Technical Session - 1
Diversity Analysis and Conservation of Medicinal Plants

Lead Paper-1

Conserving medicinal plants for equitable healthcare

Veena Gupta and Anjali Kak
Division of Germplasm Conservation, ICAR-National Bureau of Plant Genetic Resources, PusaCampus, New Delhi 110012.
Email: veena.gupta@icar.gov.in

Plant Genetic Resources are the most essential of biological resources for sustaining life on earth as they provide food, nutritional and health security for the ever increasing population. Thus, their conservation along with sustainable utilization is of utmost important, not only for present generation but also for our future generations. The changing scenario at global level impacting genetic resources management include the recent international treaties, conventions, agreements; global climate change; use of biotechnology and other technological advances in agriculture; bio-security and bio-safety issues. Many international developments like the Convention on Biological Diversity (CBD), the International Treaty on Plant Genetic Resources for Food and Agricultural (ITPGRFA), the GATT/ WTO/ TRIPs regimes etc. are now emphasizing the conservation and sustainable utilization of genetic resources specially the medicinal plants.

India with its unique range of climatic condition ranging from cold arid deserts to highest rainfall area in North- East to dry deciduous deserts of Rajasthan and two hotspots of biodiversity harbor a tremendous reservoir of plant biodiversity. Systematic efforts are needed to conserve this biodiversity which shows varied reproductive behavior. To conserve this array of biodiversity, National Buearu of Plant Genetic Resources (NBPGR) has been entrusted to collect, conserve and characterize this diversity including the medicinal plants. The National Genebank (NGB) at NBPGR is a state of art facility comprising seed genebank (conserving orthodox seeds), in vitro genebank (conserving vegetatively propagated plants) and cryo genebank (conserving the recalcitrant type of seeds, embryos and pollen). The sincere efforts made by the NBPGR in last forty years have resulted in conservation of more than four lakh accessions at seed Genebank including 7274 accession of medicinal and aromatic plants. These also include the trait specific germplasm viz., 26 accessions of released varieties in 14 commercial medicinal crops and 47 accessions belonging to 28 crops of registered germplasm at NGB. The NGB also maintains 1900 culture accessions of vegetatively propagated plant species under *in-vitro* conditions which include 155 accession cultures of medicinal species. Alternately, around 11522 accessions belonging to 720 species have been cryo-preserved at optimum moisture contents of 5-8% in vapour phase of liquid nitrogen at a temperature of –150 to –196^{0}C. Taking into consideration the emerging IPR issues, DNA Profiles (655) are also being conserved in the cryo-bank.

Conservation of medicinal plants could succeed when these are linked with the economic development of farmers/rural poor. Pragmatic multi-disciplinary research and policy support are needed to evolve farming systems which can provide quality production of raw material for growing pharmaceutical industries and ensuring economic security to the local health programmes. Therefore it would be more appropriate if the conservation and commercialization should be directly linked to the sustainable utilization to ensure health security for all.

Lead Paper-2

Conservation of threatened ethnomedicinal plants of trade Importance in Tamil Nadu

T. Sekar
P.G. & Research Department of Botany, Pachaiyappa's College,
Chennai-600 030, Tamil Nadu, India
Email: tsekar_2005@yahoo.com

Abstract

Nature has been a source of medicinal agents for thousands of years, and an impressive number of modern drugs have been isolated from natural sources, based on their use in traditional medicine. India is a home for thousands of medicinally important plant species: it is ranked sixth among 12 mega diversity countries of the world. Out of the estimated 18,000 species of vascular plants in India, around 15% are feared to be under threat. While the demand for medicinal plants is increasing, their survival in their natural habitats is under threat and a number of medicinal plants have been assessed as endangered, vulnerable and threatened due to over harvesting in the wild. Tamil Nadu is having a rich diversity of ethnomedicinal plants and the areas with rich plant diversity likes Agasthiyamalai hills, Nilgiri hills, Kolli hills, Elagiri hills and Palni hills. These areas are also having a hundreds of endemic and threatened plants with medicinal importance. There is an urgent need to record indigenous knowledge on traditional plant use before it is lost to rapid urbanization. In addition, commonly used and commercially important ethnomedicinal plants, which are in endemic and threatened category, should be given priority for their conservation in natural habitats with biotechnological tools. In view of these, we have successfully develop standard tissue culture protocols for the *Ruta graveolens, Mappia foetida, Justicia gendurussa., Tylophora inidca, Phyllanthus debilis* and *Gymnema sylvestre* which are having a high trade value and also widely used by the various indigenous people in Tamil Nadu for treating different ailments. In addition, much attention must be given to classify endemic and threatened medicinal plants that are used by the tribal people, herbalists and plant gatherers, etc, because they do not have the knowledge and idea about the endemic and threat status of each medicinal plant collected by them. It concluded that, conservation measures targeted at the endemic and threatened plants as well as most important medicinal plants of an area would prevent destruction of natural vegetation. The above *ex situ* protocol developed in our laboratory is highly useful in field of agrotechnology for Lab to Land transfer method of highly potential medicinal plants. Cultivars and researcher can reintroduce the above threatened species in to the natural environ to conserve its population without being extinct.

Lead Paper-3

Prioritization of wild relatives of selected medicinal plants for collection and conservation in India

K Pradheep,KC Bhatt,DP Semwaland E Roshini Nayar
ICAR-National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi 110 012

Wild relatives (WR) of crop plants are taxa related to crop plants, include wild progenitors and/ or wild forms of crops, which are an important source of useful traits in crop improvement. In medicinal plants, wild relatives apart from their usefulness in contributing for breeding traits, would possibly be richer in active ingredients (than cultivated counter partners), hence worthy of direct utilization. National Bureau of Plant Genetic Resources, anodal organization at national level for the sustainable management of plant geneticresources (PGR) of food and agriculture, has explored vast areasunder this countryand collected diversity in wild species of PGR importance (about 12% of total collection). Considering the large number of medicinal plants species of major use and as substitute or supplement, prioritization of medicinal plants and their gene pool, their collection and conservation needs more focussed attention.This paper therefore, aims at prioritization ofWR ofselected medicinal plants (10) ofmajor economic importance as well as a focus of ICAR/CSIR research institutes *viz*. *Andrographis paniculata*, *Asparagus racemosus*, *Chlorophytum borivilianum*, *Mucuna pruriens*, *Ocimum basilicum*, *O. tenuiflorum*, *Piper longum*, *Senna alexandrina* (syn. *S. angustifolia*), *Tinospora cordifolia* and *Withania somnifera*, which will form the first step in PGR management programmes.

Major criteria followed for shortlisting the WR include closeness to cultivated taxa, possessing traits of breeders' importance/use, extent ofdistribution/threatand storage behaviourof seed.Accordingly, a total of 36 WR (out of about 200 taxa under respective genus boundary in India)have been categorized into different priority groups. It includes wild forms of nine medicinal plants (barring *Senna alexandrina*),infraspecific taxaunder*Mucuna pruriens* and *Tinospora cordifolia*, a natural hybrid species, apart from species of high conservation significance (6) and introduced ones (3). Some prioritized species are *Andrographis ceylanica*, *Chlorophytum arundinaceum*, *C. tuberosum*, *Ocimum americanum*, *O.* × *africanum* (*Ocimum basilicum* × *O. americanum*), *O. minimum*, *Tinospora sinensis*, *T. crispa* and *Withania obtusifolia*. It is known that *Ocimum basilicum*on hybridization with *O. americanum*, yielded allopolyploids having higher herbage and essential oil content. Besides collection and conservation of intra-specific diversity in the prioritized species, biochemical evaluation and population ecology studies are essential in their PGR management.This paper discusses about prioritization of WR, their nomenclature, specific occurrence, contributing traits, conservation constraints, etc.

Lead Paper-4

MEDICINAL PLANT INDUSTRY CHALLENGES AND APPORTUNITIES

S.B. Dandin, Liaison officer, Bioversity International
and formerly Vice Chancellor, UHS, Bagalkot
email:dandinbnm@gmail.com
s.b.dandin@cgiar.org

Abstract

India is the rich biodiversity country with two biodiversity hot spots and large number of endemic flora and fauna. Indian subcontinent stands 10th among the plant genetic resource countries and one of the top twelve mega biodiversity centers harboring about 15000-20000 species of medicinal plants, which accounts for 6% of the medicinal plants in the world. Around 70% India's medicinal plants are found in tropical areas in various forest ecosystems across the Western and Eastern Ghats, the Vindhyas, Chotanagpurplatue, Aravalis, A&N Islands and Himalayas extending up to entire North Eastern region.

Use of medicinal plants for human wellbeing and civilization grew together. Ever since the human settlement started, cultivation of useful plants also started. Indian contribution to the science of medicinal plants is remarkable. Aryans of the Indus valley wrote three treatises viz the **"Rig-Veda**" (2000 BC) "**Atharvana-Veda**" (2000-1000 BC) and **"Ayur-Veda**" (100-160 BC) where mention of several medicinal plants is made including the hallucinogenic mushrooms, *Amantiamuscaria* and *Rauvolfiaserpentina* used to treat snake bite, epilepsy, mental disorders etc**., "The Charaka Samhita**" an encyclopedia of Indian medicine published at Varanasi between 1000 BC and 100 AD is the comprehensive record of medicinal plants and their use. Later the Arabs and British invades introduced several medicinal plants into the country and an era of modern medicine stated from 1200 AD onwards. Today chemical and pharmaceutical investigations have added a great deal of knowledge and value of medicinal plants is much appreciated. As a result the chemical prospects Ephihedra, Sarpagandha (R.serpentina) which were well known in 4000 BC .Through pharmacopoeias knowledge about the use of medicinal plants has been accrued through centuries and such plants are valued and used even today.

In India medicinal plant sector has traditionally occupied an important position in the socio-economic, cultural and spiritual arena of rural and tribal lives. The Indian coded systems encompass a large number of treaties on recognized systems of medicine viz. Ayurveda, Unani, homeopathy and siddha. The Ayurvedic system of medicine, which accounts for major segment of population, currently utilizes as many as 1000 single drugs and over 8000 compound formulations of recognized merit. Other systems of medicine viz. Siddha and Unani system of medicine together utilize about 1800-1900 medicinal plant species. 80% people rely on plant for health care. Today approx. 35% of modern medicine are derived from natural products. In India, 95% of the prescriptions are plant-based in the traditional systems of medicines. 1700 plants have been documented as medicinal in Ayurveda and Modern Treatise 400 plants are used commercially in India for medicinal values but only about 20 species are grown as crops.

90% of the raw material is wild harvested and 70% of these are harvested destructively. At global level 4160 MAPs are threatened. In India according to Red Data Book; 427 Indian Medicinal plant are endangered, of which 28 are considered extinct, 124 endangered, 81 rare and 34 insufficiently known. >70% threatened medicinal plant species are in active trade. Limited cultivation, over-exploitation, unscientific-harvesting habitat destruction, climate change have added to the acute scarcity of raw material resulted in high commercial demand. Need for sustainable utilization on one hand and emphasis on systematic large scale cultivation on commercial scale appears to be the only answer for long tem sustainability of the industry. Ways and means to active self-sufficiency in meeting the ever increasing demand of the industry and generating gainful employment and economic sustainability on the other for the tribes and small and marginal farmers are discussed in this paper. Possibility of contract and corporate farming and establishing long term sustainable linkages between producer and processing firms is also discussed,besides, adding few points for way forward including the policy frame work for future.

Lead Paper-5

Conservation and Sustainable Utilization of Medicinal Plants: Possible Role of DNA Barcoding, Plant Biotechnology, Phylogenetic Analysis and Chemical Profiling

Shashi B. Babbar*
Department of Botany, University of Delhi, Delhi 110007

For thousands of years people in the Indian sub-continent have utilized traditional systems of medicine, which to a large extent depend on plants. Of the estimated 17,000-18,000 species of flowering plants existing in India, as per National Medicinal Plant Board of India, 6,000-7,000 are listed in different scriptures as the plants used in alternative or traditional systems of medicine, or as folk medicine. Of these 960 are traded in market, with 178 having trade volume of more than 100 metric tonnes per annum. Only a few of these are cultivated and the rest are collected from wild and presumably, their demands are met through indiscriminate and unsustainable collections from the wild adversely affecting their populations in wild. Realizing the possible threat to these plants, many of these have been included in various Appendices, including Appendix I, of CITES thus regulating, restricting or even prohibiting their trade. However, their trade in vegetative or fragmented forms cannot be effectively checked because of the incapability of the prevalent taxonomic methods of identification. Moreover, because of the unavailability or limited availability of these plants, other plants not having comparable efficacy, are used as substitutes, which do not necessarily satisfy the Auyervedic principle “Abhava Pratinidhi Dravyas”. To check illicit trade and substitution/adulteration of medicinal orchids and to ensure their conservation and sustainable utilization, a three pronged strategy needs to be adopted. To effectively curtail the illegal trade practices, DNA barcoding, a technology by which species can be identified even a minute amount of tissue or its DNA is available, needs to be adopted by the concerned enforcement agencies. However, a complete check in their collections from wild and substitutions could only be imposed if alternative source of supply is developed or substitutes satisfying the principle of “Abhava Pratinidhi Dravyas” and available abundantly are identified. The former could be accomplished by domestication the species in demand and developing suitable agro-techniques for their cultivation and harvest. For the latter, species closest to the medicinal ones needs to identified through phylogenetic tools followed by confirming their suitability by comparing the biochemical profiles of the potential substitute with the original one. In the lecture, DNA barcoding as a technology would be introduced and the progress made in its application to plants including the medicinal ones would be highlighted. Illustrative examples of use of plant biotechnology for the large scale multiplication of plants and phylogenetic analysis for identifying the closest species that is/are likely to have biochemical profile similar to that of the original species, would be presented and discussed.

Prof. S. B. Babbar, Email: babbars@rediffmail.com, Tel.: 91-11-27666708 (Off.), 09810278024 (Mobile)

Lead Paper-6

Genetic resources of medicinal and aromatic plants: status and future priorities

KC Bhatt, DP Semwal and SP Ahlawat
Division of Plant Exploration and Germplasm Collection, ICAR-NBPGR, New Delhi

Abstract

In India, the importance and uses of genetic resources of medicinal and aromatic plants (M&AP) have been known since the prehistoric times. About 70% of Indian population relies on herbal medicines for treatment of various ailments. Indian subcontinent holds more than one fourth of the world's known M&AP wealth, which is distributed in different phyto-geographic regions. Among these, the Himalayas are extremely rich and have a high degree of endemism. While the other diversity rich regions namely Western Ghats, Eastern Ghats, North-eastern hill region, Eastern Himalaya, arid & semi-arid region, Andaman and Nicobar Islands are also rich in medicinal and aromatic plants wealth. Over 8,000 species of ethno-medico-botanical importance are also reported in the country. Thus, India is a treasure house of M&AP species that is being utilized in several formulations of Indian Systems of Medicine (ISM). During last four decades, ICAR-National Bureau of Plant Genetic Resources has done sincere efforts to collect, characterize and conserve genetic resources of major M&AP. For this several germplasm collecting expeditions were undertaken in collaborative mode and over 7000 accessions in about 600 species (including threatened, endangered and rare) have been collected. In majority of the cases efforts were made to collect species diversity from diverse habitats of country. In addition to this, associated indigenous knowledge was also gathered from local practitioners/healers, tribals during explorations. Majority of accessions were mainly collected in *Ocimum* spp. (243), *Asparagus* spp. (225), *Aloe barbadensis* (207), *Withania somnifera* (193), *Abrus precatorius* (171), *Andrographis paniculata* (144), *Mucuna pruriens* (143), *Tinospora cordifolia* (130), *Commiphora wightii* (113), *Acorus calamus* (108), *Costus speciosus* (96), *Bacopa monnieri* (86), *Chlorophytum* spp. (82), *Aristolochia indica* (77), *Urgenia indica* (75), *Coleus forshkohlii* (74), *Rauvolfia serpentina* (69), *Centella asiatica* (63), *Alpinia galanga* (55), *Vitex negundo* (54), *Gloriosa superba* (53), *Curculigo orchioides* (45), *Hedychium spicatum* (40), *Valeriana jatamansi* (36), *etc.* The regions covered for collection of these included Kumaon and Garhwal hills of Uttarakhand, high altitude regions of Himachal Pradesh, Jammu & Kashmir, Uttar Pradesh, Western & Eastern Ghats, Chhattisgarh, Jharkhand, NEH region, Rajasthan and Gujarat. Among the assembled diversity, germplasm of different M&APs has also been conserved under different storage facilities *viz.* seed gene bank (4519 acc.), tissue culture repository (172 acc.), cryo-gene bank (849 acc.). several vegetatively propagted species *viz. Acorus, Aloe, Alpinia, Aristolochia, Asparagus, Bergenia, Bixa, Centella, Celastrus, Cissus, Commiphora, Costus, Cryptolepis, Curcuma, Curculigo, Cymbopogon, Garcinia, Geranium, Gloriosa, Hedychium, Hemidesmus, Hodgsonia, Homalomena, Plumbago, Rauvolfia,*

Terminalia, Tinospora, Valeriana, Vetiveria, Vitex, Zingiber, etc. are maintained under field gene banks of NBPGR Regional Stations/ Base Centres and National Active Germplasm sites.

Germplasm of M&AP species are facing sever threats particularly due to overexploitation, lack of regeneration/multiplication and systematic cultivation methods. There is a need to prioritize species to collect, standardize collection and conservation techniques, incorrect botanical identity, different plant habits (herb, shrub, tree and climber), distribution in diverse regions, having different plant propagules (seeds, roots, rhizomes, tubers, clones, cuttings, etc.), short viability and post handling problems. Moreover, the plant material collected from wild may also be contaminated by other species or parts thereof and also differ in active constituents from area to area, which is difficult to observe in field during collection. Hence, an organized and systematic planning is required to collect, characterize, conserve and utilize their genetic diversity for developing varieties having desired traits.

OP-1

The need for resolving taxonomic ambiguities and the study of genetic diversity in *Barleria* - an underexploited medicinally important genus

Sonal Malik[1] and Suman Lakhanpaul
Department of Botany, University of Delhi, Delhi-110007

India is one of the twelve mega-biodiversity countries of the world which has a rich heritage of plants including several taxa of medicinal value. *Barleria* with its 300 species is the third largest genus of pan-tropical family Acanthaceae. Several phytochemicals and active constituents have been isolated and analyzed from various species of this genus with potential pharmacological applications.

The genus *Barleria* is predominantly an old world taxa with two centers of diversity, i.e., Africa and Asia. Among Asiatic countries, India is one of its major centers of biodiversity having more than 25 species. Some species of *Barleria* are endemic in nature whereas others are widespread in their occurrence. Due to various reasons, certain endemic species of genus such as *B. repens, B pilosa* etc. have become endangered. Therefore, there is a need to devise strategies to conserve these species, thus requiring their diversity analysis at the inter- and intra-population level. In addition, the taxonomic delimitation of the Indian species of *Barleria* has remained ambiguous and comprehensive studies using recent molecular approaches are needed to resolve the disputes arising due to morphology based characterization. Studies on these aspects are rather scanty in spite of immense economic value of the taxa.

