



वार्षिक प्रतिवेदन
annual report 2011-12



भारतीय प्राकृतिक राल एवं गोंद संस्थान
(भारतीय कृषि अनुसंधान परिषद)
नामकुम, राँची 834 010 (झारखण्ड)

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



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(Clock - wise) Net house, IRF; Bundling of broodlac for inoculation; Gum *ghatti* (*dhawada*); Various forms of lac resin; Gum *Arabic*; Students observing lac insects at NATLIGEC; Gum *karaya* tree.

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PREFACE

We are at the threshold of the XII Plan, taking initiatives in the directions set in the Plan document, which incorporates priority areas and required course corrections in research programmes. Planning is as important as execution, which is reflected in the adage 'Good planning is halfway to success.' Alan Lakein warns 'Failing to plan is planning to fail.' Therefore, an attempt has been made in the Plan Document of IINRG to identify the priority areas for the Institute through brainstorming sessions with experts and interactions with the stakeholders. Any commodity or sector is no more viewed exclusively in the national perspective; due consideration of global scenario is no less important. An article published couple of years back, authored by 53 experts, contains the top hundred questions of importance to future of global agriculture (*doi:10.3763/ijas.2010.0534*). This article was circulated among ICAR institutes and a similar exercise was subsequently done by the ICAR in the national context. It is worthwhile looking at some of the points raised in the former article relevant to NRG sector in general and the Institute in particular.

The relevant issues for the Institute from the foregoing article appear to be: i) prediction of critical impacts of climate change; ii) increased rainwater harvesting on local hydrological fluxes; iii) combinations of forestry, agro-forestry, grass cover, water-collecting systems and storage facilities, drought-resistant crops and water-saving technology; iv) sustainable soil management; v) improved resilience of agricultural systems to both gradual climate change and increased climatic variability and extremes; vi) long-term carbon sinks on farms (e.g. through soil management practices, perennial crops, trees, ponds, biochar); vii) best integrated cropping and mixed system options for different agro-ecological and socio-economic situations, taking account of climate and market risk, farm household assets and farmers' circumstances; viii) facilitation of institutional change and technical innovation to ensure that widest number of farmers are reached and engaged and viii) sustainable agricultural intensification to maintain livelihoods for smallholder farmers. Many of them have been taken on board in the XII Plan as well as Vision 2030 documents; others will be taken up in future as per prioritized needs and resources available. The Research Advisory Committee of the Institute played a significant role in shaping up the IINRG XII Plan as well as the IINRG Vision 2030 documents. A new QRT has been constituted for the Institute and it is hoped that its recommendations would lead to taking the Institute forward in the right direction.

Natural gums and resins are export-oriented and also linked to the livelihoods of the growers/collectors. Market factors related to significant shifts in demand and prices, lead to considerable turbulence in the sector, such as interest in production, industrial economics, including R&D needs. Therefore we have to be fully cognizant of market dynamics in order to ensure that current researches are relevant. Export of guar gum jumped to 3.53 lakh tonnes (lt) in 2010-11 from 2.18 lt last year. The prices of guar seed which remained at a modest level of Rs 2360/- per quintal, also shot up to Rs 3892/- by the middle of this year. Due to the favourable market climate, the area under guar production this year is projected to touch 3 million ha in 2011, about 15% higher than the previous year. Guar is a rainfed crop grown in drier areas of the country, especially the northwestern states. A negative relationship is reported between the rainfall and production/area. But the production dynamics are influenced by the temporal and spatial distribution of the rainfall as well as the market perception.



India is also the global leader in lac production. The quantity of lac exported in 2010-11 remained almost at the same level as the previous year, but the value nearly doubled from Rs 1100.2 million to Rs 2111.3 million, mainly due to major plunge in lac production due to unfavourable rainfall during 2010-11. But, improved climatic conditions and aggressive promotion activities is expected to lead to a quick recovery of lac production. It is imperative that the lac industry maintains a favourable price for the lac, so that the farmers interests are sustained and a healthy marketing environment prevails.

Guggul gum is a resinoid derived from plant exudate, used extensively in medicinal preparations especially in ayurvedic formulations and dietary supplements. Indian pharmacopoeia specifies that guggul should be derived from *Commiphora wightii*, which is distributed in India and Pakistan. Over a hundred ayurvedic formulations are reported to contain gum guggul. *C. wightii* had therefore been highly exploited and finds its place in IUCN red data book; Govt. of India has also included this species under RET category. A number of initiatives have been taken in country National Medicinal Plants Board and other Govt. departments to sustain guggul gum production in the country. Interaction with industry indicates huge potential of guggul gum consumption. The demand of the Indian ayurvedic industry is at present practically met from imports. A national mega-initiative is the need of the hour for achieving a quantum jump in production of guggul gum coupled with desired quality.

It is time that the research thrusts in natural resins and gums (NRGs) transcend to sunrise areas. This will not only open up newer consumption areas but substantial economic benefits would also accrue. A paradigm shift is needed in research planning to fully harness the benefits of knowledge explosion. Natural resins and gums provide the versatility and diversity in terms of structure and functional properties, besides being the ideal choice for materials related to human consumption and contact. Natural resins like shellac have been highly useful in coating of food items ranging from fruits to candies. Shellac holds potential for use as wall material for coating of perishables for retention of quality and minimize deterioration, leading to improved shelf life. Lac resin is also amenable for development of nanoparticles and nanospheres which can be harnessed for controlled release of drugs and other chemicals. Natural gums vary in their chain length and branching characteristics, which provide ample variation for chemists to work in developing molecules for targeted drug delivery and other specialized applications. Nurturing tangent thinking with sound theoretical basis would certainly add new dimensions to the application of NRGs.

July, 2012

Namkum, Ranchi

R Ramani

Director



उत्पादकता एवं गुणवत्ता सुधार

- आगरा (उ.प्र.), बनखेड़ी (म.प्र.), इम्फाल (मनिपुर), नांगल एवं रोपर (पंजाब) से एकत्र किये गए पाँच लाख कीट संग्रहों का मूल्यांकन किया गया तथा उनके जैविक भिन्नता / आर्थिक गुणों जैसे स्थापन धनत्व, आरंभिक मरनशीलता, नर अनुपात, कोशिका वजन, राल वजन एवं प्रजनन में संग्रहों के बीच तथा ऋतुओं के बीच उल्लेखनीय भिन्नता पाई गई।
- चयन एवं बहुगुणन के द्वारा एक नयी कुसमी पीली किस्म विकसित की गई है। इस कीट की कुसुम, बेर एवं सेमियालता पर अच्छी उत्पादकता होती है तथा लाख रंजक पीला होता है। अगात परिपक्व होने के कारण इसमें तना से लाख की पपड़ी का अलगाव कम होता है जैसा कि पिछात किस्मों में देखा जाता है।
- संस्थान के राष्ट्रीय लाख कीट जननद्रव केन्द्र (नैटलिजेक) में त्रिसुर (केरल) एवं मदुरै (तमिलनाडु) से लाए गए दो नए कीट संग्रह शामिल किये गए। इस संग्रहों का मूल्यांकन के लिए बहुगुणन किया जा रहा है। नैटलिजेक के फिल्डजीन बैंक में *फ्लेमिंजीया सेमियालता* के गमले में लगे पौधे पर 72 लाख कीटों के 1800 संवर्द्धों का संरक्षण किया जा रहा है।
- 04-17 जुलाई, 2011 के दौरान केरल एवं तमिलनाडु के चुने गए जिलों में वृहद सर्वेक्षण किया गया। त्रिसुर में *एमहर्सिया नोबलिस* एवं मदुरै में रेन ट्री, *अल्वीजीया समन* पर लाख कीट देखा गया एवं संग्रह किया गया।
- *केरिया चीनेनसीस* का नये लाख परिपालक *मालवेवीस्कस पेन्डुलीफ्लोरस* पर प्रारंभिक अध्ययन से संकेत मिलता है कि *केरिया चीनेनसीस* की बागान स्तर पर खेती के लिए यह पौधा बहुत आशाजनक है।
- केरिया के 48 किस्मों का 185 क्षेत्र आरडीएनए का क्रमीकरण से अंतः विशिष्ट स्तर तक पर्याप्त बहुआकारिकी दर्शाता है। नये सिरे से आंकड़ों के विश्लेषण से पता चलता है कि किरमिजी एवं पीले किस्मों में 4172 एवं 3975 टिप्पणी अनोखे थे, जबकि 4463 दोनों प्रकारों में एक समान थे।

फसल उत्पादन पद्धति प्रबंधन

- शरद ऋतु में एक सेमियालता पर लाख की खेती के दौरान बोरोन, मॉलिब्डेनम एवं नाइट्रोजन के प्रयोग के

बाद नर आबादी में 29, 85 एवं 47 प्रतिशत वृद्धि देखी गई जबकि तांबा के प्रयोग से 28 प्रतिशत की कमी देखी गई।

- वर्षाश्रित परिस्थितियों के अन्तर्गत बेर एवं सेमियालता (शरद ऋतु) तथा पलास (ग्रीष्म ऋतु) पर काला एवं सफेद पॉलीथीन, सावयव (घास पत्तियाँ), मिट्टी, धूल पलवार एवं लाख कीचड़ को मिलाकर बनाए गए पलवारों का मूल्यांकन किया गया। सभी तीन परिपालकों में काले पॉलीथीन के प्रयोग से मिट्टी की नमी का संरक्षण वेहतर रहा। सभी परिपालकों में सफेद पारदर्शी पलवार में मिट्टी का तापमान अधिकतम रहा। काले पॉलीथीन मल्व में खरपतवार का दमन उच्चतम रहा।
- बेर वृक्ष पर कुसमी लाख फसल की उपज (ग्रीष्म एवं शरद ऋतु) तथा प्ररोह के निकलने के संबंध में घड़ा उर्वरक के प्रभाव का मूल्यांकन किया गया। ग्रीष्म ऋतु की लाख की फसल (जेठवी) में नियंत्रण की तुलना में घड़ा उपचार में लाख उपज अनुपात के साथ-साथ प्ररोह की लम्बाई एवं घेरा में भी वृद्धि देखी गई।

प्रसंस्करण, भंडारण एवं गुणवत्ता प्रबंधन

- धोवन अवक्षेपित विरंजित लाख को अम्ल मुक्त करने के लिए एक उर्ध्व धोवन इकाई की अभिकल्पना एवं विकास किया गया। धोवन इकाई को कुसमी चौरी के 3 कि.ग्रा. लॉट से विरंजित लाख तैयार करने के लिए उपयोग किया गया।

मूल्यवर्द्धन, प्रयोग विकास एवं उत्पाद विविधिकरण

- लाख आधारित सुत्रण के संपुटिकरण के परिणाम स्वरूप हरी इलायची में रंग बनाए रखने में सुधार तथा जायफल, धनियाँ, जीरा, कालीमिर्च पर मानसुन के दौरान कवकीय संक्रमण में नियंत्रण देखा गया।
- लकड़ी के सतह के लिए लाख व्यूटिलेटेड मेलामाइन फॉर्मलडिहाइड रजिन आधारित वार्निश में 30-50% चपड़ा अवयव विस्थापित होता है, जिसमें वार्निश के गुणों में हल्की कमी के साथ निर्माण लागत में कमी आती है।
- धातु की सतह में वेहतर चमक, खरोंच से उँच्च कठोरता एवं प्रभाव प्रतिरोध प्रदान करने के लिए प्रलाक्षा के उपयोग के लिए दो चपड़ा नोवोलैक संमिश्र (कोड: एस एन बी के 73, एस एन बी के-55) तथा चपड़ा



इपोक्सीकृत नोवोलैक संमिश्र (कोड संख्या एस ई एन वी- 55) की अनुशंसा की जा सकती है।

- प्लास्टर ऑफ पेरिस के विकल्प के रूप में एक लाख आधारित सुत्रण विकसित किया गया है, जिसके परिणाम आशाजनक हैं। सुत्रण से विकसित किये गए बैन्डेज का आसंजन एवं कड़ापन संतोषजनक पाया गया। विकसित प्लास्टर परंपरागत प्लास्टर ऑफ पेरिस से वजन में हल्का है।
- लाख आधारित सुत्रण से लेपित नागपुर मैडरीन नारंगी के फल में कड़ापन, चमक, उँच्च टी एस एस एवं अधिकतम रस प्राप्ति में सुधार देखा गया। हालांकि डिप्लोडिया एवं पेनीसिलियम के द्वारा सड़न के नियंत्रण की आवश्यकता है।
- विभिन्न एकिलीक अम्ल विकल्पों के साथ रूपांतरित गोंद के सहबहुलक का उपयोग कर एकेसिया गोंद एवं कराया गोंद से हाइड्रोजेल का संश्लेषण किया गया। रूपांतरित गोंद का बनावट कड़ा था जबकि अन्तर प्रविष्ट नेटवर्क की संरचना के कारण हाइड्रोजेल की बनावट छिद्रवार थी।
- विभिन्न मोरडैन्ट, हल्दी सत्व एवं लाख रंजक का प्रयोग कर प्राकृतिक आलता विकसित किया गया। यह संमिश्र वाणिज्यिक आलता, जिसमें हानिकारक कृत्रिम रंग होते हैं, की तुलना में सुरक्षित था।

कृषकों का क्षमता निर्माण एवं उद्यमशीलता विकास

- लाख की वैज्ञानिक खेती, प्रसंस्करण एवं उपयोग पर किसानों, प्रशिक्षकों एवं छात्रों के लिए सधन प्रशिक्षण कार्यक्रम आयोजित किया गया। आठ राज्यों जैसे झारखण्ड, ओडिशा, छत्तीसगढ़, प. बंगाल, मध्य प्रदेश, आन्ध्र प्रदेश महाराष्ट्र एवं बिहार के 22 जिलों के कुल 768 किसानों ने इन कार्यक्रमों में भाग लिया।
- लाख की वैज्ञानिक खेती, उत्पादन, प्रसंस्करण एवं उपयोग पर प्रशिक्षक प्रशिक्षण कार्यक्रम के अन्तर्गत 13 विभिन्न पाठ्यक्रमों के माध्यम से 314 प्रतिभागियों को प्रशिक्षित किया गया।
- चार पाठ्यक्रमों के माध्यम से 117 छात्रों को लाख की खेती, प्रसंस्करण एवं इसके उपयोग पर एक सप्ताह का शैक्षणिक प्रशिक्षण दिया गया।
- लाख की वैज्ञानिक खेती पर प्रक्षेत्र प्रशिक्षण कार्यक्रम के अन्तर्गत झारखण्ड, महाराष्ट्र, ओडिशा एवं गुजरात के अन्य संगठनों के सहयोग से 72 शिविर (5251 कृषक आयोजित किये गए)।

- विभिन्न राज्यों के सरकारी एवं गैर सरकारी संगठनों के सहयोग से लाख की खेती पर प्रक्षेत्र प्रोत्साहन/पूरक प्रशिक्षण कार्यक्रम के अन्तर्गत 32 शिविर आयोजित किये गए। इस कार्यक्रम के अन्तर्गत छः राज्यों के बारह जिलों के लगभग एक सौ ग्रामों का प्रतिनिधित्व करते हुए 3447 व्यक्तियों (मुख्यतः किसान) को लाभान्वित किया गया।
- विभिन्न राज्यों के सरकारी एवं गैरसरकारी संगठनों के साथ लाख की खेती पर परिसर के अन्दर अभिविन्यास कार्यक्रम के अन्तर्गत प्राकृतिक राल एवं गोंद पर 44 शिविर (2602 कृषक एवं छात्र) आयोजित किये गए।
- झारखण्ड, छत्तीसगढ़ एवं महाराष्ट्र के 31 स्थानों पर कुसमी लाख की फसल का निरीक्षण, तकनीकी परामर्श, नाशकजीव आक्रमण के लिए सुधारात्मक उपाय, संचारण का प्रदर्शन, छिड़काव इत्यादि गतिविधियाँ आयोजित की गईं।

प्रौद्योगिकी मूल्यांकन, परिष्करण, प्रसार एवं प्रदर्शन

- प्रयोगशाला परिस्थितियों के अन्तर्गत यूब्लीमा एमावीलीस के अंडों के विरुद्ध अंडनाशी प्रभाव के लिए चार कीटनाशी जैसे इन्डोक्साकार्व, स्पीनोसाड, फिप्रोनील एवं इथोफेनप्रॉक्स का मूल्यांकन किया गया। स्पीनोसाड के उपचार से अधिकतम अंडनाशी प्रभाव देखा गया। उसके बाद इथोफेनप्रॉक्स, फिप्रोनील एवं इन्डोक्साकार्व का स्थान रहा।
- प्रयोगशाला परिस्थितियों के अन्तर्गत लाख कीट के परभक्षी एवं परजीवी के प्रादुर्भाव पर बीहन लाख को डूबाने के प्रभाव का अध्ययन किया गया। यूब्लीमा एमावीलीस की उपस्थिति में अधिकतम कमी इन्डोक्सा कार्व (85-96%) से रहा तथा उसके बाद स्पीनोसाड (77-85%) एवं इथोफेनप्रॉक्स (31%) का स्थान रहा।
- लाख उत्पादन पद्धति में पहली बार जीजीफस मौरिसियाना (बेर) पर दो करक्यूलोनीड जैसे माइलोसेरस डेन्टीफर (कॉलिओप्टेरा: करक्यूलोनाइडी) एवं जैन्थोचेलस फाउनस आलिवियर (कॉलिओप्टेरा : करक्यूलोनाइडी) रिकार्ड किया गया।
- लाख परिपालक ब्यूटिया मोनोस्पर्मा (पलास) पर करक्यूलोनीड विवील्स की उपस्थिति जैसे माइलोसेरस डिसकलर बोहमैन (कॉलिओप्टेरा: करक्यूलोनाइडी) एम्बलीरहाइनस पोरिकोलिस स्कोनहर (कॉलिओप्टेरा: करक्यूलोनाइडी) एवं पेल्टोट्रैचेलस प्रजाति (कॉलिओप्टेरा: करक्यूलोनाइडी) दर्ज की गईं।



- छत्तीसगढ़ राज्य में प्रभाव संबंधी अध्ययन से पता चला कि अप्रशिक्षित लाख उत्पादकों की तुलना में प्रशिक्षण के पश्चात सभी तीन परिपालकों के उपयोग में वृद्धि हुई है।
- प्रशिक्षित लाख उत्पादकों के मामले में लाख की खेती की कुल आमदनी में 17 प्रतिशत से 25.2 प्रतिशत तक वृद्धि हुई है। प्रशिक्षित लाख उत्पादकों का रोजगार सृजन पलास, बेर एवं कुसुम पर क्रमशः 86,59 एवं 58 प्रतिशत बढ़ा है।
- छत्तीसगढ़ के जगदलपुर क्षेत्र में वन विभाग द्वारा लाख की खेती आरंभ की गई जिसमें भा.प्रा.रा.गो. सं. के विशेषज्ञों द्वारा रा. कृ. न. प. के अन्तर्गत प्रौद्योगिकी संबंधी जानकारी के साथ-साथ समय-समय पर फसल की निगरानी भी की गई।
- झारखंड के जामतारा जिले के सभी छः प्रखंडों में 21 कृषकों द्वारा पलास पर रंगीनी ग्रीष्मकालीन फसल उगायी गयी। रा.कृ.न.परि. कार्यक्रम के अन्तर्गत अंगीकार किये गए ग्रामों से प्राप्त जानकारी एवं प्रेक्षण के बाद इन प्रखंडों के किसानों ने रंगीनी लाख की खेती को अंगीकार/पुनराारंभ किया।

प्रौद्योगिकी का वाणिज्यीकरण

- 34 वें राष्ट्रीय खेल के शुभंकर छऊआ को वार्निश करने एवं चमकाने के लिए 40.0 लीटर लाख ग्लेज वार्निश की आपूर्ति सर्वश्री झारकाफ्ट (झारखण्ड सरकार), राँची को की गई।
- 31 दिसंबर 2011 को अनुज्ञप्ति द्वारा किन्नु के लिए फल लेपन सुत्रण की प्रौद्योगिकी के हस्तांतरण हेतु भा. प्रा. रा. गो. सं. एवं सर्वश्री गुप्ता ब्रदर्स (शैलैक) बुण्डु, राँची के बीच समझौता ज्ञापन पर हस्ताक्षर किया गया।

पेटेन्ट

- केरिया प्रजातियों की पहचान के लिए समूह-विशिष्ट प्रारंभक भारतीय प्राकृतिक राल एवं गोंद संस्थान, 580/ के ओ एल/ 2011, अप्रैल 25, 2011

डाटावेस

- बारकोडिंग एवं विश्लेषण के लिए, लाईफ डाटा सिस्टम के बारकोड, बारकोडिंग केरिया परियोजना

के अन्तर्गत सी ओ आई - 5 पी जीन के 52 क्रम का निर्धारण

आयोजन

- भा. प्रा. रा. गो. सं. राँची द्वारा 20 जनवरी 2011 को के. क.प्रौ. अनु. से. मुंबई में औद्योगिक बैठक (निःप्राव गोंद प्रसंस्करणकर्ताओं एवं निर्यातकों के लिए) का आयोजन
- 10 फरवरी 2011 को संस्थान के वार्षिक किसान मेला सह प्रदर्शनी का आयोजन किया गया।
- 10 मार्च 2011 को के.शु. क्षे. अनु.सं. जोधपुर में भा.प्रा. रा. गो सं. द्वारा संस्थान- ग्वार उद्योग सम्पर्क बैठक का आयोजन किया गया।
- संस्थान में 29-30 जून 2011 को झारखण्ड राज्य में रा. कृ.न.प. की समीक्षा बैठक आयोजित की गई।
- संस्थान का 88 वाँ स्थापना दिवस 20 सितम्बर 2011 को मनाया गया। पूर्व भारतीय लाख अनुसंधान संस्थान के संस्थापक निदेशक सुश्री डोरोथी नोरीस के सम्मान में प्रथम स्मारक व्याख्यान प्रो० गजेन्द्र सिंह, पूर्व उप महानिदेशक (अभि०), भा. कृ. अनु. प. द्वारा दिया गया।
- संस्थान में 21 सितम्बर, 2011 को "भारत में लाख कीट केरिया प्रजाति की विभिन्नता की प्रकृति को समझना" विषयक रा.कृ.न.प. - एल आई डी परियोजना की चौथी सीएसी एवं सीआईसी बैठक का आयोजन किया गया।

सहयोगात्मक परियोजनाएं (बाहरी वित्तीय सहायता प्राप्त परियोजनाएं समेत)

- संस्थान द्वारा सहयोगात्मक रूप से संस्थान निधि से (रा. सा.अनु. के. नागपुर; आई आई एस आर. कालीकट; रा. कृ. वा. अनु. के. झांसी; आई आई डब्ल्यू एस एण्ड टी., वेंगलूरु) तथा बाहरी वित्तीय सहायता प्राप्त रा.कृ.न.प., निकरा परियोजना तथा ज.ने.कृ. विवि, जवलपुर; रा.कृ. वा अनु. के. झांसी; के. शु. क्ष. अनु. सं. जोधपुर, ई. गा. कृ. विवि., रायपुर; वाइ एस परमार विवि. सोलन; एम.ए.यू., परभनी; उपकेन्द्रों के साथ नेटवर्क परियोजनाएं समेत कई परियोजनाएं चलाई जा रही हैं। संस्थान झारखंड, गुजरात, छत्तीसगढ़ जैसे राज्य सरकारों एवं ट्राइफेड तथा नाबार्ड जैसे संगठनों के साथ भी कार्य कर रही है।



EXECUTIVE SUMMARY

Productivity and Quality Improvement

- Evaluation of five lac insect stocks collected from Agra (UP), Bankhedi (MP), Imphal (Manipur), Nangal and Ropar (Punjab) showed significant variation in biological / economic attributes viz. density of settlement, initial mortality, male proportion, cell weight, resin weight and fecundity among the stocks and between seasons.
- A new *kusmi* yellow variety was developed through selection and multiplication. The insect has good productivity on *kusum*, *ber* and *semialata* and yields yellow lac dye. Being early maturing it minimizes detachment of lac encrustation from the stem as seen in late maturing varieties on *semialata*.
- Two new stocks from Thrissur (Kerala) and Madurai (Tamil Nadu) were added to National Lac Insect Germplasm Centre (NATLIGEC) of the institute; the stocks are being multiplied for evaluation. 1800 cultures of 72 lac insect lines are being conserved live on potted plants of *Flemingia macrophylla* in the Field Gene Bank of NATLIGEC.
- An exhaustive survey of selected districts in Kerala and Tamil Nadu was carried out during July 04-17, 2011. Lac insects were observed and collected from *Amherstia nobilis* at Thrissur and Rain tree, *Albizia saman* at Madurai.
- Preliminary studies carried out with *Kerria chinensis* on new host plant - *Malvaviscus penduliflorus* indicated the potential of this plant for exploiting culture of *K. chinensis* on plantation scale.
- Sequencing of 18S region rDNA of 48 lines of *Kerria* showed adequate polymorphism even at intra-specific level. *De novo* transcriptome data analysis of *K. lacca* has revealed that 4172 and 3975 annotations were unique to crimson and yellow lines, whereas 4463 were common to both forms.

Crop Production System Management

- An increase of 29, 85, and 47 percent in male population was found after boron, molybdenum and nitrogen application, while 28 percent

reduction of the same was observed due to copper application during winter *kusmi* lac cultivation on *F. semialata*.

- Mulches comprising of black and white polyethylene, organic (grasses/leaves), soil/dust mulch and lac mud were evaluated on *palas* (summer) and *ber* & *semialata* (winter) under rainfed conditions. Black polyethylene mulch showed superiority in conserving soil moisture in all the three hosts. White transparent mulch showed maximum soil temperature under all hosts. Weed suppression was highest under black polyethylene mulch.
- The impact of pitcher fertigation on shooting response and *kusmi* lac crop yield (summer and winter) on *ber* trees was evaluated. Summer lac crop (*jethwi*) showed increased lac yield ratio along with shoot length and girth under pitcher treatment over control.

Processing, Storage & Quality Management

- A vertical washing unit for washing precipitated bleached lac for making it acid-free was designed and developed. The washing unit was used in preparing bleached lac from 3 kg lot of *kusmi* seedlac. The acid value of the bleached lac was 69.16.

Value Addition, Application Development and Product Diversification

- Encapsulation with lac-based formulations resulted in improved color retention in green cardamom capsules, and control of fungal infestation on nutmeg, coriander, cumin and black pepper in monsoon conditions.
- 30-50% of shellac component may be replaced with rosin in lac-butylated melamine formaldehyde resin-based varnishes for wooden surfaces, so as to reduce manufacturing cost with slight decrease in the properties of the varnish.
- 2 new formulations shellac novolac blend (Code: SNBK-73, SNBK-55) and shellac-epoxidised novolac



blend (Code: SeNB-55) can be recommended for use in lacquering metal surfaces, for providing superior gloss, high scratch hardness and impact resistance.

- A lac-based formulation was developed as an alternative to plaster of Paris, which showed promising results. Adhesion and hardness of the bandage developed from the formulation were found to be satisfactory. The developed plaster was light in weight, as compared to conventional plaster of Paris.
- Coating of Nagpur mandarin oranges with lac-based formulations resulted in improved fruit firmness, gloss, higher TSS, and maximum juice recovery. However, spoilage by *Diplodia* and *Penicillium* needs to be controlled.
- Hydrogels were synthesized from *Acacia* gum and gum *Karaya* using grafted co-polymer of modified gum with different acrylic acid substituents. The modified gum showed a tight structure while its hydrogel had a porous structure due to the formation of interpenetrating networks.
- Natural *alta*, using different mordants, turmeric extracts and lac dye was developed. The composition was safer, as compared to commercial *alta*, which contain harmful synthetic dyes.

Capacity Building of Farmers and Entrepreneurship Development

- Extensive training programmes on scientific lac cultivation, processing and utilization were organized for farmers, trainers and students. A total of 768 farmers from 22 districts of eight states namely Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Andhra Pradesh, Maharashtra and Bihar participated in the programmes.
- Under Trainers' training programme on 'Scientific method of lac cultivation, production, processing and utilization', 314 participants were trained through 13 different courses.
- One week educational training in lac cultivation, processing and its uses was imparted to 117 students through four courses.
- Under *On-farm training on 'Scientific cultivation of lac'*, 72 camps (5251 farmers) were organized in

collaboration with other organizations in Jharkhand, Maharashtra, Odisha and Gujarat.

- Under *On-farm, motivational/ supplementary training programme on lac cultivation*, 32 camps were organized in collaboration with NGOs and GOs of different states. 3,447 persons (mainly farmers) representing around 100 villages of twelve districts of six states benefited from this programme.
- Under *In-campus Orientation programme on lac cultivation*, 44 In-camps (2602 farmers and students) on natural resin and gums were organized with NGOs and GOs of different states.
- Monitoring of *kusmi* lac crop, technical guidance, remedial measures for pest attack, demonstration of inoculation, spraying etc activities were conducted in Jharkhand, Chhattisgarh and Maharashtra at 31 places.

Technology Evaluation, Refinement, Dissemination and Demonstration

- Four insecticides *viz.*, indoxacarb, spinosad, fipronil and ethofenprox were evaluated for their ovicidal action against eggs of *Eulemma amabilis* under laboratory conditions. Maximum ovicidal action was observed with the treatment of spinosad followed by ethofenprox, fipronil and indoxacarb.
- Response of broodlac dipping on emergence of predators and parasites of lac insect was studied under laboratory conditions. Maximum reduction in *Eulemma amabilis* emergence was observed with the treatment of indoxacarb (85-96%) followed by spinosad (77-85%) and ethofenprox (31%).
- Two Curculionids, *viz.*, *Myloccerus dentifer* (Coleoptera: Curculionidae) and *Xanthochelus faunus* Olivier (Coleoptera: Curculionidae) were recorded for the first time in lac production system on *Ziziphus mauritiana* (ber).
- Occurrence of Curculionid weevils *viz.*, *Myloccerus discolor* Boheman, (Coleoptera: Curculionidae), *Amblyrrhinus poricollis* Schoenherr (Coleoptera: Curculionidae) and *Peltotrachelus sp* (Coleoptera: Curculionidae) was recorded for the first time on lac host, *Butea monosperma* (palas).
- Impact study in Chhattisgarh state showed that host utilization has increased after training of lac



growers in comparison to untrained lac-growers for all the three hosts, viz. *palas*, *ber* and *kusum*.

- The share of income from lac cultivation in total income increased in case of trained lac-growers from 17 per cent to 25.2 per cent. The employment generation increased by 86, 59 and 58 per cent in *palas*, *ber* and *kusum* respectively for trained lac-growers.
- In Jagdalpur area of Chattisgarh, lac cultivation was started by Forest Department, all technological knowhow being given by IINRG experts in this respect, besides crop monitoring from time to time, under NAIP.
- *Rangeeni* summer crop was raised on *palas* trees by 21 farmers in all six blocks of Jamtara district of Jharkhand. Farmers of these blocks adopted/re-started *rangeeni* lac cultivation after learning and observation from adopted villages under NAIP programme.

Technology Commercialised

- An MoU was signed between IINRG, Ranchi and M/s Gupta Brother (Shellac), Bundu on December 31, 2011 for technology transfer of fruit coating formulation for *kinnow*, through licensing.
- 40.0 litres of *Lac Glaze* varnish was prepared and supplied to M/s JHARCRAFT (Govt. of Jharkhand), Ranchi, for varnishing and embellishing the 34th National Games Mascot 'Chhaua'.

Patent

- Group-specific primers for identification of *Kerria* species. Indian Inst. of Natural Resins and Gums. 580/KOL/2011, April 25, 2011.

Database

- Submission of 52 sequences of COI-5P gene, under project Barcoding *Kerria*, to the Barcode

of Life Data System, Ontario, for barcoding and analysis.

Events Organised

- Industry Meet (for Exudate Gums Processors & Exporters) organized by IINRG, Ranchi was held at CIRCOT, Mumbai on Jan. 20, 2011.
- The Annual Exhibition-cum-Kisan Mela of the Institute was organised on February 10, 2011.
- Institute - *Guar* Industry Interface Meet, organized by IINRG was held at CAZRI, Jodhpur on March 10, 2011.
- Review Meeting of the NAIP Projects in Jharkhand State was held on June 29-30, 2011 at the Institute.
- The Institute celebrated its 88th Foundation Day on September 20, 2011. The first Memorial Lecture in honour of Ms. Dorothy Norris, the Founder Director of the erstwhile Indian Lac Research Institute, was delivered by Prof. G. Singh, former DDG (Engg.), ICAR.
- Fourth CAC and CIC Meetings of NAIP-LID project 'To Understand the Nature of Diversity in Lac Insects of *Kerria* spp. in India and the Nature of Insect x Host Interaction' were organized on September 21, 2011.

Collaborative Projects (including externally funded projects)

- The Institute continued to work in collaborative mode, in several projects, both Institute funded (with NRC Citrus, Nagpur, IISR, Calicut, NRC Agroforestry, Jhansi, IIWS & T, Bangalore), and externally funded NAIP projects, NICRA Project, Network Project with sub-Centers at JNKVV, Jabalpur, NRC Agroforestry, Jhansi, CAZRI, Jodhpur, IGKVV, Raipur, YS Parmar University, Solan, MAU, Parbani. The Institute also worked in close collaboration with the state governments of Jharkhand, Gujarat, Chattisgarh, and organisations such as TRIFED and NABARD.

INTRODUCTION



Historical Perspectives

Lac, a natural resin, is a non-timber forest produce cultivated and collected by tribals inhabiting the sub-hilly tracts of Jharkhand, Chhattisgarh, West Bengal, Madhya Pradesh, Maharashtra, Odisha and Uttar Pradesh. Before the advent of synthetic plastics and resins, lac was invaluable for molding 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.

Subsequently, on the recommendations of the Royal Commission on Agriculture, the Indian Lac Cess Committee (ILCC) was constituted, which took over the reigns of the Indian Lac Research Institute in 1931. As a result of reorganization of agricultural research and education within the country after independence, 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 88 years of existence. It has contributed immensely towards all-round development of lac besides maintaining India's leadership in production, installed processing capacity and export of the commodity.

Recognizing the importance of other natural resins and gums, which are cultivated / collected in the Indian sub-continent, and are of tremendous industrial importance in diverse industries and export markets, the ICAR revised the mandate of ILRI and renamed it as IINRG. All natural gums and resins were brought under its scope, under the revised research mandate of the Institute *w.e.f.* September 20, 2007. Subsequently, the ICAR also sanctioned a Network Project, to facilitate research activities pertaining to post harvest processing

and value addition of natural resins, gums and gum-resins, with 7 Centres across the country, including the Lead Center at IINRG. Researches on *rosin (Pinus roxburghii)*, *guar gum (Cyamopsis tetragonoloba)*, *karaya gum (Sterculia urens)*, *gum Arabic (Acacia senegal)*, *guggul (Commiphora mukul)* and agro-forestry models based on resins and gums received a fillip through the Network Project.

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

Organizational Structure

The IINRG has responded to the globalization of industries and agricultural enterprises of the country as well as functional reorganization of ICAR. The Institute also has undergone structural changes and the priorities have been redefined. In 1995 - 96, the erstwhile Divisions and Sections were abolished and the scientific manpower divided into three divisions, *viz.*, Lac Production, Processing and Product Development, and Transfer of Technology. The Institute is headed by a Director.

Staff

The Institute has a sanctioned strength of 1 RMP, 46 scientific, 62 technical, 31 administrative and 81 supporting grade with total of 221 sanctioned posts, out of which 30 scientific (including RMP), 54 technical, 25 administrative and 60 supporting posts with total of 169 staff in position.

Infrastructure

Manned by dedicated scientists from various disciplines including entomology, plant sciences,



organic chemistry, physics, engineering, biotechnology etc., the Institute has about 170 staff in scientific, technical, administrative and supporting categories. The Institute has several prestigious labs, viz., High Voltage Laboratory, Biotechnology, Bio-control Laboratory, Instrumentation Laboratory, an ISO-certified Quality Evaluation Laboratory etc. There are several well organized and equipped service sections to support research activities of the Institute. The administrative wing comprises of Director's Office, Administrative Section, Audit and Accounts Section, Purchase and Central Stores. The following sections provide the technical support: Library, Prioritization, Monitoring and Evaluation Cell, Institute Research Farm and Maintenance & Workshop Unit. The Auxiliary units are: Hindi Cell, Security, Medical and Estate Maintenance services.

The Institute Research Farm spread over 36 ha. has all conventional and cultivated lac host plants. The Institute is responsible for the collection and maintenance of germplasm of lac insect lines as well as lac host trees. Presently, the IINRG is maintaining more than sixty five lines of the lac insect, which include collection from different parts of the country, inbred and crossbred lines. Similarly, the Institute Research Farm has approx. 1550 host trees of *S. oleosa* (*kusum*), 2480 trees of *B. monosperma* (*palas*), 1351 *Z. mauritiana* (*ber*) and 8700 minor host plants. The field gene bank of the Institute has 12 genera and 53 species covering tree, medium and bushy type of lac host plants. The field gene bank include 12 collections of *Ficus*, 4 collections each of *Acacia* and *Albizzia*, 5 of *Flemingia*, 3 of *Ziziphus*, 2 each of *Prosopis*, *Dalbergia*, *Calliandra*, *Butea*, and *Desmodium* alongwith each of *Cajanus*, *Croton*, *Garuga*, *Pithecelobium*, *Peltoforum*, *Schleichera*, *Malvaviscus*, *Annona*, *Eriolaena*, *Grewia*, *Paulownia* and *Adensonia*. Altogether 89 collections of 53 lac host species collected from different agro climatic regions have been planted in the field gene bank.

The IRF also maintains a nursery of host plants for meeting demand from institution as well as farmers, a green agro-shade of 25m x 10m has been constructed in year 2010 under JLDS for serving the purpose. More than 1800 cultures of 72 lac insect lines are being conserved live on potted plants of *bhalia* (*F. 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 labor.

The IINRG Library has holdings of more than 35,000 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 is also a partner of the Consortium for e-Resources in Agriculture (*CeRA*), of ICAR. 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 accredited under IS IISO 9001:2000, caters to the quality control needs of the lac processing/lac product industries as well as exporters of lac/lac products. The lab has facilities for carrying out testing of lac/lac products as per BIS requirements.

The PME cell provides the scientists, access to internet and e-mail facilities for communication and information retrieval. The Institute website at: <http://ilri.ernet.in/~iinrg/> is a valuable source of information on the Institute, which is regularly updated.

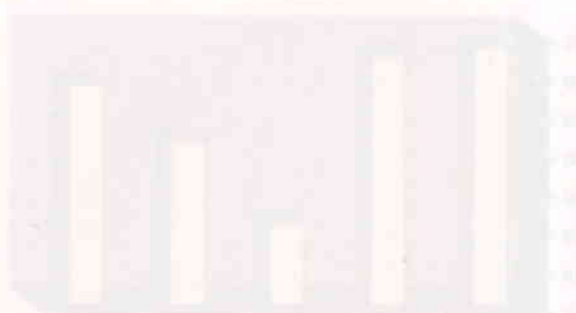
Budget

During 2011-12, the non-Plan expenditure was Rs. 1092.11 lakh, against a revised estimate of Rs. 1124.55 lakh; the Plan expenditure was Rs. 247.08 lakh, against a revised estimate of Rs. 247.10 lakh. The detailed figures are shown in the following table.



Budget Allocation and Utilisation during 2011 – 12

| Sl. No. | Head of Account | PLAN | | NON-PLAN | |
|---------|----------------------------------|---------------|------------------------|----------------|----------------|
| | | R.E. | Actual | R.E. | Actual |
| | | 2011-12 | Expenditure | 2011-12 | Expenditure |
| A i | Establishment Charges | 0.00 | 0.00 | 813 | 788.21 |
| ii | Wages | 0.00 | 0.00 | 0.00 | 0.00 |
| iii | O.T.A. | 0.00 | 0.00 | 0.30 | 0.26 |
| iv | Traveling Allowances | 6.00 | 6.00 | 4.50 | 4.50 |
| v | H.R.D. | 3.00 | 2.99 | 0.00 | 0.00 |
| vi | Other charges | 62.00 | 61.99 | 66.25 | 66.24 |
| vii | Equipments | 65.00 | 65.00 | 3.00 | 2.99 |
| viii | Furniture Fixture | 12.00 | 12.00 | 0.00 | 0.00 |
| ix | Information technology | 0.00 | 0.00 | 0.00 | 0.00 |
| x | Works | 85.10 | 85.10 | 0.00 | 0.00 |
| xi | Special Repairs | | | | |
| | (a) Equipment & Vehicle | 0.00 | 0.00 | 12.00 | 12.00 |
| | (b) Office Building | 0.00 | 0.00 | 62.00 | 62.00 |
| | (c) Residential building | 0.00 | 0.00 | 28.00 | 28.00 |
| xii | Library and Journals | 14.00 | 14.00 | 0.50 | 0.49 |
| B | Loans & Advances | 0.00 | 0.00 | 5.00 | 5.00 |
| C | Pension & Retirement Benefits | 0.00 | 0.00 | 130 | 122.43 |
| | Total (A+B+C) | 247.10 | 247.08 | 1124.55 | 1092.11 |
| | Plan Schemes | | | | |
| i | Network Project | 90.00 | 79.44 | 0.00 | 0.00 |
| ii | IPR | 7.50 | 7.47 | 0.00 | 0.00 |
| iii | NICRA | 20.00 | 19.99 | 0.00 | 0.00 |
| | Revenue Generation target | 36.00 | Target achieved | | 49.14 |



LAC PRODUCTION

1. Productivity and Quality Improvement

1.1: Collection, conservation, characterization and documentation of lac insect bio-diversity

Evaluation of lac insect stocks

Evaluation of five lac insect stocks collected from Agra (UP), Bankhedi (MP), Imphal (Manipur), Nangal and Ropar (Punjab) continued for *baisakhi* (summer season) crop 2010-11 and *katki* (rainy season) crop 2011. Post-harvest attributes viz. cell weight, resin weight and fecundity of summer season (*baisakhi* 2010-11) crop (Fig. 1 & 2) and all the attributes of rainy season (*katki* 2011) crop viz., density of settlement, initial mortality, male proportion, cell weight, resin weight and fecundity (Figs. 3 to 6) were studied.

