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President : **Prof. T. N. Lakhanpal**

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PRESIDENTIAL ADDRESS

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PRESIDENTIAL ADDRESS

Biodiversity and Biotechnology- Explore Experience and Enjoy

President : Professor T. N. Lakhanpal*

Hon'ble Chairman, the elite assembly of "Ever Greens" delegates, ladies and gentlemen, at the outset allow me to express my deep sense of gratitude to the fraternity in plant sciences for having elected me Sectional President unanimously. It is not only a great honour but a rare privilege to be part of the continuum that nurtured and illuminated the path of botanical teaching and research over a century and brought it to the level where we feel securely anchored to-day. I realize my limitations, still with the blessings of all those, I venture to step into their shoes. Therefore, I dedicate this address to all those, but before them to the Divine, Lotus Feet of the Almighty, and then at the reverential feet of my parents and teachers who moulded and groomed this inconspicuous '*spore*' into a '*conspicuous fruiting body*'. The entire credit for making me tread the path and attain the goal is theirs, since "*No one unaware of the goal can choose the path and No one unaware of the path can reach the goal*".

I also dedicate this lecture to the 'battery' of my students who trained me in patience and perseverance and were continuously a part of my learning process, shaping **Information into Knowledge and Knowledge into Wisdom.** I have attempted to select a subject which is in conformity with the main theme of the Science Congress; because I realized that the best ethical role models are the Plants! Along with this came the realization that the Nature provides the best experience and enjoyment, if explored properly. Hence the topic I wish to share with you all is **Biodiversity and Biotechnology : Explore Experience and Enjoy.** The topic begins with nature, and its inherent ethics, the biodiversity that it supports, and groups I worked with during the last four decades.

Nature exhibits multiplicity of objects. Multiplicity results from multiplication i.e. when one becomes many. Multiplication leads to variations and variations bring in diversity. This diversity is like rainbow or seven musical notes, which have origin

*Department of Biosciences, Himachal Pradesh University, Shimla-171005, H.P.

in a single source. Hence the apparently diverse forms are inherently unified. The diversity offers opportunities for exploration, experience and enjoyment. But enjoyment or bliss is perceived only when the senses are used in moderation.

Diversity at global level is estimated to be represented by 5-30 million species of living forms on the earth. Of these only 1. 5 million have been identified, which include 3,00,000 species of green plants and fungi, 8,00,000 species of insects 40, 000 species of vertebrates and around 3,60,000 species of microbes. In India over 1,15000 species of plants and animals have been identified so far, in which about 15000 species of flowering plants, 2700 Bryophytes, 1600 Lichens, 500 Algae, 600 Pteridophytes and 20,000 Fungi. Proteomics and Genomics reveal that all this diversity of organisms is unified at molecular level. There is a unity of purpose in nature and all these organisms are not totally independent but exhibit dependence in the ecosystem.

Nature and its constituents are role models for man to emulate. For example the plants not only get sustenance from earth but provide sustenance to millions of members of biota. Similarly the different cycles operative in nature are also excellent role models exhibiting regularity in duty with devotion and discipline.

In this wonderful world of plants, fungi are a very diverse group of organisms both like and unlike plants. They are in fact more diverse than any other group of organisms. Though colourless (without chlorophyll), they are most ‘colorful’ and amazing. During the last almost four decades, I had an opportunity to Explore, Experience and Enjoy this wondrous group of organisms. Some of the traditional groups I worked with are not even considered as true fungi in the recent systems of classification. The groups I worked with are the Cellular Slime Moulds (Acrasiomyetes) and Acellular Slime Moulds (Myxomycetes). The other groups of my interest have been mushrooms and toadstools (Discomycetes, Agaricals and Aphyllopharales) and mycorrhiza.

I was introduced to the fascinating world of myxomycetes by my revered teacher, Prof. K. S. Thind, Punjab University, Chandigarh and later I could carry this interest forward under the guidance of Prof. K. G. Mukerji University of Delhi, both doyens in the realm of fungi. The myxomycetes have been called **Animal-Plants** because they defy man made classifications and share characteristics with both plants and animals. They are plant-like in their manner of reproduction and resemble the animals in the characteristics of their assimilative phase. The assimilative phase consists of a free living, acellular mobile mass of protoplasm, the

Plasmodium which exhibits a characteristic, rhythmical reversible streaming of the protoplasm at a very high velocity and shows synchronous nuclear division. They unify plants and animals exemplifying the unity in diversity as if saying "All are one, be alike to everyone". They have rendered service not only to taxonomists but to physiologists, biochemists and geneticists being good model systems for understanding biochemical characteristics and nature of protoplasm, *Physarum polycephalum* being the most used taxa.

The work on slime moulds initially was related to systematics but later on it was extended to life cycle studies, genetic behavior, sporophere development and corticolus myxomycetes. Before our studies only 36 genera and 183 species of myxomycetes were known, now the figure stands at 48 genera and 350 species. 12 genera and 50 new species have been recorded in addition to a large number of new records. Pioneering work on ecology of myxomycete, especially those which inhabit bark of living trees has also been carried out (Thind, 1977; Lakhanpal and Mukerji, 1981 Lakhanpal, & Chopra, 1994; Lakhanpal, 1994; Lakhanpal, 1983, Chopra, 1984). The other equally interesting group of slime moulds is the cellular slime moulds having a world renowned representative *Dictyostelium discoideum* which became almost synonymous with studies on morphogenesis. Pioneering work on this group was carried out by Cavender and Lakhanpal (1986). In India little attention had been paid to this group till then. Agnihothrudu (1956) made a brief report on dictyostelids in rhizosphere of cultivated plants in Southern India. Rai & Tiwari (1961) reported on two species occurring around Lucknow. In our studies dictyostelids were isolated from soils collected from five vegetational- climatic zones from sea level to an elevation of 2700 m. Twelve species were isolated from West Central Himalaya as well as from tropical forests in Peninsular India. The greatest average density of propagules was in soils of cool temperate oak-pine zone. A total of 6353 clones were isolated *Polysphondylium pallidum* was represented in all zones. *D. aureo-stipes* was particularly abundant in the slopes of Himalaya. In terms of species composition and diversity, population of the West Central Himalaya and Peninsular India were more similar to those of East Africa than South East Asia.

Cellular slime moulds are so called because most of them have walled cells in their stalks. They are delicate, ephemeral, minute and inconspicuous. The unit structure in them is a uninucleate, naked, haploid myxamoeba that feeds by engulfing bacteria; the myxamoebae aggregate to form a pseudoplasmodium (Grex or Slug), in which the constituent myxamoebae retain their individuality, yet

cooperate as members of well organized community until sporulation, earning the name 'communal slime moulds'. Alexopoulos *et al*. (1996) point out that 'here is an opportunity to study the problem of unicellularity and multicellularity and also the problem of differentiation which have intrigued biologists for centuries'. These slime moulds teach a valuable lesson in cooperation and coexistence for man to emulate for man is a limb of society and the society is limb of creation and there is expected to be a harmonious relationship amongest them for appreciating unity in diversity.

My journey with mushrooms initially and then with mycorrhiza began after joining the department of Bioscience, in HP University, Shimla in 1976. It was discovered that the agarics of N. W. Himalaya were not explored much though the area presented very favourable conditions for the growth of agarics. The Himalayas represent the loftiest chain of mountain in the world. Himachal Pradesh is situated between $30^0$22'-$33^0$12N and $75^0$47'-$79^0$04E in the North-Western Himalayas along the northern border of India. The forests in the state vary from tropical to alpine pastures. The varied climatic conditions and altitudinal zones make the state rich in natural resources. The Himalayan forests are natural reservoirs of a wide variety of wild mushrooms.

Mushrooms are the macro fungi with fleshy, subfleshy, or sometimes leathery, umbrella like sporophores that bear their fertile surface either on lamellae or lining the tubes, opening out by means of pores. The lamellate members are called 'mushrooms' or 'toadstools' depending upon whether they are edible or poisonous and the tube bearing poroid members, as boletes. Mushrooms have been by far most extensively studied in the western world. The most standard reference for mushroom families so far is, "The Agaricalers in Modern Taxonomy" by Singer (1986). Many other regional compendia and lists have been published periodically from different parts of the world. The first list on Indian Fungi was published by Butler and Bisby (1931), and then revised by Vasudeva (1960), Several additional lists appeared in between culminating with the fungi of India by Bilgrami *et al*. (1979, 1981). Status of Indian Agricales was reviewed first by Sathe and Rahalkar (1975) making 1825 as the base and then by Manjula (1983), providing a very exhaustive list of Agaricoid and Boletoid fungi from India and Nepal. This is so far the best list which enumerates 538 valid genera and 20 families in the Agaricales. This list has been recently updated by Natarajan *et al*. (2005). The systematics of Agaricales can be divided into three phases; Phase I (1825-1899), Phase II (1900-1969) and Phase III (1970- onwards). The following groups became active in the III Phase : Natarajan and his group in

South India, Sathe and Co-workers, in South West India, Kapoor and associates in and around Delhi, Rawla and his students Saini and Atri and their students in North India, Lakhanpal and his co-workers, Kaul and his associates and Upadhaya *et al.* at DMR Solan in the Himalayan region.

In the north-western Himalaya the prominent publications have been by Watling and Gregory (1980), Hongo (1965), Horak (1980, Kaul and Kachroo (1974), Abraham *et al.* (1980), Saini and Atri (1981, 1982a, b, 1984), Saini *et al*. (1983) Rawla and Sarwal (1983), Sharma and Lakhanpal (1981), Lakhanpal et al. (1985, 1986, 1988), Sharma (1980), Bhatt (1986), Kumar (1987), Shad (1985, 1989), Kaisth (1985), Sharma (1986, 1987, 1993) Chaturvedi (1987), Thakur (1990), Lakhanpal and Shad (1986a, b), Lakhanpal *et al*. (1988), Bhatt and Lakhanpal (1988a, b, c), Sagar and Lakhalpal (1990), Kumar et al. (1990), Lakhanpal (1977), Lakhanpal *et al*. (2010). From a survey of mushrooms in the N. W. Himalayas Lakhanpal and his associates recorded agarics belonging to 300 species, 59 genera and 15 families of Agaricales. This survey provides an inventory of the species occurring in the Himalayas, a list of species of mushrooms which enter into mycorrhizal relationship with forest trees; and a list and description of non-conventional edible species discovered during the surveys.

Watling and Gregory (1980) presented a comprehensive list of 119 taxa from Jammu and Kashmir. Abraham (1991) published a list of agarics with ecological notes from Kashmir Himalayas reporting 250 species. Lakhanpal (1995) reviewed exploratory work on the Himalayans agarics and concluded that the taxa recorded are least commensurate with the vastness and diversity in the mountainous range. Atri and Saini (1989) reviewed the work on Russulaceous fungi the world over and reported the Indian contribution, Atri et al. (1994) published the checklist of Indian Russulaceous wherein 48 species of *Lactarius* and 67 taxa of *Russula* have been listed. Saini and Atri (1995) reviewed exploratory work on mushrooms from Punjab and listed 94 taxa spread over 24 genera. Gupta et al. (1994) reviewed Indian work on Agaric systematics. While working on the taxonomy of the genus from North West India, Gupta (1994) made 261 collections falling in 66 taxa, which include 4 new species. From South Indian region, excluding Kerala, Natarajan (1995) reported 457 species of agarics spread over 76 genera. Work on mushrooms from Kerala has been reviewed by Bhawani Devi (1995). Patil et al. (1995) listed 212 species of agarics spread over 63 genera from Maharashtra. Verma *et al*. (1995) listed 95 additional species of mushrooms.

The wild mushroom seem to have been traditionally consumed by man since very early times, but these were then probably considered a food in wilderness, which now have come to occupy a very popular place in the modern dietic regimen because of its nutritive value (Bano, 1976).

Mushrooms are seasonal fungi, which occupy diverse niches in nature in the forest ecosystem. They predominantly occur during the rainy season and also during spring when the snow melts.

Systematics of Mushroom Diversity

Exploration of Mushroom diversity in Himalayas has been an exhilarating experience. The forays 'spared moments to Stand and Stare'. Camping in the deep woods was reminiscent of 'Miles to go before I Sleep'. Staying in the forests for days together in a group with limited facilities but unlimited collection of mushrooms which 'mushroomed' every where, was most satisfying. A half day collecting trip will keep a group of 7-10 people busy till mid night, taking field notes, spore prints, photographs, as these have to be recorded in the fresh specimens. Many mushrooms change colour on handling, cutting and bruising and with chemical reagents, a fascinating phenomenon to observe. Macroscopic features and colour reactions are important criteria in the identification of the species. The enthusiastic students would coin similes, give different names to mushrooms, shout full –throated in the forest and cut jokes to relive the stress, all this made the trips lively. The sense of involvement, the concern for each other, the family atmosphere, the feeling of brotherhood of man and realizing the fatherhood of god, on spotting wild animals, were all life time experiences. The forays infused a sense of sacrifice, taught caring and sharing and created social awareness through interaction with local people and learnt to appreciate the traditional wisdom they possessed as our cultural heritage. In the evenings their will always be a sumptuous treat with a large variety of wild edible mushrooms. Even the supporting staff participated fully in all the activities right from collection to cooking. Collection of morels has been an experience of its own kind. Because of its high commercial value, one has to compete with local people for collections and at times one may have to face their wrath as well.

(I) Systematics of Agaricales

A systematic survey of mushrooms and toadstools of N. W. Himalayas was started in 1976 and has been carried through all these years. (Sharma and Lakhanpal, 1981; Sagar 1988; and Lakhanpal, 1996). Luckily Dr. Roy Watling from Royal Botanical Gardens, Edinburgh extended all possible help in the identification

of mushrooms specially Boletes. Prior to Dr. Roy Watling's visit one of his students Dr. Alexander, who worked on the mycorrhiza, visited Shimla as a guest of the Conifer Research Centre, now Himalayan Forest Research Institute. It was he who for the first time introduced me to mycorrhiza; these visits led to my 'symbiotic association and journey with mushrooms and mycorrhiza'.

Since Agaricales is a large assemblage of mushrooms and toadstools, comprising more than 20 families (Singer, 1986), instead of initiating work on all families, I decided to begin family wise survey, starting with the family Boletaceae (Sharma and Lakhanpal, 1981; Sharma, 1980, Sharma, 1986; Sagar 1988; Lakhanpal, 1996). In the family Boletaceae 7 genera and 57 species were recorded. The seven genera recorded are *Austroboletus* (1) *Boletus* (37), *Gyproporus* (2), *Leccinum* (6), *Strobilomyces* (3), *Suillus* (5) and *Tylopilus* (3). This work included 5 new species and an equal number of new varieties. The work on Boletaceae was compiled into a monograph : Mushrooms of India-Boletaceae (Lakhanpal, 1996) The systematics was accompanied by supplementary data on edible species and 22 species in Boletaceae were found to be edible. Among these *Boletus edulis* was the species of choice. Besides a new species *B. hoarkii* sp. nov. was also identified. About 22 species of boletes were identified to be mycorrhizal with different predominant tree species.

In 1981, the mushroom exploration was extended to the families Amanitaceae, Russulaceae and Cantharellaaceae. The collections were primarily made from Shimla and adjoining areas. In these collections the genus *Amanita* in Amanitaceae was represented by 12 species; genus *Lactarius* and *Russula* in Russulaceae by 14 and 22 species, respectively and genus *Cantharellus* and *Craterellus* by 5 and 2 species respectively (Bhatt, 1986; Bhatt and Lakhanpal, 1988a, b,c). With the sanctioning of a project on mushrooms by the Department of Science and Technology (GOI) in 1983, work was extended to different parts of Himachal Pradesh and 6 more species in Amanitaceae were collected bringing the total number to 18 in the N. W. Himalayas and 25 in India (Kumar, 1987). This resulted in the publication of "Amanitaceae of India" (Kumar *et al*. , 1990). This work included 4 taxa new to science, 13 species were observed to be mycorrhizal with different trees species. Out of these only *Amanita caesaria* and *A. vaginata* were found to be edible and consumed locally by the people. Typical *A. muscaria* was not recorded however; only *A. muscaria var. flavivolvata* was recorded. Similarly the exploration was also intensified on Russulaceae and Cantharellaceae (Bhatt, 1986).

The family Cantharellaceae was represented by 2 genera *Cantharellus* and *Craterellus*, each is further comprised of 5 and 2 species, respectively, and out of which one species each is new to science. *Cantharellus cibrarius* and *C. minor* and *Craterellus cornucopoides* are edible species and the former two are also mycorrhizal with *Cedrus deodara*. In the family Russulaceae, the genus *Lactarius* is represented by 14 species and *Russula* by 22 species and these include 4 species in the former and 5 new species in the latter. On the family Russulaceae very extensive work has been carried out at Punjabi University, Patiala by Saini and Atri (Saini and Atri, 1985a, b, 1984, 1985; Saini et al. 1982,1988,1989' Atri and Saini 1986, 1988, 1989 and 1990a, b, c; Atri *et al*. 1991a, b,c, d, 1992c,d 1993a They described 50 species of *Russula* from HP, in addition to Watling and Gregory (1980) and Rawla and Sarwal (1983). Bhatt *et al*. (1995) described 4 species of *Russula* from Uttrakhand. Eleven taxa are reported to be mycorrhizal with different trees species and 13 species are observed to be edible in literature out of which only *Lactarius delicious*, *L. sanguifluus* and *Russula brevipes* are the most favoured ones in the Himalayan region.

The systematic work was further extended to families Agaricaceae, Hygrophoraceae, Pluteaceae and Tricholomatatceae (Lakhanpal, 1986; Kumar, 1987). In the family Agaricaceae 6 genera have been recorded : *Agaricus*, *Cystoderma*, *Lepiota*, *Macrolepiota*, *Leucoagaricus* and *Leucocoprinus*. The last two were unrecorded from N. W. Himalaya earlier. In the genus *Agaricus* 8 species are reported from N. W. Himalayas (Henning, 1900; Watling and Gregory, (1980; Singh and Mehrotra, 1974; Heinemann, 1968; Bakshi, 1974). Lakhanpal (1986) and Kumar (1987) described 4 species in this genus from Himachal Hiamalaya; *Agaricus angustus* Fr. , *A. arvensis* Schaeff. *A. campestris* L. ex. Fr. And *A. placomyces* Peck. Atri and his students have described around 25 species in the genus from different parts of Panjab and Dhancholia and Bahukhadi (1991) describe two species for Garhwal Himalaya.

The genus *Cystoderma* was so far unrepresented from N. W. Himalayas. One species, *C. amianthinum* (Fr.) Fayod, has now been reported in the genus from N. W. Himalaya (Lakhanpal, 1986, Kumar, 1987). The species is mycorrhizal with *Cedrus deodara*.

No species in the genus Lepiota was so far known from N. W. Himalayas. The two species known from the Himalayan region are from Eastern Himalayas. Lakhanpal (1986) and Kumar (1987) recorded three species in this genus : *L.*

acutesquamosa (Weinon) Kummer, *L. clypeolaria* (Bull ex. Fr.) Kummer and *L. cristata* (Fr.) Kummer, the last two are mycorrhizal with *Cedrus deodara*.

The genus *Leucocoprinus* is represented by *L. cepaestipes* (Sow. Ex. Fr.) Pat and a new species *Leucocoprinus* sp. nov. and in the genus *Leucoagaricus* only one species, *L. rubrotinctus* (Peck) Singer has been recorded. *M. procera* (Scop. ex. Fr.) Singer a new species, *M. macrolepiota* sp. nov. , *A. angustus* and *Leucoagaricus rubrotinctus* are new records from India. *A. arvensis*, *C. amianthium*, *L. acutesquamosa*, *L. clypeolaria*, *L. cepaestipes* have been recorded for the first time from N. W. Himalayas and *A. campestris* and *L. cristata* have been recorded for the first time from Himachal Pradesh.

In the family Hygrophoraceae, only two genera *Hygrophorus* and *Hygrocybe* were represented in the N. W. Himalayas. Kumar (1987) also recorded *Camerophyllus* for the first time. In *Hygrophorus* the following taxa have been described : H. ebureneus (Bull. Ex. Fr.) Fr. , *H. pudorinus* (Fr.) Fr. , *H. pudorinus* var. *fragrans* (Murr.) Hesler and a new variety in *H. pustulatus*. Earlier only two species in the genus were known. In *Hygrocybe* only one species was known so far from N. W. Himalaya i. e. *H. psittacina* (Schaeff. Ex. Fr.) Kummer. Kumar (1987) described 3 more species : *H. conica* (Scop ex. Fr.) Kummer and *H. calopus* sp. nov. which forms *mycorrhiza* with *Q. leucotrichophora*.

The genus *Camerophyllus* has been found to be represented by one species *C. pratensis* (Pers. Ex. Fr.) Kummer, and is recorded for the first time. Earlier it was known only from Maharashtra. Only one species *Gomphidius maculatus* (Scop. ex. Fr.) has been reported in the family *Gomphidiaceae* (Lakhanpal, 1986). However, earlier Watling and Gregory (1980) reported *Gomphus clavatus* (pers. Ex. Fr.) S. F. Gray in the family Gomphidiaceae from Kashmir.

In the family Pluteaceae, out of the three genera recorded from India, two are represented in the N. W Himalaya. These are *Pluteus* and *Volvariella*. Out of the 6 species of *Pluteus* in India, 5 are represented in the Himalayan region but only one i. e. *Pluteus cervinus* (Schaeff. Ex. Fr.) Kummer in N. W. Himalayas (Watling and Gregory, 1980; Kumar, 1987), In the genus *Volvareilla*, only *V. volva*cea (Bull ex. Fr.) Singer was so far known from N. W. Himalayas (Hennings, 1901). Lakhanpal *et al*. (1986) described *V. bombycina* (Schaeff. ex. Fr.) Singer from H. P. collected on the living decorticated trees of *Picea smithiana* (7000-9000 ft.). Lakhanpal (1986) and Kumar (1987) respectively listed and described *V.*

pussila (Pers. Ex. Fr.) Singer as well from Himachal Pradesh, Kumar (1987) described a new species of *Volvariella*, apparently which was collected on soil, associated with *C. deodara*. Natrajan *et al*. (2005) list two additional species in *Pluteus* and 12 in the genus *Volvariella*, some already recorded and some from new locations.

In the family Pleurotaceae, the genus *Pleurotus* is represented by 6 species, all collected from Jammu & Kashmir (Watling and Gregory) 1980 as : *P. drynius* (Pers. ex. Fr.) Kummer, *P. ostreatus* (Kaul and Kachroo, 1974), *P. membranaceus* Massee and *P. fossu*latus (Cooke) Sacc. Lakhanpal (1986) recorded *P. ostreatus* from Himachal Pradesh and Chaturvedi (1987) conducted experimental trials on its cultivation. In the genus *Lentinus* only two species are known from N. W. Himalayas, *L. strigosus* (Schwein) Fr. and *L. tigrinus* (Watling and Gregory, 1980; Lakhanpal (1986), Natrajan *et al*. (2005) treat these two genera in Polyporaceae listing two species in *Lentinus* and three in *Pleurotus*.

The family Tricholomataceae is one of the largest families of the Agricales with its members distributed far and wide and occupying a variety of ecological niches. Out of the 98 genera reported from all over the world, 41 genera are represented in India as well (Manjula, 1983), However, Natrajan *et al*. (2005) reported 34 genera in this family from 1984-2002. Twenty five genera have been reported from the Himalaya and only 5 from N. W. Himalaya. These genera are : *Armillaria, Tricholoma, Collybia, Leucopaxillus* and *Melanoleuca*. Kumar (1987) recorded in addition to these, 8 more genera from N. W Himalayas. These are : *Asterophora, Clitocybe, Lepista, Mycena, Oudemansiella, Tricholomopsis, Laccaria* and *Marasmius*. Lakhanpal (1986) has also recorded these and two additional genra i. e. *Lyophyllum* and *Flammulina* from N. W. Himalayas.

So far only *A. mellea* (Vahl. Ex Fr.) Kummer, and *A. obscura* (Pers. ex. Secr.) Romagn are known from Himalayas. We have recorded only *A. mellea* from Himachal Pradesh. Similar has been the case with the genus *Asterophora* in which only one species *A. lycoperdoi*des (Bull ex. Mirat) Ditmar ex. Fr. was for the first time recorded from India by Kumar *et al*. (1985), which was collected growing gregariously on the carpophores of *Russula*.

The genus *Clitocybe* hitherto unrecorded from N. W Himalays, is known to be represented by four species (Kumar, 1987; Lakhanpal, 1986). *C. clavipes* (Fr.) Kummer, *C. diltata* Pres. ex. Karsten, *C. gibba* (Fr.) Kummer and *C. squamulosa* (Fr.) Kummer. All the four have been found to be mycorrzizal.

Only three species in the genus *Collybia* are so far known from N. W. Himalaya. Out of these *C. peronata* (Boltr. ex. Fr.) Kummer was recorded from Mussoorie (U. P.) by Hennings (1901). The other two were recorded by Watling and Gregory (1980) from Kashmir viz. *C. dryphila* (Bull ex. Fr.) Kummer and *C. fuscopurpurea* (Pers ex. Fr.) Kummer.

In the genus *Laccaria, L. laccata* (Scop. ex. Fr.) Cooke, and *L. amethystea* (Bull. ex. Gray) Murrill (earlier known from Nilgiri hills) have been recorded from N. W. Himalaya. The fungus has gained much prominence in the last few decades being a good mycorrhizal species, which forms mycorrhizal associations with many tree species. In the genus *Lepista*, only one species, *L. nuda* (Bull. Ex Fr.) Cooke, has been recorded from N. W. Himalayas (Lakhanpal, 1986; Kumar, 1987) which is mycorrhizal with *Quercus semicarpifolia*.

In the genus *Leucopaxillus*, four species have been reported from N. W. Himalaya by Watling and Gregory (1980); *L. albissimus* (peck) Singer var. *piceinus* (Peck) Singer and Smith, *L. laterarius* (Peck) Singer and Smith, *L. amarus* (A&S. ex. Fr.) Kuhn, *L. roseobrulles* (Murr.) Singer and Smith and *L. giganteus* (Sow, ex. Fr.).

The genus *Marasmius* surprisingly has been reported to be represented by just one species in the N. W. Himalaya, *M. cohaerens* (A&S. ex. Fr.) Cke & Quel. Kumar *et al.* (1991) reported a new species, *M. ellipsoidosporus* and a new record *M. siccus* (Schw.) Fr. from H. P.

In the genus *Melanoleuca* two species *M. subpulverulenta* (Pers. ex. Fr.) Singer and *M. melaleuca* (Pers. ex. Fr.) Murr. , were so far known from Kashmir Himalaya (Watling and Gregory, 1980). Kumar (1987) recorded *M. alboflavida* (Pk.) Murrill from H. P. for the first time.

The genus *Mycena* is so far represented by five species in the N. W. Himalayas : *M. aetites* (Fr.) Quel. , *M. atrocyanea* (Fr.) Gillet, *M. golericulata*, *M. epiterygia* (Scop. ex. Fr.) Kummer. The last two have been reported from Himachal Pradesh by Kumar (1987) and Lakhanpal (1986).

The genus *Oudemansiella*, is observed to be represented only by one species i. e. *O. radicata* (Relh.) ex. Fr.) Singer from N. W. Himalayas (Lakhanpal, 1986; Kumar, 1987).

Tricholoma, a widely distributed and represented genus the world over, has only *T. terreum* (Bull. ex. Fr.) Kummer recorded from N. W. Himalaya (Watling

and Gregory, 1980). Two more species have been now recorded from N. W. Himalayas. These are : a new species of *Tricholoma* and *T. virgatum* (Fr. ex. Fr.) Kummer. The latter has been observed growing in mycorrhizal association with *C. deodara* (Lakhanpal, 1986 : Kumar, 1987).

The genus *Tricholomopsis* is so far represented by two species from India, one from U. P. (Singh and Mehrotra, 1974) and other from Eastern Himalaya (*T. rutilana*, Sarwal, 1984). Kumar (1987) and Lakhanpal (1986) recorded *T. rutilans* (Schaeff. ex. Fr.) Singer and *T. sulphureoides* (Peck) Singer from N. W. Himalayas for the first time.

In the genus *Flammulina* only *F. velutipes* (Curt ex. Fr.) Karst. has been reported so far from India and Himalaya. In the genus *Lyophyllum* represented by four species in India, has not been recorded so far from Himalayan ranges. Lakhanpal (1986) recorded *L. decastes* (Fr. Ex. Fr.) Singer from H. P.

In the genus Resupinatus Watling and Gregory (1980) recorded *R. applicatus* from Kashmir and in the genus *Xeramphalina*, out of the three species recorded from India and Himalayas, *X. aurara* Horak and *X. campanella* (Batsch. ex. Fr.) Maire, have been recorded from N. w. Himalaya (Watling and Gregory, 1980)

II. Systematics of morels

The genus *Morchella* (Ascomycetes) commonly know as morels and 'Guchhi' in the Indian market is at present, the costliest and most sought after wild mushroom. It has an excellent flavour and is highly prized for its culinary aspects. Morel collections generate extra income for the local inhabitants. Attempts have been made to domesticate it but success has been only partial. Therefore, studies were undertaken to investigate all possible aspects of morel biology (Shad, 1989; Lakhanpal and Shad 1999, Shad and Lakhanpal, 1991, Thakur 2001, Rana, 2002, Lakhanpal et al. 2010). All the six classical species viz. *M. angusticeps, M. conica, M. crasispes, M. deliciosa, M. esculenta* and *M. semilibera* have been collected and described from the Himalayan region.

The systematics of genus *Morchella* and its species has been in a state of flux. Presently though most of the authors favour a six species concept, even for these species there is little consensus. On the basis of morphological features, out of the four species in *M. esculenta* complex. (*M. esculenta, M. deliciosa, M. conica* and *M. crassipes*), *M. conica M. crassipes* have at least one distinguishing characteristics each (conical shape in the former and swollen stipe in the latter)

by which they can be easily identified. But there is hardly any such feature that separates *M. esculanta* and *M. deliciosa*, so that these have been often regarded as a single species. However, the data of Gessner *et al*. (1981) on allelic variation and segregation in these two species clearly points that these are two different taxa. This data plus data of Hervey *et. al*. (1978) suggested that the potential for gene exchange may be used as a means of discriminating taxa within the genus *Morechella*. Therefore, similar studies are needed on the six traditional species and that are they considered variants or have been described as new species in recent times (*M. rotunda*, *M. tibelica*, *M. umbrina* and *M. simlensis* sp. nov.).

The polymorphism and genetic diversity in the species *Morchella* was assessed at molecular level. The phlylogenetic tree (dendrogram) generated was based on the data resulting from RAPD analysis. At 64% similarity coefficients, all seven species were separated in seven different clusters. The resulting dendrogram clustered *Morchella* species into two major groups; A and B at 15% similarity level which are further divided into different sub-groups. The phylogenetic tree suggested that the black morels –*M. angusticeps*, and *M. conica* (Group A) and yellow morels –*M. esculenta*, *M. deliciosa* and *M. crassipes* (Group B) have been reported to be separate taxonomic groups and were distantly related. The other two species, *M. tibelica* and M. *simlensis* sp. nov. have also been categorized to these respective groups. M. *simlensis* sp. no. has been more conspecific to yellow morels (28% similarity level) and M. *tibelica* showed similarity to the black morels (24% similarity level) There has been high degree of conspecific variability needs to be checked between yellow morels i. e. yellow morels have been very less variable intra specifically but black morels demonstrated high intra specific variability.

Similar studies as on morels were then extended to all the prominent non-conventional edible mushrooms of the N. W. Himalayas. The studies have been conducted on their taxonomy, ecology, physiology and nutritional requirements, ethnic uses and analysis of nutritive components. (Sharma, 1993). *Helvella crispa, Gyromitra esculenta* among members of *Ascomycotina, Lactarius delicious, L. sanguifluus, Macrolepiota procera* and *Russula brevipes* among gilled members and *Boletus edulis, B. erythropus, B. hoarkii, Cantharellus cibarius, Hydnum repandum, Ramaria botrytoides* and *Sparassis crispa* among the non gilled members of *Basdiomycotina*.

It has been observed that the protein values in these edible mushrooms are higher than those reported for various vegetables. The fibre contents are also

higher. They contain low fat and carbohydrate and low energy, which can be beneficial in low caloric diets considerable amount of minerals, suggest their important role as mineral sources in human diet.

The studies revealed that these mushrooms are similar to commercially cultivated mushrooms with regard to their cultural ability and chemical composition. There is need to develop and standardize the cultivation technology for these wild edible mushrooms. They are already accepted for consumption by local people.

Nutraceutical potential :

In past two decades mushrooms have assumed a greater role in maintenance of good human health because of their projected nutraceutical potential. This potential is enormous but untapped. The mushrooms possess antitumour, immunomodulating and hypocholesterolemic properties. Some well known medicinal mushrooms are : *Ganoderma lucidum, Grifola frondosa, Trametes versicolor, Schizophyllum commune, Lentinula edodes, Agaricus blazeii* and *Cordyceps sinesis*. The active constituents found in mushroom are : Polysacchanides, dietary fibers, Selenium oligosaccharides, triterpenoids, peptides, proteins, alcohol, Phenols, amino acids and mineral elements. They show anti-cancerous, anti-HIV, anti-viral activity and also ameliorate toxic effects of chemo and radiotherapy.

Nutraceutical potential of morels has been investigated (Lakhanpal, *et al.* 2010). Nutraceutical attributes of morels compare favourably with the mushroom species listed above. They are even a better source of Polysaccharides, crude fibre, nucleic acids,minerals especially Se, Zn, K, Cu, Na, and Ca, Vitamin (B_1, B_2, C,A, D and K; proteins and all the essential amino acids. They are free from cholesterol. Hence they are good of nutraceutical use.

Ethno mycological Studies :

Ethno mycological studies were initially conducted on morels. These studies were conducted to gather information on methods of collection, myths associated, propagation in nature, local and vernacular names and recipes of morels in vogue with the local communities and to see the impact of morel collection on socio-economic aspects of the inhabitants. It was revealed by survey that morels are collected by local inhabitants of all ages and creeds Shepherd, herdsmen, women and school going children are more active collectors. The nomenclature of morels and of other mushrooms varies in different valleys in the Himalayan region. They are commonly called “Guchhi” in the Indian markets, but their vernacular names

differ in different areas : they are called “Rangmuts” and “Jangmuts” in Kinnaur “Dhunglu or Chunchru” in Lahaul & Spiti and “Chankedes” and “Bhuntu” in Chamba districts. In and around Shimla they are called “Chiaun” and “Kaiun” in Kullu valley. The myths associated with morels and other mushrooms are almost similar. The most common belief is that morels emerge from ground after lightening strikes and that they come up in grater abundance in the burnt up areas. Also that only few lucky or naturally gifted people can spot them. There is a common myth among people that *Morchella sporophore* does not increase in size, once it is spotted. Such myths have lead to indiscrete collections, removing even the smallest bits of fructifications. Deforestations have also led to the loss of inoculum at different sites. *Morchella* and other mushrooms are consumed in a variety of ways and recipes differ in different localities, but the commonest method of its consumption is by preparing ‘Pulao’ with rice or a dried vegetable or a vegetable with gravy. But the trade of morel is in few hands, however. The middlemen buy these collections at site at the rate of rupees 1000-2000 whole sellers at the rate of 3000-4000 and these ultimately reach the consumers at the rate 10,000-12,000 /Kg. The morels are mostly collected by low income group people. The morel collection adds a substantial amount to the income of the poor people. Thus it is a source of additional income for the marginal farmers in high hill zones of the Himachal Pradesh.

Ethno mycological data has been collected on other mushrooms in addition to morels : *Lactarius delicious, L. sanguifluus, Amanita vaginata, Russula brevipes, Sparassis crispa, Hydnum repandum,* specie of *Clavaria, Macrolepiota procera* etc. (Kaisth, 1985; Sharma, 1993; Rathore 2002; Sharma, 2002). The general myths are almost the same for all these mushrooms. Even the recipes are similar but the varieties are more. Previously most of these mushrooms were dried for use in winter months by the local inhabitants when most of the areas in H. P. are snow bound. Now the use is declining with the introduction of off season vegetables and other cash crops.

Ecological Studies :

(1) Distribution, phenlogy and mycorrhizal association of Agaricales

The forest in N. W. Himalaya exhibit variation in composition with difference in latitude, elevation, soil types and other factors. The mycofla changes with the different forest types i. e. different trees species have different species of fungi on mycorrhizal associates. The studies were limited to Basidiomyectes, especially the

member of Agaricales. The purpose was (i) to determine the distribution / occurrence of particular species of fungi in different elevational/ vegetational zones (ii) to identify the species of fungi entering into mycorrhizal association with particular species of trees, and (iii) to quantify fruiting phenlogy of different species of fungi.

The ecological data was collected from forest lying in the outer, middle and inner ranges (Tara Devi, Glan and Jakhu Forests) and also along a gradient with altitude varying from 6000-10,000 ft. msl. (Narkanda forest). These forests vary in topography, aspect and vegetational zones. The species of mushrooms also vary in these forests. However, the forest zones with similar altitude and vegetational elements integrade in mushroom flora also. In Tara Devi forest the species recorded are *Amanita emilii, A. fulva, A. umbonata; Lactarius camphorates, L. indicus* sp. nov. , *L. lutescens* sp. nov. , *L. piperatus; Russula foetens, R. laurocerasi, R. lilaceae* and *R. subflavescens* sp. nov.

In Glen forest, species like *Amanita gemmata*, A. *emilli, A. rubescens, A. vaginata; Cantharellus cibarius, C. minor; Craterellus cornucopoides; Lactarius hygrophoroides, L. indicus* sp. nov. , *L. piperatus, L. volemus; Russula brevipes, R. crustosa, R. densifolia, R. foetens* and *R. subflavescens* sp. nov. , have been collected repeatedly. In Jakhoo forest, *Amanita indica* sp. nov. m *A. pantherina; Cantharellus luteocomus*; *Lactarius pudicus* sp. nov. ; *Russula lilacea, R. murinoides* sp. nov. , and *R. rosea* have been found growing frequently. Among the hard woods, *Quercus* and *Rhododendron* spp. were the most common associates while *Pinus* and *Cedrus* spp. , among the conifers for mushrooms.

The appearance of mushrooms seems to be controlled by temperature and relative humidity. In Tara Devi and Glen forests (at lower altitudes, 5000-6000 ft.) the species which appeared during the early monsoon season appear during the late monsoon in Narkanda, Khadrala forests (at higher altitudes, 7000-9000 ft.) To study the distribution of mushrooms in different altitudinal vegetational zones along a gradient, a forest in Narkanda in Shimla district was selected. It was divided into 4 zones, each zone covering an altitude of 1000 ft. from 6000 ft. to 10000 ft. the soil characteristics of each zone were also taken into consideration, Soil pH, and NPK contents of the soil were also estimated (Kumar *et. al*. 1990).

