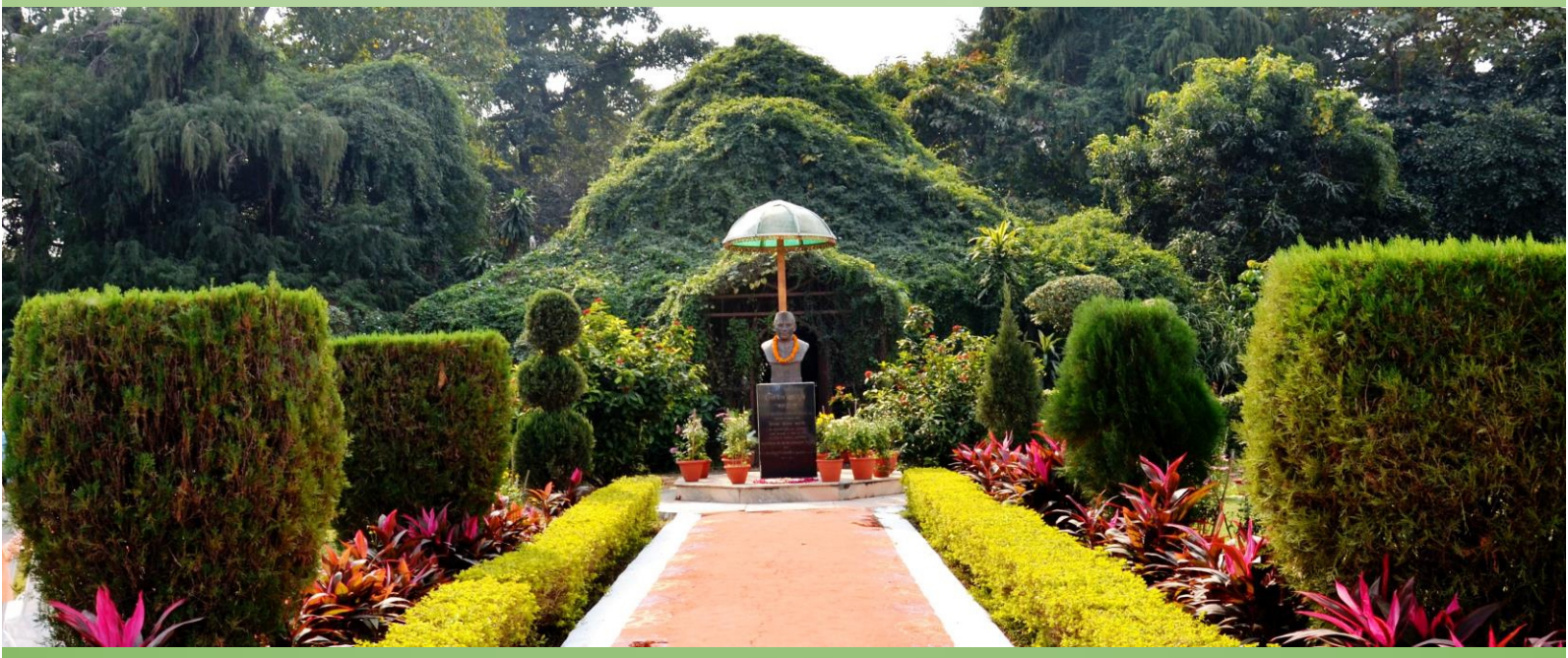
THE INDIAN BOTANICAL SOCIETY

XLV ALL INDIA BOTANICAL CONFERENCE

October 14-16, 2022

Climate Change: Biodiversity, Adaptation and Mitigation

ABSTRACTS



Department of Botany, University of Lucknow, Lucknow

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XLV ALL INDIA BOTANICAL CONFERENCE
of
THE INDIAN BOTANICAL SOCIETY

on
Climate Change: Biodiversity, Adaptation and Mitigation

October 14-16, 2022

Patron
Prof. Alok Kumar Rai

Organizing Secretary
Prof. Nalini Pandey

Organized by

Department of Botany
University of Lucknow
Lucknow

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राज्यपाल, उत्तर प्रदेश

सत्यमेव जयते

राज भवन
लखनऊ - 226 027

28 सितम्बर, 2022

सन्देश

मुझे यह जानकर अतीव प्रसन्नता हुई कि लखनऊ विश्वविद्यालय, लखनऊ के वनस्पति विज्ञान विभाग द्वारा विश्वविद्यालय के सौ वर्ष पूर्ण होने के अवसर पर 14 से 16 अक्टूबर, 2022 तक 45वें अखिल भारतीय वानस्पतिक विज्ञान सम्मेलन का आयोजन किया जा रहा है।

जलवायु परिवर्तन वर्तमान समय में समस्त विश्व के लिये चिन्ता का विषय है और सभी देश भविष्य में संभावित जलवायु परिवर्तन के दुष्प्रभावों से सशंकित हैं। इस दृष्टि से सम्मेलन का विषय 'जलवायु परिवर्तन' अत्यन्त ज्वलन्त और प्रासंगिक है। मुझे विश्वास है कि इस सम्मेलन में देश भर के वनस्पति विज्ञानियों द्वारा जलवायु परिवर्तन पर जो चिन्तन और विचार–विमर्श किया जायेगा, उसके निष्कर्ष भविष्य के लिये अत्यन्त उपयोगी होंगे।

मैं लखनऊ विश्वविद्यालय के वनस्पति विज्ञान विभाग को इस आयोजन की सफलता के लिए बधाई और शुभकामनाएं प्रेषित करती हूँ।

आनंदीबेन

(आनंदीबेन पटेल)

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Prof. Dhirendra Pal Singh
Education Advisor to
Hon'ble Chief Minister, U.P.
Former Chairman,
UGC, New Delhi
23 September 2022

MESSAGE

I am happy that the 45th All India Botanical Conference is being held in Lucknow – the Science City of U.P., and the hub of studies in Botanical Sciences supported with national laboratories of CSIR, DST and ICAR. It is delighting that the Department of Botany of the University of Lucknow is hosting the event for the fourth time. This Department was established in 1921 by late Prof. Birbal Sahni, a doyen of Botany who played pivotal role in the foundation of the Indian Botanical Society in 1920 and nurtured the society in the formative years from this very Department. I am sure that the All-India Botanical Conference will kindle interest in Botany among young scholars. I wish the conference much success.

Prof. Dhirendra Pal Singh

प्रो. आलोक कुमार राय
कुलपति
Prof. Alok Kumar Rai
Vice-Chancellor

लखनऊ विश्वविद्यालय
(नैक द्वारा **A++** ग्रेड प्रत्यायित)
लखनऊ–226007 (उ.प्र.) भारत
University of Lucknow
(Accredited **A++** by NAAC)
Lucknow-226007 (U.P.) India

MESSAGE

I am happy to know that the **XLV All India Botanical Conference** is being held for the fourth time in the Department of Botany of the University of Lucknow. I extend a very warm welcome to the society members and the delegates participating in this prestigious academic event held annually by the **Indian Botanical Society**. It is heartening to know that the doyen of Botany, **Professor Birbal Sahni, FRC,** who established the department of Botany in 1921 is also a founder member of the Indian Botanical Society. The department has made notable progress in research and teaching spanning over 100 years. At present the department has the support of **12 Professors, 02 Associate Professors & 09 Assistant Professor,** dedicated towards academic advancement and R & D progression in the different fields of botanical sciences, fetching national and international recognitions.

University of Lucknow has been accredited A++ by NAAC and is striving to achieve excellence at Global level. In spite of your hectic schedule it would be nice if you take out sometime to visit at least a few departments, museums and some of the infrastructural facilities on the campus. This will also be an opportunity for the botanists coming for the first time to the culturally rich city of Lucknow to get a glimpse of the multitude of premier institutions that are exploring the frontiers of plant biology.

I congratulate the Organizing Secretary and her team for holding the conference on a very pertinent and burning issue. The theme is extremely relevant in present day scenario where escalating environmental stresses leading to climate change, are a threat to biological resources. I am sure that the deliberations of the conference will help in fostering prospective actions and solutions to safeguard our biodiversity in the climate change regime.

I convey my best wishes to the organizers and participants for the success of the Conference.

(Prof. Alok Kumar Rai)

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Prof. Pramod Tandon
Padma Shri Awardee
Honorary Scientist, The National Academy of Sciences, India
(Formerly: Professor of Botany & Vice-Chancellor, NEHU, Shillong; Project Director, IIM, Shillong; Member, National Advisory Council to the Prime Minister; CEO, Biotech Park, Lucknow)

September 16, 2022

It gives me immense pleasure to learn that my Alma Mater - Department of Botany, University of Lucknow- is organizing the 45th All India Botanical Conference. It assumes great significance as this national scientific event is being hosted for the record fourth time by our Department on the completion of 100 years of illustrious journey since its establishment in 1921. The Department of Botany has rich scientific traditions. Bringing the young and established botanists on one platform for exchange of ideas and interactive discussions would be an enriching experience and the deliberation would set high standards for future research, teaching and extension of the discipline of Botany.

I do hope that delegates would also get an opportunity to have a glimpse of the multitude of premiere institutions in the city of Lucknow that are exploring the frontiers of plant biology.

I compliment and congratulate the Indian Botanical Society for choosing the culturally rich city of Lucknow as the venue, and the hosts to choose a topical theme 'Climate Change: Biodiversity, Adaptation and Mitigation' for the prestigious event.

I am confident that the deliberations at the Conference would truly be vibrant, scientifically challenging and socially engaging.

I extend my best wishes for the grand success of the event.

Pramod Tandon

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Prof. (Dr.) Pravin Chandra Trivedi
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DDU Gorakhpur University, Gorakhpur (UP)
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Message

I am glad to know that the 45th All India Botanical conference of the Indian Botanical society is being organized by Department of Botany, University of Lucknow, Lucknow during October 14-16, 2022. The theme " Climate Change: Biodiversity, adaptation and Mitigation" is not only of contemporary relevance but of absolute and immediate concern for drafting appropriate policy responses to tackle the manifold challenges that lie ahead as the imperative for progress needs to be balanced with preservation of natural ecosystems and the environment and all the flora and fauna. And it is in incremental changes, by leveraging technology and using scientific approach that answers to a sustainable future will eventually be found.

I hope that the deliberations during the conference will be fruitful for the participating scientist, researchers and academics in sharing and understanding new innovations and developments in plant sciences.

I wish all the best to all participants and organizers of the conference.

Trivedi

(P.C.Trivedi)

Ex. Vice Chancellor

मानसरोवर ग्लोबल विश्वविद्यालय
MANSAROVAR GLOBAL UNIVERSITY

प्रोफेसर अरूण कुमार पाण्डेय
कुलपति
Professor Arun K. Pandey
Vice - Chancellor

Message

I am delighted to know that Department of Botany, University of Lucknow, is organizing XLV All India Botanical Conference on Climate Change: Biodiversity, Adaptation and Mitigation, on October 14-16, 2022.

Taxonomy is the cornerstone of conservation, as we need to inventorize our species diversity before we can devise policies to protect them, manage their habitats and other natural resources in a sustainable manner. Many studies in recent years have investigated the effects of climate change on the future of biodiversity. Understanding adaptations of biodiversity to climate change using taxonomy global distributions of species and their community composition are expected to shift as a consequence of climate change. Thus, there is need to examine the impact of climate change that can operate at individual, population, species, community, ecosystem and biome scales.

I sincerely hope that the conference will be of immense benefit to the participants especially in motivating the young minds to take up research on biodiversity, taxonomy and climate change.

It is a matter of commendation that such a conference is being organised in the Department of Botany, University of Lucknow, the Department where I learnt the basics of Botany as M.Sc. (Botany) student during 1971-1973.

I wish the conference a grand success.

AKPandey

(Arun Kumar Pandey)

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Prof. SK Barik
Director

September 6, 2022

Message

It is a matter of great pleasure that the Indian Botanical Society (IBS), the oldest plant science professional society of our country will be holding its annual scientific conference in Lucknow, the science city of India, during 14-16 October, 2022. Lucknow with its several universities and national institutes, which are active centres of botanical research, teaching and allied activities, is the ideal city to host the most important annual event of the IBS. It is also heartening to note that the Botany Department of the University of Lucknow is hosting the event for the record 4th time, and it coincides with the centenary year celebration of the Department's establishment.

The organisers deserve special appreciation for choosing the most appropriate conference theme i.e. Climate Change: Biodiversity, Adaptation and Mitigation'. The topic is of high national and international relevance in the present-day context. I am sure that the deliberations of the conference would provide some remarkable plant-based solutions to the climate change-related problems that the country is facing today.

The CSIR-NBRI wishes grand success to the 45th conference of the IBS. On behalf of the organizers and on my own behalf, I extend a very warm welcome to all the conference delegates coming from different parts of India to Lucknow. I strongly believe that each one of you would enjoy the scientific culture of our country and the rich tradition of *Lakhnav*i hospitality during your stay in Lucknow.

(SK Barik)

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1946

डॉ. वन्दना प्रसाद
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Director

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Lucknow - 226007, India

Message

The organization of the 45th Indian Botanical Conference at the Department of Botany, University of Lucknow, as part of the Centenary celebrations is a delight. This Department of Botany has been the cradle for some of the foremost botanists the country has seen. It is indeed a matter of pleasure for me to have been an alumnus of this Department. My congratulations to the Department of Botany on the completion of a very illustrious hundred years.

The Indian Botanical Society too, is possibly the oldest Society for scientists working on plants. The Society has evolved over the years and has helped in dissemination of plant science concepts through the Journal of the Indian Botanical Society, and through its Conferences such as this one.

The theme of the 45th Indian Botanical Conference, *Climate change: biodiversity, adaptation, and mitigation*, is timely and relevant. Climate change has been a matter of concern as it affects not just plants, but animals, microbes etc. It cannot be seen only in the context of rising temperatures or varied monsoonal profiles of a given area, since climate change has affected entire civilizations and has the potential to drastically alter their behaviour. Interestingly, climate change also leads to migration of plants as well as animals. In this larger context, I hope the deliberations during the Conference will come out with concrete suggestions on mitigation.

I wish the Department of Botany, and the Indian Botanical Society a very successful event.

Vandana Prasad.

Vandana PRASAD
Director

Lucknow
September 30, 2022

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Dr. Prabodh Kumar Trivedi, FNA, FNASc, FNAAS
JC Bose National Fellow
Director

Date:15/09/2022

Message

It is a matter of immense pleasure for me to know that the Indian Botanical Society (IBS) is organizing the XLV All India Botanical Conference of the Indian Botanical Society on "**Climate Change: Biodiversity, Adaptation and Mitigation**" during 14-16 October, 2022, at the Department of Botany, University of Lucknow, in Lucknow, the Science City of India. This conference is very timely and will be providing a common platform to researchers, academicians, scholars, progressive farmers, technologists, industry and other stakeholders along with IBS members, enabling them to interact among themselves. The various scientific sessions, symposia, poster presentations and other activities of the conference will facilitate exchange of opinions and scientific interaction. The theme of the three-day conference is highly relevant for scholars of Botany in view of the continuously changing climatic conditions across the globe. Evidently, the conference is focused towards initiating a deliberation on finding means to protect our biodiversity. I am confident that the conference will be a great success with the proven track record of the organizers from the Department of Botany, which happens to be in its '101 Year'. Finally, I wish great success for the conference and hope that it would be scientifically fruitful to all the participants.

(Prabodh K. Trivedi)

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II

PRESIDENTIAL ADDRESS

PRESIDENTIAL ADDRESS

MY JOURNEY WITH PLANTS

S. R. Yadav
INSA Senior Scientist, Department of Botany, Shivaji University, Kolhapur 416004
sryadavdu@rediffmail.com

It has been almost 50 years of journey with plants since I joined as a student of Botany in 1973. Summarizing this journey with plants in 40 minutes is a difficult task but I shall try to give glimpses of contributions in the field of Taxonomy by our school at Kolhapurof which I am a component.

The standing of Taxonomy and Taxonomists was bad when I completed my education. Taxonomy was referred to as a dry, dead, boring, unexciting, dull, tedious, uninteresting subject in comparison to modern applied branches of biology. However, in 1985, the word 'Biodiversity' was coined and all of sudden people started recognizing the importance of biodiversity and role of Taxonomy in documentation, conservation, bioprospecting and sustainable utilization of biodiversity. I joined the Department of Botany, Shivaji University, Kolhapur in 1985 and started "Angiosperm Taxonomy" as a specialization at P. G. level in 1989. Single handedly I conducted "Angiosperm Taxonomy" classes for 20 years with a workload of 30 hours a week. I initiated Botanical Gardendevelopment in 1985 and today we have one of the richest Lead Botanical Garden (LBG) in India. My taxonomic research started with floristics of Kolhapur and taxonomy of grasses which resulted in recognition of our laboratory as "Centre for grass Systematics". Work on flora of Kolhapur reported the highest number of species for a district in India at that time. In between I worked for a few years in Goa and Delhi University, however, the major period of my service was in Shivaji University

Throughout my journey with plants, I tried to educate and train students through classes and field tours. I tried to promote awareness to the masses regarding the importance of biodiversity, especially plant diversity, and the need for conservation and sustainability through my lectures. Our School of Taxonomy is recognized as a Center for education, learning and research training in Angiosperm Taxonomy. Flora of Vasota fort, Kolhapur, Belgaum, Bagalkot, Ramghat, Khatav and grasses of Maharashtra have been documented and genera like *Barleria, Drimia, Ceropegia, Vigna, Cucumis, Abelmoschus, Chlorophytum, Glyphochloa* have been revised through Ph. D. programs. The School of Taxonomy has discovered more than 78 taxa new to science. Some of them are *Trithuria konkanensis*, one of the basal angiosperms, *Crinum malabaricum* which has the longest leaves and with the highest Galanthamine content, *Aponogeton nateshii* with unique embryo and *Corynandra elegans* with elegant flowers. With reference to bioprospecting of our plants, *Delphinium*

malabaricum (Nilambari), a wild ornamentalwas released as floricultural crop after primary domestication, wild Barlerias were introduced as ornamental in Botanical Gardens and many medicinal, ornamental, endemics and economically important wild plant species are introduced in LBG. Attempts have been made to restore 20 threatened species (viz. *Abutilon ranadei, Ceropegia anantii, C. anjanerica, C. attenuata, C. bhatii, C. concanensis, C. evansii, C. fantastica, C. huberi, C. jainii, C. juncea, C. lawii, C. maccannii, C. mahabalei, C. media, C. mohanramii, C. noorjahaniae, C. oculata, C. odorata, C. panchganiensis, C. rollae, C. sahyadrica, C. santapaui, C. spiralis, C. vincifolia, Erinocarpus nimmonii and Hubbardia heptaneuron and H. diandra*) in their natural habitats.

Lead Botanical Garden (LBG) of the Department has now become a hub for several botanical activities including education, training, Ex-situ conservation, nursery for multiplication and distribution of saplings of indigenous, threatened and endemic plants of Western Ghats and bioprospecting of our plant resources. Shivaji University has recognized the LBG as an asset of the University. In order to understand species, speciation and evolution, attempts have been made to study *Ledebouria revoluta, Dipcadi, Drimia, Iphigenia, Pancratium, Chlorophytum, Aponogeton, Amorphophallus, Glyphochloa* through biosystematics approach.

In addition to the amazing diversity of plants and their academic aspects, I have realized during my journey with plants that the true capital of man is biodiversity, especially plants most required for our food (hunger), health and breath and the very existence of animals including man depends on plants. Plant Diversity is a biological capital of man and the species are invaluable. Plants are supreme teachers of life in this world. The important question today is in what form we are going to handover mother earth to the next generation? The present lecture narrates my journey with plants and what lessons I learned from them.

III

AWARD LECTURES

BIRBAL SAHNI MEDAL AWARD LECTURE

ECOLOGICAL THREATS FROM ALIEN INVASIVE PLANTS IN SHIVALIKS: ROLE OF ALLELOPATHY

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Invasions and Introductions of exotic plants in non-native areas are not new. However, their rate and dimensions have increased in the recent past. Such invasions impact the native flora, dependent fauna, microbiota, and soil. It results in altering hydrology, fire regimes, nutrient cycling competing with native plants, reducing species richness, threatening biodiversity and changing the structure and composition of native communities; thus, the ecosystem integrity and ecology, and hence, the recent global attention to the issue.

According to the Global Assessment on Biodiversity and Ecosystem Services, humans have altered about 75% of land and 66% of marine environments (IPBES 2019). The natural forces and climate change add to such disruption of ecological processes. Such irreversible changes, even in small ecosystems, can break down the functioning of a global biosphere. Therefore, biodiversity loss is a primary concern for ecologists and environmentalists. There is a strong need to understand the reasons to attempt to reverse the trend. India, one of the 12 centres of origin of cultivated plants and credited with 23% endemism and 4 of the 36 Biodiversity hot spots, is not free from Invasion of exotic plants. As per the old study by Reddy in 2008, there were173 invasive alien species from 117 genera under 44 families. Later, as per Khuroo ***et al.*** 2012, 1599 (8.5%) of the species are exotic, and 225 (14%) are invasive. The latest estimate counts 471 naturalised alien plants in India (Inderjit, 2018).

The rate of invasion in the Himalayas is unprecedented high. As per our study in 2005, alien invasives in 1990 increased from 5% to 9.37% in 15 years. Unfortunately, as per the latest report, the ratio between exotic and native plant species is 52 % and 48 %, respectively (Mehraj et al. 2018). Why are the Shivalik Hills range of the Himalayas prone to Invasion? Very fragile soil of loosely packed molasses of sandstone easily gets washed away with water. The number of rivulets /choes wash away fertile soil while cutting across the sloppy agricultural fields. The stress on the ecosystem due to increasing anthropogenic activity, tourism, pollution, and grazers and browsers of the Gujjar/ Gaddis add to disturbing the habitat, leaving vacant areas prone to Invasion by exotics.

In a study under the framework of the BP Pal National Fellowship award of the MoEF&CC, we laid 15000 quadrats (12 districts x 5 zones x 5 sites x 5 locations x 10 quadrats) in each of the 4 seasons in Himachal Pradesh. We observed that over 70 % of the exotic plants in the lower Himalayas were the three American weeds: *Lantana camara, Parthenium hysterophorus* and *Ageratum conyzoides*. These constituted 10% of the total vegetation. Of these, *Ageratum* was the most prevalent in the lower altitude. Several ecological & biological attributes, including wide environmental amplitude, high adaptability to a diverse habitat, fast growth, very high Importance Value Index, absence of natural enemies and rich natural product chemistry, help these exotics to be a successful encroacher. It infringes on the arable lands, interferes with crops, and invades grasslands, wastelands, forests, and plantations, especially at ecotones or forest edges.

In Kangra district, the villagers started to abandon their agricultural fields because of the Invasion of Ageratum. They called it "*ujardu*" as it devastated the croplands. It came to the notice of the Parliament. The MoEF & CC prompted us to find the reason for such aggression of the weed. It was intriguing how it smothers the native vegetation and makes its everlasting kingdom. We planned many lab and field-oriented experiments to understand the mode and mechanism of such severe competitive ability of the weed. There must be some intrinsic and extrinsic factors responsible for it. We studied the basic biology of the weed and found it to possess the characteristics of a fast growth rate, high reproductive potential, stoloniferous spread, massive production of very light and quickly disseminated seeds, short span of life cycle, and long seed viability.

We tested the growth and other parameters of the native plants and crops, especially wheat, rice, and chickpea. To understand the responsive external factors, we initially prepared leachates from the weed in pure water and tested the seed germination and seedlings' growth, which were impacted severely. Likewise, the respiratory and photosynthetic activity of the native plants got impaired. We also amended the control soil with different proportions of weed-infested soil.

PANCHANAN MAHESHWARI MEDAL AWARD LECTURE

TOWARDS UNRAVELLING THE TAXONOMY OF *UTRICULARIA* L. (LENTIBULARIACEAE) IN INDIA

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The world of carnivorous plants has fascinated naturalists, botanists, ecologists, general researchers and even laymen for generations. It is incredibly diverse with a cosmopolitan distribution, not surprisingly taxonomically complex and poorly known. They have a powerful prey capturing mechanism, i.e., the carnivorous syndrome, which meets their nutritional requirements. The nutrients are derived using active or passive trapping structures, which are often the modified leaves. The vividness of these plants made them exceptional among flowering plants and they served as an excellent model system for studying functional ecology and evolution. There are about 810 species of carnivorous plants worldwide belonging to 13 angiosperm families, and the bulk of which are found in the orders Nepenthales and Lamiales. India is the home of five carnivorous genera viz., *Aldrovanda* L., *Drosera* L., *Nepenthes* L., *Pinguicula* L., and *Utricularia* L. Amongthem, the latter two belong to one of the species-rich family Lentibulariaceae (order Lamiales).

Utricularia is the largest and most fascinating carnivorous genus found all over the world with great species richness and diversity. They are commonly called "bladderworts" due to the presence of a specialized and sophisticated structure called the utricle/trap/bladder, which can capture and digest prey through its active trapping mechanism. *Utricularia* has a stunning bauplan in which true roots, stems, and leaves are absent. Besides being unique they also have a range of habitat situations, including aquatic, sub-aquatic, terrestrial, lithophytic, epiphytic and rheophytic. They prefer nutrient poor, wet environments with ambient sunlight, although some shade loving species are also found. Peter Taylor (1989) recognized 214 species under two subgenera and 35 sections. The present species count is about 250 species, of which 42 species (representing eight sections) occur in India with a sizable portion being endemics (40%). Section *Oligocista*, the largest and the most intricate group of terrestrial species, has 22 species in India, 14 of which are endemic (63%). The major centres of diversity in India are the Western Ghats, Deccan Plateau and Northeast India including Alpine Himalaya. The Western Ghats, with 32 species have the highest species diversity.

Our group at the Department of Botany, University of Calicut, has undertaken an integrative approach to unravel the life history of *Utricularia* in Indian context by focusing on morphological and molecular characterization. Additionally, research is being done on the habitat ecology, prey capturing mechanisms, conservation assessments, pollination

mechanisms, morphology/internal architecture of traps, micromorphology of seeds and pollen. This approach will help to interpret the changes within a phylogenetic and biogeographical context to understand the evolutionary pressures that are ultimately responsible for high degree of variations.

VISHWAMBHAR PURI MEDAL AWARD LECTURE

BIODIVERSITY OF PAST AND PRESENT PERIOD OF CHITRAKOOT: A LEGENDARY PILGRIMAGE PLACE OF INDIA

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Chitrakoot, meaning the hill of many wonders, is indeed a gift of nature and the gods, and located on the banks of river Mandikini and falls in the northern Vindhyan range of mountains spread over the states of Uttar Pradesh and Madhya Pradesh. The major part of Chitrakoot is situated in the northern region of Satna district of Madhya Pradesh. It is lies between 80^0 52' to 80^0 73' N latitude and 25^0 10' to 25^0 52' E longitude, covering an area of 1584 sq km. The forest of the Chitrakoot predominantly consists of tropical dry mixed deciduous type. The climate is dry and the maximum temperature goes up to 48.5^0C in the month of May and June and minimum up to 5^0 C in the month of December and January.

Since times immemorial, Chitrakoot has been famous for its religious importance, elegant environment, and spiritual peace. It is also well known for its beautiful hill ranges, historical caves, perennial streams and varied flora and fauna. Therefore, the Chitrakoot has been sacred place of worship for sages and hermits since antiquity. According to the Ramayama, it is the place where Lord Rama and his consort Sita with brother Lakshmana spent almost 12 years of their 14-year exile. It has also been a place of exile of Yaksha (a demigod) and Abdul Raheem Khan-e-khana. In several ancient epics, ancient literature and poetical works like *Ramayana* (written by Valmiki) *ShriRamcharitamanasa* (Goswami Tulsidas), *Raghubansa* (Kalidas) etc. Chitrakoot's ethnic diversity mentioned in *ShriRamcharitamanasa* are still residing in Chitrakoot forest.

At present, the ethnic and biological diversity of Chitrakoot is declining fast due to the various anthropogenic activities. Therefore, detailed floristic and ethnobotanical study has been carried out. A total of about 800 plant species, belonging to 491 genera and 111 families have been recorded during the study. Besides, more than 300 plant species used by tribal communities for various purposes in their daily life have also been documented. The voucher specimens have been collected, identified and preserved in the herbarium of Arogyadham, Deendayal Research Institute, Chitrakoot. For conserving valuable medicinal and rare and endangered plants, an herbal garden has been established in Arogyadham campus.

Y.S. MURTY MEDAL AWARD LECTURE

TAXONOMY OF SOME ILL-DEFINED AND ECONOMICALLY IMPORTANT PLANT GENERA: A CASE STUDY FROM THE NORTHERN WESTERN GHATS

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Petaloid monocots have always been troublesome for plant systematists on account of their extremely polymorphic nature. Moreover, these plants make poor herbarium specimens and hence, studies based on dry material are not rewarding as important morphological characters are lost during preservation. Here, I present how cytogenetical data can prove very useful in understaning the taxonomy of two petaloid monocots, viz. *Drimia* (Asparagaceae) and *Iphigenia* (Colchicaceae). For *Drimia* we applied data from cytogenetics, interspecific hybridization and palynology and recognize eight species, seven of which are endemic to the subcontinent. The species were grouped according to floral phenology and palynology into night-blooming species with meta-reticulate pollen and day-blooming species with micro-reticulate pollen. In case of *Iphigenia* cytogenetical studies showed that *Camptorrhiza* is a monotypic African genus. Our studies have also focused on the taxonomy of *Flemingia* (Leguminosae), a wild relative of pigeon pea. We recognize 28 species and one variety in the genus. *Barleria*, a wild ornamental (Acanthaceae) has been studied from cytotaxonomic point of view. Here, I discuss the economic potential of both the genera. I also illustrate how a well resolved taxonomy of a plant group can pave way for cutting edge multidisciplinary studies.

IV

MEMORIAL LECTURES

UMA KANT SINHA MEMORIAL AWARD LECTURE

UNRAVELING PLANT GENETIC DIVERSITY THROUGH CYTOGENETICAL AND MOLECULAR APPROACHES

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Plant geneticists, over centuries relied mostly on phenotypic parameters such as flower shape, inflorescence pattern etc. to understand the genetic diversity among plants. However, phenotypic characters are influenced by external environmental factors and are plastic in nature, hence, recalcitrant for phylogenetic appraisals. Chromosomal and genetic analyses were preferred over morphology, since the chromosome and DNA based information is highly efficient in unraveling the diversity among various plant species. Various cytological characters such as chromosomal shape, number, ploidy levels, degree of chromosome associations, number of chiasma, terminalization pattern, equal and unequal distribution of chromosomes / bivalents at Anaphase I and Anaphase II etc. and overall behaviour of chromosomes during cell division helps in decoding the genetic variations prevalent among the plants.

In recent times, molecular cytogenetic studies such as CMA/DAPI staining, FISH, GISH, Fibre FISH etc. have enhanced our understanding about distribution of heterochromatin in plant genome**.** Molecular studies using DNA based markers are rapid and can efficiently identify unique alleles among various plant genotypes. Sequence information of certain nuclear genes, chloroplast and mitochondrial DNA sequences also play a vital role in identifying differences in the plant genome sequence. Coding regions of chloroplast DNA (cpDNA) i.e., part of the genes *viz. rbcL* and *matK* have been extensively useful in this regard. Continuation of information obtained from cytological and molecular analyses has enabled us to decipher the existing genetic diversity in various angiosperm taxa**.**

During 33 years of stint with plant chromosomes and genomic DNA, we have analyzed over 180 species belonging to 40 genera / 31 families to understand the extent of genetic diversity. The diversity pattern and evolutionary path over few horticultural plants shall be discussed.

Keywords: Genome, genetic diversity, cytogenetics, molecular cytogenetics, DNA markers, phylogeny.

G. PANIGRAHI MEMORIAL AWARD LECTURE

DESIGNING CLIMATE SMART AGRO-ECOSYSTEMS FOR ECOLOGICAL AND ECONOMIC GAINS

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The ecological restoration of agro-ecosystems that has been degraded, damaged or destroyed by natural or anthropogenic disturbances needs innovations with reimagination, recreation and restoration to achieve economic and ecological gains in era of climate change and global warming. The emerging needs of the ecological restoration are evolving a global green economy with carbon trading and low emission technological management. It will require a reconsideration of our ongoing developmental pathways which have led to climate change, global warming and degraded ecosystems towards a new circular green economy and new food production systems. India with mounting young population and hard-pressed natural resources can evolve its own sustainable agrarian models capable to absorb science, technology and innovations for its ecological, health related and economic gains with adaptations and mitigations of climate change.

The agro-ecosystems have been highly contaminated and degraded due to the excessive use of toxic agrochemicals and rapid loss of bio-resources. The increasing disaster as well as the negative impacts of climate change and global warming have caused new threats of the low productivity to our traditional cropping systems and agro-ecology. The ecological agricultural practices with multiple approaches can involve designing of new below ground and above ground biodiversity of mutually competent organisms for ecological gain and socio-economic benefits. It can be supported by various kinds of STI inputs to strengthen our food security, rural economy and health management. The ecological agriculture provides enormous opportunities to develop the networks of small-scale production setups and entrepreneurships for agri-inputs and product marketing as its backward and forward linkages. Such benefits are not possible with centralized production and marketing systems based on the chemical inputs and monopolized agricultural products. The big policy and executive interventions are awaited for this change in our developmental models.

Keywords: Agrarian economy, biodiversity, carbon economy, ecosystems, entrepreneurship.

S.N. CHATURVEDI MEMORIAL LECTURE- 2021

HIMALAYAN TREELINE ECOLOGY IN A CHANGING WORLD

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Though treelines in Himalaya are the highest in the Northern Hemisphere (*Juniperus tibetica* at 4900 m), they are under-researched and under-represented in literature. The treeline elevation increases from west to east along the Himalayan Arc and from outer to inner ranges. The treeline is relatively rich floristically (58 tree species), and almost equally divisible between Angiosperms and Conifers. While species richness of herb increases towards the west, the trees species richness increases toward the east along the Himalayan Arc. All the three major growth forms, deciduous broadleaved, evergreen broadleaved, and multi-year evergreen conifers occur in the Himalayan treelines. As for species cold hardiness, the Himalayan tree species are intermediate between the two hemispheres. Treelines are largely stationary, so they are getting warmer. Towards treeline, temperature lapse rate increases from east to west and varies seasonally, the lowest being in December, which is about half of the summer time lapse rate. Climate change seems to affect temperature lapse rate. The tree water potential indicates that the species are not under water stress, but tree ring width studies point out to the effect of pre-monsoon drought as a limiting factor. A large daily change in tree water potential during monsoon and high leaf water conductance are the characteristic features of treelines. Early snowmelt seems to increase species diversity and plant growth, but long-term effects could be uncertain. There is a need to treat treelines as a separate entity for conservation and management.

V

INVITED LECTURES

WHY IS PLANT TAXONOMY ON CROSSROADS TODAY? THE MUTE MESSAGE FOR 21ST CENTURY

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The status of plant taxonomy in the country is discussed. It is said that traditional taxonomy being the oldest of all biological sciences is badly neglected by students and teachers in the universities and policy makers and fund giving bodies show apathy towards the subject. It is said that plant taxonomy today is not just confined to identification and classification of taxa but deals with a host of other issues relevant to modern society. Some of these new areas where taxonomy is most essential are discussed briefly and suggested to include the newer aspects in the syllabi of universities so that taxonomy becomes more attractive to students. The multifaceted role of herbaria is completely ignored by modern biologists resulting in the total neglect of herbaria in the universities. The author highlights the paramount role of herbaria in the modern context to draw the attention of modern biologists regarding the importance of herbaria. Although several of the offshoot sub disciplines of biology that emerged during the 20th century 'attacked' plant taxonomy, yet taxonomy contributed enormously and could withstand these attacks. But the birth of molecular biology with its novel ideas in the last few decades completely changed the concept of taxonomy.

The emergent molecular biology has attacked the very foundation of taxonomy, i.e., external morphology. External morphology of plants which formed the central focus of identification and classification during the last three centuries is severely criticized by molecular biology so much, that the place of morphology is completely neglected. A new classification, namely Angiosperm Phylogeny Group classification (APG) entirely based on DNA gene sequences is proposed based on data of just 20 years to replace all existing classifications produced by classical taxonomists based on the data accumulated over three centuries. Linnaean nomenclature established and stabilized over a period of 200 years is now being replaced by a new, again molecular based Phylo code. With the total rejection of all earlier classification systems, with the threat posed to Linnaean nomenclature by the proposal of the phylo code and with the consideration of external morphology of taxa for identification and classification as a weak point, taxonomists today are confused as to support 'morphology-based taxonomy' or 'molecular based taxonomy' and thus the author feels that taxonomy has come on the cross-roads in the 21st century. As a strong advocator of external morphology in taxonomy, the author opines that although taxonomists do not study the genes and gene sequences in a species, the external morphology (phenotype) is the resultant of the interactions of thousands of genes and therefore they cannot go wrong in their identifications. Further, the phenotypes are produced as result of interaction between genotype and the external environment (habitat). Hence, classical taxonomists are doubly justified in using external morphology for

identification of taxa. Almost all plant species identified by classical taxonomists during last 2-3 centuries using 'dead plants with a dry lens' stand valid even today.

The author is optimistic that the classical method of identification of plants cannot be replaced by any other means; inventories of the vast flora cannot be undertaken by anyone except plant taxonomy and therefore it is more than certain that classical plant taxonomy with added challenges in the 21st century will emerge as one of the fascinating areas of biology and regain its past glory. Enormous contributions of classical taxonomists are highlighted. As long as the flora and fauna exist on the surface of the earth, taxonomy surely continues to flourish and serve the humanity. The mute message of plant taxonomy is clear. The subject needs no sympathy from its own off shoot disciplines but expects due acknowledgement, appreciation, encouragement, and respect for the enormous contribution the subject has made during the last five centuries and further expects hurdle free environment for the subject to contribute much more in the 21st century for the overall good of humanity.

