Annual Report 2023

Stepping into the 100th Year









ICAR-National Institute of Secondary Agriculture

भाकृअनुप–राष्ट्रीय कृषि उच्चतर प्रसंस्करण संस्थान

Namkum, Ranchi - 834 010 (Jharkhand)

नामकुम, राँची - 834 010 (झारखण्ड)

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Preface



Understanding the pressing need of the World towards meeting the Sustainable Development Goal to "End hunger, achieve food security and improved nutrition and promote sustainable agriculture" (SDG2), countries across the World including India have shifted their focus to the development of Secondary Agriculture which has a bearing on climate change adaptation and mitigation, small farm viability and profitability, food security, nutrition, sustainable utilization of natural resources, optimal use of the produce (main as well as by-product) from primary agriculture and farm incomes. It has been the proud privilege for IINRG, which was entrusted with the work exclusively on the development, implementation, and propagation of Secondary Agriculture in India by the ICAR which renamed IINRG into National Institute of Secondary Agriculture (NISA) on September 28, 2022, which has been formalized on 2nd Feb 2023.

NISA aims at transforming the conventional–linear agriculture into a circular one for achieving bio-economy through (i) need based augmentation of agri-bioresources through intrinsic recycling and feedback loops of traditional agriculture for more sustainable resource use at lower cost, (ii) significantly enhance the existing value chains, create new ones, and ensuring value shift towards production catchments through downstream agro-processing interventions, (iii) make agriculture and allied activities sustainable by reducing its impact on climate change through enhanced resource reuse and recycling, and (iv) future-proofing agriculture by generating new income streams through rural industrialization and linkages to new sectors.

In the year 2023, the institute brought out several process protocols, machinery and value added products from agricultural commodities, which boasts strengthening the lac host plant gene bank, integrated pest management techniques, improved agronomic practices for the lac host plants, mass multiplication of lac host plants, drudgery reducing equipment for lac processing, value added products from natural gums and resins and plant wastes, processing machinery for natural gums and resins, spoilage indicators for packaging of perishable commodities, biodegradable active packaging films, coating derived from natural products to enhance the shelf life of perishable commodities and plastic alternatives.

The institute is leading two pan-India network projects, i.e., "Harvesting, Processing and Value Addition of Natural Resins and Gums" with 10 centers and Conservation of Lac Insect Genetic Resources with 11 centers. These centers allover India has brought out with location specific, need based solutions.

The institute organized 79 trainings benifitting 7908 stakeholders, and earned ₹84.76 lakhs revenue from the technology transfer.

I express my sincere gratitude to Dr. Himanshu Pathak, Secretary DARE, and Director General, ICAR, for his constant guidance and suggestions. I gratefully acknowledge the guidance given by Dr. S. N. Jha, the Deputy Director General (Agril. Engg.), Dr. K. P Singh (Assistant Deputy Director General, Process Engineering), for their unwavering support and guidance to this institute in executing R&D and other activities presented in this annual report. The administrative and financial support received from ICAR headquarter is gratefully acknowledged. I also thankfully acknowledge the annual report editorial team's contribution for their commitment to bring out this report on time. This annual report is put forth with the hope that it provides valuable input to different stake holders.

Dr. Abhijit Kar
Director

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Executive Summary

During this year, the ICAR-National Institute of Secondary Agriculture, Ranchi, has conducted various research and development activities related to the crop production and post-production processes, the development of value-added products and processes, transfer of technologies, the popularization of technologies, and human resource development. The activities of the Institute along with network projects, have been summarized as the development of new crop improvement technologies, equipment and gadgets, development of innovative value-added products and processes, transfer of successful technologies to stakeholders, IPR, training organised, research, and publications. Salient achievements and a summary of the events carried out during this period are given in the following section.

Collection, conservation, improvement and culture of sources of natural resins and gums

- **Gene bank for lac insect lines and host plants:** A total of 1290 cultures of 56 lac insect lines are being conserved on *Flemingia macrophylla* in the National Lac Insect Germplasm Centre (NATLIGEC). 92 collections of 65 species are being conserved in the lac host field gene bank.
- **Mutagen treatment for bringing genetic variability in *F. semialata***: Out of 6448 high-quality seeds undergoing treatments with two mutagens, sodium azide and N-Nitroso-N-methylurea (NMU), to bring genetic variability, only 274 seeds managed to germinate successfully. The mutagen significantly impacted various aspects of the plants, including plant height, number of shoots per bush, number of nodes per plant, and leaf area.
- **Gene identification for resin biosynthesis in lac insects:** one epoxide hydrolaseo gene and five monooxygenase genes responsible for resin biosynthesis in lac insects were identified. The epoxide hydrolase gene was cloned, and ~45 kDa protein was expressed.
- **Process proctocol for rooting enhancement in *kusum***: The application of IBA 1500 ppm + NAA 750 ppm, IBA 2000 ppm + NAA 1000 ppm, and IBA 3000 ppm resulted in 90%, 80%, and 70% rooting respectively in *kusum* (*Schleichera oleosa* Lour).
- **Assessment of the degree of variation in lac yield by different broodlac**: Introduction of high-quality broodlac to 360 selected *semialata* plants in July 2023, resulted in the average number of lac insect settlements of 29 per cm^2, with a 5% mortality rate, with significant diversity in plant height, averaging 118 cm, without any significant differences in the number of shoots and nodes.
- **Improved agronomic practices for lac production**: Total shoot count and average shoot diameter were found to be higher in upland conditions. Liming showed the best result in flower production. Fertilization could reduce the death of shoots and increase the number of inoculable shoots.
- **Intercropping of *F. semialata* with high value crops**: A study has been initiated to evaluate lac-integrated cropping systems with strawberry (variety Winter Dawn) and pea (variety PB 89) to assess the compatibility with winter *kushmi* lac.
- **Waste to wealth production through culture of black soldier flies**: During the winter season, kitchen waste-chopped *semialata* leaves (1:1 mix) produced higher BSF pre-pupal biomass than kitchen waste-brassica vegetable waste (1:1 mix).
- **Pest management techniques for *F. semialata*:** The spraying of PGR like NAA 50 ppm, NAA 100 ppm and Kinetin 200 ppm is beneficial for increasing lac yield in *F. semialata.*
- **Storage protocol for *F. semialata* seeds:** The chemically treated *F. semialata* seeds stored in polythene bags had better germination percentages than in cotton bags with lower proline and higher phenol and total sugar content. Lac coating @10% was observed to be better than the polycotton @ 6g/kg coated seeds.
- **Gum tapping technology**: Experimentation on gum tapping from *Buchanania lanzan* trees was conducted utilizing different tapping techniques, and inducer technology was found to be better compared to all other techniques.

- **Collection and Identification of lac insects**: Lac insects collected from Chikmagalur (Karnataka) on *Albizia saman* was identified as *Kerria canalis* Rajgopal, Imphal (Manipur) on Litchi was identified as *Kerria chinensis* Mahdihassan, and Bengaluru (Karnataka) on Custard apple & *Albizia saman* and from Guntur (Andhra Pradesh) on Dubai teak were identified as *Kerria rangoonensis* Chamberlin.
- **rDNA amplicon sequencing for identifying lac insects**: The endosymbionts viz., *Priestia megaterium*, *Staphylococcus epidermidis, Staphylococcus haemolyticus, Microbacterium testaceum, Microbacterium oleivorans* were identified from *kusmi* lac insects and *Staphylococcus warneri, Priestia aryabhattai, Paenibacillus sp.* from *rangeeni* lac insects.
- **Development of photographic guide**: A photographic guide, 'Lac Host-Plants of India: A Field Guide,' was developed for the identification of 60 lac host plants. It contains photographs of different parts of lac host plants, such as leaves, flowers, fruits, seeds, bark, and lac, with their botanical details.
- **Developed a map for lac insect availability**: A map was developed for lac insect availability based on the extensive survey in Tamil Nadu, Kerala, and Karnataka districts.
- **Development of liquid based bio-formulation:** Developed a liquid-based bio-formulation (nutrient media, Potato Dextrose Broth (PDB), along with the carbon source Dextrose and two nutrient sources, PDB+MgSO4 and PDB+CaCO3) for *Beauvaria bassiana* to manage pests of lac insects.
- **Identification of lac enemies**: The natural enemies of the lac insects are identified to be Lepidoptera, Hymenoptera, Coleoptera and Psocopteraas surveyed in the three states of arid western plains of India.
- **Process protocol of applying lac coating for improve post-harvest life of citrus fruits**: Lac coating formulation was found equally effective as compared to other commercial wax formulations (Citrasol, Citrasine and Fomesa) in increasing the post-harvest quality of Kinnow mandarin fruits both under ambient and cold storage conditions (4-60°C).

Value-added products and processes

- **Technology for rosin derivatives production**: Rosin was reacted with different polyols and molecules and significant improvement was observed in the adhesive strength of rosin derivatives as compared to rosin.
- **Methodology for cold-water solubility (CWS) of guar gum**: The methodology for the CWS and HWS of guar gum was designed using the response surface methodology optimization techniques using Box–Behnken Design (BBD). CWS value was found to be 85.76 with a minimum error of 2.27%.
- **Remediation of dye using gum arabic hydrogel:** Brilliant green dye adsorption onto gum arabic hydrogel was found to be endothermic and it follows pseudo-second order kinetic model. Dye adsorption gradually increased with increase in pH of the solution and tends to stabilize above 8 pH.
- **Cellulose-based films for active packaging**: Carboxymethyl guar gum and microcrystalline cellulose based active packaging material show better water uptake and water vapour permeability than the control film from carboxymethyl guar gum.
- **Process technology for improving millet dough strength**: The textural properties of the bajra and ragi flour dough improved significantly with the addition of psyllium husk, edible guar, and xanthan gum.
- **Process technology for lac wax based hair cream**: A hair cream formulation was developed using lac wax and natural ingredients without using harmful chemicals.
- **Process technology of biochar production from lac mud**: Biochar has been prepared from lac mud by pyrolysing at 400°C – 800°C and obtained a yield of 12 – 35% of biochar by weight and has been activated using a hydrothermal process by varying the biochar ratios, NaOH concentration and amount, and treatment duration at a constant temperature.
- **Encapsulation of betalains using biopolymers**: Betalains encapsulated in a biopolymeric matrix through an ionic gelation technique had improved stability (overall >75%). The release of betalains from the encapsulated formulations was found to be triggered by physiological pH.

- **Process protocol for improving sealing lac/wax textural quality**: At least 30% rosin addition in the sealing lac/wax with old lac (2-3) years increases fluidity and easiness to pour in mould. Shellac needs to be added up to 20% with rosin for firmness and to avoid breakage while removing from mould.

Development of machinery/ equipment and tool

- **Mould for lac stik production**: A total of 06 different moulds made of carbon steel, stainless steel, and aluminium alloy were developed to make sealing lac sticks in square and round shaves of 10mm-11 mm width/diameter and 180 mm length.
- **Pilot plant for guar gum derivative**: A pilot plant (capacity: 5 kg/batch) consists of different fabricated units and minor improvements in the fabricated units under progress based on preliminary evaluation trials of carboxymethyl guar gum derivative preparation.

Technology transfer, training and capacity building

- A total of nine on-farm tests (OFT), including station trials of improved technologies on various crops, were conducted on 64.55 hectares of land over three consecutive years.
- Ten front-line demonstrations were carried out on various crops involving 586 farmers on 104 hectares of land.
- Four training sessions and other extension activities were organized to enhance the knowledge and skills of farmers, farm women, and grassroots extension workers.
- Three outreach programs were conducted in the Khunti district in collaboration with the state government's line department. The impact of these programs was assessed in farmers' fields, and a Scientific Advisory Committee (SAC) meeting was organized.
- About 18 farmers' training programmes, 07 off-campus one-day training and 33 on-campus one-day exposure visits/ orientation programmes were organized benefiting 3373 farmers, stakeholders, students, etc.
- Ten days' summer school was organized in which 28 students from 02 universities participated.
- A total of 07 entrepreneurs from four firms were trained on lac processing and lac products for technology/ know-how transfer in 05 training programmes.
- Participated in 12 Kisan Mela/Exhibitions organized by various Ministry/organizations/ institutes, etc. all over the country.
- Kisan Mela and Foundation Day cum exhibition programmes were organized at ICAR-NISA, Ranchi benefitting 4500 farmers.

Publications

- Research paper: 39
- Books: 2
- Popular articles: 36
- Technical Bulletins/Manual: 1
- Extension Folder: 4
- Book Chapter: 8

Social impact of technologies

- Smt. Manjula Parthiban from Kolapallur village, Gobichettipalayam town, Erode district (TN), and Shri Chaluvaraju P., Bannikuppe, Taluk: Hunsur, District: Mysuru are successful farmers in producing *kusmi* lac from *Flemingia semialata* host plant.

- A study on the socio-economic status of lac-collecting farmers of the Bhandara district (Maharashtra) revealed that 49.92% of primary income comes from lac collection, followed by labour work, agriculture income, NTFP collection and animal husbandry income.

KVK Khunti Activities

- KVK, Khunti executed all mandatory activities in the year 2023, under which one on-farm trial on pest management in winter *kusmi* lac on *ber* was conducted at ten different locations of Khunti district. For technology dissemination, 138 front-line demonstrations (FLD) were conducted in 39 ha area on improved varieties of paddy, ragi, chickpea and vegetable pea. Ten one-day training programmes were conducted at KVK, where 250 farmers participated. In addition to the above, 219 other extension activities like Farmers Fair, Kisan Ghosti, Field Visit, Farmer-Scientist interaction, etc., were also conducted as mass awareness programmes. In these programmes, a total of 49644 farmers (21448 male, 28196 female) participated.

Events

Some of the events organised during the year include, Annual Workshops of Network Projects, QRT meeting, RAC Meeting, World Water Day Celebration, International Yoga Day, etc. The institute's museum hosted 28 VIPs and dignitaries from various states, including Jharkhand, Hyderabad, Maharashtra, Chhattisgarh, Karnataka, Delhi, West Bengal, and Odisha.

कार्यकारी सारांश

भाकृअनुप-राष्ट्रीय कृषि उच्चतर प्रसंस्करण संस्थान, रांची ने इस वर्ष के दौरान फसल उत्पादन और उत्पादन के बाद की प्रक्रियाओं, मूल्य वर्धित उत्पादों और प्रक्रियाओं के विकास, प्रौद्योगिकियों के हस्तांतरण, प्रौद्योगिकियों के लोकप्रियकरण से संबंधित विभिन्न अनुसंधान और मानव संसाधन विकास और विकास गतिविधियों का संचालन किया है। नेटवर्क परियोजनाओं के साथ-साथ संस्थान की गतिविधियों को नई फसल सुधार प्रौद्योगिकियों, उपकरणों और गैजेट्स के विकास, पहले से विकसित प्रौद्योगिकियों के मूल्यांकन और परिशोधन, नवीन मूल्य वर्धित उत्पादों और प्रक्रियाओं के विकास, अध्ययन/सर्वेक्षण हितधारकों को सफल प्रौद्योगिकियों का हस्तांतरण, आईपीआर, संगठित प्रशिक्षण, अनुसंधान और प्रकाशन आयोजित करने के रूप में संक्षेपित किया गया है। इस अवधि के दौरान की गई प्रमुख उपलब्धियाँ और घटनाओं का सारांश निम्नलिखित अनुभाग में दिया गया है।

प्राकृतिक रेजिन और गोंद के स्रोतों का संग्रह, संरक्षण, सुधार और संवर्धन

- **लाख कीट वंशावली और पोषक पौधों के लिए जीन बैंक का रखरखाव:** राष्ट्रीय लाख कीट जर्मप्लाज्म केंद्र (NATLIGEC) में फ्लेमिंगिया मैक्रोफिला पर 56 लाख कीट वंशावली की 1290 संस्कृतियों को संरक्षित किया जा रहा है। लाख पोषक क्षेत्र जीन बैंक में 65 प्रजातियों के 92 संग्रह संरक्षित किए जा रहे हैं।

- ***एफ. सेमियालता* में आनुवंशिक परिवर्तनशीलता लाने के लिए उत्परिवर्तजन उपचार:** आनुवंशिक परिवर्तनशीलता लाने के लिए दो उत्परिवर्तजनों, सोडियम एज़ाइड और एन-नाइट्रोसो-एन-मिथाइल्यूरिया (एनएमयू) के साथ उपचार किए गए 6448 उच्च गुणवत्ता वाले बीजों में से केवल 274 बीज सफलतापूर्वक अंकुरित होने में सफल रहे। उत्परिवर्तन ने पौधों के विभिन्न पहलुओं को महत्वपूर्ण रूप से प्रभावित किया, जिसमें पौधे की ऊंचाई, प्रति झाड़ी टहनीयों की संख्या, प्रति पौधे नोड्स की संख्या और पत्ती क्षेत्र शामिल है।

- **लाख कीटों में राल जैवसंश्लेषण के लिए जीन की पहचान:** लाख कीटों में राल जैवसंश्लेषण के लिए जिम्मेदार एक एपॉक्साइड हाइड्रॉलेज़ जीन और पांच मोनोऑक्सीजिनेज जीन की पहचान की गई है। एपॉक्साइड हाइड्रॉलेज़ जीन को क्लोन किया गया था, और ~45 केडीए प्रोटीन व्यक्त किया गया था।

- **कुसुम में रूटिंग बढ़ाने के लिए प्रक्रिया प्रोटोकॉल:** आईबीए 1500 पीपीएम + एनएए 750 पीपीएम, आईबीए 2000 पीपीएम + एनएए 1000 पीपीएम, और आईबीए 3000 पीपीएम के अनुप्रयोग के परिणामस्वरूप कुसुम *श्लीचेरा ओलीओजा* लौर में क्रमशः 90%, 80% और 70% रूटिंग हुई।

- **विभिन्न ब्रूडलैक द्वारा लाख की उपज में भिन्नता की दर का आकलन:** जुलाई 2023 में 360 चयनित सेमियालता पौधों में उच्च गुणवत्ता वाले ब्रूडलैक के परिचय के परिणामस्वरूप लाख कीट समूहों की औसत संख्या 29 प्रति से.मी. 2 रही, जिसमें 5% मृत्यु दर थी। पौधों की ऊंचाई में महत्वपूर्ण विविधता औसतन 118 से.मी., अंकुरों और गांठों की संख्या में कोई महत्वपूर्ण अंतर नहीं रहा।

- **लाख उत्पादन के लिए उन्नत कृषि पद्धतियाँ:** ऊपराऊँ क्षेत्रों में कुल शूट/टहनियों की संख्या और औसत प्ररोह व्यास अधिक होता है तथा लाईमिंग ने सर्वोत्तम फूल उत्पादन परिणाम दिखाए। निषेचन से शूट/टहनियों की मृत्यु कम हो सकती है और कीट संचारण योग्य शूट/टहनियों की संख्या बढ़ सकती है।

- **उच्च मूल्य वाली फसलों संग *एफ. सेमियालता* की अंतरफसल:** स्ट्रॉबेरी (किस्म विंटर डॉन) और मटर (किस्म पीबी 89) के साथ लाख-एकीकृत फसल प्रणाली का मूल्यांकन करने के लिए एक अध्ययन शुरू किया गया था। स्ट्रॉबेरी के साथ अंतरफसल लगाने से 1.21 के बी:सी अनुपात के साथ प्रति हेक्टेयर ₹ 2,37,000/- अतिरिक्त आय हुई तथा मटर की अंतरफसल खेती के परिणामस्वरूप 1.97 के बी:सी अनुपात के साथ प्रति हेक्टेयर ₹ 29,640/- अतिरिक्त आय प्राप्त हुई। ।

- **काली सैनिक मक्खियों (बीएसएफ) के पालन से कचरे को उपयोगी बनाना:** सर्दियों के मौसम के दौरान, रसोई के अपशिष्ट-कटी हुई *सेमियालता* पत्तियों के 1:1 मिश्रण से रसोई अपशिष्ट-ब्रैसिका वनस्पति अपशिष्ट के 1:1 मिश्रण की तुलना में अधिक बीएसएफ प्री-प्यूपल बायोमास उत्पन्न होता है।

- **एफ. *सेमियालता* में कीट प्रबंधन तकनिक:** एफ. *सेमियालता* में लाख की उपज बढ़ाने के लिए पीजीआर जैसे एनएए 50 पीपीएम, एनएए 100 पीपीएम और काइनेटिन 200 पीपीएम का छिड़काव लाभप्रद है।

- **एफ. *सेमियालता* बीजों के लिए भंडारण प्रोटोकॉल:** पॉलिथीन बैग में रखे गए रासायनिक रूप से उपचारित एफ. *सेमियलाटा* बीजों में कपास की थैलियों की तुलना में कम प्रोलाइन एवं उच्च फिनोल तथा कुल चीनी सामग्री के साथ अंकुरण प्रतिशत बेहतर था। यह देखा गया है कि 10% की दर से लाख की कोटिंग, 6 ग्राम/किग्रा की दर से लेपित बीजों की तुलना में पॉलीकॉटन की तुलना में बेहतर है।

- **बुकानिया लैंज़न पेड़ों के लिए गम टैपिंग तकनीक:** बुकानिया लैंज़न पेड़ों से गम टैपिंग की अन्य सभी तकनीकों की तुलना में इंड्यूसर तकनीक बेहतर पाई गई है।

- **लाख कीटों का संग्रह और पहचान:** चिकमगलूर (कर्नाटक) पर *अल्बिजिया समन* से एकत्र किए गए लाख कीटों की पहचान *केरिया कैनालिस* राजगोपाल, लीची पर *केरिया चाईनेंसिस* मेंहदिहसन, बेंगलुरु (कर्नाटक) पर कस्टर्ड सेब और *अल्बिजिया समन* के रूप में की गई है तथा गुंटूर (आंध्र प्रदेश) दुबई सागौन (टीक) पर *केरिया रंगूनेंसिस* चेम्बरलिन के रूप में की गई।

- **लाख कीटों की पहचान के लिए आरडीएनए एम्प्लिकॉन अनुक्रमण (सिक्वेंसिंग):** कुसमी लाख कीटों से विभिन्न एंडोसिम्बियोन्ट्स जैसे *प्रीस्टिया मेगाटेरियम, स्टैफिलोकोकस एपिडर्मिडिस, स्टैफिलोकोकस हेमोलिटिकस, माइक्रोबैक्टीरियम टेस्टेशियम, माइक्रोबैक्टीरियम ओलेवोरन्स* एवं रंगीनी लाख कीटों से *एंडोसिम्बियोन्ट्स स्टैफिलोकोकस वारनेरी* तथा *प्रीस्टियारीया भट्टाई*, पैनीबैसिलस की पहचान की गई है।

- **फोटोग्राफिक गाइड का विकास:** 60 लाख होस्ट पौधों की पहचान के लिए एक फोटोग्राफिक गाइड, 'लाक होस्ट-प्लांट्स ऑफ इंडिया: ए फील्ड गाइड' विकसित किया गया है। जिसमें लाख के पोषक पौधों को विभिन्न हिस्सों, जैसे पत्तियां, फूल, फल, बीज, छाल और लाख की तस्वीरें इत्यादि उनके वानस्पतिक विवरण के साथ शामिल हैं।

- **लाख कीट उपलब्धता के लिए एक मानचित्र का विकास:** तमिलनाडु, केरल और कर्नाटक जिलों में व्यापक सर्वेक्षण के आधार पर, लाख कीट की उपलब्धता के लिए एक मानचित्र विकसित किया गया है।

- **तरल-आधारित जैव-सूत्रीकरण का विकास:** *ब्यूवेरिया बेसियाना* के लिए एक तरल-आधारित जैव-सूत्रीकरण (पोषक तत्व मीडिया, आलू डेक्सट्रोज़ ब्रॉथ (पीडीबी), कार्बन स्रोत डेक्सट्रोज़ और दो पोषक तत्व स्रोत, PDB + $MgSO_4$ और PDB + $CaCO_3$) के साथ लाख कीटों के प्रबंधन के लिए एक उपकरण विकसित किया गया है।

- **लाख शत्रुओं की पहचान:** लाख कीटों के प्राकृतिक शत्रु *लेपिडोप्टेरा*, *हाइमनोप्टेरा*, *कोलोप्टेरा* और *सोकोप्टेरास* हैं, जिनकी पहचान भारत के शुष्क पश्चिमी मैदानी इलाकों के तीन राज्यों में सर्वेक्षण के दौरान की गई है।

- **खट्टे फलों की कटाई के बाद के उसे बेहतर बनाने के लिए लाख कोटिंग लगाने की प्रक्रिया प्रोटोकॉल:** किन्नू मंदारिन की कटाई के बाद की गुणवत्ता को बढ़ाने में लाख कोटिंग फॉर्मूलेशन फल परिवेशीय और शीत भण्डारण दोनों स्थितियों (4-60°C) में अन्य वाणिज्यिक मोम फॉर्मूलेशन (*सिट्रासोल*, *सिट्रासीन* और *फोमेसा*) की तुलना में समान रूप से प्रभावी है।

मूल्य वर्धित उत्पाद और प्रक्रियाएँ

- **रोजिन डेरिवेटिव उत्पादन के लिए प्रौद्योगिकी:** रोसिन ने विभिन्न पॉलीओल्स और अणुओं के साथ प्रतिक्रिया की, जिससे रोसिन की तुलना में रोसिन डेरिवेटिव की चिपकने वाली ताकत में काफी सुधार हुआ।

- **ग्वार गम की ठंडे पानी में घुलनशीलता (सीडब्ल्यूएस) के लिए पद्धति:** ग्वार गम की सीडब्ल्यूएस के लिए पद्धति बॉक्स-बेनकेन डिजाइन (बीबीडी) के उपयोग से प्रतिक्रिया सतह पद्धति अनुकूलन तकनीकों का उपयोग करके निर्मित/तैयार की गई थी। जिसमें न्यूनतम त्रुटि 2.27% के साथ CWS मान 85.76 पाया गया।

- **गम अरेबिक हाइड्रोजेल का उपयोग करके डाई का उपचार:** गम अरेबिक हाइड्रोजेल पर शानदार हरे रंग (Brilliant Green) का सोखना एक एंडोथर्मिक प्रक्रिया है और एक छद्म-दूसरे क्रम के गतिज मॉडल का पालन करता है। घोल के pH के साथ डाई सोखना धीरे-धीरे बढ़ता है और pH=8 से ऊपर स्थिर हो जाता है।

- **सक्रिय पैकेजिंग के लिए सेलूलोज़-आधारित फिल्में:** कार्बोक्सिमिथाइल ग्वार गम से तैयार नियंत्रण फिल्म की तुलना में कार्बोक्सिमिथाइल ग्वार गम और माइक्रोक्रिस्टलाइन सेलूलोज़-आधारित सक्रिय पैकेजिंग सामग्री ने बेहतर जल ग्रहण और जल वाष्प पारगम्यता दिखाई।

- **बाजरा के आटे की ताकत में सुधार के लिए प्रक्रिया प्रौद्योगिकी:** साइलियम भूसी, खाद्य ग्वार और ज़ैंथन गम को शामिल करने से बाजरा और रागी के आटे के आटे की संरचना संबंधी गुणों में काफी सुधार हुआ।

- **लैक वैक्स आधारित हेयर क्रीम के लिए प्रक्रिया प्रौद्योगिकी:** हानिकारक रसायनों का उपयोग किए बिना लैक वैक्स और प्राकृतिक अवयवों का उपयोग करके एक हेयर क्रीम फॉर्मूलेशन विकसित किया गया है।

- **लाख मिट्टी से बायोचार उत्पादन की प्रक्रिया प्रौद्योगिकी:** बायोचार को लाख मिट्टी से 400 डिग्री सेल्सियस - 800 डिग्री सेल्सियस पर पाइरोलाइजिंग द्वारा तैयार किया गया था और वजन के हिसाब से 12 - 35% बायोचार की उपज प्राप्त की गई तथा इसे बायोचार अनुपात, NaOH सांद्रता, NaOH की मात्रा एवं स्थिर तापमान एवं हाइड्रोथर्मल प्रक्रिया का उपयोग कर सक्रिय किया गया।

- **बायोपॉलिमर का उपयोग करके बीटालाइंस का एनकैप्सुलेशन:** एक आयनिक जेलेशन तकनीक के माध्यम से बायोपॉलीमेरिक मैट्रिक्स में एनकैप्सुलेटेड बीटालेंस ने स्थिरता (कुल मिलाकर> 75%) में सुधार किया है। इनकैप्सुलेटेड फॉर्मूलेशन से बीटालेंस का शारीरिक पीएच द्वारा शुरू हो जाती है।

- **सीलिंग लाख/मोम बनावट की गुणवत्ता में सुधार के लिए प्रक्रिया प्रोटोकॉल:** 2-3 साल पुराने सीलिंग लाख/मोम में कम से कम 30% रोसिन जोड़ने से सांचे में डालने में तरलता और सुविधा बढ़ जाती है। वांछित दृढ़ता के लिए और सांचे से निकालते समय टूटने से बचाने के लिए शेलैक को 20% तक रसिन के साथ मिलाने की आवश्यकता होती है।

मशीनरी/उपकरण एवं औज़ार का विकास

- **लाख छड़ी उत्पादन के लिए सांचे:** 10-11 मिमी चौड़ाई/व्यास और 180 मिमी लंबाई की सीलिंग लाख छड़ें बनाने के लिए चौकोर और गोल प्रकार में कार्बन स्टील, स्टेनलेस स्टील और एल्यूमीनियम मिश्र धातु के कुल 06 अलग-अलग सांचे विकसित किए गए हैं।

- **ग्वार गम व्युत्पन्न के लिए पायलट प्लांट:** एक पायलट प्लांट (क्षमता: 5 किग्रा/बैच) में विभिन्न निर्मित इकाइयाँ होती हैं और कार्बोक्सिमिथाइल ग्वार गम व्युत्पन्न की तैयारी के प्रारंभिक मूल्यांकन परीक्षणों के आधार पर इन इकाइयों में मामूली सुधार किए जा रहे हैं।

प्रौद्योगिकी हस्तांतरण, प्रशिक्षण और क्षमता निर्माण

- लगातार तीन वर्षों में 64.55 हेक्टेयर भूमि पर विभिन्न फसलों पर उन्नत प्रौद्योगिकियों के गंतव्य परीक्षणों सहित नौ ऑन-फार्म परीक्षण (ओएफटी) आयोजित किए गए।

- 104 हेक्टेयर भूमि पर 586 किसानों को सम्मिलित करते हुए विभिन्न फसलों पर दस फ्रंट-लाइन प्रदर्शन किए गए।

- किसानों, कृषक महिलाओं और जमीनी स्तर के विस्तार कार्यकर्ताओं के ज्ञान और कौशल को बढ़ाने के लिए चार प्रशिक्षण सत्र और अन्य विस्तार गतिविधियाँ आयोजित की गईं।

- राज्य सरकार के संबंधित विभाग के सहयोग से खूंटी जिले में तीन बाह्य पहुंचकर (आउटरीच) कार्यक्रम आयोजित किये गये। किसानों के खेतों में इन कार्यक्रमों के प्रभाव का आकलन किया गया और एक वैज्ञानिक सलाहकार समिति (एसएसी) की बैठक आयोजित की गई।

- अठारह किसान प्रशिक्षण कार्यक्रम, 07 ऑफ-कैंपस एक दिवसीय प्रशिक्षण और 33 ऑन-कैंपस एक दिवसीय एक्सपोजर विजिट/ओरिएंटेशन कार्यक्रम आयोजित किए गए, जिससे 3373 किसानों, हितधारकों, छात्रों आदि को लाभ हुआ।

- एक दस दिवसीय ग्रीष्मकालीन विद्यालय का आयोजन किया गया जिसमें 02 विश्वविद्यालयों के 28 छात्रों ने भाग लिया।

- 05 प्रशिक्षण कार्यक्रम में चार फर्मों के सात उद्यमियों को प्रौद्योगिकी/जानकारी हस्तांतरण के लिए लाख प्रसंस्करण और लाख उत्पादों पर प्रशिक्षण दिया गया।
- पूरे देश में विभिन्न मंत्रालयों/संगठनों/संस्थानों आदि द्वारा आयोजित 12 किसान मेलों/प्रदर्शनियों में भाग लिया गया।
- भाकृअनुप-राष्ट्रीय कृषि उच्चतर प्रसंस्करण संस्थान, रांची में किसान मेला और स्थापना दिवस सह प्रदर्शनी कार्यक्रम आयोजित किए गए, जिससे 4500 किसान लाभान्वित हुए।

प्रौद्योगिकियों का सामाजिक प्रभाव

- गांव कोलापल्लूर, शहर गोबिचेट्टीपलायम, जिला इरोड (तमिलनाडु) से मंजुला पार्थिबन तथा तालुक: हुनसूर, जिला: मैसूरु से श्री चालुवाराजू पी. बन्निकुप्पे तथा फ्लेमिंगिया सेमियालता होस्ट प्लांट से कुसमी लाख का उत्पादन करने में सफल किसान हैं।
- महाराष्ट्र के भंडारा जिले में लाख एकत्रित करने वाले किसानों की सामाजिक-आर्थिक स्थिति पर एक अध्ययन से पता चला कि प्राथमिक आय का 49.92% लाख संग्रहण से आता है, इसके बाद श्रम कार्य, कृषि आय, एनटीएफपी संग्रह और पशुपालन आय आती है।

कृषि विज्ञान केन्द्र, खूंटी की गतिविधियाँ

केवीके, खूंटी ने वर्ष 2023 में सभी अनिवार्य गतिविधियों को निष्पादित किया, जिसके तहत खूंटी जिले के दस अलग-अलग स्थानों पर सर्दियों में बेर पर कुसमी लाख में कीट प्रबंधन पर एक ऑन-फार्म परीक्षण आयोजित किया गया है। प्रौद्योगिकी प्रसार के लिए, धान, रागी, चना और सब्जी मटर की उन्नत किस्मों पर 39 हेक्टेयर क्षेत्र में 138 प्रथम पंक्ति प्रदर्शन (एफएलडी) आयोजित किए गए। केवीके में दस एक दिवसीय प्रशिक्षण कार्यक्रम आयोजित किए गए, जिसमें 250 किसानों ने भाग लिया। उपरोक्त के अलावा, 219 विस्तार गतिविधियाँ, जैसे किसान मेला, किसान गोष्ठी, फील्ड विजिट, किसान-वैज्ञानिक परिचर्चा आदि भी जन जागरूकता कार्यक्रमों के रूप में आयोजित की गईं। इन कार्यक्रमों में कुल 49644 किसानों (21448 पुरुष, 28196 महिला) ने भाग लिया।

आयोजन

वर्ष के दौरान आयोजित कुछ कार्यक्रमों में क्यूआरटी बैठक, आरएसी बैठक, आईएमसी बैठक, नेटवर्क परियोजनाओं की वार्षिक कार्यशालाएं, विश्व जल दिवस समारोह, अंतर्राष्ट्रीय योग दिवस आदि शामिल हैं। संस्थान के संग्रहालय ने झारखंड, हैदराबाद, महाराष्ट्र, छत्तीसगढ़, कर्नाटक, दिल्ली, पश्चिम बंगाल और ओडिशा सहित विभिन्न राज्यों के 28 वीआईपी और गणमान्य व्यक्तियों की मेजबानी की।

Introduction

Following the recommendation of Lindsay- Harlow Committee constituted in 1920 to look into all aspects of the country's lac trade and its development, Indian Lac Research Institute, Ranchi was established on September 20, 1924, under Indian Lac Association for Research. Subsequently, on the recommendations of the Royal Commission on Agriculture, the Indian Lac Cess Committee (ILCC) was constituted, which took over the reins of the ILRI in1931. The Institute became an integral part of the Indian Council of Agricultural Research (ICAR) from April 1, 1966. Till 2007, the Institute was devoted exclusively to research and technology development on lac, including its cultivation, processing, value addition, utilization and extension. Then in the month of September, 2007, the mandate was expanded to include other natural resins and gums under its purview, and the institute was renamed as the Indian Institute of Natural Resins and Gums (IINRG). In order to address the expanded mandate, without concomitant increase in manpower, two Network Projects were initiated under the Institute namely, Harvesting, Processing and Value Addition of Natural Resins and Gums (HPV on NRGs) with 10 centers and Conservation of Lac Insect Genetic Resources (CLIGR) with 11 centers across the country. Keeping in view the importance of secondary agriculture in order to substantially improve farmers' income and promote rural industrialization the institute was rechristened as National Institute of Secondary Agriculture (NISA) with effect from 27th Sept 2022 and formally inaugurated by honorable secretary DARE, DG-ICAR on 2nd February 2023.

Vision of ICAR-NISA

To become driving source for rural agro-industrialized economy and act as an International referral institute of Secondary Agriculture (SA).

Mission of ICAR-NISA

Bridging gaps in building rural industries and reducing imports through Secondary Agriculture.

Mandates of the institute

I. Research on tertiary and higher level of processing and value addition to agri-produce including natural resins, gums and aqua produce.
II. Pilot plants, human resources and entrepreneurship development for high value products' production.

Objectives

I. To Augment the Agri-bio-resources and develop processes and machinery for pilot level production of their tertiary and quaternary level processed products.
II. To develop technology for converting non-food agri-biomass to food ingredients forms and manufacture foods using machine and tools.
III. To establish agri-business incubation centres, develop human resources and disseminate the technologies of secondary agriculture.

The divisions/ Unit of the institute

Divisions/Unit and their Objectives

The objective of Agri-bioresources Augmentation (ABA) division is Identification, selection & conservation of agri and allied produces, agro-industrial by products, crop residues, food waste and marine products. Agriculture Structure and Process Engineering (ASPE) division aims at the development of technologies and processing system for higher level of processing of agri- bioresources. Downstream Agro-processing (DAP) division deals with the development of advanced processing, extraction, formulation, and delivery system from agri-bioproducts and co-products. The newly carved Automation and Plant Engineering (APE)division) looks at the development of automation systems for processing and quality control. Agri-business development (ABD) unit thrives forTransfer of technology and entrepreneurship development.

The Institute is situated 9 km south-east of Ranchi city, on the National Highway - 33 (Ranchi-Jamshedpur), at an altitude of 650 m above mean sea level between 23 ° 23'' N latitude and 85 ° 23'' longitude, with a mild and salubrious climate. It has 52.7 ha of land used for research, office and residential purposes. The major water

sources are 0ne bore well and 3 farm ponds. All the water sources are connected through an underground irrigation grid to irrigate 38.6 ha of farm area. The Institute also has a meteorological observatory, guest house facilities for 18 guests. The Research Workshop provides the facilities for fabrication of research prototypes. Advance/Full Text/Abstracts access of more than 3900 journals from several publishers has been made available online through Consortium for e-Resources in Agriculture (CeRA) to our scientists during the year. Our library is also connected with World eBook Library (WEL) facilitates by National Digital Library (NDL), New Delhi from this year. All regular institute publications (Annual Reports/Newsletters/Lac-Resins-Gums Statistics/Laksha/Dorothy Norris Lecture Series etc,.) since beginning and Research Article/ Bulletins are available in PDF form for the internal users. Annual Reports/Newsletters/Lac-Resins-Gums Statistics, Laksha' Dorothy Norris Lecture Series are also uploaded on ICAR-Krishi Portal. The library received 1 foreign, 4 national periodicals. The infrastructure created at the Institute caters to various research & development and technology transfer activities. In addition to the regular research and developmental activities, the Institute caters to the need for testing and certification of lac quality manufactured by industries.

Over the years, the Institute has developed many successful technologies. Training and skill enrichment programs for different types of stake holders, *viz*., farmers, manufacturers, upcoming entrepreneurs, extension functionaries, teachers, students, etc., of either gender have been continuing for a long time. Display and demonstrations of technologies on appropriate platforms are also persisting. ICAR-NISA became a part of the IARI-Ranchi for promoting higher education. From this year, ICAR-NISA has started offering post graduate courses in "**Process and Food Engineering"** and "**Agricultural Chemicals"**. The details of personal and finance during the year 2023 is shown below.

