Uttarakhand State Council for Science and Technology (UCOST)
6, Vasant Vihar, Phase-I,
Dehradun – 248 006 (Uttarakhand)
Ph. 0135-2762759, 2762766 (O)
2761063(Fax); email: u_cost@rediffmail.com

Printed & Produced by M/s Bishen Singh Mahendra Pal Singh
23 A New Connaught Place, Dehradun

ACHIEVEMENTS OF
RESEARCH & DEVELOPMENT

October 2005 to March 2011

Edited by

RAJENDRA DOBHAL
KIRTI JOSHI
DP UNIYAL

Supported by

Uttarakhand State Council for Science & Technology

THE AUTHORS

Dr. Rajendra Dobhal is the Director General, UCOST
Dr. Kirti Joshi is Project Scientist, UCOST
Dr. D.P. Uniyal is Sr. Scientific Officer, UCOST

This book has been published by
UCOST, 06 Vasant Vihar, Phase-I, Dehra Dun

PREFACE

Uttarakhand State Council for Science & Technology initiates, supports, promotes and coordinates R&D projects and programmes (including demonstration projects) which are relevant for the achievement of specific objectives and problems of the state. The state being rich in biodiversity, these projects particularly help in the optimum utilization of the natural resources of the state. Since its inception several projects were funded by the council. These projects are from various disciplines like botany, zoology, chemistry, biotechnology, nanotechnology, engineering, mathematics and physics etc.

Consequently this book represents a collection of selected Research and Development projects being supported by UCOST since last six years. Our motivation for compiling this text was to provide a snapshot of the type of projects being undertaken by the scientific community of the state. A holistic view focuses on how projects contribute to the strategic goals of the state.

It seeks to develop a better understanding of the potential for R&D programs and to foster technology solutions to the problems and environmental challenges facing the state. In essence, this identifies the potential for impressive advances in the development and deployment of technologies.

The contributions for this study by multiple national laboratories, Private Institutions, University participants and Non-Governmental Organizations, are another example of the effective partnerships that the Council is fostering to advance the state's Science and Technology agenda.

We believe this report will make a substantial contribution to developing a deeper understanding of the potential for technologies to meet future state S&T goals and challenges. This study provides a foundation of analysis that can help the state identify smart, sustainable policies and technologies.

Rajendra Dobhal
Kirti Joshi

Contents

An Empirical Study on Proximate Determinants of Creation of Intellectual Property in Uttarakhand

Santosh Rangnekar
Department of Management Studies
IIT Roorkee
E-mail:- srangnekar1@gmail.com

The value of knowledge is increasingly being recognized in today's global economy and society. In today's post information age, which has been labeled as knowledge society, issues such as generation, valuation, protection and exploitation of Intellectual Property (IP) are becoming more and more critically important around this global village. The intellectual property rights are now not only being used as a tool to protect the creativity and generate revenue but also to build alliance for the socio-economic and technological growth.

The proposed project identifies the current status and determines the factors that are acting as barriers to IP creation and suggest a suitable model for creation of intellectual property by technical institutions.The study aims to unfold the current state of IP creation and identify the proximate determinants of IP creation in Uttarakhand.

This study provides the guidelines for best practices to be followed in creating intellectual property which will promote and encourage and nurture the innovative spirit of young talent existing in India, particularly in the new state like Uttarakhand.The present study develops a sketch of current practices in the creation of intellectual property (IP) in Technical institutions and highlights extensive experiences in IP. It was observed that technical institutions were involved in research but werenot able to create IP. It was found that relatively little systematic attention has been paid to IP development and to establish the ability of technical Institutions to support IP creation.

Based on the extensive literature survey three main factors emerged out to be the most significant barriers to innovation which are culture, attitude & environment.

The data was collected from 180 PhD scholars from different Institutes and universities namely HNB Garhwal University(Srinagar), Kumaun university(Nainital), DSVU (Haridwar), UPES (Dehradoon), IIT Roorkee, Govt PG college (Rishikesh) and GBPUAT (Pantnagar) in Uttarakhand Region. The questionnaire was given to the Ph.D. scholars randomly, taking into consideration their availability and interest to respond the questionnaire.

The sample was drawn using purposive sampling method. A self constructed questionnaire was used to collect the data. The questionnaire was constructed after interviewing and brainstorming with the experts in the field. There were total 22 items each classified into three different factors namely environment, attitude & culture on the basis of quantitative and qualitative analysis.The data was analyzed with the help of MS Excel using different types of charts and tables. SPSS 16.0 was used for reliability analysis to calculate cronbach alpha value, descriptive statistics and to determine the factor structure. Factor analysis was conducted to identify the important factors for IP creation. Factors were also supported by qualitative analysis of different items of the questionnaire and classified accordingly.

On the basis of analysis of the data it was found that most of the scholars were doing the research for building a career and have been involved in one or the other kind of research during their masters which represents immense potential for intellectual property creation in Uttarakhand region. However, awareness about intellectual property creation is an issue of grave concern which should be paid immediate attention. It was disappointing to see that only 6% of the scholars had registered their research work. It was found that 75% of scholars were of the view that online patent registration process was user-friendly. So the first step for Uttarakhand Government should be to make the online registration process even more user friendly and making the scholars aware of the process through organizing various training programs and seminars which familiarize the scholars with the online registration process

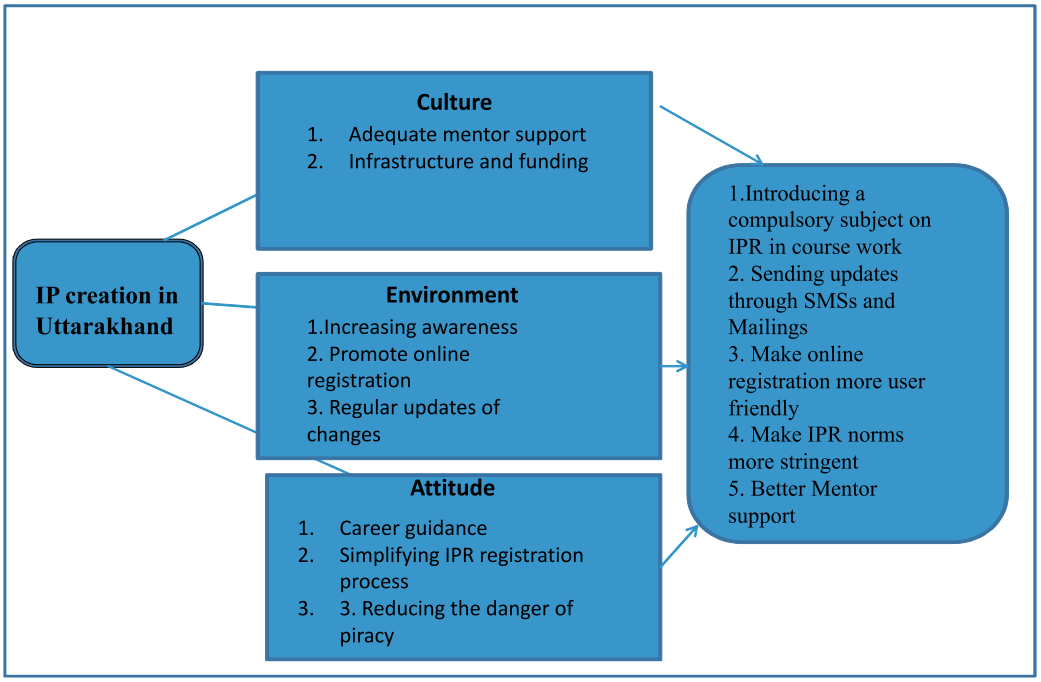
The above analysis also revealed that scholars rarely get updates of various changes in IPR system. Publications and journals were reported to be the primary source of getting the information about changes in the system. But most of the scholars preferred mailings and SMSs to be better source of information due to better approachability. Due to the geographical location and still ongoing development of Uttarakhand, there are limited sources of information. Thus, Government can set up a body which can regularly send newsletters to scholars/ technical institutes to frequently update the researchers of the rules/norms or any other changes in IPR system. Since internet might not be available to everyone, so the government could tie up with different websites or itself can start one such site which could send regular updates of Indian IPR system via SMS.

Since most of the scholars showed concern for the danger of piracy in India, this has clear policy implication for further strengthening the IPR protection laws in India and to make the scholars aware of the same. Scholars also had the opinion that the Indian IPR registration is a lengthy task and the process takes several months to complete, which is a major obstacle in increasing the number of patent applications as it discourages the scholars to file application for IPR registration.For this Uttarakhand government should take stringent actions to reduce the bureaucracy and red-tapism to smoothen the IPR registration process. For e.g. maximum time period should be fixed for the processing of application failing which the officials should be fined with certain amount, a part which would be given to the applicant to reimburse for the delay in process. Financial problems also emerged out to be one of the reasons for not applying for patents.

So a mechanism should be set in place which rewards out of the box research ideas and innovations, as providing the scholars with the rewards and recognition can act as a good motivator for the scholars to get their work registered.In addition to above, the technical institutes should be provided with adequate infrastructure and funding to meet the research needs of the scholars. Also, appropriate environment should be provided to the scholars where they can meet the scholars, experts from other fields and share their research and gain the insight from researchers in the other fields.

This would not only help to increase the awareness but also in the intellectual property creation in state. Also, course work should include on subject on IPR which could help the scholars know more about the field. Government should make it mandatory for the institutes to register a given number of IPR. This would encourage the institutes to go for more and more innovation.

On the basis of the above key findings of the study the following model was proposed for increasing the number of IPR in Uttarakhand.



An investigation of antioxidant, hepatoprotective and antimicrobial plant bioactive from Uttarakhand Himalaya

Namrata
Department of Biochemistry
Sardar Bhagwan Singh Post Graduate institute of Biomedical Sciences
and Research, Balawala, Dehradun
E-mail:- namrata.chhetri@yahoo.com

There are several plants which when coupled with the healthy life styles can be preventive and therapeutic use. Here we studied the antioxidant, hepatoprotective, renal protective ant antimicrobeal activity of *Girardinia heterophylla*, *Colocasia esculenta, Paspalum scrobiculatum, Rumex nepalensis, Diaplazium esculentum* and *Dioscorea bellophylla* against alcoholic liver and kidney injury.

The benefits of wild resources to inaccessible rural villages in Himalaya cannot be ignored. The number of wild leafy vegetables recorded in the present study area indicates its diversity is less as compared to other areas. According to several informants wild green leafy vegetables increase the amount of blood in the body in the body which is likely to refer to the high iron content of many wild greens. However, chemical analyses were beyond the scope of this study, and therefore, the information on the nutrient contents is entirely based on literature. The majority of wild edible herbs eaten typically contain high levels of important nutrients especially for diets usually high in starch.

During hepatic damage, cellular enzymes like SGOT, SGPT and ALP present in the liver cells leak into the serum, resulting in increased concentrations. Ethanol administration for 90 days significantly increased all these serum enzymes, whereas treatments with the aqueous extract of *Girardinia heterophylla, Colocasia esculenta, Paspalum schrobiculatum, Rumex nepalensis, Diaplazium esculentum* and *Dioscorea bellophylla* significantly reduced SGOT, SGPT and ALP indicating their hepatoprotective activity.

In our study, elevations in the levels of MDA in kidney, liver of alcohol treated mice were observed. The increase in MDA indicates enhanced lipid per oxidation leading to tissue damage and failure of antioxidant defense mechanism to prevent excessive formation of free radicals. Treatment with, AEGH, AECE, AEPS, AERN, AEDE and AEDB significantly reversed these changes.

In the assessment of Liver and Kidney damage induced by alcohol, the determination of enzyme levels such as AST & ALT is largely used. ALT is more specific to liver and thus is a better parameter for detecting liver injury. High levels of ALT, AST indicate damage. Our results using alcohol induced toxicity in mice demonstrated that the medicinal plant extracts (AEGH, AECE, AEPS, AERN, AEDE and AEDB) caused significant reduction in AST, ALT levels. The results also showed that the medicinal plant extracts showed significant reduction in the activity of ALP, Bilirubin, Urea and Creatinine levels.

In our study, elevations in the levels of MDA in kidney, liver of alcohol treated mice were observed. The increase in MDA indicates enhanced lipid peroxidation leading to tissue damage and failure of antioxidant defense mechanism to prevent excessive formation of free radicals. Treatment with, AEGH significantly reversed these changes.

GSH is widely distributed in cells. It protects cells against free radical, peroxides and other toxic compounds. Deficiency of GSH within living organisms can lead to enhanced lipid peroxidation, tissue disorder and injury. Treatment with medicinal plant extracts was shown to be effective in restoring the GSH levels back to normal.

To conclude the results of this study demonstrate that the plant extracts AEGH, AECE, AEPS, AERN, AEDE and AEDB have potent antioxidant and free radical scavenging properties and a very good hepatoprotective preoperties attenuates the toxic effects of alcohol by acting as an *in vivo* antioxidant as well as the hepatoprotective thereby inhibiting the initiation and promotion of lipid peroxidation or by an accelerated scavenging of free radicals and their products by conjugation with GSH.

Antimalarial Properties of Some Plants from Garhwal Region of North-West Himalaya

V.K. Dua
Sr. Deputy Director & Officer-In-Charge
National Institute of Malaria Research (ICMR)
Field Station, Hardwar 249 403
E-mail:- vkdua51@gmail.com

Malaria is one of the biggest killers in the world. Current estimates place the clinical caseload almost 1 Mio deaths per year (mainly small children in Africa) and 300-400 Mio infections annually (WHO, 2010). In 2008, 109 countries were endemic for malaria, 45 of which are in Africa [World malaria report (WHO), 2008]. There were an estimated 247 million malaria episodes in 2006.

Nineteen plants were investigated belonged to Garhwal region of North West Himalaya for their antimalarial property. The results from in vitro antiplasmodial screening from both schizont maturation and pLdh methods revealed that fractions from *A. vasica*, *A. roxburghiana*, *H. antidysentrica*, *C. bonducella*, *S. ciliata*, *R. cinerea, A. bracteosa*, *L. cephalotes, M. piperita* and *V. canescense*possessed antiplasmodial activity with their IC_{50} values≤ 15 µg/ml while other fractions have their IC_{50} values >15 µg/ml thus found in-actives. 10 out of 80 extracts were most active against *P. falciparum* K1strain, while remaining extracts were considered as non active. Chloroform extracts of *A. vasica* (AV-2), *A. bracteosa*(AB-2), *M. piperita*(MP-2), and *S. ciliata*(SC-2) showed very low antiplasmodial activity. While chloroform extract of *H. antidysentrica* (HA-2) and dichloromethane extract of *C. bonducella*(CB-2) showed moderate antiplasmodial activity. Similarly petroleum ether extract from *A. roxburghiana*(AR-1)and *R. cinerea*(RC-1)exhibited good antiplasmodial activity while chloroform extract of *A. roxburghiana*(AR-2), *R. cinerea*(RC-2) and *L. cephalotes*(LC-2)also showed good antiplasmodial activity. Only the chloroform extract from *A. roxburghiana* (AR-2)exhibited very good antiplasmodial activity with its IC_{50} value 0.417 µg/ml. Other plant extracts exhibited no inhibition against *P. falciparum* isolate.

The cytotoxicity assays of all extracts possessed IC_{50} values > 16 µg/ml and were not cytotoxic (as per WHO criteria) except petroleum ether extract of plant *V. canescense* (Violaceae) with IC_{50} value 12.39 µg/ml. The selectivity index (SI) of these active plant extracts was also determined. The chloroform extract of plant *A. roxburghiana*, *R. cinerea* and *L. cephalotes* exhibited 8 to 78 fold activity against *P. falciparum* than against the rat L-6 cell line. The petroleum ether extract of *A. roxburghiana*, *V. canescens* and, *R. cinerea* showed 4 to 10 fold activity against *P. falciparum* than against the rat L-6 cell line. 6 out of 80 extracts were found most active against parasites tested beside *P. falciparum isolate*, remaining extracts were considered as non active against these parasites. 2 extracts were effective againstamastigotes *of L. donovani*, one extract was foundeffectiveagainstamastigotes *of T. cruzi* and 3 extracts were effective againsttrypomastigotes of *T. b. rhodesiense*.

Extract showing promising results were fraction code AR-1, AR-2 from *A. roxburghiana*; CB-2 from *C. bonducella*; HA-2 from *H. antidysentrica*; LC-2 from *L. cephalotes*; RC-1, RC-2 from R. cinerea and VC-1 from *V. canescense*. These extract were assessed for its antimalarial properties

in in-vivo system against plasmodium berghei infected mice. Results revealed from *in vivo* studies of these fractions that fraction code AR-2 from *A. roxburghiana* had substantial antimalarial property, gave substantial reduction 58.8 % in parasitemia after treating the animal with an intraperitonial dose of 30 mg kg^{-1} while fraction code AR-1 did not possess any activity. Similarly fraction code RC-2 had substantial antimalarial property; reduced substantial parasitemia 60.3 % after treating the animal with an intraperitonial dose of 30 mg kg^{-1} while fraction code RC-1 did not have any activity. Fraction code CB-2 from *C. bonducella* showed antimalarial property with 59.33% reduction in parasitemia after treating the animal with an intraperitonial dose of 30 mg kg^{-1}. Similarly fraction code HA-2 from *H. antidysentrica* demonstrate 70.2% reduction in parasitemia after treating the mice with an intraperitonial dose of 30 mg kg^{-1}. While fraction code LC-2 from *L. cephalotes* did not quite reach the level of chemosupression seen with the drug used as positive control chloroquine. Due to potent inhibition of VC-1 against *P. falciparum* isolate, it is evaluated for *in-vivo* antiplasmodial activity against *P. berghei* infected mice. The percent reduction of parasitemia of VC-1 extract was found 63% on 20 mg/kg dose. Results from *in-vivo* antimalarial activity revealed that VC-1 showed significant reduction of parasitemia on dose ranges 10-20 mg/kg, without any mortality in animals of the of VC-1 extract treated group as compared to the animals of control group. Whereas the dose of 30 mg/kg showed mortality and weight loss in the animals of VC-1 extract treated group, indicates the margin of safety of the drug might be less. It is unknown whether the inhibition by VC-1 extract is caused by specific antiplasmodial action or general toxicity.

Five out of nineteen plants namely *A. roxburghiana*; *C. bonducella;H. antidysentrica*; *L. cephalotes*; *R. cinerea* and *V. canescense* showed antimalarial activity in crude form. Once it was established from in vitro and in vivo studies that essentially compounds were responsible for the antimalarial activity of these extracts, therefore targeted isolation of the active compounds from these extracts was conducted using different chromatographic methods and their characterization was done using spectroscopic methods followed by antimalarial screening.

The bioassay-guided fractions were isolated from the active plant using different chromatographic methods (column, thin layer chromatography, high performance liquid chromatography). These isolated pure compounds were than assessed for their antimalarial activity (*In vitro and in vivo*) and finally characterize and identified by mass spectrometry (MS), fourier transform Infrared spectroscopy (FTIR) and NMR experiments. Compounds responsible for antimalarial activity of *A. roxburghiana* are fiedelan-3-one with 89% reduction in parasitaemia and quercetin-3;3′,4′-trimethyl ether with 56.5%reduction in parasitaemia. Similarly compounds responsible for antimalarial activity of *C. bonducella* were norcaesalpinin A and norcaesalpinin B. Results revealed that compound Norcaesalpinin A gave substantial reduction (68.81%) in parasitaemia after treating the animals with an intraperitonial dose of 30 mg kg−1 and compound Norcaesalpinin B gave 60.83% reduction in parasitaemia after treating the animals with an intraperitonial dose of 30 mg kg−1. While On the basis of spectroscopic methods the fractions from *H. antidysentrica* were identificatied as conessine and holadysenterine. These compounds were than assessed for its *in vivo* antimalarial activity against *P. berghei* infected Swiss albino mice using Peter's 4 days test. Results revealed that compounds gave substantial reduction 73.25% and 42.03% in parasitaemia after treating the animals with an intraperitonial dose of 30 mg kg−1.

Our study could be helpful to formulate a potent herbal product with good antimalarial activity, which is the need of time against malaria.

Assessment of bacterial diversity of the Gangetic river system of Uttarakhand using molecular approaches

Piyush Pandey
Department of Microbiology
S.B.S (Pg) Institute of Biomedical Sciences &
Research, Balawala, Dehradun 248161
E-mail:- piyushgkp@rediffmail.com

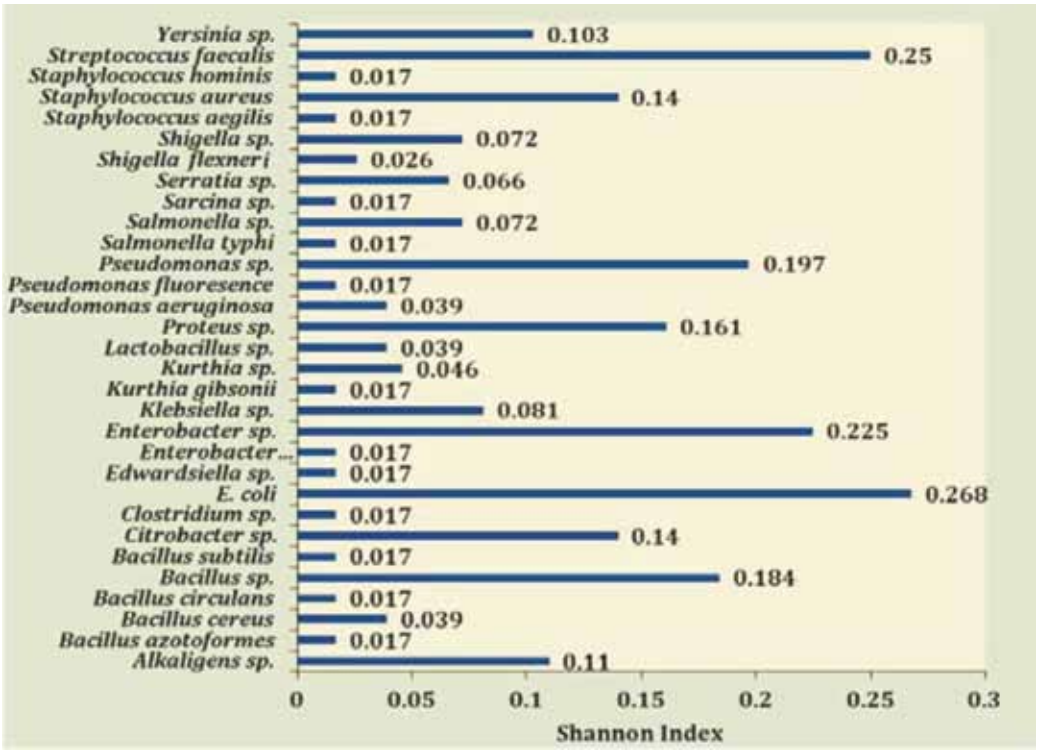
Though, considerable insights have been made on the pollution status of the Ganges, including bacteriological and physicochemical analysis, little or no efforts have been made on analysis of bacterial diversity in Uttarakhand. One of the major constrain include that the Ganges in Uttarakhand is spread over vast geographical area and cover difficult terrain, which makes the selection of sites crucial and difficult for sample collection. Owing to the rapidly increasing importance of the sustainable management of freshwater resources, detailed knowledge on the diversity, specific functions and ecology of microorganisms inhabiting freshwater ecosystems is urgently needed. Water samples were collected from thirty two different sites, scattered in three different stretches in three different seasons during. The water samples were analysed for bacteriological and physicochemical parameters. For the assessment of bacterial diversity a polyphasic approach, involving phylogenetic analyses of 16S rRNA and phenotypic characterization, was adopted. The 16S rDNA was amplified by PCR and the isolates were grouped into clusters by the analysis of restriction patterns of the PCR-amplified 16S rDNA. The cultivable bacterial diversity profile of study area was completed by establishing the phylogenetic positions of unique bacterial isolates by 16S rDNA sequence analysis. Diversity index using Shannon index were also calculated.

In bacteriological analysis the total viable count (TVC), total coliform (TC) count, faecal coliform (FC) count and fecal streptococcal (FS) count. All sites were found to have high TVC values. The TVC values were relatively higher in holy places like Haridwar and Rishikesh which may be attributed to the presence of large population residing at the banks. The TC was comparatively higher in rainy season than summer and winter. No definite pattern of FC and FS counts were observed in different stretch of study area, FC/FS ratio was obtained highest in the rainy season and was negligible in winter season. All the sites included in this study were found suitable for bathing purpose with respect to the maximum permissible limits of FC and FS counts as per the standards laid by Central Pollution Control Board, India. The study confirmed the presence of bacterial indicators of faecal origin at various altitudes in every stretch of Gangetic river system. The lower regions Gangetic river system of Uttarakhand facing severe anthropological activities, mostly due to religious believes were. A huge bacterial gene pool was obtained after this study which was indicative of immense bacterial diversity in the region. The physicochemical analysis of the water samples included pH, temperature, specific conductance, total dissolved solids, dissolved oxygen (DO), biological oxygen demand (BOD) and chemical oxygen demand (COD). All the physico-chemical properties, except BOD, of the water collected from different sites were found to be within the minimum prescribed limits. However, BOD value in all the water samples was found to be above the prescribed limits.

A total of 799 bacterial strains were isolated from the Ganga river system in Uttarakhand among which upper, middle and lower stretch comprised of 221, 329 and 249 strains

respectively. Several genera belonging to α-*Proteobacteria*, β-*Proteobacteria*, γ-*Proteobacteria*, *Firmicutes*,*Actinobacteria* and *Deinococcus*-*Thermus* represented the bacterial population. *E. coli*, being the most dominant member of the bacterial population of Ganga river system,was isolated from all the sites of the study area.Several other members of the family *Enterobacteraecea* were present in complete stretch of study area. Interestingly, most of these strains were pathogens, which are believed to be introduced in river water by anthropogenic activities. Few genera as *Azotobacter* sp., *Deinococcus radophillus*, *Fratiuria aurentia*, *Hafnia alvi*, *Klebsiella oxytora*, *Kurthia gibsonii*, *Sarcina ventricull* were found to be site specific. This suggests that these strains were intrinsic and indigenous to that particular site of the river system. Seasonally maximum diversity was observed in rainy season as compared to other two seasons.

The antibiotic resistance profile of pathogenic members of *Enterobacteriaceae* along with streptococci and staphylococci were determined. Ceftriaxone was observed to be the most effective antimicrobial agent against pathogenic enteric bacteria from Ganga river system in Uttarakhand, as 94 % of the total strains were susceptible to this antibiotic. Tetracycline resistance was the most frequent (83%) followed by that for ampicillin (72 %) and Co-Trimoxazole (49 %). On the other hand, majority of the staphylococci and streptococci were resistant for erythromycin. Serotyping of some of the pathogenic *E. coli* strains revealed that the serogroups O2 (UPEC), O14 (UPEC), O35 (UPEC), O44 (EAggEC), O102 (STEC), O105 (STEC), O114 (EPEC) and O147 (ETEC) were present at various locations of River Ganga in Uttarakhand. However, the O157:H7 which is considered to be most relevant pathogenic form of *E. coli* was altogether absent from complete stretch of study in Uttarakhand.



Shannon diversity index of bacterial isolates from Alaknanda river

Complete diversity analysis based on the combination of molecular and phenotypic techniques resulted into a total of 61 different bacterial species, which were distributed in 39 genera.

Among these bacterial isolates, 37 species were isolated from upper stretch, 40 species from middle stretch and 35 from lower stretch of Ganga river system in Uttarakhand. Species richness index for the entire Ganga river system of Uttarakhand was found to be 2.1. Overall, *E. coli* presented the highest diversity index (0.863) followed by *Enterobacter* (0.718), *Streptococcus faecalis* (0.681) and *Pseudomonas* sp. (0.583)in the entire study area. The highest evenness values were also recorded for *E. coli*, evenness being 2.705, 3.433 and 2.970 in the upper, middle and lower stretch respectively. The values of diversity index were found to be in proportion to the evenness, suggesting that the predominant genera were evenly distributed throughout the study area, while occasionally isolated genera were confined to specific sites. The majority of the cultured bacteria were closely related to previously uncultured bacteria and grouped with the γ-*Proteobacteria*, α-*Proteobacteria*, β-*Proteobacteria*, *Firmicutes,Actinobacteria* lineage. The γ-*Proteobacteria* comprised the major class dominating the gene pool with a percentage of 63%. This was followed by *Firmicutes* consisting of 32% of the total diversity. *Enterobacteriaceae* were the principal bacteria components in all the three stretches of the study area especially in the middle and lower stretch.

Physiological and biochemical characterization, phylogenetic analysis based on 16S rRNA gene sequences and phylogenetic neighbours showed that few of the strains were unique. The data generated gave insights about bacterial diversity, ecosystems stability and their role as pollution indicators in one of the most important fresh water ecosystems of the country in general and Uttarakhand in particular i.e. the Ganga. The strategy of total DNA extraction, PCR-amplification, ARDRA analysis and sequence determination of 16S rDNA of the isolates not only aided in bacterial diversity analysis of the Ganga River system in Uttarakhand but also enabled the detection and recognition of unknown bacterial sequence types from this region. These data could serve as starting-points for the development of new cultivation techniques for as yet non-isolated and unrecognised species. Further functional analyses are required for understanding the functional diversity and its possible exploitation for human welfare.

Conclusively, the present study suggests that the Ganga particularly in the state of Uttarakhand comprised of a high diversity of cultivable heterotrophic bacteria. Some of the strains had no known close relatives or reported as uncultured bacteria in literature, which highlights their taxonomic significance. Isolation of such specific bacteria paves way for more focused studies on the functions, and implications of the ecological associations in the aquatic environments.

Assessment of Banj Oak Forests and their Conservation Status in Uttarakhand

G.S. Rawat
Department of Habitat Ecology,
Wildlife Institute of India,
Post Box 18, Chandrabani,
Dehra Dun 248 001, India
E-mail:- rawatg@wll.gov.in

a, Himalayan dense oak forests; b, Flowering *Quercusleucotrichophora* tree; c, Degrading oak forests; d, Collection of oaks for fodder

Objectives

To carry out detailed inventory and mapping of Banj oak forests in Uttarakhand.
ii. To assess the status, structure and composition of oak forests in various districts,
iii. To evolve conservation and management strategies for Banj oak forests.

Results

Unsupervised classification was done on the AWiFS data for the delineation of final vegetation

land cover maps. However, control in the vegetation type, for whole state was not feasible owing to high altitudinal and topographic variations. AWiFS data of the sate was divided into four different altitudinal/forest formation zones keeping in view of dominance of the major species from 1000-2500 m asl (Banj oak zone). The lower elevations from 1000-1500 m contain seasonal broadleaved forest with Chirpine (*Pinus roxburghii*) as the dominant species. Between 1500-1800 m elevation zone have Pine-Banj oak mixed forests, where as 1800-2200 m zone is dominated by Banj oak species. From 2200-2500 m region have overlapping of Banj oak with other broadleaf species. All the four layers were overlaid to generate the final map of the state. For better understanding of distribution, structure and composition of Banj oak forests fragmentation analysis was performed in each district with the help of FRAGSTAT computer package.