In the first vegetational zone the dominant phanerogams were *Pinus roxburghii, P. wallichiana, Cedrus deodara* and *Quercus leucotrichophora*. The species

recorded were : *Agaricus angustus, A. placomyces, Lepiota clypeolaria, L. cristata*; *Amanita flavoconia, A. gemmata, A. pantherina, A. vaginata*; *Hygrocybe conica*; *Pluteus cervinus, Volvariella pusilla, Clitocybe dilatata, C. gibba, Marasmius siccus, Melanoleuca alboflabida, Mycena epipterygia* and *M. pura.*

The second zone comprised of *Pinus wallichiana, Cedrus deodara, Abies pindrow, Picea smithiana, Quercus leucotrichophora* and *Rhododendron arboreum.* The mushroom species here were common with the first zone. The additional species were *Agaricus campestris, Amanita berkeleyi, Hygrocybe miniata, Hygrophorus pudorinus* var. *fragrans, H. eburneus*; *Laccaria amethystea, Oudemanisiella radicata*. The species found in the first zone but absent from the second zone were : *Agaricus angustus* and *Amanita gemmata*. In the third zone the plant species were *Pinus wallichiana, Cedrus deodara, Quercus leucotrichophora, Q. dilatata, Picea smithiana, Abies pindrow, Q. semicarpifolia*. This zone shared some species with the second zone. The additional species recorded are : *Agaricus angustus, Cystoderma amianthianum, Leucocoprinus cepaestipes; Amanita rubescens, A. caesarea, Hygrophorus chrysodon, H. pudorinus* var. *pudorinus, Volveariella bombycina; Armillaria mellea, Collybia fusipes, Armillaria mellea, Collybia fusipes, Lepista nuda, Leucopaxillus giganteus, Marasmium* sp. nov. *Tricholoma virgatum, Tricholomopsis rutilans, T. sulphureoides, Agaricus campestris, Amanita berkeleyi, Hygrocybe minata, Hygrophorus pudorinus* var. *fragrans, Melanoleuca alboflabida, Oudemansiella raidcata* recorded in the second zone, were absent in the third zone. *, Picea smithiana, Abies pindrow, Taxus baccata, Juniperus sp. Quercus semicarpifolia, Pinus wallichiana and Rhododendron lepidotum* constitute the vegetation of the fourth zone. *Lepiota acutesquamosa; Amanita fulva, A. muscaria* var. *flavivolvata, A. ceciliae, A. volvata, Chamerophyllus pratensis, Leucopaxillus amarus, F. roseiberunneus.* These species were recorded in addition to those found in the 3rd zone. *Agaricus angustus, Leucocoprinus cepaastipes, Hygrohorus pudorinus* var. *fragrans, Volvariella pusilla* were, however, absent from the fourth zone, though they were recorded in the third zone.

The data for Indices of similarity reveals that third and fourth zone were most similar in species composition (0. 845) whereas first and fourth (0. 535) and second and fourth (0. 523) were least similar. The fruiting phenology reveals that for man of the mushroom species the peak fruiting period is mid of July to mid of

September, some may last up to mid of October, This is primarily based upon the inhabitant and communication of the rainy season in this zone 30 species of macro fungi were seen to form mycorrhizal will different tree species viz. II species were associated with *C. deodara,* 7 with *Q. leucotrichophora* 4 with *Picea smithiana* and *P. roxburghii* three with *P. wallichiana,* two with *Quercus semicarpifolia* and one each with *Rhododendron arboreum* and *Betula* sp.

(2) Ecological relationships of Morels

The relation of *Morchella* production to forest type, the fruiting period of morels plus such parameters as temperature, pH and NPK and Ca contents of morel bearing and non morel bearing soils have also been investigated. The maximum production of *Morchella* has been observed to be in the temperate mixed coniferous forests especially in deodar forests, from March to May, depending upon the amount of snowfall and subsequent precipitation.

The Mycorhhizosphere of morels bearing soils and non- morel bearing soils was also studied to identify the associated fungi. *Morchella esculenta, M. conica, M. angustceps* and *M. deliciosa* have been observed to enter into mycorrhizal association with herbaceous plants i. e. strawberry, ferns and grasses. The subterranean portion of the capophore forms a loosely woven cord near its base. Morel hyphae penetrate into all the tissues of roots except xylem. The hyphae form a loose weft on the root periphery, some of them penetrating directly into the cell lumens (Lakhanpal *et al.* 1991) : The entire work on morels has been processed into a monograph entitled, “Biology of Indian Morels” (Lakhanpal *et. al.* 2010).

Mushrooms and Environmental Amelioration

The present times witness a tremendous increase in the generation of wastes. Mushroom cultivation can be practiced to recycle some of the waste material. The processes of mushroom cultivation can bio convert all the major plant polymers. Bio-conservation of waste through mushroom cultivation is simple and low cost technology. In this process, enzyme complexes of mushroom act upon the lignocellulosic material degrading and utilizing it to produce mushroom fruiting bodies with high value food protein, which can be directly consumed by human beings. The residues can also be used as animal feed or as an effective soil fertilizer.

From amongst the 2000 species of mushrooms reported to be edible from all over the world, technology is available for the commercial cultivation of about 14 species. We were also able to develop cultivation technology for two mushrooms.

Cultivation of *Lentinus edodes* (Shitake) was achieved for the first time in India on local sawdust substrates (Kaur, 1989; Kaur and Lakhanpal, 1995). Similarly, package of practices was developed for the first time for *Calocybe indica* (Pandey *et al*. , 2002; and Pandey and Lakhanpal, 1996).

Mushrooms Linked to Mycorrhizal Biotechnology :

The mycorrhiza representing the naturally beneficial relationship between the feeder roots of plants and fungi though was discovered as early on 1885 by Frank, the real appreciation of the association became evident only much later. Marx (1976) described it as the most wide spread symbiosis of plants. Trappe (1977) emphasized that about 95% of the world's species of vascular plants are mycorrhizal and that the presence of mycorrhiza is a rule and absence an exception. The significance of the association was realized when Kessel (1927) failed to establish *P. radiata* and *P. pinaster* in Western Australia nursery beds which lacked mycorrhizal associates. The seedlings established normally after soil from natural pine stands was added to the nursery beds. This was the birth of a technology which later revolutionized the afforestation and reforestation programmes the world over (Marx and Schenck, 1983, Ruhele *et al*. , 1981, Mar *et al*. , 1989, Molina, 1980; Trappe, 1977). The early inoculations, therefore, were with the soil that contained. mycorrhizal propagules. Inoculation with pure cultures of mycorrhizal fungi was pioneered by Moser in Austria in the early 1950's (Marx, 1980) Moser's techniques were gradually modified and refined and were successfully used to form ectomycorrhizae on seedlings with pure cultures of selected fungi. In all these studies field survival and growth of seedling with specific ectomyco mycorrhizae excelled the performance of seedlings that lacked ectomycorrhizal at planting (Marx *et al*. , 1982).

It was in 1979, that Dr. Alexander University of Abreden, Scotland came as a visiting scientist at Conifer Research Centre (now Himalayan Forest Research Institute, Shimla). He for the first time introduced me to mycorrhiza and taught me how to trace the connection between mycorrhizal roots and mushroom sporocarps. This introduction later became one of the major fields of my research interests.

The mycorrhial research in India was a field that was not very well organized and much attended. The credit for collating mycorrhizologists of India goes to Dr. A. K. Oka, Canadian Embassy and New Delhi. He organized a small group meeting at the University of Delhi with the help of TERI around 1984, where Prof.

K. G. Mukerji, Prof. Ajit Verma, Prof. KVVR Tilak, Dr. Alok Adoleya and few others gathered to discuss the plans for bringing together scientists working on mycorhhiza with TERI, New Delhi as the coordinating Institution. A conference on mycorrhiza was organized at JNU in the first instance, followed by another at CAS in Botany, Madras and still another at Chang Mai, Thaliland with in a span of almost 5 years. Prof. Fortin from Canada and Prof. James Trappe from USA were associated at one or the other time Dr. D J Bhagyaraj from Bangalore and C. Manoharachary from Hyderabad along with Drs Mukerji, Mahadevan, Naatraj, Ajit Verma, K. V. V. R Tilak helped in framing the guidelines for mycorrzial research in India. I was also an active participant in all these deliberations.

These efforts helped in identifying groups as well as in generating interest in others in mycorrhizal research. IDRC Canada provided some funding and training Centers in ectomycorrhial research were established at CAS in Botany, Madras University, Deptt. of Biosciences, H. P. University, Shimla, and TERI at New Delhi. Deptt. of Biosciences at NEHU also became actively involved in ectomycorrhizal research. Since then, these institutions have carried out work on the mycorrhiza of important conifer species of their respective regions.

The research achievement on ectomycorrhiza has been periodically reviewed (Lakhanpal, 1987, 1988, 1989a, b, 1991, Lakhanpal and Sagar, 1994 Raman and Mahadevan, 1988a). The ectomycorrhizal research in India started in mid 1950's (Bakshi 1957; Bakshi and Thapar, 1960 1966). In the mid 1980's the four centres mentioned above became active almost simultaneously only. The research on ectomyrrhiza at H. P. University during the last three decades has been carried out an almost all the dominant conifer species : *P. roxburghii, P. wallichiana, P. gerardiana, Cedrus deodara, Abies pindrow, Picea smithiana* and *Taxus baccata*. In addition studies on the mycorrhiza of O*ak, Rhododendron arboreum, Monotropa, Orchids, Aesculus indica* and Apple plants has also been carried out (Kumar,1989; Singh 1982; Sagar, 1993; Thakur 1990; Gupta 1990; Sharma, 2000; Katoch 2000; Gulati, 2004). The survey of mushroom biodiversity provided basis for identifying, the species of mushrooms that enter into mycorrhizal association with tree species. Some of them have been utilized for artificial mycorrhizal synthesis with different species of conifers. The different aspects of mycorrhizal study included :

i. Identification of the mycorrhizal associates.

ii. Characterization and identification of mycorrhizae.

iii. Studies on mycorrhiza and mycorrhizae sphere;

iv. Studies on the effect of water stress and soil fumigants.

v. Estimation of nutrient status of mycorrhizal on non-mycorrhizal plants.

vi. *In vitro* synthesis of mycorrhiza, mass multiplication of inoculum, inoculation of the seedlings and assessment of the performance of the inoculated seedling for various growth parameters and performance in the field.

During a systematic survey of mushroom mycoflora of N. W. Himalaya, around 80 species of mushrooms were identified which enter into mycorrhizal association with different forest tree species. The details of these are given in the previous pages where account of mushroom systematics is provided. Predominant mycorrhizal mushrooms are : *Amanita vaginata, A. caesaria, Boletus edulis, B. Hoarkii, Suillus sibricus, S. granulatus, Laccaria laccata, Lactarius sangufluus Suillus sibricus, Canthrellus, cibarius, Tricholoma virgatum, Rhizopogon luteum, Trappeinda himalyensis* and *Tuber mesentricum*. Attempts have been made to identify the mycobiont and achieve *in-vitro* mycorrhizal synthesis.

In the Department of Biosciences, Himachal Pradesh University, Shimla the work on mycorrhiza was initiated on *Picea smithiana* and *Pinus gerardiana* with the help of Conifer Research centre (now HFRI) Dr. R. V. Singh, the then Coordinator of the Centre (later D. G. , ICFRE) provided all the necessary help. The inoculation of the seedlings with the mycobiont resulted in significantly better growth, development and establishment of the seedlings reducing the transplanting period of the seedling by one year, over the seedlings raised by traditional methods. Mycorrhizal seedlings also had much higher survival rate than the non-mycorrhizal ones. Reduction in transplanting period is quite a saving in terms of time, money and energy. This growth trend has been retained by the plants even under field conditions. This is very important because both there conifer species especially *P. gerardiana* is a threatened species. This is the source of Chilgoza of commerce. It is a multipurpose tree species in the tribal belt of Kinnaur district of Hiamchal Pradesh. The natural regeneration of the plants is almost negligible. The seeds have commercial value so almost all the seeds are extracted by local inhabitants from the cones for sale. Whatever, little is left in the cones and fall on to the ground are eaten away by rodents. Because the soil is loose and dry

and they do not embed into the soil. There is almost no rainfall, whatever rain falls is in the form of snow. Hence planting mycorrhizically tailored species can rejuvenate the dwindling forests (Kumar, 1989;Lakhanpal and Kumar, 1984; 1986a, 1986b; Lakhanpal and Choudhry 1988). The process of mycorrhization in these two plants begins when the seedling are three month old. Before sowing the seeds the nursery beds are sterilized with formaline or methyl bromide. A doze of 210m/^{4} lt of water for formaline and 130 ml/^{4} lit. for methyl bromide in *P. smithiana* and 190 ml. / ^{4} lit. of water for formaline and 110 ml/ 4 lt. of water for methyl bromide in *P. gerardiana* controlled the incidence of damping off of seedlings with normal mycorrhizal development. These dozes were much lower than the doses being used by nurserymen earlier. Therefore the inoculation of seedlings with mycobiant increases their survival and helps them in establishing better.

Another extremely important conifer of the N. W. Himalaya is *Cedrus deodara*. It is the State trees of Himachal Pradesh. It has been over exploited without commensurate plantings. Its wood is the strongest and most durable. It is an important constructional timber. Natural regeneration is influenced by seedling conditions germination and climatic conditions. Germination usually takes place during March and April and in warmer elements in January and February. The seeds remain viable for 3-4 months. In good seed years abundant seedlings may grow but even under favourable conditions, number of seedlings may die from one reason or another. Therefore, artificial regeneration has to be increasingly resorted to. The normal practice of raising seedling is on a casual mix on soil from natural zone of the plant and therefore, survival of the seedlings is also 'casual'. It takes the seedlings one and half year or two years for seedlings to attain a transplantable height of 25-30 cm. Therefore, studies were undertaken to identify and isolate the mycobiant which could be utilized for artificial inoculation of the seedlings. A number of mushrooms were identified which enter into mycorrhizal association with *C. deodara*, prominent among them were *Boletus edulis, B. hoarkii, Cantherellus cibarius* and a hypogeous fungus *Trappeinda himlayansis* gen. *et*. sp. nov. All these were edible mushrooms but for detailed mycorrhizal studies choice fell on *T. himalyansis* because it was hypogeous, and an entirely new fungus. This was observed to grow best on wheat grain medium followed by peat moss mixture. Three different types of soil : waste land level soil, forest soil and a mixture of these two were used for raising seedlings. The seedlings inoculated with pure inoculation of *T. himalayansis* excelled the control

in all growth parameters. The uptake of all major and minor elements in inoculated seedlings was also significantly higher. The inoculated seedlings acquire the requisite transplanting height of 25-30 cm in just six months whereas the inoculated seedlings reach that height in one and half to two years. This was a great saving in terms of time, money and energy (Singh, 1992).

Pinus wallichiana Himalayan blue pine is yet another important conifer which occurs in the Himalaya between 6000-8500 ft. It is a valuable timber tree and is a primary colonizes. A number of factors like seedling conditions, germination, climatic conditions, soil and light, fire and grazing influence natural regeneration of the pine. Since natural regeneration of blue pine is hindered by many factors, hence, artificial regeneration has to be increasingly restored to. The seedlings are transplanted after they attain a height of 25-30cm. Like deodar, blue pine was also observed to have a good number of mycorrhizal associates. The most common among them was *Suillus sibricus.*

In vitro synthesis of mycorrhiza was achieved between *S. sibricus* and *P. wallichiana*. Mass multiplication of the inoculum was achieved on the medium supporting maximum growth i. e. wheat grain. The seedlings were raised in three types of soil as in case of *C. deodara* : forest soil, wasteland soil and a mixture of the two in 1 :1 ratio. The inoculated seedlings started exhibiting significantly higher value for all the growth parameters i. e. shoot length, root length, number of short roots, number and percentage of mycorrhizal roots, fresh and dry weight of shoot, root and seedlings, root/shoot ratio (on fresh and dry weight basis) and seedling volume, in the mixture of soil followed by forest soil and wasteland soil. The inoculation also reduced the transplanting period considerably. The nutrient status in the inoculated seedlings was much better than the inoculated ones. Hence the studies serve as a basis for undertaking mass inoculation programme (Sagar, 1993).

Studies on mycorrhiza, mycorrhizosphere, endophytes of *Taxus baccata* have been undertaken by Sharma (2003), Gulati (2004) and on mycorrhizal inoculation by Singh and Lakhanpal (unpublished) The need for detailed study was felt because extraction of Taxol from leaves of *Taxus baccata* resulted in mass scale lopping of these trees in India and in the neighboring countries. Therefore, a project was sanctioned by GBPHIED Almora to develop simple technique of clonal propagation and study the role of mycorrhizal inoculations of rooted cuttings for their better survival after transplantation.

Planting of cuttings in traditional method in sand for rooting requires regular nutrient solution sprays to sustain the root and shoot system. It is labour intensive, uneconomical and hinders the natural acclimatisation and development of mycorrhizal association in the root system, which results in high mortality after transplantation for hardening in soil. Transfer of rooted cuttings from sand beds to the polythene bags is also labour demanding and results in root injury and root loss at the time of uprooting. Therefore, technique was modified and cuttings were planted directly in polythene bags containing 2/3rd natural zone soil in the lower portion and 1/3rdsand in the upper portion. Roots directly enter into the soil and natural acclimatisation and mycorrhizal development starts immediately after root emergence and no nutrient solution is required to sustain the root and shoot. Forest Department carried out plantation of seedlings produced through this technique and observed 100% survival percentage. Joint trials with State Forest Department were set up for the popularisation of the technology and have been approved for incorporation in the regular nursery practices of the forest department. Around 20,000 saplings were supplied to GBPHIED Almora for planting at Badrinath Shrine.

In *Abies pindrow* and *Pinus roxburghii* the morpho anatomical characteristics and identification, mycorrhizosphere and effect of water stress on mycorrhizal and non mycorrhizal seedlings has been investigated. Studies were undertaken in natural soil which have propagules of mycorrhizal symbiont and in the sterilized soils. The seedlings with natural inoculation attained better growth, Shoot-height, collar diameter and fresh and dry weight than those grown in sterilized soil. Similar studies have also been has carried out on some hard wood trees like *Robinia pseudoacacia, Aesculus indica, Quercus leucotrichophora* and four orchids species *Habenaria densa, H. edgeworthi, H. intermedia, H. pectinata* and *Mictrostylis wallichii*. The latter studies were to understand the nature of ericaceans monotropoid and orchidaceous types of mycorrhizae. In addition, VAM fungi have also have been isolated and identified from a number of angiospermic plants. (Thakur, 1990 Sharma, 1986, Chauhan, 1993, Ram, 1993)

Ecological aspects of mycorrhizae have also been investigated for the first time. The studies were designed to estimate the mycorrhizal activity of roots in a pure pine forest and in a mixed forest. The ecological implications of mycorrhizal association in natural ecosystem, the role of soil or environmental factors, mycorrhizal fungus characteristics or host plant properties a love or in

combination were considered. The mixed forest has *Cedrus deodara, Rhododendron arboreum, Aesculus indica, Quercus leucotrichophora* and *Pinus wallichiana* as its components. A comparison of ectomycorrhizal activity in two types of forests reveals that ectomycorrhizal activity was absent in both the forests during summer season. The ECM count was significantly low in chirpine forest, the organic matter of chirpine forest was also significantly low than that of the mixed forest. When the organic layer was maximum, at that time the ectomycorrhizal activity was also maximum. A comparison of volume of soil layer between seasons reveals that volume of litter layer was maximum during summer and autumn whereas the volume of humus was maximum during rainy and autumn in chirpine and the mixed forest respectively. The soil moisture and ectomycorrhizal activity were strongly related. When the soil moisture was maximum, during rainy season, the ectomycorrhizal activity was also maximum. Humus layer had higher moisture content and also had higher mycorrhizal activity. With regard to pH it was observed that pH in the acidic range supports maximum mycorrhizal activity. The nutrient content i. e. NPK were maximum in the humus layer of both the forests. They were maximum during the rainy season followed by autumn season. The nutrient content in soil seems to be directly related to ECM activity and these are therefore influenced by the presence of significant moisture and pH of soil. There has been considerable progress in our understanding of the occurrence and multifaceted role of mycorrhiza in the ecosystem during the last 100 years, but lot remains to be learnt about its ecological implications, importance in forestry, agricultural and horticultural practices. (Singh, 1998, Singh and Lakhanpal, 2005 a, b).

My journey with mushrooms and mycorrhiza is nearing completion, but there are miles to go. I have briefly touched the cultivation and nutraceutical aspects. For these and many other areas of mushroom research sky is the limit. What has been explored is just the tip of the iceberg. Many groups of mushrooms are still not properly explored : poisonous mushrooms, termite mound mushrooms, hallucinogenic mushrooms, luciferous mushrooms, and hypogeous mushrooms. The mushroom as source of “Soma” is still contested. Little has been done to conserve and preserve the biodiversity. Conservation also seeks exploration of biodiversity. Explorators of biodiversity are themselves a declining and endangered lot. In such a situation will the landing for the flights of biotechnology be safe! Taking cue from what Einstein said for religion and science it seems equally applicable to biodiversity and biotechnology “Biodiversity without is lame and Biotechnology without

Biodiversity is blind". We make earnest efforts to explore and exploit but little to experience and enjoy. Exploration is information, Experience is knowledge and enjoyment is wisdom. Wisdom dawns to create blissful state. Biodiversity and Biotechnology have been projected to be at crossroads. They should cross the roads and merge into each other to make the lives meaningful instead of lamentinbg later. The picture of modern life basically consisting of paradoxes, contradictions and confusion is very well caught by the well known poet Elliot in the following eloquent lines;

"Endless invention, endless experiment
Bring us knowledge of motion, but not of stillness
Knowledge of words and ignorance of the world.
All our knowledge brings us nearer to ignorance;
Where is the life we lost in living?
Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?
The cycle of heaven in twenty centuries
Brings us further from God and nearer to dust"

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II

ABSTRACTS OF PLATINUM JUBILEE LECTURE

PLATINUM JUBILEE LECTURE

Biotechnology of Endophytic Fungi : Inorganic Nanomaterials and Drugs

Absar Ahmad

Biochemical Sciences Division,
National Chemical Laboratory,
Pune-411008 (M. S)

One of the important challenges of considerable topical significance in nanotechnology is the development of eco-friendly experimental processes for the economical synthesis of nanomaterials in large quantities of variable size, shape and chemical composition. While it is recognized that some of the most exquisite nanomaterials are made by biological systems (examples include silica in diatoms and magnetite in magnetotactic bacteria), the potential to exploit microorganisms in a creative manner in the laboratory for eco-friendly synthesis of nanomaterials is still largely under-exploited.

In this presentation, we describe our research into the use of plant microorganisms and plant extracts in the synthesis of metal, metal sulfide and oxide nanoparticles. In a significant departure from bacteria-based methods for nanomaterial synthesis that have been investigated in some detail, we have shown that plant microorganisms such as fungi and actinomycetes when challenged with aqueous metal ions are capable of reducing the ions both intra and extra-cellularly resulting in the formation of stable metal nanoparticles. The formation of metal nanoparticles occurs by an enzymatic process and thus, the fungus-based synthesis process is not limited to reduction reactions alone. The versatility of this approach is underlined by our findings that enzymes such as sulphite reductase, nitrate reductase and hydrolyzing proteins are secreted by the fungi in response to metal stress thereby leading to the possibility of synthesis of quantum dots, metal nanoparticles and nanooxides. The biosynthesis of nanooxides using fungi is exciting since the synthesis occurs at room temperature and thus could be of considerable commercial value.

Fungi enjoy a close symbiotic relationship with plants and hence, it is quite likely that plant extracts may also possess useful biomolecules that not only carry

out the range of biotransformations listed above but also control the shape of nanoparticles. We have studied a number of plant extracts for realizing metal nanoparticles and have observed that the Geranium and Lemongrass extracts result in shape modulated gold nanoparticles. In particular, the reaction of aqueous gold ions with Lemongrass extract resulted in the large-scale synthesis of gold nanotriangles with interesting near infrared absorption. Potential application of the gold nanotriangles in hyperthermia of cancer cells and infrared absorbing glasses/polymers are being investigated.

We have also isolated, purified and completely characterized a range of plant based drugs such as Taxol from endophytic fungi and recently initiated further important steps of functionalizing the nanoparticles synthesized by green chemistry approach for targeted drug delivery application.

98th Indian Science Congress
January 3-7, 2011, Chennai

III

ABSTRACT OF AWARD LECTURE / YOUNG SCIENTIST AWARD PROGRAMME

YOUNG SCIENTIST AWARD PROGRAMME

Optimization of Cell Culture Parameters for Increased Shoot Biomass and its Enrichment for a Medicinal Compound, Picroside-1 in an Endangered Herb, Picrorhiza Kurroa Royle ex Benth

Hemant Sood* and R. S. Chauhan

Department of Biotechnology and Bioinformatics,
Jaypee University of Information Technology,
Waknaghat, Solan-173 215 H.P.
*hemant6sood@gmail. com

Picrorhiza kurroa is an endangered medicinal herb endemic in the North-Western Himalayas with a plethora of pharmacological properties primarily the richest source of hepatoprotective drugs such as Picroliv, which contains Picroside-1 as the main ingredient. As a means for the production of plant material rich in medicinal compounds, the shoot apices of *P. kurroa* cultured on a nutrient medium, MS + KN (3mg/l) + IBA (2mg/l) + sucrose 3% (w/v) + agar-agar 0. 8% (w/v) and incubated at four temperature regimes (10±1°C, 15±1°C, 25±1°C, 30±1°C) showed that the shoot biomass yield was highest with 3.73g fresh shoot wt. at 15±1°C compared to 2.01g and 1.33g fresh shoot wt. in shoots formed at 25±1°C and 10±1°C, respectively. The accumulation of Picroside-1 was maximum (2.03 mg/g fresh shoot wt.) in shoots cultured at 15±1°C compared to 0. 12 mg/g and 1.38 mg/g in shoots formed at 25±1°C and 10±1°C, respectively. The supplementation of nutrient medium with methyl jasmonate resulted in four fold increase in the biosynthesis and accumulation of Picroside-1. The current study, thus, provides a suitable alternate for *in vitro* production of Picroside-1 in shoot cultures of *P. kurroa* so as to relieve pressure from its natural habitat.

AWARD LECTURES

PROF. HIRA LAL CHAKRAVARTY MEMORIAL AWARD LECTURE

Tomato Cultivar Tolerant to Tomato Leaf Curl New Delhi Virus Infection Induces Virus-specific siRNA Accumulation and Defense Associated Host Gene Expression

Manoj Prasad

National Institute of Plant Genome Research,
Aruna Asaf Ali Marg,
New Delhi-110067
E-mail : manoj_prasad@nipgr. res. in

The cultivated tomato, *Solanum lycopersicum* L. , is the second most consumed vegetable worldwide and a well studied crop species in terms of genetics, genomics and breeding. *Tomato leaf curl New Delhi virus* (ToLCNDV) infection causes significant yield loss in tomato. Availability of conventional tolerance source against this virus is limited in tomato. By using bulk-segregant analysis (BSA) method, one PCR-based molecular marker linked with ToLCNDV was identified and mapped at a distance of 7. 9 cM from the ToLCNDV gene on long arm of chromosome 11 of tomato. The identified marker has been validated in a set of 19 different accessions of tomato for effective use in marker assisted breeding. To understand the molecular mechanism of virus tolerance in tomato, the abundance of viral genomic replicative intermediate molecules and virus-directed short interfering viral RNAs (siRNAs) by host plant in a naturally tolerant cultivar and a susceptible cultivar at different time points after agroinfection were studied. It was shown that less abundance of viral replicative intermediate in tolerant cultivar may have a co-relation with a relatively higher accumulation of virus-specific siRNAs. To study defense-related host genes expression in response to ToLCNDV infection, suppression subtractive hybridization technique was used. A library was made from tolerant cultivar between ToLCNDV-inoculated and *Agrobacterium* mock inoculated plants of this cultivar at 21 day post-inoculation (dpi). A total of 106 non-redundant transcripts were identified and classified into 12 different categories according to their putative functions. By reverse northern analysis and quantitative real time-PCR (qRT-PCR), identified differential expression pattern of 106 transcripts, out of which 34 transcripts were up-regulated (>2. 5 fold induction). Of these, 8 transcripts showed more than four-fold induction. qRT-PCR analysis

was carried out to obtain a comparative expression profiling of these 8 transcripts between tolerant and susceptible cultivars, upon ToLCNDV infection. The expression patterns of these transcripts showed a significant increase in differential expression in the tolerant cultivar mostly at 14 dpi and 21 dpi in comparison to that in the susceptible cultivar as analyzed by qRT-PCR. The present study reveals that changes in host gene expression that occurred during ToLCNDV interaction were associated with tolerant characteristics of the tolerant cultivar. A strong correlation of siRNA accumulation with ToLCNDV tolerance was also observed in tolerant cultivar. The probable direct and indirect relationship of siRNA accumulation and up-regulated transcripts with ToLCNDV tolerance mechanism is discussed.

PROF. ARCHANA SHARMA MEMORIAL AWARD

Stem Cell Regulation and small RNA Mediated Organ Patterning in Higher Plants

Ananda K. Sarkar

National Institute for Plant Genome Research (NIPGR),
Aruna Asaf Ali Marg,
New Delhi-110067

Keywords : *Stemcell, RNA, mediation, organ, patterning, higher, plants*

Higher plants continuously grow and produce organs throughout their life. Fountain of their youth are two populations of stem cells residing at two ends of a growing plant, the shoot meristem and root meristem. These ‘stem cell niches’ are established early in the embryogenesis. Aerial lateral organs, such as leaves, are produce from the flank of the shoot meristem. Shoot meristem derived unknown signal and classes of small RNAs regulate the initiation and patterning of developing leaves. A genomic approach has identified global regulators of organ development. Although apparently different, the root and shoot meristems possess conserved stem cell regulatory mechanism. Development of root lateral organs is different than shoot and is a promising area to study.

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IV

ABSTRACTS OF SYMPOSIUM / INVITED LECTURE

PROCEEDINGS
OF THE

NINETY EIGHTH SESSION OF THE

INDIAN SCIENCE CONGRESS

CHENNAI, 2011

PART II : Abstracts of Symposium/Invited Lecture

SECTION OF
PLANT SCIENCES

President : **Prof. T. N. Lakhanpal**

INVITED LECTURES

1. Bio Inoculants in Sustainable Agriculture

D. J. Bagyaraj

Center for Natural Biological Resources and
Community Development (CNBRCD),
41 RBI Colony, Anand Nagar,
Bangalore-560 024

Keywords : *Microbes, inoculants, modulation, bacteria*

Microbial inoculats play an important role in sustainable agriculture. Biofertilizers and biocontrol agents are the common inoculants used. Nitrogen, phosphorus and potassium are three major plant nutrients. Use of chemicals is not

only deleterious to environment, but injurious to human and soil health. Under these circumstances, alternate sources for fertilizers are looked for. Biofertilizers are preparations containing micro-organisms, in sufficient numbers helping plant growth and nutrition. Nitrogen abundantly present in the atmosphere is fixed by bacteria, living freely in soil or in symbiosis with plants. Legume nodulating bacteria living in symbiosis with legumes are known to fix atmospheric nitrogen up to 100 kg N/ha/ season. *Azorhizobium caulinodans* forms stem nodules in the green manure plant *Sesbania rostrata.* The green manure plant is incorporated into the field before transplanting rice. There are certain bacteria, which enter the cells of the host and form associative symbiosis and fix atmospheric nitrogen. Extensive studies have been made on *Azospirillum,* which not only fixes atmospheric nitrogen, but produce growth promoting substances. There are a large number of free living soil bacteria, which are known to fix atmospheric nitrogen. *Azotobacter* is one bacterium on which extensive studies have been carried out. Cyanobacteria are also known to fix atmospheric nitrogen.

Tropical soils are deficient in phosphorus. Further, most of them fix P and thus, make it unavailable for plant growth. There are some fungi and bacteria which can solubilize unavailable form of P to available form. There are certain fungi, which form symbiotic association with the roots of plants and help in the uptake of phosphorus. Arbuscular mycorrhizal fungi colonize roots of several crop plants, important in agriculture, horticulture and tropical forestry. At present there is also considerable interest in the potassium mobilizing bacterium *Frateuria aurantia.*

A number of micro-organisms are also used to biologically control insect pests and soil-borne plant pathogens. Especially in developing countries, microbial inoculants are a boon to farmer.

2. Curiosities in Fungi

C. Manoharachary

Dept. of Botany, Osmania University,
Hyderabad-500007, AP

Keywords : *Fungi, marvels, curiosities, dispersal*

Fungi are achlorophyllous organisms and multiply in/on diversified habitats. The shape, size, colour, reproduction, physiology, biochemistry and genetics among

fungi are varied. The absence of chlorophyll has enforced them to live as saprophytes or biotrophs. The nutrition, mode of dispersal of reproductive propagules and phylogeny developed curiosity among mycologists. Fungi living as extremophiles have a different physiological set up and adoptive characters. Fungi living in water produce zoospores and conidia of varied shapes and adoptive features which is of biological significance. *Pilobolus* and *Phycomyces* have got stimulus towards light. Majority of tropical fungi are dematiaceous compared with temperate fungi. The fruit bodies among the fungi are produced in such a fascinating manner that they not only exhibit beauty but also varied characters of adaptability.

Genetically also lot of work has been done on *Neurospora, Sordaria, Aspergillus,* yeast and others which have made greater impact on molecular biologists. The paper will present data about such marvels of curiosity existing in fungi.

3. Search for Novel Anticancer Agents from Indian Medicinal Mushrooms

K. K. Janardhanan

Amala Cancer Research Centre
Thrissur-680 555

Keywords : *Mushrooms, Anticancer, Medicinal, Pharmacology*

Mushrooms represent a major as yet largely unexplored source of pharmaceutical products. Attempts are being made in many parts of the world to use mushrooms and their products for the treatment of a variety of human ailments. However the most significant medicinal effect of mushrooms that attracted the public in recent years is their anticancer properties. Metabolites isolated from mushrooms namely, *Coriolus versicolor, Lentinus edodes* and *Schizophyllum commune* are now clinically used anticancer drugs in China and Japan. We investigated several medicinal mushrooms occurring in India for their anticancer activity. During the course of our investigations we examined the anticancer activities of *Ganoderma lucidum, Phellinus rimosus, Pleurotus florida* and *Morchella esculenta* and results of our studies revealed that these mushrooms possessed significant antioxidant, anti-inflammatory and antitumor properties.

Our studies have demonstrated that Indian medicinal mushrooms are valuable source of anticancer pharmaceuticals. We were able to isolate and characterize the active principles from *Ganoderma lucidum* and *Phellinus rimosus* and demonstrate their anticancer property. Anticancer and related pharmacological effects of some of the medicinal mushrooms occurring in India will be discussed.

4. Blue-green Algal Diversity and their Utilization

G. L. Tiwari
Department of Botany,
University of Allahabad,
Allahabad-211 002

Keywords : *Blue green algae, Diversity, utilization, heterocystous.*

India is known to have about 1600 taxa of Blue-green algae growing in various types of habitats. About 50% of them are also known to grow in rice-fields. Indian Blue-green algae include 99 genera, 1250 species and 450 varieties and forma. Morphological and taxonomical diversity have been described by Geitler (1932), Desikachary (1959) and Starmach (1966) and recent efforts by Komarek and Anagnostidis (1998 and 2005). All the above publications include characters that were observed mostly from the material collected from natural habitats. The concept of Drouet is an extreme and his reductions of genera and species have not been accepted by most of the workers. Bergey's Manual (2001) certainly deals the subject matter more critically and include all the important aspects of studies. In the present paper Blue-green algal diversity of India has been discussed in detail. It revealed that non-heterocystous forms have often been ignored and studies were restricted to *Microcystis, Synechococcus, Synechocystis, Arthrospira* (*Spirulina*), and *Plectonema*. Heterocystous forms being definitely nitrogen fixers have been studied in detail and genera included *Nostoc, Scytonema, Calothrix, Chlorogloeopsis, Symphyonemopsis* and *Westiellopsis*. Present study includes certain new taxa like *Chroococcus, Gloeothece, Coelosphaerium, Gomphosphaeria, Oscillatoria, Cylindrospermum, Microchaete, Gloeotrichia* and *Nostochopsis*. Blue-green algae have been found to be of immense technological value and have been exploited well for proteins, pigments and as biofertilizers. A lot of works on various aspects of biofertilizers have been made in India and they will be discussed in detail.

5. Microbial Diversity of Traditional Fermented Foods : A Green Pasture for Biotechnology

Tek Chand Bhalla

Department of Biotechnology
Himachal Pradesh University,
Shimla-171005

The origin of fermented foods and beverages are as old as the human history and civilization. Man has conventionally used some form of microbial processes to preserve food that would otherwise spoil and this by hit and trial or selection over ages made man to process grains or fruits or milk for the production of beer, wine, bread or yogurt like products. Fermented products were being made even at large scale much earlier than the discovery of microbes and the beginning of the era of microbiology. Traditional fermented foods and beverages are the products which are made by the common man with the local available raw materials with process based on the traditional knowledge passed from one generation to other. In every regions of the world, traditional fermented food and beverages are produced by the rural or tribal or ethnic groups of people and there is a huge variety of fermented products being made at household or community level. There exists a great diversity in terms of raw materials, fermentation conditions and inocula used. Comparatively less effort have been made to explore the microbial diversity of traditional fermented foods and beverages. The microbial diversity of the traditional fermented products has lot of potential to find out novel microbial resources for food and industrial biotechnology. There is a vast potential in this area for isolation of new fermentative organisms, their screening for bioactivity including probiotic potential, enzymes, flavor and aroma components, amino acids and vitamins and scale-up of their production. A concerted effort in this area will result in new products, processes and options in the fermentation industry.

6. Converting Agro-wastes into Mushrooms for Quality Food & Health

Manjit Singh

Directorate of Mushroom Research,
Chambaghat, Solan (HP)

Keywords : *Agrowaste, Mushrooms, Quality food, Health*

Production of edible mushrooms is a unique exploitation of the microbial technology for the bioconversion of agro-wastes into nutritious food. Indoor cultivation of mushrooms, utilizing the vertical space, is regarded as the highest protein producer per unit area. Different types of mushrooms have been collected from the jungles and consumed by local inhabitants in different parts of our country since times immemorial. Some of the mushrooms like button, oyster, paddy straw and milky mushroom have now been cultivated and various others are still collected from the jungles. Both the cultivated mushrooms like button and oyster and wild mushrooms like *Morchella*, *Cordyceps*, etc. are providing livelihood. In India the mushroom production systems are mixed type i. e. both seasonal farming as well as high-tech industry. India produces about 600 million tonnes of agricultural waste per annum and a major part of it is left out to decompose naturally or burnt *in situ*. This can effectively be utilized to produce high nutritive value food such as mushrooms and spent mushroom substrate can be converted into organic manure/ vermi-compost. Mushrooms are considered the health food and have medicinal value as well. They not only help in providing high quality protein, cholesterol free-low sodium-high fibre-diet but also have novel compounds having anti-cancer and anti-viral properties. Collecting and conserving mushroom diversity is a challenge and till date our Directorate has collected over 1500 accessions from different parts of the country. Majority of these collections have been characterized at molecular level and have been preserved by following short and medium term storage methods.

7. Arbuscular Mycorrhizal Fungi and Phytonematode Management.

P. C. Trivedi

Department of Botany,
University of Rajasthan,
Jaipur-302004

Keywords : *AF fungi, Nematode, Management*

An unseen, underground and hidden enemy pest, which silently spread from nursery to nursery & field to field, attacking most of the agricultural crops throughout the world is plant parasitic nematode. Nematode causes severe losses, not only in the form of reduced plant growth and yield but also in the marketable

quality of the produce. Feeding on plant cells by nematodes may deprive the host of nutrients and water for its growth. The association of nematodes with fungi or bacteria on disease complexes often increases the severity of the incidence. It also acts as a vector for transmission of soil-borne viruses. The mycorrhiza and plant parasitic nematode occupy root system and mycorrhizae are useful to plants, where as phytonematodes are detrimental to plant yield. Mycorrhizal fungi become a useful tool to manage nematode population in one way but in other way it provide several useful effect on host plant to increase crop yield at significant level.

The potential role of AM fungi as biocontrol agent for nematode eradication has received considerable attention. It has been observed that plants colonized with AM fungi, generally grow well in spite of presence of damaging levels of plant parasitic nematodes. It was noticed that prior establishment of mycorrhiza mitigated the deleterious effects of nematode on plant growth characters t to a considerable extent. AM fungi may cause change in the pots-infection nematode host interaction by altering nematode reproduction and development. Direct competition for space may account for reduced nematode infection on mycorrhizal root system. Increased tolerance or resistance to nematodes by AM fungi may be due to competition for host photosynthates, production iof nematistatic compound and parasitism of eggs. AM funfi alter the host either physically or physiologically and thus indirectly affect the host-nematode relationship.