A total of over 70 samples representing 29 taxa belonging to five sections, namely, Barleria, Chrysothrix, Prionitis, Somalia and Cavirostrata were collected from different parts of the country. The samples included several taxa with disputed nomenclature or lacking taxonomic identity at the species level. Protocol for obtaining genomic DNA was optimized and high quality DNA samples were tested for their amplifiability using appropriate PCR primers. Out of five taxonomically useful genomic loci tested, namely, trnK, matK, rbcL, atpEI and atpB-rbcL the atpB-rbcL and rbcL loci are showing optimal amplification and revealing sequence level variation. Attempts are being made to find additional DNA based markers to resolve the taxonomic conflicts and reveal genetic structure of the populations collected. The study will help in devising suitable conservation strategies and fill vital knowledge gaps in this important genus thereby, enabling its judicious utilization.

OP-2

Save Medicinal Plants from Extinction

S.V.S. Chauhan* & Seema Chauhan
Academy of Life Sciences, 8/13 I Kaushalpur, Bye Pass Road, Agra-282005
e-mail: svsc071241@gmail.com

Plants have been used in the traditional health care system from time immemorial, particularly among tribal communities. The World Health Organization (WHO) has listed 20,000 medicinal plants globally and about 2000 drugs used are of plant origin (WHO, 2009). India's contribution is 15-20%. More than 7,500 species of medicinal plants grow in India which is considered as the botanical garden of the world. India is one of the 17 mega diverse countries of the world with two hotspots.

In recent years more attention is being directed towards herbal medicines because these are inexpensive, non-toxic and eco-friendly. There are larger numbers of phyto-pharmaceuticals isolated from plants which are being used in modern medicine. Plants are known to contain innumerable biological active compounds which possess antibacterial properties. Several popular drugs such as opium, hashish, dhatura, rauwolfia, nux-vomica, aconite, mustard seeds, and lemon etc. are plant products. More than 70% of India's 1.1 billion populations still use herbal drugs (Ayurveda, Yoga, Unani, Sidha, Homeopathy and Naturopathy). Indian medicinal plants are rich source of antioxidants.

In last ten years there has been a dramatic increase in the export of medicinal plants and overwhelming interest in their products as well as in the traditional health systems has developed world wide. However, most of these plants are at the verge of extinction because of over-harvesting, excessive and destructive collection techniques, unprecedented environmental threat due to habitat loss, fragmentation, and invasion of exotics, pollution and climate change and conversion of habitats to crop-based agriculture. In the last few decades over-exploitation of medicinally important plants has led to species loss. As a result, 20-25% of existing plant species in India has become endangered. Medicinal plants are depleting globally at an alarming rate and a number of medicinally important plant species will soon be extent.

There is need for developing effective conservation strategies for a large number of endemic species. Reproductive biology plays an important role in biodiversity conservation of taxa (medicinally important species, orchids, mangroves) facing extinction. Cultivation of economically important medicinal plants is a challenging task because less is known about their reproductive biology and seed biology.

Most importantly, the strategies for both *in situ* and *ex situ* conservation of medicinal plants e.g. *Aconitum heterophyllum, Betula utilis, Datura stromonium, Euphorbia hirtsa, Moringa oleifera, Ocimum indicum, Ruta, chalepensis, Salvadora persica, Strychonos nux-vomica, Tridax procumbens* and *Withania sominefera* are important.

The establishment of the seedlings and rehabilitation of these species in their natural habitat and deposition of their germplasm in gene bank at National Bureau of Plant Genetic Resources, New Delhi are of utmost importance.

OP-3

Diversity analyses and conservation of medicinal plants

Oral Presentation

ABSTRACT

The use of biotechnological interventions based on *in vitro* plant tissue culture and genetic engineering has made possible for addressing the decisive problems of crop improvement for sustainable agriculture in present scenario. Plant cell tissue and organ culture is being used as a tool for rapid multiplication of virus free quality planting material by development of micropropagation protocols in most of the medicinal plants. Micropropogation technique is economical in time and space affords greater output and provides viral disease free and elite propagules. Storage and conservation of germplasm may be possible through tissue culture. Micropropagation of almost all of the medicinal and aromatic plants is possible now. Embryo rescue is proved helpful to rescue distant crosses. Haploid technology is being used to obtain complete homozygosity of the offspring that helps in phenotype selection for quantitatively and qualitatively inherited characters. Somatic hybridization and cybridization has been very useful in transferring cytoplasmic male sterility for obtaining hybrid vigour through mitochondrial recombination and for genetic transformation. *In vitro* selection makes possible to save the time required for developing biotic and abiotic stress tolerant lines. Mutants obtained from somaclonal variants can be effectively selected for tailoring tolerance/ resistant lines against different stresses .

In this presentation, micropropogation protocols of different medicinal and aromatic crops: liquorice, ashwagandha, sandalwood, *Plumbago zeylanica*, sarpagandha and aloevera developed in our lab will be discussed Besides production of secondary metabolites production in sarpgandha and chitrak will also be presented.

OP-4

Medicinal Plant Diversity of Vindhya Plateau of Madhya Pradesh

G. Tiwari*, S.K. Garg, R.N.Shrivastava

Vindhya Plateau is a rich agri-climmatic zone of M.P. with respect to the availability of medicinal and aromatic plants in their natural habitats. Extensive surveys of all the 6 districts (Vidisha, Raisen, Bhopal, Sehore, Sagar and Damoh) of Vindhya Plateau were conducted during 2014-15 and 2015-16 to explore the availability, status of natural regeneration and threat to valuable diversity of medicinal andaromatic plants of the region. The present paper emphasizes not only the current status and threat to these plants due to anthnopogamm activities but also propose the strategies to consume there in side and ex-side methods. About 200 important species were found in the region having medicinal value, out of these Jangli Pyaz, Giloe, Gumar, Bel, Aonla, Sankhpushpi, Satawar, Kalmegh, Chotta chiraita, safed musli, Jangli Haldi, Anatmool , antamool etc. are important for commercial cultivation in the region to increase crop diversity and to decrease the risk of crop failure due to climate change. In this way an alternative source of farmers income can be assured in least fertile lands.

*Associate Professor
College of Agriculture
Ganj Basodsa, Distt-Vidisha (M.P.)
Mob- +919479566954
Email- drgyanendratiwari@gmail.com

PP-1

Hippophae salicifolia: an alternative of *Hippophae rhamnoidies* in Uttarakhand Himalaya

Vijay Laxmi Trivedi* and M.C. Nautiyal
High Altitude Plant Physiology Research Centre (HAPPRC)
H.N.B. Garhwal University, Srinagar Garhwal- 246174
***Corresponding author**

Hippophae (L.) or Seabuckthorn is among those genuses of plants which are important with multipurpose benefits. Among six species of the seabuckthorn *H. salicifolia* D. Don. and *H. tibetana* Schlecht have been reported in Uttarakhand, while *H. salicifolia* is widely distributed, *H. tibetana* restricted natural pockets. As like *H. rhamnoids, H. salicifolia* also rich in all such valuable biocomponents. *H. salicifolia* is not utilized properly by local people of Uttarakhand. This species has not gained much popularity and its utilization is restricted to some valleys where it is naturally distributed and is used as chutney, juice, substitute of tomatoes, fuel wood, fencing and sometimes in veterinary medicines. *H. salicifolia* contains highest amount of vitamin C, which make it suitable for seabuckthorn juice market, which constitute 80% of total global seabuckthorn market. Such properties of *H. salicifolia* fruits providing nutritional securities and opportunities for income generations by preparing its value added products (jam, jellies, squash, pickles) by local people of Uttarakhand. Besides this chemical profiling, *H. salicifolia* proved its strong potential as a green tea producing plant. Fruits juice and pulp are considered rich in vitamin C, provitamin A, vitamin E, vitamin B, amino acids, minerals, and other phytochemicals, thereof having potential for development of health supplements and nutraceuticals. Oil obtained from seeds and pulp of *H. salicifolia* have special consideration, both pulp and seed oil are rich in carotenoids, flavonoids, tocopherols and omega fatty acids, representing potential of use of oil for cosmetic and pharmaceutical purposes. Various parts of *H. salicfolia* also posses medicinal values such as antimicrobial, antioxidant, anti stress, etc. To uplift the socio- economic status of people of remote areas of Uttarakhand, industrialization and commercialization of *H. salicifolia* is necessary. The present manuscript is based on economic aspects of *H. salicifola.*

Key words *: Hippophae salicifolia*, health supplements, nutraceuticals, omega fatty acids.

PP-2

In vitro propagation of *Hippophae salicifolia* D. Don: A multipurpose medicinal plant

Ankita Lal* and Manu Pant
Department of Biotechnology, Graphic Era University, Dehradun-248002
*Corresponding author: ankita.lal88@gmail.com

Hippophae salicifolia D. Don (Seabuckthorn), a deciduous, thorny willow-like plant species is native to Europe and Asia. In India, it is found in the Himalayan region between 1500"3500 m.a.s.l. The ripe fruit of Seabuckthorn is a natural reservoir of vitamins (A, B, C, K and E) with antioxidant, anti-cancer and anti stress properties. *H. salicifolia* generally propagates by root suckers, but, extensive collection and short growing season has hindered multiplication of the species. As natural regeneration of the species through seed is very scarce, an initiative for conserving this threatened but economically important plant species is necessary. Henceforth an attempt was made for large scale propagation of this species via tissue culture technology.

For the study, seeds of *H. salicifolia* were collected from Garhwal region of Uttarakhand. The explants were surface sterilized with mercuric chloride solution and inoculated onto culture medium *in vitro*. Of the various treatments tried, best results of seed germination were observed on basal MS Medium. The cotyledons so produced were used for callus formation. For the purpose semi-solid MS medium supplemented with several combinations of plant growth regulators was tried. Best callusing was observed on medium containing 6-benzyl amino purine (BAP), 1-Naphthaleneacetic acid (NAA), Adenine Sulphate (AS) and activated charcoal (AC). Within 20 days of callus culture shoot induction was observed on the same medium. Further experiments were done to optimise *in vitro* shoot multiplication. It was found that liquid MS medium+BAP+NAA+AS without activated charcoal resulted in formation of long and healthy shoots *in vitro*. The shoots so developed were further used for *in vitro* rooting.

PP-3

In vitro propagation of *Withania somnifera* (L.) Dunal using axillary bud explants

Vivekanand P Rao, Reshu Chaudhary and R.S. Sengar
Tissue Culture Laboratory, College of Biotechnology, S.V.P University of Agriculture& Technology Modipuram, Meerut (U.P.)- 250 110
Email: raovivekanand4@gmail.com

Withania somnifera (L.) Dunal, commonly called Indian ginseng is a member of the family Solanaceae. It is a major source of alkaloids and steroids (withanolids), which is regularly used in pharmaceutical industries.The drug extracted from roots is used for the treatment of tuberculosis, rheumatism, inflammatory conditions, cardiac, bacterial diseases, antioxidant, immunomodulatory andhaematopoietic properties.An efficient method of *in vitro* shoot propagation of one elite accessions of *Withaniasomnifera*wasdeveloped. Maximum numbers of shoots were achieved from axillary explant on Murashige and Skoog (MS) medium supplemented with 1 mgL^{-1} BAP(Benzyl Amino Purine) and 1 mgL^{-1} kinetin. Inclusion of kinetin increased shoot numbers in a shorter time-period and was effective on this elite accessions. The highest number of shoots (54±2.14 and 56±2.03) was observed. The *in vitro* raised shoots could be easily rooted on 1/2 strength MS medium supplemented with 2 mgL^{-1} IBA (Indole Butyric Acid). Rooted shoots were successfully established in a green house, soil-compost (3:1, w:w) medium in glasshouse for hardening and acclimatization.*In vitro* methodology could be used successfully for the trueto-type plant regeneration of *Withania somnifera* accessions.

PP-4

In vitro propagation of *Steviarebaudiana* as a potential Zero calorie sweetener

Ranjana Singh[1], Madhuparna Banerjee[2] and R. S. Sengar[1]
[1]*S. V. P. Univ. of Agri. & Technology, Modipuram, Meerut-250110*
[2]*Birsa Agricultural University, Kanke, Ranchi*
E-mail:ranjana4singh@gmail.com

ABSTRACT
Stevia (*Stevia rebaudiana*L.Bertoni) a member of Asteraceae familyis a subtropical perennial natural sweetener.Itleaves tastes sweet with slight bitterness and produces zero-calorie diterpene glycosides(stevioside and rebaudiosides), due to which it is also known as 'CheeniTulsi' or 'MouTulsi'.This plant is a native of north-eastern Paraguay, cultivated as a cash crop in various countries. Due to difficulties in producing the crop through seeds,micropropagation through nodal segment and shoot-tip culture is extremely favoured.From the early days, honey, fruit juices, sugar form cane and beet were used as the only source of sweetener agent that in addition to cause some chronic diseases such as diabetes mellitus, hypertension, cardiovascular diseases, etc.But now a days, stevia is widely usedcommerciallyin different forms as a sweetener agentthat has proven a boonfor the diabetic patients.*In vitro* culture using MS medium supplemented BAP 1.0 mg/l, citric acid 1.0 mg/l to prevent phenolic exudation along with adenine sulphate50.0 mg/lis found to be effective in enhancing the bud breaking and shoot multiplication percentageafter 10 days. So to fulfil the consumers demand for herbal foods, tissue culture technique may encourage stevia cultivation and productionworldwide. This would also help to enjoy the sweet taste with minimal calories for those who have restricted carbohydrate / sugar in their diet.

KEYWORDS: Stevia, Diterpene glycosides, Diseases, Micropropagation, Natural Sweetener.

PP-5

Paris polyphylla Smith: Importance and Needs for Conservation

Jyoti Sati* and M.C. Nautiyal
High Altitude Plant Physiology Research Centre (HAPPRC)
H.N.B. Garhwal University, Srinagar Garhwal- 246174
***Corresponding author**

Plant kingdom has played a very important role in human civilization; medicinal plants are one of them that have been in use from ancient times. Due to overexploitation of the natural resources, medicinal plants have been rapidly destroyed from their natural habitat over the last few decades. *Paris polyphylla* is one of them and is an endangered temperate species belonging to the family Melanthiaceae. It is distributed in India, China, Nepal, Vietnam, and Germany. In India, the species is growing in the wild state forest land of Himachal Pradesh, Uttarakhand, Manipur and in Lushai and Aka Hills of Mizoram and Tripura. It is locally known as Chonglou in China, Satuwa in Nepal, Singpan in Manipur and Satwa in Uttarakhand. It is a perennial glabrous herb, growing on light sandy and moist humus rich soil with full or partial shade under natural habitat. The rhizome of *Paris polyphylla* is used in traditional as well as modern system of medicine in China, Nepal and also in India. Its main constituent is steroidal saponins that have many biological and pharmaceutical actions such as anti bacterial, anti tumor and immunoregulatory. Traditionally rhizomes are widely used as antihelmintic, antispasmodic, digestive, stomachic, expectorant, vermifuge, and antidote against snake bite and in modern system is used for its anti cancerous activity. There was greater population of this plant in the past and it was easily available near the vicinity of villages but from last few decades peoples are doing aggressive harvesting of this herb for earning money due to excessive demand of this herb in pharmaceutical industries. Illegal collection and trade is also at alarming rate in Uttarakhand. Due to its high value medicinal properties and demand, the cultivation of this species is necessary for the conservation of its natural habitat. The present manuscript is based on the conservation aspect of the endangered species *Paris polyphylla*.

Key words*: Paris polyphylla*, medicinal properties, conservation.

Assessment of Genetic Variability and Heritability in Diverse Accessions of Wild Noni (*Morinda tomentosa* Heyne ex Roth) in North Gujarat

A. H. Rathod*, S. Acharya, A. K. Singh, S. K. Parmar and Sweta Mishra
Department of Genetics and Plant Breeding, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar- 385506 (Gujarat)
*Email ID: *avinashrthd2@gmail.com*

Genetic variability and heritability for morphological and phytochemical attributes were studied in *Morinda tomentosa*. The magnitude of genotypic coefficient of variation was higher for all but number of seeds per fruit, flavonol content in leaf, number of branches per plant, flavonol content in fruit, fruit length, total soluble sugar, plant height, ascorbic acid content in fruit and fruit width indicating lesser role of environment in the expression of the traits.The broad sense heritability was higher for all but fruit width indicating explicit realization of heritable variance and thereby offering abundant chances of improvement in those characters by simple selection. The higher estimates of genetic advance with high heritability for total phenol content in leaf, carotenoid content in leaf and carotenoid content in fruit inferred role of additive gene action in the expression of these traits that further corroborated phenotypic selection based on these traits to be more effective.

APPLICATION OF PLANT TISSUE CULTURE STRATEGIES IN MEDICINAL PLANTS

M.K. TRIPATHI[1*] R. TIWARI[2], ASHOK AHUJA[3] B.S. BAGHEL[2] AND R.P. PATEL[4]

[1]Horticultural Biotechnology Laboratory, KNK-College of Horticulture, Mandsaur

[2]Office of Dean Faculty,

[3]Department of Plant Molecular Biology & Biotechnology, College of Agriculture, Gwalior

[4]Department of Plant Pathology, KNK-College of Horticulture, Mandsaur

[*For correspondence: E-mail: drmanojtripathi64@gmail.com; *Present Address: Department of Plant Molecular Biology & Biotechnology, College of Agriculture, Rajmata Vijayaraje Scindia Agricultural University, Gwalior, MP, India

Technical Session - 2
Indigenous Knowledge, Medicinal Value and Documentation

Lead Paper-1

Goji Berry -The Ultimate Super food; A real Chi (Life Force): The inside story-Taurine factor

R.C. Gupta
SASRD Nagaland University, Medziphema 797106 India

With the arrival of second millennium, in China during Tang dynasty (1000-1400 AD),Goji Berry with beautiful orange fruits was consider as "yin" for its utility in strengthen of eyes ,liver and kidney, to a great wonder China is also the birth place of this plant. Subsequently Goji berry traveled a long journey and its potential as well as utility in number of other health problems compel to add several other of its benefits to a long list of its usefulness. With time and finding; its utility in strengthen the immune system, improve circulation, sperm production, enhanced sexual performance to modern disease like diabetes, cancer and many others have been well recognized. In this millennium it has now crossed the national boundary of China even it has climb the Great Himalayas, walked through the Asian continent, and its seems that now it has reached the all part our planet. This plant belongs to family of solanaceae, botanically known as *Lycium barbarum* also called wolfberry. The barriers are eaten raw, drunk as juice, wine or tea and also processed to tinctures, powders and tablets, The greater acceptably of the plant is due to its role in enhance longevity ,hair loss, supplementation to natural testosterone and to increase sperm count. To cope with latest taste and demand it is now part of cookies, crispy bars, chocolates, muesli, sausages and soaps and one can easily found in drug stores, "Reformhauser" and organic food shops. On chemical front, fruit the most valuable part contains, polysaccharides, carotenoids, flavonoids important for anti oxidation properties, besides it also contains minerals like Na, Ca, Mg, Fe ,Cu and Mn. The best part of this fruit is, it contain a number of free amino acids of which Taurine is abundant (.32g/100g wet wt). Taurine beneficial action has a board spectrum, and many of its protective action are now well established. Almost all biological action exhibited by Goji berry is also part of broad spectrum biological properties of taurine; from vision to cancer, anti-oxidation to host defense. It is believed that, biological properties of any substance is the cumulate index of its physio- chemicals properties in return the molecules presents as chemical initary and their arrangement, interaction, association, provides synergic effect. It is surprising to know that, Goji berry and taurine has overlapping beneficial properties. The high contents of taurine provide a basis to think; why? Such high concentration of taurine; hence is logical to conclude that it might possible, in; inside story of action mechanism of Goji berry beneficial activities; taurine may be a major contributing agent of its biological action profile. Phyto-chemicals are future bio-molecules for improving human health and preventing diseased states. The in depth study of techno-functional properties of various constituents of this plant is urgently needed and if it is done in proper from then this plant can be efficiently exploited for many fold for food ,cosmetic, longevity, ultimate pleasure and medicine application. I am sure with such happening this plant can be synonymous to "life energy" in coming decades.