A total of 1284.60 km^2 area was recorded under Banj oak forests (5.24% of forest cover and 2.40% of geographical area), of which 774.93 km^2 area falls within reserve forests (RF) and 509.66 km^2lies out side the RF. The highest cover of Banj oak was recorded in Uttarkashi district (209.08 km^2) followed by Tehri (206.68 km^2) and Pithoragarh district (148.49 km^2), while, minimum was in Champawat (53.92 km^2), Bageshwar (66.25 km^2) and Almora (66.74 km^2) districts of the Kumaun region. However, Haridwar and Udham Singh Nagar districts do not have Banj oak forests. In the state most of the extensive Banj oak forests are available between 1800-2200 m elevation zones. Better conservation status and higher density of Banj oak in these areas can be attributed to relatively low human pressure. Previous studies suggest that *Q. leucotrichophora* was dominant at elevation from 1000-2000 m throughout the Central and Western Himalaya from 10000 to 4000 years B.P. Now there dominance is restricted between 1800-2200 m elevations. These forests can be seen in Bridh Jageshwar, Binsar WS, (Almora district), Dharamghar (Bageshawar), Mandal-Bandwara, Kalimati-Gairsain, Diwalikhal-Kheti (Chamoli), Hingla Devi, Kateshwar (Champawat), Mussoorie, Hathipaon, Magra-Suakholi, Kotikimai, Chakrata (Dehradun), Kunjakharak, Maheshkhan-Gagar, Kalapatal (Nainital), Jaiharikhal-Lansdown, Thalisain, Khirsu, Pherkhal (Pauri), Chandak, Thalkedar-Badabe, Sandev-Chaubati, Jaurasi, Ghandhura (Pithoragarh), Guptakashi, Mansoona-Ukhimath, Makku, Badma Jakholi (Rudraprayag), Arakot-Chamba, Dhudhali-Bhadroj, Holanakhal-Madhukadi, Bolyadhar-Hindwal (Tehri Garhwal) and Pattharkhol-Diwarikhol, Raditop-Kafnail, Chaurangikhal (Uttarkashi).The major reason of the forest degradation in the state is low availability of other fodder species around village, especially >1800m elevation zone (Singh et al., 2010). The only easy source of fodder at this altitude is Banj oak. Continuous over exploitation and excessive grazing/browsing by livestock in the same Banj oak forests convert into the stunted scrublands. Few examples of such highly degraded Banj oak patches in the state are in Bhaiti-Ghat, Gairsain-Kalimati (Chamoli), Holankhal-Madhukadi (Tehri), Jugna-Bangaon (Uttarkashi), Gangolihat (Pithoragarh), Hingla Devi, Debidhura (Champawat) and Shama (Bageshwar).

Fragmentation analysis revals that Champawat District has most degraded Banj oak forest with high patch density (0.57/100 ha) and edge density (6.01 m/ha), while Banj oak forests of Pithoragarh district are least degraded with low patch (0.19/100 ha) and edge density (2.23 m/ha). Less degradation of Banj oak forests in Pithoragarh district can be attributed to availability of other fodder species and relatively low human pressure around Banj oak forests and vice-versa for Champawat and Rudraprayag district where there is very low fodder species population was recorded. Similarly, lower IJI value (%) in Tehri (57.42), Uttarkashi (59.73), Dehradun (60.81) and Rudraprayag (61.18) districts indicates, less interspersion and

low boundary share by Banj oak forests with other forest types. While, Banj oak forests residing in Chamoli (72.45%), Bageshwar (70.44%) and Champawat (70.14%) have higher interspersion and high boundary share with other forest types.

Based on the overall analysis, following recommendations for and management of Banj oak forests are made for the state of Uttarakhand:

i. Priority areas for conservation: Many Banj oak forests in the state exhibited high biological diversity such as occurrence of large number of epiphytic orchids and ferns, presence of endemic species and unique location of the patch in the form of corridors for wildlife. Such forest patches needs regular monitoring and additional conservation efforts both from the Forest Department, other conservation agencies with the help and cooperation from the local communities.

ii. Plantation of species for restoration of degraded banj oak forests: Sustainable utilization and plantation of important fodder tree species which can act as buffer for oaks e.g., *Ficus roxburghii, F. clavata, F. nemoralis, Celtis australis* and *Grewia optiva* and shrubs such as *Sinarundinaria falcata*, *Debregeasia longifolia* in the fringes of agriculture and barren fields help in the conservation of neighbouring village forests (Banj oak) and need to be promoted.

iii. Management of areas under recent invasion by Chir Pine: Scattered and young seedlings / saplings of Chir-pine need to be removed from the dense Banj oak patches. Chir pine is invading the Banj oak patches from the fringes and in the degraded areas.

iv. Peoples' participation in conservation of the forests: By and large, the local communities in the state of Uttarakhand are well aware of values of Banj oak. Banj forests have degraded rapidly wherever the communities are not organized and Van Panchayats (VPs) lack management inputs. Local communities need to be organized for conservation and management of forests including the degraded Banj oak patches with the help of forest department. Immediate intervention could be regulation of free livestock grazing in conservation areas and plantation of buffer species to meet fodder and fuel wood.

v. Special provision for conservation of Banj oak forests in Forestry working plan: Currently, most of the forestry working plans in the state of Uttarakhand are under revision. It is recommended that special Circles for the conservation and management of Banj oak may be established in various Forest Divisions so as to conserve the intact patches and restore the degraded areas. Proper demarcation of new regenerating, young coppice areas, degraded Banj scrub, adult and old growth Banj oak forests need to be done and appropriate management recommendation need to be prescribed for further conservation and monitoring with the help of local communities / Van Panchayats.

Bioconversion of Agrowaste for Production of Biofuel

Sanjay Gupta
Department of Biotechnology
S.B.S. (P.G.) Institute of Biomedical Sciences & Research,
Balawala, Dehradun- 248 161
E-mail:- sanjay_gupta9999@rediffmail.com

Standardization of pretreatment strategies for the saw dust of *lantana camara*.
The saw dust of lantana camara was subjected to different pretreatment strategies to alter the biomass size and structure macroscopically and microscopically and its submicroscopic chemical composition. Different pretreatment and hydrolysis strategies (acid and alkali hydrolysis, Enzymatic strategies, etc) were adopted to obtain the maximum depolymerization of cellulose residues and liberate the maximum amount of fermentable sugars for the production of biofuels. Finally, the two stage acid hydrolysis process for the steam pretreated lantana camara saw dust was followed for further depolymerization of cellulose for the release of fermentable sugars for ethanol production. Using 15% (dw/v) substrate 127 g/l total reducing sugars were obtained to give maximum depolymerization of 84% of the carbohydrate content.

Production of high specific activity cellulases and beta-glucosidase enzymes in submerged conditions.
Isolation, screening and selection of fungal strains excreting high specific activity extracellular degradative enzymes were carried out. Few strains were selected which showed the degradative potential of *L. camara* saw dust. The preliminary studies showed that out of these three strains showed the almost 65-70 % hydrolysis of lantana saw dust. Beside these two potent fungal strains with an enhanced capability of excreting extracellular cellulases and β-glucosidase were employed for the production of the degradative enzymes.The optimum performance parameters were determined.

Standardization and production of cellulose degrading enzymes by solid substrate fermentation.
One effective approach to reduce the cost of enzyme production is to replace pure cellulose with relatively cheaper substrates such as lignocellulosic substrates. In the present study, we try to produce enzymes from pretreated *Lantana camara* saw dust as a viable carbon source. The development of technology with minimum capital investment is another approach to reduce the cost of production. This can be accomplished by producing cellulase and β-glucosidase in a solid state fermentation (SSF) process that requires relatively inexpensive equipment compared to the conventional fermenters used for liquid state fermentation (LSF) process. In solid state fermentation, insoluble substrate is fermented with sufficient moisture but without free water.

Solid substrate fermentation was carried out for the production of high specific activity degradative *Trichoderma viride* MTCC 167 and *Aspergillus wentii* 2804 were utilized to produce cellulases and beta-glucosidase using *Lantana camara* saw dust as main substrate. Cultural

conditions including moisture level, incubation period, initial pH, incubation temperature, inoculums volume and age were evaluated in a flask bioreactor system with tubes with forced aeration.The cultures in an individual and mixed culture system expressed high enzymes production at 70% (w/w), initial pH 4.8, inoculums size 10% (v/w) at 32° C after 10 days at optimum substrate of 20g. The enzymes from SSF were extracted by the whole content of the flask in a total of 100 ml 0.1 M citrate buffer pH 4.8 and then shaking for 30 mins at 150 rpm at 32°C followed by filtration through glass wool. The filterate was centrifuged at 5000 rpm for 15 min and clear supernatant was used as source of the enzymes. The supernatant was brought to 100% saturation with ammonium sulphate and the protein precipitate was separated with centrifugation, re-dissolved in citrate buffer and activity of enzymes were measured. These crude enzymes were used for the enzymatic hydrolysis of steam pretreated saw dust of lantana. The conditions of enzymatic hydrolysis were standardized.

Raw material	Cellulose (%)	Hemi-cellulose (%)	Lignin (%)	Cellulose Depolymerization (%)	Ethanol Yield (g/g of cellulose)
Sugarcane bagasse	35.60	31.55	29.24	80-84	0.383
Wheat straw	32.63	28.72	20.53	82-85	0.358
Rice straw	34.07	26.45	17.25	74-80	0.295
Saw dust	56.54	20.32	21.40	70-78	0.355
Lantana camara	45.50	24.71	24.83	80-84	0.372
Corn cob	44.95	38.55	14.67	78-84	0.365
Corn stalks	34.65	20.58	28.50	76-80	0.282

Large scale production of cellulase and β-glucosidase by solid state fermentation (SSF) process: The results of the scaling up experiments show that sufficient quantity of both cellulase and β-glucosidase can be produced at relatively low cost inputs for use in enzymatic hydrolysis of cellulosic material.

Separate enzymatic hydrolysis and fermentation of *Lantana camara* saw dust :Enzymatic hydrolysis was performed separately from fermentation step for steam pretreated and alkali delignified cellulosic fraction using optimized conditions for enzymatic hydrolysis with *Trichoderma* and *Aspergillus* crude cellulases for 24 hrs at 55°C using 10% (w/v) saw dust. 86.24 g/l of total reducing sugars were obtained to give 82-84% depolymerization of carbohydrate content with the total sugar yield of 0.86 (g/g of cellulose)

Ethanol production from *Saccharomyces cerevisiae* grown on enzymatic hydrolysate of *Lantana camara:* The studies were undertaken to utilize the cellulose enzymatic hydrolysate for ethanol production by *Saccharomyces cerevisiaee* under submerged conditions. Yeast fermented hydrolysate well with a fermentation efficiency of 84.03 % to give an ethanol yield of 0.432 g ethanol per g of sugar or 0.372 g of ethanol per g of cellulose fiber with a productivity of 0.776 g/l/h.

Bioconversion of forest waste lignocellulosic biomass into ethanol

Sanjay Naithani
Cellulose & Paper Division
Forest Research Institute, Dehradun
E-mail:- sheena_san2003@yahoo.co.in

The data generated from the project suggests to utilize low cost and less competitive raw materials which have not been commercialized for any product development till date For bioethaol production the unutilized lignocellulosic biomass like Pine needle and *Lantana camara* would be an economical viable option for second generation bioethanol production because no management practice has been developed.

Improvement of environmental quality

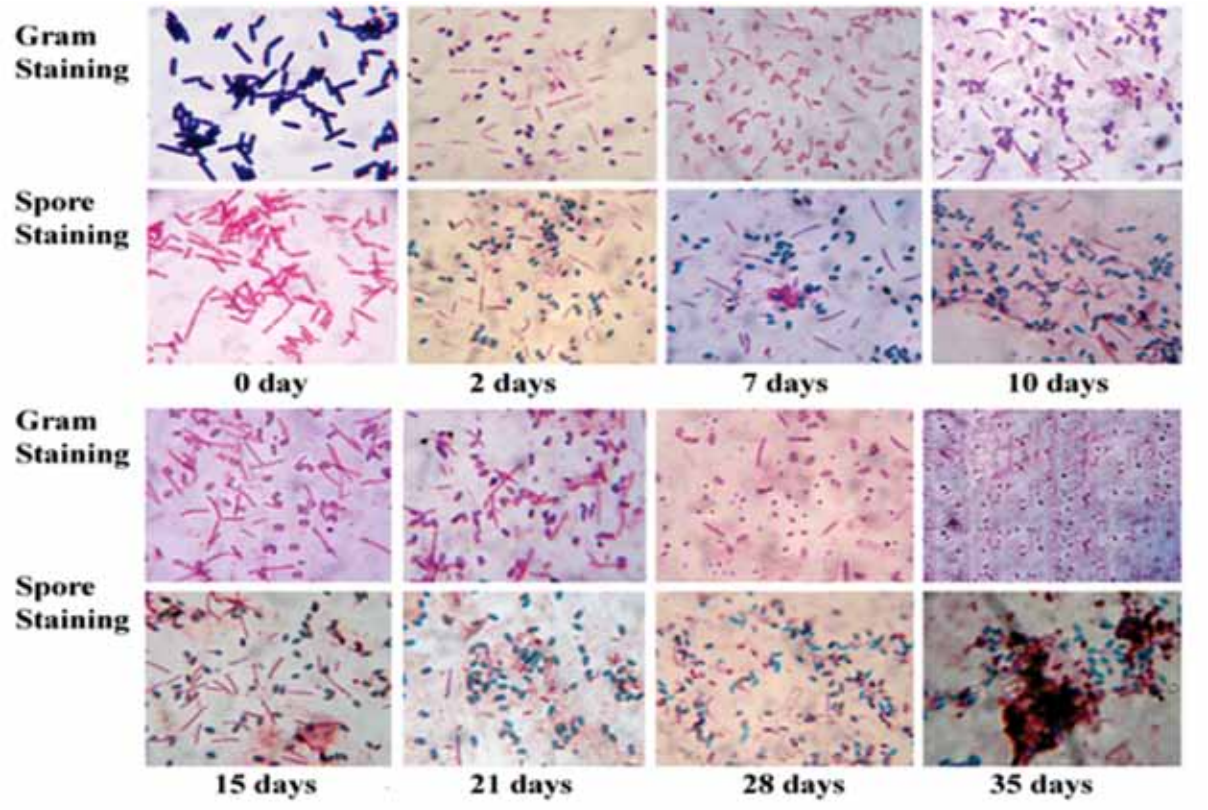
Environment quality improvement is seen positive as the problem of management of *Lantana camara*, a noxious weed, has posed serious threat to the ecology and demands concerted efforts for its management. The pine straws in form of pine needles are also hazardous for forest ecosystem. Lot of forest area destroyed every year due to forest fire and the CO_2 thus emitted causes global warming. So the approach developed for the utilization of these raw materials like *Lantana camara* and Pine needles for some value added products would improve the environmental quality.

Maximum reducing sugars was extracted 40.2 g/l (66.65 %) in *Lantana camara* and 33.9 g/l (56.20%) in case of Pine needle. An interesting results were obtained first under current study when lignocellulosic hydrolyzate obtained after hydrolysis was further heated at 100 ^{0}C for different time intervals varied from 10-100 min. After heating there was an increase in total reducing sugars (TRS) content. Pre-extraction of lignocellulosic biomass *Lantana camara* and Pine needle with different solvents resulted reduction in phenolic content (a measure of toxicity) after hydrolysis. *Lantana camara* after pre-extraction with solvent methanol reduced the phenolic content by 18.9% and Pine needle after extraction with solvent alcohol-benzene resulted reduction in phenolic content by 65.92% after hydrolysis. The decrease in phenolic content reduced the charge of chemicals during detoxification. Fermentation efficiency was increased by using different medium instead of conventional medium. Fermentation efficiency was increased from 78.93% to 80.72% in case of *Lantana camara* and 77.27% to 79.75% in case of Pine needle.

Biodegradation of a potent carcinogen Benzo (a) pyrene (BaP) by bacteria isolated from automobile contaminated soil of hilly region of Uttarakhand

Koushalya Dangwal
Department of Biotechnology
Modern Institute of Technology
Dhalwala, Rishikesh-249201,
Uttarakhand
E-mail:- kdangwal1@yahoo.co.in

The present study was aimed to characterize, optimize, and improve the BaP degrading activity of a novel strain *Bacillus subtilis* BMT4i (MTCC 9447), besides locating the BaP degrading activity to plasmid or chromosomal DNA. The BMT4i showed tremendous enhancement in growth (10^{29} fold) by degrading BaP (48%) as the sole source of carbon and energy within 7 days. BMT4i was able to degrade 84.66% BaP after 28 days of growth. The BMT4i degrades BaP by inducible pathway since induced starter culture of BMT4i was able to degrade BaP (54%) within 7 days in the presence of chloramphenicol, a protein synthesis inhibitor.The optimum physical and chemical conditions for BaP degradation in BMT4i were detemined. Among the physical conditions, the optimum temperature and pH were found to be the 30°C and pH 8.0 respectively.

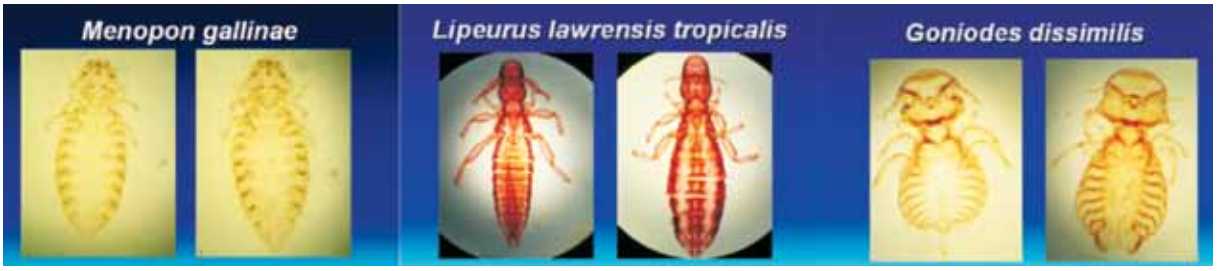


Micrograph Showing Gram Staining and Spore Staining of *Bacillus subtilis* BMT4i (Magnification 1000 X)

The photolytic pretreatment of BaP with UV was found to have positive effect on BaP degradation. The optimum chemical conditions for BaP degradation with respect to BaP concentration, surfactant treatment, ionic strength were found to be 150 µg/ml, 0.01% Tween-20 and 400-1800 µM $MgSO_4$ respectively The BaP degradation ability of BMT4i is contributed by chromosomal DNA since BMT4i lacks plasmid as confirmed by the physical methods of plasmid isolation viz. In-well cell lysis method, PFGE and chemical method of plasmid curing by acridine orange. The improvement of BaP degradation ability of BMT4i with physical mutagen UV yielded mutant namely BMT4imuv2 that was found to achieve highest BaP degradation of 62% after 7 days in comparison to 46% showed by control wild type BMT4i. Rest of the mutants did not show any significant enhancement in the BaP degradation rather some of them showed decline in BaP degradability. The BMT4imuv2 was found to degrade almost 100% of BaP on completion of 28 days in contrary to 84.66% by control wild type BMT4i. Therefore, the present study is successful in characterizing the BaP degradation activity of an efficient BaP degrader *Bacillus subtilis* strain BMT4i which degrades BaP by an inducible chromosomally encoded pathway. The study also resulted in optimization of physical and chemical parameters for maximum BaP degradation and BMT4i strain improvement that endowed a mutant strain BMT4imuv2 which was found to be more competent in degrading BaP. Hence, it could serve as a leading biological weapon to remediate HMWPAHs contaminated sites including BaP.

Bio-Diversity, Impact on Host Productivity and Eradication of Phthirapteran Ectoparasites Infesting Poultry Birds of Garhwal

Adesh Kumar
Department of Zoology
B.L.J. Govt. Degree College, Purola (Uttarkashi)
E-mail:- dr.adeshkumar@gmail.com



Phthirapteran ectoparasites are small contagious drab like wingless insect commonly known as lice. These tiny creatures are extremely host specific. These nuisance insects are parasites virtually of all birds and some mammals. All phthirapteran are permanent ectoparasite and complete their entire life cycle on the body of host. Phthirapteran diversity of Garhwal region has not been investigated so far. A routine survey work was done and specimens were collected through fumigation and ruffling techniques. The collected specimens were preserved in 70% ethyl alcohol. Thereafter, specimens were sorted out species-wise and sex-wise under trinocular stereozoom research microscope. Out of twelve lice species infesting domestic fowl all over India, nine has been recorded in present study e.g. *Menopon gallinae, Menacanthus cornutus, Menacanthus stramineus, Lipeurus lawrensis tropicalis, Lipeurus heterographus, lipeurus caponis, Goniodes gigas, Goniodes dissimilis* and *Goniocotes gallinae*. Three species out of nine were found amblyceran and rest ischnoceran. The amblyceran are haematophagous species and might decrease the productivity of poultry industry in the region.

Chicken body louse, *Menacanthus cornutus*(Schömmer) (Insecta, Phthiraptera, Amblycera) is exclusively haematophagous in nature, fast runner over host skin and cause severe irritation, itching and discomfort to host body. 541 domestic fowls were examined in fourteen localities during 2006-08 for the record of prevalence and intensity of infestation of phthirapteran as well as other ectoparasitic insects. Most of the examined birds were of desi, white leghorn, broiler breed and strains of Kalinga brown etc. Out of 541 fowl, 74.86% were found infested with one or more species of ectoparasites while 25.14% found negative host. Overall highest prevalence were found in case of *Menopon gallinae* (69.87%) followed by *L. caponis* (39.56%). The prevalence rate of *G. gallinae, L. lawrensis tropicalis, M. cornutus, G. gigas, G. dissimilis, M. stramineus and L. heterogaraphus* were 31.79, 3.14, 8.32, 4.62, 2.22, 1.66 and 0.37% respectively. Furthermore, the prevalence of ticks was 11.82. Information regarding host age, sex, colour, feather condition and health etc. has also been recorded. An attempt has also been made to record the prevalence of each species in the 14 localities of Garhwal region. Likewise, an attempt has also been made to record the monthly intensity of infestation through coding

system. An examination of data indicates that most of the host bore very light, light and moderate infestation. The numbers of heavy and very heavy infested host were few. In most of the case (e.g. *M. gallinae, L. caponis, L. lawrensis tropicalis, L. heterographus, M. cornutus, Goniodes gallinae, G. gigas, Goniocotes gallinae* and ticks) maximum infestation recorded in the rainy months (July, August, September, October) except the *M. stramineus*. It showed infestation only in the months of summer (March, April, May and June). A close look on data indicates that maximum number of heavy and very heavy infestation encountered in the months of rain. Birdspreening behaviour have been influenced by the ectoparasites. Preening scores were always found to be higher in infested bird (59.25 %) as compared to non-infested (40.74 %) ones. However, the highest preening was recorded in the morning hours (infested-25.35 % and non-infested-20.91 %) followed by evening (infested-19.03 % and non-infested-12.56 %) and then noon (infested-14.87 % and non-infested-7.25 %). Seasonal changes in the rate of preening showed that the highest preening was recorded in the month of autumn (infested-19.42% and non-infested-8.87 %) while lowest in the month of winter (infested-0.95 % and non-infested-0.89%). Preening was more or less similar in the spring, summer and rainy months. An analysis of "two tailed paired sample t-test" between infested and non-infested categories was found to be significant at 5 % level. Violent irritation caused by the lice compels bird for preening or scratching which produces severe wounds on the skin. Open wounds are serve as potential sites for inlet of secondary infection of micro-organisms (e.g. protozoa, bacteria, fungi, and viruses etc.). Heavily infested bird is found in great distress, restless and attributed ill health. Therefore, *M. cornutus* is very injurious and it might decrease the meat as well as egg production.

In the present work, impact of *Menacanthus cornutus*on meat production (weight gain) of domestic fowl has been accessed. The weight gains in uninfested categories were much faster than infested categories. *M. cornutus* able to reduce as much as 900 gm body weight per bird. The young chickens (2 to 4 months) were found to be severely affected as compared to adult. Two tailed paired t-test were found significant ($0.20<P$ (ItI ≥ 4.702) <0.50 [$P=0.33$]) between weight gain in uninfested and infested birds. So, it causes great loss to the poultry industry as well as the economy of any country.

Two flocks were maintained to access the impact of *Menacanthuscornutus* on egg production in poultry (*Gallus gallus domesticus*). The infested group started egg laying somewhat later than controlled group. 22.25% reduction in egg number has been recorded in infested group comparatively to controlled group. The average egg weight/bird/day was more or less similar in both groups. However, 24.68% reduction in average egg weight/bird/week has been recorded in infested group. Thus, it becomes obvious that *M. cornutus* infestation causes stunted growth, delay in egg laying and reduction in egg laying capacity of hens. Therefore the infestation of *M. cornutus* is extensively deleterious to host birds as well as poultry industry.

The toxicity of essential oils (E.O.) of three plants (*Vitex negundu, Origanum vulgare* and *Artemisia mariyantha*) was tested against two phthirapteran species (*Menopon gallinae* and *Lipeurus caponis*) infesting poultry. Essential oils of *Vitex negundu, Origanum vulgare* and *Artemisia mariyantha* were toxic to the two species of poultry lice (*Menopon gallinae* and *Lipeurus caponis)*. An examination of data indicates that E.O. of *Vitex negundu* causes 100% mortality of *L. caponis* in 50 minutes and *M. gallinae* in 30 minutes. E.O. of *Origanum vulgare* were caused 100% mortality of *L. caponis* in 30 minutes while the *M. gallinae* were died cent percent in 25 minutes. Results obtained by the *Artemisia mariyantha* found to be very encouraging; it kills 100% population of *L. caponis* within 20 minutes and *M. gallinae* within 10 minutes.

Biological impact of ozone depletion in Garhwal region

Sunil Kumar
Department of Zoology
D. A. V. (P. G.) College, Dehradun, Uttarakhand
E-mail:- sunilkumarddun@yahoo.co.in

Uttarakhand situated between latitude from 28° - 43′ to 31° - 28′ North and longitude 77° - 34′ to 81° - 02′ East is divided into Garhwal and Kumaon region having 13 districts. Garhwal region having mountain, valley and altitudinal variation ranging from 294 - 3581 (msl) in meter were included in the study. Sites selected for monitoring of solar ultraviolet-B radiation in Garhwal Region were Haridwar (294msl), Dehradun (639), Tehri (1650), Pauri (1814), Uttarkashi (1188), Joshimath (1875) and Kedarnath (3581).

Monitoring of Natural solar Ultraviolet-B radiation was performed through Coleparmer (USA) (VLX.3.W) In relation to diurnal variation solar UV-B level was highest between 12 noon to1.00 pm particularly at 12.30 ± 10 pm. Data on monitoring of solar UV-B is showing altitudinal, seasonal, latitudinal and diurnal variation. Natural solar UV-B radiation level was minimum in December, January and February and maximum in the month of July, August and September. Intensity of solar UV-B increases with increase in altitude. Maximum and minimum values of UV-B were recorded. Average Summer UV-B Peak Value (ASPUV) value was more than Average Winter UV-B Peak Value (AWPUV).

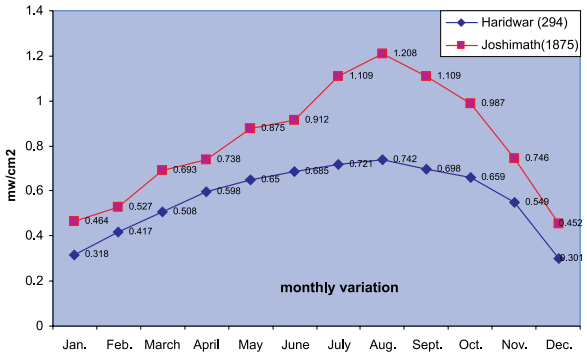
Our results on UV-B monitoring at different altitude and locations as, Haridwar, Dehradun, Tehri, Uttarkashi, Joshimath, and Kedarnath show highest value at Kedarnath and lowest in Haridwar. Maximum UV-B value reported was 1.392 mw/cm^2 in the month of July at Kedarnath altitude 3581 msl and minimum i.e. 0.298 mw/cm^2 at 294 (msl) in the month of December in Haridwar). Natural solar UV-B radiation level increased from February to July, annual mean value and mean daily terrestrial irradiance also supports the results. Annual mean value varies from 0.475 - 0.684 mw/cm^2 Uttarkhand Garhwal region. Mean daily terrestrial irradiance of solar ultraviolet was recorded at high altitude Kedarnath.

Results on "Average Summer Peak UV" (ASPUV) irradiance and "Average Winter Peak UV" (AWPUV) irradiance show higher value in summer than winter. (ASPUV) was maximum 1.245 mw/cm^2 at Kedarnath and (AWPUV) was minimum 0.385 mw/cm^2 at Haridwar. Percentage change in UV-B level with reference to minimum AWPUV at Haridwar also supports the result. 323.3% increase in UV-B level was recorded in July at Kedarnath in reference to Haridwar. 87.7% increase in solar UV-B was observed with the increase in altitude from 294 - 3581 (msl).

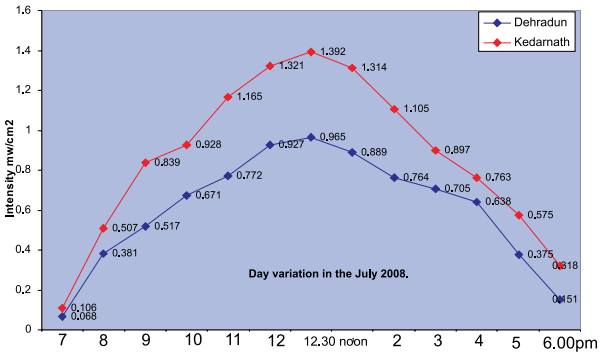
Phototoxicological studies on invertebrate's species:

Riboflavin and chloroquine phototoxicity is wavelength specific. Phototoxicity was highest in presence of artificial UV-B. Riboflavin was found non toxic but it becomes slightly phototoxic in presence of sun light. Chloroquine is phototoxic with solar light and *ultraviolet*-B both. Dose dependent change in phototoxicity of solar UV-B was observed. Long term exposure of UV-B

with photosensitizers caused physiological changes in earthworm and Daphnia. Enhanced intensity of solar UV-B is lethal to *Metaphire posthuma* and *Daphniamagna*. Photohaemolysis of erythrocytes take place by ultraviolet-B alone and with combination of chloroquine and riboflavin.



Variations in highest and lowest range of solar



Diurnal variation in solar UV-B in the month of July 2008 at UV-B at two different locations of Garhwal

Data on monitoring of natural solar UV-B is showing altitude, seasonal, latitudinal and diurnal variation. Maximum solar UV-B terrestrial irradiance was reported on clear sunny day between 12.00 noon-1.00 pm at high altitude in summer and rainy season. Intensity of solar ultraviolet-B radiation differs according to sun position weather condition as snow, haze, clouds, dust and clarity of weather.