8. Effect of Elevated CO_2 Concentration on Quality of Wheat

Pooja Gokhale Sinha and A. K. Bhatnagar

Environmental Biology Laboratory,
Department of Botany,
University of Delhi,
Delhi-110 007

Keywords : *CO_2 cons, climate change, quality of wheat*

In projected climate change scenario, apart from food security, nutritional security is also an issue of serious concern. In the last two centuries, the global atmospheric CO_2 concentration [CO_2] has risen by about 40%, reaching 389 ppm in 2009. The effect of elevated [CO_2] on crop yield is well documented. However, there have been only few attempts to see the effect of CO_2 enrichment on

nutritional quality of food grains. Reduction in nutritional quality of plants at elevated CO_2 has been previously reported in several crop species.

To assess the effect of CO_2 enrichment on quality of grain in wild and cultivated species of wheat, grains of diploid *Triticum monococcum*, tetraploid *T. dicoccoides* and hexaploid wheat *T. aestivum* were analyzed from plants grown in mid-free air CO_2 enrichment (FACE) facility in the Division of Plant Physiology, Indian Agricultural Research Institute (IARI), New Delhi. There was a significant increase in the concentration of sugars and starch in leaves as well as grains of wheat plants grown at elevated [CO_2]. Analysis of transmission electron micrographs of mesophyll and pericarp cells confirmed the observation, as conspicuous accumulation of starch was observed in the chloroplasts of wheat plants grown at elevated [CO_2]. High pressure liquid chromatography (HPLC) revealed that CO_2 enrichment differentially altered the concentration of sugars such as glucose, fructose, sucrose and maltose in the three species of wheat. A significant reduction in concentration of grain proteins in all the three species of wheat was observed at elevated [CO_2]. Also, protein profile of grains was significantly altered in grains of wheat plants grown in FACE facility. Analysis of per cent carbon and nitrogen concentration in grain flour indicated that at high [CO_2], C : N ratio of plant tissue increases, thereby adversely affecting plant stoichiometry. It may be concluded that CO_2 enrichment adversely affects nutritional quality of wheat grain and flour to identify the locality to conserve the population of this rare plant group. Hence, present investigation.

9. Xylarias - the Fascinating Fungi. Species Diversity in Western Himalayas

J. S. Dargan,

Department of Botany,
Punjabi University,
Patiala-147002

Keywords : *Xylaria, ascomycetes*

Xylaria Hill ex Schrank is a well established genus of the family Xylariaceae (Ascomycota) and is known the world over by approximately a hundred species. The majority of the species is saprophytic and grows on dead wood and leaves of

hard wood trees, however, only few are reported on conifers. They may be weak parasites or parasites on roots of hard woods causing root rots. Only few are terricolous, associated with termite nests. 'Wuling Ginseng' (Xylaria nigipes) is mentioned as medicinal and edible mushroom in Chinese literature. As many as 39 species of the genus have been previously reported by various workers, from different regions of India. . Out of which only nine were reported from Western Himalayas. During the last three decades, extensive fungal forays have been undertaken by the author and his students to collect and study these fungi from various localities of Western Himalayas. Great diversity was noticed in the morphology and distribution pattern of the taxa within the genus under different altitudnal zones viz. tropical, sub-tropical, temperate and alpine zones. Zone wise analyses of the species has also been done. An illustrated account of 31 species of the genus, based on himalayan collections, has been given in this paper. A key to all the reported species from the region is also included. 22 species are new reports for western Himalayas, while 19 species are new records for India. Three species have been reported as new species.

10. Plant Biodiversity and Impact of Biotechnology on Biodiversity

C. M Govil

Department of Botany,
C. C. S. University,
Meerut-25000-1

Keywords : *Biodiversity, megacentres, flora fauna, conservation, threatened species*

Biodiversity can be measured at any level from over all global biodiversity to ecosystem, community, species, population, individuals and even to gene within a single individual. A region with large number of individual species is said to be biologically diverse, and a species with large number of interpopulation differences, when each population gets genetically diverse is called genetic diversity of species. Biodiversity is the foundation of the earth and is crucial to the functioning of ecosystem which provides us with the products and services without which we could not live. It provides us oxygen, food, fresh water, fertile soil, medicines, shelter, protection from storms and floods, stable climate and recreation. All these have their source in nature a healthy ecosystem. We depend on it for our

security, health and social relations and give us freedom and choice. The present data reveals that the number of species of plants, animals and micro-organisms is over 10 million out of which only 1. 4 million plants, animals and other organisms are identified and named(40,OOO vertibrates,250,OOOhigher plants,70,000 fungi, 13000 nematodes and 950,000 insects, 5000 bacteria and viruses etc.). Millions of plants and animals share the earth with us from smallest micro-organisms to giant plants and animals, yet global diversity has been underthreat. It is estimated that every year there is a loss of 0. 1% 'of flora, accounting to loss of 10,000 plant species every year. This loss of flora is a disturbing trend, because plants provide essential ecosystem services that sustain life on the planet producing all the things of human requirements. Major course of biodiversity loss is the human factor like over exploitation of flora and fauna for their consumption as food, fuel, medicines, urbanization, expansion of habitat and industrialization etc. Natural calamities like storms, floods, winds, forest fires and earthquakes, change in climate due to green house effect, pollution of atmosphere and invasion of alien weeds and pathogens. . Conservation and management of biodiversity is the major concern of today. Global movement has already started and as early as 1972 first UN conference was held in Stockholm to discuss the problem related our environment and this was the first Earth Summit. It is stated, "Man is both creator and moulders of the environment : Both aspects of man's environment, the natural and man made are to the enjoyment of basic human rights and right for life itself. The Second Earth Summit was held in 1992 in Rio de Janevro, Brazil. to discuss environment and development that took place during last ten year. The resolution passed was "Human beings are the centre of concerns for sustainable development : they are entitle to healthy and productive life in harmony with nature". The third summit was held in Johanesburg, South Africa in 2002 to discuss sustainable development andthis was agenda for 2151century. The agenda was, "Human stands at defining moments in history. We are confronted with a perpetuation of disparities between and within nations a worsening of poverty, ill health and illiteracy and the continuing deterioration of natural ecosystems on which we depend for our well being" World over governments and non-governments agencies are involved in protecting the nature's gift of biodiversity. Mass awareness and education amongst the people is one most effective way of protecting our biodiversity. The major technologies used are (1) in situ conservation and (2) ex situ conservation. In situ conservation : There are about 35 areas which are identified as major hot spots of biodiversities

world over, besides many small spots which require urgent attention for conservation, because they are not only rich in the number of species but also rich in population. These biodiversities can be conserved by prohibiting these areas from human activities. The smaller spot can be protected by fencing these areas so that domestic animals do not enter for grazing. The main aim of in situ conservation is to allow the plant population to maintain and perpetuate itself with in the community environment to which it is adopted so that it has the potential for continued evolution. Naturally grown plants are the major genetic resources. The in situ. conservation is achieved by declaring such areas of diversities as sanctuaries national parks, biosphere reserves, wetland conservation, mangroves and coral reef conservations etc. It is difficult to control large areas for conservation of biodiversities. Therefore, plant from their natural habitats are brought to botanical gardens and green houses and grown in simulated natural conditions. Seed banks are alternative method of biodiversity conservation. Seeds of local area are collected, identified and preserved at low temperature under dry conditions. Ex situ conservation : is followed for both wild and cultivated plants by using modern techniques of biotechnology namely, germplasm conservation through cryopreservation, tissue culture and micro propagation. Tissue culture techniques are widely used for mass propagation of endangered species. Using rDNA techniques new plant races are developed in which foreign genels is incorporated of choice; such crops are called transgenic plant crops. Many such crop plants have been produced for the benefit of human beings.

With the development of 8M plants the concept of species has changed and new species with altered characters are added to our biodiversity, hence further widening it. There has always been a concern in human mind the impact of biotechnology on the biodiversity. The major issue ~volved is in the inter action between biodiversity and biotechnology which may have far reaching consequences. Under what economic and political conditions will biotechnology benefit agricultural productivity and thereby help biodiversity. questions anse in mind are. (i.) could newly introduce transgenicrops transfer genes to native wild piants and thereby change important characteristics of the wild plants, the explanation to this is that the gene transfer between cultivated and wild plants has always occurred with in limits of species if the two types of the plants were in the close proximity and flowered at the same time (ii) if the gene transferred from the genetically modified plant to wild type plants significantly increased the biological fitness of the recipient what will happen, but this seems unlikely. (iii) there is a crucial

difference between transfer of genes from conventially bred plants to their wild relatives and transfer of man-maid trans gene construct from a GM plant into gene pool,(iv) will the traditional var. land races disappear when and if transgenic crops are introduced, will only one or very few var. dominate in the field like soybean and maize. Scientists believe this will not happen. Soybean and maize transgenic crops have not led to a loss of agricultural biodiversity. The agriculture diversity loss is because of choice and not because of transgenic plants. All these concerns and doubts about the impact of biotechnology on biodiversity are subject to open and well informed dialogue in society with the scientists should be made to clear the doubts.

11. Genetic Resources Management – Indian Scenario

J. C. Rana

National Bureau of Plant Genetic Resources
Regional Station, Phagli,
Shimla-171004

Keywords : *Genatic resources, gene bank, cryopreservation*

Indian gene centre is one of the 12 mega diversity centres of the world and has Himalaya, Western Ghats and North-East (Indo-Burma) as three “biodiversity hot spots” among the 34 identified the world over. India hosts about 49,000 species of flowering and non-flowering plants out of the 260,000 described the world over. India is a homeland of 167 cultivated species and 329 wild relatives of crop plants and about 583 crops including exotics are cultivated in India. NBPGR is a nodal agency for the management of PGR in India. It has collected around 2. 50 lakh accessions including about 28,000 accessions of wild relatives of crops through over 2,400 explorations. The native genetic resource has been greatly enriched by introducing about 21 lakh accessions of seed and planting material and some new crops from abroad. About 1. 80 lakh germplasm accessions have been characterized while genetic resources comprising over 3. 78 lakh accessions of 1,549 species are being conserved in seed gene bank, 2,000 accessions of 158 vegetative propagated crops under *in vitro* and 8,981 accession of 726 species are *cryo* preserved. It also conserve around 1. 00 lakh

accessions as active collections in MTS facilities, 8,752 in the field gene bank and 159 under *in vitro* at its 10 regional stations and over 2. 25 lakh accessions at 57 NAGS located in different agro-climatic regions of the country. Nevertheless, there are certain issues required to be dealt through an appropriate road map keeping in view the future challenges. Crops Wild Relatives, minor crops and forages are poorly represented in the gene bank collections, thus needs to be prioritized. Germplasm from the extreme ends of the genetic diversity to bolster resistance for increasing biotic and abiotic stresses particularly to address the threats arising out from changing climatic regimes is required. Biosystematics studies on few important groups, estimates on the current status on genetic resources available on-farm, level of genetic erosion and its prediction through models and GIS based mapping of the country's PGR are other areas required attention. On-farm conservation has been viewed as one of the most important area to conserve and use PGR not only for food and livelihood security but also to mitigate the negative impacts of climate change and maintaining continuum in the genetic evolution. It also enhances the coping capacity of local communities to adversities and increase farmers' control over and access to PGR. Cryopreservation has been considered as safest and comparatively cheaper method, thus cryopreservation protocols for long-term conservation such as dormant buds are required to be developed to release pressure on field gene banks. The possibility for low cost conservation (permafrost facility) in the Himalayan region has been explored but need more research backup. To value the germplasm, approaches such as discovery of novel traits such as genes for biotic and abiotic stresses including climate change and quality attributes, dissecting the physiological/ biochemical/ molecular basis of resistance, gene prospecting and allele mining, focusing on strategies like Focused Identification of Germplasm Strategy (FIGS), developing core collections for large and diverse collections, and genetic enhancement for enhanced utilization particularly of the CWR need to be adopted early. Conservation of genomic resources comprising genomic DNA including DNA of rare and endangered species, genomic & c DNA libraries, BAC libraries, gene constructs and promoters etc. are emerging areas needs to be strengthened. Further, the issue like managing PGR in the emerging IPR regimes including access and benefit sharing, bio-safety rules and guidelines, changing climate and weather patterns and increasing commercialization of agriculture are much more complicated, and therefore, need deliberations and long-term investments.

12. A Comprehensive Study on Characterization of Elite Neem Chemotypes though Mycofloral, Tissue-culture, Ecomophometric and Molecular Analyses.

Parvathi Chary

Garden City College,
T. C. Palya, Bangalore,
Karnataka-560049

Keywords : *Azadirachta india, Azadirachtin-A, HPLC, ecomorphometry, RAPD, ISSR, FISSR,, Soil-fungi, VAM-fungi, in-vitro cultures.*

Azadirachtin-A (Aza-A), a tetranortriterpenoid, found in minuscule amounts in the neem seed-kernels, has proved to be a potent **biopesticide**. Given the **vast biodiversity** of *Azadirachta indica* (neem) in India, this study is an overview of **four main aspects** that corroborate with each other in identifying **elite neem chemotypes** based on their **Aza-A** content. These biomarkers included **mycofloral, tissue-cultural, ecomorphometrical and molecular analyses** on accessions from five ecogeographically different regions in Andhra Pradesh, India, which highlighted the characteristics of trees that yielded the highest Aza-A. In essence, **extremely-arid-alkaline regions with maximum soil pH (8. 05) yielded trees with the highest amount of this biopesticide**. Likewise, both VAM and soil fungal diversity and frequency exhibited maximal values in their rhizosphere, whereas it exhibited the least values for percentage moisture and also for several micronutrients measured (P_2O_5, Zn, Fe and Cu). *In vitro* studies on seeds with high versus low Aza-A content gave sturdier seedlings in the former; with profusely coiled roots and fibirillar foliage in tissue-culture; in addition to these seeds being more viable. Furthermore, their cotyledons alone exhibited significant amount of Aza-A, as measure by HPLC. Besides this significant difference, the impact of growth factors culminated not only in the variations of several secondary metabolites, but also differences in DNA patterns from various parts of a single *in vitro* plant. Ecomorphometric analyses clearly indicated that at least 8 parameters (seed diameter, soil pH, percentage moisture, K_20, P_2O_5, Zn, lower lobe serrations and upper-lobe-distance of leaves) were significantly related to the quantitative variations in Aza-A. Finally, PCR analyses exhibited a habitat-based molecular concordance of ISSR and FISSR profiles with Aza-A content among the neem chemotypes. Their relatedness was based on dendrograms constructed by UPGMA algorithms using similarity-index-values.

13. Biodiversity to Biotechnology in Botanical Antimicrobials

Anupam Dikshit

Biological Product Laboratory,
Department of Botany,
University of Allahabad
Allahabad-211002

Keywords : *Product development, Mechanism of action, patenting issues.*

With objective of providing eco-friendly botanical antimicrobials, different aspects of diversity in terms of richness of secondary metabolites in various groups of plants : Algae to Angiosperms as well as their potential towards management of harmful microbes of diversified categories such as Viruses, Bacteria, Fungi both unicellular and mycelial ones will be elaborated. Biotechnological tools have also been used to make the research economically viable. Product development, mechanism of action as well as patenting issues will be shared.

14. Transcriptomics : An Ideal Strategy to Elucidate Molecular Basis of Abiotic Stress Tolerance in Chickpea

Kamal Dev Sharma[1]* and Gaurav Zinta[2]

[1]Department of Agricultural Biotechnology,
CSK Himachal Pradesh Agricultural University,
Palampur-176062 HP
[2]Current address : Department of Biology,
University of Antwerp, Universiteitsplein
1, B 2610 Wilrijk, Belgium

Keywords : *Abiotic stresses, chickpea, ESTs, molecular mechanisms, transcriptomics, tolerance*

Chickpea (*Cicer arietinum* L.), the third most important grain legume in the world is one of the major sources of protein in several parts of India where majority of the population is vegetarian. The productivity of chickpea per unit area in India is low and one of the reasons contributing to its low productivity is

susceptibility to abiotic stresses. Narrow genetic base of the crop coupled with poor understanding of molecular biology of abiotic stress tolerance warrants identification of tolerant germplasm and elucidation of molecular mechanisms underlying stress tolerance. Transcriptomics have contributed greatly in elucidation of stress tolerance mechanisms in crops like *Arabidopsis thaliana* and such studies could be useful for chickpea also. Off late, several chickpea ESTs have been cloned and microarray, subtractive suppressive hybridization (SSH) and differential display reverse trancriptase polymerase chain reaction have been used to identify genes involved in stress tolerance in chickpea. At least one chickpea transcription factor, CAP2, has been implicated in dehydration and salt stress tolerance in transgenic tobacco. It appears chickpea, like other crops, respond to stresses by regulating a common set of genes and limited number of genes are stress-specific. While C-repeat-binding factor (CBF)/dehydration-responsive element-binding factor (DREB1) are the proteins which play a prominent role in cold acclimation in several crops, the mRNAs of these proteins do not transcribe in reproductive organs of cold treated chickpea indicating a different mechanism for cold tolerance. The knowledge gained so far on genes involved in stress tolerance in chickpea is scanty, however, advances made in the field of molecular biology and recent emphasis on chickpea research in India would pave the way for better understanding of stress tolerance in chickpea in near future.

15. Plant Diversity in the North West Himalaya : A Case Study of Baspa Valley in Himachal Pradesh, India

Vaneet Jishtu[1], K. S. Kapoor[2], T. N. Lakhanpal[3] and R. S. Rawat[4]

[1]Rain Forest Research Institute,
Deovan - AT Road (East) Jorhat Assam-785001
[2]Himalayan Forest Research Institute,
Shimla (HP)-171009
[3]Department of Biosciences,
H. P. University,
Shimla-171005, H P

Keywords : *Baspa Valley, plant diversity, Herbaria, exotics, enumeration.*

Baspa valley in Kinnaur district of Himachal Pradesh has remained one of the floristically under-explored valleys in the north-west Himalayan region due to its remote location and limited communication facilities. The valley with an area of about 400 km^2 and having an altitudinal range from 1750 amsl at Karchum to 4750 amsl at the Rupin pass was surveyed extensively for five years do document the plant diversity. The study area was stratified into catchment-wise and altitude-wise zones for uniform repeated surveys, for systematic documentation of the flora, using random sampling method. The field observations were supported with herbarium collections and voucher specimens kept in established herbaria including the DD and the BSI Northern Circle Herbaria at Dehradun. The authenticated herbarium sheets have been deposited in and accessed to the HFRI Herbarium, Shimla.

The study resulted in enumeration of 957 taxa belonging to 475 genera spread over 122 families of Gymnosperms and Angiosperms. While this list includes 48 cultigens and 35 exotics/ ornamentals species, it is limited to the extent that it does not include wild grasses and sedges belonging to families *Poaceae* and *Cyperaceae*. An analysis of this list shows that family *Asteraceae* with 132 taxa belonging to 61 genera is the most dominant family of flowering plants in the valley, whereas as per Hooker's Flora of British India it is the family *Orchidaceae* that contains the highest number of plants, with *Asteraceae*, placed at the seventh position. Moreover, the number of dicots far exceeds the monocots and gymnosperms in this valley with a proportion in respect of species and genera belonging to dicots and monocots being 91 :09 and 90 :10 respectively. The analysis of the growth forms of the species further reveals that the flora of Baspa valley is predominantly herbaceous with herbs forming 73.3% (702 taxa) of the total flora, followed by 19% shrubs (181 taxa) and 7.7% trees (74 taxa).

The study is a comprehensive enumeration of flora of the valley, for the first time. It provides base line information to monitor the impacts of various ongoing and planned developmental activities, including setting up of hydroelectric projects, development of eco-tourism and establishment of orchards, etc. in the valley. The study provides necessary inputs for better management and utilization of the land and plant resources of this pristine valley.

16. Potential of Mushrooms in Commercial Agri-horticultural System

Meera Pandey and Veena S. S

Indian institute of Horticultural Research,
Hessaraghatta lake post,
Bangalore-560089

Keywords : *Mushrooms, mycoreatoration, agri-horticulture*

Fungi in general and mushrooms in particular are the great recyclers on the planet. Mushrooms play a vital role not only in maintaining the health of our planet through returning the nutrients back into the ecosystem but also in maintaining the human health by offering better nutrition and medicines. The scientific community in the developed world is beginning to understand this mycological power. However in India, this inherent biological power embodied within the mycelial network of mushrooms largely remains a vast untapped resource. As the boundaries of scientific research shrink, ecologists, foresters, bioremediaters, pharmacologists and mushroom growers can come together to do innovative research for the betterment of this planet. Mushroom biology has the inherent potential to address the three basic problems : shortage of food, diminishing quality of human health and pollution of the environment. At present, about 800 million people in the world are living in poverty. On the other hand, over 70% of agricultural and forest products have not been put to total productivity, and have been discarded as waste. Mushroom biology not only can convert these huge lignocellulosic biomass wastes into valuable human food, but also can produce notable nutriceutical products, which have many health benefits. Another significant aspect of mushroom research is using the biota in creating a pollution-free and beneficial environment. One of the most intriguing opportunities offered by mushroom mycelia in the area of nbioconversion is the exploitation of their ability to degrade pollutants, many of which are highly carcinogenic, released into the environment as a consequence of human activity. Mushrooms can be used to repair or restore the weakened or damaged biosystems of environment through the concept of 'Mycorestoration' which includes the selective use of mushrooms for mycofiltration, to filter water; mycoforestry, to enact ecoforestry policy; mycoremediation, to denature toxic wastes; and mycopesticides, to control insect pests. Further in the Indian context, mushroom cultivation can be integrated with social and rural upliftment policies of the Government like National rural employment guarantee scheme, Mid-day meals in schools, Aanganwadi schemes for rural women for creating rural employment,

betterment of nutrition especially among the children and women. Hence there is a need to diversify the Indian horticulture towards non green food resources and promote research in the areas of applied Mycology for a holistic horticultural/ agricultural growth. This article sums up in brief the multifaceted role mushrooms can play in the diversification of Indian Horticulture.

17. Medicinal Plants and Their Perspective as a Source of Novel Antimicrobials

P. Kaushik and Pankaj Goyal

Deptt. of Botany & Microbiology,
Gurukul Kangri University,
Hardwar-249 404

Keywords : *Medicinal plants, antimicrobial, novel use*

In the last decade, the pace of development of new antimicrobial drugs has slowed down while the prevalence of resistance (especially multi-drug resistance) among microbial pathogens has increased astronomically. A feasible way to combat the problem of microbial resistance is the development of new antibacterial agents for substitution with ineffective ones. Thus, there is an important demand to explore and develop new classes of effective antimicrobial agents to delay or prevent the arrival of a post-antibiotic era. An analysis of the origin of the drugs indicated that natural products or drugs derived from natural products comprised almost 30% of all new chemical entities (NCEs) launched into the market. Medicinal plants belong to the earliest known health care natural products and have been the basis of many traditional and complementary/alternative medicine systems ***viz***. Ayurveda, Yoga, Unani, Siddha, Homeopathy and Naturopathy. The profound knowledge of herbal remedies in traditional cultures developed through trial and error and it continues to provide mankind with new remedies. Modern allopathic medicine has its roots in ancient medicine and it is likely that many important new remedies will be discovered and commercialized in future, by following the leads provided by traditional knowledge and experience. Many herbs used by Ayurvedic practitioners show promising results and could be appropriate for larger randomized trials; however, there is no unique category of herbal drugs as per the Indian Drugs Act. Isolation and characterization of pharmacologically active compounds from medici-

nal plants continue today, furthermore, drug discovery techniques have been applied for the standardization of herbal medicines. Different pharmacopoeial guidelines such as IP, USP etc. can be used for appropriate formulation of these herbal drugs especially for antimicrobial substances. Therefore, basic and clinical research on the medicinal plants and their formulations with the state-of-the-art methods would be highly beneficial for the society.

18. Diversity, Phylogeny and Conservation of Aralia and Panax (Araliaceae)

Arun K. Pandey

Department of Botany,
University of Delhi,
Delhi 110007

Keywords : *Aralia, Araliaceae, Molecular systematic*

Araliaceae (the ginseng family) comprise approximately 50 genera and 1500 species. The family is most broadly distributed in the tropical and subtropical regions of both hemispheres. The *Aralia-Panax* complex is composed of the genera *Aralia*, *Panax* and the monotypic *Sciadodendron*. The members of *Aralia-Panax* complex except *Sciadodendron* occurs in north eastern region of India. The internal transcribed spacer (ITS regions) of nuclear rDNA have been used in present study to assess relationships among species of *Aralia-Panax* complex. Analyses were done from 47 accessions of *Aralia* and *Panax* to access phylogenetic relationships. All trees resulting from the analyses of ITS sequences of *Aralia-Panax* complex resolve two major clades, representing *Aralia* and *Panax* respectively. The ITS data suggests that *A. spinosa* is basal to all other *Aralia*; *A. parasitica, A. franchetii* and *A. pulmosus* form a single clade (100% BS) whereas *A. leschenaultii, A. kingdom-wardii, A. subcordata, A. lihengiana* form a single clade (93% BS). Another group is represented by *A. undulata, A. stipulata* and *A. gintungenesis. A. chapaensis* forms a separate clade. Another major clade is represented by *A. foliolosa, A. dasyphylla, A. armata, A. malabarica, A. thomsonii, A. vietnamensis, A. searelliana, A. merrillii, A, spinifolia, A. finlaysonaia, A. chinensis, A. hiepiana, A. elata, A. dasyphylloides, A. debilis, A. echinauchaulis* and *A. bipinnata.* An analyses of sequence data from all *Panax* species suggests that *P. trifolius* is sister to a clade containing the rest of

the *Panax*. *P. stipuleanatus* and *P. pseudoginseng* are basal to a group composed of rest of the *Panax* species. *Panax notoginseng* and *P. japonicus* form separate clade where as *P. sinensis, P. major* and *P. vietnamensis* are supported by 80% bootstrap support. *P. ginseng* and *P. quinquefolius* are basal to a group consisting of *P. zingiberensis, P. wangianus, P. shangianus, P. variabilis, P. pseudoginseng* var. *bipinnatifidus, P. pseudoginseng* var. *angustifolius, P. omeiensis* and *P. assamicus.* It is interesting to note that *P. assamicus, P. pseudoginseng* var. *bipinnatifidus* and *P. pseudoginseng* var. *angustifolius* are nested in a single clade. It is concluded from the present study is that *Aralia-Panax* complex is monophyletic. There is an urgent need for conservation of rare, endangered and threatened species belonging to both *Aralia* and *Panax*.

19. Genus Caralluma : Sensu Lato in India

T. Pullaiah, A. Ugraiah and S. Karuppusamy

Department of Botany,
Sri Krishnadevaraya University,
Anantapur-515 003. A. P.

Keywords : *Caralluma, systamics, characteristics*

The genus C*aralluma* was first described in 1810 by Robert Brown to include an Indian species with very characteristic elongated flowering stems. Gravely and Mayuranathan (1931) described 12 species and 5 varieties of C*aralluma* (*sensu lato*). Sarkaria later on described two more species. The genus *Caralluma* R. Brown is now segregated into 17 genera by Plowes (1995) of which 4 genera i. e. , *Caralluma, Boucerosia, Borealluma* and *Cryptolluma* can be encountered in India. *Caralluma, sensu str.* , and *Boucerosia* can easily be distinguished, atleast so far as Indian forms are concerned, by the arrangement of the flowers and by the nature of the stems. In *Caralluma sensu str.,* the flowers arise in the axils of the rudimentary and evanescent leaves all along the distal portion of the stem whereas in *Boucerosia* the flowers are terminal (usually in compact umbels though sometimes solitary); *Borealluma* with the single species known from Sunderbani (Jammu) flowers in compact umbels arising at sub-apical portion of stem but not in series, always isolated, while in *Cryptolluma* flowers glabrous, single or paired,

arising in axils of leaves. *Caralluma sensu str.* , the stems are almost always more or less distinctly tapered distally, usually very markedly so, at least fully matured where as in *Boucerosia* the stems are of approximately uniform thickness throughout.

Many workers tried to solve the intricate problem of classifying various taxa of Indian *Caralluma* but still more ambiguity persisted, which made the identity of this genus a subject of controversy. For the last ten years we are working on *Caralluma* in India. We collected plants of all the species of *Caralluma* and all the varities and they are being grown in our botanical garden. A total of 13 species and seven varities of *Caralluma* occur in India. Out of 13 species of *Caralluma,* 11 species are solely endemic to South India. Many of them are rare and endangered specifically *Boucerosia truncato-coronata, Caralluma bhupenderiana, Caralluma sarkarieae* and *Boucerosia procumbens* (Nayar, 1996). Many species are not collected after the type collections even from the type localities.

Identification of some of the species in the genus is problematic due to their morphological plasticity. While these species are medicinally potential and even some species of *Caralluma* are eaten as vegetable food in India. Usually all these species are distributed in narrow endemic areas and it is essential to identify the locality to conserve the population of this rare plant group. Hence, present investigation focused on identification, utility and conservation of *Caralluma.*

20. Altitudinal Gradients Affecting Floristic Diversity : An Assessment in Namgia Valley Falling in the Cold Desert of District Kinnaur, Himachal Pradesh

R. K. Verma and K. S. Kapoor

Himalayan Forest Research Institute,
Conifer Campus, Panthaghati,
Shimla-171009 (H. P.)

Keywords : *Floristic divensity, dominance, diversity index, distribution, threataned plant*

A study to understand and assess the impact of altitudinal gradients on the floristic diversity in Namgia valley falling in cold desert area of district Kinnaur.

Himachal Pradesh was carried out during the year 2007. The altitudinal gradient in the present case varied li'om 3000m to 5000m above ms!. Total number of plant species as recorded was 142 belonging to 49 families and] 05 genera. The dominant families registered were Asteraceae, Polygonaceae, Ranunculaceae and Rosaceae. The number of tree species recorded at 3000-3500m elevation was 8 with the dominance of Populus nigra whereas Juniperus communis taking shape of dominant shrub at 3500-4000m and 4000-4500m elevations. The number of shrub species were 17, 8, 6 and 2 in the elevation of 3000-3500m, 35004000111. 4000-4500m and 4500-5000m respectively. Rosa webbiana and Rhododendron anthopogon were recorded to be the dominant shrubs at 3000-3500m and 4500-5000m elevations respectively. A total herb species as registered during the study were 72, 62, 42and 32 at 3000-3500m, 3500-4000m, 4000-4500111and 4500m -5000m elevations respectively. with Hphedra gerardiana showing its dominance at an altitude of 3000-3500111and 3500-4000m whereas Bergenia stracheyi becoming dominant herb at 4000-4500m and 4500-5000m elevational range. The distribution pattern of l110stof the plant species was contiguous in all the altitudes. Index of diversity for herb species in different elevations ranges was 3. 56, 3. 25, 3. 14 and 3. 04 thereby showing the decre~se in number of species with the increase in the altitude. Out of the 64 medicinal plant spec ies as recorded from the area, 13 species like Hetula ulilis, Ephedra geradiana, Ferula jaschkeana, Hippophae rhamnoides, Meconopsis aculeala, Pleurospermul cando/lei, Rhododendron anlhopogon, and Rhodiola heterodonta etc. fall in the category of threatened plants as per IUCN categorization.

21. Genetic Diversity and Bioprospecting for Bioactive Molecule Production in Ganoderma, the Reishi Mushroom

P. K. Khanna

Coordinator of Research College of Basic Sciences and Humanities
Punjab Agricultural University,
Ludhiana

Keywords : *Gentics Biodiversity, bioprospecting, bio active molecules, ganoderma*

Ganoderma lucidum and related species are the most sought after within the Ganodermataceae family. These are ranked highly in the Oriental traditional medicine as a remedy for many types of chronic diseases including hepatopathy, hypertension, hypercholesterolemia, hyperglycemia, coronary heart diseases, duode-

nal ulcer etc. Consequently, several *Ganoderma* products are now available in the market including ground fruiting bodies and mycelium or their dried extracts which are processed into capsules or tablets. For these preparations, *G. lucidum* has been extensively investigated, although more than 250 species have been described the world over. The pleomorphic characters based description has proved inadequate to segregate these species resulting thus, in various synonyms and recognition of several species complex. Some of the morphological characters of *Ganoderma* vary with environmental conditions and are unreliable as the sole criterion for distinguishing different species and so have limited value in objectively describing the genetic variability of different strains. With the increase in production and sales of *Ganoderma* products, some of them proprietary, great importance is being attached to the correct identification of the cultivar as it forms the prerequisite for breeding, production and valid protection of newly bred cultivars. The limitation of traditional identification techniques in classical taxonomy of *Ganoderma* species has shifted the focus to the use of molecular biology to study genetic diversity especially so with the development of PCR based techniques. These techniques include : isozyme analysis, random amplified polymorphic DNA (RAPD), restriction fragment length polymorphism (RFLP), amplified fragment length polymorphism(AFLP), internal transcribed spacer(ITS) rDNA sequencing, random amplified microsetallite (RAMS), single stranded conformational polymorphism(SSCP), sequence characterized amplified region(SCAR), sequence related amplified polymorphism(SRAP) etc. The huge amount of genetic database generated through these studies has added new dimensions in deciphering the genetic variability existing among *Ganoderma* species and in providing molecular evidence for selection of eminent cultivars with a view of their bioprospecting for therapeutic use. These studies have also helped to effectively utilize the advantage of correctly identified species of *Ganoderma* to promote both its cultivation value as well as development of proprietary products of medicinal value. Polysaccharides, triterpenes, sterols, lectins and proteins are some of the major active constituents that have been isolated from *G. lucidum* and its closely related species. In our studies, a few *G. lucidum* strains have been molecularly characterized using RAPD primers based on PCR techniques and the existing genetic diversity then exploited for studying the production of polysaccharides and triterpenes from the fruiting bodies, mycelium biomass and their extracts. The results obtained will be presented in details.

22. Studies on Mass production, Formulation and Field Trials of Indigenously Developed Mycoherbiides for the Biocontrol of Parthenium

Mithilesh Kumar Jaiswal[1] and A. K. Pandey[2]

[1]Mycology Research Laboratory,
Dept. of Biological Sciences, R. D. University,
Jabalpur-482001 (M.P.)
[2]Chairman, M. P. Private University Regulatory Commission,
Bhopal (M.P.)

Keywords : *Parthenium hysterophorus, Mycoherbicide, Trichoderma viridie, Sclerotium rolfsii, Alternaria alternata, Fusarium rosium and Phoma herberum*

Parthenium hysterophorus is the most hazardous weed which interfering with agriculture practices, besides responsible for several health problems to human and animals. Application of Mycoherbicides for the management of *Parthenium hysterophorus* is an eco-friendly approach. Classical bio- control approach is not at all successful over the mycoherbicide approach for its management. However natural product based herbicides are generally considered safer than their synthetic counterparts. Several pathogenic fungi like ***Trichoderma viride, Sclerotium rolfsii, Phoma herbarum, Fusarium roseum, Alternaria alternata*** *etc.* show their potential for the management of *Parthenium* in laboratory conditions as well as natural field condition also. Mass production of mycoherbicides of these fungi by using different agrowastes are ecofriendly and cost-effective for the management of *Parthenium hysterophorus* in the natural condition. These fungi also host specific so that they do not harm our agricultural crops. We have selected above five fungi for their comparative study of their potential, virulence and efficacy to cause disease on *Parthenium* in natural condition by using different suitable and effective formulants. *Trichoderma viride* and *Sclerotium rolfsii* have found more effective in comparison to others fungi for the biological control of *Parthenium*. Liquid formulation like Tween 20 and Tween 80 gave the better result but when formulated in oil emulsion, even the lowest conidial concentration produced significant effect on leaves of all ages. It provide effective result by using water holding compounds in the formulation or by using skinning agent to reduce evaporative losses after application of mycoherbicide.

23. Mushroomology : Biodiversity to Biotechnology

V. P. Sharma and Satish Kumar

Directorate of Mushroom Research,
Chambaghat, Solan (HP) 173213

Keywords : *Mushroom cultivation, wild mushrooms*

Edible fungi belong to the fungal classes of Basidiomycetes and Ascomycetes. About 2,000 species from more than 30 genera are regarded as prime edible mushrooms, out of which only 22 species have been cultivated commercially. Promotion of R&D in horticulture especially on mushrooms have a special significance since they are almost land independent, utilize worthless agro-wastes for production of protein rich food and help to curtail the problem of malnutrition in the country. Global production and trade in mushrooms have registered more than 10% annual growth in the last one decade. Phenomenal increase in production as well as consumption has been the outcome of immense efforts put on R&D on mushrooms. Diversification in mushrooms has not received much attention. India, despite having predominantly tropical and subtropical climate, is producing button mushroom while other mushrooms are popular in tropical part of the country. In the recent past highly refined bio- technological tools and techniques have been developed not only to understand the mushroom biodiversity, but also for the genetic improvement of the commercial mushrooms. In the era of nano technology where more emphasis is put on safer foods, problem of pesticide residue is more alarming in mushrooms as the waiting time is very less.

The mushrooms are mainly characterized on the basis of variations in the fruiting body and spore morphologies, and mycelium characteristics. The paucity of morphological markers, stage specific expression and the influence of ecological factors on the expression are some of the limitations of morphological markers. However, the recent use of DNA markers in molecular characterization of mushrooms has circumvented these limitations and has led to the precise identification and classification of wild collections upto species level in quick time. Thus, the molecular studies on genomic inter-relationships among species within a genus or between genera are of paramount importance for transfer of genes and for establishing the phylogenetic relationships. DNA markers such as RFLP, RAPD, repetitive DNA sequences, ITS sequencing and more recently AFLP have been utilized in molecular studies on mushrooms.

24. The World of Corticioid Fungi

G. S. Dhingra

Department of Botany,
Punjabi University Patiala (Pb.) 147 002

Keywords : *Aphyllophorales, corticoid, resupinate*

Corticioid fungi are the resupinate, non-poroid fungi with smooth to tuberculate to phlebioid to aculeate hymenial surface. In the traditional sense these were placed in family *Corticiaceae*, order-*Aphyllophorales* (Division-*Basidiomycotina*). However, on the basis of molecular studies these are presently placed in 10 orders within class *Agaricomycetes* (Phylum-*Basidiomycota*). Present work is an outcome of extensive fungal forays conducted since 1978 in the different localities of Eastern and North Western Himalaya, which stretch over a distance of about 2500 km, and average width along the entire longitudinal extension 100–400 km. The altitude gradients result in the tremendous biodiversity of the region. More than 2100 collections have been made so far which on the basis of macroscopic and microscopic characters have been placed in 257 Corticioid taxa belonging to 75 genera. Of the 75 genera, two have been published as new genera (*Trimitiella*, *Repetobasidiopsis*), 16 new generic records for India, and 2 new generic records for Himalaya; two new sub-genera (*Stereum* subgen. *Acanthostereum*, *Stereum* subgen. *Aculeatostereum*) within genus *Stereum* have also been published. The 257 taxa include 27 published new species (*Scytinostroma pulverulentum*, *Trimitiella indica*, *Stereum peculiare*, *Sistotrema angustispora*, *Paullicorticium indicum*, *Candelabrochaete himalayana*, *Repetobasidiopsis macrospora*, *Leucogyrophana thimphina*, *Conohypha grandispora*, *Phlebiopsis himalayensis*, *Ph. darjeelingensis*, *Phlebia microspora*, *P. kamengii*, *P. singularisa*, *P. thindii*, *P. interjacenoides*, *Fibulomyces cystoideus*, *Hyphodontia caulicystidiata*, *Hyphoderma clarusproprietas*, *H. densustextum*, *H parvispora*, *H. sikkima*, *H. singularibasidicum*, *H. sporulus*, *Tomentella kalatopii*, *T. unicusa*, *Ceraceomyces bizonathus*), 3 published new varieties (*Botryobasidium subcoronatum* var. *crassispora*, *Hyphoderma setigerum* var. *bicystidium*, *Tomentella cladii* var. *grandii*), 122 new specific records for India, 12 new records for Himalaya, 70 new host records. Earlier, Rattan (1977) gave a consolidated account of 173 resupinate, non-poroid taxa belonging to 55 genera of Aphyllophorales from the North Western Himalaya.