GERMPLASM OF OPHIOGOSSACEAE (PTERIDOPHYTA) IS ENORMOUSLY RICH IN INDIA

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Our field work since 1966 until today has yielded extremely valuable information on several genera of pteridophytes that this subcontinent is bestowed with enormous variability which has been explored only say 40% of entire plant biodiversity. I have covered about 30 localities distributed in states of Madhya Pradesh, Chhatisgarh, UP, Jharkhand, Rajasthan, Gujarat, Kerala, Uttarakhand, Himachal Pradesh and paid specific attention to find two pteridophytic genera, *Isoetes* L. and *Ophioglossum* L. in particular. In this presentation I concentrate only on the genus *Ophioglossum* a small plant genus ranging from less than 2 cm (*O. malviae, O. indicum*) to 45 cm (*O. reticulatum*) in height. The genus is popular among biologists mainly because of possessing 2n=1450 chromosomes + 10 microchromosomes. The genus *Ophioglossum* is also a glaring example of palaeoploidisation and offers numerous evolutionary strategies.

By utilizing multidisciplinary diagnostic approaches including morphology, anatomy, chromosome variation and comparative phylogentic studies based on chloroplast genes, many new species have been described from India. Almost all of them have been validated by an exhaustive study of Zhang & Zhang. These authors in particular, have reconstructed new phylogenetic trees, on the basis of investigating on four datasets: Sanger sequences of eight plastid markers of 184 accessions, 22 plastomes (12 are new), 29 morphological characters, and combined Sanger and morphological data. An important inference is that the family Ophioglossaceae (or Ophioglopsida) which is known to have *Ophioglossum, Botrychium, Helminthostachys, Mankuya* now also has phylogenetically distinct genera *Goswamia, Haukia,* and *Whittieria* which according to molecular phylogenetics are all deeply diverged from the rest as demonstrated by the long branches or numerous molecular synapomorphies of each of them.. Our studies also indicate that the shape- size of rhizome /corm and number of roots of conventional *Ophioglossum* plants is the most remarkable difference among these newly recognized genera mainly to differentiate between *Ophioglossum* L and *Goswamia* Zhang and Zhang.

BIOLOGY AND BIODIVERSITY ANOXYGENIC PHOTOTROPHIC BACTERIA AND THEIR BIOTECHNOLOGICAL APPLICATIONS

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Anoxygenic Photographic Bacteria are a unique assemblage of predominately aquatic bacteria that can grow under anaerobic conditions by photosynthesis that lacks photosystem-II and does not produce O_2. They are physiologically and phylogenetically diverse groups and contain a variety of bacteriochlorophylls (a, b, c, d, e, g) and carotenoids of spirilloxanthin, rhodopinal, sphaeroidene (yellowish-brown in the absence of O_2 and reddish-brown in the presence of O_2) and okenone series. However, all species contain cytochrome, quinones and non-heme iron protein of the ferredoxin type. They are mostly Gram-negative bacteria that are spherical, spiral, rods, or vibriod and unicellular. However, uniseriately multicellular filamentous forms also occur. In the presence of sulfide and light, cells of purple bacteria form highly refractile globules of elemental sulfur. They are widely distributed in terrestrial and diverse aquatic ecosystems including extrtemes of light, anoxic conditions, sulfide concentration, pH, temperature, and salinity.

The phosynthetic metabolism of these organisms differs from the rest of the photosynthetic organisms in that, water cannot serve as an electron donor, instead an external source of election donors such as reduced sulfur compounds, molecular hydrogen, or organic compounds is utilized. These are potential organisms for a variety of biotechnological applications due to diverse metabolic pathways (photoautotrophy, chemoautotrophy, heterotrophy, and fermentation) coupled with high growth rate and ease of manipulation. Since light is the source of energy, these bacteria proved to be highly economical and beneficial in different fields of biotechnology. They are being investigated as a source of single all protein, methane, herbicides, natural dyes, ammonia fertilizer, auxins, polyhydroxybutryate, biosurfactants, enzymes, etc.

The photobiolgical production of hydrogen offers potential, clean and renewable energy, and utilisation of wastewater for photobiological production of hydrogen by purple non-sulfur bacteria proved to be an additional advantage for its sustainability.

CLIMATE CHANGE AND FUNGI

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Earth's climate has been undergoing changes and is getting warmed at an increasing rate. Such adverse changes are mainly due to increase of gaseous emissions along with the particulate matter. 90% of terrestrial plants benefit from mycorrhizal fungi. Soil factors and plant systems may get influenced by dramatic changes in climate which disrupt mycorrhizal association, thus affecting sustainable agriculture and forestry. The increasing global temperature may have an impact by increasing the potential soil-borne and aerial phytopathogens. Recently it was found that a phytopathogen of maize, *Fusarium verticillioides* became resilient and suffered changes in gene expression. It is presumed that several of crop plants and food products may get contaminated with carcinogenic toxins such as aflataxins making a world issue for food safety. Many of the edible fungi and truffles may become endangered along with other fungi.

It is possible that several human pathogens may be on increase due to climate change. *Candidus auris*, drug- resistant yeast has already become an emerging human pathogen. However, the fungi have the capacity to bear the abiotic stress generated by climate changes, and it is possible that they may develop survival strategies. In order to bear with the global warming and other changes in climate, fungi may develop thickened cell walls, melanization, resistance to desiccation, formation of survival structures and easy way of transporting water and nutrients. It is expected that several plant pathogens may increase on crop plants resulting in shortage of food. Water bodies and marine ecosystem may get disturbed along with the loss of biodiversity including fungi which play important role in energy budget. The crop productivity of wheat and rice may not get affected, but the increase of insect pest and diseases may have greater impact.

The scientists need to explore the fungi that can provide the solutions to the global challenges. In the year 2019, when less global warming was recorded, 1886 fungi were discovered. The data of biodiversity conservation shows that around 636 fungi have already been threatened as per IUCN Data. Such data is not available for India. Therefore mycologists have to find out ways and means of conserving fungal biodiversity and they have to work in minimizing the future extinctions. In many countries, the water bodies are disappearing and desertification is happening. Recently some parts of Europe and United Kingdom have been experiencing heavy temperatures. Climate change may also affect lichen-forming fungi, black fungal yeast and others. it is surprising that black fungal yeast is found to survive in harsh habitat. *Talaromyces marneffei* has emerged as an opportunistic

pathogen, infecting immune- compromised hosts. Many of the water bodies such as lakes, rivers, oceans and also forests which are considered as homes for variety of fungi may get affected by climate change. The aspects and prospects of fungal biodiversity, conservation strategies and other related aspects in relation to climate change will be discussed.

Keywords: Biodiversity, Climate change, Conservation, Fungi, Habitat loss, Soil, Water bodies.

VIRUS UNDER SIEGE: UNRAVELING NOVEL DEFENSE MECHANISM IN PLANTS

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Tomato leaf curl disease (ToLCD), caused by strains of Tomato leaf curl virus (ToLCV), is a major constraint to tomato production. Plants have developed different strategies of defense against viruses which involves: (a) autophagy-mediated resistance mechanism and, (b) identification of viral effectors, avirulence (*Avr*) genes, by the corresponding resistance (*R*) genes, and (c) the antiviral RNA silencing mechanism (also called RNA interference; RNAi) (d) instigation of ubiquitin-26S proteasome system (UPS). Our studies focused on the contribution of autophagy-related proteins (ATGs) and resistance genes during geminivirus-plant interactions and the mechanism of plant tolerance against *Tomato leaf curl New Delhi virus* (ToLCNDV) infection.

To understand the molecular mechanism of virus tolerance, we performed a genome-wide study that identified thirty ATG encoding genes in tomato. Further, we functionally characterized (i) *SlATG18f* gene and (ii) *SlATG8f* gene, which were differentially expressed after ToLCNDV infection in tolerant cultivar. (i) An increase in viral load upon silencing *SlATG18f* in cv. H-88-78-1 was observed validating its role in tolerance. Further, a cleaved amplified polymorphic sequence (CAPS) marker was developed which showed a significant association with the tolerance characteristics in the tomato germplasm. (ii) We functionally characterized SlATG8f and found that ATG8f interacts with viral TrAP protein and mediates its degradation by the autophagy pathway. ToLCNDV TrAP is known to possess host RNA silencing suppression (RSS) activity. Degradation of TrAP results in the attenuation of its RSS activity and thus provides defense against ToLCNDV.

Apart from autophagy, our studies also focused on the contribution of microRNAs (miRNAs) and R genes in providing resistance against geminivirus infection. Through miRNAome of tomato in response to ToLCNDV infection we found that miR159 is upregulated during infection in susceptible cultivar and the inverse correlation of miR159 abundance with its target, *MYB33* suggested their putative involvement in the defense response. Molecular characterization of sly-miR159 and *SlMYB33* demonstrated their role in regulating the expression of *Sw5a* gene. Functional characterization showed that SlSw5a interacts with viral AC4 protein triggering hypersensitive response (HR) and limiting virus spread. Overall, the results obtained from our studies could be employed in developing tolerance in susceptible cultivars of tomato through modern breeding or molecular approaches. (Prasad et al. 2020; 2022; Trends in Plant Science)

PREDICTING CLIMATE CHANGE IMPACTS ON SPECIES, CROP VARIETIES AND ECOSYSTEMS FOR DESIGNING EFFECTIVE ADAPTATION STRATEGIES

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Impacts of climate change are scale-dependent and vary across biotic spectrum. Two approaches are taken to predict the impacts of climate change at species/population levels viz., modelling and Free Air Carbondioxide Enrichment (FACE) studies. Based on the species response to different climate scenarios either using models alone or together with FACE studies, future adaptive strategies are planned. For example, based on the response of specific crop varieties to climate change scenarios/ factors such as CO_2, O_3 and temperature, future adaptive strategies can be planned for different agro-ecosystems by prescribing the climate smart varieties so that yield loss can be avoided. Ecosystem level impacts can be predicted integrating climate models with habitat distribution models for the dominant species/communities. Case studies on the above propositions will be presented with empirical data. How biodiversity-rich landscapes help climate change adaptation to the vulnerable populations will also be discussed with the help of another case study. Thus, identification of climate-smart varieties/species and their incorporation into adaptation strategy planning along with maintenance of biodiversity-rich landscapes surrounding human habitations can provide effective adaptation against the climate change.

THE INDIAN PLATE AS A MUSEUM AND EVOLUTIONARY CRADLE FOR TROPICAL ANGIOSPERMS

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Tropical angiosperms are the main constituents of tropical biodiversity hotspots. Tracing the evolution of tropical angiosperms is arguably a challenging and relevant issue in plant evolution. The dramatic geological history of the Indian Plate puts on view its significant role in shaping the biogeography of tropical angiosperms. Dispersal routes between India and Madagascar till ~90-88Ma with Seychelles till 66Ma, with Africa through Kohistan Ladakh Arc (KLIA) during ~70-60Ma, and finally suturing with the Asian Plate ~50Ma onwards provides changing vegetation pattern on India plate as evident in the form of its fossil records. Early and Mid-Cretaceous sedimentary records of India have not provided any evidence of angiosperm fossils so far. Ecological opportunities due to latitudinal shift of the Indian plate in the tropical zone during Late Cretaceous-early Paleogene and the formation of dispersal routes with tropical Africa (via KLIA), and through that with Europe and later with Southeast Asia sheds light on the longstanding debate of lack of endemicity of Indian fossil flora despite isolation of Indian plate as an island. KLIA acted as a filter corridor for dispersal of tropical angiosperms from Africa to India. Perhumid climatic setting due to equatorial positioning of Indian Plate under warm climate of early Paleogene provided an ecological release for the rapid diversification and speciation of aseasonal tropical angiosperms. Post-India Asia collision led to the dispersal of the aseasonal tropical angiosperms to the low-lying tropical regions of Southeast Asia where they got an ecological release afresh, helping them speciate again and diversify to finally develop as dense tropical rain forests. These warm and humid climatic conditions were maintained for the sustainability of tropical angiosperms on Indian plate till the initiation of monsoonal climate. Lesser precipitation and long periods of dry climatic conditions with the advent of monsoonal climate led to the retraction of aseasonal tropical angiosperms from larger parts of India and restricted them to the perhumid climate of the Southwestern Ghats of India and Sri Lanka as Gondwana relic forests. The Indian Plate hence acted as both museum and cradle for tropical biodiversity and was the main driver for the emergence of tropical rain forest in Southeast Asia.

CONSERVATION OF PAPHIOPEDILUM SPECIES OF INDIA

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Paphiopedilum, often called the Venus slipper, is a genus of the lady slipper orchid subfamily *Cypripedioideae*, family Orchidaceae. The genus comprises some 80 accepted taxa including several natural hybrids. The genus is native to Southeast Asia, the Indian Subcontinent, southern China, New Guinea and the Solomon and Bismarck Islands. The species and their hybrids are extensively cultivated and are known as either *paphiopedilums*, or by the abbreviation paphs in horticulture. The type species of this genus is *Paphiopedilum insigne*. *Paphiopedilum* species are well known for their beautiful, long-lasting flowers. Although there are many *Paphiopedilum* hybrids, the species remain important in hybrid production. Many growers have re-introduced species into hybridisation to regain vigour in breeding lines. Species are being over-exploited from the wild in many parts of the world, not least in India. Ten *Paphiopedilum* species are reported from India, viz. 1. *P. druryi* 2. *P. charlesworthii* 3. *P. fairrieanum* 4. *P. hirsutissimum* 5. *P. insigne* 6. *P. spicerianum* 7. *P. tigrinum* 8. *P. venustum* 9.*P. villosum* 10. *P. wardii*. In recent years only seven species are present viz. 1. *P. druryi*, 2. *P. fairieanum*, 3. *P. hirsutissimum*, 4. *P. insigne*, 5. *P. spicerianum*, 6. *P. villosum*, 7. *P. venustum*. However, three species *Paphiopedilum charlesworthii*, *Paphiopedilum tigrinum* and *Paphiopedilum wardii* have not been recorded in recent years from India. Botanical Survey of India under its *ex situ* conservation program has taken up the seven *Paphiopedilum* species presently found in India for conservation.
Keywords: Conservation, *Paphiopedilum* species, India.

PLANT GENOME-EDITING: TOOL FOR FUNCTIONAL GENOMICS AND CROP IMPROVEMENT

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Genome-editing using sequence-specific nucleases, particularly CRISPR-Cas ribonucleoprotein, is the centerpiece of plant research and crop biotechnology. Around a decade ago, Cas9 was initially discovered to have a role in adaptive immunity in bacteria. However, later research demonstrated that Cas9 could be guided in a sequence-specific manner for efficient gene editing in organisms. CRISPR-Cas9-based genome editing revolutionized crop biotechnology by developing resilient commercial crops with improved yield and adaptation to various stresses. The approach has been used extensively for understanding genes' functions and developing new plant varieties with better traits. Our group has been using the CRISPR/Cas9 approach to determine the function of miRNAs, miRNA-encoded peptides (miPEPs), and various genes involved in secondary plant product biosynthesis and stress response. Our study, through developing CRISPR/Cas9-based mutants, suggests an involvement of the light-regulated miR858 and associated pri-miRNA-Encoded-Peptide (miPEP858) in the flavonoid biosynthesis as well as plant growth and development. CRISPR-based miR858a/miPEP858a-edited plants and miPEP858a overexpressing lines showed altered plant development and accumulated modulated levels of flavonoids. Transcriptome datasets from tissues of miR858 overexpressing lines and miR858a/miPEP858a edited plants suggest modulation in the expression of a set of genes, including the member of PSK gene family (AtPSK4), a small peptide. Genetic analysis using AtPSK4 and miR858a suggests the interaction of small molecules consisting of miPEP858/miR858-AtPSK4 regulates plant growth and development as well as the phenylpropanoid pathway leading to flavonoids biosynthesis. In addition, our group could develop tobacco and tomato CRISPR-based editing plants with improved traits. Some of these results will be discussed in the presentation.

FUNCTIONALITY OF PHYTOMOLECULES ON AGEING AND COGNITION IN *CAENORHABDITIS ELEGANS* AGEING

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In 440 BC, the Greek physician Hippocrates quoted "let food be thy medicine and medicinebe thy food" and to a large extent this seems to hold true since we know the impact of calorie or diet on gut microbiome, metabolome, transcriptome and proteome in living organisms. Traditional medicinal plants played a major role in curing human diseases since ancient times. Even today, the rural folks and tribal communities in India depend basically on the neighboring plant species for their routine needs. Increasing demand for medicinal plants in the pharmaceutical industries has generated a huge interest in the farming community for its commercial cultivation which has led to a substantial growth in their income. This trend is encouraging, both for the farming community as well as for our researchers. The medicinal plant derived extracts and molecules are known to possess anti diabetic, antibiotic, anti- cancer activities but the mode of action of a range of molecules is still not known. Ageing isan inevitable process influenced by inherited genes, life style and environmental factors which in turn increases the primary risk of age-related neurodegenerative diseases. With the elderly population increasing at an alarming rate this has presented a serious burden on the nation. Evidences have proved that medicinal plant extracts and molecules have a huge impact on ageing and age related human neurodegenerative diseases especially Alzheimer and Parkinson in multicellular model system *Caenorhabditis elegans.* The efficacy of medicinal plant extracts on ageing and age-related neurodegenerative diseases depends on the richness of various group of molecules like flavonoids, phenolics, terpenoids etc. in it. Large numbers of phytomolecule have proven their antiaging and cognitive boosting activitiesin *C. elegans* which will be highlighted in the present lecture.

PLANT GROWTH PROMOTING MICROORGANISMS FOR REMEDIATION OF SALINE AND DEGRADED AGRO-ECOSYSTEMS

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Soil is the complex mixture of minerals, water, organic matter and microbial biomass, which is vital for existence of life on Earth, and supports one quarter of all living organisms. Intensification of anthropogenic activities leading to global warming and climate change have increased the intensity of extreme weather events such as heatwaves, drought, flood along with enhanced rate of land degradation due to salinity, soil erosion or addition of xenobiotic compounds. The achievement of Sustainable Development Goals: zero poverty (SDG 1), zero hunger (SDG 2), good health and well-being (3), clean water and sanitation (6), affordable and clean energy (7), climate action (13), and proper management of terrestrial ecosystems (15) can be accomplished only with the use of climate-smart agricultural techniques. Failing to maintain the decorum of sustainability and lacking adaption according to changing climate, physical and chemicals methods need to be replaced with biological solutions such as use of microbial technology. The application of beneficial microbes for soil reclamation is popularizing, however, only ~1% of soil microorganisms have been identified compared to 80% of plants, thereby, requiring more intense studies for better picture. The lesser known below-ground biodiversity consisting of micro-soil communities have the potential to impair multiple ecosystem functions such as plant diversity, health, decomposition, and nutrient cycling, resultantly collapsing the whole ecosystem. Plant growth promoting bacteria (PGPB) residing in these hotspots play significant role in remediation of degraded lands and protecting the plants from unhospitable conditions. Soil salinization is major issue worldwide affecting the agricultural productivity and economic status of farmers, thereby requiring immediate action. Diverse spectra of salt-tolerant PGPB belonging to various groups such as pseudomonads, rhizobia, enterobacter were screened for their tolerance-action against salt stress and their potential in promoting plant growth. Novel bioformulations specifically developed for saline agro-ecosystems were applied to different crops in saline fields. The application of microbes to marginal lands over the years significantly improved the soil fertility, productivity and resulted in permanent remediation of saline soils.

VI

WOMAN BOTANIST AWARD CONTEST

DIVERSITY AND DISTRIBUTION OF MARCHANTIALES (MARCHANTIOPHYTA) IN KERALA

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Marchantiales is a well defined group among the Bryophytes characterised by dorso-ventrally flattened thallus with internal tissue differentiated into upper assimilatory region and lower storage region. Compared to the northern parts of the country, the documentation of this group in Southern India remained slow for a long period. The diversity of the Marchantiales of Kerala was not documented to the extent it deserved. Earlier studies were limited to some sporadic collection reports, listing of species, etc. A comprehensive treatment of the Marchantiales of Kerala was thus lacking. The present work was undertaken in this backdrop and is an attempt to fill the gap. The progress on the documentation of Marchantiales in Kerala is presented. It was known by 13 taxa during the year 2000, and rose to 44 species belonging to 13 genera under 10 families in 2022. This includes two species of *Riccia* described from Kerala in recent years, and some additions. Most common members of this group in Southern India are *Riccia* L. and *Cyathodium*, which are present even in almost all homesteads and human habitations. Members such as *Asterella*, *Reboulia* and *Plagiochasma* are common in habitats of medium to higher altitudes. *Dumortiera* Nees is a common element in the soil and on buttresses and exposed roots of trees and shrubs in moist forested areas. The microhabitat preferences of each species are also discussed.
Keywords: Diversity, Kerala, Macrohabitat, Marchantiales, Western Ghats

PHYTOREMEDIATION EFFICIENCY OF ORNAMENTAL PLANT SPECIES *HELIANTHUS ANNUUS L. AND TAGETES ERECTA* L. FOR MITIGATION OF HEAVY METALS FROM POLLUTED INDUSTRIAL SOIL

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Heavy metal pollution has become one of the most serious environmental problems in India and worldwide. High toxicity, non-biodegradability and accumulation in the food chain make the heavy metals hazardous for the environment and human health. Industrial effluents from various industries such as dye, textile, paper, plastic, and paint are becoming the most common source of metal pollution in soil. Crop plants that grow in nearby industrial soil contain a highly toxic metal content. Likewise, industrial effluents combined with water bodies that are used to irrigate crops cause harmful effects on plants. This research showed that concentrations of heavy metals were higher than the permissible level in all soil samples. In the present study, we have collected polluted soil samples from nearby regions of various industries like plastic industry, paper, dye, leather factory and textile industry of different areas of Uttar Pradesh, Rajasthan and Uttarakhand, India. Industrial soil samples were characterized using soil sample analyzer followed by analysis of heavy metal contaminants using atomic absorption spectrophotometer (AAS). Two ornamental plant species *Helianthus annuus* (sunflower)and *Tagetes erecta* (marigold) have been used as alternative method to cleanup heavy metal contaminated sites. The experiments were designed to (1) assess potential of *H. annuus* and *T. erecta* to accumulate heavy metals like Pb, Cd, Zn, As from polluted soil using atomic absorption spectrophotometer(2) evaluation of physiological, biochemical parameters, and antioxidant activity in plants during heavy meal stress (3) heavy metal transport in plant tissues through ultra-structural analysis using Scanning electron microscopy (SEM), energy dispersive X-ray (EDX) studies, optical microscopy, and fluorescence microscopy. Plantlets accumulated a different range of Pb, Cd, Zn, Cu, Fe and As (0.62–158.29, 0.8–59.6, 0.81–166.5, 0.09–101.89, 2.06–53.25 and 0.002–2.55 mg kg^{-1}, respectively) from the industrial soil samples. As a result, hyperaccumulating plant species, *H. annuus* and *T. erecta* can be used to clean up industrially contaminated sites through eco-friendly green approach. It would also be an effective mechanism for the removal or more specifically, reduction of the number of toxic contaminants in the environment.

Keywords: *Helianthus annuus*; *Tagetes erecta; Heavy metals* Phytoremediation; Industrial contamination; Hyperaccumulator plants.

VII

YOUNG BOTANIST AWARD CONTEST

INVESTIGATION OF *IN VITRO* AND *IN VIVO* PRESERVATIVE POTENTIAL OF *MELALEUCA CAJUPUTI* POWELL. ESSENTIAL OIL AND THEIR POSSIBLE MODE OF ACTION AGAINST AFLATOXIGENIC STRAINS OF *ASPERGILLUS FLAVUS* ISOLATED FROM STORED MAIZE SAMPLES

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This study investigated the efficacy of *Melaleuca cajuputi* essential oil (McEO) against aflatoxigenic fungi and lipid peroxidation causing deterioration of maize. GC-MS of EO revealed the presence of α-pinene as major compound. McEO exhibited inhibitory activity against growth and AFB_1 production at lower concentrations. McEO inhibited fungal growth via ergosterol inhibition, ions leakage, and damage of mitochondrial membrane potential, while AFB_1 by inhibition of methylglyoxal and binding with *Nor-1* protein. Further, McEO showed higher antioxidant activity and inhibited AFB_1 and lipid peroxidation in fumigated maize samples without changing their sensory attributes. Overall, McEO can be recommended as novel food preservative.
Keywords: *Melaleuca cajuputi* essential oil; Aflatoxin B_1; Methylglyoxal; Lipid peroxidation; Median lethal dose; Food preservative

ANTIVIRAL DEFENCE AGAINST *TOMATO LEAF CURL NEW DELHI VIRUS*: AUTOPHAGY INTO THE ACTION!

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Tomato leaf curl New Delhi virus (ToLCNDV) is a viral species belonging to the *Genera Begomovirus*. It has a bipartite genome consisting of two single-stranded, closed, circular DNA molecules (DNA-A and DNA-B). DNA-A encodes for 8 proteins that are involved in viral genome replication, transcription and translation. DNA-B encodes for 2 proteins that assist in viral cell to cell movement and nuclear shuttling. Recent studies have highlighted that important aspects of a plant's lifecycle like growth, development and adaptation to abiotic and biotic stresses is regulated by autophagy. In this study, we have found that the tomato autophagy-related protein; SlATG8f interacts with the Transcriptional activator protein (TrAP) of ToLCNDV. This interaction leads to the localization of the viral protein from the nucleus to the vacuole where degradation of the viral protein takes place. We have also shown that this nuclear export might be assisted by Exportin 1. For the first time, we have shown that autophagy acts an antiviral mechanism against ToLCNDV.
Keywords: Plant defence, Transcriptional activator protein, SlATG8f, ToLCNDV, RNA silencing suppressor, Autophagy

VIII

S. N. DIXIT POSTER AWARD CONTEST

DISSECTING THE ROLE OF *OSZ*FP37 TRANSCRIPTION FACTOR IN REGULATING DROUGHT STRESS TOLERANCE

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Lectins are carbohydrate-binding proteins known to regulate various stress responses in plants. Earlier, we demonstrated that the lectin protein, *O*sr40C1, imparts drought tolerance in rice. However, how this lectin is regulated under drought remains elusive. Here, we demonstrate that *Osr40C1* gene is transcriptionally activated in response to PEG-mediated osmotic stress, drought exposure, and ABA treatment. Further, we identified several transcription factors that can bind to its promoter. Among them *Os*ZFP37 is an interesting candidate that was strongly induced during drought. Ectopic expression of *OsZFP37* in tobacco also imparts drought tolerance thus confirming its role in modulating drought tolerance in plants.

ENHANCEMENT OF THE YIELD IN RICE BY THE GAMMA RAY-PRODUCED OLIGO-CHITOSAN

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A phase-wise study was carried out to establish the efficacy of gamma ray-produced chitosan oligos in enhancing the yield in rice.In the first phase, the effect of gamma ray-produced oligo-chitosan on the seedling growth was studied.The elicitor (a particular concentration of the oligo-chitosan) which stimulated the seedling growth were later tested in the field for its ability to enhance the growth and yield in rice under six different treatment regimens. Subsequently, the elicitor and treatment regimen which enhanced the yield contributing factors were evaluated at a larger scale in the next season. The observations suggest that 400ppm of oligo-chitosan produced by 200kGy of gamma ray enhances the yield in rice by 10.45% if sprayed during pre-flowering and grain-filling stages. Such treatment improves the overall growth and development of the plant, which probably enhances the yield of the crop.
Keywords: chitosan, growth enhancer, oligos, *Oryza sativa*, yield

THE GENUS OPHIOGLOSSUM L., (OPHIOGLOSSACEAE) FROM WESTERN GHATS OF INDIA

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The genus, Ophioglossum L., belongs to the primitive family Ophioglossaceae (class Polypodiopsida). Morphologically, it shows countless variations in the shape of the rhizomes and trophophylls depending on growing conditions. About 50 species were reported worldwide, of which 23 species are reported from India. Most of them are ground growing forms except O. pendulum L., and O. palmatum L., are epiphytic. The genus Ophioglossum is characterized by erect, fusiform, globose or tuberous rhizomorph, simple (rarely lobed) trophophylls with or without costa and persistent sheathing leaf bases, a spike (rarely bi or trifurcate) bearing two rows of sporangia. In all the species known so far, trophophylls are pale green, green, dark or light green at maturity and produces a paler spike. However, some species viz., O. gomezianum Welw. ex A. Braun, O. indicum B.L. Yadav & amp; Goswami, O. jaykrishane S.M. Patil, S.K. Patel, Raole & K.S. Rajput and O. rubellum Welw.ex A.Braun, are characterized by the presence of trophophylls with yellow, pink, reddish tobrown ting respectively. Recently, we reported biotypes having forked strobilus collected from different forest regions of Western Ghats. The present investigation deals with morpho-taxonomy, species composition, distribution and biotypes of Ophioglossum L., from Western Ghats. A total of 12 species viz., Ophioglossum costatum R.Br., O. eliminatum Khand. & amp; Goswami, O. gramineum Wild., O. gomezianum Welw. ex A. Braun, O. gujaratense S.M. Patil, R.N. Kachh., R.S. Patel & amp; K.S. Rajput, O. konkanensis S.M. Patil & amp; Dongare O. lancifolium C. Presl., O. lusoafricanum Welw. ex Prantl., O. parvifolium Hook. & amp; Grev., O. petiolatum Hook., O. polyphyllum A. Braun and O. reticulatum L., is reported. However, O. alatum M. Patel, M.N. Reddy & amp; Goswami is synonymized under the species O. reticulatum, while O. malviae M. Patel & amp; M.N. Reddy was synonymized under the species O. parvifolium and O. hitkishorei issynonymized under the species O. costatum. The species O. lusitanicum was wrongly identified from India (also from Western Ghats), hence it was excluded from the present investigation.

Keywords: Morpho-taxonomy, Distribution, Primitive, Biotypes

AN INDEGENOUS PERSPECTIVE OF BIOTECHNOLOGICAL STRATEGIES FOR CONSERVATION OF ENDANGERED ETHNOMEDICINAL PLANTS IN SOUTH-EAST REGION OF RAJASTHAN, INDIA

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The Field of Biotechnology has enhanced the value of genetic resources and related indigenous knowledge of communities. However, the vast diversity of resources as well as traditional knowledge is diminishing at an accelerated rate. Biological diversity, coupled with indigenous knowledge are necessary to maintain the options for the survival of mankind in this changing world. In medicinal plant research area, documentation plays a key role since without correctly identified material and properly documented voucher specimens the results are at best suspicious and at worst useless in the present scenario. The pharmacological evaluation of active constituents from plants is an established method for the identification of active principle which leads to the development of novel compounds. Ethnopharmacological literature reveals medicinal plants used in traditional medicine by indigenous people in Rajasthan and are facing damger of extinctiom. Plant Tissue culture technology is potent and has opened extensive areas of research for the conservation of biodiversity in general, and medicinal plants, in particular. The present study deals with the futuristic view on the said subject restricted to the important endangered ethnomedicinal plants around the rural areas of south-east region of Rajasthan. Efforts were made to isolate the active constituents of these potent ethnomedicinal plants which are facing the danger of extinction. Antimicrobial assays were carried out in few selected ethnomedicinal plants facing threat for extinction.
Keywords: Antimicrobial, Conservation, Endangered, Ethno-medicinal, Indegenous.

IX

K. S. BILGRAMI POSTER AWARD CONTEST

NOTES ON THE IDENTITY OF *CALLITRICHE WIGHTIANA* AND TWO NEW SPECIES OF *CALLLITRICHE* (PLANTAGINACEAE) FORM SOUTH INDIA BASED ON MORPHOLOGICAL AND MOLECULAR DATA.

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The genus *Callitriche* L. (Plantaginaceae) consists of 75 species worldwide. The genus is mostly monoecious, with axillary naked flowers and schizocarpic fruits. Extensive field exploration and critical examination of *Callitriche* specimens in South India, revealed two new species viz., *C. idukkiana* and *C. bracteata* and clarifies the ambiguity of *C. wightiana* in South India. Molecular phylogenetic analysis based on nuclear ITS genes revealed that *C. idukkiana* and *C. sonderi*, and *C. bracteata* and *C. wightiana* are in adjacent clades. The recognition of *C. idukkianua* and *C. bracteata* as new species is supported by combined molecular and morphological data. A detailed description, color images, line drawings, and seed micro morphological features are provided.
Keywords: Molecular and morphological data, Idukki district, *Callitriche raveniana, C. sonderi*, *C. bracteata, C. wightiana, C. idukkiana.*

MORPHOLOGICAL STUDY OF THE GENUS *JUSTICIA* L. (ACANTHACEAE) IN PENINSULAR INDIA

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Justicia L. is the largest genus in the tribe Justicieae (Acanthaceae) with approximately 700 species distributed in the tropical and subtropical regions, extending into warm temperate zones in Europe, Asia and North America. Due to its wide range of distribution, the taxonomic identity as well as generic circumscription of *Justicia* has long been a topic of debate amongst taxonomists. Furthermore, nomenclatural disputations resulted in the segregation of many species of *Justicia* under several generic names like *Adhatoda, Beloperone, Gendarussa, Hemichoriste, Justicia, Leptostachya Rhaphidospora, Rostellaria, Rostellularia* etc. Most of these treatments were purely based on herbarium studies. Later, by adopting different taxonomic approaches in defined geographical area, many of these names have been synonymised in the genus *Justicia* establishing various infrageneric groups. In this study, a morphological study on the genus *Justicia* was conducted. Nomenclatural issues relevant to the taxonomic study were also resolved resulting in subsequent synonymy, name changes and typification.

***EX-SITU* CONSERVATIONAL APPROACH OF *EULOPHIA NUDA* LINDL. A TERRESTRIAL, MEDICINAL ORCHID**

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Eulophia nuda, a medicinal orchid has been used by the local tribes of Maharashtra for treating various diseases (Nogdam, 2014). In the recent past, the illegal collection from the native population raised a threat condition thus to reduce this dependence on wild, carried *in-vitro* seed germination as a substitute for commercial and conservation approaches. Among the six different nutrient media supplemented with 2.0 mg/L kinetin, 1.0 mg/L IAA, and 2.0 mg/L GA better results in germination were shown by GA supplements while in multiple rooting and shooting under BM1 + kinetin medium. The successful survival rate of tissue cultured plantlets pioneers the regeneration protocol.

X

INDEX TO PRESENTATIONS

SECTION I

MYCOLOGY, MICROBIOLOGY AND PLANT PATHOLOGY

OP-I-01 DIVERSITY OF FAMILY AGARICACEAE FROM YEOOR HILLS THANE, MAHARASHTRA, INDIA

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Sanjay Gandhi National Park is located in Mumbai, Maharashtra, India. Northern regions of the park lie in Thane city and are popularly known as Yeoor Hills. Forays conducted in the different habitats of Yeoor Hills during the monsoon seasons in 2012-13 and 2013-14 revealed the occurrence of 60 macrofungi, of which eight species belonged to Family Agaricaceae. Identification was based on micro and macroscopic characters. The species were classified according to Hibett *et al.* (2017). This system represents the new phylogenetic classification of true fungi based on molecular data. The occurrence or absence of fungal species is a helpful indicator to evaluate the ecosystem damage or ecosystem maturity.
Keywords: Yeoor Hills, Diversity, Agaricaceae, Phylogenetic classification

OP-I-02 EFFICACY OF CITRONELLA OIL AGAINST DISEASE CAUSING FUNGI OF *MENTHA ARVENSIS* L.

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During antifungal screening of some essential oils against fungal pathogen *Alternaria alternata* and *Fusarium oxysporum,* the causative agent of the devastating wilt and leaf spot disease of *Mentha arvensis* L; the Citronella oil (*Cymbopogan nardus* (L.) Rendle) was recorded as most efficacious plant metabolite. The Minimum inhibition Concentration (MIC) of the oil against *F. oxysporum* and *A. alternata* was recorded at a dose of 1000 ppm under *in-vitro* condition, using poison food technique. Consequently, citronella oil has potential as a promising natural product for controlling wilt and leaf spot disease in menthol mint. More comprehensive formulation and field experiments are required to accomplish this.
Keywords: *Mentha arvensis* L.*,* Citronella oil, MIC, Poison food technique, Antifungal activity

OP-I-03 ASSESSING THE ANTIFUNGAL AND AFB1 INHIBITORY POTENTIAL OF *CALLISTEMON LANCEOLATUS* ESSENTIAL OIL FABRICATED IN CHITOSAN NANOMATRIX AGAINST *ASPERGILLUS FLAVUS*.

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Aflatoxin B1 (AFB1), the natural polyketide produced by *Aspergillus flavus*, has a potent carcinogenic effect on humans as well as animals. Antifungal and AFB1 inhibitory effects of *Callistemon lanceolatus* essential oil (CLEO) and CLEO loaded chitosan nanoparticles (CLEO-ChNPs) were compared. Structural characterisation of CLEO-ChNPs (SEM) revealed its spherical shape, with an average of 20-70 nm. FTIR confirmed the incorporation of CLEO inside the chitosan nanoparticles. *In vitro* release study revealed the controlled volatilization from CLEO-ChNPs. The CLEO-ChNPs causes complete inhibition of growth (5.0 µl/ml) and AFB1 (5.0 µl/ml) production by *A. flavus* Sb-09 at a low dose compared to free CLEO (growth and AFB1 inhibition (6.0 µl/ml). The antifungal and AFB1 inhibitory toxicity of CLEO-ChNPs were elucidated using biochemical and in-silico approaches.
Keywords: Aflatoxin B1, *Aspergillus flavus*, Molecular docking

OP-I-04 STUDY OF ANTIMICROBIAL AND THERAPEUTIC PROPERTIES OF *SALVADORA PERSICA*

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Salvadora persica, a member of Salvadoraceae family, commonly known as khara jaal or meswak tree, is used by local populations as chewing sticks to kill oral pathogens. It is also used traditionally as antibacterial, antifungal, anticonvulsant, analgesic, antiplaque and as antimycotic agent. In present research work, different parts of this plant were tested against seven bacterial strains such as *Staphylococcus aureus*, *Bacillus subtilis, Agrobacterium tumefaciens*, *Pseudomonas putida*, *Pseudomonas syringae*, *Enterobacter aerogenes* and *Escherichia coli.* Ciprofloxacin was used as positive control whereas DMSO and water as negative controls. Highest activity was noted in the alcoholic extract of fresh leaves against *E. aerogenes* and aqueous extract of fresh stem against *S. aureus*.
Keywords: *Salvadora persica,* Meswak, Phytoconstituents, Antibacterial

OP-I-05 SEASONAL DIVERSITY OF PHYTOPLANKTONS IN RIVER GOMTI AT LUCKNOW

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Phytoplankton diversity depends upon temperature, light and nutrients like nitrogen, phosphorus and silica. Phytoplanktons serve as indicators of water quality and pollution. The present study is on the diversity of phytoplanktons, in five ghats along Gomti river, namely Manghi ghat, Gau ghat, Kudiya ghat, Hanuman setu and Barrage, and in three different seasons of the year, viz. rainy, winter and summer. A total of 34 species were present that belonged to five planktonic classes. The density of phytoplankton recorded were

lowest during rainy season and highest in the summer season. The various anthropogenic activities and industrial wastes have polluted the river thus bringing changes in the phytoplankton community.

