

**HANDS-ON TRAINING COURSE
APPLICATION OF ADVANCED ANALYTICAL
INSTRUMENTS IN AGRICULTURE
(WORKSHOP ON ANALYTICAL METHODS)**

17th May – 24th May 2022



**Under
Synergistic Training Program Utilizing the Scientific and Technological
Infrastructure (STUTI)**

**Organized by
Punjab Agricultural University, Ludhiana
in association with
SAIF/CIL Punjab University, Chandigarh**

MESSAGE



**Dr. A S Dhatt,
Director of Research,
PAU, Ludhiana**

The agricultural sector in India is diverse in all the aspects like crops, livestock, climate, foods etc. But today, there is tremendous pressure to produce greater quantities of food, feed and biofuel on limited land and resources. Today doubling the Farmers income has become one of the major focuses of Government of India specially the vision of our Honorable Prime Minister to meet food security, sustainability and poverty reduction in India. Due to lack of knowledge about recent technologies along with management systems in agricultural sector, farmers are unable to utilize the available resources.

Stakeholders engaged in agricultural research and development is increasingly tackling risks associated with climate change. Accordingly, development and scaling of climate-agriculture are one of the priorities for all the organizations, departments and ministries associated with the farm sector.

To realize the targets of growth rate set out in the agriculture policy, adequate trained manpower, that is professionally competent, socially sensitive and ethically strong, is required to provide the technical backstopping. It is the need of the hour to educate the potential researchers about the latest techniques available in all the allied fields of agricultural sector.

This training on Application of Advanced Analytical Instruments in Agriculture has gone a long way in honing the skills of the participants in their respective research areas as well as encouraged them in collaborative work for achieving specific research goals. As the problems of agriculture are complex, the participants were trained not only in very specialized fields of science but they also had the requisite broad-based knowledge of the related fields as well. This training enabled us to utilize the infrastructural facilities to their full potential.

This training program provided a platform to discuss and exchange ideas and knowledge among the academicians, scientists and expert/ resource persons who have made their notable contribution in this field.

I thank the Department of Science and Technology for providing adequate funds for the training and extend my thanks to the organizers and participants for successful training program.

MESSAGE



**Dr. G.S. Mangat,
Additional Director of Research (Crop Improvement),
PAU, Ludhiana**

I congratulate the participants for successful completion of the training program, “Hands-On Training Course on Application of Advanced Analytical Instruments in Agriculture (Workshop on Analytical Methods) from May 17, 2022 to May 24, 2022 being organized under the aegis of STUTI in collaboration with SAIF/CIL, Punjab University, Chandigarh.

Demand for agricultural commodities is rising rapidly as the world's population grows. Agriculture's deep connections to the world economy, human societies and biodiversity make it one of the most important frontiers for conservation around the globe. The need for sustainable resource management is increasingly urgent. Punjab Agricultural University is committed to serve the farming community and support food security issues. The University has focused its research agenda towards technology dissemination programmes for sustainable development i.e. productivity enhancement accompanied by conservation/amelioration of natural resources. It emphasizes on integrated management of insect pests, diseases, nutrients and water, and conservation agriculture with tangible results.

The challenges of modern-day agriculture demand rapid and precise analysis and appropriate solutions. With the aim to impart new skills for the operation and maintenance of advanced instruments being used for precise analysis in agriculture and advanced research in the laboratories, human resource needs to be trained. The aim of such training is the improvement of the working skills of the researchers and to provide practical training in handling of advanced instrumentation.

Through this training program the participants will be able to disperse the knowledge gained by them during the seven-day training in their respective subject areas and place of work. This training program enriched the learning experience of participants which will help them in their future endeavors.

MESSAGE



**Dr. Poonam A.Sachdev,
Principal Food Technologist (Vegetable) cum Head,
Department of Food Science & Technology, PAU**

On behalf of the organizing committee, it was an honor and pleasure to organize this STUTI training program at Punjab Agricultural University, the harbinger of Green Revolution. The training program, “Hands-On Training Course on Application of Advanced Analytical Instruments in Agriculture (Workshop on Analytical Methods) from May 17, 2022 to May 24, 2022 was organized under the aegis of STUTI in collaboration with SAIF/CIL, Panjab University.

The training program encompassed key instrumental techniques and advanced strategies that are used in modern agriculture. Agriculture is a broad field which encompasses various sub disciplines such as Plant Breeding and Genetics, Fruit Science, Vegetable Science, Food Science and Technology, Entomology, Plant Pathology and Soil Science. This training program was designed to provide holistic knowledge about the various agricultural fields and upgrade the skills which would help to hone their research capabilities.

This training program primarily helped the participant in understanding the working of various advanced instrumentation in the lab and field work and the participants could further disseminate the knowledge and skills gained through this training. This training program would have played a vital role in understanding the basic and advanced instruments in agriculture field and their working. The participants through this training program were educated about proper sample collection techniques, real time PCR, CRISPR sequences, climate resilient IPM technology, product profiling for its nutritional content, breeding field crops for quality and bio-fortification etc.

Through this training program the participants would have learned about the various fields of agriculture gained new knowledge and updated their current knowledge.

MESSAGE



**Dr. Shivaprasad,
Scientist, R&D infrastructure,
DST, New Delhi**

Cordial greetings from Department of Science and Technology (DST), New Delhi
DST has many scientific and engineering programs that are aimed to promote research in science. Five flagship schemes of DST for developing R&D Infrastructure in all Science (including Medical & Agriculture) and Engineering Departments are FIST, PURSE, CURIE, SAIF and SATHI. This year DST has initiated "Azadi Ka Amrit Mahotsav" to celebrate 75th year, of Independence. Various training programs and workshops are being organized throughout the country to encourage, empower and expose the young researchers to the new innovations in the field of science.

