

“Consolidated Complete Progress Report”

[Establishment of Advance Institutional Biotech
Hub (Phase-II) at Dhing College, Nagaon
(Assam)]

Sanction ID:BT/NER/143/SP44313/2021 dated 01/02/2023



Submitted by:

**Dhing College PO& PS-Dhing, Dist-Nagaon (Assam),
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OFFICE OF THE PRINCIPAL

DHING COLLEGE

P.O.: Dhing, Pin: 782123 :: Nagaon :: Assam

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Ref. No.: DC/DBT/FSA/PC/B-02879/2026-27

Date: 11/06/2026

To

Dr. Lokesh Kumar Narnoliya
Scientist D, Programme Officer (DBT NER-BPMC)
Department of Biotechnology, Ministry of Science & Technology
Government of India, Block 3, 5th Floor, Room No. 534, CGO Complex
Lodhi Road, New Delhi-110 003
Phone: 011-24665100 and 011-41022594
Email: lokesh.narnoliya@dbt.nic.in

Sub: Submission of documents for Final Settlement of Accounts along with Project Completion Report 2023-2026. [Sanction ID: BT/NER/143/SP44313/2021 dated 01/02/2023]

Sir,

Most respectfully I beg to state that the project "Establishment of Advance Institutional Level Biotech Hub Phase-II at Dhing College" sanctioned vide Sanction ID No: BT/NER/143/SP44313/2021 dated 01-02-2023 has completed its tenure on **30-04-2026**. Therefore I am sending herewith the required documents for final settlements of accounts along with Project Completion Report as per prescribed format for your kind consideration & necessary action.

As the PI of the said project (Dr. Manoj Kr. Saikia) had retired from his service on 30/09/2023, prior to his retirement, Dr. Sanjeeb Kr. Nath a CO-PI has been serving as PI w.e.f 26/06/2023 in place of Dr. M.K. Saikia vide GB resolution No-6 dtd 09/06/2023 & letter No: DC/MST/B-01099/2023-24 dtd 26/06/2023 and DC/MKS/A-493/2023 dated 10/06/2023.

Therefore any further correspondence may kindly be communicated to Dr. S.K. Nath CO-PI through his Email address **sanjeebkumarnath@gmail.com**, PhoneNo-7002694736/9435362010.

Hope you may kindly take necessary action for which I shall be grateful to you.

Thanking you,

With regards,

List of Enclosers:

1. UC & SOE 2023-2026
2. Capital assets certificate
3. Consolidated Statement of Accounts
4. Complete Progress report
5. Format of final completion Report
6. Target & Achievement for completed report
7. Objective wise achievement table
8. Format of manpower and staffing.
9. Letter of retention of equipments.

CC mail to: ssdiwan.dbt@nic.in

CC mail to: Yogendra.nerbpmc@dbt.nic.in

Yours faithfully,

(Dr. Biman Hazarika)
Principal,
Dhing College, Dhing

Principal
Dhing College, Dhing
Nagaon, Assam

Progress Report for R&D Projects [Year 2023-2026]

Section-A: Project Details

A1. Project Title: Establishment of Advance Institutional Level Biotech Hub (Phase-II) at Dhing College, Nagaon (Assam)

A2. DBT Sanction Order No. & Date: BT/NER/143/SP44313/2021 dated 1/2/2023

A3. Name of Principal Investigator: Dr. Manoj Kumar Saikia (Retd)
Name of Co-PI/Co-Investigator: Dr. Sanjeeb Kumar Nath (**PI-Incharge**)
: Dr. Ujjayanta Das CO-PI

A4. Institute: Dhing College, PO& PS-Dhing, Dist-Nagaon (Assam), Pin-782123
Email: dhingcollege@gmail.com

A5. Address with Contact Nos. (Landline & Mobile) & Email: Dhing College, PO& PS-Dhing, Dist-Nagaon (Assam), Pin-782123 Email: dhingcollege@gmail.com
sanjeebkumarnath@gmail.com

A6. Total Cost: Rs.57, 84,720.00 [**Grant released Rs.21, 10,960.00**]

A7. Duration: 03 (three) years

A8. Approved Objectives of the Project:

PRIMARY OBJECTIVES (I&II) [Capacity building programme]

1] **Capacity Building Programme:** “Establishment of Advance Institutional Level Biotech Hub:Phase-II at Dhing College, Dhing,

- ☐ To strengthen the laboratory infrastructure of the hub for achieving excellence in teaching and training.
- ☐ To enhance the quality of the learning through ‘Hands On’ exposure to experimental work and participation in Summer Schools/ Projects.
- ☐ To promote networking and strengthen ties with neighboring institutions and other Biotech hub laboratories.
- ☐ To conduct specialized training programmes/Lecture programme /Outreach/awareness/STC for the Students, faculty & teachers to improve their skills.
- ☐ To provide access and exposure to students to R& D activities of the hub/ laboratories and industries in the NER region of India.
- ☐ To help in devising standard Operating Procedures (SOP’s)/kit’s for practicals.
- ☐ To conduct community programme their by linking with societal people/NGOetc.

II] R&D Programme: *“In vitro antimicrobial & antagonistic activity of Endolichenic Fungus (ELF) against pathogenic bacteria & fungus and evaluation of their bioactive compound using Thin Layer Chromatography (TLC) & HPLC”*

➤ **SPECIFIC OBJECTIVES [R&D Component]:**

- i] “Isolation, Identification & In-vitro evaluation of antimicrobial & antagonistic potentiality of Endolichenic fungus and their efficiency against some clinically significant human and plant pathogen.
- ii] Isolation of bioactive compounds from Lichen and their identification.

A9] Specific Recommendations made by the Task Force/APR (if any):

Recommendation-I: [The progress of the project was reviewed in the second meeting of DBT-NER Steering Committee for Human Resource Development held on 23rd-24th July, 2019 at NER-BPMC, New Delhi. The progress of the hub has been graded as “Very Good” and the following observations and recommendations were made by the Committee:

- a) The good number of publications, workshops and seminars conducted by the hub was appreciated by the committee. The committee also noted that the hub has introduced 2 diploma courses for the students.
- b) The committee recommended in-principle the continuation of the Hub into Phase-II as Advanced Institutional Level Biotech Hub, subject to submission of a focused research plan and training activities

[Response by IA: Re-introduced diploma course in Solid Waste Management and Vermicomposting w.e.f 2024]

Recommendation II: [As regards to the recommendation of **Review committee on APR/2025**, for conduct of antimicrobial Screening , MIC of Lichenoid fungal extracts and evaluation of their effect has been partially done at our laboratory following the shortage of trained manpower due to the resignation of Project Associate on 30/12/2024..

Section-B: Scientific and Technical Progress

B1. Progress made against the Approved Objectives, Targets & Timelines during the Reporting Period (1000-1500 words for interim reports; 2500-3500 words for final report; data must be included in the form of up to 3 figures and/or tables for interim reports; up to 7 figures and/or tables for final reports):

Proposed Milestone (Months)	Target Deliverables Specified in Proposal	Status & Actual Progress Realized
00 – 06 Months (Q1&Q2)	Identification of Sample site using GPS, Map preparation, specimen collection, preservation, and initial inoculation.	Completed. Field maps locked; Collection of lichen species from field stations (L1-L5) was started. Identification of species and processed into archival paper packets was done simultaneously. 29/37 species secured
07 – 12 Months (Q3 &Q4)	Mass culture of isolates, preliminary chemical color tests, and bioactivity assays.	Collection of lichen species from field stations (L1-L5) continued. Identification of species and processed into archival paper packets was done simultaneously. Around 29 species secured were identified and their photo plates were prepared. Completed. The diversity index of lichen species was calculated using Simpson diversity index. Axenic cultures established. Oxidase/catalase profiles mapped. Initial organic solvent extractions finalized.
13 – 24 Months (Q4,Q5,Q6&Q8)	Extended antimicrobial testing, minimum inhibitory concentration (MIC) evaluations and dual-culture antagonistic assays.	Completed. Polarity-based bioassays compiled for plant pathogens. Antibacterial specificity /MIC confirmed.
25 – 36 Months (Q4,Q5,Q6&Q8)	Data consolidation, final confirmatory validation, statistical processing and manuscript generation.	In Progress / Nearing Completion. Statistical matrices are being structured. Final reports and high-resolution microphotographic prints are compiled for official submission to DBT.

