for lac cultivation in future.

The dendrogram however did not reveal any distinct separation between the fruit cultivars and the wild lac host plants and formed mixed groups within the clusters from ISSR studies. This could be due to possibility that there is an exchange of genetic material across the country for commercial fruit production or through cross-pollination between the local and introduced genotypes.

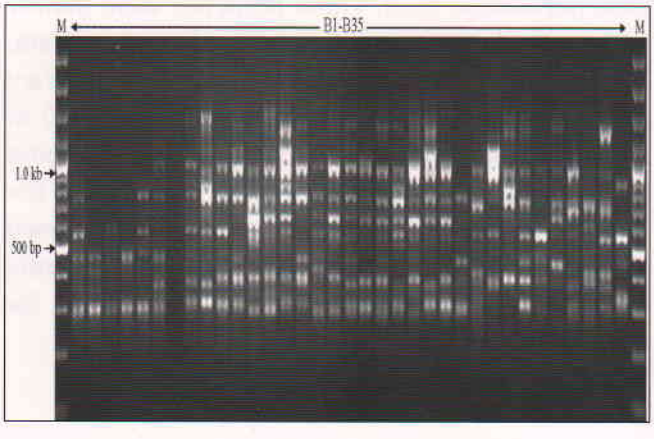


Fig. 17A : Representative gel figure of ISSR amplification

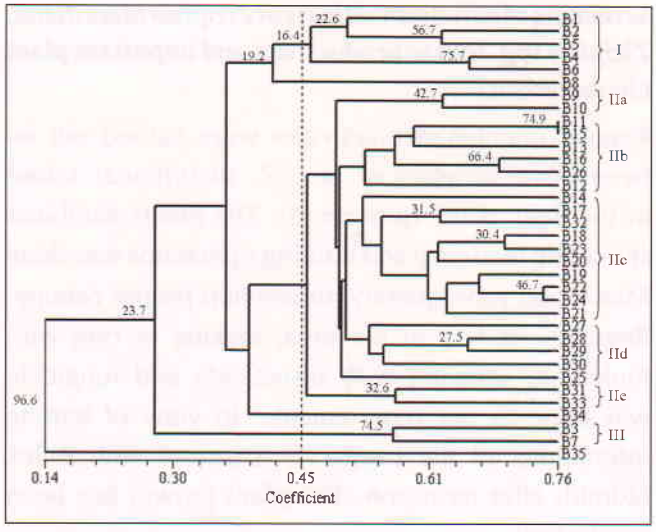


Fig. 17B : Clustering of 35 Ziziphus lines according to ISSR

DNA isolation and standardization of RAPD markers in *Kusum* and *Palas*

Three different protocols viz, Doyle and Doyle, 1990, Lin *et al.*, 2001 and Dellaporta *et al.*, 1983 were screened to isolate DNA from leaves of *kusum* and *palas*. Among these 3 protocols Doyle and Doyle, 1990 produced best yield of DNA from leaves. Young leaves of *kusum* and *palas* are ideal sample for DNA extraction. PCR reaction was optimized for RAPD analysis using DNA isolates from *kusum* and *palas*.

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

To evolve a variety of *Flemingia semialata* for *kusmi* lac crop sustainability during summer

The summer *kusmi* crop (*jethwi* 2009) raised last year on 90 plants (selected and control) was harvested. Due to intense heat insufficient summer rainfall, severe leaf fall was observed in all the plants and the lac insect colonies. The yield per plant was low in general, but mean yield per bush was higher in selected genotypes (~190g/bush) compared to control (~100g bush).

The summer *kusmi* 2010 crop has been raised on 70 plants of selected genotypes and control plants @25g per bush, ensuring about one-third coverage.

Screening of varieties/cultivars of *Ziziphus mauritiana*, *Ziziphus* spp. for lac productivity and important plant characteristics

Regular maintenance activities were carried out on twenty-five varieties of *ber* (*Z. mauritiana*) raised in the field of IRF (plot no. 5). The plants exhibited spreading tendency and training operations was done March and subsequently, to develop proper canopy. Regular weeding of the area, making of ring with mulching, spraying with insecticide and fungicide was done as per requirement. In view of termite infestation, all the plants were treated with Biflex (20ml/l) after monsoon. The plant growth has been satisfactory.

Morphological characterization of selected good yielding local cultivar of *ber*

Shoot and fruit parameters of twenty-six selections of local cultivars of *ber* at IRF identified and partially characterized last year, were studied this year. On the basis of growth habit of trees, 6, 9 and 12 trees were grouped as erect, intermediate and spreading types. The variation of the parameters studied for these genotypes have been summarised in the following table :

Attribute	Mean ± SD
Mean main stem girth (cm)	46.35 ± 37
No. of main branches	2.96 ± 1.3
Mean girth of main branches (cm)	28.03 ± 18.5
Ratio of no. of sprouts to no. of pruned points	3.27 ± 1.8
Length of current year shoot (cm)	59.77 ± 25.5
Mean inter-node length (cm)	2.43 ± 1.03
Mean no. of internodes per 25 cm of branch	7.48 ± 1.3
Mean length of mature fruit (cm)	2.02 ± 0.29
Mean width of mature fruit (cm)	1.85 ± 0.25
Mean weight of mature fruit (g)	3.90 ± 1.31

Comparison of *Flemingia macrophylla* from Amarkantak, MP (IC 558405) with old Institute collection

Studies were initiated to compare a recent collection of *F. macrophylla* from Amarkantak with existing collection of this species with respect to plant and lac yield parameters. Data were recorded in Sept.-Oct. 2009 from plants raised in double-hedge system (0.75x1.0m) of the two collections raised earlier and pruned in March as per details given below:

Field plot no IRF 65, Area: 7m X 14m; Number of bushes (amarkantak) in 5 rows: 60; Number of bushes (IINRG old) in 4 rows: 48. The mean value of chlorophyll content index (CCI) of leaves was 20.78 ± 3 (n = 40) and 21.71 ± 4.5 (n = 32) for Amarkantak and IINRG old collections respectively. The difference was not found significant with t-test (p = 0.159). The period of ripening of fruits falls between 28th Sep to 25th October. The 50% fruit maturity was observed between 2nd Oct to 15th Oct, 2009.

A new variant in F. macrophylla

This new variant phenotype was recorded in the Amarkantak collection which showed light greenish coloured leaves and thin density of branches / stem as well as longer period of ripening of fruits compared remaining plants. The primary branches are longer with less number of branches at upper apical zone. The mean number of primary branches per shoot was 1.75 in the variant compared to the base population (5.2). These branches were mainly in the apical region of the shoot in the new variant. The fruiting period also varied between the variant and the base population. It was 15.10 to 25.10 in case the variant and 28.9 to 25.10 in case of the base population. The apical leaflet is not pointed and the lateral leaflets, esp. left one, were wider. The seed weight (n = 100) of the variant was significantly lower, 10.2 + 3.2g as compared to 14.9 + 2.9g for normal bhalia (Table 8).

Table 8 . Morphometric data of the new variant of F. macrophylla compared to the base population

Parameter	New variant	Base population
Branching	Less branching	Medium branching
Leaf colour	Light green	Green
Mean leaflet length-apical (cm)	17	17
Mean left leaf let length-lateral (cm)	15	13.5
Mean right leaf let length-lateral (cm)	15	15.5
Mean leaflet width-apical (cm)	9	8.5
Mean left leaflet width-lateral (cm)	7.5	5.3
Mean right leaf let width-lateral (cm)	8	7.5

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

Since, *kusum* shows wide genetic variation, tissue culture would be an ideal process of regeneration and multiplication of genetically identical plants. To raise tissue culture plants, the node explants with axillary buds were immersed in freshly prepared chilled anti-oxidant-fungicide solution containing citric acid (0.08%), bavistin (Carbendazim 50%)(0.01%), ridomil MZ 72 WP (mixture of Metalaxyl 8% and Mancozeb 64% WP) (0.01%), and tween 20 (0.1% v/v) during the morning hours and agitated for one hour in shaker. The nodes were washed with fresh distilled water and treated sequentially with 70% ethanol for 2 minutes, mercuric chloride (0.1%) and SDS (0.1%) for 8 minutes followed by several washings with sterile distilled water.

MS medium supplemented with (i) BAP (1.0 mg/l) + NAA (0.05 mg/l) and (ii) BAP (1.0 mg/l) + Silver nitrate (1.0 mg/l) initiated highest percentage of axillary buds after 21 days of inoculation resulted in higher percentage of bud initiation (83.33% for the above two treatments as compared to 66.67% in control). Further sub-culturing (4-5 times) of explants were carried out on filter paper bridge soaked with liquid MS media consisting of 5.0 mg/l BAP for shoot elongation.

Identification of microbial contaminations and effect of antibiotics and fungicides in preventing microbial contaminations

Microbial contamination is one of the major problems faced in establishing *in vitro* cultures. In the present study the extent of microbial contaminations during the rainy season was determined and the predominant types of contaminants in the nodal cultures of *kusum* were identified so as to undertake suitable prevention measures during micropropagation of *kusum*. Five major fungal contaminants were isolated from the *kusum in vitro* node cultures and were identified through morphological and PCR methods using conserved fungal specific ITS primers. Four out of the five fungal isolates were identified as *Fusarium* spp. (5% infection rate), *Curvularia* spp. (5% infection rate), *Alternaria* spp.(10%) and *Penicillium* spp. (30%) through both microscopic studies and DNA sequence analysis (Table 9 & Fig 18). One of the fungal isolates found to be more severe (55% infection rate) to the node cultures of *kusum*, but could not be identified either through morphological or molecular tools. A single gram negative bacteria isolated as contamination in the node cultures of *kusum* was identified as *Klebsiella pneumoniae* from PCR studies using universal primers from conserved rRNA gene. Doses of fungicides like Bavistin (0.03%), Ridomil (0.05%) and Nystatin (0.05%) and antibiotic like gentamycin (40 mg/l) or cefotaxime (100 mg/l) were worked out for checking of microbial contaminations in axillary bud culture of *kusum*.

Table 9 . Morphological and molecular analysis of microbes from *kusum* node cultures

Sl. No.	Microbial contaminants	Mature colony colour	*Colony diameter (7 days after inoculation)	#Percentage distribution of infection			Blast result with NCBI database for Internal Transcribed Spacer DNA specific primers
				June	July	Aug	
1	unidentified	White	3.4 cm	50%	60%	55%	No amplification of PCR product
2	*Fusarium* spp.	Pink	2.1 cm	5%	5%	5%	99% sequence similarity to *Fusarium oxysporum*
3	*Curvularia* spp.	Black	1.5 cm	5%	5%	5%	91% sequence similarity to *Curvularia pseudorobusta*
4	*Alternaria* spp.	Green	1.2 cm	10%	5%	10%	97% sequence similarity to *Alternaria* spp.
5	*Penicillium* spp.	Olive Grey	4.2 cm	30%	25%	30%	No amplification of PCR product
6.	Gram negative Bacteria (*Klebsiella* spp.)	White	Not ascertained	< 5%			99% similarity to rRNA gene of *Klebsiella pneumoniae* subsp. pneumoniae

Data averaged from 5 observations

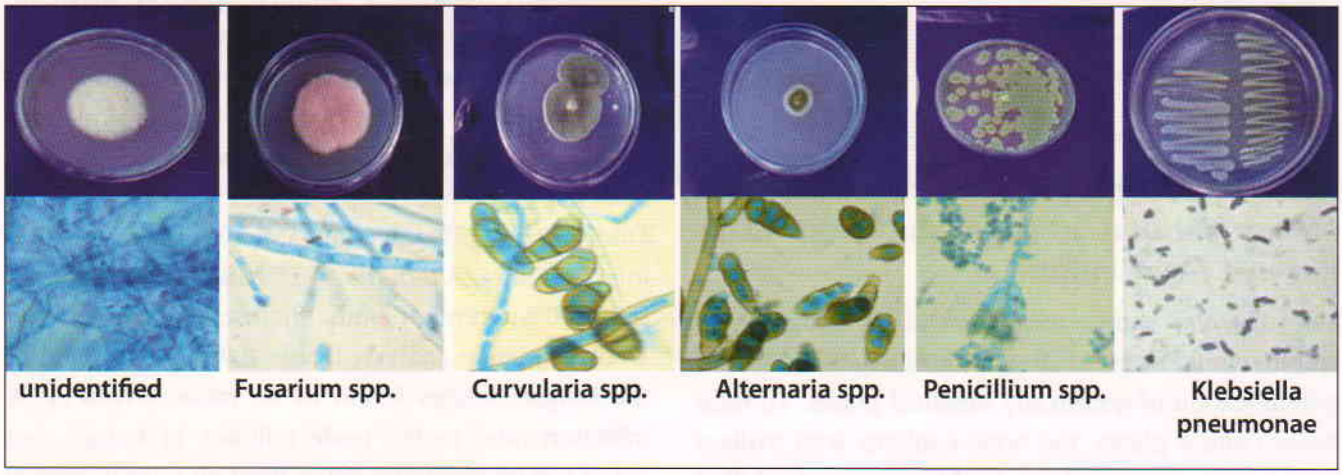


Fig. 18 : Morphological and microscopic photographs of microbial contaminants isolated from node cultures of kusum.

Optimization of root induction media and *in vitro* rooting experiment in *kusum*

One of the major bottlenecks of mature hardwood plant tissue culture is rooting of *in vitro* derived shoots. Screening and optimization of rooting hormones and conditions were carried out using *in vitro* derived shoots of another hardwood lac host plant, *Albizia lucida* in order to test the efficiency of the protocol to be carried out in *kusum*. Out of three different concentrations of IBA tried 1.0 mg/l produced best *in vitro* rooting response (75%) (Fig. 19 A) as compared to control (25%), 5.0 mg/l (50%) and 10.0 mg/l (50%) of IBA. Partial hardening of the rooted explants was also carried out under the laboratory conditions (Fig.19 B, 19 C). In case of *kusum* the response of adventitious root formation from callus was investigated using different concentrations of rooting hormones IBA (2-20 mg/l) and NAA (2-20 mg/l)

separately or in combination (5.0 mg/l both). The ½ MS media containing IBA (20 mg/l) produced best rooting response (58.33%) in initiating adventitious roots from *kusum* calli. Keeping in view the above results and subsequent literature survey, root initiation from shoots of *kusum* was tried using two different treatment combinations *viz.* (i) MS media+glucose (15g/l)+Activated charcoal (0.25%)+IBA (20 mg/l) for three days followed by sub-culturing on hormone free MS media with charcoal; and (ii) pulse treatment of explants with IBA (20 mg/l) for 30 minutes and culturing in sterile cocopeat. In both the cases the shoots did not produce any root initiation even after two months after inoculation although the plantlets appear healthy.

Fig.19 : Standardization of rooting procedures in hardwood tree Albizia lucida and kusum. (A) Rooting of in vitro derived shoots of A. lucida on MS media with 1.0 mg/l IBA. (B&C) Stages of hardening of rooted shoots of A. lucida under existing laboratory condition without humidity/mist chamber. (D&E) Rooting experiment carried out in in vitro derived shoots of kusum in cocopeat after pulse treatment with IBA (20mg/l) and MS media IBA (20mg/l), glucose and with activated charcoal, respectively.

1. 3 Crop Production

I.3.1 Studies on *in-situ* moisture conservation techniques for raising mixed plantation of *ber* and *kusum*

Four *in situ* soil moisture conservation practices were employed to assess the soil moisture level and its impact on growth and development of mixed plantation of *ber* and *kusum* at Institute Research Farm during May 2005-April 2009 in an area measuring approximately 0.3 ha. There were five treatments under the Randomized Block Design (RBD), which are as follows:

Treatments	Description
T_1	Half moon terracing/ half basin ring (75 cm radius with 25 cm of trench)
T_2	Mulching- Organic (Locally available grasses @ 10 kg/ plant- 0.8 m^2 to 1.76 m^2 area)
T_3	Compartmental bunding- Height 15 cm
T_4	Cover crop (Black gram)
T_5	Control (Without rainwater conservation treatment)

Each treatment consisted of 8 *ber* plants and 1 *kusum* plant with 4 m x 4 m row-to-row and 4 m x 4 m plant-to-plant spacing. The inter plant distance for *kusum* was 12 m with individual plot size of 12 m x 12 m. The agronomic practices like farm yard manure (FYM) application and fertilizer application were kept uniform for all the treatments. Recording of soil moisture and plant growth parameters *viz.*, plant height, basal girth (5 cm above the ground), crown spread and number of primary branches were done at monthly (25-30 days) interval.

Soil moisture

Gravimetric method was used to estimate the soil moisture content at 105°C till constant weight was obtained. Moisture content of soil on weight basis was calculated and then it was converted on volume basis. All the moisture conservation practices were found to be effective in enhancing soil moisture level and growth parameters, but mulching emerged out to be the best out of these practices. Mulching resulted in enhanced retention of soil moisture level (26.2% higher over control) during the post-monsoon period (Fig.20). It may be attributed to the fact that mulching provided the insulating effect between the soil and air environment for direct interaction which minimized vapour diffusion to the atmosphere and resulted in higher moisture conservation.

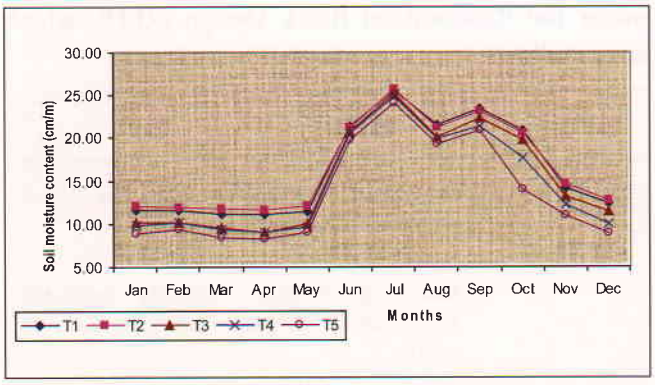


Fig. 20 : Soil moisture dynamics behaviour under different soil moisture conservation practices (Mean of 4 years)

Plant growth

Higher moisture conserved in mulching showed significant impact on plant growth parameters of *ber*. It showed significant impact over control in all the parameters, except number of primary branches. The magnitude of increment in plant height, basal girth and canopy spread was 243.4, 22.6 and 256.1 cm in mulching as compared to 198.1, 18.2 and 198.6 cm, respectively in control; showing an increase of 22.8, 24.2 and 28.9 per cent, respectively under mulching (Table 10). No definite trend was observed in case of number of primary branches over the years. It can also be observed from the Table 11 that in most of the plant growth parameters soil moisture conservation practices have got favourable effect over control in case of *kusum*. But, analysis of the data did not indicate definite trend of any particular treatment over others. Fig. 21 shows the comparison of growth attributes of *ber* plants under mulched and control (unmulched) condition.

Table 10 . Incremental vegetative growth of *ber* under different moisture conservation treatments during the study period (August 2005 - January 2008)

Treatments	Height (cm)	Basal girth (cm)	Crown spread (cm)	No. of primary branches/plant
T_1	233.6	20.4	232.8	18.6
T_2	243.4	22.6	256.1	18.4
T_3	222.3	18.6	219.7	20.1
T_4	211.6	19.1	209.5	16.1
T_5	198.1	18.2	198.6	19.9
CD (P= 0.05)	24.35	2.70	37.34	NS

Table 11 . Incremental vegetative growth of *kusum* under different moisture conservation treatments during the study period (August 2005 - April 2009)

Treatments	Height (cm)	Basal girth (cm)	Crown spread (cm)	No. of primary branches/plant
T_1	167.8	12.1	69.1	28.0
T_2	174.3	13.2	73.8	30.0
T_3	212.5	14.8	64.4	28.8
T_4	150.0	12.2	72.0	25.8
T_5	117.0	11.1	54.0	23.5
CD (P= 0.05)	NS	NS	NS	NS

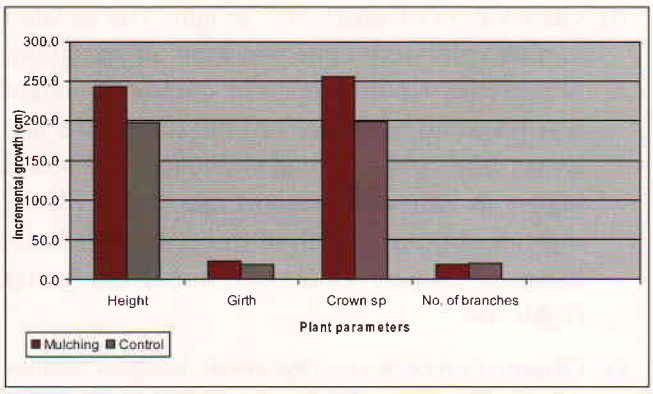


Fig.21: *Ber* Plant growth behaviour under mulching and control

Harvested biomass production

All the *ber* plants were pruned head back uniformly at 1.25 m from the ground level maintaining single stem during February 2008 and harvested biomass was recorded. Mulching yielded maximum harvested biomass (2290 kg/ha), while the lowest harvested biomass was recorded under control (1230 kg/ha). Thus an increase of 86.1% harvested biomass production was recorded in mulching over control (Fig. 22).

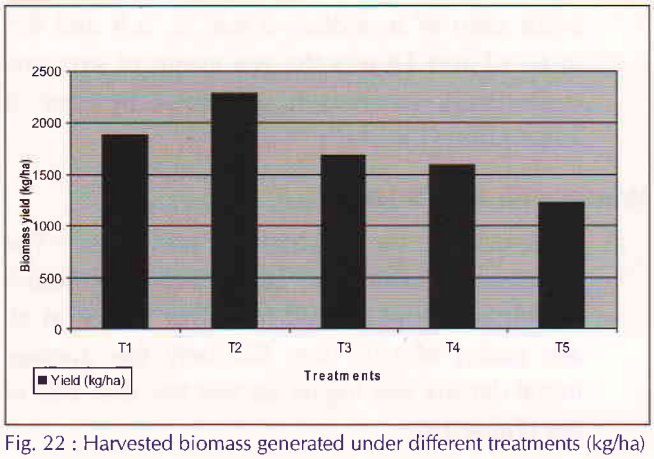


Fig. 22 : Harvested biomass generated under different treatments (kg/ha)

Winter season *kusmi* lac yield

The broodlac for winter season *kusmi* lac was inoculated at mean rate of 100 g/plant during August 2008 after three years of plants establishment and was harvested during February 2009. Under mulching broodlac yield ratio (output: input) of 3.53 was obtained as against 2.18 under control, registering an increase of 61.9 percent in broodlac production under mulching over control. The total broodlac obtained was to the tune of 24.8 kg as against the inoculation of 7.60 kg (3.26:1; output: input).

Yield of intercropped *urd* (black gram)

The intercrop black gram (local cultivar) was sown uniformly at the rate of 17.36 kg/ha in each replication of the treatment T_4 during July-August and was harvested early November every year for four consecutive years (2005-2008). The average grain yield, stalk and biomass (stalks + roots + leaves) obtained was 166.4, 863.3 and 1475.6 kg/ha, respectively (Table 12). Biomass (Roots + stalks + leaves) obtained was used over the soil surface to act as surface mulch in the plot.

Table 12 . Yield of intercropped black gram during the period

Year	Grain yield (kg/ha)	Stalk yield (kg/ha)	Biomass generated (kg/ha)
2005	169.4	65.9	228.3
2006	106.2	1007.8	1684.0
2007	230.0	1382.3	2350.0
2008	160.0	993.9	1640.0
Mean	166.4	863.3	1475.6

* *Ber* plants were pruned during February 2008, hence growth data on plant height, crown spread and number of primary branches was upto January 2008. Basal girth data recording was continued till April 2009 (Time for completion of the experiment).

Ber plant vigour under control (without rainwater conservation treatment)

Ber plant vigour under mulch

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 (W.B.). *Kusmi* summer crop (*jethwi* 2009) was raised on 23 trees of *siris*, 10 trees each in the age group of 6 and 12 months after pruning and three, 18 month after pruning. Similarly five *kusum* trees were also inoculated. The crop could survive on only two trees of *siris* of each age group *viz*., 6, 12, & 18 months after taking observation on initial mortality stage in 3rd week of April. Hence, data has been collected from trees having surviving lac insects of summer season crop.

Summer crop 2009

a) Observation on yield attributes: The settlement of insects take place mainly on primary shoots in case of 6 & 12 months old pruned trees and on secondary shoots in case of 18 month old pruned trees. The weight of broodlac per meter of lacstick was found to be 81, 87.4 and 111 gram in case of 6, 12 and 18 months old shoots respectively, whereas in case of *kusum* the corresponding figure was 200 g. The weight of dry encrustation (*phunki* scraped) was 35, 36 and 65 in case of *siris* and 110 in case of *kusum*. In view of the variable thickness and age of *siris* shoot, the encrustation was measured in terms of proportion of *phunki* scraped and plant sticks. It was 43.2, 41.2 and 58.6 % respectively, whereas in case of *kusum* it was 55%. The thickness of encrustation from *siris* tree was 5 mm (Table 13).

b) Observation of single cell weight: The isolated mother cells were collected from all age group of *siris* tree. No difference in single cell weight was recorded between 12 and 18 months age group (23.5 and 21.4 mg) whereas it was found higher in case of 6 months age group (32.45 mg). Hence, the growth of insect appears to be better on primary shoots of 6 month age group (Table 14).

c) Observation on fecundity: Single isolated mother cells were collected from all age group of siris tree and overall categorized into big and smaller cell. From big sized cell of 17.7 mg average weight, the fecundity was 107.5 or 108 whereas from smaller one of 11.9 mg it was only 79. The average fecundity of 14.8 mg weight cell was thus only 94. This is to be noted that during this period, the monsoon was delayed and in general fecundity was less on other host tree also.

d) Observation on yield: The yield ratio (productivity) measured in terms of output: input ratio of broodlac. It was 5, 5.9 and 6.5 in 6, 12 and 18 months age group of *siris* tree respectively whereas it was 8.64 in case of *kusum* tree (Table 15).

Winter crop 2009-2010

a) Observation on biological attributes: The settlement density of lac insect was found significantly low on *siris* from that of *ber* in all age group of *siris* tree. Similarly the average initial density was higher on *siris* tree than that of *ber* (Table 16).

b) Observation on yield attributes and productivity: The observation was recorded from 8, 7, and 3 trees of 6, 12 & 18 months old shoots of *siris* respectively as lac survived on these trees upto crop maturity stage. The productivity from *siris* tree was 2.56, 6.34 and 9.15 in different age group of shoots i.e. 6, 12 & 18 months respectively whereas in case of *ber* it was 10.86. The contribution of petiole towards total yield was 67.4, 48.5 and 19.7 for 6, 12 and 18 months age group of shoot respectively. This indicates that in case of 6 months, the primary shoots are also not

much suitable and survival is mainly on petiole. Similarly for 18 months, in view of suitability of secondary shoots, the contribution of petiole is little, whereas in case of one year (12 months), the primary as well as petiole was found suitable. The period of leaf fall is in March and the crop matures in February itself and hence there is no any crop loss due to leaf fall, but it contributes significantly towards overall yield (Table 17).

c) Observation on tree characters of *siris*: Observation was recorded on average length of primary and secondary shoots available after 6, 12 and 18 months of pruning. One set of trees were pruned in January and other in July in order to assess suitable time of pruning. The January pruning gave better growth of shoots than July. During 6, 12 & 18 months age group, the January pruning resulted 2.08, 2.4 and 4.0 meter length primary shoot whereas July pruning for corresponding age group results 0.57, 1.03 and 2.7 meter length of primary shoots. It has been observed that there is practically no secondary shoot during 6 months of pruning and also very small (0.08, 0.16 m) in case of 12 months old shoots. The average length in 18 months was found to be 0.40 and 0.19 m in case of January and July pruning respectively (Table 16). As per observations recorded, the January pruning is better than July and in view of availability of plenty of suitable secondary shoots available after 18 months of January pruning, it is suggested to follow 18 months wait period between crop harvesting and re-inoculation.

Table 13 . Yield related attributes from summer crop (2009) on *siris* and *kusum*

Host	Age group of tree after pruning	Shoot type	Total length of sample (cm)	Weight of brood lac (g)	Weight per meter (g) *	Weight of phunki scraped (g)	% of phunki scraped
Siris	6	Primary	19.3	16.7	81.0	35	43.2
	12	Primary	21.9	20	87.4	36	41.2
	18	Secondary	44	52.5	111	65	58.6
Kusum	18	-	23.2	46.4	200	110	55

*Thickness of encrustation from *siris* tree = 5 mm

Table 14 . Weight of single cell collected from different age group of *siris* (summer crop)

Age group of host	Shoot type	Weight of Single cell (mg)
6	Primary	32.45
12	Primary	23.5
18	Secondary	21.4

Table 15 . Yield data from summer (2009) crop

Host	Age group	Weight of broodlac inoculated (kg)	Yield of broodlac (kg)	Yield ratio (Productivity)
Siris	6	0.5	2.5	5
	12	0.90	5.35	5.9
	18	0.75	4.88	6.5
Kusum	18	2.64	22.8	8.64

Table 16 . Biological attributes of lac insect during winter crop

Host	Age group of tree (months after pruning)	Settlement density per sq cm (Range)	Settlement density (Average)	Average initial mortality (%)	Range of Initial mortality (%)	% Male
Siris	6	8-23	14.8	20.6	12-38	18
	12	2.5-21	10.95	22.4	0-33	20
	18	5.5-15.5	10.00	36.7	9-19	17
Ber	6	53-66	60.2	6.8	2-6	20

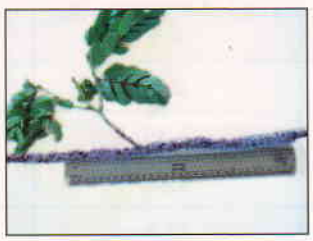
Table 17 . Productivity of lac from *siris* tree for winter crop 09-10

Host	Age group of trees after pruning (Month)	No. of trees	Weight of broodlac inoculated (kg)	Yield (kg)	Weight of petiole encrusted Broodlac (kg)	Yield ratio	% Contribution from petiole
Siris	6	10	12.0	30.7	20.5	2.56	67.4
	12	10	9	57.1	27.7	6.34	48.5
	18	3	4.0	36.6	7.2	9.15	19.7
Ber	6	3	3.5	38.0	-	10.86	-

Table 18 . Observation for gestation period between pruning and inoculation on tree characters of *siris*

Observation time	Gestation period	Pruning Time	Average length of Pr. Shoot (M) (Range)	Av length of secondary shoot * (meter)	Remark
July 2009	6	Jan 09	2.08 (1.8 – 2.5)	Nil	Insect settled mainly on petiole & Primary shoot
	12	July 08	1.03 (0.80-1.3) (No. 5-6)	0.08 (0.05-0.12)	Insect settled mainly on petiole & Primary shoot equally
	18	Jan 08	4.0 (3.8-4.5)	0.40 (0.3 – 0.45) (Nos 10-12)	Insect settled mainly on secondary shoot & petiole.
Jan 2010	6	July 09	0.57 (0.45 – 0.75)	Nil	
	12	Jan 09	2.4 (1.83-2.7)	0.16 (0.10-0.20) (Nos 7-12)	
	18	July 08	2.7 (1.90 – 3.0)	0.19 (0.15-0.25) (Nos 12-15)	

*Figures in parentheses are average numbers per primary shoot



Kusmi summer crop on *siris* twigs (June 2009)

Four years old trees of *siris* in farmers field

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

The lac insect *Kerria lacca* (syn. *Laccifer lacca*) secretes lac from its body and make a cell, leaving three pores- two anterior brachial pores (through which respiration occurs) and one posterior anal tubular pore. Species of *Capnodium* grow profusely making a dense fungal mat that covers the lac encrustation. These blocks and choke the brachial pores and result in suffocation to the lac insects in its cell. This finally results in insect's death and complete or partial failure of the lac crop.

Management of sooty mould through fungicide in *kusmi* lac in summer crop on *kusum*

An experiment was undertaken in randomized block design to study the effect of fungicides on sooty mould growth and on lac yield of *kusmi* lac on *kusum* during summer crop. Nine treatments (8 fungicide combinations and 1 control) with three replications were taken. One tree was taken in each replication of each treatment. Fungicides were applied thrice 50, 100 and 120 days after inoculation. Monsoon started in June and thus sooty mould appeared in June. Crop was harvested in July and sooty mould and lac yield was recorded on the randomized samples. Data reveals that the sooty mould was reduced by kavach (47.0), ridomil (39.2) and hexaconazole (37.0). Yield was not affected. Disease came late in June, about one month before harvest and thus not affected the yield (Table 19). The sooty mould reduced fecundity as (larval emergence/cell in healthy cell was 359.8 and in moulded cell was 102.1) and it was because it affected production of crawler.

Table 19 . Management of sooty mould through fungicide in *kusmi* lac in summer crop on *kusum*.

Sl. No.	Fungicides	Chemical name	Dose	Sooty mould (in percent)	Percent mould reduction	Yield (Broodlac produced/used)
1	Blue Copper	Copper oxychloride	2g/lt	52.3 (46.3)*		1.84
2	Taqat	Captan + Hexaconazole	2g/lt	56.2 (48.6)		2.58
3	Abic	Mancozeb	2.5g/lt	62.4 (52.3)		2.41
4	Ridomil MZ	Metalaxyl + Mancozeb	3g/lt	43.9 (41.5)	39.2	3.00
5	Contaff	Hexaconazole	2.5ml/lt	45.6 (42.4)	37.0	3.57
6	Arrest	Carbendazim	1g/lt	50.4 (45.2)	30.3	3.89
7	Arrest	Carbendazim	0.2g/lt	58.9 (50.1)		2.30
8	Kavach	Chlorothlonil	2.5g/lt	38.3 (38.2)	47.0	3.09
9	Water	Control		72.3 (58.3)		2.76
CD 5 %				(8.3)		NS

* value in parentheses is arcsine transformation

Management of sooty mould through fungicide in *kusmi* lac in winter crop, 08-09 on *ber*

Similar experiment was laid out during winter crop of kusmi lac on ber. Fungicides were applied four times on 22.08.09, 12.10.09 and 12.01.10. Sooty mould growth was recorded on harvest on 02.02.10. Data reveals that sooty mould was reduced by all the fungicides but maximum reduction was achieved by ridomil, hexaconazole and mancozeb. Copper oxy chloride showed toxicity to lac insects. Yield was increased by spraying of Chlorothalonil (81.5%), hexaconazole (63.9%) and ridomil (59.7%) over control (Table 20). The sooty mould reduced fecundity (healthy-464.4, moulded cells with thin fungal mat covering-199.9 and moulded cells with thick fungal mat covering -14.8) (Table 21)

Table 20 . Management of sooty mould through fungicide in *kusmi* lac in winter crop, 2009-10 on *ber*

Sl. No.	Fungicides	Chemical name	Dose	Sooty Mould (in %)	Yield (Br. lac produced/ used)	Percent yield increased	Remarks
1	Blue Copper	Copper oxychloride	2g/lt	6.1	1.9		Toxic to lac insect
2	Taqat	Captan + Hexaconazole	2g/ lt	11.4	3.1		
3	Abic	Mancozeb	2.5g/ lt	11.2	5.8		
4	Ridomil MZ	Metalaxyl + Mancozeb	3g/ lt	13.2	6.3	59.7	
5	Contaff	Hexaconazole	2.5ml/ lt	13.6	6.5	63.9	
6	Arrest	Carbendazim	1g/ lt	16.7	4.3		
7	Arrest	Carbendazim	0.2g/ lt	16.2	2.6		
8	Kavach	Chlorothlonil	2.5g/ lt	14.1	7.2	81.5	
9		Control		20.1	4.0		
CD at 5%				3.4	1.9		

Table 21 . Fecundity of lac insect as affected by sooty mould in *kusmi* lac in winter crop, 2009-10 on *ber*

Lac cells	Larval emergence/cell
Healthy cells	464.4
Moulded cells With thin fungal mat	199.9
Moulded cells With thick fungal mat	14.8
CD 5%	58.5

Standardization of doses of hexaconazole for management of sooty mould and prevent losses of lac yield in *kusmi* lac on ber in winter crop

Experiment was undertaken in kusmi lac on ber in winter crop in randomized block design to study the effect of doses of Cantaf (hexaconazole) on sooty mould growth and on lac yield. Cantaf was found very effective in reducing sooty mould and increasing lac yield. Ber trees were inoculated on 03.07.09. Five doses of Cantaf with 3 replications were taken. Data of sooty mould and lac yield was recorded at harvest and presented in table. All the doses were found in reducing the sooty mould growth and increasing the lac yield (Table 22).

