

Abstract Book-PARPS-2022

**NATIONAL CONFERENCE ON 'PROMOTING APPLIED RESEARCH IN
PLANT SCIENCES' [PARPS-2022]**

09th -10th November, 2022



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- ❖ Plant Biodiversity & Conservation
- ❖ Crop Plant Genomics
- ❖ Agricultural Sustainability & Waste Management
- ❖ Plant Breeding & Varietal Development
- ❖ Plant Physiology & Stress Management
- ❖ Bioinformatics
- ❖ Plant Phytochemistry
- ❖ Plant Taxonomy

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GENOMICS TOOLS AND TECHNIQUES FOR GENE DISCOVERY IN COMMON BEAN FROM WESTERN HIMALAYAS

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Common bean (*Phaseolus vulgaris* L.) is an annual legume crop and is considered the most important grain legume species in the genus *Phaseolus* for direct human consumption. The UT of Jammu and Kashmir possess huge diversity for common bean germplasm and because of this diversity, the region is also considered as secondary center of origin of common beans. We have explored all the hot-spot regions of common bean in Jammu and Kashmir and have collected 428 local landraces. The germplasm was used to study the origin of common bean germplasm grown in J&K. The germplasm was assigned to different gene pools using ITS1-ITS4 sequencing and *Phaseolus* locus genotyping. The germplasm was also genotyped using genome-wide SSR markers. Based on genotyping data and trait data a core set was constituted. The core set was also genotypes using Genotyping-by-Sequencing platform and precise genotyping using ABI genotyping at ICRISAT, Hyderabad. The core set was trait phenotyped for traits like Anthracnose, yield traits; seed Zn, Fe and protein content. In addition, data was also recorded for Starch, Sugars, Phenols, Anthocyanins etc. All the trait data and genotyping data was used together and several important genes/QTLs have been identified. In addition to identification of new genes/QTLs, several earlier identified genes/QTLs were also validated. The most important, major and stable genes could be used in common bean molecular breeding programs. The genes could be also used in development of next-generation crop varieties. Efforts have been also used by us to sequence RNA of two contrasting common bean genotypes for seed Zn and Fe content. The study led to the identification of several important and differentially expressing genes for seed Zn and Fe content. Efforts have been also used to identify differentially expressing genes for Anthracnose resistance in common bean. Detailed meta-QTL (MQTL) analysis was also carried out by combining the previously known 92 QTLs/ resistant gene loci for ANT resistance from 18 different studies. The meta-analysis results led to the identification of 11 MQTLs and 10 QTL hotspots. These MQTLs were validated by marker trait associations from previous genome-wide association studies and expression studies. The 11 MQTL regions contain 1251 candidate genes including several R genes and other defense related genes. Thus, the results of the study will help us to identify some novel sources of resistant genotypes as well as genes/ QTLs responsible for the resistance and susceptibility in common beans.

Keywords: Common bean, High-throughput genotyping, Trait phenotyping, Anthracnose, micronutrients, yield and yield related traits, Genes, QTLs, MQTL

EXPLICATING POPULATION GENOMICS FOR STRATEGIZING CONSERVATION EFFORTS OF MEDICINAL AND AROMATIC PLANT GENETIC RESOURCES

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The global herbal medicine demand is projected to rise from US \$72 billion in 2016 to US \$111 billion by 2023. It is estimated that about 80% of the world's population chiefly depends on herbal or traditional medicines for basic medical assistance. The indiscriminate use and nonscientific methods

of harvesting medicinal plants can lead to genetic erosion of medicinal plants. This has resulted in fast declining of biodiversity genetic resources categorizing approximately 35,500 species under threat of extinction. Nevertheless, the traditional medicinal system also requires the scientific validation of their safety, efficacy and quality. The next generation sequencing (NGS) with availability of multiple sequencing platforms has contributed enormously for creation of cost effective genomic resources and greatly assisted fundamental understanding of key regulatory mechanisms and biosynthetic pathways irrespective of model and non-models. Interestingly, the Indian Himalayan Region (IHR) exhibits rich biodiversity of medicinal and aromatic plants (MAPs) having documented utility in the traditional system of medicine. Our ongoing efforts on collection and characterization of genetic diversity and population structure resulted into successful identification of core genotypes/ populations for implementation of conservation strategies in the targeted MAPs.

Furthermore, successful efforts for creation of tissue-specific genomic resources enabled us for fundamental understating of specialized metabolism and identification of functionally relevant molecular markers. More than 20000 functionally relevant novel microsatellite makers were identified and utilized for diversity characterization of targeted MAPs. A larger genomic resource including organ-specific DEGs identified fundamental understanding of source and sink mediated biosynthesis of targeted bioactive metabolites. Collection and characterization of genetic diversity across the geographical ranges and creation of genomic resources will expedite the conservation efforts. Genome-wide inferences using next generation genomics will be useful for developing conservation strategies and implantation of breeding programs for sustainable cultivation of endangered Himalayan MAPs.

Keywords: extinction, next generation sequencing, molecular markers, biosynthetic pathways.

STUDIES TOWARDS UNDERSTANDING SECONDARY METABOLISM IN MEDICINAL PLANTS

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A variety of organic compounds are synthesized by plants, which are classified as primary or secondary metabolites. Secondary metabolites are phytochemicals that are not required for normal growth of the plant, but may provide unique survival advantages in a particular ecological niche. Nearly 60% of all US-FDA approved drugs are natural products (mostly secondary metabolites), natural product analogues or their derivatives. Secondary metabolites are also useful as dyes, flavors, fragrances, insecticides etc. *Coleus forskohlii* (Willd.) Briq. (Lamiaceae) is an herb possessing antihypertensive activity by virtue of production of a labdane diterpene 'forskolin', which is a potent and reversible activator of adenylate cyclase. We are employing various molecular tools to understand the biosynthetic pathways of forskolin and related secondary metabolites in *C. forskohlii*. Genes involved in the upstream MEP/MVA pathway that provide precursors for forskolin biosynthesis were identified and characterized. Cytochrome P450s that play critical roles in biosynthesis of secondary metabolites, including forskolin, were also identified and characterized using a systems level analysis. This information will be useful to generate these compounds in larger quantities in heterologous microbial or plant hosts. We have also looked at the dynamics of rhizosphere microflora viz-a-viz the growth of *C. forskohlii* and accumulation of forskolin, to possibly get an idea about the ecological roles of this metabolite. Similarly, in another plant: *Dysoxylum binectariferum* that produces

rohitukine, we carried out transcriptome analysis to understand the secondary metabolite biosynthesis. Rohitukine has anti-inflammatory properties and a synthetic analogue, flavopiridol is a CDK inhibitor and has been approved for treatment of cancers. However the role of rohitukine in plant system is not well understood. We employed *Arabidopsis thaliana* system to unravel the genome wide molecular effects of rohitukine treatment as well as its physiological effects in plants.

The talk would thus cover our studies on various aspects of secondary metabolism in of *C. forskohlii* and *D. Binectariferum*.

Keywords: ecological niche, secondary metabolites, antihypertensive, transcriptome

QUALITATIVE ANALYSIS OF THREE FOLIOSE LICHENS OF RAJOURI DISTRICT, J&K

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Lichens are composed of two different organisms and exhibit symbiosis between phytobiont (algal partner) and mycobiont (fungal partner). Known as pioneers in an ecosystem they are an economically important source of food, fodder, medicines and dyes. Their potential is being unexplored in many industries such as pharmaceuticals and cosmetics. Therefore, more lichenological studies need to be carried to understand their biology, ecology, chemistry and physiology. The present study is an attempt in this direction and the work is carried out on foliose lichens (namely *Bulbothrix setschwanensis*, *Dermatocarpon vellereum* and *Xanthoparmelia congensis*) of district Rajouri in Jammu and Kashmir. The foliose lichens collected were subjected to phytochemical analysis. Their methanolic extracts were prepared for the analysis of Alkaloids, Saponins, Tannins, Anthraquinones, Glycosides, Flavonoids, Terpenoids, Carbohydrates, Steroids, Reducing Sugar, Anthocyanin, Xanthoproteins, Carotenoids, Phenols and Volatile Oils. However, Carbohydrates and Steroids were not reported from any species. All the foliose species showed positive results for Alkaloids, Xanthoproteins, Carotenoids and Volatile oils. *Bulbothrix setschwanensis* and *Xanthoparmelia congensis* showed positive results for Tannins. *Bulbothrix setschwanensis*, *Dermatocarpon vellereum* and *Xanthoparmelia congensis* showed positive results for Terpenoids. *Bulbothrix setschwanensis*, *Dermatocarpon vellereum* and *Xanthoparmelia congensis* showed positive results for Anthocyanin. *Dermatocarpon vellereum* and *Xanthoparmelia congensis* showed positive results for Phenols. *Xanthoparmelia congensis* showed positive results for Glycosides. *Bulbothrix setschwanensis* showed positive results for Flavonoids. This lead is preliminary, yet first of its kind from this hinterland of Jammu and Kashmir which needs to be explored further.

Keywords: Lichens, Phytochemicals, Methanolic extracts.

COMPARATIVE GENETIC SYSTEMS OF WILD AND CULTIVATED CUCUMBER

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Family-Cucurbitaceae is impressive in terms of multitude of sex expressions unveiled by its different species. Monoecy however remains predominant in most of his members including *Cucumis sativus*L.

(cucumber). This species is cultivated on a large scale. For the present study we compared wild (*C. sativus* var. *hardwickii*) and cultivated variety (*C. sativus* var. *sativus*) for morphological features, reproductive efficiency and meiotic division in male track. *C. sativus* var. *hardwickii* of this species has been localized in UT of J&K in Billawar of District Kathua for the first time. Floral characters/features were found to be more pronounced in cultivated cucumber in comparison to wild one. With respect to sexual reproductive output, *C. sativus* var. *hardwickii* exhibits more and healthy fruits compared to *C. sativus* var. *sativus*. This might be due to the cytologically stable nature of wild cucumber, showing seven perfect bivalents at metaphase –I ($2n=14$) in all pollen mother cells. While in cultivated cucumber abnormal chromosome numbers ($2n=10$ & 20) were seen in few pollen mother cells (10.84%) in addition to normal euploid cells ($2n=14$). Few multivalent formations were also observed in the same. Presence of these deviant chromosomes number and multivalents in cultivated cucumber might be the reason for low reproductive success (70%) as compared to wild variety (85%).
Keywords: Morphology, Sex expression, Meiosis, Reproductive efficiency.

FERMENTATION BASED ENHANCEMENT OF POLYPHENOL CONTENT AND BIOACTIVE PROPERTIES OF *Ocimum sanctum* (LEAF) METHANOLIC EXTRACT USING *Bacillus subtilis* AND *Lactobacillus casei*

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In the present study, probiotic bacteria *B. subtilis* (MTCC-2389) and *L. casei* (NCIM-5304) were used to enhance the polyphenol content, antioxidant, anti-diabetic, anti-Alzheimer and anti-melanogenesis activity of *O. sanctum* methanolic extract. Optimization of fermentation parameters namely, inoculum load, pH, temperature and incubation time was done. DPPH radical scavenging activity, reducing power, ferric reducing antioxidant power, metal ion chelation activity, superoxide radical scavenging activity and hydroxyl radical scavenging activity assays were performed for determining the antioxidant activity. α -amylase and α -glucosidase inhibitory activity assays were performed to evaluate anti-diabetic activity. Acetylcholinesterase inhibitory assay was performed to determine anti-Alzheimer activity and tyrosinase inhibitory activity assay was carried out to evaluate anti-melanogenesis property of plant extract under study. The results of the present study showed that the optimized fermentation parameters for *B. subtilis* mediated fermentation of *O. sanctum* methanolic extract such as inoculum load, pH, temperature and incubation time were 2.98 Log CFU/mL, 6.5, 37 °C and 30 h respectively. Similarly, the optimized fermentation parameters for *L. casei* mediated fermentation of plant extract under study such as inoculum load was 3.11 Log CFU/mL, pH was 6.5, temperature was 37 °C and incubation time was 36 h. The fermentation of *O. sanctum* methanolic extract by *B. subtilis* resulted in the enhancement of total phenolic content, total flavonoid content, DPPH radical scavenging activity, reducing Power, ferric reducing antioxidant power, superoxide radical scavenging activity, hydroxyl radical scavenging activity, α -amylase inhibitory activity, α -glucosidase inhibitory activity, tyrosinase inhibitory activity and acetylcholine esterase inhibitory activity by 27.34%, 60.69%, 8.89%, 6.77%, 10.41%, 7.25%, 6.36%, 10.97%, 17.20%, 21.75% and 16.86% respectively. Likewise, fermentation of *O. sanctum* methanolic extract fermented by *L. casei* resulted in the increment of total phenolic content, total flavonoid content, DPPH radical scavenging

activity, reducing power, ferric reducing antioxidant power, superoxide radical scavenging activity, hydroxyl radical scavenging activity, α -amylase inhibitory activity, α -glucosidase inhibitory activity, tyrosinase inhibitory activity and acetylcholine esterase inhibitory activity by 45.16%, 87.59%, 19.77%, 15.95%, 25.58%, 19.24%, 15.11%, 32.86%, 40.97%, 55.03% and 38.49% respectively. The metal ion chelation activity of *O. sanctum* methanolic extract fermented by *B. subtilis* and *L. casei* was increased by 1.10 folds and 1.25 folds respectively. These results provide the foundation for further exploration of the therapeutic and functional benefits of *B. subtilis* and *L. acidophilus* mediated fermentation of *O. sanctum* methanolic extract.