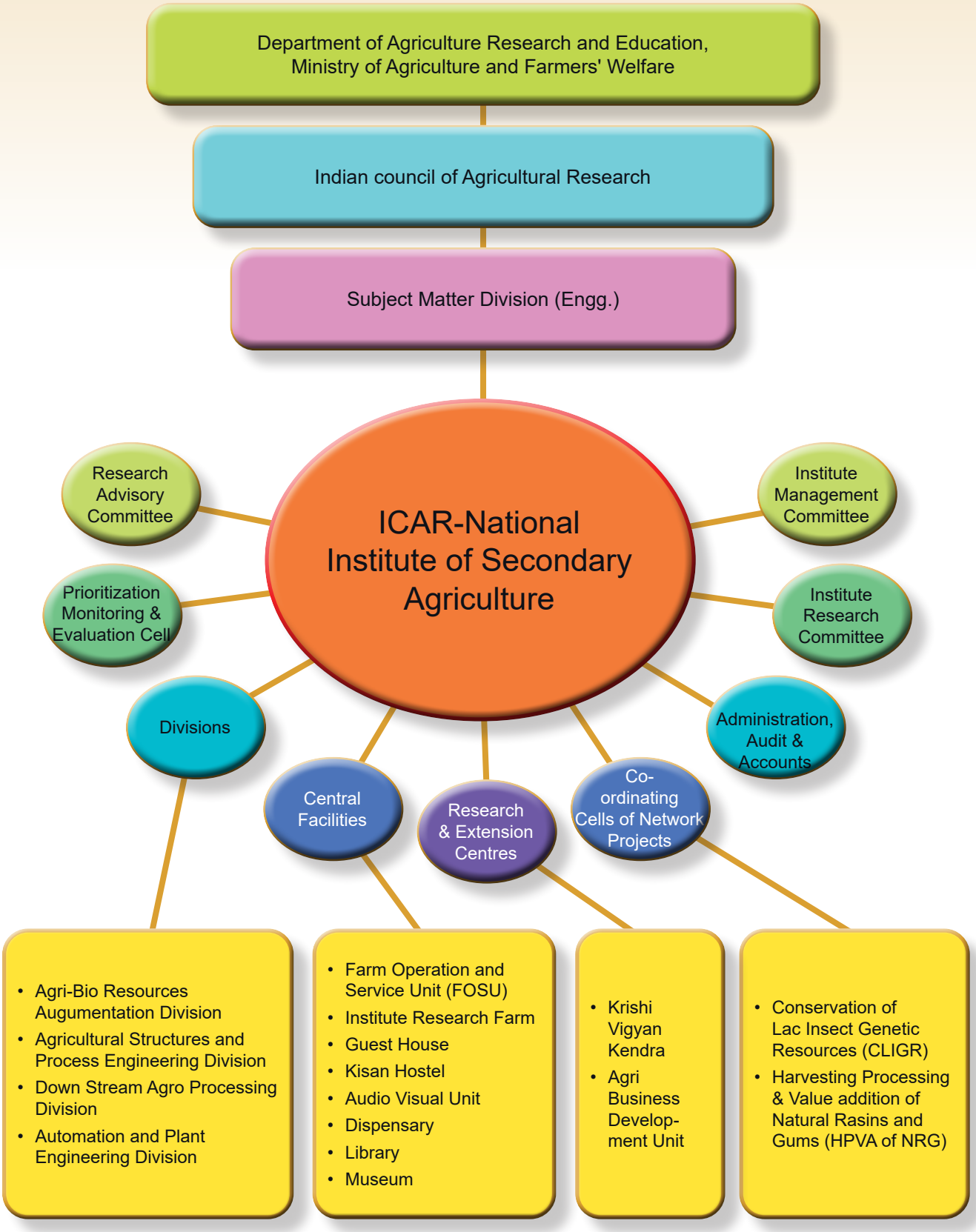
Details of scientific, technical, administrative and supporting staff of ICAR-NISA

	Sanctioned Strength	In position	Vacant
R.M.P.	01	01	0
Scientific	42	25	17
Technical	61	34	27
Administrative	29	14	15

Details of scientific, technical, administrative and supporting staff of KVK-Khunti

	Sanctioned Strength	In position	Vacant
Scientific	1	1	0
Technical	11	1	10
Administrative	2	0	2
Skill Supporting Staff	2	0	

Organogram


Department of Agriculture Research and Education, Ministry of Agriculture and Farmers' Welfare
Indian council of Agricultural Research
Subject Matter Division (Engg.)
ICAR-National Institute of Secondary Agriculture
Research Advisory Committee
Prioritization Monitoring & Evaluation Cell
Divisions
Institute Management Committee
Institute Research Committee
Administration, Audit & Accounts
Co-ordinating Cells of Network Projects
Research & Extension Centres
Central Facilities
• Agri-Bio Resources Augumentation Division
• Agricultural Structures and Process Engineering Division
• Down Stream Agro Processing Division
• Automation and Plant Engineering Division
• Farm Operation and Service Unit (FOSU)
• Institute Research Farm
• Guest House
• Kisan Hostel
• Audio Visual Unit
• Dispensary
• Library
• Museum
• Krishi Vigyan Kendra
• Agri Business Develop-ment Unit
• Conservation of Lac Insect Genetic Resources (CLIGR)
• Harvesting Processing & Value addition of Natural Rasins and Gums (HPVA of NRG)

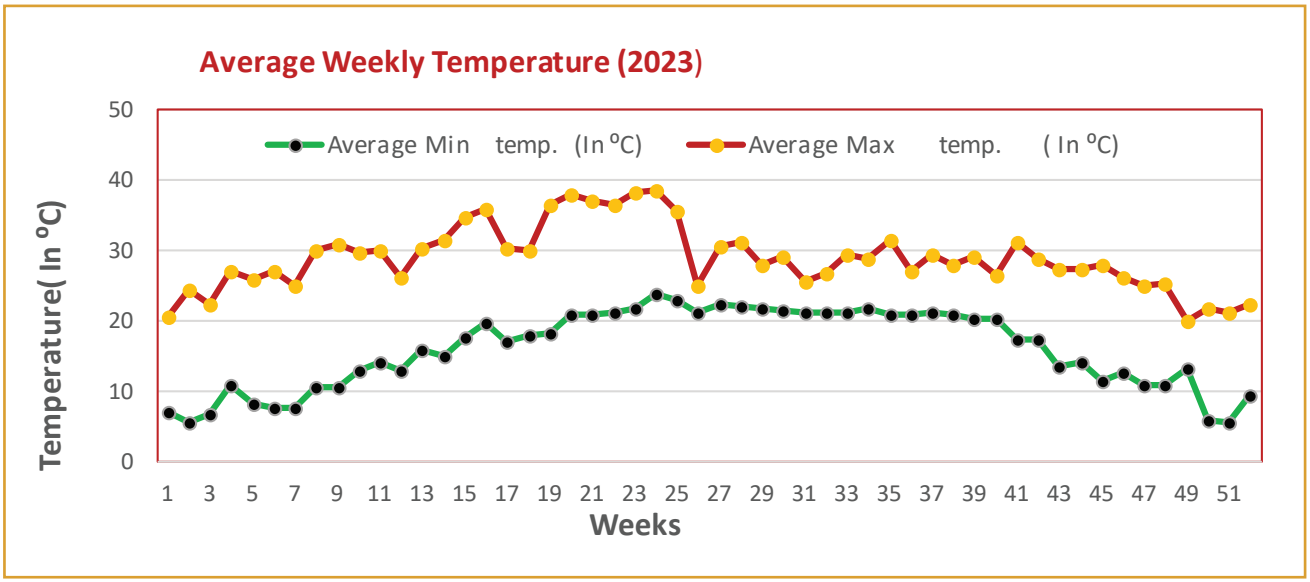
Meteorological Observations

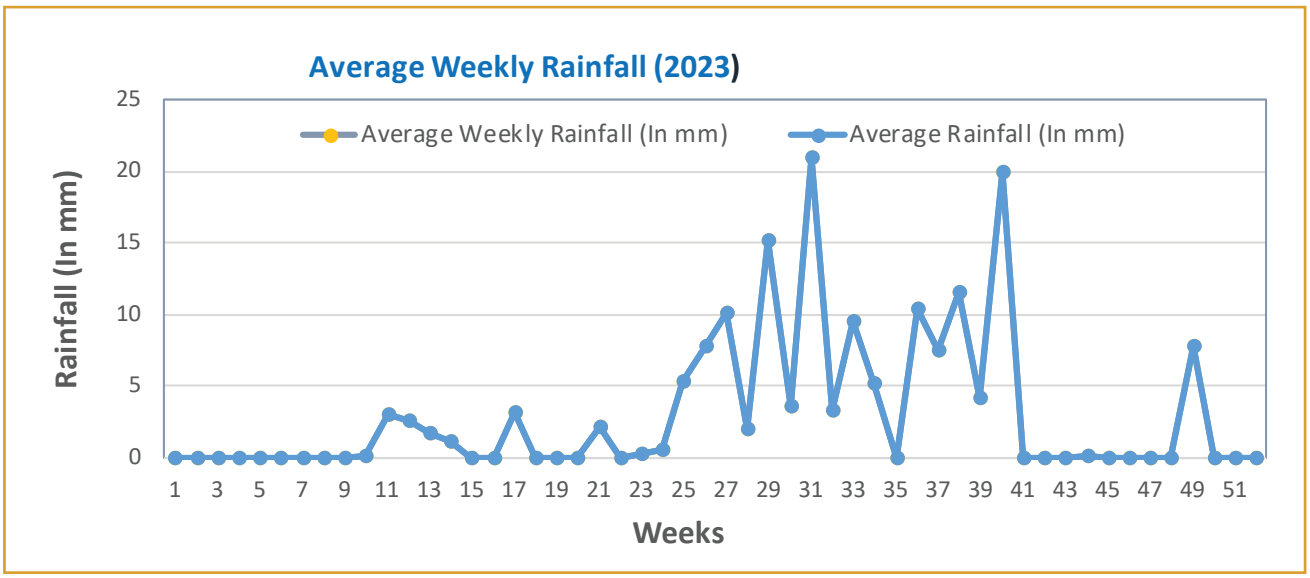
Agro-meteorological observatory of the Institute is located at 85° 23' E longitude, and 23° 23' N latitude at an elevation of 650 m above mean sea level. Rainfall, minimum and maximum temperatures, minimum and maximum relative humidity (RH) recorded on a regular basis at the observatory. Salient meteorological observations for 2023 are:

Monsoon arrived on June 20, 2023, one week after its normal arrival course and withdrew on October 05, 2023. The year's highest rainfall (55.3 mm) was recorded on July 16, 2023. Annual rainfall of 1064.2 mm occurred on 59 rainy days during the year 2023.

The maximum temperature of the year (40.4 °C) was recorded on May 21, 2023, while the minimum temperature (4 °C) was recorded on January 06, 2023.

The monthly average Relative Humidity (RH) in the morning (7:30 AM) varied from 64.27 to 84.29 per cent, while in the afternoon (2:30 PM), it varied from 57.07 to 77.35 per cent.





Research Accomplishments

AGRI-BIORESOURCES AUGMENTATION DIVISION

Maintenance of lac insect gene bank, host plant gene bank and different lac host plots

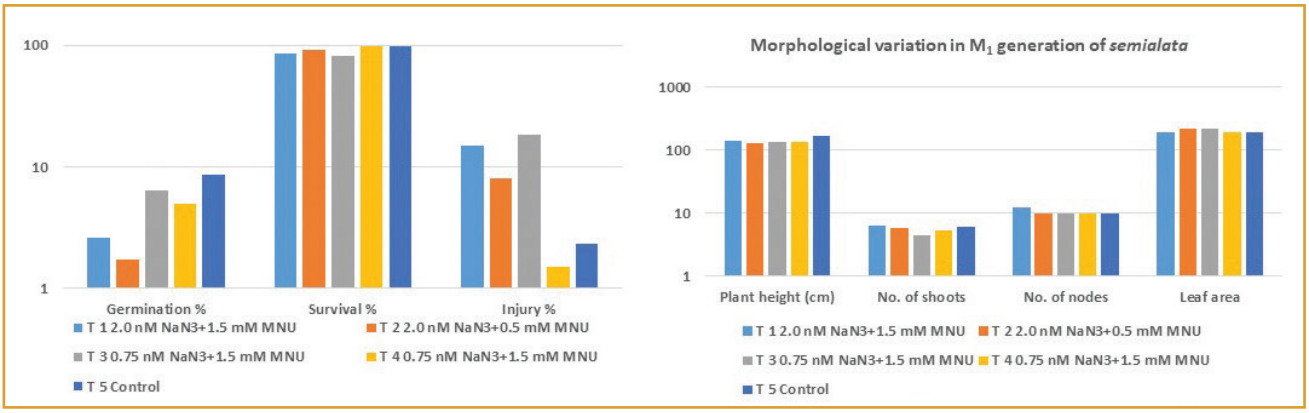
Ninety-two collections of 65 species are being conserved in the lac host field gene bank. One thousand and fifty cultures of 52 lac insect lines are being conserved on *Flemingia macrophylla* in National Lac Insect Germplasm Centre (NATLIGEC). *Swadi* Palas plantations consisting of 75 plants are being conserved in a separate plot. *Calliandra calothyrsus* (95 numbers with spacing of 4×8 m) and Rain tree (*Albizia saman*) (30 numbers with spacing of 8×8 m) have been raised.



National lac insect germplasm centre

Flemingia semialata and lac insect interaction for identification of productive combinations

Only single germplasm is available with the institute for *F. semialata*. The only disadvantage of growing semialata during summer season is the sustainability of lac insects due to stem shrinkage. Evaluation of new germinal material depends on availability of new generation of genetic variation. Mutagens allows plant breeders the possibility to create new and better cultivars with desired characteristics, including both farmer preferred characteristics. To generate genetic variability in *F. semialata* for future requirement, 6448 healthy seed have been treated with a combination of two mutagens, *viz*., sodium azide (NaN3) and N-Nitroso-N-methyl urea (NMU). These mutagens are liable to generate populations that are suitable for Tilling as well as forward genetics and mutation breeding. Of 6,448 seed treated with various combinations of chemical mutagen, only 274 seeds



Effect of mutagen treatment on seed germination and survived population



F.semialata plot comprising 223 seedlings of treated seeds including control (non-treated) & the morphological variations in the plants

germinated. Mutagens affected the germination, survival and injury in the seeds.

In addition, a new plot comprising 223 seedlings of treated seeds including check (non-treated) has been raised during July 2022. Significant effect of mutagen combinations on plant height, number of shoots per bush, number of nodes per plant and leaf area has been observed.

F. semialata is often cross pollinated. The drought tolerant lines selected on the basis of morpho-physio-biochemical parameters for summer *kusmi* lac cultivation may have variation for lac productivity; as in a changing environment, the genetic variability within a population may allow some individuals to adapt to their new situation. To know the extent of variation for lac yield, the 360 bushes of semialata have been inoculated with good quality broodlac in July 2023. The variation in plant height was significant with average of 118 cm but there was no significant variation in number of shoots and number of nodes.



Drought tolerant *F.semialata* lines

Lac attributing traits of drought tolerant lines

Lac attributing traits	Range
Lac insect settlement (no)	19-52
Survival of lac insect (no)	15-46
Mortality of lac insect (no)	2-12
Morphological traits	**Range**
Plant height (cm)	71-193
No. of shoots	1-6
No. of nodes	3-35

Plant growth regulators influencing morpho-physiology and lac yield in *Flemingia semialata* (Roxb.) under lac insect (*K. lacca* Kerr.) infested condition

Plant growth regulators, growth promotors and retardants significantly affect the plant physiology; however, their effect on the lac yield from the host plant perspective has still not been recorded. A study pertaining to this effect has been carried out on *F. semialata* grown at institute research farm (IRF) of National Institute of Secondary Agriculture, Namkum, Ranchi during 2022-23. The plants have been sprayed with plant growth promoters and growth retardants (NAA-100 ppm, NAA-50 ppm, Kinetin-200) in June 2022 before inoculation with *kusmi* strain of lac insect (*K. lacca* Kerr.) in the month of July 2022, while following standard package of practices for *kusmi* lac cultivation. Plant growth regulators significantly improved all the parameters considered under this investigation. Nevertheless, the treatment NAA-100 ppm outperformed all other treatments with respect to total fresh biomass (1821.20 g), total dry weight (547.60 g), total broodlac weight (211.00 g), broodlac weight/m shoot length (164.00 g), and scrapped lac/m shoot length (39.40 g).

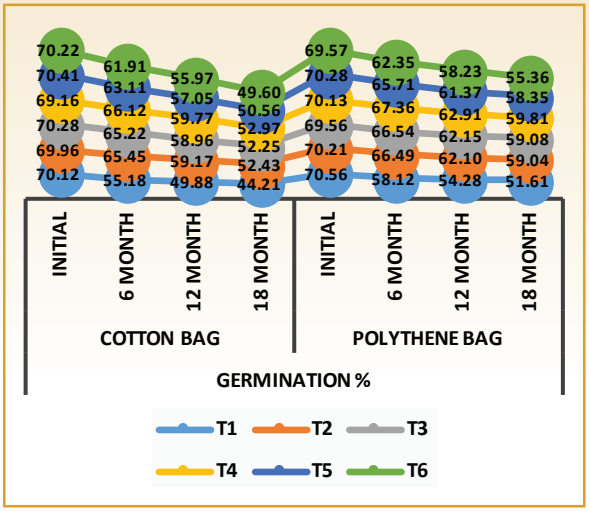
Mass multiplication of the selected lac host plants using suitable techniques

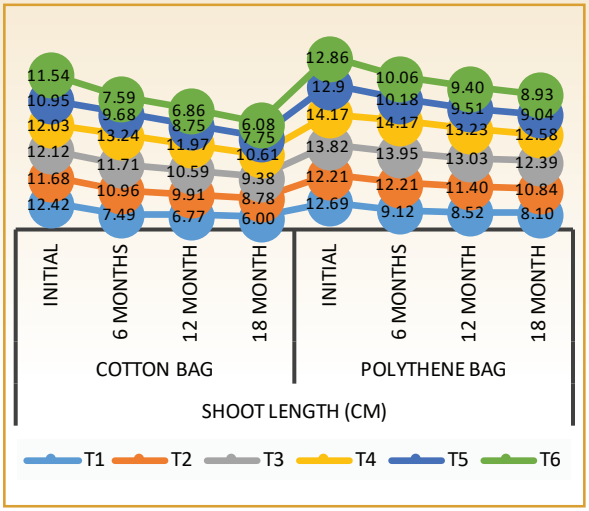
With an objective to standardize the protocol for mass propagation of *kusum* (*Schleichera oleosa* Lour), a lac host tree species of India, fresh branch of phenotypically superior Kusum tree have been pre treated with Plant growth regulators (PGRs), *viz,* IBA 3000 ppm, IBA 4000 ppm, NAA 250 ppm, NAA 1500 ppm, NAA 2000 ppm, IBA 250 ppm + NAA 225 ppm, IBA 1500 ppm + NAA 750 ppm, IBA 2000 ppm + NAA 1000 ppm. The study reveals that the treatment IBA 3000 ppm, NAA 250 ppm, IBA 1500 ppm + NAA 750ppm and IBA 2000 ppm + NAA 1000 ppm application significantly enhanced the rooting percentage of the species with a tune of 70, 60, and 90 and 80 percent, respectively. The results suggest that the application IBA 1500 ppm + NAA 750 ppm, IBA 2000 ppm + NAA 1000 ppm, NAA 250 ppm and IBA 3000 ppm may be an effective mean of rooting induction under the air layering and suitable vegetative propagation technique for the species.

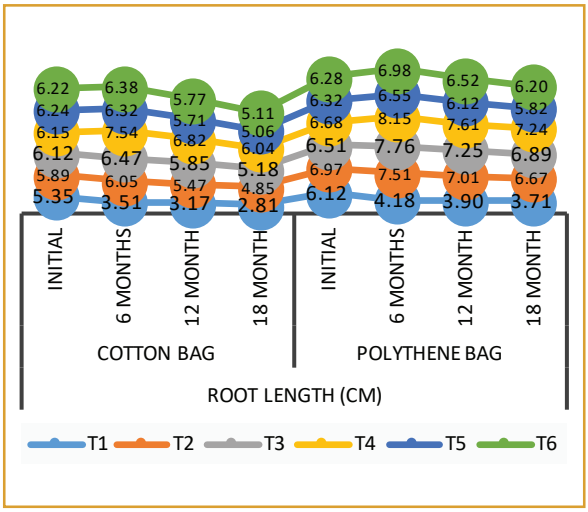
Seed deterioration and amelioration strategies during storage in *Flemingia semialata* seeds

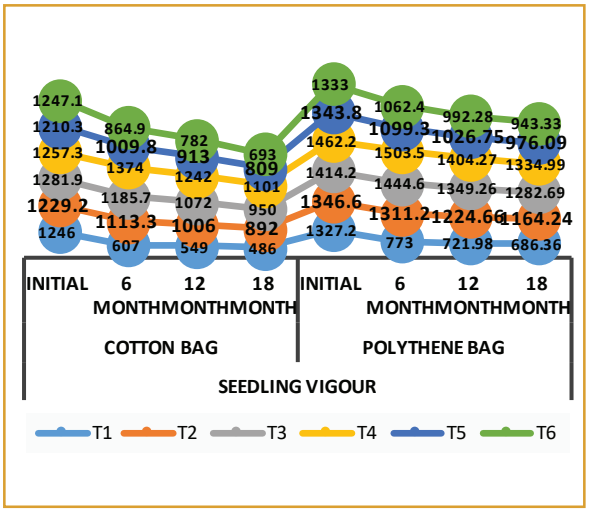
The effect of different storage materials (polythene bag 700 gauge and cloth bag) and coating materials [T1 (Control), T2 (Spinosad 45 SC @ 2 ppm), T3 (Vitavex power (Carboxin 37.5%+Thiram 37.5% WS) @ 2.5 g/kg), T4 (Spinosad 45 SC @ 2 ppm + Vitavex power (Carboxin 37.5%+Thiram 37.5% WS) @ 2.5 g/kg), T5 (Lac coating @ 10%), T6 (Polymer coating (Polykote @ 6 g/kg of seed)] on the storability of *Flemingia semialata* seeds has been assessed for 18 months. Morpho-physiological observations of the 12

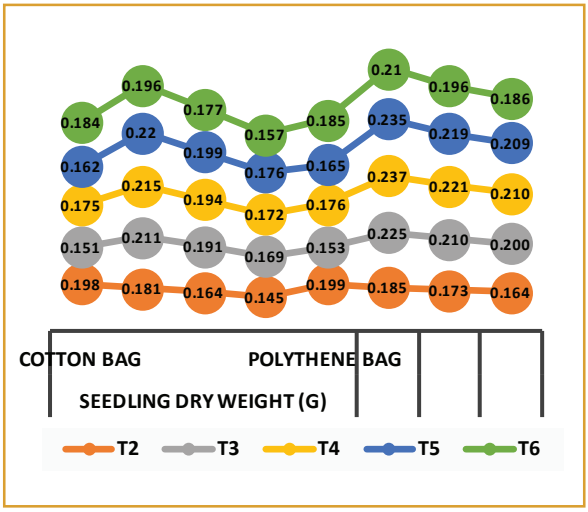
and 18 months stored seed *viz.,* germination percent, shoot length, root length, seedling dry weight have been taken up to 28 days from the date of sowing. Biochemical status such as proline, phenol and total sugar have also been analyzed in 12 and 18 months treated stored seeds.











Seed coating treatments:

T1: Control

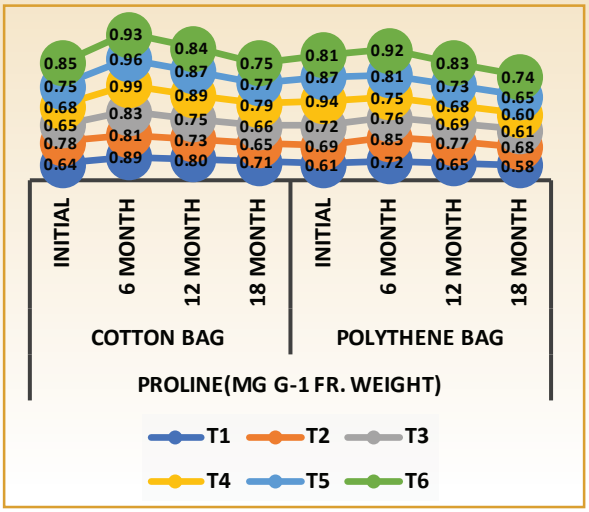
T2: Spinosad 45 SC @ 2 ppm)

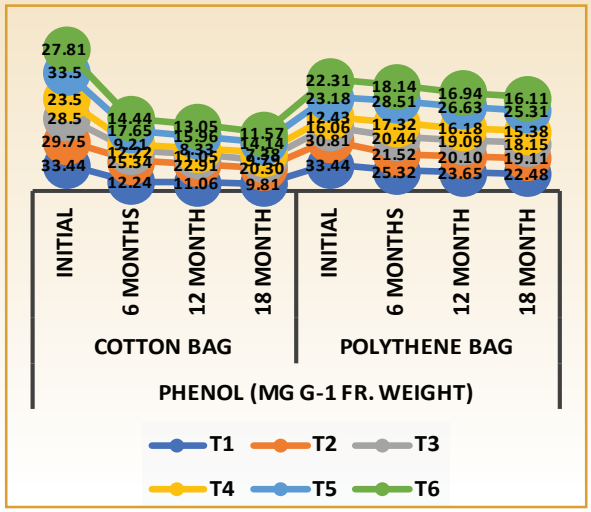
T3: Vitavex power (Carboxin 37.5%+Thiram 37.5% WS) @ 2.5 g/kg)

T4: (Spinosad 45 SC @ 2 ppm + Vitavex power

T5: Lac coating @ 10%)

T6: Polymer coating (Polykote @ 6 g/kg of seed)

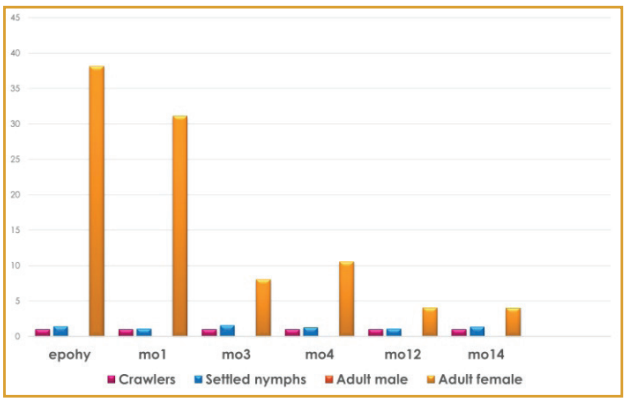




Effect of seed coating, storage period and storage containers on bio-chemical status of the seeds of *Flemingia semialata.*

qPCR validation of genes involved in aleuritic acid biosynthesis

Based on the transcriptome sequencing of different stages of lac insects *viz*., crawlers, settled nymphs, and fertilized females, Differentially Expressing Genes (DEGs) among these stages have been identified. Among the DEGs, one epoxide hydrolase gene (*epohy*) and five monooxygenase genes (*mo1, mo3, mo4, mo12,* and *mo14*) are found to be upregulated in settled nymphs and fertilized females and down regulated in males in comparison with crawlers in the qPCR experiments. Since the expression levels of these genes are in accordance with the secretion of lac resin, these could be potential candidate genes for aleuritic acid biosynthesis.



qPCR for the expression levels of epoxide hydrolase and mono-oxygenase genes in different life stages of lac insect

Heterologous expression of lac insect epoxide hydrolase in bacteria

Full length lac insect epoxide hydrolase (*kleh*) ORF (open reading frame) of 1221 bp in pGEMT(easy) has been amplified with primers having *Hin*dIII and *Xho*I restriction site overhangs and it has been ligated with pET28(a) vector. The ligation mixture was transferred into *E. coli* DH5α. Positive recombinant plasmids were isolated from *E. coli* DH5α and the presence and correct reading frame of the insert were confirmed by sequencing. Then the recombinant pET28(a) vector having epoxide hydrolase ORF was transferred into the expression host, *E. coli* BL21 (DE3) and BL21-codon Plus (DE3). After confirming the transformation, the positive clone *E. coli* of BL21-codon Plus (DE3) was used for protein expression. The desired size protein (~45 kDa) has been observed to be expressed at all the concentrations of IPTG tried.

Agronomic interventions influencing lac production in *palas* (*Butea monosperma*) in summer season

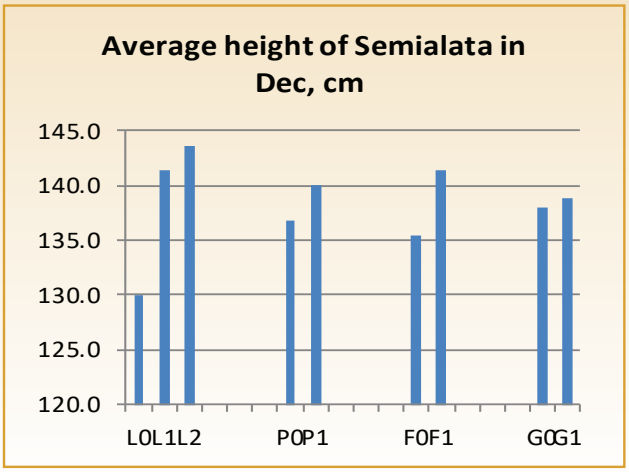
A wide variety of growth factors have been taken for validation. Some responded well to some factors while others to few other factors. Total shoot count and average shoot diameter are found to be higher in uplands. Among different fertilizers tried, liming showed best result in flower production. Fertilization could reduce death of shoots and increased number of inoculable shoots. Rest of trees for three years could improve fruit production.

Plant growth attributes and lac yield affected by fertility levels and inoculation load

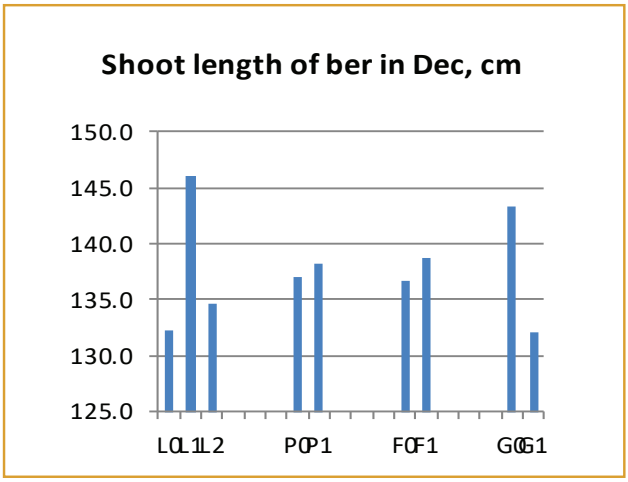
Enhanced soil fertility level has shown a mixed response in terms of tree growth and lac production. Shoot length increases significantly in higher fertility level. However, dead shoots are frequent at higher fertility levels; residual shoot weight also reduces with fertility level. Lac yield remains indifferent due to higher application of fertilizers (NPK). However, brood quality improves due to application of higher level of fertilizers, as indicated by higher value of per meter of brood weight. Experimentation also suggested that higher level of inoculation can produce higher residual leaf. In contrast, medium inoculation level could produce better brood quality.

Effect of different organic nutrients on winter *kusmi* lac cultivation on ber, semialata, palas and kusum

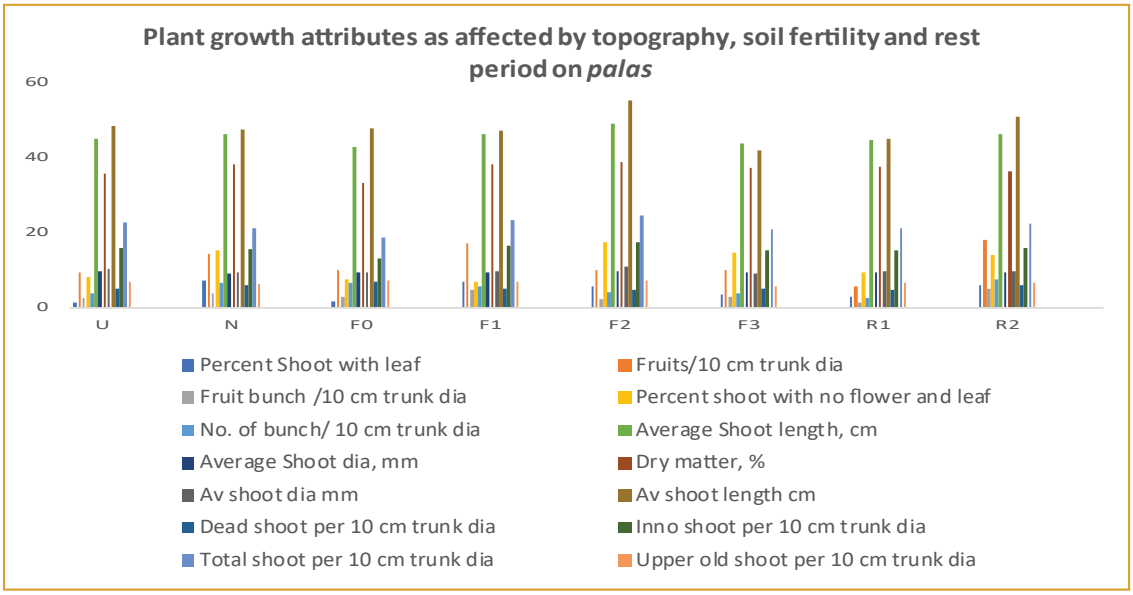
Successful lac cultivation depends largely on growth and sound health of host trees. To validate role of different organic agents, such as lime, phosphate solubilizing bacteria, Farm Yard Manure and Jeevamrit treatments on all four hosts, i.e. ber, semialata, palas and kusum, have been conducted. In majority of the cases no significant differences were observed in all the four host trees. Organic agents might take some gestation period to act upon, that could be the reason behind.

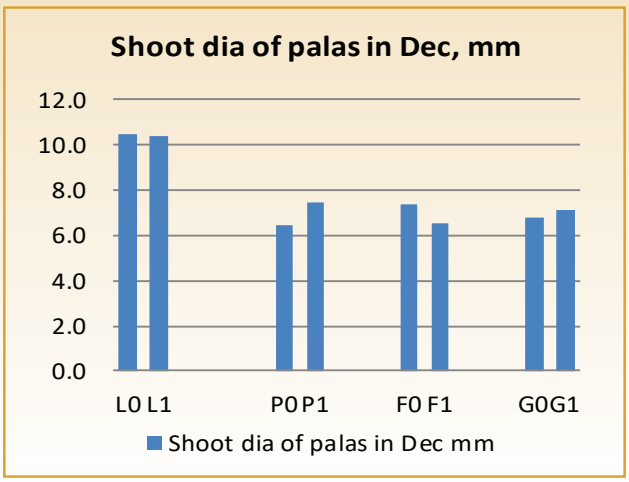


Height of semialata plants affected by different organic nutrients

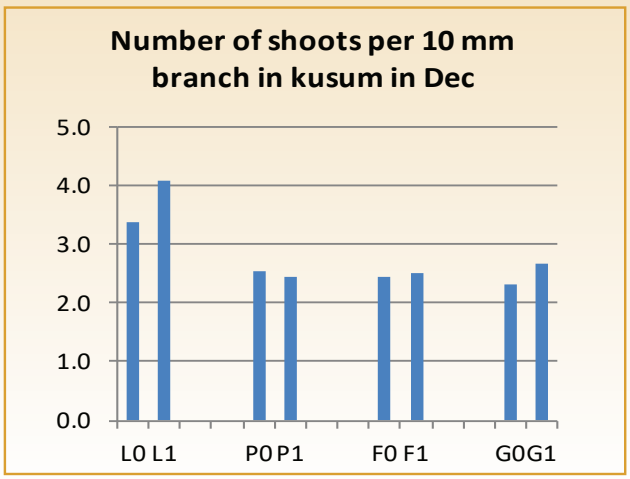


Length of ber shoots affected by different organic nutrients

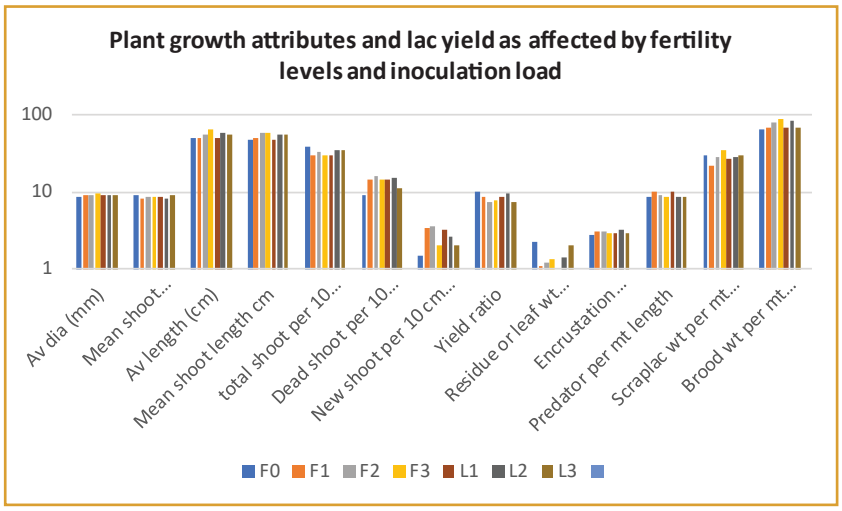




Shoot diameter of palas trees affected by different organic nutrients



Shoot diameter of kusum trees affected by different organic nutrients



Morphological characteristics of sooty mold causing fungus

Insect secrete honey dew from the anal pore and sooty mold develops on the honey dew; wherever the honey falls; sooty mold develops. Sooty mold has not been recorded on the upper part of plant; however, it can be observed that the sooty mold starts growing from the lac cells and advances to the twigs, fresh leaves and even on the soil or fallen dry leaf. A higher intensity of sooty mold has been observed at the bottom side than the upper side. The fungus produces effuse, black, blackish brown, pellicullose or crust-like black growth hyphae that are olivaceous to pale-brown, reticulate, consisting of long cylindrical cells.

The aggregation sooty mold is at the tip of the lac cell pore than the other parts. This forms a ball like structure which is only aggregation of mycelium. This aggregation of fungal mycelium formed because of getting more and more nutrient. The mycelium absorbs the nutrients near the excretion pore and slowly provides to the upper mycelium.



Aggregate mass of sooty mold at the tip of the lac cell pore



Development of ball like structure of sooty mold on tip of lac cell

Superficial growth of sooty mold

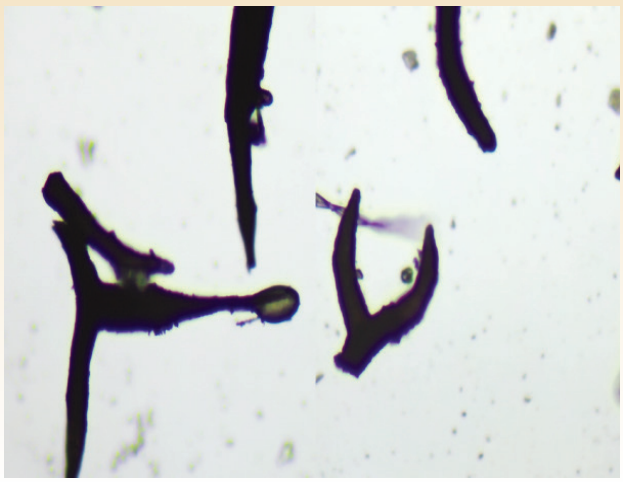
It has been observed that the growth of sooty mold is superficial. Like other pathogens, it does not produce hostoria or appendages, which helps to penetrate the host and absorbed nutrients. When the fungus gets dried it can be easily wash off from the leaf. But when the fungus is moist it is not detached easily. Upper part of the fungus from aggregation are dried but inside it is firm and holding moisture for its survival. The spores of the fungus get produced and spread along with the blowing air.



Superficial growth of sooty mold on ber leaf

Microscopic studies of sooty mold causing fungus

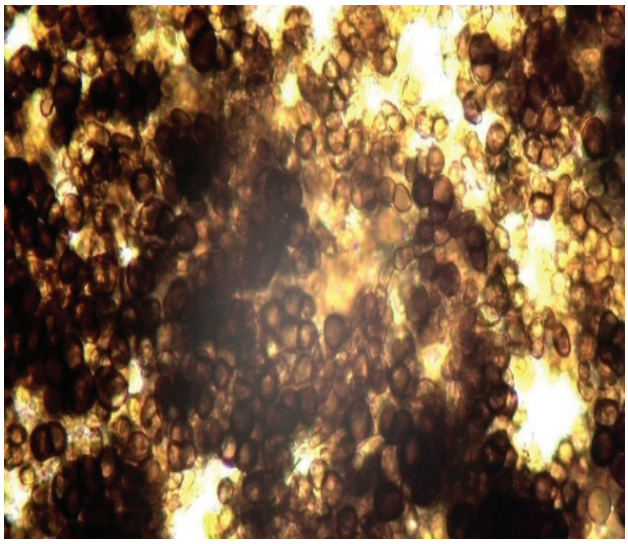
The sooty mold fungus from *semialata* plant were collected from leaf and lac cell. Slide preparation of the fungus were done and morphological observations were taken out. In microscopic study a hard corky structure was observed which may be the aggregation of fungal mycelium formed because of getting more and more nutrient.



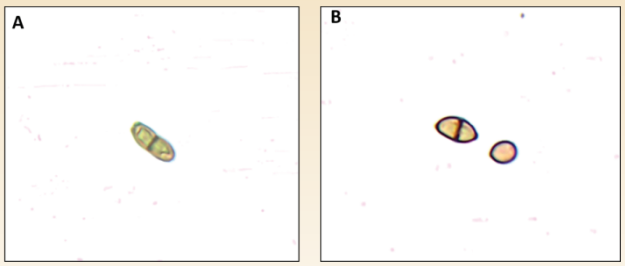
Sclerotia mass like structure developed on the host plant



Mycelium and free conidia of sooty mold



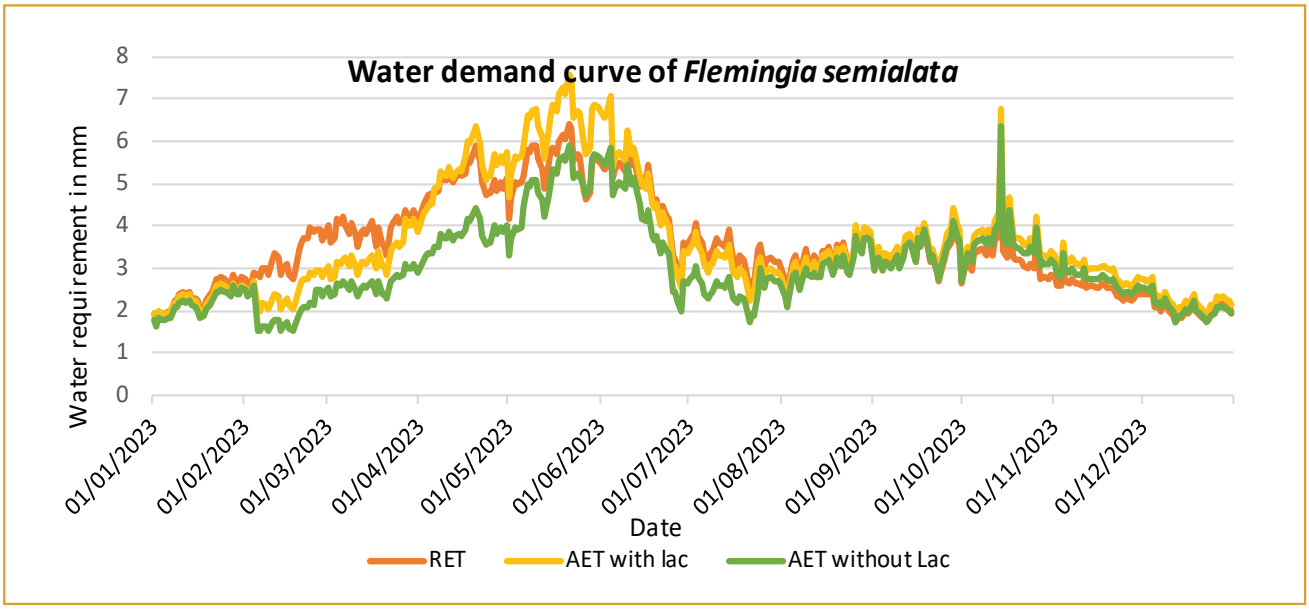
Spore mass of sooty mold



Two different types of spores from sooty mold A) blunt at the tip and having double layered B) with pointed the tip and singled layered

Estimation of water requirement and determination of growth-stage-specific crop coefficient (Kc) of *Flemingia semialata* Roxb.

Both winter *kusmi* lac (Aghani) and summer *kusmi* lac (Jethwi) was harvested in February, 2023 in both research plot and in lysimeters. All the input parameters of water balance model were measured for with and without lac in *Semialata* plant. The water balance study at three soil regimes (0-30 cm, 30-60 cm, 60-100 cm) revealed a total crop water demand of 617.32 mm for those with lac-inoculated plants and 569.44 mm for those without lac-inoculated plants in winter *kusmi* lac and a total crop water demand of 738.89 mm for those with lac-inoculated plants and 574.60 mm for those without lac-inoculated plants in summer *kusmi* lac.