It was a pleasure to be part of 4th Training Program on "Application Of Advanced Analytical Instruments In Agriculture" under the Synergistic Training Program Utilizing the Scientific and Technological Infrastructure (STUTI) initiative of DST, organized by Punjab Agricultural University(PAU), Ludhiana in association with SAIF/CIL Panjab University from 17th – 24th May, 2022. This hands-on training program was a big stride forward in fulfilling the DST's vision to build human resource and its knowledge through open access to S & T Infrastructure across the country. This training program empowered the young minds of the participants with desired technical skills and knowledge.

Participants from 15 different institutes/universities from different parts of country took part in this hands-on training program. It was very heartening to see that among the 31 participants of training program 19 were female. The organizers also took utmost care that fair representation is also given to the applicants belonging to different reserve categories.

I applaud the organizers for bringing excellent experts from different domains of agriculture for providing very knowledge and practical training to participants. I extend my sincerest compliments to the coordinators and organizing committee for a very successful training program. I am sure that all the skills learned by participants during the training program will be utilized by them for complementing their research and will also be transferred further.

MESSAGE



**Prof. G R Chaudhary,
Director, SAIF/CIL,
Coordinator STUTI-PMU,
Panjab University(PU), Chandigarh**

Dear Participants,

Greetings from SAIF, PU, Chandigarh.

I feel delighted on occasion of this fourth STUTI training program. This DST scheme envisions hands-on training programs and sensitization of the state-of-the-art equipment as well as towards sharing while ensuring transparent access of S&T facilities. Sophisticated Analytical Instrumentation Facility (SAIF), Panjab University feels proud to be part of this program. Our department is always striving for prompt services and quality analysis to support researchers from academia, R&D labs and industries from all over India.

The centre houses 25 state-of art analytical instruments with high upkeep time; workshop facilities to repair analytical instruments and postgraduate courses like MTech (Instrumentation) and M.Sc (Instrumentation).

This training program organized by Punjab Agricultural University(PAU), Ludhiana in association with SAIF/CIL Panjab University from 17th – 24th May, 2022 has imparted participants with very practical training through visits to various agricultural fields. Through this training program participants also got an opportunity to get hands-on training on sophisticated instruments in the different fields of agriculture. I strongly feel that after going through this program on "Application of Advanced Analytical Instruments in Agriculture", the participants will be able to use these instruments and use the knowledge gained through this training program more effectively in their research. This will not only improve the quality of research but also help in optimum utilization of instrumentation facilities at their institutes.

With best wishes

PUNJAB AGRICULTURAL UNIVERSITY, LUDHIANA

Located in Ludhiana city (Punjab State) in north-west India at a distance of 316 km from New Delhi, it is spread over an **area** of 494 hectares at Ludhiana with an off-campus area of 1793 hectares. The university now has four constituent **colleges**, viz.

College of Agriculture, College of Agricultural Engineering & Technology, College of Basic Sciences & Humanities, College of Community Science & College of Horticulture and Forestry, besides PAU Pre-Graduation Institutes of Agriculture at Gurdaspur and Bathinda. Presently the university, through **32 departments** and **3 schools** in the four constituent colleges, offers 43



Master's and 29 Ph.D. Programmes besides 11 under-graduate programmes. The university has on its rolls 2917 **employees**, out of which 771 comprise teaching-faculty and 2146 are non-teaching staff. The university has **8 Research Stations**, **3 Fruit Research Stations**, **4 Seed Farms**, and 18 Krishi Vigyan Kendras (**KVKs**) The university also extends services to farmers through 14 Farmers' Advisory Service Centres (**FASCs**).

The university aims at providing quality education; undertaking basic, applied and adaptive research; to seek appropriate solutions to the emerging farm problems; developing effective mechanism for technology transfer; developing technology for supporting growth of agro-based industries; and generating self-employment opportunities for the educated youth.

The spectacular improvement in productivity of food grains has led to an increase in food production from 3.2 million tonnes in 1960-61 to 26.8 million tonnes in 2014-15. It led to considerable enhancement of farmers' income in the state. The state-of-art research by the university scientists in apiculture and mushrooms led to spectacular increase in their production. The state presently produces 37% of total honey and 50% of total mushroom production in the country. The PAU has been responsible for large-scale reclamation of saline and sodic soils (6 lakh ha) in the state, thereby rendering these fit for crop production. Providing quality seed to the farmers for higher production has been an important component of PAU producing about 69,000 quintals of improved seed during 2015-16, apart from producing 3.18 lakh seedlings of fruit plants and 1.65 lakh seedlings of forest trees.

The high-quality education at PAU has resulted in recognition of its alumni at national and international levels as Director General of ICAR, CSIR, ICFRE; Member NITI Ayog; Chairman, ASRB; Chairman CACP (GOI); DDG, ICAR; Vice Chancellors; Agricultural/Horticultural Commissioners (GOI); ADG/Directors of ICAR institutes; National Professors; DDG/Director, International Organizations; Union Minister, Govt of Kenya, etc.