Keywords: Fermentation, polyphenol content, antioxidant activity, anti-diabetic, anti-Alzheimer and anti-melanogenesis property.

PICTORIAL REPRESENTATION OF BENTHAM AND HOOKER SYSTEM OF CLASSIFICATION

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Bentham and Hooker's system of seed plant classification is an example of a well-developed natural system. This classification was published in *Genera plantarum* (1862-83). Bentham & Hooker classified seed plants and described 202 families and 7596 genera. It included approximately 97,205 phanerogam species. This classification system optimized the systems proposed by A.P de Candolle and Lindley based on de Jussieu's classification. The plant descriptions were entirely based on personal studies and research from specimens. Many herbaria around the world, including those in the United Kingdom and India, use this system for specimen arrangement. Bentham and Hooker classified seed plants or Phanerogams into three classes: Dicotyledons, Gymnospermae, and Monocotyledons. Dicotyledons were seeds with two cotyledons, pentamerous or tetramerous with net-veined leaves. They were further classified into three subclasses based on the presence or absence of petals and their fusion: Polypetalae, Gamopetalae, and Monochlamydeae. 14 series, 25 orders, and 165 families were included in the dicots. Subclass Polypetalae had three series: Thalamiflorae, Disciflorae, and Calyciflorae, while Subclass Gamopetalae also had three series: Inferae, Hetermoerae, and Bicarpellatae. Curvembryae, Multiovulate aquaticae, Multiovulate terrestres, Microembryae, Daphnales, Achlamydosporae, Unisexuales, and Ordines anomaly were the eight series in the Subclass Monochlamydeae. Gymnospermae were plants with naked ovules that were classified into three families: Gnetaceae, Coniferaceae, and Cycadaceae. Trimerous Monocotyledons with parallel venation, 7 series, and 34 families. The seven series were: Microspermae, Epigynae, Coronarieae, Calycinae, Nudiflorae, Apocarpae, and Glumaceae.

It, like all other classification systems, has advantages and disadvantages. The taxa are arranged naturally based on overall natural affinities determined by morphological features that can be studied with the naked eye or a hand lens. Rather than a single character, the grouping is based on a combination of characters. All modern scientists agree on the arrangement of the taxa. The system takes a pre-Darwinian approach and does not take phylogeny into account. Furthermore, Gymnospermae are classified as a group between dicots and monocots, despite being distinct from angiosperms.

Keywords: Classification, Natural System, Dicotyledons, Monocotyledons, Phanerogams

SYNERGISTIC ANTIMICROBIAL ACTIVITY OF *Lavendula angustifolia* ESSENTIAL OIL WITH AMPICILLIN

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The aim of the present study was to investigate about the combinatorial antimicrobial interaction between various *Lavendula angustifolia* essential oil with standard antibiotic ampicillin. The volatiles are derived from different parts of plant by the utilization of clavenger type apparatus using the method of hydro distillation. The test bacteria involved three Gram positive (*Staphylococcus aureus*, *Micrococcus luteus* and *Bacillus subtilis*) and two Gram negative (*Escherichia coli* and *Klebsiella pneumoniae*) bacteria. The binary combinations of *Lavendula angustifolia* essential oil and antibiotic showed diverse types of interactions such as synergistic, partial synergistic and no effect by calculating their fractional inhibitory concentration (FIC). In the experiment, binary combination of essential oil with ampicillin showed significant decrease in minimum inhibitory concentration (MIC) value of the above mentioned antibiotic. Hence, it was observed that amalgamation of essential oil with antibiotic significantly enhanced the antimicrobial potential of the later there by minimizing its effective dose and possible secondary effects. It is suggested that synergistic interactions between essential oil and standard antibiotics might be a promising strategy for developing multidrug resistant strain treatment strategies. Future research is necessitated to investigate the molecular mechanism of the synergistic interaction between essential oils and antibiotics so that novel antimicrobial therapies can be developed for combating the resistant bacterial strains.

Keywords: Essential oils, Synergy, antibiotics, MIC, MDR, FIC

PLANT MICRORNAS (MIRNAS): MINISCULEIN STRUCTURE BUT GIGANTIC IN FUNCTION

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MicroRNAs (miRNAs) are small, endogenous, conserved, single-stranded RNAs, 21 to 24 nucleotides in length and transcribed from MIR genes. The miRNAs regulate gene expression and target mRNAs at transcriptional and posttranscriptional levels through sequence complementarity via mRNA cleavage or translational repression in various organisms and indirectly affects numerous developmental and signaling pathways in plants.

The global food necessity will increase with rise in population to 9.8 billion by 2050. But the agriculture faces challenges of climatic change and various stresses. Plants are subjected to multiple stresses in chorus leading to colossal changes in the molecular landscape of a cell. Being sessile crop is persistently exposed to various abiotic and biotic stresses with devastating effect on its survival and productivity. Recently, microRNAs have acknowledged tremendous attention due to their value in negative gene regulation and control a vast array of biological processes and abiotic and biotic stress responses. The major molecular framework of miRNA biogenesis and modes of action in plants, and crosstalk of miRNAs with different abiotic stresses will be deliberated. The stress-responsive

miRNAs are differentially expressed under various stresses and open novel perspectives to engineering plants for stress resistance.

Keywords: MicroRNAs (miRNAs), MIR genes, mRNA Cleavage, Translational Repression, Biogenesis, Modes of Action, Stress

ANTIGENOTOXIC POTENCY OF *Chrysanthemum morifolium* Ramat.: A COMPARATIVE STUDY

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The present scenario has demonstrated that heavy metals such as nickel dust/compounds are extremely potent carcinogens after inhalation. Moreover, medicinal plants maintain not only the health and vitality of individuals but also cure various diseases including cancer. Among various plants belonging to different families, the plants from Asteraceae family have been well documented to have role in curing various diseases. Considering the important therapeutic properties of *Chrysanthemum morifolium* Ramat. and wide acceptability of *Allium cepa* root chromosomal aberration assay the present study was planned to explore and compare antigenotoxic potency of *C. morifolium*, by preparing aqueous and ethyl acetate extracts of petals of *C. morifolium* by fractionation method and to compare their antigenotoxic potential against nickel induced genotoxicity. It was observed that both the extract showed significant percentage inhibition of aberrant cell during pre, post and simultaneous treatment. However, out of the two extracts aqueous extract showed efficient antigenotoxic ability as indicated by % inhibition of 85.02% during simultaneous, 85.23% in post and 78.70 % during pretreatment respectively. Overall our study reveals aqueous extract as better antigenotoxic when compared to ethyl acetate extract.

Keywords: Antigenotoxicity, *Allium cepa*, *Chrysanthemum morifolium*, Heavy metal, Nickel

EFFECT OF DIFFERENT SUBSTRATES ON NUTRITIONAL COMPOSITION OF SHIITAKE MUSHROOM (*Lentinula edodes*)

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Lentinula edodes (Berk.) Peglar, the shiitake mushroom, is worldwide one of the most widely cultivated mushrooms. The cultivation of edible mushrooms is a biotechnological process that uses various residues to produce food of high nutritional value. Two strains of *Lentinula edodes* (DMR-356 and DMR-35) were cultivated on basal substrates wheat straw and poplar sawdust alone and in combination with supplements (Wheat bran, Rice bran and Maize Meal). The fruit body of shiitake mushrooms were analyzed for crude protein, crude fiber, Moisture content, crude fat, total ash and total carbohydrates. DMR-356 strain proved best for high nutritional value crude protein (22.44%), crude fat (3.97%), crude fibers (7.69%), total ash (7.75%), total carbohydrates (63.50%) with



substrates wheat straw + wheat Bran. The least effective substrate was sawdust alone. The substrates were analyzed for cellulose, hemicellulose and lignin content at two different stages. The hemicellulose, cellulose and lignin contents in the spent substrate were 22.09–44.23%, 17.07–24.85% and 14.40–29.08% lower, respectively, than in the initial substrates

Key words: *Lentinula edodes*, substrates, supplement, proximate composition

NANOENCAPSULATION OF ESSENTIAL OILS: A WAY TO IMPROVED ANTIMICROBIAL PROPERTIES

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Plant essential oils are obtained by physical or chemical techniques from different plant parts. Recently there has been an upsurge of interest in essential oils as natural antimicrobial agents. Essential oils are made up of many different volatile compounds whose synergistic effects could lead to antifungal and antimicrobial effects. Despite all unique advantages of essential oils, however, they are sensitive materials which can easily suffer degradation in the presence of oxygen, light and moderate temperatures. Therefore the major goals in stabilizing essential oils formulations are (a) to protect them from degradation and losses by evaporation and (b) to achieve a controlled release. In order to achieve this, nano-encapsulation has been recently developed as an efficient technique for protecting EOs from evaporation and oxidation, offering prolonged activity for encapsulated compounds through controlled release, improving the stability and hence antimicrobial bioactivity of unstable compounds during food processing and storage and improving the water-solubility and bioavailability of lipophilic compounds. This study focus on the encapsulation of essential oils to provide drug resistance of some microbes by enhancement of their antimicrobials activities.

Keywords: antimicrobial agents, resistance, microbes

A REVIEW ON BIOACTIVITIES OF ESSENTIAL OIL AND OTHER EXTRACTS OBTAINED FROM ASTERACEAE FAMILY

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Asteraceae family, also called as Compositae or the daisy family, is a widespread angiospermic family of plants among the dicotyledonous, including 1,911 genera and 32,913 species, 12 subfamilies and 43 tribes that represent this plant family with cosmopolitan distribution. And in India, the family is represented by 900 species and 167 genera. Members of this family have been commonly known for their therapeutic utility. Around 7000 compounds have been isolated and more than 5000 have been identified from this family that are associated with various bioactivities like antipyretic, anti-inflammatory, detoxifying properties, antiparasitic, antifungal, antitumor, antioxidant, antimicrobial etc. Essential oils are very complex mixtures of volatile molecules produced by the secondary metabolites of aromatic and medicinal plants. Most of the essential oils are the mixtures of terpene and sesquiterpene hydrocarbons, phenylpropanoids and benzenoid oxygenated derivatives. Literature

reviews show that most of the essential oils of asteraceae family consist of bisabolol oxide, (Z)-en-yne-dicycloether, germacrene D, decanoic acid, Limonene, 1,8-cineol, caryophyllene oxide and many more. Different types of plant extracts are obtained from the asteraceae family like phenolic compounds, ethanolic compounds, methanolic compounds, nitrogen compounds terpenoids, flavanoids etc. that also performed important biological activities. It has been reported that presence of anti-inflammatory compounds, anti-bacterial compounds, anti-microbial compounds, anti-oxidant compounds are the reasons for the importance of plants of asteraceae family as the potential source of medicinal uses, drugs in future and other biological activities.

Keywords: Asteraceae, Essential oils, Anti-inflammatory, Biological activities.

ETHNOBOTANY AND DIVERSITY OF MEDICINAL PLANTS USED BY THE LOCAL PEOPLE OF BHALESSA, JAMMU AND KASHMIR: A REMOTE REGION OF WESTERN HIMALAYA

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The traditional knowledge about ethno medicinal plants has a significant impact in the human healthcare. However, across the globe especially in remote areas, this treasure-trove of traditional knowledge is being rapidly lost. Therefore, it is important to scientifically document and validate the folklore claims about medicinal plants, which will contribute in their bio prospection and sustainable use. The objective is to elucidate the traditional knowledge and practices about the usage of the medicinal plants by the tribal population inhabiting Bhalessa. The data were collected through focused interviews of the local population in the study area by employing in situ and ex-situ survey methods. A total of 80 ethno medicinal plants (77 angiosperms and 3 gymnosperm) belonging to 72 genera and 45 families were used against 17 disease categories in the area. The most frequently used plant parts were roots and leaves and the route of administration of the medicines was largely oral in the powdered form. The ICF values were indicative of a higher agreement among the users about the usage of plants in the treatment of disease category like ICD code A-B, ICD code M, ICD code R. Based on the number of use report and no of taxa utilized the most prevalent disease in the study area were joint pain and fever. Novel information has been generated as the elderly people of Bhalessa possess precious knowledge of medicinal plants. These novel folklore claims about the various therapeutic values of medicinal plants require scientifically sound validation. Therefore, we suggest doing focused phytochemical research and proper pharmacological validations of the reported medicinal uses in the study area, particularly *Aconitum lethale*, *Arisaema jacquemontii* and *Saussurea costus*, which are endemic to the Himalaya.

Keywords: Biodiversity, Traditional healthcare, Medicinal plants, Herbal medicine

ELUCIDATION OF H₂S METABOLISM IN *Solanum lycopersicum* AND ITS SIGNIFICANCE IN STRESS

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An essential gaseous signaling molecule known as hydrogen sulphide (H₂S) has been related to a number of developmental and stress responses in plants. However, little is known about the metabolism of H₂S, and only an evaluation study utilizing the plant *Arabidopsis thaliana* has been carried out so far. The purpose of the current study was to clarify H₂S metabolism in *Solanum lycopersicum* L. and its role in stress response. The study used in silico analyses to show that 29 proteins, mostly found in the cytosol, chloroplast, and mitochondria, are involved in the metabolism of H₂S. The pertinent protein-protein interactomes for subcellular compartments were also inferred, and expression data were examined under developmental and biotic stressors, specifically PAMP therapy and bacterial infection. Further research revealed that exogenous H₂S administration reduced the negative effects of Cd exposure on *Solanum lycopersicum*. Cd stress has been reported to have an inhibitory effect on germination percentage of seed, root/shoot ratio, fresh and dry weight, chlorophyll and RWC, but it accelerates the electrolyte leakage, accumulation of malondialdehyde, proline and the activity of antioxidant enzyme. However exogenous H₂S administration counteracted the aforementioned negative effects of Cd, thereby enhancing stress tolerance.