➤ **Objective wise achievement in Capacity development Programme 23-26**

S. No	Objectives	Status (Achieved/partially achieved/yet to start etc.)	Remarks (Achievement in detail /other)
1.	1] To strengthen the existing academic and laboratory infrastructure of the hub for achieving excellence in teaching and training. 2] To enhance the quality of the learning and teaching process to stimulate original thinking through ‘Hands On’ exposure to experimental work and participation in Summer Schools/ Projects. 3] To promote networking and strengthen ties with neighboring institutions and other Biotech hub laboratories. 4]. To conduct specialized training programmes/Lecture programme /OP/awareness for the Students, faculty & college teachers to improve their technical capabilities. 5] To increase capabilities of core instrumentation resources of the hub	[LEAD obtained HRD/Capacity Building Part-Phase-II] 1] Procured 12 numbers of equipments to strengthen the existing facility of the hub as per specification given in the sanction order. More over old and previous equipments were also maintain with AMC. ➤ .Workshop cum Hands-on-Training on Laboratory Instrumentation Technique ➤ Workshop cum Hands-on-Training on <i>HERBAL PROCESSING TECHNOLOGY</i> ➤ .Outreach programme on Foldscopic Visualization for School Children ➤ Short Term Course on BLENDED TEACHING & LEARNING FOR SCHOOL TEACHERS ➤ OutreachProgrammeon“ Village Level POST COVID awareness Programme” ” ➤ Outreach programme on Naturopathy and Yoga Camp in association with Arogya Yoga Kendra, Dhing. ➤ .Workshop cum Hands-on-	All together 10 Numbers of Capacity building Programme have been successfully conducted by using first year grant as on date and the numerical data table is shown in above:

	by procuring new equipments & upgrading of existing facilities. 6.] To provide access and exposure to students to R& D activities of the hub/ laboratories and industries in the NER region of India. 7]. To help in devising standard SOP's/ Kit's for practicals. 8] To conduct community programme their by linking with societal people/ NGO etc. 9]. To conduct special programmes for awareness post COVID situations. 10] To strengthen the ties with DBT with due acknowledgements & feedbacks.	Training on “Basic Laboratory Skills on Microbiology” ➤ .Outreach programme on Naturopathy and Yoga Camp ➤ Outreach programme on Foldscopic Visualization for School Children ➤ Capacity building programme on Fruit Processing and Preservation Technology ➤ Develop SOPs for student's uses & handlings of hub equipments. ➤ Established ties with few local NGO and Institution to conduct community awareness programme.	
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➤ **Objective wise achievement in R&D Programme 23-26**

Title of R&D Project: “In vitro antimicrobial & antagonistic activity of Endolichenic Fungus (ELF) against pathogenic bacteria & fungus and evaluation of their bioactive compound using Thin Layer Chromatography (TLC) & HPLC”

Objectives:

- 1].** To Isolation, Identification & In-vitro evaluation of antimicrobial& antagonistic potentiality of “Endolichenic fungus” and their efficacy against some clinically significant human and plant pathogen.
- 2].** To isolation of bioactive compounds from Lichen and their identification

2.	-do-	<u>[Achievement R & D part - Phase-II]</u> ➤ Preparation of Study area map highlighting sample sites has been completed. ➤ Collection of Lichen Species was done and 29 species of Lichens were identified from five different study sites ➤ Sample preservation & herbarium preparation was completed and are stored in the database in our College Lab. ➤ Isolation of Endolichenic fungus has been done and preserved in the Culture Lab. ➤ Preparation of different Culture media and their inoculation has been completed. ➤ Chemical analysis of Endolichenic fungus and chemical test from metabolites has completed. ➤ Antimicrobial MIC screening test using lichenoid extract has been done upon bacterial and fungus pathogen. ➤ Isolation of Bioactive compounds is yet to be done.	All possible research activity on ELF using limited hub facility has been done optimally. Due to resignation of Project associate in mid part and only using the first year grant PI has faced in many problems for which few investigations remain incomplete. Major Achievements: ➤ 01 Design Patent granted and 01 Design patent applied for. 1.Design Patent Certificate: "Glass Chamber for Surface Sterilization" 2.Patent applied: "Portable Herbarium Preservation Chamber for Lichens" Publications from project work: [Yes] Details of Publication :02 Publication in conference proceedings:04
3. Other Significant Outcomes of Phase-II: As per recommendation of task force College has Re-Introduced the 6 (Six) month diploma course in Solid Waste Management & Vermi composting [First batch passed out in June 2025 and 2nd batch is about to complete.] but diploma course in laboratory (DMLT) technology is yet to be re-introduced for technical difficulties.			

➤ **Table: 1. No. of workshop/symposia/brainstorming meeting/ trainings organized in financial year 2023-2026.**

[Outcome Indicators]

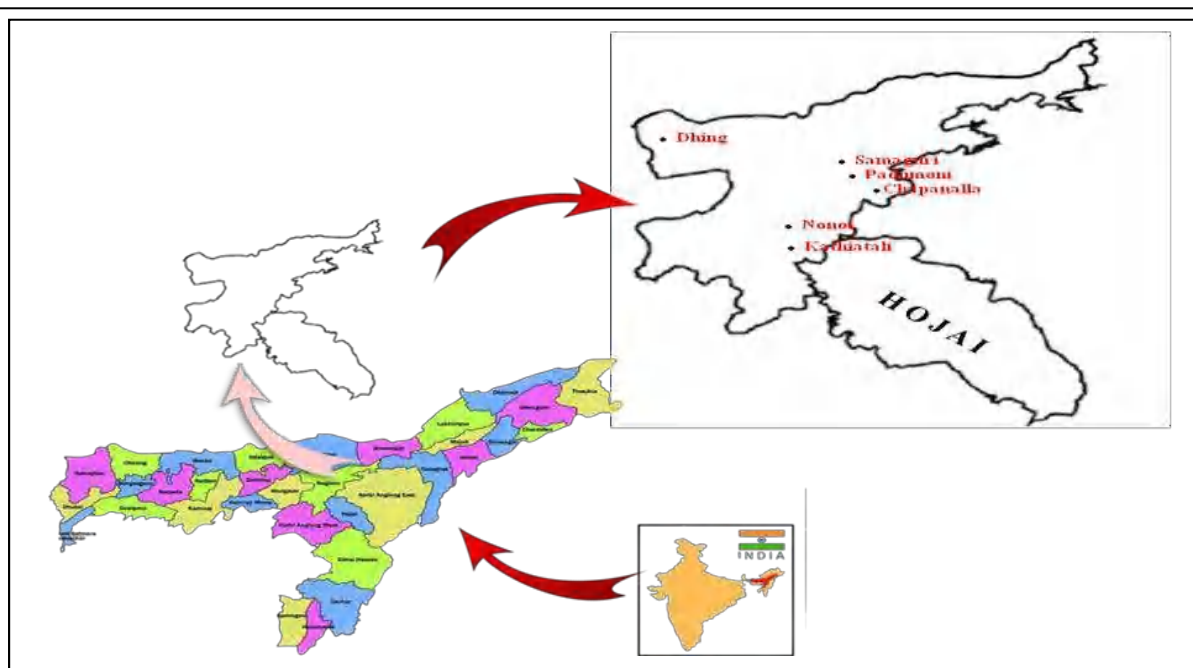
Year	1 st Year		2 nd Year		3 rd Year		Total	
Target (T)/ Achievements (A)	A	T	T	A	T	A	T	A
No. of manpower supported/ trained				287		141	428	428
No. of female beneficiaries in the DBT funded project						20	20	20
No. of publications					01	01	02	02
No. of Patents filed/ granted/commercialized						01	Gran ted 01 Filed 01	Granted 01 Filed 01
No. of products or technologies developed/ transferred/commercialized								
Others (Training/STC/ wprkshop/ OP)	3			4		3	10	10
Patents				01		01(A/F)	02	02