DEPARTMENT OF SCIENCE AND TECHNOLOGY, NEW DELHI

Department of Science & Technology (DST) was established in May 1971, with the objective of promoting new areas of Science & Technology (S&T) and to play the role of a nodal department for organizing, coordinating and promoting S&T activities in the country. The Department has major responsibilities for specific projects and programmes such as formulation of policies relating to Science and Technology, matters relating to the Scientific Advisory Committee of the Cabinet (SACC), promotion of new areas of Science and Technology with special emphasis on emerging areas, coordination and integration of areas of Science & Technology having crosssectoral linkages in which a number of institutions and departments have interest and capabilities, Undertaking or financially sponsoring scientific and technological surveys, research design and development, where necessary and support and grants-in-aid to scientific research institutions, scientific associations and bodies.

DST has many scientific and engineering programmes that are aimed to promote research in science. It includes creation of Mega Science facilities and launch Mega Science projects in and out of the country to improve access to such state-of-the-art facilities for the Indian scientific community, especially from the academic sector. Because of technical complexities and requirement of large resources, such projects are manifestly multi-agency, multi-institutional and, quite often, international in character. DST and the Department of Atomic Energy (DAE) have been jointly promoting most of such projects in the country. Another innovative program is, Innovation of Science Pursuit for Inspire Research (INSPIRE) for attracting of young talent to science.

The R&D Infrastructure Division of the Department aims to strengthen the S&T infrastructure of the country by fostering well-equipped R&D labs in the academic/research institutes/universities as well as a strong culture of research collaboration between institutions and across disciplines. It has four schemes viz. Fund for Improvement of S&T Infrastructure in Universities and Higher Educational Institutions (FIST), Promotion of University Research and Scientific Excellence (PURSE), Sophisticated Analytical Instrument Facilities (SAIF), Sophisticated Analytical & Technical Help Institutes (SATHI) and Synergistic Training Program Utilizing the Scientific and Technological Infrastructure (STUTI). The objectives of these program, at large, are establishment of R&D labs, centers, upgradation of research facilities orienting towards creating a self-reliant India.

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY



The Department of Food Science and Technology was established in 1972 under the College of Agriculture. The Department offers Food Technology as Elective in B.Sc. Agriculture, B.Tech. (Food Technology), masters and doctorate programmes in Food Technology. It has four sections viz. cereals, fruit and vegetables, dairy, meat and egg Technology. The department has produced around 450 trained food technologists so far. The department undertakes basic and applied research on value addition of foods. A pioneer among the State Agricultural Universities, the department has developed sophisticated laboratories and pilot plants for tackling the problems faced by the food processing industry in and around the state. The extension wing of the department conducts various training programmes for the benefits of the farmers, women and entrepreneurs. The expertise of the Department is also available to the industry in diverse ways, which include developing technologies and assessment of quality and analysis of raw material and food products. The Department has built linkages with private and public sectors, food industries, other agencies and institutes. The Department has established Food Industry Centre with the technical guidance of Ohio State University, USA with the aim of upscaling the technologies developed for value addition of food crops. Similarly, the department has set up Food Processing Training-cum-Business Incubation Centre at Bathinda to impart hands-on training to farmers and entrepreneurs in food processing.

HIGHLIGHTS OF THE TRAINING PROGRAM

Modern day agriculture demands perfection in terms of inputs, monitoring and quality control. The aim of this training is to apprise the participants about the working of the advance instruments in the various allied fields of agriculture like plant breeding and genetics, soil science, horticulture science, plant protection, food science etc. The training will hone the skills of the faculty/ PhD scholars/ research fellow who are actively involved in research and development and require knowledge of agriculture field.

This will enhance the skills of participants in the assessment of quality parameters regarding breeding of field crops and horticultural crops, rheology of food products, strategies for pest control, DNA fingerprinting and strain typing in plant pathogenic bacteria, and use of state of art instruments in soil, plant and water analysis.

This training will also provide the opportunity to the participants to have one-to-one interaction with eminent scientists in the field of agriculture and allied fields.

LEARNING OUTCOMES OF THE PROGRAM

At the end of the training, participants will be conversant with the following

- Basic and advanced instruments in agriculture field and their working
- Method of sample collection for soil analysis
- Rheological measurements of semi solid foods and cereal doughs
- Real time PCR
- Strain typing using bacterial tal effector
- CRISPR sequences
- Climate resilient IPM technology
- Product profiling for its nutritional content
- Breeding field crops for quality and bio-fortification

RESOURCEPERSONS



Dr (Mrs) Achla Sharma

Principal Wheat Breeder,
Dept. Plant Breeding & Genetics, CoA,
PAU Ludhiana



Dr (Mrs) RupinderKaur

Principal Rice Breeder
Dept. Plant Breeding & Genetics, CoA,
PAU Ludhiana



Dr (Mrs) Neerja Sharma

Principal Biochemist (Rice)
Dept. Plant Breeding & Genetics, CoA,
PAU Ludhiana



DrInderjit Singh

Principal Pulse Breeder
Dept. Plant Breeding & Genetics, CoA,
PAU Ludhiana



Dr (Mrs) Grewal, SatvirKaur

Senior Biochemist
Department of Biochemistry
PAU Ludhiana



Dr. LenikaKashyap

Analyst (Wheat)
Dept. Plant Breeding & Genetics, CoA,
PAU Ludhiana



DrAnirudh Thakur

Associate Professor (Fruit Science)
Department of Fruit Science, College of
Horticulture and Forestry, PAU, Ludhiana



DrJaswinder Singh Brar

Principal Fruit Scientist
Department of Fruit Science, College of
Horticulture and Forestry, PAU, Ludhiana

RESOURCEPERSONS



Dr. Abhishek Sharma

Principal Virologist
Department of Vegetable Science, College of
Horticulture and Forestry, PAU, Ludhiana