Keywords: Hydrogen sulfide, Tomato, In silico, Metabolism, cadmium

EXPLOITATION OF MACROFUNGI IN BIOREMEDIATION AND AGRICULTURAL SUSTAINABILITY

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With ever expanding commercialization, many industries have flourished all over the world which has in turn resulted in contamination of air, water and soil by the release of many toxic chemicals including harmful pesticides and insecticides in agriculture. These toxic pollutants like hydrocarbons directly enter our environment through oil spill, tank leakages, and excessive use of chemicals in land or wastewater disposal. The enormous quantity of pollutants, their persistence and mobility in natural environments and their frequent toxicity, has created a need to understand their behavior in natural environment and devising means of bringing about their either reduction or total eradication as this process has further affected the agricultural sector at large. In this line, many macrofungi have recently been studied to show effectively the process of bioremediation/mycoremediation to transform a wide variety of hazardous chemicals. Mushroom forming fungi (mostly basidiomycetes), are amongst nature's most powerful decomposers, secreting strong extra cellular enzymes due to their aggressive growth and biomass production. These enzymes include lignin peroxidases (LiP), manganese peroxidase (MnP) and laccase etc. White rot fungus has been used for biotransformation of pesticides, degradation of petroleum hydrocarbons and lignocellulolytic wastes in the pulp and paper industry. Furthermore, many diverse macrofungi (AMF) in association with other microbes affect the rhizosphere of plant in a positive manner and help them flourish well and increase their overall yield. *Phanerochaete chrysosporium*, *Agaricus bisporus*, *Trametes versicolor* and *Pleurotus ostreatus* amongst many mushrooms have been reported in the decontamination of polluted sites. Furthermore, *Lentinus squarrosulus*, *Pleurotus tuber-regium* and *P. pulmonarius* have been employed in bioremediation of contaminated soils both in-situ and ex-situ. Thus, this abstract uncurtains the fact that mushroom growing in wild or cultivated is not just a rapidly expanding business but it is also a significant tool for restoration, replenishment and remediation of over-burdened ecosphere.

Keywords: macrofungi, bioremediation, plant crop yield.

DE-SCALING, EXPERIMENTAL, DFT, AND MD-SIMULATION STUDIES OF UNWANTED GROWING PLANT AS NATURAL CORROSION INHIBITOR FOR SS-410 IN ACID MEDIUM

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The bio-corrosion inhibitor from *Ageratum houstonianum* (*A. houstonianum*) a unwanted growing plant will be very useful for our nature because in present time we are using lot of hazardous synthetic chemical for protection of metal from corrosion, so when we will replace them by bio-corrosion inhibitors, then this will be resolve the problem of these hazardous chemicals and unwanted growing plant. De-scaling will save economic losses caused by changing whole pipelines over time. By de-scales, can clean choked pipelines and the oil flow will be maintained. The SS-410 steel is used in the petroleum industry, tested for adsorption and corrosion studies. The preliminary corrosion tests were carried out using weight loss analysis and it was confirmed with the electrochemical measurements 93% inhibition efficiency was achieved at 500 mg/l concentration. The inhibition efficiency increases *A. houstonianum* extract concentration. The extract of *A. houstonianum*, obeyed the Langmuir's adsorption isotherm. Quantum chemical calculations show that the Beta-tertamethoxy phenyl, 6-hydroxyl 2,3,4,5-tetramethoxy Benzoic Acid (BHB) has the greatest inhibition efficiency investigated phytochemicals of *A. houstonianum*. The adsorption analysis done by atomic force microscope (AFM) supports the concept that the surface of SS-410 steel protected by the *A. houstonianum* extract in a destructive medium.

Keywords: bio-corrosion, phytochemicals, adsorption, SS-410 steel, atomic force microscope

EFFECTS OF PRE-SOWING SEED TREATMENTS WITH AM FUNGI ON THE ACCUMULATION OF SEED PROTEINS IN SOYBEAN UNDER CADMIUM STRESS

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Various abiotic stresses imposed naturally or by anthropogenic activities negatively impact global agricultural output. Compared to cereals, legumes are more prone to environmental stress. The present study aimed to understand better cadmium's effects on numerous seed protein characteristics in soybean. Considering the legumes' tolerance to Cd and its permissible limit in the soil, Cd (as CdCl₂.H₂O) at concentrations of 10, 20, and 30 mg per kg of soil was supplied to plants. In soils with different levels of Cd, the effects of the arbuscular mycorrhizal fungi (AMF), *Glomus mosseae* and *G.fasciculatum* (added as VAM powder, 25g/1kg of seeds) on growth, total seed protein content, the proportion of seed protein fractions, and the relative intensity of polypeptides on SDS gels were studied. At maturity, seeds were collected and stored in a deep freezer till further analysis. It was found that the total amount of seed protein content in control decreased gradually from 41.5% to 38.5% when the concentration of Cd was increased from level 1 (10 mg) to level 3 (30 mg). However, the effect of Cd was reduced in plants that were treated with AM fungi, which resulted in considerable improvements in the total seed protein content. Compared to *G. mosseae*, *G. fasciculatum* is more

effective in boosting plant growth and the amount of protein they contain at Cd levels 1 and 2. In contrast, at the third Cd level, both *Glomus* species equally improved the plants' growth characteristics. On SDS gels, quantitative changes in polypeptide intensity were also observed. Gel Analyzer was utilised to compute and examine polypeptide bands' Rf values and intensities.

Keywords: Soybean, AM fungi, Cadmium, SDS-gel.

IMPACT OF ELICITATION AND PRECURSOR FEEDING ON PHYTOCHEMICAL PROFILE AND ANTIOXIDANT ACTIVITY OF COMMON BEAN SPROUTS

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The present study was carried out to evaluate the impact of different elicitors namely salicylic acid (SA), folic acid (FA), sucrose (S), ascorbic acid (AA) alone as well as in combination with precursor [L-phenylalanine (P) and L-tyrosine (T)] feeding on phytochemical profile and antioxidant activity of 8 day old common bean sprouts. Combination of AA (1mM) with phenylalanine was found to be the most effective treatment. Elicitation with AA (1mM) + P showed the highest total phenolic, total flavonoid and condensed tannin content of 12.39 ± 0.16 mg GAEs/g FW, 1236.57 ± 3.48 μ g QEs/g FW and 564.49 ± 4.00 μ g CE/g FW respectively. Elicitation with optimized concentration of elicitor alone as well as in combination with phenolic precursors also resulted in a considerable increase in the antioxidant potential of sprouts, which was found to be positively correlated with total phenolic content. Treatment AA (1mM)+ P showed the highest DPPH radical scavenging activity (IC₅₀ value of 70.13 ± 0.97 mg FW/ml), reducing power (IC₅₀ value of 51.10 ± 0.30 mg FW/ml), FRAP (9902.70 ± 55.22 μ M Fe²⁺eq./g FW) and metal ion chelation activity (89.68%) in 8 day old common bean sprouts. From the above study, it may be concluded that elicitation is a simple and inexpensive method to increase nutraceutical potential of common bean sprouts.

Keywords: Elicitor, Salicylic acid, Folic acid, Nutraceutical, Tyrosine.

BIOREGULATORS -AS A BOON FOR ROOTING IN CUTTING

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Bioregulators are small, simple organic substances of diverse or different chemical composition which are required in low concentration like hormones in animals. The bioregulators are also called as plant growth regulators, plant hormones or phyto hormones. They influence physiological activities of plants leading to promotion, inhibition and modification of growth. There are different types of bioregulators (major and new generation). They have different mode of action in plant growth and development. The most important bio-regulator for rooting in cutting is "Auxin" (IAA, IBA, and NAA). Cutting is separation of a portion from mother plant and planting it in a medium suitably so that it may constitute a new plant successfully. The root formation from cutting is a genetically and physiologically governed phenomenon. During adventitious root formation the auxin polarly comes downward concentrate at cut point. Several studies have shown that exogenous hormone treatment

accelerates cell division, promotes synthesis of endogenous hormone, stimulate carbohydrate accumulation, and consequently induces root formation. It also increases peroxidase (POD) and polyphenol oxidase (PPO) activity. There are four rooting stages i.e Root pre-emergence stage, early stage of root formation, Massive root formation and root post emergence stage. Firstly there is formation of root primordia. The other hormones like jasmonic acid, ethylene also increases at the site of wounding. Bioregulators has also effect on germination, flowering, sex expression, parthenocarpy etc. The type and concentration of hormone had a significant effect on rooting percentage of cutting and rooting time of cutting. Therefore bioregulators shorten the rooting time and increase the rooting percentage in cuttings.

Keywords: Bioregulators; root formation; cutting; root primordia

SPELT WHEAT: AN ALTERNATIVE EXTRAORDINARY CROP

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Nowadays, a considerable interest in the consumption of alternative crops and foods delivering high nutritional value has arisen. This prompts the development of new grain varieties in order to meet consumer expectations worldwide. As a result, in the last few decades spelt, an ancient grain with low soil and climatic requirements, has been receiving renewed and increasing interest as it is considered a healthier and less over-bred cereal than modern wheat. Spelt is considered a low-input crop, suitable for growing without the use of pesticides, in harsh ecological conditions and in marginal areas of cultivation. Spelt is an interesting genetic resource for the search of useful genes for plant breeding of modern wheat varieties. Useful traits of spelt include resistance to diseases, high levels of grain protein and mineral nutrients, particularly Zn and Fe, early flooding tolerance and winter hardiness. The nutritive content of spelt wheat is quite high and contains all the basic elements required for the development of human being. The present study was carried out at the division of plant physiology, SKUAST-JAMMU to find out the chlorophyll content and the protein content of the spelt wheat and the check wheat variety WH 1080. Spelt was found to have higher protein content and a higher participation of the aleurone layer in the kernel than common bread wheat. Spelt wheat and its products could thus serve as an abundant source of protein. Spelt varieties were found to have more level of chlorophyll content as compared to common bread wheat.

Keywords: Spelt Wheat, breeding, nutritional value

MALE AND FEMALE MEIOSIS EVINCE DIFFERENTIAL PATTERNS OF CHROMOSOME BEHAVIOUR IN THREATENED *Allium roylei* L: ATRANSLOCATION HETEROZYGOTE

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For carrying out complete analysis of recombination and breeding behaviour of any taxon, cytological studies on both the sexes is very important. Presently, chromosome number and behaviour was analysed in megaspore (MMCs) and pollen mother cells (PMCs) of *Allium roylei* L. consistently having 16 chromosomes in the somatic cells. While PMCs of ten plants scrutinized contained

uniform count of 16, variable count was witnessed in MMCs of three plants and uniform count in the rest seven plants. This species is further peculiar in exhibiting structural heterozygosity, manifested by presence of meiocytes with multivalents. The complexity of multivalents also varied in two tracks. While the female sex cells contained at the most quadrivalents, male ones possessed complex associations comprising of 3-16 chromosomes. The chiasma frequency also varied in the two sexes. The average chiasma frequency per pollen mother cell at diakinesis was 18.33, whereas the value of this trait figured as 19.22 in megaspore mother cell. These cytological variations in male and female sex cells along with the possible causes of these differences will be discussed during the presentation.
Keywords: *Allium roylei* L.; Pollen mother cells; Megaspore mother cells; Chiasma Frequency; Multivalents

BIODIVERSITY OF HERBS WITH MEDICINAL POTENTIAL OF DISTRICT SAMBA, JAMMU AND KASHMIR, INDIA

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The Union Territory of Jammu and Kashmir is one of the 26 biodiversity hotspots in India. This study conducted in 2010-2013, investigates diversity of medicinal herbs and dendroflora in district Samba which is unexplored in terms of floristic wealth. The present investigation is based on field surveys on medicinal herbs medicinal flora in Samba in 2010-2013. The morphological characters of the plants were recorded in-situ for identification through literature and subject experts and plants were photographed. The collected data was re-scrutinized through literature. This research article examines the diverse natural and cultural medicinal herbaceous flora of district Samba from 36 families, including 93 genera and 105 plant species with wide range of growth forms. Asteraceae, Amaranthaceae, Apiaceae, Brassicaceae, Cucurbitaceae, Fabaceae, Lamiaceae, Malvaceae, Poaceae and Solanaceae showed key representations. Some 23 plant families were mono-generic. The plant species showed flowering periods in June (41.90%), July (65.71%), August (71.42%), and September (49.52%) with highest percentage of plants with flowering traits in the month of August. The main focus here was on the therapeutic potential of various herbs of Samba region. The plant parts like leaves (23 %), stems (5%), tubers and rhizomes (2% each), flowers (10 %), fruits (8%), seeds (19%), bark and bulbs (1% each), roots (13%), and even whole plant parts (16%) possess remedial worth against various anthropological disorders.

