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INTERNATIONAL YEAR OF MILLETS 2023

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भाकृअनुप–राष्ट्रीय कृषि उच्चतर प्रसंस्करण संस्थान
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Director's office, ICAR-NISA

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Preface

Established on September 20, 1924 by the then British Government under the administrative control of Indian Lac Association for Research (ILAR), Indian Lac Research Institute (ILRI), was meant for providing all necessary support for lac production to the entire lac value chain. Since it's inception the institute has been instrumental in the all round development of lac besides maintaining India`s leadership in production, installed processing capacity and export. In the process the institute has been a source for the development of sustainable livelihoods of thousands of lac farmers who predominantly belong to the scheduled caste and scheduled tribe communities.

The administrative control of ILRI was transferred from ILAR to Indian Lac Cess Committee (ILCC) on August 01, 1931 and subsequently to Indian Council of Agricultural Research (ICAR) w.e.f. April 01, 1966. ICAR, recognizing the similarities in production systems, economic aspects, and application areas between lac and other natural resins and gums, expanded the mandate of the institute and renamed it as Indian Institute of Natural Resins and Gums (IINRG) on September 20, 2007. This expanded mandate allowed for comprehensive research and development support for various important natural resins and gums, in addition to lac, guar gum, and karaya gum.

Understanding the pressing need of the World towards meeting 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 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.

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 order to achieve the above, we at NISA intend to (i) develop suitable models and/or modify existing/traditional agro-production methods to achieve desired quality and quantity of agro-produce and by-products/co-products, (ii) develop/improvise suitable processes, methods and technologies for handling and processing of the agro-produce and their by-products/co-products, (iii) development of suitable sensors and equipments for precise system/process control for achieving products of highest quality, and (iv) create rural employment and enterprise through trainings and skill development programmes, encouraging setting up of rural industries and development of supply chains through market linkage both B2B and B2C.

July, 2023
Namkum, Ranchi

(Abhijit Kar)
Director

Introduction

Mandate

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

Historical Perspectives

ICAR-National Institute of Secondary Agriculture (ICAR-NISA) fills in the gap of a national R&D institution to the Secondary Agriculture, which is quite important from social, export and ecological angles. To increase the income of farmers, value addition of the produce and utilizing the crop residues is attaining high priority. Secondary Agriculture is high value addition to primary agriculture. It helps in using all parts of an agricultural produce (e.g. crop residues, animal hair, bones, viscera, etc), processing to enhance shelf-life, increasing total factor productivity, and generating additional jobs and income for farmers. Certain alternative agriculture activities like lac culture, beekeeping, mushroom cultivation, agri-tourism, etc, also fall under the ambit of secondary agriculture. By-products from agricultural crops, if processed appropriately for deriving industrial products could pave a way in getting better economic returns from agriculture.

The origin of the Institute dates back to 1920s during the British era, when the need for establishment of an R&D organization for lac, a natural resin of insect origin, was felt. Realizing the strategic importance of this commodity, the then Imperial Government of India constituted the Lindsay- Harlow Committee in 1920 to look into all aspects of the country's lac trade and its development. On the suggestions of this committee, lac merchants organized themselves into the Indian Lac Association for Research, under the aegis of which, the foundation stone of the Indian Lac Research Institute (ILRI) was laid on September 20, 1924 at Ranchi. Subsequently, on the recommendations of the Royal Commission on Agriculture, the Indian Lac Cess Committee (ILCC) was constituted, which took over the reigns of the ILRI in 1931. As a result of reorganization of agricultural research and education in the country after independence, the ICAR took over the administrative control of the ILRI in April 1966. This Institute is thus, one of the oldest institutions within the ICAR system, having completed more than 98 years of existence. It has contributed immensely towards all round development of lac maintaining India's leadership in production, installed processing capacity and export of the commodity.

Recognizing the importance of other natural resins and gums, which are cultivated and collected in the Indian subcontinent, and are of tremendous industrial importance in divergent industries and export markets, the ICAR revised the mandate of ILRI and renamed it as Indian Institute of Natural Resins and Gums (IINRG). All natural gums and resins were brought under its scope, under the revised research mandate of the Institute w.e.f. September 20, 2007. Subsequently, the ICAR also sanctioned a new Network Project on Conservation of Lac Insect Genetic Resources launched in August, 2014 with eight centres besides the existing Network Project on Harvesting, Processing and Value Addition of NRGs with increased strength since November 29, 2009. The Institute is recognized as National Lac Insect Germplasm Centre (NATLIGEC). On May 30, 2015, the Institute was certified as ISO 9001: 2008 organization.

Keeping in view the importance of secondary agriculture in rural industrialization in order to improve farmer's income, it was proposed to further widen the mandate of the IINRG. Therefore, the Governing Body of ICAR Society in its 256th meeting approved the proposal and the new name of the Institute as National Institute of Secondary Agriculture. Consequent to this decision of the Council, Indian Institute of Natural Resins and Gums has been rechristened as National Institute of Secondary Agriculture (NISA) w.e.f. September 28th, 2022.

Location and Agro-Climate

The Institute is located 9 km south-east of Ranchi city, on the Ranchi-Jamshedpur highway (NH33) at an altitude of 650 m above mean sea level, 230 23'' N latitude and 850 23'' E longitude. The soil of the experimental farm is of lateritic type. The area experienced mild salubrious climate, with rather good rainfall of about 1064 mm, of which about 75 per cent (795 mm) was during the monsoon season.

Organizational Structure

ICAR-NISA has responded to the globalization of industries and agricultural enterprises of the country as well as functional reorganization of ICAR. The Institute also has undergone structural changes and the priorities have been redefined. In April 2021, the erstwhile divisions were abolished and the scientific manpower was divided into four divisions, *viz*., Quality and Productivity Improvement Division, Production and Extension Management Division, Application and Product Development Division and Mechanization and Process Engineering Division. The Institute is headed by a Director.

Staff

The Institute has a sanctioned strength of 1 Research Management Position (RMP), 42 scientific, 61 technical, 29 administrative and 43 supporting grade staff with a total of 176 sanctioned posts, out of which 25 scientific including RMP, 32 technical, 10 administrative and 22 supporting posts with a total of 89 staff are in position as on December 31, 2022.

Infrastructure

Manned by a team of dedicated scientists from various disciplines including Agricultural Entomology, Plant Sciences, Agricultural Chemicals, Engineering, Biotechnology etc., the Institute has 89 staff in scientific, technical, administrative and supporting categories. The Institute has a number of prestigious labs, like Biotechnology, Bio-control Laboratory, Instrumentation Laboratory, Quality Evaluation Laboratory etc. The Institute shoulders the responsibility of collection and maintenance of germplasm of lac insect lines as well as lac host trees (NATLIGEC). Similarly, the Lac Host Field Gene Bank of the Institute has 90 collections of 69 species comprising trees, medium and bushy types of lac host plants collected from different agro-climatic regions of the country. There are several well organized and equipped service sections to support research activities of the Institute. The administrative wing comprises Director's Office, Administrative Section, Audit and Accounts Section, Purchase and Central Stores. The sections providing technical support are Library; Prioritization, Monitoring and Evaluation Cell; Institute Research Farm and Maintenance & Workshop Unit. The Auxiliary units are Hindi Cell, Security, Medical and Service Unit.

The Institute Research Farm (IRF) spread over 36 ha, has all conventional and cultivated lac host plants. Presently, it has approx. 1550 host trees of *Schleichera oleosa* (*Kusum*), 2480 trees of *Butea monosperma* (*palas*), 1351 trees of *Ziziphus mauritiana* (*ber*) and 8700 minor host plants. The IRF also maintains a nursery of host plants for meeting the demand from other institutions as well as farmers. More than 1050 cultures of 52 lac insect lines are being conserved live on potted plants of *bhalia* (*Flemingia macrophylla*) under protected conditions.

The ICAR-NISA library has a holding of about 24,780 volumes of scientific journals, rare books, including back volumes of research periodicals in the field of resins and gums including lac and surface coatings. Since the holdings of back volumes of certain journals date back to circa 1868, the library is also a partner of the Consortium for e-Resources in Agriculture (CeRA), of ICAR. Besides catering to the learning needs of scientists and the staff of the Institute, the library also attracts researchers from neighboring educational and research institutions, including Birla Institute of Technology, Ranchi University, Birsa Agricultural University and ICAR Research Complex for Eastern Region-Regional Center, Ranchi and others.

Quality Evaluation Laboratory of the institute caters to the quality control needs of the lac processing/ lac product industries as well as exporters of lac/ lac products. The lab has facilities for carrying out testing of lac/ lac products as per BIS requirements.

The PME Cell provides access to internet and e-mail facilities for communication and information retrieval to the scientists. The Institute website at: https://nisa.icar.gov.in is a valuable source of information about the Institute.

Executive Summary

Biodiversity Conservation and Characterization of Lac Insect and NRG Yielding Plants

- 1050 cultures of 52 lac insect lines are being conserved on *Flemingia macrophylla* in National Lac Insect Field Gene Bank and 90 collections of 69 host plant species are being conserved in the lac host field gene bank.
- First incidence of *Kusum* gall midge *Contarinia* sp. (Cecidomyiidae: Diptera) was reported during first week of March in the freshly emerged twigs of *kusum* trees. During March month 20% of the newly emerged leaves were infested by the gall midge while during April galls were observed in 50% of the newly emerged leaves.
- Full-length coding sequence (CDS) of an epoxide hydrolase gene (*epo 35981*) of lac insects obtained from the RNA seq data was cloned in pGEMT easy vector and sequenced and the size of the CDS was found to be 1221 bp.
- Transcriptome sequencing of different developmental stages namely, crawlers, settled nymphs, and fertilized female lac insects was carried out in triplicates on illumina HiSeq X10 platform for read length of PE150. A total of 1309,710 transcripts were obtained and after transdecoder filtering 1,72,864 transcripts were obtained. The smallest transcript was of 180 bp and the longest one is 28,529 bp. N50 value obtained for the assembled transcripts was 2430 bp.
- Differentially expressing genes were computed based on their expression level. In crawlers *vs* settled nymphs, there were 5851 and 7526, downregulated and upregulated transcripts, respectively. In crawlers *vs* fertilized female insects comparison, there were 10729 and 4762 downregulated and upregulated transcripts, respectively. In settled nymphs *vs* fertilized female insects comparison, there were 7996 and 3472 downregulated and upregulated transcripts, respectively.
- Few genes having probable role in lac resin biosynthesis were found to be differentially express in the lac secreting stages (settled nymphs and fertilized female insects) compared to lac non secreting stage (crawlers). They include Fatty acid desaturases, Monooxygenases, Cytochrome P450 monooxygenases, Epoxide hydrolase, Farnesyl pyrophosphate synthase, Prenyl transferases, genes for Isoprenoid biosynthesis and Acetyl-CoA biosynthesis, Mevalonate kinase, Mevalonate decarboxylase and HMG-CoA reductase.
- The total isoflavone content in *F. semialata* and *B. monosperma* leaves was found to be 4086.06 µg/g and 2916.08 µg/g dry weight, respectively. These lac host plants belong to the *Fabaceae* family and showed high isoflavone content, especially daidzin in leaves.

Lac Insect-Host Plant Environment for Improved Quality and Productivity

- *Flemingia semialata* plants were sprayed with plant growth regulators (PGRs) and then inoculated with *kusmi* strain of lac insect in July, 2022. Treatment kinetin 200 ppm recorded highest shoot length (148.76 cm) followed by NAA 50 ppm (143.12 cm) and NAA 100 ppm (142.88 cm) as compared to control (123.48 cm).
- Host mediated moisture stress during critical post mating growth stages of lac insects was found to have significant negative effect on lac yield as well as reproductive physiology since 11.37%, 32.48% and 40.20% reduction for fresh weight, resin weight and numbers of crawlers emerged/cell respectively was recorded in moisture stress treatment as compared to optimum watered treatment.
- Higher germination percent after six months was observed in the seeds stored in polythene bag (58.12) than cotton bag (55.18). Shoot length, root length and dry weight also showed higher in polythene bag stored seed by 8.1 cm, 4.21 cm and 188 mg than the cotton bag storage by 5.49 cm, 3.51 cm and 181 mg.
- Among the treatments, Spinosad 45 SC @2 ppm + Vitavex power (Carboxin 37.5% + Thiram 37.5% WS) @ 2.5 g/kg) treated seeds under polythene bag storage showed higher germination percent (67.36), shoot length (14.17 cm), root length (8.15 cm) and seedling dry weight (235 mg) than cotton stored seeds, 69.16%, 11.24 cm, 7.54 cm and 220 mg, respectively.

- The performance of Vitavex power (Carboxin 37.5%, (Thiram 37.5% WS) @ 2.5 g/kg) treatment was observed at par with Spinosad 45 SC @2 ppm + Vitavex power (Carboxin 37.5%, Thiram 37.5% WS) @ 2.5 g/kg) treatment in both storage packages. Under polymer coating treatment, lac coating @10% observed better than the polycote @6g/kg coated seeds.

Crop Production System Management and Evaluation

- Number of inoculable shoots per 10 cm tree diameter, actual shoot diameter and its length was found to be influenced significantly by allowing rest to the trees. Inoculable shoots were found to increase 43% when pruning interval was 19 months as compared to 7 months. Similarly 11.5% and 26% increase in shoot diameter and length was observed due to allowing higher rest period before pruning of *palas* trees.
- Significantly higher number of new shoots was produced on upland condition than lowlands. Higher values of residual shoot weight and number were also noticed in upland condition. Most surprisingly, upland condition could produce lac more than double compared to lowland condition. Yield ratio obtained was 2.16 and 0.95, respectively.
- Growth attributes like shoot length was found to be affected significantly due to higher level of fertility. Highest level of fertility could register 25 percent higher growth compared to control.
- The water balance study was carried out at three soil regimes *i.e.* 0-30 cm, 30-60 cm, 60-100 cm and the study revealed a total crop water demand of 1055.36 mm with lac inoculated plants and 1007.71 mm without lac inoculated plants up to the end of December, 2022.
- Two types of conidia were observed from the single sample of sooty mold fungus which was collected from *F. semialata*. One was having small stal and multi-septed and based on the available references it was confirmed that the fungus is *Capnodium salicinum*. Another spore was blunt at the tip and having double layered and based on the available references it was confirmed that the fungus is *Anopeltis venezuelensis*.

Capacity Building, Technology Dissemination, Impact Assessment and Market Intelligence

- 17 Farmers' Training Programmes on 'Scientific lac cultivation, processing and utilization' were organized for 614 farmers from four states *viz.* Jharkhand, Bihar, Odisha and West Bengal.
- Organized three Educational programme on "Industrial Training on Natural Resins and Gums" for total 104 students from different universities (10 days).
- Five on-farm training were organized for 248 stakeholders of Jharkhand. Two On-farm motivational training organized for 98 farmers. 44 On-campus one day orientation programmes on 'Natural resins and gums' were organized; 1483 stakeholders visited the institute.
- Nineteen training programmes for 565 Scheduled Caste farmers were organized under DAPSC programme.
- Three Kisan Gosthis were also organized by the institute.
- In total, 5948 beneficiaries got benefitted through different programmes.
- 13 VIPs and dignitaries were visit the institute museum.

Synthesis, Process Development and Quality Management

- The genuine samples of plant exudate natural gums were collected directly from the respective trees and other samples like seaweed gums, microbial gums, etc. were procured from the HIMEDIA Pvt. Ltd. The volatile matter (%), pH and UV-Vis characterization of the 31 different gum samples were carried out following BIS standard procedure (IS: 7437 – 1974: Methods of sampling and test for vegetable adhesives). Volatile matter % of all the gums was found in the range of 4.9 to 14.8 %. The pH of most of the gums was found to be in the range of 4.0 to 6.5. Keeping in view the non-applicability of cold water soluble (%) estimation's method described in the BIS standard (IS: 7437 – 1974) to high viscous gums, a new method for the same was developed. Twenty five different gum samples were analyzed by this procedure and the cold water solubility was found in the range of 5 to 95%. All the gums showed prominent absorption maxima in the UV region between 190 to 200 nm.

- The hydrogel was prepared by the graft copolymerization of purified natural *Terminalia bellirica* (Baheda) gum with initiator and crosslinker. Polymerization time and volume of reaction mixture are significant reaction variables and polymerization time increases with increase in the volume of reaction mixture. Swelling characteristics was studied and it was observed that swelling of hydrogel gradually increases from 3570 to 4150 with increase in the temperature from 25 °C to 45 °C.
- Swelling characteristic and behavior of the synthesized cross-linked Arabic based hydrogel was carried out in various pH buffer systems (2, 5, 7 and 10) and at various temperatures. High swelling was observed at two pH (at 5 and at 10). It was noted that efficiency increased as we increase the temperature gradually upto a certain limit and after optimized temperature it practically remain constant. Adsorption isotherms were studied using Langmuir isotherm model for brilliant green dye adsorption onto Arabic gum hydrogel and it was found that adsorption increase from 5.3 to 8.0 mg/g as we move from 25 °C to 45 °C. This suggests that adsorption was endothermic and satisfied this model.

Value Addition and Product Development

- Encapsulation of beta carotene was accomplished using dietary fibre in liposomal formulation and detailed characterization of the encapsulated beta carotene was carried out. The *in vitro* gastrointestinal release study of the encapsulated beta carotene reveals that liposomes protect active substances from damage during digestion and helps in the targeted delivery of the beta carotene.
- A number of nanocomposite films reinforced with piyar-AgNPs were developed through solution casting method. The water uptake and water vapour permeability studies showed that the developed nanocomposite films having effective barrier properties against water vapour for packaging application. The antibacterial efficacy of the developed nanocomposite films were evaluated against both gram negative and gram positive bacteria and exhibited potential activity against bacterial pathogen.

Designing and Development of Farm Tools and Processing Machineries

- Carboxy methyl guar gum derivative was prepared from guar gum with variation in processing parameters. Results revealed that carboxy methyl guar gum derivative with higher viscosity can be prepared with reduced mixing time (30 min), reaction time 3h and drying time 3h having similar pH and degree of substitution.
- All units of carboxy methyl guar gum derivative pilot plant fabricated in collaborative mode at ICAR – Central Institute of Agricultural Engineering, Bhopal and material handling equipments including brought out components installed in the different fabricated units with minor improvement. Functionality trials of the fabricated units and components are under progress with minor adjustments at ICAR – Central Institute of Agricultural Engineering, Bhopal.
- Guar gum based hydrogel was dried using laboratory scale Refractance Window (RW) dryer at five water temperatures and three thicknesses of Mylar plastic sheet. Process variables of the RW drying were optimized using Response surface methodology.
- Cohesion-adhesion behavior of seedlac was evaluated at nine different temperatures (30 to 120 °C) with the help of texture analyser. Rheology behavior of seedlac samples was determined at seven different temperatures (70 to 130 °C). Two prototypes of manually-operated ram-extruder were fabricated and evaluated.

Process Refinement, Commercialization and Entrepreneurship Development

- Preliminary trial of making sealing wax in existing wax candle mould tried with old shellac and fresh shellac with varying % of rosin ranging from 10 % to 40 % and found no issue of fluidity in making sealing stick using fresh shellac with lower 10 % rosin compared to old shellac which requires higher rosin.
- New moulds of different shapes like square, round, hexagonal with cooling arrangement were designed for fabrication purpose in carbon steel, stainless steel and aluminium alloy material.

Network Project on Harvesting, Processing and Value Addition of NRGs

- Seven *Cordiarothii* tree were selected to carry out the experiment at ICAR-CAZRI, Jodhpur research farm in summer season (March – April, 2022). Tree structural traits of selected trees like average height, DBH and canopy cover were 4.54 m, 7.46 cm and 2.66 sq. m. Average gum yields 88.14 g/ tree was found ranging from 52.0 g to 137 g.
- The button mushrooms treated with coating material prepared using babul gum and carboxymethyl cellulose maintained good firmness and had palatable eating quality till 8 days of storage.
- In a study carried out at IGKV, Raipur centre, it was found that development of film for coating fruits and vegetable was possible using Charota seed gum in combination with starch and plasticizer.
- Guggul stored in earthen pot wrapped with moist jute bag was better in comparison to the Guggul stored in earthen pot in wet sand bath in retaining maximum bioactive compounds of Guggul.
- The production of Dog Pet Food Crackers developed by incorporation of guar meal protein isolate at VNMKV, Parbhani Centre started in collaboration with V-cube Fresh Pvt. Ltd, Parbhani for sale.
- Amongst the different borehole angles (25°, 40°, 55° and 70°) studied, the highest oleoresin yield (4255.22 g/season) in Nauni campus was recorded at an angle 40° and in diameter class >60 cm.
- In Rill method, all the trees were classified into four diameter classes *viz.*, 30-40 cm (D1), 40-50 cm (D2), 50-60 cm (D3) and >60 cm (D4). The effect of diameter (dbh) on oleoresin yield has showed that the highest oleoresin yield (7.93 kg/season) was found in diameter class >60 cm (D4) and lowest (4.62 kg/season) was observed in diameter class 30-40 cm (D1).
- The oleoresin yield was found to be positively correlated with maximum temperature whereas; it was negatively correlated with average relative humidity. The oleoresin yield exhibited positive significant correlation coefficient with maximum temperature (0.959) and the negative significant correlation coefficient was observed between oleoresin yield and average relative humidity (-0.852).
- Round the year gum exudation study in *Butea monosperma* revealed that maximum exudation takes place in the month of December and January, while in the month of July, August and September, gum exudation was negligible.
- In more than 48 villages of Chauhatan and Baytu tehsils of Barmer district; Shergarh and Phalodi tehsils of Jodhpur district; and some villages of Nagaur, Jhunjanu and Pali districts farmers adopted the gum inducing technology on large scale. In the year 2022, 14520 trees of *A. senegal* were treated by CAZRI gum inducer, resulting in production of approximately 6.53 tons of gum Arabic. In the year the average rate of gum Arabic was Rs. 800/- per kg in local market. Thus, farmers registered at CAZRI, Jodhpur of said villages earned revenue of Rs. 52.24 lacs. In this way, in each village additional income of Rs. 1.08 lakhs came to farmers through sale of gum Arabic.

Network Project on Conservation of Lac Insect Genetic Resources

- The entomopathogenic fungi *Isaria fumosorosea* showed promising results for the management of *Eublemma amabilis*. Bio-safety analysis of this entomopathogenic fungus on lac insects revealed that it is extremely safe against lac insects in both field and laboratory conditions. The technology of bio-formulation of *I. fumosorosea* has been recommended in Technical Committee Meeting, Kharif held on 29th April, 2022 for conducting On Farm Trial (OFT) at farmer's field of West Karbi Anglong.
- Cadaver of two hemipteran pests *i.e. Megacopta cribraria* and *Brachyplatys subaeneus* with fluffy fungal growth was collected from the Regional Field Gene Bank, AAU, Jorhat. The collected specimens were isolated, pure culture and subsequent subculture were done. Pathogenicity study was carried out in different group of insects and was found to be effective against lepidopteran pests. Morphology and molecular characterization of the native EPF were carried out and it was identified as *Fusarium oxysporum*.
- Location specific studies to explore and ascertain the possibilities of lac cultivation in arid western plain agro-climatic zone and to combat the problems responsible for the low production and adoption of lac cultivation in the region was carried out and the research findings revealed that based on productivity linked

parameters studies among the different hosts, *ber* was the best suited host for the cultivation in the region.

- The studies of bio-efficacy of pesticides against major lepidopteran predators of lac insect (*Eublemma amabilis* and *Pseudohypatopa pulverea*) revealed that the most effective treatment with the highest mean survival percentage of lac insect was spray of Emamectin benzoate 5 SG @ 0.4 g/l with (68.89%) adult predators. For the management of lepidopteron predators among the organic treatments, two applications of Tekha sat at 10% were the most effective in reducing the predatory population on lac, followed by neem seed kernel extract at 5% and Bramhastra at 5%. Whereas two treatments Neem oil at 2% and cow urine at 10% were found least effective against the predators.
- To maintain the broodlac *Albizia lebbeck* and *Calliandra macrophylla* were found the most suitable lac host plants for *ex situ* conservation while *Acacia nilotica* and *Ziziphus mauritiana* were recorded as the best host plants under Jammu conditions.
- Study revealed that the insect pests of okra, mustard and sunflower increased significantly as the distance of agricultural field neighboring lac plots increased whereas the incidence of natural enemies decreased significantly.
- Bacterial diversity of different stages of *Kerria lacca* by amplicon sequencing of 16S rRNA revealed that lac insects were found to harbour Proteobacteria and Actinobacteria as the most abundant phylum OTUs, Alphaproteobacteria and Gammaproteobacteria as the most abundant class OTUs, Enterobacteriales as the most abundant order OTUs and Enterobacteriaceae as the most abundant family OTUs. *Hymenobacter*, *Bacillus*, *Pantoea*, *Allorhizobium*, *Neorhizobium*, *Pararhizobium*, *Rhizobium*, *Serratia*, *Methylobacterium*, *Enterobacter*, *Pseudomonas* and *Sphingomonas* were the most abundant bacterial genera present in lac insects.
- The first National Lac Insect Day was celebrated by all the Network Cooperating Centres and Voluntary Centres on May 16, 2022. Various programmes related to creating awareness of the importance of lac insects and their conservation were conducted for different stakeholders such as farmers, students, scientists and the general public.

Krishi Vigyan Kendra, Khunti

- On farm testing of eight developed technologies and one station trial were conducted in 7.29 ha area with 27 beneficiaries and front line demonstrations (FLDs) of five technologies were carried out in 21.64 ha with 236 beneficiaries.
- Two new plots of Lac Integrated Farming System were developed in two adopted villages. Altogether 265 beneficiaries were involved in demonstration of technologies.
- Fifty-one awareness-cum-training programme was organized on production technology of major crops (paddy/ pigeonpea/ mustard/ chickpea/ green gram), natural farming, scientific lac cultivation, fisheries cultivation and demonstration of farm mechanization during kharif and rabi season in which 2232 farmers participated.
- Several important extension activities/ programme/ events were organized/ arranged *viz.*, Field Day, International Women's Days, World Soil Day, International Yoga Day, Parthenium Awareness Week, Mahil Kisan Diwas, World Food Day, Vigilance Awareness Week, National Unity Day, World Science Day, National Education Day, National Constitution Day, Kisan Diwas, Plantation of agro-forestry Trees, Atma Nirbhar Bharat, Poshan Awareness Campaign, Farmers Scientists Interface on Climate Resilient Varieties, Technologies and practices, address of Hon'ble PM on Natural Farming, Swachhata Pakhwada, Awareness on PM Kisan Yojna and Agromet Advisory under DAMU.

कार्यकारी सारांश

जैव विविधता का संरक्षण तथा लाख कीट और प्राकृतिक राल एवं गोंद (एनआरजी) देने वाले पौधों का लक्षण वर्णन

- राष्ट्रीय लाख कीट फील्ड जीन बैंक में *फ्लेमिंजिया मैक्रोफाइला* पर लाख कीट की 52 वंशावलियों के 1050 संवर्द्धों (कल्चर्स) का संरक्षण किया जा रहा है और लाख के परिपालक वृक्षों के फील्ड जीन बैंक में लाख परिपालक पौधों की 69 प्रजातियों के 90 संग्रहों को संरक्षित किया गया है।

- *कुसुम* गॉल मिज के *कंटेरिनिया* प्रजाति (सेसिडोमाइडी : डिप्टेरा) का प्रथम प्रकोप मार्च के पहले सप्ताह के दौरान *कुसुम* पेड़ों की नई टहनियों में पाया गया। मार्च के महीने में 20% नई पत्तियों में गॉल मिज का संक्रमण देखा गया जबकि अप्रैल के दौरान नई निकली पत्तियों में से 50% पत्तियों में गॉल मिज का प्रकोप देखा गया।

- आरएनए सीक्वेंस डेटा से प्राप्त लाख कीटों के एक एपॉक्साइड हाइड्रॉलेज़ जीन (*epo 35981*) की संपूर्ण– लंबाई कोडिंग अनुक्रम (सीडीएस) को पीजीईएमटी ईजी वेक्टर में प्रतिरूपित (क्लोन) करके अनुक्रमित किया गया गया और उसके सीडीएस का आकार 1221 बीपी पाया गया।

- क्रॉलर्स, संस्थापित निम्फ और निषेचित मादा लाख कीटों का उनके विकास के विभिन्न चरणों में पीई –150 की रीड लंबाई के लिए इलुमिना हाईसीक्वेंस X10 प्लेटफॉर्म पर तीन प्रतियों में उनका ट्रांसक्रिप्टोम अनुक्रमण किया गया। कुल मिलाकर 309,710 ट्रांस्क्रिप्ट (प्रतिलिपि) प्राप्त हुए और ट्रांसडिकोडर फ़िल्टरिंग के बाद 1,72,864 ट्रांस्क्रिप्ट (प्रतिलिपि) प्राप्त हुए। सबसे छोटी ट्रांस्क्रिप्ट (प्रतिलेख) 180 बीपी की थी जबकि सबसे लंबी 28,529 बीपी की पाई गई। एकीकृत प्रतिलिपि के लिए प्राप्त एन50 वैल्यू (मान) 2430 बीपी था।

- जीनों में अंतर अभिव्यक्त करने वाले जीनों की गणना उनके अभिव्यक्ति स्तर के आधार पर की गई। क्रॉलर्स बनाम संस्थापित निम्फों में क्रमशः 5851 और 7526 अधोनियमित एवं उपरिनियमित ट्रांसक्रिप्ट पाए गए। क्रॉलर्स बनाम निशेचित मादा कीटों की तुलना करने पर क्रमशः 10729 और 4762 अधोनियमित एवं उपरिनियमित (डाउन रेगुलेटेड और अपरेगुलेटेड) ट्रांसक्रिप्ट प्राप्त हुए। संस्थापित अर्भक (निम्फ) बनाम निशेचित मादा कीटों की तुलना करने पर क्रमशः 7996 और 3472 अधोनियमित एवं उपरिनियमित (डाउनरेगुलेटेड एंड अपरेगुलेटेड) ट्रांसक्रिप्ट मिले।

- लाख राल के जैवसंश्लेषण में संभावित भूमिका रखने वाले कुछ जीनों को लाख कीट की गैर–स्रावित अवस्था (क्रॉलर) की तुलना में लाख स्रावित अवस्था (संस्थापित अर्भक एवं निषेचित मादा कीटों) में भिन्न तौर पर अभिव्यक्त पाया गया। इनमें फैटी एसिड डेसट्यूरेज, मोनोऑक्सीजिनेज, साइटोक्रोम पी450 मोनोऑक्सीजिनेज, एपॉक्साइड हाइड्रॉलेज़, फ़ार्नेसिल पायरोफ़ॉस्फेट सिंथेज़, प्रीनिल ट्रांसफ़ेरेज़, आइसोप्रेनॉइड बायोसिंथेसिस और एसिटाइल–सीओए बायोसिंथेसिस हेतु जीन, मेवालोनेट काइनेज, मेवालोनेट डिकार्बोक्सिलेज और एचएमजी–सीओए रिडक्टेस को सम्मिलित पाया गया।

- *एफ. सेमियालता* और *बी. मोनोस्पर्मा* की पत्तियों में आइसोफ्लेवोन के कुल अंश को क्रमशः 4086.06 माइक्रोग्राम/ग्राम एवं 2916.08 माइक्रोग्राम/ग्राम शुष्क भार पाया गया। ये लाख परिपालक पौधे *फैबेसी* कुल से संबंधित हैं और इनकी पत्तियों में आइसोफ्लेवोन अंष विशेषकर डेडज़िन की उच्च मात्रा पाई गई।

बेहतर गुणवत्ता एवं उत्पादकता हेतु लाख कीट–उनके परिपालक पौधों का परिवेश या पर्यावरण

- *फ्लेमिंजिया सेमियालता* के पौधों पर पादप वृद्धि विनियामकों (पीजीआर) का छिड़काव किया गया और फिर जुलाई, 2022 में उन पर लाख कीट के *कुसमी* स्ट्रेन को संचारित किया गया। गैरउपचार (123.48 सेमी) की तुलना में काइनेटिन 200 पीपीएम से उपचारित करने पर प्ररोह की सर्वाधिक लंबाई (148.76 सेमी) दर्ज की गई, इसके बाद इसे एनएए 50 पीपीएम (143.12 सेमी) और एनएए 100 पीपीएम (142.88 सेमी) उपचार में पाया गया।

- लाख कीटों के मेटिंग (मिलन) के बाद की महत्वपूर्ण वृद्धि अवस्थाओं के दौरान परिपालक पौधों से उपजी नमी दबाव के कारण लाख की उपज के साथ–साथ उनके प्रजनन संबंधी शरीर–क्रिया पर भी महत्वपूर्ण नकारात्मक प्रभाव पाया गया, क्योंकि ताजा वजन, राल वजन और उभरे हुए क्रॉलर/कोशिकाओं की संख्या में इष्टतम् जल उपचार की तुलना में नमी तनाव उपचार में क्रमशः 11.37%, 32.48% और 40.20% की कमी पाई गई।

- कपास से निर्मित थैली (कॉटन बैग) में भंडारित किए गए बीजों (55.18) की तुलना में पॉलिथीन बैग (58.12) में भंडारित बीजों में छह महीने तक भंडारण के उपरांत अधिक अंकुरण प्रतिशत देखा गया। प्ररोह की लंबाई, जड़ की लंबाई और प्ररोह के शुष्क भार को पॉलिथीन बैग में भंडारित बीजों में अधिक पाया गया जो क्रमशः 8.1 सेमी, 4.21 सेमी और 188 मिग्रा था जबकि कपास की थैली में भडारित बीजों में इसे क्रमशः 5.49 सेमी, 3.51 सेमी और 181 मिग्रा पाया गया।

- दिए गए उपचारों में, पॉलिथीन बैग में भंडारित बीजों को स्पिनोसैड 45 एससी को 2 पीपीएम की दर से + वीटावेक्स पावर (कार्बोक्सिन 37.5% + थिराम 37.5% डब्ल्यूएस) को 2.5 ग्राम/किग्रा की दर से उपचारित बीजों में अंकुरण प्रतिशत (67.36), प्ररोह की लंबाई (14.17 सेमी), जड़ की लंबाई (8.15 सेमी) और प्ररोह का शुष्क भार (235 मिग्रा) अधिक पाया गया जो कपास के थैलियों में भंडारित बीजों की तुलना में क्रमशः 69.16%, 11.24 सेमी, 7.54 सेमी और 220 मिग्रा था।

- दोनों प्रकार के भंडारण पैकेजों में विटावेक्स पावर (कार्बोक्सिन 37.5% + थिराम 37.5% डब्लूएस) का 2.5 ग्राम/किग्रा की दर से उपचार करने पर इसे स्पिनोसैड 45 एससी का 2 पीपीएम की दर से + विटावेक्स पावर (कार्बोक्सिन 37.5%+ थिराम 37.5% डब्लूएस) का 2.5 ग्राम/किग्रा की दर से उपचारित करने के तुल्य पाया गया। पॉलिमर कोटिंग से उपचार में 10% की दर से लाख कोटिंग को पॉलीकोट को 6 ग्राम/किग्रा लेपित बीजों की तुलना में बेहतर पाया गया।

फसल उत्पादन प्रणाली का प्रबंधन एवं मूल्यांकन

- पेड़ों को अधिक विश्रांति (रेस्ट) देने पर प्रति 10 सेमी व्यास वाले पौधों में संचारण योग्य प्ररोहों की संख्या, प्ररोह का वास्तविक व्यास और इसकी लंबाई को काफी प्रभावी पाया गया। जब प्ररोहों की छंटाई के अंतराल को 7 महीने की तुलना में 19 महीने रखा गया तो संचारण योग्य प्ररोहों में 43% की वृद्धि पाई गई। इसी प्रकार, *पलास* के पौधों में छंटाई से पहले अधिक विश्रांति समय देने पर प्ररोहों के व्यास और लंबाई में क्रमशः 11.5% और 26% की वृद्धि देखी गई।

- निचले इलाकों में ऊपरी इलाकों की तुलना में काफी अधिक संख्या में नए प्ररोह निकले। ऊपरी इलाकों में अवशिष्ट प्ररोह के भार एवं संख्या के उच्च मान देखे गए। यह आश्चर्य की बात है कि ऊपरी इलाकों में निचले इलाकों की तुलना में दोगुने से भी अधिक लाख का उत्पादन संभव हो सका। प्राप्त उपज का अनुपात क्रमशः 2.16 और 0.95 पाया गया।

- उर्वरता का स्तर अधिक होने से प्ररोहों के वृद्धि संबंधी लक्षणों में से प्ररोह की लंबाई काफी प्रभावित हुई। उर्वरता के उच्चतम स्तर पर कंट्रोल (गैरउपचार) की तुलना में 25 प्रतिशत अधिक वृद्धि दर्ज की गई।

- मृदा की तीन स्थितियों अर्थात 0–30 सेमी, 30–60 सेमी, 60–100 सेमी की गहराई पर जल संतुलन का अध्ययन किया गया। इस अध्ययन से पता चला कि दिसंबर, 2022 के अंत तक लाख संचारित पौधों हेतु फसलीय जल की कुल मांग 1055.36 मिमी और बिना लाख संचारण वाले पौधों के लिए 1007.71 मिमी थी।

- *एफ. सेमियालता* के पौधों से एकत्र एकल सैंपल में सूटी मोल्ड फंगस के दो प्रकार के कोनिडिया देखे गए। जिसमें से एक छोटे स्टाल वाला और बहुजातीय (मल्टी सेप्टेड) था और उपलब्ध संदर्भों के आधार पर इसकी *कैपनोडियम सैलिसिनम* कवक होने की पुष्टि की गई। दूसरा स्पोर (बीजाणु) सिरे पर ब्लंट (कुंद) और दोहरी परत वाला था और उपलब्ध संदर्भों के आधार पर इसकी *एनोपेल्टिस वेनेजुएलेंसिस* नामक कवक होने की पुष्टि की गई।

क्षमता निर्माण, प्रौद्योगिकी प्रसार, प्रभाव का आकलन तथा बाजार संबंधी इंटेलिजेंस (आसूचना)

- झारखंड एवं पश्चिम बंगाल को सम्मिलित करते हुए चार राज्यों के 614 किसानों के लिए 'वैज्ञानिक लाख उत्पादन, प्रसंस्करण एवं उपयोग' पर किसानों के लिए 17 प्रशिक्षण कार्यक्रमों को आयोजित किया गया।
- विभिन्न विश्वविद्यालयों के 104 छात्रों के लिए ''प्राकृतिक राल एवं गोंद पर औद्योगिक प्रशिक्षण'' पर तीन शैक्षिक कार्यक्रम (10 दिन) आयोजित किए गए।
- झारखंड के 248 हितग्राहियों हेतु पांच खेत प्रशिक्षण (ऑन–फार्म) का आयोजन किया गया। 98 किसानों के लिए खेतों पर (ऑन फार्म) 02 प्रेरक प्रशिक्षणों का आयोजन किया गया। 'प्राकृतिक राल एवं गोंद' पर एक दिवसीय 44 ऑन कैंपस (परिसरीय) अनुकूलन कार्यक्रमों को आयोजित किया गया; तथा 1483 हितग्राहियों ने संस्थान का दौरा/अवलोकन किया।
- डीएपीएससी कार्यक्रम के तहत अनुसूचित जाति के 565 किसानों के लिए 19 प्रशिक्षण कार्यक्रमों का आयोजन किया गया।
- संस्थान द्वारा तीन किसान गोष्ठियों का भी आयोजन किया गया।
- इन विभिन्न कार्यक्रमों का लाभ कुल मिलाकर 5948 लाभार्थियों ने उठाया।
- प्रतिवेदित अवधि के दौरान 13 अति विशिष्ट लोगों (वीआईपी) और गणमान्य व्यक्तियों ने संस्थान संग्रहालय का दौरा/अवलोकन किया।

संश्लेषण, प्रक्रिया–विकास एवं गुणवत्ता प्रबंधन

- पौधों से निकलने वाले प्राकृतिक गोंद के मूल नमूनों को सीधे संबंधित पेड़ों से एकत्र किया गया तथा अन्य नमूने जैसे समुद्री शैवाल गोंद, माइक्रोबियल गोंद आदि को हाईमीडिया प्राइवेट लिमिटेड से क्रय किया गया। बीआईएस मानक प्रक्रिया (आईएसः 7437 – 1974 : वानस्पतिक आसंजकों (एडेसिव) हेतु नमूनों का प्रतिचयन एवं जांच) अपनाते हुए अलग–अलग गोंद के 31 नमूनों के वाष्पशील पदार्थ (%), पीएच और यूवी–विस़ का लक्षणवर्णन किया गया। सभी प्रकार के गोदों में वाष्पशील पदार्थ का प्रतिशत 4.9 से 14.8% के बीच पाया गया। अधिकांश गोंद की पीएच 4.0 से 6.5 के बीच पाई गई। अधिक श्यानता (उच्च चिपचिपे) वाले गोदों के लिए बीआईएस मानक (आईएसः 7437 – 1974) में वर्णित विधि के अनुसार ठंडे जल में घुलनशीलता (%) की आकलन विधि की अन–प्रयुक्तता को ध्यान में रखते हुए इसके लिए एक नई विधि विकसित की गई। इस प्रक्रिया द्वारा अलग–अलग गोंदों के 25 नमूनों का विश्लेषण किया गया जिसमें ठंडे पानी में घुलनशीलता के प्रतिशत को 5 से 95% के बीच पाया गया। सभी गोंदों ने यूवी क्षेत्र में 190 से 200 एनएम (nm) के बीच स्पष्ट अधिशोषण मैक्सिमा प्रदर्शित किया।
- शुद्ध प्राकृतिक *टर्मिनेलिया बेलिरिका* (बहेड़ा) गोंद के ग्राफ्ट को प्रारंभिक एजेंट (इनिशिएटर) और क्रॉसलिंकर सहित को–पोलिमराइजेशन (सह–बहुलीकरण) द्वारा हाइड्रोजेल तैयार किया गया। उल्लेखनीय प्रतिक्रियात्मक वेरिएबल्स (चरों) में बहुलीकरण (पॉलिमराइजेशन) का समय एवं प्रतिक्रिया मिश्रण की मात्रा शामिल हैं और प्रतिक्रिया मिश्रण के आयतन (वाल्यूम) में वृद्धि के साथ पॉलिमराइजेशन समय में वृद्धि होती है। गोंद के फूलने की विशेषताओं का अध्ययन किया गया और यह देखा गया कि तापमान में 25 ^{0}सें0 से 45 ^{0}सें0 तक की वृद्धि होने पर हाइड्रोजेल के फुलाव (स्वेलिंग) में धीरे–धीरे 3570 से 4150 तक वृद्धि हो जाती है।
- विभिन्न प्रकार के पीएच बफर प्रणालियों (2, 5, 7 एवं 10) और अलग–अलग तापमानों पर संश्लेषित क्रॉस–लिंक्ड अरेबिक गोंद आधारित हाइड्रोजेल की फूलने की विशेषताओं एवं उसके व्यवहार का अध्ययन किया गया। दो पीएच मानों (5 एवं 10 पर) पर उच्च फुलाव देखा गया। यह देखा गया कि जैसे–जैसे तापमान को एक निश्चित सीमा तक धीरे–धीरे बढ़ाया गया, फूलने की दक्षता में वृद्धि पाई गई और ईष्टतम् तापमान के बाद यह प्रकट तौर पर स्थिर हो जाता है। अरेबिक गोंद के हाइड्रोजेल पर ब्रिलिएंट ग्रीन डाई अधिशोषण हेतु लैंगमुइर आइसोथर्म मॉडल का उपयोग

करके अधिशोषण आइसोथर्म के अध्ययन में पाया गया कि जैसे–जैसे तापमान को 25 °सें0 से 45 °सें0 तक बढ़ाया जाता है, अधिशोषण 5.3 से बढ़कर 8.0 मिग्रा/ग्राम तक हो जाता है। इससे पता चलता है यह अधिशोषण ऊष्माशोषी (एंडोथर्मिक) था और यह इस मॉडल के उपयुक्त पाया गया है।

मूल्य वर्द्धन एवं उत्पादों का विकास

- लाइपोसोमल फॉर्मूलेशन में आहारीय रेशों के उपयोग से बीटा कैरोटीन के संपुटीकरण (इंकैप्सुलेशन) को पूरा किया गया और संपुटित बीटा कैरोटीन का विस्तारपूर्वक लक्षण वर्णन किया गया। संपुटित बीटा कैरोटीन के प्रयोगशाला में किए गए (*इन विट्रो*) गैस्ट्रोइंटेस्टाइनल (जठरांत्रीय) रिलीज़ अध्ययन से पता चलता है कि लाइपोसम पाचन के दौरान सक्रिय पदार्थों को क्षति से बचाते हैं और बीटा कैरोटीन के लक्षित कार्य संचालन में मदद करते हैं।

- सोल्यूशन कास्टिंग विधि द्वारा पियार – AgNPs के साथ प्रबलित कई नैनोकम्पोजिट फिल्में विकसित की गईं। जल उद्ग्रहण एवं जल वाष्प पारगम्यता अध्ययनों से पता चलता है कि इन विकसित नैनोकम्पोजिट फिल्मों में पैकेजिंग के लिए जल–वाष्प के विरुद्ध प्रभावी अवरोधक गुण मौजूद हैं। इन विकसित नैनोकम्पोजिट फिल्मों की जीवाणुरोधी प्रभावकारिता का मूल्यांकन ग्राम नकारात्मक एवं ग्राम सकारात्मक बैक्टीरिया दोनों के लिए किया गया और इनको जीवाणु रोगज़नकों के विरुद्ध प्रबल रूप से सक्रिय पाया गया।

कृषि उपकरणों एवं प्रसंस्करण मशीनरी का प्रकल्पन (डिजाइनिंग) तथा विकास

- प्रसंस्करण प्रक्रिया में अंतर के साथ ग्वार गोंद से कार्बोक्सी मिथाइल ग्वार गोंद व्युत्पन्न तैयार किया गया। परिणामों से स्पष्ट होता है कि कम मिश्रण समय (30 मिनट), प्रतिक्रिया समय 3 घंटे और शुष्कन समय 3 घंटे में उच्च श्यानता (चिपचिपे) वाले कार्बोक्सी मिथाइल ग्वार गोंद व्युत्पन्न को समान पीएच और प्रतिस्थापन डिग्री के साथ तैयार किया जा सकता है।

- भाकृअनुप – केंद्रीय कृषि अभियांत्रिकी संस्थान, भोपाल के सहयोग से कार्बोक्सी मिथाइल ग्वार गोंद व्युत्पन्न पायलट प्लांट की सभी इकाइयों को निर्मित किया गया तथा सामग्री प्रबंधन उपकरणों और मामूली संशोधन सहित विभिन्न निर्मित इकाइयों में स्थापित घटकों को लाया गया। भाकृअनुप – केंद्रीय कृषि अभियांत्रिकी संस्थान, भोपाल में मामूली समायोजन के साथ इन निर्मित इकाइयों और घटकों की कार्यक्षमता का परीक्षण किया जा रहा है।

- प्रयोगशाला स्केल रिफ्रैक्टेंस विंडो (आरडब्ल्यू) ड्रायर का उपयोग करके जल के 05 विभिन्न तापमानों और 03 अलग–अलग मोटाई वाली मायलर प्लास्टिक शीट पर ग्वार गोंद से निर्मित हाइड्रोजेल को सुखाया गया। रेस्पांस सर्फेस कार्यप्रणाली का उपयोग करके आरडब्ल्यू शुष्कन के प्रॉसेस वेरिएबल्स (प्रक्रिया चरों) को अनुकूलित किया गया।

- नौ अलग–अलग तापमानों (30 से 120° सें0) पर टेक्सचर एनालाइजर की सहायता से चौरीलाख (सीडलैक) के संशक्ति–आसंजन व्यवहार का मूल्यांकन किया गया। चौरीलाख के नमूनों का सात अलग–अलग तापमानों (70 से 130° सें0) पर रियोलॉजी व्यवहार का निर्धारण किया गया। हस्तचालित रैम–एक्सट्रूडर के दो प्रोटोटाइप तैयार करके उनका मूल्यांकन किया गया।

प्रक्रिया का परिष्करण, व्यावसायीकरण एवं उद्यमिता विकास

- मोमबत्ती के मौजूदा सांचे में सीलिंग वैक्स बनाने का प्रारंभिक परीक्षण, पुराने चपड़ा (शेलैक) एवं ताजे चपड़ा के साथ किया गया, जिसमें 10% से 40% तक रोसिन की अलग–अलग मात्रा प्रयुक्त की गई और पाया गया कि पुराना चपड़ा जिसके लिए अधिक रोसिन प्रतिशतता की आवश्यकता होती है की तुलना में 10% कम रोसिन के साथ ताजा चपड़े से सीलिंग स्टिक बनाने में तरलता की कोई समस्या नहीं पाई गई।

- इन सांचों के निर्माण के लिए कार्बन स्टील, स्टेनलेस स्टील और एल्यूमीनियम मिश्र धातु डाई बनाने की सामग्री में कूलिंग व्यवस्था के साथ वर्गाकार, गोल, हेक्सागोनल जैसे विभिन्न आकारों के नए साँचे डिजाइन किए गए।

एनआरजी का संग्रह, प्रसंस्करण और मूल्य संवर्धन पर नेटवर्क परियोजना

- गर्मी के मौसम (मार्च–अप्रैल, 2022) में काजरी (सीएजेडआरआई) के अनुसंधान फार्म में परीक्षण के लिए सात *कॉर्डियारोथी* पेड़ों का चयन किया गया। इन चयनित पेड़ों के संरचनात्मक लक्षणों जैसे औसत ऊंचाई, डीबीएच और छत्र कवर क्रमशः 4.54 मीटर, 7.46 सेमी और 2.66 वर्ग मीटर थे। गोंद की औसत उपज 88.14 ग्राम/वृक्ष तथा इसके रेंज को 52.0 ग्राम से 137 ग्राम के बीच पाया गया।

- बबूल गम और कार्बोक्सिमिथाइल सेलूलोज़ का उपयोग करके तैयार की गई कोटिंग सामग्री से उपचारित बटन मशरूम ने अच्छी दृढ़ता बनाए रखी और भंडारण के 8 दिनों तक इसे खाने योग्य पाया गया।

- आईजीकेवी, रायपुर केंद्र में किए गए एक अध्ययन में पाया गया कि स्टार्च और प्लास्टिसाइज़र के संयोजन से चरोटा बीज गोंद का उपयोग करके फलों और सब्जियों पर परत चढ़ाने के लिए फिल्म का विकास संभव है।

- गीले रेत में रखे मिट्टी के बर्तन में भंडारित गुग्गुल की बजाय नम जूट की थैली में लिपटे मिट्टी के पात्रों में संग्रहित गुग्गुल में अधिकतम बायोएक्टिव यौगिकों को बनाए रखने में बेहतर पाया गया।

- वी–क्यूब फ्रेश प्राइवेट लिमिटेड, परभणी के सहयोग से वीएनएमकेवी, परभणी केंद्र में ग्वार मील प्रोटीन के वियोजकों को शामिल करके विकसित डॉग पेट फूड क्रैकर्स का उत्पादन उसकी बिक्री हेतु प्रारंभ किया गया।

- अध्ययन किए गए विभिन्न सूराख (बोरहोल) कोणों (25^0, 40^0, 55^0 और 70^0) में से नौनी परिसर में सर्वाधिक ओलियोरेसिन उपज (4255.22 ग्राम/मौसम) 40^0 कोण और 60 सेमी से अधिक व्यास वर्ग के वृक्षों में दर्ज की गई।

- रिल विधि में, सभी पेड़ों को चार व्यास वर्गों अर्थात 30–40 सेमी (डी1), 40–50 सेमी (डी2), 50–60 सेमी (डी3) और 60 सेमी (डी4) से अधिक में वर्गीकृत किया गया। ओलियोरेसिन उपज पर पौधे के व्यास (डीबीएच) के प्रभाव से पता चला है कि ओलियोरेसिन की सर्वाधिक उपज (7.93 किग्रा/सीजन) 60 सेमी (डी4) से अधिक व्यास वर्ग में पाई गई और सबसे कम उपज (4.62 किग्रा/सीजन) 30–40 सेमी (डी1) व्यास वर्ग में पाई गई।

- अधिकतम तापमान का ओलियोरेसिन उपज के साथ सकारात्मक संबंध पाया गया तथा तापमान का औसत सापेक्ष आर्द्रता के साथ नकारात्मक संबंध पाया गया। ओलियोरेसिन उपज ने अधिकतम तापमान (0.959) के साथ महत्वपूर्ण सकारात्मक सहसंबंध गुणांक प्रदर्शित किया तथा ओलियोरेसिन उपज और औसत सापेक्ष आर्द्रता (–0.852) के बीच महत्वपूर्ण नकारात्मक सहसंबंध गुणांक देखा गया।

- *ब्यूटिया मोनोस्पर्मा* में साल भर गोंद के रिसाव पर किए गए अध्ययन से पता चलता है कि दिसंबर और जनवरी माह में सबसे ज्यादा गोंद का रिसाव होता है जबकि जुलाई, अगस्त और सितंबर के महीने में गोंद का रिसाव नगण्य पाया गया।

- पियार – AgNPs के साथ प्रबलित नैनोकम्पोजिट फिल्म को सॉल्यूशन कास्टिंग विधि द्वारा विविध अनुप्रयोगों के लिए विकसित किया गया। इस विकसित फिल्म में बेहतर यांत्रिक अवरोधक, कवकरोधी एवं जीवाणुरोधी गुण पाए गए। इस अध्ययन से संकेत मिलता है कि इन नैनोकम्पोजिट फिल्मों का उपयोग संभावित रोगाणुरोधी पैकेजिंग सामग्री के रूप में किया जा सकता है।

- बाड़मेर जिले की चौहटन एवं बायतु तहसीलों के 48 से अधिक गांवों; जोधपुर जिले की शेरगढ़ और फलोदी तहसीलों; और नागौर, झुंझनू और पाली जिलों के कुछ गांवों के किसानों ने बड़े पैमाने पर गोंद उत्प्रेरण तकनीक को अपनाया। वर्ष 2022 में *ए. सेनेगल* के 14,520 पेड़ों का काजरी के गोंद उत्प्रेरण (गम इंड्यूसर) द्वारा उपचार किया गया, जिसके परिणामस्वरूप लगभग 6.53 टन अरेबिक गोंद का उत्पादन हुआ। वर्ष के दौरान गम अरेबिक की औसत दर स्थानीय बाजार में रु0 800/किग्रा थी। इस प्रकार, उक्त गांवों के काजरी, जोधपुर में पंजीकृत किसानों ने 52.24 लाख रुपये का राजस्व अर्जित किया और प्रत्येक गाँव में अरेबिक गोंद की बिक्री से किसानों को 1.08 लाख रुपये रुपये की अतिरिक्त आय प्राप्त हुई।

लाख कीट के आनुवंशिक संसाधनों के संरक्षण पर नेटवर्क परियोजना

- एंटोमोपैथोजेनिक कवक *इसारिया फ्यूमोसोरोसिया* ने *यूब्लेम्मा अमाबिलिस* के प्रबंधन में आशाजनक परिणाम प्रदर्शित किए। लाख कीटों पर इस एंटोमोपैथोजेनिक कवक के जैव–सुरक्षा विश्लेषण से पता चला कि यह खेत और प्रयोगषाला दोनों ही दशाओं में लाख कीटों के विरुद्ध बेहद सुरक्षित है। 29 अप्रैल, 2022 को आयोजित तकनीकी समिति, *खरीफ* की बैठक में पश्चिमी कार्बी आंगलोंग के किसानों के खेतों में ऑन फार्म ट्रायल (ओएफटी) आयोजित करने के लिए *आई. फ्यूमोसोरोसिया* के जैव–फार्मुलेशन की सिफारिश की गई।

- रोएंदार कवकीय वृद्धि वाले दो हेमिप्टेरन कीटों अर्थात् *मेगाकोप्टा क्राइबेरिया* एवं *ब्रैचीप्लेटिस सुबेनियस* के शवों को क्षेत्रीय फील्ड जीन बैंक, एएयू, जोरहाट से एकत्र किया गया। इन एकत्रित नमूनों को अलग करके उनका शुद्ध कल्चर और सबकल्चर किया गया। कीटों के विभिन्न समूहों में रोगजनकता का अध्ययन किया गया और इसे लेपिडोप्टेरान नाशीकीटों के विरुद्ध प्रभावी पाया गया। मूल ईपीएफ का आकृति विज्ञान संबंधी एवं आणविक लक्षण वर्णन किया गया और इसकी पहचान *फ्यूजेरियम ऑक्सीस्पोरम* के रूप में की गई।

- शुष्क पश्चिमी मैदानी कृषि–जलवायु क्षेत्र में लाख की खेती की संभावनाओं का पता लगाने और इस भूभाग में लाख की खेती को अपनाने तथा लाख के कम उत्पादन हेतु जिम्मेदार समस्याओं का मुकाबला करने के लिए स्थान–विशिष्ट अध्ययन किए गए और शोध निष्कर्षों से पता चला कि विभिन्न परिपालक वृक्षों में उत्पादकता संबंधी मापदंडों के अध्ययन के बाद, *बेर* को इस क्षेत्र में खेती के लिए सबसे उपयुक्त परिपालक वृक्ष पाया गया।

- लाख कीट के प्रमुख लेपिडोप्टेरान परभक्षियों (*यूब्लेम्मा अमाबिलिस* एवं *स्यूडोहाइपेटोपा पुलवेरिया*) के विरुद्ध कीटनाशकों की जैव–प्रभावकारिता के अध्ययन से पता चलता है कि लाख कीट की जीवितता के सर्वाधिक औसत प्रतिशतता के साथ सबसे प्रभावी उपचार (68.89%) वयस्क परभक्षियों के साथ इमामेक्टिन बेंजोएट 5 एसजी का 0.4 ग्राम/लीटर की दर से छिड़काव करना था। जैविक उपचारों में लेपिडोप्टेरॉन परभक्षियों के प्रबंधन हेतु 10% पर तेखा सैट के दो छिड़काव लाख पर परभक्षियों की संख्या को कम करने में सबसे प्रभावी पाए गए, इसके बाद नीम के बीज का अर्क 5% और ब्रम्हास्त्र 5% के छिड़काव को पाया गया जबकि दो उपचारों जिसमें नीम का तेल 2% और गोमूत्र 10% सम्मिलित है को परभक्षियों के विरुद्ध सबसे कम प्रभावी पाया गया।

- बीहनलाख को बनाए रखने के लिए *एल्बिजिया लेब्बेक* तथा *कॉलियांड्रा मैक्रोफाइला* को बहिस्थलीय (*एक्स सीटू*) संरक्षण के लिए सबसे उपयुक्त लाख परिपालक वृक्ष पाया गया जबकि *अकेशिया निलोटिका* एवं *ज़िज़िफस मॉरिशियाना* को जम्मू की दशाओं में सबसे अच्छे परिपालक पौधों के रूप में दर्ज किया गया।

- अध्ययन से पता चलता है कि लाख खेतों की निकटवर्ती फसलीय खेतों से दूरी बढ़ने पर भिंडी, सरसों और सूरजमुखी के कीटों में काफी वृद्धि हुई जबकि इनके प्राकृतिक शत्रुओं की व्यापकता में काफी कमी आई है।

- 16एस आरआरएनए के एम्प्लिकॉन अनुक्रमण द्वारा *केरिया लैक्का* के विभिन्न चरणों की जीवाणु विविधता से पता चलता है कि लाख के कीटों में प्रोटीओबैक्टीरिया और एक्टिनोबैक्टीरिया सबसे प्रचुर फ़ाइलम ओटीयू, अल्फाप्रोटोबैक्टीरिया और गैमप्रोटोबैक्टीरिया सबसे प्रचुर क्लास ओटीयू, एंटरोबैक्टीरिया सबसे प्रचुर ऑर्डर ओटीयू और एंटरोबैक्टीरियासी सबसे प्रचुर फैमिली (कुल) ओटीयू के तौर पर पाया गया। लाख कीटों में सबसे प्रचुर मात्रा में उपस्थित जीवाणु जेनेरा में *हाइमनोबैक्टर, बैसिलस, पैन्टोइया, एलोराइज़ोबियम –नियोराइज़ोबियम –पैराराइज़ोबियम–राइज़ोबियम, सेराटिया, मिथाइलोबैक्टीरियम, एंटरोबैक्टर, स्यूडोमोनास* और *स्फिंगोमोनस* थे।

- नेटवर्क परियोजना के सभी सहयोगी और स्वैच्छिक केंद्रों द्वारा प्रथम राष्ट्रीय लाख कीट दिवस 16 मई, 2022 को मनाया गया। इस अवसर पर किसानों, छात्रों, वैज्ञानिकों और जनसामान्य जैसे विभिन्न हितग्राहियों के लिए लाख कीटों के महत्व और उनके संरक्षण के बारे में जागरूकता पैदा करने के लिए कई कार्यक्रमों का आयोजन किया गया।

कृषि विज्ञान केन्द्र, खूंटी

- संस्थान द्वारा विकसित 08 प्रौद्योगिकियों का खेतों में परीक्षण और एक स्टेशन परीक्षण 27 लाभार्थियों के साथ 7.29 हेक्टेयर क्षेत्रफल में किया गया और 236 लाभार्थियों के साथ 21.64 हेक्टेयर में पांच प्रौद्योगिकियों के अग्र पंक्ति के प्रदर्शनों (एफएलडी) का संचालन किया गया।
- गोंद लिए गए दो गांवों में लाख एकीकृत कृषि प्रणाली के दो नए भूखंड (खेत) विकसित किए गए। प्रौद्योगिकियों के प्रदर्शन में कुल मिलाकर 265 लाभार्थी शामिल थे।
- *खरीफ* और *रबी* मौसम के दौरान प्रमुख फसलों (धान/अरहर/सरसों/चना/मूंग) की उत्पादन तकनीक, प्राकृतिक खेती, लाख की वैज्ञानिक खेती, मछली पालन और कृषि मशीनों के प्रदर्शन पर कुल मिलाकर 51 जागरूकता सह प्रशिक्षण कार्यक्रमों का आयोजन किया गया जिसमें 2232 किसानों ने सहभागिता की।
- प्रतिवेदित अवधि में कई महत्वपूर्ण प्रसार गतिविधियों/कार्यक्रमों/विशेष समारोहों जैसे खेत दिवस, अंतर्राष्ट्रीय महिला दिवस, विश्व मृदा दिवस, अंतर्राष्ट्रीय योग दिवस, *पार्थेनियम* जागरूकता सप्ताह, महिला किसान दिवस, विश्व खाद्य दिवस, सतर्कता जागरूकता सप्ताह, राष्ट्रीय एकता दिवस, विश्व विज्ञान दिवस, राष्ट्रीय शिक्षा दिवस, राष्ट्रीय संविधान दिवस, किसान दिवस, कृषि वानिकी वृक्षों का रोपण, आत्म निर्भर भारत, पोषण जागरूकता अभियान, जलवायु अनुकूल किस्मों पर किसान वैज्ञानिकों की पारस्परिकता (इंटरफ़ेस), प्रौद्योगिकी और अभ्यास, प्राकृतिक खेती पर माननीय प्रधान मंत्री का संबोधन, स्वच्छता पखवाड़ा, पीएम किसान योजना पर जागरूकता और डीएएमयू के तहत कृषि मौसम संबंधी सलाह जैसे कार्यक्रमों का आयोजन किया गया।

Research Accomplishments

Quality and Productivity Improvement

1. Biodiversity Conservation of Lac Insect and NRG Yielding Plants

1.1 Collection, conservation, characterization and evaluation of lac insect/ host plant bio-diversity

Influence of plant growth regulators on morpho-physiology of *Flemingia semialata* (Roxb.) under lac insect (*K. lacca* Kerr.) infested condition

The study was carried out on *Flemingia semialata* grown at institute research farm (IRF) of Indian Institute of Natural Resins and Gums (IINRG), Namkum, Ranchi during 2022-23. The plants were sprayed with plant growth promoters and growth retardants on 24th June, 2022 before inoculation. Plants were inoculated with *kusmi* strain of lac insect (*K. lacca* Kerr.) in the month of July, 2022. Plants with no spraying along with lac insect served as control. The standard cultural/ package of practices for *kusmi* lac cultivation were followed. The observation on shoot length, total biomass, and nodes per plant were taken. *F. semialata* plants were sprayed with plant growth regulators (PGRs) and then inoculated with *kusmi* strain of lac insect in July, 2022. Treatment Kinetin 200 ppm recorded highest shoot length (148.76 cm) followed by NAA 50 ppm (143.12 cm) and NAA 100 ppm (142.88 cm) as compared to control (123.48 cm). The data on inter-nodal length showed that treatment NAA 50 ppm recorded highest average inter-nodal length (8.9 cm) followed by NAA 100 ppm (8.18 cm) and Kinetin 200 ppm (7.78 cm) as compared to control (7.24 cm). In case of average number of nodes per plant, the treatment NAA 100 ppm has highest average number of nodes of (15.6) followed by Kinetin 200 ppm (14.36), NAA 50 ppm (14.32) as compared control (12).

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

- 90 collections of 69 species are being conserved in the lac host field gene bank.
- 1050 cultures of 52 lac insect lines are being conserved on *F. 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 4×8 meter) and Rain tree (*Albizia saman*) (30 numbers with spacing 8×8 meter) were raised and developed in separate plots for further study.

1.2. Taxonomic studies of lac insects (Hemiptera: Coccoidea: Tachardiidae) and associated insect fauna

Studies on emerging pests of *kusum*

Earlier a new emerging insect pest of *kusum* was identified from the state of Jharkhand. It was identified as *Contarinia* sp. (Cecidomyiidae: Diptera) which causes severe hairy galling in young *kusum* leaf (Fig. 1.1). No information is available till date about the seasonal incidence, population dynamics and biology of this pest. Hence, a study has been initiated this year to study the bionomics of this emerging pest. Study revealed that the first incidence of leaf gall is visible during first week of March in the freshly emerged twigs of *kusum* trees. During March month 20% of the newly emerged leaves were infested by the gall midge while, during April galls were observed in 50% of the newly emerged leaves. Infestation severity was significantly higher in trees which were pruned this year as compared to the last year pruned trees. The galls were observed to attain maturity in 12-14 days. Different gall development stages as well as mechanism of gall formation are presently being studied (Table 1.1).

Fig. 1.1: Gall midge larva inside dissected leaf gall of *kusum*

Table 1.1: Life cycle of *kusum* gall midge

Life stage	Duration (days)
Egg	1.82±0.43
Larva	8.31±2.90
Pupa	4.92±1.66
Adult	2.13±1.56

2. Lac Insect-Host Plant Environment for Improved Quality and Productivity

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

Palas tree growth affected by agronomic interventions

Computed values of number of inoculable shoots per 10 cm diameter of tree trunk and branch, number of shoots per centimeter of prune point diameter, actual shoot diameter and its length, yield ratio and other growth parameters are presented in Table 2.1.

Number of inoculable shoots per 10 cm tree diameter, actual shoot diameter and its length was found to be influenced significantly by allowing rest to the trees. Inoculable shoots were found to increase 43% when pruning interval was 19 months as compared to 7 months. Similarly 11.5% and 26% increase in shoot diameter and length was observed due to allowing higher rest period before pruning of *palas* trees.

So far as topography is concerned, significantly higher number of new shoots were produced on upland condition than lowlands. Higher values of residual shoot weight and number were also noticed in upland condition. Most surprisingly, upland condition could produce lac more than double compared to lowland condition. Yield ratio obtained was 2.16 and 0.95, respectively.

Data on dead shoots, residual/ left over shoots and yield ratio showed some consistency created due to imposing different soil fertility levels on the host tree. Values for branch mortality was 6.5 per 10 cm trunk diameter in no fertilizer application treatment, while the same value was 4.5 when highest level of fertility was applied to it. Lac yield ratio was 2.2 in highest level of fertilization, compared to 0.52 as in control. It indicated that more than four times increase in lac production can be obtained if proper fertilization is done to the hosts.

The existing experiment has got a pruning cycle of two and three years. Keeping the inconvenience of a long waiting period in view, a separate experiment was laid out to examine whether enhanced soil fertility levels *i.e.* F0, F1, F2, F3 and F4 (Control/ Lime 1 kg + Urea 200 g + DAP 200 g + MOP 400 g/ Lime 2 kg + Urea 400 g + DAP 400 g + MOP 800 g/ Lime 4 kg + Urea 800 g + DAP 800 g + MOP 1600 g) and varying inoculation load *i.e.* L1, L2 and L3 (25, 50 and 75% inoculation) can enable *palas* trees to endure pruning every year. Relevant observations have been presented in Table 2.2.

Growth attributes like shoot length was found to be affected significantly due to higher level of fertility. Highest level of fertility could register 25 percent higher growth compared to control. Other attributes like shoot dry matter percent and diameter remained unaffected by any of the factors. However, dry matter percent showed a tendency to decrease with increased fertility.

Table 2.1 : Plant growth attributes and summer lac yield as affected by topography, soil fertility and rest period on *palas*

	No. of dead branches per 10 cm trunk diameter	No. of inoculable shoots per 10 cm branch diameter	No. of inoculable shoots/ 10 cm tree diameter	No. of inoculable shoots per cm PP thickness	Shoot diameter in July, mm	Shoot diam-eter in Dec, mm	Shoot length in July, cm	Shoot length in Dec, cm	No. of upper new shoots per 10 cm trunk diameter	No. of upper old shoot per 10 cm trunk diameter	Residual shoot No. per 10 cm trunk diameter	Residual shoot wt/ 10 cm trunk diameter, kg	Male percent	Yield ratio
U	4.65	20.29	46.33	1.56	10.13	10.12	52.55	55.45	11.84	12.03	28.99	1.76	32.41	2.16
N	4.13	16.92	38.77	1.60	9.91	9.84	50.99	50.94	7.92	10.85	7.67	0.61	32.75	0.95
$CD_{(0.05)}$	1.15	3.74	9.33	0.30	0.46	0.43	4.90	5.21	2.90	3.75	7.64	0.56	3.85	0.71
	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	*	*	ns	*
F0	6.52	21.23	45.15	1.81	9.71	9.62	51.33	54.45	14.85	19.59	9.65	0.71	34.14	0.52
F1	3.01	16.19	48.51	1.63	10.02	9.83	55.29	55.61	9.91	9.56	21.27	1.34	30.10	1.84
F2	3.58	17.22	37.03	1.51	10.15	10.42	53.56	54.84	8.06	7.06	21.63	1.22	33.88	1.66
F3	4.45	19.77	39.50	1.36	10.19	10.05	46.90	47.88	6.70	9.54	20.77	1.46	32.20	2.20
$CD_{(0.05)}$	1.62	5.29	13.20	0.43	0.65	0.61	6.94	7.37	4.10	5.30	10.80	0.79	5.44	1.00
	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	*
R1	4.77	17.07	34.90	1.52	9.47	9.42	45.80	47.59	9.99	12.17				
R2	4.02	20.14	50.19	1.64	10.56	10.53	57.74	58.80	9.76	10.70				
$CD_{(0.05)}$	1.15	3.74	9.33	0.30	0.46	0.43	4.90	5.21	2.90	3.75				
	ns	ns	*	ns	*	*	*	*	ns	ns				

*Significant at 5% level

Table 2.2 : Plant growth attributes as affected by fertility levels and inoculation load

	Mean shoot dry matter (%)	Mean shoot diameter (mm)	Mean shoot length (cm)
F0	36.27	8.92	47.56
F1	35.89	8.34	48.80
F2	35.69	8.71	57.20
F3	35.22	8.71	59.44
$CD_{(0.05)}$	2.70	0.80	8.70
	NS	NS	*
L1	36.41	8.66	48.25
L2	35.11	8.35	56.29
L3	35.79	9.01	55.21
$CD_{(0.05)}$	2.34	0.70	7.53
	NS	NS	NS

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

Storage quality of *Flemingia semialata* seed is very poor. Fresh seeds of *F. semialata* were used for storage study. The main objective is to study the effect of storage packages (polythene bag 700 gauge and cloth bag) and treatments at the different duration on seed quality under ambient storage conditions for 36 months storage period. Samples were drawn and tested after six month intervals. Different seed coating treatments *viz.*, 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) were used before the storage. Morpho-physiological observations of the 6 months stored seed *viz.,* germination percent, shoot length, root length, seedling dry weight were taken up to 28 days from the date of sowing.