Table 22 . Standardization of doses of hexaconazole

Sl. No.	Doses (ml/ litre)	Sooty mould (%)	Yield (brood produced / used)
1	0.0	24.0	2.6
2	0.5	16.3	5.4
3	1.0	11.9	4.9
4	1.5	13.3	6.4
5	2.5	12.9	6.4
	CD 5 %	7.0	1.1

Effect of mode of spraying of hexaconazole on sooty mould severity and lac yield in *kusmi* lac on *ber* in winter crop

Experiment was undertaken in *kusmi* lac on *ber* in winter crop in randomized block design to study the effect of mode of spraying of Cantaf (hexaconazole) on sooty mould growth and on lac yield. *Ber* trees were inoculated on 03.07.09. Three spraying conditions were taken: T-1: only leaf canopy of the host was sprayed; T-2: only lac encrustation was sprayed; T-3: both host canopy and lac encrustation were sprayed. Four replications were taken. Data of sooty mould, insect mortality and lac yield were recorded and presented in Table 23. Results revealed that spraying on host canopy (T-1) is not able to either control the sooty mould or to check the loss in lac yield. Spraying

on only lac encrustation (T-2) and both host canopy and lac encrustation (T-3) reduced sooty mould infestation and increased lac yield. It also reduced the lac mortality (Table 22). Hexaconazole is a systemic fungicide and it was supposed that with spraying on host canopy the fungicide will move downward through phloem and will be sucked by lac insect with plant sap and go to the body of the insect and will protect from any fungal lac insect pathogen. Since spraying only on host canopy has not reduced either lac insect mortality or the lac yield loss, it is presumed that reduction in lac yield is mainly because of sooty mould infestation on lac encrustation and not due to any fungal lac insect pathogen infection.

Table 23 . Effect of mode of spraying on sooty mould severity and lac yield

SL. No.	conditions	Sooty mould (%)		Mortality (%)		Yield (brood Produced/used)
		19.09.09	20.10.09	19.09.09	20.10.09	
1	Host canopy	32.0	47.1	25.6	16.9	0.6
2	Lac encrustation	15.1	30.7	18.0	10.8	4.1
3	Both	15.0	30.2	11.6	9.1	3.3
	CD 5 %	9.3	12.7	NS	3.8	2.6

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) to have better ventilation and in another set it was sparse (D-2) ie less ventilated. Experiment was undertaken at IRF. Eight replications were taken. One replication had one ber tree. Observations of sooty mould severity and lac yield were taken at harvest. Two branches were randomly selected for sooty mould and yield data. Results revealed that Ventilation reduced the sooty mould infestation and increased the brood lac yield also. Percent sooty mould was low (22.0%) in well ventilated plants whereas it was (29.1%) in less ventilated plants. Brood lac yield was 7.1 in well ventilated plants whereas it was only 3.7 in less ventilated plants (Table 24).

Table 24 . Effect of ventilation on sooty mould severity and lac yield

Micro environmental conditions	Sooty mould (percent)	Yield (brood Produced/used)
Well ventilated	22.0	7.1
Less ventilated	29.1	3.7
t test	P=0.01	P=0.06

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

Soil pH under each treatment area was estimated and lime requirement was calculated and proper liming was done in June. N, P and K fertilizers were applied in July on rings as per schedule.

Plant growth character:

Chlorophyll content index (CCI), per cent increase in shoot length/ diameter and shoot diameter per cent are presented in Table 25. CCI values at 15, 30 and 45 days after application (DAA) of fertilizers showed a positive trend. Values proved to be significant due to liming at 15 and 45 DAA registering 10.5 & 20.5 per cent increase; due to N at 45 DAA registering 25.5 percent increase over control. Similarly, all the growth factors have increased values in parameters like per cent increase in shoot length, shoot diameter and prune point diameter. Values touched level of significance in case of shoot diameter due to liming (7.1 %) and N application (26.5 %) and in case of shoot length due to N (24%). Shoot growth was found to reduce 10% due to K_2O application. Shoot dry matter per cent in July found to be influenced negatively due to K application. Data also revealed that application of lime reduced the Transmission ratio significantly, which indicates that enhanced growth of *ber* trees has taken place due to liming.

Table 25 . Plant growth parameters as affected by levels of liming, N, P and K applications in 2009-10

Factors	Chlorophyll content index			% increase in shoot diameter	% increase in shoot length	Shoot dry matter % (Aug)	% increase in prune point diameter	Transmi-ssion ratio
	15 DAA	30 DAA	45 DAA					
No lime	25.96	27.88	26.14	40.48	55.8	39.0	5.2	66.5
Liming	28.70	28.70	31.51	43.36	58.8	39.6	6.6	62.4
SEM±								
$CD_{(0.05)}$	2.42*	3.05 (NS)	4.12*	2.63*	5.1 (NS)	1.6 (NS)	1.3*	3.8*
N_0	26.90	28.81	27.38	35.80	50.2	39.5	5.0	67.8
N_{100}	26.35	27.05	24.18	41.20	56.3	39.8	6.1	62.7
N_{200}	27.08	27.68	29.37	45.38	60.4	39.1	6.2	63.4
N_{400}	29.00	29.61	34.37	45.30	62.4	38.9	6.2	63.7
SEM±								
$CD_{(0.05)}$	3.42 (NS)	4.31 (NS)	5.82*	3.71*	7.3*	2.3 (NS)	1.8 (NS)	5.4 (NS)
P_0	26.87	26.68	27.96	41.75	54.7	39.2	5.6	63.6
P_{150}	27.80	29.90	29.69	42.09	59.9	39.5	6.1	65.2
SEM±								
$CD_{(0.05)}$	2.42 (NS)	3.05 (NS)	4.12 (NS)	2.63 (NS)	5.1 (NS)	1.6 (NS)	1.3 (NS)	3.8 (NS)
K_0	26.26	28.33	27.13	43.19	60.6	40.3	5.5	63.4
K_{150}	28.40	28.25	30.52	40.65	54.1	38.3	6.3	65.4
SEM±								
$CD_{(0.05)}$	2.42 (NS)	3.05 (NS)	4.12 (NS)	2.63 (NS)	5.1*	1.6*	1.3 (NS)	3.8 (NS)

*Significant at 5%

Insect character:

Initial mortality, settlement and male % are given in Table 26. Only N application @ 100 g/ tree could prove itself superior to check initial mortality by 33 percent over control. Subsequent higher doses increased mortality. Male % was found to reduce 10 percent due to K application.

Table 26. Insect growth parameters as influenced by levels of liming, N, P and K applications in 2009-10

Factors	Initial mortality (%)	Initial settlement/ sq cm	Male %
No lime	28.1	104.4	43.5
Liming	27.1	102.4	42.5
$CD_{(0.05)}$	5.6 (NS)	9.3 (NS)	4.6 (NS)
N_0	30.1	100.9	43.2
N_{100}	20.3	94.0	43.8
N_{200}	29.3	107.8	40.6
N_{400}	30.8	110.9	44.4
$CD_{(0.05)}$	8.0*	13.2 (NS)	6.6 (NS)
P_0	27.6	102.0	43.3
P_{150}	27.6	104.8	42.7
$CD_{(0.05)}$	5.6 (NS)	9.3 (NS)	4.6 (NS)
K_0	29.3	102.9	45.3
K_{150}	25.9	103.9	40.7
$CD_{(0.05)}$	5.6 (NS)	9.3 (NS)	4.6*

*Significant at 5%

Lac survival and termite infestation:

Lac crop survival both on thin and thick shoots was recorded. Lac on 72-80% thin shoots was found to die. Only liming could reduce lac mortality on thick shoots as lac crop on 4% thick shoots died in liming treatments as against 8% in no liming. Termite infestation expressed by coverage of tree trunk with termite borne soil are presented in Table 27. Higher doses of N have been found to increase termite infestation significantly in relation to percent coverage of tree trunk length and actual length per tree.

Table 27. Lac survival and termite infestation % as affected by levels of liming, N, P and K applications in 2009-10

Factors	Per cent shoot with dead lac (basal diameter)		Termite infestation	
	< 1.0 cm	> 1.0 cm	Percent of trunk length	Length (m)
No lime	79.6	7.8	37.4	3.1
Liming	71.5	3.5	38.8	3.6
$CD_{(0.05)}$	9.9 (NS)	4.1*	8.7 (NS)	0.9 (NS)
N_0	75.3	2.3	30.6	2.1
N_{100}	77.2	8.9	37.1	3.6
N_{200}	72.1	4.9	35.8	3.8
N_{400}	77.6	6.3	48.8	4.0
$CD_{(0.05)}$	14.0 (NS)	5.8 (NS)	12.3*	1.3 *
P_0	76.0	5.6	36.9	3.5
P_{150}	75.1	5.7	39.3	3.2
$CD_{(0.05)}$	9.9 (NS)	4.1 (NS)	8.7 (NS)	0.9 (NS)
K_0	76.8	4.4	38.4	3.4
K_{150}	74.2	6.9	37.7	3.3
$CD_{(0.05)}$	9.9 (NS)	4.1 (NS)	8.7 (NS)	0.9 (NS)

*Significant at 5%

Soil analysis report:

Residual soil fertility status (N, P_2O_5, K_2O, $CaCO_3$, Organic Carbon, pH and E.C) of soil samples collected in Dec, 08 was analyzed to assess how it varied with application of different levels of nutrients (Liming, N, P_2O_5 and K_2O). Liming could influence K_2O, N, organic carbon content and pH in positive direction. Decrease in soil pH was obtained due to application of phosphorus (from 5.03 to 4.69) and potassium (from 4.94 to 4.78) (Table 29).

Table 28. Effect of liming and application of N, P and K on lac yield ratio in 2008-09

Factors	Yield ratio	Rejected yield ratio
No lime	4.77	1.03
Liming	5.55	0.94
SEM±		
$CD_{(0.05)}$	NS	NS
N_0	5.7	1.1
N_{100}	4.1	1.1
N_{200}	5.52	0.8
SEM±		
$CD_{(0.05)}$	NS	NS
P_0	5.0	1.1
P_{150}	5.3	0.9
SEM±		
$CD_{(0.05)}$	NS	NS
K_0	4.9	0.9
K_{150}	5.4	0.9
SEM±		
$CD_{(0.05)}$	NS	NS

Other information:

Effect of soil fertility levels (control, 50 + 85 +40 and 100+ 170+ 80 g NPK per tree) and sources of nutrient (full N as organic, ½ N as organic+ ½ N as inorganic and full N as inorganic) on raising of *ber* plantation:

Observation recorded in October, 09 showed that average plant height, basal diameter and CCI is significantly higher in both the levels and sources over control. Two fertility levels remained at par to each other in relation to all the growth parameters. Increase in plant height, basal diameter and chlorophyll content

index values were 42, 48 and 49 % in in lowest fertility level as compared to control. Similarly, performance of different sources remained at par to each other sowing over all superiority over control (Table 30).

Volume and weight of crawlers emerged from standard *kusmi* broodlac from *ber*:

10.5 kg *kusmi* brood lac measuring 51.93 m brood sticks from *ber* was collected for the study and kept under laboratory condition (shade) for emergence of crawlers. Total emergence was complete by 15th day. Volume and weight of crawlers emerged was @ 90 ml and 31.2 g per kg brood respectively, while number of crawlers were 4173468 (approx.) per kg. Moisture % in fresh crawlers was estimated to be 48.1% which is equivalent to 2.4% of broodlac weight. Volume and weight of crawlers emerged per meter broodlac was 18.3 ml and 6.32 g.

Table 29. Soil residue of different nutrients as affected by application rates during 2008-09

Factors	Nitrogen (Kg/ ha)	Phosphorus (Kg/ ha)	Potassium (Kg/ ha)	Soil pH	E.C. (dS/ m)	$CaCO_3$ (%)	Org. Carbon (%)
No lime	139.3	27.3	123.4	4.81	0.18	1.81	0.33
Liming	152.9	27.5	133.7	4.92	0.20	1.83	0.36
$CD_{(0.05)}$	13.1*	1.3	4.7*	0.10*	0.03	0.12	0.02*
N_0	151.2	28.8	127.8	4.93	0.19	1.87	0.35
N_{100}	143.5	25.7	127.4	4.70	0.18	1.80	0.34
N_{200}	140.4	26.8	130.7	4.90	0.19	1.83	0.33
N_{400}	149.3	28.2	128.3	4.93	0.21	1.79	0.35
$CD_{(0.05)}$	18.5	1.9*	6.7	0.14*	0.04	0.17	0.03
P_0	148.6	28.0	125.5	5.03	0.19	1.85	0.35
P_{150}	143.6	26.8	131.6	4.70	0.19	1.80	0.34
$CD_{(0.05)}$	13.1	1.3	4.7*	0.10*	0.03	0.12	0.02
K_0	143.0	26.3	121.5	4.94	0.20	1.86	0.34
K_{150}	149.2	28.4	135.6	4.79	0.19	1.79	0.35
$CD_{(0.05)}$	13.1	1.3*	4.7*	0.10*	0.03	0.12	0.02

*Significant at 5%

Table 30. Growth characters of *ber* trees as affected by fertility levels and sources of nutrients in October 09

Factors	Plant height (cm)	Basal diameter (cm)	CCI
Level I	226.7	3.09	23.8
Level II	232.0	3.29	24.0
$CD_{(0.05)}$	43.3	0.74	5.6
Full organic	233.0	3.18	23.4
Full inorganic	201.5	2.87	25.5
50% organic + 50% inorganic	253.5	3.52	22.8
$CD_{(0.05)}$	53.0	0.9	6.8
Control	159.0	2.08	15.9
C.D. (Control vs rest $_{(0.05)}$	63.3*	1.08*	8.2*

*Significant at 5%

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

(i) Large scale production of broodlac

During the year 2009-10, total 3171.5kg broodlac was produced and Rs. 3, 86,805/- have been earned as revenue from the sale of 2012.5kg broodlac, 1431.4kg sticklac and other means. *Phunki* lac is yet to be collected from *kusum* trees. Closing balance of the scheme during the year 2009-10 is Rs. 22, 60, 846.

Summer season (*jethwi*) crop

1469.6 kg broodlac was produced under Revolving Fund Scheme on *kusum* during summer season (*jethwi*) crop 2009. This included 137.0 kg of *ber* stock, 311.0 kg of Gumla stock, 441.5 kg of Kulajanga, 190.6 kg of Nawadih, 313.0 kg of Bandgaon and 76.5 kg of mix stock. 890.5 kg of broodlac (worth Rs. 97,955) was sold to needy farmers/ NGOs and about 580 kg inoculated on *ber* / *khair* trees for winter season (*aghani*) crop 2009-10.

Winter season (aghani) crop

1701.9kg broodlac was produced on *ber* during winter season (*aghani*) crop 2009-10. This included 310.7 kg of *ber* stock, 505.6 kg of Gumla stock, 541.3 kg of Kulajanga, 148.6 kg of Nawadih and 195.7 kg of *kusmi* late stock. 1122.0kg of broodlac (worth Rs. 1,23,420) has been sold / provided to Institute projects and about 579.9kg inoculated on *kusum* trees for summer season (*jethwi*) crop 2010.

75 kg of *rangeeni* lac was inoculated on *palas* during October 2008. However, complete mortality was observed by March 2009.

(ii) Comparative performance of different productive kusmi breeds on *kusum*

Maintenance and multiplication of productive *kusmi* breeds of lac insects was carried out under RFS. Record maintenance of individual *kusum* tree was initiated from last year to assess the comparative performance of different productive *kusmi* breeds on *kusum* during summer season (*jethwi*) crop and identification of good yielding trees continued this year also. Observations recorded are shown in Table 31.

Table 31. Comparative performance of different productive *kusmi* breeds on *kusum* during summer season (*jethwi*) crop 2009.

Lac insect Stock	No. of trees inoculated	Broodlac inoculated (Kg)	Broodlac harvested (Kg)	Output / Input ratio	Yield per tree
Kulajanga	49	114.2	441.5	3.866	9.010
Nawadih	66	177.1	190.6	1.076	2.888
Ber	24	49.2	137.0	2.785	5.708
Bandgaon	88	117.0	313.0	2.675	3.557
Gumla	49	118.6	311.0	2.622	6.347
Mix	19	38.8	76.5	1.972	4.026
Total	**295**	**614.9**	**1469.6**	**2.390**	**4.982**

(iii) Effect of irrigation on lac yield during summer season

Summer irrigation (about 300 l / tree) was provided during April / May at weekly interval to seventeen *kusum* trees. No significant difference was observed between irrigated and un-irrigated trees (Table 32) because (i) irrigation could not be provided as per schedule due to paucity of water in IRF during summer season and (ii) Occurrence of rain during the period offset the advantage of whatever irrigation was provided to the trees.

Table 32. Effect of irrigation on lac yield during summer season

Stock	No. of trees inoculated	Broodlac inoculated (Kg)	Broodlac harvested (Kg)	Output / Input ratio	Yield per tree
Un-irrigated	17	31.7	148.0	4.668	8.706
Irrigated	17	45.5	182.0	4.001	10.706

(iv) Infestation and management of Indarbela tetraonis in kusum plantation

Stray incidences of *Indarbela tetraonis* were observed in *kusum* plantation under RFS during August last year. The trees were sprayed with 0.05% solution of Dichlorvos to control the damage. However, this year infestation was observed again and on a very large scale. Of the 1245 trees 79.28% were found infested. Frequency of occurrence of the larvae ranged up to 72 on a single tree (Fig. 23). The holes bored by the larvae were pricked with a spike, filled with 0.05% solution of Dichlorvos and plugged with wet soil. No infestation has been observed till December 2009.

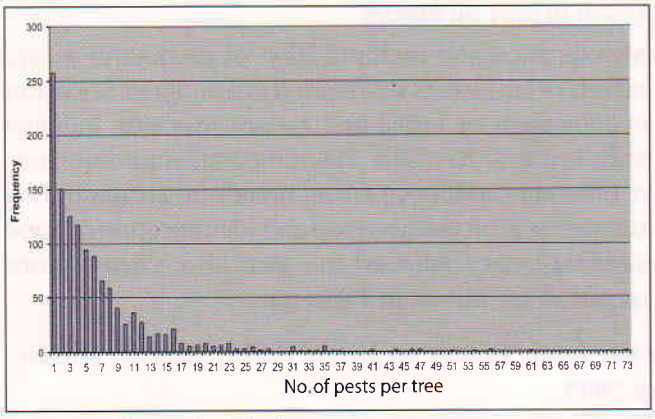


Fig. 23 : Incidence of Indarbela tetraonis

1.3.7 Evaluation of potential herbicides for weed management in *Flemingia semialata* and *ber* plantation

During the period under report, four experiments were repeated to evaluate potential herbicides for weed control and their safety to lac insects and host plants.

Like previous year, there were seven weed control treatments (Herbicides -5, weed free-1, and unweeded as control) imposed at pre and post planting as well as pre and post inoculation stages in new and established plantations of *F. semialata* and *ber*.

Lac yield :

Kusmi lac crop (*aghani* 2008-09) raised on *F. semialata* and *ber* were harvested and assessed towards the end of February 2009. The effect of weed control treatments on sticklac at pre and post inoculation stages had no adverse effect on lac yield. The highest stick lac yield was obtained with glyphosate treated plot (200.6 g/bush or 16.05 q/ha) which was 21.5% higher than that of control in established plantation of *F. semialata*. In one year old *F. semialata* plantation, the highest yield was with weed free treatment (11.04 q/ha) which were at par with others. Similarly in *ber* per meter stick lac production was with glyphosate treated plot (132.5 g/m shoot length) while in weed free and unweeded (control) treatments, lac production were 90.16 and 84.54 g/m shoot length respectively (Table 33).

Table 33 . Sticklac yield on *F. semialata* and *Z. mauritiana* in different treatments of weedicides

Treatments	*Semialata* Stick lac yield (q/ha)		*Ber* Sticklac yield (g/meter shoot length)
	One year old plantation	Established plantation	Established plantation
Weed free (Manually)	11.04	-	90.16
Paraquat @ 0.4 kg ai/ha	10.08	15.42	91.45
Glyphosate @ 1.0 kg ai/ha	10.56	16.05	132.59
Glufosinate @ 1.0 kg ai/ha	10.80	15.21	90.18
Atrazine @2.0 kg ai/ha	8.56	13.25	81.15
Quizalofop-p-ethyl @ 0.2 kg ai/ha	8.56	13.25	108.32
Unweeded (control)	8.96	13.24	84.54
CD at 5%	NS	NS	NS

* There was no weed free treatment in established plantation

Growth phonology

Initial and final shoot length and girth of *ber* in established plantation were recorded just after settlement of lac larvae and thereafter before harvesting of the lac crop to assess the effect of weed control treatments on shoot growth and lac yield. The highest increase in shoot length was 15.84% with weed free treatment followed with glyphosate (14.84%) whereas in case of girth, it was highest with paraquat treatment (19.28%) followed by weed free (16.45%) and glyphosate (14.63%) treatments.

The plant growth attributes i.e. height and girth of *F. Semialata* in one year old plantation were measured after larval settlement and before harvesting of lac crop to know the effect of weed control treatments on growth. The highest percentage of increase in plant height and girth were 48.34 and 31.59% with atrazine and paraquat treatments respectively. However, all weed control treatments were found to be at par with each other.

Effect of herbicides on weed suppression

Nursery raised seedlings of *F. semialata* and *ber* were planted in the field after 18 and 23 days of imposition of pre planting weed control treatments and repeated after 27 and 35 days of planting respectively. Simultaneously, weeds were removed manually in weed free treatment. Amongst herbicides, glyphosate was found to be superior to all tested herbicides showing 80.69% and 88.98% weed control efficiency (WCE) at pre and post planting of *F. semialata* where as 85.90 and 88.89% in weed free (manually) treatment, respectively. Almost similar trend was observed in *ber*. WCE as influenced by different treatments at pre and post planting of *F. semialata* and *ber* has been depicted in Fig. 24 and 25.

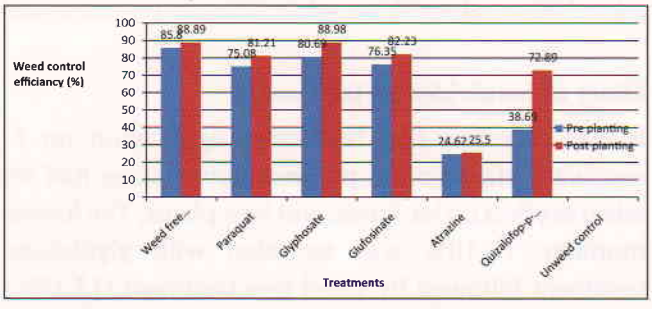


Fig. 24 : Weed control efficiency as influenced by different treatments at pre and post planting of *F. semialata*

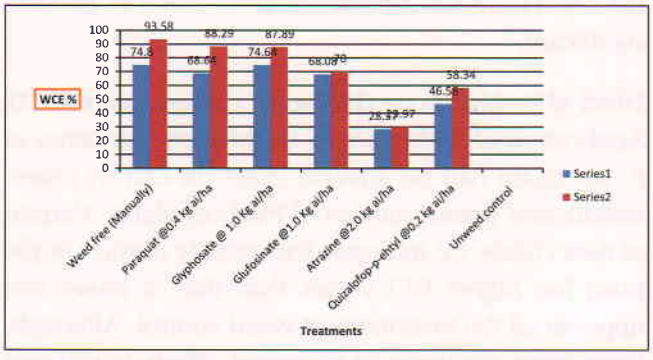


Fig. 25 : Weed control efficiency as affected by different treatments at pre and post planting stages in *ber* (Series 1 = Preplanting, Series 2 = Post planting)

Imposition of weed control treatments at 4-5 leaf stage of weeds at pre and post planting stages of *F. semialata* observed only 3.7% over all mortality of the host plants. The highest mortality (1.59%) was recorded with paraquat treatment followed by control (1.32%) while no mortality were recorded with weed free, glyphosate and Atrazine applied treatments.

Pre and post planting treatments in newly planted *F. semialata* plants.

In established plantation of *F. semialata*, herbicides were applied 10 days prior to lac inoculation. Weed supression and WCE studies were under taken after 35 DAS (Days After Spraying). The results revealed that all the non selective herbicides (paraquat, glyphosate and glufosinate) and manual weed control (weed free) performed better than those of other treatments to suppress all categories of weeds and their dry matter accumulation except dry matter of sedges (Table 34). The highest weed control efficiency were determined with weed free treatment (89.93%) followed by glyphosate (88.57%).

Weed control treatments in *ber plantation.*

Effect of herbicides on soil flora

The study concerned to quntification of microbial

population in lac host plants revealed that all the herbicides had a suppression effect on the soil microbial population (fungal) within five days of herbicides application and there after there was a build up of soil fungal population.

Table 34 . Weed population, dry matters accumulation and weed control efficiency as influenced by different treatments at 35 DAS.

Treatments	Population of weeds (No/m²)			Dry matter of weeds (g/m²)			Weed control efficiency (%)
	Grasses	Broad leaved	Sedges	Grasses	Broad leaved	Sedges	
Weed free (Manually)	4.78 (22.0)	7.58 (57.5)	2.50 (5.33)	3.30 (9.91)	4.22 (17.12)	1.42 (1.37)	89.93
Paraquat @ 0.4 kg ai/ha	6.70 (47.0)	9.51 (90.0)	2.12 (6.0)	4.62 (20.92)	6.42 (40.42)	1.55 (2.02)	77.63
Glyphosate @ 1.0 kg ai/ha	4.93 (23.5)	5.93 (48.0)	2.09 (4.0)	3.44 (10.86)	4.43 (20.70)	1.25 (0.68)	88.57
Glufosinate @ 1.0 Kg ai/ha	6.60 (45.0)	8.22 (72.0)	2.19 (6.67)	4.07 (16.04)	5.71 (32.44)	2.94 (8.88)	79.66
Atrazine @2.0 Kg ai/ha	9.29 (86.0)	14.32 (214)	2.19 (6.67)	7.23 (51.65)	10.36 (107.48)	1.83 (3.03)	42.54
Quizalofop-p-ethyl @0.2 kg ai/ha	7.77 (61.0)	13.32 (184.0)	5.18 (26.57)	5.99 (35.16)	10.76 (114.96)	3.21 (9.99)	43.23
Unweeded (control)	16.25 (266)	18.35 (336)	6.88 (46.67)	9.80 (95.53)	12.41 (55.16)	5.55 (31.64)	-
CD at 5%	2.07	2.16	2.66	1.25	2.15	2.00	-

Original values in parentheses were transformed to $\sqrt{x+1}$.

The data confirmed the findings of previous year. Amongst herbicides the highest depression of fungal population at 5 DAS was recorded with glyphosate ($0.38x10^{-6}$/g oven dry soil) treatment and also the highest build up of fungal population ($2.77x10^{-6}$/g oven dry soil) at 45 DAS with the same herbicide followed with glufosinate (2.46×10^{-6}/g oven dry soil) (Fig. 26).

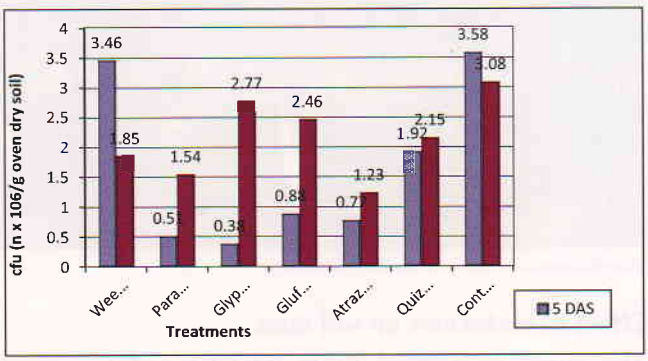


Fig. 26 : Rhizospheric fungal population in different treatments

Effect of herbicides on lac insects

It was observed that herbicides application on *F. semialata* plantation at pre inoculation stage had no adverse effect on lac larvae and host plants. The lowest mortality 16.10% was recorded with glyphosate treatment followed by weed free treatment (17.17%) where as highest mortality was recorded with paraquat (27.05). However, differences were found to be non-significant.

Effect of herbicides on chlorophyl content index (CC1)

Application of herbicides in established plantation of *F. semialata* had no adverse effect on CCI in lower, middle and upper porition of the host plants. Perusal of data (Table 35) indicates that middle portion of the plant has higher CCI values than that of lower and upper in all the treatments of weed control. Although, there were variations in treatment effects but, it was found to be non-significant.

Table 35. Effect of weed control treatments on chlorophyl content index (CCI) in *F. semialata* plantation.

Treatments	Chlorophyl content index (CCI)			
	Lower	Middle	Upper	Mean
Weed free (Manually)	19.00	24.07	11.63	18.53
Paraquat 0.4 kg ai/ha	13.10	22.29	12.80	16.06
Glyphosoate @1.0 kg ai/ha	22.87	24.00	15.20	20.69
Glufosinate @ 1.0 kg ai/ha	22.23	25.07	11.80	19.70
Atrazine @2.0 kg ai/ha	21.57	21.77	13.30	18.88
Quizalofop-p-ethyl @ 0.2 kg ai/ha	13.13	19.67	13.00	15.27
Unweeded (Control)	10.73	17.90	10.87	13.17
CD at 5%	NS	NS	NS	NS

1.3.8 *Rangeeni* lac insect survival on *ber* and *palas* in relation to season, physiology of host plant and soil moisture stress: a biochemical approach from host plant perspective

Biochemical analysis of bark and leaf extracts of *ber* and *palas* was carried out to know the relationship between the biochemical status of the host plant and lac insect survival. Analyses were conducted for Nutritional compounds such as reducing sugars, non reducing sugars, total soluble protein, methionine and tryptophan; Stress and defence chemicals viz. proline, Phenyl alanine ammonia lyase, Polyphenol oxidase and Polyphenoles/tannins; Physical parameters viz. bark moisture content and leaf relative water content. Analysis was carried out for *katki* crop, 2009. The entire experiment was divided in to two treatments, viz. lac inoculated (T_1) and lac un-inoculated (T_2).

There was no significant difference with respect to moisture content between inoculated (T2) and control (T1) plants in both *ber* and *palas*. This indicates that the texture/softness of bark does not change significantly during the period which may cause any physical hindrance to phloem sap feeding of lac insect

Relative water content was measured was calculated according to the following formula

$$\text{Relative Water Content (\%)} = \frac{\text{(Fresh Wt. -Dry Wt.)}}{\text{(Turgid Wt. –Dry Wt.)}} \times 100$$

The results indicated that both ber and palas were under moisture stress during the month of June as the value of RWC falls below 60%. There was no significant difference between the total soluble protein between the T1 and T2. This clearly suggests that lac insect infection does not deplete the soluble protein from the host plant

Both in case of palas and ber, the reducing sugar content reached to a maximum in the month of September. This may be due to increase in photosynthetic rate as all the new flush developed reaches full maturity stage by this period

Non-reducing sugar also showed the same trend as reducing sugar except for the fact that maximum content was observed in the month of august for palas instead of September.

The content of the methionine showed an increasing trend from June to October having positive correlation with the increase in soluble protein content.

Tryptophan content in ber and palas showed positive correlation with total soluble protein. In case of palas there was significant reduction in the tryptophan content during September due to lac insect infection. The reduction in both methionine and tryptophan indicates that these two essential amino acids are required in high quantity by the insect during their active growth period.

Due to lac inoculation on ber, the content of proline has significantly increased from august onwards. The increasing effect continued till October. This indicates that the ber plant is under stress just after two months of the lac inoculation. While in case of palas the proline content was shown significant increase from the month of September only. This indicates that palas is able to with stand the stress opposed by the lac insect better in comparison the ber (Fig. 27 and 28).

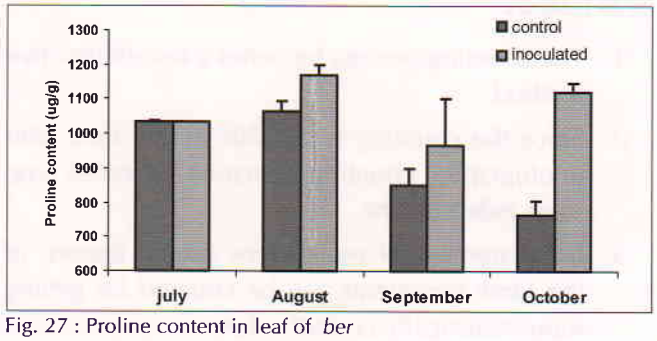


Fig. 27 : Proline content in leaf of *ber*

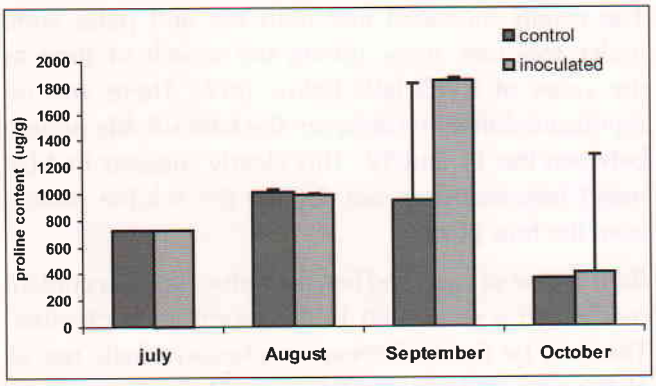


Fig. 28 : Proline content in leaf of *palas*

Unlike in other stress parameters, polyphenol did not show any significant difference in its content due to lac inoculation during *katki*.

Phenylalanine ammonia- lyase (PAL) is principal enzyme of the phenylpropanoid pathway. The results indicated that the PAL activity did not show any significant differance in case of *ber* between T_1 and T_2 while, T_2 shows more PAL activity than T_1 in case of *palas*. This indicates that stress response involving PAL is working only in case of *palas* and it is not effective in *ber*

Both in *palas* and *ber,* inoculation with lac causes an increase in the Poly phenol oxidase activity. This can be viewed as a defensive response of the host plant against the lac insect invasion

A non-Destructive method for counting lac insects

A non-destructive method for calculation of initial settlement density of lac insect, lac insect mortality and sex ratio has been developed. The method involves taking photographs of the lac insect settlement at desired stages placing a $1cm^2$ window in front of the settled twigs. Counting of the lac insect can be done manually at any later period by using computer display or printouts of the same. The advantage of the method is as follows.

1. The counting process becomes a non-destructive method.
2. Since the counting is possible at any time after photography, counting operation becomes crop stage independent.
3. Large number of replications (photo frames) of the same treatments can be counted for getting more statistically correct value.

1.3.9 Development of lac production system using high density *ber* plantation under semi-protected condition (NABARD sponsored)

Management of plantation and canopy management

The *ber* plantation was raised in a plot of 16 x 45 m, with a triple hedge system (four strips) in Aug. 2006, in plot no. 33. Mulching was done in February with dried paddy straw. Vermicompost was applied @ 100 kg per strip of the plants, in mid-May. Soil samples which were collected annually year were got analyzed for key fertility parameters at NHRDF, Nasik. At the end of three years, the mean girth, number of shoots/plant and shoot length were 12.3 cm, 3.2 and 177.5 cm, respectively. Thus, the high-density plantation of *ber* has been established in three years, as per objective.

Raising of winter *kusmi* and summer *rangeeni* crops

The summer *rangeeni* (*baisakhi*) was raised in the third week of Oct. 2008 on 176 plants in two strips of plants using 30 kg. broodlac. The settlement, survival and growth of the lac crop were excellent till March and subsequently complete mortality of the crop was observed. Therefore, these trees were pruned in April so that subsequent crop could be raised.

The winter *kusmi* crop (*aghani* 2009-10) has been raised in July, using a total 29 kg broodlac, in two strips containing 268 plants The crop condition is satisfactory.

Erection of structure for providing controlled shading

Agro-shade (7 m high) has been erected over the half the length of the plantation (22 x 20m), which will be used for evaluating the performance the summer crop, under shaded condition.

1.3.10 Production of summer *kusmi* broodlac on *kusum* for promotion of lac cultivation in Gujarat with farmers participation

Visit of Gujarat was undertaken in connection with the collaborative project with Gujarat Forest Dept, Gandhinagar during May 9-18, 2009. Villages Malegaon, Rawaniya, Jamaliya and Chorwani were visited for selection of kusum trees. The selected kusum (4320 trees) were pruned during April-May 2009 to be inoculated with summer season kusmi broodlac during January- February 2010.

Another tour was undertaken to Gujarat during December 7-13, 2009 in this connection. A two-day training programme was conducted at Malegaon (Dist. Dang; Ahwa Forest Division) under which 83 farmers and 16 forest officials were imparted motivational and on-farm training in two batches. The important topics covered were lac insects of India, their life cycle and crop cycle, important regular and alternate host plants, lac pests and their management and lac production technologies and its economics.

It was found during the trip that *kusum* didn't coppice well during the period April-December and it was not ready to be inoculated with the broodlac during Jnauary-February 2010. Hence, pruned *kusum* trees will be used for summer season *kusmi* broodlac inoculation during January-February 2011. Six hundred fourteen kg of broodlac was arranged from the Institute and sent to Gujarat. Nearly 500 *kusum* trees were inoculated during February 2010 in and around Malegaon area.

Training to farmers and forest officials at Malegaon, Dang Dist., Gujarat

On- farm Training on scientific lac cultivation

1.3.11 Development of Lac-integrated Farming System at IRF

Production of winter lac crop on *Flemingia semialata*, under Lac-Integrated Farming System

A multi-tier lac-horticulture model is being evaluated under Lac-Integrated Farming System (LIFS) approach at the Institute Research Farm in area of 0.25ha; the plantation was raised in July 2008. The model comprises of fruit plants (amla, guava and papaya) with integration of lac hosts (*ber* and *semialata*) in the interspaces. The *semialata* plants, in 9 rows of 80 plants each, have been divided into two parts for raising the summer and winter *kusmi* crops, in alternation. Summer *kusmi* (*jethwi*) crop was raised in four rows of semialata, using five kg of broodlac, in February, vegetables, viz., cucumber and bitter gourd are integrated in the inter-plant spaces of semialata. An yield of of 54.3 kg of selected, and 8.75kg of rejected broodlac was harvested in July, which shows a very good yield ratio (>10). The yields of bitter gourd and cucumber were 160 and 95 kg, respectively. The winter crop was raised in five rows of *semialata* in the fourth week of June, last year. Irrigation was provided during the post-monsoon period as per requirement. The crop was progressing satisfactorily.

