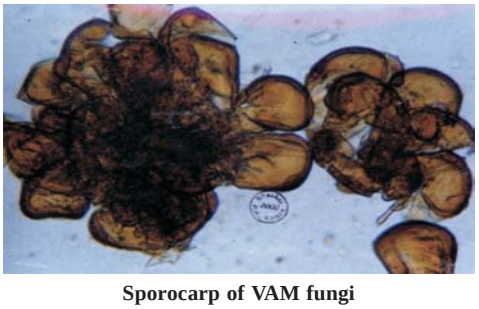
Vesicular Arbuscular Mycorrhiza: a potential biofertilizer

One of the most significant events in the terrestrialization of plant was the evolution of biotrophic root inhabiting symbiosis. Fungal-root symbiosis, referred to as 'Mycorrhiza', plays an important role in the development of terrestrial plants. Broadly, two major associations of mycorrhizae are classified on the basis of their relation with roots. Ectomycorrhizae are characterized by a complete sheath of fungal tissue, which encloses the ultimate rootlets of the root system together with an intercellular infection of the epidermis and cortex. Endomycorrhizae is the fungal-root association in which the hyphae regularly penetrate the cortical cells of the host. Endomycorrhizae have been classified into five different types. Of these, the most widespread and unbiquitous is Vesicular-Arbuscular Mycorrhiza (VAM).

VAM is the most abundant kind of mycorrhiza described as 'a universal plant symbiosis'. They are found in practically every taxonomic group of plants and the list of species not infected is probably far shorter than the infected ones. Lack of host specificity is even more characteristic of this symbiosis than other types known. Studies on VAM fungi conducted during last few decades envisaged their occurrence in a wide variety of hosts, different habitats and variability in their quality and quantity.

Wide spread distribution both in terms of habitats and host speices, symbiotic relationships since the advent of terrestrialization, host growth promotiveness and protection, obligate nature and non specificity for host, positive interaction with other rhizosphere microbes and several other characteristics of VAM fungi have obviously forced to find out their practical aspects. After the development of isolation techniques, mass production methods and inoculation, VAM fungi have been regarded as the boon for agriculture, forestry and restoration of disturbed ecosystems.

Intraradical spores of VAM fungi



Sporocarp of VAM fungi

Needs for indigenous VAM species isolation, screening and identification have been emphasized for these purposes. It has been a common experience that although chemical fertilizers have doubled the agricultural productivity but the mycorrhizal infection together with spore production have decreased. There is a need to use the VAM fungi as biofertilizers together with the minimum use of other chemicals. Experiments as done in agriculture have been considered for trees and other plants for forest development. Although a few studies have been conducted on tropical trees, the results are encouraging as the growth of seedlings and productivity was found enhanced. Use of VAM fungi in forestry appears to be more important than in agriculture because in countries like India no large scale provisions exist to irrigate, fertilize and protect the plantation. Practical use of VAM fungi seems to be more appropriate as they are effective in overcoming the stress conditions like draught, disease incidences and deficiency of nutrients.

- Bhaskar Chaurasia

Receding glacier – a threat on fresh water

Water is life; it is a precious resource. All living beings need water for survival. Water is the lifeblood of the environmental system. There is no clear-cut evidence or proof as to when and how water was formed on this planet. It is largely believed that water came into existence about 4,500 million years ago when the earth was formed. 77.33% of fresh water of our planet is mostly contributed by polar ice caps and glaciers.

Kedardome peak in the Gangotri glacier

The Himalaya, which confers many gifts to the Indian sub-continent, locked 1,400 km^3 of snow and ice spread over nearly 33,200 km^2 area in higher altitude. There are over 15,000 glaciers here. It is provider of life giving water to the sub-continent. Snow and glacier covered mountains in the Himalaya are the perennial sources of the rivers and streams, which flow out of them. Nearly 1,20,00,000 million cubic meters of water flow down in the Himalayan rivers annually. This region is, therefore, immensely rich in water resources and possesses huge potential of hydropower generation and irrigation for agriculture.