Significantly higher germination percent after six months storage was observed in the seed stored in polythene bag (58.12) than cotton bag (55.18). Seed coated with T4 treatment and stored under polythene bag showed higher germination percent (67.36) followed by T3 treatment (66.54) and T2 (66.49). The performance of T3 treatment was observed at par with T4 treatment in both storage packages. Under polymer coating treatment, lac coating @10% observed better than the polycote @6g/kg coated seeds (Table 2.3). The germination percent in lac coating @10% treatment and stored under polythene bag was observed by 65.71 followed by Polymer coating (Polykote @ 6 g/kg of seed (62.35). The seed germination trend in seed coating treatment and stored under cotton bag was found same but the storage performance was found better in polythene bag storage.

Seedling shoot length was observed higher in polythene bag stored seeds (14.17 cm) where as cotton bag stored seeds observed to 13.24 cm in T4 treatment (Table 2.3). Likewise, root length was also found higher in polythene bag (8.15 cm) stored seeds in the same treatment and closely followed with T3 treatment.

Seedling vigour was observed higher in polythene bag storage (1503.5) than cotton bag (1374.0) in T4 treatment followed by T3 (1444.6) and T2 (1311.2) in polythene bag storage whereas 1185.7 and 1113.3, respectively in cotton bag storage (Table 2.4). Unlike seedling vigour, seedling dry weight was observed higher with T3 treatment (0.237 g) followed by followed by T4 treatment (0.235 g) in polythene stored seeds and in cotton bag stored seeds observed higher seedling dry weight in T4 (0.220 g) followed by T3 (0.215 g).

It is pertinent to note that the seeds of *Flemingia semialata* at its preliminary phase, stored in polythene bag (700 gauge) with the coating of Spinosad 45 SC @2 ppm + Vitavex power (Carboxin 37.5% + Thiram 37.5% WS) @ 2.5 g/kg and Vitavex power (Carboxin 37.5% + Thiram 37.5% WS) @ 2.5 g/kg more likely to give a good results in the nursery (Table 2.4).

Table 2.3: Effect of seed coating, storage period and storage containers on seed quality of *Flemingia semialata* under ambient condition.

Treatments	Germination (%)				Shoot length (cm)				Root length (cm)			
	Cotton bag		Polythene bag		Cotton bag		Polythene bag		Cotton bag		Polythene bag	
	Initial	6 months	Initial	6 months	Initial	6 months	Initial	6 months	Initial	6 months	Initial	6 months
T1	70.12	55.18	70.56	58.12	12.42	7.49	12.69	9.12	5.35	3.51	6.12	4.18
T2	69.96	65.45	70.21	66.49	11.68	10.96	12.21	12.21	5.89	6.05	6.97	7.51
T3	70.28	65.22	69.56	66.54	12.12	11.71	13.82	13.95	6.12	6.47	6.51	7.76
T4	69.16	66.12	70.13	67.36	12.03	13.24	14.17	14.17	6.15	7.54	6.68	8.15
T5	70.41	63.11	70.28	65.71	10.95	9.68	12.90	10.18	6.24	6. 32	6.32	6.55
T6	70.22	61.91	69.57	62.35	11.54	7.59	12.86	10.06	6.22	6.38	6.28	6.98
SEm±	0.22	0.55	0.28	0.61	0.25	0.39	0.31	0.29	0.19	0.22	0.10	0.24
CD (1%)	NS	1.66	NS	1.84	NS	1.16	NS	0.81	0.53	0.66	0.28	0.66

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 (Carboxin 37.5%+Thiram 37.5% WS) @ 2.5 g/kg), T5 (Lac coating @10%), T6 (Polymer coating (Polykote @ 6 g/kg of seed)

Table 2.4: Effect of seed coating, storage period and storage containers on seedling vigour & seedling dry weight (g) of *Flemingia semialata* under ambient condition.

Treatments	Seedling vigour				Seedling dry weight (g)			
	Cotton bag		Polythene bag		Cotton bag		Polythene bag	
	Initial	6 month	Initial	6 month	Initial	6 months	Initial	6 months
T1	1246.0	607.0	1327.2	773.0	0.198	0.181	0.199	0.185
T2	1229.2	1113.3	1346.6	1311.2	0.151	0.211	0.153	0.225
T3	1281.9	1185.7	1414.2	1444.6	0.175	0.215	0.176	0.237
T4	1257.3	1374.0	1462.2	1503.5	0.162	0.220	0.165	0.235
T5	1210.3	1009.8	1343.8	1099.3	0.184	0.196	0.185	0.210
T6	1247.1	864.9	1333.0	1062.4	0.191	0.194	0.193	0.204
SEm±	36.44	43.27	0.33	0.46	0.007	0.009	0.005	0.008
CD (1%)	NS	126.82	0.99	1.39	NS	NS	NS	NS

2.3. *In vitro* production of aleuritic acid

Transcriptome sequencing of lac insects

Transcriptome sequencing of different developmental stages namely, crawlers, settled nymphs, and fertilized female lac insects was carried out in triplicates on illumina HiSeq X10 platform for read length of PE150. The phred score (Q30) of more than 84% was obtained for almost all the samples. Total reads obtained from all the samples varied from 50 to 90 million reads. After removing adapters, quality filtering, and trimming, good quality reads obtained ranged from 40 to 80 million reads. They were assembled using Trinity software. A total of 3,09,710 transcripts were obtained and after transdecoder filtering 1,72,864 transcripts were obtained. The smallest transcript was of 180 bp and the longest one is 28,529 bp. N50 value obtained for the assembled transcripts was 2430 bp. The assembled transcripts were annotated using BLASTX and GO (Gene Ontology) analysis. In GO analysis, 4124 biological process GO terms, 1071 cellular component GO terms and 2330 molecular function GO terms were obtained.

Differentially expressing genes

Differentially expressing genes were computed based on their expression level. In crawlers vs settled nymphs, there were 5851 and 7526, downregulated and upregulated transcripts, respectively. In crawlers vs fertilized female insects comparison, there were 10729 and 4762 down regulated and upregulated transcripts, respectively. In settled nymphs vs fertilized female insects comparison, there were 7996 and 3472 downregulated and upregulated transcripts, respectively. Volcano plots for differentially expressing genes in lac insect life stages are given in Fig. 2.1. Few genes having probable role in lac resin biosynthesis were found to differentially express in the lac secreting stages (settled nymphs

and fertilized female insects) compared to lac non secreting stage (crawlers). They include Fatty acid desaturases, Monooxygenases, Cytochrome P450 monooxygenases, Epoxide hydrolase, Farnesyl pyrophosphate synthase, Prenyl transferases, genes for Isoprenoid biosynthesis and Acetyl-CoA biosynthesis, Mevalonate kinase, Mevalonate decarboxylase and HMG-CoA reductase.

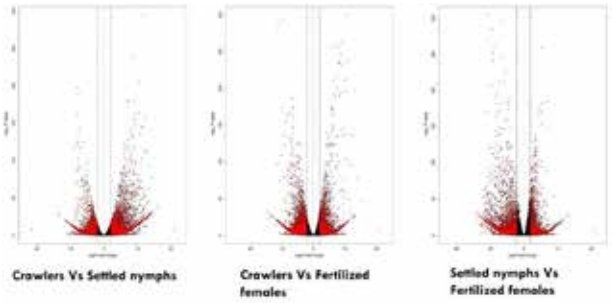


Fig. 2.1: Volcano plots for differentially expressing genes in lac insect life stages

Cloning of epoxide hydrolase gene

Full-length coding sequence (CDS) of an epoxide hydrolase gene (*epo 35981*) obtained from the RNA seq. data was cloned in pGEMT easy vector and sequenced and the size of the CDS was found to be 1221 bp.

2.4 Study of physiological adaptations of *Kerria lacca* (Kerr) under moisture stress

Moisture stress in host plant adversely affected productive traits of lac insects

Rangeeni Baisakhi strain of *Kerria lacca* (Kerr.) maintained on potted pigeon pea variety *Bahar* under optimum soil moisture condition produced female lac insect cells with average fresh weight of (26.66 ± 2.49) mg, resin weight of (11.17 ± 1.06) mg and (570.83 ± 80.84) numbers of crawlers emerged/cell at crop maturity as compared to the plants maintained under moisture stress (50% lower than field capacity) where average fresh weight, resin weight and numbers of crawlers emerged/cell recorded were (23.63 ± 3.04), (7.54 ± 1.72) mg and (341.38 ± 90.44) numbers respectively. Host mediated moisture stress during critical post mating growth stages of lac insects was found to have significant negative effect on lac yield as well as reproductive physiology since 11.37%, 32.48% and 40.20% reduction for fresh weight, resin weight and numbers of crawlers emerged/cell respectively was recorded in moisture stress treatment as compared to optimum watered treatment.

2.5. Genetic manipulation in lac host plant to establish better plant lac insects interaction

Induced mutations for forward/reverse breeding for the development of novel semialata (*Flemingia semialata*) "SEMTILLNRG"

6448 seeds were treated with mutagens different doses of NaN_3 and MNU in combination. Data on germination was recorded at 15, 30 & 45 days of treatment and survival at 6 months of seedlings emergence. Highest germination (78) was recorded at NaN_3- 0.75 + MNU- 1.5. Survival of seedlings was highest at lower doses of chemicals *i.e.*, NaN_3- 0.75 + MNU- 0.5. 248 seedlings were sown at IRF on 20 July 2022. Maximum seedling emergence reduction (%) was recorded in NaN_3- 0.75 + MNU- 1.5 and seedling growth reduction (%) in NaN_3- 0.75 + MNU- 0.5. We may not get M_2 seeds as flowering was not initiated (Fig. 2.2)

Fig. 2.2: Sowing and evaluation of mutagen treated *Flemingia semialata* at IRF

2.6 Exploratory Study

Analysis on the prebiotic potential of *Acacia* gum

Probiotics, in recent years has gathered immense interests owing to its tremendous application in food as well as health industries and *L. casei* strain *shirota* is one such established probiotic microbe conferring various health benefits. Different gums have an advantage in helping probiotics establish in the human colon, rendering them transfer their health beneficial properties. Partial hydrolysates of acacia gum (PHAG) were explored for probiotic encapsulation and potential as a prebiotic material. In a comparison study, glucose supplemented MRS liquid media demonstrated cell growth at 6.0×10^9 CFU/ml (Fig. 2.3). The PHAG supplemented MRS media also supported cell growth at 8.0×10^8 CFU/ml.

The reduction in total sugar content of the culture media after bacterial growth in MRS media supplemented with PHAG further confirmed that probiotics use PHAG as a carbon source and thus could be used as a promising prebiotic (Fig. 2.4). Analysis of total reducing sugars by BCA method in the culture media showed the use of reducing sugars present in the medium after inoculation, signifying them as preferred substrates for the bacteria.

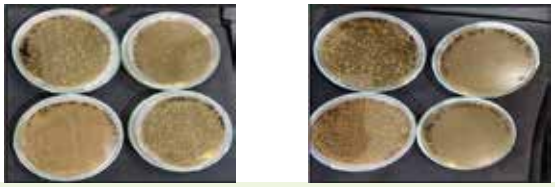


Fig. 2.3: Representative pictures of bacterial colonies in MRS agar plates supplemented with 1% glucose or 1% Partially Hydrolysed Acacia Gum (PHAG)

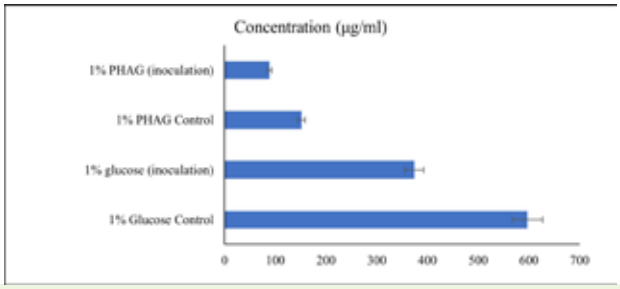


Fig. 2.4: Total sugar estimation in the *L. casei* strain *shirota* inoculated with 1% Glucose and 1% PHAG

In the *in-silico* comparison of *L. casei* strain *shirota* with other *Lactobacillus* type strains a high relative abundance of gene copies for the metabolism of mannose and galactose was observed (Fig. 2.5). Interestingly, mannose and galactose constitute major components of natural gums like gum arabic, suggesting it to be a potential prebiotic for this strain.

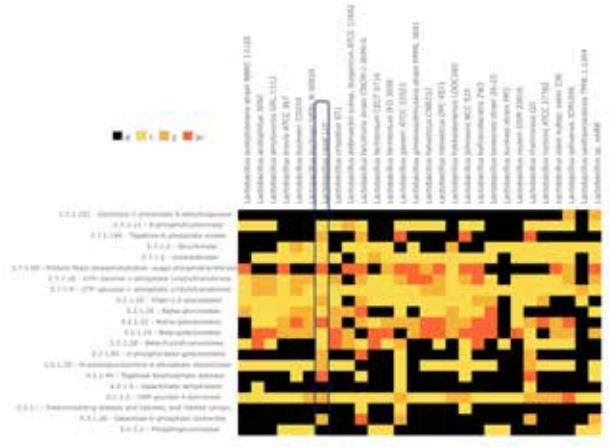


Fig. 2.5: A heat map depicting copy number of different enzyme activities belonging to the galactose metabolism pathway in different *Lactobacillus* species represented by their type strains

Method optimization for naturally sourced isoflavones extraction and estimation for its use as a dietary supplement

Leguminous plants contain a class of secondary metabolites, *i.e.*, isoflavones, which are involved in establishing a symbiotic association with *Rhizobium*. These compounds belong to the flavonoids, which themselves come under the polyphenolics. Major isoflavones in the legumes include genistein, daidzein, glycitein and formononetin. In different clinical and molecular studies, isoflavones have been shown to have health-promoting effects. These health-beneficial properties are due to their structural similarity with the 17-β-estradiol. The presence of an isoflavone-rich diet in east Asian countries is associated with reduced incidences of breast cancer and other post-menopausal disorders like osteoporosis. The isoflavones are also excellent antioxidant compounds and protect against oxidative damage in the body.

Due to the health benefits mentioned above, isoflavones are used as nutraceuticals and dietary supplements. Soybean is among the wealthiest sources of isoflavones and is grown around the globe as an oilseed and can serve as an excellent source of isoflavone extraction.

A (U) HPLC method for the separation of different isoflavones was standardized in this study (Fig. 2.6). The three major isoflavones present in the soybean and their glucosidic forms were separated in this study. Total isoflavones were extracted from soybean seed pods and also from lac host plants *i.e.*, *Flemingia semialata* and Palas (*Butea monosperma*) (Figs. 2.7 & 2.8). Amongst six cultivars, VS-16 cultivar seed pods were found to have highest total isoflavone content *i.e.*, 418.82 µg/g dry weight. It also had the highest content of the genistein (344.75) which is the most potent antioxidant among different isoflavones. The total isoflavone content in *F. semialata* and *B. monosperma* leaves was found to be 4086.06 µg/g and 2916.08 µg/g dry weight respectively. These lac host plants belong to the *Fabaceae* family and as per our hypothesis showed high isoflavone content, especially daidzin in leaves.

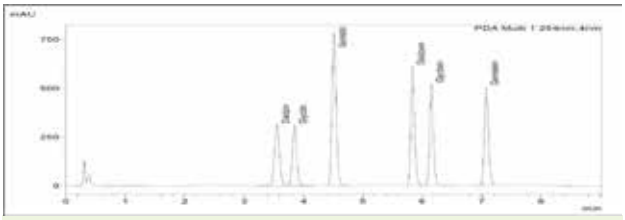


Fig. 2.6: UHPLC separation of six different isoflavones present in soybean namely daidzin, glycitin, genistin, daidzein, glycitein and genistein

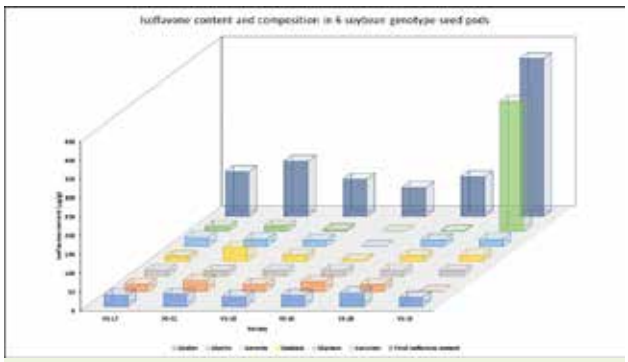


Fig. 2.7: Isoflavone content and composition in six different soybean genotype seed pods

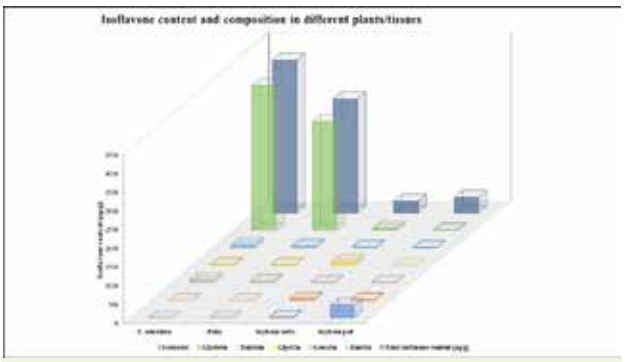


Fig. 2.8: Isoflavone content and composition in different plants/tissues

Relationship between shoot colour and lac production

Lac production capability of shoots varies according to size. At the same time, colour of shoots varies according to its size/ diameter. Five different shades of green colour shoots and two shades of brown/ ash colour shoots of *palas* were selected and inoculated in June/July for *katki* crop. Second to fourth shade (in the gradient of light green to dark green) performed the best in terms of quality encrustation and total lac production. Ideal shoot thickness was found to be in the range of 8.4 to 1.4 mm at maturity (Table 2.5).

Table 2.5: Shoot colour affecting rainy season *rangeeni* lac production in *palas*

	Brood weight (g)	Scraplac weight (g)	Encrustation thickness (mm)	Shoot thickness (mm)	Living cell percent
G1	12.00	3.33	1.56	6.06	92.18
G2	45.33	13.00	2.61	8.48	86.38
G3	32.00	5.67	3.15	9.53	92.12
G4	44.00	5.67	3.50	10.40	--
G5	4.00	1.00	1.48	8.54	--
Bh1	4.00	0.67	1.12	7.64	74.32
Bh2	35.00	3.67	3.02	7.04	73.75
$CD_{(0.05)}$	23.02	4.71	2.36	4.84	18.94
	*	*	NS	NS	NS

*Significant; NS: Non-significant

3. Crop Production System Management and Evaluation

3.1 Characterization and management of sooty mold associated fungi in lac and documentation of other diseases of lac host plants

Microscopic studies of sooty mold causing fungus

The sooty mold fungus from *F. semialata* plant were collected from lac cell. The visual study of fungi by microscope provides more information, as multiple species may be observed simultaneously. 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. The mycelium absorbs the nutrients near the excretion pore and slowly provided to the upper mycelium. It was also observed that the mycelium gets aggregate at the tip of the pore and form sclerocial mass like structure (Fig. 3.1).

Fig. 3.1: Hard sclerocial mass like structure (A) blocking the breathing pore, (B) Microscopic image of the same masses at 10X

These fungi are saprobic on sugary exudates from insects growing on the upper surface of living leaves forming soot-like coating. Thallus is of 3–5 µm thick and hyphae is superficial, cylindrical, aseptate and constricted at the septum.

Two types of conidia were observed from the single sample of sooty mold fungus which was collected from *F. semialata*. One was having small stal and multi-septed and based on the available references it was confirmed that the fungus is *Capnodium salicinum* (Fig. 3.2). Another spore was blunt at the tip and having double layered and based on the available references it was confirmed that the fungus is *Anopeltis venezuelensis* (Fig. 3.3).

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

Design, construction and set up of Low-cost drainage lysimeters for study of crop water requirement

The low-cost drainage lysimeters were designed, constructed and set up at the Institute research farm, ICAR-NISA to measure the water requirement of *F. Semialata* Roxb.

- No of lysimeter = 6
- Length × Width × Depth = 3 m × 2 m × 1.5 m
- Drain pipe diameter = 75 mm with 5^0 slopes at its bottom end
- Covered with all sides and bottom by LDPE sheet of 500-micron thickness

A drainage filter (consisting of layers of gravel, sand and nylon cloth) was designed and provided at the bottom end to prevent stratification during the collection of deep percolated water.

Water balance study and crop coefficient determination

All the input parameters of the water balance model were measured in both the caeses of with lac and without lac *Semialata* plant. The parameters like input components (precipitation and irrigation) and output components (deep percolation, runoff and AET) were quantified based on the soil moisture and other meteorological data at regular intervals and presented in Table 3.1.

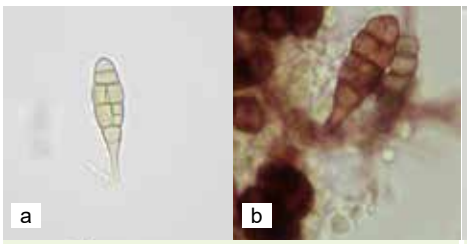


Fig. 3.2: Spore of *Capnodium salicinum* a. sample strain, b. reference strain

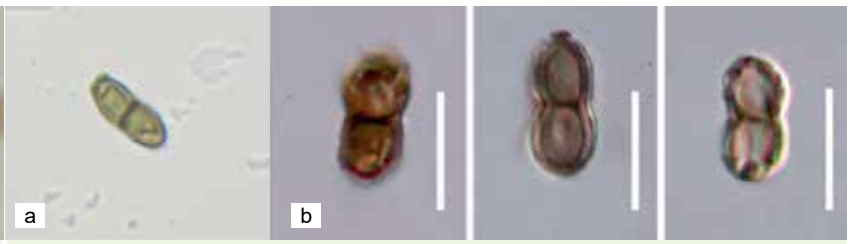


Fig. 3.3: Spore of *Anopeltis venezuelensis* a. sample strain, b. reference strain

Table 3.1: Water balance components estimated in the drainage lysimeters

Period (in days)	Input components		Output Components			
	Precipitation (mm)	Irrigation (mm)	Deep percolation (mm)	Runoff (mm)	AET (With Lac) (mm)	AET (Without Lac) (mm)
0-50	54.8	60	0	0	43.9	43.9
51-60	25.6	20	0	0	12.0	12.0
61-70	0	80	0	0	15.7	15.7
71-80	0	120	0	0	20.6	20.6
81-90	0	110	0	0	24.6	24.6
91-100	0	80	0	0	29.5	29.5
101-110	0	100	0	0	34.6	34.6
111-120	0	120	0	0	38.5	38.5
121-130	4.4	110	6.38	0	37.6	37.6
131-140	12.2	80	52.46	0	39.7	39.7
141-150	62.8	120	143.37	0	39.4	39.4
151-160	0.9	130	96.33	0	40.8	40.8
161-170	20.4	40	21.37	0	34.7	34.7
171-180	91.4	0	63.49	0	36.7	36.7
181-190	39.6	20	10.19	0	36.1	34.7
191-200	126.8	0	90.67	0	33.2	31.0
201-210	52.5	0	24.38	0	33.6	31.4
211-220	76.5	0	39.50	0	37.3	34.9
221-230	236.8	0	203.82	0	32.5	29.8
231-240	210.2	0	165.06	0	35.7	32.3
241-250	44.1	0	8.50	0	39.7	37.3
251-260	123.6	0	93.59	0	37.7	35.1
261-270	112.7	0	62.63	0	38.0	35.2
271-280	59	0	25.54	0	39.6	36.2
281-290	7.6	0	0	0	40.4	36.7
291-300	3.9	0	0	0	37.0	33.9
301-310	0	60	0	0	31.6	29.1
311-320	0	80	0	0	29.8	27.8
321-330	0	80	0	0	26.8	23.8
331-340	0	80	0	0	24.8	21.5
341-350	0	80	0	0	22.0	19.7
351-360	0	80	0	0	20.6	19.0

The water balance study was carried out at three soil regimes *i.e.* 0-30 cm, 30-60 cm, 60-100 cm. and the study revealed a total crop water demand of 1055.36 mm for lac inoculated plants and 1007.71 mm for without lac inoculated plants up to the end of December, 2022.

The *F. Semialata* Roxb. plant's entire crop growing period was divided into 4 stages based on the water requirements and sensitivity of the various growth stages, and the crop coefficient for each stage was calculated separately (Table 3.2.) The fluctuation of crop water demand of both lac inoculated and without lac plants as compared to reference evapotranspiration is presented in Fig 3.4.

Table 3.2: Different crop growth stages and their respective crop coefficient values

Growth period (in days)	With lac insect		Without lac insect	
	Crop growth stage	Crop Coefficient (Kc)	Crop growth stage	Crop Coefficient (Kc)
0-90	Initial	0.428	Initial	0.428
90-180	Development	0.73	Development	0.73
180-310	Intermediate	1.122	Mid-season	1.039
310- Continuing	Lac-maturity phase	1.106	Late season	0.996

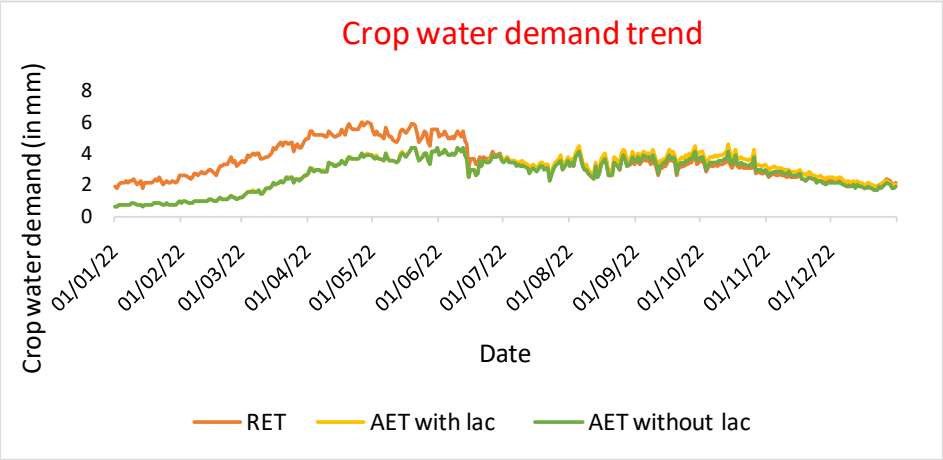


Fig. 3.4: Crop water demand trend line of *F. Semialata* Roxb.

*Abbreviation used; AET= Actual Evapotranspiration; RET= Reference Evapotranspiration

4. Capacity Building, Technology Dissemination, Impact Assessment and Market Intelligence

4.1. Learning, capacity building, extension education and information services on NRGs

ICAR-National Institute of Secondary Agriculture, Namkum Ranchi has conducted different types of training programmes pertaining to scientific lac cultivation, processing and utilization under Capacity Building and Entrepreneurship Development programme (Table 4.1). It continuously assessed the needs of stakeholders and modified the programmes accordingly. Besides many On-campus programmes, field out-reach activities in terms of training, technical guidance, lac crop monitoring etc. were also undertaken. A total of 4746 stakeholders were benefited under various capacity building and skill development programs.

Table 4.1: Details of capacity building and entrepreneurship development programme

Sl.No.	Name of programme	No. of batch/camps	No. of beneficiaries
1.	Farmers training programme on "Scientific lac cultivation, processing and utilization"	17	614
2.	Educational programme on "Natural Resins and Gums" (10/15 days)	03	104
3.	On-farm training programme on lac cultivation	05	248
4.	On-farm Motivational/ Supplementary training programme on lac cultivation	02	98
5.	On-campus one-day Orientation programme on lac cultivation	44	1483
6.	Participation in Exhibition/ Kisan Mela	03	1300
7.	Schedule Caste Sub-Plan (SC -SP)	19	565
8.	Advisory Services on lac cultivation, raising of host plant etc.	121	121
9.	Kisan gosthi/ Workshop/ Educational Programme on lac cultivation	03	1500
10.	VIP Visit at Institute Museum in 2022	13	13
Total		**220**	**4746**

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

The programme entitled "Scientific lac cultivation, processing and utilization" of one week duration was organised in 17 batches and it constitutes lac cultivation, processing at farm level and its uses. A total of 614 farmers from different districts of three states *viz*., Jharkhand, Odisha and West Bengal participated in the programme. The participants were sponsored by various organizations and details are given in Annexure 1.

Educational programme on "Natural Resins and Gums" (10/15 days)

Organized educational programme on "Industrial Training on Natural Resins and Gums" for 104 students from BHU, Varanasi, Uttar Pradesh; Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (Uttar Pradesh); Binod Bihari Mahto Koylanchal University, Dhanbad (Jharkhand) and Gopal Narayan Singh University, Sasaram (Bihar). The details are enclosed in Annexure 2.

On-farm training programme on scientific lac cultivation

ICAR-NISA has organized 05 on-farm training programme on lac cultivation in collaboration with various GOs and NGOs of different states. A total of 248 farmers nominated by Forest Divisions of Jharkhand (Annexure 3) participated in the training programme from different districts of Jharkhand.

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

A total of 98 participants were trained in 02 on-farm motivational/ supplementary training programme on lac cultivation in collaboration with ATMA, Gumla, Jharkhand as detailed in Annexure 4.

On-campus one-day Orientation Programme on Natural Resins and Gums

On-campus, one day Orientation Programme (44 nos.) on Natural Resins and Gums were organized in collaboration with GOs and NGOs of Jharkhand, Bihar, WB, Assam, MP, Odisha, and Punjab states and 1483 farmers, school children, college students and executives visited the institute for this purpose. These were nominated by various agencies as details in Annexure 5.

Participation in Exhibition/ *Kisan Mela*

The Experts from ICAR-NISA, Ranchi participated in Eastern Zone Regional Agriculture Fair and Agrotech-2021, BAU, Kanke, Ranchi and provided technical expertise on NRG to their stakeholders. A total of 1300 beneficiaries got benefitted and got awared about the technology of ICAR-NISA. Need based advisory services were also provided among the various stakeholders.

Schedule Caste Sub-Plan (SC SP)

19 training programmes for 565 Scheduled Caste farmers were organized under DAPSC programme. The details are enclosed in Annexure 6.

***Kisan gosthi*/ Workshop/ Educational Programme**

The institute has organized/participated Kisan Gosthi/ Workshop/ Educational Programme on lac cultivation in collaboration with various institutions. A total of 03 such events were conducted and 1500 stakeholders were benefited (Annexure 7).

One To One Programme

An One to One Programme (OTOP), Market Oriented Technical Advisory Services, diagnostic crop monitoring services were provided and benefited 121 stakeholders from different states of India. Laksha Updates initiatives boosted the linkages with stakeholders.

VIP Visit at Institute Museum

Thirteen VIPs visited the Institute Museum during the period. They were exposed about the latest know-how about natural resins & gums.

5. Synthesis, Process Development and Quality Management

5.1 Synthesis of rosin derivative for its application

A number of rosin derivatives were synthesized by reaction of rosin with different polyols and molecules at different temperatures for different time durations. The reactions were carried out in the presence/ absence of catalyst. The synthesized esters, in some cases, were further reacted with dienophiles to produce adducted rosin ester using Diels-Alder reaction.

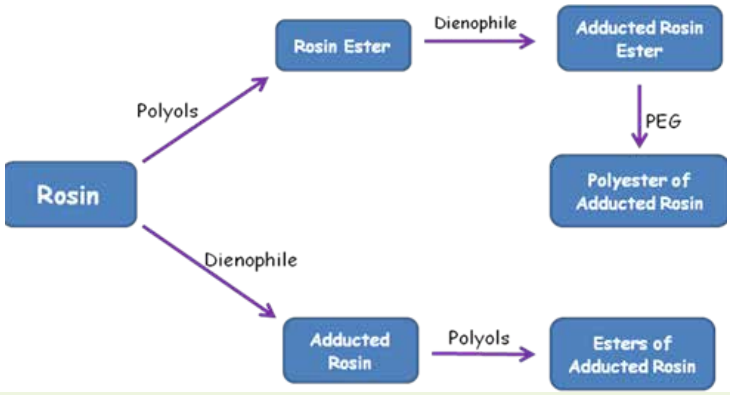


Fig. 5.1: Synthetic route for synthesis of rosin derivatives

The adducted rosin ester, in some cases, was further esterified with poly-glycols to produce the modified esters, as given in Fig. 5.1.

Acid value and colour index of the synthesized derivatives were determined. Acid values were found in varying range. Colour was found to be higher and did not match with the standard solution in some cases (Table 5.1). Colour values of the synthesized rosin derivatives along with rosin were determined with the help of Hunter Lab colorimeter. The values determined have been given in the Table 5.2. It was observed that colour of rosin becomes darker when derivatives were prepared.

Table 5.1: Acid value and colour index of synthesized rosin derivatives

Codes	Acid Value	Colour index
Rosin	165	08 (spirit), 12 (Xylene)
TF-20	210.66	DNM
TF-21	39.37	DNM
TF-22	71.38	DNM
TF-23	71.31	DNM
TF-24	124.24	DNM
TF-25	26.42	DNM
TF-26	24.32	DNM
TF-27	15.47	DNM
TF-28	44.87	DNM
TF-29	27.38	DNM
TF-30	16.10	DNM
TF-31	13.47	DNM
TF-32	16.12	DNM
TF-33	7.06	11

Table 5.2: Colour determination by Hunter Lab Colourimeter

Codes	L-value	a-value	b-value
Rosin	89.29	-0.06	12.59
TF-30	56.78	6.59	22.32
TF-31	47.17	7.24	20.05
TF-32	45.93	7.95	20.06
TF-33	80.71	1.26	22.84

Thermal analysis with DSC

Glass transition temperature and softening point of rosin derivatives were analyzed using Differential Scanning Calorimetry (DSC). Softening point was recorded in the range of 45-80 ^{O}C as revealed by the thermograms (Fig. 5.2).

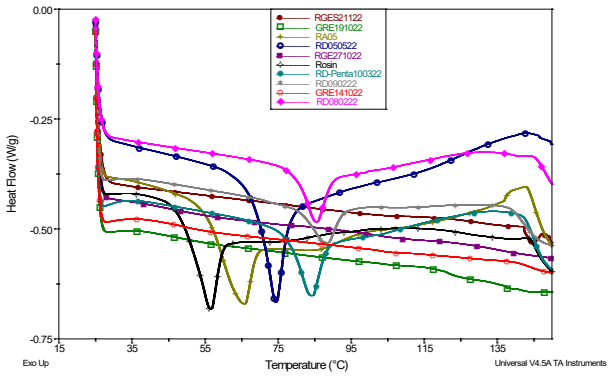


Fig. 5.2: DSC thermograms of rosin and rosin derivatives

Softening point of synthesized rosin derivatives (using melting tube method)

Softening point of the synthesized rosin derivatives was determined using melting tube method. It was observed that the derivatives synthesized from rosin have higher softening point in comparison to rosin (Fig. 5.3).

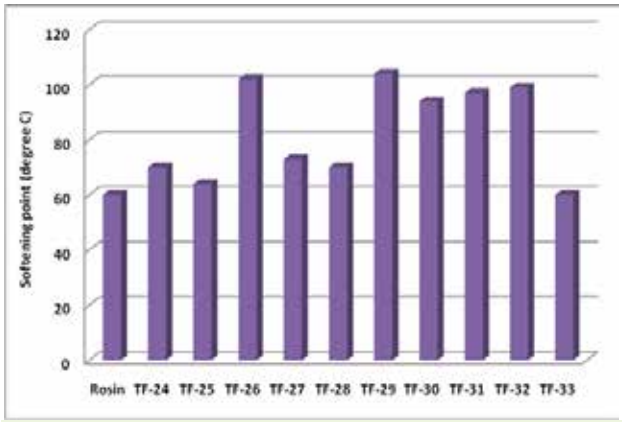


Fig. 5.3: Softening point of synthesized rosin derivatives

FTIR analysis

Rosin and their derivatives were characterized with FTIR analysis. Spectra showed shift of carbonyl group peak of acid to higher frequency, indicating the ester formation. Peaks for hydroxyl groups in the derivatives were clearly shown in the range of 3400-3600 cm^{-1} in the spectra (Fig. 5.4).

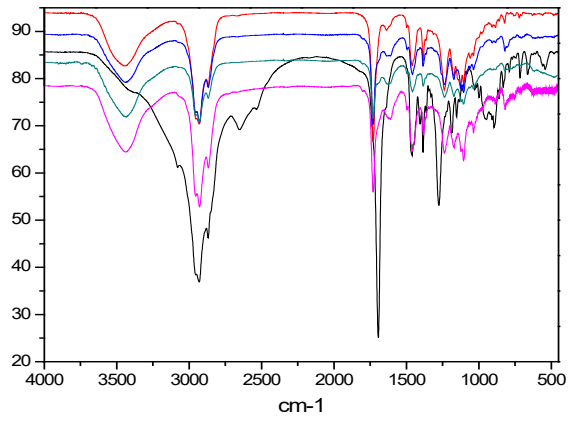


Fig. 5.4: FTIR spectra of rosin and derivatives

Determination of adhesive strength

The synthesized derivatives were studied for their adhesive strength (Zero Peel strength) using texture analyzer. Adhesive (Peel) strength of the reacted product was recorded in the range of 12-89N. Maximum zero peel strength recorded was 89.41N.

5.2 Biodegradation study of lac

Lac samples, buried in pot soil and field directly (without net) were drawn after interval of three years and washed thoroughly. Samples were cleaned from all the impurities and weight loss was determined. Sticklac, seedlac and shellac samples showed loss of 69%, 58% and 37%, respectively. Physicochemical properties such as flow, life under heat, colour index and cold alcohol insoluble (%) of the samples were studied along with control samples. No fluidity was observed in any of the samples except shellac (control), showing fluidity of 7.0 mm. Sticklac and seedlac samples showed no life while shellac samples showed life of 22 min (control), 30 min (shellac buried in pot soil) and 18 min (shellac buried in field soil). No much significant difference was recorded in colour index values of the samples. Cold alcohol insoluble % of the samples increased continuously.

Report on biodegradation study of lac samples at accelerated condition were received from CIPET, Chennai. Sticklac sample recorded 49.7% biodegradation, while seedlac and shellac samples showed biodegradation of 50.4% and 47% respectively with reference to 100% degradation of positive reference (cellulose), at the end of 180 days.

5.3 A study on various techniques for identification of commercially important natural gums

The genuine samples of plant exudate natural gums were collected directly from the respective trees and obtained from the various centres of the network project on natural gums and resin run by the institute. Other samples like seaweed gums, microbial gums, etc. were procured from the HIMEDIA Pvt. Ltd. The volatile matter (%) and pH of the 31 different gum samples (Fig. 5.5) were calculated following BIS standard procedure (IS: 7437 – 1974: Methods of sampling and test for vegetable adhesives). Tamarind gum had lowest volatile matter (4.9%) whereas gum Arabic sample collected from Jhansi showed maximum volatile matter (14.8%). Volatile matter (%) of the remaining gums was found within this range. The pH of most of the gums (1% solution at 27°C using EUTECH PC-700, table top pH meter) was found to be in the range of 4.0 to 6.5. Gum karaya had the lowest pH (4.48), whereas sodium alginate gum, being salt of alginic acid, showed maximum pH (7.0).

Keeping in view the non-applicability of cold water soluble (%) estimation's method described in the BIS standard (IS: 7437 – 1974) to high viscous gums, a new method for the same was developed. Instead of 2% solution of the reported method,

range of concentration (0.1 to 2%) was used, out of which best results were obtained for 0.5% solution for all the gums. The solutions were subjected to various centrifuge speed from 1000 to 6000 RCF and it was observed that 1000 RCF was enough to get the results. Twenty five different gum samples were analyzed by this procedure and the cold water solubility was found in the range of 5 to 95%.

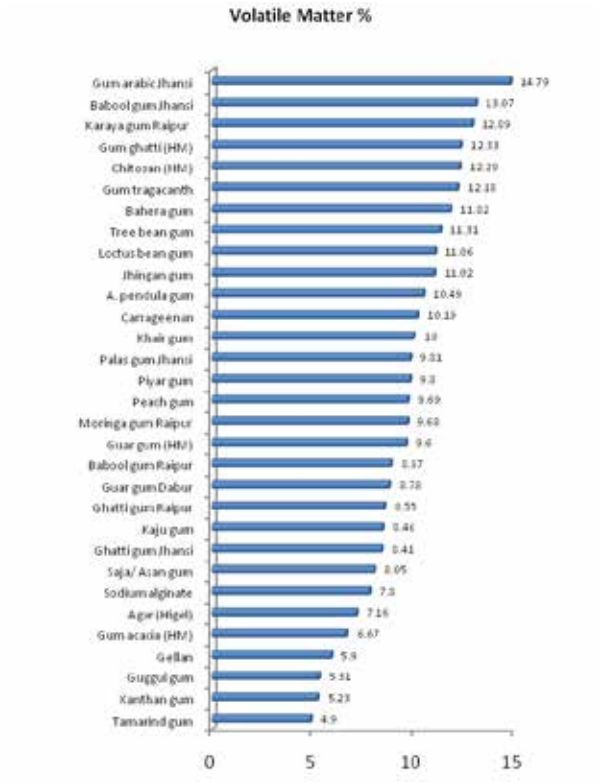


Fig. 5.5: Volatile matter (%) of various gum samples

UV-Vis characterization of natural gum sample solutions was carried out (Fig. 5.6) using Evolution One Plus, UV-Vis spectrophotometer, Thermo Fisher Scientific, USA. All the gums showed prominent absorption maxima in the UV region between 190 to 200 nm. Palas gum (*Butea monosperma*) showed exceptional absorption maxima at the higher side, around 200 nm, which may be due to the additional tannin content of the gum. Actual absorption maxima for all the other gums could not be detected as the lowest detection limit of the instrument was 190 nm.

FTIR spectra of the twelve major gum samples including four exudate gums (ghatti, arabic, karaya and babool), three seed gums (guar, tamarind and locust bean), three seaweed gums (agar, sodium alginate and carrageenan), and two microbial gums (xanthan and gellan) were recorded with Perkin Elmer, Spectrum Two, USA, equipped with a laser source, KBr beam splitter (KBr windows), and high-performance DTGS (deuterated tri-glycine sulphate) MIR detector.

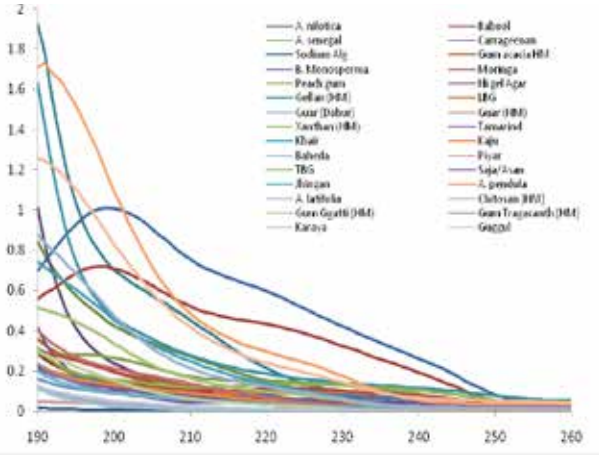


Fig. 5.6: UV-Vis characterization of the collected gum samples

5.4 Synthesis of *Terminalia bellirica* exudate gum hydrogel-metal nanoparticle composite materials for evaluation in drug release

The *Terminalia bellirica* exudate gum (*Baheda* gum) was tapped and collected form Institute Research Farm. The gum was cleaned by removing dirt and other extraneous materials and dried in sun followed by in hot air oven at 45 °C until a constant weight was obtained and it became sufficiently brittle. The dried gum was manually sorted into light coloured and dark coloured grades. The light coloured grade was selected for further purification and processing by making into fine powder in a domestic blender. *Terminalia bellirica* exudate gum was purified by dissolving the gum in cold distilled water and precipitating with ethanol. The precipitated gum was dried in an oven at a temperature less than 45 ℃. The dried gum was finely powdered and stored in desiccator.

Physicochemical properties like solubility, viscosity, pH, moisture content, ash value, acid insoluble matter and other properties of *Baheda* gum samples were determined using standard methods and reported in the Table 5.3.

Table 5.3: Physicochemical properties of *Terminalia bellirica* exudate gum

Properties	Values/observations
Solubility	Forms gel in water, practically insoluble in ethanol, chloroform and acetone
Water Absorption (ml)	16.0
Loss on Drying	2.0%

Properties	Values/observations
Bark and Other Foreign Organic Matter (Percentage by mass)	0.159
pH (5% w/v)	4.99
Ash Content	1.38%
Acid insoluble matter	0.052%
Acid Value	16.45
Viscosity (35°C, 5% aq. soln., 20 rpm, spindle no.3)	1639.5 cP
Tannin (TAE per gram of gum)	0.204 mg

The graft copolymerization of purified *Baheda* gum with acrylamide was conducted by dispersing *Baheda* gum (1.0 g) in distilled water in three-necked flask equipped with a mechanical stirrer, a reflux condenser, a thermometer under nitrogen atmosphere. The dispersion was heated at 60 ^{0}C for 1 h to form colloidal slurry. The hydrogel was prepared by the graft copolymerization of purified natural *Baheda* gum with acrylamide using potassium persulfate (KPS) as initiator and N,N'-methylenebisacrylamide (MBA) as crosslinker. A series of reactions has been conducted for optimization of reaction conditions with respect to concentration of monomer, cross linker and initiator. The results indicated that polymerization time and volume of reaction mixture as significant reaction variables and polymerization time increases with increase in the volume of reaction mixture.

Swelling behaviour of hybrid hydrogel material was studied at 25°C, 30°C, 35°C, 40°C and 45°C temperature to attain the equilibrium swelling and it was found that equilibrium swelling (%) of hydrogel obtained was 3570, 3660, 3845, 4080 and 4150 respectively. With increase in temperature, the disentanglement between polymer chains happens and the network expands. As a result, the swelling enhanced with increase in the temperature from 25°C to 45°C.

5.5 Synthesis of Gum Arabic based hydrogel for remediation of dye contaminated water

Swelling characteristic and behavior of the synthesized cross-linked arabic based hydrogel was carried out in various pH buffer system (2.5, 7 & 10) using distilled water as a medium. The percentage swelling index was estimated. High swelling was observed at two pH (at 5 and at 10). In low pH (~2–5), due to excess of H^+ ions, amide functional group got protonated resulting in mutual repulsion between two polymeric chains, thus allowing more spaces for water. In alkaline condition, COOH exists as carboxylate ions (COO^-). These negative charge ions induced repulsion among adjacent carboxylate ions of polymeric chains and anions counter part of alkaline buffer solution. Hence, huge intramolecular spaces were available for water. Swelling characteristic of the synthesized hydrogel was also carried out at various temperatures and it was noted that efficiency increased as we increased the temperature gradually upto a certain limit. After optimized temperature adsorption remain practically constant. This is due to aggregation of hydrogel took place without increasing the specific surface area at higher temperature (Fig. 5.7).

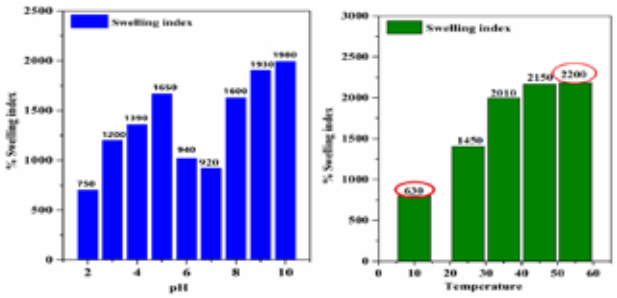


Fig. 5.7: Swelling index of hydrogel at different pH and Temperature

Adsorption study of Brilliant Green (BG) dye using synthesized hydrogel was carried out under various reaction parameters. Different concentrations of BG dye solutions (10 to 80 mg/L) were taken and adsorption was studied. It was observed that adsorption decreased as we moved towards higher concentration. This could be due to availability of larger number of adsorption sites.

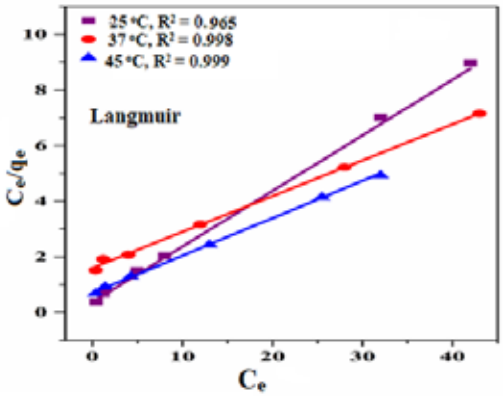


Fig. 5.8: Langmuir isotherm at different temperatures

Adsorption isotherms were studied to understand the phenomena taking place during dye adsorption process particularly adsorbent and adsorbate interaction using Langmuir isotherm model. It was found that adsorption increases from 5.3 to 8.0 mg/g as we move from 25 °C to 45 °C. This suggested that adsorption was endothermic and satisfied this model.

High Correlation coefficient of Langmuir isotherm with R^2 (0.965-0.999) indicted the applicability of the Langmuir isotherm for BG dye adsorption onto arabic gum hydrogel (Fig. 5.8).

6. Value Addition and Product Development

6.1 Study on natural gum based dietary fibre as encapsulant for delivery of functional feed

Encapsulation of beta carotene was carried out with incorporation of gum Arabic dietary fibre (GDF) using liposome encapsulation technique. The soya lecithin along with GDF is used to encapsulate beta carotene using simple liposome encapsulation technique. After encapsulation, the encapsulated beta carotene loaded liposomes are lyophilized to store for longer duration. The encapsulation efficiency is calculated as 72-80%. The liposome prepared with higher GDF concentration showed higher encapsulation efficiency as compared to the control (44%). The study showed that encapsulation efficiency of liposome formulation with dietary fibre was higher than the control formulation.

Characterization of liposome encapsulated beta carotene incorporated with GDF was carried out using FTIR spectroscopy, particle size analysis (Fig. 6.1) and Field Emission - Scanning Electron Microscopy (FE-SEM) (Fig. 6.2). The characterization data confirms that beta carotene is encapsulated into the liposome.

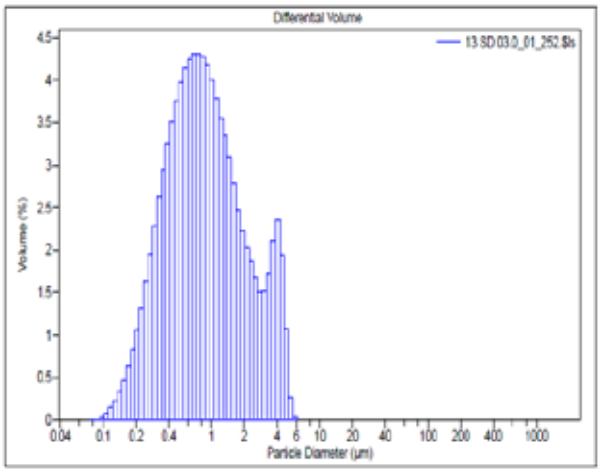


Fig. 6.1: Particle size analysis data of liposome encapsulated beta carotene incorporated with gum Arabic dietary fibre

In vitro gastro-intestinal release study of the liposome encapsulated beta carotene was studied in the simulated gastric fluid (SGF) and simulated intestinal fluid (SIF). The results of the study showed that release of beta carotene was slower in SGF and released 27.05% of total amount and in the SIF environment release of beta carotene was higher than the previous SGF. In SIF the cumulative release of beta carotene was 66.45% (Fig. 6.3). The results showed that liposomes could protect active substances from damage in the stomach and release them in the small intestine, where they can be absorbed.

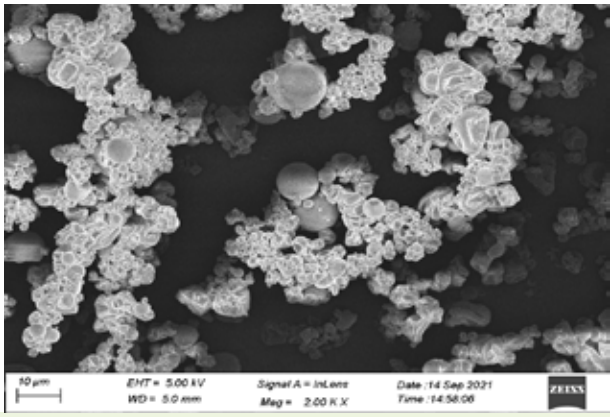


Fig. 6.2: FE-SEM images of liposome encapsulated beta carotene incorporated with gum Arabic dietary fibre

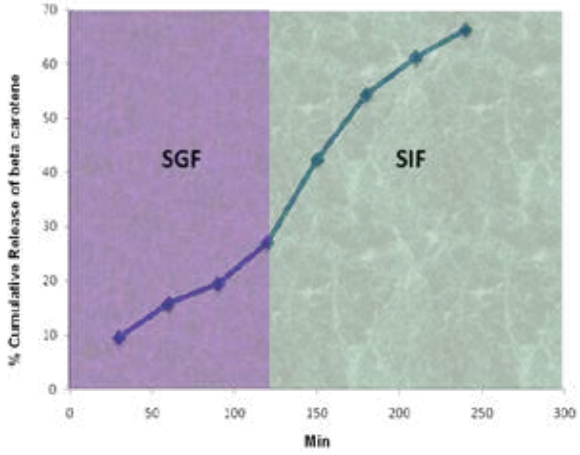


Fig. 6.3: *In vitro* gastrointestinal release studies of beta carotene from liposome

The encapsulation of the probiotic bacteria was carried out by freeze drying method using dietary fibre (PHGG, gum Arabic) as cryo protectants. The encapsulated and freeze dried samples were stored in airtight vials at 4°C for viability study. The viability of the encapsulated sample was calculated using the values of enumerated colony forming units (CFUs). The PHGG and dietary fibre of gum Arabic shows good viability of 11.5% and 16.8%, respectively with the cell counts reading 1.05×10^3 and 1.2×10^3 CFU, as compared to control (viability 8.2% and cell counts 1.5×10^2 CFU) which indicates that the dietary fibre may be acting as potential cryo protectant for probiotic bacteria (Fig. 6.4).

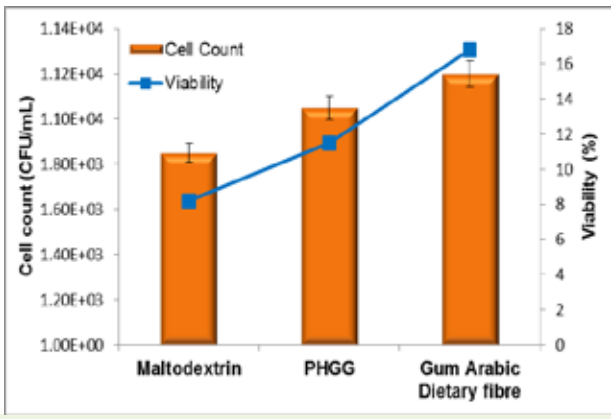


Fig. 6.4: Viability study of the dietary fibre encapsulated probiotic bacteria

6.2 Development of adhesive for making biodegradable food container and other utility items

In response to the request made by M/s Agropak Industries Pvt. Ltd. Bengaluru, different lac based natural adhesive formulations were developed for making biodegradable food containers using coconut shell powder and jute. Jute reinforced sheets were prepared using developed different lac based formulations. Bowls were prepared using the formulations and found to be good in respect of strength, flexibility and aesthetic appeal. Samples of the adhesive formulations were supplied to the firm for evaluation at their end. The firm evaluated the formulation and bowls were prepared using the formulations (Fig. 6.5). The firm informed that the formulation is working well and requested for technology transfer.

In another industrial collaboration with M/s Mutha Industries Pvt. Ltd. Mumbai, for development of natural adhesive/binder utilizing bamboo saw dust for making toys and other utility items, different sheets were prepared using bamboo saw dust and different lac based formulations. Sheets prepared were aesthetically good.

Fig. 6.5: Bowls prepared using the developed lac based formulations

Other Activities:

Collaboration with institutes for evaluation of fruit coating formulations

- Collaboration has been made with CSIR-CFTRI, Mysuru (Karnataka), for evaluation of coating formulation developed by the institute through coating method technology, developed by CSIR-CFTRI, Mysuru and CSIR-CSIO, Chandigarh. 1 litre coating formulation was prepared and sent to CSIR-CFTRI Mysuru for its trial.
- Two coating formulations for Banana (250 ml each) were prepared and sent to ICAR-NRC Banana, Trichy (Tamil Nadu) for their evaluation on Banana, in collaborative mode.

Supply of lac based formulations for evaluation and revenue generation

- Total 14 litre coating formulation for fruits and vegetables was prepared and supplied to network project centre at PAU Ludhiana, KVK, Yemmiganur, Kurnool District (AP), KVK, Mettupalayam, Coimbatore District, TN for OFT. Institute earned revenue of Rs. 21,240/- in the process. Brochure of Kinnow coating formulation was redesigned and submitted to ADG (FE), as desired.
- 10 litre aqueous coating formulation for paper packaging material was prepared, and sent to Mr. Sanjay Agrawal, M/s Nature's Solutions, Gautam Buddha Nagar, for evaluation on the papers. Institute earned revenue of Rs 11,800/- in the process.
- In response to the request made by Mr. Harpit Singh, New Delhi, two coating formulations were developed and 500 ml each was sent to the firm for evaluation on black garlic at their end. Institute earned revenue of Rs. 1,180/-in the process. The firm evaluated the formulations and reported that one of the formulations is working very well and requested for more formulation for commercial trial and technology transfer.

- Nail Polish samples were prepared and sent to Ms. Payal Patel, Bengaluru for evaluation at their end.

Interaction with Industry

- An online meeting was organized with an industry M/s. India Glycol Pvt. Ltd. Gurugram on 04/11/2022. Interacted with Mr. Atul Govil and his team of India Glycol Pvt. Ltd. and a presentation on the promising technologies developed and technologies ready for commercialization was done from the institute. The firm also made a presentation mainly about their activities, products dealing and possible area for collaboration, followed by detailed discussion with the team on guar gum derivatives, dietary fibre and paper packaging.

7. Designing and Development of Farm Tools and Processing Machineries

7.1 Development of pilot plant of guar gum derivative for training and demonstration

Experimentation on carboxy methyl guar gum derivative preparation

Carboxy methyl guar gum derivative prepared from guar gum powder using reagents with variation in mixing time (30, 60 and 90 min), reaction time (3h) and drying time (3h) in different batches to study the effect of processing parameters on quality (viscosity, pH and degree of substitution). Highest mean viscosity (cP) of the prepared carboxy methyl guar gum derivative was found 2781.5 with mixing time 30 min, reaction time 3h and drying time 3h with similar pH and degree of substitution. Results of experimental trials reveal that carboxy methyl guar gum derivative with higher viscosity can be prepared with reduced mixing time having similar pH and degree of substitution

Fabrication of carboxy methyl guar gum derivative pilot plant

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 under development of carboxy methyl guar gum derivative pilot plant. Required material handling equipments and brought out components installed in the different fabricated units with minor improvement (Fig. 7.1). Functionality trials of the fabricated units and components without raw material completed and adjustment carried out as per requirement. Trials of manufacturing carboxy methyl guar gum derivative from guar gum powder using reagents through fabricated plant under progress.

7.2 Development of refractance window dryer for gum based hydrogels

Variation in drying time and energy consumption due to Mylar sheet thickness

Three Mylar plastic sheets (polyester film) of 75, 175 and 250 µm thicknesses, respectively were used to develop the laboratory scale Refractance Window dryer (RWD) which was further used to conduct the trials on drying of guar gum (GG) based hydrogel. During drying experiment, thickness of Mylar plastic sheet was varied as 75, 175 and 250 µm whereas water temperature (95°C) and initial loading of the hydrogel (8 kg/m^2 of Mylar sheet) were kept constant. Results indicated that from practical stand point there was no significant difference in drying time and energy consumption as affected by sheet thickness (Table 7.1). However, Mylar sheet with 250 µm thickness was found better in terms of handling, temperature induced distortion, sheet formation, elongation etc. Hence, this sheet was used in further experiments.

Table 7.1: Effect of Mylar sheet thickness on drying time and energy consumption

Sheet Thickness (µm)	Drying time (h)	Energy consumption (kWh)	Avg. room temp (°C)	Avg. Room RH (%)
75	2.31	2.77	33.40	48.33
175	2.20	2.30	32.53	44.33
250	2.30	2.33	32.31	54.33

Variation in drying time and energy consumption due to water temperature

GG based hydrogel was dried using five water temperatures (75°C, 80°C, 85°C, 90°C and 95°C) by keeping Mylar sheet thickness (250 µm) and initial loading of the hydrogel (8 kg/m^2 of Mylar sheet) constant. Results indicated that the drying occurred in two distinct drying periods irrespective of the water temperature (Fig.7.2). During first drying

Mixing-cum-reaction unit | Filtration unit | Drying-cum-agitator unit | Distillation unit

Fig. 7.1: View of fabricated units under guar gum derivative pilot plant

period, moisture was removed very slowly whereas during second drying period, sudden decrease in the moisture was observed. Such drying behavior might be attributed to the strong hygroscopic bonding and cross-linking in the hydrogel. Effect of water temperature on drying time and energy consumption is presented in Table 7.2.

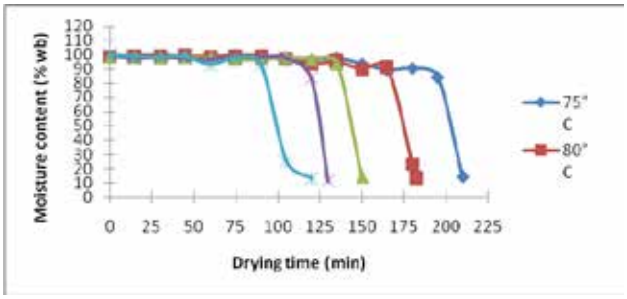


Fig. 7.2: Drying curves of GG based hydrogel at different temperaure

Table 7.2: Effect of water temperature on drying time and energy consumption

Water Temperature (°C)	Drying time (h)	Energy consumotion (kW)
75	3.30	1.8
80	3.02	2.0
85	2.30	1.9
90	2.10	2.0
95	2.00	2.3

Optimization of process variables using Response Surface Methodology

Experiment was designed in MINITAB 17 software for three independent variables with 5 levels; namely water temperature (75-95°C), water content of GG gel (60-100 ml of water/g of GG) and initial loading of hydrogel (4-20 kg/m^2). Total number of experiments was 20 and dependent variables recorded during experiments were yield, moisture content, swelling index, and energy consumption. The steps involved in each experiment are depicted in Fig. 7.3.

Two optimal solutions were determined using Response Optimizer in the MINITAB (Fig. 7.4). First optimal solution included water temperature 75°C, initial loading 7.72 kg/m^2 and initial water content as 66.87 ml/g of GG. Second optimal solution was determined by fixing the value of initial water content as 80 ml/g of GG. Second solution included water temperature 75°C, initial loading 8.20 kg/m^2 and initial water content as 80 ml/g of GG.

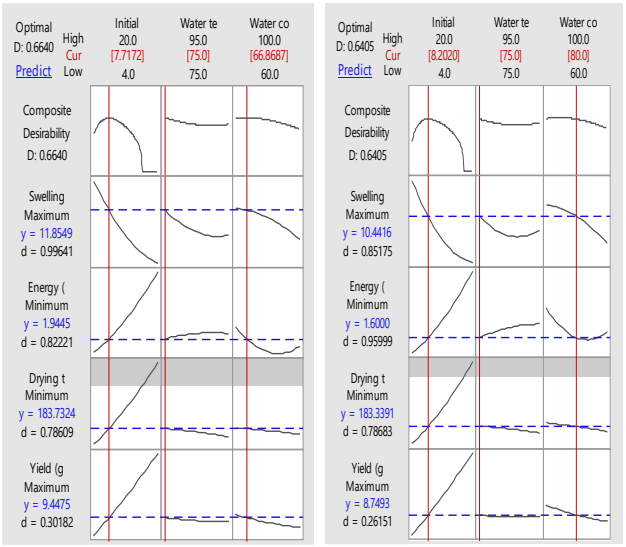


Fig. 7.4: Optimal solutions

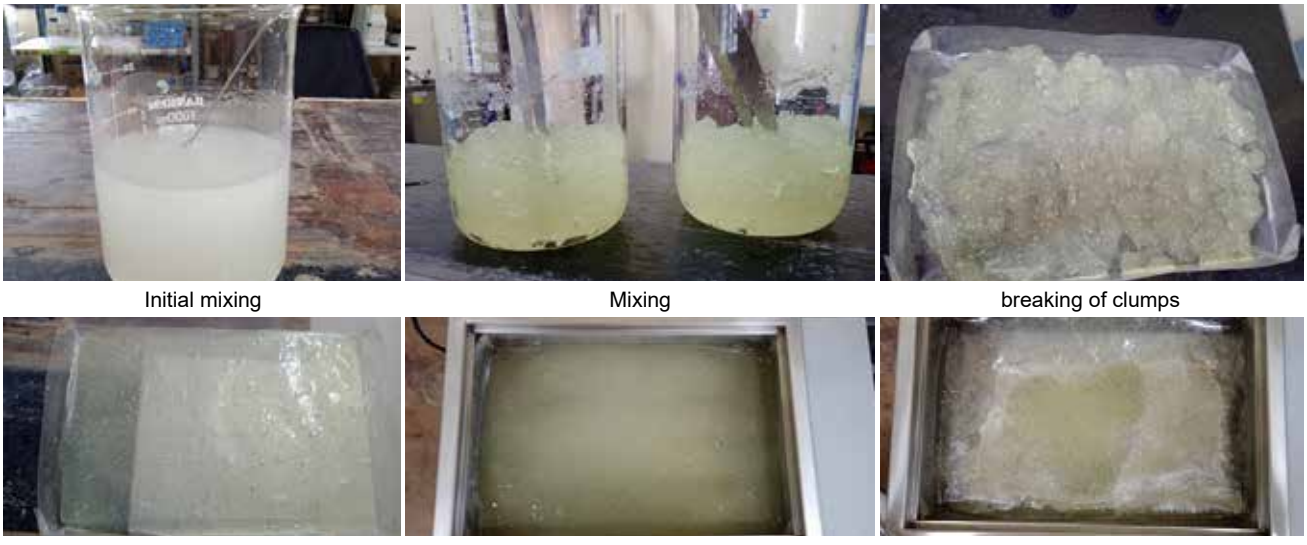


Fig. 7.3: Steps involved the laboratory scale RW drying experiments

7.3 Development of extrusion based mechanized system for hot filtration of seedlac

Cohesion and adhesion behavior of seedlac

Cohesion and adhesion behavior of seedlac was determined at nine different temperatures (30- 120°C having 10°C interval) with the help of texture analyser. For analysis, a stainless steel probe of 12 mm diameter having off-site testing arrangement as well as a set-up for in-situ heating of seedlac was developed as shown in Fig. 7.5. Results indicated that cohesion of seedlac samples increased till 60°C and drastically decreased at ≥ 70°C (Fig. 7.6). Cohesion was almost negligible at ≥ 80°C which might be due to the melting of the seedlac at 70-75°C. Adhesion was observed negligible up to 50°C and it increased up to 90°C and then decreased considerably. Observations indicated that seedlac lost its cohesion as well as adhesion at >110°C. Thus, we may say that during hot filtration, it should be heated at/or above 110°C.

Fig. 7.5: Setup for determination of cohesion-adhesion behavior of seedlac samples

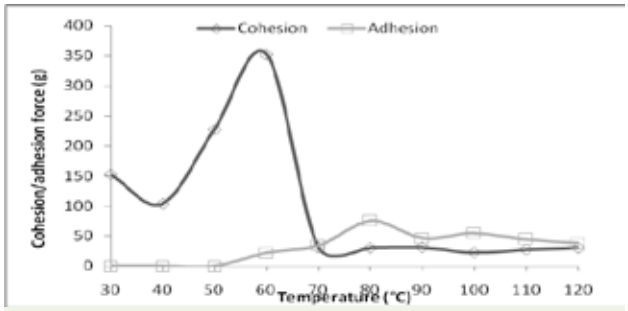


Fig. 7.6: Cohesion-adhesion behavior of seedlac samples

Rheology analysis of seedlac samples

Rheology behaviour of seedlac (*kusmi* from ber and *kusmi* from *Semialata*) was determined at seven different temperatures (70°C, 80°C, 90°C, 100°C, 110°C, 120°C and 130°C) using Rheometer (Model: MCR 302, Anton Paar) at Birla Institute of Technology, Mesra, Ranchi. Results indicated that the flow behavior of lac is temperature dependent and its smooth flow occurs at ≥90°C. Dynamic viscosity significantly decreased with increase in the temperature as presented in Table 7.3.