Lead Paper-2

Medicinal Plants and Fomeag Cafeteria

V N Pandey
Professor of Botany, Experimental Botany and Nutraceutical Lab. Department of Botany DDU GorakhpurUniversity, Gorakhpur- 273009
Email: vnpgu@yahoo.co.in

Medicinal plants used throughout world since antiquity. Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions. Chemical compounds in plants mediate a definite effect on the human body through processes identical to those which already well understood for the chemical compounds in conventional drugs. Herbal medicines do not differ greatly from conventional drugs in terms of how they work which enables herbal medicines to have beneficial pharmacology.

The World Health Organization (WHO) estimates that 80 percent of the population of some Asian and African countries presently use herbal medicine for some aspect of primary health care. The study of traditional human uses of plants, is recognized as an effective way to discover future medicines. Many compounds used in modern medicine derived from "ethnomedical" plants. Many of plants used by humans as food also yield useful medicinal compounds. Journey of plantsestablished the significance of medicines and therapeutic uses in society.Traditional knowledge of society can guide the selection of factors such as optimal dose, species, time of harvesting and target population.Adulteration, inappropriate formulation, or lack of understanding of plant and drug interactions have led to adverse reactions that are sometimes life threatening or lethal. is not mandated, but even products made to the same specification may differ as a result of biochemical variations within a species of plant.Hence, Safety is important regarding standardization, purity and dosage of medicine.Extinction of medicinal plant species is an alert to us due to over exploitation and destruction of natural habitats.

Conservation is a great mile stone and natural process which is done either by ex-situ or in-situ methods especially with **Fomeag**(Fo=Food/Fodder, Me = Medicine and AG=Arboretum Garden (Forest)/ Agricultural Garden/Aquatic Garden) **cafeteria**. The Conservation can be done locally by using following ways.

A. Ban on an indiscriminate and voracious utilization/ collection, ensuring proper use throgh**Fomeag cafeteria** with the help of local Administration.

B. Planning and control for sustainability through Fomeag cafeteria,

C. Awareness through village panchayat, village panchayat officers, school teachers, kisanmitra (Farmer's friend), block development officer, sub divisional magistrate and District magistrate along with forest Department.

D. Places (land/ water reservoir / forest /public sites) for conservation of Local Region Specific Plant (LRSP).

Fomeag Cafeteria would be a new mile-stone and vision to the nature's health, biodiversity-

climate links, utilization and conservation of biodiversity especially medicinal plants and provides a new impetus in revolutionizing the sustainable and economically feasible development of the country and the whole world. It help in establishing the nation a as a developed nation and sustainable nature's treasure as whole.

Lead Paper-3

Medicinal Plants: Importance and Research Needs including Seeds

Manish Das
Principal Scientist, Horticultural Science Division
Indian Council of Agricultural Research
KrishiAnusandhanBhawan-II, New Delhi-110012
manishdas50@gmail.com

Among ancient civilisations, India has been known to be rich repository of medicinalplants. The forest in India is the principal repository of large number of medicinal andaromatic plants, which are largely collected as raw materials for manufacture of drugs andperfumery products.India has a rich resource base of medicinal plants, plush with about 8,000 different species. According to the Government of India, traditional medicines are the sole means of health care for about 65 percent of the population. However, there is need for conservation of threatened species of medicinal plants and their habitats and support for livelihood security through protection of wild medicinal plants based on sustainable harvesting. This deals about the promotion of sustainable medicinal plant cultivation through the process of building IPR and field gene bank. In-situ conservation of medicinal plants in and around the mountains and national park areas and ex-situ techniques involving cryopreservation and conducting ethno medical survey to explore utilization of medicinal plants. This involves the research on the propagation and cultivation methods of selected indigenous medicinal plants for human and livestock disease. Impact on wild populations of medicinal plants through harvesting and other activities that involves the conservation of medicinal plants on-farm, pilot propagation and cultivation trials of medicinal plants are the research priorities. Development and implementation of appropriate management options and guidelines for sustainable harvesting of medicinal plants by applying various conservation techniques are the key issues. Establishment of field gene bank could servefor research and conservation. Seed standards for medicinal plants need to be developed and options for production of foundation seeds are to be guided. Further guidelines for sustainable harvest of medicinal plants and its cultivation practices need to be developed by providing income generating activities such as incentives and also creating market opportunities for both import and export and for formalizing traditional medicine.

OP-1

Mass propagation via axenic root culture of *Swertia chirata* Buch.-Ham.ex Wall.: an endangered medicinal herb

Manu Pant*,[1] , Prabha Bisht and Manju P. Gusain** ***

*Department of Biotechnology, Graphic Era University, Dehradun, Uttarakhand

**Tissue Culture Lab, G&TP Division, Forest Research Institute, Dehradun, Uttarakhand 248006,

***Zoo.-Biotech Deptt. HNB Garhwal University, Srinagar Garhwal, Uttarakhand, India.

[1] Corresponding author: himaniab@gmail.com

Swertia chirata (common name chirayata) is a medicinal plant native to temperate Himalaya (altitude above 4,000-10,000 ft.). The drug obtained from the dried plant is held in high esteem in India. It is prescribed in a variety of forms and combinations in chronic fever, anemia and is used as a special remedy for bronchial asthma, liver and stomach disorders, malaria and diabetes leading to an increasing pharmaceutical demand of the species both, in indigenous and world market. *S. chirata* is also among the highly prioritized medicinal plants of India as identified by National Medicinal Plant Board, Govt. of India. Chirayata is difficult to propagate on mass scale via seed owing to non-availability of seeds, low viability and germination percentage of seeds or due to harvesting of plants before seeds mature. The species is, therefore, deprived of natural regeneration. Consequently, according to the new International Union for Conservation of Nature and Natural resources (IUCN) criteria, this priority plant has been designated as critically endangered. The need to develop techniques for its mass multiplication through different regeneration pathways, therefore, becomes imperative.

The present study was taken up to establish an efficient alternate *in vitro* propagation system for *Swertia chirata*. For the purpose, 2-3 cm long root segments from axenic shoot cultures were used as explant. Best results of shoot regeneration from root, without any intervening callus phase were observed on 1/2 MS (Murashige and Skoog's medium, 1962) medium supplemented with 6, benzylaminopurine (BAP) and á-naphthalene acetic acid (NAA). Regenerated shoots were further multiplied on full strength MS medium supplemented with different concentrations of plant growth regulators. Maximum shoot multiplication was achieved on MS medium fortified with BAP, indole-3 acetic acid (IAA) and adenine sulphate (Ads). Optimal results of *in vitro* rooting was observed on 1/2 strength MS medium containing IBA. Plants with well-developed shoots and roots were successfully acclimatized and hardened *ex vitro.*

OP-2

Need for utilization of *Cannabissativa* L.growingasaweedformedicinal purposes

Jyoti Kumar Sharma·GaneshDatt Bhatt and Amit Kumar Tripathi
Environmental Sciences and Natural Resource Management
School of Natural Sciences, Shiv Nadar University,
Village - Chithera, Tehsil - Dadri,
Gautam Buddha Nagar - 201314, UP.

Cannabis sativa L.,generally considered a monotypic genus, is one of the most widely distributed plant species in the world. The history of cannabis is complex and it has not been possible to describe a precise geographical origin to the plant. However, there is a general agreement that cannabis is Asiatic in origin and probably originated in Central Asia in Himalayas just north of Afghanistan.The plant has become so widespread that even it is termed as "weed" in some of the countries.The plant is distributed throughout India and wild in North-West India.Over the years*Cannabis sativa,* which was apparently restricted in its distribution up to Muzaffarnagar district some five decades back, has now spread up to Gautam Buddha Nagar district in Uttar Pradesh and even in many residential areas of Delhi. In Dadri Tehsil it has become an invasive weed as all the vacant areas, waste lands and bunds of agricultural fields are covered by dense growth of *Cannabis sativa* plants;even the agricultural fields are being invaded by cannabis as one could find numerous plants growing interspersed with the agricultural crops thus posing threat to biodiversity. The plant which contains as many as 66 cannabinoids, has numerous medicinal properties such as in treating AIDS, remedy for malaria, black water fever, blood poisoning and dysentery, poultice in local inflammation and neuralgia, bark in inflammations and hemorrhoids and leaves as sedative, anodyne, narcotic, antispasmodic, aphrodisiac, diuretic, digestive and astringent and leaf juice for removing dandruff from the hair and pain in the ear need to be utilized appropriately for medicinal purposes.. The paper will highlight exploitation of cannabis weed for various medicinal purposes which otherwise is used by the local people as a narcotic and firewood.

Keywords: Cannabis sativa, weed, medicinal properties, plant utilization

OP-3

Processing of Bittergourd (*Momordica charantia*): A medicinal vegetable

Aparana Sharma and Priya Awasthi
JNKVV-College of Agriculture, Ganj Basoda, Distt- Vidisha, 464221 Madhya Pradesh, India
sharmappi@gmail.com

Key words: Drying, sun drying, microwave drying, bitter gourd, acceptability

Abstract

Bitter gourd has medicinal properties and hence is recommended for curing various life style diseases including blood diseases, rheumatism, diabetes and asthma. Its pulp, leaf juice and seeds are anthelminitic, leaves act as galactagogue even its roots are astringent. Its fruits are rich in proteins, minerals and vitamins thus considered highly nutritive. Due to its medicinal goodness, the crop is used as a vegetable preserved as pickle and consumed even after drying. In Indian cusine, bitter gourd is liked for its typical bitterness, crunchiness as well as appreciated for its medicinal importance in regular intake. Drying has been the oldest method of preservation and is as old as the human civilization started cultivating. Today also, fruits and vegetables are dried in open sun to extend their shelf life. Looking at the advantages of drying on the extension of shelf life and hence the availability of fruits and vegetables in off seasons, scientists have worked on controlling the atmosphere of drying. In the present investigation, crunchy lush green bitter gourds were selected which were washed and air dried to remove extra surface water. Whole lot of bitter gourd were divided in to six groups. Fruit from each lot was finely sliced of approximately equal thickness. The finely cut slices of two lots were blanched in boiling water for 2 minutes, cooled under running tap water and spread immediately in thin layer for drying. One lot was dried under sun and other was dried in microwave till crisp. Slices of two other lots were dipped in KMS solution (@1g/lt water for 2 minutes) and spread in thin layer for drying in sun and for microwave drying. Rest of the two lots of sliced bitter gourd were kept as control after sun drying and microwave drying. The slices of dried bitter gourd were evaluated for its water holding capacity, colour, texture (appearance) and crispiness. The slices of bitter gourd treated with KMS and further dried in microwave had a bright colour and crispy. Slices of control (untreated) and sundried bitter gourd were least acceptable as per its colour and texture.

PP-1

Evaluation of anti-aging potential of a natural sesquiterpene â-caryophyllene using *Caenorhabditis elegans* (*C. elegans*) model system

Vikas Mishra[1]*; Virendra Shukla[2], Rakesh Pandey[3]

[1, 2, 3] Department of Microbial Technology & Nematology, CSIR-Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow -226015, India

***Correspondence**:*

[1] Department of Microbial Technology & Nematology, CSIR-Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow -226015, India.

Email: vikasbiotechnologist@gmail.com

Contact: +919807528308

Aging is the progressive loss of function in the cell over time that increases the probability of disease and death. Aging is a degenerative process which makes the people dependent on others and in this way affecting health and economy of a society or a larger population of a country. Day by day adverse changes in the environment and in human life style are increasing the risk of aging and age related disease. In this aspect phytomolecules from the medicinal and aromatic plants can be a novel and potential solution of aging and to cure the age related diseases. Beta-caryophyllene (BCP) or (“) -â -caryophyllene is a natural bicyclic sesquiterpene found in large proportion in the essential oils of various medicinal and food plants, such as Hop, Basil, Clove, Black pepper, Copaiba oil and others. BCP exerts various medicinal properties including anti-microbial, anti-oxidant, anti-carcinogenic, Anti inflammatory, anti arthritic activity as well as local anaesthetic activity. But the role of BCP in aging process is still unidentified. Thus the present study is mainly focused on the role of Beta-caryophyllene in reversing the aging process using *C. elegans* and its different strains (Bristol N2, sir 2.1, mev-1, GST-4:: GFP and daf-16). In this context several aging end point parameters e.g. Lifespan, Body length and diameter, Pharyngeal pumping, thermal tolerance, Oxidative stress and chemo-taxis behaviour was studied. In addition to these factors intracellular ROS scavenging activity of BCP was also evaluated with different non-toxic concentration (25, 50,100 M) along with control. 50 M concentration of BCP was found to be the best on the studied parameters of aging. Effective concentration (50 M) was significantly reducing the intracellular ROS and shows anti-aging effects on other age related parameters. Findings from this study can be further explored using more specific and sensitive techniques in *C. elegans* to determine the involvement of specific genes, pathways and GFP expression. Importantly these results can be transferred and explored in mammalian systems due to the high homology between *C .elegans* and the mammalian system.

PP-2

A Study on Ethnobotany of the Bhotiya Tribe in Chhinka Village, Chamoli, Uttarakhand

Vaishali Chandola* and A. R. Nautiyal
High Altitude Plant Physiology Research Centre, H.N.B. Garhwal University, Srinagar (Garhwal) Uttarakhand
*corresponding author [E-mail: vaishali.chandola04@gmail.com]

Since time immemorial man has been dependent on plants for the cure of various ailments and diseases. His curiosity had made him knowledgeable about these plants and how to make use of them. In this modern age of technology there are still some places which are bereaved of basic healthcare facilities and where people are dependent on natural medicines. An ethnobotanical study on traditional medicinal plants was conducted between February and March 2013 in a village Chhinka of district Chamoli, Uttarakhand that is inhabited by Bhotiya tribe. The study led to the documentation of the indigenous knowledge on ethno medicinal practices by the Bhotiya tribal community of the village. The study basically focused on identifying medicinal plants, ailments treated, part of the plants used and methods of preparation through a questionnaire survey. A total of 34 plants were identified which are used medicinally for treating different ailments by the local people. Out of these 23 (68%) were wild and 10 (28%) were cultivated. The route of administration is mainly topical and oral.

Key words: Ethno medicine, Indigenous Knowledge, Bhotiya Tribe, Chhinka Chamoli.

PP-3

Some important traditional medicinal and aromatic plants of Rudraprayag district of Garhwal Himalaya Uttrakhand India

Ankit Singh Rawat* and M.C. Nautiyal
High Altitude Plant Physiology Research Centre (HAPPRC)
H.N.B. Garhwal University, Srinagar Garhwal – 246174, Uttarakhand, India
*Corresponding author Singhankitrawat333@gmail.com

Keywords: Conservation, drug preparation, Sustainable use, Traditional knowledge**,** Western Himalaya

Indian Himalaya holds rich geographical and biological diversity and medicinal plants are one of the treasures of this area which are used by local inhabitants for their health care needs. Local inhabitants mostly elder people (*Bujurg)* have enormous knowledge including identity, their natural distribution and habitat, uses and methods of drug preparation.

Present study is aimed to identity most useful plants or most frequently used plants for different ailment categories based on highest fidelity level (FL%) of medicinal plants of district Rudraprayag, Uttarakhand, India. Study revealed that a total of 38 plants species having highest FL % of 36 genera representing 27 families are used for local health care. Medicinal plants used by local inhabitants of Jakholi show variability in their life forms (e.g. herb, shrub, tree and climber) but mostly herbaceous plants numbering 25 are used to cure different ailments. Other recorded life forms used for treatment of different diseases are 7 trees species, 3 shrubs and 3 climbers.

Due to overexploitation and unawareness among the local people, MAPs are rapidly declining from their natural habitat, weeds are replacing their natural pockets, and thus these species are becoming threatened, so urgent need is required to conserve these important species for sustainable use of traditional knowledge and subsist ecological balance.

Maps are drastically decreasing from their natural pockets due to the illegal exploitation for trade to the pharmaceutical industries. Farming of threatened valuable MAPs can be a good method for conserving their natural populations. Farming of medicinal plants may improve lifestyle of local inhabitants and also increase economy, health and ecological balance of biodiversity. Present manuscript describes the important medicinal plants used by local inhabitants of Rudraprayag district of Uttarakhand and also discuss their status and conservation issues.

PP-4

Ethnomedicinal Charachterization and Utilization of *Dillenia indica* L.

Shipra Pandey and V.N. Pandey*
Experimental Botany and Nutraceutical Laboratory,
Department of Botany, DDU Gorakhpur University,
Gorakhpur - 273009, (U.P.) India
vnpgu@yahoo.co.in*

Dillenia indica L. is one of the most important medicinal plant of North Eastern Terai Region of UP, India. *Dillenia indica* L. belongs to the family Dilleniaceae. The plant is commonly known as Elephant Apple, Chulta, Bhavya or Agai. The plant is distributed in India from Himalaya to South India. Morphologically the bark, leaves, flowers and fruits of the plant have characteristic features. The plant is variously utilized by many ethnic tribes. The fruits of *Dillenia indica* L. are used in making curries, pickels, jam, jellies and various Indian cuisines. The plant is of great medicinal use. The Ayurveda described various medicinal properties of the plant. It has strong antioxidant activities. Fruits are used as an astringent, Antipyretic and Cardiotonic. Various plant parts are used in food poisoning, as an antidote, in increasing semen quantity and relieving abdominal pain. Phytochemical screening is under processing in the laboratory. Phytochemical analysis showed that some biomolecules such as tannins, glycosides, steroids, flavonoids, reducing sugar and glucosides. It can be bio-prospected as potent nutraceutical plant of India.