Land resource development

The plot covered partially with *kusum* plantation was undulated. The plot 39B has been divided into two parts. One portion (50x30 m) has been raised by pond sludge from near by pond and has been demarked from the other portion. Thus, elevated portion contained *kusum* trees planted earlier. Planting of *kusum* saplings was done in vacant spaces of the rows under different conditions. By adopting mulching and irrigation twice after planting, survival of 85% plants has been achieved.

The average depth of water harvesting pond under this component was increased upto 0.5 m during April 2009, making its new dimension as (27x20x3) cu m. Present water harvesting capacity of the pond is 1410 cu m.

Lac cultivation

All the *ber* plants raised under LIFS are growing satisfactorily. *F. semialata* raised on the bunds showed

satisfactory growth and lac was inoculated in July, 09 and harvested in February, 2010. A total 3.5 kg broodlac was inoculated on 110 bushes and 8.4 kg sticklac was obtained as yield. Two scheduled sprays of insecticides and fungicides were done during the crop growth period.

Cultivation of Agricultural crops

Elephant yam (16 kg) was raised on 63 pits spaced at 1x1 m distance. Each corm pit was fertilized with 5 kg FYM, 100 g DAP, 50 g urea (top dressing) and 50 g MOP. FYM, DAP and MOP were applied during planting i.e. in June and top dressing was done in Aug. Subsequently, one earthing up and one weeding was done. A harvest of 83.5 kg yam was obtained from 63 sq m. area. Besides, colocasia was raised in 250 sq. m. area. 150 kg FYM, 15 kg DAP and 10 kg MOP were applied as band placement in June and further 19 kg urea was applied as top dressing in Aug. Subsequently, one earthing up and one weeding were done. 308.7 kg colocasia was harvested from the area out of 35 kg seed. Mustard (Varuna) was sown on an area of 2400 sq m. FYM was applied @ 50 q/ ha. In addition to FYM, N, P2O5 and K2O was applied @ 40:60:40 kg/ ha. A yield of 52 kg was obtained from the area. Since no supplemental irrigation was applied under rainfed condition, yield suffered considerably. Preliminary data on effect of shade on colocasia and yam reveals that yield of colocasia is affected significantly, when plants are located under the *kusum* trees. Per plant yield was recorded to be 17, 172 and 208 g per plant when colocasia plants are situated just beside, 1.5 m and 3.0 m away from the *kusum* tree. On the other hand, shade could not make much difference on yield of yam. Per plant yield of yam at shade and at light was recorded to be 1.40 and 1.74 kg with variance 0.

1.3.12 Impact of pitcher irrigation with fertigation (urea) on shooting response and *kusmi* lac yield on *ber*

One set of 32 pruned ber trees were selected and all the trees were inoculated with *kusmi* broodlac for summer season lac crop @ 400 g/tree in Jan 09. 16 trees were equipped with pitchers (4 pitchers for each tree) at a radial distance of 2/3 of canopy cover. Same number of trees was kept under control (no pitchers). Spraying schedule was kept uniform for treatment and control trees.

Before starting irrigation through pitchers, the periphery of the *ber* trees was flooded with water to bring the root zone in saturated condition. The irrigation was started from March. The seepage rate through pitchers was observed to be 0.04 lph (litre per hour).

The summer lac crop was harvested in July 2009 and data on shoot length, shoot girth and broodlac yield ratio was recorded. The data revealed that increase in shoot length and shoot girth under pitcher irrigation was 38.9 and 23.3 per cent, respectively as against 19.2 and 9.8 per cent under control at the time of lac crop harvesting during mid July. The initial data for the parameters on shoot length and shoot girth was recorded during broodlac inoculation. The broodlac yield ratio for pitcher irrigation was recorded to be 3.9:1, while it stood at 0.10:1 (output: input) in control.

For broodlac value calculation, 1.2 kg summer season broodlac was inoculated on 10 *ber* plants (@ 120 g) of nearly uniform age for winter season lac production. Under broodlac value calculation, the parameters that were considered were weight, coverage and thickness of broodlac at the time of harvesting. The broodlac was harvested in February 2010 and data on mentioned parameters was recorded. The broodlac ratio (output: input) was found to be 4.1:1, while the mean broodlac coverage and thickness was found to be 193.3 cm and 4.61 mm, respectively. It can be inferred, from the trend observed, that the summer season lac is of fairly good quality and it can be used as winter season lac production.

Broodlac inoculation for winter season *kusmi* lac crop on the other set of *ber* trees (32 Nos.) was done during August 2009. A total of 17.95 kg, @ mean rate 1.12 kg/tree, broodlac was inoculated on pitcher treatment trees, while 18.55 kg, @mean rate 1.16 kg/ tree, broodlac was inoculated on control trees. The broodlac was harvested to the tune of 52.30 kg and 53.90 kg under pitcher and control trees. Thus the ratio under both the treatments stood at 2.9:1. There was also not any major difference in shoot length and girth under both the treatments for winter season lac crop. The activities will be repeated this year also with an added component of urea @ 200 g/tree through fertigation.

2. PROCESSING AND PRODUCT DEVELOPMENT

2.1 Synthesis and Product Development

2.1.1 Synthesis of thio-semicarbazide and thiodiazoe from aleuritic acid and testing its activity as antifungal/hypoglycemic/ antinemic

Compounds, 4-chlorophenyl thio-semicarbazide (1.701g) and 4-methylpheylthiosemicarbazide (1.253g) and 2-bromopheylthiosemicarbazide (1.75852 g) of aleuritic acid was synthesized from aleuritic acid. The yield of the compound varied from 67 to 70%. The presence of different groups in compound were confirmed through IR spectra and found to be 3209-3282 cm^{-1} (N-H), 1128-1199 cm^{-1} (C=S) and 1660-1683 cm^{-1} (C=O). The purity of the compound was confirmed by thin layer chromatography using mixture of solvents (ethyl acetate and 0.1% glacial acetic acid).

The derivatives of thiosemicarbazide of aleuritic acid were tested *in vitro* against *Fusarium sp.* at 250 ppm, 500 ppm and 1000 ppm concentrations by food poison technique on potato dextrose agar medium and Bavistin as a (-) control. It was observed that compounds having concentration (250 ppm) had least effect, while inhibition of pathogen was more in plate having dose 1000 ppm (Table 36).

Hydarzide and thiosemicarbazide (of aleuritic acid) were also tested against j_2 of *Meloidogyne incognita* (root knot nematode) at five concentrations e.g. 1000, 500, 250, 125, 62.5 ppm, for their antinemic activity. The compound was active at concentration 125 ppm and above. However, the mortality rates of the compounds at 250 ppm were found to be 70% and 72.3%, respectively.

The above compounds were also evaluated for hypoglycemic activity in rat. The glucose level 1 in treated diabetic rat was not reduced significantly as compared to control.

Table 36 . *In vitro* analysis of antifungal property of compounds

Compound	Dose (ppm)	Growth inhibition (%) over control
C1	250	33.09
C2	500	61.04
C3	1000	83.10
D1	250	71.32
D2	500	81.62
D3	1000	100
E1	250	52.94
E2	500	66.18
E3	1000	83.10
F1	250	51.46
F2	500	72.79
F3	1000	91.92
H1	250	38.98
H2	500	62.49
H3	1000	100
11	250	27.95
12	500	38.23
13	1000	63.24
G1	250	26.89
G2	500	32.06
G3	1000	61.03
Bavistin as (-) control	250	100

*Average of three replications

2.1.2 Comparative evaluation of physico-chemical anti-inflammatory and hypolipidemic properties of oleo gum resins from *Boswellia serrata, Commiphora mukul* and *Commiphora wightii*

Extraction of exudates for their respective resins of (i) *Boswellia serrata* from Hyderabad, Jabalpur and

Vadodara (ii) *Commiphora wightii* from Ajmer and (iii) *Commiphora mukul* from Anjar (Gujarat) and Gwalior were carried out with ethylacetate and ethyl alcohol. Some of the physico-chemical properties of above resins of *Boswellia serrata* were also evaluated (Table 37). Acid values of *Commiphora wightii* from Ajmer and extracted in ethylacetate and ethanol have been found to be 15.07 and 14.65, respectively. Acid values of *Commiphora mukul*, from Anjar (Gujarat) and Gwalior extracted in ethyl acetate, have been found to be 15.77 and 13.10, respectively.

Table 37. Physicochemical properties of *B. serrata*

Extracted in Ethyl acetate	Appearance & Yield (%)	Moisture (%)	Ash (%)	Acid Value	Iodine Value
Hyderabad	White solid, 68	0.77	Nil	7.27	100.17
Jabalpur	Light brown solid, 66	0.70	Nil	26.02	114.80
Vadodara	White solid, 66%	0.75%	Nil	24.64	101.83
Extracted in Ethanol					
Hyderabad	White solid, 66	0.76	Nil	6.80	100.17
Jabalpur	Light brown solid, 65	0.65	Nil	25.67	114.80
Vadodara	White solid , 66	0.45	Nil	23.68	101.83

2.1.3 Synthesis of hydrogel from gum acacia and gum *karaya* for their comparative evaluation in drug release.

Chemical modification of purified *gum acacia* and *gum karaya* have been carried out separately. Chemically modified *gum acacia* and gum *karaya* were washed, dried and finely powdered. FTIR Spectra of the chemically modified gums were also recorded. Spectrum of the modified gum (*gum acacia*) does not show any peak of hydroxyl group (3300-3600 cm^{-1}), indicating clearly that gum have been modified after purification. Differential scanning calarometry thermogram of modified gum acacia was recorded. Experiment was conducted (at BIT, Mesra) to prepare the hydrogel from grafted copolymer of gum acacia with acrylamide using cross linking agent

2.2 Surface coating and Use diversification

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

Novolac and epoxidized novolac was synthesized. Blending of shellac with novolac and epoxidized novolac was done separately. Various combinations of shellac-novolac blends and shellac-epoxidized novolac were tried and their surface coating properties were studies as per standard procedure.

Shellac – Novolac Blends

It was observed that gloss of blended products was increased as the concentration of novolac was increased. Scratch hardness was increased by blending novolac and maximum resistance was recorded for 80:20 and 70:30 shellac:novolac blends. Shellac:novolac blends 90:10 and 80:20 showed resistance towards impact and passed the test.

Shellac-epoxidized Novolac Blends

Gloss of shellac and epoxidized novolac was found to be maximum for 80:20 and 70:30 ratio. Scratch hardness was increased as the concentration of epoxidized novolac was increased. Epoxidized novolac did not pass impact resistance but their blends showed resistance towards impact and passed the test.

Blending of shellac with PEO and PEG

Shellac was blended with Polyethylene oxide (PEO) and Polyethylene glycol (PEG) in aqueous medium. Blends were developed successfully and their film properties were studied on glass slides. It was observed that PEG films and their blends did not dry at ambient

temperature. Water holding capacity of the films was studied and found that the blends absorbed water but their holding capacity was not good.

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

1. Compilation of available information on physico-chemical properties

Guar gum: Guar gum is the powdered endosperm of the seeds of *Cymopsis tetragonoloba* which is an annual legume. Guar seed range from 0.254 to 0.635 cm (0.1 to 0.25 in) in diameter and the endosperm is from 35 to 42% of the weight of seed. India is the major producer of guar in the world and its contribution to the world production is around 80%. Rajasthan, Haryana, Gujarat and Punjab are the important states for the production of seeds.

The endosperm contains a complex polysaccharide called galactomannan (guaran), a polymer of d-galactose and d-mannose. Guar gum is a white to yellowish white powder. It is nearly odorless. The Indian standard specifications for non-edible guar gum, crude and refined, respectively are: moisture (max), 13.0, 13.0; ash(max), 1.5, 1.0; protein (max), 9.0, 5.0 (dry basis); residue (insoluble in acid, max) 14.0, 7.0; gum (min), 65.0, 75.0%; viscosity at 27°C (min), 1000, 2500 cps. Analysis of a food grade gum gave: moisture, 10-15%, protein, 5-6; crude fibre, 2.5; ash, 0.5-0.8; and polysaccharide, 78-82%.

The gum has been shown to be a linear chain of (1→4)-linked β-D-mannopyranosyl units with single α-D-galactopyranosyl units connected by (1→6) linkages to, on the average, every second main chain unit. The ratio of D-mannosyl to D-galactosyl unit is 1.8:1.

The average molecular weight of guaran is reported as 220,000. The results from size exclusion chromatography and low-angle laser light scattering show the average molecular weight to be in the range $1–2 \times 10^6$.

The analysis of the composition of typical guar gum gave: Galactomannan, 75-85%; moisture, 8-14%; protein (N x 6.25), 5-6%; fibre, 2-3% and ash, 0.5-1%.

Several chemical derivatives are made out made out of guar gum. Some of the important derivatives are hydroxypropyl, hydroxy ethyl, carboxy methyl and oxidized guar.

Guar gum and its derivatives swell and/or dissolve in polar solvents that form strong hydrogen bonds e.g. water, liquid ammonia, hydrazine, formamide, ethylene diamine. Non solvents are nonpolar such as hydrocarbons, alcohols, ketones, high-mol-wt glycol, ethers and dimethyl sulfoxide. The rate of dissolution and viscosity development generally increases with decreasing particle size, decreasing pH and increasing temperature.

Guar gum has the highest solution viscosity of all natural gums, being 5,000-6,000cps for 1% aqueous solution. Viscosity is not only influenced by purity but by processing techniques. The gum shows pseudoplastic or 'shear thinning' behaviour in solution. The degree of pseudoplasticity increases with concentration and molecular weight. Solutions of guar gum do not exhibit yield stress properties.

Aqueous solutions of guar gum form gels when treated with cross linking agents under controlled pH conditions. Effective cross linking agents include borates and transition metal ions.

The presence of 0.001 to 0.05 % dissolve guar gum can reduce fluid friction by 20 to 70%. Guar gum products show excellent resistance to shear degradation. Salt tolerance is one of the unique properties of guar gum. Viscosity of 1% guar gum solution in 25% NaCl (pH 5.5) is reported as 6300 cp.

Guar gum and its derivatives are able to absorb onto hydrophilic solid matter, particularly mineral particles. Cationic guar gum derivatives are flocculants for organic matter such as sewage and cellulose fibre that are negatively charged.

Guar gum films have high tensile strength, are brittle and do not elongate under stress.

Guar gum is stable over a wide pH range, and due to its non-ionic nature there is little change in solution viscosity in the pH range 1–10.5. Guar gum products can be hydrolyzed by acids. Guar gum is easily depolymerized by certain enzymes. Thermal degradation occurs when guar gum solutions are

heated to very high temperature. The solution will lose viscosity when heated to 80-90° for extended period of time. The powdered commercial grades of guar gum and its derivatives are all stable in the dry form.

2. Analysis of number of publications on different natural gums

The number of references on research topics containing the concepts of different natural gums was analyzed. The number of references was higher for guar gum. The year wise analysis for the above gums as shown in Fig. 29 to Fig. 35, in general showed a marked increase in the number of publications during the recent decade (e.g. 1995-2008) indicating an increased interest on natural gums.

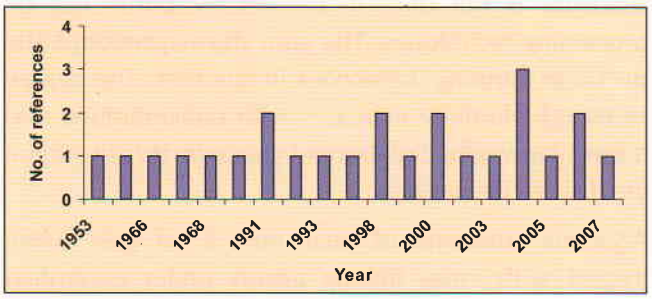


Fig. 29 : Number of references for babool gum

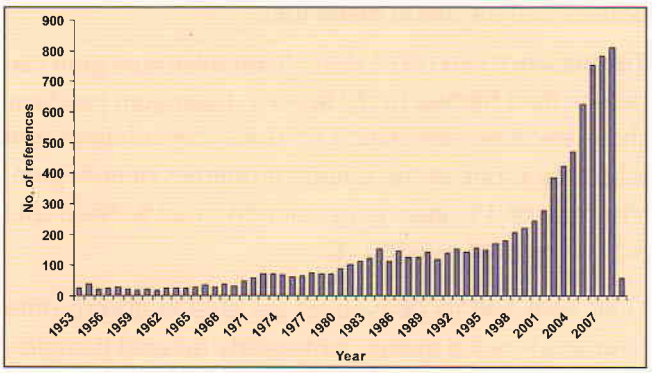


Fig. 30 : Number of references for khair gum

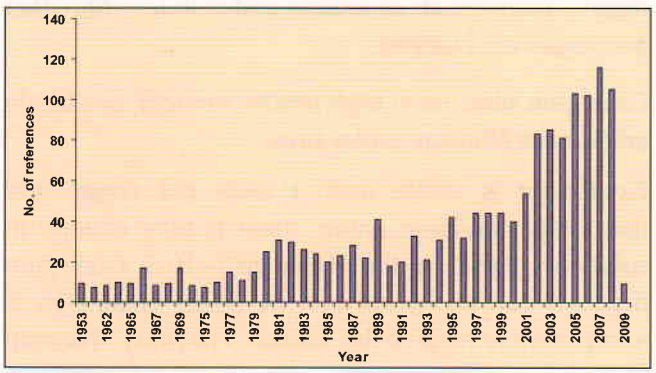


Fig. 31 : Number of references for karaya gum

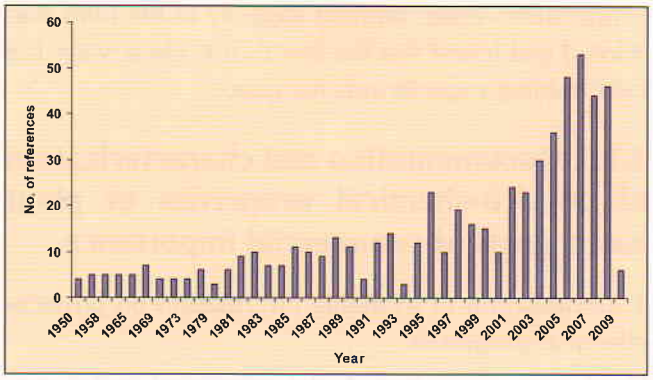


Fig. 32 : Number of references for gum ghatti

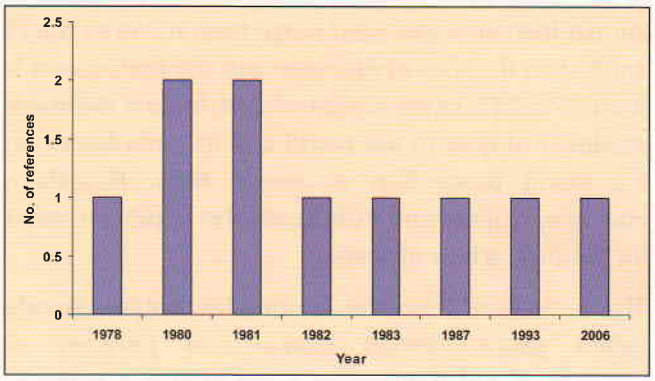


Fig. 33 : Number of references for salai gum

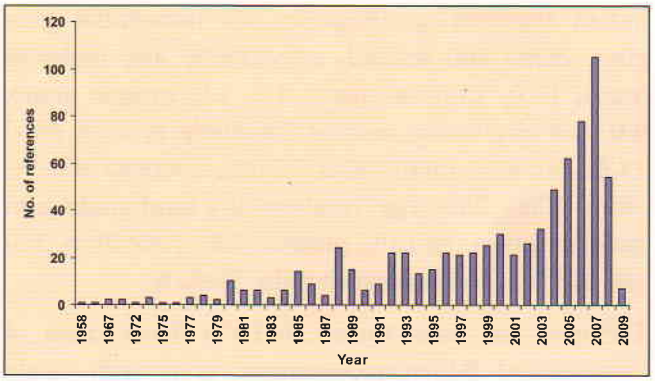


Fig. 34 : Number of references for tamarind gum

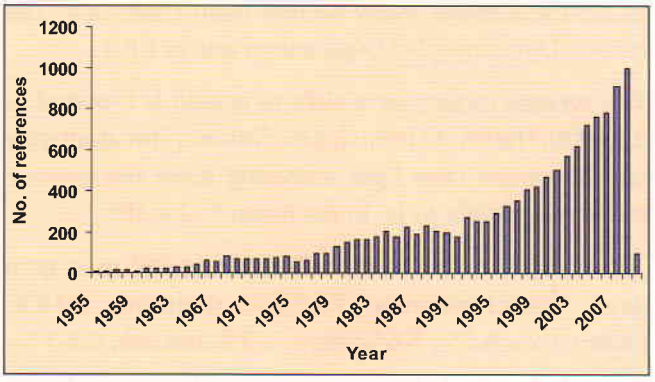


Fig. 35 : Number of references for guar gum

3. Infrared spectra, differential thermal and thermo-gravimetric analysis (DTA & TGA) of natural gums

Fourier Transform Infrared (FTIR) spectra of different gum samples were studied by KBr disk technique. The spectra are shown in Figures 36 to 42. The FTIR spectra showed the major bands of polysaccharides due to OH, CH and CO stretching vibrations.

DTA and TGA of different natural gum samples were carried out in nitrogen atmosphere in the temperature range 30–700°C. The thermo grams are shown in figures 43 to 49. The thermo grams generally showed endothermic peak below 100°C and exothermic peaks in the region 300-500°C. The major weight losses for different gums are as given in Table 38. It is found from the above table that in general, the major weight loss occurs in the range 220-340°C probably due to degradation of polysaccharide.

Table 38. Thermo gravimetric analysis of plant gums

Sl No	Gum Sample	I	II	III
	Total wt loss ~ 30-700°C	(wt loss ~ 30-130°C)		(wt loss ~ 220-340°C)
		%	%	%
1	Babul gum (*Acacia nilotica*)	8.90	56.56	82.15
2	Khair gum (*Acacia catechu*)	9.82	54.89	80.25
3	Karaya gum (*Sterculia urens*)	14.34	43.97	83.79
4	Gum ghatti (*Anogeissus latifolia*)	10.30	44.59	97.09
5	Salai gum* (*Boswellia serrata*)	9.90	41.36	76.48
6	Tamarind gum (*Tamarindus indica*)	6.16	48.73	97.16
7	Guar gum (*Cyamopsis tetragonalobus*)	8.91	57.39	95.48

(* Gum component of oleo-gum-resin)

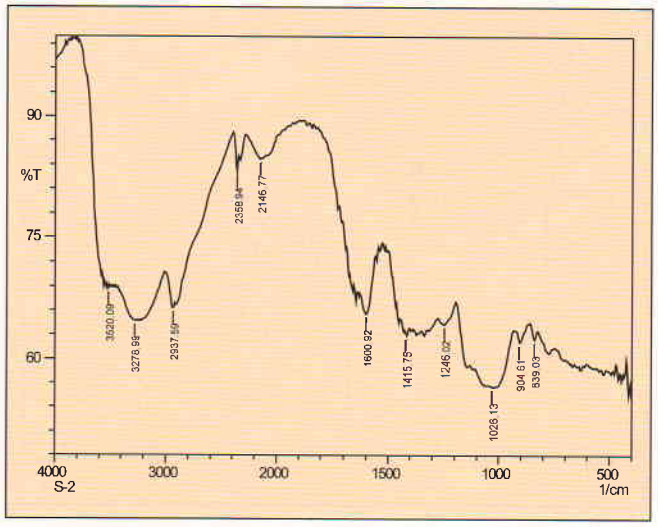


Fig. 36 : FTIR spectra of babool gum.

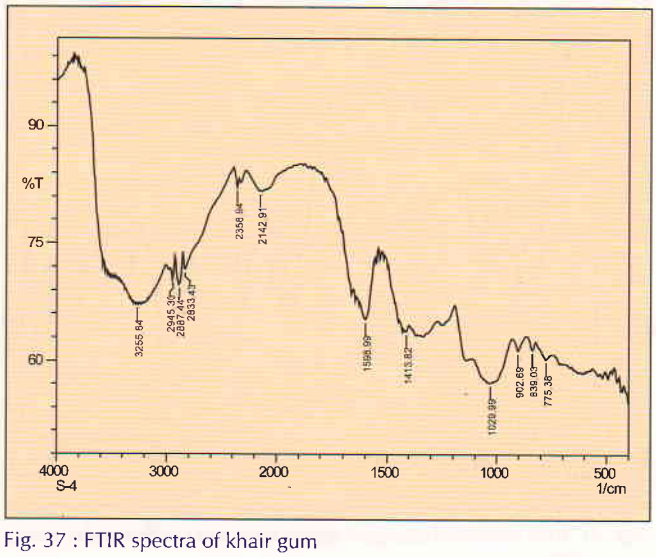


Fig. 37 : FTIR spectra of khair gum

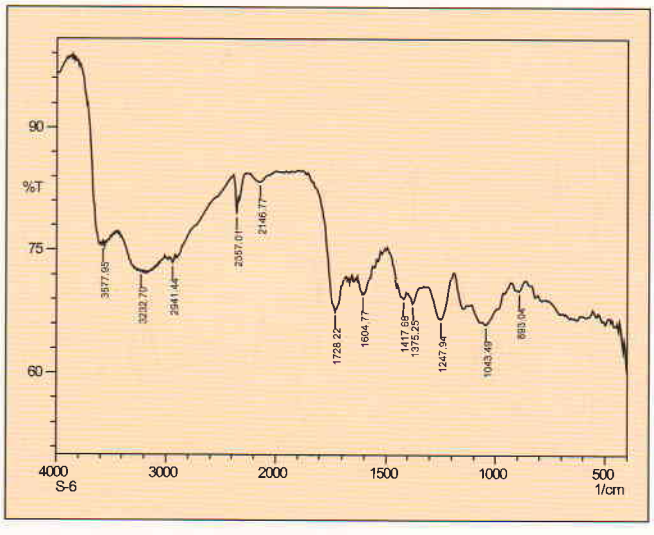


Fig. 38 : FTIR spectra of karaya gum

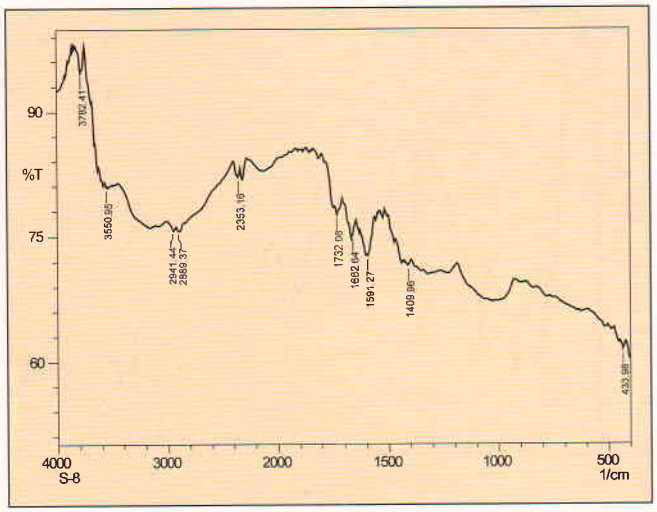


Fig. 39 : FTIR spectra of gum ghatti

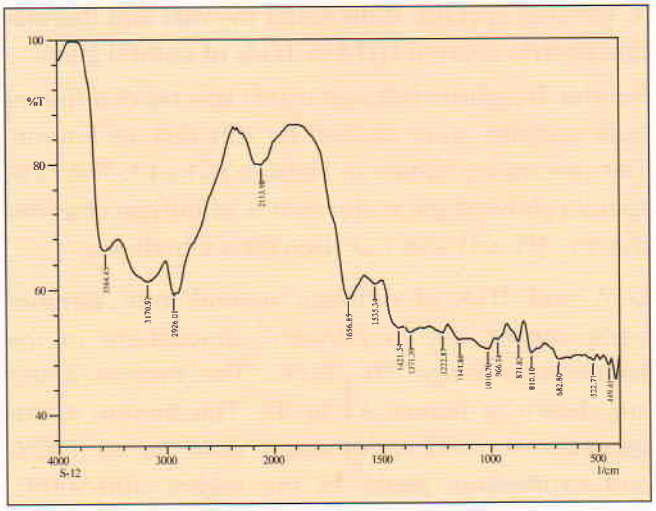


Fig. 42 : FTIR spectra of guar gum

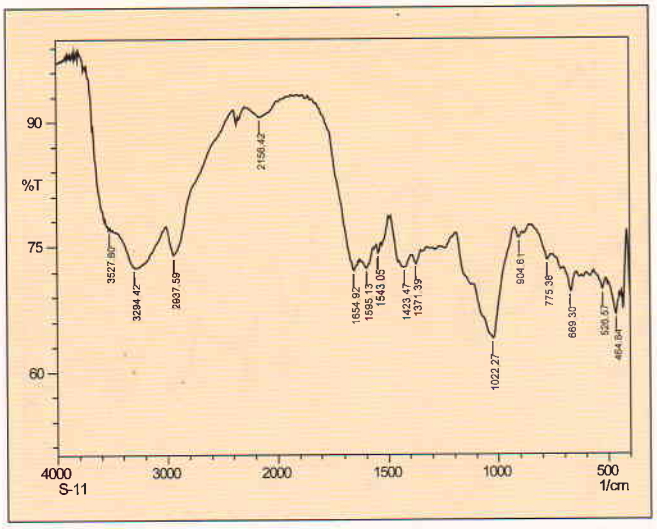


Fig. 40 : FTIR spectra of salai gum (gum component of *Boswellia serrata* gum resin)

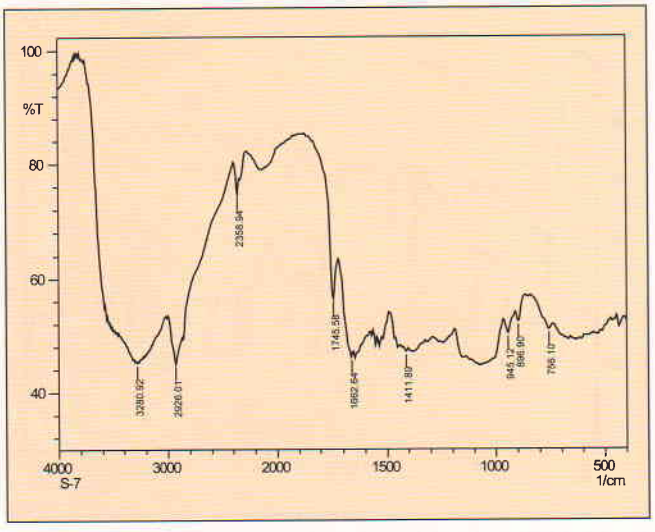


Fig. 41 : FTIR spectra of tamarind gum

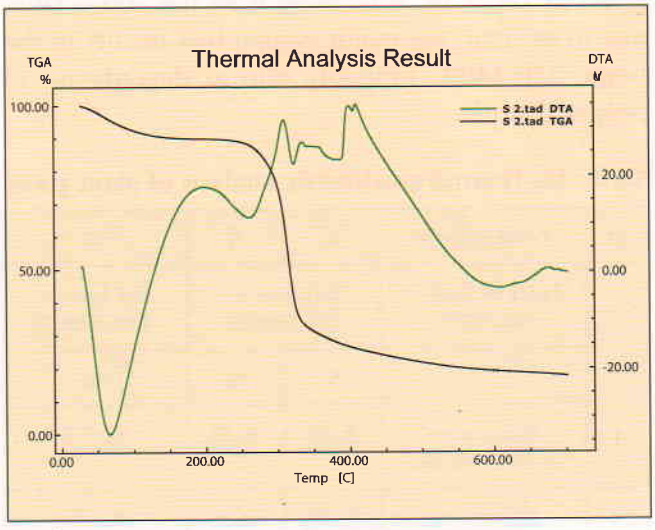


Fig. 43 : DTA and TGA curves of babool gum

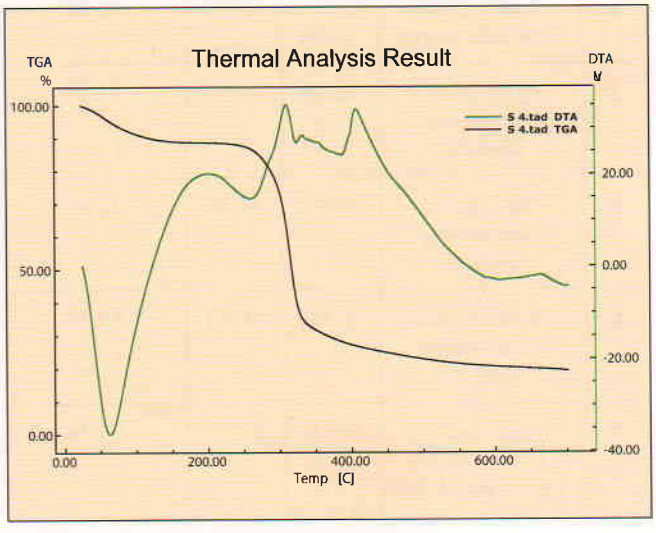


Fig. 44 : DTA and TGA curves of khair gum

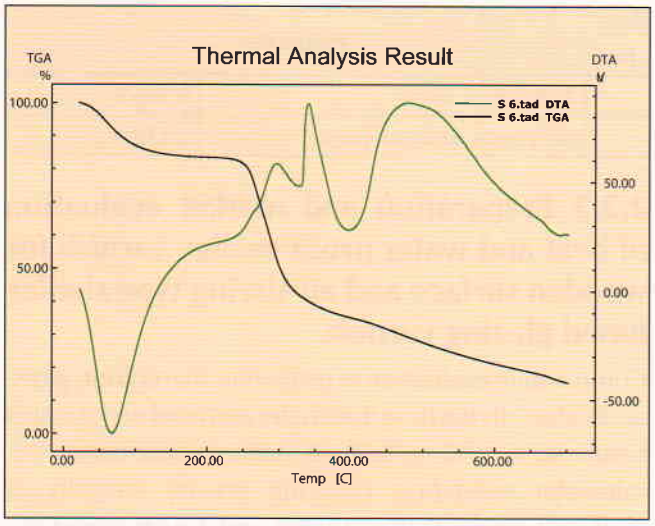


Fig. 45 : DTA and TGA curves of karaya gum

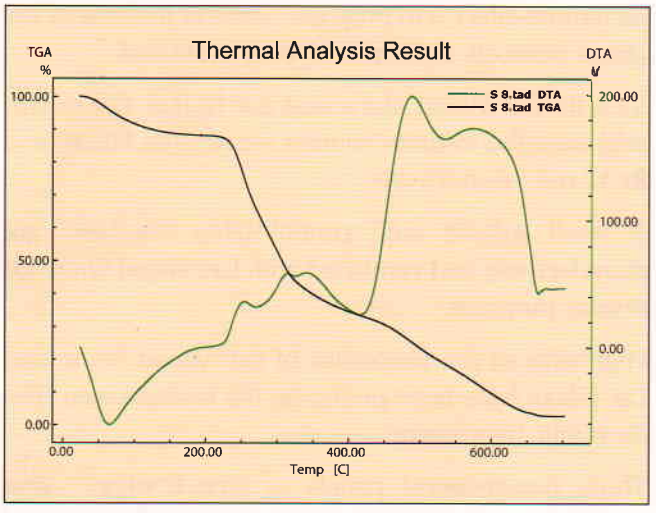


Fig. 46 : DTA and TGA curves of gum ghatti

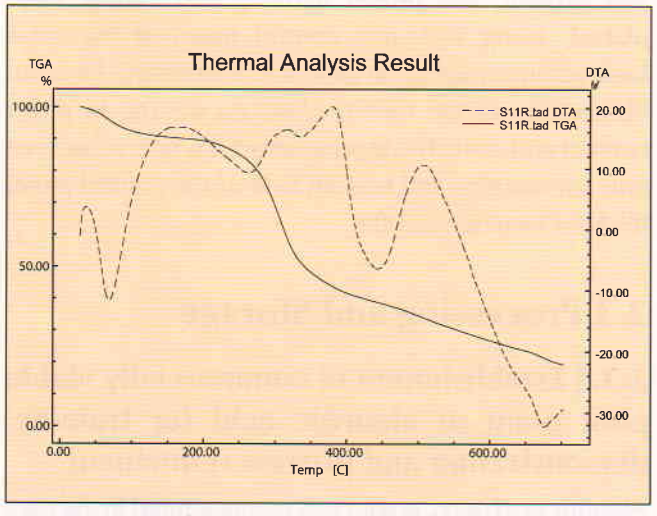


Fig. 47 : DTA and TGA curves of salai gum (gum component of *Boswellia serrata* gum-resin)

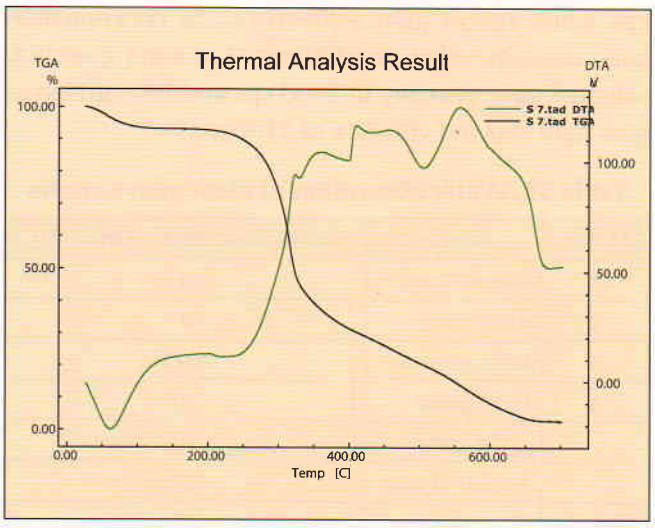


Fig. 48 : DTA and TGA curves of tamarind gum

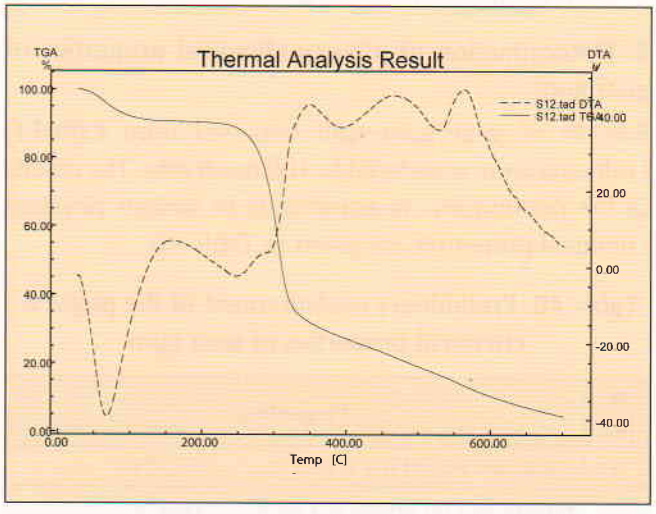


Fig. 49 : DTA and TGA curves of guar gum

4. Determination of water absorption and viscosity of gum solution

The water absorption of different gums was studied by dispersion of 2g of 100 mesh size powdered samples in 50cc of water for 24hrs. The results are given in Table 39. Karaya gum and guar gum were observed to show comparatively high water absorption values.