Dr. Mandeep Singh Hunjan

Principal Plant Bacteriologist
Dept. Plant Pathology, CoA,
PAU Ludhiana



Dr. Parminder Singh Tak

Plant Pathologist
Dept. Plant Pathology, CoA,
PAU Ludhiana



Dr. Yesmin Kaur

Plant Pathologist
Dept. Plant Pathology, CoA,
PAU Ludhiana



Dr. Jaspal Singh

Principal Entomologist
Department of Entomology,
PAU, Ludhiana



Dr. Kamaljeet Singh Suri

Principal Entomologist
Department of Entomology,
PAU, Ludhiana



Dr. Manmeet Brar Bhullar

Principal Acarologist
Department of Entomology,
PAU, Ludhiana



Dr. Smriti Sharma

Sr Scientist (Residue Analysis)
Department of Entomology,
PAU, Ludhiana

RESOURCE PERSONS



Dr Vijay Kumar
Principal Entomologist
Department of Entomology,
PAU, Ludhiana



Dr Vikas Jindal
Principal Entomologist
Department of Entomology,
PAU, Ludhiana



Dr Jaspreet Kaur
Food Technologist
Department of Food Science and Technology,
PAU, Ludhiana



Dr Sukhpreet Kaur
Food Technologist (Fruit & Vegetable)
Department of Food Science and Technology,
PAU, Ludhiana



Dr Dhanwinder Singh
Principal Soil Chemist
Department of Soil Science,
PAU, Ludhiana



Dr Gazala Nazir
Soil Scientist
Department of Soil Science,
PAU, Ludhiana



Dr. G.S. Dheri
Assistant Soil Chemist
Department of Soil Science,
PAU, Ludhiana



Dr Sumita Chandel
Assistant Soil Chemist
Department of Soil Science,
PAU, Ludhiana

DAY 1. 17.05.2022

Dr. Poonam A. Sachdev, Head, Department of Food Science & Technology, PAU and coordinator of the STUTI training program being held at PAU, Ludhiana from 17-24 May, 2022, gave a formal welcome to dignitaries and participants and she also highlighted the diversity of participants in the training program ranging from Jammu & Kashmir to Tamil Naidu.



Dr. Poonam A. Sachdeva



Dr. G.R Chaudhary

Guest of Honour, **Prof. G. R. Chaudhary**, Director SAIF/CIL & Panjab University and Coordinator of the STUTI-PMU, PU, Chandigarh focused on integrating technology for transforming waste into valuables. He also shared the details of the state-of-the-art equipments and facilities that SAIF/CIL offers. Along with this, he highlighted the contributions made by the department by innovating and donating air-purifiers and UV currency sanitizers to hospitals and offices in and around Chandigarh during the COVID-19 pandemic. He talked about the popularity and success of the previously held STUTI training and awareness programs.

Dr. A.S. Dhatt, Director of Research, PAU, Ludhiana and chairperson, welcomed the chief guest and guest of honor with potted medicinal plants. He further gave the information about research activities of PAU and its role in transforming the basic research to applied research in the field of agriculture.



Dr. A.S. Dhatt



Dr. Shivaprasad

Worthy **Chief Guest Dr. Shivaprasad**, Ministry of Science & Technology, gave information about various schemes of DST regarding R&D infrastructure (FIST, SAIF, PURSE and SATHI). He also encouraged the participants and faculty member to avail the opportunities through the STUTI program to build human resources and its knowledge capacity through open access to S&T Infrastructure.

Dr G S Mangat proposed vote of thanks



Dr. G.S. Mangat





DAY 2, 18.5.2022

Dr.Achla Sharma delivered a lecture on, 'Quality breeding in wheat: Status and prospects.' The quality has emerged as a newer mandate in view of changing policies and consumer awareness. The reorientation and reprioritization of the breeding methods, their implications and anticipated outcomes was discussed in detail.

Dr.LenikaKashyap, in a practical session discussed the nutritional importance of wheat in relation to wheat constituents and their specific role in determining the end product quality. She discussed different methods used for the quality evaluation of wheat grains, flour and products. The physical characteristics of grain shape, size, colour, weight and hardness indicative of potential processing quality were discussed.

Information on several chemical (protein content, sedimentation test and gluten index) and rheological tests including Mixograph, Farinograph, Alveograph for evaluation of dough and gluten strength and baking quality, was shared. Methodologies for important quality parameters analysis and instruments being used for quality analysis were demonstrated.

Dr.RupinderKaur and DrNeerja Sharma discussed the rice quality parameters, their present status in terms of breeding progress and prioritization and the outcomes. The participants were briefed about the facilities available for evaluation of rice quality and biofortification.



Expert Talk

Dr Inderjeet Singh and Dr Satbir Kaur discussed the quality mandates in pulses breeding, especially in case of chickpea and pigeon pea. The biofortification avenues in terms of enhanced iron and zinc in already protein enriched pulse grains were discussed and the participants were shown the infrastructure and the fields.



Hands on Training & Field Visit to BISA, Laddowal



Briefing about the facilities available for evaluation of rice



Discussion about the quality mandates in pulses breeding

DAY 3, 19.05.2022

The demonstrations and hand-on training on field application of IRGA was given to the participants with CID Bio-Science's CI-340 Handheld Photosynthesis System which is a portable and handheld tool that measures photosynthesis, respiration, transpiration, stomatal conductance, PAR and internal CO₂. The trainees were acquainted with importance of photosynthesis in plants, methods of measurement, principal of IRGA and practical training for recording of rate of photosynthesis in fruit crops viz. guava and citrus.