Keywords: Medicinal potential, herbs, flowering period, plant parts used, Human disorders, Samba

INFLUENCE OF PAINT INDUSTRY EFFLUENTS ON THE GROWTH AND PHOTOSYNTHETIC PIGMENTS OF *Triticum aestivum* L.

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With the human lifestyle moving towards urbanization and industrialization, the impact of industrialization on the environment has led the way with certain positive and large negative outcomes, with progressive rates and inventions. There are numerous resourceful natural elements,

such as water, air, soil, and fisheries that are regarded as positive and fertile assets. Wastewater from various industrial sectors contains many toxic pollutants that are hazardous to human and aquatic life, as well as agriculture. Heavy metals such as chromium (Cr), zinc (Zn), lead (Pb), copper (Cu), iron (Fe), cadmium (Cd), nickel (Ni), arsenic (As), and mercury (Hg) are examples of such pollutants. The majority of these heavy metal pollutants is produced by the paint and dye industries, as well as the textile, pharmaceutical, paper, and fine chemical industries. Plants require certain heavy metals for growth and maintenance; however, excessive amounts of these metals can be toxic to plants; and the ability of plants to accumulate essential metals also allows them to acquire non-essential metals. Some of the toxic effects of high metal concentration include inhibition of cytoplasmic enzymes and oxidative stress damage to cell structures. The current study aims to assess the effects of industrial effluents on the growth and photosynthetic pigments of *Triticum aestivum*. For seven days, plants were exposed to varying concentrations of untreated paint industry water effluents (0 %, 20%, 40%, 60%, 80%, and 100%). The results showed that industrial untreated effluent toxicity affected the amount of photosynthetic pigments (chl a, chl b, total chl) and electrolyte leakage in treated *Triticum aestivum* plant compared to control. Furthermore, increasing wastewater concentration had an effect on germination rate and early growth parameters such as seed germination, root length, shoot length, decrease in fresh weight, dry to fresh weight ratio, root to shoot length ratio, and increase in ion leakage with increasing concentration of wastewater.

Keywords: Heavy metals, stress physiology, industrialization, pigments, germination, effluents.

MORPHOLOGICAL CHARACTERIZATION OF DIVERSE BREAD WHEAT GENOTYPES FOR NITROGEN STRESS

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Wheat (*Triticum aestivum* L.) is an edible starchy cereal grain and the grass plant belonging to family Poaceae. It is the most extensively grown staple cereal crop in the world, covering about 225 million hectares with a production of 772.64 million tonnes. The total area under wheat cultivation in India is 31.5 million hectare with a production and productivity of about 108 million tonnes and 34 q/ha respectively. In Jammu & Kashmir (UT), the total area under wheat cultivation is 2.88 Lakh ha with production and productivity of about 6.7 Lakh tonnes and 23.3 q/ha respectively. Nitrogen (N), an essential nutrient for growth and development in plants and is added to the agricultural fields to boost crop yields. Improved NUE has the potential to increase yields and profits with minimal environmental impacts when growing grain crops. NUE measures how much nitrogen a plant uptakes as well as how much of this nitrogen uptake is lost via nitrous oxide emissions from the plants. This measures how efficiently plants use and retain nitrogen. NUE is also considered as the efficiency with which nitrogen applied to soil, through natural or artificial means, is taken up by plants and not used for other purposes such as feeding anaerobic bacteria that cause denitrification or leaching via nitrogen dissolution in water. Nitrogen use efficiency is the amount of nitrogen a crop takes in and retains until harvest compared to the amount of nitrogen that was actually available for the crop to consume, with a particular emphasis on how much fertilizer is applied to soils compared to how much nitrogen crop intakes and retains until harvest. Diverse genotypes of wheat are taken and different morphological parameters are analysed under different doses of nitrogen. Morphological characters like plant height, number of leaves, leave area, productive tillers and grain yield is calculated at



different nitrogen doses. Wheat varieties LIRA/TAN, BWL4433 and NP-710 are showing high values even in Nitrogen stress for morphological and yield parameters.

Keywords: *Triticum aestivum*, nitrogen dissolution, stress.

CROSS TALK OF NITRIC OXIDE WITH PHYTOHORMONES UNDER ABIOTIC STRESS

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A key signalling molecule in plants, nitric oxide (NO) serves a variety of physiological purposes. Various signal cascades inside the plant works to bring tolerance against the stressed conditions like salinity, drought stress, heavy metal stress, temperature stress etc. In order to tolerate these conditions plants directly or indirectly regulate the level of the endogenous NO. NO is the key player during the abiotic stress and act as the signalling molecule by interacting with various phytohormones (PHs). In the abiotic stresses, NO regulates signalling pathways by interacting with PHs like auxin, cytokinin, gibberellin, ethylene, ABA, jasmonic acid, salicylic acid, brassinosteroids and others to control plant growth, development and metabolism, thus confer resistance against stress. NO and PHs show both antagonistic and synergistic relationship, depending on the plant species and intensity of stress conditions. NO brings about the changes majorly by post-translational modifications of proteins (like S-nitrosylation, tyrosine nitration and metal nitrosylation) or by regulating the expression of genes involved in antioxidant metabolism. This poster summarises the current understanding about role of NO as a signalling molecule in confronting abiotic stresses by controlling plethora of plant responses through interaction with phytohormones.

Keywords: nitric oxide, phytohormones, abiotic stress, post-translational modifications

A NEW APPROACH FOR CUCUMBER FARMING BY HYDROPONICS METHOD

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Nowadays, the agricultural land is declining due to the other purposes like roads, buildings, houses, companies etc. Also the erosion by both water and wind leads to lesser agricultural land. So in order to get fresh fruits and vegetables that too in a lesser time and space, the farmers are adopting the new technology of hydroponic system. This system helps to grow vegetables and fruits with higher quality without any soil and lesser number of labour or no labour. This hydroponic system grows fruits and vegetables in less space and provides higher production by using growing medium or substrate which is a substance through which roots grow and extract water and nutrients. Media which are used in hydroponics are perlite, cocopeat, vermiculite vermicompost etc. Hydroponics is the technique of growing plants in soil-less condition with their roots immersed in nutrient solution. Farmers grow cucumber for its cooling effect and it helps to avoid constipation. So the cucumber seedlings after 15 days will be transferred in this hydroponic systems with the treatment combinations of the above said growing medias. The cucumber plant roots will get the nutrients from the hydroponic system via water. This will show the best growing media for the cucumber vegetable crop in hydroponic system.

Hence this will help the farmer to get the fresh and good quality cucumber in lesser time for the whole year.

Keywords: Hydroponics, cucumber, labour, soil less technique

ETHNOMEDICINAL EXPLORATION OF SOME COMMON PTERIDOPHYTES USED BY THE TRIBALS OF HIMACHAL PRADESH (INDIA)

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The present study pertains to the ethnomedicinal uses of some common Pteridophytes by the tribal communities of Himachal Pradesh (India) for the treatment of various ailments. In India, Himachal Pradesh is a unique state from the perspective of biodiversity with occurrence of several valuable and economically important medicinal and aromatic herbs of great therapeutic value. Apart from the higher Angiospermic plants, the tribal communities of study area also use some common Pteridophytic plants for their healthcare management. The present article documents ethnomedicinal uses of some common Pteridophytes which are prevalent in the study area along with Botanical Name, Family, Vernacular Name/s, Part/s Used and Ethnomedicinal Uses.

Keywords: Ethnomedicinal, Pteridophytes, Tribals, Himachal Pradesh

SCREENING OF FRENCH BEAN GENOTYPES AGAINST *Colletotrichum lindemuthianum* INCITING FRENCH BEAN ANTHRACNOSE

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French bean (*Phaseolus vulgaris* L.) is an important leguminous crop locally called as 'Rajmash' in India and is also known as common bean, bush bean, kidney bean, snap bean and haricot bean. Pulses play an essential role in the Indian dietary system due to its nutritional value and richness in protein. Its dry seed contains 69.9 per cent carbohydrates, 21.1 per cent protein, 1.7 per cent fat, 425 mg phosphorous, 381 mg calcium, and 12.4 mg iron per 100 g of edible part. The crop is vulnerable to various biotic factors like diseases and insect-pest, among them disease are known as the major constraint in its production. Various diseases including fungal diseases [rust (*Uromyces appendiculatus*), anthracnose (*Colletotrichum lindemuthianum*)], bacterial diseases [bacterial blight (*Xanthomonas compestrispv.phaseoli*)] and viral diseases [Bean Golden Mosaic Virus (BGMV), Bean Common Mosaic Necrosis Virus (BCMNV), Bean Yellow Mosaic Virus (BYMV)] are considered as the major limitation in its production. Among the fungal diseases, anthracnose disease caused by *Colletotrichum lindemuthianum* is known to be the predominant disease that pose a serious threat to its production. The pathogen attack the crop at all the growth stages i.e. leaves, stems, pods, seeds and can causes a yield loss of 90-100 per cent in severe conditions. During the cropping season of the year 2021 and 2022, a study was conducted to evaluate 100 genotypes against *Colletotrichum lindemuthianum* causing anthracnose disease. The primary objective of the study was to find out the host resistance source as it is the most economical as well as effective approach for the management of disease and the resistant genotypes can be used in breeding programme for resistance against the

disease. Out of these 100 genotypes, 30 genotypes were found moderately resistant, 42 genotypes were found moderately susceptible and 28 genotypes showed susceptible response against the anthracnose disease terminal disease severity ranged between 7.59 to 10.00 per cent, 11.52 to 24.99 per cent and 26.04 to 39.47 per cent, respectively. Genotype EC-286067 recorded the minimum terminal disease severity of 7.59 per cent followed by EC-285579 (7.81 %), EC-284256 (8.34 %), IC-311705 (8.60 %), whereas maximum terminal disease severity of 39.47 percent was recorded in WB-832.

Keywords: french bean, anthracnose, screening, resistance

ETHNOBOTANICAL STUDY OF TRADITIONALLY USED MEDICINAL PLANTS BY INHABITANTS OF RANBIR SINGH PORA, DISTRICT JAMMU (JAMMU AND KASHMIR) INDIA

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Plants and plant based formulations have been used by humans for millennia to cure different ailments. This study was aimed at exploring and documenting indigenous knowledge on medicinal plants used to cure different ailments by the villagers of RS Pora of district Jammu, Jammu and Kashmir, India. Ethnobotanical information, including local names of plants, parts used, and method of preparation were gathered using semi-structured questionnaires. In total, 49 species of the plants were reported in the present study belonging to 33 families are used to cure various day to day prevailing diseases, Asteraceae, Combretaceae, Moraceae, and Poaceae (3 member each), followed by Euphorbiaceae (2), Fabaceae (2), Lamiaceae (2) and Malvaceae (2) were some dominant families from the study area. Plants used for curing various type of ailments in which 27 herbs, 05 shrubs, 15 trees and 2 climber was found, the leaves 18 was the most used plant part followed by whole plant 10, root 09 times, bark 04 times, seed were used in 04 preparations, fruit 08, flower 02 and stem 01 respectively were the least used plant part recorded in the present study. The current finding are an indication that the villagers have good knowledge of their local flora to cure different ailments and might provide baseline information for further phytochemical analysis to evaluate the pharmacological efficacy and safety of the identified medicinal plants to formulate some novel drug.

Keywords: Ethnobotany, Medicinal plants, RS Pora.

BORON AFFECTS POLLEN CHARACTERISTICS IN DIFFERENT *Malus domestica* L. CULTIVARS

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The upshot of shifting boron concentrations on in vivo pollen germination and tube penetration in four dissimilar apple cultivar crosses among 'Golden Delicious,' 'Red Delicious,' 'Gala' and 'Fuji' was appraised. Boric acid (H₃BO₃) with two different concentrations: 1000 and 2000 mg L⁻¹, was squirted on the foliage long before the commencement of flowering. Pollen-pistil interaction vis-a-vis pollen germination and tube penetration was calculated using fluorescence based microscopy technique, 72 and 120 h after manual pollination. Among different crosses, female Golden delicious x

Red delicious male treated at 1000 mg L⁻¹ concentration of boric acid showed maximum (27.39%) pollen germination and pollen tubes at different levels inside the style. In control without boron, only 6.49% germination was observed. Interaction of boron conc. x time described highest pollen germination and tube number 120 hap. The study demonstrates that foliar application of boron beyond 1000 mg L⁻¹ on different apple cultivars reduces germination of pollen and development of pollen tubes down the style.

Keywords: Germination, Golden delicious, Boric acid, fluorescence, microscopy technique

PLANT BIODIVERSITY & CONSERVATION

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Biodiversity can be defined as the variability among and between the living organisms and species of surrounding ecosystems and ecological complexes of their life support. Advances in plant biotechnology provide options for collection, multiplication and short to long-term conservation of plant biodiversity. Special care should be taken for the species which are threatened and at the verge of extinction. Efforts should be made to protect the indigenous genetic diversity. Conservation of plant biodiversity can be performed *in situ* or *ex situ*. *In situ* methods both plants and their natural habitat are protected while, *ex situ* methods involve preservation and maintenance of plant species outside their natural habitat by developing seed banks or gene banks. The biotechnological methods such as plant tissue culture, plant cell culture, anther culture, embryo culture etc. are quite applicable and useful techniques for *ex situ* conservation. Cryopreservation (liquid nitrogen, -196 °C) is the only technique ensuring the safe long-term conservation of a wide range of pathogenic free plant species. The production of superior quality seeds has been enhanced by the application of plant biotechnology. Modern biotechnological interventions (marker technology, DNA fingerprinting, RNAi, molecular markers) can also be used in the field of biodiversity conservation.