Keywords: Phytoplanktons, Gomti river, Water quality, Planktonic

OP-I-06 ELECTROPHORETIC STUDIES OF LACCASE EXTRACTED FROM *PLEUROTUS SAJOR-CAJU*

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The present study describes the results of electrophoretic analysis of soluble proteins and laccase enzyme using crude as well as partially purified extract from freshly harvested fruiting bodies of *Pleurotus sajor-caju*. Proteins were separated for analysis by Native-PAGE (polyacrylamide-gel electrophoresis). Gel was stained for 30 minutes in Coomassie Brilliant Blue R- 250 staining solution for proteins. Activity staining for laccase was performed with ABTS as the substrate. The pattern and overall intensity of the protein bands distinctly revealed one prominent band which can be correlated with laccase activity (45–48 kDa) by silver staining method. The protein profile–zymogram also showed presence of number of proteins ranging from 16-180 kDa.

*Keywords***:** Electrophoretic study, Zymogram, Laccase, *Pleurotus sajor-caju*

OP-I-07 AM FUNGAL ASSOCIATION WITH MUNG BEAN FROM TELANGANA, INDIA

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AM fungi are the plant root obligate symbiotic associations, with greater ability of soil exploration and nutrient uptake, including phosphorus, besides increasing the plant growth, yield and immunity. AM fungi increases soil binding capacity and acts as a biofertilizer. Data on AM Fungal spore count, morpho-taxonomy, root colonization and impact of some soil factors with reference to *Vigna radiata* (L) R. Wilczek has been presented. The data also has indicated the association of 15 AM fungi in rhizosphere soils of three important locations. The percentage of root colonization varied with reference to localities, highest being in the root samples of Eturnagaram. The inoculation of Pot Culture Inoculum of *Glomus fasciculatum* increased the plant height, fresh and dry weight, number of leaves and number of pods over the control. The data clearly indicated the role of AM fungi in the plant growth.

Keywords: AM Fungi, Hyphae, Soil, Plant growth, Rhizosphere, *Vigna*

OP-I-08 ISOLATION AND IDENTIFICATION OF FUNGAL PATHOGEN ASSOCIATED WITH *CURCUMA LONGA* L. AND ITS MANAGEMENT

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Rhizome of the *Curcuma longa* L. is the most valuable part used as a spice and herbal-drug worldwide. Curcumin is the major phyto-constituent of turmeric rhizome having wide range of pharmacological properties, including anti-inflammatory, antimicrobial, antioxidant, antimutagenic, anticancer and anti-obesity; hence, having great demand globally. However, various fungal diseases, such as leaf spot, leaf blotch, rhizome rot, and storage rot, are common and cause deterioration as well as affect its quality and economics. Therefore, an attempt has been made to isolate and identify the fungal pathogens, and its ecofriendly management.
Keywords: *Curcuma longa*, Rhizome, Fungal disease and management

OP-I-09 MODELING, DOCKING AND SIMULATION DYNAMICS REVEALS THE THERMOS-STABLE AND GLUCOSE TOLERANT BEHAVIOUR OF ENZYME β-GLUCOSIDASE IN *PAENIBACILLUS LAUTUS* BHU3 STRAIN

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β-glucosidase mediates the rate limiting step of conversion of cellobiose to glucose and thus, plays a vital role in the process of cellulose degradation. The present study deals with the analysis of the bacterial strain *Paenibacillus lautus* BHU3 for identifying high-efficiency thermostable, glucose tolerant β-glucosidases. The blind molecular docking of the model enzymes structures with cellobiose and *p*NPG gave high negative interaction energies. Molecular dynamics simulation analysis performed for the WP_096774744.1- *p*NPG complex predicted Glu5, Arg7, Lue68, Gly69 and Phe325 as the major contributing residues for accomplishing hydrolysis of β-1-4-linkage. Further, the molecular docking of WP_096774744.1 enzyme with glucose revealed a distinct glucose-binding site distant from the substrate-binding site, thus confirming the deficient competitive inhibition by glucose. Hence, WP_096774744.1 β-glucosidase appears to be an efficient enzyme with enhanced activity to biodegrade the cellulosic materials.
Keywords: Cellulose, β-glucosidase, Glucose tolerant, Thermostable, Molecular docking

OP-I-10 TARGETED METAGENOMICS REVEAL TEMPORAL SHIFT IN ENDOPHYTIC MICROBIOME DURING SPIKE DEVELOPMENT IN *PIPER LONGUM*

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Piper longum is an ethnomedicinal plant, which is widely used to treat respiratory and digestive disorders in Ayurvedic, Siddha and Unani medicine systems. The root and female spikes of *P. longum* are rich in amide alkaloids (such as piperine and piperlongumine) and represent the economically important part of the plant. This study uses culture-independent approach to investigate the diversity and abundance of bacterial and fungal endophytes across different stages of spike development. Using the 16S rRNA gene and ITS-based metagenomics approach, we observed temporal shift in endophyte abundance during early, mid and late stages of spike development.
Keywords: Endophytes, *Piper longum*, Metagenomics, 16S rRNA, ITS sequencing

OP-I-11 FABRICATION AND CHARACTERIZATION OF NANO-ENCAPSULATED *CORIANDRUM SATIVUM* ESSENTIAL OIL WITH ITS EFFICACY TO PRESERVE FOOD AND FRUIT SYSTEM AGAINST FUNGI AND AFLATOXIN B1 CONTAMINATION

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The present study aimed to fabricate *Coriandrum sativum* essential oil loaded chitosan nanoemulsion (Nm-CSEO) with effective inhibition against fungal proliferation, and aflatoxin B_1 contamination in rice and *C. aurantifolia* fruits. Physico-chemical characterization of Nm-CSEO by SEM, FTIR, and XRD confirmed successful encompassment of CSEO into chitosan nanomatrix. Reduction in ergosterol and methylglyoxal biosynthesis illustrated antifungal and antiaflatoxigenic mechanism of action. In addition, *in-situ* investigation in *C. sinensis* fruits and rice showed significant protection against contaminating fungi, with maintenance of nutritional components and antioxidant enzymes. Moreover, mammalian non-toxicity of Nm-CSEO could provide exciting potential for application as eco-smart and safe preservative.
Keywords: *Coriandrum sativum,* Aflatoxin B_1, Essential oil, Chitosan nanomatrix, Nm-CSEO

OP-I-12 ANTIFUNGAL ACTIVITY OF TWO AQUATIC HYPHOMYCETES AGAINST SOME PLANT PATHOGENS

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Aquatic hyphomycetes produce antibiotics useful for medical, industrial, and agricultural expanses. The antifungal activity of two potential aquatic hyphomycetes was tested against three plant pathogenic fungi using agar well method. Crude fungal extract was made in ethyl acetate and methanol, while dry extract was prepared in DMSO. Carbendazim was used as positive control. *C. aquaticum* showed maximum inhibition against *Fusarium oxysporum* followed by *F. solani,* while least activity was seen against *Rhizoctonia solani.* In contrast to *C. aquaticum, B. rhombica* showed maximum inhibitory effect against *F. solani* and *R. solani,* while least effect was seen against *F. oxysporum*.
Keywords: Antifungal, Aquatic hyphomycetes, Agar well method, Plant pathogens

OP-I-13 ESSENTIAL OILS AND THEIR NANOFORMULATION: AN ECO-FRIENDLY APPROACH AGAINST FUNGAL AND MYCOTOXIN CONTAMINATION

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Approximately 25% of the world agricultural products are reported to deteriorate due to fugal and mycotoxins contamination. Among all the known 300 mycotoxins, Aflatoxin B_1 (AFB_1) secreted by *Aspergillus flavus* is considered as more dangerous due to its hepatotoxic, teratogenic and immunosuppressive effects. In addition, AFB_1 is also recognized as class 1 carcinogen by International Agency for Research on Cancer. In this context, various synthetic preservatives are reported to be highly efficacious against molds and mycotoxins. However, their indiscriminate application imposes hazardous effects on health and environment. Hence, plant based green chemicals, including essential oils (EOs) and their bioactive compounds, are of prime interest to scientists and researchers as a novel and eco-friendly approach to control fungal and mycotoxin contamination. Plant based preservatives are also categorized as Generally Recognized as Safe (GRAS) substances by U.S. Food and Drug Administration. The mechanistic investigation against *A. flavus* demonstrates ergosterol, ion leakage and methylglyoxal as their targeting mode of action. In addition, newly emerged nanotechnology also boosted the bio-efficacy of green preservatives. Therefore, EOs and its encapsulated form may be recommended as an eco-friendly, biorational plant-based preservative against fungal and AFB_1 contamination of stored food commodities.
Keywords: Mycotoxin, AFB1, Essential oils, Bioactive compounds, Nanoformulation

OP-I-14 MYCORRHIZAE INFLUENCES GROWTH OF BANANA CULTIVATION IN DIFFERENT CULTIVATION SYSTEM FROM NANDED DISTRICT, MAHARASHTRA, INDIA

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Nanded district has the largest area of cultivation for banana followed by Jalgaon district. Arbuscular mycorrhizal fungi are beneficial synergistic organisms that have a good impact on the growth vigour of Banana. A high mycorrhizal frequency (82.5%) and overall mycorrhizal rate of 27.33 percent was found in soil samples from the various field in the region. While less vigorous banana plants were identified in soils with fewer AMF spores, strong ones were found to be growing there. In terms of the quantity of spores, cultivars varied significantly as well. *Glomus, Acaulospora, Scutellospora, Gigaspora, Diversispora, Enterophora* and *Pascispora* were the most prevalent genera. The field banana revealed no distinct differences in the diversity indices richness, abundance, and Shannon H.
Keywords: Mycorrhizae, Banana, Vigor.

PP-I-01 TRADITIONAL CULTURE AND CULTIVATION OF EDIBLE MUSHROOMS AND THEIR MEDICINAL USES

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Mushrooms are globally appreciated for their nutritional value and medicinal properties. The cultivation is an effective bioconversion technology of transforming waste and woods into potentially valuable resources, and could also be an important part of sustainable agriculture and forestry. Jharkhand state in India has the advantage of favourable agro-climate, abundance of agro-based, relatively low-cost labour, and a rich fungal biodiversity, but still has witnessed a lukewarm response in mushroom cultivation. Besides low fat and high protein and vitamin content, mushrooms are a rich source of several minerals and trace element as well as dietary fibres, emerging as a wonderful source of neutraceuticals. The reported medicinal effect of mushrooms include anti-inflammatory, antioxidant, anti-cancer, anti-microbial and anti-diabetic, with anti-inflammatory compounds comprising a highly diversified group in terms of their chemical structure. In this study an attempt has been made to provide an insight into the nutritional and medicinal properties present in edible mushrooms, and various aspects of mushroom cultivation in Jharkhand, India.
Keywords: Agriculture, Cultivation, Edible, Medicinal, Nutritional

PP-I-02 FUNGAL DISEASES OF *ZINGIBER OFFICINALE* AND ITS BIOMANAGMENT

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Zingiber officinale, a member of family Zingiberaceae, is prime perennial herb, commonly known as ginger. Ginger has several health promising benefits owing to its phytoconstituents as well as having great demand worldwide. Ginger crop is affected by several fungal diseases, namely soft rot, wet rot, leaf spot and storage rot, which are responsible for its qualitative and quantitative losses. Although, there are many fungicides available in the market to control these fungal diseases, but they have several side effects. Therefore, bio-managment of these fungal diseases is need of the hour.
Keywords: *Zingiber officinale,* Fungal diseases, Fungicides, Bio-management

PP-I-03 LEAF SPOT DISEASE OF *WITHANIA SOMNIFERA* AND MANAGEMENT

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Ashwagandha (*Withania somnifera* L. Dunal), is a high valued medicinal plant having a great demand globally. It has pharmaceutical uses, such as anti-stress, anti-cancerous, anti-inflammatory, as it is a major source of alkaloids, steroids, amino acids. However, there are number of fungal diseases viz., leaf spot, damping off, root rot and wilt, which cause quantitative and qualitative deterioration. Out of these, leaf spot is considered as a major problem, and yield losses up to 50- 60% have been reported. Therefore, an attempt has been made for isolation and biological management of leaf spot disease, under in vitro and pot trial conditions.
Keywords: *Withania somnifera*, Pharmaceuticals, Leaf spot, Biological management

PP-I-04 ANTIMICROBIAL AND PHYTOCHEMICAL SCREENING OF ETHANOLIC AND AQUEOUS EXTRACTS OF *MURRAYA* AND *CALLICARPA*

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This work aims to evaluate the antimicrobial and phytochemical potential of ethanolic and aqueous extracts of *Murraya* and *Callicarpa* against bacterial strains *Bacillus cereus, B. subtilis* and *Staphylococcus aureus,* and fungal strains *Aspergillus fumigatus* and *Penicillium*

chrysogenum. Preliminary phytochemical screening was also performed along with DPPH assay to detect antioxidant activity of extracts. *Murraya* extracts displayed the presence of saponins, tannins, phenols, alkaloids, terpenoids and volatile oils whereas *Callicarpa* extracts displayed the presence of flavanoids, terpenoids, steroids, amino acids, glycosides and saponins. It was found that *Callicarpa* extracts have higher phenolics as compared to *Murraya* extracts. Both plants contain high phenolic content resulting in higher antioxidant activity. Both ethanolic and aqueous extracts of *Callicarpa* exhibit significant antibacterial activity but no antifungal activity, and ethanolic extracts were more effective as compared to aqueous extracts. Synonymous results were obtained from aqueous and ethanolic extracts of *Murraya* displaying antibacterial activity but no antifungal activity.
Keywords: *Murraya, Callicarpa*, Antimicrobial activity, Antioxidant

PP-I-05 FOLIICOLOUS FUNGI FROM KATARNIAGHAT WILDLIFE SANCTUARY, BAHRAICH, UP

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The leaves provide a very suitable habitat for the growth and development of fungal pathogen by providing ample surface area and nutrient supply. Such leaf inhabiting fungi are known as foliicolous fungi, and the invaded area of the leaf appears as leaf spot. The weed and forest plants serve as reservoir for leaf spot pathogens. India is the one of the twelve mega biodiversity countries of the world, with two of the worlds eighteen biodiversity hot spots located in the Western ghats and in the Eastern Himalayas. Katarniaghat Wildlife Sanctuary Bahraich belongs to Northern Tarai Region. 60 medicinal plants were collected during survey and 30 plants representing 25 genera within 20 families were found infected with 20 fungal species. Four plants each were infected with *Alternaria* sp. and *Cercospora* sp. *Phoma* sp. was found on *Glycosmis pentaphylla*, *Teliocora* sp. and *Mallotus philippensis*. *Meliola* was recorded on *Mallotus philippensis* and *Rungia* sp. Rest were found on single host.
Keywords: Foliicolous fungi, Katarniaghat, Tarai region, Medicinal plants

PP-I-06 *IN SILICO* DRUG TARGETING AGAINST *EREMOTHECIUM GOSSYPII* USING PLANT-BASED BIOACTIVE COMPOUNDS

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The present study reports the findings of drug targeting studies performed to identify the active plant-derived molecule against the fungus *Eremothecium gossypii* responsible for stigmatomycosis in cotton. Initially, the essential genes in *E. gossypii* were predicted by training the machine classifier employing the data from *S. cerevisiae* using 17 different genome features. Later, the essential genes whose products are localised in the plasma membrane were identified for molecular docking using six drugs viz., azadirachtin,

cleistanthin A, cleistanthin B, daturine, embelin and nicotine. The molecular docking was performed using Autodock Vina software. The maximum interaction was found between cleistanthin B and plasma membrane ATPase of the pathogen. Thus, cleistanthin B can be investigated further to develop a fungicide against *E. gossypii*.
Keywords: BLAST, Essential genes, Machine learning, Molecular docking

PP-I-07 INDUCTION OF SYSTEMIC ANTIVIRAL RESISTANCE BY A PLANT PROTEIN AND CHEMICALS

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Plant virus infections, difficult to control, necessitate novel approaches. Systemic acquired resistance (SAR) is activated in hosts by pathogen infection, or through chemicals such as salicylic acid (SA) and Benzothiadiazole (BTH). Efficiency of resistance induction in *Nicotiana tabacum* cv. White Burley against TMV was compared using SA, BTH and CIP-29, an antiviral resistance inducing protein isolated from leaves of *Clerodendrum inerme*. Progression of mosaic symptoms, detection of TMV coat protein, and expression of pathogenesis-related (PR) protein genes, chitinase and lignin-forming peroxidase, was determined at 14 dpi. 50% disease incidence was noted in CIP-29 treated set compared to SA and BTH treated sets, with undetectable viral RNA in resistant plants. PR-protein genes were maximally expressed by the pathogen, followed by chemical treatments. Chitinase gene expression was not observed in CIP-29 and DW-treated sets. SA treatment scored over CIP-29 and BTH in growth promotion.
Keywords: Systemic resistance, CIP-29, Salicylic acid, Benzothiadiazole, TMV

PP-I-08 ANTIBACTERIAL ACTIVITY AND PHYTOCHEMICAL ANALYSIS OF *RICINUS CUMMUNIS*

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Ricinus cummunis, commonly known as "Castor", is an arid plant possessing antibacterial, antifungal, analgesic, anti-inflammatory and antipyretic properties. In the present study, antibacterial activity of root, leaf, flower, and fruit of *Ricinus cummunis* was tested against some pathogenic bacteria viz *Staphylococcus aureus*, *Bacillus subtilis*, *Agrobacterium tumefaciens*, *Pseudomonas putida*, *Pseudomonas syringae*, *Enterobacter aerogenes* and *Escherichia coli.* Aqueous, ethanol, chloroform and petroleum ether extracts exhibited significant antibacterial activity, and highest activity was observed in petroleum ether extracts of fruit and leaves against *E. coli* and *A. tumefaciens*, respectively. The phytochemical

analysis showed the presence of terpenes, phenols, flavonoids, alkaloids and tannins in different plant extracts.
Keywords: *Ricinus communis*, Antibacterial, Phytochemical analysis, Plant extract

PP-I-09 OCCURRENCE OF GASTROID FUNGUS *BROOMEIA CONGREGATA* IN INDIAN THAR DESERT, RAJASTHAN

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During a survey of macro-fungi from diverse regions of Indian Thar desert, a gastroid fungus was found growing in the Botanical Garden of Jai Narain Vyas University, Jodhpur. The morphological features (Basidioma and spore sac), microscopic characteristics viz. gleba, columella, capillitium threads and basidiospore etc. were recorded. Spore and spore wall ornamentation were studied under scanning electron microscopy (SEM). The molecular marker ITS-5.8S rRNA gene sequences were constructed/generated and compared with that of available rRNA gene sequences of gastromycetous fungi. The taxonomical descriptions and molecular identification validated *Broomeia congregata Berk.* as a new record from great Indian Thar Desert, Rajasthan. The ITS-5.8S rRNA gene sequences were assigned GenBank accession number MK208821 as type sequence that represented DNA barcode. The type specimen has also been deposited in the HCIO at IARI, New Delhi (accession number 52181).
Keywords: Gastroid fungus, *Broomeia congregata*, ITS-5.8S rRNA, Thar desert

PP-I-10 ANTIBIOGRAM COMPARATIVE STUDY OF *EUPHORBIA THAMIFOLIA* L. AND *JATROPHA CURCUS* L. AGAINST VARIOUS PATHOGENS

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Two plant species belonging to the Euphorbiaceae family, used as traditional medicine and found in Dalma Range of East-Singhbhum district of Jharkhand, are evaluated for antibacterial and antifungal activity using agar diffusion method. The plants used for antimicrobial outcome are *Euphorbia thamifolia* L. and *Jatropha carcus* L. The powdered leaf materials of these two selected plants were extracted with methanol, and solvent extracts were evaporated to dryness with the help of rotary evaporator. Remaining dry residue was dissolved in methanol, Ethanol, Acetone and distilled water. Antimicrobial potential of these two plants has been evaluated against bacterial atrains *Staphylococcus aureus* and *Escherichia coli,* and fungal strains *Candida albicans* and *Trichophyton* species.
Keywords: Antibiogram, Traditional medicine, Antimicrobial

PP-I-11 *FUSARIUM* WILT IN PIGEONPEA (*CAJANUS CAJAN* L.) AND ITS BIOCONTROL APPROACHES.

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Pigeonpea (*Cajanus cajan*), a member of family Fabaceae, is an important legume crop. Seeds are rich in proteins, amino acids, vitamins, and important minerals. Additionally, pigeonpea is susceptible to *Fusarium* wilt, a soil borne disease, that causes severe yield losses throughout the growing area. Classical methods like fungicides are recommended for the control of this disease, but ample uses of fungicides have various disadvantages. Under these circumstances, biocontrol approaches involving use of bioagents, namely *Trichoderma harzianum, Pseudomonas fluorescens,* etc., are gaining importance in sustainable management of *Fusarium* wilt, and growth promotion of pigeonpea in a manner.
Keywords: *Cajanus cajan*, *Fusarium* wilt, Fungicides, Biocontrol approaches.

PP-I-12 EVALUATION OF ANTIBACTERIAL ACTIVITY OF *BACOPA MONNIERI* (L.) PENNELL AGAINST *STAPHYLOCOCCUS AUREUS*

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Foodborne bacterial pathogens include *Staphylococcus aureus*, *Escherichia coli*, *Listeria monocytogenes, Klebsiella pneumonae,* and *Salmonella typhi*. Antimicrobial studies along with phytochemical screening were carried out on traditional plant *Bacopa monnieri* (L.) against *S. aureus.* Chloroform extract of plant exhibited highest antibacterial activity with inhibition zone of 16.33±0.58 mm and was comparatively higher than tetracycline drug (12.0±0 mm). Petroleum ether and aqueous extracts were found to be ineffective against *S. aureus*. Chloroform extract also possessed highest extraction yield (14.72%) value when compared to other plant extracts. Phytochemical screening on *B. monnieri* (L.) suggested the presence of some important phytochemical groups.
Keywords: Food-borne illness, *Bacopa monnieri*, Herbal-based antibacterial agents.

PP-I-13 ROLE OF METAL TOLERANT RHIZOBACTERIA ISOLATED FROM MINES IN ECO-REMEDIATION OF CADMIUM BY *BRASSICA JUNCEA*

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Plant growth promoting rhizobacteria (PGPR) play a supporting role in promoting the

mobility and availability of heavy metals to plants through the release of chelating agents, acidification, phosphate solubilization, growth promoting substance and redox changes, ultimately boosting the effectiveness of phytoremediation processes. Four (SMHMZ2, SMHMZ4, SMHMP4, and SMHMP23) out of 91 isolates obtained from rhizosphere soil of mines and landfills showed better tolerances to cadmium, hence were used for phytoremediation study employing *Brassica juncea* as the host. SMHMZ4 treatments significantly improved seed germination of *B. juncea* and increased the soluble heavy metals in soil by 7.78-fold. The growth and health parameters, pigmentation, and metal accumulation in the roots and shoot of *B. juncea* cultivated on soil contaminated with $CdCl_2$ were significantly boosted by SMHMZ4.

Keywords: PGPR**,** Heavy Metal, Phytoremediation, Bioconcentration Factor

PP-I-14 SEASONAL VARIATION IN AMF SPORE POPULATION IN THE RHIZOSPHERIC SOIL OF SOME MEDICINAL PLANTS GROWING IN PRAYAGRAJ AND ADJOINING AREAS

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Arbuscular mycorrhiza fungi (AMFs) are a group of soil-dwelling fungi that form symbiotic associations with plants. The present study was undertaken for assessing the AM fungal spore population and their seasonal variation in five different selected medicinal plants, namely *Withania somniferun, Rauvolfia serpentina, Andrographis paniculata, Ocimum sanctum, Chlorophytum borivilianum*, growing in Prayagraj and adjoining areas. Five genera (29 species) of AM fungi were identified, viz. *Glomus*, *Acaulospora*, *Gigaspora, Scutellospora,* and *Funneliformis*. *Glomus geosporum*, *A. scrobiculata*, *G. etunicatum*, *F. mosseae*, and *G. constrictum* were the prevalent species. The AMF spore diversity varied according to the plant and season, maximum diversity was observed in rainy season followed by winter and summer season for all the selected plants. The AM fungi spore density ranged from 29 to 180 per 10 g of air-dry soil.

Keywords: AM fungi, *Glomus*, Medicinal plants, AMF spore diversity

PP-I-15 REVIEW ON MYCO-ENDOPHYTES FROM *AEGLE MARMELOS* AND *MURRAYA KOENIGII* LEAVES

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Endophytes have been categorized as species of microbes residing inside the plant tissues but not causing any apparent infection or harm to the plant. They are said to produce many valuable metabolites which maybe similar to their host plants. Family *Rutaceae* is medicinally and economically significant worldwide. The myco-endophytes from members of this family are known to produce various phytochemicals. For the present study, *Aegle marmelos* (L.)

Correa and *Murraya koenigii* (L.) Spreng. leaves were selected. A systematic review with respect to the diversity of fungal endophytes isolated from the selected medicinal plants was carried out. Most papers showed use of molecular taxonomy for identification using 18S rRNA sequencing method. Several pathogenic fungi were found to be inhabiting the said plants as endophytes during the review.
Keywords: Myco-endophytes, *Aegle marmelos*, *Murraya koenigii*, 18S r-RNA sequencing

PP-I-16 SECONDARY FUNGAL DIVERSITY ASSOCIATED WITH LICHENS: A CASE STUDY FROM INDIA

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The lichen is a stable and self-supporting symbiosis between fungi (mycobionts) and photoautotrophic algal partners, namely green algae and/or cyanobacteria (photobionts/cyanobionts). Since the mycobiont is unique in the symbiotic association and usually dominates it, lichens are traditionally classified as a fungal life form. In addition to the mycobiont of the lichen, the thallus is usually home to endolichenic fungi (asymptomatic, cryptic microfungi that live inside the thallus in close association with the photobiont) and lichenicolous fungi (symptomatic fungi which resides outside the thallus). In the present paper I will provide the first thorough assessment of secondary fungal diversity associated with lichens of India, their biodiversity, secondary metabolites, and associated bioactivity.
Keywords: Lichenized fungi, New species, Novel compounds, Secondary fungi

PP-I-17 IMPACT OF ORGANIC COMPOST FOR THE GROWTH OF SAPROPHYTIC EDIBLE FUNGI FOR SUSTAINABLE AGRICULTURAL

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Mushrooms are nowadays considered as full source of nutrition for day today life. It is produced from lignocellulosic biomass and several synthetic fertilizers. Despite their seemingly quick impact on growth, synthetic fertilizers can seriously deplete the nutritional content of foods as well as cause serious health problems. Considering these adverse effects, the current work focuses over the usage of organic medium as compost with combination of several barns, seed cake, saw dust and eggshells in straw for the growth of edible saprophytic fungi. In addition to compost, the casing soil required for fruiting body formation. Two edible mushrooms *Agaricus bisporus* (J.E. Lange) Imbach and *Pleurotus ostreatus* (Jacq. Ex fr.) P. Kumm were selected for mass production using organic additives

to boost rural economy.
Keywords: Organic, Compost, Saprophytes, Mushrooms, Sustainable

PP-I-18 *IN-VITRO* CONSERVATION AND COST-EFFECTIVE GREEN SYNTHESIS OF SILVER NANOPARTICLES FROM ENDANGERED PLANT *WITHANIA COAGULANS* DUNAL HAVING ANTICANCEROUS PROPERTIES

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Intense, fast rate shoot multiplication has been achieved utilizing thin cell layer explants for endangered pharmaceutical plant *Withania coagulans* Dunal of family Solanaceae having high hypoglycemic potential. Silver nanoparticles have been synthesized utilizing *in-vitro* grown leaf extract of *W. coagulans* Dunal that reduces silver nitrate solution and synthesized silver nanoparticles. Further the validation of silver nanoparticles has been carried out as antioxidant, antibacterial and anti-cancer agent against cervical cancer hypertriploid SiHa cell lines. Cumulative results showed that *W. coagulans* plant extract silver nanoparticles were spherical in shape, with an average size of 14 nm. X-ray diffraction pattern showed face centered cubic structure of silver nanoparticles and, according to Debye-Scherrer equation, calculated size was determined as 10.75 nm. Synthesized nanoparticles showed greater antioxidative property than *W. coagulans* plant leaf extract. In our finding we also observed apoptosis after 48 h incubation of SiHa cells with 13.74 µg/ml (IC_{50}) concentration of silver nanoparticles. These results concluded that *W. coagulans* leaf extract have potential as bio-reducing agent for synthesis of silver nanoparticles, which can be exploited as antioxidant, antimicrobial and anti-cancerous agent.
Keywords: *Withania coagulans*, Silver nanoparticles, Green synthesis, Antioxidant

PP-I-19 ANTIMICROBIAL ACTIVITY OF *PIMPINELLA ANISUM* L. ESSENTIAL OIL AGAINST *TRICHOPHYTON MENTAGROPHYTES* AND ITS MODE OF ACTION

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The present study evaluates the composition, antifungal activity and mechanism of action of *Pimpinella anisum* essential oil (PAEO) against pathogenic Dermatophyte (*T. mentagrophytes*). PAEO from the plant aerial parts was obtained by hydro distillation followed by chemical profiling by GC-MS with a flame ionization detector. The minimum inhibitory concentration (MICs) was determined according to disk diffusion method and minimum fungicidal concentration (MFCs) was determined by incorporating various

concentrations of PAEO in Sabouraud dextrose agar. The PAEO caused complete inhibition of mycelia growth and death of mycelia at 0.04 and 0.14 µL/mL, respectively. In addition, the PAEO reduced the ergosterol content of fungal plasma membrane and enhanced the leakage of vital cellular ions along with the loss of 260 and 280 nm suggesting plasma membrane as action site. The PAEO also showed moderate free radical quenching activity during DPPH assay. The high antifungal activity of PAEO may confirm its utility as a novel alternative to synthetic drug.

Keywords: *Pimpinella anisum* L. essential oil, *Trichophyton mentagrophytes*, Antifungal, Ergosterol inhibiting, Antioxidant

PP-I-20 MECHANISTIC INVESTIGATION OF CHEMICALLY CHARACTERIZED *MENTHA ARVENSIS* ESSENTIAL OIL ON MITIGATION OF *ASPERGILLUS FLAVUS* AND AFLATOXIN B_1 IN STORED DRY RED CHILIES

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The stored dry red chilies often get deteriorated due to presence of *Aspergillus flavus*, which secretes a carcinogen aflatoxin B_1. We have isolated most toxigenic strain of *A. flavus* (AF LHP Teja-2) from stored dry *Capsicum annuum* (Teja variety). The MAEO exhibited antifungal, antiaflatoxigenic and antioxidant potential. Herein, we investigated the efficacy of essential oil on fungal plasma membrane as target site which showed the reduction of ergosterol content, enhanced leakage of vital cellular ions in addition to the loss of absorbing materials. In conclusion, the investigation showed promising preservative potential of MAEO against the *A. flavus*, AFB_1 production and also shed light on it as a shelf-life enhancer of stored food products.

Keywords: Mentha arvensis, Essential oils, Methylglyoxal, Aflatoxin B_1, Biodeterioration, Antifungal, Antiaflatoxigenic

PP-I-21 ISOLATION AND IDENTIFICATION OF MYCOFLORA FROM RHIZOSPHERE OF CHICKPEA

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A study was undertaken with an objective to study microbial interaction between wilt of chickpea causing pathogen, *Fusarium oxysporum*, and other rhizospheric fungi. A total of eight genera, including 25 species, have been isolated from the rhizosphere of chickpea. The genera comprised *Alternaria*, *Aspergillus, Mucor, Rhizopus, Fusarium, Penicillium, Trichoderma,* and *Curvularia*.

Keywords: Rhizosphere, Chickpea, Mycoflora, *Fusarium*

PP-I-22 DEVELOPMENT OF RAPID NOVEL DETECTION ASSAY FOR *DICKEYA DADANTII* BASED ON LOOP-MEDIATED ISOTHERMAL AMPLIFICATION

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Dickeya dadantii is a devastating plant pathogen. In the present study, *D. dadantii* has been detected with hydroxynaphthol blue dye (HNB), using loop-mediated isothermal amplification of DNA (LAMP) based on the Indigoidine gene. The LAMP reaction provided more rapid and accurate results, amplifying the target pathogen at an optimal temperature of 63°C for 45 min. The sensitivity and specificity of the LAMP assay developed in the study was 10-3 ng mL^{-1}, which was more sensitive than conventional PCR. When HNB dye was added prior to amplification, samples with *D. dadantii* DNA developed a characteristic sky-blue color. The results of the HNB staining method were reconfirmed when LAMP products were subjected to gel electrophoresis. The assay developed in this study can be valuable for rapid point-of-care detection, which is imperative for quarantine, eradication, disease management, and border protection, permitting early detection and prediction of disease and reducing the risk of epidemics. The LAMP assay can be used to test crude extracts prepared directly from symptomatic lesions.
Keywords: *Dickeya dadantii,* loop-mediated isothermal amplification of DNA, LAMP, hydroxynaphthol blue dye

SECTION II

ALGAE, BRYOPHYTES AND PTERIDOPHYTES

OP-II-01 EVALUATION OF THE ORNAMENTAL VALUE AND ECONOMIC POTENTIAL OF FERN-A CASE STUDY

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A survey of ferns for evaluation of ornamental worth and economic potential was conducted in three major cities *viz.* Varanasi, Gorakhpur, and Lucknow of Uttar Pradesh during the year 2021-2022. Collected plant samples were identified morphologically. Information was gathered about the source of origin of the ferns, their supply chain, and distribution to different florist shops and plant nurseries through flower and foliar markets. The present contribution provides an insight into the methods for evaluation of the economic potential of ferns, alongside a comparative analysis of their economic value in terms of the price per frond in different cities.

Keywords: Pteridophytes, Ornamental ferns, Economic potentials, Indoor plants, Aesthetic

OP-II-02 AN ASSESSMENT OF ASEXUAL DIASPORES PRODUCING BRYOPHYTES OF MUKTESHWAR AND SURROUNDINGS

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Bryophytes are well known to reproduce asexually by producing variety of diaspores. During bryodiversity analysis in and around Mukteshwar area, 28 gemmiferous bryophytic species belonging to 13 different families were recorded. Colourful variety of asexual propagules ranging from unicellular to multicellular, rhizoidial to filamentous forms were encountered. Interestingly a multicellular, filamentous gemmae producing pleurocarpous moss, *Pylaisiadelpha capillacea* (Griff) B.C. Tan & Y. Jia turned out to be the new record for Western Himalayan moss flora. Stick type protonemal gemmae were observed in a famous "copper moss" *Scopelophila cataractae* (Mitt.) Broth. Asexual propagules may be useful as an interesting tool for identification of bryophytes.

Keywords: Copper moss, Gemmiferous bryophytes, *Pylaisiadelpha capillacea*

OP-II-03 BRYOPHYTES OF ARALAM WILDLIFE SANCTUARY IN THE WESTERN GHATS OF KERALA

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Aralam Wildlife Sanctuary, the northernmost Wildlife Sanctuary in Kerala, is rich in bryophyte diversity. A total of 165 bryophyte taxa from 102 genera and 47 families are now recorded from the Sanctuary. *Mitthyridium cardotii (*M. Fleisch.) H. Rob., *Radula acuminata* Steph., *Cololejeunea sigmoidea* Jovet-Ast et Tixier and *C. trichomanis* (Gottsche) Besch. are new additions for Kerala.

Keywords: Aralam Wildlife Sanctuary, Bryophytes, Distribution, Kannur, Western Ghats

OP-II-04 DIVERSITY OF MOSSES IN MIXED OAK-CONIFER FOREST AT NAINA PEAK, NAINITAL

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The aim of the present Bryo-exploratory study is to document the existing mosses flourishing in diversified habitat and micro-habitat offered by mixed Oak conifer forest (2100-2600m) at Naina peak, Nainital, Uttarakhand, India. In all, 96 species of mosses (51 Acrocarpous and 45 Pleurocarpous) spreading over 64 genera belonging to 28 families have been documented. Interestingly, 14 mosses turned out to be gemmiferous. One of the mosses, *Mawenzhangia thamnobryoides* is being reported as new genus and species from India. Due to rapidly increasing anthropogenic activities the existing bryo-vegetation is changing drastically. The present documentation of moss diversity will be useful for future multi-dimensional studies.

Keywords: Bryo-diversity, Mosses, Acrocarpous, Pleurocarpous, Gemmiferous

OP-II-05 BRYOPHYTE DIVERSITY AT SUHELWA WILDLIFE SANCTUARY, UTTAR PRADESH

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During the explorations at Suhelwa Wildlife Sanctuary (SWLS), Uttar Pradesh, 55 taxa of bryophytes belonging to 27 genera of 16 families have been identified for the first time. The study has revealed 21 mosses viz., *Barbula flavicans* D. G. Long, *Brachymenium bryoides* Schwägr., *Ditrichum tortuloides* Grout, *Erpodium glaziovii* Hampe., *Entodontopsis nitens* (Mitt.) W. R. Buck & R. R. Ireland, *Garckea phascoides* (Hook.) Mull. Hal., *Hydrogonium pseudo-ehrenbergi* (M. Fleisch.) P. C. Chen, *H. spathulifoilum* (Dixon et P. Varde) Aziz et Vohra, *Fissidens ranchiensis*, *F. virens* Thwait et Mitt., *F. polysetulus* Gangulee and Norkett, *F. taxifolius* Hedw., *F. laxitextus* Broth. ex Gangulee, *Oxystegus stenophyllus* (Mitt.) Gangulee, *Philonotis leptocarpa* Mitten, *Ptychostomum pallescens* (Schleich ex Schwaegr.) J. R. Spence *Trematodon confermis* Mitt., *Thuidium plumulosum* (Dozy & Molk.) Dozy & Molk., *Tortula khasiana* Mitt. *Taxiphyllum giraldii* (Mull. Hal.) M. Fleisch, *Taxithelium nepalense* (Schwaegr.) Broth. and two liverworts viz., *Asterella khasiana* (Griff.) Pande, K.

