

CSIR-INSTITUTE OF HIMALAYAN BIORESOURCE TECHNOLOGY

Developing technologies to boost bioeconomy through sustainable utilization of Himalayan bioresources



HIMALAYAN BIORESOURCES

Ecology and Environment

Databases
GIS-Mapping
Remote sensing
Hyperspectral signatures
Ecosystem services
Chemical signatures

Industry

Enzymes, Molecules,
Food & Nutraceuticals,
Alternative sweeteners,
Quality control

Society

Mountain Floriculture
Commercially important RETs
Cultivation and processing
of herbals and tea



Facility @ CSIR-IHBT

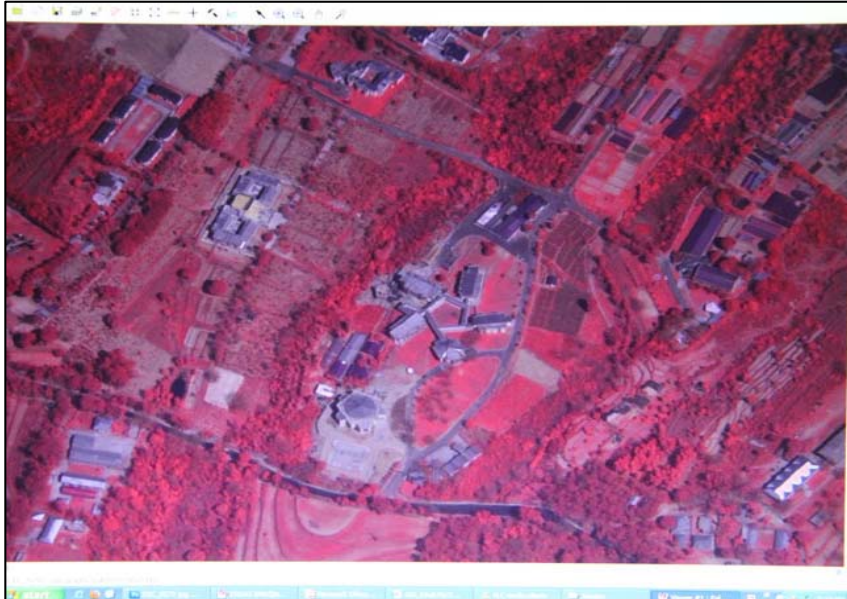


GIS, MAPPING AND DATABASE FACILITY

GIS, Mapping and Hyperspectral Signatures of Plants



Computing Systems



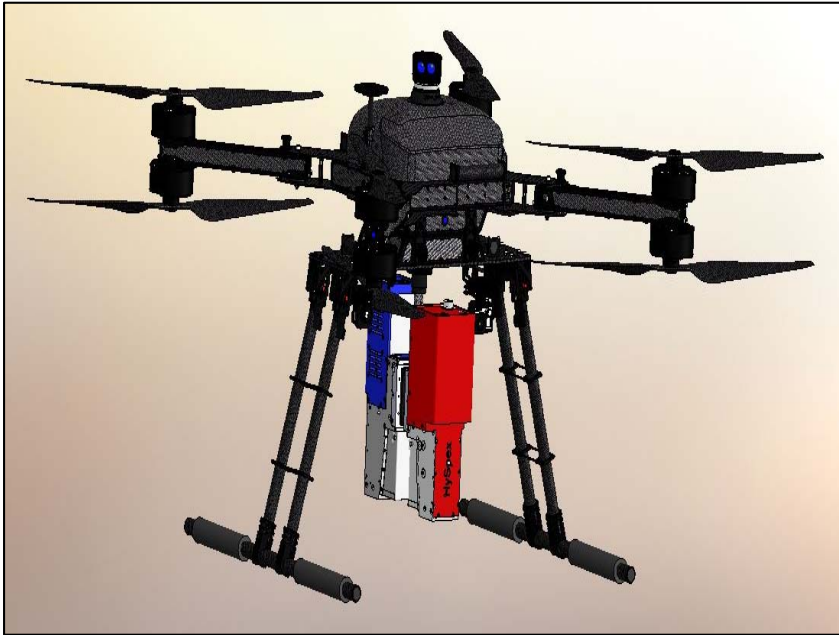
Plotter

Hyperspectral Signatures

First of its kind in India with “Laboratory + Field + Airborne setup”.



HySpex VNIR 1800 (400-1000 nm) & SWIR 384 (930-2500 nm) Imaging Sensors



- Model: Stark Hx8 Power Series XL
- Make: Harris Aerial, USA
- Payload: 30kg
- Flying altitude: 400 ft AGL
- Endurance: 15-20 min
- Also equipped with Optical camera

As per DGCA guidelines, airborne data can be acquired up to 200 ft by a government organisation informing the local administration. DGCA permission is required above 200 ft.

LiDAR Remote Sensing

LiDAR (Light Detection and Ranging) is an active remote sensing system.



Vehicle mounted LiDAR

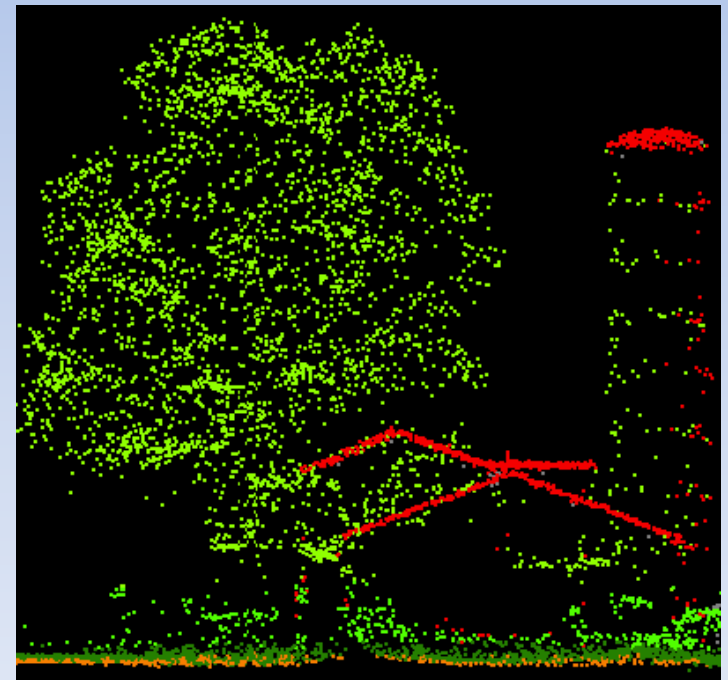


Back pack LiDAR



Airborne LiDAR

Sends light energy (point clouds) to the ground, which return back after hitting object.



LiDAR Point Cloud data

- Model: VLP 16; Make: 3DT, Italy
- Range: 100 m (360 degree); Cloud point: 3 lakh/sec
- Class 1 eye safe

Handheld Thermal Sensors (HTS)

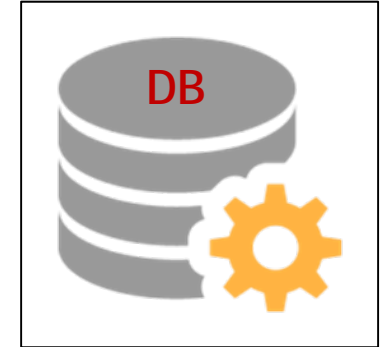
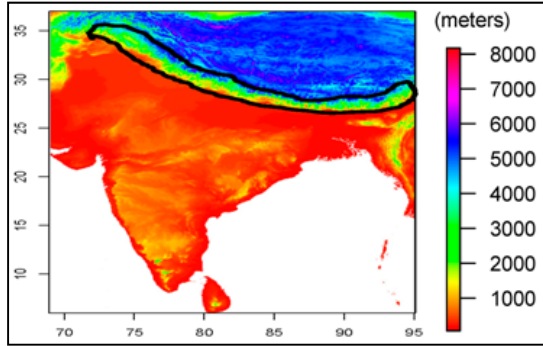


- Camera System: FLIR T650 SC
- Infra-red resolution: 640x480 pixels
- Spectral range: 7.5 to 14 μm
- Temperature Range: -40 $^{\circ}\text{C}$ to +2000 $^{\circ}\text{C}$
- Thermal sensitivity: <20mK@30 $^{\circ}\text{C}$
- Accuracy: ± 1 $^{\circ}\text{C}$

Biological Applications

- Crop management
- Monitoring invasive pest populations
- Screening for better varieties, Stress identification
- Low cost high-throughput field phenotyping for abiotic stress tolerance in crops
- Plant species counting and Vegetation health
- Microhabitat temperature in alpine areas
- Leaf water content
- Abiotic stress
- Animal and Bird count
- Animal Tagging, etc.