Keywords: Biodiversity, Biotechnology, Cryopreservation, Gene banks, Genetic diversity.

STUDIES ON DOWNY MILDEW OF KNOL-KHOL INCITED BY *Peronospora parasitica* (Pers.)

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Knol-khol (*Brassica oleracea* var. *gongylodes* L) is a cool season crop popular in Jammu and Kashmir, West Bengal and Karnataka. The present investigations were undertaken to investigate various key aspects of the downy mildew of Knol-khol and to determine the status of disease, the epidemiological studies and its management through chemical, bio-control agents and botanical. The symptoms on Knol-khol were observed as a small angular spot with pale yellow colour which turns to black in colour. On the lower side of leaves, the damaged areas are enclosed with a grey white optimum downy growth formed of numerous conidiophores bearing conidia. Morphological characteristic of *Peronospora parasitica* revealed, conidia are aseptate, hyaline in colour and globose

to spherical in shape with length ranging from 19.69 to 28.66 μm and breadth from 17.09 to 23.10 μm with an average length and breadth of 22.99 μm and 20.67 μm , respectively. Results of survey on disease in Jammu division revealed a considerable variation in disease incidence and intensity in all the locations of districts viz., Jammu and Samba at different days after transplanting (DAT) viz., 30, 40, 50 and 60. Overall mean per cent incidence and intensity recorded during 30, 40, 50 and 60 days after transplanting (DAT) was 12.66, 9.73; 21.77, 17.48; 41.07, 36.02 and 53.15, 43.67 per cent, respectively. The disease is significantly affected by the weather condition prevailing during the cropping period with significant variation of 99 per cent. Correlation data between weather parameters and per cent disease intensity revealed that maximum and minimum temperature showed a highly significant and positive correlation of 0.94 and 0.84 with the disease index. A highly significant negative correlation of - 0.83 and -0.72 was observed with maximum and minimum relative humidity, respectively. However, a non-significant and negative correlation of - 0.49 was observed with rainfall. Among the fungicides, bio-control agents and botanical, minimum disease intensity of 16.29 per cent and yield of 205.80 q/ha was recorded with application of two foliar sprays of Metalaxyl + Mancozeb (0.25%) followed by Azoxystrobin (0.1%) with 18.32 per cent and yield of 202.23 q/ha as compared to that of control where a disease intensity of 54.29 per cent and yield of 140.73 q/ha was recorded. Among the bio-control agents *Trichoderma viride* (@ 0.6%) exhibited the minimum disease intensity of 32.38 per cent and yield of 174.20 q/ha as compared to that of control. The efficacy of treatments against the disease and yield was found in order of Metalaxyl + Mancozeb > Azoxystrobin > Mancozeb > Propiconazole > Copper oxychloride > *Trichoderma viride* > *Trichoderma harzianum* > *Pseudomonas fluorescence* > Neem > control.

Keywords: Bio-control agents, Botanical, Disease incidence, Disease intensity, Days after transplanting, Epidemiological studies, Knol-khol, *Peronospora parasitica*.

SOME ETHNOMEDICINAL PLANTS OF CHINTA FOREST OF BHADERWAH FOREST DIVISION (J&K)

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The present work relates to some ethno-medicinal plants of Chinta Forest of Bhaderwah Forest Division (J&K) used by the different tribes and other Ethnic groups inhabiting different areas of the region. In this work, ethno medicinal information on some plant species has been presented by interrogating the local people, Hakeems and traditional practitioners. The plant diversity of this area is quite rich in herbal wealth and most of the villagers depend on these plants for procuring household remedies and consider them as their village dispensaries. Most of the plant species of medicinal uses have been found in wild habitat while some species are cultivated. It has been noticed that various parts of the plants are being utilized to cure diseases such as diarrhea, skin problems, dysentery, fever, ulcer, rheumatism, wounds, diabetes, respiratory and gastrointestinal problems. A large number of health-related issues are being cured utilizing ethno medicinally important tree species. It has also been observed that the majority of villagers in the area are very less aware of their ethnic knowledge and are also not so much interested in such learning. Thus, a precise documentation of this information with a traditional knowledge base from the ethnic people has great relevance for human welfare. The study suggested the need for training local people for sustainable utilization of these plant resources and their proper conservation. The suggestions to encourage learning to sustain their

ethnic wisdom has also been given which would help creating employment among local inhabitants. In this paper concerned scientific names along with their family, vernacular name, part used, disease cured have also been discussed.

Keywords: Dysentery, Conservation, Inhabitants, Ethanobotany, Medicinal

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON SOIL PROPERTIES AND YIELD OF CHICKPEA (*Cicer Arietinum* L.)

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A field study was conducted on the "Effect of Integrated Nutrient Management on soil properties and yield of chickpea (*Cicer arietinum* L.) Cv. PUSA372", at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj during Rabi season 2018-2019. The soil of experimental area falls in order Inceptisol and soil texture was sandy loam. The design applied for statistical analysis was carried out with 2x3 factorial randomized block design having two factors with three levels of NPK @ 0, 50, 100% ha', three levels of organics (FYM and Vermicomposting) @ 0,50,100ha" respectively. The result showed that plant height, no. of branches, no. of pods, seed weight, and total grain yield during 30, 60, 90 &120 DAS were shown significantly increased with application of 100 % NPK & Organic fertilizers. Growth parameters and yield parameters increased significantly in T, and Ts treatments. The lowest values related to all parameters were obtained in control plot treatment. And the results showed that pH, EC, Bulk Density, Pore space, organic Carbon, Nitrogen, Phosphorus, Potassium shown in significant effect and particle Density non-significant effect with the application of 100% NPK & Organic fertilizers T, and T, treatments.

Keywords: Pods, seed yield, Test weight, Chick Pea, EC, pH, OC, NPK, BD and PD

EVALUATION OF WEATHER PARAMETERS ON VIRULENCE OF EARLY BLIGHT PATHOGEN (*Alternaria solani*) ON THE POTATO CROP

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The effect of weather factors on the virulence of early blight (*Alternaria solani*) was studied on the crop sown in November, the variety "Kufri Chandramukhi" was sown for this purpose. Observations on the intensity of early blight starting from 30th December 2018 (52 SMW) to 29th February 2019 (8 SMW) were recorded at seven days intervals. Early blight symptoms appeared 25 days after planting as minute brown to black usually round necrotic spots on older leaves. The data indicated that disease intensity gradually increased from 6th January to 24th February. In the 1st SMW of January and 8th SMW of February, the disease increased at a faster rate (10.9% to 42.4%) when the maximum

temperature was 24.0 °C and 28.2 °C and minimum temperature was 6.4 °C and 12.6 °C the mean relative humidity (RH) was (69 % and 60 %). In the 5th and 7th standard week of February, the disease intensity increases at a slower rate. It was observed that the disease incidence was maximum during January – February when the maximum temperature was 24.0 °C – 28.2 °C and minimum temperature was 6.4 °C – 12.6 °C and average relative humidity ranged between (69 % to 60 %) which was favourable for early blight development. The correlation coefficients on maximum temperature ($r = 0.69$) exhibited a significantly positive correlation with PDI, minimum temperature ($r = 0.87$) was a significantly positive correlation with PDI, mean relative humidity ($r = -0.39$) was no-significantly negatively correlated with PDI and rainfall ($r = 0.41$) was a no-significantly positive correlation with PDI.

Keywords: Early blight, virulence, *Kufri chandramukhi*, Disease intensity

GROWTH, YIELD AND QUALITY OF AONLA (*Emblica officinalis* Gaertn.) AS AFFECTED BY INTEGRATED NUTRIENT MANAGEMENT UNDER SUBTROPICAL CONDITIONS OF JAMMU

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An experiment was conducted to study the effect of integrated nutrient management on growth, yield and quality of aonla cv. NA-7 on ten year old plant at Farmers Field, Akhnoor, Jammu, J&K India. Aonla plant recorded increase in plant height (10.86%), plant spread (13.86% NS and 13.82% EW) and canopy volume (40.71%) with the application of 25 per cent nitrogen through FYM and remaining nitrogen through urea augmented with *Azotobacter* and was at par with the plants supplied with cent per cent nitrogen in the form of urea augmented with *Azotobacter* with recommended dosage of SSP and MOP. The physico-chemical characteristics of aonla fruits were significantly influenced with integrated use of organics, urea and *Azotobacter*. Application of 25 per cent nitrogen as FYM and remaining as urea augmented with *Azotobacter* resulted in maximum number of fruits (2391.75 per tree), fruit weight (48.78 g), fruit volume (47.34cc), fruit size (4.51 cm x 5.23 cm), pulp weight (40.57 g) and fruit yield (116.67 kg per tree) compared to all other treatments. All the fruit quality parameters improved with the integrated application of FYM along with inorganic fertilizers and biofertilizers. The total soluble solids (11.25 °Brix), total sugars (6.71 per cent) and reducing sugars (3.41 per cent) were found maximum in fruits receiving 50 per cent nitrogen in the form of FYM and 50 percent through urea augmented with *Azotobacter*, whereas the ascorbic acid content was found maximum (623.17 mg/100g of pulp) with cent per cent nitrogen through application of FYM augmented with *Azotobacter*. The result suggested that for improving the growth, yield and quality of aon that fertilization of aonla with chemical fertilizers can be minimized when 25 per cent nitrogen is applied with FYM and 75 per cent with urea augmented with *Azotobacter*.

Keywords: Aonla, FYM, *Azotobacter*, growth, yield and quality.

EPIGENETICS: IMPRINT ON EVOLUTION

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Epigenetics refers to genetic factors that change an organism's appearance or biological functions without changing the actual DNA sequence by addition or deletion of a methyl group to a DNA base, turning the gene on or off, or to packaging of the chromatin structure by silencing or opening regions of the genome by winding or unwinding the DNA around histones. Epigenetic changes are more frequent than mutations that change the actual structure of the DNA. In evolutionary processes, direct and indirect contribution of epigenetic variation is greatly appreciated. In first place, intergeneration transmission of epigenesis can directly affect phenotype of offspring. In plants, *bona fide* heritable 'epialles' are quite commonly found and are subjected to natural selection as similar to conventional DNA based alleles. Secondly, phenotypic variation and phenotypic plasticity are enhanced by epigenetic variation. Phenotypic plasticity is crucial for organism's ability to adapt; epigenetic mechanisms that generate this property for acclimatization are of great importance in evolutionary theory. Third, some genes are being selected to have sex information "imprinted" on them, resulting in parent-of-origin dependent gene expression and effects. These outcomes may lead to hybrid dysfunction and aid in speciation. Finally, epigenetic activities, particularly DNA methylation, directly contribute to the evolution of DNA groupings since they function as mutagens from one perspective and balance genome soundness from another by keeping transposable elements in place.

Keywords: Epigenesis, gene silencing, Phenotypic plasticity, mutagens

A GENOME WIDE ASSOCIATION STUDY (GWAS) UNCOVERS THE NOVEL SNPS FOR YIELD RELATED TRAITS IN INDIAN UPLAND COTTON

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Cotton is one of the most significant cash crops, cultivated worldwide with great economic significance and is utilised as a raw material in the textile industry. It belongs to the genus *Gossypium* in the family Malvaceae and has the highest species diversity, making it one of the largest genera in the tribe Gossypieae, including approximately 44 diploids ($2n = 2x = 26$) and 7 tetraploids ($2n = 4x = 52$) species. More than 123 nations produce cotton, ranging from arid to semi-arid parts of the tropics and subtropics. Despite having the largest land area for cotton cultivation, India ranks 22nd in terms of yield with just 457kg of cotton produced per hectare (USDA, 2022). Reduced cotton production in India is a result of several factors, including a small gene pool, insufficient annual rainfall, susceptibility to insect pests, and morphologically based variety development, which can alter in the environmental changes and agronomic practices. As a result, boosting cotton output is a major priority and is considered an on-going goal that requires further research. However, cotton yield is a complicated multi-factorial trait that is either fully or partially under the influence of a network of

determinants, and our understanding of the genetic underpinnings of these yield qualities is still restricted.