Table 7.3: Dynamic viscosity of seedlac samples at different temperatures

Temperature (°C)	Average dynamic viscosity (mPa·s)	
	Ber	*Semialata*
70	2.17E+07	1.77E+07
80	2.41E+06	1.99E+06
90	5.22E+05	4.13E+05
100	1.30E+05	1.07E+05
110	48176.28	34396.1
120	21509.52	14247.26
130	12385.22	9928.844

Polymerization of seedlac at different temperatures

Effect of temperature and exposure-time on amount of polymerization of seedlac was evaluated in QEL laboratory, ICAR-NISA. Seedlac samples used were ber (*kusmi*) and *Semialata* (*kusmi*). Temperatures used in the study were 80, 90, 100, 110, 120, 130, 140 and 150°C. Exposure time was 5 h or time required for attaining life of seedlac, whichever is earlier. At each temperature, 5 samples of the same seedlac were kept for polymerization and were withdrawn one by one at pre-decided time interval. Amount of polymerization in the seedlac samples exposed to varying temperatures-time combination is shown in Table 7.4.

Table 7.4: Effect of temperature and exposure-time on polymerization of seedlac

Temperature (°C)	Time (min)		Polymerization (%)	
	Ber	*Semialata*	*Ber*	*Semialata*
80	300	300	4.50	2.43
90	300	300	6.54	3.09
100	300	300	17.88	13.33
110	300	300	21.46	22.45
120	125	262	23.52	36.53
130	75	125	33.77	36.10
140	45	71	40.03	33.83
150	29	48	42.18	44.46

Fabrication of lac-extruder

Fabricated the manually operated first prototype of ram extruder for hot filtration of seedlac consist of two infrared heaters (630 W and 1000 W) as heat source developed using structural materials (stainless steel - pipe and ram, brass screen of 100 mesh, GI sheet screen holder of 26 gauge, supporting frame made of wood and aluminum heat shield) having extruder pipe length 21 inches with 2 inch diameter (Fig. 7.7). Trials on first prototype indicated that controlled heat/ heat source providing conductive heat is required for better output.

Fig. 7.7: First prototype of ram-extruder

Fig. 7.8: Second prototype of ram-extruder

Subsequently manually operated second prototype of ram extruder having vertical barrel axis of 3 ft length (46 mm internal diameter) of capacity 800 g seedlac and ram's length 120 cm consist of two electric heaters of 2000 W as heat source was fabricated (Fig. 7.8). Trials on ram-extruder for hot filtration of seedlac were conducted and results indicated that ram-extruder was able to filter the seedlac however, further improvement in filtration-unit is required.

8. Process Refinement, Commercialization and Entrepreneurship Development

8.1 Standardization of sealing lac/wax preparation and process mechanization

Trials on sealing lac/wax preparation

Preliminary trial of making sealing wax in existing wax candle mould tried with old shellac and rosin (Fig. 8.1). Under the trials, a total nine piece of sealing sticks were prepared with 2 years old seedlac mixed with 20% and 30% rosin. Trials of sealing lac stick preparation was carried out by mixing rosin 20%, 30%, 35% and 40% in shellac and observed that sealing lac stick preparation was possible using mould.

Trials of making sealing lac/wax with fresh shellac (left over filtered lac of *Bhatta* process) was tried in existing mould with different ratio of rosin 10%, 20% and 25% with shellac and found no issue of fluidity in making stick due to use of fresh shellac.

Fig. 8.1: Prepared sealing lac stick

Design and development of mould for manufacturing sealing lac/wax making

Design drawing for development of new moulds for manufacturing different shape (square, round and hexagonal) sealing lac/wax of size ½ inch and length 6.75 inch prepared for fabrication in different material (mild steel, stainless steel and aluminium/ alloys). Moulds fabrication in different materials as per developed design drawing is in progress.

Network Project on Harvesting, Processing and Value Addition of Natural Resins and Gums

9.1 Lead Centre: ICAR-NISA, Ranchi

Preparation and characterization of modified guar gum nanocomposite films reinforced with piyar-AgNPs for diversified applications

Mechanical properties of nanocomposite film: To improve the mechanical strength of the modified guar gum, silver nanoparticles impregnated nanocomposite films were developed. Fig. 9.1 shows the mechanical properties such as tensile strength, modulus, and elongation at break values or break strain of control and nanocomposite films. It clearly reveals that nanocomposite film has improved mechanical strength *i.e.* tensile strength and modulus than control film. This enhancement of tensile strength and modulus indicates the excellent interaction between polymer matrix and Ag-nanoparticles, and intermolecular forces and electrostatic force between Ag-nanoparticles and polymer matrix that makes the film strengthened and shows better mechanical properties. Similarly, the break strain or percentages of elongation are more for nanocomposite films. This may be attributed to the fact that Ag metal nanoparticles make the film more flexible and observed that the incorporation of Ag-nanoparticles increases tensile strength and make the film more flexible.

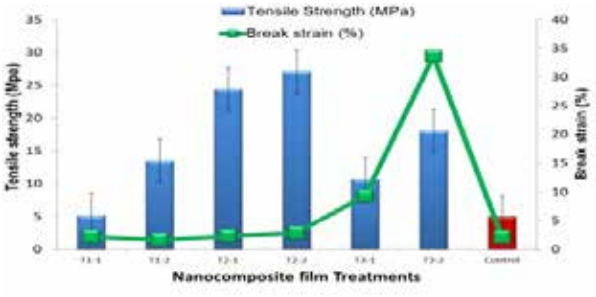


Fig. 9.1: Mechanical properties of the developed nanocomposite film

DSC thermogram of nanocomposite film: DSC thermogram of the nanocomposite films was carried out to determine thermostability of the developed films. DSC thermogram of the nanocomposite films (Fig. 9.2) depicted one endothermic peak at 85.44 °C and one exothermic peak at 287.20 °C. The endothermic peak indicates the loss of water and plasticizer molecules from the films, whereas, the exothermic peak indicated thermal degradation of the modified guar gum and plasticizer molecules in the films. DSC thermogram also indicated that the onset of the thermal degradation started at 260 °C. The results indicated that the developed nanocomposite films are thermo stable up to 250 °C.

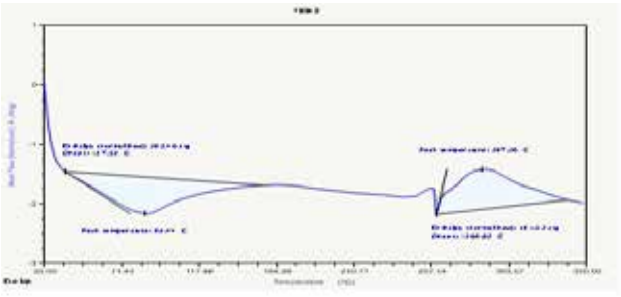


Fig. 9.2: DSC thermogram of the developed nanocomposite film

Water uptake studies: Water vapor is the main cause of color change and microbial growth in foods. Subsequently, it affects the quality and shelf life of food. Fig. 9.3 shows water uptake studies of the nanocomposite films with control. The water uptake continuously increases up to a certain period of time and the control film (90%) shows higher water uptake than the nanocomposite film (56%). These results clearly indicate that silver nanoparticles create an impermeable medium by binding with electron-rich oxygen atoms of CMC-Guar gum film and restrict the water penetration into the films. Thus nanocomposite films performed better compared to control films in food packing applications.

Water vapour permeability studies: The water vapor permeability (WVP) is an essential parameter for the film used as a packaging material and it was determined following the standard ASTME96/E 96 M with slight modifications. The packaging film must impede the moisture transfer between the packet item and the surrounding environment as much as possible. So that the packed item freshness could be maintained. Fig. 9.4 shows water vapor permeability studies of nanocomposite films with control. The decreasing value of the WVP of the nanocomposite film indicates the interaction between the polymer component and silver nanoparticles causing increased hydrophobicity of the nanocomposite film. Therefore, the diffusibility of the water vapor molecules through the nanocomposite film decreased compared to control film.

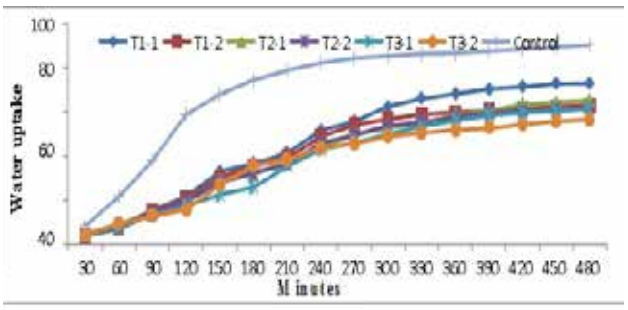


Fig. 9.3: Water uptake of the developed nanocomposite film

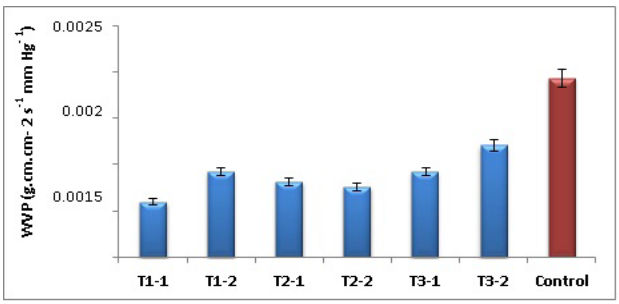


Fig. 9.4: Water vapor permeability of the nanocomposite film

(A) *S. aureus*

(C) *B. cereus*

(B) *V. vuluificus*

(D) *P. fluorescens*

Fig. 9.5: Antibacterial activity of different microorganism

Evaluation of anti-bacterial activity of nanocomposite film : Antimicrobial test was performed by disc diffusion technique and Mueller Hinton agar was used to prepare the test medium. Antimicrobial activity of the developed nanocomposite film is depicted in Table 9.1 and Fig. 9.5. The nanocomposite film showed varied activity for different microorganism with highest and lowest antimicrobial activity, respectively against *P. fluorescens* and *S. aureus.*

Table 9.1: Antibacterial activity of the developed nanocomposite film

Treatments	Zone of inhibition (in mm)			
	S. aureus **(gram + ve)**	***B. cereus*** **(gram + ve)**	***Vibriovuluificus*** **(gram - ve)**	***P. fluorescens*** **(gram - ve)**
T1-1	03	03	03	03
T1-2	05	03	05	08
T2-1	03	02	07	08
T2-2	04	07	05	10
T3-1	03	03	06	10
T3-2	05	05	10	10
Control	01	01	01	02
Chloramphenicol (10mg/ml)	20	17	25	15

The nanocomposite films showed higher activity against gram negative bacteria in comparison to gram positive bacteria.

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

During the year 2022, visits were made to surrounding forest areas of Ranchi, Jharkhand and photographs were taken for missing plant parts of some gum-resin trees. During local surveys photographs of season-specific plant parts including flowers, fruits, leaves, whole plants and gum exudation of different plant species were taken (Fig. 9.6 to Fig. 9.8).

Fig. 9.6: Different plant parts of the *Anogeissus rotundifolia* tree

Fig. 9.7: Different plant parts of the *Garcinia gummi-gutta* tree

Fig. 9.8: Different plant parts of the *Grevillea robusta* (Silver oak) tree

In order to increase the scope of this study, two centres namely KAU, Thrissur, Kerala, for photographing different plant parts of gum and resin plants of western Ghats of Kerala and CAZRI, Jodhpur (Rajasthan), for arranging photographs of different plants parts of the gum-resin producing trees from the arid regions of Rajasthan were involved in the project. The list of approximately 80 important NRG producing plants for which photos and information was compiled is as given in Table 9.2a and 9.2b.

Table 9.2a: List of major NRG producing plants

Sl.No.	Major NRG plants	Sl.No.	Major NRG plants
1	Karaya (*Sterculia urens*)	17	White-bark acacia (*Acacia leucophloea*)
2	Gum Arabic (*Acacia Senegal*)	18	Guar (*Cyamopsis tetragonoloba*)
3	Babul (*A. nilotica*) Sub-species: Indica	19	Tamarind (*Tamarindus indica* Linn.)
4	Babul (*A. nilotica*) Sub-species: adstringens	20	Isabgol / Psyllium (*Plantago* spp.)
5	Gum Ghatti (*Anogeissus latifolia*)	21	Cakunda (*Cassia tora*)
6	Jhingam (*Lannea coromandelica*)	22	Salai gum (*Boswellia serrata*)
7	Palas (*Butea monosperma*)	23	Guggul (*Commiphora wightii*)
8	Chironji (*Buchanania lanzan*)	24	White Damar (*Vateria indica*)
9	Asan (*Terminalia tomentosa*)	25	Black Dammar (*Canarium strictum*)
10	Baheda (*Terminalia bellirica*)	26	Chir Pine (*Pinus roxburghii*)
11	Neem (*Azadirachta indica*)	27	Blue pine (*Pinus wallichiana*)
12	Cashew nut (*Anacardium occidentale* L.)	28	Khasi Pine (*Pinus kesiya*)
13	Drumstick/Sahjan (*Moringa oleifera*)	29	Chilgoza (*Pinus gerardiana*)
14	Israeli babool (*Acacia tortilis*)	30	Sal (*Shorea robusta* Gaertn.f.)
15	Khair (*Acacia catechu*)	31	Jalari (*Shorea roxburghii*)
16	Sweet acacia (*Acacia farnesiana*)	32	Dikamali (*Gardenia gummifera*)

Table 9.2b: List of minor NRG producing plants

Sl.No.	Minor NRG plants	Sl.No.	Minor NRG plants	Sl.No.	Minor NRG plants
1	*Acacia chundra*	18	*Colophospermum mopane*	35	*Macaranga peltata*
2	*Acacia mearnsii*	19	*commiphora berryi*	36	*Mangifera indica*
3	*Acacia nilotica* Cupressiformis	20	*Commiphora caudata*	37	*Mesua ferrea*
4	*Acacia sieberiana*	21	*Cordia dichotoma*	38	*Moringa concanensis*
5	*Ailanthus excelsa*	22	*Dichrostachys cinerea shami*	39	*Parkia timoriana -Parkia roxburghii*
6	*Ailanthus triphysa*	23	*Dipterocarpus turbinatus*	40	*Prosopis cineraria*
7	*Albiziaamara*	24	*Enterolobium contortisiliqum*	41	*Prosopis juliflora*
8	*Albizialebbeck*	25	*Garcinia gummi-gutta*	42	*Prunus persica*
9	*Albizialucidior*	26	*Garcinia xanthochymus*	43	*Pterocarpus marsupium*
10	*Albiziaprocera*	27	*Garuga pinnata*	44	*Samanea saman*
11	*Anogeissus pendula*	28	*Grevillea robusta Silver oak*	45	*Sapindus trifoliatus*
12	*Anogeissus rotundifolia*	29	*Hardwickia binata*	46	*Soymida febrifuga*
13	*Balanite sroxburghii*/*B. aegyptiaca*	30	*Hevea brasiliensis*	47	*Spondias mombin*
14	*Bombaxceiba*	31	*Kingiodendron pinnatum*	48	*Spondias pinnata*
15	*Calophyllum inophyllum*	32	*Leucaena leucocephala*	49	*Terminalia bellirica*
16	*Ceiba pentandra*	33	*Limonia acidissima*	50	*Vatica chinensis*
17	*Cochlospermum religiosum*	34	*Macaranga indica*		

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

Experimentation on gum tapping from *Buchanania lanzan* trees at Kewali forest, Namkum, Ranchi (Jharkhand) was initiated (Fig. 9.9) in the first week of May, 2022 with three replicates and different treatment as detailed in Table 9.3 after survey at many villages of Torpa block of district Khunti (Jharkhand), Bundu and Namkum blocks of Ranchi (Jharkhand).

Fig. 9.9: Experimental site at Kewali forest, Namkum, Ranchi

Table 9.3: Experimental plan for gum tapping from *Buchanania lanzan* trees

Tool/method	Drilling diameter (inch)	Inducer application (4 ml)	Patching
Battery operated drilling	½	×	√
		√	√
Hand operated drilling	½	×	√
		√	√
	1	×	√
		√	√
IINRG – Gum Tapping Blazer - 75	NA	×	×
Semi Circular Incision	NA	×	×

Under the present investigation, gum inducer method, semi circular blazing method using IINRG – Gum tapping blazer – 75 and semi circular blazing method using chisel were used for gum production from *Buchanania lanzan* trees.

Inducer technology of gum tapping: A small size hole of 12.5 mm diameter and 100 mm deep with 45^0 inclination towards inner side was made on the

tree trunk about 1.0 m above the ground level with the help of battery operated drill (Fig. 9.10) and 4 ml inducer was dispensed in the hole through syringe and the hole was plugged with clay/piece of wood having approximately same diameter. Similarly, remaining trees were bored and treated with inducer and exudated *piyar* gum was collected after 1 month, hole of each tree was re-bored up to the same depth for opening the clogged gum ducts for further gum exudation. Similar process of inducer method of gum tapping as discussed above was performed using manually operated hand drill (½ and 1 inch), respectively with and without inducer application (Fig. 9.11).

Fig. 9.10: Development of bore hole using battery operated drill

Fig. 9.11: Development of bore hole using hand operated drill

Scientific technique of *karaya* gum tapping : Scientific method of *karaya* gum tapping from *Striculia urens* tree known as semi circular blazing technique, developed and standardized by Kovel Foundation, Visakhapatnam in collaboration with Girijan Co-operative Corporation Limited, Visakhapatnam was used for *piyar* gum tapping from *Buchanania lanzan* trees (Fig. 9.12).

Fig. 9.12: Developed blaze on *Karaya* tree for gum tapping

IINRG – Gum Tapping Blazer - 75: To maintain the uniform shape, size and depth of blaze on the tree trunk for *piyar* gum tapping from *Buchanania lanzan* trees, IINRG – Gum Tapping Blazer – 75 was used (Fig. 9.13). Blazer was placed on the tree trunk and hammered thoroughly up to the bark thickness and depth of blaze maintained utilizing depth control mechanism (Fig. 9.14).

Fig. 9.13: IINRG – Gum Tapping Blazer -75

Fig. 9.14: Blaze development utilizing blazer

Blaze developed easily with sharp edges, desired depth and size on the tree trunk utilizing IINRG – Gum Tapping Blazer - 75 with reduced manpower requirement, drudgery and time (Fig. 9.15). Gum started oozing after couple of days in trees treated using battery and hand drill without and with inducer and immediately after blaze development using

IINRG – Gum Tapping Blazer – 75 (Fig. 9.16) and chisel for semi circular incision.

Fig. 9.15: Developed blaze

Fig. 9.16: Gum exudation from developed blaze

Based on the experimentation of gum tapping from *Buchanania lanzan* trees through different tapping techniques for a period of six month from June – November, 2022 (initiated in the month of May, 2022) at village Kewali under block Namkum and district Ranchi, following conclusions were drawn.

- Gum production was about 20.91 and 10.83 times higher in trees treated with battery and hand drill (½″) and 5.93 times higher in trees treated using hand operated drill (1″) along with inducer application compared to without inducer.
- Mean gum production was found 1.97 times higher in blaze developed using IINRG – Gum Tapping Blazer - 75 compared to blaze developed using chisel.
- Gum inducer technology was found better for *piyar* gum tapping from *Buchanania lanzan* trees using battery operated drill as gum production was higher compared to all other techniques based on six month observation.
- Total maximum gum yield was found for bore hole developed using battery operated drill (½″) with inducer and minimum for battery operated drill (½″) without inducer.
- Maximum and minimum monthly *piyar* gum was collected in June and October, 2022.
- Blaze developed easily with sharp edges on the tree trunk utilizing IINRG – Gum Tapping Blazer – 75 with enhanced productivity of gum tapper compared to manual method of blaze development using chisel.

Germplasm Collection and Conservation: 'Resin and Gum plants germplasm farm' was developed by planting various NRG trees collected from various parts of the country at the Institute. More than 30 plants of the resin trees like, Pine (*Pinus roxburghii*), Dikamali (*Gardenia resinifera*) and gum trees like, Jhingan (*Lanea coromandellica*), Moringa (*Moringa oleifera*) and Piyar gum (*Buchnania lanzan*) transplanted to replace dead seedlings at the Resin and Gum plants germplasm farm (Fig. 9.17) during rainy season of 2021 were maintained in the farm.

Fig. 9.17: NRG germplasm at ICAR-NISA, Ranchi

Network Cooperating Centers

9.2 Project on gum Arabic at ICAR-CAZRI, Jodhpur

Study on gum production from known and lesser known gum producing tree species of arid zone of Rajasthan

Well-known gum producing tree species:

A. Senegal: In case of *A. senegal* tree species both standard CAZRI gum inducer (Fig. 9.18 and Fig. 9.19) and colourless ethephon (Fig. 9.20 and Fig. 9.21) gum inducer were applied to compare their performance. The morphological effect, gum yield, tree structural traits such as girth, height and canopy were also observed after application of inducer. Results indicated that gum *Arabic* production started 10-12 day after treatment and there was no adverse effect on tree.

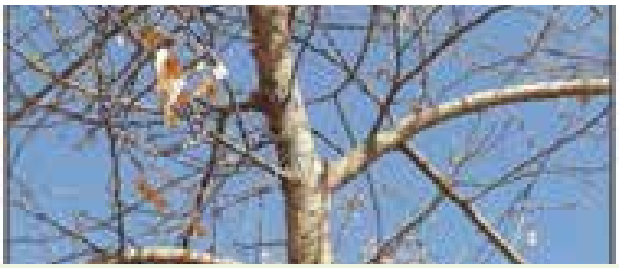


Fig. 9.18: Gum exudation in *A. senegal* tree species with standard CAZRI gum inducer

Fig. 9.19: A wide view of exuded gum in *A. senegal* tree species via standard CAZRI gum inducer

Fig. 9.20: Exuded gum in *A. senegal* tree species with colourless inducer

Fig. 9.21: A wide view of exuded gum in *A. senegal* tree species via colourless inducer

The gum produced were collected at 10 days picking interval. It was also observed that average production of gum Arabic in first picking was higher compared with subsequent pickings (Fig. 9.22). Maximum average yield 522.33 g/tree was found in standard CAZRI gum inducer in comparison to the colourless inducer *i.e.* 382 g/tree.

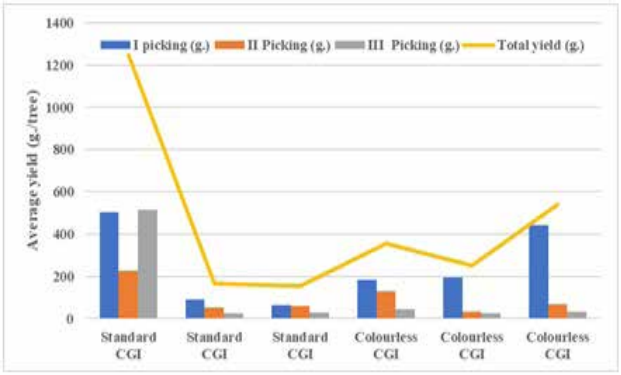


Fig. 9.22: Gum harvesting pattern of *A. senegal* tree with standard CAZRI inducer and colourless ethephon at CAZRI

Anogeissus rotundifolia: Structural traits and gum yield of *Anogeissus rotundifolia* were recorded this year (March to April, 2022). This year, both normal ethephon and colourless ethephon gum inducer were applied in separate treatment group of trees. For each treatment three trees per treatment were selected. The concentration of ethephon was kept same in coloured and colourless gum inducer. As in regular CAZRI gum inducer, dye is used which gives a reddish tint to the gum produced, but with colourless ethephon gum produced was more transparent and lighter in colour (Fig. 9.23 and Fig. 9.24). Gum yields pattern were also recorded with same interval (12 days/picking) from trees of different treatments. In all the treatments maximum gum yields were found in first and second picking which gradually decreased in its subsequent picking. In some tree groups, total gum production was observed with only two picking in both the inducers used (Fig. 9.25).

Fig. 8.23: Gum exudation from *A. rotundifolia* tree species with Colourless gum inducer

Fig. 8.24: Gum exudation from *A. rotundifolia* tree species with Standard CAZRI gum inducer

Fig. 9.25: Gum yields pattern in different picking interval (12 days/picking) from treatment of tree in both inducer used

Lesser-known gum producing tree species: In this context standardization of gum exudation technology in various tree species like *M. oleifera*, *B. serrata* and *C. rohtii* is under trial with use of regular CAZRI gum inducer and colourless inducer.

***Moringa oleifera*:** In *Moringa* the two methods *i.e* bore hole method and blaze method were used for gum production. The gum yield obtained with bore hole method was more compare to blaze method (Fig. 9.26 and Fig. 9.27).

Fig. 9.26: Gum-resin yield in *Moringa* tree species via Blaze method

Fig. 9.27: Gum-resin yield in *Moringa* tree species via Borehole method

Boswellia serrata: In case of *Boswelia serrata* three methods *i.e.* blaze method, spray method and control (use of no gum inducer) were compared for oleo resin production from trees. Overall higher production of oleo resin was found in blaze-spray method however, no adverse effect of gum inducing methods was observed in all treated trees (Fig. 9.28).

Control | Blaze-spray | Blaze droplets

Fig. 9.28: Exuded oleo-gum-resin with different treatment from *B. serrata* tree species

Higher average oleo resin production was found in spray method (Fig. 9.29) in first three pickings and no production in 4th picking *i.e.,* 32.2, 21.6, 51.33 and 0.0 gram/tree. While in blaze droplets method in four pickings production were 22, 20, 30.6 and 7.3 gram/tress respectively.

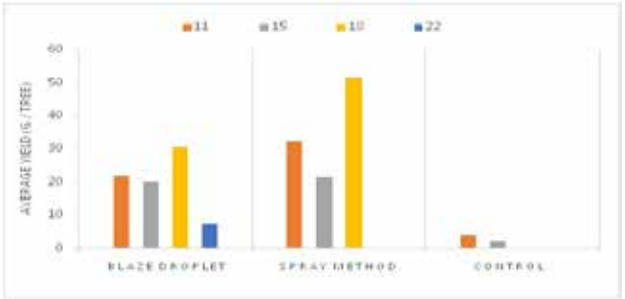


Fig. 9.29: Production pattern in different treatment of *B. serrata* tree species

Cordia rothii: In case of *Cordia rothii* tree species, seven trees were selected to carry out the experiment at CAZRI research farm in summer season (March-April, 2022) with 2 ml dose of CAZRI gum inducer. Tree structural traits were recorded accordingly. The average height (4.54 m.), DBH (7.46 cm) and canopy cover (2.66 m.) were recorded. Average gum yields

88.14 g/ tree found with range from 52.0 g to 137 g in all treated trees (Fig. 9.30).

Fig. 9.30: Gum exuded from *C. rothii* tree species

Value addition of gum Arabic through convenient technology

Gum Arabic based sweets/confectionary products: In making sweets and confectionaries gum Arabic was used in the range of 16-37.5% to enhance nutritive value and organoleptic characters of prepared products. Highest energy value 651.0 kcl was obtained in *Gond Laddu* (Fig. 9.31), followed by *Gond* chocolate 644.9 kcl (Fig. 9.32). Maximum calcium content (48 mg/100 g) was found in *gond laddu*; whereas, maximum iron content (12.02 mg/100g) was found in gond chocolate.

Fig. 9.31: *Gond Laddu*

Fig. 9.32: Gond chocolate

Extension of gum inducing technique in arid regions of Rajasthan

In the year 2022, 14,520 trees of *A. senegal* were treated by CAZRI gum inducer, resulting in production of approximately 6.53 tons of gum Arabic. In more than 48 villages of Chauhatan and Baytu tehsils of Barmer district; Shergarh and Phalodi tehsils of Jodhpur district; and some villages of Nagaur, Jhunjanu and Pali districts farmers adopted the gum inducing technology on large scale. Thus, farmers registered at CAZRI, Jodhpur of said villages earned revenue of Rs. 52.24 lacs through sell of gum arabic @ Rs. 800/kg based on prevailing rate in the local market. In this way, in each village additional income of Rs. 1.08 lacs came to farmers through sale of gum Arabic.

9.3 Project centre at ICAR-CAFRI, Jhansi

Productivity of gum-yielding tree-based agroforestry models

A. Plant growth

Growth and survival data of trees planted in various agroforestry models established at central research farm of the institute were recorded. Maximum GBH, plant height and canopy spread were recorded in *A. marmelos*, followed by *A. senegal*, *C. limon* and *C. carandas*. *C. carandas* recorded maximum survival (%), followed by *A. senegal*, *A. marmelos* and *C. limon*.

Rainfed agroforestry model (rainfed agri-silviculture): The survival of *A. senegal* and *A. nilotica* ranged from 77.5 to 79.2 and 61.9 to 82.2%, respectively. *A. senegal* recorded maximum survival planted in spacing 10×5 m while *A. nilotica* in 5×5 m spacing. After nine years of plantation, higher GBH and plant height were recorded in *A. nilotica* than *A. senegal* in almost all the spacing, barring few exceptions.

Silvi-herbal model: In silvi-herbal model-I, *Terminalia arjuna* showed maximum survival (100%), followed by *A. senegal* and *A. nilotica*. Maximum plant height was recorded in *A. senegal* and minimum in *T. arjuna*. In silvi-herbal model-II, *T. arjuna* showed maximum survival (100%), followed by *A. nilotica* and *A. senegal*. Highest GBH, plant height and canopy spread were recorded in *A. nilotica.* In silvi-herbal model-I, root slips of lemongrass were planted using four different spacing with four replications. In different replications, a total of 164 root-slips were planted in spacing of 100×50 cm; 112 in 100×75 cm, 84 in 100×100 cm and 68 in 100×125 cm. Results depicted in Fig. 9.33 and Fig. 9.34 clearly showed that it was found maximum in 100×125 cm (76.38%), followed

by 100×100 cm (69.88%), 100×75 cm (67.72%) and 100×50 cm (66.98%). Similarly, in silvi-herbal model-II, maximum survival was recorded in 100×125 cm (71.08%), followed by 100×100 cm (65.87%), 100×75 cm (62.80%) and 100×50 cm (49.39%).

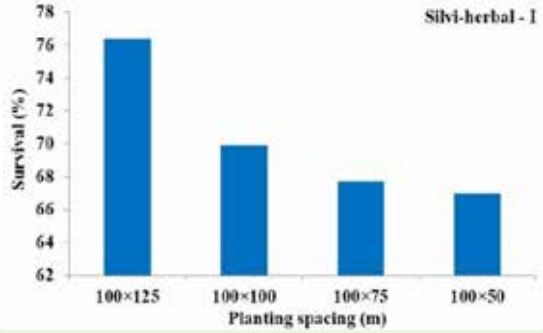


Fig. 9.33: Survival (%) of lemongrass in silvi-herbal model-I

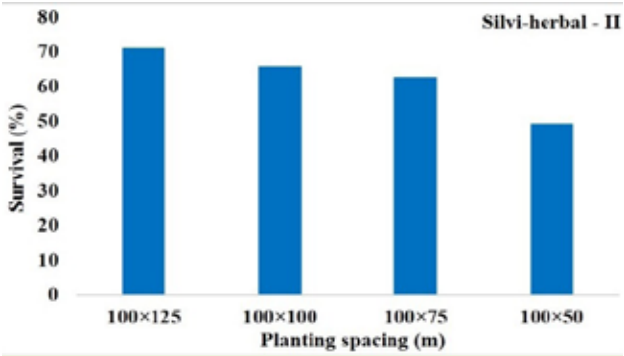


Fig. 9.34: Survival (%) of lemongrass in silvi-herbal model-II

Block plantation on rocky hillock: Survival of *A. senegal* in block plantation on rocky hillock was found to be 100% and plants attained mean height of 489.1 cm with GBH of 26.6 cm.

***A. senegal* based gum garden:** Survival (%) was higher in *A. senegal* than *B. monosperma* in both the gardens. *A. senegal*, planted in new gum garden, showed relatively higher survival.

B. Productivity

In this model (Fig. 9.35), fruit yields were recorded from 13 plants of *C. limon*, 18 plants of *A. marmelos* and 18 plants of *C. carandas.* A total of 151 kg *C. limon*, 58 kg *C. carandas* and 2080 kg *A. marmelos* fruits were harvested. The average weight of *A. marmelos* variety CISH B1 was 0.82 kg and variety CISH B2 was 2.00 kg.

Cultivation of wheat

Lemon fruits

Bael fruits

Karonda fruits

Fig. 9.35: *Acacia senegal* based agri-horti-silviculture model at CAFRI research farm

Similarly, in rainfed agroforestry model (rainfed agri-silviculture), *E. sativa* and *S. indicum* could not be sown, as soil in most part of the field remained saturated and could not reach at tilth conditions. During summer season, natural exudation of gum in different fields of *A. Senegal* (Fig. 9.36) was observed. Gum yield ranged from 17.59–138.79 g/tree in *A. senegal* based multi-component agri-horti-silviculture model (average: 78.39 g from 3 trees); 4.03–903.56 g/tree in rainfed agri-silviculture model (average: 119.41 g from 9 trees); 3.76–73.04 g/tree in old gum garden (average: 27.92 g/tree from 10 trees); 2.39–171.61 g/tree in new gum garden (average: 35.98 g/tree from 17 trees); and 1.85–184.93 g/tree (average: 27.93 g/tree from 8 trees) in block plantation at rocky hillock. Maximum number of gum tears/tree (4.11) was recorded in *A. senegal* based multi-component agri-horti-silviculture model while minimum (1.88) was recorded in new gum garden. Similarly, natural exudation of gum in different models of *A. nilotica* was also observed (Fig. 9.37) and the gum yield ranged from 12.04–30.24 g/tree in silvi-herbal model (average: 19.10 g/tree from 6 trees) and 6.29–40.11 g/tree in rainfed agri- silviculture (average: 14.29 g/tree from 8 trees).

Fig. 9.36: Natural exudation of gum from *A. senegal*

C. Soil health

Soils of different gum yielding tree-based agroforestry models established at ICAR-CAFRI research farm *viz*., silvi-herbal model, gum gardens (new and old), progeny and plus tree trials of *A. pendula,* block plantation of *Anogeissus pendula* (field no. 33) and *Anogeissus latifolia* (field no. 34) were characterized. Soil samples were collected from two layers (0-15 and 15-30 cm) and K, Fe, Mn, Zn and Cu recorded (Fig. 9.38). It was observed that soil depth affected the soil properties. Soil pH was recorded comparatively higher in sub-surface soil does not showed any definite trend; it was found higher in sub-surface soil of almost all the models, except in *A. senegal* based gum gardens (new and old) as well as progeny trials of *A. pendula*. Relatively higher SOC was recorded in surface soil of all the studied models. Availability of N, P and K were also higher in top layer of the soil (0-15 cm) in almost all the agroforestry models. Higher amount of Fe, Mn and Zn were recorded in surface soil (0-15 cm) of all the agroforestry models, barring few exceptions, amount of Cu was comparatively higher in sub-surface soil (15-30 cm) in all the models, except in *A. senegal* based gum gardens.

Fig. 9.37: Natural exudation of gums from *A. nilotica*

Fig. 9.38: Analysis of soil samples

Demonstration and development of gum yielding tree based agroforestry models on farmer's fields: In agroforestry models planted on farmer's fields, the maximum growth in terms of GBH of *A. senegal* (41.7 cm) was obtained in Garhkundar watershed area (in the field of Shri Himmat) while minimum (18.8 cm) at village Ambabai (in the field of Shri Maniram). Among the bio-fence models established for demonstration, maximum growth of *A. senegal* after 3.5 years was recorded in double row bio-fence model-III (26.36 mm collar diameter) planted on bunds of *E. officinalis* orchard. During earlier planting season, 6000 *A. senegal* plants were provided (Fig. 9.39) for planting on farmers' fields under the scheme 'Doubling Farmers' Income'. Besides, 1000 seedlings of *A. senegal* were planted on research farm of ICAR-IISWC, Regional Centre, Datia to establish a bio-fence for protection against stray cattle.

Fig. 9.39 : *A. senegal* seedlings distribution

Indigenous technical knowledge (ITK) on gum and resin's tapping, applications and post-harvest value addition

Villages of various districts, dominantly inhabited by Saharia tribes (Sheopur), Korkoo and Bhilala (Dewas), and Korkoo, Bhilala, Barela and Gond (Khandwa) were selected and related informations were collected from the tribal communities with the support of local forest officials (Fig. 9.40). Main occupation of Saharia tribes in Sheopur district was to cultivate agricultural crops (rainfed farming) on the land allotted to them on *patta* basis. In this district, major livelihood option for the tribal peoples is collection of NTFPs from the forest. These people migrate to nearby cities for earning their livelihood. In Dewas district, peoples of Korkoo (Thakur) and Bhilala communities depend upon agriculture, as most of them are having *patta* lands. Some of the landless tribal families depend on the forest for their livelihood security; they collect *dhawra* and *salai* gum. In Khandwa district, though the gum tapping is strictly banned by the State Forest Department; however, all the tribal communities (Korkoo, Bhilala, Barela and Gond) are engaged in harvesting *dhawra* gum from

the forests. Since, *Boswellia serrata* is occurring in few patches in the forest; hence, they do not harvest *salai* gum in higher quantity.

Village - Ratanpur (District: Dewas)

Village - Chakra (District: Khandwa)

Village - Khorhee (District: Sheopur)

Village - Golai (District: Khandwa)

Fig. 9.40: Survey of tribal dominated areas of Madhya Pradesh for collection of information of NRGs tapping, uses and value addition

Indigenous tapping techniques for gums: In all the surveyed villages, the tribal peoples generally peel off the bark (2-3 inches) of *B. serrata* and make a ring along the tree girth and collect gum after 4-5 days. For peeling off the bark, they use a special tool called *"Saluli"* and for collecting *salai* gum, they use tool called *"Gaantri"*. On an average, they collect 200-400 g *salai* gum from single tree. Normally, they peel off tree bark 15-20 times in a season, start at men's height and slowly move upwards as the season of gum exudation progresses from September to April. The tribal families in Sheopur do not make any cut or injury to *A. latifolia* but collect the exuded gum in form of tears. However, in Dewas and Khandwa districts, the tribal peoples generally make cuts on *A. latifolia* using a wooden bat having nails and axe, respectively for inducing gummosis. Tribal peoples in village Chakra of district Khandwa were using a gum inducer "Ethrex". They generally make cuts with the help of axe on stem surface of *A. latifolia* and spray/ pour Ethrex in each cut. They collect *dhawra* gum during summer season. Saharia tribe in Sheopur also collects natural exudation from *Acacia catechu* during summer season. For tapping *palas* gum, the tribal families in Sheopur and Dewas generally make cuts on the stem bark of *Butea monosperma* with the help of axe and collect gum after 3-4 days of notching.

Constraints faced by tribals of surveyed areas: The tribal dominated villages surveyed in Sheopur and Dewas districts enjoy full rights on forest for tapping gums and collection of other NTFPs. In district Khandwa, Forest Department imposed complete ban on gum tapping during 2019 while, collection of other NTFPs are not banned by the department. The tribal peoples of the area are tapping gum yielding trees illegally and collecting gums. When interviewed, they refused to provide any information on gum tapping, collection and their post-harvest value addition. The officials of Forest Department informed that the tribes of Khandwa district usually set forest on fire during the summer season, which probably increases the gum exudation from *A. latifolia* trees.

Value addition of gums and other NTFPs: Normally tribals of surveyed areas sell collected produce to local traders in original form *i.e.* without any post-harvest value addition. For storage of *salai* gum, traders of Sheopur as well as Dewas, make small balls from the *salai* gum by applying coat of *selkhadi* powder (chalk powder). Traders in Dewas informed that the juice exuded from *salai* gum fetches more price (Rs. 500/L). This practice of value addition to *salai* gum is not followed by the tribal peoples (Fig. 9.41). We noticed that all the traders have employed specific trained women labourers to segregate and grade the *dhawara* gum by its appearance and smell. The detailed insights of identifying gum-tears of particular species from a mixed lot need further discussion with the women.

Standardization of gum tapping techniques

Based on past research, it is inferred that specially designed bill hook for regulating depth and length of incisions is most suitable tool for tapping *kamarkas* (*palas* gum). Out of four types of incisions, simple notching yielded maximum gum, and the optimum depth and length of incision was 1.0 cm. For maximum gum yield, 45 notches/feet^2 of stem surface area of the trees is recommended. For inducing gummosis in *B. monosperma*, application of 390 ppm ethephon as spray on tree surface before notching was found effective. Likewise, for maximum gum exudation in *A. pendula,* application of 1170 ppm ethephon as injection at the base of tree trunk in the month of October is effective.

Natural drying of *salai* gum in open area

Processing of *salai* gum by trained labourers

Processed tears of *salai* gum

Fig. 9.41: Value addition of *salai* gum by trained labourers at village Patla, District Khandwa

Root and biomass distribution pattern in *Acacia Senegal*

Root distribution pattern as well as ground biomass (above and below) of 1 to 3 years old *A. senegal* was studied which were planted in gum gardens at the Institute research farm. For determining root biomass of *A. senegal*, roots of selected tree was excavated manually (Fig. 9.42). Prior to excavation, rooting zone was moistened with water, and sufficient care was taken to reduce the damage to the fine roots. Whole root system was dug-out, and entire root system was cut in different sections, for recording the observations. Then, from different sections, primary, secondary and tertiary (fine roots having <2 mm size) roots were separated, and observations on diameter, length and weight were recorded. Below ground root bound soil volume was 0.375, 0.672 and 17.300 m^3 in one, two and three year old *A. senegal*, respectively. The respective values of above ground biomass were 0.06, 0.90 and 24.02 kg, and below ground biomass was 0.02, 0.32 and 3.34 kg. Carbon sequestration potential of one, two and three year old *A. senegal* was 0.04, 0.58 and 13.00 kg/tree, respectively. The root to shoot ratio of one, two and three year old *A. senegal* was 0.287, 0.358 and 0.139, respectively.

Fig. 9.42: Excavation of complete root system of three-years old *Acacia senegal*.

9.4 Project on Guar gum at VNMKV, Parbhani

Extraction of PHGG using different enzymes and their quality assessment

The percentage recovery of partially hydrolyzed guar gum was found 96%, 95%, 93% and 94% of native guar gum by hydrolysis with Cellulase, Mannanase, Pectinase and Pullularase enzymes, respectively (Fig. 9.43). Further proximate analysis was carried out and protein was found to be reduced with increased fiber.

Significant change of fiber content was observed as compared to native guar gum sample. This might be due to the hydrolysis of native guar gum *i.e.* conversion of branched chain in to linear short chains. Viscosity of native guar gum showed 5600 cPs in 1% aqueous solution while 1% PHGG solution showed drastic reduction in viscosity. Significant increase in solubility was noticed in case of partially hydrolyzed guar gum samples than native guar gum, also same trend was observed with respect to average molecular weight.

PHGG samples indicated reduced value of average degree of polymerization as compared to native

guar gum due to its decreased molecular weight as a result of enzymatic hydrolysis. It was concluded that PHGG produced by cellulase enzyme was better with respect to quality parameters than other enzymes.

PHHG (Cellulase Enzyme hydrolyzed) PHHG (Mannanase Enzyme hydrolyzed)

PHHG (Pectinase Enzyme hydrolyzed) PHHG (Pullulanase Enzyme hydrolyzed)

Fig. 9.43: All samples of PHGG by different enzymes

Development of guar seed fractions based edible film

Guar seed fractions based edible film was developed and microbiological evaluation showed differential bacterial count, total plate count increased slightly with increased storage period and sample was free from microbial spoilage up to 30 days of storage. The total plate count after 45, 60, and 75 days were $8x10^2$, $66x10^2$, $272x10^2$ cfu/ml, respectively (Fig. 9.44 to Fig. 9.48), whereas after 90 days of storage period, the total plate count was $>387x10^2$ cfu/ml. There was no presence of yeast and mould count observed in the guar seed fraction based edible film from 0 to 45 days of storage. This could probably be attributed to the heat treatment given to the guar seed fraction based edible film during processing. After 60, 75 and 90 days of storage period yeast and mould count was recorded $7x10^3$, $11x10^3$ and $16x10^3$ cfu/ml under ambient storage condition. In the present study, the percentage of carbohydrate was very high compared to other parameters because of the potato starch present in the composition in making of guar seed fraction based edible film is the main ingredient for stabilizing and maintaining the thickness and the overall quality of guar seed fraction based edible film. Mineral profile of guar seed fraction based edible film indicated that guar seed fraction based edible film contain high level of phosphorus and magnesium.

Fig. 9.44: Total plate count 45th Day $8×10^2$

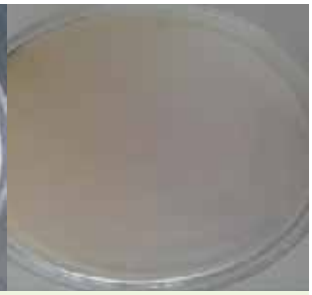


Fig. 9.45: Yeast and mold count 45th Day not detected

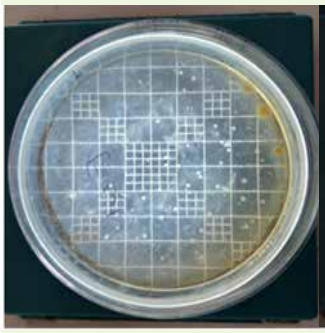


Fig. 9.46: Total plate count 60th Day $66×10^2$

Fig. 9.47: Total plate count 75th Day $272×10^2$

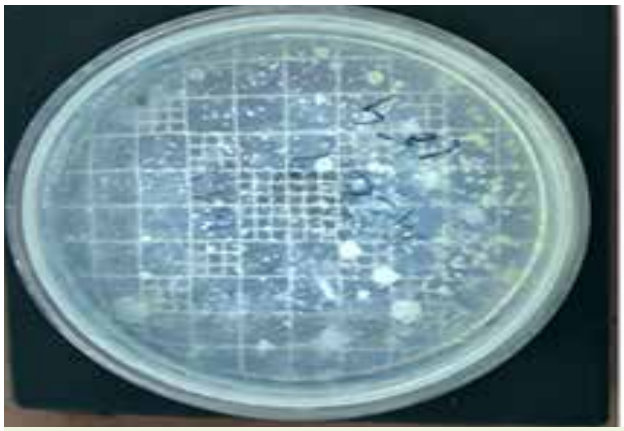


Fig. 9.48: Total plate count 90th Day$>387×10^2$

Effect of feeding different levels of guar meal on growth performance of kaveri chicken

Efforts have been made to standardize the formulation of poultry feed ration by replacing 4% to 8% soya meal with guar meal. In the starter and finisher diet of poultry, guar meal was added from 4 to 8% by replacing soya meal in the experimental birds as per treatment. It was observed that growth parameters of the poultry birds fed with guar meal based poultry

feed was at par with soya meal based feed and also there was no evidence of adverse effect on health of the poultry birds. The hematological parameters of birds showed no significant difference in blood Hb concentrations and red blood cells count. There was significant decrease in total protein, albumin, globulin and glucose with increase in level of guar meal.

Feed consumption: The feed consumption of experimental kaveri birds under various experimental treatments was recorded at weekly interval throughout the experimental period in winter season. The pattern of average weekly feed consumption (g) per bird is depicted in (Fig. 9.49). It was observed that feed consumption increased from 3rd to 8th week, and later it decreased in 9th and 10th week, which may be due to galactomannan content of guar meal which increases viscosity and suppresses the nutrient digestibility to cause growth depression with increasing amount of guar meal. The data on the cumulative body weights of experimental kaveri birds under various experimental treatments was recorded during the periods of ten weeks of age in winter season and the pattern of cumulative body weight was depicted in (Fig. 9.50). On the basis of growth performance, it was concluded that guar meal can replace costlier soya meal based ration as an alternative source.

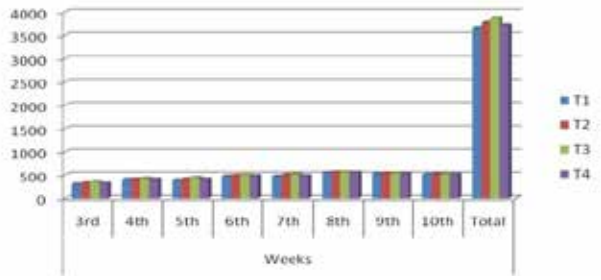


Fig. 9.49: Average weekly feed consumption (g) per bird

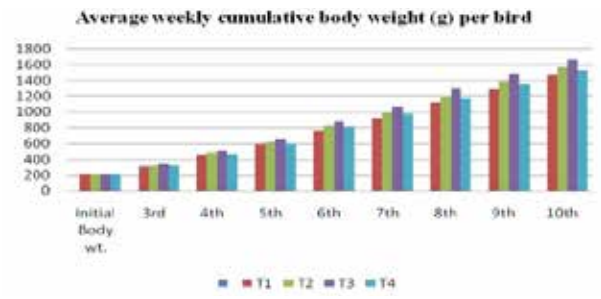


Fig. 9.50: Average weekly cumulative body weight (g) per bird

The data on average weekly gain in body weight of live kaveri birds under various experimental treatments were recorded during the periods from 3rd week to 10 week of age in winter season (Fig. 9.51) and the cumulative body weight gain is depicted in (Fig. 9.52). The result obtained in the experiment *i.e.* 6% guar meal in the starter and finisher stages showed beneficial effect on growth performance in the kaveri birds. There was no significant effect of non inclusion of CGM in juvenile phase on BWG; though feed intake did not differ significantly by CGM inclusion but FCR was significantly higher at all inclusion levels of CGM (6%).

Feed conversion ratio (FCR): The weekly feed conversion ratios during 3-10 weeks were calculated from data of average weekly body weight gained and weekly feed consumption and the results up to tenth week are presented in (Fig. 9.53). It was concluded that FCR ratio increased with increasing level of CGM percentage.

Fig. 9.51: Live body weight gain

Fig. 9.52: Average weekly gain in body weight (g) per bird

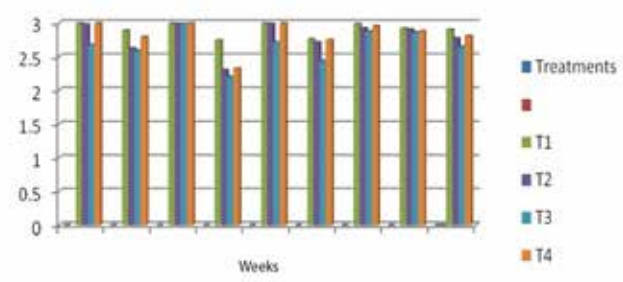


Fig. 9.53: Average weekly feed conversion ratio of birds

Haemato-biochemical parameters

Haematological parameters: The average mean blood parameters including haemoglobin (Hb) and red blood cells (RBC) of chicken were tested at 70 days of age. The analyzed value are presented in Fig. 9.54 and Fig. 9.55.

Fig. 9.54: Haemoglobin (Hb) of improved backyard chicken

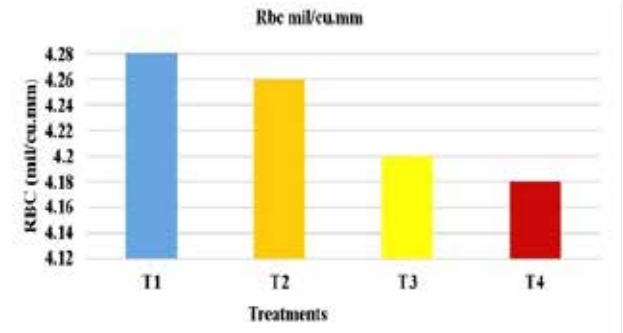


Fig. 9.55: Red blood cells (RBC) of improved backyard chicken

The hematological parameters in blood collected from birds (Fig. 9.56) showed no significant difference in blood Hb concentration level in all treatments. The concentration of Hb in T1, T2, T3 and T4 were 11.8 g/dl, 11.65 g/dl, 11.50 g/dl, 11.45 g/dl, respectively.

Red blood cells count in T1 (control) was 4.28 mil/cu.mm, followed by 4.26 mil/cu.mm for T2 while 4.20 mil/cu.mm for T3 and 4.18 mil/cu.mm for T4. There was no significant difference observed in between four treatments.

Biochemical parameters: Data regarding biochemical parameters like total protein, albumin, globulin and glucose was estimated at the end of experiment and the results are depicted in Fig. 9.57. From the study it was concluded that there was significant decrease in total protein, albumin, globulin and glucose level with increased guar meal.

Fig. 9.56: Blood collection of experimental birds

The total protein was observed in chicken at 70 day in T1, T2, T3 and T4 3.87, 3.80, 3.77 and 3.60 g/dl, respectively. The levels of albumin at 70 day in T1, T2, T3 and T4 were 1.5, 1.32, 1.25 and 1.10 g/dl, respectively. The differences in level of albumin in T1, T2, T3 and T4 were significant. The albumin was highest in T1 (1.5 g/dl) followed by T2 (1.32 g/dl), T3 (1.25 g/dl) and lowest value in T4 (1.10 g/dl). There was significant decrease in albumin with increase in level of guar meal. The levels of globulin at 70 day in T1, T2, T3 and T4 were 2.2, 2.15, 1.98 and 1.88 g/dl, respectively. The globulin was highest in T1 (2.20 g/dl) in control and lowest in T_4 (1.88 g/dl). The values of globulin decreased with increase in guar meal. The levels of glucose at 70 day in T1, T2, T3 and T4 were 238, 194, 162 and 132 mg/dl, respectively. The glucose was highest in T1 (238 mg/dl) in control and lowest in T4 (132 mg/dl). There was significant decrease in glucose level with increase in guar meal. From the present study it was concluded that there was significant decrease in total protein, albumin, globulin and glucose level with increased guar meal.

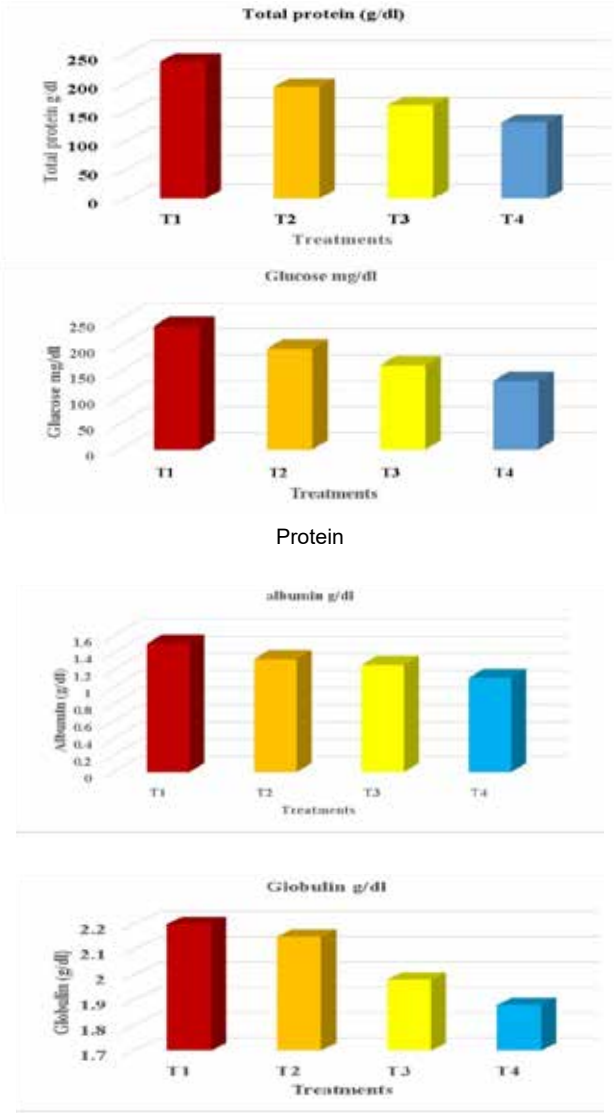


Fig. 9.57: Levels of different Biochemical Parameters in improved backyard chicks

Economics

The economic analysis was carried out considering total amount of feed consumed by improved birds under T1 control and other three guar meal fed groups. Other factors such as cost of day old chicks, medicine, vaccine and litter material were common for all the treatments and control groups. The data regarding average live body weight, average feed consumption, feed consumption per kg live weight gain, cost of feed, total cost of feed (including cost of guar meal used under different treatments), cost of feed per kg live weight gain and net profit per bird are given in Table 9.4.

Table 9.4: Economics of production per bird

Particulars	T1	T2	T3	T4
Cost of day old chicks	20	20	20	20
Cost of feed per bird (Rs/ kg)	37.26	39.47	31.76	44.51
Avg. total feed consumption per bird (g)	3366.5	3781.8	3881.7	3727.51
Cost feed consumed per bird (Rs)	136.62	149.27	123.28	150.09
Initial body weight at 3rd week (g)	312.15	320.25	340.8	315.40
Avg. body weight at end of 10th week (g)	1471.11	1570	1673	1536.10
Avg. body weight gain (g)	1264.15	1361.88	1466.97	1328.47
Feed consumption per kg live weight (g)	2492.3	2408.5	2320.2	2426.6
Cost of feed per kg live weight gain (Rs)	108.08	109.67	84.16	113.01
Cost of medicine, vaccine and litter material per bird (Rs)	15	15	15	15
Cost of production (1+4+10)	171.62	184.27	158.28	185.09
Avg. price realized @ Rs.170 per Kg live weight (Rs)	250.07	266.9	284.41	261.12
Net profit per bird (12-11)	78.45	82.63	126.13	76.03

The average body weight of bird at the end of 10th week were 1471.11, 1570, 1673 and 1536.10 g/bird in the treatments T1, T2, T3 and T4, respectively. The birds are sold at the rate Rs. 170/Kg and price realized per bird were Rs. 250.07, Rs. 284.41, Rs. 266.9 and Rs. 261.12, respectively in the treatments T1, T2, T3 and T4. The highest price realized was from the treatment T3 *i.e.* Rs. 284.41 followed by T2 (Rs. 266.9), T4 (Rs. 261.12) and lowest price realized from the treatment T1 control (Rs.250.07).

The net profit per bird was highest in, T3 (Rs. 126.13) followed by T2 (Rs. 82.63), T1 (Rs. 78.45) and lowest for T4 (Rs. 76.03). The observations indicated the performance of chickens in treatment T3 group was superior to that of the control and other treatments and 6% guar meal in chicken diet seems to be economical.

9.5 Project on Rosin at Dr. YSPUH & F, Solan

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

Experiment on natural stand at Nauni (Solan) and Bhota (Hamirpur): The results obtained under standardization of borehole angle for oleoresin tapping in *Pinus roxburghii* Sargent at Nauni (Masariya Majhgaon) and Bhota (Hamirpur) are as under.

Effect of borehole angles on oleoresin yield: The effect of different angles (A_1-25°, A_2-40°, A_3-55° and A_4-

70°) on oleoresin yield in borehole method was found to be significant at 5 per cent level of significance. The highest oleoresin yield of 4255.22 g/season/tree was recorded at an angle A_2 (40°) and the lowest yield of 2181.88 g/season was observed at A_4 (70°) for Nauni (Masariya Majhgaon). Similarly, the highest oleoresin yield of 2175.87 g/season was recorded at an angle A_2 (40°) and the lowest yield of 1381.16 g/season/tree at A_4 (70°) for Bhota (Hamirpur).

Effect of borehole angle and diameter class on oleoresin yield: Among the different diameter classs (D_1: 30-40 cm, D_2: 40-50 cm, D_3: 50-60 cm and D_4: >60 cm) at Nauni (Main Campus) UHF, Solan the highest oleoresin yield of 2600.86 g/hole/tree was recorded in the diameter class >60 cm whereas, lowest oleoresin yield of 2066.37 g/hole/tree was observed in the diameter class 30-40 cm. The analysis of variance revealed significant differences for treatments and mean maximum oleoresin yield of 3668.88 g/hole/tree was observed at an angle of A_2 (40°) with mean minimum yield of 1205.53 g/hole/tree in A_4 (70°). The interaction between angle and diameter classes also showed significant effect on oleoresin yield. Maximum oleoresin yield of 4,239.12 g/hole/tree was recorded in A_2 and D_4, whereas minimum (1,016.74 g/hole/tree) in A_1 and D_2. Similarly, the highest oleoresin yield of 1523.42 g/hole/tree was recorded in the diameter class >60 cm, whereas lowest oleoresin yield of 1112.39 g/hole/tree was observed in the diameter class 30-40 cm for Bhota (Hamirpur). The analysis of variance revealed significant differences for treatments and mean maximum oleoresin yield of 1897.50 g/hole/tree was observed at an angle of A_2 (40°) and mean minimum yield of 801.77 g/hole/tree in A_4 (70°). Interaction between angle and diameter classes also showed non-significant effect on oleoresin yield.

Effect of storage conditions and containers on rosin content of oleoresin: Experimental data revealed significant difference for rosin content of *Pinus roxburghii* from three different storage conditions (deep freeze, freeze and room temperature) and for different time period (2, 4, 6 and 8 months) in different storage containers (glass, plastic, steel, earthen pot and tin). Maximum rosin content (82.38%) was found in the earthen pot at room temperature and minimum (78.37%) in tin at deep freeze condition with less than two months storage. Under four months storage conditions, the maximum and minimum rosin content were recorded in earthen pot (82.58%) at room temperature and in tin (79.15%) at deep freeze condition. For six months storage conditions, the maximum (82.99%) and minimum rosin content (79.69%) was found in earthen pot at room temperature and in tin at deep freeze condition. For eight months storage condition, the maximum rosin content (83.07%) was noticed in earthen pot at room temperature condition and minimum rosin content (80.68%) was recorded in glass under deep freeze condition.

Effect of storage condition and container on turpentine content of oleoresin: Significant difference for turpentine content of *Pinus roxburghii* from three different storage conditions, durations with storage containers were recorded. Maximum and minimum turpentine content recorded was 21.63% and 17.62% for two month storage, 20.85% and 17.42% for four month storage and 20.31% and 17.01% for six month storage in tin container at deep freeze condition and earthen pot at room temperature, respectively. After eight months storage, maximum turpentine content (19.32%) was recorded in glass at deep freeze and minimum (16.93%) in earthen pot at room temperature.

Effect of diameter classes on oleoresin yield in rill method: In rill method, effect of different diameter class on oleoresin yield was found significant at 5 per cent level of significance. Highest oleoresin yield (7.93 kg/season/tree) was recorded in diameter class >60 cm (D_4) and lowest (4.62 kg/season) in diameter class 30-40 cm (D_1).

Anatomical characteristics of wood of *Pinus roxburghii* Sargent

The results obtained in experiment on effect of anatomical characteristics on oleoresin yield in *Pinus roxburghii* Sargent at Nauni (Main Campus) are detailed below.

Resin ducts: The effect of number of resin ducts on oleoresin yield in borehole method was found to be significant at 5 per cent level of significance. Maximum number of resin ducts 1.17/mm^2 was observed in diameter class D_4 (>60 cm) and minimum 0.86 /mm^2 in diameter class D_1 (30-40 cm).

Tracheid length and tracheid diameter: Maximum tracheid length and diameter 4.12 mm and 0.077 mm was observed in diameter class D_4 (>60 cm) whereas, minimum tracheid length and diameter 3.09 mm and 0.51 mm was noticed in diameter class D_1 (30-40 cm) and D_2 (40-50 cm), respectively.

Length, width and frequency of medullary rays: Maximum and minimum ray height 0.45 mm and 0.025 mm was observed in diameter class D_3 (40-50 cm) and D_1 (30-40 cm). Maximum (0.050 mm) and minimum (0.023 mm) ray width was recorded in diameter class D_4 (>60 cm) and D_1 (30-40 cm), respectively. Frequency/number of medullary rays was found higher (39.15 /mm^2) in diameter class D_4

(>60 cm) and lower (27.93/ mm^2) in diameter class D_1 (30-40 cm).

Anatomical characteristics of wood of *Pinus roxburghii* from different progenies

Length, width, frequency of medullary rays and tracheid diameter: The maximum ray length (0.439 mm) was recorded in progeny Kaldoo P4 whereas, minimum (0.188 mm) was in Dibkon P3. The maximum (0.045 mm) and minimum (0.018) ray width was observed in Kaldoo P4 and Leda P5 progenies, respectively. Whereas, maximum (37.10 /mm^2) and minimum (27.04 /mm^2) number of rays was found in Kopra P5 and Kaldoo P9, respectively. Maximum tracheid diameter (0.085 mm) was observed in Kopra P5 and minimum (0.049 mm) in progenies Rakni P-8 and Kather PT Black Centre.

Environmental correlation coefficient: Simple correlation coefficients between environmental factors *viz*., maximum temperature (max T°C), minimum temperature (min T°C), average relative humidity (RH%), total rainfall (RF mm) and total evaporation (EVP mm) and oleoresin yield are presented in Table 9.5. Out of 15 correlation combinations, two was positively and one negatively significant at 1% level of significance and one was negatively significant at 5% level of significance. The correlation coefficients between rests of the combinations were found to be non-significant.

Table 9.5: Simple Correlation Coefficient between Oleoresin Yield and Environmental Factors (2010 to 2020)

	Oleoresin Yield	Max T (°C)	Min T (°C)	Av. RH (%)	Total RF (mm)	Total EVP (mm)
Oleoresin Yield	1	0.959**	0.344	-0.852*	0.162	0.506
Max T (°C)		1	0.533	-0.913**	0.392	0.555
Min T (°C)			1	-0.736	0.892**	0.624
Av. RH (%)				1	-0.567	-0.746
Total RF (mm)					1	0.657
Total EVP (mm)						1

**Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level; *Max T: Maximum Temperature; Min T: Minimum Temperature; Av. RH: Average Relative Humidity; Total RF: Total Rainfall; Total EVP: Total Evaporation

The oleoresin yield exhibited positive significant correlation coefficient with maximum temperature (0.959). The negative significant correlation coefficient was observed between oleoresin yield and average relative humidity (-0.852).

Demonstration of borehole technology of oleoresin tapping

The borehole method of oleoresin tapping was demonstrated to the Forest Guards of Forest Training Institute, Chail, Solan, Himachal Pradesh in two batches (Fig. 9.58 & 9.59) as detailed in Table 9.6.

Fig. 9.58: Demonstration-cum training on borehole method of oleoresin tapping in 1st batch to the Personnel of Forest Training Institute, Chail, Solan (Himachal Pradesh)

Fig. 9.59: Demonstration-cum training on borehole method of oleoresin tapping in 2nd batch to the Personnel of Forest Training Institute, Chail, Solan (Himachal Pradesh)

Table 9.6: Details of training imparted to the forest guards at Forest Training Institute, Solan

Training details	Date	No. of trainees
Demonstration of borehole method of oleoresin tapping to the Forest Guard trainees of Forest Training Institute, Chail, Solan, Himachal Pradesh (Batch no. 1)	23rd July, 2022	45
Demonstration of borehole method of oleoresin tapping to the Forest Guard trainees of Forest Training Institute, Chail, Solan Himachal Pradesh (Batch no. 2)	30th July, 2022	48

9.6 Project centre at IGKVV, Raipur

Sustainable utilization of gum and resin by establishing improved tapping technique in Dhawara / Ghatti (*Anogeissus latifolia*)

Dhawara/Ghatti: As compared to mechanical methods use of gum inducer enhanced the gum production in dhawara and tree trunk diameter of one meter or more is suitable for gum production with favourable season (temp >38 °C & RH <50%). Use of gum inducer had synergistic impact on gummosis process and gum production. Application of small amount of ethylene producing substance (etherel, ethephon), 50-150 mg/tree/season injected in hole made by hand/battery operated drill in sap wood (at a depth of 2-3 cm) in summer season resulted in enhanced gum production. Combined effect of ethylene and sulphuric acid (2 ml, 1-5%) was found effective for higher gum production in dhawara during winter season.

Sustainable utilization of gum and resin by establishing improved tapping technique in Salai (*Boswellia serrata*)

Salai (*Boswellia serrata Roxb*): Salai (*Boswellia serrata Roxb*) is one of the high potential gum-resin producing tree abundantly available in almost all climatic zones of Chhattisgarh state. Double V shape cuts at one DBH (2 cm deep) on more than 90 cm diameter tree was found best amongst all mechanical and traditional tapping in both the seasons. Use of gum inducer *i.e.* combined effect of ethephon 78-156 mg per tree per season with 2 ml sulfuric acid @5-10%, injected in sap wood (2-3 cm deep) hole made by hand or battery operated drill was found to be superior over mechanical and traditional method of gum tapping for both the season. SEM analysis indicated that Ca, K and Mg were present in salai gum and DSC (Differential Scanning Calorimetry) confirms exothermic peak at around 200°C. Solubility of salai gum was found more in organic solvents (acetone and ethanol) indicated more resin content availability in exudates. Physiochemical properties of gum tapped by mechanical, traditional and gum enhancer indicated that there were non-significant difference in their properties with respect to moisture, ash, protein and nitrogen content, viscosity, solubility, and pH value. Tannin and phenol content slightly (non-significant) increased with use of gum inducer in exudate of salai.

Development of tapping techniques for sustainable extraction of biopolymer in Rohini (*Soymida fembrifuing* Roxb), Chironji (*Buchanania lanzan Spreng*) and Saja (*Terminalia tomentosa* Roxb.)

Experimentation on gum tapping from Rohina (*Soymida febrifuga*), Salai (*Boswellia serrata*) and Saja (*Terminalia tomentosa*) was conducted using various gum inducer and traditional tapping method and observed that season of tapping plays significant role on gum/resin production and high temperature with low RH were found favorable for enhanced gum/resin production. Eexudation started in experimental trees within week after treatment with various gum inducer. Gum/resin exudation was relatively less in winter season (January and February) compared to summer season. In all the experimental trees treated with the gum inducer, exudation started within a week and continued throughout the summer (March to June) and winter (January to February). Use of ethephon @3.9% at three places was found to be significantly effective for enhanced exudation in Salai and Rohina in winter and summer. However, use of H_2SO_4 @2% and H_2SO_4 @5% at three places in summer and winter was significantly effective for enhanced exudation in Saja. Combined effect of ethephon @3.9% + H_2SO_4 @10% single place was quite effective in chironji (*Buchanania lanzan* Spreng.) tapping.

Physicochemical properties of different exudate gum obtained were analyzed and slightly different physico-chemical properties (pH, swelling index, acid insoluble and ash) observed using gum inducer. Significantly increased hydrophobic protein, tannin content, alkaloid and ash content observed in the gums tapped with gum inducer with no change in crude fat, total fiber content. DSC analysis indicated stable salai exudates compared to other gums and presence of volatile compounds and ash was confiremed by TGA (Thermal Gravimetric Analysis).

Harvesting and collection of Palash (*Butea monosperm)* gum:

Palas trees of girth 1.5 – 2.3 m at 1 DBH were tapped following mechanical (Semi-circular cut

and single straight horizontal cut) and gum inducer (T1-ethephon @0.39%; T2-ethephon @0.78%; T3-ethephon @1.17%; T4-ethephon @1.17% + H_2SO_4 @1% and T5-H_2SO_4 @1%) methods to know the suitable tapping method for palas gum and observed commencement of gum exudation within a week in all treatments and continues up to 2 weeks (Fig. 9.60).