Keywords: *Dillenia indica,* / Antipyretic / Nutraceuticals

PP-5

Food and Medicinal value of *Trapa bispinosa* Roxb.

Vageshwari and V.N Pandey*
Experimental Botany and Nutraceutical Laboratory,
Department of Botany,
DDU Gorakhpur University,
Gorakhpur - 273009, (U.P.) India
vnpgu@yahoo.co.in*

Trapa bispinosa Roxb. belongs to family Trapaceae a monogeneric family. *Trapa* is a nutritional and aquatic jewel of India. It is an annual floating herb commonly known as water chest nut or singhara. The plant of *Trapa* is used in ayurvedic system of medicine in cure of various diseases. Traditionally, plant and plant parts are used locally in several ailments as medicine in treatment of various diseases. Parts the plants are used in the treatment of diarrhea and dysentery. Stem juices of the plant is used in the treatment of eye disorder. Singhara is a valuable fruit crop consumed as raw or as a vegetable and grown in ponds during rainy season and harvested in the beginning of winter season. *Trapa* is an alternative source of starch and used as a fruit during fast. This establishes journey of life and biofunctional food, medicine, water and other facets involved in life and life supporting system. Hence, *Trapa* is recorded a nutritional jewel of India and exploited as food, medicine, therapeutics and nutraceuticals from water reservoirs of rural India.

Keywords: *Trapa*, Ayurvedic, Medicine, Nutraceuticals, Therapeutics

PP-6

Ethnobotanical and Medicinal Properties of *Mimusops elengi* L.

Vineeta Singh and V.N. Pandey*
Experimental Botany and Nutraceutical Laboratory,
Department of Botany,
DDU Gorakhpur University,
Gorakhpur - 273009, (U.P.) India
vnpgu@yahoo.co.in*

Mimusops elengi L. a biofunctional evergreen tree belonging to family Sapotaceae. It is commonly known as maulsari and bakul. In traditional Indian system of medicine, the ayurveda and in various folk system of medicine different parts of the plant is used in treatment of various disease by local people. Local people use extract of bark as tonic, as gargle for odontopathy, as febrifuge, used in inflammation and bleeding of gums. Flower is used as astringent to the bowels, use to cure disease of blood, liver complaints, heart disease, as antidiuretic agent. It also used to prepare lotion for wounds and ulcer. Latex is applied to treat scabies and skin sores. Young twigs are used for cleaning teeth. Ripe fruit pulp is useful in chronic dysentery. Unripe fruit is used as masticatory and help to fix loose teeth. Tribal people use leaves in treatment of snake bite. Juice of leaves squeezed into the eye for sore. Root is aphrodisiac, diuretic, astringent to bowel and used as gargle which cure in relaxation of gum. In this sequence the evergreen leaves were tested for the bioavailability of biofunctional molecules. The results revealed that presence of flavanoid, glycoside, terpenoid, steroid, saponin and absence of tannins and carbohydrates.

Key words: Ethnobotanical / Medicinal / Aphrodisiac /*Mimusops elengi* L.

Technical Session - 3
Agrotechnologies

Lead Paper-1

Quality assurance of medicinal plants raw drug through good agricultural practices

Satyabrata Maiti
Former Director, DMAPR, Anand and Presently, International Consultant, FAO (China)

Cultivation of medicinal and aromatic plants in a limited scale and in limited species although started in the beginning of the nineteenth century but its large scale cultivation with large number of species is a recent phenomenon. Cultivation of medicinal and aromatic species gives scope to improve the quality of the drugs. Merits of commercial cultivation of MAP is the outcome of implementation of number of critical factors like location-selection; good genetically stable planting materials; good agrotechnological practices; nutrient input; harvesting management and implementation of suitable post harvesting techniques to preserve the end product till smart and effective marketing arrangements are made.

In recent decades there have been a number of widely publicized cases of consumers suffering adverse health effects caused by poor quality herbal medicines. In many of these cases the cause of the problems has been linked to the quality of the raw materials used to make the medicines.

The growing demand for herbal products has also led to over-harvesting from the wild, causing concern over the long-term environmental impact and availability of certain medicinal plant species if they are not collected in a responsible manner. As a result of these concerns the herbal industry has come under increasing pressure to provide consumers with assurance that herbal products in the market are safe to use and do not have a negative impact on the environment. Some governments have responded to this pressure by creating new laws, requiring herbal manufacturers to adhere to stricter regulations, both in the manufacture of medicines as well as in the sourcing of raw materials.

The call for greater quality assurance has highlighted the need to improve the quality standards of the medicinal plant growers, collectors and processors. It is in this context that the World Health Organization developed the GACP (Good Agricultural and Collection Practices) guidelines, which various governments have subsequently adopted into regional guidelines. National Medicinal Plant Board (NMPB) in India also developed a set of guidelines for Good Agricultural and Field Collection Practices (GACP) in 2009 and subsequently certification criteria as a voluntary certification scheme was launched in 2012. In this paper, GAP has been discussed in detail. Summary of some the key concerns that are addressed by the GAP guidelines are Hygiene and Cleanliness; Prevention of Contamination; Identification of right species; Efficacy of the raw drug; Yield and income of the farmers; and Traceability of the medicinal plant material back to its origin.

OP-1

Vegetative propagation of *Tinospora cordifolia* through stem cuttings varying with node, length and diameter

NEERAJ BALONI, DINESH CHAND NAITHANI, VIJAY KANT PUROHIT AND ANANT RAM NAUTIYAL

High Altitude Plant Physiology Research Centre, H.N.B. Garhwal University (A Central University), Srinagar Garhwal, 246 174 - Uttarakhand, India

Abstract

Medicinal plants are rich in secondary metabolites and a good source of herbal drugs. These secondary metabolites include alkaloid, glycosides, coumarins, flavonoids, steroids, etc. are varying in plants to plants in various parts of the counter in different environmental and climatic conditions. Plants which grow wild in forest region, classified as minor forest product, supply a substantial amount of raw material required for the indigenous industry. India has about 2000 species of medicinal plants and a vast geographical area with high production potential and varied agro climatic conditions. Most of these plants can subsist under stress condition and are thus suited even for rained cultivation of medicinal plants offers considerable scope for rural employment and export for foreign-exchange. The *Tinospora cordifolia* locally known as Giloy is one of the important medicinal climber grow in tropical and subtropical region of India ascending to an altitude of 300 mt to 1500 mt. In Indian system of medicine, giloy is also known as amrita and belongs to the family of Menispermaceae. At the ancient time the people used the root and stem of giloy in combination with other drugs as an antidote to snake bites and scorpion bite. According to Ayurvedic system of medicine the stem is bitter stomachic, stimulants bile secretion, cause constipation, tonic, vomiting, diuretic, enriches the blood, cures jaundice, useful in skin diseases, the juice is useful in diabetes. The stem of giloy contain alkaloids like berberin, palmatine, tembetarine and mangnoflorine and root contain choline, tinospora, iscolumbin, etc and the leaves are good source of protein. According to the bases of all the medicinal and economic value, the exploitation of giloy is important in the view of herbal medicine and income generation. To obtain the large number of plants of giloy, the study on vegetative propagation has been conducted using stem cuttings varying with node, length (2 inch to 5 inch) and diameter (0.88,1.42 and 1.90 cm). The cuttings were planted inside the Poly house condition in the month of May with mixture of sand, soil and Farm Yard Manure (FYM) in the ratio of 1:1:1. The results of present investigation shows that the cuttings with double nodes were found the best in terms of sprouting (82%), percentage of rooting (82%) and no of roots/cuttings (2.31), while the cuttings having 1.42 cm diameter-2 shows the best performance in terms of length of roots per cuttings (50.80cm).

Keywords: *Tinospora cordifolia*, Giloy, Vegetative Propagation, Medicinal plants, Secondary metabolites, Ayurvedic System of Medicine, Foreign-exchange, Economic value, Node and FYM.

OP-2

Water Management Strategy Proposed for Medicinal Plant Naturally Occurring in Vindhya Plant M.P.

R.N.Shrivastava*, G. Tiwari, S.K. Garg

Medicinal plant cultivation is an emerging sector of present era due to increasing demand within India and across the globe. Irrigation scheduling and water management of medicinal and aromatic plants is burning issue for development of improved production technology of these crops with reference to Vindhya Plantue agro Climate zone of Madhya Pradesh. This region is the natural habitat of many medicinal plant commercially cultivated in Madhya Pradesh. Of these safed musli, Asgandh, Satawar, Kalmegh, Shankhpushpi, Jangli Pyaj, Gurmer, Giloe and Aonla are much important. There are areas in the region, having degraded upper fertile crust and no significant vegetation is noted except some important medicinal plant and that too are at the verge of extinction or at endangered state. They are Jangli Pyaj, sankhpushpi, Chhota chiraita, safed Musli etc. On the basis of observation recurred in the area where these crops are naturally glown a suitable water management plant is proposed in this paper to generate improved production technology for increasing and quality of these medicinal crops.

*Associate Professor
College of Agriculture
Ganj Basodsa, Distt-Vidisha (M.P.)
Mob- +09425856719
Email- dr.rnshrivastava@gmail.com

OP-3

Mass propagation via axenic root culture of *Swertia chirata* Buch.-Ham.ex Wall.: an endangered medicinal herb

Manu Pant*,[1] , Prabha Bisht** and Manju P. Gusain** *
*Department of Biotechnology, Graphic Era University, Dehradun, Uttarakhand
**Tissue Culture Lab, G&TP Division, Forest Research Institute, Dehradun, Uttarakhand 248006,
***Zoo.-Biotech Deptt. HNB Garhwal University, Srinagar Garhwal, Uttarakhand, India.
[1] Corresponding author: himaniab@gmail.com

Swertia chirata (common name chirayata) is a medicinal plant native to temperate Himalaya (altitude above 4,000-10,000 ft.). The drug obtained from the dried plant is held in high esteem in India. It is prescribed in a variety of forms and combinations in chronic fever, anemia and is used as a special remedy for bronchial asthma, liver and stomach disorders, malaria and diabetes leading to an increasing pharmaceutical demand of the species both, in indigenous and world market. *S. chirata* is also among the highly prioritized medicinal plants of India as identified by National Medicinal Plant Board, Govt. of India. Chirayata is difficult to propagate on mass scale via seed owing to non-availability of seeds, low viability and germination percentage of seeds or due to harvesting of plants before seeds mature. The species is, therefore, deprived of natural regeneration. Consequently, according to the new International Union for Conservation of Nature and Natural resources (IUCN) criteria, this priority plant has been designated as critically endangered. The need to develop techniques for its mass multiplication through different regeneration pathways, therefore, becomes imperative.

The present study was taken up to establish an efficient alternate *in vitro* propagation system for *Swertia chirata*. For the purpose, 2-3 cm long root segments from axenic shoot cultures were used as explant. Best results of shoot regeneration from root, without any intervening callus phase were observed on 1/2 MS (Murashige and Skoog's medium, 1962) medium supplemented with 6, benzylaminopurine (BAP) and á-naphthalene acetic acid (NAA). Regenerated shoots were further multiplied on full strength MS medium supplemented with different concentrations of plant growth regulators. Maximum shoot multiplication was achieved on MS medium fortified with BAP, indole-3 acetic acid (IAA) and adenine sulphate (Ads). Optimal results of *in vitro* rooting was observed on 1/2 strength MS medium containing IBA. Plants with well-developed shoots and roots were successfully acclimatized and hardened *ex vitro.*

PP-1

Possibilities of Productivity Enhancement of MAP's through Micro-irrigation in Hilly Regions of Uttarakhand

Dharam Chand* and M. C. Nautiyal
High Altitude Plant Physiology Research Centre (HAPPRC), HNB. Garhwal University Srinagar Garhwal-246174 (Uttarakhand)
*Corresponding author e-mail: *dcattri13@gmail.com*

Sustainable agricultural development is dependent on efficient use of irrigation. In the last few decades availability of water for irrigation has been declining rapidly all over the world. The situation of India is also critical even though India has the largest irrigated area in the world. On the contrary, the demand for access to irrigation has been growing faster in India especially in hilly areas. Farmers of hilly regions especially in Uttarakhand, are engaged in the cultivation of MAP,s and other cash crops for their livelihood security. But they are facing irrigation problems due to typical hilly terrains, steep slopes, high altitudes, low soil depth and ever decreasing vegetative cover on hills owing to anthropogenic interferences as well as natural phenomena. The availability of water in non-monsoon period for crop production is a prime one. Even though the state has given rise to many important rivers from the greater Himalayan ranges and the forest cover is around 60 percent of the total geographical area but the irrigation scenario is grim. We can overcome the obstacles in irrigation by using advanced techniques of irrigation like Micro-sprinkler and Drip-irrigation. Unlike flood irrigation method, drip irrigation can be efficiently operated in all types of grounds- undulating terrains, rolling lands, hilly areas and shallow lands. Drip method of irrigation has many advantages over traditional system of irrigation, water saving and yield increase is the foremost among them. Drip irrigation is the most efficient method of watering today because it places the precise amount of water where we need it, prevents over watering and reduces weeds level.

In the recent past the demand of endangered high altitude MAP,s such as *Podophyllum hexandrum, Aconitum heterophyllum, Nardostachys grandiflora, Picrorhiza kurroa, Rheum emodi, Angelica glauca, S. costus* and *Inula racemosa* has increased from pharmaceutical industries and the status of these MAP,s has decreased in nature. The productivity of traditional farming is very low and now a number of farmers are not interested in the cultivation of traditional crops due to less productivity and more hard work. A number of policies have already been launched by the central and state governments for the promotion of MAPs cultivation in hilly regions of Uttarakhand. Due to increased demand of raw material from pharmaceutical industries and less availability of MAP,s in natural habitats, sustainable cultivation through Drip- irrigation is the only precise way to meet the demands. This advanced technique of irrigation is easy to handle and already adopted by some states but in Uttarakhand, this technique is not practiced on MAP,s till now. Drip irrigation is the efficient method to eradicate the watering problem of crops in hilly areas and it has the immense possibilities to increase the productivity of MAP,s and will also be helpful to reduce the labour cost and work load. The present paper is based on the possibilities of micro-irrigation in hilly regions of Uttarakhand.

Keywords: Farmers; micro-irrigation; MAP,s; hilly regions and possibilities, etc.

PP-2

In Vitro Propagation of an Important But Less Prioritized Medicinal Plant *Ajuga bracteosa* Wall. Ex Benth.

Sudeep Chandra Semwal* and P. Prasad

High Altitude Plant Physiology Research Centre, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand

*corresponding author [E-mail: sudeepsemwal@yahoo.com]

Because of the accelerated local, national and international interest in recent years the demand for medicinal and aromatic plants has increased manifolds and pharmaceutical industry views plant wealth as a source of income. Due to easy availability, no side-effects, and sometimes only source of health care, the demand for medicinal plants is increasing in both developing and developed countries. Conservation and sustainable use of medicinal plants are issues on which immediate focus is required in the context of conserving biodiversity. Considering these facts it is important to know about the medicinal plants of the nearby areas either present locally or in the vicinity of forest and well protected areas. In the present study, a successful *in vitro* propagation of a less prioritized but highly valuable medicinal plant *Ajuga bracteosa* Wall. Ex Benth, has been achieved. Effects of MS medium supplemented with different concentration of plant growth regulators on nodal and leaf explants were evaluated. 2 M BAP produced average 23.5 shoots per culture while 5 M BAP produced average 30.94 shoots per culture within 35 days of inoculation. Shoot proliferation decreases at higher concentrations of cytokinins. It was also observed that 10 and 15 M BAP did not produce any shoot. Plant growth regulator free MS medium was found unable to induce shoot multiplication. Effect of repeated sub culturing on nodal explants was also evaluated and found that shoot multiplication increased after 1st subculture. Rooting also evaluated with different composition of MS media and IBA. In half strength MS medium average 2.85 roots per culture was found while full MS supplemented with 2 M IBA induced average 13 roots per microshoot and 5 M IBA produced average 12.5 roots per microshoot with an average length of 12.83mm and 11.0mm respectively. 100% rooting obtained with 2 M and 5 M IBA while 66.6% rooting in Half MS. It is also observed that 2,4-D induce callusing in leaf explants, but repeated sub culturing on same media show slow growth of callus and failed to induce organogenesis.

Key words: *Ajuga bracteosa,* Conservation, Sustainable use, In-vitro Propagation

PP-3

Agro techniques of Tuberose (*Polianthes tuberosa* L.): An Important Aromatic and Ornamental Plant

Mamta Bohra[1] and B.P. Nautiyal[2]

[1]Department Floriculture and Landscape Architecture and [2]Dean (V.C.S.G.C.H, Uttarakhand University of Horticuture and Forestry, Bharsar) Pauri Garhwal, Pin code: 246 123

Email: mbohragbptu@gmail.com

Tuberose (*Polianthes tuberosa* L.) ver *Rajnigandha* is one of the most important essential oil yielding aromatic plant and leading cut flowers in the Indian flower trade. It is originated in Mexico and belongs to family Amaryllideace. In India it is popularized with various names like Gulchari, Gulshabbo, Sukandaraji, Nilasampangi and Sugandhraja. It can be successfully grown in warm humid climatic conditions where temperature ranges from 20 to 30 ^{0}C. It is bulbous perennial and perpetuating itself through bulbs. It occupies a premier position among aromatic plants because of its prettiness, elegance and sweet pleasant stink. The oil extracted from its flowers is known as tuberose oil which is very expensive and used in high grade perfumes. The common constituents of the tuberose oil are geraniol, nerol, benzyl alcohol, methyl benzoate, methyl salicylate, eugenol, benzyl benzoate and methyl anthranilate. Bulb of tuberose is extensively utilized as medicine for headache, diarrhea, rheumatism and allied pains. Dried and powdered bulbs are used as a remedy for gonorrhea. Apart from the aromatic and medicinal uses, its flowers are used for cut as well as loose flower purpose. Flowers are used for making artistic garlands, floral ornaments and bouquets. The variegated types of plants are used for garden display or as a pot plants. Keeping the above points in view, the commercial cultivation of this plant can be utilized to earn more income. For this, scientific and standardized agro technique of tuberose is very much essential. Present paper deals with detail agro technique for improving quality and quantity production of tuberose.