During summer season crop quantity of resin secreted by individual female lac insect ranged between 9.72 to 14.11 mg for Bankhedi and Nangal stocks respectively. During rainy season crop, density of settlement was 39 in Agra to 62 per sq. cm in Imphal and initial mortality varied between 5.48 – 27.13 % in Imphal and Ropad stocks respectively. Male proportion ranged between 21 in Imphal to 67 per cent in Agra. Resin weight varied from 8.15 mg in Agra to 13.48 mg in Bankhedi stock. Fecundity was the lowest (188) in Agra stock and the highest (240) in Bankhedi stock.

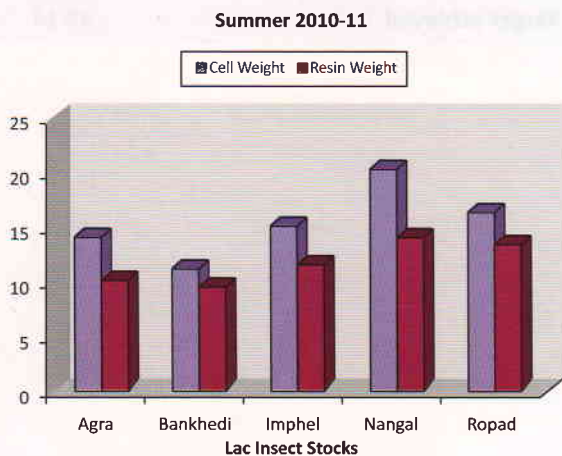


Fig. 1 Cell weight and resin weight of different lac insect stocks during summer 2010-11

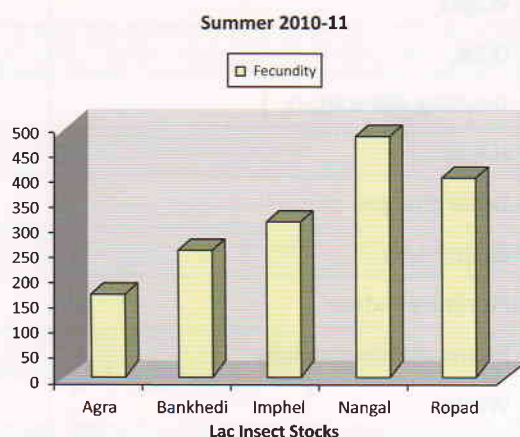


Fig. 2 Fecundity of different lac insect stocks during summer 2010-11

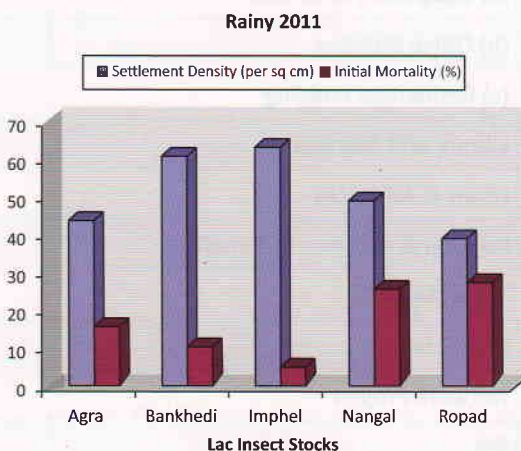


Fig. 3 Density of settlement and initial mortality of different lac insect stocks during rainy season 2011

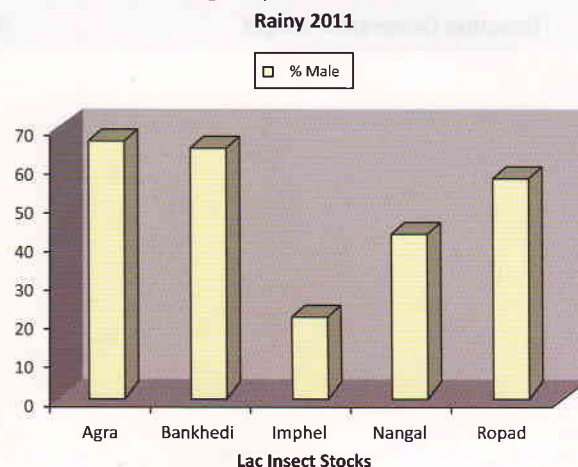


Fig. 4 Male sex ratio in different lac insect stocks during rainy season 2011

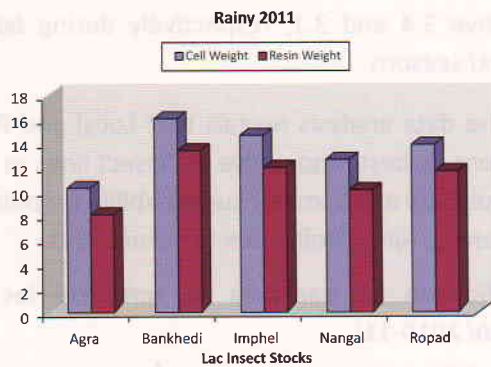


Fig. 5 Cell weight and resin weight of different lac insect stocks during rainy season 2011

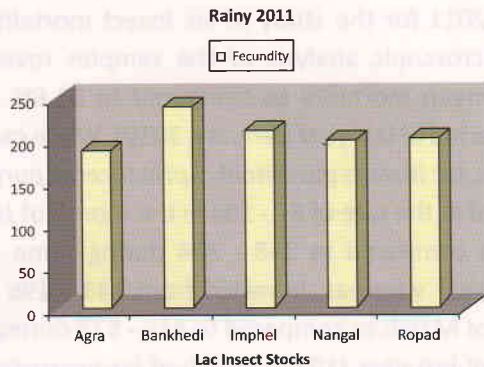


Fig. 6 Fecundity of different lac insect stocks during rainy season 2011

A new kusmi yellow variety

Evaluation of *kusmi* yellow breed developed through selection and multiplication was completed. The insect showed good productivity on *kusum*, *ber* and *semialata* and yields yellow lac dye. Being early maturing, early detachment of lac encrustation from stem is minimized, as compared to late maturing breeds.

Multiplication of the breed suffered during *aghani* (winter season) crop 2011-12 as a complete washout occurred due to heavy and continuous rainfall during emergence. However, satisfactory survival on *semialata* (Fig. 7) was observed perhaps because dense foliage prevented wash out of the emerged larvae. Efforts are being made to multiply the variety on *semialata*.



Fig. 7 Winter crop of new *kusmi* yellow lac insect on *semialata*.

National Lac Insect Germplasm Centre (NATLIGEC)

Conservation of lac insect stocks

1800 cultures of 72 lac insect lines are being conserved live on potted plants of *Flemingia macrophylla* in the Field Gene Bank of NATLIGEC. Two new stocks from Thrissur (Kerala) and Madurai (Tamil Nadu) (Fig. 8) have been added to NATLIGEC; the stocks are being multiplied for evaluation.



Fig. 8 Lac insect on *Albizia saman* at Madurai in Tamil Nadu

Multiplication and evaluation of potential rangeeni lac insect lines

Five (5) *rangeeni* lac insect lines: Kanker (Chhattisgarh), Putidih (W.B.), Ajmer & Pushkar (Rajasthan), one old collection (Rajasthan) and the local line (Jharkhand) were multiplied and evaluated on *bhalia* for broodlac productivity point of view during both the seasons *viz.*, summer (*baisakhi* 2010-11) and rainy season (*katki* 2011) crop and were simultaneously inoculated in field condition on *palas* and *ber* trees (Table 1 & 2). Broodlac productivity of Local (8.2) and Ajmer (7.1) collection were best and Kanker (5.0) was the least. These lines when inoculated during rainy season crop on *bhalia*; again Local collection was best (6.9) and Kanker was least productive (4.5).

Biological attributes *viz.*, fecundity, fresh and dry cell weight of matured female were also recorded for summer season (*baisakhi* 2010-11) crop. The data showed that fecundity of both collections from Rajasthan were highest and was significantly superior over others. The calculated fecundity of Kanker collection was least. Fresh and dry cell wt. of matured female of both collections from Rajasthan was highest and least for Kanker.



1.2: Field evaluation of promising insect races, lines and breeds for higher productivity and superior performance

Field evaluation for superior productivity and summer sustainability

Among the five lines evaluated during summer season (*baisakhi* 2010-11) crop on *palas*, the performance of Local (6.3) was best followed by Putidih (5.0) and Kanker (3.6) (Fig. 9 & 10). The Local collection (4.9) showed best productivity followed by Putidih (4.6) and Ajmer (3.9). Similarly, during rainy season (*katki* crop 2011) on *palas*, the performance of Local (4.3) and Putidih (4.2) collection were best followed by Kanker (3.2) (Fig. 11 & 12). These lines when inoculated on *ber* trees during the same period; the Putidih (3.9) and Ajmer (3.9) collection showed best productivity followed by local (3.2). Kanker (2.9) collection was least productive (Fig. 13 & 14).

Simultaneously, three lines viz., Ajmer, Rajasthan and Putidih collections were also evaluated on *Acacia catechu* (*khair*) trees (Fig. 15). The broodlac productivity of Ajmer collection was 6.2 and 5.9 followed by Rajasthan collection 5.3 and 4.7, respectively during *baisakhi* and *katki* seasons. Kanker population was least

productive 3.4 and 3.1, respectively during *baisakhi* and *katki* seasons.

Thus, the data analysis reveals that Local and Putidih collections as best among five lac insect lines in terms of productivity and summer sustainability for *palas* and *ber* whereas, Ajmer collection for *khair* trees.

Quantification of parasites in *rangeeni* lac crop (*baisakhi* 2010-11)

Rangeeni lac crop samples from IRF, Jharkhand and Putidih, West Bengal were collected in January and March 2011 for the study of lac insect mortality (Fig. 16). Microscopic analysis of the samples revealed a 16.3% mean mortality as compared to 81.6% during same period of last year (January, 2010). While caging of samples, lac insects parasitoid, *Aprostocetus purpureus* emerged at the rate of 67 - 104 in the month of January 2011 as compared to 248 - 364 during same period of last year whereas, it varied from 143 - 196 in the month of March as compared to 416 - 573 during same period of last year (10 cm length of lac encrustations). Subsequent caging of samples did not show any significant emergence of *A. purpureus* emergences. Thus, a good harvest of *baisakhi* crop 2010-11 was obtained due to low incidence of parasitoids.



Fig. 9 Baisakhi crop on *palas* trees



Fig.10 Baisakhi harvest from *palas* tree



Fig. 11 Katki crop on *palas* trees



Fig. 12 Katki harvest from *palas* trees



Fig. 13 Katki crop on *ber* trees



Fig. 14 Katki harvest from *ber* trees



Fig. 15 Katki crop on *khair* trees



Fig. 16 Photograph showing heavy parasitization

Table 1. Details of summer (*baisakhi*) crop raised during 2010-11

| Source of Broodlac | Broodlac used (g) | No. of Plant(s) inoculated | Broodlac produced (output: input) |
|--------------------|-------------------|----------------------------|-----------------------------------|
| Kanker | 180 | 1- <i>ber</i> | --- |
| | 500 | 1- <i>palas</i> | 1800g (3.6) |
| | 20 | 10- <i>bhalia</i> | 100g (5.0) |
| Ajmer & Pushkar | 220 | 1- <i>ber</i> | 860g (3.9) |
| | 500 | 1- <i>palas</i> | --- |
| | 250 | 1- <i>khair</i> | 1550g (6.2) |
| | 20 | 10- <i>bhalia</i> | 142g (7.1) |



| Source of Broodlac | Broodlac used (g) | No. of Plant(s) inoculated | Broodlac produced (output: input) |
|----------------------------|-------------------|----------------------------|-----------------------------------|
| Local (IRF) | 400 | 2-ber x 200g | 1940g (4.9) |
| | 1000 | 2-palas x 500g | 6300g (6.3) |
| | 20 | 10-bhalia | 164g (8.2) |
| Rajasthan (From Gene Bank) | 700 | 1-ber x 350g | ---- |
| | 500 | 1-palas | ---- |
| | 160 | 1-khair | 848g (5.3) |
| | 20 | 10-bhalia | 120g (6.0) |
| Putidih (W.B.) | 700 | 2-ber x 350g | 3250g (4.6) |
| | 500 | 2-palas x 250g | 2500g (5.0) |
| | 250 | 1-khair | 850 g (3.4) |
| | 20 | 10-bhalia | 122g (6.1) |

Table 2. Details of katki crop raised during 2011

| Source of Broodlac | Broodlac used(g) | No. of Plant(s) inoculated | Broodlac produced (output: input) |
|----------------------------|------------------|----------------------------|-----------------------------------|
| Kanker | 150 | 1-ber | 430g (2.9) |
| | 150 | 1-palas | 482g (3.2) |
| | 20 | 10-bhalia | 90g (4.5) |
| Ajmer & Pushkar | 250 | 1-ber | 980g (3.9) |
| | 250 | 1-palas | ---- |
| | 250 | 1-khair | 1470g (5.9) |
| | 20 | 10-bhalia | 118g (5.9) |
| Local (IRF) | 400 | 2-ber x 200g | 2560g (3.2) |
| | 1000 | 2-palas x 500g | 4300g (4.3) |
| | 20 | 10-bhalia | 138g (6.9) |
| Rajasthan (From Gene Bank) | 250 | 1-ber | 770g (3.1) |
| | 250 | 1-palas | ---- |
| | 250 | 1-khair | 1170g (4.7) |
| | 20 | 10-bhalia | 122g (6.1) |
| Putidih (W.B.) | 500 | 2-ber | 1950g (3.9) |
| | 1000 | 2-palas | 4225g (4.2) |
| | 250 | 1-khair | 770g (3.1) |
| | 20 | 10-bhalia | 120g (6.1) |



1.3: In vitro culturing of lac insect cells

Mature female lac insects were taken and surface sterilized with suitable agents and the ovaries were these dissected out. The dissected ovaries were macerated using tissue homogenizer and washed with 1X PBS. The macerated ovarian cells were treated with trypsin at 37 °C and washed with 1X PBS twice. Ultimately cells were plated and incubated at 27°C. The cell culture medium was supplemented with antibiotics to avoid further contamination. These experiments were done in TNMFH and MM media. Change in the medium and supplementing the medium with different concentrations of FBS (10 -30%) did not affect the behaviour of cultured cells. The adherence of the cells is lasted for 3-4 days and at last for a week. Almost 70% of the cultures raised during monsoon were contaminated with fungus.

Since adherence of the cells was not obtained, suspension culture was tried. The protocol of preparing the cells was same as that for adherent cells except for seeding. The cells were incubated in flasks containing 10 ml medium. The cells got contaminated with fungus in 50% of the cases. In rest of the cultures, doubling had not occurred even after a month of incubation.

1.4: Collection, conservation, characterisation and documentation of lac host biodiversity

Seed collection and propagation of swadi palas and palas variants for flower colour

Seedlings were raised from 400 seeds of *swadi palas* and 200 seeds of yellow *palas*; 70 and 50 seedlings of these variants, respectively could be established.

Conservation and enrichment of field gene bank of lac hosts

The field gene bank of lac hosts at the Institute was strengthened during the year. In all, 88 collections are conserved in the field gene bank of lac hosts comprising of 56 plant species. Two *Calliandra spp.* viz., *C. calothyrsus* (from Kenya) and *C. surinamensis* (from New Delhi) and one each of *Butea sp. B. superba* called *latar palas* /climbing *palas* (from Parasnath hills, Jharkhand) were added to the Field Gene Bank.

Biodiversity in palas (*B. monosperma*)

In a survey conducted during April 2011 at Bahadurpur, Bokaro, Dumri and Girdih (Jharkhand). four flower-colour variants were observed in *palas* (*B. monosperma*)

compared to normal with scarlet coloured flowers, Observed flower colour variants have been classified as mustard yellow, Golden yellow, Dumri, yellow, Dumri and chrome yellow, Bahadurpur. Comparative study of *swadi palas* and *palas* from IRF showed that there is variation in size and shape of flowers of both varieties of *palas*. The size of leaf and flower of *swadi palas* is larger than the normally occurring *palas*. Leaflets are acuminate in shape in *swadi palas*, whereas it is obtuse in normal *palas*. As far as the flower colour is concerned, *swadi palas* flower is orange as compared to scarlet in normal *palas*.

Biochemical analysis of leaf of flower colour variants of palas

Total soluble protein

The total soluble protein was found to vary between 4-7% on wet weight basis among the flower colour variants of *palas* tested (Fig.17). White *palas* showed maximum soluble protein content, while mustard flower coloured *palas* showed minimum protein content in leaf.

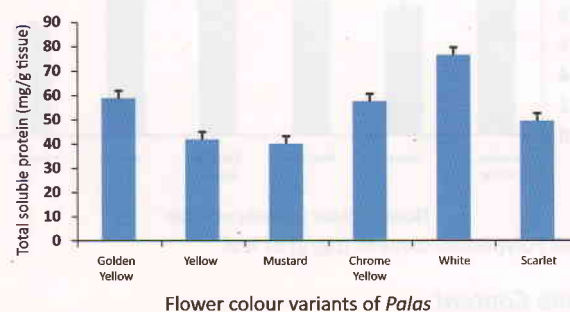


Fig. 17. Total soluble protein content (mg/g) in the leaf

Reducing and non-reducing sugars

The study (Fig.18) indicated that during the month of May, yellow *palas* have maximum content of reducing sugar followed by chrome yellow *palas*. In case of non-reducing sugar content (Fig.19) chrome yellow *palas* showed maximum level followed by yellow *palas*.

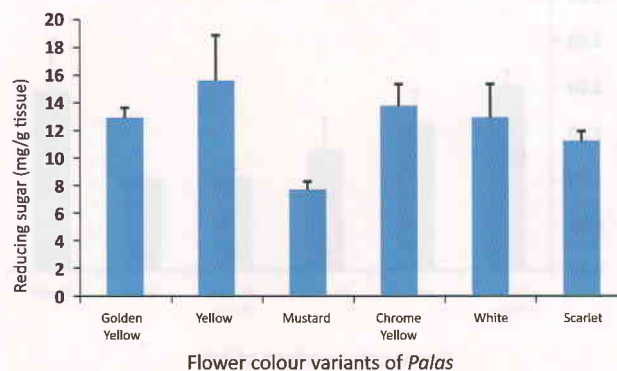


Fig.18. Reducing sugar content (mg/g) of leaf

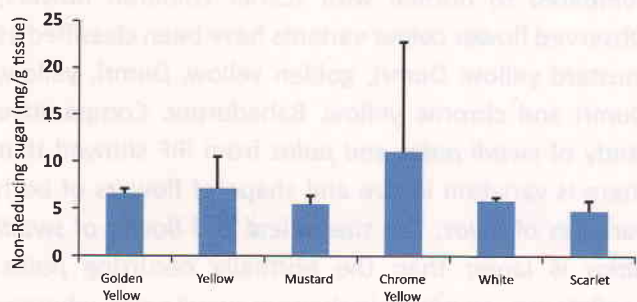


Fig.19 Non-reducing sugar content in (mg/g) of leaf

Polyphenol Content

In the present study (Fig.20), all flower colour variants are at par with respect to polyphenol content. The most commonly used flower colour variant *i.e.*, scarlet *palas* gave least polyphenol content indicating that it is most suitable for lac production. Golden yellow *palas* exhibited maximum polyphenol content.

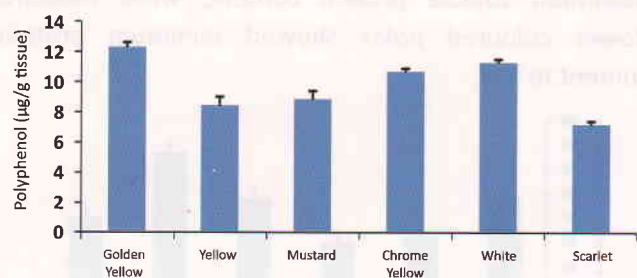


Fig. 20 Polyphenol content (µg/g) of leaf

Proline Content

The data reveals (Fig.21) scarlet and golden yellow *palas* as most tolerant to moisture stress as the proline content is significantly high in comparison to others. Chrome yellow and white *palas* showed minimum level of proline indicating low ability of the plants to withstand moisture stress.

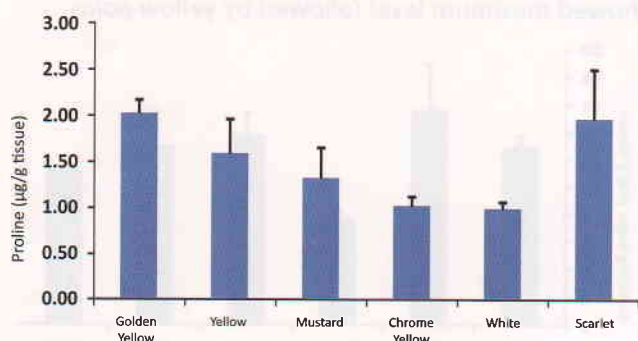


Fig.21 Proline content (µg/g) of leaf

Malon dialdehyde content

Malon dialdehyde is an indirect indicator of oxidative stress inside the host plant. The study (Fig.22) revealed that, white and yellow *palas* have maximum malon dialdehyde content indicating that these are more prone to oxidative stress during moisture deficient period. While, mustard *palas* has shown least content of MD indicating its tolerance to oxidative stress.

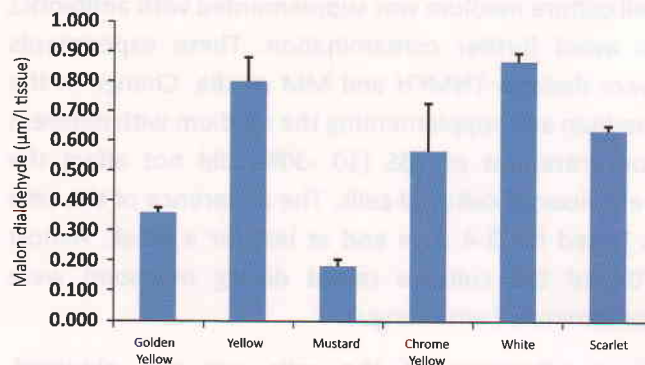


Fig.22. Malon dialdehyde content (µg/g)

Molecular characterization of *palas* variants for flower colour

In six flower colour variants (scarlet, yellow, golden yellow, chrome yellow, white and mustard colour) of *palas*, 12 ISSR primers produced 127 scorable bands. The size of the amplified fragments obtained from ISSR primers ranged from approximately 200 - 1800 bp. A maximum of 19 and a minimum of 7 scorable bands were produced by ISSR primers. The resolving power (Rp) range among the ISSR primers were 0.8-7.33. Out of the 12 primers used four were having resolving power above five. Average polymorphic band percentage is 85% showing the robustness of the primers used in distinguishing the genotypes selected.

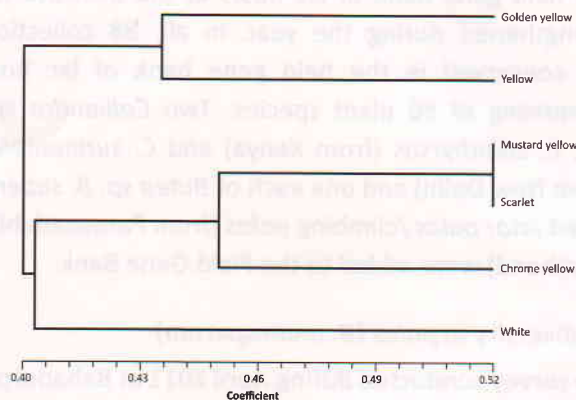


Fig. 23 Dendrogram depicting grouping of colour variants in different clusters



The diversity index values obtained for ISSR were in the range of 2-11.3. The clustering analysis using Jaccard's coefficient showed 2 clusters; first comprising of yellow and golden yellow and the second comprising of mustard, scarlet, chrome yellow and white colour variants of *palas* (Fig 23) Cv3 (mustard coloured) and Cv6 (scarlet) are very closely related.

1.5: Host plant evaluation and improvement for lac productivity and summer sustainability

Selection of *Flemingia semialata* for summer sustainability of kusmi lac crop

Broodlac production from the selected line of *F. semialata* was significantly higher as compared to control. However, the selected line could produce significantly higher (~2 times) fresh biomass yield than the control eventhough the yield was very poor. Inter-specific crosses between *F. macrophylla* and *F. semialata* was made (102 cross + 7 reciprocal cross), seed harvested and sown. Only seven seeds germinated and one variant with elongated broad leaf was observed. Inter specific hybridization was also initiated between *F. semialata* and *F. stricta*. About 1000 crosses made between three species of *Flemingia*.

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

Aghani crop was evaluated on reported five high yielding kusum plants at farmer's fields at Ghora Bandh village of Raigarh district in Chhattisgarh. One hundred and fifty four kg broodlac was harvested from 20 kg kusmi lac, with average output ratio of 7.7 (Fig 24). Canopy management as well as gap filling (with cutting) was done in *galwang* plot during August-September, 2011.

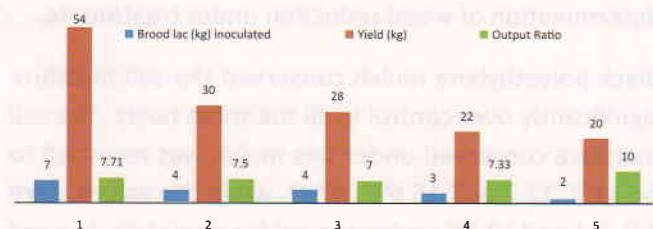


Fig. 24 Performance of winter (*aghami*) crop on farmers selected kusum plants at Raigarh

Evaluation of *Ziziphus* spp. / varieties for lac productivity

One plot of new budded plants from five selected *ber* genotypes was raised in IRF for further evaluation.

Three hundred and seventy seedlings of *ber* have been budded with five high yielding (for brood lac) *ber* plants. Kusmi broodlac was inoculated on hundred plants of twenty-four improved cultivars of *Ziziphus mauritiana* @ 50gm/plant. The crop was raised under natural condition at IRF. Among 24 varieties, only 15 varieties were evaluated for *aghami* crop. Few varieties viz., Bagwadi, Thornless, CAZRI Gola and F1 seb x Gola performed better in lac yield with output ratio ranged from 1.8 to 3.5 (Fig. 25).

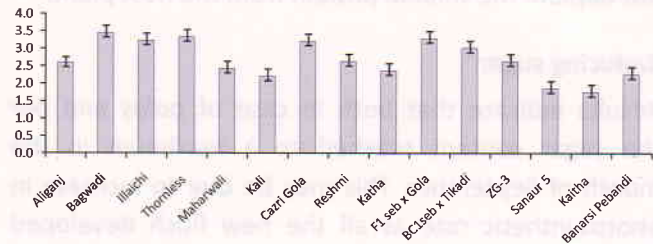


Fig. 25 Performance of winter (*aghami*) crop on ber varieties

Evaluation of Pigeonpea varieties for lac productivity

Twenty-two varieties of Pigeon pea were raised for *rangeeni* / kusmi lac productivity. Plants were bagged with nylon net for getting pure seeds. *Jethwi* crop has been raised for evaluation.

2. Crop Production System Management

2.1: 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.

The project was concluded in December 2011. Biochemical analysis of bark and leaf extracts of *ber* and *palas* was carried out for *katki* crop, 2011, to know the relationship between the biochemical status of the host plant and lac insect survival, as below:

Moisture content of bark

There was no significant difference with respect to moisture content between inoculated (T2) and control (T1) plants in both *ber* and *palas* trees. 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 (RWC) of leaf

RWC gives an indirect estimation of the moisture stress. It is proposed to be a better indicator of plant health



than water potential. The results indicate that both *ber* and *palas* were not under moisture stress during the *katki* period as the value of RWC was above 60%.

Total soluble protein

Soluble protein content of the bark gives an indirect idea about the nutritional status of the host plant. The result shows that there is no significant difference between the total soluble protein between the T_1 and T_2 . This clearly suggests that lac insect infection does not deplete the soluble protein from the host plant.

Reducing sugar

Results indicate that both in case of *palas* and *ber* the 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

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.

Proline

Proline is known to occur widely in higher plants and normally accumulates in large quantities in response to environmental stresses. The result indicates that due to lac infection in *ber* the content of proline has significantly increased from August onwards. The increasing effect continued till October. This gives an indication 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.

Polyphenol

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

Phenyl alanine ammonia lyase (PAL) activity

Stress induces production of phenolic compounds such as flavonoids and phenylpropanoids. Phenylalanine ammonia-lyase (PAL) is considered to be the principal enzyme of the phenylpropanoid pathway. The result indicates that the PAL activity is showing no difference

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*.

Polyphenol oxidase (PPO) activity

Oxidative enzymes such as polyphenol oxidase (PPO) and lipoxygenase (LOX) covalently modify dietary protein through the production of reactive o-quinones and lipid peroxides. This will have deleterious effect on the insects which feed on such plants. The result shows that in both *palas* and *ber* inoculation with lac causes an increase in the PPO activity. This can be viewed as a defensive response of the host plant against the lac insect invasion.

2.2: Evaluation of mulches for enhancing lac production on *palas*, *ber* and *Flemingia semialata* under rainfed condition

Five mulch materials *viz.*, black polyethylene, white transparent polyethylene, organic (local grasses / leaves), dust mulch/soil mulch and lac mud were evaluated for assessment of soil moisture retention, soil temperature, weed suppression and lac yield (*kusmi* winter crop on *ber* and *semialata* and *rangeeni* summer crop on *palas*).

Soil moisture content was evaluated for two depths *i.e.*, 0-30 cm and 31-60 cm for all the three hosts during January to May and November to December. Soil temperature data was also recorded for these two depths from February to May and November to December. Weed samples were collected in October (before imposition of the mulch materials) and in May (after harvesting of *rangeeni* lac crop on *palas*) for determination of weed reduction under treatments.

Black polyethylene mulch conserved the soil moisture significantly over control in all the three hosts. The soil moisture conserved under this mulch was recorded to be 11.9, 12.2 and 15.6% (w/w), while the values were 9.0, 8.4 and 12.8% under control for *semialata*, *ber* and *palas*, respectively.

Soil temperature recorded was found to be highest under white transparent polyethylene mulch *i.e.*, 22.7, 24.2 and 22.9 °C, respectively for *semialata*, *ber* and *palas* while the lowest temperature was recorded under grass mulch with the value of 21.8, 22.8 and 21.6 °C for



these hosts (Fig. 26). Thus, the temperature difference was found to be 0.9, 1.4 and 1.3 °C, respectively for the lac host plants. Overall, soil temperature was found to be significantly different in grass mulching with respect to other mulches.

Observations on weed biomass showed black polyethylene superior over other mulch materials. The mean weed biomass reduction with black polyethylene was found to be 80.7 % for *palas*, 100% for *ber* and 84.4% for *semialata* (Fig. 27).

Kusmi winter crop on *ber* and *semialata* was harvested in February 2011 and the data on broodlac yield ratio was recorded. Moisture conservation treatments, in general, were found to be superior in terms of broodlac yield ratio. For *semialata*, white transparent polyethylene mulch showed the maximum yield ratio (2.9:1) and the lowest broodlac yield ratio was found with lac mud (1.6:1), while control recorded 1.7:1. Analysis of data for *ber* revealed the maximum yield ratio with black polyethylene (3.9:1) and the lowest with lac mud (2.4:1), while control recorded 2.9:1.

Summer lac crop (*baisakhi*) was harvested on *palas* in April 2011 as *ari*. The lac yield trend in *palas* was found to be erratic and no definite trend was observed as analysis of data for *palas* revealed maximum yield ratio with control (2.6:1) and the least under grass mulch (0.6:1).

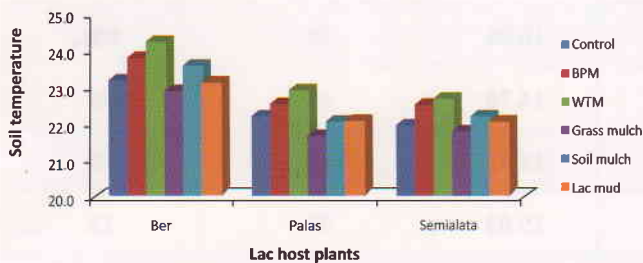


Fig. 26 Average soil temperature (°C) at 0-60 cm under different conservation practices for *ber*, *palas* and *semialata*

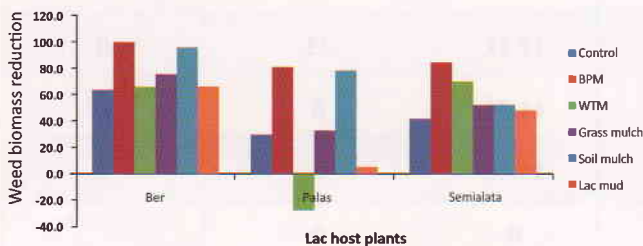


Fig. 27 Weed biomass suppression under different conservation practices for *ber*, *palas* and *semialata*

2.3: Lac Integrated Farming System

Under Lac Integrated Farming System, 15 kg of broodlac was inoculated on *F. semialata* in four rows in Jan, 2011. 60kg broodlac + 22kg rejected lac was obtained from *jethwi* crop, whereas for raising *aghani* crop, 17 kg broodlac was inoculated on *semialata* plants in five rows and 48 kg (broodlac + rejected lac) obtained in Dec, 2011. Guava plants yielded 114 kg fruits and 88.25kg of bittergourd was harvested in the reported period. Canopy management of guava plants was carried out in LIFS block. Besides, *Aonla* plants were also grafted with improved cultivars.

2.4: Development of spraying schedule of fungicides for management of sooty mould in winter kusmi lac crop

Species of *Capnodium* grow profusely on lac encrustations, making a dense fungal mat and blocking / choking the branchial pores of the lac insects, resulting in suffocation of the insects in individual cells. High RH during rainy season provides favourable climate to the sooty mould fungi, which causes significant loss to the lac crop if not controlled.

Optimum dose of Kavach® (chlorothalonil) on ber in winter crop

Kavach® (chlorothalonil) had been found very effective in reducing sooty mould and increasing lac yield in *kusmi* lac in winter crop in earlier experiments. An experiment was therefore undertaken in *kusmi* lac on *ber* (winter crop) in RBD. Twenty *ber* trees were inoculated and five doses of *Kavach*® (0, 0.5, 1, 1.5 and 2.5 g/lit water) were taken as treatments, replicated 4 times. Fungicides were sprayed thrice at 60 days, 90 days and 120 days, after broodlac inoculation. Recommended insecticide sprays were also given (*Thiodan*® at 21st day and *Dhawagold*® at 50th day after inoculation).

Standardization of Cantaf® (hexaconazole) spraying on ber, semialata and kusum

To optimize use of fungicide, an experiment was laid out to standardize suitable spraying schedule of *Cantaf*® (hexaconazole). Eight treatments with four replications were taken. In earlier experiments, a dose of 0.5 ml/lit of water was found equally effective as its higher doses in managing sooty mould and therefore in the present experiment 0.5 ml/ liter dose was used. The experiment was replicated on three hosts- *ber*, *semialata* and *kusum*.



Thirty-two *ber* trees and 32 *kusum* trees were inoculated, each tree taken as one replication. In case of *semialata*, 10 bushes were taken as one replication. Accordingly 320 bushes were inoculated for the experiment. Recommended two insecticide spray was given (*Thiodan*® at 21st day and *Dhawagold*® at 50th day after inoculation).

2.5: Influence of macro / micronutrients on kusmi lac production in comparison to standard package of *F. semialata*

Male percentage was influenced remarkably due to copper, boron, molybdenum and nitrogen application. 24.8% male was observed in control. An increase of 29, 85, 47 percent male was found due to boron, molybdenum and nitrogen application while 28 percent reduction of the same was observed due to copper application in recommended dose during winter season *kusmi lac* cultivation on *F. semialata* (Table 3).

Chlorophyll Content Index (CCI) of *F. semialata* was not influenced significantly due to application of different

macro and micro nutrients. Mean CCI of the plant varied in between 13.3 and 17.3. However, values of the same varied remarkably due to its size. Big (> 6.0' height) and small (< 5' height) sized plants recorded CCI values 13.3 and 17.3 respectively (Table 3).

Dry matter (DM) accumulation on shoots of *F. semialata* was found to be influenced significantly due to application of different macro and micro nutrients. Only due to inoculation, succulency of plants reduced by 7 percent, as the dry matter per cent observed on control (un-inoculated) was 28.2% as against 30.42% on control (inoculated) in September (Fig 28). Thus, succulence level increased (~ lower dry matter %) due to application of boron, potassium, nitrogen and in combinations of N, P₂O₅ and K₂O. Range varied in between 7 and 16 percent. However, in October, there was a depression in succulency level (Fig. 29). Maximum increase in DM% was found in potassium-treated plants.

Study on root nodulation suggests that copper, boron, molybdenum, lime and potassium (higher dose) are having positive and consistent role on nodulation.

Table 3. Plant and insect characters influenced due to macro and micro nutrients on *F. semialata*

| Treatments | Male % (Av) | CCI at November | Small plants (<5') with effective nodulation (%) | Big plants (>5') with effective nodulation (%) |
|--|-------------|-----------------|--|--|
| Control (Inoculated) | 24.86 | 15.37 | 0 | 66 |
| Zinc (25 kg zinc sulphate/ ha) | 26.44 | 14.51 | 0 | 0 |
| Copper (25 kg copper sulphate/ ha) | 17.77 | 16.96 | 33 | 100 |
| Boron (10 kg borax/ha) | 32.23 | 14.76 | 66 | 66 |
| Molybdenum (1 kg sodium molybdate/ ha) | 46.07 | 15.42 | 33 | 33 |
| Lime (125 g/ sq m) | 28.99 | 15.83 | 33 | 33 |
| Potassium (50 g/ plant MOP) | 25.68 | 14.61 | 0 | 66 |
| Potassium (100 g/ plant MOP) | 22.12 | 14.74 | 33 | 66 |
| Nitrogen (50 g/ plant) | 30.23 | 17.27 | 33 | 0 |
| Nitrogen (25 g/ plant) | 36.75 | 16.24 | 0 | 33 |
| Combination of NPK (50, 25, 50 g/ plant) | 25.75 | 14.46 | 0 | 0 |
| Control (un-inoculated) | 13.28 | 0 | 0 | |
| CD (0.05) | 5.67 | NS | | |

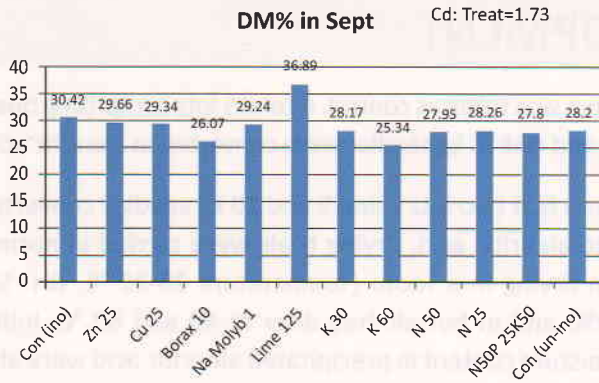


Fig. 28 Dry matter % affected by treatments (Sept)

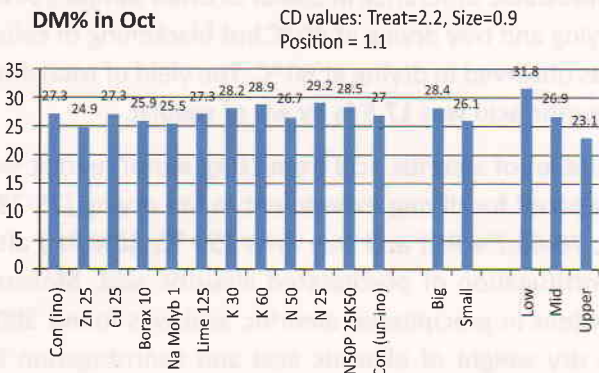


Fig. 29 Dry matter % affected by treatments (Oct)

Lac productivity related parameters were also studied in relation to shoot thickness of *F. semialata*. Thicker shoots (> 10 mm basal diameter) did not show any change in dry matter % due to lac growth in October (Fig. 30). Sticklac production per thin shoot started increasing rapidly when basal shoot diameter increased from 6.25 mm. (Fig.31) in October i.e. with a production capacity of 4 g sticklac. Thin shoots showed reduced succulence with higher lac insect load. Therefore, thin shoots lesser than 6.25 mm basal thickness can be discarded for reducing crowdedness and increasing productivity.

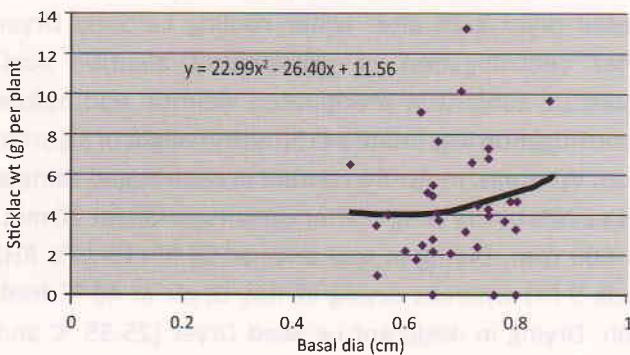


Fig. 30 Sticklac weight and basal diameter of thin shoots (Oct)

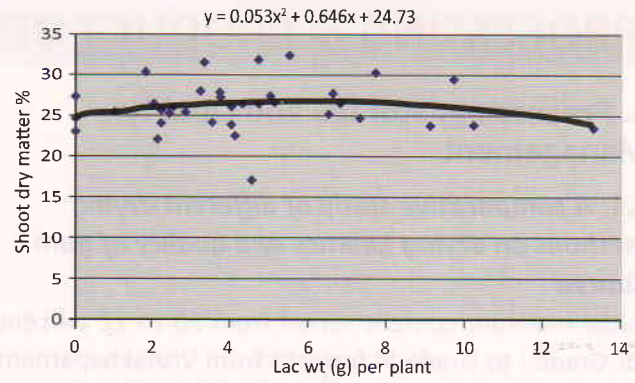


Fig. 31 Sticklac weight and dry matter % of thin shoots (Oct)

Length of lac encrustation as affected by plant parameters (9 factors) was estimated through regression analysis. Plant height, number of shoots per plant and number of thin shoots per plant had shown to affect length of lac encrustation significantly (Fig. 32, 33, 34). Following regression equation was obtained:

$$Y = 314.2 + 18.8 X_1 - 26.5 X_2 - 1.8 X_3$$

(Y= length (cm) of lac settlement/ plant, X1= Total number of shoots/ plant, X2= Number of thin shoot/ plant and X3= Plant height (cm))

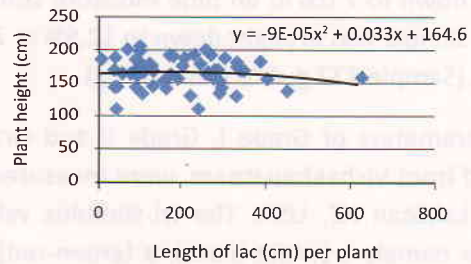


Fig. 32 Plant height and length of lac settlement in October

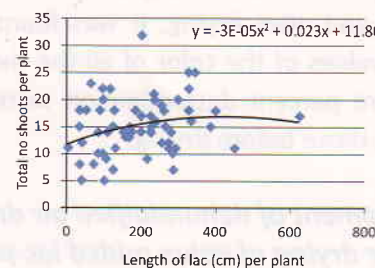


Fig. 33 Total shoot and length of lac settlement in October

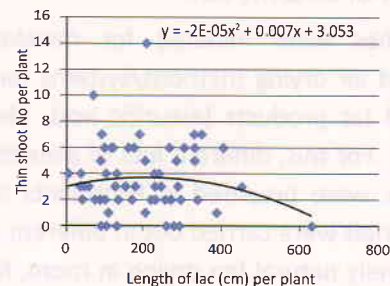


Fig. 34 No of thin shoots and length of lac settlement in October



PROCESSING & PRODUCT DEVELOPMENT

3. Processing, Storage and Quality Management

3.1: A comparative study of different drying methods on drying kinetics and quality of gum Karaya

Initial moisture content varied from 20 to 22 percent for Grade I to Grade III brought from Vishakhapatnam (A.P). Viscosity of fresh Grade I, Grade II and Grade III, collected from Vishakhapatnam in their varying concentrations from 0.25 % to 0.1 % was determined by Brookfield Digital Viscometer (using Spindle No. 1) at 50 RPM and 100 RPM and found that Grade III had the highest viscosity followed by Grade II and Grade I.