P. Srivastava and Sultan Khan and *Cololejeunea latilobula (*Herzog.) Tixier as new records to Uttar Pradesh. The present paper provides an account of the mosess and liverworts with their extended range of distribution in Uttar Pradesh for the first time.
Keywords: Suhelwa Wildlife Sanctuary, Uttar Pradesh

OP-II- 06 MICROHABITAT PREFERENCES OF BRYOPHYTES IN NELLIYAMPATHY RESERVE FOREST, SOUTHERN WESTERN GHATS IN KERALA

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Nelliyampathy Reserve Forest is situated at the southern side of Western Ghats and southern-western side of Palakkad Gap. The area harbours a good variety of flora and fauna. Bryophytes are highly adaptable, surviving small sized cryptogam; that have its unique ecological and taxonomic role. It is the only group of plants which are very specific about its microhabitat niches. The availability of proper microhabitat is influencing these spore bearing plants in its succession and survival. Present study is to enumerate the specific microhabitats of bryophytes at Nelliyampathy Reserve Forest which have both the influence of Gap climatic and geographic properties and the rich biodiversity of Western Ghats.
Keywords: Western Ghats, Palakkad Gap, Nelliyampathy Reserve Forest

OP-II-07 *BRYUM TENUISETUM* LIMPR. NEW TO INDIA

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Bryum tenuisetum Limpr. is an acrocarpous moss belonging to family Bryaceae. The species has been identified during survey and investigation of mosses of Garhwal Hills, Uttarakhand, Western Himalaya which constitutes a new record for Indian sub-continent. Earlier, this species was reported from Europe (Hungary) and North America (New York). Presently, the species is being reported from Pandukeshwar in Chamoli district, Uttarakhand, Western Himalaya. The species is an unbranched, erect growing, yellowish-brown plant, characterized by distantly arranged leaves and by presence of Rhizoidal tubers. Leaves are ovate- lanceolate in shape with single costa which is strong and excurrent. Leaf margin is serrulate in the upper $1/3^{rd}$ part of the leaf. Leaf cells are smooth, elongated and rhomboidal. Rhizoidal tubers are large, globose, angular and yellowish-brown in colour.
Keywords: Bryophytes, Mosses, Acrocarpous, Bryaceae, *Bryum tenuisetum* Limpr.

OP-II-08 AN OBSERVATION ON ABNORMAL CELLULAR ORGANIZATION IN SOME BRYOPHYTES

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Occurrence of abnormal cellular organization in four mosses and one leafy liverwort encountered during the course of identification of bryophytes collected from Gairsain and surroundings areas (altitude) of Garhwal Himalayas is being reported for the first time. Although, a comprehensive analysis of the encountered abnormality has apparently not been made, but it is suggested that these abnormalities may be due to physical injury, sudden change in the availability of nutrients and water content, rapid climate change or genetic factors. These preliminary findings will open a new line for future research.
Keywords: Abnormal, Bryophyte, Cellular organization, Garhwal Himalayas

OP-II-09 PRELIMINARY STUDY ON THE TAXONOMY AND SPECIES RICHNESS OF FERNS AND FERN-ALLIES (PTERIDOPHYTES) IN WEST KAMENG, ARUNACHAL PRADESH

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West Kameng district in Arunachal Pradesh ranges from a quite low altitude to 15000 feet with an average annual rainfall of 1607.4 mm, -3°C to 25°C temperature, 80.72% relative humidity, and harbors incredibly diverse floristic richness. As such, there was no attempt to botanize the pteridophytic flora of the area. In view of the above, a floristic survey and quantitative analyses of the pteridophytes from three different circles *viz.* Bhalukpong (698 ft), Dirang (5118 ft), and Bomdila (7923 ft) of the district were made. A preliminary taxonomic study and quantitative analyses of the data have revealed the occurrence of 57 species, 31 genera, and 22 families. The present contribution provides a preliminary taxonomic account, distribution pattern, and species richness at three variable altitudinal ranges with various environmental factors.
*Keywords***:** Floristic richness, Taxonomy, Diversity, Distribution pattern, Species richness

OP-II-10 ECOLOGICALLY SIGNIFICANT MICROBIOTA AND THEIR INTERACTION WITH ABIOTIC CONSTITUENTS: STUDY FROM BIHAR, INDIA

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A study of sixty-six water samples from the different aquatic environments, with nutrients such as nitrate, phosphate, and biogenic silica, in Bihar, India, was carried out to investigate the algal community of Cyanophyceae, Chlorophyceae, and Bacillariophyceae (diatoms), so as to ascertain the extent of their biological diversity. Significant outcomes were found wherein the diatoms were correlated with biogenic silica, while the Cyanophyceae closely interacted with nitrate and pH. The Chlorophyceae group was well associated with low nutrients and require pristine water conditions. Thus, the entire study suggests the varying role of nutrients in the diversity and development of ecologically sensitive microbiota.
Keywords: Aquatic environments, phosphorous, nitrogen, Cyanophyceae, Chlorophyceae, Bacillariophyceae

OP-II- 11 IMPACT OF *SPIRULINA* ADMINISTRATION ON RURAL WOMEN HAVING ITCHING PROBLEM ON SKIN

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A clinical study was carried out to find out the impact of *Spirulina* administration on the rural women suffering from itching problem. Periodic blood biochemistry revealed significant increase in haemoglobin (Hb), Total Red blood Corpuscles Count (TRBC), and High Density Lipoprotein- Cholesterol (HDL-C), with simultaneous decrease in Erythrocyte Sedimentation Rate (ESR), Total Cholesterol (TC), and Triglycerides (TG), Low density lipoprotein cholesterol (LDL-C), Very Low density lipoprotein cholesterol (VLDL-C) and Blood Sugar. This overall impact on blood biochemistry may be the possible cause to cure the itching problem. Mechanism of this impact of *Spirulina* administration will be discussed in detail.

OP-II- 12 HYPOCHOLESTEROLEMIC EFFECT OF *SPIRULINA* ADMINISTRATION ALONG WITH *PROSOPIS CINERARIA* IN ATHLETES

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Prosopis cineraria (Fabaceae) is known as Khejri in India or the golden tree of Indian deserts. Its potential as a dietary supplement in sports nutrition and its effect on regulating lipid profile has never been investigated. *Spirulina* is a superfood with high nutritional value and is a popular supplement among athletes. In the current study, *Spirulina* and Khejri were used as supplements by cricket players to improve their physical fitness and lipid profile. Our results show that Cholesterol and Triglyceride levels were significantly decreased pre- vs.

post-intervention by Khejri and Spirulina supplements in cricket players.
Keywords: Prosopis cineraria, Spirulina, Sports Nutrition, Khejri

OP-II-13 ANTIFUNGAL ACTIVITY OF TWO LEAFY LIVERWORTS AGAINST THREE PLANT PATHOGENIC FUNGI

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Bioactivity of bryophytic extracts is one of the most required areas of research due to their rich bioactive potential. Antifungal activity of selected leafy liverworts was tested against the phytopathogenic fungi viz, *Fusarium oxysporum, F. solani* and *Rhizoctonia solani* by using Agar Well Diffusion method. The extract of *Plagiochila asplenioids* and *Heteroscyphys hyalinus* were prepared in different solvents (ethanol, methanol, acetone and chloroform). Interestingly, the ethanol and acetone extracts were found most effective, followed by methanol and chloroform. The percent inhibition activity was also compared by using carbendazim. The antifungal activity of *P. asplenioids* and *H. hyalinus* against selected fungi is being reported for the first time.
Keywords: Antifungal activity, Bioactive**,** Extract, Liverworts, Phytopathogens

PP-II-01 GRID-BASED QUANTITATIVE ANALYSIS OF PLANT DIVERSITY IN CHAMBAL RAVINES OF UTTAR PRADESH

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Chambal ravines comprise diverse vegetation on either side of Chambal River in Uttar Pradesh. A complete stretch of the ravine in Uttar Pradesh is about 154 km long, 3-10 km wide with a range of 525-345 ft. altitude. Grid-based plant resource mapping was carried out and a total of 101 Angiosperms, 1 Pteridophyte, 12 Bryophytes and 10 Lichens were observed. The study on plant resource richness along the altitudinal gradient revealed weak positive correlation of the number of species and abundance with altitudinal gradient, and negative correlation of density and frequency with altitude gradient. A comparative and quantitative analysis also revealed that maximum number of species were present between a certain range of altitudes.
Keywords: Chambal ravines, Quantitative, Species richness, Altitude

PP-II-02 FATTY ACIDS AND PHYTOCHEMICALS FROM A FERN-ALLY [*EQUISETUM DIFFUSUM* D. DON] AND A TRUE FERN [*NEPHROLEPIS CORDIFOLIA* (L.) C.PRESL] REPRESENTATIVE: AN OVERVIEW ON THEIR MEDICINAL AND NUTRITIVE STATUS TO ETHNIC PEOPLE OF DARJEELING

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A cosmopolitan population of Pteridophytes in Darjeeling indicates their significant adaptive capability. Present study is aimed at determining the metabolite content of *Equisetum diffusum,* a fern-ally and *Nephrolepis cordifolia,* a true fern, exploited for nutritive potentiality and curative purposes by local ethnic people. On comparison, total carbohydrate and protein content of *E. diffusum* is higher but the lipid content is lower; in contrast, phenolic and terpenoid content is less in its mature leaves. GC-MS analysis revealed presence of nutritionally important omega-3 and omega-6 fatty acids, like eicosapentanoic acid (20:5n-3) and arachidonic acid (20:4n-6), along with other PUFAs in both species, necessitating further exploration.
Keywords: Ferns-ally, Primary metabolites, Secondary metabolites, Fatty acids

PP-II-03 STUDY ON SPECIES RICHNESS OF PTERIDOPHYTES ALONG VARIABLE ALTITUDINAL GRADIENT IN PACHMARHI BIOSPHERE RESERVE, MADHYA PRADESH, CENTRAL INDIA

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Investigations on pteridophyte diversity along elevation gradients to understand the population ecology and environment has not received much attention. Present contribution is an attempt to study the species richness of pteridophytes along elevation gradients in Pachmarhi Biosphere Reserve. The relationship between species richness, family, genus, and species, with elevation, is also summarized to linear regression as indicated by correlation coefficients. A total of 58 species of pteridophytes belonging to 40 genera and 28 families were recorded in the present study. Maximum species richness is observed at low altitude followed by mid altitude. Noticeably, with increasing elevation there is a decline in species richness. Correlation between the family, the genus, and species richness was negatively significant, and has been discussed.
Keywords: Altitude, Species richness, Correlation, Biosphere Reserve

PP-II-04 A STUDY ON SELECTED ENDEMIC TAXA OF HORNWORTS (ANTHOCEROTOPHYTA) IN INDIA

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In India, hornworts (Anthocerotophyta) are represented by six genera and 39 species, out of which about 19 species are endemic. During a recent study on endemic hornworts the conservation status of these taxa has been assessed along with their critical morpho-taxonomical and ultrastructure study. In the present communication an account of six endemic taxa viz., *Anthoceros pandei* Udar & Asthana, *Folioceros physocladus* (Schiffn & Pande) Bharad., *F. satpurensis* K.P. Srivast. Ex Bharadwaj & K.P. Srivast., *F. dixitianus* (Mahab.) Bharadwaj, *Phaeoceros kashyapaii* Asthana & S.C. Srivast. and *P. udarii* Asthana & Nath have been provided with the details of thallus anatomy, sporoderm pattern and Pseudoelater characteristics, which play a significant role in their taxonomy.
Keywords: Anthocerotophyta, Endemic, Systematic-data, India

PP-II-05 *PLAGIOCHILA DURELII* SUBSP. *GUIZHOUENSIS* GROLLE & M. L. SO (PLAGIOCHILACEAE), NEW TO INDIA

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Genus *Plagiochila* (Dumort.) Dumort. belonging to family Plagiochilaceae (Marchantiophyta) is known to be a complex genus in terms of diversity. About 480 species of *Plagiochila* are known from Asia, while 82 species are so far reported from India. During a study on liverworts of Govind Wildlife Sanctuary (Uttarakhand), plants of *Plagiochila durelii* subsp. *guizhouensis* Grolle & M. L. SO have been identified which is a new record for India. It was earlier reported from Guizhou and Sichuan provinces of China. Distinguishing features like fragile or brittle margin of leaf with asexual propagules clearly differentiates this taxon from the other subspecies of *P. durelii*, namely, *P. durelii* Schiffner ssp. *durelii* which already occurs in India.
Keywords: Uttarakhand, Liverwort, New record, India

PP-II-06 A LEMBOPHYLLACEOUS MOSS, *MAWENZHANGIA THAMNOBRYOIDES* ENROTH, SHEVOCK & IGNATOV –NEW TO INDIA

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Mawenzhangia thamnobryoides, a monotypic, Lembophyllaceous pleurocarpous moss is being reported as a new genus and species from India. The collection was made from the acidic (pH 5.6-6.3) bark of *Cedrus* trees from Lohaghat and Nainital (1600-2300 m) areas in the Kumaun region of Western Himalaya, Uttarakhand. Earlier, this taxon was reported only from the Shangri-la region of Yunnan Province, China. Prostrate primary stem bearing frondose branches with abundant flagelliform branchlets; ecostate stipe leaves, unicostate, elliptic-ovate branch leaves with serrate margins and prorate laminal cells are the distinctive features of the moss. The present collection puts on record the new, extended distributional range of this taxon in India.

Keywords: Epiphytic, Flagelliform, Monotypic, Pleurocarpous moss, Western Himalaya

PP-II-07 SUBGENUS *PACHYFISSIDENS* (FISSIDENTACEAE; BRYOPHYTA) IN THE WESTERN GHATS, INDIA

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Fissidentaceae Schimp. are monotypic family with a cosmopolitan genus *Fissidens* Hedw. distributed mainly in the tropics. Genus *Fissidens* is divided into four subgenera *viz., Pachyfissidens*, *Octodiceras*, *Fissidens* and *Aloma.* Subgenus *Pachyfissidens* includes the most primitive species with three sections: *Pachyfissidens, Amblyothallia* and *Crispidium*. Section *Amblyothalia* contains only one species, section *Pachyfissidens* contains seven species with two subspecies and four varieties, and section *Crispidium* contains seven species with three varieties in Western Ghats. Among these, *F. crispulus* var. *nelliampathiae* is newly reported, and *F. asplenioides* and *F. taxifolius* are new records to Kerala. *F. involutus* subsp. *curvatoinvolutus* is a new record to Karnataka.

Keywords: Fissidentaceae, *Fissidens*, *Pachyfissidens*, Western Ghats

PP-II-08 CONTRIBUTION TO THE KNOWLEDGE OF *HELICOBARBULA PORPHYREONEURA* (MÜLL. HAL.) M.J. CANO. FROM INDIA-AN OVERLOOKED ENDEMIC SPECIES FROM SEMI ARID REGIONS OF RAJASTHAN

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Moss family Pottiaceae is the most species□rich moss lineage with more than 1400 species falling under 76 genera, comprising more than 10% of the moss species known from the entire world. Due to its high diversity, the taxonomy of this family and its constituent genera is very complicated and hence its generic circumscription has been the subject of continued debate. The present paper describes the occurrence of *Helicobarbula porphyreoneura* (Mull. Hal.) M. J. Cano in and around Jaigarh Fort of Jaipur, Rajasthan (India), growing luxuriantly

on the soil-covered wall of the monument. The article reports in detail the delimitation of *Pseudocrossidium* and the segregated genus *Helicobarbula*, where *P. porphyreoneurum* is currently placed, and provides a detailed taxonomic background and description of the species. Besides this, the present status of the distribution of *Helicobarbula* and *Pseudocrossidium* in India is also discussed.

PP-II-09 ADAPTIVE STRATEGIES IN SOME POLYTRICACEAE SCHWÄGR. MOSS MEMBERS OF DARJEELING HILLS

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Mosses are successful due to elastic metabolic networking. Some Polytricaeae [*Pogonatum aloides*, *P. papillosulum*, *P. hexagonum*, *Atrichum undulatum* and *A. pallidum*], collected from same ecoclimate were investigated. Phenolics, flavonoids, terpenoids, carbohydrate, protein and lipid content showed distinctive variations with species specificity in spectrophotometric analysis. Although residual water content is lower in *Atrichum* compared to *Pogonatum,* indicating differentiation in hydrome organization, the spore size is larger by SEM. Membrane lipid (Phospholipid and Glycolipid) and storage lipids were scrutinised by fatty acid profiling with GC-MS. Besides palmitic acid, members dominate with C18-compounds, signifying "angiosperm type" evolutionary trend.
Keywords: *Mosses, Darjeeling hills, Polytricaeae, Pogonatum, Atrichum*

PP-II-10 *IN-VITRO* STUDY ON REPRODUCTIVE BIOLOGY OF A THREATENED TREE FERN *CYATHEA CRINITA* (HOOK.) COPEL.

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Tree ferns (Cyatheaceae) comprise approximately 500 species globally. *Cyathea crinita* is an endemic species reported from a few localities of Kerala and Tamil Nadu, and designated as "endangered" in the IUCN category. Spores of *C. crinita* were collected from Munnar in Kerala, for *in-vitro* investigations. Processed spores were inoculated on Parker and Thompson's culture media, and kept in culture room at light intensity of 560×10 Lux (10:14 Light:Dark), 23±2°C, RH 20-30%. Present contribution provides detailed account of *in-vitro* study on spore viability, germination percentage, and the developmental pattern of gametophytes to observe the bottlenecks of free multiplication through the spores.
Keywords: *Cyathea crinita*, Endangered, *in-vitro*, Gametophyte

PP-II-11 ALGAL FLORA OF POLYTHENE DEBRIS AND STUDY OF THEIR POSSIBLE ROLE IN DEGRADATION OF POLYTHENE

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Polythene is highly damaging to the environment and for life forms because of its slow rate of degradation. The biological method of polythene degradation has emerged as the eco-friendly solution to this widespread issue of plastic pollution. From an algal bloom on polythene bags collected from various water waste sites of Ajmer, Rajasthan, ten algal species were identified. The polythene films were exposed to the algal isolates and incubated for a month before being assessed for degradation. Samples of polythene bags that underwent biological treatment were examined for weight reduction. To examine the changes in the morphological and chemical properties of the polythene samples, additional FTIR and SEM analyses were also carried out. Among the isolated algae *Oocystis, Phormidium,* and *Scenedesmus* were able to degrade the PE samples.
Keywords: Biological degradation, Polythene, *Oocystis*, *Phormidium*, *Scenedesmus*

PP-II-12 THE DIVERSITY AND DISTRIBUTION OF THE GENUS *COLOLEJEUNEA* (LEJEUNEACEAE) IN KERALA

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Cololejeunea (Spurce) Steph. is one of the largest genera of the liverwort family Lejeuneaceae having worldwide distribution. It is one of the major components of the epiphyllous liverworts of tropics. In India it is known by about 60 species and two varieties. Recent classification suggests eight subgenera under this genus due to its complex nature. The present study reports 20 species under seven subgenera, among these six are new distributional records from Kerala. Diagnostic characters and distribution of each species is provided here. Photo plates and illustration of new record of species is also provided along with specimen examined.
Keywords: *Cololejeunea*, Distribution, Kerala, Lejeuneaceae, Morphotaxonomic study

PP-II-13 STUDY OF PTERIDOPHYTE DIVERSITY USING 2 LOCUS PLANT DNA BARCODE (RBCL + MATK), AND LOCAL SCALE DISTRIBUTION PATTERN AUGMENTED WITH EDAPHIC AND ENVIRONMENTAL FACTORS

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An extensive study was undertaken to assess the relationship between pteridophyte diversity and local scale distribution and richness in the Kudremikh National Park (KNP) reserve forest in the Western Ghats, Karnataka. We first studied pteridophyte diversity using 2-locus plant DNA barcoding markers (rbcL + matK) as the Consortium for the Barcode of Life proposed. Secondly, the richness and distribution of each pteridophyte were assessed against the environmental and edaphic correlates. The results enumerated 46 different fern species belonging to 19 families in KNP, and their distribution was mapped using QGIS. The DNA Barcoding results suggested matK to be unsuitable as a secondary locus to rbcL in 2-locus plant DNA barcoding due to its low PCR amplification and sequence recovery rate (41.4%) in ferns. The distribution and richness of pteridophytes in the KNP (local scale) were closely related to edaphic factors rather than environmental factors. Principal component analysis (PCA) based Soil Quality Indexing (SQI) revealed moisture content, Copper, Potassium, and Phosphorous to be the critical soil parameters influencing the fern distribution and richness at a local scale. Significantly we report an SQI method (PCA-based minimum data set (MDS) with linear scoring and weighted additive integration method) that is well suited to study the relation between fern richness and soil quality.
Keywords: ribulose-1,5-bisphosphate Carboxylase/Oxygenase large subunit, maturase K, GIS-based mapping, Soil Quality Indexing

PP-II-14 STUDIES ON THE PHYTOREMEDIATION POTENTIAL OF AN AQUATIC FERN, *SALVINIA NATANS* (L.) ALLIONI

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The Heavy metals like Cd and Pb are serious environmental contaminants for biota. The non- costly process of removing heavy metals from the contaminated soil is phytoremediation. The present study shows that Cd and Pb are toxic to *S. natans* as shown by the toxicity symptoms such as chlorosis, decrease in the relative growth rate and biomass, pigment content, osmolyte content, and effects on antioxidant enzymes. The study

concludes that this species could tolerate Pb in their tissues better than Cd. The results indicated that *S. natans* was a moderate phytoremediator of Cd and a good phytoremediator of Pb and is also a promising biological agent in heavy metal phytoremediation.
Keywords: Phytoremediation, *Salvinia natans*, Heavy metals, Ferns

PP-II-15 ALGACEUTICALS: EXPLORING COASTAL ALGAL DIVERSITY IN INDIA FOR POTENTIAL APPLICATIONS

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Recently, algal products are being used world-wide with a tag of Neo-generation cosmetics, algaceuticals, functional food, rapid food and power packed diets full of nutrition. Since the algal culture and production require minimum setup and care in systematic manner, cultivation and production of value-added products are very common in south Asian countries. India has more than 7000 km of seacoast, however the systematic cultivation of algae is very limited to Okha coast and some parts of south India. Seaweeds have been reported to have various important uses for the purpose of human development; therefore they have a very high potential for employment generation. Seaweeds have been used successfully as food, fodder, and bio-fuel in various countries. Government of India supports seaweed cultivation programs. Under these schemes, a special focus will be laid on employment generation activities such as seaweed and ornamental fish cultivation.
Keywords: Algae cultivation, Neutraceutical, Algaceuticals

PP-II-16 EPIPHYTIC LEAFY LIVERWORT DIVERSITY ALONG THE ALTITUDINAL GRADIENT OF ANAMUDI SHOLA NATIONAL PARK IN THE WESTERN GHATS OF KERALA

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The Anamudi Shola National Park represents a large number of bryophytes unique to the high altitude shola grassland vegetation. The altitude ranges between 1600-2400 m. The forest is seen as a continuous patch from 1600 to 2200 m. Above 2200 m, the area is with small shola patches dispersed among the grasslands that are planted with wattle. The present study was carried out to assess the variability in the species diversity using appropriate quantities and statistical analysis along with the altitudinal gradients in the Anamudi Shola National Park in the Western Ghats of Kerala. A total of 35 leafy liverworts species are found as epiphytes in the study area. The analysis of diversity reveals that the species diversity in the 2001-2200 m are more compared to other zones. The dominant epiphytic species are

Lophocolea bidentata, L. minor, in altitude zone- I (1600-1800 msl), *Porella campylophylla, P. perottetiana* are in altitude zone-II (1801-2000 msl), *Frullania campanulate*, *F. tamarisci*, *Lejeunea flava* are in altitude zone-III (2001-2200 msl) and *Plicanthus birmensis, Bazzania tridens* zone-lV (2200 msl above).

Keywords: Altitudinal gradients, Anamudi Shola National Park, Epiphytic, Kerala, Leafy liverworts, Western Ghats

PP-II-17 IMPACT OF ALGAE AND ENVIRONMENT ON MONUMENTS

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India has a rich cultural heritage and a large part of it is in the form of monuments. Many algae occur frequently and spoil the affected external surface of these monuments, making them look ugly. Algae deteriorate the texture of the substratum, and renovation involves expenditure. In the present study, efforts have been made on few selected monuments and heritage sites of Allahabad, which are being deteriorated by Algae. These include Allahabad Fort, Khusrau Bagh, Senate Hall, All Saints Cathedral and certain old famous temples of Allahabad. After the survey, the algal forms from these monuments were collected and cultured in the laboratory for further study The microbial components of these crusts have been investigated and found that they contain principally cyanobacterial forms as these organisms survive on the exposed surfaces of the monuments on various substrata tolerating high solar radiation. The effect of algicides and other chemicals on their growth has also been studied, so that a method could be involved to control their unwanted appearance.

Keywords: Deterioration, Monuments, Environment, Culture

PP-II-18 MORPHOLOGICAL CHARACTERIZATION OF ASSORTED ALGAL FORMS UNEARTHED ON THE MONUMENTS OF PRAYAGRAJ

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Magnificence and beauty have consistently been the aspirations of architecture. For the creation of monuments, artists and architects utilized durable, long-lasting, and beautiful stones like natural rock. Under an array of environmental scenarios, the invasion of microorganisms and their subsequent interaction with the mineral matrix of the stone substrate accelerate the biodeterioration and biocorrosion of stones through several mechanisms leading to a loss of strength, durability, and aesthetic appeal. Here, we examined a few historical monuments in the Prayagraj district and performed innumerable morphological characterizations of the diverse algal forms that were existent there.

Keywords: Biocorrosion, Biodeterioration, Colonisation, Monuments

SECTION III

SEED PLANTS: ANATOMY, REPRODUCTIVE BIOLOGY

OP-III-01 PHYLOGENETIC STUDY ON THE MICROMORPHOLOGICAL LEAF TRAITS OF FOUR GENERA OF CYCADS DELINEATING THEIR ECOLOGICAL STATUS AND INTERRELATIONSHIP

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Cycads constitute an ancient lineage of extant Gymnosperms exhibiting a long evolutionary history since Jurrassic times. Micromorphological variations in leaf traits contributes to the diversification of the genera into different species as per their ecological conditions. The present work is a comprehensive approach encompassing studies on micromorphological traits of leaf surface in four genera and seven species viz; *Cycas* (two spp.), *Zamia* (three species), *Encephalartus* (one sp.) and Dioon (one sp.) of Cycads grown in Roxburgh Botanical Garden, Department of Botany, University of Allahabad; giving an overview of their phylogenetic and ecological relationships. Intergeneric as well as intrageneric variations in leaf traits including leaf area, dry matter content, stomatal density, leaf thickness, stomatal size and thickness of adaxial and abaxial surface was studied and the observations depicted in the form of a phylogenetic clade revealing existing phylogenetic relationships among these Cycads. The work is an insight into understanding of role of micromorphological and anatomical characters in deciphering the phylogenetic clade also ascertaining their evolutionary status and thereby contributing to the conservation of these highly threatened lineage of plants.
Keywords: Cycads, Micromorphological, Stomatal density, Phylogenetic clade

OP-III-02 LEAF AND STEM ANATOMY OF MADHAVILATA

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Hiptage benghalensis is a native of India, commonly known as Madhavilata, and belongs to family Malphigiaceae. This plant is known and is mentioned in folklore as insecticidal, cardiotonic, anti-inflammatory etc. In spite of the plant being used in herbal medicine, very little is known about its anatomy which can be useful for the identification of the plant part in herbal market. In present study, an attempt has been made to investigate anatomical features like transverse section, stomatal index, vein islet number, palisade ratio for leaves and transverse section for the stem for the said plant.
Keywords: *Hiptage benghalensis*, Stem anatomy, Leaf anatomy

OP-III-03 PALYNOLOGICAL STUDIES ON ENDEMIC SPECIES OF *IXORA* L. (RUBIACEAE, SECT. *OTOBACTRUM*) IN SOUTHERN WESTERN GHATS, INDIA

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The southern Western Ghats with an area of 7000 km^2 possesses very rich biodiversity. Among the 22 species of *Ixora* found in this region, 12 are endemic. The section *Otobactrum* is represented by 11 species in India, and five species namely, *I. agasthyamalayana*, *I. elongata*, *I. malabarica*, *I. predeepii* and *I. sivarajiana,* occur in southern Western Ghats, and are all endemic. As a part of the ongoing revisionary study of Indian *Ixora,* pollen morphology of these five endemic species is carried out using light and scanning electron microscopy. The pollen characters and their significance in the taxonomy of the genus are discussed in this paper.
Keywords: Palynology, Endemism, *Ixora*, Western Ghats

OP-III-04 STIGMA MORPHOLOGY AND ITS IMPLICATIONS IN THE BREEDING SYSTEM OF THREE SPECIES OF *INDIGOFERA* L.

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Present communication is based on three species of genus *Indigofera* of family Leguminoseae, namely *Indigofera tinctoria*, *I. heterantha* and *I. linifolia.* While *I. linifolia* is highly selfed, *I. tinctoria* and *I. heterantha* are predominantly outcrossed. Difference in their breeding system is mediated mainly by their stigmatic surface. Stigma in *I. tinctoria* have well developed trichomes and cuticle layer covering the stigmatic surface. This species needs the intervention of insect in order to disperse the trichomes as well as to disrupt the cuticle. In all the three species studied presently, insect tripped flowers show the maximum fruit set, revealing the efficiency of insects in affecting both self as well as cross pollination.
Keywords: Breeding, *Indigofera*, Legumes, Spectrum, Stigma

OP-III-05 REPORT OF THE DICOTYLEDONOUS UNILOCULAR FRUIT FROM THE DECCAN INTERTRAPPEAN BEDS OF MARAI PATAN, TALUKA-JIWATI, DIST. - CHANDRAPUR, MAHARASHTRA, INDIA

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The present paper deals with the description of a new species of petrified capsular fruit from the Deccan Intertrappean beds of Marai Patan, Tahsil-Jiwati, Dist.- Chandrapur, Maharashtra, India. The fruit is stalked, oblong, dry, dehiscent, capsular, dicot fruit with basal placentation. It does not resemble any living capsular fruit or any recorded fossil flora of Intertrappean beds except *Geraniocarpon intertrappea* (Dahegaonkar 2002) with minor differences, hence, it is named as *Geraniocarpon patanii* sp. nov. The generic name is after the capsular type of fruit *Geraniocarpon intertrappea* (Dahegaonkar 2002) and specific name indicates the name of the locality from where it was collected.

*Keywords***:** Capsular fruit, Epicarp, Cotyledons, Radicle, Embryo

OP-III-06 IDENTIFICATION OF FIVE SPECIES OF *BEILSCHMIEDIA* USING LEAF ARCHITECTURE – AN ANATOMICAL TOOL

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The genus *Beilschmiedia* belongs to family Lauracaeae. For the present study five species of genus *Beilschmiedia* namely *Beilschmiedia assamica, B. gammieana, B. roxburghiana, Beilschmiedia brandisii* and *B. fagifolia* were collected. All five species of genus *Beilschmiedia* studied show Pinnate Camptodromous festooned brochidodromous type of venation. The highest vein order is 6^{o}. Based on the secondary veins angle of divergence and angle of origin of tertiary veins, the species can be further separated. There is very little work done on the leaf architecture studies in this genus and so this present study was undertaken. The species are so intimate by their leaf morphological characters, it is often difficult to determine their nomenclature types. Hence attempt has been made to recognise the taxonomic value of laminar architecture of the species growing in India.

Keywords: Leaf architecture, *Beilschmiedia,* Pinnate Camptodromous, Festooned brochidodromous

OP-III-07 STEM ANATOMY OF INDIAN *BARLERIA* SPECIES

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The genus *Barleria* is known for its different growth forms such as herb, shrubs, climbers, and rarely tree, which shows wide range of variation in wood structure. In the present

communication, a complete study of stem anatomy of 35 taxa (28 species, one subspecies and two varieties and four forms) of Indian *Barleria* was carried out. While some species lacked rays, others showed well developed uni- biseriate, multiseriate rays and enough secondary xylem. Vessel elements were angular or oval. Xylem rays were found to be uni-biseriate and multiseriate. Interxylary phloem is distributed randomly in secondary xylem, whereas intraxylary phloem on pith side is the characteristic of all studied species.
Keywords: *Barleria*, Stem anatomy, Xylem, Phloem

PP-III-08 EXAMINATION AND ANALYSIS OF POLLEN VEGETATION OF PATNA DISTRICT IN BIHAR, INDIA

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The flora of Patna is highly diverse, hence, the aim of this study was to examine the pollen vegetation of Patna, to help in the study of plant evolution and systematics. Field survey with laboratory methods was used to prepare the list of plants. The habit and the habitat, along with other details was noted for each plant. Anther was collected, and in palynological examination, the morphology and anatomy of exine was studied. The results indicated a wide range of pollen variation with respect to their structure and morphology.
Keywords: Anatomy, Exomorphic character, Pollen flora.