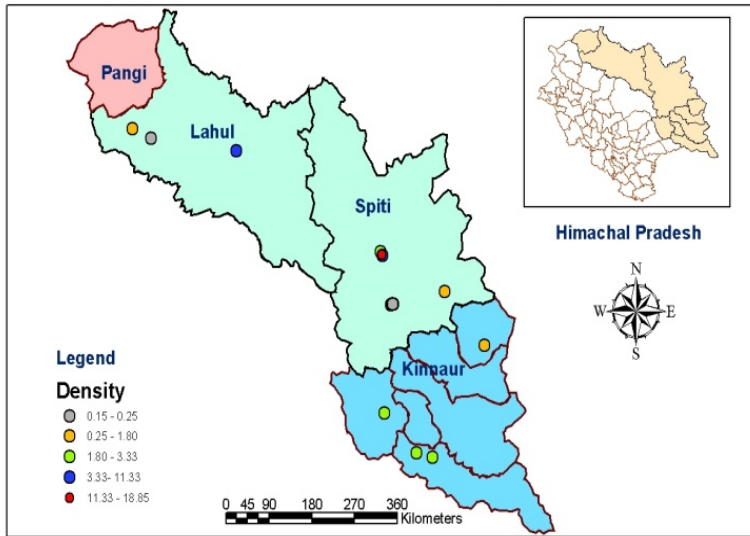
- ❖ Database for flowering plants in western Himalaya
- ❖ Database on medicinal plants in Indian Himalayan region



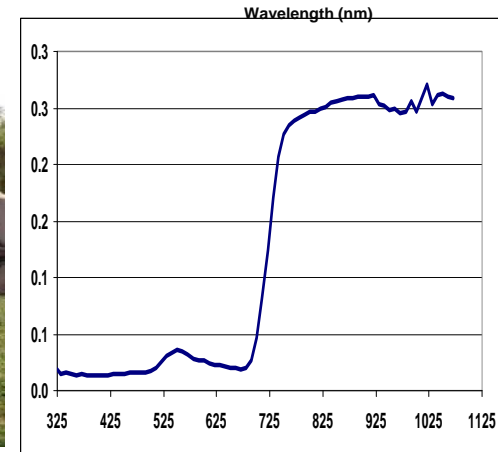
- ❖ Traditional Knowledge Digital Library (TKDL)
- ❖ Traditional Medicinal Plant Information System (TRAMPIS)
- ❖ Database on bamboos

DOCUMENTATION OF PLANT WEALTH OF HIMALAYA

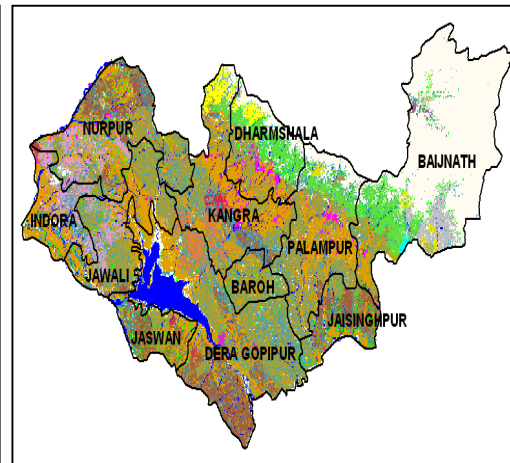
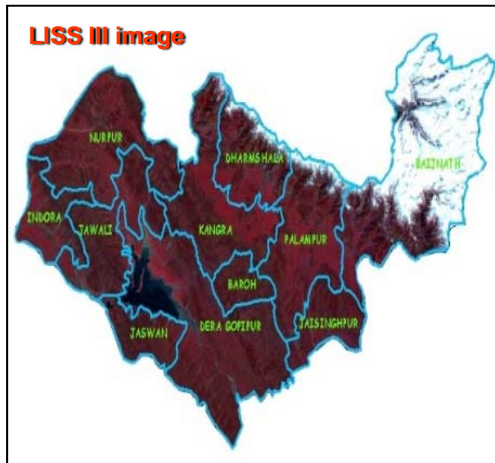
MAP FOR ZONE IV SHOWING DISTRIBUTION OF *Hippophae rhamnoides*



Spectral reflectance



Species specific distribution maps



	Cedrus deodara & Quercus semecarpifolia		Agriculture
	Quercus semecarpifolia		Bare Rocks
	Woodfordia frucosa (Dhaoc)		Habitation
	Pinus roxburghii & Woodfordia frucosa		Water
	Delbergia sissoo		Snow
	Bamboo		Airport
	Cedrus deodara		Rhododendron
	Pinus wallichiana (Kail)		Acacia catechu
	Abies pindrow		Pinus roxburghii
	Abies pindrow (Rai) & Piscea smithiana (Tos)		Anogeissus latifolia (Dhaur)
	Quercus leucotrichophora (Bani)		Mixed forest
	Scrubland		Grassland

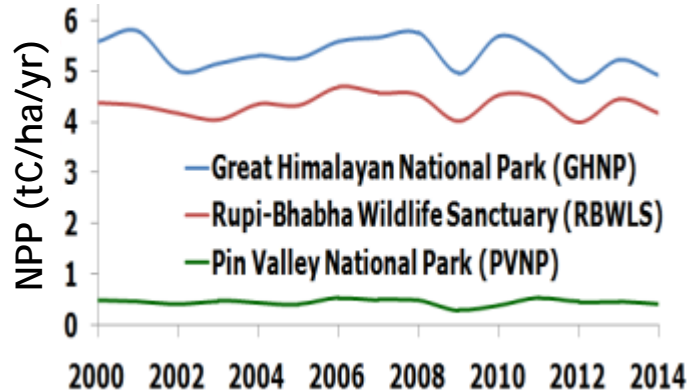
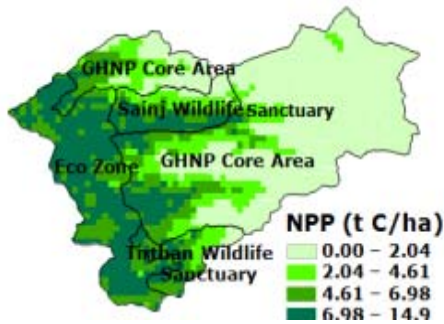
Landuse maps of Kangra

STRATEGIC RESEARCH ON HIMALAYAS

- Remote sensing & GIS
- Ground truthing

- Carbon stock assessment,
- Net primary productivity of forests

- Negotiation for carbon credits
- Identification of carbon deficient zones
- Carbon sequestration capacity
- Forest health and productivity



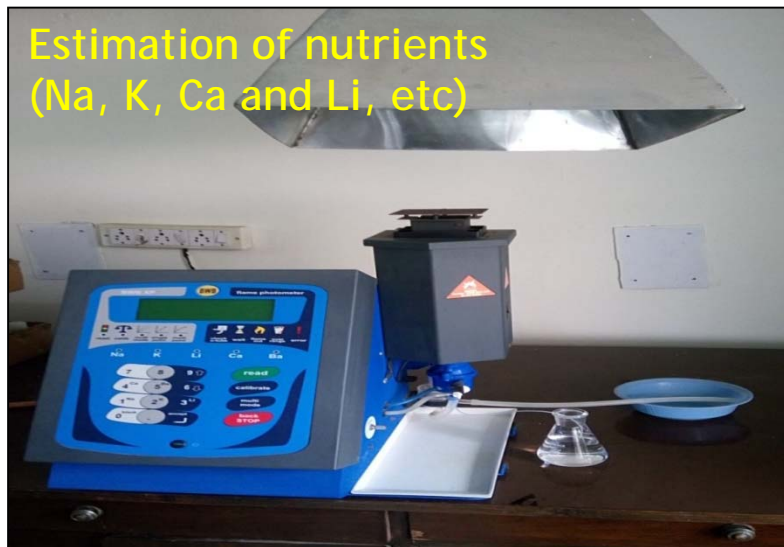
Species	#1	#2	#5
<i>Abies pindrow</i>	135	-	80
<i>Acer caesium</i>	5	52	10
<i>Betula utilis</i>	-	105	-
<i>Prunus cornuta</i>	23	75	-

Dominant species in plots



- Species up-migration patterns
- Change in species composition
- Ecosystem response

Plant, Litter and Soil Analysis



Estimation of nutrients
(Na, K, Ca and Li, etc)