Hand drilling | Injecting gum enhancer

Covering with clay | Gum exudation

Fig. 9.60: Enhancer method of palash (*Butea monosperma*) gum tapping

It was observed that moisture content was high in gum sample tapped by semi arc method (12.57%) followed by single cut method (12.15%) and minimum moisture content was observed in gum tapped using H_2SO_4@ 1% (11.11%) or in combination with ethephon @ 1.17% + H_2SO_4@ 1% is 11.11%. Ash content was recorded high (6.06%) in palash gum sample tapped traditionally (single cut method) and low (3.8%) in semi arc method. Ash content in gum inducer methods were 3.59 and 3.47%, respectively for 1.17 ethephon + H_2SO_4 @1% and 0.78% ethephon with pH range 5.53 – 5.91.

Utilization of gum as edible coating for shelf life extension of button mushroom (*Agaricus bisporus*):

Babul gum solution (3-7%) was prepare by dissolving different weight of babul gum in 100 ml of distilled water to create gum based edible coating solution, agitated at low temperature (40°C) for 60 minutes using hot plate magnetic stirrer and un-dissolved contaminants were then filtered out using cheese cloth. After cooling at 20 °C, carboxymethyl cellulose of known weight was added as emulsifier in order to increase the potency and flexibility of the coating solutions, mixed properly for 10 minutes and stored for one hour at room temperature. Before application of coating soulution, mushroom was subjected to washing, cleaning and dried at room temperature. Dried mushroom was than dipped in coating solutions for one minute and controlled samples of mushrooms were dipped in distilled water. Coated mushrooms were than air dried at room temperature and packed in LDPE polythene (with 1% open area) and stored in refrigerated condition (10-12 °C) for 8 days. It was observed that treated mushrooms maintained good firmness and quality after 8 days of storage (Fig. 9.61).

0^{th} day | 8^{th} Day

Uncoated

0^{th} day | 8^{th} Day

Coated (BG 7% + CMC 1.5%)

Fig. 9.61: Coated and uncoated mushrooms

Development of biopolymer film from extracted Charota (*Cassia tora*) seed gum

To prepare charota seed gum based polymer film, methodology as depicted in Fig. 9.62 was adopted and gum was extracted from charota seed in the laboratory of department of Agricultural Processing and Food Engineering, SVCAET & RS, IGKV, Raipur. It was observed that development of polymer film is possible using extracted charota seed gum with combination of starch and plasticizer.

Training and demonstration

Scientific method of gum tapping was demonstrated to 398 farmer beneficiaries (Fig. 9.63) in 10 batches as one day training programme at different KVKs in district Chhattisgarh (Table 9.7). The major focus of the training programme was to make awareness

regarding importance of gums and scientific method of gum tapping among the beneficiaries to promote gum production in the region.

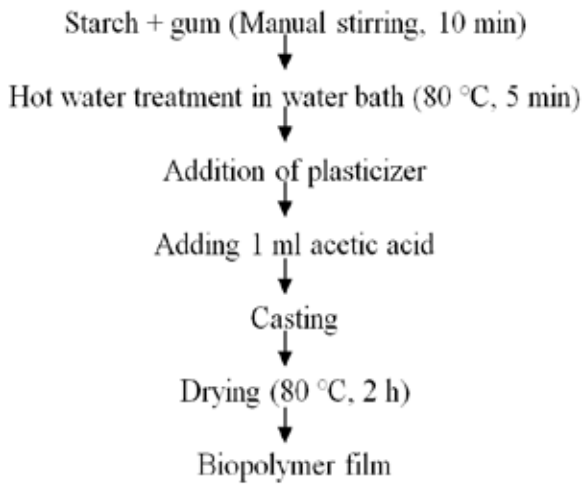


Fig. 9.62: Methodology of biopolymer development

KVK, Dhamtari

KVK, Bilaspur

DFO, Rajnadgaon

KVK, Kanker

KVK, Mahasamund

Fig. 9.63: Demonstration of scientific method of gum tapping at different locations

Table 9.7: Training programme carried out on scientific method of gum tapping

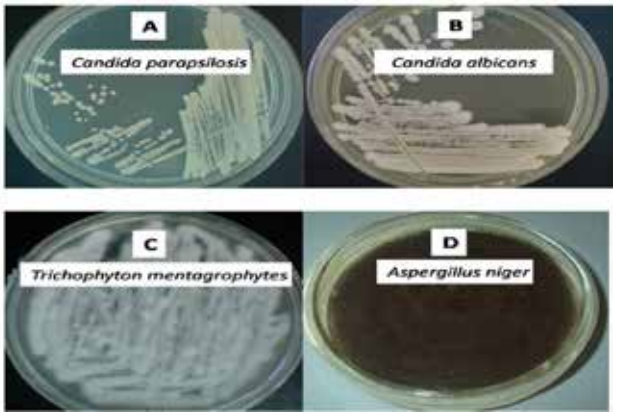
Place	Date	Participants
KVK, Ambagarh Chowki, Dist. Rajnadgaon (Village:- Sonsaytola)	17.02. 2022	45
KVK, Ambagarh Chowki, Dist. Rajnadgaon (Village:- koudutola)	18.02.2022	47
KVK, Rajnandgaon	22.02.2022	30
KVK, Kanker	24.02.2022	41
KVK, Balod	28.02.2022	30
KVK, Dhamtari	04.03.2022	48
KVK, Bilaspur	09.03.2022	44
KVK, Bemetara	11.03.2022	41
KVK, Rajnandgaon	24.03.2022	30
KVK, Mahasamund	25.03.2022	42
	Total	**398**

9.7 Project on Guggul at JNKVV, Jabalpur

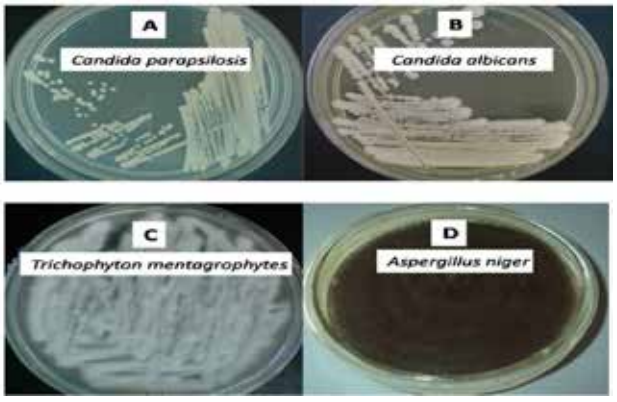
Qualitative analysis of guggul gum stored in moist earthen pots: Guggul sample stored in different conditions and materials revealed that a total of seventeen compounds with different retention time were recorded from the guggul sample stored in the earthen pot wrapped with moist jute bag against just 13 compounds in guggul stored in the earthen pot in moist sand bath, after 24 months of storage. It was concluded that guggul gum stored in earthen pot wrapped with moist jute bag was better in retaining maximum bioactive compounds of guggul.

Analysis of anti-fungal activity of guggul stored in different containers

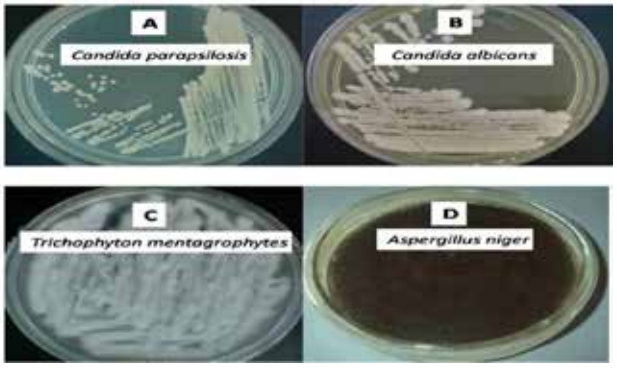
Methanol extracts of guggul gum oleoresin stored in earthen pot had better Minimum Inhibitory Concentration (MIC) against studied fungal isolates (Fig. 9.64) over the samples stored in other containers. Ethanol extract of guggul sample stored in earthen pot was again found better in comparison to other samples stored in jute bag, plastic container and polythene bag. Guggul samples stored in earthen pot showed better results and inhibited the growth of most of the studied fungal isolate with the use of minimum concentration of this sample.



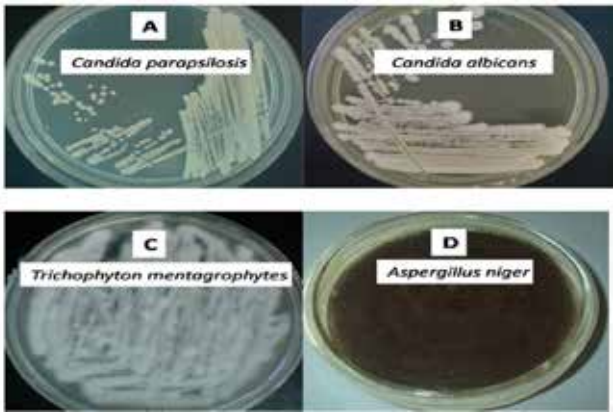
Candida parapsilosis



C. albicans



Trichophyton mentagrophytes



Aspergillus niger

Fig. 9.64: Growth of different fungal isolates

Analysis of anti-fungal activity of guggul gum stored in moist earthen pots

Alcoholic (Methanol and Ethanol) extracts of guggul gum oleoresin stored in both earthen pots, the earthen pot wrapped in moist jute bag had better efficiency against studied fungal isolates in comparison to the sample stored in earthen pot in wet sand bath. Aqueous extracts of guggul samples stored in earthen pot wrapped in moist jute bag showed better results and inhibited the growth of most of the studied fungal isolate with the use of minimum concentration.

9.8 Project on Tamarind seed gum at TNAU, Coimbatore

Effect of florigen application on tamarind genotypes

The study was undertaken for productivity improvement in tamarind seed gum and six different genotypes (FCRI-TAM-06, FCRI-TAM-09, PKM-1 (Control), FCRI-TAM-03, FCRI-TAM-04 and FCRI-TAM-08) were planted under high density planting system supplemented with florigen application for flower and fruiting management.

Paclobutrazol 500 ppm and etherel 500 ppm showed maximum fruit yield in FCRI-TAM-06 and FCRI-TAM-08 (9.05 kg/tree and 6.22 kg/tree, respectively). Seed testa to kernel ratio varied among the genotypes in which FCRI-TAM-06 observed maximum kernel percentage (76.15%) and minimum kernel content in FCRI-TAM-04 (71.63 cm). Tamarind seed gum yield was observed highest in genotype FCRI-TAM-06 with the value of 2.59 g in 5 g of tamarind kernel powder and lowest 2.31 g/5g of TKP in FCRI-TAM-04. In case of biochemical characteristics of TKP and seed gum yield, FCRI-TAM-06 accounted best genotypes in their performance. The pH of tamarind gum (1% solution) was found to be 6.25±0.20 and 6.72±0.07 in chemical

and non-chemical extracted TSG and the ash value of tamarind gum was determined to be 8.16±0.26 per cent and 13.72±0.45 per cent, respectively. Physical properties like bulk density (0.95±0.03 and 0.83±0.02 g/cm^3), tapped density (3.43±0.03 and 2.57±0.06 g/cm^3), compressibility index (0.782±0.01 and 0.743±0.01 g/cc) and Hausner ratio (2.12±0.02 and 3.09±0.03) recorded for chemical and non-chemical extracted TSG, respectively.

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

The preliminary assessment of gum production for the species *viz.,Chloroxylon swientenia*, *Acacia leucophloea* and *Azadirachta indica* were carried out at Forest College and Research Institute, Mettupalayam, Coimbatore.

Chloroxylon swientenia

Gum tapping from *Chloroxylon swientenia* were carried out and result revealed that maximum yield observed as 36.67 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 45-60 cm and minimum in T_4 (Hand operated drilling with ½ inch drill + patching with moistened clay) in diameter class of 30-45 cm (2.67 g/tree/month) as detailed in Table 9.8.

Table 9.8: Gum tapping in *Chloroxylon swientenia* in different diameter class

Treatments	Mean yield (g/tree/month)	
	30-45 cm	45-60 cm
T1 - Battery operated drilling with ½ inch drill bit + patching with moistened clay	3.77	4.33
T2 - Battery operated drilling with ½ inch drill bit + 2 ml inducer application patching with moistened clay	6.33	7.00
T3 - Battery operated drilling with ½ inch drill bit + 4 ml inducer application+ patching with moistened clay	13.00	24.67
T4 - Hand operated drilling with ½ inch drill + patching with moistened clay	2.67	3.67
T5 - Hand operated drilling with ½ inch drill + 2 ml patching with moistened clay	8.00	10.67
T6 - Hand operated drilling with ½ inch drill + 4 ml inducer application + patching with moistened clay.	24.67	36.67
T7 - IINRG - Gum Tapping Blazer – 75 + Ethephon	10.67	13.67
S.Ed	**0.36**	**0.56**
CD (=0.05)	**0.77**	**1.16**

Acacia leucophloea

Gum tapping from *Acacia leucophloea* were carried out and result revealed that maximum yield 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) as in Table 9.9.

Table 9.9: Gum tapping in *Acacia leucophloea* in different diameter class

Treatments	Mean yield (g/tree/month)		
	30-50 cm	50-70 cm	70-90 cm
T1 - Battery operated drilling with ½ inch drill bit + patching with moistened clay	2.80	3.70	6.50
T2 - Battery operated drilling with ½ inch drill bit + 2 ml inducer application patching with moistened clay	5.06	5.40	6.60
T3 - Battery operated drilling with ½ inch drill bit + 4 ml inducer application+ patching with moistened clay	7.70	9.30	9.10
T4 - Hand operated drilling with ½ inch drill + patching with moistened clay	2.30	2.90	3.00
T5 - Hand operated drilling with ½ inch drill + 2 ml patching with moistened clay	4.40	4.70	5.40
T6 - Hand operated drilling with ½ inch drill + 4 ml inducer application + patching with moistened clay.	8.90	16.80	28.20
T7 - IINRG - Gum Tapping Blazer – 75 + Ethephon	5.70	6.60	10.70
S.Ed	**0.36**	**0.56**	**0.44**

Azadirachta indica

Gum tapping from *Azadirachta indica* were carried out and observed 49.65 g/tree/month yield in T_6 (Hand operated drilling with ½ inch drill + 4 ml inducer application + patching with moistened clay) of diameter class of 70-80 cm and minimum in T_1 (Battery operated drilling with ½ inch drill + patching with moistened clay) in diameter class (Table 9.10) of 50-60 cm (8.20 g/tree/month).

Table 9.10: Gum tapping in *Azadirachta indica* in different diameter class

Treatments	Mean yield (g/tree/month)		
	50-60 cm	60-70 cm	70-80 cm
T1 - Battery operated drilling with ½ inch drill bit + patching with moistened clay	8.20	11.70	10.60
T2 - Battery operated drilling with ½ inch drill bit + 2 ml inducer application patching with moistened clay	20.40	22.70	25.50
T3 - Battery operated drilling with ½ inch drill bit + 4 ml inducer application+ patching with moistened clay	32.61	35.70	39.80
T4 - Hand operated drilling with ½ inch drill + patching with moistened clay	13.75	14.50	16.20
T5 - Hand operated drilling with ½ inch drill + 2 ml patching with moistened clay	29.11	32.30	35.00
T6 - Hand operated drilling with ½ inch drill + 4 ml inducer application + patching with moistened clay.	40.24	44.50	49.65
T7 - IINRG - Gum Tapping Blazer – 75 + Ethephon	27.90	32.45	45.60
S.Ed	**0.36**	**0.56**	**0.43**
CD (=0.05)	**0.77**	**1.16**	**0.86**

Standardizing the gum tapping techniques of *Moringa oleifera*

Gum extraction techniques for *Moringa oleifera* were 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 (25.40 g/tree/month) was observed in T_6 (Hand drilling with 4ml gum inducer) in 90-120 cm followed by T_5 (Hand drilling with 2ml gum inducer) in diameter class of 90-120 cm and minimum (1.73 g/tree/month) in T_1 (Mechanical drilling without gum inducer) in diameter class of 30-60 cm (Fig. 9.65).

A. Blaze developed using IINRG - Gum Tapping Blazer - 75

B. Bore hole developed using battery operated drill

C. Bore hole developed using manual drill and inducer application

Fig. 9.65: Gum exudation from *Moringa oleifera* tree using different tapping technique

Assemblage of gum yielding tree species of regional importance

Gum yielding tree species *viz., Acrocarpus fraxinifolius, Pterocarpus marsupium, Azadirachta indica, Butea monosperma, Vachellia nilotica and Acacia senegal* were assembled at tree gum garden, Mettupalayam. In addition, *Pterocarpus santalinus, Lannea coromendalica, Moringa oleifera* were planted on 'D' block of Forest College and Research institute, Mettupalayam. Maximum biometric observation of height recorded in gum yielding tree species with regional importance was for *Acrocarpus fraxinifolius* with height of 9.73 m followed by *Vachellia nilotica* (9.18 m), *Pterocarpus marsupium* (8.70 m), *Azadirachta indica* (6.97 m) and minimum 5.49 m in *Acacia senegal.* The basal girth was observed maximum in *Vachellia nilotica* with the value 48.52 cm followed by *Acrocarpus fraxinifolius* (43.58 cm), *Azadirachta indica* (41.10 cm), *Pterocarpus marsupium* (40.72 cm). Details of biometric attributes of different gum yielding trees of regional importance are mentioned in Table 9.11.

Table 9.11: Biometric attributes of gum yielding tree species of regional importance

Gum yielding trees	Height (m)	Girth at Breast Height (cm)
Butea monosperma	5.76	39.79
Vachellia nilotica	9.18	48.57
Acrocarpus fraxinifolius	9.73	43.58
Pterocarpus marsupium	8.70	40.72
Azadirachta indica	6.97	41.10
Acacia senegal	5.49	32.48

9.9 Project on natural dammars at KAU, Thrissur

Development of Germplasm of gums and resins yielding trees of Western Ghats

Identification of plants and selection of collection sites: Secondary data was collected from various floras and various regions were selected for detailed survey, documentation and all the morphological data were recorded and further studies. It was found that most of the resin and gum yielding trees are evergreen or semi evergreen species and only few of them are deciduous or dry deciduous in nature. Survey was conducted to build up more collections for selected trees known to exist in the identified pockets in previously explored areas.

Collection of seeds/seedlings: Information regarding flowering and fruiting collected during the survey and documented including digital herbarium preparation for gum and resin yielding trees of Kerala forests. Common trees seen around were excluded and endemic and critically endangered species were included for the establishment of germplasm center. Using previously collected data and with the help of tribals, flowering and fruiting period of trees were determined for the timely collection. Survey of Athirappilly, Vazhachal, Nelliampathy, Munnar, and Marayoor forest areas initiated during the period.

Establishment of Germplasm conservation for resins & gum trees: Three replicates of six species *i.e. Canarium strictum*, *Vateria indica*, *Calophyllum inophyllum*, *Palaquim ellipticum*, *Chukrasia tabularis* and *Myristica beddomei* were planted adopting 5×5 m spacing. Seedlings of *Kingiodendron pinnattum, Vatica chinensis, Semecarpus anacardium, Mesua ferrea, Garcinia spicata* and several other plants

were collected and raised in nursery for planting in the next monsoon season.

Success Story

Commercial production of black dammar incense sticks and dhoop cones

KAU made a technical alliance with Kerala State Federation of SC ST Development Co-operatives Ltd. (KSFSCSTDC Ltd.), Trivandrum for value addition of dammar and other forest sourced NTFPs. One of their registered center from Vilangad, Kozhikkode District received training and technical support regarding production of black dammar incense sticks and dhoop cones and successfully launched their own product as "VANAMAALIKA". The mentioned product was officially launched by Mr. MV Govindan, Hon'ble State Minister for Co-operation, GoK. Inauguration of the production unit and first sale was conducted by Mr. Vijayan, Hon'ble MLA, Kerala in the presence of KAU officials (Fig. 9.66).

Fig. 9.66: Launch of "VANAMAALIKA" brand @ COOP Expo by Mr. MV Govindan, Hon'ble State Minister of Co-operation, Government of Kerala

Publications

Research Papers published

- Prasad N, Thombare N, Sharma SC and Kumar S (2022). Production, processing, properties and applications of karaya (*Sterculia* species) gum. *Industrial Crops and Products*, 177, 114467.
- Prasad N, Thombare N, Sharma SC and Kumar S (2022). Recent development in the medical and industrial applications of gum karaya: a review. *Polymer Bulletin*, 1-23. https://doi.org/10.1007/s00289-022-04227-w
- Prasad N, Thombare N, Sharma SC and Kumar S (2022). Gum Arabic - A versatile natural gum: A review on production, processing, properties and applications. *Industrial Crops and Products*, 187(A): 115304.
- Thomas M, Meena KC, Shrivastava A and Tripathi N (2022). *In vitro* assessment of cytotoxic effect of guggul in L929 mouse skin fibroblast cells. *Annals of Phytomedicine* 11: 1-7.
- Gupta M, Singh S, Kurmi A, Luqman S, Saika D, Thomas M and Rout PK (2022). Correlation of boswellic acids with antiproliferative, antioxidant and antimicrobial activities of topographically collected *Boswellia serrata* oleo-gum-resin. *Phytomedicine Plus*, 2: 1-10. https://doi.org/10.1016/j.phyplu.2022.100289.
- Kshirsagar RB, Jadhav BA and Deshmukh NM (2022). Effect of incorporation of guar gum in combination with Arabic gum on quality of peanut *Chikki. The Pharma Innovation Journal*, 11 (9): 1207- 1210.
- Manimaran V, Balasubramanian A, Radhakrishnan S, Prasath CN, Thirumoorthy P, Sivaprakash M, Anjali KS and Swathiga G (2022). Extraction of tamarind seed polysaccharides as source of food and pharmaceutical through non-chemical method. *Biomass Conversion and Biorefinery*, 1-12. https://doi.org/10.1007/s13399-022-03483-0
- Manimaran V, Balasubramanian A, Radhakrishnan S, Sekar I, Boominathan P, Hariprasath CN and Sivaprakash M (2022). Pruning impact on flowering in Tamarind clones under high density planting. *Agricultural mechanization in Asia,* 53 (9): 9851-9863.
- Vennila, P (2022). Studies on utilization of tamarind seed kernel powder as a natural food additive in selected processed foods. *The Pharma Innovation*, 11(5): 10-15.

Patent filed

- Patent 'A novel low cost efficient storage system for guggul oleo-resin and method thereof' (Application no. 202121048803) was filed by inventors M. Thomas, N Tripathi, KC Meena and A Shrivastava on 24.08.2021 from Intellectual Property Rights (IPR), Patent Office, Mumbai.

Papers Presented/ Contributed in Conferences/ Symposia/ Seminars

Following papers were presented in International Conference on Agriculture Science and Technology: Challenges and Prospects (AST-2022), Rani Lakshmi Bai Central Agricultural University, Jhansi, May 06-08, 2022.

- Prasad Rajendra, Alam B, Handa AK, Arunachalam A, Kumar Vikas, Shukla Ashok and Singh Prashant (2022). Financial analysis and risk bearing capacity of *Acacia senegal* based multi-component agroforestry model for climatic resilience in semi-arid tropics, p. 67.

- Prasad Rajendra, Arunachalam A, Debnath S, Shukla Ashok and Singh Prashant (2022). Soil biological health in relation to tree density of *Hardwickia binata* Roxb. in agroforestry systems of semi-arid region, p. 241.
- Prasad Rajendra, Alam B, Handa AK, Arunachalam A, Shukla Ashok and Singh Prashant (2022). Gum exudation in *Acacia senegal* in relation to rainfall and soil moisture in Bundelkhand region of Central India, p. 75.

Following papers were presented in हिन्दी वैज्ञानिक संगोष्ठी on विज्ञान एवं किसान : भारत / 75, ICAR – National Institute of Natural Fibre Engineering & Technilogy (ICAR - NINFET), Kolkata, September 19, 2022.

- Sharma SC, Pandey SK, Prasad N and Raj Himanshu (2022). सहजन गोंद उत्पादन के लिए ब्लेजर,

Following papers were presented in 56th Annual Convention of Indian Society of Agricultural Engineers (ISAE) on Agricultural Engineering Innovation for Global Food Security and International Symposium on India 2047: Agricultural Engineering Perspective, TNAU, Coimbatore, November 09 – 11, 2022.

- Sharma SC, Pandey SK, Prasad N and Raj H (2022). Effect of tapping techniques on gum yield from *Moringa oleifera* trees, p. 499.

Following chapters were published in different Books/ Manuals as detailed below :

- Mishra S, Mate Ch J, and Thombare N (2022). Chemistry, biological activities and uses of Moi gum. *Gums, Resins and Latexes of Plant Origin,* 1-32.
- Thombare N, Ali Mohd and Swami S (2022) Introduction and recent advances in application of natural resins and gums in agriculture. In: *Training Manual on Natural Resins and Gums*, ICAR-IINRG,Ranchi, p. 103-108.
- Tewari JC, Pareek Kamlesh, Tewari Pratibha, Sharma Anil and Shiran K (2022). The paradigm shift in *Prosopis juliflora* use through community participation by developing value chain of value-added products from pods. In: María Cecilia Puppo, Peter Felker (Eds.), *Prosopis as a Heat Tolerant Nitrogen Fixing Desert Food Legume*, p. 213-230.

Extension Folders

- SC Sharma, SK Pandey, N Prasad and H Raj (2022). Moringa (*Moringa oleifera*) Gum Tapping Blazer, ICAR – Indian Institute of Natural Resins and Gums, Ranchi, 1 – 4.
- सतीश चन्द्र शर्मा, संजय कुमार पाण्डेय, निरंजन प्रसाद एवं हिमांशु राज (2022). सहजन/मुनगा (*मोरिंगा ओलीफेरा*) गोंद उत्पादन के लिए ब्लेजर, भाकृअनुप – भारतीय प्राकृतिक राल एवं गोंद संस्थान, राँची, 1 – 4
- मोनी थॉमस, नीरज त्रिपाठी, निरंजन प्रसाद एवं जी के कौतु (2022). गुग्गल पौध प्रवर्धन तकनीक, जवाहरलाल नेहरु कृषि विश्वविद्यालय, जबलपुर, पेज–1–6

Popular articles

Following popular articles were published in *Laksha*, 2022 (ISSN No. 2454-7840), ICAR- IINRG, Ranchi, p. 122:

- अर्णब रॉय चौधुरी एवं रोहित कुमार पांडेय। चाकोड गोंद : खाद्य योज्य के रूप में एक नई संभावना, पृष्ठ. 20–23.
- देवब्रत हरि, अर्नब राय चौधुरी एवं महताब जाकरा सिद्दीकी। झारखण्ड राज्य में औषधीय पौधों की बहुलता, पृष्ठ. 94–97.
- सतीश चन्द्र शर्मा, संजय कुमार पाण्डेय, निरंजन प्रसाद एवं हिमांशु राज। *मोरिंगा ओलीफेरा* के वृक्षों से गोंद उत्पादन पर तकनीकी का प्रभाव, पृष्ठ. 10–19
- सतीश चन्द्र शर्मा, संजय कुमार पाण्डेय, निरंजन प्रसाद एवं हिमांशु राज। सहजन के वृक्ष से *मोरिंगा* गोंद उत्पादन के लिए हस्त चालित पोर्टेबल ब्लेजर, पृष्ठ. 27–33
- नंदकिशोर ठोंबरे, उषा कुमारी, रेशमा शिंदे तथा सखाराम काले। कृषि उत्पादों के मूल्यवर्धन द्वारा रोजगार वृद्धि की संभावनाएं, पृष्ठ. 45–51.
- उषा कुमारी, नंदकिशोर ठोंबरे तथा निरंजन प्रसाद। कृषि के क्षेत्र में मोबाइल एप्स का उपयोग, पृष्ठ. 78–81.
- नीरज त्रिपाठी एवं मोनी थॉमस। गुग्गलः आयुर्वेदिक ग्रंथों की दृष्टि में, पृष्ठ. 100–102.

Following popular articles were published in ***फल फूल***, 2022.

- नंदकिशोर ठोंबरे, लोकेश मीना तथा निरंजन प्रसाद। चिरोंजी की बागबानी. 43 (4): पृष्ठ. 12–13.

Following popular articles were published in ***कृषिओमिकि***, 2022.

- उषा कुमारी, नंदकिशोर ठोंबरे, प्रदीप कुमार सरकार एवं रेशमा शिंदे। कृषि वानिकी आधारित बहुस्तरीय कृषि प्रणाली की झारखण्ड राज्य में संभावनाएं. पृष्ठ. 10–13.

Following popular articles were published in *Krishi*, 2022.

- नंदकिशोर ठोम्बरे, उषा कुमारी और निरंजन प्रसाद। द्वितीयक कृषि से आमदनी. पृष्ठ. 43–44.

Following popular articles were published in *Agriculture & Food e-Newsletter*, 2022.

- Chowdhury AR and Mate CJ (2022). *Cassia tora* gums: A new possibility for food additive. 04 (07): 437-438 pp.
- Pandey RK, Chowdhury AR and Mate CJ (2022). Moringa: A gift from nature. 4 (11): 203-205 pp.
- Mate CJ, Chowdhury AR and Thombare N (2022). Importance of minor gums for diverse applications. 04 (07): 107-108 pp.

Following popular articles were published in *Indian Farming Digest*, 2022.

- Hari Dewbrat, Chowdhury Arnab Roy and Thombare Nandkishore (2022). Guar gum - A natural biopolymer for industrial application. 1 (4): 1-4 pp.

Following popular articles were published in *Agri Journal World*, 2022.

- Yogi RK, Yadav SKS, Sharma SC, Thombare Nandkishore and Pal Govind (2022). Value chain of natural resins in India. 2(10): 20-28 pp.

Participation in Conferences/Meetings/Seminars/ Symposia/Workshops/Trainings

- Dr. SC Sharma, Sr. Sc. attended lecture on "Entrepreneurship potential and opportunities in natural resins and gums for startups" jointly organized by Agri Business Incubation Centre, ICAR – IGFRI, Jhansi; ISAE, New Delhi and Range Management Society of India, Jhansi, September 17, 2022.
- Dr. Bhupender Dutt (PI), Dr Rajneesh Kumar (Co-PI) and Dr Heena (RA) attended One Day "Institute - NRG Stakeholders meet on the theme Enhancing Value - Addition and Domestic Consumption of Lac and other NRGs" organized by ICAR – IINRG, Ranchi, January, 28, 2022.
- Dr. BA Jadhav and Dr. NM Deshmukh attended online lecture on "Promotion of gum yielding trees on farmland for livelihood security" jointly organized by ICAR - Central Agro Forestry Research Institute, Jhansi and National Agricultural Extension Management, Hyderabad, July 12-14, 2022.
- Dr. BA Jadhav and Dr. NM Deshmukh participated in "IP Awareness/Training program under National Intellectual Property Awareness Mission by Government of India" September 02, 2022.
- Dr. RB Kshirsagar, Dr. BA Jadhav and Dr. NM Deshmukh participated in International Conference on "Innovative food system Transformations for Sustainable Developments in Agro-Food and Nutrition Sector" organized by VIGNAN'S University, Guntur, November 16 – 17, 2022.

Award and Recognition

- Dr. Nandkishore Thombare, Sr. Sc. received 'Distinguished Worker Award - 2022' in the Scientific Category on the occasion of 99th Foundation Day of ICAR-IINRG, Ranchi, September 20, 2022.

Following scientists were awarded during 'Hindi Diwas Samaroh' organized by the Institute, September 30, 2022.

- Dr. Nandkishore Thombare, Sr. Sc. received first prize in the Essay competition under non hindi category.
- Dr. SC Sharma, Sr. Sc., Er. SK Pandey, Sc. and Dr. N Prasad, Pr. Sc. & Head, MPE Division received best popular article award for the article कराया गोंद उत्पादन के यंत्रीकरण की स्थिति एवं सुधार की संभावनाए published in लाक्षा – 2021 (ISSN : 2454-7840).
- Er. Anmol Kr. Mishra, SRF received first prize in the Essay competition.
- VNMKV Parbhani, received an appreciation letter form Association of Pet Food Manufacturers, New Delhi for the research carried on developing Vegetarian Pet Food Crackers for Dogs under All India Network Project on Harvesting, Processing and Value Addition of Natural Resins and Gums.

Trainings/demonstrations organized

- A one-day training programme under SC Sub plan on the topic "Sustainable harvesting and value addition of NTFPs" organized by College of Forestry, Kerala Agricultural University, Kerla, March 02, 2022.
- Workshop on value addition of various products for Van Dhan Vikas Kendra (VDVK) Scheme organized jointly by College of Forestry, Kerala Agricultural University, Kerala and SFDA, Kerala, March 05, 2022.
- One day training programme under SC sub plan on 'Distribution and Training on Agroforestry Machineries' organized jointly by College of Forestry, Kerala Agricultural University, Kerala and Athirappilli Grama panchayath, Kerala, March 27, 22.
- Training on 'Black Dammars and Utilization of lesser used Fruits' for value addition imparted to ST groups at Attapadi, Kerala by College of

Forestry, Kerala Agricultural University, Kerala, April 29, 2022.

- A webinar on 'Ecology and socio-economic importance of lac insects' to commemorate the First national Lac day was organized by ICAR – IINRG, Ranchi, May 16, 2022.
- Three hands on training imparted on 'Agarbatti and dhoop cone making" at Vilangad STSC society organized by College of Forestry, Kerala Agricultural University, Kerala, June 07, 2022; July 18, 2022 and October 18, 2022, respectively.
- Training on 'Manual pedal type agarbathy making machinery" imparted to the Forest Officals including Wildlife Warden, Range Officer and Deputy Range Officers from Bhavani Range Palakkad organized by College of Forestry, Kerala Agricultural University, Kerala, August 06, 2022.

Technology Transfer/Release

- Technology of 'Instant tomato soup powder by fortification of partially hydrolyzed guar gum (PHGG) as a soluble fiber source' was released in Joint Agricultural Research and Development Committee 2022 Organized at Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli.
- The technology of 'Dog Pet Food Crackers using guar meal" was transferred to V-cube Fresh Pvt. Ltd, VNMKV, Parbhani for commercial production and sale.

Details of technology developed

- Tamarind seed gum (TSG) freeze drying technique
- TSG spray drying technique
- TSG hydrocolloid filtration technique
- Protein separation technique in TSG
- Value addition of TSG
- Flowering induction in tamarind (Florigen Application)
- Gum inducer method for gum production from *Moringa oleifera* tree

Ph.D Thesis

- V Manimaran (2022). Silvicultural options for intensive management of *Tamarindus indica* L. for gum utility, Tamil Nadu Agricultural University, Coimbatore, 285p.

UG Thesis

- R Aravind (2022). Exudate Gum characteristics of *Lannea coromandelica* (*Houtt.*) *Merr*. and *Moringa olifera Lam*. Tamil Nadu Agricultural University, Coimbatore.
- N Arun (2022). Exudate Gum characteristics of *Chloroxylon Swietenia.* Tamil Nadu Agricultural University, Coimbatore.
- M Dinesh Krishnan (2022). Exudate Gum characteristics of *Acacia leucophloea*. Tamil Nadu Agricultural University, Coimbatore.
- Eniya (2022). Exudate Gum characteristics of *Azadirachta indica*. Tamil Nadu Agricultural University, Coimbatore.

Network Project on Conservation of Lac Insect Genetic Resources

10.1 Lead Centre: ICAR – NISA, Ranchi

Bacterial diversity in different life stages of lac insect

Different life stages namely crawlers, settled nymphs, adult male insects, adult female insects after fertilization and matured female insects were taken up for 16S rRNA amplicon sequencing to identify the bacterial endosymbionts present in them. Genomic DNA was isolated from different stages of lac insects and universal bacterial barcoding region *i.e.*, V3-V4 of 16S rDNA were amplified and subjected to illuminaHiSeq sequencing. Number of reads obtained for all the samples varied from 200707 to 276413. 83 to 86% reads had phred score more than 30. Pre-processed reads from all the samples were pooled and clustered into OTUs based on their sequence similarity using Uclust program (similarity cutoff = 0.97) available in QIIME software. A total of 81816 OTUs were identified from 776516 reads. From 81816 total OTUs, 68305 OTUs with less than 2 reads were removed and 13511 OTUs were selected for further analysis. The representative sequences from each clustered OTUs were picked and aligned against SILVA core set of sequences using PyNAST program. Further, taxonomy classification was performed using RDP classifier by mapping each representative sequence against SILVA OTUs database. The relative abundance of OTUs at different taxa level showed most of the OTUS were of unknown taxa. Besides them, lac insects were found to harbour Proteobacteria and Actinobacteria as the most abundant phylum OTUs, Alphaproteobacteria and Gammaproteobacteria as the most abundant class OTUs, Enterobacteriales as the most abundant order OTUs and Enterobacteriaceae as the most abundant family OTUs. *Hymenobacter*, *Bacillus*, *Pantoea*, *Allorhizobium*, *Neorhizobium*, *Pararhizobium*, *Rhizobium*, *Serratia*, *Methylobacterium*, *Enterobacter*, *Pseudomonas* and *Sphingomonas* were the most abundant bacterial genera present in lac insects.

Isolation and identification of endophytes from lac host phloem sap

Barks were collected from the lac host plants *viz*., *Flemingia semialata*. For surface sterilization they were washed with 70% ethanol for two minutes, followed by 2% sodium chlorite for one minute, and with 0.2% mercuric chloride for 30 seconds. Then the barks were washed thoroughly with autoclaved double distilled water for 5 times. Washed water was collected for checking contamination (as a control). Phloem sap was collected (by centrifugation method) and inoculated in Nutrient Broth at 28 ºC. Phloem sap inoculated in Nutrient Broth showed growth 72 hai (hours after inoculation), Then the broth was serially diluted and plated in three different media *viz*., Brain Heart Infusion, Blood Agar and Peptone Yeast Extract Agar media. Colonies were obtained in all the media 72 hai. For molecular identification of the colonies, 16S rRNA genes were amplified and sequenced. Based on the sequences, they were identified as *Priestia megaterium*.

Isolation and identification of endosymbionts present in *kusmi* lac insect collected from *Flemingia macrophylla*

Kusmi lac insects were collected from *Flemingia macrophylla*. For surface sterilization they were washed with 70% ethanol for five minutes, followed by 0.2% sodium chlorite for two minutes and with 0.05% mercuric chloride for two minutes. Then the insects were washed thoroughly with autoclaved double distilled water five times. Washed water was collected for checking contamination (as a control). Insects were crushed with the help of a pestle and serially diluted; and plated from 10^{-4} and 10^{-5} dilutions in a four different media *viz*., Brain Heart Infusion, Tryptic soya agar, Nutrient agar and Luria agar media and incubated at 37 ºC for 72 hai. Morphologically different colonies were obtained in all the media. For molecular identification of the colonies, bacterial DNA were isolated, 16S rRNA genes were amplified and sequenced. Based on the sequences, they were identified as *Kosakonia cowanii, Staphylococcus arlettae, Staphylococcus saprophyticus, Staphylococcus aureus, Staphylococcus epidermidis, Moraxella osloensis, Pantoea agglomerans, Pantoea sp., Acinetobacter baumannii,* and *Enterobacter cloacae*.

Isolation and identification of endosymbiont from *rangeeni* lac insect collected from *Flemingia macrophylla*

Rangeeni lac insects were collected from *Flemingia macrophylla*. For surface sterilization they were washed with 70% ethanol for five minutes, followed by 0.2% sodium chlorite for two minutes and with 0.05% mercuric chloride for two minutes. Then the

insects were washed thoroughly with autoclaved double distilled water five times. Washed water was collected for checking of contamination (as a control). Insects were crushed with the help of a pestle and serially diluted; insects were plated from 10^{-4} and 10^{-5} dilutions in a four different media *viz.*, Brain Heart Infusion, Tryptic soya agar, Nutrient agar and Luria agar and incubated at 37 ºC for 72 h. Morphologically different colonies were obtained in all the media. For molecular identification of the colonies, bacterial DNA were isolated, 16S rRNA genes were amplified and sequenced. Based on the sequences, they were identified as *Pantoea* sp., *Staphylococcus hominis, Staphylococcus warneri, Bacillus subterraneus and Acinetobacter schindleri*.

Isolation and identification of microbes present in honey dew collected from *Flemingia semialata*

Honey dew was collected from *Flemingia semialata* in a 1.5 ml tube through sterile graduated capillary. The samples were diluted and plated from 10^{-1} to 10^{-4} dilutions in a different media *viz.*, Tryptic soya agar, and Nutrient agar and incubated at 37 ºC for 72 h. Morphologically different colonies were obtained in 10^{-4} plate 72 hai. For molecular identification of the colonies, bacterial DNA were isolated, 16S rRNA genes were amplified and sequenced. Based on the sequences, they were identified as*Pantoea vagans*.

Barcoding of lac associated fauna

Samples were collected from *palas* during *katki* season 2022. Genomic DNA was isolated from a single insect. Genomic DNA was amplified with *cox1* universal barcoding primers (Folmer *et* al., 1994). The amplified product of around 700 bp was sequenced. Good quality sequence of 599 bp was obtained which was blasted against the entries in NCBI database. It was found to show maximum similarity with *Eublemma amabilis.*

Sample was collected from *palas* during *katki* season 2022. Genomic DNA was isolated from the sample. Genomic DNA was amplified with *cox1* universal barcoding primers (Folmer *et* al., 1994). The amplified product of around 700 bp was sequenced. Good quality sequence of 621 bp was obtained which was blasted against the entries in NCBI database. It was found to show maximum similarity with *Aprostocetus sp.*

Barcoding of lac host associated fauna

Apocrypta bakeri from *Ficus racemosa: Apocrypta bakeri* were collected from *F. racemosa* tree. Genomic DNA was isolated from the collected *Apocrypta bakeri* sample. Genomic DNA was amplified with *cox1* universal barcoding primers (Folmer *et* al., 1994). The amplified product of around 700 bp was sequenced. Good quality sequence of 609 bp was obtained which was blasted against the entries in NCBI database. It was found to show maximum similarity with *Apocrypta westwoodi*.

Ceratosolen fusciceps on *Ficus racemosa*: Cox1 barcode sequence of *Ceratosolen fusciceps* samples collected from the lac host plant *F. racemosa* tree. Genomic DNA was isolated from the collected sample. Genomic DNA was amplified with *cox1* universal barcoding primers (Folmer *et* al., 1994). The amplified product of around 700 bp was sequenced. Good quality sequence of 560 bp was obtained which was blasted against the entries in NCBI database. It was found to show maximum similarity with *Ceratosolen fusciceps*.

Analysis of phloem sap from different lac host plants

Leaves from *F. semialata* plants were cut at the base of the petiole and immediately placed in the 20 mM K2-EDTA solution. The base of the leaf petioles was recut again and transferred immediately into another tube with the 20 mM K2-EDTA solution. All the samples were kept in the dark or in the light to collect the exudates and left for one hour. After 1 hour, leaves were removed from the container and thoroughly washed with distilled water to remove all EDTA. Immediately leaves were transferred into the tubes containing distilled water and kept in the collection containers for collection of exudates. Four sets were prepared for standardizing collection time. First sample was collected after one hour, second after two hours, third after four hours and fifth after six hour. After collection, the samples were lyophilized and stored at -80°C for GC-MS (sugars and metabolites) studies.

The following methodology has been standardized for GC-MS/MS

GC Purge Flow -5 ml/min

GC injector temperature 220˚C

GC detector temperatures 260˚C

GC Column: Rxi-5MS

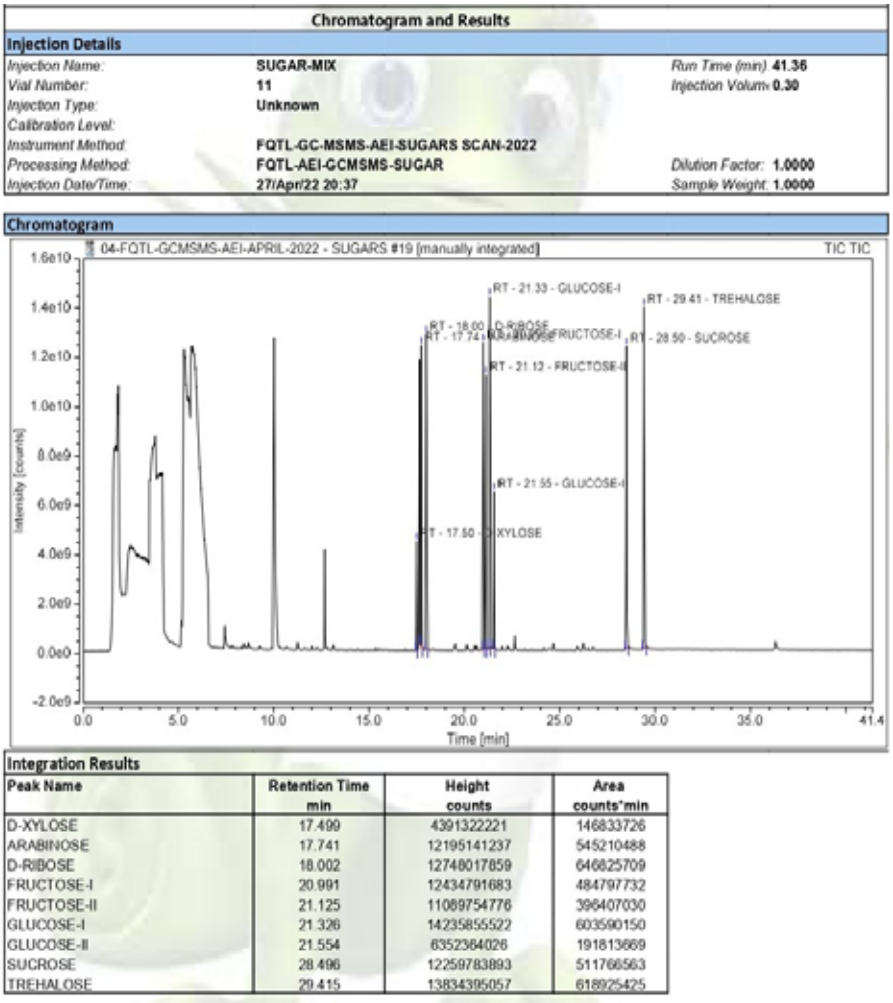
GC Column length: 30 (m)

Initial temperature was held at 70˚C for 5 min, and then increased to 180˚C at a rate of 10˚C/min, held for 2 min, increased further to 280˚C at 10˚C/min, held for 1 min, increased to 300˚C, and finally held for 5 min.

Duration of Run: 41.40 min.

The major sugars identified through GCMS analysis with their retention time, following the above method,

were D xylose (17.49), arabinose (17.74), D ribose (18.02), fructose-I (20.99), fructose-II (21.12), glucose-I (21.32), glucose-II (21.55), sucrose (28.49) and trehalose (29.41). The clubbed peaks appeared in the analysis from retention time 1 to 8 minutes could not be separated and identified, indicating the highly complex and closely related nature of the test sample. The sugar units detected from retention time of 17 to 30 minutes give valuable information about the content of sap (Fig. 10.1).



Peak Name	Retention Time min	Height counts	Area counts*min
D-XYLOSE	17.499	4391322221	146833726
ARABINOSE	17.741	12195141237	545210488
D-RIBOSE	18.002	12748017859	646825709
FRUCTOSE-I	20.991	12434791683	484797732
FRUCTOSE-II	21.125	11089754776	396407030
GLUCOSE-I	21.326	14235855522	603590150
GLUCOSE-II	21.554	6352364026	191813669
SUCROSE	28.496	12259783893	511766563
TREHALOSE	29.415	13834395057	618925425

Fig. 10.1: Sample run of GC-MS for the analysis of phloem sap

Diel changes in leaf starch in response to lac insect feeding on host plant Pigeon Pea (*Cajanus cajan* (L) Millsp.)

Starch in the plant cell acts as a reserve during the dark period, mobilized to provide sugars which are then utilized for growth and maintenance of the plants. The lac insect (*Kerria lacca* Kerr.) feeds on the phloem sap of the host plants to produce a resin known as 'lac', to protect its body. It is imperative to know the level of starch in host plant upon lac insect feeding. Therefore, a study was initiated to measure the level of leaf starch in lac insect infested plants at different lac insect developmental stages and compared with the control (plants without lac insects). The level of starch decreased (range -16.3% to -36.70%) in lac infested plants as compared to control in all the developmental stages of lac insect. The previous day evening sample was compared with next day morning sample to know the percent utilization by lac insect during the dark period. Initial developmental stage reveals 8% more consumption of starch by lac insect as compared to control. But in post sexual maturity stage of lac insect, level of starch was increased by 2.77% compared to control (-7.84%). This result shows that lac insect prompts host plant to increases starch level to fulfill own nutritional requirement at peak developmental stage. Towards lac insect maturity stage, 14% more consumption of starch by lac insect was observed as compared to control. This might be due to flag end stage of host plant, where plant is unable to produce sufficient starch (Table 10.1).

Table 10.1: Diel changes in host plant leaf starch in response to lac insect feeding

	Morning		Afternoon		Evening		CD	SE(m)
	Lac insect Infestation	Control	Lac insect Infestation	Control	Lac insect Infestation	Control		
	mg/g fr.wt							
Initial developmental stage	15.03	20.40	35.47	46.19	31.17	39.87	2.864	0.942
% increase/ decrease	-26.32		-23.22		-21.82			
Post sexual stage	27.18	40.13	33.99	51.38	27.58	42.01	2.685	0.883
% increase/ decrease	-32.27		-33.84		-34.34			
Maturity stage	24.58	38.83	51.72	64.89	51.53	62.13	5.362	1.763
% increase/ decrease	-36.70		-20.30		-17.06			

Pruning response of *Calliandra calothyrsus* and evaluation of lac insect (*kusmi*) on pruned plants

Pruning of *C. calothyrsus* was done in fourth week of every month from September 2021 to September 2022. Observations *viz*., time of initial sprouting, collar diameter, main and sub branch diameter, number of shoots, shoot length, shoot diameter were recorded at monthly intervals per plant in each month of pruning (Fig. 10.2).

Fig. 10.2: Characteristics of selected plants during different months of pruning

Evaluation of lac insect (*kusmi*) on pruned plants during *aghani* (winter) crop

Number of shoots, shoot length, shoot diameter were recorded on pruned plants in the month of September, October, November, December 2021 and January to September 2022. March and April 2022 months of pruning recorded longest shoot with more diameter as compared to other months of pruning (Fig. 10.3). *Kusmi* broodlac was inoculated on 8th July, 2022 (*aghani* crop) on the plants pruned during different months from September 2021 to February 2022. Broood lac ratio obtainedfrom different months of pruned plants were found to be 8.5, 3.5, 1.3, 8.2, 10.7 and 14.4 for theSeptember, October, November, December 2021, January and February 2022 plants, respectively. January and February months of pruning recorded more broodlac ratio as compared to other months of pruning.

Fig. 10.3: Pruning response of *C. calothyrsus* with respect to different months of pruning

Network Cooperating Centres

10.2 Assam Agricultural University (AAU), Jorhat

a) Study on life cycle parameters of *Kerria chinensis* and *Kerria lacca* on *Flemingia semialata*

Experiments to study the various life parameters of *K. chinensis* on *F. semialata* for last 7 years (2016-2023) revealed that the average pre-sexual maturity period (50.14 days), duration of male emergence (93.16 days) and female longevity (193.16 days) were recorded the highest in summer season than in winter.

Likewise, experiments to study the various life parameters of lac insect species collected during 2018, from Howrah (AAUK-17) and inoculated at Regional Field Gene Bank (RFGB), AAU, Jorhat on *F. semialata* revealed that the strain is tri-voltine in nature.

Study on pathogenicity of naturally occurring indigenous isolate of entomopathogenic fungi (EPF) against *Eublemma amabilis* and lac insect

The fungal isolate obtained from *E. amabilis* was identified as *Isaria fumosorosea* through morphological and molecular basis (Fig. 10.4 to 10.6).

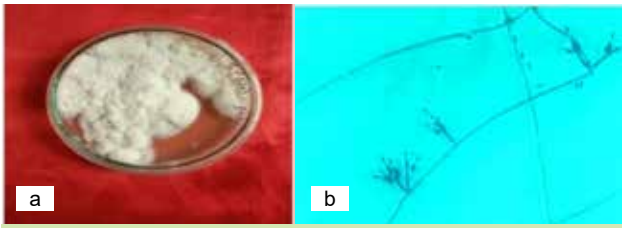


Fig. 10.4: *Isaria fumosorosea* (a) fungal culture on PDA media (b) conidia and conidiophores cells (under 40X).

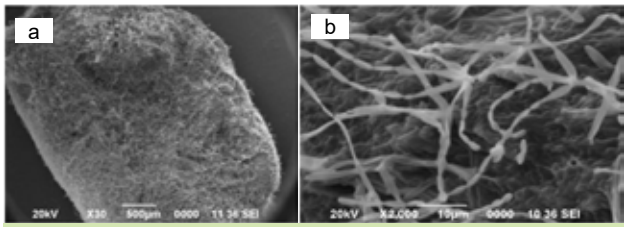


Fig. 10.5: Scanning Electron Microscope (SEM) images of *I. fumosorosea* infected cadaver of *E.amabilis* (a) dead larvae (b) chain of conidia

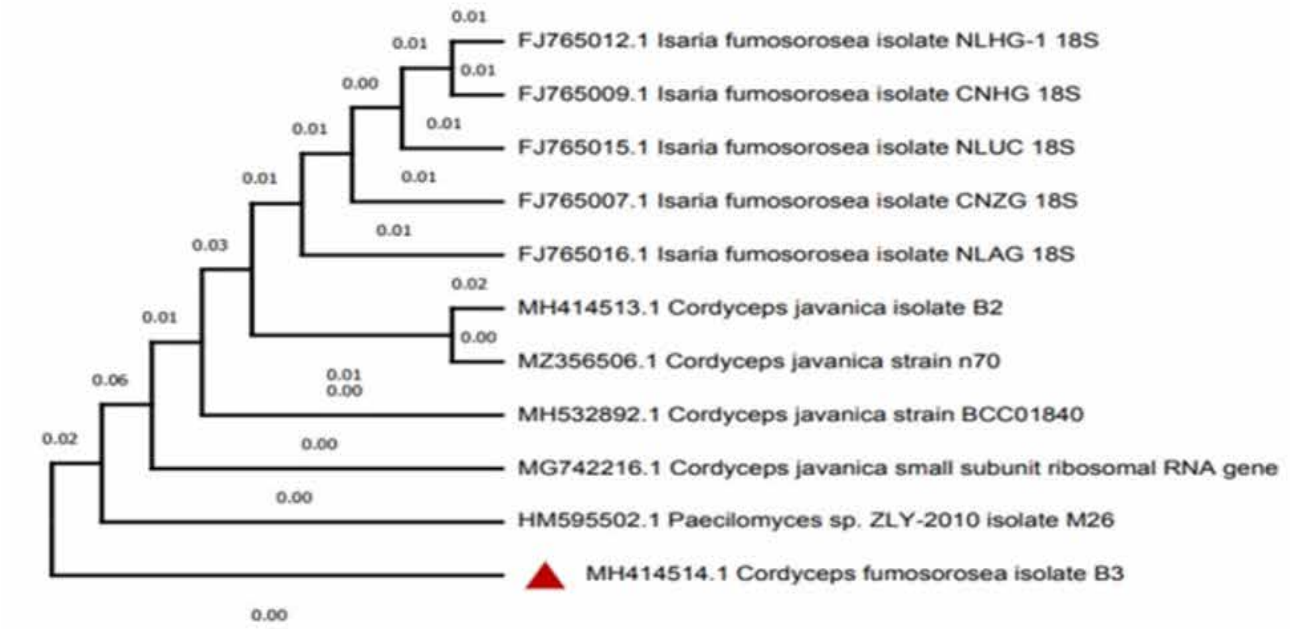


Fig. 10.6: Phylogenetic tree of MH414514.1 sequence and its closest homologs inferred using Neighbour-Joining method in MEGA v6. 1.0. The numbers of nodes represent the percentage of boot strap value obtained from 1000 sampling. Bar 0.01 shows the substitutions per nucleotide position

In vitro pathogenicity of *I. fumosorosea* against different stages of *E. amabilis*

The mortality of 3rd instar larval stage of *E. amabilis* due to infection of *I. fumosorosea* (MH414514.1) was evaluated at different spore dilutions by dipping and spraying methods. In the initial stage, morphological changes in the body of *E. amabilis* larvae were observed after application of the fungus *i.e.* the larval body color changed from creamy white to blackish brown and later became stiff (Fig. 10.7). On 15 DAT, the mortality recorded was 96% and 72% in dipping and spraying method, respectively

The *I. fumosorosea* (MH414514.1) strain was also potent against the pupae of *E. amabilis*. Adult emergence from the pupae was found to be the highest in the untreated control and a delay of adults' emergence with some deformities in their physical appearance were noticed in treatment with high dilution (Fig. 10.8).

Fig. 10.7: White fluffy growth and deformed larvae of *E. amabilis* treated with *Isaria fumosorosea* strain

Fig. 10.8: White fluffy growth and deformed adults of *E. amabilis* emerged from treated pupae

***In vivo* condition**

The application of *I. fumosorosea* at 10^7spore/ml of water during monsoon, winter, and summer crops was found to be effective in reducing the mean percent population of predators *i.e. E. amabilis* over control which was at par with Fipronil 5% SC.

Bio safety analysis of lac insects after spraying conidial suspension

Study revealed that spraying of *I. fumosorosea* at 10^7spore/ml on lac insects recorded appreciably good results in terms of duration of life cycle as well as productivity linked parameters.

In order to record the emergence of crawlers from the gravid female cell, the cells were treated with *I. fumosorosea* condial dilution under laboratory conditions at 29±1°C and RH 85-90%. The study recorded that this EPF was extremely safe for lac insects and their emergence was recorded up to 19 days of treatment. From a single cell around 250-350 crawlers were recorded, which was at par with the untreated control. It was recommended for On-farm trial during Technical committee meeting, *Kharif*, 2022.

A new native entomopathogenic fungi recorded from lac ecosystem

Infected cadaver of *Megacopta cribraria* and *Brachyplatys subaeneus* (pest of *F. semialata*) with fluffy fungal growth was collected from the RFGB, AAU, Jorhat which could not fly actively as compared to normal adult bug (Fig. 10.9 & 10.10).

Fig. 10.9: Infected cadaver of *Megacopta cribraria*

Fig. 10.10: Infected cadaver of *Brachyplatys subaeneus*

The infected bug was collected for identification in the laboratory. Pathogenicity test confers its efficacy on this pest. The efficacy of this isolate was again tested on some Lepidopteran pests of rice. Molecular characterization of the *Megacopta* sp. isolate, was carried out by using ITS rRNA. Hence, the fungus has been confirmed as *Fusarium oxyosporum* and its gene bank accession number obtained was OP389110.

Chemical characterization of lac resin produced by *Kerria chinensis* and value addition

Optimization of extraction and dyeing parameters of lac dye

Lac dye was extracted by using three different solvents such as acid, alkaline and aqueous solution. Synthetic and natural mordants were used to dye the cotton yarn. These dyes were used to dye gamusa and handkerchiefs.

Pests and diseases of lac host plants and their management

Megacopta cribraria, *Brachyplatys subaeneus* and *Archips* sp. were in abundance in host plants of lac insect at RFGB, Jorhat. Besides these pests, *Biston suppressaria*, *Hyposidra talaca*, Tussock moth, White fly, Flea beetle, *Somena scintillans,* Aphids were also observed in host plants of lac.

Integrated farming - lac culture with apiculture and other vegetables

Apiculture was intercropped with lac culture. During dearth period honey bees were observed visiting the plot having inoculated lac in *F. semialata*. This study showed a promising result and harvested 2kg honey/box during dearth period (Fig. 10.11). Lac culture was also intercropped with other fruits and vegetables like Assam lemon, bitter gourd, tomatoes and king chilli for getting more benefits.

Fig. 10.11: Intercropping lac culture with apiculture

Germplasm conservation of lac insect and its host plants

A total of 23 lac germplasms has been collected since inception and at present two live races of Assam and onelac race of West Bengal have been conserved at RFGB, AAU, Jorhat.

Collection of lac host plants

With an attempt to conserve lac host plant, a total of 18 lac host plant species have been collected and maintained at RFGB, AAU, Jorhat.

10.3 Central Agricultural University (CAU), Imphal

Comparative studies on the productivity linked parameters of *Kerria manipurensis* on *Magnolia champaca* and other host plants in use

In four months crop of *Kerria manipurensis* (February-March 2022 to June-July 2022), inoculation was done on five hosts plants *i.e. Malvaviscus penduliflorus, Flemingia semialata, Flemingia macrophylla, Magnolia champaca* and *Ficus religiosa* and replicated three times in the Regional Field Gene Bank (RFGB) for studying the productivity linked parameters like initial density of settlement, initial nymphal mortality, male-female sex ratio, final density of settlement and fecundity.

The mean initial density of settlement of *Kerria manipurensis* was found to be the highest on *Malvaviscus penduliflorus* (138.56 no. per sq cm) followed by *Flemingia semialata*, *Flemingia macrophylla*, *Magnolia champaca* and *Ficus religiosa* (124.66 no. per sq cm). The mean mortality percentage was the highest (14.50%) on *F. semialata* and the lowest (11.48%) was recorded on *M. penduliflorus*. The mean final density of settlement was observed to be the highest on *M. penduliflorus* with 122.66 no. per sq cm and the lowest on *Flemingia semialata* with 114.10 no. per sq cm. The mean sex ratio was very high which ranged from 96.50% in *M. penduliflorus* to 97.27% in *M. champaca* (Fig. 10.12).

Fig. 10.12: Photograph showing the high male percentage in *Ficus religiosa* and *Malvaviscus penduliflorus*

In eight months crop of *Kerria manipurensis*(June-July, 2022 to February-March 2023) inoculation was done on four hosts plants *i.e. Malvaviscus penduliflorus, Flemingia semialata, Flemingia macrophylla* and *Magnolia champaca* in the RFGB and replicated 3 times for studying the productivity linked parameters like initial density of settlement, initial nymphal mortality, male-female sex ratio, final density of settlement and fecundity.

The mean initial density of settlement in eight months crop of *Kerria manipurensis* was recorded to be the highest on *Malvaviscus penduliflorus* (135 no. per sq cm) followed by *Flemingia semialata*, *Flemingia macrophylla* and *Magnolia champaca* (130.33 no. per sq cm). The mean mortality was recorded to be the highest (8.31%) on *F. macrophylla* and the lowest (6.68%) on *Malvaviscus penduliflorus*. The mean final density of settlement was recorded to be the highest on *Malvaviscus penduliflorus* (125.99 no. per sq cm) followed by *F. semialata*, *F. macrophylla* and *M. Champaca* (119.88 no. per sq cm), respectively.

From the present studies, it has been revealed that *K. manipurensis* can be artificially inoculated on *M. champaca* like other potential host plants. The crawlers settled successfully after inoculation in both four months and eight months crop. Mortality percentage was low and the insect settled successfully after 21 days of inoculation in both 4 months and 8 months crop. However, the male percentage is very high in 4 months crop (above 90%) in all the inoculated hosts plants leading to crop failure and the male percentage in case of 8 months crop is low which ranges from 17.94% to 23.91% which makes *M. champaca* a potential new host plant for *K. manipurensis.*

Insect pests of host plants recorded during 2022

Pests of *F. semialata* recorded are given in Fig. 10.13.

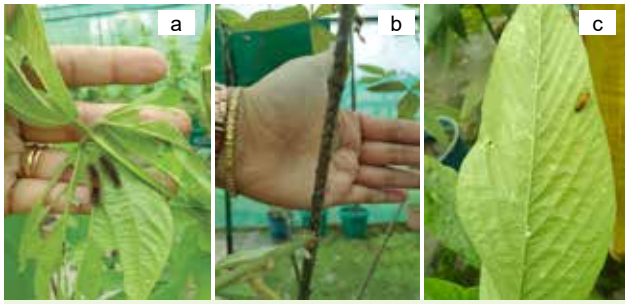


Fig. 10.13: New pests of *F. semialata* observed during 2022. *a.* Itchy Caterpillar, *Euproctis spp b.* Scale insect, *Trijuba oculata c.* Click beetle, *Ampedus balteatus*

1. Itchy Caterpillar, *Euproctis spp* (Lepidoptera: Lymantridae):

The larva of *Euproctis sp.* was seen during April to July. The larvae are voracious feeders and feed on the leaves of *Flemingia* initially from the margin and gradually they moved towards the midribs.

2. Scale insect, *Trijuba oculata* (Brain) (Hemiptera: Coccidae):

Both nymphs and adults suck the sap from the *Flemingia* plants. Sap feeding causes yellowing and wilting of leaves, stunting. Its infestation was

observed during May to September.

3. Click beetle, *Ampedus balteatus* (Coleoptera: Elateridae):

Only the larval stage of click beetle causes damage. Larvae feed on the seeds, preventing germination, or on the underground roots and stems of the *Flemingia*, causing them to wilt and their growth. Adults are active during May until July to August. Adults have two light producing spots on the thorax and one onthe abdomen, somewhat similar to that of lightning bugs.

New host plants

During the year 2022, the lac insect *K. manipurensis* was observed infesting on three new host plants during survey of Manipur (Fig. 10.14).

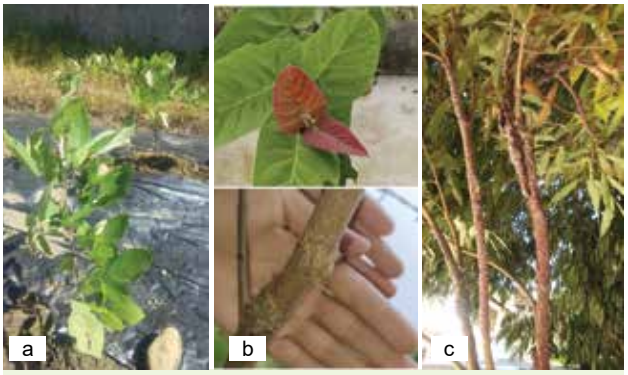


Fig. 10.14: Newly identified lac host plants in Manipur a. *Ficus semicordata,* b. *Dendrolobium triangulare* and c. *Mesua ferrea*

Survey for the naturally occurring lac insect and their host plants

Arunachal Pradesh

During 2022, survey was conducted in two districts of Arunachal Pradesh *i.e.*Tawang and West Kameng district. A total of 10 blocks were covered, four from West Kameng District and six from Tawang District of Arunachal Pradesh. No lac insect observed on any of the host plants found in West Kameng and Tawang district. Very less number of host plants were observed in both districts. Host plants like *Mesua ferrea, Malvaviscus penduliflorus* and *Flemingia macrophylla* were found.

Sikkim

Completed survey of 11 blocks (total 32 blocks) from different districts of Sikkim. In 2022, survey was conducted in all the four blocks of North Sikkim. Only some lac host plants *i.e. M. penduliflorus, Ficus religiosa* and *Calliandra surinamensis* were found. *Flemingia macrophylla* was found very rarely (found in only 1 village). Dead lac was found on *M. penduliflorus*. No live lac was observed on any of host plant during the survey.

Manipur

Survey was conducted in both valleys and hilly areas of Manipur during 2022 covering nearly seven blocks from different districts of Manipur and lac insect could be located from 15 villages.

Distinguished visitors

Hon'ble Chancellor of Central Agricultural University Dr. S. Ayyappan visited the NPCLIGR centre, CAU Imphal Centre during the interaction programmes of Faculty and Students of CAU on 11th July, 2022 and observed the activities of the project and appreciated (Fig. 10.15).

Fig. 10.15: Visit of Hon'ble Chancellor of Central Agricultural University Dr. S. Ayyappan to the NPCLIGR centre, CAU, Imphal

10.4 Kerala Forest Research Institute (KFRI), Thrissur

Even though the cultivation practice of lac is absent in the southern states of India such as Kerala, Tamil Nadu, Pondicherry Union territories (Lakshadweep, Yanam, Karaikkal, Mahi and Puducherry), 135 places have been reported with lac insects so far. Kerala has lesser availability of lac insects due to high humidity and rainfall.

(i) Survey and collection of lac insect

Ten districts were covered partially during 2022 namely Coimbatore, Erode, Karur, Namakkal, Tiruppur, Dindigul, Puducherry, Kadalur, Thanjavur, and Vellore. No lac insects were found except in Tiruppur district. Mild infestation of approximately three months old live lac insects on *Albizia saman*

tree was found in two locations namely Mannarai block and Kulathupalayam (Fig. 10.16). Field surveys were conducted in the month of January in Trichy, Madurai, Karur, and Dindigul, Tamil Nadu. Live lac insect was reported from a new location from Tiruppur, *i.e.,*Uthukuli Road, Tamil Nadu on rain trees.

Fig. 10.16: Live lac insect at Tiruppur district (TN)

(ii) Development of Regional Field Gene Bank

Seeds of *kusum, palas*, *ber*, *Flemingia semialata*, *F. macrophylla* and *Calliandra calothyrsus* obtained from the lead center (ICAR-National institute of Secondary Agriculture, Ranchi) germinated in KFRI nursery during the month of June 2022. Nearly 900 (including around 600 seedlings of *F. semialata,* 200 seedlings of *F. macrophylla,* 50 each of *Butea monosperma and Schleicera oleosa* and 10 seedlings of *Ziziphus mauritiana)*. 500 seedlings of *Flemingia* spp. were distributed to the farmers of Tamil Nadu. Various activities of RFGB at KFRI are given in Fig. 10.17 and seedlings developed at RFGB are given in Fig. 10.18.

Fig. 10.17: Various activities at RFGB, Thrissur

Fig. 10.18: Seedlings of *Ficus racemosa, Albizia saman* and *Flemingia semialata* at RFGB

(iii) Establishment of lac farms in Tamil Nadu

Mr. Manjula Parthibhan from Gobichettipalayam, Erode district of Tamil Nadu has become a new lac farmer for KFRI. Three *Ziziphus mauritiana* trees were successfully inoculated in the farmer's plot and mature lac was obtained. The farmer has also prepared a plots 100x100 sq. ft for lac cultivation on *Flemingia semialata* plants with intercropping of coconut trees, banana and cowpea (black eye pea). Another field visit was conducted in Dindigul district of Tamil Nadu showed nearly 250 numbers of *F. semialata* grown as intercrop cultivation along with banana and field bean in an area of 2600 sq. ft at the field of Parthasarathi Arumugam.

(iv) Collection of lac insect and host plant enemies

Eight different species of moths have been collected as pests feeding on *F. semialata* leaves (Fig. 10.19). These were collected in larval stages and then reared in KFRI Lab for identification.

Fig. 10.19: Insect pests of *Flemingia semialata*

(vi) Awareness programme

An exhibition stall with posters, lac insect by-products and other relevant information on lac insects was set up as part of National Science week celebrations at KFRI. Large number of people visits to the exhibition This helped in promoting knowledge on lac, especially for school students.