The viscosities of solutions of above gums were determined by Brookfield viscometer. The values measured after 24hrs were as follows: The viscosities of 20% solutions of babool gum and khair gum were observed to be 40 and 80cps respectively while for 25% solutions, the values were 120 and 140 cps respectively. Gum ghatti (10% solution) showed viscosity as 200

cps while karaya gum solution of 2% concentration gave viscosity value as 1220 cps. Tamarind gum (5% solution) gave viscosity of 4400 cps and 1% solution of guar gum showed viscosity of 1100cps.

Table 39. Water absorption of plant gum samples

Sl. No.	Sample	Water absorption (24hrs) (%)
1	Babool gum	4
2	Khair gum	4
3	Karaya gum	100
4	Gum ghatti	20
	Salai gum*	20
	Tamarind gum	24
	Guar gum	72

(* Gum component of oleo-gum-resin)

5. Determination of physico-chemical properties of guar gum

Sample of guar gum split obtained from CIPHET, Ludhiana were powdered to 100 mesh size. The results of the preliminary measurements of various physico-chemical properties are given in Table 40.

Table 40. Preliminary measurement of the physico-chemical properties of guar gum

Sl. No.	Properties	
1	Moisture content (65% RH)	6.38%
2	Weight loss on drying at 110^0 C	8.3%
3	Acid insoluble residue	2.45%
4	Total ash content	1.67%
5	Nitrogen content	0.67%
6	Dielectric strength (Break down voltage)	16.8kV/cm^2
7	Surface resistivity	1.6x10^{12}Ohm
8	Volume resistivity	0.9x10^{11}Ohm-cm
9	Viscosity (1% solution after 10min)	250 cps
10	Adhesiveness	
	Gum:Water (1:3)	
	(i) Stress at break	20.532 MPa
	(ii) Strain at break	0.627%
	(iii) Energy to break point	0.107J
	Gum:Water (1:20)	
	(i) Stress at break	26.775 MPa
	(ii) Strain at break	0.595%
	(iii) Energy to break point	0.1187J

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.

Comparative evaluation of properties like colour, gloss, acid value, drying time (touch dry and hard dry), scratch hardness, flexibility, heat-resistance, water-resistance, salt-water resistance, covering power, viscosity of marketed products like Wudfin and Touch Wood vis-à-vis our Lac Wood Shine has been carried out. Study on termite-effect is in progress. Some of the tests of the above products are required to be evaluated.

52.5 lit. Lac Wood Shine and 6.4 lit. Lac Glaze was sold from the institute counter fetching Rs.8925/- and Rs.1216/- , respectively.

A small sofa-set with central table has been got manufactured and varnished with Lac Wood Shine for display purposes.

Highlights of the properties of Lac Wood Shine and Lac Glaze have been put up on the Institute web sites for public information.

Three mango-wood panels of size 6″x4″x1″ after varnishing each with Lac Wood Shine, Touchwood and Wudfin, and proper marking and curing, were placed, along with one control panel of the same kind without varnish, at plot No.29 of IINRG Farm for observation of the termite-effect on 4.9.09, in direct contact with soil. The termite-effect has been observed only on margins and bottom side of the control panel till 31st December, 2009.

2.3 Processing and Storage

2.3.1 Establishment of commercially viable pilot plant of aleuritic acid for training, demonstration and process refinement

Aleuritic acid (tech. grade) was manufactured in the pilot plant using different period of saponification time and

filtering materials and methods. The yield of aleuritic acid (technical grade) was found to be higher (19%) when cotton filter clothes were used as compared to polyester clothes (yield: 16.3%), at the saponification time for 10 days. The yield reduced from 19% to 16.5%, when saponification time was decreased from 10 days to 7 days. Melting point of the product was measured to ascertain the purity of the product. It is found to be 92-93°C for cotton filter cloths and around 90°C for products obtained using polyester cloths. Based on acid value determination, the purity of aleuritic acid prepared using cotton filter cloths and 10 days saponification time was around 96.5%.

High pressure air (using compressor) was provided during filtration of sodium aleuritate for completer removal of the filtrate. The yield of aleuritic acid (technical grade) was approx. 19.8 % of the weight of seedlac. A portion of the sodium aleuritate solution was filtered using a filter cloth to separate the wax instead of manual separation. Higher melting point (95-96°C) of aleuritic acid (technical grade) was found in the sample where wax was filtered using filter cloth compared to manually filtered samples (92-93°C).

Aleuritic acid prepared in the pilot plant

Modification in the plant was made for gravity filtration of sodium aleuritate solution and for separation of wax in the filter press. Filtration of sodium aleuritate solution at different temperature (60-90°C) and through cotton filter cloth, nylone filter cloth and 120 mesh sieves has been tried to separate the wax. The melting point of aleuritic acid obtained by different methods varied between 92 and 95°C

Preparation of aleuritic acid from old and degraded seedlac

Around 8-10 years old and degraded *rangeeni* seedlac was purchased from JHASCOLAMPF, Ranchi for evaluation of yield of aleuritic acid from the old seedlac in the pilot plant. The seedlac had flow value of zero (Table 41) and was useless for other purpose.

Table 41. Properties of old seedlac

Hot alcohol insoluble (Impurity), %	9.95
Flow, mm	Nil
Life, minutes	29
Colour index	18
Rate of filtration, ml	78

Aleuritic acid (technical grade) was prepared from 3 to 8 years old *rangeeni* seedlac in the pilot plant with different wax filtration methods and conditions. The yield of aleuritic acid obtained in different trials varied from 16 to 16.7% of the weight of seedlac. The products obtained were evaluated for quality parameters like melting point and acid value. The melting point of the products varied between 90 and 95°C and acid value varied between 67 and 207. The total yield of aleuritic acid was approximately 16% of the weight of seedlac.

Pilot scale training and demonstration of aleuritic acid manufacture was given to two employees of JHASCOLAMPF, Ranchi and to 8 entrepreneurs from Balarampur, West Bengal

2.3.2 Establishment of pilot plant for dewaxed bleached lac (40 kg cap) for training, demonstration and process refinement.

Trial runs of Pilot-plant were carried out with 10 kg batch of seedlac and dewaxing of bleached lac solution was carried out separately in two different filters, open tray filter and Sparkler filter with porous filter media for comparing their performance. The wax content and acid value in tray filter were found 0.26 % and 81.5, whereas, it was 0.30% and 81.46 in case of sparkler pressure filter. The wax content in both case

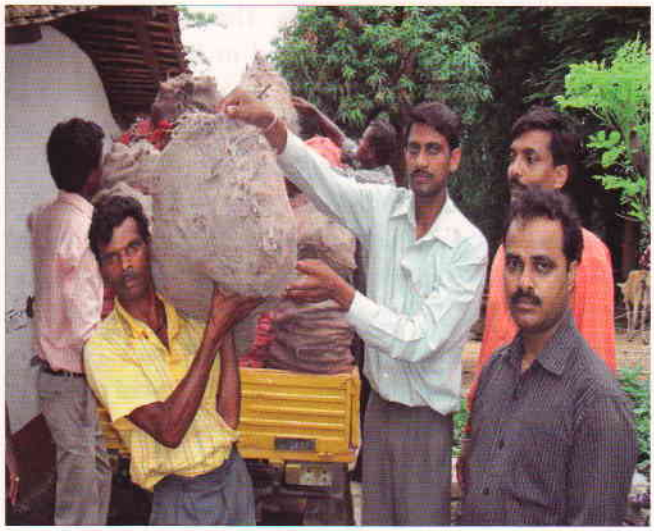
was below permissible IS limit (0.50 %maximum). However, reproducible results were not obtained for filtration through pump operated sparkler filter. The reason may be due to possibility of emulsification of wax in pump impeller resulting in difficulty in separation of wax.

Wax filtration was also carried out in horizontal plate and frame filter under gravity fed system at two different conditions (**A**. ambient temperature 27 ± 1 °C and **B**. cooled solution 15 ± 2°C). It was found suitable for dewaxing of lac solution. The wax content of the prepared bleached lac in both condition was 0.22-0.26% (BIS maximum limit- 0.5%) with acid value from.80- 88. Thus the processing conditions were finalized for operation of the bleached lac plant and training was imparted to entrepreneurs following these conditions.

2.3.3 A value chain on lac and lac based products for domestic and export markets

The NAIP Project on"Lac Value Chain" was started in February, 2009. As per the guideline of NAIP, first baseline survey was conducted to know the status of lac production in Ranchi-Khunti catchment area and status of lac processing and quality aspects of different lac products taken under this project. For carrying out baseline survey, a meeting was organized in each of the four villages selected for it. A respondent was selected from each related villages. Farmers were briefed for the purpose of the survey and its benefits. Among 92 beneficiaries farmers under the project, 60 were selected; 30 each from Ranchi and Khunti districts for bench mark survey through structured questionnaire. Questionnaire was prepared as per the requirement of the project and format received from monitoring and evaluation wing, NAIP.

A team was constituted including scientists, consortia partners and RAs for the above work to complete it within time frame of six months. Works were distributed among them and information was collected. Baseline information on status of lac processing and yield and quality of different lac products were also collected. Finally informations collected were compiled and Baseline survey report was submitted to NC, Component-2 and M& E consultant.



Broodlac distribution to farmers

Procurement and Distribution of broodlac for model demonstration and promotion of cultivation of high yielding lac insect on existing 362 ber trees was done in the targeted Ranchi-Khunti Catchment area with inoculation of 1,100 kg Kusmi broodlac (Lac seed) in the month of June-July. The trees belong to 92 farmers in 8 villages of these two districts.

Transplanting of lac host plants.

To demonstrate lac cultivation on plantation basis, quick growing lac host plants (F. semialata) were planted in about 2 hectare land at three different locations in three villages i.e. Mangubandh (in Ranchi district), Lupungdih and jordag salga (khunti district). Plantations of ber were also carried out in about 1 hectare land in Mangubandh and jordag salga village of the two districts.

Experts imparting on farm training to farmers.

As per the approved activity of this project different training programmes were conducted. Fifty nine farmers were given one week training for Scientific method of lac cultivation in Institute and 250 farmers in three batches, received on-farm training on Scientific method of lac cultivation. Seventy farmers in two batches visited Institute Research Farm and Museum as Exposure Visit Programme.

The work on processing aspect of lac and different lac products was also initiated under this project and present potential and status was analysed for improvement in recovery/yield and quality of different lac product as per approved activity for the project. Sixteen samples of Shellac, Bleached lac, Aleuritic acid and lac dye from exiting lac industry were analysed from Quality evaluation Lab (QEL) of this Institute for evaluating the present status on quality of these lac products. The details of work done as per technical programme are given below.

Deliverables	Targets	Achievements	Remarks
Objective 1. To promote cultivation of high yielding lac insects (kusmi) for continuous supply-chain management			
No. of trees/Plants exploited for lac cultivation	300	362	
No. of farmers/ youth employed	100	102	
Area identified under potential plantation (ha)	02	02	
Number of training / field demos conducted	12	02	
Number of farmers trained	100	59	
Number of indigenous technologies/methods identified	08	08	
IRF Visit program for farmers	02	02	
Objective 2. To promote primary processing of lac at village level			
Number of machines &equipments procured	02	02	Order has been placed and firm has supplied units.
Objective 3. To reduce losses during processing, improve quality, develop suitable packaging for lac (shellac) and lac based products (bleached lac and aleuritic acid) for domestic and export markets			
No. of shellac manufacturing unit surveyed	07	07	
No. of units analyzed for yield and cost of production of shellac	07	07	
No. of samples of shellac from existing press method evaluated	07	05	
No. of firms dealing with bleached lac contacted	05	05	
No. of bleached lac samples from existing method got evaluated	05	05	
No. of firms dealing with Aleuritic acid contacted	02	02	
No. of Aleuritic acid samples from existing method got evaluated	02	01	
Objective 4. To recover and purify the by-product of lac industry (lac dye from wash water) for economic benefits			
No. of Lac dye units surveyed	02	02	
No. of samples of lac dye recovered from existing method got evaluated	02	02	

3. TRANSFER OF TECHNOLOGY

3.1 Human Resource Development

Project 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 pertaining 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 programmes, field out reach activities in terms of training, technical guidance, lac crop monitoring were also undertaken.

Farmers' and Housewives' training programme

One-week programme for farmers and housewives mainly covered lac cultivation, processing at farm level and uses of lac. A total of 396 farmers from 14 districts of six states namely Jharkhand, Orissa, Chhattisgarh, West Bengal, Madhya Pradesh and Bihar participated in the programme. A summary of different courses conducted are given in Table 42. It is evident from the table that maximum participation was from Chhattisgarh (152) followed by Orissa (94), Jharkhand (71), Madhya Pradesh (52), West Bengal (25) and Bihar (2).

Expert imparting training to the farmers and housewives

Table 42. Farmers training programme on Scientific lac cultivation, processing and utilization

Month	Course No.	Sponsoring Organization	State	Period	No. of partici-pants
January	1	Society for Human Development and Educational Research, Raipur.	Chhattisgarh	29 Dec 2008-2 January 2009	7
	2	Private	Jharkhand	19-23 January, 2009	2
March	3	Human Research Development Centre, GEL, Church, Ranchi	Jharkhand	2-7 March, 2009	3
	4	Janmitram Kalyan Samiti, Raigarh	Chhattisgarh	16-21 March, 2009	39
		TRIFED, Sundargarh	Orissa	do	51
		Private	Orissa	do	1
	5.	District Industries Centre, Bankura	West Bengal	23-28 March, 2009	25
		TRIFED, Bolangiri and Kalahandi	Orissa	do	43
		NAIP IINRG & BAU Ranchi, Component-4 (Jamtara)	Jharkhand	do	6

Month	Course No.	Sponsoring Organization	State	Period	No. of partici-pants
April	6	NAIP IINRG & BAU Ranchi, Component-4 (Dumka)	Jharkhand	31 March 09-2 April, 2009	24
	7	Private	Jharkhand	20 -25 April, 2009	1
May	8	SUPPORT, Hazaribag	Jharkhand	21 -23 May, 2009	9
	9	Janmitram Kalyan Samiti, Raigarh	Chhattisgarh	25 -30 May, 2009	33
July	10	Forest Dept., Dhamtari	Chhattisgarh	20 -24 July, 2009	7
		Private	Jharkhand	do	3
October	11	Forest Dept, Surguja	Chhattisgarh	5 -9 October, 2009	50
	12	NAIP-Value Chain, Ranchi	Jharkhand	12 -16 October, 2009	17
	13	Udyami Vikash, Mandla	Madhya Pradesh	26 -31 October, 2009	16
December	14	Forest Department, Jagdalpur	Chhattisgarh	7 -11 December, 2009	16
		Private	Bihar	do	2
		Private	Jharkhand	do	2
	15	Udyami Vikash, Mandla	Madhya Pradesh	14 -19 December, 2009	36
		Total			**377**

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

The agriculture graduate students from Allahabad Agricultural Institute (Deemed University), Uttar Pradesh and Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh have undergone one week training in lac cultivation, processing and its uses (Table 43). A total of 103 students were educated through four courses under the programme.

Expert imparting training to students.

Table 43. Educational programme (One-week) on production, processing and uses of Natural gums and resins

Course No.	Sponsoring Organization	State	Period	No. of participants
	Allahabad Agriculture Institute (Deemed University), Allahabad.	Uttar Pradesh	29 Dec , 2008-3 January, 2009	31
	Allahabad Agriculture Institute (Deemed University), Allahabad.	Uttar Pradesh	5 -9 January, 2009	16
	B.H.U.,Vanarasi	Uttar Pradesh	11 -16 May, 2009	32
	Allahabad Agriculture Institute (Deemed University), Allahabad.	Uttar Pradesh	8 -12 June, 2009	24
	Total			**103**

Trainers' training programme on scientific lac production, processing and uses

Manager, Primary Forest Produce, Unemployed educated rural youth designated as Lac facilitator, Master Trainers and Junior Lac Executive sponsored by Chhattisgarh State Minor Forest Produce (Trade and Development Federation Ltd), Raipur, field staff of BAIF Orissa and SMS from KVK, OUTA, have undergone Trainers' training programme on scientific method of lac cultivation, production, processing and utilization. A total of 128 trainers have completed the course through 8 courses (Table 44).

Table 44. Trainer`s training programme on "Scientific lac production, processing and uses"

Course No.	Sponsoring Organization	State	Period	No. of participants
1	BAIF, Orissa	Orissa, Sundergarh	19-23January, 2009	30
2	Chhattisgarh State Minor Forest Produce (Trade and Development) Federation Ltd., Raipur	Chhattisgarh	23-28 February, 2009	5
3	Chhattisgarh State Minor Forest Produce (Trade and Development) Federation Ltd., Raipur	Chhattisgarh	2-7 March, 2009	8
4	Chhattisgarh State Minor Forest Produce (Trade and Development) Federation Ltd. , Raipur	Chhattisgarh	13 -17 April, 2009	27
5	Chhattisgarh State Minor Forest Produce (Trade and Development) Federation Ltd. , Raipur	Chhattisgarh	20 -25 April, 2009	9
6	KVK, O.U.A.T, Orissa.	Orissa	18-20 June, 2009	5
7	Chhattisgarh State Minor Forest Produce (Trade and Development) Federation Ltd. , Raipur	Chhattisgarh	6 -11 July, 2009	24
	Private	Jharkhand	do	2
8	Chhattisgarh State Minor Forest Produce (Trade and Development) Federation Ltd., Raipur and KVK Lohardaga.	Chhattisgarh	23 -25 September, 2009	18
	Total			**128**

Field out-reach programme:

On- Farm training on "Scientific cultivation of lac":

Four camps were conducted in collaboration with other organizations in Jharkhand and West Bengal covering four districts in which 359 farmers benefited from the programme. Maximum participation was from Gumla district of Jharkhand, followed by Lohardaga, Bankura and Latehar district. The details of training programme conducted have been presented in Table 45.

Table 45. On-farm training programme on "Scientific lac cultivation"

Camp No.	District -State	Sponsoring/ Nominating Agency	Venue (Village, Block)	Dated	No. of Participants
1	Lohardaga, Jharkhand	Forest Dept. Lohardaga	Rest house, Peshrar	06.02.09	67
2	Latehar, Jharkhand	DFO, Latehar	Traning Hall, Latehar	22.02.09	60
3	Bankura, West Bengal	Industrial Development Office, Bankura	Panchayat Office Hall, Badulara	04.03.09	65
4	Gumla, West Bengal.	Forest Department, Gumla.	Gumla Van Pramandal Office.	07.03.09	167
				Total	359

On-farm, motivational/ supplementary training programme on lac cultivation

During the year, 22 camps were organized for 3,336 farmers representing 95 villages of 10 districts in collaboration with NGOs and GOs of different states. Details of training programme conducted have been given in Table 46.

Table 46. On-farm Motivational/ Supplementary training programme on lac cultivation

Camp No.	District -State	Sponsoring/ Nominating Agency	Venue (Village/Block	Dated	No. of Participants
1	Khunti, Jharkhand.	R.C.Mission Gourbeda	Gourbeda, R.C. Mission Compound, Jaria,Torpa.	03.02.09	60
2	East -Singhbhum, Jharkhand	Shramajivi Unnayan, Patamda.	Training Hall, Gobargushi	20.02.09	55
3	Balaghat, Madhya Pradesh	M P, Minor Forest Produce Fed. Ltd.	*Panchayat Bhawan, Shabhagar*, Kirnapur.	06.06.09	113
4	do	do	*Gram Van Suraksha Samiti,*Tingipore	07.06.09	351
5	do	do	Community Hall,Pachmedi, Nagarwada	07.06.09	201
6	Dhamtari, Chhattisgarh	Forest Dept. Dhamtari.	Baderi, Dhamtari	07.06.09	75
7	do	do	Zila Union, Katangi.	08.06.09	261
8	do	do	Range Office,Lalbarra.	08.06.09	111
9	Seoni,Madhya Pradesh.	do	Govt. Primary School, Janamkhari,	09.06.09	63
10	do	do	Ecco Centre, Dhuma.	10.06.09	43
11	Jagdalpur, Chhattisgarh	Forest Dept. Jagdalpur.	Ziragaon, Jagdalpur	10.06.09	30
12	do	do	Bare Jeerakhal (Morenga)	10.06.09	30
13	Narayanpur, Chhattisgarh	do	Guturpare, Kerlapal	11.06.09	60
14	do	R. K. Mission.	Sankribera, Narayanpur	12.06.09	60
15	Kanker, Chhattisgarh	do	Deharipar, Kolar	12.06.09	75

Camp No.	District -State	Sponsoring/ Nominating Agency	Venue (Village/Block	Dated	No. of Participants
16	Khunti, Jharkhand	SAIL, Ranchi	Dandol	03.07.09	72
17	Seoni, Madhya Pradesh	Pragya Research	Sitakhoh, Katangi	28.08.09	1000
18	Jagadalpur Chhatisgarh	Forest Deptt. Jagdalpur	Bare Jeerakhal (Gorenga)	09.10.09	40
19	Narayanpur Chhatisgarh	R. K. Mission	Sargipal	10.10.09	21
20	do	R.K.Mission	Chote Dongar, Kangerbera	11.10.09	190
21	Purulia, West Bengal	Forest Dept. (DFO)	Murguma, Beat Range office	03.11.09	350
22	Ranchi, Jharkhand	Seva Bharti, Jonha	Koinardih	13.11.09	75
				Total	**3,336**

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 47. These activities were carried out in the states of Jharkhand, Chhattisgarh and West Bengal.

Table 47. Demonstration and other (Lac crop monitoring) Transfer of Technology activities related to lac production

Sl No.	District -State	Venue (Village/Block)	Collaborating Agency	Dated	Purpose
1	Khunti, Jharkhand	Chitramu	PRADAN	26.1.09	Plantation of *Flemingia semialata*
2	Dhamtari, Chhattisagrh	Gondalnara	Forest dept, Dhamtari	22.3.09	*Rangeeni* lac on *palas* and *kusmi* on *kusum*
3	Jagdalpur, Chhattisgarh	Lalagora	Jagdalpur, Ag. College	24.3.09	*Kusmi* lac on *kusum*
4	Jagdalpur, Chhattisgarh	Jiragaon, Machkot	Forest dept, Jagdalpur	24.3.09	*Kusmi* lac on *kusum* tree
5	Kanker, Chhattisgarh	Nathia Nawangaon	Private Entrepreneur	25.3.09	Plantation of *Flemingia semialata* 9,500 plants on 2.5 acre land)
6	Ramgarh, Jharkhand	Sugia tola	Private entrepreneur	11.4.09	Mixed plantation of *Siris* and *ber* on 2 acre land
7	Ramgarh, Jharkhand	Dhanbera	Private entrepreneur	11.4.09	Late *kusmi* crop on *kusum* tree
8	Jagdalpur, Chhattisgarh	Machkot	Forest department	10.6.09	*kusmi* lac crop on *kusum*, *Accacia auriculiformis* and *Shorea robusta*
9	Jagdalpur, Chhattisgarh	Dimrapal, Garenga	Forest department	10.6.09	*kusmi* lac crop on *kusum*
10	Narayanpur, Chhattisgarh	Palki	R K Mission, Narayanpur	11.6.09	*Kusmi* lac crop on *kusum* tree

Sl No.	District -State	Venue (Village/Block)	Collaborating Agency	Dated	Purpose
11	Kanker, Chhattisgarh	Deharipar, Kolar	R K Mission , Narayanpur	12.6.09	*Kusmi* lac crop – High temperature mortality
12	Purulia, West Bengal	Putidih	TRIFED, Ranchi	19.6.09	*Rangeeni* lac crop on *palas*
13	Jagadlpur, Chhattisgarh	Kamanar, Jodraguda Neganar	Forest department	8.10.09	*Kusmi* lac on *kusum* and *ber* trees
14	Jagdalpur, Chhattisgarh	Shankarmani Bhaluguda	Forest department	9.10.09	*Kusmi lac on kusum on more than 50 trees*
15	Jagdalpur, Chhattisgarh	Chirgaon	Forest department	9.10.09	*Kusmi* lac on *kusum*, more than 30 trees
16	Jagdalpur, Chhattisgarh	Porebara	Forest department	9.10.09	*Kusmi* lac on *kusum*
17	Jagdalpur, Chhattisgarh	Dimrapal	Forest department	9.10.09	*Kusmi* lac on *kusum* and *Ficus species*
10	Narayanpur, Chhattisgarh	Sargipal	R K Mission	10.10.09	Monitoring of kusmi lac crop on trees of *kusum*

Training on Product demonstration:

Technology was transferred to five persons on different aspects of product demonstration as detailed in Table 48.

Table 48. Transfer of technology for lac based products

Sl No.	Subject	Sponsoring agency	Duration	Persons
1	➤ Testing and Analysis of Lac ➤ Melfolac ➤ Non-Spirit MSV 005 Varnish ➤ Water Soluble lac	M/S Coating & Coating (India) Pvt Ltd 1602 Ambrosia, Opp. Old Hiranandani Foundation School, Hiranandani Garden Powai, Mumbai 400 076	2-10 July, 2009	Shri Malay Kumar Bhayani
2	➤ Testing and Analysis of Lac ➤ Processing of Lac	Self	1-11 September, 2009	Ms Debshri Dutta House No. 379 Sunder Nagar, Raipur-492 001
3	Aleuritic Acid	JASCOLAMPF, Ranchi	5-16 October, 2009	Sh Surendra Pandey Sh Binod Pd Karn
4	Dewaxed bleached lac	Koti Co, Chennai	20-27 October, 2009	Sh DRS Koti Sah O No. 25/2, N. M 53/2 Iyah Mundali St Chintadripet Chennai 600 012
5	➤ Lac wood Shine (Melfolac) ➤ Non Spirit MSV 005 ➤ Shellac based glazed varnish (lac glaze)	PNP Corporation ,Mumbai	30-31 October, 2009	Sh Punit Vayada, 4A Prem Kanku Navroji Lane Ghatkopar (W) Mumbai - 400 086

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)

A. Training

- One-Week training was provided to one SRF under the JLDS project during 13-17 April, 2009.
- On-farm trainings have been organised for 1421 beneficiaries of the project (Table 49).

Table 49. On - Farm Training at various villages for beneficiaries sponsored by different NGOs.

Sl. No.	Venue / Place	Nominating NGO	No. of families participated	Date
1	Hudu, Saraikela	Indian Gramin Service	100	27.02.09
2	Primary School, Kedal, Rauka, Garwa	AWARD	149	10.11.09
3	Primary School, Saikat, Garwa	AWARD	150	10.11.09
4	Community Hall, Dungra, Khunti	VICAS	59	11.11.09
5	Dungra Field Village	VICAS	56	11.11.09
6	Panchayat Bhawan Hall, Hatinghode	Evaluation for integrated Spiritual Awareness	86	13.11.09
7	Panchayat Bhawan Hall (South side), Hatinghode	Evaluation for integrated Spiritual Awareness	45	13.11.09
8	Panchayat Bhawan Hall (North side), Hatinghode	Evaluation for integrated Spiritual Awareness	77	13.11.09
9	Govt. Middle School, Nawadih, Latehar	Gramin Vikas Trust	91	21.12.09
10	Angnawadi Hall (North), Nawadih, Latehar	Gramin Vikas Trust	76	21.12.09
11	Angnawadi Hall (South), Nawadih, Latehar	Gramin Vikas Trust	65	21.12.09
12	Technical School, Bagheralta, Simdega	Gramin Vikas Trust	95	22.12.09
13	Technical School, Bagheralta (South), Simdega	Gramin Vikas Trust	55	22.12.09
14	Technical School, Bagheralta (North), Simdega	Gramin Vikas Trust	65	22.12.09
15	Lattakhamhau Stadium, Simdega	Gramin Vikas Trust	94	23.12.09
16	Lattakhamhau Stadium (North), Simdega	Gramin Vikas Trust	85	23.12.09
17	Lattakhamhau Stadium (South), Simdega	Gramin Vikas Trust	73	23.12.09
		Total	**1421**	

B. Action Research

1. Intensive lac cultivation on bushy host-plants

Field demonstration of *kusmi* lac cultivation on *semialata* was carried out in two villages of Ranchi and Khunti districts in collaboration with NGO namely SEEDS and PRADAN. Last year, 35.0 kg of *kusmi* early broodlac was inoculated during winter (*aghani*) season crop in July 2008 on 1264 *semialata* plants in Kharsidag (Ranchi). A very good crop (241 kg broodlac) was harvested in February 2009 from 1084 plants giving an output: input ratio of 6.89. Similarly, at Chitramu (Khunti) 12.0 kg of *kusmi* broodlac was inoculated on 435 *semialata* plants and about 100 kg broodlac was harvested giving an output: input ratio of 8.33. This year, 40.0 kg of *kusmi* broodlac has been inoculated in July on about 1200 *semialata* plants in Kharsidag village in the field for demonstration of

kusmi lac cultivation under JLDS in collaboration with SEEDS, an NGO. The crop is progressing well. Termite attack on the plant, sooty mould on lac encrustation and damage due to inappropriate method of spraying were some of the major problems encountered by the farmers during cultivation.

Lac cultivation on *semialata*

Sooty mould growth on lac encrustation

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

Plantations of *Albizia procera, Prosopis juliflora* and *Ziziphus mauritiana* raised at IRF under Jharkhand Lac Development Scheme have showed a very healthy and promising growth. One year old saplings of these host-plants raised in the nursery in poly bags were transplanted in the field during July 2007. Average height of the two year plants in July 2009 was observed to be 4.89 m in *A. procera* and 2.64 m in *P. juliflora* and 3.52m in *Z. mauritiana*.

Kusmi broodlac was inoculated on plants of *A. procera* in July 2009. As reported last year also, lac insect showed the preferential tendency of settling on petioles than on twigs. Heavy mortality was observed on twigs but lac insects survived well on petioles of the plants. However, the petioles were shed in December before crop could attain maturity. Some of the plants were found affected by an unidentified disease / pest(s) giving an appearance of bark peeling from the stem wilted bunchy top.

Lac encrustation on petiole of *Albizia procera*

3. Field demonstration of productive breeds of lac insects

Twenty kg broodlac each of two breeds (Kulajanga and *ber* stock) inoculated on *ber* at Mangobandh, Ranchi gave yield of 68 kg and 66 kg respectively. Similarly, 20 kg each of three stocks (Kulajanga, Ber and Nawadih stock) inoculated on *ber* at Gutwa, Khunti gave yield of 28, 45 and 1 kg respectively. Yield was affected due to incessant

rain during settlement in Nawadih stock. This year, 70 kg each of three productive breeds (Kulajanga, Nawadih and late variety) have been inoculated at Mangoband (20 kg each), Chitir (30 kg each) villages in Ranchi district and Chitramu (20 kg each) village of Khunti district. The crop is progressing well.

C. Infrastructure Development carried out under JLDS

- Lac information Cell has been established at TOT Division of the Institute. Two computers with paraphernalia and furniture have been procured. Lac data (State / district / market wise) related to production, processing, marketing etc. since 1974 has been compiled. Daily Meteorological data (Maximum temperature, Minimum temperature, Humidity, Rainfall) of the last 38 years *i.e.* since 1971 to March 2009 has been digitised under the JLDS project. It would help in developing weather based lac crop insurance product / Model.
- A 25m x 10 m green net house having *pucca* beds with motorized irrigation and misting facilities is under construction.
- Training Hall has been furnished with modular furniture. Boarding facilities have further been strengthening for the trainees – training hostel has been provided with, beds, blankets etc.

Green net house with pucca beds

Other Experimentation

(i) Ant-lac- host plant association at IRF

Ants have been reported to have symbiotic relationship with plants and scale insects, the group to which lac insect belongs. It has been observed in our Institute Research Farm that ants have formed nests in and around the root zone of many plant species. But only lac-hosts were studied. Ants were found to be associated with all major lac hosts (10.6% in *palas* to 35.4% in *kusum*). Some of these ants are prolific excavators bringing out the inner soil on to the ground. The excavated soil, if analyzed would help in investigating the mutual benefits, if any, of this ant plant association. 36 samples of soil have been collected from *kusum*, *ber*, *palas*, *khair* and *semialata* plantations for analysis of major and minor elements to understand the implications of the association.

Ant nests in and around the root zone of plant.

(ii) Development of broodlac standards

Study on Broodlac standards has been initiated. 10 kg broodlac each of *kusmi* from *kusum* and *rangeeni* from *palas* was studied for length : weight ratio, weight of sticks, scraped lac and daily weight loss of broodlac, sticks and scraped lac during July 2009. Similar observations were taken during October for *rangeeni* broodlac from *palas*. Data are being analysed.

(iii) Summer *kusmi* lac production on *semialata*

A small experiment on summer *kusmi* lac production on *semialata* under irrigation and agro shade was initiated in two villages at Kharsidag – about 800 plants (Ranchi) and Nichitpur – about 500 plants (Torpa, Khunti). Crop was progressing well till April month. But large scale mortality of lac insect as well as plants was observed in May due to water scarcity as the source of water (Well) dried up. Some cultures under shade lived to crop maturity but performance was highly unsatisfactory.

(iv) Pre-summer large scale *rangeeni* mortality

Experiment on pre-summer large scale *rangeeni* lac insect mortality was initiated at IRF on *palas* in October 2008. Ten *palas* trees were inoculated with yellow *rangeeni* lac insects. Pesticide spray as per recommended schedule and flood irrigation was provided to the trees at fortnightly interval. However, complete mortality was recorded on all the trees by first week of March, 2009. Visits were also made during the period to different villages (Chitramu, Barudih, Irud, Otongora, Ruitola and Mangobandh) from where lac insect mortality had been reported. Samples of dead lac insects were collected to study possible cause of mortality. Collected samples were caged for recording observations on pest / parasite emergence. Parasitic emergence was not seen probably because samples were collected almost a month after mortality of lac insect had taken place. Lac cultures on *bhalia*, *ber* and *palas* have been initiated during October 2009 for elaborate study on possible causes(s) of mortality.

Field visits under taken under the project

Nine field visits to Nineteen villages were undertaken during the year for technical guidance, lac crop monitoring, pre-summer lac insect mortality etc. (Table 50).