PP-III-09 STRUCTURAL DIVERSITY OF LEAF IN RELATION TO PLANT REPRODUCTION

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Plants arrived earlier than animals. With lapse of time, their adaptation became more sensitive to their surroundings, population, and the atmosphere. In course of evolution leaves modified themselves into flower, hence, there is a relationship between leaf architecture and the mode of pollination. In case of distantly located dioeciously flowering plants like *Borassus flabellifer, Ricinus communis* and *Carica papaya*, leaf venation is multicostate, divergent and grooved. They evolved in such a manner that even in absence of insects, pollen grains may efficiently be dispersed, and harvested from the surrounding air currents efficiently for pollination (Anemophily), even if the air currents have few pollens grains.
Keywords: Multicostate and divergent leaves, Anemophily, Dioecious

SECTION IV

SEED PLANTS: TAXONOMY, ETHNOBOTANY AND RESOURCE UTILIZATION

OP-IV-01 CURRENT PROGRESS IN THE FIELD OF LAMIACEAE RESEARCH: A SCIENTOMETRIC ANALYSIS

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The present study aims to provide recent trends in Lamiaceae research and a historiograph network for writing a literature review on this particular subject. We employed biblioshiny, a web interface of bibliometrix, an R package, and VOSviewer for comprehensive science mapping analysis by using the metadata downloaded from the web of science Core Collection database using the search string "lamiaceae" (All fields) or "labiatae" (All fields). A total of about 9,144 documents including research articles and proceedings papers published in English language during the period from 1989 to 2021 were retrieved from Web of Science. There is an increase as well as minor decrease in annual scientific production over the period having a 11.75 % average growth rate and the most relevant author, journal, country, and institution were Baser KHC (108 articles), Phytochemistry (550 articles), Turkey (2332 articles) and University of Belgrade, Serbia (320 articles), respectively.
Keywords: R package, Bibliometrix, Biblioshiny, Lamiaceae, Labiatae, Scientometrics

OP-IV-02 ETHNO MEDICINAL PLANT DIVERSITY IN NANTA FOREST REGION, KOTA DISTRICT, RAJASTHAN

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Kota district is situated in the South-east region of Rajasthan and is well known for its floral biodiversity. The present study has been done in the Nanta forest area which is located in the Sakatpura forest range in forest division of Kota. Its coordinates are 25.197496° N latitude and 75.7931599° E longitude. This area is still unexplored but the anthropogenic activities are at their peak here. The present study reveals ethnomedicinal diversity, their identification, and medicinal uses based on the knowledge gathered from rural folk, natives, and local vaids. It is requisite to preserve the diversity of this region. In the present study, 60 species belonging to 27 families are being used as ethno medicinal sources by local inhabitants.
Keywords: Nanta, Ethno-medicinal diversity, Anthropogenic activities

OP-IV-03 CHITOSAN-BASED NANOENCAPSULATION OF *OCIMUM AMERICANUM* ESSENTIAL OIL AS SAFE PRESERVATIVE AGAINST FUNGI, AFLATOXIN B1 SECRETION, AND LIPID PEROXIDATION IN MILLETS

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Present study deals with the encapsulation of *Ocimum americanum* essential oil (OAEO) into chitosan nanomatrix. Major component of OAEO was citral (66.72%). OAEO-CsNe completely inhibited the growth and AFB1 production of *Aspergillus flavus* at 0.200 and 0.175 µL/mL, respectively. Inhibition of ergosterol biosynthesis followed by release of vital cellular ions, 260/280 nm absorbing materials, and significant reduction of cellular Methylglyoxal level in AFLHPSi-1 cells. OAEO-CsNe showed enhanced antioxidant activity and caused significant *in-situ* lipid peroxidation inhibition. Moreover, appreciative safety profile in mammalian model system strengthens its recommendation as effective green preservative to extend shelf-life of food commodities during storage conditions.
Keywords: *Setaria italica*, Aflatoxin B1, *Ocimum americanum*, Nanoencapsulation, Antioxidant

OP-IV-04 ETHNO-MEDICINAL STUDIES OF SOME COMMON PLANTS OF SERAIKELLA-KHARSAWAN DISTRICT, JHARKHAND, INDIA

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Traditional medicine has played a key role in the health systems of different ethnic groups living in remote areas of Seraikella-Kharsawan District of Jharkhand, India. Ethno medicinal study of medicinal plants of research area was done during 2020-2021. In the present study 30 species of plants growing wild in rural, urban, semi forest and forest area which are commonly used by the local people for curing different diseases like skin ailments, cough, asthma, diarrhoea, wound, piles and other common diseases is researched. Present study shows some common plant species and their scientific name, family, common name, parts used, mode of preparation and mode of administration for curing various diseases.
Keywords: Traditional medicine, Seraikella-Kharsawn, Semi forest, Preparation, Mode of administration

OP-IV-05 SOME ETHNOMEDICINAL PLANTS OF KUMBHALGARH WILDLIFE SANCTUARY, RAJASTHAN

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The Kumbhalgarh Wildlife Sanctuary is situated in the heart of Aravalli mountain range. Major forest types of the sanctuary are Dry Deciduous and Tropical Thorn forests. There are a good number of endemic as well as ethnomedicinal plants. During the present

ethnomedicinal investigation 28 plant species belonging to 19 families has been recorded. Some of them have extremely high ethnomedicinal value viz. *Anogeissus latifolia* (Roxb. ex DC.) Wall. Ex Guill & Perr., *Asparagus racemosus* Willd., *Boswellia serrata* Roxb., *Gloriosa superba* L. and *Tecomella undulata* (Roxb.) which are used to cure recovery after delivery, increase vitality, men impotency, abortifacient and abortion, respectively.
Keywords: Ethnomedicinal plants, Kumbhalgarh Wildlife Sanctuary, Rajasthan

OP-IV-06 IMPACT OF YAGYA ON HUMAN BEINGS: A HOLISTIC APPROACH

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The objective of present study was to measure the awareness of the pilgrims of Kumbh-2022, Prayagraj, Uttar Pradesh regarding the yagya and its impact on holistic human health as well as on the environment. The various parameters were taken as age, sex, education, daily routine of yagya or not, type of various plant part used in hawan samagri for observation. A number of families were found to perform yagya by using different plants resources and claimed healthier as compared to non-yagya performing individuals. Several people acclaimed happier and more energetic with positive feeling after performing yagya as a part of their cognitive test. Therefore, it can be concluded that our rituals as yagya, as resource from various plants can make lot of population healthy and wealthy with pure and clean environment.
Keywords: Yagya, Hawan, Cognitive, Kumbh, Plant resources

OP-IV-07 RESOLVING THE DISCREPANCIES IN THE DISTRIBUTION AND IDENTITY OF TWO INDIAN *GERANIUM* SPECIES

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The genus *Geranium* L. belongs to family Geraniaceae, comprising 325 species with global distribution except the lowland tropics. The genus is divided into three subgenera: subg. *Geranium,* subg. *Erodioidea* (Picard) Yeo, and subg. *Robertium* (Picard) Rouy. In India, 31 species of *Geranium* have been reported so far, with Himalaya representing major center of diversity. The sect. *trilopha* under subg. *Robertium*, is represented by three species: *G. indicum, G. mascatense* and *G. ocellatum*. The latter two, however, bear ambiguity in distribution and identification due to their alienness. Although taxonomic accounts express uncertainty about occurrence of *G. mascatense* in Indian subcontinent, Indian authors though

confident about its occurrence, don't negate its demarcation from *G. ocellatum*. Extensive field survey and herbarium data will enable to resolve existing discrepancies among the two.
Keywords: Geranium, Alienness, Distribution, Peninsular India

OP-IV-08 ETHNOBOTANICAL PRACTICES AND CONSERVATION OF PLANTS IN GAUTALA SANCTUARY

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Ethnobotanical practices are common among the tribal people. Traditional use of plants plays a significant role in the life of local people, especially treatment of various common ailments. India is rich in its floristic wealth. In folklore, common among tribal people, undocumented traditional knowledge is transmitted orally from one generation to other. The present study is based on the conservation of disappearing traditional knowledge of Ethnobotanical practices of tribal people of approximately 21 villages of Gautala Sanctuary, Aurangabad conducted in 2019-2020. Study was focused on various uses of plants by local people. Study documented the usage of plants for various purposes, especially ethnomedicine, ethnoveterinary and other resolutions. Plant samples were collected, and the herbarium was deposited in the Herbaria of Maulana Azad College, Aurangabad. Furthermore, the rare plants were tried to be conserved by in-situ and ex-situ methods.
Keywords: Ethnobotanical, Traditional uses, Ethnomedicine, Ethnoveterinary, In-situ, Ex-situ

OP-IV-09 AMELIORATIVE STUDIES OF *ACTINODAPHNE HOOKERI* MEISSN. ON CHICK EMBRYO

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It is a well-known fact that traditional systems of medicines have played an important role in meeting the global health care needs. India has the unique distinction of having recognized systems of medicines which are - Unani, Homeopathy, Siddha, Yoga, Naturopathy and Ayurveda. Existing drugs are not adequate and give rise to numerous side effects. A safer alternative therapy is the need of the hour for which therapeutic resources are being considered. The embryo protective and ameliorative effect of hydro-alcoholic extracts of leaf of *Actinodaphne hookeri* Meissn. in Metformin induced toxicity in chick embryos was investigated. The leaf extract of *Actinodaphne hookeri* was administered into chick embryos

6 hours prior to administration of Metformin. Embryo protective role of leaf extract was assessed post 48 h of incubation. Overall histological observations revealed normal histomorphology of stomach tissue without any abnormality.
Keywords: Actinodaphne hookeri, Ameliorative, Chick Embryos, Histopathology, Stomach

OP-IV-10 SUSTAINABLE ETHNOBOTANICAL USES OF WILD EDIBLE PLANTS BY THE TRIBAL PEOPLE OF SOUTH-EASTERN RAJASTHAN: A CASE STUDY

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India possesses a rich and diverse variety of plant resources to meet the growing demand for plant-based perfumery and flavor items, because of the availability of wide variation in soil and climate. Hadoti, the South-eastern Rajasthan region is rich in biodiversity with variability in climatic, edaphic, and topographic features with the widest variety of biomass. Several permanent and nomadic tribes like Sahariya, Bheels, Meenas, Gadolialohars, Kalbelias, Raibaries, Banjara, Sansis and other tribal people reside in different forest patches of the study area. In the present study, documentation has been made to observe an impact on the local people and the tribes particularly the younger generation could remember their knowledge potential on the traditional culture and plants to help in the conservation, sustainable utilization, economic strategies and equitable sharing of the benefits of plant genetic resources.
Keywords: Biodiversity, Rajasthan, Tribes, Conservation

OP-IV-11 PHYLOGENY OF THE GENUS *BETULA* L. (BETULACEAE) IN INDIA INFERRED USING NUCLEAR RIBOSOMAL DNA ITS REGION AND CHLOROPLAST GENE SEQUENCES

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Betula L. (birch) is a genus of approx. 65 species, subspecies or varieties having a complex phylogeny. The genus *Betula* is represented by five taxa such as *B. alnoides* Buch-Ham. Ex D. Don, *B. ashburneri* McAll. &Rushforth, *B. cylindrostachya* Wall. ex Lindl., *B. utilis* subsp. *utilis* D. Don and *B. utilis jacquemontii* (Spach) Ashburner and McAll, in India, which are mainly distributed in the Indian Himalayan Region. A phylogenetic study was carried out using concatenated sequences of nrDNA ITS and cpDNA loci (*rbc*L, *psb*A-*trn*H and *trn*L-F)

using Maximum Likelihood and Bayesian analyses. *Alnus* and *Betula* formed the Betuloideae subfamily clade, and other genera like *Corylus*, *Carpinus, Ostrya* and *Ostryopsis* comprised the Coryloideae subfamily clade. *Alnus* and *Betula* clustered together, while *Corylus* showed close affinity with *Ostryopsis–Carpinus–Ostrya*, group. The genus *Ostryopsis* formed the sister group with *Carpinus–Ostrya* clade. The present phylogenetic study is in congruence with the recent taxonomical treatment of the genus *Betula*.

Keywords: Betula, ITS, CpDNA Loci, Maximum Likelihood, Bayesian Analyses, Molecular Phylogeny

OP-IV-12 EFFICACY OF *TINOSPORA CORDIFOLIA* STEM IN THE TREATMENT OF ACIDITY

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Tinospora cordifolia is a well-known and excellent medicinal plant belonging to the family Menispermaceae, generally used for fever treatment. It is also called 'Giloy' or 'Amrita' in Hindi and 'Tinospora' in the English Languages. In present study, we observed that *Tinospora cordifolia* stem extract and decoction play an important role in the treatment of acidity. After taking decoction or extract two times daily, acidity was reduced within 28 days, and instead, appetite of patients increased sufficiently. SPOT, SGPT, and Bilrubin reached their normal levels within 28 days. Eventually we found that 95% patients suffering from acidity were cured due to the effect of *Tinospora cordifolia*.

Keywords: Tinospora cordifolia, Giloy, Medicinal Plant, Stem Extract

OP-IV-13 PHYTOCHEMICAL EVALUATION OF THE BIOACTIVE SECONDARY METABOLITES OF UNDER-EXPLORED AND CRITICALLY ENDANGERED SPECIES OF CURCUMA: *CURCUMA CAESIA*

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Curcuma caesia (Black Haldi), a critically endangered medicinal plant of the Zingiberaceae family, is found in the northeast, central, and southern India. The plant possesses potent antioxidant and antimicrobial properties and is traditionally used to cure leprosy, wounds, asthma, fever, cancer, menstruation problems, inflammation, gonorrheal discharges, etc. In order to determine the organic and elemental profile of the plant, the current work attempted to coalesce basic phytochemical and histochemical research with advanced phytochemical analytical techniques including FTIR spectroscopy, GC-MS, and LIBS. The study signifies the plant's pharmacological potential and encourages the sustainable use of the plant in novel drug development.

Keywords: *Curcuma caesia*, Zingiberaceae, Critically endangered, Antioxidant, FTIR, Histochemistry

OP-IV-14 SPECIES DELINEATION OF AXILLARY FLOWERED *MURDANNIA* ROYLE (COMMELINACEAE) IN INDIA BASED ON NUCLEAR AND CHLOROPLAST GENES

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Murdannia Royle, one of the largest genera of Commelinaceae (subfamily Commelinoideae, tribe Commelineae) comprises about 60 species and is distributed in the neotropics and paleotropics. Currently, the genus comprises 32 species. The genus exhibits a great diversity of inflorescence morphology resulting from the variation in the position of the main inflorescence, number of cincinni and number of flowers in each, and in the arrangement of cincinni on each node of the main inflorescence. The basic inflorescence of *Murdannia* is the many-branched pedunculate terminal thyrse, with verticillate cincinni and each cincinnus is multi-flowered. The present study focuses on the delineation of axillary flowered *Murdannia* in India based on morphological and molecular data. Molecular analyses were performed using nuclear ITS and chloroplast *rps*16 intron of all taxa except for *M. sanjappae*. Bayesian analyses were performed using MrBayes software, and ML analyses by using IQTree. The study reveals the paraphyletic origin of species with axillary flowers.
Keywords: *Murdannia,* Cincinni, Nuclear ITS, *rps* intron, Bayesian analysis

OP-IV-15 ASSESSMENT OF ESSENTIAL OIL VARIABILITY IN *JUNIPERUS* SPECIES FOUND IN WESTERN HIMALAYAN REGION OF INDIA

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The *Juniperus* species, namely *Juniperus communis* (common Juniper), *J. indica* (black Juniper) and *J. semiglobosa* (pencil cedar) are widespread at higher altitudes (1676-4572 m) in western Himalayan region of India. The hydro-distillation of aerial parts of the three species sampled from Lahaul valley, Himachal Pradesh, was carried out which yielded 3.9%, 5.0% and 3.13% pungent tinged pale-yellow essential oil, respectively (v/w air dried weight basis). Chemical composition of the essential oils was investigated by gas chromatography-mass spectroscopy (GC-MS), and a total of 74 volatile constituents accounted for ~98% of the oils were identified. The results of this study have been presented.
Keywords: Essential oil, Himalaya, Common Juniper, Terpenes, GC-MS

OP-IV-16 PHARMACOGNOSTIC, PHYTOCHEMICAL AND NUTRITIONAL STUDIES ON UNDERUTILIZED WILD EDIBLE *SMILAX ZEYLANICA*

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Smilax zeylanica Linn. a Smilacaceae member, is known for its medicinal value but remains unexplored in the context of its edibility. In tribal dominated part of Central India, its young shoots are used as vegetable for preparing dishes. The present study aims at finding out pharmacognostic, phytochemical, and nutritional of these young apical shoots. Pharmacognostic parameters like microscopy, stomatal standards and proximate analysis including dry matter (15.67%), moisture content (84.33%) and ash content (2.49%) are prominently found in our observation throughout the study. Moreover, phytochemicals like phenolics, flavonoids, tannins, saponins, alkaloids have also been clearly visible in methanolic and water extracts. The quantitative analysis reflects 1.55% phenolics, 0.66% flavonoids and 0.54% alkaloids. What is more to be noted here, nutrients like proteins, carbohydrates and minerals like calcium and iron have been found in adequate quantity in selected plant parts.
Keywords: Microscopy, Proximate, Minerals, Flavanoids, Antioxidants

OP-IV-17 STUDIES OF POLLEN GRAINS WITH SPECIAL REFERENCE TO HONEY IN DISTRICT KAUSHAMBI, U.P., INDIA

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Melissopalynology is the study of pollen contained in honey. Pollen grains are very crucial for the nutrition of honeybee. Generally, these pollen grains are collected from different types of entomophilous and anemophilous plants. This nutrition is very helpful for the survival and reproduction of honeybee. The present work throws light into the pollen composition of honey samples collected from Kaushambi and adjoining areas of U.P. This information may help the beekeeper to conserve plant resources for honey production. It is also used to determine the geographical and botanical origin of honey.
Keywords: Melissopalynology, Entomophilous, Anemophilous, Honey, Pollen

OP-IV-18 ETHNOMEDICINAL USE OF WILD VEGETATION IN TARAI REGION OF BALRAMPUR UTTAR PRADESH

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Tarai region is a good repository of wild plants that is the best source of medicine. The Terai region lies along the foothills of Himalayas covering 21 districts of Uttar Pradesh, India. Balrampur is one of them. The soil of this terai region is very fertile, clayey in composition and has high water retaining capacity. The objective of the present study is to identify different medicinal plant species. A survey of this region was conducted over the period of one year. Survey results indicates that the Asteraceae family was dominant.
Keywords: Tarai region, Medicine, Balrampur, Asteraceae

OP-IV-19 CONSERVATION, DIVERSITY, AND UTILIZATION OF N*ELUMBO NUCIFERA* (LOTUS)

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Nelumbo is among the oldest flowering plants on this planet. Lotus possesses extraordinary aesthetic, medicinal, nutraceutical, Ayurvedic, economic and ethnobotanical utilities. It is not only important in India but is highly revered in whole of South East-Asian region. The Lotus flower is said to be the centre of the universe in Hindu mythology. Use of lotus motifs in architecture has been highlighted with coloured pictorial evidences in India and abroad. All the parts of Lotus possess immense medicinal and nutraceutical properties extremely beneficial for the human health. Various applications of *Nelumbo* in bio-remediation, conservation and landscaping have been elaborated. Besides, lotus perfume is considered as the best and costliest perfume all over the world. Lotus is immortalized on stamps as well as the coins in India and various other countries. Lotus is the crop of the future because of the unique Lotus Silk and various modern applications of the "Lotus Effect" in paint as well as the textile industry. The conservation of lotus and various industrial applications will certainly help to boost the rural and urban economies and the employment generation besides conservation of aquatic resources in India and South-East Asian region. All such issues will be discussed in detail during the course of presentation.
Keywords: Lotus, *Nelumbo nucifera*, Conservation, Ethnobotanical significance, Lotus Effect

OP-IV-20 DATE SEEDS AS INGREDIENT IN THE PRODUCTION OF FUNCTIONAL FOODS

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Date seeds could possibly be used as ingredients in the production of some functional foods for human consumption by escalating the nutritional value of several food products. Date seed drink is used as a substitute for coffee beverages. Coffee-like drink made from date seeds is consumed in several Arab countries. Roasting date pits into a caffeine-free drink could provide a substitute to satisfy consumer habitual coffee drinking while mitigating caffeine related side effects (e.g., for hypertensive patients). Five different varieties of date seed (Kalmi, Sukkari, Rabia, Zahidi and Iranian) have been used for comparing their chemical composition with coffee seed. Phenolic compounds of fruit seeds, such as phenolic acids and flavonoids, have been shown to possess many beneficial effects, including antioxidant, anticarcinogenic, antimicrobial, antimutagenic, and anti-inflammatory activities, and the reduction of cardiovascular disease. We can conclude that date seeds contain high amount of phenolics, flavonoids, and reducing sugar, as compared to coffee seeds. Further, being high in antioxidant activity and lacking caffeine, they can be drunk as an alternative to coffee.
Keywords: Date seed, Functional food, Coffee, Caffeine free, Substitute

PP-IV-01 CURRENT DISTRIBUTION AND MORPHOLOGICAL VARIATION IN CITRON (*CITRUS MEDICA*)

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The citron (*Citrus medica* L., Rutaceae) is a major citrus fruit of commerce. Citron is distributed naturally in India, Myanmar, and China. It is found as wild and semi-wild in north-east India and also cultivated on a smaller scale in other warmer parts of India. Field trips were conducted to document citron's current distribution and diversity in northeast India. Citron accessions were collected from protected and reserve forests and home gardens. Significant variations were observed in habitat, habit, fruit, and seed characteristics. Fruits collected from home gardens were relatively larger than those of wild and semi wild citron, which were smaller and medium in size. The extent of morphological and habitat diversity in this native wild species of *Citrus* in India is presented here.
Keywords: Citrus medica, Genetic resource, Northeast India, Rutaceae

PP-IV-02 STUDY OF ETHNOMEDICINAL PLANTS OF BARMER DISTRICT OF RAJASTHAN

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Climate change predominantly affects the environment. Ethno-medicinal and aromatic plants have played important role in lives of every organism since ancient times. Rapid climate change, urban development, deforestation, industrial boom, over-population, pollution, shrinking forest cover, habitat loss, over-harvesting, destructive harvesting, drought and floods, are some major reasons of destroying indigenous knowledge of ethno-medicinal plants. Current study is focused on the endangered and vulnerable medicinal plants used as drug and medicine in pharmaceutical industries. This study focuses on survey, identification, awareness and conservation of endangered ethno-medicinal plants of Thar Desert of Barmer district of Rajasthan state.
Keywords: Ethno-medicinal, Endangered plants, Thar

PP-IV-03 FLORAL DIVERSITY IN THE VICINITY OF SUGAR MILL EFFLUENTS OF KISAN SEHKARI SUGAR MILL, SEMIKHERA, BAREILLY, UTTAR PRADESH

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India is one of the 17 most biodiversity-rich countries. In order to study the effect of sugar mill effluents on native flora in vicinity of the Kisan Sehkari Sugar Mill located in Semikhera, Bareilly (Uttar Pradesh), extensive field surveys were conducted. Results of the present study revealed that 50 plant species belonging to 26 families were growing luxuriantly without showing any phytotoxic effect of sugar mill effluents. Among the collected plants, maximum numbers of species belonged to the family Asteraceae, followed by Moraceae, Amaranthaceae, Fabaceae, Solanaceae, Apocynaceae, Commelinaceae, and Poaceae. Besides, two species of pteridophytes, which belonged to the family Thelypteridaceae and Pteridaceae, were also found. Further work on effect of toxic effluents of sugar mill in internal metabolic adaptation of some dominant species is under progress.
Keywords: Sugar Mill, Effluents, Floral diversity, Bareilly

PP-IV-04 EXPLORATION OF WILD EDIBLE FRUITS OF SOHELWA WILDLIFE SACTUARY, UTTAR PRADESH, INDIA

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The present investigation is based on the exploration and documentation of wild edible fruits of Sohelwa wild life sanctuary, Uttar Pradesh, situated in the Tarai region of Balrampur and Shravasti. The sanctuary is divided into seven forest ranges, most of which are home to the "Tharu" tribe and other local rural residents. This study is the result of a routine and deliberate journey to various ranges in the Sohelwa forest for the purpose of exploration and documentation. The majority of young people in the "Tharu" tribe have been found to be less interested in learning about their ethnic background and less conscious about the importance of wild edible fruits. The use of wild fruit plants by human as a source of food and medicine, is in practice since time immemorial. Therefore, accurate documentation of information based on traditional knowledge from ethnic groups is extremely important for promoting human wellbeing.
Keywords: Wild edible fruits, Tharu, Sohelwa Wildlife Sanctuary, Uttar Pradesh

PP-IV-05 BIOIVERSITY OF MEDICINAL PLANTS OF NANDED DISTRICT

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India is one of the mega biodiversity center of the world. The search for traditional knowledge and uses of medicinal plants, their pharmaceutical properties and drug development is a recent aspect of bioprospecting potential. Ethnopharmacology of medicinal plants have been drawing attention of different workers throughout the World. Therefore, study of medicinal plants from a particular geographical region is very important. Marathwada is a region of Maharashtra state and about 1700 species of flowering plants have been recorded from this region, out of which 350 species are used as medicinal plants. The present study analyzes the biodiversity of medicinal plants, especially in Nanded district.
Keywords: Medicinal plants, Traditional knowledge, Bioprospecting potential

PP-IV-06 PROSPECTS AND PROBLEMS OF LEMONGRASS CULTIVARS IN NORTH EASTERN REGION OF INDIA

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Lemongrass (*Cymbopogon flexuosus*; Family Poaceae) is an important cash crop for the farmers of North Eastern Region (NER). Approximately 2000 tonnes essential oil (EO) is produced annually, out of which about 1200 tonnes is produced from Indian states and NER. Farmers of NER, cultivate it on wasteland, slopy and rainfed areas to generate extra income and uplift their socio-economic conditions; most farmers obtain very good yield of essential oils. The EO and distilled herbage are used in several value-added products like vermicompost, scented candles, soaps and for the treatment of various diseases. However, there are several pest and diseases that affect the quantity and quality of Eos; and therefore, needs urgent management.

Keywords: Lemongrass, Essential oil, North Eastern Region, Pest and Diseases

PP-IV-07 AN OVERVIEW OF SPECIES DIVERSITY AND DISTRIBUTION OF THE GENUS *HENCKELIA* SPRENG. (GESNERIACEAE) IN INDIA

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The genus *Henckelia* Spreng. belongs to tropical plant family Gesneriaceae. Globally, *Henckelia* includes about 76 species of annual or perennial herbs. India harbors highest diversity of the genus with 40 species, followed by China [27 spp.] and Myanmar [17 spp.]. *Henckelia* exhibits an extensive morphological diversity and high degree of endemism. The present study aims to document morphological diversity and distribution of Indian *Henckelia* species. About 1200 herbarium specimens of 39 species were studied from 25 national and international herbaria. More than 320 accessions of 30 species were freshly collected, studied, and documented. Study revealed that the growth forms, inflorescence pattern, corolla colour, stamens, ovary, and capsules are important characters for species delineation. Moreover, this study led to the discovery of a new species *H. umbellata*.

Keywords: Biodiversity, *Chirita*, Endemism, Gesneriads, Lithophytes, Taxonomy

PP-IV-08 SUPPLEMENT TO THE FLORA OF ALLAHABAD DISTRICT

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The Allahabad district (now Prayagraj) is floristically very rich in diversity. B. K. Misra and B. K. Verma have compiled and published the Flora of Allahabad district in year 1992, which has been adopted by various authors from time to time. Now it is desirable to revise it critically as it was published 30 years ago. In published flora, 713 species were reported. The

present work is a supplement to the flora of Allahabad comprising 110 newly identified taxa. The supplement does not claim to be perfect nor complete, but every effort has been made to present a complete and reliable list of plants of the district.
Keywords: Flora, Taxa, Prayagraj, Diversity

PP-IV-09 A NATURAL ANTIOXIDANT ALTERNATIVE FROM *FICUS SP* FOR SYNTHETIC DYES

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Ficus religiosa and *Ficus benghalensis* have a very high growth rate, and they are usually pruned just before the monsoons. This generates a lot of waste due to their high biomass which is usually dumped at the dumping grounds or landfills. Hence, an attempt has been made to utilize the waste material to extract dyes, which can be used as an affordable substitute for synthetic dyes. Dyes were extracted by boiling barks of the two trees in a water bath at suitable temperature. Phytochemical analysis of the extracted dyes showed the presence of alkaloid, tannins, proteins, sugars, flavonoids, etc. The extracted dyes were also analysed for their antioxidant activity and were tested on cotton, hemp and wool using six different mordants. Several tests were carried out to check fastness to rubbing, washing, and perspiration at BTRA (The Bombay Textile Research Association).
Keywords: *Ficus religiosa, Ficus benghalensis* Phytochemical Screening, Antioxidant Activity, Textile Industry Applications

PP-IV-10 TASAR COCOONS REINFORCED WITH GRAPHENE SPUN BY TASAR SILKWORM *ANTHERAEA MYLITTA* DRURY (DABA TV)

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Graphene is a carbonic material having mechanical strength and antimicrobial properties. Aim of this study was to increase the quality and quantity of Tarar cocoons and silk with the reinforcement of graphene. For the first time in India, graphene sprayed leaves of Asan plant fed by tasar silkworm and form the cocoons. Graphene was successfully fed, as confirmed by graphene signature of excrement obtained from silkworm through Raman spectroscopy. The finding suggested cocoons crop obtained from rearing on graphene sprayed Asan plant [*Terminalia tomentosa* (Roxb.)] had higher larval weight, cocoon weight, shells weight, cocoon volume as compared to rearing on performance of Asan plant.
Keywords: Antimicrobial properties, Asan tree, Cocoon, Graphene, Tasar silk

PP-IV-11 LARVICIDAL EFFICACY OF ESSENTIAL OIL OBTAINED FROM *CALLISTEMON CITRINUS* LEAVES AND CHEMICAL CHARACTERIZATION USING GC-MS ANALYSIS

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More than half of the developing and under-developed countries in the world suffer from mosquito-borne diseases and life-threatening after-effects. Many of the insecticides and insect repellant chemicals used for mosquito control have harmful effects on human health and other non-target populations and have a high rate of biomagnification. Therefore, search for natural, eco-friendly alternatives such as bio-insecticides is imperative. In this study, larvicidal efficacy of the essential oil obtained from the leaves of *Callistemon citrinus* (Curtis) Skeels was tested on *Aedes aegypti* (dengue vector) and *Culex* sp. (chikungunya vector). Also, the chemical composition of the essential oil was studied using GC-MS analysis. Essential oil from *Callistemon citrinus* showed excellent potential, and thus can be considered as one of such bio-insecticides. It has many therapeutic active constituents in its essential oil and 80-100% larvicidal activity when used in varying concentrations.
Keywords: *Callistemon citrinus*, Larvicidal, *Aedes aegyptii*, *Culex* Mosquito, Bio-Insecticides

PP-IV-12 STUDIES ON PHARMACOGNOSTICAL ANALYSIS OF *CISSUS QUADRANGULARIS* LINN

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Cissus quadrangularis Linn. is a perennial climber belonging to family Vitaceae. It is popularly known as Hadjod which means bone setter owing to its cementing properties at breakage. The epidermal peeling of *Cissus quadrangularis* Linn. leaf exhibits stephanocytic type of stomata. Macroscopic and Microscopic characters of the *Cissus quadrangularis* Linn. was carried out. Transverse section of leaves and petiole of the plant were studied and characteristic features were observed. Macroscopic observation for the fresh leaves such as shape and size, colour, surfaces, apex, base, texture, odour and taste were studied.
Keywords: Vitaceae, Cementing, Breakage, Stomata, Pharmacognostic

PP-IV-13 PHYTOCHEMICAL SCREENING AND ETHNOMEDICINAL STUDY OF SELECTED PLANTS IN AND AROUND DALMA REGION, A WILDLIFE SANCTUARY, JAMSHEDPUR, JHARKHAND

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Utilizing the plants in many ceremonies to using them in treating diseases the knowledge and art of herbal treatment has long history and deep roots in Indian culture. In order to conserve and sustainable use of these medicinal plants, it is important to re-establish the knowledge by scientific method. The purpose of the research was to document the selected medicinal plants like *Acorous calamus* commonly called Ghorbach belonging to family Acoraceae and *Hemidesmus indicus* commonly called Anantmul which belongs to the family Apocynaceae. Present study reports that tribal people in and around Dalma, a wild life sanctuary use these plants to cure diseases. Semi structured interviews, direct observations, group discussions and indepth interviews were used to collect information from the traditional herbal practitioners and the healers.
Keywords: *Acorous calamus, Hemidesmus indicus*, Ethno Medicine, Traditional Knowledge

PP-IV-14 NATURAL REGENERATION OF SOME DRY DECIDUOUS MIXED FORESTS OF NAORARADEHI WILDLIFE SANCTUARY, SAGAR, M.P.

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Natural regeneration of dry deciduous forest trees in Naoradehi sanctuary of Sagar, along with percentage distribution of area in Mohali, Singhpur, Naoradehi Sarra and Dongargown sites have been studied. A very high density of sampling and coppices growth of *Tectona grandis* and its associates indicate extremely good regeneration at the initial stages. Natural regeneration and behavior of tree species is characterized by their population structure within the ecosystem. Forest are dense, heterogeneous, having great biodiversity of species in sites.
Keywords: Deciduous forest trees, Naoradehi sanctuary, *Tectona grandis*

PP-IV-15 *HYPTIS SUAVEOLENS* L. POIT: AN UNDEREXPLORED TREASURE-TROVE OF BIOACTIVE SECONDARY METABOLITES FOR DEVELOPING NOVEL THERAPEUTICS

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H. suaveolens L. Poit is an under-utilized weed in the family Lamiaceae used to treat a range of ailments in traditional medicine. Preliminary phytochemical and histochemical analysis showed that it is a source of phytochemicals such as phenolics, flavonoids, alkaloids, saponins, glycosides. The accumulation of phenolics, saponins, and alkaloids were found in trichomes, while flavonoids were observed in cortical and steler regions of stem and foliar mesophyll cells. FTIR results confirmed the presence of nitro compounds, aromatics, alkanes, phenols, alkynes, alcohols, and aliphatic components of the plant. Further, GC-MS analysis revealed the presence of constituents such as Caryophyllene oxide, Caryophyllene, Hydroxycaryophyllene, Bergamotol, Digitoxin, Z-α-trans and Ageratriol. This vast range of bioactive components would serve as the basis for developing and designing drugs for future.
Keywords: Lamiaceae, Secondary metabolites, Histochemical, GC-MS, FTIR

PP-IV-16 ETHNOMEDICINAL TREES USED BY MALDHARIES OF GIR SANCTUARY

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Gir sanctuary is located between three districts of Gujarat, and it is the home of Asiatic Lion and the nomads, Maldharies. This study was conducted with the aim of identifying the traditional healers and to quantitatively document their traditional knowledge of utilizating trees to cure ailments. A total of three indices: Informant Consensus Factor (F_{IC}), Use Value (UV) and Fidelity Level (FL) were used. Total 29 tree species were used as ethnomedicines and cured 42 types of ailments. These ethnomedicinal trees are important to the nomads of Gir because they treat many ailments.
Keywords: Ethnomedicine, Quantitative analysis, Gir Sanctuary, Maldharies

PP-IV-17 A STUDY TO CONSERVE ENDANGERED ETHNOMEDICINAL PLANTS OF SHEKHAWATI REGION OF RAJASTHAN

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Since historic periods, plants are medicinal sources to cure diseases. But today various medicinally important plants are at the edge of extinction due to climate change and overexploitation. Numerous pharmaceutical industries are enhancing the natural drug formulations against diseases because of their fewer side effects. However, it is important to know whether a particular plant species is abundant in the environment or is it at the verge of extinction. To investigate it, an ethnomedicinal survey was conducted in Shekhawati region of Rajasthan and an endangered ethnomedicinal plant was selected. Further, attempts were

made for its micropropagation so that its precious drug properties can help mankind to fight against various ailments.
Keywords: Medicinal plants, Drug formulations, Ethnomedicinal survey, Micropropagation

PP-IV-18 TRADITIONAL KNOWLEDGE ON USES AND CONSERVATION OF MEDICINAL PLANTS IN JHARKHAND STATE (INDIA)

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Forests provide a wide range of Ecosystem Services. Deforestation, livelihood option and unsustainable harvesting of forest produce are the key pervasive issues related to natural resource management in Jharkhand, India. Medicinal plants in many areas face extinction due to their excessive use. The paper reports on the influence of Traditional Knowledge (TK) systems on conservation of medicinal plants in the forests of Jharkhand. In present context of globalization and pressure on biodiversity, it is urgent to collect and systematize TK to conserve the threatened flora. Present paper compiles the documentation of fifty plants and associated TK on their various uses and conservation eg. *Abrus precatorius*, *Acorus calamus*, *Adhatoda zeylanica*, *Allemanda cathartica*, *Asparagus racemosus*, *Bacopa monniera*, *Clitoria ternatea*, *Hemidesmus indicus*, *Vitex negundo*, *Ocimum sanctum*, *Rauvolfia serpentina*, *Terminalia tomentosa*, *Terminalia Arjuna*, *Trachyspermum ammi* etc. Collaboration among the rural people, herbalists, scientists, and forest officials can improve the conservation prospects of biodiversity.
Keywords: Jharkhand, Medicinal Plants, Traditional Knowledge, Conservation

PP-IV-19 AN ETHNO-MEDICINAL SURVEY OF IMPORTANT PLANTS IN THE SHEKHAWATI REGION OF RAJASTHAN, INDIA

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Plants are ancient important sources for disease curing medications and contribute to the survival of tribes, and ethnic groups, as plants are easily available and less expensive than modern drug formulations. A variety of different chemical substances are obtained from plants via phytochemical screenings and techniques such as HPTLC, GCMS etc. These chemical compounds have the capability to be used as medications. The objective of present study was to learn about the medicinal properties of ethno medicinal plants and to enhance awareness about its ethnic significance. An ethno medicinal survey was conducted in the Shekhawati region of Rajasthan by interviewing local people of the area with the help of structured questioner. Based on its various plant species were identified belonging to different families that are employed by local traditional practitioners to treat various ailments.

Keywords: Ethno-Botany, Medicinal Uses, Medicinal Plants, Diseases, Traditional Knowledge, Shekhawati Region

PP-IV-20 PHYTOCHEMICAL PROFILE AND PHARMACOLOGICAL PROPERTIES OF MEDICINAL HERB *WEDELIA CHINENSIS*

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Wedelia chinensis (Osbeck.) Merra, a member of the Asteraceae family is a rich source of phytochemicals having therapeutic value. Phytochemical analysis revealed that it is a complex source of secondary metabolites such as phenols, flavonoids, terpenoids, alkaloids, essential oils, tannins and saponins. Due to presence of these phytochemicals, plant show antidiabetic and anticancerous activity. In *Wedelia chinensis*, the distribution of flavonoids and phenolics is observed in epidermal and cortex region, while alkaloids accumulate in vascular region of stem and root. Some unique bioactive substances found in *Wedelia chinensis* like Cleroindicin E, Cornoside, Wednenic, and Wednenol, have the potential to substitute synthetic medications in future.
Keywords: Asteraceae, Phytochemical, Secondary metabolites, Histochemical, Flavonoids

PP-IV-21 A FIELD SURVEY OF ETHNO-MEDICINALLY SIGNIFICANT PLANT *MARTYNIA ANNUA* L. (*MARTYNIACEAE*) IN RANCHI DISTRICT

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The Jharkhand state has rich diversity of ethno-medicinal plants. *Martynia annua* L. belongs to family Martyniaceae. A field survey of *Martynia annua* L., a common weed of ethno-medicinal value was done in certain blocks of Ranchi District [Silli, Mandar, Lapung, Kanke, Ormanjhi, Bundu, Tamar, Nagri, Angara, Bero, Burmu, Itki, Namkum, Ratu, Rahe, Chanho] during the month of July, employing the open-ended and semi-questionaire mode. It was revealed that medicinally it can be used as paste or oil-boiled juice. The herbal practioners administer it in three ways, tolan: taken orally and externally applied, chapan: only externally applied, Malish: externally applied massage. Plant was also collected to prepare its herbarium for identification.
Keywords: Folkflore, Chapan, Khadgarha, Vaidyas, Kaviraja

PP-IV-22 MORPHOLOGICAL CHARACTER VARIATIONS IN *DIDYMOCARPUS* (GESNERIACEAE) WALL. IN INDIA

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The genus *Didymocarpus* Wall., belongs to the family Gesneriaceae. It comprises about 107 species of perennial lithophytic or terrestrial herbs, distributed in India, Bangladesh, Nepal, Bhutan, Myanmar, South and Southwest China, and southwards to Vietnam, Thailand, Laos, Cambodia, Malay Peninsula, and northern Sumatra. In India, *Didymocarpus* is represented by 26 species, with main centers of distribution in the mid-elevation mountain forests of western and eastern Himalayas, and Northeast India. The taxonomy of this genus has been complicated by their extensive morphological diversity. The aim of the present study is to determine the affinities and variations in morphological characters within Indian *Didymocarpus*. The study revealed that morphological characters such as stem height, flower colour, shape and surface, and capsule are the key characters to identify each species.
Keywords: Didymocarpus, Diversity, Gesneriaceae, Morphological characters

PP-IV-23 KARYOMORPHOLOGICAL STUDIES OF THREE SPECIES OF FAMILY CAESALPINIACEAE

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The karyomorphology of three shrub species (Caesalpiniaceae) has been investigated for establishing 1. Chromosome numbers, 2. Karyotypic formula and 3. Taxonomic relationships of the species. The species are *Bauhinia acuminata* L., *Caesalpinia bonduc* Roxb. and *Cassia occidentalis* L. They have great morphological variations in leaf type, number of leaflets, type of stipules, colour of petals, number of fertile stamens and size and shape of the fruits and seeds. Mitotic metaphase of *B. acuminata* and *C. occidentalis* have 2n=28 chromosome number, whereas *C. bonduc* has 2n=24. The taxa is represented by polyploid with tetraploid forms with the base numbers x = 6 (2n = 24) and x = 7 (2n = 28). *C. occidentalis* has larger chromosomes showing a length range 1.53 µm to 4.00 µm with the total haploid chromatin length 30.17 µm, while *B. acuminata* has shorter chromosomes with a length range 1.12 µm to 2.42 µm and the total chromatin length is 24.44 µm. The highest T.F.% value of *B. acuminata* (43.69) point to its primitive position within the taxa under reference, while lower T.F.% value of *C. occidentalis* (42.09), indicates asymmetrical karyotypes and specialized nature. *C. bonduc* is intermediate between the two.

Keywords: Karyomorphology, *Bauhinia acuminata* L., *Caesalpinia bonduc* Roxb., *Cassia occidentalis* L.