Moisture % of Grade I, Grade II and Grade III, collected from Vishakhapatnam and dried in oven at 60 °C were found to be 5.3%, 7.35% and 6.75%, respectively in 7h time. In another attempt drying Grade-II Sample in air drier at 60 °C the moisture content was brought down to 9.5% in 7h time. At 70 °C the moisture content was brought down to 7.0% in 6h time moisture content of grade III sample was brought down to 12.5% at 70 °C in 7h time. (Sample 472 g, 470 g and 607 g)

Color parameters of Grade I, Grade II and Grade III, collected from Vishakhapatnam, were measured using Hunter, LabScan XE, USA. The tri-stimulus values of the color namely L (white-black), a (green-red) and b (blue-yellow) of all the three grades were measured both before and after drying. It was found that the tri-stimulus values of the color of all the three grades after moisture percent determination were lower as compared to those before drying.

3.2: Development of dehumidified air drying methods for drying of value added lac products

Drying study of aleuritic acid

Drying studies were initiated for development of dehumidified air drying methods/systems for drying of value added lac products (aleuritic acid, bleached lac and lac dye). For this, different lots of aleuritic acid and bleached lac were prepared in Pilotplants of PD Unit and drying trials were carried out in different condition/systems namely natural fan drying in room, hot air tray drier and desiccant based drier (Seed Dryer). Drying in

room was taken as control. A total 5 lots comprising one 5 kg and rest 10 kg seedlac were converted to aleuritic acid.

From first two lots using 5 and 10 kg seedlac converted into aleuritic acid, drying trials were carried in normal fan drying in a room (Temperature 28-32 °C, RH- 50-70%) and in hot air tray drier at 40 and 60 °C. Initial moisture content in precipitated aleuritic acid were also observed and found 250-280%. Although there was no appreciable difference in colour of dried samples of fan drying and tray drying at 40 °C but blackening of colour was observed in drying at 60 °C. The yield of total dried aleuritic acid was 17.5 % by wt. of seedlac

Third lot of aleuritic acid from 10 kg *kusmi* seedlac was prepared for drying experiment in fan drying (25-28.6 °C, 78-83.7% RH) and tray drier (50 °C, 40% RH) after centrifugation of precipitated aleuritic acid. Moisture content in precipitated aleuritic acid was found 300% by dry weight of aleuritic acid and centrifugation for 25 minutes at 600 rpm resulted in 150 % reduction in moisture content by dry weight of aleuritic acid. Fan drying took nearly 5 day for drying where as in hot air tray drier it took 13 hrs. The yield of total dried aleuritic acid was 15.2 % by weight of seedlac.

Fourth lot of aleuritic acid prepared from 10 kg *kusmi* seedlac was dried in desiccant based dryer i.e Seed Dryer (30-43 °C, 12-16% RH) with both without centrifugation and after centrifugation of precipitated aleuritic acid (moisture content- 180% by dry weight). Moisture content in precipitated aleuritic acid was found 337% by dry weight of aleuritic acid. Fifth lot of aleuritic acid from 5 kg old shellac (10-15 year old) was dried in ambient in room with fan (22-24 °C, 51-62.5% RH), heated tray drier (40, 50 °C) and desiccant based dryer with after water cooling i.e Seed Dryer after centrifugation of precipitated aleuritic acid. Moisture content in precipitated aleuritic acid before centrifugation was found 341% by dry weight of aleuritic acid. Whereas, moisture content in centrifuged sample was 220% by dry weight after centrifugation for 20 min. at 600 rpm. Drying in tray drier at 50 °C (16-17% RH) took 9 hrs whereas drying in Tray Dryer at 40 °C took 10h. Drying in desiccant i.e Seed Dryer (25-35 °C and 7-17% RH) took 8-9h. Yield of aleuritic acid from shellac in this trial was 16%. The melting points of aleuritic



acid samples of all trials were determined by capillary method and found and found varying from 92 to 94 °C.

Drying study of bleached lac

Bleached lac prepared in this lot and washed in vertical washing unit was dried in natural fan drying (27-30 °C, 74-80% RH) and in desiccant based seed dryer after centrifugation for 25 minutes at 600 rpm. The initial moisture content in precipitated bleached lac was 137% by dry weight and moisture content after centrifugation was 72% by dry weight. Precipitated bleached lac without centrifugation took one week (approx.) to dry due to rainy season. Whereas drying in Seed Dryer at (30-40 °C, 12-17% RH) took 9 hrs. in drying. The yield of bleached lac was 82.3% by weight of seedlac. Dried samples were evaluated at QEL, IINRG and compared with samples of natural fan drying. There was no appreciable difference in quality parameters in comparison with natural drying.

| Washing & Drying types | Flow (mm) | Life (min.) | Color | Impurity (%) | Acid value |
|---|-----------|-------------|-------|--------------|------------|
| Hand washing & natural drying | 20 | 8 | 0.5 | 1.05 | 67.60 |
| Vertical washing unit & natural drying | 20 | 7 | 0.5 | 1 | 69.16 |
| Vertical washing unit & desiccant dryer | 20 | 8 | 0.5 | 1 | 67.60 |

4. Value Addition, Application Development and Product Diversification

4.1: Synthesis of hydrogel from gum Acacia and gum Karaya for their comparative evaluation in drug release

Hydrogels have been synthesized from *Acacia* gum and gum *Karaya* using grafted co-polymer of modified gum with different acrylic acid substituents. Equilibrium swelling (%) of *Acacia* based two hydrogels was determined using tea bag method at room temperature and it was ~ 3200 and 4100. Equilibrium swelling of three hydrogels synthesized from *Karaya* gum using acrylic acid, acrylamide and substituted methacrylate as grafted copolymers and summarized in the table.

| Grafting used in the hydrogel | Equilibrium swelling (%) |
|-------------------------------|--------------------------|
| Acrylic acid | 1600 |
| Acrylamide | 1230 |
| Substituted methacrylate | 1190 |

Equilibrium swelling (%) of the hydrogel prepared from methacrylate grafted gum *Acacia* was determined at pH 4.0, 7.0, 9.2 and 10 and it was 3300, 4100, 4260 and 4370 respectively after 24h at room temperature.

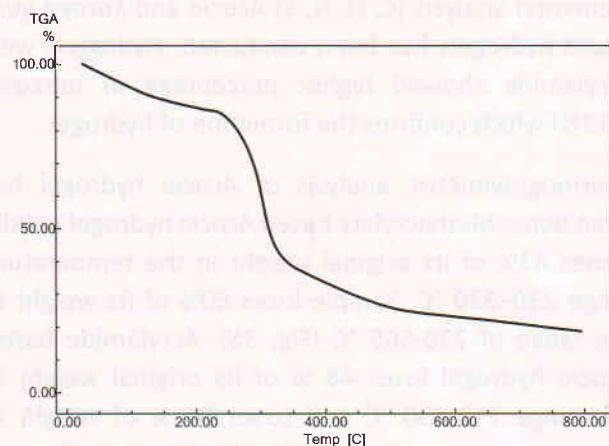


Fig. 35 Thermal analysis of methacrylate based *Acacia* hydrogel

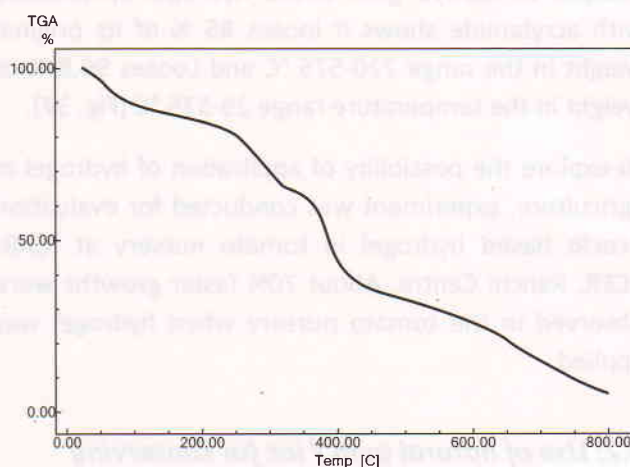


Fig. 36 Thermal analysis of acrylamide based *Acacia* hydrogel

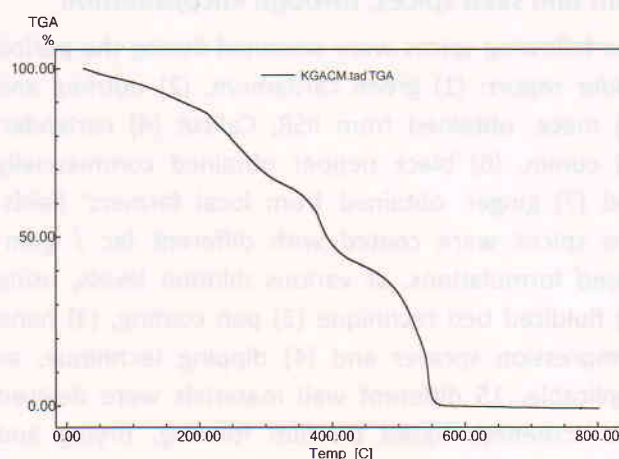


Fig. 37 Thermal analysis of acrylamide based *Karaya* hydrogel

Characterization of grafted *Acacia* gum based hydrogel has been done by SEM, FT-IR, Elemental analysis and thermogravimetric analysis. The morphologies



of modified gum and its hydrogel were analyzed by SEM images. The modified gum showed a tight structure while its hydrogel had a porous structure due to the formation of Interpenetrating Networks. Elemental analysis (C, H, N, S) *Acacia* and *Karaya* gum based hydrogels has been conducted. Hydrogels with acrylamide showed higher percentage of nitrogen (>13%) which confirms the formation of hydrogel.

Thermogravimetric analysis of *Acacia* hydrogel has been done. Methacrylate based *Acacia* hydrogel rapidly loses 43% of its original weight in the temperature range 230–330 °C. Sample loses 60% of its weight in the range of 230-565 °C (Fig. 35). Acrylamide based *Acacia* hydrogel loses 48 % of its original weight in the range 210-450 °C and Loses 94 % of weight in the temperature range 30-800 °C (Fig. 36). Thermal analysis of *Karaya* gum based hydrogel synthesized with acrylamide shows it loses 85 % of its original weight in the range 220-575 °C and Loses 99.8 % of weight in the temperature range 29-575 °C (Fig. 37).

To explore the possibility of application of hydrogel in agriculture, experiment was conducted for evaluation *Acacia* based hydrogel in tomato nursery at ICAR-RCER, Ranchi Centre. About 20% faster growths were observed in the tomato nursery when hydrogel was applied.

4.2: Use of natural gum / lac for conserving natural characteristics and shelf life of select fruit and seed spices, through encapsulation

The following spices were screened during the period under report: (1) green cardamom, (2) nutmeg and (3) mace, obtained from IISR, Calicut (4) coriander, (5) cumin, (6) black pepper obtained commercially and (7) ginger, obtained from local farmers' fields. The spices were coated with different lac / gum-based formulations, at various dilution levels, using (a) fluidized bed technique (2) pan coating, (3) hand compression sprayer and (4) dipping technique, as applicable. 15 different wall materials were devised and screened, based on film forming, drying and encapsulating properties. These were primarily based on lac resin, gum *Acacia*, gum *Xanthan*, *Guar* gum and gum *Ghatti*. It was observed that wall materials based on lac were most suitable in all cases. Lac + gum were not compatible as wall material, except lac + gum

Acacia; Wall materials based on gum alone had poor drying and film forming characteristics, except gum *Acacia*. They were prone to fungal attacks.

Regarding application technique, pan coating was suitable for heavy spices like ginger and nutmeg. Lighter spices like mace, coriander and cumin were coated in fluidized bed coater. Dipping could be a cheap alternative, at farmers' level, but coating parameters could not be controlled and optimum drying was a problem.

Ginger, coriander and cumin were evaluated at IINRG. Physico-chemical analysis of ginger coated with different formulations, (Code named: SH1, SH2, SH3 and BH01) were made from 0 to 45 days of storage. All formulations were effective in controlling the moisture loss. However BH01 (lac-gum *Acacia*) was most effective formulation compared to other formulations. Despite heavy monsoons in 2011, the coating could control fungus infestation on nutmeg.



Fig. 38 Pan Encapsulating Unit at IINRG



Fig. 39 Fluidised Bed Drying-cum-Coating at IINRG



4.3: Development of natural resin/gum based sticker bindi

Powdered samples of *kusmi* hand made shellac; dewaxed decolourized lac (DDL) and rosin were prepared. Rosin sample was obtained from Dr. YS Parmar University of Horticulture & Forestry, Solan (HP). Several non-drying adhesive compositions were prepared using (i) shellac (ii) DDL (iii) shellac (70%) & hydrolyzed lac (30%) (iv) DDL (70%) & hydrolysed lac (30%) (v) shellac (70%) & rosin (30%) (vi) DDL (70%) & rosin (30%) and (vii) hydrolysed lac. The adhesiveness and acid values of the above compositions were studied. The adhesiveness was measured with 15g load using 1sq. cm area of plywood of 2mm thickness. The results are given in Table 4.

Table 4. Adhesiveness and acid value of non-drying adhesive compositions

| Sl. No. | Samples | Adhesiveness (15g load) cm/sec | Acid value |
|---------|-----------------------------|--------------------------------|------------|
| 1 | Shellac | 0.013 | 25.5 |
| 2 | DDL | 0.022 | 34.0 |
| 3 | Shellac (70%) + HL (30%) | 0.017 | 34.0 |
| 4 | DDL (70%) + HL (30%) | 0.016 | 36.7 |
| 5 | Shellac (70%) + rosin (30%) | 0.024 | 13.7 |
| 6 | DDL (70%) + rosin (30%) | 0.047 | 9.5 |
| 7 | HL | 0.005 | 73.6 |

(DDL- Dewaxed Decolourised Lac; HL - Hydrolysed Lac)

The bulk densities of adhesive compositions were found to be in the range 0.9-1.1g/cc while the pH values were in the range 6-7. Analysis of microbial load was carried out. No bacterial growth was observed till seven days after incubation under culturing conditions. Further work continues.

A new methodology was devised to measure pH of sticky substances made out of lac resin. In this method, sticky substance is made in to solution by using proper solvent (strong alkali,). An alkaline solution of known pH (12.0) is taken and mixed with the sticky sample prepared before in 100:1 proportion. The pH of the resulting solution is measured. Then the difference in the pH between the solutions is calculated by using an equation derived using standard pH solutions. The pH of the sticky substance is measured by subtracting the

difference in pH from the pH value of known sample. All five formulations tested were found to have pH in the neutral range (6 - 7). Analyses of microbial load in sticker *bindi* formulations were carried out and no bacterial growth was observed till seven days after incubation under culturing conditions

4.4: Development of surface coating compositions based on shellac - synthetic resin / polymer blends (Completed Project)

The project has been concluded on March 31, 2011. The salient findings of the project are as follows:

Blending of different polymers is widely practiced in the polymer industries for achieving desirable combination of properties of the resultant products. Blending of shellac with rosin, novolac and epoxidised novolac was done to get either improved properties or reduced cost of end products.

Blending of Shellac with rosin

- Blending with rosin has marked improvement in the physico-chemical properties like flow, life under heat, colour index, hot alcohol insoluble % tremendously, which remains maintained for a longer period of time. Flow (fluidity) and life of blended compositions increased to about 65% and 115% respectively to that of shellac alone by blending of rosin with shellac 70:30 ratios. Color index decreased with increasing ratio of rosin, because of pale color of rosin.
- After three years of storage, very significant difference was observed mainly in flow, life and hot alcohol insoluble % of the samples. Flow of the shellac sample (100%) was decreased by 78% whereas 58%, 44% and 26% decrease was recorded in shellac rosin blend samples 70:30, 50:50, and 40:60 respectively. Life of shellac sample was decreased by 60% while 27% decrease in 70: 30 shellac-rosin blends was recorded. Hot alcohol insoluble % was increased by 60% in control shellac sample while less increase was recorded in shellac rosin blend samples. In rest of the properties like acid value, saponification value, wax % and colour index, less significant differences were observed.
- Blending with rosin did not show any marked improvement on surface coating properties of shellac, rather it decreased the properties. But



addition of melamine formaldehyde resin improved gloss, water and heat resistance of the blends (upto 50:50 ratio). Contact angle with water increased with the increase in the concentration of rosin upto 50%, indicating increase in hydrophobicity of the blends. Increase in contact angle defines the hydrophobicity of the materials and *vice versa*.

Blending of shellac with novolac

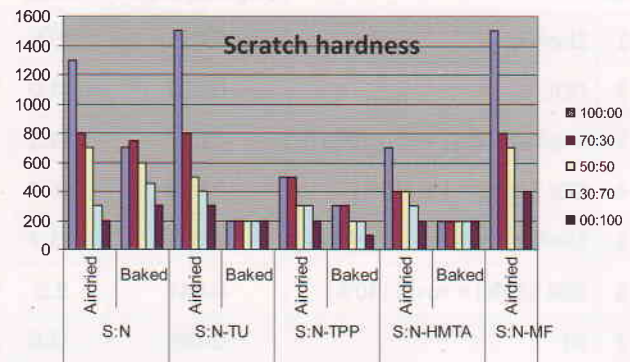
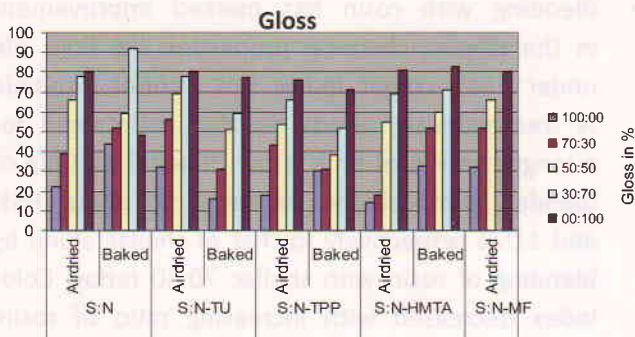
- Novolac is very glossy in nature. Blending of shellac with novolac improved gloss of the blends remarkably, but decreased the properties like scratch hardness, heat and water resistance. Higher concentration of novolac is to be used with shellac where high gloss is required with no consideration of scratch hardness, heat and water resistance.
- Baking improved gloss as also water resistance of the films of the blends, but decreased scratch

hardness of the films. There was no need of adding any chemical reagent (cross-linking agent) for getting water resistance only.

- For getting higher gloss, good heat and water resistance of the blends at ambient temperature, melamine formaldehyde resin addition is recommended (Figs. 40 & 41).

Blending of shellac with epoxidised-novolac

- Blending of shellac with epoxidised novolac improved gloss, scratch hardness and impact resistance.
- In comparison to novolac, gloss of epoxidised novolac was less.
- Addition of melamine formaldehyde resin improved water resistance and further gloss also. Scratch hardness decreased with the addition of MF resin (Fig. 42).



Figs. 40 & 41. Comparative gloss and scratch hardness of the blends

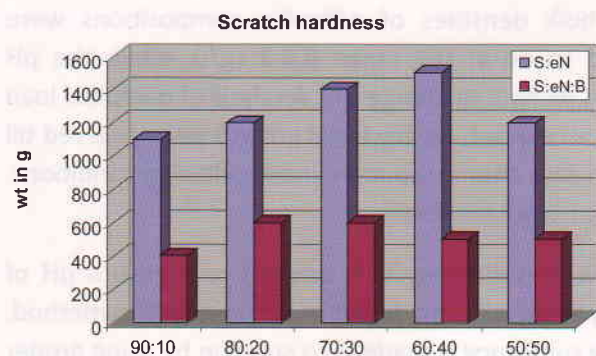
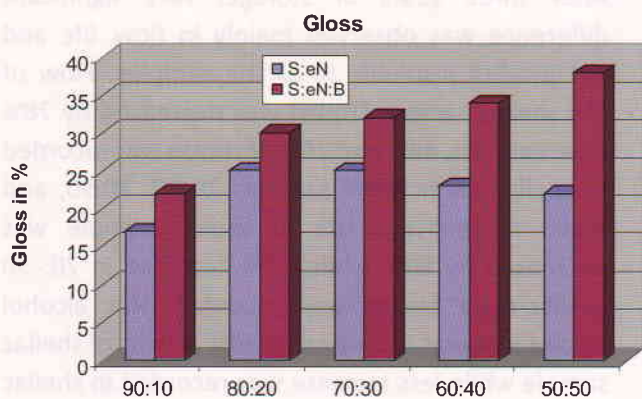


Fig. 42 Comparative gloss and scratch hardness



TRANSFER OF TECHNOLOGY

5. Capacity Building of Farmers and Entrepreneurship Development

5.1: Training, demonstration, extension education and information service on lac culture, processing and product development

The Institute conducted different types of training programmes pertaining to scientific lac cultivation, processing and utilization, continuously assessing the needs 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.

Training programme for farmers and housewives

This one-week programme on “Scientific lac cultivation, processing and utilization” mainly covers lac cultivation, processing at farm level and uses of lac. A total of 768 farmers from 22 districts of eight states viz. Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Andhra Pradesh, Maharashtra and Bihar participated in the programme (Appendix I). These were sponsored by various organizations given below:

| Sponsoring Organization | State |
|---|----------------|
| MECON India Ltd., NAIP - Lac Value Chain, Forest Departments of Ranchi, Latehar, Saraikela, Giridih, Department of Afforestation, Vyakti Vikas Kendra, India (Art of Living) - Steel Authority of India Ltd., NAIP - Livelihood, Jamtara - Birsa Agrl. University, RK Mission, Narayanpur, TRIFED, Ranchi and private organizations from Ramgarh, Nizamabad, Gumla, Ranchi and Simdega. | Jharkhand |
| District Industries Centres (DIC) of Midnapur, Purulia, Murshidabad and Malda and some private organizations | West Bengal |
| TRIFED, Mahasamund, NAIP - Livelihood Jagdalpur – Indira Gandhi Krishi Viswa Vidyalaya, Raipur, Forest Departments of South Surguja, Mahasamund and Raigarh | Chhattisgarh |
| TRIFED, Nabrangpur, Sundergarh and Odisha (Sarvodaya Samiti) | Odisha |
| Forest Department, Hosangabad and private organization from Midnapur | M.P. |
| CCN Sahayog, Vishakhapatnam | Andhra Pradesh |
| Forest Department, Yavatmal | Maharashtra |
| Private organization from Jamui | Bihar |

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

Manager, Primary Forest Committee, unemployed educated rural youth (henceforth Lac facilitator after training), Master Trainers and Junior Lac Executive sponsored by Chhattisgarh State Minor Forest Produce (Trade and Development Federation Ltd), Raipur, progressive farmers and forest official from Rajpipla, Gujarat, obtained training under “Trainers’ training programme on Scientific methods of lac cultivation, production, processing and utilization”. A total of 314 participants were trained as trainers through 13 different courses. These were sponsored by Forest Departments of different districts of Chhattisgarh, West Bengal and CGMFP Fed. Ltd., Chhattisgarh (Appendix I).

One week educational programme on Production, processing and uses of natural resins and gums

The agriculture graduate students from Sam Higinbottom Institute of Agriculture Science & Technology, Allahabad (formerly Allahabad Agricultural Institute), Institute of Agricultural Sciences, Banaras Hindu University, from UP and Guru Ghasidas Viswavidyalaya, Bilaspur, Chhattisgarh obtained one week training in lac cultivation, processing and its uses. A total of 117 students were educated through four courses under this educational programme (Appendix I).

Field out-reach programme

On- Farm training on “Scientific cultivation of lac”

A total of 72 camps were organised in collaboration with different organizations, covering 11 districts viz. Gadchiroli of Maharashtra, Ranchi, Khunti, Chatra, Palamu, Chaibasa, Gumla, East Singhbhum, Saraikela of Jharkhand; Mayurbhanj of Odisha and Valsad of Gujarat. A total of 5,251 farmers benefited from this programme. These were sponsored by Jharkhand Lac Development Scheme, Forest departments of Jharkhand and Maharashtra, NAIP-Lac Value Chain, IINRG, K.C. Pur Lac Co-operative Society Ltd., Odisha, Adivasi Mahila Samaj Seva Kendra, ARROWS, KVK, Saraikela and BPYP, Latehar of Jharkhand.

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

32 camps were organized in collaboration with NGOs and GOs of different states. A total of 3,447 persons



(mainly farmers) representing around 100 villages of twelve districts of six states viz. Maharashtra, West Bengal, Chhattisgarh, Jharkhand, Odisha and Madhya Pradesh got benefit from this programme. These were nominated by R.K. Mission of Jharkhand, West Bengal and Chhattisgarh, TRIFED of Jharkhand and West Bengal, Forest departments of Maharashtra, Chhattisgarh and Madhya Pradesh, K.C. Purbee Co-operative Ltd., Odisha, Purulia Zila Unayan Parishad, West Bengal, ASMITA, Chhattisgarh, Youth, Advasi Mahila Samaj Seva Kendra, Lac Sahayog Samiti, Farmer's Group and W. Cdr. Gyaneshwar of Jharkhand.

In-campus Orientation programme on lac cultivation

In-campus Orientation programme (44 nos.) on Natural Resins and Gums were organized with NGOs and GOs of different states. 2,602 farmers and students visited the Institute for the purpose. These were nominated by PRADAN, R.K. Mission, Jharkhand Tribal

Development Society, Administrative Training Institute, Forest department, Surendranarh Centenary School, Kairali School, St. Michael School, Carmel Girl's School, Kasturba Gandhi School, Birla Institute of Technology, Birsa Agriculture University, Institute of Forest Productivity, Nirmala College, Christian Movement of India - Students, Navbharat Jagriti Kendra, A.M.S.S. Kendra, B.W.D. Torpa, Krishi Vigyan Kendra, Saraikela, Adivasi Vikas Sangathan of Jharkhand, R.E.A.D.S, Jashpur, Chhattisgarh, S.W.O.R.D, Bihar, Narottam Gosmi Amethi and Horticulture Department of Chhattisgarh.

Other activities

Monitoring of *kusmi* lac crop, technical guidance, remedial measures for pest attack, demonstration of inoculation, spraying etc. at different locations were carried out (Table 5). These were conducted in the states of Jharkhand, Chhattisgarh and Maharashtra at 31 places.

Table 5. Other activities related to lac production

| District, State | Venue (Village Block) | Collaborating Agency | Date | Purpose |
|----------------------------|---|----------------------|----------|--|
| Jagdalpur, Chhattisgarh | Sant Karmary Range, Kripavan, Jagdalpur | Forest Department | 07.04.11 | <i>Kusmi</i> lac on <i>kusum</i> tree |
| Jagdalpur, Chhattisgarh | Cheurgaon Range, Kripavan, Jagdalpur | Forest Department | 07.04.11 | <i>Kusmi</i> lac on <i>kusum</i> tree |
| Jagdalpur, Chhattisgarh | Jaiber Range, Kripavan, Jagdalpur | Forest Department | 07.04.11 | <i>Kusmi</i> lac on <i>kusum</i> tree |
| Jagdalpur, Chhattisgarh | Komar Range, Kripavan, Jagdalpur | Forest Department | 07.04.11 | <i>Kusmi</i> lac on <i>kusum</i> tree |
| Jagdalpur, Chhattisgarh | Saleguda Range, Kripavan, Jagdalpur | Forest Department | 07.04.11 | <i>Kusmi</i> lac on <i>kusum</i> tree |
| Jagdalpur, Chhattisgarh | Kolebera Range, Kripavan, Jagdalpur | Forest Department | 07.04.11 | <i>Kusmi</i> lac on <i>kusum</i> tree |
| Latehar, Jharkhand | Pesrar, Latehar | TRIFED | 04.05.11 | <i>Rangeeni</i> lac on <i>palas</i> and <i>ber</i> |
| Manika, Jharkhand | Manika, Latehar | TRIFED | 05.05.11 | <i>Rangeeni</i> lac on <i>palas</i> and <i>ber</i> |
| Ranchi, Jharkhand | Lapung, Ranchi | TRIFED | 10.05.11 | <i>Baisakhi</i> crop on <i>akashmani</i> |
| Ranchi, Jharkhand | Lapung, Ranchi | TRIFED | 11.05.11 | <i>Baisakhi</i> crop on <i>palas</i> and <i>ber</i> |
| Saraikela-Kharsawan, Jh. | Kuruspur, Saraikela-Kharsawan | KVK, Saraikela | 14.07.11 | Inoculation of <i>rangeeni</i> lac |
| Luxmipuram, Andhra Pradesh | Barada, Luxmipuram | CCN Sahyog | 15.07.11 | <i>Kusmi</i> crop on <i>kusum</i> trees |
| Raigarh, Chhattisgarh | Rathia, Bilaspur | Forest Department | 22.07.11 | <i>Kusmi</i> lac crop raised with 2.6 quintal broodlac |
| Raigarh, Chhattisgarh | Khokhra, Raigarh | Forest Department | 22.07.11 | Evaluation of field area for <i>ber</i> trees |
| Raigarh, Chhattisgarh | Chandli, Raigarh | Forest Department | 23.07.11 | 400 <i>kusum</i> trees inoculated |
| Raigarh, Chhattisgarh | Kharsia, Raigarh | Forest Department | 24.07.11 | 500 <i>palas</i> trees inoculated |



| District, State | Venue (Village Block) | Collaborating Agency | Date | Purpose |
|----------------------|-----------------------|--------------------------|----------|--|
| Potka, Jharkhand | Jhiki and Potka | KVK, Divyayan | 04.08.11 | Settlement of <i>kusmi</i> lac on <i>ber</i> |
| Purulia, West Bengal | Putidih, Jhalda | IINRG, Ranchi | 06.08.11 | Spray of pesticides |
| Purulia, West Bengal | Putidih, Jhalda | IINRG, Ranchi | 19.08.11 | Disease surveillance, <i>Chrysopa spp</i> collection |
| Ranchi, Jharkhand | Beradih, Ranchi | NCS, Ranchi | 28.08.11 | <i>Kusmi</i> lac on <i>ber</i> |
| Ranchi, Jharkhand | Sorha, Ranchi | NCS, Ranchi | 28.08.11 | <i>Kusmi</i> lac on <i>ber</i> |
| Khunti, Jharkhand | Khunti, Ranchi | NCS, Ranchi | 28.08.11 | <i>Kusmi</i> lac on <i>F.semialata</i> |
| Ranchi, Jharkhand | Gutidih, Ranchi | Udyogini, Ranchi | 31.08.11 | <i>Kusmi</i> lac on 400 <i>ber</i> trees |
| Ranchi, Jharkhand | Jaradih, Ranchi | Udyogini, Ranchi | 31.08.11 | <i>Kusmi</i> lac inoculated on <i>ber</i> trees |
| Latehar, Jharkhand | Lalli, Latehar | IINRG | 03.09.11 | <i>Kusmi</i> lac on <i>ber</i> trees and <i>rangeeni</i> lac on <i>palas</i> trees |
| Khunti, Jharkhand | Jate, Khunti | IINRG | 13.09.11 | 30 q. <i>kusmi</i> broodlac inoculated |
| Khunti, Jharkhand | Altanda, Khunti | IINRG | 13.09.11 | -do- |
| Khunti, Jharkhand | Sarigaown, Khunti | IINRG | 13.09.11 | 600 kg. <i>kusmi</i> lac inoculated on <i>ber</i> |
| Khunti, Jharkhand | Tiwan Tola, Khunti | IINRG | 13.09.11 | -do- |
| Gumla, Jharkhand | Dalmadih, Basia | TRIFED | 07.10.11 | <i>Aghani</i> crop on <i>ber</i> & <i>kusum</i> trees. |
| Ranchi, Jharkhand | Silli, Muri | Wg. Cdr. G. Singh (Rtd.) | 16.10.11 | <i>Katki</i> crop is in maturity stage |

6. Technology Evaluation, Refinement, Dissemination and Demonstration

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

The project was initiated with an objective to bring about novel and eco-friendly pest management technology for managing insect pests associated with lac insects and host plants in the lac production system.

Evaluation of chemical insecticides on rangeeni lac crop

Summer season (*baisakhi*) *rangeeni* lac crop was raised on 75 *palas* trees and rainy season (*katki*) *rangeeni* lac crop was raised on 160 *palas* trees at IRF as well as farmers field at Putidih, Jhalda, West Bengal for evaluation of pesticides against predators and parasitoids of lac insect.

Insecticides viz., indoxacarb (0.007%), spinosad (0.005%), fipronil (0.005 and 0.01%), carbosulfan

(0.01%), bifenthrin, lambda-cyhalothrin, ethofenprox (0.02%) and endosulfan (0.05%) were evaluated on *baisakhi* lac crop and insecticides viz. indoxacarb (0.007%), spinosad (0.005%), fipronil (0.005 and 0.01%) and ethofenprox (0.02%) were evaluated on *katki* lac crop raised on *B. monosperma*. All the insecticides were found to be effective in suppressing the incidence of lac insect predators. Reduction in incidence of *Eublemma amabilis* and *Pseudohyapatopa pulverea* in different treatments varied from 42-81% and 67-100%, respectively over control. Reduction in incidence of *E. amabilis* and *P. pulverea* was observed to the tune of 69 and 100%, respectively in *Bacillus thuringiensis* (*Bt*) treatment.

Evaluation of chemical insecticides and *Bacillus thuringiensis* formulations on kusmi lac crop

Summer season (*jethwi*) *kusmi* lac crop was raised on 45 *Schleichera oleosa* (*kusum*) trees and winter season (*aghani*) *kusmi* lac crop has been raised on 30 *Ziziphus mauritiana* (*ber*) trees at IRF for evaluation of their



bioefficacy against predators and parasitoids of lac insect.

Four chemical insecticides: indoxacarb (0.007%), spinosad (0.005%), fipronil (0.005%), ethofenprox (0.02%) and one biopesticide (*Halt*) was evaluated on summer season *kusmi* lac crop raised on *kusum*. Whereas, four chemical insecticides (indoxacarb, spinosad, fipronil and ethofenprox) and three biopesticides (*Halt*, *Knock WP* and *Delfin*) were evaluated on winter season *kusmi* lac crop raised on *ber*.

Significant reduction in incidence of lac insect predators was observed with the application of pesticides. Reduction in incidence of *E. amabilis* was varied from 62-87% in different treatments over control. Reduction in incidence of *P. pulverea* in different treatments over control varied from 61-89% when evaluated on summer season *kusmi* lac crop.

Two newer commercially available *B. thuringiensis* var. *kurstaki* formulations (*Halt 5 WP*, serotype H 3a, 3b, 3c and *Knock WP*) of indigenous origin at two concentrations (2g /lt of water) along with *Bt* formulations *Delfin* (3g/5 lt of water) of exotic origin was evaluated on winter season *kusmi* lac crop raised on *Z. mauritiana (ber)* for the management of lepidopteran lac insect predators viz., *E. amabilis* and *P. pulverea*. Application of biopesticides was found to be quite effective in reducing the incidence of lepidopteran lac insect predators. Percent rejection of broodlac was higher in untreated crop as compared to treated ones.

Ovicidal action of insecticides against eggs of *E. amabilis* - a lepidopteron predator of lac insect, *K. lacca*:

Four insecticides viz., indoxacarb, spinosad, fipronil and ethofenprox which are safe to lac insects and effective in suppressing the incidence of this predator under field condition were evaluated for ovicidal action against eggs of *E. amabilis* under laboratory conditions. Observation on egg hatching was recorded at different intervals. Maximum ovicidal action was observed with the treatment of spinosad followed by ethofenprox, fipronil and indoxacarb. Insecticide spinosad have shown very good egg inhibition effect even at low concentrations. The egg hatching inhibition effect was recorded to the tune of 1.7 to 67.2% with the treatment of indoxacarb, 36.8 to 75.4% with fipronil, 81.6 to 100%

with spinosad and 82.0 to 100% with ethofenprox. The recommended concentration of indoxacarb (0.007%), fipronil (0.007%), spinosad (0.005%), ethofenprox (0.02%) based on field evaluation against predators of lac insect exerted 51, 73, 100 and 85% inhibition of egg hatching of *E. amabilis*, respectively. The study indicates that the application of these insecticides at the time of egg laying stage of the lac insect predator, *E. amabilis* will be useful in nipping the problem of incidence in bud stage itself. These newer insecticides can be suitably integrated in pest management programme in lac ecosystem for containing the menace of this important predator of Indian lac insect without much disturbing the environment.

Response of broodlac dipping on emergence of predators and parasitoids of lac insect

Response of broodlac dipping on emergence of predators and parasitoids of lac insect was studied under laboratory conditions. *Rangeeni* broodlac was dipped in insecticidal solution of indoxacarb (0.007 and 0.014%), spinosad (0.005 and 0.01%), fipronil (0.005 and 0.01%) and ethofenprox (0.02 and 0.04%) for 5, 10 and 15 minutes. Normal lac insect emergence without any adverse effect on settlement was observed with the treatment of broodlac dipping in insecticidal solution. Significant reduction in pest emergence was observed with all the treatment of insecticides. Maximum reduction in *E. amabilis* emergence was observed with the treatment of indoxacarb (85-96%) followed by spinosad (77-85%) and ethofenprox (31%). All the insecticides have shown very good response against predator *P. pulverea*. Fipronil and spinosad have shown promising response against parasitoid *Tachardiaephagus tachardiae*.

Residual effect of insecticides on adults of *Eupelmus tachardiae*

Residual toxicity of indoxacarb, spinosad, fipronil and ethofenprox was assessed against most prevalent and key parasitoids, *E. tachardiae* of Indian lac insect, *K. lacca* under laboratory conditions by exposing the parasitoids on residual film of insecticides. Residual film of insecticides was prepared with pouring the insecticidal solution in glass test tubes. Residual film was allowed to dry before release of insects. Initial observation indicates more sensitivity of adult male insect towards insecticides than the female. Spinosad



exerted maximum residual effect on adults of *E. tachardiae* followed by fipronil and indoxacarb. Residual response of ethofenprox on *Eupelmus* was relatively low against as compared to other insecticides.

Insect pests of lac host plants

- Two Curculionids, viz., *Myloccerus dentifer* (Coleoptera: Curculionidae) and *Xanthochelus faunus* Olivier (Coleoptera: Curculionidae) were recorded for the first time in lac production system on *Z. mauritiana (ber)* trees. Classical symptoms of Curculionids attack were round holes and “C” shape cut on *ber* leaves. Insect has been identified from IARI, New Delhi.
- Incidence of Horned treehoppers (cow bug), *Otinotus* sp. (Hemiptera: Membracidae) on was observed on *Z. mauritiana (ber)* trees during first week of April, 2011 in IRF. Tender twigs of all most all plants (66 trees) were heavily infested with large number of nymphs, congregated in initial stages. Nymphs and adults suck the sap and leaving patchy spots on tender twigs. Incidence will adversely affect the settlement of lac insect on infested twigs. Due to hopping nature, adults can easily migrate from one plant to another. Population started declining from 2nd and 3rd week of May and almost disappeared from 2nd week of June.
- Tingid bug (Hemiptera: Tingidae) infestation was noticed during the month of April, 2011 on leaves of *Z. mauritiana (ber)* trees. Bug was a small insect (4 mm) with transparent, shiny, reticulated wings and black body. Adults and nymphs suck the sap from the undersurface of leaves. Infested leaves turn yellowish brown and finally dry up. Tingid bug infestation was recorded for the first time on lac host trees.
- Occurrence of Curculionid weevils viz., *Myloccerus discolor* Boheman, (Coleoptera: Curculionidae), *Amblyrrhinus poricollis* Schoenherr (Coleoptera: Curculionidae) and *Peltotrachelus* sp (Coleoptera: Curculionidae) was recorded on *B. monosperma (palas)* trees during first week of April - May, 2011 in plantation of IRF. Insects have been identified from IARI, New Delhi. Above pests recorded for the first time and have not been reported earlier on *palas* trees. Occurrences of above pests are also common on *kusum* and *ber* trees.

Occurrence of predators in lac production system

Occurrence of Vedalia beetle, *Rodolia cardinalis* (Mulsant) (Coleoptera: Coccinellidae) - One of the classical biocontrol agent introduced from Australia to California in 1888 to control cottony cushion scale, *Icerya purchasi* and successful even to this day was observed in lac production on *Z. mauritiana (ber)*. The immature stages (grubs) of this beetle were observed moving in large numbers on tender twigs and leaves of *ber* trees.

The adults of *Cheilomenes sexmaculatus* (Fabricius) (Coleoptera: Coccinellidae) – a common Indian species of ladybird beetles was observed in lac production system on *Z. mauritiana (ber)*. Beetles specialize in predated upon coccids (scale insects), aphids, mealy bugs, aleyrodids (whiteflies), mites, psyllids and other soft bodied pests of agricultural crops.

Adults of Ladybird, *Exochomus* sp. (Coleoptera: Coccinellidae) which is an African predator of mealy bugs and ladybird beetle, *Coccinella septumpunctata* L. (Coleoptera: Coccinellidae) was observed during the months of April and May in lac production system on *B. monosperma (palas)*.