We used GBS-based genome wide association study (GWAS) with a mixed linear model (MLM) to identify the significant loci associated with six yield-related traits in 117 Indian upland cotton cultivars for better understanding of the genetic mechanism underlying these traits. To accomplish this, we used GBS sequencing to find 1, 75,604 SNPs across 117 cotton cultivars. Six traits, such as the boll number (BN), boll weight (BW in g), lint percentage (LP %), seed cotton yield (SCY, g/plant), seed index (SI in g), and lint index (LI in g), were assessed in two different cotton cultivation zones (i.e., Northern zone-PAU, Faridkot, Punjab and Southern zone-TNAU, Coimbatore, Tamil Nadu). In both environments, every trait had a nearly normal distribution with significant variance. All the cotton cultivars were divided into six sub-groups and proven to share genomes by fast STRUCTURE analysis. Six traits related to cotton fibre yield were studied using a genome-wide association approach at PAU, Faridkot, and the results revealed a total of 58 SNPs that were significantly associated above the threshold of $\log P 4$ ($= p 0.001$), which include seven SNPs for BW, 32 for BN, one for LI, two for LP, 15 for SCY, and one for SI, respectively. The same study at TNAU, however, revealed 35 significantly associated markers, including one for BW, three for BN, seven each for SI and LI, 13 for LP, and four for SCY. Four of the associated SNPs were for LI, LP, and SI at TNAU, whereas 12 were common markers for BN, BW, and SCY at PAU. Thus, our study found a sizable number of significant SNPs, which may offer crucial information on the genetic control behind cotton's high yield. Additionally, it would make it easier for future breeding initiatives in India to generate high yielding cotton varieties using marker assistance selection (MAS)

Keywords: Cotton, yield-related traits, SNPs, GWAS, fastSTRUCTURE, mixed linear model (MLM), GBS sequencing, marker assistance selection (MAS)

FOLIAR PHYTOLITH DIVERSITY AND BIOCHEMICAL ANALYSIS OF PANICOID AND POOID GRASSES OF RAHYA SUCHANI AREA

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Phytoliths are microscopic, solid silica bodies formed by the process of biosilicification. The precipitation and polymerization of silica within and between plant cells results in the formation of soluble, monomeric silicic acid, $\text{Si}(\text{OH})_4$, in the form of polymerized insoluble silica SiO_2 . These are abundantly present in grasses constituting Poaceae family of angiosperms, protect them from various types of biotic and abiotic stresses and enhance their growth and development. Phytoliths are very resilient and they are often preserved as fossil records, because they survive death and decomposition of the plant; their inorganic nature helps them to resist the destructive forces and survive as sediments in diverse environments of land and ocean ecosystems. They are becoming more widely used as novel vegetation, habitat, and climate proxies due to their resilience in soil, arid conditions and unique morphologies. Phytoliths play significant role in characterizing and demarcating grass species at different taxonomic ranks. The present work is related to the comparative study of phytolith diversity and markers in the four grass species *Triticum aestivum* L, *Phalaris minor* Retz., *Cenchrus ciliaris* L, *Panicum antidotale* L Retz., belonging to subfamilies Pooideae and Panicoideae respectively. *Triticum aestivum* is important as food plant whereas other three grasses are important for fodder and ecology.

Occurrence of variations in phytolith morphotypes was analyzed by employing clearing solution method and epidermal cells patterning in leaf of these grasses. Dry ashing method was used for extraction of silica from leaves and the phytolith morphotypes present in silica were studied. Data of their frequency and morphometric measurements were also studied by analyzing biochemical architecture of silica from X-ray diffraction (XRD) and Fourier transform infrared microscopy (FTIR). Principal component analysis (PCA) of different shape descriptors of phytolith morphotypes clearly indicates the principal components contributing in variance of morphotypes. *In situ* pattern of phytoliths of *Triticum aestivum* showed that rondel type phytoliths were present in coastal and intercoastal region in 1-3 row whereas in *Phalaris minor* sinuate elongate phytoliths are present in only 1-2 rows in coastal and intercoastal region. In *Cenchrus ciliaris* bilobate type in coastal regions were present in 1-2 rows. Prickle hair type phytoliths were found *Panicum antidotale* both on adaxial and abaxial surface. Highest silica content was present in *Cenchrus ciliaris*. Diagnostic phytolith morphotypes globular, rondel, acicular in *Triticum aestivum*; rondel, acicular, elongate in *Phalaris minor*. Bilobate simple, bilobate short cell in *Cenchrus ciliaris* and bilobate, carinate in *Panicum antidotale*. Variations were also observed in morphoforms of silica and structural bonds in all these species. It was concluded that phytolith study provide important taxonomic evidence in characterizing and classifying different grass species.

Keywords: Biosilicification, Diversity, Grasses, Phytoliths, Taxonomy

COMPREHENSIVE SCREENING OF WHEAT GERMPLASM FOR CEREAL LEAF BEETLE (*Oulema melanops* L.) RESISTANCE IN WESTERN HIMALAYAN HIGH-ALTITUDE REGION OF KASHMIR, INDIA

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Globally wheat (*Triticum aestivum* L.) covers about 217 million hectares, the most of any crop, with an annual yield of around 764 million tones. Wheat cultivation in Kashmir valley is under risk due to severe infestation of cereal leaf beetles. Both grub and adult scrape the chlorophyll content in vegetative stage of the flag leaf leading to reduction in photosynthesis and yield. Infestation during flag leaf stage causes 40% yield losses. Continued application of insecticides causes negative effects on non-target organisms and toxic residues reached to human beings through various ways. Therefore, it is imperative to work on cereal leaf beetle resistant in Kashmir valley and develop cereal leaf beetle resistant wheat varieties for sustainable wheat production in Kashmir. To achieve this goal it is essential to understand the mechanism of resistance against cereal leaf beetles in wheat. In this contest, we attempted a multitier screening of ~5000 diverse wheat genotypes. Efforts have been made to record trait data on cereal leaf beetles in the field (First tier screening) and under controlled conditions in the green house. Efforts have been also made to quantify several important targeted traits induced due to cereal leaf beetle infestation in wheat. Based on trait data analysis, a mini-core set of ~400 genotypes was constituted and this mini-core set is being evaluated for several biochemical/defensive enzymes including Reactive oxygen species (ROS) like Catalase, peroxidase,



Superoxide dismutase, lipid peroxidation and hydrogen peroxidation (Second Tier Screening). In third tier screening, comparative metabolome studies of one each resistant and susceptible genotype is being conducted. The trait data once recorded will be used along with whole genome genotypic data for working out marker-trait associations through Genome-wide association studies (GWAS). This study will lead us to identify new sources of cereal leaf beetle resistance under Kashmir conditions and the candidate genes for wheat molecular breeding programs aimed at enhancing cereal leaf beetle resistance in wheat.

Keywords: Wheat, Core-set, mini-core set, cereal leaf beetle, multitier screening, resistance gene.

MULBERRY (*Morus* spp.) IS THE APPROPRIATE PLANT FOR SUSTAINABLE DEVELOPMENT

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Mulberry (*Morus* spp.) of the Moraceae family is regarded as a unique plant on this planet due to its wide geological distribution across the continents, ability to be cultivated in various ways, multiple uses for leaf foliage, and positive impact in environmental safety approaches like Eco restoration of degraded lands, bioremediation of polluted sites, conservation of water, prevention of soil erosion, and improvement of air quality through carbon sequestering. By harnessing the physiologically active pharmacokinetic chemicals contained in the leaf, stem, and root portions, the mulberry is also employed as a medicinal plant to improve and enhance human life. The manufacture of several goods for the pharmaceutical, food, cosmetic, and health care sectors using mulberries has attracted industrialists' interest. As mulberry is used in the pharmaceutical, cosmetic, food, and beverage sectors in addition to being used in environmental safety measures, it is reasonable to refer to it as the plant that is most ideal for sustainable development. All the crucial mulberry traits were included in the present article in order to evaluate it as the perfect plant for ensuring a sustainable future.

Keywords: Environmental protection, bioremediation, ecorestoration, mulberry sericulture, and sustainable development

NATURE OF IMPORTANCE OF VARIOUS PARAMETERS FOR IDEAL BIOFUEL CROP AS A SOURCE OF RENEWABLE ENERGY: A SPECIAL REFERENCE TO RAPESEED MUSTARD

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To increase the performance of diesel engine and environment the utilization of biofuel as a major source of renewable energy is justified. It is well understood that agri based biofuel is always the also choice in case of utilization as biofuel because of requirement of processing and thereat to food security. Therefore scope of improvement increases as it is yet to efficiently exploit as major full in the world. There are numerous factors which

influence the efficiency of a fuel and its combustion. The physiochemical properties viz. viscosity, surface tension, flash point, latent heat of vaporization, oxidation etc allows the fuel to work efficiently during combustion. Thus, interest in biofuels has been increased and various experimental studies have been developed for diesel engines consisting of methanol and methyl ester of rapeseed oil. To achieve ideal biofuel its relevant study various biotechnological advances at the frontiers of plant science to dissect the underlying traits for identification of fatty acid profile useful for oil production and quality is essential, thereby ensuring food security. The plant based fuel and its efficient utilization depends upon its oil quality and quantity, which thereby can be evaluated and enhanced by various conventional and non-conventional approaches of engineering and plant sciences.

Keywords: Biofuel, Combustion, Fatty acid profile, Physiochemical, biotechnological.

MORPHOLOGICAL AND MOLECULAR DIVERSITY ANALYSIS OF DIFFERENT *Ficus* species

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For the first time the genus *Ficus* was introduced by Linnaeus (1753). *Ficus* is the Latin word which was derived from the Indian 'Fag' from which come the Italian, Portuguese and the Spanish 'Figs', the French 'Figsee' and the German 'Feigen' and the Dutch 'Rijig' (Masilamoney, 1984). In the family Moraceae, the genus *Ficus* contains over 850 species of woody trees, shrubs, vines, epiphytes, and hemi epiphytes. Fig trees have had a significant impact on culture through a variety of religious practises. The sacred fig tree (*Ficus religiosa*) and other banyan figs, such as *Ficus benghalensis*, are some of the more well-known species. The present investigation entitled Morphological and Molecular Diversity analysis of different *Ficus* species was carried out at the Forest Biotechnology Laboratory, College of Forestry, Navsari Agricultural University, Navsari. The different *Ficus* species studied were *Ficus benghalensis*, *Ficus religiosa*, *Ficus racemosa*, *Ficus krishnae*, *Ficus pumila*, *Ficus mysorensis*, *Ficus hispida*, *Ficus amplissima*, *Ficus longifolia*, *Ficus benjamina*. The study was undertaken with the objective morphological and molecular profiling and diversity analysis of 10 different *Ficus* species with RAPD markers. The results reveal varying morphological characteristics in leaf shape, margin, phyllotaxy, texture (upper and lower surface), leaf apex, venation pattern, veinlets, presence or absence of stipules, petiole length, lamina length, leaf width, leaf color, and the presence or absence of trichomes (upper and lower surface). Out of 30 RAPD primers tested 10 gave clear and reproducible band. The number of loci amplified by these RAPD primers ranged between 5 for OPD-03 and OPT-15 to 17 for OPT-13. A total of 116 loci were amplified out of which 113 (94.00%) loci were polymorphic. The percentage of polymorphism ranged from 40 % for OPT-15 to 100% for OPD-03, OPD-08, OPD-18, OPR-02, OPS-02, OPS-02, OPS-11, OPS-12, OPT-12 and OPT-13. Highest PIC value – 0.47 (OPR02), effective multiplex ratio – 17 (OPT-13), Marker Index – 7.31 (OPT-13) and resolving power – 5.40 (OPT-13). The highest similarity based on Jaccard's similarity coefficient shared between the species is *Ficus benghalensis* and *Ficus religiosa* (0.44), *Ficus benghalensis* and *Ficus pumila* (0.41) and *Ficus religiosa* and *Ficus racemosa* (0.40) respectively. The PCoA results corresponded well with the cluster analysis obtained through UPGMA. The first three coordinates accounted for 19.50, 15.54, and 13.63 percent of the total variance, respectively. Thus, the total variance accounted by these three coordinates was 48.67

percent. Overall, studied *Ficus* species are diverse. The morphological study provides the economic importance of any plant, understanding function, taxonomy, heredity, ecology, development and other aspects of biology. Genetic diversity considers presence of different alleles and different genotypes within the population. These findings provide a foundation for further studies on phylogenetic relationships within the genus. This approach would help identify superior genotypes for cultivar upgradation as well as, evolving strategies for effective conservation. The information about molecular and phenotypic properties has great importance in the future selection of breeding populations, particularly for the traits that possess commercial values.

Keywords: *Ficus*, diversity, leaf, morphology, molecular, RAPD, primers

MORPHOLOGICAL VARIATIONS IN *Ipomoea* L. species IN JAMMU AND SAMBA DISTRICTS

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Ipomoea L., the largest genus of tribe *Ipomoeae* with more than 600 species worldwide, 60 in India and 16 in Jammu and Kashmir, belongs to the family Convolvulaceae. It is divided into three subgenera- *Ipomoea*, *Quamoclit* and *Eriospermum*. The genus is distributed throughout the tropical and sub-tropical areas of the world with pantropical origin. Apart from *I. batatas* L. which is the seventh important food crop of the world, species of this family are reported to be used for medicinal, ornamental and edible purposes. Not much attention has been given to other species of this genus. The genus often gets mis-identified because of its morphological diversity. The last report of *Ipomoea* L. in this region was in Flora of Samba (2018) in which 13 species were reported and only six of them were named. A detailed account of 16 species of *Ipomoea* L. was described in erstwhile state of J&K a decade ago by Bhellum (2012). In the recent times, there is a spurt of developmental activities in the Jammu region, hence documentation of the reported species is essential due to habitat destruction, before any potential species gets lost. Therefore, revisiting and assessing the status of genus *Ipomoea* L. in this region is crucial. The present work is a preliminary account of morphometric details of different species collected from Jammu and Samba Districts. Taxonomic key to the taxa *Ipomoea* L. of J&K is constructed for correct identification of plants.

Keywords: *Ipomoea*, Taxonomy, Key, Morphometry

ISOLATION AND CHARACTERIZATION OF PLANT GROWTH PROMOTING RHIZOBIA FROM RHIZOSPHERIC SOIL OF *Phaseolus vulgaris* L.