Comparative variation of water requirement in lac cultivation [*AET= Actual Evapotranspiration, RET= Reference Evapotranspiration]

Performance of Black soldier fly reared on agro-waste generated from lac integrated farming system and household organic waste

The Black Soldier Fly (BSF), *Hermetia illucens* has garnered significant attention in sustainable agriculture and integrated farming systems due to its ability to convert low-value organic substrates into high-value proteins and fats. In the context of *Flemingia semialata* based lac integrated farming systems, the utility of BSF can be multifaceted and beneficial across several aspects. BSF larvae can feed on a variety of organic wastes, including the by-products and residues from *F. semialata* cultivation and lac processing. This capability allows for the efficient recycling of biomass into valuable insect biomass, reducing waste and contributing to the sustainability of the farming system. Kitchen waste with balanced composition consisting both fruits and vegetables is considered as optimum for larval growth of BSF. However, the composition of kitchen waste of Indian household is strongly influenced by seasonality. While summer and rainy season kitchen waste is dominated by cucurbitaceous vegetables, mostly Brassica vegetables are available during winter season. Brassica vegetables are known for their high content of glucosinolates which serve as natural plant defense mechanisms against insect pests. To integrate BSF rearing with *F. semialata* based lac integrated farming systems it is essential to ensure availability of suitable growing substrate round the year. BSF larva being omnivorous can also feed on *F. semialata* leaves which in turn have potential

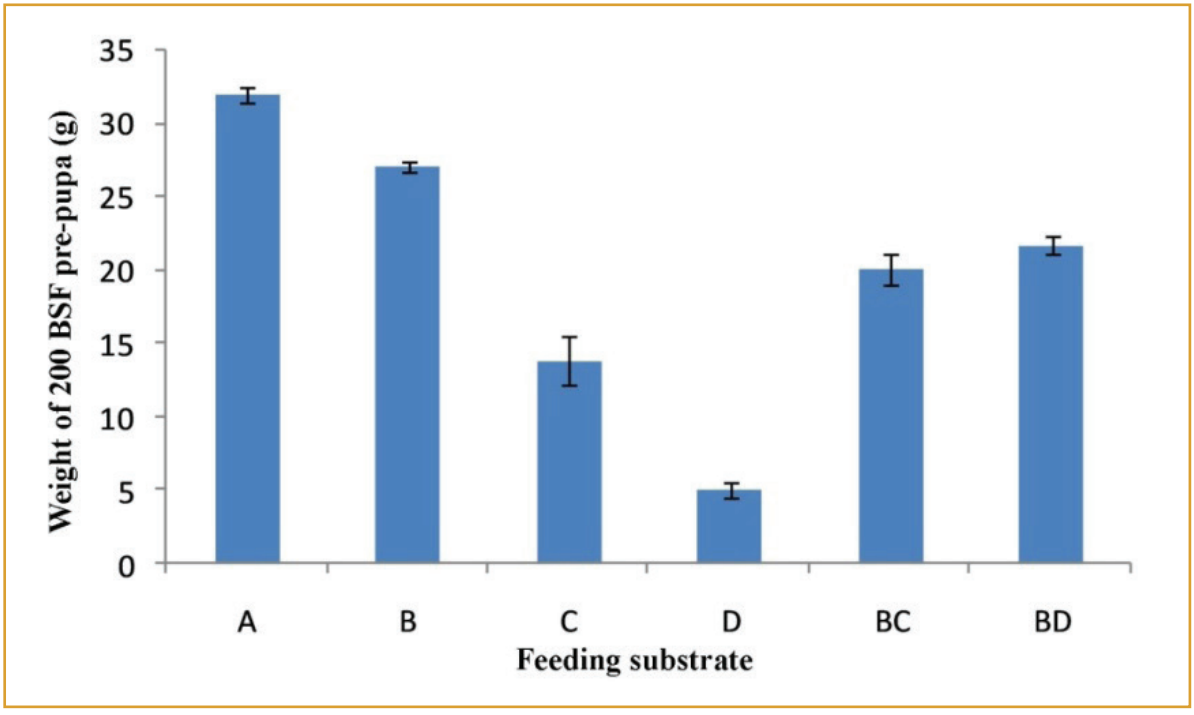
to substitute Brassica vegetable waste during winter season. The performance evaluation of different feeding substrate i.e. A (Chicken feed-control), B (Kitchen waste without Brassica vegetables), C (Brassica vegetable waste), D (Chopped semialata leaves), BC (Kitchen waste-Brassica vegetable waste 1:1), BD (Kitchen waste-chopped semialata leaves 1:1) on BSF larval growth revealed that both Brassica vegetable waste and chopped semialata leaves are unviable standalone substrate for rearing BSF. However, they can be used in combination with kitchen waste. The kitchen waste-chopped semialata leaves (1:1 mix) produces higher BSF pre pupal biomass than kitchen waste-brassica vegetable waste (1:1 mix), but the difference was not statistically significant.



Kitchen waste



Black soldier fly larvae and pupa

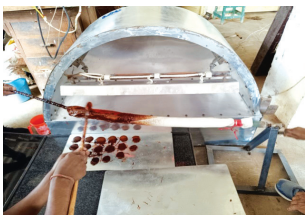


Effect of different feeding substrates on fresh weight (mean ± SE) of 200 BSF pre-pupa. [Treatment details: A (Chicken feed-control), B (Kitchen waste without Brassica vegetables), C (Brassica vegetable waste), D (Chopped semialata leaves), BC (Kitchen waste-Brassica vegetable waste 1:1), BD (Kitchen waste-chopped semialata leaves 1:1).

AGRICULTURAL STRUCTURES AND PROCESS ENGINEERING DIVISION

Solar powered electric bhatta for button lac production

Traditional button lac production in a manual operation involving drudgery. The operation exposes the operator to high heat generated from the traditional *Bhatta,* where biomass or coal is burnt to generate heat, causing discomfort and health issues in a long run. To improve the operating conditions of button lac production, a Solar Powered Electric Bhatta has been developed, which resembles the traditional *Bhatta* and comprises of three units: Oven, Operator-seat and Stone-slab. Oven is a semi-circular dome shaped unit with reflector- Infrared heating assembly installed in it. During each trial, 8 feet long woven cloth-bag is filled with 3 kg of seedlac, and fixed on manually on the rotating-head. One end of the woven cloth-bag is fixed on rotating-head, whereas the other end is held by the operator. The bag is heated portion-wise by keeping it under slow rotation below the reflector-heater assembly of the *Bhatta*. Performance evaluation of the solar powered electric Bhatta has the following indicators: The energy consumption (2.85 kWh), button lac yield (88 - 91%), yield (1.8 kg/h) and kiri yield (7 – 10%).



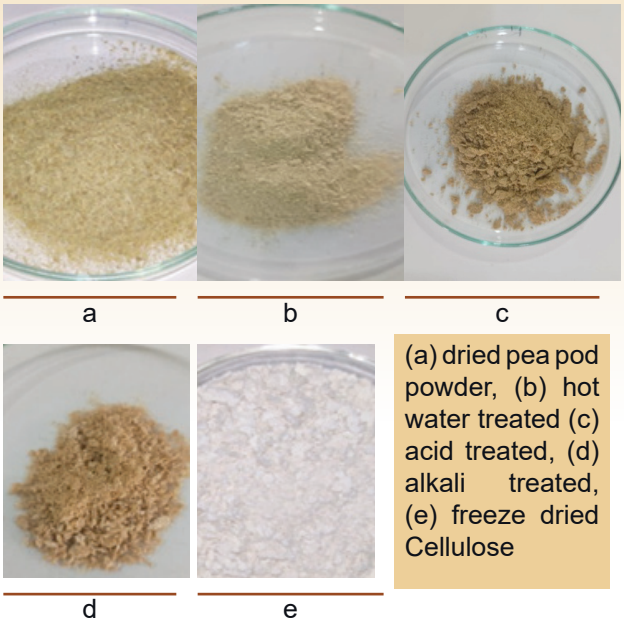
Melting of seedlac



Button lac

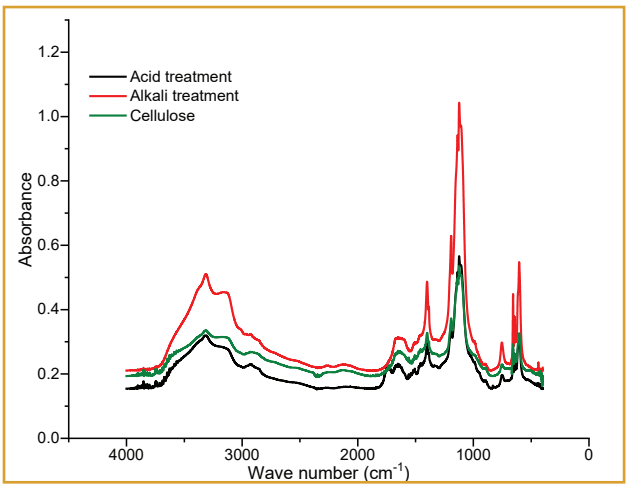
Extraction of cellulose from vegetable by-products

Horticultural byproducts such as peels, pomace, and seeds typically make up 35-40% of the dry weight of the produce. Despite containing significant amounts of biopolymers, e.g. cellulose, hemicellulose, lignin, xylose, ash, crude proteins, and phytochemicals, these byproducts are often discarded as waste. Extracting cellulose and other polymers from these biomass resources can transform them into valuable raw materials. This process not only addresses waste management issues but also generates additional income, thereby promoting a circular economy. Cellulose comprises approximately 5-60% of the byproducts from fruits and vegetables.

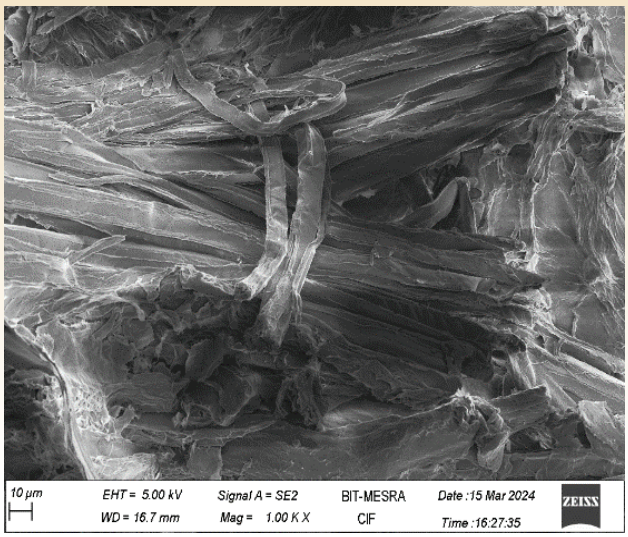


(a) dried pea pod powder, (b) hot water treated (c) acid treated, (d) alkali treated, (e) freeze dried Cellulose

Extraction of cellulose from green pea peels has been carried out by conventional acid- alkali hydrolysis. Pea pods was dried by sun drying followed by hot air drying at 50° C and the ground to fine powder in a mixer grinder. The cellulose was isolated by conventional hydrolysis consisting of boiling, acid treatment, alkali treatment, bleaching and freeze drying with a yield of 11.75%.The FT-IR spectra of raw pea pod powder, HCl treated powder, NaOH treated powder and cellulose has been studied in wavenumber range 4000 to 400 cm^{-1}. These peaks confirmed the removal of hemicellulose, and lignins from pea pods; resulting in chemically purified cellulose.



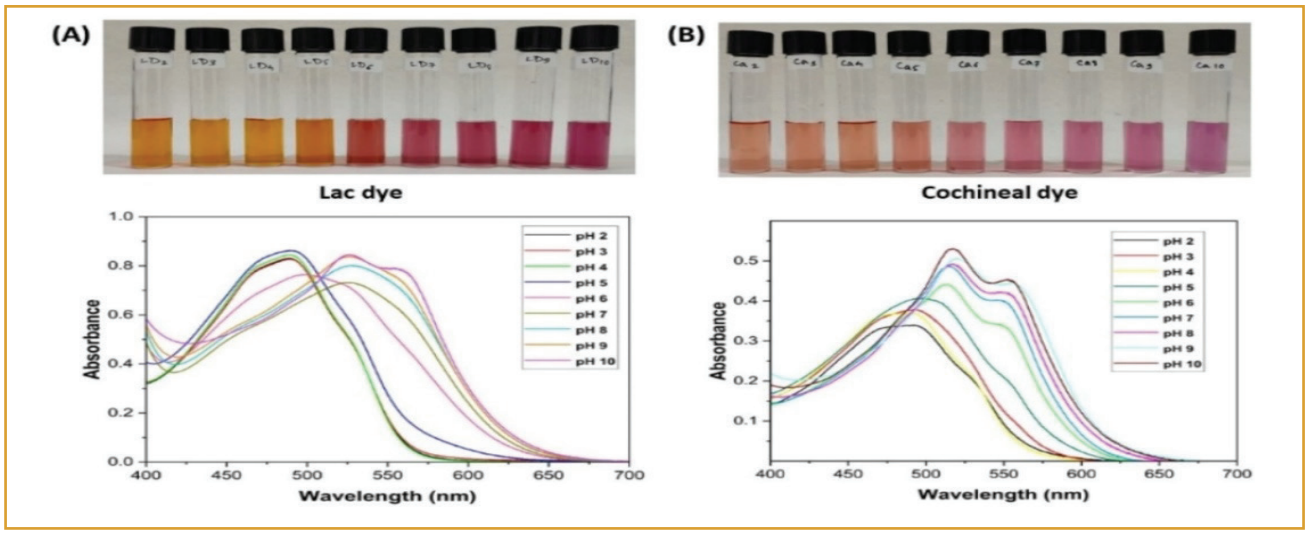
FTIR spectra of pea pod powder during various stages of extraction

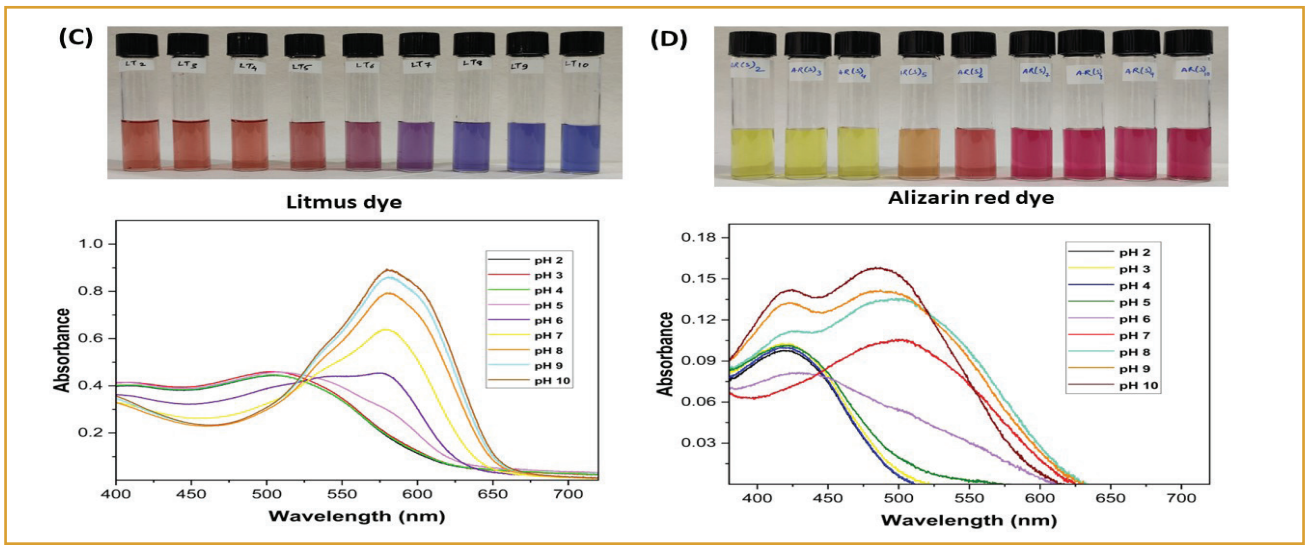


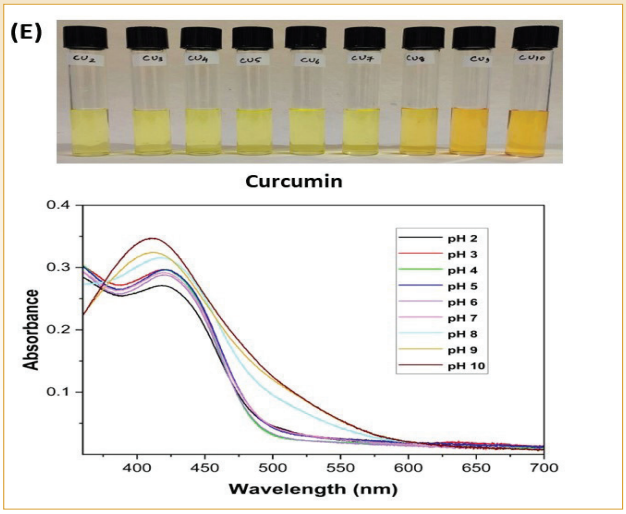
SEM images of cellulose isolated from pea pod

Natural dye-based intelligent indicators for real-time freshness monitoring of packaged perishable food products

The color change of different natural dyes (lac, alizarin red, litmus, cochineal, and curcumin) at varying pH (2-10) has been determined with a UV-Vis spectrophotometer. Lac and chochineal dye display orange-red color in acidic pH and purple color in alkaline pH. Alizarin red displays yellow color in acidic-pH and purple color in alkaline pH. Litmus displays red color in acidic pH and blue in alkaline pH. Curcumin is yellow in acidic medium and dark yellow in basic pH. When the color of the dye solution changes with pH, there will be a shift in absorbance peak. Further, the color change of dye combinations have also been studied to get a wide range of color variation with pH. With the aim to produce freshness indicator using 3D printing technology, bigel (combination of oleogel and hydrogel) formulation has been optimized for immobilization of dye.





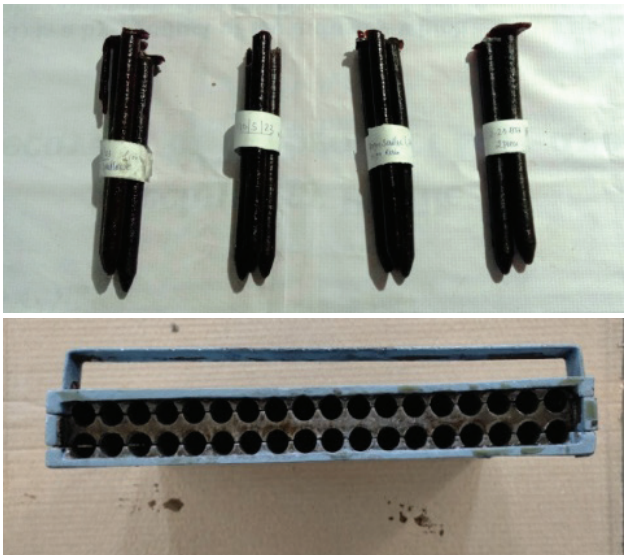


A, B, C. D, E: Optical images and UV-Vis absorbance spectra of dye solutions at different pH



F. Bigel indicator

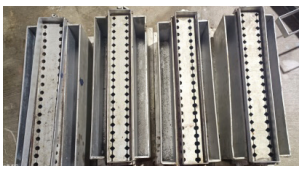
Process protocol for Sealing lac/wax preparation



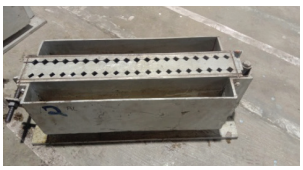
Due to polymerisation, products prepared from old lac does not pose adequate strength. Addition of rosin can improve the rhelogical characteristics and provide strengthn to the lac products. A process protocol has been developed for the preparation of sealing lac/wax with 2 years old seedlac with 30%, 35% of rosin and mollama with 20%, 30% of rosin addition using existing candle mould. Preparation of sealing stick with 30% rosin has only been successful with old molamma. Preparation of sealing stick with 5 years old button lac with 30% rosin has been proved to be unsuccessful. Preparation of sealing lac/wax with shellac has been tried in existing candle mold with different ratio 20%, 25%, 30%, 35% and 40% of rosin with Seedlac/shellac/Mollamma and rosin. Lac stick prepared with 80% rosin and 20% lac have adequate strength to prevent breakage while being removed from mold.

Development of fresh molds for making sealing lac/wax

A total 06 different molds of carbon steel (C-45), stainless steel (SS 304/306) and Aluminium alloy in square and round type have been fabricated. Trials of making sealing lac/wax with shellac and 0% ,10%, 20%,30%, 40%, 50% and 60% rosin have been carried out in newly fabricated molds and total 31 samples of sealing lac sticks have been prepared successfully in these new molds.



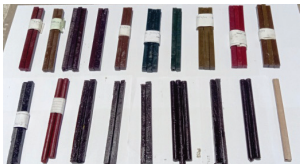
Different types of mold



Square hole type mold



Round hole type mold

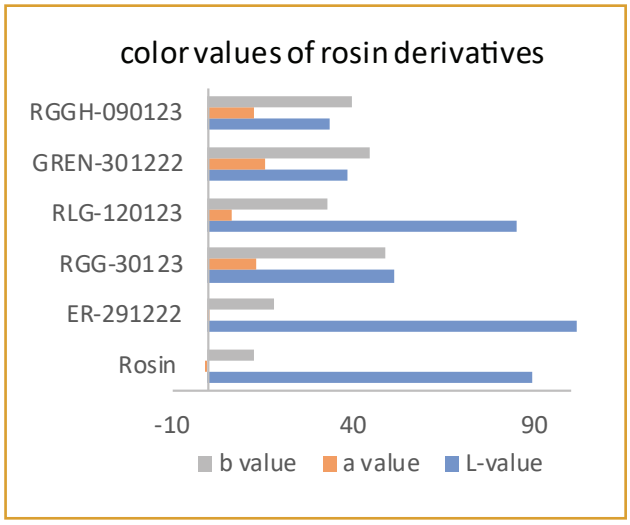


Sealing lac stick from developed mold

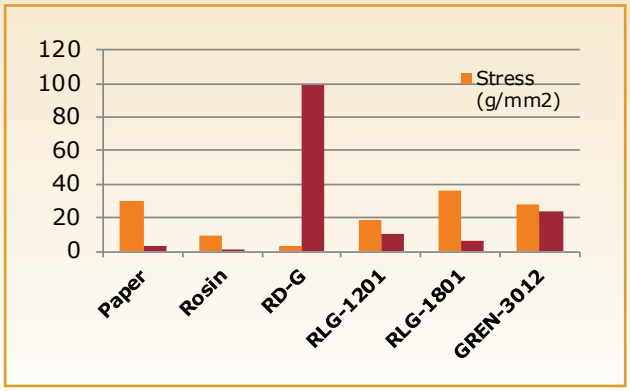
DOWNSTREAM AGRO PROCESSING DIVISION

Synthesis of rosin derivative for its application

Rosin has been reacted with different polyols and molecules at different temperatures and for different time durations and a number of rosin derivatives have been synthesized. Acid values of the synthesized derivatives are determined and found in varying range (15-45). Color has been determined with the help of Hunter Lab colorimeter. Generally, it can be observed that color of rosin becomes darker when derivatives were prepared. However, L value of one of the derivative is found higher as compared to that of rosin. Softening point of rosin has been analyzed using Differential Scanning Calorimetry (DSC) and recorded in the range of 60-85 ^{O}C as revealed by the thermograms. It is observed that the derivatives synthesized from rosin are having higher softening point as compared to that of rosin. The synthesized derivatives are studied for their adhesive (Zero Peel) strength using texture analyzer instrument. Adhesive (Peel) strength of the reacted product increased and recorded in the range of 19-36 g/mm^2, while rosin showed the strength of 9 g/mm^2. Adhesive strength is observed to be too high to be measured on paper strip, in one of the formulation. Paper strip is found to be broken but the paper has not slipt or lost adhesion. Strain% of the derivatives recorded is in very large scale (07-100%), while in the case of rosin, it is found to be 1.1%. In one of the formulation, strain has been recorded as 100%.



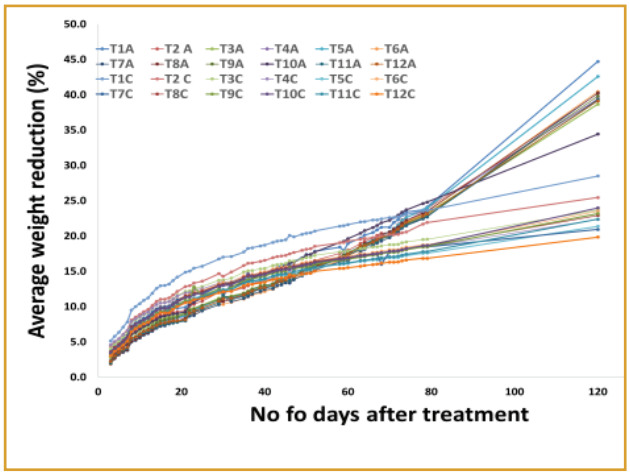
Adhesive strength measurement

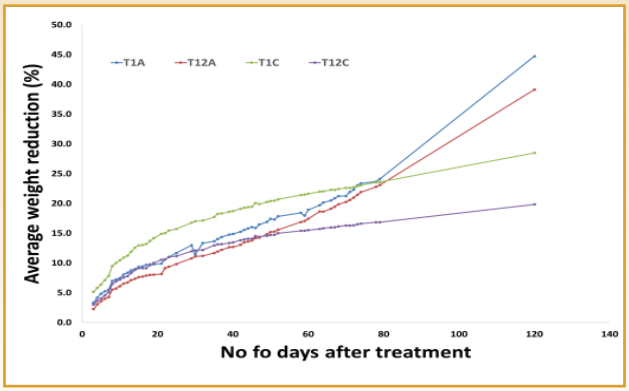


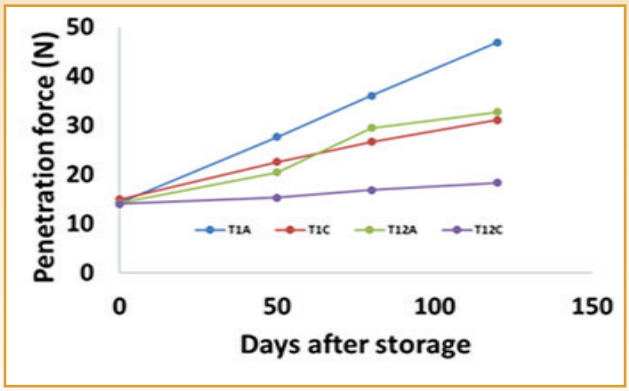
Adhesive strength of rosin and rosin derivatives

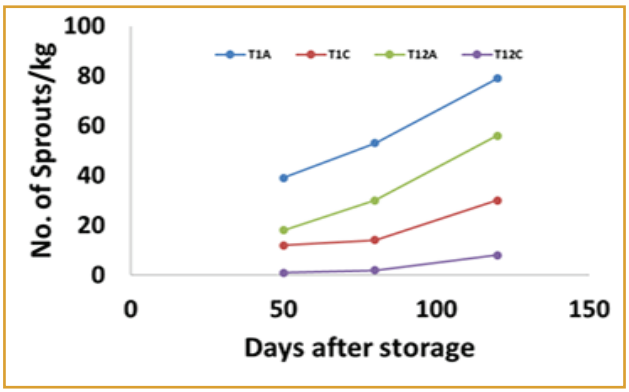
Lac based coating formulation for extending shelf life of ginger

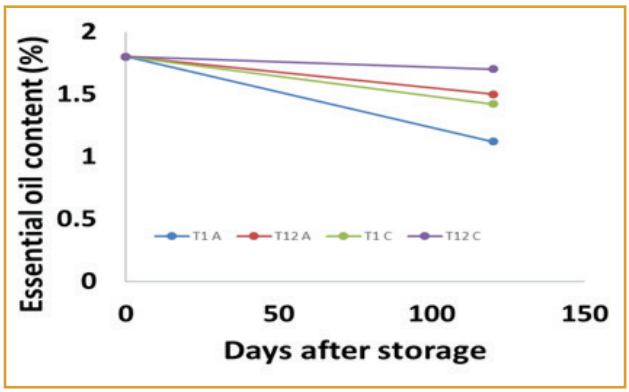
A study has been carried out as off-shoot study in DSC sponsored project, for enhancement of shelf life of Ginger. Lac based coating formulation has been prepared and supplied to ICAR-IISR Kozhikode (Kerala) for study of coating of ginger. Ginger once harvested loses moisture, weight loss, characteristics etc. very fast. Fresh ginger, after harvesting, has been thoroughly washed with water to remove all the impurities, followed by sterilization with 5% sodium hypochlorite solution for 5, 10 and 15 minutes. The treated ginger has been coated with lac based coating formulation (5% and 10%) and stored at ambient (29-31^{O} C, RH 65-72%) and 20^{O} C (RH- 55%) for four months. The samples are drawn periodically (0, 50, 80 and 120 days) and studied for weight loss, number of sprouts/ Kg, sprouts growth (mm), shrivelling%, penetration force, etc. The result are presented in the following graphs :

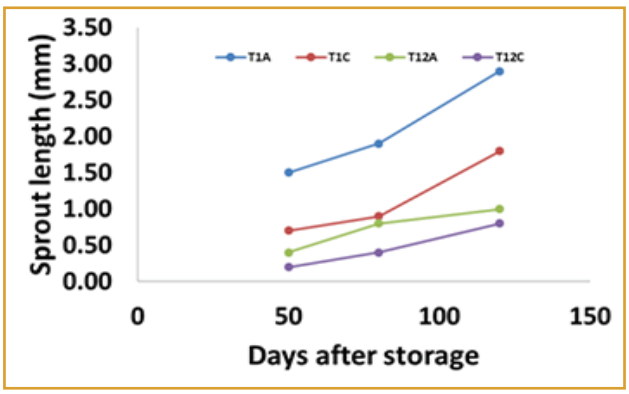


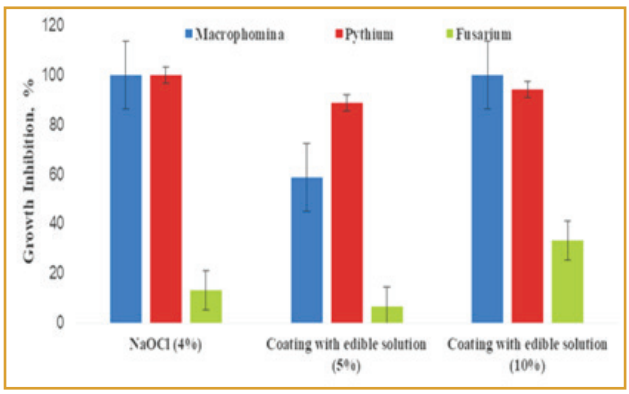

Average weight reduction (%)
T1A
T12A
T1C
T12C
No fo days after treatment

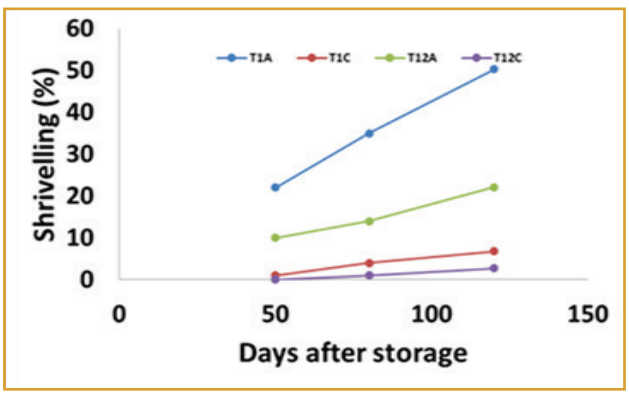

Penetration force (N)
T1A
T1C
T12A
T12C
Days after storage

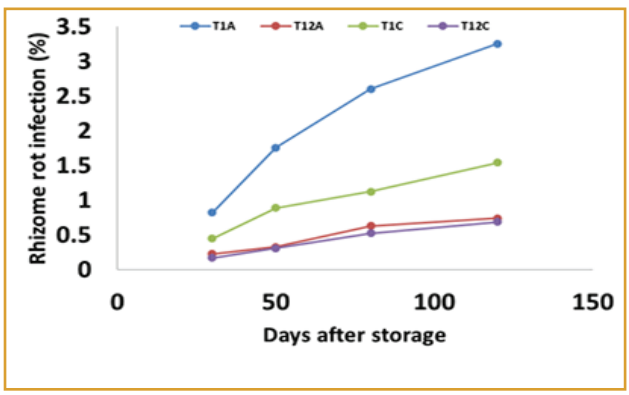

No. of Sprouts/kg
T1A
T1C
T12A
T12C
Days after storage


Essential oil content (%)
T1 A
T12 A
T1 C
T12 C
Days after storage


Sprout length (mm)
T1A
T1C
T12A
T12C
Days after storage


Growth Inhibition, %
Macrophomina
Pythium
Fusarium
NaOCl (4%)
Coating with edible solution (5%)
Coating with edible solution (10%)


Shrivelling (%)
T1A
T1C
T12A
T12C
Days after storage

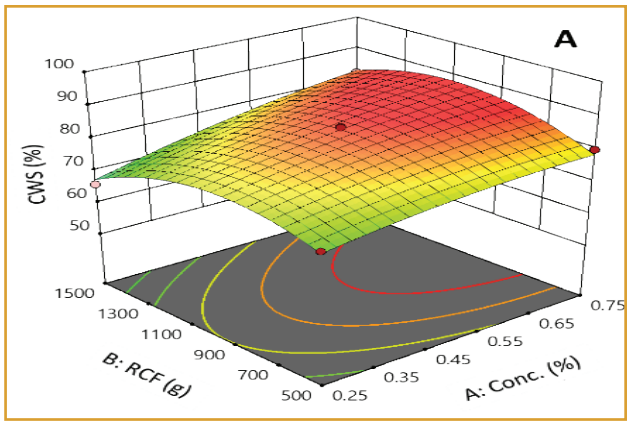

Rhizome rot infection (%)
T1A
T12A
T1C
T12C
Days after storage

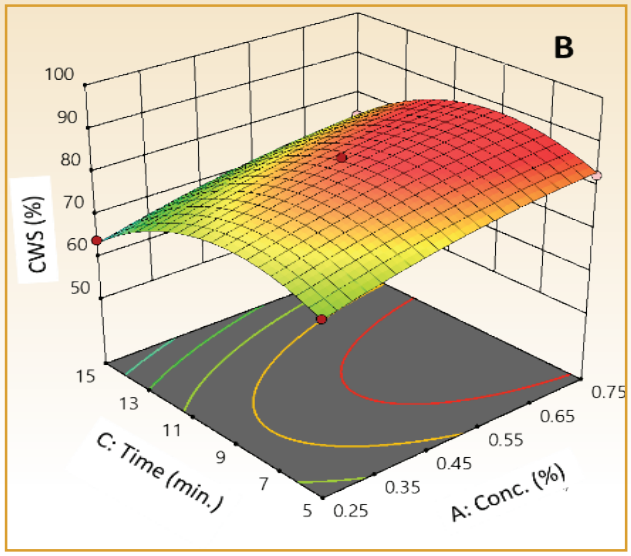


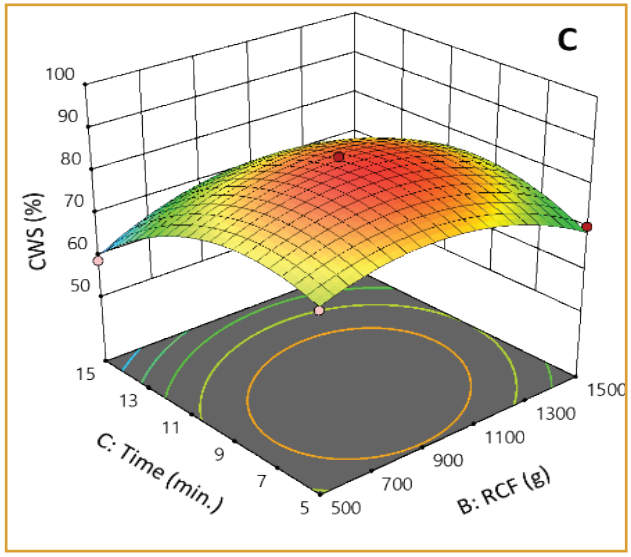
Ginger coated with the formulation coupled with sterilization at ambient temperature and in cold condition

Process protocol development for cold and hot water solubility (CWS) of natural polysaccharides

A new, convenient, easy, and statistically optimized method for estimating cold water solubility (CWS) of natural polysaccharides has been developed addressing the limitations of the conventional methods. Guar gum has been used as a reference polysaccharide to standardize the method using Box–Behnken design (BBD) of response surface methodology (RSM). The effective parameters in the study are solution concentration, centrifuge speed, and centrifugation time; with turbidity and CWS as dependent parameters. The CWS-based model has been found to be reliable with R^2 = 0.987, adjusted R^2 = 0.971, and the predicted R^2 values (0.8300) with a difference of < 0.2 in terms of predicting CWS. However, the turbidity-based model predicted CWS even more precisely with values of R^2, adjusted R^2, and predicted R^2 as 0.999, 0.999, and 0.997, respectively. The model predicted optimized values for three selected parameters came out as 0.5% initial gum concentration, 1000 ×g relative centrifugal force, and 10 min centrifugation time.

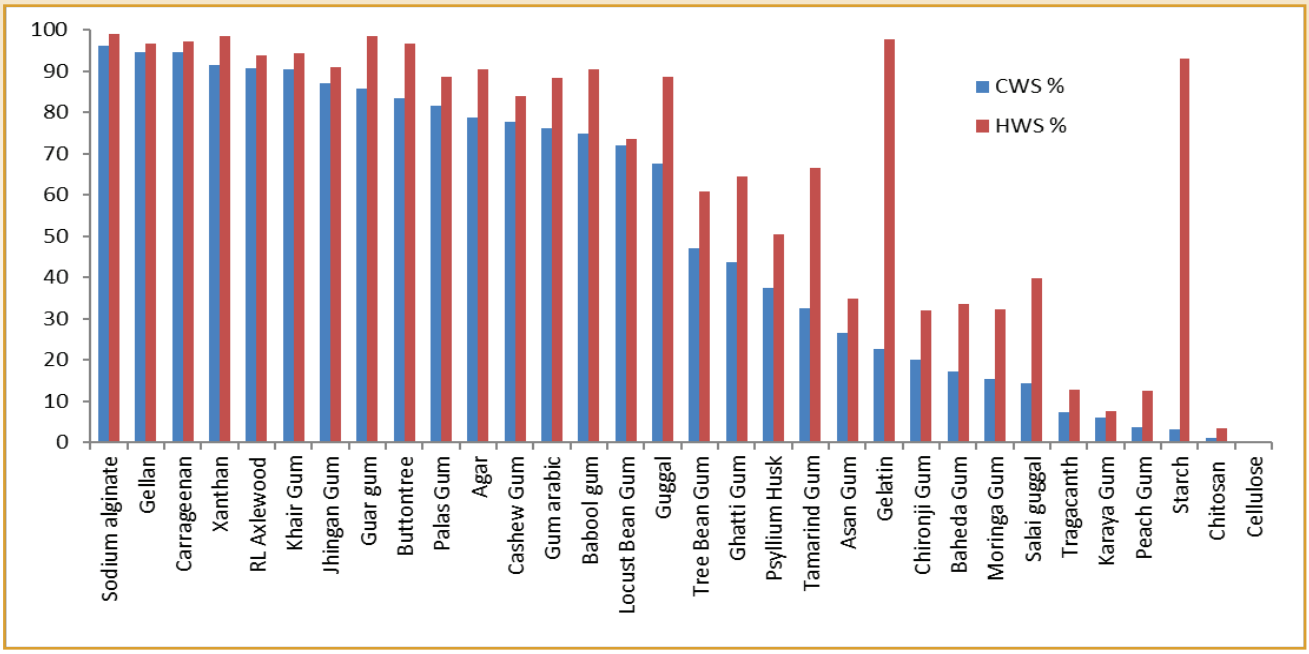






3D response surface methodology (RSM) plots showing interactions of different independent variables on CWS [A. Concentration and RCF, B. Concentration and Time, & C. RCF and Time]

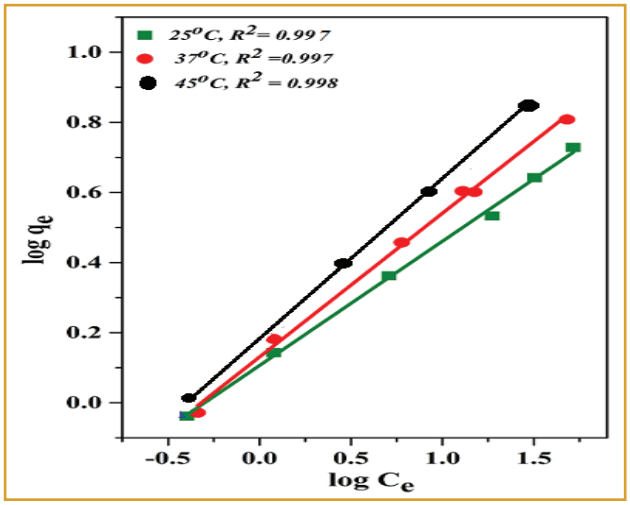
The model-predicted CWS value using optimized conditions (83.85%) is confirmed experimentally and very close to the actual value (85.76) with an error of 2.27%. The method developed for estimating CWS using guar gum is proposed to apply to all other natural polysaccharides and successfully tried for 32 others. Three broad categories of natural polysaccharides are presented based on their CWS as (i) insoluble (CWS < 10%), (ii) partially soluble (CWS 10 – 70%), and highly soluble (CWS > 70%). In order to determine hot water solubility, one additional step of heat exposure to polysaccharide solutions at 80 ^{0}C for 30 minutes has been incorporated.

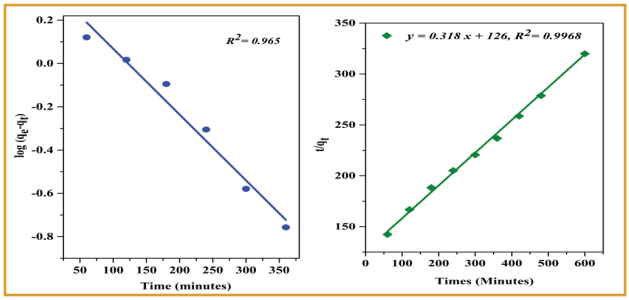


The cold and hot water solubility of the test gums

Synthesis of gum arabic based hydrogel for remediation of dye contaminated water

Adsorption study of brilliant green (BG) dye using synthesized hydrogel has been carried out under various reaction parameters. It is observed that adsorption decreased as it moved towards higher concentration. The study of adsorption revealed that it is pH dependent. It is found that optimized condition for dye brilliant green gradually increased with increase in pH of the solution which then tends to stabilize above pH=8. It is noted that raising the temperature of dye solution increased adsorption process. Adsorption isotherms are studied to understand the phenomena taking place during dye adsorption process particularly adsorbent and adsorbate interaction using Langmuir, Freundlich and Temkin isotherm models. It is found that adsorption increase from 53 to 80 mg/g as it move from 25 °C to 45 °C. Correlation coefficient of Langmuir isotherm has R^2 (0.965-0.999). The KF value of Freundlich isotherm is within the range of 2.26-2.69. The R^2 from the Temkin model is in the range of 0.85 to 0.91.