PP-4

Effect of Different Concentration of auxin (IBA) on Root formation in Cuttings of Pomegranate *(Punica granatum* L.) CV. Kandhari

NEERAJ BALONI[*1], MANJU RAWAT[2] AND VIJAY KANT PUROHIT[1]

[1]High Altitude Plant Physiology Research Centre, H.N.B. Garhwal University (A Central University), Srinagar (Garhwal)

[2]Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand

[*]**balonineeraj@gmail.com**

Abstract

Horticulture has a vast potential for socio-economic development as employment generation and foreign exchange. It also contributes towards the health, happiness and prosperity of people. In fruit production, India ranks second after China and its share in the world production of fruit is about 10%. In the year 2012-13 India has about 6983 hectare land was under the cultivation of different fruits with a total annual production of 81285 MT (source:-Indian Horticulture database 2013). Among the large number of fruits cultivated in India pomegranate has its own importance as fruit as well as medicinal crop. It is botanically known as *Punica granatum* L. and belongs to the family of Punicaceae. It is a native of Iran and can be grown in tropical and subtropical region up to 1850 mt. In India the cultivated area of pomegranate has about 113 hectare with an annual production of 745 MT and productivity of 6.6 MT/ hectare and the maximum area (4,500 hectare) covered in this crop is in Maharashtra (source:- Indian Horticulture database 2013). The pomegranate is winter hardy, drought tolerant pant and can be grown in diverse type of soils. All the parts of the tree have been utilized as source of tannin for curing the leather. The trunk bark contains 10.0 to 25.0 % tannin, root bark contains 28.0 % tannin and the leaves contain 11.0 % tannin. The medicinal properties of pomegranate are high and the juice yields citric acid and sodium citrate for pharmaceutical purposes. Pomegranate juice is useful for diabetes, anemia and hart problem patient. Juice enters into preparation for treating dyspepsia and is considered beneficial in leprosy. Because of their tannin content, extracts of the bark, leaves and immature fruit given as astringents to halt diarrhea, dysentery and hemorrhages. Because of its sweet juice and high medicinal properties, pomegranate has great demand in the market. Beside this, it is very hardy plants and therefore considered a good fruit for arid zones of India. But at present its cultivation is limited and in small scale in other parts of India. To meet the growing demand of its fruits, there is need to enhance its production in several folds. Therefore, to increase its cultivation, there is need to produce large number of true to type plants of high yielding varieties and which can be obtained through vegetative propagation. Therefore, a study on development of reliable propagation methods using hard wood cuttings treated with different concentrations (30 cuttings in each concentration) of Indole-3-butyric acid (1500 ppm, 2500 ppm, 3500 ppm, 4500 ppm and 5500 ppm) with one set of untreated cuttings has been done in *Punica granatum,* Cultivar (CV) Kandhari. The cuttings were planted in Polybgas in the month of February with the

mixture of sand, soil and Farm Yard Manure (FYM) in the ratio of 1:1:1. The results of the present study revealed that the cuttings treated with 5500 ppm of Indole-3-butyric acid (IBA) showed the best performance in terms of number of sprouted cuttings (6.66±0.38), number of sprouts/cuttings (10.53±0.73), percentage of root formation (73.33±3.80) and number of primary (42.80±1.60) and secondary roots (91.40±3.96) formation in per cuttings. The length (20.66±0.78 cm) and diameter (0.41±0.13 cm) of sprouts was also recorded high in same concentration after three months of plantation of cuttings in the open conditions.
Keywords: *Punica granatum* L, Vegetative propagation, Berry Fruit, Medicinal properties, Foreign-exchange, Tannin, Auxin

PP-5

Effect of pre-sowing treatments on seed germination of *Angelica glauca:* a Critically Endangered Plant of Higher Himalaya

Rajeev Ranjan Kumar, Vijay Kant Purohit, P. Prasad, A.R. Nautiyal and Keshav Chandra Gairola

High Altitude Plant Physiology Research Centre, H.N.B. Garhwal University (A Central University), Srinagar (Garhwal), Uttarakhand

rranjan675@gmail.com

Abstract

Angelica glauca Edgew**,** belongs to family Apiaceae and locally known as chora. It is a high value critically endangered medicinal and aromatic plant of higher Himalayan region. The species has very long history of use as medicine in Ayurveda formulation as Kumarspistikritghrita, Mahapaisachic-ghrit and Rasnadi churna. It increases appetite with tonics and given in typhoid and fever. Root powder dissolved in cold water is also given in diarrhea. The "curry" or Daal (local dishes) flavored with root powder gives strength and vitality to woman after delivery. In Indian Himalayan region it is distributed from temperate to alpine zones of Kashmir, Himachal Pradesh and Uttarakhand. It mostly grows in moist rocky soil situation near water springs and shady and sloppy areas between 2800 - 3800 m asl. Due to increasing demand of the roots of the species at local as well as national level its natural populations are under pressure of over-exploitation and therefore the species needs to be cultivated. However, low seed germination has been reported in this species and therefore the present study was undertaken to devise methods for improved germination of *Angelica glauca* seeds. To test the seed germination at lower altitude (550 m asl), the seeds were collected from two sites of Garhwal region of Uttarakhand, - Manni (3400 m asl), Ukhimath Block, District Rudrapryag and Ghesh (2500 m asl), Dewal Block, District Chamoli in the month of October. The freshly collected seeds were treated with different concentrations of PGRs namely GA_3, BAP and Kinetin and Chemicals KNO_3 & Thiourea (100 M, 500 M and 1000 M). The treated seeds were sowed in Styrofoam trays containing mixture of garden soil and sand (1:1) and the trays were placed under the green house conditions (minimum temperature 11.8°C and maximum temperature 33.0°C; minimum humidity 60% and maximum humidity 97%) at Srinagar Garhwal (550 m asl). Seeds collected from Manni and treated with Thiourea (500 M) for 24 hrs gave the maximum 69.0% germination in comparison to seeds sowed untreated (51.0% germination) as control. Therefore, on the basis of this study, Thiourea (500 M) for 24 hrs treatment is recommended for the improved germination of seeds of *Angelica glauca.*

Key Words: *Angelica glauca* Critically Endangered, Himalayan Region, Medicinal and Aromatic Plants, Seed Germination, Thiourea.

Technical Session - 4
Biotec and Abiotec

Lead Paper-1

Utilization of Microbes to Tackle the Phytonematode Menace in Medicinal Plants

Rakesh Pandey
Principal Scientist & Head
Department of Microbial Technology & Nematology, CSIR-Central Institute of Medicinal and Aromatic Plants, P.O. CIMAP, Lucknow - 226 015, INDIA
E mails: *r.pandey@cimap.res.in, rakeshpandey66@hotmail.com*

An unseen, underground and hidden, enemy pest, which silently spread from nursery to nursery, and field-to-field, attacking most of the agricultural crops including medicinal and aromatic crops throughout the world is plant parasitic nematode. Plant parasitic nematodes are microscopic roundworms that live in diverse habitats viz. soil and plant tissues. Due to obligate nature of these parasites, nematodes attack the root or other plant parts in soil like bulb and tubers, and interrupt the uptake of water and nutrients by plants. The annual global loss in agriculture due to damage by variety of phytonematodes can be estimated as more than US$100 billion worldwide. Among the different phytonematodes, root-knot nematode (*Meloidogyne incognita & M. javanica*), root lesion nematode (Pratylenchus *thornei*) and stunt nematode (*Tylenchorhynchus vulgaris*) influence the yield of major medicinal plants. The economically important medicinal plants which suffer root-knot nematode infestation are: Ashwagandha, Serpagandha, Brahmi, Menthol mint, Henbanes, Basil, Opium poppy, Coleus, Qinghao and Safed Musli. It has become inevitable to manage nematode problems in medicinal plants through alternative methods because chemical nematicides have an adverse impact on human health and environment. The assault on the environment and human health through the use of chemical nematicides as well as unreliable results from cultural methods of nematode management has necessitated the search for sustainable, effective and environmentally acceptable nematode management options. Rhizosphere is the site of intensive interaction between plant and other rhizospheric microbes. Rhizospheric flora has reportedly immense potential for soil and plant health. But this all depend on the density and types of microbes. Useful microbes like PGPR, mutualistic fungi, and other nematode antagonists disfavor the multiplication and development of phytonematode population in soil, enhancing the growth/yield of the crop. For example when nematode population density reaches a certain level, host crop yields suffer greatly as few host plant support faster multiplication of nematodes and others do not. For sustainable cultivation of medicinal plants, effective management of phytonematodes is essential. As my group begins to develop a better understanding of the complex ecologies of soils and agricultural ecosystems, more strategies for exploitation of microbes for the management of phytonematodes have been developed. The suggested characteristics of microbes for nematode management and better medicinal plants health include host specificity, easy in vitro/in vivo manipulation, mass production and easy dissemination with standard equipments. Besides it should also have potential for establishment and recycling, longer shelf life providing control for extended periods and should not be harmful to the environment.

Lead Paper-2

Management of Important Diseases of Medicinal and Aromatic Plants Using *Trichoderma* spp.

H.B. Singh
Department of Mycology & Plant Pathology, Institute of Agricultural Sciences,
Banaras Hindu University, Varanasi-221005
Email: hbs1@rediffmail.com

Trichoderma spp. inhabit nearly all agricultural soils especially those containing high organic matter have shown outstanding biological properties in controlling growth of other, less desirable or more harmful (pathogenic) types of fungi. What makes *Trichoderma* so interesting is that they use local materials (decaying products) for their proliferation, are nontoxic and biodegradable, produce numerous useful metabolites with complex chemistry and perform diverse biological activities. What is more intriguing, however, is their ability to target a specific mechanism rather than killing or repelling organisms indiscriminately. Although the biological control ability of *Trichoderma* has been shown for many years, the ability of these fungi to increase the rate of plant growth and development, especially to enhance the production of more robust roots is now being documented. While working on more than 260 strains of *Trichoderma* collected from different habitats, we have documented the biocontrol ability of these organisms not only at laboratory level but also at field level as well as upto the extent of commercialization. We also noticed that several strain increase the size and numbers of deep roots quite below the soil surface. These deep roots cause crops, such as corn, fruit crops and ornamental plants to become more resistant to drought. Besides such potentialities, certain *Trichoderma* species are highly efficient producers of many extracellular enzymes and are used commercially for production of cellulases and other enzymes that degrade complex polysaccharides. They are frequently used in the food and textile industries. *Trichoderma* protease appears to exhibit excellent mechanisms of action in controlling grey mold on bean leaf surfaces by preventing mold spore germination and deactivating harmful mold enzymes. Our recent interests warrant the use of secondary metabolites as potential biopesticides as well as biofungicidal agents. In our recent observation, we have noticed the enhancement of antioxidant and free-radial scavenging properties in the agricultural crops (vegetables, fruits etc.) treated with *Trichoderma*. These *Trichoderma*-treated crops are free from pesticidal contaminations, organic and are safer for human consumption. We are now planning to extend such studies on important vegetable crops using *Trichoderma* formulations and other fungal bioagents with an aim to evaluate their biological activity and their ability to be used successfully in field trials to produces better crops through the control of many crop pathogens.

Two U.S. Patents have been awarded for this work on *Trichoderma harzianum*. The first patent pertains to the process for preparation of novel growth media from distillation and other plant wastes for mass multiplication of biocontrol fungi (US PTO No.6511821) and the other for strain of *T. harzianum* useful as nematode inhibitor, fungicides and plant

growth promoter and a process of isolation there of (US PTO No. 6475772). Our work on a novel *Trichoderma* strain with enhanced fungicidal, nematicidal and growth promotion property is an outstanding one among the fungal bioinoculants consisting of *Trichoderma harzianum* and the technology was transferred to Department of Agriculture, U. P. Government for its commercial production by U. P. Government's 9 biopesticide manufacturing units. This technology has also been transferred to Gujarat Green Revolution Company limited (GGRC), Vadodara, a joint venture of Gujarat State Fertilizer and Chemicals Limited (GSFC), Vadodara; Balaji Crop Care Pvt. Ltd., Hyderabad by National Botanical Research Institute (CSIR), Lucknow. GGRC has launched the product "Sardar Ecogreen Biofungicide" and Balajee Crop Care, Hyderabad has launched "TRICHA" based on this technology. The products have reached farmers' fields in several states of the country. The product 'Sardar Ecogreen Biofungicide' and "TRICHA" are based on a potential strain of *Trichoderma harzianum* NBRI-1055, having the abilities to control phytopathogenic fungi, tolerate abiotic stress, stimulate plant growth, induce phenol contents in plants, induce systemic resistance in plants against several phytopathogenic organisms, as well as an efficient root colonizer with long shelf life. A talk-based formulation (2% WP) using *Trichoderma viride* strain 2953 has recently been transferred to Balajee Crop Care Pvt. Ltd., Hyderabad for commercial production.

We have started promoting the usage of *Trichoderma* formulation as a component of integrated farming practices with involving farmers of eastern Uttar Pradesh. Farmers of advised to use seed treatment techniques with *Trichoderma* formulation, rural production technology of *Trichoderma* on cow dung, for managing important soil borne diseases of vegetable crops. The present paper will discuss about important diseases of medicinal and aromatic plants and their management using *Trichoderma* spp. Other aspects related to commercialization, registration and IPR related issues of *Trichoderma* spp. will also be discussed.

Lead Paper-3

Characterization of phytoplasmas infecting medicinal plants in India

Madhupriya and G.P. Rao
Division of Plant Pathology, ICAR- Indian Agricultural Research Institute, Pusa Campus, New Delhi-1100012, India
*Email: gprao_gor@rediffmail.com

Medicinal plants constitute a group of industrially important crops which are of great value for domestic use and export. Plant based drugs are being increasingly preferred all over the world. Phytoplasma cause diseases in several medicinal plant species causing serious economic losses. In our study during 2010-2015, symptoms including white leaves, yellowing, proliferation of shoots, little leaves and witches' broom were observed on *Portulaca oleracea, Cymbopogan citratus* (lemongrass), *Tylophora asthmatica* (Antamula), *Catharanthus roseus, Cannabis sativa* subsp. *sativa* and *Cannabis sativa* subsp. *Indica, Phyllanthus niruri* L., *Datura stramonium and Calotropis giganteum*. Presence of phytoplasmas in the above mentioned plants were confirmed by nested PCR assays using universal primer pairs, P1/P7 and R16F2n/R16R2. Four different groups of phytoplasma, *viz*.16Sr I, II, VI, and XIV were identified and characterized. '*Ca.* P. asteris' (16SrI group) was identified on *P. oleracea, C. sativa* subsp. *sativa*, *P. niruri* and *C. roseus*. '*Ca.* P. australasia' (16Sr II group) was identified on *C. citratus* (lemongrass) , *T. asthmatica* (Antamuula), '*Ca.* P. trifoli' (16SrVI group) was identified on *Datura stramonium and Calotropis giganteum.* However *C. sativa* subsp. *sativa* and *C. sativa* subsp. i*ndica* were also identified as host of *Ca*.P. cynodontis' (16Sr XIV), respectively. In our study both '*Ca.* P. asteris' and '*Ca.* P.trifoli' was identified as the major groups associated with important medicinal plants. Early detection of these phytoplasmas associated with medicinal plants diseases are very important to exclude the possibility of further spreading of new phytoplasma diseases to important medicinal and other commercial crops.

OP-1

Identification of 16SrI group phytoplasma associated with *Ocimum basilicum*, a medicinal weed herb in Uttar Pradesh, India

Madhupriya[1], Sajad un Nabi[1], Durgesh Dubey[2], Manish Kumar[1],G. P. Rao[1]
[1]Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi 11001
[2]Department of Botany, DDU Gorakhpur University, Gorakhpur 273 009, UP, India
*Corresponding author: madhuiari011@gmail.com

Ocimum basilicum popularly known as 'Tulsi' in hindi and holy basil in English belongs to family Lamiaceae, is one of the sacred herbs for Hindus in Indian subcontinent and finds diverse uses in the indigenous system of Medicine. Basil is native to India, China, Southeast Asia, and New Guinea. It was originally domesticated in India, having been cultivated there for more than 5,000 years. It is a half-hardy annual plant, best known as a culinary herb. Depending on the species and cultivar, the leaves may taste somewhat like anise, with a strong, pungent, often sweet smell .The fresh leaves of the plant have been used as an expectorant, diaphoretic, anti cancer, antihelminthic, antiseptic, analgesic and tonic rejuvinator. Dry leaves are used in fungal infections, the fresh juice of the leaves are used in the treatment of bronchitis, otitis media, and skin diseases. Little leaf symptoms were observed on *Ocimum bacilicum* plants during survey of sesame fields at Kushinagar district of Uttar Pradesh, India in 2013-2014. The DNA extracted from symptomatic plants yielded amplicons of 1.25 kb in nested PCR assays with R16F2/R2n primer pair. BLASTn comparison and phylogenetic analysis of 16Sr DNA sequence of *Ocimum bacilicum* phytoplasma isolate revealed association of '*Ca* Phytoplasma asteris' 16Sr I group. This is the first report of 16SrI group phytoplasma association with *Ocimum basilicum* little leaf disease in the world.

OP-2

Post Harvest Management of Medicinal Plants

S.K. Garg*, G. Tiwari, R.N. Shrivastava

Pace of increasing cultivation of medicinal and aromatic plants in India is decreasing after consistent increase during 1980 to 2000. This trend may possibly be due to lack of suitable processing technology and organized market for farmers growing these plants. There is urgent need to develop processing techniques for variable plant parts for different medicinal crops to increase the storability and transport to available market, in addition to increase quality of final crop produce and there sale rate. In the present paper an attempt is made to propose shorten to farmers of the area regarding stapes and method of harvesting and processing methods for different plant parts and for different crop according to demand of market and pharmaceutical companies. This will not only increase the farmer's income but also encourage common farmers to grow these valuable medicinal crops as an alternation to their traditional crop. It is proposed that on the co-operative basis in participatory mode mini processing plants should be installed in a cluster of villages and training on processing skills should be organized by the KVK and agril colleges at block level.

*Associate Professor
College of Agriculture
Ganj Basodsa, Distt-Vidisha (M.P.)
Mob- +918989686456
Email- sanjeevkgarg@gmail.com

OP-3

Serological Characterization of *Papaya leaf curl virus* in Eastern Uttar Pradesh

DK DUBEY and PP UPADHYAYA
Department of Botany, DDU Gorakhpur University, Gorakhpur-273009
Email:durgesh2183@gmail.com

ABSTRACT:
During survey of six districts of Eastern Uttar Pradesh viz., Gorakhpur, Deoria Kushinagar, Mahrajganj, Sant Kabirnagar, Siddharthnagar during the year 2008- 2011 , 5-35%. Incidence of Papaya leaf curl disease (PLCD) was recorded .The characteristic symptom observed were severe downward leaf curling, swelling of veins, twisting and reduction of petioles, inverted leaf bowls and stunted growth of the entire plant which bore a few small, distorted fruit. A total of fifty three symptomatic samples of PLCD were screened with polyclonal antiserum of *Tomato leaf curl Delhi virus* in DAC-ELISA test. Out of which 41 samples reacted positive with TLCNDV polyclonal antiserum indicating the positive relationship of the samples with Geminivirus. Our results suggests that papaya plant infected with papaya leaf curl disease in Eastern Uttar Pradesh was affected by *Papaya leaf curl geminivirus* and was widespread all over Eastern U.P.

