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BIODIVERSITY AND BIOTECHNOLOGY

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ABSTRACT

"Biodiversity and genomics are two key words governing bioscience in the 21st century. The Convention on Biological Diversity will be increasingly important". Modern biotechnology tools and techniques including tissue culture, micro-propagation, transgenic plants and animals, and genomics can be used to defend, conserve and propagate all forms of biodiversity. In short, biotechnologies should be used with other possible means to maintain biodiversity".

INTRODUCTION

The concept of biological biodiversity includes all organisms, species, and populations; the genetic variation among these; and all their complex assemblages of communities and ecosystems. It can also be defined as the interrelatedness of genes, species, and ecosystems and their interactions with the environment. Broadly biodiversity are discussed under genetic, species, and ecosystem diversity.

Genetic diversity includes different genes contained in all individual plants, animals, fungi, and microorganisms within a species as well as between species.

Species diversity includes all the differences within and between populations of species, as well as between different species. Ecosystem diversity is all the different habitats, biological communities, and ecological processes, as well as variation individual ecosystems.

Modern biotechnology applications have opened a new door to conserve the agricultural biodiversity. The best well seen practical example is the transgenic crops that are more likely to increase agricultural biodiversity and help maintain native biodiversity rather than to endanger it.

Current concerns to Biodiversity

The loss of biodiversity is a significant concern for all human beings since its directly or indirectly related to us and our lives. Species are becoming extinct at the fastest rate and most of these extinctions have been done directly by human, for ex-Rapid population growth and unsustainable patterns of resources consumption are major cause in the loss of species, populations, and ecosystems. The over-exploitation and human generated pollution and contamination are other major concerns which are also directly related to Global climate change. And in current scenario to world "Global Warming" is presenting a real threat to the life is also a result of loss of biodiversity as well.

"Since the 1600s, over 250 species of birds, mammals, reptiles, and amphibians worldwide have become extinct as a result of human

Dr. Rajan Kumar Gupta

Dr. Rajan Kumar Gupta obtained his M.Sc. and Ph.D. degree from Banaras Hindu University and worked on Ecophysiology of Antarctic Cyanobacteria for his Ph.D. degree with Prof. A.K. Kashyap, Centre of Advanced study in Botany, Banaras Hindu University, Varanasi. For the past twenty years he has been working on various aspects of Antarctic microflora.

Dr. Gupta was deputed by Govt. of India for his participation as Biological Scientist in Antarctica twice. He has participated in XIth and XIVth Indian Scientific Expeditions to Antarctica during 1991-92 and 1994-95. He has visited several countries like Mauritius, Japan, Nepal Thailand, South Africa and Belgium for presentation of his work on different aspects of algae. Dr. Gupta has worked on various aspects of cyanobacteria i.e. morphology, ecology and nitrogen fixation, biotechnological applications and published more then 40 technical papers in various National and overseas Journals and more then 30 chapters in various books. Dr. Gupta has published three Botany Practical Books one book on Paryavaran Adhyan (Environmental Studies) and three reference (research) books entitled "Glimpses of cyanobacteria" and "Advances in Applied Phycology" and "Soil Microflora". Three students have been awarded the D.Phil degree and four are working under his supervision for their D.Phil degree of HNB Garhwal University. He has worked on Use of Cyanobacteria as Biofertilizer in Antarctica as well as in Foot Hills of Garhwal Himalaya and worked on a couple of project on Cyanobacteria of Paddy fields of Dehradun District of Himalaya. Presently Dr. Gupta is working on a project sponsored by Uttarakhand Council for Science and Technology, Dehradun on Diversity of Vasicular Arbuscular Mycorrhiza. Dr. Gupta is member of number of organization in India and abroad. He is the Fellow of the Society for Environment & Ecoplanning and International Botanical Society and Chaired various sessions in the conferences in India and abroad. He is in the editorial and advisory board of various journals. Presently Dr. Gupta is teaching Microbiology and Biotechnology in Department of Botany, Govt. P.G. College, Rishikesh 249201 (Dehradun), Uttarankhand

Dr Mukesh Kumar

Dr Mukesh Kumar (b. 1963) obtained his M.Sc and M. Phill degrees in Botany, and M.Ed in Education from Meerut University, Meerut - 250005 (now C.C.S. University, Meerut). He took his doctorate degree on Polyhouse Technology from H. N. B. Garhwal University, Srinagar – 246174 (Uttarakhand). Presently he is working as Reader at the Department of Botany, Sahu Jain Post-Graduate College, Najibabad – 246763 (Bijnor) U.P.

Dr Kumar is well known for his researches in the fields of Polyhouse Technology and Cyanobacteria. He is a member/ fellow of several National and International research organizations. Working on various aspects of Cyanobacteria *i.e* distributional pattern, population dynamics and dominance of different genera, he has explored the biodiversity of Cyanophycean Flora of the Sub-Himalayan Belt of Garhwal and Kumaon region of Uttarakhand state of India. He has accomplished a couple of Research Projects in the fields of his specialization *i.e* Polyhouse Technology and Cyanobacterial Diversity sponsored by the University Grants Commission, New Delhi. Presently he is working on another Project on Ganga water pollution sponsored by the UGC.