PP-IV-24 ASSESSMENT OF DIOECIOUS PLANT DIVERSITY OF ALLAHABAD DISTRICT, UTTAR PRADESH, INDIA

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The paper deals with an account of dioecious plant diversity of the Allahabad district based on extensive fieldwork and herbarium studies. We observed that these dioecious plants were commonly associated with multiple ecological traits such as herb or woody habits, fleshy fruits, and small, inconspicuous flowers. About 55 species belonging to 20 families and 44 genera are reported in this field survey. Out of 52 species, 24 trees, 18 climbers, 7 herbs and 3 shrubs are reported. Menispermaceae is the largest family (9 species), while *Diospyros, Morus*, and *Tinospora* are dominant genera of dioecious flora.
Keywords: Allahabad, Dioecious, Diversity, Flora

PP-IV-25 A CONSPECTUS OF THE GENUS *TRIBULUS* L. (ZYGOPHYLLACEAE) IN INDIA

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The genus *Tribulus* L. (Zygophyllaceae) comprises of 32 species in the world across warm temperate and tropical regions of southern Europe, southern Asia, throughout Africa, New Zealand and Australia. In India, the genus is mainly distributed in Saharo-Sindian Phytogeographical zone and is represented by 8-10 taxa. The taxonomy of genus is considered troublesome due to phenotypic plasticity within and between the species. Updating nomenclature and resolving the taxonomy of genus is very crucial as some species of the genus are frequently exploited for their medicinal properties which raises the concern for their conservation. During the present investigation, 10 different Indian herbaria were visited, and plant material present at various foreign virtual herbarium were explored to study the specimens of *Tribulus* species. A preliminary overview of the ongoing work is presented here with distribution map.
Keywords: Tribulus, Taxonomy, Zygophyllaceae, Distribution

PP-IV-26 STUDIES ON PLANT BASED FLUOROSIS MITIGATION TECHNIQUES

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The disease fluorosis is caused due to intake of fluoride rich water or fluoride rich food-stuffs. The present study reports that Rajauli block of Nawada district, Bihar is fluorosis endemic zone as in many groundwater sources the concentration of fluoride is higher than 1.5 mg/L, which is the maximum permissible limit. Currently the plant based defluoridation methods are gathering momentum due to lower cost and easy availability. Various plant parts including tea leaves, tamarind fruit, vetiver grass, neem leaves, coffee husk, chakora leaves, drumstick leaves and other edible plant materials containing Ca^{2+} ions have the tendency to remove fluoride from water. In Rajauli, the leaves and fruits of *Moringa oleifera* are being consumed by the fluorosis affected inhabitants which showed promising results.
Keywords: Fluorosis, Endemic, *Moringa oleifera*, Nutritional supplement, Inhabitants

PP-IV-27 DIVERSITY ASSESSMENT OF GENUS *GERANIUM* (GERANIACEAE) FROM INDIA

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Geranium L. (Geraniaceae) has ca. 325 species distributed throughout the world except lowland tropical areas. During the revisionary study of the genus *Geranium* from India we have conducted extensive field survey in Indian Himalayan region followed by consultation of national as well as international herbaria and literature survey. We have documented 31 taxa of genus *Geranium* belonging to the two subgenera i.e. subg. *Geranium* and subg. *Robertium*. Maximum diversity in Indian *Geranium* is exhibited in western Himalaya followed by eastern Himalaya.
Keywords: Geranium, Diversity, India, Himalaya

PP-IV-28 *ARIOPSIS IDUKKIANA* (ARACEAE), A NEW SPECIES FROM IDUKKI DISTRICT, KERALA WITH NOTES ON THE VARIATIONS IN *ARIOPSIS PELTATE*

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The genus *Ariopsis* Nimmo consists of three species and one variety world-wide and belongs to Araceae (tribe Colocasieae). Among them, *A. peltata* Nimmo is distributed in Western Ghats and the Darjeeling- Sikkim region of eastern Himalayas, while *A. protanthera* N.E.Br. in the tropical eastern Himalayas as well as in northern Burma and Thailand. During a recent scientific survey, as a part of documenting the floristic diversity of monocotyledons in the Idukki district of Kerala in the southern Western Ghats, an interesting specimen of *Ariopsis* was collected. The specimen represents a hitherto undescribed species, which is described and illustrated here as *Ariopsis idukkiana.* The new species is morphologically most similar to *A. peltata*, but can be easily distinguished by its acute spathe, ovate dome-shaped male spadices, and slightly angled fruits. *A. peltata,* the type species of the genus, shows wide variation in its vegetative and floral features within the same population. These variations are discussed in detail. A detailed description, photographic images, distribution map, and preliminary conservation risk assessments are provided in this paper.
Keywords: *Ariopsis idukkiana*, Western Ghats, *A. peltata*, Colocasieae

PP-IV-29 ETHNOMEDICINAL USES, PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITY OF *ZANTHOXYLUM ARMATUM DC.*

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Zanthoxylum armatum (Rutaceae) is known as Timur or Nepali dhania and Prickly Ash. It is a small aromatic tree with a prickled trunk, trifoliate leaves and winged stalk. In traditional medicine, it is used to treat toothaches. In ethnomedicine, its fruits and seeds are used as tonics against fever, dyspepsia, and dysentery. It has been explored for antibacterial and antifungal, larvicidal, cytotoxic, hypolipidemic and hypoglycemic activities. Its seeds are known to contain essential oils rich in monoterpene content with a major percentage of linalool and limonene. Other compounds are 1,8-cineole, α terpinene, sabinene, geraniol, caryophyllene, palmitic acids, α and β amyrin and lupeol etc.
Keywords: *Z. armatum*, Timur, Hypoglycemic, Monoterpene, Linalool

PP-IV-30 A STUDY ON PHYTOCHEMICAL VARIATION BETWEEN TWO *BARLERIA* SPECIES THROUGH CHEMICAL PROFILING

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Morphological patterns are commonly used for identification of a plant. However chemical variation persists even in closely related species. Therefore, in this study a chemotaxonomic approach has been used to differentiate between two *Barleria* species. Phytochemical investigation of *Barleria prionitis* and *Barleria cristata* was done to identify compounds distributed in different parts of the plant, including leaf, root, stem, and inflorescence. Plant material was extracted in 70% ethanol, defatted, and subjected to direct mass measurement using ESI-QTOF-MS analysis. A chemical fingerprint of parent ion signal was generated which was further subjected to MS/MS analysis through information dependent acquisition (IDA) method. Their identity was confirmed by HRMS analysis and study of their fragmentation pattern. Iridoid glycosides, phenolic compounds and sugars were identified from both *Barleria sp.* showing variation in their presence and distribution. Most common iridoid glycosides were barlerin, acetylbarlerin and shanzhiside methylester, whereas acetoside, acetylacetoside, poliumoside were the important phenylethanoid glycosides present in the plants. *B. prionitis* was found to be rich in iridoid glycoside whereas phenylethanoid glycosides were abundant in *B. cristata*. Variation in identified phenolic acids was also observed, such as caffeic acid, ferulic acid, melilotic acid, syringic acid, hydroxycinnamic acid and coumaric acid.
Keywords: *Barleria*, Phytochemical, Iridoid glycoside, Phenolic compound

PP-IV-31 VASCULAR PLANT DIVERSITY AND ETHNOBOTANICAL COMPILATION OF AMBA MATA SACRED GROVE OF YAVATMAL DISTRICT, MAHARASHTRA

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The Wani taluka of the Yavatmal district, Maharashtra, is home to the sacred grove of Amba Mata, which is an underexplored region from the perspectives of ethnobotanical research and floristic diversity. It covers an area of seven hectares and is dedicated to the tribal goddess Amba mata. The Sukne gaon village's tribal inhabitants value the site highly due to its holiness, abundance of vegetation, and ethnobotanical wisdom. Gond, Kolam, and Pradhan are the three prominent tribes residing in the region. The village residents adhere to certain guidelines concerning the grove, which aids in the preservation of the grove's biodiversity.

The grove has reported 117 plant species, 93 of which are known to be significant in terms of ethnobotany. The quantitative ethnobotanical indices *viz.* Use Value and Fidelity Level and Informant Consensus Factor was also calculated. *Butea monosperma*, *Wrightia tinctoria, Diospyros melanoxylon* and *Tectona grandis* are the dominant tree species of the grove. The tribal community in the study area contributes to the conservation of the grove's sacredness by preserving the flora and fauna of the region from being degraded by the expanding requirements of the human population.

Keywords: Sacred grove, Maharashtra, Ethnobotany, Diversity, Indigenous knowledge

PP-IV-32 PHYLOGENY BASED ON MICRO-MORPHOLOGICAL CHARACTERS IN SOME GENERA BELONGING TO FAMILY FABACEAE

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The family Fabaceae is second largest family of the flowering plant according to number of genera which includes 650 genera and 1800 species including intraspecific taxa. A study of micro morphological characters included proved to be useful in taxonomy at different hierarchical levels. The fresh samples of the selected 10 species of family Fabaceae were collected from Satpuda hilly ranges and western ghat of Maharashtra. The SEM sample of pollen and seed was prepared as per standard procedure followed by preparation of dendrogram using unitary and binary data matrix. Total 22 seed SEM morphological characters and 19 pollen SEM characters were considered for the study. The seed SEM dendrogram reveals separation of species into two major clades isolating species into two groups. Clade I group the species on the basis of reticulate seed coat pattern and black seed colors. Clade II group on the basis of seed color and seed shape. The pollen SEM dendrogram reveals separation of the species into two major clusters, Cluster 1 represent genera *Alysicarpus* with rounded triangular outline and oblate spheroidal shape of pollen. Cluster II represents mix species i.e. *Tephrosia purpurea, T. villosa, T. pumila, Zornia diphylla, Smithia bigemina, S. conferta*, *Zornia diphylla* found as an out group.

Keywords: Satpuda, Western Ghat, Micro-morphology, Phylogeny, Dendrogram

PP-IV-33 SURVEY OF INVASIVE ALIEN PLANTS (IAPS) AND THEIR ETHNOMEDICINAL USES IN BAHRAICH, UTTAR PRADESH-INDIA

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Invasive Alien Plants (IAPs) threatens the native biodiversity and ecosystem after successful invasion and colonization in field due to anthropogenic activities, absence of natural enemies and their allelopathic competitive strategies. Bahraich is the Terai (low land) district of Uttar Pradesh. Present study reports the 34 IAPs belonging to 21 families in Bahraich found during the aforesaid study. These IAPs are Invasive Alien plants *Amaranthus spinosus* L., *Calotropis procera* Roxb., *Ageratum conyzoides* L., *Tridax procumbens* L., *Xanthium stumarium* L., *Sonchus oleraceous* L., *Parthenium hysterophorous* L., *Opuntia elatior* Mill., *Cassia occidentalis* L., *Cassia tora* L., *Cannabis sativa* L., *Chenopodium album* L., *Convolvulus arvensis* L., *Ipomoea fistulosa* Mart DC., *Bryophyllum pinnatum* Lam., *Croton bonplandianum* Boil., *Euphorbia hirta* L., *Ricinus communis* L., *Hyptis suaveolens* L., *Ocimum americanum* L., *Malvastrum coromandelianum* L., *Sida acuta* Burm.f., *Callistemon lanceolatus* L., *Mirabilis jalapa* L., *Oxalis corniculata* L., *Argemon mexicana* L., *Cynodon dactylon* L., *Eichornia crassipes* Mart., *Anagalis arvensis* L., *Datura metel* L., *Nicotiana plumbaginifolia* Viv., *Physalis minima* L., *Solanum nigrum* L., and *Lantana camera* L.
Keywords: IAPs, Biodiversity, Ecosystem, Invasion, Anthropogenic

PP-IV-34 FIRST-OFF REPORTING ON PARASITIC INFESTATION IN TIMBER OF *ARTOCARPUS CHAMA* BUCH. -HAM.

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An enormous number of commercial timbers are prone to parasites due to the exudates they possess and are worth protecting. These exudates could be responsible for both susceptibility and resistivity of plants towards diseases. In plants they are stored into cavities or ducts and are referred to as secretions. We observed that an assembly of enemies are lined up to attack only wood hand samples of *Artocarpus chama* and not any other tree species that were stored in *Xylarium* (DDw) – Forest Research Institute, Dehradun, Uttarakhand, India. On further investigation, *Microtermes obesi* Holmgren; a termite of insect group was identified from microscopic slides and appeared as the first ever reported woody parasite on *Artocarpus chama.* Insect attack towards specific timber is attributed to its anatomical, biochemical, and physiological features. The findings could be useful in wood seasoning and preservation of *Artocarpus chama* to maintain the durability of timber. A number of heartwood timbers exhibited resistance towards *Microtermes obesi*. Therefore, understanding natural insect durability of wood is critical for making sensible and wise use of wood.
Keywords: Artocarpus chama, Termite, Plant exudates, Cavity and ducts, Timber durability

PP-IV-35 *OROXYLUM INDICUM* (L.) VENT: A HERBAL WEALTH THAT NEEDS TO BE DECIPHERED

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Oroxylum indicum (L.) is an important indigenous medicinal plant of family Bignoniaceae. It is very common among the tribal peoples of Himalayan foothills like India, Bhutan, Southern China, Malaysia, Indonesia, Philippins, Nepal, Thailand, and Vietnam. Its "Panchang"-root, stem, leaves, fruits and seeds are frequently used by different tribal communities of India like Anal, Kuki, Mao, Maram, Oraon, Nagesia, Asur, Virhore, etc. Important bioactives are Adenosine, Aequinetin, Baicalein-7-O-glucoside, Chrysin-6-C-β-D-glucopyranosyl-8-C-α-L, which have antibacterial activities and are also used as blood purifier, anthelmintic, antiviral, anti-inflammatory, expectorant and in healing of wounds, articulation of broken bone, amebiasis.
Keywords: Indigenous, Blood purifier, Anthelmintic, Antiviral, Anti-inflammatory, Expectorant

PP-IV-36 WEEDS OF UTTARAKHAND CAN BECOME A MEANS OF LIVELIHOOD, EMPLOYMENT GENERATION

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Weed commonly called *khar-kabad* in Uttarakhand or *kharpatawar* in India and worldwide. Farmers are often concerned that weeds may reduce crop yields. Weeds use the same nutrients that crop plants use, often in very similar proportions. They also use resources such as water, sunshine and space that might have gone to crops. The more similar the weed and crop requirements, the more they will compete for those resources. Weeds that compete aggressively with crops reduce their yield. Immature weeds can interfere with harvesting operations. Weed seeds in harvested crops increase risk of spoilage. This can reduce crop value or increase shipping costs. Weeds in grasslands are generally those that are less palatable. They increase with grazing because the livestock graze them less than the more palatable plants. Some weeds may have uses in medicine, or may be used as organic manure/fertilizer, bioinsecticides, biofungicides.
Keywords: Weeds, Kharpatawar, Bioinsecticides

PP-IV-37 FROM AYURVEDA TO COSMETOLOGY: SKIN PROBLEMS AND PLANTS

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Herbal cosmetics gained popularity, acceptability, and demand as people grew more aware of the harmful side effects caused by synthetic cosmetic chemicals. Since the beginning of time, traditional-ethnic plants like *Curcuma longa, Emblica officinalis, Ocimum sanctum, Aloe Vera, Azadirachta indica* are being used in treatment of skin problems in Ayurveda. These plants are abundant in bio-functional secondary metabolites that are therapeutically employed in the treatment of skin and hair issues. Steroids, antibiotics, parabens, silicones, butylated hydroxyanisole, triclosan, sulphates, phthalates, lead, polyacrylamides are loaded in cosmetics, like anti-aging products, sun-protection creams, fairness creams and moisturizers etc. that are not only harmful but can be carcinogenic. Natural medicinal herbs are readily available, environmentally friendly, and relatively safe. It is crucial to promote the usage of our folklore plants that have been used historically to treat a range of skin diseases in order to safeguard human lives.
Keywords: Cosmetics, Ethnic plants, Dermatological, Skin disease

PP-IV-38 COMPARATIVE STUDIES OF IMPROVED VARIETIES OF MENTHOL MINT (*MENTHA ARVENSIS* L.) OVER TRADITIONAL CROPS IN DISTRICT SITAPUR, UTTAR PRADESH

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Since last 30 years, India is the world leader in production and export of menthol mint oil and its associated products. Menthol mint oil is mostly used in confectionary products, and pharmaceutical and cosmetic industries. In India, Uttar Pradesh is the leading producer of mint oil, producing about 80 % mint oil. About 75 % of menthol mint oil produced in the country is exported to other countries. India dominates the world market, contributing about 80 % (30,000 tons) of menthol mint oil in various forms like flakes, menthol crystals and powder, and dementholised mint oil. CSIR-CIMAP has played an important role in developing the mint industry in India from a menthol importing country to the leading global producer and exporter, by increasing cultivation of short duration high yielding varieties, and superior agro and processing technologies. After development of short duration variety of menthol mint, farmers of district Sitapur adopted the rice-potato-mint, rice-mustard-mint, rice-lentil-mint cropping system, and harvested more income compared to traditional crops.

This paper deals with comparative studies of improved varieties of menthol mint (*Mentha arvensis* L.*)* and its crop rotation over traditional crops in district Sitapur, Uttar Pradesh.
Keywords: *Mentha arvensis* L., Menthol mint oil, High yielding varieties

PP-IV-39 Genus *Rotala* L. (Lythraceae) of India

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Rotala L., one of the most diverse genera of the family Lythracea, with 55 species distributed in tropical and subtropical countries, mostly old-world tropical, is the largest genus of the family in Asia. At present, the genus is represented by 36 species, out of which 25 species are endemic to the country. Out of the species known from the country, four species viz., *R. andamanensis*, *R. rubra, R. subrotunda,* and *R. vasudevanii* are known by single collections and two species, *R. cookii* and *R. vasudevanii*, assessed to be Critically Endangered and Probably Extinct. The genus is known for its phenotypic plasticity, where we were able to observe tri-, tetra- and penta-merous flowers in a single individual of multiple species. Additionally, there are a number of cryptic morphological characters which create species delimitation challenging. To resolve these challenges, we studied micro- and macro-morphological characters. Further studies are required to understand the species relationship of the group through phylogenetically informed taxonomy.
Keywords: *Rotala* L., Lythraceae, Endemic, Critically Endangered

SECTION V

CYTOGENETICS, PLANT BREEDING AND MOLECULAR BIOLOGY

OP-V-01 EVALUATION OF METRIBUZIN INDUCED CYTOGENOTOXIC EFFECTS IN *VIGNA MUNGO* L. HEPPER GENOTYPES: A BIOMARKER BASED STUDY

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Metribuzin is an important non-selective herbicide used to destroy weeds in crop fields. However, its excessive use results in toxic effects on non-target crop plants. In view of this concern, the present study was performed to assess the effect of Metribuzin on cytological parameters of root meristem cells of different genotypes of *Vigna mungo*. The results obtained indicate dose-dependent reduction in mitotic index, and an increase in the percentage of chromosomal aberrations (CAs) and relative abnormality rate (RAR) in all the genotypes. The present experiment is a fine example of a biomarker-based genotoxic assessment of cytological damage caused by Metribuzin.
Keywords: Metribuzin, *Vigna mungo,* Cytogenotoxic, Mitotic index

OP-V-02 SODIUM AZIDE, ETHYL METHANE SULPHONATE AND GAMMA RAYS INDUCED HIGH YIELDING AND SUPERIOR QUALITY MUTANTS IN *LINUM USITATISSIMUM* VAR. PKV NL - 260

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Development of high yielding linseed cultivars with superior quality is one of the top research areas. In the present study, seeds of *Linum usitatissimum* var. PKV NL – 260 were subjected to different doses of sodium azide, Ethyl Methane Sulphonate and gamma rays. Mutagenized seeds were sown to raise M1 generation; the seeds harvested from which were sown to obtain M2 generation. M2 population was screened for high yielding, bold seeded and high oil content mutants. About four high yielding mutants, two bold seeded mutants, one high yielding dwarf mutant and three high oil mutants were recorded.
Keywords: Linum usitatissimum, Mutation, High yield, Bold seed

OP-V-03 GENETIC VERSATILITY - A WAY TO DISSIPATE INTO NEW ADDRESSES: CASE STUDY OF GENUS *ARTEMISIA*

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Present study covers four species of *Artemisia*: *A. maritima*, *A. nilagirica*, *A. scoparia* and *A. tournefortiana,* which inhabit different altitudinal ranges of NW Himalayas. Geographical variations have a significant effect on the morphological characteristics, which have been linked to the cytological changes. We found that *A. nilagirica* is most complex, with four cytological races, with chromosome numbers as 2n=18, 32, 34 and 54. *A. scoparia, A. maritima* and *A. tournefortiana* are cytologically stable; *A. scoparia* exhibits a diploid chromosome number 2n=16, whereas *A. maritima* and *A. tournefortiana* have 2n=18. Reproductive output was found to be maximum in *A. maritima* and minimum in *A. nilagirica*.

Keywords: *Artemisia*, Chromosome, Diploid, Polyploidy, Reproductive efficiency, Rootstock

OP-V-04 MITOTIC AND MEIOTIC STUDIES OF INDIAN APONOGETON SPECIES

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Aponogetonaceae Planch., a monogeneric family with genus *Aponogeton* L.f., has 10 species in India, of which five are endemic. The present paper aims to study mitotic and meiotic behaviour of Indian *Aponogeton* species and an apomict Madagascan species, *Aponogeton decaryi*. Among the Indian species, *A. satarensis* has lowest chromosome number i.e. 2n = 26 and *A. undulatus* has highest chromosomes i.e. 2n = 84. Mostly metacentric and sub metacentric chromosomes were recorded in studied species. All the species with low ploidy level reproduce sexually and showed normal meiosis whereas *A. bruggenii* and *A. undulatus* with high ploidy level showed sexual sterility, meiotic anomalies, and reproduce by vegetative propagation.

Keywords: Aponogeton, Mitosis, Meiosis, Chromosomes, Apomictic

OP-V-05 IMPACT OF GAMMA IRRADIATION ON CYTOMORPHOLOGICAL CHARACTERS OF *LEPIDIUM SATIVUM* L. (GARDEN CRESS)

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Lepidium sativum has medicinal importance and is consumed as salads due to its pungent taste. To meet its high demand, it is required to induce genotypic changes to increase its genetic variability with desirable characteristics. The present study shows the potent mutagenic property of gamma radiation, which is highly effective in enhancing both qualitative and quantitative traits. Our results show that there was an increase in

chromosomal aberrations at higher doses of gamma radiation. The prominent abnormality were stickiness, precocious movement at anaphase and unorientation. A broad spectrum of chlorophyll and viable mutants/variants with different frequencies were observed.
Keywords: *Lepidium sativum*, Mutagenesis, Gamma, Garden cress

OP-V-06 DIMORPHISM OF SEX CHROMOSOMES IN *CYCAS* SPP. AND ITS EVOLUTIONARY SIGNIFICANCE

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Understanding the molecular factor(s) behind sex expression has immense importance both in basic and applied research. Plants provide an excellent opportunity to address this question as separate sexes (dioecy) evolved many times independently. *Cycas* is a dioecious plant revealing clear cut dimorphism in sex chromosomes, with X the larger one and Y the smaller chromosome. Conventional karyotyping combined with molecular cytogenetics could be significant in deciphering the epigenetic modifications in sex chromosome, which is a gap in cytogenetic characterization of *Cycas* species. The present work is a conventional karyotyping approach adding to the first step towards addressing the evolutionary quest.
Keywords: Dimorphic sex chromosomes, Dioecy, Karyotyping, Epigenetic modifications

OP-V-07 KARYOTYPE OF FOUR PLANT SPECIES OF FABACEAE

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The four species of Fabaceae, *Vicia faba*, *Pisum sativum*, *Lens culinaris* and *Trigonella foenum-graecum,* serve as classical material for cytogenetic investigations. It is known that fundamental laws of genetics are based on gene organization of *Pisum* and chromosomal features of *Vicia* make it an ideal material for genotoxicity assays. Detailed karyotype analyses indicate these four species to be diploid with varying basic numbers 6, 7, 8. They display symmetrical karyotype (2A, 3A) having median to sub-median chromosomes, except *Vicia* that displays asymmetrical karyotype (3B) with median and acrocentric chromosomes. *Vicia* is also exceptional in having relatively big chromosomes. Arranged according to Total Chromatin Length, *Vicia* is placed first, followed by *Trigonella, Pisum*, and *Lens.*
Keywords: Karyotype, *Vicia, Pisum, Lens*, *Trigonella*

OP-V-08 PROTEIN STABILITY STUDY WITH RESPECT TO MUTATION IN *BRASSICA JUNCEA, BRASSICA CAMPESTRIS* AND *BRASSICA NAPUS*

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Mutation induction offers the possibility of inducing desired attributes that cannot be found in nature or have been lost during subsequent mutation generations. In the present study, different M_5 mutant lines of *Brassica juncea, B. campestris* and *B. napus* were analyzed in M_6 generation for protein profiling using SDS-PAGE. The electrophoretic pattern of seed protein of *Brassica* genotypes gave different molecular weight bands, ranging from 9 to 65 kDa. Statistical analysis revealed that 41 bands were polymorphic, 7 bands were unique, and 7 were monomorphic. Based on polymorphic and unique bands, there is 86% polymorphism among the mutants with respect to earlier generations.
Keywords: Mutation, *Brassica juncea, Brassica campestris, Brassica napus,* SDS-PAGE, Polymorphism and Similarity

OP-V-09 CYTOGENETICAL, MORPHOLOGICAL, CUTICULAR AND PALYNOLOGICAL STUDIES IN *LEDEBOURIA REVOLUTA* (L. F.) JESSOP (ASPARAGACEAE) IN INDIA

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Ledebouria revoluta is a very variable species with reference to shape, size and blotching pattern of leaves. Total 26 populations of *L. revoluta* were collected from different regions of India. Data on chromosomes, morphology, leaf cuticular parameters and palynology are provided. Four cytotypes were recorded in the present study, i.e., $2n=2x=30$, $2n=3x=45$, $2n=4x=60$ and $2n=6x=90$. Various leaf shapes such as ovate-obovate, narrowly to broadly lanceolate, linear-lanceolate, oblong, elliptic etc. were observed. The stomatal length ranged from 30.10–49.90 µm. P/E ratio of pollen grains ranged from 0.50–0.69. Studies indicated that *L. revoluta* is highly polymorphic species adapted to various climatic conditions in peninsular India.
Keywords: *Ledebouria revoluta,* Palynology, Leaf cuticle, Chromosomes

PP-V-01 EXPLOITATION OF CAFFEINE TO INDUCE EFFICIENT MUTAGENIC VARIATIONS IN *LINUM USITATISSIMUM* L.

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Linseed is an important medicinal crop grown for its edible seed, seed oil, and fibres from the stems. Induced mutagenesis pave a way to crop improvement by inferring variations in germplasm. In the present investigation, *Linum* was treated with five doses of caffeine i.e, 0.10%, 0.25%, 0.50%, 0.75%, and 1.0%. Biological parameters were found to be decreased in treated population compared to control. Lower concentration was found to be effective in increasing quantitative traits viz, seed yield and seed weight. SEM analysis also shows beneficial variations at lower dose of the mutagen.
Keywords: *Linum usitatissimum* L., Chemical mutagen, Caffeine, SEM

PP-V-02 KARYOMORPHOLOGICAL STUDIES ON TWO RECENTLY DESCRIBED SPECIES OF DIPCADI (L.) MEDIK. FROM PENINSULAR INDIA

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In the present study, mitotic metaphase chromosomes of *Dipcadi coimbatorensis* V. Ravich., R.Kr. Singh & Murugan and *Dipcadi krishnadevarayae* B.R.P. Rao, described from Tamil Nadu and Andhara Pradesh respectively, were studied. The somatic chromosome count 2n = 20 were found in both species. Based on the position of the centromere, chromosomes in both the species were found to be submetacentric, sub telocentric and telocentric.
Keywords: *Dipcadi*, Chromosome, Metaphase, Mitosis, Peninsular India

PP-V-03 AMELIORATION OF HERBICIDE CYTOGENOTOXICITY BY SALICYLIC ACID APPLICATION IN *ALLIUM CEPA* L.

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Treatment of Metribuzin, a herbicide, causes decrease in root length, number of root tips, mitotic index and different types of chromosomal abnormalities in *Allium cepa.* The present study investigated the possible ameliorative effect of salicylic acid in protecting plants from herbicide toxicity. Equal-sized and healthy bulbs (25–30 mm in diameter) of a commercial variety of *Allium cepa* L. (2n = 16) were treated with different concentrations (10, 20, 40,

60, 80 and 100 ppm) of Metribuzin for 24 h, with and without 1 mM salicylic acid. These results exemplify the ameliorative effect of salicylic acid under Metribuzin stress.
Keywords: Metribuzin, *Allium cepa,* Salicylic acid, Mitotic index, Chromosomal abnormalities

PP-V-04 KARYOMORPHOLOGY OF *VIGNA RADIATA* L. COLLECTED FROM KEONJHAR, ODISHA

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The karyomorphological study of *Vigna radiata* revealed that this species was diploid with 2n=22. The total chromatin length was 56.75 ± 4.52 µm; the total form percentage was 27.92; whereas Gradient Index and Symmetry Index was 21.42 and 38.75, respectively. The chromosomes varied from sub-median to sub-terminal. This structural variation indicates the shifting of species from primitive to advancement. The stomata were found to be paracytic, with maximum number of stomata present on abaxial surface (29.04 ± 0.83). The pollen shape was found to be convex-triangular to sub circular and the rate of fertility was 87.43%.
Keywords: Karyomorphology, Total Chromatin Length, Asymmetric, Paracytic, Pollen

PP-V-05 INSIGHT INTO NITROGEN RESPONSIVE TRAITS FOR SUSTAINABLE AGRICULTURE

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Nitrogen (N) fertilization is an important driver of crop yields and rely on the selection of cultivars through breeding which possess inherently high N responsiveness. In the present study we use contrasting N levels to unveil physio-genetic basis for N responsiveness in a diversified foxtail millet, *Setaria italic* (L.) population. We show that N dependent increase in yield of foxtail millet is achieved through grain number and relies on a set of trait indices to determine N responsiveness of various yield components. Using genome-wide association studies (GWAS), we identified 22 unique SNP loci affecting this trait, among which 6 of them exhibit haplotypes. In addition, differential accumulation of transcripts of 3 of proximate genes with identified haplotypes in these two groups showing association with N responsive expression in a genotype dependent manner. Conclusively, this study illustrates the importance and potential of taking an account of N responsiveness as selection trait and decodes genetic components worth exploring molecular basis of N responsiveness in foxtail and other plants in pertinence to sustainable N use and food security.
Keywords: Nitrogen, Sustainable agriculture, GWAS, SNPs

PP-V-06 A COMPARATIVE STUDY OF THE RUBISCO SMALL SUBUNIT GENE SEQUENCE IN A FEW ORGANISMS

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An investigation was carried out to understand the variation in the gene sequence of the small subunit of Rubisco (*rbcS*) from fifty-one photosynthetic organisms. Multiple sequence alignment was generated through BioEdit using the nucleotide sequences of *rbcS* from GenBank. Later, a dendrogram was drawn using this multiple sequence alignment in Mesquite. The trees were searched using two rearrangers *viz*., Nearest neighbour interchange and Subtree pruning and regrafting. The two dendrograms had similar topology with respect to the arrangement of a few taxa, while it differed with respect to the other taxa. However, a striking difference between the lower and higher organism was evident. The present investigation reveals the considerable diversity in the nucleotide sequence of the *rbcS* gene
Keywords: Bioedit, Dendrogram, Clade, Mesquite, MSA

PP-V-07 APPRAISAL OF MITODEPRESSIVE AND CLASTOGENIC POTENTIAL OF LEAF EXTRACT OF *PONGAMIA PINNATA* (L.) PIERRE IN ROOT TIP CELLS OF *ALLIUM CEPA* L.

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The present study aims to evaluate the genotoxic potential of aqueous leaf extract of *Pongamia pinnata* (L.) Pierre (Fabaceae) on the mitotic index (MI) and chromosomal anomalies (CA) in the meristematic root tip cells of *Allium cepa* L. The present study revealed that the aqueous leaf extract of *Pongamia pinnata* had mito-depressive activity and induced a variety of chromosomal abnormalities (CA) such as stickiness, fragments, bridges, laggards, micronuclei, binucleate, and disturbed metaphase /anaphase/telophase. The frequency of cell division (MI) and chromosomal abnormalities (CA) were noted in different mitotic stages of cell division in each treatment. The results showed that *Pongamia pinnata* extracts significantly depressed the mitotic index from 17.26 ± 0.14 to 05.48 ± 0.42 in comparison to control *i.e.*18.10 ± 0.23; however the frequency of CA was gradually induced with increasing concentration of the leaf extract which was recorded up to 29.17%. The genotoxic impact of the plant extracts might have been due to the phytochemicals, however the exact mechanism of their action on genotoxicity can be explored through an extensive molecular analysis of the plant extracts.
Keywords: Genotoxic, MI, Chromosomal abnormalities, *Pongamia pinnata*

PP-V-08 CYTOLOGICAL AND BANDING INVESTIGATIONS IN *CHLOROPHYTUM BORIVILIANUM* SANTAPAU & FERNANDES FROM MELGHAT TIGER RESERVE, AMRAVATI

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Chlorophytum borivilianum is a member of family Liliaceae, one of the largest plant families with about 240 genera and 4,000 species distributed throughout the world. Cytological studies in *Chlorophytum* confined that the ploidy ranges from diploid to octaploid with two basic numbers, x=7 and x=8. The diploid chromosome number of some species of *Chlorophytum* like *C. borivilianum* Santapau & Fernandes is 2n=16 and while other species shows ploidy up to 2n=56 in *Chlorophytum nepalensis.* Earlier chromosomal studies in *Chlorophytum borivilianum* have been carried out during 1960-1980s by the renowned cytologist and the findings of these workers show the variations in karyotype and meiotic chromosome behaviour. However, there are very scanty reports on the banding studies in *Chlorophytum.* Considering present situation karyotype and meiotic studies in *Chlorophytum borivilianum* were carried out to trace differential banding pattern in chromosomal segments which revealed important insights on the numerical and structural chromosome changes involved in the evolution of the genus.
Keywords: *Chlorophytum borivilianum*, Meiotic studies, Karyotype, Banding patterns

SECTION VI

ECOLOGY AND ENVIRONMENTAL BIOLOGY

OP-VI-01 PHYSIOLOGICAL AND BIOCHEMICAL ASSESSMENT OF TWO VARIETIES OF HYACINTH BEAN (*DOLICHOS LABLAB* L.) UNDER ELEVATED OZONE CONDITIONS AND NUTRIENT AMENDMENTS

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Tropospheric ozone (O_3) has been the topic of discussion for the last few decades due to its highly oxidizing nature and its extensive role in global crop yield curtailments. Several modelling studies suggest a continuous increase in ground-level ozone concentrations in the near future, which makes this study influential. The present experiment was conducted to assess the effects of nitrogen amendments under elevated ozone conditions on two varieties of *Dolichos lablab*. Four types of nitrogen amendments and 30 ppb elevated O_3 were given (1) elevated O_3+Control with no nitrogen supplement, (2) elevated O_3+N1 with a recommended dose of nitrogen, (3) elevated O_3+N2 with 1.5 times the recommended dose, and (4) elevated O_3+N3 with 2 times the recommended dose of nitrogen. Physiological analysis revealed that *dolichos* plants provided with nitrogen amendments performed better under elevated O_3 concentrations. The biochemical analysis also revealed similar results that showed increased enzymatic activity (APX, SOD, CAT, GR) and decreased lipid peroxidation in plants with nitrogen amendments in comparison to control.
Keywords: Tropospheric ozone, Stress, Amendments

OP-VI-02 A RETROSPECTIVE VIEW OF NOISE POLLUTION DURING BHAVNATH MELA

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India a democratic country housing a population of around 140 Crore, is rich with its religious and cultural diversity, with more than 80 major festivals, celebration and public gatherings in the form of fairs commonly known as 'Mela'. These public gatherings cause various types of pollution. The current study focuses on the identification of various types of noise in the Eco-sensitive zone during the Bhavnath mela, thereby measuring the sound intensities and comparing it with the sound intensity of the normal days, along with precautionary measures and policies that can be framed for controlling, monitoring and eradication of unwanted noise.
Keywords: Cultural Diversity, Pollution, Eco-sensitive, Noise

OP-VI-03 ORNAMENTAL FISHES AND HUMAN BEINGS WITH REFERENCE TO STRESS

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The present study was done with an objective to investigate the impact of ornamental fishes on human stress. A survey was conducted on 100 persons (50 people with aquarium and 50 without aquarium) in Prayagraj. Sheldon Cohen (1994) Perceived Stress Scale (PSS) was used to measure perceived stress. It is the most widely used psychological instrument for measuring the perception of stress. Results indicates the substantial differences in perceived stress score ($t=15.57$; $p<.001$) among people with aquarium and people without aquarium. The participants mean score of perceived stress score of people with Aquarium and people without Aquarium was 12.72 and 23.14, respectively. It was also observed that low perceived stress score was among the people with aquarium, and moderate perceived stress score was among the people without aquarium.
Keywords: Ornamental fishes, Aquarium, Perceived Stress, Psychological instrument

OP-VI-04 AQUATIC PLANTS AS WATER PURIFIERS FROM GODAVARI RIVER AT NANDED

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For survival of all types of living organisms, water is an essential factor. Due to increase in population, industrialization, and urbanization, a number of rivers, lakes and even oceans are getting polluted. In Maharashtra, rivers are the major source of potable water and are largely exploited, as a source of drinking water, for agriculture, and as vital source of all types of life including plants. River water is the integral constituent of aquatic plant life and one of the most important natural resources. The present work was undertaken with a view to study the water pollution created by industries around the Godavari River at nanded and the role of macrophytes which are growing around the polluted areas. These macrophytes are found to be efficient in reducing the pollution by absorbing heavy metals which are harmful to human health.
Keywords: Aquatic angiosperms, Heavy metals, Water Pollution, Human health

OP-VI-05 PREDICTING CURRENT AND FUTURE HABITAT SUITABILITY OF THE *BERGENIA CILIATA* (HAW.) STERNB: A HIGH VALUE MEDICINAL PLANT OF INDIAN HIMALAYAN REGION

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Bergenia ciliata (Haw.) Sternb. is a valuable medicinal species belonging to family Saxifragaceae, which occurs in the Indian Himalayan Region (IHR). We used MaxEnt Model with 131 occurrence records and nine non-correlated environmental variables to predict the potential impact of climatic change on different scenarios of *B. ciliata*. The Akaike information criterion (AICc=0), feature combination (FC=H), and regularization multiplier (RM=4) were used to select the optimal model. The key factors were elevation, precipitation, and temperature that govern the habitat suitability and distribution for *B. ciliata* in IHR. The highly suitable areas are found to be Uttarakhand, Himachal Pradesh, Jammu and Kashmir, Sikkim, Darjeeling, Arunachal Pradesh, Meghalaya, Nagaland, Mizoram, and Manipur. Overall, from current to the future period, potentially suitable habitat of *B. ciliata* has reduced in IHR. Under the maximum greenhouse gas emission scenario in 2050 and 2070 (RCP8.5), the highly suitable areas would remain 43,986 km^2 and 40,334 km^2, respectively.