25. Investigation of Taxonomic, Cultural, Cultivation and Nutraceutical Aspects of In India

N. S. Atri, Rajinder Singh and R. C. Upadhyay*

Department of Botany,
Punjabi University,
Patiala, Punjab
*Directorate of Mushroom Research,
Chambaghat, Solan, H.P.

Keywords : *lentinus, squarrosulus, taxonomy, physiology, nutraceutical*

Lentinus squarrosulus (Mont.) Singer is widely accepted edible mushroom species throughout equatorial Africa, South-East Asia, the Pacific Islands, Australia and Bhutan. Beside its acceptability as food item, *L. squarrosulus* possesses nutraceutical properties which draw the attention of the scientists. In view of its importance in human welfare, work on the taxonomy, physiological and biochemical aspects with particular reference to nutritional composition and presence of lectins in the mushroom mycelium and their utility in haemagglutination activity and sugar specificity studies was undertaken on an indigenous culture of *L. squarrosulus* raised on Potato Dextrose Agar from the wild specimen collected from Kotla Barog in Sirmour District of Himachal Pradesh during July, 2006. Its cultural characteristics were evaluated on fifteen solid and equal number of liquid media, out of which Yeast extract agar and Yeast glucose media turned out to be the most suitable for vegetative growth of this mushroom mycelium. Temperature at 30±1°C, pH 4. 0 and darkness supported maximum vegetative growth when incubated for 13 days. Substitution of Fructose for Glucose as carbon source and DL-Leucine as a substitute for nitrogen in place of yeast in Yeast Glucose medium supported maximum mycelial growth. Nicotinic acid, Gibberellic acid and Manganese in specific concentrations along with selected vitamin, growth regulator and trace elements proved to be good supplement in the culture media which favored good growth of the vegetative mycelium. Wheat grains have been evaluated as the remunerative and easily available substrate for spawn production. Half kg of dry abundantly available ligno-cellulosic wastes including wheat straw, paddy straw, rice husk and saw dust independently and in 1 :1 :1 :1 mixture of all these were used for undertaking cultivation studies. Crop

appeared in 3-5 flushes in a period spread over 30-50 days if colonized bags are incubated initially at 30±1°C during colonization and after protuberance emergence the temperature of the cropping room was lowered to 22±1°C for fruiting. In the mixture of all the four substrates mushroom gave maximum (68. 7%) biological efficiency as compared to biological efficiency obtained in wheat straw (55. 52%), saw dust (19. 21%) and rice husk (7%). No fruiting was obtained in rice straw substrate. Biochemical analysis of 100 gm dry sample of mushroom possessed 1. 721% proteins, 1. 83% crude fibers, 2. 21% ash, 87. 42% carbohydrates and 0. 62% crude fats with 194. 34 saponification value, 17. 14 acid value. The energy value of 380 Kcal per 100 gm of sample has been obtained which is comparable with other edible mushrooms. From amongst the macro nutrients, Na (2. 392 mg), Mg (1. 200 mg) and K (0. 0530 mg) while from amongst the micro nutrients, Fe (6. 41mg), Zn (6. 10 mg) and Cu (0. 750 mg) have been estimated from 100 gm of the dry sample. The presence of lectins in the fresh mushroom mycelium and lectin specificity with various sugars and its haemagglutination properties highlights the importance of this species in human medicine. In view of the results achieved during the present investigation, it is apparent that *L. squarrosulus* is nutraceutically important mushroom species that fits in the menu of modern calorie conscious society. Its commercial production not only promises a strong food alternative for mushroom lovers with a potential to provide equally potent culinary option as is provided by other edible species of *Agaricus*, *Pleurotus*, *Volvariella*, *Lentinula*, etc. It needs the attention of Indian scientists for initiating work for its large scale production and evaluation for nutraceutical components and subsequent popularization amongst the consumers.

26. Nutritional and Nutraceutical Potential of Five Wild Edible Lentinus species

B. M. Sharma, *Sapan Kumar, *N. S. Atri, **Robin Joshi,

**Ashu Gulati and **Arvind Gulati

Department of Plant Pathology, CSKHPKV,

Palampur-176062

*Department of Botany, Punjabi University,

Patiala (Punjab)-147002

Institute of Himalayan Bioresource Technology (CSIR)-176062.

Keywords : *Lentinus, nutrition, nutraceutical, mushrooms*

Genus *Lentinus* is widely appreciated for its culinary and neutraceutical attributes. Presently five wild species of this genus, namely *Lentinus sajor-caju*, *L. connatus*, *L. torulosus*, *L. cladopus* and *L. squarrosulus* were selected for evaluating the nutritional and nutraceutical components. These were collected from different hosts in different seasons and from different altitudes ranging from 200 m to 2,100 m in North West India. Among the nutritional components- total protein by Kjeldhal method, crude fibers by digestion with acid and base, crude fat through soxhlet apparatus and carbohydrates from the difference between total constituents and minerals through atomic absorption spectrophotometer. As the protective role of sugars for cell healing these have been characterized by HPLC. Investigations were conducted on samples taken from dried fruit bodies. Out of all the samples examined for nutritional components, maximum amount of protein (2. 450 %) was recorded in *L. torulosus* and lowest contents were found in *L. connatus* (0. 525 %). *L. sajor-caju* and *Lentinus cladopus* showed highest percentage of crude fat (0. 80 %) while other three contain considerably low percentage of crude fat. Total crude fibres were found in high quantity in *L. sajor-caju* (3. 99 %) and minimum percentage was observed in *L. squarrosulus* (1. 83 %). Ash contents were found maximum in *L. squarrosulus* (2. 21 %) and minimum were observed in *L. torulosus* (1. 52 %). The carbohydrate percentage was found to be maximum in *L. cladopus* (89. 10 %) and minimum in *L. sajor-caju* (85. 82 %) the other three species contain good amount of carbohydrates. Although the samples were dried at 45 ºC, the samples still contained moisture. The rest of the part is constituted by moisture. Minerals were estimated in mg/100 gm of the dried sample. Out of all the samples examined, maximum amount of Ca (221. 3 mg) was recorded in *L. connatus* followed by *L. sajor-caju* (97. 3 mg). The other species contained very low Ca. Mg recorded maximum levels in *L. connatus* (1,722 mg) followed by *L. cladopus* (1,260 mg). The other three species also possesses significant levels of this mineral with *L. torulosus* having minimum quantity (807 mg). Maximum amount of copper (3. 33 mg) was recorded in *L. cladopus* followed by 2. 33 mg in *L. torulosus* where as minimum quantity of this mineral (0. 75 mg) was recorded in *L. squarrosulus*. Zn was maximum (6. 10 mg) in *L. squarrosulus* followed by 4. 0 mg in both *L. cladopus* and *L. sajor-caju* whereas minimum quantity (3. 0 mg) of Zn was recorded in *L. connatus.* Maximum amount of Fe (37. 0 mg) was recorded in *L. cladopus* followed by 18. 66 mg in *L. connatus* whereas minimum

amount (6. 41 mg) was recorded in *L. squarrosulus.* Na was maximum (2. 39 mg) in *L. squarrosulus* followed by 1. 15 mg in *L. cladopus* whereas minimum quantity of this element (0. 71 mg) was recorded in *L. connatus.* K was maximum (0. 06 mg) in *L. cladopus* followed by 0. 05 mg in *L. squarrosulus.* Minimum amount of K (0. 018 mg) was recorded in *L. connatus.* Among sugars recorded in (% dry weight), highest amount of manitol was observed in *L. torulosus* (0. 78%) and minimum was observed in *L. cladopus* (0. 21%). Glucose was found to be highest in L. connatus (1. 28 %) and minimum was observed in *L. sajor-caju* and *L. squarrosulus* (0. 65 %). Fructose was found highest in L. connatus (0. 82 %) and minimum was found in *L. cladopus* (.06 %) and Mannose was highest in *L. cladopus* (0. 52 %) and minimum was found in *L. sajor-caju* (0. 26%)

27. Biological Control of Plant Pathogens : Progress and Constraints in Application

R. S. Upadhyay

Department of Botany,
Banaras Hindu University,
Varanasi-221005

Keywords : *Application, Biological control, Plant pathogens, Progress, Constraints.*

Biological control of plant pathogens has been subject of an intensive research since more than 60 years. The early studies were carried out by only a few researchers without much organized efforts. Later, this subject was established to a fascinating stage with the hope of delivering goods to modern agriculture. Several patents of the biocontrol agents have been obtained and many more are in process. However, after such a long period of organized efforts by the scientific community, the biocontrol methods have not been able to replace or minimize the use of pesticides in crop production system. The reason for the slow progress has been mainly due to several constraints, the important ones being : (i) lack of research support by government and semi-government organizations, (ii) unwillingness of the industry to develop products from research output because of the skepticism, and (iii) apprehensions of the farming community on the efficacy and safety of the biocontrol agents. The scientific community has provided several theories of biocontrol for practice as a component in plant disease management, but unfortu-

nately majority of them still remain scientific information and are not in practice. In the present paper progress of biological control research and constraints in its application has been discussed with particular emphasis on biological control of soil-borne plant pathogens.

28. Distribution of Arbuscular Mycorrhizal Fungi in Garhwal Region Uttrakhand, India

B P Chambola

Department of Forestry,
HNB Garhwal Univ Srinagar,
Uttrakhand

Keywords : *Mycorrhiza, AM, nutrient uptake, symbiosis*

Mycorrhizal fungi in symbiotic association of roots have evoked worldwide interest because of their positive role in uptake of nutrients and plant growth. Despite the vast research data available on mycorrhizal aspect and their ecology in diversified habitats in India, there is no data on the taxonomy and ecology of AM fungi of Garhwal soil. During the present investigations, soil samples from different parts of the Garhwal region i. e. different locations of district Chamoli, Dehradun, Pauri, Rudraparyag, Tehri and Uttarkhashi were analysed for AMycorrhizal association.

Arbuscular mycorrhizal (AM) fungi are widely distributed in the soil of throughout the area studies i. e. all the area Garhwal region *viz.* district Chamoli, Dehradun, Pauri, Rudraparyag, Tehri and Uttarkhashi with different altitudes ranging from 600m to 3000m above mean sea level. AM fungi were recorded from 98% of the site examined with *Glomus fasciculatum* and *Glomus macrocarpum* being the most dominant species. Mean species diversity was found to be maximum in the areas thickly vegetated and undisturbed. The average spore number from the area of district Dehradun was recorded very high followed by areas of district Pauri, Chamoli, Rudraparyag, Tehri and Uttarkashi. Soil samples taken from various locations showed variation in AM fungal spore number. Spore number also varied in soil samples taken from different habitats of the same district. The undisturbed natural vegetation showed maximum spore number followed by cultivated area and non- cultivated barren lands.

The investigations have shown wide distribution of AM fungi in the Garhwal region. All the AM fungi isolated are commonly found and are equally abundant. Among the isolated AM fungi were 5 species each of *Acaulospora* and *Gigaspora,* 37 species of *Glomus,* 2 species of *Archeospora,* 7 species of *Scutellospora* and 1 species of *Entrophospora.*

29. Role of Thermophilic Fungi in Shortening the Duration of Composting for Agaricus Bisporus (White Button Mushroom) Cultivation

B. Vijay, Ashutosh Pathak, Vikas Taank and Manjit Singh

Directorate of Mushroom Research,
Chambaghat, Solan (HP) 173213

Keywords : *Mushrooms, thermophiles, composting, button mushroom*

White button mushroom (*Agaricus bisporus*) is an ideal tool in converting agricultural residues into proteinaceus food. It grows on a special compost, prepared using variety of agricultural waste materials. Compost production is the most important and integral part of button mushroom cultivation and its quality parameters mainly determine success or failure of a crop. It is a product of fermentation brought about by the activities of thermophilic organisms and among them fungi especially *Scytalidium thermophilum, Humicola insolens* and *Humicola grisea* play a decisive role in bringing about the selectivity and productivity of the compost. This Directorate conducted several experiments on shortening the composting period using above thermophilic fungi. Methodology for total indoor compost production using consortium of above thermophlic fungi standardized. In this case, compounding mixture after its thorough wetting (3days) was directly filled in the Phase II tunnel, escaping Phase -I conditions altogether. Compost was subjected to pre- pasteurization conditioning, pasteurization and post pasteurization conditioning. Entire operation lasted for 10 days (3days mixing + 7days in tunnel). Experiment gave excellent results (> 18% conversion). In another experiment compost was prepared by long method (LMC) in 20 days time with the help of thermophilic fungi, *S. thermophilum* (X-21 strain), *H. insolens* (I-33 strain) and *H. insolens* (I-3 strain) and their consortium. It was observed that thermophiles inoculated piles harboured least numbers of competitors and productive compost could be prepared with the help of *S. thermophilum*.

30. Biodiversity of the Water Borne Conidial Fungi

S. C. Sati

Botany Department, D. S. B. Campus,
Kumaun University,
Nainital-263001

Keywords : *Aquatic fungi, biodiversity, conidial fungi*

The term biodiversity is a simple derivative of biological diversity and may be defined as the sum total of all biotic variation from the level of genes to ecosystem. Biodiversity has long been a source of amassment and scientific curiosity but now it is increasingly becoming a matter of concern. Aquatic fungi which predominantly occur in water, constitutes an important component of biodiversity. Aquatic mycoflora especially Hyphomycetes has a particular significance in the energy transfer and nutrient cycling through decomposition in the aquatic habitats and are generally considered as the primary microbial decomposers of leaves in well aerated water and directly or indirectly related to the fresh water productivity. A considerable amount of information on aquatic Hyphomycetes and their role in the colonization of leaf litter has been produced by the several investigators. Some recent studies have also shown their endophytic occurrence and bioactive potentiality. Fresh water mycoflora includes a great diversity of water borne conidial fungi which are usually the anamorph stages of Ascomycotina and Basidiomycotina, characterize by their magnificent, triradiate tetra radiate spore types. They were first noticed by DeWildmen (1893) but well studied by Ingold (1942), and named as “Aquatic Hyphomycetes” as they complete their life cycle under submerged conditions. Occurrence and distribution of these fungi have now been recorded from all over the world but in India the knowledge of these fungi is quite meagre. During in last three decades nearly 125 species of waterborne conidial fungi have been recovered from different water bodies of India.

In Kumaun Himalaya, a significant work has been carried out on the biodiversity of conidial aquatic fungi. A total of 80 species belonging to 42 genera of water borne conidial fungi, have been explored from different habitats including water-foam, scums, submerged leaf litter and the roots of ravine plants. Many

species have also been collected from submerged gymnospermous leaf litter hitherto less known. 27 species of these fungi were also recovered as root endophytes. Altogether 36 species were recovered new to Indian mycoflora while 4 species were found new to science.

31. Harnessing Diversity of Wheat in Containing Rusts in India

S. C. Bhardwaj and M. Prashar

Regional Station,
Directorate of Wheat Research,
Flowerdale, Shimla 171002 H.P

Keywords : *Wheat, rust, Pathotypes, Epiphytotics*

Wheat is the second most important cereal of India and is cultivated in around 27 million hectares. India with a production of about 81 million tonnes is the second largest producer of wheat in world following China. Among the biotic constraints in wheat production, rusts are the most important world over. The problem becomes all the more grim with their capability to spread aerially across the continents, frequent evolution of new variants rendering resistant varieties susceptible.

Flowerdale Station of Directorate of Wheat Research is engaged in wheat rust management strategies since 1930. It has given the backbone support to contain the wheat rusts in India. New pathotypes are identified in initial stages, pathotype distribution is made known, advance varietal accessions are evaluated and rust resistance genes are characterized. Based on the distribution of rusts/ pathotypes, deployment of rust resistant varieties is practiced for different ecological zones. To increase diversity durum, dicoccum and bread wheat varieties are deployed. Varieties with slow rusting traits and adult plant rust resistance have found place in cultivation. India is successful in containing the wheat rusts through deployment of diverse rust resistance for the last thirty seven years even when many countries in the world experienced epiphytotics. Diversity is the key word of this success.

32. Pre-empting Threat of Plant Pathogens- A Case Study of Ug99

M. Prashar and S. C. Bhardwaj

Regional Station,
Directorate of Wheat Research, Flowerdale,
Shimla 171002, H. P.

Keywords : *plant pathogens, Food Security, Resistance, genes.*

Plant pathogens pose a serious threat to our food crops thereby threatening food security of the country. Such challenges, if not addressed in time, have the potential to cause serious food crisis in the country. Latest threat of plant pathogens came in the name of Ug99 that threatened our wheat crop. However, the national wheat programme our country accepted this challenge and undertook several activities to meet this threat. The key actions ranged from making wheat workers aware of the challenge, comparing both Indian rust pathogens with Ug99, pre-breeding activities and ultimately incorporation of resistance genes in Indian wheats. An international cooperative was also established to keep this pathogen away from spreading to other nations. Indian wheats were also screened against this pathogen in Kenya to know the status of resistance. Many varieties including few presently being cultivated were found resistant. These initiatives not only enhanced rust resistance of Indian wheats but also showed the way to address future challenges.

33. Teaching Biotechnology in India

S. M. Paul Khurana

Director, Amity Institute of Biotechnology,
Haryana, Gurgaon (Manesar)-12

Keywords : *Teaching, biotechnology, microbes, genetic manipulation*

Plant biotechnology is taught both in UG and PG programs, extending further into research/Ph D programs for providing comprehensive knowledge of the subject where in the students learn underlying principles, concepts, theories and practical skills to make them familiar with current developments in biotechnology research.

The program covers plant sciences, molecular biology and biotechnology for the improvement of plants and commercial application of their products. Besides the basic science subjects, advanced courses are taught and lab skills essential for research are acquired initially in the first year. These are further developed by exposure to other advanced courses/ techniques in 2^{nd} to 4^{th} year of B. Tech. curriculum. This is designed to teach subjects, cell biology, biochemistry, physiology, genetics, genetic manipulation, plant microbes, cell signaling, genomics, proteomics, plant pathogens & their control, downstream processing, pharmaceuticals etc In the 5th Semester 8-10 weeks while 12-16 weeks training in the 8^{th} Semester is obtained through internship. This inculcates critical thinking, team work, data handling and interpretation. The two year PG courses embrace specialized subject matter(s) where by the acquisition of a broad professional competence is achieved for development and application of genetic- engineering methods for the release and production of the transgenic. Also the term paper helps self study and analysis for understanding a wider canvas of the biotechnology. The biotechnology degree for plants/agriculture prepares students for a challenging career in industrial or academic field, basic/applied research, commerce and teaching/ training as well as equips them in a wide range of skills and knowledge base of great value for the industry.

The presentation would critically discuss at length the short comings and improvements suggested for bringing about global competence in our students.

34. Different pattern of gene regulation by ectomycorrhizal fungus Laccaria bicolor to heavy metals

M. Sudhakara Reddy

Thapar University,
Department of Biotechnology,
Bhadson Road, Patiala 147 004

Keywords : *ectomycorrhizal fungi, metal tolerance, metallothioneins, Laccaria bicolor*

Laccaria bicolor, a homobasidiomycete forms ectomycorrhizal symbiosis with several tree species. This is the first symbiotic fungus with its genome

sequence available and is susceptible to genetic modification by *Agrobacterium* mediated transformation and serves as model fungus for functional genomic studies in ectomycorrhizas. Metallothioneins (MTs) and phytochelatins (Pcs) are intracellular chelating agents involved in metal homeostasis and detoxification. We have characterized two MT genes *LbMT1* and Lb*MT2* from *L. bicolor* in this study. Expression of Lb*MT1* and Lb*MT2* under metal stress conditions were studied by RT-PCR analysis. The full length cDNAs were used to perform functional complementation in yeast mutant strains. As revealed by heterologous complementation assays in yeast, Lb*MT1* and Lb*MT2* each encode a functional polypeptide capable of conferring increased tolerance against Cu and Cd. The mRNA accumulation of Lb*MT1* was not influenced by Cd, whereas Cd induced the transcription of Lb*MT2*. Zinc did not affect the transcription of both *LbMT1* and Lb*MT2*. These results show that *L bicolor* encode different MTs and that each of them has a particular pattern of expression, suggesting that they play critical specific roles in improving the survival and growth of ectomycorrhizal trees in ecosystems contaminated by heavy metals.

35. Diversity and Biotechnological Applications of the Species of Bacillus and Geobacillus

T. Satyanarayana

Department of Microbiology,
University of Delhi South Campus,
New Delhi

Keywords : *Bacillus, Geobacillus, nutritional, thermo stable*

The species of *Bacillus* and *Geobacillus* are ubiquitous in their occurrence because of their nutritional versatility, broad tolerance for environmental extremes and stress-tolerant thick walled endospores. In the last two decades, we have isolated a large number of species of *Bacillus* and *Geobacillus* from a variety of environmental samples, and screened them for the production of thermo stable hydrolases and carbonic anhydrase. A novel psychrotolerant and alkaliphilic *Bacillus lehensis* produces low temperature-active and alkaline protease, which is active in the presence of commercial detergents.

Extremely thermophilic bacterium *Geobacillus thermoleovorans* NP54 produces saccharogenic, high maltose-forming, Ca^{2+}-independent and hyperthermostable á-amylase. Another strain of *G. thermoleovorans* NP33 secretes amylopullulanase that cleaves a-1,6 and a-1,4 – glycosidic linkages in starch. a-Amylase and amylopullulanase of *G. thermoleovorans* and a glucoamylase of a thermophilic mould *Thermomucor indicae-seudaticae* could be integrated in developing an ideal starch saccharification process. An acidophilic strain of *B. acidicola* produces acidic and high maltose-forming á-amylase. These enzymes exhibit anti-stale property and are useful in improving the shelf life and texture of bread. A strain of *G. thermoleovorans* isolated from pulp samples and *Bacillus halodurans* isolated from paper pulp industry effluent secrete thermo-alkali-stable endoxylanase. The inclusion of the enzyme in pulp bleaching process led to 14% saving of chlorine with amelioration in brightness. An alkalitolerant strain of *B. pumilus* produces extracellular alkaline pectinase, which is useful in eco-friendly fibre processing. Another strain of *B. pumilus* is a source of carbonic anhydrase that efficiently catalyzes hydration of CO_2 to carbonate, and thus useful in carbon sequestration. Significant findings of our work on the production of enzymes and their potential applications will be discussed.

36. Biodiversity of Ectomycorrhizal Mushrooms in Central India

Ram C. Rajak

SCH Centre for Biotechnology,
B-96, Priyadarshini, Housing Society,
Dumna Road, Jabalpur-482001,
Madhya Pradesh

Keywords : *Ectomycorrhizal, fungi, inoculations*

Ectomycorrhizal, can account for 25% or more of forest root biomass, representing a major below-ground structural component of fungal species diversity. Ectomycorrhizal associations are key factors in forest ecosystems for survival and growth of trees supplying nutrients to host plants particularly immobile nitrogen and phosphorus. Knowledge of the distribution and ecology of ectomycorrhizal fungi is important for conserving their diversity and selection of species for forest nurseries

inoculations. In forest ecosystems richness and diversity of ectomycorrhizal communities strongly contrast with low number of woody species. Scores of fungal species are commonly associated with single tree. Besides two recognized hotspots (Western Ghats and Northeastern Himalaya), India is endowed with biodiversity rich regions in Central India managed by Department of Forestry. It is noticed that some parts have been explored extensively while others (including Central India) remain untouched. The lack of information on ectomycorrhizal fungi is due to a number of reasons including the fact that complete surveys of fungal diversity at species level even for a small geographic region is an exhaustive task. Moreover, these ectomycorrhizal mushrooms fruit on a sporadic basis. The purpose of this investigation was to record the species diversity of ectomycorrhizal mushrooms in central India. Once species diversity of a region is assessed, database prepared may be used as reference to access and monitor particular ecosystem in future.

The mycological expedition (2004-2008) to Madhya Pradesh and Chhattisgarh forests (sponsored research project under DBT, New Delhi) documented ectomycorrhizal mushrooms of this region. About 61 ectomycorrhizal mushroom species including 9 genera were identified. Out of 61, 38 were *Agaricales* (61%), 11 *Boletales* (17%), 12 *Sclerodermatales* (19%). *Russula* was found to be the dominant genus inhabiting Sal (*Shorea robusta*) forests. The interdependence of vegetation with fungi of this region occurring in various forest types is discussed.

37. Production of Nutraceuticals Through Plant Biotechnological Processes

G. A. Ravishankar

Plant Cell Biotechnology Department
Central Food Technological Research Institute,
Mysore-570 020

Keywords : *nutraceuticals, pharma food, phyto chemicals*

Studies on human nutrition are presently focusing on the aspects of prevention of nutritional disorders and also protection from diseases. Thus, preventive medicine through food has been receiving preference for enhancement of health status and for disease prevention. The latest terminologies for such specialized foods are -

functional foods, nutraceuticals, pharma foods, designer foods, chemo preventors and phyto chemicals. From the product point of view, they are labeled as medicinal foods, dietary supplements and herbal products and botanicals. Broader definition of functional foods is as foilows : "A food that has a component incorporated in it to give a specific medical or physiological benefit other than being purely nutritional benefit." A nutraceutical is one which provides health benefits from the food ingredients that extends beyond the basic nutritional benefit. FOSHU - Foods for Specific Health Use was recognized in the year 1991 by the Ministry of Health and Welfare of Japan. Similarly several countries including USA, Canada have provided attention to the functional ingredients of foods. Functional ingredients under the FOSHU, which are being made use of for nutraceutical development include - Dietary fibre, oligosaccharides, sugar alcohols, polyunsaturated fatty acids, peptides and proteins, glycosides, isoprenoides and vitamins, phenols, cholines (lecithin), lactic acidbacteria, minerals, vitamins and others. In our lab, we are involved in production of algal biomass, *Spirulina, Dunaliella,Ha~matococcus* for several nutraceutically important molecules such as Phyto chemicals, β-carotene, astaxanthin. The studies are focused on cloning of astaxanthin pathway genes, β carotene ketolase and β-carotene hydroxylase from *Haematococcus* and mobilization of the same to *Dunaliella* for pathway engineering of carotenoids to produce astaxanthin. Macroalgae suchas *Euchema, Porphyra, Enteromorpha* were found to be rich in protein, vitamin and minerals for use in nutritional /nutraceutical -enriched foods.

38. Weeds as Herbal Remedies from Southern Sectors of City Beautiful

M. P. Sharma

Bio-Age, Industrial Area, Phase IX,
Mohali-160062

Keywords : *Useful Weeds, Cure Diseases, Southern Sectors, Chandigarh, Ethno-botany, weeds.*

During weed survey of tricity, particularly Mohali which is adjacent to southern sectors from sector 48 (of Chandigarh - City Beautiful) onwards, several weeds were identified which could be commercially exploited for their usage in controlling certain serious diseases. The ailments are : fever, cough, bronchial

asthma, stomach ache, piles and fissures, inflammations, removing worms in children, gonorrhoea, urino-genital disorders, Kidney stones, stops vomitting, scorpio, bees and snake bite, besides laxatives, cure for bums boils, itches and even for Leprosy e. g. *Commelina nudiflora* and *Commelina benghalensis* and other skin diseases. Some weeds are used as tonics. g. Asgandh. In this paper fifteen taxa representing 12 angiospermous families, with their vernacular names uses for different diseases are briefly described. The taxa used are as under : *Boerhaavia diffusa, Punarnava* ***Nyclltaginaceae****; Achyranthes aspera, Puthkanda -* ***Amaranthaceae;*** *Datura stramonium, Datura -* ***Solanaceae;*** *Withania somnifera, Asgandh - Solanaceae; Aloe vera, Kanwar gand -****Liliaceae;*** *Adhatoda vasica, Vasaka,-* ***Acanthaceae;*** *Ocimum sanctum, Tulsi -****Lamiaceae;*** *Citrulus colo-cynth is,{Kaur Tumm -****CucurbiJzceae;*** *Sisymbrium irio, Khob Kalan -* ***Brassicaceae;*** *Fumaria indica, Pitpapra -* ***Fumariaceae;*** *Tribulus terrestris, Bhakra, -Zygophyllaceae, Phyllanthus niruri -****Euphorbiaceae;*** *Commelina nudiflora-Commelinaceae; Rinicus communis,Casto -****Euphorbiaceae*** *and Eu-ph-or-bia hirta, Lal Dudhi -****Euphorbiaceae.***

39. Consumer Perceptions of Genetically Modified Food

Nisha Singh[1] and Anesh Maniraj Singh[2]

[1]School of Biological and Conservation Sciences,
[2] Graduate School of Business,
University of KwaZulu-Natal,
Private Bag X54001, Durban 4001,
South Africa

Keywords : *Genetically modified, consumer preception.*

South Africa is ranked eighth in terms of global biotech crop production, and is the only country in Africa where genetically modified crops are produced commercially. Yet it is reported that the majority of South Africans are not aware of the existence of GM foods. The objective of this study was to gain better understanding about South African consumers' perceptions of GM foods. The study investigated consumer responses to statements on benefit, health, risks, importance, ethics, profit, knowledge about consequences, and trust in policy makers regarding

four GM food applications in maize, soybean, tomatoes and rice, using a Likert-scale. The results indicated that consumer perceptions to GM foods were more negative than positive. The mean score for benefit was 74. 53% whilst that for healthy and consequences were 60% and 54. 69% respectively. Although the risk associated with GM foods was high (70%), the survey rated tampering with nature and profiteering even higher where the mean values were 72. 97% and 77. 19% respectively. The lowest scores were obtained for ethical and trust in policy makers which were 51. 72% and 48. 91% respectively. Overall the mean percentage score for the combined positive perceptions was 65. 59% whilst that for the combined negative perceptions was 73. 39%. Health ranked as a major issue, but there was greater concern regarding profiteering, ethics and lack of trust in policy makers.

40. Exploring the Potential of Islets in Diabetic Research

Vijayalakshmi. V, Sashi Kiran. G, Raj Kumar. D.

Biochemistry Division,
National Institute of Nutrition,
Hyderabad

Keywords : *Diabetes, islets, hypoglycemia*

Diabetes is characterized by hyperglycemic condition associated with decreased insulin secretion or resistance with progressive loss in islet mass. Islet regeneration is an important issue, which can compensate for the loss of functional b cells and thus is an attractive strategy in the management of diabetes. According to the International Diabetes Federation, there are 194 million people with diabetes worldwide. This figure is projected to rise to 330 million by 2025 and India is believed to be the single country with largest number of diabetics (~58 million). Studies using the embryonic, fetal and adult stem cells from both the pancreatic and non pancreatic tissues have emphasized the potentials of the stem cells to give rise to functional insulin secreting cells both in vivo and invitro thereby giving new hope to the diabetic subjects. Also, understanding the interplay of the factors with in the microenvironment of the stem cells /progenitor cells could be of immense interest in biomedical, biotechnological and Translational research such as in tissue regeneration.

Some recent developments in the area of adult stem cells have been the induced pluripotent stem cell, or IPS cell, created from an adult cell such as a skin cell through the introduction of genes that reprogram the skin cell and transform it into a cell that has all the characteristics of an embryonic stem cell. The term pluripotent connotes the ability of a cell to give rise to multiple cell types, including all three lineages such as ectoderm, endoderm and mesoderm derived forming the body's organs, nervous system, skin, muscle skeleton and pancreas. The promises of the embryoid bodies derived from the adult stem cells appears similar to the ones formed from the. It remains to be seen whether reprogrammed skin cells differ in significant ways from embryonic stem cells. Comparative studies of embryonic and induced pluripotent stem cells will be necessary to ensure they are the same. It is essential for science to explore the full spectrum of research options to bring stem cell research to clinical fruition as soon as possible. Some of the recent developments which is yet another application of the isolated islets is to understand the mechanism of the ß-cell death invitro and possibly identify the sites of interventions towards the retention of the cytoprotective function resulting in the repopulation of the ß-cell mass.

41. Ethnobotany in the N. W. Himalaya

S. K. Sood and Kuldip S. Dogra

Deptartment of Biosciences,
H. P. University,
Shimla-171005
E. mail : sood. sarvesh@yahoo. co. in

Keywords : *Ethnobotany, biodiversity, tribal, ethnic, Himalaya*

Himalayas are a rich repository of tradition, culture and heritage. They are extremely rich in flora and fauna. Different aspects of ethnobotany in the Himalayas have been studied in depth. The various areas investigated are Lahaul-Spiti, Rewalsar, JoginderNagar, Pragpur, Palampur, Paonta-Sahib and SunderNagar. Most of these areas have not been ethnobotanically explored earlier. The data generated reveals many hitherto unknown facts. Some of the findings have been published in the form of books, namely *Ethnobotany of Cold Desert Tribes of Lahaul-Spiti* (*N. W. Himalaya*), Deep Publications, 2001; *Ethnobotany of*

Rewalsar Himalaya, Deep Publications, 2004; *Ethnobotany of Shrubs, Trees and Climbers of Himalaya.* Satish Serial Publications, 2009; *Ethnobotany of the Heritage Region of Shiwalik Himalaya-Pragpur, Himachal Pradesh*. Anamika Publishers, 2010. Ethnobotanical information pertaining to the usages of some of the important plants for their sustainable exploitation for the welfare of the mankind would be presented.

42. Variations in Smut Fungi of India

R. V. Gandhe

Emeritus Scientist, DST,
Agharkar Research Institute,
Mycology group, Pune, Maharashtra-411004.
Email : rvgandhe@hotmail. com

Keywords : *Review, Ustilaginales, morphology, variations, spore germination.*

Generic and species variations are noted in smuts of India with 44 genera and 363 species on more than 21 angiosperm families, of which, the members of Poaceae (Gramineae) is widely affected.

Variation abounds in the smut fungi, in both morphology and physiology. Morphologically, many species vary widely in spore markings, size, shape, colour or pigmentation, surface ornamentations and gross symptoms expressed by the diseased hosts. In addition to morphological variations of fertile spores, sterile cells and their components intermixed with fertile spores, forming a central column or a peridium or scattered in groups are also vary in the smut genera. Considerable range of permanently embedded spore balls and their composition is seen in the species of *Burrillia, Heterodoassansia, Doassansia, Doassansiopsis,* and *Narasimhania*. The spore ball of *Heterodoassansia* shows cortex with two types of sterile cells inner layer of larger, empty sterile cells with ornamental inner surface and external layer of small, smooth, empty sterile cells. There is a still confusion and controversy regarding the identification of the species of *Sorosporium, Sphacelotheca, Ustilago* and *Sporisorium* because of composition of spore ball. The genus *Georgefischeria* is restricted to India with its four species. The species *G. narasimhanii, G. mundkurii* and *G. thirumalacharii* strikingly differ in

infection pattern than the type species *G. riveae*. Physiologically, variation in nutrient requirements in the haplophase is minimal, while nutrient requirements of dikaryophase is seemingly implicit in host specificity, while for those with a wide host range have apparent requirement.

There is a variation in spore germination and germination products in smut fungi though basic germination pattern for Ustilaginaceae with phragmobasidium with lateral and terminal sporidia and Tilletiaceae with holobasidium with terminal sporidia is fixed. Conjugation of germination products is very frequent in Ustilaginales and very often basidial cells conjugate to establish dikaryophase. However, the species of *Georgefischeria* did not show conjugation of germination products.

Variation in growth type and mutability of monosporidial colonies in culture are notable in smuts. Monosporidial colony growth is extremely slow in *Georgefischeria riveae* on 2% PDA and 2% HEA (host-extract-agar). The variations with different parameters in smuts are important and considerable mainly in taxonomy, phylogenetic studies, disease development.

43. Understanding Life at High Temperature

Ved Pal Singh

Depatment of Botany
Delhi University

Keywords : *Thermal envioronment,Radioactivity, Solar radiation*

The changing climate of the Mother Earth has left human civilization at the crossroad, which inculcates in us the desire to understand as to how to cope with harsh environments, especially the global warming. Thermal environments result from : (i) solar heating, (ii) combustion processes, (iii) radioactive decay, and (iv) geothermal activity. Although, in man-influenced environments, most of the heat generated comes from combustion processes (both biological and non-biological), but the contribution of radioactivity in heat production cannot be underestimated because of fast growing nuclear energy establishments all over the world. It is, therefore, imperative to have an insight into the mechanism(s), which could provide the basis for thermophilic existence of living beings, considering microbial model as a case study, since this is the only group which can withstand wide range of thermal environments. Most biomolecules, including enzymes, necessary for various meta-

bolic transformations, get denatured at elevated temperatures, but thermophiles keep on growing under such adverse conditions. The possible biochemical mechanisms leading to thermophilic existence of living organisms include : (i) involvement of lipids and membranes, (ii) inherent thermostability of macromolecules, (iii) role of stabilizing factors and highly charged macromolecular environment, (iv) allostery, thermoadaptation and transformation, and (v) rapid resynthesis/turnover of heat inactivated molecules.

In my lead lecture, I am going to present a model/mechanism, highlighting implication of macromolecular dynamics/turnover for the sustainability of life at high temperature, without precluding the possibility of involvement of macromolecular charged environment and ordered cellular organization, considering both membrane-bound (ATPase) as well as soluble (acid and alkaline phosphatases) enzymes as reference macromolecules in an ideal thermophilic model system – *Thermoactinomyces vulgaris*.

44. Potential Herbal drugs and Bioactive molecules from some Indian Medicinal Plants

N. Raaman

Herbal Sciences Laboratory University of Madras,
Guindy Campus Chennai-600 025
E-mail: raaman55@gmail.com

In recent years there has been growing interest in alternative therapies and the therapeutic use of natural products, especially those derived from plants. *Clausena dentala* was taken for phytochemical, pharmacological and antibacterial investigations. Three coumarins and one alkaloid, extracted from stem bark, showed very good pharmacological activities. The investigation revealed that the leaves, stem and root of *C. dentata* contained appreciable amount of vitamins such as carotene, thiamine, riboflavin and ascorbic acid and minerals like, iron and zinc, proximate principles such as protein, fat and carbohydrate. The amount of these vitamins, minerals and proximate principles were comparatively in higher amount in leaves of *C. dentata* than leaves of *M. koenigii*. Three compounds isolated from *Leptadenia reticulata* showed very good antibacterial as well as antidermatophytic activities. The amount of vitamins and minerals were comparatively in higher amount in *L. reticulata* than in many commonly used green leaf and stem vegetables.

Two conipoimds isolated from *Artemisia pollens* showed very good antimicrobial activity. In the *in vitro* cyclooxygenase enzyme inhibitory assay, the extracts from *Cissus quadrangularis* and *Hypericum mysorense* showed remarkable COX-i and COX-II inhibition which is comparable to aspirin and celebrax. The positive results shown by *C. quadrangularis* and *H. mysorense* reveals the potential use of these plant extracts as an anti-inflammatory drug. Two biomolecules isolated from *Ipomoea sepiaria* showed very good activity against the multi-drug resistant bacteria. Two compounds isolated from *Scoparia dulcis* exhibited remarkable anti-dermatophytic activity.

A compound isolated from *Solanum trilobatum* was tested for anticancer activity against 4-NQO induced oral cancer in råts. The compound at the concentration of 30 mg/kg/b.wt. was found to have anti-tumor effect. The anticancer and antioxidant potential of selenium and selenium enriched garlic and tomato along with other biochemical properties were evaluated in DEN induced tumour bearing animals. Methanol extracts of *Asparagus racemosus* and *Tinospora cordifolia* showed anticancer activity.

From the results of docking studies, it was found that a compound isolated from *Scoparia dulcis* may be a PNP inhibitor as per the minimized energy values of the complexes and has lower energy level and more binding energy than PNP: Immucillin-H complex.

AYUSREM, an Ayurvedic formulation invented by the author with Dr K Balasubramanian of Ramoni research Foundation has won clinical attention with evaluations proving many facts and it is a potential herbal drug swine flu.