Flame Photometer



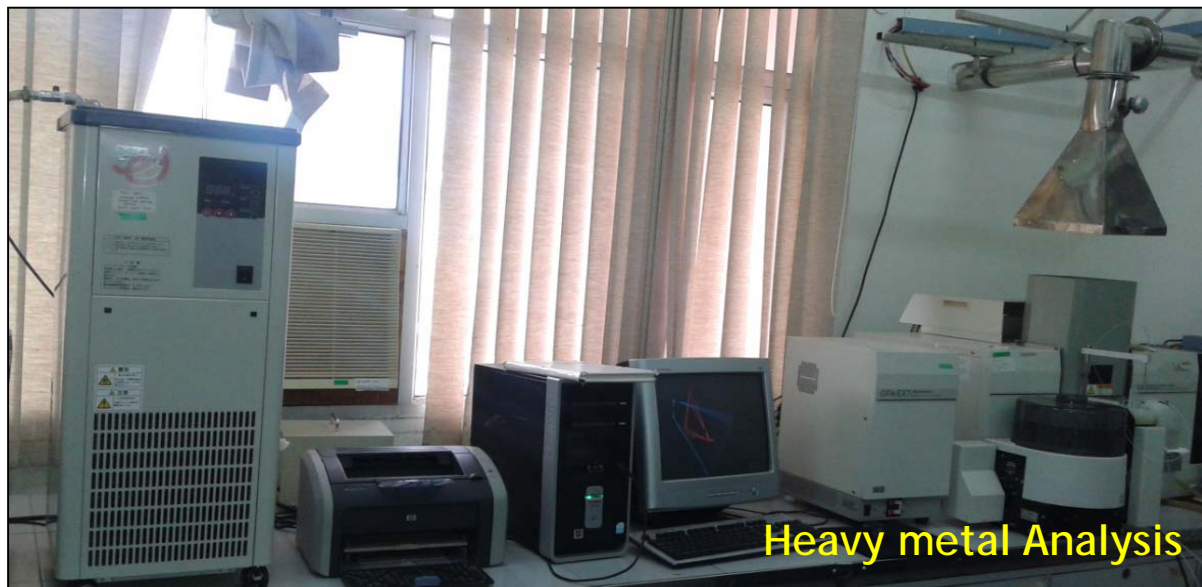
Morphology of plants
and plant materials

Trinocular Stereozoom
Microscope



Plant Pathology

Ultramicrotome



Heavy metal Analysis

Atomic Absorption Spectroscopy



PLANT ADAPTATION STUDIES

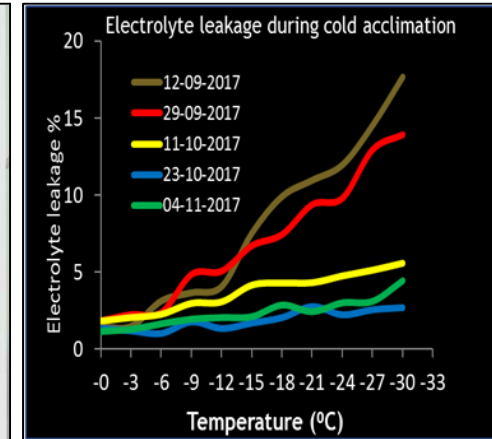
Freezing Temperatures Simulation



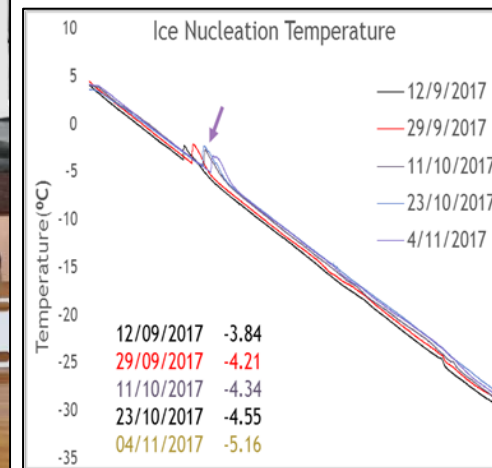
Model: Grant TXF 200
Model: Measurement Computing TC32

A photograph of the experimental setup. A white Grant TXF 200 refrigerated circulating water bath sits on a black table. A Measurement Computing TC32 data acquisition system is connected to the bath. A dense, tangled mass of brown cables connects the TC32 to various sensors and components. The Grant logo and model number 'R4' are visible on the water bath.

Refrigerated circulating water bath and data acquisition system



Facility to study freezing tolerance in Plants



FREE AIR CO₂ ENRICHMENT (FACE) AND FREE AREA TEMPERATURE INCREASE (FATI) FACILITIES



FACE AND FATI FACILITIES

NURSERIES & POLYHOUSES



NURSERIES & POLYHOUSES



FIELD FACILITIES

Improved varieties of Calla lily and Gerbera released by Hon'ble PM on 26.10.2016



HIM SUMUKH



HIM SHWETA



HIM KEERTI



HIM APOORVA



**HIM
ABHA**



**HIM
SAUMYA**



**HIM
GAURAV**

ROSE ROOTSTOCK



IHBT-WR-16 (*Rosa brunonii*)



IHBT-WR-21 (*Rosa alba*)



IHBT-WR-23 (*Rosa cathayensis*)



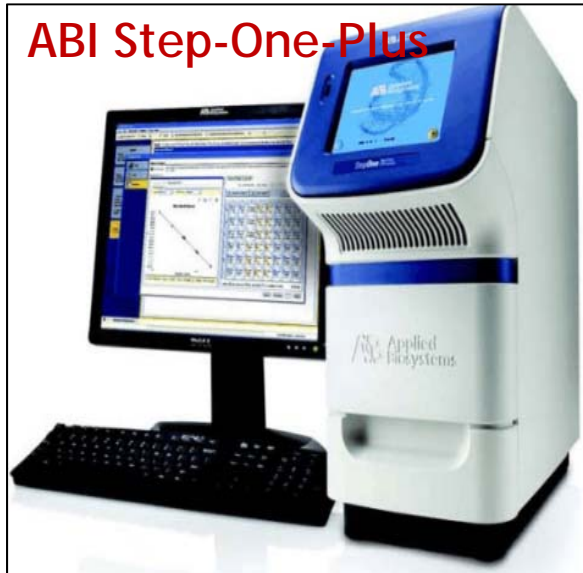
IHBT-WR-24 (*Rosa multiflora*)