Several studies report on the receding rates of the Himalayan Glaciers, i.e. Gangotri 24, Pindari 23.5, Milam13.3, Dokriani 17.00 m in the Uttaranchal, Chota Shingri 44.3 and Trilokinath 15.4 m in the Himanchal Pradesh, and Zemu 13.2 m in the Sikim every year.

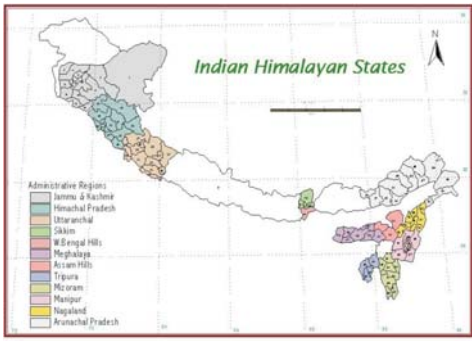
Glaciers all over the world have been in receding mode. The rates of receding are faster in the Himalayan glaciers due to many unique characteristics. They are covered by thick pile of debris, moraines in the ablation zone of the Himalaya indicating faster rate of melting. Summer temperature in the Himalayan glaciers is also slightly higher than European glaciers. In addition to the above, the climate and meteorology of the Himalaya also determine the water resources. Indian summer monsoon is the dominant controlling factor for snow accumulation and ablation on the entire southern Himalaya; summer Indian monsoon causes snowfall and ablation simultaneously. The receding rates of the Himalayan glaciers indicate global warming and climatic change. A recent study by UNEP reported that the Global temperature has increased by 0.6 ^{0}C in last century and there is a possibility of 1.1^{0}C rise in the forthcoming 25 years. Therefore, according to the prediction of the Glaciologists the glaciers of the Himalaya may start to disappear by the year of 2035.

In the context of Indian Himalaya region the information on glaciers is very limited as there are insufficient weather monitoring stations near the glaciers to collect required information and to create a data base. However, some studies are being conducted by the Department of Science and Technology, Government of India in the form of funded projects in the region. But these are not adequate enough to make any effective plan to know detailed status of the glaciers. Hence, there is a need of serious coordinated efforts among the institutes/organizations working in this direction in the Indian Himalayan region specially for the glaciological study. Most dams and hydro-power stations are dependent on melting of glaciers. Data on the contribution of sediment and runoff have to be considered while planning and executing power projects and irrigation schemes in the Himalayan region.

- M.S. Miral and Kireet Kumar

Forest cover assessment in the Himalayan region

The Indian Himalayan Region (IHR) laying between 21°57' – 37° 5'N latitudes and 72° 40' – 97° 25'E longitudes occupies the strategic position of entire northern boundary (North-West to North-East) of the nation and touches as many as seven international borders with India. This great chain of mountains in Indian territory extends all along the northern border of the country from the eastern border of the Pakistan on the west to the frontiers of the Myanmar in the east for about 2,500 km in length with an average width of 240 km. The IHR covers an area of about 5 lakh km^2 and contributes about 16.2% of India's total geographical area. The geographical spread of IHR in different administrative regions is shown in the figure.



Administrative regions of the Indian Himalaya

The region forms of snow-clad peaks and glaciers on higher Himalaya and dense forests in mid-Himalaya. The forest is the major landuse parameter, which covers above 52% of the total reporting area of the region. According to the State of Forest Report 2001, the forest cover in the region is 215,658 km^2. The north-eastern states account for the lion-share as all the states/regions contribute more than 50% of forest to their respective geographical area. However, the forest covers of theses states (except Tripura) depict a marginal decline (exponential trend < 1) during the period 1993-2001. On the other hand, all the states of central and western Himalaya, West Bengal hills and Sikkim state, have recorded an increasing trend over the years. The most significant change in terms of increase in forest cover has been recorded in West Bengal Hills and Sikkim, especially the hill region of the West Bengal has recorded a very large increase (>50%) in forest cover during 1999-2001. The following table shows the assessment of forest cover during 1993 to 2001 in the IHR.