A webinar entitled "Insects, Friends or Foes? A tale of the lac insect in India" was conducted for the students of Kalasalingam Academy of Research and Education, Krishanakoil, Tamil Nadu on 10th February, 2022.

(v) Inspection visit from the Lead Center

A yearly inspection was conducted by Dr. Vaibhav D Lohot, Sr. Scientist and Co-PI during April 28-29, 2022 at KFRI, where he visited the Lac insect Lab, Museum, Gene Bank, and other areas and gave valuable suggestions to improve our progress (Fig. 10.20). He also identified several new potent host plants for lac cultivation at KFRI, which were added to the RGFB. Newly added lac insect host plants are *Ficus religiosa, F. recemosa, Calliandra calothyrsus, Ziziphus mauritiana, Schleichera oleosa and Flemingia sp* in the Lac insect Host plant Gene Bank.

Fig. 10.20: Visit of Dr. Vaibhav D Lohot to KFRI centre

10.4a *Krishi Vigyan Kendra*, Sirsi

(i) Collection and conservation of lac insect genetic resources from different parts of Karnataka

Survey for presence of natural lac insects and host plants in all 31 districts of Karnataka was completed. Ten districts were completely surveyed by KFRI Thrissur during 2015-18. The remaining 21 districts were surveyed between 2019-20 to 2020-21 by KVK Sirsi. Number of blocks/Taluks surveyed were 86. Lac encrustation (live and dead) was noticed in 29 blocks. Revisiting / intensive surveys were conducted during 2021-22 to till date in Mysuru, Uttara Kannada, Chitradurga, Haveri and Shivamogga districts covering different blocks. Natural lac infestation was noticed on *Albizia lebbeck* (L.) Benth, *Ficus benjamina* L., *Ficus lacor* Buch.- Ham, *Ficus benghalensis* L., *Ficus religiosa* L, *Ficus carica* Linn., *Albizia (Samanea) saman* (Jacq.), *Annona squamosa* L. and *Litchi chinensis* Sonn. Commercial cultivation of *kusmi* lac insect strain was noticed on *Flemingia semialata* Roxb., *Ziziphus mauritiana* Lam., *Schleichera oleosa* Lour. (Oken), and *Calliandra calothyrsus* Meissn.

(ii) Popularization of lac cultivation in Karnataka

Kusmi brood lac of 35 kg was procured from ICAR-NISA, Ranchi for commercial cultivation of summer lac on *ber* and *Flemingia* in Karnataka and Maharashtra under NP-CLIGR. Some farmers from Bannikuppe village and Green Agri Tech Rural Development Trust (R) are actively involved in popularization of lac cultivation in Mysuru district under the technical guidance of KVK, Sirsi and ICAR-NISA, Ranchi.

Efforts made by Green Agri Tech Rural Development Trust (R), Mysuru district

Green Agri Tech Rural Development Trust (R) is actively involved in popularization of lac cultivation in Mysuru district under waste land development programmes. 15 kg broodlac was inoculated on unpruned *ber* trees with tender shoots in Mysuru, Bheemanakolla, Hunsur and H. D. Kote area. Due to poor emergence of crawlers and loss during transit, yield ratio was very less (1: 0.86). Green Agri Tech Rural Development Trust (R) is organizing awareness programmes on lac cultivation in association with KVK, Sirsi for enhancing livelihood of farmers.

(iii) *Kisan Melas*, Exhibitions, Institute-industry interface meeting:

Exhibitions were arranged on different forms of lac, lac products, natural enemies of lac insect at KVK Sirsi during visit of Scientists from ATARI, Bengaluru, UAS Bengaluru and KVK Karnataka, Kerala and Lakshadweep on June 20, 2022 and SAC meeting

on November 05, 2022. Exhibition and charts on lac insects, different forms of lac and products were showcased during *Krishi Mela* organized at UAS Dharwad from 17th to 20th October, 2022.

Success stories: One, published in leading newspaper of Karnataka "*tambaku ke kshetra me argu ki kheti ke chamatkar*" about success story of Shri P. Cheluvaraju on successful lac cultivation as an alternate to Tobacco in Prajavani dated May 09, 2022 (Fig. 10.21).

Fig. 10.21: Success story published in Local leading dailies Prajavani dated May 09, 2022

(iv) Capacity Building: Capacity development programmes on awareness and commercial lac cultivation was conducted on July 20 and 22, 2022 at Bannikuppe and Hanumanthapur villages of Mysuru district in association with an NGO, Green Agri Tech Rural Development Society (R), Mysuru (Fig. 10.22 to 10.24).

Fig. 10.22: Awareness programme on Lac cultivation at Hanumanthapur, Mysuru district

Fig. 10.23: Visit to *kusmi* lac cultivated plots at Bannikuppe, Mysuru

Fig. 10.24: Excellent Lac Farmer Award 2022 from ICAR-IINRG, Ranchi to KVK Lac contact farmer Shri Cheluvaraju

10.5 Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur

(i) District and block wise surveys in arid western plain region of the country

A detailed survey of lac insect genetic resources and their host-plants at block level was carried out in the states of Rajasthan, Haryana and Gujarat during 2022. The available natural hosts of the region were recorded and observed for the presence of the natural lac population thriving on them. Total 84 blocks in 30 districts of these three states were surveyed, in which 29 blocks in 7 districts of Rajasthan, 29 blocks in 11 districts of Haryana and 26 blocks in 12 districts of Gujarat were surveyed, respectively. During survey the observations on different parameters of host plants were recorded as per the passport data sheet of host plants. The host plants were thoroughly surveyed and noticed for the presence of lac insects, their stage, intensity, presence of predators, if any and observations were recorded for the parameters of lac insect as per passport data sheet. During survey prevalence of lac insect was noticed at 142 locations of which total of nine hosts were identified as natural host for natural prevalence of the lac insect in the region. It was noticed that at majority of locations, lac insect was recorded on *peepal, ber, babool, bargad, palas,* custard apple, *sheesam, siras* and *kikar*. 74 live and 68 dead samples of lac were collected from 142 locations. It was also observed that at all locations only *rangeeni* strain was present on these natural hosts. In the majority of regions *peepal, bargad* and *ber* were found in more number as compared to other hosts.

(ii) Collection and *in-situ* and *ex-situ* conservation of the biological diversity of lac insects of the region

(a) Conservation of lac insect under *in-situ* conditions: The different activities for the conservation of the lac insect under *in-situ* conditions were undertaken at different locations and at farmers' fields where available host plants were identified for the conservation of insect under *in-situ* conditions. The broodlac sticks bearing mature female lac insects were collected from various host plants from Udaipur region during *baisakhi* and *katki* seasons and were inoculated on *palas, seetafal, ber, kikar* and *babool* in different areas. A total 102 hosts were utilized for the conservation of lac insect under *in-situ* conditions during 2022 (Fig. 10.25).

Fig. 10.25: Inoculation of brood lac at farmer's fields under *in-situ* conservation

(b) Conservation of lac insect under *ex-situ* conditions: Lac insect genetic resources available in the region were collected and conserved under *ex-situ* conditions on different hosts available at the Regional Field Gene Bank (RFGB) situated at Department of Entomology, RCA, Udaipur. 143.58 kg broodlac sticks of mature live lac insects collected from different locations were maintained during *katki* season on *palas*, *Flemingia* spp., *ber*, *kiker*, *arhar*, *Acacia* spp.,and custard apple at RFGB for each location. Lac insect resources are maintained on 119 plants of *ber, palas*, *Flemingia* spp and custard apple plant and are tagged properly for further observations (Figs. 10.26 & 10.27).

Fig. 10.26: Lac-insect RFGB and Green net house

Fig. 10.27: Inoculation of broodlac and maintenance activities at Lac insect RFGB

(iii) Biology and Management of Major Lepidopteran Predators of Lac Insect, *Kerria lacca* (Kerr.)

The study revealed that incubation period of *Eublemma amabilis* ranged from 3 to 5 days, the total larval-pupal period ranged from 22-38 days, pre-oviposition period ranged from 4 to 6 days, the oviposition period lasted 5 to 7 days, the post-oviposition period lasted between 3 and 6 days. Under the laboratory conditions total life cycle of female is 48-54 days, total lifespan of male was 43 to 50 days. The average number of eggs laid by *E. amabilis* was 103.60. The Incubation period of *Pseudohypato papulverea* ranged from 5 to 6 days. The total larval-pupal period ranged from 23 to 39 days, pre-oviposition period ranged from 5 to 6 days, oviposition period ranged from 7 to 9 days. The post-oviposition period lasted between 5 and 8 days, total life cycle of *P. pulverea* between 49 to 59 days. The average number of eggs laid by of *P. pulverea* was 92 eggs.

10.6 Punjab Agricultural University (PAU), Ludhiana

(i) Survey for collection of information / lac insects / host plants from different parts of Punjab, Delhi and Uttar Pradesh

Regular surveys were conducted for collecting the information with respect to lac insects and their host plants during the year 2022 in six districts of Punjab, four districts of Delhi and 12 districts of Uttar Pradesh (four new) (Fig. 10.28 to 10.30).

Fig. 10.28: Districts covered in Punjab during 2022

- **Districts covered**

Fig. 10.29: Districts covered in Delhi during 2022

Ziziphus mauritiana

Fig. 10.30: Districts covered in Uttar Pradesh during 2022

Ficus virens

(ii) *Ex-situ* Conservation / Brood Multiplication

A total of 592 number of host plants, *i.e. Ziziphus mauritiana*, *Butea monosperma*, *Acacia nilotica*, *Cajanas cajan*, *Schleichera oleosa*, *Flemingia macrophylla, Flemingia semialata, Calliandra haemetocephala*, *Litchi chinensis*, *Ficus benjamina* are being maintained in the Regional Field Gene Bank for *ex-situ* conservation and multiplication of broodlac (Table 10.2). Out of these, 11 plants of *Z. mauritiana*, 5 plants of *F. benjamina*, 5 plants of *C. haematocephala* and 5 plants of *L. chinensis* were newly planted during 2022.

Table 10.2: Lac host plants maintained in the Regional Field Gene Bank

Host Plants	Number
Ziziphus mauritiana	27
Butea monosperma	5
Schleichera oleosa	5
Ficus benjamina	15
Flemingia semialata (pots & field)	390
Flemingia macrophylla (pots & field)	100
Acacia nilotica	5
Cajanas cajan	35
Litchi chinensis	5
Calliandraha ematocephala	5

Croping Season	Host Plants	Total plants inoculated
***Baisakhi* (2021-2022)**	*Flemingia semialata*	20
	Flemingia macrophylla	20
	Ziziphus mauritiana	3
	Butea monosperma	3
***Katki* (2022)**		
	Flemingia semialata	10
	Flemingia macrophylla	10
	Ziziphus mauritiana	2
	Butea monosperma	-

Brood multiplication: Four host plants were utilized for conservation of lac insect (*rangeeni* strain; *baisakhi* and *katki* crop) (Fig. 10.31). During 2022, a total of 55.74 kg broodlac was multiplied on these host plants at Regional Field Gene Bank.

***Rangeeni* strain; *baisakhi* crop**: Total broodlac of 46.49 Kg was harvested during July 2022 from four host plants, (*Z. mauritiana, F. semialata*, *F. macrophylla* and *B. monosperma)* from *baisakhi* crop.

Fig. 10.31: *Ex-situ* conservation/brood multiplication at Regional Field Gene Bank

***Rangeeni* strain; *katki* crop:** A total of 9.25 kg broodlac was harvested during first fortnight of November 2022 from three host plants, (*Z. mauritiana, F. semialata* and *F. macrophylla)* from *katki* crop.

(iii) Studies on life cycle and productivity-linked parameters of lac insect (*rangeeni* strain; *baisakhi* crop) on *Butea monosperma*

The biological and productivity-linked parameters of *rangeeni* strain of lac insect were studied on host plant, *B. monosperma* at RFGB, PAU Ludhiana during November, 2021 - July, 2022 (*baisakhi* crop).

The results of different biological and productivity linked parameters on *Butea monosperma* presented as under:

- Initial density of lac insect settlement was observed to be 89.33 ± 1.86 insects/ cm^2 with initial percentage mortality of 8.77 ± 1.73.
- Mean duration of female and male cell differentiation, *i.e.*, duration of pre-sexual stages was 113.66 ± 1.85 (range 110-116 days**).**
- Mean male emergence was observed to be initiated after 156.66 ± 3.06 days (range -152-160 days) with sex-ratio (% male insects) of 12.40 ± 0.39.
- Mean density of surviving female lac insects (after initial mortality and emergence of male lac insects) was found to be 5.00 ± 0.23/cm^2.
- Duration of *baisakhi* crop (*rangeeni* strain) on *B. monosperma* varied from 216-245 days under Punjab conditions.
- Mean weight of female cell recorded after crawler emergence was 8.66 ± 0.24 mg (range 6.30-9.85 mg).
- Average resin produced by an individual female cell recorded after removing the dead insect body from the cell was 5.81 ± 0.29 mg (range 4.00-7.55 mg).

- Average number of young ones produced by the single female insect ranged from 119 to 167 individuals (139.70 ± 4.31).
- Broodlac output ratio recorded after crop harvesting was 7.23 ± 0.27 during *baisakhi* crop.

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

Studies on the insect fauna associated with lac insect were carried out during 2021-22. Lac encrusted sticks were observed visually for the presence of predator population. The samples were kept in bioagent collection cages (20 x 20 x 30 cm). These cages were monitored at regular intervals to record the emergence of parasitoids and predators.

Under Punjab conditions, lac insect associated fauna comprised eight species namely *Eublemma amabilis* (Noctuidae: Lepidoptera), *Pseudohypatopa pulverea* (Blastobasidae; Lepidoptera), *Chrysoperla* sp. (Chrysopidae: Neuroptera), *Tribolium* sp. (Coleoptera), *Tachardiaephagus tachardiae somervilli* (Encyrtidae: Hymenoptera), *Bracon greeni* (Braconidae: Hymenoptera), *Eupelmus tachardiae* (Encyrtidae: Hymenoptera), *Aprostocetus purpureus* (Eulophidae: Hymenoptera). Among these, *Tribolium* sp. the predominant species under Punjab conditions during 2022 (Fig. 10.32).

Tachardiaephagus tachardiae ***Eupelmus tachardiae*** ***Aprostocetus purpureus***

Pseudohypatopa pulverea ***Chrysoperla*sp.** ***Eublemma amabilis***

Bracon greeni ***Tribolium*sp.**

Fig. 10.32: Lac associated fauna collected during survey in Punjab

Experiment to integrate lac cultivation (*rangeeni* strain: *katki* crop) with *Cajanus cajan* was conducted on two PAU recommended varieties (PAU 881 and AL 882). However, there was large scale mortality of lac insects due to attack of parasitoids, *i.e. Aprostocetus purpureus* and *Eupelmus tachardiae* during rainy season.

10.6a ICAR – Research Complex for Eastern Region, Patna

Survey in Eastern Uttar Pradesh

Survey was done in two districts of Eastern UP namely Faizabad and Sultanpur. In Faizabad six blocks (Masodha, Pura Bazar, Bikapur, Faizabad, Milkipur, Amaniganj) were surveyed and no lac insect was observed at any place whereas, out of three blocks (Sultanpur Sadar block, Kurebhar, Kadipur) of district Sultanpur, surviving lac insects were observed on *Ficus religiosa* in Sultanpur Sadar block (Fig. 10.33).

Survey for lac insects in potential districts of Bihar

Survey was done in 22 new blocks of three districts (Patna, Banka and Sitamarhi) of Bihar. In Patna out of 12 blocks (Danapur, Bihta, Bakhtiarpur, Barh, Paliganj, Daniawan, Sampatchak, Khusrupur, Bikram, Athmalgola, Fatwah and Naubatpur), lac insects were found in five blocks (Danapur, Paliganj, Sampatchak, Bikram and Naubatpur) on *Ficus religiosa, F. benghalensis* (Fig. 10.34) and a few places on *Ziziphus mauritiana*. In Banka, out of six blocks (Bounsi, Amarpur, Sambhuganj, Belhar, Chandan and Rajoun), lac insects were observed in two blocks (Bounsi and Chandan) on *Ficus* sp. and at one place on *Butea mauritiana* in Sitamarhi out of four blocks (Bajpatti, Parsauni, Bathnaha and Pupri) surveyed, lac insects were observed in one block namely Pupri on *Litchi chinensis* (Fig. 10.35).

Fig. 10.33: Lac insect on *Ficus religiosa*

Fig. 10.34: Lac insect on *Ficus benghalensis*

Fig. 10.35: Naturally occurring lac insect on *Litchi chinensis*

Fig. 10.36: *Flemingia semialata* bushes for lac cultivation

Establishment of bushy lac host *Flemingia semialata* for conservation

Fifty *Flemingia semialata* seedlings are being raised in farmer's (Shri Siddhant) field in Sahu Chowk of Dumra block (district Sitamarhi) to raise *Aghani* 2023 crop for demonstration and lac cultivation on *semialata*. The host crop will be ready for inoculation in July, 2023 to raise *Aghani* 2023 crop (Fig. 10.36).

Capacity building and popularization of lac cultivation in potential areas of lac cultivation has been initiated at two locations: one in Rupaulitola Dhanuki (Dumra block) of district Sitamarhi on *F. semialata* and *siris* and another in Babu Mahal village (Katoria block) of district Banka on *Palas* and KVK, Banka on *ber* trees. In Banka district 30 *palas* trees and 5 small *ber* trees were inoculated in last week of October, 2022 to raise *baisakhi* crop.

10.7 Acharya NG Ranga Agricultural University (ANGRAU), Guntur

Survey was conducted to study the occurrence of lac insects in Srikakulam, Parvathipuram, Chittoor, Tirupati, Guntur, Bapatla, Kurnool, Anantapuramu and West Godavari districts of Andhra Pradesh. During the survey, occurrence of lac insect was observed on *Albizia saman* in Chittoor, Kurnool and Guntur districts of Andhra Pradesh. Lac encrustation was recorded in Tirumala holy shrine, Tirupati Mandal on *Albizia saman*. Lac encrustation was also observed on *Conocarpus lancifolius* Chittoor, Tirupati, Kurnool, Nellore and Guntur districts of Andhra Pradesh. Samples were collected from Guntur on *Albizia saman* and *Ficus* species (Fig. 10.37).

***Albizia saman* at Kurnool and Tenali, Guntur**

***Ficus* sp. at Chebrolu, Guntur**

***Conocarpus lacifolius* at Bapatla**

Fig. 10.37: Occurrence of lac insects on different hosts in Andhra pradesh

Lac insect collected from *Albizia saman* at Tenali and inoculated on *Conocarpus lancifolius* at Bapatla has successfully completed its life cycle on *Conocarpus lancifolius* at Bapatla. Some parts of East Godavari for *Flemingia semialata*, Parvathipuam Manyam, Srikakulam and Guntur districts for *A. saman* were identified as potential areas for lac cultivation.

For the first time research work on, "Studies on occurrence of lac insects and its potential on bushy host *Flemingia semialata* Roxb" has been assigned to an M.Sc (Ag) student at Agricultural College, Bapatla, ANGRAU with the following objectives: (i) Studies on occurrence of lac insect and its host plants in Andhra Pradesh and (ii) Evaluation of selected lac insects for its potential on bushy host *F. semialata.* Broodlac was collected and inoculated on *F. semialata*.

Presently, *Butea monosperma*, Sitaphal, *Conocorpus lancifolius, Flemingia semialata* and *Flemingia macrophylla* plants are being maintained at Regional Field Gene Bank, Agricultural College, Bapatla.

10.8 State Forest Research Institute (SFRI), Jabalpur

Survey for lac insects and host plants

Intensive survey was conducted block-wise in Maharashtra for lac insect and their host plants. Before undertaking the survey work, local people were contacted along with farmers, traders and Divisional Forest officer of each district. Thereafter, each Forest Range officers and farmers in each block at various districts were interviewed to obtain information about lac insect, their host plant and potential areas. Availability of lac insects and host plants have been tagged by Global Positioning System (GPS). The data was collected on lac insect population size, stage, crawler period, special characteristics, source/ habitat, frequency, predators, parasitoids, disease symptoms, host plants. The information on lac insect/ host plants during each field survey was recorded in passport data sheets and compiled.

Survey on lac insect and host plants was conducted in 16 blocks of five districts and lac occurrence was found in seven blocks of five districts in Maharashtra on *palas* (*Butea monosperma*), *pipal* (*Ficus religiosa*) and rain tree (*Albizia saman*) (Fig. 10.38a & 10.38b).

Fig. 10.38a: Lac encrustation on *pipal* in Pimpla, Ambajogai, Beed

Fig. 10.38b: Lac encrustation of *rain tree* in Loha, Nanded

Lac insects were found to be occurring naturally in farm lands, revenue lands, roadside and urban areas. It was also observed that in almost all locations only *rangeeni* strain was found growing well on these natural hosts.

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

Lac insect samples from 10 sites of Narmadapuram, Mandla, Seoni, Narsinghpur, Betul, Balaghat, Dindori districts of Madhya Pradesh and 13 sites of Bhanadara, Gondia, Beed, Jalna, Aurangabad, Hingoli, Washim, Buldana, Nanded districts of Maharashtra were collected, conserved and multiplied on 255 plants or trees of *F. macrophylla*, *F. semialata, palas, ber (Ziziphus mauritiana) kusum (Schleichera oleosa), rain tree, pipal, gular (Ficus racemosa, jangli jalebi (Pithecellobium dulce), sitaphal (Annona squamosa), bargad* (*Ficus benghalensis*) *etc.* in Regional Field Gene Bank (RFGB) (Fig. 10.39 and 10.40a & 10.40b) and temperature data was also recorded at regular intervals. The data on population size (low, moderate and high), girth and height of lac bearing host plant, colour variation and GPS coordinates of each location were also recorded. Collected lac samples were also preserved in absolute alcohol for the identification of lac insect species.

***Pipal* lac sample from Washim (MH)**

***Pipal* lac sample from Sekta, Aurangabad (MH)**

***Pipal* lac sample from Begarwani, Seoni (MP)**

Fig. 10.39: Collection of lac insect sample from Madhya Pradesh and Maharashtra

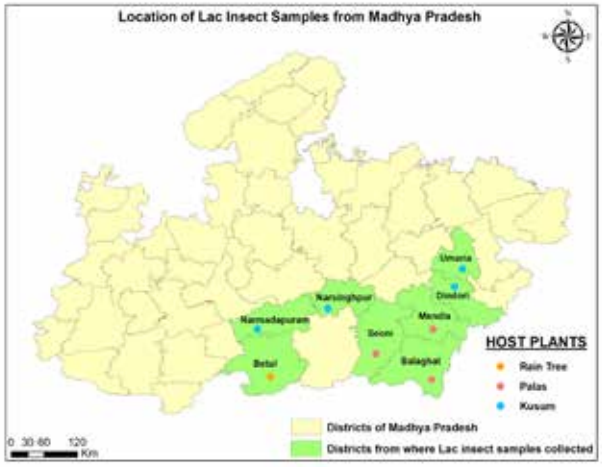


Fig. 10.40a: Location of lac insect samples from Madhya Pradesh

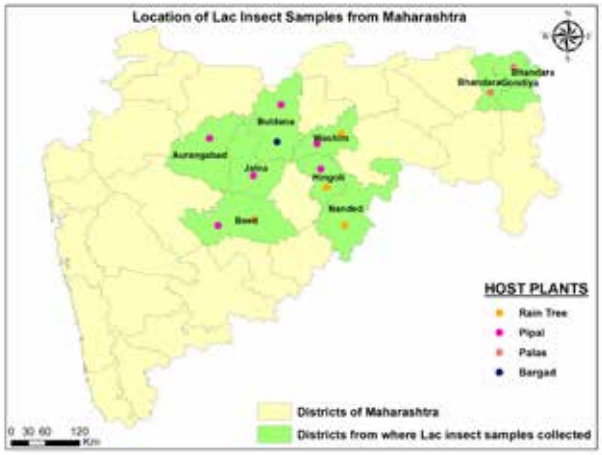


Fig. 10.40b: Location of lac insect samples from Maharashtra

Conservation of lac host plants in Regional Field Gene Bank

Eight *ghont* (*Ziziphus xylopyra*) and ten *kusum* plants have been maintained in RFGB which were collected from Katni Forest Division, Kanha buffer area, Mandla and Bankhedi (Narmadapuram).

Status of lac host plants in Regional Field Gene bank

226 plants of *Flemingia macrophyla* and 356 plants of *Flemingia semialata* maintained in lac host bed and potted condition.

Hundred fourty eight plants/trees of 15 different host plants species *viz.*, *F. macrophylla, F. semialata, palas, gular, jangli jalebi, ber*, *pipal*, *sitaphal, shisam (Dalbergia sissoo), bargad, kusum, rain tree, akashmoni (Acacia auriculiformis), khair (Senegalia catechu), safed siris (Albizia procera), ghont, kala siris (Albizia lebbeck)* maintained in lac host plant park.

Study on variation of crawler emergence period of lac insect in Maharashtra

The present study was carried to know variation of crawler emergence period of lac insect in different districts of Maharashtra. During the survey, collection of broodlac samples, emergence period of crawler was documented in 14 sites of Gondia, Bhandara, Washim, Buldana, Aurangabad, Jalna, Beed, Nanded, and Hingoli districts of Maharashtra on *palas, pipal, bargad,* and *rain* tree host plants. *Rangeeni* lac insect crawler emergence period varied from third week of October to mid week of November in different districts of Maharashtra. The earliest crawler emergence was observed on *bargad* at Sindhkhede Raja (Buldana) in third week of October, whereas the posterior crawler emergence period was observed on *pipal* at Sindhkhede Raja (Buldana) in the last week of October followed by *pipal* at Washim, *rain tree* at Beed, *pipal* at Pimpla, Ambajogai (Beed) in first week of November, *palas* at Amgaon, Gondia and Chandori, Bhandara, *pipal* at Bituda, Manglurpeer (Washim), *pipal* at Sekta, Aurangabad, *pipal* at Ambad, Jalna, *pipal* at Kalamnuri, Hingoli and rain tree at Malhivra, Hingoli in the second week of November, whereas late emergence was observed on *rain* tree at Loha, Nanded in mid week of November.

10.9 Sher-e-Kashmir University of Agricultural Science and Technology (SKUAST), Jammu

i. Maintenance and multiplication of the location specific local lac insect collections

Multiplication of collected local lac-insect population

For the conservation and multiplication of the location specific local collection of lac insects, plants of *Flemingia semialata, Flemingia macrophylla, Dalbergia sissoo, Albizia lebbeck, Calendra macrophylla, Acacia nilotica, Ziziphus mauritiana* and *Butea monosperma* were raised in the Regional Field Gene Bank (RFGB) for rearing lac insects.

Broodlac was inoculated on the succulent branches of substitute experimental hosts *i.e. F. semialata, F. macrophylla, D. sissoo, A. lebbeck, C. macrophylla, A. nilotica, Z. mauritiana* and *B. monosperma Phunki*.

Periodic management of lac host plants bearing lac insect crawlers was performed.

Conservation through selfing in Jammu region

Partial brood was allowed for natural inoculation on the same host plants for sustaining and conserving native strain. To be more precise, we also inoculated secure plants in the vicinity (Fig. 10.41)

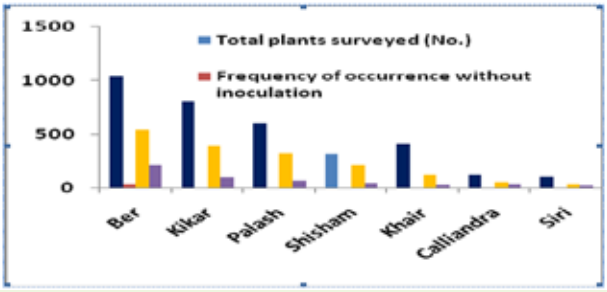


Fig. 10.41: Conservation through selfing in Jammu region

Artificial inoculation and conservation in mid hills to escape summer mortality

Extensive surveys were conducted in mid hills and outer plains on previously inoculated host plants that were artificially inoculated with and local lac insect strain. The mortality was calculated as ratio of plants that showed live brood/ total number of plants previously inoculated with lac and mean mortality in each host plant was recorded. It was found that for conservation, *kikar* (*A. nilotica*) showed the lowest mortality (35.58) while it was highest on *ber* (*Z. mauritiana*) plant (69.83). There is no denying the fact that *palash* (*B. monosperma*) and *Ficus* also supported brood maintenance to adesired level but the local sprone the set rees for fodder purpose ethere by hampering conservation efforts. As *kikar* (*A. nilotica*) is hardly pruned for local purpose, we are further exploring the possibility to use it for summer brood maintainer (Fig. 10.42 & 10.43). In comparison to plains, midhills showed better potential as the mortality was lower in these areas. Mortality was 48.95% on wild *ber* (*Z. mauritiana*) in mid hills and 65.37% in *Ficus* spp. Since *kikar* (*A. nilotica*) and *palash* (*B. monosperma*) are not found in mid hills they were not considered. It was concluded that among the natural hosts of lac insect which include *ber* (*Z. mauritiana*), *palash* (*B. monosperma*), *kikar* (*A. nilotica*) and *Ficus* etc. the least mortality was recorded in *kikar* (*A. nilotica*) and *siris* (*Albizia lebbeck*) trees during the summer season as shown in Table 10.3.

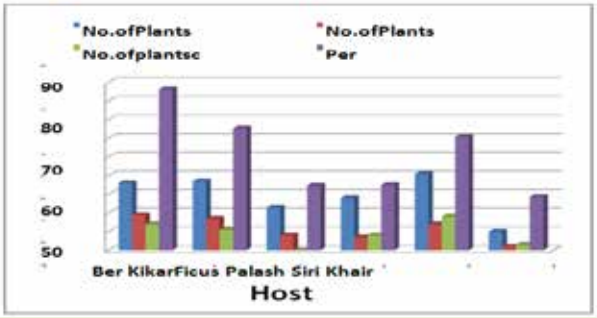


Fig. 10.42: Conservation in mid hills to escape summer mortality

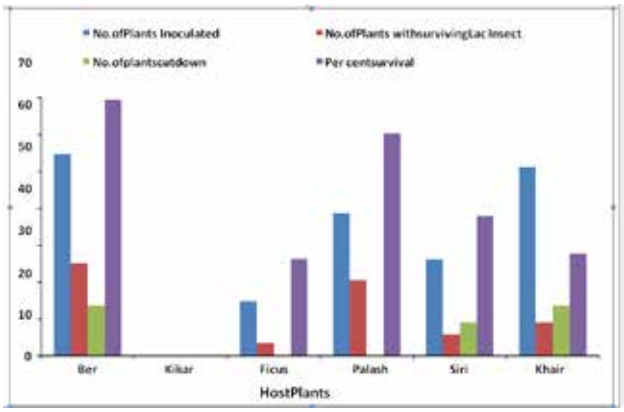


Fig. 10.43: Conservation in plains to escape summer mortality

Artificial inoculation conservation

At University Rainfed Research Station, Raya and around the Jammu region and Himachal Pradesh for the purpose of conservation artificial succulent branches of *Ficus* sp., *ber* (*Z. mauritiana*) and *kikar* (*Acacia nilotica*) were inoculated where brood twigs were tied with the selected and tagged plants.

ii. *In situ and ex situ* conservation initiative for sustainability

Artificial inoculation for multiplication on *ber* (454 No.) and *kikar* (389 No.) in Jammu region

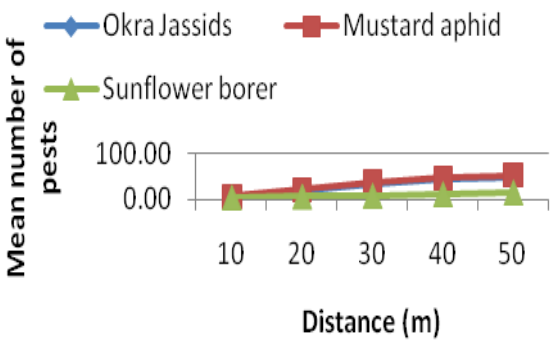
Artificial inoculation was done for the multiplication of lac insect. Brood twigs were cut in size 20 - 30 cm in length. Then, the cut pieces of brood twig were tied to fresh tree twigs in such a way that each stick touches the tender branches of trees at several places. This was done on or pre pruned *ber* (*Z. mauritiana*) and succulent branches of *kikar* (*A. nilotica*), *khair* (*A. catechu*), *palash* (*B. monosperma*) and *Ficus* around the Jammu region and Himachal Pradesh where brood twigs were tied with the selected and tagged plants.

Table 10.3: Mortality percent on natural hosts of lac insect

Sl. No.	Name of the host	No. of Plants Surveyed	No. of plants recorded with mortality	% Mortality
1	*Ber*	22	10	45.45
2	*Palash*	18	7	58.33
3	*Kikar*	23	6	26.08
4	*Pipal*	8	7	87.50
5	*Siri*	21	8	38.09
6	*Khair*	19	11	57.89

Pest incidence of agricultural fields neighbouring lac plots

Study revealed that the incidence of many sucking pest of okra jassids, mustard aphid and sunflower borer was decreased significantly as the distance of agricultural field neighboring lac plots increased (Fig. 10.44). However, it was interesting to note that with increase in distance of agricultural fields neighboring lac plots the incidence of natural enemies decreased significantly (Fig. 10.45).



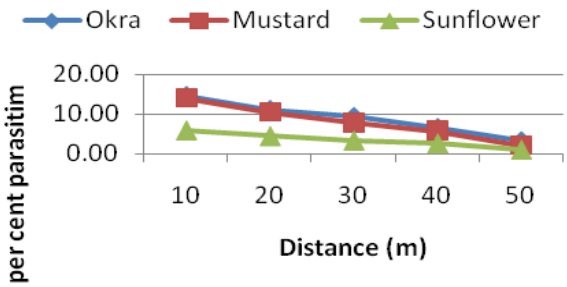


Fig. 10.44: Mean number of pests in agricultural fields neighboring lac plots

Fig. 10.45: Mean parasitism in agricultural fields neighboring lac plots

Effect of live lac insect population on carbon dioxide emission: Study revealed the positive correlation between number of live cells and CO_2 concentration *i.e.* with increase in number of live cells, CO_2 concentration also increased (Fig. 10.46).

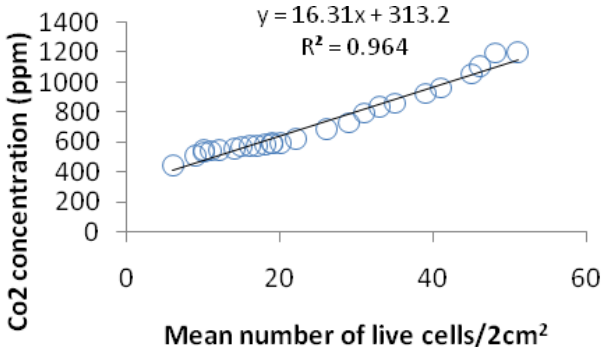


Fig. 10.46: Relationship between number of live cells and CO_2 concentration

Effect of temperature on survival of lac insect

The relationship between the temperature and mortality is depicted that showed increased mortality with the increase in temperature (Fig. 10.47). The mortality started increasing from 11th standard week, when the temperature tends to reach around 26.9 °C. Among *ber* (*Z. mauritiana*), *kikar* (*A. nilotica*), *Flemingia* and *arhar* (*C. cajan*), maximum mortality of 54.19% was recorded in *ber* followed by *Flemingia, arhar* and *kikar* with per cent mortality of 51.63, 49.53 and 34.29 respectively, when the maximum temperature of 41.7 °C was recorded.

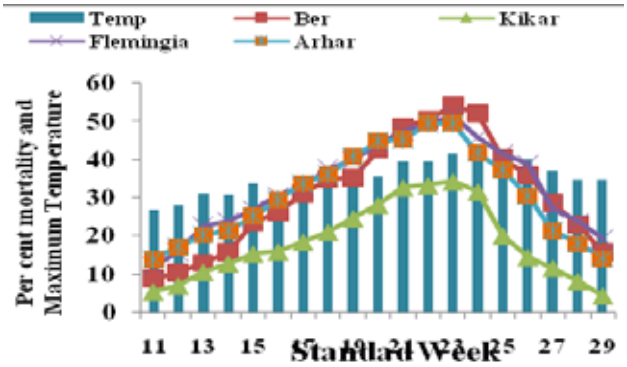


Fig. 10.47: Relation between temperature and mortality of lac insect as observed under field conditions

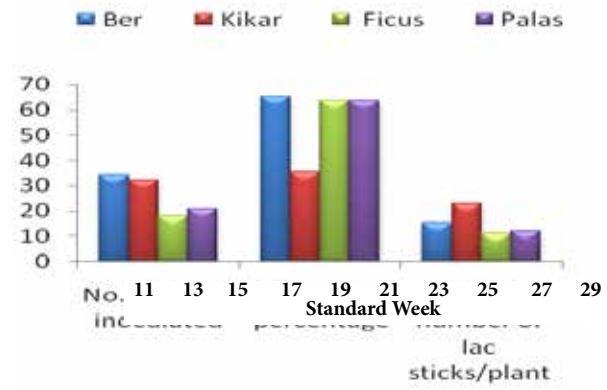
iii. Training and demonstrations on cultivation technologies

Trials at Research Farm, SKUAST-Jammu and at fields of progressive growers: At Research Farm of SKUAST-Jammu five trails were conducted whereas at selected progressive growers' fields fifteen trails wherein eighty five farmers were exposed to lac cultivation while nearly three hundred fifty seven farmers were shown lac being grown / cultivated at selected sites for the demonstration of lac cultivation technologies. Saplings of *F. semialata* and *F. macrophylla* and brood lac were distributed to the potential growers for conservation and multiplication. Two hundred and thirty farmers were provided with broodlac. Twenty five visits for continuous deliberations with the people of the areas were conducted regarding the presence of lac insect and also information was given to them regarding lac cultivation and its value and uses. Informative pamphlets (1050 No.) were also distributed among the participants. Six interactive sessions were conducted for the farmers.

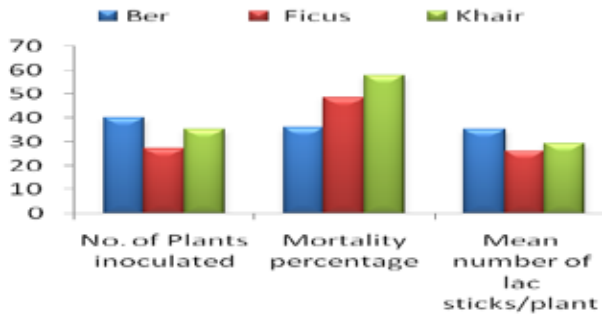
iv. Climate smart lac initiatives

Effect of temperature on mortality of lac insects

Outer plains of Jammu: During the survey, it was ascertained that the lac insect is highly prone to summer mortality in Jammu region. The results revealed that *A. nilotica* showed the lowest mortality (35.33%) while the highest mortality was observed on *Z. mauritiana* plant (65.18%) (Fig. 10.48).There is no denying the fact that *Butea monosperma* (63.58%) and *Ficus* (63.45%) also supported brood maintenance to a desired level but the local people prune these trees for fodder purpose, thereby, hampering conservation efforts. However, *A. nilotica* is hardly pruned for local purpose and it can be further used for summer brood maintenance. Mean number of lac sticks per plant were recorded in *A. nilotica* (22.79/plant) followed by *Z. mauritiana* (15.40/plant) and *Ficus* (11.93/plant) and least was in *B. monosperma* (11.13/plant).



Outer Plains



Mid Hills

Fig. 10.48: Effect of temperature on mortality of lac insect

Mid hills: In comparison to plains, mid hills showed better potential as the brood cell mortality was lower in these areas. Mean survival of lac on inoculated plant was highest on wild *ber* (64.26%) followed by *Ficus* (51.62%) and *khair* (42.11%). Mortality was 57.89% on *khair*, followed by 48.38% in *Ficus* spp. and least mortality was recorded in wild *ber* (35.74%) in mid hills. Since *kikar* and *palas* are not found in mid hills, they were not considered. Mean number of lac sticks were recorded highest in wild *ber* (35.14/plant) followed by *khair* (29.32/plant) and *palas* (26.19/plant) (Fig. 10.48).

It was concluded that among the natural hosts of lac insect which include *ber, palas, kikar, pipal etc.* the least mortality was recorded in *kikar* trees in plains during the summer season while in mid hills wild *ber* with high canopy was found to be the most suitable.

Changes in phenology of lac host

The results revealed that the little respite in climate is not only crucial for lac survival while it also affects the phenology of lac host (*F. semialata*). In the present study, leaves of *F. semialata* grown in outer plains (153.07 mm) were significantly smaller in size as compared to leaves of mid hills (210.61 mm) and high hills (236.65 mm) (F = 8.73; df = 2,27; P = 0.001). Similarly, width of the leaves significantly decreased with the decrease in temperature (F = 4.16; df = 2, 27; P = 0.027). The leaves of *F. semialata* grown in outer plains were wider (68.24 mm) followed by mid (65.11 mm) and high hills (60.27 mm). However, no significant differences were observed in height (F = 0.423; df = 2, 27; P = 0.659) and shoot width (F = 1.41; df = 2,27; P = 0.261) of the host plant from the respective areas. Significant differences were observed both in number of leaves (F = 6.05; df = 2, 27; P = 0.007) and Leaf Area Index (LAI) (F = 30.19; df = 2, 27; P = 0.000). However, no significant differences were observed in number of leaves and LAI of mid hills and high hills. LAI of *F. semialata* is inversely proportional to number of leaves. This host has the tendency to compensate with the climate change making it an excellent host for lac cultivation (Fig. 10.49 and Table 10.4).

Table 10.4: Changes in phenology of lac host (*F. semialata*) under elevated temperature

Sl. No.	Parameters	Plains (High temp)	Lower hills (Moderate temp)	Mid hills (Lower temp)	(F/df; P)
1	Leaf Length (mm)	153.1 ± 13.99 a	210.6 ± 12.53 b	236.7 ± 16.61 c	8.73/2,27; P = 0.001
2	Leaf Width (mm)	68.2 ± 2.07 b	65.1 ± 2.56 a	60.3 ± 0.85 a	4.16/2,27; P = 0.027
3	Height (inch)	37.3 ± 2.05 a	38.9 ± 2.87 a	40.5 ± 2.27 a	0.423/2,27; P = 0.659
4	Shoot Width (mm)	4.1 ± 0.28 a	3.8 ± 0.20 a	3.5 ± 0.27 a	1.41/2,27; P = 0.261
5	No. of Leaves	36.3 ± 6.51 b	21.1 ± 1.98 a	19.2 ± 1.33 a	6.05/2,27; P = 0.007
6	LAI	8.6 ± 0.33 a	11.1 ± 0.36 b	11.9 ± 0.24 b	30.19/2,27; P = 0.000

Biotic stress to lac insects

In case of biotic stress, *Eublemma amabilis* and *Pseudohypatopa pulverea* are the most destructive key predators of lac insect. However, in agro climatic conditions of Jammu and Kashmir only predator that affects lac production is *E. amabilis.* The mean number of predators emerged per jar is shown in Table 10.5.

Table 10.5: Biotic stress to lac insect under various agro climatic zones in Jammu and Kashmir

S. No.	Agro-climatic zones	No. of lac sticks/jar	No. of predators emerged/jar
1	Outer Plains	12	15.6
2	Mid Hills	12	7.2
3	Lower	12	4.8

Publications

Research articles

- Das P, Borah B, Saikia P, Hazarika LK, Sharma KK, Mohanasundaram A, Boro RC, Kalita R and Gautom T (2022). Molecular characterization of an *Isaria fumosorosea* (Wize) native strain, and its pathogenicity on *Eublemma amabilis* (Lepidoptera: Noctuidae. *Egyptian Journal of Biological Pest Control*, 32:122.
- Kandasamy T, Ekbal S, Kumari K, Lohot VD, Mohanasundaram A and Sharma KK (2022). Unraveling bacterial diversity of the Indian lac insect *Kerria lacca* (Kerr.) using next generation sequencing. *International Journal of Tropical Insect Science*, 42: 2365-2372.
- Lodhi B, Majumdar A, Barman R, Singh VB, Bhatnagar P, Sarkar and Agnihotri A (2022). Socio economic status of lac growing farmers of

Fig. 10.49: Changes in phenology of lac host under protected and unprotected condition

Balaghat district of Madhya Pradesh and Gondia district of Maharshtra, *Journal of Non-Timber Forest Products,* 29 (1), 21-27.

- Meena Mahaveer, Hemant Swami**,** Lekha, Gaurang Chhangani, Pradeep Kumar Gautam, Piyush Sharma, Mahendra Yadav and Neeraj Kumar Meena (2022). Bio-Efficacy of organic treatments against major lepidopteran predators of lac insect. *Frontiers in Crop Improvement*, 10: 1067-1069.
- Muthukumar S, Sajeev TV, Krishnan A, Joseph A, Mohansundaram A, Sharma KK and Sajily VS. (2022). Management of whitefly, *Bemisiatabaci* (Gennadius) in bushy lac host, *Flemingia semialata* at Thrissur, Kerala. *International Journal of Zoology and Applied Biosciences*, *7* (6): 34-38.
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- Singh A, Kaur R, Shera PS, Sharma S, Mangat HK and Thakur A (2022). Study of biological and productivity linked parameters of *Kerria lacca* (Kerr.) infested on *Ziziphus mauritiana. Agricultural Research Journal,* 59 (3): 462-467.
- Singh A, Kaur R, Shera PS, Sharma S, Thakur A, Mangat HK and Mohanasundaram A (2022). Diversity of natural enemies associated with lac insect *Kerria lacca* (Kerr.) in Punjab. *Indian Journal of Entomology,* Doi: 10.55446/IJE.2022.583.
- Singh KI, KL Devi., Th. R Singh, CN, Singh, CS Devi., Haldhar, SM and TR Singh (2022). Insect pest complex of *Flemingia species* a common host plant for lac insect. *J. Appl. Zool. Res.,* 33 (2) :137-143.
- Singh KI, KL Devi, Th. R Singh, T Robindro Singh, RK Sandeep Singh and H. Ramananda Singh (2022). Effect of mordants on dyeing of silk fabric with lac dye. *J. Appl. Zool. Res.,* 33 (2) :148-155.

Abstract published

- Lekha, Hemant Swami, Gaurang Chhangani and N. L. Regar. Host plant diversity of Lac insect [*Kerria lacca* (Kerr.)] in Arid Western Plains of India.
- Patil Roopa S., Javaregowda and KK Sharma. (2022). Lac cultivation: An emerging enterprise for economic sustainability in Karnataka during International Conference on "Sustainable Agricultural Innovations for Resilient Agri-Food Systems" held during 13th to 15th October, 2022 at SKUAST, Jammu.
- Swami Hemant, Lekha, Gaurang Chhangani and N. L. Regar. Diversity of natural enemies associated with lac [*Kerria lacca* (Kerr.)] in Arid Western Plains of India.

Books / Monographs

- AAU - A monograph on Intregative taxonomy of *Isariajavanica* (Hypocreales: Cordycipitaceae) - A potential entomopathogenic fungi of *Eublemma amabilis,* a pest of lac insect AAU/DR/22/MG/502/2022-23
- AAU - A monograph on white moth, *Eublemma amabilis* Moore - a major pest of lac insects in Assam AAU/DR/22/MG/553/2022-23

Pamphlet

- Sajeev TV, Muthukumar S, Mohanasundaram A and Thamilarasi K (2022). Introduction and cultivation of lac insect in Southern India. (Pamphlets were printed in English and Tamil languages and distributed to the common people and museum visitors).

- Swami Hemant, Dr. Lekha and Dr. Gaurang Chhangani. Processing of Lac & its Products: *Kerria lacca* (Kerridae: Hemiptera): Gift of Nature by NPCLIGR, Department of entomology, RCA, MPUAT, Udaipur.

Popular Articles / Newspaper clippings

- Das P, Kashyap P and Saikia P (2022). *Callosobruchus chinensis (L.)* (Coleoptera: Bruchidae), a major stored grain pest of *Flemingia* spp. SANRAG E-Newsletter 3 (2): pp 2.
- Das P, Saikia Pand and Borah B (2022). *Biston suppressaria* (Guen.) and *Hyposidra talaca* (Walk.): recorded as insect pests of *Flemingia spp.* SANRAG E-Newsletter 3 (1): pp 6-7.
- Gupta RK, Bali K and Thakur J (2022). Productive Insects: A source of safe and sustainable food. *Northlines,* May 16, 2022.
- Monobrullah Md. (2022). Harnessing potential of insect based resin and its product towards entrepreneurship development, In: Agri-preneurship development for doubling farmer's income through recent approaches in livestock and allied sectors (eds. Kumar P, Rajak SK, Singh PK and Prasad JK). Published by Bihar Veterinary College, Bihar Animal Sciences University, Patna, pp. 233-236.
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- Singh KI, KL Devi, Th. R Singh (2022). Occurrence of lac insect in North East India. SANRAG e- Newsletter 3(2): 2-3.
- Swami Hemant, Ashok Kumar Meena, Gaurang Chhangani, Lekha and Kavita Kumawat 2022. Mealy Bugs (*Megapulvinaria* Species) Insect on Ber Fruit Plant in Southern Rajasthan. *Just agriculture* e-newsletter (e-ISSN: 2582-8223) 2(9). May 2022.
- मो. मोनोब्रुल्लाह, दीपक रंजन किशोर एवं सुदीपा कुमारी झा (2022). लाख एक प्राकृतिक रालः किसानों के लिए वैकल्पिक आय का स्रोत, कृषि मंजूसा, 5 (1): 41–45
- SFRI –उन्नत तकनीक से सेमियालता (*Flemingia semialata*) के पौधे पर कुसमी लाख उत्पादन की प्रक्रिया, लघुवनोपज संदेश, *स्मारिका,* अर्न्तराष्ट्रीय हर्बलफेयर, 20–26 दिसम्बर, 2022, भोपाल (म.प्र.)
- PAU - 78 Students were briefed about Lac insect and its Importance. Hindustan Times, May 17, 2022
- PAU celebrated Lac Insect Day, PAU website (Flash Message), May 16, 2022
- PAU vich lakh de keere bare jagruktadi haramanaya (in Punjabi) PAU website (Flash Message), May 16, 2022
- PAU vich lakh de keere bare jagrukta di haramanaya (in Punjabi), Ludhiana Live, Punjab News May 17, 2022
- PAU vich lakh de keere bare jagruktadi haramanaya (in Punjabi), *Waah Kheti*, May 17, 2022

Papers presented/ contributed / Participation in Conferences / Symposia/ Seminars

- Dr P.S. Shera, PI, NPCLIGR, PAU, Ludhiana participated in Institute - NRG stakeholders' Meet-2022 on Enhancing Value Addition and Domestic Consumption of Lac and other Natural Resins and Gums on 28th January, 2022 (Online mode) organized by ICAR-Indian Institute of Natural Resins and Gums Namkum, Ranchi (Jharkhand) in collaboration with Shellac & Forest Products Export Promotion Council (SHEFEXIL), Kolkata (West Bengal)
- Dr. K.I. Singh, PI of the project CAU Imphal Centre had delivered an oral presentation on the topic "Study on host preference of lac insect species existing in Manipur" at XVIII AZRA International Conference on "Advances in applied zoological researches towards food, feed & nutritional security and safer environment" on 10-12 November, 2022 at Hotel Suryansh, Bhubaneswar, Odisha.
- Das P and Saikia P (2022). Lac based indigenous technical knowledge of Assam. 2nd Biotic Science Congress and International Conference on Recent Advances in Agricultural, Biological and Applied Sciences Research, Nagaon, Assam, India, August, 8-9, p. 88.
- Borah B, Das P, Saikia P and Mohanasundaram A (2022). Biology and morphological characterization of *Eublemma amabilis* Moore (Lepidopteran: Noctuidae): a major pest of lac insect (*Kerria* spp.). 2nd Biotic Science Congress and International Conference on Recent Advances in Agricultural, Biological and Applied Sciences Research, Nagaon, Assam, India, August, 8-9, p. 89.

- Gupta RK, Bali K, Ganai SA and Sharma KK. 2022. Kikar, *Acacia nilotica*: a promising host plant for the conservation of lac insect in outer plains. Regional Conference on Speciality Agriculture in the Context of Farm Economy of Himalayan Region, SKUAST-Jammu, J&K, September 21-22, p. 49-50.

Technical Bulletin / Extension Folders

- Gupta RK, Bali K and Sharma A. 2022. Enriching J&K Handicraft and through application of lac. Page No. 1-4, Directorate of Research, SKUAST-Jammu.
- Gupta RK, Bali K and Sharma A. 2022. Inventory of lac host plants in Jammu region of Jammu and Kashmir in Local vernacular language Page No. 1-10, Directorate of Research, SKUAST-Jammu.
- Gupta RK, Bali K and Sharma A. 2022. Reviving Lac cultivation in Jammu region. Network Project on Conservation of Lac Insect Genetic Resources, Division of Entomology, SKUAST-Jammu and ICAR- Indian Institute of Natural Resins and Gums, Ranchi.
- Gupta RK, Bali K and Sharma A. 2022. लाख से लाख कैसे कमाए. Network Project on Conservation of Lac Insect Genetic Resources, Division of Entomology, SKUAST-Jammu and ICAR- Indian Institute of Natural Resins and Gums, Ranchi.
- AAU - Natural dye from lac insects AAU/DR/22/BU/560/2022-23
- KVK Sirsi - "*Flemingia semialata* dalli Vaijnanika Aragu Krishi (in Kannada) January 2023.
- स्वामी हेमन्त, डॉ. लेखा, डॉ. गौरांग छंगाणी एवं एन एल रेगर। बेर पर लाख पालन। नेटवर्क परियोजना–लाख कीट अनुवांशिकी संसाधन संरक्षण, कीट विज्ञान विभाग, राजस्थान कृषि महाविद्यालय, उदयपुर

Radio Talk /TV talks / Video

- Dr. KI Singh, PI, NPCLIGR delivered TV talk for awareness on "The life cycle, Behaviour and Importance of lac insect" through videography at Doordarshan Kendra, Imphal in local vernacular language on 20th December, 2022.
- Dr. R. K. Gupta. 2022. Telephonically delivered radio talk in programme on "Lac cultivation: How, When and Why?" All India Radio, Jammu in the month of June, 2022.
- Dr. Kamlesh Bali. 2022. Telephonically delivered radio talk in programme on "Different hosts of lac insect" All India Radio, Jammu in the month of June, 2022.
- Dr. P. Das delivered radio talk on "Prospect of lac cultivation in Assam" AIR Dibrugarh on dated 4th September, 2022.

Honours, Awards and Recognitions

- Priyanka Saikia, SRF and Ph.D Scholar and Purnima Das, PI, NP-CLIGR, received Best Poster Presentation Award on "Lac based indigenous technical knowledge of Assam" at 2nd Biotic Science Congress, and International Conference on Recent Advances in Agricultural, Biological and Applied Sciences Research, Jointly organized by Society for Biotic Environmental Research (SBER), Tripura in collaboration with Nowgong College (Autonomus), Nagaon, Assam and ICAR-CAFRI, Jhansi during 8-9 August, 2022.
- Network Cooperating Centre of NPCLIGR, Punjab Agricultural University was adjudged the best performing centre of Network Project on Conservation of Lac Insect Genetic Resources (NPCLIGR) from ICAR-IINRG, Ranchi.
- MPUAT - Appreciation award for outstanding Team performance as P.I (NPCLIGR) by Honorable Vice Chancellor, MPUAT, Udaipur -2022.
- MPUAT - Appreciation award to center for contribution in the field of Natural Resins and Gums by ICAR-IINRG, Ranchi-2022.
- Best stall award 2022 SKUAST-Jammu

List of Research Projects for the Year 2022-23

Sl. No.	Project No.	Title of the Project	Name of Investigators	% Time	Year of Start	Year of Completion	* Associated Scientists
QUALITY AND PRODUCTIVITY IMPROVEMENT DIVISION							
Core Programme I: Biodiversity conservation of lac insect and NRG yielding plants							
1.	1.1.070/2020 (Old1.1.072)	Collection, conservation, characterization and evaluation of lac insect/ host plant diversity	Dr. VD Lohot (PI) Dr. J Ghosh Dr. Thamilarasi K Dr. Achintya Pramanik	25 25 25 25	March, 2020	Of continuing nature	Dr. KK Sharma Director
2.	1.1.082/2018 (Old1.1.070)	Taxonomic studies of lac insects (Hemiptera: Coccoidea: Tachardiidae) and associated insect fauna Sub project Taxonomic studies on lac insect predators and host plant associated insects in *Kusum* and common *Ficus* species	Dr. Achintya Pramanik	25	June, 2018	Of continuing nature	-
Core Programme II: Lac insect-host plant environment for improved quality and productivity							
3	1.1.088/2021	Study of physiological adaptations of *Kerria lacca* (Kerr) under moisture stress	Dr. Achintya Pramanik (PI) Mr. Sandeep Kumar	25 25	July, 2021	June, 2024	-
4	1.1.089/2021	*In Vitro* Production of Aleuritic Acid	Dr. Thamilarasi K (PI) Ms. Shruti Sinha Mr. Sandeep Kumar Dr. Preeti Srivastava (IIT Delhi)	25 25 25	May, 2021	April, 2024	Dr. AR Chowdhury
5.	1.1.090/2021	Seed Deterioration and Amelioration strategies during Storage in *Flemingia semialata*	Dr. NK Sinha (PI) Dr. VD Lohot	25 25	August, 2021	July, 2024	Dr. J Ghosh
7.	1.1.097/2022 (New)	Biochemical Characterization of Major Kerria genotypes for Aleuritic acid content	Mr. Sandeep Kumar (PI) Dr. Sujit Bishi, IIAB, Ranchi	25	April, 2022	March, 2025	Dr. Thamilarasi K. Dr. Achintya Pramanik
8.	1.1.098/2022 (New)	Induced Mutations for Forward / Reverse Breeding for the Development of Novel Semialata (*Flemingia semialata*) 'SEMTILLNRG'	Dr. J Ghosh (PI)	25	June, 2022	June, 2026	Dr. VD Lohot Dr. Sandeep Kumar Dr. NK Sinha
PRODUCTION AND EXTENSION MANAGEMENT DIVISION							
Core Programme III : Crop production system management and evaluation							
9.	1.1.084/2019 (Old1.1.069)	Agronomic interventions influencing lac production in *palas* (*Butea monosperma*) in summer season	Dr. S Ghosal (PI)	50	March, 2019	May, 2025	-
10.	1.2.058/2019 (Old1.1.071)	Lac Integrated Cropping System through Participatory Approach	Dr. S Ghosal (PI) Dr. NK Sinha	25 25	April, 2019	March, 2022 (Extension upto June 2022)	-
11.	1.2.091/2021	Estimation of water requirement and determination of growth-stage-specific crop coefficient (Kc) of *Flemingia semialata* Roxb."	Er. Pradosh K. Paramaguru (PI) Dr. S Ghosal Dr. Santosh S. Mali, FSRCHPR, Plandu, Ranchi	25 25	April, 2021	March, 2024	-
12.	1.2.092/2021	Characterization and management of sooty mold associated fungi in lac and documentation of other diseases of lac host plants	Dr. Rahul R. Bakade (PI)	25	April, 2021	March, 2024	Dr. Achintya Pramanik Dr. N Thombare

Sl. No.	Project No.	Title of the Project	Name of Investigators	% Time	Year of Start	Year of Completion	* Associated Scientists
13.	1.2.099/2022 (New)	Management of inimical entomofauna of lac insect through organics and newer insecticidal molecules	Dr. Asish Kumar Rout (PI)	25	April, 2022	March, 2025	Dr. Rahul Bakade
Core Programme IV : Capacity building, technology dissemination, impact assessment and market intelligence							
14.	1.2.076/2017 (Old1.3.052)	Capacity building, skill development, extension education and information service on natural resins and gums	Dr. Nirmal Kumar (PI) Dr. Rahul R. Bakade Er. Pradosh K. Paramaguru Dr. Asish Kumar Rout	25 25 25 25	October, 2017	Of continuing nature	-
APPLICATION & PRODUCT DEVELOPMENT (APD) DIVISION							
Core Programme V : Synthesis, process development and quality management							
15.	1.3.093/2021	Synthesis of *Terminalia bellirica* exudate gum hydrogel-metal nanoparticle composite materials for evaluation in drug release	Dr. SKS Yadav (PI) Dr. Ch. Jamkhokai Mate	50 25	August, 2021	July, 2023	
16.	1.3.094/2021	Synthesis of Gum Arabic based Hydrogel for remediation of dye contaminated water	Dr. Ch. Jamkhokai Mate (PI) Dr. SKS Yadav	30 25	April, 2021	March, 2024	Dr. N Thombare Dr. AR Chowdhury
17.	1.3.095/2021	Synthesis of rosin derivative for its use as tackifier	Dr. MF Ansari (PI)	25	April, 2021	March, 2023	Dr. AR Chowdhury
18.	1.3.100/2022 (New)	A study on various techniques for identification of commercially important natural gums	Dr. Nandkishore (PI) Dr. AR Chowdhury Dr. MF Ansari	25 25 25	April, 2022	March, 2025	
Core Programme VI : Value addition and product development							
20.	1.3.086/2019 (Old1.2.075)	Study on natural gum based dietary fibre as encapsulant for delivery of functional feed	Dr. AR Chowdhury (PI) Shri Ch. Jamkhokai Mate Dr. Biplab Sarkar, ICAR-IIAB, Ranchi	30 25 -	Septem-ber, 2019	August, 2022	Dr. Sandeep Kumar Dr. N Thombare
MECHANIZATION AND PROCESS ENGINEERING (MPE) DIVISION							
Core Programme VII : Designing and development of farm tools and processing machineries							
21.	1.4.073/2017 (Old1.2.070)	Development of pilot plant of *guar* gum derivative for training and demonstration	Dr. SC Sharma (PI) Dr. N Prasad Er. SK Pandey Dr. SK Giri, CIAE, Bhopal	25 25 25	April, 2017	March, 2022 (Extension upto March 2023)	Dr. AR Chowdhury
22.	1.4.101/2022 (New)	Development of Refractance Window Dryer for Gum based Hydrogels	Dr. Sakharam Kale (PI) Dr. Nandkishore Thombare	25 25	April, 2022	March, 2025	Dr. N Prasad
23.	1.4.102/2022 (New)	Development of Extrusion based Mechanized System for Hot filtration of Seedlac	Dr. Sakharam Kale (PI) Dr. SC Sharma	35 25	April, 2022	March, 2025	Dr. N Prasad Er. SK Pandey
Core Programme VIII : Process refinement, commercialization and entrepreneurship development							
24.	1.4.103/2022	Standardization of sealing lac/wax preparation and process mechanization	Er. SK Pandey (PI)	25	April ,2022	March, 2024	Dr. SC Sharma Dr. N Prasad
ICAR-Network Projects							
25.	3.4.026/2009 (Old3.2.026)	Network project on Harvesting, Processing and Value Addition of Natural Resins and Gums (ICAR)	Dr. N Prasad (PC & PI) Dr. AR Chowdhury Dr. SC Sharma Er. SK Pandey	25 25 25 25	February, 2009	March, 2026	Dr. N Thombare Dr. VD Lohot
26.	3.1.055/2014 (Old3.1.054)	Network project on Conservation of Lac Insect Genetic Resources (ICAR)	Dr. KK Sharma (PC & PI) Dr. VD Lohot Dr. Thamilarasi K	25 25 25	August, 2014	March, 2026	-

Sl. No.	Project No.	Title of the Project	Name of Investigators	% Time	Year of Start	Year of Completion	* Associated Scientists
KVK, Khunti, Ranchi							
27.	4.2.087/2020	Evaluation and dissemination of agricultural technologies for sustainable livelihood in tribal region	Dr. Jyotirmoy Ghosh (PI) Dr. N K Sinha Dr. VD Lohot Dr. SC Sharma Dr. Rahul Bakade Dr. Ashish K Rout Er. Pradosh K Paramguru	25 10 10 10 25 25 25	July, 2020	June, 2025	Dr. Nirmal Kumar
Agri-Business Incubation							
28.	Institute Activity	Agri-Business Incubation under Component-II of NAIF Scheme of ICAR	Er. SK Pandey (PI) Dr. SC Sharma	25 25	April, 2019	Continuous in nature	
Inter-Institutional Projects							
1. ICAR-IINRG, Ranchi & ICAR-IIAB, Ranchi							
29.		Development and evaluation of the efficacy of novel nanoparticles for enhancing yield in rice and Indian major carp	Dr. AR Chowdhury, Co-PI	25	August, 2016	July, 2021	-
2. ICAR-IINRG, Ranchi & ICAR-RCER Farming System Research Centre for Hill and Plateau Region, Plandu, Ranchi							
30.		Enhancing food, nutritional and livelihood security of marginal and small farmers in Jharkhand through need based agricultural technologies	Dr. Nirmal Kumar, Co-PI	15	April, 2018	March, 2022	Dr. NK Sinha
31.		Development of technology for post harvest management for value addition of Jackfruit in Eastern region	Dr. Sakharam Kale, Co-PI	15	January, 2022	December, 2024	-
32.		CRP on Secondary agriculture	Dr. AR Chowdhury Dr. Nandkishore Thombare				
Externally Funded Project							
33.		Design and development of portable device for estimation of life and color index of lac samples NABARD sponsored	Dr. Nandkishore Thombare (PI)	25	April, 2022	March, 2024	Dr. MF Ansari
34.		Aflatoxin management in spices: Development of preventive methods	Dr MF Ansari	25	December, 2020	December, 2022	

*Indicates scientist concerned would assist/facilitate the study without formally being associated with the project.

Explanation for coding of the Project Nos.

i. First number indicate the category of the project (1) Institute (2) Externally funded (3) Network Project (4) KVK

ii. Second number indicate the Division (1) QPI (2) PEM (3) APD (4) MPE

iii. Third number will indicate the project number

iv. Year: Project Starting Year

For example **1.1.070/Year**

- Year → Indicates Project Starting Year
- 070 → Indicates Project Number
- 1 → Indicates Division
- 1 → Indicates Institute Project

Publication and Publicity

Publications

Research papers

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- Bhatnagar P, Lodhi B, Bhalavi R, Prajapati S and Sharma KK (2022). Record of lac insect occurrence in Maharashtra. *Journal of Entomology and Zoology Studies,* 10(1): 193-200.
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- Mohanasundaram A, Sharma KK, Lohot VD, Kandasamy T, Shree U and Zeeshan N (2022). Calliandra calothyrsus: A Potential Host for the Indian Lac Insect (Kerr.) Cultivation in India *Kerria lacca*. *Indian Journal of Ecology,* 49 (1): 201-206.
- Muthukumar S, Sajeev TV, Aswathy K, Joseph A, Mohanasundaram A, Sharma KK and Sajily VS (2022). Management of whitefly, *Bemisiatabaci* (Gennadius) in Bushy lac host, *Flemingia semialata* at Thrissur, Kerala. *International Journal of Zoology and Applied Biosciences,* 7(6): 34-38.
- Nath P, Kale S, Vishwakarma RK and Kaur C (2023). Innovative freeze-thaw step prior to osmotic dehydration produces softer aonla candies. *Journal of Food Measurement and Characterization*, 17(3): 2454-2463.
- Pal G, Bakade R, Deshpande S, Sureshkumar V, Patil SS, Dawane A, Agarwal S, Niranjan V, PrasannaKumar MK and Vemanna RS. (2022) Transcriptomic responses under combined bacterial blight and drought stress in rice reveal potential genes to improve multi-stress tolerance. *BMC Plant Biology,* 22(1): 349.
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- Srivastava S, Chowdhury AR, Walia S, Saha S and Lohot VD (2022). Lac Wax Policosanol – A Natural Plant Growth Regulator. (Patent no. 394379 and Application no. 201631013579) was granted on April 9, 2022.
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- Thamilarasi K, Sinha S, Kumar S, Ekbal S, Kumari K and Sinha A (2022). Transcriptomics based approach to unravel lac resin biosynthesis in Souvenir of National Conference on Biotechnology and Omics Sciences held at Department of Biotechnology, Alagappa University, Karaikudi, Tamilnadu, May 24-28, 2022, p. 42.
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- Yogi RK (2022). Project report in video conferencing of XXIX research advisory committee (RAC) ICAR- NISA, Ranchi, February 16-17, 2022.

❖ Following paper presented in 56th Annual Convention of Indian Society of Agricultural Engineers (ISAE) on Agricultural Engineering Innovation for Global Food Security" and International Symposium on "India 2047 : Agricultural Engineering Perspective" organized at Tamil Nadu Agricultural University (TNAU), Coimbatore. Organized jointly by Indian Society of Agricultural Engineers, New Delhi and Tamil Nadu Agricultural University, Coimbatore, November 09 -11, 2022.

- Sharma SC, Pandey SK, Prasad N and Raj H (2022). Effect of tapping techniques on gum yield from *Moringa oleifera* trees, p. 499.
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- सतीश चन्द्र शर्मा, संजय कुमार पाण्डेय, निरंजन प्रसाद एवं हिमांशु राज (2022). सहजन गोंद उत्पादन लिए ब्लेजर

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- Ghosh J and Lohot VD (2022). Scientific lac cultivation on fruit varieties of ber, palas variant and pigeonpea Bakade RR, Paramguru PK, Ghosh J, Kumar N and Sharma KK (Eds.), Ranchi, 3-16 pp.
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Newsletters

- Dr. SC Sharma, Sr. Sc. compiled, reviewed Natural Resins and Gums, ICAR–IINRG Newsletter for different quarters *i.e.* April–June, 2021, July–September, 2021, October–December, 2021, January–March, 2022 and April–June, 2022 and published through outsourcing.