Ladybird beetle or seven spot ladybirds is a natural enemy of many sap feeding agricultural pests especially aphids. European species was introduced into US for managing some aphid pests. Both adults and grubs are voracious predators of aphids. Insects have been identified from IARI, New Delhi.

6.2: Demonstration of lac cultivation technologies under farmer's field condition

The project has been initiated during the year for demonstration of the proven lac cultivation technologies in the field through participation of the farmers and NGOs. The demonstrations on three lac cultivation technologies viz. *rangeeni* lac cultivation on *B. monosperma (palas)*, *kusmi* lac cultivation on *Z. mauritiana (ber)* and *kusmi* lac cultivation on *F. semialata* were planned and carried out in eight districts covering six states having linkages with the NGOs and progressive farmers (Table 6). The lac host plants viz. *ber*, *palas* and *F. semialata* were utilized for the different demonstrations. The inputs provided by the Institute for the demonstrations are depicted in Table 7.



Table 6. Demonstration of lac cultivation technologies in different states and districts

| State | District | Technologies | Host plants utilized | Linkages |
|---------------|------------------|---|-------------------------------------|--|
| Jharkhand | Palamau | <i>Rangeeni</i> lac on <i>palas</i> | <i>Palas</i> - 50 | JSLPS (Jharkhand State Livelihood Promotion Project) |
| | Latehar | <i>Kusmi</i> lac on <i>ber</i> <i>Rangeeni</i> lac on <i>palas</i> | <i>Ber</i> -50 <i>Palas</i> - 70 | Progressive farmers |
| | Ranchi | <i>Kusmi</i> lac on <i>ber</i> | <i>Ber</i> -150 | NGO-KVK (Divyayan) |
| Chhattisgarh | Raigarh | <i>Kusmi</i> lac on <i>semialata</i> | <i>F. semialata</i> -1,000 | NGO (Janmitram) |
| Bihar | Patna | Raising of <i>F. semialata</i> | ---- | ICAR- Research Centre for Eastern Region (RCER) |
| West Bengal | Paschim Midnapur | <i>Kusmi</i> lac on <i>semialata</i> | <i>F. semialata</i> -1,000 | NGO- International Mass Awareness Programme (IMAP) |
| Odisha | Mayurbhanj | <i>Kusmi</i> lac on <i>semialata</i> | <i>F. semialata</i> -900 | Progressive Farmers |
| Uttar Pradesh | Allahabad | <i>Kusmi</i> lac on <i>semialata</i> | <i>F. semialata</i> -1,000 | NGO- BIOVED Research Institute of Agri. & Technology |

Table 7. Inputs provided by the Institute to different partners for demonstrators

| State | District | Village(s) | Inputs | |
|---------------|------------------|------------------------------|---|-------------------------|
| | | | Quantity of broodlac and its source | Pesticides |
| Jharkhand | Palamau | Halumard | <i>Rangeeni</i> -30 kg (IINRG) | Nukil and Bavistin |
| | Latehar | Lalli and Nadbelwa | <i>Rangeeni</i> - 75 kg (IINRG) <i>Kusmi</i> - 50 kg (IINRG) | Bavistin, Nukil & Nuvan |
| | Ranchi | Putadag, Jhiki and Kuturloba | <i>Kusmi</i> - 150 kg for 3 locations (IINRG) | Bavistin and Nukil |
| Chhattisgarh | Raigarh | Baihamunda | <i>Kusmi</i> broodlac provided by the NGO | Bavistin and Nukil |
| West Bengal | Paschim Midnapur | Garbeta | <i>Kusmi</i> broodlac provided by the NGO | Bavistin, Nukil & Nuvan |
| Odisha | Mayurbhanj | Badpurunapani | <i>Kusmi</i> -15 kg (IINRG) | Bavistin, Nuvan & Nukil |
| Uttar Pradesh | Allahabad | Mohra | <i>Kusmi</i> - 30 kg (IINRG) | Bavistin, Nuvan & Nukil |

- In all the locations *kusmi* and *rangeeni* broodlac (provided by the Institute for seven locations) was inoculated at the scheduled time, *phunki* lac removed and spraying of insecticides and fungicides were carried out at appropriate time.
- For the demonstrations the scientists and technical personnel visited the different areas at regular interval and provided necessary guidance and demonstrations for selection and bundling of broodlac, spraying of pesticides etc.
- In two demonstration locations (Paschim Midnapur and Allahabad), *kusmi* lac raised on *F. semialata* received a severe setback in terms of crop loss due to massive infestation of the predatory pest *E. amabilis* and fungal infestation. In the demonstration plot of Paschim Midnapur the density of *E. amabilis* was recorded to be 25-30 predators per meter of lac encrustation. The predators were found to be present in various developmental stages during the period August/ September.



- The reason for massive pest infestation and fungal infestation particularly in the *F. semialata* plantations can be attributed to severe monsoons during the months of July to September. The pesticides could not show their effect properly due to continuous rains immediately after the sprayings. In spite of taking all necessary precautions the crop could not be saved particularly in the above mentioned two locations and it had to be harvested premature (in form of stick lac).
- The *rangeeni* crop (*katki*) raised on *palas* at Latehar fared well and the entire broodlac obtained was

utilized for raising the *baisakhi* crop by the farmers on about 250 *palas* and *ber* trees.

- The *kusmi* lac crop (*aghani*) raised on *ber* and *F. semialata* are progressing well at different locations of Ranchi, Latehar, Mayurbhanj and Raigarh districts. The mature crop is likely to be harvested during February 2012.
- For demonstration at Patna, necessary seeds of *F. semialata* were provided by the Institute for raising the nursery and transplanting for raising plantation at appropriate time. The germination of the seeds was also affected due to rains.

OTHER PROJECTS

7. NAIP Projects

7.1: To understand the nature of diversity in lac insects of *Kerria* spp. in India and the nature of insect x host interaction (NAIP- Component -4)

Survey of Kerala and Tamil Nadu for lac insects

An exhaustive survey of Thrissur & Palakkad districts in Kerala and Coimbatore, Erode, Thirupur, Madurai, Virudhunagar, Thoothukudi, Thirunelveli, Theni and Dindigul districts in Tamil Nadu was carried out during July 04 - 17, 2011. Lac insects were observed and collected from *Amherstia nobilis* (*Simsapa virksham*, Fabaceae) at Thrissur (Fig. 43) and Rain tree, *Albizia saman* at Madurai. Dead lac insects were observed on *A. saman*, along the road side at Thenkashi and at Theni. Lac hosts plants viz., *A. saman*, *A. lebbek*, *Ficus* spp, *Hibiscus chinensis* (Fig. 44), *Schleichera oleosa*, *Peltophorum ferrugenium*, *B. monosperma*, *Annona squamosa*, *Z. mauritiana*, *Prosopis juliflora* and *Acacia catechu* were observed in the areas surveyed.



Fig. 43 Lac insect on *Amherstia nobilis* in Thrissur of Kerala



Fig. 44 Lac insect on *Malvaviscus penduliflorus*

Malvaviscus penduliflorus – a promising lac host for *Kerria chinensis*

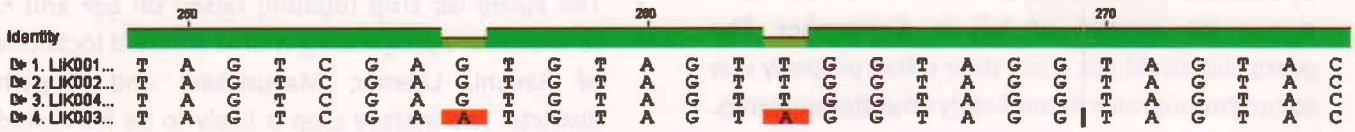
Kerria chinensis collected from Meghalaya showed good productivity on *F. macrophylla* under Field Gene Bank evaluation. Major local host plants have not been found suitable for the lac insect collected from NE region and many of the host plants reported from NE are not found in Jharkhand and adjoining areas. Therefore, preliminary studies were carried out with *K. chinensis* on a new host plant - *M. penduliflorus*. About 50 g was inoculated in October 2010 and more than 300 g harvested in May, 2011 from a single bush. Similarly, more than 200 g was obtained during May - October 2011 crop from 50 g broodlac

Molecular Characterization

Sequencing of 18 S region rDNA of 48 lines of *Kerria* has shown adequate polymorphism even at intra-specific level. Sequence variation in D2 region and elongation factor alpha was studied with three polymorphic lines (Fig. 45).



Elongation factor alpha



D2 region

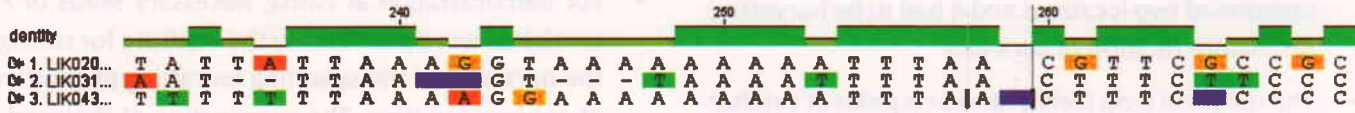


Fig. 45 Elongation factor α-gene sequence showed less polymorphism than D2 region of LSU region in the test lines.

Transcriptome analysis of *Kerria lacca* DNA

Sequencing of transcriptome of *K. lacca* (wild-type and yellow mutant) using next generation sequencing performed with cDNA. *De novo* transcriptome data analysis of high quality reads for both the samples assembled resulted in 11,411 and 10,962 transcript contigs for KL-C and KL-Y, respectively (Fig. 46). It has revealed that 4172 and 3975 annotations were unique to crimson and yellow lines, whereas 4463 were common to both forms.

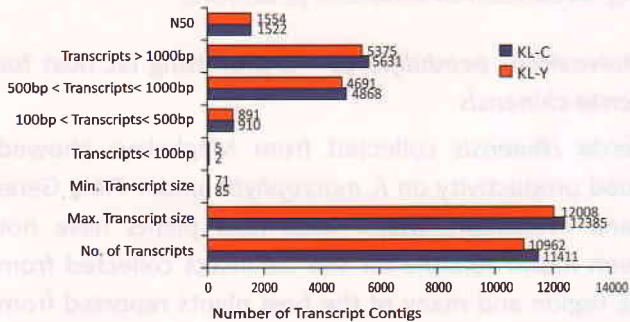


Fig. 46 Transcriptome analysis of *Kerria lacca* DNA

Spectral analysis of body colour pigment from lac insect

Spectral analysis of body colour pigment from 48 lac insect lines were studied (Fig 47 & 48). All crimson lines studied had absorbance maxima at 292nm, 526 nm and 356-360 nm. All yellow lines showed absorbance maxima at 307nm and 440nm. The major peak in case of crimson lines was at 292nm while the same in case of yellow lines were at 307nm. Overlay spectral diagram of both crimson and yellow lines studied are as shown below.

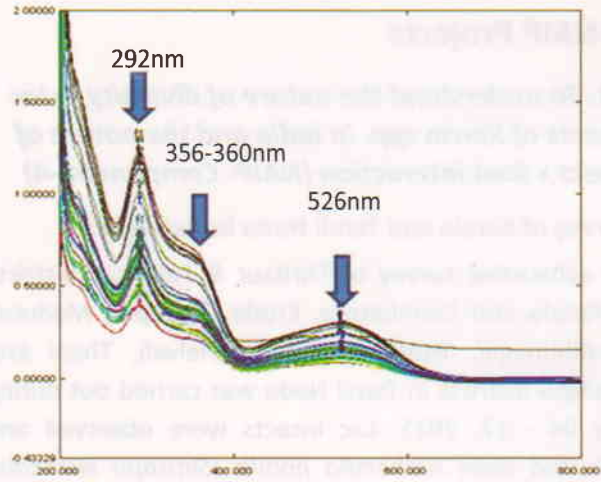


Fig. 47

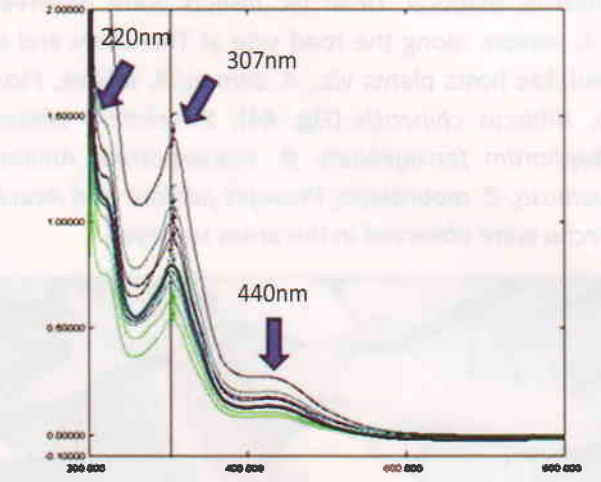


Fig. 48

The average relative absorbance of major absorbance maxima obtained for the crimson and yellow lac insect lines showed that in case of crimson lac insects, absorbance maxima at 526nm and 360nm are 24.2±4.9



and $54.1 \pm 3.3\%$ of the major absorbance maxima at 292nm respectively (Fig. 49). In case of yellow lac insects, peak at 440nm is having relative absorbance of $17.2 \pm 0.8\%$ of the major absorbance maxima at 307nm (Fig. 50).

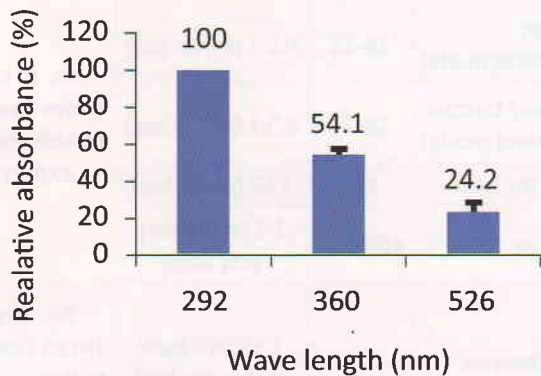


Fig. 49 Relative absorbance of various λ_{max} for crimson lac insect lines

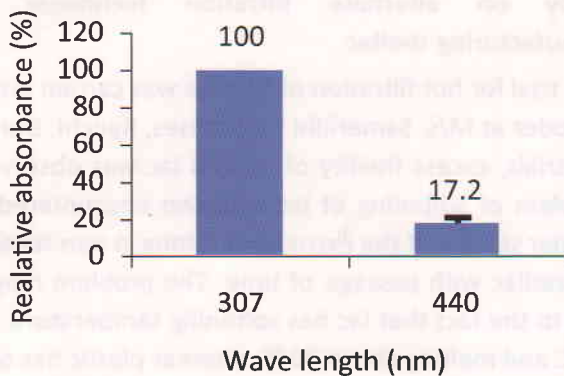


Fig. 50 Relative absorbance of various λ_{max} for yellow lac insect lines

HPLC analysis of body colour pigment

HPLC analysis of body colour pigments from 30 lac insect lines (22 crimson and 8 yellow) has been carried out. Relative abundance of each peak obtained are as shown below (Fig. 51).

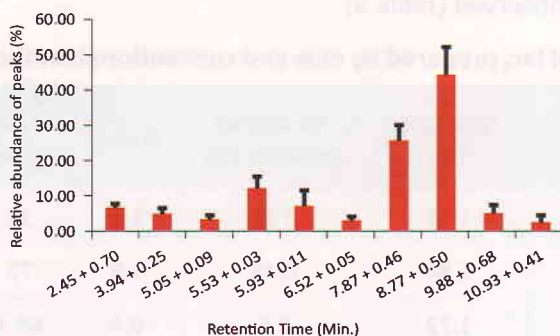


Fig. 51 The relative abundance of each peak from crimson lac insect lines

All crimson lac insects except LIK006 showed uniform pattern of fractionated components having peaks with retention time of $2.45 + 0.70$, $3.94 + 0.25$, $5.05 + 0.09$, $5.53 + 0.03$, $5.93 + 0.11$, $6.52 + 0.05$, $7.87 + 0.46$, $8.77 + 0.50$, $9.88 + 0.68$ and $10.93 + 0.41$ minutes.

All yellow lac insects analysed showed uniform pattern of fractionated components having peaks with retention time of $4.36 + 0.43$, $5.56 + 0.05$, $5.80 + 0.09$, $6.09 + 0.21$, $6.76 + 0.74$, $9.89 + 0.33$, $10.88 + 0.42$, $12.11 + 0.34$ minutes (Fig. 52).

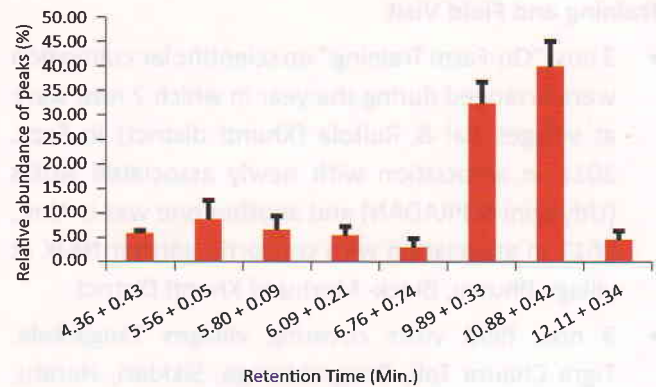


Fig. 52. The relative abundance of each peak from yellow lac insect lines

Biological characterization

Biological attributes of 20 lines showed significant differences in various strains and hosts; Insect host-plant interaction of two strains on five hosts studied and revealed significant differences in biological / economic attributes between strains, seasons and host-plants.

7.2: Value Chain on Lac and Lac-based Products for Domestic and Export Markets

Promotion of kusmi lac cultivation on ber

To promote kusmi lac cultivation on ber under the project, broodlac was distributed to 311 farmers in July, 2011, in 23 villages of Ranchi and Khunti districts. Each farmer got two to four kg broodlac as per their possession of pruned lac host trees ready for inoculation

Raising of new plantation of F. semialata and ber for lac cultivation on plantation basis

Seedlings of *F. semialata* and *ber* were distributed during June - July, 2011 among 20 farmers in 20 villages of Ranchi and Khunti districts. Farmers were also imparted training on method of transplanting and care during their growth period.



- 10,800 nos. *F. semialata* seedlings were distributed among 15 farmers of 15 villages for raising plantation and demonstration of lac cultivation on plantation basis.
- 2.0 Kg *F. semialata* seeds were also distributed among farmers of 5 villages of both districts for raising about 60,000 seedlings.
- 530 nos. *ber* seedlings were distributed among 5 farmers in five villages of both districts for raising *ber* plantation and for further demonstration of lac cultivation on plantation basis on *ber*.

Training and Field Visit

- 3 nos. "On-Farm Training" on scientific lac cultivation were arranged during the year in which 2 nos. were at villages Rai & Ruitola (Khunti district) in Sept. 2011 in association with newly associated NGOs (Udyogini & PRADAN) and another one was in Nov., 2011 in association with consortia partner NBJK at village Bhusru, Block- Murhu of Khunti District
- 3 nos. field visits covering villages Tangarkela, Tigra Chaura Toli, Bhagrabhanga, Sikidari, Heratu, and Getalsud farm of R. K. Mission were made for observation of newly raised *F. semialata* plants and condition of crop raised on *ber* in June- July, 2011.

Primary Processing

A small scale lac processing unit (100 kg sticklac/day) was established at Institute Research Farm, for training farmers under regular Institute training programme. 342 farmers and 15 M.Sc. students were trained under Institute one week training programme

Cost-analysis of manufacturing lac products

The cost-analysis of manufacturing lac product by existing methods were analysed through survey of lac processing units in Ranchi, Khunti and other areas and interaction with entrepreneurs of lac industry which is given in Table 8.

Table 8. Cost analysis of manufacturing lac products

| Lac product | Different costs/kg product | | |
|---------------------------------|----------------------------|-----------------------------------|--|
| | Processing cost, (Rs./kg) | Packaging cost, (Rs./kg) | Transportation cost, (Rs./kg) |
| Seedlac | 6-7 | 0.5-1 (in jute bag) | Rs. 1/ kg (from Ranchi to Kolkata for export) |
| Shellac (machine made) | 10-15 | 0.5-1 (in jute bag) | |
| Shellac/ button lac (hand made) | 18-20 | 0.5-1 (in jute bag) | |
| Aleuritic acid | 150 | 1.50 (paper bag) | |
| Lac dye | 400-500 | 1-2 (in ordinary poly bags) | Rs. 3/kg (from Ranchi to Kolkata for export) |
| Bleached lac | 65 | 1.50 (in 5 layer craft paper bag) | |

Study on alternate filtration technique of manufacturing shellac

One trial for hot filtration of seedlac was carried out in extruder at M/s. Samaridhi Enterprises, Ranchi. During the trials, excess fluidity of melted lac was observed. Problem of softening of lac was also encountered at hopper section of the extruder resulting in non-feeding of seedlac with passage of time. The problem maybe due to the fact that lac has softening temperature 40-50 °C and melting above 70 °C whereas plastic has only melting temperature above 70 °C.

Improvement in processing / quality of lac based products (bleached lac and aleuritic Acid)

Bleached Lac

In a study on keeping quality of bleached lac samples with alternate bleaching agents, an improvement in life even after storage of 6 months in ambient condition, was observed (Table 9)

Table 9. Comparison of physico-chemical parameters of bleached lac, prepared by new and conventional methods

| Method of making bleached lac | | Life (min) | Flow (mm) | Moisture (%) | Hot alcohol insoluble (%) | Colour | Acid value |
|--|----------------|------------|-----------|--------------|---------------------------|--------|------------|
| Seedlac + alternate bleaching agent | Initial | 17 | 30 | 1.41 | 0.32 | 1.8 | 76 |
| | After 6 months | 15 | 18 | 1.84 | 0.45 | 1.8 | 70 |
| Seedlac + NaOCl (conventional bleaching agent) | Initial | 7 | 16 | 1.72 | 0.5 | 0.4 | 85.4 |
| | After 6 months | Nil | Nil | 1.75 | 4.0 | 0.4 | 55 |



Commercial trial of making bleached lac in batch of 60 kg seedlac was carried out with improved bleaching agent at premises of M/s Tajna Shellac, Consortium Partner in this project. The yield of bleached lac was 80%.

Aleuritic acid

Improved process (in filtration and saponification) for making aleuritic acid was developed, with increased yields (12-14 % to 18%) and superior quality (melting point: 95- 96°C)

Study on packaging material for enhancing shelf life of shellac, bleached lac and lac dye

Commercial samples of bleached lac from M/s. Tajna Shellac Pvt. Ltd., Khunti, lac dye and hand-made shellac from M/s. Gupta Brothers (Shellac), Bundu were procured and packed in different packaging materials (HDPE-50 μ , LDPE-50 & 100 μ , PP-50 μ , aluminium coated polythene and paper bags) to standardize the packaging material for storage and enhancing shelf-life of the products.

Different quality parameters i.e. moisture content, flow, life, impurity, acid value, and dye content were determined at the Institute Quality Evaluation Laboratory, on quarterly basis. The colour parameters (L, a, b) were also studied using Hunter Lab Colourimeter. The results obtained till six month for lac dye and bleached lac, indicated no appreciable change in quality parameters.

Recovery and purification of by-product of lac industry

Lac Dye

Modification in wash water collection unit, pipelines, filtration system and pumps of lac dye plant at M/s Gupta Brothers (Shellac), Bundu, Consortium Partner, was carried out for recovery of dye of higher dye content and quality. Preparation of lac dye was done in the modified lac dye unit and the firm produced about 60 kg of lac dye during April-June, 2011. The intervention improved dye quality, the product being preferred in the market and easily sold.

7.3: Developing Sustainable Farming System Models for Prioritized Micro Watersheds in Rainfed Areas of Jharkhand (Component -3)

The Institute is a Consortium Partner and Birsa Agricultural University, Ranchi is the Lead Centre of

this Project. Other partners include ICAR-RCER, Ranchi and CRURRS (CRRI), Hazaribagh.

Performance and output from rangeeni summer crop

Inoculation was done on *palas* trees (*Butea monosperma*) in the adopted area. The performance of *rangeeni* lac was good in Badamanjhladih of Jamtara district. The crop completed its cycle in the last week of June with larval emergence. In comparison to Badamanjhladih, other villages of Jamtara and Dumka district showed variation in relation to broodlac production (Table 10). During this year, a total of 819 kg of broodlac was produced in nine adopted villages from summer season crop. Due to very high temperatures, the desired output could not be obtained.

Identification of kusum tree in Dumka district

Schleichera oleosa is the conventional and most popular lac host tree for lac production. Farmers of *Karela* and *Bhoura* villages identified an area where plenty of *kusum* trees are available. Around 150 kg of *kusmi* broodlac was inoculated in July, 2011 on these species. *Kusmi* lac crop was also raised on *kusum* and *ber* trees in Karela (Fig. 53) and adjoining villages of neighboring states.

Performance and marketing of rainy season crop

During October 2011, a total of 279 kg of broodlac was produced in seven villages of Jamtara district benefitting 16 families directly. Besides, 193 kg of *rangeeni* and *kusmi* scraped lac worth Rs. 24,890 was produced in 11 villages by 30 families. Due to prolonged monsoons, and heavy incidence of insect-predators on lac crop, production of *rangeeni* brood lac crop was not upto desired level. A total of Rs. 90,640/= was earned by 32 families from lac production (Table 11, 12).

Market linkages

Farmers of Jamtara and Dumka district have established market linkages by themselves. The broodlac produced by these adopted families was of very good quality and they sold their produce easily at reasonable rates in the market.

Trainings Conducted

A total of 34 farmers from Jamtara and Dumka districts successfully completed one week training course on



“Scientific lac cultivation, processing and uses of lac” at the Institute. Seven trainings were conducted in *Krishi Vigyan Kendra*, Jamtara and ATMA, Jamtara to disseminate scientific method of lac crop on *palas* and *ber* in new adjoining area of NAIP adopted villages of Jamtara district.

Radiation effect

Rangeeni summer crop was raised on *palas* trees by 21 farmers of all six blocks of Jamtara district viz; Udalbani (Jamtara block), Dhobana (Kundahit block), Bandardiha (Nala block), Mohanpur (Karmatand block) and Khijuria (Fatehpur block) of Jamtara district. After learning and observation of NAIP programme-adopted villages, farmers of these blocks adopted/re-started *rangeeni* lac cultivation.

Crop monitoring

Lac crop monitoring and interaction with farmers was carried out regularly in different villages of both districts. Farmers were guided for protection of lac crop against insect-pests.

Inoculation of *rangeeni* summer crop

A total of 67 beneficiaries were involved in raising *rangeeni* summer crop. Around 1760 *palas* tree were inoculated with 1500 kg of broodlac in both districts by the farm families (Table 13).

Involvement of women in lac production and its marketing

Women of area under NAIP project were actively involved in lac production activities, specially scraping and marketing at village level.

Table 10. Production, marketing and income generation from *rangeeni* (baisakhi) broodlac in Jamtara and Dumka districts

| District | Block | Village | No. of beneficiaries | Production of broodlac produced (in kg) | Average income per family (Rs.) | Max. income |
|----------|------------|----------------|----------------------|---|---------------------------------|-------------|
| Jamtara | Jamtara | Rupaidih | 1 | 62 | 3720 | 3720 |
| | | Dahartola | 1 | 86 | 5160 | 5160 |
| | | Sinjotola | 3 | 146 | 2920 | 4140 |
| | | Saurimundu | 3 | 134 | 2700 | 3600 |
| | | Charedih | 1 | 27 | 1620 | 1620 |
| | Narayanpur | Badamanjhladih | 5 | 245 | 2940 | 4380 |
| Dumka | Dumka | Karmatanrh | 1 | 24 | 1440 | 1440 |
| | Jama | Bhoura | 1 | 150 | 9000 | 9000 |
| | | Karela | 1 | 45 | 2700 | 2700 |
| | Total | | 16 | 819 | 49,050* | |

*Total income generated

Table 11. Production and marketing of scraped lac in Jamtara and Dumka districts

| District | Block | Village | No. of beneficiaries | Quantity of broodlac produced (kg) | Average income per family (Rs) | Max. income |
|----------|------------|----------------|----------------------|------------------------------------|--------------------------------|-------------|
| Jamtara | Jamtara | Sinjotola | 5 | 46.5 | 1395 | 2700 |
| | | Saurimundu | 2 | 13.1 | 1200 | 1200 |
| | Narayanpur | Badamanjhladih | 5 | 21.0 | 1064 | 3000 |
| Dumka | Jama | Bhoura | 1 | 23.4 | 3638 | 3638 |
| | | Karela | 4 | 40.0 | 3330 | 6250 |
| Total | | | | 144 | 24,890* | |

*Total income generated



Table 12. Production and Income generation from *rangeeni (katki) broodlac* in Jamtara and Dumka districts

| District | Block | Village | No. of beneficiaries | Quantity of broodlac produced (kg) | Average income per family (Rs.) | Max. income |
|----------|------------|----------------|----------------------|------------------------------------|---------------------------------|-------------|
| Jamtara | Jamtara | Saurimundu | 3 | 50 | 1000 | 1750 |
| | | Dahartola | 2 | 40 | 1200 | 1500 |
| | | Sinjotola | 3 | 30 | 600 | 600 |
| | Narayanpur | Badamanjhladih | 4 | 65 | 970 | 1500 |
| Dumka | Dumka | Karmatanrh | 3 | 35 | 700 | 900 |
| | Jama | Bhoura | 1 | 60 | 3600 | 3600 |
| | Total | | 16 | 279 | 16,700 | |

Table 13. Inoculation of *rangeeni* summer lac crop in Jamtara and Dumka district during October 2011

| District | Block | Village | No. of beneficiaries | Quantity of <i>rangeeni</i> broodlac used (kg) | No. of palas tree inoculated |
|--------------------|------------|----------------|----------------------|---|------------------------------|
| Jamtara | Jamtara | Jhilimtand | 5 | 85 | 100 |
| | | Nawadih | 10 | 155 | 175 |
| | | Chalna | 8 | 110 | 110 |
| | | Karmatand | 9 | 125 | 204 |
| | | Sinjotola | 1 | 10 | 15 |
| | | Dahartola | 1 | 10 | 15 |
| | | Saurimundu | 1 | 25 | 35 |
| | | Sub total | 35 | 520 | 654 |
| | Narayanpur | Badamanjhladih | 5 | 80 | 110 |
| | Total | 40 | 600 | 764 | |
| Dumka | Dumka | Karmatand | 9 | 180 | 265 |
| | | Guhiajori | 1 | 50 | 105 |
| | | Kodokhicha-7 | 1 | 15 | 30 |
| | | Jiyathar | 3 | 40 | 80 |
| | | Sagbehri | 8 | 160 | 210 |
| | | Sub total | 22 | 445 | 690 |
| | Jama | Bhoura | 1 | 120 | 50 |
| | | Amra | 2 | 200 | 150 |
| | | Muswachak | 1 | 30 | 30 |
| | | Sarepahari | 3 | 75 | 53 |
| | | Lilatari | 3 | 30 | 25 |
| Sub total | 10 | 455 | 308 | | |
| Total | | 32 | 900 | 998 | |
| Grand total | | 67 | 1500 | 1762 | |



Fig. 53 *Kusmi* lac crop on *ber* tree at village Karela, Jharkhand

7.4: Improving rural livelihood security through sustainable integrated farming system model and allied enterprises in Bastar region of Chhattisgarh (Component – 3)

IINRG is a Consortium Partner and SG College of Agricultural Research, Jagdalpur (Indira Gandhi Krishi Vishvavidyalaya, Raipur) is the Lead Centre. As per information collected, six farmers of Lalaguda village trained at IINRG, produced nine quintals of *kusmi* broodlac from 40 *kusum* trees from 2010 summer crop and earned around Rs 20,000/= each. Similarly three families of Bastanar earned Rs 10,000/= each, from 2010 *kusmi* summer crop.

Trainings conducted

A total of 33 persons, from Bastar, Kanker, Jagdalpur and Narayanpur, including RAs, SRFs and farmers directly involved in lac cultivation, completed one week training programme on "Scientific lac cultivation, processing and uses" at IINRG, Ranchi from April, 14-19, 2011. On-farm training on "Scientific lac cultivation" was imparted at Brehembera farm of RK Mission, Narayanpur to 80 farmers on April 8, 2011. Details of in campus training

Technological backstopping

Direct interaction with 15 lac farmers of Lalaguda, Bastanar and Kotamsar was carried out in respect of lac cultivation technologies. The doubts of the farmers in management of insect pest of lac, symptoms of lac crop maturity, harvesting time and marketing of scraped lac and broodlac, were cleared.

Crop monitoring

Lac crop on *kusum* tree (summer crop) was observed in Lalguda, Bastanar and Kotamsar. Monitoring of *kusmi* lac crop was done for winter crop growing on *ber* trees and in the demonstration plant of *F. semialata* in Brehembera farm of Narayanpur district (Fig. 54).

Impact- radiation of lac production technology

The farmers of adjoining villages of Pusagaon and Palki in Narayanpur district have started lac cultivation. In Jagdalpur area, lac cultivation was started by the Forest Department and all scientific know-how was provided by IINRG in this respect, besides crop monitoring from time to time.

A newly established school of RK Mission, Narayanpur, have used seedlac for coating of computer tables. The lac was produced and processed under NAIP project (Fig. 55).



Fig. 54 Lac on *Flemingia semialata* at Brehembera farm Narayanpur, Chhattisgarh



Fig. 55 Shellac coating on computer table in a School at Narayanpur, Chhattisgarh



8. Externally Funded Projects

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

The project was completed in March 2011. However, crop was harvested after completion of the project and the progress are is being reported here.

Intensive lac cultivation on bushy host-plants

20 kg *kusmi* broodlac was inoculated in July 2010 on 800 *semialata* plants in Kharsidag village in the field in collaboration with SEEDS, an NGO. A satisfactory crop (80 kg broodlac and 20 kg scraped lac) was harvested in February 2011. 35 kg of *kusmi* broodlac was inoculated in July on one year old 1100 *semialata* plants in Kharsidag village. A good crop (146 kg broodlac and 30 kg scraped lac) was harvested in February 2011. Non-irrigation during the summer caused stunted growth of plants resulting in lesser output ratio.

Field demonstration of productive breeds of lac insects

40 kg each of three productive breeds (Kulajanga, Nawadih and late variety) was inoculated at Mangoband (20 kg each) and Chitir (20 kg each) villages in Ranchi. A very good crop giving 156 kg broodlac of Kulajanga, 221 kg of Nawadih and 182.5 kg of late variety respectively was harvested at Mangobandh. Performance pattern of the breeds at other location was similar but yield was comparatively lower.

Lac cultivation on reported high yielding / alternate host plants

Four - year old plants raised from reported high yielder *ber* at Purulia and from local variety were inoculated with *rangeeni* broodlac in October 2010 and *kusmi* broodlac in July 2011 for comparative performance. Average yield per plant of *rangeeni* yield was 3.52 and 4.77 kg respectively for Purulia and local *ber* and *kusmi* yield was 2.53 and 4.52 kg respectively for Purulia and local *ber*. 60 kg *kusmi* broodlac was inoculated on eighteen month old twigs of 60 *A. procera* trees. The larvae showed preferential tendency of settling on petioles. But the crop did not survive beyond initial mortality stage *i.e.* less than 30 days, confirming that *A. procera* is not a good host under Ranchi conditions.

Rangeeni lac cultivation on *Cajanus cajan*(*Arhar*)

Summer season crop of *rangeeni* lac insect, inoculated on three varieties (early, normal and late maturing) of

arhar, (*C. cajan*) during October, 2010 was harvested in July, 2011. The crop was provided irrigation at 10 day intervals from Feb. 2011 onwards. Crop An output : input ratio of 1.15 : 1, 6.33 : 1 and 6.31 : 1 respectively of broodlac for the crop. Though, quantity of broodlac harvested was similar in medium and late varieties, good quality of broodlac obtained from late variety (68.2% of total broodlac) was significantly higher than the medium variety (47.4% of total broodlac) showing the promise of utilizing late variety *arhar* for lac cultivation under irrigation. Yield of pulse from the lac - inoculated plants was reduced by about 30-70% depending upon the frequency of irrigation provided.

A new/ unknown pest attacking red gram, *F. macrophylla* and *ber*

The pest collected from the lac host plants *viz.*, red gram, *ber* and *F. macrophylla* was identified under Network Project of Insect Biosystematics (NPIB) at IARI, New Delhi as *Lawana conspersa* (Walker) (Homoptera: Flatidae).

Effect of crop geometry on *kusmi* broodlac quality on *semialata*

Four years old *semialata* plantation (single-row and paired-row) were used for growing rainy season (*aghani*) crop of *kusmi* lac (see AR 2010 also). Crop harvesting data was recorded from 150 *semialata* plants under the two systems of planting. Harvested broodlac was divided into three categories: good (more than 80% coverage of twig), medium (40-80% coverage) and bad (less than 40% coverage) quality.

It was observed that the total yield of broodlac was higher (517 g) in paired rows in comparison to single row (465 g) and quality of broodlac was also better (Fig. 56).

Effect of crop geometry on quality of *kusmi* broodlac during winter season (*aghani*) crop

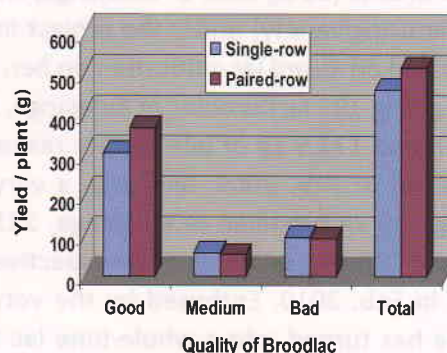


Fig. 56 Effect of crop geometry on quality of *kusmi* broodlac during rainy season (*aghani*) crop 2011.



Pre-summer large scale mortality

Study on possible causes(s) of lac insect mortality continued during *baisakhi* (summer) season of 2010-11. About 25% parasitisation was recorded during March 2011. The crop survived till maturity, confirming parasitisation to be the major factor in causing large scale pre-summer mortality.

Success stories based on research, development and extension activities under JLDS

Intensive kusmi lac cultivation on *semialata* for sustained lac cultivation

Shri Santosh Nirmal Horo raised a plantation of *semialata* in July / August, 2007 in area of ≈ 0.2 ha with more than 2000 plants in Kharsidag village, Ranchi district, with technical support from IINRG under the project. 35 kg of *kusmi* broodlac was inoculated in July 2008 on 1264 *semialata* plants. 241 kg broodlac and 15 kg scraped lac was harvested in next February from 1084 plants giving an output: input ratio of 6.89. Similarly, 40 kg of *kusmi* broodlac was inoculated in July on 1202 *semialata* plants. A very good crop (333 kg broodlac and 45 kg scraped lac) was harvested in February 2010, giving a broodlac output: input ratio of 8.325. On an average, a net profit of Rs. 56, 650 per annum (broodlac @ Rs. 200 / kg and scraped lac @ Rs. 150 / kg) was earned from 0.2 ha land. His success motivated other farmers of the village to engage in intensive *kusmi* lac cultivation on *semialata*.

Productive kusmi breeds for improved lac production

Shri Prakash Sanga of Mangobandh village of Ranch district was involved in lac cultivation since long but his harvested yield was very low. IINRG had provided him the required technical guidance and broodlac of productive breeds (20 kg each of Kulajanga, Nawadih and late maturing variety) under the project in 2008. He was trained on *kusmi* lac cultivation on *ber*. A very good crop giving 191 kg broodlac of Kulajanga, 207 kg of Nawadih and 174.5 kg of late variety respectively was harvested in Feb. 2009. Similarly, a very good crop giving 156 kg broodlac of Kulajanga, 221 kg of Nawadih and 182.5 kg of late variety respectively was harvested in Feb. 2010. Enthused by the very good returns, he has turned into a whole-time lac farmer and is a leading good-quality broodlac supplier of the region

8.2: Production of summer kusmi broodlac on kusum for promotion of lac cultivation in Gujarat with farmers' participation (Forest Department, Gujarat)

For production of summer *kusmi* lac crop, about 160 kg broodlac was arranged from the Institute and sent to Malegaon area of Dang district in March 2011. It was inoculated on 40 *kusum* trees and about 300 kg broodlac (including about 100 kg rejected broodlac) was produced (Fig. 57 & 58). Out of broodlac produced, 50, 60 and 20 kg was inoculated on *ber* trees at Rajpipla, Motia and Godhra, respectively. Rest broodlac was inoculated on unpruned *ber* trees at and around Shivrajpur and Piplej research farm.

Overall condition of the lac insect settlement was found to be very good at Motia. At Rajpipla hq., the crop condition was found to be good, while crop condition was poor at Godhra due to sparse settlement of lac insects on relatively thicker *ber* shoots.



Fig. 57. Summer *kusmi* lac crop development on *kusum* tree at Malegaon (May 2010)



Fig. 58. Monitoring of summer *kusmi* lac crop at Malegaon (May 2010)



8.3: National Action Plan (NAP) for sustainable income generation of tribals through cultivation and processing of lac (TRIFED sponsored)

The project is located in 6 select districts of 6 states viz. Jharkhand, West Bengal, Odisha, Madhya Pradesh, Chhattisgarh and Andhra Pradesh, in which 666 SHGs comprising 6,600 tribal members in 6 states are covered.

On-Farm Training (OFT) / Motivational Programmes on Scientific Lac Cultivation

8 camps of on-farm training programmes were organized as per proposal received from

The TRIFED for 826 beneficiaries of Jharkhand and West Bengal states (Table 14).

Table 14. On-farm training camps organized (sponsored by TRIFED, Ranchi)

| District - State | Venue (Village-Block) | Date | No. of participants |
|----------------------|--|--------------|---------------------|
| Latehar, Jharkhand | Middle School, Richuguta | 4 May, 2011 | 97 |
| Latehar, Jharkhand | Govt Utkramik Middle School, Ritchuguta | 5 May, 2011 | 120 |
| Gumla, Jharkhand | Dalmadih Middle School, RC Mission Compound, Block-Basia | 6 May, 2011 | 60 |
| Ranchi, Jharkhand | Aam Bagicha, Koisara, Kakaria, Lapung | 10 May, 2011 | 76 |
| Ranchi, Jharkhand | Aam Bagicha, Koisara, Kakaria, Lapung | 11 May, 2011 | 80 |
| Purulia, West Bengal | Kiribera and Kalma of Jhalda Block | 2 June, 2011 | 130 |
| Purulia, West Bengal | Rampado Mahto Maidan Jargo; Farmers participated from Dantia, Papdahudung, Nawadih, Kemtia, Jargo,llu, Baraphura, Ohatu villages | 3 June, 2011 | 77 |
| Purulia, West Bengal | Ajodhya Pahar and RK Mission Center of Bagmundi Block | 4 June, 2011 | 186 |
| Total | | | 826 |

Training of Trainers (TOT) Programmes on Scientific Lac Cultivation (in-campus one week training programme)

In-campus training was organized for the trainers of Chhattisgarh, Jharkhand and Odisha states, in six camps for 253 beneficiaries (Table 15).