1. Results on mortality rate and reproduction in *Daphnia* indicates that mortality was highest in chloroquine + Ultraviolet-B exposed group followed by in solar radiation + chloroquine, ultraviolet–B + riboflavin, UV-B exposed groups and minimum in control and riboflavin treated groups.
2. Results on mortality rate of *Daphnia* and *Metaphire* indicate that, riboflavin is not harmful when given separately but it becomes photo-toxic in presence of solar light. Mortality rate in *Daphnia* was found highest i.e. 57% on 3rd day of artificial UV-B exposure with chloroquine. Result also indicates that artificial UV-B has more phototoxicity than solar radiation.
3. The highest 40% mortality in earthworm was observed in chloroquine + artificial UV-B treated group followed by 30% in solar radiation + chloroquine and 20% in chloroquine alone with S-shaped jumping movement was observed. 10 % mortality was recorded in earthworm exposed with artificial UV-B and solar radiation + riboflavin.
4. The level of MDA was highest in UV-B + chloroquine followed by solar radiation + chloroquine treated group. The MDA level denoted that UV-B + chloroquine treatment is most phototoxic in comparison to other groups.
5. Maximum reduction in glutathione level was observed in UV-B + chloroquine treated groups.
6. Riboflavin is less phototoxic, while chloroquine is more phototoxic with solar light and artificial ultraviolet-B radiation both.
7. Organisms as *Metaphire posthuma* and *Daphnia magna* are good model for phototoxicological studies and adverse physiological changes among individual and population occurring due to enhanced solar UV-B exposure.

8. Haemolysis was found highest i.e. 71% after 3 hours exposure of artificial UV-B dose-1.65 mw/cm^2 exposure with chloroquine followed by 62% on artificial UV-B dose-0.824 mw/cm^2 with chloroquine and 54% with same dose of solar UV-B + chloroquine exposure.
9. Comparing with equal dose (0.824mw/cm^2) of solar and artificial UV-B, artificial UV-B was found more phototoxic.
10. On the bases of above results we conclude that generally artificial UV-B is more phototoxic than solar UV-B, when equal amount of intensity is taken.
11. Photohemolysis rate depends upon intensity and duration of exposure. Photohemolysis increases with higher intensity and with the increase in time duration.
12. Erythrocyte suspension system and invertebrate species *Daphnia magna* and *Metaphire posthuma* are important model to monitor the biological effect attributed due to increment in UV-B radiation caused by stratospheric ozone depletion.

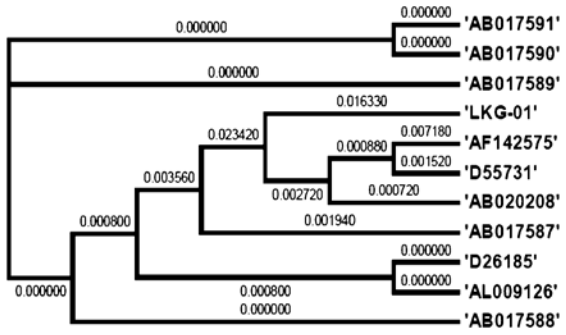
Bioprospecting for Novel Antimicrobials and Industrially Important Enzymes from Microbial Isolates in Uttarakhand Himalaya

Balvinder Singh
Department of Biochemistry
Sardar Bhagwan Singh Post Graduate institute of Biomedical Sciences and Research, Balawala, Dehradun, Uttarakhand
E-mail:- bsinghlko@gmail.com

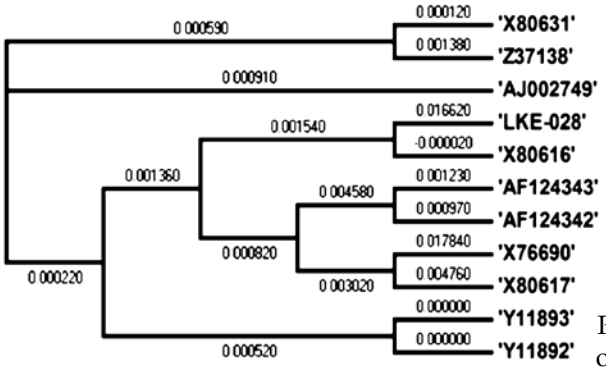
The Himalayas is the great storehouse of microbial diversity that remained unexplored. New generation of antimicrobial compounds and enzymes have been isolated from marine resources. Therefore isolation and characterization of the antimicrobials and enzymes from the microbial species present in the Himalayan biosphere and development of their production process have been targeted in the proposed project.

Enzymes expressed by extremophiles offer new opportunities for green chemistry arena where biocatalysis and biotransformations play a pivotal role. The major road block of industrial usage of known esterases is their limited thermostability, mainly at high temperatures, and pH stability in various operating industrial conditions. Microbial esterases have attracted considerable attention in biotechnology because of current applications and the perspective of new compound synthesis to be used in food, pharmaceutical, and chemical industries. A newly isolated *Rhodococcus* sp.LKE-028 (GenBank accession no.GU944774) from *Gangotri* region ofUttarakhand Himalayan produced a thermostable esterase. The enzyme was purified to homogeneity with purification fold 62.8 and specific activity 861.2 U mg−1 protein with 26 % recovery. The molecular mass of the purified enzyme was 38 KDa. The values of Km and Vmax were 94.7 μg ml^{-1} and 1666.7 $U.mg^{-1}$protein, respectively. The esterase was active over a broad range of temperature from 40°C to 100°C and pH ranges from 7 to 12. The esterase was most active at pH 11.0, and was stable in the pH range 8.0–11.0. The temperature optimum was 70^0C and the enzyme was completely stable after 3 h pre-incubation at 60^0C. Metal ions like Ca^{2+}, Mg^{2+} and Co^{2+}stimulated the enzyme activity. Enzyme activity was slight increase the presence of laboratory detergents (Tween 20, Tween 80 and Triton X-100), and compatible with oxidizing agents (H_2O_2) and reducing agents (β-marcaptoethanol). LKE-028 esterase retained appreciable activity in presence of organic solvents like DMSO, benzene, toluene, methanol, butanol, acetone, isoamyl alcohol after 10 days long incubation.Enzyme reflected more enhanced activity with 1-5 M (w/v) NaCl and esterase was 100 % active with 10 M(w/v) NaCl. And it was inhibited PMSF, suggesting that it is a Serine enzyme. The novelty of this enzyme is resistance against protease. L-glutaminase has inculcated significant buzz in food industry as a potential flavor modulating agent, imparting a savory flavor as it increases food's glutamic acid content. It finds application in food fermentation by hydrolyzing L-glutamine to produce highly savory amino acid L-glutamic acid imparting a unique taste called *umami* and thereby regarded as a key enzyme that controls the delicious taste of fermented foods such as soy saucePurification and characterization of halotolerant, thermostable alkaline L-glutaminasefrom a *Bacillus* sp. LKG-01 (MTCC 10401), isolated from *Gangotri* region of Uttarakhand Himalaya is being reported in this paper. Enzyme has been purified 49 fold from cell-free extract with 25% recovery, (specific activity 584.2 U/mg protein) by $(NH_4)_2SO_4$

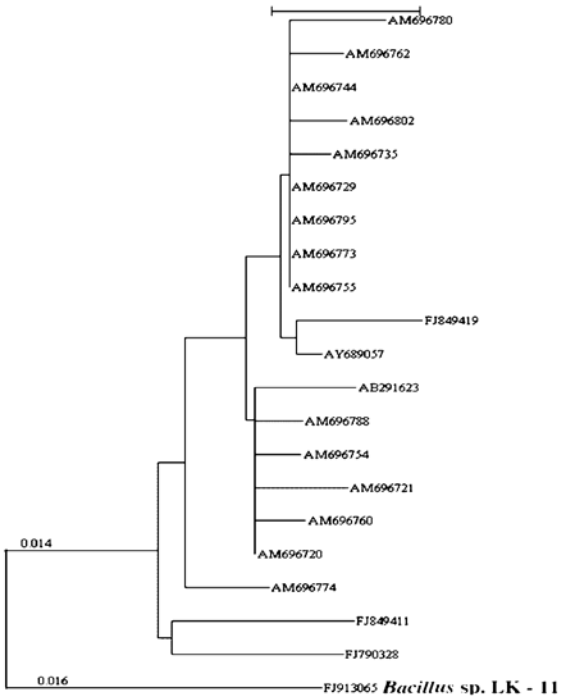
precipitation followed by anion exchange chromatography and gel filtration. Enzyme has a molecular weight of 66 kDa. L-glutaminase is most active at pH 11.0, and stable in the pH range 8.0–11.0. Temperature optimum is 70^0C and is completely stable after 3 h pre-incubation at 50^0C. Enzyme reflects more enhanced activity with 1-20 % (w/v) NaCl, which is further reduced to 80% when NaCl concentration was incread up to 25%. L-glutaminase is almost active with K^+, $Zn^{2+}$and Ni^{2+} ions, and K_m and V_{max} values of 35.14 ± 0.2 µg ml^{-1} and 277.77± 1.1 U/mg proteins, respectively. Higher specific activity, purification fold, better halo-tolerance and thermostability would make this enzyme more attractive for food fermentation with respect to other soil microbe derived L-glutaminase reported so far.



Phylogenetic dendrogram, indicating the position of the L-glutaminase producing strain Bacillus sp. LKG-01



Phylogenetic dendrogram, indicating the position of the esterase producing strain Rhodococcus sp. LKE-028



Phylogenetic dendrogram, indicating the position of the protease producing strain *Bacillus* sp. LK-11

Wide scale applications of proteases in the detergents, food, pharmaceuticals, chemicals, leather, silk, paper and pulp industries are well established. This enzyme is used as an active ingredient in the development of biopharmaceutical product like contact lens cleaner, and is also effective in cleaning a wide variety of polymeric protein substrates. Stability is a crucial factor for the application of enzymes in biotechnology. Investigation of protease activity in new *Bacillus* sp. LK-11 (MTCC 5541) is being reported here as a potent producer, showed that high specific activity could be achieved up to 720.2 U/mg proteins by 74.7 fold with optimum catalytic conditions of pure enzyme were 60^oC and pH =8.5 and LK-11 Protease activity was slightly activated by Ba^{2+} and Cu^{2+}, stable with Zn^{2+}, K^+, Ca^{2+} Mg^{2+}, Fe^{3+} but drastically reduced by Co^{2+}, Hg^{2+}. LK-11 enzyme activity was is compatible with the presence of laboratory detergents (Tween 20, Tween 80 and Triton X-100), oxidizing agents (H_2O_2) and reducing agents (ß-marcaptoethanol). LK-11 protease retained appreciable activity in presence

of many water miscible and immiscible organic solvents after a week long incubation. This protease was found to be compatible with many market available detergents that are capable of removing blood stain completely from cotton fabrics. This is one of the very few reports of microbial bioprospecting for industrial enzyme from Indian *Himalaya* to the best of our knowledge. The isolated protease LK 11 activity in the presence of organic solvent, detergent & oxidant as well long-term stability in liquid state more than a year makes it a potent candidate for its application in detergent industries and non aqueous biocatalysis.

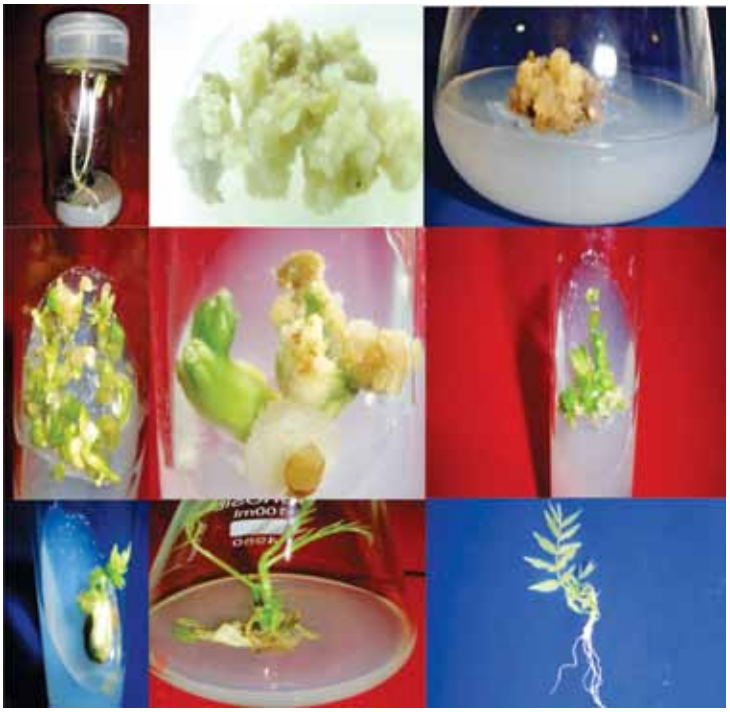
Biotechnological approach for the propagation of some medicinal plants of Garhwal Himalaya

N.S. Bisht
Dept. of Botany
HNB Garhwal University Pauri campus
Pauri
E-mail:- nsbotany@yahoo.co.in

Considering the medicinal importance of *Sapindus mukorossi* and *Malaxis acuminata*, the present work was done for their conservation and multiplication using tissue culture protocols.

The analysis revealed that the 22 pretreatments differed in germination behaviour. In general, it was found that seeds germinated faster in acid treatment than other treatments indicating positive response of acid to hasten the germination process. Again the germination increased with the increase in duration of soaking in acid as there was 66.66 per cent germination in seeds soaked in concentrated HCl for 110 minutes.

On the basis of present study 2.0:0.5 mgl-1 of BA:IBA and 2.0 mgl-1 NAA concentration in MS media can be recommended for maximum shoot and root induction respectively using pseudobulb as an explants of *M. acuminata*.

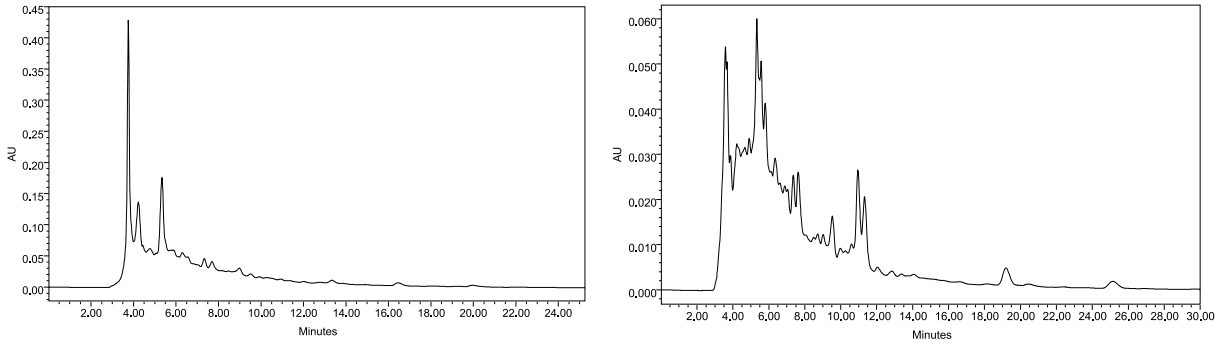


Different stages of *in vitro* regeneration in *S.mukorossi*

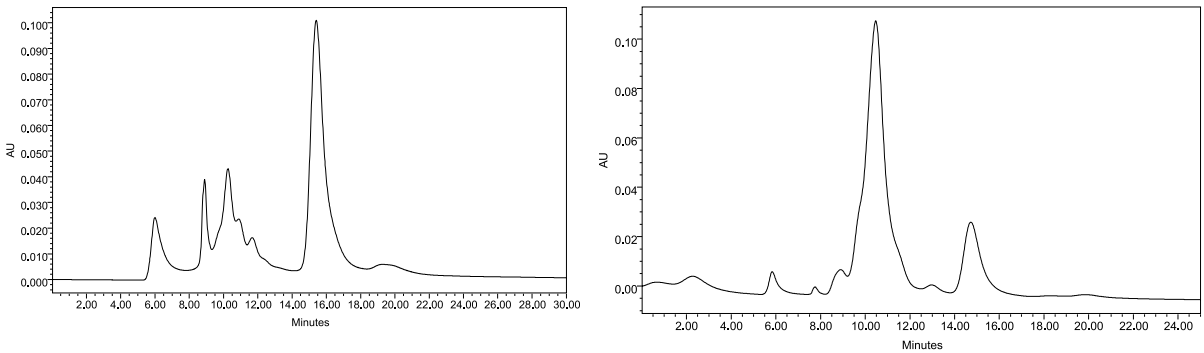
Chemical profiling for certification of some medicinal herbs of Garhwal

M.S.M. Rawat
Department of Chemistry
HNB Garhwal University
Srinagar, P. Box. 63
Uttarakhand
E-mail:- msmrawat@hotmail.com

- The objectives of the present proposal were:
  - To study the variation in the concentration of bioactives of different population with season, maturity and altitude.
  - To get information about the proper and optimum harvesting period of the plant produce.
  - To determine a comparative chemical profile of different plant parts and comparison of chemistry of cultivated spp of different sites with wild populations.
  - To study intra and inter species variation of the active components and to find a possibility of introducing alternate species for commercialization.
  - To determine the inorganic composition of the ash of the selected medicinal plants.
  - To identify the healthy and comparatively superior genotype for further cultivation.
  - To initiate establishing a herbal quality assurance/ control lab in the department for the benefit of the farmers of Uttarakhand region.



Chromatograms of *A. racemosus* (a) leaves and (b) rhizomes collected from Mandal



Chromatograms of leaves extracts of (a) *S. chirata*, (b) *S. speciosa*

Results:

- Higher concentrations of both xanthones were found in S. *speciosa* among all the species studied.
- Maximum concentration of xanthones was found in those samples which are collected from higher altitudes.
- The concentration of xanthones was also influenced by seasons; maximum concentration of xanthones was found in those samples which are collected in October.
- The concentration level of sapogenin in *Asparagus* species also varies from site to site and season to season. The concentration of sapogenin was higher at higher altitudes (2000-2250 m) and in those samples which are collected in June.
- The RP-HPLC method described in this thesis is accurate, precise and sensitive and can be used for determination of sarsasapogenin as its acetate.
- This method overcomes the detection problem in sapogenin and is the first report of RP-HPLC method for sapogenin acetate.
- *Asparagus* and *Swertia* species grown at different altitudes showed significant difference in the micro and macro elements content.
- Significance differences of mineral elements contents were also found in different plant parts collected in different seasons.
- *Asparagus* species grown in higher altitude have higher percentage of trace elements than those grown in lower altitudes.
- In *Asparagus* species leaves showed highest concentration of Zn, Cu, Mn, Fe, Co, Na, K and Ca but Li in roots.
- *A. curillus* could be a replacement of *A. racemosus*.
- In *Swertia* species leaf samples showed the highest concentration of Fe, Mn and Cu. Zn and Cu was in moderate concentration whereas Mn and Li had lower concentration.

Conserving the Sacred: Ethno biological study into the relationships between culture and biodiversity

C.S. Negi
Department of Zoology,
L S M Government Post Graduate College,
Pithoragarh (Uttarakhand) - 262 502
E-mail:- csnsacred1@rediffmail.com

Salient research achievements:

1. A total of **168** sacred natural sites (SNS), including 75 sacred forests, 74 sacred groves, 10 water bodies and 9 pastures, and extending across the nine districts within the State of Uttarakhand, were covered for the study of existent taboo system.
2. The institution of social taboos across all these sacred natural sites was studied in detail.
3. Some of the major festivals surrounding the sacred natural sites, viz., Chipla Kedar jaat, Festival of Nanda Astami in Johaar valley, Hokara Devi festival, were extensively covered for their socio-religious as well as for their inherent environmental ethics.
4. A dozen of selected pastures were studied for their floral diversity. Similarly, a preliminary survey of some of the sacred forests, too were carried out, viz., in case of Thal Ke Dhar, Dhwaj and Kanaar Devi forest.
5. Most importantly, a number of sacred forests have been identified, which are not just zealously guarded by the stakeholders, or where the social taboos are intact, but more so since these forests needs to be studied for their floral as well as faunal diversity.
6. Some of the folklores too were studied for their socio-religious as well as environmental significance, viz., Kaak puran in Askote Conservation Landscape.
7. Additionally, even though not part of the current project (and hence not being incorporated), floral depiction in temple architecture, too has been covered, which will be in a form of a chapter in the forthcoming title, a book.

Summary of the progress:

Even though, the figure of 168 sacred natural sites, may sound big, however, the number may increase, as some of the foremost sites, located in the highlands could not be surveyed, not just because of the lack of time, but more importantly, since the routes to these are opened for a brief interval of 3-4 months. Hence, to save time all the hill districts (numbering nine) were covered, even though, it is believed that some of the sacred sites (in all probability, only sacred groves, if any around the temples) might have been missed out in the left out districts. Some of the major sacred forests, wherein the taboo system is strong, as well as having diverse vegetation profile, have been identified for a detailed study. Also, some of the major festivals surrounding the SNS have been identified for a more holistic future study, as relates to the precise management of the sacred forests or more precisely the socio-religious or even political role of the sacred site.

New observations:

1. Even though, the most commonly held belief that dilution in the social taboos surrounding

the resource exploitation has taken place, what is more significant, as regards the sustainability or the viability of the institution, is the fact that a significant percentage of the stakeholders were aware of the environmental or ecological role played by the sacred forests, as elicited by these observations- (i) the vegetation cover is important (expressed by 34 per cent of those interviewed), or that the forest cover represents the source of water (23 per cent).

2. The above findings have important consequences for any developmental programmes, surrounding villages located in the precincts of these forests, for the singular reason that this practical aspect of the existence and thus the benefits accrued from the sacred forests, and as perceived by the stakeholders, needs to be taken cognizance of by the policy makers, too.
3. The success of the phenomenon of dedication of forests for a period of 5-20 years (at times even perpetually) to the most fearsome deity, viz., Kotgyari Devi in Kumaun, lends credence to the effective role of religion in conservation. Around ten such forests were covered for the preliminary survey, as regards the success of the endeavour.
4. Dilution of faith as relates to the very institution of sacred is concerned, has undeniably taken place over the period. However, the phenomenon is not just on account of the current western type education being imparted or due to migration of the locals outside or even due to the developmental work in and around the sacred site, but interestingly, more on account of the recent tide in replacing the native deity with sanskritized gods (principally Radha and Krishna), with makeshift traditional temples being replaced by new constriction in the gab of promoting tourism!

Detection of geo-spatial hotspots for enteric diseases using GIS and spatial scan statistic and to study the effect of water pollution on physical and mental health of residence of Almora and Nainital district of Uttarakhand

Neeraj Tewari
Deptt.of Statistics, KumaunUniversity,
S. S. J. Campus Almora
E-mail:- kumarn_amo@yahoo.com

Since the start of the project, we have collected the complete secondary data from Almora and Nainital district required for the project. This secondary data consists of the enteric disease cases during the last five years from Integrated Disease Surveillance Project (IDSP) records of the two districts and case diary of different PHC's and CHC's as well as private hospitals/clinics of the two districts. The following five enteric diseases were considered for the present study: (i) Diarrhoea (ii) Dysentery (iii) Hepatitis (iv) Typhoid (v) Gastro-enteritis

After collecting the secondary data from Almora and Nainital district, the hotspots of enteric diseases in both the districts have been obtained with the help of SatScan software and they have been depicted in geographical maps using GIS software Arc View 9.3. A questionnaire has been prepared to collect primary data from these two districts. The questionnaire has been tested for its reliability and validity with the help of a sample of 100 respondents taken randomly from two blocks of Almora district. The process of collection of primary data of 1000 enteric diseases patients randomly selected from Almora and Nainital districts of Uttarakhand is in progress.

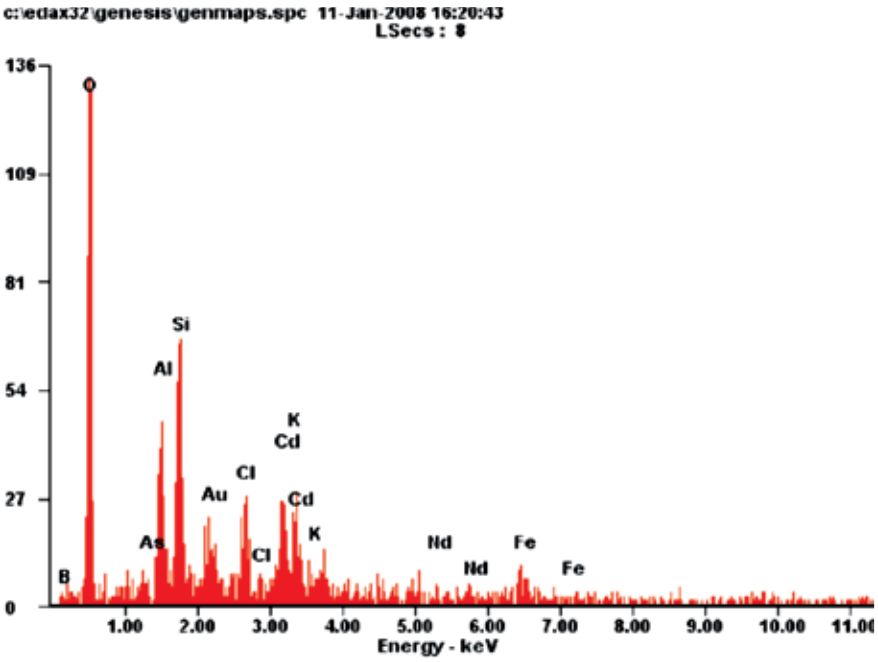
New Observations:

Hotspots of enteric diseases from Almora district of Uttarakhand have been found at Dwarahat, Tarikhet and Chaukhutiya blocks and from Nainital Districts the hotspots have been found at Motahaldu block. A questionnaire for the collection of primary data has been prepared which has been found valid and reliable.

Development and Characterization of Laser Materials

Y. K. Sharma
Department of Physics
S.B.S. Govt.P.G.College Rudrapur-263153
E-mail:- dryksharma@yahoo.com

In the development of rare earth doped optical device, the host glass matrix is a very important factor to be considered. The choice of suitable glass-forming and glass-modifier systems help in tailoring glass matrix to meet the specific requirements. So far, much effort has been spent on fluoride systems owing to their lower phonon energy as compared to oxide systems. On the other hand, the oxides are more useful than fluorides as host materials for practical applications due to their high chemical durability and thermal stability. Among oxide glasses, phosphate and silicate glasses are the two most important hosts which have been used extensively for lasers and fiber amplifiers. As compared to silicate glasses, phosphate glasses have their limited use because the phosphate glasses are hygroscopic in nature and have lower glass transition temperature. On the other hand silicate glasses have superior chemical resistance and are optically transparent at the excitation and lasing wavelengths. Therefore, they are more compatible with the fabrication process in the development of optical devices. Furthermore, frequency upconversion can be realized in the glass with lower phonon energies, but it is difficult to be observed in silicate glasses with higher phonon energies, resulting in a higher optical gain in the fiber amplifier. Looking to the importance of silicate glasses, it was thought to design a new type of rare earth doped silicate glass and investigate its optical properties by studying its absorption and fluorescence spectra. Such spectral studies give valuable information about the structure and bonding in the glass and radiative and non-radiative properties of rare earth ion doped in glass matrix. This information is essentially required while developing new optical devices.



FE-SEM of Glass Specimen

Rare earth ions doped with sodium silicate and borosilicate glass specimens have been prepared by melt quenching technique. About 60 sodium silicate and 20 borosilicate glass

specimens were tried. Half of these were spoiled due to power failure during the melting processes. Some of the earlier specimens were not up to the mark due to fracture and brittle nature / poor transparency. Moreover the dopant concentration was varied from 0.2 to 0.5wt. %. In certain cases the glass materials became opaque or were of poor optical quality. Finally we could prepare 18 sodium silicate and 6 borosilicate glass specimens, which have been included in this present report. The final composition (in wt%) of the sodium silicate glass specimen is SiO_2(68.94)- Na_2O (22.55)- CaO (1.91) -K_2O(4.96) - As_2O_3 (0.29) - B_2O_3(0.85)- xRE and for borosilicate glass is SiO_2(70.28) -Na_2O(10.06)- K_2O (3.95) - B_2O_3(15.21) –xRE where RE is the rare earth ions { Pr^{3+}, Nd^{3+}, Sm^{3+},Gd^{3+} and Er^{3+}} and x represent the concentration (0.0 -0.5 wt %) of the dopant ion. Pr^{3+}, Nd^{3+}, Sm^{3+}, Gd^{3+} and Er^{3+} doped sodium silicate and borosilicate glasses have been characterized by XRD, SEM and FE-SEM.

Looking to the importance of the rare earth ions in the environment of glassy matrix, it is worthwhile to study absorption and fluorescence spectra of Pr^{3+}, Nd^{3+}, Sm^{3+}, Gd^{3+} and Er^{3+} doped sodium silicate and borosilicate glasses.

Development and Promotion of *Pleurotus* based Cottage Industry using Local Natural Resources in Mid Hills of Pauri District

S.K. Mishra
E-mail:- mishra_sk1972@indiatimes.com

The project work of "Development and Promotion of *Pleurotus* based Cottage Industry using Local Natural Resources in Mid Hills of Pauri District" were completed in three different steps for the duration of 2007-2010. Initially 8 germplasms of *Pleurotus* and 5 local organic substrates were procured and collected, that are being evaluated on there different temperature ranges e.g. 0-10^{0}C, 12-15^{0}C and 23-25^{0}C. The observations on the period of substrate colonization, number of mushroom fruits, biological efficiency, total protein, carbohydrate and fat were undertaken. *Pleurotus flabellatus* and *P. ostreatus* were fully colonized the paddy straw and wheat straw within 21-28 days in lower and mid range of temperature and produced maximum numbers of fruits with 40-60 per cent biological efficiency. The biological efficiency of these species recorded was highest in comparison to rest treatments. However *Pleurotus membranecious* was taken 18 days for substrate colonization at higher temperature range which being produced highest number and biological efficiency. Out of 5 substrates tested kodo husk was known to produce highest biological efficiency (44.88-81.54%). However, lowest 2.85-32.81% biological efficiency was recorded with substrate of pine needles. The spawn run in the substrate of kodo husk comparatively consumed more days. *Pleurotus florida*harvested from thepaddy straw (0-10^{0}C), Kodo husk (12-15^{0}C) and forest grass (23-25^{0}C) was assigned for 64.7, 60.2 and 65% carbohydrates. The maximum protein content of 40-41.44 per cent was estimated from the treatments of *Pleurotus florida*+paddy straw, *Pleurotus flabellatus*+wheat straw, *Pleutotus flabellatus*+pine needles of 0-10^{0}C, *Pleurotus ostreatus*+forest grass of 12-15^{0}C and *Pleurotus florida*+wheat straw, *Pleurotus sapidus*+forest grass of 23-25^{0}C. The minimum fat content of 0.19 % was estimated from *Pleurotus membranecious* that was grown on the pine needles. In the second step of project selected combinations of species and substrate were demonstrated to the field 20 farmers of 15 different villages of Pauri District with training programme. The selection of the combinations was made on the basis of biological efficiency.

Twenty farmers were directly benefitted from the project however, more than 300 farmers indirectly learned the cultivation techniques. In the third steps of the project mushroom powder, mushroom pickle, mushroom candy were prepared and successfully evaluated. Consequently**, *Pleurotus flabellatus, Pleurotus florida,*** kodo husk, forest grass were found superior on the basis of biological efficiency. Thus these species and substrates can be opted for *Pleurotus* cultivation in different hill regions. The kodo husk and forest grass may be used as an alternate substrates of the paddy straw and wheat straw. The substrate of pine needles though was found useful but it needs intensive research attention in future.