STATE-OF-THE-ART GENOMICS FACILITIES

Biomek FX^P Automated Library Prep Workstation



ABI Step-One-Plus

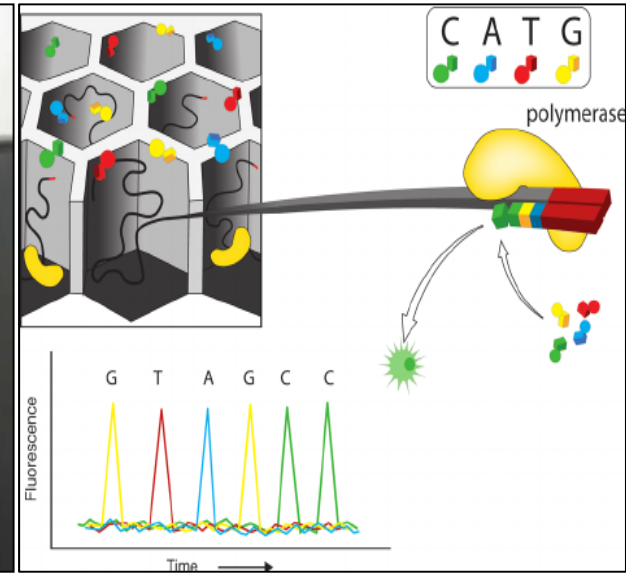


Real Time PCR

PacBio RSII



High-throughput Long Read DNA Sequencer



ABI 3730xl

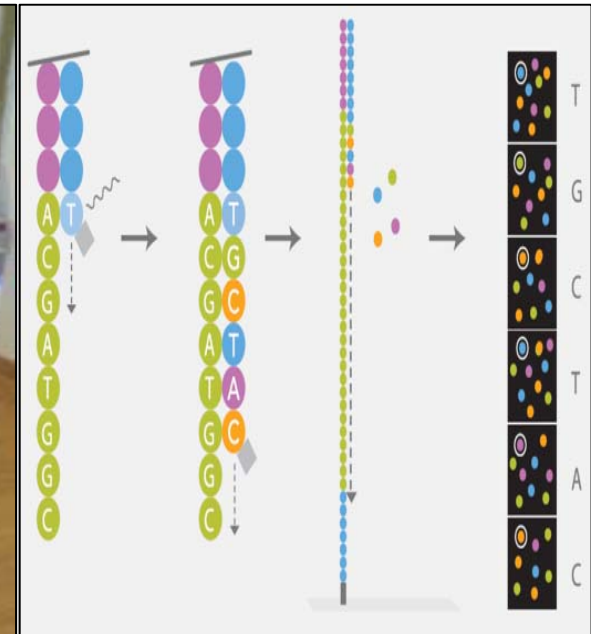


Sanger DNA Sequencer

NovaSeq 6000



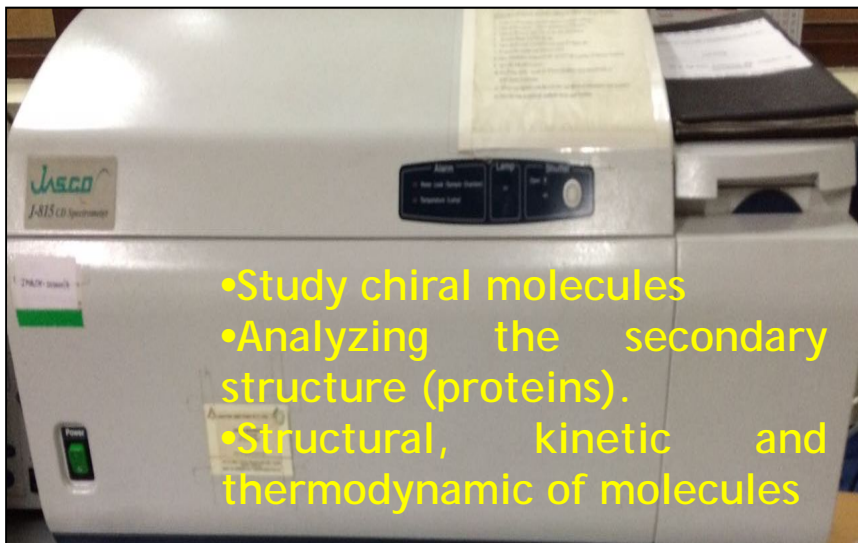
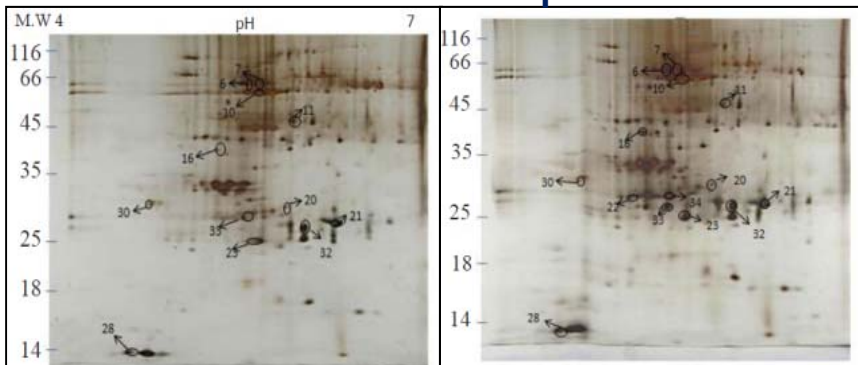
High-throughput Short Read DNA Sequencer



STATE-OF-THE-ART PROTEOMICS FACILITY



2D Gel electrophoresis



- Study chiral molecules
- Analyzing the secondary structure (proteins).
- Structural, kinetic and thermodynamic of molecules

CD- Spectrometer



Akta Explorer for Protein Purification



- (Microfiltration, Ultrafiltration and Dialysis)

Akta Flux system

nanoLC- PROTEINEER fc II

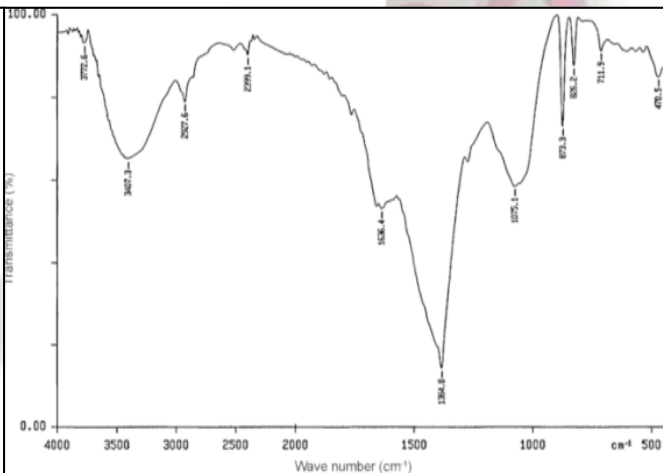
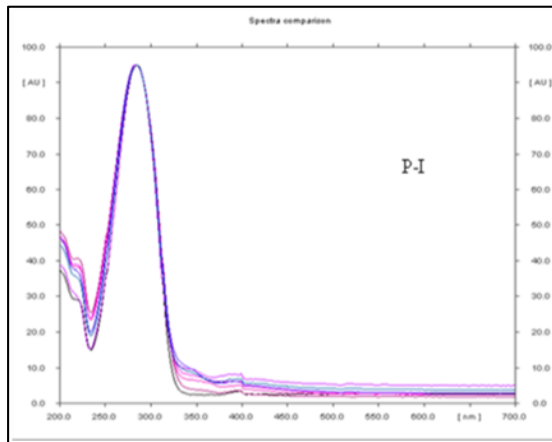


MALDI ToF-MS

MALDI ToF-MS/MS

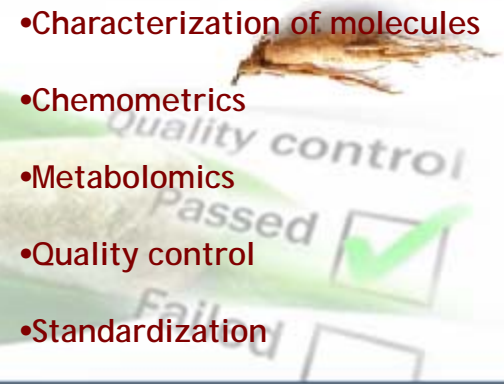


STATE-OF-THE-ART METABOLOMICS FACILITY



Plants chemical diversity signatures

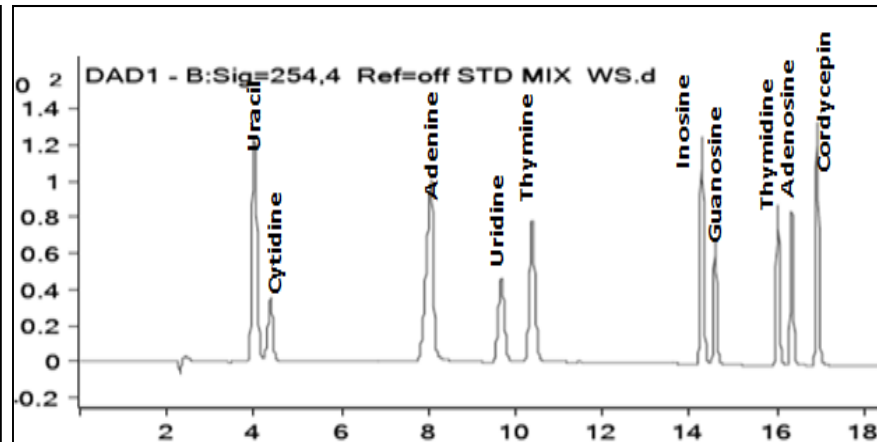
- Characterization of molecules
- Chemometrics
- Metabolomics
- Quality control
- Standardization