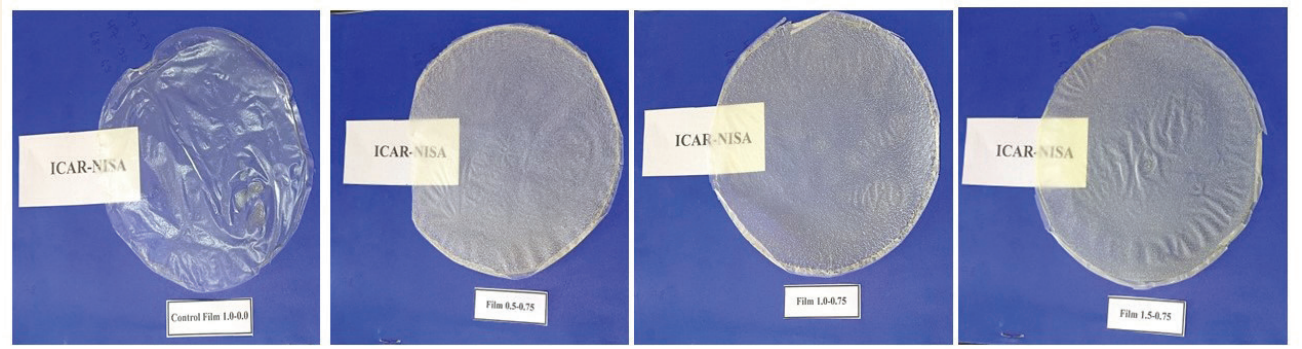
Pseudo-First order kinetic and pseudo-second order Kinetic study of BG Dye onto Arabic gum-Based hydrogel

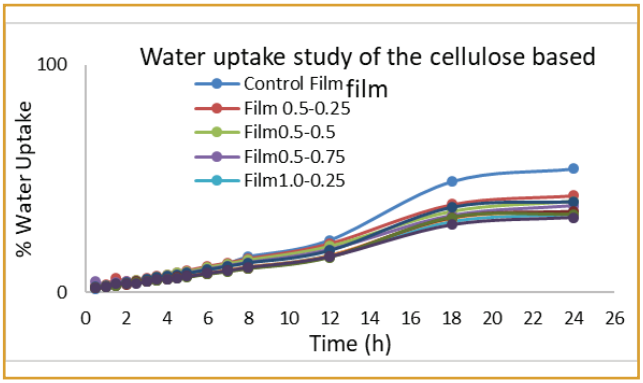
The rate constant for pseudo-first order kinetics is found to be 7 x 10^{-3}(min^{-1}) with R^2 value of 0.965. For pseudo-second order kinetics, the rate constant is found to be 8 x 10^{-4} (g mg^{-1} min^{-1}) with R^2 value of 0.996.

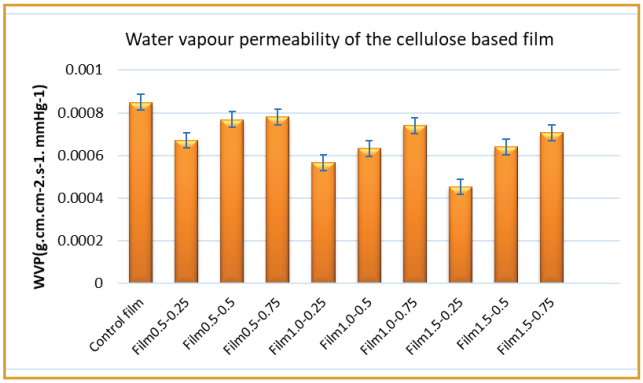
Development of bioactive compounds functionalized active packaging for shelf life improvement of perishable food commodity

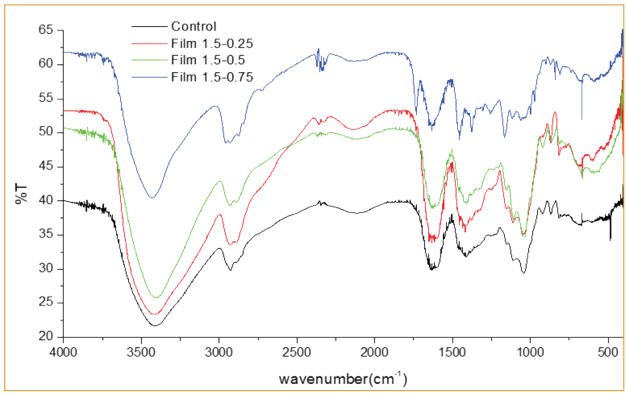
Cellulose based films are developed for use as active packaging material for shelf life improvement

of perishable food commodities. Different combinations of carboxymethyl guar gum (CMG) and microcrystalline cellulose (MCC) are prepared using the solution casting method using combinations of CMG and MCC and glycerine as plasticizer. The physical properties of the prepared films are estimated (thickness, opacity, color value) and the films are characterized by spectral properties like UV-Vis, FT-IR spectroscopy. The water uptake and water vapour permeability tests of developed cellulose based films are also accomplished. The highest thickness of the film has a higher content of the CMG and MCC. The opacity of the film increases with the higher cellulose content. The color values (L, a & b value) and colour









difference (ΔE) of the films are enhanced with the addition of cellulose. With the increase of cellulose concentration, the films become thicker, opaque and with lower transparency. The FT-IR spectra of the film indicate the peaks at 1600–1650 cm^{-1} are due to O–H bending from adsorbed water. The bands between 1400-1450 cm^{-1} are attributed to CH_2 intertwined in the cellulosic material which confirmed the presence of cellulose in the prepared film. The water uptake continuously increases up to a certain period of time (24 h) and the control film shows higher water uptake than the cellulose-based film (54%). Thus cellulose films are preferred compared to control films in food packing applications. The results of the WVP of the cellulose films indicate the interaction between the cellulose and CMG causing variable hydrophobicity of the film. The optimum combination of the both the polymer components shows least value of the WVP among the different combination of the film. Therefore, the diffusivity of the water vapor molecules through the cellulose based film decreases as compared to control film.

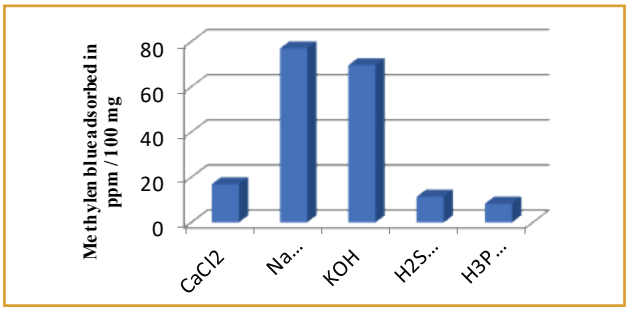
Biochar from lac mud and its utilization for dye removal from water

Biochar has been produced from lac mud through pyrolysis, spanning a temperature range of 400-800 °C in an electric furnace under oxygen. The resulting biochar exhibits a weight percentage ranging from approximately 12% to 35%. Among the various biochar samples obtained, the one with the highest yield has been selected for further treatment. This selected biochar have been treated with various activating agents, including KOH, NaOH, H_2SO_4, H_3PO_4, and $CaCl_2$. NaOH-treated biochar exhibits the maximum adsorption capacity of 77 ppm per 100 mg

of activated biochar, while the biochar treated with H_3PO_4 shows the least efficacy of 8 ppm/100 mg of activated biochar.



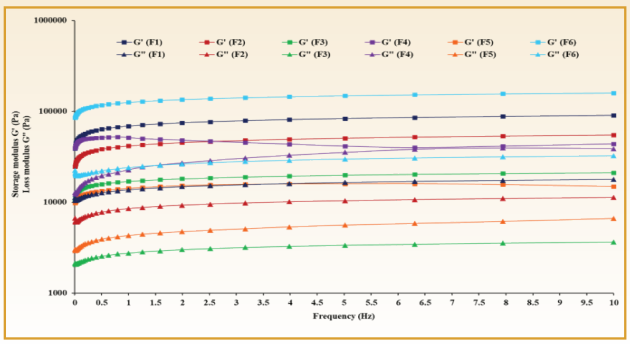
Biochar from lac mud



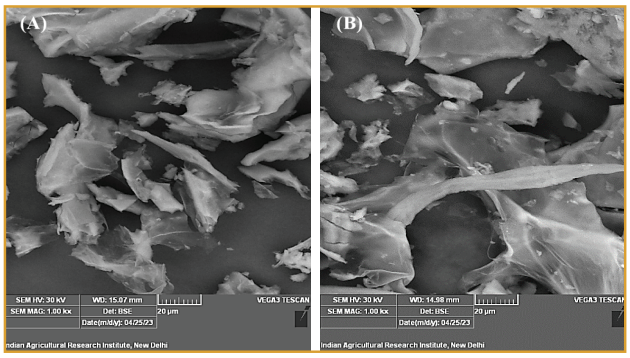
Methylene Blue adsorbed by activated biochar by different activating agent

Controlled release formulation of betalains

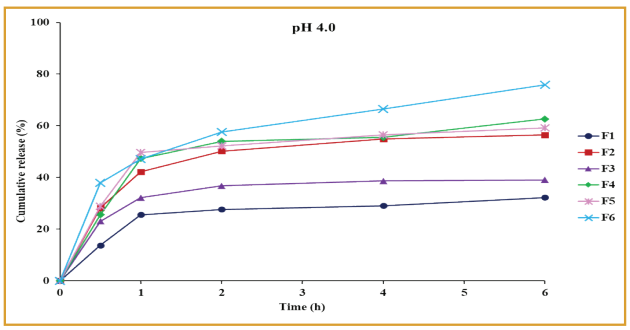
Six formulations of betalains, extracted from dragon fruit peels, have been developed through the ionic gelation technique with variable concentrations of chitosan and κ-carrageenan and sodium tripolyphosphate as an intramolecular cross-linker for chitosan to reinforce the gel. All the gels have elastic (solid-like) behavior. The FT-IR spectra of the powdered formulations indicates that the betalains are fully encapsulated within the biopolymeric matrix. SEM images indicates fluffy morphology of the formulations. All the formulations exhibit high encapsulation efficiency (70.38-97.08%) and loading capacity (6.90-10.65%). Encapsulated betalains remain highly stable at the freezing and ambient temperature conditions with minimal degradation. Yet, accelerated storage conditions can degrade a certain proportion of the encapsulated betalains within the formulations. The cumulative release of betalains from the prepared formulations is more rapid at neutral pH than in the acidic conditions A significant portion of the encapsulated betalains in the powder formulations is accessible during the gastric phase after ingestion; a notable amount of betalains from the formulations, except two formulations is also available during the oral phase.

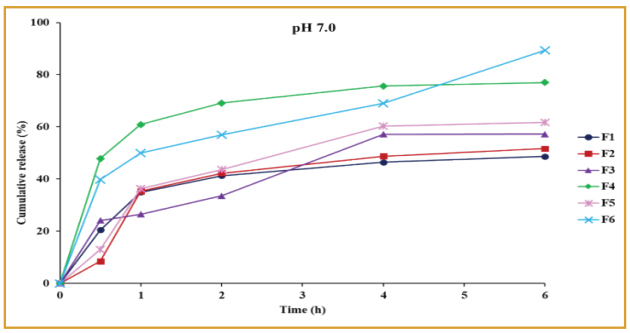


Rheological characterization of the pre-dried gels

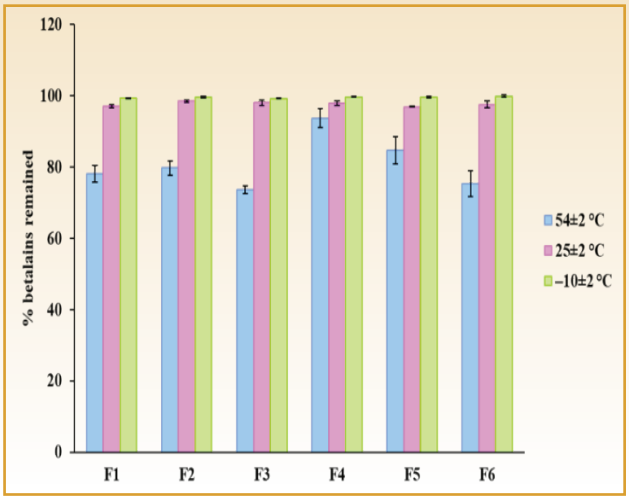


Representative SEM images of the prepared formulations

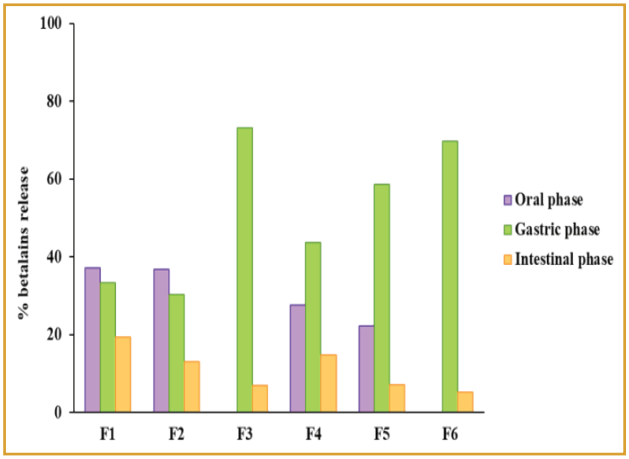




Cumulative release of betalains from the prepared formulations at different pHs



Stability of encapsulated betalains at different storage conditions



In vitro bioavailability study of betalains from the formualtions

Design and development of portable device (LaCilyser) for estimation of life and color index of lac samples

An electronic hand-held device for lac color index analysis has been developed based on the principle of calorimetry through collaboration of NISA with CSIR-Central Scientific Instrument Organization, Chandigarh funded by NABARD. The device offers accurate results across a wide range of lac color index values with its pre- calibrated system and resolution of color index ±1.0. Operating on a user-friendly interface, the device incorporates data acquisition and processing capabilities, providing quick and reliable measurements in just 30 seconds. The standardized preparation of the lac solution, as per IS:6921-1973, ensures consistency and adherence to recognized protocols.



AUTOMATION AND PLANT ENGIUNEERING DIVISION

Development of carboxy methyl guar gum derivative pilot plant

To mechanize the process of carboxymethyl guar gum derivative preparation from guar gum powder with reagents, a pilot plant (capacity: 5 kg/batch) consists of different units (mixing-cum-reaction unit, filtration unit, drying-cum-agitator unit, and distillation unit) fabricated in collaborative mode at ICAR – Central Institute of Agricultural Engineering, Bhopal and functionality trials of the different fabricated units and their components without raw material completed, including installation of brought-out components with minor improvements and adjustments.

Preliminary evaluation trials of carboxymethyl guar gum derivative preparation from guar gum powder and required reagents utilizing the pilot plant being fabricated were carried out and minor improvements in the mixing-cum-reaction unit and drying-cum-agitator unit are under progress based on evaluation trials conducted for manufacturing CM guar gum derivative. Quality parameters of the prepared carboxy methyl guar gum derivative was evaluated for viscosity, pH and degree of substitution and found 1230 cP, 8.19 and 0.0183, respectively.



Mixing-cum-reaction unit



Filtration unit



Drying-cum-agitator unit



Distillation unit



Success Story

Shri Chaluvaraju, P. P. Village: Bannikuppe, Hobli: Kasaba, District: Mysore, State: Karnataka



Shri Chaluvaraju PP, a farmer from Bannikuppe village, Kasaba Hobli, Mysore district, Karnataka, transformed his three-acre farm with organic methods and rainwater harvesting. He ventured into lac cultivation in 2014, planting 40 Ber trees and 70 semialata lac hosts. Overcoming market challenges, his premium lac gained popularity among artisans and toy manufacturers. Despite initial obstacles, Shri Chaluvaraju's persistence turned adversity into opportunity, showcasing the potential of innovative farming. The year 2018-19 proved to be a turning point when Shri Chaluvaraju engaged with experts from ICAR-NISA (formerly ICAR-IINRG, Ranchi) and KVK, Sirsi. This interaction broadened his horizons, infusing his farming practices with knowledge and diversity. Collaborating with the forest department under the lac promotion scheme, he was able to elevate his farm's income, signifying the emergence of a prosperous phase in his agricultural journey. In addition to lac cultivation, he is also cultivating other fruit and planation crops. Shri Chaluvaraju's farm became a testament to growth and adaptation. From a modest yield of 76 kilograms in 2015 to an impressive 210 kilograms in 2022, the journey of lac production paralleled the evolution of his strategies. The price of lac also increased from ₹ 180/kg when he had begun to ₹ 450/kg in 2022. His gross income from lac cultivation increased from ₹ 13,680 to ₹ 94500.00 over a span of these seven years. Embracing scientific methods for pest management, tree pruning, and broodlac techniques, he not only augmented his own living standards but also became a beacon of hope for farmers in his community.

"Reviving Tradition: Udghosh Foundation's Journey towards Sustainable Growth and Empowerment"



Udghosh Foundation was established in 1860 and has remained steadfast in its dedication to environmental conservation, self-employment, and fostering self-reliance. Since 2021, the foundation has been actively championing its noble cause. With roots tracing back to 2015, members of the organization have been actively involved in creating employment opportunities centered around Palas flowers, with a particular emphasis on preserving the largest Kunderi Lah Bagh in the Asian continent. Besides Lac cultivation, the foundation has placed a significant focus on harnessing the potential of Palas flowers to produce herbal colors, utilizing bamboo, leaves, and chowri. The members of the foundation received specialized training in herbal color production from ICAR-NISA, Ranchi during 2017. During June 16, 2023, the Udghosh Foundation reestablished of its unit dedicated to producing herbal gull from Palas flowers. Plans for expansion are already in motion, signalling a promising future. Priced at ₹ 25 per kilogram, Palas flowers are sourced from rural channels, processed into herbal colors, sold in the market under the brand name "TESU". Responding to the surging demand, herbal gulal are now available in various sizes, packaged in bamboo-made boxes ranging from 20 g to 250 g. With no adverse effects, there is a growing demand for this herbal gulal in the market. Women play a pivotal role in its production, utilizing traditional methods. This initiative not only bolsters environmental conservation efforts but also empowers rural women economically, marking a significant stride towards sustainable development.



Salient Achievement of Network Projects

NETWORK PROJECT ON CONSERVATION OF LAC INSECT GENETIC RESOURSES

ICAR-National Institute of Secondary Agriculture

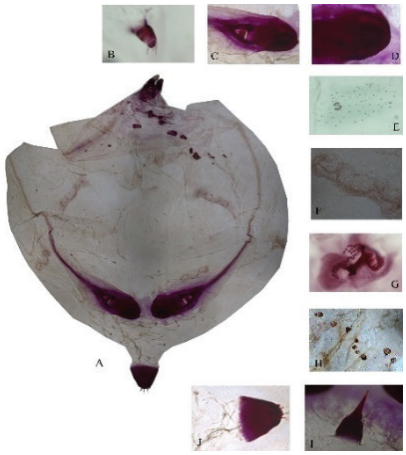
Identification, morphological characterization and documentation of the lac insects collected from different agro climatic zones

The survey for lac biodiversity by different network centers resulted in collection of natural lac insect populations from different locations of the country on different host plants. Total 20 populations have been collected by SFRI, Jabalpur Centre, which are primarily processed and preserved for taxonomic identification. Six samples collected from Madhya Pradesh and Maharashtra have been processed to prepare permanent slide mounts.

Taxonomic identification, illustration and description

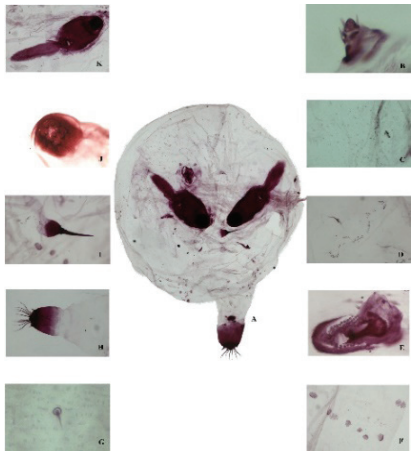
Lac insects collected from Chikmagalur (Karnataka) on *Albizia saman* has been identified as *Kerria canalis* Rajgopal. That collected from Imphal (Manipur) on Litchi has been identified as **Kerria chinensis* Mahdihassan. The insect samples collected from and Bengaluru (Karnataka) found on Custard apple &

Lac host plants identified from different locations of India			
Sl. No.	**Location**	**Host plants**	**Collected Center**
1	Maharashtra	Peepal (*Ficus* sp.)	SFRI, Jabalpur
2	Maharashtra	Peepal (*Ficus* sp.)	SFRI, Jabalpur
3	Maharashtra	Rain tree (*Albizia saman*)	SFRI, Jabalpur
4	Maharashtra	Gular (*Ficus racemosa*)	SFRI, Jabalpur
5	Madhya Pradesh	Peepal (*Ficus* sp.)	SFRI, Jabalpur
6	Madhya Pradesh	Peepal (*Ficus* sp.)	SFRI, Jabalpur



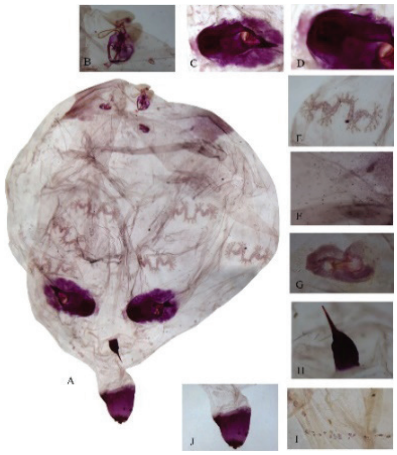
Kerria canalis (Rajgopal)

A, whole mount. B, antenna. C, brachia. D, brachial plate, crater with dimples. E, ventral duct cluster. F, marginal duct cluster. G, posterior spiracle. H, perivulvar pore cluster. I, dorsal spine. J, anal tubercle.



Kerria chinensis (Mahdihassan)

A, whole mount. B, antenna. C, ventral duct cluster. D, marginal duct cluster. E, posterior spiracle. F, perivulvar pore cluster. G, ventral seta. H, anal tubercle. I, dorsal spine. J, brachial crater with dimples. K, brachia with anterior spiracle and sclerotized trailing.



Kerria rangoonensis (Chamberlin)

A, whole mount. B, mouth parts and antenna. C, brachia. D, brachial plate, crater with dimples. E, marginal duct cluster. F, ventral duct cluster. G, posterior spiracle. H, dorsal spine. I, perivulvar pore cluster. J, anal tubercle.

Albizia saman and from Guntur (Andhra Pradesh) on Dubai teak has been identified as *Kerria rangoonensis* Chamberlin.

Identification of endosymbionts from different strains of lac insect

Culturing method

By following culturing and 16S rDNA amplicon sequencing method, the following endosymbionts have been identified from *kusmi* (*aghani*) and *rangeeni* (*baisakhi*) lac insects. *Priestia megaterium*, *Staphylococcus epidermidis, Staphylococcus haemolyticus, Microbacterium testaceum, Microbacterium oleivorans* are identified from *kusmi* lac insects and *Staphylococcus warneri, Priestiaarya bhattai, Paenibacillus sp.* from *rangeeni* lac insects.

The Gene Bank accession numbers for 16S rDNA sequences of the endosymbionts

Endosymbiont	16S rDNA GenBank accession
Priestia megaterium	OR294197
Staphylococcus epidermidis	OR294198, OR186654
Staphylococcus haemolyticus	OR186654
Microbacterium testaceum	OR186656
Microbacterium oleivorans	OR186657
Staphylococcus warneri	OR294196
Priestiaarya bhattai	OR186659
Paenibacillus sp.	OR186660

Culture independent method

16S rDNA amplicon and ITS amplicon sequencing have been carried out through Illumina platform to identify bacterial and fungal endosymbionts of *kusmi* and *rangeeni* strains of lac insect. *Proteobacteria* and *opalinat*a are the most abundant phylum in *kusmi* and *rangeeni* strain, respectively. *Wolbachia* and *Opalinata* are the most abundant genus found in *kusmi* and *rangeeni* strain, respectively. As far as fungal endosymbionts are concerned, *Ascomycota* is the most abundant phylum, whereas, *Sordariomycetes* is the most abundant class, while *Hypocreales* is the most abundant order, and *Nectriaceae* is the most abundant family in both strains of lac insects. *Ramichloridium* is the most abundant genus in *kusmi* insects, whereas *Acremonium* and *Cladosporium* are the most abundant genus in *rangeeni* lac insects. *Ramichloridium luteum* and *Ramichloridium apiculatum* are the most abundant species found in *kusmi* lac insects; whereas, *Acremonium cavaraeanum* and *Cladosporium velox* are the most abundant species found in *rangeeni* lac insects.

Isolation of soil bacteria that can utilize lac as a carbon source

Bacteria that can utilize lac resin as a carbon source were isolated from soil samples. For this experiment, different concentrations of seedlac dissolved in acetone have been used as a carbon source. MSM (Minimal Salt Media) media with different concentrations of lac as a carbon source (0.02%, 0.5%, 1%, and 2%) has been tried. As a positive control, glucose as a carbon source; and a negative control without any carbon source are used. For molecular identification of the colonies, 16S rRNA genes have been amplified from genomic DNA and sequenced. Based on the sequences, they are identified as *Erwinia* sp. (0.02% and 0.5%) and *Pantoea* sp. (1% and 2%).

Analysis of phloem sap from *Flemingia semialata* lac-host plant

Flemingia semialata plant has been inoculated with *kusmi* strain of Indian lac insect (*Kerria lacca* Kerr). The leaf phloem sap samples are collected from inoculated plants for studying the composition and compared with uninoculated plants samples, i.e. control. The phloem sap collected from lac insect infested plant shows elevated content of total sugar (136.12 µg/mL) than with no lac insect infestation (64.58 µg/mL). There has been 110.80% increase in total sugar in lac insect infested over non infested condition. The phloem sap collected from lac insect infested plant shows higher content of reducing sugar (72.33 µg/mL) than with no lac insect infestation (34.92 µg/mL). There has been 107.16% increase in reducing sugar in lac insect infested over non infested condition. The phloem sap collected from lac insect infested leaves shows elevated protein content (30.83 µg/mL) over non infestation plant (11.00 µg/mL). There has been 180.30% increase in protein content in lac insect infested over non infested condition. Phenol content in phloem sap collected of lac insect infested plant is higher (188.33 µg/mL) than no lac insect infested (128.83 µg/mL) plant. There has been 211.30% increase in phenol content in lac insect infested over non infested condition. This shows that lac insect upon sucking the sap triggers the extra synthesis of biochemical in the host plant so that it not only supports lac insect but also ensures survival of host plant.

Photographic field guide for identification of major lac host plants of India

With the objective of creating a photographic guide for identification of major lac host plants, the photographs of different parts of lac host plants such as leaves, flowers, fruits, seeds, bark, lac, with their botanical details has been compiled for 60 lac host plants in the form of a book 'Lac Host-Plants of India: A Field Guide'

List of lac host plants covered is as follows

Sl. No	Host Plant	Sl. No	Host Plant	Sl. No	Host Plant
1	Kusum (*Schleichera oleosa*)	21	Litchi (*Litchi chinensis*)	41	White Powder Puff (*Calliandra haematocephala Alba*)
2	Palas (*Butea monosperma*)	22	Weeping Fig (*Ficus benjamina*)	42	Red Powder Puff (*Calliandra haematocephala*)
3	Ber (*Ziziphus mauritiana*)	23	Gular (*Ficus racemosa*)	43	*Eriolaena spectabilis*
4	Semialata (*Flemingia semialata*)	24	Pilkhan (*Ficus rumphii*)	44	Showy Desmodium (*Phylldoium pulchellum*)
5	Bhalia (*Flemingia macrophylla*)	25	Soft Fig (*Ficus mollis*)	45	Banchalita (*Leea asiatica*)
6	Rain Tree (*Albizia saman*)	26	Anjeer (*Ficus carica*)	46	Jungle Jalebi (*Pithecellobium dulce*)
7	Arhar (*Cajanus cajan*)	27	Drooping Fig (*Ficus semicordata*)	47	Siris (*Albizia lebbeck*)
8	Peepal (*Ficus religiosa*)	28	Jori (*Ficus amplissima*)	48	Khejri (*Prosopis cineraria*)
9	Babul (*Acacia nilotica*)sp:indica	29	Karal Fig (*Ficus tsjakela*)	49	Blue Jacaranda (*Jacaranda mimosifolia*)
10	Potka Siris (*Albizia lucidior*)	30	Indian Laurel Fig (*Ficus microcarpa*)	50	Garuga (*Garuga pinnata*)
11	Ghont (*Ziziphus xylopyrus*)	31	Pendulous Sleeping Hibiscus (*Malvaviscus penduliflorus*)	51	Mango (*Mangifera indica*)
12	Red calliandra (*Calliandra calothyrsus*)	32	Israeli babool (*Acacia tortilis*)	52	Indian Tulip Tree (*Thespesia populnea*)
13	Khair (*Acacia catechu*)	33	Custard apple (*Annona squamosa*)	53	Pongam Creeper (*Millettia extensa*)
14	Copperpod (*Peltophorum pterocarpum*)	34	Salpan (*Flemingia chappar*)	54	Akashmoni (*Acacia auriculiformis*)
15	Sandan (*Desmodium oojeinense*)	35	Wild Hops (*Flemingia strobilifera*)	55	Baobab (*Adansonia digitata*)
16	Bargad (*Ficus benghalensis*)	36	*Flemingia stricta*	56	Kaamala (*Mallotus philippensis*)
17	Putri (*Croton persimilis*)	37	Palas (*Butea monosperma*) var swadi	57	Pumpkin (*Cucurbita maxima*)
18	Serrulate-Leaved Grewia (*Grewia multiflora*)	38	Lata Palas (*Butea superba*)	58	Pride of Burma (*Amherstia nobilis*)
19	Jalari (*Shorea roxburghii*)	39	Suriname Powderpuff (*Calliandra surinamensis*)	59	Shisham (*Dalbergia sissoo*)
20	Sweet acacia (*Acacia farnesiana*)	40	Sweet acacia (*Acacia farnesiana*)	60	Mesquite (*Prosopis juliflora*)

NETWORK COOPERATING CENTRES

Assam Agriculture University, Jorhat (Assam)

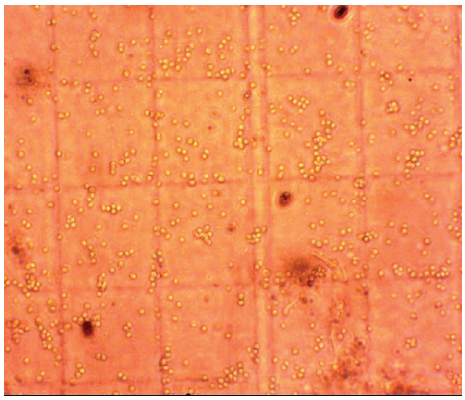
Development of liquid based bio-formulation of *Beauvaria bassiana* utilizing agricultural wastes for management of pests of lac insect

Two nutrient media with different carbon, nitrogen and nutrient sources have been evaluated for culturing of liquid based bioformulation of *B. bassiana*. Potato Dextrose Broth (PDB), Rice gruel are taken as base medium with three carbon sources, Dextrose, Starch, Mannitol; four Nitrogen sources- Chitin, Yeast extract, Casein, Peptone and two mineral sources-$MgSO_4$, $CaCO_3$. After 14-21 days on incubation on rotary incubating shaker the conidial density has been recorded. Of the evaluated carbon sources, highest conidial density of 4.02×10^7 and 4.55×10^7 conidia/mL are recorded in Dextrose with both PDB and Rice gruel, respectively. Of the two nutrient sources, PDB+ $MgSO_4$ and PDB+$CaCO_3$ has recorded conidial density of 4.06×10^7 and 3.87×10^7 conidia/mL, respectively, which is higher than the conidial density observed in Rice gruel. Among the four Nitrogen sources, conidial density is highest in PDB in combination with all the sources. Conidial density has been recorded as 3.67×10^7, 3.84×10^7, 4.59×10^7, 6.36×10^7 conidia/mL in Casein, Yeast extract, Chitin and peptone, respectively in PDB.

Conidial density with different base substrates and nutrient sources

Sl. No	Treatment	Conidial density, $\times10^7$ Conidia/mL	Sl. No	Treatment	Conidial density, $\times10^7$ Conidia/mL
1.	PDB+ 1% Dextrose	4.02	10.	Ricegruel+1% Dextrose	4.55
2.	PDB+ 1% Starch	3.85	11.	Ricegruel+ 1% Starch	3.43
3.	PDB+ 1% Mannitol	3.74	12.	Ricegruel+ 1% Mannitol	3.51
4.	PDB+1% Casein	3.67	13.	Ricegruel+ 1% Casein	3.42
5.	PDB+1% Chitin	4.59	14.	Ricegruel+ 1% Chitin	3.69
6.	PDB+1% Yeast extract	3.84	15.	Ricegruel+ 1% Yeast extract	3.50
7.	PDB+1% Peptone	6.36	16.	Ricegruel+ 1% Peptone	4.60
8.	PDB+1% $CaCO_3$	4.06	17.	Ricegruel+ 1% $CaCO_3$	3.48
9.	PDB+1% $MgSO_4$	3.87	18.	Ricegruel+ 1% $MgSO_4$	3. 51

In addition to Rice gruel, agricultural by-products, such as vermiwash in combination with PDB at three different ratios *i.e* 1:1, 1:2, 2:1 have also been evaluated as initial experiment for culturing *I. fumosorosea* and *B. bassiana*. In the case of Vermiwash base media, at ratio of 2:1 (Vermiwash: PDB), highest conidial density of 1.8×10^7 conidia/mL has been recorded in *I. fumosorosea*. *B. bassiana* has shown highest conidial density of 1.9×10^7 conidia/mL at ratio 1:1 (Vermiwash: PDB).

Conidial density of fungi with vermiwash substrate			
SN	**Treatment**	**Conidial density (×10^{7}Conidia/mL)**	
1.	**Vermiwash+ PDB (2:1)- *I. fumosorosea***	**1.81**	
2.	Vermiwash+ PDB (1:1)- *I. fumosorosea*	1.25	
3.	Vermiwash+ PDB (1:2)- *I. fumosorosea*	0.58	
4.	Vermiwash+ PDB (2:1)- *B. bassiana*	1.14	
5.	**Vermiwash+ PDB (1:1)- *B. bassiana***	**1.90**	
6.	Vermiwash+ PDB (1:2)- *B. bassiana*	1.80	Conidial count of B. Bassiana culture on Haemocytometer

Bio-intensive management of insect pests of *F. semialata*

Fipronil @ 1mL/L was found to be very effective against insect pests of *F. semialata*. percent reduction of *Arachis* sp. was 83.33% and *Hypocedra talaca* was 86.54% after 10 days of treatment.

Central Agriculture University, Imphal (Manipur)

Survey

During the survey, occurrence of the lac insect *Kerria manipurensis* was observed infesting on 3 new host plants at various blocks of Manipur

Occurrence of lac insect *Kerria manipurensis* at various blocks of Manipur				
Sl. No	**Name of the new host plant**	**District/ Block**	**GPS location**	**Remarks**
1	Common Name: Scientific name: *Maesa sp* Family: Primulaceae	Langjing, Imphal West	24.7786° N, 93.8770° E	Infestation of lac insect
2	Common Name: Stink bean Scientific name: *Parkia sp* Family: Fabaceae	Konthoujam, Imphal West	24.7452° N, 93.8477° E	Lac insect infestation was observed but the population size is less.
3	Yet to be identified	Yairipok, Thoubal	24.6788° N, 94.0625° E	The trunk is infested with live lac.

Response of fertilizer on the growth of *Flmingia macrophylla* and lac yield

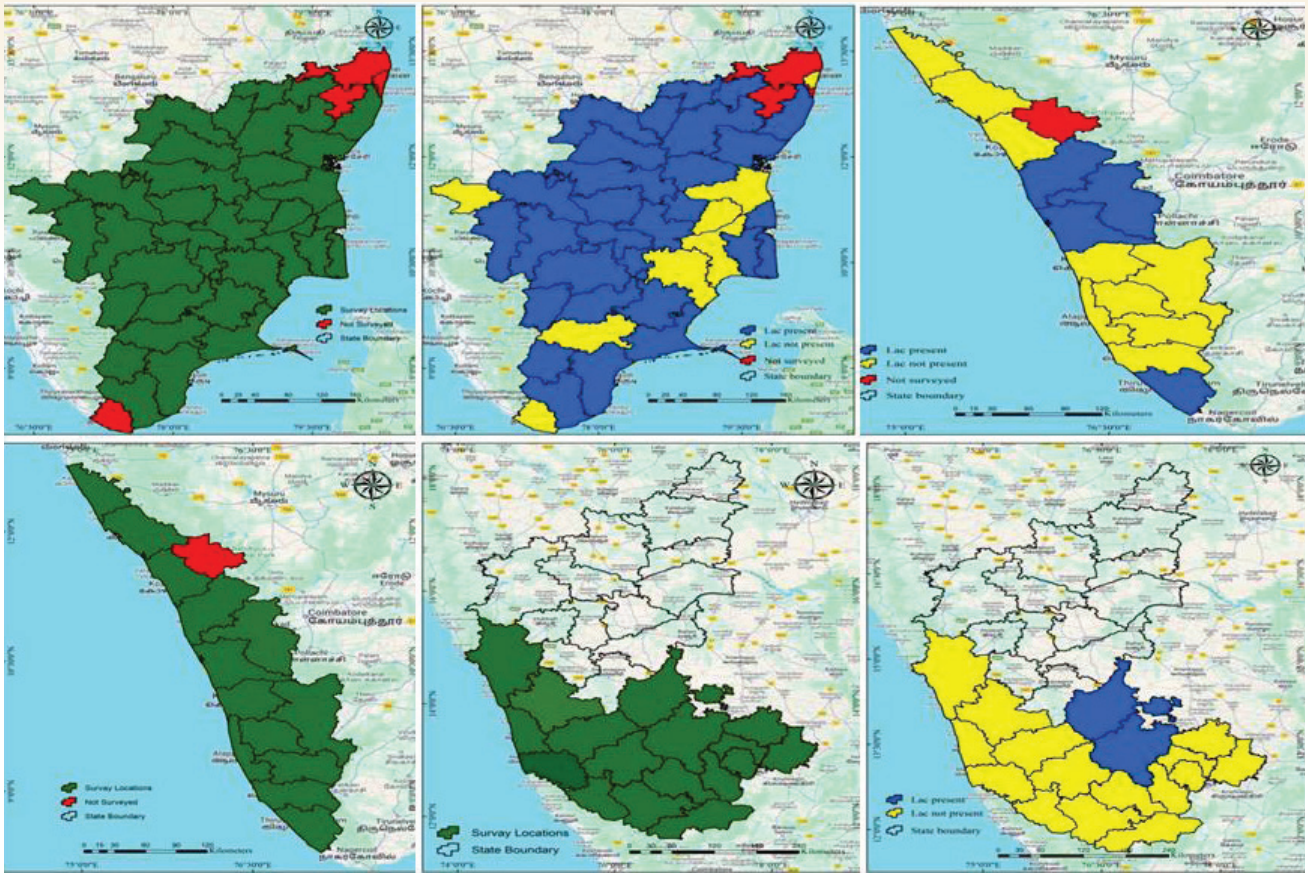
A study on the has been carried out esponse of fertilizer on the growth of *Flemingia macrophylla* and lac yield in the Regional Field Gene Bank of NP-CLIGR, CAU, Imphal centre. The response of fertilizer experiment has been conducted in CRD manner with 6 treatments of N, P, and K at different combinations i.e. T1=N_5:P_5:K_{15}; T2=N_5:P_5:K_5; T3=N_{15}:P_5:K_5; T4=N_{15}:P_{10}:K_{15}; T5=N_{10}:P_5:K_{10}; T6=N_5:P_{10}:K_5 and untreated. All the plants have been inoculated with 15 g of broodlac. Maximum growth of the host plant has been observed in T_4=N_{15}:P_5:K_{15} (173.2 cm) followed by T_3=N_{15}:P_5K_5 (165.6 cm) and T_5= N_{10}:P_5:K_{10} (157.9 cm) over control (137.5 cm), which has the lowest plant height. Broodlac yield is the maximum in T_4=N_{15}:P_5:K_{15} (232.6 g/plant) closely followed by T1= N_5:P_5:K_{15} (230.5 g/plant) and T6= N_5:P_{10}:K_5 (211.3 g/plant). The lowest yield of broodlac (182.6g/plant) has been recorded in the untreated. Thus, the fertilizer combination applied with the maximum amount of nitrogen and potash and minimum amount

of phosphorus has obtained the maximum growth of plant height and also the highest yield of broodlac.

Kerala Forest Research Institute, Thrissur (Kerala)

Survey

Surveys have been conducted to collect broodlac from previously documented sites of Tamil Nadu, Kerala, and Karnataka Field Gene Bank. During the survey, a novel lac insect host plant named *F. exasperata* has been identified for the first time in Kerala.



Maps representing surveyed data of Tamil Nadu, Kerala, and Karnataka
Green: Survey completed; Red: Survey not completed; Blue: Presence of Lac insect; Yellow: No lac insect found



A new lac insect host plant named *F. exasperata* was identified for the first time at Thrissur district in Kerala

Manjula Parthipan's lac insect success story in Erode District of Tamil Nadu

With the intervention of KFRI (Kerala Forest Research Institute), Manjula Parthiban from Kolapallur village, Gobichettipalayam town, Erode district (TN), started lac cultivation with 500 *Flemingia semialata* host plant in 2022. Intially 150 *F. semialata* plants have been inoculated with *Kerria madurensis* lac insect species in November 2022. The harvesting was done after five months of inoculation. Approximately 50 kg of broodlac was harvested from 150 plants, averaging around 200-250 grams of broodlac per plant. Of the harvested broodlac, 10 kg was sold to farmers in South Karnataka states like Mysore and Bangalore at a selling rate of Rs 1000/kg.

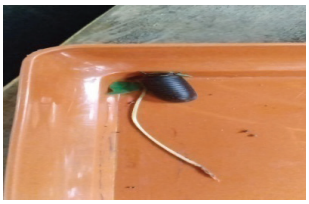




Success story of Manjula Parthipan a progressive farmer in Erode District of Tamil Nadu

Lac insect host plant enemies

Two new lac insect host plant enemies have been recorded as new pests, namely: Pill bug (*Armadillidium vulgare*) and leaf cutter (*Megachile perihirta*).





(Armadillidium vulgare) | *Megachile perihirta*

ICAR - Krishi Vigyan Kendra, Uttara Kannada, Sirsi (Karnataka)

Kusmi lac cultivation at the farmers' field of Shri Chaluvaraju P., Bannikuppe, Taluk: Hunsur, District: Mysuru

Summer crop: Out of 71 kgs of *kusmi* lac harvested from previous Aghani crop, 50 kgs of good quality kusmi lac has ben utilized as broodlac. Rejected 21 kgs of lac has been sold @ Rs 520/kg to local toy artisans. Out of 50 kg of broodlac, 47 kg has been inoculated to 40 Ber trees in February 2023 @ 1.0 to 1.50 kg per tree depending on number of tender shoots and 3 kg has been inoculated on 25 *Flemingia semialata* plants @ 100 to 150 g per plant. Regular spray schedules are followed. Crop has been harvested in July 2023. On Ber, 105 kg of broodlac is obtained with yield ratio of 1: 2.23. In *Flemingia,* 5.0 kg of broodlac yield is obtained with the yield ratio of 1: 1.67.

Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan)

Survey

A total of 50 blocks of two states Rajasthan and Gujarat are surveyed during 2023, out of which, 20 blocks are from 11 districts of Rajasthan and 30 blocks from 09 districts of Gujarat. During the survey, the prevalence of lac insect is noticed at 147 locations from where 49 live samples are collected, and at 98 locations dead lac is observed. A total of 09 hosts *viz., peepal*, *ber*, *babool*, *bargad*, *palas*, custard apple, *sheesam*, *siris*, and *kikar* are identified as hosts for the natural prevalence of lac insect in the region during 2023.

Diversity and morpho-taxonomic studies of major predators of lac insect, *Kerria lacca* (Kerr) in arid western plains

Lac associated insect fauna emerged from different host plant samples of lac insect:

Studies are carried out to record the emergence of natural enemies from the lac samples collected from the three states of arid western plains of India. The lac associated insect fauna recorded under the present investigation belong to four different orders *viz.,* Lepidoptera, Hymenoptera, Coleoptera and Psocoptera. Among all the natural enemies, the two species of predators *viz., Eublema amabilis* Moore and *Pseudohytopa pulverea* Meyrick of families Noctuidae and Blastobisidae, respectively belong to Lepidopteran order. The primary parasitoids of families Encyrtidae and Eulophidae and hyperparasitoid of family Braconidae belong to order Hymenoptera. Apart from these, large populations of storage pests are also observed which belong to two different families Curculionidae and Liposelidae of orders Coleoptera and Psocoptera, respectively. Among all the insect fauna, observed to be associated with lac insect, Lepidopteran predators, *E. amabilis* and *P. pulverea* contribute to 30.52 and 7.89%, respectively, to the total population of natural enemies.



Adult lac insect predators *E. ammabilis* and *P. pulverea*



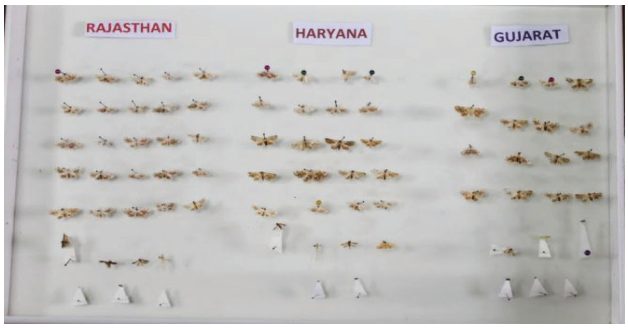
Emererged larvae of *Eublemma ammabilis*

Emererged adult of *Eublemma ammabilis*

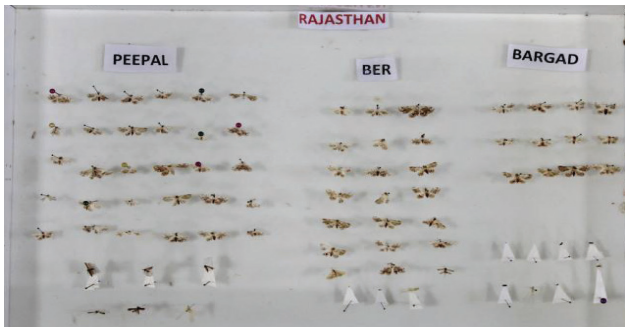
Hymenopteran primary parasitoids, *Erencyrtus dewitzii*, *Tachardiaephagus tachardiae, Aprostocetus purpureus* and hyperparasitoid, *Bracon greeni* of Braconidae family contribute to 33.68, 10.52, 12.63 and 4.73%, respectively to the total natural enemy population. In addition to these, the storage pests *Sitophilus oryzae*, *Oryzaephilus surinamensis* and *Liposcelis divinatorius* contribute to 15.40, 1.20 and 83.38%, respectively of the total storage pest population that emerged from lac samples. Among the lac associated insect fauna, primary parasitoid *E. dewitzii* (33.68%) is in abundance followed by the predator *E. amabilis* (30.52%) while other natural enemies *viz*., *T. tachardiae*, *A. purpureus*, *P. pulverea* and hyperparasitoid, *B. greeni* contribute to the extent of 10.52, 12.63, 7.89 and 4.73%, respectively.

Study of the diversity and species richness of natural enemies of lac insect:

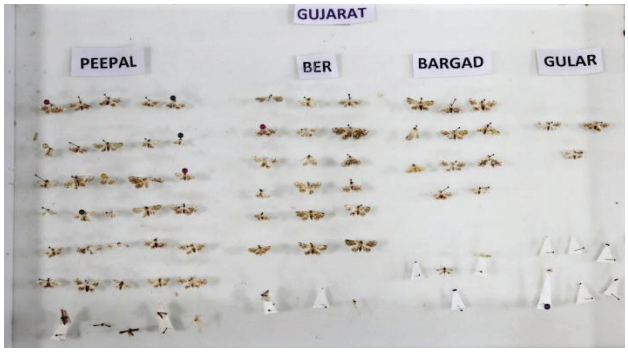
The investigations undertaken to record the diversity and species richness of natural enemies of lac insect in the three states of arid western plains demonstrates that the relative density of the natural enemies emerged from the collected lac samples is maximum with 46.31% in Rajasthan followed by 34.73% in Haryana and 18.94% in Gujarat. Among the three states, the relative density of primary parasitoids is maximum in Gujarat with 61.10% followed by 59.08 & 52.05% in Rajasthan & Haryana, respectively; whereas the relative density of predators is the highest in Haryana with 43.92% followed by 36.35 & 33.33% in Rajasthan & Gujarat, respectively. The relative density recorded for hyperparasitoid is the highest in Gujarat with 5.55%, followed by Rajasthan and Haryana with equal relative density of 4.54% in both states. The value of both Shannon- Weiner and Simpson's Diversity indices are the highest for Rajasthan with the value of 1.54 & 0.712 followed by Haryana with the value of 1.46 & 0.672 and the lowest diversity indices are for the state of Gujarat with the value of 1.26 & 0.592, respectively. The results demonstrate that samples of Rajasthan has the highest and Gujarat has the lowest diversity of natural enemy fauna associated with the natural lac insect, *Kerria lacca*.



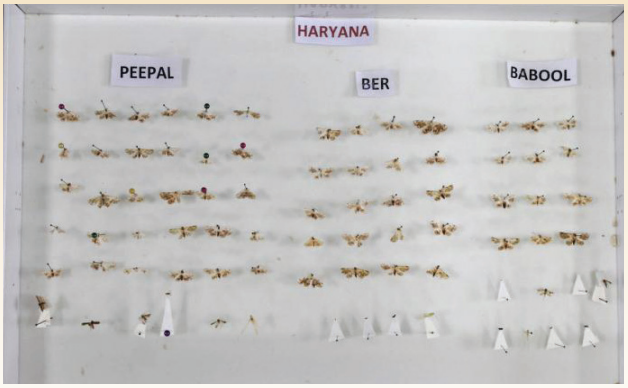
Natural enemies emerged from three states of Arid Western Plains



Host wise emergence from Rajasthan



Host wise emergence from Gujarat



Host wise emergence from Haryana

Morpho-taxonomic study of major predators of lac insect, *Kerria lacca* (Kerr):

Morpho-taxonomic studies are carried out for the major predators of lacinsect (*Kerria lacca*) viz., *Eublemma amabilis* (Moore) and *Pseudohypatopa (=Holcocera) pulverea* (Meyrick) in the Lac laboratory cum Museum established under NP-CLIGR. The observations for various morphological parameters *viz.,* body length, wingspan, length of right and left antennae, length and breadth of both fore wings and hind wings of both male and female of major predators reveal that females are larger in size than males for both predators.The mean of body length, total wingspan, length of right & left antenna, length of right & left fore wing and hind wing, breadth of right & left fore wing and hind wing are 1.08, 2.60, 0.39 & 0.39, 1.15 & 1.13, 0.50 & 0.49, 0.86 & 0.85. 0.47 & 0.47 mm, respectively for *E. amabilis* male and 1.11, 2.60, 0.39 & 0.40, 1.03 & 1.05, 0.57 & 0.58, 0.78 & 0.77, 0.49 & 0.49 mm for *E. amabilis* female, respectively. Similarly, for male *P. pulverea,* the mean of the parameters is 0.66 mm for body length, 1.50 mm for wing span, 0.47 mm length for both antennae, 0.68 mm length & 0.18 mm breadth for both right and left forewings, 0.63 mm length & 0.25 mm breadth for both right and left hind wings. Likewise, the mean parameters recorded for female *P. pulverea* are 0.74 mm for body length, 1.70 mm for wingspan, 0.47 mm length for antennae, 0.76 mm & 0.77 mm length for both right and left fore wings, 0.20 mm breadth for both fore wings, 0.61 mm length & 0.32 mm breadth for both right and left hind wings.The overall result of the investigation also shows that all the parameters of females are larger in both *E. amabilis* and *P. pulverea*



A) Body length



B) Total Wing Span



C) Left Forewing Breadth



D) Left Hindwing Breadth



E) Right Forewing Length



F) Left Hindwing Length

Description of morpho-taxonomic parameters of female *Eublemma amabilis.*



A) Body length



B) Total Wing Span



C) Left Forewing Breadth



D) Left Hindwing Breadth



E) Left Forewing Length



F)) Right Anttenal Length

Description of morpho-taxonomic parameters of male *Eublemma amabilis.*

Studies on the productivity linked parameters and bio-chemical properties of major lac hosts for the lac insect in Southern Rajasthan

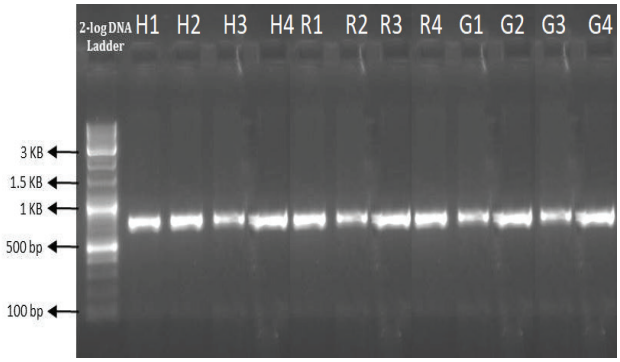
Productivity linked parameters:

On the basis of different productivity linked parameters of *rangeeni* strain of lac insect, it is concluded that *ber* is the most preferred host for the lac cultivation in Southern Rajasthan followed by *peepal*, *Acacia sp*., *palas*, *Flemingia*, pigeon pea, custard apple and *kikar* during *baisakhi* season, 2022-2023.

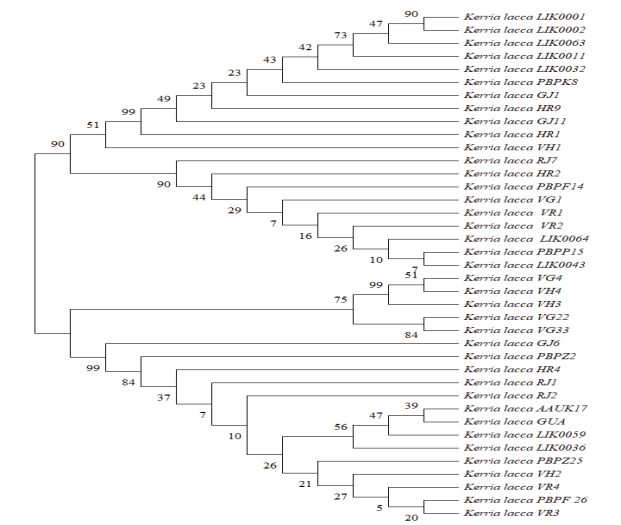
Bio-chemical properties:

The biochemical properties of the bark of the different host plants of lac *viz.* phenol and alkaloid content have been evaluated before and after inoculation of the lac insect. The total concentration of phenol and alkaloids increases after the inoculation of *K. lacca*. Correlation studies between the phenol content of plants and the production of lac revealed a positive relationship. The total production of lac gradually increases with increase in the concentration of plant phenol content. The highest phenol content recorded in *ber* is 5.12 mg/g of bark and 5.53 mg/g of bark and the lowest phenol content is found on *Cajanus cajan* with 0.45 mg and 0.54 mg per g of bark, respectively, both before and after inoculation of *K. lacca*. The highest alkaloid content has been observed in *C. cajan* (0.04 mg and 0.06 mg per g of bark) and the lowest in *Flemingia* (0.01 mg and 0.02 mg per g of bark) both before and after inoculation. However, correlation studies does not show any relation with alkaloid content in the production of lac.

Molecular diversity analysis of lac insect genetic resources in arid western plain zone: Molecular analysis of the population of lac insect from different locations of arid western plains of India reveals that there is little variation observed as majority of the samples have same ancestral lineage and the variation observed in some is due to the environmental conditions.



Molecular diversity analysis of lac insect genetic resources in arid western plain zone using *Cox1primer*



Phylogenetic tree of lac insect collected from the arid western plains of India

Punjab Agriculture University, Ludhiana (Punjab)

Survey

Regular surveys are conducted for collecting the information with respect to lac insects and their host plants during the year 2023 in 13 districts of Punjab (revisit) and eight lac insect samples are collected from host plant, ber (*Ziziphus mauritiana*) ranging from medium to high infestation. In Uttar Pradesh 7 districts (4 new) are surveyed. Lac insect is exclusively found on *Ficus religiosa*, though other lac host plants *Zizyphus mauritiana* and *Ficus virens* are also present. Seven lac insect samples are collected from Mohanlalganj (Lucknow), Rahi (Rae Barelli), Lakshampur, Katra Medniganj (Pratapgarh), Paschim Sarira and Dheraha (Koushambi) ranging from low to high lac population.

Ex-situ conservation / brood multiplication

A total of 13 host plants (585 in number), i.e. *Ziziphus mauritiana*, *Butea monosperma*, *Acacia nilotica*, *Cajanas cajan*, *Schleichera oleosa*, *Flemingia macrophylla*, *Flemingia semialata*, *Calliandra haemetocephala*, *Litchi chinensis*, *Dalbergia sisoo*, *Ficus benjamina*, *Albizia lebbeck* and *F. religiosa* are being maintained in the Regional Field Gene Bank for *ex-situ* conservation and multiplication of broodlac. Out of these, 3 plants of *Albizia* sp. were newly planted during 2023. For *ex-situ* conservation, 18 lac insect samples from Punjab, 5 from Delhi and 6 from Uttar Pradesh are being maintained at Regional Field Gene Bank, Entomological Research Farm, Punjab Agricultural University, Ludhiana.

Brood multiplication: Four host plants namely, *Flemingia semialata Flemingia macrophylla, Ziziphus mauritiana* and *Butea monosperma* are utilized for conservation of lac insect (*Rangeeni* strain; *Baisakhi* and *Katki* crop). During 2023, a total of 150.24 kg broodlac has been multiplied on these host plants at Regional Field Gene Bank.

Production potential and economic attributes to identify suitable lac insect-host plant combinations for higher yield

The duration of *Baisakhi* crop (*Rangeeni* strain) on *B. monosperma* varies from 219-243 days under Punjab conditions. Mean weight of female cell is 7.87±0.26 mg (range 7.40-8.68 mg) recorded after crawler emergence. The average resin produced by an individual female cell recorded after removing the dead insect body from the cell is 4.74±0.34 mg (range 4.60-4.87 mg). Average number of young ones produced by the single female insect ranges from 154 to 166 individuals (161.17±9.47). Broodlac output ratio recorded after crop harvesting is 7.65±0.16 during Baisakhi crop

Studies on integrated management of lac natural enemies

Diversity of natural enemies (parasitoids and predators) associated with lac insect

Under Punjab conditions, lac insect associated fauna comprised of five species and *Tachardiaephagus tachardiae* is the predominant species.

Natural enemies of lac insects under Punjab conditions (2023)

S. No	Name	Predator/ parasitoid	Order	Per cent abundance
1.	*Tachardiaephagus tachardiae*	Parasitoid	Hymenoptera	56.45
2.	*Aprostocetus purpureus*	Parasitoid	Hymenoptera	23.56
3.	*Tribolium sp.*	Predator	Coleoptera	11.92
4.	*Eublemma amabilis*	Predator	Lepidoptera	4.83
5.	*Chrysoperla zastrowi sillemi*	Predator	Neuroptera	3.22

Evaluation of various insecticides/ biopesticides against predator, *Eublemma amabilis* and their safety to lac insect

Bacillus thuringiensis, chlorantraniliprole, flubendiamide, emamectin benzoate and indoxacarb are comparatively safer to lac insects, while Chlorpyriphos is most toxic at all the tested concentrations.

Effect of lac based wax formulation coating on shelf life and post-harvest quality of kinnow mandarin under ambient and cold storage conditions

A study has been conducted to improve the shelf life of *kinnow* mandarin with lac-based coatings as compared to synthetic waxes, under ambient conditions at PAU Regional Research Station (Abohar) and under cold storage conditions in the Department of Fruit Science, PAU Ludhiana.

Treatment details of wax coatings

Treatment	Name of wax
T_1	Citrashine
T_2	Citrasol
T_3	Fomesa*
T_4	Lac-based formulation
T_5	Control
*under cold storage conditions only	

The harvested fruits of similar sizes and weight are taken from Fruit orchard at Abohar. The harvested fruits were washed in clean water with wet foam, followed by dip in chlorinated water (0.01%) for one minute, followed by partially drying under shade. Wax coating has been done with help of foam pad, followed by drying in shade. Two synthetic (citrashine, citrasol) waxes and one natural wax (lac-based formulations) are used along with control fruits. The treated fruits are stored in Corrugated Fiber Board (CFB) boxes (45 fruits/box) and are replicated three times. The fruits are stored at ambient conditions (temperature 3.16 - 14.51°C, Humidity – 62.54 to 78.04%) up to 20 days. The treated fruits are stored under cold storage conditions (Temp. 4-6°C) in CFB boxes for a period of 3 months at 10 days' time interval and are replicated three times. The values of physiological loss in weight, spoilage%, tss increase with increasing storage intervals. Physiological loss in weight and spoilage% are observed to be lower in all waxed fruits as compared control, whereas the values of juice percentage, acidity and ascorbic acid decrease with increasing the storage interval, during ambient storage. On the basis of appearance and other quality parameters, *kinnow* fruits are observed acceptable up to 15 days in T_1, T_2 and T_3 treatments as compared to control (T_5) at ambient conditions. Physiological loss in weight and spoilage% is observed to be lower in all waxed fruits as compared control, under cold storage condition. On the basis of appearance and taste i.e., organoleptic tasting, *kinnow* fruits are observed acceptable up to 60 days when coated with citrasol, citrashine, fomesa and lac based formulation as compared to control treatment under cold storage conditions. Coating of *Kinnow* mandarin fruits prior to storage with lac formulation is equally effective as compared to other commercial wax formulations (Citrasol, Citrasine and Fomesa) both under ambient and cold storage conditions.

ICAR Research Complex for Eastern Region, Patna

Survey

Twenty-four blocks of three districts of Eastern UP (Azamgarh, Mau and Chandauli) are surveyed and lac insects are observed only in Chakia block (Chandauli) on *Ficus religiosa*. *Palas* trees are observed in Mau and Chandauli whereas, other hosts like *ber*, *siris* and *Ficus* sps are found in all three districts.

Lac cultivation initiative in two villages of Banka (Bihar)

Lac has been introduced in two villages of Banka (Bihar) on Palas and Ber for the first time but due to high temp. (+43 °C day and +33 °C night) the summer crop suffered severe mortality, which resulted in crop failure.

Brood multiplication for Katki 2023 crop in *palas*

Katki 2023 crop is raised on 25 *palas* trees by inoculation of 32 kg broodlac during July 2023 which produced 76 kg broodlac (Fig. 59.) Further, it has been inoculated during 23-24 in November 2023 on 38 *palas* and 5 *ber* trees to raise *baisakhi* 2023-24 crop in village Hirmoti of Banka block. Crop has progressed well and initial density of settlement is satisfactory.

Acharya N G Ranga Agricultural University, Guntur (Andra Pradesh)

Survey

Survey has been conducted in all the blocks of four districts of Andhra Pradesh. Lac encrustations is noticed in 2 blocks in Bapatla, 9 blocks in Guntur district, 1 block in Parvathipuram Manyam district and 1 block in Srikakulam district. Among host plants, *Ficus spp* (*Ficus religiosa* and *Ficus benghalensis*)., *Albizia spp* (*Albizia lebbeck* and *Albizia saman).*, *Conocarpus lancifolius*., Ber (*Ziziphus mauritiana*) and Palas (*Butea monosperma)* are most common. Two natural enemies, white moth *Eublemma amabilis* and *Tachardiaephagus tachardiae* are reported during the survey. New host plant of Lac insect, *Ficus amplissima* is reported from Vadlamudi village, Chebrolu Mandal, Andhra Pradesh.



Occurrence of Lac insect on *Ficus* amplissima at chebrolu,Guntur Andhra Pradesh

State Forest Research Institute, Jabalpur (Madhya Pradesh)

Survey

Survey has been conducted in 14 blocks of Wardha, Nagpur, Jalna, Amravati districts of Maharashtra in which lac insect occurrence is found in 3 different blocks and different hosts viz., rain tree in Karanja (Wardha), Gular in Ramtek (Nagpur) and Palas in Ghansawangi (Jalna).

Collection and conservation of lac-insect under *ex-situ* condition

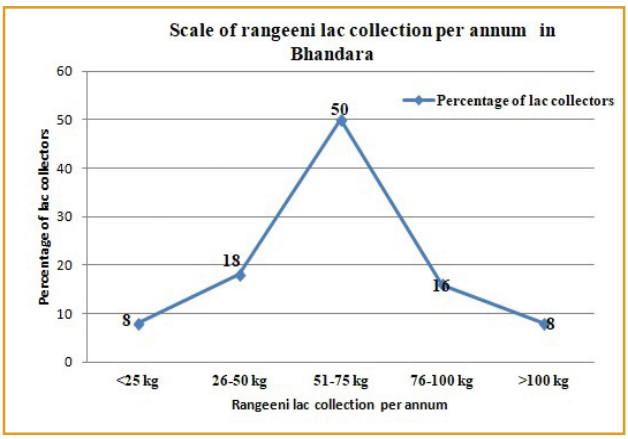
Lac insect samples are collected from 15 sites of 11 districts i.e., Wardha, Nagpur, Washim, Latur, Jalna, Parbhani, Beed, Nanded, Hingoli, Buldana, and Aurangabad of Maharashtra from rain tree, pipal, bargad, and palas host plants. The collected lac insects are conserved in Regional Field Gene Bank on 215 host plants/ trees of 8 different species. They are evaluated for their performance and data on population size (low, moderate, high), girth and height of lac bearing host plant, colour variation are recorded.

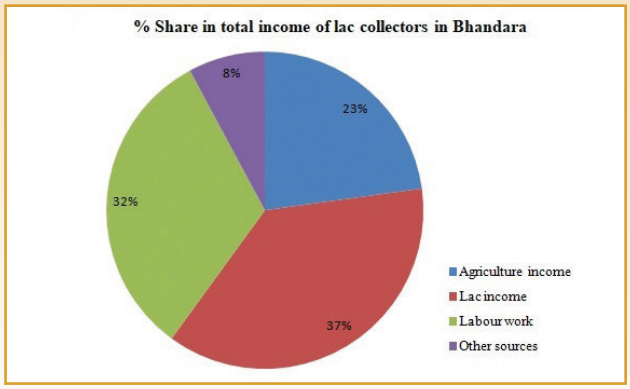
Study on diameter and thickness of lac encrustation in Maharashtra

The studies on thickness, diameter growth, of lac encrustation in 14 sites of 11 districts of Maharashtra are carried out in the year 2023. The study reveals that in Maharashtra, maximum diameter thickness of lac insect occurred in Latur on rain tree (16.75 mm) followed by in Nanded on rain tree (14.95 mm), whereas the lowest diameter of lac encrustation occurred in Ambad, Jalna on pipal (4.55 mm) followed by in Aurangabad on pipal (6.3 mm).

Socio-economic status of lac collecting farmers of Bhandara district of Maharashtra

Socio economic status of 50 lac collecting farmers of Bhandara district of Maharashtra has been done to document the impact of lac cultivation for increasing farmers' income. On an average, a single farmer collected 69.09 kg lac and earned Rs 16346.6 per annum from lac collection during the study period. Amongst the different sources of income, income from lac collection ranked first (37.21%) followed by labour work (32.13%), agriculture income (22.81%), and other sources of income (7.85%).

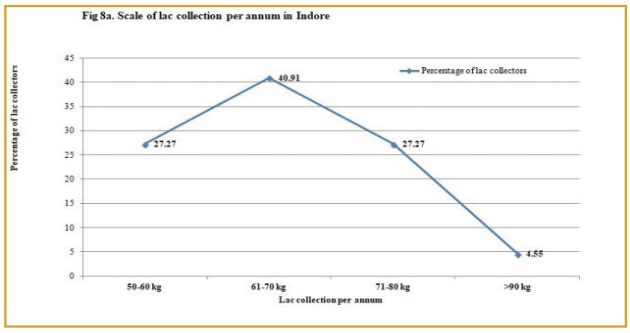


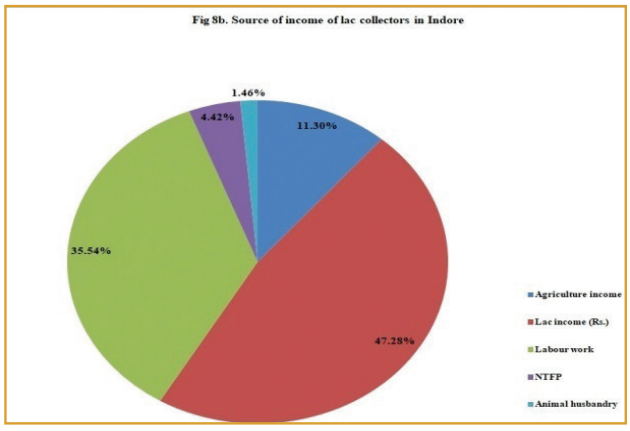


Socio-economic status of lac collecting farmers of Bhandara district of Maharashtra

Socio-economic status of lac collecting farmers of Indore district of Madhya Pradesh

Socio economic status of 22 lac collecting farmers of Indore district of Madhya Pradesh has been done during the year 2023. On an average farmers collected 69.31 kg lac and earned Rs 26626.36 per annum from lac collection. Amongst the different sources of income, income from lac collection ranked first (47.28%) followed by labour work (35.54%), agriculture income (11.30%), NTFP collection (4.42%), and animal husbandry income (1.46%).



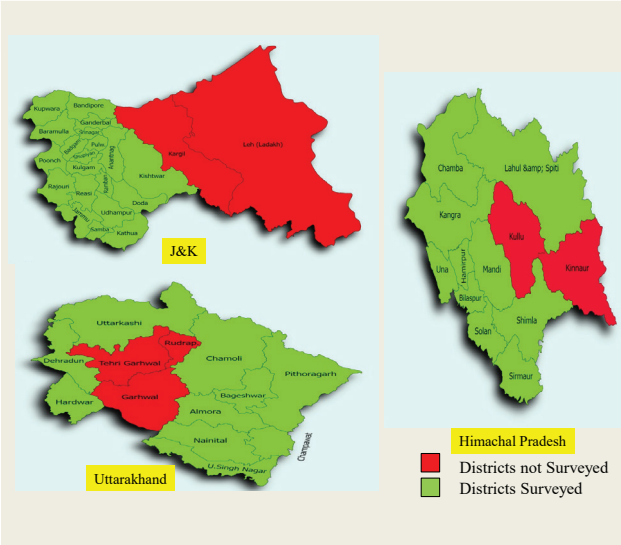


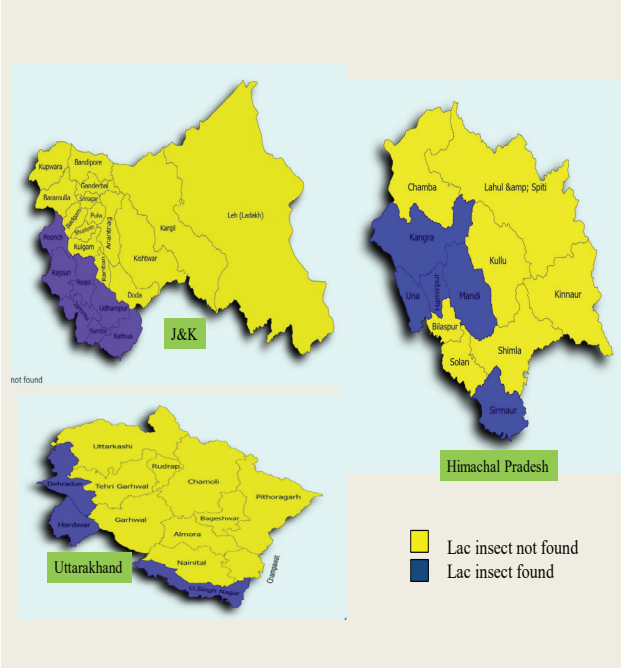
Socio-economic status of lac collecting farmers of Indore district of Madhya Pradesh

Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu (Jammu & Kashmir)

Survey

Extensive surveys have been conducted for collecting the information with respect to lac insects and their host plants during the year 2023. *Albizia lebbeck* is found to be the most suitable hosts for summer broodlac conservation, while *Acacia nilotica* and *Ziziphus mauritiana* are the best host plants for lac cultivation.

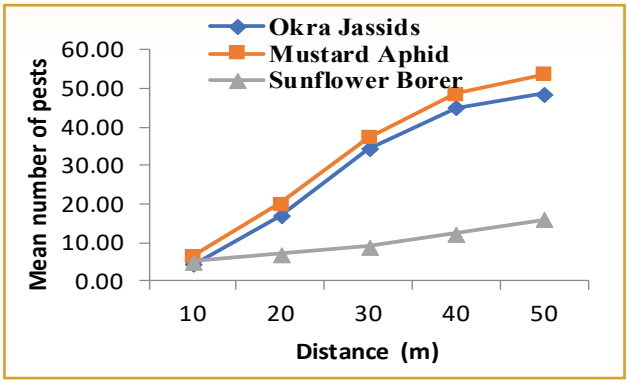




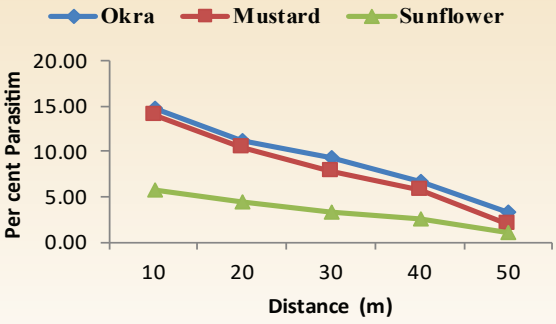
Survey map of J&K, Himachal Pradesh and Uttarakhand

in situ and ex situ conservation initiatives for sustainability

A study conducted at Regional Field Gene Bank, SKUAST-Jammu, Chatha during 2022 and 2023 reveals that the incidence of many sucking pests of okra (jassids), mustard (aphid) and sunflower (borer) decreases significantly as the distance between agricultural field and lac plots decreases. However, with the increase in distance between agricultural fields and neighboring lac plots, the incidence of natural enemies (*Eublemma amabilis and Pseudohytopa pulverea*) decreases significantly.



Mean number of pests in agricultural fields neighboring lac plots



Mean parasitism in agricultural fields neighboring lac plots

Study of productivity linked parameters of lac insect

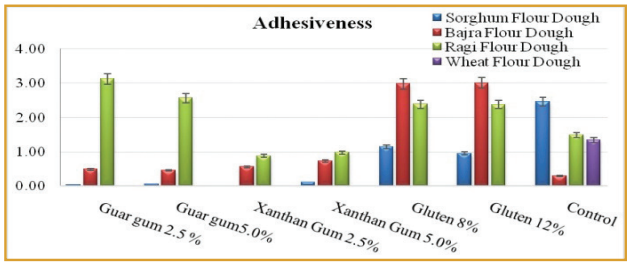
On the basis of productivity linked parameters, the Gole Market, Jammu strain has been found to be the most promising in terms of higher settlement rate (182.55 Crawlers/cm^2), lower mortality (34%), greater fecundity (225 larvae per cell) and dense female cells (11.32/cm^2), differences being significant with respect to all other strains. Productivity linked parameters like cell and resin weight (19.83 and 8.15mg) are also found significantly higher in this strain.

NETWORK PROJECT ON HARVESTING, PROCESSING AND VALUE ADDITION OF NATURAL RESINS AND GUMS

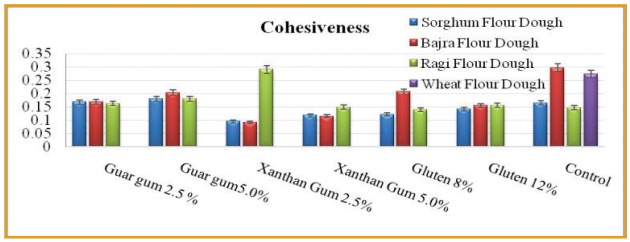
Lead Centre: ICAR-NISA, Ranchi

Development of matrix independent NRG based gluten free binder for use with millets and pseudo cereals

In this study, different edible natural gums (gum Arabic, guar gum, xanthan gum and psyllium husk) and gluten as positive control are used to develop matrix independent gluten free binder for different millets like sorghum (jowar), pearl millet (bajra) and finget millet (ragi). During the preparation of dough from the millet flour specific volume of lukewarm water has been added to the millet flour, until it forms a shape to get consistent dough. Texture profile analysis (TPA) of the dough of the millet flour added with natural gum based binder has been performed at room temperature. The particle size of the millet flour dough has been determined using particle size analyzer. The adhesiveness of the ragi flour dough has been found to be improved with the addition of guar gum and gluten; however, there has been no improvement of the same for other millets. In the case of bajra flour, the adhesiveness reduces with addition of natural gum based binder. The cohesiveness of the millet flour dough does not change with addition of natural gum binder, where as, in the case of ragi flour, the cohesiveness increases with the addition of xanthan gum. The particle size (d_{50}) of jowar, bajra, ragi flour are 64.75 µm, 15.73 µm and 16.84 µm, respectively.



The dough from millet flour added with natural gum based binder for texture profile analysis



The dough from millet flour added with natural gum based binder for texture profile analysis

Standardization of the process of separation of proteins from tamarind seed gum and valorization

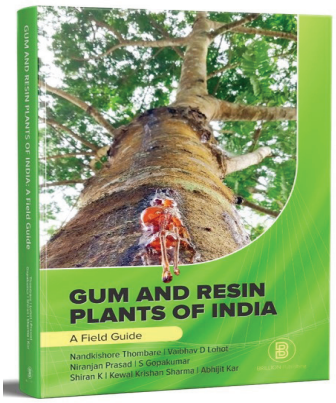
A study has been carried out for improving the quality of tamarind seed gum by removal of protein using ultrasonicator and isoelectric pH. The parameters *viz.,* gum yield (%), gum purity (%) and protein (%) are assessed. Protein from defatted tamarind seed powder has been isolated by iso-electric point precipitation. The Decorticated Tamarind Kernal Powder (DTKP) has been given different ultrasonic treatments (sonication amplitude 25% and 50% (0.5 and 1 Watt/cm^3) with 5 s "on" and 5 s "off" for 15 or 30 min). The highest percentage of gum yield has been obtained in the control with the value of 64.25% followed by 61.81% (25% Ultrasonication amplitude +15 minutes) and 58.22% (Isoelectric pH) and lowest gum yield is observed in 49.61% (50% Ultrasonication amplitude + 30 minutes). Gum purity is observed to be maximum in the treatment (50% Ultrasonication amplitude + 30 minutes) with value of 95.10%, followed by 93.78%, 93.67%, 92.73% in (50% Ultrasonication amplitude + 15 minutes), (Isoelectric pH), (25%Ultrasonication amplitude + 30 minutes) and minimum in Control with the value of 68.78%. Deposition of protein (%) varies significantly among the treatments in which protein percentage in the sample directly linked to the purity of gum. The maximum deposition of protein is observed in 1.26% (-Isoelectric pH), followed by T_4 - 50% Ultrasonication amplitude 30 minutes (1.87%), 50% Ultrasonication amplitude + 15 minutes (2.32%) and minimum in control.

Isolation of tamarind seed gum using protease enzyme

In this study protease treatment of 0.2, 0.4 and 0.8U/ml and digestion time of 1,3 and 5 h is given to decorticated tamarind kernel powder (DTPK). It is found that the polysaccharide yield ranges from 60% to 76%, while the protein content in the product decreases from 20% in DTKP raw material to 7.69% in TSG isolated using 0.80 U/mL protease and 5 h digestion time. Also, treatment time has high influence on the polysaccharide yield. At 1 h, the loss of polysaccharide raw material is over 25% and this loss reaches 40% with 5 h time. The longer the polysaccharide stays in the solution (with or without protease), the more it swells and dissolves into the solution, culminating in the loss in the polysaccharide yield. Comparing to treatment time, the protease

enzyme effect on the polysaccharide loss is small. The loss in yield is mostly due to polysaccharide solubility and mass transfer accelerated by treatment time. The increase in treatment time even though increases the amount of protein eliminated but it causes high loss of polysaccharide. The extraction of tamarind seed gum has been standardized with different filtration techniques, *viz.,* bucket centrifuge, basket centrifuge, filter press and sparkler filter. For this centrifuge, different filtration cloth (woven polypropylene and non-woven polyester) are used for hydrocolloid extraction. The maximum gum yield has been observed in bucket centrifuge with woven polypropylene cloth (58.21%) and the minimum in filter press with non-woven polyester cloth (47.23%). The gum purity and protein content of the gum reveal the quality of the product in which the maximum gum purity has been observed in sparkler filter with non-woven polyester cloth (78.61%) and the minimum in bucket centrifuge with woven polypropylene cloth (62.23%). In contrast, protein content has been recorded the maximum in bucket centrifuge with woven polypropylene cloth (14.23%); the minimum in filter press with non-woven polyester cloth (10.25%).

Exploration of minor gum and resin plants in india and preparation of field guide



A study has been conducted to collect all required information about the gum and resin plants in India. Photographs of different plant parts (leaves, flowers, fruits, seeds, bark, and whole tree appearance) are captured to identify gum-resin plants of India and published as 'Gum and Resin Plants of India: A Field Guide'. The published field guide provides important information to readers regarding various vernacular names, the common and botanical names of the plants, and information on the potential of their gum/resin products for various applications.

Effect of tapping techniques on gum yield from *Buchanania lanzan* trees

To finalize the best tapping technique and tools for sustainable *piyar* (*chirounji*) gum production from *Buchanania lanzan* trees, experiment has been conducted through different tapping techniques and gum yield obtained under experimentation through different tapping technique and season are analyzed. Gum yield is about six times higher in the trees treated with battery operated drill and seven times higher in the trees treated with hand operated drill, both having ½ inch drill bit diameter; while, about four times higher for trees treated using hand operated drill with 1.0 inch drilling diameter with application of gum inducer compared to without gum inducer application. The gum inducer technology has been found better for *piyar (chirounji)* gum tapping from *Buchanania lanzan* trees in the Ranchi region using hand operated drill.

Preparation and characterization of modified *guar* gum nanocomposite films reinforced with *piyar-silver nanoparticles (*agnps) for diversified applications

A number of nanocomposite films reinforced with *piyar*-AgNPs have been developed for diversified applications through solution casting method and the developed nanocomposite films have been characterized by evaluating the physical attributes thickness opacity, color values and instrumentation techniques like UV-Vis, FT-IR spectroscopy, Field Emission-Scanning Electron Microscopy (FE-SEM) and Energy Dispersive Spectrum (EDS) analysis and Differential Scanning Calorimetry (DSC). The developed nanocomposite films have better mechanical properties (tensile strength, flexibility) than the control film. The developed nanocomposite film shows improved barrier properties (water uptake and water vapor permeability) than the control film. The antifungal and antibacterial efficacy of the developed nanocomposite films are evaluated and exhibit potential activity against fungal and bacterial pathogen. The study indicates that the nanocomposite films can be utilized as potential antimicrobial packaging material.

Project on gum Arabic at ICAR-CAZRI, Jodhpur

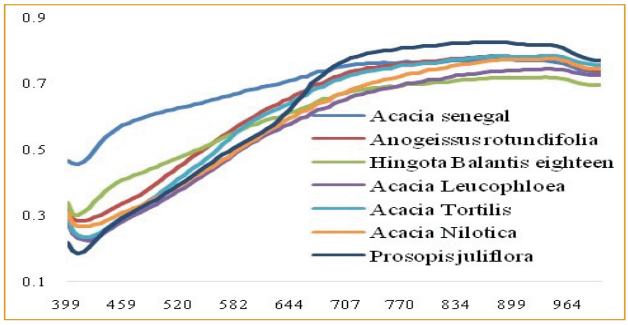
Characterization and value addition of Gum arabic

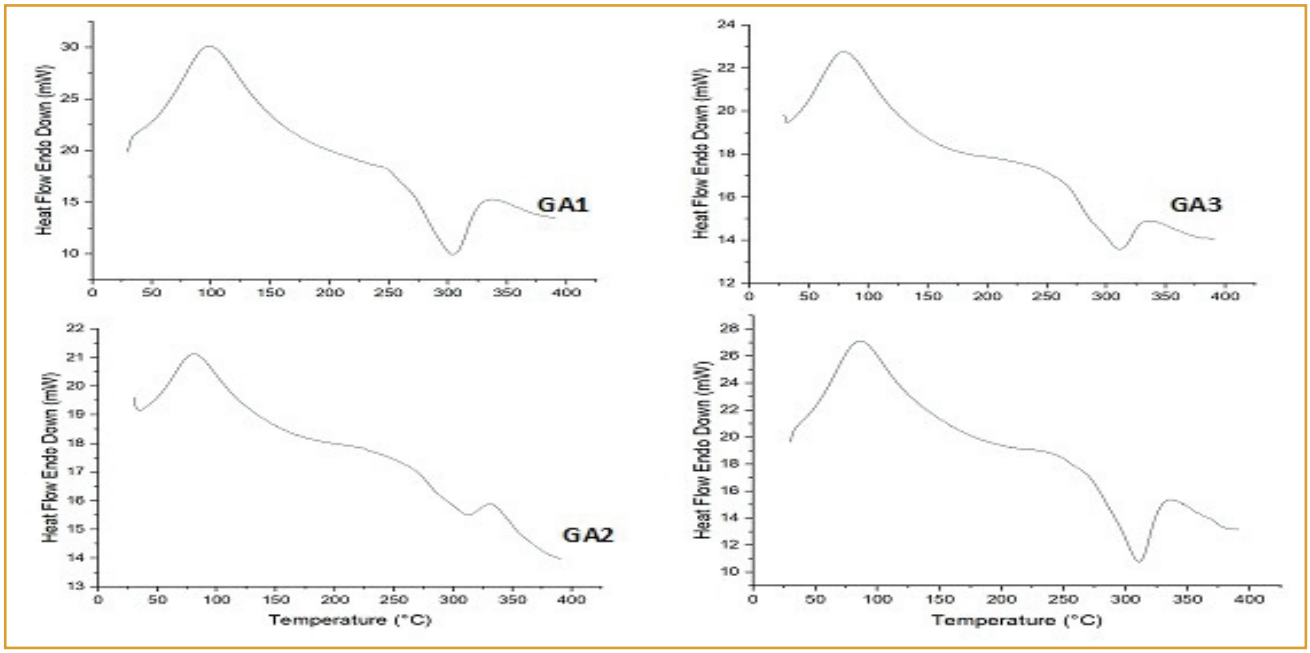
Naturally exuded and induced *gum arabic* samples have been ground to fine powder, sieved and dissolved in distilled water at different concentrations. The pH of gum solution is recorded and viscosity is measured by Lamy viscometer using spindle L-2 at 25 °C for gum solution of 20% concentration at 30 rpm. The thermal behavior of powdered gum samples has been measured by DSC (Differential

scanning calorimetry) with temperature ranging from 30 °C to 390 °C. Ethephon residues in µg/kg are determined by GCMS analysis of the gum samples. In the initial study, the pH values of the induced gum samples are recorded to be 4.4 to 4.5 and that of naturally exuded gum samples, 4.6 to 4.7. Similarly, the viscosity of induced gum has been recorded to be varying between 22.8 and 27, whereas that of naturally exuded gum is 19.4 and 24.4. The thermal behaviour of different gum samples at temperature range from 30 °C to 390 °C shows similar trend with a broad peak at 50°C to 100 °C. The ethephon residue analysis of the gum is performed for the naturally exudate gum collected from CAZRI farm, induced gum from CAZRI farm, induced gum from farmer's field and gum exuded at the site of injection hole. The gum samples are dried, cleaned, ground, sealed in vials and sent for GCMS analysis. In the initial study, all samples show no detectable residues of ethephon.