Extension folders

- SC Sharma, SK Pandey, N Prasad and H Raj (2022). Moringa (*Moringa oleifera*) Gum Tapping Blazer, ICAR–Indian Institute of Natural Resins and Gums, Ranchi, 1–4.
- सतीश चन्द्र शर्मा, निरंजन प्रसाद एवं संजय कुमार पाण्डेय (2022). समेकित लघुस्तरीय लाख प्रसंस्करण इकाई, भाकृअनुप–भारतीय प्राकृतिक राल एवं गोंद संस्थान, राँची, 1–4
- सतीश चन्द्र शर्मा, संजय कुमार पाण्डेय, निरंजन प्रसाद एवं हिमांशु राज (2022). सहजन/मुनगा (*मोरिंगा ओलीफेरा*) गोंद उत्पादन के लिए ब्लेजर, भाकृअनुप–भारतीय प्राकृतिक राल एवं गोंद संस्थान, राँची, 1–4

Popular articles/e-publication

- Prerna Nath, SJ Kale, Pankaj Kannaujia, AK Singh (2022). Processing and value addition of Aonla: An opportunity for women entrepreneurs. *Marumegh* (Kisaan e-Patrika) 7(2): 5-11.
- S Kumar, M Sasi, S Bishi and R Sanyal (2022). Role of Probiotic α-galactosidases in the Reduction of Flatulence Causing Raffinose Oligosaccharides (RFOs). *Biotica Research Today* 4(8): 640-642.
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- A Mohanasundaram, J Ghosh and RK Yogi (2022). Entrepreneurial ecosystem for tribal agriculture development: A case study of Lac Integrated Agro-forestry System (LIAS). (3)2: 3-4.
- RK Yogi, N Kumar and KK Sharma (2022). A legendary tycoon of lac sector: Journey from Punjab to Jharkhand. 3(2): 4-6.
- RK Yogi, N Kumar and KK Sharma (2022). Export and import performance of natural resins and gums. 3(1): 3

- RK Yogi, N Kumar and KK Sharma (2022). Lac production scenario in India. 3(1): 2.

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- CJ Mate, AR Chowdhury and N Thombare (2022). Importance of Minor Gums for Diverse Applications. 4(7): 107-108.
- CJ Mate, AR Chowdhury and N Thombare (2022). Cassia tora Gums: A New Possibility for Food Additive. 4(7): 437-438.
- CJ Mate, AR Chowdhury and N Thombare (2022). Various Techniques Commonly Employed for Grafting Polymers. 4(8): 86-87.
- SH Deshmukh, AR Chowdhury and VR Parate (2022). Moringaoleifera Gum – A Promising Hydrocolloid. 4(9): 01-03.
- CJ Mate, AR Chowdhury and N Thombare (2022). Importance of Gum Arabic. 4(9): 185-186.
- CJ Mate, AR Chowdhury and N Thombare (2022). Importance of Prosopis Gum. 4 (10): 105-106.
- Rohit Kumar Pandey, Arnab Roy Chowdhury and Ch. Jamkhokai Mate (2022). Moringa: A Gift from Nature. 4(11): 203-204.
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- Thamilarasi K, Kanchan Kumari and Sajiya Ekbal (2022). Insect Pigments. 475-478.

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- N Thombare, S Kumar, R Shinde and PK Sarkar (2022). Hydrogel technology: Opportunities for advancement in agriculture. 1(1): 1-5.
- M Sasi and S Kumar (2022). Enhancement of isoflavone bioavailability and bioactivity in soybean: A journey from daidzin to equol, 1(2): 8-13.
- D Hari, AR Chowdhury and N Thombare (2022). Guar gum – A natural biopolymer for industrial application. 1(4): 1-4.

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- RK Yogi, SKS Yadav, SC Sharma, Nandkishore Thombare and Govind Pal (2022). Value chain of natural resins in India. (10) 20-28.
- RK Yogi, N Kumar and G Pal (2022). A story of the legendary tycoon of lac sector: Inspiring journey of a small entrepreneur towards the business leader. 2(10).
- RK Yogi., Rahul Bakade, A Mohanasundaram, SC Meena and J Ghosh (2022). Lac cultivation: An option for livelihood security in aspirational districts of India. 2(10).

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- S Ghosal and A Sinha (2022). Lakh utpadak ki safalta katha*. Kheti* (April) 16.
- नंदकिशोर ठोंबरे, उषा कुमारी और निरंजन प्रसाद (2022). द्वितीयक कृषि से आमदनी. खेती. अप्रैल पृष्ठ 43–44.

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- M Ali (2022). Biochar: Preparation and its application in agricultural soil remediation. 5(1): 25-27.
- बी सरकार, पी के सुंदरम, ए पी अनुराग, एस के पटेल, एस सी शर्मा एवं पी जीत (2022). भारत में कृषि यंत्रीकरण की संभावनाएं. 5(1): 56–62.

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- ए मोहनासुन्दरम, मो. मोनोब्रुल्लाह, अनीस के., राज कुमार योगी एवं केवल कृष्ण शर्मा (2022). भारतीय लाख कीट, *केरिया लक्का* (केर) की फसल के उत्पादन पर जलवायु परिवर्तन का प्रभाव. ICAR IIAB, Ranchi (1): 52–56.
- उषा कुमारी, नंदकिशोर ठोंबरे, प्रदीप कुमार सरकार एवं रेशमा शिंदे (2022). कृषि वानिकी आधारित बहुस्तरीय कृषि प्रणाली की झारखण्ड राज्य में संभावनाएं. पृष्ठ 10–13.

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- मुहम्मद फहीम अंसारी (2021). लैकेरिंग और पेंटिंग में लाख की उपयोगिता, पृष्ठ 17–25.
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- च जाम्खोकई माते एवं मुहम्मद फहीम अंसारी (2021). झिंगन गमः एक आशाजनक लघु गोंद, पृष्ठ 61–62.
- अनमोल कुमार मिश्रा, सतीश चन्द्र शर्मा एवं निरंजन प्रसाद मोबाइल एग्रीकल्चर स्कूल एंड सर्विसेस के सफलता की कहानी, पृष्ठ 70–74.

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- राजीव कुमार, मुहम्मद फहीम अंसारी एवं संतोष कुमार सिंह यादव (2022). 'ग्वारः एक बहुउपयोगी औद्योगिक गोंद', पृष्ठ 1–7.
- सतीश चन्द्र शर्मा, संजय कुमार पाण्डेय, निरंजन प्रसाद एवं हिमांशु राज (2022). *मोरिंगा ओलीफेरा* के वृक्षों से गोंद उत्पादन पर तकनीकी का प्रभाव, पृष्ठ 10–19.
- अर्नव राय चौधरी एवं आर के पाण्डेय (2022) चकोड़गोंद : खाद्य योजना के रूप में एक नई संभावनाएँ, पृष्ठ 20–23.
- सतीश चन्द्र शर्मा, संजय कुमार पाण्डेय, निरंजन प्रसाद एवं हिमांशु राज (2022). सहजन के वृक्ष से *मोरिंगा* गोंद उत्पादन के लिए हस्त चालित पोर्टेबल ब्लेज़र, पृष्ठ 27–33.
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- नंदकिशोर ठोंबरे, उषा कुमारी, रेशमा शिंदे तथा सखाराम काले (2022). कृषि उत्पादों के मूल्यवर्धन द्वारा रोजगार वृद्धि की संभावनाएं, पृष्ठ 45–50.
- प्रदोष कुमार परमगुरु, आशीष कुमार राउत एबं तृप्तिमयी सुना (2022). लाख की खेतीः प्राकृतिक संस्थान प्रबंधन के लिए एक वरदान, पृष्ठ 51–55.
- राहुल आर बाकड़ें एवं आकाश सिन्हा (2022) सूटी मोल्ड–एक परिचय, पृष्ठ 56.
- सौरव कुमार, अनुपमा शर्मा तथा नंदकिशोर ठोंबरे (2022). लाखः प्राचीन भारतीय साहित्य तथा वेदों में वर्णित एक बहुमूल्य पदार्थ, पृष्ठ 60–64.
- तमिलरसी के एवं अमृता सिन्हा (2022). कीड़ा के अन्तः सहजीवी, पृष्ठ 65–69.
- सतीश चन्द्र शर्मा, प्रेम कुमार सुन्दरम् एवं संजय कुमार पटेल (2022). छोटे भूमि धारकों के लिए बुवाई एवं खरपतवार नियंत्रण के उपकरण, पृष्ठ 70–77.
- उषा कुमारी, नंदकिशोर ठोंबरे तथा निरंजन प्रसाद (2022). कृषि के क्षेत्र में मोबाइल एप्स का उपयोगं, पृष्ठ 78–81.
- प्रदोष कुमार परमगुरु, तृप्तिमयी सुना एबं सास्वत कुमार कर (2022). मलचिंगः जल संरक्षण एबं वर्षा आधारित कृषि की एक विधि. पृष्ठ 82–86.
- अनमोल कुमार मिश्रा, सतीश चन्द्र शर्मा, संजय कुमार पाण्डेय एवं निरंजन प्रसाद (2022). फसल सुरक्षा के उपकरणः अधिक फसल उत्पादन का एक स्रोत, पृष्ठ 87–93.
- देवब्रत हरी, अर्नव राय चौधरी एवं महताब जाकिरा सिद्दीकी (2022) झारखण्ड राज्य में औषधीय पौधों की बहुलता, पृष्ठ 94–97.
- प्रेरणा नाथ ए एवं सखाराम काले (2022). जामुन मधुमेह नियंत्रक फल, पृष्ठ 98–102.

Institute Publications

- ICAR-IINRG Annual Report 2021-22, 1-196 pp.
- Natural Resins and Gums, ICAR-IINRG Newsletter, January - March 2022, 26(1), 1-12 pp.
- Natural Resins and Gums, ICAR-IINRG Newsletter, April - June 2022, 26(2), 1-12 pp.
- Sharma KK, Thamilarasi K, Mohanasundaram A and Yogi RK (2022). SANRAG e-Newsletter, ICAR-IINRG Ranchi, 3(1): 1-8 pp.
- Sharma KK, Thamilarasi K, Mohanasundaram A and Yogi RK (2022). SANRAG e-Newsletter, ICAR-IINRG Ranchi, 3(2): 1-10 pp.

Publicity

Tours/ Visits

- Dr. SC Sharma, Sr. Sc. visited M/s. Tajna Shellac Pvt. Ltd, Khunti; M/s. Indian Shellac Industries, Khunti and Jharkhand State Co-operative Lac Marketing & Procurement Federation Ltd factory, Sidraul, Ranchi regarding orientation of lac

industries for Dr. Sakharam Kale, Sc., January 05, 2022.

- Dr. S. Ghosal, Pr. Sc. participated as resource person in the state level meeting organized by Jharkhand State Plantation Advisory Committee to strengthen activity of Birsa Harit Gram Yojana, March 07, 2022
- Dr. Nandkishore Thombare, Sr. Sc. and PI, NABARD funded project visited the Jharkhand Regional Office of NABARD at Bariatu, Ranchi and discussed the progress and future plan of project, April 26, 2022.
- Dr. SC Sharma, Sr. Sc. visited Kewali village, Namkum block, Ranchi regarding initiation of piyar gum tapping experiment from *Buchanania lanzan* trees with different treatments, May 07, 2022.
- Dr. SC Sharma, Sr. Sc. visited M/s. Ideal Onscreen Solution, Above Kundan Tyre, Ranchi College Road, Ranchi regarding Mock Test under Computer Based Test (CBT) for AO & FAO Examination – 2021, May 09, 2022.
- Er. SK Pandey, Sc. visited IIT(ISM), Dhanbad with competent authority, ICAR-IINRG and Head, APD Division for signing of MoU w.r.t. the project on developing an inclusive agriculture ecosystem for lac cultivation in Jharkhand, May 13, 2022.
- Dr. SC Sharma, Sr. Sc. visited Kewali village, Namkum block, Ranchi regarding *piyar* gum tapping experiment from *Buchanania lanzan* trees with different treatments, June 08, 2022.
- Er. SK Pandey, Sc. visited JASCOLAMPF, Ranchi with respect to observation on their sealing lac unit and different mould being used there. June 10, 2022.
- Dr. SC Sharma, Sr. Sc. visited ICAR – Central Institute of Agricultural Engineering (CIAE), Bhopal regarding fabrication of guar gum derivative pilot plant, July 03 – 09, 2022.
- Dr. SC Sharma, Sr. Sc. visited M/s. Siladon Lakh Utpadak Sahyog Samiti Limited, Khunti regarding items to be used under sealing lac/wax manufacturing, August 04, 2022.
- Er. SK Pandey, Sc. visited Van Dhan Vikas Kendra and Shiladon Vanoutpad Sangh Sanstha, Shiladon, Khunti w.r.t. new Sealing lac/wax project. August 04, 2022.
- Dr. SC Sharma, Sr. Sc. visited Kewali village Namkum block, Ranchi regarding gum tapping from *Buchanania lanzan* trees with different treatment, September 06, 2022.
- Dr. S. Ghosal, Pr. Sc. Dr. Sakharam Kale, Sc. Mr. Sandeep Kumar, Sc. and Mr. Mousam Kumar Ram, Tech. Asst. visited Mangobandh village, Namkum to conduct a programme under "Mera Gaon Mera Gaurav" with objective to create awareness amongst the villagers about "Climate change and water conservation" along with routine monitoring of the farmer's field and address farming issues, September 08, 2022.
- Dr. Arnab Roy Chowdhury, Sc. visited Sildah villages in Khunti district for awareness drive on soil fertility and soil conservation under "Mera Gaon Mera Gaurav" programme. The team contacted farmers engaged in lac production, self-help women groups and local officials from the villages, September 29, 2022.
- Dr. Ch Jamkhokai Mate, Sc. and other scientific team visited Sildah villages in Khunti district under the "Mera Gaon Mera Gaurav" programme. The team shared knowledge on lac cultivation, discussion on various problems related to agriculture and distribution of over 150 seedling of *Calliandra calothyrsus* to the villagers, September 29, 2022.
- Er. SK Pandey, Sc. visited M/s Indolacca shellac Pvt. Ltd., Balrampur, w.r.t. preparation of Buttonlac/shellac from seedlac for new sealing lac project, gathering information on button lac production, market and ABI activities, October 17, 2022.
- Dr. SC Sharma, Sr. Sc. visited Tamil Nadu Agricultural University (TNAU), Coimbatore regarding participation in 56th Annual Convention of Indian Society of Agricultural Engineers (ISAE) on Agricultural Engineering Innovation for Global Food Security" and International Symposium on "India 2047: Agricultural Engineering Perspective" organized at Tamil Nadu Agricultural University (TNAU), Coimbatore jointly by Indian Society of Agricultural Engineers (ISAE), New Delhi and Tamil Nadu Agricultural University (TNAU), Coimbatore, November 09 -11, 2022.
- Dr. S. Ghosal, Pr. Sc. participated and Inaugurated (in favour of Director) the NABARD funded *Semialata* based vegetable intercropping project of SUPPORT, Ramgarh and Tata-Sini Trust at Basaria village, Dadi Block, November 16, 2022.
- Dr. S. Ghosal, Pr. Sc. participated in the in-house Scientist-Farmer interaction meeting convened

by RK Mission, Ranchi in a bid to formulate a project for protecting rangeeni lac crop from summer season mortality, December 02, 2022

- Dr SKS Yadav, Sc. visited Diyakel villages in Khunti district and conducted 'Farmer's Field School' on scientific methods of lac cultivation under the "Mera Gaon Mera Gaurav" programme, December 08, 2022.
- Dr. S. Ghosal, Pr. Sc. participated in the meeting convened by the BDO, Namkum for organizing visit of the DDC, Ranchi in the Institute, December 14, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. visited Mangobandh village several times during the year 2022 under 'Mera Gaon Mera Gaurav' programme and guided the farmers for scientific lac cultivation. Discussions were also held with farmers related to insect-pest and disease problems on the local vegetable and rice crop.

Popularization and publicity of Lac and lac based products in Newspaper

- Front page head-mast of Newspaper '*DainikBhaskar'* was prepared with seedlac and published on the foundation day of the newspaper September 25, 2022. Seedlac was applied on the head-mast of the paper using adhesive. 15,000 papers were published with seedlac head-mast and distributed in twelve districts of Jharkhand on 25th September 2022. Material for information on Lac and Lac based products was published in the paper.

Newspaper published with seedlac applied head-mast and material on lac and lac based products published in the newspaper

Radio/ TV Talk

By Director

- Dr. KK Sharma, Director, ICAR-IINRG participated in live phone in programme at DDK, Ranchi on, '*Lahk mulya samvardhan evam vipanan vyavstha*' on April 28, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG delivered a talk at DDK, Ranchi on, '*Barsat ke mausam mein beehan lakh sancharan evam savdhaniyan*' on July 19, 2022 (recorded on July 09, 2022).
- Dr. KK Sharma, former Director, ICAR-NISA participated in live phone in programme at DDK, Ranchi on, '*Kisanon ko lakh ki kheti se labh evam uska mulya samvardhan*' on November 03, 2022.
- Dr. KK Sharma, former Director, ICAR-NISA participated at DDK, Ranchi in *Nav Bharat manthan* live discussion on, '*Kisanon ki badhti aay*' on December 05, 2022.
- Dr. KK Sharma, former Director, ICAR-NISA delivered a TV talk on, '*Lakh ki kheti se rozgar ke awsar.*' on January, 2023 (recorded on December 28, 2022).

By Others

- Dr. Nandkishore Thombare, Sr. Sc. delivered a TV talk on 'TV 9' channel and Facebook Live on the topic 'देश के किसानों के लिए गेमचेंजर साबित होगा हाइड्रोजेल' on March 07, 2022.

- Dr. S Ghosal, Pr. Sc. delivered a TV talk for E.TV Bharat during technology demonstration programme to showcase use of fertilizer on *palas* trees to combat summer season *rangeeni* lac mortality. Programme was uploaded on the same day through the link: https://www.etvbharat.com/hindi/jharkhand/city/ranchi/scientists-of-iinrg-found-reason-for-death-of-red-insects/jh20220623172147320320162, June 23, 2022.

Database

- **Sequences submitted to NCBI GenBank database**

Gene	Accession no.
Polyketide synthase	OP515797
16S rDNA of *Priestia megaterium*	OQ096684
Cytochrome oxidase 1 of lac insect collected from Sri Rangam, Tamilnadu	OM089768
Cytochrome oxidase 1 of lac insect collected from Trichy, Tamilnadu	OM089769
Cytochrome oxidase 1 of lac insect collected from Dindugal, Tamilnadu	OM089770

Participation of Scientists in Conferences/ Meetings/ Seminars/ Symposia/ Workshops/ Trainings

By Director

Chaired / Convened

- Dr. KK Sharma, Director, ICAR-IINRG chaired the 57th Institute Management Committee meeting of Indian Institute of Natural Resins and Gums, Ranchi held online on March 30, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG chaired the Institute Research Council meeting of Indian Institute of Natural Resins and Gums, Ranchi held online on April 22-23, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG chaired the Technical Session – 2 of the 5th International Conference on Advance in Agriculture Technology and Allied Sciences (ICAATAS), 2022 with Dr. M. Devender Reddy on June 4, jointly organized by Society of Agriculture Research and Social Development; MS Swaminathan School of Agriculture and Centurion University of Technology and Management, at Paralakhemundi, Gajapati, Odisha, India through hybrid mode on June 4-5, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG chaired the 24th Meeting of Brushware, Polishes, Lac and Lac Products Sectional Committee CHD 23 held online on June 17, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG chaired the 93rd meeting of Institute Joint Staff Council held on June 28, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG was invited as Chief Guest in Institute-Industry Meet jointly organized by ICAR-IIAB, ICAR-IINRG, and ICAR-RCER, RC, Palandu, at ICAR-RCER, RC, Palandu on September 22, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG chaired the 94th meeting of Institute Joint Staff Council held on September 24, 2022.
- Dr. KK Sharma, Director, ICAR-NISA was invited as Guest of Honour in the 'National Symposium on Vanya Sericulture: Opportunities Galore' organized by Central Tasar Research and Training Institute, Ranchi, Jharkhand on October 28-29, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG was invited as Chief Guest in Hindi Pakhwada program at Central Tasar Research and Training Institute, Nagri, Ranchi on September 29, 2022
- Dr. KK Sharma, Director, ICAR-IINRG chaired the 25th Meeting of Brushware, Polishes, Lac and Lac Products Sectional Committee CHD 23 held online on October 10, 2022.
- Dr. KK Sharma, Director, ICAR-NISA chaired the Technical Session – 4 'Recent advances in Post Cocoon Technology, Seri Byproduct utilization and Marketing in Vanya Sector' of the National Symposium on Vanya Sericulture: Opportunities Galore, organized by Central Tasar Research and Training Institute, Ranchi, Jharkhand on October 29, 2022.

Participated

- Dr. KK Sharma, Director, ICAR-IINRG participated in State Level Committee Meeting of National Mission for Sustainable Agriculture at Nepal House, Ranchi in May, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG participated in State Level Unit Cost Committee Meeting 2022-23 of NABARD, Ranchi on May 18, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG was invited as Keynote speaker in the 5th International Conference on Advance in Agriculture Technology and Allied Sciences (ICAATAS), 2022 jointly organized by Society of Agriculture Research and Social Development; MS Swaminathan School of Agriculture and Centurion University of Technology and Management, at Paralakhemundi, Gajapati, Odisha – 761211, India in hybrid mode during June 04-05, 2022.
- Dr. KK Sharma, Director, ICAR-IINRG delivered a Keynote lecture on, 'Nature of diversity in lac insects and lac insect-host plant interaction' online in the 5th International Conference on Advance in Agriculture Technology and Allied Sciences (ICAATAS), 2022 jointly organized by Society of Agriculture Research and Social Development; MS Swaminathan School of Agriculture and Centurion University of Technology and Management, at Paralakhemundi, Gajapati, Odisha – 761211, India in hybrid mode on June 04-05, 2022 in. June 05, 2022.

- Dr. KK Sharma, Director, ICAR-IINRG was invited as speaker in the State-level Workshop on Building a Climate-Resilient Jharkhand Way-Forward for Adaptation and Mitigation A Future-Ready Jharkhand organized by Department of Forest, Environment and Climate Change, Govt. of Jharkhand on 21 June 2022. He delivered a lecture on, 'Is climate change affecting sustainability of lac farming as a viable livelihood option?' on June 21, 2022.
- Dr. KK Sharma, former Director, ICAR-NISA was invited as lead speaker to deliver a lecture in 3rd National Symposium on Entomology 2022: Innovation & Entrepreneurship at PJTSAU Campus, Hyderabad. He delivered a lecture on, 'Advances in lac insect culture research and scope for innovative entrepreneurship using natural. December 8-10, 2022.

By Others

Participated

- Dr. A Roy Chowdhury, Sc. attended the interaction meeting with Dr S N Jha, DDG (Ag Engg), ICAR, New Delhi through virtual mode on January 15, 2022.
- Dr. SC Sharma, Sr. Sc. participated in Institute – NRG Stakeholders' Meet – 2022 organized at ICAR – IINRG, Ranchi through virtual mode on January 28, 2022.
- Dr RK Yogi, Sr. Sc. attended the workshop and delivered an online lecture on "Production and value addition of NRGs: Current status and trends" during the one-day "Institute– NRG stakeholders meet" with a theme on "Enhancing value addition and domestic consumption of lac and other NRGs "jointly organised by ICAR-IINRG Ranchi & SHEFEXIL Kolkata through virtual mode on January 28, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a member of Institute-NRG Stakeholders' Meet 2022 held at ICAR-IINRG on January 28, 2022.
- Dr. A Roy Chowdhury attended an online webinar on 'Encapsulation of Neutraceuticals' by Dr K Narsaih form ICAR-CIPHET, Ludhiana on February 03, 2022.
- Dr J. Ghosh, PS and I/C KVK join the meeting with DDC Khunti in the subject of Agriculture Park & Agriculture Allied Activities collectorate building on February 10, 2022.
- Dr. A Roy Chowdhury, Sc. attended the XXIX RAC meeting of the Institute during February 16-17, 2022.
- Dr. SC Sharma, Sr. Sc. participated in tender committee meeting regarding finalization of tender for purchase of machinery and equipments for Bundu Lac Farming and Processing Cluster under SFURTI Scheme organized through virtual mode by CEO, Mukhya Mantrri Laghu Evam Kutir Udyam Vikas Board, Ranchi on February 18, 2022.
- Dr. Ch Jamkhokai Mate acted as a Co-Chairman for Institute-cum-KVK Khunti Stall Exhibition Committee at Kisan Meal held on Feb 26-27, 2022.
- Dr. SC Sharma, Sr. Sc., Dr. AR Choudhary and Er. SK Pandey, Sc. participated in interactive session during the visit of Dr. G R Chintala, Chairman, NABARD organized at ICAR – IINRG, Ranchi on March 03, 2022.
- Dr. A Roy Chowdhury, Sc. attended annual meeting of CRP on Secondary Agriculture of ICAR-CIPHET, Ludhiana via online mode and presented a new project proposal titled 'Study on extraction of protein isolates from guar meal for its potential applications' from ICAR-IINRG, Ranchi for inclusion in the project on March 23, 2022.
- Dr. SC Sharma, Sr. Sc. participated in "Regional Workshop on Opportunities & Challenges in Creating Micro-Enterprises in Green Trade" organized by *Krishi Gram Vikas Kendra* (KGVK), Ranchi at Hotel Le Lac Sarovar, Ranchi, March 29, 2022.
- Dr. Ch Jamkhokai, Sc. Mate acted as an Observer –II for online Tier-I (CBT) of Administrative Officer (AO) and Finance & Accounts Officer (F & AO Examination-2021 at SHREE INFOTECH, Kokar, Ranchi, Jharkhand on May 10, 2022.
- Dr. A Roy Chowdhury, Sc. attended lecture on 'Natural Farming' by Sri Siddarth Jaiswal and 'The Protection of Plant Varieties and Farmers' Rights Act, 2001' by Sri Phool Singh Malviya on the awareness programme on the theme *'Kisan Bhagidari Prathmikta Hamari*' under '*Azadi ki Amrit Mahotsav*' programme at the Institute on April 28, 2022.
- Dr. A Roy Chowdhury, Sc. attended the programme on 1st Lac insect Day on 17th May, 2022 and the lecture series on the eve of 'Productive Insect Conservation Week' at the Institute during May 18-20, 2022.
- Dr. A Roy Chowdhury, Sc. attended the interaction session with Sri Arjun Munda, Hon'ble Minister of Tribal Affairs at the Institute, May 31, 2022.

- Dr. R Chaudhari, SMS (Agro meteorology) and Ashutosh Prabhat, Observer participated in Block level Ravi workshop in Karra block on June 01, 2022.
- Dr. A Roy Chowdhury, Sc. attended internal audit meeting of QEL lab and carried out the internal audit of training of QEL lab as per the assigned role on June 28, 2022.
- Er. SK Pandey, Sc. collaborated and participated in webinar on BIRAC-BIG Webinar 21st Call a-IDEA ICAR-NAARM organised for ABI incubattee on July 21, 2022.
- Er. SK Pandey, Sc. participated online in Brainstorming meet on India @ 2047: In Agricultural Engineering Industry perspective organised by SMD (Engg.) on July 29, 2022.
- Er. SK Pandey, Sc. participated in online webinar on Intellectual Property Rights (IPRs) Awareness Programme organised by Office of the Controller General of patents, Design & Trademark, Govt. of India in association with ICAR from August 01-05, 2022.
- Er. SK Pandey, Sc. participated in intellectual Property Rights Awareness Webinar Series under National Intellectual Property Awareness Mission (NIFAM) organized by IP&TM Unit, ICAR during August 01-05, 2022.
- Er. SK Pandey, Sc. participated in online meeting with network centre under Network Project on HPVA of NRG on September 06, 2022.
- Dr. SC Sharma, Sr. Sc. participated in हिन्दी वैज्ञानिक संगोष्ठी on विज्ञान एवं किसान : भारत @ 75 organized by ICAR – NINFER, Kolkata and presented paper titled सहजन गोंद उत्पादन के लिए ब्लेजर on September 19, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as Co-Chairman in Invitation and Publicity Committee for Institute 99th Foundation Day held on September 20, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. and other scientific team visited Sildah villages in Khunti district under the "*Mera Gaon Mera Gaurav*" programme. The team impart knowledge on lac cultivation, discussion on various problems related to agriculture and distribution of over 150 seedling of *Calliandra calothyrsus* to the villagers on September 29, 2022.
- Er. SK Pandey, Sc. participated in executive committee meeting called by Mukhyamantri Laghu and Kutir Udyog Vikas Board for discussion on tender related matter w.r.t. Common Facility Centre (CFC) establishment work of Vedic Lac foundation, Bundu under SFURTI scheme of MSME on October 14, 2022.
- Dr. SC Sharma, Sr. Sc. participated in 56th Annual Convention of Indian Society of Agricultural Engineers (ISAE) on Agricultural Engineering Innovation for Global Food Security" and International Symposium on "India 2047: Agricultural Engineering Perspective" organized at Tamil Nadu Agricultural University (TNAU), Coimbatore jointly by Indian Society of Agricultural Engineers, New Delhi and Tamil Nadu Agricultural University, Coimbatore, and presented paper titled "Effect of Tapping Techniques on Gum Yield from *Moringa oleifera* Trees" during November 09 -11, 2022.
- Dr. Sakharam Kale, Sc. participated and presented a paper in 56th annual convention of ISAE and International symposium on India @ 2047: Agricultural Engineering Perspective" held at Tamil Nadu Agricultural University, Coimbatore, Tamilnadu during November 09-11, 2022.
- Dr. A Roy Chowdhury, Sc. attended 23rd meeting of BIS CHD -23 (Brushware, Polishes, Lac, Lac Products) through online mode on October 10, 2022.
- Dr. A Roy Chowdhury, Sc. attended online live telecast of PM Kisan Samman Sammelan organised by IARI, New Delhi and telecasted at the Institute Palas Conference Hall. October 17, 2022
- Dr. Vaibhav D Lohot, Sr. Sc. participated in International Conference on 'Physiological and Molecular Mechanisms for Abiotic Stress Tolerance in Plants' organised by Department of Botany, University of Calicut, Malappuram, Kerala during October 26-28, 2022.
- Dr. A Roy Chowdhury, Sc. attended a joint online meeting with Industry (Ms India Glycols Ltd, Noida , UP) regarding collaboration for scaling up research, production of guar gum and other natural gums based derivatives and presented brief achievements of the Institute on November 04, 2022
- Dr. A Roy Chowdhury, Sc. attended online presentation by Dr H Pathak, DG, ICAR and Secretary DARE on 'Revitalizing ICAR: Aspiration and Action Plan' November 11, 2022.
- Dr. A Roy Chowdhury, Sc. attended online presentation by Dr S N Jha, DDG (Ag Engg.)

ICAR, New Delhi on 'Aspiration and Action Plan of ICAR'on November 17, 2022.

- Dr. A Roy Chowdhury, Sc. attended online presentation by Dr B N Tripathi, DDG (Animal Science) ICAR, New Delhi on 'Aspiration and Action Plan of ICAR'. November 22, 2022.
- Dr. A Roy Chowdhury, Sc. attended online presentation by Dr SK Choudhari, DDG (NRM) ICAR, New Delhi on December 02, 2022.
- Dr. A Roy Chowdhury, Sc. attended online presentation by Dr AK Singh, DDG (Horticulture) ICAR, New Delhi on December 05, 2022.
- Dr. A Roy Chowdhury, Sc. attended online presentation by Dr HK Pathak, DG, ICAR and Secretary DARE on the eve of World Soil Day, December 05, 2022.
- Dr. A Roy Chowdhury, Sc. attended online presentation by Dr JK Jena, DDG (Fisheries) ICAR, New Delhi. December 13, 2022.
- Dr. A Roy Chowdhury attended a presentation by Vinod Kumar on '*Parishad dwara rajbhasha ki unnati sambandhi yojnayon ki samanya jankari*' on December 15, 2022.
- Dr. A Roy Chowdhury, Sc. attended online presentation by Dr. DK Yadava, ADG (seeds) ICAR, New Delhi on the eve of International year of Millets on December 15, 2022.
- Dr. A Roy Chowdhury, Sc. presented the progress of the ICAR-NISA centre during Pre Annual Workshop meeting of All India Network Project on Harvesting, Processing and Value Addition on Natural Resins and Gums on December 20, 2022.
- Dr. A Roy Chowdhury, Sc. attended online presentation by Hon'ble Agricultural Minister Sri Naredra Singh Tomar on the eve of National Farmer's Day on December 23, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. Acted as Co-Chairman for Quarter Allotment Committee and carried out various works assigned as per requirement for the year 2022.
- Dr. Ch. Jamkhokai Mate, Sc. compiled the monthly reports and RAC reports of all scientists of APD divisions for the year 2022

Human Resource Development:

- Dr. Ch. Jamkhokai Mate, Sc. acted as member Departmental Promotion Committee for promotion of Technician (T-1) (Lab Technician Group) from Skilled Support Staff (SSS) held at ICAR-IINRG on January 10, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a member of Institute-NRG Stakeholders' Meet 2022 at ICAR-IINRG held on January 28, 2022.
- Dr. SC Sharma, Sr. Sc. attended Institute – NRG Stakeholders' Meet – 2022 organized at ICAR – IINRG, Ranchi through virtual mode on January 28, 2022.
- Er. SK Pandey, Sc. attended online Workshop on Yes Bank "Agri Infinity programme" organised by IP&TM Unit of ICAR on February 02, 2022.
- Dr. AR Chowdhury, Sc. attended 3 days online training programme on "Competency Enhancement Programme for Effective Implementation of Training Functions by HRD Nodal Officers of ICAR", organized by ICAR-NAARM, Hyderabad on February 21-23, 2022.
- Dr. AR Chowdhury, Dr. SKS Yadav, Sc., Sc., Dr. SC Sharma, Sr. Sc., Dr. Nandkishore Thombare, Sr. Sc. attended one day in-house awareness programme for implementation of Smart Performance Appraisal Report Recording Online Window (SPARROW) organized by In-charge, CR Cell on March 23, 2022.
- Dr. SC Sharma, Sr. Sc. attended "Regional Workshop on Opportunities & Challenges in Creating Micro-Enterprises in Green Trade" organized by *Krishi Gram Vikas Kendra* (KGVK), Ranchi at Hotel Le Lac Sarovar, Ranchi on March 29, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. nominated as External Member of Selection Committee for recruitment of One SRF held at ICAR-RCER Plandu, Ranchi on April 28, 2022
- Dr. Ch. Jamkhokai Mate, Sc. acted as a member for Assessment Committee for Technical Personal under Category-II (Lab Tech. Group) at ICAR-IINRG held on April 30, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a member for Assessment Committee for Technical Personal under Category-II (Press & Editorial Group) at ICAR-IINRG held on May 17, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a member for Assessment Committee for Technical Personal under Category-II (Lab. Tech Group) at ICAR-IINRG held on May 19, 2022.
- Dr. Thamilarasi K, Sr. Sc. guided one B. Sc (Biotech) student Ms. Nikita Chaubey from D.Y. Patil Deemed to be University, Navi Mumbai

for 6 months dissertation on "Cloning of monooxygenase genes, putative key genes of aleuritic acid – a component of resin secreted by the Indian lac insect, *Kerria lacca* (Kerr)" from December 2021 to May 2022.

- Dr. SC Sharma, Sr. Sc. attended unveiling of the new website of Indian Society of Agricultural Engineers (ISAE) virtually organized by ISAE, New Delhi on June 25, 2022.
- Dr. Thamilarasi K, Sr. Sc. guided one M. Sc (Life Science) student Ms. Anshu Priya from Devi Ahilya Vishwavidyalya, Indore for 6 months dissertation on "Cloning of monooxygenase genes from the Indian lac insect, Kerria lacca (Kerr)" from January 2022 to June 2022.
- Dr. MF Ansari, Pr. Sc. attended a training programme 'Managing technology value chains for Directors and division heads', organized by Administrative Staff College of India (ASCI), Hyderabad. July 25-29, 2022.
- Dr. SC Sharma, Sr. Sc. attended intellectual Property Rights Awareness Webinar Series under National Intellectual Property Awareness Mission (NIFAM) organized by IP&TM Unit, ICAR on August 1-5, 2022.
- Er. SK Pandey, Sc. attended online lecture on "Entrepreneurship potential and opportunities in NRGs for start-ups" delivered at IGFRI Diamond Jubilee online lecture series 2022 organized by ABI Centre, IGFRI, Jhansi on September 09, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. was nominated as External Member for Selection Committee for One Young Professional-1 under Revolving Fund Scheme held at ICAR-RCER Plandu on September 13, 2022.
- Dr. SC Sharma, Sr. Sc. and Er. SK Pandey, Sc. attended lecture on "Entrepreneurship Potential and Opportunities in Natural Resins and Gums for Startups" delivered by Dr. N. Prasad, Pr. Sc. & Head MPE Division under IGFRI Diamond Jublee Online Lecture Series 2022 jointly organized by Agri Business Incubation Centre, ICAR – IGFRI, Jhansi; ISAE, New Delhi and Range Management Society of India, Jhansi on September 17, 2022.
- Dr. SC Sharma, Sr. Sc. attended हिन्दी वैज्ञानिक संगोष्ठी on विज्ञान एवं किसान : भारत @ 75 organized by ICAR – NINFER, Kolkata. September 19, 2022.
- Dr. SC Sharma, Sr. Sc. and Er. SK Pandey, Sc. attended lecture on "Automation and IoT in Agriculture" delivered by Dr. Syed Ismail, Director, SIFA Sanpra Systems Pvt. Ltd., Mumbai, as 12th D. Norris Memorial Lecture on the occasion of 99th Foundation Day of the institute on September 20, 2022.
- Dr. SC Sharma, Sr. Sc. and Er. SK Pandey, Sc. attended lecture on "Corruption free India for developed nation" delivered by Sh. Vimal Kumar, Vigilance Officer and Chief Manager, Mining, CCL, Ranchi organized under Vigilance Awareness Week at ICAR – NISA, Ranchi on November 04, 2022.
- Dr. SC Sharma, Sr. Sc. attended 56th Annual Convention of Indian Society of Agricultural Engineers (ISAE) on Agricultural Engineering Innovation for Global Food Security" and International Symposium on "India 2047: Agricultural Engineering Perspective" organized at Tamil Nadu Agricultural University (TNAU), Coimbatore jointly by Indian Society of Agricultural Engineers, New Delhi and Tamil Nadu Agricultural University, Coimbatore during November 09 -11, 2022.
- Er. SK Pandey, Sc. attended online presentation 'Achievements and Aspiration' presented by Dr. SN Jha, DDG (Engineering). November 17, 2022.
- Er. SK Pandey, Sc. attended online presentation 'Achievements and Aspiration' presented by Dr. BN Tripathi, DDG (Animal Science) on November 22, 2022.
- Dr. SC Sharma, Sr. Sc. and Er. SK Pandey, Sc. attended lecture on 'राष्ट्रीय एकता अल्पसंख्यक कल्याण, सांप्रदायिक सद्भाव, बंधुत्व को बढ़ावा' delivered by Dr. V. N. Singh, Ex-Programme Officer (Doordarshan), Vikas Bharti Parisar Booty More, Ranchi on November 25, 2022.
- Er. SK Pandey, Sc. attended online presentation 'Achievements and Aspiration' presented by DDG (Education), on November 25, 2022.
- Er. SK Pandey, Sc. attended online presentation 'Achievements, Aspiration and Action Plan of ICAR' presented by Dr. S. K. Chaudhary, DDG (NRM), on December 02, 2022.
- Er. SK Pandey, Sc. and Dr. SC Sharma, Sr. Sc. attended online presentation 'Achievements, Aspiration and Action Plan of ICAR' presented by Dr. AK Singh, DDG (Horticulture), on December 05, 2022.

- Er. SK Pandey, Sc. and Dr. SC Sharma, Sr. Sc. attended World Soil Day celebration organized virtually by ICAR – Central Coastal agricultural Research Institute, Goa followed by presentation of DG, ICAR on December 05, 2022.
- Dr. SC Sharma, Sr. Sc. and Er. SK Pandey, Sc. attended lecture 'परिषद् द्वारा राजभाषा की उन्नत सम्बन्धी योजनाओं की सामान्य जानकारी' delivered by Sh. Vinod Kumar, ACTO and I/C, Library on December 15, 2022.
- Dr. SC Sharma, Sr. Sc. and Er. SK Pandey, Sc. attended presentation on International Year of Millet delivered virtually by DG, ICAR on December 15, 2022.
- Dr. Thamilarasi K, Sr. Sc. guided one M.Sc (Biotechnology) student, Ms. Deepanjali Kumari from Magadh University Bodh Gaya for M.Sc thesis on "Cloning of epoxide hydrolase from the Indian lac insect, Kerria lacca (Kerr) from June 2022 to December 2022.
- Dr. Thamilarasi K, Sr. Sc. guided four B.Sc (Biotechnology) students from Ranchi University (Mr. Ebne Saud, Mr. Rahat Hasan, Mr. Rishav Raj, and Ms. Shiwani Kumari) for dissertation training on "Barcoding of lac insects" from October 2022 to December 2022.
- Dr. SC Sharma, Sr. Sc. attended जागरूकता कार्यक्रमः प्राकृतिक खेती एवं पौध किस्मों और किसानों के अधिकार संरक्षण अधिनियम on theme किसान भागीदारी प्राथमिकता हमारी jointly organized under आजादी का अमृत महोत्सव by ICAR – IINRG, Ranchi and KVK, Khunti.
- Dr. SC Sharma, Sr. Sc. and Er. SK Pandey, Sc. attended seminar on "Income Tax Payment and saving" delivered by Mr. Ajay Kumar, Tax Recovery Officer, Ranchi.
- Dr. SC Sharma, Sr. Sc. and Er. SK Pandey, Sc. attended national event "Agri Startup conclave and Kisan Sammelan–2022" organized by ICAR – IARI, New Delhi telecasted at ICAR – NISA, Ranchi.
- Dr. A Roy Chowdhury, Sc. compiled Annual Training Plan (ATP) 2022-23 of the Institute, submitted to Director, ICAR-IINRG for approval and onward transmission to council as Nodal officer HRD cell.
- Dr. A Roy Chowdhury, Sc. compiled different reports regarding HRD activities of the Institute and submitted to HRD cell, New Delhi as Nodal officer HRD cell.
- Dr. Sandeep Kumar, Sc. guided one M.Sc. student for the thesis research work in 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a member for Library Management Committee for the year 2022.

Honors, Awards and Recognitions

- Dr. SC Sharma, Sr. Sc. acted as Member, Assessment Committee for Technical Staff, Category – I and II (Workshop and Engineering Group) organized on January 10, 2022.
- Dr. Niranjan Prasad, Pr. Sc. appointed as member of Assessment Committee for assessment of Technical Personnel of Engineering Group in ICAR-IINRG, Ranchi organised on January 10, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a Departmental Promotion Committee for promotion of Technician (T-1) (Lab Technician Group) from Skilled Support Staff (SSS) held at ICAR-IINRG on January 10, 2022.
- Dr. SC Sharma, Sr. Sc. acted as external member of selection committee for selection of Young Professional – II (Estate) for ICAR-Indian Institute of Agricultural Biotechnology (IIAB), Ranchi on January 11, 2022.
- Dr. SC Sharma, Sr. Sc. acted as member Young Professional – II selection committee for MPE Division, ICAR – IINRG, Ranchi on January 14, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a Co-Chairman for Institute-cum-KVK Khunti Stall Exhibition Committee at Kisaan Mela held on February 26-27, 2022.
- Dr. SC Sharma, Sr. Sc. acted as observer IARI, New Delhi regarding Computer Based Test (CBT) for T – 1 examination organized at M/s. Anuruma Technical Service Pvt. Ltd., Pragati Path, Samlong, Lower Chutia, (near Ganesh Nursing Home), Ranchi on February 28, 2022.
- Dr. A Roy Chowdhury, Sc. was nominated to act as a judge for Regional level Jawaharlal Neheru National Science, Mathematics and Environment Exhibition (JNSMEE)-2022 at Kendriya Vidyalaya, Namkum on February 28, 2022.
- Dr. SC Sharma, Sr. Sc. acted as observer IARI, New Delhi regarding Computer Based Test (CBT) for T – 1 examination organized at M/s. Anuruma Technical Service Pvt. Ltd., Pragati Path, Samlong, Lower Chutia, (near Ganesh

Nursing Home), Ranchi during March 02-04, 2022

- Dr. Sakharam Kale, Sc. evaluated M. Tech. thesis of Process & Food Engineering Department, SKAUST-K, Kashmir and conducted a thesis *viva-voce* examination through online mode on March 28, 2022.
- Dr. SC Sharma, Sr. Sc. acted as Co-convener, Technology & Machinery Demonstration Mela – 2022 and successfully organized the same at ICAR-IINRG, Ranchi on April 02, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. nominated as External Member of Selection Committee for recruitment of SRF held at ICAR-RCER Plandu, Ranchi on April 28, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a member for Assessment Committee for Technical Personal under Category-II (Lab Tech. Group) held at ICAR-IINRG on April 30, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as an Observer –II for online Tier-I (CBT) of Administrative Officer (AO) and Finance & Accounts Officer (F & AO Examination-2021 at SHREE INFOTECH Kokar Ranchi, Jharkhand on May 05, 2022.
- Er. SK Pandey, Sc. acted as Observer regarding Computer Based Test (CBT) for AO & FAO Examination – 2021 organized by ASRB, New Delhi during May 09-10, 2022.
- Dr. SC Sharma, Sr. Sc. acted as Observer regarding Computer Based Test (CBT) for AO & FAO Examination – 2021 organized by ASRB, New Delhi at M/s. Ideal Onscreen Solution, Above Kundan Tyre, Ranchi College Road, Ranchi. May 10, 2022.
- Dr.Ch. Jamkhokai Mate, Sc. acted as a member for Assessment Committee for Technical Personal under Category-II (Press & Editorial Group) held at ICAR-IINRG on May 17, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a member for Assessment Committee for Technical Personal under Category-II (Lab. Tech Group) held at ICAR-IINRG on May 19, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as reviewer in Magazine Agriculture & Food e-Newsletter since June 02, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. was nominated as External Member for Selection Committee for Young Professional-1 under Revolving Fund Scheme held at ICAR-RCER Plandu on September 13, 2022
- Dr. Nandkishore Thombare, Sr. Sc. received 'A Mosaic Company Foundation Award- 2019-20' for outstanding doctoral research in the area of plant nutrition, in the presence of Dr. H Pathak, Secretary DARE & DG ICAR and other dignitaries on September 14, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. received 'Distinguished Worker Award- 2022' in the Scientific Category, during 99th Foundation Day of ICAR-IINRG, Ranchi on September 20, 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as Co-Chairman, Invitation and Publicity Committee for Institute 99th Foundation Day held on September 20, 2022.
- Er. SK Pandey, Sc. participated as expert from ICAR-IINRGA, Ranchi in Seminar on 'Technological Readiness Level and its Application in Food Processing and Agriculture Technologies' organised at IIT(ISM) Dhanbad, Jharkhand on September 26, 2022.
- Dr. Arnab Roy Chowdhury, Sc. and groups awarded the first prize in Hindi quiz competition in the eve of *Hindi Chetna Samaroh* on September 30, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. received 'Best Essay Award' during *Hindi Diwas Pakhwada* organized by the Institute on September 30, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. was invited as a jury member, evaluated student's projects during the 30th National Children's Science Congress 2022, organized by Kendriya Vidyalay, Hinoo on November 02, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. received a 'Best Oral Presentation Award' for the paper 'Shellac modification to prepare non-drying adhesive for sticky insect traps' during VIIth International Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences, organised at Birsa Agricultural University, Ranchi on November 21-23, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. acted as a co-chairman in the session 'Agroforestry, livelihood and sustainable management practices' during VII International Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences, organised at Birsa Agricultural University, Ranchi on November 21-23, 2022.
- Dr. SC Sharma, Sr. Sc. acted as external Examiner regarding Viva – Voce examination of

M. Tech (Ag. Engg.) Thesis at Birsa Agricultural University (BAU), Ranchi on November 24, 2022.

- Dr. SC Sharma, Sr. Sc. received Best Popular Article Award for the article कराया गोंद उत्पादन के यंत्रीकरण की स्थिति एवं सुधार की संभावनाएं published in लाक्षा – 2021 (ISSN : 2454-7840).
- Dr. SC Sharma, Sr. Sc. acted as external expert and prepared sets of question paper for course No. AEN – 201 (Farm Machinery & Power) under End Term Examination of B.Sc. (Agril.), Dr. RPCAU, PUSA, Samastipur (Bihar).
- Dr. SC Sharma, Sr. Sc. reviewed manuscript "Response Surface Methodology for Optimization of Operational Parameters for Axial Flow Paddy Thresher (Article reference No. - 999) submitted for possible publication in *Journal of Agri Search*.
- Dr. SC Sharma, Sr. Sc. reviewed thesis entitled "Effect of Puddling Methods and Soil Sedimentation Periods on Performance of Rice Transplanters" submitted for the requirement for the degree of Master of Technology in Agricultural Engineering (FMPE), College of Agricultural Engineering, BAU, Kanke Ranchi.
- Dr. Sakharam Kale, Sc. reviewed 02 manuscript of Journal of Agricultural Engineering (ISAE Journal).
- Dr. Sakharam Kale, Sc. prepared a question paper for the course SWE-427 (Plastic Applications In Agriculture), Semester-II of Final Year B.Tech. (Agricultural Engineering), MPUAT, Udaipur.
- Dr. Sakharam Kale, Sc. has been nominated as an expert member on "Selection Board for the post of Assistant Professor in the discipline of Farm Structures" for the year 2022-2023 by Vice-Chanceller, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra.
- Dr. Ch. Jamkhokai Mate, Sc. Arnab Roy Chowdhury, Sc. & Nandkishore Thombare, Sc. received Best Article Award for article id 38064 entitled 'Importance of Gum Arabic' published in Volume 4, Issue 9 in Agriculture & Food: e-Newsletter, for the year 2022.
- Arnab Roy Chowdhury, Sc., Ch. Jamkhokai Mate, Sc. and Nandkishore Thombare received Best Article Award for article id 37642 entitled 'Cassia tora gums: a new possibility for Food additive' published in Volume 4, Issue 7 in Agriculture & Food: e-Newsletter, for the year 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as Co-Chairman for Quarter Allotment Committee for the year 2022.
- Dr. Ch. Jamkhokai Mate, Sc. acted as a member for Library Management Committee for the year 2022.
- Dr. Ch. Jamkhokai Mate registered as member of Magazine Agriculture & Food: e-Newsletter with Membership of AM-AFM 2633 in the year 2022.
- Er. PK Paramaguru, Sc. acted as observer ASRB, New Delhi regarding CBT for T–1 examination and AO & FAO examination organized by ASRB, New Delhi .
- Er. PK Paramaguru, Sc. acted as observer IARI, New Delhi regarding ICAR-IARI Assistant exam 2022 organized by IARI, New Delhi .
- Dr. J Ghosh, Pr. Sc. nominated as "Panel of Reviewers" of the Journal of Agricultural Science.
- Dr. J Ghosh, Pr. Sc. nominated as "Panel of Reviewers" of the Journal of Non Timber Forest Products.
- Dr. J Ghosh, Pr. Sc. evaluated projects by experts before RAG meeting of IFP Ranchi during 2022.
- Dr. J Ghosh, Pr. Sc. nominated as external expert by Faculty of Forestry, Birsa Agricultural University, Ranchi for Ph. D. (Forestry) programme.
- Dr. J Ghosh, Pr. Sc. nominated as external expert by Faculty of Agriculture, Birsa Agricultural University, Ranchi for M Sc. (GPB) programme.
- Dr. J Ghosh, Pr. Sc. nominated as Member of Board of Studies, Faculty of Agriculture, Birsa Agricultural University, Ranchi
- Dr. J Ghosh, Pr. Sc. nominated as expert for Annual Essay competition 2021 for B. Sc., M. Sc. and PhD student of Department of Genetics and Plant Breeding, Kanke, Ranchi under the banner Indian Society of Genetics and Plant Breeding Ranchi chapter.
- Dr. Ch. Jamkhokai Mate acted as reviewer in Magazine Agriculture & Food e-Newsletter from June 02, 2022 to June 02, 2023.

Capacity Building/Lectures/Talk Delivered:

- Dr. Nandkishore Thombare, Sr. Sc. delivered a lecture on 'Introduction and recent advances in application of natural resins and gums in agriculture' to the BSc Agriculture students of BHU, Varanasi, during a summer school organized (27.12.2021 to 05.01.2022). January 01, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. conducted a field visit of the BSc Agriculture students of BHU,

Varanasi, to the 'Gum and Resin germplasm farm' explaining the identification and uses of NRG plants during a summer school organized (27.12.2021 to 05.01.2022). January 03, 2022.

- Dr. Ch. Jamkhokai Mate, Sc. delivered lecture on 'Medicinal importance of natural resins and gums' to the B.Sc. Agriculture students of BHU, Varanasiduring a summer school organized during December 27, 2021 to January 5, 2022.
- Dr. Nandkishore Thombare, Sr. Sc., as a member of Selection Committee for nine posts of the Young Professionals at IINRG, conducted screening tests and interviews of the candidates at ICAR-IINRG, Ranchi. January 14-15, 2022.
- Dr. MF Ansari, Pr. Sc. chaired the selection committee for selection of YP-I in NABARD sponsored externally funded project 'Design and development of portable device for determination of life and colour index', on May 02, 2022, and participated in selection committee for selection of Young Professional (YP-1) on January 15, 2022.
- Dr. SC Sharma, Sr. Sc. delivered lecture on overview of ICAR–IINRG, Ranchi including equipments for lac cultivation, primary processing of lac, pilot plants for value added lac based products manufacturing and tapping techniques for resins and gums to 5th semester students (Polytechnic in Agricultural Engineering) from Anand Agricultural University, Gujrat.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Sampling method/determining resin content of raw lac and primary processing of lac to 52 participants in two batches under training programme "Lac Value Addition" organized by Jharkhand State Co-operative Lac Marketing & Procurement Federation Ltd. (JASCOLAMPF), Purulia Road, Ranchi, respectively on January 11, 2022 and January 25, 2022.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Manufacture of button lac and handmade shellac to participants in three batches (77 participants) under training programme "Lac Value Addition" organized by Jharkhand State Co-operative Lac Marketing & Procurement Federation Ltd. (JASCOLAMPF), Purulia Road, Ranchi. January 01, 2022; January 13, 2022 and January 27, 2022.
- Dr. Niranjan Prasad, Pr. Sc. delivered a lecture on Importance of NRG and its Export Potential in Institute –NRG Stakeholder Meet 2022 held online. January 28, 2022.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Sampling method/determining resin content of raw lac and primary processing of lac to 41 participants under training programme "Lac Value Addition" organized by Jharkhand State Co-operative Lac Marketing & Procurement Federation Ltd. (JASCOLAMPF), Purulia Road, Ranchi. February 08, 2022.
- Er. SK Pandey, Sc. delivered lecture on Manufacture of Lac sealing stick was delivered at ICAR-IINRG, Ranchi in training programme of JASCOLAMPF organized for farmers/ beneficiaries in series of total 10 batch training programme to be held for total 250 farmers on lac processing and value addition. February 11, 2022.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Manufacture of button lac and handmade shellac to 38 participants under training programme "Lac Value Addition" organized by Jharkhand State Co-operative Lac Marketing & Procurement Federation Ltd. (JASCOLAMPF), Purulia Road, Ranchi. February 14, 2022.
- Er. SK Pandey, Sc. delivered lecture on the topic "Entrepreneurship opportunities in lac processing and product development" on 02nd March 2022 in a training program on 'Agri-Entrepreneurship opportunities in Jharkhand' organised by ABI project of FSRCHPR, Plandu, Ranchi during Feb 28 to March 02, 2022.
- Dr. S Ghosal, Pr. Sc. delivered lecture on "*Urvarokon ka poshok vriksh par samuchit upoyog*" for regular training programme of the Institute. 24 trainees attended the same. March 02, 2022
- Dr. SC Sharma, Sr. Sc. delivered lecture on Sampling method/determining resin content of raw lac and primary processing of lac to 51 participants from Angarah and Ormanjhi block under training programme "Lac Value Addition" organized by Jharkhand State Co-operative Lac Marketing & Procurement Federation Ltd. (JASCOLAMPF), Purulia Road, Ranchi. March 08, 2022.
- Dr. S Ghosal, Pr. Sc. delivered lecture on "*Urvarokon ka poshok vriksh par samuchit upoyog*" for regular training programme of the Institute. 60 trainees attended the same. March 08, 2022.
- Dr. S Ghosal, Pr. Sc. convened a three days workshop at Angara, Sogod and Banta of Ranchi District on "Sustainable lac integrated farming

practice for livelihood security" for commoration of "*Azadi ka amrit mahotsav*". March 07-09, 2022.

- Dr. MF Ansari attended a Hindi workshop on 'वर्तमान समय में आयकर भरने एवं बचत सम्बन्धी सामान्य जानकारियाँ' delivered by Sri Ajoy Kumar, Tax Recovery Officer, Income Tax, Ranchi, in Palas Conference Hall, March 10, 2022.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Manufacture of button lac and handmade shellac to 51 participants from Angarah and Ormanjhi block under training programme "Lac Value Addition" organized by Jharkhand State Co-operative Lac Marketing & Procurement Federation Ltd. (JASCOLAMPF), Purulia Road, Ranchi, March 11, 2022.
- Dr. SC Sharma, Sr. Sc. delivered lecture on "Processing of Lac at Village Level for Entrepreneurship Development" through virtual mode under Forest College and Research Institute training programme "Awareness of lac insect under agro forestry system and its processing" as per letter received from Dr. T. K. Parthiban, Dean (Forestry), TNAU, FC&RI, Mettupalayam, Tamilnadu, March 14, 2022.
- Er. SK Pandey delivered lecture on Manufacture of Lac sealing stick was delivered at ICAR-IINRG, Ranchi in training programme of JASCOLAMPF organized for farmers/beneficiaries in series of total 10 batch training programme to be held for total 250 farmers on lac processing and value addition. March 14, 2022
- Dr. SC Sharma, Sr. Sc. delivered lecture on Sampling method/determining resin content of raw lac and primary processing of lac to 17 participants from Angarah block under training programme "Lac Value Addition" organized by Jharkhand State Co-operative Lac Marketing & Procurement Federation Ltd. (JASCOLAMPF), Purulia Road, Ranchi. March 22, 2022.
- Dr. S Ghosal, Pr. Sc. delivered lecture on "*Urvarokon ka poshok vriksh par samuchit upoyog*" for regular training programme of the Institute. 50 trainees attended the same. March 23, 2022
- Dr. SC Sharma, Sr. Sc. delivered lecture on Manufacture of button lac and handmade shellac to 21 participants from Angarah and Ramgarh under training programme "Lac Value Addition" organized by Jharkhand State Co-operative Lac Marketing & Procurement Federation Ltd. (JASCOLAMPF), Purulia Road, Ranchi. March 25, 2022.
- Dr. S Ghosal, Pr. Sc. delivered lecture on "*Urvarokon ka poshok vriksh par samuchit upoyog*" for regular training programme of the Institute. 50 trainees attended the same. March 30, 2022.
- Dr. Nandkishore Thombare, Sr. Sc., attended a lecture on 'प्राकृतिक खेती' delivered by Mr. Siddharth Jaiswal, CEO, Business Management and Development, BAU Society during the program organized on 'किसान भागीदारी, प्राथमिकता हमारी' by ICAR IINRG and KVK, Khunti. April 28, 2022.
- Dr. Nandkishore Thombare, Sr. Sc., attended a lecture on 'पौधा किस्मों और किसानों के अधिकार संरक्षण अधिनियम' delivered by Mr. Fulchand Malviya, Faculty, BAU, Ranchi, during the program organized on 'किसान भागीदारी, प्राथमिकता हमारी' by ICAR IINRG and KVK, Khunti. April 28, 2022.
- Dr. MF Ansari, Pr. Sc. carried out the duty of FAO during October 22, 2020, to May 04, 2022.
- Dr MF Ansari, Pr. Sc. attended post SOC meeting with DDG (Engg.) and ATR on proceeding of the meeting was submitted. April 07, 2022 & May 06, 2022.
- Dr. S Ghosal, Pr. Sc. worked as committee member in the assessment committee to consider the case of technical personnel under category II (press and editorial group). May 17, 2022.
- Dr. S Ghosal, Pr. Sc. worked as committee member in the assessment committee to consider the case of technical personnel under category II (F/F Tech. group). May 19, 2022
- Dr MF Ansari, Pr. Sc. attended 1st National Lac insect Day on May 16, 2022 and addressed the gathering on the occasion as Head, APD Division, during Productive Insects Conservation week May 16-22, 2022. Attended lecture on Lac insect biodiversity delivered by Dr V D Lohot on May 17, 2022, Indian Silk Industry: An overview delivered by Dr A H Naqvi, Sc-D, Central Tasar Research and Training Institute (CTR&TI), Nagri on May 18, 2022 and 'Utility of Honey bees in Human life and agriculture, delivered by Dr Milan Kumar Chakravarthy, Project Coordinator, AICRP on Millet, BAU Ranchi in Palas Conference Hall on May 20, 2022.
- Er. SK Pandey, Sc. organized training as training in-charge/co-ordinator for Mr. Rohit Jaisawal, Balrampur and imparted training on aleuritic acid in PD Unit (MPE Div.). May 23-27, 2022.

- Dr. S Ghosal,Pr. Sc. delivered a lecture on "Agronomical management of lac host plants" for the B.Sc (Ag) students of SHUAS&T, Prayagraj. 25 students attended the same. May 23-27, 2022.
- Dr. MF Ansari, Pr. Sc. attended two lectures on 'प्राकृतिक खेती श्री सिद्धार्थ जायसवाल, बि.कृ.वि, द्वारा तथा पौधा किस्म कृषक अधिकार संरक्षण अधिनियम श्री फूल सिंह मालवीय द्वारा, किसान भागीदारी प्राथमिकता हमारी (April 25–30, 2022), भारत की आजादी के अमृत महोत्सव प्रोग्राम के अंतर्गत, on April 28, 2022 in Palas Conference Hall. Attended meeting of *Hindi Rajbhasha Karyanvayan* committee on May 28, 2022.
- Dr. Sakharam Kale, Sc. delivered lecture on "Processing of Natural Resins and Gums" in students training. May 29, 2022.
- Er. SK Pandey, Sc. delivered lecture on "Lac based technologies for entrepreneurship" in Summer school Workshop/Training (26.05.22 to 04.06.22) on Natural resins & gums to B.Sc. (Ag.) students of Sam Higginbottom University of Agriculture, Science and Technology, Prayagraj. May 30, 2022.
- Dr. Nandkishore Thombare, Sr. Sc., delivered a lecture on 'Introduction and recent advances in applications of natural resins and gums in agriculture' during summer school workshop cum training to the students of San Higginbottom University of Agriculture, Science and Technology, Allahabad, May 30, 2022.
- Dr MF Ansari attended PM's programme *'Pradhanmantri Garib Kalyan'* on completion of 8 years of government formation and participated in interaction meeting with Shri Arjun Munda, Tribal Affairs Minister, on May 31, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. was nominated as a member of Institute Joint Staff Council since May, 2022.
- Dr. AR Chowdhury, Sc. delivered a lecture on 'characterization of natural resins and gums' in summer school workshop on Natural Resins and Gums for B. Sc (Ag) students of SHUAT, Prayagraj, June 02, 2022.
- Dr. Vaibhav D Lohot, Sr. Sc. delivered a lecture entitled "Collection and Conservation of lac insect and host plant Biodiversity" during Summer School Workshop/Training on 'Natural Resins and Gums' to B. Sc. (Ag.) students of Sam Higginbottom University of Agricultural Science and Technology, Prayagraj (Allahabad) during 26/05/2022 to 04/06/2022 conducted by PEM division of ICAR-IINRG, Ranchi. June 02, 2022.
- Dr. MF Ansari, Pr. Sc. delivered lecture on 'Diversified uses of Lac and Quality control of Natural Resins and Gums' to B. Sc. (Ag.) students of Sam Higgingbottom University of Agriculture Science and Technology, Allahabad. June 02, 2022.
- Dr. RK Yogi, Sr. Sc. delivered an invited lecture on "Employment opportunities for tribals in India" for Agriculture Information (www.agricultureinformation.com). June 09, 2022.
- Dr. MF Ansari, Pr. Sc. attended CHD-23 meeting online as alert panel member. Attended CHD 23 meeting. Comment on BIS standard for determination of Brushware adhesive were submitted to BIS through Director. June 17, 2022.
- Dr. S Ghosal, Pr. Sc. convened a three day workshop on "Adaptation and mitigation strategies to prevent summer mortality in *Rangeeni* lac for summer sustainability", joint with ICAR-IINRG and JASCOLAMPF, Ranchi. June 21-23, 2022
- Dr. SC Sharma, Sr. Sc. demonstrated pilot plant and machineries available at PD unit to 37 Agricultural Engineering Students from College of Agricultural Engineering, Birsa Agricultural University, Ranchi on June 23, 2022.
- Dr. SC Sharma, Sr. Sc. delivered invited lecture on "Role of Tapping Techniques, Processing and Value Addition to Natural Gums in Enhancing Livelihood Options and Income of Rural Poors" under 03 days online collaborative training programme on Promotion of Gum Yielding Trees on Farm Land for Livelihood Security organized by ICAR – CAFRI, Jhansi. July 12 – 14, 2022.
- Dr. Niranjan Prasad, Pr. Sc. delivered a lecture on "Importance of Natural gum yielding trees in livelihood security and needs to promote them on farmland in India" in Training programme on Promotion of gum yielding trees on farmland for livelihood security organized by CAFRI, Jhansi in collaboration with MANAGE, Hyderabad. July 12-14, 2022.
- Er. SK Pandey, Sc. organized residential training organized on Primary processing of lac for 05 nos. farmers (Gents-02, Ladies-03) of ICICI Foundation for Inclusive Growth. July 12-15, 2022.
- Dr. SC Sharma, Sr. Sc. imparted training on primary processing of lac to 05 participants

sponsored by ICICI Foundation, Ranchi organized by MPE Division, July 12 – 15, 2022.

- Dr. Niranjan Prasad, Pr. Sc. delivered lecture on Natural Resins and Gums based Technological Intervention for Entrepreneurship development in Semi-Arid Zone online in training programme on Agri based technological interventions for Entrepreneurship development in Semi-Arid Zone conducted by ICAR-DRMR, Bharatpur and sponsored by MANAGE, Hyderabad. August 24, 2022
- Dr. Nandkishore Thombare, Sr. Sc. as a co-supervisor, is supervising the PhD work of Mr. Saurav Kumar, Scientist, CSIR-CSIO, Chandigarh, related to exploring the uses of shellac for electronic application since August, 2020.
- Dr. RK Yogi, Sr. Sc. delivered a Lecture on Lac as an alternative means of livelihood security in tribal areas of India for Agriculture Information (www.agricultureinformation.com) on September 13, 2022.
- Dr. Niranjan Prasad, Pr. Sc. delivered lecture on Entrepreneurship potential of Natural Resins and Gums for Start-ups online in the IGFRI Diamond Jubilee Lecture Series on "Entrepreneurship Development in Processing Fodder and Allied Crops" in association with ISAE & Range Management Society of India. September 17, 2022.
- Dr. MF Ansari, Pr. Sc. and Chairman organised different Hindi competitions, like Synonyms, antonyms, essay writing for SSS, general and non-hindi participants, Hindi songs singing, quiz, Format and Comments etc. on September 30, 2022.
- Dr. MF Ansari, Pr. Sc. attended lecture on 'Corruption free India: Developed India' delivered by Er. Vimal Kumar vigilance officer CCL, Ranchi under vigilance awareness programme on November 04, 2022.
- Dr. MF Ansari, Pr. Sc. attended communal harmony programme. Dr B N Singh, former Actg. Executive Director, *Doordarshan*, delivered lecture on the occasion. November 25, 2022.
- Dr. MF Ansari, Pr. Sc. attended presentations by DG on world soil day, DDG (NRM), DDG (Horticulture) and DDG (Fisheries) on different dates. December 05, 2022.
- Dr. S Ghosal, Pr. Sc. QPI Division delivered a lecture on "Agronomical management of lac host plants" to 50 farmers sponsored by JHASCOLAMPF, Ranchi. December 05, 2022.
- Dr. S Ghosal, Pr. Sc. delivered a lecture on "Agronomical management of lac host plants" to 25 students sponsored by Forest Training Institute, Mahilong. December 13, 2022.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Sampling Method/Determining Resin Content and Primary Processing of Lac & Value Addition to 50 participants under training on Lac organized by JHASCOLAMPF, Ranchi. December 19, 2022.
- Dr. S Ghosal, Pr. Sc. delivered a lecture on "Agronomical management of lac host plants" to 25 farmers sponsored by JHASCOLAMPF, Ranchi. December 20, 2022.
- Dr. SKS Yadav, Sc. delivered 16 lectures on 'Lakh ke Upayog' under Farmers Training Programme on "Advanced techniques for lac cultivation, processing and utilization" during January-December 2022.
- Dr. SKS Yadav, Sc. delivered 2 lectures under Summer Students' Workshop on Natural Resins and Gums during January-December, 2022.
- Dr. SKS Yadav, Sc. delivered one lectures under Inter Institutional HRD Training Programme on Natural Resins and Gums during January-December, 2022.
- Dr. SC Sharma, Sr. Sc. delivered lecture on lac processing at village level for entrepreneurship development to 25 B.Sc. (Ag) students from BHU, Varanasi and BAU, Ranchi, respectively under Winter School on Natural Resins and Gums organized by PEM Division.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Improved Equipments for Lac Processing to participants in nine batches sponsored by JASCOLAMPF, Ranchi under farmers training programme "Improved Method of Lac Production and Uses" organized by Production and Extension Management Division.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Improved Equipments for Lac Processing in two batches to participants sponsored by ICICI Foundation, Ranchi under farmers training programme "Improved Method of Lac Production and Uses" organized by Production and Extension Management Division.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Improved Equipments for Lac Processing to participants sponsored by Tata Steel Foundation, Nuamandi under farmers training programme

"Improved Method of Lac Production and Uses" organized by Production and Extension Management Division.