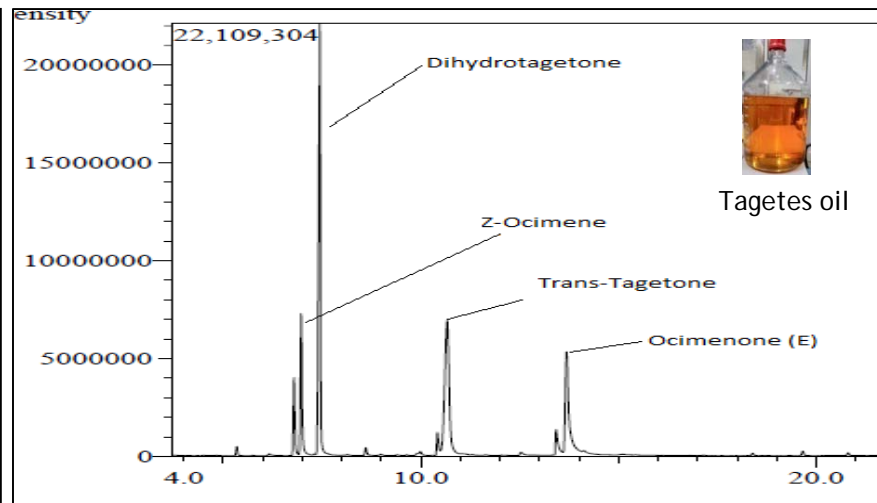
UHPLC



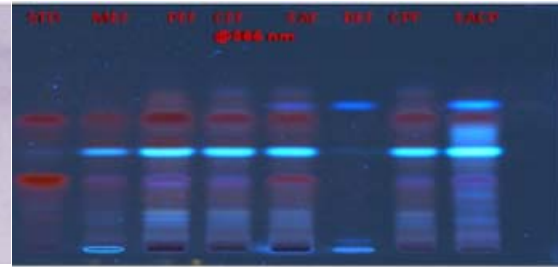
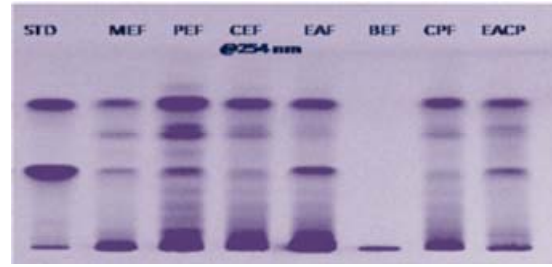
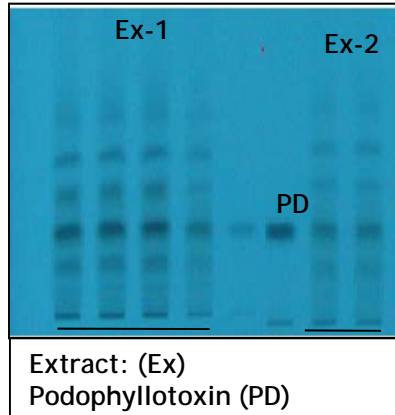
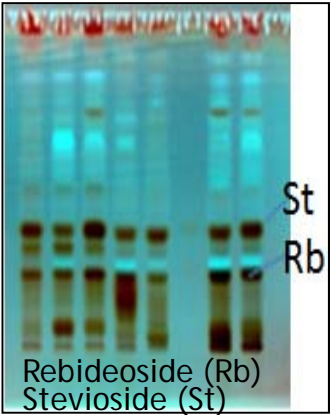
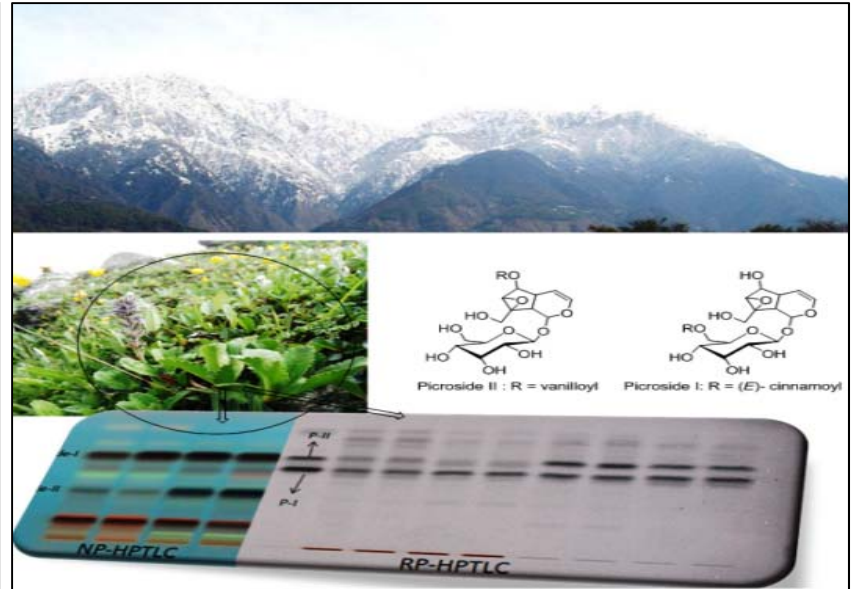
UPLC



GC



HPTLC Fingerprinting

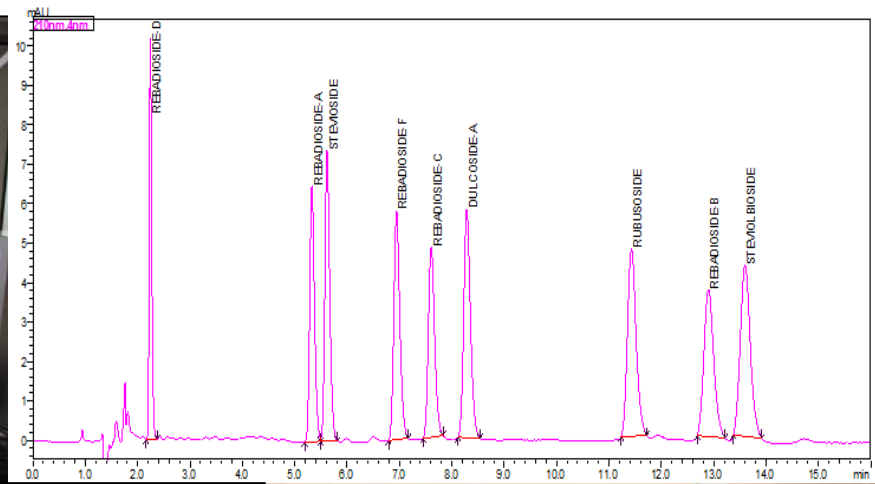


β,β-dimethylacryl shikonin ←

Shikonin ←



LC-MS

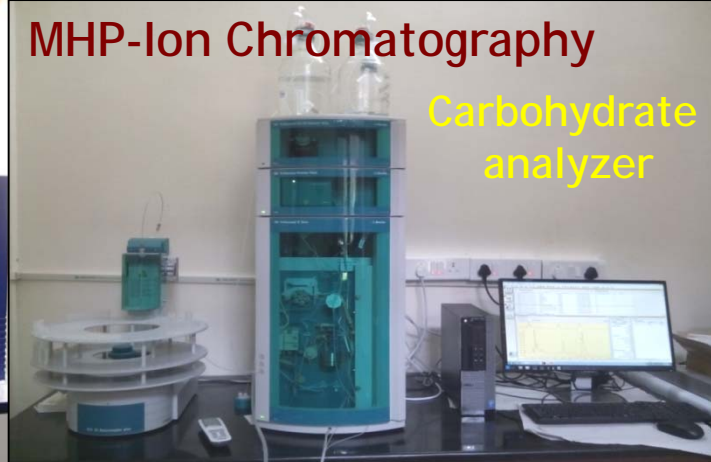


LC-MS-MS



MHP-Ion Chromatography

Carbohydrate analyzer

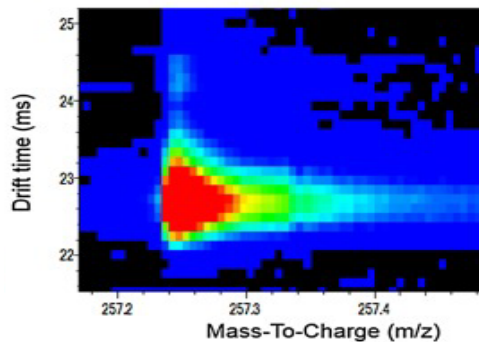


GC-MS

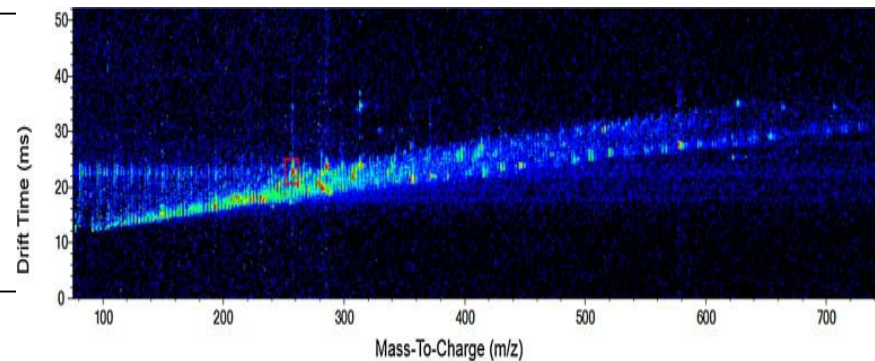


- Metabolomics
- Glycomics
- Lipidomics
- Quality control

Ion Mobility Q-TOF LC/MS



- ❖ Metabolomics
 - Lipidomics
 - Glycomics
- ❖ Proteomics



Features

- Greater numbers of trace level components detected in complex matrices
- Better separation of lipids and glycans
- Direct determination of accurate collision cross section measurements
- In-depth characterization of structural conformations and isomeric compounds
- Preservation of structural fidelity of labile molecules in gas phase