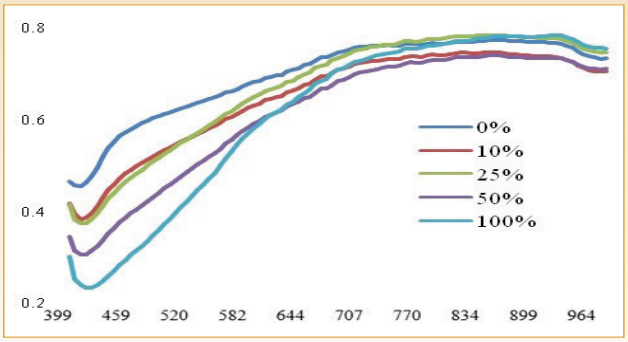
Authentication of gums by hyperspectral imaging:

Seven samples of arabic gums, i.e., *Acasia senegal*, *A. leucophloea*, *A. Tortilis, A. Nilotica, Anogeissus rotundifloia, Hingota balantis* Eighteen and *Prosopis juliflora* have been collected from ICAR-CAZRI farm. The dried gum materials are ground into powder using mortar and pestle. The ground sample of *A. senegal* has been adulterated in three levels (10, 25 and 50%) with *A. tortilis*, while *A.senegal* sample considered as 0% and *A.tortilis* as 100% adulterated samples. The hyper-spectral images of gum samples have been acquired using line scan (push-broom) imaging system. Each line-scan width in the produced images is 1312 pixels and the average reflectance spectra obtained from masked hyper-spectral images encompassing the spectral region of 398-1003 nm for the experimental groups of different gums for the adulterated samples indicates markedly changes in morphological features of the curves at visible region (400-550 nm) in both the experiments. Further, it can be inferred that the reflectance increases with increment in wavelength and the reflectance lines are closed at NIR region than the visible region. Also, by visual inspection of mean spectra, it can be observed that the reflectance intensity of *A. senegal* is the highest at visible region with significant difference while at the NIR zone, it is from *P. juliflora*. The reflectance intensity of samples is reduced with the increase in adulteration in visible region.



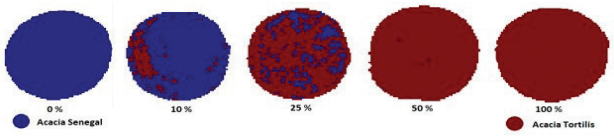


DSC thermograms of naturally exuded and induced gum arabic samples showed similar thermal behaviour



Average reflectance spectra (A) different gum samples (B) Adulterate samples.

In order to discriminate between control and adulterated gum samples, partial least square-discriminate analysis model (PLS-DA) has been trained on pixel data of pre-processed hyper-spectral images of adulterate gum samples. The output of the model has been divided into two categories: *A. senegal* (blue pixels) and *A. tortilis* (red pixles). With the increase in adulteration in *A. senegal* samples the numbers of pixels represented by *A. Senegal* are reduced and the numbers of pixels represented by the *A. tortilis* are increased.



Output of PLS-DA model for classification of adulterated and pure *A. senegal* gum.

Project centre at ICAR-CAFRI, Jhansi

Productivity of gum yielding tree-based agroforestry models

In *Acacia senegal* based multi-component (agri-horti-silviculture) model, maximum GBH (57.3 cm) and canopy spread (36.8 m^2) has been recorded in *Aeglemar melos* followed by *A. senegal* with similar observation for rain-fed agroforestry (agri-silviculture) model. In silvi-herbal models, *A. nilotica* (101.1 cm) recorded maximum GBH in model – II while *A. senegal* (48.2 cm) in model-I. *A. senegal* has attained maximum GBH (29.5 cm) in gum garden while survival and growth of *Butea monosperma* is found to be not encouraging. Survival of *A. senegal* in different bio-fence model ranges from 40 to 100%. In general, tree growth of double row bio-fence model appears to be more effective as barriers on field boundary. In *Acacia senegal* based multi-component model, during the year 71 kg lemon, 74 kg karonda and 1400 kg of bael fruits have been produced from fruit components of this model. In rain-fedagri-silviculture, the yield of taramira has been affected by *A. nilotica* and *A. senegal* planted at three spacing viz. 10×10 m, 10×5 m and 5×5 m. Maximum yield has been observed in 10×10 m spacing while the least in 5×5m.In silvi-herbal model-II, the maximum survival and growth of lemon grass tussock and biomass production has been observed in tussocks planted at 100×100 cm spacing. During the year natural exudation has been observed in all the agroforestry models established at farm and maximum mean gum yield of *A. senegal* (175.5 g/tree) is produced in agri-horti-silviculture model, while *A. nilotica* (102.3 g/tree) in silvi-herbal model.

Standardization of gum tapping techniques

Maximum gum yield is obtained in the month of December from the *B. monosperma* trees followed by January and February. From December to June, the gum yield declined and during rainy season in the month of July, August and September the exuded gum could not be collected as all the exudates washed away with the rain water. To assess response of different progenies of *A. pendula*to ethephon application on gummosis single dose (4 mL/tree) of ethephon (30% concentration) has been injected in tree trunk and gummosis has been observed in subsequent months. All the progenies responded to ethephon application and exhibited gum exudation and the maximum gum yield has been given by trees of AP-20 and the least by J-62 progeny.

Documentation of indigenous technical knowledge (ITKs) on harvesting, processing and value addition of NRGs in India:

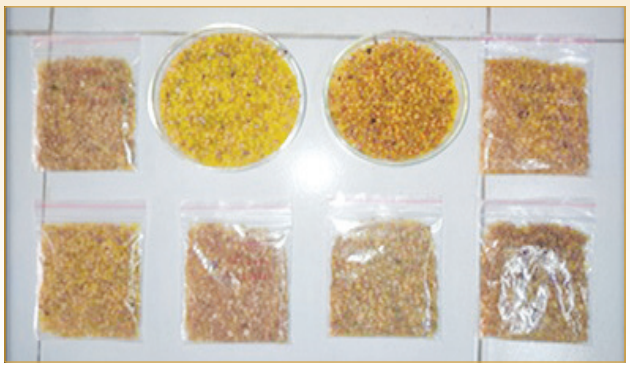
During the year survey of Jhalawar and Baran districts of Rajasthan, Shivpuri district of Madhya Pradesh has been conducted during which, it is found that tribal women are skilled and possess the knowledge, wisdom and ability to identify particular gum-tear with the help of specific aroma, shape & lustre of gum-tears.

Project on guar gum at VNMKV, Parbhani

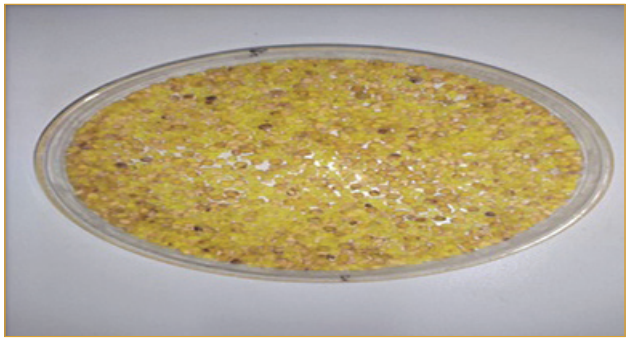
Studies on characterization of guar gum genotypes of different locations

Seed samples of guar genotypes of 14 varieties are obtained from different centers of AICRP on legumes viz; Kanpur, Jodhpur, Gwalior & Parbhani, and evaluated for gum content and viscosity. The guar gum has been isolated by wet process. The mature seeds are treated and purified to extract gum. The purified gum has been vacuum dried and pulverized

to 200 mesh. The viscosity profiling of guar gum solutions has been carried out at 35 -75 ^{0}C (Labman Viscometer LMDV-100) and the pH values are also determined.



Different location wise guar seeds with splits.



Guar seed splits.

The obtained comparative results of location wise hull content (%), endosperm content (%), germ content (%) and gum content (%) of different guar seed genotypes are summarized in the following table.

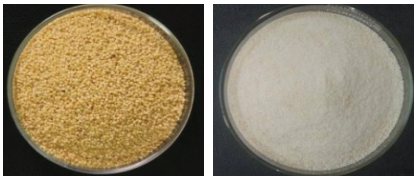
Guar gum solutions are stable over a wide pH range of about 1.0–10.5, due to its non-ionic and uncharged behaviour. Final viscosity of guar gum is not affected by the pH, but the hydration rate shows variation with any change in pH. Fastest hydration is achieved at pH 8-9, slowest at pH above 10 and below 4.

Standardisation and quality evaluation of millet based instant appe mix powder with incorporation of guar gum.

Millet based instant *appe* mix has been prepared with varying the composition of selected ingredients including rice, black gram, finger millet, foxtail millet and guar gum. In the control sample of appe mix millets are not incorporated.

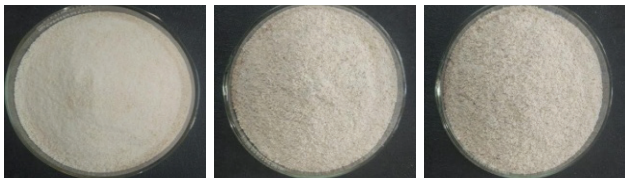


Rice Black gram dal Finger millet

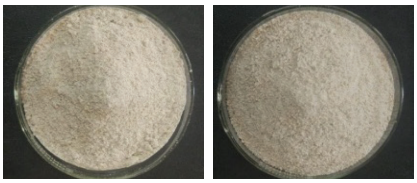


Foxtail millet Guar Gum Powder

Selected ingredients for preparation of appe mix powder with incorporation of guar gum



Control T_1 T_2



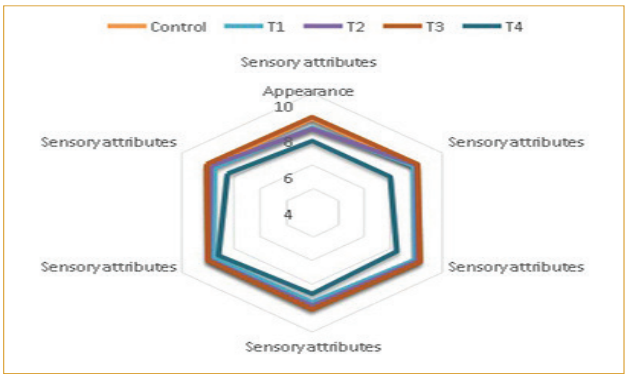
T_3 T_4

Prepared appe mix-powder with incorporation of guar gum

Hull, endosperm, germ and gum contents of various genotypes of guar gum

Parameters	Maximum	Location	Genotype	Minimum	Location	Genotype
Hull content,%	17.11	Parbhani	GG - 1909	14.52	Kanpur	HG-2-20
Endosperm content,%	33.56	Jodhpur	X-30	29.64	Parbhani	GG - 1909
Germ content,%	44.50	Jodhpur	RGR-20-15	40.88	Kanpur	RGC-1066
Gum content,%	30.43	Jodhpur	RGR-20-15	26.65	Parbhani	X - 25

Organoleptic evaluation of appe mix powder has been carried out with the help of trained and semi trained panel members using the 9-point Hedonic scale. The parameters like appearance, color, taste, flavor, texture and overall acceptability are considered. The results obtained from the organoleptic score reveals that the highest overall acceptability score (8.1) is for the T_3 sample. For the parameters like color, flavor and texture sample T_3 showed the highest score. While sample T_4 showed the lowest score for all the parameters with overall acceptability score (6.5). Increasing the concentration of millets to 25% or above is found to be unacceptable by the consumers due to the flavor and odor of millets. So the acceptable limit of the finger millet and foxtail millet is found to be acceptable at 20%. Incorporation of finger millet helps to enhance the color attributes.



Organoleptic evaluation of appe mix powder with incorporation of guar gum



Millet based guar gum incorporated appe product

Further analysis of the sample reveals that sample T_3 is superior as compared to control. Except zinc, calcium, magnesium, phosphorous, iron and copper are found to be at higher side than the control. Prepared millet based instant appe mix samples on the basis of organoleptic evaluation are stored at room temperature and analyzed at the interval of 7 days for TPC and yeast and mold count. The results pertaining to microbial examination are depicted in te following table.

Table: Microbial analysis of appe mix powder with incorporation of guar gum

Days	Total Plate Count (CFU/g)10^3		Yeast and Mold (CFU/g)10^3	
	Control	Selected(T_3)	Control	Selected(T_3)
0	4.3 ×10^3	3.6 ×10^3	3.9 ×10^3	3.1 ×10^3
7	6.8 ×10^3	5.4 ×10^3	5.6 ×10^3	5.2 ×10^3
14	9.6 ×10^3	7.8 ×10^3	8.1 ×10^3	7.6 ×10^3
21	11.2 ×10^3	9.3 ×10^3	9.6 ×10^3	9 ×10^3
28	13.5 ×10^3	11.1 ×10^3	10.2 ×10^3	9.9 ×10^3
35	15.7 ×10^3	13.6 ×10^3	11.8 ×10^3	10.3 ×10^3

Control=75 g rice and 25 g black gram dal
T_3=40 grice, 20 g black gram dal, 20 g finger millet, 20 g foxtail millet and and 2 g guar gum

Shelf life of prepared appe mix powder has been studied for 90 days at room temperature. The parameters such as weight of product, moisture content, water absorption capacity and overall acceptability are considered. The different packaging materials used for the shelf life study analysis such as

HDPE standing pouch, HDPE aluminium laminated standing pouch, PP and PET. The data reveals that there is a slight increase in the weight of the sample with increasing days. HDPE aluminum laminated standing pouch is found to be affordable and most.

Using a standard calculating procedure, the estimated production cost has been computed for 1 kg of prepared millet-based appe mix to establish its techno-economic feasibility. The cost for manufacturing of 1 kg of instant appe mix is found to be ₹ 95.4/-. The cost of 100 appe mix powder packed in HDPE laminated pouches is estimated to be ₹ 9.54/- which is affordable to the customer.

Project on rosin gum at Dr. YSPUH&F, Solan

Effect of oleoresin storage on turpentine content in *Pinus roxburghii* Sargent

In this experimental study, the oleoresin extracted through borehole method of tapping has been stored for 2, 4, 6 and 8 months at three different storage conditions, *viz*., room temperature, freeze and deep freeze conditions in five different containers (Glass, Plastic, Steel, Earthen pot and Tin). The processing of oleoresin for rosin and turpentine has then been performed and analyzed for the loss of content during storage at different time intervals. The data reveals significant difference for rosin content of *Pinus roxburghii* from three different storage conditions and for different time period in different storage containers. Among two months' storage conditions, the maximum rosin content (80.89%) is found in the earthen pot container stored at room temperature. The minimum rosin content (78.97%) is noticed in the glass jar stored at deep freeze condition. For eight months' storage condition, the maximum rosin content (81.27%) is noticed in the earthen pot at room temperature condition and minimum rosin content (79.26%) in tin at deep freeze condition. The perusal of data reveals significant difference for turpentine content of *pinus roxburghii* from three different storage conditions and for different time period in different storage containers. At the end of eight months' storage condition, the maximum turpentine content (20.74%) is noticed in tin at deep freeze condition and minimum rosin content (18.73%) is recorded in the earthen pot stored at room temperature condition.

Study on the effect of anatomical characteristics on oleoresin yield from experimental sites

Effect of borehole angle and diameter classes on oleoresin yield

The oleoresin yields have been found to be affected by the borehole angle and tree diameter. The highest oleoresin yield of 2214.13 g/hole/tree has been recorded in the diameter class >60 cm whereas, lowest oleoresin yields of 1438.04 g/hole/tree has been observed in the diameter class 30-40 cm. The analysis of variance shows significant differences for treatments, the mean maximum oleoresin yield of 2,382.67 g/hole is noticed at an angle of A_2 (40°) and mean minimum yield of 1,542.92 g/hole in A_4 (70°). However, the interaction between the angle and diameter classes also shows significant effect on oleoresin yield. The maximum oleoresin yield of 3592.50 g/hole has been recorded for 40° angle and >60 cm diameter, whereas the minimum (1039.83 g/hole) for 70° angle and 30-40 cm diameter.

Natural stand of chir pine located in the university campus has been marked and numbered. In this experiment, diameter at breast height (DBH) has been measured and all the trees are classified into four diameter classes, *viz*.,30-40 cm, 40-50 cm, 50-60 cm and >60 cm for determination of effect of different chemical stimulants, i.e. [(T_1-Control), (T_2-10% CEPA+20% H_2SO_4), (T_3-3% CEPA_2-chloroethyl phosphonic acid), (T_4-500 mM potassium sulphate (K_2SO_4), (T_5-10 mM benzoic acid), (T_6-1m MNAA) & (T_7-20% H_2SO_4+20% HNO_3) (1:1) on oleoresin yield. The initial area of the borehole at the time of drilling, which is used for calculation is 4.91cm^2. The highest unhealed area of 4.60 cm^2 is noticed in control (T_1) and the lowest of 3.53 cm^2 in tree boreholes treated with 1 mM NAA (T_6). The highest healing percentage of 30.33% is obtained in treatment (T_6) after one year.

Diameter class: 30-40 cm	**Tapping methods:** 2
Number of treatments: 14 (7×2)	a) M_1-Borehole Method
Number of trees: 42	b) M_2-Rill Method
Anatomical Characteristics studied	**Treatment Detail:**
Ray Height (mm)	T_1=Control
Ray Width (mm)	T_2=10% CEPA (2-chloroethyl phosphonic acid) + 20% H_2SO_4
Number of resin duct/mm^2	T_3=3% CEPA (2-chloroethyl phosphonic acid)
Diameter of resin duct (mm)	T_4=500 mM K_2SO_4 (Potassium Sulphate)
Tracheid dimensions	T_5=10 mM BA (Benzoic Acid)
Tracheid length (mm)	T_6=1 mM NAA (Naphthalene Acetic Acid)
Tracheid diameter (mm)	T_7=20% H_2SO_4 + 20% HNO_3 (1:1)

Effect of different chemical stimulants on oleoresin production and wood quality

Effect on anatomical characteristics: The study comprised fourteen treatments. In total, 42 trees have been tapped and six different chemical stimulants are used. The details are given above.

Anatomical characteristics studied under this experiment are ray height and width, number of resin ducts/ mm^2, diameter of resin ducts (mm), trachied length and diameter. Among these 6 anatomical characteristics, ray height and diameter are found to be non-significant in relation to the oleoresin as the ray height changes on regular basis as the tree grows. This change is due to the transverse division of ray cells initials and fusiform initials of adjacent ray; besides, environmental stress also effects the pace of cambial growth resulting in ray height reduction. The highest ray height and width are recorded in treatment T_1 (untapped wood). The highest number of resin ducts/mm^2 and diameter of resin ducts are found in the rill method (M_2) and treatment T_3 (five year tapped wood) and T_2 (one-year tapped wood), respectively in the case of untapped and tapped chir pine wood. Number of resin ducts/ mm^2 have been compared for all the tapping methods. The maximum value of 0.764/mm^2 has been recorded in rill method and the minimum value of 0.660/mm^2 for borehole method. The data is significant for all the treatments. The maximum value of 0.880/mm^2 is recorded in T_2 (10% CEPA + 20% H_2SO_4 and minimum value of 0.489/mm^2 in T_1 (Control). The interactions between methods (bore hole and rill method) and treatments are found to be significant. The highest value of 0.960/mm^2 is found in rill method with treatment of 10% CEPA + 20% H_2SO_4. The lowest value of 0.395/ mm^2 is recorded in borehole method and control. Diameter of resin ducts (mm) are found maximum (0.196 mm) in rill method and minimum (0.190 mm) in borehole method. Further, with the treatments only, the maximum value of 0.256 mm is recorded in T_7 (20% H_2SO_4 + 20% HNO_3) and minimum (0.140 mm) in T_5 (10 mM benzoic acid). With the interactions between methods and treatments, the highest value of 0.300 mm is found in rill method with 20% H_2SO_4 + 20% HNO_3 treatment and lowest (0.125 mm) in rill method with 10 mM benzoic acid. The highest tracheid length has been recorded in the rill method (M_2) and treatment T_3 (five year tapped wood) tracheid length revealed non-significant difference in the case of methods. Further, the treatments are found to be significant with the maximum value of 6.50 mm recorded in T_7 (20% H_2SO_4 + 20% HNO_3) and minimum (4.32 mm) in T_1 (Control). The interactions between methods and treatments are found to be significant with the highest value of 6.88 mm in borehole method with 20% H_2SO_4 + 20% HNO_3, and the lowest (4.29 mm) in borehole method and control. The highest tracheid diameter is recorded in the bore hole method (M_1) and treatment T_3 (five year tapped wood) in the case of untapped and tapped chir pine wood. The oleoresin yield exhibited positive and highly significant correlation coefficient with temperature (0.731). The oleoresin yield had non-significant and positive correlation with relative humidity (0.283) and rainfall (0.278).

Project on babool gum at IGKVV, Raipur

Physico-chemical & morphological characterization of babool (*Acacia nilotica l.*) gum grown across different agro-climatic zones and its valorization

Babool tree (*Acacia nilotica L.*) can be tapped only in summer season and for sustainable tapping, tree girth should be more than 85-90 cm in diameter. Ethephon @3.9% injected by drill method is quite effective in April to May at high temperature and

low RH%. Also sample collected via gum enhancer technique are having the solubility index, angle of repose and bulk density of gum 78.90%, 38.91^0 and 0.94 g/cc, respectively, whereas, in traditionally collected gum, the same are 79.02%, 39.5^0 and 0.93 g/cc, respectively. However, true density is observed to be 1.02 g/cc in both the gum samples collected traditionally and scientifically.



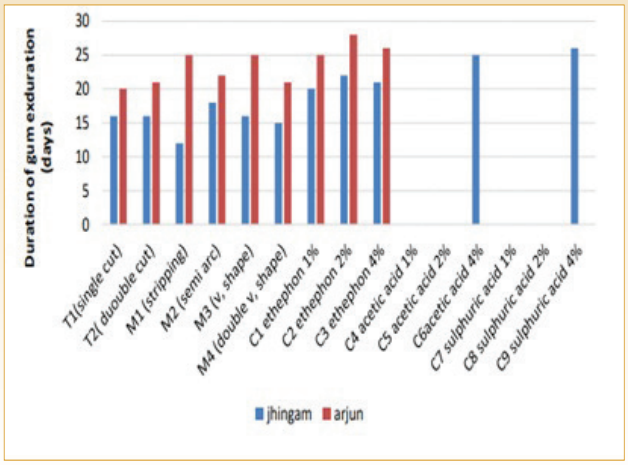
Babool tree tapped by drill method

Study of exudation behaviour of jingum indian ash tree (*lannea coromondelica*) for potential production of gum:

The Jhingam trees have tremendous potential of tapping and possibility to enhance the Non Wood Forest Produced resources and to improve the income and livelihood of marginal farmers of Chhattisgarh. The rate of gum exudation is high during the summer months (May-June) in Jhingam trees, while in Arjun trees, the rate of exudation peaks in March to April and the use of a gum enhancer, particularly ethophon @ 2%, proves to be superior in both winter and summer seasons in Jhingam trees for higher production of biopolymer and the application of gum enhancers show a slight reduction in moisture content and pH, whereas it results in a notable increase in fat content, protein content, and ash content. However, there are no alterations observed in the bulk density and tapped density of the biopolymers extracted from the experimental trees.



Jingum Indian ash tree (*Lannea coromondelica*)



Duration of gum exudation by traditional, mechanical and gum enhancer methods experimental trees in summer season-2023

Utilization of gum as edible coating for shelf life extension of button mushroom (*agaricus bisporusl.*)

Different concentration of edible coating treatments applied on button mushrooms and storage time has a significant impact on the physiological weight loss of the mushroom, with the minimum weight loss recorded in mushrooms coated with BG (Babool Gum) 7% + CMC (Carboxy methyl cellulose) 1.5% (3.454, 4.257, 5.234 and 6.296%) whereas, the maximum physiological weight loss is recorded in the controlled button mushroom (11.087%) on the 8th day of storage. The maximum moisture content ias observed and recorded in mushroom coated with BG 7.83% + CMC 2% (91.52, 90.94, 90.91 and 90.03%) whereas, the minimum moisture content is observed in controlled button mushroom (87.77%) on 8th day of storage.



Exudates obtained from Lannea coromondelica (Jhingam gum)



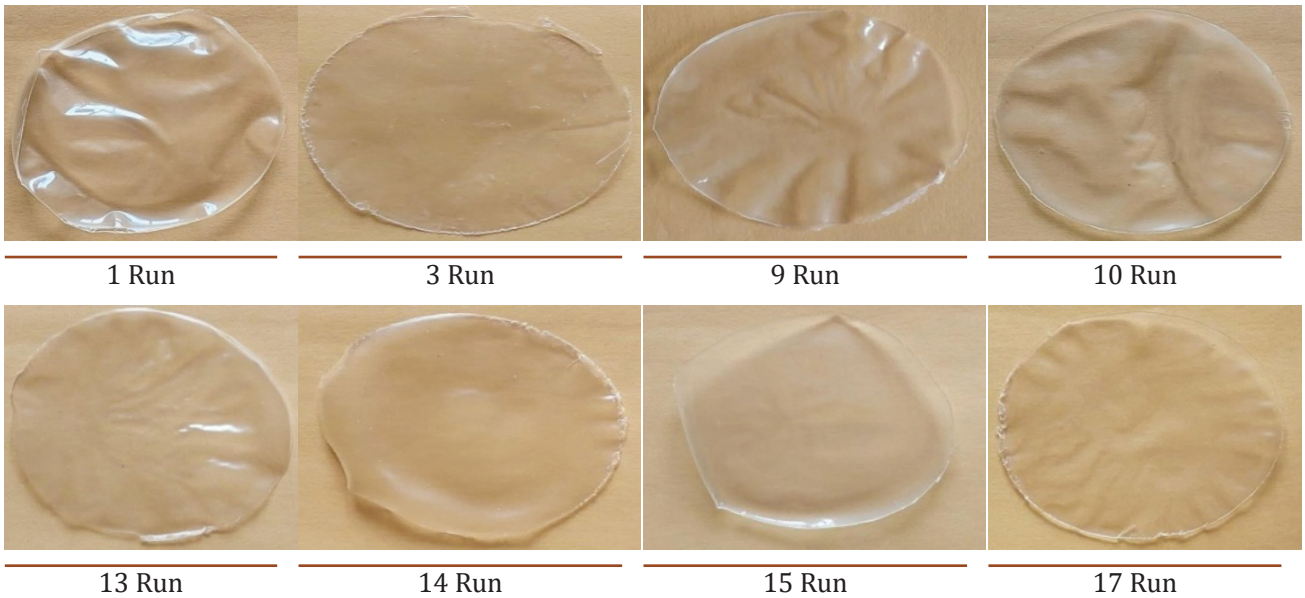
Un-coated mushrooms samples



Mushrooms coated with BG 7%+CMC 1.5%

Development of biopolymer film from extracted charota (*cassia tora*) seed gum:

Extracted charota seed gum has been used for development of polymer film along with corn starch and glycerol in different proportions. Response surface methodology (RSM) using design expert software (version 10.0.5), has been followed for each of the responses, *viz*., water solubility, moisture uptake, transparency and water vapor permeability.



Polymer films made with different combinations of film forming solution

The numerical solution for the desired goals using desirability function approach for optimal process variables are as follows: starch 3.87 g, gum 0.21 g, and glycerol 32.352 g, with Water solubility 21.94%, Moisture uptake 19.47 (%), Transparency 63.72 (%), WVP 0.00 (g-mm/Pa-m-s) and Desirability of 0.768.

The quality of polymer film prepared with the optimum combination of factors (corn starch, charota

seed gum and glycerol) has been analyzed. The optimized sample has the thickness 0.15± 0.01 mm, density 0.74± 0.16 (g/cm^3) and Water absorption capacity 103.77± 5.34 (%). The soil burial test (Biodegradability) is depected in the following table.

Soil profile for soil burial test for degradability

Compo-sitions	Moist-urecontent (%)	pH	Elec.Condu-ctivity(dS/m)	Orga-nic carbon(%)	Nitro gen(kg/ha)	Phos-phorus(kg/ha)	Pota-ssium(kg/ha)	Sand (%)	Silt(%)	Clay(%)
Value	21.767	6.65	0.18	0.47	163	26.61	69.496	56.23	28.02	16.11

Project on guggul at JNKVV, Jabalpur

Conservation of data deficient guggul plants (*Commiphora wightii*):

The study of fruit and seed production of guggul has been studied during the year 2013-14 to 2022-23 and the following conclusions are drawn from the study. July month is found to be the best and suitable time for guggul seed sowing in the Chambal ravines. Over 10,000 guggul seedlings are raised by the technique and the commercial level plantation around 48540 planted by Rexnault India Pvt Ltd. in Madurai survived and has attained an average plant height of more than 6 feet with good branches. On an average 292 g fresh fruits are produced per plant per year and 105 g seeds are extracted from per kg fruits and the mean fruits collected are 1.68 kg per day per person. The percent of germination of guggul seeds varies from 0.90 to 2.30% with an average of only 1.75% guggul seeds germination. The germination percent of *C. wightii* varies significantly among the different treatments. the highest (56.67%) in T_3 - 24 Chambal soil + Vermi compost followed by T_1 - Chambal soil (46.67%), T_4 - Black soil + Vermi compost (43.33%) and T_2 - Black soil (36.67%). In the present investigations, the test materials, i.e., guggul gum are found to be non-cytotoxic upto 10 mg/mL concentration for a period upto 96 h in L929 cells and the trends of result of NRU assay are similar to that of MTT assay; no cyto-toxicity can be observed for any of the concentration at any of the time point of exposure, i.e., 24-96 hours for all the three samples of guggul gum.

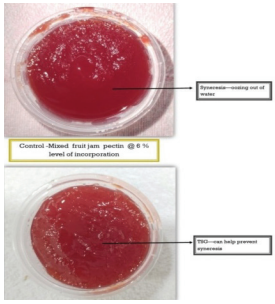
Project on tamarind seed gum at TNAU, Coimbatore

Tamarind kernel powder based mixed fruit jam and coconut jelly

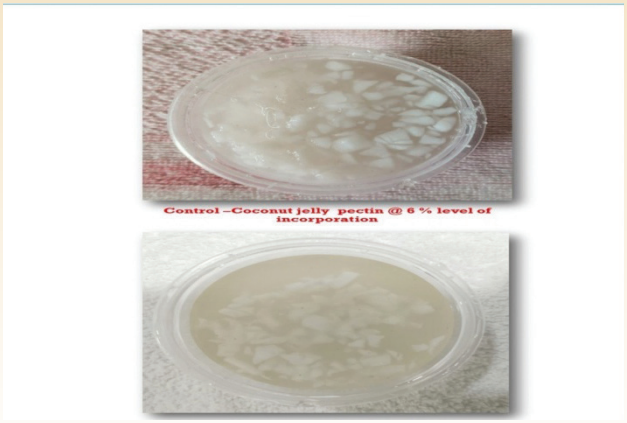
The incorporation level of tamarind kernel powder in the mixed fruit jam at different concentration such as 2.0, 4.0, 6.0 and 8.0% have been used and the mixed fruit jam has been tested for their consumer acceptability. The control T_0 samples prepared by using 10.0% pectin has 100% (9.0/9.0) organoleptic scores. The jam prepared with incorporation level of T_4(Fig. 8.30) attained maximum quality attributes score 8.2/9.0 for overall acceptability compared to other levels. The incorporation level T_2 and T_3 have scored 7.1/9.0 and 7.5/9.0, respectively for overall acceptability by the judges, whereas the combination T_1 has the lowest 6.9/9.0 score. Similarly, for coconut jelly prepared with T_4 attained the maximum score for 9.0/9.0 for overall acceptability compared to other incorporation levels.

Tamarind gum based mixed fruit jam and coconut jelly

Mixed fruit jam and coconut jelly have been developed by incorporating 2.0, 4.0, 6.0 and 8.0% tamarind seed gum. 9-point hedonic scale has been used to evaluate the samples. For the mixed fruit jam, in terms of overall acceptability T_3 (6.0% tamarind gum) is found to be highly acceptable. In various attributes among all the incorporation levels, T_1 (2.0%) and T_4 (8.0%) are the least acceptable (6.8/9.0) as compared to the control. Similarly, for coconut jelly in terms of overall acceptability T_3 (6.0%) is highly acceptable while using pectin. T_1 (2.0%) and T_2 (8.2%) are the least acceptable (7.4/9.0), as compared to the control (8.2 /9.0).



Tamarind gum based mixed fruit jam



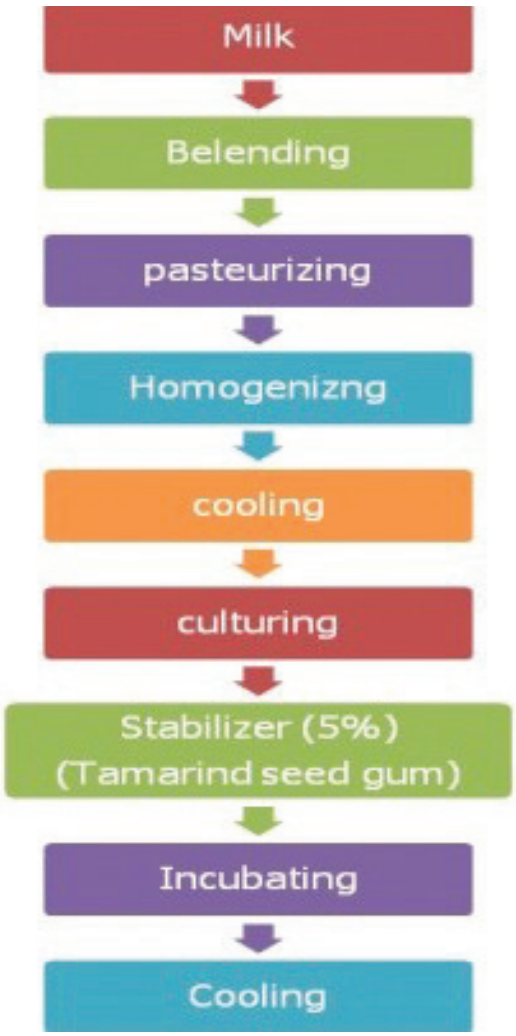
Tamarind gum based coconut jelly jam

Properties of TKP/TSG based value added products

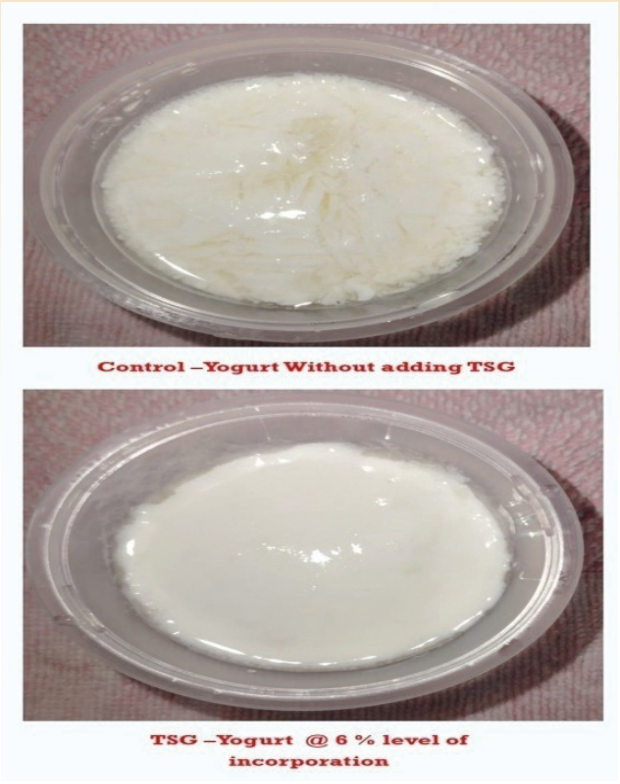
Sampleds prepared using the optimized levels of Tamarind Kernel Powder (TKP) and Tamarind Seed Gum (TSG) in mixed fruit jam and coconut jelly have been subjected to analysis of physiochemical properties, *viz.,* TSS (°Brix), pH, acidity, total sugars, reducing sugars, carbohydrates, vitamin C and β-Carotene. The carbohydrates (%), total sugar (%), reducing sugar (%) and acidity (%) are observed as 27.34%, 62.78%, 21.72% and 1.12% in TSG incorporated mixed fruit jam, while TKP incorporated jam has the value of 25.43% carbohydrates, 61.52% total sugar, 21.13% reducing sugar and 0.99% acidity. TKP incorporated jam has a minimum value of vitamin C (26.04 mg/100 g) and β-Carotene (92.82 µg/ 100 g) as compared to the TSG incorporated jam (26.93 mg/100 g and 93.42 µg/ 100 g) and control (25.85 mg/100 g and 89.45 µg/ 100g). Results reveal that the evaluated nutrients increase in TKP and TSG incorporated jam than the control except for vitamin C and β-Carotene content. Similarly, TKP/TSG incorporated coconut jelly has the same TSS (°Brix), pH and acidity (%) for the two samples (65.0° Brix, 3.2 and 1.00 per cent) because these parameters are directly linked to the quality of the coconut jelly. In the case of carbohydrates (%), reducing sugar (%) and total sugars (%), TSG incorporated jelly has the maximum value as 35.73%, 42.52% and 67.89%, respectively. On contrary, TKP incorporated jelly has the minimum value of total sugar (60.48%) and reducing sugar (21.13%). TKP incorporated jelly has the maximum value of vitamin C (52.24 mg/100 g) and β-Carotene (56.17 µg/ 100 g) and minimum in the TSG incorporated jelly (56.93 mg/100 g and 58.37 µg/100 g) as compared to standard using pectin (47.75/ 100 g and 58.01 µg/100 g). There is no significant difference between the optimized level of TKP and TSG incorporated jelly when compared with control.

Sensory evaluation of tamarind seed gum based Yogurt:

The major steps involved with making yogurt – blending, pasteurizing, homogenizing, cooling, culturing, incubating, and cooling. Tamarind seed gum as stabilizers have been used for the preparation of yogurt and subjected to sensory evaluation with respect to appearance, flavor, taste, smoothness, mouth feel and overall acceptability with incorporation level of 2.0%, 4.0%, 6.0% and 8.0%, respectively. The smoothness and mouth feel has the best score in T_3 (6% TSG 8.8/9.0 and 9.0/9.0) as compared to control T_0 (9.0/9.0 and 9.0/9.0). Mean organoleptic scores showed that overall acceptability for yogurt is maximum in T_3 (6.0%) with the value of 9.0/9.0 followed by 8.6/9.0 (T_2 – 4.0%) and minimum in T_1 (7.2/9.0).



Process for preparation of yogurt



Tamarind gum based Yogurt

Seed priming technique for separation tamarind seed germ from tamarind seed

A study has been carried out for improving the quality of tamarind seed gum by removal of germ from tamarind seed for minimizing protein content in tamarind seed gum using mechanical scarification, hot water treatment, cold water treatment and concentrated H_2SO_4 treatment. The parameters *viz.,* number of days before germination, number of seed germinated and germination percentage have been assessed.

Table Effect of pre-treatment on germination of *Tamarindus indica* seeds.

Pre-treatment	No of days before Germination	Number of seed Germinated	Germination percentage (%)
Mechanical scarification	3	24	96
Hot water treatment	6	17	68
Cold water treatment	8	18	72
Concentrated H_2SO_4	10	20	80

De-germinated tamarind kernel powder has been subjected to biochemical analysis, such as total carbohydrate, protein, crude fibre and fat content compared to without removing of tamarind kernel powder. The crude protein, carbohydrate, fat, fibre and ash content in the de-germinated tamarind kernel powders are 22.30%, 58.65%, 6.80%, 2.50% and 1.20%, respectively, while the whole tamarind kernel powder has 19.06%, protein and 3.70% crude fibre, fat 3.6 -7.4%, and carbohydrate 63.54%. The protein content of the germ has significantly increased from 19.06 to 23.30%.

Amino acid content of tamarind seed gum solution after ultra-sonication treatment:

The tamarind seeds are an important source of protein and valuable amino acids. The seed is also rich in cysteine and methionine but threonine and tryptophan are limiting amino acids. The results of amino acid analysis of tamarind seed protein shows that the tamarind seed are rich in glutamic acid, aspartic acid, proline, and sulphur containing amino acids (methionine and cysteine). The proportions of hydrophobic amino acids (alanine, valine, leucine, isoleucine, and phenylalanine) and hydrophilic amino acids (lysine, histidine, aspartic acid, glutamic acid, and arginine are also present tamarind gum solution. The result help to separate soluble, insoluble protein, alcohol soluble and alkaline soluble protein for further purification tamarind seed gum.

Standardizing the gum tapping techniques of *Moringa oleifera*

Gum extraction techniques for *Moringa oleifera* have been followed in both irrigated and non-irrigated condition of different diameter classes (30-60 cm, 60-90 cm and 90-120 cm). In *Moringa oleifera*, maximum gum yield (33.40g/tree/month) has been observed in T_6 (Hand drilling with 4 mL gum inducer) in 90-120 cm dia tree, followed by T_5 (Hand drilling with 2 mL gum inducer) in diameter class of 90-120 cm and minimum (3.2 g/tree/month) in T_1 (mechanical drilling without gum inducer) in diameter class of 30-60 cm and the processing. Quality analysis of moringa gum, i.e. physico-chemical properties, biochemical properties and viscocity in different concentration has been carried out.