Development of Acoustically Rich Speech Corpus for Garhwali Hindi Dialect of Uttarakhand

R.K. Upadhyay
Department of Physics
Pt. L.M. Sharma Government P.G. College
Rishikesh Dist. Dehradun
Uttarakhand – 249 201
E-mail:- rku8@rediffmail.com

Research on the development of Speech recognition and Synthesis systems are of wide utility and have shown that there is urgent-need for creating phonetically segmented and labeled Text to Speech Systems. The databases are generally useful as an aid to the development and diagnostic evaluation of the several schemes (algorithms) of speech recognition and rules of synthesis of speech. The Text to Speech System will also be useful as a tool for fundamental and applied research in phonetics of Indian/Regional Indian languages.

Being the first of its kind the study will open new direction in applied research to the benefit of a large section of people. The above mentioned phonetically rich database of Garhwali Hindi will act as a common database to different speech groups working in India and help in the speedy development of voice input/output systems. It will also help in standardization, comparison and evaluation of various speech processing techniques and systems. Efforts will be made to establish methods for evaluating both the objectives performance of various speech processing techniques and the subjective acceptability of such techniques for man-machine interface in laboratory and field environment.

A detailed study of the Garhwali Hindi literature has been carried out through the books, magazines and local regional newspapers available. Creation of Speech Corpus for different utterances of speech samples by large number of speakers in a variety of environmental and phonetic context is the basic and essential knowledge source for any research and development activity in speech technology. Data has been obtained to structure the variability that occurs in the speech signals due to inter and intra speaker variations and the co-articulation effects, noise and communication conditions etc.

For the creation of acoustically rich Garhwali Hindi Speech Corpus, we have created a corpus of about 11188 Garhwali Hindi speech words involving all the consonants as well as vowels. We have prepared a list of different Garhwali Hindi sounds which are most commonly used in daily life.

These speech sounds have been recorded by a microphone in a partially acoustically treated room for three or four speakers and then these speech sounds are being digitized through a PC based speech station. Thus, during these twenty six months, we have collected, selected and started to record speech sounds and generated relevant corpus based on the linguistic knowledge.

Speech Input/ output devices developed using Indian languages will have a large number of applications in industry, robotics, office automation, information storage and retrieval systems, aids for the handicapped and automatic language translating machines. These systems will have long ranging technological impact and production potential in India.

An acoustically rich speech corpus of Garhwali Hindi dialect of Uttarakhand will be available for various kinds of studies and will be used for creating synthesized speech sounds and machine recognition of local dialect of Uttarakhand.

Development of Agro- technologies of Some *Rare, Threatened* and *Endangered* Taxa of Himalayan Medicinal Herbs

A. K. Badoni
High Altitude Medicinal Plants Research Foundation
Society for Himalayan Environmental Research (SHER)
Lane No-3, Turner Road, P.O. Clement Town
Dehradun
E-mail:- sher@sancharnet.in

For the state-of-the-art study on the species like ***Aconitum atrox, Aconitum heterophyllum, Saussurea lappa,*** etc. in order to propagate these plant genetic resources in controlled conditions, generate appropriate agro technologies for their cultivation in the field and work out techno-economic viability for their commercial cultivation., the present project is successfully conducted

Objectives

To establish a "Seed Park" (Field Gene Bank) in order to promote ex-situ conservation of ***Aconitum atrox, Aconitum heterophyllum*** **and** ***Saussurea lappa,***

- To select the suitable Cultivars/Strains in terms of growth potential, yields, disease resistance etc. in order to make the cultivation practices of ***Aconitum atrox, Aconitum heterophyllum*** **and** ***Saussurea lappa.***

- To develop valid field applicable multiplication as well cultivation technologies for the selected medicinal plant species through conducting research studies.

Development of light weight palky

Krishna kumar
Director
Dehradun Institute of Technology (DIT), Dehradun
E-mail:- dit@ditddun.org

The project has social importance in hilly areas where no transport facility is available. Palky may be defined as a structure normally made of wood used for transporting patients, weaker persons, old person and pilgrim from one place to another place with the help of more than one person. The present palky is having limited life, it is bulky and congested. The passengers as well as the carriersfeel uncomfortable during transportation due to its bulkiness. Therefore the existing palky was modified by redesigning the shape and proper selection of materials of construction to have more comfortable and economic features.

Cost of the palky without the medical oxygen cylinder- Rs. 1245

Cost of the palky with the medical oxygen cylinder- Rs. 6870

Weight of the palky without the medical oxygen cylinder- 7.5 Kg

Weight of the palky with the medical oxygen cylinder- 16 kg

Development of micropropagation technique for economically important bamboos: *dendrocalamus hamiltonii* and *gigantochloa atter*

Prabha bisht
Scientist- B
Tissue Culture Discipline,
Forest research Institute,
Dehradun – 248006
E-mail:- prabhabisht25@gmail.com

The present investigation was taken up with an aim to develop tissue culture techniques for growth and multiplication of *Dendrocalamus hamiltonii* and *Gigantochloa atter*. A detailed stepwise procedure was developed for micropropagation of both the bamboos.

An efficient procedure for *in vitro* propagation through axillary bud proliferation has been developed for *Dendrocalamus hamiltonii* Nees et Arn. Ex Munro. Best results for bud induction were obtained in liquid MS medium supplemented with 15µM BAP. MS supplemented with10µM BAP was found to be optimal for shoot multiplication giving an average shoot multiplication rate of 9.13 folds. Multiplied shoots were further cultured onto MS medium supplemented with auxin for *in vitro* rooting. Optimal rooting (66.13%) was obtained on MS medium supplemented with 25µM IBA in four weeks. The *in vitro* raised plantlets with well developed shoots and roots were subsequently hardened in green house conditions. A survival rate of over 90% was achieved on transferring the plants to field conditions where they exhibited normal growth.

Micropropagation of *Gigantochloa atter*. Fig. A: Mature mother clump; Fig. B: Axillary bud break; Fig. C: *In vitro* multiplication; Fig. D & E: *In vitro* rooting.

A procedure for the regeneration of complete plantlets of *Gigantochloa atroviolaceae* Widjaja (*G.atter sensu* Kurz.), *through* axillary shoot proliferation is described. Axillary bud break was

accomplished in full strength liquid MS medium fortified with 25.0 µM BAP. Axillary shoots produced were multiplied on semi-solid MS medium supplemented with BAP (20µM) + NAA (3.0µM) giving a multiplication rate of 2.39. *In vitro* shoots were rooted on full strength MS medium supplemented with varying concentrations of auxins. Optimal rooting was achieved on medium supplemented with 35.0µM IBA. Regenerated plantlets were successfully hardened and acclimatized under net house conditions with over 80% survival.

Development of Polyherbal Antidiabetic Formulation from Medicinal Plants of Garhwal Himalaya

Versha Parcha
Professor,
Dept. of Pharmaceutical Sciences,
SBSPGI, Balawala, Dehradun
E-mail:- vershap@rediffmail.com

The Polyherbal Antidiabetic formulation from aqueous extracts of *Aloe vera, Azadirachta indica, Emblica officinalis & Piper longum* was successfully developed and it was analyzed for various quality parameters and therapeutic efficacy along with effect on various biochemical parameters.

In the first phase, samples of *Aloe vera* and *Azadirachta indica* were standardized according to various parameters given by WHO along with *Emblica officinalis* (Amla), and *Piper longum* (Pipli). Extracts were prepared using different solvents in an order of increasing polarity. The extracts *of A vera* and *A indica* were screened for their antidiabetic potential. The aqueous extracts of *Aloe vera* & *Azadirachta indica* gave the best hypoglycemic effect in comparison with other extracts.

Following the results from the Ist phase the active aqueous extracts of *Aloe vera* and *Azadirachta indica* were again screened for their blood lowering capacity in combination with *Emblica officianlis* as antioxidant and *Piper longum* as bioavailability enhancer. Aqueous extracts of *Aloe vera* and *Azadirachta indica* in combination with *Emblica officinalis* and *Piper longum* in the ratio 1:1:1:1 caused reduction in the blood glucose level of alloxan induced diabetic rats (58.4%) as compared to standard drug. Therefore attempts were made to develop a suitable dosage form for its mode of delivery. After preparing the suspension it was evaluated for its detailed pharmacological activity in which its anti-hyperglycemic activity, liver function test (SGOT, and SGPT) and serum urea test (kidney function test) were observed to see the effect of formulation in elevated blood glucose and disorders of other biochemical function.

The blood lowering capacity of the formulation was found to be significant in 4^{th}, 7^{th}, and 15^{th} day of oral treatment to the chemically induced diabetes in white albino rats. The other biochemical functions were also found to be effectively treated by the formulation. Some of the actions of formulation were found to be superior while comparing results with standard drug Glibenclamide.

Finally on analyzing all the quality parameters it could be concluded that suspension exhibited good organoleptic properties, portability and physical stability. Therefore meeting the basic qualification of good suspension dosage form and offering physician and patient acceptance.

Thus it can be concluded that the so formed suspension is significantly effective in lowering the blood glucose level and also simultaneously effective against other complications which are associated with *Diabetes mellitus*.

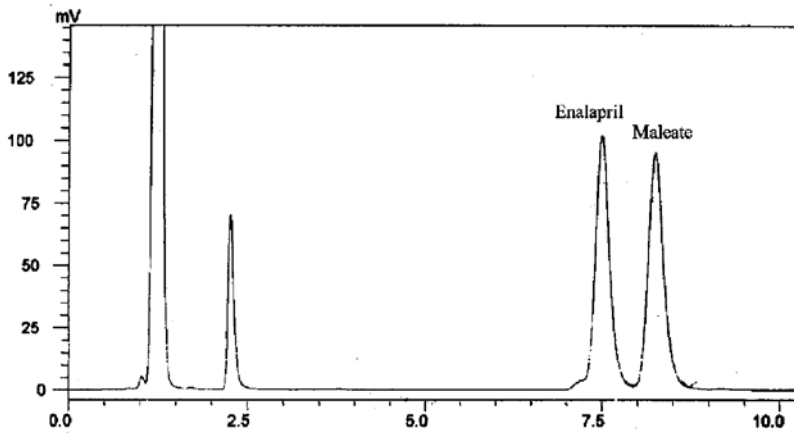
Development of procedures for assay of drug formulations and resolution of their racemic mixtures

Shalini Joshi
K.L.D.A.V.(P.G.) College, Roorkee
E-mail:- shajoshi@yahoo.com

Objectives

- Development of chromatographic and other chemical assays for drug formulations.
- Determination of optical purity of various drugs.
- Resolution of racemic drugs.
- A comparative study of methods developed for assaying of drug formulation.
- Effect of storage conditions on stability of drug

The study suggests that charge transfer interaction may be further exploited to develop fluorescence detection for lactam group of antibiotics. Method is extremely simple but sensitive. Method developed can easily be adopted on ready-made silica gel G plate after running these plates in solution of impregnation reagent. Use of harmful solvents like acetonitrile, methanol and benzene etc. has been avoided. Non destructive UV detection method for various drugs makes it comparable with other latest assays. Hence our approach to impregnate stationary phase has successfully evolved an economical alternative to existing methods for analysis of antibiotics, antihypertensive and NSAIDs. Also our efforts to use preparative TLC-spectrophotometry for quantitative determination have given encouraging results.



Chromatogram for separation of amlodipine besilate (Rt=2.4) and Enalapril maleate (Rt= 6-9)

Enantiomeric separation by using of impregnated silica gel-G layers for resolution of β-blockers and naproxen have led to very interesting results based on a new approach.

RPTLC has been successfully employed to study lipophilicity behaviour of antihypertensive drug molecule. Hydrophobicity parameter (Rm_0) values have been correlated well with log P value from literature. Since drugs showing higher lipophilicity value are better absorbed in gastrointestinal tract, hydrophobicity parameter evaluated as discussed can be helpful in QSPR studies.

Development of Spring Sanctuary & Strategy for Environmental Regeneration in Ghat Gad Watershed

D.D. Chauniyal
Department of Geography,
H.N.B. Garhwal University, Srinagar
E-mail:- Chauniyal_devidatt@yahoo.co.in

The present research proposal has been selected for recharge of water sources and regeneration of environment in the highly populated part of the Lesser Himalayan region of the Uttarakhand. The main objective of the study was to assess the geo-hydrological conditions of the Ghat Gad watershed (a tributary of Bino river in Syalde block of Almora district) and development of spring sanctuary for recharge and management of springs which will reduce the water scarcity in the villages.

1. Geological investigation shows that there are three stratigraphic zones in the study area. Central meta-sedimentary layer is highly folded and faulted in the watershed which is aquifer zone and responsible for hydrological conditions of the watershed.
2. The head water zone of the watershed is highly degraded by anthropogenic activities like deforestation, grazing and soil erosion which requires sufficient treatment by conservation techniques.
3. Geo-hydrological investigation shows that there are 33 perennial and 9 seasonal springs existed in the watershed, out of which 4 springs are recently decimated and 5 are likely to be losing their discharge. The overall water discharge of the springs is continuously decreasing due to the global warming and lack of rainfall.
4. Two spring sanctuaries having an area 500 sq.m and 300 sq. m along with one nursery were established in the head water zone of the watershed in which 5000 tree species had been planted. Mainly oak and associated species are replanted in the area.
5. Continuous two years (2007 to 08) water discharge data of springs and climatic data have been monitored. It indicates that the springs are losing their discharge every year which is the only source of drinking water and irrigation. During dry season there is scarcity of water.
6. The average rainfall of the area was 205.21cm and average water discharge was 48.25 L/ sec. The annual average rate of water discharge in the watershed was 295.27 L/sec/ km^2/y.
7. The annual average suspended sediment of Ghat Gad was estimated about 22.38 Tons during the project tenure. Out of which more than 75% was during rainy season.
8. One of the spring sanctuaries is well established and reforested in the area but due to the village politics and non co-operation of Kelani villagers, second conserved area could not be developed properly. Few plant species (40%) are alive there. It requires further development and proper management.
9. Slumping of land, land slide and debris avalanches were maximum during rainy season but were not properly managed.

Effect of ectomycorrhizal fungal diversity and composition on growth of *Quercus leucotricophora* and *Pinus roxburghii* seedlings, the principle forest species of Uttarakhand"

Veena Pande
Department of Biotechnology,
Kumaun University, Nainital
E-mail:- veena_biotech@rediffmail.com

Pinus roots inoculated with *B. edulis*

Species composition of the tree layer in a forest greatly influences the soil characteristics and underground flora. Environmental factors such as moisture,light, soil texture and water holding capacity etc. also directly or indirectly influence the tree species composition to some extent. These factors in turn affect the occurrence, diversity and distribution of fleshy fungi.

To study the Diversity of ectomycorrhizal fungi eight different sites were selected from Nainital and Almora district of Uttarakhand having different altitude, aspect, flora and soil characteristics. The morphological and other characteristics of selected sites were also determined. Total 105 ectomycorrihzal species were collected. Out of 105 species 8 species were unidentified and rest 97 species were from 27 genera. The genera recorded were *Agaricus, Amanita, Astraws, Bovista, Boletus, Clitocybe, Cortinarius, Entoloma, Geastrum, Gyrodon, Hebeloma, Helvella, Hydnum, Hygrocybe, Inocybe, Lactarius, Laccaria, Leccinum, Lycoperdon, Romaria, Russula, Scleroderma, Strobilomyce, Suillus, Tricholoma, Vascellum* and *Xerochomus*. Out of 27 genera recorded across various study sites the genus *Russula* was represented by maximum number of species(27 species) followed *by Lactarius* (10), *Amanita* (7), *Agaricus* (5), *Lycoperdon* (4), *Tricholoma* (4), *Geastrum* (4), *Clitocybe* (4), *Entoloma* (4), *Scleroderma* (3), *Boletus* (2), *Hydnum* (2), *and unidentified* (8).

This study indicated that the fungal species seem to have a marked influence on competitive outcome of the seedlings, their growth and health status. Effect of *Russulla veternosa* was more with oak seedlings whereas *Amanita verna* and *Boletus edulis* were more effective with pine seedlings. Genus *Boletus* is used first time for these type of studies in our region and showed more positive effect on Pine seedlings in comparison to *Amanita verna*. These fungal species are now getting developed as biofertilizers for the better growth of these tree species so that by applying specific fungal species as biofertilizers, depletion of particular tree species could be minimized in specific forest sites and they could be recovered by positive effects of these biofertilizers.

Enhanced Coliforms Removal in Sequencing Batch Reactor Activated Sludge Process

Absar A. Kazmi
Civil Engineering Department
Indian Institute of Technology Roorkee
E-mail:- kazmifce@iitrenet.in

Pilot Scale Experimental Setup of SBR System Phase I & III

Experimental setup of 20 L SBR Systems

Normally higher efficiency is required in all treatment plants irrespective of their location; however hilly regions have their own special requirement due to high altitude, low temperatures, small communities and lower dilution in water bodies due to variable seasonal flows. Continuous flow (One Tank) SBR in addition simple configuration and high efficiency (BOD, COD, TN, TSS, TC and FC in the range of 85,81,73,71 and 99%) is applicable for sewage discharge at the d/s of dam or where almost nil dilution in rivers exists. Sequencing batch reactors (SBRs) have gained wide interest for wastewater treatment because of their simple configuration in which all necessary operations take place sequentially in a single basin. A very complex microbial ecosystem consisting of bacteria, bacteriophages, protozoa, metazoa, viruses, worms, helminthes etc is involved in this sequential degradation of organics followed by nitrification, denitrification and phosphorous removal. Prerequisites to successful removal of all these substrates are efficient growth of biomass for organics, low COD, high DO and long SRT for nitrification, while reverse is true for denitrification in the form of sufficient COD in the absence of DO, low SRT for phosphorus uptake and absence of any form of electron acceptor including nitrate during anaerobic phosphate release, pH and alkalinity during reduction nitrification and denitrification, while high pH and alkalinity requirement for chemical precipitation of phosphate. These *contradictions are* themselves difficult preposition to optimize or even achieve.

In summary, the entire process is conversion of different components of wastewater by oxidation and reduction to end products, namely CO_2, H_2O, N_2, PO_4, new cells and fractions of intermediateries remaining due to inefficiencies. Moreover, the conventional SBR possesses some shortcomings as well; such as it needs at least two reactors and absence of substrate during denitrification.

Therefore, this study was performed to minimize above mentioned obstacles by virtue of continuous flow of wastewater without any interruption during the operation cycle and variable DO conditions. The impact of DO on conventional SBR with intermittent seed was also studied. The experiments were carried out using municipal sewage in a pilot scale SBRs of 120 L and 40 L capacities.

The results obtained under different operating conditions are summarized below:

1. Higher removal efficiencies in intermittent feed due to spillover effect in continuous feed condition.
2. High DO has not hampered denitrification as DO depleted quickly.
3. The maturation level of the sludge in terms of MLVSS/MLSS ratio improved tremendously with increase in DO from 1 to 6 mg/L.
4. Decrease in MLSS with DO shows lower growth rate at high DO.
5. Total nitrogen has not adversely affected by continuous feed due to availability of Spilled BOD during settling and decantation phases. However this disadvantage was overcome by hydrolysis of excess sludge at high DO.
6. Similarly the COD removal affected adversely at high DO due to hydrolysis causing increase in soluble COD of the effluent.

DO (mg/L)	COD Rem (%)		TKN Rem (%)		TN Rem (%)		MLSS (mg/L)		MLVSS (mg/L)		MLVSS/MLSS Ratio	
	I	C	I	C	I	C	I	C	I	C	I	C
0.9	90.6	86.5	59.1	47.5	39.5	48.2	4468	3547	2904	2660.6	0.65	0.75
1.8	93.7	84.1	63.2	62.8	52.7	49.4	3556	2241	2205	1366.7	0.62	0.61
6.0	91.9	79.6	93.9	86.3	51.0	59.5	3638	1502	2167	780.5	0.59	0.52

I = Intermittent Feed C = Continuous Feed

It could be finally summarized that for sewage treatment the conventional intermittent feed SBR is more feasible except total nitrogen removal, however in places where influent nitrogen is less this advantage would also be nullified expectedly.

The increase in maturation level of the sludge in terms of MLVSS/MLSS ratio at high DO as substrate limitation caused deeper diffusion of DO into the floc; thereby increasing the volume of the floc.This ultimately caused degradation of accumulated hydrolyzed cells with marginal increase in soluble COD in the effluent which normally occurs in all other lysis-cryptic growth processes. Nevertheless, further studies with emphasis on inside the sludge floc properties are needed to elaborate the phenomena of biomass reduction under high DO conditions. Moreover, this study needs to be validated using a synthetic waste in a chemostat to get meaningful data.

Field establishment of *in vitro* raised plants of *Ephedra gerardiana*

Manjul Dhiman
Department of Botany
Kanahiya Lal DAVP.G. College
Roorkee.
E-mail:- manjul.dhiman@rediffmail.com

Experiments were conducted to study the effect of various combinations of auxins (2,4-D, NAA) and cytokinins (BAP, Kn, TDZ) onto nodal segment, internodal segments and mature embryo culture of *Ephedra gerardiana.* A successful micropropagation protocol has also been described using nodal segment culture.

Nodal Segment Culture: In case of nodal segments, the cytokinins alone could bring about proliferation of shoot buds in the present work When higher concentration (15μM) of kinetin was used in the basal medium, all cultures exhibited initiation of shoot buds with little friable callus on the swollen base of nodal segment.

At lower concentrations of TDZ (0.5 to 2.5μM), shoot buds were produced directly from node without callus. At higher concentrations of TDZ (5 to 20μM), swelling of the node was followed by compact callusing in 45 to 100% cultures. Shoot bud were also produced from compact callus at these concentrations however, there was a decrease in percentage of cultures responding as there was an increase in TDZ concentrations from 8 to 20μM.

Stem Internodal Segment Culture Studies: Internodal segments were also cultured *in vitro* to study their regeneration potential. Onto 2 and 5μM 2,4-D supplemented medium, explant induced moderate callusing. The callus initiated from junction of the explant with the medium within one week. Onto high 2,4-D (10μM), all cultures exhibited heavy callusing with root production. The degree of callusing was very high onto this medium. Internodal segments were also cultured onto NAA containing medium to differentiate its morphogenic response with 2,4-D supplemented medium. Onto basal medium containing 1μM NAA, only 12.5% cultures exhibited callus induction from junction of the explants with medium after 2 weeks. Onto 1 and 2μM NAA supplemented medium, degree of callusing was very mild. When 5μM NAA was added into the medium, moderate callusing was observed besides rooting in few cultures. At further high concentration of NAA (10μM), heavy callusing was obtained without root induction. The callus was formed by rupturing the epidermis. The degree of callusing was very high onto this medium, however root formation was not achieved.

Various concentrations of TDZ were also tried in MS medium to study morphogenic potential of internodal explants. When explants were cultured onto BM + 1μM TDZ containing medium, all cultures produced callusing. The explants yielded shoot buds directly from one end after 5 weeks of culture. The callus produced from cut ends however initiated somatic embryos. The callus bearing embryos were transferred onto basal medium where they germinated into young plantlets. When TDZ concentrations were increased, the percentage response

remained same however, the degree of callusing was decreased. The callus was initiated from longitudinally injured surface of the explants. Callus was also proliferated from cut end of the explants within next 4-5 weeks. The greenish white callus yielded embryoid like structure in only 10% of cultures onto this medium after further 4 weeks. The embryoid like structure obtained from embryogenic callus turned into somatic embryos. Higher concentration of TDZ (1.5 -5µM) produced only callusing without any organogenic response.

Embryo Culture Studies: Addition of 2,4-D in the basal medium resulted in a multifold increase in size of embryo explants followed by callus formation. Onto 2µM 2,4-D, the explants exhibited induction of callus from radicular region. When 2, 4-D concentration was increased to 5µM, the explants showed a multifold increase in size followed by coiling of the cotyledon. The enlarged explant started producing callus. However onto higher 2,4-D (10µM), the enlarged explants also showed vitrification.

NAA was also tried in basal medium to study the morphogenic potential of embryo explants. The lower concentration of NAA did not elicit any morphogenic response or size enlargement. At 5µM of NAA supplemented medium, the embryos showed small compact callus induction. Onto 10µM NAA, the degree of callusing was higher as compared to 5µM supplemented medium. The compact callus yielded green nodular structures onto this medium. NAA alone at higher concentration induced callusing followed by organogenic response in embryonal explant in *Ephedra gerardiana*.

Callus Culture: The callus obtained onto 2,4-D or NAA supplemented medium did not produce significant shoot buds. The callus thus formed was therefore transferred onto lower auxin and higher cytokinin or different concentrations of cytokinin containing media.

The enlarged cotyledon or callus was transferred onto 2µM 2,4-D and 5µM BAP containing medium. The callus regenerated into small roots. The callus further proliferated well onto this combination without shoot bud formation. The enlarged cotyledons were transferred onto 2µM 2,4-D and 5µM Kn supplemented medium also. The explant initialized callus from cut ends. The callus was nodular in appearance. The nodular callus did not show any shoot bud or root formation onto this medium. The compact nodular callus obtained onto NAA supplemented medium was further subcultured onto 2µM NAA and 5µM BAP supplemented medium. The nodular compact callus initiated small green shoot bud like structures. However, these could not grow further. The compact callus also showed rooting in few cultures.

The enlarged part of the explant was also transferred onto medium containing 2µM NAA + 5µM Kn. The explant initiated callus from lower surface after one week of subculture. The callus continued to grow further onto this medium. The callus resulted into regeneration of roots. The nodular compact callus was further transferred onto different concentrations of BAP or Kn alone to observe further response. The callus did not elicit any morphogenic response onto this medium. The callus exhibited compact nodular structure after 3 weeks of culture. The nodular structures turned into embryoid like structure. The callus bearing somatic embryos formed onto 10µM BAP supplemented medium was highly friable. The nodular callus was also subcultured further onto both BAP and Kn containing medium, onto which hairy callus was obtained.

Cotyledon Culture: The excised embryos were germinated onto basal medium for cotyledon

culture. The green enlarged cotyledons were cultured onto 2,4-D and BAP supplemented medium. Onto 5µM 2,4-D with 10µM BAP in the culture medium, the cotyledon further enlarged in size and induced callus from one end. The callus further proliferated onto same medium. The enlarged cotyledon initiated compact green callus which became nodulated. The nodulated callus further gave rise to shiny white structures. The callus later on yielded nodulated structures onto this combination.

Seeds of previous year generation were tried for embryo and cotyledon culture because seeds stored for more than 2 year did not show germination. However, stem segments were taken from both mature as well as young plants. It was observed that in case of nodal segment, the mature plants exhibited well. However in case of internodal segment, only young stems showed organogenic response.

Shoot Elongation: Shoots regenerated directly or indirectly through callus were of variable length. Callus pieces containing shoots or directly regenerated shoots were transferred onto basal medium for further elongation. The shoots grew further and attained a length of 3 to 8 cm onto basal medium.

Rooting: Rooting of excised shoots was achieved *in vitro*. For this, two auxins viz. IBA and IAA were used. None of the IAA containing medium initiated roots in present investigation. The IBA only proved to be the rooting induction hormone. MS with its major salts reduced to half and one fourth strength was tested for rooting of the *in vitro* multiplied shoots of *E. gerardiana*. Shoots rooted best on ¼ MS and 20µM IBA.

Field evaluation of Microbial Inoculants developed for use in Mountains

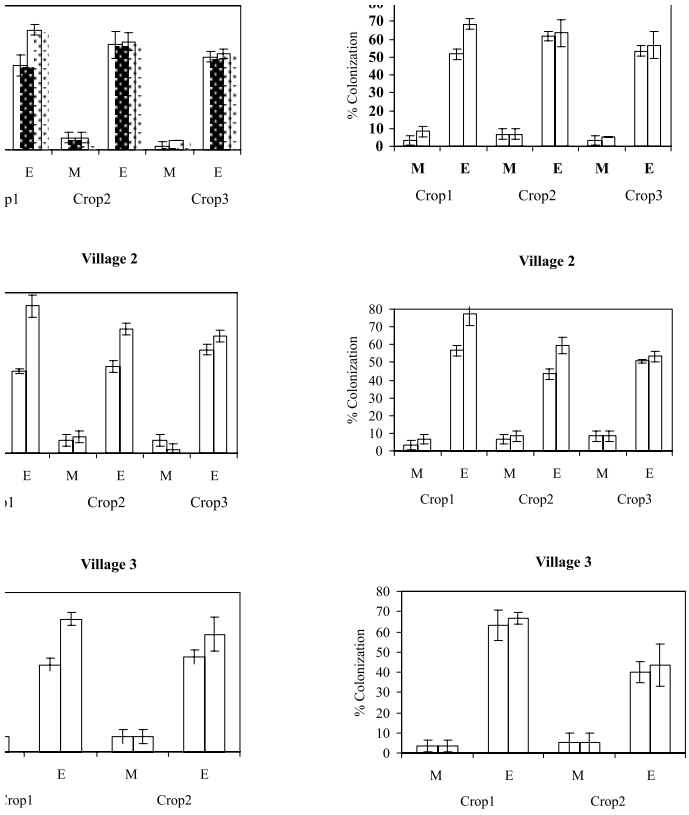
Anita Pandey
GB Pant Institute of Himalayan Environment and Development
Kosi-Katarmal, Almora- 263 643, Uttarakhand, India
E-mail:- anita@gbpihed.nic.in

Bacterial inoculation of lentil Agricultural practices in mountain ecosystem are unique. On the basis of the series of experiments that have been conducted under this project, it is concluded that for field application of this microbe based technology, understanding of the agricultural practices applicable under various ecosystems, with a view of farmers' perception is essential. *Bacillussubtilis* (NRRL B-30408B), initially isolated from a mountain location that has been evaluated for the desirable traits related to plant growth promotion and biocontrol, is recommended for field application under mountain ecosystem. On-farm demonstration trials in collaboration with the local farmers, following an integrated approach using ecologically competent microbial inoculants in addition of other organic inputs and appropriate water management will be essential to adopt this technology for improving crop productivity.

Rhizosphere studies on *Ginkgobiloba*
Data suggest that, while the species of *Glomus* dominated the rhizosphere of *G. biloba*, an inverse correlation exist between the colonization of general microflora and the colonization of arbuscular mycorrhizal fungi including endophytes.

The success of this study can be attributed to the fact that (1) the microorganisms used as inoculants originally were isolated from temperate or alpine locations of high altitudes, (2) large scale screenings for desirable traits (mainly nitrogen fixation, phosphate solubilization, disease control and tolerance to low temperature), and (3) their ability to influence a 'microbial shift' in the native microflora, mainly in form of stimulation of beneficial microbes and suppression of disease causing microbes.

The villagers have shown a positive attitude to adapt this inexpensive and ecofriendly microbe based technology. The technology can be integrated with



Percent colonization of mycorrhizal and endophytes in the roots of all three crops in both the years. Control Inoculated M=Mycorrhizae, E=Endophytes

the traditional useof organic inputs and water management. The microbial inoculants along with the local farmyard manure may work as microbial fertilizers that will help in enhancing the overall plant productivity.Isolation of an endophytic bacterium from the cortical sells of mycorrhizae infected *G. biloba* roots is a promising lead towards conservation of this medicinally important tree species in Uttarakhand. There is a need of establishment of production unit(s) for large scale production of microbial inoculants in form of cottage industry. This concept requires attention at policy level, specifically in mountain states, such as Uttarakhand.