Method demonstration of photosynthesis (IRGA) system



Hand-on training on application of IRGA for photosynthesis measurement in the field

The trainee participants were provided with hand-on training on drilling in the stem/trunk portion of woody plants to insert sensors to install Sap Flow Meter, fixing of solar panel and data downloading of sap flow meter.



Practical demonstration of Sap Flow Meters



Hand-on training

Demonstration and hand-on-training was given on F-900 model of Ethylene analyzer. It provides measurements of ethylene in real time. Used for controlled atmosphere facilities, cold storage, and shipping containers. In the training, the measurement of ethylene in PPM and PPB concentration present in different fruit samples was demonstrated using GC measurement methods of ethylene analysis.

Ethylene analysis of immense significance for experimentation of Post-Harvest Technology of horticultural crops. For training purposes, a measured weight of the plum fruits was stored in a glass container of known volume and kept for different intervals for buildup of ethylene inside the container. The ethylene gas accumulated in the containers was extracted with the help of glass syringe and inserted in the connecting tube for determination of ethylene concentration. The trainees obtained the hand-on practice for starting of equipment, calibration of equipment, setting for data recording, extraction and injection of ethylene gas inside the connecting tube, final data recording and flushing of gas from the equipment for next recording.



Trainees getting training on ethylene analysis in fruit samples



Training on HPLC system



Trainees undergoing hands-on training on qPCR and other Instrument at Department of Vegetable Science, PAU, Ludhiana



DAY 4, 20.05.2022

The morning session included visit to the Food Industry Business Incubation Centre to apprise the trainees about the processing facilities of the department.

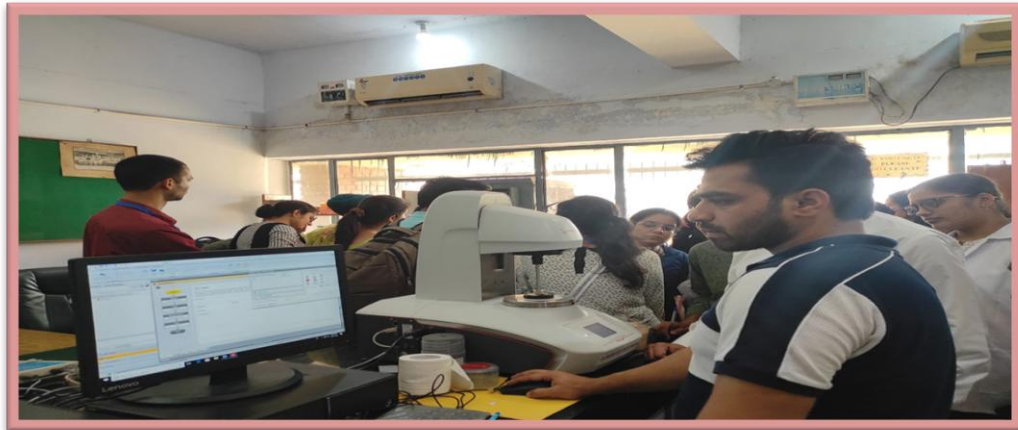
The first lecture by DrJaspreetKaur, Food Technologist, Department of Food Science and Technology was regarding rheological measurements in foods. After briefing the trainees about the important applications of rheology in foods, she gave an overview of the rheological measurements in foods. She also explained the application and working of Farinograph and Rheometer in quality analysis of cereal doughs and visco-elastic fluids.



In the second lecture, Dr. Sukhpreet Kaur, Food Technologist (Fruit and Vegetable) presented the working and applications of Rapid Visco Analyzer for starch-based products. She explained in detail, the pasting behaviour and factors affecting the pasting properties of cereal as well as tuber starches



In the afternoon, the trainees were given hands-on training on the sample preparation and analysis of food samples using a Doughlab and Rheometer.



Hands-on Training on Doughlab and Rheometer

Day 5, 21.05.2022

ECO-FRIENDLY STRATEGIES FOR MANAGEMENT OF MAJOR INSECT PESTS IN FIELD CROPS

The first talk of the 5th day was delivered by Dr Vijay Kumar, Principal Entomologist, Department of Entomology, PAU, Ludhiana who spoke on eco-friendly strategies for management of major insect pests in field crops. Dr Kumar broadly cover the cultural, mechanical, biological and botanical control measures developed and recommended against major insect pests of field crops for the farmers of the Punjab. The talk also included various other technology developed like economic threshold level, waiting period. He also emphasized on use of various non-chemical approaches to reduce the pesticide load in the environment.

The second lecture was delivered by Dr Vikas Jindal, Principal Entomologist, Department of Entomology, PAU, Ludhiana, who spoke on the Identification of potential genes for management of insect pests. Dr Jindal also explained the how the molecular techniques can be used for identification of insect pests. The use qPCR machine for gene expression studies in insects was also demonstrated.

The third lecture was delivered by Dr K S Suri, Principal Entomologist, Department of Entomology, PAU, Ludhiana on impact of climate change on insect pests of rice and wheat. He discussed about the climate resilient strategies like constant surveillance, early detection and rapid response, periodic revalidation of recommended IPM practices and strict quarantine needs to be undertaken at regional, national and international levels to prevent the entry of invasive pests to new areas.

The practical hand on training was given by Dr Smriti Sharma, Senior Scientist (Residue Analysis) on estimation of pesticide residues in different commodities. It included a brief overview on the importance of pesticide residues and their analysis followed by training on extraction and cleanup methodology for analysis. Further, different analytical techniques and detection and estimation of pesticide residues on instruments like Gas chromatograph, High pressure liquid chromatograph, Gas chromatograph mass spectrometer and liquid chromatograph mass spectrometer were explained to the participants.