Table 2: List of Identified Lichens from various sample sites

Lichen Samples	Site	Scientific Name	Figures
Sample 1	Kathiatoli (Nagaon)	<i>Parmotrema tinctorum</i> (Nyl.)Hale	Figure1-3
Sample 2	Dhing (Nagaon)	<i>Oxneriopsisbassiae</i> (Ach.)S.Y. Kondr.Upreti &Hur	Figure4
Sample 3	Padumoni (Nagaon)	<i>Dirinariiaegiliata</i> (Afzel.ExAch.) Moore	Figure5-6
Sample 4	Dhing (Nagaon)	<i>Cryptotheciastriata</i> Thor.	Figure7
Sample 5	Padumoni (Nagaon)	<i>Parmotrematinctorum</i> (Nyl.)Hale	Figure1-3
Sample 6	Chapanala (Nagaon)	<i>Dirinariapapillulifera</i> (Nyl.)D.D. Awasthi	Figure8-9
Sample 7	Chapanala (Nagaon)	<i>Pyxinesubcinerea</i> Stirton	Figure10-11
Sample 8	Kathiatoli (Nagaon)	<i>Lecanoraachroa</i> Nyl.	Figure12
Sample 9	Chapanala (Nagaon)	<i>Graphisscripta</i> (L.) Ach.	Figure13-14
Sample 10	Chapanala (Nagaon)	<i>Phaeographiscaesioradians</i> (Leight.) Archer	Figure15-16
Sample 11	Dhing	<i>Parmotrematinctorum</i> (Nyl.)Hale	Figure1-3
Sample 12	Bordua	<i>Pyxinesorediata</i> (Ach.)Mont.	Figure17-18
Sample 13	Chapnala	<i>Bacidiacconnexula</i> (Nyl.) Zahlbr.	Figure19-20
Sample 14	Chapnala	<i>Lecanoraachroa</i> Nyl.	Figure12
Sample 15	Padumoni	<i>Thelotrema</i> sp.	Figure21-22
Sample 16	Dhing	<i>Pyxinecoccoes</i> (Sw.)Nyl.	Figure23
Sample 17	Dhing	<i>Pyxinereticulate</i> (Vain.)Vain.	Figure24
Sample 18	Dhing	<i>Parmotremapraesorediosum</i> (Nyl.) Hale	Figure25
Sample 19	Chapnala	<i>Parmotremapraesorediosum</i> (Nyl.) Hale	Figure25
Sample 20	Chapnala	<i>Pyxinecoccoes</i> (Sw.)Nyl.	Figure23
Sample 21	Chapnala	<i>Pyxinefarinose</i> Kashiw.	Figure26
Sample 22	Bordua	<i>Dirinariapapillulifera</i> (Nyl.)D.D.aWAwasthi	Figure8-9
Sample 23	Bordua	<i>Graphisnigroglauca</i> Leighton	Figure27-28

Sample 24	Bordua	<i>Bacidia incongruens</i> (Stirton) Zahlbr.	Figure29
Sample 25	Chapnala	<i>Parmotrema crinitoides</i> J.C. Wei	Figure30
Sample 26	Chapnala	<i>Graphis</i> sp.	Figure31-32
Sample 27	Dhing	<i>Graphinarufopallida</i> (Vainio) Zahlbr.	Figure33-34
Sample 28	Dhing	<i>Chrysothrix candelaris</i> (L.) Laundon	Figure35
Sample 29	Chapanala (Nagaon)	Sample is not a lichen but probably [A wooddecaying fungus]	Figure36
Sample 30	Dhing	(Fruticose Lichen)[unidentified]	Figure37

Map1: Geographical Map of Lichen Collection Sites:



Map2: Location, GPS Details of Lichen Collection Sites:-

Sample site	Name	Nature	Latitude & Longitude
1	Dhing	Plain area	Lat:26.457140, Long: 92.487541
2	Chapanala	Foot hills	Lat:26.339437, Long: 92.894914
3	Padumoni	Foot hills	Lat:26.369124, Long: 92.844875
4	Kathiatoli	Foot hills	Lat:26.225751, Long: 92.808177
5	Bordua	Plain area	Lat:26.402127, Long: 92.536625

➤ **Table 3: Isolation of ELF corresponding to Lichen Species**

Genus	Identified Lichen Species	ELF identified
Bacidia	Bacidia connexula (Nyl.) Zahlbr.	Colletotrichum
	Bacidia incongruens (Stirton) Zahlbr.	Trichoderma Sp
Chrysothrix	Chrysothrix candelaris (L.) Laundon	Phomopsis
Cryptothecia	Cryptothecia striata Thor.	Trichoderma Sp
Dirinaria	Dirinaria aegiliata (Afzel. Ex Ach.) Moore	Alternaria spp
	Dirinaria papillulifera (Nyl.) D.D. Awasthi	Cladosporium sp.,
Graphina–	Graphina rufopallida (Vainio) Zahlbr.	Fusarium Sp
Graphis	Graphis scripta (L.) Ach.	Aspergillus
	Graphis scripta (L.) Ach.	Alternaria spp
	Graphis spp.	Fusarium Sp
Lecanora	Lecanora achroaNyl.	Cladosporium sp.,
Oxneriopsis	Oxneriopsis bassiae (Ach.) S.Y. Kondr.Upreti& Hur	Trichoderma Sp
Parmotrema	Parmotrema tinctorum (Nyl.) Hale	Alternaria spp
	Parmotrema praesorediosum (Nyl.) Hale	Alternaria spp
	Parmotrema crinitoides J.C. Wei	Fusarium Sp
Phaeographis	Phaeographis caesioradians (Leight.) Archer	Alternaria spp
Pyxin	Pyxine cocoes (Sw.) Nyl.	Xylaria sp
	Pyxine farinosaKashiw.	Fusarium Sp
	Pyxine subcinerea Stirton	Daldinia
	Pyxine reticulata (Vain.) Vain.	Fusarium
	Pyxine sorediata (Ach.) Mont.	Aspergillus
Thelotrema	Thelotrema sp.	Trichoderma Sp

Table 4: Simpsons Diversity Index of Lichen Species of Nagaon District:

$$\text{Diversity Index} = 1 - \sum (n/N)^2$$

n=Total Number of organisms of a particular species

N= Total number of organisms of all species

D=Diversity Index

➤ **Data Collection:**

Lichen samples	Total species identified
<i>Parmotrema</i>	6
<i>Oxneriopsis</i>	1
<i>Dirinaria</i>	3
<i>Cryptothecia</i>	1
<i>Pyxine</i>	6
<i>Lecanora</i>	2
<i>Graphis</i>	3
<i>Phaeographis</i>	1
<i>Bacidia</i>	2
<i>Thelotrema</i>	1
<i>Graphina</i>	1
<i>Chrysothrix</i>	1
FruticoseLichenspp	1
Total=29	

➤ **Calculation of $(n/N)^2$ for each species:**

Lichen samples	$(n/N)^2$	
<i>Parmotrema</i>	$(6/29)^2$	0.042849
<i>Oxneriopsis</i>	$(1/29)^2$	0.001156
<i>Dirinaria</i>	$(3/29)^2$	0.010609
<i>Cryptothecia</i>	$(1/29)^2$	0.001156
<i>Pyxine</i>	$(6/29)^2$	0.042849
<i>Lecanora</i>	$(2/29)^2$	0.004761
<i>Graphis</i>	$(3/29)^2$	0.010609
<i>Phaeographis</i>	$(1/29)^2$	0.001156
<i>Bacidia</i>	$(2/29)^2$	0.004761
<i>Thelotrema</i>	$(1/29)^2$	0.001156
<i>Graphina</i>	$(1/29)^2$	0.001156
<i>Chrysothrix</i>	$(1/29)^2$	0.001156
FruticoseLichenspp	$(1/29)^2$	0.001156
Sum the squared proportions $(\sum (n/N)^2)$:		0.12453
Calculation of $D(1-\text{Sum})1-0.12453$		0.87547

Table 5 : Qualitative antimicrobial activity of lichen extracts against selected plant pathogens

Pathogen	Acetone	Methanol	Petroleum Ether	Diethyl Ether	Positive Control
<i>Pseudomonas syringae</i> (MTCC 673)	+++	++	+++	++	++++ (Streptomycin)
<i>Ralstonia solanacearum</i> (MTCC 13168)	+++	++	+++	++	++++ (Streptomycin)
<i>Alternaria alternata</i> (MTCC 13407)	-	-	±	-	++ (Carbendazim)
<i>Fusarium oxysporum</i> (MTCC 12994)	±	-	±	-	++ (Carbendazim)

Scale: ++++very strong inhibition,+++Strong,++Moderate, + Weak, -No inhibition.

TABLE 6: STATION WISE COLLECTION OF DATA:

☐ **Sample Station (L-01): Dhing Area (Campus and nearby forest):**

Code	Habitat	GPS	Type	Location
D-01	Corticolous	Lat. 26.457140, Long. 92.487541	Crustose	Dhing College Campus
D-02	Corticolous	Lat. 26.457747, Long. 92.485705	Crustose	Dhing College Campus
D-03	Corticolous	Lat. 26.457747, Long. 92.485705	Foliose	Dhing College Campus

☐ **Sample Station (L-02): Chapanala and Samaguri Area (Nearby forest):**

Code	Habitat	GPS	Type	Location
C-01	Saxicolous	Lat. 26.339437, Long. 92.894914	Crustose (White and orange)	Chapanala
C-02	Corticolous	Lat. 26.339251, Long. 92.894884	Crustose (Whitish green)	Chapanala
C-03	Ramicolous	Lat. 26.369144, Long. 92.844882	Foliose	Chapanala
C-04	Corticolous	Lat. 26.339251, Long. 92.894884	Foliose	Chapawati falls area
C-05	Corticolous	Lat. 26.321012, Long. 92.904060	Crustose (Whitish green)	Chapawati falls area
C-06	Corticolous	Lat. 26.368863, Long. 92.845258	Foliose	Chapawati falls area
C-07	Corticolous	Lat. 26.320604, Long. 92.904717	Crustose (Green)	Chapawati falls area
C-08	Corticolous	Lat. 26.320604, Long. 92.904717	Crustose (Whitish)	Chapawati falls area
C-09	Ramicolous	Lat. 26.340091, Long. 92.894852	Foliose (Green)	Chapawati falls area
C-10	Corticolous	Lat. 26.340091, Long. 92.894852	Crustose (Whitish green)	Chapawati falls area