Table 50. Field visits under taken under the project:

Sl. No.	Date	Village	Purpose
1	21.01.09	Nichitpur and Later, Khunti	Guidance on inoculation of broodlac on *semialata*
2	31.01.09	Kharsidag and Mangobandh, Ranchi	Monitoring of lac crop on *semialata* and *ber*
3	04.03.10	Chitramu, Barudih and Irud, Khunti	Lac crop monitoring for pre-summer lac crop mortality
4	06.03.10	Otongoda and Ruitola, Khunti	Lac crop monitoring for pre-summer lac crop mortality
5	16.05.10	Chitramu, Churdag, Devgain and Nichitpur, Khunti	Monitoring of *semialata* plantation, site selection for new plantation and lac crop on *ber*
6	20.05.10	Kharsidag, Ranchi	Site selection for new plantation of *semialata*
7	02.07.09	Kharsidag and Kochbong, Ranchi	Site selection for new plantation of *semialata*
8	31.07.09	Chitir and Sodah, Ranchi	Lac crop monitoring of productive breeds.
9	29.08.10	Irud, Khunti	Guidance on *semialata* plantation

3.1.3 Developing sustainable farming system models for prioritized micro watersheds in rainfed areas of Jharkhand

The project was sanctioned in July 2008 under component-3 of NAIP. The institute is a consortium partner and Birsa Agriculture University, Ranchi is the lead centre. The other partners are Horticulture and Agroforestry Research Programme, Ranchi, Central Upland Rice Research Station, Hazaribag.

Pruning of *palas* trees: More than 800 new trees of *palas* and same number of *ber* trees were pruned in adopted villages of Jamtara and Dumka district for inoculation of summer crop in November.

Raising of lac crop on *palas* and *ber* trees:

A total of 45 beneficiaries of eight villages inoculated 204 trees of *palas* and 172 *ber* with 700 kg of broodlac during November 2009 in Jamtara district (Table 51). Similarly a total of 34 beneficiaries of seven villages inoculated 195 trees of *palas* and 161 *ber* with 600 kg of broodlac during November 2009 in Dumka district (Table 52).

Table 51. Inoculation of summer *rangeeni* lac crop on *palas* & *ber trees* in Jamtara district- Nov 09

Block	Village	No. of beneficiaries	Quantity of *rangeeni* broodlac used (kg)	No. of *palas* trees	No. of *ber* trees	Total trees
Jamtara	Sinjotola	6	60	18	15	33
	Dahartola	6	75	32	8	40
	Saurimundu	3	25	12	5	17
	Rupaidih	2	40	15	6	21
	Charedih	5	100	22	30	52
	Sub total	**22**	300	99	64	163
Narayanpur	Baramajhladih	10	300	105	55	160
	Rampur	5	40	-	23	23
	Raitola	4	35	-	18	18
	Muslimtola	1	25	-	12	12
	Sub total	20	400	105	108	213
	Total - Jamtara	**42**	**700**	**204**	**172**	**376**

Table 52. Inoculation of summer *rangeeni* lac crop on *palas* & *ber trees* in Dumka district- Nov 09

Block	Village	No. of beneficiaries	Quantity of broodlac used (kg)	No. of *palas* trees inoculated	No. of *ber* trees inoculated	Total trees inoculated
Dumka	Karmatand	5	80	25	16	41
	Guhiajori	4	50	15	8	23
	Kodokicha-6	5	80	10	35	45
	Kodokicha-7	6	90	30	16	46
	Sub total	**20**	300	80	75	155
Jama	Bhounra	6	200	70	32	102
	Ragat	5	50	25	29	54
	Karela	3	50	20	25	45
	Sub total	**14**	**300**	**115**	**86**	**201**
	Total - Dumka	34	600	195	161	356
	Grand total	**76**	**1300**	**399**	**333**	**732**

Production of lac in focussed area of Jamtara district (Output):

Though many farmers started marketing of broodlac themselves but in our focussed area 24 farm families of Jamtara and Narayanpur block earned substantial income from lac production as given in Table 3. A total of 1372 kg of broodlac and sticklac worth Rs 68,600 have been produced by these groups of farmers. The estimated profit for these groups of farmers comes around Rs 60,000 during 2009-2010. This is in addition to farmers who marketed directly to traders. The output in terms of broodlac (lac seed) and sticklac comes during April, July, October and December. An estimated 281addtional mandays generated for these 22 farm families with this venture in Jamtara district (Table 53).

Table 53. Employment and income generation from lac production

Block	Village	No. of farm families	Production of sticklac (kg) in April	Production of broodlac (kg) in July	Production of broodlac (kg) in October	Marketing of Scraped lac (kg)	Total Production (kg)
Jamtara	Dahartola	3	13	64	50	4	131
	Charedih	2	12	102	80	-	194
	Rupaidih	1	3	12	-	-	15
	Sinjotola	5	21	106	20	-	147
	Saurumundu	1	6	70	-	-	76
	Sub total	**12**	**55**	**354**	**150**	**4**	**563**
Narayanpur	Baramajhladih	12	81	439	250	39	809
	Grand total	24	136	**793**	**400**	**43**	**1372**
Estimated no. of man-days (working days) generated			**35**	**160**	**80**	**6**	**281**
Estimated Income generated (Rs)			**6,800**	**39,650**	**20,000**	**2,150**	**68,600**

Utilisation of trees located on bunds of paddy field: In several adopted villages, though *palas* and *ber* trees are mainly present on barren land in clusters. But at many places, *palas* trees are also present on borders of paddy field. These were earlier used for fuel wood purpose only and smaller trees were also removed. Such border trees are now being utilised by the farmers of Baramajhladih and Dahartola villagers for lac cultivation without any adverse effect on paddy production (Photograph). Lac on these trees survived better in view of better moisture availability during summer season.

Demonstration and Training on Scraping of lac from plant sticks:

Lac scraping machine procured under the project has been given to a group in Bramajhladih village. Technique of scraping lac from sticks by lac scraper (Electric motor and manually operated) has been demonstrated to farmers of Baramajhladih village. More than 10 women folk and 15 men participated. Lac crop harvested from *palas* tree during April 2009 was scraped from this machine. Women were mainly involved to carry out this activity. Though machine is electric operated also but at present it scraped by hand operation as the desired quantity of lac was not produced. The farmers of this village scraped more than 40 kg of lac from lac sticks successfully with the available option of electric motor.

Marketing of scraped lac at *Baramajhladih* (Narayanpur block of Jamtara)

Women are being trained for scraping of lac from sticks

Paddy farming in open land between *palas* plantation (Village-Dahartola)

Sh Subodh Hembrom of charedih village who produced 122 kg broodlac (lac seed) and earned Rs 6,500 during 09-10 from lac only

Farmers from Dahartola, Charedih, Rupaidih and Sinjotola (Jamtara) after receiving cash income from lac

Lac crop on *palas* tree located on border of paddy field in Dahartola village - No harm to paddy

Marketing of scraped lac as a cash crop at Kodokicha village in Dumka district

Visit of Director IINRG: Dr Bangali Baboo, Director IINRG visited adopted villages of Jamtara and Narayanpur block on 21st May 2009 in order to monitor status of lac crop intervention in Jamtara district. The team comprises two senior Scientists, and representative of one NGO from Palamau where there is frequent lac crop mortality. The Director appreciated the efforts made so far in the area. He also addressed a gathering of farmers actively involved in lac production activity. The farmers stated that earlier they were not convinced with this intervention and they have been forced to inoculate their trees with broodlac during October 2008. But after assessing their crop status during April 2009, they were delighted and promised to inoculate more trees under lac production which were otherwise left as such and use this tree for fuel wood purpose. A group of farmers assured to develop this area as broodlac production centre (lac seed village) so that lac production spreads to other adjoining area also.

Dr Bangali Baboo, Director IINRG visited lac crop at Baramajhladih village in NAIP area.

Dr Bangali Baboo, Director IINRG addressing and congratulating farmers for successfully adopting lac cultivation in Baramajhladih village of Jamtara district

Training conducted for Dumka and Jamtara farmers

A total of 24 farmers received training of three days duration on "Scientific lac production processing and uses of lac" at Indian Institute of Natural Resin and Gums. It was concluded on 2nd April 2009 . Besides, On- farm training on "Scientific lac production" on *palas* and *ber* trees was also conducted in farmers field at Baramajhladih and Rupaidih village of Jamtara district where 95 farmers participated. As a feedback, farmers informed that earlier they were afraid of lac insect and not willing to take up this venture but now there is definite change in their perception as they utilise their free time for this venture.

Involvement of women folk

Women folk were actively involved in lac production activity specially scraping and marketing at village level. For the first time women came to know the merits of lac in terms of its value. Scraping and marketing was done by women folk in villages of Dumka district. Earlier these farmers were not even aware of lac but now slowly have under taken this activity.

3.1.4 Improving rural livelihood security through sustainable integrated farming system model and allied enterprises in Bastar region of Chhattisgarh

The project started in October 2008 under component-3 of NAIP. The institute is a consortium partner and S G College of Agriculture, Jagdalpur of Indira Gandhi Krishi Viswavidyalaya, Raipur is the lead centre. The other partners are Agrocret Society, Kanker (NGO), Participatory Action for Rural Development Society (PARDS) Jagdalpur, CSWCRTI, ICAR and Sanjeevni (MFP Forest dept) Raipur. The work is being carried out in four clusters namely *Bastanar, Pandawada , Pusagaon* of Jagdalpur district and *Kanhanpuri* in Kanker district. Promotion of lac cultivation is one of the interventions in these areas. On-farm training programme and crop monitoring has been conducted with consortium partners as given in the Table 54.

Table 54. On-farm training conducted under the project

Sl No.	Consortium partner	Venue of training	Date of training	Number of participants
1	Agrocret Society, Kanker	Primary School, village- Kanhanpuri Kanker	7.6.09	25
2	PARDS, Jagdalpur	Village, Kotamsar, block- Daibha Jagdalpur	8.6.09 8.10.09	25 50
3	S G College of Agriculture, Jagdalpur	Village –Tahakapal Jagdalpur	8.6.09	80
	Do	Rautpara-Lalaguda	9.6.09	200
4	R K Mission Ashram, Jagdalpur	village *Palki* Narayanpur	11.6.09 10.10.09	60 150
		Total		**590**

Lac intervention and crop monitoring

Kusmi lac crop on *kusum* tree was successfully taken in Palki village of Narayanpur district. Similarly same crop was also taken from *ber* trees at the demonstration centre of R K Mission farm at Brehmbera. Plantation of *Flemingia semialata* was raised at the farm for demonstration purpose along with papaya. Growth performance of bushy host *Flemingia semialata* is excellent under irrigated condition as it produce upto 6 tillers per plant within 6 months of planting. The *kusmi* broodlac inoculated on *ber* trees during July 2009, could not survive in Tehkapal area due to continuous rain at the time of inoculation. In view of this, *rangeeni* broodlac was inoculated during October 2009 as succulent shoots were available on trees. The pest management technology was adopted as per recommendation.

Lac Cultivation training at village Palki (Narayanpur)

Lac encrustation on *Kusum* tree at village Palki, Narayanpur (Winter Crop - 2009)

Demonstration of *kusmi* lac production on *ber* trees at R K Mission Brehembera farm

Demonstration of Mixed plantation of Papaya and *Semialata* at Brhembera farm R K Mission- Narayanpur

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

Evaluation of chemical insecticides

Field experiment was undertaken at Institute Research Farm and Farmer' s field for identification of some newer chemical pesticides on lac culture which are safe to lac insect and effective in reducing the incidence of lac insect predators. For the management of two key lepidopteran predators *viz.*, *Eublemma amabilis* Moore and *Pseudohypatopa pulverea* Meyr on the lac crop, some IPM recommended newer chemical insecticides *viz.*, indoxacarb, spinosad, fipronil, lambdacyhalothrin, alphamethrin and bifenthrin, identified on the basis of previous years trials were again evaluated for their safety to lac insect and efficacy against lac insect predators on *rangeeni* and *kusmi* lac crops raised on *palas* (*Butea monosperma*) and ber (*Zizyphus mauritiana*). Recommended insecticides endosulfan and ethofenprox which are currently in use were also sprayed for comparison of effectiveness with the newer insecticides.

Evaluation of chemical insecticides on *rangeeni* rainy season (*katki*) lac crop raised on *palas*

Six newer chemical insecticides viz., indoxacarb, spinosad, lambdacyhalothrin alphamethrin, fipronil and bifenthrin along with recommended ethofenprox and endosulfan were evaluated on rainy season (*katki*) *rangeeni* lac crop raised on *Butea monosperma (palas)* at IRF, Ranchi. For evaluation of chemical insecticides for their safety to lac insect and toxicity towards lac insect predators, the broodlac was inoculated during the month of July, 2009. First insecticidal spray was made 30-35 days after crop inoculation and repeated after 60-65 days of crop inoculation. For recording survival/mortality of lac insect to assess the safety of insecticides towards lac insect, samples were collected 10-15 days after first application of insecticides. Out of six newer chemical insecticides evaluated, insecticides indoxacarb, spinosad, alphamethrin, fipronil and bifenthrin were found to be promising and safe to lac insect for the third consecutive crop season also in which survival of lac insect in different insecticidal treatments ranged from 76-86% as against 81% in control, confirming the previous findings. Per cent reduction in different treatment of insecticides with respect to lepidopteran predator, *Eublemma amabilis* was observed between 70-95%. Whereas reduction in incidence of *Pseudohypatopa pulverea* with treatment of different insecticides was observed to the tune of 86-100% over control (Table 55).

Table 55. Efficacy of pesticides on lac insect and incidence of lac insect predators (IRF)

Sl	Insecticide	Conc. (%)	Survival of lac insect (%)	Reduction in Predator's incidence (%) over control	
				E. amabilis	*P. pulverea*
1.	Indoxacarb	0.0036	85.84	60.0	71.4
		0.0072	79.41	80.0	100.0
2.	Spinosad	0.0025	82.84	75.0	85.7
		0.005	82.07	95.0	100
3.	Fipronil	0.005	82.08	70.0	100.0
4.	Ethofenprox	0.02	76.21	80.0	100.0
5.	Endosulfan	0.05	79.46	75.0	85.71
6.	Control		81.10	-	-

Three newer insecticides viz., indoxacarb, spinosad, fipronil and one *Bt* formulation (Halt) of indigenous origin along with recommended insecticides ethofenprox and endosulfan were evaluated on rainy season (*katki*) *rangeeni* lac crop raised on *Butea monosperma (palas)* at Putidih, Jhalda with farmer's participatory mode. All the pesticides proved safer to lac insect as evident from the survival of lac insect in different treatments of insecticides which ranged from 92-98% as against 93% in control (Table 56). All the pesticides were found effective in reducing the incidence of lac insect predator's *viz.*, *E. amabilis and P. pulverea*. The general feedback received from the farmers about the performance of pesticides spray was quite encouraging and satisfactory.

Table 56. Efficacy of pesticides on lac insect and incidence of lac insect predators (Farmers field)

Sl	Insecticide	Conc. (%)	Survival of lac insect (%)	Reduction in Predator's incidence (%) over control	
				E. amabilis	*P. pulverea*
1.	Indoxacarb	0.0036	98	72.2	100
		0.0072	95	83.3	100
2.	Spinosad	0.0012	97	52.3	72.7
		0.0025	92	72.2	100
		0.005	93	88.9	100
3.	Fipronil	0.005	94	80.6	100
4.	Ethofenprox	0.02	96	86.1	54.5
5.	Endosulfan	0.05	96	66.7	100
6.	Halt (Bt)	2 gm/lt	96	86.1	45.5
7.	Control		93	-	-
	CD (0.05)		9.34 NS		

Evaluation of chemical insecticides on *kusmi* rainy season (*aghani*) lac crop raised on *ber*

Newer insecticides indoxacarb, spinosad and fipronil along with recommended ethofenprox and endosulfan were evaluated on winter season (*aghani*) *kusmi* lac crop raised on *Zizyphus mauritiana* (*ber*) at IRF and farmer's field. For raising the lac crop, broodlac was inoculated during the month of July on 6 months old pruned trees. First application of insecticides was made 30-35 days of crop inoculation and survival/mortality of lac insect was recorded 10-15 days after application of insecticides. Insecticides were found to be quite safe and did not show any detrimental effect on lac insect. *Kusmi* lac crop raised on *ber* tree is progressing well and quantification of lac insect predators and parasitoids incidence will be carried out at the time of crop harvesting.

Large scale bioefficacy trial of newer insecticide fipronil was carried out on *kusmi* winter crop raised on *Flemingia semialata* (Nos 4500) by the SHG of Moredongari, Bastar, Kanker. As reported by SHG, the insecticide was found to be safe on lac insect.

Evaluation of *Bacillus thuringiensis* formulation

Two newer commercially available *Bacillus thuringiensis* var. *kurstaki* formulations (Halt and Knock WP) of indigenous origin along with *Bt* formulation (Delfin) of exotic origin were evaluated on winter season (*aghani*) *kusmi* lac crop raised on *Zizyphus mauritiana* (*ber*) at two concentrations (2gm/lt and 3 gm/lt) for their safety to lac insect and toxicity to lepidopteran lac insect predators *viz.*, *E. amabilis* and *P. pulverea*. For raising the lac crop, kusmi broodlac was inoculated in the month of July, 2010. First application of biopesticides was made after 40-45 days of inoculation. The survival of lac insect after first application of biopesticides was at par with the control indicating the safety of biopesticides towards lac insect.

Insect Pests of lac host plants

- Incidence of surface grass hopper was observed on small plants of *kusum* devouring the leaves of *kusum* in the month of July-August.
- Incidence of scale insect was observed in the month of October-November on tender twigs of *palas* trees. Samples have been collected and sent to Division of Entomology, IARI, New Delhi for identification.

3.2.2 Study and documentation of cultivation and processing of lac in Chhattisgarh and market survey on lac based products

Listing of Training programme on lac for Chhattisgarh

- Different training programmes on Scientific methods of lac cultivation *i.e.* One week farmers training programme, Master's training programme, Educational programme, On-farm training programme, Motivational training programme, One day orientation training programme, training programme on management of broodlac and training on lac processing and product development in Chhattisgarh were compiled for last nine years (Table 57, 58).
- A total number of 8275 persons have been trained on scientific lac cultivation from different district of Chhattisgarh.
- A total number of 3647 farmers trained under On-farm training programme followed by Motivational training programme (2561) and One week farmers training programme (1534)

- Out of total farmers trained under in Chhattisgarh since last nine years, the maximum 1596 farmers were from Kanker district followed by Raigarh (1503), Bastar (951), Mahasamund (738), Rajnandgaon (538) and Jashpur (538).
- Under training programme on lac processing and product development, training were imparted on Aleuritic Acid, Bleached lac, Lac dye, Iso-ambretollide and Testing and analysis of lac to lac entrepreneurs in Chhattisgarh.

Table 57. Year-wise total number of farmers trained under various training programme in Chhattisgarh

Type of training	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
One week farmers training programme	0	0	8	40	6	604	285	399	192	**1534**
Master's training programme/ Educational programme	0	0	0	11	20	0	29	20	325	405
On-farm training programme	82	175	0	145	30	1418	474	691	632	**3647**
Motivational training programme	0	0	0	349	303	145	0	270	1494	**2561**
One day orientation training programme	0	0	0	0	21	64	0	0	0	**85**
Training programme on management of broodlac farm	0	0	0	0	0	0	0	43	0	**43**
Total	**82**	**175**	**8**	**545**	**380**	**2231**	**788**	**1423**	**2643**	**8275**

Table 58. District-wise total number of farmers trained under various training programme.

Name of District	One week farmers training programme	Master's training programme/ Educational programme	On-farm training programme	Motivational training programme	One day orientation training programme	Training programme on management of broodlac	Total
Raipur	66	43	239	0	16	0	**364**
Mahasamund	25	4	285	424	0	0	**738**
Dhamtari	66	14	109	25	0	0	**214**
Kanker	312	62	896	303	0	23	**1596**
Bastar	259	13	319	350	0	10	**951**
Durg	0	8	0	0	0	0	**8**
Rajnandgaon	91	20	75	352	0	0	**538**
Narayanpur	0	5	0	0	0	10	**15**
Bijapur	0	4	0	0	0	0	**4**
Dantewada	184	12	190	0	0	0	**386**
Korba	53	29	277	0	0	0	**359**
Bilaspur	0	49	0	180	0	0	**229**
Surguja	60	52	213	0	69	0	**394**
Kawardha	0	12	0	136	0	0	**148**

Name of District	One week farmers training programme	Master's training programme/ Educational programme	On-farm training programme	Motivational training programme	One day orientation training programme	Training programme on management of broodlac	Total
Janjgir	0	19	0	0	0	0	**19**
Koriya	0	18	253	0	0	0	**271**
Jashpur	111	12	325	90	0	0	**538**
Raigarh	307	29	466	701	0	0	**1503**
Total	**1534**	**405**	**3647**	**2561**	**85**	**43**	**8275**

Development of questionnaire

The following questionnaire/ schedule have been developed under the project for collection of data and information:

- Information from Forest offices
- Survey of lac growers
- Survey of lac growers for documentation of success story
- Survey of lac traders
- Survey of lac manufacturers and exporters
- Survey of markets
- Survey of consuming units

Documentation of all lac related activities and progress in Chhattisgarh

Survey has been conducted in three districts (Raipur, Dhamtari and Mahasamund) and five forest divisions (E. Raipur, Raipur, Gariyaband, Dhamtari and Mahasamund) of Chhattisgarh for collection of information and data related to lac under various projects taken up by the Chhattisgarh Government. The necessary data and information have been collected for documentation purpose.

Raipur district

One Self Help Group has been selected for promotion of lac cultivation in Gidani village of Chhura block of Raipur district by Zila Panchayat under 'Nava Anjor' programme (*Chhattisgarh Gramin Garibi Unmulan Priyojana*) during the year 2006-07. The total budget of the project was Rs. 0.405 Lakh and funding agency was World Bank. Training to the lac growers were provided by Forest department, Kanker. Project has been completed and is sustainable.

Raipur Forest Division

During last five years (*i.e.* 2004-05 to 2008-09) no project on lac has been sanctioned or implemented in the division. A three years project in 2009-10 on lac production has been started by MFP District Union, Raipur in *Baya Prathamic Vanopaj Samiti* of Devpur range. The project was sanctioned under European Commission fund and the total budget of the project is Rs. 9.00 lakh. Resource survey has been conducted by MFP District Union. The major activities in the project are training on scientific methods of lac cultivation to farmers, distribution of broodlac and tool kit production assessment, etc.

East Raipur Forest Division

During last five years no project on lac has been sanctioned or implemented in the division. Out of 7 ranges in the division, 3 ranges *i.e.* Chhura, parsuli and Gariyaband having lac cultivation in practices. Newly appointed field facilitates has made resource survey in their ranges on lac hosts availability.

Gariyaband Forest division

A one year project on lac production has been started by MFP District union, Gariyaband in Indagaon range. The project was sanctioned under European commission fund and the total budget of the project is Rs. 16.00 Lakh during the year 2009-10. Resource survey has been conducted by MFP District Union on lac host availability. The major activities in the project is resource survey, pruning, crop protection, broodlac distribution, Farmers training, Masters training, village level processing etc. The project includes 342 families having 2360 *Kusum* hosts. During the last five years no specific project on lac has implemented in the

division. Farmers training on scientific methods of lac cultivation have done in the division. Out of 4 ranges in the division except Udanti range, all ranges having lac cultivation in practice.

Mahasamund district and Forest division

A project on lac production in the division has been started during 2003-04 with the budget of Rs. 16.00 Lakh. The funding agency was Zila Panchayat and MFP district Union. A total number of 750 families have been adopted (394 for *palas*, 356 for *kusum*) for lac cultivation. This includes 7893 *Palas* and 1003 *Kusum* trees in 6 ranges of the division. The project includes training on scientific methods of lac cultivation, distribution of broodlac, etc. Resource survey has been conducted by MFP District union. Initially the broodlac was purchased from Seoni and Balaghat district of Madhya Pradesh for inoculation purpose.

Dhamtari district and East division

A project on lac production in the division has been started during 2002 in Sakra range with the budget of Rs. 12 lakh. The project was funded by Zila Panchayat and MFP District Union. A 3 years new project entitled 'Lac based employment Generation Programme' has been started in the district during 2009-10. The project was sanctioned under European commission fund and the total budget of the project is Rs. 6.00 Lakh. The project includes 396 families (7 Self Help Groups) in *Gedra Prathamic Vanopaj Samiti* of Birgudi range. The project includes 2688 *palas*, 134 *ber/kher* and 103 *kusum* trees for lac cultivation.

Selection and Sampling of District and lac growers

Selection of district

There are eighteen districts in the state of Chhattisgarh (including two newly created districts namely Narayanpur and Dantewada). For the purpose of present study four districts has been selected for impact study of lac related activities/projects in the state. For the present study four districts has been selected purposively keeping in view the following point:

1. Number of lac related projects implemented and number of trained manpower on scientific method of lac cultivation in the district.
2. Lac production scenario in the district
3. High potential of lac production but actual production is low.
4. Representation of North and South Chhattisgarh.
5. District with lac processing facility and without lac processing facility.

Considering the above points in view Korba, Raigarh, Kanker and Raipur districts have been selected for the present study:

In each selected districts 100 numbers of lac growers will be selected applying stratified random sampling technique in following manner.

Survey of lac growers

Survey of lac growers (10 in each village) has been conducted in the village namely Kanhanpuri, Bhansuli, Basanbahi, Nawadobri, Badabani of Naharpur block and Mungwal, Terhi Kondal, Tudage of Bhanupratappur block of Kanker district. First hand information shows that agriculture and lac cultivation is the main occupation of farmers. Majority of farmers cultivating lac on *kusum* while some farmer cultivating lac on *palas* and *khair* as these two hosts are available in lesser quantity. After implementation of projects/ training majority of lac growers adopting improved cultivation technology *i.e.* coupe system, pruning, selection of quality broodlac, *phunki* removal, synthetic net, spray of fungicide and insecticide. Annual production of lac at growers level have increased more then two times to majority of lac growers after implementation of project. The visible impact has been seen in sticklac and broodlac production as no growers producing broodlac before implementation of project. Majority of farmers using only axe and Dauli for lac cultivation operation while some farmer using scecateur and Gatoor sprayer provided under the project. In the study area earning from lac, forest produce and labour is the major source of cash income of farmers while majority of production of foodgrains, vegetables, livestock is used for home consumption and only surplus amount sold in the market. Sticklac is sold by growers to traders in village or nearly weekly *haats* while broodlac is sold with the help of Forest Department, Kanker. Majority of growers sell lac in the lot of 5-10 kg. in every market while some big lac producer sell in the lot of 25-50 kg. Growers need mid-term/refresher course on scientific lac cultivation to refresh and update their knowledge on scientific lac cultivation.

Market Survey on Diversified uses of lac in India

Domestic consumption of lac and its value added products in various sectors have been quantified after having detailed discussions with lac traders, lac manufacturer and exporter of lac. Present scenario of product-wise consumption of lac in various sectors with approximate quantity has been presented and given in the Table 59.

Table 59. Diversified uses of lac in India with approximate quantity

Name of products	Approximate quantity (tons)	Application area	Share of different sectors (in %)
Seedlac/ Shellac/ Button Lac	2500	Paint & Varnish	58
		Handicraft (cottage)	20
		Ornaments	5
		Cosmetics	3
		Electrical insulation	4
		Pharmaceutical Industries	3
		Bulb capping cement	4
		Others	3
Bleached lac	150	Colorless varnish	70
		Pharmaceutical Industries	15
		Chocolate coating	5
		Other	10
Aleuritic Acid	25	Perfumery Industry	85
		Cosmetics	10
		Fine chemicals/ Bio-active	3
		Pharmaceutical Industries	2
Dewaxed De-colorized Lac	100	Fruit coating	5
		Varnish	80
		Other	15
Gasket Shellac	150	Automobile Industries	40
		Sanitary fitting	60
Wax	15	Polish (Floor, Shoe, Auto mobile polish)	70
		Cosmetics	10
		Other	20
Dye	2	Textile Industries	100

3.3 Liaison, Information and Advisory Service

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

Survey for collection of information on Natural resins and Gums

- Information has been obtained from Forest department and market survey on production of gums in different states. The production of all gums in the states during the year 2008-09 are as following
- Gujarat– 279 quintals; Andhra Pradesh – 2,525 quintals, Orissa - 3000 quintals; Jharkhand - 1200 quintals.

Organization of Industrial meet

- An Institute-Industry interface meeting was organized in association with the Dhamtari Lakh Udyog Sangh, Dhamtari on 28-3-2010 at Dhamtari, Chhattisgarh. More than 50 participants consisting of lac industrialists, forest officials, traders, progressive farmers etc. participated in the meeting. Presentation was made on the Institute activities. Discussions were held to find out the problems faced by lac manufacturers. The major problems posed by the entrepreneurs are requirement of analytical method to address problem of adulteration in lac, drying of seedlac during rainy season, mechanization of removal of woody matter from seedlac, utilization of gummy mass after isolation of Aleuritic acid, requirement of cheaper alternative for charcoal and possible mechanization of the process for preparing button lac etc. to address problems of charcoal and labour unavailability.

Identification of industrial problem

- As per survey conducted in the processing units located at Dhamtari and Kanker , the major problem posed by processors were – drying of seedlac during rainy season and presence of wood/sand particles in seedlac.

Preparation of Directory

- More than 350 addresses with their complete details *i.e.* name, address, phone, fax, mail, commodities handled etc. of traders, manufacturer, exporters, importers, GOs, NGOs related to natural resins and gums has been collected from primary and secondary sources for preparation of Directory related to Natural Resins and Gums. The Directory has been published.

Information and advisory services

- Two press releases namely Management of lac insect pests during rainy season and Management of lac insect pests during *baisakhi* lac crop season with general tips on lac cultivation have been given.
- A Radio talk has been delivered on *Lakh Keeto Ki Surakksha Kaise Karein* on 21 November, 2009.
- One write-up has been prepared on protection of *baisakhi* lac crop for publication in news paper.
- Information have been collected on the production areas in different states of major gums and resins for preparing maps.
- Five episodes related to lac crop production, pest management, host plant management etc. were broadcast by Etv Bihar/Jharkhand
- A Detailed Project Report (DPR) for Common Facility Centre for lac cluster was prepared by the Scientists on the request of District Industries Centre, Purulia.
- Scientists attended the Awareness Programme on Shellac Cluster organized by the District Industries Centre, Purulia at Balarampur.
- The Institute participated in 8 Kisan Melas, Regional Fair & Exhibitions etc. organized in different places for extension, awareness, promotion of technologies and products developed by the Institute.
- Visits have been made to Gangcha village in Chandrakona-I Block of Paschim Medinipur to monitor the activities and plantation raising of *F. semialata* (a bushy lac host plant) by the NGO *i*MAP (International Mass Awareness Programme) under technical guidance of this Institute.
- About 78,000 plants of *F. semialata* are already in the field in over three hectares of land spread out in about 23 surrounding villages involving 35 farmers.
- Demonstration for *kusmi* lac crop on 45 bushes of *F. semialata* and 25 bushes of *F. macrophylla* is being carried out in the Technology Park of BAU, Kanke, Ranchi. The plants were inoculated during August 2009 and recommended pesticide application carried out as per schedule.
- Visit was made to Bankhedi Forest Range (Hoshangabad District, Madhya Pradesh) and adjoining areas during July, 2009 for providing advice and inspection of areas/sites for carrying out *kusmi* lac cultivation in association with the Forest Department and KVIC. Bankhedi range is having over 50,000 *kusum* trees in forest and private land. Trees of *Sterculia urens* (gum Karaya) and *Boswellia serrata* (guggal) are available in plenty in the forests of Satpura mountain range near Pachmarhi.
- Visit to village Kantajhar (Elga) in Kutra Block of Sudergarh District, Orissa during September, 2009 for monitoring of lac crop raised on 600 *Flemingia semialata* bushes by a farmer under FLD.
- Scientists attended the Farmer's Awareness Programme at village Salgadih, Tamar on 19 May, 2009, organized by the Jharkhand State Kisan Mahasabha.
- Monitoring of lac crops in different places in the states of Jharkhand, West Bengal, Orissa and Chhattisgarh

3.3.2 Network project on harvesting, processing and value addition of natural resins and gums

Collection and compilation of information on tapping of natural resins and gums :

Taping of pine resin

Four methods for tapping pine trees in India have been reported. These are (a) box method (b) cup and lip method (c) rill method and (d) bore hole method.

Box method

- This is the oldest method of resin tapping.
- A cavity or box is chopped at the base of the trees. This cavity is 10 x 10 cm and up to 12 cm deep.
- It is meant to collect the resin as it exudes from the blaze or incision that is made just above the box, by chipping the bark and outer layer of the sapwood.
- The resin oozes out of the blaze and is collected in the box.
- However, this method is very wasteful and the trees tend to die some years after resin tapping is started.

Cup and Lip Method

- In this method, the outer bark of the tree is scraped off with an adze to reasonably smooth surface 60 cm long and 15 cm wide and 25 cm above the point where the lip is fixed.
- A cut about 15 cm broad and slightly slanting outwards is made with a curved chisel and mallet at a height of 16.5 cm above the ground.
- The lip, a rectangular piece of galvanized iron (15 cm x 15 cm) is driven into the cut to collect resin into a pot kept below. Pot is partially covered to prevent pieces of bark and dirt etc. from falling into the oleoresin and also to minimize the evaporation of turpentine from resin

Rill Method of Rosin Tapping

Rill Method is an improved method standardised at Forest Research Institute, Dehra Dun to overcome the disadvantages of Cup & lip method (Verma, 1983)

- In this method the bark of the tree over a surface area of about 45 cm x 30 cm and about 15 cm above the ground level is removed with the help of a bark shaver. The surface is made very smooth and the thickness of the bark left should be more than 2 mm to facilitate freshening of the blaze.
- Blaze frame is kept on the stem in the vertical position, 15 cm above the ground level and the position of the blaze is marked with a marking gauge. The central groove is cut with a groove cutter by drawing it from top to bottom.
- The lip is then fixed in the tree with nails.
- A 5 cm nail is then driven into the tree, about 2 cm below the mid point of the lip and pot is hung from the nail.

Bore hole method:

- There is less stress due to small size (1" dia.) of the hole. The hole heals fast.
- The technique is very suitable for the protection of tree against fire, insect/pest and diseases.
- Prolonged resin flow can be obtained from boreholes for a period of several months without wounding the stem.
- The holes are made with the help of a machine, therefore the labour productivity of this technique is several folds greater than the other method.
- The technique could be very effective in conservation and management of pine resources of India

Tapping of Dammar Resin

Sal dammar

In India, tapping involves removing 3-5 narrow strips of bark of tree (*Shorea robusta*), 90-120 cm above the ground. In about 12 days, the grooves become filled with the resin, which oozes out as a whitish liquid that changes to brown soon after drying. The cavities of the exudation continue and the resin is collected as before. The process is repeated several times in a year.

White dammar

Semi-circular incisions are made on the stem of the tree (*Vateria indica*) up to the surface of the sapwood. Blazes or cuts are so spaced as to cause least damage to the tree. The resin starts oozing from the incisions in 3-4 days and continues for 60-90 days. The resin is also exuded when the bark is scorched by lighting fire around the base of the tree. This method gives a high yield of resin but damages the timber and may even kill the tree.

Black dammar

Tapping is done by making vertical incisions on the bark in a belt about 1.8 m from the bottom and then lighting a

fire around the base of the tree (*Canarium strictum*). The resin flows out after two years and continues for about 10 years. The flow lasts for about six months every year from November to April. The viscous resin that oozes out hardens into a somewhat translucent mass of a bright shining colour that is collected manually.

Gum Tapping in *Stereculia urens* Roxb.

In *Stereculia urens* Roxb. wounding the tree was found to result in the disintegration of the parenchyma cells in the wood near the cambium into gummy substance. In fact this is the tissue which contributes much in making available the commercial quantities of gum. Since most of the gum exudes from the ducts in the wood formed after wounding, it is necessary that the blazes should be deep enough just to expose the newly formed wood for obtaining the gum. After blazing the wound responses have been observed to extend on all the four sides of the blaze but more on the vertical direction that laterally maximum being on the upper side of the wound. The gum canals are continuously formed in the wood for several years and the tree is wounded.

Selection of trees for tapping

Trees of and above 90 cm in girth at breast height are tapped. Trees of lower firth classes are not tapped since any damage to them may adversely affect their growth. Middle aged trees yield more gum.

Season of Tapping

The gum exudes from the trees all the year round. The flow is more in hot weather. Tapping may be done from October to June. No collection should be done in rainy season as most of the exuded gum is either washed away or becomes darker in colour.

Collection

Collection of gum may be done by picking at fortnightly intervals when freshening is also done. Gum may be collected when completely dry. This will reduce processing cost and it will not contain loose bark adhering to it.

Yield

A tree of about 1.4 to 1.9m girth with two blazes yields 2 to 5 kg of gum in a year and produce upto 10 kg depending upon the locality, size and vigour of the growth of tree and method of tapping. The yield per 100 blazes is estimated to be 75 to 150 kg per year on an average.

Gums exudes from wounds of the trees throughout the year but is at its maximum in summer, from mid April to mid June being about 25-30% and also immediately after the rains from September to October being 15-20% of the year collection. Exudation is less from November to February and starts increasing again from March onwards till rains.

Gums also exudates in the form of coiled threads from small holes or cracks on the stem of tree, made by borers, healing wounds etc. However, the yield being low it has not commercial value.

Tapping of Gum Ghatti

The trees are usually not tapped for gum. The gum oozes out naturally from the bark through injuries and wounds mostly in summers and is collected manually. In some places, artificial incisions are made in the tree bark to increase the gum yield. These incisions are made carefully so as not to permanently injure or kill the tree.