Table 15. Training of trainers programmes organized

| District - State | Sponsoring / Nominating Agency | Date | No. of participants |
|------------------------------------|--------------------------------|----------------------|---------------------|
| Mahasamund - Chhattisgarh | TRIFED, Mahasamund | 17-22 January, 2011 | 49 |
| Nabrangpur - Odisha | TRIFED, Nabrangpur | 7-11 February, 2011 | 19 |
| Mahasamund - Chhattisgarh | TRIFED, Mahasamund | 21-26 February, 2011 | 39 |
| Ranchi - Jharkhand | TRIFED, Ranchi | 9-13 May, 2011 | 19 |
| Gumla - Jharkhand | TRIFED, Ranchi | 20-25 June, 2011 | 7 |
| Ranchi - Jharkhand | TRIFED, Ranchi | 27 June-2 July, 2011 | 18 |
| Sundargarh and Navrangpur (Odisha) | TRIFED, Odisha | 21-26 November, 2011 | 58 |
| Sundargarh and Navrangpur (Odisha) | TRIFED, Odisha | 12-17 December, 2011 | 44 |
| Total | | | 253 |



Crop monitoring and technical guidance

Seven visits were made by the experts of the Institute to assess the progress of lac crop in different adopted lac - growing areas in the states of Odisha, Jharkhand and West Bengal. Necessary suggestions were given to farmers for the effective management of lac crop (Table 16).

Table 16. Visits undertaken for crop monitoring and technical guidance

| District - State | Venue (Village-Block) | Sponsoring / Nominating Agency | Date | Observation / Remarks |
|----------------------|--|--------------------------------|-------------------|--|
| Sundergarh, Odisha | Villages Ambatoli, Kantajher, Chorichoka, Elga Baki Bahal and Jam Bahal of Kutra Block | RM, TRIFED BBSR, Odisha | 1-6 January, 2011 | Monitoring of standing lac crop raised on <i>ber</i> and planning for raising <i>jethwi</i> lac crop, 2011 in Sundergarh district. |
| Purulia, West Bengal | Village Kulajunga, Nimdih, Kewatia, Ohatu, Bhusudih, Birudih, Ana, Ranigarha and Dorpa of Jhalda Block | TRIFED, Ranchi | 11 January, 2011 | Crop monitoring, technical advice and sample collection of <i>Baisakhi</i> crop raised on <i>palas</i> . Crop condition was good. |
| Purulia, West Bengal | Bhusudih of Jhalda Block | TRIFED, Ranchi | 28 March, 2011 | <i>Baisakhi</i> lac crop (2010-11) raised on <i>palas</i> and crop raised on <i>ber</i> was very good. |
| East Singhbhum | Papdagadu and Khadban of Potka Block | TRIFED, Ranchi | 29 March, 2011 | Crop condition was very poor and almost total crop failure was observed in an area. |
| Ranchi, Jharkhand | Koisara village | TRIFED, Ranchi | 10 May, 2011 | <i>Rangeeni</i> lac crop raised on <i>palas</i> and <i>ber</i> was good. Farmers were advised to prune the <i>palas</i> trees. |
| Ranchi, Jharkhand | Semla village | TRIFED, Ranchi | 11 May, 2011 | <i>Rangeeni</i> lac crop was very good on Akashmani trees. Farmers were advised to prune the <i>palas</i> trees. |
| Gumla, Jharkhand | Dalmadih area of Basia Block | TRIFED, Ranchi | 7 October 2011 | Winter season (<i>aghani</i>) <i>kusmi</i> lac crop raised on <i>ber</i> trees was good. But winter season (<i>aghani</i>) <i>kusmi</i> lac crop raised on <i>kusum</i> trees was not satisfactory due to fungal attack. |

8.4: Climate Change and Lac Crop Performance (NICRA sponsored)

A project entitled "Climate change and lac crop performance" was approved ICAR under National Initiative on Climate Resilient Agriculture (NICRA) on August 29, 2011. This project is proposed to operate in five distinct agro-climatic regions located at Jharkhand, West Bengal, Madhya Pradesh, Rajasthan and Jammu & Kashmir. The duration of the project is 3 years with a total budget outlay of Rs. 53 lakhs. The project aims to look at the effect of changing climate on lac crop performance with special emphasis to biology, productivity, associated fauna of lac insects

and the biochemical status of their hosts in distinct agro-climatic regions. Strategy development for amelioration of adverse impact of climate change on lac crop performance is also envisaged in the project.

8.5: Study and Documentation of lac cultivation and processing of lac in Chattisgarh and market survey on lac based products (Chattisgarh Govt. Project)

Impact assessment

Impact assessment analysis of various lac-related activities and projects were carried out in Chhattisgarh, as per the following parameters:



Lac host utilization

Utilization percentage increased in case of benefited lac growers for *palas*, *ber*, *kusum* and other hosts in comparison to non-benefited lac growers. Host utilization percentage of *palas* increased from 23.4 per cent to 62.1 per cent, *ber* increased from 27.1 per cent to 36.2 per cent and *kusum* increased from 31.0 per cent to 44.5 per cent (Fig 59).

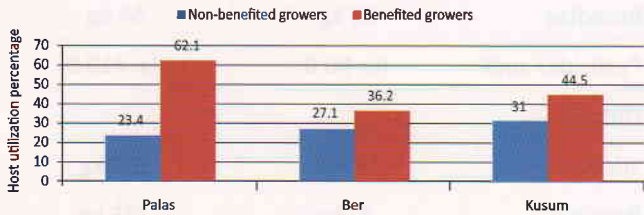


Fig. 59 Host utilization of lac growers

Annual lac production

A shift was observed in case of benefited lac growers from lower production group to higher production group in both sticklac and broodlac production (Fig 60 and 61). Majority of non-benefited (59 per cent) and benefited growers (51 per cent) produced sticklac in the production group below 100 kg annually, but the average annual sticklac production was high (69 kg) in case of benefited growers. Also in case of broodlac production, majority of non-benefited (69 per cent) and benefited growers (46 per cent) produced broodlac in the production group below 50 kg annually, but the average annual broodlac production was high (34.2 kg.) in case of benefited growers. Higher level of broodlac production resulted in self sufficiency in broodlac and more utilization of host trees for lac cultivation.

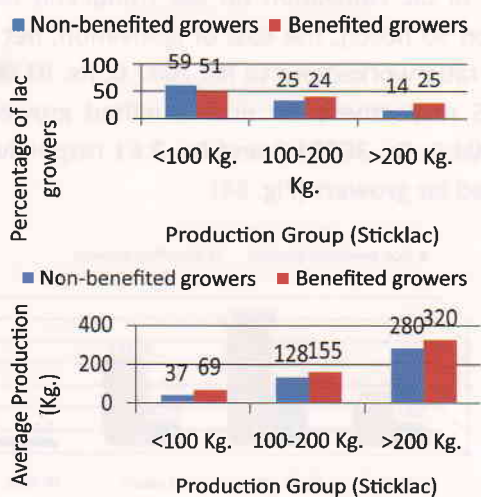
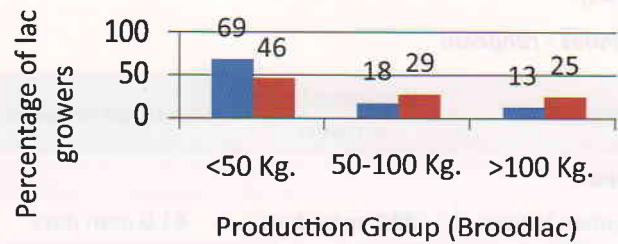


Fig. 60 Annual sticklac production by benefited and non-benefited lac growers

Non-benefited growers Benefited growers



Non-benefited growers Benefited growers

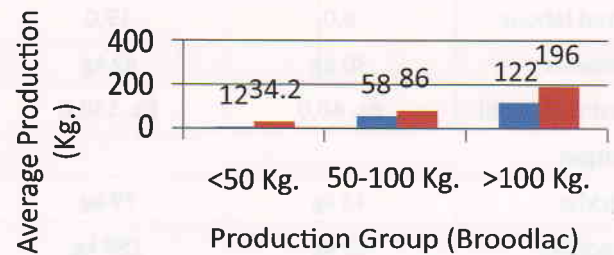


Fig. 61 Annual broodlac production by benefited and non-benefited lac growers

Source of income

The share of farm income in total income of lac growers increased in case of benefited lac growers. It was 51.5 and 59.4 per cent for non-benefited and benefited lac growers. The share of lac income has also increased in case of benefited lac growers and it was 17.0 and 25.2 per cent for non-benefited and benefited lac growers respectively. In case of off-farm income from forest produce and labour activity was the major source of income (Fig 62).

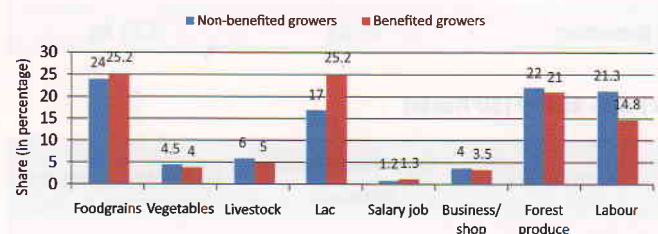


Fig. 62 Source of farm and off-farm income of benefited and non-benefited lac growers

Physical input and output in lac cultivation

Physical input and output used in lac cultivation on *palas*, *ber* and *kusum* have been presented in the Table 17. It is evident that level of input used in lac cultivation by benefited growers were higher in comparison to non-benefited growers resulted in to higher level of output for lac cultivation on all hosts. The higher level of input used is due to adoption of improved practices by the benefited growers.



Table 17. Physical input and output in lac cultivation on (50 hosts)

a) Palas - rangeeni

| Particulars | Non-benefited growers | Benefited growers |
|------------------|-----------------------|-------------------|
| Input | | |
| Human labour | 22.0 man days | 41.0 man days |
| Family labour | 19.0 | 22.0 |
| Hired labour | 3.0 | 19.0 |
| Broodlac | 30 kg | 42 kg |
| Pesticide/ sutli | Rs. 40.0 | Rs. 160.0 |
| Output | | |
| Sticklac | 48 kg | 79 kg |
| Broodlac | 62 kg | 158 kg |

b) Ber- rangeeni (50 hosts)

| Particulars | Non-benefited growers | Benefited growers |
|------------------|-----------------------|-------------------|
| Input | | |
| Human labour | 42.0 man days | 67.0 man days |
| Family labour | 30.0 | 42.0 |
| Hired labour | 12.0 | 25.0 |
| Broodlac | 45 kg | 94 kg |
| Pesticide/ sutli | Rs. 85.0 | Rs. 400.0 |
| Output | | |
| Sticklac | 185 kg | 595 kg |
| Broodlac | 35 kg | 129 kg |

c) Ber- kusmi (50 hosts)

| Particulars | Non-benefited growers | Benefited growers |
|------------------|-----------------------|-------------------|
| Input | | |
| Human labour | 42.0 man days | 67.0 man days |
| Family labour | 30.0 | 42.0 |
| Hired labour | 12.0 | 25.0 |
| Broodlac | 62 kg | 104 kg |
| Pesticide/ sutli | Rs. 90.0 | Rs. 480.0 |
| Output | | |
| Sticklac | 135 kg | 224 kg |
| Broodlac | 182 kg | 425 kg |

d) Kusum (10 hosts)

| Particulars | Non-benefited growers | Benefited growers |
|------------------|-----------------------|-------------------|
| Input | | |
| Human labour | 35.0 man days | 57.0 man days |
| Family labour | 28.0 | 30.0 |
| Hired labour | 7.0 | 27.0 |
| Broodlac | 37 kg | 54 kg |
| Pesticide/ sutli | Rs. 90.0 | Rs. 410.0 |
| Output | | |
| Sticklac | 167 kg | 197 kg |
| Broodlac | 77 kg | 235 kg |

Economics of lac cultivation

In case of lac cultivation on *palas* (analysis based on 50 hosts), the cost of cultivation, net return and BC ratio were worked out to Rs. 4351.0, Rs. 4109.0 and Rs. 1.94 respectively for non-benefited growers and Rs. 7239.0, Rs. 11721.0 and Rs. 2.61 respectively for benefited lac growers (Fig. 63).

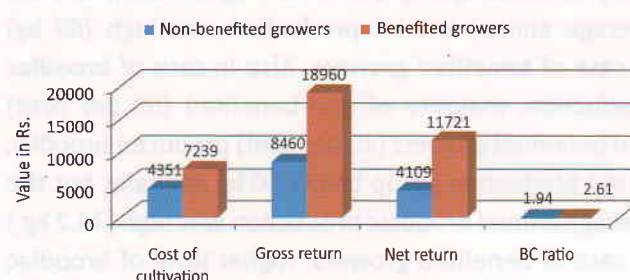


Fig. 63 Cost of cultivation on *ber-rangeeni* (50 hosts)

In case of lac cultivation on *ber (rangeeni)* (analysis based on 50 hosts), the cost of cultivation, net return and BC ratio worked out to Rs. 7047.0, Rs. 8128.0 and Rs. 2.15 respectively for non-benefited growers and Rs. 13904.0, Rs. 36381.0 and Rs. 3.61 respectively for benefited lac growers (Fig. 64).

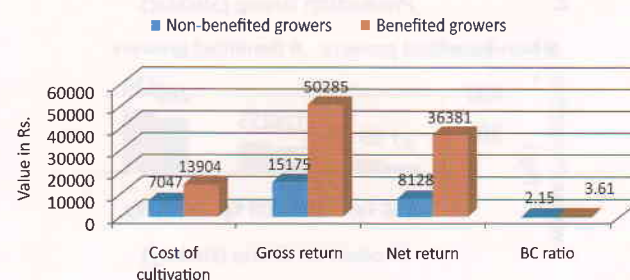


Fig. 64 Economics of lac cultivation on *ber-rangeeni* (50 hosts)



In case of lac cultivation on *ber (kusmi)* (analysis based on 50 hosts), the cost of cultivation, net return and BC ratio were worked out to Rs. 12466.0, Rs. 25634.0 and Rs. 3.05 respectively for non-benefited growers and Rs. 21849.0, Rs. 59821.0 and Rs. 3.73 respectively for benefited lac growers (Fig. 65).

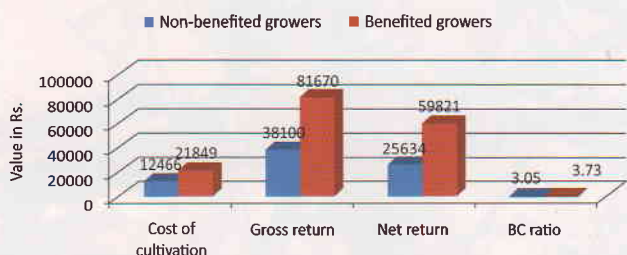


Fig. 65 Economics of lac cultivation on *ber-kusmi* (50 hosts)

In case of lac cultivation on *ber (kusmi)* (analysis based on 10 hosts), the cost of cultivation, net return and BC ratio were worked out to Rs. 8231.0, Rs. 18349.0 and Rs. 3.22 respectively for non-benefited growers and Rs. 12887.0, Rs. 40093.0 and Rs. 4.11 respectively for benefited lac growers (Fig. 66).

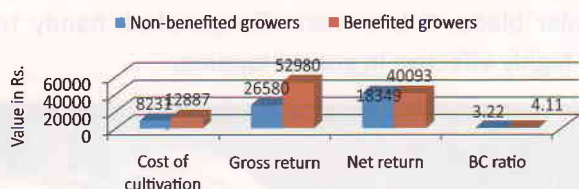


Fig. 66 Economics of lac cultivation on *kusum* (10 hosts)

Labour utilization in lac cultivation

Utilization of labour in lac cultivation on *palas, ber* and *kusum* has been presented in Fig. 67. It is evident that benefited lac growers utilized more man days in comparison to non-benefited growers in lac cultivation on all hosts. The employment generation increased by 86, 59 and 58 per cent in *palas, ber* and *kusum* respectively, for the benefited lac-growers. Benefited lac growers also employed more number of hired labour due to the higher level of labour use in lac cultivation on all host *i.e. palas, ber* and *kusum*.

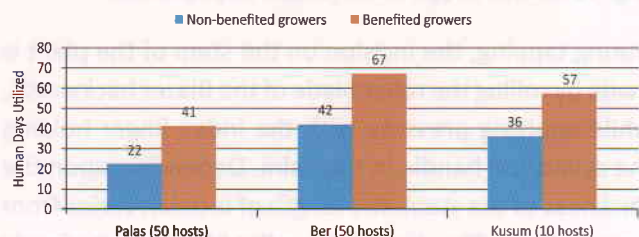


Fig. 67 Utilization of labour in lac cultivation

Adoption of improved techniques in lac cultivation

Significant increase was observed in case of benefited lac growers regarding adoption of improved techniques. Adoption percentage of improved techniques by benefited lac growers was 85 per cent for adoption of coupe system, 96 per cent for pruning of lac hosts, 84 per cent for selection of quality broodlac, 81 per cent for bundling of broodlac and tagging on plant, 100 per cent for *phunki* removal, 64 per cent for spraying of insecticides, 21 per cent for use of synthetic net and 55 per cent for spray of fungicide. Low adoption level of spraying of insecticide, use of synthetic net and spray of fungicide was due to unavailability of inputs in local markets (Fig. 68).

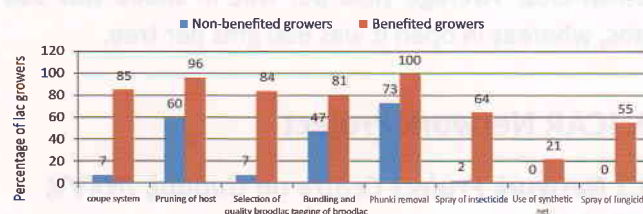


Fig. 68 Adoption level of improved techniques by benefited and non-benefited lac growers

8.6: High density *ber* plantation for lac production under semi-protected conditions (NABARD Project)

Ber plantation raised in four strips (each having 134 plants) using high density system in plot no. 33 at the research farm of the Institute. In January 2011, plants (*aghani crop*) started showing signs of drying just like frost injury and severity recorded was less in shade covered plants which resulted mortality of *aghani* crop. Loss of moisture from the pits resulted after removal of fallen structure stubbles was found affecting the plants. The plants recovered after filling the pits and providing irrigation. Crop was harvested in February 2011 from two strips. Total yield of 45 kg broodlac was obtained from 25 kg of broodlac inoculated.

Canopy management

Canopy management operations were carried out in the plot in two strips in Feb 2011, as the plants under shade were having more height touching the top of the structure. Upper and thick portion of the shade covered plants were cut down and dried branches of the plants were removed, to help in inducing new branches and give proper shape to the plants' canopy.



Raising of *jethwi* crop

25 kg of summer *kusmi* (*jethwi*) broodlac was inoculated in February 2011. *Phunki* lac was removed after 21 days of inoculation. Mulching was done with dried paddy straw in the month of March and the mulch also sprayed with chlorpyrifos to avoid termite infestation. The crop growth was satisfactory throughout the crop period. In the month of July, the crop matured and was harvested. Yield data was recorded from shade and without shade plants and a yield of 69 kg as broodlac including sticklac was obtained. *Jethwi* crop yielded 69 kg (47 kg brood + 22 kg as sticklac) of lac from 25 kg of brood lac inoculated in Feb 2011. There was positive non-significant increase in yield with respect to light in *jethwi* crop. Average yield per tree in shade was 510 gms, whereas in open it was 650 gms per tree.

9. ICAR Network Project

9.1 Network Project Centre on Guggul, JNKVV, Jabalpur

Study on distribution of Guggul plants in India

Natural stand of Guggul (*Commiphora wightii*) is found in districts Morena, Sheopur, Shivpuri and Bhind of Madhya Pradesh. The plants are tall with variation in height from 1 m to 4 m, having smooth bark and found to fruit during December- January. Guggul plants are also found in Kachchh and Jamnagar districts of Gujarat. The plants of the region are having rough bark and found along the undulated areas with poor soil. Two types of Guggul plants *i.e.* taller and shorter were observed in the region. Shorter plants attain height ranging from 0.5 m to 1.5 m with dense branching and shorter internodes. Due to shorter internodes and longer spines, plants appear more spiny and bushy. These types of plants are found on the rocks, near the rocks or on the skeletal soil.

Investigation on bark thickness of Guggul plant

The oleo-resin from the plant oozes from the secondary phloem in the bark. Thus it is essential to measure the bark thickness, improve tapping technique and develop suitable device for sustainable harvest of oleoresin. Pruning the secondary branches revealed the exudation of oleoresin from the bark in the form of droplets of oleo- resin exudate on the cut portion of the bark in a bead fashion (Fig. 69).



Fig. 69 Oleo-resin secretion from pruned branch of *C. wightii*

Design and development of guggul tapping device

To tap oleo-resin from guggul trees, a tool was developed and named as *Jawahar Guggul Blazer* (Fig. 70). It was made of stainless steel with a handle and circular blade. It is a manually-operated, handy tool and highly effective in guggul tapping.



Fig. 70 *Jawahar Guggul Blazer* (Guggul tapping device)

During tapping, the incision on the stem of the plant is made by rolling the roller blade of the Blazer backwards, while applying pressure with the index finger holding the cylindrical handle in the palm. Depending upon the thickness of the stem, the length of incision varies from 5 cm to 9 cm. The disc of the roller blade moves freely on its axis fitted to the handle of the blazer.



The rim of the roller blade prevents the blazer from travelling beyond 2 mm depth into the bark. This leaves the hardwood with minimum or no damage, saving the tree from drying as observed in destructive and competitive tapping. The blazer was tested in Gujarat and Madhya Pradesh. It takes 5 to 10 minutes (depending upon the plant and its location) to make 5 to 8 blazes per plant. All the fifty tapped plants in the year 2009-2010 and 2010-2011 have healed and are healthy.

9.2 Network Project Centre at NRC Agroforestry, Jhansi

Evaluation of developed agro-forestry models

Agri-horti-silviculture

Higher survival (100%), collar diameter (45.70 cm) and height (252.86 cm) was observed in *Acacia senegal* after 18 months of planting, whereas minimum occurred in *C. carandus*. The yield of *kharif* crop i.e., black gram (PU-19) was drastically reduced due to problems exhibited from the seed source, throughout Bundelkhand region. Vegetative growth particularly plant height gone up to 2.1 m, but grain formation was greatly affected. It took 122 days for reaching crop maturity. The grain yield reduction under tree canopy was observed in the order of *A. senegal* > *C. limon* > *A. marmelos*. Grain yield ranged from 2.84 q ha⁻¹ (*A. senegal*) to 10.02 q ha⁻¹ (open area) was observed. It indicated high risk and uncertainties in sole agriculture which depends on many uncontrolled factors. Thus, integration of other commodities viz., fruit trees, gum yielding trees etc. will certainly help to risk partitioning.

Horti-silviculture I

A. senegal and *C. limon* recorded cent per cent survival. Maximum tree height and collar diameter was registered by *A. senegal* followed by *C. limon*. *Terminalia arjuna* trees were planted in the middle of the two tree rows at 1 x 1 m spacing for tasar silk cultivation and medicinal plants viz., *Aloe vera* and *Cantheranthus roses* (during 2010) were also introduced as intercrops.

Horti-silviculture II

More survival and tree growth was exhibited by *A. nilotica* and *P. guajava*. At the age of 18 months, 36 *P. guajava* trees became bearing, out of 48 trees. An average of 2.32 ± 0.19 kg per tree was produced with the total production of 2.80 q ha⁻¹.

Horti-Silviculture III

A. catechu recorded a survival of 75% while *M. oleifera* recorded 34.8%. Lesser survival by *M. oleifera* was due to biotic pressure by neighbouring villagers. On an average, *M. oleifera* produced 7 kg (fresh weight) drumsticks per tree.

GKD Watershed

In Shri. Thakur Das' field, both *A. nilotica* and *P. guajava* recorded 77% survival. Tree height of *A. nilotica* was more compared to others. He obtained 0.55 q ha⁻¹ yield as intercrop of black gram. Higher survival in *E. officinalis* (94%) followed by *A. senegal* (83%) was observed in Shri. Himmat's field. The yield of groundnut from the inter-spaces was 5.32 q ha⁻¹. Lesser survival per cent of *C. limon* (30%) and *E. officinalis* (28%) was observed in Shri. Saligram's field. *A. nilotica* which was planted in the boundary, was totally damaged due to Anna Pratha system of grazing.

Gum extraction from *B. monosperma (palas)* tree

Traditional method of gum collection by the tribal community of Bundelkhand region from *B. monosperma* was documented. This gum is popularly known as "gummer ghas" used to relieve back pain. It acts as an astringent and used as a substitute for *Kino* gum. About 10-15 trees/ha are available in the farmers' field of this region. The gum is collected from November to February/March, once in a year. Only the tribal community collects the gum resin from *palas*, even though the trees are available in the other farmers' fields. This is a social taboo. Tree owners permit the tribal community to collect gum free of cost from *palas* trees.

Gum extraction: Traditional method

Palas trees with minimum 25-30 cm girth are selected and the bark upto reachable height is removed by specially-made bill hook. It has sharp edges on three sides. In case of big trees, the tribals climb the trees and do the operations. Knotching (incisions) is done on the stem by the bill hook from downwards to a depth of 2-3 cm spaced 10-15 cm apart. Tears/juice exuded from the knotches, hardens into brittle ruby-colored gum beads and collected after two days. Average yield of gum ranges from 200 to 300 g/tree.

Local buyers buy the gum resins from the individuals at the rate of Rs. 40-50/kg and sell to major contractors in



the cities of Uttar Pradesh and Madhya Pradesh at the rate of Rs. 42-52/kg. This traditional method of gum collection is labour-intensive. Both men and women are engaged in the gum collection process. Hard operations viz. removing bark and knotching is done by men and gum collection done by the women.

9.3 Network Project Centre on Gum Arabic at CAZRI, Jodhpur

Gum production from *A. nilotica*, *Prosopis juliflora*, *Prosopis cineraria* and *Anogeissus rotundifolia*

Gum production trials on *Acacia nilotica*, *P. cineraria*, *P. juliflora* and *A. rotundifolia* using CAZRI gum-inducer

revealed that these species could be potential sources of gum in arid Western Rajasthan. Except *P. juliflora* gum, all other gums are edible. Gum exudation in all the species started within 7-8 days after treatment and continued upto 30 days. Total gum yield was maximum in *A. rotundifolia* (Table 18). *P. cineraria* which was treated first time yielded only 20 g of gum. It appears the dose being applied was not suitable for *P. cineraria*; therefore to standardise the dose of gum inducer and as well as time, an experiment is being set up. There was no relation between any tree structural trait and gum yield.

Table 18. Tree structural traits and gum yield

| Species | Height (m) | CD (cm) | Basal area (cm ² tree ⁻¹) | Gum yield (g) | Plantation age (Years) |
|--------------------------------|------------|---------|--|---------------|------------------------|
| <i>Acacia nilotica</i> | 8.18 | 39.32 | 1213.66 | 56.20 | 22 |
| <i>Prosopis cineraria</i> | 8.06 | 38.16 | 1143.11 | 20.24 | 50 |
| <i>Prosopis juliflora</i> | 6.12 | 27.92 | 611.93 | 105.64 | 19 |
| <i>Anogeissus rotundifolia</i> | 7.26 | 56.34 | 2491.74 | 210.00 | 45 |

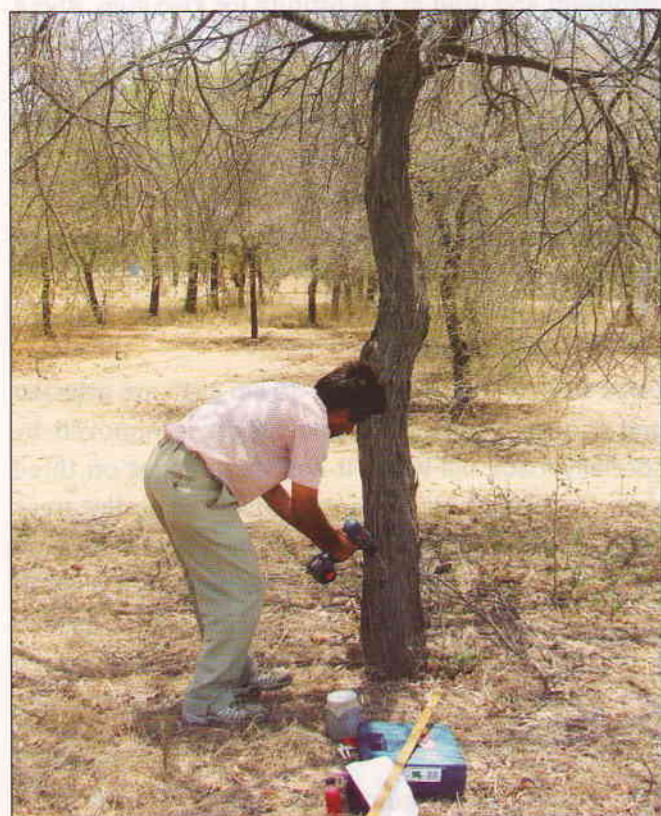


Fig. 71 Treating *A. nilotica* for gum tapping



Fig. 72 Gum exudates on *P. cineraria* with CAZRI gum inducer



Fig. 73 Gum exudates on *P. juliflora*

Effect of management practices and gum inducer on gum production from *Acacia senegal* in rocky land

Treatments comprised of 2 factors. Factor one consisted of 3 levels of management practices viz., irrigation, manuring and irrigation + manuring with an absolute control. Factor 2 consisted of 2 concentrations of gum inducer viz., half concentration of normal dose and normal dose with an absolute control. Normal dose

contains 195 mg ethephon/ml of solution. The results of the experiment are given in Table 19 and Fig. 74. In case of control (conventional practice making blazes on tree trunk), the gum production was negligible. However, two irrigations at fortnightly intervals before treatment resulted in production of gum to the tune of 20 g/tree in case of half concentration of the normal dose treatment and 46 g/tree in case of normal dose treatment.

Table 19. Effect of management practices (P) and different concentrations (C) of gum inducer on gum production of *A. senegal* in semi-rocky area of Bhopalgarh (Jodhpur)

| Management practice (P) | Gum Producing, g | | | Mean gum production, g |
|-------------------------|----------------------------------|----------------------------------|------------------------------------|------------------------|
| | Concentration of gum inducer (C) | | | |
| | 0 concentration (Control) | Half of the normal concentration | Normal concentration | |
| Control | 0.0 | 9.3 | 32.7 | 14.0 |
| Irrigation (I) | 0.0 | 28.3 | 51.7 | 26.7 |
| Manuring (M) | 0.0 | 36.7 | 63.3 | 33.3 |
| I + M | 3.3 | 62.0 | 21.7 | 29.0 |
| Mean | 0.6 | 22.7 | 28.2 | 25.7 |
| | Between means of P | Between means of C | Between Interaction (P x C) | |
| SEm± | 2.92 | 2.53 | 1.68 | |
| CD (P=0.05) | 8.55 | 7.41 | 4.94 | |



Interaction effect of irrigation, manuring and concentration of gum inducer on gum production of *A. senegal*

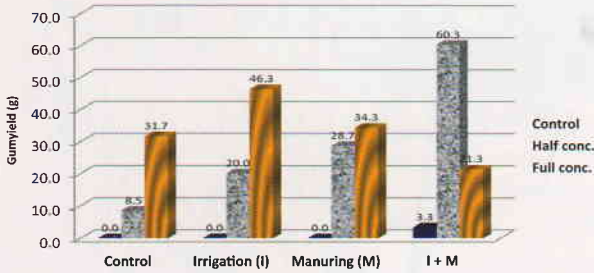


Fig. 74 Gum yield (g) with different levels of concentration of gum inducer and management practices

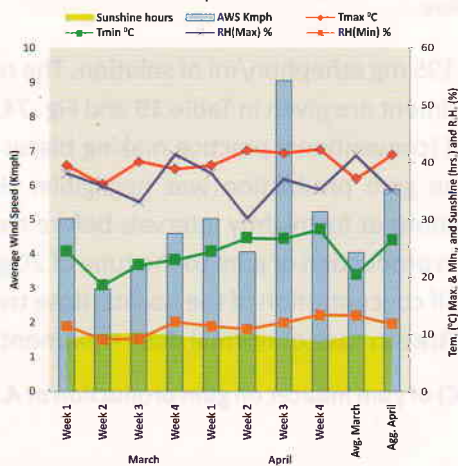
Establishment of plantation of high gum yielding plant type of *A. senegal*

A stand of high gum yielding plant type of *A. senegal* (Nigerian origin) was established on Central Research Farm of CAZRI, during monsoons of 2010. The survival percentage after 8 months was more than 99%. The row to row and plant to plant distance is 3 x 3 m. On an average plant attained a height of 73 cm and collar diameter (CD) 1.15 cm.

Effect of weather aberration on gum production

Several households, from villages at Barmer and Jodhpur districts were surveyed for gum production from *A. senegal* in similar way as previous year (2010). On the basis of this study, average gum production per tree was only 338 g as compared to 500 g last year. Thus, though number of trees treated by the farmers was more this year however, production declined. The last year's estimate of gum production was 10.5 t from around 21,000 trees, which declined to 6.7 t from 22,500 trees. The major climatic parameters during March and April (main season for gum *Arabic* production) of current year and as well as last year were analysed, which indicated that maximum and minimum temperature during this year were about 3 °C lower than the last year (Fig. 75). Perhaps lower temperature did not favour optimum gum production and this slight decrease in temperature resulted in about 30% reduction in gum *Arabic* production (Fig. 76)

Weather parameters 2010



Weather parameters 2011

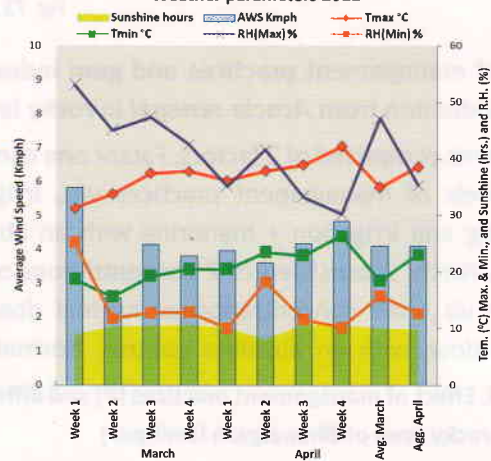


Fig. 75 Weather parameters during March and April 2010 and 2011

Number of trees treated and average gum production from *Acacia Senegal* in western Rajasthan during 2010 and 2011

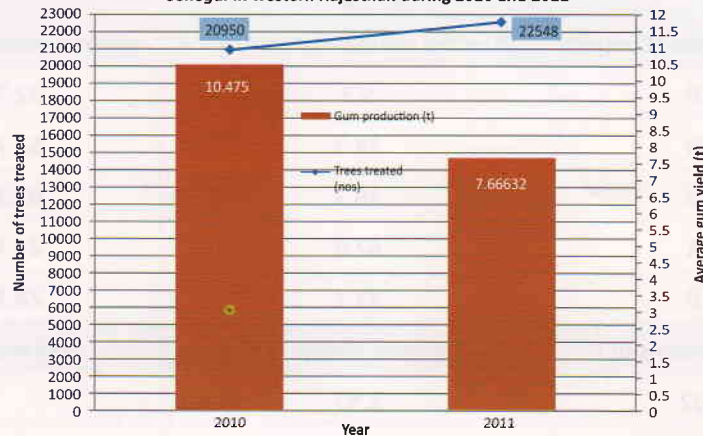


Fig. 76 Gum production from *A. senegal* during 2010 and 2011 in western Rajasthan



Extension and adoption of gum-inducing technique

The farmers of Chauhatan and Baytu tehsils of Barmer district; Shergarh and Phalodi tehsils of Jodhpur; and some villages of Nagaur and Pali districts have adopted the gum inducing technology and the number of trees treated with gum inducer reached to 2,2600 during 2010-11 (Fig. 77), resulting in production of 6.7 t of gum *Arabic* (Fig. 10). They earned revenue of Rs. 38,00,000/- with an average rate of Rs. 500/- per kg, (Fig. 78). With the introduction of Network Project on Resins and Gums at CAZRI Centre, the villagers could earn Rs. 117.9 lakhs, through the sale of gum *Arabic* in the local market and CAZRI has earned revenue of Rs. 5.5 lakhs through the sale of CAZRI gum inducer. This gum exudation technology was adopted by a large number of farmers and every year the population of treated trees of *A. senegal* is increasing substantially.

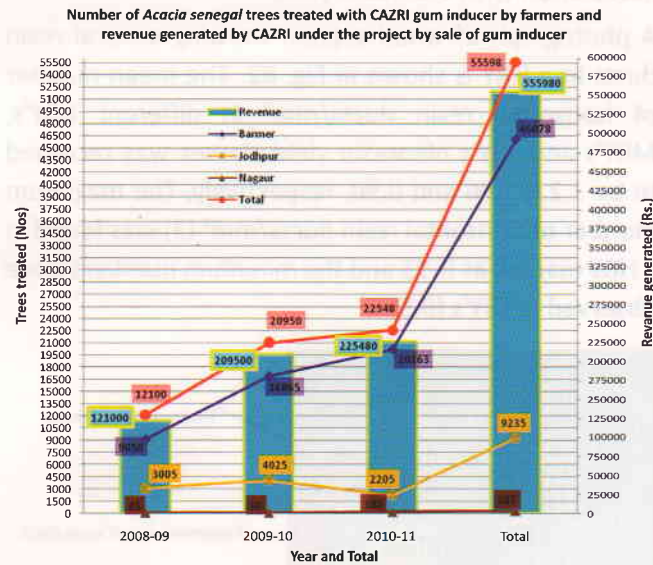


Fig. 77 Sale of gum inducer and revenue earned by CAZRI

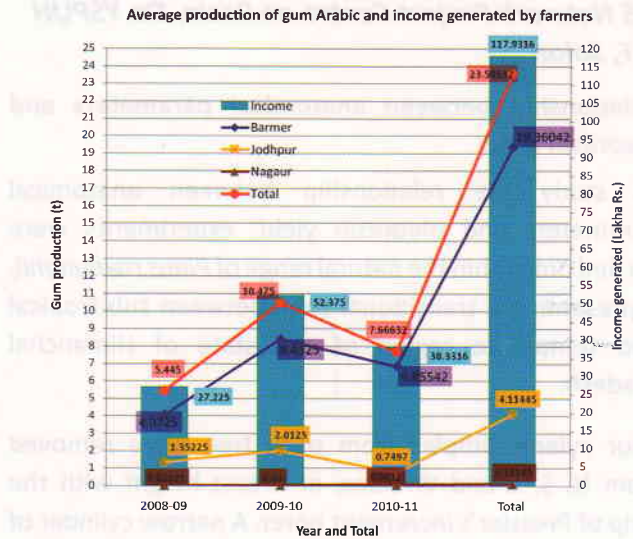


Fig. 78 Gum production (t) and income (Lakh) earned by farmers

9.4 Network Project Centre on Gum Karaya at IGKVV, Raipur

Gum tapping from *Acacia nilotica*, using gum-inducer ethephon

35 nos. *A. nilotica* trees were selected at Phunder village and in the University premises. Four holes, each of approx. 6 mm diameter, were made in the tree trunk of *A. nilotica* in each tree, 90 cm above the ground with hand operated drill machine (Fig. 79). Five trees each were injected with 1, 2, 3 and 4ml of ethephon. A set of 5 trees was injected with distilled water to act as control. The result of 4 ml ethephon dose was encouraging.

Since *karaya* gum trees were available in limited numbers, 10 nos. trees of *karaya* gum, located at Kurrabhata village of Gariaband was injected with 4ml ethephon. Average gum yield from *Sterculia urens* for application of 4 ml ethephon application was 320 g.



Fig. 79 Gum exudation in 4 ml Ethephone treated trees



9.5 Network Project Centre on Rosin, Dr. YSPUH & F, Solan

Relationship between anatomical parameters and oleoresin yield

To study the relationship between anatomical parameters and oleoresin yield, experiments were carried out within the natural range of *Pinus roxbunghii*, representing a transitional zone between sub-tropical and temperate region of the state of Himanchal Pradesh.

Four xylem samples from each tree were removed from N, S, E and W sides, at breast height with the help of Pressler's increment borer. A narrow cylinder of wood of size 1 cm diameter and 4 cm length was drilled with the help of increment borer from all 75 trees. The samples contained xylem of the most recent year's growth. An arrow was put on the sample with the help of a permanent marker which indicated the orientation of the sample. The samples were immediately preserved in 100 ml of FAA, which consists of 90 ml of 70 per cent ethyl alcohol, 5 ml of glacial acetic acid and 5 ml of formaldehyde.

Number of vertical resin ducts/mm² and its association with oleoresin yield

The wood section showing vertical resin ducts in a High Resin Yielder (HRY) is shown in Fig. 80. The average number of vertical resin ducts for HRY, Medium Resin Yielder (MRY) and Low Resin Yielder (LRY) trees was recorded to be 1.20, 1.05 and 0.85, respectively. The maximum number of vertical resin ducts/mm² was found in a HRY (3) marked as R-93 and the minimum numbers were observed in LRY's (0.50).

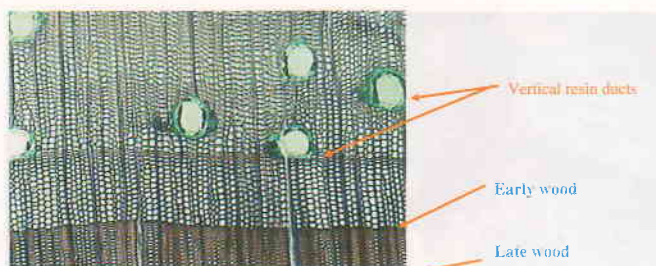


Fig. 80 Wood section showing number of vertical resin ducts

Diameter of vertical resin ducts (μm) and its association with oleoresin yield

A photograph of wood section showing diameter of vertical oleoresin ducts in a HRY is shown in Fig. 81. The

average value of diameter of vertical oleoresin ducts for HRY's, MRY's and LRY's was 249.48, 218.70 and 193.86 μm, respectively. The maximum value of vertical resin duct diameter (297 μm) was recorded in two HRY trees marked as R-11 and R-74, and minimum value of diameter (162 μm) in LRY's marked as R-20 and R-58.