❑ **Padumoni area (L-03) nearby forest**

Code	Habitat	GPS	Type	Location
P-01	Corticolous	Lat. 26.369128, Long.92.844901	Crustose (Whitish green)	Podumoni Village
P-02	Corticolous	Lat. 26.369058, Long. 92.844810	Foliose (Green)	Podumoni Village

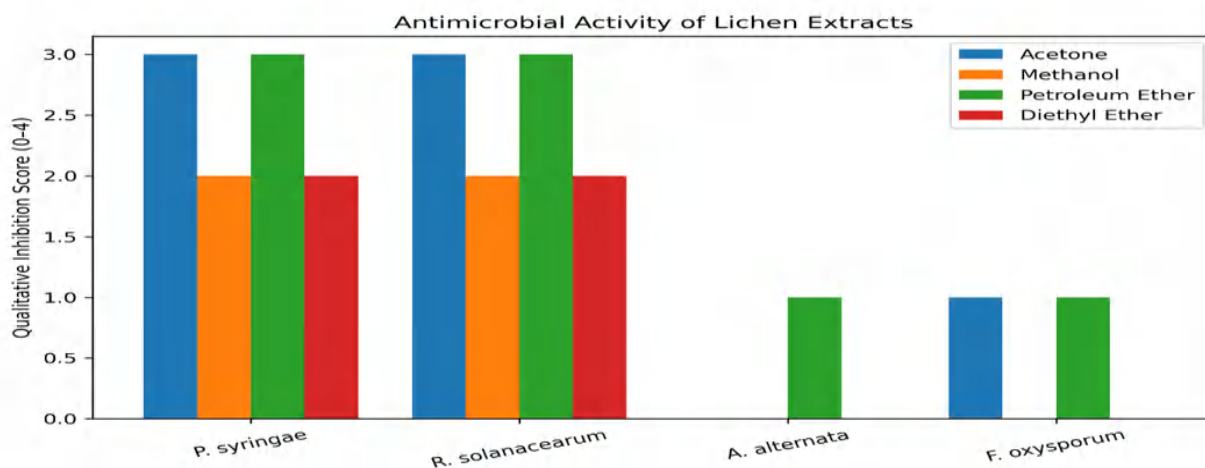
❑ **Kothiatoli area (L-04) nearby forest**

Code	Habitat	GPS	Type	Location
K-01	Corticolous	Lat. 26.225755, Long.92.808166	Crustose (white)	Kothiatoli Foothills
K-05	Ramicolous	Lat. 26. 225746, Long.92.808177	Foliose	Kothiatoli Foothills

❑ **Nonoi area (L-05) nearby forest**

N-01	Corticolous	Lat. 26.225750, Long.92.808167	Crustose	Nonoi Area
N-02	Corticolous	Lat. 26. 225760, Long.92.808182	Crustose	Nonoi Area

➤ **Fig 1 : Antimicrobial activity of Lichen Extract.**



➤ **Photo Plate 1: : Antimicrobial activity of Lichen Extract.**

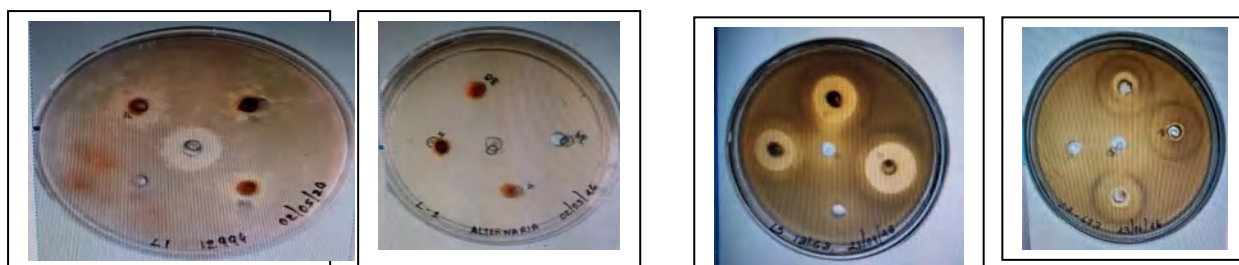


Table 7: Percent Inhibition (%) of bacterial and fungal pathogen treated with lichen extract at OD_{600nm} using UV-VIS spectrophotometer [mean value of 3 replicas in petroleum and ethanol extract]

Pathogen/Test organism	ppm	OD _{Control}	OD _{Sample}	% Inhibition (mean of 3 replica)
<i>Pseudomonas syringae</i>	25	0.625	0.489	21.76
	75	0.634	0.464	26.81
	50	0.649	0.455	29.89
	100	0.697	0.408	41.46
<i>Ralstonia solanacearum</i>	25	0.615	0.478	22.27
	75	0.629	0.455	27.66
	50	0.640	0.452	29.37
	100	0.678	0.425	37.31
<i>Alternaria alternata</i>	25	0.630	0.621	0.90
	50	0.645	0.640	0.77
	75	0.650	0.649	0.15
	100	0.670	0.666	0.59
<i>Fusarium oxysporum</i>	25	0.623	0.620	0.48
	50	0.639	0.635	0.62
	75	0.657	0.651	0.91
	100	0.662	0.659	0.45

➤ **Perform calculation:**

➤ A control= Brooth+ Test organism [Absorbance before adding extract]

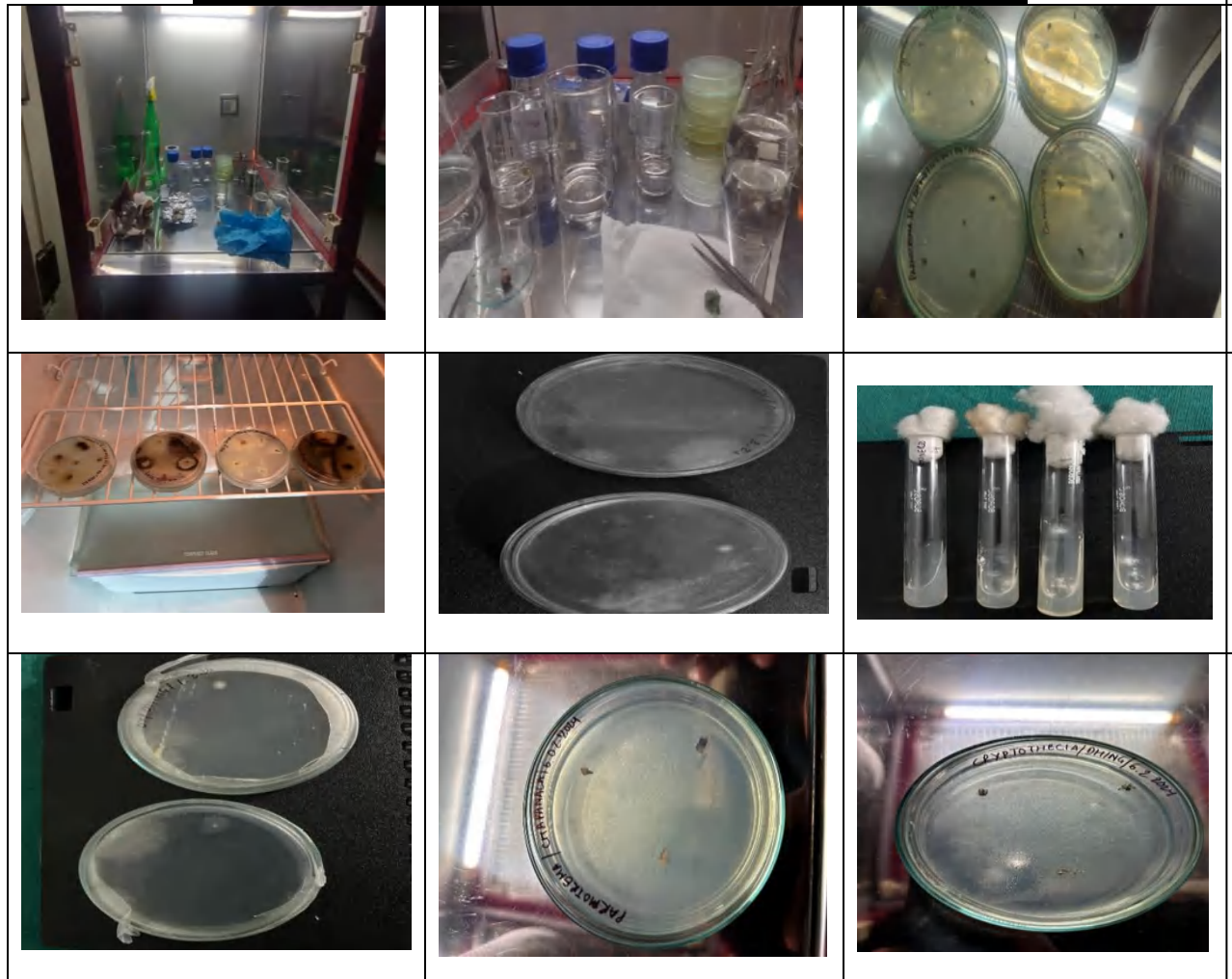
➤ A sample= Brooth+ Test organism+ extracts [Absorbance after adding extract]