States/Regions	Geographical area (km^2)	Assessment year					Exponential trend
		1993	1995	1997	1999	2001	
Jammu & Kashmir	222236*	9.20	9.19	9.20	9.20	9.56	1.0039
Himachal Pradesh	55673	22.46	22.45	22.49	23.50	25.79	1.0162
Uttaranchal [a]	53483	-	-	43.46	43.49	44.76	1.0074
Sikkim	7096	43.95	44.07	44.10	43.94	45.00	1.0022
West Bengal Hills[b]	3149	-	-	-	46.21	69.74	-
Meghalaya	22429	70.31	70.06	69.81	69.70	69.48	0.9986
Assam Hills [c]	15322	-	-	-	86.52	79.82	-
Tripura	10492	52.78	52.78	52.86	54.76	67.38	1.0266
Mizoram	21087	88.67	88.09	89.04	86.96	82.98	0.9928
Manipur	22327	78.92	78.64	78.01	77.86	75.81	0.9955
Nagaland	16579	86.54	86.20	85.78	85.43	80.49	0.9923
Arunachal Pradesh	83743	81.99	81.94	81.92	82.21	81.25	0.9993
India	3287263	19.45	19.43	19.27	19.39	20.55	1.0054

* Includes 78,114 and 37,555 km^2 occupied by Pakistan and China, respectively, and 5,180 km^2 handed over by Pakistan to China.

[a, b, c] Estimated from the state-hood figures of Uttar Pradesh, West Bengal, and Assam respectively.

[Source: State of Forest Report, 2001]

- S.N. Nandy

Aconites in Danger in Paradise

Spread of *Epilobium latefolium* in the Valley of Flowers

The world famous paradise for flowering plants, the Valley of Flowers, in the Chamoli district of the Uttaranchal state has remained under strange controversies since its inception in the Protected Area Network as a National Park in 1982. The point of contention is that the conservation attempt is proving to be the problem rather than the solution. For the past two decades, there have been occasional reports about weeds (e.g. *Polygonum polystachyum* and *Impatiens sulcata*) choking the plant diversity of the region. However, this concept is not unanimously accepted even by all the local communities. Some of the local people praise the conservation attempt by saying that the diversity of many flowering plants has increased after imposing ban on livestock grazing while others are more critical and brush off this theory.

Besides, I have noticed some more phenological changes in the flowering plant species within the Valley of Flowers in recent years. An endangered medicinal plant locally called as Mitha (*Aconitum balfourii*) grows mostly away from *Polygonum polystachyum* patches and obtains a strong stem but unfortunately I have observed that many individuals of this Aconite species were dying without bearing flowers. Many of these individuals start getting a dark colour on the apical part, which descends gradually to the remaining parts of the plant. After a few days, the leaves of the upper portion of the plant become wrinkled. This is most likely a deadly disease, which might even eliminate this plant from the valley. The causal organism needs to be studied before this species is wiped out from its habitat in the valley. Another species of the same genus - *Aconitum heterophyllum* - was mentioned by Frank Smythe but during my decade long studies in this valley I did not come across of this critically endangered medicinal plant species. I am afraid that the spread of this disease may affect the population of other flowering plant species if the preventive measures are not taken up soon.

- Chandra Prakash Kala

Research Projects

R&D Projects on Environment and Development

G.B. Pant Institute of Himalayan Environment and Development, under its Integrated Ecodevelopment Research Programme (IERP), has been supporting about 80 ongoing research projects in the Indian Himalayan Region (IHR). During the year 2003-2004, following twenty-eight new projects were sanctioned and funded.

- Development of strategies to improve the nutrition of dairy animals in the mountains of Uttaranchal by Dr. Vir Singh, Department of Animal Science, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttaranchal.
- Improvement of community wastelands through the introduction of improved grass and legumes species in sub-montane and low hills subtropical zone of Himachal Pradesh by Dr. Purushottam Kumar, Department of Agronomy, CSK H.P. Krishi Vishvavidyalaya, Palampur, Himachal Pradesh.
- Popularisation and dissemination of GBPIHED and DARL (DRDO) agro-technology for multipurpose tree plantation through peoples participation in remote areas of Pithoragarh district by Mr. A.S. Bisht, Gramodayag Sewa Kalyan Samiti (GSKS), Panda, Pithoragarh, Uttaranchal.
- Mistletoes heavy loss assessment to fruit and seed production, reproductive value, and progenies of ten important forest trees of Garhwal Himalayas by Dr. Y.P.S. Pundir, DBS Post Graduate College, Dehradun, Uttarachnchal.