PROCEEDINGS
OF THE

NINETY EIGHTH SESSION OF THE

INDIAN SCIENCE CONGRESS

CHENNAI, 2011

PART II

SECTION OF
PLANT SCIENCES

President : **Prof. T. N. Lakhanpal**

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INDIAN SCIENCE CONGRESS

CHENNAI, 2011

PART II : Abstracts of Oral/Poster Presentation

SECTION OF
PLANT SCIENCES

President : **Prof. T. N. Lakhanpal**

I. ALGAE, BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS

1. seasonal Diatom Diversity in Mansagar Lake of Rajasthan, India

Meenakshi Singh, Payal Lodha, Gajendra Pal Singh and Rajesh Singh*
Algal Biotech Lab, Department of Botany,
University of Rajasthan,
Jaipur (Rajasthan)
*Sr. Scientific Officer, Biology Division,
Forensic Science Laboratory, Jaipur

Keywords : *Freshwater diatoms, Mansagar Lake, Rajasthan, India.*

The present investigation accounts for the seasonal studies of Mansagar Lake (Jalmahal), Jaipur on the diatom diversity, density and distribution in different

seasons and their correlation with physico-chemical properties of water. The study reveals the presence of 35 diatom species. A limited number of these were recorded throughout the year, while others were distributed in different seasons mainly in winter and summer. These taxa belong to 22 genera viz. *Stephanodiscus, Coscinodiscus, Cyclotella, Gomphonema, Melosira, Navicula, Cymbella, Epithemia, Amphora, Synedra, Diadesmis, Falcula, Rhopalopodia, Eunotia, Aulacoseira, Diatoma, Hantzschia, Tabularia, Surirella, Fragillaria, Anomoneis* and *Nitzschia*. The deposited sediment of lake was found to be rich in sand (66%), silt (16%), clay (18%) and other soil nutrients as compared to control soil. Total diatom density showed significant positive correlation with electrical conductivity and total dissolved solids ($p<0.01$) and significant positive correlation with chemical oxygen demand ($p<0.05$). Shannon-Weiner diversity index (H') value (1.372) and Evenness (J') value (0.903) were found to be highest during winter while Berger-Parker index of dominance (0.147) was highest in monsoon. This study reveals that the diatom species attain maximum growth in post monsoon and winter months and gradually declines in summer to reach its minimum during monsoon. These types of studies are prerequisites for evolving fish culture programmes and management of water resources.

2. Biochemical Composition and Total Nitrogen Content of Nostoc Species

G. S. Shinde, S. D. Pingle and V. R. Gunale[1]

K. J. Somaiya College of Arts,
Science and Commerce,
Kopargaon
1. Department of Botany,
University of Pune, Pune

Keywords : *Ahmednagar district, biochemical contents, Nostoc punctiforme.*

Blue-green algae are often referred to as "Miniature Factories" of the biological world and represent an alternate source of a variety of bioactive compounds, lipids, proteins, enzymes, pigments and compounds of pharmaceutical value. However, little work has been done to exploit the full range of biochemical diversity among these organisms for production of value added products. With this view the present research attempt was undertaken with the studies on biochemical

composition and total nitrogen content of ten *Nostoc* species isolated from the soil, covering various agro-practices areas of Ahmednagar District, Maharashtra state. During the study, remarkable variation in the biochemical contents of the analyzed *Nostoc* species was observed. The results revealed that, as far as their total nitrogen, chlorophyll-a, crude proteins and lipid contents was concerned, *Nostoc punctiforme* was found to be the foremost species while *Nostoc calcicola* was poor in biochemical content.

3. Studies on Species Diversity of Gloeotrichia of Lakes of Jalgaon District, Maharasbtra

S. R. Mahajan

Department of Botany,
Bhusawal Arts, Science and P. O. N. Commerce College,
Bhusawal-425 201 Dist-Jalgaon

Keywords : *Gloeotrichia, lake. Jalgaon*

During the study of algae of lakes situated in Jalgaon district the author came across several members of blue green algae. Amongst them species of Gloeotrichia are interesting and rarely occured. The present investigation deals with the systematic accounts of 06 taxaof genus Gloevtrichia. The genus Gloeotrichi are represented by 3 species with 3 varieties.

4. Biodiversity of Cyanobacteria in Various stressed habitats of Jaunapur city (U. P.)

K. N. Mishra and Beena Sahu

Department of Botany
T. D. College
Jaunpur-222002 (V. P.)

Keywords : *cyonobacteria, sustainability, ecosystem, samples, randomly*

Recent advancement towords eco-friendly application of cyanobacteria for biofertilizer, bioremediation and bioactive compounds has drawn world wide atten-

tion for documentation and screening of cyanobacteria for ecosystem sustainability. Cyanobacterial diversity of Jaunapur city has been least explored. We Studied the effect of pollution and seasonal change on cyanobacterial species diversity in Jaunpur city located at 25°44'to 25°45'(lat.) and 87°42'to 87°43'(long.) in tropical semiarid type of climatic zone. In the present study cyanobacteria (heterocystous & nonheterocystous) and water samples randomly collected from five different sites located at the Gomti river of fresh area of lotic water, the major sewage of the city is drained through the nalas in the Gomti river, water logging condition near road side,lentic pond water near T. D. College, in the pipelines of water supply. The physico-chemical properties of effluents from different sites have been investigated. The sample water of different sites have range of pH (7. 50-8. 40), temperature (29. 00-30. 75), Alkalinity (115. 50-267. 50) mg-1,Acidity (4. 43-16. 75) mg-I,N03(. 67-1. 70) mg-1,P04(. 27-1. 37) mg-I. On the basis of this physico-chemical studies, most polluted sites have been marked. This study reveals that the density ofBGA is more in polluted waters. The number of cyanobacteria increases in summer months (peakin apriI). In total (56) (heterocystous and non-heterocystous) blue green-algal forms were recorded belonging to genera viz. *Nostoc, Anabaena, Plectonema, Phormidium,Micro cys tis, Chroococcus, Gloeocapsa, Gloeotheca, Oscilliatoria, Lyngbya, MerismI.'*

5. Transmission Electron Microscopic Studies on Gelidium elegans

K. Sivakumar

Department of Botany,
Annamalai University,
Annamalainagar-608 002, Tamil Nadu,

Keywords : *TEM, Gelidium, SEM*

Studies were made on the mature vegetative thalli of Gelidium elegans (Kutzin. g)using Scanning and Transmission Electron Microscopy. SEM studies reveals that presence of thick amorphous mucilagineous epidermal layer followed by cortical cells and cortical cells are interposed between the group of rhizoidal filaments. Rhizoidal cells are more or less hemispherical in shape and distinct hallow in the centre region. TEM studies showed that the epidermal cell wall consisted of an outer layer with fine, parallel fibrils, an amorphous mid layer with discarded

fibrillar materials and an inner layer with fibrillar material in parallel arrangement. The outer cell wall layer is more electrondense then the inner layer. The cortical region consists of one to three layers of small and rectangular or triangular in shapes, which contain dense cytoplasm packed with plastids and florideanstarch grains. Medullary region consists of highly vacuolated large cells. Thin peripheral cytoplasm contains elongated and also anomalous plastids with thylakoids disorganization were found in medullary cell. In between cortical and medullary cell there is a thin layer of jagged cell membrane was observed in Rhizoidal cell. It consists of Mitochondria, Granularbodies, Fibrous vacuole and thin micro fibrillar net work of the cell membrane layer with confluent mucilage sac in the rhizoidal cell. The refractile inclusion of these rhizoidal cells is comprised of numerous electron translucent vacuoles enclosed by an electron opaque matrix, while observed rhizoidal cell in medullary portion the vesicle enlarged by continued deposition of synthesized material and coalescence with other vesicle. All vesicles eventually coalesce to form mature vacuole. A crystalline array of fibrils develop in the cytoplasm during later stages of vacuole enlargement. Active release of vacuolar material does not occur and organ less for extra cellular secretion are not present (except, rhizoidal cell). Structural evidence suggests a storage rather than secretary function for the cell. Rhizoidal cells walls are relatively thin, which in tum would aid the transfer of metabolites to the secretary/storage like structure. These features of the rhizoidal cells provide essential clues to the production and secretary/storage of the halogenated metabolities In G. *elegans* and offer new insights in to a possible mechanism for their release.

6. Diversity of Bryophytes in Selected Habitats of Dominant Forests of Higher Altitude in Centra Himalaya

Neerja Pande

Department of Botany,
D. S. B. Campus, Kumaun University Nainital,
Uttarakhand

Keywords : *Bryophytes, diversity, kharsu oak, silver fir, horse-chestnut, maple, similarity index*

The diversity of bryophytes (liverwort and mosses) in the dominant forest sites namely, horse chestnut (*Aesculus indica*) maple (*Acer cappadoicum*) (decidu-

ous); silver fir (*Abies pindrow*) and kharsu oak *(Quercus semecarpifolia*) (evergreen) growing luxuriantly on various habitats (boulders, forest floor, decaying logs and stems of dominant trees) at higher altitude of Pindar catchment of Nanda Devi Biosphere Reserve in Central Himalaya was studied. In each of the habitat of each forest, the bryo-vegetation was collected by placing 5cm x 5cm. quadrats (10 in number). The plants of each habitat were identified in the laboratory and the data obtained were used to calculate the similarity index of bryophytes among the habitats and sites. In all 47 species of bryophytes were recorded. These were spread over to 25 families. Family pottiaceae was represented maximally by four genera viz, *Bryoerythrophyllum*, *Desmatodon*, *Hymenostyleum* and *Oxystegus*. Pleurocarpous mosses were most abundant (55%). Across the forest, species richness was in the order KO>HC>SF>M. Similarity index values indicated maximum similarity (83%) between the bryo- vegetation of kharsu oak and silver fir forest. Across the habitats, distribution pattern of bryophytes was in the order boulder> epiphytes> decaying logs> forest floor. In the present study, distribution pattern of bryophytes across the habitats did not exhibit any specific host preference indicating more or less similar micro-climatic conditions.

7. Ethno medicinal Importance of some common Pteridophytes used by Tribals of Ranchi & Latehar Dist. of Jharkhand, India

Malay Bharti

Department of Botany
Doranda College, Ranchi,
Jharkhand-834 002

Keywords : *Ethno medicinal, Pteridophytes, Diseases,*

The present study deals with ethno medicinal uses of common pteridophytes used by the tribal community of Ranchi & Latehar Dist. of Jharkhand, India, in the treatment of various diseases. Apart from the higher angiospermic plants, the tribal communities of the study areas are found to use some common Pteridophytic plants in their ethno medicinal health care system. The present paper documents ethno medicinal uses of 23 Pteridophytic plants which are prevalent in study areas along with botanical name, family, plant parts and mode of ethno medicinal use.

8. Azolla Vermicompost for Sustainable Agriculture

A. Gandhi and K. Sivakumar

Department of Botany,
Annamalai University,
Annamalainagar-608 002, Tamil Nadu,

Keywords : *azolla, vermicompost, sustainable, agriculture*

Azolla is an aquatic free floating fern grows rapidly in various types of water bodies to its beneficial association with endo-symbiotic cyanobacterium. *Anabaena azollae* which having high ability of atmospheric nitrogen fixation at high rates. Azolla is a good source of nutrient rich biomass which is being mass multiplied and usd as a green manure cum biofertilizer for rice crop by incorporating with soil in order to provide a natural source of the crucial nutrient nitrogen. As azolla grows on stagnant water bodies, it is being used for wet land rice crop. The positive effects of fresh azolla on growth and yield of rice crop are well demonstrated by several workers but the fertilizers usefulness of azolla for dry land crops has not been studied much. A wide range of crop residues, animal dung and other organic waste are being converted as organic fertilizers by vermicomposting,. The vermicompost produced from azolla, cowdung and leaf litter were applied individually to dry land crop *Vigna mungo* and it was observed that the application of azolla-vermicompost enhanced the plant growth and biochemical properties significantly when compared to other treatments under pot experiments. The results of these studies will be discussed.

9. Enhanced Auxillary Bud Proliferation in Nodal Segment Cultures of *Ephedra Gerardiana*

Vandana Sharma*, Manjul Dhiman and Subodh Kumar Gupta

Department of Botany,
K L DAV P G College,
Roorkee-247667 (U.A.)

Keywords : *Ephedra, Conservation, Cytokinins, Micro propagation.*

An increase in number of herbal medicinal products is leading to a mass scale exhaustion of medicinal plant wealth of India. Immediate steps using biotechnological tools are needed to protect and conserve endangered and threatened medicinal plant resources. *Ephedra* is an important drug plant used in Indian Ayurveda since long. *Ephedra* has been the main botanical source of active alkaloids, l-ephedrine (E) and d-pseudoephedrine (PE) with records of its medicinal use dating back to 5000 years B. C. Excessive use of this plant is leading to a loss of the *Ephedra* germplasm in its natural habitat. In India, high alkaloid containing species is *Ephedra gerardiana* which occurs at high altitudes in Northwest Himalayas. Present report is an attempt to conserve *Ephedra gerardiana* using micropropagation technique.

The paper describes application of different cytokinins for an enhanced auxillary bud proliferation in cultured nodal segments of *E. gerardiana*. The explants were cultured onto MS medium containing various cytokinins, alone or in various combinations. There was a multifold increase in number of shoot buds when both BAP and Kn were used in basal medium. Maximum percentage of cultures exhibiting shoot bud proliferation as well as maximum number of shoots per explant was achieved onto 5µMBAP+10µMKn supplemented medium. The shoot buds were further multiplied onto same medium and elongated onto hormone free medium. The shoots rooted when transferred onto ¼ strength basal medium supplemented with 15µM IBA. The plants thus produced were finally grown in glass house followed by soil beds. Transplanted saplings were further rehabilitated in its natural habitat.

II. MYCOLOGY, PLANT PATHOLOGY, MICROBIOLOGY AND NANOSCIENCE

10. Aparaginase Production by Endophytic Fungi Isolated From Salt Marsh Plant in Parangipettai Coast

K. Indira, M. Mahalakshmi and M. Srinivasan

Centre of Advanced Study in Marine Biology,
Faculty of Marine Sciences
Annamalai University,
Parangipettai-608 502Tamil Nadu

Key words : *Salt marsh plant, Endophytic fungi, Asparaginase.*

Asparaginase is an important enzyme used as an anti cancer compound. Salt marsh plant (Suveda monoica) was used for fungal isolation by triple surface sterilization method. Twenty three isolates of endophytic fungi were evaluated for asparaginase production using qualitative and quantitative analyses. Seven isolates demonstrated pink zone around their colonies. *Fusarium* spp, and *Aspergillus* spp, isolated from salt marsh plant were highly active when tested with quantitative assay. The endophytic fungi with high activity are proposed as a possible asparaginase source to manage cancer cells.

11. Phytotoxic Effects of Pyrethroid Insecticide on Seed Germination of *Zea mays*

Shraddha Sharma and Babita Sharma

Institute of Applied Medicines & Research
9th Km. Stone, Delhi-Meerut Road, Duhai,
Ghaziabad (U.P.)

Keywords : *Zea mays cypermethrin,*

For the present study *Zea mays* var. Ganga 2 was selected. The insecticide chosen for the study was cypermethrin (25% EC). For the study, three different concentrations of insecticide i. e. recommended dose 0. 05% (x), twice the recommended dose 0. 1% (2x) and four times the recommended dose 0. 2% (4x) were taken. The control was tap water. The uniform viable seeds of var. Ganga 2 were soaked in various concentrations of insecticide and tap water. It was found that seed germination was inhibited at all the used concentrations. The seed vigour also declined as the concentrations of insecticide was increased from x to 4x. Various growth parameters like fresh weight and dry weight of the seedling, % moisture content, number of leaves, number of roots and average root lengths were adversely affected by the chemical stress induced by insecticide. The reduction in growth was minimum at the x dose and was maximum at 4x dose of insecticide. ?-amylase activity also declined in response to pesticide treatment. Decrease in enzyme activity was maximum at 4x concentration. A decline in chlorophylls (*a*, *b* and total), carbohydrate, protein, carotenoid and anthocyanin content was observed in the seedlings exposed to different concentrations of insecticide.

12. Effect of Nanoporous Adsorbants on Shelf-life Enhancement of Neem based Bio-pesticides.

Devendra Kumar[1], Parag Vilas Naik[1], Dr. M. C. Gopinathan[1] and Naresh Pal[2]

[1]EID Parry (I) Ltd.,
R&D Centre, 145 Devanahalli Road,
(Off) Old Madras Road,
Bangalore 560 049
[2]Department of Chemistry,
S. S. V. (P. G.) College,
Hapur (Ghaziabad)

Keywords : *Neem, Azadirachtin, Nanotechnology.*

Neem tree, *Azadirachta indica* A. Juss., has drawn significant attention world wide in the changing organic farming scenario because of its safe and environment friendly pest control properties. Azadirachtin A is the key active ingredient for manufacturing most of the neem-based bio-pesticides. An approach to make use of nanotechnology resulted in identification of a nano-porous substance of pore size <1 nanometer which was able to enhance half-life of Azadirachtin A in liquid formulations by 40. 2%. The neem formulations were treated with nanoporous adsorbents such as precipitated silica, neutral alumina, fly ash, tea leaf powder and nano-porous activated carbon and found that nano-porous activated carbon of pore size distribution of "micropores r<1 nanometer, mesopores r = 1–25 nanometer and macropores r>25 nanometer" has ability to selectively remove the impurities causing degradation to the molecule and significantly enhances its stability in liquid formulations. The studies on identification of the compounds adsorbed by nano-porous activated carbon revealed that organic fatty acids as oleic acid were eliminated upto an extent of 46. 5% and four toxins *viz.* Aflatoxin B1, Aflatoxin B2, Aflatoxin G1 and Aflatoxin G2 were removed upto an extent of 43. 1, 66. 0, 57. 1 and 100% respectively.

13. Biological Management of Moong Bean Crop for Sustainable Agriculture

B. K. Mishra, R. C. Mishra, K. P. Pandey, Rohit Mishra and Anupam Dikshit

Biological Product Lab,
Botany Department, University of Allahabad,
Allahabad-211002

Keywords : *Trichoderma viride, bioagents., isolates*

To reduce indiscriminate use of chemical pesticides for the disease management of moong bean crops, different isolates of *Trichoderma viride* were tested alone and in combination with permissible and safer doses of chemicals. After the primary trials different carriers were screened to develop a suitable formulation with long shelf life. Shelf life of formulation was tested at different storage temperature to develop best way for storing bioagents. Mass multiplication of the formulation was done using different agricultural and farm remains. After successful pot and field trials result show that talcum based formulation with 5% CMC was most useful as carrier of bioagent. Maximum shelf life was recorded when formulation was stored at 30^0C temperature. Temperature below 20^0C and above 40^0C results in reduction of shelf life of the bioagent. It was further recorded that use of cattle dung was found to be cheap and best agri and farm remains for the multiplication of the bioagent. *Trichoderma* based formulation along with vitavax (1%) was found to be most useful for controlling fungal diseases of pulses without any adverse effect on environmental and human health.

14. Potentiality of Piper longum Oil as Natural Antifungal Against Onychomycosis Related Fungi

Mamta Patra Shahi1 and Sushil K. Shahi2*

Department of Biotechnology,
Meerut Institute of Engineering and Technology, Meerut
*Bioresource Tech Laboratory,
Microbiology Department, CCS University,
Meerut-250005

Keywords : *Antifungal, essential oil, Epidermophyton, Microsporum, Trichophyton, dermatophytoses, herbal therapy*

The essential oil of *Piper longum, in vitro* showed strong fungicidal activity. The minimum inhibitory concentrations of the oil were found to be 0. 1, 0. 2, 0. 2, 0.1 and 0.1?l/ml *Epidermophyton floccosum, Microsporum gypseum M. nanum, Trichophyton rubrum* and *T. mentagrophytes* respectively. The oil inhibited potency against heavy doses of inoculum at 1. 0 ?l/ml concentration. The oil was found thermostable upto 80^0 C and the antifungal activity did not effected upto 36 month of storage. The oil have quick killing action. The oil also showed broad antifungal activity as also killed some other dermatophytic and non-dermatophytic fungi at the range of 0. 5-2. 0 ?l/ml concentrations. . Moreover, the oil did not cause any adverse effects on mammalian skin upto 5% concentration. Thus, the oil could be used as potential source of antifungal agent after undergoing successful multicentre clinical trial.

15. Screening of Antagonistic Fungi against Toxigenic Aspergillus flavus and Biodegradation of Aflatoxins

Rajesh Kumar and Ved Pal Singh

Applied Microbiology and Biotechnology Laboratory,
Department of Botany
University of Delhi,
Delhi -110 007

Keywords : *Alfatoxin, Aspergillus, detoxification*

Aflatoxins are cyclopeptides, polyketoacids, terpenes, and nitrogenous secondary metabolites produced by *Aspergillus flavus*. Aflatoxin B_1 is one of the most harmful mycotoxins in most foods, feeds and other agricultural produce, posing potential threat to both human and animal health as well as the environment. In the present investigation, two fungi, isolated from the soils of Garwal Himalaya and identified as *Trichoderma reesei* and *Trichomyces flavus*, using 18S rRNA gene sequence analysis, inhibited the growth of toxigenic *Aspergillus flavus* (CMI

102566). The antagonistic fungus Trichoderma *reesei* degraded aflatoxins B_1 to the extent of 82,69% and $B_{2.}$ to the extent of 64. 34%. The other fungal antagonist, *Talaromyces flavus* degraded these toxins (B_1 and B_2) to tune of 56. 9% and 68. 09%, respectively. The biological control of aflatoxins and their producer organism, *Aspergillus flavus* provides an effective, eco-friendly and economically viable detoxification strategy so as to minimize the use of expensive and hazardous chemicals.

16. Bio Control of Alternaria Leaf Blight of Sunflower

Vikas V. Patel, Reetu Gangwar and U. S. Mishra

Phytopathology Lab.
Department of Botany
Bareilly College,
Bareilly M. J. P. Rohilkhand University,
Bareilly-243006

Keywords : *Alternaria leaf blight, sunflower, seed germination, seedling vigour, management*

Alternaria leaf blight of sunflower is a very common and destructive disease in Rohilkhand region. Despite the rapid spread of the crop in India, the productivity is going down in recent years due to the susceptibility of this crop to the fungal diseases. The symptoms of *Alternaria* leaf blight appeared in the month of March in the form of characteristic small circular, brown coloured patches on the surface of leaves and these brownish patches grow in size and coalesced to cover the entire surface of leaves producing blight symptoms. Marked blight symptoms are seen in the head (capitulum) of heavily infected plants in which seeds are also infected with *Alternaria helianthi.* Naturally infected seeds with *A. helianthi* and artificially inoculated one showed 38. 6% and 23. 0% reduction in germination respectively. Shoot and root length of seedlings was also significantly reduced in both cases. There was a marked increase in number of seedlings showing blight incidence with increase in spore load of *A. helianthi* on seeds. Biocontrol of *Alternaria* blight by selected natural herbal plant extracts *in-vitro* has been observed and recommended for use to the farmers.

17. Diversity of Genus Tomentella in Himachal Pradesh

Jaspreet Kaur*, Harpreet Kaur, Nina Jain and G. S. Dhingra

Department of Botany,
Punjabi University
Patiala (Pb.)-147 002

Keywords : *Thelephoraceae, Thelephorales, Basidiomycota*

Genus *Tomentella* Pat. is a cosmopolitan genus within family *Thelephoraceae* (O-*Thelephorales*, Phylum-*Basidiomycota*) with 80 known species (vide Kirk *et al*. , 2008). It is characterized by resupinate, arachnoid, mucedinioid or pelliculose, adherent to separable basidiocarps; monomitic or dimitic hyphal system; 2-4 spored basidia; globose to ellipsoid, regular or irregular in outline to lobed, warted or echinulate basidiospores.

Present work is based on the collections made from the different localities in Himachal Pradesh during the years 2008-2009. On the basis of macroscopic and microscopic studies these have been keyed out as 10 species of genus *Tomentella*. Of these, as many as 9 (*Tomentella clavigera, T. rufobrunnea, T. bresadolae, T. radiosa, T. rhodopheae, T. subclavigera, T. brevispina, T. violaceofusca* and *T. griseoviolacea*) are new specific records for India and 1 (*T. terrestris*) new record for Himachal Pradesh. Earlier workers have described 37 taxa of this genus from India [Thind and Rattan (1971) 7 taxa, Rattan (1977) 14 taxa from North-West Himalaya; Natrajan and Chandershekara (1978) 1 new species (*T. vesiculosa*) from South India; Dhingra (1985) 3 taxa from Eastern Himalaya; Dhingra and Malka Rani (1994) 10 taxa including 1 new species (*T. kalatopii*) and 1 new variety (*T. cladii* var. *grandii*) from Dalhousie hills (H. P.)], of which 33 are described from Himachal Pradesh. With the present study the number of taxa of *Tomentella* has increased from 37 to 46 in India and from 33 to 42 in Himachal Pradesh. Consolidated key to all the species, including previous reports, has been given. The color standards used are as per Kornerup and Wanscher (1978) and abbreviations used for Herbaria are according to Holmgren and Keuken (1974).

18. Seed Borne Fungi : An Important Tool for the Biological Management of Parthenium Hysterophorus, a Deadly Weed of India

***Nikita Banerjee and A. K. Pandey[1]**

*Mycology Research Laboratory,
Dept. of Biological Sciences,
R. D. University,
Jabalpur-482001 (M.P.)
Email : nikitabanerjee@rediffmail. com

[1]M. P. Private University Regulatory Commission,
Bhopal (M.P.)

Keywords : *Parthenium, seed borne fungi, weed, biological management.*

Parthenium hysterophorus is an obnoxious and pernicious weed, causes damage in environment and agriculture by spreading disease causing agents in various ways. The conventional and mechanical techniques used for the management of *Parthenium* have been failed due to several reasons. Also, modern agriculture and the proper usage of chemical herbicides have greatly decreased the number of weeds; however, they continue to cause significant losses. Use of plant pathogens, especially fungi have been suggested as one of the possible means of controlling the weed population with ecofriendly properties as an alternative source of chemical herbicides. Numerous seed borne fungi from many different weeds have been isolated and reported till date. The present paper deals with the exploitation of seed borne fungi for the biological management of *Parthenium hysterophorus*.

19. Pesticidal Effects on Nodulatioin and N-Fixation in Groundnut (Arachis hypogaea L) C. V. SB-11

R. S. SALER

P. G. Deptt. of Botany
K. T. H. M. College,
Gangapur Rd, Nashik-2 Maharashtra

Keywords : *Groundnut, Pesticides, N-fixation, germination*

Application of pesticide compounds to soil affected the germination, shoot and root growth, nodulation and N- content in different ways. 2,4-D completely inhibited seed germination at 1500 µg/ml. In streptomycin, Aureofungin, Thiram, Carbofunran, Thiodan, Hexacap, Difolatan and calixin less than 50% germination was observed. In case of RH-124 and Calixin seeds were germinated but did not survive after 30 days at 1500 µg/ml and 80ppm respectively. In Dithane Z-78, Ceresan, Dithane M-45, Blitox, Blitane, Brassicol, Topsin-M, RH-124, Bavistin, Disystan, Dasanit and Hexafeb 50-90% seed germination was observed. Rovral give 100% germination. Shoot length was stimulated by Bavistin, Blitox, Brassicol, Ceresan, Dithane Z-78, Hexacap and Disystan while it was inhibited by other compounds. Similarly stimulation of nodule formation was seen in Bavistin, Blitox, Brassicol, Ceresan, Rovral and Thiram. Consequently increased due to these compounds. Difolatan, Hexafeb, Thiram and Dasanit, however, delayed flowering period.

20. Taxonomic Studies on the Genus Psathyrella from Punjab

M. K. Saini, Harwinder Kaur, N. S. Atri and Amanjeet Kaur

Department of Botany,
Punjabi University,
Patiala-147002

Keywords : *Taxonomy, mushrooms, Psathyrella*

A number of fungal forays were undertaken in the past decade to various localities of Punjab, with an aim to collect the agarics from the wild. As a result of these forays, 24 collections were found to be falling under the 10 species of genus *Psathyrella* (Fr.) Quél. of family Psathyrellaceae. The collections were taxonomically worked out for their macroscopic and microscopic details. The 10 species of *Psathyrella* included in this paper are *P. naivashaiensis* Pegler var. *macrospora*, *P. singeri* Smith, *P. incerta* (Peck) Smith. , *P. longistriata* (Murrill) Smith, *P. obtusata* (Fr.) Smith, *P. moshiana* Pegler, *P. lithocarpi* Smith, *P. spintrigera* (Fr.) Konr. & Maubl. , *P. atroumbonata* Pegler, and *P. candolleana* (Fr.) Maire. . Out of these, first six are first time reports from India and one new variety, namely *P. naivashaiensis* Pegler var. *macrospora* has been proposed. For all these taxa, the taxonomic details are given. *P. lithocarpi* is being reported for first time from North India while the other three species are re-reported.

21. Systematic Studies on Genus Amanita Section Validae from India

M. K. Saini and Yadwinder Singh

Department of Botany,
Punjabi University,
Patiala-147002, Punjab

Keywords : *Taxonomy, Amanita, Mushrooms*

Work on the diversity & taxonomy of genus *Amanita* was planned, thus a number of forays were undertaken to various localities viz. Yamunotri, Mussoorie, Chakrata, Deoban, Dhanaulti, Kedarnath, Chopta, Joshimath in Uttarakhand and Shimla, Narkanda, Solan, Mandi, Manali, Palampur, Churdhar, etc. in Himachal Pradesh in North-West India. As a result of these forays number of amanitas were collected, the present paper deals with the species of *Amanita* belonging to section *Validae* (Fr.) Quél. , which is characterized in possessing amyloid spores, non-appendiculate cap margin and lacking membranous limbate to saccate volva. Seven species of genus *Amanita* section Validae viz. *A. brunneolocularis* Tulloss, Overbo & Halling (forms putative ectomycorrhizal association with *Quercus semecarpifolia*), *A. karea* G. S. Ridl. (found under *Pinus roxburghii*), *A. flavoconia* var. *inquinata* Tulloss, Ovrebo & Halling (found under *Picea smithiana*), *A. flavoconia* G. F. Atk. (found under *Pinus roxburghii* and *Cedrus deodara*), *A. fritillaria* (Berk.) Sacc. (forms putative ectomycorrhizal association with *Pinus roxburghii*), *A. flavipes* S. Imai (found under *Cedrus deodara*), and *A. orsonii* Ash. Kumar & T. N. Lakh. (found under *Quercus semecarpifolia*). Out of these, the first three taxa are first time reports from India and are taxonomically described for their macroscopic and microscopic details.

22. Taxonomy of Russulaceous Mushrooms from Himachal Pradesh

M. K. Saini, N. S. Atri and Samidha Sharma

Department of Botany,
Punjabi University,
Patiala-147002. Punjab

Keywords : *Taxonomy, Russula, Mushrooms*

This paper records six species of genus Russula belonging to Section *Tenellae* from different localities of Himachal Pradesh. The documented species include *R. nitida, R. nauseosa, R. melzeri, R. versicolor, R. puellaris* var. *puellaris, R. brunneoviolacea* var. *rubeogrisea* and *R. brunneoviolacea* var. *macrocarpa* var. nov. Out of these *R. brunneoviolacea* var. *macrocarpa* var. nov. is a new variety proposed and *Russula puellaris* var. *puellaris* Fr. and *R. brunneoviolacea* var. *rubeogrisea* Romang. are the first time reports from India. The diagnostic characters of new taxa proposed and the new records are given in the ongoing account.

23. Addition to the Myxomycetes Flora of India

Jadhav D. M. and S. P. Nanir*

Dept. of Botany,
G. M. D. Arts B. W. Commerce & Science College,
Sinnar-422103 Maharashtra
*Dept of Botany,
Institute of Science,
Caves Road, Aurangabad,
Maharashtra

Keywords : *Fungi, Myxomycetes, Diderma*

The Genus ***Diderma*** Pers. is represented by over about 57 species from the world. Up till now about 29 species have been described from the Indian flora and about 11 species from the state of Maharashtra. In the present paper 2 species are being described and illustrated from the region of north eastern ranges of western Ghat and constitute the addition to the list of Myxomycetes flora of India. viz**.** ***Diderma donkii*** Nann. –Brem. and ***Diderma lohogadensis*** Patil Ranade and Mishra. Former species constitutes new record to the Indian Myxomycetes while later has been collected for first time after type collection.

24. Broad-spectrum Herbal Pesticide Fight Post Harvest Spoilage of *Malus pumilo* L.

Sushil K. Shahi[1] and Mamta P Shahi[2]

[1]Bio-resource Tech Laboratory,
Department of Microbiology, CCS University,
Meerut-250005
[2]Department of Biotechnology,
Meerut Institute of Engineering and Technology,
Meerut-250005

Keywords : *Eucalyptus citriodora* Hook., fungicidal spray, fruit rot, herbal pesticide, *Malus pumilo*

Eucalyptus citriodora oil, in vitro showed potent bioactivity against dominant post harvest fungal pathogens. The minimum bioactive concentrations with fungicidal action of the oil was found to be 1. 0 ?l ml^{-1} for *Alternaria alternata, Botrytis cinerea, Cladosporium cladosporioides, Colletotrichum capsici, C. falcatum, Fusarium cerealis, F. culmorum, Gloeosporium fructigenum, Penicillium digitatum, Penicillium expansum, P. italicum, P. implicatum, P. miniooluteum,* 1. 2 ?l ml^{-1} for *Aspergillus flavus, A. fumigatus, A. niger, A. parasiticus, Curvularia lunata, Fusarium oxysporum, F. udum, Penicillium variable, Helminthosporium oryzae,H. maydis, Phoma violacea,* and 1. 4 ?l ml^{-1} for *Rhizopus nigricans*. The oil exhibited potency against heavy doses (30 mycelial disc, each of 5 mm in diameter) of inoculum at 2. 0 ?l ml^{-1} concentrations. The bioactivity of the oil was thermostable up to 100^0C and lasted upto 72 months. The oil preparation did not exhibit any phytotoxic effect on the fruit skin (epicarp) of *Malus pumilo* up to 50 ?l ml^{-1} concentrations. In vivo trials of the oil as a fungicidal spray on *Malus pumilo* for checking the rotting of fruits, it showed that 30 ?l ml^{-1} concentration controls 100% infection by pre-inoculation treatment, while in post-inoculation treatment, 40 ?l ml^{-1} concentration of fungicidal spray were required for the 100% control of rotting. The fungicidal spray was found to be cost effective (INR 15/L) has long shelf life (72 month) and devoid of any adverse effects. Therefore, it can be used as a potential source of Sustainable Eco- friendly broad-spectrum herbal pesticide (SEBHP-2002), after successful completion of wide range trials.

25. Quantitative Estimation of Water Borne Conidial Fungi in Two Freshwater Streams of Kumaun Himalaya

Pratibha Arya and S. C. Sati

Botany Department,
Kumaun University,
Nainital-263002, Uttarakhand

Keywords : *Water borne conidial fungi, freshwater streams, quantitative estimation.*

Water borne conidial fungi commonly occur in all types of natural freshwaters streams and form one of the most important components of freshwater ecosystem as decomposers. They produce tremendous conidia in submerged condition. In the present study conidial concentration of these fungi in per unit volume of water in two freshwater streams situated at different altitudes viz. , Ratighat (1200 m asl) and Vinayak (1500 m asl) was determined by using the millipore filter paper technique following Iqbal and Webster (1973). The results demonstrate that in Ratighat stream 21 species of water borne conidial fungi belonging to 15 genera were found. Maximum numbers of conidia were observed in the month of December (41. 05 × 10^3 conidia/litre) and minimum numbers of conidia were observed during May (12. 83 × 10^3 conidia/litre). In Vinayak stream 26 species of water borne conidial fungi belonging to 18 genera were found. Maximum concentration of conidia per litre of stream water sample was observed during the month of January (74. 40 × 10^3 conidia/litre) and the minimum concentration of conidia was observed during June (30. 79 × 10^3 conidia/litre).

26. Sterigmatocystin Induced Changes in the Hematological Features of Guinea Pigs (*Cavea cavea*).

Chandra Shekhar[1] Varma and Ramashankar Prasad[2]

[1]Reader, University Dept. of Botany,
V. K. S. U., Ara.
[2]Jagjiwan College, Ara

Keywords : *sterigmatocystin, hemoglobin, R. B. C. count, guinea pigs.*

Animals were exposed to sub-acute oral dose of pure sterigmatocystin (150 µg / kg). Blood samples were collected for hematological evaluation after 20 weeks of treatment. Significant ($P < 0.01$) decrease in the amount of hemoglobin (Hb) and R. B. C. count was observed among animals receiving sub-acute oral dose of sterigmatocystin when compared with that of control. The level of hemoglobin in control group was 14.22 ± 0.19 whereas in that of toxin treated group was 11.3 ± 0.27 ($P < 0.01$). Erythrocyte count in control group was $5.43 \pm 0.10 \times 10^6$ / mm^3 whereas in treated group it stood as 4.1 ± 0.08 ($P < 0.01$). Health conditions of animals among toxin treated group, too, were poorer. Weight loss, feed refusal, reduced reproductive performance and hair loss were common incident in animals receiving sterigmatocystin.

27. Characterization of Endophytic PGPR Isolates from Root Nodules of *Medicago Sativa*

Saroj Sharma[1], Mangal S. Rathore[2] and R. K. Gaur[1]*

[1]Biotechnology Laboratory,
Department of Science, FASC,
Mody Institute of Technology and Science (MITS),
Lakshmangarh, Sikar, Rajasthan-332311
[2]Discipline of Wasteland Research,
CSMCRI, A Constitute of CSIR, Bhavnagar
Gujarat-364001

Keywords : *PGPR, Medicago sativa, phosphate solubilization, 16S rDNA.*

Endophytic bacteria colonize plant tissues and have often been reported to promote plant growth. Rhizobacteria are particularly known for their symbiotic relationship with legumes. A bacterial strain RM-1 was isolated from surface-sterilized root nodules of *Medicago sativa*. Plants of *Medicago sativa* were uprooted from the Laxmangarh, (Sikar) Rajasthan, India. Nodules were collected, washed several times in sterile water, surface-sterilized with 70% ethanol and 0.1% $HgCl_2$, and repeatedly washed with sterile water. Sterile nodules were crushed and the resulting suspension was streaked on yeast extract mannitol (YEM) agar plates, which were incubated at 28 °C. Pure isolates were subjected to phenotypic and Biochemical characterization, wherein all isolates appeared

similar. RM-1 was Gram-negative, capsulated, motile, non-endospore forming rod with free nitrogen (N) fixation ability. Effect of temperature, salinity, pH and heavy metals was observed in 50 ml YEM broth. The flasks were inoculated with 500 µl liquid culture of isolate and incubated at 28 °C at 120 rpm. One flask with normal broth inoculated with culture served as control. Absorbance was measured after 24 hours and growth monitored at 610 nm. Biochemical characterization includes MR-VP test, casein hydrolysis, starch hydrolysis, H_2S production, citrate utilization, nitrate reduction, triple sugar iron test and carbohydrate fermentation. The strain was further screened for plant growth promoting activities like Catalase production, phosphate solubilization, indole production, HCN production and NH_3 production. Molecular characterization also carried out on the basis of 16S rDNA.

28. Antifungal and Antioxidant Efficacy of Piper Betle Essential Oil Against *A. flavus* and some Common Storage Fungi and its Safety Assessment

Nawal Kishore Dubey, Bhanu Prakash and Prashant Mishra,
Ravindra Shukla and Priyanka Singh
Department of Botany,
Banaras Hindu University,
Varanasi-221005

Keywords : *Antifungal; Antioxidant; Piper betle*

The paper recommends the *Piper betle* essential oil as a nontoxic antimicrobial, antiaflatoxigenic and antioxidant agent. The EO exhibited pronounced antifungal activity against the tested moulds and also possessed inhibitory effect on aflatoxin B_1 (AFB_1) synthesis. It completely checked the AFB_1 synthesis by the toxigenic strains of *A. flavus* at 0. 6 ìl/ml. Eugenol (63. 39%) and acetyleugenol (14. 05%) were the major components from the EO identified through GC and GC–MS analysis. EO also exhibited strong antioxidant potential as its IC_{50} value (3. 6 ìg/ml) was close to that of ascorbic acid (3. 2 ìg/ml) and lower than that of butylated hydroxytoluene (BHT) (7. 4 ìg/ml). The EO was found non-mammalian toxic with showing high LD_{50} (2437. 33ìl/kg) during oral toxicity on mice.