Dr. Manmeet Brar Bhullar, Principal Acarologist showed the insect museum where collection of various insect pests belonging to different orders and families and also discussed their economic importance.



The day concluded with a visit to Apiculture Unit at Entomological Research Farm, PAU, Ludhiana, where Dr Jaspal Singh, Principal Entomologist and Amit Chaudhary, Entomologist discussed about the several avenues for increasing apiary profitability. Among these avenues, production, processing, packaging and marketing of royal jelly, pollen, propolis, bee venom, beeswax and rearing queen bee at commercial level are the major aspects for development of entrepreneurship.





Visit and Hands on training at Apiculture Unit at Entomological Research Farm



Plant Growth Chamber with CO₂ regulation installed in the Climate Change Laboratory of the Department of Entomology, PAU, Ludhiana

Day 6, 23.05.2022

In the forenoon, the participants were apprised about different activities of Department of Plant Pathology and the Plant bacteriology laboratory. DrMandeepHunjan, Principal Plant Bacteriologist introduced the trainees with novel techniques that are being used in the Plant Bacteriology Laboratory for genetic fingerprinting of plant and human pathogenic bacteria. He gave a detailed presentation of the topic “TAL effectors- and CRISPR- based markers- Towards genetic decoding of race pattern, evolution and population structure in phytobacterial pathogens”. Later on the participants were provided demonstration on how to develop TAL effector- and CRISPR-based DNA markers *in silico* and their use in wet lab experiments. DrYesminKaur and MsSonaliKatoch, PhD student in the lab demonstrated setting up a PCR followed by Gel analysis, gene cloning, sequencing and sequence analysis.

During the afternoon, the participants were taken to Biocontrol lab of the department where MsSukhmanAulakh, a PhD student provided the trainees with hands-on training on use of automatic bio fermenter for mass production of biocontrol agents. Dr D.S. Buttar, Inchargebiocontrol unit of the department gave a brief lecture on mass production of biocontrol agents, their formulated products and eventually their field use by the State farmers.



DrYesminKaur and MsSonaliKatoch demonstrating on the use of various equipments for CRISPR – based DNA fingerprinting of Plant Pathogenic bacteria



Dr D.S. Buttar and Dr Mandeep Hunjan interacting with the trainees about the working of biocotnrol lab in the Department of Plant Pathology



Ms Sukhman Aulakh, PhD student in the Department of Plant Pathology explaining the working of digital automated fermenter to the trainees

Day 7, 24.05.2022

The first lecture was delivered by Dr GS Dheri, Senior Soil Chemist, Punjab Agricultural University, Ludhiana on “Sampling and Measurement of Greenhouse Gases in Agriculture”. He emphasized the importance of quantifying greenhouse gas emissions from different agricultural practices required to develop climate change mitigation technologies. Training participants have introduced the concept of climate change and the global warming potential of various sectors in India. The basic principle of air sampling and analysis of CO₂, CH₄ and N₂O using a Gas Chromatograph was demonstrated. He familiarized the participants with the essential components of GC like the Injector port, column, detectors, and data processing unit.



He briefly discussed the method of collecting air samples from the agriculture system. The analysis parameters of the instrument, dimension of the static gas chamber, types of gases used, sample preparation assembly, and functioning of the Autosampler were introduced to the participants. The session was followed by hands-on learning of the Gas Chromatograph in the laboratory.

Trainees were acquainted with the data management software of the instrument and gas calibration standards. Participants were given the demonstration of analysis of air samples by showing the peaks of CO₂, CH₄ and N₂O. He explained the different steps of instrument standardization, air sampling, vial evacuation, and results

interpretation. The session was concluded by answering the queries of the participants.

The second lecture was delivered by DrGazalaNazir, Soil Scientist, Department of Soil Science, PAU. She gave an insight to the participants on the working of UV-VIS Spectrophotometer, basic principle and its application in soil, plant and water analysis. The talk emphasized on the use of this new technique in several scientific fields especially in soil science. Each component of the instrument was briefly discussed. She familiarized the participants about the various types of spectrophotometers.

The session also included hands-on-training program on this instrument with regard to water analysis. The participants engaged themselves in the analysis of the sample where they got aware about the different steps and processes followed in the procedure. The quantity (nitrate) of water sample was checked with regard to the standard curve which was prepared from Potassium nitrate. The session was followed by the queries from the participants.

The third lecture was delivered by DrDhanwinder Singh, Principal Soil Chemist, Punjab Agricultural University, Ludhiana on the use of Inductively Coupled Plasma -Atomic Emission Spectrophotometer (ICP-AES) in soil, plant and water analyses. He familiarized the participants with the basics of instrumentation techniques used in flame photometer, atomic absorption spectrophotometer, ICP-AES and ICP-MS. He manifested the principle and working of ICP-AES.

Each and every component of the instrument and its function was introduced and demonstrated (sample introduction system; nebulizer, spray chamber, ICP torch compartment and detectors) to the participants. He emphasized on the excellent technology of ICP-OES for elemental analysis with its high speed, excellent sensitivity, precision, low cost per sample and multi-element analysis capability.

The session was followed by hands on training of this instrument by DrSumitaChandel, Soil Chemist, PAU, Ludhiana. She gave the insight about the scope and sample preparation for elemental estimation in ICP-OES. Trainees were acquainted with ICP Expert, a user friendly and intelligent software to run the instrument, which can examine the sample data during an analytical run.