He has a credit to present his original research findings on the platform of plant scientists in several conferences / seminars and workshops. He has published more than 25 technical papers to various journals and chapters in several reputed books. The great success of his previous books entitled. "Glimpses of Cyanobacteria" and "Soil Microflora" has inspired him to work more on the phytodiversity, the most important issues of the earth environment.

He is the fellow of Indian Botanical Society and life member of several research journals. Four research scholars have already been awarded their Ph.D degrees of MJP Rohilkhand University, Bareilly, and four other are currently working for their Ph.Ds under his supervision. Presently he is actively engaged in the studies on Ganga water pollution with particular reference to the quality of soil, water and phytoplankton growth in and around the stream along with the impact of tourism on various parameters.

activities. In the past four years alone, 121 species have been added to the 11,167 already known to be threatened with extinction (i.e., those currently on the Red List of Threatened Species issued by the Species Survival Commission of the World Conservation Union [IUCN]) **(** Fonseca and Benson)

"Loss of biodiversity can be measured by a loss of individual species, groups of species or by decreases in numbers of organisms" (Crane &

Bateson 2003). The major threats to global biodiversity are habitat loss (result of increasing Industrialization and Globalization)). Habitats can also be damaged by flooding, lack of water, climate changes. Tropical humid forests are particularly rich in biodiversity and It is estimated that only half of the original 16 million km^2 of these forests a century ago are left, with about one million km2 being destroyed every 5 to 10 years.

Importance of Biodiversity

In one words it's our "life "and we can have a very simple example justifying this statement that humans have always depended on the Earth's biodiversity for food, shelter, and health. Biological resources that are the basic needs of the day to day life for human beings include food, shelter and medicines all came from biodiversity.

Food—species that are hunted, fished, and gathered, as well as those cultivated for agriculture, forestry, and aquaculture;
Shelter —timber and other forest products and fibers such as wool and cotton;
Medicines—both traditional medicines and those synthesized from biological resources and processes.

All food is directly or indirectly obtained from plants and other photosynthetic organisms. Apart from direct benefits of biodiversity from the harvest of domesticated or wild species for food, fibres, fuel, pharmaceuticals and many other purposes, humans also derive benefit from its influence on climate regulation, water purification, soil formation, flood prevention and nutrient cycling (i.e. ecological services); and the aesthetic and cultural impact is obvious (Daily 1997; Balmford *et al* 2002) . The loss of populations, species, or groups of species from an ecosystem can unbalance the normal function and disrupt these ecological services. The Earth's biodiversity contributes to the productivity of natural and agricultural systems. Insects, bats, birds, and other animals serve as pollinators. Parasites and predators can act as natural pest controls. Various biodegradable organisms are responsible for recycling organic materials and maintaining the productivity of soil. Genetic diversity is also important in terms of evolution. And being a biotechnologist I am proud to say the fact that some times and for some diseases Biodiversity provides medical models for research into solving human health problems. Biodiversity is thus fundamental for current and future social and economic livelihoods.

Biotechnology and Biodiversity

The tools of biotechnology can be applied to maintain biodiversity. The biotechnology can be used as a great resources for knowledge by understanding its molecular level concepts by applying molecular biology advancements as well as using this knowledge practically and in applied way for the plant and animal breeding that is to transfer genetic information from one sort of organism to a particular crop, or to a farm animal to make it transgenic known as Transgenic plants, and Transgenic animals. And these became possible because of the excellent discovery in the field of biotechnology that is "Recombinant DNA Technology" (also known as Genetic engineering) which in fact revolutionized the whole concepts and led to the discovery of new era to modern biotechnology. Biotechnology has also proven useful for following genetic markers in plant and animal breeding. Animal or plant varieties are crossed conventionally by sexual means then analyzing a few cells of the newly born calf or of the newly sprouted crop, one can look at the desired forms of gene. This gives scope to predict a phenotypic property, which will only show up later in life, for example characteristics of a cow's milk or the crop's expected resistance to an infectious plant disease. In vitro fertilization is another revolutionary tool of biotechnology of animals through which the laboratory test can be done even before the embryo is implanted, which is refereed as pre-implantation diagnostics. Genetic conservation of crops is another good example to prove the power of biotechnology for biodiversity conservation.

According to Dr. Channaputra S. Prakash, "Biotechnology improvements are in development that would allow hybrid rice to be colonized by bacteria that fix nitrogen from the atmosphere. Plants that are able to fix nitrogen improve productivity in the absence of synthetic fertilizers (which are typically unavailable to poor

farmers). Further, improved tools such as cryopreservation, developed by bio-technologists, will help in the ex situ preservation of biodiversity, while creative techniques, such as gene shuffling, will help create more biodiversity and, perhaps, will even re-create extinct crop traits"(Prakash, C. S., 2000).