Fish-Trematode Diversity in Water Bodies of Dehradun

R. M. Saxena
Deptt.of Zoology,
D.A.V. (PG) college,
Dehradun- 248001

(a) The fishes were collected from Eastern Doon (Tributaries of Ganga- Sahastradhara, Raipur, Balawala, Doiwala, Raiwala) and from western Doon (Tributaries of Yamuna- Sahaspur, Dhalipur, Herbertpur, Dakpathar & Kalsi).

(b) The following fish species have been recovered from the above mention selected sites-

Barilius bendelisis, Barilius vagra, Barilius bola, Garra gotyla gotyla, Labeo dero, Puntius chola, Puntius sarana, Puntius ticto,Puntius conchonius, Tor putitora, Tor tor, Tor chelynoides, Shizothorax richardsoni, Clarias batrachus, Belone cancila, Channa punctatus, Mastacembelus armatus.

(c) The trematode diversity revealed the occurrence of 7 species-

Monogenetic-*Lobotrema rajendari,* Srivastava and Jauhari 1983,*Diplozoon indicum* Dayal,1941.

Digenetic-*Allocreadium mehseri,* Pande 1938, *Asymphylodora tincae,* Modeer,1790, *Orientocreadium batrachoides,* Tubangui, 1931 ,*Bucephalopsis sinhai,* Dayal,1948, *Eucreadium pandeyi,* Srivastava et. al. (1983).

(d) In all 697 (Male-517+Female-180) fish specimens belonging to 17 species have been collected. As for as infection of trematode is concerned only 12 sp. of fishes were found infected. The fishes were not found infected are-*Barilius bola, Garra gotyla-gotyla, Labeo dero, Schizothorax richardsonii and Tor chelynoides,* thus a total of 641 fish specimens were examined for infection, of which only 299 fish specimen were found infected. Out of 299 fish specimen, 211 (71%male) and 88 (29%female) were found infected. The overall infection was found to be 46%.

(e) Gills and intestine are the main sites of infection. The monogenean were found on the gills whereas digeneans were recovered from the intestine. The incidence of monogenean was found 19% as compare to digeneans 44%. The over all incidence of infection was recorded 37%.

(f) The frequency of trematode infection has also been correlated with size range of the fish specimen. The moderate size range of fishes has been preferred by the parasites.

(g) For pH, temperature and turbidity Water samples were collected and analyzed every month. All the three parameters were correlated with the incidence of trematode infection. It has been found that with the increase of pH and temperature the rate of infection also varies.

(h) On the basis of analysis of food present in the gut, the fishes have been classified as Herbivorous (*P.chola P.ticto P.conchonius, T. putitora, Tor- tor,*), Carnivorous (*C. batrachus, B.cancila, Channa .punctatus, M.armatus*) and Omnivorous (*Bariliusvagra, Barilius bola*, *Puntius sarana).*

New Observations:

(1) The incidence of trematode infection is more in the fishes dwelling in western Doon rivers than Eastern Doon rivers.

(2) The incidence of infection was found more in male than female fishes.

(3) The incidence of digenetic trematodes (5 species) was found more than monogenetic trematodes (2 species).

(4) The rate of infection in herbivorous fishes (5 sp.-77% in *Tor-tor*) was observed more than carnivorous (4 sp.-75% in *Mastacembelus armatus*) and omnivorous fishes (3 sp.-in *Barilius bendelisis*).

(5) pH and temperature have direct positive effects on the incidence of trematode population.

(6) *B. sinhai* and *E. pandeyi* were found host specific at species level whereas host specificity at sp./generic level has been observed in *A. tincae*, *D. indicum* and *Lobotrema rajendrai.*

(7) Both the species of monogenetic trematodes are found only on 2nd& 3rd gills.

(8) The metacercarial cysts of *Clinostomum* (the adult is found in Pond Herone) have been recovered from the intestine of *Channa punctatus.*

(9) Amphistome, Echinostome, Furcocercous and Xiphidiocercuscercariae were recovered from snails.

(10) Fish borne zoonotic trematodes (FZTs) are not found in the fishes dwelling in water bodies of Dehradun.

At present there is no danger of fish borne zoonosis in Dehradun, but the possibility can't be ruled out as all the pre- requisites for zoonosis is present in and around the vicinity of water bodies of Dehradun, which are conducive for transmission of the infection.

Hyporheic Biodiversity of The River Bhagirathi Downstream The Tehri Dam, Uttarakhand Himalayas, India

Manisha Uniyal,
Shri Guru Ram Rai (P.G.) College, Dehradun,
E-mail:- muniyal19@rediffmail.com

Polycentropus spp.

Chironomus spp.

Pinnularia spp.

Biological diversity or biodiversity is the variety and variability of flora and fauna in an ecosystem. Articulated into genes, species and ecosystems, it provides biological plasticity needed by life on the Earth to adopt the changes. Fluvial biodiversity *i.e.* biodiversity of riverine ecosystems can be categorized surfacewater and hyporheic (Surfacewater and groundwater ecotone) biodiversity. Surfacewater biodiversity includes the aquatic biota present in the forms of zooplankton, phytoplankton, macrozoobenthos, macrophytes and fish. Surfacewater ecology is well studied world wide. Many workers had contributed on this aspect. This is for the first time that hyporheic zone of river Bhagirathi downstream the Tehri dam has been explored in India in the form of present work.

The biotic component (Hypoheic organism) identified from the study area includes Microphytobenthose (20 geners belonging to four families i.e. Bacillariophyceae, Chlorophyceae, Desmidiaceae and Myxophyceae), Microzoobenthos (12 genera belonging to 3 groups i.e. Rotifera, Copepoda and Cladocera) and Macrozoobenthos (26 genera belonging to 6 orders i.e. Ephemeroptera, Trichoptera, Diptera, Coleoptera, Odonata and Plecoptera). Mean monthly Shannon's diversity of biological component was recorded to be minimum in monsoon and maximum in winter season. The density decreases with the increasing depth of hyporheic zone.

Till date there is no reference on the pre-impoundment and the post impoundment study of hyporheic zone of river Bhagirathi, but this study can be compared with some pre-impoundment studies on surfacewater conducted by Semwal and Akolkar (2005) and Agrawal and Thapliyal (2005). They reported complete absence of benthic macroinvertebrates during their study. The river pollution was categorized into class E of biological water quality criteria (BWQC) in river

Bhagirathi at old Tehri town, downstream Tehri dam at Zero Point, inlet of diversion tunnel at Koteshwar and upstream of Devprayag.

But now condition is improved which can be supported by the presence of hyporheic organisms (hyporheos) observed during the present study. However, the second site (S2) showed complete absence of hyporheos which may be attributed to the ongoing construction activites of another small dam called Koteshwar dam.

During the field study some natural and anthropogenic factors adversely affecting the hyporheic biodiversity have been reported, if the effect of these factors can be minimized using the suggested remedial measures, by the dam authorities the banks of river Bhagirathi may be restored and thus will help in conservation of aquatic biodiversity and improvement of water quality.
Moreover, the present work is providing the baseline data on the hyporheic biodiversity of river Bhagirathi downstream the Tehri dam reservoir. This may be utilized for planning strategies for conservation of aquatic biodiversity of river Bhagirathi by THDC and other authorities which is an important tributary of the "Ganges" now designated as the national river. Such studies should be promoted in future also as they help in monitoring the river water quality and the biodiversity of the aquatic ecosystem.

In situ conservation of some medicinal plants of Garhwal Himalaya, Uttarakhand

JMS Chauhan
Field Research Station, Khirsu
Botany Division
Forest Research Institute
Dehradun (Uttarakhand)
E-mail:- chauhanjms@icfre.org

Multiplication of *Swertia chirata* plants collected from Auli (Chamoli)

Propagation of *Bacopa monnieri* plants in nursery beds

Natural habitats of plant species under project were surveyed. Identification, collection and preparation of herbarium sheets of medicinal plant species were completed. Grasses, shrubs and weeds were removed andnursery beds were prepared and pits were dug out.Seeds of *Swertia chirata, Aconitum heterophyllum and Berberis asiatica* were sown in pots to raise seedlings for planting in the nursery beds.Cuttings of *Berberis asiatica* and *Cinnamomum verum* plants were collected from Forest area and inoculated into poly bags for rooting. Seedlings of *Berberis asiatica* and *Cinnamomum verum* were collected fromforest floor and transplanted in the nursery beds. *Bacopa monnieri* plants that were multiplied in earthen pots were transferred to nursery beds. *Swertia chirata* and *Aconitum heterophyllum* plants were collected from Chakrata Forest Division and Joshimath Forest Division were multiplied in poly bags at Khirsu and subsequently transferred to nursery. Healthy plants of C*innamomum verum* and *Berberis asiatica* were collected from different areas of forest and transplanted in nursery at Khirsu. Medicinal plant species that are found above 8,000 ft. viz. *Swertia chirata, Aconitum heterophyllum* and *Bacopa monnieri* are not native to Khirsu and adjacent area (5900 ft.) but adapted themselves to a different climatic condition.

Conservation of *Berberis asiatica* in Khirsu Nursery

In vitro rapid mass multiplication and germplasm conservation of some medicinal plants

Vikash Singh Jadon
Plant Molecular Biology Lab, Department of Biotechnology
Sardar Bhagwan Singh (P.G.) Institute of Biomedical Sciences and Research
Balawala, Dehradun
E-mail:- jadon@rediffmail.com

In-Vitro multiplication of *Swertia chirayita*

Recent global emphasis on exploitation of herbal resources and instances of patenting of developing-country plants by developed countries emphasize the need to generate databases on indigenous medicinal plants which can be used for future reference. So, there is an urgent need to design a strategy for the conservation and improvement of these medicinally important plants and as well as to ensure a sustained supply of medicinally important herbs in the future. The growing demand of herbal products has tripled the exports from India during the last decade and is expected to increase even more in the years to come.

Swertia chirayita and *Aconitum heterophyllum* are the medicinal plants indigenous to temperate Himalaya. *Swertia* is a genus in the gentian family containing plants sometimes referred to as the felworts. Some species bear very showy purple and blue flowers. The plant is used as a bitter tonic in treatment of fever and for curing various skin diseases. *Swertia chirayita* has an established domestic (Indian) and as a well as an international market. *Aconitum* is the botanical name of the genus commonly known as aconite, monkshood etc. The genus *Aconitum* belonging to the family Ranunculaceae is widely distributed in the alpine and sub-alpine regions of tropical parts of Northern hemisphere. They are mainly cultivated for their tubers. Aconite produced from the roots of number of different species of *Aconitum* is used in curing wide range of diseases.

The application of tissue culture technique to the regeneration and commercial propagation of whole plant is a more recent development of India.Thus the present study is aimed to develop the efficient tissue culture protocol for the rapid mass multiplication of the plant species undertaken by standardization of various media composition for their best growth response. The protocol was optimized for reducing the concentration of plant growth regulators in the medium, at the same time attaining the maximum multiplication and rooting rate. The *in vitro* propagated plants were further assessed through molecular markers for the validation of pure germplasm and detection of any existing somaclonal variation. This was aimed to detect and eliminate the variations persisiting among the clonally propagated plant material. Thus based

upon above mentioned views the protocol was aimed so that this important medicinal herb can be propagated on mass scale with clonal fidelity. The work also revealed conservation measures in natural zone of distribution of *Swertia chirayita and Aconitum heterophyllum* by mass production of clonal material with less extent of variability.

In vitro regeneration of *meizotropis pellita* (vern. Patwa)", a very rare endangered, endemic plant of patwadanger, Nainital, Uttarakhand

Tapan Kumar Nailwal
Department of Biotechnology, Department of Botany1,
Kumaun University, Nainital, Campus Bhimtal-263136
E-mail:- tapannailwal@gmail.com

An efficient protocol for high frequency *in vitro* regeneration of *Meizotropis pellita* an endangered and endemic plant of Patwadanger, Nainital, Kumaun Hills, Uttarakhand was developed.

Shoot regeneration from leaf explant | Root induction | 20 day old plant of *M. pellita*

To avoid contamination observed on explants taken from the field, seeds were collected from the plants and germinated *in vitro*. The seed coats were removed and the seeds were soaked overnight in water and transferred to hormone free MS medium and MS medium supplemented with GA_3 after 10-15 days of incubation in dark, the seed germination started. Seed germination was more effective in MS medium containing GA_3. After the immergence of whole plant the plant was maintained in culture room conditions. The nutrient medium consisted of MS salts, vitamins supplemented with 3% (w/v) sucrose and 0.8 % (w/v) agar was used in all experiments. The pH of the medium was adjusted to 5.8 by 1N NaOH and 1N HCl. The culture vials containing the media were autoclaved at 121^0C temperature and 106 kg cm^{-1}pressure for 20 min. All the cultures (except seeds) were maintained at 25±2 ^{0}C and 60±5 relative humidity in the culture room conditions under 16 h photoperiod with photosynthetic photon flux density of 40µ mol m^{-2} s^{-1} fluorescent lamps. The leaf, stem and roots of i*n vitro* germinated plants were used as a source of explant. The explants were transferred to MS medium supplemented with growth regulators 2-4, D alone or in combination with 2-iP. No prior treatments to explants were given because the seeds were allowed to germinate in aseptic conditions. The results indicated that best callus induction and proliferation was observed in MS medium supplemented with 2-4,D + 2-iP (9.06+7.38µM). The callus was then transferred to shoot regeneration medium containing MS medium supplemented with different growth regulators. The results indicated that best shoot regeneration was achieved in MS medium supplemented with BA + GA_3 (13.2+1.0, 17.6 + 1.0 µM). The cultures were maintained in culture room conditions. The cotyledonary nodes of *in vitro* germinated seeds were also used

as source of explant for direct shoot regeneration. The nodal explants were transferred to MS medium containing different growth regulators. Best shoot regeneration was achieved in MS medium supplemented with Kinetin+GA_3 (4.6 +1.0 µM). The *in vitro* raised shoots 3-5cm in height obtained from callus and nodal explants were transferred to MS medium supplemented with different growth regulators for root induction. Best response was observed in MS medium supplemented with IBA (4.9 µM). Half strength MS medium was more effective in root induction as compared to full strength MS medium. The *in vitro* regenerated plant was transferred to earthen pots containing a mixture of soil and sand (3:1) for hardening.

In this way after the laborious work of about 4 years the *invitro* raised and subsequently hardened plant was developed and was ready for *ex situ* establishment.

Integrated Approach For Sustainable Water Resources Development Planning of Asan River In Western Doon Valley Using Remote Sensing and GIS Techniques

IP Pandey
Oil Extraction, Environmental & Disaster Management Lab.,
Department of Chemistry,
D.A.V. (P.G.) College, Dehradun
E-mail:- ippande@gmail.com

This study was undertaken with the prime objectives of developing a mathematical model which connects the observed hydro-metrological data with the data obtained from satellite images and to analyze the water quality parameters for pollution purposes in the western part of Doon valley between 77°38′ E and 78°6′E longitude and 30°14′N and 30°31′N latitudes (area of approximately 1400 km^2) where Asan river flows north-westwards and joins the Yamuna river. Asan river watershed drains part of Doon Valley into Yamuna river. Eco-development of this valley has assumed Significance in view of increasing human pressure in the form of hill-terrace cultivation, deforestation, mining activities, tourism and human settlements etc. To meet the requirements of increasing population and to achieve sustainable development for water resource development and management this work was undertaken considering hydro-geomorphological, drainage, surface water body, land-use/landcover maps and topographic features.

The overall study period was divided into three seasons mainly winter (Nov. – Feb.), summer (Mar. – Jun) and monsoon (July – Oct.). Water samples were collected at regular intervals from three sites and analyzed for various physico-chemical parameters.

In the wake of increasing urbanization and industrialization, the pollution potential of river is gaining very-very less. The survey of river revealed that villages and towns which are situated in the way of river do not dump much waste water and toxic waste in the river. Due to this there is not much pollution in the river and so the river water is potable and is posing no threats to the survival of aquatic flora and fauna.

Investigation of Terpenoid Composition and Antimicrobial Activity of Some Medicinal and Aromatic Plants of Family Lamiaceae

Anand B. Melkani
Chemistry Department
DSB Campus, Kumaun University
Nainital
E-mail:- melkanib@rediffmail.com

The plant material of the various genera covered under this project were collected from both the Garhwal and the Kumaon regions ranging from 1,300 m to 3,500 m elevation. The whole aerial parts of the plant were used for the extraction of oil.The plants studied were ***Salvia leucantha,Salvia nubicola,Salvia hians,Salvia mukerjeei ,Salvia cocciana, Scutellaria scandens,Scutellaria grossa, Scutellaria repens ,Teucrium royleanum*** and ***Teucrium quadrifarium*** Salient Research Achievements:

All the ten plants species have been investigated for their essential oil composition and antimicrobial activity. Except *Salvia leucantha*, all other species were taken up for the first time for such study and will deliver first ever report in phytochemical literature.

Salvia leucantha Cav: Total 48 compounds were identified. β-Caryophyllene 13.9%, α-guaiene 12.6%cis-muurola-3,5-diene 10.8%, bicyclogermacrene 8.7%, bornyl acetate 23.9% and germacrene D 13.8% were the principal constituents of the oil.

Salvia nubicola Wall ex Sweet: Total 64 components were identified and germacrene D was found to be the main constituent (45.2%).

Salvia hians Royle ex Benth.: Total 62 components were identified.The main constituents were β-bourbonene 4.2%, germacrene D 5.5%, caryophyllene acetate 9.7%, 7-epi-α-eudesmol 5.1%, cubenol 6.1%, γ-cadinene 10.9% and δ-cadinene 9.2% of the oil.

Salvia mukerjeei Benet & Raizada: Seventy one compounds were identified in the essential oil; β-phellandrene 5.0%, γ-muurolene 15.5%, dehydro aromadendrene 9.5%, α-guaiene 5.4% and β-caryophyllene 28.7% were the principal constituents.

Salvia cocciana Juss ex Murr.: Fifty three compounds were identified. The main constituents were β-caryophyllene 4.2%, palmitic acid 5.9%, ageratochromene 5.6% and germacrene D 9.7%.

Scutellaria scandens D. Don: Total 34 components were identified including β-caryophyllene 27.7%, α-amorphene 6.5%, cubebol 4.8% and germacrene D 19.0%.

Scutellaria grossa Wall ex Benth.: Total 52 components were identified. The principal constituents were identified to be 3-octanol 6.2%, linalool 37.0% and 1-octen-3-ol 32.0%.

Scutellaria repens Batch-Ham. Ex D. Don: Total 46 compounds were identified in its essential oil. β-Funebrene 15.0%, β-gurjunene 8.0%, aromadendrene 30.7%, β-acoradiene 4.1% and α-neo-clovene 5.0% were found to be the major constituents.

Teucrium royleanum and ***Teucrium quadrifarium*** : Fifty eight compounds were identified in the oil samples from both the plants. Interestingly, both the samples showed remarkable similarity in their terpenoid profile. The major components in both the samples were identified to be germacrene D (28.9 & 9.4%), β-caryophyllene (23.6 & 38.5%), linalool (4.8 & 1.5%) and 1-octen-3-ol (8.5 & 0.7%) of the oil.

The antimicrobial screening of the oil samples was conducted at 1000µL/mL concentration. The minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values were determined at five different concentrations prepared by serial dilution method (500µL/mL to 31.25µL/mL). Six oil samples demonstrated higher level and broad spectrum antibacterial activity comparable to standard antibiotics used as positive control.

The zone of inhibition (ZOI) shown by the oil samples is either higher or comparable to the standard antibiotics and the minimum inhibitory concentration (MIC) was found to be as low as 31.25 µL/mL. The results indicate that the oil extract from the six species should be quite effective to control the growth of five pathogens. Similarly, the oil samples of *Salvia* and *Scutellaria* species were found very effective to inhibit the growth of certain fungi.

Management of fungal deterioration of medicinal plant produce in storage by the use of botanical fungitoxicants

N.S.K Harsh,
Forest Pathology Division,
F.R.I, Dehradun
E-mail:- harshnsk@icfre.org

Withania somnifera

Stevia rebaudiana

Samples of medicinal plant produce were collected from different depots i.e. Ramnagar, Kathgodam, Saharanpur, Rishikesh and Mandal (Gopeshwar) depots. The storage conditions were inappropriate. Five medicinal plant produce have been selected for further studies - *Carum carvi* (seeds), *Cinnamomum verum* (bark), *Piper longum* (fruits), *Stevia rebaudiana* (leaves) and *Withania somnifera* (roots).

Seventeen fungi have been isolated and identified from the five selected medicinal plant produce viz. *Aspergillus flavus, A. fumigatus, A. niger, A. terricola, Botrytis cinerea, Rhizopus nigricans, Penicillium restrictum, Geotrichum* sp., *Penicillium frequentens*, , *P. implicatum, P. restrictum, Phymatotrihum* sp., *Rhizopus nigricans, Trichoderma harzianum, T. koningii and Thielaviopsis bassicola*. These are not reported earlier from these medicinal plant produce in storage.

Extracts from various plants like *Ocimum sanctum, Cinnamomum camphora, Trachyspermum copticum, Eucalyptus citriodora, Mentha arvensis*, *Ferula assafoetida* and aromatic oils (citronella, eucalyptus, geranium, garlic, peppermint and lemongrass), were tested by poison food technique and filter disc method for their antifungal activity. Except eucalyptus oil and garlic oil, all oils gave 100 per cent inhibition of growth for all the nine test fungi in filter disc method. Eucalyptus oil was not effective in inhibiting the growth of *Aspergillus flavus,Phymatotrichum* sp. and *Thielaviopsis* sp. whereas it inhibited the growth of other fungi. Garlic oil was effective against all fungi except *Aspergillus flavus*.

In volatile effect method in plates all oils were found to be effective. Lemongrass, garlic and peppermint oils gave best results as they completely inhibited the growth of all nine test fungi followed by eucalyptus oil which was less effective against *A. flavus*.Geranium oil was least effective as it inhibited the growth of only four fungi.

In volatile effect method in flasks garlic and peppermint oils were found most effective in inhibiting the growth of all test fungi, whereas geranium oil was least effective as it inhibited growth of only six test fungi. Volatile effect of these oils was also tested on spore germination inhibition in which all oils inhibited 100 per cent germination of conidia of all nine test fungi.

Four oils were tested for their fungitoxicity through volatile effect to reduce population of test fungi in storage conditions. The storage fungi were significantly reduced in treated conditions as compared to control, however, the volatile effect to control fungi diminished with time (2 months) and need to be added again. Combination of oils also found very effective in controlling the storage fungi except eucalyptus oil with citronella and lemon grass oil.

Key findings: The results of effect of aromatic oils on different stored products are summarized below:

1. ***Withania somnifera*** **roots**
   - All oils were found effective against *Aspergillus flavus* and *Trichoderma harzianum.*
   - Eucalyptus oil and lemongrass oils were active against all fungi except *Rhizopus nigricans.*
   - Except citronella oil all oils were effective against *Aspergillus niger* and *Penicillium restrictum*
2. ***Carum carvi*** **seeds**
   - All oils were effective against *Rhizopus nigricans*, *Penicillium frequentens* and *Trichoderma harzianum.*
   - Citronella oil, geranium oil and eucalyptus oil were effective against all fungi except *Aspergillus niger*.
   - Geranium oil was not effective against *Penicillium restrictum*.
   - Lemongrass oil was effective against all fungi.
3. ***S. reabaudiana*** **leaves**
   - Only eucalyptus oil was effective against *Aspergillus flavus*, *Rhizopus nigricans* and *Penicillium restrictum.*
4. ***Piper longum*** **fruits**
   - All oils were effective and controlled all fungi.
5. ***Cinnamomum verum*** **bark**
   - All oils inhibited *Aspergillus flavus*, Eucalyptus oil inhibited all fungi except *Rhizopus nigricans.*

Trends

1. Some fungi appear late during storage.
2. Volatile effect of oils decline with time.
3. After second application of oils most fungi were inhibited.
4. Some fungi diminish/ disappear after treatments (1-2 months).
5. Different products behaved in varying manner against test oils.
6. *Alternaria alternata* was not found during storage of medicinal plant products.
7. Aromatic oils in combination gave effective control against most fungiu during storage.
8. Some aromatic oils in combination were not effective in inhibiting fungal population in stored medicinal plant produce such as citronella and eucalyptus and lemongrass and eucalyptus oils though individually they were effective.

Unique outcome

Present study comes out with useful findings for the protection of stored medicinal plants/ produce from the fungal infestation. The antifungal activity of aromatic oils in vapour phase

can be used as fumigant for the control of fungal infestation in the stored medicinal plant produce. The aromatic oils tested in the present study were found to have varying effects on different produce. Their bioactivity in vapor phase makes them an attractive prospect as possible fumigant for the protection of stored medicinal plants/ products.

The present study strongly recommends the use of volatile effects of aromatic oils in stored medicinal plant/ produce for their protection from storage fungi.Such findings have not been reported elsewhere and hence new breakthrough in science.

Mangement of Chukar partridge A*lectoris chukar* in Garhwal Himalaya: Distribution, status, ecology and behaviour

M. S. Bisht
Department of Zoology
H. N. B. Garhwal University Campus
Pauri – 246 001
E-mail:- bisht_msgwl@rediffmail.com

In survey conducted in District Pauri Garhwal of Uttarakhand, Chukar partridge *A. chukar* was sighted in 16 localities or sites in 41 visits covering an area of 33.10 km^2 at Ranshi, Lwali, Khandusain, Parsundakhal, Maitakund, Kanskhet, Sakinkhet, Baganikhal, Bheti, Taklana, Uphalda, Agrora, Thapli, Naugoan, Satyakhal and Badiyargarh with overall average 7.78±2.07 individuals/sighting and 5.31±0.86 birds/$km^{2,}$.

Maximum number of birds (more than one dozen in single sighting) was observed at Bheti, whereas minimum number (2 pairs/sighting) was recorded at Kanskhet, Sakinkhet and Satyakhal area. Chukars were observed in groups of 2 to 14 birds with an average group size of 5.77±0.89.

The partridges were sighted in the altitude range of 720 to 1940m. asl and were observed to prefer south-east facing slopes with open forests (mainly Chir pine or mixed pine forests comprising of *Pinusroxburghii*, dense to open shrub (*Rhus* sp., *Rubus* sp.,*Berberis* sp. and *Rumex* sp.) and crops field.

The monthly records on population and group size revealed a seasonal pattern. The monthly average number of birds recorded per sighting ranged from 1.85±0.08 (April) to 8.37±0.76 (November). Mean group size was recorded 4.02±0.54, ranged between 1.50±0.27 (March) to 7.59±0.65 (September). Less number of birds in the population and group as recorded from February to May (spring and summer seasons). During post monsoon and winter season (September to December), high number of individuals and relatively large groups size were seen due to merging of small coveys with newly hatched.

Chukars were observed using all types of habitats: forest, scrub, grassland, crop fields and rocks or stony areas during the year round. Of the total 315 sightings recorded throughout the year, scrub and crop fields were preferred habitats, where more than 30% sightings were recorded. The forest habitat with 8.41±0.87% sightings was the least preferred. Seasonal variation was also observed in the percent sighting of Chukar partridge in different habitats. During the spring, sightings (6.62±0.70%) in forest habitat were low but were maximum (30.97±3.71%) in scrub habitat was recorded. During breeding season May-June, minimum sightings (<10%) were recorded in forest and grassland habitats. During the monsoon and post monsoon season (July to October), maximum sightings (37.46±4.59%) were observed in scrub habitat. In the winter season, the highest (45.77±7.54%) sightings were recorded in the crop fields. Over all the scrub and crop fields were the most used by Chukar partridge.

Records on the distance covered by Chukar partridges revealed that this population does not

show seasonal movements in the habitats studied as reported earlier that Chukar descends to low altitude during the winter. In our study area, birds were never observed descending beyond a range of 100 m.

In Chukar partridge, breeding was found starting from February - April when adult male and female segregate and form small groups or breeding pairs. During this time, the group size was recorded 1.87±0.45 which remains small throughout the summer (May - June). Again a large group size was observed during the monsoon season (July - October) when 7.04± 0.51 individuals were observed in a group. After pair formation, male Chukar partridge was found establishing its territory by giving characteristic *Khak khak khak,Khawk-khak, khawk-kak* calls which were quite different from general calls produced at every morning and evening.

During survey conducted for information on distribution and status in the month of April-May, 8 active nests were located. All nests were simple, build in a scrape on the ground or open crop fields, under stones or in mist of shrubs/grass. Records on the vegetation cover revealed that the forest cover, shrub cover and litter are not necessary for nesting because all these covers were less than 20%. Only grass cover near the nests was more than 50 percent. The nesting material included dry leaves of vegetations like dry grass, leaves of *Rhus, Cloris* and fine dry twigs of shrubs. Average diameter of the nests was measured 13.24 cm and depth 8.31cm.

A clutch size of 4 to 12 eggs were recorded. Eggs in all the nests were creamy white without any pigmented spots and had a size of eggs of the domestic hen Average length; width and volume of eggs were recorded 4.38 cm, 3.47 cm and 29.60 cm^3 respectively. A positive correlation was also observed between clutch size and nest dimension ($r = 0.75$, $p<0.01$) and clutch size and egg volume ($r = 0.83$, $p<0.005$).

Hatching observed during day hours at morning to evening, with 77.60 percent success (ranging between 62.50 to 91.60%).

Results of micro-analysis of faeces of Chukar partridge revealed its omnivorous habits, feed both plant and animal diet along with the grits. The plants part including food grains constituted a major portion of the faecal content (91.57±2.78%), which exhibited a seasonal variation with maximum value 91.57±2.78% during September and minimum value 84.66±6.43% of dry weight during April. In the non-vegetative matter, the arthropod content was recorded with overall value 9.361.46%. The fine organic matter (F.o.m) along with grits was recorded with over all value 2.84±1.17% of mean dry weight.

In the plant diet, fragments of leaves, flowers, fruits, seeds, roots, rhizomes etc of 24 plants belonging to 13 families (Anacardiaceae, Asteraceae, Berberidaceae, Cruciferae, Cyperaceae, Fabaceae, Malvaceae, Menispermaceae, Plumbaginaceae, Poaceae, Rosaceae Saxifragaceae, and Urticaceae) were identified. The family Poaceae was recorded dominant (33.33%) in vegetative diet composition of Chukar partridge, followed by Fabaceae (12.5%), Anacrdiaceae and Rosaceae (8.33%) while rest of families contributed 4.14%.

In the non-vegetative diet, fragments of the mandible, maxillae, antennae, wings, legs and elytra of Arthropods belonging to 8 Orders viz., Araneae, Diptera, Dissotera, Heteroptera, Hymenoptera, Isoptera, Lepidoptera and Zoraptera were indenified in the faecal contents.