- Dr. SC Sharma, Sr. Sc. delivered lecture on Improved Equipments for Lac Processing to 22 participants sponsored by ADARSHA, Odisha under farmers training programme "Improved Method of Lac Production and Uses" organized by Production and Extension Management Division.
- Dr. SC Sharma, Sr. Sc. delivered lecture on primary processing of lac (conversion of sticklac to seedlac) on Small Scale Lac Processing Unit to 05 participants sponsored by ICICI Foundation, Ranchi.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Improved Equipments for Lac Processing to 22 participants sponsored by ATMA, Banka, Bihar under farmers training programme "Improved Method of Lac Production and Uses" organized by Production and Extension Management Division.
- Dr. SC Sharma, Sr. Sc. delivered lecture on "Lac Processing at Village Level for Entrepreneurship Development" to B.Sc. (Ag.) and M.Sc. (Ag.) students from Binod Bihari Mahto Koylanchal University, Dhanbad and Gopal Narayan Singh University, Sasaram, Bihar under HRD Training on Natural Resins and Gums organized by PEM Division.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Improved Equipments for Lac Processing under farmers training programme "Improved Method of Lac Production and Uses" organized by Production and Extension Management Division.
- Dr. SC Sharma, Sr. Sc. delivered lecture on Improved Equipments for Lac Processing and demonstrated equipments for lac processing to 67 participants sponsored by Forest Training Institute, Mahilong, Ranchi under farmers training programme "Improved Method of Lac Production and Uses" organized by Production and Extension Management Division.
- Er. SK Pandey, Sc. delivered lecture on topic "Making of sealing Lac/wax" on 19.12.2022 at ICAR-NISA, Ranchi to first batch of 50 farmers in training programme organised by JASCOLAMPF for four batches to be held during December 10, 2022 to February 08, 2023.
- Dr. MF Ansari, Pr. Sc. reviewed a research paper entitled 'Turmeric as eco-friendly corrosion inhibitor for electron beam-curable steel coating in 3.5% sodium chloride solution' was done for the journal Pigment and Resin Technology (Emerald publication).
- Dr. MF Ansari, Pr. Sc. reviewed a research paper entitled 'Evaluation of Natural Oil Polyol Hydrophobic Acrylic-Based Coating Incorporated with SiO2 Nano- particles for Enhanced Corrosion Protection' for the journal Pigment & Resin Technology.
- Dr. MF Ansari, Pr. Sc. chaired DPC for screening of SSS and administrative staffs for giving benefits of MACP and promotion of SSS to T1 and probation clearance of two admin staffs.
- Dr. MF Ansari, Pr. Sc. contributed in compilation of Vision 2047.
- Dr. Nandkishore Thombare, Sr. Sc. was nominated as a member secretary of 'Project Monitoring and Review Committee (PMRC)', for regular review of NABARD funded project on *'Design and development of portable device for estimation of life and color index of lac samples*'.
- Dr. Nandkishore Thombare, Sr. Sc. deputed as a Co-Nodal officer of KRISHI portal.
- Dr. Nandkishore Thombare, Sr. Sc. reviewed eight manuscripts received from various International and NAAS rated journals.
- Dr. Vaibhav D Lohot, Sr. Sc. guided two students Ms. Namrata Anand and Ms. Shreya Sinha of M.Sc. Biotech Dept., Ranchi Women's College, Ranchi University, Ranchi in 2022 at Plant Physiology and Biochemistry Lab.
- Dr. Nandkishore Thombare, Sr. Sc. as a member of publication committee, compiled, edited and designed various Institutes' publications, including annual report 2021-22, Laksha-2022, etc. during the year 2022.
- Dr. Nandkishore Thombare, Sr. Sc. as a Chairman of 'Vehicle Arrangement and Management Committee' looked after the regular maintenance and management of the Institute vehicles for office work during the year 2022.

Under Winter school on Natural Resins and Gums, for B.Sc. (Ag.) students of Banaras Hindu University, Varanasi, during 27.12.2021 to 05.01.2022 and in the HRD training on Natural Resins and Gums (Date: 08.11.22), for B.Sc./M.Sc.(Ag) students of Binod Bihari Mahto Koyalanchal University, Dhanbad and Gopal Narayan Singh University, Sasaram, Bihar. November 07-16, 2022 following lectures are delivered :

- Dr. MF Ansari, Pr. Sc. delivered lecture on 'Diversified uses of lac and quality control of natural resins and gums'. November 11, 2022.
- Dr. AR Chowdhury, Sc. delivered a lecture on 'characterization of natural resins and gums'. November 14, 2022.
- Er. SK Pandey, Sc. delivered lecture on "Lac based technologies for entrepreneurship". November 16, 2022.
- Dr. Sakharam Kale, Sc. delivered lecture on "Processing of Natural Resins and Gums" in students training. November 16, 2022.
- Dr. Sandeep Kumar, Sc. delivered lectures on the "Lac biosynthesis and its manipulation" (Date: 2.1.22) during the Winter school on Natural Resins and Gums.

Training imparted

- Dr. Nandkishore Thombare, Sr. Sc., as a co-convener organized "Institute-NRG stake holder's Meet-2022" with the theme '*Enhancing value addition and domestic consumption of lac and other natural resins and gums*', through virtual mode in the joint collaboration of ICAR-IINRG, Ranchi and SHEFEXIL, Kolkata, on January 28, 2022.
- Dr. Nandkishore Thombare, Sr. Sc., as Convener of 8th International Yoga Day, organized a Yoga training program for the Institute staff, June 21, 2022.

Infrastructure Developed

- Dr. AR Chowdhury, Sc. purchased an autoclave instrument of 120 lit capacities (Cost Rs 3.58 lakh) and installed in the Product Development Lab –I of the APD division. March 20, 2022.
- Dr. AR Chowdhury, Sc. procured Muffle furnace with vacuum and nitrogen gas purging facility (Cost Rs 7.19 lakh) and installed the equipment in the APD division. August 23, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. purchased a DSLR camera with accessories worth Rs. 3,19,500/- under Network Project on HPVA on NRG during March, 2022.
- Dr. SKS Yadav, Sc. purchased a UV-Visible Spectrophotometer with accessories worth Rs.12,25,000/- during March, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. purchased a digital camera worth Rs. 50,000/- in under the NABARD funded project during September, 2022.
- Dr. Nandkishore Thombare, Sr. Sc. as a Coordinator of 'Gum and Resin germplasm farm' planted a new plot of gum producing tree, consisting of 15 peach seedling (*Prunus persica*) in the germplasm, brought from ICAR, Plandu.
- Dr. Nandkishore Thombare, Sr. Sc. established 'Natural Resins and Gums- Display Shelf' at the entrance of the Application and Product Development Division for the purpose of demonstration of various NRG samples and technologies developed by the division to the visitors.

Resource generation:

- Dr. Nandkishore Thombare, Sr. Sc. on the request of M/s Bridgedots Tech services Pvt. Ltd., Bhiwadi, Rajasthan, sent samples of red and orange Alta, 500 ml each, which earned Rs. 2000/- to the Institute, during July 2022.
- Quality Evaluation Laboratory received total 186 samples of lac, lac-based products and Natural Gums from Govt. organization/Private Industries/ various division of the Institute and 384 tests have been carried out and a sum of Rs. 51,300/- only has been earned from external source.

Events

ICAR-IINRG organized Summer School on Natural Resins and Gums

A ten-day Summer School on Natural Resins and Gums was organized during 27th December, 2021 – 5th January, 2022 for under graduate (Agriculture) students from Banaras Hindu University, Varanasi; Sai Nath University, Ormanjhi, Ranchi and Birsa Agriculture University, Kanke, Ranchi. Aim of the summer school was to develop knowledge as well as interest among the students regarding NRGs. Total 34 lectures were delivered by the experts under the programme including exposure visit, demonstration and practical on lac cultivation, insect taxonomy, lac processing, lac entrepreneurship, different gums and its uses *etc*. Video films were shown to the participants for better visualization about NRGs. Technologies developed by ICAR-IINRG including recent advances for the same were also discussed by the concerned expert during lecture and demonstration. The programme was attented by 37 trainee students from different universities.

Group photo of student trainees

9th Annual Review Workshop of Network Project on Conservation of Lac Insect Genetic Resources

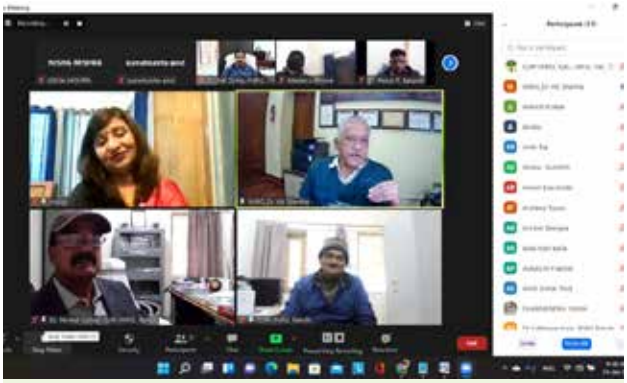
ICAR-IINRG organized 9th Annual Review Workshop of "Network Project on Conservation of Lac Insect Genetic Resources" (NP-CLIGR) through online mode on 20th January 2022. The inaugural function was graced by Dr. SN Jha, DDG (Agri. Engineering) and Dr. KK Singh, ADG (Farm Engineering). In his opening remarks, Dr. KK Sharma, Director ICAR-IINRG and Project Co-ordinator NP-CLIGR welcomed all the delegates and highlighted the importance of this project. He also presented the overall annual progress for the period 2021. Dr. KK Singh, ADG (Farm Engineering) congratulated all the centres for their progress under this project. He has asked all the centres to focus on the success stories, patents, staff position and deliverables of this project and emphasized to align the project with the national and global trends during the coming plan period. Dr. SN Jha, DDG (Agri. Engineering) expressed his views on the importance of conserving the indigenous natural resources of the nation like lac insects. He asked the Network Cooperating Centres to work on carbon sequestration capabilities of the lac host plants. He also said the finding of entomo-pathogenic fungi under this project was a good lead; and all the DNA sequences generated must be submitted to NCBI. He asked the Scientists to explore the ways of production of lac resin by lac insects without host plants. The inaugural function was followed by presentations of the PI of the individual centres. Constructive recommendations were given at the end of each

presentation. A concluding session was held at the end in which general aspects for smooth execution of the project activities were discussed. Earlier, Dr. K Thamilarasi, Co-PI welcomed all the participants to the workshop and at the end, Dr. Vaibhav D Lohot, Co-PI proposed vote of thanks.

Workshop of NP-CLIGR in progress

National Girl Child Day

ICAR-Indian Institute of Natural Resins and Gums, Namkum, Ranchi and *Krishi Vigyan Kendra*, Khunti, jointly organized National Girl Child Day through online mode on January 24th, 2022 in which 90 students and staff of Mahatma Narayan Das Grover, DAV Public School, Torpa, Khunti participated. In the program, Dr KK Sharma emphasized on gender quality and said that girls are in no way less than our Boys. Guest Speaker Mrs. Shashi Singh, Program Coordinator of Radio Birsa Hariyali, spoke on many topics related to women and daughters such as female feticide, disproportionate number of women at work place, pay disparity for work, problem of school dropout, lack of physical nutrition, problems related to cyber maze, their share of inheritance, economic dependence in married life, *etc*. Smt. Shashi exhorted the girls to develop their inherent abilities and interests. Dr. Nirmal Kumar, coordinator of the program said that there is a need to adopt the rights of women enshrined in the Constitution in our lives. Co-convener of the program Dr. Jyotirmoy Ghosh presented vote of thanks.



Director, IINRG addressing the participants

Institute– Natural Resin and Gums stakeholders' Intraction Meet

ICAR- Indian Institute of Natural Resins and Gums, Namkum, Ranchi organized one-day "Institute– NRG stakeholder's meet" on 28th January, 2022 through virtual mode in collaboration with Shellac & Forest Products Export Promotion Council (SHEFEXIL), Kolkata. The theme of the meet was 'Enhancing value addition and domestic consumption of lac and

other natural gums and resins (NRGs)'. The objective of the meet was to have need based research leading to product and technology development through interactions held between industry and research institution. Another purpose of the meet was to convey the problems of the industry, NRG processors, dealers and exporter to the policy makers.

The inaugural session started with welcome address by Dr. MF Ansari, Convener and Head APD division. After that brief presentations were made by the experts of IINRG on the overview and applications of NRGs, commercializable technologies developed by IINRG, Current status and trends in the marketing of NRGs. A presentation on status and requirements for the export of natural resins and gums was given by the SHEFEXIL, Kolkata.

Virtual interaction with stakeholders and officials of SHEFEXIL

Dr. K. K. Sharma, Director, ICAR- Indian Institute of Natural resins and gums, Ranchi, highlighted the importance of quality of the products as well as price rationalization for healthy trade of the commodity. He also added that the value addition of NRG products before export and the coordination among industries, stakeholders, government organization and line departments is very much essential for development of the NRG sector. Dr. N. Prasad, Head Mechanization and Process Engineering Division, emphasized the importance of sustainable tapping of natural resins and gums and their primary processing at the site itself. During the meet, Dr. Debjani Roy, Executive Director, SHEFEXIL, highlighted the need of export of more value added products to earn more foreign exchange as well as generating employment in the country.

Detailed and meaningful interactions among the participants, businessmen, industrialists, experts and researchers in the field of NRGs were held during the meeting. Total 120 participants including stakeholders from Industry side, farmers, state line departments, TRIFED, JASCOLAMPF, SHEFEXIL, ICAR Institutions, State Agricultural Universities, *Krishi Vigyan Kendra*, *etc*. joined and got benefited from the meeting. The meeting provided a platform to share the problems and experiences of natural resins and gums stakeholders with the experts. Dr. Nandkishore Thombare coordinated the meeting and the vote of thanks was proposed by Dr. Arnab Roy Chowdhury, co-convener and scientist.

Address of the Director, ICAR-IINRG in the NRG stakeholders' meet

XXIX RAC meeting of ICAR-IINRG, Ranchi

The XXIX meeting of Research Advisory Committee (RAC) of the Institute was held online on February 16-17, 2022 at ICAR-IINRG, 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. Kanchan K. Singh, ADG (FE), ICAR, New Delhi; Dr. HN Mishra, Professor (Food Technology), IIT, Kharagpur; Dr. Dandamudi Usharani, Principal Scientist, CSIR-CFTRI, Mysuru; Dr. N. Kotwaliwale, Director, ICAR-CIPHET, Ludhiana; Dr. SK Dhyani, Former Director, ICAR-CAFRI, Jhansi; Dr. Debaraj Behera, Professor & Head, OUAT, Bhubaneshwar; Dr. Kewal Krishan Sharma, Director, ICAR-IINRG, Ranchi and Dr. NK Sinha, PS, ICAR-IINRG, Ranchi - Member Secretary. The committee gave certain specific recommendations for better execution of ongoing and the new research projects.

RAC meeting in progress

ICAR-IINRG, Ranchi organized *Kisan Mela*-cum-Agricultural Exhibition

ICAR-Indian Institute of Natural Resins and Gums (IINRG), Ranchi organized two days *Kisan Mela*-cum-Technology Exhibition in association with *Krishi Vigyan Kendra* (KVK), Khunti during February 26-27th, 2022 at IINRG, Ranchi.

The Mela was inaugurated by the Chief Guests Hon'ble Governor, Jharkhand Shri Ramesh Bais. Shri Snajay Seth, Hon'ble Member of Lok Sabha, Ranchi was the Guest of Honour on this occasion.

Dr KK Sharma, Director, ICAR-IINRG, while welcoming the dignitaries, informed about the contribution of the institute in research and development of the commodity. He told that during its glorious journey of more than 97 years, the institute has worked for welfare of the poor tribal farmers and lac based industries through development of relevant technologies. He explained the need of having a National Lac Development Board for expanding the lac cultivation throughout the country.

The Chief Guest outlined the usefulness of natural products for protection of health and the environment. He appreciated the achievements and role of the Institute in developing the NRG sector. He emphasized that lac can play an important role in increasing income of the farmers while protecting our forests. He assured the farmers that he will advise the state government to take steps for development of the lac board. During the exhibition, progressive farmers, entrepreneurs and forest officials were felicitated by the Chief Guest for their contribution in promotion of lac.

Address by Hon'ble Governor, Jharkhand

Shri Sanjay Seth said that lac cultivation plays an important role in climate change mitigation as farmers conserve the trees for income generation. He hoped that Institute will continue to work for development of lac for the benefit of lac growers.

Kisan Goshthis were also organized on both days wherein experts of the institute, sister organizations, State Agricultural University and Tassar Research institute interacted with the farmers and provided on the spot solutions to farm based problems raised by them. About 1385 farmers participated in the Mela including dignitries from different organizations. They were shown around the Institute Research Farm and the Lac Museum of the Institute. Different research organizations, entrepreneurs, NGOs showcased their technologies and products through 60 stalls.

View of awardees for promotion of lac

Dr. Subhash Singh, Director, SAMETI, Jharkhand, was the Guest of Honour during the Valedictory Session. He said that doubling income is not possible by adopting only traditional methods of farming, unless we combine our struggle and hard work with scientific approach. Dr. Nirmal Kumar, Head, Production and Extension Management Division and the Convenor proposed vote of thanks.

Participation of dignitries and farmers

Visit of Chairman, NABARD to ICAR-IINRG, Ranchi

Dr. G R Chintala, Chairman, NABARD, visited the Institute on 3rd March, 2022. He was also accompanied by Smt. Sushila Chintala, MD and CEO of NABKISAN, Dr. GK Nair, CGM, NABARD, Jharkhand and other officials from local office of the NABARD. During the visit, Dr. Chintala along with the NABARD team visited Institute Research Farm and the Museum of IINRG where the visitors had an exposure to the scientific practices for lac cultivation on various host trees and machineries involved in the processing of lac.

An interaction meeting with the scientists of IINRG was also organized on this occasion, where Dr. KK Sharma, Director, IINRG, welcomed the guests and briefed them about the status, role and potential of lac cultivation in the livelihood support of the resource constrained farmers. Dr. Chintala, during his address, appreciated the efforts of IINRG in developing various technologies for scientific cultivation, processing of lac and taking them to the field through trainings, exhibition, *etc*.

Visit and interaction of Chairman, NABARD to ICAR-IIINRG, Ranchi

He assured that the NABARD will collaborate with IINRG for bringing lac cultivation in its WADI programmes and for other activities related to natural resins and gums. During the event, Chairman, NABARD handed over the sanction letter of a project on 'Development of portable equipment for quality testing of lac' sponsord by NABARD to the Director, IINRG. The program ended with the formal vote of thanks by Dr. Nandkishore Thombare, Scientist and coordinator of the event.

Technology and Machinery Demonstration Mela-2022

ICAR-IINRG, Ranchi, in collaboration with the *Krishi Vigyan Kendra*, Khunti, Jharkhand organized *Technology and Machinery Demonstration Mela-2022* on 02nd April, 2022 at Institute's Research Farm. On this occasion, Chief Guest, Dr. K.K. Sharma, Director, ICAR-IINRG, Ranchi underlined that the main objective of the *Mela* is to apprise the farmers about the modern machineries *i.e.* Mould Board plough, Disk plough, Rotavator, Seed Drill, Planter, Pedal operated paddy thresher, Multi Crop Thresher, Straw Chopper Shredder, Tractor Drawn Sprayer, Reaper-cum-Binder, Small Scale Lac Processing Unit *etc*. The availability of the provision for Custom Hiring at the Block Level and Machines at the subsidized rate in the various Government Schemes was also highlighted by Dr. Sharma. Dr. Nirmal Kumar, Head, Production and Extension Management Division, stated that by using the machines, one can minimize the cost of cultivation and maximize the profits. Dr. Niranjan Prasad, Head, Mechanization and Process Engineering Division emphasized on the relevance of the farm machines / implements in doubling the farmers' income. Dr. J. Ghosh, Incharge, *Krishi Vigyan Kendra*, Khunti, highlighted the benefits of the integrated farming. In this exhibition agricultural equipments/machines and recent natural resins and gums based products and technologies were also displayed. More than 155 farmers/officials participated in the event.

Inauguration of exhibition by the Director

Demonstration of agricultural machineries

Workshop on farmer's participation, our priority under *Amrit Kheti*

ICAR-IINRG, Ranchi and KVK, Khunti jointly organized workshop on farmer's participation, our priority under *Azadika Amrit Mahotsav* during April 25 – 30, 2022. On this occasion, Dr. KK Sharma, Director, ICAR – IINRG said that institute is working towards organic farming and is engaged in promotion of such practices. During the event, Shri Siddhaarth Jaiswal, Expert from Birsa Agricultural University, Ranchi said that in the last few decades there has been a significant decline in nutritional content of vegetables produced in our country. He stressed on the widespread adoption of nectar farming, saying that small insects and bacteria play a significant role in the growth of our crops/products. While addressing the program, Mr. Phool Singh Malviya, Deputy Registrar, PPV-FR, Ranchi made the farmers aware of the Indian Plant Varieties and Farmers' Rights Protection Act, 2001 and its importance. About 200 beneficiaries including farmers participated in the program.

BAU, Ranchi expert

Deputy Registrar, PPV-FR, Ranchi

ICAR-IINRG organized 1st National Lac Insect Day

ICAR-IINRG, Ranchi took initiative to observe 1st National Lac Insect Day (N-LiD) on May 16, 2022 and also the Productive Insects Conservation Week during May 16 – 22, 2022 (Silk Day on May 18th, World Bee day on May 20th and World biodiversity day on May 22nd). N-LiD was celebrated across the country by organizing awareness campaigns, expert lectures and field days for farmers, Students, faculty and other stakeholders.

Institute officials attending 1st N-LiD

Welcome of Guest Speaker

To commemorate the occasion, earlier on May 13th a Memorandum of Association (MoA) was signed between ICAR-IINRG, Ranchi and IIT (ISM), Dhanbad for implementation of the project on 'Inclusive Agriculture Ecosystem for Jharkhand: Application to Fin-tech and Block-chain' for designing an integrated block-chain and Artificial Intelligence enabled platform that will allow farmers, FPOs, organizations, processing and consuming industries, digital lenders and importers to connect on a single platform. The project aims to design an integrated blockchain and artificial intelligence enabled platform that will allow all players involved in lac farming, FPOs, digital lenders, processing units, industries, and importers to connect on a single platform.

Exchange of MoA between ICAR – IINRG, Ranchi and IIT (ISM), Dhanbad

On this occasion, Dr. KK Sharma, Director of the Institute highlighted the importance of beneficial insects, especially the lac insect, in the ecosystem services and livelihood security of the dependent human population. He also highlighted the need of conservation efforts to protect the beneficial insect biodiversity available in the country.

Experts delivering lecture

Student's intraction with expert

Network Cooperating Centers of Network Project on Conservation of Lac Insect Genetic Resources *viz*., AAU, Jorhat; CAU, Imphal; PAU, Ludhiana; ANGRAU, Guntur; MPUAT, Udaipur; SKUAST, Jammu; KFRI, Thrissur; SFRI, Jabalpur; ICAR-RCER, Patna; KVK Sirsi, UAS, Dharwad and two Centers of Network Project on Harvesting, Processing and Value Addition of Natural Resins and Gums *viz*., JNKVV, Jabalpur and Forest College and Research Institute, TNAU, Mettupalayam actively participated in the event.

H.E. Governor of Jharkhand; Hon'ble Chief Minister of Jharkhand; Central Government Ministers of Agriculture and Farmers Welfare; Tribal Affairs; Commerce and Industry; DG, ICAR; DG, ICFRE; Chairman, Biodiversity Authority of India; DDG (Engg.); ADG (FE) and Directors of Research Institutes congratulated and appreciated the initiative taken by the IINRG for successful organization of 1st National Lac Insect Day.

Telecast of "Garib Kalyan Sammelan"

A nation-wide interaction of Hon'ble Prime Minister with beneficiaries of about 16 schemes under 9 Ministries/Departments of Govt. of India was telecast to beneficiaries at institute on May 31, 2022. The principal objective of the interaction was to understand how these schemes have brought about ease of living for the citizens, to explore possibility of convergence and saturation and to assess the citizens' aspiration for India as it completes 75 years of independence. The national level event was organized at Shimla, (HP) which was presided over by Hon'ble Prime Minister of India. More than 2700 farmers of Ranchi Districts attended the programe at ICAR – IINRG, Ranchi.

Live telecast of Hon'ble Prime Minister's address

The program was presided over by Hon'ble Shri Arjun Munda, Union Minister of Tribal Affairs, Govt. of India as Chief Guest. Shri Sanjay Seth, MP, Ranchi Lok Sabha attended the program as Special Guest. Shri Arjun Munda urged the beneficiaries that they should also make others aware of such schemes so that the objective of holistic development can be achieved. On this occasion, the Chief Guest, while highlighting the commercial importance of lac, stressed on the need to make extensive contribution in this field by interacting with the institute for its development.

Union Minister Shri Arjun Munda addressing the participants

Hon'ble Shri Sanjay Seth said that farmer is the food donor of the country and with *Kisan Samman Nidhi*, he is able to plan his agricultural activities smoothly.

After the telecast, Hon'ble PM released 11th *Kisan Samman Nidhi* Installment to the farmers. Pocket booklet with the name "*Seva Sushasan Gareeb kalyan*" distributed to the dignitaries on the occasion. Later Shri Arjun Munda intracted with the scientists of the institute to promote and develop the lac related activities as it directly affects the large section of tribal population of the state.

Presentation of "Seva Sushasan Gareeb Kalyan" booklet by the dignitaries

Dr. KK Sharma, Director, ICAR-IINRG, Ranchi; Dr. Arunava Patnaik, Director, ICAR-IIAB, Ranchi and Dr. Nirmal Kumar, the convener of the program, shared the views on the occasion.

Summer School on Natural Resins and Gums

A ten-day "Summer School on Natural Resins and Gums" was organized by the institute from 26th May, 2022 to 4th June, 2022 for undergraduate (Agriculture) students. Dr. Nirmal Kumar, Head, PEM Division welcomed the participants. Dr. KK Sharma, Director ICAR-IINRG, Ranchi shared his views regarding production, processing, value addition including promotion of natural resins and gums in the country. Aim of the training was to develop knowledge as well as interest in students regarding NRGs. Initially, for better visualization films on NRGs were screened and technologies developed by ICAR-IINRG including recent advances were discussed among the trainees. Lac cultivation and NRG processing was demonstrated during the programme including entrepreneurship development, different uses and applications of NRGs. 22 students from 'Sam Higginbottom University of Agriculture, Technology & Sciences', Prayagraj, Uttar Pradesh attended the training program.

Trainees with Director and Scientists

8th International Day of Yoga

8th International Day of Yoga was organized on 21st June, 2022 at ICAR-Indian Institute of Natural Resins and Gums, Ranchi. During the programme Smt. Renu Kumari Pandey, Yoga Instructor, guided the staff and explained about different *Asana*, *Pranayama* and *Mudras* including their benefit to maintain health and happiness in our daily life.A session on meditation was also conducted during the programme. After practicing the yoga, an interaction session was held to answer the various queries raised by the participants. Scientists, technical, administrative and contractuals actively participated in the event.

Participation of institute officials in 8th International Day of Yoga

During the program Dr. Niranjan Prasad, Head MPE Division highlighted the importance of yoga in our life to enlighten our inner energy to increase self-esteem. Dr. Nandkishore Thombare, Convener of the program, drew attention towards benefits of yoga for both mental and physical health, relaxation and to reduce stress in our daily life.

Head, MPE Division falicitating yoga instructor

National campaign on *Poshan Abhiyan* and *Vriksharopan*

ICAR-IINRG and KVK, Khunti jointly organized a Research-Extension-Farmers-interface meeting and an Awareness Campaign on *"Poshan Abhiyan* and Tree Plantation" at Diyankel village, Torpa block, Khunti on 17th September, 2022. Main aim of the event was to educate the farmers about the benefits of nutri-garden and bio-fortified varieties as well as the effects of nutri-cereals and their role on human health. During the campaign, mango tree saplings and seeds of various vegetables were distributed among farmers. More than 125 farmers participated in the campaign.

Organization of Research-Extension-Farmers-interface meeting

ICAR-IINRG celebrated 99th Foundation Day

ICAR-IINRG celebrated its 99th Foundation day on 20th September, 2022 in both offline and virtual mode. On this occasion, Professor Indranil Manna, Vice Chancellor, Birla Institute of Technology, Mesra Ranchi was the Chief Guest and Dr. SN Jha, Deputy Director General (Engineering), ICAR New Delhi was the Guest of Honour, who joined online. Dr. A Pattanayak, Director, ICAR-Indian Institute of Agricultural Biotechnology, Garhkhatanga, Ranchi graced the occasion as special guest. Welcoming the dignitaries, Dr. KK Sharma, Director ICAR-IINRG appraised of the expertise gained by the Institute in the field of production, processing and value addition of lac and other Natural Resins and Gums (NRGs). He also added that the Institute is going to complete its centenary in 2024 and efforts are continued to make significant impact on the farming community through the scientific cultivation of the lac and other NRGs.

To commemorate the occasion, 12th Ms. Dorothy Norris memorial lecture was delivered by Dr Syed Ismail, Director, SIFA Sanpra Systems Pvt. Ltd., Mumbai on 'Automation and Internet of Things (IoT) in Agriculture'. He illustrated particularly application of sensors and IoT in the agricultural sector in

Welcome address by Director, IINRG Ranchi

Expert delivering the memorial lecture

Lighting of lamp by the dignitaries

Distinguished worker felicitation

Address by the Chief guest

Presenting memento to the Chief guest

Glimpse of 99th Foundation Day celebration

country for overall benefits of the agrarian society. He stressed on the need to focus on the processing sectors of Natural Resins and Gums for upliftment of the tribal community and its value added products for domestic consumption and export as well. Distinguished workers of the Institute in scientific, technical, administrative and skilled supporting staff categories were felicitated with certificates and trophies for their commendable contribution in their sphere of work on the occasion.

Professor Indranil Manna highlighted the importance of the institute and stressed on the need for collaboration between science and application. He emphasized that research should lead to logical extension for making it universally available at an affordable price. Addressing the gathering online, Dr. SN Jha, congratulated the IINRG team on the 99th Foundation day of the Institute, emphasized on tertiary and quaternary level processing of NRGs and called for compilation of achievements and aspirations of the institute on completion of its 100 years. Dr. A Pattanayak, congratulated staff of IINRG for the remarkable achievements in the field of the NRGs and lac, highlighted the achievements and technologies developed and transferred by the Institute. Dr. N Prasad, Head MPE Division delivered vote of thanks to the dignitaries at the concluding session of the programme. Dr. MF Ansari convened the programme.

Covid vaccination camp - Free precaution any dose

ICAR-IINRG Health Centre organized one day Covid Vaccination Camp under the guidance of Mission Director, National Health Mission, at the institute premises on 22nd September, 2022 under the Govt. of India new initiative 'COVID Vaccination Amrit Mahotsav' to provide free precaution any dose (Booster dose) to all the government employees. In the camp, employees, pensioners, contractual staff, RA, SRF, Young Professionals and their adult dependents including underage group 12-18 yrs were vaccinated. Precaution any/ Booster Dose were given to the beneficiaries who had taken the 2nd dose and the subsequent dose to the other beneficiaries who had taken either1st dose or 2nd dose of specific brand. About 180 beneficiaries took the covid vaccination dose. IINRG Health Centre coordinated the programme.

Organization of Covid Vaccination Camp

ICAR - IINRG organize *"Hindi Chetna Maah"*

In the compliance of Official Language Act and progressive increase in the use of official language in official work "*Hindi Chetna Maah*" was organized at ICAR - Indian Institute of Natural Resin and Gum, Ranchi from 01st – 30th September, 2022 and *Hindi Day* was celebrated on 30th September, 2022 at the institute.

Chief guest Dr. Jang Bahadur Pandey, Head (Retd.), Hindi Department, Ranchi University, Ranchi while addressing, said that India is the only country which celebrates official language day in the world. He emphasized means of Rajbhasha as language of the kingdom while official language is a constitutional language and needs to make Hindi as practical language of the country. Hindi is no longer limited only to the borders of India as Hindi is taught in the universities of 95 countries of the world and even the most developed countries want to study Hindi.

Guest delivering the lecture on the occasion of Hindi Diwas

Director of the institute, Dr. KK Sharma in his welcome address said that *Hindi Day* celebrations have been organized under *Hindi Chetna Maah*. Official language Hindi has been used in the institute for a long time. Hindi is used in our office work as well as in scientific literature and institute regularly publishes bilingual booklets, leaflets etc. in Hindi. In the coming time, we will try our level best to do more and more work in Hindi only at the institute.

During the period of '*Hindi Chetna Maah*' different competitions *i.e.* noting, drafting, essay writing, quiz, synonyms and antonyms were organized in Hindi and winners were honoured. On the occasion *Laksha*-2022 was released by the chief guest. Award for best article published in *Laksha*-2021 was also given. On the occasion, Shri Binod Kumar, Officer-in-Charge, Official Language Cell presented the official language Report. All the institute officials participated in the Hindi Day celebration.

Winners receiving the certificate from the delegates

ICAR-NISA organized Special Swachhta Campaign

ICAR-NISA and KVK, Khunti jointly organized five "Swachhta Awareness campaigns" in the institute campus and different village of khunti district under "Special Swachhta Campaign 2.0" from 2nd - 31st October, 2022. Experts explained about the importance of cleanliness in day-to-day life and its effect on our health to the tribal farmers and their family members followed by cleaning of the public places in the villages.

Glimpse of Swachhta Awareness campaigns

Telecast of Hon'ble Prime Minister's addresses

Under the joint aegis of ICAR-National Institute of Secondary Agriculture, Ranchi and *Krishi Vigyan Kendra*, Khunti, telecast of Hon'ble Prime Minister's addresses program was screened to farmers on 17th October 2022. The principal objective of the Hon'ble Prime Minister's interaction was to understand how these schemes have brought about ease of living for the citizens, to explore possibility of convergence and saturation and to assess the citizens' aspiration for India as it completes 100 years of independence in the year 2047. Dr KK Sharma urged the beneficiaries that those people who are still deprived of the benefits of these schemes in their villages should also make others aware of such schemes so that the objective of holistic development can be achieved, while highlighting the commercial importance of lac, stressed on the need to make extensive contribution in this field by interacting with the institute for its development. He said that farmer is the food donor of the country and in today's time, with the amount reached by *Kisan Samman Nidhi*, they may be able to plan his agricultural activities smoothly, while on the one hand, the amount received is helpful in doing agricultural work and on the other hand, with the remaining money other essential activities of the family like education, health care can also be done smoothly. The telecast was attended by about 300 participants including officials of the institute.

Address by Hon'ble Prime Minister's to farmer

Institute officials and farmers attending the live telecast

Interaction meeting with industry

An online interaction meeting was organized by Downstream Agro Processing Division on November 04, 2022 with M/s. India Glycol Pvt. Ltd. Gurugram regarding the engagement for scaling up research, production of guar gum and other natural gum based derivatives including value added products. During the interation meeting, expert from the DAP Division made a presentation on promising technologies developed and technologies ready for commercialization from the institute for possible collaboration. Similarly, presentation about activities, products and area for collaboration was shared by the concerned industry representative followed by detailed discussion on guar gum derivative, dietary fibre, paper packaging etc. Dr. MF Ansari, Dr. A Roy Chowdhury and Dr. N Thombare participated in the meeting.

Summer school on Natural Resins and Gums

A ten-day Summer School was organized on Natural Resins and Gums (NRGs) during November 07 – 16, 2022 for under graduate (Agriculture) students. The aim of the training was to develop knowledge as well as interest in students regarding NRGs. Forty five students from two different universities (Binod Bihari Mahato, Koyalanchal University, Dhanbad and Gopal Narayan Singh University, Sasaram, Bihar) participated in the training program. During inaugural session, the Director ICAR - IINRG and the Head of PEM division while addressing the participants highlighted the importance, uses and contributions of natural resins and gums in the economy of rural sector especially to the tribal and remote areas of Jharkhand. Students were told about the career prospects and opportunities of this sector. Under the training progremme, lectures on different aspects *i.e.* lac cultivation, insect taxonomy, lac processing, its entrepreneurship, different gums and its uses were delivered by the experts. Lac cultivation and NRG processing including NRGs based entrepreneurship development were also demonstrated to the participants through practicals. Participants were also exposed to lac industry and other institute like Institute of Forest Productivity (IFP), Ranchi; Central TASAR Research & Training Institute, Ranchi and Farming Syatem Research Centre for Hill and Plateau Region, Ranchi of ICAR-Research Complex for Eastern Region, Patna. For better understanding, concept building and proper visualization of the topic taught, film on NRG was also shown to them along with showcasing all the technologies developed by ICAR-NISA.

Experts with participants of summer school on NRGs

Event organised at Khunti, Jharkhand

World Pulse Day 2022

Kisan Goshthi-cum-awareness program was organized on February 10th, 2022 at *Krishi Vigyan Kendra*, Khunti on the occasion of World Pulses Day under *Azadi Ka Amrit Mahotsav* program to commomerate 75th year of india's independence. The Chief Guest Dr. Nirmal Kumar told the farmers that India is the largest producer and consumer of pulses and contributes about 24 percent to the global production of pulses in the world.

Experts intracting with participants

He said that country's production of pulses has increased from 14 million tonnes to 24 million tonnes in the last five-six years. He also said that pulse is the major source of protein, iron, magnesium and zinc. These nutrients are very important to keep the body healthy and fit. Dr. Jyotirmoy Ghosh, discussed about the benefits of pulses among the farmers and said that fiber and iron present in it increases the body's energy as well as immunity. He told farmers about some selected varieties for cultivation according to the weather of Khunti district. The programme was attended by 75 farmer participants.

International Women's Day

Two different programmes one at ICAR-IINRG, Ranchi and other at KVK, Khunti were organized on March 8th, 2022 on the occasion of International Women's Day. Dr. KK Sharma while expressing his views said that women are the basic foundation of the structure of our family and our society and society has to provide them ability and opportunities to take decisions on their own in the event organized in collaboration with LIVE Foundation at the institute.

Expert intracting with participants

In the event organized at KVK, Khunti, Dr Nirmal Kumar said that in almost all the households, women are engaged in agricultural work, yet they are not given status equal to man for such hard work.

Appreciating the remarkable work done by them, he said that with the changing times, today women are not only helping in the livelihood of the family but also becoming the main source of livelihood.

Participation of women beneficiaries

Dr. J Ghosh, In-charge KVK, Khunti said that today women take an active part in politics, sports, administration and social welfare. He said that the evil practice of dowry established in our society is affecting the plights of women. In the program, women groups doing farming in different villages of Torpa were honoured and vegetable seeds were distributed to them. The programme was attended by about 110 farm women.

Workshop on Sustainable Lac Integrated Farming Practices for Livelihood Security

As a part of the *Azadi Ka Amrut Mahotsav* celebration on the 75th year of India's Independence, ICAR IINRG, Ranchi organized a workshop on March 9th, 2022 at farmers' field on "Sustainable lac integrated farming practices for livelihood security" at village Sogad, Ranchi. While addressing the villagers Dr. Soumen Ghosal, Head, QPI Division, suggested that farmers apply fertilizers at recommended doses to raise healthy lac host plants.

Distribution of bushy lac host saplings among the farmers

On the special occasion of International Women's day he encouraged the female participants to take an active role in lac cultivation to becoming financially self reliant. Dr. Achintya Pramanik, Scientist emphasized on scientific pest and disease management on lac to prevent yield loss due to natural enemies. Mr. Sandeep Kumar, Scientist laid stress on having a healthy diet and proper nutrition of women during, pre and post-pregnancy. Then successful progressive farmers from Angarah, Sogad and Banta village of Ranchi district elaborated their experience of scientific lac cultivation and suggested the fellow farmers to follow the same. On this occasion 150 saplings of bushy lac host plant *Calliandra calothyrsus* were also distributed among the farmers. The workshop was attended by about 400 progressive lac farmers from three villages *i.e.* Angarah, Sogad and Banta including institute officials.

World Water Day

An awareness programme was organized on March 22nd, 2022 on the occasion of World Water Day with the theme Ground Water: Making the Invisible Visible. While addressing the participants, Dr. Rajan Choudhary, SMS (Agrometrology) said that excess use of water due to industrialization and exploitation of the natural resources creates scarcity of quality water. He suggested for judicious utilization of ground

water, otherwise situation will become alarming in future. The percentage of hazardous chemicals and toxic elements including fluoride and arsenic is increasing day by day in ground water which affects drinking water quality and agricultural produce and adversely affects the human health. Conservation of ground water through development of ponds, reservoirs and rain water harvesting structures *etc*. may be beneficial for maintaining the quality drinking water as well as for agricultural purpose in the region.

Villagers creating awareness through rally

Awareness creation by formation of human chain

Different activities *i.e.* rally and formation of human chain was organized during the programme to creat awareness among the villagers about conservation of ground water. About 90 villagers participated under the event.

World Meteorological Day

An awareness program on World Meteorological Day was organized on March 23rd, 2022 in Kotenger village. Main objective of the program was to apprise the district agricultural weather unit "*Gramin Krishi Mausam Seva*" about the project in Khunti district. While addressing the participants Dr. Rajan Choudhary, SMS (Agrometrology) said that agriculture is the backbone of India's economy and agricultural productivity is completely dependent on weather, climate and availability of irrigation water. He also said that climate change is having a direct impact on agricultural production, while the indirect effect is being reflected in the form of less income and enhanced prices of food grains. More than 70 participants attended the programme including institute officials.

Expert addressing the villagers

Training on fish farming

As per the instructions of the Ministry of Agriculture and Farmers Welfare, Government of India, under the *Azadi Ka Amrit Mahotsav* campaign, under the joint aegis of ICAR-Indian Institute of Natural Resin and Gum, Namkum, Ranchi and Krishi Vigyan Kendra, Torpa, "Kisaan Bhagidari-Prathmikta Hamari", an awareness program on organic fisheries was organized on 27 April, 2022 under In this training, senior scientist of Indian Institute of Agricultural Biotechnology- Dr. Sanjay Kumar Gupta shared information related to various aspects like cumin harvesting, use of manure, artificial feeding, maintenance while giving information related to fish farming. During this training cum awareness programme 60 farmers were present.

Experts interacting with the farmers

Kisan Mela-2022

Ministry of Agriculture and Farmers Welfare, Government of India, under the *Azadi Ka Amrit Mahotsav* campaign, ICAR-Indian Institute of Natural Resin and Gum, Namkum Ranchi and *Krishi Vigyan Kendra*, Khunti jointly organised Kisan Mela cum awareness program which was held in Torpa, Khunti on 27th April, 2023. The Minister of Agriculture and Farmers Welfare, Government of India – Shri Narendra Singh Tomar emphasized on enriching the farmers by getting inspired towards organic farming. He also interacted directly with the farmers

through the respective *Krishi Vigyan Kendras*. Dr. Nirmal Kumar, Head of the Department of Product and Extension Management of the Institute, Ranchi attended and Dr. Sanjay Kumar Gupta, Senior Scientist of Indian Institute of Agricultural Biotechnology jointly inaugurated this fair. Dr. Nirmal addressed the farmers emphasizing on cultivation of biofortified crops. Senior Scientist- Dr. Sanjay Gupta, provide information related to fish farming and shared information related to various aspects like cumin harvesting, use of manure, artificial feeding, and maintenance. Mahila Vikas Kendra, Torpa and Udyogini made their valuable contribution in making this event a success. 302 farmer participated in this program.

Demonstration of different exhibits at the farmers fair

A view of pandal at Kisaan Mela 2022

Natural farming information given in Kharif workshop

Kharif workshop was organized by *Krishi Vigyan Kendra,* Khunti on 15 June 2022, Torpa at village-Chiddi in Torpa. In this workshop, the farmers were explained about the crops to be grown in Kharif season. Dr. J. Ghosh incharge of the centre, said that we should plant the seeds in the fields only after seed treatment, by doing this we can increase our productivity considerably, as well as keeping in mind the paste control and weed control we need to use only organic pesticides.

Campaign on Water Harvesting and Water Conservation

Awareness campaign on Water Harvesting and Water Conservation on the theme “Catch the rain, where it falls, when it falls” was jointly organized by ICAR-IINRG, Ranchi and KVK, Khunti on 21st June 2022 at Torpa block of Khunti district (Jharkhand) to create awareness among the farmers about the importance of water in life and agriculture. During the campaign, information on water harvesting and its importance, rooftop rain-water harvesting and advanced water - saving technology particularly drip irrigation systems were explained by the scientists of the institute to farmers and advised them to adopt rainwater harvesting, drip irrigation systems in their houses and fields, respectively for improving land and water productivity. The programme was attended by 100 farmers of respective block and villages.

Experts intracting with participants

Awarness campaign on efficient and balanced use of fertilizers (Including nano fertilizers)

Awareness campaign on efficient and balanced use of fertilizers including nano-fertilizers, natural farming and ways of maintaining soil health, regional agro-forestry and insect pest management of cereals, pulses and vegetables was organized on 21st June, 2022 jointly by *Krishi Vigyan Kendra*, Khunti and ICAR - IINRG, Ranchi. Under the campaign, farmers were edified regarding soil health and they were given an overview of the importance of “Soil Health Card” and its economic benefits. Need for soil health assessment, basic criteria for soil testing and soil sampling technique for effective soil health assessment, diversification of crops and judicious application of fertilisers required to boost farm productivity were discussed among the farmers including application of nano-fertilizers and how the micronutrient deficiencies can be eradicated through balanced and efficient use of fertilizers. Deeper insights on combating insect-pests on various crops were also discussed and farmers were made aware regarding the need based and judicious application of pesticides to minimize their harmful impact on the environment and yet to manage the pests efficiently. Tools and components of natural farming and its

synergism with ecosystem towards a sustainable production system were discussed and farmers were made aware about agro-forestry systems and its role in livelihood security. About 100 *Kusum* saplings and 100 Mango plants were distributed to the farmers with the aim to promote agro-forestry system. About 100 farmers and scientists attended the programme.

Distribution of Mango saplings to the villagers by institute officials

Officials of the institute speaking during the programme

National Fish Farmers Day

National Fish Farmer's Day was jointly organized by ICAR-IINRG, Ranchi and *Krishi Vigyan Ken*dra, Khunti, on 11th July, 2022 at Torpa block of Khunti district under *Aazadi ka Amrit Mahotsav* programme. On the occasion, Sh. P Patmanjhi shared views on various aspects related to fish farming especially fish culture, use of manure, artificial feeding including their maintenance and urged the farmers to include fish farming with agriculture for enhanced income. He said that farmers can do fish farming in small ponds and lakes as government is also encouraging fish farming since last few years and provide subsidy under the *Pradhan Mantri Matsya Sampada Yojana* for the same as tremendous demand exists in the market. Due to short supply and high demand in the market, farmers of the region have shown their interest in fish farming.

Participation of villagers

Dr. Rajan Chaudhary mentioned that fish provide nutrients such as iron, zinc, iodine, magnesium and potassium, vitamin D as well as calcium including phosphorus and contains high quality protein with low fat, omega-3 fatty acids, vitamin D and vitamin B2 (riboflavin). 95 farmers of Diyakel panchayat participated in the programme.

Expert delivering talk

Kisan Goshthi on agriculture management under scarcity of rainfall

A *Kisan Goshthi* on the theme "Information of short duration crops in view of scarcity of rain and need for emergency agriculture management" was organized at Karra block by ATMA, Khunti and *Krishi Vigyan Kendra*, Khunti on 22nd July, 2022. While addressing the participants, Dr. Rajan Choudhary, said that farmers of the district may plant short duration crops and select drought tolerant strains which need minimum irrigation considering possibility of drought due to delay in monsoon and deficit rainfall. He said that short duration paddy variety *i.e.* Vandana, Anjali, Birsa Vikas Paddy 108, 109 and 110 can be selected for present situation of deficit rainfall. Alternative Kharif crops like Arhar (Upas 120 and Birsa Arhar 1), Maize, Sesame (Kake White), Kulthi (Birsa Kulthi 1), Madua (CSB 17 I, Birsa Maduwa 1, 2 and 3), Urad (Birsa Urad 1), Jawar (Pant U 19, Pant U 31, Pant U 35 I, CSB 16), Soybean (Birsa White Soyabean 2 and Birsa Soyabean 1) and Moong can also be grown in the area in prevailing situation. Farmers can plant groundnut or paddy or Urad along with Tur in intercrop farming. 41 farmers including newly appointed public representatives attended the programme.

On the same theme, 2nd *Kisan Goshthi* was organized at District Agriculture Office, Khunti by ATMA, Khunti and *Krishi Vigyan Kendra*, Khunti on 27th July, 2022. During the *goshthi*, Sh. Vidyapati Vidyakar highlighted aerobic method of paddy cultivation without transplanting which needs minimum irrigation as seeds are sown in line. He also highlighted that

in aerobic method of paddy cultivation only 6 kg seeds are sufficient for one hectare. Reduced growth of pests and diseases also observed with aerobic method of paddy cultivation which reduces chemical requirement for crop protection including saving in manpower and fertilizer. The *goshthi* was attended by about 50 farmers.

Glimpses *of Kisan Goshthi* at Karra block, Khunti

Glimpses of *Kisan Goshthi* at DAO, Khunti

Awareness programme on water harvesting and water conservation

Awareness campaign on "Water Harvesting and Water Conservation" at Torpa block of Khunti district and Sarbo village, Raniya, Khunti on the theme 'Catch the rain, where it falls, when it falls' was jointly organized by the institute and KVK, Khunti on 22th July, 2022 and 06th August, 2022, respectively with the aim to create awareness among the farmers about the importance of water in sustainable agriculture based on global water crisis. Importance of water in agriculture, benefits of water conservation, technology of water harvesting including technology of rooftop rain-water harvesting, advanced water-saving technology particularly mulching and drip irrigation systems were explained by the experts of ICAR-IINRG and KVK-Khunti. During the programme, experts suggested to farmers for adoption of rainwater harvesting, mulching and drip irrigation systems for their houses and fields for improving land and water productivity. They stressed on conservation and efficient use of water for agriculture to harvest "More Crop Per Drop". More than 60 farmers participated in the programme including farmers' representative.

Torpa, Khunti

Sarbo village, Raniya, Khunti

Glimpse of water harvesting and water conservation programme

Distribution-cum-awareness programme under "Lac Integrated Farming System"

2000 saplings of *F. Semialata* were distributed among the villagers of Diyankel and Pakna Munda Toli, Torpa block, Khunti by Krishi Vigyan Kendra, Khunti on 17th August, 2022 under LIFS (Lakh Integrated Farming System) as these villages have been selected for demonstration of model mutual farming.

Sapling distribution and planted sapling

Awareness drive and Field visit under MGMG Programme.

ICAR-Indian Institute of Natural Resin and Gums, Namkum, Ranchi, Jharkhand and Krishi Vigyan Kendra, Khunti visited the adopted Village-Silda, Block-Khunti, District-Khunti, State-Jharkhand under the “Mera Gaon Mera Gaurav - MGMG” programme on 25th August, 2022. Team discussed about the problems of farmers faced in cultivation of lac, paddy, tomato, brinjal, ginger, arhar and many other crops. Team suggested proper management of pests and diseases in due course. It was emphasized to adopt Natural farming and organic farming for the healthy environment with healthy food. Judicious and proper use of farm yard manure in the field of agriculture is needed. Preparation of Gomutra (Cow urine) with its desired list of items and its application in foliar spray and other application were acquainted to the farmers. Farmers were also advised to carry out the activities in a scientific way such as scientific lac cultivation, water & soil conservation, health & drinking water management etc. to get maximum benefit for their livelihood. It was also discussed about the management of newly setup primary lac processing unit/Mini lac processing plant at the adopted village for the manufacturing of seedlac with the help of solar power and storage & marketing of seedlac. About 40 farmers (30 Males and 10 Females) participated in this programme.

World Soil Day

On the occasion of World Soil Day, an awareness campaign followed by Research-Extension-Farmers-interface meeting was organized jointly by ICAR–National Institute of Secondary Agriculture, Ranchi and KVK, Khunti at Diyankel village of Torpa block, Khunti on December 05, 2022 . Major objective of this event was to educate the farmers about benefits of biofertilizers, compost, organic farming and their role on human health and sustainable agriculture. The programme was attended by more than 50 farmers including officials from ICAR–NISA, Ranchi and KVK, Khunti.

Participation of dignitries and farmers under World Soil Day celebration

Farmer’s field school on scientific methods of lac cultivation

ICAR-NISA and KVK, Khunti jointly organized a farmer’s field school on “Scientific methods of lac cultivation” on December 08, 2022 at Baghiya village, Raniya block of district Khunti (Jharkhand). The main focus of farmer’s field was to create awareness among the farmers about the benefits of scientific lac cultivation. During the programme, a progressive lac farmer shared his experiance about scientific lac cultivation to sensitize the villagers for enhancing their income through adoption of lac cultivation in the area. More than 80 farmers participated in the programme including their representatives.

Glimpse of farmer's field school

Scientific Advisory Committee (SAC) meeting

SAC meeting was organized on 14th December, 2022 at KVK, Khunti. Altogether SAC 25 members along with progressive farmers and staff of KVK and ICAR-IINRG participated.

Director, ICAR-NISA lightening the lamp

Director ICAR-NISA welcoming Director ATARI, Patna

Group photo of the officials participated in the meeting

Kisan Samman Diwas

National Institute of Secondary Agriculture, Namkum Ranchi, and Krishi Vigyan Kendra, Torpa, in collaboration with ATMA, Khunti, organized the Kisan Samman Divas program in Karra block premises on 23rd December, 2022. District Agriculture Officer, and Block Development Officer while addresing the program, said that at present farmers are increasing the pride of the country by their hard work and struggle. His austerity associated with farming is helping the entire nation to get a positive identity on the world stage. In this program the farmers were informed about their rights and the major government schemes being run

Officials from different line department attending the programme

Expert speaking to the farmer at the event

for them. He said that the Jharkhand government is running various schemes to promote agriculture for the farmers. Along with this, the government aims to double the income of the farmers by implementation of several schemes like Jharkhand Agriculture Loan Waiver Scheme, Integrated Birsa Village Development Scheme, Kisan Samriddhi Yojana, Scheme for the cultivation of horticulture crops in cities, Jharkhand State Crop Relief Scheme, Chief Minister Drought Relief Scheme, Livestock Scheme, Drip Irrigation Scheme on ninety percent subsidy. Speakers said that by associating with the Krishi Vigyan Kendra, farmers should be aware of new techniques of farming from time to time.

ICAR-NISA organized Swachhta Pakhwada 2022

ICAR-NISA and KVK, Khunti jointly organized "*Swachhta Pakhwada* 2022" from 16th - 31st December, 2022. The officials of ICAR-NISA, Namkum, Ranchi participated in *Swachhta Pakhwada* and *Kisan Diwas* on 23rd December, 2022. A number of events were organised in cleanliness and sanitation drive at different villages and schools to create awareness about Swachhta Abhiyan. On the occasion of *Kisan Diwas,* ICAR – NISA and KVK, Khunti celebrated *Kisan Diwas* with the farmers of Torpa block in Khunti District, Jharkhand. About 75 farmers of the different villages under block participated in this programme.

Glimpse of swachhta pakhwada 2022

Campaign on Water Harvesting and Water Conservation

A total six awareness campaign on Water Harvesting and Water Conservation on the theme "Catch the rain, where it falls, when it falls" were jointly organized by ICAR-NISA, Ranchi and KVK, Khunti during March–December, 2022 at different villages of Khunti district (Jharkhand) to create awareness among the farmers about the importance of water in life and agriculture including water management. During the campaign, information on water harvesting and its importance, rooftop rain-water harvesting and advanced water-management technology particularly mulching and drip irrigation systems were explained by the scientists of the institute to farmers and advised them to adopt rainwater harvesting, drip irrigation systems in their houses and fields, respectively for improving land and water productivity. The programme was attended by 337 farmers of different villages of the district Khunti.

Experts interacting with participants

District Agro-met Unit

Gramin Krishi Mausam Seva (GKMS) under District Agro-met Unit is the scheme of IMD in Krishi Vigyan Kendra, Khunti. This programme was conducted at different Block like Torpa, Murhu, Khunti, Raniya, Karra & Arki etc. and at DAO (District Agriculture Office) in Khunti district. Dr. Rajan Chaudhari, SMS, Agro meteorology delivered lecture on importance of weather forecast in farming among farmers or different topic. In this programme farmers were given necessary suggestions for weather-based farming and to prevent the loss of crops. Farmer's awareness program was conducted at 22 different villages in which approx. 1500 farmers benefited and 49550 disseminations of Agro-advisory about maintenance of crops due to the changes in the weather as well as sowing time of crop and how and when to irrigate, weeding, spray the pesticides and fungicides for all blocks in Khunti district. Ten diffrent block watsapps groups and social media facebook, email, You tube were created. Shri Ashutosh Prabhat, Agro-mate Observer was also present in this programme.

Details of FAP under DAMU

SN.	Date	District/ Block	Village	Topic	No. of farmers
01	12.05.2022	Torpa	Konkeya	Weather-based agriculture advice	47
02	08.06.2022	Torpa	Marcha	Weather-based agriculture advice	65
03	15.06.2022	Karra	Chiddi	Weather-based agriculture advice	80
04	21.06.2022	Torpa	Villages in Diyankel Panchayat	Weather-based agriculture advice	87
05	06.07.2022	Torpa	Gopla	Weather-based agriculture advice	20
06	22.07.2022	Karra	Diffrent village in Karra	Weather-based agriculture advice	41
07	06.08.2022	Raniya	Sarbo (Badka Toli)	Weather-based agriculture advice	22
08	25.08.2022	Khunti	Silda	Weather-based agriculture advice in kharif season	40
09	28.09.2022	Khunti	Different village in Khunti district	Weather-based crop planning	40
10	28.10.2022	Torpa	Kanakloya	Weather based agriculture advice	25
11	25.11.2022	Khunti	Different village in Khunti district	Weather based crop planning	25
12	05.12.2022	Raniya	Digree	weather-based agriculture advice	75
13	08.12.2022	Raniya	Baghiya, Tutikel, Kulap, Bilkidura	Weather-based agriculture advice	75
14	23.12.2022	Karra	Different village in Karra	weather-based agriculture advice	65

(i) Other extension activities

Nature of Extension Activity	No. of activities	Mo. of farmers		
		M	F	T
Field Day	2	45	65	110
Kisan Mela	1	1060	490	1550
Kisan Ghosthi	4	245	190	435
Exhibition	1	210	130	340
Workshop	1	20	25	45
Lectures delivered as resource persons	20	550	990	1540
Agro-Advisory Services by DAMU	196	35000	14550	49550
Scientific visit to farmers field	12	25	28	53
Soil health Camp	1	30	75	110
Swachhta Hi Sewa	9	150	195	345
Total	**247**	**37335**	**16738**	**54078**

(ii) Celebration of important days

Celebration of Important Days	No. of activities	No. of farmers		
		M	F	Total
International Women's Day (8th March)	1	0	115	115
Parthenium Awareness Week (16th to 22nd August)	1	20	50	70
Mahila Kisan Diwas (15th October)	1	4	121	125
World Food Day (16th October)	1	50	35	85
Vigilance Awareness Week (27th October to 2nd November)	1	8	1	9
National Unity Day (31st October)	1	24	26	50
National Constitution Day (26th November)	1	64	25	89
World Soil Day (5th December)	1	5	70	75
Kisan Diwas (23rd December)	1	48	45	93
Total	**9**	**223**	**488**	**711**

Mera Gaon Mera Gaurav

The *Mera Gaon Mera Gaurav* programme is aimed to increase the farmer-scientist interface to reduce the delay in delivery of authentic information to the target group of farmers, to promote the direct interface of scientists with the farmers, to hasten the lab to land process. *Mera Gaon Mera Gaurav* is being implemented by ICAR-NISA, Ranchi in five villages by teams of 20 scientists of the Institute along with KVK, Khunti. The objective of this scheme is to provide farmers with the required information, knowledge and advisory regularly by adopting villages. Under MGMG 80 filed interventions were made benefitting 2260 farmers. Various agriculture and allied activities has been conducted especially related to cultivation of lac on *kusum, ber, palas, semialata and Calliandra calothyrsus* plants. Some activities conducted are given in detail below (Tables and Figures).

Details of activities organised under MGMG

S. No.	Name of activity	No. of activities conducted/ provided	No. of farmers participated & benefitted
1.	Visit to village by all teams	9	210
2.	Interface meeting/ *Goshthies*	3	105
3.	Training organized	2	90
4.	Demonstrations conducted	5	70
5.	Mobile based advisories	51	1550
6.	Literature support provided	5	110
7.	Awareness programmes	5	125
	Total	80	2260

Facilitation under MGMG

(i)	**Seeds**	**Crop**	**Variety**	**Seeds provided in quintal/No.**	**Farmers Benefitted (No.)**
		Paddy	Swarna Shreya	120 Kg	6
		Ragi	BM 10 A - 404	60 Kg	12
(ii)	**Seedlings**	Lac	*F. Semialata* (host plant)	2000	3
		Lac	*Calliandra calothyrsus (*host plant)	150	25
		Tomato	Swarn Anmol	500	3
		Chilli	Swarna Praphulya	600	3
(iii)	**Nutrient management**	**Crop**	**Quantity (quintal/Kg)**		**Farmers Benefitted (No.)**
(a)	**Fertilizer**	Nano Urea	100 bottle of 250 ml		100
(b)	**Bio-fertilizer**	Rhizobium	20 pkt of 100 g		20
(iv)	**Technology (No)**	**Numbers**	**Name of technology**	**Area (ha)**	**Farmers Benefitted (No.)**
		1	Scientific lac cultivation	100 trees	20
		1	Drought tolerant paddy	6 ha	6
		1	Improved Ragi varieties	10 ha	10
		1	Improved pigeon pea	4 ha	16

- **The Right Use of Fertilizer Application** method was demonstrated to the farmers for optimum utilization of resources.
- **Distribution of Insecticides and Tool Kit** for lac cultivation was done and method of its application was also demonstrated to farmers for obtaining better result from the crop.
- **Literature** support was provided with practical advice about lac cultivation so that they can learn in detail about the practice of cultivation, production and processing.
- **Swachchata Abhiyan** was organized under this programme and MGMG team's visited adopted village with the purpose to develop the social awareness among the villagers regarding cleanliness.
- **Awareness Programme on Single Use Plastic** was conducted and its harmful impact on the environment as well as for agriculture was explained to the villagers. Use of alternative jute or cloth bags in place of plastic bags was encouraged as it is a better substitute of plastic bags.
- **Distribution of Dustbins** in villages was done to install them at the places of community or public gathering so that the objective of localized garbage dumping to keep the village vicinity free of waste disposal at multiple areas.
- **Linkages** with government and non-government organizations like ATMA, JSLPS, PRADAN (NGO) and Mahila Vikas Kendra, Torpa, Khunti have been developed.

Activity-wise action photographs under MGMG:

Team of scientist and technical officer from ICAR-NISA, Ranchi discussed the soil fertility management and lac host diversification among the farmers of the Sildah village

Team of scientist and technical officer from ICAR-NISA, Ranchi organized an awareness programme under MGMG scheme in Sildah village

Distribution of pesticides and fertilizers amongst farmers at Mangobandh village, Ranchi

Discussion session with villagers about farming related problems at Mangobandh village, Ranchi

Awareness programme at Sarnatoli, Diyankel, Torpa, Khunti

Awareness programme at Kendtoli, Diyankel, Torpa, Khunti

MGMG event at Sarnatoli, Torpa, Khunti

Swachhata abhiyan at Sarnatoli, Diyankel, Torpa, Khunti

Distribution of sapling of lac host plants among the farmers of the Sildah village under MGMG programme

Meetings of Important Committees

Institute Management Committee (IMC)

The 57th meeting of the Institute Management Committee (IMC) of the Institute was reconvened, as per the guideline received from the SMD, due to administrative regions. The meeting held in hybrid mode on 20th October, 2022, in which following members were present:

Dr. KK Sharma, Director, ICAR-NISA, Ranchi	Chairman
Dr. Panna Lal Singh, In-charge, ADG (FE), ICAR, New Delhi	Member
Dr. MS Malik, BAU, Kanke, Ranchi	Member
Dr. SK Giri, Pr. Sc., ICAR-CIAE, Bhopal	Member
Dr. Bikash Das, Pr. Sc., ICAR-RCER-RC, Palandu, Ranchi	Member
Sri CP Srivastava, Dy. Director, Agril., Lucknow	Member
Sri Balmukund Sahay, Social Worker, Ratu Rd., Ranchi	Member
Sri Shailendra Kumar Mishra, Social Worker, Bettiah	Member
Sri Ravi Mishra, I/c Sr. AO, ICAR-NISA, Ranchi	Member Secretary

Invited members

- Dr. Nirmal Kumar, Pr. Sc. & In-charge, PEM Division, ICAR-NISA, Ranchi
- Dr. Niranjan Prasad, Pr. Sc. & In-charge, MPE Division, ICAR-NISA, Ranchi
- Dr. NK Sinha, Pr. Sc. & In-charge, QPI Division, ICAR-NISA, Ranchi
- Dr. MF Ansari, Pr. Sc. & In-charge, APD Division, ICAR-NISA, Ranchi
- Dr. VD Lohot, Sr. Sc & I/c PME Cell, ICAR-NISA, Ranchi
- Dr. (Ms.) Thamilarasi K, Sr. Sc., QPI Division, ICAR-NISA, Ranchi
- Sri Rishi Kant, In-charge, Sr. FAO, ICAR-NISA, Ranchi
- Sri Raghunath Mahto, AAO & I/c Admin. II Section, ICAR-NISA, Ranchi
- Sri K. Oraon, AAO and In-charge, Admin-I Section, ICAR-NISA, Ranchi
- Sri Binay Kumar, Estate Section, ICAR-NISA, Ranchi
- Sri Arjun Gope, Asstt. In-charge, Admin-III Section, ICAR-NISA, Ranchi

Welcome address by the Member Secretary

The meeting started with the welcome address by Sri Ravi Mishra, I/c SAO and Member Secretary, IMC, ICAR-NISA, Ranchi. After the formal speech by Member Secretary, IMC, he invited Chairman for his opening remarks.

Introductory remarks by the Chairman

Dr. KK Sharma, Director, ICAR-NISA and Chairman, Institute Management Committee, ICAR-NISA, Ranchi welcomed the members present in the meeting. He apprised the members about the significant achievements of the Institute since last meeting of the IMC. He added that Institute has organized many events during the last year for the development of natural resins and gums including lac. He informed that the institute has taken several newer initiates including proposal to declare lac as an agriculture commodity. He appraised the members of the Action Plan prepared by the institute alongwith budget requirement and submitted to the SMD/ Council for upcoming Centenary Year of the institute in 2024.

Scientific presentation before IMC

A scientific lecture and presentation on 'Aleuritic acid: a high value industrial compound of lac insect and its prospects' was delivered by Dr. Thamilarasi K, Sr. Scientist, QPI Division. Members of IMC appreciated the newer insights in to the research on aleuritic acid and commended the efforts made for developing a more efficient and less time consuming process of preparing aleuritic acid under Network Project on Conservation of Lac Insect Genetic Resources.

Presentation on research achievement of the Institute

Dr. VD Lohot, Sr. Scientist and In-charge, PME Cell presented the research achievements of the Institute since last IMC. Members of IMC appreciated the achievements attained by the institute.

Presentation on the financial status of the Institute

Sri Rishi Kant, I/c SFAO presented the financial status of the Institute. He briefed that fund under "Grant in Aid General" has fully been utilized, whereas grant in Aid Capital is yet to be utilized. He also presented the financial status of Network Projects on HPVA of NRG and CLIGR. The expenditure status was found satisfactory.

Presentation on Administrative status of the Institute

Sri Ravi Mishra, I/c Sr. AO presented the administrative status of the Institute. He informed the members about the vacant and in-position manpower of the Institute. He told that information on vacant posts in all the categories has been communicated to the SMD for expediting the recruitment process. Proposals for procurement of 'Capital' items are under process and will be completed very soon based on the budget provision.

Agenda of the meeting

Agenda 1: Formation of the Institute Grievance Committee

Sr. AO informed that a Member equivalent to the level of Head of Division and *ex-officio* members *viz.*, I/c Sr. AO and Sr. FAO need to be nominated to the newly constituted Grievance Committee of the Institute on the recommendations of the IMC. It was further informed that as on date, there is no grievance pending before the Grievance committee of the Institute.

The committee recommended nomination of Dr. N Prasad, Pr. Sc. and In-charge, MPE Division; I/c Sr. AO and I/c Sr. FAO as members of the Grievance Committee.

Agenda 2: Vetting and approval of the additional amount of Rs. 1,23,96,000/-

It was presented that subsequent upon approval by the Director, preliminary estimate for vertical extension of QPI Division (National Lac Insect Germplasm Centre) amounting to Rs. 1,23,96,000/- has been received from CPWD. Since the estimate is more than 1,00,00,000/- recommendation of IMC will be required as per norms. It was further informed that amount of Rs. 60,00,000/- was proposed in the SFC; the remaining expenditure will be met from the matching saving of the capital items.

The IMC vetted and approved the proposal.

Agenda 3: Purchase of solar street light for Institute Research Farm

It was presented that in view of the security of the Institute Research Farm during night, installation of solar street lights in different locations is needed. Permission of the IMC was sought for the same.

The IMC recommended to purchase the items as it was concerned to the security.

Agenda 4: Any other item(s)

(i) **National / International Year of NRGs:** In the XXIX meeting of the Research Advisory Committee, it was suggested to celebrate 'National / International year of NRGs' keeping in view the importance of NRGs in providing livelihood to millions through the world and also generating considerable foreign exchange as the Institute will be celebrating 100 years of its journey in 2024. It was informed that a proposal to declare 2023 as National and 2024 as International Year of Natural Resins and Gums has already been forwarded to DG, ICAR through DDG (Engg.) for further action. The same was put-up before the IMC for its information.

The IMC members appreciated the agenda and the proposal. They desired that all efforts may be taken to finalize the proposal.

(ii) **National Lac-insect Day (*Rashtriya Lakh-Keet Diwas*):** Dr. NK Sinha, Member Secretary, RAC in earlier IMC meeting had informed that Research Advisory Committee has suggested to observe 'National Lac-insect Day' every year to popularize the production and productivity of lac. He had suggested that there is need to conserve *rangeeni* lac strain by creating awareness and taking other necessary steps like observing *Rashtriya Lakh-Keet Diwas* as earlier contribution of this strain was the highest in total lac production, but due to climatic factors affecting this strain its production has gone down drastically. He had further proposed to celebrate *Rashtriya Lakh-Keet Diwas* on Mid-day of May every year as most of the summer *rangeeni* crop (which is commercial crop) is harvested as *Ari* (immature) during the month of May. It was informed that Institute observed the First National Lac-insect Day (N-LiD) on May 16, 2022 throughout the country and Cooperating Centres of both the Network Projects actively participated in the celebrations.

The IMC members lauded and recommended to adopt the ideas as it is one of the most effective methods to create awareness about the importance of lac insect in livelihood generation among the stakeholders and the policy makers.

(iii) **Rechristening of the IINRG to NISA:** The Director, ICAR-NISA appraised the members of the IMC that keeping in view the importance of secondary agriculture in rural industrialization, mandate of the IINRG has further been widened and consequent to this dicision of the Council, Indian Institute of Natural Resins and Gums

(IINRG) has been rechristened as National Institute of Secondary Agriculture (NISA) *w.e.f.* September 28th, 2022. He informed that besides working on secondary and higher processing of the prioritized commodities, the institute will continue to work on the existing mandate also, as conveyed by the SMD. Since, no specific definition of Secondary Agriculture is availavle, the Institute will follow the definition of the Committee on 'Doubling Farmers' Income' under the Chairmanship of Dr. Ashok Dalwai. He told that relocating of CRP on Secondary Agriculture from CIPHET, Ludhiana to NISA, Ranchi as envisioned in the proposal would be the first justifiable action to initiate the NISA towards newer vision. He further informed that the institute is planning to convene a brainstorming session to set the priorities, focus areas and fine tune the mandate and objectives of the institute keeping in mind the newer vision and mission. Additional manpower and budget will be required to work on the vision and mission of the NISA. This transformation of IINRG to NISA work is in progress; to become a world class institution would require collective thinking, dynamic leadership and wholehearted support from the Council.