OP-4

Antibacterial activity profiles of *Ocimum* species essential oils for biochemical variation

Rajendra P Patel*, Rakshapal Singh, Anju kesarwani, M P Darokar and B R Rajeswara Rao
CSIR-Central Institute of Medicinal and Aromatic Plants, PO-CIMAP, Lucknow-226015, India
*email: rajbt76@yahoo.com

Abstract:
Antibacterial activity of essential oils of 15 different genotypes representing five *Ocimum* species (*Ocimum sanctum, O. basilicum, O. canum, O. grtissimum* and *O. kilimandscharicum*) were analysed against eight strains of bacteria, including both gram positive (*Bacillus subtilis, Staphylococcus aureus, Streptococcus mutans, Micrococcus luteus*) and gram negative (*Klebsiella pneumonia, Roultella planticola, Escherichia coli, Salmonella typhi*) through the disc diffusion method. The extent of inhibition was observed in the term of diameter of net zone of inhibition (ZOI) and the antibacterial activity of various oils were grouped into four categories viz. highly active (ZOI >7mm), moderately active (ZOI 3-7mm), less active (ZOI <3mm) and nearly inactive (ZOI <1mm). It was assessed that all the essential oils except *O. kilimandscharicum* inhibited the bacterial growth. The essential oil of *O. sanctum* and *O. gratissimum* containing high eugenol was found to be the most active having the highest antibacterial activity against any of the tested bacterial strains with >7 mm ZOI. Among all of the tested strains, *M. luteus* and *S. mutans* were found to be the most sensitive to the tested essential oils (40%), while the bacterium like *E. coli* (gram negative) was found to be least sensitive for most of the essential oils tested (73.33%) followed by *K. pneumonia* (60%). *R. planticola* a non-spore forming gram negative pathogen was highly active against tested essential oils in contrast to other tested gram negative bacteria. It was also observed that 67% essential oil samples were moderately inhibited the growth of two strains (*B. subtilis* and *S. aureus*) of bacteria. The result may suggest that the various essential oils of *Ocimum* possess natural biochemicals with antibacterial activities, and therefore could be used as natural preservative ingredients in neutraceutical and pharmaceutical industries.

Key words: *Ocimum*, Bioactivity, Pathogenic bacteria, ZOI

OP-5

Efficient biological management strategy for root-rot and wilt of *Coleus forskohlii* Briq.

Rakshapal Singh*, Rajendra P. Patel, M. Zaim, Alok Kalra
Central Institute of Medicinal and Aromatic Plants, PO CIMAP,
Lucknow:226015, India
* Email: rakshapal2002@yahoo.com

Root-rot and wilt caused by *Fusarium chlamydosporum* affects the cultivation of *Coleus forskohlii*, a medicinal plant grown for its roots, which contain a pharmaceutically important compound called forskolin. In this study, management of this disease under low and high inoculum levels was assessed with four arbuscular mycorrhizal (AM) fungi and a strain of *Pseudomonas monteiili* (strain CRC1). The AM fungus *Glomus fasciculatum* and *P. monteilii* were the most effective treatments that reduced the severity of root-rot and wilt of *C. forskohlii* by 56-65% and 61-66%, respectively, under lower and higher levels of pathogen *F. chlamydosporum*. *G. fasciculatum* increased the dry shoot and root weight by 108-241% and92-204%, respectively, while in plants treated with *P. monteilii*, an increase of 97-223% and 97-172% in dry shoot and root weight, respectively, was observed. Although *P. monteilii* was effective, it gave higher root yields only under lower inoculum level of the pathogen. *G. fasciculatum* performed equally well under both lower and higher inoculum levels. Increase in yields with both the biocontrol agents was accompanied by increase in P uptake and in K uptake. The forskolin content of the roots was significantly increased (14-21%) by *G. fasciculatum*, *P. monteilii* or *G. mosseae* under lower inoculum level of pathogen.

PP-1

Infection of *Velvet bean severe mosaic virus* on *Mucuna pruriens* a "magic bean" medicinal plant

Aruna Jangid[*], Yogesh Kumar[**], Vanita Chandel[*] and Narayan Rishi[*]
[*]Amity Institute of Virology & Immunology, Amity University Uttar Pradesh, Noida 201313, India.
[**]Present address: DAV University Jalandhar, Punjab 144012, India.

M. pruriens, a tropical legume also known as velvet bean. It is one of the rare Ayurvedic "herb that actually balances all three dosha's ie. vatta, pitta and kapha. In Ayurvedic system it is known as Kapikachhu. Ayurvedic herbal medicine has relied on mucuna since 1500 BC to support many ailments such as snakebite, intestinal disorder, sexual response, fertility issues, nervous system disorder, depression. In *M. pruriens*, a biochemical active compound levodopa or L-dopa is present which is a precursor to several neurotransmitters including adrenaline, noradrenal and dopamine. It has been used for the treatment of parkinson's disease , as it is partially characterized by decreased brain production of dopamine. Natural form of L-dopa in mucuna provides equivalent result as synthetic levodopa irrespective of the common side effects of nausea vomiting and involuntary muscle movement. Mucuna has hypoglycemic, antioxidant and aphrodisiac activity which makes it better medicine for the treatment of blood sugar level, stress and depression, and infertility in both male and female. It increases the production of youth hormone and sperm count when used in infertility treatment.

It is a matter of concern that distinct bipartite *Begomovirus* species (VbSMV) has been reported to cause a severe mosaic disease in *M. pruriens* in India. Infected Mucuna plants were collected and analyzed for the presence of the virus through RCA using Õ29 DNA polymerase. The RCA product was restricted and cloned. Complete sequence was obtained by primer walking. VbSMV was found to be a bipartite *Begomovirus* comprising of DNA-A and DNA-B. Unlike all other viruses VbSMV encodes for candidate suppressor of RNAi. For identification of these candidate suppressors all genes have been cloned in expression vector pCAMBIA1302. Further work of RNAi suppressor(s) identification is in progress. Our effort is to find an effective management strategy of the problem.

PP-2

Antagonistic chitinolytic microbes alleviate *Meloidogyne incognita* (Kofoid and White) Chitwood induced reactive oxygen species generation in *Bacopa monnieri* (L.) Pennell

Rupali Gupta[1,2] , Akanksha Singh[1], Swati Srivastava[1] and Rakesh Pandey[1*]

[1]Department of Microbial Technology and Nematology, CSIR- Central Institute of Medicinal and Aromatic Plants, P.O. CIMAP, Lucknow, India-226015

[2]Academy of Scientific and Innovative Research, CSIR-CIMAP Campus, Lucknow 226015, Uttar Pradesh, India

E-mail: r.pandey@cimap.res.in, Phone - 0522-2718530, FAX-0522-342666

Root knot nematode, *Meloidogyne incognita* (Kofoid and White) Chitwood a calamitous plant pathogen affects almost all the commercial crops, especially medicinal plants viz. *Bacopa monnieri* L.. In the present investigation the efficacy of chitinolytic microbe's viz., *Chitiniphilus* sp. MTN22 and *Streptomyces* sp. MTN14 and their combination on mitigation of reactive oxygen species induced by *M. incognita* in *B. monnieri* was evaluated under green house conditions. Periodical studies revealed that initially the production of H_2O_2 at 3rd day after nematode inoculation (dani) was observed to be 1.4 fold higher in dual microbes treated plants, when compared to *M. incognita* inoculated control plants. Similarly, the expression of the antioxidant enzymes superoxide dismutase and free radical scavenging activity was also highest in the single and dual treatment at 7th dani which was correlated with lesser lipid peroxidation in *B. monnieri* under the biotic stress. Microscopic analysis also confirmed reduction in total reactive oxygen species, programmed cell death, free radicals like H_2O_2, and O_2^- by exogenous application of these strains. The physiological responses were directly correlated with the nematode density as least root gall index was recorded in the dual microbe treated plants. The data obtained thus suggest an augmented elicitation of stress response in *B. monnieri* under *M. incognita* stress by both *Chitiniphilus* sp. MTN22 and *Streptomyces* sp. MTN14 in a synergistic manner. Therefore these strains can be used to develop effective plant growth promoters along with reduced the root-knot nematode infestation for maximizing their use in field conditions.

PP-3

Antibacterial properties of the aqueous leaf extract of *Flacourtiajungomas*in controlling post-harvest bacterial diseases of *Citrus sp.*(Lemon and Oranege)

Deepanjali Sinha[1], Alok K. Srivastava[2]andMadhulika Srivastava[1]

[1]Biotechnology and Molecular Biology Centre,Mahatma Gandhi Post Graduate College, Gorakhpur – 273 001, U.P., India.

[2]Department of Chemistry, Mahatma Gandhi Post Graduate College, Gorakhpur – 273 001, U.P., India.

In eastern region of Uttar Pradesh the trees of *Flacourtiajangomas* had been very common in northern part of Gorakhpur and Maharajganj districts and are still found in these areas, but in an endemic form due to illegal cutting of green trees for mere cause of urban area expansion.

During the present investigation treatment of the aqueous leaf extract of *Flacourtiajungomas* by spraying the extract has been done on the harvested fruits(Lemon and Orange) for the control of post-harvest bacterial citrus canker disease caused by *Xanthomonascitri*. The obtained results have indicated that 20 ml/litre concentration was more effective against the pathogen till seven days as a natural antibacterial spray. This concentration of extract has been found to be nontoxic under *in vivo* condition than other chemical treatments.

Key words:*Flacourtiajangomas, Xanthomonascitri.*

PP-4

Antifungal properties of the aqueous leaf extract of *Cyperusrotundus*(Nagarmotha)in controlling watermoulds causing fish diseases

Gaurav K. Srivastava[1], Ausaf Ahmad[2] and S.K. Prabhuji[1]

[1]Biotechnology and Molecular Biology Centre,Mahatma Gandhi Post Graduate College, Gorakhpur – 273 001, U.P., India.

[2]Amity Institute of Biotechnology, Amity University, Lucknow, U.P., India

The parasites and diseases constitute one of the important factors in regulating the fish population in *Pisciculture.*Fungi are known to attack eggs, fry, fingerlings and adults of fishes and as a general rule the fungal infection starts when the host gets injured either mechanically or as a result of infections other than fungal. In India, the incidence of disease has been observed in major carps cultured in different parts of the country.

During the present investigations the effect of aqueous leaf extracts of *Cyperusrotundus*has been studied on watermoulds viz., *Pythiumaphanidermatum, Aphanomyceslaevis,* and *Achlya orion.* Obtained results has indicated *that* 100 l / ml of *Cyperusrotundus*aqueous leaf extract was fungicidal against all the pathogensas a natural fungicide in both *in vitro* and *in vivo* conditions. This concentration of the extract has been found to be nontoxic to fish fingerlings of *Labeorohita*(Rohu), *Labeocalbasu* (Bhakur)and *Hypophthalmichthysmolitrix* (Silver carp).

Key words:*Pisciculture,* fry, fingerlings*, Cyperusrotundus*, *Pythiumaphanidermatum, Aphanomyceslaevis,* and *Achlyaorion.*

PP-5

Study of Quality based Changes in Button Mushroom during Blanching Process

Kavita Arora, PP Upadhyaya and Anil K Dwivedi.
Department of Botany, DDU Gorakhpur University, Gorakhpur-273009 (U.P.)
kavita621@gmail.com

Mushroom is one of the most favorite foods and because of its specific properties it is recommended by medical practicenors also. Storage of mushroom is a problem and blanching is an easy method of temporary storage. Blanching is done to control the activity of enzymes. In this process mushrooms are placed in boiling water or a solution of salt and acid for 2-4 minutes. To find out suitable time period and treatment blanching of *Agaricus bisporus* was done for 3 different durations (2, 4 and 6 minutes) in 2 treatments like- In plain water and in 2% NaCl solution. Blanching for 2 minute was quite good. In higher NaCl concentration the size of button mushroom decreases and the colour diminishes. In the plain water treatment colour change was not prominent.

PP-6

Antagonistic effect of *Pseudomonas* spp. isolated from rhizospheric soil of *Picrorhiza kurrooa* (kutki) against phytopathogenic fungi

Pradeep Dobhal, Harish Chandra and A.R. Nautiyal
High Altitude Plant Physiology Research Centre, H.N.B. Garhwal University (A Central University), Srinagar Garhwal-246174, Uttarakhand
Author for correspondence: pradeepdobhalhapprc@gmail.com

ABSTRACT
Plant protection is an important area which needs attention since most of the hazardous inputs added into the agricultural system are in the form of plant protection chemicals. *Pseudomonas* spp. possesses a variety of promising properties which make it better Bio-control agent. The objectives of the present study were to isolate *Pseudomonas* spp. from the rhizospheric soil of a medicinal herb *Picrorhiza kurrooa*. *Pseudomonas* spp. was isolated from rhizospheric soil on King's B medium and its antagonistic effect on three fungal plant pathogens was studied in vitro by inoculating fungi at the center and the *Pseudomonas* was streaked on same. *Pseudomonas* spp. on co-inoculation with fungal pathogens inhibited the growth as compared to control. Maximum inhibition was observed in *Rhizoctinia solani* (63.6%) followed by *Aspergillus ocharaceus* (63%) and *Aspergillus candidus* (45.4%). Effect of the isolated secondary metabolites on the fungal growth by broth dilution technique and antifungal activity by agar well diffusion technique was studied. *Pseudomonas* spp. produces a broad-spectrum antifungal compound, which inhibits a variety of plant pathogenic fungi and inhibits *Rhizoctinia solani* more when compared to other plant pathogens in the present study. Further investigations on the type of antifungal components and in vivo experiments could make *Pseudomonas* spp. as one of the most suitable bio-control agents in suppressing the phytopathogenic fungi and replace chemical fungicides.

Keywords: *Pseudomonas* spp., Bio-control, *Picrorhiza kurrooa*, Antifungal, Phytopathogenic

Phytoremediation of Cadmium Affected Soil Associated with PGPR (Plant growth promoting rhizobacteria) Derived Siderophores

Poonam Gusain* and Vir Singh
GB Pant University of Agriculture and Technology Pantnagar, 263145 India
Email-poonamgsn@gmail.com

The heavy metal pollution of soils is an emerging environmental issue and a growing threat to humanity. Soil is an important source for heavy metals in crops and vegetables since the plant roots can absorb these pollutants from soil, and transfer them to seeds and indirectly to human diets and food chain. Various methods of remediating metal polluted soils exist; they range from physical and chemical methods to biological methods.

Biological approach (Siderophoregenic phytoremediation) on the other hand, has generated a global interest in uptake of heavy metals. Microorganisms produce siderophores to facilitate iron acquisition. Siderophores are metal regulatory machinery and play a vital role in maintaining homeostasis of metals and divalent metal ions for cell viability. In present study the investigations on PGPR siderophore have been carried out under laboratory conditions. Ten heavy metal-resistant bacterial strains were procured and isolated from heavy metal-contaminated sites All ten isolates namely, C1, C2, C3, C4, C5, C6, C7, C8, C9 and C10 were characterized morphologically, biochemically and screened for plant growth promotory properties such as, Phosphate-solubilization, IAA production and siderophore synthesis in the presence of metals cadmium and. The PGPR isolates C3, C8, C9 and C6 tested on cadmium, synthesized excellent amount of siderophores with 81.8%, 78.2%, 78% and 75.5 %SU respectively. FTIR analysis further confined the characteristic hydroxamate and catecholate nature of siderophores. For better elucidation of the integral physiological response of siderophores to Cd chelation and plant growth promotion, plants were grown in vivo net house. Plant growth attributes and yield characterstics, in the presence of PGPR isolates were appreciable in metal free Indian mustard (*Brassica juncea*) plants as compared to control treatment, however mustard plants were failed to grow in cadmium supplemented soil. In our second trial with spring wheat (*Triticum estivum*), the plants accumulated high concentrations of cadmium into roots and shoots, indicating that this cereal crop could be a better hyperaccumulator and employed for phytoextraction of heavy metal contaminated surface soils. The nature of siderophores produced by isolates C3, C6, C8 and C9 was found to assist cadmium uptake, in future recommended for phytoremediation purposes.

Management of soil zinc deficiency for sustainable productivity of medicinal plants: An overview

Kuldeep Singh and Brijesh Kumar
Amity Center for Soil Sciences and Amity Science, Technology and Innovation Foundation, Amity University Uttar Pradesh, Sector-125, Noida 201303, Email: ksingh6@amity.edu

Of late, there is an increasing concern on the use of medicinal plants to combat sickness and diseases and malnutrition in human populations. In recent decades, the low cost and milder side effects of herbal medicines, compared to conventional synthetic drugs, have enhanced their worldwide use (Rai and Mehrotra, 2005). Of the many factors affecting horticulture, vegetable, medicinal plants and field crops quality and yield, fertility is one of the most important. In other words, the single most important factor limiting crop yields especially among resource - poor farmers - is soil infertility. Soil fertility and plant nutrition management has only been recently recognized at national level as a key pathway toward food security, sustainable resource management and rural well-being. Unless soil fertility is restored, farmers will gain little benefit from the use of improved varieties of horticulture, vegetable, medicinal plants, field crops and more productive cultural practices.

Zinc deficiency in soils does not only reduce plants productivity, but it also leads to low-zinc plant food produce causing human malnutrition. The problem is global, however, it is more acute in India as billions of people suffers from zinc malnutrition, also known as "hidden hunger" that is caused by lack of sufficient zinc in diet. There are negative health effects of zinc malnutrition. Zinc deficiency causes stunting, reduced fertility, impairment in physical development, immune system and brain function. Zinc is second most abundant trace elements in the human body after iron. Research has shown that the regions in the world with zinc deficient soils are also characterized by widespread zinc deficiency in humans. There is a highly significant correlation between zinc deficiency in soils and crop plants and zinc deficiency in humans (Cakmak,et al. 1999; Cakmak, 2008). Lack of a clinical syndrome of zinc deficiency has delayed its recognition as a public health problem. To date, serum zinc is the only biochemical indicator of zinc status for populations. Zinc (Zn) is by far the most important micronutrient in soil fertility management when judged in terms of its deficiency in Indian soils. More than 90% of Zn in soils occurs as insoluble Zn and is unavailable to plants. Zinc deficiency is common in about half of the Indian soils which will increase to 63% soils by 2025 leading to low crop yield and zinc malnutrition in human beings. Hence, Zinc deficiency in India should be considered as "national zinc nutrition menace in all soils and crops" (Singh, 2009).