Maximum quantity of the gum is collected during the summer months *i.e.* from March to mid of June. During this time, as the weather gets warmer, the yield increases. Normally the largest crop is picked in April. A tree on an average yields around 1-2 kg gum in a year. Gum yield depends upon the locality, size and vigour of the growth of tree and method of tapping.

Tapping of Gum Arabic

The gum exudes from the cracks on the bark of the tree under difficult conditions such as heat, dryness, wounds and diseases. The gum flows naturally from the bark of the trees in the form of a thick and rather frothy liquid, and speedily concretes in the sun into tears.

Harvesting/ Collection of Gum-Resin

Taping of Asafoetida

The gum-resin is obtained from incisions in the roots and rhizomes of the plants (*Ferula asafoetida*). Usually plants of four to five years old develop very thick and fleshy, carrot shaped roots. The upper part of the root is laid bare and the stem is cut close to the crown. The

exposed surface is covered by a dome shaped structure made of twigs and earth. A milky juice exudes from the cut surface which soon coagulates when exposed to air. After some day, the exudates gum-resin is scraped off and a fresh slice of the root is cut.

Tapping of Salai gum

Usually trees (*Boswellia serrata*) of 90 cm girth and above at breast height are tapped for the gum-resin. Trees of lower girth classes should not be tapped since any damage done to them may adversely affect their growth. A thin band of bark of about 30 cm in length and 20 cm wide is shaved from the trunk of the tree at a height of about 0.75 meter from the ground. Thus the reddish phloem in which the resin canal and ducts lie is exposed. The blaze is freshened after every fourth or fifth day. The first collection of the gum-resin is made after 2 weeks. Collection is done by a scraper keeping a tray having a semi-circular edge around the blazed surface. Freshening of the blaze is done from time to time and the original blaze is slowly widened.

Tapping of Guggul

The gum-resin resides in the ducts located in the soft bark of the tree (*Commiphora mukul* and *Commiphora wightii*). It is obtained through a process called tapping. After attaining complete maturity of plant it is tapped from main stem. The resin ducts occur in the bark portion near cambial layer. Plant attaining 7.5 cm diameter is suitable for tapping. Usually 1.5 cm deep circular incisions are made on the main stem, not beyond the thickness of the bark. Guggul oozes out from these incisions as a pale yellow, aromatic fluid that quickly solidifies to form a golden brown or reddish brown agglomerate of tears or stalactic pieces. It is collected manually with spear. The gum-resin is scraped off the wound with the knife. The collection is done at an interval of 10-15 days.

Collection and compilation of information on processing and storage of natural resins and gums

Processing and storage of Rosin

The pine resin collected in tins is first emptied in to the Resin Pit. During winter, resin is a bit hard to work, so some amount of Turpentine Oil is mixed to dilute the resin. The Screw Elevator lifts this resin along with the impurities (pine needles, bark pieces and other foreign particles) to the mixing vat. The resin is heated indirectly in the vat by passing steam through copper coils for 4 to 6 hours to melt the resin in it. The temperature is maintained up to 95°C. The molten resin is then stirred with Iron arms mechanically and passed through 40-mesh stainless steel wire net to remove bigger impurities like pine needles, bark pieces etc. and then pumped by centrifugal pump into a rest vat. The resin is allowed to rest in the rest vat from 18 to 20 hrs. During this rest period, the impurities and dust if present, settle down by gravity. The dust/impurities are removed through a bottom valve and sent for processing separately as inferior grades of rosin. Resin from rest vat is carried to the compression chamber, from which it is carried to distillation kettle by steam pressure.

In the Distillation Kettle, the resin is cooked for 1-2 hrs by indirect steam. The molten resin remains inside the copper tubes and steam remains in the outside. In this process the turpentine oil and moisture present in the resin get evaporated and condensed in the condenser. Turpentine oil is collected in a separator.

The rosin left in the distillation kettle is taken out at 165° C and collected in trolleys, wherein about 100-200 gms of oxalic acid (depending on the quality of resin) is mixed to increase the transparency / shine of rosin. Further rosin is then packed in Tin Patra Barrels of 200 kg. capacity for storage and transportation.

Processing of Dammar

White dammar

The exuded resin is allowed to dry on the tree before it is collected. Collected resin is cleaned by sieving and hand picking to remove foreign matters, and packed in sacks for transfer to points of sale, either nationally or internationally.

Dammar is sometimes dewaxed for improving the qualities of varnishes made from it. The dewaxed damar is prepared by dissolving damar in a hydrocarbon solvent and precipitating and removing a high-melting, resinous fraction. The remaining soluble fraction is then more compatible with the

cellulose component of cellulose lacquers. In India, oil is distilled from dammar resin which is used for fragrance and medicinal purposes.

Processing and storage of Guar gum

Gaur Gum

Guar is a pod-bearing plant with six to nine seeds per pod. Each seed or bean is composed of hull, endosperm and germ parts, typically in a weight proportion of 15%, 40% and 45% respectively. The germ portion is predominantly protein, and the endosperm predominantly guar galactomannan or guar gum. Germ and hull are used as animal feed after proper treatment. In the processing, all three constituents are separated. The guar gum powder is obtained after removing the hull and germ from the seed and grinding the endosperm into fine powder called guar gum powder, which is achieved by different processing methods. The endosperm ranges from 32-42% depending on the variety and maturity of the crop. So, the main unit operations involved in the processing of guar seeds is cleaning, grading, dehusking, splitting and separation of endosperm, grinding and purification of powder. On arrival at the processing plant, seeds are screened for removal of dirt, stones, sand, metal debris, chaffs and broken seeds. Standard seed cleaning vibrators, electromagnets, and shifters are used for cleaning.

Dehulling and splitting of the seed is done by two processes i.e. dry grinding and wet grinding. In some of the industries, charring of the hull is done by flame treatment also and then separation of husk is done. Recovery in wet processing method is 8 to 10% higher than in dry processing. However, the quality of the gum is not good. Hence, dry processing or charring the seed is used in most of the industries.

Burr mills, pin mills and modified hammer mills are usually used for splitting of guar seeds into two halves so as to separate the germ and endosperm. The splits are then heated in kilns and passed through the dehusking machines usually consisting of a two-tired chamber, each with a rotating saw-toothed blade. Spilts stripped of their hull pass to sifters that separates the clean endosperm pieces on a 20-mesh screen.

Guar gum powder is produced from endosperm splits simply by grinding in attrition mills, hammer mills, ultra fine grinders or other size reduction equipment. However, guar gum with the best thickening power and fastest hydration rate is produced when the splits are first soaked in water and then flaked, extruded or ground.

The guar gum powder is usually modified with chemicals to give them new properties for broader applications. For industrial applications, many guar gum products are formulated with additives that control rate of hydration, enzyme resistance, dispercibility, dry flow, or other special properties. The most common commercial derivatives of guar gum are hydroxypropylguar, carboxymethylguar and 2-hydroxy-3(trimethylammonium chloride) propylguar.

Storage and handling

Guar gum powders are generally packed only in sound clean, dry and un-used polythene bags placed inside gunny bags or multi-ply craft paper sacks Guar gum powders and its derivatives are stable in dry form. It has a long storage life in its dry form provided that it is warehoused properly. The properties of guar gum remain unchanged for 12-18 months. However, when exposed to humid conditions, guar gum absorbs moisture which results in microbiological degradation, fermentation and lumping of the powder and the properties of the gum is adversely affected. Hence, guar gum should be packed in moisture proof packets/ containers and stored in a cool dry place away from heat and sunlight. It is advised to consume the guar gum within a reasonable time period once the bag is opened. The shelf life of guar gum may be extended by adding suitable preservatives.

Processing and storage of Gum ghatti

Gum ghatti

Harvesting and grading of gum ghatti are done by methods similar to those used for gum karaya. The exudates are hand picked by the locals, mostly tribal and laid to dry in the sun

for several days. At the processing centers, gum with bark and gum without bark are sorted. The barks are hand picked and removed from gum. The gums with bark are also fed to processing machine where barks are detached from the gum. The finer crushed particles are screened and removed. The gum is then hand-sorted into various grades according to color and amount of impurity.

Ghatti tears are further processed mainly by grinding in which the gum is pulverized to fine powder. However, various other mesh separations are also made as per the demands of the consumer. During the process of particle breakdown, impurities are removed from the gum by shifting, aspiration, and density table separation. Some work has been done on spray drying the soluble fraction to obtain powdered gum ghatti.

Storage and handling: Graded gum ghatti is usually packed in burlap bags of 50 kg capacity for storage and transportation purposes. Warehousing in a cool, dry place is recommended for extended storage. If the gum becomes damp, it tends to agglomerate and form lumps.

Processing and storage of gum arabic

Gum arabic

Just after the harvest, *Acacia* gum is delivered to cleaning sheds for the removal of impurities, sand, and pieces of bark. There after, it is sorted to different grades based on colour and per cent of impurities. Sorted and cleaned gum arabic is usually traded as tears that are approximately 2.5 to 5 cm in size packed in 100 kg jute bags.

Gum arabic is further processed in the destination countries into forms needed for incorporation into the final products. These processes include 'kibbling' (making uniform pebble size pieces), granulating, powdering and spray-drying. Kibbling entails passing whole or large lumps of gum through a hammer mill and then screening it to produce smaller granules of more uniform size. These pieces are more easily dissolved in water, and under more reproducible conditions, than the raw gum and so are preferred by the end-user.

Powdered gum may be produced from kibbled gum but it may also be produced by a process known as spray-drying. This furnishes a high-quality, free-flowing powder with even better solubility characteristics than kibbled gum. The gum is dissolved in water, filtered and/or centrifuged to remove impurities and the solution, after pasteurization to remove microbial contamination, is sprayed into a stream of hot air to promote evaporation of the water. The powder is then screened to assure uniformity of particle size.

Transportation and Storage: The crude gum arabic is stored and exported either in burlap or jute sacks. The graded gum is packed in heavy duty bags of about 80 kg each. The US regulations require that only new, unused jute sacks are used. Semi-processed and processed kibbled variety, granules and powdered gum arabic is exported in drums, polyethylene lined multi-wall paper bags or polyethylene lined cardboard boxes. Gum arabic, when stored in cool (21 -24°C) and dry place, has an unlimited shelf life.

Processing and storage of Gum karaya

Gum karaya

Gum collected by the villagers is delivered to the agents appointed by the trading corporation at rates fixed according to quality of gum. It is then packed in gunny bags and transported to towns. The gum often contains many impurities like tree bark etc.

At the grading centre, the big lumps are broken into small pieces of about 1 to 3 cm in diameter. The broken pieces are then graded manually in five different grades, which are registered with the Indian Agmark organisation, and which are based mainly on criteria of viscosity, colour and free from external bark, sand etc.

Gum is further purified by size reduction and removal of pieces of bark by air flotation methods. Other mechanical methods are used to remove sand, dirt and other types of foreign matter. Gum karaya is also granulated and powdered for obtaining a homogenous dispersion. Granulated or crystal gum karaya are usually processed so that the particle size is between 6

and 30 mesh. These granulated gum karayas are used principally as bulk laxatives.

Storage: Gum karaya tends to agglomerate or form lumps when exposed to wet and humid conditions. Therefore, handling recommendations include storage in sealed polythene lined containers. For extended storage, materials should be warehoused in a cool, dry place.

The graded gum is packed in heavy duty bags of about 80 kg each. Sometimes the gum is powdered and packed in 5 to 6 kg kraft paper bags or 75 to 100 kg fibre drums. In dry form, Karaya loses viscosity in storage, especially under high heat and humidity. The rate of loss for powdered material is more as compared to granules. To minimise this, storage under colder temperature is advised. The viscosity loss of karaya dispersions in storage can be minimised by the addition of preservatives like benzoates, sorbates, phenols and related compounds.

Processing and storage of Salai gum:

Salai gum

Salai gum is collected in a semi-solid state. After collection, the bark and other impurities are removed manually. The crude gum-resin is allowed to remaining a bamboo basket for upto a month during which the fluid portion, locally known as *ras*, flows out. The *ras* forms about 8 to 10 per cent of the raw material and is used in paints and varnishes. Remaining semi-solid to solid part is the gum resin, which is dried thoroughly and sometimes treated with soapstone powders to make it brittle. It is then broken into small pieces by wooden mallet or chopper. During this process, bark and other impurities are again removed manually. The gum-resin is then graded according to its colour and impurities.

Processing and storage of *Asafoetida*

Asafoetida

Asafoetida powder

The milk juice obtained from the root becomes a brown, resin-like mass after drying. Asafoetida is processed and marketed either as lumps or in powdered form. The lump *asafoetida* is the most common form of pure asafoetida. The trading form is either the pure resin or so-called "compounded *asafoetida*" which is a fine powder consisting to more than 50% of rice flour and gum prevent lumping. The advantage of the compounded form is that it is easier to dose. The gum-resin is also steam distilled to obtain the essent

4. APPROVED ON-GOING RESEARCH PROJECTS

4.1 Insect Improvement

Sl	Project	Principal Investigator
1.	Collection, conservation, characterization and documentation of lac insect bio-diversity.	Dr KK Sharma
2.	Field evaluation of promising lac insect races, lines and breeds for higher productivity and superior performance.	Dr Md Monobrullah
3.	*In-vitro* culturing of lac insect cells	Dr Thamilarasi, K
4.	To understand the nature of diversity in lac insect of *Kerria* spp in India and the nature of insect x host interaction (NAIP)	Dr R Ramani

4.2 Host Improvement

5.	Collection, conservation, characterization and documentation of lac host bio-diversity.	Shri SC Srivaastava
6.	Host plant evaluation and improvement for lac productivity and summer sustainability.	Dr R Ramani
7.	Clonal propagation of *Schleichera oleosa* (*kusum*), a major lac host plant through tissue culture.	Dr D Saha

4.3 Crop Production

8.	Studies on *in-situ* moisture conservation technique for raising mixed plantation of *ber* and *kusum*	Shri RK Singh
9.	Development of *kusmi* lac cultivation technology on *Albizia procera (Siris).*	Dr AK Jaiswal
10.	Collection, identification and assessment of the diseases of commercial lac hosts.	Dr AK Singh
11.	Management of sooty mould, causing lac insect death and failure of lac crop.	Dr AK Singh
12.	Soil fertility management of *ber* (*Z. mauritiana*) for shoot growth and lac yield (*aghani*).	Dr S Ghosal
13.	Production of quality *kusumi* broodlac at Institute Research Farm (IRF)	Dr KK Sharma
14.	Evaluation of potential herbicides for weed management in *semialata* and *ber* plantation.	Dr BP Singh
15.	*Rangeeni* lac insect survival on *ber* and *palas* in relation to season, physiology of host plant and soil moisture stress: a biochemical approach from host plant perspective	Shri Anees, K
16.	Development of lac production system using high density *ber* plantation under semi protected conditions. (NABARD sponsored)	Dr R Ramani
17.	Production of summer *kusmi* broodlac on *kusum* for promotion of lac cultivation in Gujarat with farmer's participation. (Forest Department Silva Division, Gujarat)	Shri RK Singh

4.4 Synthesis and Product Development

18.	Synthesis of thiosemicarbazide and thiodiazole from aleuritic acid and testing its activity as antifungal / hypoglycemic / antinemic.	Dr Divya
19.	Comparative evaluation of physico-chemical anti-inflammatory and hypolipidemic properties of oleo gum resins from Boswellia serrata, Commiphora mukul and Commiphora wightii.	Dr MZ Siddiqui
20.	Synthesis of hydrogel from gum acacia and gum karaya for their comparative evaluation in drug release.	Shri SKS Yadav
21.	Screening of bioactive compound synthesized from aleuritic acid.	Dr RN Majee

4.5 Surface Coating and Use Diversification

22.	Development of surface coating formulation based on shellac synthetic resin/polymer blends.	Shri MF Ansari
23.	Documentation and characterization of physico-chemical properties of plant based gums of commercial importance.	Dr KP Sao
24.	Preparation and market evaluation of heat and water proof shellac varnishes for wooden surfaces and air drying type shellac based glazing varnishes.	Dr MZ Siddiqui

4.6 Processing and Storage

25.	Establishment of commercially viable plant of aleuritic acid for training, demonstration and process refinement.	Dr SK Giri
26.	Establishment of pilot plant for dewaxed bleached lac (40 kg capacity) for training demonstration and process refinement.	Er M Prasad
27.	A value chain on lac and lac based products for domestic and export markets (NAIP)	Dr N Prasad

4.7 Human Resource Development (HRD)

28.	Training, demonstration, extension education and information service on lac culture, processing and product development.	Dr AK Jaiswal
29.	Enhancing livelihood options for poor tribal families of the Jharkhand state through capacity building in cultivation of lac and its value addition (JLDS).	Dr KK Sharma
30.	Developing sustainable farming system models for prioritized micro water shed in rainfed area in Jharkhand under component 3: sustainable rural livelihood security (SRLS) of National Agricultural Innovation Project (NAIP component-3).	Dr AK Jaiswal
31.	Improving Rural Livelihood security through sustainable Integrated Farming System Model and Allied Enterprises in Bastar Region of Chhattisgarh (NAIP component-3)	Dr AK Jaiswal

4.8 Technology Assessment, Refinement and Dissemination

32.	Evaluation of some newer insecticides and bio-pesticides for eco-friendly management of insect pests associated with lac insect and host plants.	Dr JP Singh
33.	Front line demonstration on scientific lac cultivation.	Dr A Bhattacharya
34.	Lac based agro forestry in Bundelkhand region: introduction and evaluation (NRCAF collaborative project)	Dr S Ghosal
35.	Study and documentation of cultivation and processing of lac in Chhattisgarh and market survey on lac based products (MFP, Chhattisgarh Government)	Dr Govind Pal

4.9 Liaison, Information and Advisory Service

36.	Strengthening, liaison, information and advisory services on natural resins and gums.	Dr A Bhattacharya
37.	Network project on harvesting, processing and value addition of natural resins and gums (ICAR)	Dr N Prasad

4.10 Exploratory trial

38.	Impact of pitcher irrigation with fertigation (urea) on shooting response and *kusmi* lac yield on *ber*.	Shri RK Singh

5. PUBLICATIONS AND PUBLICITY

5.1 PUBLICATIONS

5.1.1 Research Papers

- Ghosal S and Mishra YD. 2009. Canopy structure of *ber* (*Zizyphus mauritiana*) trees influencing lac yield. *Environment and Ecology*, **27** (4A): 1879-1881.
- Goswami DN, Prasad N, Baboo B, Kumar KK and Ansari MF, Day A. 2009. Degradtion of lac with storage and a simple method to check the same. *Pigment and Resin Technology*, **38** (4): 211-217.
- Pal Govind, Bhagat ML and Bhattacharya A. 2007. Socio-economic characteristics of lac growers in Jharkhand. *Manage Extension Research Review*, **8** (2): 61-68
- Pal Govind, Bhagat ML and Bhattacharya A. 2009. Lac cultivation as a risk coping strategy for agriculture in Jharkhand. *The Indian Forester*, **135** (5): 611-617.
- Pal Govind, Bhagat ML and Bhattacharya A 2009. Economics and resource use efficiency of lac cultivation in Jharkhand. *Indian Journal of Forestry*, **32** (1):95-98.
- Pandey SK, Baboo B and Prasad N. 2009. Drying requirements in lac processing and scope of improvement. *Agricultural Engineering Today*, **33** (1): 7-10.
- Prasad N and Pandey SK. 2009. Drying characteristics of seedlac. *Indian Journal of Agricultural Sciences*, **79** (6): 458-60.
- Sao KP and Pandey SK. 2009. Utilization of aleuritic acid free gummy mass - an industrial by-product for making particle board. *Indian Journal of Chemical Technology*, **16:**196-199.
- Singh JP, Jaiswal AK, Monobrullah Md and Bhattacharya A. 2009. Response of some selected insecticides on neuropteran predator (*Chrysopa lacciperda*) of lac insect (*Kerria lacca*). *Indian Journal of Agricultural Sciences*, **79** (9):727-31.
- Singh RK, Singh BP, Baboo B and Singh B. 2008. Impact of *in-situ* soil moisture conservation practices on soil moisture level and growth of *ber* and *kusum* for sustained lac production in Jharkhand. *Indian Journal of Soil Conservation*, **36** (2): 105-108.
- Singh RK, Mishra YD and Baboo B. 2009. Influence of pitcher irrigation and mulching on the summer season lac crop production. *Environment and Ecology*, **27** (4 B): 2132-2134.

5.1.2 Papers presented / contributed in conferences / symposia / seminars

- Ghosal S, Singh RK, Ramani R and Baboo B. 2009. Development of Lac Integrated Farming System (LIFS) for Eastern Plateau and Hilly region. *Proceedings of Conference on Integrated Farming System Models for Eastern Region of India*. 82-90 pp.
- Ramani R and Anees K. 2009. An overview of eastern plateau and hills region of India with special emphasis on systems approach in agriculture. *Proceedings of Conference on Integrated Farming System Models for Eastern Region of India*. 1-11 pp.
- Ramani R, Monobrullah, Md and Baboo, B. 2009. Lac hosts and gum-yielding trees for Agroforestry in Jharkhand. World Forestry Day, *Envis-Jharkhand News*. 21 March, 2009, 75-79 pp.
- Saha D, Ranjan SK, Ramani R and Baboo B. 2009. Implication of biotechnology in lac insect and host plant research for improvement in sustainable lac culture. *International Conference on Recent Trends in Life Science Researches vis-a-vis Natural Resource Management, Sustainable*

Development and Human Welfare held at Vinoba Bhave University, Hazaribag, Jharkhand, India during 27-29 June, 2009.

- Sharma KK. 2009. Living off Biodiversity: Lac cultivation for livelihood generation and ecological development. *International Conference on Resent Trends in Life Science Researches vis-a-vis Natural Resource Management, Sustainable Development and Human Welfare* held at Vinoba Bhave University, Hazaribag, Jharkhand, India during 27-29 June, 2009.
- Singh RK, Ramani R and Baboo B. 2009. Lac-integrated agriculture: Means for efficient resource utilization. *Conference on Food and Environmental Security through Resource Conservation in Central India: Challenges and Opportunities*. (FESCO 2009). 126 pp.

5.1.3 Books / Book Chapters/ Bulletin / Training Manual

- Pal G, Bhattacharya A and Jaiswal AK. 2009. Lac Statistics at a Glance – 2009, 20 pp.
- Majee, RN 2009. Bio-active compounds from aleuritic acid, Technical Bulletin, 24 pp.
- Jaiswal AK and Singh JP. 2009. *Kaise karen kusum vriksh per lakh ki kheti*, Technical Bulletin, 12 pp.
- Jaiswal AK and Singh JP. 2009. *Kaise karen palas vriksh per lakh ki kheti*, Technical Bulletin, 18 pp.
- Jaiswal AK and Singh JP. 2009. *Kaise karen ber vriksh per lakh ki kheti*, Technical Bulletin, 14 pp.
- Baboo B, Singh JP and Jaiswal AK. 2009. Lac in Jharkhand – A Status Report, 23 pp.
- Pal G, Bhattacharya A, Giri SK and Singh JP. 2009. Natural Resins and Gums directory of related organizations, 39 pp.

5.1.4 Popular Articles

- Ansari MF and Baboo B. 2009. Shellac based plates for dental use, ICAR News, **15** (1): 17.
- Giri SK, Singh RK and Pal G. 2009. Lac processing based small scale industry for employment and income generation, *Rashtriya Krishi*, **4** (1): 24-26.
- Prasad N, Baboo B and Pandey SK. 2008. Design and development of Hand Operated Lac Grader AMA (Autumn 2008), **39** (4): 88.
- Srivastava S, Pal G and Ansari, MF. 2009. Superiority of Indian lac quality over other lac producing countries, *Rashtriya Krishi*, **4** (1), 45-46.
- Venkatesh A, Singh R, Chaturvedi OP, Monobrullah Md and Ghosal S. 2009. *Bundelkhand kshetra me lakh ki kheti krishivaniki ka ek swarup. Krishivaniki Alok*, **3**: 42-44.

5.1.5 Institute Publications

- Network Project Booklet, 8 pp
- Lakchha – Hindi Magzine, 72 pp
- A value chain on lac and lac based products for domestic and export markets (NAIP project booklet), 16 pp
- To understand the nature of diversity in lac insect of *Kerria* spp in India and the nature of insect-host interaction (NAIP project booklet), 12 pp
- IINRG – *Natural Resins and Gums Newsletter*,, **13**(1), 16 pp
- IINRG Annual Report, 2008-09, 124 pp
- IINRG – *Natural Resins and Gums Newsletter*, **13**(2): 16 pp
- Lac based formulation for commercial waxing of Kinnow fruit, Folder, 4 pp
- *Lac Statistics at a Glance* – 2009 : 20 pp
- *Bio-active compounds from aleuritic acid*, Technical Bulletin, 24 pp
- *Kaise karen kusum vriksh per lakh ki kheti*, Technical Bulletin, 12 pp
- *Kaise karen palas vriksh per lakh ki kheti*, Technical Bulletin, 18 pp
- *Kaise karen ber vriksh per lakh ki kheti*, Technical Bulletin, 14 pp

- Lac in Jharkhand – A status report, 23 pp
- Small scale lac processing unit for seedlac, Folder, 4 pp
- IINRG – *Natural Resins and Gums Newsletter*, **13** (3): 16 pp
- Natural Resins and Gums directory of related organizations, 39 pp

5.2 PUBLICITY

5.2.1 Participation in Kisan Melas and Exhibitions

- Dr BP Singh, Principal Scientist and Sri K Sharan Museum Attendant participated in the *Paryavaran Mela* 2009, organized by Society for Environment and Social Awareness at Town Hall, Daltongunj during 17 -18 January, 2009 and put up a stall on lac.
- Sri DK Singh, Technical Officer, participated in the *Kisan Diwas* celebration of *Goonj Pariwar* at Silli, Ranchi on 20 January, 2009 and attended the *Kisan Gosthi*, organized during the function.
- Sri D K Singh, Sri R P Srivastava, TOs and Shri K Sharan Museum Attendant, participated in the 31st Annual Central *Kisan Mela* held at Getalsud Farm (Angara Block), Ranchi, organized by Ramakrishna Mission Mission, Ranchi during 23 - 24 January, 2009 and put up a stall on lac. Sri D K Singh participated in the *Kisan Gosthi* also.
- Sri Madan Mohan, T-2 and Shri K Sharan, Museum Attendant participated in the 14 th All India Memorial National Expo 2009, organized by Dr BR Ambedkar Memorial Committee at Jamshedpur during 4 – 8 February, 2009 and put up a stall on lac.
- Sri R N Vaidya, Technical Officere, Smt. Ratna Sen, T-4 and Shri K Sharan, Museum Attendant participated in the Agro-Tech 2009 *Kisan Mela* during 26 – 28 February, 2009 at Birsa Agriculture University, Kanke, Ranchi. Dr A Bhattacharya and Dr BP Singh, PS participated in the *Kisan Gosthi* held during the Mela.
- The Institute participated in the Appropriate Technology Exhibition, during 17 - 21 March, 2009 at Town Hall, Ranchi, organized jointly by National Handloom Development Corporation (NHDC), Govt. of India and Directorate of Handloom, Department of Industries, Government of Jharkhand.
- Sri Binod Kumar, T-5 and Sri S B Azad, T-4 participated in the exhibition organized by Swadeshi Prem Jagriti Sangosthi, Mahmada, Samastipur, during 28-29 May, 2009 and put up a stall on lac.

Field surveys / Crop monitoring

- Sri AK Sinha, Technical Officer visited Bundu, (Ranchi District) and Potka, (East Singhbhum District) areas for monitoring and advice on *rangeeni* lac crop on 9th, 12th and 13th January, 2009 under the TRIFED project.
- Dr JP Singh, Senior Scientist visited Putidih (Purulia District.) for monitoring of *rangeeni* lac crop on 7 March, 2009.
- Shri DK Singh, TO visited village Mangubandh (Ranchi District) in the months of February and March, 2009 for monitoring of *kusmi* lac crop.
- Dr G Pal, Scientist (SS) and Shri Madan Mohan, T-2 visited Gondia (Maharashtra), Seoni and Balaghat districts in Madhya Pradesh during 19-24 March 2009 for survey of lac traders, lac manufacturer for collection of information and data related to lac production and processing.
- Dr A Bhattacharya, Dr AK Jaiswal and Dr JP Singh visited Dhanberwa village (near Sugiya colliery) in Ramgarh District, Jharkhand on 11 April, 2009 for witnessing the *siris* plantations raised by a progressive farmer Shri Prem Lal Mahato. Plantations consisting about 2,200 *siris* plants have been raised during 2006 by his own initiatives.
- Dr G Pal and Shri Madan Mohan visited lac processing units at Khunti and Bundu on 20 April, 2009 for interacting with the industrialists for validation of the data collected on lac production and processing at national level.

- Dr A Bhattacharya and Sri DK Singh visited Kharsidag and Mangubandh village of Ranchi district on 15 May, 2009 for monitoring of *kusmi* lac crop and photography of high yielding *kusum* trees in Mangubandh area.
- Dr A Bhattacharya, Sri RP Srivastava and Sri DK Singh visited Mahiskudar village and Chakidih Brood lac Farm in Mayurbhanj District, Orissa during 25-26 May, 2009 for providing advice, photography and inspection of a site for FLD on *Flemingia semialata*.
- Dr A Bhattacharya and Sri DK Singh visited Latehar and adjoining villages on 30 May, 2009 for interaction with the farmers, providing advice and inspection of areas/sites for carrying out FLD on lac cultivation in association with the NGO Dhan Foundation.
- Dr A Bhattacharya and Dr Md. Monobrullah visited several villages in Bundu and Potka Blocks on 6 June, 2009 for monitoring of *rangeeni* lac crop cultured on *palas* trees.
- Shri AK Sinha, visited several villages in Jhalda Blocks of West Bengal on 23 June, 2009 for monitoring of *rangeeni* lac crop cultured on *palas* trees.
- Dr A Bhattacharya and Sri DK Singh visited Bankhedi Forest Range (Hoshangabad District, Madhya Pradesh) and adjoining areas during 8-13 July, 2009 for providing advice and inspection of areas/sites for carrying out *kusmi* lac cultivation in association with the Forest Department and KVIC. Bankhedi range is having over 50,000 *kusum* trees in forest and private land. Trees of *Sterculia urens* (gum karaya) and *Boswellia serrata* (guggal) are available in plenty in the forests of Satpura mountain range near Pachmarhi.
- Dr A Bhattacharya, Dr BP Singh and Sri DK Singh visited the FLD villages in Latehar, Satbarwa and Chianki on 4 August, 2009. Training for bundling of broodlac and crop inoculation on *ber* trees was given to the farmers in Dulsulma village.
- Dr A Bhattacharya and Sri MF Ansari visited Dhamtari, Kanker, Jagdalpur, Kondagaon, Raipur etc. areas in Chhattisgarh during 10-15 August, 2009 for identifying the problems related to lac processing and probe the possibilities for use of lac based varnishes in the wooden furniture industry at Jagdalpur. They interacted with the lac processors, farmers, traders and craftsmen in different places.
- Dr A Bhattacharya and Sri DK Singh visited village Kantajhar (Elga) in Kutra Block of Sundergarh District, Orissa during 1-2 September, 2009 for monitoring of lac crop raised on *Flemingia semialata* plants by a farmer under FLD.
- Dr Govind Pal and Sri Madan Mohan visited Raipur, Dhamtari and Kanker during 30 August to 6 September, 2009 for survey of lac traders, lac processors and lac growers for lac production assessment.
- MF Ansari and Er. M Prasad visited Guwahati, Tezpur, Nagaon, Jakhalabandha regarding popularization and promotion of lac based varnishes Lac Wood shine and Lac Glaze during 5-12 October, 2009.

5.2.2 Radio / TV talks by Subject Matter Specialists

Radio/TV Progamme

- Harvesting of winter season (*aghani*) *kusmi* broodlac and their inoculation by Dr JP Singh, Sr. Scientist, telecast by ETV on 19 February, 2009.
- DD Kendra, Ranchi took an interview of the Director, IINRG on the welfare schemes for the farmers of Jharkhand by the Institute for telecast under the Krishi Darshan programme on 25 February, 2009.
- Care and management of summer season (*baisakhi*) *rangeeni* lac crop by Dr JP Singh, Sr. Scientist, telecast by ETV on 27 February, 2009.
- Pruning of different host plants for lac production by Dr JP Singh, Sr. Scientist, telecast by ETV on 28 February, 2009.
- *Lakh keeton ke suraksha kaise karein,* Radio talk by Dr A Bhattacharya for AIR, Ranchi on 17 November, 2009 under Kisan-vani programme.

5.2.3. Lac Promotion Activities

Lac promotion activity was initiated in association with iMAP (International Mass Awareness Programme a

NGO in Chandrakona, West Medinipur district (West Bengal)

During monsoon season 2009, about 78,000 plants of *F. semialata* were raised in approx. 3.0 ha in different villages of Chandrakona block (Dingul, Karargiria, Mohishi mudi, Ikbalpur etc.), Medinipur, West Bengal by iMAP under the technical guidance of this Institute. It was observed that within six months, *F. semialata* plants attained a height of 7-8' and reached the stage of inoculation. Therefore, out of which two thousand plants were inoculated during February, 2010 with *kusmi* strain of lac insects with 50 Kgs of broodlac for raising summer season lac crop (Jethwi 2010) under irrigated condition. Initially development and growth of lac crop were observed to be quite satisfactory.

Table : Showing states, centres, villages, adopted host plants, broodlac utilized and yield

Sl.	State	Centre	Village	Lac host	Lac host exploited (Nos.)	Lac crop raised	Broodlac utilized (Kg)	Yield obtained, if any (Kgs)
1.	Jharkhand	Dhan Foundation, Latehar	4	*Palas & ber*	155	*Rangeeni*	165	Crop standing
2.	Jharkhand	KVK Chianki, Palamau	2	*Palas & ber*	63	*Rangeeni*	65	Crop standing
3.	Jharkhand	KVK Lohardaga	1	*Kusum*	7	*Kusmi*	50	150
4.	Orissa	Sundargarh	1	*F. semialata*	600	*Kusmi*	30	90
5.	Chhattisgarh	Raigarh	1	*F. semialata*	1000	*Kusmi*	50	175

- The Institute facilitated 50 kg *rangeeni* broodlac each to KVK Palamau, Chianki and Dhan Foundation, Latehar for carrying out FLD on *rangeeni* lac cultivation on *palas* trees.
- The Institute facilitated 30 kg *kusmi* broodlac to a progressive farmer at Village Kantajhar (Elga), Kutra Block of Sundergarh district, Orissa for carrying out FLD on 600 bushes of *Flemingia semialata*.
- A proposal for *kusmi* lac cultivation on 16,000 plants of *Flemingia semialata* was prepared on the request of an NGO Kishore Chandrapur Lac Industrial Co-operative Society Ltd. Dist. Balasore, Orissa.
- KVK Nayagarh, Orissa procured 40 kg of *kusmi* broodlac from the Institute for initiating lac cultivation on *kusum* trees.
- The Institute facilitated 50 kg *kusmi* broodlac to KVK Lohardaga, for carrying out FLD on *kusmi* lac cultivation on 5 *kusum* trees.
- Demonstration for *kusmi* lac crop on 45 bushes of *F. semialata* and 25 bushes of *F. macrophylla* carried out in the Technology Park of BAU, Kanke, Ranchi. The plants were inoculated during August 2009 and recommended pesticide applications carried out as per schedule.
- The Institute facilitated *rangeeni* broodlac to Dhan Foundation, Latehar (135 kg) and to KVK Palamau, Chianki (65 kg) and for raising *baisakhi* lac crop on *palas* trees under FLD programme.
- Demonstration for three lac cultivation technologies have been carried out in three states (Jharkhand, Orissa, Chhattisgarh) in association with KVKs, NGOs and progressive farmers

Awareness/Exposure Programme/Educational Tour

Date of visit	Sponsoring Agency / from	No. of participants
24.04.2009	R.K. Mission, Purulia, West Bengal	25 (Purulia, W.B)
13.05.2009	Human Resource Development Centre, GEL Church, Ranchi	80 (Jharkhand, Orissa, Chhattisgarh, Assam)
15.05.2009	RK Mission Vivekananda University, Ranchi	17 Students
26.05.2009	Faculty of Forestry, BAU, Ranchi	14 Students
29.05.2009	Singhbhum Gram Udyog Vikas Sansthan	18 (Chaibasa)
1.6.2009	Support for sustainable society, Harmu, Ranchi	14 (Jharkhand)
16.06.2009	R.C. Church, Gaurbera	10 (Jharkhand)
22.06.2009	ATMA, Madhepura, Bihar	20 (Bihar)
27.06.2009	Entomology Dept., BAU, Kanke	6 Students
07.08.2009	St Michael's School, Ranchi	81 students and 2 Faculty members
22.08.2009	Dept. of Forestry, BAU, Kanke	13 students and 2 Faculty members
15.09.2009	R K Mission, Narendrapur	25 Farmers and 2 Officials
03.10.2009	Dept. of Plant Pathology, BAU, Kanke	28 students and 2 faculty members
20.10.2009	Mission from Khunti	14 farmers
10.12.2009	Dept. of Polymer Engg., BIT, Mesra	6 students and 3 faculty members
08.12.2009	NAIP Project, IINRG	30 farmers
09.12.2009	NAIP Project, IINRG	34 farmers

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

6.1 Participation in Conferences / Meetings / Seminars etc.

6.1.1 By Dircetor

- Conference of Directors of ICAR, NASC, New Delhi, during 15-16 January, 2009.
- State Credit Seminar 2009-10, NABARD Regional Office Jharkhand, Ranchi on 27 January, 2009.
- Launch workshop of Network project on harvesting, processing and value addition of natural resins and gums. IINRG, Ranchi, during 9-10 February, 2009.
- Meeting of Institute Management Committee of ICAR Research Complex for Eastern Region, Patna on 9 March, 2009.
- Meeting of ICAR and UAS, Bangalore Teams for setting up modern jaggery processing plant at VC Farm, Mandya, UAS, Bangalore on 14 March, 2009.
- Meeting of Institute Management Committee of IINRG, Ranchi on 18 March, 2009.
- Inaugural function of awareness and training programme on ground water problems, issues, rainwater harvesting and artificial recharge to ground water, CGWB, Ranchi on 28 March, 2009.
- Launch workshop of NAIP sub-project on "A value chain on lac and lac based products for domestic and export markets" IINRG, Ranchi. on 30 April, 2009.
- Research Advisory Committee meeting of IINRG. IINRG, Ranchi during 12-13 May, 2009.
- 68th Meeting of Board of Management, Birsa Agriculture University, Ranchi on 27 May, 2009.
- Coordination Committee meeting of AICRP on PHT at CTCRI, Trivandrum during 29-31 May, 2009.
- Workshop on strategies for Lac development in Chhattisgarh, CGMFP Federation Ltd., Raipur on 6 June, 2009.
- Third meeting of Lac cell, Deporment of Forests and Environment, Government of Chhattisgarh, Raipur on 6 June, 2009.
- First meeting of Coordination committee of Network project on harvesting, processing and value addition of natural resins and gums, CAZRI, Jodhpur during 8-9 June, 2009.
- 9th Agricultural Science Congress. NASS-SKUAST, Srinagar during 22-24 June, 2009.
- National workshop of AICRP Agro-forestry, College of Agriculture, Nagpur on 4 July, 2009.
- National debate on DUS test guidelines for tropical and sub-tropical plantation crops and trees organized by PPV and FRA at CPCRI, Kasaragod on 10 July, 2009.
- Seminar on increasing agricultural production-national perspective. The Institute of Engineers (India), Jharkhand State Centre, Ranchi on 7 August, 2009.
- Meeting of Executive Council, Indian Society of Agricultural Engineers, NASC, Pusa, New Delhi on 25 August, 2009.
- Interaction with lac growers and see the lac cultivation near Anupur (Madhya Pradesh), as well as visit of Network Project Centre at JNKVV, Jabalpur and visit to CIAE, Bhopal during 12-15 October, 2009.
- Agriculture and Food Engineering Department, IIT, Kharagpur during 18-19 October, 2009.