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Phaseolus vulgaris L. commonly known as Rajma is the most widely consumed legume. In addition to its enticing colour and flavor, it is abundant in protein, fiber, vitamins, and minerals. Bhaderwah rajma from UT of Jammu and Kashmir are well distinguished for their savor in the whole world.



Isolating and scanning the beneficial microorganisms from the rhizosphere of *Phaseolus vulgaris* L. has been prime objective of this research. Three soil samples were collected from the rhizosphere of the plant *Phaseolus vulgaris* L., from Bhaderwah region and isolation procedures were carried out from them. Soil samples collected from the Bhaderwah region yielded a total of 24 bacterial isolates which were then characterized for their growth promotion activity. Besides these growth promoting activities, the isolates were also evaluated for production of cell wall degrading enzymes like cellulase and protease. The pure bacterial isolates were then screened for various plant growth promoting activities like catalase, phosphate solubilization, IAA production, Ammonia production, HCN production and to characterize them as plant growth promoting rhizobia (PGPR). B4P1 was the sole isolate to not display any of the activities; all the other isolates displayed at least one of the activities. None of the isolates showed all the biochemical activities. Ammonia production activity was exhibited by 83% of isolates followed by catalase (50%) while a single isolate B6P1 exhibited HCN production activity.

(Abbreviations: UT-Union territory, IAA- Indole acetic acid, HCN-Hydrogen cyanic acid, PGPR-Plant growth promoting rhizobia)

Keywords: *Phaseolus vulgaris* L., PGPR, Bhaderwah

EXPLORING THE IN-VITRO DROUGHT TOLERANCE AND BIOCHEMICAL CHARACTERIZATION OF PGPR (PLANT GROWTH PROMOTING RHIZOBIA) ISOLATED FROM RHIZOSPHERE OF THE COMMON BEAN (*Phaseolus vulgaris* L.) IN BHADERWAH REGION OF J&K

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Phaseolus vulgaris L. (Rajma) is a pioneer legume as it abounds in dietary fibre, proteins, vitamins and fatty acids. It is also known for its agro-commercial significance, hardy nature and nitrogen fixing capability. Drought stress is the most common and potential abiotic stress glaring common bean affecting about 60% of the common bean production. The rhizosphere of *P. vulgaris* L. harbours a broad spectrum of rhizobacteria in its rhizosphere. Certain rhizobia, out of the entire rhizospheric microbial flora, known as PGPR (Plant Growth Promoting Rhizobia) extend an additional plant growth promotional tendency to this crop plant, including drought stress resistance. There is a staggered information about the drought resistant PGPR from the rhizosphere of *P. vulgaris* L. in the region of Bhaderwah, J&K and thus solicits supplemental attempts. The present communication is a research endeavour to explore the same and has led to the collection of 3 rhizospheric soil samples from 3 locations in Bhaderwah, consequently leading to isolation of 27 pure bacterial isolates. These deduced isolates were screened through multiple biochemical characterisation tests, of which 16 isolates showed catalase activity, 19 isolates showed ammonia production activity, 14 isolates showed IAA production activity, 1 isolate showed HCN production activity and 10 isolates showed Phosphate solubilisation activity. An in-vitro assessment of the drought tolerance competence of these potential PGPR was also registered using two concentrations i.e. 400 µg/ml and 800 µg/ml of PEG-400 (Polyethylene Glycol-400) resultant of which 9 isolates and 4 isolates exhibited strong drought tolerance at 400 µg/ml and 800 µg/ml of PEG-400, respectively. These potential PGPR can be

leveraged as an alternative to synthetic fertilizers and pesticides, along with ameliorating the drought stress and augment the much coveted concept of sustainable agriculture.

Keywords: *Phaseolus vulgaris* L., rhizosphere, drought stress, PGPR

ISOLATION AND IDENTIFICATION OF WET BUBBLE (*Mycogone pernicioso*) AND DRY BUBBLE DISEASES(*Verticillium fungicola*) OF BUTTON MUSHROOM (*Agaricusbisporus*)CROP GROWN IN JAMMU REGION

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Isolation and identification of diseases viz., wet bubble (*Mycogone pernicioso*), and dry bubble (*Verticillium fungicola*.) are a devastating disease in the crop production of mushroom, in India, it has been reported to cause serious crop losses. It is also a common contaminant, occurring in mushroom houses in the Jammu region. The aim of the study was to investigate physiological characteristics of wet bubble, and dry bubble diseases isolated from button mushroom (*Agaricus bisporus*). The assessment of the factors affecting the development and spread of diseases was also done. This fungal pathogen was constantly associated with the disease and produced typical and characteristic symptoms of wet bubble and dry bubble diseases. The isolates revealed that the average maximum radial growth of *Mycogone pernicioso* was observed on Czapek,s dox agar (65.67mm) followed by potato dextrose agar (64.43mm). Microscopic examination of the pathogen revealed that the mycoparasite was present both inter and intra-cellular. The conidiophores were erect, long and verticillately branched. Conidia were oval measuring (5-10 × 4-5 μm), single, Bi-cellular and thin walled. Average maximum radial growth of *verticillium fungicola* was observed on Czapek,s dox agar (73.21mm) followed by potato dextrose agar (69.33mm). Microscopic examination of the pathogen *verticillium fungicola* revealed that the mycoparasite was present, repeated braching of conidiophores, Oblong to cylindrical Conidia (3.5-15.9 × 1.5-5μm) measuring, one celled and thin walled. The colour of the culture varied from white to light brown in *Mycogone pernicioso* isolates while yellowish to white in *Verticillium fungicola*.

Keywords: *Diseases, Symptoms, Different media and Agaricus bisporus.*

TOXIC EFFECTS OF POLYSTYRENE MICROPLASTICS ON TERRESTRIAL PLANTS USING *Allium cepa* ROOT TIP CHROMOSOMAL ABERRATION ASSAY

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The accumulation of micro-plastics in the environment has resulted in different ecological and health concerns. The ubiquitous and persistent nature of MPs makes it an important pollutant to be reported in both aquatic and terrestrial ecosystems. The occurrence and toxicity of MPs in aquatic ecosystems have already been studied sparsely, while their effects on terrestrial plants are still unknown. Keeping

this in view, present study was conducted to measure the effect of different sizes (80, 100, 200, 500, 1000, 2000, 4000, 8000 nm) of polystyrene MPs (PS-MPs) on root length and cell division of root tip cells of *Allium cepa*. The toxic effects of PS-MPs on cell division of *A. cepa* were studied using *A. cepa* root chromosomal aberration root tip assay. *Allium* bulbs were treated with two different concentrations of PS-MPs (100 and 400 mg/L). It was observed that MPs particles of size 4000 and 8000 nm showed highest reduction in root length with respect to negative control (Milli Q water) while, mitotic index decreased significantly in both size and concentration manner, where lowest (12.06 %) was recorded in 100 nm size PS-MP at 100mg/L. Also, induction of different types of chromosomal aberrations, with the highest percent of clumped chromosomes (CC), followed by C-mitosis (CM), delayed anaphase/s (DLA), vagrant/s (VG), laggard/s (LG), distorted/disturbed metaphase/s (DM), multi-polarity (MP), bridge/s (BG), break/s (BK), ring chromosome/s (RC) and nuclear anomalies like micronuclei (MN) and nuclear bud (NB) in root tip cells of *A. cepa* were reported. Chromosomal abnormality index (CAI) and nuclear abnormality index (NAI) showed significant decrease with respect to size of PS-MPs. Present study concluded that MPs irrespective of sizes and concentrations can cause cyto-toxic effects and nuclear damage to the plant cells by adversely impacting their cell division or spindle formation. In future, more research should be carried out on different plastic types, co-occurring contaminants and plants, in order to fill the knowledge gaps regarding the co-toxic potential of MPs and other pollutants, as well as their mode of toxicity to higher plants.

Keywords: Plastics, *Allium cepa*, icoplastics, Plants, Environment

INTEGRATED APPROACH FOR DAMPING OFF AND ROOT ROT DISEASE MANAGEMENT IN PAPAYA (*Carica papaya* L.)

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Papaya seedlings and trees are mostly affected by damping off disease in nursery bed and root rot disease in field, respectively. An effective management of damping-off requires the deployment of a number of strategies. The investigations were carried out at HRC, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut during the year 2021-22. Adopting effective phytosanitary techniques usually makes it possible to manage damping-off disease since most of the pathogens that cause it are either soil- or water-borne rather than airborne. In the experiment seed treatment were done with Carbendazim @ 0.1% before sowing in nursery poly bags. In addition to chemical treatments, physical seed treatment can be applied including hot water, hot air, and electron. Finally, a number of biological seed treatment methods are being developed and used in recent years with a satisfactory level of damping-off disease suppression worldwide and most of them are based on antagonist fungi, including *Trichoderma spp.* and *Gliocladium spp.* or bacteria such as *Pseudomonas spp.* and *Bacillus spp.* Use relatively acidic soils with a low pH (4.5–6.0), increase soil pH with organic amendments, with applications of aluminium sulfate, sulfur, or acid peat has found effective. After the transplanting, maintain moderate humidity, escape application of high water volume to avoid waterlogging and adopt frequent and light applications, and maintain adequate light and optimal temperatures. Soil drenching near root zone have been frequently done with Rodomil/Metmack

fungicide @ 1gm/lit of water at 15 days interval. It follows that there are chances to create IPM techniques given the significant economic significance of dampening-off disease and the growing concern over finding long-term solutions to this issue.

Keywords: Integrated, Papaya seedlings, Nursery, Worldwide, Phytosanitary techniques

BIOCHAR: A PROMISING SOLUTION TO SECOND GENERATION FOR WASTE MANAGEMENT

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Owing to the population explosion, the present generation is facing tremendous pressure in context of environment and agriculture. For the multifaceted problems in relation to agronomy, environment, soil ecosystem etc a single approach i.e., biochar provides a solution for all the above mentioned snags. Biochar (formed from pyrolysis of different feedstock like agricultural waste, poultry waste, kitchen waste, forest litter, wood materials etc) enhances the soil nutritional level by adding various nutrients, depending its parent feedstock. Biochar is a modern method of C-sequestration. The biochar production from pyrolysis of plant biomass converts much of the aliphatic carbon (having no carbon ring structures) to an aromatic carbon (containing carbon rings) which is stable in soils for hundreds of years. The ability to store carbon and improve fertility will depend on physico-chemical properties of soil, which later depends on pyrolysis temperature and choice of feedstock. Soil benefits include increase in pH, WHC (water holding capacity), improving CEC (cation exchange capacity) and retaining nutrients. These benefits have been shown to increase yield in biomass and crops under varied conditions. Biochar is highly resistant to decomposition in soil; its residence time ranges from tens of years to millions. The persistent nature of biochar-C in soil shows that it will contribute to soil C-sequestration and reduce GHGs emissions. We recommend the use of use of organic amendments i.e., biochar instead of chemical fertilizers because it is not only environment friendly but also acts as a substitute for fertilizer for crop production. It is a multidisciplinary approach that provides solution to many questions regarding soil health, crop production, bioenergy, GHG's emission, C-sequestration etc and also considered as a clean development mechanism according to UN Framework Convention on Climate Change.

Keywords: WHC, CEC, GHG's, C-sequestration, pyrolysis, bioenergy.

ARTIFICIAL INTELLIGENCE: AN EMERGING SCIENCE IN AGRICULTURE

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Agriculture is the principal foundation of subsistence for about 58% of India's population. The population is expanding enormously and with this expansion the interest of food and business is likewise expanding. Artificial Intelligence (AI) has a huge impact in all industrial sectors and has been

progressing at an outstanding speed. AI accomplished solving numerous problems and saving a profitable resource by minimizing environmental deterioration. Artificial Intelligence is making a revolution in agriculture by replacing traditional methods by using methods that are more efficient and helping the world to become a better place. Intervening of AI in agriculture is serving farmers to recover their farming efficiency and diminish environmental hostile influences. Disease infection is the main drawback of agriculture as a result of which the quality and quantity of agriculture products are degraded. To identify and detect the disease on agriculture product, the AI technique is introduced. In the field of agriculture, Artificial Intelligence is a rising revolution. Artificial Intelligence has boost crop production and better-quality real-time monitoring, harvesting, processing and marketing. The Internet-of-Things (IoT) is a foundation to impact a wide array of sectors and industries, ranging from manufacturing, health, communications and energy to the agriculture industry. The application of IoT in agriculture is about empowering farmers with the decision tools and automation technologies that seamlessly integrate products, knowledge and services for good efficiency, quality and profit. By using proper tools of Artificial Intelligence and with the proper dataset, farming can be made more efficient for farmers. These methods can be considered as the major implementations to solve the future crisis.

Keywords: Artificial intelligence, Environmental deterioration, Farmers, Future crisis.

IMPACT OF ORGANIC AND INORGANIC SOURCES OF NUTRIENTS INTEGRATION WITH BIOFERTILIZERS ON NUTRIENT STATUS OF LEAF AND FRUIT IN AONLA (*Emblca officinalis* Gaertn.)