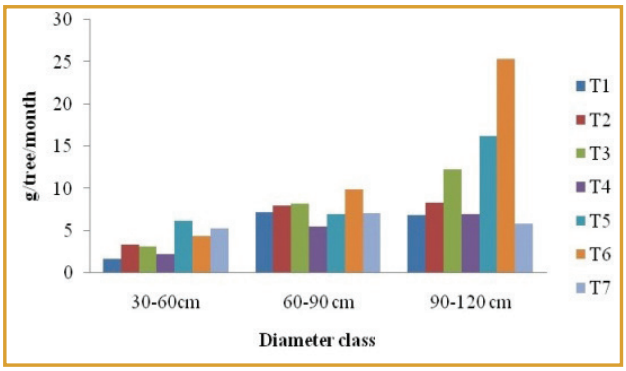
Hand drilling with 4ml gum inducer



Gum exudate from hand operated drilling

Gum exudate from IINRG–gum blazer

Hand operated drilling with ½ inch drill + 4 mL inducer application



Month-wise gum yield in *Moringa oleifera* under different diameter class

T_1 - Battery operated drilling with ½ inch drill bit + patching with moistened clay

T_2 -Battery operated drilling with ½ inch drill bit + 2 mL inducer application patching with moistened clay

T_3 - Battery operated drilling with ½ inch drill bit + 4 mL inducer application+ patching with moistened clay

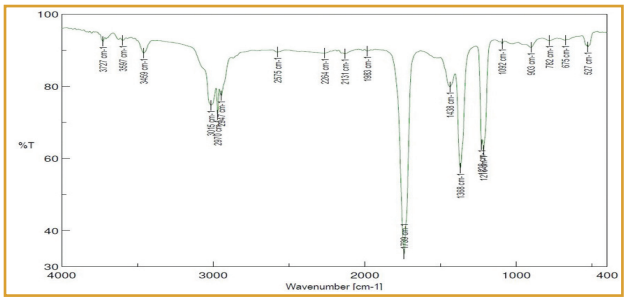
T_4 - Hand operated drilling with ½ inch drill + patching with moistened clay

T_5 - Hand operated drilling with ½ inch drill + 2 mL patching with moistened clay

T_6 - Hand operated drilling with ½ inch drill + 4 mL inducer application + patching with moistened clay.

T_7 - IINRG - Gum Tapping Blazer – 75.

Fourier Transformed Infrared Spectroscopy (FT-IR) spectrum of *Moringa oleifera* reveals that the attribution of main absorptions are the characteristic of polysaccharide structures and related to OH stretching (3637 cm^{-1}); CH stretching (2922 cm^{-1}); C=C alkenes aromatic (1641 cm^{-1}); C-N amine (1070 cm^{-1}); CHO stretching (1745 cm^{-1}); C-O-C stretching (1020 cm^{-1}) shows the absorption peaks at 3669 to 3674 cm^{-1} as OH stretching, 2932 cm^{-1} as CH stretching, 1645 cm^{-1} as C=C alkenes aromatic, 1065 cm^{-1} as C-N amines, 1738 cm^{-1} as CHO stretching confirming the polysaccharide structures.



FTIR analysis of moringa gum

Florigen's used for inducing flower production in high density tamarind plantation:

Flower and fruit production is very poor in tamarind trees. In order to address this issue, the effect of different flower production inducing chemicals have been applied to the trees and floral characters of tamarind have been observed under high density tamarind plantation at FCRI, TNAU, Tamil Nadu. The flowers are examined for flowering percentage, inflorescence length and flower production per inflorescence and per branch. Exogenous foliar application of chemicals plays a major role in the flower opening, fruit drop, growth and development of fruits, enhancing yield and keeping quality of fruits. Hence, the chemicals like ethrel, cycocel, paclobutrazol and KNO_3 are selected as flower inducing chemicals for the present experimentation.

Flower inducing chemicals selected for experiment

Treatment	Details
T_1	Foliar application of Ethrel @ 200 ppm
T_2	Foliar application of Ethrel @ 500 ppm
T_3	Foliar application of Paclobutrazol @ 500 ppm
T_4	Foliar application of Paclobutrazol @ 1000 ppm
T_5	Foliar application of NAA @ 50 ppm
T_6	Foliar application of NAA @ 100 ppm
T_7	Control (No treatment)

Effect of florigen application on flowering and fruiting in tamarind genotypes:

The present study has been undertaken for productivity improvement in tamarind with particular reference to tamarind seed gum. In this regard, six different genotypes (FCRI-TAM-06, FCRI-TAM-09, PKM-1 (Control), FCRI-TAM-03, FCRI-TAM-04 and FCRI-TAM-08) are tested under high density planting system supplemented with florigen application for flower and fruiting management, and the study result reveal that paclobutrazol 500 ppm in FCRI-TAM-06 has recorded maximum number of flower per branch with the value of 270 flowers per branch followed by paclobutrazol 1000 ppm in FCRI-TAM-06 (192.00 flower per branch), etherel 500 ppm in FCRI-TAM-08 (122.00 flower per branch) and the lowest in control (13.00 flowers per branch) in FCRI-TAM-04 as compared to paclobutrazol 500 ppm in PKM-1 (102.00 flower per branch) as a check variety. Similarly, the highest tamarind fruit yield has been observed in paclobutrazol 500 ppm of FCRI-TAM-06 with the value of 10.86 kg. followed by etherel 500 ppm of FCRI-TAM-08 (7.46 kg.), paclobutrazol 500 ppm of FCRI-TAM-08 (6.59 kg.) and the lowest in control of FCRI-TAM-04 (0.03 kg.) as compared to the 3.36 kg in paclobutrazol 500 ppm of PKM-1.



Flowering in tamarind FCRI-TAM-06



Fruiting of tamarind

After florigenflowering and fruiting yield

Preliminary studies on assessing gum production in few tree species of regional importance:

A preliminary assessment of gum production for the species *Acacia leucophloea* has been carried out at Forest College and Research Institute, Mettupalayam, Coimbatore district. Result reveals that maximum yield is 28.20 g/tree/month in T_6 (Hand operated drilling with ½ inch drill + 4 mL inducer application + patching with moistened clay) of diameter class of 70-90 cm and minimum in T_4 (Hand operated drilling with ½ inch drill + patching with moistened clay) in diameter class of 30-50 cm (2.30 g/tree/month).





Gum extraction technique & exudates of *Acacia leucophloea*.

Gum tapping in *Acacia leucophloea* in different diameter class

Treatments	Mean yield (g/tree/month)		
30-50 cm		50-70 cm	70-90 cm
T_1 - Battery operated drilling with ½ inch drill bit + patching with moistened clay	2.80	3.70	6.50
T_2 - Battery operated drilling with ½ inch drill bit + 2 mL inducer application patching with moistened clay	5.06	5.40	6.60
T_3 - Battery operated drilling with ½ inch drill bit + 4 mL inducer application+ patching with moistened clay	7.70	9.30	9.10
T_4 - Hand operated drilling with ½ inch drill + patching with moistened clay	2.30	2.90	3.00
T_5 - Hand operated drilling with ½ inch drill + 2 mL patching with moistened clay	4.40	4.70	5.40
T_6 - Hand operated drilling with ½ inch drill + 4 mL inducer application + patching with moistened clay.	8.90	16.80	28.20
T_7 - IINRG - Gum Tapping Blazer – 75 + Ethephon	5.70	6.60	10.70

Summary of biochemical properties, physico-chemical properties and viscosity of different concentration of *Acacia leucophloea* is depicted in the following table.

Physico-chemical properties, biochemical properties and viscocity of *Acacia leucophloea*in different concentration

Physico-chemical properties		Biochemical properties		Viscocity of *Acacia leucophloea*in different concentration	
Parameters	Acacia leucophloea	Parameters	Acacia leucophloea	Concentra-tion	Viscocity (cp)
Percentage Yield (%)	40±1.31	Carbohydrate (%)	65.50±0.49	0.4%	34.0
pH	5.18±0.17	Protein (%)	3.20±0.09	0.8%	34.3
Swelling Index (%)	138.7±1.51	Fat (%)	2.90±0.01	1.0%	35.3
Bulk Density (g/mL)	0.625±-0.01	Ash (%)	3.00±0.05		
Bulkiness (mL/g)	1.6±0.04	-	-	-	-
Tapped Density (g/mL)	0.714±0.01	-	-	-	-
Carr's compressibility Index (%)	12.46±0.23	-	-	-	-
Hausner Ratio	1.14±0.03	-	-	-	-

*Mean of 4 replications.

Project on natural dammars at KAU, Thrissur

Documentation of the phenology of gum and resin yielding trees of western ghats and development of a germplasm in the main campus of college of forestry

Identification of plants and selection of collection sites:

For this study, secondary data has been collected from various published floras. From this data, various forest regions have been identified for detailed survey and documentation. All the morphological data have been recorded and further studies including onsite survey and documentation of flowering, fruiting periods of each resin & gum trees have been carried out using this data. Fine grid survey has been conducted to build up more collections for selected trees known to exist in identified pockets in previously explored areas.

Collection of seeds/seedlings:

The documentation and digital herbarium preparation of gum and resin yielding trees of Kerala forests is still

continuing as regular activity of the center. Endemic and critically endangered species are included for the establishment of germplasm center. Using previously collected data and with the help of indigenous people, flowering and fruiting period of trees are determined for the timely collection. Field surveys are completed at Athirappilly, Vazhachal, Nelliampathy, Aralam, Kuruva, Tholpetti, Parambikulam, Silent Valley, Chinnar, Munnar, and Marayoor forest areas of Kerala.

Establishment of germplasm conservation for resins & gum trees:

Ex-situ conservation efforts create "a living store of genetic diversity" that can support many activities in conservation and research in agriculture and allied sciences. These collections will also act as a "live field laboratory" for students and researchers for their academic and research purposes. Initial plot for ex-situ conservation of germplasm has been selected and works, such as leveling of field, building of boundary using metal nets to avoid the intrusion of wild animals has been completed. Three replicates of ten species i.e. *Canarium strictum, Kingiodendron pinnattum*, *Vatica chinensis, Dipterocarpus indicus, Dipterocarpus bourdillonii, Vateria indica*, *Calophylluminophyllum*, *Palaquimellipticum*, *Myristica beddomei* and *Commiphora wightii* have been planted adopting 5 × 5 m spacing. Seedlings of *Semecarpus anacardium*, *Mesua ferrea*, *Garcinia spicata, Chukrasia tabularis* are collected and raised in nursery and the same will be planted in the upcoming monsoon season.

Value addition of gum oleo-resin of *Ailanthus triphysa*

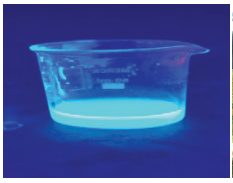
Updated Cup and Lip method: Cup and Lip method has been found to be more efficient for the extraction of Ailanthus oleoresin. In this method, the most significant challenge observed has been the difficulty in separating impurities from the collected resin. To address this impurity issue, to collect the oozing gum, instead of traditional cups, closed bottles with a small opening are employed. This proved to be a successful alternative for impurity free resin collection.

Potential for bio-film development:

The oleoresin is separated into two portions, hydrophilic and hydrophobic. Using these two portions, formation of thin layers has been tried with various solvents like acetone, ethanol and chloroform in various concentrations. However, formation of thin film layer has been observed to be difficult due to the highly sticky nature of the oleoresin. Florescent activity of the oleoresin has been detected in UV light.

Sticky fly trap experiment:

Flypapers are extremely sticky paper coated with sweet and fragrant substances to attract flies and a toxic substance that traps and kills them. As the ailanthus oleoresin is sticky, a sticky fly trap experiment has been conducted with the help of Department of Entomology, wherein ailanthus resin based sticky traps are compared with commercially available traps. Though the number of trapped insects is less in Ailanthus resin card, the data collected indicates that the *Ailanthus* resin have a natural insect repellent property. To confirm this hypothesis an insect repellent study is planned and is progressing in a phased manner.



Florescent activity of the oleoresin is detected in UV



Sticky fly trap experiment

Anti-cancerous study:

A study has been designed with the assistance of Amala Cancer Research Centre, Thrissur to assess the anticancer activity of Ailanthus resin and Black Dammar Resin. Prior to this, a short-term cytotoxicity assay on Normal and Dalton's Lymphoma Ascites cells (DLA) has been attempted. Three types of samples are used, i.e., resin dissolved and filtered in solutions of Ethanol, Hexane, and Dimethyl sulfoxide. *Ailanthus* oleoresin dissolved in Ethanol solvent shows less toxicity towards normal cells and more to cancer cells which is encouraging. The studies have been repeated in another cell line (Ehrlich's Ascites Carcinoma cells) to double check and verify the trend of the result.

Technology Transfer

AGRI-BUSINESS DEVELOPMENT UNIT

Different capacity building programmes focusing on the scientific lac cultivation, processing and utilization are regularly organised by the Institute, catering to the need of various stake holders, involving farmers budding entrepreneurs, students and self helf groups. In addition to on-campus activities, the institute also conducted field outreach endeavors, such as off farm training sessions, technical guidance, etc. In total, 7908 stakeholders benefitted from these capacity-building and skill development initiatives. Through these efforts, the institute aimed to empower individuals with the necessary knowledge and skills to excel in lac cultivation, contributing to both economic growth and agricultural development in the region.

Details of capacity building and entrepreneurship development programmes

Capacity building programmes	No. of programme/ batches/ courses	No. of beneficiaries
Farmers training programme on “Scientific method of lac cultivation, primary processing and utilization”	18	688
Off-Campus one day Training	07	559
On Campus one-day Exposure Visits/ Orientation Programme on Natural Resins and Gums	33	2124
Training/Summer School conducted for students	02	28
Processes and Products training to entrepreneurs	05	07
Participation in programme, Mela, Events, exhibition etc. from ICAR-NISA, Ranchi	12	-
Kisan Mela -cum- Exhibition Organized	01	2500
Total	**78**	**5908**

AGRI-BUSINESS INCUBATION

Agri-business incubation Center, ICAR-NISA, signed one Memorandum of Understanding with M/s Vishnu Shellac Industries, Shakti Chattisgarh for Aleuritic acid and dewaxed bleached lac production technology and imparted training during 22.03.2023 to 21.03.2024.

Training imparted

SN	Date	Technology Transfer	Trainees	Address of the Trainees
1	09.01.2023 to 18.01.2023	Recovery of lac dye	Mr. Niladri Kabi Mr. Srikanta Rajak	Chemshel, Purilia, West Bengal
2	20.02.2023 to 24.02.2023	Dewaxed bleached lac	Mr. Biswajit Indra	M. B. Natural Product Corporation West Bengal
3	13.03.2023 to 24.03.2023	Dewaxed bleached lac and aleuritic acid	Mr. Sudhir Kumar Agrawal	Vishnu Shellac Industries, Sakti, Chattisgarh

SN	Date	Technology Transfer	Trainees	Address of the Trainees
4	10.04.2023 to 27.04.2023	Primary processing of lac, Bleached lac, aleuritic acid, Dewaxed decolourised lac and Isoambrettolide	Mr. Shivam Sharma	Shivmake Fragrances and Allied Chemicals Pvt. Ltd., Raipur, Chattisgarh
5	30.09.2023 to 03.11.2023	Dewaxed bleached lac	Sri Ashutosh Kumar Agrawal	Triloki Lakh Udyog, Kathgora, Korba, Chattisgarh

INSTITUTE TECHNOLOGY MANAGEMENT UNIT

Event organized by Institute Technology Management Unit (ITMU)

The ITMU, ICAR-NISA, Ranchi organized a talk on "Role of Women in IP Innovation" delivered by Dr. K. Shyamala, Associate Professor and Dean, National University of Study and Research in Law, Ranchi, jointly with ICAR-Research Complex for Eastern Region, Research Centre, Ranchi, on 26.04.2023.

Training on Secondary Agriculture



For the first time in ICARI-NISA, a ten days training program on Secondary Agriculture, has been organized for under graduate (Agriculture) students after the change of institute's mandate, from 29th May 2023 to 9th June 2024. The aim of the training is to impart knowledge as well as creating awreness and interest in the students regarding Secondary Agriculture. Total 26 students from Banaras Hindu University, Varanasi and Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj have participated in the training program. Total 34 classes have been arranged in the training including exposure visit, demonstration and practical, on lac cultivation, plant propagation, nutraceuticals, quality control, sensors and AI techniques, packaging, etc. Visit to industry and successful farmers have also been arranged during the training. Along with this, all the technologies developed by the Institute and recent advances have been taught in the training. A training manual on Secondary Agriculture published (e-copy) for the trainees and distriduted to them. Participants appreciated the training. Director, ICAR-NISA, addressed the students and wished them for their bright future.

Participation in events

Sl. No.	Events	Period		Venue
		From	To	
1	95th ICAR Foundation and Technology Day 2023	16.07.2023	18.07.2023	NASC Complex, PUSA, Delhi
2	Industry Interface Fair on Agro-processing & Kisan Mela (IIFA-2023)	03.10.2023	05.10.2023	ICAR-CIPHET, Ludhiana

Patent filed by the institute during 2023

Sl. No.	Product/process for patent	Application No.	Filing date
1	A rapid process for the preparation of multipurpose conducting ink using rosin as conductivity enhancer	202331016762	13.03.2023
2	A system for estimation of Color Index of shellac and A process thereof	202331062688	18.09.2023

Technology transfer

Technology of 'Natural Adhesive for making Biodegradable Food Container' was transferred to Ms Payal Patel, M/S Agropak Pvt. Ltd. Bengaluru. Licensing agreement of the technology was signed on June 14, 2023



a) Bowls prepared using the developed lac based formulations and b) Exchange of MOU with the firm

TV and Radio talks

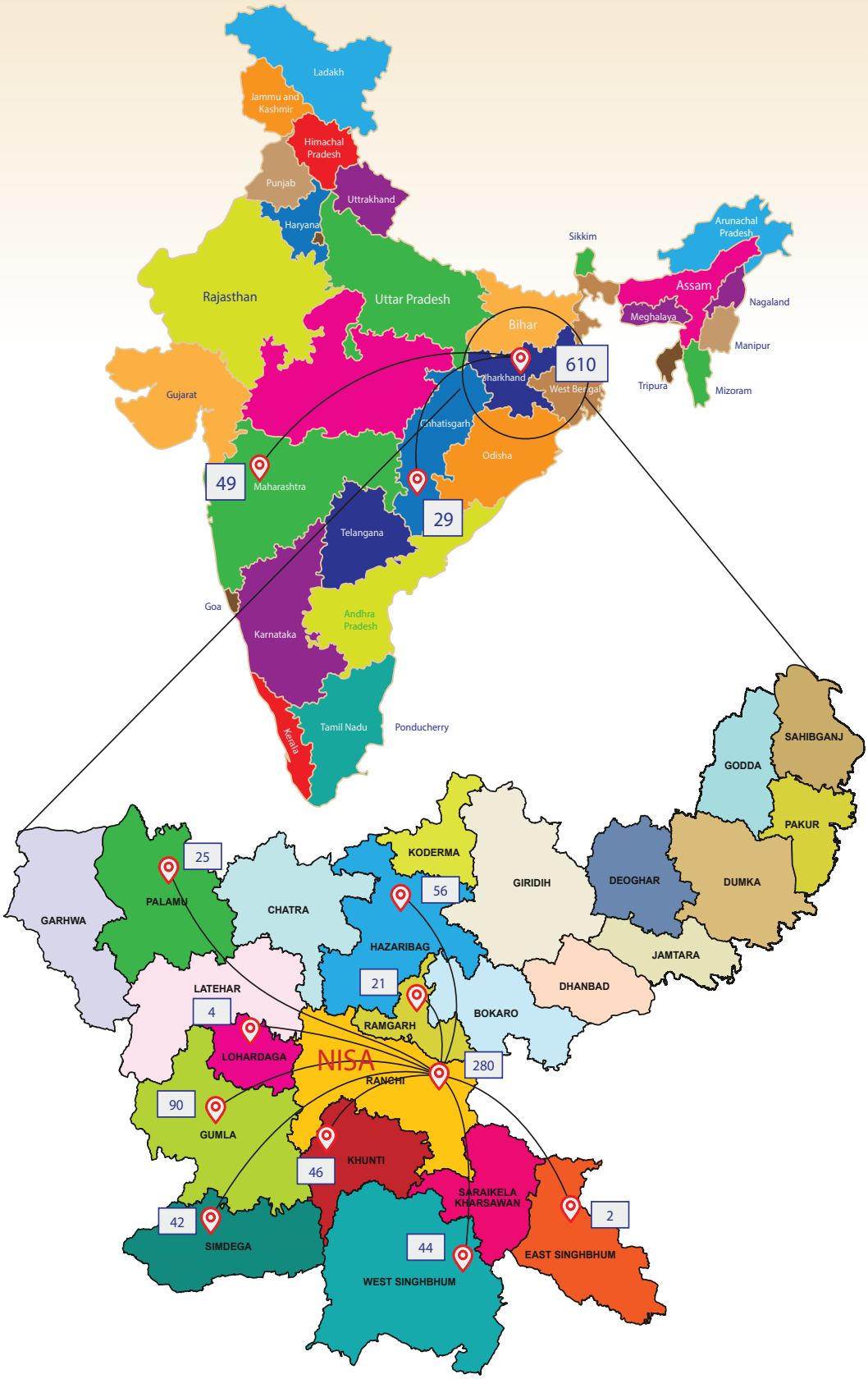
Sl. No.	Name of the Scientist	TV/Radio Talk/ Short film	Topic	Broadcasting company	Date of Broadcast
1.	Er. S K Pandey	Talk on Short Video Film	NRGs	Doordarshan, Ranchi	20.02.2023
2.	Dr. J Ghosh	Radio Talk	सेमिअलता पर कुसमी लाह की खेती	Kisanwani, Aakashwani	19.05.2023
3.	Dr. Achintya Pramanik	TV Talk	बर्षा ऋतु मे लाह फसल की सुरक्षा	Doordarshan, Ranchi	15.06.2023
4.	Dr. S Ghosal	TV talk	बरसात के मौसम में कुस्मी लाख एवं किट प्रबंधन	Doordarshan, Ranchi	20.07.2023
5.	Dr. S Ghosal	TV Talk	टिकाऊ लाख उत्पादन के लिए कृषि प्रबंधन	Doordarshan, Ranchi	28.08.2023
6.	Dr. J Ghosh	Radio Talk	पलास पर रंगीनी लाख की खेती	Kisanwani, Aakashwani	21.10.2023

Technology Transfer and MoU signed by ICAR-NISA, Ranchi

Sl. No.	Title	MoU signed between	Month of signing MoU	Valid up to
1	Collaboration on Agri-business incubation	a-IDEA NAARM, Hyderabad and ICAR-NISA, Ranchi	26.05.2023	25.05.2026
2	Natural adhesive for making biodegradable food container	M/s. Agropak Pvt. Ltd., Bengaluru	14.06.2023	13.06.2028



Farmer's Training at ICAR-NISA, Ranchi from diffferent States during 2023



Development Action Plan for Scheduled Caste, ICAR-National Institute of Secondary Agriculture, Ranchi for the year 2023-24

Training sessions were conducted for 439 Scheduled Caste farmers from Ranchi, Khunti, Gumla, Simdenga, Lohardaga, and Purulia in seven events. Additionally, seven awareness campaigns and exposure visits were organized, with 589 beneficiaries participating from Seraikela Kharsawan, Simdenga, Ranchi, Khunti, Gumla, and Lohardaga districts in Jharkhand. Leaflets on crop production, protection, and value addition were distributed during the training, while 1,000 planting materials were provided to 189 farmers, and farmer implements were distributed to 289 trained beneficiaries. Furthermore, 43 sewing machines were provided to Scheduled Caste women following hands-on training on stitching, and bio-fertilizers and bio-pesticides were given to farmers with cultivable land. The impact of this scheme was monitored during four visits to Garwah, Chatra, Palamu, and Bokaro.

Impact assessment







The assessment of the impact of training on various aspects for livelihood upliftment and distribution of small implements, poultry, small animals, sewing machines, honey bee kits, etc., derived from focused group discussions, is as follows:



1. **Training:** The beneficiaries experienced a significant increase in their knowledge level, enabling them to cultivate different crops using scientific methods. They also maintained regular contact to address any problems encountered during cultivation. The areas with horizontal explanations saw an improvement of 8-12%.

2. **Lac cultivation**: The beneficiaries adopted scientific lac cultivation including broodlac pre-treatment and harvested five times broodlac on ber trees. Farmers earned ₹2, 11, 900 by selling broodlac from 100 ber plants.

2. **Small implements**: The beneficiaries successfully produced compost in vermibeds and utilized it for vegetable cultivation. As a result, the number of irrigations required decreased by 15-20%. Additionally, they efficiently carried out farm operations using small implements, resulting in an average annual income ranging from 16,000 to 22,000 rupees per family, in addition to their other income sources.

3. **Animal components**: The beneficiaries in Chatra successfully multiplied the goats provided through this scheme. Currently, they earn an average annual income of ₹12,000 to ₹16,000 from selling goats. In Garhwa, the beneficiaries earn an additional income of₹ 20,000 to ₹25,000 per annum from backyard poultry farming, ₹30,000 to ₹35,000 rupees per annum from backyard pig farming, and ₹25,000 to 30,000 rupees per annum from backyard goat farming.

4. **Stitching component**: The unemployed rural women in Garhwa acquired tailoring skills during the skill training. They have since started their own tailoring businesses from home, earning an average monthly income of ₹8,000 to ₹10,000.

Krishi Vigyan Kendra (KVK), Khunti, ICAR-NISA

Under the *Krishi Vigyan Kendra* (KVK), Khunti, various extension activities were carried out during the year 2023 – 24 including on farm trial, front line demonstration and training programme as detailed in the different sections below.

On farm trial (OFT)

Trial on pest management in winter *kusmi* lac on *ber* has been conducted at ten different locations of Khunti district. Recommended practice (Brood lac dipping in water having Fipronil concentration (@1.5 mL/L) for 10-15 minutes + 1st spray of Indoxacarb (1 mL/L water) + Carbendavzim (1.0 g/L water) after 25-30 days of brood lac inoculation followed by 2nd spray of Spinosad (2 mL/L water) + Carbendazim (1.0 g/L water) after 25-30 days of 1st spray has been applied in comparison with the farmers practice (no use of control measures). Study reveals the cost of cultivation to be ₹ 12075.0 higher in the case of recommended practice compared to the farmer's practice with double yield, net return and benefit cost ratio ₹277200.0 and 6.25:1, respectively. The demonstrated technology is being adopted by the farmers of Khunti district for lac cultivation.



Front line demonstration (FLD)

Front line demonstration (FLD) on *Sahbhagi* variety of paddy (08 Nos) and A 404 variety of ragi (8 Nos) has been conducted in 5 and 29-hectare area, respectively at farmers' field of Khunti district by *Krishi Vigyan Kendra*, Khunti. Demonstration reveals that the yield of paddy and ragi increases by 101.6% and 192.7%, respectively compared with local varieties (check). Net return for *Sahbhagi* variety of paddy and *A 404* variety of ragi are found to be ₹ 46665.0/- and ₹ 3800/- per hectare with B:C ratio 2.34:1 and 3.17:1, respectively, while the net return of ₹ 7735.0/- and ₹ 13350/- per hectare with B:C ratio 1.24:1 and 1.87:1, respectively can be achieved in the case of local variety (Check). Hence, it is recommended that *Sahbhagi* variety of paddy and *A 404* variety of ragi should be cultivated in Khunti district for higher paddy and ragi production.



Trainings organized

Different training programmes of one-day duration (10 Nos.) have been organized in the month of December, 2023 by the *Krishi Vigyan Kendra* (KVK), Khunti to upgrade the knowledge and mitigate the field problems of farmers. The training programmes are attended by about 250 farmers including 184 males and 66 females.



Details of training programme organized by KVK, Khunti

Title of the training programme	No of Participants		
	Male	Female	Total
Disease in vegetable pea	19	6	25
IPM in potato crop	17	8	25
Pest management in french bean	18	7	25
IPM in chickpea crop	15	10	25
Pest management in mustard crop	20	5	25
Pest management in lac cultivation	17	8	25
IPM in paddy crop	19	6	25
Importance of hand tools in weed	18	7	25
IPM in cole crop	20	5	25
IPM in tomato crop	21	4	25
Total	**184**	**66**	**250**

Other extension activities

To create mass awareness on agriculture, different type of extension activities have been conducted by *Krishi Vigyan Kendra* (KVK), Khunti. During the year, a total 219 extension activities/programmes have been organized, in which 49644 farmers and extension personnel participated.

Details of extension activities organized by KVK, Khunti

Extension Activity	No. of activities	No. of participants		
		Male	Female	Total
Kisan Mela	1	2377	723	3100
Kisan Ghosthi	4	175	350	525
Exhibition	1	175	216	391
Participation in exhibition	2	67	130	192
Film Show	5	97	105	107
Group discussion	3	49	25	74
Lectures delivered as resource persons	2	55	12	67
Advisory Services	104	18010	26015	44025
Scientific visit to farmers field	30	27	5	32
Farmers visit to KVK	40	17	33	50
Diagnostic visits	3	0	0	8
Soil test campaigns	2	32	7	39
Self Help Group Conveners meetings	2	10	40	50
Mahila Mandals Conveners meetings	2	15	55	70
Swatchta Hi Sewa	8	125	243	358
Celebration of important date	10	319	237	556
Total	**219**	**21550**	**28196**	**49644**









KVK Events

Popularization of Technology of Scientific Lac Cultivation and Natural Farming

ICAR-National Institute of Secondary Agriculture, Ranchi, KVK-Khunti and ATMA Khunti jointly organized awareness campaigns on “Scientific lac cultivation and natural farming” from 28th Feb, 2023 to 02nd March, 2023 at KVK, Torpa, Khunti. The main objective of this programs was to popularize scientific methods of lac cultivation to increase its productivity and aware farmers about natural farming practices for sustainable agriculture. Total 25 farmers were benefitted by this programme.



Awareness program with farmers about Scientific lac cultivation and natural farming

Popularization of Technology of Lac-Integrated Cropping System with Lac Host Plants (like *Kusum*, *Palash*, *Ber*, *Calindra* and *Semialata*)

ICAR-National Institute of Secondary Agriculture, Ranchi, KVK, Khunti and ATMA Khunti jointly organized six Awareness campaigns on “Lac-integrated cropping system” from 15th March, 2023 to 17th March, 2023 at KVK building, Torpa, Khunti. The main objective of this programs was to popularize all the lac-integrated cropping system models developed by ICAR-NISA to the lac growers of Khunti district. Intercropping crops, lac-host plants and their benefits were explained by the scientists and officials of ICAR-NISA and KVK-Khunti. 25 farmers were benefitted by this programme.



Interaction with farmers about "Lac integrated cropping system model"

Participatory Technology Development Programme on “Millets for Opportunity in Natural Farming” and “Energy Conservation in Agriculture”

ICAR-National Institute of Secondary Agriculture, Ranchi, KVK, Khunti jointly organized two awareness campaigns on “Millets for opportunity in natural farming” and “Energy Conservation in Agriculture” on 18th March, 2023 at KVK, Torpa, Khunti. The main objective of this programs was to aware farmers about the importance of millet production and millet consumption and to teach the techniques how to conserve energy in agriculture by using solar power and solar pumps were also explained by the scientists and officials of ICAR-NISA and KVK-Khunti. Total 95 farmers attended this program.



Interaction with farmers about "Millets for Opportunity in Natural Farming and Energy Conservation in Agriculture"

Participatory Technology Development programme on "Energy Conservation in Agricultural Sector"

ICAR-National Institute of Secondary Agriculture, Ranchi, KVK, Khunti and Jharkhand Renewable Energy Development Agency (JREDA) jointly organized a participatory technology development program on "Energy conservation in Agricultural sector" on 28th Feb, 2023 to 20th April, 2023 at KVK, Torpa, Khunti. The main objective of this program was to popularize the energy conservation techniques and renewable energy technologies among farmers for energy security and sustainable development. Total 82 farmers were benefitted by this programme.



Participatory technology development program on "Energy conservation in Agricultural sector"

हिन्दी प्रकोष्ठ की गतिविधियाँ

भारत सरकार के राजभाषा विभाग (गृह मंत्रालय) द्वारा किये गए वार्षिक कार्यक्रम एवं राजभाषा अधिनियम व नियम के समबन्ध में भारतीय कृषि अनुसंधान परिषद्, नयी दिल्ली से समय समय पर प्राप्त निर्देशों पर अनुवर्ती कार्रवाई तथा सरकारी कार्यों में हिंदी के प्रयोग को और गति प्रदान करने के लिए संस्थान में राजभाषा इकाई की स्थापना की गयी है। इसमें एक सहायक मुख्य तकनीकी अधिकारी (प्रभारी अधिकारी राजभाषा) कार्यरत हैं। संसथान 'क' क्षेत्र में है , इसे राजभाषा अधिनियम की धारा 10(4) के अंतर्गत केंद्रीय बजट में अधिसूचित किया जा चुका है। संस्थान के सात अनुभागों को शत प्रतिशत कार्य हिंदी में करने हेतु विनिर्दिष्ट की गया एवं प्रवीणता प्राप्त सभी अधिकारीयों/ कर्मचारियों को अपना-अपना कार्य हिंदी में करने हेतु व्यक्तिशः आदेश दिए गए हैं। राजभाषा नियम के अनुपालन एवं दैनिक कार्य में हिंदी के प्रयोग में प्रगति लाने तथा इसे सर्वग्राह्य बनाने के लिए राजभाषा इकाई द्वारा निम्नलिखित कार्य सम्पादित किये जाते हैं :-

संस्थान राजभाषा कार्यान्वयन समिति की तिमाही बैठकों का आयोजन, कार्यसूची एवं कार्यवृत की तैयारी तथा बैठकों में लिए गए निर्णयों पर अनुवर्ती कार्रवाई। वार्षिक रिपोर्ट के हिंदी संकरण का ई-प्रकाशन , राजभाषा की वार्षिक पत्रिका लाक्षा का प्रकाशन, कार्यालय आदेश, परिपत्र, ज्ञापन , निविदा इत्यादि एवं पत्राचार हेतु विभिन्न सामग्रियों का आवश्यकतानुसार अनुवाद। नगर राजभाषा कार्यान्वयन समिति (नाराकास) के सदस्य कार्यालयों द्वारा आयोजित विभिन्न हिंदी प्रतियोगिताओं एवं कार्यशालाओं में सहभागिता हेतु प्रेरित करना।

संस्थान के दैनिक कार्य में हिंदी के प्रयोग में प्रगति एवं सरल बनाने के लिए राजभाषा इकाई द्वारा निम्नलिखित कार्य सम्पादित किये जाते हैं :

- संस्थान की वार्षिक राजभाषा पत्रिका लाक्षा के 15वें संस्करण लाक्षा-2023 के प्रकाशन के लिए विभिन्न रोचक एवं ज्ञानवर्धक विषयों पर लिखे गए लगभग 25 लेखों का संकलन कर प्रकाशित कर दिया गया है।
- लाक्षा-2022 में प्रकाशित सर्वश्रेष्ठ आलेख के चयन हेतु कमिटी का गठन किया गया तथा कमिटी द्वारा सुझाए गए आलेख के लेखकों को पुरस्कार प्रदान किया गया है।
- अधिकारियों और कर्मचारियों को नगर राजभाषा कार्यान्वयन समिति के सदस्य कार्यालयों द्वारा आयोजित विभिन्न हिन्दी प्रतियोगिताओं एवं कार्यशालाओं में सहभागिता हेतु प्रेरित करने का कार्य किया गया।
- हिन्दी दिवस, हिन्दी चेतना मास एवं योजनानुसार नगर स्तरीय राजभाषा संबंधी, संगोष्ठी एवं कार्यशाला का आयोजन किया गया।
- द्विभाषी नामपट्ट एवं बैनरों के निर्माण में सक्रिय सहयोग किया गया।
- प्रचार सामग्रियों को तैयार कर 16 समारोहों के मीडिया प्रबंधन का कार्य किया गया एवं समाचार संकलन का कार्य किया गया।
- प्राशासनिक एवं स्वास्थ्य संबंधी विषयों पर हिन्दी कार्यशाला/ व्याख्यान का आयोजन-*इन्फ़्लुएन्जा एन-1 एच-2 एवं अन्य वायरस* : बचाव एवं उपचार विषय पर दिनांक - 27.03.2023 को, *न्यूट्रास्यूटीकल्स: मानव स्वास्थ्य के लिए भविष्य* विषय पर दिनांक 16.06.2023 को, *हिंदी दिवस समारोह* का आयोजन दिनांक 29.09.2023 को, *सांप्रदायिक सदभाव* विषय पर दिनांक 24.11.2023 को संस्थान
- प्रवीणता प्राप्त सभी अधिकारियों/कर्मचारियों को व्यक्तिशः आदेश जारी कर दिया गया।
- सभी कम्प्यूटरों में यूनिकोड या गुगल हिन्दी सॉफ्टवेयर की व्यवस्था की गई।
- संस्थान के सभी विभागों एवं अनुभागों को निदेशक महोदय के हस्ताक्षर के साथ विभिन्न जाँच-बिन्दु जारी किए गए।
- राजभाषा नियम 8(4) के अन्तर्गत संस्थान के सभी आठ अनुभागों को सम्पूर्ण कार्य हिन्दी में करने हेतु विनिर्दिष्ट करना।
- प्रत्येक तिमाही में संस्थान के आगत-निर्गत पत्रों का विवरण तैयार कर विहित प्रपत्र में तिमाही रिपोर्ट तैयार की गयी तथा परिषद् समेत सभी संबंधित कार्यालयों को समय से प्रेषित की गयी।
- वैज्ञानिक उपकरणों से जुड़े कम्प्यूटरों को छोड़कर संस्थान के कुछ अन्य कम्प्यूटरों में हिन्दी फॉन्ट लगा दिये गये हैं तथा ज्यादातर कम्प्यूटरों में यूनीकोड/गूगल हिन्दी सॉफ्टवेयर डाला गया है।
- 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।

पुरस्कार / सम्मान

- नगर राजभाषा कार्यान्वयन समिति (नाराकास) रांची द्वारा दिनांक 21.03.2023 को आयोजित बैठक में संस्थान की राजभाषा पत्रिका **लाक्षा-2020** को प्रथम पुरस्कार से सम्मानित किया गया।

हिन्दी दिवस समारोह-2023

राष्ट्रीय कृषि उच्चतर प्रसंस्करण संस्थान में राजभाषा अधिनियम के अनुपालन एवं कार्यालय कार्य में राजभाषा हिन्दी के प्रयोग में उत्तरोत्तर वृद्धि के लिए संस्थान में दिनांक-01.09.2023 से 30.09.2023 तक हिन्दी चेतना मास का पालन किया गया। इसके अन्तर्गत दिनांक 29.09.2023 को अपराह्न 03.00 बजे हिन्दी दिवस समारोह का आयोजन किया गया। हिन्दी दिवस समारोह के अवसर पर मुख्य अतिथि के रूप में उपस्थित डॉ अंजेश कुमार, पूर्व मुख्य तकनीकी अधिकारी, भाकृअनुप-भाप्रागोसं., रांची ने कहा कि आज के समय में सोशल मीडिया के माध्यम से भाषा का प्रसार तो बढ़ा है परन्तु भाषा का गिरता

स्तर अत्यन्त ही चिन्तनीय विषय है। उन्होंने पुराने समय में आकाशवाणी, दूरदर्शन एवं भारतीय फिल्म जगत द्वारा निर्मित कार्यक्रमों एवं फिल्मों की सराहना करते हुए कहा कि उस समय के कार्यक्रमों एवं फिल्मों में भाषा के संस्कार के साथ किसी किस्म का समझौता नहीं किया जाता था। हमें आज के समय में हिंदी भाषा के प्रसार पर बल देने के साथ-साथ उसके गौरव को भी अक्षूण रखना है। डॉ अंजेश ने कहा कि आज भी भारत में अधिकांश भू-भाग पर हिंदी भाषा ही विराजमान है परन्तु क्षेत्रीय बोलियों की लोकप्रियता एवं प्रासंगिकता को भी नकारा नहीं जा सकता। वर्तमान समय में मात्र सरकारी प्रयासों से हिंदी का विकास संभव नहीं है इसके लिए हमारी व्यक्तिगत रूचि एवं स्वीकार्यता को भी अपने स्तर से बढ़ाने की आवश्यकता है।

डॉ निरंजन प्रसाद, विभागाध्यक्ष ने अपने स्वागत भाषण में कहा कि हिन्दी चेतना मास के अन्तर्गत हिन्दी दिवस समारोह का आयोजन किया गया है। 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। उन्होंने कहा कि संस्थान में हिन्दी का प्रयोग सिर्फ इसिलिए नहीं हो रहा है कि संस्थान हिन्दी क्षेत्र में आता है बल्कि हमारा पूरा प्रयास रहता है कि हम अपने स्तर पर हिन्दी को बढ़ावा दें। संस्थान के अधिकारियों का किसानों से संवाद तथा संस्थान द्वारा किसानों को दिए जाने वाले प्रशिक्षण भी हिन्दी में ही होता है। साथ हीं संस्थान के वैज्ञानिक साहित्यों का भी प्रकाशन हिन्दी के साथ-साथ अन्य स्थानीय भाषाओं में होता है। हमें हर भाषा का सम्मान करना चाहिए, हिन्दी देश में सबसे अधिक बोली जाने वाली भाषा है इसिलिए इसका चयन राजभाषा के रूप में इस उद्देश्य के साथ किया गया कि यह पुरे देश को एक सूत्र में जोड़ेगी। आने वाले समय में हमारी पूरी कोशिश रहेगी कि हम संस्थान में होने वाले कार्य अधिक से अधिक हिन्दी में ही करें।

हिन्दी चेतना मास की अवधि में दिनांक- 11-12 सितम्बर 2023 को हिन्दी टिप्पण, प्रारूप लेखन, निबंध, हिन्दी गीत गायन, हिन्दी प्रश्नोत्तरी, पर्याय एवं विपरीतार्थक शब्द प्रतियोगिताओं का आयोजन किया गया। जिनके विजेताओं को कार्यक्रम में सम्मानित किया गया। कार्यक्रम में मुख्य अतिथि द्वारा लाक्षा के नविनतम संस्करण लाक्षा-2023 का विमोचन किया गया। इसके साथ ही समारोह में लाक्षा-2022 में उत्कृष्ट आलेख का पुरस्कार भी प्रदान किया गया। श्री विनोद कुमार, प्रभारी अधिकारी, राजभाषा प्रकोष्ठ ने राजभाषा प्रतिवेदन प्रस्तुत किया। कार्यक्रम के प्रारंभ में महान वैज्ञानिक एवं हरित क्रांति के जनक के रूप में विख्यात स्व. डॉ एम एस स्वामिनाथन की दिवंगत आत्मा की शांति के लिए दो मिनट का सामूहिक मौन धारण किया गया। कार्यक्रम का संचालन श्री मो तारिक जमां एवं धन्यवाद ज्ञापन डॉ मो फहीम असांरी, विभागाध्यक्ष एवं अध्यक्ष, हिन्दी दिवस समारोह आयोजन समिति ने तथा छायांकन श्री विकास सिंह ने किया। इस अवसर पर संस्थान के सभी अधिकारियों/कर्मचारियों ने भाग लिया।



मुख्य अतिथि का स्वागत करते हुए डॉ. निरंजन प्रसाद



गणमान्य जनों द्वारा द्वीप प्रज्जवलन कर कार्यक्रम का शुभारंभ

Human Resource Development

Sl. No.	Name of the Scientist	Webinar/ Conference/ Training	Event	Organized by	Date
1.	Dr. Anirban Dutta	3-day training	Laboratory Management System	ICAR-National Institute of Natural Fibre Engineering & Technology, Kolkata	October 04-06, 2023
2.	All scientists of NISA	Attended talk and address	CSIR-ICAR Collaboration: Aspirations & Action Plan	ICAR, New Delhi	January 12, 2023
			Address of Hon'ble Prime Minister and Sh. Sanjeev Kumar Balyan, Hon'ble Member of State, Ministry of Fisheries on Accelerator Fund for AGri-Start ups	ICAR, New Delhi	February 24, 2023
			Address of Hon'ble Prime Minister *Samman Nidhi*	ICAR – NISA, Ranchi	February 27, 2023
			Pension and Retirement Benefits and National Pension System	Dr. Sunil Kumar Das, Chief Finance & Account Officer, ICAR – NIASM, Baramati	August 08, 2023
			Ms. Dorothy Norris memorial lecture on Secondary Agriculture: An Enabler of Sustainable and Profitable Agri-Food System in India	Dr. T. Mohapatra, Former DG, ICAR and Chairperson, PPVFRA, New Delhi organized at ICAR-NISA, Ranchi	December 26, 2023
7.	Er. P. K. Paramaguru	Six days training programme	Hydrologic modeling using SWAT+	NIH, Roorkee	May 22 - 27, 2023
8.	Dr. Udaykumar M. S.	Foundation Course	Foundation Course for Agriculture Research Service (112 FOCARS)	ICAR-National Academy of Agricultural Research Management, Hyderabad	April 11, 2023 to July 10, 2023
		Professional Training	Three months Professional Attachment Training (PAT)	Institute for Social and Economic Change (ISEC), Nagarabhavi, Bengaluru	August 21, 2023 to November 20, 2023

Awards, Honours and Recognitions

Sl. No	Name of the scientist	Honors, Awards and Recognitions	Theme	Event Organized on
1.	Dr Arnab Roy Chowdhury Dr. Nandkishore Thombare	First Prize	Best Popular Article Award	29.09.2023
2.	Dr. Nandkishore Thombare Dr. Santosh Kumar Singh Yadav	First Prize	Hindi Essay Writing competition	
3.	Dr. AnirbanDutta	Second Prize		
4.	Dr Arnab Roy Chowdhury	Second Prize	Hindi synonym and antonym competition	
5.	Dr. Priyanka Sakare	Fellowship for Training of Young Scientists	MPCST (Madhya Pradesh Council of Science & Technology)	17-19.03.2023
6.	Dr. Sakharam Kale Dr. Nandkishore Thombare Dr. Niranjan Prasad Dr. Abhijit Kar	Best Oral Presentation Award (Second Place)	Evaluating the Potentiality of Refractance Window Drying Technique in Production of Guar-Gum based Hydrogel	06-08.11.2023

Publications

Research papers

1. Ali M. (2023). What function of nanoparticles is the primary factor for their hyper-toxicity? Advances in Colloid and Interface Science, 314: 102881. https://doi.org/10.1016/j.cis.2023.102881
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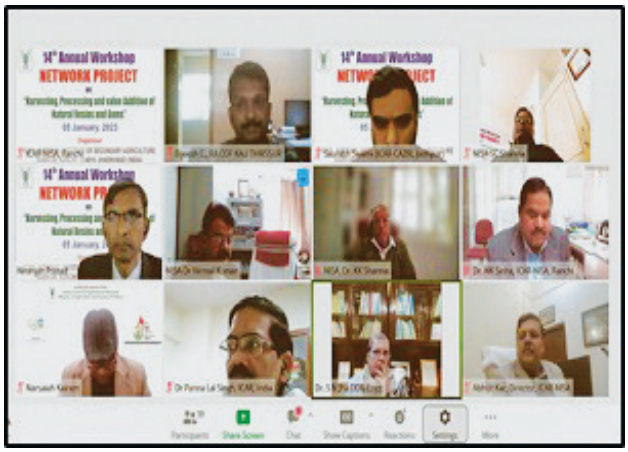
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Events Organised by the Institute

ICAR-NISA organized several events in the year 2023. These events are being reported here chronologically.