❖ Apply Formula:

$$\text{➤ \% Inhibition} = \frac{[A_{\text{control}} - A_{\text{sample}}]}{A_{\text{control}}} \times 100$$

A control

➤ **PhotoPlate-2: Photographs of Identified Lichen Thallus**



➤ **PhotoPlate-2: Photographs of identified Lichen Thallus**

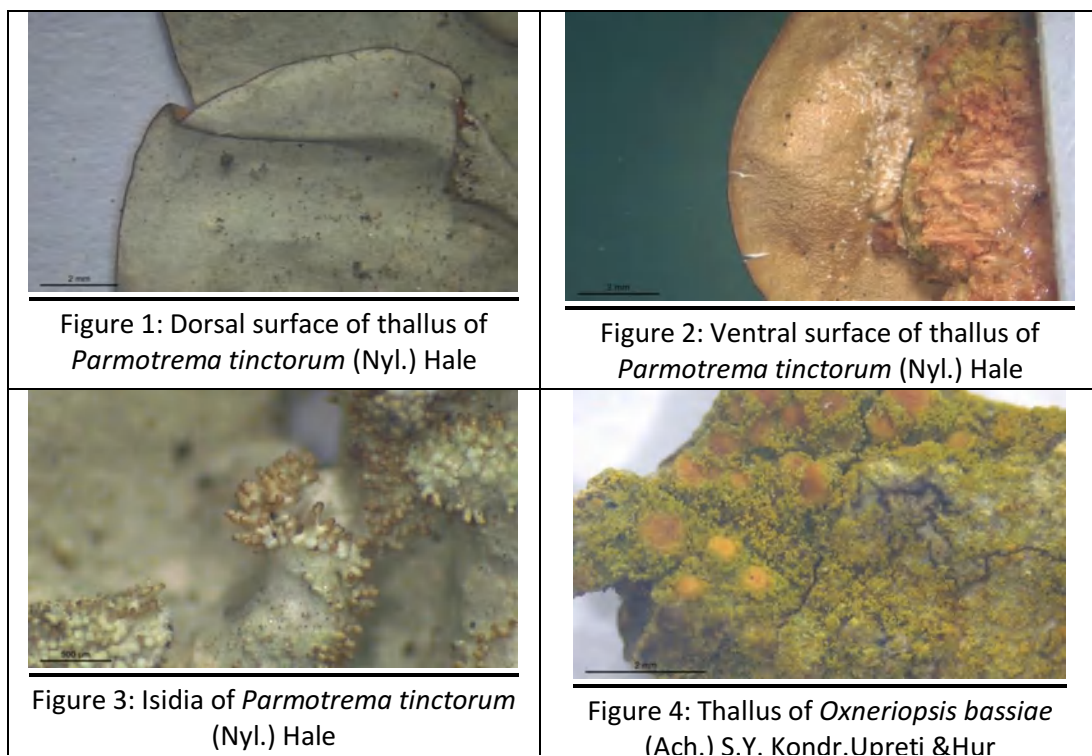




Figure 5: Thallus of *Dirinaria aegiliata* (Afzel. Ex Ach.) Moore



Figure 6: Soralia of *Dirinaria aegiliata* (Afzel. Ex Ach.) Moore



Figure 7: Thallus of *Cryptothecia striata* Thor.

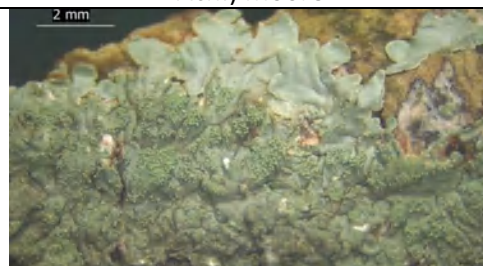


Figure 8: Thallus of *Dirinaria papillulifera* (Nyl.) D.D. Awathi



Figure 9: Isidia of *Dirinaria papillulifera* (Nyl.) D.D. Awathi

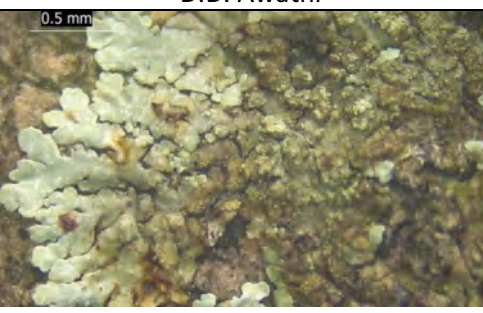


Figure 10: Thallus of *Pyxine subcinerea* Stirton

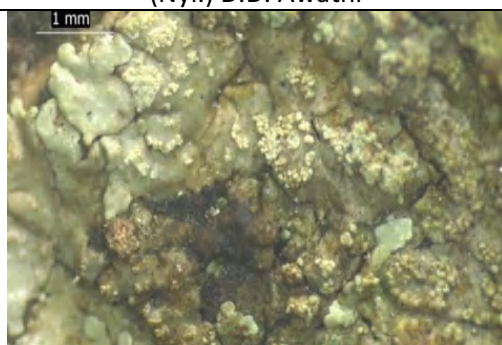


Figure 11: Soralia of *Pyxine subcinerea* Stirton



Figure 12: Thallus of *Lecanora achroa* Nyl.

➤ **PhotoPlate-3: Photographs of identified Lichen Thallus**

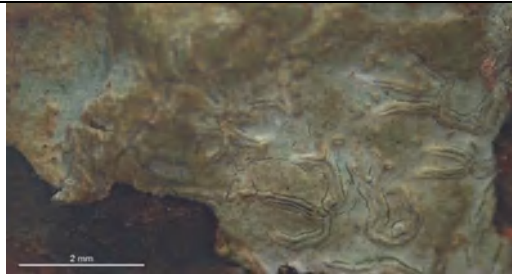


Figure 13: Thallus of *Graphis scripta* (L.) Ach.



Figure 14: Spore of *Graphis scripta* (L.) Ach.



Figure 15: Thallus of *Phaeographis caesioradians* (Leight.) Archer



Figure 16: Spore of *Phaeographis caesioradians* (Leight.) Archer



Figure 17: Thallus of *Pyxine soorediata*



Figure 18: Spores of *Pyxine soorediata*



Figure 19: Thallus of *Bacidia connexula* (Nyl.) Zahlbr.

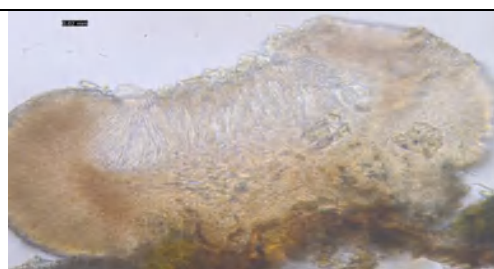


Figure 20: Apothecia of *Bacidia connexula* (Nyl.) Zahlbr

➤ **PhotoPlate-4: Photographs of identified Lichen Thallus**



Figure 21: Thallus of *Thelotrema* sp.



Figure 22: Spores of *Thelotrema* sp.

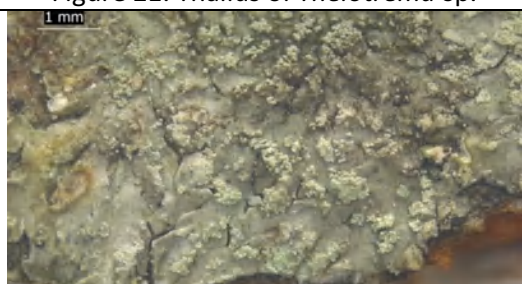


Figure 23: Thallus of *Pyxine cocoes* (Sw.) Nyl.



Figure 24: Thallus of *Pyxine reticulata* (Vain.) Vain.



Figure 25: Thallus of *Parmotrema praesorediosum* (Nyl.) Hale



Figure 26: Thallus of *Pyxine farinose* Kashiw.