29. Studies on Cellulolytic Fungi Isolated from the Soil of Patna.

Namita Kumari, Surendra Kumar Prasad and *Arvind Kumar

Magadh Mahila College
College of Commerce,
Patna-l Patna-20

Keywords : *Cellulolytic Fungi, Cellulosic materials and Cellulase.*

In the present study an attempt was made to examine the different fungal forms found in the soil of Patna, which is responsible for the degradation of different Cellulosic materials such as cotton cloth, paper andjute. These cellulolyticfungi degrade cellulose by secreting enzyme cellulase and maintain the Carban balance in nature. All together twelvefungal species had been isolated, containingfour species of Aspergillus. Four species of Chaetomium, two species of Trichoderma and one species each from fusarium and Geotrichum. This inv~stigation gives the clear picture of Microbial population which are responsiblefor qualitative loss of cloths, paper andjute.

30. Three New Ascomycetes from Maharashtra

P. S. Kaste and D. V. Hande*

Assistant Professor, Deptt. Of Botany,
J. D. Patil Sangludkar Mahavidyalaya,
Daryapur, Distt. Arnravati (M. S.)-444 803.
Deptt. of Botany,
Shri Shivaji Science College,
Amravati (M.S.)-444 604

Keywords : *Ascomycetes, new species, Maharashtra.*

During our investigations on the Ascomycetes of Maharashtra, three new species of Ascomycetes viz., PeroneutypaBerlese, Physalospora Niessl and Pteridiospora Penz. and Saccowere collected growing saprophytically on dead stems of Lantanacamara L., dead leavesof Agave americanaL. and dead stems of

Bambusa arundinaceae (Retz.) Willd. respectively. For its diagnosis and specific identify the fungi were studied in detail with respect to morphology and dimensions of various fruiting structures, especially the stromata, perithecia, asci and as-cospores. Further, they were also compared with the earlier known species and found to differ greatly in the size of various fruiting structures. Hence, they are described here under a new taxa.

31. Response of *Zea mays* L. Plant to Vesicular Abuscular Mycorrhizal Inoculation

Nitin Kumar, Navneet Kumar Mishra and Reena Mohanka.

Plallt pathology and Microbiology laboratory,
Department of Botany,
Patlla Uiliversity, Patlla, Bihar.

Keywords : *Vasicular -arbuscular mycorrhiza, Zea mays, Autoclave, soil*

The vesicular arbuscular mycorrhizal (VAM) symbiosis formed between plant roots and fungi is one of the most wide spread symbiotic associations found in the plant. Vesicular arbuscular mycorrhizae can increase plant uptake of nutrients. The present investigation has been made about the response of vesicular arbuscular mycorrhizal fungi on Zea mays L. plants. Soil was collected from different regions of Hajipur in Bihar during March 2010. The present experiment was done in two sets of pots, each set had 10 pots. The first set had no mycorrhizal inoculatiDns, while the second was inoculated with mycorrhizal spores. Their length and biomass were measured and p~acedin the table.

32. Mycoflora in the Ganga River near Danapur region of Bihar.

Chandan kumar, Gazala Tabassum and Choudhary Sharfuddin.

Plant Pathology and Microbiology Laboratory,
Deptt. of Botany,
Patna University, Bihar

Keywords : *Microfungi, Pure culture, Incubation and Photoplates.*

A frequent discharge of sewage in the River Ganga and a periodic inundation recession of annual flood water depositing silts, has drastjcally affected the ecology of Ganga River. The seasonal variation in the frequency of the fungi were found to be regulated by many factors like temperature, water chemistry, pollutants, dissolved oxygen etc. Consequently the present investigation was under taken to survey of the mycoflora of Ganga water near Danapur region of Bihar. Water samples collected in a sterilized small plastic container during November 2008 to October 2009. Samples were analyzed for mycoflora on Martin's rose bengal Agar medium. Around 23 fungi of different groups were identified. Their percent frequency were also measured and placed in the table.

33. Antiswarming and Antibacterial Activity of *Euphorbia Trigona*

Roshan Kumar*, Archana Mehta and Jinu John

Plant Biotechnology Lab,
Department of Botany,
Dr. Hari Singh Gour University,
Sagar (M.P)-470 003

Keywords : *Euphorbia, Antiswarming and Antibacterial activity.*

Euphorbia trigona was analyzed for possible antiswarming and antibacterial activity. Antimicrobial activity with disc diffusion method has showed that all the extracts were not so effective in inhibiting the growth of the bacteria. In antiswarming activity most of the extracts were found out to inhibit swarming of *Proteus vulgaris* but h1iled to inhibit the growth of the bacteria. Swarming of bacteria is related with the virulence of the organism. By inhibiting swarming we are probably disallowing the pathogenic organism to spread disease without affecting its growth. We have probably succeeded in isolating natural non-toxic compound from the Euphorbiawhich doesn't affect the growth of the bacterium but inhibits swarming.

34. Incidence of Fungi on Seeds and Husks of Isabgol

Rashami Agarwal and Singh
Department of Botany
Agra College, Agra

Keywords : *isbgole, husk, toxigenic mycoflora*

Isabgol (Plantago ovata. Forsk) is well known ancient medicinal plant. The main object of our study was to evaluate the quality of seeds and husks of Isabgol and to list associated predominant toxigenic mycoflora which is mainly concerned with the possible health hazards due to intake of mycotoxin contamined husk of Isabgol is consumed daily by elder people who are suffering from constipation and digestive disorders. In all 26 fungi were recorded from seed and husk samples of Isabgol. The predominant fungi includes 16 species of *Aspergillus*, 3 species of *Penicillium*, 4 species of *Fusarium* and one species each of *Acremonium, Alternaria, Cladosporium, Curvularia, Drechslera, Memnoniella, Mucor, Nigrospora, Rhizopus*, *Stachybotrys, Torula, Trichoderma* and *Ulocladium*. The most dominant mould was *Aspergillus flavus.* A total of 38 isolates of A. jlavus were isolated and screened aflatoxigenic nature. Out of these 23 isolates showed aflatoxigenic nature in orange yellow pigmentation test, thereby showing aflatoxigenic nature of 60. 60/0 isolates. The other dominant moulds were Fusarium oxysporum and penicillium citrinum. These forms are also known to elaborate mycotoxins.

35. Mushrooms and Ethnomycology in North-West Himalaya of Jammu and Kashmir, India

Sanjeev Kumar* and Yash Pal Sharma
Department of Botany,
University of Jammu, Jammu,
Jammu & Kashmir-180006

Keywords : *mushrooms, ethnomycology, edibility*

Explorations were undertaken over a period of three years (2006-2009) to collect and document the wild edible mushroom diversity occurring in the

north-west Himalayan forests of Jammu and Kashmir State. Consequent upon these forays, sixty two taxa of wild edible mushrooms belonging to Ascomycetes, Basidiomycetes and Gasteromycetes are described and illustrated in the present communication. Out of these, forty taxa are actually consumed in the region and twenty-two are of known edibility elsewhere but not consumed in the study area. Our observations indicate that the region represents a mycophilic society and gathering of wild mushrooms is a traditional activity among the inhabitants of the area. The paper examines the ethnomycological aspects related to the culinary significance and folk taxonomy of the commonly collected mushroom species.

36. Yield loss Assessment in Ash Gourd due to Fungal Diseases

Rajeev Kumar Yadav, B. N Pandey and Somesh Yadav

Department of botany,
Bareilly College,
Bareilly, U.P-243005

Keywords : *ash gourd, fungi, pathogen, disease*

Ash gourd (Benincasahispida) is one of the major vegetable used commercially in preparation of common sweet"Petha". Basicaly it is cultivated at Agraregion of U. P but nowthe crop is well expanded in near by eareas and Bareilly has become a part of that petha hub. Thet otal Production n of pumpkin,squash and gourds in India I s35,00000tones per year harvested from 3,60000 hectare, out of which Benincasa hi~pida(ashgourd) is 15,326 tons per year. Bareilly produces nearly 4500 tones/year. Like other cucurbitaceous vegetable the crop is infected with various pathogens,some of which cause heavy damage to the crop in form damping off, flower and fruit rot. The study was therefore planned to estimate loss in yield of Ash gourd production. An extensive survey was made around ash gourd producing fields of Bareilly district. Forthe estimation of loss in yield during crop season healthy and diseased Plant from

each field were selected randomly and the number of fruits were counted. Size of the fruit was measured separately and compared to the average out of fruits taken from Healthy plants. The total yield loss due to fungal diseases was about 40% that is very big harm To the farmers. During present study the vast prevalent diseases on crop were investigated *Bipolaris tetramera* blight on leaves in high intensity during early November and February, poor growth and reduction in fruit size due to *Aternaria alternata* infection, severe rotting Caused by *Fusarium pallidoroseum* during monsoon season,wilting of leaves and rotting of fruits by the *Curvularia lunata* infection.

37. Efficacy of Biocontrol Agents against Root Rot (*Rhizoctonia solani*) of Mungbean

N. H. Shahare, A. U. Pachkhede and S. H. Kanherkar[1]

Department of Botany,
Brijlal Biyani Science College,
Amravati, (M.S.)-444602
[I]Yashwantrao Chavan College,
Mangrulpir, Dist. Washim (M.S.)

Keyword : *Biocontrol Agents, Mung bean root rot, Rhizoctonia solani.*

Root rot caused by *Rhizoctonia solani* is a soil bornedisease reported on mung bean in India, Taiwan, Iran Philippines and WestMalaysia(Baker1981). Biocontrol agents like antagonistic Fungi and bacteria can be successfully used to control such disease in purview of integrated disease Management system. Five antagonistic fungi viz. *Trichoderma viride, T. harzianum,Aspergiltus flavus, and Penicillium* sp. were tested against pathogenic fungi,isolated form mungbean. In dual culture Trichoderma viride, T. hazianum and *Aspergillus flavus* were effective in inhibiting the growth of *Rhizoctonia solani*. These findings are relevant for development of biocontrol agents sagainst root rot of mungbean.

38. Impact of Postharvest Treatments and Packaging on Enzymes of Sweet Pepper (*Capsicum annum* L.) in Different Storage Conditions

Khilana K. Shah, Neeta B. Gol and T. V. Ramana Rao*

B. R. Doshi School of Biosciences,
Sardar Patel University
Vallabh Vidyanagar-388 120,
Gujarat, India

Keywords : *Capsicum annum, postharvest, treatment, storage, peppers*

The influences of salicylic acid and calcium chloride treatments on sweet pepper fruits packaged in plastic (polythene) bags and stored at 28°C and 4°C were evaluated at 0, 9 and 18 days of, storage period. The activities of cell wan modifying enzymes such as polygalacturonase, pectin mlethyl esterase, cellulase, â galactosidase and antioxidant enzymes like peroxidase, catalase and ascorbic acid oxidase were elucidated in the fruits of experimental sets and they were compared with that of control set. The higher activities of scavenger antioxidant enzymes, including peroxidase and catalase in the treated peppers at the 18days storage period is probably due to the effect of salicylic acid and calcium chloride. The data of the present study may be an indicative that the high peroxidase activity and low activity of cell wall degrading enzymes, such as polygalactuonase,pectin methyl esterase, cellulose β galactosidase in the treated peppers might ‘have been associated with a high integrity of the cell membrane and few changes in the cell wall ‘constituents, which contributed to high levels of brittleness and firmness in the peppers during storage. Thus it may be concluded that the salicylic acid treatment may aid in delaying the softening process, while retaining the nutritional quality, of sweet pepper more than that of calcium chloride treatment.

39. In Vitro Antibacterial Activity of Cassia Fistula Leaves

Subhadip Hajra*, Archana Mehta and Pinkee Pandey

Department of Botany,
School of Biological and Chemical Sciences
Dr. H. S. Gour University,
Sagar (M.P). India

Keywords : *Disc diffusion, Cassia fistula, Phytochemical, Acetone*

In the present study evaluate the antibacterial activity of *Cassia fistula* leaves against *E. coli, P. aeruginosa, K. pneumonia, S. aureus, B. subtilis, S. typhimurium* and *A. culicicola* using agar disc diffusion method. Acetone extract showed much better activity as compared to alcoholic and aqueous extracts. Acetone extract was most susceptible against *P. aeruginosa* and *E. coli* (zone of growth inhibition was 14. 3 : :1 :0. 45 mm and 13. 5 : :1 :0. 08mm) while most resistant bacteria is *S. aureous* (zone of growth inhibition was 10. 0 : :1 :0. 22mm) at the concentration of 200mg/ml. Phytochemical analysis showed the presence of alkaloids, flavonoids, tannins and saponins these may be the active components.

40. Assessment of Antibacterial Activity of *Flacoartia Indica* using Disc Diffusion Method

Pinkee Pandey*, Archana Mehta and Subhadip Hajra

Plant Biotechnology Lab" Deptt of Botany,
School of Biological & Chemical Sciences
Dr. Rari Singh Gour Central University,
Sagar (M.P)-470003

Keywords : *Flacoartia indica, hydro-alcoholic, disc-diffusion, streptomycin and phytochemical*

In the present study, we evaluated the antibacterial activity in the leaf extracts of *Flacoartia indica againstE. coli (MTCC40), P. aeruginosa(MTCC424), K. pneumonia (MTCC432),S. aureus (MTCC 96), B. subtilis (MTCC 619), S. typhimurium (MTCC 98) and A. culicicola* by agar-disc diffusion method. The hydro-alcoholic leaf extract showed pronounced inhibition than methenolic, chloroform and water extract. The hydro-alcoholic extract showed most susceptible activity against *S. aureus and B. subtilis* (zone of inhibition was 19. 0 :I :0. 04mm and18. 4 :1 :0. 24mm) respectively at a concentration of 200µg/ml. Phytochemical analysis showed mainly the presence of alkaloids and steroids, which may the active compounds.

41. Antimicrobial Activity of some Medicinal Plants of Central Region of India

Babita Gupta and Satish Nayak

Bansal College of Pharmacy,
Kokta, Anand Nagar,
Bhopal (MP)

Keywords : *Emblica officinalis, Eucalyptus globules;* extraction, antimicrobial activity.

Present investigation focused on antimicrobial screening of *Emblica officinalis* and Eucalyptus globules against two fungi and two bacteria, *A. niger, A. flavus and E. coli, S typhi.* The hot water and ethnolic extraction technique for extraction of these plants leaves and fruits. The MIC of the extract determined by dilution method of various concentrations. The results show that the extract exhibit better antimicrobial activity.

42. Antibacterial Potential of Hexane and Methanol Extracts of Galls of *Rhus Succedanea*

K. V. Mahalaxmi, B. Lavanya, B. E. Ravi shankara,

S. Sundara Rajan[1] and
Y. L. Ramachandra[1]
Dr. S. G. Reddy College,
Bangalore-560071
[1]Department of Biotechnology,
Kuvempu University,
Shimoga-57? 451

Keywords : *Rhus succedanea, Escherichia coli, Micrococcus luteus,Salmonella typhi, Streptococcus aureus, Anti-bacterial studies*

Rhus succedanea is a deciduous tree and its gall have been used as substitute for karkatasringi, an important plant based product which has importance in ayurveda. xtract of Rhus succedanea galls are prepared in hexane and methanol. These extracts were tested for the antibacterial activity against standard cultures

of *Escherichia coli, Micr, ococcus luteus, Salmonella typhi,* and *Streptococcus aureus*. Both the extracts are effective against Gram positive and Gram negative bacteria. Both the extracts exhibited moderate to significant concentrate dependent antibacterial activity. *Salmonella typhi* and *Streptococcus aureus* is found to be more susceptible to Hexane extract than the Methanol extract. *Micrococcus luteus* is more susceptible to methanol extract than the hexane extract, where as *Escherichia coli* are susceptible to both Methanol and Hexane extract. The phytochemical analysis indicated the presence of Phenols, steroids, triterpenes, Tannins, Alkaloids and carbohydrates in Methanol extracts and flavonoids, terpenes, steroids and alkaloids in Hexane extract. The increased antimicrobIal property of methanol may be due to presence of tannin, phenol and triterpenes. Hence the galls of *Rhus succedanea* are potentially good source of antimicrobial agents.

43. *In vivo* Analgesic and *in vitro* Anti Diabetic Activity of *Momordica dioica*

K. Nagaveni[1], M. D. Khaleel[1], Savitri Shrestha[1], S. Sundara Rajan[1], Sujan Ganapathi[2] and B. E. Ravi shankara[3]

[I]Dr. S. G. Reddy College, Domlur,
Bangalore-560071
[2]Department of Biotechnology,
Kuvempu University, Shimoga
[3]Schoolof graduate studies, Jain University,
Bangalore-560002

Keywords : *Anti-diabetic; Momordica dioica; alpha amylase inhibition assay by DNS method, writhing test, tail immersion test*

Spine gourd is consumed by tribal groups and the native folks for its nutritional and medicinal value. The objective of this study was to evaluate hexane extract of spine gourd *(Momordica dioica*) for its anti-diabetic property in vitro and analgesic property by in vivo method. The study revealed that pancreatic amylase activity was inhibited by the hexane extract randomly at different intervals of time. Thereby suggesting that the fruits of spine gourd act as a potent anti-diabetic source. The analgesic activity using the hexane extract of the fruits of spine gourd was performed using acetic acid writhing test and tail immersion method. The results showed that the hexane extract of *Momordica dioica* acts as an analgesic drug also.

44. *In vitro* Antioxidant Activity and *In vitro* Analgesic Activity in Galls of *Cinnamomum zeylanicum*

Minakshi Pandey[I], S. Navya[I] and B. E. Ravi Shankara[1],
S. Sundara Rajan[2] and Sujan Ganapathy[2]
Dr S. G. Reddy College,
Bangalore-560071
Department of Biotechnology,
Kuvempu University,
Shimoga-577451

Keyword : *Cinnamomum zeylanicum; antioxidant activity; scavenging activity; Tail immersion test; Writhing method*

Cinnamomum zeylanicum is an important spice and aromatic crop having wide application in flavoring, perfumery, beverages and medicines. The present study was carried on to check the antioxidant and analgesic activity of *Cinnamomum zeylanicum* galls using ethanol and aqueous extracts by testing scavenging activity against the DPPH radicals and Superoxide radicals. The study shows that the aqueous extract was more effective as an antioxidant than the ethanol extract at concentration of 10mg/lml. Aqueous extract is more potent in scavenging the DPPH radical with ICsovalue of O. 66mglml. The Aqueous extract is also effective against superoxide radical with ICso being O. 92mglml. This scavenging is also found to be dose dependent. The ethanolic extract was found to be moderate in its scavenging activity with IC50 being 1. 28µg/ml and IC50 being O. 96µg/ml. The analgesic activity using ethanolic extract of galls of Cinnamomum zeylanicum was performed invivo by Tail immersion test and Writhing method. The results showed that the ethanol extract would have a high analgesic activity as against Aspirin which was used as a control. These results suggest that cinnamon galls extracts can be used as food antioxidants and as an analgesic drug.

45. Characterization and Antimicrobial Activity of Silver Nanoparticles Synthesised from Biophytum Sensitivum

K. Pillai Raji*[1], Bishwajeet Singh Bhardwaj[2], Deep Punj[2], N. Chandramohanakumar[1] and M. Kailasnath[3]

[1]Rajiv Gandhi Chair in Contemporary Studies,
Cochin University of Science and Technology,
Cochin-682 022

[2]Centre of Excellence in Lasers and Optoelectronic Sciences,
Cochin University of Science and Technology,
Cochin-682 022

[3]International School of Photonics,
Cochin University of Science and Technology,
Cochin-682 022

Keywords : *Bioreduction, silver nanoparticles, Biophytum sensitivum, antimicrobial*

Biosynthesis of nanoparticles has received increased attention due to a growing need to develop environmentally benign technologies in material synthesis. The possibility of using plants in the deliberate synthesis of nanoparticles is a recent phenomenon. A green, low-cost, reproducible aqueous room temperature synthesis of silver nanoparticles using *Biophytum sensitivum* is investigated. The Ag nanoparticle synthesis is modulated by varying the pH of the reaction medium. The bioreduction of the Ag+ ions was monitored intermittently by measuring the UV-Vis spectra of the solution. The nanoparticles obtained were characterized by Field Emission Scanning Electron Microscopy (FE-SEM), Energy Dispersive Spectroscopy (EDS), X-ray diffraction (XRD), Photoluminescence (PL), Fourier Transform Infrared Spectroscopy (FTIR) and Transmission Electron Microscopy (TEM) techniques. Variation of pH of the reaction medium consisting of silver nitrate and *Biophytum sensitivum* leaf extract gave silver nanoparticles of different shapes and size. The in vitro antimicrobial activity of the synthesised Ag nanoparticles against common human bacterial pathogens were investigated using Agar disc diffusion technique on Mueller Hinton agar media. Standard antibiotics were used as positive controls. The zone of inhibition of the growth of the bacteria is compared with the standard antibiotics. Analysis of the Minimum Inhibitory Concentration (MIC) was done. A significant zone of inhibition was obtained against Gram

positive and Gram negative organisms. Microbes are unlikely to develop resistance against silver, as they do against conventional and narrow target antibiotics because the metal attacks a broad range of targets in the organisms which means that they would have to develop a host of mutations simultaneously to protect themselves. Biological method of high-yield, fast, and low cost synthesis of silver nanostructures for potential biomedical applications is an eco-friendly alternative with immense potential.

46. Design Herbal *Aloe vera* Cosmetic for Skin Care and Cure of *Pityriasis Versicolar*

Amit Kumar Tiwari, Rohit Kumar Mishra, Awadhesh Kumar, Anand Pandey, Shalu Srivastava and Anupam Dikshit

Biological product laboratory,
Department of Botany,
University of Allahabad,
Allahabad-211002

Keywords : *Aloe vera, Antioxidant, APG, Cosmetic, DPPH, Malassezia.*

Aloe vera is one of the oldest known medicinal plants commonly known “true aloe” by gift of nature. Currently APG II placed the genus in the family Asphodelaceae formerly it had been consider as member of the family Liliacae. *Aloe vera* is a unique plant with multi purpose and multi nutritional qualities. It possesses multiple actions to prevent diseases and promotes healing. It contains Vitamins, Enzymes, and Minerals Laxatives (Anthraquinones) Lignin’s, Saponins, Fatty, acids, salicylic Acid, amino acids, proteins and sugars. A lot of *Aloe vera* formulations are available in the market for skin care. However, market formulation and product contain very less amount of *Aloe vera* and herbal component and claiming a wonderful herbal formulation. Present study deals with the development and characterization of *Aloe vera* cosmetic herbal hydrogel formulations using *Aloe vera* leaf and other natural component with scientific validation. *Malssezia* is main culprit organism causing Pityriasis versicolar in human. Antipityriasis action of ethanolic leaf extracts action was study *in vitro* against using broth micro dilution method recommended by CLSI. *Malssezia* is main culprit organism causing

Pityriasis versicolar in human. Antipityriasis action of ethanolic leaf extracts action was study *in vitro* against using broth micro dilution method recommended by CLSI. Five formulations were developed which differ in the ratio of hydrogel forming polymers. Formulations BPLAV1, BPLAV2, BPLAV3 and BPLAV4, BPLAV5 were composed of Phyllanthus, Acacia HPMC, and gelatin in the ratio of 1 : 1 : 1 : 1, 1 : 1 : 2 : 1, 1 : 2 : 1 : 1, 1 : 1 : 1 : 2 and 1 : 1 : 1 : 2 respectively. All the formulations were evaluated for rheology, viscosity, transparency, smoothness, density, pH and microbial growth. On the basis of evaluation parameter formulation BPLAV4 was selected as developed skin care formulation and BPLAV5 for cure of PV. It is also concluded that *Aloe vera* herbal cosmetic hydrogel may be used for cosmetic purpose and cure of Pityriasis versicolar. The antioxidant activity was also determined by means of the DPPH free radical scavenging test. Results were expressed in milimole(mM) ascorbic acid equivalent (AAE) per 100gram fresh weight of fruits.

47. Phylogenetic Interpretations based on Antibacterial Activity of some Essential Oils

Amritesh Chandra Shukla[1], Awadhesh Kumar[1], Rita Gupta[1] and Anupam Dikshit[2]

[1]Dept. of Horticulture,
Aromatic & Medicinal Plants,
Mizoram University,
Aizawl-796009
[2]Biological Product Laboratory,
Department of Botany,
University of Allahabad
Allahabad-211002

Keywords : *Phylogenetic interpretations, CLSI, Bacterial pathogens.*

The plants essential oil of *Micromeria biflora* and *Citrus reticulata* were extracted from the hydrodistilation method. The comparative antibacterial efficacies of the essential oil of both aromatic plants were determined on the basis of MICs and IC50 values using Broth microdilution method recommended by CLSI (NCCLS). The essential oil showed antibacterial activity against gram negative water bacterial

pathogens, *Escherichia coli*, *Salmonella typhimurium*, *Shigella dysenteriae*, and *Vibrio cholerae* respectively. In present investigation, the ClustalW computer program is helpful for studying the phylogenetic relationship of the tested pathogens. The appreciable minimum inhibitory concentrations of essential oil of *M. biflora* were recorded for *E. coli* (ATCC) 0. 172 mg/ml, *E. coli* (MTCC) 0. 308 mg/ ml, S. *dysenteriae* (ATCC) 0. 178 mg/ml, *S. typhimurium* (MTCC) 0. 202 mg/ml and the oil is not effective against *V. cholerae* (MTCC). Whereas the essential oil of *C. reticulata* showed MICs *E. coli* (ATCC) 2. 60 mg/ml, *V. cholerae* (MTCC) 8. 06 mg/ml, S. *dysenteriae* (ATCC) 2. 99 mg/ml, *S. typhimurium* (MTCC) 5. 18 mg/ml here this oil is not effective against *E. coli* (MTCC).

48. Anti-bacterial activity of *Trachyspermum ammi* L. and its major active constituents against water borne pathogens

Awadhesh Kumar[1], Rohit Kumar Mishra[1], Shalu Srivastava[1], Amit Kumar Tiwari[1], Anand Pandey[1], Amritesh Chandra Shukla[2] and Anupam Dikshit[1]

[1]Biological Product Laboratory,
Department of Botany,
University of Allahabad
Allahabad-211002
[2]Department of Horticulture,
Aromatic and Medicinal Plants,
Mizoram University, Tanhril,
Aizawl-796 009

Keywords : *Active constituents, Thymol, Citral, MIC, NCCLS.*

The unsafe drinking water serves as the main source of human fatal diseases of bacterial origin. The Clustal W computer program is helpful for knowing the phylogenetic relationship of five water borne bacterial pathogens using their ITS1 sequences of the aligned standard strains. In the present study water pathogenic gram negative bacteria were inhibited by the action of essential oil of *Trachyspermum ammi* L. The essential oil extracted by hydrodistilation process and their bio-active constituents were analyzed by the Gas Chromatography and Mass Spectroscopy. Of all the various constituents, Thymol; the major constituent was used against

gram –ve bacteria. *In vitro* antibacterial activity of essential oil was tested against *Escherichia coli* (ATCC-25922); **E***scherichia* **coli *(MTCC-723);*** *Vibrio Cholerae* (MTCC-3906); **Salmonella typhimurium *(MTCC- 98) and* Shigella dysenteriae *(ATCC-23513)*** using Broth Microdilution method recommended by CLSI (NCCLS). The essential oil of *T. ammi* exhibited the minimum inhibitory concentration against **E. coli** (ATCC) 0. 087 mg/ml, **V. cholerae** 0. 107 mg/ml, *S. typhimurium* 0. 109 mg/ml, **E. coli *(MTCC)*** 0. 128 mg/ml, *S. dysenteriae* 0. 087 mg/ml. Phytochemical study and susceptibility testing indicated that the active constituents from essential oils of *T. ammi* L. proved to be the most potent antibacterial tool for purification of drinking water.

49. Endomycorrhizal Biodiversity Associated With Some Medicinal Plants of Uttrakhand State

Chhavi Mangla, Aditya Kumar, Anju Tanwar and Ashok Aggarwal

Department of Botany,
Kurukshetra University,
Kurukshetra-136119, India

Keywords : *Endomycorrhza, medicinal plants AMF,*

In India, Uttrakhand is a unique state from the perspective of biodiversity. Since, part of Western Himalaya falls in the state, it lends its biodiversity richness to the state with occurrence of several valuable and economically important medicinal and aromatic herbs of great threopeutic value. Medicinal plants have faced great demand in recent years due to their tremendous potential in the world of medicine. Hence, there is a need for research in improving the yield of medicinal plants in relatively shorter period. And Arbuscular Mycorrhizal Fungi (AMF) are the one which can play a major role in the quest for sustained plant productivity in all segments of agriculture. Considering the importance and status of medicinal plants, the present investigation was carried out to study the endomycorrhizal status of twelve medicinal plants belonging to eight families of Uttrakhand region. Mycorrhizal status was determined by AM spore quantification and root colonization. Wide range of variations was observed in terms of AM spore population as well as percentage mycorrhizal colonization in all studied plants. Percentage root

colonization was studied in terms of presence of mycelium, arbuscules and vesicles. AMF colonization ranged from 16. 06±5. 33 to 100±0. 00. The plant showing 100% AMF colonization was *Acorus calamus*. The least AM root colonization was found in *Psidium guyava* L. The AM spore density ranged from 67. 66±2. 52 in *Curcuma longa* Linn. to 648±4. 58 in *Allium sativum* Linn. Minimum spore population was possessed by *Terminalia arjuna* (Roxb. ex DC.)W. &A. (116. 33±4. 04) while higher spore density was observed in *Azadirachta indica* A. Juss. (295. 66±4. 50). Amongst the various AMF genera, 5 genera were reported including 18 species i. e. *Glomus* (*G. mosseae, G. aggregatum, G. intraradices, G. diaphanum, G. fasciculatum, G. convolutum, G. fuegianum*), *Acaulospora* (*A. laevis, A. bireticulata, A. nicolsonii, A. lacunosa, A. foveata, A.* denticulata), *Gigaspora* (*G. gigantea, G. albida*), *Sclerocystis* (*S. ceremoides. S. rubiformis*), *Entrophosphora infrequens*. The result attributed to the dominance of *Glomus* genera followed by *Acaulospora, Gigaspora, Sclerocystis and Entrophospora*. From the above results it is clear that biodiversity of arbuscular mycorrhizal fungi differ in differ plants. So, Mycorrhizal associations act as a potential factor for determining the diversity of ecosystem.

50. Antimycotic Activities of Some Rhizosphere Fungi against Leaf Spot of Cotton Caused by *Myrothecium roridum in vitro*.

Kanherkar S. H., N. H. Shahare* and A. U. Pachkhede*

Department of Botany,
Y. C. Arts & Science College,
Mangrulpir, Dist. Washim (M.S.)
*Brijlal Biyani Science College, Amravati, (M.S.)

Keywords : *Antimycotic, Rhizosphere, Cotton, Myrothecium, Trichoderma.*

A study was conducted to investigate the antimycotic activities of some rhizosphere fungi of cotton against *Myrothecium roridum*. Serial dilution method was adopted for isolation of rhizosphere fungi from collected soil samples of cotton fields. The dual culture method have been used to observe the antimycotic property. Among the all five antagonist tested *in vitro* against *Mtrothecium roridum. Trichoderma harzianum* were found to be most effective followed by *T. viride, Aspergillus flavus, Penicillium oxalicum* and *A. niger.*

51. Diversity of Endomycorrhizal Fungi Associated With Some Ornamental Flowers

Karishma, Aditya Kumar, Neetu, Sonika Chauhan and Ashok Aggarwal

Department of Botany,
Kurukshetra University,
Kurukshetra-136119

Keywords : *A. M, ornamental plants, Endomycorrhiza*

Ornamental plants play very important role in modern society. Large scale production of ornamental flowers are in great demand due to increased consumption. To fulfill the need of flowers new technologies have to be adopted by farmers. Use of Arbuscular Mycorrhizal (AM) fungi is one of the most successful techniques of enhancing yield, growth and other growth parameters of ornamental plants. Keeping all these facts in view, the present study was undertaken for the isolation and identification of the indigenous mycorrhizal population associated with rhizosphere of some ornamental flowering plants. For this, 25 ornamental plants belonging to 16 families were examined. Their rhizospheric soil was collected and analysed. Root colonization ranged from 9. 39±9. 10 to 100±0 percent. *Narcissus jonquilla* plant showed 100 percent of mycorrhizal root colonization. Least mycorrhizal root colonization was shown by *Dianthus caryophyllus* (9. 39±9. 10). Among studied families, Amryllidaceae showed maximum root colonization while Caryophyllaceae were observed least mycorrhizal. The spore number ranged from 102. 33±4. 04 to 369. 33±7. 23 spore per 50 g of soil. The Narcissus showed highest spore number (369. 33±7. 23). The lowest spore count was observed in *Arctotis stoechadifolia* (102. 33±4. 04). A total of 29 AM species belonging to six genera i. e. *Glomus, Acaulospora, Gigaspora, Sclerocystis, Enterophospora* and *Scutellospora* were found to be associated. Glomus was the dominant genus (16 species) followed by *Acaulospora* (7 species), *Gigaspora* (2 species), *Sclerocystis* (2 species), *Scutellospora* (1 species) and *Enterophospora* (1 species). The present investigation showed that there was a great diversity in the occurrence of AM fungal spores and there was no positive correlation between AM spore number and percent mycorrhizal root colonization.

52. Antibacterial Activity of Leaves of *Alocasia indica* Linn.

Preeti Verma and Archana Verma

Department of Botany,
Government Autonomous Girls P. G. College of Excellence
Sagar (M.P)-470 003

Keywords : *Alocasia indicaLinn. Antibacterial activity, Filter Paper Disc diffusion,*

Alocasia indica belonging to the family Araceae is widely cultivated in several parts of India. Antimicrobial activity of different extracts prepared with petroleum ether, chloroform, acetone, ethanoland water from leaves of *Alocasia indica* Linn. is evaluated using "Filter Paper Disc Diffusion Method" against gram positive,gram negative bacterial strains. Gentamicin (5 ìg/ml) and Fluconazole (5 ìg/ml) were used as standard for antibacterial assay respectively. Extracts show significant *in-vitro* antibacterial activity. Ethanol extract is found to possess potent antimicrobial activity.

53. Quantitative Anti-pityriasis Assay of Ethanolic Extract of Indian Plants using Phylogenetic Approach

Rohit Kumar Mishra, Amit Kumar Tiwari and Anupam Dikshit

Biological product laboratory,
Department of Botany,
University of Allahabad,
Allahabad-211002

Keywords : *Antioxidant, Pityriasis versicolor, DPPH, Malassezia, Phylogenetic relationship*

Pityriasis versicolor is one of the most common infections in India commonly known as Sehuwa (Hypopigmentation) in human skin. It is caused by unicellular yeast like fungus known as *Malassezia*. The incidence increases in summers and monsoon. The phylogenetic relationship of unicellular fungal pathogens has been studied using ITS1 sequences of the standard strains were aligned by using the ClustalW computer program. More than 100 skin isolates were collected from

different age group peoples from Allahabad and identified with the help of molecular tool using Real Time PCR as well as cultural morphology as compared with standard strains namely *M. furfur*- 1878; *M. restricta*- 7877; *M. globosa*- 7966; *M. slooffiae*- 7956; *M. dermatis*- 9169; *M. sympodalis*- 9974; *M. obtusa*- 7876; *M. yamatoensis*- 9725; *M. nana*- 9558 and *M. japonica*- 9432 obtained from CBS, Netherland. In the present investigation 50% ethanolic leaf extracts of *Nyctanthes arbor-tristis* were tested against test pathogens using broth micro dilution method recommended by CLSI with slight modification. The antioxidant activity was also determined by means of the DPPH free radical scavenging test. Results were expressed in milimole(mM) ascorbic acid equivalent (AAE) per 100gram fresh weight of fruits. Relationships of the Pityriasis versicolor causing pathogens to the toxicity of the extract vis-à-vis phylogeny using molecular data of pathogens have also been discussed.

54. Water Borne Bacterial Contaminants and their Management by Essential Oil of *Mentha Arvensis* L. using Phylogenetic Approach

Shalu Srivastava, Rohit K. Mishra, Awadhesh Kumar, Amit K. Tiwari, Anand Pandey and Anupam Dikshit*

Biological Product Laboratory,
Dept. of Botany,
University of Allahabad,
Allahabad-211002

Keywords : *Antibacterial activity; Essential oil; Phylogenetic analysis; water borne bacterial pathogens*

The phylogenetic relationship of five water borne bacterial pathogens has been studied using ITS1 sequences of the standard strains were aligned by using the Clustal W computer program. The chemical compositions of the essential oil from *Mentha arvensis* L. was analyzed by gas chromatography-mass spectrometry (GC-MS) and showed eight major active constituents. The antibacterial activity of the oil was evaluated against five water borne pathogens such as *Escherichia coli* (ATCC-25922); *Vibrio Cholerae* (MTCC-3906); **Klebsiella pneumoniae *(MTCC-109);* Salmonella typhimurium *(MTCC- 98) and* Shigella dysenteriae *(ATCC-23513)*** using broth microdilution method recommended by Clinical Laboratory

Standards Institute (CLSI) formely (NCCLS). *Mentha arvensis* L. leaf essential oil showed excellent activity against *Vibrio Cholerae* with their Minimum inhibition concentration (MIC) 0. 72mg/ml and (IC_{50}) 0. 28mg/ml and less effective against **Klebsiella pneumoniae**. The essential oil of *Mentha arvensis* L. from leaf has played a significant role against water borne bacterial pathogens. Relationships of the water borne pathogens to the toxicity of the oil vis-à-vis phylogeny using molecular data of pathogens have also been discussed.

55. VAM and Dark Septate Endophytic Fungi in a Tropical Dry Deciduous Forests in India.

Priyangana Tripathi and P. K. Khare

Department of Botany,
Dr. H. S. Gour University,
Sagar (M.P.)-470003

Keywords : *Vesicular Arbuscular mycorrhizal fungi, mycorrhiza type, Dark Septate*

Vesicular arbuscular mycorrhizal colonization and spore density was studied in 12 forest plants collected from Tropical Dry Deciduous Forests of Sagar (M. P.). Root and rhizosphere soil samples collected from forest plant species and analysed for quantitative and qualitative study of VAM Fungi and DSE. VAM spores were isolated by wet sieving and decanting method following Gerdemann and Nicolson (1963). Quantitative estimation of spores was followed after a modified method of Gour and Adholeya (1994). We observed three mycorrhizal types including Arum-type, Paris-type, and an intermediate type among the plants. Another type of potentially beneficial fungi associated with roots of nine species was also observed, namely, dark septate endophytic fungi (DSEF). Of the 12 sample plants examined, nine species were co occurred by the two target fungi (Vesicular Arbuscular mycorrhizal fungi (VAMF) and DSEF). Maximum VAM colonization was observed in *Tectona grandis* and minimum in *Albizia lebbek* Benth. Based on this investigation, we speculated that the DSEF are ubiquitous in forest ecosystems and can co-occur with VAMF in forest plants, functioning much like VAM fungi. Further studies will be required to elucidate interactional mechanisms with VAMF and the mechanisms operating in forest ecosystem.