Microbial Diversity Indicator of Pollution in Gangetic River System of Uttarakhand

Shivesh Sharma
Department of Microbiology
Sardar Bhagwan Singh (P. G.) Institute of Biomedical Sciences
and Research, Balawala, Dehradun (U. A.)
E-mail:- sharmashivesh@gmail.com

Microbial diversity, the richness of species in environmental site, provides huge reservoir of resources, which we can utilize for our benefit. However, little is known about the true diversity of bacterial life. Despite the acknowledged value of microorganisms, our understanding of their diversity and many of their key roles in sustaining life support systems is still very scarce. Ganges is the most important river of Uttarakhand, which flows through diverse geographical and ecological zones. The region is bestowed with uncharacterized microbial gene pool yet to be harnessed. Keeping this in mind, the study was aimed to examine the seasonal incidence of indicator organisms, physico-chemical properties for determining the water quality in Gangetic river system of Uttarakhand.

Intensive survey of the study area was done in the beginning to select different sites from entire stretch of river Ganga. The study area was divided first into Bhagirathi river system, Alaknanda river system and then further into 3 different stretches i.e. Upper, Middle and Lower stretch. Water samples were collected in sterile containers in triplicate from thirty two different selected sites in summer, rainy and winter seasons.

Summary of Bacterial diversity during different seasons and various stretches of Gangetic river system

Isolate	ALAKNANDA				BHAGIRATHI				Total A+B
	SUMMER	RAINY	WINTER	TOTAL (A)	SUMMER	RAINY	WINTER	TOTAL (B)	
E.coli	24	27	13	**64**	22	22	6	**50**	**114**
Streptococci	17	23	6	**46**	5	13	7	**25**	**71**
Enterobacter	21	16	20	**57**	14	5	7	**26**	**83**
Proteus	17	7	1	**25**	12	2	1	**15**	**40**
Pseudomonas	6	15	15	**36**	2	7	9	**18**	**54**
Bacillus	3	12	7	**22**	0	13	2	**15**	**37**
Citrobacter	2	11	7	**20**	2	8	2	**12**	**32**
Yersinia	1	10	4	**15**	1	2	7	**10**	**25**
Salmonella	2	5	-	**7**	3	4	1	**8**	**15**
Shigella	-	8	-	**8**	-	1	-	**1**	**9**
Staphylococcus	-	3	8	**11**	-	3	5	**8**	**19**
Alkaligenes	3	2	6	**11**	1	0	1	**2**	**13**
Serratia	-	4	3	**7**	-	1	-	**1**	**8**
Klebsiella	-	-	7	**7**	-	-	4	**4**	**11**
Characterized	96	143	97	**336**	62	81	52	**195**	**531**
Uncharacterized	32	55	70	**157**	18	46	47	**111**	**268**
Total isolates	128	198	167	**493**	80	127	99	**306**	**799**

Water samples were utilized for bacteriological water analysis including total viable count (TVC), total coliform (TC), faecal coliform (FC), faecal streptococci (FS) and FC/FS ratio. The study highlighted the presence of large reservoir of bacterial gene pool in this region**.** The study revealed the presence of bacterial indicators at various stretches of river Ganga. Apart from microbiological examination of water samples, physicochemical analysis was also performed which included pH, conductivity, temperature, dissolved oxygen, BOD and COD etc. In most of the physicochemical parameters water was found to be fit for drinking purpose. The isolated bacterial strains were characterized as per *Bergey's Manual of Systematic Bacteriology*. The study showed *E. coli* as the most dominant isolate followed by *Enterobacter*,*Streptococci, Pseudomonas* and *Proteus* whereas *Shigella* and *Serratia* were found to be the least dominant strains in all the water samples.

The results can be used as biomonitoring standard and also to monitor pollution, for environmental planning and the database generated can be further utilized for bioprospecting. In this regard, the priority of next phase of the work was to reveal the genetic diversity, ecological significance and phylogenetic affiliation of various bacterial communities in Gangetic river system.

Microzonation, Geotechnical Appraisal and Remedial Suggestions for Landslide Zones on Rishikesh-Neelkanth-Diuli Area of Pauri Garhwal District, Uttarakhand

A. K. Biyani
Department of Geology
DBS College, Dehradun
E-mail:- biyani_ajay@yahoo.com

Natural hazards in the Himalayan terrain are not uncommon due to its tectonic setting and immature topography. Among various hazards landslides, earthquakes, snow avalanches and cloudbursts are frequently ravaging the landscape and taking heavy tolls in terms of loss of life and property. In terms of frequency landslides occur much more than the others. Not only they disrupt the routine life but also put recurring burden on exchequer for restoration of damaged infrastructural facilities as well as source of constant risk to life without prior warning.

Location:-A study was undertaken in Rishikesh-Neelkanth area in Pauri Garhwal district to Uttarakhand, to investigate the problem of landslides on the foot track (11 km long from Swargasharam and 8 km from Mauni Baba ashram) as well as metalled road (34 km long from Virbhadra barrage) as both routes are used by millions of pilgrims in rainy peak season, incidentally time of maximum disaster risk disaster.

Geology:- The study area is geologically part of Garhwal Synform was made of mainly Proterozoic rocks and Cambrian and tertiary rocks. Most of the lithology is very strong or competent but due to highly fractured and folded nature of strata area is prone to all forms of paleo- and present (active) mass wasting processes.

Geotechnical lab: - A lab was established for determination of geotechnical properties of rocks by the UCOST funding comprising of rock coring machine, uniaxial compressive strength tester, and soil shear strength tester, sieve shaker for sediment grain size analysis, balance and related instruments.

Debris flow:- Investigations reveal that area is prone to landslides as well debris flow. The debris flow is a seasonal phenomenon which occurs at the time of heavy rainfall. Heavy rainfall thoroughly washes the mountain slopes of catchment area. The loose martial generated by weathering and erosion in dry period moves as slurry in time of heavy rains along the rivers, their tributaries or through the gullies. This slurry spreads on the road and blocks the traffic even for several hours after the rain and at times on the down slope habituated area the earth material damages the infrastructures. At least twenty sites have been identified where debris flow occur. In case of gullies, the debris quantity is less and fine but in case of rivers not only quantity of debris is large but size of debris material goes up to few cubic feet in volume with deep noise of clinkering. The preventive measures for debris is soil conservation and check on excavation in long term and in short term constructions of strong check dams, deep root tree

plantation, plantation of shrubs on the river and gully beds. Debris has economic utility in construction industries.

Both metalled road and foot track is highly landslide prone irrespective of lithology. Field investigations suggest that landsliding is not a phenomenon of recent time but also in past landslides did take place on massive scales, which now evidenced at several locations on both tracks. Different forms of landslides as described in classifications were noticed.

Palaeolandslides:- In case of palaeolandslides huge boulders of ~100 m length are strewn at Mauni Baba and between Pundrasu and Dhandlapani sections giving the evidences of toppling and usual sliding. Four boulders/ blocks of Kakara limestone appears to resting firmly on the slopes of Tamakhanisot but in case of reactivation may create havoc. Similarly near Mauni Baba numbers of paleoboulders are very large and their size varies between few m to ~50 m maximum. Since they are at lower slope where ground is moderately sloping, hence pose no apparent risk. But in case of Leh type cloud burst of 2010, mobility of these boulders can not be ruled out. The July 1991 cloud burst that occurred at four places in Neelkanth area perished large number of pilgrims and cattle suggest possibilities of cloud burst can not be ruled out in this region. The cloud burst is totally unexpected phenomenon and can occur anywhere.

Active landslides:- 33 landslides out of which 11 are major/problematic ones sites are recorded on metalled road section between Virbhadra barrage and Neelkanth. During study landslide was extended to Diuli village on the Duggada road as menace of landslide is very severe here. In fact a triangle is formed between Diuli-Neelkanth and Maun village having area of >15 sq km. In this triangle, weak and transported lithology in the form of sericite-chlorite-mica schist and phyllites are present. Closely spaced foliation, severe deformation, intense fracturing and water absorbing minerals in the rock make it weak. Other major landslides in this section occur at intervals. These slides have different width and are planar, wedge and rotational types.

On foot track, the largest landslide (2 km length by 30-70m wide) active zone concealed by thick forest cover exists between Mauni Baba ashram and Dhandlapani section. This section is made of highly crushed/fractured Subathu shale/phyllites. Besides this four small landslides are also present on the track which causes damage of different degree.

Causes of landslides: – large number of causes have been identified such as frequent change in lithology, juxtaposition of incompatible rocks, high degree of fracturing presence of two active thrust namely the Main Boundary Thrust and Amri Thrust, regional and small scale faulting, folding, crossing of faults, repeated jerking by earthquakes, location of the area in frontier part of the lesser Himalaya among geological one, favorable slope (30-50°), intense weathering and erosion, toe erosion by the Ganga and Hiuni river, percolation of water, seepage of rainwater due to improper outlet, heavy rainfall, cloud bursts, shaking of land due atmospheric thundering, presence of soluble rocks and heavy anthropogenic interference in the form of large scale civil construction, slope modification for commercial, agricultural, road widening, spread of agricultural field and habitat construction, deforestation, heavy vehicle movements, use of explosives, modifications in ground water regime etc. these identified causes are for all landslides. Only a set specific causes act at a specific place. Geotechnical Investigations- uniaxial compressive strength (UCS) was determined of multiple samples of all rock types, shear strength of the soil along with physical properties such as grain size, density, porosity etc were determined in the lab for stability analysis and 'factor of safety' calculations. The UCS value varies between0.032- 8.5 MPa.

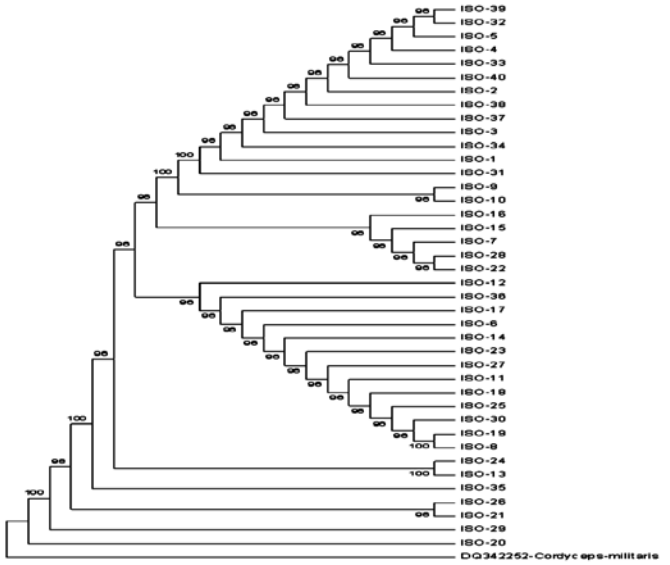
Molecular variability in *Cordyceps sinensis* isolates of Uttarakhand

Amit Pandey
Forest Pathology Division
Forest Research Institute, Dehradun
E-mail:- pandey.amit@yahoo.com

RAPD-PCR was conducted with isolates of *Cordyceps sinensis* collected from different locations in Uttarakhand for studying the variability among the isolates. Total nine population lines were identified. Internal transctibed region of nrDNA (ITS regions) were amplified and sequenced for the authentic identification of the isolates of *Cordyceps sinensis*. BLAST search results affirmed their identity as *Cordyceps sinensis* (the new name is *Ophiocordyceps sinensis*).

Cordyceps sinensis

The sequenced ITS regions of rDNA were aligned and analysed for phylogenetic studies and correlations. The taxonomic position of isolates with reference to the earlier depositions including ATCC type specimen DNA fingerprint and other closely related taxa, made by different workers from different part of the world in the gene bank, a phylogenetic tree was constructed and demonstrated. The ITS regions were aligned for studying the variability between the isolates, however, due to the neutral mutations lack of specific trend in the dendrogram compelled us to go for multigenic study. For multigenic study, we amplified the beta tublin gene region using universal primers and the product was sequenced and aligned. The dendrogram thus constructed supported our RAPD results to a large extent and correlated with the geographical locations, though large variations were observed between the isolates of same location. For the first time beta tublin gene region of *Cordyceps sinensis* bas been sequenced, studied and deposited in gene bank. This will help the researchers in the authentic identification of this species apart from ITS region of nrDNA. We designed forward and reverse species specific primers for the identification of *Cordyceps sinensis*. Though the primers passed the theoretical PCR test, at NCBI they failed to give the desired amplification during validation. After trying different combinations/factors we succeeded in validating the forward primer designed by us in combination with the universal ITS 4 reverse primer.



Phylogenetic tree obtained by Maximum Parsimony analysis of the ITS region

Monitoring of Malaco Faunal Diversity - An Investigation on Malacologic Schistosomiasis in Foot-hill Region of Garhwal

R.K. Jauhari
Parasitology Lab., Dept. of Zoology,
D.A.V.(P.G.) College,
Dehradun – 248 001
E-mail:- jauharirk@hotmail.com

Indoplanor bisexustus

Physa acuta

Melanoides tuberculata

The snail diversity revealed the occurrence of 23 species belonging to 8 different families, contributing 18 species from Haridwar, 16 from Dehradun and 13 from Kotdwar.

(i) *Melanoides nevilli, Physa acuta, Segmentina calatha*; *Bithynia pulchella* and *Gyraulus barrackporensis* are first record from Dehradun region.

(ii) *M. tuberculata, L. (P) luteola, L. acuminata* and *G. convexiusculus* are most commonly occurring snails.

(iii) *Radix acuminata,Indoplanorbis exustus* and *Melanoidestuberculata* were found infected with cercariae.

(iv) Four kinds of cercariae *viz*., Monostome, Amphistome,furcocercous and liver fluke/ xiphidio have been recorded.

(v) The cercarial infection during the winter season was recorded more than other season.

(vi) Aetiological factors responsible for development of furcocercous cercariae and their zoonotic significance included climatological factors (rainfall, temperature and humidity), physico-chemical and biological factors of snail's habitats (vegetation, zooplanktons, etc.). A survey work on the spread of cercarial dermatitis has been made and some cases of dermatitis have been found. The demography including social status and occupation of inhabitants of selected villages has been pin-pointed. Mostly, the occupation was confined to farming and business. The farming included livestock keeping, agriculture practices, fishing and washing clothes. This shows their direct contact to water. Hence the chances of spread of skin infection increase among the inhabitants. It is expected that occupation of the inhabitants of the study area is the main parameter, in particular their contact with the water. Further, their direct contact with the livestock could also be one of the means of spread of infection

Novel Antioxidants from Plants of family Lamiaceae growing in Uttarakhand region: Search for new Nutraceuticals

Om Prakash
Department of Chemistry
College of Basic Sciences and Humanities,
G. B. Pant University of Agriculture & Technology
Pantnagar – 263145 (Uttarakhand)
E-mail:- oporgchem@gmail.com


Mentha spicata


Perilla frutescens


Scutellaria scanidance

In this project plants of family Lamiaceae given in table were collected from different regions of Uttarakhand as per the first objective of the project. The collected plants were identified and authenticated with help of plant taxonomist at Department of Biological Sciences, College of Basic Sciences and Humanities, G.B.,Pant, University of Agriculture and Technology, Pantnagar. The specimen of the plants were deposited at Department of Biological Sciences, GBPUAT, Pantnagar for future references.z

As per approved objectives the essential oils of the fresh collected plants were isolated by both hydrodistillstion and steam distillation processes. The isolated oils were analyzed by modern chromatographic (GC) methods viz; gas chromatography and gas chromatography-mass spectrometry (GC/MS) methods. During GC and GC/MS analysis we could found some new chemotypes and variation of constituents in essential oil composition of the plants undertaken in present investigation which may be possibly due to changes in edaphic, climatic or altitudinal conditions. Detailed plant wise report on chemical composition of essential oils from each plant is being given in this report. Major compounds from some of the essential oils (*T. quadrefarum*) were isolated using column chromatography and the structures of isolated compounds were elucidated with the help of spectroscopic methods viz; mass spectrometry, Infrared spectroscopy and Nuclear magnetic resonance spectroscopic techniques using ^{1}H-NMR and ^{13}C-NMR spectroscopy. In order to study in vitro anti oxidant activity of the extracts the air dried material of the collected plants were subjected to cold percolation in methanol: water (70:30). All the extracts were studied for their antioxidant activities and total phenolic contents. During the antioxidant assay of the extract it was observed that some of the extracts have very good antioxidant potential in comparison to the standard antioxidants

butylated hydroxyl toluene, catechin and gallic acid. All the essential oils were studied for their in vitro antioxidant activity by using reducing power assay, chelating activity on Fe^{2+} ions and 2,2-diphenylpicrylhydrazyl free radical scavenging activity. The essential oils showed good to maderate activity however some of the oils were found to be very good in their antioxidant activity. The detailed plant wise report is being provided as under.

In order to assess the toxicological evaluation of essential oils and extracts lethality of some of the plants were determined by oral administration of 40, 60 and 80% oil, and extracts no behavioral or physiological change was observed for 24 hr and on subsequent day. None of the treated mice died all reflexes (pedal and corneal) and rectal temperature as well heart, respiration rates were within normal physiological limits in the extract treated mice. More time is required since these have to be evaluated in college of veterinary sciences under the guidance of ethical committee and the sanctions for which are granted periodically. These studies are in progress and will be reported when the observations are complete.

S.No	Plant's name	Collection sites	% yield of essential oil
1.	*Mentha longifolia*	Joshimath, Chamoli	0.57 and 0.58 %
2.	*Perilla frutescens*	Pantnagar, Almora, Bharsar, Ranibagh (Nainital), Chaurlekh (Nainital), Birar (Almora)	0.16, 0.61, 0.17, 0.15, 0.32 and 0.34% respectively
3.	*Micromeria biflora*	Dogaon (Nainital)	0.5%
4.	*Teucrium quadrifarum*	Bhowali and Patwadanger (Nainital)	0.28%
5.	*Mentha spicata*	Khatima, Rishikesh, Almora, Tanakpur, Kashipur, Nainital, Champawat, Pithoragarh, Haldwani, Harinagar	0.57, 0.61, 0.59, 0.71, 0.81, 0.89, 0.67, 0.77, 0.84 and 1.0% respectively
6.	*Origanum vulgare*	Bhowali,Harinagar-Bhirapani, Gopeshwar(Chamoli), Joshimath(Chamoli) Milam(Khati)	0.48, 1.0,0.20 0.45 and 0.48% respectively
7.	*Scutellaria repens* and *Scutellaria scanidance*	Bhimtal,Nainital	0.23% and 0. 35%
8.	*Mentha aquatica*	Bhimtal	0.63%
9.	*Thymus linearis*	Saharaphatak (Almora), Dhanachuli (Nainital),	0.7% and 0.8%

During the study chemical make up of essential oils of plants undertaken for the current study have been investigated and their in vitro antioxidant activities have been determined. However the antioxidant activity and pharmacological activities of the individual components are yet to be determined. Such studies will be of immense importance for future drug discovery programmes and are of commercial utility for development of new flavor constituents and their neutraceutical insignificance.

During present work, expertise has been developed in micro scale extraction and separation of constituents. The expertise has also been developed in elucidation of structural data of compounds by Mass spectral and NMR studies. Collaboration links with Department of Pharmacology has also been developed for determination of Pharmacology activity of the natural products. The main achievement of the project was to develop skill of analysis among the post graduate students who were involved to take up small project for their M.Sc. dissertations they were also provided hand on training on GC and HPLC.

Nutraceuticals: future prospective of the wild edible fruits of garhwal himalya

Sarla Saklani
Dept.of Pharmaceutical Sciences,
HNBGU Srinagar Garhwal
E-mail:- pharmachemhnbgu@gmail.com

Nutritional composition of some lesser known crops and wild edible fruits used by the ethnic communities and local folks of Garhwal Himalaya

Man needs an appreciable amount of nutrients in his diets to perform various body functions and to lead a healthy life. The nutrients include protein, fat, carbohydrates, fiber, vitamins, and minerals. An average Indian of 60 kg body weight, doing moderate physical and mental work requires 60 gms protein, 20 gm fat, 28 mg iron, 40 mg vit. C, 2875 k cal energy etc. in the daily diet. The dietary habits of the ethnic comminutes in different regions are usually determined by the availability of local foods, and satisfaction of hunger is the primary goal of their food intake. They may not be nutrition specific in most occasions. The Garhwal region of Uttarakhand is highly enriched with its vegetation including lesser known crops and wild edible fruits due to its varied eco- geographical and eco-climatic conditions. These crops and fruits are consumed by local inhabitants to play a significant role as supplementary food. They are especially beneficial to such areas where there is a limited availability and variety of marketed fruits and grains. The wild fruits and lesser known crops cover a wide range of taste, flavors, and colors ripening season and are free from pesticides, insecticides, fertilizers and other poisons. Such wild fruits are ingredients, which are gathered, grown or produced locally and prepared into dishes, which often represent local specialties**.** Generally watered by rainfall only, according to natural seasonal cycle, grow within specific climatic zone and having natural adaptation/habitat. Wild fruits are harvested from the forest. The plants are safe and ready to produced fruits for next year and we get highly nutritive fruits without any environmental loss. This renewable resource of raw

Wild Edible Fruits of Garhwal Himalaya

materials is ecofriendly processes and may bring economic prosperity to the local inhabitants. Local inhabitants largely depend on these edible fruits for their food and other livelihood. Although they extract wild edible fruits from the forests, a portion of the wild fruits in excess of their requirements, huge quantities are usually wasted and remained uncollected. This is mainly because of the fact that their availability and potential as a subsidiary food sources is partially unknown to the other villagers as well as urban communities. The study of such fruits can also be used to enhance genetically the existing popular crops and cultivated fruit species to develop new varieties for commercial distribution. Such fruits have the potential to play an important role as nutraceuticals in healthy diet and may contribute to the prevention and treatment of diseases. Since the food and phyto-resources are shrinking globally with the hike in population, it is the need of the hour to find new alternatives for enriching the resource base of our food basket. So there is a pressing need for investigating these resources and documenting their nutritional properties, palatability and overall acceptability, indigenous methods of harvesting and preparation.

Information available on concerned edible fruits as well as therapeutic property data on their nutritional composition is negligible. Therefore, the present study is aimed at the estimation of nutritional value of lesser known crops and wild edible fruits along with their collection, identification, recording vernacular names, and documenting their distribution and availability in the study area.

There is wide variation in vegetation of Garhwal Himalaya due to different altitude and habitat conditions corresponding to climate and topography of the region. Based on the folklore, and literature survey a list of important lesser known crops and wild edible fruits of the region. In view of potential utility, some hitherto unexplored genera, used frequently by local inhabitants were selected for their biochemical and chemical analysis

The present study is divided into the following four categories. The first one-wild edible fruits, second- spices, third-pulces and the fourth one- grains. Selected plants of concerned species were kept under regular observation and fruits or crops had been collected for the investigation of nutrient composition.

Out of 90 wild edible fruits reported from the forest of Garhwal Himalaya, ten (10) fruits based on their individual popularity and desirability were analyzed for their nutritional value. 100 gm of fresh fruits were taken for analysis and compared with daily intake of different nutrients by the adults, again compared with nutrients present in the cultivated fruits.

Population status assessment and screening of active constituents in the selected medicinal plants of Uttarakhand Himalaya

ID Bhatt
GB Pant Institute of Himalayan Environment
and Development, Kosi- Katarmal,
Almora, 263 643, Uttarakhand
E-mail:- id_bhatt@yahoo.com

Himalaya is well known for richness and uniqueness of medicinal plants. A great number of these plants are in use of various systems of medicine, like Ayurveda, Siddha and Unani, etc. Of the total 1748 species reported form the region, 700 species are being used by pharmaceutical companies in India in which the Himalayan medicinal plants contribute almost 50%, 350 species. However, poor scientific objectivity in available information of medicinal plants of the region has been stated as one of the major impediments in defining conservation priorities and ensuring sustainable utilization of the group. Among other issues of research, screening of medicinal plants for active constituents and evaluating the antioxidant activity deserve priority attention keeping in view the increasing demand of herbal medicine in different system of medicine. Keeping this background in view, two Himalayan medicinal plants, *Hedychium spicatum* and *Roscoea procera* were selected for the detailed investigation. The project aimed to (i) assess the range of variation (quantitative / qualitative) in active ingredients of selected medicinal plants, (ii) optimize the suitable phenophase and best harvesting time in the selected species for optimum production of active ingredients, (iii) evaluate the potential source of natural antioxidant through the identification of antioxidant activity in extract / isolated compound by certain bioassay methods, and (iv) maintain the accessions of target species collected from different location in ex-situ gene bank. The salient achievements of the project are as follows:

- Towards screening the phenolics and flavonoids content among different population of target species, plant material were collected from 16 different populations of Uttarakhand Himalaya. Results reveals that total phenolic and flavonoids content significantly ($p<0.01$) *v*aried among the populations and ranged between 2.81 to 4.75 mg gallic acid equivalent/g dry weight in *H. spicatum* and 2.11 mg to 3.58 mg GAE/g dw in *R. procera.*While developing relationship between phenolics/flavonoid and altitude, a significant positive relationship ($p<0.05$) in *H. spicatum* with altitude was observed while the same was not found in *R. procera*.

- Essential oil yield in *H. spicatum* varied among the populations and ranged from 0.15% (Chinapeak) to 1.36% (Kalika). Across the altitude, no significant relationship between essential oil yield and altitude was observed.

- GC-MS analysis of essential oil obtained from different rhizome of *H. spicatum* revealed that 1,8-cineole was obtained as a major component (33.32%) followed by β-eudesmol (22.17 %). Other major compounds present in the essential oil of the species were elemol, linalool, bornyl acetate, terpineol, γ-epoxy alememe, 10-epi-γ-eudesmol, ρ-menth-1-en-8-ol, β-pinene.

- Antioxidant activity measured by three different in vitro assay namely ABTS, DPPH and FRAP assay revealed a significant variation ($p<0.01$) among populations of both the species. In both the species, antioxidant activity showed significant positive relationship ($p<0.01$) with total phenolic content.

- In order to optimize the suitable phenophase for harvesting, flowering stage of *H. spicatum* was found best for higher essential oil yield (0.82%), whereas, antioxidant phytochemicals such as total phenolic content, total flavonoids content, gallic acid, catechin, hydroxyl-benzoic acid, and ρ-coumaric acid were found best in fruiting stage of *H. spicatum*. In case of *R. procera*, senescence stage was found best for total phenolic content, total flavonoids content, gallic acid, catechin and ρ-coumaric acid. Similar results were obtained for antioxidant activity of both the species.

- Towards strengthening the genebank of both the species, propagules collected from different populations were planted in herbal garden (Suryakunj). At the end of project, 34 accessions of *H. spicatum* and 22 accessions of *R. procera* were planted and maintained.

Details of accessions collected from different districts and planted in herbal garden of the institute.

S.N.	District	*Hedychiumspicatum*	*Roscoeaprocera*
1	Almora	8	11
2	Bageshwar	2	-
3	Chamoli	3	1
4	Champawat	1	3
5	Dehradun	4	2
6	Nainital	6	5
7	Pauri Garhwal	1	-
8	Pithoragarh	3	1
9	Rudrapryag	2	2
10	Tehri	3	3
	Total	**33**	**28**

Finally it is concluded that the rhizomes of both the species demonstrate potential antioxidant activity. This study suggests that isolation of bioactive compounds and their impact on various health improvement/control of free radical mediated diseases through *in vivo* studies is needed. As these species are used largely on the different ayurvedic medicine and also consumed traditionally in various forms of food, the potential for health or medicinal foods can be promoted. The large variation in total phenolics and flavonoids content among populations recommends mass propagation of plants collected from elite populations. In *H. spicatum*, plants obtained from higher altitudes are the best source of phenolic compounds, domestication of the species at around 2100 m asl in the region can be recommended. Similarly, for harvesting the plants for maximum phenolic content, flowering stage for *H. spicatum* and senescence stage for *R. procera* is recommended. The information generated in this study would enrich the existing information base on antioxidant activities of Himalayan medicinal plants.

Predator-People conflict in the mountainous landscapes of the Alaknanda valley in Garhwal Himalaya

S. Dasgupta
Assistant Professor, Ecology & Environment
Department of Forestry
HNBGarhwalUniversity
Srinagar (Garhwal) Uttarakhand
E-mail:- sabya_job@yahoo.com

The work was initiated in the month of mid march 2009. The total 76 villages falling under 15 blocks were surveyed. Out of these villages in 45 villages, human wildlife conflict cases were recorded. About 49% of the livestock killed in the forest during noon time in between 11 AM to 3 PM. whereas second highest 26% livestock are killed in the night time. These night killings mostly occurred inside the cattle shed. The reason for maximum killing of Cows and Goats were probably cattle grazing in the forest without any herder. Owner usually bring them back to homes at late evening.

Crop raiding by wild boar was reported a common problem in almost 23% of the family. In most cases maize, rice and pulses were raided by wild boar. These croplands are unintentionally providing high quality food for animals. Out of the total crop raiding problem 87% of the respondent's opinion that the problem of crop damage is increase day by day.The reason for maximum killing of goats is that most of the people leave their livestock for grazing in the forest without any herder and people bring them back to homes at late evening so there was no herder with the goats and thus they proved to be the easier prey for the leopard.In the maximum cases of livestock death, killings of the livestock occurred inside the forest. Some dogs (30) are also killed within home boundary in some villages.The hundred percent documented kill sites occurred in gentle terrain. Hilly areas with gentle terrain and bushes seems to be the most preferred areas for kill.

Almost 62.5% of kill sites were having bushes. Whiles human trails are present in about 59.4 % of the kill sites and grass cutting, lopping etc. were present in about 34.4 % locations of kill/ attack. The only one case of human injury by leopard near river bank was recorded in the recent past.

Key findings.

- More than 50 % of the cases were in open areas without any canopy cover.
- Kill sites distance from nearest water body (river) pecked at around 0.5 km and 1.0 km.
- About 32.3 % kill sites were well within the village whereas rests of the kill sites were spread almost uniformly over than 1 km range around the village.

- Most of the cases were having moderately dense bush (35.5%). About 58.1% of the kill sites were having human trails, whereas 84% of the kill sites showed presence of cattle dung.
- Grazing & grass cutting was present in 22.6% & 35.5% kill sites respectively.
- Lopping was observed in about 36% Kill sites.
- Fire, indirect signs of Facal material of leopard were present only in 3-4 % of the cases.
- Pugmark & Scratch mark of Leopard were present in 10% of the Cases.
- As a whole no significant correlation could be attributed between kill sites and associated attributes. Opportunistic encounter between prey and predator may be the case in many incidences. However, this requires verification through further study.

Cow and Goat were the common prey of leopard in the study area. In total 203 livestock were killed by the leopard during the last 5 years. This includes 46% cow and 30% goat. The estimated loss of property in the surveyed population for the aforesaid time period was about Rs. 9,01,200.