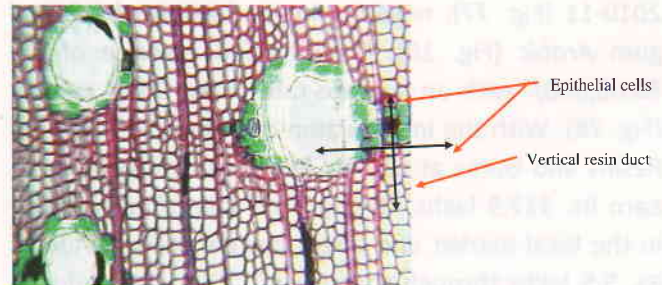


Fig. 81 Wood section showing diameter and number of epithelial cells in a vertical resin duct

Number of horizontal resin ducts/mm² and its association with oleoresin yield

A photograph of wood section showing vertical resin ducts in a HRY is shown in Fig. 82. The mean number of horizontal resin ducts/mm² in different HRY's, MRY's and LRY's oleoresin yield classes was recorded to be 1.22, 1.06 and 0.90, respectively. The maximum number of horizontal resin ducts/mm² (3) was found in a HRY marked as R-93 and the minimum numbers were observed in LRY's (0.50).

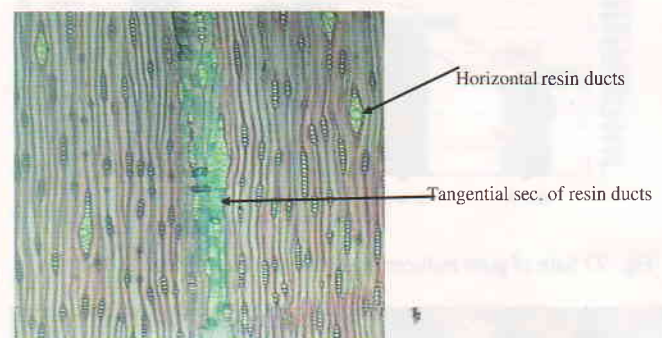


Fig. 82 Wood section showing number of horizontal resin ducts

Diameter of horizontal resin ducts (μm) and its association with oleoresin yield

A photograph of wood section showing diameter of horizontal oleoresin ducts in a HRY is shown in Fig. 83. The average value for diameter of horizontal resin ducts for HRY's, MRY's and LRY's was recorded to be 79.92, 77.22 and 70.74 μm. The maximum value of diameter (108 μm) was recorded in two HRY trees marked as R-11 and R-93, and minimum value of diameter (54 μm) in five LRY's.

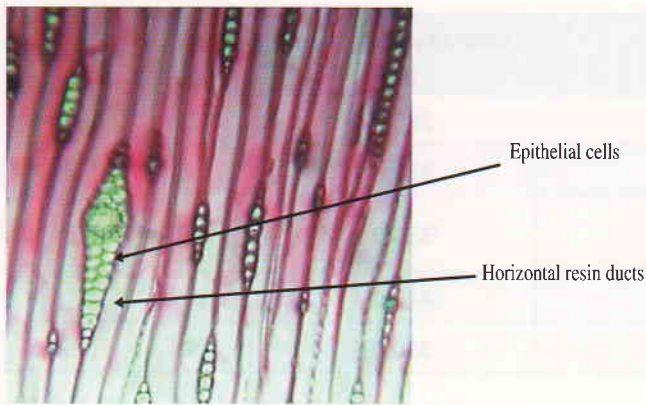


Fig. 83 Wood section showing diameter and number of epithelial cells in a horizontal resin duct

9.6 Network Project Centre on Guar Gum, MAU, Parbani

Detoxification of anti-nutritional factors in guar germ meal

Experiments were carried out for detoxification of anti-nutritive factors (such as haemagglutinin) in guar germ meal by various treatments *i.e.* soaking in distilled water, soaking treatment in chemicals, boiling and roasting. The result of the experiments revealed that soaking for 48 hours in distilled water, roasting for 15 and 20 minutes at 140°C completely reduced haemagglutinin.

Viscosity of 1% guar gum solution of different genotypes obtained from different location

Viscosity of 1% gum solution of guar genotypes of different locations, Durgapur, Jodhpur and Parbhani during *kharif* 2010 was determined. The data revealed that the viscosity varied from 3175 to 6047 mpa/s. On the basis of average of mean value, the highest viscosity was observed in genotype MRG- 1786 (5440 mpa s) followed by RGC- 1002 (5332 mpa s). Location wise, maximum viscosity was found in gum samples from Jodhpur 4947 mpa.s followed by Durgapur (4611 mpa s) and Parbhani (4215 mpa s).

Table. 20 Details of guggul (*C. wightii*) exudates received and processed for the extraction of oil

| Month & year of collection | Place of collection | Quantity processed (g) | Oil obtained (g) | Yield (%) |
|----------------------------|--|------------------------|------------------|-----------|
| Nov., 2010 | Rudraksha Ayurvedic Pvt. Ltd., Jabalpur (M.P.) | 750.0 | 2.55 | 0.34 % |
| Nov., 2010 | Neemuch (M.P.) | 350.0 | 2.10 | 0.60 % |
| Feb., 2011 | K.K. Traders, Amritsar (Punjab) | 100.7 | Insignificant | - |
| April, 2011 | Dhaulpur (Raj.) | 740.0 | 2.90 | 0.39 % |

9.7 Network Project at Lead Centre, IINRG, Ranchi

Improvement of functional properties of Mince Meat Product by incorporation of guar gum and gum Arabic

The effect of adding gum Arabic and guar gum in meat and poultry nugget formulation was studied. Three levels (0.5%,1.0% and 1.5%) of both gums were added in processing of meat and poultry nuggets. Purpose of addition of gums was to improve yield, textural property and also to reduce oil content in the final products.

Meat nuggets were prepared out of chevon meat purchased from local market. Chicken meat was obtained from chicken of poultry farm of Central Avian Research Institute, Izatnagar. Hand de-boned chicken meat was chopped in a bowl chopper. De-boned meat was also minced in the same manner. Standard formulation of meat nuggets and chicken nuggets were same. Gum Arabic and Guar gum were added at 0.5%, 1.0% and 1.5% level in meat and chicken meat. Batter was prepared in bowl chopper and mincer. Prepared malange were packed individually in molds and cooked in a steamer for 1.5 hours. Processed products were refrigerated and for sampling, they were cut into cubes.

Physico-chemical properties, textural profile, color and sensory quality of products were analyzed. Based on the analysis, it was found that even after reduction of fat, products had improved functional and eating quality, as well as cooking yield by addition of 1% gum Arabic and 0.5% Guar gum.

Study of changes in aromatic components (essential oils) of guggul (*Commiphora wightii*) in the marketing-chain

Aromatic components (essential oils) were extracted from nine (six old and three fresh) exudates of guggul, collected from different places of M.P. Details are given (Table 20 and Table 21) below.



| Month & year of collection | Place of collection | Quantity processed (g) | Oil obtained (g) | Yield (%) |
|----------------------------|------------------------------------|------------------------|------------------|-----------|
| April, 2011 | Morena (M.P.) | 260.0 | 1.56 | 0.60 % |
| May, 2011 | Morena (M.P.)* | 350.0 | 3.0 | 0.86 % |
| May, 2011 | Aetha Block, Distt. Bhind (M.P.)** | 350.0 | 2.0 | 0.57 % |
| May, 2011 | Morena (M.P.) | 445.0 | No oil | - |
| Aug., 2011 | Morena (M.P.)*** | 350.0 | 2.26 | 0.65 % |

* Freshly harvested guggul exudates packed in local plastic bag.

** Freshly harvested guggul exudates packed in LDPE bag.

*** Same batch of freshly harvested guggul exudates (Sl. No. 6), collected by trader, handled and stored by him, was sent by the associate duly packed in local plastic bag.

Table 21. Physico-chemical parameters of the extracted essential oils

| Parameters | Standard oil* | Oil 1 | Oil 2 | Oil 4 | Oil 5 | Oil 6 | Oil 7 | Oil 9 |
|---------------------------------|---------------|---------|---------|---------|---------|---------|---------|---------|
| Solubility | Alcohol | Alcohol | Alcohol | Alcohol | Alcohol | Alcohol | Alcohol | Alcohol |
| Acid value (mg/KOH/g) | 6.0 | 25.0 | 7.43 | 14.93 | 5.85 | 5.24 | 5.28 | 5.96 |
| Saponification value (mg/KOH/g) | 117.93 | 258.89 | 83.98 | 196.88 | 148.23 | 60.89 | 69.54 | 78.15 |
| Ester value | 111.93 | 233.89 | 76.55 | 181.95 | 142.38 | 55.65 | 64.26 | 72.19 |
| Iodine value (g/g) | 43.187 | Rancid | 90.34 | 101.98 | 90.57 | 41.02 | 42.14 | 84.64 |
| Moisture % | 2.32 % | 3.82 % | 2.62 % | 3.93 % | 2.47 % | 2.24 % | 2.43 % | 2.51 % |
| Ash % | 0.32 % | 0.37 % | 0.28 % | - | - | - | - | - |

*Standard oil supplied by Rudraksha Ayurvedic Private Limited, Jabalpur (M.P.).

Development of enzymatic/chemical method for removal of residual gum from Guar meal

Effect of pH on protein contents of *Guar* meal Lignin-bound residual gum present in *Guar* meal was separated through Soxhlet extraction and removal of residual gum from *Guar* meal was undertaken at four different pH levels of 3.5, 4.0, 4.5 and 5.0. Residual gum was obtained through centrifugation at 5,000 rpm at all the pH levels. On treating on the solution having pH 4.5 gave best result as regards *Guar* gum removal from *Guar* meal. The protein content (%) estimated in the samples with pH of 3.5, 4.0, 4.5 and 5.0 were 31.76 ± 6.08 , 34.69 ± 2.47 , 39.15 ± 5.34 , 36.99 ± 3.29 respectively, whereas protein content (%) in untreated *Guar* meal was estimated to be 50.61 ± 2.21 (Fig. 84 & 85).



Fig. 84 Residual gum isolated from guar meal at different pH (3.0, 3.5, 4.0 and 5.0)

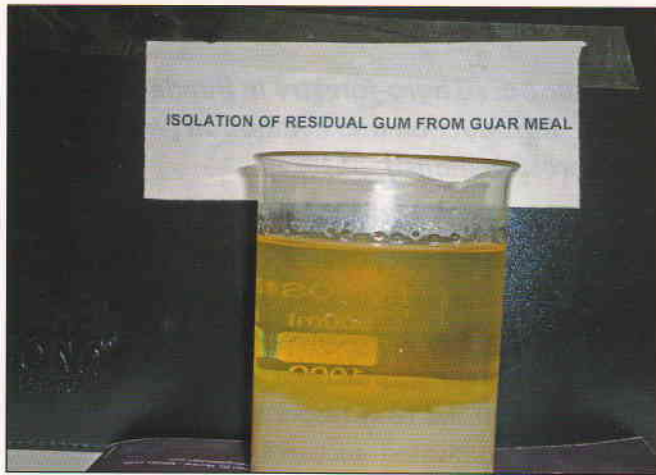


Fig. 85 Residual gum isolated from guar meal at pH 4.5

Isolated *Guar* gum is purified through washing with ethanol/water. Yield of isolated residual gum on w/w basis was recorded as 7.0, 8.0, 6.0, 8.0 and 12.0 g at pH 3.0, 3.5, 4.0, 4.5 and 5.0 respectively. The gum was purified through washing with ethanol/water estimation and identified through following tests: Borax test, Fehling's solution test and Molisch's test

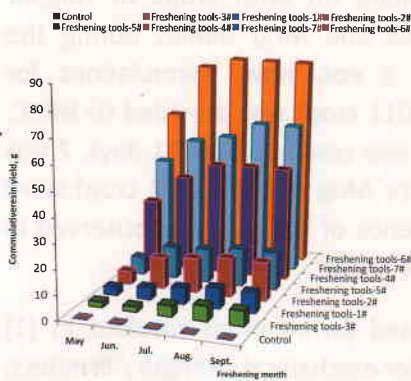


Fig. 86 Effect of freshening tools and month of freshening on cumulative resin yield

Development of freshening tool for bore hole technique of pine resin tapping

Seven different types of freshening tools were designed considering the different available mechanism to perform freshening operation in bore hole method of pine resin tapping. Design was done using CAD software, Pro Engineer. The prototype as per developed design drawings (Reamer type push-pull, Reamer type rotary, reamer type with combination of push-pull and rotary, fork type freshening tool with serration, fork type freshening tool with blade, scissor type freshening tool with blade and adjustable type freshening tool with fins) were fabricated at CIAE, Bhopal.

Performance evaluation of the tools were carried out at Dr. Y. S. Parmar University of Horticulture and Forestry, Solan (HP). In the Fig. 86, the effect of freshening tools and month of freshening on cumulative resin yield have been presented. The maximum increase in resin yield as observed for Scissor and Blade type freshening tool (Fig. 87).



Fig. 87 View of scissor and blade type freshening tool

Development of suitable method and technology for efficient storage of gum karaya and gum Arabic.

- Different packaging materials viz. LDPE (200 gauge), HDPE (300 & 400 gauge), Polypropylene (200 gauge), aluminum foil laminate, five layer craft paper bag and gunny bag were used for storage of gum *karaya* and gum *Arabic*. The latter was packed in different packaging materials above at 6 and 10 % moisture contents and stored in ambient condition for the study. Gum *karaya* was packed in similar materials as in case of gum *Arabic* at 10 % moisture content and stored in ambient condition for the study (Fig. 88 a&b).



Fig. 88a Gum Arabic



Fig. 88b Gum Karaya



To see the effect of packaging material on quality of gums parameters *i.e.* moisture content, colour, solubility, viscosity and microbial content are being measured at three and six month's interval.

Colour parameter of Gum Arabic

To know the effect of storage period on colour parameters of gum arabic and gum karaya the gum samples were packed in different packaging materials as discussed above and colour parameters *i.e.* L, a, and b were determined using Hunter's colorimeter. Effect of storage period on total colour difference, ΔE ($\Delta E = (\Delta L^2 + \Delta L^2 + \Delta L^2)^{1/2}$) is presented for gum *Arabic* in Table 22 and for gum *Karaya* in Table 23. In both gum *Arabic* and gum *Karaya*, after 6 months of storage in HDPE (400 gauge), the total colour difference was minimum.

Table 22. Total colour difference observed in gum *Arabic* due to different storage period, moisture levels and packaging materials

| Packaging material | Total colour difference (ΔE) at 6% moisture content | |
|--------------------------------|---|----------------|
| | After 3 months | After 6 months |
| LDPE (200 gauge) | 6.63 | 6.70 |
| HDPE (300 gauge) | 7.67 | 8.67 |
| HDPE (400 gauge) | 7.42 | 1.68 |
| Polypropylene (PP) (200 gauge) | 4.33 | 2.31 |
| Al foil (laminated) | 4.11 | 6.52 |
| Paper Bag | 5.58 | 9.66 |
| Jute Bag | 14.75 | 9.45 |

Table 23. Total colour difference observed in gum *Karaya* due to different storage period, moisture levels and packaging materials

| Packaging material | Total colour difference (ΔE) at 6% moisture content | |
|--------------------------------|---|----------------|
| | After 03 month | After 06 month |
| LDPE (200 gauge) | 7.82 | 11.33 |
| HDPE (300 gauge) | 7.42 | 16.57 |
| HDPE (400 gauge) | 8.31 | 8.81 |
| Polypropylene (PP) (200 gauge) | 6.76 | 14.35 |
| Al foil (laminated) | 7.17 | 9.95 |
| Paper Bag | 22.20 | 17.67 |
| Jute Bag | 19.48 | 17.46 |

10. Collaborative Projects

10.1: Lac based agro-forestry in Bundelkhand region: Introduction and evaluation [with NRC Agroforestry, Jhansi]

Under the project, *rangeeni* lac was inoculated for both summer and rainy season crop of 2011. Twenty trees of *palas* in each season were inoculated. This time, summer crop performed well as compared to other years. Broodlac produced in summer and rainy season were 30 and 70 kg respectively. It indicated that lac is being cultivated successfully at Bundelkhand. The Institute (NRC AF) has explored marketing of the produce after washing it in the form of seedlac. They got a rate of Rs 400/ kg for seedlac.

10.2: Studies on lac-based coating formulations for extending shelf life of Nagpur mandarin (*C. reticulata* Blanco) fruits [with NRC Citrus, Nagpur]

Studies were continued on both crops of Nagpur mandarin, *viz.* *Ambia* and *Mrig Bahar*, during the year under report. 2 nos. novel formulations for *Ambia* (December 2011 crop) was provided to NRCC, Nagpur. Experiment was continued for 21 days. 2 nos novel formulations for *Mrig* (March 2012 crop) were provided. High incidence of spoilage was observed in *Mrig*, as compared to *Ambia*.

Coating with lac-based formulations resulted in (1) higher gloss (2) greater mechanical strength / firmness, (3) improved cosmetic appearance, (4) higher total soluble solids and (4) maximum juice recovery, as compared to control. Lac-based formulations also had superior Drying characteristics, as compared to commercial waxes, and had no unpleasant odors or gaseous emissions, during application.

However percentage spoilage (particularly by *Diplodia* and *Penicillium* spp.) was not desirable. The work will be further refined and continued in the current season, based on preliminary data obtained from 1st year's experiments.

10.3: Termite borer and fungal resistance of shellac based varnishes [IWS & T, Bangalore]

An MoU was signed between IINRG, Ranchi & Institute of Wood Science & Technology, Bangalore



(IWS&T), Bangalore on 10th October, 2011 for anti-termite, anti-borer and anti-fungal tests of shellac-based varnishes on wooden surfaces. For the above collaborative study, four shellac-based varnishes (10.0 litres each) were prepared and supplied to IWS&T at first instance.

11. Exploratory Studies

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

Kusmi broodlac for summer (*jethwi*) lac production was inoculated on 32 pruned *ber* trees at the mean rate of 400 g/tree in January 2011. Fertigation through pitchers was applied to 16 trees from February end till mid-June (onset of monsoon). Same number of trees was kept under control. Spraying schedule was kept uniform for treatment and control. The quantity of urea was kept at



Fig. 89a Overview of the experimental site at IINRG Farm

11.2: Validation of role of potassium influencing summer rangeeni lac yield on palas and kusmi lac yield on *F. macrophylla*

Broodlac production on *palas* in summer crop was affected by direction, (south and north), liming, and potassium application is presented in Table 24.

Southern side showed clearcut superiority over northern side by producing 55% more broodlac. Other

200 g/tree for the duration and it was split accordingly, at weekly intervals.

Summer *kusmi* lac crop was harvested in July 2011. The broodlac harvested under the pitcher fertigation and control was registered to be 38.6 and 28.4 kg, respectively, against the inoculation of 6.4 kg for each treatment. Thus, the broodlac yield ratio was 1: 6.0 and 1: 4.4 for pitcher and control, respectively, registering broodlac increase of 35.9%.

Ber shoot length and girth was recorded at the time of broodlac inoculation and its harvest time. The mean shoot length and girth value for *ber* under pitcher treatment was 106.9, 3.9, 139.3 and 4.7 cm at the time of broodlac inoculation and harvesting, respectively; while the values recorded were 118.9, 4.0, 145.7 and 4.7 cm under control, respectively. An increase of 30.3 and 21.6% was observed under pitcher treatment as against 22.5 and 17.6% under control (Fig. 89 a & b).



Fig. 89b Summer *kusmi* lac crop in progress April 2011 on *ber*

yield attributing characters e.g. rejected brood yield ratio, broodlac and sticklac yield per unit length were not affected significantly. However, results suggested that good quality brood (with thick and smooth encrustation) reduced with liming, as amount of the same was recorded to be only one third of that recorded in trees with no liming. Encrustation thickness during harvest was influenced by all the factors. Change in encrustation thickness was observed after first week of



May. Observation on other supporting attributes were also recorded e.g. percent branches with wax at 60 DAI, light interception %, survival of lac at first week of March etc. Potassium application increased percent of branches with wax significantly. Light interception was 8% lower in the northern side than that in the southern side. Similarly, potassium application has increased light interception.

Following regression analysis was done to estimate how survival of lac varies with light intensity.

$$Y = 42.2 + 0.21X \text{ (R Sq value 0.18 and multiple reg 0.42)}$$

Y: percent shoots with living lac

X: Percent light interception as compared to normal

The equation validates that the denser the tree canopy having lesser light interception the lesser the lac survival.

Potassium application to *F. macrophylla* could increase summer broodlac yield almost twice than that in control (Table 25 & 26 and Fig 90 & 91). However, rejected broodlac production was significantly lower (40%) in potassium applied plants than control. Thickness of encrustation was also 16% higher in potassium applied plants. It signifies that potassium application could bestow higher brood value to kusmi lac on *F. macrophylla*.



Fig. 90 Lac crop on *F. macrophylla* with no potassium

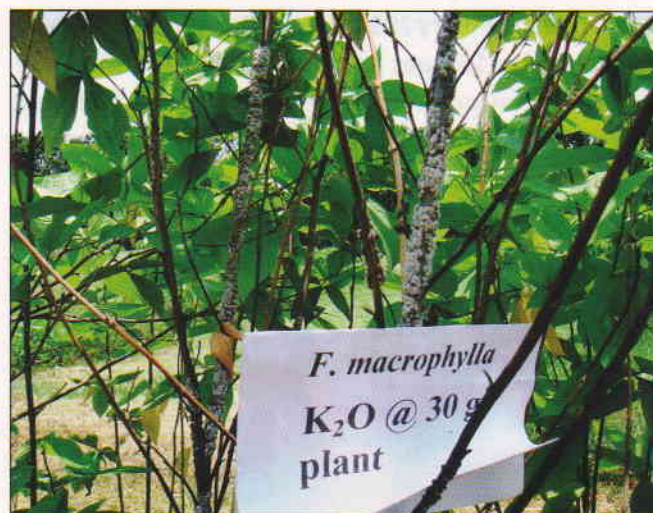


Fig. 91 Lac crop on *F. macrophylla* with potassium

Table 24. Summer season *rangeeni* lac yield and yield attributes on *palas* as affected by directions and levels of liming and potassium application

| Factors | Lac stick survival % 150 DAI | Light interception % 150 DAI | First wax 60 DAI | Thickness 180 DAI | Thickness 170 DAI | Thickness 210 DAI | Thickness 240 DAI | Brood yield ratio | Rej brood yield ratio | Smooth brood (g/tree) | Brood wt/ 10 cm | Sticklac wt/ 10 cm |
|-------------------|------------------------------|------------------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-----------------------|-----------------------|-----------------|--------------------|
| South | 64.53 | 68.56 | 42.67 | 0.25 | 0.34 | 0.40 | 0.55 | 7.22 | 2.11 | 49.33 | 7.67 | 2.10 |
| North | 47.50 | 56.95 | 33.33 | 0.25 | 0.29 | 0.36 | 0.52 | 4.64 | 1.52 | 32.00 | 7.73 | 1.79 |
| CD | 4.13* | 10.35* | 16.35 | NS | 0.02* | 0.02* | 0.02* | 1.74* | 0.70 | 31.39 | 1.23 | 0.48 |
| L0 | 55.56 | 61.32 | 40.00 | 0.25 | 0.32 | 0.38 | 0.57 | 6.12 | 1.64 | 60.33 | 7.67 | 2.07 |
| L _{2.25} | 56.47 | 64.19 | 36.00 | 0.25 | 0.30 | 0.38 | 0.51 | 5.73 | 1.99 | 21.00 | 7.73 | 1.82 |
| CD | 4.13 | 10.35 | 16.35 | NS | 0.02 | 0.02 | 0.02* | 1.74 | 0.70 | 31.39* | 1.23 | 0.48 |
| K ₀ | 56.35 | 54.57 | 21.00 | 0.25 | 0.29 | 0.38 | 0.51 | 6.23 | 1.79 | 35.00 | 7.42 | 1.93 |
| K ₁₉₀ | 53.66 | 70.14 | 55.00 | 0.26 | 0.30 | 0.40 | 0.55 | 5.17 | 1.92 | 39.25 | 7.68 | 1.93 |
| K ₃₈₀ | 58.02 | 63.55 | 38.00 | 0.25 | 0.35 | 0.37 | 0.55 | 6.38 | 1.73 | 47.75 | 7.99 | 1.98 |
| CD | 5.05 | 12.68* | 20.02* | NS | 0.03* | 0.03* | 0.02* | 2.13 | 0.86 | 38.44 | 1.50 | 0.59 |

*Significant at 5%



Table 25. Effect of potassium application and genotypes on broodlac yield (summer) of *F. macrophylla*

| Factors | Brood yield ratio | Rejected yield ratio | Thickness of brood (cm) | Thickness of rejected brood (cm) |
|----------------------|-------------------|----------------------|-------------------------|----------------------------------|
| K ₃₀ | 8.58 | 5.06 | 0.44 | 0.31 |
| K ₀ | 4.31 | 8.41 | 0.38 | 0.28 |
| CD _(0.05) | 3.62* | 2.32* | 0.04* | 0.07 |
| Amarkantak | 7.15 | 5.30 | 0.40 | 0.30 |
| Local | 5.74 | 8.17 | 0.42 | 0.29 |
| CD _(0.05) | 3.62 | 2.32* | 0.04 | 0.07 |

*Significant at 5%

Table 26. Broodlac production of summer *rangeeni* crop in farmers' field as affected by potassium application

| Sl No | Particulars | No. trees inoculated | Total Broodlac inoculated (kg) | Total Broodlac harvested (kg) |
|-------|--|----------------------|--------------------------------|-------------------------------|
| 1 | Potassium application @ 1 kg MOP/ tree | 5 | 7.0 | 22.0 |
| 2 | No application | 15 | 25.0 | 40.0 |

11.3: Characteristics of high yielding *palas* trees

A multiple regression was done in between lac yield ratio and ten lac yield attributing characters of *palas* during summer crop season. Among these, three plant characters e.g. branch thickness (primary), coefficient of variation (CV) of shoot (secondary shoots on which lac settles) thickness and shoot length were found to affect lac yield significantly. These factors could justify 41% of the variation of lac yield on *palas*. Branch diameter ranged from 1.93 to 4.09 cm, CV of shoot diameter ranged from 26 to 39% and shoot length varied from 36 to 100 cm for different trees.

The following equation was derived:

$$Y = -1.77 + 4.67X_1 - 0.41X_2 + 0.093X_3$$

(R² = 0.41; X₁= average branch diameter (cm), X₂= CV of shoot diameter and X₃=shoot length cm, Y= lac yield ratio)

As the equation suggests, a good yielding *palas* tree is supposed to have higher branch thickness, lesser variation in shoot diameter and longer shoots.

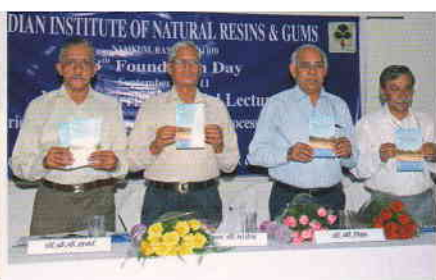


APPROVED ON-GOING RESEARCH PROJECTS

| Sl.No. | Project Title | Principal Investigator |
|--|--|------------------------|
| Productivity and Quality Improvement | | |
| 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. | Collection, conservation, characterization and documentation of lac host bio-diversity | Dr. VD Lohot |
| 5. | Host plant evaluation and improvement for lac productivity & summer sustainability | Dr. J Ghosh |
| Crop Production System Management | | |
| 6. | Evaluation of mulches for enhancing lac production on <i>palas, ber</i> and <i>Flemingia semialata</i> under rainfed condition | Dr. RK Singh |
| 7. | Lac Integrated Farming System | Dr. V Singhal |
| 8. | Development of spraying schedule of fungicides for management of sooty mold in winter <i>kusmi</i> lac crop | Dr. AK Singh |
| 9. | Influence of macro / micronutrients on <i>kusmi</i> lac production in comparison to standard package of <i>F. semialata</i> | Dr. S Ghosal |
| Processing, Storage and Quality Management | | |
| 10. | A comparative study of different drying methods on drying kinetics and quality of gum <i>Karaya</i> | Er. M Prasad |
| 11. | Development of dehumidified air drying methods/ systems for drying of value added lac products | Er. SK Pandey |
| Value Addition, Application Development and Product Diversification | | |
| 12. | Synthesis of hydrogel from gum <i>Acacia</i> and gum <i>Karaya</i> for their comparative evaluation in drug release | Shri. SKS Yadav |
| 13. | Use of natural gum/ lac for conserving natural characteristics and shelf life of select fruit and seed spices, through encapsulation | Dr. PC Sarkar |
| 14. | Development of natural resin/ gum based sticker <i>bindi</i> | Dr KP Sao |
| Capacity Building of Farmers and Entrepreneurship Development | | |
| 15. | Training, demonstration, extension education and information service on lac culture, processing and product development | Dr AK Jaiswal |



| Sl.No. | Project Title | Principal Investigator |
|---|--|------------------------|
| Technology Evaluation, Refinement, Dissemination and Demonstration | | |
| 16. | Evaluation of some newer insecticides & bio pesticides for eco-friendly management of insect pests associated with lac insect & host plants | Dr. JP Singh |
| 17. | Demonstration of lac cultivation technologies under farmers' field condition | Dr. A Bhattacharya |
| NAIP Projects | | |
| 18. | To understand the nature of diversity in lac insects of <i>Kerria spp.</i> in India and the nature of insect x host interaction (NAIP- Component -4) | Dr. KK Sharma |
| 19. | A value chain on lac and lac based products for domestic and export markets. (NAIP-Component -2) | Dr. N Prasad |
| Externally - Funded Projects | | |
| 20. | 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 |
| 21. | Production of summer <i>kusmi</i> broodlac on <i>kusum</i> for promotion of lac cultivation in Gujarat with farmer's participation. (Forest Department, Silva Division, Gujarat) | Er. RK Singh |
| 22. | National Action Plan (NAP) for sustainable income generation of tribals through cultivation and processing of lac (TRIFED) | Dr. JP Singh |
| 23. | Climate change and lac crop performance (NICRA sponsored) | Dr. Md. Monobrullah |
| 24. | Study and documentation of lac cultivation and processing of lac in Chattisgarh and market survey on lac based products (Chattisgarh Govt. Project) | Dr. G Pal |
| 25. | High density <i>ber</i> plantation for lac production under semi protected conditions (NABARD Project) | Shri. SC Meena |
| ICAR Network Project | | |
| 26. | Network project on harvesting, processing and value addition of natural resin and gums (ICAR) | Dr. N Prasad |
| Collaborative Projects | | |
| 27. | Lac based agro-forestry in Bundelkhand region: Introduction and evaluation [with NRC Agroforestry, Jhansi] | Dr. S Ghosal |
| 28. | Studies on lac based coating formulations for extended shelf life of Nagpur mandarin (<i>C. reticulata</i> Blanco) fruits [With NRC Citrus, Nagpur] | Dr. PC Sarkar |
| 29. | Termite borer and fungal resistance of shellac based varnishes [IIWS &T, Bangalore] | Dr. MZ Siddique |
| Exploratory Studies | | |
| 30. | Impact of pitcher irrigation with fertigation (urea) on shooting response lac yield on <i>ber</i> and <i>kusmi</i> | Er. RK Singh |
| 31. | Validation of role of potassium influencing summer <i>rangeeni</i> lac yield on <i>palas</i> and <i>kusmi</i> lac yield on <i>F. macrophylla</i> | Dr. S Ghosal |
| 32. | Characteristics of high yielding <i>palas</i> trees | Dr. S Ghosal |



PUBLICATION AND PUBLICITY

Publications

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- Pal G and Patel B (2011), *Chhattisgarh mein lakh vipadhan: Vastustithi Avam Sambhavnayien. Chhattisgarh Kheti*, IGKV, **18 (1)**: 4.
- Pal G and Patel B (2010), Lac Production in Orissa: Current status and Prospects. *Kisan Ki Awaaz*, **1 (12)**: 26-28.
- Pal G and Patel B (2011), *Odisha mein lakh utpadan: Vartaman Avam Sambhavanai, Modern Kheti*, February, 39-41.
- Jaiswal AK and Singh JP (2011), *Kusum briksh per lac ki kheti, Kheti*, March, 34-36.

Institute Publications

- Lac, Plant Resins & Gums Statistics at a Glance 2011. Indian Institute of Natural Resins and Gums, Ranchi
- *Bhartiya Prakritik Raal avam Gond Sansthan: Ek Nazar mein'* IINRG, Ranchi.

Publicity

Corporate Film on IINRG

- A publicity film on the Institute of 15 min duration, entitled "Prosperity through Nature", and its Hindi version, *Prakriti Se Sampannata* was produced by M/s Super-Ads, Delhi, under the technical supervision of Dr. PC Sarkar, Sr. Scientist. The films were formally released on 20th September 2012, on occasion of the 88th Foundation Day of the Institute.

Kisan Melas, Exhibitions, Institute – Industry Interface Meetings

- Dr. Md. Monobrullah, Sr. Scientist participated in the Regional Agriculture Fair at ICAR-RCER, Patna, during March 6-11, 2011.
- Dr. MZ Siddiqui, Sr Scientist, and Sri K Saran, SSS, put up the Institute's stall of Lac, Gums and Lac-based Products at the 10th Kisan Mela-2011 held at Indian Veterinary Research Institute, Izatnagar, Bareilly, during October 18-20, 2011.
- An Institute – Industry Meet on "Researchable Issues and Problems of Natural Gums industry was organised by the PPD Division, in association with CIRCOT Mumbai, on January 20, 2011.

- An Institute – Industry Meet on "Researchable Issues and Problems of Indian *Guar* Gum Industry was organised at Jodhpur (Rajsthan) by the PPD Division in association with CAZRI Jodhpur, on March 10, 2011.
- Consortium Implementation Committee (CIC) meeting of NAIP on *Lac Value Chain* was organized on July 21, 2011 at IINRG, Ranchi.
- 3rd Consortium Advisory Committee meeting of NAIP on *Lac Value Chain* was organized on Feb. 7-8, 2011 at IINRG, Ranchi.
- 4th Consortium Advisory Committee meeting of NAIP on *Lac Value Chain* was organized on Sept. 1-2, 2011 at IINRG, Ranchi.
- 3rd Coordination Committee Meeting of Network project on HPVA of NRG was organized during Nov. 22-23, 2011 at IASRI, New Delhi.

Tours / Visits

- Dr. Md. Monobrullah, Sr. Scientist and Shri RK Singh, Scientist, visited Rajpipla (Narmada district) and Malegaon (Dang district), Gujarat during January 4-10, 2011 to monitor *kusmi* lac crop on *ber* and *kusum*, and conduct a 1-day motivational training programme on 7 January, 2011 on lac production technologies and its economics.
- Dr. J Ghosh Sr. Scientist, visited Koinerdih, Angarha on April 19, 2011 and collected about 300 pods of *Swadi Palas* from tree of *Bedia Sohrai*.
- Dr. Md. Monobrullah, Sr. Scientist, visited SKUAST-J, Jammu during July 11-16, 2011 to monitor *rangeeni* lac inoculation (for *katki* crop) on *ber* and *palas* trees.
- Dr. Md. Monobrullah, Sr. Scientist and Shri RK Singh, Scientist visit Waghai, Dunderda in Gujarat to conduct an interview for selection of RA (as a member) and to monitor summer season *kusmi* lac crop at Malegaon raised under the collaborative project.
- Shri Anees K., Scientist, visited Central Tassar Research Institute, Ranchi on October 3, 2011 and collected leaf samples of *arjun* and *asan* for cryo-grinding.
- Dr. Md. Monobrullah, Sr. Scientist, visited Halumard, Satbarwa in Latehar district on October 25, 2011



to supervise the *rangeeni* broodlac inoculation on *palas* and to monitor *kusmi* lac crop raised under FLD programme.

- Dr. A. Mohanasundaram, Scientist, visited Putidih (Jhalda), West Bengal on November 30, 2011. Leaf and lac insect samples were collected from *ber* and *palas* trees under NICRA project.
- Dr. Md. Monobrullah, Sr. Scientist, visited Putidih, Jhalda district of West Bengal on November 30, 2011 for collection of *rangeeni* lac insect samples inoculation on *ber* and *palas* for initial density of settlement and initial mortality study.
- Dr. MZ Siddiqui, Sr. Scientist, visited Institute of Wood Science & Technology, Bangalore, from September 27–29, 2011 for anti-termite, anti-borer and anti-fungal tests of shellac-based varnishes on wooden surfaces.
- Dr. PC Sarkar, Sr. Scientist, visited Kerala from December 15-22, 2011, for technical discussions under ongoing project on PHT of spices with Indian Institute of Spices Research, Calicut. He also visited Central Institute of Fisheries Technology, Cochin, for exploring the possibility of collaborative research on fish processing technology.

Radio / TV Talks

- Dr. J Ghosh, Sr. Scientist, delivered a radio talk recording on *Arhar Ki Kheti Se Zyada Labh Kaise Kare* on November 26, 2011 at AIR, Ranchi.
- Dr. J Ghosh, Sr. Scientist, delivered a radio talk on *Lakh ke kheti*, broadcast on February 24, 2012, from AIR, Ranchi.

Database

- Ramani R (Project Manager), Submission of 52 sequences of COI-5P gene, under project Barcoding *Kerria*, to the Barcode of Life Data System, Ontario, for barcoding and analysis.

Patents developed

- Ranjan SK, Vidyarthi AS and Ramani R. 2011. Group-specific primers for identification of *Kerria* species. Indian Inst. of Natural Resins and Gums. 580/KOL/2011, April 25, 2011.

Commercialization of Technologies

- **Shellac-based / Varnish** : 40.0 litres of *Lac Glaze* varnish was prepared and supplied to M/s JHARCRAFT (Govt. of Jharkhand), Ranchi, for varnishing and embellishing the 34th National Games Mascot 'Chhau'. An amount of Rs 7,600/- was realized against the same. The *Lac Glaze* was used for varnishing 14,500 pieces of 'Chhau' mementos of three different sizes i.e. 6", 9" and 18" for gifting to all participants of the National Games and the dignitaries associated with the Event.
- **Fruit Coating Formulation** : An MoU was signed between IINRG, Ranchi and M/s Gupta Brother (Shellac), Bundu on December 31, 2011 for technology transfer of fruit coating formulation for *kinnow*, through licensing. An amount of Rs 1,11,100/- was realized through this technology transfer.

Success Stories

Intensive *kusmi* lac cultivation on *semialata* for sustained lac cultivation

- Shri Santosh Nirmal Horo raised a plantation of *semialata* in July / August, 2007 in area of ~ 0.2 ha with more than 2000 plants in Kharsidag village, Ranchi district with technical support from IINRG under the JLDS project. 35.0 kg of *kusmi* broodlac was inoculated in July 2008 on 1264 *semialata* plants. 241 kg broodlac and 15 kg scraped lac was harvested in next February from 1084 plants giving an output: input ratio of 6.89. Similarly, 40.0 kg of *kusmi* broodlac was inoculated in July on 1202 *semialata* plants. A very good crop (333 kg broodlac and 45 kg scraped lac) was harvested in February 2010 giving a broodlac output: input ratio of 8.325. On an average, a net profit of Rs. 56, 650 per annum (broodlac @ Rs. 200 / kg and scraped lac @ Rs. 150 / kg) was earned from 0.2 ha land. His success has motivated other farmers of the village to engage in intensive *kusmi* lac cultivation on *semialata*.

Productive *kusmi* breeds for improved lac production

- Shri Prakash Sanga of Mangobandh village in Ranchi district was involved in lac cultivation since long, but his harvested yield was very low. IINRG provided him the required technical guidance and broodlac



of productive breeds (20 kg each of Kulajanga, Nawadih and Late maturing variety) under the JLDS project in 2008. He was given training on *kusmi* lac cultivation on *ber*. A very good crop giving 191 kg broodlac of Kulajanga, 207 kg of Nawadih and 174.5 kg of late variety respectively was harvested in Feb. 2009. Similarly, a very good crop giving 156 kg broodlac of Kulajanga, 221 kg of Nawadih and 182.5 kg of late variety respectively was harvested in Feb. 2010. Enthused by the very good returns, he has turned into a whole time lac farmer and is a leading good quality broodlac supplier of the region.

Scientific method of lac cultivation in Chattisgarh

- In Kanker and Jagdalpur total thirteen farmer’s data and information were taken for documentation of

success story of lac production. The majority of successful farmers have adopted scientific method for lac production resulting in to very good crop of lac. Farmers and his family member were happy because they gain much amount of money from lac cultivation. Farmers have worked with the co-operation of lac technician present in Forest Department, Kanker and Jagdalpur. Farmer’s socio-economic condition has improved and some farmers purchased motorcycles, made *pucca* (brick) homes, and installed tube wells for irrigation. Average host holding of surveyed farmers was 50-60 trees of *kusum* and 2-5 trees of *ber*, some farmers have about 100 trees of *kusum*. Average annual income of surveyed farmers from lac is Rs. 65,000

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

Conferences / Meetings / Seminars etc.