Trainees were given the demonstration on ICP-AES calibration and working by running the standards followed by unknown samples on the instrument. She discussed different steps of instrumental calibration, sample analysis, and interpretation of the data. The session was concluded with the interaction with the trainees.



DrGazalaNazir, Soil Scientist, Department of Soil Science, PAU delivering lecture on the working of UV-VIS Spectrophotometer.

VALEDICTION



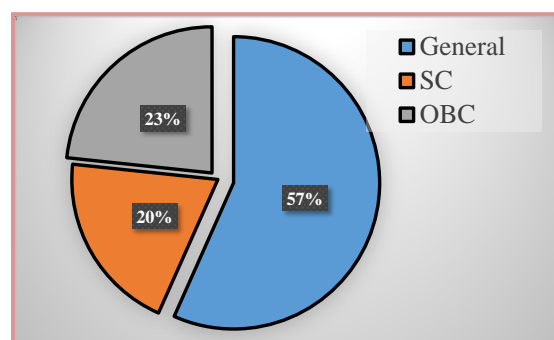
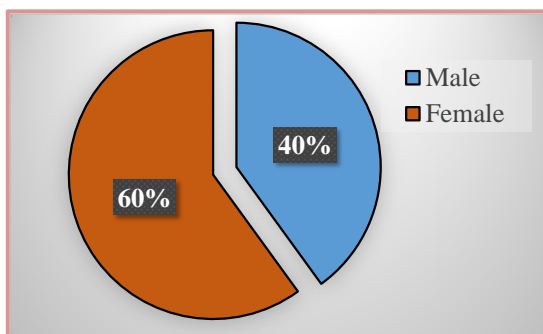
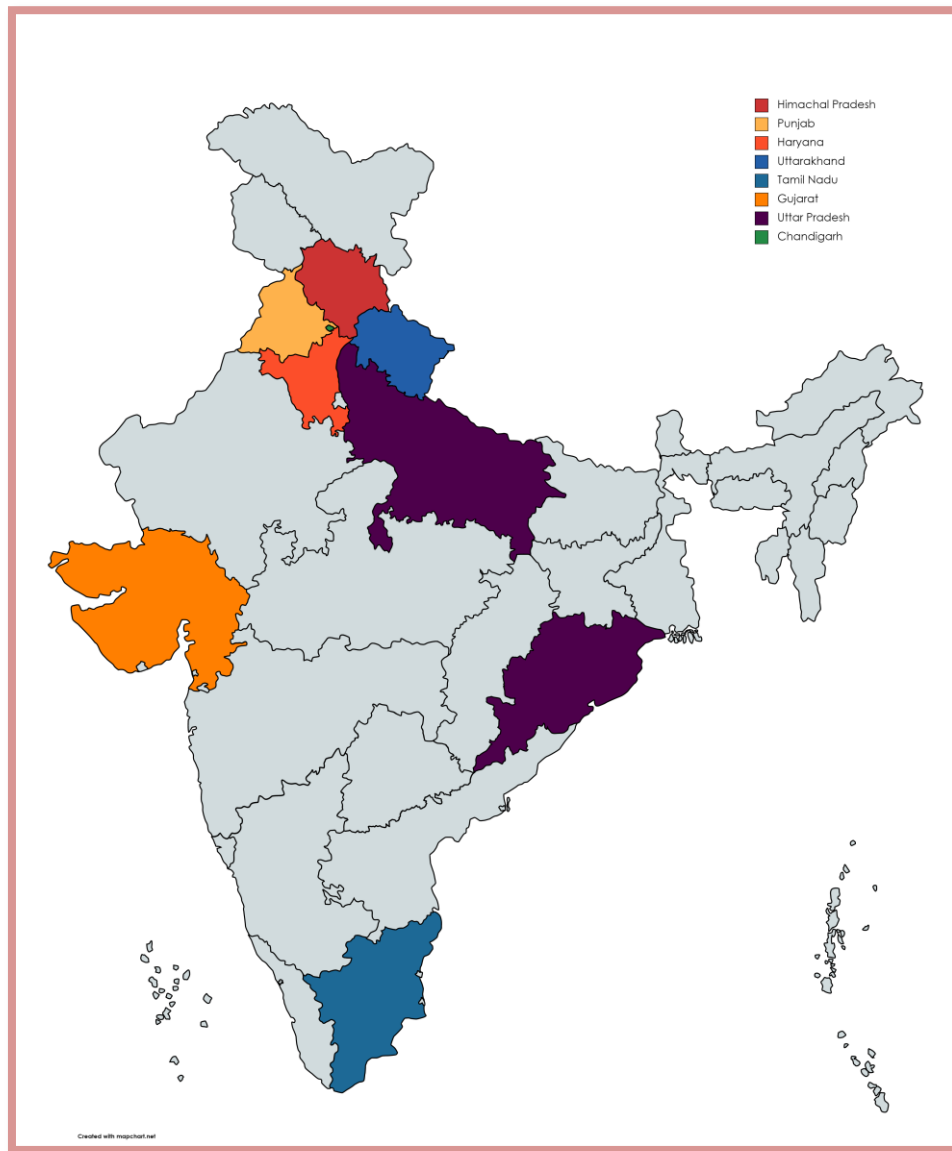
VALEDICTION





PARTICIPATION SUMMARY

(STATE WISE)