Types of livestock Killed							
Livestock Killed	**Cow**	**Goat**	**Dog**	**Ox**	**Horse**	**Buffaloes**	**Mule**
No of Livestock	94	62	30	8	4	3	2
Estimated Cost/ind.	4906.38± 2137.67	3137.09± 660.16	NA	3185.5± 1099.92	22000± 3559.03	15666.67±577.35	42500± 3535.53

Compensating for livestock depredation is one of the most common mitigation measures but his process can be complex and bureaucratic, long time delays between the claim and the reimbursements are a common feature. Compensations are paid as a result the claimants have to wait for an entire year to receive the payments. The process of claiming compensation requires photographic proof, medical report (P.M Report) and also needs to be verified from the forest guard. It also involves considerable documentation work. These complex and bureaucratic processes discourage people from availing these schemes. Though results did not show any significance between the differences in attitudes of the people who are compensated against those who were not, improvement in the compensation scheme might help in reducing the impact of conflict and increasing the tolerance towards the animal in conflict.

Preparation, Synthesis and Study of Optical and Electrical Properties of Nanoparticles

Akhilesh Kumar
Department of Physics
Pt. L.M.S. Govt. P. G. College
Rishikesh-2249201
Uttarakhand
E-mail:- drakhilesh26@gmail.com

Objectives

1. To Prepare Nanoparticles of Various Semiconductors.
2. To Synthesize the prepared Nanoparticles by

(a) Absorption spectra in UV-Visible region

(b) Photoluminescence spectra in visible region

(c) XRD

(d) SEM

(e) TEM

(f) AFM

3. Study of Electrical Properties such as, Dielectric measurements at low and high temperature, Electroluminescence, photovoltaic effects, Photoconductivity, Intensity and Temperature dependence etc. of Various Nanoparticles.

4. Study of optical properties

Results

(a) Nanomaterials by soft chemical route method of CdS, ZnO, ZnS, ZnSe , CdSe and CdO of various size have been prepared.

(b) Nanomaterials have been synthesized by UV-Vis Spectrophotometer, XRD, SEM & TEMtechnique, Photoluminescence spectrophotometer (PL) and FTIR spectroscopy.

(c) Optical properties of above prepared nanomaterials have been studied.

(d) Electrical properties such as dielectric measurements (Impedance spectroscopy) from lowtemperature 143 to 473K measurements and high temperature measurements up to 12000 C in frequency range 50 Hz-1 MHz for above materials has been completed.

Pressure -Temperature-Fluid Evolution of Crystalline Rocks of Munsiari Formation & Vaikrita Group In Main Central Thrust Zone, Kumaun Himalaya

S.N. Lal
Geology Department
Kumaon University
Nainital
E-mail:- snlal2001@rediffmail.com

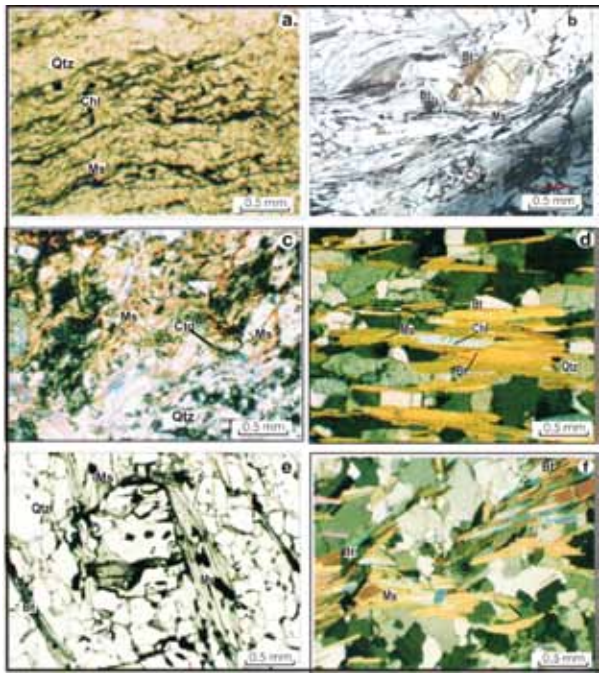
Loharkhet-Khati-Phurkia area

The area which is investigated is a part of Munsiari Formation and Vaikrita Group of Central crystallines of Kumaun Himalaya **(Latitude 30^0 4′-30^0 15′ N Longitude 79^0 54′-79^0 60′ E)**. The area falls under Bageshwar district of Uttarakhand. The area can be reached through a motorable road from Nainital via Almora and Bageshwar. From Loharkhet a briddle path leads to the Pindari Glacier, the source of Pindari river. The present transect lies in between the way. Our traverse was Loharkhet-Dhakuri-Chiltadevi-Wachham-Khati-Dwali-Phurkia.

Pelitic schists of the present transect display Barrovian sequence as follows:

Kyanite zone
---------- kyanite isograd----------
Staurolite zone
---------- Staurolite isograd----------
Almandine zone
----------Almandine isograd----------
Chlorite-biotite zone

In this investigated area, the rocks have suffered at least three episodes of deformation. Some representative microprobe analyses of various minerals has also been done.
P-T conditionsof metamorphism has been estimated using the models whose formulae are given below.



a. S_2 Schistosity defined by parallel orientation of flaky minerals. b.Microfolded biotite and muscovite within chlorite-mica schist. c.Microfolding showing folded flakes of muscovite and development of S_2 schistosity d. Chlorite occurs as an inclusion in association with muscovite and biotite. e. Biotite and muscovite lying oblique to the schistosity. f. Muscovite defines well developed S_2 schistosity.

Chlorite-Biotite Zone: 425±25° C,
Garnet Zone : 475±30° C/ 6.25±0.50 kbar
Staurolite Zone : 550±40° C/ 8.0±0.60 kbar.
Kyanite Zone : 650±25° C/ 8.2± 0.2 kbar.

Propagation and improvement of a therapeutically important orchid, *Dactylorhiza hatagirea*, using conventional and tissue culture approaches

Sushma Tamta
Associate Professor
Department of Biotechnology
Bhimtal Campus, K.U. Nainital (Uttarakhand)
E-mail:- sushma_tamta@yahoo.com

Tuber collected from alpine region

Initiation and flowering stage

D. hatagirea (D. Don) Soo, a high altitude terrestrial orchid occurs in temperate to alpine regions (2500–5000 m) in India, Pakistan and Nepal, and commonly known as 'Hatajari' in Uttarakhand and 'Salampanja' in Kashmir. It has been categorized as critically endangered, rare and listed under appendix II of CITES. The tubers of this species are known to yield a high quality 'Salep' which is extensively used in local medicine as nerve tonic, for its astringent and aphrodisiac properties, and is highly nutritive and useful in treating diarrhoea, dysentery and fever and also used as a sizing material in the silk industry. The decoction of the plant is administered during colic pain, tubers are used as expectorant and the extract of the tuber is also used to relieve hoarseness. As the annual consumption of the 'Salep' obtained from this species in India is about 7.38 tonnes (valued at about Rs 50 lakhs), most of it is imported from other countries.

Due to its high medicinal properties and endangered status, the present study was aimed to develop propagation protocols for its regeneration and conservation. In this project work, to know the status of the target species in the selected study sites, first of all a survey was conducted. A total of twenty four herb species were encountered across the study sites at Tungnath, Garhwal Himalaya by using random quadrate method and out of six study sites, only two sites showed the presence of *D. hatagirea.* Therefore we can say that it is dwindling from its natural habitat.

In the next step attempts were made to induce sprouting as well as flowering in this alpine species at lower elevation (1990 m) with the help of combined effect of plant growth regulators and alpine soil. Sprouting and flowering stages were induced at lower elevation with the help of combined effect of PGRs and alpine soil. Both alone were not able to induce flowering. Induction of flowering in *D. hatagirea* is a novel finding at lower altitude.

Attempts were made to develop *in vitro* propagation protocol by using different ex-plants of *D. hatagirea.* In *in vitro* experiments PLBs and plantlets were developed only when green pods were taken as explants.For green pod culture, 4 nutrient media i.e. KC, MS, VW and VJ were used with different growth additives. KC medium did not respond well after PLBs development. PLBs and further plantlets were developed only in MS medium. *In vitro* propagation of *D. hatagirea* is very slow, tedius and difficult.

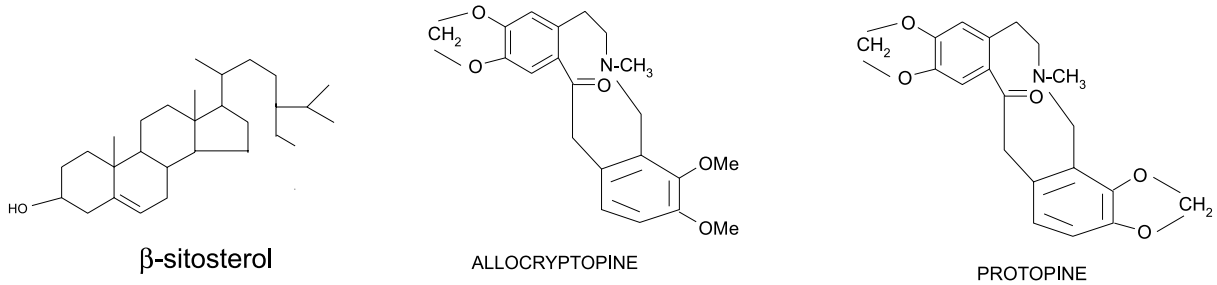
Propagation of *D. hatagirea* through vegetative means is not very much effective although some success has been achieved in generating plants via this method. More than 25% rooting was achieved in tuber cutting by applying IBA treatment but only in apical segments. *D. hatagirea* is an important medicinal terrestrial orchid, dwindling from its natural habitat. Findings of this study could serve as important clues towards the propagation and conservation of this endangered alpine orchid.

Prospecting for Utilization of Unexplored Ethno botanically Important Medicinal plants of Uttarakhand

V.K. Varshney
Chemistry Division
Forest Research Institute
(Indian Council of Forestry Research & Education), Dehradun
E-mail:- Varshney@yahoo.com

Dicentra pucinervia (Tubers)

Uttarakhand state with a forest cover of about 64.8% is bestowed with a number of medicinal plants. These plants occupy an important position in the socio-cultural and economical arena of the State. Their sustainable utilization can not only be of immense benefits to the local and national economies but also may offer a sustainable livelihood to majority of the marginal farmers of the State. There are several plant species in the State which have not been studied from their chemistry point of view and are considered important for development of plant based medicines because of their use by the local people in treatment of different ailments. In view of increasing demand of medicinal plants and their products in national and international market Uttarakhand, being the State of rich biodiversity, has a distinct place to supply the high quality raw material and products. The project was aimed at chemical examination of three medicinally important plant species - *Dicentra paucinervia, Pavetta indica* and *Scindapsus officinalis* to characterize their chemical constituents which may be responsible for their medicinal activity. These plants have been included in the CCRAS' s data base of medicinal plants used in Ayurveda. *Dicentra paucinervia* is a perennial herb and its tubers are used in treatment of different ailments.



Chemical constituents characterized in tubers of *Dicentra paucinervia*

Chemical examination of the tubers was carried out. The tubers were extracted with different solvents and fractionation of the so obtained extracts using column chromatography afforded three pure compounds which were identified as beta sitosterol, protopine and allocryptopine. Protopine and allocryptopine were characterized with the aid of different spectroscopic techniques while beta sitosterol was identified by comparison with the standard reference compound. These compounds have been identified for the first time in this species. HPTLC technique for quantitation of protopine and allocryptopine was also developed and applied

to estimate the contents of these compounds in the tubers of the plant naturally grown and cultivated. The quantity of both the components (protopine 0.50, 0.55%; allocryptopine 0.69, 0.70%) was found to be comparable. *Pavetta indica* is a perennial shrub and its leaves were examined for their chemical constituents. The leaves were extracted with different solvents and so obtained extracts were analyzed by column chromatography and six pure compounds were isolated. These were identified as D-mannitol, ursolic acid, alpha amyrin, para hydroxybenzoic acid, caffeic acid, Quercitin -3-O-galactoside by comparison with the standard reference compounds. Presence of D-mannitol, ursolic acid and Quercitin -3-O-galactoside in the leaves of *Pavetta indica* was not known earlier. D-mannitol is reported to be biologically active possessing compatibility with physiologically active substances. This compound also serves as a platform chemical to synthesize bioactive compounds. A non destructive harvesting approach to isolate D-mannitol from renewable source was shown. Earlier it has been reported from the roots of the plant. *Scindapsus officinalis* is a perennial climber and chemical examination of its leaves was carried out. The leaves were extracted with different solvents and the respective extracts were obtained. Column chromatography of these extracts afforded four pure compounds-beta sitosterol, quercetin, rutin and dihydrokaempferol and their identity was established by comparison with the standard reference compounds. Presence of one anthocyanin named cyanidin was also determined in the leaves. These compounds have been characterized for the first time in the leaves of *Scindapsus officinalis*. The work carried out in the project demonstrated that the chemical constituents identified in the target plant species may be responsible for the medicinal properties of these plants.

Racemization of Antifungal Agents Enantiomers Possessing Benzylic Proton at Physiological pH

Prashant Singh
Associate Professor,
Department, of Chemistry,
DAV(PG) College, Dehradun
E-mail:- prashantraj86@yahoo.com

It is well known that out of the two enantiomers of any drug, only one form [(+)- or (-)] is found to be optically active, where as the other form is either inactive or toxic. It has also been observed that enantiomeric forms of certain optically active compounds racemize in vitro and in vivo with different time intervals leading to toxicities and various side effects. A benzylic proton at the chiral center of the drug molecule is found to be at pH 7.4 (physiological pH) in phosphate buffer leading to racemization of enantiomeric forms. The use of such drugs may be injurious for health as the optically active enantiomers racemize leading to the decrease of their potency and serious side effects due to the production of other toxic enantiomer(s).

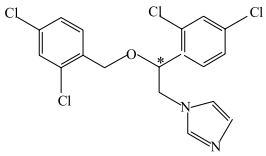
Moreover, the time taken by the drug for racemization is important parameter from usefulness of drug for curing any disease. If half life period of any drug is less, it will racemize in human body (at physiological pH 7.4) early and required quantity of drug will not be available for ailment for specified duration. In other words, the higher quantity of drug will be required for more number of days. This leads to excess expenditure on medical bill as well as side effects are also caused due to the formation of toxic enantiomer(s). Similarly, rate of racemization of any drug is another criteria which affects drug's efficacy for treatment. If rate of racemization is less, better is the drug. The drug being administered should not be converted into either inactive racemate or toxic form of enantiomer at a faster rate. Thus, the required quantity of drug will not be available for treating particular infections and patient will have to spent more money on additional dosage, which may also lead to side effects due to overdose as well.

In view of the above, it is not advisable to take such drugs without knowing their (i) mode of racemization (ii) time of racemization and (iii) rate of racemization. Therefore, it was thought worthwhile to explore the racemization process of optically active drugs in phosphate buffer of different pHs [especially at pH 7.4, which is a pH of blood] along with study of the racemization in human plasma. The four optically active imidazole antifungal drugs, possessing benzylic proton at chiral center labile at physiological pH namely isoconazole, miconazole, econazole and sulconazole have been selected for the proposed study. The percentage of racemization, time of racemization, half life ($t_{1/2}$) of enantiomer for conversion of these four antifungal drugs into racemic form and kinetics have been studied in human plasma.

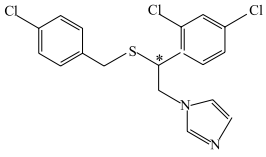
Structures of four Imidazole Antifungal Drugs Studied

In the present project, work presented comprises the racemization study of four chiral antifungal agents i.e. isoconazole, miconazole, econazole and sulconazole in phosphate buffer and human plasma at physiological pH using Solid Phase Extraction (SPE) and High Performance Liquid Chromatography (HPLC). The SPE method has been used for the sample preparation work

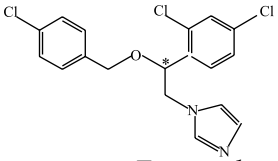
in phosphate buffer and human plasma. The results of the experimental work leading to the development of advanced methods of racemization study and their practical application for the above said four antifungal drugs in phosphate buffer and human plasma are reported in the project report. In addition to this, the relative importance of electron withdrawing functional groups on the lability of a chiral center, with a benzylic proton of these drugs, has been studied. Correlation coming from these studies could be used for predicting the appropriateness of a chiral synthetic method for these drugs. The outcome of the proposed work will be beneficial for formulating these drugs for public use.



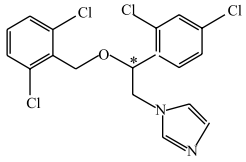
Miconazole



Sulconazole



Econazole



Isoconazole

Screening of *Tanacetum* species from Uttarakhand for their essential oil profile

Hema Lohani
Centre for Aromatic Plants (CAP)
Industrial Estate, Selaqui-248197, Dehradun (Uttarakhand)
E-mail:- hemalohani2004@rediffmail.com

Uttarakhand is blessed with a wide variety of soil and climatic conditions which supports the enormous plant wealth. About 12 species of *Tanacetum* L. are reported growing in temperate regions in India. *Tanacetum* is a member of family Asteraceae. *Tanacetum* is an aromatic herb found in cold deserts of Garhwal and Kumaun regions of Uttarakhand. On the basis of literature survey and specimens observations in various libraries and herbaria, showed that five species are found in Uttarakhand. These reported species are:

1. *Tanacetum nubigenum* Wallich ex. DC.
2. *Tanacetum tomentosum* DC. (syn. *T. senecionis*)
3. *Tanacetum longifolium* Wall. (syn. *T. dolichophyllum*)
4. *Tanacetum gracile* Hook f.&T.
5. *Tanacetum tibeticum* Hook f.&T.

The area of research is to screen *Tanacetum* species, growing widely in Uttarakhand forest, for their essential oil profiles and finger printing on the basis of essential oil components and to explore the commercial possibility to use this unexploited weed as source of essential oil or their isolates.

Components reported in the present study have potentiality in fragrance, flavour and perfumery. Borneol, bornyl acetate, 1,8-cineole etc. have been identified as major components in the essential oils of *Tanacetum* species. These compounds used chiefly as a scent in the manufacture of perfumes, as fragrance ingredients and also used in flavouring. During the survey it is observed that whole herb of *T. nubigenum* is generally used as incense by the tribal of Niti valley and Milam region.

Tanacetum genus is chemo-taxonomically distinct, because of the presence of different components within species as well as different species. In the present study selin-II-en-4α-ol reported as the major component in Gothing sample of *T. nubigenum*, while borneol in Burfu, bornyl acetate in Milam Glacier and 1,8-cineole in Indradhara (Badrinath). In *T. tomentosum*4-carene (21.0%) was the major component in the sample collected from Nagula Bridge (Geoldong) while β-besabelol constituted 50.0% in Geoldong sample. β-eudesmol was detected as the major component in Chandrasila (Tungnath) sample of *T. longifolium*, whereascis-lanceol was found in the sample collected from Bakria Top (Dyara). Similarly α-bisabolol was obtained as a major component in T. gracile. Our findings also indicated that:-

- *T. tibeticum* was earlier reported in Milam region but during the survey this species was not available, *T. nubigenum* was identified and collected from this region.

- *T. nubigenum* collected from Indradhara (Badrinath) showed high oil percentage and light blue oil colour while same species from other places having light greenish colour.
- Variation in essential oil composition has been observed in the samples of *Tanacetum*.

On the basis of this study, it was observed that the flowers and herb of *Tanacetum longifolium* are being used by the pilgrims for offering to lord Shiva in Tungnath temple, keeping in view centre has submitted a proposal for the cultivation, value addition and sustainable harvesting of *Tanacetum longifolium* and other aromatic plants which have religious importance in Chardham area of Uttarakhand. By the cultivation local tribes of Chardham region will be motivated to manufacture the potpourri (dried aromatic herb for fragrance), aroma oils, Agarbatti etc. for selling to tourists/ pilgrims of Chardham. The raw material required for making these products will be obtained through cultivation and sustainable harvesting of *Tanacetum* and other aromatic plants.

Status of Insect Pollinators in the Orchards of Apple, Peach, Pears and Citrus in Mukteshwar Area of District Nainital

P.C. Joshi
Dept. of Zoology and Env. Sciences
GurukulaKangriUniversity, Haridwar-249404
E-mail:- prakash127@yahoo.com

The entire study area represents characteristic high altitudes environ and falls within an altitudinal range of 2000–2300 m and is surrounded by fruit orchards and thick coniferous forest.

Taxonomic composition of entomofauna collected from the study area: A total of 2418 insects belonging to 112 species of 31 families and 8 insect orders were recorded from different study sites during study period.Maximum number of identified insect species belonged to Order Lepidoptera (53), followed by Hymenoptera (20), Coleoptera (14), Diptera (9), Orthoptera (8), Odonata (4), Hemiptera (2) and Heteroptera (2). Maximum number of individuals belonged to order Lepidoptera, which contributed 39.51% and 46.81% during 2007–2008 and 2008–2009 respectively, followed by Hymenoptera (19.76% and 19.15%), Coleoptera (13.58% and 13.83%), Diptera (9.88% and 6.38%), Orthoptera (8.64% and 5.32%), Odonata (3.70% and 4.26%), Hemiptera (2.47% and 2.13%) and Heteroptera (2.47% and 2.13%) during 2007–2008 and 2008–2009, respectively.

Taxonomic composition of insect pollinators: A total of 1961 individuals belonging to 87 species, 21 families and 5 insect orders were recorded as frequent visitors on apple, peach, pears and citrus flowers in the orchards of the study area during the study period (2007-09), among which Lepidoptera was found to be the most dominant order with 53 species followed by Hymenoptera (20 species), Diptera (09 species), Coleoptera (04 species) and Hemiptera (01 species). Maximum number of species were recorded from Site II and Site VII (59 species each) followed by Site IV and Site V (55 species each), Site I and Site VIII (46 species each), Site VI (41 species) and only 31 species were recorded from Site III.

In the present study the following factors were identified as threats to the insect pollinators:

1. Fragmentation of habitat is a major cause of concern in the study area. This is further adding to the loss of biodiversity of entomofauna because large area which were once having natural vegetation (forests) or fruit orchards are being cut or removed to change the land use pattern in the area. The villages are expanding day by day. The study area is well known in the tourist map of Uttarakhand as a result many hotels, shopping complexes and resorts are being built in the area by clearing forest/agricultural land.

2. A large number of chemicals are sprayed in the area by farmers including Metasystox, Desis, Sevin, Thiodan and Rogor. Major insecticides used in the study area were identified and are listed. A major decline in the number of pollinator was recorded just after the spray of these chemicals. Thus these chemicals are causing harm to the insect pollinators.

3. **Parasites can cause a great harm** to the bee colonies. Some of the bee species including the wild bees were found to be infected by some diseases. The honeybees have suffered dramatic declines following the rapid spread of it; this continues as resistance to chemical control agents is increasing. Two species of insect predator odonates (*Crocothemis servilia servilia, Orthetrum pruinosum*) have also been recorded from the study sites.

4. **PredatoryBirds** . They play a very important role in maintaining the insect abundance of any area. It is generally seen that the insect abundance and sometimes the richness too is less in those areas where the insectivorous birds are more in number. Some insectivorous birds which have been observed during the flowering season from different study sites included Verditer flycatcher, Warbler, Great Tit, Himalayan Swift and Grey headed canary flycatcher etc. A total of 24 insectivorous birds have been identified from the orchards of the study area.

5. Introduction of newer species: During the study period it has been observed that during the flowering season of apple, *A. mellifera* is being introduced in the study area which is giving a competition to the native species (*A. cerana* and others). A difference was seen in the foraging bahaviour of both exotic (*A. mellifera*) and native (*A. cerana*) species, and it was observed that, the exotic species *A. mellifera* covers less distance in search of food in comparison to *A. cerana* therefore; it not only increased the competition for the native species but also decreased the probability of finding nectar and pollen to the nearby place of hive of a native species. A decline in the number of *A.* cerana was also recorded after the introduction of *A. mellifera* in the study site. Therefore, the introduction of this species in the area is also a great threat to the native insect pollinator species like *A. cerana* and other insect pollinator species. Thus a controlled introduction should be done to regulate the intra community competition among the pollinators.

Structure and functioning of grassland ecosystem of Garhwal Himalayas

SK Gupta
K.L.D.A.V.P.G.College,
Roorkee(Uttarakhand)
E-mail:- subodhgupta@rediffmail.com

Studies within this project have been under taken to solve practical problems of resources management and to assess the effects of fire, clipping and grazing on the composition, structure and functioning of grassland ecosystem of sub-tropical, temperate, sub-alpine and alpine zones of Garhwal Himalaya with special reference to environmental control.

1. In this project structure, productivity, nutrient cycling, energeties and socio-economic aspects of grasslands in Garhwal Himalaya were evaluated. Different experimental sites of grasslands in sub- tropical, temperate, sub-alpine and alpine regions differing in grazing and clipping treatments were selected. The effects of fire, altitude and topography on these parameters have also been considered. Emphasis was placed on the study of forage quality, measurement of nutritive values, energy conserving efficiency and net energy conserving rate of grasses. Evaluation of most suitable species for upgrading these grasslandse needed for cattle grazing, maintenance of soil fertility and conservation of soil was also made. The ability of indigenous species in relation to climate factors was also evaluated socio-economic parameters including the carrying capacity of these grasslands have also been discussed in view of the management and sustainable development.
2. It is concluded that clipped plot recorded higher values of IVI. The correlation studies indicate that dominant species are positively correlated. In fired plot, *Cymbopogon distans* and *Heteropogon contortus* replaced *Arundinella nepalensis* and *Chryosopogon montanus* and occupied dominant position in temperate grasslands. In sub-alpine grasslands, the species were different on flat and inclianted topography. Dissimilarity index between both the sites accounted 0.82. In alpine pasture, *Agrostis stolonifera* recorded the highest IVI in control plot. However, *Agrostis stolonifera* was also found dominating with *D. cruciata* in free grazed plot.
3. It is also concluded that burning, clipping and moderate grazing are beneficial for increasing the potentiality of range grasses since burning exposes sprouting buds to environment and clipping stimulated the buds to grow by releasing them from apical dominance. However, uncontrolled grazing and firing destroy the buds resulting in a decline in tiller numbers. Flowering tillers were not produced during summer at higher altitudes.
4. In sub-tropical grassland, similarity index between combination was high (0.947) during summer while dissimilarity index was found maximum during rainy season (0.260). Hemi-cryptophytes dominate in these grasslands followed by Thereophytes. In sub-alpine grassland, similarity index among possible combinations amounted 0.18. This value increased to 1 when the index was calculated between the grassland plots of the same site. Dissimilar index between different sites (flat and inclianted topography) accounted 0.82.
5. Total amount of solar energy trapped by green plants in the form of organic matter is

referred to as gross primary production. In this study net primary productivity was evaluated by measuring biomass. Net aboveground productivity measured 615.8 g/m^2/yr in close clipped plot followed by moderate clipped (485.3 g/m^2/yr) and control (258.9 g/m^2/yr) in sub-tropical grasslands. In temperate region, fired plot produced higher values (196.8 g/m^2/yr) as compared to control (132.1 g/m^2/yr). Free grazed grassland produced the lowest values of net productivity (20.6-38.9 g/m^2/yr) as compared to control plots (100.6-110.8 g/m^2/yr) in sub-alpine region. In alpine pasture also free grazing inhibits the net productivity (87.1 g/m^2/yr) when compared with undisturbed grassland (197.14 g/m^2/yr). Clipping also increased the productivity of underground parts (152.7-162.8 g/m^2/yr) as compared to control treatment (127.8 g/m^2/yr) in sub-tropical area. Same results are obtained when the grasses were burnt in temperate region. However, uncontrolled grazing reduced the productivity at higher altitude. Total net productivity including above and underground parts followed the same trend as was obtained for aboveground productivity. The highest value of 778.6 g/m^2/yr was obtained in closed clipped plot of sub-tropical grassland when compared with the grasslands of others altitudes. Lowest value of 67.2 g/m^2/yr was recorded for free grazed plot of sub-alpine region.

6. Highest value of productivity of litter was obtained for subtropical grassland (144.5 g/m^2/yr). The lowest values were obtained for free grazed grasslands (3.67 g/m^2/yr) of sub-alpine region.

7. Total community net productivity amounted 786.3 g/m^2/yr in closed clipped followed by a value of 699.4 in moderate–clipped plot and 531.2 in control in sub-tropical grasslands. Fired plot obtained 368.8 g/m^2/yr net productivity as compared to 264.1 g/m^2/yr in control in temperate grassland. Sub-alpine grasslands recorded 223.0-375.7 g/m^2/yr community productivity in control plot as compared with free grazed plot (70.9 -137.7 g/m^2/yr). In alpine pasture also free grazed plot recorded lower values of 283.7 g/m^2/yr as compared to 611.5 in control plot.

8. Respiratory loss followed a trend of sub-tropical > alpine >temperate > sub-alpine grasslands.

9. Turnover ratio of aboveground parts was found maximum in clipped plots (0.75-0.96 g/m^2/yr) in sub-tropical grassland. This value is followed by alpine region (0.76-0.89 g/m^2/yr). The lowest values were obtained for temperate (0.59-0.61 g/m^2/yr) and sub-alpine grasslands (0.53-0.87 g/m^2/yr).

10. Turnover ratio of underground parts was found lowest in sub-tropical grassland (0.34 g/m^2/yr). The higher values were obtained at high altitudes and followed a trend of 0.59 (Sub-alpine)> 0.56 (temperate)> 0.53 (alpine).

11. The total net production was multiplied by 0.30 to get respiratory rate which is added to the total net production to obtain gross production. Sub-tropical grasslands obtained highest values of gross production of 873.9 followed by alpine grasslands (505.3), temperate grasslands (411.4) and sub-alpine grasslands (152.4) which recorded the lowest values.

12. Calorific values of plant parts were calculated to find out the ecological efficiency of grasslands under the influence of clipping, burning and grazing treatments and to study the effects of climatic factors on these values. In sub-tropical grassland, a definite trend of caloric concentration, accumulation and conservation in descending order from close clipped plot to moderate and undisturbed grassland was recorded. The highest average

values of 4733.6 cal/g/yr was recorded for close clipped followed by moderate (4726.0 cal/g/yr) and control (469.05 cal/g/yr).Temperate grassland accumulated less energy having caloric values of 4451.1 cal/g/yr (fired plot) and 4052.8 cal/g/yr as (control plot) compared to sub-tropical vegetation. In this case, fire stimulated the accumulation of caloric values. In sub-alpine grassland higher caloric values (4715.9-4688.4 cal/g/yr) were recorded for undisturbed plot as compared to free grazed plot (4015.9-4062.1 cal/g/yr). However, in alpine pasture these values were higher in free grazed plot (4851.2 cal/g/yr) as compared to control (4671.6 cal/g/yr).