By Director

- Attended International Symposium on Plant Biotechnology towards Tolerance to Stresses and Enhancing Crop Yield. Sept. 28 - Oct 1, 2011. BIT Mesra; Chaired the Session on Abiotic Stresses on Oct. 22, 2011.
- Participated in Seminar on Green Technology and New Trends in Waste Management at NEERI, Nagpur, Dec. 21, 2011.
- Chaired IINRG-Industry Interface Meeting at CIRCOT, Mumbai, Jan. 20, 2011.
- Attended State-level Lac Committee meeting organized by Chhattisgarh Minor Forest Produce (Trade and Dev) Co-operative Federation Ltd, Raipur under the chairmanship of Hon. State Forest Minister, Jan 31, 2011.
- Attended the First RAC meeting of National Bureau of Agriculturally Important Insects, Bengaluru, Feb. 15, 2011.
- Attended and made a presentation in the Interactive Session of KSSRDI, Bengaluru to promote lac-moriculture integration in Karnataka, Feb. 17, 2011.
- Participated and delivered Lead Lecture in the IX SPPS National Symposium at CARI, Port Blair; Chaired one Technical Session, Feb. 18-19, 2011.
- Actively participated in the Directors' Conference, New Delhi, Feb. 23-24, 2011.
- Attended RAC Chairpersons and Directors Interface of Engg. Division and Crop Sciences Division and made presentation on the ATR of RAC recommendations as well as XII Plan Overview, Feb. 28- Mar. 1, 2011.
- Chaired the Institute - Guar Industry Interface at CAZRI, Jodhpur organized by the Institute March 10, 2011.
- Special Guest, ICAR-Industry Meet, BAU, Kanke organized by ZTM-BPDU; Chaired IV Technical Session, April 1-2, 2011.
- Member, Selection Committee, for the posts of Head, PPD Division and Head, LP Division at ASRB, New Delhi, April 28-29, 2011.
- Attended Conclave on Preparation of XII Five Year Draft Plan and Road Map for Jharkhand at BNR Hotel, Ranchi, May 19, 2011.
- Attended National Committee Meeting on PHT&VA at NASC, New Delhi, June 11, 2011.
- Attended ICAR Directors' Conference on 15th July 2011 and ICAR Foundation Day Function July 15-16, 2011.
- Participated in Special Meeting for collaborative research on integrated Lac-Sericulture at CSR&TI and Annamalai University at CSR&TI, Mysore, Aug 20, 2011.
- Attended National Meeting of Entomologists at NBAIL, Bengaluru Aug 25, 2011.
- Participated in RRAC Meeting at RSRS, Ranchi, Oct 12, 2011.
- Was ICAR Nominee in Selection Committee meeting for the posts of Asst. Prof. and SMS at MPUAT, Udaipur, Nov 24, 2011.
- Attended Selection Committee Meetings for the posts of SMS as ICAR Nominee Dec 9, 2011
- Participated in Meeting of the Chemical Division Council of Bureau of Indian Standards at NEERI, Nagpur, Dec 21, 2011.

Papers in Conference, Symposia

- Ramani R (2011), Environmental quality, change and stress through biomonitoring. *In Proceedings of International Symposium on Plant Biotechnology towards Tolerance to Stresses and Enhancing Crop Yield. Sept. 28-Oct 1, 2011. BIT Mesra. p15.*
- Shamim G, Ranjan SK, Pandey DM and Ramani R (2011), Polyketide pathway in anthraquinone biosynthesis: A comparative analysis in phylogenetically diverse organisms. *In Proceedings of International Symposium on Plant Biotechnology towards Tolerance to Stresses and Enhancing Crop Yield. Sept. 28-Oct 1, 2011. BIT Mesra. p 69.*

Talks delivered

- Phone-in programme of Doordarshan, Ranchi Kendra, on lac cultivation and activities of the Institute on July 28, 2011.



- 'Natural resin-based Composites' at Meeting with the scientists at NIRJAFT, Kolkata on Sept 15, 2011.
- 'Role of lac in livelihood development and rural entrepreneurship' in the Conference on Business Development Service and Sustainable Livelihood Approach by Udyogini at Hotel Pratap Residency, Ranchi on Sept 30, 2011.
- 'Natural resins and gums for human consumption and in agriculture' at NAIP-sponsored National training programme, on Jan 24, 2012.
- 'Pharmacological importance of natural resins and gums: traditional and modern perspectives' at NAIP-sponsored National Training Programme, on Jan 25, 2012.

By Others

- Anees K., Scientist, participated and presented one poster entitled "Lac insect (*Kerria lacca*) survival in relation to stress status of ber (*Ziziphus mauritiana*)" at International Symposium on Plant Biotechnology towards Tolerance to Stresses and Enhancing Crop Yield at BIT Mesra, September 28 - October 1, 2011.
- Anees K., Scientist, attended National Dialogue on Application of Nanotechnology in Agriculture at CIFE, Mumbai, on October 8-9, 2011 and presented two Concept Notes on behalf of the Institute.
- Dr. M Monobrulla, Sr. Scientist, attended 13th Indian Agricultural Scientists and Farmers' Congress on "Sustainable Developmental Strategies for Food Security, Bio-diversity and Livelihood Security" organized by Bioved Research Society, Allahabad, February 19-20, 2011 at Allahabad and presented a paper on "Field evaluation of *rangeeni* lac insect lines for higher productivity and summer sustainability".
- RK Singh, Scientist, attended 13th Indian Agricultural Scientists and Farmers' Congress on 'Sustainable Developmental Strategies for Food Security, Bio-diversity and Livelihood Security' at Allahabad and presented a paper on "Mulching- A viable soil moisture conservation technology for early establishment of ber (*Ziziphus mauritiana*) plantation from broodlac production perspective", February 19-20, 2011.
- RK Singh, Scientist SS, attended a Workshop on 'Water Harvesting and Conservation- Affordable

Water Technologies' convened by AFPRO, Ranchi and presented a case study on 'Role of soil moisture conservation practices for establishment of ber (*Ziziphus mauritiana*) plantation in Jharkhand' on December 16, 2011.

- Thamarasi K, Scientist, attended International Symposium on Plant Biotechnology towards Tolerance to Stresses and Enhancing Crop Yield at BIT Mesra, September 28 to October 1, 2011.
- Thamarasi K, Scientist attended Workshop on "Intellectual Property Rights" at BIT, Ranchi, Dec 2, 2011.
- Thamarasi K, Scientist, participated in National Symposium on "Assessment and Conservation of Forest Genetic Resources through Biotechnological Interventions" held at Institute of Forest Productivity, Ranchi on December 19-20, 2011 and presented a paper on "Molecular Diversity Analysis of Flower Colour Variants of *Butea monosperma* using ISSR Markers.
- Dr. PC Sarkar, Sr. Scientist, Dr. G Pal, Scientist (SS) and Sri S.K. Pandey, Scientist (SS) participated in FICCI-India Innovation Growth Programme 2010 on Jan 11, 2011, at Hotel Green Horizon, Ranchi.
- Dr. N Prasad, Pr. Scientist and Dr. Divya, Sr. Scientist, attended an Interaction Meet with Scientists Trained Abroad in Frontier Areas of Agricultural Sciences at NASC, Pusa, New Delhi during November 28- 30, 2011.
- Dr. N Prasad, Pr. Scientist, attended 45th ISAE Annual Convention and International Symposium on Water for Agriculture held at College of Agriculture, Nagpur on Jan 17-19, 2011.
- Er. M Prasad, Dr. N. Prasad, Pr. Scientists and Sri KK Prasad T-7/8 attended Industry Meet (for Exudate Gums Processors & Exporters) organized by IINRG, Ranchi at CIRCOT, Mumbai on Jan. 20, 2011.
- Dr. N Prasad, Pr. Scientist, attended NAIP Review Meeting held at GBPUAT, Pantnagar during Feb. 18-19, 2011.
- Dr. N Prasad, Pr. Scientist, attended Attended Review Meeting of NAIP Sub-Project in Jharkhand held on June 29, 2011 at IINRG, Ranchi.
- Er. M Prasad and Dr. N. Prasad Pr. Scientists attended an Interaction Meeting of Project Coordinators/ Project Directors on June 16, 2011 at CIAE, Bhopal.



- Dr. N Prasad, Pr. Scientist, attended Meeting of Project Coordinators of AICRPs of Engineering Division chaired by the DG, ICAR and attended by DDG(Engg), ADG(PE) and ADG(Engg) at NASC, New Delhi on August 4, 2011 and presented Progress and XII Plan proposal of Network Project on HPVA of NRG in a meeting.
- Dr. N Prasad, Pr. Scientist, attended Meeting of Vice-Chancellors of Agricultural Universities with Project Coordinators of AICRPs Chaired by the DG, ICAR at NASC, New Delhi on Sept. 26-27, 2011 and presented progress and issues related to Network project on HPVA of NRG.
- Dr. N Prasad, Pr. Scientist, attended 3rd Coordination Committee Meeting of Network project on HPVA of NRG during Nov. 22-23, 2011 at IASRI, New Delhi.
- Dr. N Prasad, Pr. Scientist, delivered a lecture on Permeability of Thermoplastic Polymers in NAIP-sponsored National training Programme on Smart Packaging for Shelf Life Enhancement & Retention of Bio-active Compounds in Food, at CIPHET, Ludhiana, on Oct. 24, 2011.
- Dr PC Sarkar, Sr. Scientist, delivered a talk on Natural Resins & Gums in Food Processing and Packaging, at CIFT, Cochin, on December 16, 2011.
- Dr. Divya, Sr. Scientist, attended an International Conference "IFT Annual Meeting & Food Expo" in New Orleans, USA, June 10 -14, 2011.
- Dr. AK Jaiswal, Pr. Scientist and Head, Transfer of Technology Division, attended 13th Agriculture Scientist and Farmers Congress on "Sustainable development strategies for food security, bio-diversity and livelihood security organized by Bioed Research Institute of Agriculture and Technology, Allahabad, on February 19-20, 2011.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended Workshop on Livelihood Resource on March 15, 2011 at Jubilee Park organized by Forest department, Dalbhum Division, East Singhbhum, Jharkhand.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended a Meeting of *Gram Sabha Karykram Krivanya Samiti* on March 27, 2011, organized by Jharkhand Tribal Development Society at Tribal Research Institute Morhabadi, Ranchi.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended a meeting of *Senate* at Birsa Agriculture University, Ranchi on April 21, 2011.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended "Scientific Advisory Committee" meeting of KVK Koderma on May 3, 2010 at KVK, Koderma, Jharkhand.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, and CO-PI of NAIP, Component-3 attended a Meeting of CIC on May 25, 2010 at Birsa Agriculture University, Ranchi.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended a attended "Meeting-cum-Workshop Towards More Effective Role of Heads of Division and Regional Station in ICAR Institutes" on June 14-15, 2011 at Central Institute of Agriculture Engineering, Bhopal.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended "Extension Council Meeting" on June 17, 2011 at Birsa Agriculture University, Ranchi, Jharkhand.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended "Scientific Advisory Committee" Meeting of Divyayan KVK, Ranchi on September 2, 2011 at RK Mission Ranchi.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended "Scientific Advisory Committee" Meeting of Vikas Bharti, KVK, Gumla on September 30, 2011 at Gumla, Jharkhand.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended "Launch Workshop-cum Training on Lac Production" on October 14, 2011 at Jubilee Park organized by Forest department Dalbhum Division, East Singhbhum, Jharkhand.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended "Kharif Council Meeting" on October 25, 2011 at Birsa Agriculture University, Ranchi.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended National Workshop on "Development of training module on NTFP" for distance learning on November 3-4, 2011 at National Institute of Rural Development, Hyderabad.
- Dr. AK Jaiswal, Pr. Scientist and Head, TOT Division, attended a Workshop on IPR at BIT, Ranchi on December 2, 2011.



- Dr A Bhattacharya, Pr. Scientist, attended Workshop on Results Framework Document at Vigyan Bhawan, New Delhi, organized by Prime Minister Secretariat on February 22, 2011.
- Dr A Bhattacharya, Pr. Scientist, attended Review Meeting of Management System, Licencees of ERO at Kolkata, organized by BIS, Eastern Zone, Kolkata on March 14, 2011.
- Dr. A Bhattacharya, Pr. Scientist, attended An Exclusive Event “Microsoft Elevate 2011” at Hotel Capitol Hill, Ranchi organized by Microsoft India on May 17, 2011.
- Dr. A Bhattacharya, Pr. Scientist, attended Management Development Programme (MDP) on PME support to NARS at NAARM, Hyderabad, Sept. 22-27, 2011.
- Dr. A Bhattacharya, Pr. Scientist attended Workshop on Intellectual Property Rights (IPR-2011) at BIT Mesra December 2, 2011.
- Dr. G Pal, Scientist (SS) attended a National Training Programme on ‘Project formulation, risk assessment, scientific report writing and presentation at IARI, New Delhi, September 26 – 30, 2011.

Human Resource Development

- RK Singh, Scientist (SS), attended a training course on “Research Station Management” during January 17-22, 2011 at ICRISAT, Patancheru, Hyderabad.
- SC Meena, Scientist, attended 21 days training on BIPM from Feb 17 – March 9, 2011 at TNAU, Coimbatore.
- Anees K., Scientist, attended a training programme on “High Performance Bio-Computing and Drug Design” at IIT Delhi on September 12-22, 2011.
- Dr. J Ghosh, Sr Scientist, participated in “Refresher Course on Agriculture Research Management” for newly recruited Senior Scientists and Principal Scientists from non-ICAR Institutes, from November 3 – 23, 2011 at NAARM, Hyderabad.
- Dr. A Mohanasundaram, Scientist, attended the Winter School on “Introduction to biosystematics of insects, mites, spiders and their biodiversity” during November 14–23, 2011 at NBAII, Bangalore.
- Anees K, Scientist, attended one day Workshop on Intellectual Property Rights at BIT, Mesra on December 2, 2011.

- Dr. M. Z. Siddiqui, Sr. Scientist, participated in NAIP sponsored MDP on “Creativity and Innovation” during August 1-3, 2011 at the Indian Institute of Management, Lucknow.
- Dr. Divya, Sr. Scientist, attended NAIP - sponsored training on Bio-molecules at the Department of Food Science, Dale Bumper College, University of Arkansas, USA, from March 29 - June 27, 2011.
- Dr. PC Sarkar, Sr. Scientist, attended NAIP - sponsored training on Synthesis & Characterization of Nanomaterials and their Applications in Agriculture, at CIRCOT Mumbai, during November 16–29, 2011.

Honors, Awards and Recognitions

- Anees K, Scientist, won First Prize for the poster presentation at International Symposium on plant biotechnology towards tolerance to stresses and enhancing crop yield at BIT, Mesra on Sept 28 – October 1, 2011, for the poster entitled “Lac insect (*Kerria lacca*) survival in relation to stress status of ber (*Ziziphus mauritiana*)”.
- Anees K, Scientist, won Best Worker Award in Scientific Category for the year 2011 during Institute Foundation Day Celebration, 2011.
- Dr. J Ghosh, Sr. Scientist, participated in Hindi Fortnight Celebration from September 1 – 15, 2011, at Institute and won prize in *Antakshari*.
- Dr. KK Sharma and his team bagged Distinguished Team Award – 2011 of the Institute for their commendable contribution in Conservation & Multiplication of Productive Lac Insect Breeds and Resource Generation under the Revolving Fund Scheme.
- Dr. Md. Monobrullah, Sr. Scientist, was conferred “Young Scientist Associate Award” in the field of Entomology and Environmental Biology on February 19, 2011 during 13th Indian Agricultural Scientists and Farmers Congress organized by Bioved Research Society at Allahabad.
- RK Singh, Scientist (SS), was conferred conferred ‘Young Scientist Associate Award 2011’ in the field of Soil & Water Conservation Engineering 2011 by Bioved Research Society, Allahabad.
- SC Meena, Scientist, participated in Hindi Fortnight Celebration from September 1 – 15, 2011 and won first prize in Drafting and *Antakshari*.



- Dr. Thamilarashi K, Scientist, was awarded best paper presentation for “Molecular Diversity Analysis of Flower Colour Variants of *Butea monosperma* using ISSR Markers” in National Symposium on “Assessment and Conservation of Forest Genetic Resources through Biotechnological Interventions” held at Institute of Forest Productivity, Ranchi on December 19-20, 2011.
- Dr. V Singhal, Sr. Scientist, participated in Hindi fortnight celebration from September 1- 15, 2011 at the Institute and won second prize in Noting.
- Dr. N Prasad, Principal Scientist received ISAE Commendation Medal (2008-09) for outstanding contribution in the field of Processing, Dairy and Food Engineering during 45th ISAE Annual Convention and International Symposium on Water for Agriculture held at College of Agriculture, Nagpur, Jan. 17-19, 2011.
- Dr. N Prasad, Pr. Scientist, was nominated as Member of the Management Committee of Central Institute of Post Harvest Engineering and Technology, Ludhiana for a period of three years w.e.f. 09-06-2011.
- Dr. N Prasad, Pr. Scientist, was nominated as Resource Person for National Training on Smart Packaging Techniques for Self-life Enhancement and Retention of Bioactive Compounds in Food being organized by CIPHET, Ludhiana during October 11-24, 2011.
- Dr. N Prasad, Pr. Scientist was appointed as External Examiner for evaluation of Ph. D. thesis entitled ‘Studies on different Drying methods for onion (*Allium cepa* L.)’ by Orissa University of Agriculture & Technology, Bhubaneswar.
- Dr. AK Jaiswal, Pr. Scientist received “Scientist of the Year” Award 2011 by Bioved Research Institute of Agriculture and Technology” Allahabad on February 19, 2011.

Achievements in Sports

- Anees K, Scientist, was awarded the best all-rounder player during ICAR Zonal Sports Meet 2011 for Eastern Zone at IVRI, Izatnagar, UP.
- Anees K, Scientist, bagged silver medal in 4 x 100m relay race, 400m race; bronze medal in 200m race,

long jump and became runner up in table tennis at ICAR Zonal Sports Meet 2011, for Eastern Zone at IVRI Izatnagar, UP.

- Dr. A Mohanasundaram, Scientist, participated the ICAR Eastern Region Sports Meet and won silver medal (200m and 4×100 relay) at IVRI, Izatnagar, UP.

Capacity Building

- Anees K., Scientist, attended *viva-voice* examination for MSc biotechnology students as external examiner at Marwari College, Ranchi, on January 5, 2011.
- Anees K., Scientist, attended Board of Studies Meeting for Biochemistry at Marwari College, Ranchi as a Member on May 7, 2011.
- Dr. KK Sharma, Pr. Scientist & Head, LP Division, guided one M. Sc Biotechnology student of Lovely Professional University, Ludhiana, for six month project work on ‘Bar coding of parasitoids (*Aprostocetus purpureus* and *Tachardiaephagus tachardiae*) of lac insects using Cox1 sequence’.
- Dr. KK Sharma, Pr. Scientist & Head, LP Division guided one M. Sc Biotechnology student from Mangalmai Institute of Management and Technology, Greater Noida, for six month project work on ‘Bar coding of parasitoids (*Aprostocetus purpureus* and *Tachardiaephagus tachardiae* of lac insects using ITS2 sequence’.
- RK Singh, Scientist, presented a case study on ‘Role of Soil Moisture Conservation Practices for Establishment of *Ber* (*Ziziphus mauritiana*) Plantation in Jharkhand’ on December 16, 2011 in a Workshop convened by AFPRO, Ranchi.
- Dr. S Srivastava, Sr. Scientist delivered a lecture on ‘Industrial aspects of quality control for natural resins and gums’ to M.Sc. (Forestry) students from Guru Ghasidas University, Bilaspur on May 9, 2011.
- Dr. S Srivastava, Sr. Scientist delivered a lecture on ‘Industrial aspects of quality control for natural resins and gums to the BSc (Ag & Technology) students from Sam Higginbottom Institute of Science Ag & Technology, Allahabad, June 3, 2011.



Meetings –cum-Workshops on IPR

- Dr A Bhattacharya, Pr. Scientist, and SK Pandey, Scientist, SS and I/c ITMU attended Meeting-cum-Workshop of ZTMC at Kolkata, organized by NIRJAFT, Kolkata, January 28 -29, 2011.
- ITMU, IINRG participated in ICAR-Industry Meet organized by ZTM-BPD Unit, NIRJAFT at DWM, Bhubaneshwar on Feb 17 - 18, 2011.
- SK Pandey, Scientist, SS and I/c ITMU attended in ICAR-Industry Meet organized by ZTM-BPD unit, NIRJAFT at BAU, Ranchi on April 1 - 2, 2011.
- SK Pandey, Scientist, SS and I/c ITMU attended Agribusiness-Campaign of BPD Unit, NIRJAFT, on August 11 -12, 2011 for commercialization of Institute technologies.
- SK Pandey, Scientist, SS and I/c ITMU attended in the Review Meeting of all ITMUs of East Zone organized by ZTMC unit, NIRJAFT, Kolkata on Dec. 16 - 17, 2011.
- Self-review of the XI Plan Scheme (ITMU) Intellectual Property Management and Transfer/ Commercialization of Agricultural Technology was prepared and send to ADG (IP&TM), ICAR.
- ATR on recommendation of ICAR-Industry Meet 2010-11 was prepared for submission to ICAR.
- One Meeting of ITMC was organized on September 26, 2011, for technology transfer of fruit coating formulation for *kinnow*.
- Technology evaluation of potential IINRG technologies was done by ZTM-BPD Unit of NIRJAFT at IINRG, Ranchi on November 8 - 9, 2011, to evaluate cost of technology for commercialization.

Industry Meet

- Industry Meet (for Exudate Gums Processors & Exporters) organized by IINRG, Ranchi was held at CIRCOT, Mumbai on Jan. 20, 2011.
- Institute - Guar Industry Interface Meet, organized by IINRG was held at CAZRI, Jodhpur on March 10, 2011.

Exhibition-cum-Kisan Mela 2011

The Annual Exhibition-cum-*Kisan Mela* of Indian Institute of Natural Resins and Gums, Ranchi was organised on February 10, 2011. The *Mela* was inaugurated by Shri Sawna Lakra, Chief Whip, Congress Vidhayak Dal and Honourable MLA, Jharkhand. Shri AK Sarkar, Principal Secretary, Forests & Environment Department, Government of Jharkhand, presided over the function. More than 1000 farmers from different states including Andhra Pradesh, Chhattisgarh, Jharkhand, Madhya Pradesh and West Bengal participated. Dr. R. Ramani, Director, IINRG, in his Welcome Address, threw light on research achievements, activities and various programmes of the Institute for the welfare of lac farmers. He stressed on increasing lac production and conservation of broodlac in lac production system.

Shri Sawna Lakra, Chief Guest, opined that there is a great scope of lac production in forest and sub-forest areas of the country. He appreciated the contribution of the Institute and stressed that the State Government will render all support to the Institute in its endeavours. He also honoured a lac farmer with a cash award of Rs. 1000/- for his achievement in lac production. Shri AK Sarkar said that lac production is more important in terms of livelihood security for the lac growers. He asserted that the efforts taken by the Institute to generate awareness among the farmers for undertaking scientific cultivation of lac is yielding good results.

The farmers were shown around the Institute Research Farm and Museum and apprised of the various lac production technologies, new lac-host plants introduced for lac cultivation and pest management techniques. A *Kisan Gosthi* was convened on the occasion and the farmers were apprised of various lac production technologies, new lac-host plants introduced for lac cultivation and pest management methods, and on allied agricultural activities like horticulture, tasar and silk culture etc.

Besides experts of the Institute, subject matter specialists from Birsa Agricultural University (BAU), Kanke; ICAR Research Complex for Eastern Region



– Ranchi Center (ICAR-RCER-RC), Palandu, Central Tasar Research & Training Institute (CTRТИ), Nagri and Central Integrated Pest Management Center (CIPMC), Ranchi directly interacted with the farmers and tried to solve, on the spot, the problems faced by farmers in lac cultivation and other agricultural / horticultural activities.

An Exhibition comprising of 19 stalls of different organizations was also put up during the occasion. Excellent Lac Farmers Award was given to Shri Balder Marandi, Excellent Lac Production Entrepreneurship Award were given to *Lakh Sahyog Samitee*, Gaurbeda, *Maa Sharda Sanyukt Purush Mahila Samooh*, Gutidih, Jonha and Excellent Lac Promotion Executive Award was given to Sh. Sanjееv Kumar, IFS, DFO, E. Singhbhum. The Institute put up an exclusive stall for demonstration of lac-based formulations for application on different agricultural produce, including capsicums, tomatos, brinjals, pointed gourd and different spices, for increasing their shelf life and improving their cosmetic appearance. 200ml samples of coating formulations were distributed to interested farmers, on a complimentary basis.



Fig. 92. Dignitaries visiting IINRG stall to see fruit coating

On this occasion, a Press Conference was organized, in which research and extension achievements of the Institute were presented to media persona.

IINRG Foundation Day Celebrations

The Institute celebrated its 88th Foundation Day on September 20, 2011. A memorial lecture in the honour of Ms. Dorothy Norris, the Founder Director of the erstwhile Indian Lac Research Institute, marked the initiation the Celebrations. Chief Guest, Dr. Gajendra Singh, Former DDG (Engg.) ICAR and the Guest of Honour Dr. MP Pandey, VC, BAU graced the occasion.

Besides, Dr. OP Dubey, Former ADG (PP), Dr. KK Kumar, Former Director and Dr. RK Varshney, a pioneer in lac taxonomy, a large number of distinguished scientists from Central Tasar Research and Training Institute, Birsa Agricultural University, Regional Center of ICAR-RCER, Regional Station of NBPGR etc. participated in the programme.



Fig. 93. Dr G. Singh, Chief Guest, delivering First Dorothy Norris Memorial Lecture

While welcoming the Chief Guest, Dr. R Ramani, Director, dwelt upon the achievements of the Institute in the past one year – new yellow *kusmi* variety, new variant of *palas*, identification of factors causing large scale pre summer mortality in *rangeeni* lac, safer insecticides for lac, alternative bleaching method, yield improvement in aleuritic acid, long term safety of lac dye, new formulation for surface coating being some of them. He described in detail, the profile and contributions of the Mrs. Norris, Founder Director.

Dr. G. Singh, in his first Memorial Lecture on Agricultural Mechanization and Food Processing in India, underlined the necessity to exploit the huge potential for processing and value addition of agro produce for creation of employment and additional income generation. He emphasized on strengthening and sustaining the competitive advantage through constant innovations and need to take relevant research and development programmes.

Dr. KK Sharma, Head, LP Division and Convener, informed that Ms. D Norris was the longest serving Director of the institute and played a very vital and dynamic role in establishment of the institute. She was instrumental in creating a sound infra structure for the Institute, including the Chemical and Entomological Laboratories and the Research Farm.

On this occasion, distinguished workers of the institute viz. Shri Anees K, Shri P Patmajhi, Shri CL Meena and



Shri Lodo Lakra & Md. Nayeem Ansari from scientific, technical, administrative and skilled supporting staff category respectively were awarded with certificates and trophies for their commendation contribution in their sphere of work, while team award was bagged by Dr. KK Sharma and his team for Revolving Fund Scheme. Three publications viz., '*Bhartiya Prakritik Raal avam Gond Sansthan: ek nazar mein*', '*Kusum vriksh par vaigyanik lakh ki kheti*' and '*Rain water conservation for increased plant growth and lac yield on ber in Jharkhand*' and a video film, '*Prosperity through Nature*', a documentary film on IINRG, Ranchi were also released. Dr. KK Sharma, Head, LPD and Convener of the programme, proposed Vote of Thanks.

Earlier, Foundation Day was declared as an Open Day for the public in which 458 students from different schools and colleges of the city visited the institute. They were shown around the Museum and Research Farm of the Institute. A film on activities and achievements of the institute was screened for them.

A Cultural Program, organized in the evening for the participants and the employees of the Institute, followed by dinner culminated the Celebrations. The event was widely covered in the local print media.

Review Meeting of the NAIP Projects in Jharkhand

Dr. KK Sharma, Pr. Scientist and Head, LP Division organized the Review Meeting of the NAIP Projects in Jharkhand State on June 29-30, 2011 at the institute. Dr. Bangali Baboo, ND, NAIP, Dr. RC Agrawal, NC, Component - 1 and Dr. R Ramani, Director, IINRG besides 26 other CPIs, CCPs and Co-PIs participated in the Meeting.

CAC and CIC Meeting of NAIP-LID project

Fourth CAC and CIC Meeting of NAIP-LID project 'To Understand the Nature of Diversity in Lac Insects of *Kerria* spp. in India and the Nature of Insect x Host Interaction' were organized on September 21, 2011 at the Institute. Partners from BIT, Mesra, IARI and Delhi University, New Delhi participated in the Meeting.



MEETINGS OF IMPORTANT COMMITTEES

Institute Management Committee (IMC)

During the period under report, the 45th, 46th and 47th Meetings of the IMC were held on 28th January, 17th October and 24th December, 2011 respectively. The Meetings were Chaired by Dr. R. Ramani, Director, IINRG, and conducted by Shri. Ashok Ghosh, Administrative Officer, IINRG and *ex-officio* Member Secretary, IMC. Members included senior officials and eminent persona from other Govt. Departments, ICAR Institutes, and related sectors.

The following recommendations emerged out of the Meetings

- Development of new earthen pond at Farm I
- Purchase of 25 KVA generator for IRF
- Electrical renovation of LP Division
- Nomination of new Members of Institute Grievance Cell
- Recognition of hospitals and test centers
- Reorganisation of office space for Administrative and Finance & Accounts Sections
- Procurement of modular furniture for Institute
- Purchase of 30 nos. solar lights
- Purchase of 2 new computers in lieu of franking machine
- Purchase of power operated potting machine
- Purchase of Sapflow Meter in lieu of Canopy Analyzer
- Purchase of Vacuum Rotary Evaporator + Power Pack, horizontal and PAGE electrophoresis Units
- Purchase of Differential Scanning Calorimeter

Research Advisory Committee (RAC)

The XVIIth Meeting of the RAC was held on April 15, 2011 at IINRG. Following Members were present:

| | |
|---|----------|
| Dr. Suresh Prasad, Professor, Agril. & Food Engg. Deptt., IIT, Kharagpur (W.B.) | Chairman |
| Dr. A.B Rodge, Head, Deptt. Of Food Chemistry & Nutrition, College of Food Technology, Marathwada Agricultural University, Parbhani (Maharashtra) | Member |

| | |
|---|------------------|
| Dr. B.L. Soni, Managing Director, Shree Ram gum & Chemical C- 7G, Marudher Industrial Area, Basni, Phase- II, Jodhpur (Rajasthan) | Member |
| Sh. Devendranath Choubey, Gurunanak Ward, Gondia (Maharashtra) | Member |
| Dr. N.P.S. Sirohi, ADG (Engg.) ICAR, New Delhi | Member |
| Dr. Ramani, Director, IINRG, Ranchi | Member |
| Dr. K.P. Sao, Principal Scientist, PPD Division, IINRG, Ranchi | Member Secretary |

The major recommendations given by the RAC are as follows

1. Efforts should be made to strengthen infrastructure and capacity building of scientists in the area of analytical chemistry for developing higher level of derivatives/products.
2. Scientists should endeavor to establish industrial linkages and collaborations to develop need-based commercial products.
3. For enhancement of lac production, 4-5 sets of processing equipment should be provided to villagers free of charge and feedback should be analyzed after one year.
4. Organized cultivation of *ber* and *semialata* (in 1-1-5 acre clusters) should be planned in villages to enhance production of lac.
5. Watershed development approach should be adapted to enhance lac production. A case study may be undertaken in village Mangubandh under Institute's outreach programme by developing water resource through check dam on seasonal river for year-round availability of water for irrigation to host plants.
6. Institute should bring out a publication incorporating success stories of the cases where technological interventions have enhanced the income of farmers.
7. To evolve a healthy guar gum industry, guar gum should be delinked from National Commodity and Derivative Exchange (NCDEX) as it is counter productive to fair trade.



- To promote value addition of guar gum in the country, Vishesh Krishi and Gram Udyog Yojana (VKGUY) status to guar splits should be withdrawn.

XVIIIth Meeting of Research Advisory Committee was held on November 11-12, 2011 at IINRG, Namkum, Ranchi. Following Members were present:

| | |
|--|------------------|
| Dr. Suresh Prasad, Professor, Agril. & Food Engg. Deptt., IIT, Kharagpur (W.B.) | Chairman |
| Dr. A.B Rodge, Head, Dept. of Food Chemistry & Nutrition, College of Food Technology, Marathwada Agricultural University, Parbhani (Maharashtra) | Member |
| Sh. Devendranath Choubey, Gurunanak Ward, Gondia, (Maharashtra) | Member |
| Dr. N.P.S. Sirohi, ADG (Engg.) ICAR, New Delhi | Member |
| Dr. Ramani, Director, IINRG, Ranchi | Member |
| Dr. K.P. Sao, Principal Scientist, PPD Division, IINRG, Ranchi | Member Secretary |

Major recommendations given by the RAC are as follows

- Technology of pitcher irrigation developed in the Institute must be demonstrated in farmers' fields on large scale and a feedback be presented.
- Field evaluation of lac production of archer and host identification especially for the production in summer should be carried out.
- In view of high productivity of *K.chinensis* line, demonstrated in the preliminary trials, work on developing suitable insect-host combination for enhanced lac productivity should be given priority.
- Management of root system in *F. semialata* should be studied for enhancing productivity/efficiency.
- Commercial product from recently concluded project on development of surface coating compositions based on shellac-synthetic resin/polymer blends
- Process development for manufacture of *Guar* gum derivatives
- Synergetic effect/blending of gums for special applications

- The Institute should take up more extension and publicity of lac production in potential districts of Maharashtra.
- Initiation of certificate courses on natural resins and gums
- Initiation of onfield demonstration and training programme on natural resins and gums under Network Project
- Consolidated report for review for three long-term programmes in project mode on training, insect and host plant conservation & evaluation.
- Laboratory construction/renovation and improvement in infrastructure facilities

Institute Research Council (IRC)

The Institute Research Council (IRC) meeting for the year: 2011-2012 was held during April 20-21 and May 7, 2011 under the Chairmanship of Dr. R. Ramani, Director, to review the progress of institutional research projects. In his opening remarks, the Director & Chairman, IRC, welcomed the HODs, Member Secretary, IRC and the Scientists present in the meeting. He informed that the Meeting had been called to review the progress of the ongoing Institutional research projects, presentation on the new project proposals. He opined that the Scientists have to give a lot of thinking before proposing new projects considering the QRT/RAC recommendations.

Following general remarks were given by the Chairman for implementation

- Every scientist should be having at least one Institute project as PI.
- Please submit the required information as per agenda and format of IRC report.
- The timing of IRC meetings needs to be rescheduled. The first can be held in April and the second interim meeting sometimes in last week of November.
- In between the two scheduled meeting of IRC, meetings would be held for discussion on the ATRs. As soon as the decisions are taken in the IRC, action should be initiated immediately by the concerned Scientist.
- The progress of the projects be reported against the technical programme for year and ATRs should adequately covered.



- The PIs are responsible for submitting progress of the project in correct format and content.
- During the HODs presentation they should present the overall divisional activities (viz. infrastructure, training, revenue generation, publication, seminar/symposia organized etc.). The research progress/achievements will be presented by the respective PIs.
- PME Cell may prepare and circulate the format for the presentation of the HODs in future IRC meetings.
- The HODs were requested to review the time involvement and load of the Scientists.
- Er. R.K. Singh, Scientist, LPD was requested to deliver the seminar on "Farm Management System" based on his training at ICRISAT, Hyderabad.

Mid-term Institute Research Council meeting was held on December 12-13, 2011 to review the progress of ongoing institutional projects. Dr. R. Ramani, Chairman IRC, in his Welcome Address, greeted the HODs, Member Secretary, IRC, and Scientists present. He informed that the Meeting had been called to review the progress of the projects as stated by the Member Secretary.

The following were the suggestions of the Chairman, IRC:

- Proceedings of the last RAC meeting may be circulated amongst the Scientists for information and initiating action on the recommendations. He

mentioned that the proceedings have been sent to the Council, and the approval is likely to be conveyed soon.

- The HODs should present only the gist of research progress as per developed performance and focus more on developmental aspects of the Divisions in their presentations in future IRC Meetings.
- Scientists should develop technologies which are easily adoptable by the farmers.
- Lot of emphasis has been given for training the Scientists in frontier areas this year. They should make proper use of their visits/trainings for fruitful utilisation in their research projects.
- All HODs will put –up a proposal by December 25, 2011, for organizing an event except *Kisan Mela* and Foundation Day for the period January - December 2012.
- Group meeting with Divisions for strengthening quality publication by I/C, PME Cell.
- Broodlac production at IRF may be strengthened by utilizing the available host plants but not at the cost of experiments.
- A study on broodlac storage and delaying the crawler emergence during adverse climatic conditions may be planned.
- Experiment on effect of irrigation on lac culture on *semialata* may be included while evaluating performance of early maturing variety.

DISTINGUISHED VISITORS

| Date | Visitors |
|------------|---|
| 13.01.2010 | Sh. Vivek Kataruka, Lac Industrialist, Kolkata, West Bengal |
| 20.01.2011 | Sh. Ashok Kumar, Joint Director (Official language), Gol |
| 20.01.2011 | Dr. Ramapati Tiwari, Manager (Official language), MECON, Ranchi |
| 27.01.2011 | Dr. P. Dayanandan, Emeritus Scientist, Member RAMC, BSI, ZSI, Botanist, Ranchi |
| 28.01.2011 | Sh. D.J. Mitra, IFS, CCF, Ranchi |
| 15.04.2011 | Sh. B L Soni, MD, Shree Ram Gum Chemicals Ltd., Jodhpur |
| 15.04.2011 | Dr. A. K. Dubey, Pr. Scientist, CIAE Bhopal |
| 27.04.2011 | Dr. S.M.H. Qadri, Director, CSR&TI, Central Silk Board, Ministry of Textiles, Gol, Mysore |
| 26.05.2011 | Sh. Praveen Kumar Tiwari, IPS, Lucknow |
| 19.06.2011 | Dr. C.D. Mayee, Chairman, ASRB, New Delhi |
| 27.06.2011 | Sh. Rajiv Mehrishi, Secretary ICAR & AS DARE, New Delhi |
| 30.06.2011 | Dr. R.C. Agrawal, NC-I, NAIP, ICAR, N. Delhi |
| 31.10.2011 | Sh. L. K. Hazarika, Dean, Faculty of Agriculture, AAU, Jorhat |
| 31.10.2011 | Sh. R. K. Gupta, Associate Professor, SKUAST, Jammu |
| 25.11.2011 | Sh. Edward Mallone, IFAD Consultant, London |
| 14.11.2011 | Sh. P. Thamma Rao, CCN, Visakhapatnam |
| 29.11.2011 | Sh. Achyut Das, Director, AGRAGAMEE, Kashipur, Orissa |
| 02.12.2011 | Dr. R. Vijaya Kumar, NTFP-Project Manager, SERP Hyderabad |
| 05.12.2011 | Sh. T.K. Gagrai, IFS, DFO Simdega |
| 07.12.2011 | Dr. N. Sarangi, Ex-Director, CIFA, Bhubaneswar |
| 16.12.2011 | Dr. Satyendra Kumar, Head, Dept. of Zoology, SNS College, Hajipur |

SUPPORT SERVICES



Institute Research Farm (IRF)

Infrastructure Development

- A water harvesting pond of 3157 cu.m capacity was constructed at IRF in May- June, 2011.
- Brush cutter-1, disc harrow-1, balance of 100kg capacity-1, motorized sprayer- 1 and pedal operated paddy thresher -2 were purchased under XI plan
- Transplanting of 119 papaya (68 *Pusa nanha* and 51 *Simdega* varieties) and 475 *Flemingea semialata* plants was done in plot no. 38 and gap filling of 10 *Karaya gum (sterculia urens)* was done in Farm II.
- Leveling of plots, repairing of bunds and roads were completed at plot nos 55, 56, 60 and part of 61.

Lac culture

The produced broodlac/sold is as follows

| Strain | Crop | Produced broodlac (kg) | Broodlac sold (kg) | Used in Research (kg) |
|----------|----------|------------------------|--------------------|-----------------------|
| Kusmi | Aghani | 1794.5 | 1663.5 | 131.0 |
| | Jethwi | 1067.0 | 888.0 | 179.0 |
| Rangeeni | Katki | - | - | - |
| | Baisakhi | 255.0 kg | 175.0 | 80.0 |

- Beside the above broodlac production, 399 kg broodlac was inoculated on 450 *ber* trees and 76 kg *kusmi* broodlac on *F. semialata* plants
- 305 kg *kusmi* broodlac was produced by a single *kusum* tree situated behind the Director's Bungalow
- 305 kg *rangeeni* broodlac was received from research

Maintenance

- Weeding and cleaning around of 1700 *kusum*, 2500 *ber*, 2500 *palas*, 950 *galwang*, 90 *ghont*, 750 *khair*, 18 *sandan* and 1000 others trees was supervised for completion of work. The lime pasting with Biflex TC was done for termite control

Miscellaneous

- Necessary arrangements were made for visit of dignitaries like DG, ICAR and Chairman, ASRB, New

Delhi on their visit to Institute Research Farm.

- Agricultural crop – 6.1 quintal *IR – 36* (medium) and 1.4 quintal *Kasturi* (fine) paddy was harvested.

Resource generation

An amount of Rs. 9, 38,947/- (Rupees nine lakhs, thirty eight thousand, nine hundred and forty seven) only was generated as revenue from sale of farm produce during January 2011 to December 2011 as follows-

| Broodlac/ sticklac (Rs) | Fuel/ pruned twigs (Rs) | Water tanker fuel charge (Rs) | Other farm produce (Rs) | Total (Rs) |
|-------------------------|-------------------------|-------------------------------|-------------------------|------------|
| 7,98,991/- | 2,10,29/- | 2,70,00/- | 91,927/- | 9,38,947/- |

Quality Evaluation Lab (QEL)

During the period under report, a total no. of 213 samples of lac & lac-based products were received by the Laboratory from Govt. organizations / private industries / various research Divisions of the Institute, and in all 826 tests were carried out; A sum of Rs. 1,20,043/= only was earned through testing charges.

Prioritization, Monitoring and Evaluation (PME) Cell

The activities performed by Prioritization, Monitoring and Evaluation (PME) Cell, during the period under report are:

- Correspondence, compilation and preparation of various reports to the Council like Monthly reports, Monthly reports for Cabinet Secretariat, Quarterly Progress Reports, Six Monthly Progress Reports of scientists and material for DARE report, etc.
- Management of HRD programmes of scientists and other staff of the Institute
- Maintenance of Research Project Files of the Institute
- Processing of manuscripts on research/publicity 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 and staff



- Annual maintenance of computer systems and local area networking (LAN) of the Institute
- Arranging Power Point presentations during Meetings, Seminars etc.
- Maintenance of Conference Hall of Institute
- Maintenance of RAC, QRT and SRC files
- Maintenance of Database for Personnel Information Management System Network (PERMISNET) and Intelligent Reporting System
- Processing requests under Right to Information
- Maintenance of Database for Project Information Management System (PIMS Net- ICAR) a web-based software
- Hosting, Maintenance and Updation of Institute website
- Development of Application Software for record keeping of Institute publications and HRD

The PME Cell presently maintains three servers namely, Proxy server for providing internet connectivity to various Division/ Section, Mail Server for providing e-mail facilities and Apache Web Server for hosting website.