The IMC members congratulated the IINRG on its name change to NISA with a widened mandate and consented with the roadmap presented.

Comments of the IMC members:

- Dr. PL Singh, In-charge ADG (FE) appreciated the research achievements of the institute and assured that SMD will make all efforts for not only an early relocation of CRP on Secondary Agricultuer to NISA, Ranchi, but also providing assitional budget and manpower to the NISA.
- Dr. CP Srivastava, Member, IMC suggested the Institute to move a proposal to the State Govt. of Jharkhand and other adjoining states to utilize the funds granted under "Tribal Welfare" for development of lac sector. A co-operative project in association with State Govt. may also be formulated in this direction.
- Sri Balmukund Sahay, and Sri Shailendra Kumar Mishra, Members, IMC suggested the institute take its developed technologies to the end users especially to the farmers. More emphasis may be given on the On-farm training to have maximum benefit to the lac growers.

The meeting ended with a vote of thanks to the Chair and all the esteemed members by the Member Secretary, IMC.

Research Advisory Committee (RAC)

The XXIX meeting of the Research Advisory Committee (RAC) of the Institute (First meeting of the current RAC constituted *vide* the council letter no. A. Engg.4/11/2021-IA-II (AE) e-file no. 171040 dated December 27, 2021) was held online on February 16-17, 2022 by ICAR-IINRG, 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. Kanchan K. Singh, ADG (FE), ICAR, New Delhi
- Dr. HN Mishra, Professor (Food Technology), IIT, Kharagpur
- Dr. Dandamudi Usharani, Principal Scientist, CSIR-CFTRI, Mysuru
- Dr. N. Kotwaliwale, Director, ICAR-CIPHET, Ludhiana
- Dr. SK Dhyani, Former Director, ICAR-CAFRI, Jhansi
- Dr. Debaraj Behera, Professor & Head, OUAT, Bhubaneshwar
- Dr. Kewal Krishan Sharma, Director, ICAR-IINRG, Ranchi
- Dr. NK Sinha, PS, ICAR-IINRG, Ranchi - Member Secretary

Specific recommendations of RAC

1. Prepare a mega project involving multi-disciplinary scientists as per revised mandate, global/ national/ regional needs and Govt. Missions/ schemes targeting external funding with quantifiable/ measurable output/ deliverables/ outcome for stakeholders.
2. Develop NRGs-Processing and Value Addition Centre to facilitate rural industry.
3. Develop a digital catalogue/ decision support system/ web page/ App for taxonomical information on lac insects for use in the absence of scientific expertise.
4. Develop ergonomic handy tools for tribal lac farmers.
5. Transfer / license the sticky insect trap technology to industry.
6. Explore possibility of production of bio-ethanol from NRGs by-products.
7. Explore application of other minor gums for value addition.

XXIX RAC meeting in progress through online mode

Institute Research Council (IRC)

The Institute Research Council (IRC) Meeting was held on 22-23, April 2022 and 4th & 12th May, 2022 (Special Session) to review the progress of the on-going, completed and the new project proposals etc. The IRC was attended by twenty one scientists from ICAR-IINRG. Seventeen ongoing projects, three completed project were reviewed. Seven new project proposals were also discussed and approved. Consequent on renaming and formation of new division, their core programmes were also finalized.

Distinguished Visitors

Sl. No.	Name	Designation/ Organization	Date Visited
1	Prof. T.V.K. Singh	Dean of Agriculture (Retd.) PJTSAU and Emeritus Scientist ICAR, New Delhi	22.02.2022
2	Mr. R.K. Singh	G.M. CCL, Ranchi	27.02.2022
3	Mr. Nageshwar Singh	A.G.M. (Retd.) Gaya, Bihar	27.02.2022
4	Dr. G.R. Chintala	Chairman, NABARD	08.03.2022
5	Dr. Budheswar Maji	PS & Head (Retd.) ICAR-CSSRI, West Bengal	06.05.2022
6	Dr. P.K. Rai	Director, ICAR-DRMR, Bharatpur	20.05.2022
7	Mr. S.C. Garg	DGM, NABARD, Ranchi	02.06.2022
8	Ms. Gudiya Kumari	Manager, NABARD, Ranchi	02.06.2022
9	Dr. N.K. Krishna Kumar	Former DDG (Hort. Sc.) ICAR, New Delhi	18.06.2022
10	Mr. R.L. Das	Former Commissioner, Patna	27.06.2022
11	Dr. C.R. Mehta	Director, CIAE, Bhopal	20.07.2022
12	Mr. Noyal Thomas	IFS-PCCF, Kerala	13.09.2022
13	Mr. Dinah Bind	56 RVE LABAT, France	15.12.2022

Support Services

Institute Research Farm

Resource Generation

Broodlac/ Scraplac (Rs.)	Fuel Wood (Rs.)	Water + Fuel charges (Rs.)	Lac host plant seeds and seedlings (Rs.)	Other farm produce (Rs.)	Total (Rs.)
3,50,410	18020	700	37,200	1,43,706	5,50,036

Nursery Management

- *Bhalia* seeds (2 kg), Semialata (10 kg) were produced and *Khair* (2 kg), *Galwang* (5 kg), *Ber* (5 kg), and *Kusum* (2 kg) were collected from different trees.
- 164 *F. semialata*, (plot no. 63, and 64) were transplanted for gap filling.
- Bio-composting by utilizing leaves and cow dung for nursery purpose was done and the biocompost manure is being used in the nursery.
- *Semialata* seedlings (4850 nos.), *Bhalia* seedlings (100 nos.) *Ber* seedlings (100 nos.), *Calliandra* seedlings (100 nos.), *Kusum* seedlings (150 nos.) and *Semialata* seeds (3 kg) were provided to scientists for research purpose and for distribution amongst farmers under different projects.
- Seeds and seedlings of lac host plants were sold to farmers, KVK and other organizations. Details are as under:

Lac host plant	Quantity
Semialata seedlings	2000 Nos.
Semialata seeds	2 kg
Bhalia seeds	1 kg
Kusum seedlings	100 Nos.
Calliandra seedlings	100 Nos.
Ber seedlings	100 Nos.
Galwan seeds	500 gm

Farm Management

- Executed field related experimental work of the scientists of QPI, PEM and APD Division including IRF activities as per their requirements.
- Inputs like fertilizers, farm yard manure, farm machinery like tractors with ploughing implements, power tiller and irrigation facilities were provided to the scientists for maintaining their research plots.
- More than 20 kg *F. semialata* seeds was collected by the successful management of pod fly through appropriate and periodic chemical interventions.
- Infestation of white fly on *F. semialata* was observed and managed by spray of systemic insecticides. *Spodoptera* larva infested nursery plants managed periodically by spray of chemical pesticides like spinosad.
- Weeding, cleaning and lime application mixed with chlorpyriphos on approx. 5000 lac host plants and other trees.
- The production of vermicompost is being done at IRF in HDPE vermined and the same is being applied on vegetable crops grown at IRF. Verm wash is being sprayed on the nursery plants for improving their robustness and health.
- Wheat (var. HD-2967) and paddy (variety Basmati and Pioneer 864 hybrid) grown on unutilized plots of IRF were harvested and sold for resource generation.
- Lac Integrated crop production with *zingiber officinale* (Adrak) plot no 55
- Lac Integrated crop production**:** Vegetable crops *viz. Zingiber officinale*, sweet corn, long bean, sponge gourd bottle gourd, bitter gourd, bottle gourd, Ridge gourd etc. were grown.

Similarly, onion was grown in integration with *F. semialata* and 460 kg onion bulbs were produced and sold for revenue generation.

Lac integrated cropping with onion at *F. semialata* plot

Lac integrated cropping system with horticultural crop

Rice crop grown at IRF

Sweet corn cultivation at unutilized plot of IRF

Wheat sowing at unutilized plots

Harvesting of wheat crop at IRF

Lac culture

- 1127 kg *Kusmi* broodlac was harvested and 1120 kg inoculated on *Kusum* (112 nos.), *Ber* (534 nos.) and *Flemingia semialata* plants for both summer and winter *kusmi* crops. Similarly, 396.5 kg of *rangeeni* broodlac was harvested and 283 kg inoculated on *Palas* (79 nos.) and *Ber* (117 nos.) and *Galwan* (50 nos.) for both *Baisakhi* and *Katki* crops.
- 70 kg *kusmi* scrapped lac and 30 kg *rangeeni* brood lac was provided to scientists for their research works and for distribution to farmers under FLD and other projects.

Soil amendment and nutrient management in lac hosts

- Green manuring was done using *Dhaincha* and *Sanai* (100 kg each) in *kusum* (plot no. 33-49) and *Ber* (plot no. 17-29) for soil amendment.
- Farm yard manure (FYM) and biocompost was applied at lac host plant plots and vermicompost produced at IRF was applied on nursery plants.
- Lime and fertilizer application in 135 no. of *kusum*, 120 *Ber* and 55 no. of *palas* trees was done at the onset of monsoon season to enhance productivity of the hosts.

Application of lime for soil amendment

Application of fertilizers for nutrient management in lac hosts

Prioritization, Monitoring and Evaluation (PME) Cell / Institute Research Information System (IRIS) Cell

The activities performed by PME Cell & IRIS Cell during the period under report were:

- ❖ Submission of various time-bound reports:
  - Cabinet Monthly Report to ADG (FE) by 20th of every month
  - Monthly brief updates on progress to DDG (FE) by 20th of every month
  - Half Yearly Progress Report (HYPM)
  - Quarterly Targets & Achievements
  - DARE report, Annually
  - Annual Plan Outcome Budget
  - Preparation & submission of Annual Training Programme for the Year 2022-23 for all the employees of the Institute to the Council
  - Preparation & submission of Annual Physical and Financial Targets and Achievements (April 2022 to March 2023) of all the employees of the Institute to the Council
- ❖ PME Cell conducted Institute Research Council (IRC) Meeting on 22-23 April, 2022 and 4th & 12th May, 2022 (Special Session)
- ❖ Conducted RAC Meeting
- ❖ Maintenance of Research Project Files: Institute (24), ICAR-Network Projects (2), ICAR-ICRAF (1), ICAR-DBT Bio-CARe Project - (1) and Inter-Institutional (ICAR-IIAB & IINRG) (1), (ICAR-RCER & IINRG) (2), (ICAR-IIHR & IINRG) (1), KVK, Khunti - (1), Agri-Business Incubation under Component-II of NAIF Scheme of ICAR- (1)
- ❖ Processing of research papers & popular articles for various Journals submitted by the scientists
- ❖ Processing of papers submitted by the scientists /staff for conferment of Awards/ Honours/ Recognitions etc.

Plantation of *kusum* seedling by Hon'ble Governor Shri Ramesh Bais

- ❖ Processing of papers submitted by the scientists for their participation in National/ International Conferences/ Symposia
- ❖ Coordination for conducting RAC, IMC & Director's Conference
- ❖ Coordination for HRD Programmes for all the employees (Scientists, Technical & Administrative) of the Institute
- ❖ PME Cell provides different services like:
  - LAN and internet connectivity to the divisions & sections of the Institute
  - E-mail services
  - Annual maintenance of computer systems, Local Area Networking (LAN), EPBAX, Biometric Devices & CCTVs
  - Maintenance of web-based Data Base for Personnel Management Information System (PERMISNET), Enterprise Resource Planning (ERP) and Project Information Management System (PIMS), E-Office, Support for PFMS.

Library and Documentation Centre

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

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) facilitate 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 also continued to exchange institute publications with the scientific institutions in and outside the country.

Services provided by the Library to its users

- ❖ E-journals access through CeRA
- ❖ Document Delivery Services.
- ❖ Reprographic Services.
- ❖ Bibliographic Services.
- ❖ Current Awareness Services.
- ❖ Sale and distribution of Institute publications.
- ❖ Institute news compilation and disribution.

Journals & periodical received

- ❖ Foreign Periodicals (Gratis/exchange)-01
- ❖ Indian Periodicals (Gratis/exchange)-04

Library holdings (as on 31/12/2022)

Documents	Additions	Total
Holdings	07	24730
Annual Report	21	3570
IS-Specification	-	184
Thesis	-	13

Estate Section

Function of Estate Section

- ❖ Security management of institute premises
- ❖ Power & water supply to offices & residential quarters
- ❖ Civil & electrical maintenance of office buildings & residential quarters
- ❖ Provide assistance in engineering related work
- ❖ Planning & supervision of infrastructure development work in the institute
- ❖ Maintenance of electrical infrastructure *i.e.* maintenance of overhead electrical lines, electrical tubular poles, transformer, operating panel, feeder panels, DG sets.
- ❖ Maintenance of water supply infrastructure *i.e.* water pumps, water pipe lines and civil infrastructure of office buildings and residential quarters.
- ❖ Management of general maintenance & upkeep of institute premises

Works (civil) ongoing through CPWD during the year 2022

- Renovation of transformer room
- Integral water proof treatment for roof of museum
- External & internal renovation of LPD Division
- Renovation of Kisan Hostel at PDU
- Renovation of Type-III/17 quarter
- Renovation & roof treatment of Type-II/9,10 quarters
- Providing aluminium glazed partition,false ceiling & flooring in main building at PDU
- Road carpeting of main campus
- Renovation & roof treatment of library building
- Construction of Administrative building at KVK, Khunti

Works (civil) taken up departmentally during the year 2022

- Distemper, PCC(1:2:4), enamel paint of type – II/15 quarter
- Putty and distempering in Type - V/4 quarter
- Putty, primer, distemper, plastering, P.C.C. (1:2:4) in qtr. Type –III/14 & 15 quarters
- Painting of door, window & Grill in Type –III/14 & 15 quarters

Electrical work

- Maintenance of electrical installation of office buildings & residential quarters
- Maintenance of Genset & associated panels
- Maintenance of street lights, solar lights & associated panels
- Electrical renovation of Type-III/22-29 quarters
- Electrical renovation of pilot plant building
- Laying of higher rating cable from transformer room to estate section.

General Maintenance

The work is being outsourced and is monitored by Estate Section to ensure the work is done satisfactorily as per our scope of work

Jobs entered in job register

- Plumbing & water supply - 354
- Electrical work - 306
- Carpentry work - 121
- Welding work - 100
- Turner work & other related work - 409

Most of above works have been completed satisfactorily

Quality Evaluation Laboratory

During the period under report a total 186 samples of lac, lac based products and natural gums have been received from Govt. Organization/ Private Industries/ various division of the institute and total 384 tests have been carried out and a sum of ₹ 51,300/- has been earned from external source.

Health Centre

The Institute has a functional Health Center in the campus under the Chairmanship of Dr. M. F. Ansari (PS). Dr. Kailash Prasad and Dr. (Mrs.) Reema K Khalkho have been providing their services as a part time Medical Officers (AMAs) on contractual basis on alternate days in the center. Most of the medical cases are being handled in the center itself and complicated cases are referred to authorized CGHS hospitals and pathology clinics in the city for expert diagnosis and treatment. In the year 2022, several more investigation centers and hospitals were attached with the institute and the treatment are being provided as per the CGHS rates. The Health Center is equipped with routine instruments to handle general/minor dressing, first aid, physical examination of patients, measure B.P., pulse, height, weight, blood sugar, etc. Total 3895 patients were registered and treated in the health center. Around 45 patients were monitored for blood sugar by test strips method in the center itself as per the advice of AMAs and 52 patients were advised for medical rest and were issued medical fitness certificates. The center has a computerized inventory system, facilitating retrieval of records like issue of medicines, date of receiving, unregistered patient along with the near date of expiry of medicine, etc. This ultimately helps the AMAs in taking better decision while prescribing medicines. Most of the medicines prescribed by AMAs were made available to the patients from the Health Center itself. Apart from attending regular employees, pensioners, and contractual staff of various on-going research projects, medical treatment are also provided to trainees and labourers on humanitarian ground, in case of emergency and casualty.

Additionally, apart from daily routine duty, two camps were arranged within the institute campus. Free eye screening and educational camp was organized through Shreshtha Netra Chikitsalaya, Ashok Nagar, Ranchi where about 80 patients were registered and took the benefit. Covid Vaccination Amrit Mahotsav

camps were also organized under the reference and guidance of Govt. of India through the Director, National Health Mission, Ranchi Jharkhand to provide free precaution dose to all the adult eligible population in the institute campus. Around 180 beneficiaries were registered and taken their respective sequence dose of Covid vaccine.

Institute Technology Management Unit (ITMU)

Er. SK Pandey, Sc. worked as I/c, Institute Technology Management Unit (ITMU) under NAIF scheme through which following work were done in 2022.

- Details of technologies of the institute submitted to PME Cell for onward transmission to headquarteras.
- Information on reducing compliance burden under category "Business" for Action Plan for year 2022 regarding certificate, license, permission etc. sent to PME cell for sending information to headquarter.
- Details of production, process and product technologies submitted to PME cell for onward submission to headquarter for updation in ICAR website.
- Information for technology developed, commercialized, training etc. during last five years (2017-2022) sent to PME Cell for sending the same to headquarter for updation of informations under Agricultural Engineering Division on ICAR website.
- Institute Technology Management Unit, ICAR – IINRG, Ranchi participated in Technology and Machinery demonstration Mela 2022 and demonstrated institute generated technologies.
- Organized lecture on PPV & FRA delivered by Sri Phool Singh Malviya, Dy. Registrar Protection of Plant Variety and Farmer's Right Authority, Ranchi at ICAR-IINRG, Ranchi, April 04, 2022.
- Patent on 'Lac Wax Policosanol - A natural plant growth regulator' (Application No. 201631013579) processed through M/s. Anjan Sen and Associate, Kolkata.
- Details of patents and technologies of the institute during last three year (2019-2022) submitted to PME Cell as per proforma for onward submission to headquarter for institute performance.
- Comment/ feedback for follow up on decision taken during Director's Conference on IPR and technology commercialization issues submitted to IP & TM Unit, New Delhi.
- Posters on lac processing, pilot plants of aleuritic acid and lac dye submitted to PME cell for onward submission to Engineering Division, ICAR, New Delhi.
- Achievements of NAIF Scheme regarding ICAR Governing Body meeting submitted to headquarter
- Details of patent filed, technology commercialized and revenue generated etc. for period 2017 – 22 submitted to IP&TM Unit, New Delhi.
- Details of technology/machine commercialized and process protocol developed submitted to Head, MPE Division and PME cell for onward submission to PIM Unit, ICAR, New Delhi.
- Suitable technologies for north east region compiled and submitted to PME Cell as per notice of lok sabha question (Dy. No. 645 dated 19.07.22).
- Details of NRG processes and product technologies (21 Nos.) of the institute shared to IIT (ISM), Dhanbad for uploading the same on their google document for Technology readiness level (TRL) determination under the project 'Technological Readiness Level and its Application in Food Processing and Agriculture Technologies'.
- State wise information on technology transfer and training etc. compiled and submitted to Head, PME Division for onward transmission to headquarter regarding visit of Hon'ble PM/AM/MoS and NITI Ayog digniteries.
- Report under NAIF Scheme Component-I compiled and submitted to IP&TM Unit New Delhi for DARE/ICAR Annual report 2022-23.

NAIF Scheme Component-II: Agri-Business Incubation at ICAR-NISA, Ranchi

Er. SK Pandey, Sc. worked as PI, ABI project and following work was carried out by him in the year 2022:

- Mr. Shaktidhar Koiri, Chutia, Ranchi has been registered in February, 2022 under entrepreneur category-II for Agribusiness Incubation on intensive lac cultivation, integrated lac farming system and nursery raising of lac hosts/plants presently for one-year period.
- Mr. Maheshwar W. Shirbhate, Gandhi ward Bela, Bhandra (Maharashtra) sponsored by Trinentra Padum, Krushi and Gramin Bahu S. Sansthan (NGO) has been registered in February, 2022 under NGO category-III for Agribusiness Incubation on technology for *rangeeni* lac product ion on *palas* and *ber*, air- drying & baking type

insulating varnishes, process of making lac dye, tapping/ harvesting of resin & gums, guar gum based superabsorbent hydrogel presently for one-year period.

- Mr. Jitendra Dubey, Dewark Agro Forest Pvt. Ltd., Gaya, Bihar has been registered in March 2022 under firm/company category-I for Agribusiness Incubation on lac production, processing & other natural resins and gums technologies namely 1) Early *kusmi* breed cultivation on *F. Samialata* 2) Herbal *gulal* from *palas* flower and 3) Tapping/ harvesting of resins and gums presently for one-year period.
- Smt. Payal Patel, AGROPAK, Benguluru, Karnataka has been registered in May 2022 under firm/company category-I for Agribusiness Incubation on button lac/ lac as binder in natural composite field application presently for one-year period in F.Y. 2022 - 23.
- Details of start-ups at Agri-Business Incubation, ICAR-IINRG, Ranchi compiled including note on policy issue for Start-ups conclave organised at Headquarter submitted to IT & TM Unit, ICAR, New Delhi.
- Information of Agri-Business Incubation, ICAR-IINRG, Ranchi incubatee M/s. IndoLACCA shellac (Pvt.) Ltd., Balrampur, West Bengal compiled in success story format and submitted.
- Details of start-ups and entrepreneur supported by Agri-Business Incubation, ICAR-IINRG, Ranchi compiled and submitted to to PME Cell for onward transmission to headquarter.
- PI, Agri-Business Incubation, ICAR-NISA, Ranchi visited M/s. IndoLACCA Shellac Pvt. Ltd, Balrampur, West Bengal to discuss and suggest proper measure for commercial production of lac dye utilizing newly established lac dye unit by the mentioned incubatee firm.
- Report under NAIF Scheme Component-II compiled and submitted to IP&TM Unit New Delhi for DARE/ICAR Annual report 2022-23.

Agro-meteorology Unit

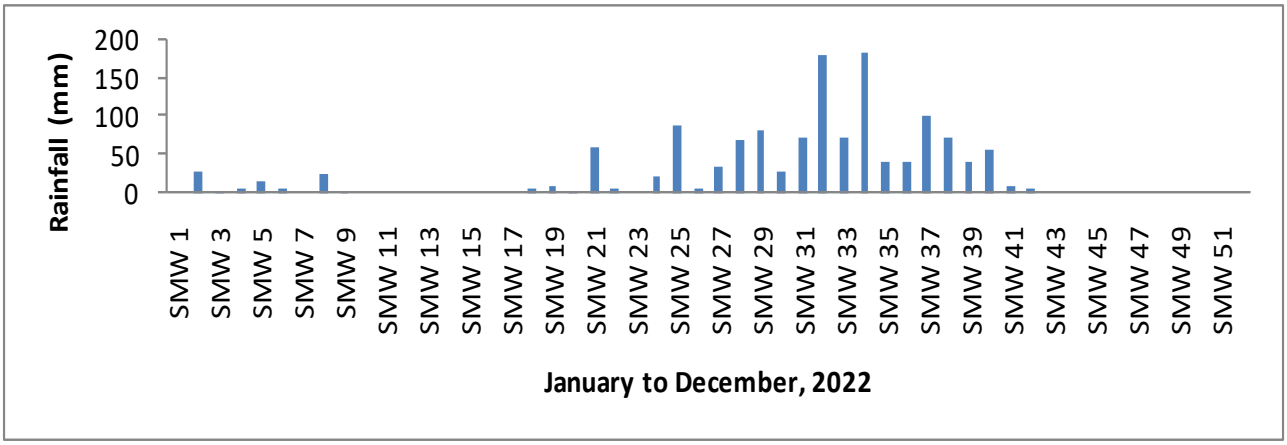
Agro-meteorology Unit of the Institute is situated at 23^{0}23' N latitude, 85^{0}23' E longitude at 650 m altitude. During the year 2022, different weather parameters were recorded and updated daily as well as weekly at the Institute website. Month wise weather data, daily Self-Recording Rain Gauge (SRRG) sheets and daily rainfall data for the year were sent to India Meteorological Department (IMD), Kolkata. The monthly mean relative humidity (RH%), mean temperature (^{0}C) and total rainfall (mm) is given in the Table. Weekly analysis of rainfall has been presented in Figure.

Hottest and coldest months of the year were April and December with mean monthly temperature maximum at 37.37^{0}C and minimum at 7.62 ^{0}C, respectively. Maximum temperature for the year was recorded on 12th June (40.5 ^{0}C), while the minimum temperature was recorded on two days in the year on 18th January and 29th January (4 ^{0}C). During August, relative humidity (RH) was the maximum at 8:30 hours (85.48%), with 83.52 per cent in the 14:00 hours, while the minimum RH was observed at 14:00 hours (61.77%), with 63.60 per cent in the 8:30 hours in the month of April. Total annual rainfall was 1365.8 mm. It is pertinent to say that 20th August received maximum daily rainfall *i.e.* 90.5 mm. Maximum monthly rainfall was observed in August (521.3 mm), whereas lowest rainfall occurred in the two months, November and December (0 mm) of the Calendar Year 2022.

Mean monthly meteorological data recorded at agro-meteorological unit of the Institute during 2022

Month	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)
	Min (08:30 am)	Max (02:00 pm)	Max (08:30 am)	Min (02:00 pm)	
January	7.90	20.28	75.48	68.38	35.2
February	8.39	23.60	70.89	63.42	45.2
March	14.00	31.92	68.10	62.39	0.0
April	19.51	37.37	63.60	61.77	0.0
May	20.77	34.85	69.55	65.03	79.4
June	22.02	33.86	75.97	75.3	112.7
July	21.51	28.78	81.90	77.35	235.4
August	21.01	27.92	85.48	83.52	521.3

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	Min (08:30 am)	Max (02:00 pm)	Max (08:30 am)	Min (02:00 pm)	
September	21.02	28.82	83.5	75	267.7
October	17.32	27.95	74.81	68.46	68.90
November	9.61	25.44	72.73	68.23	0
December	7.62	23.91	78.61	71.32	0
Total Annual Rainfall (mm)					**1365.8**



Weekly distribution of rainfall for the year, 2022

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

Project 1.4.001: Assessment, Diffusion and Adoption of Crop Production and NRGs Technologies

A. Trials conducted during the year 2022

1. On farm testing 1 (OFT-1): Drought tolerant paddy varieties during 2022

Drought tolerant paddy varieties Sahbhagi dhan, Swarna Shreya, IR 64 DRT 1 and Birsa Vikas Dhan 209 were evaluated in 6 ha. BVD 209 and IR 64 DRT 1 performed better with output ratio of 0.6 and 0.4 respectively.

Technology option	No of trials	No. of effective tillers/hill	No. of spikelet per panicle	100 grain wt.(g)	Disease/ insect pest incidence (%)	Yield (q/ha)	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	BC ratio
Sahbhagi Dhan	6	10	157	2.56	5	19.0	30000	38760	8760	0.29
Swarn Shreya	6	11	152	2.43	4	18.8	30000	38420	8420	0.28
IR64 DRT 1	6	12	148	2.78	6	20.5	30000	41820	11820	0.39
BVD 209	6	13	150	2.62	6	22.9	30000	46750	16750	0.56
Local	6	9	135	2.35	8	15.3	25000	31280	6280	0.25
CD at 5%						6.4				

2. On farm testing 2 (OFT-2). Integrated weed management in paddy during 2022

Weed management in paddy was conducted with 4 new technologies in 3 ha land. Application of Butachlor @ 1.0 kg/ka (3-5 DAT) and 2,4 D @400g/ha (25-28 DAT) gave better result followed by application of Butachlor @ 1.0 kg/ka (3-5 DAT) alone and two hand weeding (20 and 40 DAT). The benefit cost ratio ranged from 0.6 to 0.8.

Technology option	No. of trials	Yield component			WCE (%) at 90 DAS	Grain yield (q/ha)	Straw yield (q/ha)	Cost of cultivation (Rs./ha)	Gross return (Rs./ ha)	Net return	BC ratio
		No. of effective tillers/ hill	No. of spikelet per panicle	(100 grain wt. (g)							
Manual weeding sometimes (FP)	6	7	8.5	2.1	-	18.8	19.45	25000	39678	14678	0.59
Two Hand weeding (20 and 40 DAT)	6	12	11.2	2.3	88.2	20.5	23.42	28000	47777	19777	0.71
Butachlor@1.5 kg/ha (3-5 DAT)	6	11	9.4	2.2	64.3	21.7	22.43	26000	45757	19757	0.76
Butachlor @1.0kg/ha (3-5 DAT) *fb*&2,4 D @400g/ha (25-28 DAT)	6	13	10.6	2.2	69.4	22.9	23.8	27200	48552	21352	0.79
CD (0.05)	-				-	3.6	2.9				

3. On farm testing 3 (OFT – 3): Integrated pest management in paddy during 2022

Technologies on pest control in paddy were demonstrated in 3 ha. Clipping of seedlings at transplanting control major pest followed by application of Coragen® 18.5 SC and Fame® 39.34% w/w. the benefit cost ratio ranged from 0.26 in farmers practice to 0.57 in cultural control.

Technology option	Trials	Insect infestation (no. /m²)				Grain (q/ha)	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	BC ratio
		Observed	Natural Enemy	Dead heart	White ear head					
FP (No use of pesticide)	6	Before	5.6	4.3	3.3	15.4	25000	31416	6416	0.26
		After	7	5	5					
TO-1: Cultural control (Clip the seedling))	6	Before	5.7	5.1	3.3	19.2	25000	39168	14168	0.57
		After	4.3	1.7	2.3					
TO-2: Fame (Flubendiamide 480S , 39.35% w/w)	6	Before	5.3	4.9	3.7	20.6	30000	42024	12024	0.40
		After	1.3	1.3	1.3					
TO-3: Coragen (Chloran-traniliprole 18.5% SC)	6	Before	5.1	4.7	4.3	21.1	30000	43044	13044	0.43
		After	1.3	1	0.7					
CD (0.05)			0.92	1.22	0.67	1.8				

4. On farm testing 4 (OFT-4): Improved varieties of ragi during 2022

Improved ragi varieties A-404, Birsa marua 10 were evaluated in 11 ha. A 404 performed best with BC ratio of 1.9 followed by Birsa marua 10 with output ratio of 1.0.

Technology option	No. of trials	Yield component			Disease/ insect pest incidence (%)	Yield (q/ha)	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	BC ratio
		No. of effective tillers/hill	No. of spikelet per panicle	Test wt. (100 grain wt.)						
A 404	11	5.7	5	3.5	8	13.8	17000	49198	32198	1.9
BBM 10	11	4.4	4	3.1	11	9.5	17000	33991	16991	1.0
Local	11	3.2	3	2.8	13	6.2	13027	22327	9300	0.7
CD 5%						1.2				

5. On farm testing 5 (OFT-5): Integrated weed management in ragi during 2022

Chemical combination Pendimethalin @ 750g ai/ha as pre-emergene followed by 2,4-D @750 g ai/ha – as post emergence controlled weeds with output ratio of 1.07 followed by any weedicide alone, however manual hoeing at 20 and 40 DAT also control weeds with output ratio of 1.0.

Technology option	No. of trials	Yield component			WCE (%) at 90 DAS	Grain	Straw Yield (q/ ha)	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ ha)	BC ratio
		No. of effective tillers/hill	No. of spikelet per pan-icle	(100 grain wt.							
Pendimethalin@750g ai ha-1 as pre-emergene	5	10	4	0.31	52.3	9.5	9.45	17000	33991	16991	1.00
(2.4-D @750g ai ha-1 post –emergene	5	12	5	0.32	58.2	9.9	10.42	17500	35351	17851	1.02
Pendimethalin@750g ai ha-1 as pre-emergene fb 2,4-D @750 g ai – emergene ha-1 as post	5	11	6	0.32	44.3	10.4	10.43	18000	37211	19211	1.07
Hoeing at 20 and 40 DAT	5	13	6	0.34	59.4	10.0	10.8	17900	35780	17880	1.00
Farmers practice	5	7	3		55.4	7.9	10.54	15000	28266	13266	0.88
CD 5%	-				-	0.4	0.6				

6. On farm testing 6 (OFT-6): Farm mechanization in paddy during 2022

Nine demonstrations were conducted with conoweeder to control weed in paddy crop. The cost of weeding per hectare was Rs. 1800/ha by Cono weeder which was much less as compared to manual/ traditional method of paddy weeding (Rs. 13,537/ha) thus saving of about Rs. 11,737/ha by cono weeder with cost reduction of Rs. 1800/ ha was observed along with minimum man power (6 /ha) compared to manual weeding (45/ha).

Technology option	No. of trials	No of operator	Travel Speed (km/hr)	Weeding efficien-cy,%	Time requirement (weeding paddy crop per hectare), h	Manpower requirement (weeding paddy crop per hectare)	Labor reduction (man days)/ha	Cost reduction (Rs./ ha or Rs./Unit) @ Rs. 300/- day per man-power
Cono weeder	9	2	1.192	78.09	48	6	39	1800
Manual	9	2	-	-	361	45	-	13,537

7. On farm testing 7 (OFT-7): Pest management in winter *kusmi* lac

New technology on *kusmi* lac cultivation was demonstrated involving 10 beneficiaries. Fifty-eighth kilogram good quality broodlac was dipped in Fipronil @ 1.5 kg/ha of water for 10 minutes and followed scientific method of lac cultivation. The benefit cost ratio was calculated as 5.22 as compared to 2.67 in farmers' practices.

Technology	Beneficiaries	Broodlac kg	Yield BL (kg)	Gross return (Rs.)	Net Cost (Rs.)	Net return (Rs.)	BC ratio
TO-1: Broodlac dipping with Fipronil @1.5 ml per lit of water for 10 to 15 minutes + Scientific practice	10	58	505	252500	40600	211900	5.22
FP: No broodlac dipping + Farmers' practice	10	50	220	110000	30000	80000	2.67

Drought tolerant rice variety

Kusmi lac broodlac treatment

Weeding in the paddy crop using cono weeder

Findings of FLDs conducted during the year: 2022

(i) Sahabhagi dhan was sown in 9.3 ha. land of 90 farmers' field. It gave more than 28.2% better grain yield than farmers' local.

(ii) Pigeon pea variety IPA-203 were sown in 1 ha land involving 12 farmers. IPA-203 gave 26.4% higher yield than farmers' local

(iii) Sixty-two kilogram *Kusmi* broodlac was inoculated on 141 trees of 20 farmers and adopted scientific lac cultivation practices. Our technology had 92% higher broodlac yield than farmers' practice

(iv) Ragi variety- A-404 was shown in 1.32 ha land of 14 farmers. A-404 had 26.3% higher yield than local

(v) Pusa mustard 30 was sown in 10.4 ha land of 59 farmers. Pusa mustard 30 gave 36.6% higher yield than local

Economic yield along with locations, area, beneficiaries of OFT

Crop/ year	Locations	Name of the technology demonstrated	No. of Farmers	Area (ha)	Yield (q/ha)		% Increase
					Demo	Check	
Paddy 2022	Ken toil, Churgi, Diyankel, Manhatu	Sahbhagi	90	9.31	13.14	10.25	28.2
Ragi 2022	Churgi, Diyankel, Manhatu	A-404	14	1.32	7.2	5.7	26.3
Pigeon pea (2021)	Silda, Kherkai, Kachchabari	IPA-203	12	1	18.2	14.4	26.4
Lac (2022)	Murhu, Raniya, Torpa, Arki	Kusmi	20	141 trees	31.7	23.2	36.6
Mustard (2020)	Ken toil,	Pusa mustard 30	59	10.4	14.2	10.24	38.7

संस्थान के राजभाषा प्रकोष्ठ की गतिविधियाँ

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

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

संस्थान राजभाषा कार्यान्वयन समिति की तिमाही बैठकों का आयोजन, कार्यसूची एवं कार्यवृत की तैयारी तथा बैठकों में लिए गये निर्णयों पर अनुवर्ती कार्रवाई। वार्षिक रिपोर्ट के हिन्दी संस्करण का प्रकाशन (पी डी एफ रूप में), राजभाषा की वार्षिक पत्रिका लाक्षा का प्रकाशन, कार्यालय आदेश, परिपत्र, ज्ञापन, निविदा इत्यादि एवं पत्राचार हेतु विभिन्न सामग्रियों का आवश्यकतानुसार अनुवाद। हिन्दीतर अधिकारियों और कर्मचारियों को हिन्दी शिक्षण योजना द्वारा आयोजित प्रशिक्षण एवं नगर राजभाषा कार्यान्वयन समिति के सदस्य कार्यालयों द्वारा आयोजित विभिन्न हिन्दी प्रतियोगिताओं एवं कार्यशालाओं में सहभागिता हेतु प्रेरित करना ।

संस्थान के दैनिक कार्य में हिन्दी के प्रयोग में प्रगति एवं इसे सरल बनाने के लिए राजभाषा प्रकोष्ठ द्वारा निम्नलिखित कार्य सम्पादित होते हैंः

- संस्थान राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन, कार्यसूची एवं कार्यवृत की तैयारी एवं बैठकों में लिए गये निर्णयों पर अनुवर्ती कार्रवाई।
- वार्षिक रिपोर्ट के हिन्दी संस्करण एवं वार्षिक राजभाषा पत्रिका लाक्षा का प्रकाशन, समाचार पत्रिका, कार्यालय आदेश, परिपत्र, ज्ञापन, निविदा, सूचना एवं पत्राचार हेतु विभिन्न सामग्रियों का अनुवाद।
- अधिकारियों और कर्मचारियों को नगर राजभाषा कार्यान्वयन समिति के सदस्य कार्यालयों द्वारा आयोजित विभिन्न हिन्दी प्रतियोगिताओं एवं कार्यशालाओं में सहभागिता हेतु प्रेरित करना।
- हिन्दी दिवस, हिन्दी चेतना मास एवं योजनानुसार नगर स्तरीय राजभाषा संबंधी, संगोष्ठी एवं कार्यशाला का आयोजन करना।
- संदर्भ साहित्य, हिन्दी पत्रिका, शब्दकोश एवं तकनीकी शब्दावली के उपार्जन हेतु कार्य।
- द्विभाषी मुहरों, नामपट्ट के निर्माण में सक्रिय सहयोग करना।
- प्रचार सामग्रियों के हिन्दी रूपान्तर एवं समारोहों के समाचार संकलन एवं मीडिया प्रबंधन का कार्य
- विभागीय विषय पर तकनीकी शब्दावली का निर्माण।
- हिन्दी में वैज्ञानिक गोष्ठी के साथ साथ प्रशासनिक तथा तकनीकी वर्ग के लिए कार्यशाला का आयोजन।
- निदेशक महोदय की अध्यक्षता में वर्ष 2022 में संस्थान राजभाषा कार्यान्वयन समिति की चार तिमाही बैठकों का आयोजन निम्नलिखित तिथियों को किया गया तथा प्रगति की समीक्षा की गई। तिमाही रिपोर्ट एवं कार्यवृत परिषद सहित अन्य संबंधित कार्यालयों में प्रेषित की गई :

(क) दिनांक–08.02.2022 (ख) दिनांक–28.05.2022

(ग) दिनांक–10.08.2022 (घ) दिनांक–21.11.2022

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

- संस्थान में हिन्दी में मूल रूप से पत्राचार बढ़ाने के लिए नकद पुरस्कार योजना का अनुपालन।

- ❖ वार्षिक कार्यक्रम 2022–23 के प्रस्ताव पर चर्चा।
- ❖ गृह पत्रिका लाक्षा–2022 का प्रकाशन।
- ❖ वर्ष 2022–23 के लिए नकद पुरस्कार योजना लागू करना एवं वर्ष 2021–22 के प्रतिभागियों के लिए पुरस्कार का निर्धारण।
- ❖ प्रशासनिक एवं स्वास्थ्य संबंधी विषय पर हिन्दी कार्यशाला/व्याख्यान का आयोजन।
- ❖ द्विभाषी मुहरों का निर्माण।
- ❖ द्विभाषी नामपट्ट की व्यवस्था।
- ❖ लाक्षा–2021 के सर्वश्रेष्ठ आलेख का चयन एवं पुरस्कार।
- ❖ हिन्दी दिवस/हिन्दी प्रतियोगिताओं का आयोजन।
- ❖ प्रवीणता प्राप्त सभी अधिकारियों/कर्मचारियों को व्यक्तिशः आदेश जारी करना।
- ❖ सभी कम्प्यूटरों में यूनिकोड या गुगल हिन्दी सॉफ्टवेयर की व्यवस्था।
- ❖ अनुवाद के लिए आउटसोर्सिंग।
- ❖ हिन्दी पुस्तकों का उपार्जन।
- ❖ जाँच–बिन्दु का निर्धारण।
- ❖ राजभाषा नियम 8(4) के अन्तर्गत संस्थान के सभी अनुभागों को सम्पूर्ण कार्य हिन्दी में करने हेतु विनिर्दिष्ट करना।

राजभाषा प्रकोष्ठ की उपलब्धियां–2022–23

- ❖ आउटसोर्सिंग द्वारा सम्पूर्ण वार्षिक रिपोर्ट का अनुवाद कराया गया।
- ❖ संस्थान की वार्षिक हिन्दी पत्रिका लाक्षा–2022 का प्रकाशन किया गया।
- ❖ संस्थान के आगत–निर्गत पत्रों का विस्तृत (अनुभाग/विभाग व क्षेत्रवार) विवरण तैयार कर विहित प्रपत्र में तिमाही रिपोर्ट तैयार की गयी तथा परिषद् समेत सभी संबंधित कार्यालयों को 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/गुगल 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।
- ❖ लाक्षा–2021 के सर्वश्रेष्ठ आलेख के चयन के लिए कमिटी गठित कराई गई तथा सर्वश्रेष्ठ आलेख का चयन कर लेखकों को पुरस्कार प्रदान किया गया।
- ❖ सरकारी काम काज मूल रूप से हिन्दी में करने हेतु संस्थान में नकद पुरस्कार योजना लागू की गई, इसमें तकनीकी एवं प्रशासनिक वर्ग के कुल 08 अधिकारियों/कर्मचारियों को पुरस्कार प्रदान किए गए।

कार्यक्रमों का आयोजन

- ❖ वर्तमान समय में आयकर भरने संबंधी सामान्य जानकारियां विषय पर दिनांक–10.03.2022 को, प्राकृतिक खेती स्वास्थ्य के लिए लाभदायक विषय पर दिनांक–28.04.2022 को, हिन्दी दिवस समारोह का आयोजन दिनांक–30.09.2022 को एवं परिषद द्वारा राजभाषा की उन्नति संबंधी योजनाओं की सामान्य जानकारी विषय पर दिनांक–15.12.2022 को हिन्दी कार्यशाला सह व्याख्यान का आयोजन किया गया।

हिन्दी दिवस समारोह–2022

भारतीय प्राकृतिक राल एवं गोंद संस्थान में राजभाषा अधिनियम के अनुपालन एवं कार्यालय कार्य में राजभाषा हिन्दी के प्रयोग में उत्तरोत्तर वृद्धि के लिए संस्थान में दिनांक–01.09.2022 से 30.09.2022 तक हिन्दी चेतना मास का आयोजन किया गया। इसके अन्तर्गत दिनांक–30.09.2022 को अपराह्न 02.30 बजे हिन्दी दिवस समारोह का आयोजन किया गया।

हिन्दी दिवस समारोह के अवसर पर मुख्य अतिथि के रूप में उपस्थित डॉ जंग बहादुर पाण्डेय, विभागाध्यक्ष–हिन्दी विभाग (सेवानिवृत), राँची विश्वविद्यालय, राँची ने कहा कि भारत ही एकमात्र ऐसा देश है जो राजभाषा दिवस मनाता है विश्व में कोई और देश अपना राजभाषा दिवस नहीं मनाता है बल्कि अपनी भाषा में पुरे वर्ष कार्य करता है। वहीं हम साल में एक बार राजभाषा (हिन्दी) दिवस मनाते हैं और फिर पुरे वर्ष इसे भूले रहते हैं। भाषा के लिए हमारे देश में कई आयोग व समितियां बनीं हैं लेकिन कोई भी इसे व्यावहारिक सम्मान नहीं दिला पाया। हिन्दी राजभाषा के रूप में केवल संवैधानिक भाषा बनकर ही रह गई है।

राजभाषा का अर्थ है राज की भाषा, राज–काज की भाषा। राजभाषा संवैधानिक पद है, हिन्दी को देश की व्यावहारिक भाषा बनाने की आवश्यकता है। हिन्दी भारत माता के माथे की बिंदी है, यह भारत की मान बढ़ाती है। अनौपचारिक रूप से हिन्दी संयुक्त राष्ट्र संघ की सातवीं अधिकारिक भाषा के रूप में शामिल हो चुकी है, अधिकारिक घोषणा होना अभी शेष है, यह हिन्दी के लिए सबसे सुखद छणों में से एक होगा। हिन्दी अब सिर्फ भारत की सीमाओं तक सिमित नहीं रह गई है, विश्व के 95 देशों के विश्वविद्यालयों में आज हिन्दी पढ़ाई जाती है। आज सबसे विकसित देश भी हिन्दी पढ़ना चाहते हैं। बाहर हिन्दी का मान–सम्मान है, घर में ही नहीं है। हिन्दी आपको सबकुछ देगी, आप बस इसे सम्मान दें। हिन्दी आपकी भाषा है, मान की भाषा है, शान की भाषा है। आज की आवश्यकता है कि हिंद हिन्दी बोले।

संस्थान के निदेशक, डॉ केवल कृष्ण शर्मा 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 साहित्यों 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 इसलिए नहीं हो रहा है कि संस्थान हिन्दी क्षेत्र में आता है बल्कि हमारी पूरी कोशिश रहती 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 ज्यादा बोली जाने वाली भाषा है इसलिए इसका चयन राजभाषा के रूप में इस उद्देश्य के साथ किया गया कि यह पुरे देश को जोड़ेगी। आने वाले समय में हमारी पूरी कोशिश रहेगी कि हम संस्थान में होने वाले कार्य ज्यादा से ज्यादा हिन्दी में ही करें।

हिन्दी चेतना मास की अवधि में दिनांक– 08–09 सितम्बर 2022 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 एवं प्रमाण पत्र प्रदान किया गया। कार्यक्रम में मुख्य अतिथि द्वारा लाक्षा के नवीनतम संस्करण लाक्षा–2022 का विमोचन किया गया। इसके साथ ही समारोह में लाक्षा–2021 में उत्कृष्ठ आलेख का पुरस्कार भी प्रदान किया गया। श्री विनोद कुमार, प्रभारी अधिकारी, राजभाषा प्रकोष्ठ ने राजभाषा प्रतिवेदन प्रस्तुत किया।

धन्यवाद ज्ञापन डॉ निरंजन प्रसाद, विभागाध्यक्ष एवं अध्यक्ष, हिन्दी दिवस समारोह आयोजन समिति ने किया। इस अवसर पर संस्थान के सभी अधिकारियों/कर्मचारियों ने भाग लिया।

Budget allocation and utilization during the financial year 2022-23

(Figures in lakh rupees)

Head of Expenditure	Other than NEH & TSP		NEH/SCSP		Total	
	Approved RE	Expenditure	Approved RE	Expenditure	Approved RE	Expenditure
ICAR-NISA			SCSP	SCSP		
Grant-in-aid Capital	74.97	74.97	34.87	34.87	109.84	109.84
Grant-in-aid-General	303.14	303.14	37.14	37.14	340.28	340.28
Non-Scheme (1270)	200.00	200.00	0.00	0.00	200.00	200.00
Grant-in-aid Salaries	1353.85	1353.85	0.00	0.00	1353.85	1353.85
Pension	291.60	291.60	0.00	0.00	291.60	291.60
Total	**2223.56**	**2223.56**	**72.01**	**72.01**	**2295.57**	**2295.57**
NWP on HPVA of NRG			**NEH**			
Grant-in-aid Capital	14.85	14.85	0.00	0.00	14.85	14.85
Grant-in-aid Salaries	0.00	0.00	0.00	0.00	0.00	0.00
Grant-in-aid-General	96.59	96.59	0.00	0.00	96.59	96.59
Total	**111.44**	**111.44**	**0.00**	**0.00**	**111.44**	**111.44**
NWP on CLIGR			**NEH**			
Grant-in-aid Capital	22.27	22.27	0.00	0.00	22.27	22.27
Grant-in-aid Salaries	0.00	0.00	0.00	0.00	0.00	0.00
Grant-in-aid-General	96.59	96.59	11.14	11.14	107.73	107.73
Total	**118.86**	**118.86**	**11.14**	**11.14**	**130.00**	**130.00**
Table-III (REVENUE GENERATION TARGETS & ACHIEVEMENTS)						
Financial Year		Target for the financial year			Revenue Generated	
2022-23		19.45			44.92	

Personnel

Details of scientific, technical, administrative and supporting staff (including KVK) as on December 31, 2022

Scientific	Sanctioned Strength	In position
R.M.P.	1	1
Principal Scientist	0	0
Sr. Scientist	8	4
Scientist	30	20
HoDs	4	0
Total	43	25
Technical		
Category-I	41	19
Category-II	20	13
Category-III	0	0
Total	61	32
Administrative		
Sr. AO	1	0
SF&AO	1	0
AAO	3	3
Private Secy.	1	1
Security Officer	0*	1
P.A.	3	0
Assistant	10	5
Sr. Clerk	5	0
L.D.C.	5	0
Total	29	10
Skilled Support Staff		
S.S.S.	43	22

* The post of Security Officer has been declared as dying cadre.

Cadre	Sanctioned post	In position
RMP	1	1
Scientific	42	24
Technical	61	32
Administrative	29	10
Supporting	43	22
Total (including RMP)	**176**	**89**
	K.V.K., Khunti	
Scientific	**Sanctioned Strength**	**In position**
P.C.	1	0
Total	1	0
Technical		
Category-I	2	0
Category-II	3	0
Category-III	6	0
Total	11	0
Administrative		
Assistant	1	1
Steno. Gr. III	1	0
Total	2	1
Skilled Support Staff		
S.S.S.	2	0

Cadre	Sanctioned post	In position
Scientific	1	0
Technical	11	0
Administrative	2	1
Supporting	2	0
Total	16	1

PERSONNEL	
DIRECTOR CELL	
Dr. Abhijit Kar, Director	
Sri S. K. Yadav, P.S. to Director	
QUALITY & PRODUCTIVITY IMPROVEMENT (QPI) DIVISION	
Dr. N.K. Sinha, P.S. & I/c Head	Seed Technology
Dr. S. Ghosal, P.S.	Agronomy
Dr. J. Ghosh, P.S.	Genetics & Plant Breeding
Dr.V.D. Lohot, Sr. Scientist	Plant Physiology
Dr. (Ms.) Thamilarasi K., Sr. Scientist	Agril.Biotechnology
Dr. Achintya Pramanik, Scientist	Agril. Entomology
Ms. Shruti Sinha, Scientist	Agril.Biotechnology
Mr. Rajgopal N.N., Scientist (On Study Leave)	Agril.Entomology
Mr. Sandeep Kumar, Scientist	Plant Biochemistry
Sri S.K. Tripathi, STA	F/F Tech. Group
Ms. Naaserah Zeesan, TA	F/F Tech. Group
Sri Vidyapati Vidyakar, TA	Lab.Tech. Group
Sri Anmol Dan Kindo, Technician	Lab.Tech. Group
Sri R.K. Nayak, SSS	
PRODUCTION & EXTENSION MANAGEMENT (PEM) DIVISION	
Dr. Nirmal Kumar, P.S. & I/c Head	Agril. Extension
Dr. Rahul R. Bakade, Scientist	Plant Pathology
Er. S.K. Srivastava, Scientist,	L.M.W.E.
Er. P.K. Parmaguru, Scientist	LWME
Sri P. Patamajhi, ACTO	F/F Tech. Group
Mohammad Tariq Zaman, TA	F/F Tech. Group
Sri Jaleshwar Horo, Technician	F/F Tech. Group
Sri R.C. Mandap, SSS	
APPLICATION & PRODUCT DEVELOPMENT (APD) DIVISION	
Dr. Md. Fahim Ansari, P.S.	Agril.Chem.
Dr. N. Thombare, Sr. Scientist	Agril.Chem.
Dr. A.R. Chowdhury, Sr. Scientist	Agril.Chem.
Dr. S.K.S.Yadav, Scientist	Agril.Chem.
Sri Md. Ali, Scientist	Agril.Chem.
Sri Ajay Kumar, T.O	Lab.Tech. Group
Sri Dewbrath Hari, TA	Lab.Tech. Group
Sri Haraprasad Naiya, TA	Lab.Tech. Group
Ms. Manju Devi, SSS	
MECHANIZATION & PROCESS ENGINEERING (MPE) DIVISION	
Dr. N. Prasad, P.S.	AS & PE
Dr. S.C. Sharma, Sr. Scientist	FM & PE
Er. S.K. Pandey, Scientist	Mech. Engg.
Dr. Sakharam Kale, Scientist	AS & PE
Er. Priyanka Sakare, Scientist	AS & PE
Sri Anup Kumar, T.O	Lab.Tech. Group

P.M.E. CELL	
Dr. V.D. Lohot, Sr. Scientist & I/c	
Sri Dipankar Ganguly, ACTO	Lab.Tech. Group
Sri Sunil Kumar, ACTO	Lab.Tech. Group
HEAD OF OFFICE	
Sri Ravi Mishra, I/c SAO	
AUDIT & ACCOUNTS SECTION	
Sri A.K. Tripathi, AAO	
Sri R.K. Toppo, Asstt.	
Sri Baijnath Mahto, SSS	
ADMIN. I SECTION	
Sri Kameshwar Oraon, AAO	
Sri K.M. Kumar, Asstt.	
Sri M.S. Purty, SSS	
Sri D.R. Gorait, SSS	
ADMIN.II SECTION	
Sri Raghunath Mahto, AAO/DDO	
Sri Abhishek Kumar, Asstt.	
Sri K.P. Kashi, Asstt.	
Sri Nageshwar Mishra, SSS	
Sri Binay Kumar Singh, SSS	
ADMIN. III SECTION	
Sri Arjun Gope, Asstt.	
RAJBHASHA PRAKOSTH	
Sri Binod Kumar, ACTO & I/c Hindi Cell	
LIBRARY	
Sri Binod Kumar, ACTO	
INSTITUTE RESEARCH FARM	
Dr. Rahul Bakade, Scientist & I/c	
Sri Satish Kumar, T.O.	F/F Technician Group
Sri Jhirga Oraon, Sr. Technician	Workshop & Engg. Group
Sri Sadhu Mahli, Technician	F/F Technician Group
Sri Paulus Ekka, SSS	
Sri Lodo Lakra, SSS	
Sri Rameshwar Mahto, SSS	
Sri Shankar Mahto, SSS	
Sri Raju Tirkey, SSS	
Sri Baiju Oraon, SSS	
Sri Luis Ekka, SSS	
ESTATE SECTION	
Sri A.K. Yadav, Security Officer.	
Sri Binay Kumar, T.O.	Workshop & Engg. Group
Sri R.K. Ravi, T.O.	Workshop & Engg. Group
Sri K.Tirkey, T.O.	Workshop & Engg. Group
Sri A.K. Sharma, T.A.	Workshop & Engg. Group
Sri Sukra Ekka, Sr.Technician	Workshop & Engg. Group
Ms. Laxmi Kumari, Asstt.	
Health Centre	
Dr. M.F. Ansari, P.S. & I/c	
Dr. Reema Khalkho, AMA	
Dr. Kailash Prasad, AMA	
Sri C.K. Singh, TO	Medical & Paramedical Group
Sri Ranvijay Singh, Technician	Lab. Tech. Group

QUALITY EVALUATION LAB.	
Dr. S.K.S. Yadav, Scientist & I/c	
Sri B.K. Singh, TO	Lab Technical Group
Sri Dewbrat Hari, TA	Lab Technical Group
VEHICLE POOL	
Sri Arvind Kumar, TO	Workshop & Engg. Group
Sri Mandeshwar Singh, TO	Workshop & Engg. Group
Sri R.K. Yadav, TO	Workshop & Engg. Group

KRISHI VIGYAN KENDRA, KHUNTI	
Dr. J. Ghosh, P.S. & I/c	Genetics & Plant Breeding, Incharge KVK
Smt. Laxmi Kumari	Assistant
Sri Rajan Choudhary	S.M.S. (Agrometeorology)
Sri Ashutosh Prabhat	Agromate Observer (GKMS)

JOINING
Dr. Abhijit Kar, Director taken over the charge on 01.11.2022
PROMOTION
Dr. (Ms.) Thamilarasi, Sr. Scientist promoted to the next higher grade w.e.f. 26.06.2020
Dr. S.C. Sharma, Sr. Scientist promoted to the next higher grade w.e.f. 15.12.2021
Dr. R.K. Yogi, Sr. Scientist (SS) promoted to the next higher grade w.e.f. 01.09.2019
Dr. A. Mohanasundaram, Sr. Scientist (SS) promoted to the next higher grade w.e.f. 20.04.2019
Dr. A.R. Chowdhury, Sr. Scientist (SS) promoted to the next higher grade w.e.f. 15.04.2021
Dr. Nandkishore Thomare, Sr. Scientist (SS) promoted to the next higher grade w.e.f. 15.09.2021
Dr. Ch. Jamkhokai Mate, Scientist promoted to the next higher grade w.e.f. 01.01.2018
Sri Bandhanoo Oraon, SSS promoted to the post of Technician (Lab. Tech. group) w.e.f. 12.01.2022
Sri Ranvijay Singh, SSS promoted to the post of Technician (Lab. Tech. group) w.e.f. 12.01.2022
Sri Jaleshwar Horo, SSS promoted to the post of Technician (F/F Tech. group) w.e.f. 12.01.2022
Sri Sadhu Mahli, SSS promoted to the post of Technician (F/F Tech. group) w.e.f. 12.01.2022
MACP
Ms.Laxmi Kumari, Assistant was given the benefit of M.A.C.P. w.e.f. 16.06.20222
Sri Abhishek Kumar, Assistant was given the benefit of M.A.C.P. w.e.f. 03.08.20222
PROBATION CLEARANCE & CONFIRMATION
Sri K.P. Kashi, Assistant, confirmed to the post from 14.11.2021
Sri K.M. Kumar, Assistant, confirmed to the post from 14.11.2021
TRANSFER
Sri Lokesh Meena, Technician was relieved on 19.02.2022 from the institute on his transfer to ICAR-CSWRI, Avikanagar, (Rajasthan)
Dr. Ashish Kumar Rout, Scientist was relieved from the institute on 31.08.2022 to join at ICAR-IIPR, Regional Station, Bhubneshwar (Odisa) on his transfer.
Dr. Ch. Jamkhokai Mate, Scientist (Agricultural Chemicals) was relieved from the institute on 27.10.2022 to join ICAR-IARI, Assam on transfer.
Shr Harihar Singh, Technical Assistant was relieved from the institute on 18.11.2022 on his transfer to ICAR-IIVR, Varanasi.
Sri Akash Sinha, Technical Asststant resigned to join to the post of Assistant Director (Agril.), Govt. of Jharkhand on 04.06.2022.
RETIREMENT
Sri Binod Kumar, T.O. on 31.01.2022
Sri Sukra Ekka, Sr. Technician on 30.04.2022
Sri Birsa Oraon, SSS on 30.06.2022
Sri Bandi Lakra, Technical Assistant on 31.07.2022
Sri Bandhanoo Oraon, Technician on 31.07.2022
Sri S.B. Azad, T.O. on 31.08.2022
Sri Bandhu Mahto, UDC on 30.11.2022
Sri Madan Mohan, T.O. on 31.12.2022

Appendix

Annexure 1: Farmers training programme on "Scientific lac cultivation, processing and utilization"

Month	Sl. No.	Sponsoring Organization	State	Period	M	F	No. of partici-pants
January	1.	JHASCOLAMPF, Ranchi	Jharkhand	11.01.22-15.01.22	21	09	30
		Private, Murshidabad, W.B.	West Bengal	11.01.22-15.01.22	01	-	01
	2.	ICICI, Foundation	Jharkhand	17.01.22-21.01.22	22	03	25
	3.	JHASCOLAMPF, Ranchi	Jharkhand	25.01.22-29.01.22	20	-	20
		Private, Jamshedpur	Jharkhand	25.01.22-29.01.22	01	-	01
February	4.	JHASCOLAMPF, Ranchi	Jharkhand	01.02.22-05.02.22	13	13	26
	5.	Tata Steel Foundation, Novamundi, West Singhbhum	Jharkhand & Odisha	14.02.22-18.02.22	40	06	46
	6.	JHASCOLAMPF, Ranchi	Jharkhand	23.02.22-27.02.22	15	14	29
March	7.	ICICI Foundation, Ranchi	Jharkhand	01.03.22-05.03.22	19	05	24
	8.	JHASCOLAMPF, Ranchi	Jharkhand	07.03.22-11.03.22	31	28	59
	9.	JHASCOLAMPF, Ranchi	Jharkhand	22.03.22-26.03.22	16	14	30
April	10.	JHASCOLAMPF, Ranchi	Jharkhand	29.03.22-02.04.22	16	16	32
	11.	JHASCOLAMPF, Ranchi	Jharkhand	26.04.22-30.04.22	17	13	30
June	12.	NABARD,Ganjam, Odisha	Odisha	06.06.22-10.06.22	23	-	23
September	13.	ICICI Foundation	Jharkhand	26.09.22-30.09.22	45	05	50
		Private	Jharkhand	26.09.22-30.09.22	02	-	02
October	14.	B.T.M., Banka, Bihar	Bihar	10.10.22-14.10.22	04	18	22
November	15.	JHASCOLAMPF, Ranchi	Jharkhand	21.11.22-25.11.22	31	10	41
December	16.	JHASCOLAMPF, Ranchi	Jharkhand	05.12.22-09.12.22	47	03	50
	17.	SFTI, Mahilong, Ranchi	Jharkhand	12.12.22-16.12.22	69	04	73
Total					**453**	**161**	**614**

Annexure 2: Educational programme on "Training on Natural Resins and Gums" (10/15 days)

Month	Sl. No.	Sponsoring Organization	State	Period	M	F	No. of partici-pants
Jan.	1	BHU, Varanasi, Uttar Pradesh	Uttar Pradesh	27.12.21-05.01.22	18	19	37
June	1	Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (Uttar Pradesh	Uttar Pradesh	26.05.22-04.06.22	08	14	22
Nov.	1	Binod Bihari Mahto Koylanchal University, Dhanbad (Jharkhand) and Gopal Narayan Singh University, Sasaram (Bihar).	Jharkhand & Bihar	07.11.22-16.11.22	21	24	45
Total					**47**	**57**	**104**

Annexure 3. On-farm training programme on lac cultivation

Camp No.	District – State	Nominating Agency	Venue (Village, Block)	Dated	M	F	No. of Participants	Expert
1	Giridih, Jharkhand	Forest department, Giridih	Khurchutta forest rest house, Bengabad	06.01.22	20	30	50	Sh. P. Patmajhi
2	Gumla Jharkhand	ATMA, Gumla	Suruhu Panchayat, Kamdara	16.03.22	45	07	52	Sh. P. Patmajhi
3	Gumla Jharkhand	ATMA, Gumla	Basia Block Training Hall	16.03.22	20	26	46	Sh. S.B. Azad

Camp No.	District – State	Nominating Agency	Venue (Village, Block)	Dated	M	F	No. of Participants	Expert
4	Garhwa (S) Jharkhand	Forest department, Garhwa (South)	Training Hall, Garhwa (South)	29.11.22	50	-	50	Sh. P. Patmajhi
5	Chandwa, Jharkhand	RFO, Chandwa	Forest Range Office	17.12.22	50	-	50	Sh. P. Patmajhi
Total					**185**	**63**	**248**	

Annexure 4: On-farm Motivational/ Supplementary training programme on lac cultivation

Camp No.	District – State	Nominating Agency	Venue (Village, Block)	Dated	M	F	No. of Participants	Expert
1	Gumla, Jharkhand	ATMA, Gumla	Suruhu Panchayat Sachivalaya, Kamdara	16.03.22	45	07	52	Sh. P. Patmajhi
2	Gumla, Jharkhand	ATMA, Gumla	Training Hall, Basia	16.03.22	20	26	46	Sh. SB Azad
Total					**65**	**33**	**98**	

Annexure 5: On-campus one-day Orientation programme on lac cultivation

Camp No.	District –State	Nominating Agency	Dated	M	F	No. of Participants
1.	Ranchi, Jharkhand	Forest Training School, Mahilong, Ranchi	12.01.22	26	02	28
2.	Ranchi, Jharkhand	R. K. Mission Vishwavidlaya, Ranchi	21.02.22	10	28	38
3.	Ranchi, Jharkhand	Forest Training School, Mahilong, Ranchi	26.02.22	20	03	23
4.	Ranchi, Jharkhand	Progressive farmers (Individual)	26.02.22	51	-	51
5.	Ranchi, Jharkhand	Marwari College, Ranchi	10.03.22	15	25	40
6.	Samastipur, Bihar	ATMA, Samastipur, Bihar	26.03.22	29	-	29
7.	Ranchi, Jharkhand	Bishop West Cott girls School, Doranda	02.04.22	-	55	55
8.	Ranchi, Jharkhand	JAC, Namkum, Ranchi	08.04.22	05	-	05
9.	Ranchi, Jharkhand	Amity University, Ranchi	19.04.22	03	13	16
10.	Hazaribag, Jharkhand	AISECT University, Hazaribag	02.05.22	19	28	47
11.	Ranchi, Jharkhand	R. K. Mission Vishwavidlaya, Ranchi	17.05.22	40	36	76
12.	Ranchi, Jharkhand	Sai Nath University, Ranchi	17.05.22	35	25	60
13.	Ranchi, Jharkhand	YBN University, Ranchi	18.05.22	18	10	28
14.	Ranchi, Jharkhand	Rai University, Ranchi	19.05.22	29	20	49
15.	Ranchi, Jharkhand	BAU, Kanke, Ranchi	20.05.22	22	40	62
16.	Ranchi, Jharkhand	Army Officers from Namkum Cantonment	28.05.22	19	01	20
17.	Ranchi, Jharkhand	Ranchi University, Ranchi	30.05.22	05	09	14
18.	Ranchi, Jharkhand	Government officials	02.06.22	04	05	09
19.	Ranchi, Jharkhand	Lt. Col. Varun Shety & Army Officials	18.06.22	30	31	61
20.	Ranchi, Jharkhand	Ozford Public School, Ranchi	21.06.22	27	30	57
21.	Ranchi, Jharkhand	College of Agricultural Engineering, BAU, Ranchi	23.06.22	19	19	38
22.	Ranchi, Jharkhand	VDVK, Perka	23.06.22	03	09	12
23.	Guwahati, Assam	Officials from different KVKs	07.07.22	03	02	05
24.	Ranchi, Jharkhand	ICICI Foundation, Ranchi	15.07.22	02	03	05
25.	Ranchi, Jharkhand	BAU, Kanke, Ranchi	21.07.22	14	29	43
26.	New Alipore, W.B.	New Alipore College, West Bengal	02.08.22	12	-	12
27.	Ranchi, Jharkhand	NBJK, Ranchi	23.08.22	09	16	25
28.	Ranchi, Jharkhand	The Voice (NGO), Ranchi	26.08.22	03	-	03
29.	Balaghat, M.P.	Gram Seva Trust, Balaghat, Madhya Pradesh	07.09.22	01	01	02
30.	Latehar, Jharkhand	Progressive farmers (Individual)	12.09.22	25	04	29
31.	Ranchi, Jharkhand	Progressive farmers (Individual)	26.09.22	43	05	48

Camp No.	District –State	Nominating Agency	Dated	M	F	No. of Participants
32.	Akola, Maharashtra	RC&MC, Akola, Maharashtra	03.10.22	08	14	22
33.	Banka, Bihar	B.T.M.	11.10.22	04	18	22
34.	Ranchi, Jharkhand	Santosh College of Teacher Training, Ranchi	20.10.22	25	125	150
35.	Ranchi, Jharkhand	Agricultural Directorate, Ranchi	21.10.22	01	03	04
36.	Sundargarh, Odisha	Nuagaon, Sundargarh, Odisha	02.11.22	10	10	20
37.	Ludhiana, Punjab	Progressive farmers (Individual)	03.11.22	03	03	06
38.	Ranchi, Jharkhand	College of Agricultural Engineering, BAU, Ranchi	09.11.22	08	31	39
39.	Khunti, Jharkhand	R.K.M., Murhu, Khunti	10.11.22	15	10	25
40.	Ranchi, Jharkhand	XISS, Ranchi	25.11.22	25	20	45
41.	Ranchi, Jharkhand	Jamtoli, BSO, Ranchi	05.12.22	47	03	50
42.	Ranchi, Jharkhand	CTR&TI, Nagri, Ranchi	07.12.22	06	09	15
43.	Ranchi, Jharkhand	SFTI, Mahilong, Ranchi	12.12.22	67	03	70
44.	Ranchi, Jharkhand	HARD, Katma, Ranchi	16.12.22	16	09	25
Total				**776**	**707**	**1483**

Annexure 6: Schedule Caste Sub-Plan (SC-SP)

Number	Particulars	Number of beneficiaries	Duration
Palamu			
1	Scientific method of Mushroom cultivation	30	5
2	Natural Farming	30	3
3	Natural Farming	30	3
4	Pig rearing	30	3
5	Goat rearing	30	3
6	Integrated Farming System	30	3
Ranchi			
7	Vegetable cultivation through DRIP irrigation system	25	4
8	Nutritional Garden	25	4
9	Cultivation of Drumstick and its processing	25	3
10	Multilayer Vegetable Production	25	5
11	Botanical Pesticides – Best Income generating module	25	5
12	Pulse production and its processing	25	4
13	Production of Mustard & other oilseed crops	25	3
Garhwa			
14	Stitching to SC women	30	15
15	Natural farming	30	3
16	Masroom cultivation	30	6
17	Cultivation of nutricireal	30	3
18	Honeybee rearing	30	3
19	Integrated farming system	30	3
	Total	**565**	**36**

Annexure 7: Kisangosthi/Workshop/Educational Programme on lac cultivation

Camp No.	District –State	Nominating Agency	Venue (Village, Block)	Dated	No. of Participants	Name of programme
1.	Ranchi, Jharkhand	IINRG, Ranchi	Football Ground, ICAR-IINRG, Namkum, Ranchi	26.02.22	750	Kisan Mela-cum- Agricultural Technology Exhibition-2022
2.	Ranchi, Jharkhand	IINRG, Ranchi	Football Ground, ICAR-IINRG, Namkum, Ranchi	27.02.22	635	Kisan Mela-cum- Agricultural Technology Exhibition-2022
Total					**1385**	

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