When soils are deficient in zinc, the zinc concentrations of medicinal plants grown on those soils are lower. People eating produce of medicinal plants grown in zinc-deficient soils receive less zinc from their diets and are therefore at risk of zinc deficiency. Various field test conducted in India indicate that various crop plants grown on soils containing less than 0.6 ppm DTPA-extractable zinc (Singh, 2009) respond positively to zinc fertilization

at a rate of 5 kg Zn/ha. Improving the zinc nutritional status of medicinal and other crop plants by agronomic biofortification is a creative approach for fighting zinc malnutrition in humans. A direct application of zinc fertilizer under field conditions is highly effective and very practical way to maximize uptake and accumulation of zinc in medicinal plants. In the case of requirement of increasing zinc concentrations in medicinal plants, foliar zinc application is expected to be more effective than the soil zinc applications.Among the different strategies to reduce Zn malnutrition in human populations, the agronomic bio-fortifications is considered most sustainable and cost effective approach to enhance the zinc concentrations in grain or produce of medicinal plants and to address zinc deficiency in soils-plants-humans chain. There are reports that farmers growing field crop and medicinal plants have the tendency to go for unbalanced fertilization and do not apply zinc fertilizers even in low zinc status fields (Singh, 2011). Of late, it is predicted that as high as 25-30 per cent Zn content in field crops and medicinal plants will gradually decline with rising concentrations of atmospheric CO2 for the middle of this century. Zinc deficiency in soil is having a 'serious' impact on human health and plant nutrition. Currently, there is no standard method of relating zinc deficiency in soils and plants to their suboptimal levels in humans. Therefore, an serious attempt is required to be made to develop innovative new diagnostic test to diagnose Zn- malnutrition in human beings by plant/tissue/human hair/ urine/ blood serum zinc analysis.

Technical Session - 5
Pharmacology, Pharmacognosy and Phytochemistry

Lead Paper-1

Lead Lecture

Medicinal Plants are effective remediation for fungal diseases of fish

S.K. Prabhuji
Biotechnology and Molecular Biology Centre, Mahatma Gandhi Post Graduate College, Gorakhpur – 273 001, U.P., India.

Fish is one of the man's oldest foods, and because of its importance as a rich source of protein, it is of great nutritional value. At present more than half of the world's population does not get enough protein and the entire Asia, Africa and Latin America suffer from malnutrition. In view of the rapid growth of the world's population, it seems advisable to be careful with this important source of very rich, palatable and easily digested protein.

The parasites and diseases constitute one of the important factors in regulating the fish population in Pisciculture. To increase fish production, it is necessary that the various contributory factors to mortality of fish are reduced, so that the disease-free fish of good quality is made available to the consumer, but, sufficient attention has not yet been paid to fish diseases and their control in our country.

In India, the incidence of disease has been observed in major carps cultured in different parts of the country. The fry and fingerlings, when transported over long distances, get bruised on the body and, unless properly disinfected, these become sites of fungal infection, resulting sometimes in large scale mortality. The major fungal components that infect the fish populations causing mortality are watermoulds which include members of Saprolegniaceae, Pythiaceae and Blastocladiaceae. The most damaging members of Saprolegniaceae are *Saprolegnia*, *Achlya* and *Aphanomyces*.

Some of the usually used chemicals having potent antifungal properties are Sulphur, Potassium permanganate, Potassium dichromate, Gentian violet and Phenols like Resorcinol and Metol. They effectively kill the bacteria and fungi, but penetrate into the muscles of fish and remain there in a residual form that directly or indirectly affects the fish-consumers

We have used the leaf extracts of *Boerhaavia diffusa, Flacourtia jungomas, Eclipta alba, Cordia myxa* and *Madhuca longifolia* are also safe control measures. All these tested extracts have been found to be non-toxic to fishes and may be safe for human consumption. The chemical control experiments will be conducted, *in vitro*, based on our earlier studies (Prabhuji *et al*., 1983 (caffeine), 1986 (amino acids), 2013 (yeast culture filtrate); Sinha, 1985 (common salt); Srivastava *et al*., 2012 (paniala fruit extract)). Emphasis will be laid on the use of natural biochemicals, particularly isolated from certain medicinal plants to avoid host toxicity.

OP-1

PLANTS AS HERBAL DRUGS RENDER THEIR BEST FOR THE QUALITY LIFE AND HEALTH TO HUMAN BEINGS: AN URGENT CALL TO BIOMEDICAL COMMUNITY

DR. D. M. TRIPATHI, ASSOCIATE PROFESSOR , Post Graduate Department of Zoology, Govt. Autonomous Post Graduate College Rishikesh, Uttarakhand, India
Presenting Author: E mail ID: dmtripathi31@gmail.com

Man looked curiously towards the **Mother Nature** for the disease free and quality life ever science the dawn of human civilization which thereby became the sole cause for the advent of **Ayurvedic Therapy** applying plants as chief source. Further, the intensified scientific and technological developments, in every sphere of life, led the emergence of **synthetic drugs**- the modern allopathic drugs. These drugs almost replaced the Ayurvedic Herbal Drug led Ayurvedic Therapy. Undoubtedly, allopathic drugs combat and contain the infections and the diseases with extreme degree of success thereby enhancing the vitality of human beings. These drugs, however, are associated with inherent complications, due to **active component** principle of drug development based on **reductionism approach,** like side effects, drug resistance, withdrawal effects, recurrence of diseases, immunosuppressive effects, cost factor and unavailability in far flung areas e.t.c. and hence, deter their prompt, frequent, rational and judicious uses in cases of human ailments. Ayurvedic herbal drugs, as safe alternatives to these allopathic drugs- the better **futuristic drugs of choice,** are free from these traumatizing complications. **Pro to body concept, holistic approach,** principle of totality, eco-biofriendly innocuous nature, easy availability e.t.c., are significant qualities of these natural ayurvedic herbal drugs. These drugs are, however, deprived of reproducibility, clinical validity, credibility and finally the acceptability. It is, henceforth, urgently realized to apply **Biotechnological techniques and tools** for crediting them to be the **futuristic drugs of choice** for global benefits and welfare of mankind by way of their **modernized promotion.**

The findings of our comprehensive research on several Ayurvedic herbal drugs, applying various **Modern Biotechnological and Biomedical Parameters** like immunological, biochemical, pathological and clinical including single blind and double blind placebo controlled clinical trials, proved these drugs working mainly as immunofacilitators, rejuvenators, revitalizers in cases of human immunocompromised diseases including diarrhoeal diseases. Thus, these drugs were clinically standardized and formulated, validated and subsequently authenticated being tested on these parameters. Clinical standardization, reproucibility and credibility of results and finally the global acceptability to these **futuristic drugs of choice** are issues of extreme importance which need to be addressed by the establishment of an exciting discipline- **Herbal Biomedical Technology** and we walked confidently in this direction. Our research findings provide sound basis to reproucibility and credibility of results and finally the global acceptability to these **futuristic drugs of choice.** These observations will be deliberated during presentation.

Key words- Allopathic drugs, ayurvedic herbal drugs, modern biotechnological / biomedical techniques, clinical standardization of ayurvedic herbal drugs.

OP-2

Correlation and Path Coefficient Analysis for Morphological and Phytochemical Character in Wild Noni (*Morinda tomentosa* Heyne ex Roth)

A.H. Rathod*, S. Acharya, A.K. Singh, S. Mishra, and S. K. Parmar
Department of Genetics and Plant Breeding, Sardarkrushinagar Dantiwada Agricultural University,
Sardarkrushinagar- 385506 (Gujarat)
*Email ID: *avinashrthd2@gmail.com*

The estimates of correlation coefficients indicated that the enhancement of fruit yield per plant was associated with both morphological and phytochemical traits. In general the values of genotypic correlation were higher than their phenotypic counterparts indicating strong inherent relationship among them. Path analysis also indicated contribution of both morphological and phytochemical traits to fruit yield per plant. However, anthocyanin content in leaf, carotenoid content in fruit, tannin content in leaf and flavonol content in leaf evinced more direct negative effect on fruit yield per plant. These characters also exhibited desirable indirect contribution to fruit yield via other traits too. Thus, big fruits with more length to breadth ratio and lesser contents of anthocyanin, tannin and total phenol in leaf but richer contents of anthocyanin, flavonol and total phenol in fruit should be aimed for enhancement of fruit yield / plant through selection in *Morida tomentosa*.

Keywords: *Morinda tomentosa*, Wild noni, Correlation, Path analysis, Phytochemicals, Phenol

OP-3

Characterization and antioxidant activity of essential oil of *Cinnmomum tamala*

Dr. Anju Bhatnagar
Assistant Professor, D.B.S. (P.G.) COLLEGE DEHRADUN (INDIA)-248001
anju_bhatnagar_2007@yahoo.com

Oral presentation

The objective of present study was to determine the antioxidant activity of essential oil extracted from Cinnmomum tamala of different climatic zone of uttarakhand. Cinnmomum tamala is aromatic and medicinal important, commonly known "tejpat" is a member of family lauraceae. The oil is commonly used for flavouring food and widely used in pharmaceutical industries. Phyto-chemicals are active chemical ingredients derived from plants, it's essential oil contain carminative, hypoglycaemic and stimulant properties. Essential oil extracted from dried leaves of Cinnmomum tamala by distillation and subjected to GC-MS. Thy yield of the oil on a dry weight basis ranged from 1.0 % to 4.2%(w/w). GC-MS analysis was done to find out the chemical composition of oil. Phenyl propanoids constitute the major portion (88.0-92.0%) of the oil, 54 compounds were identified from the oil. The main constituent of tejpat leaf oil is eugenol. The antioxidant capacity of essential oil was significant determined by 2,2' diphenyl 1- picryl hydrazyl (DPPH) radical scavenging method. Antioxidant capacity of oil compared with that standard compound eugenol.

Key words: Cinnmomum tamala, eugenol, antioxidant capacity, DPPH

OP-4

Antioxidant activity and Glycemic response of *Urtica Dioica* powder Incorporated in Indian Flat Breads in Euglyemic Subjects

Neelam Chaturvedi
Food Science and Nutrition Department, Banasthali University,Tonk, Rajasthan, India 304022.
Email: neelam295chaturvedi@rediffmail.com

Urtica dioica L is traditional ayurvedic herb commonly known as Stinging Nettle and frequently used by humans for medicinal purposes with numerous pharmacological activities. It has antioxidant, anti-inflammatory, hepatoprotective, antihypertensive and antidiabetic properties. This study deals with the antioxidant activity of the *U dioica* aqueous extract were evaluated by 1,1-diphenyl-2-picryl hydrazyl (DPPH) radical scavenging, total phenols and flavonoids content of the extracts were determined using Folin–Ciocalteu and aluminium chloride methods, respectively, after which the products (Chapatti, Naan, Khakhara, Lachaparatha) were prepared by incorporating its leave powder in three different concentrations i.e. 2%, 4% and 6% respectively and compared with the standard product.Acceptability evaluation was carried out using 5 point composite score and 9 point hedonic scale. The study was also designed to determine the glycemic response of best selected test product on euglycemic subjects and to determine glycemic index and glycemic load by Incremental Under Area Curve. The results of present study revealed that the phenolic and total flavonoids content in aqueous extract of U. dioica were found to be 11.06±0.55 GAE mg/g and 4.66±0.56 QE mg/g respectively and The extract exhibited strong antioxidant DPPH radical scavenging activity with IC_{50} value (62 g/ml) when compared to standard ascorbic acid. The products with 2 and 4% incorporation of leave powder were more acceptable by the semi trained panels. Further study was conducted on euglycemic subjects who were fed test and standard recipes (Chapatti and Naan) and there was decrease in fasting and post prandial blood glucose after intervention of test recipe, which showed low Glycemic response on experimental subjects. The glycemic index of test chapatti was 37 (low) and glycemic load was in medium category (11) as compared to test Naan and their standard products .The finding demonstrated that *U. dioica* possess high antioxidant potential and when its powder based products were given to the euglycemic subjects, there was a significant reduction in blood glucose levels as compared to the control group thus helping in improving insulin sensitivity and hence, it can be used as a supplement in a diet which may lead for the management of diabetes more effectively.

Keywords: *Urtica dioica*, Antioxidant activity, Glycemic index, Glycemic load.

OP-5

Phytochemical analysis and *in vitro* haemolytic activity of leaf and flower extracts of *Rhododendron arboreum* Sm.

Deepshikha Gairola, Kumud Saklani, Hem Pant and Aditi Grover
Department of Biotechnology, Shri Guru Ram Rai (PG) College, PathriBagh, Dehradun-248001, Uttarakhand, India.

The tree species *Rhododendron arboreum* Sm., valued greatly for its magnificent flowers and evergreen foliage, is a medicinally and economically important plant species distributed in the Himalayas. In the present study, the haemolytic activity of the leaf and flower extracts of *R.arboreum* was investigated against normal human erythrocytes. The phytochemical screening of their ethanolic and petroleum ether extracts revealed the presence of alkaloids, saponins, tannins, terpenoids, phenolics and flavonoids. Four different concentrations of the leaf and flower extracts were taken for studying the haemolytic activity. The extracts showed dose dependent haemolytic activity. The ethanolic extracts of both the plant parts showed high haemolytic activity even at lower concentrations in comparison to the petroleum ether extracts but the leaf extracts of *R.arboreum* showed greater haemolysis at all concentrations when compared with the flower extracts. Thus the present study indicates the haemolytic potential of this plant.

OP-6

Effects of different sucrose and agar concentrations on *in vitro* propagation of Rose cultivars

Hem Pant and Kumud Saklani*

Department of Biotechnology, Shri Guru Ram Rai (PG) College, PathriBagh, Dehradun-248001 Uttarakhand, India. E-mail: kkumud.kumud@gmail.com

Abstract

Roses, the most important garden flowers, are valued greatly by horticulturists due to their commercial importance as cut flowers including their wide use for medicinal and aromatic purposes. Efficientmicropropagation of Rose cultivars was achieved by improving upon the shoot proliferation and rooting by varying the sucrose and the agar concentrations in Murashige and Skoog (MS) medium. Best shoot initiation in the nodal explants occurrred in the MS medium containing sucrose (3.0 %, w/v) and agar (0.8 %, w/v)supplemented with 6-benzyladenine (BA), 6-furfuryl aminopurine (Kn) and Naphthalene acetic acid (NAA) in combination (3.5 mg l^{-1} + 1.5 mg l^{-1} + 1.0 mg l^{-1}). Enhanced multiplcation and growth was observed on subculturing the mother explants with regenerated shoots on fresh MS medium containing higher sucrose (3.5%, w/v) and lower agar(0.6%, w/v) concentrationsupplemented with lower cytokinin combination of BA and Kn (2.5 mg l^{-1}+1.5 mg l^{-1}) respectively. The use of half strength MS medium containing sucrose (2.5 %, w/v) and agar (0.2%, w/v) with NAA and BA (1.5 mg l^{-1}+0.5 mg l^{-1}) induced good rooting in *in vitro* microshoots of Rose cultivars.

OP-7

Composition of the essential oil of *Callistemon citrinus* (Curtis) Skeels from Uttarakhand (India)

Harish Chandra Andola*[a], S. Zafar Haider[b], Pramod Singh Negi[c], Kusum Arunachalam[a]
[a] School of Environment & Natural Resources (SENR), Doon University, Dehradun-248 001, Uttarakhand, India
[b] Centre for Aromatic Plants (CAP), Industrial Estate, Selaqui-248011, Dehradun, Uttarakhand, India
[c] Department of Chemistry, H.N.B. Garhwal University, Srinagar-246 174, Uttarakhand, India

*Corresponding author (Harish Chandra Andola); Email: andolah@rediffmail.com

Abstract.
The essential oils from fresh, shade dried and oven dried leaves of *Callistemon citrinus* were separately hydrodistilled and analyzed by GC and GC-MS in order to determine the variation in occurrence of the constituents. The average yield obtained, was ranged from 0.30-0.97% and the maximum yield recorded in oven dried leaves (0.97±0.08%), followed by shade dried (0.52±0.03%) and fresh leaves (0.30±0.03%). Twenty compounds amounting 98.4-99.1% were identified in the oils. Among the volatile constituents, the major component was identified as 1,8-cineole (87.2, 86.0 and 80.0% in shade dried, oven dried and fresh leaves, respectively). 1,8-Cineole is used for its aromatic properties and as an ingredient in pharmaceutical and industrial applications. Result shows that the quantitative variations occurred in the oils of fresh, shade and oven dried leaves depend upon several factors such as drying methods and also varied by chemical transportation of components in different conditions like sun light, shade and oven temperature.

PP-1

Bryophytes as potential source of novel compounds for medicine

***Mayurika Goel and P L Uniyal**
Department of Botany, University of Delhi, Delhi 110007
*Department of Basic and Applied Sciences, GD Goenka University, Gurgaon-122103

Bryophytes are a diverse and distinct group of plants that appeared during the early history of land plants and evolved as unparalleled diversity of morphology, occupied wide range of habitats and harbour variety of chemical compounds. They have traditionally been used as medicinal plants to cure cuts, burns, external wounds, liver ailments, ringworm bacteriosis, pulmonary tuberculosis, neurasthenia, fractures, convulsions, scalds, uropathy, pneumonia, neurasthenia etc. More than 200 novel compounds have been isolated from bryophytes. Terpenoids are the largest group of secondary metabolites found in bryophytes with approximately 1400 reported structures. The biological characteristics of the terpenoids and aromatic compounds isolated from the bryophytes are: (1) characteristic scents, pungency and bitterness; (2) allergenic contact dermatitis; (3) cytotoxic, anti-HIV, and DNA polymerase b inhibitory; (4) antimicrobial and antifungal activity; (5) insect antifeedant activity, mortality, and nematocidal activity (6) superoxide anion radical release inhibitory activity; (7) 5-lipoxygenase, calmodulin, hyaluronidase, cyclooxygenase inhibitory activity, and nitric oxide (NO) production inhibitory activity; (8) piscicidal and plant growth inhibitory activity; (9) neurotrophic activity; (11) muscle relaxing activity; (12) cathepsins B and L inhibitory activity; (13) cardiotonic and vasopressin antagonist activity and (14) antiobesity activity. It is estimated that 80% of the bryophytes contain a bitter principle, some species present a surprisingly pungent taste and others can induce allergenic contact dermatitis. The extract of bryophytes as *Conocephalum, Dumortiera, Sphagnum,* etc. can check the growth of microorganism because of the presence of antibiotic compounds. Some phenolic compounds isolated from *Plagiochila* and *Wiesnerella* are potential pesticide. Aromatic compounds consist of benzenoids, flavonoids, phenylpropanoids, and bibenzyl derivatives Isoflavonoids, flavonoids, and bioflavonoids have been reported to be possible chemical barriers against microorganisms. As numerous potentially useful compounds, including oligosaccharides, polysaccharides, sugar alcohols, amino acids, fatty acids, aliphatic compounds, phenylquinones, and aromatic and phenolic substances have been discovered in bryophytes, but much work remains to link medical effects with specific bryophyte species or compounds

Key words : liverworts, terpenoides, biological activity, biopesticide

PP-2

Turmeric Spice Bowl of the World Improvement through Biochemical Analysis

Ashu Singh and RS Sengar
Department of Ag. Biotechnology, College of Agriculture, S.V.P. University of Agriculture & Technology, Meerut 250 110 India
Email: ashubiot25@gmail.com

Curcumin (diferuloylmethane) is a yellow pigment present in the spice turmeric (Curcuma longa) that has been associated with antioxidant, anti-inflammatory, anticancer, antiviral, and antibacterial activities as indicated by over 6,000 citations. Micro propagation of turmeric was first to reported on MS medium supplemented with coconut milk, kinetin and BAP or on Smith's medium supplemented with coconut milk, kinetin, BAP and inositol according to TCL standardized protocol. The use of mass spectrometry and HPLC-mass spectrometry together with spectral databases is a powerful tool in the chemometric profiling of bio-sources for natural product production. High throughput, high sensitivity flow NMR is an emerging tool in this area as well. Whether by cell based or biomolecular target based assays, screening of natural product extract libraries continues to furnish novel lead molecules for further drug development, despite challenges in the analysis and prioritization of natural products hits. Looking its biochemical status standards these germplasm will be favorably recommended for farming sector entrepreneurs and pharmaceutical industries may explore to use widespread expansion at different agroclimatic zones especially the farmers so that these recommendation can be used for cultivation of resulted varieties to be favorably grown in the local area.