14th Annual workshop of NP on HPVA of NRG 2023

The 14th Annual Workshop of Network Project on 'Harvesting, Processing and Value Addition of Natural Resins and Gums' (NP-HPVA of NRGS) has ben organized on January 05, 2023 via virtual platform (co-ordinated by lead centre ICAR- IINRG, Ranchi) to review the annual progress of the Network Project centres and to discuss the technical programme for the year 2023–24. Dr. S.N. Jha, Deputy Director General (Agricultural Engineering), the Chairman of the Inaugural session, appreciated the good work on the development of biodegradable film and edible coating under this project. He said future research work under this project should be carried out under the revised mandate of ICAR-NISA and urged for review of the sub-projects of different network centres.



Virtual participation in 14th Annual Workshop of NP on HPVA of NRG

Dr. P. L. Singh, the co-chair, urged that more effort is needed for better visibility of the project. He emphasized on the importance of compiling the technologies developed under the project in the form of a leaflet/brochure. He said centres may approach different agencies like Sate Rural Livelihood Mission(SRLM) and forest department for funding the research projects. Dr K. Narsiah, Assistant Director General (PE) urged to focus the research on extraction of high-value compounds and making derivatives from Natural Resins and Gums. Dr. AbhijitKar, Director, ICAR-NISA stated that all the centres should explore the possibilities of funding from other source for future work. He also urged to work in partnership mode with private organization. Dr. N. Prasad, Project Coordinator, presented the Coordinator's Report and ATR on recommendations of 13th Annual Workshop. He also briefed the objectives of the Project and methodologies / techniques, process/products, & technologies/ patents developed or transferred by the PIs of the Network Project to the farmers/stakeholders. Seven publications by different centres under the Network Project were released during the Inaugural Session by the dignitaries.

58th Institute Management Committee (IMC) Meeting ICAR-National Institute of Secondary Agriculture

The 58th meeting of the Institute Management Committee (IMC) was held online through zoom platform on 23rd January, 2023 at 11:30 AM, with the attendance of Dr. A. Kar, Director, ICAR-NISA, Ranchi, Dr. P. L. Singh, ADG(FE), ICAR, New Delhi, Dr. S. N. Sushil, Director, ICAR-NBAIR, Bengaluru, Dr. S. S. Mallick, Dean (Agro-forestry), BAU, Ranchi, Dr. S. K. Giri, Pr. Scientist, ICAR-CIAE, Bhopal, Dr. Bikash Das, Pr. Scientist, ICAR-RCER, RS Plandu, Ranchi, Sri. C. P. Srivastava, Dy, Dir. Agri (Soil Consv.), Lucknow Div., Sri R. Mahto, SAO, ICAR-NISA, Dr. N. Prasad, Head (Act.), ABA Division, ICAR-NISA, Dr. N. K. Sinha, Head (Act.) ABA Division, ICAR-NISA, Dr. M. F. Ansari, Head (Act.), ABA Division, ICAR-NISA, Dr. S.C. Sharma, Head (Act.), APE, Division ICAR-NISA, Dr. N. Kumar, I/C ABD unit, ICAR-NISA, Sri. K. Oraon, Asst. Officer. In the meeting, the logo of the institute and naming of the institute in Hindi was finalized. The translation of the names of the approved Divisions were also discussed and finalized. A small presentation about the aims and activities of the institute in lieu of the changed mandate of the institute was made by the Director & Chairman IMC for the benefit of the members of the IMC. The meeting ended with vote of thanks to the Chairman and members of the IMC by the Member Secretary.

Mera gaon mera gaurav programme at Sarjamdih, Angraha, Ranchi

Mera Gaon Mera Gaurav programme was organized by ICAR-National Institute Secondary Agricultural, Namkum, Ranchi on 06/02/2023 at village - Sarjamdih, P.O. –Angarha, District-Ranchi. The program was coordinated by Dr. S.C. Sharma under

the chairmanship of Dr. Niranjan Prasad. Dr. V. D. Lohot, Shri VidyapatiVidyakar, Anmol Kumar Mishra, along with Mr. Jeet Ram Vedia were present in the programme in which about 35 farmers participated.

Dr. S. C. Sharma explained the purpose of the program and gave information about the machines useful in agricultural work. Dr. N. Prasad gave detailed information about various machines related to crop cultivation and agricultural produce processing and storage. During the program, Dr. V.D. Lohot gave detailed information about the application of manure and fertilizer to lac host trees for increasing lac production and maintaining the health of the host trees. He also explained how to protect lac host trees and lac crop from enemy insects and pests. Mr. Vidyapati Vidyakar, gave detailed information to the farmers about the problems related to chilli cultivation and their solution. He explained the scientific cultivation of chilli and also suggested integrated farming in it. At the end of the program, Er. Anmol Kumar Mishra gave special emphasis to the farmers to adopt scientific cultivation of paddy (Sri Vidhi) and gave them measures to increase the income from the crop. He further explained the methods for removing weeds from paddy field using Cono Weeder. Demonstration and detailed information was given on Cono weeder and twin wheel hoe. Dr. S.C. Sharma concluded the programme by proposing vote of thanks and handing over reading materials to the School Manager for use in teaching students.

Kisan mela-cum-agricultural technology exhibition -2023

ICAR-National Institute of Secondary Agriculture (NISA), Ranchi organized two days Kisan Mela-cum-Agricultural Technology Exhibition -2023 in association with Krishi Vigyan Kendra (KVK), Khunti during 16-17th February, 2023 at ICAR-NISA, Ranchi.



More than 2500 farmers were participated in the Mela. In the impressive exhibition technology products and services were displayed in various thematic stalls like technology-based interventions, farm machineries, post-harvest technology, value addition, etc.

Research advisory committee (RAC) meeting

The XXX meeting of the Research Advisory Committee (RAC) of the Institute (Second meeting of the current RAC was held on March 13-14, 2023 by ICAR-NISA, Ranchi. The meeting was presided over by the Chairman, RAC Dr. K. Alagusundaram, former DDG (Engg.), ICAR, New Delhi. The following members were present, Dr. PL Singh, ADG (FE), ICAR, New Delhi, Dr. HN Mishra, Professor (Food Technology), IIT, Kharagpur, Dr. Dandamudi Usharani, Principal Scientist, CSIR-CFTRI, Mysuru, Dr. SK Dhyani, Former Director, ICAR-CAFRI, Jhansi, Dr. Debaraj Behera, Professor & Head, OUAT, Bhubaneshwar, Dr. Abhijit Kar, Director, ICAR-NISA, Ranchi, Dr. NK Sinha, PS & I/C Head, ABA Div., ICAR-NISA, Ranchi - Member Secretary along with special invitees Dr Bengali Baboo, Former Director, ICAR-IINRG and Chairman QRT, ICAR-NISA, Ranchi, Dr KK Sharma, PC, NP CLIGR, Dr. Nirmal Kumar, PS & I/C ABD Unit, Dr. Niranjan Prasad, I/C Head, ASPE Division and PC, NP HPVA on NRGs, Dr. MF Ansari, I/C Head, DAP Division, Dr. SC Sharma, I/C Head, APE Division, and Dr. VD Lohot, In-charge, PMEC. The RAC suggested to improve the quality of research by the cientist of ICAR-NISA.





HRD program on “Lac Production and Value Addition of Agri-Produce”

ICAR-National Institute of Secondary Agriculture, Ranchi, organized a one-day HRD program on “Lac production and value addition of Agri-produce” on 17th March 2023 at ICAR-NISA campus.



Interaction Probationary officers (JPS) at ICAR, NISA

The program was attended by Probationary officers (JPS) of Jharkhand govt., to know about lac cultivation related information, technology developed by the institute and lac-integrated cropping system models developed by ICAR-NISA for their field level implementation. About 45 officials participated in this program.

9th International Yoga Day Celebration

On June 21, 2023, international yoga day was celebrated at ICAR-NISA. Dr. Nandkishore Thombare, as Convener of 9th International Yoga Day, organized a Yoga training session for the Institute staff, where members of Art of Living (AOL) Foundation, Jharkhand, conducted a yoga session and briefed the staff about the importance of yoga for healthy lifestyle.



Quinquennial Review Team (QRT) Meeting

Director General (DG), ICAR constituted seventh Quinquennial Review Team (QRT) to review the work done by the ICAR-IINRG (now NISA), Ranchi, as per the terms of reference, for the period of April 01, 2017 to March 31, 2022.



The esteemed members of QRT tare Dr Bangali Baboo (Chairman), Dr D C Joshi, Dr N A Shakil, Dr A K Jaiswal, Dr Kriti Bardhan Gupta. Dr M F Ansari (principal scientist, NISA) was the member secretary. Dr S N Jha, Dy. Director General (Engg.) introduced the newly appointed members on March 15, 2023. Review process started with preliminary planning meeting held on June 23, 2023 at Krishi Anusandhan Bhawan –II, Pusa, New Delhi in the presence of Dr S N Jha, DDG (Engg), ICAR. Dr K P Singh, ADG (FE) presented the draft analysis of the background information of the institute along with the network project centres. The first meeting was held during July 24-26, 2023, the QRT visited the Institute and reviewed the ATR on the recommendations of last QRT, achievements of institute including externally funded projects and some centres (03 Centres of HPVA of NRGs, 04 Centres of CLIGR) of both the network projects. QRT visited KVK, Khunti and one of the lac processing industry M/s Tajna Shellac Industries, Khunti.



In the second round The second meeting the QRT visited ICAR-Central Arid Zone Research Institute (CAZRI), Jodhpur and reviewed 03 centres (CAZRI, Jodhpur; CAFRI, Jhansi; YSPUHF, Solan) of NP HPVA of NRGs and 03 centres (MPUAT, Udaipur; PAU Ludhiana (including ICAR RCER Patna), and SKUAST, Jammu of NP CLIGR during September 13-14, 2023. QRT visited two guar gum processing industries namely Sunita Hydrocolloids Pvt. Ltd., and Shreeram Gum and Chemicals Pvt. Ltd., Basni, Jodhpur. In the third round, the QRT visited Kerala Agricultural University (KAU), Thrissur, Kerala and reviewed achievements of 03 centres (VNMKV, Parbhani; TNAU, Coimbatore; KAU, Thrissur) of NP HPVA of NRGs and 02 centres (KFRI, Thrissur (including KVK Sirsi); ANGRAU, Guntur) of NP CLIGR during September 26-27, 2023. QRT visited experimental sites of KAU and KFRI centres, Thrissur and the experimental sites of FC&RI, Mettupalayam. Two online meetings were organized for discussion on future perspective of the institute, in which one meeting was held internally with the institute, on October 10, 2023 and on November 02, 2023. The sixth meeting was held on February 20, 2024 to

discuss and finalize the report and the committee interacted with the IMC. Final QRT report was submitted to DG ICAR New Delhi on March 26, 2024.

100th Foundation Day Celebration

ICAR-National Institute of Secondary Agriculture (NISA), Ranchi organized 100th Foundation Day on 20th September, 2023.

His Excellency Governor Sri C P Radhakrishnan graced the occasion as Chief Guest. Sri Rajesh Kachhap, MLA, Khijri Vidan Sabha, Dr. Himanshu Pathak, Secretary DARE & DG ICAR, Dr. Shyam Narayan Jha, DDG Eng., Sri Abubkar Siddiqui, IAS-Secretary, Agriculture, Animal Hasubandary and Cooperative Department Govt of Jharkhand were the guest of honour.





During this foundation day, an exhibition was also organized in which technologies developed by various institutes, government and non-government organizations were exhibited through stalls. More than 2000 Farmers got benefited through this programme.

Celebration of "Special Campaign 3.0" by ICAR-NISA

ICAR-National Institute of Secondary Agriculture, Ranchi and KVK, Khunti, jointly organized "Special Campaign 3.0" from 02 - 31 October 2023 in the institute campus and in different villages. ICAR-NISA identified Swachhta cleanliness sites before Cleanliness campaigns during the preliminary phase from September to 30th Sept. 2022.



Awareness campaign and cleanliness drive organised by ICAR-NISA in different villages

These sites were cleaned during the implementation phase from 2nd Oct. to 31st Oct 2022. To promote swachhta and this cleanliness drive among tribal farmers, five awareness camps were held in various villages throughout the Khunti districts. The villagers were informed of the visit's purpose, its goals, and the introduction by the ICAR-NISA and KVK-Khunti team. The team made a brief tour around the village to assess and provide suggestions on the situation of cleanliness and farming activities.

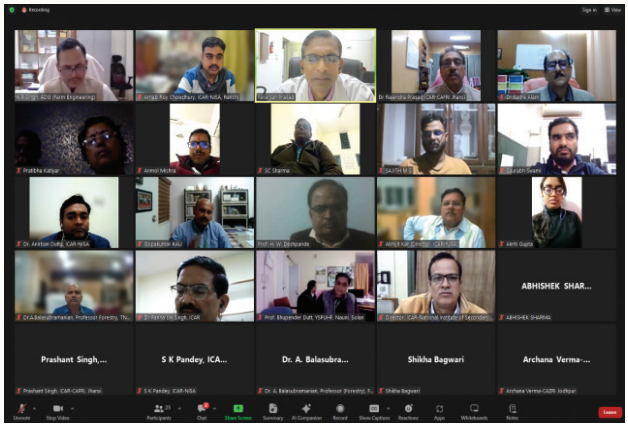
59Th Institute Management Committeee Meeting of ICAR-NISA Ranchi

The 59TH Meeting of the Institute Management committee was held at ICAR-NISA, Ranchi on 6th November 2023 at 9:00 AM in hybrid mode in the presence of Dr. A. Kar, Director, ICAR-NISA, Dr. S.N.Sushil, Director, ICAR-IIHR, Bengaluru, Dr. P.L. Singh, Principal Scientist, Engg. Division, ICAR, New Delhi, Dr. B. Das, Director, NRC on Litchi, Muzzaffarpur, Dr. S. K. Giri, Principal Scientist, ICAR-CIAE, Bhopal, Shri. B.K. Sinha, CAO (SG), ICAR-NISA, Ranchi, Shri R. Kumar, CF&AO, ICAR-NISA, Ranchi. Dr. Abhijit Kar, Director and Chairperson, extended a warm welcome to the participants. He briefed the IMC about various scientific programmes and activities undertaken by the Institute. He also appraised the House about the recently held Centenary celebration of the Institute. Subsequent to this, Agenda was taken up for discussion. The member secretary informed that the Proceedings of 58th IMC Meeting held on 23.01.2023 was approved by the Council vide communication dated 27th February, 2023.CF & AO presented the status of expenditure as on 31.10.2023. This was followed by presentation of staff position, by the CAO (SG). The meeting concluded with thanks to the chair.

15th Annual Workshop of the NP on HPVA of NRG

15thAnnual Review Workshop/Co-ordination Committee meeting of "Network Project on

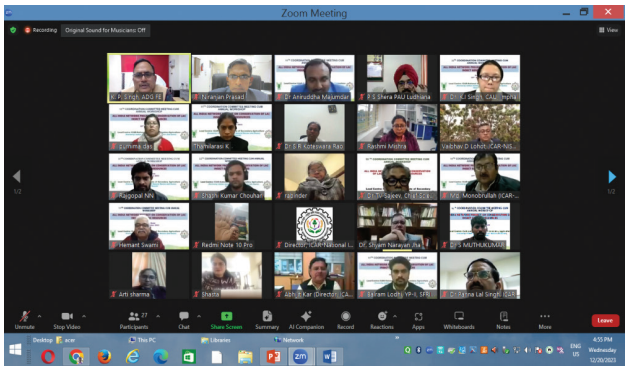
Harvesting, Processing and Value Addition of Natural Resins and Gums" (NP-HPVA of NRG) was held online on 19th December 2023 to review the annual progress of the lead & co-operating centres; and to finalize the technical programmes for the year 2024–25. The entire process was divided into inaugural session, two technical sessions and a concluding session. The inaugural session was chaired by Dr. Shyam Narayan Jha, DDG, Engineering and Dr. K. P. Singh, ADG (FE), Dr. Abhijit Kar, Director ICAR-NISA, and Dr. Niranjan Prasad, PC, NP-HPVA on NRG, all the PI's, Co-PI's and other staff of the lead and co-operating centres attended the same.



Dignitaries & delegatesin online 15th Annual Workshop of NP on HPVA of NRG

11th Annual Workshop of the NP on CLIGR

The 11th Annual Review Workshop of "Network Project on Conservation of Lac Insect Genetic Resources" (NP-CLIGR) was held online on 20th December 2023 to review the annual progress of the lead & co-operating centres, and to finalize the technical programmes for the year 2024. The review process was divided into an inaugural session, technical session and a concluding session.



Dignitaries & delegates in online 11th Annual Workshop of NP on CLIGR (Dec.20,2023)

The inaugural session was chaired by Dr. Shyam Narayan Jha, DDG (Engineering). The program was attended by Dr. KP Singh, ADG (Farm Engineering), Dr. AbhijitKar, Director, ICAR-NISA, Dr. Niranjan Prasad, PC, NP-CLIGR and Dr. Panna Lal Singh, Pri. Sci (ICAR headquarters), lead center's PIs & Co-PIs, Cooperating center's PIs & Co-PIs and other staff of NP on CLIGR online meeting.

13thMs Dorothy Norris Memorial Lecture

The 13th Dorothy Norris Memorial Lecture was held on 26th December 2023 at the ICAR-National Institute of Secondary Agriculture (NISA), Namkum, Ranchi. The lecture was delivered by Dr Trilochan Mohapatra, Chairperson of Protection of Plant Varieties and Farmers' Rights Authority (PPV&FRA), Govt of India, on 'Secondary Agriculture: An Enabler of sustainable and profitable agro-ecosystem in India'. Dr Mohapatra paid rich tributes to Ms Dorothy Norris, the founder director of the erstwhile Indian Lac Research Institute, who made significant contributions to the lac industry in India. He also remembered Dr MS Swaminathan, the father of the Green Revolution in India, who brought food security to the nation. In his lecture, Dr Mohapatra highlighted the challenges of achieving sustainable development goals by 2030 and urged young scientists and students to adopt secondary agriculture to enhance farm income and reduce environmental pollution. He explained that secondary agriculture uses agro-waste and by-products for value addition through higher-level processing. He further emphasized that any technology should be economically viable, ecologically sustainable and socially uplifting for it to be successful. Dr. Sujay Rakshit, Director, ICAR-Indian Institute of Agricultural Biotechnology introduced the speaker and highlighted his illustrious career and accomplishments. Dr Abhijit Kar, Director ICAR-NISA, welcomed the dignitaries and participants on this occasion and gave a brief overview of the institute's activities.





Dr Trilochan Mohapatra delivering the memorial lecture

The lecture was attended by students and scientists from four different ICAR research institutes part of ICAR-IARI's Ranchi hub, i.e., ICAR-NISA, ICAR-IIAB, ICAR-RCER, ICAR-NBPGR. The programme was organized by Dr M F Ansari, Head, Downstream Agro-Processing Division.

Visit of Officers from NI-MSME, Hyderabad and Jharkhand Industrial Infrastructure Development Corporation (JIIDCO), Govt. of Jharkhand to ICAR- NISA

A team of officers from NI-MSME, Hyderabad and Jharkhand Industrial Infrastructure Development Corporation (JIIDCO), Govt. of Jharkhand, visited the ICAR-NISA Campus on 28th December, 2023 for interaction at ICAR-NISA regarding Lac Farming and Processing Cluster, Bundu, Ranchi.



Dr. Abhijit Kar, Director, ICAR-NISA, interacting with officers from ni MSME, Hyderabad and JIIDCO, Govt. of Jharkhand

The official visited were Dr. S Glory Swarupa, Director General, NI-MSME, Hyderabad, Mr. K Surya Prakash Goud, Faculty Member, NI-MSME and Mr. Saquib Ahmad, Assistant Manager, JIIDCO, Govt. of Jharkhand. Purpose of visit was to get technical support from ICAR-NISA for Lac Farming and Processing Cluster, Bundu, Ranchi, in which Lac dye unit, Aleuritic Acid and Isoambretollide Plant are being established under SFURTI Scheme of Ministry of MSME, Govt. of India. The proposed project targets to benefit more than 1000 family of Bundu village and in around location of the cluster. They also visited the ICAR-NISA Museum.

Celebration of "Swachtta Pakhwada 2023

ICAR-National Institute of Secondary Agriculture, Ranchi and KVK, Khunti, jointly organized "Swachtta Pakhwada 2023" from 16 - 31 December 2023 in institute campus and in different villages outside the main campus. During this pakhwada a number of swachhta drive and awareness campaigns were organised to aware about the importance of swachhta in society. During this pakhwada Hon'ble agricultural minister Shri Arjun Munda ji also participated in a planation drive programme. About 565 farmers, children and staffs of ICAR-NISA and KVK-Khunti participated during "Swachtta Pakhwada 2023".



Plantation drive and swachhta pledge at ICAR, NISA



Swachhta awareness campaign among villagers and school children organised by ICAR-NISA

List of Ongoing Projects

S.N.	Project No.	Title of the Project	Name of Investigators
1	1.1.01/2023	Exploring the available genetic diversity of genus of *Flemingia*, *Calliandra*, *Schleichera*, *Butea* and *Ziziphus* for lac cultivation in India	**Dr. Vaibhav D. Lohot** Dr. Jyotirmoy Ghosh
2	1.1.02/2023	Selection of better lac yielding plants from the major lac-host species	**Dr. Jyotirmoy Ghosh** Dr. Vaibhav D. Lohot Dr. Nawalesh Kumar Sinha Dr. Shruti Sinha
3	1.1.03/2023	Mass multiplication of the selected plants using suitable techniques	**Dr. Nawalesh Kumar Sinha** Dr. Vaibhav D. Lohot Dr. Jyotirmoy Ghosh
4	1.1.04/2023	Exploration, collection and conservation of the available genetic diversity of *Kerria* species in India	**Dr. N N Rajgopal** Dr. K Tamilarasi
5	1.1.05/2023	Molecular characterization of genes associated with lac and its by-product synthesis	**Dr. Thamilarasi K** Dr. Shruti Sinha Dr. Sandeep Kumar
6	1.1.06/2023	Optimization of the water use efficiency under different systems of cultivation of lac	**Er. Pradosh Kumar Paramaguru** Dr. Soumen Ghosal
7	1.1.07/2023	Optimization of agronomic practices under different systems of cultivation of lac	**Dr Soumen Ghosal** Dr.. NN Rajgopal Er. Pradosh Kumar Paramaguru
8	1.1.08/2023	Development of suitable IPM practices for different systems for cultivation of lac	**Dr. Rahul R Bakade** Dr. Achintya Pramanik Dr. N N Rajgopal
9	1.1.09/2023	Study of the molecular basis of interaction between lac insect and lac host	**Dr. Shruti Sinha** Dr. Thamilarasi K. Dr. Sandeep Kumar
10	1.1.10/2023	Development of suitable lac based integrated farming systems for sustainable livelihood and circular agriculture	**Dr. Achintya Pramanik**, Dr. Nawalesh Kumar Sinha Er. Pradosh Kumar Paramguru Dr. Rahul Bakade
11	1.2.11/2023	Development of adsorbent material from agri-bioproduce for remediation of dye from water	**Dr Santosh Kumar Singh Yadav** Dr Mohamed Ali
12	1.2.12/2023	A study on various techniques for identification of commercially important natural gums	**Dr. Nandkishore Thombare** Dr. Arnab Roy Chowdhury Dr. Mohammad Fahim Ansari
13	1.2.13/2023	Development of pressure sensitive adhesive using natural resin based tackifier	**Dr Mohammad Fahim Ansari** Dr Arnab Roy Chowdhury
14	1.2.14/2023	Development of men's hair cream formulation from Lac wax	**Dr. Mohamed Ali** Dr. Mohammad Fahim Ansari Dr. Santosh Kumar Singh Yadav
15	1.2.15/2023	Preparation of biochar from Lac mud and its utilization for dye removal from water	**Dr Mohamed Ali** Dr Santosh Kumar Singh Yadav Dr. Sakharam Kale

S.N.	Project No.	Title of the Project	Name of Investigators
16	1.2.17/2023	Targeted utilization of bioactive compounds through suitable delivery mechanisms	**Dr. Anirban Dutta** Dr. Arnab Roy Chowdhury Dr. Nandkishore Thombare Dr. Achintya Pramanik Dr. Priyanka Sakare
17	1.3.18/2023	Standardization and process mechanization of sealing wax preparation	**Er. Sanjay Kumar Pandey** Dr. Satish Chandra Sharma Dr. Niranjan Prasad
18	1.3.19/2023	Development of Refractance Window dryer for gum based hydrogels	**Dr. Sakharam Kale** Dr. Nandkishore Thombare Dr. Niranjan Prasad
19	1.3.20/2023	Development of extrusion based mechanized system for hot filtration of seedlac	**Dr. Sakharam Kale** Dr. Satish Chandra Sharma Dr. Niranjan Prasad
20	1.3.21/2023	Development of process for extraction of cellulose from bio-produce	**Dr. Archana Mahapatra** Dr. Priyanka Sakare Dr. Arnab Roy Chowdhury Dr. Sakharam Kale
21	1.4.23/2023	Natural dye based intelligent indicators for real-time freshness monitoring of packaged perishable food products	**Dr. Priyanka Sakare** Dr. Archana Mahapatra Dr. Nandkishore Thombare
22	1.4.25/2023	Development of bioactive compounds functionalized active packaging for shelf life improvement of perishable food commodity	**Dr Arnab Roy Chowdhry** Dr Rahul Bakade Dr Archana Mahapatra Dr Anirban Dutta Dr Priyanka Sakare
23	1.5.26/2023	Capacity building, skill development, extension services on production, processing and product technologies	**Er. Sanjay Kumar Pandey** Dr. M.S. Udaykumar
24	1.5.27/2023	Information management and Impact assessment of technological interventions and capacity building/skill development programs	**Dr. M.S. Udaykumar** Er. Sanjay Kumar Pandey Dr Santosh Kumar Singh Yadav

ICAR-Network Projects			
25	2.3.01/2009	Network project on Harvesting, Processing and Value Addition of Natural Resins and Gums (ICAR)	Dr. Niranjan Prasad (PC) Dr. Arnab Roy Chowdhry Dr. Satish Chandra Sharma Er. Sanjay Kumar Pandey Dr. Nandkishore Thombare Dr. Vaibhav D. Lohot
26	2.1.02/2014	Network project on Conservation of Lac Insect Genetic Resources (ICAR)	**Dr. Niranjan Prasad (PC)** Dr. Vaibhav D. Lohot Dr. Thamilarasi K
27	Institute Activity	Agri-Business Incubation under Component-II of NAIF Scheme of ICAR	**Er. Sanjay Kumar Pandey** Dr. Satish Chandra Sharma

Inter-Institutional Projects				
S.N..	**Project No.**	**Title of the Project**	**Name of Investigators**	**Collaborating institute**
1	3.1.01/2018	Enhancing food, nutritional and livelihood security of marginal and small farmers in Jharkhand through need based agricultural technologies	**Dr. Nawalesh Kumar Sinha, Co-PI** Virender Kumar Yadav (ICAR-FSRCH & PR)	ICAR-RCER Farming System Research Centre for Hill and Plateau Region, Plandu, Ranchi
2	3.3.01/2022	Development of technology for postharvest management for value addition of Jackfruit in Eastern region	**Dr. Sakharam Kale, Co-PI** Dr. Prerana Nath (PI) (ICAR-FSRCH & PR)	ICAR-RCER Farming System Research Centre for Hill and Plateau Region, Plandu, Ranchi
3	1.2.16/2023	Extraction and characterization of isoflavones from available agri-bio resources	**Dr. Sandeep Kumar** Dr. Anirban Dutta Dr. Sujit Bishi (ICAR-IIAB)	Indian Institute of Agricultural Biotechnology, Ranchi
4	1.4.22/2023	Development of non-destructive quality evaluation system for natural products	**Dr. Nandkishore Thombare** Dr. Anirban Dutta Dr. Priyanka Sakare Dr. Arnab Roy Chowdhury Dr. Saurav Kumar (CSIO)	CSIR- Central Scientific Instruments Organisation, Chandigarh
5	1.4.24/2023	Development of pilot plant of guar gum derivative for training and demonstration	**Dr. Satish Chandra Sharma** Dr. Niranjan Prasad Er. Sanjay Kumar Pandey Dr. Arnab Roy Chowdhury Dr. Saroj Kumar Giri (CIAE)	ICAR-Central Institute of Agricultural Engineering, Bhopal

Externally Funded Project					
Sl. N.	**Project No.**	**Title of the Project**	**Name of Investigators**	**Funding agency**	**Budget, ₹, lakhs**
1	4.2.01/2022	Design and development of portable device for estimation of life and color index of lac samples	**Dr. Nandkishore Thombare** Dr. Mohammad Fahim Ansari	NABARD	16

Important Committees

Quinquennial Review Team (QRT)

Name of expert	Address	Role
Dr B. Baboo	Former National Director, NAIP, ICAR; 1/241-Rashmi Khand, Sharada Nagar, Lucknow -226002, U.P.	Chairman
Dr D.C. Joshi	Ex-Vice Chancellor, Agriculture University, Kota; 17- Laksh Gold, BIH D Z Patel School, Vidyanagar Road, Anand - 388001, Gujarat	Member
Dr N.A. Shakil	Principal Scientist and Head, Division of Agricultural Chemicals, ICAR-Indian Agricultural Research Institute, New Delhi-110012	Member
Dr A.K. Jaiswal	Ex-Principal Scientist and Head, ToT Division, ICAR- IINRG Ranchi. 595-Subhash Nagar, Mumfordganj, Prayagraj -211002, U.P.	Member
Dr K.B. Gupta	Associate Professor, Centre for Food & Agri-Business Management, Indian Institute of Management, Prabandh Nagar, Off Sitapur Road, Lucknow-226013, U.P.	Member
Dr M.F. Ansari	Principal Scientist and Head, Downstream Agro Processing Division, ICAR-National Institute of Secondary Agriculture, Namkum, Ranchi-834010, Jharkhand	Member Secretary

Research Advisory Committee (RAC)

Name of expert	Designation	Role
Dr. K. Alagusundaram	Former DDG (Engg.), ICAR, New Delhi	Chairman
Dr. H.N. Mishra	Professor (Food Technology), IIT, Kharagpur	Member
Dr. D. Usharani	Principal Scientist, CSIR-CFTRI, Mysuru	Member
Dr. S.K. Dhyani	Former Director, ICAR-CAFRI, Jhansi	Member
Dr. D. Behera	Professor & Head, OUAT, Bhubaneshwar,	Member
Dr. A. Kar	Director, ICAR-NISA, Ranchi	
Dr. N.K. Sinha	PS & I/C Head, ABA Div., ICAR-NISA, Ranchi	Member Secretary

Institute Management Committee (IMC)

Sl.	Name / Designation	Role
1.	Dr. A. Kar, Director, ICAR_NISA, Ranchi	Chairman
2.	Dr. P. L. Singh, ADG(FE), ICAR, New Delhi	Member
3.	Dr. S. N. Sushil, Director, ICAR-NBAIR, Bengaluru	Member
4.	Dr. S. S. Mallick, Dean (Agro-forestry), BAU, Ranchi	Member
5.	Dr. S. K. Giri, Pr, Sc, ICAR-CIAE, Bhopal	Member
6.	Dr. B. Das, Pr, Scientist, ICAR-RCER, RS Plandu, Ranchi	Member
7.	Sri. C. P. Srivastava, Dy, Dir. Agri (Soil Consv.), Lucknow Div.	Member
8.	Sri R. Mahto, SAO, (Actg.) AS &PE Divison, ICAR-NISA, Ranchi	Member Secretary
9.	Dr. N. Prasad, Head (Act.), ABA Division, ICAR-NISA, Ranchi :	Special Invitee
10.	Dr. N. K . Sinha, Head (Act.) ABA Division, ICAR-NISA, Ranchi	Special Invitee
11.	Dr. M. F. Ansari, Head (Act.) , ABA Division, ICAR-NISA, Ranchi	Special Invitee
12.	Dr. S. C. Sharma, Head (Act.), APE, Division ICAR-NISA, Ranchi	Special Invitee
13.	Dr. N. Kumar, I/C ABD Init, ICAR-NISA, Ranchi	Special Invitee
14.	Sri. K. Oraon, Asst. Officer, IINRG, Ranchi	Special Invitee

Budget allocation and utilization during Financial Year 2023-2024

Head of Expenditure	Other than NEH & TSP		NEH/SCSP		Total	
	Approved	Expenditure	Approved	Expenditure	Approved	Expenditure
	RE		RE		RE	
NISA			SCSP	SCSP		
Grant-in-aid Capital	275.00	275.00	62.00	62.00	337.00	337.00
Grant-in-aid Salaries	1402.95	1402.53	0.00	0.00	1402.95	1402.53
Pension	417.09	417.09	0.00	0.00	417.09	417.09
Grant-in-aid-General	383.90	383.90	38.00	38.00	421.90	421.90
Non Scheme(1270)	150.00	150.00				150.00
Total	2628.94	2628.52	100.00	100.00	2578.94	2728.52
NWP ON H & PHP & VANR& G			NEH			
Grant-in-aid Capital	76.00	76.00	0.00	0.00	76.00	76.00
Grant-in-aid Salaries	0.00	0.00	0.00	0.00	0.00	0.00
Grant-in-aid-General	100.00	100.00	0.00	0.00	100.00	100.00
Total	176.00	176.00	0.00	0.00	176.00	176.00
NWP ON CLIGR			NEH			
Grant-in-aid Capital	15.00	15.00	0.00	0.00	15.00	15.00
Grant-in-aid Salaries	0.00	0.00	0.00	0.00	0.00	0.00
Grant-in-aid-General	100.37	100.37	20.00	20.00	120.37	120.37
Total	115.37	115.37	20.00	20.00	135.37	135.37
REVENUE GENERATION TARGETS & ACHIEVEMENTS						
Financial Year		Target for the financial year			Revenue Generated	
2023-24		38			84.76	

Personnel

Details of scientific, technical, administrative and supporting staff (including KVK)

	Sanctioned Strength	In position	Vacant
R.M.P.	01	01	0
Scientific	42	25	17
Technical	61	34	27
Administrative	29	14	15

PERSONNEL	
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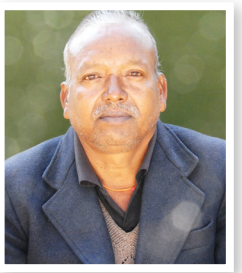
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Shri Dharmendra Singh, Sr. Tech. Asstt.	dharmendra.singh1@icar.gov.in

NEW MEMBERS OF ICAR-NISA			
			
Dr. Udaykumar M.S. Scientist joined on 20.07.2023	Dr. Deepak Rai, Senior Scientist & Head KVK joined on 01.09.2023	Dr. Saroj Kumar Giri Principal Scientist & Head, AS &PE Div. joined on 29.12.2023	Dr. Debabandya Mohapatra Principal Scientist & Head, A &PE Div. joined on 29.12.2023

PROMOTION		
		
Dr. Vaibhav D. Lohot, Sr. Scientist promoted to the post of Pr. Scientist	Dr. Anirban Dutta, Scientist promoted to the post of Sr. Scientist	Shri Dharmendra Singh, T.A. promoted to the post of Sr. Tech. Asstt.
		
Sri Baijnath Mahto, S.S.S. promoted to the post of Technician (F/F Tech. group) on 05.07.2023	Shri Binay Kumar Singh, S.S.S. promoted to the post of Technician (F/F Tech. Group) on 05.07.2023	Shri Manohar Singh Purty, S.S.S. promoted to the post of Technician (F/F Tech Group) on 05.07.2023

TRANSFER			
	Dr. Shruti Sinha, Scientist transferred to ICAR-NBPGR, New Delhi on 15.12.2023		Dr. Rajgopal N.N., Scientist transferred to ICAR-NBAIR, Bengaluru on 31.12.2023

RETIREMENT				
				
Arvind Kumar, TO retired on 31.01.2023	Dinu Ranjan Gorait, SSS, retired on 28.02.2023	Rameshwar Mahato, SSS, retired on 31.03.2023	Sri A.K. Sharma, TA, retired on 30.04.2023	Dr. K.K. Sharma, Director, retired on 31.05.2023
				
Shri R. C. Mandap, S.S.S., retired on 30.06.2023	Dr. Nirmal Kumar, Pr. Scientist, retired on 31.08.2023	Shri Sanchu Mahto, S.S.S., retired on 30.09.2023	Shri M.S. Purty, S.S.S., retired on 30.09.2023	Shri Shankar Mahto, S.S.S., retired on 31.10.2023

1924 - 2024

100th Year

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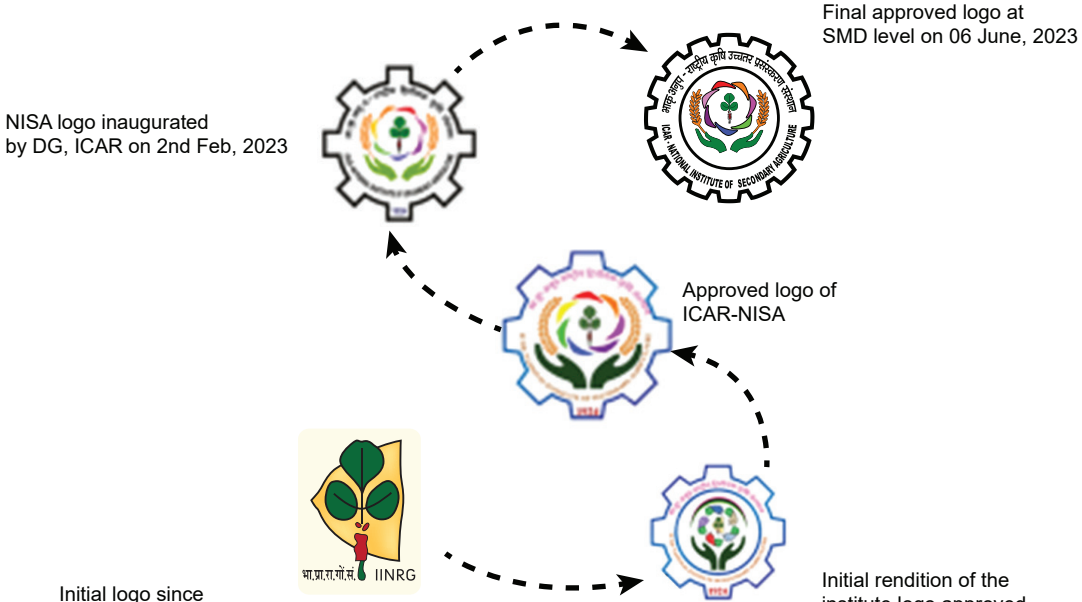
Namkum, Ranchi



भाकृअनुप
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किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

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भाकृअनुप–राष्ट्रीय कृषि उच्चतर प्रसंस्करण संस्थान

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