Figure 27: Thallus of *Graphis nigroglauca* Leighton



Figure 28: Spore of *Graphis nigroglauca* Leighton.



Figure 29: Thallus of *Bacidia incongruens* (Stirton) Zahlbr.



Figure 30: Thallus of *Parmotrema crinitoides* J.C.

➤ **PhotoPlate-5: Photographs of identified Lichen Thallus**



Figure 31: Thallus of *Graphis* sp.



Figure 32: Spore of *Graphis* sp.

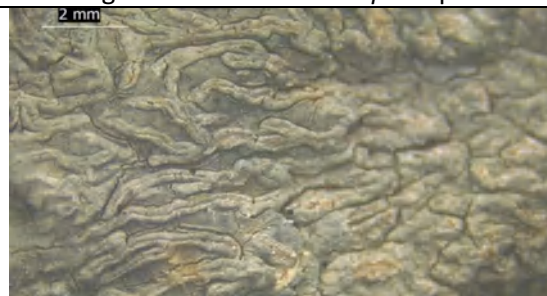


Figure 33: Thallus of *Graphina rufopallida* (Vainio) Zahlbr



Figure 34: Spore of *Graphina rufopallida* (Vainio) Zahlbr.



Figure 35: Thallus of *Chrysothrix candelaris* (L.) Laundon

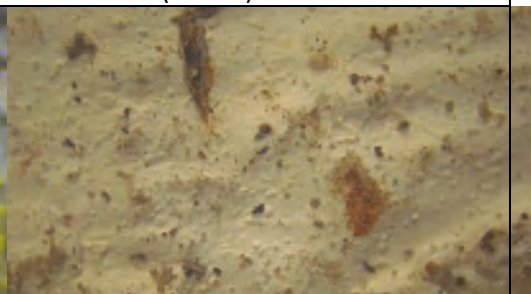


Figure 36: Sample no. 29 is a wood decaying fungus



Figure 37: Is a Fruticose Lichen species

Total identified=29

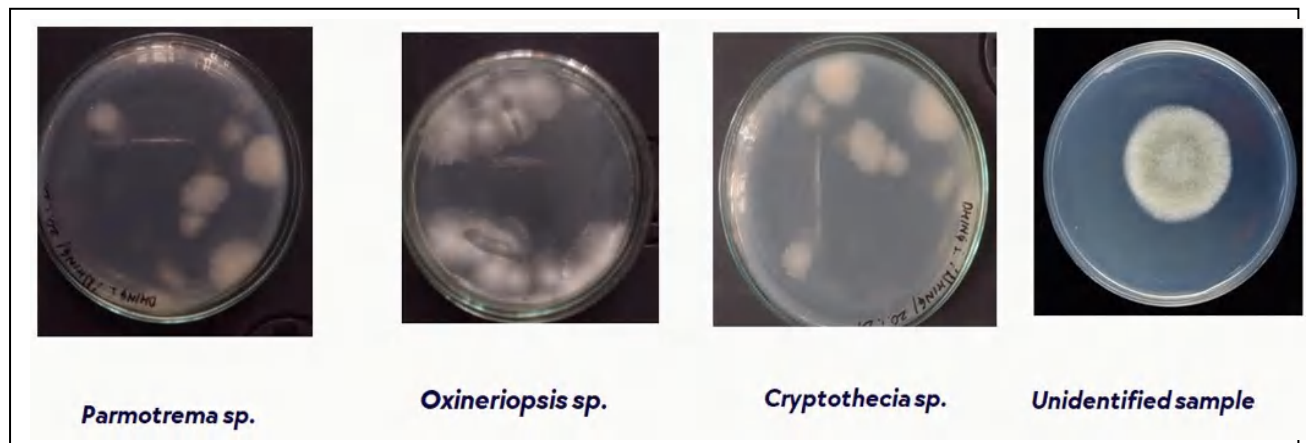
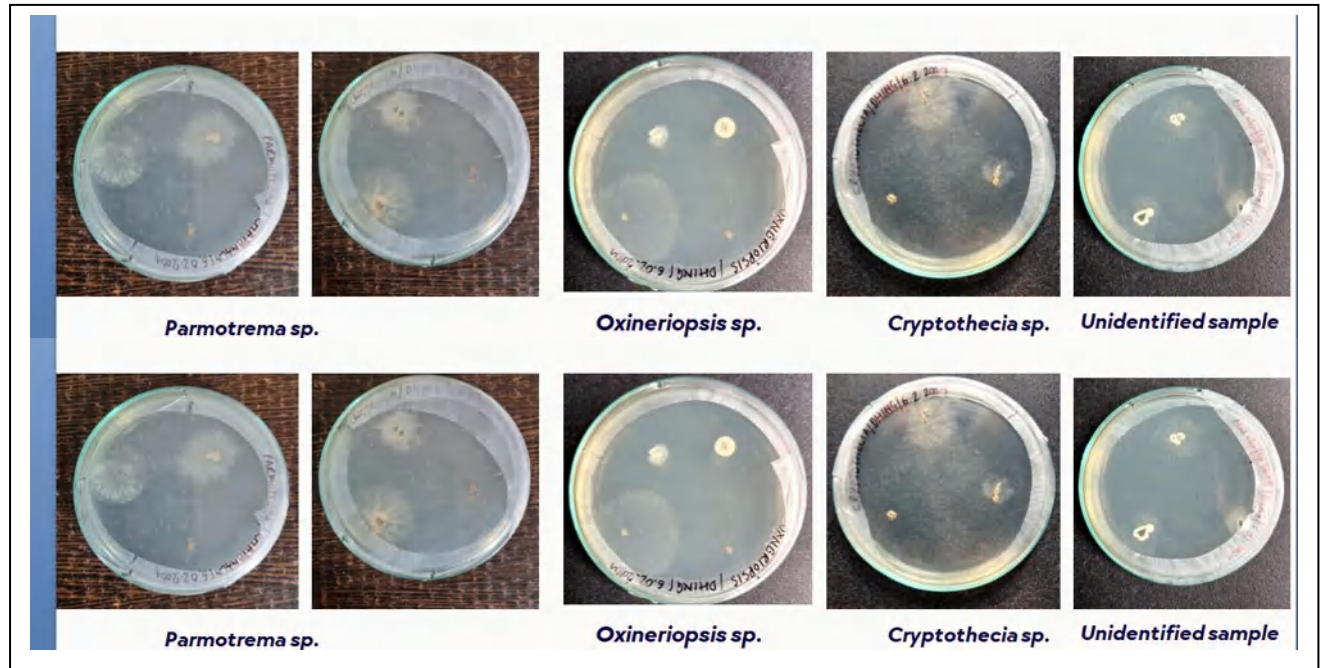
➤ Photoplate 6: Location wise collection of Lichens

L1	 Dhing, AS, India Dhing, Dhring, 782123, AS, India Lat 26.457140, Long 92.487543 11/01/2023 01:44 PM GMT+05:30 Note : Captured by GPS Map Camera	 Dhing, AS, India SH 47, Dhing, Dhring, 782123, AS, India Lat 26.457787, Long 92.485705 11/01/2023 01:55 PM GMT+05:30 Note : Captured by GPS Map Camera
L2	 Nagaon, AS, India Simgaon, Nagaon, 782140, AS, India Lat 26.339430, Long 92.894914 11/04/2023 11:41 AM GMT+05:30 Note : Captured by GPS Map Camera	 Lat 26.320604, Long 92.904717 11/04/2023 12:41 PM GMT+05:30 Note : Captured by GPS Map Camera
L3	 Nagaon, AS, India Simgaon, Nagaon, 782140, AS, India Lat 26.339430, Long 92.894914 11/04/2023 11:41 AM GMT+05:30 Note : Captured by GPS Map Camera	 Nagaon, AS, India Simgaon, Nagaon, 782140, AS, India Lat 26.339430, Long 92.894914 11/04/2023 11:41 AM GMT+05:30 Note : Captured by GPS Map Camera
L4&L5	 Lat 26.225750, Long 92.808167 12/04/2023 12:30 PM GMT+05:30 Note : Captured by GPS Map Camera	 Lat 26.225742, Long 92.808169 12/04/2023 12:27 PM GMT+05:30 Note : Captured by GPS Map Camera

➤ **Photo Plate: 7 Collection and Surface Sterilization of collected Species:**



➤ Photo Plate 8: Surface Sterilization.