Library & Documentation Center

The Library of the Institute playing an important role in meeting the information needs of its user. Library of the Institute is a repository of scientific and Technical information on natural resins and gums. Besides catering to the needs of Institute scientists it also renders services to other researchers, academicians, technologists and students as well as lac/gums/resins industrialists from other part of the country.

The Library maintained adequate linkage with leading reference libraries for strengthening the information resources. This library also supplies photocopies of rare research articles to NISCAIR, New Delhi from time to time against payment.

Advance/Full Text/Abstracts access of 2735 journals from several publishers has been made available online through Consortium for e-Resources in Agriculture (CeRA) to our scientists during the year.

Revenue generated Rs 4,011/= from the sale of publications and reprographic services during the year.

The Library also continued to exchange of institute publications with the scientific institutions in and outside the country.

Services provided by the Library to its users

- E-journals access.
- C.D. Searches.
- Document Delivery Services.
- Reprographic Services.
- Bibliographic Services.
- Current Awareness Services.
- Inter Library Loan Services for resource sharing.
- Sale of Institute Publications.

Journals & periodicals subscribed received

- Foreign Periodicals (subscribed) 06
- Foreign Periodicals (*gratis/exchange*) 04
- Indian Periodicals (subscribed) 44
- Indian Periodicals (*gratis/exchange*) 16

Library holdings (as on 31/12/2011)

| Documents | Additions | Total Holdings |
|--------------------|-----------|----------------|
| Books | 151 | 7,851 |
| Bound Journals | 66 | 21,452 |
| Annual Reports | 81 | 4,857 |
| CD- Rom | - | 123 |
| BIS Specifications | 05 | 162 |
| Maps | - | 37 |
| Patents (Foreign) | - | 327 |
| Patents (Indian) | - | 15 |
| Theses | - | 10 |

Estate Section

The Estate Section of the Institute takes care of essential services

(1) Security of institute premises (2) Water and power supply (3) Infrastructure development work of the institute (4) Engineering research work and (5) Civil & electrical maintenance of residential quarters and research divisions / sections.



Civil Works

Completion through CPWD

AR & MO of residential quarters: (a) Type- II – 1-12 in Main campus. (b) Type III- 9,11 in main campus (c) Type IV- 1,2 in main campus (d) Type-V-3, 4 in main campus (e) AR & MO of Bungalow No.3 (f) Construction of Extension of guest house (g) Laying of new pipe line in main campus (h) construction of boundary wall at river bed pump house (i) reconstruction of part of boundary wall at IRF (j) AR & MO of building of pump house at river bed pump house and (k) roof treatment of bungalow No.1

Work carried out departmentally

(a) Distemping and white washing of quarter Type III- 1 & 13 (b) distemping and white washing of quarter Type (c) construction of PCC approach road and plinth of pump house at PDU Campus (d) RCC work of surface of transformer room (e) PCC roof work of vehicle garages in main campus (f) construction of plinth of garage and weather coating of garage (g) renovation of kitchen of Bungalow No.3 and distemping of two rooms (h) installation of net fencing in front of TOT Division and Bungalow No.2 and (i) landscaping in main campus and PDU campus.

Electrical work

Completion of work through C.P.W.D included (a) electrical renovation of PPD and TOT Divisions, (b) electrical installation of new guest house, (c) removal of poles and underground laying of new power cables, and (d) electrical renovation of river bed pump house.

Work carried out departmentally included (a) electrical renovation of Estate Section, (b) electrical renovation of identified staff quarters, (c) electrical wiring of Training Hall, (d) shifting of tubular poles etc. as well as (e) maintenance of genset and associated panels, transformer, overhead LT lines in operational condition through out the year.

The Section also carried out relevant carpentry work, as well as jobs of fitter and welder, as required from time to time.

Other activities

- Kenya grasses were planted in front of the Director's office

- 60 nos. of dropping *Ashok* trees were planted
- General maintenance and upkeep of the entire Institute premises

Health Services

The Institute has its own Dispensary in the Campus, for medical treatment / referral services of the officers and staff of the Institute, both serving and retired. It also provides services to the contractual staff appointed under various externally-funded projects operating in the Institute. Two nos. Authorised Medical Attendants: Dr. Anil Kumar and Dr. (Mrs.) Vipula Verma, continued to work as a part time Medical Officers on contractual basis on alternate days. Most of the cases were handled in the dispensary itself, except complicated cases which were referred to authorized hospitals in the city for specialised treatment.

The Dispensary is well equipped with basic instruments /accessories to handle the cases of general/minor dressing, first-aid, physical examination of males / lady patients, e.g. determining B.P, Pulse, Weight, Blood Sugar etc.. During the period under report, around 5,204 patients were attended to, in the Dispensary; 104 patients were examined for blood sugar by glucometer. Most of the medicines prescribed by AMAs were made available to the patients from Dispensary itself.

Agrometeorology

Agro-meteorology Unit of the Institute is situated at 23°23' N latitude, 85°23' E longitude and 650 m altitude. During the year: 2011, different weather parameters recorded by the unit are presented in Fig. 94. Total rainfall recorded was 2021.1 mm, of which monsoon rainfall (June-September) was 1787.4 mm, making a contribution of 88.4%. Rainfall witnessed during the monsoon period this year was even more than the average annual rainfall of Ranchi *i.e.* 1430 mm.

The heaviest rainfall of the season (166.4 mm) was recorded on August 8, 2011. Besides, August also experienced the maximum rainfall with 757.9 mm and February, the lowest, with 5.4 mm. The period during August 6-19, 2011 experienced a rainfall of 665.6 mm, which was the highest for the area during last 20 years in terms of cumulative rainfall during a fortnight. No rainfall was witnessed in March, November and December.



The maximum temperature of the year (41.2°C) was recorded on May 27 and 30, 2011 while minimum temperature (1.4°C) was recorded on December 18, 2011. The highest mean maximum temperature (39.2°C) was observed in the month of May and

the lowest mean minimum temperature (2.8°C) in January.

Relative humidity in the morning (8.30 h) varied from 36 to 100% while in the afternoon (14.00 h) it varied from 25 to 100%.

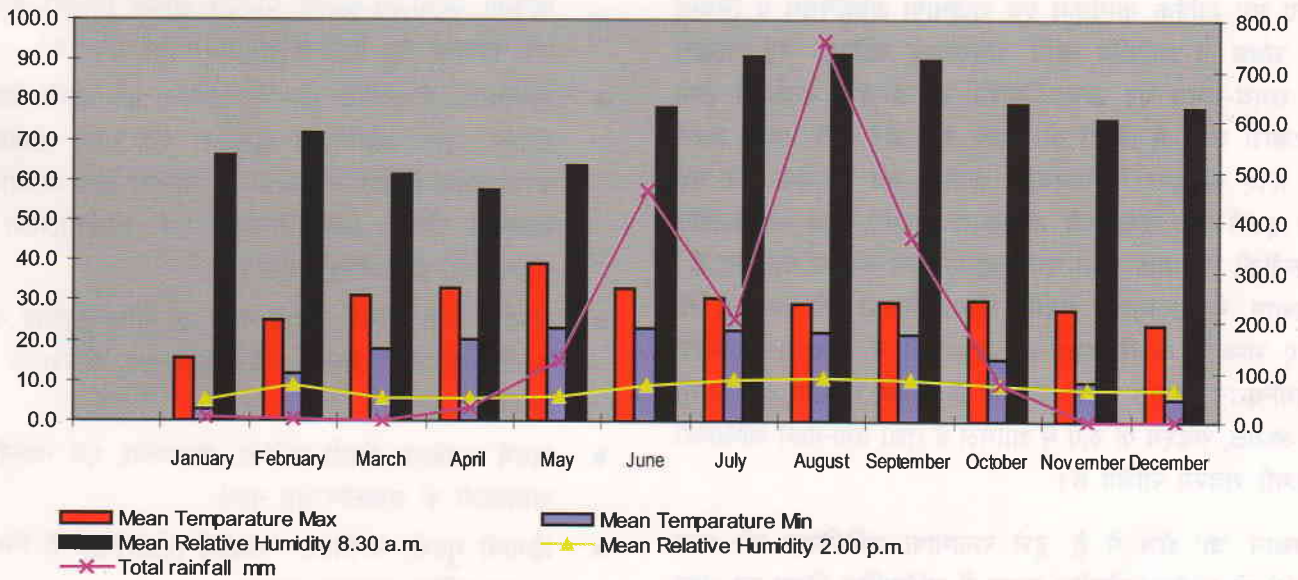


Fig. 94. Meteorological data recorded at Agro-Met Unit of the Institute during 2011



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 निदेशों 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 क्रिया-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 अन्तर्गत केन्द्रीय गजट में अधिसूचित किया जा चुका है। संस्थान के चार अनुभागों 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 हैं:

संस्थान राजभाषा कार्यान्वयन समिति की तिमाही बैठकों का आयोजन, कार्यसूची एवं कार्यवृत्त 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 हैं:

- संस्थान राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन, कार्यसूची एवं कार्यवृत्त 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, शब्दकोष, एवं तकनीकी शब्दावली के उपार्जन हेतु कार्य
- द्विभाषी मुहरों, नामपट्ट, 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 2011 में संस्थान राजभाषा कार्यान्वयन समिति की **चारों तिमाही बैठकों** का आयोजन निम्नलिखित तिथियों को किया गया तथा प्रगति की समीक्षा की गई। तिमाही रिपोर्ट एवं कार्यवृत्त परिषद सहित अन्य संबंधित कार्यालयों में प्रेषित की गई :

(क) दिनांक **04.02.2011**. (ख) दिनांक **25.05.2011** (ग) दिनांक **08.08.2011** एवं (घ) दिनांक **19.11.2011**

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

- संस्थान में हिन्दी में मूल रूप से पत्राचार बढ़ाने के लिए नकद पुरस्कार योजना का अनुपालन।
- वार्षिक कार्यक्रम 2011-12 के प्रस्ताव पर चर्चा।
- हिन्दी प्रकोष्ठ के लिए अनुबंध पर लिपिक की व्यवस्था।
- गृह पत्रिका लाक्षा-2011 का प्रकाशन।
- गोंद एवं राल के विभिन्न पहलुओं पर व्याख्यान।
- वित्त संबंधी विषय पर हिन्दी कार्यशाला का आयोजन।



- द्विभाषी मुहरों का निर्माण।
- द्विभाषी नामपट्ट की व्यवस्था।
- राजभाषा प्रकोष्ठ को प्रचार संबंधी कार्य का दायित्व।
- हिन्दी दिवस/हिन्दी चेतना मास/हिन्दी प्रतियोगिताओं का आयोजन।
- हिन्दी पुस्तकों का उपार्जन।
- हिन्दी में वैज्ञानिक संगोष्ठी का आयोजन।
- जाँच विन्दु का निर्धारण।

राजभाषा प्रकोष्ठ की उपलब्धियाँ - 2011

- "फार्म प्रबंधन पद्यति" विषय पर दिनांक 14.11.2012 को वैज्ञानिक संगोष्ठी/कार्यशाला का आयोजन किया गया।
- "लाख की वैज्ञानिक खेती" विषय पर दिनांक-09.12.2011 को हिन्दी संगोष्ठी व्याख्यान 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** के तीसरे अंक का जुलाई 2011 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।
- वर्ष 2011 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 प्रशासकीय वर्ग के कुल 05 अधिकारियों/ कर्मचारियों ने भाग लिया।

कार्यक्रम

हिन्दी चेतना मास/हिन्दी दिवस समारोह-2011

भारतीय प्राकृतिक राल एवं गोंद संस्थान में राजभाषा अधिनियम के अनुपालन एवं कार्यालय कार्य में राजभाषा के प्रयोग में उत्तरोत्तर वृद्धि के लिए संस्थान में दिनांक-01.09.2011 से 30.09.2011 तक हिन्दी चेतना मास का पालन तथा दिनांक-12.09.2011 को अपराह्न 02.00 बजे हिन्दी दिवस समारोह का आयोजन किया गया, जिसकी अध्यक्षता संस्थान के निदेशक, डॉ. रंगनातन रमणि ने की।

हिन्दी दिवस समारोह के अवसर पर मुख्य अतिथि के रूप में उपस्थित डॉ. जंगबहादुर पांडेय, प्राध्यापक, हिन्दी विभाग, राँची विश्वविद्यालय, राँची ने साहित्य की उपयोगिता विषय पर व्याख्यान दिया। डॉ. पांडेय ने मानव जीवन में साहित्य की उपयोगिता पर प्रकाश डालते हुए कहा कि ज्ञान की विभिन्न शाखाएं हमें जानकारी देती हैं, परंतु साहित्य हमें समझदारी सिखलाती है। साहित्य में ही मानव जीवन का हित छिपा हुआ है।



इस अवसर पर विशिष्ट अतिथि श्री चन्द्रेश्वर, वरिष्ठ पत्रकार एवं संयोजक, संसदीय राजनीतिक कोश निर्माण समिति, झारखण्ड विधान सभा परिसर, राँची ने अहिन्दी भाषी राज्यों में हिन्दी पत्रकारिता विषय पर प्रकाश डाला। उन्होंने अहिन्दी भाषी राज्यों में हिन्दी के शब्दों के प्रचलन की जानकारी देते हुए कहा कि लगभग सभी प्रान्तों में हिन्दी के शब्दों का बहुतायत से उपयोग किया जाता है। आज जरूरत है कि हम हिन्दी भाषा में क्षेत्रीय भाषाओं के उपयुक्त शब्दों के प्रयोग को बढ़ावा दें, जिससे हिन्दी भाषा और समृद्ध होगी।

संस्थान के निदेशक, डॉ. रंगनातन रमणि ने अपने स्वागत भाषण में कहा कि हिन्दी चेतना मास के अन्तर्गत हिन्दी दिवस समारोह का आयोजन के साथ-साथ संस्थान में लम्बे समय से राजभाषा हिन्दी का प्रयोग होता रहा है। हमारे यहाँ कार्यालय कार्य के साथ-साथ वैज्ञानिक साहित्य में भी हिन्दी



का अच्छा प्रयोग हो रहा है। संस्थान द्वारा नियमित अंतराल पर हिन्दी/द्विभाषी पुस्तिकाएं, पत्रक इत्यादि प्रकाशित होते रहते हैं। हमारा संस्थान हिन्दी के प्रयोग को बढ़ावा देने में सदैव तत्पर रहा है। हमारा पुस्तकालय वैज्ञानिक साहित्य की दृष्टि से बहुत समृद्ध है, साथ ही यहाँ प्रचूर संख्या में हिन्दी की पुस्तक/पुस्तिकाएं उपलब्ध हैं।

हिन्दी चेतना मास की अवधि में 02-03 सितम्बर 2011 को हिन्दी टिप्पण, प्रारूप लेखन, निबंध, अंताक्षरी, पर्याय, एवं हिन्दी सुलेख प्रतियोगिताओं का आयोजन किया गया। जिसमें डॉ.विभा सिंघल, डॉ. ज्योतिर्मय घोष, सर्वश्री विनोद कुमार सिंह, कामेश्वर उराँव, विनोद कुमार, रंजय कुमार सिंह, कवल किशोर प्रसाद, मदन मोहन, रघुनाथ महतो, प्रहलाद सिंह, मुन्ना लाल रविदास, हारत चन्द्र लाल, अरुण कुमार त्रिपाठी, सी एल मीणा, एस सी मीणा, अनिल कुमार सिन्हा इत्यादि को पुरस्कार प्रदान किया गया।

भारतीय कृषि अनुसंधान परिषद, नई दिल्ली के साथ-साथ संस्थान के हिन्दी प्रकाशनों की एक प्रदर्शनी लगाई गई। सभा संचालन डॉ अंजेश कुमार, त.अ. एवं धन्यवाद ज्ञापन समारोह के अध्यक्ष एवं वरिष्ठ वैज्ञानिक डॉ जय प्रकाश सिंह ने किया।

इस अवसर पर संस्थान के सभी अधिकारियों/कर्मचारियों ने भाग लिया।

वर्ष 2011-12 की अवधि में संस्थान के हिन्दी/द्विभाषी प्रकाशन

- लाख की खेती कब, क्यों, कैसे-पुस्तिका, पृष्ठों की संख्या-22
- पलास वृक्ष पर लाख की वैज्ञानिक खेती, फोल्डर, पृष्ठों की संख्या-06
- बेर वृक्ष पर लाख की वैज्ञानिक खेती, फोल्डर, पृष्ठों की संख्या-06
- कुसुम वृक्ष पर लाख की वैज्ञानिक खेती, फोल्डर, पृष्ठों की संख्या-06
- लाक्षा, राजभाषा पत्रिका, पृष्ठों की संख्या-96

- भा.प्रा.रा.गों.सं.-एक नजर में, पुस्तिका, पृष्ठों की संख्या-12
- लाख की खेती पूछें आप बताएं हम, पुस्तिका, पृष्ठों की संख्या-38
- कैसे करे पलास वृक्ष पर लाख की खेती पुस्तिका पृष्ठों की संख्या-20
- कैसे करे बेर वृक्ष पर लाख की खेती, पुस्तिका, पृष्ठों की संख्या-16
- कैसे करे कुसुम वृक्ष पर लाख की खेती, पुस्तिका, पृष्ठों की संख्या-12
- प्राकृतिक राल एवं गोंद, भा.प्रा.रा.गों.सं. समाचार पत्रिका-जनवरी-मार्च 15(1) - पृष्ठों की संख्या-08
- प्राकृतिक राल एवं गोंद, भा.प्रा.रा.गों.सं.समाचार पत्रिका - अप्रैल - जून 15(2)-पृष्ठों की संख्या-08
- प्राकृतिक राल एवं गोंद, भा.प्रा.रा.गों.सं.समाचार पत्रिका - जुलाई-सितम्बर 15(3)-पृष्ठों की संख्या-08
- प्राकृतिक राल एवं गोंद, भा.प्रा.रा.गों.सं.समाचार पत्रिका - अक्टूबर-दिसम्बर 15(4)-पृष्ठों की संख्या-08
- राँची नगर राजभाषा कार्यान्वयन समिति की छमाही बैठक दिनांक 28.01.2011 एवं 29.08.2011 को केन्द्रीय मनश्चिकित्सा संस्थान, काँके, राँची में आयोजित की गई तथा संस्थान का प्रतिनिधित्व डॉ. अंजेश कुमार, तकनीकी अधिकारी (रा.भा.) ने किया। समिति के सचिव के अनुरोध पर दोनों बैठकों का संचालन भी किया गया।
- 03-04 मार्च 2011 की अवधि में अर्थशास्त्रीय शब्दावली नई संकल्पनाएं एवं सामन्जस्य विषय पर रांची विश्वविद्यालय में आयोजित दो दिवसीय संगोष्ठी में संस्थान के तीन अधिकारियों को नामित किया गया।
- दिनांक 15.06.2011 को कुसुम एवं फ्लेमिंजीया सेमियालता के विभिन्न भागों का उपयोग विषय पर वैज्ञानिक व्याख्यान कार्यशाला का आयोजन किया गया।



| सं.रा.क.स.में लिए गए निर्णय | अनुवर्ती कार्रवाई |
|---|---|
| नकद पुरस्कार योजना लागू करना | रिपोर्ट की अवधि में नकद पुरस्कार योजना लागू की गई। |
| जाँच बिन्दु जारी करना | राजभाषा हिन्दी के अनुपालन के लिए जाँच बिन्दु लागू किये गए। |
| लाक्षा 2011 का प्रकाशन करना | लाक्षा 2011 का प्रकाशन जुलाई 2011 में किया गया। |
| वैज्ञानिक व्याख्यान का आयोजन | दिनांक 15.06.12 को वैज्ञानिक व्याख्यान का आयोजन किया गया। |
| प्रवीणता प्राप्त अधिकारियों/कर्मचारियों को व्यक्तिशः आदेश जारी करना | प्रवीणता प्राप्त अधिकारियों/कर्मचारियों को व्यक्तिशः आदेश जारी कर दिए गये हैं। |
| हिन्दी चेतना मास एवं हिन्दी दिवस समारोह का आयोजन | दिनांक 01.09.2011 से 30.09.2011 तक हिन्दी चेतना मास तथा दिनांक 12.09.2011 को हिन्दी दिवस समारोह का आयोजन किया गया। |
| हिन्दी प्रतियोगिताओं का आयोजन | हिन्दी चेतना मास की अवधि में हिन्दी प्रतियोगिताओं का आयोजन किया गया। |
| नकद पुरस्कार योजना 2010-11 का मूल्यांकन एवं पुरस्कार वितरण | नकद पुरस्कार योजना 2010-11 के मूल्यांकन के लिए गठित समिति द्वारा कार्यों की जाँच के उपरान्त पुरस्कार का निर्धारण एवं वितरण किया गया। |
| वैज्ञानिक गोष्ठी/कार्यशाला का आयोजन | दिनांक 14.11.2012 को 'फार्म प्रबंधन पद्धति' विषय पर वैज्ञानिक गोष्ठी/कार्यशाला का आयोजन किया गया। |
| हिन्दी पुस्तकों का उपार्जन | इसके अन्तर्गत लाख सहित अन्य गोंद-राल संबंधी विषयों के उल्लेख को ध्यान में रखते हुए वेद एवं मत्स्य पुराण तथा अन्य पुस्तकों का क्रय किया गया। |
| हिन्दी में वैज्ञानिक गोष्ठी/कार्यशाला का आयोजन | लाख की वैज्ञानिक खेती विषय पर दिनांक 09.12.2011 को संगोष्ठी/कार्यशाला का आयोजन किया गया। |
| प्रशासनिक विषय पर हिन्दी कार्यशाला | यह कार्यशाला फरवरी 2012 में आयोजित की जाएगी। |
| अनुवाद के लिए आउटसोर्सिंग | परिषद से आउटसोर्सिंग की निर्धारित दर प्राप्त करने के बाद स्थानीय स्तर पर यह कार्य कराया जाएगा। |

PERSONNEL

Details of Scientific, Technical, Administrative and Supporting Staff as on December 31, 2011

| Scientific | Sanctioned Strength |
|------------------------------|---------------------|
| R.M.P. | 01 |
| Principal Scientist | 06 |
| Senior Scientist | 14 |
| Scientist | 26 |
| Total | 47 |
| Technical | |
| Category - I | 41 |
| Category - II | 21 |
| Total | 62 |
| Administrative | |
| Sr. A.O. | 01 |
| F.& A.O. | 01 |
| A.A.O. | 02 |
| A.D. (O.L.) | 1 |
| P.S. | 01 |
| Security Officer | 01 |
| P.A. | 02 |
| Assistant | 10 |
| Sr.Clerk | 05 |
| Jr.Clerk | 06 |
| Steno Gr.III | 01 |
| J.A.O. | 01 |
| Total | 32 |
| Skilled Support Staff | |
| S.S.S. | 82 |
| Total | 82 |

| Cadre | Sanctioned | In-Position |
|----------------|------------|-------------|
| Scientific | 47* | 29* |
| Technical | 62 | 54 |
| Administrative | 32 | 25 |
| Supporting | 82 | 60 |
| Total | 223 | 168 |

* Including one RMP (Director)

| Dr. R. Ramani | Director |
|-----------------------------------|----------------------|
| Division of Lac Production | |
| Dr. KK Sharma, P.S. & Head | Agril. Entomology |
| Dr. AK Singh, P.S. | Plant Pathology |
| Dr. S Ghosal, Sr. Sc. | Agronomy |
| Dr. Md. Monobrullah, Sr. Sci. | Agril. Entomology |
| Dr. (Smt) V. Singhal, Sr. Sci. | Agro- Forestry |
| Dr. J Ghosh, Sr. Sci. | Pl. Breeding |
| Sri RK Singh, Sc.(Sr. Scl.) | Soil, Water C. Engg. |
| Dr. VD Lohot, Sc. | Pl. Physio. |
| Sri Anees K, Sc. | Biochemistry(PS) |
| Dr. (Smt) Thamarasi K, Sc. | Biotechnology (Ag.) |
| Dr. A Mohanasundaram, Sc. | Agril.Entomology |
| Sri SC Meena, Sc. | Agril. Entomology |
| 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 B Kumar, T-5 | F/F Tech. |
| Sri RK Swansi, T-5 | F/F Tech. |
| Sri SK Tripathi, T-3 | F/F Tech. |
| Sri B Kumar, T-2 | Lab. Tech. |
| Sri SK Yadav, P.A. | Admin. |



| Division of Processing and Product Development | |
|---|--------------------|
| Sri M Prasad, P.S. & I/c | Chemical Engg. |
| Dr. KP Sao, P.S. | AS & PE |
| Dr. N Prasad, P.S. | AS & PE |
| Dr. PC Sarkar, Sr. Sci | Agril. Chemicals |
| Dr. Divya, Sr. Sci | Agril. Chemicals |
| Dr. S Srivastava, Sr. Sci. | Agril. Chemicals |
| Dr. MZ Siddique, Sr. Sci. | Agril. Chemicals |
| Sri SK Pandey, Sci.(Sr. Scl.) | Mech. Engg. |
| Sri MF Ansari, Sci. (Sr. Scl.) | Agril. Chemical |
| Sri SKS Yadav, Sci. | Agril. Chemicals |
| Dr. SC Sharma, Sci. | Farm Mach. & Power |
| Dr. A Roy Chaudhary, Sci. | Agril. Chemicals |
| Sri DD Singh, T(7-8) | Lab. Tech. |
| Sri TK Saha, T-6 | Lab. Tech. |
| Sri KK Prasad, T(7-8) | Lab. Tech. |
| Sri Bholu Ram, T-5 | Lab. Tech. |
| Smt. P Devi, T-5 | Lab. Tech. |
| Sri B Kumar, T-3 | Lab. Tech. |
| Sri SK Tirkey, T-3 | Lab. Tech. |
| Sri A Kumar, T-3 | Lab. Tech. |
| Sri RK Rai, T-3 | Lab. Tech. |
| Sri A Kumar, T-3 | Lab. Tech. |
| Division of Transfer of Technology | |
| Dr. AK Jaiswal, P.S. & Head | Agril. Entomology |
| Dr. A Bhattacharya, P.S. | Agril. Entomology |
| Dr. JP Singh, Sr. Sc. | Agril. Entomology |
| Dr. G Pal, Sc.(Sr. Scl.) | Agri. Economics |
| 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-5 | F/F Tech |
| Smt R Sen, T-5 | Lab. Tech |
| Sri P Patamajhi, T-5 | F/F Tech. |

| Sri Madan Mohan, T-3 | Lab. Tech. |
|-------------------------------------|----------------------------|
| Sri Hari Vilas, Steno | Admin. |
| P.M.E. Cell | |
| Dr. A Bhattacharya, P.S. | I/c PME |
| Sri AK Sahay, T-(7-8) | F/F Tech. |
| Sri D Ganguly, T-6 | Lab. Tech. |
| Sri S Kumar, T-5 | Lab. Tech. |
| Administrative Section | |
| Sri Ashok Ghosh | Administrative Officer |
| Admin. I | |
| Sri SC Lal | Asstt. |
| Sri RN Mahto | Asstt. |
| Sri RK Toppo | Asstt. |
| Sri KM Kumar | Jr.Clerk |
| Sri B Mahto | Jr.Clerk |
| Admin. II | |
| Sri D Ghosh,T(7-8) | D.D.O. |
| Sri A Pandey | Asstt. |
| Sri AK Tripathi | Asstt. |
| Sri A Gope | Asstt. |
| Sri S Kumar | Sr.Clerk(Cashier) |
| Sri KK Deonath, | Sr.Clerk |
| Admin. III | |
| Sri P Singh | Incharge(Pur.Sec.) |
| Sri Ravishanker | Asstt. |
| Sri T Minz | Asstt. |
| Sri B Sahu | Asstt. |
| Steno | |
| Sri AK Sinha | Private Secretary |
| Audit & Accounts Section | |
| Sri GC Joshi | Finance & Accounts Officer |
| Sri CL Meena | J.A.O. |
| Sri K Oraon | Asstt. |
| Sri KP Kashi | Sr.Clerk |
| Sri A Kumar | Jr.Clerk |



| Institute Research Farm | |
|--|--------------------|
| Sri LCCN Shahdeo, T-(7-8) I/c Farm | F/F Tech. |
| Sri M Surin, T-5 | F/F Tech. |
| Sri S Kumar, T-4 | F/F Tech. |
| Sri SK Mukherjee, T-3 | F/F Tech. |
| Sri J Oraon, T-1 | T. Driver |
| Estate Section | |
| Sri AK Yadav, Security Officer | I/c Estate |
| Sri HL Bhakta, T-4 | Workshop Tech. |
| Sri B Kumar, T-3(J.E.) | Workshop Tech. |
| Sri A Sharma, T-3 | Workshop Tech. |
| Sri RK Ravi, T-3 | Workshop Tech. |
| Sri K Tirkey, T-3 | Workshop Tech. |
| Sri BS Choudhary, T-3 | Workshop Tech. |
| Sri P.VD Tirkey, T-2 | Workshop Tech. |
| Sri R K Singh, T-2 | Workshop Tech. |
| Sri AK Sharma, T-2 | Workshop Tech. |
| Sri M Mahto, T-1 | Workshop Tech. |
| Sri S Oraon, T-1 | Workshop Tech. |
| Sri A Kishore, AAO | Admin. |
| Library | |
| Sri V.K.Singh, T-(7-8), | I/c, Lib. & Doc. |
| Sri Binod Kumar, T-5 | Lib. & Doc. |
| Hindi Cell | |
| Dr. A Kumar, T-5 | Sr. Translator |
| Quality Evaluation Lab (PPD Division) | |
| Sri D Ghosh, T-(7-8) | Lab. Tech. |
| Sri BK Singh, T-2 | Lab. Tech. |
| Dispensary | |
| Dr. (Smt) V Verma | A.M.A. (Part time) |
| Dr. S Dutta | A.M.A. (Part time) |
| Dr. (Smt) SR Reddy | A.M.A. (Part time) |
| Sri CK Singh | Pharmacist (T-3) |
| Transport | |
| Sri A Kumar, T-4 | Driver |
| Sri J Tewari, T-3 | Driver |
| Sri M Singh, T-3 | Driver |
| Sri RK Yadav, T-3 | Driver |
| Sri B Oraon, T-1 | Driver |

(A) Promotion:

Administration

1. Sri RK Toppo, Asstt. promoted to the post of Asstt. w.e.f. 30.03.2011

M.A.C.P.

The financial benefit given to Sri Thibu Minz, Asstt. to the next higher grade pay w.e.f. 01.09.2008.

Technical

1. Sri M Surin, T-3 promoted to the post of T-4 w.e.f. 01.01.2001
2. Sri BS Choudhary, T-2 promoted to the post of T-3 w.e.f. 01.07.2009
3. Sri J Tewari, T-2 promoted to the post of T-3 w.e.f. 10.05.2010
4. Sri Rama Kant Singh, T-1 promoted to the post of T-2 w.e.f. 13.01.2010
5. Sri Binod Kumar, T-4(Library) promoted to the post of T-5 w.e.f. 27.12.2009
6. Sri Bhupal Kumar, T-1 promoted to the post of T-2 w.e.f. 06.12.2009
7. Sri KA Nagruwar, T-4 promoted to the post of T-5 w.e.f. 03.02.2010
8. Sri SB Azad, T-4 promoted to the post of T-5 w.e.f. 01.07.2010
9. Sri Satish Kumar, T-3 promoted to the post of T-4 w.e.f. 05.06.2011
10. Sri SK Mukherjee, T-2 promoted to the post of T-3 w.e.f. 04.06.2011
11. Sri SK Tripathi, T-2 promoted to the post T-3 w.e.f. 05.06.2011
12. Sri Madan Mohan, T-2 promoted to the post of T-3 w.e.f. 04.06.2011
13. Smt. Prabha Devi, T-4 promoted to the post of T-5 w.e.f. 03.02.2010
14. Sri RK Swansi, T-4 promoted to the post of T-5 w.e.f. 03.02.2010
15. Sri BK Singh, T-2 promoted to the post of T-3 w.e.f. 05.06.2011
16. Sri RK Rai, T-2 promoted to the post of T-3 w.e.f. 04.06.2011



17. Sri Ajay Kumar, T-2 promoted to the post of T-3 w.e.f. 05.06.2011
18. Sri SK Tirkey, T-2 promoted to the post of T-3 w.e.f. 04.06.2011
19. Sri Anup Kumar, T-2 promoted to the post of T-3 w.e.f. 06.06.2011
20. Sri Binod Kumar, T-2 promoted to the post of T-3 w.e.f. 04.06.2011
21. Sri Markus Surin, T-4 promoted to the post of T-5 w.e.f. 01.01.2006
22. Sri Arvind Kumar, T-3 promoted to the post of T-4 w.e.f. 29.06.2011
23. Sri Kunwar Tirkey, T-2 promoted to the post of T-3 w.e.f. 14.06.2011
24. Sri RK Ravi, T-2 promoted to the post of T-3 w.e.f. 29.06.2011
25. Sri Arjun Sharma, T-2 promoted to the post of T-3 w.e.f. 29.06.2011
26. Sri AK Sharma, T-1 promoted to the post of T-2 w.e.f. 30.12.2010

Supporting

- (i) The financial benefit given to all 62 S.S.S. to the next higher grade pay w.e.f. 01.09.2008 & onwards.
- (ii) The financial benefit given to S/Sri Mahavir Mahto, Sukra Ekka and Bandi Lakra, S.S.S. to the next higher grade pay w.e.f. 01.09.2008

(B) Advance Increments

1. Two advance increments were granted to Sri ML Ravidas, T-5 (F/F) w.e.f. 08.06.2008
2. Three advance increments were granted to Sri RL Ram, T-5 (F/F) w.e.f. 01.01.2010
3. Three advance increments were granted to Sri RP Srivastava, T-5 (F/F) w.e.f. 01.01.2010

(C) Joining

- (i) Dr. KK Sharma, P.S. took over the charges of Head, L.P.D. on 26.05.2011
- (ii) Dr. Arnab Roy Choudhary joined as Scientist (Agril. Chemicals) on 05.09.2011

(D) Death

- (i) BK Rajak, Ex-Assistant on 24.01.2011

APPENDIX

Appendix I

Details of weekly training programmes organized

Farmers' training programme on "Scientific lac cultivation, processing and utilization"

| Sponsoring Organization | State | Period | No. of participants |
|---|-----------------------------|--------------------|---------------------|
| MECON India Ltd., Ranchi | Jharkhand | 03.01.11 -07.01.11 | 16 |
| District Industries Centre, Midnapur | West Bengal | 03.01.11 -07.01.11 | 07 |
| National Agriculture Innovation project (NAIP) Lac Value Chain, IINRG, Ranchi | Jharkhand | 10.01.11-15.01.11 | 31 |
| Forest Department | Jharkhand | 10.01.11- 15.01.11 | 06 |
| TRIFED, Mahasamund | Chhattisgarh | 17.01.11- 22.01.11 | 49 |
| Forest Department, Khunti | Jharkhand | 17.01.11 -22.01.11 | 01 |
| Vyakti Vikas Kendra, India (Art of living) - Steel Authority of India Ltd, Ranchi | Jharkhand | 24.01.11- 29.01.11 | 21 |
| MECON India Ltd., (KanDr.i) Ranchi | Jharkhand | 24.01.11 -29.01.11 | 07 |
| District Industries Centre (DIC), Purulia | West Bengal | 24.01.11 -29.01.11 | 21 |
| DIC Murshidabad & Malda | West Bengal | 24.01.11 -29.01.11 | 09 |
| NAIP- Livelihood, Jamtara- Birsa Agrl. University | Jharkhand | 31.01.11 -03.02.11 | 13 |
| Vyakti Vikas Kendra, India (Art of living), SAIL, Ranchi | Jharkhand | 31.01.11- 03.02.11 | 16 |
| Forest Department, Ranchi | Jharkhand | 31.01.11 -03.02.11 | 16 |
| TRIFED, Nabrangpur, Odisha (Sarvodaya Samittee) | Odisha | 07.02.11 -1.02.11 | 19 |
| NAIP- Livelihood Jagdalpur – Indira Gandhi Krishi Viswa vidyalaya, Raipur | Chhattisgarh | 14.02.11 -19.02.11 | 33 |
| Private- Ramgarh & Nizamabad | Jharkhand Andhra Pradesh | 14.02.11 -19.02.11 | 02 |
| TRIFED- Forest Department, Mahasamund | Chhattisgarh | 21.02.11- 26.02.11 | 39 |
| Forest Department, South Surguja | Chhattisgarh | 07.03.11 -11.03.11 | 24 |
| NAIP- Livelihood, Jamtara- Birsa Ag University | Jharkhand | 14.03.11 -16.03.11 | 21 |
| Forest Department, Latehar | Jharkhand | 14.03.11 -18.03.11 | 06 |
| Forest Department (Afforestation), Ranchi | Jharkhand | 14.03.11 -18.03.11 | 09 |
| Forest department, Saraikela | Jharkhand | 04.04.11 -08.04.11 | 09 |
| Department of Afforestation, Ranchi | Jharkhand | 04.04.11- 08.04.11 | 17 |



| Sponsoring Organization | State | Period | No. of participants |
|--|---------------------------|--------------------|---------------------|
| Forest Department, Hosangabad Private- Ranchi | M.P. Jharkhand | 18.4.11 - 23.4.11 | 07 01 |
| R K Mission, Narayanpur | Jharkhand | 25.4.11 - 30.04.11 | 33 |
| CCN Sahayog, Vishakhapatnam | Andhra Pradesh | 02.5.11 - 07.5.11 | 10 |
| Forest Department, Mahasamund | Chhattisgarh | 02.5.11- 07.5.11 | 12 |
| TRIFED, Ranchi | Jharkhand | 09.05.11- 14.05.11 | 19 |
| Forest Department, Yavatmal | Maharashtra | 25.5.11 - 28.5.11 | 24 |
| Forest Department, Raigarh Private- Ranchi | Chhattisgarh Jharkhand | 13.06.11- 18.06.11 | 36 03 |
| Forest Department, Giridih | Jharkhand | 20.06.11 -25.06.11 | 05 |
| TRIFED, Ranchi | Jharkhand | 20.06.11 -25.06.11 | 07 |
| TRIFED, Ranchi | Jharkhand | 27.06.11 -02.07.11 | 18 |
| Forest Department, Ranchi | Jharkhand | 11.10.11- 15.10.11 | 13 |
| Private- Palamau, Ranchi | Jharkhand | 17.10.11 -22.10.11 | 02 |
| Forest Department, Ranchi | Jharkhand | 19.10.11- 22.10.11 | 03 |
| Forest Department, Ranchi | Jharkhand | 08.11.11 -12.11.11 | 25 |
| Private- Surguja | Chhattisgarh | 14.11.11- 19.11.11 | 02 |
| Private-Jamui | Bihar | 14.11.11- 19.11.11 | 01 |
| TRIFED, Nabrangpur TRIFED, Sundergarh | Odisha | 21.11.11-26.11.11 | 28 29 |
| Private -Gumla | Jharkhand | 21.11.11 -26.11.11 | 02 |
| Private- Ranchi | Jharkhand | 28.11.11- 03.12.11 | 02 |
| MECON, Ltd., Ranchi | Jharkhand | 05.12.11- 09.12.11 | 40 |
| NAIP- Value chain- IINRG Ranchi | Jharkhand | 05.12 - 09.12.11 | 01 |
| Private | West Bengal | 05.12 - 09.12.11 | 01 |
| TRIFED, Nabrangpur TRIFED-Sundergarh | Odisha | 12.12.11 -17.12.11 | 23 21 |
| Private- Midnapur | M.P. | 12.12.11 -17.12.11 | 02 |
| Private-- Simdega | Jharkhand | 12.12.11- 17.12.11 | 01 |
| Forest Department, Bundu, Ranchi | Jharkhand | 19.12.11- 24.12.11 | 05 |
| Total | | | 768 |



Master trainers' programme on scientific lac cultivation, processing and utilisation

| Sponsoring Organization | State | Period | No. of participants |
|--|-----------------------------|---------------------|---------------------|
| Forest Department, Korba & Surguja | Chhattisgarh | 28.02.11 - 05.03.11 | 14 |
| Forest Department, North Surguja | Chhattisgarh | 07.03.11- 11.03.11 | 21 |
| Forest Department, Surguja | Chhattisgarh | 22.03.11- 26.03.11 | 51 |
| Forest Department, Dhramjaigarh, Raigarh | Chhattisgarh | 18.04.11- 23.04.11 | 44 |
| Forest Department, Raipur | Chhattisgarh | 11.07.11- 16.07.11 | 41 |
| Forest Department, Raipur | Chhattisgarh | 18.07.11 - 23.07.11 | 22 |
| Forest Department, Raipur | Chhattisgarh | 25.07.11- 30.07.11 | 07 |
| CGMFP Fed. Ltd., Durg -Master trainers | Chhattisgarh | 01.08.11 -06.08.11 | 20 |
| Private – Ambikapur, Raipur, Coochbehar | Chhattisgarh West Bengal | 11.10.11 - 15.10.11 | 2 2 |
| Forest Department, Raigarh | Chhattisgarh | 17.10.11 -22.10.11 | 02 |
| Forest Department, Korea | Chhattisgarh | 14.11.11 - 19.11.11 | 30 |
| Forest Department, Manendragarh, Korea | Chhattisgarh | 28.11.11- 03.12.11 | 24 |
| Forest Department, Manendragarh, Korea | Chhattisgarh | 19.12.11- 24.12.11 | 34 |
| Total | | | 314 |

Educational programme (One-week) on production, processing and uses of natural gums and resins

| Sponsoring Organization | State | Period | No. of participants |
|--|---------------|---------------------|---------------------|
| Sam Higinbottom Institute of Ag. Sc. & Tech, Allahabad | Uttar Pradesh | 03.01.11- 07.01.11 | 02 |
| Guru Ghasidas Viswavidyalaya, Bilaspur | Chhattisgarh | 02.05.11 - 11.05.11 | 15 |
| College of Agriculture, Banaras Hindu University, Varanasi | Uttar Pradesh | 16.05.11 -21.05.11 | 26 |
| Sam Higinbottom Institute of Ag. Sc. & Tech, Allahabad | Uttar Pradesh | 30.05.11 - 04.06.11 | 40 |
| College of Agriculture, Banaras Hindu University, Varanasi | Uttar Pradesh | 06.06.11 -10.06.11 | 34 |
| Total | | | 117 |



INDIAN INSTITUTE OF NATURAL RESINS AND GUMS

(Formerly Indian Lac Research Institute)

Namkum, Ranchi - 834010 (Jharkhand)

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