- Biodiversity, ecology and conservation of wild silk moths in Nagaland by Dr. Lakhmi Nandan Kakati, Department of Zoology, Lumami, Mokokchung, Nagaland.
- Development of suitable propagation technologies of three *Terminalia* species by Dr. Subhash Nautiyal, Botany Division, Forest Research Institute, Dehradun, Uttaranchal
- Vermicomposting from locally available substrate materials and its quality evaluation by Dr. Raj Pal Sharma, Department of Soil Science, CSK H.P. Krishi Vishvavidyalaya, Palampur, Himachal Pradesh.
- Evaluation of superior tea hybrids for adaptability and dissemination of technology to the planters for the development of model tea estate by Dr. Satish Paul, Department of Tea Husbandry and Technology, CSK HP Krishi Vishvavidyalaya, Palampur, H.P.
- Micopropagation of important bamboo species for Indian Himalayan region by Dr. Anjuli Agarawal, Zonal Agricultural Research Station, GBPUA&T, Majhera, Garampani, Nainital, Uttaranchal.
- Training cum extension program for organic farming in the border area villages of Uttaranchal by Ms. Rajeshwari Bisht, Department of Organic Farming, Bal Vikas Siksha Samiti, Bhetiyara, Dhontri, Uttarkashi, Uttaranchal.
- Establishment of eco-awareness clubs and income generation activities through nursery raising of medicinal plants in primary and upper primary schools of Paubo block of district Pauri Garhwal by Dr. Munna Singh, Institute of Himalayan Awakening and Environmental Research, Dehradun, Uttaranchal.
- Assessment and promotion of economic wetland biodiversity of Manipur : A concern for ecological, ethnical and economical dimensions by Dr. Huidrom Birkumar Singh, Regional Research Laboratory, Manipur Substation (CSIR), Lamphelpat, Imphal, Manipur.
- Conservation of biodegradable waste materials of Imphal city into usable compost through vermicomposting by Mr. S. Sanjay Singh, Agricultural Development Organization (ADO), Manipur University Campus, Canchipur, Imphal, Manipur.
- Screening of suitable genotypes of *Parkia roxburghii* for agroforestry systems in NEH Region by Dr. B.P. Bhatt, Agroforestry Division, ICAR, Barapani, Meghalaya.
- Nutritive value, anti-nutritional and toxic factors, and domestication potential of some edible wild foods of Meghalaya by Dr. Dipika Agrahar-Murugkar, Division of Animal Nutrition, ICAR Research Complex for NEH Region, Umroi road, Umiam, Meghalaya.
- Exploration of ophidian fauna of Nagaland by Dr. J. Meren Ao, Kohima Science College, Jotsma, Kohima, Nagaland.
- A study on the bio-diversity of Orchids in southern Assam and their conservation by Dr. B.K. Dutta, Department of Ecology and Environmental Science, Assam University, Silchar, Assam.
- Ichthyofaunal diversity and fishery potential in the wetlands of Hajo, Kamrup district, Assam and study of socio-economic status of the fisherman community by Dr. (Mrs.) Sabitry Choudhury Bordoloi, Resource Management and Environment Division, Institute of Advanced Study in Science and Technology (IASST), Khanapara, Guwahati, Assam.
- Chemical prospecting of certain less known medicinal plant species of Assam used for anti-fertility [target plant species : *Meyna laxiflora* and *Stephania henandifolia*] by Dr. J. G. Handique, Department of Chemistry, Dibrugarh University, Dibrugarh, Assam.
- Antibacterial activities of folk medicinal plants against the flacherie disease in Muga silkworm *Antheraea assama* (Ww) by Dr. B. G. Unni, Department of Biochemistry, Regional Research Laboratory, Jorhat, Assam.
- Vermicomposting and its application in rural agricultural development in Assam by Mr. Sarfraz Haque/Dr. H. Dhattareya, Institute of Integrated Resource Management, Mission Chariali, Dekargaon, Sonitpur, Assam.
- Conservation of microbial diversity in North Eastern India including Majuli and its potential application in agriculture and industry by Dr. G.N. Bordoloi, Department of Botany, Bahona College, Jorhat, Assam.
- Ecorestoration of degraded sacred groves of Meghalaya by Dr. H.N. Pandey, Department of Botany, North Eastern Hill University, Shillong, Meghalaya.