B2] Summary and Conclusion of the Progress made so far (100-200 words):

The findings of this study offer valuable insights into the lichen diversity and endolichenic fungal community in the Nagaon district of Assam. The collection of 29 lichen species across five distinct areas demonstrates the region's rich lichen flora and the associated endolichenic fungal community. Through meticulous collection efforts across five distinct areas (**Map 1&2**) namely *Dhing*, *Kothiatoli*, *Nonoi*, *Podumoni*, and *Chapanala* – a total of 29 lichen species were identified, with *crustose* species comprising 60% and *foliose* species 40% of the total (**Table-2, Photo plate 2-7**). Notably, a prevalence of *corticolous* lichen was observed within the sampled regions. Expert identification conducted at lichenology laboratories at Nowgong University, Nagaon, and the ICFRE-Rain Forest Research Institute, Jorhat, Assam, facilitated accurate categorization of specimens, with *Parmotrema* being the predominant genus among foliose lichens.

Following collection, surface sterilization techniques (**Photo plate-8**) were employed to isolate sporulated endolichens, leading to the successful isolation and storage of pure colonies for further analysis. Biochemical and growth pattern evaluations of the endolichens revealed consistent positive delayed *catalase* and *oxidase* activity across all endolichenic fungi (ELFs). To enhance understanding and distinction among various lichen associated ELFs, ongoing efforts include the implementation of additional biochemical and MIC test. These endeavors aim to deepen our comprehension of the diverse endolichenic fungal community within the region, paving the way for potential applications in ecological research and biotechnology. The findings of this study offer also provide us an valuable insights into the lichen diversity and endolichenic fungal community in the Nagaon district of Assam. The collection of 29 lichen species across five distinct areas demonstrates the region's rich lichen flora. The predominance of crustose species, comprising 60% of the total, suggests a preference for substrates conducive to their growth, while the presence of foliose species, particularly those belonging to *Parmotrema*

genus, highlights the diversity within this group. The identification of lichen specimens was facilitated by collaboration with expert lichenology laboratories at Nowgong University, Nagaon , and the ICFRE- Rain Forest Research Institute, Jorhat, Assam. This ensured accurate taxonomic classification and laid the foundation for further investigations into the ecological roles and potential applications of these lichen. The successful isolation and storage of pure colonies of sporulated endolichens signify a crucial step towards understanding the endolichenic fungal community associated with these lichens. The consistent positive delayed catalase and oxidase activity exhibited by all endolichenic fungi (ELFs) suggest metabolic activity indicative of potential symbiotic or parasitic relationships with their lichen hosts. These findings corroborate previous studies highlighting the metabolic diversity of endolichenic fungi and their potential ecological significance. The planned implementation of additional biochemical and molecular tests aims to elucidate the diversity and genetic makeup of the endolichenic fungal community further. These tests will provide valuable insights into the functional roles of ELFs within lichen symbiotic associations and their potential biotechnological applications. Overall, this study contributes to our understanding of lichen diversity and endolichenic fungal communities in the Nagaon district of Assam. The data generated pave the way for future research endeavors aimed at exploring the ecological, evolutionary, and biotechnological significance of these fascinating organisms in natural ecosystems. The study reveals rich lichen diversity with *Parmotrema* and *Pyxine* being dominant genera, thriving due to favourable climatic conditions. Most samples were collected from rural areas having favourable annual rainfall, temperature and humidity which favours the growth of others lichen species namely *Corticolous*, *Saxicolous* and *Lignicolous* lichens in this locality. In the present study the Simson's Diversity Index (**Table- 4**) of Lichens species from 5(five)sample sites of Nagaon District was calculated as- $D=0.87547$ which signify the high diversity of lichen species . The study reflects both richness and evenness, a few dominant species lead to low diversity, while many species with similar number lead to high diversity.

The interpretation of the value of Simpson's indices was calculated. The value 0.87547 is likely from the most commonly used diversity index (1-D), as this range makes intuitive sense. If the value is for Simpson's Diversity Index (Gini-Simpson Index, or 1-D): The index ranges from 0 to 1. A value of 0.87547 in the present study is close to 1, which signifies a high degree of diversity (many different species with a relatively even distribution of individuals among those species).

A value between approximately 0.7 and 1.0 is often considered high diversity. If the value is for Simpson's Index (D, or Dominance Index): The index also ranges from 0 to 1, but the interpretation is counterintuitive: higher values indicate *lower* diversity (or higher dominance by one or two species). In this case, 0.87547 would suggest very low diversity/high dominance (a value > 0.7 is typically very low diversity). The high diversity index indicates a robust ecosystem, suggesting potential for discovering n Further the antimicrobial activity of the lichen extracts was evaluated against two bacterial pathogens, *Ralstonia solanacearum* (MTCC 13168) and *Pseudomonas syringae* (MTCC 673), and two fungal pathogens, *Fusarium oxysporum* (MTCC 12994) and *Alternaria alternata* (MTCC 13407), using agar well diffusion assay. The extracts prepared using *acetone, methanol, petroleum ether and diethyl ether* exhibited varying degrees of antimicrobial activity against the tested pathogens (**Table-5, Photoplate-1& Figure-1**). Among the tested microorganisms, the bacterial pathogens showed greater susceptibility to the lichen extracts than the fungal pathogens. The highest antibacterial activity was observed against *R. solanacearum* and *P. syringae*, with petroleum ether and acetone extracts producing comparatively larger zones of inhibition. Methanol and diethyl ether extracts also exhibited inhibitory activity, although the zones were relatively smaller. Streptomycin, used as the positive control, produced the largest inhibition zones against both bacterial pathogens. In contrast, the fungal pathogens exhibited lower sensitivity to the lichen extracts. Only weak to moderate inhibition was observed against *F. oxysporum* and *A. alternata*, irrespective of the solvent used for extraction. Carbendazim, used as the positive control, showed superior antifungal activity compared to the lichen extracts. ew species in future studies to come which may contribute ICBN. The comparatively lower inhibition observed against the fungal pathogens may be attributed to differences in cell wall composition and inherent resistance mechanisms. The results indicate that the lichen extracts possess promising antibacterial activity, particularly against phytopathogenic bacteria.

The variation in antimicrobial activity among the solvent extracts may suggests that the extraction efficiency of bioactive secondary metabolites depends on the polarity of the solvent employed. The MIC test of lichenoid extract upon selected bacterial pathogen *Ralstonia solanacearum* & *Pseudomonas syringae* and two fungal pathogen *F. oxysporum* and *A. alternate* as identified in the ELF list (**Table-3**) from the study sites. the above said pathogens (bacteria and ELF) was also conducted in laboratory using VIS-UV spectrophometer (**Table-7**) which also confirm that lichen extracts has greater inhibition effect on bacterial pathogen than fungal pathogen which need further investigation for biotechnological application .These tests will provide valuable insights into the functional roles of ELF's within lichen symbiotic associations and their potential biotechnological applications. .Overall, this study contributes to our understanding of lichen diversity and endolichenic fungal communities in the Nagaon district of Assam. The data generated pave the way for future research endeavors aimed at exploring the ecological, evolutionary, and biotechnological significance of these fascinating organisms in natural ecosystems.

B3.Details of New Leads Obtained, if any: Nil

B4.Details of Publications & Patents, if any: 01 Patent granted, 01 Applied.

1] Design Patent Granted Certificate: “Glass Chamber for Surface Sterilization”



2. Patent applied: “Portable Herbarium Preservation Chamber for Lichens”

FORM 1

Application for Registration of Design

[See section 5 and 44]

You are requested to register the accompanying design in:

Sr.	Class	Sub Class	Articles
1	24-00-Medical and laboratory equipment	24-01-APPARTUS EQUIPMENT FOR DOCTORS, HOSPITALS AND LABORATORIES	PORTABLE HERBARIUM PRESERVATION CHAMBER FOR LICHENS

In the name of :

Sr.	Name	Nationality	Address
1	Dr. Sanjeeb Kumar Nath	India	Co-PI, Advanced Institutional Level Biotech Hub (Phase II) & Associate Professor & HOD, Department of Botany, Dhing College, Dhing, Nagaon, Assam 782123
2	Dr. Monoj Kumar Saikia	India	PI, Advanced Institutional Level Biotech Hub (Phase II) & Rtd Associate Professor Department of Botany, Dhing College, Dhing, Nagaon, Assam 782123
3	Chandamita Goswami	India	Project Associate , Advanced Institutional Level Biotech Hub (Phase II), Dhing College Dhing, Nagaon, Assam 782123
4	Uddhab Talukdar	India	Laboratory Assistant , Department: Advanced Institutional Level Biotech Hub (Phase II), Dhing College, Dhing, Nagaon, Assam 782123
5	Mousumi Terangpi	India	Assistant Professor, Department of Botany, Dhing College, Dhing, Nagaon, Assam 782123

who claim(s) to be the proprietor(s) thereof.

Four exactly similar representations of the design accompanying this request.