56. Effect of Biological Agents as Substitutes for Chemical Seed Treatment on Groundnut Cultivation

S. Sujanya[1] and S. Chandra[2]

PG Dept, Queen Marys College (Autonomous),
Chennai-600004,
Tamil Nadu

Keywords : *biofertilizer, Arachis hypogea, yield FYM, NPK, BA, BGA*

Field trials were conducted during the years 2009-2010, at a private farm in Puttaparthi, Anantapur District, India, to study the effect of biological agents as effective seed treatment substitutes over commonly used chemicals on ground nut plants, *Arachis hypogea.* The biological agents (BA) tested for this purpose involved, BGA, *Azotobacter* and *Azospirillum*. Seeds were treated prior to sowing with each of these 3 agents both individually and in combination. Commonly used chemical for seed treatment, chlorophyrous, was used as the control. The treated seeds were sown on the soil combination, 3 :1 FYM : NPK, derived from earlier experiments. The use of biological agents, as a replacement for chemical seed treatments, revealed an overall improvement in all crop parameters studied. BGA proved to be the best among the 3 agents. The effect of *Azotobacter* was marginal when used alone. However, the same was augmented in the presence of BGA. *Azospirillum* seemed to have a negative effect on growth and yield, when applied alone and in combination with BGA.

57. Biological Management of Moong Bean Crop for Sustainable Agriculture

**B. K. Mishra, R. C. Mishra, K. P. Pandey,
Rohit Mishra and Anupam Dikshit**

Biological Product Lab,
Botany Department,
University of Allahabad,
Allahabad-211002

Keywords : *Biological Control, Trichoderma, Sustainable Agriculture*

To reduce indiscriminate use of chemical pesticides for the disease management of moong bean crops, different isolates of *Trichoderma viride* were tested alone and in combination with permissible and safer doses of chemicals. After the primary trials different carriers were screened to develop a suitable formulation with long shelf life. Shelf life of formulation was tested at different storage temperature to develop best way for storing bioagents. Mass multiplication of the formulation was done using different agricultural and farm remains. After successful pot and field trials result show that talcum based formulation with 5% CMC was most useful as carrier of bioagent. Maximum shelf life was recorded when formulation was stored at 30^0C temperature. Temperature below 20^0C and above 40^0C results in reduction of shelf life of the bioagent. It was further recorded that use of cattle dung was found to be cheap and best agri and farm remains for the multiplication of the bioagent. *Trichoderma* based formulation along with vitavax (1%) was found to be most useful for controlling fungal diseases of pulses without any adverse effect on environmental and human health.

58. Effect of Alternaria Leaf Blight on Seed Germination and Seedling Vigour of Sunflower in Rohilkhand Region

Vikas V. Patel, Reetu Gangwar and U. S. Mishra

Phytopathology Lab. Department of Botany,
Bareilly College,
Bareilly
M. J. P. Rohilkhand University,
Bareilly-243006

Keywords : *Alternaria leaf blight, sunflower, seed germination, seedling vigour, management.*

Alternaria leaf blight of sunflower is a very common and destructive disease in Rohilkhand region. Despite the rapid spread of the crop in India, the productivity is going down in recent years due to the susceptibility of this crop to the fungal diseases. The symptoms of *Alternaria* leaf blight appeared in the month of March

in the form of characteristic small circular, brown coloured patches on the surface of leaves and these brownish patches grow in size and coalesced to cover the entire surface of leaves producing blight symptoms. Marked blight symptoms are seen in the head (capitulum) of heavily infected plants in which seeds are also infected with *Alternaria helianthi*. Naturally infected seeds with *A. helianthi* and artificially inoculated one showed 38. 6% and 23. 0% reduction in germination respectively. Shoot and root length of seedlings was also significantly reduced in both cases. There was a marked increase in number of seedlings showing blight incidence with increase in spore load of *A. helianthi* on seeds. Biocontrol of *Alternaria* blight by selected natural herbal plant extracts *in-vitro* has been observed and recommended for use to the farmers.

59. *In vitro* Evaluation of Phytoextracts and Fungicides for *Curvularia Lunata*

Ashwani Tapwal[1], Upender Singh[2], Gurpreet Singh[2], Nandini Gautam[2] and Rajesh Kumar[1]

[1]Rain Forest Research Institute,
P. B. 136, Deovan,
Jorhat, Assam
[2]Shoolini Institute of Life Sciences and Business Management,
Anand Campus, The Mall Solan, HP

Keywords : *Curvularia lunata, botanicals, fungicides, IPM*

Fungal diseases are serious threats to the plant kingdom and sometime they cause a heavy mortality in nurseries and field. The genus *Curvularia* include a group of phramosporus dematiaceae in which most distinguishing character is the disproportionately large middle cell or cells of the conidium. *C. lunata* is very important pathogens having wide host range infecting grasses, cereals and forest species. These diseases are often very difficult to control and some losses can usually be expected during each seedling crop. At present, quick and effective management of plant diseases is generally achieved by the use of synthetic pesticides but it is very expensive and also not an environment friendly approach. The need of hour is to minimize the use of synthetic pesticides by encouraging the

use of some botanicals to develop integrated pest management (IPM) model. In the present study we have investigated the efficacy of five fungicides as well as the crude extract of five plant species at varied concentrations on *Curvularia lunata*. The results revealed that Dithane and Ridomil were was most effective showing complete inhibition of pathogen even at 50ppm of concentration followed by Blue copper, Captaf, and Bavistin. Among botanicals at the concentration of 20% of leaf extract, *Cannabis sativa* was most effective with absolute growth inhibition of pathogen followed by *Urtica dioeca, Polystichum squarrosum, Adiantum venustum* and minimum 13. 64% by *Parthenium hysterophorus.* From present work it can be concluded that some botanicals are quite effective against *Curvularia* and in future they can be integrated with synthetic pesticides to reduce their use.

60. Association of Mycorrhizal Fungi with the Dipterocarps of Assam

Ashwani Tapwal, Rajesh Kumar, R. K. Borah, D. P. Borah and Rajesh Turi

Rain Forest Research Institute,
Jorhat, Assam-785001

Keywords : *Ectomycorrhiza, endomycorrhiza, Depterocarpus, Shorea*

Species of *Dipterocarpus* and *Shorea* are very important for the requirement of timber and wood in the northeast region of India. Although, the natural regeneration of these species is good, but to meet the demand of various afforestation and reforestation programmes being undertaken, where mycorrhizae can play an important role in establishment, survival and growth of these species. Application of mycorrhizae can improve the quality stock in nursery, thereby increasing survival and growth in field. Genera belonging to Dipterocarpaceae are predominantly ectomycorrhizal but endomycorrhizal association is also reported. A study was conducted in Jeypore, Digboi and Margerita in upper Assam and Amsoi, Kulsi, Dhupdhara in lower Assam to find out the association of mycorrhizal fungi with *Depterocarpus retusus, Shorea robusta* and *S. assamica*. Closely associated mushrooms (ectomycorrhizal fruit bodies) and rhizosphere soil along with mycorrhizal roots of selected plant species were collected in different

seasons. Morphology and anatomy of the fruit bodies were worked out for their proper identification and taxonomic details. Out of five ectomycorrhizal fungi collected, three were identified as *Russula, Lactarius* and *Amanita* sp. *Russula* was dominant species and reported to be associated with all selected species. Pure cultures of associated fungi were raised on potato dextrose agar. In addition to this 10 unidentified fungi associated with rhizoplane of selected species were also isolated and maintained. To find out the endomycorrhizal association, the soil samples from rhizospheric region were also collected from trees of the same species from different regions and mixed to form a composite sample. The spores isolated from the soil were identified and feeder roots collected from the trees were treated with 10% KOH, stained by trypan blue and observed under microscope. The endomycorrhizal association was represented by species of *Glomus, Acaulospora Gigaspora* and *Entrophospora*. *Glomus* was the most dominant species but degree of infection was very less.

61. *In Vitro* Effect of Plant Extracts on Fungi

P. Gopal Reddy

Department of Botany,
Padmashri Vikhe Patil College,
Pravaranagar,
Dist : Ahmednagar, Maharashtra

Keywords : *Leaf extracts, Test fungi, Effect, Growth, % inhibition.*

The effect of methanolic leaf extracts of eight plants viz; *Andrographis paniculata, Cassia auriculata, Lantana camara, Leucas longifolia, Oscimum bascilicum, Sida acuta, Tribulus terrestris, Withania somnifera* on the growth and development of four fungi viz; *Alternaria alternata, Aspergillus niger, Candida albicans, Fusarium oxysporum,* was evaluated by food poison technique. % inhibition of mycelium growth of test fungus was noted. The extracts of all plants inhibited the growth of test organisms. However maximum % of growth inhibition was observed due to the effect of leaf extracts of *L. camara* and *O. bascilicum* than the extracts of other plants. The results are presented.

62. Occurrence of Arbuscular Mycorrhizal Fungi in Rhizosphere Soils of some Oil-yielding Plants

A. K. Pandey, Rekha Shukla and Ajay Kumar Gond*

Mycological Research Laboratory,
Department of Biological Sciences,
Rani Durgavati University,
Jabalpur-482001

Keywords : *Arbuscular mycorrhizal fungi, rhizosphere soils, oil-yielding plants*

Arbuscular mycorrhizal fungi are most ubiquitous. They form mutualistic relationship with almost all major roles in ecosystem. Mycorrhizal plants are better able to obtain their nourishment in soil and resist and biotic stresses. Arbuscular mycorrhizal fungi are associated with rhizosphere soils of various oil-yielding plants. Nineteen species of Arbuscular mycorrhizal fungi were isolated and identified from the rhizosphere soils of five oil-yielding plants which belonging to five different genera. *Glomus* was represented by ten species. *Gigaspora* and *Acaulospora* by three species and *Enthrophospora* with two species and *Archaeospora* by only one species. *Glomus* genera were the more predominant species that was associated with oil-yielding plants.

63. The Antimicrobial activity of medicinal plants – *Terminalia catappa* L. and *Phyllanthus emblica* L.

Prasanth Ghanta and Basavaraju R.

Department of Biosciences,
Sri Sathya Sai Institute of Higher Learning
Prasanthi Nilayam

Keywords : *Antimicrobial, medicinal, Terminalia catappa and Phyllanthus emblica.*

The use of plants as remedies to treat various forms of an ailment has been a common practice all over the world, in various fields of medicine – Ayurveda, Siddha, Unani, Homeopathy and folk. The root, bark, flower, fruit and seed of *P. emblica* are used for treatment of Asthma, Tuberculosis and Cardiac diseases. The

bark, leaf and fruits of *T. catappa* are used for the treatment of Asthma, diabetes and are used as constituents in cardiac tonic. The antimicrobial activity of aqueous extracts of leaves and stem of *P. emblica* and *T. catappa* along with the methanol extracts of the stems and leaves of *P. emblica* and leaves of *T. catappa* are evaluated for the antimicrobial activity on gram negative *Escherichia coli* and gram positive *Bacillus cereus* using Antimicrobial Disc Diffusion Method. Methanol, when used as solvent exhibited highest yield followed by water in all cases. The results (basing on the presence of zones of Inhibition) indicate that the aqueous and methanol extracts of leaves of *P. emblica* along with the methanol extract of the stem of *P. emblica* had a considerable antimicrobial activity with *Escherichia coli*. In case of tests conducted with *Bacillus cereus*, it was observed that the methanol extracts of both stem and leaves of *P. emblica* have considerable level of antimicrobial activity. The methanol extracts of the leaves of *T. catappa* had considerable antimicrobial activity with *Escherichia coli* whereas, the aqueous extracts of the stems and leaves of *T. catappa* showed no antimicrobial activity with both *Escherichia coli* and *Bacillus cereus.*

64. Possible threats of Soil Borne Bacteria to Marine Algal Consortium

Shibayan Ganguly, Soumi Sinha Roy, Dipavali Acharya, Malavi Sengupta, Debarati Shome, Monalisa Baidya and Dr. Arup Kumar Mitra*

Department Of Microbiology, St. Xavier's College, Kolkata
*Faculty department of Microbiology

Keywords : *Marine algae, antagonistic relationship, soil borne bacteria, Bacillus mycoides*

The Indian Subcontinent has shown luxuriant growth of Marine algae along its continental shelf. The algal consortium discussed here was collected from a fisherman's net in the Arabian Sea at the Kovalam Beach, Trivandrum, Kerala. The geographical location of the spot is 8°30'27''N 76°58'19'1£. The algae after collection was kept in 10% of saline water collected as an aliquot from the Arabian Sea itself. Further observation showed that the algae caused blackening of the layer of sand which got precipitated beneath the vessel due to liberation of hydrogen sulphide (HzS). It was experimentally observed that Hydrogen Sulphide was

liberated not by the algae but by the bacteria present in the vicinity. The algae were having an antagonistic relationship with bacteria, as the later reduced the algal viability and shelf life. The bacteria was isolated, characterized and identified by 16s DNA analysis. It was gram positive, non motile organism and a common resident of soil and genetically identified as *Bacillus mycoides*,_*which* probably is not a natural resident of sea. It showed citrate positive, methyl red and Voges Prauskaur tests positive. It is clear showing that the sewage carried by different rivers or canals flowing into the sea is causing serious damage to the marine biodiversity in the estuarine areas of the subcontinent.

65. Integrated Control of Seed Born Mycoflora of *Abelmoschus Esculentus* with Volatile Oils and Fungicides

P. M. Beebi Razeena[1] and Rasheed Ahamad[2]

[1]Department of PG Studies and Research in Botany,
Sir Syed College, Taliparnmba,
Kernla-670142
[2]Department of Applied Botany,
Mangalore University,
Mangalagangothri, Mangalore,
Kamataka-574199

Keywords : *Abelmoschus esculentus, seed borne fungi, fungicides*

Integrated control with fungicides like bavistin (Carbendazin 50% WP), Copper oxychloride 80% WP (COPLAN) and Mancozeb 75% WP (Indofil M-45) separately in different Concentrations like 0. 1, 0. 2 and 0. 3% and volatile oil of *cinamomum zeylanicum* (Bryan) and *Cymbopogan citrates* (DC) under in vivo and in vitro conditions against *Aspergillus jlavus*, *Asp. niger*, *Fusarium moniliforme* and *Macrophomina phaseolina,* dominant pathogenic fungi of okra. Under in vitro condition *Cinamomum zeylanicum,* Bavistin, Mancozeb and *Cymbopogan citrates* showed 100% inhibition of mycelial growth of all test fungi compared to control. Copper oxychloride showed 67% inhibition of *Aspergillus jlavus,* 88. 3% inhibition of *I Asp. niger,* 88. 8% and 100% inhibition of *Fusarium moniliforme* and *Macrophomina phaseolina* respectively in 0. 3% cone. Under in vivo condition also, all the bio agents and fungicides showed enhanced vigour and germination.

66. Effect of Phosphate Solubalising Microorganisms [PSM] On the Growth of *Triticum aestivum*

A. P. Waghmode

Department of Botany,
Yashwantrao Chavan College of Science,
Vidyanagar, Karad-415 124 (MS)

Keywords : *biofertilizer, Phosphate, solubalizing, microorganisms*

Effect of Phosphate solubalizing microorganisms [PSM] mixed with black and red soil is studied on growth of *Triticum aestivum.* Density of bacteria was about thrice in black soil while fungi density was reduced to about fifty percent when compared with biofertilizer as control. Germination percentage and shoot length was almost unaffected while increased chlorophyll content was noted in seedlings grown in black and red soil mixed with biofertilizer.

67. Role of Saline Tolerant Aspergillus Spp. In Calcium Recycling from Sea Urchin Shell

Soumi Sinha Roy* Anwesha Saha, Gaurav Saha Pritam Naskar, Arindam Ghatak and Dr. Mahasweta Mitra Ghosh**

Department of Microbiology,
St. Xaviers College,
Kolkata

Keywords : *Seaurchin, pH, Calcium, Biomass, Aspergillus spp. , Bipolaris spp.*

The samples of sea urchin shell walls were collected from the beach and later on the fungi residing on its calcareous shell was isolated. On culturing in PDA, these fungi were identified as *Bipolaris* spp. and *Aspergillus* spp. The best growth conditions for *Aspergillus* spp were studied, by varying the pH and by calcium, concentration of Potato Dextrose Broth, and thereby measuring the dry weight of the fungal biomass. The optimum pH for its growth was pH seven with a biomass dry weight of 2. 58gm. The fungal species showed maximum growth (biomass dry weight of 0. 89gm) for a Calcium concentration of 75 ppm in the media with an

uptake of 71. 15ppmby the fungal biomass. It is worth mentioning that the fungus produced a red quinine pigment at pH 3 which on one hand reduced its partner in the consortiumbut also had a protective role on the ascospore. Spores of *Aspergillus flavus* dipped in the red pigment isolated from the shell fungi showed more germination in 24 hrs as compared to control (distilled water), indicating that the pigment facilitated the germination of spores as well. Hence it is concluded that the Aspergillus spp had several adaptive mode to colonize in the sea urchin shell and probably participate in the estuarine calcium recycling process.

68. Immobilization of Yeast Cells Using Perforated Soft Woods

Rubina Islam*, Amrita Mukherjee, Arya Gupta, Ayan Adhikari, Palabi Bhattacharyya, and Shibayan Ganguly

Department of Microbiology,
St. Xavier's College,
Kolkata-700016
Sponsored by- MIS Global Agro Solutions Pvt. Ltd.
Kolkata-700019

Keywords : *Yeast cells, perforated soft wood, mahua wort, immobilization,, reduced fermentation*

Saccharomyces cerevisiae strain no. 180 from MTCC, Chandigarh was immobilized using perforated lignin free wooden cubes. The wooden cubes were subjected to caustic treatment to make them almost ITeeITomlignin and then washed in order to bring down the pH around 7. 0. A pure culture of the yeast cell, previously grown on Sabouraud Agar Medium, was inoculated into 200ml of OM 5 broth medium and incubated at 37°C under shaking condition for 48hrs. The experiment was scaled up in a 1litre flask where the yeast cells were grown under the same conditions for 7 days. The morphology of the yeast cells was determined by staining with lactophenol cotton blue and the size of a yeast cell was calculated to be 1.67 micron. The initial count of yeast cells was recorded using a haemocytometer and it was calculated to be 308x 101\4cells/ml. The yeast cell count was again determined 7 days after immersion ofthe perforated wooden cubes in the OM 5 broth medium. The fmal celt count was observed to be 144xlO1\4cellslml. There being a drastic reduction in the cell count in the

medium after immersion of the wooden cubes, it can be concluded that the yeast cells were immobilized in the perforated wooden cubes. Fermentation was carried out with Immobilized Packed Bed in a glass Fermenter column. Circulation of the mahua wort through the column by means of a pump continued for several hours. Evolution of C02 generated from sugar to ethanol was observed and the reaction being exothermic the circulating liquid was continuously cooled in a glass condenser Special technique was adopted to keep the wooden cubes under flooded condition while the liquor being continuously circulated. To determine the efficacy of immobilization, circulation of liquor was carried out at various flow rates with the help of metering pump and samples at definite intervals were taken to examine if cells are dislodged from the surface of wooden cubes due to increasing shear force with increasing flow rate of circulating liquid. The critical flow rate was recorded beyond which the cells became mobile and also the rate of fermentation declined at higher flow rates due to lower contact time (residencetime) between the circulating liquor and immobilized cells. The results obtained are extremely encouraging which could be meaningfully utilized for commercial exploitation.

69. Insect-Fungus Interaction in the Development of Leaf Spot Disease in High Altitude Mango Plant and Its Control

Pip Banerjee, Priyanka Lahiri*, Ishita Mukherjee, Ayantika Bhattacharya, Rohit Das, Gaurav Saha and Dipanjali Saha

Department of Microbiology
St. Xavier's College 30,
Park Street, Kolkata,
West Bengal-700016

Keywords : *Dwarf mango variety, White spot, Brown Spot, Gall, fungicide, Malathione,*

In our project we studied the mechanism of disease incidence by a fungal pathogen- *Cercospora mangiferae*, its agonistic relationship between an insect of *Procantarinia sp* of the Lepidoptera group and then suggest a fungicide to prevent such occurrence. The sample was collected from a place called Jorolle (NH 88) near a place called Sundemagar 10 kms away from the Beas-Sutlej

confluence in the state of Himachal Pradesh. It was collected in the month of January-February when temperature was around 7-14°C and the place was dry, dusty and plagued by vehicular emission. Mango varieties of Himachal Pradesh include the Chausa, Langra, Dashehari, which grow from April to June. They are generally prone to fungal diseases and our test plant is no exception. It has 2 spots- one white and one brown spot. The progress in the infection occurred from the lower matured to the upper younger leaves. The magnitude of infection was much greater in the leaves having galls along their margin. This gall was a result of some mechanical damage caused by the entry of the Midge insect- *Procantarinia sp.* The galls had a diameter of 3-4 mm. As stated the leaves with galls were seen greater infection by the fungus *Cercospora mangiferae.* Hence an agonistic relationship prevails where the primary infection caused by the Midge insect paves the way for the secondary infection by the fugal pathogen *Cercospora mangiferae.* Our ultimate aim was to propose a fungicide to prevent such a relationship from occurring as well as preventing both the infections individually. Our test fungicide is Hilcron, a fungicide of the Malathione group. Its main component is Monocrotophos and it interferes with the nerve impulse transmission. It was applied in different concentrations and it was found that at 45% w/w of the pesticide, it was effective in bringing about control of 100% germination. Hence at effective concentrations when the fungicide is used till run-off, the young leaves of *Mangiferae indica* won't be affected by the either the Midge insect or the fungal spathogen.

70. Molecular Identification of a Common Bacterial Pathogen Reducing the Shelf Life of *Agaricus bisporus* and its Prevention

Rohini Datta, Amrapali Ghosh, Suchismita Dey, Disha Sengupta, Maitrayee Ghosh, Arijit Mal and A. K. Mitra*

Department of Microbiology,
St. Xavier's College,
Kolkata-700 016

Keyword : *Agaricus bisporus, Microbial spoilage, Bacterial blotch, Shelf life*

Microbial spoilage of *Agaricus bisporus* causes "bacterial blotch and surface slime formation on the pileus. In our study, we characterized the bacteria

that caused microbial spoilage in a population of *Agaricus bisporus* collected from a local market in Kolkata, West Bengal. Initial characterization was performed using Gram staining, foHowed by biochemical tests (catalase, oxidase, nitrate reductase, IMViC, TSI reduction, starch hydrolysis, gelatin hydrolysis, carbohydrate fermentation) and motility tests, following culture of the exudates from spoilt mushrooms. Final characterization was achieved by performing 168 rDNA analysis. The spoilage organism was found to be a bacterial pathogen, *Stenotrophomonas maJtophilia strain* 1. 22, based on nucleotide homology and phylogenetic analysis. The second component of our study focused on increasing the shelf life of another population of :fresh *Agaricus bisporus* collected :from the same source, exposed to the same bacterial pathogen. By employing the processes of acid blanching (acetic acid) and antibiotic spraying (Streptomycin), the shelf life of the :fresh button mushrooms, at chilled storage conditions (4°C) was incr~ased appreciably, by 3 to 16 days. Increasing the shelf life of button mushroom has commercial importance as *Agaricus bisporus* is very susceptible to spoilage by enzymatic or microbial methods.

71. Biological Control of Crown Gall Disease

Nimbalkar Balaji Ravsaheb
Deptt. of Botany

Keywords : *crown gall, Aqrobacterium tumifaciens, Ginger/Garlic*

Crown gall is caused by the bacterium *Aqrobacterium' tumifaciens. Aqrobacterium tumifaciensare* the rod shaped, gram negative soil bacteria symptoms are caused by the insertion of small segments of DNA (known as T-DNA) which includes the nitrogen fixing legume symbionts. With Rhizobiaceae family. The bacteria induce galls or tumors on the roots, crowns, trunk and canes of infected plants. Crown gall is found in dicotyledons plants not in monocotyledons plants such as. Ex. Rose, Apples, Pears and All stone fruits.

72. Mycotaxonomic Study on Fungi of Sagar (M.P.)

S. Shrivastava, Ravindra Singh Thakur*, Naveen Verma and A. N. Rai

Department of Botany,
Dr. B. S. Gour University.
Sagar-47000 Madhya Pradesh

Keywords : *foliicolous, identilication*

While making a routine survey for the collection and identilication of foliicolous fungal forms from Sagar and nearby areas. Two interesting eye catching symptoms were encountered. The slide preparation. identilication. camera lucida drawing, description and illustration reveal these to be *Leptoxyphum axillatum* (Cook) Singh and *Leptoxyphium logisopra* Jain infecting the leaves of *Dendrocalamus strictus* Roxb. (Poaceae) and *Hibiscus rosa-sinensis* Linn. (Malvaceae) respectivdy from the forest flora of the Sagar.

73. Effect of Biological Agents as Substitutes for Chemical Seed Treatment on Groundnut Cultivation

S. Sujanya1 and S. Chandra[2]

PG Dept, Queen Marys College (Autonomous),
Chennai-600004, Tamil Nadu

Keywords : *biofertilizer, Arachis hypogea, yield FYM, NPK, BA, BGA*

Field trials were conducted during the years 2009-2010, at a private farm in Puttaparthi, Anantapur District, India, to study the effect of biological agents as effective seed treatment substitutes over commonly used chemicals on ground nut plants, *Arachis hypogea.* The biological agents (BA) tested for this purpose involved, BGA, *Azotobacter* and *Azospirillum.* Seeds were treated prior to sowing with each of these 3 agents both individually and in combination. Commonly used chemical for seed treatment, chlorophyrous, was used as the control. The treated

seeds were sown on the soil combination, 3 :1 FYM : NPK, derived from earlier experiments. The use of biological agents, as a replacement for chemical seed treatments, = revealed an overall improvement in all crop parameters studied. BGA proved to be the best among the 3 agents. The effect of *Azotobacter* was marginal when used alone. However, the same was augmented in thepresence of BGA. *Azospirillum* seemed to have a negative effect on growth and yield, when applied alone and in combination with BGA.

74. Resupinate Agaricomycetous Fungi Associated with *Cedrus deodara* (Roxb. : Lamb) G. Don in Himachal Hiamlaya

Avneet P. Singh

Department of Biology,
SD College, Barnala (Pb.)-148 101

Keywords : *Cedrus deodara, Himachal Pradeah*

Himachal Himalaya situated in the state of Himachal Pradesh has got a stretch of 595 km of mountain ranges, falling in the Western Himalayan region of the great Himalayan ranges, with altitude ranging from 350 to 7000 m above mean sea level. . *Cedrus deodara* is one of the most important economically important coniferous trees growing in the temperate zone with an area of 811 km^2 and a growing stock of 16129 M^3. Keeping in view the large area under deodar in Himachal Himalaya and very few taxa reported, several fungal forays were conducted during the years 2002-06 and a total of 320 collections were made associated with *C. deodara*, which belong to 53 taxa spread over 23 genera of resupinate Agaricomycetous Fungi. Of the 53 taxa, 11 are being reported for the first time from India, 5 new records for the study area, and 21 first time in association with *C. deodara*. As many as 9 taxa (7 species i. e. *Laeticorticium pachypleurasporium*, *Ceraceomyces bizonatus*, *C. minutibasidicystidiatus*, *Phlebiospis mussoriensis*, *Hyphoderma microbasidispora*, *H. singularisbasidicum*, *H himachalensis* & 2 varieties i. e. *Amphinema byssoides var. macrosporus*, *Ceraceomyces microsporus var. augustisporus*) have been named and described as new. A consolidatd key toall the taxa reported from the study area has been given.

75. Mitigation of salt stress in Trigonella foenum-graecum by inoculation with Glomus intraradices

Heikham Evelin, *Bhoopander Giri and Rupam Kapoor

Applied Mycology Laboratory, Department of Botany,
University of Delhi,
Delhi-110 007
*Swami Shraddhand College,
University of Delhi,
Alipur-110 036

Keywords : *Salt stress, inoculation, AM*

The productivity and spatial distribution of plants, particularly many agronomical and horticultural crop plants of commercial importance, are severely affected by a variety of environmental factors. Among these factors, drought and salt play very significant roles in reducing agricultural production worldwide. High salt concentrations cause ion imbalance and hyperosmotic stress in plants. As a consequence, secondary stress reactions such as oxidative damage occur. Ionic imbalance occurs due to excessive accumulation of Na^+ and Cl^-, which reduces the uptake of other mineral nutrients, such as, K^+, Ca^{2+}, and Mn^{2+}. Arbuscular mycorrhizal fungi (AMF) are obligately symbiotic soil fungi that colonize the roots of the majority of plants. AM fungi widely exist in salt-affected soils. Many studies have demonstrated that, inoculation with AMF the plant receives a variety of benefits that may result in increased growth, improved water relations, enhanced nutrient uptake over non-inoculated control plants. In pursuit of a better understanding of salt stress-arbuscular mycorrhiza interaction, an experiment was conducted with varying concentration of NaCl (0, 50, 100 and 200 mM) on *Trigonella foenum-graecum* L. (fenugreek) inoculated with *Glomus intraradices*. Growth, nutrient concentration and membrane integrity were studied as physiological parameters as they represent a first step towards gaining understanding of mycorrhizal plants to initial NaCl-stress. *Trigonella* plants inoculated with the AM fungus showed better growth and higher fresh and dry weights. Concentrations of chlorophyll a, b and carotenoids and soluble sugars were higher than in non-mycorrhizal plants under given NaCl concentration. Mycorrhizal plants maintained higher K^+/Na^+ ratio, higher concentration of Ca^{2+}.

76. Antioxidant Activity of Lentinus-An Edible wild Mushroom

***Ritu Panjwani and **A. K. Pandey**

*Mycology Research laboratory,
Deptt. of Biological Sciences,
RDVV, Jabalpur (M.P.)
Email : panjwani_ritu @yahoo. com
**Chairman, M. P. Private Universities Regulatory Commission,
Bhoj University,
Bhopal (M.P.)

Keywords : *Mushroom, Lentinus, antioxidant*

The term "Mushroom" is a macro fungus with a distinctive fruiting body mostly belonging to Basidiomycetes. *Lentinus* mushroom are the second most important edible mushroom in the world used for the cultivation, also known as Shiitake and black forest mushroom. At the present time, numerous scientific investigation have established the nutritive value and medicinal benefits of *Lentinus* are may be due to the alkaloids, flavonoids, terpenoids, phenolic compounds, amino acids, inorganic elements, fatty acids and other biological active compounds such as Polysaccharides, protein, lectins, etc. which are having **antioxidant**, antimicrobial, anti-inflammatory, antitumor, hepatoprotective, antiviral, anticancer, immunomodulating, antiaging and other medicinal properties.

In the present study, 3 different solvent viz. ethanol, methanol and distilled water extracts of an edible mushroom *Lentinus* were investigated for antioxidant activities. To confirm the total antioxidant activity, reducing power, DPPH free radical-scavenging assay were carried, along with total phenolic and flavonoid concentration test. The DPPH and Reducing power assay showed that the inhibitory activity of ethanol extracts were 76. 6±0. 7% and 83. 4±0. 4% respectively, which have admirable results comparative with the positive control BHT (78. 5±0. 8%). The total flavonoid concentration and total phenolic content of ethanolic extracts were found to be 21. 4±1. 0 mg^{-1} quercetin equivalent and 38. 2±0. 82 mg^{-1} pyrocatechol equivalent respectively, the result showed best antioxidant activity by ethanol extracts followed by methanol and distilled water. Thus, the present study shows that *Lentinus* mushrooms can be considered as good source

of natural antioxidants for medicinal and commercial uses. Mn^{2+}, Zn^{2+} and Cu^{2+}. Sodium concentration in roots or shoots was lower in mycorrhizal than non-mycorrhizal plants. *G. intraradices* inoculated plants had higher electrolyte concentrations in leaves and lower electrolyte leakage, malondialdehyde concentration and H_2O_2 concentration in leaves than non-mycorrhizal plants under given NaCl concentration. The results indicate that *Glomus intraradices* plays an important role in mitigation of NaCl-stress in fenugreek plants, the acquisition of salt tolerance in AM plants may be a consequence of improved resistance to oxidative stress, maintenance of ion homeostasis, osmotic adjustment by higher accumulation of osmoprotectants.

77. Taxonomic, Nutritional and Sociobiological Investigations on Termitophilous Mushrooms from North India

N. S. Atri, Babita Kumari and M. K. Saini

Department of Botany,
Punjabi University,
Patiala-147002, Punjab

Keywords : *Termitomyces, taxonomy, sociobiology, nutritive value*

The present paper aims to investigate taxonomy, chemical composition and sociobiological aspects of 7 wild edible species of Termitomyces viz. , Termitomyces microcarpus, T. radicatus, T. badius, T. medius, T. heimii, T. striatus, and T. mammiformis collected from different localities of North India during monsoon season. Description including macro and microscopic detail of these mushrooms has been given in this paper. Besides, these mushrooms have been analyzed for their nutritional components viz. , proteins, carbohydrates, crude fat, crude fibers, moisture content and ash content following standard biochemical techniques. Out of the seven Termitomyces species analyzed maximum protein content has been found in T. medius (46. 2%) followed by T. badius (44%) while T. striatus (12. 95%) contained lowest amount of protein content per 100 gram of dry sample. Carbohydrate percentage was found to be maximum in T. badius (61%) followed by T. radicatus (58. 93%) while T. medius (33. 3%) contained lowest amount of

carbohydrates. Ash content was maximum in T. microcarpus (15. 6%) and in comparison lowest amount of ash per 100 gram of dry sample was recorded in T. medius (5%). Moisture content and crude fibers in dried samples were found to be maximum in T. mammiformis (7. 7 & 8%) and minimum percentages of these were documented in T. badius (5. 7 & 2. 5%). Besides, paper also includes information about local name, seasonal availability, edibility and different types of recepies prepared by the local people in North India. Two of its species, namely T. heimii and T. mammiformis are being collected from their natural habitats in bulk by local villagers and sold to the local vendors for a premium ranging from Rs. 40-60 per Kg at local markets in Rajpura and Hoshiarpur during monsoon season. Vendors further sold these to the consumers @ Rs 20-25 per 250 gm of fresh mushrooms.

78. Oxylipins are Involved in the Resistance of Pearl Millet Against Downy Mildew Disease

Geetha N. P and Shetty H. S.

Departement of studies in Biotechnology,
University of Mysore,
Mysore-570 006

Keywords : *oxylipins, pearl millet, downy mildew disease, defense responses*

Oxidized lipid-derived molecules called oxylipins was found involved in development of systemic resistance in pearl millet against downy mildew disease. GC–MS analysis showed Oxylipins accumulated upon pathogen infection although they are differ with hydrogenation interactions during pathogenenesis. Among oxylipins, levels of 8-HO-FA, a free radical-catalyzed by the oxidation of oleic acid, was very low and levels of 12- and 16-HO-FA, were highest among the non-enzymatically formed HO-FA which implicated during incompatible host-pathogen interaction. Chemotactic response of pathogen to HO-FA oxylipins indicated that 8, 11, and 15 HO-FAs show moderate tendency; whereas 13-HO-FAs elicited a strong chemotactic response. Further, 13-HO-FA and chitinase enzymes had synergistic effect to over express the resistance parameters as accumulated effect was observed *in vivo* studies. IEF experiment indicated highest intensity of chitinase isoforms with 13-HO-FA-treatement.

79. Antibacterial Evaluation of Leaf Extracts of *Araucaria Cunninghamii* Sweet. from Kumaun Himalaya

Savita Joshi and S. C. Sati

Department of Botany,
D. S. B. Campus,
Kumaun University,
Nainital-236002

Keywords : *Antibacterial activity, Araucaria cunninghamii, Crude extract, Kumaun*

Kumaun Himalaya possesses a great wealth of medicinal plants. In recent times due to rapid development of multidrug resistant bacterial strains and high cost of new generation antibiotics forced the interest of scientist to look for the antimicrobial substances from natural sources. Therefore, the present study was undertaken to explore the antibacterial activity of *Araucaria cunninghamii* Sweet. (Araucariaceae), a gymnospermous plant of Kumaun Himalaya and ethnobotanically well known for its medicinal properties. Chloroform, ethanol and water extract of *A. cunninghamii* were tested against five pathogenic strains (*Bacillus subtilis, Agrobacterium tumefaciens, Escherichia coli, Erwinia chrysanthemi* and *Xanthomonas phaseoli*) employing Disc diffusion method.

Chloroform and ethanol extracts of *A. cunninghamii* were found effective by showing a mark zone of inhibition except aqueous extract. The ethanol extract showed maximum inhibition against the test microorganisms (ZOI, 13-17mm) followed by chloroform extract (ZOI, 10-14mm). The inhibitory activity of these extract were found very promising as compared to ampicillin (10mcg) and erythromycin (15mcg) standard antibiotics which were used as positive control against these tested microorganisms. These results of different extracts of *A. cunninghamii* indicate their broad spectrum activity against a panel of bacteria and can be exploited for the management of the most common human and plant bacterial diseases.

80. Prehistoric *Cordyceps Sinensis* (Keera Jari) as Therapeutic Natural Compound – A Review

Arvind Kumar Bhandari*, J. S. Negi, V. K. Bisht and M. K. Bharti
Herbal Research and Development Institute - Mandal,
Gopeshwar (Chamoli), Uttarakhand-24640

Keywords : *Cordyceps sinensis, clavicipitales, herbal Viagra, caterpillar, fungus.*

A medicinal compound of long and illustrious history, *Cordyceps sinensis* belonging to Ascomycetes fungus closely related to the mushrooms. In Garhwal Himalayan region an ancient *Cordyceps* genus of Ascomycete fungi is a rich source of *Cordyceps sinensis* (Keera jari). The Latin etymology describes cord as club, ceps as head, and sinensis as Chinese. *Cordyceps sinensis*, in Indian Garhwal Himalayan region (Uttarakhand) it is known as Keera jari, in china it is known as Dong Chong Xia Cao (Yarsagumba), in English commonly as caterpillar fungus as it is grow inside caterpillars, collection phase only 45 days. *Cordyceps sinensis* is a high potency in curing various diseases; help recover fertility by increasing sperm count. It is reported that *cordyceps sinensis* feeding to increase the ratio of adenosine triphosphate (ATP) to inorganic phosphate (Pi) in the liver, chemical constituents in *Cordyceps sinensis* as Cordycepic acid, glutamic acid, amino acids (phenylalanine, proline, histidine, valine, oxyvaline, arginine); inorganic elements, organic acids and Vitamins. In market it is highly demanded and cost is vary high in Indian market ‘3,00000. 00(three lacks) per kg. and International market ‘30,00000. 00(thirty lacks) per kg.

81. Screening of Dietary Substances : New Blockade Strategy on Quorum Sensing

M. Dhaneesha[1], D. Arathy Pai1 and H. Jayalakshmi[2]
[1]School of Environmental Studies,
Cochin University of Science & Technology,
Cochin-682 022
[2]Amrita School of Biotechnology,
Amrita Vishwavidyapeetham,
Kollam-690 525

Keywords : *Quorum quenching, fruit extracts, Chromobacterium violaceum*

The increasing occurrence of multiresistant pathogenic bacterial strains has gradually rendered traditional antimicrobial treatment ineffective. Quorum sensing, which is ubiquitous in bacteria, is the cell density dependent expression of species in bacteria mediated by hormone like compounds called autoinducers. Quorum quenching, which is the ability to disrupt quorum sensing, has a great therapeutic potential. The observation that quorum sensing is linked to virulence factor production, suggest that many virulent microbes could potentially be rendered nonpathogenic by inhibition of their quorum sensing systems. Though antimicrobial properties of dietary phytochemicals is well known, their ability as quorum sensing modulators is less studied. The primary objective of this investigation was to determine the quorum sensing inhibition activity of common fruit extracts, viz. , *Ananas cosmosus, Citrus sinensis, Vitis Concord Seedless, Punica granatum, Phyllanthus emblica, Anacardium occidentale, Lycopersicon esculentum, Malus domestica, Vitis muscat and Vitis vinifera*. The bacterial strain used was *Chromobacterium violaceum* MTCC 2656. Loss of purple pigment in *Chromobacterium violaceum* is indicative of quorum sensing inhibition by the fruit extract introduced. The experiments were done in triplicate using standard methods. 6 fruit extracts, viz. , *Ananas cosmosus, Citrus sinensis, Vitis Concord Seedless, Punica granatum, Lycopersicon esculentum* and *Vitis muscat* expressed quorum quenching activity. *Phyllanthus emblica* showed antimicrobial activity. Quantitative assessment of pigment inhibition indicated that the quorum quenching activity of the fruits is concentration dependent. *Citrus sinensis* showed lowest quorum quenching activity. The molecules within the extracts that are involved in the inhibition of quorum sensing and the mechanism of quorum quenching are to be studied as a future prospect in order to exploit the wide possibilities of quorum quenching as a possible future treatment scenario for infections caused by bacteria which regulate pathogenocity by means of quorum sensing.