- Visited Network Project Centre at NRC for Agroforestry , Jhansi on 3 November, 2009.
- Inaugural lecture in Winter school on crop residue, grass, fodder and its value addition on 4 November, 2009.
- ASRB foundation day programme on 9 November, 2009.
- Collaborative research project with ICRAF in SMD 29 December, 2009.

6.1.2 By Others

- Dr JP Singh, Sr. Scientist attended the monthly meeting of IMPCC, Ranchi on 22 January, 2009 at AIR, Ranchi.
- Dr R Ramani, HOD, Lac Production Division delivered an invited lecture on"Lac insects-impact of climate change" at the *National Symposium on IPM strategies to combat emerging pest in the current scenario of climate change* at CHF, CAU, Pasighat, Arunachal Pradesh on 29 January, 2009.
- Dr A Bhattacharya, HOD attended the monthly meeting of IMPCC, Ranchi on 26 February, 2009 at Doordarshan Kendra, Ranchi.
- Dr JP Singh, Sr. Scientist attended the National Seminar on Agriculture Extension during 27-28 February, 2009 at NAS Symposium Hall, NAS Complex, New Delhi.
- Monobrullah Md. attended regional conference on "Integrated farming system models for the eastern region" organized by IINRG, Ranchi at Ranchi on March 13, 2009.
- Monobrullah Md. attended workshop on Forest management organized at the office of conservator of Forest and Director, Forest Training School, Mehlong, Ranchi on March 19, 2009 and delivered lecture on role of Natural resins and gums yielding trees in agro-forestry system.
- Monobrullah Md. attended World agro-forestry day workshop on "Agro-forestry in Jharkhand" organized by Environment Information System (ENVIS) - Jharkhand at Dahu, Ormanjhi on March 21, 2009 and delivered lecture on "Lac hosts and gum yielding trees for agro-forestry in Jharkhand".
- Dr A Bhattacharya, Principal Scientist, Dr JP Singh, Sr. Scientist and Dr Anjesh Kumar, TO participated in the monthly meeting of IMPCC, Ranchi on 24 March, 2009 held at the Institute.
- Dr S Ghosal and Shri RK Singh participated in 11th Bioved Research Agricultural Scientists and Farmers Congress at Ishwar Sharan Degree College, Allahabad and presented Institute activities/Research highlights in the form of posters, leaflets, extension bulletins and CD during February, 2009.
- Shri RK Singh attended a National seminar on *Peya jal ki upalabdhata* at Shri Krishna Public Administration Institute, Ranchi on 22 March, 2009 sponsored by Yugantar Bharti.
- Dr N Prasad, Sr. Scientist attended a meeting of Network project on gum *karaya* at IGKVV, Raipur on 8 April, 2009.
- Dr N Prasad, Sr. Scientist attended a meeting held in the office of the PCCF, Raipur, Chhattisgarh on 8 April, 2009.
- Dr R Ramani, attended the Annual workshop of ICAR-NAIP Component 4 held at IVRI, Izatnagar during 14-15 April, 2009.
- Dr Md Monobrullah, Sr. Scientist visited Udheywalla, Akhnoor, Raya and Chattha of Jammu Division to monitor *baisakhi* crop raised on *ber* and *palas* and to assess the survival/ mortality of *rangeeni* lac insect during 28-29 April, 2009.
- Dr JP Singh, Sr. Scientist attended the monthly meeting of IMPCC, Ranchi on 29 April, 2009 at RIMS, Ranchi.
- Dr N Prasad, Sr. Scientist attended Launch workshop of NAIP project and CAC meeting at IINRG, Ranchi on 30 April, 2009.
- Dr Md Monobrullah, Sr. Scientist visited NRCAF, Jhansi and Bundelkhand regions to monitor *baisakhi* crop raised on *palas* and to assess the

survival/mortality of *rangeeni* lac insect during 4-5 May, 2009.

- Dr (Ms) MZ Siddiqui, Sr. Scientist delivered a lecture on "Drug Delivery Approaches" in AICTE sponsored programme, organized by the Department of Pharmaceutical Sciences, BIT, Mesra, Ranchi on 14 May, 2009.
- Dr A Bhattacharya attended the Farmer's awareness programme at village Salgadih, Tamar, organized by the Jharkhand State Kisan Mahasabha on 19 May, 2009.
- Dr B Baboo, Dr AK Jaiswal, Dr S Ghosal, Dr Md. Monobrullah and Shri Alok Dubey visited Baramajhladih, Dahartola, Charedih and Tetuliatand villages of district Jamtara to monitor *baisakhi* crop raised on *palas* and to assess the survival/mortality of *rangeeni* lac insect on 21 May, 2009.
- Dr N Prasad, Sr. Scientist attended NAIP component -2 Annual workshop held at ANGRAU, Hyderabad during 21-22 May, 2009.
- Dr G Pal, Scientist (SS) attended the monthly meeting of IMPCC, Ranchi at CCL, Darbhanga House, Ranchi on 28 May, 2009.
- Dr Bangali Baboo, Dr A Bhattacharya, Dr AK Jaiswal, Dr JP Singh, Dr G Pal and Sri RK Singh attended the meeting with TRIFED officials at IINRG, Ranchi on 2 June, 2009.
- Dr A Bhattacharya, Dr Md. Monobrullah and Shri Shailander of TRIFERD visited Potka block of district Jamshedpur to monitor *baisakhi* crop raised on *palas* and to assess the survival/mortality of *rangeeni* lac insect on 6 June, 2009.
- Dr AK Jaiswal, Principal Scientist, Dr SK Giri, Scientist (SS) and Shri MF Ansari, Scientist (SS) attended the workshop on "Strategy for lac development and related activities in Chhattisgarh" at Raipur on 6 June, 2009.
- Dr N Prasad, Sr. Scientist attended a meeting with representatives of guar gum industries at CAZRI, Jodhpur on 8 June, 2009.
- Dr N Prasad, Sr. Scientist attended I[st] Coordination committee meeting of Network project on "Harvesting, processing and value addition of natural resins and gums" held at CAZRI, Jodhpur during 8-9 June, 2009.
- Dr Thamilarasi K, Scientist attended a workshop for "Young professionals on Successful grant writing for agricultural research and development" conducted by YPARD (Young Professionals' Platform for Agricultural Research for Development), Terra Viva Grants and VIT University at VIT University, Vellore during 9 -10 June, 2009.
- Dr N Prasad, Sr. Scientist attended meeting of Board of Director's JHAMCOFED, Ranchi at Project Building, Ranchi on 23 June, 2009.
- Dr JP Singh, Sr. Scientist attended the quarterly meeting of AIR, Ranchi on 30 June, 2009.
- Dr SK Giri, Scientist (SS) participated in the Seminar on "Increasing agricultural production – national perspective", organized by The Institute of Engineers (India) Jharkhand State Chapter on 7 August, 2009.
- Dr A Bhattacharya attended the Scientific Advisory Committee of KVK, Divyayan of Rama Krishna Mission, Morabadi on 22 August, 2009.
- Dr Md. Monobrullah, Sr. Scientist, Dr JP Singh, Sr. Scientist, RK. Singh, Scientist (SS), Dr Anjesh Kumar, TO and Satish Kumar T-3 attended a Hindi sangosthi on *'Jalwayu parivartan par antrarashtriya rajnitik pahal'* at ICAR Research Complex for Eastern Region, Patna, Ranchi centre on 29 August, 2009.
- RK Singh, Scientist attended a conference on 'Food and environmental security through resource conservation in central India: Challenges and opportunities' at Central Soil and Water Conservation Research and Training Centre, Agra during 16-18 September, 2009.
- Dr R Ramani and Dr D Saha attended "18[th] APSI Scientists Meet 2009 and National conference on plant sciences: Diversity, products and environmental planning" on 12 October, 2009.

- Dr KK Sharma presented a paper entitled, 'Living off biodiversity: Lac cultivation for livelihood generation and ecological development' in the National conference on biodiversity conservation and management of bioresources organized by Andhra University and AZRA at Visakhapatanam during 28-29 October, 2009.
- Dr KK Sharma presented a paper entitled 'Canopy management in lac cultivation for biodiversity conservation and sustainable livelihood support' in the 5th International canopy conference 2009 - Forest canopies: Conservation, climate change and sustainable use, convened by ATREE at Bangalore during 25-31 October, 2009.
- Dr Md Monobrullah. delivered lecture on "Developing gums and resins based agroforestry models" during winter school "Harvesting, processing, value addition and quality assessment of Natural resins and gums" held at IINRG, Ranchi during November 5-25, 2009.
- Dr Md Monobrullah delivered lecture on "Role of natural gums and resins in agroforestry system" during model training course "Processing and value addition of natural resins and gums" held at IINRG, Ranchi during December 15-22, 2009.
- Dr AK Jaiswal, Dr Md Monobrullah and Dr JP Singh visited Putidih, Ranidih, Bhusudih and Jargo of district Purulia to monitor *baisakhi* crop raised on *palas* and to assess the survival/ mortality of *rangeeni* lac insect on December 3, 2009.

6.2 Human Resource Development

- Shri K M Kumar, Jr. Clerk attended a training programme at IIPM, New Delhi for administrative personnel of Scientific Institute of Government of India, coducted by Department of Science and Technology, during 2-20 February 2009.

6.3 Honours / Awards / Recognitions

Dr Bangali Baboo, Director, IINRG, Ranchi has been nominated as Chairman / Member of following Committees:-

- Member, State Techincal Group on Guidance, Monitoring and Coordination to
- centrally sponsored scheme "Support to State Extension Programmes for Extension Reforms". Department of Agriculture, Government of Jharkhand.
- Member, Institute Management Committee, ICAR Research Complex for Eastern Region, Patna.
- Member, ICAR Experts Team for setting up modern jaggery processing plant at Mandya (Karnataka)
- Chairman, Lac, Lac Products and Polishes Sectional Committee, CDH-23, BIS, New Delhi.
- Member, Jharkhand State Level Banker's Committee on Agriculture and Allied Activities,Ranchi.
- **Laksha-Shree Award, 2008** was conferred to Dr Bangali Baboo, Director, IINRG, Ranchi for his outstanding creative organizational deeds and research contribution on lac by the International Consortium of Contemporary Biologists.
- Dr JP Singh, Sr Scientist unanimously elected as a **Councilor** of the Entomological Society of India, Division of Entomology, Indian Agricultural Research Institute, New Delhi for the year 2009-10 in the Annual General Body meeting of the society.
- Dr A Bhattacharya, HOD has been recognized as **Distinguished Reviewer** 2008 by Agricultural Research Communication Centre, Karnal.
- Dr Soumen Ghosal, Sr Scientist has been conferred **Dr RS Paroda Medal** 2009, for his contribution to quality broodlac production by Bioved Research Society, Allahabad.
- Dr Dipnarayan Saha, Scientist (SS) of the Institute was awarded with the prestigious **Jawaharlal Nehru Award - 2008 in Biotechnology (Plant)** by the ICAR, New Delhi on the occasion of ICAR foundation day on 16th July 2009 for outstanding Ph.D. work in the field.
- Dr KK Sharma has been felicitated with **AZRA Fellowship Award** for the year 2009 at

Visakhapatanam on 28 October, 2009 during AZRA Conference.

- Dr. Md. Monobrullah, Sr. Scientist LP Division was conferred the **Life Fellow Award** 2009 for his outstanding contribution in the field of Applied Entomology by the Entomological Society of India, New Delhi.
- Shri Anees K, Scientist, awarded **Silver medal** for long jump in ICAR inter-zonal sports meet held during 12-15 December, 2009 at NDRI, Karnal.
- On the occasion of 86th Foundation Day of the Institute following staff members were awarded for their **outstanding contribution** in the year 2009:

  Dr AK Jaiswal, Principal Scientist, TOT Division and Dr N Prasad, Sr Scientist, PPD Division in Scientist category.

  Shri DK Singh, TO and Shri Satish Kumar, T-3 in Technician category.

  Shri K Oraon, Assistant and Shri AK Tripathy, Sr. Clerk in Administrative category.

  Shri D Ram, SS Grade and Late Josef Terky (Posthamously) in supporting staff category.

Letter of appreciation from Chhattisgarh State Minor Forest Produce

A letter of appreciation has been received by IINRG from Chhattisgarh State Minor Forest Produce for the efforts of the institution relating to technological research, standardization and capacity building for enabling Indian Lac to get a special niche in the lac market in India and abroad emphasizing the admirable and valuable support, guidance and suggestions by IINRG regarding lac development in Chhattisgarh State. They thanked the Director, Dr. Bangali Baboo for the special attention and Dr. A.K. Jaiswal for training and repeated field visits in C.G. Three major lac based processing technologies i.e. production of seedlac, Bleach lac and Alueritic acid has been transferred to CSMFP. Testing facilities for broodlac & other allied products were also given to the state. About 7 executives, 212 Agricultural Extension Officers and 160 youth were trained in the state by IINRG. The shortcomings and suggestions given by IINRG scientists for improvement in lac development were also highlighted. Study and documentation of status of lac cultivation, processing of lac in the CG State and survey of the market opportunities for lac based products were undertaken by IINRG.

NABARD SHG-Bank Linkage and Farmer' Clubs Awards – 2007-08

IINRG was awarded NABARD SHG-Bank Linkage and Farmer' Clubs Awards – 2007-08 by National Bank for Agriculture and Rural Development for it commendable performance in providing training, exposure visits and related support to NGOs, SHGs, Farmers clubs etc. during the year 2007-08.

Achievement in sports

A team comprising of 31 contingents represented the institute in Tournament of Eastern Zone (TEZ 09) at ICARCER, Patna from 29th February, 2009 with Sri Anees K., Scientist as Chief De-Mission and Sri Prahlad Singh, AAO as team manager. Institute bagged 4th position in the final medal tally with 20 points. Sri. Anees K. Scientist, bagged two gold medals for long jump and high jump. Sri Arjun Gope, Sr. Clerk bagged silver medal in shot put and bronze medal in discuss throw. Sri Bandhanu Oraon got silver medal in high jump. Institute team (members Sri Aness K., Sri RK Yadav, Sri RC Mandap and Sri Balram Ram) obtained bronze medal in 4 x 100m relay race.

7. EVENTS

7.1 Launching of Network Project

An All India Network Project on Harvesting, **Processing and Value Addition of Natural Resins and Gums** was launched on 9 Feburuary, 2009 by Dr. Mangla Rai, Seceretary, DARE, Government of India and Director General, ICAR, New Delhi at a function organized at the IINRG, Namkum. The project will have its co-operating centers namely, Dr YS Parmar, University of Horticulture and Forestry, Solan (Himanchal Pradesh), Indira Gandhi Krishi Vidyalaya (IGKVV), Raipur (Chhattisgarh), Jawaharlal Nehrun Krishi Vishwa Vidyalaya (JNKVV), Jabalpur (Madhya Pradesh); Marathwada Agricultural University, Prabhani (Maharashtra), Central Arid Zone Research Institute (CAZRI), Jodhpur (Rajasthan) and NRC for Agro-forestry, Jhansi, (Uttar Pradesh). The project aims to address the problems related to Natural Resins and Gums by developing techniques to increase the harvest, their handling and storage, development of new products of commercial importance an dits applications, as it is the major source of livelihood in disadvantaged areas like forests, sub-forests, deserts and mountains etc.

Addressing the scientists, officers of the IINRG and other sister institutions and delegates from cooperative centres, Dr. Rai said that the Council has upgraded and renamed this Institute to work on all plant based gums and resins. Funding support has been enhanced more than 3 times during XIth Plan. He stressed the need for processing, product development and value addition of natural resins and gums so that more advantage of crop could reach the farmers and end users. He said that the crop will not only enrich environment but also can pave the way to utilize barren and wasteland.

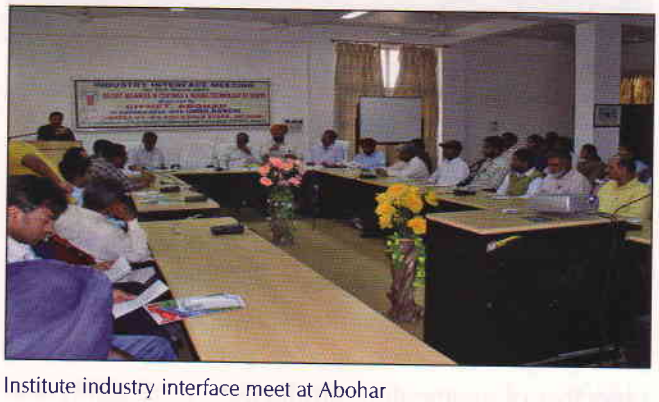
7.2 Conference on Integrated Farming System Models for Eastern Regions of India

Conference on Integrated Farming System Models for Eastern Region of India was organized on 13 March 2009 at kusmi conference hall, IINRG, Ranchi. The conference was inaugurated by Dr AK Malhotra, PCCF, Government of Jharkhand. Thirteen presentations on different aspects were made by the experts working in the region. A compilation of recommendation which can be used as guidelines for developing IFS models for the eastern region was prepared as per the suggestions during the conference.

7.3 Institute-Industry Interface Meet at CIPHET Abohar

An institute industry interface meet on "Recent advances in coating and waxing technologies of fruits" was organized by IINRG, Ranchi in collaboration with CIPHET, Ludhiana at Abohar on 16 March, 2009 for popularization of lac-based formulation developed by the Institute, for extending the shelf-life of fruits and vegetables. The meet was attended by owners of waxing plants, farmers, traders of kinnow fruits, NGOs and PG students of PAU. The meeting was chaired by Ch. Surinder Jakhar, Chairman IFFCO and President, Punjab kinnow waxing and grading plants association.

A brief presentation on Application of lac-based formulation for extending shelf life of fruits and vegetables covering the economics, safety aspects and merits of lac-based formulation over commercial formulation were highlighted in the meet.



Institute industry interface meet at Abohar

Owners of waxing plants were convinced with the result of application and performance of Lac-based formulation on kinnow fruit in which 83 tons of kinnow fruit was coated with 40 litres of the formulation in various kinnow waxing and grading plants *viz*. Orient Fruits, Alamgarh; Shri Om Waxing plant, Abohar; Farmer's First Grading and Waxing center, Mouzgarh; Sai Kirpa waxing Plant, Sitto Byepass, Abohar during the months of January and February, 2009. During discussion and recommendation session, kinnow waxing plant owners showed their willingness to purchase the lac-based fruit coating formulation technology either by signing MoU with Institute or through invitation of sealed tender by us.

7.4 Launch of NAIP Project on A Value Chain of Lac and Lac Based Products for domestic and export markets launched

Dr AK Singh, DG, Shri Krishna Institute of Public Adminstration, Ranchi (Jharkhand) launched the NAIP project on *A value chain of lac and lac based products for domestic and export markets* at its Lead Centre, on 30 April, 2009. Dr J Mittal, National Coordinator, NAIP, Dr Bangali Baboo, Director, IINRG, CPI & CCPIs of the project, Scientists of institute, farmers and industrialists associated with the project etc. were also present during the project launch programme.

Dr AK Singh addressing the audience

The project has three partners i.e. M/s Tajna Shellac Pvt. Ltd., Khunti, M/s Gupta Brothers (Shellac), Bundu and Nav Bharat Jagriti Kendra (NBJK), Khunti (Jharkhand). The project aims to improve the present lac value chain comprising lac production, processing, storage, packaging, export and quality parameters with the objective of augmenting production, profitability and income of lac growers and ultimately increasing export earning for the country. The project is for duration of 3 years and 6 months with a total budget of Rs. 227.413 lakhs. A booklet on this NAIP sub project was also released during the programme.

7.5 Launch of NAIP-funded Project on Lac Insect Diversity

An ICAR-NAIP-funded research project, under Component 4, entitled "To understand the nature of diversity in lac insects of *Kerria* spp. in India and the nature of insect x host interaction," was launched in a combined workshop of three NAIP-sponsored research projects on biosystematics of insects, fungi and nematodes on 12 May, 2009 at the University of Delhi,. IINRG, Ranchi is the lead institute of the consortium comprising of IARI, New Delhi; BIT, Mesra and Delhi University. The project is scheduled for three years with a sanctioned budget of Rs 296.78 lakhs. Consortium Implementation Committee meeting of the project was conducted on 4 June, 2009 at IINRG, Ranchi.

7.6 Launch of a new project in Gujarat

A collaborative project entitled 'Production of summer *kusmi* broodlac on *kusum* for promotion of lac cultivation in Gujarat with farmers participation' to be undertaken by Gujarat forest department, Gandhinagar with active participation of IINRG, Ranchi has been approved with a budgetary provision of 17.42 lakhs for two years. MoU between Director IINRG and CCF (Research), Gandhinagar, Gujarat has been signed.

7.7 International Day for Biological Diversity

International Day for Biological Diversity was observed at the Institute on 22 May, with a programme organized to create awareness among the staff about the importance of biodiversity, biodiversity conservation and invasive alien species through talks by Dr Bangali Baboo, Director and Dr R Ramani, Head, Lac Production Division on the above subject.

7.8 Meeting for promotion of lac

A meeting was held at the Institute on 20 July, 2009 for discussion on the strategies for promotion of lac

in Jharkhand state. The Principal Secretary, PCCF and Addl. PCCF from the State held discussions with the Director and Scientists of the Institute. The visitors were given an exposure of the different activities of the Institute.

7.9 86th Foundation day celebration

To mark the occasion on the completion of 85 years of dedicated service to the Nation and to mark the occasion of 86th foundation day of the Institute on September 20, 2008, a Brainstorming session on **Strategies for Enhancing Lac production and Domestic Consumption'** was organized at the Institute. More than fifty participants from research and financial institutions, NGOs, industry, lac farmer actively took part in the deliberations. Presentations were made by experts in the field, following by brainstorming and finalization of recommendations.

Release technical bulletin by Dr MM Pandey, DDG (Engg.)

7.10 Winter School

A Winter School on "Harvesting, Processing, Value Addition and Quality Assessment of Natural Resins and Gums" was organized by the Institute, during 05-25 November, 2009. Total twelve participants belonging to KVK's, State Agricultural Universities, ICAR KVK's from five states took part in the above course. Speaking in the inaugural session Er M Prasad, Course Director emphasized upon the importance of Natural Resins and Gums for various applications. Dr Bangali Baboo, Director, IINRG focused on importance of gum and resins yielding trees, need for processing and value addition of these natural products etc. The course curriculum was designed to impart the theoretical as well as practical knowledge of harvesting/tapping technique for production of gums and resins, their processing, value addition, quality standards and characterization.

Dr NN Singh, VC, BAU delivering inaugural address

7.11 Model Training

A Model Training Course for eight days on "Processing and Value Adition of Natural Resins and Gums" sponsored by Directorate of Extension, Ministry of Agriculture, Govt. of India was organized during 15-22 Deccember, 2009 with the objective to acquaint the officials/stackholders with advanced processing and application technology of resins and gums. In this course total 19 official from state Forest Dept. of State Govt. of M.P., Jharkhand and West Bengal were participated. Training programme was inaugurated by Dr A Bhattacharya, Head, TOT Division. During the training lectures, demonstrations and field trips were organized for the trainees. The important aspects on harvesting of gums, processing of gums and resins and its value addition in different field were dealt in detail.

7.12 MoU between IINRG and BIOVED

A memorandum of understanding has been signed between Indian Institute of Natural Resins and Gums, Ranchi and Bioved Research Institute of Agriculture & Technology (BRIA & T), Allahabad, for creating livelihood through lac cultivation for upliftment of poor masses through advanced technology developed by IINRG. It is a technical collaboration between the two institute with regard to R & D programmes and extension activities like training, technology transfer to BRIA & T, rural development experiences. This will enhance transfer of technology programme more effectively and create livelihood options for the poor masses.

8. MEETINGS OF IMPORTANT COMMITEES

8.1 Institute Management Committee

The 42nd Institute Management Committee meeting was held on 18 March, 2009 at 10 AM in Kusmi Conference hall under the chairmanship of Dr. Bangali Baboo, Director and following members attended the meeting.

1. Dr. Bangali Baboo, Director, IINRG	-	Chairman
2. Dr A K Sarkar, Dean (Agri) BAU, Ranchi	-	Member
3. Dr H A Khan, Principal Scientist, CAZRI, Jodhpur	-	Member
4. Er M Prasad, Principal Scientist & Head PPD Division, IINRG, Ranchi	-	Member
5. Dr. A K Jaiswal, Principal Scientist& Trg. Coord., IINRG	-	Member
6. Shri Baboo, R K, F&AO, ICAR, Res. Comp. Eas. Reg., Patna	-	Member
7. Shri K K Prasad, AO, IINRG, Ranchi	-	Member-Secretary

Invited Members

1. Dr O P Dubey, Chairman, QRT and Ex ADG, ICAR, New Delhi
2. Dr A Bhattacharya, Principal Scientist & Head TOT Division, IINRG, Ranchi
3. Dr R Ramani, Principal Scientist & Head LPDivision, IINRG, Ranchi
4. Shri Rajesh Sahay, F& AO, IINRG, Ranchi

Institute Management Committee meeting was held on 18.03.2009 & following decisions has been taken:-

1. Confirmation of proceedings of 41st IMC meeting.
2. Condemnation of vehicle No. BEN- 4562 & BR-14A-0841 which has crossed their useful life period.
3. RE- appropriation of "other charges Equipment (Plan) to works (Plan) during 2008-09.
4. Demolition of four abandoned building.

8.2 Institute Research Committee

The Institute Research Committee (IRC) meeting for the year 2009-2010 was held during 29-30 June, 2009 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. Dr. KK Singh, Head, Division of Food Grains & Oil Seeds Processing, CIPHET, Ludhiana was special invitees as outside experts in the meeting. Dr. R.P. Singh "Ratan", Director Extension, Birsa Agriculture University, Ranchi was not able to attend the meeting due to some urgent engagements.

In his opening remarks, Dr. Bangali Baboo, Chairman, IRC and Director of the Institute, welcomed the Experts, Member Secretary and the Scientists present in the meeting. Chairman emphasizes the present scenario of meager database, increasing demand of natural materials, decreasing production base, decreasing manpower in research, increasing challenges, failure of lac crop in some parts of Jharkhand and West Bengal, particularly *rangeeni* crop. To address these issues he outlined some strategies as compile available information on gums and resins, develop package of practices for sustained tapping, scientific method of lac cultivation, processing, value addition, new products development with techno-economic analysis, human intervention for increasing production through plantation and efficient technologies, interaction with international organization like ICRAF, IFAD, WHO etc and national organization like MEF, MFPI etc were also suggested. He invited suggestions to identify possible causes of lac insect mortality and crop failure. In his concluding remarks, Chairman IRC offered following suggestions.

Chairman, IRC desires at least quarterly monitoring of each project by HODs. The proceedings alongwith

comments send 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 sciences application projects on gums amd resins.

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 23- 24 December, 2009 in the Institute Conference Hall. Chairman suggested that Two IRC be held in a year. The purpose of the mid-term IRC would be to review the half yearly progress of the research projects and ATR on RAC recommendations. PME cell should meet at least quarterly toreview progress and advise on specific projects / programmes. During two days deliverations the progress of on-going research projects were critically reviewed.

8.3 RESEARCH ADVISORY COMMITTEE

XIVth meeting of RAC was held on 12-13 May, 2009. Following members were present during the meeting:

Name and Designation	Status
Prof Suresh Prasad Department of Agricultural and Food Engineering, IIT, Kharagpur -721 302	Chairman
Dr P Chandra, ADG (PE), ICAR Krishi Anusandhan Bhawan II, Pusa, New Delhi	Member
Dr GP Gupta, Retd Prof, Division of Entomology, IARI, New Delhi	Member
Shri Devendranath Choubey Gurunanak Ward, Gondia, Maharashtra	Member
Dr Bangali Baboo, Director IINRG, Ranchi – 834 010	Member
Dr KP sao, Pr Scientist PPD Division, IINRG, Ranchi – 834 010	Member Secretary

The significant suggestions / recommendations given by the RAC was:

- Completion of taxonomical and molecular characterization of all 67 lines of insects available in Insect Gene Bank and Identification and evaluation of 4-5 potential high yielder for kusmi and rangeeni strain.
- Selection, evaluation and conservation of high yielding/elite host plants of kusum and ber.
- Identification of causal factors and remedial measures to alleviate frequent rangeeni lac crop failure in Jharkhand and adjoining areas of W.B.
- Compilation, determination and documentation of physico-chemical properties of important Indian natural resins, gum resins and gums.
- Isolation, characterization, evaluation and documentation of potential bio-active compounds from lac.
- Development/up gradation of standards for quality evaluation and quality certification of lac dye.
- Development of surface coating blends for surface coating application and reduced product cost from natural resins and gums.
- Documentation of status on collection/harvesting, production, processing, value addition, uses, marketing and export of rosin, gum karaya, gum arabic, guar gum and guggual (gum-resins).
- Development of process technology for utilization of by products from guar gum industries.
- Initiative for introduction of certificate and diploma courses on lac, gums and natural resins.
- Initiative for development of course contents for the under graduate and post graduate students for its inclusion in the course curriculum of State Agricultural Universities (SAUs), Indian Institute of Forest Management and other forest based institutes. The course could cover agro-forestry concept, livelihood, climate moderation etc.
- Evaluation and refinement in developed technologies.
- The technologies of lac based coating on citrus fruits and pure food grade lac dye need intensive efforts for commercialization and popularization.
- Documentation of data and information on various aspects of natural resins and gums and its validation.
- Preparation of documentary films on lac production, processing and its application and important gums and resins.

9. DISTINGUISHED VISITORS

Visitors

Date	Visitor (s)
09.02.2009	Dr Mangla Rai, Secretary DARE DG ICAR, New Delhi and Dr. Pritam Chandra, ADG (PE), ICAR, New Delhi
16.02.2009	Delegates of the ISAE Workshop
28.02.2009	Brigadier Sagar Singh, Commandant 61 Infantry Brigade
06.03.2009	Mrs Anu Aneja w/o Brigadier S K Aneja, Director General of NCC (Bihar & Jharkhand)
13.03.2009	Dr A K Malhotra, PCCF, Govt. of Jharkhand & Dr K K Kumar, Director, NRC Litchi, Mujjaffarpur
18.03.2009	Prof. Gajendra Singh, Ex DDG (Engg.), ICAR & Dr O P Dubey, Ex ADG (PP), ICAR, New Delhi.
21.03.2009	Dr Mrutyunjaya, National Director, NAIP, ICAR & Dr K C Sashidhar, CGM, NABARD, Ranchi
21.03.2009	Mr Tanmoy and Mrs Senjuti Bhattacharya, Trustees, International Mass Awareness Program (IMAP), Kolkata
18.04.2009	Sri R. Santhanam, Member, CAT (Admin), Hyderabad .
28.04.2009	Dr H Chandrasekharan, Head, USI, IARI, New Delhi
29.04.2009	Dr J P Mittal, NC-NAIP, New Delhi
30.04.2009	Dr A K Singh, IAS, Director General, SKIPA, Ranchi
06.05.2009	Shri Puran Chand, News Editor, Ranchi Express
26.05.2009	Dr. P. Mukhapadhya, DE, Cooch Bihar (WB
29.05.2009	Dr G J Varshney, Director, NRC on Weed, Jabalpur
29.05.2009	Dr. N.P. Singh, Joint Director, ICAR, Tripura
4.09.2009	IAS probationers -Sri Harsh Mangla, Sri Nand Kumar, Sri Chandrasekhar, Sri Rajkamal
20.07.2009	Shri Sukhdeo Singh, Principal Secretary (Forest), Dr A K Singh, PCCF and Shri B K Johar, Addl, PCCF, Forest Dept., Jharkhand
21.07.2009	Dr. M A Khan, Director, ICAR-RCER, Patna
13.08.2009	Dr V P Singh, Regional Representative, WAC
02.09.2009	Sri K C Joshi, Dy. Secretary, ICAR, New Delhi

Date	Visitor (s)
19.09.2009	Dr M M Pandey, DDG (Engg.), ICAR, New Delhi
19.09.2009	Dr. B K Dwivedi, Director, BIOVED Research Institute, Allahabad
20.09.2009	Dr. Moni Thomas, Chief Minister's Fellow, Jabalpur
13.10.2009	Mr Michael and Mrs Patricia Picone, USA
15.10.2009	Dr A K Banerjee, Sr. Scientitic Officer, DST, Govt of W. Bengal
22.10.2009	Shri A K Upadhyay, Spl. Secretary, DARE and ICAR
23.10.2009	Shri Rajiv Bakshi, IFS, DFO Lohardaga
31.10.2009	Smt Radha Shankarnarayanan,w/o HE K Shankarnarayanan First Lady of Jharkhand and Smt Suman Pathak, OSD to Governor
31.10.2009	Dr A P Dikshit, Consultant, IFAD
07.11.2009	Shri A K Sharma, Chief Vigilance Officer, CMPDI, Ranchi
20.11.2009	Shri Lievene Kindo, IAS
15.12.2009	Prof. P K Mohanty, Utkal University, Bhubaneshwar
17.12.2009	Thirty officials of NABARD

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 and tried to result in minimum experimental error due to farm condition. The following activities were undertaken during the period under report.

Research Farm Management

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 275 seedlings of *khair* were transplanted in gaps and gap filling of *khair* plots were completed. In Gum and Resin Farm, 15 plants of *Anogiessus latifolia* and 5 plants of piar gum were planted and maintained. Vacant plots were utilized for cultivation of crops *viz.*, wheat, paddy, soybean and urd for resource generation. Research farm and its roads, paths, hedges and nursery were maintained in good condition for healthy look of farms.

Infrastructure Development

- Six main roads along with sides of pucca roadand 12 bunds were prepared in different plots.
- Pitching work was done in pucca pond.
- About 1500 fingerlings (*Catla, Rohit* and *Mirgal*) were released in in Pucca pond for Pisciculture.
- Disilting of pucca pond was completed.
- Renovation of main gate of IRF was completed.
- Amrapali mango (45) were planted and maintained nearby areas of pucca pond.
- Roads were repaired by spreading of soil.
- Lining of pond with brick masonry work for water retention was completed.
- Host trees were pasted with mixture of lime and chlorpyri phos for the management of termite and a programme was initiated to eradicate termitoria from the Institute Research Farm.
- Termitorium (200) have been treated with Chlorpyriphos (TC) >

Resource Generation:

An amount of Rs. 2, 99,011 (Rupees Two lakh ninety nine thousand and eleven only) has been generated as revenue from sale of the farm produce during the period under report.