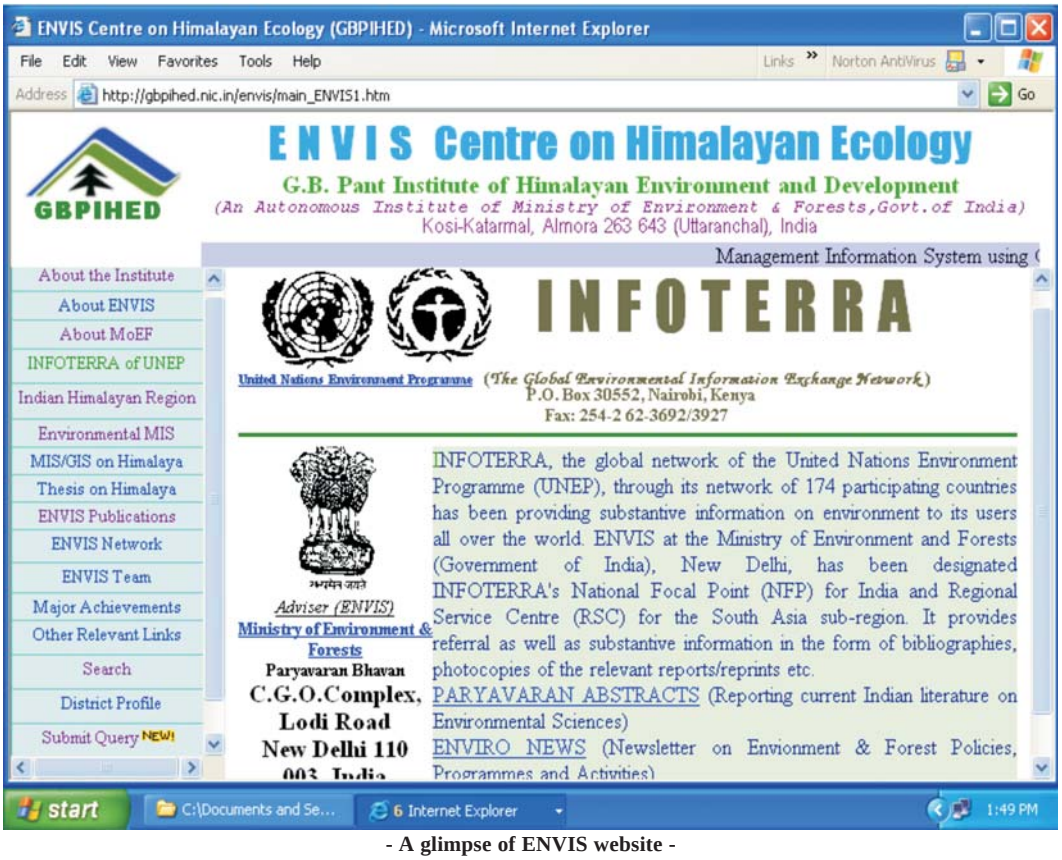
- Ecorestoration and conservation of religious sites in eastern Himalayan region by Dr. C.K. Baruah, Department of Botany, Gauhati University, Guwahati, Assam.
- Studies on land use dynamics and environmental restoration in and around Monasteries in Tawang district of Arunachal Pradesh by Dr. A. Arunachalam, Department of Forestry, North Eastern Regional Institute of Science and Technology, Nirjuli, Arunachal Pradesh.
- Restoration of biodiversity of hills of Kujapuri Siddhapeeth following Badrivan restoration approach by Dr. H.B. Vashistha, Division of Forest Ecology and Environment, Forest Research Institue, Dehradun, Uttaranchal.
- Inventory and spatial mapping and modeling of sacred biodiversity landscapes for conservation in Meghalaya by Dr. Uma Shankar, Department of Botany, North Eastern Hill University, Shillong Meghalaya.
- Eco-restoration and conservation of biodiversity around Shri Baba Balak Nath (Hamirpur) and Shri Naina Devi Ji (Bilaspur) temples in Himachal Pradesh by Dr. S.D. Kashyap, Directorate of Research, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh.