Keywords: Climate change, *Bergenia ciliata,* Habitat suitability, Indian Himalayan Region, MaxEnt modelling

OP-VI-06 EFFECT OF INTRASPECIFIC COMPETITION ON EARLY SEEDLING GROWTH IN *TRIGONELLA FOENUM-GRAECUM*

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Present study aims to investigate effect of competition on various growth traits of *Trigonella foenum-graecum*. Two sets of growth tubes were prepared; first set consisted of full- strength MS media, whereas another set only had agar solution. Each of these two sets were further divided into five sub types based on number of seeds inoculated in each growth tube, ranging from one to five; kept in controlled conditions of light and temperature (28±2ºC). Significant variations in dry seedling weight and total seedling length were due to treatment as well as competition, whereas, for root apical diameter, statistically significant results were observed only due to competition. It indicates that seedlings are capable of adapting their root response to different nutrient concentrations and intraspecific competition. An increase in relative yield with increasing seed number and negative values of competition indices (competition intensity

and absolute severity of competition) suggests competition avoidance in early seedling stages of *Trigonella foenum-graecum.*
Keywords: Competition, Early seedling growth, Competition intensity

OP-VI-07 WOODY SPECIES COMPOSITION AND PHYTOSOCIOLOGICAL CHARACTERS OF SAWAI MANSINGH SANCTUARY, RAJASTHAN, INDIA

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Ranthambhor tiger reserve is a milestone in conservation ecology. This research was conducted in Sawai Mansingh sanctuary, an important part of Ranthambhor Tiger Reserve, to delineate its tree diversity status. The study was conducted throughout the year seasonally and from all possible habitats like plateau, hills, slopes, valleys, ground, and river banks by random sampling method. For data collection, quadrates of 100 m×100 m were drawn randomly in the sanctuary, data was collected in form of dbh, and trees were recorded carefully. A total of 19,613 individuals belonging to 42 tree species, among 30 genera and 17 families, were recorded during the study. Most of the tree species are thorny and show xerophytic characters. *Anogeissus pendula* was recorded as the most dominant species, and Fabaceae as the most dominant family of the forest.
Keywords: Dominant, Sawai Mansingh Sanctuary, Tiger reserve, Woody species

OP-VI-08 *QUERCUS GRIFFITHII* (FAGACEAE): DISTRIBUTION AND CURRENT SUITABLE HABITATS IN NORTH EAST INDIA

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Quercus griffithii Hook. f. & Thomson ex Miq. is a deciduous tree species found in the western Himalayan and northeastern regions of India. Climate change, deforestation, and anthropogenic activities have caused habitat destruction of *Quercus griffithii.* We employed MaxEnt modeling tool to identify the most important environmental predictor and suitable habitat in current scenario. The AUC value was greater than 0.85, indicating the robustness of the model. Maximum temperature of the warmest month (bio5; 40.1%), temperature annual range (bio7; 18.2%), elevation (elev; 16.6%), and slope (11.4%) were the most influencing environmental variables. A total of 87 occurrence records and 10 environmental variables were used to predict habitat suitability. The model estimated highly suitable (9626 km^2), moderate suitable (86449 km^2), and least suitable (108720 km^2) areas occupied by *Q.*

griffithii. Current suitable habitat was found in East Khasi Hills in Meghalaya, western and eastern region of Arunachal Pradesh, northern Manipur including bordering area of Nagaland and eastern Mizoram. These predictions can be used for future explorations to study the genetic diversity, and to conserve and restore the *Q. griffithii* in north-eastern region of India.
Keywords: Climate change, MaxEnt, North-East India, *Quercus griffithii*

OP-VI-09 IMPACT OF BLACK STONE MINES ON WATER IN PAKUR

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Water is an indispensable commodity for the survival of life and maintenance of environment. There is an appreciable impact of black stone mining on ground and surface waters. Rapid development of mining areas in Pakur is causing impact on water. The water enters into ground table by pores of the rocks, cracks and crevices, etc. Thus, a sizeable quantity of groundwater is locked up and generally left unapproached. The mining causes impact on surface water and groundwater, lowers the water table, reduces moisture content in atmosphere and soil, raises the temperature and causes disturbance of hydrological cycle, rainfall and climate. In present study, the impact of black stone mining in water of Pakur area has been discussed.
Keywords: Black stone mining, Pakur, Ground water, Surface water

OP-VI-10 EFFECT OF INTERACTION OF HYDROPRIMING AND HALOPRIMING WITH INTENSITIES OF LIGHT ON GROWTH PARAMETERS OF TWO GENOTYPES OF WHEAT (*TRITICUM AESTIVUM* L.)

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The effect of interaction of hydropriming and halopriming (0.5%,1.0%, and 1.5 % concentrations of KCl, KH_2PO_4, $Mg(NO_3)_2$ and $MgSO_4$ salts), and different light intensities (100%, 70%, and 50%) were analysed on the morphological characteristics of the two genotypes of wheat namely WR-544 and DBW-187. Distilled water was used for hydropriming whereas K- and Mg- salts at different concentration were used for halopriming. The 70%, light intensity was created using muslin cloth, while for 50% light intensity, Mosquito net Iron frame was used. The genotype WR-544 showed a better plant height over DBW-187 at all the light intensities. Fluctuating trend was observed under the interaction of different light intensities and priming, considering the number of leaves and tillers. The wheat genotype WR-544 showed better S/R ratio than DBW-187 under interaction, however a better leaf area ratio was observed in DBW-187 as compared to WR-544.
Keywords: Hydropriming, Halopriming, Light Intensity, S/R Ratio, Leaf Area Ratio

OP-VI-11 CONSERVATION AND MANAGEMENT OF ENDANGERED SPECIES BY HUMAN POPULATION-A STUDY IN CHEGUR VILLAGE, HYDERABAD

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The life on earth began over 4.5 billion years ago. In the beginning, survival was difficult for all life forms and a large number of species were threatened, as the time passed numerous even got extinct, the reason can be known as the EVIL QUARTET. According to the IUCN Red List, in the future, many species have been listed as threatened and will get extinct in the nearing future. Few institutes like HEARTFULNESS are taking initiatives like afforestation where they preserve critically endangered species of plants. Kanha Shanti Vanam in Chegur Village has a HEARTFULNESS tree conservation center where new varieties of saplings are preserved utilizing the tissue culture technique. The Telangana government is also taking great pleasure in initiatives like these, which will be beneficial for our human society.
Keywords: Evil Quartet. Endangered, IUCN, Kanha Shanti Vanam Hyderabad, Tissue culture

OP-VI-12 *PYXINE COCOES* (SW.) NYL. AS A BIOMONITOR OF AIR POLLUTION IN SOME DISTRICTS OF UTTAR PRADESH

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Lichens are widely utilized organisms for air quality monitoring worldwide. The objective of the present study is to investigate heavy metal deposition in lichen species *Pyxine cocoes* (Sw.) Nyl. collected from Ballia, Lakhimpur Kheri, Moradabad and Raebareli districts of Uttar Pradesh. The microwave-acid digested samples of thalli were analyzed for different elements in ICP-MS. The mean concentrations of As and Fe were found higher in samples collected from Lakhimpur Kheri district followed by Co and Mn in Moradabad district and Cr and Zn in Raebareli district. In the analyzed lichen thalli metal concentrations ranked in the order of Zn>Mn>Fe>As>Cr>Co. Based on the present study, we can conclude that Moradabad and Raebareli were highly polluted followed by Lakhimpur Kheri and Ballia district of Uttar Pradesh. The source of pollution in these areas are mostly anthropogenic activities, vehicular emissions, construction, and roadside soil or dust. This study revealed the capability of *Pyxine cocoes* as an excellent accumulator of heavy metals.
Keywords: Biomonitor, climate change, contaminant, pollution, heavy metal

OP-VI-13 IMPACT OF PRADHANMANTRI UJJAWALA YOJANA (PMUY) OVER ADOPTION OF CLEAN FUEL IN RURAL AREAS OF PRAYAGRAJ

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Subsidized gas connections were distributed as cooking fuel to poor households to increase the use of LPG after the inception of Pradhan Mantri Ujjwala Yojana of the Government of India. However, with a large number of LPG connections, it is also important to understand how the beneficiaries have adopted it. This paper examines beneficiary households' response to the PMUY in respect of actual use of LPG, and identifies the underlying factors in rural areas of Prayagraj district, Uttar Pradesh. This study uses 400 data collected from households, and employed descriptive statistics and estimated the limited dependent model (Incidence of LPG) in relation to certain independent variable. The independent variables include gender, age, literacy, house, livelihood, caste, SHG, loan, agricultural land. The Probit regression model analysis highlighted the socio-economic and other factors that influenced the LPG usage. *Keywords*: LPG, Gender, Age, Literacy, House, Caste, Loan, Probit model

OP-VI-14 VARIABILITY IN PRIMARY AND SECONDARY METABOLITES IN *ALHAGI MAURORUM* MEDIKUS FROM INDIAN ARID ZONE

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The present paper deals with variability in primary (leaf pigments, osmotic potential, proline, total sugars, crude protein and phosphorus) and secondary (total alkaloids and phenols) metabolites during different developmental stages, *viz.* vegetative, flowering and fruiting in *Alhagi maurorum* Medikus (Family: Fabaceae), commonly known as Camelthorn from the Indian Thar desert. The plants are used to treat numerous diseases such as headache, toothache, cancer, liver disorders, kidney stone and urinary tract infections. The results revealed that leaf pigments, total sugars, phosphorus and crude protein were maximum during vegetative, whereas proline and osmotic potential during flowering and fruiting stages, respectively. Total alkaloids and phenols were found to be maximum during flowering stage. Thus, in present study an attempt was made to evaluate most suitable plant developmental stage for obtaining maximum amount of primary and secondary metabolites in *Alhagi maurorum*.
Keywords: *Alhagi maurorum*, Camelthorn, Fabaceae, Metabolites

OP-VI-15 EFFECT OF ZINC AND IRON FERTILIZATION WITH THE APPLICATION OF *OXALIS* EXTRACT IN ALLUVIAL SOIL ON GROWTH AND BIOCHEMICAL RESPONSES OF SPINACH

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A field experiment was conducted to study the effect of zinc and iron fertigation along with *Oxalis* extract in alluvial soil. Spinach plants were grown on: I-alluvial soil (Control), II-$ZnSO_4$ (25 kg ha^{-1}), III-$ZnSO_4$+plant extract, IV-$FeSO_4$ (25 kg ha^{-1}), V-$FeSO_4$+plant extract. Observations were made on growth and biochemical constituents (chlorophylls, protein, and activity of catalase and peroxidase). Growth and biochemical constituents were enhanced by zinc application along with *Oxalis* extract (10%). Iron fertigation also enhanced growth and biochemical constituents but abovesaid parameters were decreased on application of *Oxalis* extract.
Keywords: Zinc, Iron, *Oxalis* extract, Spinach

OP-VI-16 AMF SPORE DIVERSITY IN THE RHIZOSPHERIC SOIL OF GRAM AND PEA PLANT GROWING IN DIFFERENT AGRICULTURAL FIELDS OF JAUNPUR DISTRICT (U.P.)

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Arbuscular mycorrhizal (AM) fungi are beneficial symbionts for plant growth. AM Fungi protect the plant from all biotic and abiotic stresses. The present study has been undertaken for assessing the AM fungal spore population and diversity in the rhizospheric soil of *Pisum sativum* (Pea) and *Cicer arietinum* (Gram) at three different stages (seedling, vegetative and flowering) from three different agricultural fields of Jaunpur (UP). AMF spore population and diversity varies according to stages of plant growth for both the plants. AM fungal population varies from 18 to 97 spores per 10g soil. Maximum diversity has been recorded in *Pisum sativum*. Total of 28 AM fungal spores from five different genera *viz. Glomus*, *Acaulospora*, *Gigaspora, Scutellospora* and *Funneliformis* species, have been isolated. *Glomus* was predominant genus in all the stages of both selected plants for all the selected sites. AM fungi population and diversity is dependent on physico-chemical properties of soil.
Keywords: Arbuscular Mycorrhizal Fungi, Symbionts, Diversity

OP-VI-17 EFFECT OF PHOSPHORUS FERTILIZATION IN AN ALLUVIAL SOIL OF GOMATI UPLAND ON GROWTH AND SOME BIOCHEMICAL RESPONSES OF *CATHARANTHUS* SP.

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A bulk composite soil sample was collected from an area of Lucknow district (Badshahbaugh, Lucknow University Campus) 1.5 Km ahead from the river Gomti. Collected soil sample was evaluated for some physical and chemical properties including available phosphorus content (< 50 mg Kg^{-1} soil). Various levels of phosphorus fertilizer DAP (diammonium phosphate) were amended in the soil viz. nil (control), 25, 50, 100 and 150 mg kg^{-1} soil. *Catharanthus* plants were grown and studied for growth (length and dry weight) and some biochemical constituents such as pigment content (Chlorophyll a, b, total chlorophyll, and carotenoids), protein content and activity of catalase and peroxidase in leaves. Maximum growth and biochemical responses were observed at 50 mg DAP kg^{-1} soil amendment level.
Keywords: Phosphorus fertilizers, *Catharanthus,* Alluvial soil, Growth

PP-VI-01 ASSESSMENT OF BIODIVERSITY AND BIOACCUMULATION OF HEAVY METALS BY NATURALLY OCCURRING VEGETATION GROWING ON FLY ASH DUMPS

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The present study focused on screening native plants growing on fly-ash (FA) contaminated area near Talcher Thermal Power Plant, Odisha, with a view to use those for the eco-restoration of the FA contaminated areas. Nine herbs, three shrubs and eight trees were screened for heavy metal accumulation ability. *Typha latifolia* was most efficient metal accumulator for Fe in roots (5016 mg kg^{-1} dw) and *Pteris vittata* for As in frond (22 mg kg^{-1} dw). Maximum concentration of Cr (3.5mg kg^{-1} dw) was found in roots of *Pennisetum glaucum* and *Hyptis suaveolens*. In general, herbs accumulated more metal than shrubs and trees.
Keywords: Biodiversity, Fly-ash, Heavy metals

PP-VI-02 EVALUATION OF GROWTH RATE AND PHOTOSYNTHETIC PIGMENTS OF *SACCHARUM OFFICINARUM* (L.) FROM POLLUTED AREA IN INITIAL STAGE

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Saccharum officinarum is a valuable crop that has high sugar content. In this research, effect of air pollution on vegetation was investigated. We chose polluted and non-polluted sites for the comparative study of plant sample. Plant grown in the polluted area had stunted growth, increased chlorosis and scars on stem and leaves. These were the effect of obnoxious gaseous factors which had been found in multiplied stage within the polluted place. Stem eye viability was reduced in polluted area than that of non-polluted area. This study portrays a clear view of the detrimental effects of air-pollutants on vegetation. Physiological and biochemical results also shows variation in the vegetation grown in polluted and non-polluted areas.
Keywords: Air pollution, *Saccharum officinarum,* Physiology, Biochemistry

PP-VI-03 COMPARATIVE STUDY OF CHROMIUM PHYTOREMEDIATION BY TWO AQUATIC MACROPHYTES

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Catastrophic effect of Chromium includes both mutagenic and carcinogenic activities. It occurs in several oxidation states in which hexavalent forms of Cr are more toxic and causes several health hazards. A preliminary hydroponic experiment was conducted to analyze the comparative uptake of chromium in two aquatic macrophytes: viz. *Marsilea minuta* and *Pistia stratiotes.* Exposure of four concentrations (0.5 mM, 1.0 mM, 1.5 mM, and 2.0 mM) of $K_2Cr_2O_7$ salt was given to both plants for 3 days to visualize the effect of Cr metal. Highest uptake of chromium was seen in 1.0 mM concentration at 72 hours in both the plants. Dry weights and MDA content were found elevated in comparison of both the plants. Further analysis of some other biochemical and antioxidative parameters is required to understand the physiology under stress. The results of initial studies indicate that both the macrophytes are suitable candidates for Cr phytoremediation.
Keywords: Bioaccumulation, Heavy metals, Ferns, Antioxidants, Oxidative stress

PP-VI-04 COMPARATIVE BIOMONITORING STUDY OF ATMOSPHERIC QUALITY IN FIVE LOCATIONS OF JAIPUR CITY (RAJASTHAN) EMPLOYING THE TRANSPLANTED LICHEN *PYXINE COCOES* (SW.) NYL.

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Lichens are the best bioindicators of environmental pollution. In present study, we measured the level of air pollution at different sites of Jaipur City by transplanting an epiphytic lichen *Pyxine cocoes* (Sw.) Nyl collected from control site i.e., Mt. Abu. Chlorophyll content at control site was found to be maximum (0.380μgg^{-1}), at Jaipur junction, Rambagh circle (0.342 μgg^{-1} 0.336 μgg^{-1}, respectively) followed by Sindhi camp bus stand, General post office MI road, Chandpole (0.294 μgg^{-1}, 0.252 μgg^{-1}, 0.247 μgg^{-1}, respectively). Carotenoid content ranged between 0.137 to 0.368 μg g^{-1} and was highest in Rambagh circle Jaipur. Net protein content varied from 0.493 to 1.747 μgg^{-1} fresh weight observed to be maximum in samples transplanted along roadside. Elemental concentration of heavy metals such as Aluminum, Iron, Nickel, Chromium, Cadmium, Zinc, Lead, and Copper showed a variable trend. Results showed that Sindhi camp and Chandpole are highly polluted areas as compared to other transplant sites.
Keywords: Air pollution, Lichen, Chlorophyll content, Heavy metal, Jaipur

PP-VI-05 INTERACTIVE EFFECTS OF ELEVATED OZONE AND NITROGEN AMENDMENTS ON MEDICINAL PLANTS: A CASE STUDY OF LEMONGRASS

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The phytotoxic tropospheric ozone (O_3) is a secondary air pollutant. Nitrogen amendments are known to assist in plants in management of O_3 stress, thereby reducing the deleterious effects of O_3 injury. This experiment estimated the oxidative stress of ambient and elevated (ambient+15, 30 ppb) ozone treatment individually and in combination with soil nitrogen doses (N_1: recommended; N_2: 1.5 times recommended and N_3: 2 times recommended) on various morphological, physiological, biochemical and yield parameter of *Cymbopogon citratus.* Ozone oxidative stress activated the antioxidant pool with an accompanying increase in secondary metabolites and ROS scavenging activities suggesting an adaptive approach for *Cymbopogon citratus* plant against ozone stress. It was observed that the yield of essential oils also increased upon O_3-N interactions, with the highest increments being observed at N_2 treatment. Thus, different soil nitrogen doses led to a partially mitigating role (N_2 does: most effective) against ozone stress and improving the plant's medicinal properties.

Keywords: Ozone, Nitrogen amendments, Medicinal plants, Bioactive components, Essential oils

PP-VI-06 COMPREHENSIVE ANALYSIS OF WATER QUALITY CHANGES OF GOMTI RIVER AT VARIOUS LOCATIONS

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Air, streams, ponds and groundwater hold less than 1% of fresh water which fulfills the vital demand of fresh water. Water holds a significant part in the daily routine of people and other existing life on earth. Presently, due to the degradation of water quality the potable water available to the public is a serious concern. In the present study we analyzed the water of the Gomti River at various time points and from various sampling areas. The water quality was analyzed considering the eight physical properties like pH, BOD, UA, COD, Temperature, Stiffness, TDS and Alkalinity.
Keywords: Temperature, pH, BOD, UA, COD, Physiochemical parameters

PP-VI-07 IMPACT OF CLIMATE CHANGE ON WHEAT YIELD AND GRAIN NUTRIENT CONTENT

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Wheat varieties were exposed to elevated levels of CO_2 (550 ppm), O_3 (+ 20 ppb above ambient) and temperature (+ 20C above ambient) under Free Air Concentration Enrichment facility to understand their responses under future climate change scenario. Cultivar HD-2967 showed 58% loss in yield in combined treatments as compared to control, while in PBW-154 only 5% yield loss was recorded. Grain carbohydrate and starch contents were reduced by 64 %, 16 %, respectively in HD 2967, while they increased in PBW 154 by 50 % and 55%, respectively. The study assumes significance in identifying the climate resilient wheat variety.
Keywords: CO_2, O_3, Temperature, FACE, Wheat

PP-VI-08 THE IMPACT OF UNSUSTAINABLE ACTIVITIES ON THE FERTILE SOIL OF TONS RIVER ECOTONE NEAR PRAYAGRAJ (U.P.)

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The study was carried out in the ecotone region of Tons River, Prayagraj, to explore damage caused to it through the encroachment by local villagers. Continuous recycling of nutrients occurs here by the regular flow of river water making the whole area fertile and hence

enabling a wide range of flora and fauna to flourish here. This ecotone is devoid of natural vegetation as it is majorly used as agricultural farms which makes it susceptible to soil erosion. Encroachment of this area by locals, waste disposal, and other environment deteriorating practices are posing the major threat of soil contamination by heavy metals, altering of soil biota, LULC (land use/land cover) changes, soil-borne pathogens, non-biodegradable wastes like polythene, synthetic fabrics, etc. in this region and hence causing damage to its ecosystem.

Keywords: Ecotone, LULC (Land Use/Land Cover), Heavy metals, Soil-borne pathogens, Soil biota

PP-VI-09 EFFECT OF APPLICATION OF ORGANIC AMENDMENTS ON *TRITICUM AESTIVUM* L. CROP UNDER THE NICKEL-INDUCED CONDITION

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Effect of organic amendments (rice husk-RHA and sugarcane bagasse ash-SBA) applied at 1%, 2%, and 4% on Ni (100 µg/g DW)-induced toxicity in wheat (*Triticum aestivum* L. var. HUW 234 and HUW 510) seedlings. These varieties were examined at 45 and 90 days after seed germination, for growth, physiological and biochemical levels in leaf tissues. Growth parameters, though reduced significantly due to Ni contamination, were increased significantly due to application of RBA in Ni-contaminated soil. As compared to control, biochemical parameters were significantly elevated in leaf tissues of plants grown in Ni-contaminated soil. Conversely, plants growing on Ni-contaminated soil showed significant drop-in all biochemical assays with increasing application rates of both RBA. When applied to HUW 234 as opposed to HUW 510, SBA at 4% had the greatest ability to reduce Ni-induced toxicity. Findings showed that organic amendment can reduce the deleterious effects of nickel on agricultural crops and may assist increase crop output in Ni-contaminated areas.

Keywords: Nickel, *Triticum aestivum,* Organic amendments, Toxicity

PP-VI-10 ROS GENERATION DUE TO GENOTOXIC EFFECTS OF LEAD (PB) IN SEEDLINGS OF *TRITICUM AESTIVUM*

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Genotoxicity arising due to heavy metal pollution is growing at an alarming rate. The genotoxic effects of heavy metal pollution, with special reference to lead, were observed in *Triticum aestivum*. The study includes seed germination assay, cytotoxic assay, enzyme assay and bioaccumulation in seeds to reveal the toxic effects of heavy metal pollution on bioaccumulation, growth and development of *Triticum aestivum* seedlings. There was a significant alteration in the activities of APx and GPx enzymes, coupled with chromosomal

abnormalities such as chromosome decondensation, chromosomal laggard, C- mitosis, Anaphase Bridge, micronuclei formation, and vagrant metaphase due to heavy metal accumulation in cells.

Keywords: Genotoxicity, Free radicals, Oxidative stress, Heavy metals, Lead, *Triticum aestivum*

PP-VI-11 VISIBLE INJURY AND BIOMARKERS AS POTENTIAL BIOMONITORING TOOL FOR OZONE STRESS IN PLANTS

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Tropospheric ozone (O_3) is a secondary air pollutant and an abiotic stressor. Ozone-generated ROS led to oxidative stress in plants activating signal transduction pathways resulting in up- or down-regulation of genes, remodeling of protein expression pattern, and altered metabolic processes. This disrupted metabolism manifests as visible foliar symptoms in sensitive plants. Such sensitive plants are utilized as biological indicators to monitor ambient O_3 levels, irrespective of direct estimation of O_3 uptake. Antioxidative enzymes, ascorbic acid, thiols, secondary metabolites, and HSPs have been detected as O_3 stress biomarkers. Also, O_3-induced transcripts, protein expression, and DNA damage can aid as molecular markers for O_3 stress. However, the biomonitoring approach's utmost challenge is to establish a linear relationship between the measured markers in plants and pollutant concentrations. Present work illustrates the bioindicators' efficacy to monitor O_3 phytotoxicity.

Keywords: Biomonitoring, Biomarkers, Foliar injury, Molecular markers, Tropospheric ozone

PP-VI-12 VARIOUS NATURAL AND ANTHROPOGENIC FACTORS RESPONSIBLE FOR WATER QUALITY DEGRADATION

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Recognition of sustainability issues around water resource consumption is gaining traction under global warming and land utilization complexities. These concerns increase the challenge of gaining an appropriate comprehension of the anthropogenic activities and natural processes, as well as how they influence the quality of surface water and groundwater systems. The characteristics of water resources cause difficulties in the comprehensive assessment regarding the source types, pathways, and pollutants behaviours. As the behaviour and prediction of widely known contaminants in the water resources remain challenging, some new issues have developed regarding heavy metal pollutants. The main aim of this review is to focus on certain essential pollutants' discharge from anthropogenic activities categorized based on land-use sectors such as industrial applications (solid/liquid wastes, chemical compounds, mining activities, spills, and leaks), urban development (municipal

wastes, land use practices, and others), and agricultural practices (pesticides and fertilizers). Further, important pollutants released from natural processes classified based on climate change, natural disasters, geological factors, soil/matrix, and hyporheic exchange in the aquatic environment, are also discussed. Moreover, this study addresses the major inorganic substances (nitrogen, fluoride, and heavy metals concentrations).
Keywords: water quality degradation, contamination sources, anthropogenic activities

PP-VI-13 Interactive effect of ozone (O_3) and CO_2 on wheat

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The present experiment has been designed to study the interactive effect of elevated O_3 and elevated O_3 on selected wheat cultivars with varying O_3 sensitivity as both the entities have antagonistic effects on the plants. While as O_3 is a potent oxidative pollutant and CO_2 acts as a substrate for photosynthesis. The experimental plants were subjected to elevated O_3 and CO_2 treatments, singly and in combination. Results clearly show that the CO_2 fertilization was successful in the management of O_3 stress in wheat cultivars, with sensitive cultivar showing more positive results. The present experiment proposes the utilization of elevated CO_2 in ameliorating O_3 stress in plants in near future.
Keywords: Ozone, CO_2, Wheat, Amelioration

SECTION VII

PLANT PHYSIOLOGY AND BIOCHEMISTRY

OP-VII-01 SHORT-TERM UV-B TREATMENT FOR SECONDARY METABOLITE INDUCTION IN *WITHANIA SOMNIFERA*

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Ashwagandha (*Withania somnifera*) is an ancient medicinal plant and withaferin A is being actively utilized for treatment of various cancers and many other diseases. The low production of metabolites in plant lead to development of strategies to enhance its production. In present study, UV-B in mild doses for short term irradiation was applied that resulted in enhanced withaferin A in leaves of *W. somnifera*. A maximum of 102% increment in withaferin A after UV-B irradiation was reported; whereas, flavonoids showed 100% increment under UV-B irradiation. The size of glandular trichomes which are the storage site for secondary metabolites were also slightly enhanced.
Keywords: *Withania somnifera*, Abiotic stress, Withaferin A, Anthocyanin, Flavonoid

OP-VII-02 MORPHOLOGICAL AND PHYSIOLOGICAL PARAMETERS OF IRON ON THREE BLACK GRAM VARIETIES

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Iron is one of important and limiting micronutrients. Effect of iron supplied either in soil or in combination of both soil and foliar spray (0.5%) was studied in black gram varieties in term of their growth, photosynthetic pigments and enzyme activities at 30 and 60 days of growth. Root and shoot length plants increased markedly after 30 days of soil and foliar application. Iron application increased photosynthetic pigments at 30 and 60 days of growth in all three varieties black gram. Catalase activity was increased initially at 30 days and decreased at 60 days of growth. Peroxidase activity was decreased both at 30 and 60 days of growth.
Keywords: Black gram, Growth, Photosynthetic pigments, Catalase and Peroxidase

OP-VII-03 UNRAVELING THE ROLE OF GLUTATHIONE IN REGULATING SUB-CELLULAR IRON HOMEOSTASIS IN *ARABIDOPSIS THALIANA*

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Maintaining iron (Fe) homeostasis under Fe deficiency is crucial for plant survival. Here, we explored the glutathione (GSH)-mediated regulation of Fe homeostasis during Fe deficiency in Arabidopsis. The GSH-depleted mutants, *cad2-1* and *pad2-1*, displayed increased sensitivity to Fe deficiency with a lower expression of the vacuolar Fe exporters, *AtNRAMP*3 and *AtNRAMP*4, and the chloroplast Fe importer, *AtPIC*1. Moreover, the mutants accumulated higher Fe content in the vacuole and lower in the chloroplast compared with Col-0 under Fe limited condition. Further analysis revealed that the GSH-GSNO module induced transcription of these genes via the *S*-nitrosylated transcription factors, *At*bHLH29, *At*bHLH38 and *At*bHLH101.

Keywords: Glutathione, Fe homeostasis, Fe exporters, *S*-nitrosylated transcription factors

OP-VII-04 IDENTIFICATION OF miRNAs IN *SORGHUM BICOLOR* (L.) MOENCH FOR IMPROVING BIOMASS AND DEFENCE

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One of the best crops for producing bioethanol is sorghum (*Sorghum bicolor* L.). Small non-coding RNAs known as microRNAs (miRNAs) have gained attention as potential critical targets for engineering agronomical propertiesof crops, including biomass output, sugar accumulation, blooming time, abiotic stress, etc. The genes involved in flower development were submitted to miRNA target prediction using the *in silico* method, psRNA target, in order to determine the function of miRNAs in sorghum blooming. Furthermore, RNA hybrid, another online source corroborated these targets. The important sorghum flowering genes were revealed to be the targets of many miRNAs. This shows that miRNAs may be crucial in regulating sorghum flowering and thereby may be useful in boosting biomass production.

Keywords: *Sorghum*, microRNA, Flowering, Biomass, Gene regulation

OP-VII-05 IMPACTS OF ULTRAVIOLET RADIATION ON THE CYANOBACTERIUM *SYNECHOCYSTIS* SP. PCC6803 AND ITS RECOVERY UNDER PHOTOSYNTHETICALLY ACTIVE RADIATION

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In this study, we have investigated the effects of ultraviolet radiation (UVR) and photosynthetically active radiation (PAR) on the cyanobacterium *Synechocystis* sp. PCC 6803 for 48 hours. The photosynthetic performance, reactive oxygen species (ROS), and cell death were recorded. The chlorophyll *a* and carotenoids decreased significantly after 48 h of PAR+UV-A+UV-B (PAB) treatment. The accessory light-harvesting pigment phycocyanin

(PC) decreased significantly to 69% after 48 h of PAB treatment as compared to PAR+UV-A (PA). ϕPSII decreased to 41% as compared to control. There was a 5-fold increase in ROS after 48 h of PAB treatment as compared to control. In post-irradiated recovery, Chl *a* and total protein contents were increased significantly, confirming the recovery of *Synechocystis* cells.

Keywords: Cyanobacteria, Flow cytometry, Photosynthetically active radiation (PAR), Ultraviolet radiation (UVR), *Synechocystis* sp. PCC 6803

OP-VII-06 Nitric oxide and hydrogen sulfide: Warriors against arsenate stress in rice seedlings

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Anthropogenic activities have resulted in water bodies and paddy fields to be enveloped with arsenate exposure resulting in stress. Nitric oxide (NO) and hydrogen sulfide (H_2S) since their discovery have proven to individually incorporate in plant stress management while the pathways of stress regulation through their crosstalk remain elusive. The current study focuses on investigating the interplay of NO and H_2S signalling in the amelioration of arsenate As(V) toxicity in rice seedlings and managing its growth, photosynthesis, sucrose and proline metabolism. Results show that As(V) exposure declined fresh weight (biomass) due to induced cell death in root tips. Moreover, a diminished RuBisCO activity, decline in starch content with high proline dehydrogenase activity and increased total soluble sugars content was observed which further intensified in the presence of Nω-nitro-L-arginine methyl ester hydrochloride (L-NAME, an inhibitor of nitric oxide synthase-like activity), and DL-propargylglycine (PAG, an inhibitor of cysteine desulfhydrase activity). These results correlate with lower endogenous level of NO and H_2S. Addition of L-NAME increased As(V) toxicity. Interestingly, addition of SNP reverses effect of L-NAME suggesting that endogenous NO has a role in mitigating As(V) toxicity. Similarly, exogenous H_2S also significantly alleviated As(V) stress, while PAG further stimulated As(V) toxicity. Furthermore, application of H_2S in the presence of L – NAME and NO in the presence of PAG could still mitigate As(V) toxicity, suggesting that endogenous NO and H_2S could independently mitigate As(V) stress.

Keywords: Arsenate stress, Mitigation, Signalling, Cell Death, RuBisco activity

OP-VII-07 Plant growth regulators: A remedy to mitigate metribuzin toxicity in *Vigna radiata*

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Metribuzin is an important herbicide intended for controlling weed population in crops. Excessive use of metribuzin in agriculture may cause toxicity in crop plants. In view of this concern, the present study was conducted to assess the toxicity of metribuzin and its mitigation through plant growth regulators (GA, IAA and SA) in *Vigna radiata*. Metribuzin treatment to plants resulted in inhibition of seedlings growth and alteration of biochemical parameters (lipid peroxidation, proline accumulation and antioxidant enzymes). However, exogenous application of plant growth regulators significantly improved the morphological and biochemical parameters of plants.

Keywords: Plant growth regulators, Metribuzin, *Vigna radiata*, Lipid peroxidation

PP-VII-01 IMPACT OF BIOGENIC *PIPER BETLE* MEDIATED GOLD NANOPARTICLES ON PHYSIOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF *VIGNA MUNGO*

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Piper betle L., an evergreen creeper, is known to possess medicinal properties. The objective of this study was to determine the impact of betel bioengineered gold nanoparticles (AuNPs) on physiological and biochemical attribute of *Vigna mungo*. Seeds of *Vigna mungo* were treated with different concentrations of betel AuNPs (50, 100, 200 400 and 800µM) to study impact of betel AuNPs on seed germination, plant growth and biochemical parameters. This study revealed that lower concentrations (50-200 µM) of betel AuNPs improved seed germination, photosynthesis and mitigated production of reactive oxygen species. High concentration (800 µM) of betel AuNPs induced oxidative stress and affected plant growth and photosynthetic efficiency.

Keywords: *Vigna mungo*, Photosynthetic pigments, Germination, Gold nanoparticles, Betel

PP-VII-02 CADMIUM INDUCED OXIDATIVE STRESS AND EVALUATION OF ANTIOXIDANT DEFENSE SYSTEM IN *SORGHUM BICOLOR*

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Cadmium (Cd) is a non-essential and hazardous metal. The study evaluates role of antioxidants in alleviation of Cd stress in *Sorghum bicolor* (sorghum). Fifteen days old hydroponically grown seedlings of sorghum were subjected to Cd stress at different concentrations (10 to 200 µM). Cd-treated sorghum seedling were harvested after 24, 48, 72, 96, 120, 144 and 168 h to analyze plant growth and oxidative stress. After 96 h of Cd treatment, Sorghum exhibited Cd tolerance at lower concentrations (50, 75 µM), but after 168 h same Cd concentration was sub-lethal. The present study revealed that sorghum has high

stress tolerance potential and phytoremediation ability against Cd stress. It can be used as a hyperaccumulator at Cd-contaminated sites.
Keywords: Abiotic stress, Metal, Cadmium, Toxicity, *Sorghum bicolor*, Antioxidants

PP-VII-03 STUDY OF VARIATION IN PHYTOCHEMICAL PROFILE, ENZYME AND ANTIOXIDANT ACTIVITY OF SOME INDIAN WHEAT (*TRITICUM AESTIVUM* L.) VARIETIES DURING GERMINATION

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Wheat is a major grain in human diet. Differences in phytochemical profiles and antioxidant activities of different wheat varieties influences the nutritional and health benefits of this cereal. Germinated wheat grains are more packed with health promoting bioactive compounds. Therefore, the objective of this study was to determine the phytochemical, enzyme and antioxidant status of ten different Indian wheat varieties during germination. The experiments included estimation of total phenolic, protein, carbohydrate, flavonoids, catalase, peroxidase and superoxide dismutase activity. Antioxidant activity was determined by DPPH and FRAP assay. The results showed a multifold increase in tested parameters, with varietal differences.
Keywords: Antioxidant, *Triticum aestivum*, Bioactive compounds

PP-VII-04 INSIGHT THE FUNCTIONAL MECHANISM OF OsSALT, A JACALIN DOMAIN CONTAINING PROTEIN: A MASTER REGULATOR OF DROUGHT STRESS TOLERANCE *IN PLANTA*

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Plants always face a plethora of environmental stresses during their life cycle. In recent climatic condition, drought is a major threat for crop production. Rice is the staple crop in India and the cultivation is severely hampered by drought stress. Recently, lectin was identified as a key regulator of biotic as well as abiotic stress tolerance in plants. In this study, we identified that *OsSalt,* a JRL subfamily member displayed significant drought tolerance in plants. Further, in depth analysis highlighted that *OsSalt* interacts with two drought responsive transcription factors, *OsNAC1* and *OsDREB2A* to impart drought stress tolerance in planta.
Keywords: Drought tolerance, *OsSalT*, *OsDREB2A*, *OsNAC1*

PP-VII-05 INFLUENCE OF NaF ON GROWTH AND PHOTOSYNTHESIS CHARACTERISTICS OF *WITHANIA SOMNIFERA* L.

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Withania somnifera is a potent medicinal herbal drug used for rejuvenating cellular system of the human beings, cures memory loss and immunity. It is a perennial herb with alternate dull green colour leaves, tuberous roots enriched with bioactive molecules. Our findings revealed plant growth upon application of NaF. The severity of NaF impaired plants' growth linked with SPAD values. NaF negatively influenced stomatal conductance and photosynthesis while VPD enhanced it. These characteristics were found to be very well correlated with the harvest index and plant productivity.
Keywords: *Withania somnifera*, Sodium fluoride, Stomatal conductance, Photosynthesis

PP-VII-06 EFFECT OF PLANT GROWTH REGULATORS ON GROWTH AND YIELD OF CHILLI (*CAPSICUM ANNUM* L.)