CHARGES OF ANALYSIS

400MHZ FT-NMR SPECTROMETER				500MHZ FT-NMR SPECTROMETER			
Facilities		PU	PU	Other Educational Inst.	R&D	Industry	
1 D (1H NMR, 13C NMR, DEPT Experiment, NMR of any other Nucleus) (for each sample)	CDCL3/ D2O DMSO-d6	200 400	320 520	400+18% GST 600+18% GST	1200+18% GST 1400+18% GST	2000+18% GST 2200+18% GST	
2D (2DCOSY, NOESY, Experiments, HSQC, ROESY, TOCSY, HMBC Experiment, Any other 2D experiment) (for each sample)	CDCL3 / D2O DMSO-d6	400 600	640 840	800+18% GST 1000+18% GST	2400+18% GST 2600+18% GST	4000+18% GST 4200+18% GST	
MALDI-TOF SYNAPT XS HD MASS SPECTROMETER							
Facilities		PU		Other Educational Inst.	R&D	Industry	
Protein intact Mass by UPLC MS		900		1200+18% GST	3600+18% GST	6000+18% GST	
MALDI TOF/TOF - Protein identification by MS/MS for gel band and gel spots		750		1000+18% GST	3000+18% GST	5000+18% GST	
Protein Profiling for complex mixture using 2D Nano-LC. (LC/MS/MS)		1350		1800+18% GST	5400+18% GST	9000+18% GST	
Sequencing of Peptides using Bio Lynx software (for pure peptide only) (direct infusion)		750		1000+18% GST	3000+18% GST	5000+18% GST	
Molecular weight confirmation/accurate mass determination.		750		1000+18% GST	3000+18% GST	5000+18% GST	
Polymer analysis etc.		750		1000+18% GST	3000+18% GST	5000+18% GST	
Ion Mobility Study to separate reverse peptide or isobaric compounds using Drift scope Software		450		600+18% GST	1800+18% GST	3800+18% GST	
ETD compounds study.		750		1000+18% GST	3000+18% GST	5000+18% GST	
LIQUID CHROMATOGRAPHY MASS SPECTROMETRY							
Facilities	PU		Other Educational Inst.	R&D	Industry		
MASS	480		600+18% GST	1800+18% GST	3000+18% GST		
LCMS	800		1000+18% GST	3000+18% GST	5000+18% GST		
MS-MS	640		800+18% GST	2400+18% GST	4000+18% GST		
HRMS	800		1000+18% GST	3000+18% GST	5000+18% GST		
WAVELENGTH DISPERSIVE X-RAY FLUORESCENCE							
Facilities	PU		Other Educational Inst.	R&D	Industry		
Powder/ Solid Samples	480/-		600/-+18% GST	1800/- +18% GST	3000/- +18% GST		
Liquid Samples (Charges as per Element)	320		400+18% GST	1200+18% GST	2000+18% GST		
FIELD EMISSION SCANNING ELECTRON MICROSCOPE							
Facilities	PU		Other Educational Inst.	R&D	Industry		
FESEM	960		1200+18% GST	3600+18% GST	6000+18% GST		
EDX	240		300+18% GST	900+18% GST	1500+18% GST		
Mapping	240		300+18% GST	900+18% GST	1500+18% GST		
GAS CHROMATOGRAPHY MASS SPECTROMETRY							
Facilities	PU		Other Educational Inst.	R&D	Industry		
GCMS	800		1000+18% GST	3000+18% GST	5000+18% GST		
MS only / GC only	480		600+18% GST	1800+18% GST	3000+18% GST		
CHNS-O ELEMENTAL ANALYZER							
Facilities	PU		Other Educational Inst.	R&D	Industry		
CHNS	640		800+18% GST	2400+18% GST	4000+18% GST		
CHNS-O	1280		1600+18% GST	4800+18% GST	8000+18% GST		
INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (ICP-MS)							
Facilities	PU		Other Educational Inst.	R&D	Industry		
Standardization	300		600+18% GST	1800+18% GST	3000+18% GST		
Subsequent sample per element	75		100+18% GST	300+18% GST	500+18% GST		
Sample Digestion	400		500+18% GST	1500+18% GST	2500+18% GST		
LIQUID NITROGEN				REOMETER			
PU	Other Educational Inst.	R&D	Industry	PU	Other Edu. Inst.	R&D	Industry
30	40+18% GST	50+18% GST	100+18% GST	50	60+18% GST	180+18% GST	300+18% GST
FT-IR SPECTROPHOTOMETER				TRANSMISSION ELECTRON MICROSCOPE			
PU	Other Educational Inst.	R&D	Industry	PU	Other Edu. Inst.	R&D	Industry
160	200+18% GST	600+18% GST	1000+18% GST	800	1000+18% GST	3000+18% GST	5000+18% GST
SMALL ANGLE X-RAY SCATTERING				X-RAY DIFFRACTOMETER			
PU	Other Educational Inst.	R&D	Industry	PU	Other Edu. Inst.	R&D	Industry
500	1000+18% GST	3000+18% GST	5000+18% GST	320	400+18% GST	1200+18% GST	2000+18% GST
MICROPHOTOGRAPHY				SCANNING ELECTRON MICROSCOPE			
PU	Other Edu. Inst.	R&D	Industry	PU	Other Edu. Inst.	R&D	Industry
15/shot	20/shot+18% GST	40/shot+18% GST	100/shot+18% GST	560	700+18% GST	2100+18% GST	3500+18% GST
UV-VIS-NIR				LAB VISIT, SEMINAR HALL & WORKSHOP CHARGES			
PU	Other Edu. Inst.	R&D	Industry	Lab Visit Charges	Workshop Charges	Seminar Hall Booking - 3500/-	
70	90+18% GST	270+18% GST	450+18% GST	750+18% GST	As per job requirement	for PU & 3500+18% GST	



Compiled by:

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