Theses on Himalayan Ecology (1999-2002)

Research work for following doctoral (Ph. D.) theses were carried out at the GBPIHED on different aspects of plant/environmental/social science

Fellow	Thesis Title
Agnihotri, R.K.	Exploration and eco-physiological studies of various landraces of rice (*Oryza satival*) *L.* in Kumaun Himalaya.
Arya, S.C.	Assessment of habitat diversity, distribution of vegetation and human dependence in alpine meadows of Nanda Devi Biosphere Reserve, west Himalaya.
Bhuchar, S.K.	An eco-physiological evaluation of *Thysanolaena maxima* (broom grass) : a multipurpose, perennial grass of high fodder value.
Bisht, A.K.	Conservation and propagation of a critically endangered, medicinal herb, *Angelica glauca* Edgew. of western Himalaya.
Chandra, Bhuwan	Studies on propagation, agrotechnology and phytochemical evaluation of some alpine medicinal herbs of Himalayan region.
Joshi, H.C.	Assessment of habitat diversity, forest vegetation and human dependence in the buffer zone of Nanda Devi Biosphere Reserve of west Himalaya.
Joshi, Meena	Developing propagation protocols of selected high altitude endemic medicinal Umbellifers of the Himalaya with a focus on *Angelica archangelica* L. var *himalaica* Cl.
Kandpal, K.D.	Organic matter decomposition and its effect on available nitrogen, phosphorus and potassium in mountain crop field soils.
Maharana, Iyata	Economic benefits and conservation linkages from tourism development in the Sikkim Himalaya.
Manjkhola, Sumit	Biology and conservation of *Arnebia benthamii* – an endemic medicinal herb of high altitude Himalaya .
Nautiyal, Sunil	Ecosystem function of buffer zone villages of Nanda Devi Biosphere Reserve.
Pandey, Bhawana	Ecology of *Myrica esculenta* Buch. Ham. ex D. Don with special reference to natural regeneration and source dependent variation in propagation response.
Purohit, V.K.	Mass propagation of Banj, Tilonje and Phaniyat oaks.
Shah, Anubha	A comparative study of status and fertility behaviour of rural and urban women in Himalayan Kumaun: a geographical perspective.
Sharma, Purnima	Ecological linkages of carbon dynamics in relation to land-use/cover change in a Himalayan watershed.
Singh, H.B.K.	Grazing impact on plant diversity and productivity along a tourist trekking corridor in the Khangchenjunga Biosphere Reserve of Sikkim.
Sundriyal, Manju	Distribution, propagation and nutritive value of some wild edible plants in the Sikkim Himalaya.
Tiwari, S.D.	Studies on forest ecosystem in a protected area of Garhwal Himalaya.

The Website



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ENVIS Newsletter on Himalayan Ecology

Volume 1, 2004

In this issue

Editorial

ENVIS Newsletter on Himalayan Ecology is an annual non-priced publication of the ENVIS Centre, which was established in the headquarters of the G.B. Pant Institute of Himalayan Environment and Development (GBPIHED) in 1992 with the financial support from the Ministry of Environment and Forests, Government of India, New Delhi. The first volume of this Newsletter contains four articles received from the researchers of this Institute. The opinions expressed in these articles of the Newsletter do not necessarily reflect the official views of the GBPIHED. The content of the Newsletter may be quoted or reproduced for non-commercial use provided the source is duly acknowledged. The contributions to the next volume of the Newsletter in the form of research/popular article(s) and news item(s), etc., related to the aspects of Himalayan Ecology, are welcome. The matter supplied by the individual/organization may be edited for length and clarity. Request for subscription of the Newsletter may be sent to the Executive Editor of the Newsletter. The comments/suggestions for the improvement of the Newsletter are also welcome.

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Executive Editor

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