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The current work was carried out at Dharmabad, Nanded district, Maharashtra. The experiment was set up in a randomized design with three replications and ten different growth regulator treatments. The results showed that foliar treatment had an effect on plant vigor and yield of chilli plants. The growth regulators tricontanol and gibberellic acid applied on foliage at flowering and bud stage were found to be effective in increasing plant height, plant spread, number of branches, and number of fruits per plant when compared to control in terms of yield contributing characters such as days to 25% flowering, fruit set, fruit length, and fruit diameter.
Keywords: Growth regulators, Flowering, Plant height, Plant spread

PP-VII-07 PHYTOREMEDIATION OF HEAVY METALS: A QUENCHING PROCESS OF ENVIRONMENTAL TOXICITY

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Heavy metals are rapidly increasing in the environment (air, soil, and water) because of anthropogenic activities and industrialization. Heavy metals are non-biodegradable and thus persist in environment for long periods of time, affecting ecosystems as well as human health

through their entry into the food chain. Phytoremediation is a plant-based sustainable approach for removal of heavy metals from the soil. The plant uses different techniques and modes for the accumulation of toxic metals in vacuoles in a non-toxics form. Phytoremediation efficiency of plant can be enhanced through the genetic approach and *via* modulation of metabolic pathways that are involved in heavy metal accumulation. Further investigations are needed to develop new methods of effective recovery of metals from the harvested biomass.

Keywords: Phytoremediation, Heavy metals, Accumulation, Sustainable, Ecosystem, Tolerance

PP-VII-08 PHYTOREMEDIATION: A PROMISING APPROACH TO REMEDIATE SALT FROM SALINE AND SODIC SOIL

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Salt stress is one of the major harmful abiotic stress. Increased soil salinity poses a severe global threat to agricultural productivity. It impacts about 1 billion hectares in over 100 nations worldwide and the numbers are continuously increasing. A variety of preventative and proactive (reclamation) techniques can be used separately or in combination to increase plant salt resistance and crop nutrition in salt-affected environments. Phytoremediation is an acceptable green technology in which plants work as hyper-accumulators, extracting and accumulating salts from soils. To increase the efficiency of phytoremediation; search for more active hyper accumulators with fast growth, high biomass, better tolerance and accumulation of metals, salts and other inorganics is essential. Moreover, phytoremediation may be examined for further investigations at molecular and nanoscale levels.

Keywords: Salinity, Salt stress, Phytoremediation, Hyperaccumulator, Reclamation, Sodic soil

PP-VII-09 SALICYLIC ACID ALLEVIATES GROWTH ATTRIBUTES OF *VIGNA RADIATA* L. SEEDLINGS UNDER BENZOIC ACID TOXICITY

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Phytohormone supplementation could regulate growth and development of plants both under favourable and unfavourable conditions. The current study was undertaken to assess the potential roles of salicylic acid (SA) in mitigating the deleterious effects of benzoic acid (BA) in *Vigna radiata* seedlings. BA, a phenolic allelochemical is known to cause detrimental effects on plant species. The results revealed that BA could alter physiological and biochemical parameters of test plant resulting in reduced growth. However, SA application

ameliorated BA toxicity by strengthening the defensive mechanisms of *V. radiata* efficiently. Our results concluded that SA could promote growth of plants under allelopathic stress.
*Keywords***:** Benzoic acid, *Vigna radiata*, Salicylic acid, Reactive oxygen species, Oxidative stress

PP-VII-10 EFFECT OF ZINC AND CHELATE (EDTA) APPLICATION IN SOIL ON GROWTH AND SOME BIOCHEMICAL CONSTITUENTS OF *PHASEOLUS VULGARIS*

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A clay pot experiment was conducted for zinc management with help of chelate (EDTA) application (10 mMole) in soil. Plant growth (shoot length and dry weight), pigments and protein content of *Phaseolus vulgaris* were measured. Various doses of Zn such as I – Control (native soil), II – 10 mg/kg $ZnSO_4$, III- 25 mg/kg $ZnSO_4$, IV – 50 mg/kg $ZnSO_4$and V- 25 mg/kg $ZnSO_4$+EDTA were applied in soil. Maximum plant growth (shoot length and dry weight) was observed in the soil applied with $ZnSO_4$ and EDTA at 25 mg/kg and 10 µM respectively. Biochemical constituents were also enhanced by Zn application but promontory effect was more in plants supplied with Zn along with chelate (EDTA).
Keywords: Zinc, EDTA, *Phaseolus vulgaris*, Biochemical constituents

PP-VII-11 EXOGENOUS APPLICATION OF H_2S AND ITS IMPACT ON PHYSIOLOGICAL ATTRIBUTES OF *SPINACIA OLERACEA* PLANTS GROWN IN Cd CONTAMINATED SOIL

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The present study was based upon the assessment of physiological attributes of *Spinacia oleracea* plants grown in Cd contaminated soil and supplemented with foliar application of NaHS (10, 50,100, 200 and 500 µM). Among all these doses, maximum reduction of Cd and level of oxidative biomarker was recorded at 100 µM NaHS. The foliar spray of NaHS leads to increase in the growth and antioxidant properties of plants as compared to those grown without NaHS supplementation. The live cell and SEM imaging supported the data by showing the better stomatal density and pore size at 100 µM of NaHS application. It suggests this dose could be beneficial for the growth and mitigation of Cd-induced oxidative stress.
Keywords: Heavy metal, Signaling molecule (NaHS), Cadmium, *Spinacea oleracea*

PP-VII-12 EFFECT OF CADMIUM CONTAMINATED SOIL ON OKRA (*ABELMOSCHUS ESCULENTUS*): HYPERACCUMATION AND MORPHO-OXIDATIVE STRESS

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The current investigation aimed to gauge the effect of different dose of cadmium (0, 30, 45, 60, 75 mg/kg of soil) on morphology and biochemistry of okra under natural conditions. The cadmium was applied through soil at 10 days after sowing (DAS). The plants were sampled at 30 DAS to monitor different parameters. The result directs that most of the studied traits such as plant growth, leaf area, and photosynthetic parameters were significantly reduced in a dose-dependent way. Stress application increased the proline content and reactive oxygen species (ROS) build-up. Out of several tested dose, 75 mg/kg of soil Cd proved worst in causing stress in tested plants.
*Keywords***:** Heavy metal stress, Reactive oxygen species, Phytoextraction, Growth, Biochemistry

PP-VII-13 EFFECT OF FOLIAR SPRAY OF CRUDE LIQUOR ON GROWTH AND TUBER YIELD IN POTATO (*SOLANUM TUBEROSUM* L.)

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The effect of foliar spray of crude liquor was assessed on potato crop under field conditions. *Chipsona*1 tubers were raised into seedlings, allowed to grow to achieve our objectives. Four doses (25, 50, 75 & 100%) of crude liquor diluted with water were sprayed over potato crop plants to monitor plant height, foliar and tuber fresh weights along with harvest index. Our findings negatively favoured for plant height (20-50%) and foliar fresh weight (42-82%) with increasing applied liquor doses. Notably, 25 and 50% doses of crude liquor used for spraying over the potato crop plants have shown significant improvement in tuber fresh weight yield (*ca.* 2folds) to support the socioeconomic and agribusiness of the potato growers of U.P.
Keywords: Crude liquor, *Solanum tuberosum*, Chipsona1, Foliar spray, Socioeconomy

PP-VII-14 INFLUENCE OF ASCORBIC ACID IN IMPROVEMENT OF FUNCTIONAL Fe STATUS IN MAIZE PLANTS

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Iron is one of the essential micronutrients. The present study was aimed to decipher role of reductant in increasing functional Fe status in maize (*Zea mays)* plants under hydroponic culture condition. Maize seedlings were supplied with 150 µM Fe-EDTA (as positive control), 50 µM Fe-EDTA (Fe-deficient as negative control) and 50 µM Fe-EDTA along with 50 µM ascorbic acid (as a ligand-reductant treatment). Visual observations and biochemical studies revealed that Fe-EDTA along with ascorbic acid were effective in term of their contributions towards improving functional Fe status as indicated by high chlorophylls, carotenoids, lipid peroxidation, and heme-Fe enzymes activities (catalase and ascorbate peroxidase).
Keywords: *Zea mays*, Functional iron, Fe-EDTA, Ascorbic acid, Heme-Fe enzymes

PP-VII-15 ALLEVIATIONS OF ZINC DEFICIENCY BY EXOGENOUS NITRIC OXIDE SUPPLY IN RICE PLANTS

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Nitric oxide (NO) is a diffusible signalling molecule. The present study was aimed to decipher the protective role of NO-releasing compounds (sodium nitroprusside, SNP, and S-nitrosoglutathione, GSNO) against Zn-deficiency-induced oxidative stress as indicated by enhanced H_2O_2, and lipid peroxidation and decreased chlorophyll concentration. The effect of Zn-deficiency was moderated by exogenous NO application as indicated by levels of H_2O_2, and antioxidant defence enzymes: catalase, guaiacol peroxidase, and glutathione reductase. Ferric chelate reductase was restored by NO application in Zn-deficient plants. The effect on the release of phytosiderophore, however, was differential and it was enhanced by GSNO and decreased by SNP in Zn-deficient plants.
Keywords: *Oryza sativa,* Nitric oxide, Zinc deficiency, Hydrogen peroxide, Antioxidant enzymes

PP-VII-16 RHIZOME-SOAKING WITH SMOKE-SATURATED WATER BOOSTS GERMINATION AND LEAF PHYSIOLOGY OF *MENTHA ARVENSIS* L.

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Plant-derived smoke plays a significant role in seed germination, seedling growth and other physiological attributes with regard to several medicinal and aromatic plants. To ascertain the effect of smoke solutions, a rhizome-soaking experiment was conducted on mint (*Mentha arvensis* L). Prior to planting, mint rhizomes were soaked for 24 h with smoke-saturated water (1:125, 1:250, 1:500, and 1:1000 v/v), employing double distilled water as control treatment. Rhizome soaking with 1:500 v/v concentration of smoke-saturated water increased the growth attributes, leaf physiology of mint plant. Results indicated that smoke-saturated water, might be successfully used to augment germination, growth and development of mint.
Keywords: Smoke-saturated water, Leaf physiology, *Mentha arvensis* L.

PP-VII-17 IMPACT OF DIMETHOATE 30% EC ON SEED GERMINATION, SEEDLING GROWTH, SEEDLING BIO-MASS OF *LATHYRUS ODORATUS* L. AND THEIR SYNERGISTIC EFFECT WITH CYTOKININS

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Seeds of *Lathyrus odoratus* L have been treated with Dimethoate 30% EC and a mixture of Dimethoate and cytokinin (0.10%, 0.05%, 0.02% and 0.01% v/v) for 4 h. Dimethoate 30% EC caused variation in seed germination (86-96%), seedling height (13–16 cm), fresh weight (12.58-18.48 g) and dry weight (2.98-4.16 g). Synergistic effect of pesticide and cytokinin was observed in seed germination (87 to 100%), seedling height (13.84-14.95 cm), fresh weight 13.88-19.36g) and dry weight (3.06-4.68g). Seed germination,seedling growth, fresh weight and dry weight were optimum at 0.02% supply in both pesticide and mixture of pesticide and cytokinin solutions.
Keywords: Dimethoate, Cytokinins, Germination, Seedling, *Lathyrus odoratus*

PP-VII-18 INSIGHT INTO THE GLUTATHIONE REDUCTASE IN CYANOBACTERIA USING BIOINFORMATICS APPROACHES AND WET LAB STUDIES

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The role of glutathione reductase (GR) in cyanobacteria has been explored, but the bioinformatic analysis of GR is poorly investigated. Therefore, the present *in-silico* studies of *Anabaena* sp. PCC 7120 GR (BAB76667.1) through different bioinformatic tools helped in the preliminary characterization of GR found in cyanobacteria. The sequences of GR enzyme are highly conserved among different species of cyanobacteria indicated the enzyme had all the regions for functionality. Moreover, wet lab analysis shows higher GR activity under stress condition suggested its role in redox metabolism.
Keywords: Glutathione reductase, *In silico* analysis, *Anabaena* sp. PCC 7120, Cyanobacteria, Stress

PP-VII-19 STUDIES ON THE EFFECTS OF DIFFERENT LIGHT CONDITIONS ON GROWTH AND ARTEMISININ CONTENT OF *ARTEMISIA ANNUA* L.

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The potential of artificial different light conditions in controlling plant growth and secondary metabolite production in *Artemisia annua* L. has been studied. The white, red, blue, and combinations of lights were used to illuminate plants. Results demonstrated increased accumulation of several antioxidants, proteins, and secondary metabolites, increased photosynthetic rate, stomatal conductance and transpiration rate under monochromatic lights. In addition, the gene expression studies along with western blotting and GC-MS analysis revealed that monochromatic lights induce artemisinin biosynthesis. Our data revealed that monochromatic lights act as an important factor for expression variations resulting into production of terpenoids in *Artemisia annua*. Therefore this study would be a beneficial way to increase the plant quality and medicinal values.
Keywords: *Artemisia annua* L., Artemisinin, RT-PCR, Photosynthetic rate, GC-MS

PP-VII- 20 EFFECT OF GLYPHOSATE ON MEIOTIC PARAMETERS OF *VIGNA RADIATA* AND *VIGNA MUNGO* VARIETIES

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Glyphosate is a broad spectrum, non selective herbicide, which interferes with the aromatic acid biosynthetic pathway. Three varieties of *Vigna radiata* IPM99125, IPM2-14 and IPM2-03 and two varieties of *Vigna mungo* IPU94-1 and IPU2-43 were chosen for study. The effect of glyphosate on meiotic behaviour of these five varieties was studied. It was found that glyphosate caused a distinct increase in the number of abnormal cells as compared to control. Highest relative abnormality rate was found in IPU94-1 (22.77±0.69) and lowest relative abnormality rate was found in IPM2-14 (16.10±0.9). The chromosomal abnormalities included laggards, bridges, stickiness, c-metaphase and disoriention.
Keywords: *Vigna radiata, Vigna mungo,* Glyphosate, Mitotic index, Chromosomal abnormalities

PP-VII-21 ROLE OF REACTIVE OXYGEN SPECIES IN WOOD FORMATION IN POPLAR PLANTS

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Reactive oxygen species (ROS) particularly superoxide anion and hydrogen peroxide may cause oxidative damage, but they also act as signalling molecules involved in the growth and development of plants. The objective of this study was to decipher the physiological role of ROS in growth and development processes of above ground plant parts (stem and leaves) in 7 selected clones (Wimco-81, Wimco-83, Wimco-108, Wimco-109, Wimco-110, Wimco-111, Wimco-112) of poplar (*Populus deltoides*). Qualitative and quantitative analysis of ROS revealed that plants with high superoxide anion radicals exhibited better growth and plants with high hydrogen peroxide exhibited slow growth as indicated by their stem diameter, leaf size and plant height.
Keywords: Superoxide anion, Hydrogen peroxide, Wood formation, Poplar

PP-VII-22 ALLEVIATION OF NICKEL TOXICITY BY IRON IN GREEN GRAM

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An experiment was conducted to study the modulation of Ni toxicity induced oxidative damage by Fe in green gram (*Vigna radiata* L. Wilczek syn. Var.K-851). Excess supply of Ni significantly decreased the chlorophyll concentration and the activities of iron containing enzymes- SOD, POD, CAT and aconitase in plants supplied excess Ni suggesting decreased availability of iron. This was substantiated by the decrease in the concentration of Fe in leaves of these plants and its recovery after supply of additional Fe to Ni toxic plants. Additional supply of Fe to plants subjected to Ni excess also reversed partially, the above metabolic changes induced by excess Ni.
Keywords: Antioxidative defense, Lipid peroxidation, Ni toxicity, Oxidative stress, *Vigna radiata* L, Water potential

PP-VII-23 INFLUENCE OF PHOSPHORUS NUTRITION ON CHICKPEA (*CICER ARIETINUM* L.VAR. AVRODHI)

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Chickpea plants (*Cicer arietinum* L.var. Avrodhi) were grown till maturity in sand culture in graded levels of phosphorus ranging from 0.56, 1.12, 4.5, 9.0 and 18.0 meq P in the form of NaH_2PO_4. The studies carried out on chickpea at different growth stages indicated its effects on oxidative metabolism and seed quality. The chlorophyll and carotenoid concentrations decreased and MDA, H_2O_2, ascorbate, dehydroascorbate and proline were increased. The activity of enzymes APase, RNase, SOD, POD, APX were increased but the activity of CAT and GR were decreased at deficient as well as excess level of P supply. Reproductive yield was also decreased but it was well marked in phosphorus deficient plants. All protein fractions (albumin, globulin, glutenins and prolamine) were decreased in post harvested seeds from phosphorus deficient plants.

Keywords: Phosphorus, Oxidative stress, Antioxidative enzymes, Seed quality

PP-VII-24 QUALITATIVE PHYTOCHEMICAL ANALYSIS OF *PINUS ROXBURGHII* NEEDLES AND *AESCULUS INDICA* LEAVES FROM GARHWAL HIMALAYA

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The northern part of India possesses a great diversity of medicinal plants due to the great Himalayas having distinct geographical and environmental conditions. The maximum number of plant species used as medicines has been reported from Garhwal Himalaya in Uttarakhand. To harness this potential, first there is a need to gather information on medicinal properties of the plants found here which can be achieved by phytochemical screening. The information obtained will help in knowing the potential of particular plant in terms of its medicinal purpose. Thus, with this background we propose to carry out the qualitative phytochemical screening of *Aesculus indica,* and *Pinus roxburghii* from Garhwal Himalaya.

Keywords: Garhwal Himalaya, Medicinal plants, Phytochemical screening

PP-VII-25 IMPACT OF CHROMIUM ON WHEAT METABOLISM GROWN *IN-VITRO* CULTURE

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Wheat plants (*Triticum aestivum* L.) were treated with chromium along with basal medium (MS medium) at different concentration levels: nil Cr (control), 5, 10, 20 and 40 μM in the form of Cr (VI). The effect of chromium was evaluated as the decrease in germination rate, seedling growth and tolerance index. The concentration of MDA, H_2O_2 and proline contents was increased with increase in Cr concentration. The enzymatic and non-enzymatic antioxidative system were also affected by Cr toxicity.

Keywords: Antioxidative, Chromium, Wheat, *In-vitro*, Oxidative stress

PP-VII-26 COPPER OXIDE NANOPARTICLES INDUCED BIOCHEMICAL AND METABOLIC ALTERATIONS IN *HYDRILLA VERTICILLATA* (I.F) ROYLE

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The exponential increase in the demand and utilization of CuO Nps has generated the concern of proper disposal and management of nano materials because the soil and water act as a major sink for these pollutants, so we are investigating the phytotoxic impact of CuO Nps on *Hydrilla verticillata*. The plants were exposed to CuO Nps for 8 days and showed decrease in fresh weight, dry weight and photosynthetic pigment of plant. One of the known markers for water stress, proline, increased dramatically in all treated samples. The stress marker like H_2O_2 and membrane lipid peroxidation (MDA) were also unregulated. The results of FT-IR analysis clearly reflected the alteration in metabolite functional group stretching which potentially supports the phytotoxic impacts of CuO Nps. These finding will be helpful in safe and sustainable utilization of CuO NPs.
Keywords: Copper oxide nanoparticles, Phytotoxicity, Metabolic adaptations

PP-VII-27 COMPARATIVE TRANSCRIPTOME PROFILING OF RESISTANT AND SUSCEPTIBLE GROUNDNUT (*ARACHIS HYPOGAEA* L.) GENOTYPES IN RESPONSE TO STEM ROT INFECTION CAUSED BY *SCLEROTIUM ROLFSII*

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The aim of this study was to analyse the transcriptome of different stages of resistant (CS-319) and susceptible (JAL-42) groundnut genotypes against *Sclerotium rolfsii* infection. We report *de novo* assembly-based transcriptomic response in groundnut plants. Both genotypes were assessed at control, 24-, 72- and120-Hour Post Inoculation (HPI). We found 7796 differentially expressed genes, 6783 transcription factors and 88424 putative markers. This study revealed majority of DEGs up regulated in 24 HPI in resistant genotype such as pathogenesis related genes, defense- related (R) genes, plant-fungus interaction, oxidation-reduction related genes, transport, metabolic, proteolysis-related genes, transcription factors, secondary metabolic pathways related genes, and photosynthesis-related genes. The result was validated through RT-qPCR.
Keywords: Transcriptome, *Sclerotium rolfsii*, *Arachis hypogaea*, DEGs, Secondary metabolic pathways

PP-VII-28 COMPARATIVE SEED STORAGE PROTEIN VARIATION IN SOME TAXA OF FAMILY CAESALPINIACEAE

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Protein banding patterns in different species viz. *Bauhinia acuminata* L., *Caesalpinia bonducella* Flem., *Cassia occidentalis* L., *Delonix regia* Rafin., *Parkinsonia aculeata* L., *Peltophorum ferrugineum* Vogel., *Saraca indica* L. and *Tamarindus indica* L. of family Caesalpiniaceae has been performed. A total of 22 bands have been identified and the number of bands varied among different species under consideration. 14 protein bands were detected in *Bauhinia acuminata* and *Caesalpinia bonducella,* 13 in *Cassia occidentalis*, 12 in *Parkinsonia aculeata,* 11 in *Delonix regia,* 10 in *Peltophorum ferrugineum*, 9 in *Tamarindus indica* while a minimum of 8 bands were identified in *Saraca indica*. The banding pattern both in number and intensity is considered to reflect homology between the taxa. The percentage homology between taxa varied. The maximum percentage similarity (86.66%) is seen between *Bauhinia acuminata* and *Caesalpinia bonducella* while minimum percentage similarity (18.75%) is seen between *Peltophorum ferrugineum* and *Tamarindus indica.*
Keywords: Protein banding patterns, Caesalpiniaceae, Seed storage protein

PP-VII-29 ANTIOXIDANT PHYTOCONSTITUENT STUDIES IN SOME VARIETIES OF SOYBEAN [*GLYCINE MAX* (L.) MERR.] AND THEIR HYBRIDS

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In the present investigation, an attempt has been made to congregate the phytochemical studies done on intervarietal F1 hybrids of soybean (*Glycine max* L.) along with their parents. The eleven F1 hybrids were obtained by intervarietal crossing done using five varieties of soybean viz Bragg (BG), NRC7 (NR), Punjab1(PN), PUSA98-14 (PU) and JS9560 (JS). Estimation of phenols was done by FCR Method using Gallic acid as standard. The total phenolic content was found highest in the cross JSXNR and lowest in BGXNR. Total tannin content was determined using FCR method. Total tannin content was highest in NRXJS and least in BGXPN. In addition, total flavonoids were determined using Alcl3 reagent and antioxidant activity by DPPH method. Total flavonoids were found to be maximum in PNXNR and least in PUXPN respectively. Highest Antioxidant Activity was 50.31% in JSXPN and lowest was 39.08% in NRXJS. The results suggested that besides protein and oil contents, the phenolic contents should also be considered as an important characteristic feature of soybean seeds, and as a potential selection criterion for antioxidant activity in soybean.

Keywords: Antioxidant Activity, Flavonoids, Phytochemical, Soybean, Phenols

PP-VII-30 IMPACT OF DIMETHOATE 30% EC ON SEED GERMINATION, SEEDLING GROWTH, SEEDLING BIO-MASS OF *LATHYRUS ODORATUS* L. AND THEIR SYNERGISTIC EFFECT WITH CYTOKININS

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The present paper reports the effect of Dimethoate 30% EC ($C_5H_{12}NO_3$ PS_2) pesticides and their synergistic effect with cytokinins on seed germination, seedling growth, and seedling biomass performance of *Lathyrus odoratus* L. (Fabaceae) as compared to control. In Dimethoate 30% EC, the percent seed germination varied from 86% to 96% in comparison to control *i.e,* 92%, seedling growth (root and shoot length in cm) varied from 13.12±0.02 to 16.05±0.02 in comparison to control *i.e.,* 13.15±0.25 while fresh weight varied from 12.58±0.04g to 18.48±0.12g (15.32±0.25 g control), and dry weight varied from 2.98±0.03g to 4.16±0.07g as compared to 3.74±0.30g control. Due to synergistic effect of pesticide and cytokinins, the percentage of seed germination varied from 87 to 100% in comparison to control *i.e.,* 92 %, seedling growth varied in cm from 13.84±0.10 to 14.95±0.04g in comparison to control *i.e,* 13.15±0.25, fresh weight varied from 13.88±0.03g to 19.36±0.01g (15.32±0.01g control), and dry weight from 3.06±0.04 g to 4.68 ±0.20 g (3.74±0.30 g control) at different concentrations. The coefficient of variation (CV) test confirmed that Dimethoate 30% EC was more effective than a mixture of Dimethoate and cytokinins. It was interesting to note that the percent seed germination, seedling growth (root and shoot length), fresh weight and dry weight, were optimum at 0.02 % concentrations in both pesticide solution alone, and a mixture of pesticide and cytokinin solutions. Furthermore, Dimethoate 30% EC was more effective than a mixture of Dimethoate and cytokinins solution at 0.10 % concentration.
Keywords: Dimethoate 30% EC, Cytokinins, Germination, Seedling, *Lathyrus odoratus* L.

SECTION VIII

PLANT BIOTECHNOLOGY

OP-VIII-01 ON THE STANDARDIZATION OF *IN VITRO* PROTOCOL FROM CLADODE EXPLANTS OF *ASPARAGUS RACEMOSUS*

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Asparagus racemosus (fam. Asparaginaceae), commonly known as 'Shatavari' in Ayurveda, is valued for its fascicular roots for revitalizing and lactation promotion properties. Due to heterogeneity in seed progenies, it is desirable to develop *in vitro* procedures of propagation. But this plant does not produce true leaves/leaf primordia (a popular source of explant), instead it has cladodes which lack pericycle. To address this challenge, efforts are being made to develop *in vitro* protocol using true stem and cladode explants. Multiple shoot regeneration and callus induction was observed on MS medium with 3% sucrose, 0.8% Agar, pH 5.8, temperature 25±2°C, light intensity 2000 lux (PAR) with 60 - 65% humidity. For callus and shoot initiation, MS medium with different concentration and combination of PGRs (BAP 0.1-0.3.5 mg/L, NAA 0.1-1.5 mg/L, Kn 0.1-1.5 mg/L) were used. Root initiation was observed on half MS media with BAP (0.1- 1.5 mg/L) and Indole butyric acid (0.5-1.5 mg/L).
Keywords: Asparagus racemosus, Cladode explant, *In vitro* protocol

OP-VIII-02 DIRECT SOMATIC EMBRYOGENESIS OF *CEROPEGIA MACULATA* BEDD. FROM LEAF EXPLANTS

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An efficient system was established for somatic embryogenesis (SE) from leaf explants of *Ceropegia maculata* for the first time. Somatic embryo was obtained from leaf explants on Murashige and Skoog (MS) medium. The highest frequencies of 98.66% and 86.33% SE were obtained from 1.0 mg/l 2,4-dichlorophenoyacetic acid (2,4- D) and 0.7 mg/l of Thidiazuron (TDZ), respectively. The maturation and germination frequency were highest on MS medium containing NAA 0.5 mg/l (61.66%). Following transfer of SE to MS medium augmented with 50 mg/l ABA, the rate of embryo maturation, germination, and plant formation was increased up to 75.33%. The somatic embryo derived plantlets were successfully hardened and acclimatized and then established in the greenhouse with the survival rate of 85%.
Keywords: Endemic plant, *Ceropegia maculata*, Leaf explant, Somatic embryos, Thidiazuron

OP-VIII-03 EFFECT OF CNPs ON *IN VITRO* ORGANOGENESIS AND TUBERIZATION OF A MEDICINALLY POTENT PLANT SPECIES OF THAR DESERT: *CEROPEGIA BULBOSA*

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Carbon nanomaterials (CNMs) are the most popular nanomaterials. In recent years, carbon nanomaterials are widely used due to its role in plant growth and development. Present research is focused on evaluating the role of carbon nanoparticles in cell cultures of *Ceropegia bulbosa*, and its effect on biomass production. *C. bulbosa* is a threatened and medicinally important plant species of Thar Desert which need to be conserved through *in vitro* techniques. MS medium, augmented with different concentration of PGRs for *in vitro* cultures, and various concentrations of carbon nanoparticles, between 100 mg/l to 500 mg/l, was used to observe the effect of Carbon nano material on the growth of cultures of *C. bulbosa*. Out of the various concentrations tested, 200 and 320 mg/l CNPs concentration shown optimum results for callus biomass production, retardation of callus browning, *in vitro* organogenesis and tuberization.
Keywords: CNPs (Carbon nanoparticles), PGR, Callus cultures, Organogenesis, Tuberization

OP-VIII-04 ESTIMATION OF GENETIC VARIABILITY IN *GYMNEMA SYLVESTRE* (RETZ.) R. BR. EXSCHULT. POPULATIONS USING DAMD AND ISSR MARKERS

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Genetic diversity and population genetic structure of 118 accessions belonging to 11 wild populations of *Gymnema sylvestre* was estimated using two DNA fingerprinting techniques (DAMD: Directed Amplification of Minisatellite-region DNA and ISSR: Inter Simple Sequence Repeats). The accessions were sampled from seven Indian states (UP, MP, Chhattisgarh, Maharashtra, Telangana, Karnataka, and Kerala). The present analysis with 25 markers (17 ISSR and 8 DAMD) revealed significant genetic diversity (H = 0.26, I = 0.40, PPL = 80.89%) at species level whereas the average genetic diversity at population level was considerably low. Among the 11 populations studied, PCH and UTK populations showed maximum diversity, followed by KNR and AMB, while TEL population revealed least genetic diversity. The clustering patterns indicated that genetic diversity in *G. sylvestre* is corresponding with geographical diversity of the populations.
Keywords: DAMD, *Gymnema sylvestre*, Genetic diversity, ISSR, Population structure

OP-VIII-05 EVALUATION OF GROWTH AND SECONDARY METABOLITE PRODUCTION OF *SPIRULINA PLATENSIS* IN DIFFERENT MEDIA

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Spirulina platensis is a filamentous, multicellular and autotrophic cyanobacterium, resides in alkaline water. It is recognized as a best bio-agent and used as an experimental model organism. To optimize the growth of *S. platensis*, four different culture media are used (Zarrouk modified medium, Zarrouk medium, BG11 medium and F-2 medium). The growth analyses were performed after 30 days. Temperature was maintained at 30±2°C under 12:12 hour light-dark cycles, light illuminated (4500 lux). The maximum biomass 0.641 gm/ml was achieved in Zarrouk modified medium. Maximum concentration of phycocyanin content (0.19 mg/ml) and total carotenoid contents (5.99µg/ml) were observed in Zarrouk's modified medium followed by Zarrouk's medium (0.12 mg/ml and 5.51 µg/ml) and minimum amounts were observed in F-2 medium (0.08 mg/ml and 3.08 µg/ml).
Keywords: *Spirulina platensis*, Secondary metabolites, Zarrouk's medium

PP-VIII-01 *IN-SILICO* ANALYSIS, EXPRESSION PROFILING OF LLPS AND FUNCTIONAL CHARACTERIZATION OF LLP1 IN ABIOTIC STRESS TOLERANCE OF *ARABIDOPSIS THALIANA*

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Legume lectin-like proteins (LLPs) are a group of apoplastic proteins known to be expressed in regenerating cell walls and play crucial role in immune responses. Cell wall is the first barrier and sensor of most of the abiotic stresses. So, LLPs might be involved in abiotic stress mitigation or signaling. The *in-silico* analysis and expression profiling supported that LLPs are associated with abiotic stresses and AT5g03350 (LLP1) appeared as an important gene. We have created LLP1 specific overexpression line, complementation line and procured mutant line from NASC. ROS accumulation and survival assay under selected abiotic stresses revealed protective role of LLP1.
Keywords: Abiotic stress, *Arabidopsis thaliana*, Legume Lectin-like Proteins, Lectin receptor- like kinases, Signaling

PP-VIII-02 IDENTIFICATION OF miRNA AND THEIR TARGET GENES IN *CESTRUM NOCTURNUM* AND *CESTRUM DIURNUM* WITH RESPONSE TO STRESS

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Homology-based approaches were employed to identify miRNAs and their targets in the common neglected plants *Cestrum nocturnum* and *Cestrum diurnum*. A total of 32 miRNAs were identified in *C. nocturnum*and 12 miRNAs in *C. diurnum*. Eight miRNAs were identified to have regulatoryresponses in biotic and abiotic stresses in both the plants. PIF1, UBP12, LRR, GRAS family, PLP6, MYB48, PIF1 helicase and UBP12 have been reported to enhance drought tolerance. These putative miRNAs and their target genes were validated with qRT-PCR, revealing that miR815a, miR849, miR5205a, miR1089, miR172, miR1436 and miR530 have control over stress responses in these two plants.
Keywords: miRNA, *Cestrum nocturnum, Cestrum diurnum,* Stress

PP-VIII-03 CONSERVATION STRATEGIES IN *KAEMPFERIA SPP.* THROUGH BIOTECHNOLOGICAL APPROACHES

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Kaempferia, a member of the family Zingiberaceae, is widely distributed throughout Asia. The plant has important ethnobotanical significance and is known for its therapeutic applications. Despite being one of the most important medicinal plants, the conservation methods are not very well developed, and the genus faces threatened status due to overexploitation for its rich phytochemical constituents found in rhizome. The herb is annual in nature with limited production of underground parts, leading to the complete destruction of the plant. Therefore, the conservation techniques like organogenesis, micropropagation and multiple shoot inductionusing various plant tissues can play cost-effective solution for the mass production of these plants and sustainable usage.
*Keywords***:** *Kaempferia,* Phytochemicals, Therapeutic applications, Conservation, Organogenesis, Micropropagation

PP-VIII-04 HIGH FREQUENCY SHOOT REGENERATION FROM THIN CELL LAYER CULTURE OF *MENTHA ARVENSIS* L., AN IMPORTANT MEDICINAL AND AROMATIC CROP

Ashish Chandran and Laiq ur Rahman
Department of Plant Biotechnology, CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow-226 015

Menthol mint (*Mentha arvensis* L) is an essential oil producing medicinal and aromatic crop. This study was aimed to develop an efficient *in vitro* regeneration protocol for direct regeneration of *M. arvensis* using thin cell layer (TCL) technique. Internodal thin cell disc explants were cultured on MS medium supplemented with benzyladenine (BA) and α-naphthalene acetic acid (NAA) for shoots induction. The maximum number of shoot induced (53.60 shoots/explant) on MS medium containing 5.0 mg/LBA and 0.5 mg/L NAA. Regenerated micro-shoots from TCL explants were rooted successfully and acclimatized in the glasshouse. The results of this study suggest that direct regeneration of *M. arvensis* by TCL internodal explant is a highly efficient and promising method of mass propagation of the quality shoots and *in-vitro* transformation.
Keywords: *Mentha arvensis,* Thin cell layer, Explants, Regeneration, Transformation

PP-VIII-05 IN VITRO PROPAGATION AND CONSERVATION OF *TYLOPHORA INDICA*: A MEDICINALLY IMPORTANT PLANT SPECIES

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Tylophora indica (Burm.f.) is a perennial woody climber, belongs to family Apocynaceae. It is a nutraceutically important plant as it is used for curing respiratory problems, like asthma and cough. *T. indica* is found to be rich in alkaloids such as tylophorine, tylophorinine and tylophoridine. For induction of regenerative callus of *T. indica*, leaf segments were used as explants and regeneration and multiplication of shoots was attempted. Different parameters were studied for induction and proliferation of callus from explants like, concentration of sucrose, PGRs and different strength of salts of MS medium. The optimum response was observed on full strength MS medium containing 4 µM of NAA with 3% sucrose.
Keywords: Tylophora indica, Regeneration, Multiplication, Callus

PP-VIII-06 A TOMATO TRANSCRIPTION FACTOR, *SLDREB3*, REGULATES FRUIT GROWTH, RIPENING ONSET AND SHELF LIFE BY ALTERING ABA LEVELS

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Fruit ripening is a genetically programmed process controlled by several transcription factors and the action of hundreds of genes. It also involves the crosstalk between hormones like ethylene, ABA, auxin and GA. We have identified a ripening related transcription factor *SlDREB3* that is up-regulated during ripening and mediates ABA-related responses. Suppression of *SlDREB3* accelerates the onset of ripening by 4-5 days and is associated with an early peak of ABA at 35 DPA while it is delayed by 7-8 days to ~43 days in over-expression lines. The fruits of suppression lines grow faster and have a larger diameter whereas over-expression lines have smaller fruits. Although ripening is delayed in over-expression line fruits, post-harvest shelf-life of these fruits is better and increases by 3-4 days while suppression line fruits deteriorate early. The results show that *SlDREB3* functions as a key regulator of fruit ripening by negatively regulating ABA levels and responses, and by governing the expression of ripening-related transcription factors.
Keywords: Transcription factor, *SlDREB*, Fruit ripening, Hormones

PP-VIII-07 CALLUS INDUCTION AND ORGANOGENESIS STUDIES IN *COCCULUS HIRSUTUS* (L.) DIELS.

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An efficient protocol has been developed for *in vitro* propagation of *Cocculus hirsutus* (L.) Diels (Menispermaceae), a medicinally important threatened plant, through callus. Effect of different plant growth regulators (BAP, Kn, IAA, NAA and 2,4-D) and their concentration on callus induction and organogenesis in various explants was studied. Optimal callus was developed for regeneration from nodal explants on Murashige and Skoog's (MS) medium supplemented with various concentrations of auxins and cytokinins. Callus induction was noticed in 90% of cultures. The callus was subcultured on MS medium supplemented with BAP (0.5-2.5 mg/l) or Kn (0.5-2.5 mg/l) alone or in combination for shoot organogenesis. Maximum shoot multiplication was observed on MS medium supplemented with BAP 0.5-2.5 mg/l. Rooting of *in vitro* grown shoots was achieved on MS medium supplemented with 0.5-2.5 mg/l IBA. Thus, the results obtained will be useful for efficient *in vitro* propagation of *Cocculus hirsutus* via callus cultures. The results of this study may also prove useful for further genetic manipulation of the plant to obtain more secondary metabolites.
Keywords: *Cocculus hirsutus,* Organogenesis, Threatened, Callus, Explants

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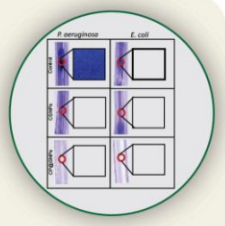

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