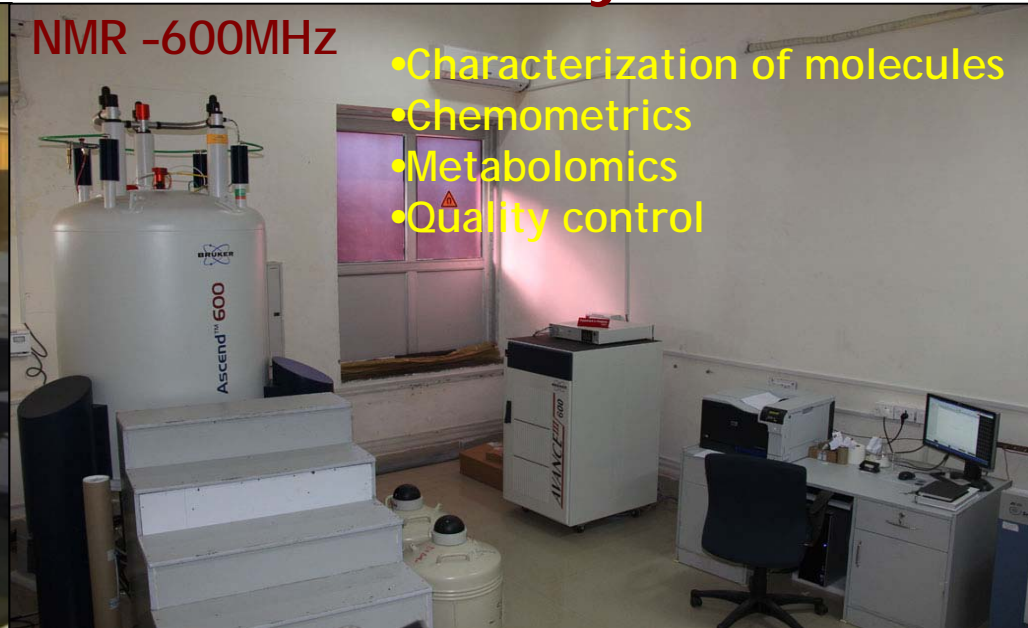
Plants chemical diversity signatures

NMR-300 and 600 MHz Facility

NMR - 300MHz

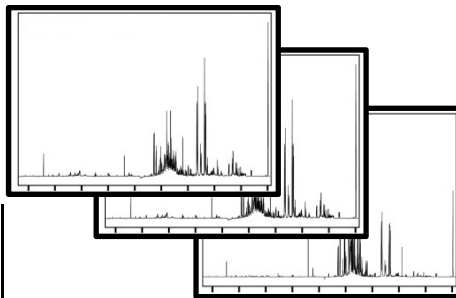
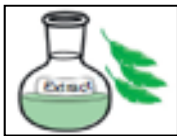


NMR -600MHz



- Characterization of molecules
- Chemometrics
- Metabolomics
- Quality control

Sampling \rightleftharpoons Data acquisition \rightleftharpoons Set of metabolites \rightarrow Data processing \rightleftharpoons Chemometrics