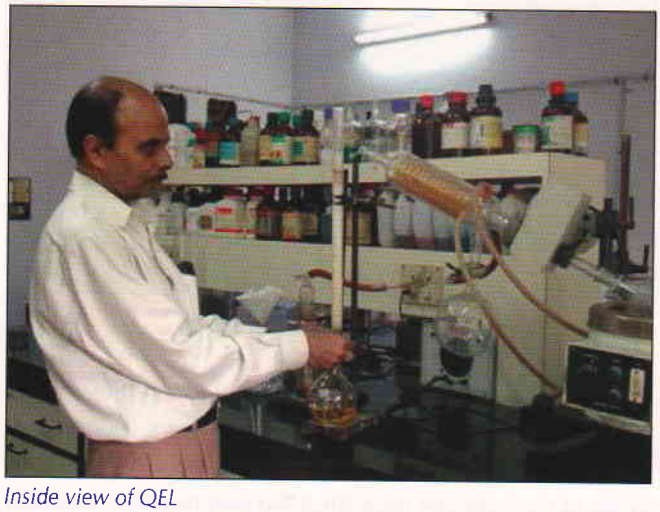
Revenue generated by IRF

Sl.	Item	Amount
1	Lac (Brood lac, scrapped lac etc.)	Rs. 1,13,890
2	Wood (Fuel / pruned twigs, bamboo etc.)	Rs. 33,233
3	Other Farm produces (Lac host seeds, seedlings, Paddy, wheat, ornamental plants etc.)	Rs. 1,36,638
4	Others (Water Tanker, Fuel charges etc.)	Rs. 15,250
	Total :	**Rs. 2,99,011**

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 165

samples of seedlac/ shellac/ bleached lac/ aleuritic acid/ lac dye/ by products of lac were received from Govternment.organizations/ Private industries/ Various division of the Institute and in all 555 tests were carried out. In addition to this two trainee was trained in the Analysis and Testing of lac and lac based products. Eleven trainees were trained in the determination of bleach index. A sum of Rs 36,503 has been earned as testing charges.



Inside view of QEL

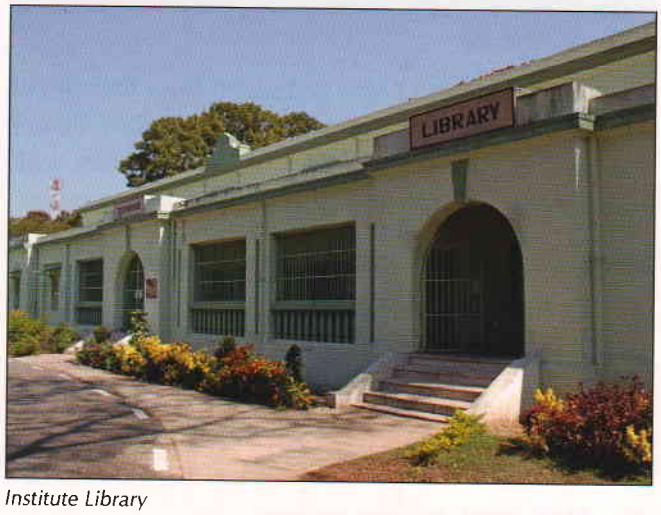
10.3 RESEARCH MANAGEMENT UNIT

Activities performed by the research management unit of the institute during the period under report were:

- Correspondence and sending important reports to the Council.
- Compilation and preparation of various reports to the Council like monthly report, monthly report for cabinet secretariat, quarterly progress report, six monthly report of the scientists 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.
- 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
- Upgradation of Internet connectivity to 512 kbps from ERNET India is in process.
- Maintenance of RAC, QRT and SRC files.
- Maintenance of database for Personnel Information Management System Network (PERMISNET) and Intelligent Reporting System.
- Right to Information.
- Maintenance of database for project information and Management System (PIMS Net-ICAR) a web based software.

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



Institute Library

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 and Technologists of the Institute, it also renders services to other researchers, academicians and students as well as lac industrialists from all parts of the country.

Advance/Full Text/Abstracts access of 2905 journals from several publishers has been made available online through *Consortium for e-Resources in Agriculture (CeRA)* to our scientists during the year.

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

Inside view of library

Revenue of Rs.12153 was generated from the sale of publications 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.
- Document delivery services.
- Bibliographic services.
- Current awareness services.
- Inter library loan services for resource sharing.
- Sale of institute publications.

Library holdings as on 31.12.2009

Documents	Additions	Total Holdings
Books	17	7644
Bound Journals	132	21341
Annual Report	79	4694
CD- Rom	-	123
ISI-Specification	02	139
Maps	-	37
Patents (Foreign)	-	327
Patents (Indian)	-	15
Thesis	01	09

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:

Civil and Water supply

A. Completion of work through CPWD

1. AR & MO of Residential Quarters

- Quarter Type – III (5-8) in main campus
- Quarter Type – III (18-21) in PDU campus
- Quarter Type – II (15-20 & 25-32) in PDU campus

2. Construction of storage water tank of one lakh litre capacity in the main campus.

3. AR & MO of Lac Production Division.

B. Work carried out departmentally

- Construction of morum road from Guest House ti Residential Quarter Type IV.
- Constructions of cycle stand in IRF.
- Installation of two 20 HP monoblock pump at riverbed pump house.

- Installation of one 5 HP submersible pump in storage tank at main campus.
- Installation of one 4 HP submersible pump in newly constructed deep bore well at PDU campus.
- Snowcem of front boundary wall in main campus.
- Distemper inside the room and snowcem outside walls of guest house.

Total number of jobs entered in various units of Estate section are-:

- Carpentry works- 336 jobs for divisions and 89 for residential quarters.
- Welding work- 311 jobs
- Mechanical works- 446 jobs
- Turner work- 348 jobs

Electrical and Genset

A. Completion of work through CPWD.

- Electrical renovation of guest house.
- Electrical renovation of LPD.
- Lying of under ground power cable & installation of feeder and distribution panel.

B. Work carried out departmentally

- Electrical renovation of purchase section.
- Electrical renovation of Bungalow No 1.
- Electrical renovation of Residential quarters Type III-18 to 21 and Type II-15 to 20 and 25 in PDU campus.
- Electrical power connectivity to drip irrigation system at IRF.
- Electrical power connectivity to newly installed two monoblock pump at riverbed pump house, one 4 HP submersible pump of newly constructed deep bore well at PDU campus.

Other activies

- Fifty memento pieces were prepared for TOT Division.
- Nine panel doors were prepared for guest house.
- Showcase for displaying mementoes in Director's chamber was prepared.
- One model secretariat table and one sofa set modal for exhibition in surface coating lab were prepared.
- Approximately Rs one lakh revenue was realized from Guest House and Trainee's Hostel.

10.6 HEALTH CARE

The Institute is running its own Dispensary in the Campus. Dr. Anil Kumar and lady doctor AMA Dr. (Mrs.) Vipula Verma are working as a part time Medical Officer on contractual basis on alternate days. Most of the cases are handled in the dispensary itself and the complicated cases are referred to authorized hospitals in the city for expertise treatment. The dispensary is well equipped with all instruments / accessories to handle the cases of general/minor dressing, first aid, medical examination of gents/ ladies patients and determining blood pressure, blood sugar, pulse, weight etc. During the period, around 5,208 patients were attended by both the AMAs in the IINRG dispensary and 289 patients were examined for blood sugar by Glucometer. Most of the medicines advised by the AMAs were made available to the patients from the dispensary itself.

Institute Dispensary

10.7 AGROMETEOROLOGY

Agro-meteorology Unit of the Institute is situated at 23°23' N latitude, 85°23'E longitude and 650m altitude. During the year 2009, different weather parameters recorded by the unit are presented in Table 1. Total rainfall recorded was 1103.8 mm, which was 25.3% less than the previous year (1477.8 mm). The highest rainfall (283.9 mm) was recorded during September month, distributed in ten days and the lowest in the month of April (2.0 mm). There was no rainfall during the months of February and December. August month experienced the maximum number of rainy days distributed in 18 days with cumulative precipitation of 273 mm. The maximum one-day rainfall (135.3 mm) was recorded on 7 September. Monsoon months (June to September) alone accounted for 877.5 mm (79.5%) of the total yearly rainfall. The highest mean maximum temperature (38.9°C) was observed in the month of April and the lowest mean minimum temperature (6.1°C) during December. May 2nd and December 30th were recorded as the hottest and coldest day of the year with a temperature of 44.0° C and 6.0° C, respectively.

Table1. Meteorological data recorded at Agro-Met Unit of the Institute during 2009.

Month	Mean Temperature (° C)		Mean Relative Humidity (%)		Total Rainfall (mm)
	Maximum	Minimum	7.00 a.m.	2.00 p.m.	
January	26.74	9.28	69.0	46.0	10.0
February	30.89	10.70	53.0	27.0	0.0
March	34.19	14.35	43.0	24.0	21.0
April	38.91	20.11	37.0	22.0	2.0
May	38.32	21.97	58.0	45.0	106.0
June	35.03	20.29	65.0	48.0	95.0
July	30.27	22.59	88.0	75.0	225.6
August	28.81	22.18	90.0	73.0	273.0
September	29.53	23.28	83.0	70.0	283.9
October	29.20	20.02	65.0	53.0	63.7
November	26.10	12.43	80.0	57.0	23.6
December	22.80	6.10	61.0	51.0	0.0
				Total Rainfall (mm)	**1103.8**

11. संस्थान के राजभाषा प्रकोष्ठ की गतिविधियाँ

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

संस्थान 'क' क्षेत्र में है, इसे राजभाषा अधिनियम की धारा 10(4) के अर्न्तगत केन्द्रीय गजट में अधिसूचित किया जा चुका है। संस्थान के चार अनुभागो को शत प्रतिशत कार्य हिन्दी में करने हेतु विनिर्दिष्ट किया गया है एवं प्रवीणता प्राप्त सभी अधिकारियों/कर्मचारियों को अपना-अपना कार्य हिन्दी में करने हेतु व्यक्तिशः आदेश दिये गये हैं। राजभाषा नियम के प्रावधानों के अनुपालन एवं दैनिक कार्य में हिन्दी के प्रयोग में प्रगति लाने तथा इसे सर्वग्राह्य बनाने के लिए राजभाषा प्रकोष्ठ द्वारा निम्नलिखित कार्य सम्पादित होते है:-

संस्थान राजभाषा कार्यान्वयन समिति की तिमाही बैठकों का आयोजन, कार्यसूची एवं कार्यवृत की तैयारी तथा बैठकों में लिए गये निर्णयों पर अनुवर्ती कार्रवाई। वार्षिक रिपोर्ट का सारांश, कार्यालय आदेश, परिपत्र, ज्ञापन, निविदा इत्यादि की 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।

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

- संस्थान राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन, कार्यसूची एवं कार्यवृत की तैयारी एवं बैठकों में लिए गये निर्णयों पर अनुवर्ती कार्रवाई।
- वार्षिक रिपोर्ट का सारांश, भा.प्रा.रा.गों.सं. समाचार पत्रिका, 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 चेतना मास एवं योजनानुसार नगर स्तरीय राजभाषा संबंधी प्रतियोगिता एवं कार्यशाला का आयोजन करना।
- संदर्भ साहित्य, हिन्दी पत्रिका, शब्दकोश एवं तकनीकी शब्दावली के उपार्जन हेतु कार्य।
- द्विभाषी मुहरों, नामपटट, पत्रशीर्ष (लेटरहेड) के निर्माण अथवा सक्रिय सहयोग करना।
- प्रचार सामग्रियों के हिन्दी रूपान्तर एवं समारोहों के समाचार संकलन का कार्य।
- विभागीय विषय पर तकनीकी शब्दावली का निर्माण।
- हिन्दी में वैज्ञानिक गोष्ठी के साथ साथ प्रशासनिक तथा तकनीकी वर्ग के लिए कार्यशाला का आयोजन।
- निदेशक महोदय की अध्यक्षता में वर्ष 2009 में संस्थान राजभाषा कार्यान्वयन समिति की चारो तिमाही बैठको का आयोजन निम्नलिखित तिथियों को किया गया तथा प्रगति की समीक्षा की गई। तिमाही रिपोर्ट एवं कार्यवृत परिषद सहित अन्य संबंधित कार्यालयों में प्रेषित की गई :

(क) दिनांक 27.02.2009 (ख)दिनांक 05.05.2009

(ग) दिनांक 14.08.2009 एवं (घ) दिनांक 12.11.2009

जिसके अर्न्तगत निम्नलिखित प्रमुख चर्चायें हुईं तथा सर्वसम्मति से निर्णय लिए गए :-

- संस्थान में हिन्दी में मूल रूप से पत्राचार बढाने के लिए नकद पुरस्कार योजना का अनुपालन।
- वार्षिक कार्यक्रम 2009-10 के प्रस्ताव पर चर्चा।
- नगर स्तरीय हिन्दी व्याख्यान प्रतियोगिता का आयोजन।
- गृह पत्रिका लाक्षा-2009 का प्रकाशन।
- नकद पुरस्कार योजना का अनुपालन।
- वित्त संबंधी विषय पर हिन्दी कार्यशाला का आयोजन।
- द्विभाषी मुहरों का निर्माण।
- द्विभाषी नामपट्ट की व्यवस्था।
- प्रशासनिक विषय से संबंधित हिन्दी कार्यशाला का आयोजन।
- हिन्दी दिवस/हिन्दी प्रतियोगिताओं का आयोजन।
- स्वास्थ्य संबंधी विषय पर हिन्दी कार्यशाला।
- हिन्दी में वैज्ञानिक संगोष्ठी का आयोजन।
- जॉच विन्दु का निर्धारण।
- गोंद एवं राल के विभिन्न पहलुओं पर व्याख्यान।

राजभाषा प्रकोष्ठ की उपलब्धियाँ-2009

- "नए पुर्नसंयोजी लाख कीट की प्रजाति की खोज एवं इसका महत्व" विषय पर दिनांक-12.02.2009 को वैज्ञानिक हिन्दी संगोष्ठी का आयोजन किया गया।
- "रासायनिक रंगों के खाद्य पदार्थो में प्रयोग का परिणाम" विषय पर दिनांक-15.04.2009 को हिन्दी व्याख्यान प्रतियोगिता का आयोजन किया गया।
- "नए वेतनमान के संबंध में यात्रा भत्ता संबंधी नियम" विषय पर दिनांक-08.05.2009 को वित्त संबंधी हिन्दी कार्यशाला का आयोजन किया गया।
- "छुट्टी संबंधी नियम एवं भविष्य निधि के प्रकार व नियम" विषय पर दिनांक- 03.08.2009 को हिन्दी में प्रशासनिक कार्यशाला का आयोजन किया गया।
- "प्राकृतिक राल एवं गोंद- भा.प्रा.रा.गों.सं. समाचार पत्रिका" का सम्पूर्ण अनुवाद एवं वार्षिक प्रतिवेदन के सारांश का हिन्दी अनुवाद किया गया।
- संस्थान की वार्षिक हिन्दी पत्रिका **लाक्षा 2008** के प्रवेशांक का मार्च, 2009 में प्रकाशन किया गया।
- संस्थान के आगत-निर्गत पत्रों का विस्तृत (अनुभाग/विभाग व क्षेत्रवार) विवरण तैयार कर विहित प्रपत्र में तिमाही रिपोर्ट तैयार की गयी तथा परिषद् समेत सभी संबंधित कार्यालयों को प्रेषित की गयी।
- वैज्ञानिक उपकरणों से जुड़े कम्प्यूटरों को छोड़कर संस्थान के कुछ अन्य कम्प्यूटरों में हिन्दी फॉन्ट लगा दिये गये हैं।
- **सतर्कता जागरूकता सप्ताह** के अवसर पर दिनांक 07.11.09 को प्रशासनिक पारदर्शिता के लिए सतर्कता जागरूकता विषय पर व्याख्यान का आयोजन किया गया।
- **कौमी एकता सप्ताह** के समापन समारोह का आयोजन दिनांक 26.11.09 को किया गया।
- वर्ष 2009 में राजभाषा प्रकोष्ठ की पहल पर विज्ञान एवं साहित्य से जुड़े कुछ हिन्दी पुस्तकों का उपार्जन किया गया।
- समय-समय पर हिन्दी के प्रयोग को प्रोत्साहित करने के लिए विभिन्न प्रकार की **हिन्दी प्रतियोगिताओं** का आयोजन किया गया।
- हिन्दी में श्रुतिलेखन (डिक्टेशन) देने के लिए पुरस्कार योजना संस्थान में लागू की गई है।
- सरकारी काम काज मूल रूप से हिन्दी में करने हेतु संस्थान में नकद पुरस्कार योजना लागू की गई, इसमें वैज्ञानिक, तकनीकी एवं प्रशासनिक वर्ग के कुल 12 अधिकारियों/कर्मचारियों ने भाग लिया।

कार्यक्रम

हिन्दी दिवस समारोह का आयोजन

भारतीय प्राकृतिक राल एवं गोंद संस्थान, नामकुम, राँची में 15 सितम्बर 2009 को अपराह्न 02.30 बजे प्रौद्योगिकी हस्तांतरण विभाग के रंगीनी व्याख्यान कक्ष में **हिन्दी दिवस समारोह** का आयोजन किया गया जिसकी अध्यक्षता संस्थान के निदेशक डॉ. बंगाली बाबू ने की।

हिन्दी दिवस समारोह

इस अवसर पर मुख्य अतिथि के रूप में बोलते हुए संत जेवियर महाविद्यालय, रॉची के हिन्दी विभाग के अध्यक्ष डॉ. कमल कुमार बोस ने कहा कि हिन्दी एक सक्षम भाषा है तथा जो इसकी क्षमता पर प्रश्न उठाते हैं वे स्वय इसका मूल्यांकन करने में सक्षम नहीं हैं। उन्होंने हिन्दी भाषा के व्यवहारिक पहलू पर जोर देते हुए कहा कि हमें अपने वातायन खुले रखने चाहिए तथा दूसरी भाषाओं के प्रचलित शब्दों को भी आत्मसात करने के लिए तैयार रहना चाहिए। डॉ. बोस ने बोल-चाल एवं कार्यालय कार्य में सरल हिन्दी के प्रयोग की सलाह दी।

अपने अध्यक्षीय भाषण में संस्थान के निदेशक डॉ. बंगाली बाबू ने कहा कि अपनी राट्रभाषा को राष्ट्रीय गर्व के रूप में लें तथा प्रत्येक देशवासी इससे जुड़कर अपने को सम्मानित महसूस करें, तभी हम भाषा को पूर्ण रूप से अंगीकार कर पाएंगे। उन्होंने संस्थान के सभी अधिकारियों/कर्मचारियों से कार्यालय कार्य में हिन्दी के प्रयोग की गति बनाए रखने की अपील की। डॉ. बाबू ने बताया कि एक बड़े भूभाग में बोली जाने वाली भाषा हिन्दी अब बाजार एवं व्यापार की जरूरत बन गई है।

समारोह का शुभारंभ मुख्य अतिथि द्वारा दीप प्रज्जवलन के साथ हुआ तथा संस्थान के निदेशक डॉ. बंगाली बाबू एवं हिन्दी दिवस समारोह आयोजन समिति के अध्यक्ष व प्रधान वैज्ञानिक, डॉ अजय कुमार सिंह ने पुष्पगुच्छ देकर मुख्य अतिथि का स्वागत किया। समारोह में शामिल अतिथियों, संस्थान के अधिकारियों/कर्मचारियों एवं मुख्य अतिथि का स्वागत करते हुए डॉ. अजय कुमार सिंह ने कार्यक्रम के महत्व पर प्रकाश डाला। विविध कार्यक्रम के अंतर्गत श्री सी. एल. मीणा, श्री कवल किशोर प्रसाद एवं डॉ अंजेश कुमार ने कविता, संस्मरण, चुटकुले इत्यादि प्रस्तुत किए।

संस्थान में हिन्दी कार्य से संबंधित प्रगति प्रतिवेदन तकनीकी अधिकारी (रा.भा.) डॉ अंजेश कुमार ने प्रस्तुत किया। इस अवसर पर आयोजित की गई हिन्दी टिप्पण, प्रारूप लेखन, निबंध, पर्याय, श्रुतिलेख व अन्ताक्षरी प्रतियोगिताओं के विजेताओं को मुख्य अतिथि के कर कमलों से पुरस्कार प्रदान किया गया। विजेताओं में डॉ संजय श्रीवास्तव, श्री संतोष कुमार सिंह यादव, डॉ एम.जेड.सिद्दिकी, सर्वश्री एम.एफ.अंसारी, सी.एल. मीणा, विनोद कुमार, कवल किशोर प्रसाद, रंजय कुमार सिंह, वीरेन्द्र कुमार सिंह, प्रहलाद सिंह, मदन मोहन, अर्जुन शर्मा, अनिल कुमार सिन्हा, अर्जुन गोप आदि शामिल हैं। समारोह स्थल पर संस्थान से प्रकाशित ताजा हिन्दी/द्वि भाषी प्रकाशनों तथा उपार्जित किए गए हिन्दी प्रकाशनों की एक प्रदर्शनी भी लगाई गई।

कार्यक्रम का संचालन एवं धन्यवाद ज्ञापन डॉ अंजेश कुमार, तकनीकी अधिकारी (रा.भा.) ने किया।

संस्थान के हिन्दी/द्विभाषी प्रकाशनों की सूची

1. प्राकृतिक राल एवं गोंद-भा.प्रा.रा.गों.सं. समाचार पत्रिका (द्विभाषी) अंकों की संख्या-04, पृष्ठों की संख्या-64
2. ईयर प्लानर सह प्रचार पत्रक (द्विभाषी), पृष्ठों की संख्या-28
3. कैसे करें कुसुम वृक्ष पर लाख की खेती-पूस्तिका, पृष्ठों की संख्या-12
4. कैसे करें पलास वृक्ष पर लाख की खेती-पूस्तिका, पृष्ठों की संख्या-20
5. कैसे करें बेर वृक्ष पर लाख की खेती-पूस्तिका, पृष्ठों की संख्या-16

संस्थान राजभाषा कार्यान्वयन समिति की तिमाही बैठकों मे लिए गए निर्णय एवं की गई कार्रवाई

कम सं	लिए गए निर्णय	अनुपालन/की गई कार्रवाई
1.	नगर स्तरीय व्याख्यान प्रतियोगिता	"रासायनिक रंगों के खाद्य पदार्थों में प्रयोग का परिणाम" विषय पर संस्थान में दिनांक-15.04.2009 को केन्द्र सरकार एवं अन्य कार्यालयों के लिए नगर स्तरीय व्याख्यान प्रतियोगिता का आयोजन किया गया।

कम सं	लिए गए निर्णय	अनुपालन/की गई कार्रवाई
2.	द्विभाषी मुहरों का निर्माण	द्विभाषी मुहरों का निर्माण किया गया है। कुछ और मांग-पत्र विलम्ब से प्राप्त हुए हैं जिनपर कारवाई की जा रही है।
3.	सभी कम्प्यूटरों में हिन्दी सॉफ्टवेयर लगाना	वैज्ञानिक उपकरणों से जुड़े कम्प्यूटरों को छोड़कर संस्थान के शेष सभी कम्प्यूटरों में हिन्दी फॉन्ट लगा दिये गयें हैं ।
4.	संस्थान की हिन्दी पत्रिका लाक्षा का प्रकाशन	संस्थान की हिन्दी पत्रिका लाक्षा का प्रकाशन मार्च 2009 में कर लिया गया है।
5.	हिन्दी प्रतियोगिताओं का आयोजन	संस्थान में टिप्पण, प्रारूप लेखन, निबंध, श्रुतिलेख, अंताक्षरी इत्यादि हिन्दी प्रतियोगिताओं का आयोजन किया गया एवं विजेताओं को पुरस्कार वितरित किया गया।
6.	हिन्दी चेतना मास एवं हिन्दी दिवस का आयोजन	हिन्दी चेतना मास एवं हिन्दी दिवस का आयोजन किया गया।
7.	हिन्दी कार्यशाला/संगोष्ठी का आयोजन	प्रशासनिक विषय हिन्दी कार्यशाला एवं वैज्ञानिक विषय पर संगोष्ठी का आयोजन किया गया।
8.	नकद पुरस्कार योजना लागू करना	हिन्दी में मूल पत्राचार को बढ़ावा देने के लिए नकद पुरस्कार योजना लागू की गई है।
9.	जॉच विन्दु का निर्धारण	राजभाषा अधिनियम के प्रावधानों के अनुरूप जॉच विन्दु का निर्धारण किया गया है।

अन्य गतिविधियॉ

- केन्द्रीय मनश्चिकित्सा संस्थान, कांके में दिनांक - 21.01.2009 को आयोजित राँची नगर राजभाषा कार्यान्वयन समिति की बैठक में संस्थान का प्रतिनिधित्व डॉ. अंजेश कुमार, त. अ. (रा.भा.) ने किया तथा बैठक में संस्थान की गतिविधियों की जानकारी दी।
- निफ्ट, हटिया में दिनांक-18.08.2009 को आयोजित नगर राजभाषा कार्यान्वयन समिति की बैठक में के.म. संस्थान, कांके के अनुरोध पर कार्यक्रम का संचालन डॉ. अंजेश कुमार, त. अ. (रा.भा.) ने किया।
- सतर्कता जागरूकता सप्ताह के समापन समारोह का आयोजन दिनांक 07.11.2009 को तथा कौमी एकता सप्ताह के समापन समारोह का आयोजन दिनांक - 26.11.2009 को किया गया।
- डॉ. अंजेश कुमार, त. अ. को दिनांक- 17.08.2009 से सहायक निदेशक (रा.भा.) का अतिरिक्त प्रभार दिया गया।
- केन्द्रीय ईधन अनुसंधान संस्थान, नामकुम राँची में आयोजित हिन्दी पखवाड़ा के शुभारंभ के अवसर पर संस्थान के तकनीकी अधिकारी (रा.भा.) डॉ. अंजेश कुमार को विशिष्ट अतिथि के रूप में आमंत्रित किया गया।
- केन्द्रीय रिजर्व पुलिस बल प्रशिक्षण महाविद्यालय, तिरिल, राँची द्वारा संस्थान के तकनीकी अधिकारी (रा.भा.) को हिन्दी दिवस के अवसर पर मुख्य अतिथि के रूप में आमंत्रित किया गया।

12. PERSONNEL

Sanctioned strength of Scientific, Technical, Administrative and supporting staff as on 31.12.2009

Scientific

R.M.P.	01
Principal Scientist	04
Senior Scientist	11
Scientist	31
Total	**47**

Technical

Category-I	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
Sr.Clerk	13
Jr.Clerk	03
Steno Gr.III	01
J.A.O.	01
Total	**36**

Skilled Supporting Staff

SSG-IV	10
SSG-III	20
SSG-II	34
SSG-I	17
Total	81
Grand Total	**226**

Cadre	Sanctioned	In position
Scientific	47*	30*
Technical	62	53
Administrative	36	26
Supporting	81	69
Total	**226**	**178**

* Including RMP

Dr. Bangali Baboo — **Director**

Lac Production Division

	Disciplines
Dr R Ramani, P.S. & Head	Agril. Entomology
Dr AK Singh, P.S.	Plant Pathol.
Dr KK Sharma, Sr. Scientist	Agril. Entomology
Sri SC Srivastava, Sci. (SG)	Plant Breeding
Dr Soumen Ghosal, Sr. Sci.	Agronomy
Dr Md Monobrullah, Sr. Sci.	Agril. Entomology
Sri D Saha, Sci. (Sr Scale)	Biotechnology
Sri RK Singh, Sci (Sr scale)	SWCE
Sri Anees, K, Scientist	Plant Biochemistry
Mrs Thamilarashi, K, Scientist	Biotechnology
Sri RL Ram, T-5	F/F Tech.
Sri ML Ravidas, T-5	F/F Tech.
Sri PA Ansari, T-5	F/F Tech.
Sri Binod Kumar, T-5	F/F Tech.
Sri RK Swansi, T-4	F/F Tech.
Sri DW Runda, T-4	F/F Tech.
Sri KA Nagruwar, T-3	F/F Tech.
Sri SKTripathi, T-2	F/F Tech.
Sri Bhupal Kumar, T-1	Lab. Tech.

Processing and Product Development Division

Sri Murari Prasad, Pr Sci. and I/c	Chemical Engg.
Dr RN Majee, Pr Scientist	Org. Chem.
Dr KP Sao, Pr Scientist	Physics
Dr PC Sarkar, Sr Scientist	Org Chemistry
Dr S Srivastava, Sr Scientist	Org. Chem.
Dr MZ Siddique, Sr. Sci.	Org. Chem.
Dr Divya, Sr. Scientist	Org. Chem.
Sri SK Pandey, Sci.(Sr Scale)	Mech. Engg.
Dr SK Giri, Sci (Sr Scale)	A.S.&P.E.
Sri M.F.Ansari, Sci (Sr Scale)	Org.Chem.
Sri SKS Yadav, Scientist	Org.Chem
Sri DD Singh, (T-7-8)	Lab. Tech.
Sri KK Preasad, T-7-8	Lab. Tech.
Sri Jagdish Singh, T-7-8	Lab. Tech.
Sri TK Saha, T-6	Lab.Tech
Sri Bhola Ram, T-5	Lab.Tech.
Sri BP Ghosh, T-5	Lab.Tech.
Smt Prabha Devi, T-4	Lab.Tech.
Sri Binod Kumar, T-2	Lab.Tech.
Sri SK Tirkey, T-2	Lab.Tech.
Sri Ajay Kumar, T-2	Lab.Tech.

Transfer of Technology Division

Dr A Bhattacharya, P.S.&Head	Agril.Ento.
Dr BP Singh, P.S.	Agronomy
Dr KM Prasad, PS	Org.Chem.
Dr AK Jaiswal, PS	Agril.Ento.
Dr N Prasad, Sr.Sci.	A.S.&P.E.
Dr JP Singh, Sr. Sci	Agril. Ento.
Dr G Pal, Sc.(Sr.Scale)	Agri.Eco
Sri PM Patil, Sc.(SS)	Phys.Chem.
Sri RN Vaidya, T-6	F/F Tech.
Sri RP Srivastava, T-5	Photographer
Sri DK Singh, T-5	F/F Tech.
Sri AK Sinha, T-5	F/F Tech.
Sri SB Azad, T-4	F/F Tech.
Smt. Ratna Sen, T-4	Lab. Tech.
Sri P Patamajhi, T-4	F/F Tech.
Sri RK Rai, T-2	Lab. Tech.
Sri Anup Kumar, T-2	Lab. Tech.
Sri Madan Mohan, T-2	Lab. Tech.

Research Management Unit

Dr A K Jaiswal, Pr Scientist	I/c RMU
Sri AKSahay, T- 7-8	F/F Tech.
Sri DGanguly, T-6	Lab. Tech.
Sri KM Sinha, T-6	Lab. Tech.
Shri Sunil Kumar, T-4	Lab. Tech.

Quality Evaluation Lab (Under PPDDiv)

Dr S Srivastava, Sr.Sci.	I/c QEL
Sri D Ghosh,T-7-8	Lab. Tech.
Sri BK Singh, T-2	Lab. Tech.

Library

Sri VK Singh, T-7-8 I/c Lib.	Lib. & Documentations.
Sri Binod Kumar, T-4	Lib. & Documentations.

Institute Research Farm

Sri LCN Shahdeo, T-7-8	F/F Tech.
Sri M Surin, T-3	F/F Tech.
Sri Satish Kumar,T-2	F/F Tech.
Sri SK Mukherjee,T-2	F/F Tech.

Estate

Sri AK Yadav,	Security Officer
Sri HL Bhakta,T-4	Workshop Tech.
Sri Binoy Kumar, T-3 (JE)	Workshop Tech.
Sri ID Das, T-2	Workshop Tech.
Sri Arjun Sharma, T-2	Workshop Tech.
Sri RK Ravi, T-2	Workshop Tech.
Sri K Tirkey, T-2	Workshop Tech.
Sri BS Choudhary, T-2	Workshop Tech.
Sri PVD Tirkey, T-2	Workshop Tech.
Sri Ramakant Singh,T-1	Workshop Tech.
Sri Anil Kr Sharma,T-1	Workshop Tech.
Sri KK Deonath, Sr Clerk	Admin.

Official Language Cell

Dr Anjesh Kumar, T-5	Press & Editorial

Dispensary

Dr AK Jaiswal	I/c Dispensary
Dr Anil Kumar	A.M.A.(Part time)
Dr Vipula Verma	A.M.A.(Part time)
Sri Chittaranjan Kr Singh	Pharmacist (T-3)

Administration

Sri Ashok Ghosh	Administrative Officer

Admin-I

Sri P Singh	AAO
Sri SC Lal	Asstt.
Sri RN Mahto	Asstt.
Sri A.K.Tripathi	Sr.Clerk
Sri RK Toppo	Sr.Clerk
Sri Krishna Murari Kumar	Jr.Clerk
Sri Bandhu Mahto	Jr.Clerk

Admin-II

Sri Amrendra Kishore	AAO/ D.D.O.
Sri W Guria	Asstt.
Sri BK Rajak	Asstt.
Sri Bihari Sahu	Sr.Clerk
Sri Samal Kumar	Sr.Clerk (Cashier)
Sri BN Gope	Sr.Clerk

Admin-III

Sri KK Prasad T-7-8	Incharge (Purchase Section)
Sri Ravishanker	Asstt.
Sri Thibu Minz	Asstt.
Sri Kameshwer Oraon	Asstt.

Steno Pool

Sri R Ravidas	Sr PA to Director
Smt S Prasad	PA
Sri AK Sinha	PA
Sri SK Yadav	Steno Gr. III

Finance and Accounts Section

Sri Rajesh Sahay	F &A O
Sri CL Meena	J.A.O.
Sri Vijay Ram	Asstt.
Sri Anant Pandey	Asstt.
Sri Arjun Gope	Sr.Clerk
Sri KP Kashi	Jr.Clerk

Transport

Sri KK Prasad, T-7-8	Chairman
Sri J Tewari, T-2	Driver
Sri Arbind Kumar,T-2	Driver
Sri Mandeshwer Singh,T-2	Driver
Sri RK Yadav, T-2	Driver

Promotions

Sl. No	Name and Designation	Promoted to the post of	Date of promotions
1.	Sri K K Prasad, T-6	T- 7-8	01. 01. 2006
2.	Sri Jagdish Singh, T-6	T -7-8	01.01. 2006

Placement of Tech. personnel from category I to II

Sri Markus Surin, T-1-3 to T-3 w.e.f. 01.01.1995
Sri KA Nagruwar, T-1-3 to T-3 w.e.f. 03.02.2000

Clearance of Probation Period

Sri KP Kashi, Jr Clerk w.e.f. 01.05.2008
Sri Bhupal Kumar, T-1 w.e.f. 06.12.2006
Sri Ramakant Singh, w.e.f. 13.01.2007
Sri AK Sharma, T-1 w.e.f. 30.12.2007

Transfers to the Institut

Dr PC Sarkar, Sr Scientist joined on 01.10.2009 after transfer from ICAR, New Delhi.

Appointments during 2009

Shri Amrendra Kishore, AAO	01.10.2009

Retirements

Name & designation	Date of retirement
Shri DW Runda, T-4	31.03.2009
Shri ID Das, T-2	31. 03. 2009
Smt Kamla Devi, SG IV	31.03.2009
Shri RN Vaidya, T-6	31.07.2009
Shri Vijay Ram, Asstt	31.07.2009
Shri YD Mishra, Sci (SS)	31.08.2009
Dr RN Majee, Pr Sci	30.11.2009
Shri W Guria, Asstt	30.11.2009
Shri Jagdish Singh, T-7-8	31.12.2009

Voluntary retirement

Shri BN Gope, Sr Clerk on 01.04.2009

Members of Institute Joint Staff Council (IJSC)

Chairman

Dr Bangali Baboo, Director

Members (Official Side)

Dr KP Sao, Principal Scientist
Mr RK Singh, Scientist
SK Giri, Scientist (SS)
Dr Govind Pal, Scientist (SS)
Administrative Officer
Sri Rajesh Sahay, F&AO

Secretary (Official Side)

Dr KP Sao, Principal Scientist

Elected Members (Staff Side)

Sri Binod Kumar, T-5
Sri Ajay Kuamr, T-2
Sri RK Toppo, Sr. Cleark
Sri Arjun Gope, Sr. Cleark
Sri Lodo Lakra, Supporting Staff
Sri Naim Ansari, Supporting Staff

Secretary (Staff Side)

Sri Binod Kumar, T-5

Members of Institute Grievance Committee

Chairman

Dr Bangali Baboo, Director

Members (Official Side)

Dr R Ramani, Principal Scientist & Head LPD
Administrative Officer
Sri Rajesh Sahay, F&AO

Members (Staff Side)

Dr JP Singh, Sr. Scientist
Sri Raj Kumar Rai, T-2
Sri Bihari Sahu, Sr. Cleark
Md Naim Ansari, Supporting Staff
AAO (Admn-I), Member Secratory

INDIAN INSTITUTE OF NATURAL RESINS AND GUMS

(Formerly Indian Lac Research Institute)

Namkum, Ranchi - 834010 (Jharkhand)

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