PP-3

Effects of medicinal plants extract on fish fingerlings during mycoses caused by watermoulds.

Gaurav K. Srivastava[1], Richa[1], Shail Pande[2] and Chhamta Srivastava[2]

[1]Biotechnology and Molecular Biology Centre,Mahatma Gandhi Post Graduate College, Gorakhpur – 273 001, U.P., India.

[2]Department of Botany, Mahatma Gandhi Post Graduate College, Gorakhpur – 273 001, U.P., India.

The parasites and diseases constitute one of the important factors in regulating the fish population in *Pisciculture.*Fungi are known to attack eggs, fry, fingerlings and adults of fishes and as a general rule the fungal infection starts when the host gets injured either mechanically or as a result of infections other than fungal. In India, the incidence of disease has been observed in major carps cultured in different parts of the country.

During the present investigations the effect of aqueous leaf extracts of the medicinal plants *Aeglemarmelos, lawsoniainermis,* and*Artemesia vulgaris* has been studied on watermoulds viz., *Pythium sp., Aphanomyces sp.,* and *Achlya sp.* Obtained results haveindicated that100 l / ml of*Aeglemarmelos,* 120 l / ml of *lawsoniainermis*and70 l / ml of *Artemesia vulgaris* were found fungicidal against all the pathogens and were effective as a natural fish-fungicide in both *in vitro* and *in vivo* conditions. These concentrations of extract have been found to be nontoxic to fish fingerlings of *Labeorohita*(Rohu)and *Hypophthalmichthysmolitrix* (Silver carp).

Key words: Pisciculture, fry, fingerlings*, Aeglemarmelos, lawsoniainermis, Artemesia vulgaris*, *Pythium sp., Aphanomyces sp., Achlya sp.*

PP-4

In-vitro hypoglycemic activity of *Talinum triangulare* root extracts

Abhai K Srivastava, Nidhi Gupta and VN Pandey
Experimental Botany and Nutraceutical Laboratory
Department of Botany, DDU Gorakhpur University, Gorakhpur-273009.

The roots of *T. triangulare*, a green leafy vegetable, is bulbous and stores secondary metabolites. The motif of this study was to investigate antidiabetic potential of root extract by á-amylase inhibition assay. Different concentration (10,20,30,40,60,80 and100 g/mL) of ethanolic extract of dried root powder was prepared.Starch was used as substrate. The result shown that ethanolic extract of root has appreciable á-amylase inhibition activity with an IC_{50}-39.10 g/mL The study suggests further pharmacological investigation of *T. triangulare* root for its effective use in diabetic disorder.

PP-5

Nitric Oxide Radical Scavenging activity inseed coat of *Euryale ferox*Salisb.

Nidhi Gupta, A.K. Srivastavaand V. N. Pandey*
Experimental Botany and Nutraceutical Laboratory
Department of Botany
DDU Gorakhpur University,
Gorakhpur-273009.
E-mail: vnpgu@yahoo.co.in

Radical scavenging activity in seed coat of *Euryale ferox* Salisb. (Family-Nympheaceae) collected from Chilua Lake of Gorakhpur U.P. was investigated by using Nitric Oxide Scavenging assay and were compared with the standard antioxidants such as BHA, Gallic acid and Ascorbic acid. The Nitric oxide radical scavenging activity in *Euryale ferox* seed coat extracted by methanolic solution varied in the range of 68.94%-85.03% whereas standard of BHA, Ascorbic acid and Gallic acid showed 87.79%, 85.68% 88.44% activity respectively. The study indicate that seed coat of *Euryale ferox*possess strong nitric oxide radical scavenging activity and can be used in therapeutic formulation after their biological trials.

Key word: Nitric oxide, seed coat, scavenging activity, standard antioxidant.

PP-6

Coloured Fruits and Vegetables: A Potential Source of Phytochemicals and antioxidant

Sarvesh Patel and V N Pandey
Experimental Botany and Nutraceutical Laboratory,
Department of Botany, DDU
Gorakhpur University, Gorakhpur-273009.
Email: vnpgu@yahoo.co.in

Abstracts
The colours of fruits and vegetables speak volume about their nutritional value. These nutritional value are due to presence of some bioactive substances. Glucosinolates found in green colour fruits and vegetables and help in reduction of cancer. The orange coloured fruits and vegetables have á and â-carotene help asprecursorsof vitamin-A. It helps in synthesisof hormoneand regulatesimmune responses. The orange and yellow colours are due to â-cryptoxanthin.It has anti-viral, anti-inflammatory, anti-histamine and antioxidant properties. The redandpurple colour are due to lycopene and anthocyanin respectively. Colours are indicator of antioxidativeenergy which importantioxidant activities. Antioxidant coloured biomolecules bear free radicalsscavenging properties which neutralizes free radicals. The yellow-green colours are due to zeaxanthin and lutein, it is a type of xanthophylls. The colour act as antioxidant and worksagainst many disorders body especially ophthalmic disease and ageing.

Key Words – Coloured Fruits, Vegetables, Phytochemicals, Antioxidant, Ophthalmic, Glucosinolates

PP-7

Medicinal properties of Ethnobotanical Plant *Sagittaria sagittifolia* L.

Anita Rao and V.N. Pandey*
Experimental Botany and Nutraceutical Laboratory, Department of Botany,
DDU Gorakhpur University, Gorakhpur - 273009, (U.P.) India
vnpgu@yahoo.co.in*

Abstract
Sagittaria sagittifolia L. a beautiful fresh water ethno-botanical plant growing on the sides large watershed, rivers, ponds, nullas belongs to family Alismataceae. It is commonly known as Arrowhead and Newsa an indigenous plant of north estern terai region U.P. People of the area have significant relationship with plantfor the various uses as food, vegetables, medicine, nutraceutical and treatment of skin diseases, anti-inflammatory, Immunomodulator, diuretic, antiseptic and antitumor. Hence its phytochemical and bioactive compounds were tested and confirmed in the laboratory. Quanlitative analysis of tubers and leaf extracts confirmed the presence of Phytonutrients and secondary metabolites such as saponins, tannins, steroids, glycoside, protein, carbohydrate, terpenoids and phenols. Overall findings provided the starchy tuber extracts was characterized by the large number of contents of phytonutrients and they may be introduced as new drugs in the treatment and prevention of various human ailments.

Key Words: *Sagittaria sagittifolia*, New drugs, Anti-inflammatory.

PP-8

Medicinal and Biofunctional Characterization of *Schleichera oleosa* (Lour.) Oken

Neha Tiwari and V.N. Pandey*
Experimental Botany and Nutraceutical Laboratory,
Department of Botany,
DDU Gorakhpur University,
Gorakhpur - 273009, (U.P.) India
vnpgu@yahoo.co.in*

Schleichera oleosa (Lour.) Oken that belonging to family Sapindaceae is a well known tree of medicinal value in India. It is commonly known as "Kusum" occurs in Indian Subcontinent and Southeast Asia. The *Schleichera oleosa* (Lour.) Oken is a large deciduous tree upto 40 metres in height and leaves are generally compound, paripinnate, 1-3 mm long. Inflorescence is axillary panicles, flowers are polgamodioecious and subsessile. Fruits are 1-2 seeded, ellipsoidal to subglobular berry. In the traditional medicinal system, the bark, leaves, seeds and other parts are used against various diseases. The bark of plant is used as an astringent, antipyretic agent and in treatment of menorrhoea, ulcers and boils. The oil extracted from the seeds are used against skin troubles, acne, burns, rheumatism and for promoting hair growth. The leaves are used in treatment of various types of cancers. The leaves of *Schleichera oleosa* (Lour.) Oken were extracted in water, ethanol, methanol, chloroform and acetone for analysis of phytochemicals. The *Schleichera oleosa* (Lour.) Oken is a handsome tree full of leaves with phytochemicals. The phytochemical analysis revealed the presence of saponins, tannins, steroids, terpenoids, Carbohydrates, cardiac glycosides and various other phytochemicals in varying solvents. The present study is undertaken to investigate the presence of phytochemical constituents as the possible agent responsible for medicinal activities of leaves of *Schleichera oleosa* (Lour.) Oken. The diversity of phytochemicals found in leaves suggests that *Schleichera oleosa* (Lour.) Oken could serve as a natural source of traditional medicine for treatment of various diseases.

Keywords: *Schleichera oleosa,* Tannins, Phytochemicals.

Technical Session - 6
Marketing Networks

Lead Paper-1

Products of bio-business and livelihood interest from medicinal and aromatic plants resources

V.S. Rana and N.A. Shakil
Division of Agricultural Chemicals, ICAR-Indian Agricultural Research Institute, New Delhi-11012

Abstract
Historically, agriculture plays key role in food, environmental and health securities of living being. Among the agricultural crops, medicinal and aromatic plants are considered to have specialized uses in therapeutics, cosmetic, flavours and perfumery besides other usefulness including aesthetic value. Numbers of plant based products such as carbohydrates, fats and oils, food colouring agents, natural dyes, oleoresins, botanical pesticides, therapeutic extracts/ molecules, essential oils, aroma molecules and neutraceuticals are obtained from the medicinal and aromatic plants. The bioactive compounds enriched fractions and bioactive and aromatic molecules either from complex crude extracts or essential oils are used as main ingredient for the development and formulation of herbal based products for health care, flavouring and perfumery purposes since many decades. Plant as whole or plant's part, collected from wild and or cultivated sources forms the primary and basic raw material for primary and secondary processing to obtain essential oils and crude raw drugs. The crude essential oil, concrete and absolute and their main compounds are of commercial value from aromatic plants used in perfumery, flavouring, cosmetic and toiletries products. These raw products are used as additives in variety of other ingredients for preparation of end use products such as dhoop, agarbatti, scent, perfume, confectionary, cosmetic and toiletries products and in aromatherapy. Flavouring and aroma chemicals and essential oil are also used in the products having unpleasant flavours and odors to improve their acceptability among the consumers. Medicinal plants as whole or their parts are also used as sources of crude raw drug powder or extracts or therapeutic molecules for health care in traditional and modern medicines. There are many unique medicinal and aromatic plants in different regions of India with business utility but many of them have not yet commercially cultivated and placed in Indian market. It has been found that many farmers in different states started cultivation of medicinal and aromatic plants but left cultivation due to cost dynamics and lack of assured buyers or buy-back arrangement with minimum support prices. Thus, linking an approach of medicinal and aromatic plants cultivation to value addition in cooperative system will help the farmers to have alternative and better source of livelihood together with their traditional cropping system. This will not only attract the farmers for cultivation of commercially useful medicinal and aromatic plants, development of value added products, bio-business and accessibility to users but will also minimize the gap and huddles of buyers continued since many decades. Thus, translation of medicinal and aromatic plants into bio-business through collective cultivation and value addition in a cooperative approach for the production of crude drugs, bioactives and essential oils, will certainly augment the medicinal and aromatic plants sector in India.

Lead Paper-2

Production barriers and technological options for medicinal and aromatic plants production in India

ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand-387 310, Gujarat

Medicinal and Aromatic Plants (MAPs) and their derivatives are used for prevention as well as curing of human health problems (diseases and disorders) since time immemorial, and there is global resurgence now in use of plant based drugs where modern drugs are either unavailable, unaffordable or unsatisfactory. The international market of medicinal plants is over US $ 60 billion per year, which is growing at the rate of 7 per centper annum (Planning Commission, Govt. of India, 2000). The present export of herbal raw materials and medicines from India is about US $ 100-114 million per year mainly to the USA, Germany, France, Switzerland, U.K. and Japan, which is 75-80 per cent of the total export. India has rich heritage and long history on use of medicinal and aromatic plants (MAP) as medicine, cosmetics, health hygiene, toiletries, fragrance and food supplements in improving the quality of life. Simultaneously, MAPs are also gradually recognized as source of significant livelihood opportunities for many rural communities, especially, primitive forest-dependent tribes, landless poor and marginalized farmers. However, the every stakeholder playing role in MAPs sector is facing problems; farmers are unable to cultivate medicinal plants in large scaledue to lack of knowledge, unavailability of quality planting material and proper market; pharmaceutical companies are unable to maintain the quality in their drugs due to variation in raw drug materials; traders facing the problem due to fluctuation in demand and supply and policy support. Overall the sector is facing the problems of conservation of spp. and habitats; lack of novel, high yield, quality and resistant to biotic & abiotic stresses varieties; technology for economic and efficient processes for extraction and isolation of bioactive molecules; development of GAP, GCP, GLP and GMP; emerging biotic and abiotic stresses and changing climatic conditions; lack of availability of reference and high value innovative products; and lack of coordination among different stakeholders of MAPs. Under these situations, MAP sector require a strategic plan, which takes a holistic view of the entire situation from sustainable utilization to economic development, conservation of vital biodiversity, crop diversification of the existing cropping systems and value addition and marketing with the advancement of technologies.

The global herbal trade of medicinal and aromatic plants is likely to touch five trillion US$ mark by 2050, however, India's contribute only 150 million US$ annually which is a disturbing statistics that deserves a logistic scrutiny. One of the most deterring factors behind India's poor market shares in herbal trade has been the lack of quality consciousness of Indian herbal companies for raw herbs that often results in batch to batch inconsistency in their finished products. More than 90% of the plant material used in pharma and aromatic industries is presently collected as non-descriptive uncharacterized land races from forest and other wild resources. More often than not, such collections are usually made using destructive harvest from the wild. This is neither sustainable nor acceptable in a globally

competitive scenario. In order to arrest extinction and rapid decline in the diversity of medicinal plants and to maintain the quality of the raw material to be used for the production of herbal formulations, there is a pressing need for a change in the mind-set of Indian pharma industry to shift from collection to cultivation of MAPs.

In order to bring this shift in the paradigm, farmers and traders need to be sensitized, and provided with material of improved MAPs varieties with quality tags to initiate cultivation in the country. It should be produced by following good agricultural practices from cultivation to harvest and post-harvest operations to produce quality raw drugs and finished products of international standard. It also requires proactive initiatives in establishing linkages among farmers, end-user industry, funding institutions and quality accreditation agencies for creating a complete value-chain for the MAP sector. It also needs to identify appropriate locations within the country where strong cultivation and/or marketing hubs of in-demand MAPs can be established to strengthen these linkages. In addition to advancing R&D domains of genetic up-gradation, varietal improvement and development of suitable agrotechnologies for cultivation of industrially important MAPs in different agro-climatic zones of the country, we also need to generate bench-level data on potential inter- or mix-cropping systems of medicinal and aromatic crops like mints, aromatic grasses, scented rose, geranium, garlic, coleus, ashwagandha, centella, sarpagandha, ocimums, senna, aloe vera, kalmegh, brahmi, satawar etc. within the cycles of cultivation of food crops such as wheat, sugarcane, lentil, arhar, rice, vegetables and brassicas. Information generated by CSIR-CIMAP and ICAR-DMAPR on integration of MAP crops in agro-forestry, agro-horticulture and agri-orchards systems is also very encouraging. The agrieconomics of such efforts have also been worked out to attract adoption of such approaches by the farmers. Initial testing results are promising in terms of Land Use Efficiency (LUE), Area Time Equivalency Ratio (ATER), efficient water and fertilizer usage, lesser pesticidal applications that may ultimately add to improved per unit earning of the farmers. The advantage of medicinal and aromatic crops is that most of them require low-inputs, and can withstand stresses of salinity, alkalinity, drought, temperature, heavy metal toxicities, pest infestations etc and, hence can be very good candidates for the utilization of *hitherto* under-utilized poor soils. They may also prove good alternatives for phytoremediation and soil reclamation/rejuvenation efforts besides improving carbon sequestration efficiency. Since useful secondary metabolites present in MAPs generally make them unpalatable to animals, pests and microbes, they can also be inter-cropped with food crops as protection shields. It is hoped that the proposed brain storming exercise will help in establishing the required links and networks in this direction and get the ball rolling towards evolving a much desired new agricultural paradigm.

PP-1

Microbiological quality of raw medicinal plant material used for the preparation of Ayurvedic drug

Harish Chandra* and A. R.Nautiyal
High Altitude Plant Physiology Research Centre
H. N. B. Garhwal University (A Central University), Srinagar, Garhwal-246174, Uttarakhand
*corresponding author hreesh5@rediffmail.com

Medicinal plants are now gaining popularity these days due to increasing resistance to antimicrobials and their possible side effects. Raw material is most often degraded by the microorganisms before harvesting, during handling and storage. The presence of high fungal count and bacterial count may directly or indirectly affect the health of consumers.

The present study deals with microbiological examination of raw medicinal plant material used for the preparation of Ayurvedic drugs. For the determination of the quality of raw medicinal plant material in respect of the microbial infestations, 20 samples (n=20) from Haridwar, Srinagar and Rishikesh were collected from stockists/vendors and analyzed for microbial load. The results showed the Total bacterial count in the range from 3.4×10^2 cfu/gm to TNTC and Total fungal count from 3.9×10^2 to 1.7×10^6 cfu/gm. The raw medicinal plant material tested contained *Aspergillus niger, A. flavus, Penicillium, Mucor, Rhizopus* spp*., Alternaria alternate, Fusarium* spp*, E. coli, Klebsiella, Bacillus subtilis, Staphylococcus* spp. and *Pseudomonas* spp. The most prevalent fungi isolated was *A. niger* (80%) and most prevalent bacteria species was *E. coli* (70%). Out of the 20 samples, 07 samples for bacterial count exceeded the limit set by WHO and 18 samples for total fungal count exceeded the limit set by WHO. The inferior quality of raw material may influence the quality of finished product, therefore proper pre-harvest and post-harvest techniques must be practiced to maintain the quality of raw material.

Keywords: Medicinal Plant, Total fungal count, Total Bacterial count