Biotechnological Approaches to Conservation

Ex Situ Conservation

It is the biological process of protecting an endangered species of plant or animal by removing part of the population from a threatened habitat and placing it out of the context of their natural habitats is referred to as ex-situ conservation. Examples include Zoos, botanical gardens and seed banks etc.

Ex situ conservation in genebanks is widely applicable method of preserving the genetic diversity of crops and wild species of plants. Cryogenic facilities are used for living sperms, eggs or embryos. The samples are frozen in liquid Nitrogen. With ex situ conservation, the long-term safety and integrity of genetic resources can be maintained by collecting and preserving desired endangered seeds, living plants, cuttings, and tissue cultures. To save a endangered plant it can be moved from In situ to a gene bank for ex situ conservation.

The functions of a gene bank include –

- ✓ Maintenance and expansion of germplasm collections,
- ✓ Long-term conservation
- ✓ Characterization and evaluation of samples
- ✓ Data management
- ✓ Exchange of germplasm among researchers
- ✓ And the promotion of germplasm use to enhance crop productivity.

Transgenic plants and animals/ GM Technology

We can improve food production and distribution in order to feed and fulfill the demand of growing world populations through GM technology which is also known as "transgenic plants" and the food and crop produced is known as transgenic crops and foods. GM technology can be applied to plants and micro-organisms to address the current challenges. Foods can be produced through the use of GM technology has several advantage –

- ✓ More nutritious,
- ✓ Stable in storage and,
- ✓ Health promoting
- ✓ Increase yield without increasing land under cultivation
- ✓ Virus resistant crops
- ✓ Pest resistant crops

Since all genes consist of DNA, and the information in this DNA molecule is read in the same way in all organisms in order to make proteins, it is in principle possible to take any (single) gene from any organism and

Transfer of genetic materials that are DNA (gene of interest) from one organism to any other organism (so that the recipient produces a protein normally only made in the donor) is called transgenic. The first transgenic plants were made in 1985, and the first transgenic crop appeared in supermarkets in the USA, the "FlavrSavr" tomato.

Other Biotechnology Tools

The effective biotechnological tools available for conservation of endangered species are cryopreservation of gametes, artificial insemination, embryo transfer, in vitro fertilization, and cloning. These technologies have great feasible potential for the preservation of biodiversity. Embryo transfer technology is used to introduce fertilized embryos into surrogate mothers. Artificial insemination is a successful tool used in cattle farming. Frozen samples of sperm are thawed and introduced into females that are ovulating. The quality of cattle has been improved using selected males to breed entire generations. Cloning procedures have been widely used in animal farming and has proven to be very feasible.

Biotechnology, Biodiversity and Dug discovery & Development

Natural products has had been an important part of drug development since from past to present and will continue into the future. The DNA sequencing of the human genome has laid new milestones to understand and identify

the defective proteins expressed by defective genes. These proteins can be used as molecular targets/drug targets for testing and identifying the natural compounds through the applications of new technology for ex- High throughput technology. "Natural product medicines have come from various source materials including terrestrial plants, terrestrial microorganisms, marine organisms, and terrestrial, vertebrates and invertebrates".

"An analysis of the origin of the drugs developed between 1981 and 2002 showed that natural products or natural product derived drugs comprised 28% of all new chemical entities (NCEs) launched onto the market" (Newman et al., 2003). In addition, "24% of these NCEs were synthetic or natural mimic compounds, based on the study of pharmacophores related to natural products"(Newman *et al*., 2000). This combined percentage (52% of all NCEs) suggests that "natural products are important sources for new drugs and are also good lead compounds suitable for further modification during drug development".**(** Young-Won Chin *et al*., 2006)

We have several successful histories of plants products which have produced a lot of important and effective drugs. Some examples are –

- ✓ Quinine - the anti-malarial drug btained from the bark of *Cinchona* species.
- ✓ Morphine - the analgesic obtained from the opium poppy
- ✓ Digoxin - for heart disorders, From *Digitalis purpurea*.
- ✓ Reserpine - the antihypertensive agent, from *Rauwolfia serpentine*
- ✓ Ephedrine - an anti-asthma agent, from *Ephredra sinica*.
- ✓ Tubocurarine - the muscle relaxant, from *Chondrodendron* and *Curarea*species.
- ✓ Taxol – the anti cancer agents from the bark of Taxus brevifolia.
- ✓ Vinblastin and Vincristine – the anti cancer agent from *Catharanthus rosesus*.

Microorganisms have also been extremely important in drug applications, ushering in the "golden age of antibiotics":

- ✓ Anti-bacterial agents from *Penicillium* species.
- ✓ Other antibacterial agents includes cephalosporins, aminoglycosides, tetracyclines, and polyketides.
- ✓ Immunosuppressants include cyclosporins and rapamycin, from *Streptomyces* species.
- ✓ Cholesterol lowering agents includes mevastatin and lovastatin, from *Penicillium* species.
- ✓ Anthelmintics and antiparasitic drugs include ivermectins, from *Streptomyces* species.

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