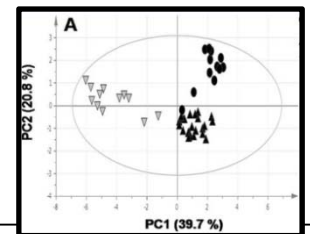


Metabolites fingerprinting

distribution of signal intensity

Metabolite profiling

Signal assignments, metabolite ID



Pattern recognition classification

Unsupervised: eg. PCA
Explorative methods

supervised: eg. PLS-DA
Discriminant distribution

Improvement of biochemical knowledge
Plants chemical diversity signatures



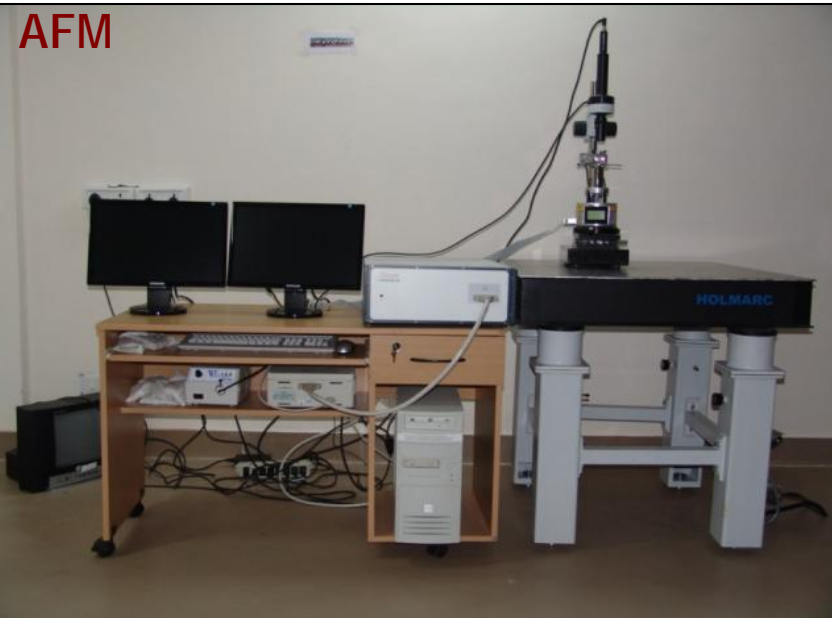
Nanotechnology

SEM



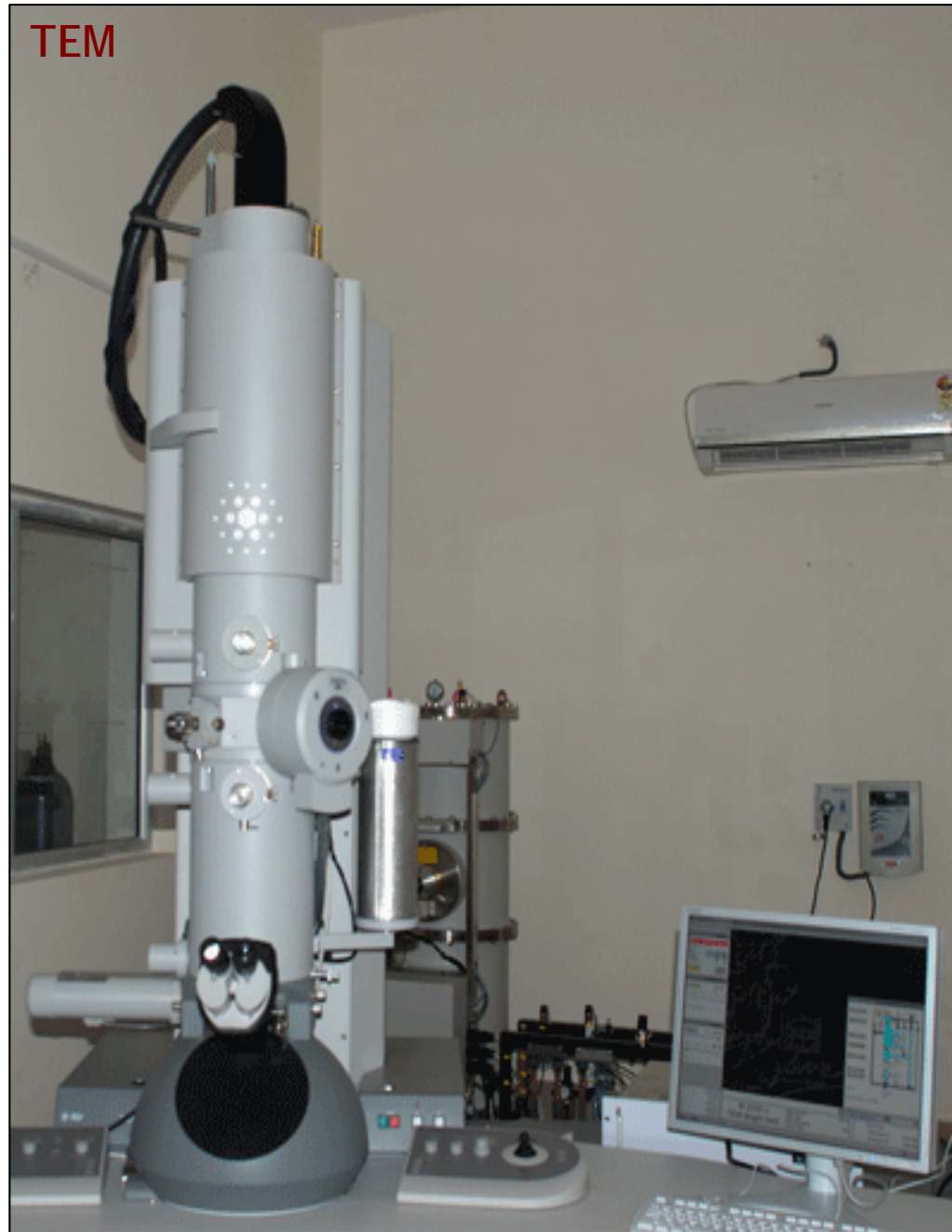
Scanning Electron Microscope

AFM



Atomic Force Microscope

TEM



Transmission Electron Microscope

Microbiology



Fermenter for Enzyme Production



CELL AND TISSUE CULTURE FACILITY

CELL AND TISSUE CULTURE



Plant Tissue Culture room



Bioreactor



Plant Tissue Culture

HYDROPONICS AND AEROPONICS FACILITY

HYDROPONICS AND AEROPONICS

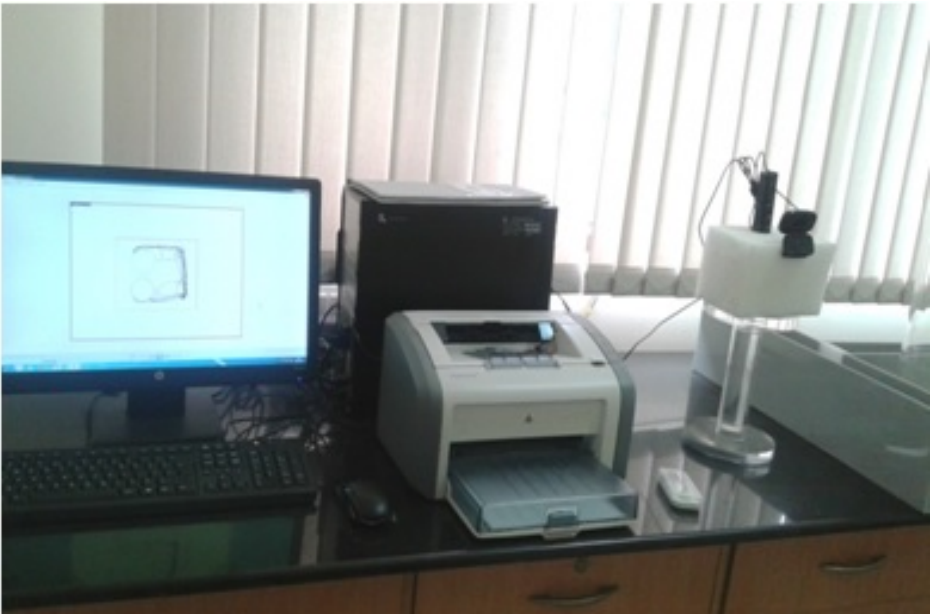


REGULATORY RESEARCH FACILITY

IVC System

Animal Facility







Protocols are in place as per GLP norms for toxicological testing of food, nutraceuticals and cosmetic products



Zebra Fish facility
For screening of large
number molecules for
bioactivity



Imaging Flowcytometer:
For immuno-phenotyping

Pilot Plants



Spray Drier

Processing of Herbals



Distillation Unit

Pilot Plant - Tea Processing



Incubation Centre



Established as CRTDHs of DSIR
under **Affordable Health**

भारत सरकार
सूक्ष्म, मध्य एवं बड़े उद्यम विभाग
सूक्ष्म उद्यम एवं बड़े उद्यम-विभाग संयुक्त
संयोजित कार्यालय, चम्बगढ़, जम्मू और
श्रीलंका, भारत
पिन कोड - 171213

Govt. of India
Ministry of MSME
MSME-Development Institute
Electronics Complex, Chambaghat
Solan (H.P.)-171213

MSME
Ministry of MSME

No. T/101(27)/NMCPEMDI/2016-17 -11-
Date 12.04.2016

To
The Additional Secretary & Development Commissioner,
(MSME)
Govt. of India, Ministry of MSME,
Nirman Bhawan, 7th Floor,
New Delhi-110108

Sub: **Formation of Business Incubators in Himachal Pradesh- reg.**

Respected Sir,

To form business incubators in Himachal Pradesh, this Institute approached following institutes-

1. CSIR, IHBT, Palampur (HP)
2. IIT, Mandi, Ministry of HR (HP)
3. Directorate of Nucleus Research, Ministry of Agriculture, Dist. Solan (HP)
4. Baddi University, Baddi, Distt. Solan (HP)

Out of the above Sr. No. 1 & 2 have submitted their acceptance letters (Copies enclosed). We have requested them to submit their proposal in Perfomance of Host Institute for Submission of Project proposals. Since these are Govt. of India organisations & engaged in Research, Technology Transfer & Teaching they may be considered as Business Incubators for MSE Sector.

Thanking you,

Yours faithfully,
(C.V. Saxena)
Director

Copy to:-
1. The Director, CSIR, IHBT, Post Box No. 6 Palampur (HP)-176061.
2. The Director, IIT, Mandi, Karnal, Distt. Mandi (HP)-175005

(C.V. Saxena)
Director

Office/Telephone No. - 0191-28284, 28286 E-fax /E-mail - dmi@msme.gov.in
mail @msme - www.msme.gov.in helpline Number:- 1800-180-6763

CSIR-IHBT has been
recognized as one of the
centres under MSME in H.P

CATALYZING ECONOMY OF HIGH ALTITUDE TRIBAL AREAS



Cultivation and processing
of aromatics (*salvia sclarea*)



Cultivation of high
value plants



Floriculture



Centre for High Altitude Biology



Demonstration of snow
Water harvesting



Training in food processing



Hippophae rhamnoides germplasm

Germplasm and resource
generation

TEA AND TEA BASED PRODUCTS

TEA CATECHINS AS NUTRACEUTICALS

Applications of Tea Catechins

Antioxidant value: 400-450mg/gm

- Physiological antioxidant
- Helps in weight reduction
- Anti-inflammatory
- Anti-microbial activity

INDUSTRIAL PARTNER:

M/S Baijnath Pharmaceuticals Pvt. Ltd;

DIRECTORATE OF INDUSTRIES &
COMMERCE, TN

MoU being finalized with INDCOSERVE

Tamil Nadu Challenges:

Labour shortage

Coarse pluck

Stagnation of tea market

Poor returns



Global market 4400 tonnes valued at 850 Cr

Return is about 9 times > made tea



TEA BASED PRODUCTS



RTS (US\$ 30 Billion)

Tea concentrates and
Ready to serve tea

Antioxidant value:
3.8-4 mg/ml

MoU with M/s. Himalayan
Brew, Thakurdwara

Market of organic wines
188 billion USD by
2019

Antioxidant value:
150-200 $\mu\text{g/ml}$



MoU signed with M/s SDZ Cha Sarl
Mozambique on tea wines



Mozambique Challenges:

Untrained labour
Poor quality tea
Low export potential
Poor returns

BAMBOO AND BAMBOO BASED PRODUCTS

PROSPECTING BAMBOO (Cellulose prospection)

Check soil erosion, Industrial products



Institute supplied 5 lakh plants of 12 edible spp. supplied to 15 states, 3125 acres area covered

Bamboo candies by self-help groups

Planting materials to HP govt. for 5000 ha of degraded lands and involvement of local youths.