13. Standing crop of energy ranged from 239.7-352.5, 114.4-184.1 and 39.1-154.6 K cal/m^2/yr in sub-tropical, temperate and sub-alpine grasslands respectively. Control and fired plots accumulated higher values in sub-tropical and temperate grassland.
14. Highest value of net energy conserving rate was recorded for alpine grassland (16.67 K cal/m^2/day) followed by sub-tropical (6.45 K cal/m^2/day) on annual average basis.
15. Energy conserving efficiency was also found higher in alpine grassland (0.74%) followed by sub-tropical (0.27%), sub-alpine (0.13%) and temperate grassland (0.02%).
16. In sub-tropical grassland, higher annual uptake of minerals was recorded in closed clipped plot followed by moderate clipped and control plot. N, P and K, attained their peak values prior to flowering, dropped afterwards. Negative values after clipping were recorded in the underground parts. The nutrient values were reduced during winter.
17. Nitrogen amounted 0.85 and 0.74% in sub-tropical and temperate grasslands respectively. However, these values increased to 1.2 and 2.0 in sub-alpine and alpine vegetation. Phosphorous contents were low (0.34%) in alpine pasture as compared to sub-alpine (1.06%) and temperate (0.11%) grassland. Sub-tropical vegetation occupied the middle position (0.53%). Potassium also followed the pattern of nitrogen accumulation. Highest values of standing crop of nitrogen were recorded in sub-alpine grassland as compared to alpine. The lowest values were obtained for temperate grasslands. Potassium recorded the highest percentage in sub-alpine and alpine pasture; the lowest values were obtained in temperate region. The pattern of accumulation of standing crop of phosphorous followed sub-alpine>subtropical>alpine> temperate trend. Positive correction coefficient between mineral contents and energy values shows that by increasing the nutrients in the plant parts, the energy values are also increased.
18. Almost all the plant species were palatable in all or any of the life stages. No grass species was found 100% palatable throughout its life cycle.
19. On an average a house hold keeps 6 animals viz., 1 buffalo, 2 bullocks, and 3 cows. The number of animals provided the social status to hilly people and also provides manure, milk, meat and transportation. In sub-tropical region, the carrying capacity of the grassland amounted 0.58-1.08 cows per hactore. This value ranged from 0.17 in alpine pasture to 10.6 in subtropical grasslands.
20. Grazing lands at higher altitude experience severe grazing especially during summers when migratory grazers invade. These lands are also subjected to legal/illegal cutting. Therefore, the economic prosperity is directly proportional to the population. It is concluded that to maintain maximum carrying capacity at an opti-mal level, grazing pressure should be reduced by animal population.

Studies on diversity of am fungi and their role as bioprotectant of economically important crops of uttarakhand

Rajan Kumar Gupta
Department of Botany
Pt.L.M.S.GovernmentPostGraduateCollege
Rishikesh – 249201 (Dehradun)
Uttarakhand, India
E-mail:- rajankgupta1@rediffmail.com

Present study is intended to study the effect of individual VAM species on the growth of *Camellia sinensis*. Sites selected for study in Doon valley were Good rich tea garden and Archadia tea garden.VAM species identified and isolated were *Gf, Gm, G.sp.-I* and *Ac.* Wet sieving and decanting method followed for Identification and isolation of VAM fungi and then colonized with paddy plant roots. Study was also carried out for the identification of density of VAMF throughout the year at both sites of Doon valley. In term of study it was observed that Archadia tea garden contains higher number of VAM species specially with *Gf*. Also total number of spores were maximum during the rainy season. In peak winter and summer season's growth of VAM fungi was effected. It was also observed that environmental factors are highly responsible for VAM growth and multiplication.VAM fungal spore of the genera *Glomus* and *Acaulospore* were detected in the rhizospheric soil of two sites and occurrence of VAM species are following type Good Rich- *Gf, Gm,Ac* andArchadia - *Gf, Gm, G.sp.-1,Ac.* Present studies were focused on to identify the symbiotic relationship of *Camellia sinensis* and effect of VAM cultures of *Camellia sinensis* growth, cultivation and propagation. Experiments exposed that plants inoculated with VAM gave significant growth in all aspects i.e. root length, shoot height, number of leaves and leaf area. A significant growth enhancement in 6 and 12 months after plantation in terms of total shoot height and root length was observed in studies. It was also observed that treatments with *Gf, Gm* and equiproprotion combination of *Gf +Gm* have shown different positive results. Treatments with *Gf* have resulted in shoot height of *Camellia sinensis* at higher side in comparison to the plants treated with *Gm.* While incase of plants treated with the combination of equal proportion *Gf+Gm* have shown maximum shoot height. Root length results have also shown that like shoot height, plants treated with *Gf* showed higher root length of *Camellia sinensis* in comparison to the plants treated with *Gm.* Again plants treated with the combination of *Gf + Gm* have shown maximum root length as compared to both fungi treated alone and control samples.

It was also observed that higher numbers of leaves were found in the plants treated with the equiproportion VAM species in combination. Results have shown that plants treated with the

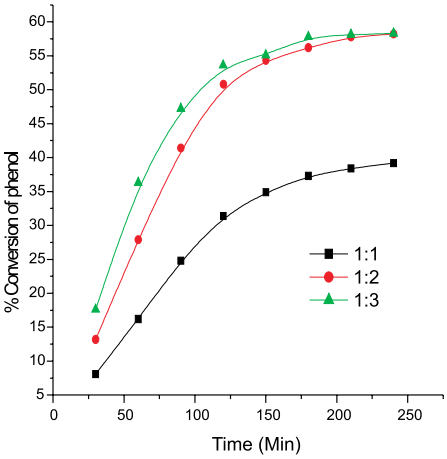
Gf have shown more number of leaves then the plants treated with *Gm*.Studies were made to identify and establish the effct of VAM in quality of *Camellia sinensis*. As F is known as the quality indicator for leaves of *Camellia sinensis* and therefore a study was made to establish a relationship for VAM and F. Experiments have indicated that plants inoculated with VAM is in negative correlation with VAM fungi. Plants with higher number of spores of VAM have shown decrasing trend of F. Although it's too early to say any thing over this subject as it requires more exoeriments and studies to look forward the effect of VAM on fluoride absorption especially in Doon valley.

Study was also carried out on VAM and its correlation with the crop production and protection from diseases. Result of experiments show that plants inoculated with VAM have shown lesser frequency of diseases. VAM inoculation has shown significant protection from Algal leaf spot Grey blight and Brown blight infections in *Camellia sinensis* plantations. VAM can prove to be very important tool for *Camellia sinensis* plantation as an immunity booster. VAM is the most abundant kind of mycorrhiza described as a universal plant symbiont. VAM can also be an important tool for cultivation in low fertility areas or we can say in environmentally compromised areas. Results of present study have revealed the facts that VAM is a useful tool in low fertility areas. Studies have shown significant growth enhancement in terms of total shoot height and root length observed in studies in 6 and 12 months plantation in low fertility areas.

Syntheses, characterization and catalytic activities of nano-sized double metal Cyanide complexes

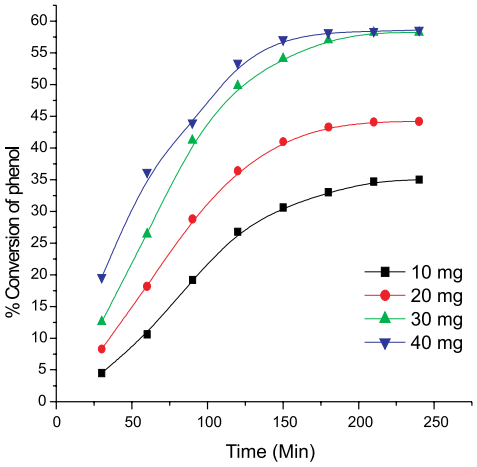
Shah Raj Ali
Department Of Chemistry
D. S. B. Campus Kumaun University
Nainital – 263 002
E-mail:- shahrajali@gmail.com

In this project, nano-sized particles of different double metal cyanide complexes have been synthesized and their use as heterogeneous catalyst for the oxidation of phenol has been studied. Three series of double metal cyanide complexes, namely, metal hexacyanoferrate, metal hexacyanocobaltate and metal hexacyanochromate have been synthesized. These complexes have been synthesized using the method reported by Qu et al. In this method, a dilute solution of metal ions was slowly added to a dilute solution of hexacyanoferrate or hexacyanocobaltate or hexacyanochromate drop by drop. The particles size of double metal cyanide complexes depends on the reaction conditions viz. concentration of solutions, temperature and the shaking of the reaction mixture.



Effect of phenol : H_2O_2

Metal hexacyanoferrates were synthesized by adding 500 ml of 0.01M solution of metal nitrate (containing equimolar quantity of EDTA) drop by drop slowly to 200 ml of 0.01M potassium hexacyanoferrate (containing equimolar quantity of potassium chloride). EDTA was used to control the size and shape of the particles of these complexes and to provide stability to these particles. The reaction mixture of the aforesaid solutions was shaken vigorously for 5-10 minute and then kept as such for 30 minute. Then the reaction mixture was filtered using Buchner funnel, washed thoroughly with distilled water and dried in an oven. The material thus obtained was grinded in a mortar and sieved through 100 mesh size sieve. For the syntheses of metal hexacyanocobaltates and metal hexacyanochromates, 100 ml of 0.01M solution of metal nitrate was used with 50 ml of 0.01M potassium hexacyanocobaltate and potassium hexacyanochromate, respectively. Potassium hexacyanochromate was synthesized by Groub's method. The percentage of carbon, hydrogen and nitrogen in the synthesized complexes was determined by CHNS analyzer. The percentage of metal atoms was determined by absorption spectroscopy and the number of the molecules of water was determined by TG/DT analysis. Thus, the aforesaid analyses were used to determine the molecular formulae of the synthesized



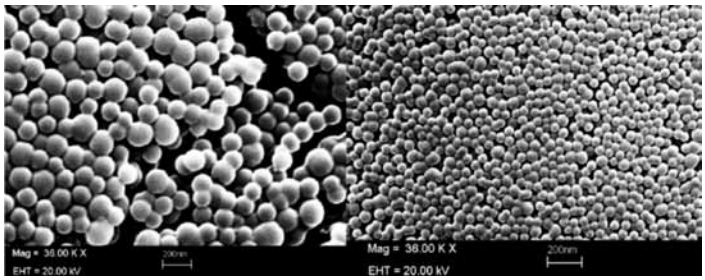
Effect of amount of catalyst

complexes. IR spectroscopy was used to determine the nature of bonds and to study the functional groups present in the complexes. These complexes were also analyzed by X-ray Diffraction method and the average particle size was determined by Debye-Scherrer formula. Nano-sized double metal cyanide complexes were used as catalysts for oxidation of phenol. These complexes were found as effective heterogeneous catalysts for oxidation of phenol using hydrogen peroxide as oxidant. The percent conversion of phenol was found to depend upon reaction conditions and therefore the reaction conditions were optimized. For example, 58% of phenol was oxidized when 50 mmol of phenol was reacted with 100 mmol of hydrogen peroxide (30%) in presence of 30 mg of copper hexacyanocobaltate as catalyst. The reaction was carried out for 3 hours at 75 C. The oxidation products of were characterized as catechol and hydroquinone. The catalysts showed different selectivity and different percentage conversion of phenol. Generally, catechol and hydroquinone obtained by oxidation of phenol further oxidize into catequinone and benzoquinone. However, in present study, no catequinone and/or benzoquinone was obtained. It shows that these catalysts were able to control the oxidation of phenol into catechol and hydroquinone only. Also, these catalysts were used for oxidation of 2-chlorophenol but their efficiency for this reaction was found considerably less than that of oxidation of phenol. All the catalysts were found heterogeneous, stable, insoluble in water and recyclable. It exhibits the green nature of these catalysts. The use of green catalysts is an important aspect of green chemistry which is essential for sustainable economical development.

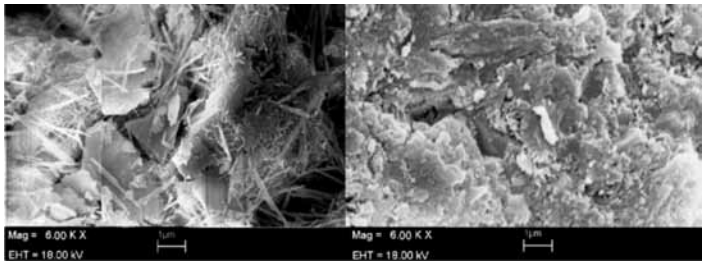
Synthesis & Characterization of nano-silica and its subsequent use in Calcium-Silicate-Hydrate system

L.P. Singh
Central Building Research Institute (CBRI),
Roorkee
E-mail:- singh_cbri@yahoo.co.in

Durability of cementitious materials is a major concern and new ways to improve concrete properties to ensure longevity are being investigated. Use of nanotechnology is one such novel route through which Ultra High Performance Concrete can be developed to address the issues of sustainability and durability. Use of nano-sized ingredients such as alumina and silica particles and understanding of the hydration behaviour are the latest research areas dealing with cement and concrete materials. The mechanical behaviour of concrete depends on the nano-sized calcium-silicate-hydrate (C-S-H) gel produced as a result of hydration process in the cement. Using nanotechnology as a tool, it is now possible to modify the nano structure of concrete material to improve the material's bulk properties; improve significantly the mechanical performance, volume stability, durability and sustainability of the concrete. In addition, the nanomodification can result improvements in strength, shrinkage, ductility and impact resistance.



(A) Without Surfactant (~150nm), (B) Using Surfactant (~50nm)



SEM micrographs of plain cement paste (PC28) and nano silica incorporated cement pastes (NS28) at 28 days of hydration

Huge potentials have been predicted for nanotechnology applications in construction. Even minor improvement in materials and processes could bring large accumulated benefits. In the short to medium term, the greatest impact to the construction industry and the economy is likely to come from enhancement in performance of materials. In the medium to long term, nanotechnology development will lead to truly revolutionary approaches to design and production of materials/structures with much improved energy efficiency, sustainability and adaptability to changing environment.

The Problem

Presently more than two tonnes of concrete per person are used annually on an average around the world. Continual efforts are being made in the field of construction technologies to develop stronger and more durable concrete structures. Application of nano-materials into the production of cement and concrete can lead to improvements in civil infrastructure because

the mechanical strength and life of concrete structures are determined by the micro-structure and by the mass transfer in nano-scale. In past years, superfine industrial by-products with pozzolanic and cementitious properties such as fly ash, slag and silica fume have been ingredients for high-strength cement. Silica fume has been gainfully used for enhancing properties such as abrasion resistance, mechanical properties, bond strength with steel rebar and corrosion resistance of steel rebar. Nano chemistry offers the possibilities of understanding the extremely small complex structures of cement based materials at nano level. It is expected that, when nano particles are incorporated into conventional building materials, such material can possess advanced or smart properties required for the constriction of high–rise, long-span or intelligent civil and infra systems. Nano particles are unique because extremely small size of nano particles may affect the behavior of the cement. Nano size particles may provide a faster kinetics in cement due to stronger electrostatic forces and greater specific surface area. Therefore, keeping view the important of nano science, efforts have been made to use nanotechnology as a tool in the understanding of basic structure of cementitious system i.e. calcium-silicate-hydrate by incorporating nanomaterials and understanding the mineralogical and morphological attributes.

Objectives

- Synthesis of nano-silica (<100 nm) powder
- Characterization of synthesized nano-SiO_2 through advanced X-ray Diffraction (XRD), Scanning Electron Microscopic (SEM), Microscopy (SEM), Differential Thermal Analysis (DTA) etc.
- Understanding of nano-SiO_2 incorporated calcium-silicate-hydrate system in regard to strength, setting time etc.
- Comparative morphological and mineralogical studies of pure and nano-SiO_2 incorporated calcium-silicate-hydrate system.

Spherical silica nanoparticles with controllable size have been synthesized using tetraethoxysilane as starting material and ethanol as solvent by sol-gel method and further these nano silica particles were supplemented to cement for studying the strength imparting behavior of the C-S-H gel. Using sol-gel process the size and shape of silica nanoparticles may be controlled by additives such as electrolytes, surfactants and organic acids. The size of the nano silica particles was controlled by using non-ionic surfactants. From SEM micrographs revealed that silica nanoparticles are spherical, dispersed and approx 50 nm in size.

X-ray diffraction profile further revealed the amorphous nature of the synthesised particles. The ^{29}Si MAS NMR spectra of silica nanoparticles show the T and Q sites. The signals at approx -113.0 and -103.0 ppm arise from the Si species Q^4 ($Si(OSi)_4$) and Q^3 ($Si(OH)(OSi)_3$), respectively. A low-intensity peak at -94.20 ppm arises from chemical shift correlation and relaxation data to germinal-hydroxyl silanol sites.

Further, to investigate the comparative mineralogical and morphological attributes of calcium-silicate-hydrate gel these silica nanoparticles were added to cementitious system. Cement is the mixture of tricalcium silicate, dicalicum silicate, triclacium aliminate and tetracalcium aluminoferrite. The main strength imparting phase in the cement matrix is the CSH gel which is approximately 50% of the total quantity produced during the hydration process. Through recent advancement in microscopy it has recently been established that the CSH gel is a granular structure of few nanometer size. Addition of silica nanoparticles up to 5.0%

improved compressive strength of cement paste and the setting time of fresh cement paste was decreased by increasing the content of silica nanoparticles. Addition of silica nanoparticles into cement paste improves the micro-structure of the paste and calcium leaching is significantly reduced as silica nanoparticles reacts with calcium hydroxide (CH) and thereby forming a secondary calcium-silicate-hydrate (C-S-H) gel. It was further established that, CH content in silica nanoparticles incorporated cement paste reduced 90% at 1 day and up to 59% at 28 days. The compressive strength of cement paste containing 5% silica nanoparticles is 64% higher at 1 day & 35% at 28 days than that of control cement paste. Results of SEM studies show the comparative micro-structural behavior of controlled cement pastes and with the addition of silica nanoparticles, indicating a denser structure and significant reduction in CH content. Therefore, it can be concluded that the microstructure of the cement can be tuned with the help of nanoparticles and thus producing more durable and sustainable concrete.

Technological Empowerment for Segregation of Races and Post Harvest Handling of Pulses Growing at Uttarkashi District of Uttarakhand

Arun K. Agrawal,
Department of Botany,
Government Post Graduate College,
Uttarkashi – 249 193
E-mail:- renuka2003@hotmail.com

Present proposal was implemented at five blocks namely Barkot, Mori, Chinyalisaur, Purola and Bhatwari of district Uttarkashi. A total of thirteen villages covering all the five developmental blocks are selected which are leading pulse producing villages. A total of twenty two farmers were identified for the production of seeds of pulses for conservation of diversity.

Only four species of pulses, namely Kidney bean, Bhatt (Soybean), Black gram and Horse gram are considered for the present work because these are produced in bulk.

The major objectives of the project were:

1. To ascertain the level of women participation in pulse production, protection and post harvest handling
2. To analyze the consumption, value addition and disposal pattern of pulses at house hold level
3. Segregation of various races of pulse species and their seed bank creation for conservation of diversity
4. Technology package development for post harvest handling and storage of varieties

Under the project, One the basis of colour differentiation, shape, volume and size of seed three varieties and fifteen races of kidney beans, two varieties and three races of Bhatt (Soybean), one variety and two races of horse gram and one variety and two races of black gram were identified.

During the project implementation, it was observed that farmers lack the technology related to drying and their threshing of the pulse crops due to that they were unable to get appropriate prices in the market. The storage technologies, they adopted, are traditional and due to those huge losses in storage of crops were observed. The grading and post harvest technologies were totally absent in the area and people were forced to sell their crops immediately after their harvesting resulting in to low prices in the market due surplus availability of pulse crops.

Various technologies related to storage, post harvest and value addition were demonstrated through the project activities. Through front line demonstrations, improvement in production potential utilizing traditional seeds and technologies were also carried out successfully.

During front line demonstrations of the pulse crops, significant increase in production potential of the crops was observed through improved technologies and tools. The technology related to selection method of seed production of pulse crops was transferred to the farmers for the production and conservation of traditional seeds and genetic diversity of the area.

Though the project activities, identification of traditional races and varieties of the pulse crops was carried out. The collected samples were tested for various morpho-physical properties during the project activities:

Characteristics of seeds of various pulse varieties.

Name of Pulse	No, of traits studied	Mois-ture %	No. of seeds /kg	Volume of seeds (mm^3)	No. of pods per plant	No. of seeds per pod
Kidney Bean	32	18 - 28	3335 - 6232	3.3 – 10.2	14 - 60	4-10
Horse Gram	02	20 – 32	8982 – 9857	0.8 – 1.4	11 - 36	4 – 8
Black Gram	02	16 - 25	8675 - 8892	0.4 - 11	21 - 44	6 – 9
Soybean	03	19 - 29	7127 - 8225	1.4 – 3.1	19 - 32	2 - 5

There is a sizeable quantitative and qualitative loss of pulses during different post-harvest operations like threshing, winnowing, transportation, processing and storage. Hence, it is appropriate to give due emphasis to reduce qualitative as well as quantitative losses of pulses during post-harvest operations. It has been reported that about 2.38 percent losses occurred during post harvest operations at the producers' level. The details are as under:

Estimated post-harvest losses of pulses at producers level

Sl. No.	Stages Production	loss (%age)
1	Losses in transport from field to threshing floor	0.67
2	Losses in threshing	0.63
3	Losses in winnowing	0.61
4	Losses in transport from threshing floor to storage	0.19
5	Losses in storage at producers level	0.29
Total losses at producers level		2.38

We have studied the decay percentage of seeds of all the four types of legumes in respect to moisture percentage and duration of storage. It was observed that decay of seeds were observed 80 – 85 percent in case of 25 to 30 percent of moisture content in seeds in 65 to 100 days of storage by insects particularly borer and fungal decay. Reduction in moisture percentage up to 10 percent increases the number of days of safe storage with 15 to 20% losses in seeds attack. It was observed that 10 – 12 % moisture percentage in seeds and storage in cool and dry place is sufficiently safe for storage of these legumes.

A seed bank of different pulse varieties and races is created at Government Post graduate College, Uttarkashi. 15 kg seeds of each variety are stored in seed containers with proper care for future utilization and front line demonstrations.

The Study of Submanifolds in Conformal and Pseudo Conformal Spaces

K.C.Petwal
Dept. of Mathematics,
H.N.B. Garhwal University,
Badshahi Thaul Campus,
Tehri Garhwal-249 199
E-mail:- kcpetwal@gmail.com

Objectives

(1). To study the sub-manifolds in conformal and pseudo-conformal spaces and to investigate some recent approaches for various types of motions and transformations; like complex, almost complex, pseudo-complex, almost pseudo-complex, manifolds; Riemannian, pseudo-Riemannian, Tachibana, almost Tachibana, Kaehlerian, pseudo-Kaehlerian, Hermitian and pseudo-Hermitian manifolds and so on.

(2) To reduce the gap in the existing knowledge of various kinds of manifolds and to introduce a smooth connection among the subfields of differential geometry as there are still some problems of geometrical illustrations and applied applications in hi-tech fields as well as in our daily life.

Here is the brief discussion over some crucial results obtained from our research in favor of spatial transformation of DT-MRI.

$$D^{ij} = \sum_{a=1}^{\delta} \frac{\partial X^a}{\partial X^i} \frac{\partial X^a}{\partial X^j}$$

In order to justify the results of Riemannian geometry in the study of DT-MRI, we have calculated the inverse diffusion tensor whose value is defined as. Also, with its help we have defined a metric between any two nearby water molecules diffused along any axon fiber and measured the length of that arbitrary axon fiber.

As it has been verified that diffusion tensor manifolds are generally Riemannian symmetric and hence we have introduced for Riemannian symmetry, from which we have deduced that the brain cortical manifold, *i.e.*, the diffusion manifold is not merely a Riemannian symmetric but also a semi-symmetric manifold. Thereby, not only the results of Riemannian geometry can be made valid for DT-MRI studies, but the results of semi-symmetric geometry can also be justified therein.

We have setup a relation for the inclination of two axon fibers in terms of the angle between two hyperspheres which are orthogonal to the considered fibers. Also, the same has been calculated in terms of the inclination of two tangent vectors drawn to any two water molecules of corresponding axon fibers at some specific instant. By comparing, we have concluded that the isotropic behavior of diffusion tensor could not be directly introduced and then we cannot introduce an isotropic cone. The inclination is also calculated between two fiber tracts of brain white matter in terms of reciprocal diffusion tensor and its leading diagonal components.

Hopefully, the third conclusion of this article can express a bit mechanism for the brain injury. The MRI study of popular neural disorders, the "seizure disorders" mainly involves detection of malformations of cortical brain surface. Such malformations disturb the parallel orientations of axon fibers and fiber tracts and are a common cause of epilepsy. Thus by using third conclusion, one can geometrically detect the status of seizure disorder by simply calculating the angular disorders among fibers or fiber tracts.

We have discussed a comparison theory of two axon fibers by means of involute-evolute geometry. By this study, one is able to check out the geometric configuration of fibers in the brain white matter as if we establish a 1-1 correspondence between the diffused water molecules along considered axon fibers, then by having information about one of the fiber, the same information can be assessed for others.

The fiber geodesics for the axon fibers lying in the brain cortical manifold have also been calculated which can be used to identify the underlying manifold. Also, it is emphasized that, if one calculates the least and greatest fiber geodesics depending upon the size of healthy brain, the calculated data can be used to find out the symptoms of neuropsychiatric disorders in unhealthy brains by means of comparative data studies. Fiber geodesics (in case of torsion full affine connection) also manipulated.

Finally, spatial transformations, like affine collineation, isometric collineation, projective motion and conformal transformation of DT-MRI by making use of geometry of Lie derivatives have been studied. The strong reason behind the use of Lie geometry for such a study is that whenever spatial transformations are applied to DT-MR images, they could be distorted or deformed (distortion or deformation of DT-MR images may depend upon the nature of spatial transformation applied to them) and hence in order to preserve the consistency and validity of DT-MRI data, it is mandatory to re-orient the transformed image and the Lie operator is the only operator which can bring back the transformed image to its original position.

The above spatial transformations, specially the conformal transformations could be used to examine the symptoms arise due to brain tumors, schizophrenia and other psychiatric disorders as in case of brain tumors the axon fiber tracts may got disruption (angular or parallel) or displacement and hence conformal transformation are able to map the orientation of anatomical shapes of brain both in terms of sense and magnitude. Also, the case of schizophrenia can be geometrically examined using the aforementioned spatial transformations, as in this disease the fiber tracts lose their orientation.

Utilization of Glass Waste For The Degradation of Waste Plastic

Deepak Pant
Deptt. of Chemistry
Dolphin (P. G.) Institute of Bio-Medical & Natural Sciences,
Manduwala, Chakarata Road
Dehradun 248 007
E-mail:- deepakpant1@rediffmail.com

The present project developed a method for the management of common variety of municipal solid waste glass and plastic. Waste glass material containing majority silica with other elements which after activation method can be converted to amorphous zeolite and acting as a catalyst for degradation. Activation involving the following steps: (i) pulverization; (ii) initial separation by cyclone; (iii) classification into specific size with the help of vibratory shaker; (iv) and final activation step involving thermal or chemical treatment.

In activation method the obtained glass powder was categorized into two kinds: fine (mesh size in between 100-200); and superfine (more than 200 mesh size). Thermal activation was achieved by calcine the powder temperature of about 400^0C to about 575^0C. Chemical modification process involved the use of fluoride reagent followed by final calcinations. Superfine thermally activated glass powder with calcinations temperature shows application as absorbent material in chromatography including column and thin layer; while chemically activated material can be used as skeleton and isomerization catalyst for polyolefin degradation.

The resultant chemically activated waste glass material thus obtained was used for the degradation of various kinds of polyolefin namely polypropylene and polyethylene and the following are the findings:

1. Alkanes are obtained as a principle degradation product in all the cases of degradation all kinds of waste plastics;
2. Liquid fuel products obtained by the plastic degradation are in between the range of 50-70% indicates practical and economic aspects of this degradation, as collection and transportation of liquids are easier compared with gases;
3. In this method degradation is achieved by using economic catalysts which makes the process more economic;
4. No hazards products were obtained after degradation;
5. Potential method for the conversion of waste plastic to fuel products.

Unique Outcome

By the above project it is possible to produce amorphous Zeolite at the cost of about 100-120 rupee per KG (the cost of commercial amorphous Zeolite was around 1200-1400 rupee per KG. The cost of fuel oil thus obtained from waste plastic was around the cost of 30-32 per liter.

Two reactors, one pilot scale and another laboratory scale, were also designed in this project. The pilot scale reactor can be used for the pulverization and separation of silicate containing solid waste and laboratory scale.

Utility of work to Uttarakhand

The problems associated with the management of solid waste like glass with plastics is more problematic at hilly areas. According to report by Uttarakhand environmental protection and pollution control board in most of the kumaon and Garhwal hills most of the solid waste spread as open dumps because designing of scientific landfill site was always a problem for these areas. In this context management by degradation is most promising way to manage these waste and definitely this technique may provide unique contribute in this area to solve the problem.

Assessment of solid waste generation & contamination in Gahli & Toli (Neelkanth tourist zone) micro-watersheds of River Hinyul, Yamkeshwar Block, Pauri Garhwal

R.K. Mukerji
Society for People's Economic Development, (SPeED)
39, Block II, Bahndari Bag,
Dehra Dun - 248001
E-mail:- rkmukerji@yahoo.co.in

Rural areas of hilly regions of Uttarakhand are witnessing newer and more potentially damaging problems of waste management. The fragile hilly slopes, valleys and drainage lines are commonly seen littered with plastics & other waste materials mostly non-biodegradable in nature. These clubbed with problems of poor sanitation & hygiene practices cause severe water contamination problems in village areas, especially during the rainy seasons. Influence of urbanization & encroachment of FMCG culture into the remotest corner of the rural setting have multiple and cumulative effect with regular generation of toxic & hazardous waste thrown & scattered all along the hill slopes and valleys.

The increasing problem of Solid Waste Management in rural mountain areas is more due to lack of awareness about influx of urbanization pattern in rural habitat, increased use of Fast Moving Consumer Goods in rural areas (especially plastic & non bio-degradable packaging materials), lack of proper dumping & disposal sites around the habitational areas and access to appropriate technology options for disposal & management of non bio-degradable waste material. The generation and disposal of solid waste is more pronounced in these areas, such as Neelkanth Tourist Zone due to the presence of religious tourism site of ***"Neelkanth Mahadev Mandir"***. Due to heavy influx of devotees and other tourists, large quantities of packed & packaged items are sold in the area, which regularly generate huge quantity of waste, which needs appropriate disposal and management options. The problem of waste management in hilly areas become more complex because of scattered and seasonal variation of waste generated in the rural setting. The scattered waste along the hill slops & terraced field ultimately ends up in local drainage and water bodies and clogging the local water channels, springs & minor irrigation systems. As the quantity of waste generated in rural areas at any place or location is not enough for commercial waste management options, economics of waste management needs specific and local based solutions rather than the known conventional waste management practices often adopted at large urban clusters. This calls for assessment of locally generated waste, classification of waste, seasonal variation and local management options involving communities & other stakeholders.

During the one year intervention in the two micro-watersheds in the Hinyul River Valley popularly well known for the Neelkanth Mahadev temple situated in the valley, community initiated waste assessment and management options were implemented. During the intervention period waste assessment in 11 selected villages in two MWSs and Neelkanth Temple complex was done including the waste classification and seasonal variation assessment. The on-going waste management practices were studied and possible local community based

options were assessed. Community awareness and involvement was the key object of the whole programme in addition to the scientific assessment and classification of waste generated in the area. In addition mapping of drinking water sources in the intervention area was conducted and periodic community based water testing was promoted involving children, students and women and Panchayat community members. Special awareness and orientation drive was organized involving local Vyapar Mandal and Mandir Samittee for management of waste generated in the Temple complex.