The design is to be applied to **PORTABLE HERBARIUM PRESERVATION CHAMBER FOR LICHENS**,



Controller General of Patents, Designs and Trademarks
Department of Industrial Policy and Promotion
Ministry of Commerce and Industry

Design Application Details

Application Number: 454312-001
CBR Number: 207280
CBR Date: 04/04/2025 17:57:45
Applicant Name:
1. Dr. Sanjeeb Kumar Nath
2. Dr. Monoj Kumar Saikia
3. Chandamita Goswami
4. Uddhab Talukdar
5. Mousumi Terangpi

Design Application Status

Application Status: Application Under Process(awaiting for Technical Examination)

[Back](#)

❑ **Publications from project work:**

➤ **Journal Publication:**

1]. Title: Lichens of Dhing, Nagaon District, Assam

Authors: Sanjeeb Kumar Nath, Manoj Kumar Saikia, Uddhab Talukdar,
Mousumi Terangpi

Published in December 2025

“Name of Journal: Himalayan Journal of Basic and Applied Sciences” (ISSN 3107-9113) Vol. 1, Issue 2 Page 133-138

[An open-access, peer-reviewed Journal]

2]. Applied for Publication on Cryptogam Biodiversity and Assessment.
(Receive letter is enclosed)

➤ **PUBLICATION AND CONFERENCE PRESENTATION**

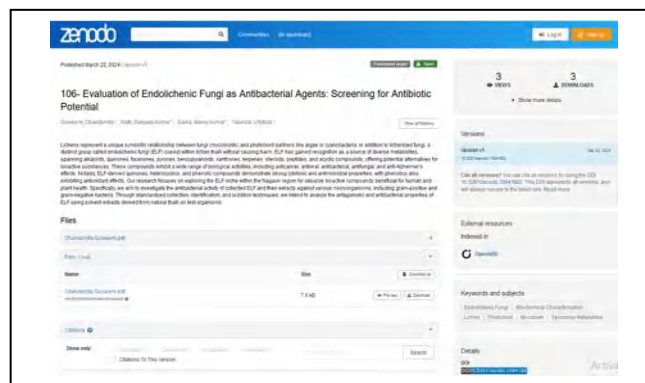
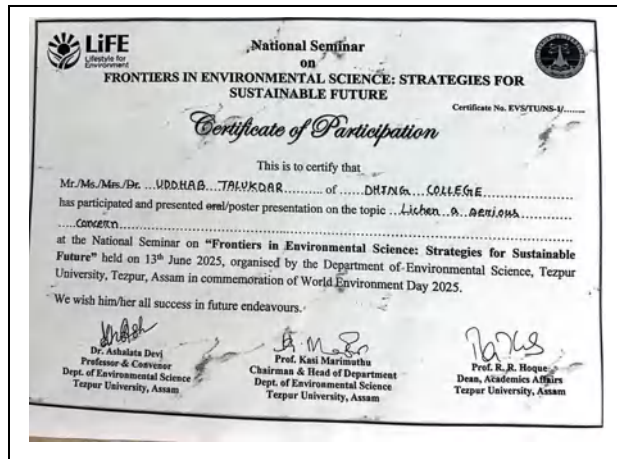
1. Abstract titled “Screening of antimicrobial properties of endolichenic fungi against certain bacterial species” was presented in International conference “International Conference on Plant science & Sustainable Agriculture” organized by SARPS.

2. Abstract titled “Evaluation of Endolichenic Fungi as Antibacterial Agents: Screening for Antibiotic Potential” was presented in International conference “International Conference on Traditional Knowledge Exploring Traditional Knowledge: Bridging Past and Future” organized by Internal Quality Assurance Cell, Nowgong College (Autonomous) In Association with Research and Development Cell (RDC), Nowgong College (Autonomous)

3. Talukdar, U. (2024) “107- Survey of Lichens of Nagaon, Assam”. International Conference on Traditional Knowledge (Exploring Traditional Knowledge: Bridging Past and Future), Zenodo. doi: 10.5281/zenodo.10841908.

4. Goswami, C. (2024) “106- Evaluation of Endolichenic Fungi as Antibacterial Agents: Screening for Antibiotic Potential”. International Conference on Traditional Knowledge (Exploring Traditional Knowledge: Bridging Past and Future), Zenodo. doi:

Certificates of participation and presentation:



Section-C: Details of Grant Utilization:

C1.Equipment Acquired or Placed Order with Actual Cost:

S. N o.	Name of Equipment(s)/ Asset(s) Acquired	Sanctioned Cost	Quantity Procured	Actual Cost (Figures not to round off)	Amount lapsed/Remar ks
	1	2	3	4	
1	Digital PH Meter with electrode	21000.00	1	19540.00	
2	SPSS data Packages for Windos 10	45000.00	1	64900.00	
3	Digital Automatic Colony Counter	30000.00	1	29205.00	
4	Micro pipette varying sizes	30000.00	1	29087.00	
5	Andersen Amp	59000.00			
6	Fundoo lab Foldscope Basic Kits	45000.00	1 box	42480.00	
7	Desktop Computer with Printer	60000.00	1	64310.00	
8	Weight Balance	48000.00	1	37760.00	
9	Double Stage water distillation	56000.00	1	56050.00	
10	Digital Conductivity Meter	21000.00	1	19470.00	
11	Thin Layer Chromatography	26000.00	1	26250.00	
12	Hot air oven with digital temp.	59000.00	1	51330.00	
13	Column Chromatography	0.00	1	250.00	Procured without sanction
	Total	500000.00		440382.00	0.59618 Lapsed

C2.] Manpower Staffing and Expenditure Details:**Due- Drawn Statement**
(Manpower & Staffing)

SL	Name & designation of the Manpower engaged	Pay Scale Provided (Basic pay + 8% HRA) Per Months	Date of Appointment	Date of Leaving	Salary Due	Salary Drawn	Difference	Reasons for leaving
1.	Chadamita Goswami Project Associate	Rs. 33480.00	15.09.2023	30/12/2024	518940.00	518940.00	0.00	Resigned for for Ph.D at VIT on 30/12/2024
2.	Uddhab Talukdar Laboratory Assistant	Rs. 21600.00	09.09.2023	30/01/2026	615600.00	399600.00	2,16,000.00	Released due completion of the project period on 30/01/2026
	Total				1134540.00	918540.00	2,16,000.00	

C3.] Details of Recurring Expenditure:

Heads	Heads	Allocated Budget (1 st year grant)	Total expenditure	Amount Lapsed	Balance
GIA-Capital(Non-Recurring)	Equipments	5,00,000/-	4,40,382/-	59618.00 Lapsed	0.00
GIA-General (Manpower)	Manpower	660960.00	1134540.00	0.00	(-) 4,73,580.00
GIA-General (Recurring)	Consumable	4,00,000/-	261249.00	84116.00 Lapsed	54635.00
	AMC	1,00,000/-	14010.00		85990.00
	Travel	50,000/-	23500.00		26500.00
	Training/ Workshop	3,00,000/-	294893.00		5107.00
	Contingency	50,000/-	32,844/-		17156.00
GIA-General (Overhead)	Overhead	50,000/-	16,800.00		33200 =+222580.00
Total		21,10,960.00	2218218.00 BL=(-)107258.00	143734.00 Lapsed amount	(-) 2,51,000.00 Negative balance

C4] Financial Requirements for the Next Year with Justifications:

❑ Financial requirement for Manpower:

A] Project Associate: Not applicable [The project Associate had already resigned from her post on 30/12/2024 and no new project fellow had been recruited after her resignation due to shortage of fund or not receiving subsequent grant from DBT.

B] Laboratory Assistant: As per UC&SoE an amount of negative balance Rs.2, 16,000.00 remain un cleared for the salary of laboratory Assistant. Therefore this amount may kindly be released.

C] GIA General: As per UC&SoE an amount of negative balance Rs.35, 000.00 remain un cleared for the GIA grant. Therefore this amount may kindly be released.

Sanjeeb Kr. Nath

[Signature(s) of the Investigator(s)]

Coordinator & PI
Biotech Hub
Dhing College

B. N. Singh

Signature of Finance Officer

UDA cum Accountant
Dhing College
Dhing: Nagaon(Assam)

[Signature]
[Signature of Head of Institution]

Principal
Dhing College

Instructions:

- (i) All the information needs to be provided; otherwise the Progress Report will be treated as incomplete. In case of 'Nil' / 'Not Applicable' information, the same may be indicated.
- (ii) In case of multicentre project, a combined Progress Report should be submitted incorporating the progress of all components. The Project Co-coordinator/ PI will be responsible for this.
- (iii) *Please indicate the reporting period [i.e. Year 1/2/3/4/5].
- (iv) Submission of Progress Report by the end of the 11th month of grant sanction is linked with further continuation of the project and timely release of funds for the next year.

#Grant utilization details (UC&SE, Assets Certificate & manpower details) also required to be submitted separately as per the prescribed format