Cellulose Fiber Yarn



Bamboo Charcoal
M/s Unifect Ltd UK @ \$ 5.0/ kg

Target 2017-20
Cultivation & utilization 500 farmers
Income: Rs 1 Cr
Additional income 0.50 Cr

STEVIA AND STEVIA BASED PRODUCTS

Him Stevia: Introduced Sweetness but no calories and safe for diabetics

Improved variety with higher Reb A content , & Standardized agrotechnology for higher yield (3.5 t/ha) compared with others varieties (2.5 t/ha)

Impact:

Agro-Technology	Area (acre)	Beneficiary (Farmers)	Monetary Benefit (Rs Cr)	Income over traditional crops
Stevia	2000	2500	25	2 times

Technologies Transferred (2015-17)

- AN Pvt. Ltd, Ludhiana (18/2/16)
- SA Pvt. Ltd, Indore (18/7/2016)
- VK, Bulandshahar (30/12/2016)
- DLB Herbs, Delhi (2/2/2017)

Future plan (2017-2020)

- Improved Reb-A enriched variety
- 2500 acre area
- New sweetener crops: 60 farmers
- Income 0.30 Cr
- Additional income 0.22 Cr

Challenge:
Lack of high Reb-A variety, agrotechnology & Process technology



TAGETES MINUTA: CROP OF THE DAY

TAGETES MINUTA

- Global annual demand 1500 t
- Improved variety - Him Gold
- Major constituents of the oil: Ocimene (Z and E), Limonene, dihydro tagetone, Tagetone (Z and E).
- The oil used in blending high grade perfumes

Net Profit: 1.3 lakh/ha/yr
Rural Emp: 0.4 lakh mandays
Farmers: 1500
Return: 2.8 times higher

2015-17

K 5000 & JAAG project in J&K state
(along with IHBT) and other MAPs in
mountain (1296 acres)

Farmer: 1427
Monetary benefits Rs 8.29 Cr
Additional income: Rs. 6.61 Cr



Parameter	Amount (ha/yr)
Biomass yield	200 q/ha
E. oil yield	50 kg
Net Returns (Av)	1.50 Lakhs



Essential oil



Mobile distillation

ZERO WASTE TECHNOLOGY FOR APPLE PROCESSING

ZERO WASTE TECHNOLOGY FOR APPLE PROCESSING

Problem: Environmental Pollution, Loss of natural resources, Disposal Cost

Apple pomace generated (@30% of total processed fruits) 2,700 tonnes



Pomace

Processing

Seed separation



Apple seed separation prototype (Patent : EP2775864A1, EP2775864B1, US9011952, US20140255575, WO2013069028A1 and 0116NF2011)

Apple seed antimicrobial properties



Dietary Fibre has huge commercial demand (>3 billion dollars global market, 2010-11)

Dietary Fibre

5000 t pomace: 225 tonnes fibre (4 Cr)
11 t seed into: 1100 L oil (15 Lakhs)



VALUE ADDED CRISPY FRUITS

Drying technique	Nutritional loss (%)
Sun drying	42-45
Oven drying	35-40
Our Technology	12-15



Crispy Apple



Crispy Banana



MoU signed with M/s Roots and Flowers

GLUTEN-FREE PRODUCTS

VALUE-ADDED BUCKWHEAT PRODUCTS (GLUTEN-FREE)

Gluten free products (30K Cr market)

In India, about 60-80 million people are gluten intolerant.

- Traditional crop of high altitude Himalayan region: 92 ha area under Buckwheat in Lahaul & Spiti
- puffed snacks and noodles
- Puffed products launched at Tribal Fair, Keylong (Lahaul and Spiti)
 - Lauli Puff-Healthy Snack
 - Lauli Puff-Nutri Bar
- Snacks and noodles rich in rutin, proteins, and carbohydrates

Buckwheat Grain



Buckwheat Puffed



Buckwheat Flour



*Fagopyrum
tartaricum*
var. IC 109
Reshwal



Puffed Buckwheat Bar



Buckwheat
Extruded Snacks

PRESERVATIVE FREE READY TO EAT FOOD

REVIVING ETHNIC RECIPES OF HIMALAYAS

Benefits: Healthy food with prebiotic attribute,
Involve local communities for out sourcing of ingredients



Industrial partner: M/S Sai Industries Baijnath (H.P.)

ENZYME PROSPECTION

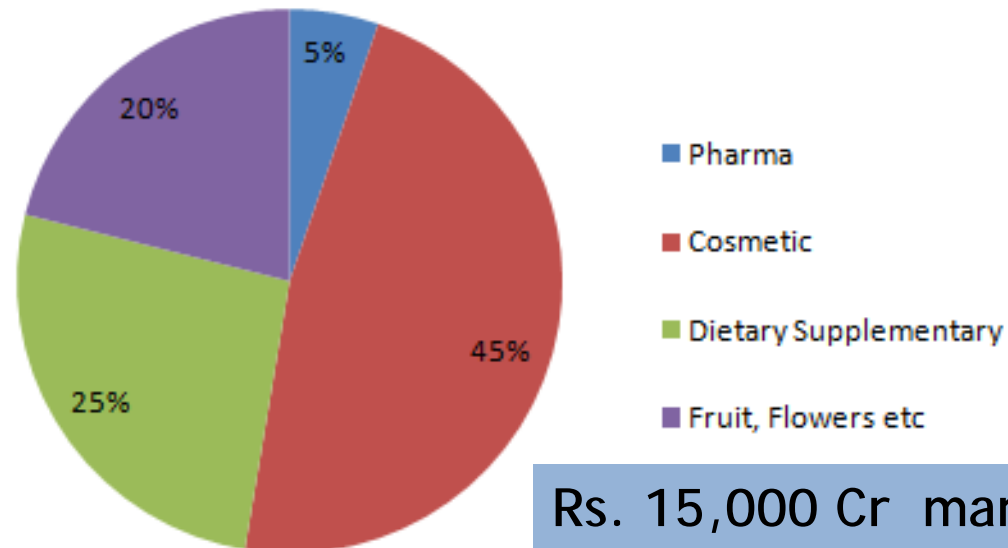
ENZYME PROSPECTION

World enzyme market : \$ 6.2 billion
therapeutic enzymes: 40%



UNIQUE SUPEROXIDE DISMUTASE (SOD) ENZYME FROM THE HIMALAYAS

- Thermostable (121 °C)
- Function from sub zero to 50° C
- Room temperature stable

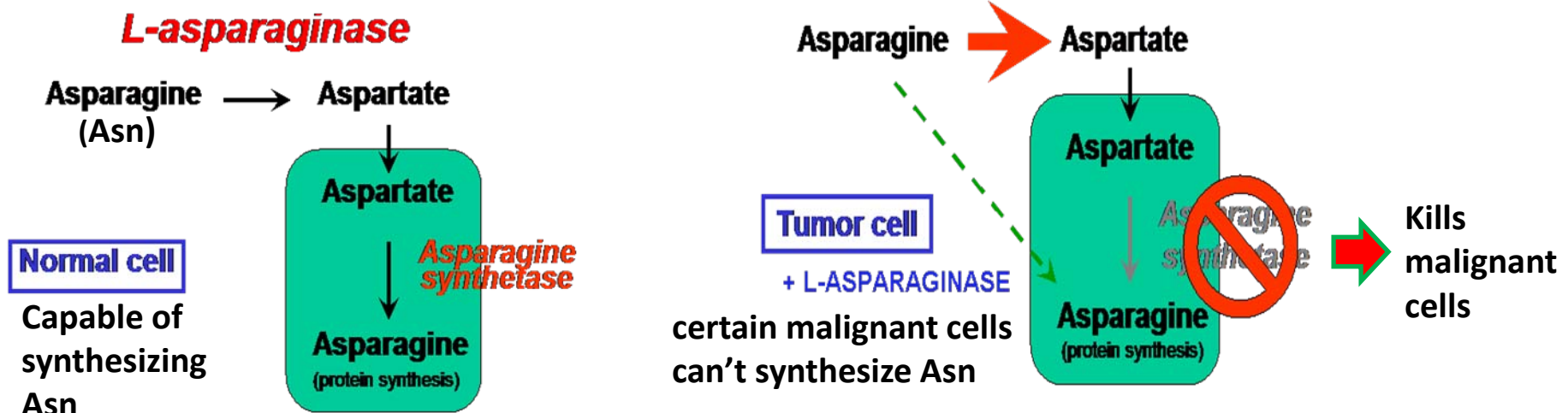


Rs. 15,000 Cr market



L-ASPARAGINASE WITH LOW GLUTAMINASE ACTIVITY FOR THERAPEUTIC APPLICATIONS (market: US\$ 30.97 Billion)

Treatment of acute lymphoblastic leukemia, pancreatic carcinoma and bovine lymphomasarcoma.



Problem: Associated glutaminase activity

Our Solution: No glutaminase activity

Revenue generation scope : 5.0 Cr+ royalty

TESTING AND CERTIFICATION ACTIVITIES

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- Himalayan Plant Certification Centre as a flagship programme with state deptt.
- CPSCEA (Committee for the Purpose of Control And Supervision of Experiments on Animals) approved breeding of small animals for research and sale
- Accredited Test Laboratory (ATL) for virus indexing by DBT, Govt. of India (till 2012) - Revalidation underway

Major Testing Services

- Toxicity and Evaluation
- DNA Fingerprinting
- DNA sequencing
- Electron Microscopy
- Plant Identification

BAMBOO MUSEUM

BAMBOO MUSEUM



Multifaceted uses of bamboo depicted through bamboo museum



Thank You