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An experiment was conducted to find out the effect of organic and inorganic sources of fertilizers along with bioinoculants on leaf and fruit nutrient content as well as soil microbial population in aonla cv. NA-7 under different treatment on ten year old plant at Farmers Field, Akhnoor, Jammu, J&K India. Leaf and fruit study were conducted to analyze the status of nutrients in aonla. Leaf and fruit nutrient content in all the treatments increased after fertilizer application as compared to control and almost all the treatments showed a significant increase in the level of nutrient content in leaf and fruit with the application of FYM, urea and Azotobacter. The highest concentration of leaf and fruit nitrogen (2.77 and 0.14%), phosphorous (0.22% and 0.031%), calcium (2.33% and 0.031%) and Mg (0.47 and 0.020%) with the combined application of Azotobacter + 25% nitrogen as FYM and 75% nitrogen as urea. While highest leaf and fruit K (2.44 and 0.31%) were recorded with 50 % nitrogen through FYM + 50 % nitrogen through urea along with Azotobacter. Use of FYM to supply cent per cent nitrogen augmented with Azotobacter resulted in highest Azotobacter counts (22.4×10^4 cfu), bacterial counts (24.2×10^6 cfu) and fungal counts (20.3×10^5 cfu). The results suggested that 25 per cent nitrogen can be replaced through chemical fertilization along with FYM on N-equivalent basis plus Azotobacter inoculation.

Keywords: Aonla, organic, inorganic biofertilizer, leaf and fruit nutrients

ENHANCEMENT OF BIOACTIVE PROPERTIES OF *Terminalia bellerica* USING GREEN SOLVENTS

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Most conventional organic solvents are toxic and offer high risks to human health. In this context, green solvents, such as natural deep eutectic solvents (DES), have been developed as a promising environmentally-friendly solvent capable of replacing organic ones, mainly in the extraction and purification of biomolecules. Five choline chloride-based natural deep eutectic solvents (NADESs) were used in extraction of phenolic and flavonoid content from *Terminalia bellerica*. The solvents were choline chloride: glucose (2:1) - ChGlu; choline chloride: fructose (2:1) - ChFru; choline chloride: xylose (2:1) - ChXyl; choline chloride: glycerol (1:2) and -ChGly and choline chloride: malic acid (1:2) - ChMa. All NADESs were prepared using 30% of water and also pure methanol was used for comparison. The antioxidant capacity, as well as the antidiabetic activity were also evaluated for each of the extracts obtained. All NADES-based extracts showed higher phenolic content, flavonoids content, antioxidant capacity (DPPH, Reducing power and FRAP assays) and antidiabetic activity than the alcohol extract. Quantitative and qualitative profiling of phenols in ChMa (showing the highest activity among all other NADESs) and methanolic extracts was also carried out using high performance liquid chromatography (HPLC) and eight standard phenolic compounds namely caffeic acid, chlorogenic acid, *p*-coumaric acid, ferulic acid, gallic acid, *p*-hydroxybenzoic acid, vanillic acid and syringic acid. All the eight standard phenolic compounds were detected in ChMa and methanolic extract. The maximum change was found in the content of ferulic acid in both the methanolic (28.41 mg/g DW) and natural deep eutectic solvent (NADES) extracts (58.19 mg/g DW). The level of caffeic acid was 22.01 mg/g DW in NADESs extracts and 13.48 mg/g DW in methanolic extract followed by the level of *p*-hydroxybenzoic acid which showed the value 17.18 mg/g DW as compared to the methanolic extract (10.00 mg/g DW). Level of gallic acid, chlorogenic acid, syringic acid, vanillic acid and *p*-coumaric acid were better in NADESs extracts (13.82 mg/g DW; 5.28 mg/g DW; 5.03 mg /g DW; 3.44 mg/g DW and 4.40 mg/g DW) respectively as compared to methanolic extracts. Herein, it was showed that NADESs components could be chosen not only to fine-tune solvent physicochemical characteristics but also to enhance biological activity of extracts prepared in DESs. Therefore, NADESs are excellent and promising choice of solvents for sustainable and green extraction, which will lead to its novel application in food and pharmaceutical industry.

Keywords: Natural deep eutectic solvents, *Terminalia bellerica*, bioactive properties, HPLC.

PHYTOCHEMICAL SCREENING, ANTIOXIDANT ACTIVITY AND TOTAL PRODUCT YIELD OF *Citrus maxima* Burm VARIETIES FOUND IN ASSAM, INDIA

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Citrus maxima is one of the most popular citrus fruit of Assam, which is consumed pleasantly during the paddy harvesting season. It is the largest citrus fruit with yellowish to greenish skin and white to pinkish flesh with a sweetish-acidic flavor. Since time immemorial, citrus fruits have been used in virtually all cultures as a source of medicine. It is consumed as whole fruits, fresh juices, and preserved snacks, dipped in a salt mixture or used in salad. Since ancient times, its pulp has been used as an appetizer, antitoxin, cardiac stimulant, and stomach tonic. It is a rich source of vitamin C and juice of *Citrus maxima* possess hypoglycemic and hypocholesterolemic activities. The aim of this study was to evaluate the Antioxidant potential of pomelo (pink and white varieties) using DPPH radical-scavenging assay based on the method as established by Braca et al, 2002 and total product yield of both the varieties found in Assam. According to the yield, more quantity of juice is found in the pink variety (400ml) than white variety (150ml). DPPH activity evaluated showed an inhibition percentage of 94.05 and 93.30 at 100 μ l/ml for both pink and white varieties respectively. This current study can be used to develop functional foods, nutritional foods and medicines which will further increase the value of pomelo and generate livelihood among the local farmers.

Keywords: *Citrus maxima*, antioxidant, indigenous, Assam

POPULATION OF FRUIT FLIES AS PESTS OF PHALSA, *Grewia asiatica*

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Data on the incidence of *Bactrocera dorsalis* and *Bactrocera zonata* of fruit flies species were identified as the pest of phalsa in Sher-e-Kashmir University of Agriculture Science and Technology of Jammu. For recording the data on adult fruit flies on phalsa crop, fruit fly pheromone trap had been installed in the experimental field of phalsa crop. The perusal of data on fruit fly weekly mean number of trap catches was recorded maximum adult fruit flies population during 24th standard week at the time of maximum fruit maturity of phalsa. No aberration in fruit flies population in trap catches was observed as many other food sources were already available during the experimentation. The corresponding temperature maximum during 24thSW was recorded to be 38.6°C and minimum temperature of 26.1 °C for adult fruit flies catches while relative humidity morning and evening was recorded as 58.3 and 34.0 per cent.

Keywords: Phalsa, Fruit flies, Traps

SITE SPECIFIC NUTRIENT MANAGEMENT: AN APPROACH TOWARDS SUSTAINABLE AGRICULTURE

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In the present scenario of rising population, the need of hour is to produce more food from less land to feed the growing population. To meet the goals of sustainable agriculture (increased food and fibre production, profitability, input use efficiency, and a proper care for the environment), application of

balance of optimal nutrient levels is the key. Over the past 5-6 decades Indian agriculture has been focused on increasing use of external inputs. Fertilizers have played a major role in improving crop productivity. Food grain production was more than doubled from sixties to twenties, whereas the fertilizer use is 12 times more. Keeping in view the potential for soil nutrient supply and plant nutrient demand an approach of supplying plants nutrients to best matches their inborn spatial and temporal requirements for supplemental nutrients by using different tools such as remote sensing, GPS, GIS to achieve better production targets are changing at a faster rate than the existing nutrient management approaches. Thus, Site Specific Fertilizer Management (SSNM) is a key tool for precise nutrient treatments in various crops. Site Specific Nutrient Management (SSNM) is systems, VRT, and yield monitoring along with the right source, right rate, right time, and right place of nutrient utilization which also allows for fine-tuning crop management systems and therefore as a results the amount of nutrients given primarily decreases and the crop yields increases.

Key words: Food, fiber, sustainable, GPS, GIS, input use efficiency

THE DIGITAL REVOLUTION - DIGITAL AGRICULTURE

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Digital agriculture is an extension of the notion of "precision farming," which focuses on agricultural production techniques, and is based on the "digital earth" concept developed in the 1990s. A digital agricultural system is a database that contains not only many types of agricultural data, such as soil conditions and market assessments, but also optimum decision functions that assist in making the best judgments in a series of agricultural production and marketing operations. A system like this is an important tool for agricultural risk management since it can help analyze climate change risks, construct a revenue protection strategy for farmers, and establish a soil quality management plan. The structure of the agro-climate database is presented in depth, as well as methods for estimating data inaccuracy and instructions for constructing optimum decision functions. Crop insurance will require a strategic plan to deal with the changed tail probability distribution of unfavorable weather events such as drought, flooding, high wind, and extreme temperature under future climate change scenarios. The insurance sector may utilize the digital farm system to construct a dynamical business strategy for the changing climate. Using sophisticated technology, computerized tools, and information and communication technologies (ICTs) to improve decision making and production, the digital revolution is altering agriculture. The use of a number of cutting-edge technologies in agriculture, ranging from GPS and remote sensing to big data, artificial intelligence and machine learning, robots, and the tool, is resulting in higher yields, cheaper prices, and decreased environmental impact. Data-driven solutions are unlocking the potential of manufacturing in a way that is both sustainable and resource efficient. Precision agricultural management systems are enable farmers to take use of the new flood of data available to them. To find patterns and answers, these systems gather, categorize, and analyze massive volumes of data. Farmers may use them to observe,



understand, and control variability in their production systems by customizing inputs to achieve desired outputs. GPS-controlled tractors can plough, sow, and harvest around the clock while collecting continuous "on-the-go" georeferenced data. With the use of GPS, Geographical Information Systems (GIS), and Variable-Rate Technology, these self-driving cars can execute exact tasks (VRT).

Keywords: Digital Agriculture, Precision Farming, Tool, GPS

MORPHOLOGICAL AND MOLECULAR CHARACTERIZATION OF STRAWBERRY CULTIVARS UNDER SUBTROPICAL CONDITIONS OF JAMMU

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The strawberry is a widely grown hybrid species of the genus *Fragaria*, and is an octaploid ($2n=8x=56$), dicotyledonous, perennial low growing herb grown in most arable regions of the world. It belongs to the family Rosaceae, which comprises 23 species. It is the most important soft fruits worldwide owing to its high nutritive value, aesthetic appeal and refreshing taste, bright red color, juicy texture, and sweetness. It is consumed in large quantities, either fresh or in such prepared foods. It is amongst the few crops, which gives quick and very high returns per unit area on the capital investment, as the crop is ready for harvesting within six months of planting. It is a crop cherished by the growers of sub-tropical and temperate regions of the world due to its low cost of growing and high returns per unit area. It is widely, adapted in geographically diverse areas in world. For purposes of commercial production, plants are propagated from runners and in general, distributed as either bare root plants or plugs. Cultivation follows one of two general models-annual plasticulture or a perennial system of matted rows or mounds. Greenhouses produce a small amount of strawberries during the off season. The wide diversity of strawberry plant gives an idea of its potential for selection work. Choice of cultivars is of paramount importance for successful strawberry cultivation. Modern breeding is largely based on identifying superior phenotypes, hybridizing them, and then selecting the best offspring for trials as potential cultivars and/or use as parents for the next generation. Environmental stresses can be exacerbated by a lack of genetic diversity. Polymorphic Markers can be a useful tool for studying population divergence in strawberries. Molecular markers in strawberry have been developed and used to characterize germplasm collections. Many biochemical and molecular markers have been used for strawberry cultivar identification including RAPD (Random Amplification Polymorphic DNA), AFLP (Amplified Fragment Length Polymorphism), SSR (Simple Sequence Repeats) and ISSR (Inter Simple Sequence Repeats). SSR markers have been used extensively in strawberry because of their reproducibility and ability to sensitively detect the polymorphism that exists in the population. Utilizing the diverse array of germplasm that exists in strawberry both from regionally adapted cultivars and also from exotic sources is essential for future breeding programmes. Keywords: Molecular markers, biochemical, diversity, phenotypes hybridizing.

Fruit Yield and Quality of Okra (*Abelmoschus esculentus* L. (Moench) Evaluated under High Temperature Stress

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Okra (*Abelmoschus esculentus*) is also known as lady's fingers, gumbo or bhindi which is the most important vegetable crop of the tropical and subtropical regions of the world. It belongs to the genus *Abelmoschus* and family Malvaceae. It is a multipurpose crop valued for its tender and delicious pods. In West Africa- leaves, buds, flowers of okra are also consumed. Its dry seeds contain 18-20% oil and 20-23% crude protein. Foliage can be used for biomass, and the dried stems serve as a source of paper pulp or fuel. It has an average nutritive value of 3.21, which is higher than tomato, eggplant, and most cucurbits except bitter gourd. The cultivation of okra extends throughout the tropics and warmer parts of temperate Asia. A little evidence of the impacts of high temperature stress on various biological processes for okra is found but not so extent work on the genetic variation is known. This study characterized and evaluated 150 diverse okra germplasm under constant high temperature to assess morphological and physiological changes to growth and development and to identify molecular markers linked to heat tolerance. Significant marker trait associations (MTAs) were found for various morphological traits. These included days to fruiting, plant height and stem diameter, that once validated, could be used for marker- assisted breeding. The accumulation of Ca, Na and Fe and sugars in the fruit of some genotypes acted not only as protectants during fruit development, but also influenced signal transduction and maintenance of cell membrane integrity. A negative correlation between relative ploidy and genome size showed a downsizing of the genome with increased ploidy level.

Keywords: Okra, temperature stress, yield, genetic variation