82. Determination of *in vitro* Antioxidant activity *Cassia occidentalis* L.

J. P. Yadav

Department of Genetics,
M. D. University,
Rohtak-124001, Haryana

Keywords : *Cassia occidentalis; free radical scavenging activity; phenolic compounds.*

Cassia occidentalis (Caesalpiniaceae) is called as Kasmard in Sanskrit, Kasondi in Hindi and Coffee Senna in English is an important ethnomedicinal plant. In the present study an attempt has been made to investigate the free radical scavenging activity of methanolic extracts of different plant parts of *C. occidentalis* collected from Haryana region by employing various established *in vitro* systems from Haryana region. The methanolic extract of seeds were found to have highest hydroxyl radical, superoxide radical and â-carotene-linoleic acid scavenging potential as compared to corresponding leaves and stem extracts. However, methanolic extract of leaves and stem were found to possess highest metal chelating and nitric oxide radical scavenging potential respectively as compared to seed extract.

83. Studies on the Mycorrhizal Association of Some Threatened Plant Species of Sangla Valley in Kinnaur, North West Himalaya

Vaneet Jishtu[1], Rupam Kapoor[2] Ashwani Tapwal[3], K. S. Kapoor and T. N. Lakhanpal[4]

[1]&[3] Rain Forest Research Institute,
Jorhat, Assam-785001
[2] Department of Botany,
University of Delhi-110007
[4]Department of Biosciences,
HP University, Shimla-171005
E-mail : jishtu@yahoo. com ; tezlakhanpal@rediffmail. com

Keywords : *Vesicular Arbuscular Mycorrhizae (VAM), Kinnaur, Himachal Pradesh, conservation programmes, endangered.*

More than 90% of the 300, 000 species of vascular plants in the world form Vesicular Arbuscular Mycorrhizae (VAM). VAM fungi colonise the fine absorbing roots of plants, producing specialized structures known as vesicles and arbuscules. VAM fungi belong to the family Endogonaceae (Order : Mucorales). *Glomus, Gigaspora, Acaulospora, Sclerocystis, Entrophospora* and *Scutellospora* are the genera that have been known to form symbiotic associations.

A study was conducted to identify the mycorrhizal association of some of the rare/ endangered/ threatened plant species of Sangla valley, the tribal region of

Kinnaur in Himachal Pradesh, to facilitate regeneration/conservation programmes for the future. After repetitive consultations with the local inhabitants, 15 plants were selected, which were locally important and threatened or endangered. The shortlisted species includes : *Abies spectabilis, Acer caesium, Betula utilis, Elaeagnus umbellata, Fritillaria roylei, Hippophae tibetana, Juglans regia, Juniperus communis, Piptanthes nepalensis, Quercus ilex, Rohododendron campanulatum, Saussurea costus, Sophora mollis, Rheum austral and Ribes alpestre.* The result revealed that among different genera, the association of *Glomus* was dominant having association with all of the plants species examined. While among species *G. mosseae* was observed most prevalent in its occurrence. It is in agreement with other similar works on mycorrhizae carried out in other parts of the globe.

Today, the mycorrhizae, is fast emerging as an important tool of biotechnology, which will go a long way in aiding the eco-restoration activities and success of any future afforestation programmes.

84. Diversity of Arbuscular Mycorrhizal Fungi in Alkaline/Sodic Soils

Varun Khare and Harbans Kaur Kehri

Sadasivan Mycopathology Laboratory,
Department of Botany,
University of Allahabad,
Allahabad-211002

A systematic survey of alkaline/sodic soils of the three different sites viz. , Handia, Phulpur and Pratapgarh located near Allahabad was undertaken to assess the population and diversity of AM fungi in such soils. Each site was divided into four different zones consisting of barren unproductive land, grassy patches, scanty vegetation and cultivated fields.

The results showed that average AM spore population ranged from 7. 3 to 70. 3 spores/50g air dried soil. Highest AM spore population was recorded at Pratapgarh, while lowest at Phulpur. Significant variation was recorded in the AM spore population in relation to the seasonal changes. Maximum spore population

was recorded in winter and maximum in summer. A total of 29 species belonging to five genera of AM fungi were isolated from the different zones of the selected sites. Glomus was recorded as the most dominant genus with 20 species. Species diversity of the AM fungi calculated through Shannon-Weiner index which ranged from 2. 24 to 2. 71. Maximum diversity of AM fungi was recorded at Pratapgarh, while the lowest at Handia. Glomus mosseae was the most frequent and abundant species at Handia and Phulpur, while Glomus fasciculatum at Pratapgarh. Likewise, Acaulospora denticulate was the least frequent and abundant at Handia and Sclerocystis dussi at Phulpur and Pratapgarh. Detailed findings will be presented during the conference proceedings.

85. Effect of Varying Levels of Fly Ash on the Growth Performance of *Phaseolus Mungo*

Rollie Verma and Harbans Kaur Kehri

Sadasivan Mycopathology Laboratory,
Department of Botany,
University of Allahabad,
Allahabad-211002

In India, about 75% of the electricity is generated by coal-based thermal power plants, which produce nearly 65 million tons/year of fly ash as a by-product. Disposal of such huge amounts of fly ash is posing a great environmental problem. During recent years its use in improving the nutrient status of stress soils has been recommended. It has the potential of modifying the soil texture and bulk density, optimizing the soil pH, improving the water holding capacity of soil, improving yield, and as a micronutrient supplement to soil.

In view of this the present study has been undertaken to investigate the effect of varying levels of fly ash on the growth performance of Phaseolus mungo in saline-alkaline soils which are regarded as unfit for agriculture on account of high concentration of soluble salts and exchangeable sodium. A number of microbes helpful in increasing the nutrient status of soils viz. , VAM fungi, phosphate solubilizers and N2 fixers were also evaluated alone as well as in combination to nullify the ill effects of salt stress. Detailed findings will be presented during the conference proceedings.

86. Role of Vam And Pgpr in Plant Disease Management

Harbans Kaur Kehri

Sadasivan Mycopathology Laboratory,
Department of Botany,
University of Allahabad
Allahabad-211002

During recent past, it has been fully realized that the increase in agricultural production through the use of chemical pesticides is contaminating the environment, ground water and food stuffs. Therefore, during the past few decades a significant priority has been given to search for new and effective biocontrol agents by the research and development community. Biological control is a reliable and safe alternative method. So far, more than a dozen microbial biocontrol agents for plant diseases have been registered in US and Europe. Agrobacterium radiobacter K-84 (for use against crown gall), Pseudomonas fluorescens (against Rhizoctonia and Pythium damping off of cotton), Gleocladium virens (against seedling disease of ornamental plants), Trichoderma harzianum and T. polyporum (against wood decay), Bacillus subtilis (as seed treatment), Peniophora gigantia (against Heterobasidium annosus of conifers), Trichoderma viride (against Chondriostereum purpureum of plum trees) are some of them.

Few more types of microbial biocontrol agents have been discovered by the scientists who have proved their potentiality to control the deleterious microbes beyond their expectations viz. plant growth promoting rhizobacteria (PGPRs) and vesicular arbuscular mycorrrhiza (VAM). Both of these hold tremendous potential for use as biocontrol agents for plant pathogens. More emphasis will be given on the mechanism of the action and important constraints in their wide applications.

III. ANGIOSPERM BIODIVERSITY AND ANATOMY

87. Effect of Hedging on Shoot Production in Various Seed Sources of *Jatropha curcas* L. in Lower Himalayan Region of HP

Sandeep Sharma, Arun Kumar and R. Rathore

Himalayan Forest Research Institute,
Shimla-171009

Keywords : *Hedging, Seed source, Variation, Lower Himalayas, Jatropha curcas*

With extensive use of nonrenewable petroleum sources and increase in environmental pollution there appears a sense of requirement to find out an alternate energy source. *Jatropha curcas* L. a perennial plant of Euphorbiaceae family received much attention as an alternate source for diesel as its oil is used as bio-diesel. 25 no. seed sources of *Jatropha curcas* raised as Demonstration Plantation under Department of Biotechnology (DBT) funded project during 2005 at Nalagarh, Solan in lower Himalayan region of Himachal Pradesh were hedged after four years of planting at 60 cm above ground. Production of no. of shoots/ plant, average root length and average diameter of new shoots were recorded after one year of hedging. The hedging produced maximum no. of new shoots in Laraghat, Bilaspur (H. P.) seed source *i. e.* 25. 95/plant followed by Parwanoo, Solan (H. P.) seed source *i. e.* 17. 20/plant and Jagdalpur, Bastar (Chhatisgarh) seed source *i. e.* 15. 47/plant. The least no. of shoots/plant was recorded in Kotdware, Dehradun (Uttarakhand) seed source *i. e.* 7. 80/plant. Significant seed source variations were recorded in all the studied parameters. Overall hedging improves branching in *Jatropha curcas* plants which will subsequently lead to more fruiting and seed production.

88. Exomorphic and Endomorphic Features of *Swertia chirayita*

A. B. D. Selvam

Pharmacognosy Section, Botanical Survey of India,
Howrah-711103.

Keywords : *Chiraita, Swertia chirayita, anatomy, identification*

The trade name '*Chirata*' refers to both *Swertia chirayita* (Roxb. *ex* Flem.) Karsten. (Gentianaceae) and *Andrographis paniculata* (Burm. *f*) Nees (Acanthaceae). These ambiguous names give room for fraudulent activities. The plant *Swertia chirayita* has already been studied by many authors. However, the basic vascular structures have been misinterpreted in Pharmacognosy books and also in the Indian Herbal Pharmacopoeia. In the present paper, exomorphic and endomorphic features of *Swertia chirayita* have been critically studied and the correct usage of the scientific terms and distinguishing structural features have also been highlighted, which would be useful in identification and authentication of this plant.

89. Vegetational Structure, Diversity and Fuel Load in Fire Affected Areas of Tropical Dry Deciduous Forests in Chhattisgarh

M. K. Jhariya, S. S. Bargali, S. L. Swamy and Lalji Singh

Deptt. of Forestry,
College of Agriculture, IGKV,
Raipur (C. G.)-492006

Keywords : *Diversity, fuel load, vegetation, regeneration pattern, pre-fire, post-fire*

The present study deals with the vegetational structure, diversity and fuel load in fire affected areas of Tropical Dry Deciduous Forests in Bhoramdeo Wildlife Sanctuary in Kabirdham district of Chhattisgarh state during the year 2009-2010. The study was conducted in the four forest fire zones i. e. , high fire zone, medium fire zone, low fire zone and non-fire zone of tropical dry deciduous forest. The variation in species composition, regeneration status, diversity and quantification of fuel load were studied. Along the fire gradients the tree species exhibited highest density of seedlings in low fire zone. The highest density of saplings and trees were present in non-fire zone, whereas shrubs and herbs layer showed the highest density in medium fire zone. In the dry deciduous forest the seedlings as well as the ground vegetation preferred the shade and moist conditions for their survival. In this study we found that protected areas (non-fire zone) contained more species as compared to burnt areas. The diversity pattern showed that the medium fire zone showed maximum diversity followed by non-fire zone, whereas low fire zone had minimum Shannon index. The regeneration

pattern of tree species in all the fire zones and non-fire zone generally showed five general patterns, details of which will be discussed in the presentation.

90. A Comparative Study of Seedling Diversity in the Genus *Eragrostis* (Poaceae)

***Dhara Gandhi, Susy Albert and Neeta Pandya**

Department of Botany,
Faculty of Science,
The Maharaja Sayajirao University of Baroda,
Vadodara, Gujarat

Keywords : *Seedling, Eragrostis, ligule, collar regions*

A seedling comes in being when a seed germinates. A seedling is helpful in assessing the natural regeneration of an ecosystem and is of great importance to the forest planners. Seedlings of tree species are very easily identifiable while grasses and herbaceous plants are very difficult to identify at seedling stages, particularly in the one- to- two-leaf seedling growth stage. *Eragrostis* is a genus belonging to the Tribe Eragrosteae. In Gujarat, 14 species of *Eragrostis* are found, out of which 6 different species has been analyzed. In the species of *Eragrostis* the common feature is hairy ligule and presence of long cilia/hairs at the collar region. This is the main feature on the basis of which *Eragrostis* is easily differentiated from the other genera. Further, on the basis of hairy ligule type, concentration of hairs, arrangement of hairs and length of hairs different species of *Eragrostis* can be differentiated.

91. Petiolar Vasculature and its Application in Taxonomic Diagnosis of the Genus *Dioscorea* Linn.

Elsamma Joseph Arackal* and A. G Pandurangan

*Department of Botany,
Maharajas College, Ernakulam
Plant Systematics and Evolutionary Science Division,
Tropical Botanical Garden and Research Institute,
Thiruvananthapuram-695562

Keywords : *Vasculature, taxonomy, Phylogenetic, dioscoria*

The studies on the vascular profile of the petiole as viewed in transections have long been considered as one of the powerful tools to resolve the systematic and phylogenetic considerations of plants as well as herbal diagnosis (Grew, 1675; Decandole, 1868; Vesque, 1885; Petit, 1887; Hare, 1943; Howard, 1979). The structure of the petiole does not yield to structural changes to environmental stress and this fact further strengthens the validity of petiolar anatomy in application to taxonomy to confirm the taxonomic identity of different species as compliment to alpha taxonomy especially when reproductive features are not available.

Dioscoreaceae, a unique taxon among monocotyledons has equally been a controversial group with regard to the circumscription of genera included in this family (Ayensu, 1972). Systematic studies on Dioscoreaceae were mainly based on the external morphology of the plants. It was later realized that internal structure of Dioscorean taxa are potentially reliable for the analysis of classification, phylogeny and interrelationships among various taxa in the family Dioscoreaceae and with other families in the order Dioscoreals. The present study is an attempt towards analyzing the petiolar anatomy of selected species of *Dioscorea* inhabiting the Western Ghats of Peninsular India.

Transectional profiles of the petiole at different levels were studied with the help of wax embedded microtome sections stained with Toluidine Blue (Sass, 1940; O'Brien *et al.* , 1964). Photomicrographs at different magnifications were prepared to highlight the gamut of variation of the petiolar structure. Tran sectional outline, winged or wingless condition, number of vascular strands, presence or absence of sclerenchyma cylinder around the vascular system and the number of phloem units in each strand are the criteria given accent in the study. The results of the data obtained are critically evaluated with reference to the relevance of the structural diversity in the taxonomy of the Taxon *Dioscorea*. An artificial dichotomous key has been provided to diagnose the different species of Dioscorea which is also included in the presentation.

92. An Approach to Identify different Varieties of *Mangifera indica* L. with the help of Morphological Traits

[1]Bhavna Sharma, [2]Susy Albert and [3]Hareshkumar Dhaduk

[1,2]Department of Botany,
Faculty of Science,
The Maharaja Sayajirao University of Baroda,
Vadodara. 390 002. Gujarat
[3]Department of Agricultural Botany,
College of Agriculture,
Junagadh Agriculture University,
Junagadh 362001, Gujarat

Keywords : *Leaf, inflorescence, morphology, anatomy, Mangifera*

Mature leaves and inflorescence of seventeen varieties of *Mangifera indica* L. namely Alphonso, Badshahpasand, Goto, Sindoria, Rucchado, Desi, Dudhpendo, Fasli, Jamadar, Cowasji, Kesar, Khodi, Totapuri, Pairi, Rajapuri, Sopari and Langda were examined to determine the variations amongst the varieties. The vegetative characters (leaf shape, size, etc.) and floral characters (inflorescence position, shape, size, colour, flower characters etc.) exhibited by the types showed great variation. An identification key has been prepared to identify these varieties with the help.

93. Floristic Diversity of Labpur, Bolpur-Shantiniketan and Sainthia of Birbhum District, West Bengal

Bijayasis Ghatak, Nirupam Saha, Sk. Asif Iqbal, Md Jafar Iqbal, Sawkat Hossain and P. K. Bhattacharyya[1]

Deparment of Botany
Sambhu Nath College Labpur,
Birbhum(W.B.)
[1] UGC-CAS Department of Botany
University of Burdwan
Golabag-713104, (W.B.)

Keywords : *Floristic diversity, Labpur, Bolpur-Shantiniketan, Sainthia, Phanersphyte*

Study of floristic diversity of Labpur and surrounding other two blocks Bolpur-Shantiniketan and Sainthia was carried out in 13 selected study sites having uniform composition. A total number of 438 species of angiosperms were encountered during the sampling of vegetation. Showing the diversity of flora. They belonges to 87 families including 78 of dicotyledons and 09 of monocotyledons. Based on species contributions. Papilionaceae (30), Cyperaceae (30),Poaceae (25),Asteraceae (24),Solanaceae (20) were found as dominant families. The phanersphytic and chamaepphytic life form was comparatively higher in these areas. All specimens are preserved in herbaria of Botany department of Sambhu Nath College, Labpur.

94. Tree Species Diversity and Dominance of Forest Vegetation in Central India

A. S. Thakur[1] and P. K. Khare[2]

[1]Department of Botany,
Govt. College, Khurai,
Sagar 470117 (M.P.)
[2] Department of Botany,
Dr. H. S. Gour Vishwavidyalaya,
Sagar-470003 (M.P.)

Keywords : *Species diversity, Richness, Diversity, Forest communities, Sagar District*

Species and diversity of tree species were analysed in 10 respresentative forest sites occurring in Sagar District (Madhya Pradesh). Species richness and species richness index ranged from 18 to 50 and 1. 120 to 2. 343 respectively. Shannon-Wiener diversity index ranged between 2. 22-3. 66 and Beta diversity ranged between 0. 69-1. 83. The values of concentration of dominance were generally low at all study sites indicating the dominance is shared by more than one and/or many species. Dominance-diversity curves showed log-normal distribution, also indicative of shared resources pattern by a number of species and mixed nature of vegetation.

95. Occurrence of Polyembryony in *Juniperus polycarpos* C. Koch. (Himalayan Pencil Cedar)

P. S. Negi

Himalayan Forest Research Institute,
Shimla-171009 (HP)

Keywords : *Juniperus polycarpos C. Koch. syn. Juniperus macropoda Boiss, Polyembryony,*

Juniperus polycarpos C. Koch syn. *Juniperus macropoda* Boiss. commonly known as "Himalayan Pencil Cedar" is a shrub or tree up to 40-50ft. in height and 6-7 ft. in girth found in inner arid ranges of the Western Himalayas from Nepal to Uttrakhand, Himachal, Jammu & Kashmir, Pakistan, Afghanistan at an altitude of 5,000-14,000ft. above mst. It belongs to the family Cupressaceae. Junipers are socially and ecologically quite important plant species because their wood is used as fuel wood, twigs and dried leaves are used as incense in almost every house and in temples and monasteries for performing various religious rites in Kinnaur and Lahaul Spiti district of Himachal Pradesh and Ladakh region of Jammu & Kashmir. The natural regeneration in Junipers is quite low. Its seed do not germinate due to the phenomenon of seed dormancy. The seeding ~salso not frequently and good seed year occurs in the interval of 3-4 years. While studying the seed germination behaviour of Juniperus polycarpos, a twin seedling was found germinated from a single seed which has been reported. This is the first instance of occurrence of polyembryonic seedlings in Juniperus polycarpos which have been reported in this manuscript. The twin seedlings have been resulted due to the phenomenon of polyembryony which is of rare occurrence in this species,however, the production of abnormal seedlings has been reported earlier also in other forest tree species. The twin seedlings were found to be independent having separate taproots and cotyledons. The seedlings were later transplanted in a polybags filled with Soil : Sand : FYM (2 :1 :1 :) to observe the further growth of the seedlings. After three months, it was noticed that both the twin seedlings shriveled and died where as the normal seedlings continued to grow normally and produced all the essential features of a plant.

96. Vivipary in Papaya : A New Report

Sushil Pradhan

Department of Botany'
Boudh Panchayat College,
Buddha Vihar,
Boudh-762014 (Orissa)

Keywords : *Vivipary,Germination, Seed, Epigeal, Hypogeal, Papaya.*

Viviparyis a special type of seed germination where the seed gets germinated while still inside the fruit being attached with the parent plant. It is seen in plants growing in salt lakes and sea coasts. So the seed germinates within the fruit while the later is still attached to the parent plant. Papaya, Botanically knownas *Carica papaya* L (Family-Caricaceae) exhibits"Epigeal"type of seed germination but vivipary has been recently observed by the present author and is being reported in this august body of Plant Scientists for discussion and appreciation.

97. Structural, Histochemical and Chemical Composition of Tension, Opposite and Normal wood of *Leucaena leucocephala* (Subabul)

Pramod S* and K. S. Rao

BRD School of Biosciences,
Sardar Patel University,
Vallabh Vidyanagar,
Gujarat-388 120

Keywords : *Anatomy, histochemistry, Lignin, tension wood, Leucaena leucocephala*

Structure, histochemistry and chemical composition of tension, opposite and normal wood of Leucaena leucocephala have been studied using histological, histochemical and biochemical methods. Anatomical studies have revealed that tension wood is characterized by longer vessel elements with narrow lumen, low vessel. density, fibres with wider lumen and short and narrow rays. Histochemical stlidies using Wisner reaction and Maille reaction revealed that the lignified walls in the tension wood fibres are rich in guaiacyl units. Fluorescence microscopy also

showed a high autofluorescence from lignified walls of tension wood fibres indicating presence of more condensed lignin units in G-fibres compared to that of normal and opposite wood. FTIR spectroscopy of cell wall residue and Klason lignin revealed significant variation in the chemical composition of tension wood from normal wood, especially by reduction. in hemicelluloses and more condensed lignin units (G and GS type). Klason lignin content reduced significantly in tension wood while opposite wood was characterized by more lignin content than the normal wood. Acetyl bromide method used for the confirmation of lignin content analysis also showed the similar pattern of variation in total lignin content in tension, opposite and normal wood. Thioacidolysis of lignin showed that tension wood has a lower S/G ratio compared to that of opposite wood.

98. Ecomorphometric Markers Reflect Variations in (-) Hydroxycitric acid Content of the Fruit Rinds of *Garcinia cambogia*

Chandu Vijay[1] and Parvathi Chary*[2]

Sri Sathya Sai University,
Dept of Biosciences,
Prashanthi Nilayam, Puttaparti-515134
Present Address : Garden City College,
T. C. Palya, Bangalore,
Karnataka-560049

Keywords : *Hydroxycitric acid, ecomorphometry, Garcinia cambogia, HPLC, SPSS Version 10.0*

Ecomorphometric characteristics reflect the quantitative variations in (-) Hydroxycitric acid (HCA) from the fruit rinds of *Garcinia cambogia* (Family Clusiaceae), a compound known for its anti-obesity property along with several other medical factors. Sixty accessions from five eco-geographically distinct regions in Kerala, India were studied. Various statistical tools were utilized to determine the factors that indentify elite chemotypes of *G. cambogia* based on their high levels of total (-) HCA and free (-) HCA. Our results suggest that those accessions growing in soil with high moisture content and inorganic carbon proved to be elite chemotypes; given that these parameters could significantly contribute to the **rind-width** and the **weight of the fruit**, from which **(-) HCA** is extracted.

99. Rare and Endangered Medicinal Plants from Karnataka

Sreenath, K. P., Shiva Manjunath, M. P. and Lokesh, K. B.
Department of Botany,
Bangalore University,
Bangalore-560 056

Keywords : *Rare, endangered, medicinal plants, new record, Karnataka*

During the course of investigation on medicinal plants of Karnataka, the authors have come across few potential and hitherto unrecorded plants viz., *Cardiospermum canescens* Wall., and *Euphorbia acaulis* Roxb. The *Cardiospermum canescens* differs from *C. halicacabum* in having pubescent leaves and emarginated hilum, both belong to Sapindaceae. Gamble (1918) published the occurrence of *C. canescens* from Deccan and Carnatic from Kistna through Mysore to S. Arcot, usually inland, extending to the North and Eastern slopes of Nilagiris. After a lapse of 92 years, the authors could able to collect from Kanakapura range (Scrub jungle) of Ramanagara District of the Karnataka State. It is the first report for the Ramanagara District. Rarity indicates, it is an endangered. Baker (1868) reported the occurrence from Nile land of tropical Africa. No research information is available to this *Cardiospermum canescens* Wall. Whereas *C. halicacabum* L. occurs universally as medicinal as well as weed. Raghupathy (2007) has reported as a potential vine for treating rheumatoid arthritis and anticonvulsant. The tribals and native vaidyas do not know the difference between the two species, are using it as medicinal plants. Therefore, rigorous study is warranted. Another interesting *Euphorbia acaulis Roxb.* (Euphorbiaceae) has been collected from Bababudan hills (2070m), Kanakapura (900m) and Bellary (1100m) after a lapse of 92 years. It is the only species that doesn't have stem, but flowers in hot summer, the leaves measures upto 30cm or more long. The tuber may range upto 60cm. Taxonomically or chemically not much of information is available. The tribals living in and around the forest range may use as galactogague.

Therefore, *Cardiospermum canescens* and *Euphorbia acaulis* have come under the category of endangered plants according to IUCN. It is an urgent and dire need to save and conserve medicinally important plants from Karnataka State. The occurrences of these two species are new to the Flora of Ramanagara, Bangalore (sensu lato), and Chickamangalur and Bellary districts.

100. North-West Himalayan Aromatic Plants : Conservation Imperatives

G. S. Goraya[1] and Vaneet Jishtu[2]

[1]Chief Conservator of Forests,
Himachal Pradesh Forest Department,
Shimla (HP)
[2]Rain Forest Research Institute,
Jorhat (Assam)

Keywords : *North-west Himalayas; Aromatic Plants; Floristic Diversity; Ethno-botany; Plant Conservation.*

Aromatic plants form a very important component of the floristic diversity of the north-west Himalayan landscape. Local communities across this region have a long tradition of reliance on a variety of wild aromatic plants growing in their surrounds for use in daily worship of deities, religious ceremonies and rituals, purification of home environment, culinary, repelling insect pests and primary health care. Aromatic parts of most of these plants - leaves, flowers, twigs, whole plants, wood, roots or rhizomes - were usually collected by the local people from across the altitudinal range in these hills during transhumance, dried and stored for use. Many of these species, hitherto collected sustainably from the wild for bonafide domestic use of the local communities and petty trade, have come under ruthless exploitation to meet commercial demands, putting the resource under tremendous pressure. The increasing developmental and biotic pressures are only adding to this stress and wild populations of many of these species have come to face a serious threat of extinction.

This paper attempts to assess the conservation status of selected naturally occurring aromatic plants of north-west Himalayas with special reference to their status in Himachal Pradesh and proposes mitigation strategies to build their wild populations.

101. Study of Phenology of some Important Dominant Trees of Natural Forest of Moist Tropics of Uttar Pradesh, India

Upama Mall and G. S. Singh
Department of Botany,
Banaras Hindu University,
Varanasi-221005 (U.P.)

Keywords : *Phenology, Moist deciduous, flowering, fruiting, leaf fall, leaf initiation.*

The present study has been carried out in the moist tropics of two districts Gorakhpur and Mahrajganj of north-eastern Uttar Pradesh. The aim of this paper is to discuss about phenological pattern of some important forest tree species of moist deciduous forest. For the study, complete survey has been done from June 2007 to December 2009 at monthly intervals. Total 90 trees were found in permanent plots. The phenological study has been carried out in all 90 trees species but in this paper only 16 dominant tree species will be discussed. These 16 species were belong to 13 families comprising of are Anacardiaceae, Apocynaceae, Bombacaceae, Combretaceae, Dipterocarpaceae, Euphorbiaceae, Fabaceae, Lythraceae, Mimosaceae, Myrtaceae, Rubiaceae, Sapindaceae and Verbenaceae. Generally, most of trees flower in March-July and minimum in November-December. Leaf fall is generally occurred in the months of November to February, while leaf renewal/initiation is from February to April. The flowering and fruiting in this tree species are influenced by climatic as well as ecological factors like temperature and rainfall. Thus, phenological study is generally influenced by seasonal variations and it can be useful for planning proper management of the forest for sustainable regeneration and development.

102. Revised Bark - Terminology

J. Asokan
Department of Plant Biology and Plant Biotechnology
Sir Theagaraya College, Tamil Nadu,
Chennai-600 021

Keywords : *Bark anatomy, terminology, standardization*

Bark is one of the potential sources of medicinal, industrial and commercial products. Knowledge of the structure and organization of the bark enables efficient utilization of barks. Descriptive terminology of bark tissues is the basic aspect in the study of bark. It seems that many of the terms used to describe the bark structure are ambiguous. A large number of synonymous terms reveal the lack of concise terminology of bark anatomy that could be preserved or discarded in order to maintain uniformity in the description of the structural spectrum of the barks.

103. Total Extractives in Sound and Decayed Wood of Teak (*Tectona grandis*)

Tapan Kumar Maitra; Associate Professor and Head

Department of Botany
Ananda Mohan College,
Kolkata-700 009

Keywords : *Air-dry wood meal, Soxhlet's apparatus, Primary and Secondary mycelia*

Cowling 91960) has modified the method of TAPPI standard T 12m – 45 for this analysis. Cowling's (1960) modified method has been followed in the present investigation for the analysis of total extractive materials from sound, partially decayed and naturally decayed wood.

104. A Comparative Study on Diversity and Regeneration Status of Tree Species in Oak Forests inside and around Zoo, located in Nainital Catchment

Kiran Bargali, Y. S. Rawat, Priyanka Bisht and Abida Khan

Department of Botany,
DSB Campus, Kumaun University,
Nainital-263002 Uttarakhand.

Keywords : *Basal area, density, diversity, girth class, population structure, regeneration.*

The existence of a species in a forest community largely depends on its ability to regenerate under varied environmental conditions. In the present study, effect of biotic disturbance was assessed and analysed on diversity and regeneration of predominant tree species of oak forests. For this, two adjacent sites were selected in mixed oak forest zone (2100 m asl) viz. undisturbed open area (inside zoo) and moderately disturbed open area (out side zoo). Phytosociological analysis of tree and shrub layer vegetation was done and density, diversity index, Importance Value Index etc were determined for both the sites. Regeneration status of tree species was analysed by developing population structures. Species richness (tree as well as shrub) was high in disturbed site (11-20) as compared to protected site (9-11), and in both the sites the species richness was maximum at hill slope. Species diversity and concentration of dominance was also higher in disturbed site as compared to protected site. Among the tree species *Quercus floribunda* was domionant with highest value of IVI in protected site. Contrary to this, *Quercus lecotrichophora* was dominant in disturbed site at hill base and hill slope, while *Q. floribunda* was dominant at hill top site. Tree density ranged from 780 to 1000 trees ha^{-1} in protected site and from 260 to 780 trees ha^{-1} in disturbed site. In both the sites, *Q. leucotrichophora* and *Q. floribunda* have higher proportion of individual in younger girth classes (seedlings and saplings), indicating expanding type of population structure. However, conversion into higher girth classes was more prominent at protected site as compared to disturbed site. Thus, it can be concluded that oak species of Kumaun Himalayan region have ability to regenerate when anthropogenic pressure are negligible.

105. Ethnomedicinal Plants Used by Tribal Inhabitants of Senapati District, Manipur

Lisham Sangita Devi and R. K. Imotomba

Krishi Vigyan Kendra,
Bishnupur District,
Manipur

Keywords : *Data base, Ethnomedicine, Tribe, Senapati, Manipur*

An extensive and intensive field survey were conducted in Senapati district, of Manipur for the medicinal plants used by tribal inhabitant area and to find out the

extent of the availability of the medicinal plants with the help of GPS in around 38 villages and then mapped on the satellite district map. The medicinal values along with the extent of availability at their natural habitat of 176 important plant species (111 identified and 65 unidentified) used by these tribal elders, traditional siddha healers, academics, staffs of herbal gardens were recorded and chemical compounds of some medicinal plants have also been documented.

106. Medicinal Plants of Pavagadh, Gujarat : a Taxonomic Overview

Hitesh R. Patel, F. J. Thakor and R. P. Bhoi

Smt. B. C. J. Science College,
Khambhat, J and J. Science College, Nadiad

Keywords : *Ethnobotany, taxonomy, knowledge gap*

Since ancient times, humans have used plants for their medicinal properties. In Gujarat Pavagadh hill is a rich repository of medicinal wealth. Despite number of studies, many on the ethobotany, an updated and reliable taxonomic assessment of medicinal flora on Pavagadh hill is still unavailable. To fill this knowledge gap, the paper presents a taxonomic overview of the medicinal plants of this distant region. During the present investigation, 160 medicinal plant species distributed among 70 families have been recorded.

107. Species Composition of Grasslands of Saharsa District, Bihar

Surya Mani Kumar

Department of Botany,
Ramesh Jha Mahila College,
Saharsa, Bihar

Keywords : *Grazing effect, species composition, Saharsa, Bihar.*

The study area was confined to near Saharsa air stripe, Bihar to study the species composition, life-form and biological spectrum of grasslands of Saharsa, Bihar. The total number of grassland species were recorded to be 8,7 and 5 on

protected and 21, 14 and 9 on grazed grasslands in rainy, winter and summer seasons, respectively. Thero-hemicryptophytic life-form was comparatively higher on both types of grasslands. Biological spectrum of protected and grazed grasslands species were compared with that of Raunkiaer's normal spectrum and it was found that percentage of therophyte was higher on both types of grasslands than other life-form classes.

108. Clematis (Ranunculaceae) on Biophysical Observation.

C R DAS

Kolkata-700 153

Keyword : *Adaptation, Base, Climate, Disease, habitat, Influence Photosynthesis Substratum*

Genus *Clematis* in Family Ranunculaceae is very sensitive to climate. and has Climbing habit and the plant is poisonous but important medicinally It has 150 species of very wide geographical distribution mostly abundant in Temperate regions 80 species as native to East Asia.

IV. ETHNOBOTANY AND HUMAN WELFARE

109. Plants in Traditional use from Hemis High Altitude National Park in Ladakh, North West India

Vaneet Jishtu[1], G. S. Goraya[2] and G. S. Rawat[3]

[1]Rain Forest Research Institute,
Jorhat (ASSAM)
[2]Chief Conservator of Forests (Research);
HP State Forest Department,
Talland, Shimla (HP)
[3] Head Habitat Ecology,
Wildlife Institute of India,
Chanderbani, Dehradun (UK)

Keywords : *Traditional use, Amchi System, Hemis High Altitude National Park, Ladakh, Protected Area (PA), anthropogenic pressures, Western Himalaya; India*

Ladakh is the northernmost part of India and is amongst the few most elevated regions of the world. The region appears to be barren with scarce tufts of vegetation, however it boasts of a large number of plants which in one way or the other contribute to the wellness of the local inhabitants from times gone by. This scarce but valuable plant diversity has found multifarious usage among the people in the region and has carved a permanent niche in the ancient traditional system of medicine called the "Amchi System" which is followed with utmost religious passion even today. Hemis High Altitude National Park is the largest Protected Area (PA) in the region and lies in the Zanskar range. A number of small dwellings dot the lower part of the PA, with the people living in subsistence farming as the growing season is limited to a few months from May to September. For centuries the people living in this harsh terrain has learnt to reap the benefits from the available plants around them. The region boasts of a varied and colorful plant diversity dominated by curiously shaped bushes, most of which are spinescent. However, this study highlights the traditional usage of only 50 prominent plant species found within the PA and its outer periphery by the local tribal people. The plants are listed giving family, plant name, vernacular names and traditional usage, the families being arranged as per the Benthem and Hooker's System of classification. The people over the years have restricted the collection and usage of these plants in a systematic sustainable manner. However, as on today, the habitat of most of these plant *taxa* has diminished due to the ever increasing anthropogenic pressures, mainly heavy livestock grazing and unregulated tourism. Therefore, a systematic approach involving the local community and the developmental agencies is required to protect and enhance their populations for future sustainable harvesting.

110. Effect of *Cissus quadrangularis* and *Lepidium sativum* on Fracture Healing

Raghunandan Singh Nathawat and Payal Lodha.

Plant Tissue Culture and Biotechnology laboratory,
Department of Botany,
University of Rajasthan, Jaipur.

Keywords : *Cissus quadrangularis, Lepidium sativum, fracture healing.*

Cissus quadrangularis Linn (Syn : *Vitis quadrangularis* Wall : Family : Vitaceae) and *Lepidium sativum* Linn. (Family : Brassicaceae) are indigenous medicinal plants of India. *Cissus quadrangularis* is known as "Harsankar" in Hindi and "Asthisanghara" in Sanskrit and *Lepidium sativum* called "Chandrasura" in Sanskrit and "Halim" in Hindi. A study was undertaken to evaluate the effect of methanolic and aqueous extract of Cissus *quadrangularis* and, *Lepidium sativum* on the healing process of experimentally fractured radius-ulna of rabbits. *Cissus quadrangularis* and *Lepidium sativum* treated animals revealed faster initiation of healing process than the control animals on radiological, biochemical and histological examinations. The treated group also revealed a decrease in serum calcium level to a greater extent than the control group. Healing was almost complete on twenty first day of fracture in the treated animals and remained incomplete in the control animals. No significant alteration of serum calcium level was observed on twenty first day of fracture in both the groups. Both these plant extracts are more effective than allopathic drugs, without producing any side effect.

111. Antimicrobial and In vitro Cytoprotective studies of Triphala for various ophthalmic disorders

Dolly Singh*, Akshay Srivastava, Deepti Singh**, R. M. Painuli* and Ashok Kumar**.**

Department of Botany/ Microbiology,
H. N. B. Garhwal Central University,
Garhwal, Srinagar
Department of Biological Sciences and Bioengineering,
IIT Kanpur, Kanpur

Keywords : *Triphala, anti-microbial, ophthalmic wound healing*

Primary objectives in ophthalmic disorder management are to reduce exposure and growth of microorganisms and hence minimize the risk of infection, while optimizing local conditions to encourage healing. Even though many of the oldest antibiotics are still being effectively used, most of the drug designers are mainly

concentrating in developing new antibiotics to eradicate resistant microbes. As Triphala possesses potential pharmaceutical activities and used in several Ayurvadic formulations, findings in this study may provide scientific rationale for the use of combination of all the three plants or as an individual extracts used as new drug compound for preparation of eye drops and also in various therapeutic.

112. Traditional use of Calotrapis (Asclepiadaceae) used by the Tribal and Local People in the Treatment of "Leucoderma in Central India

Dr. Radheshyam

Napit Govt. Degree College
Jaipur

Keywords : *Calatropis, genera, tribal and local inhabitants "Lucoderma".*

Frequent Ethnobotanical surveys were conducted during January 2003 – December 2007 in Shahdol district. Results of these surveys indicated that one genera two species Calotropis are interestingly used by the tribal and local inhabitants.

113. Plants Based Folk Songs used by Tribals of Rajasthan State, India.

Aparna Pareek and P. C. Trivedi

Department of Botany,
University of Rajasthan,
Jaipur-302055

Keywords : *Folklore, religious belief, tradition, culture*

The present paper is an endeavor to bring out the fascinating study for the understanding of the social customs and religious belief of the tribal's of. Rajasthan constituting around twelve percent of the total population of the state. The tribes of Rajasthan, India constitutes of Bhils,Meena, Banjara, Kathodi Rabaris,Sansi and Kanjar who use folk songs which forms one of the pleasant chores of an ethno botanical investigation. The folk songs give an idea of climatic conditions of the area

too. The folk songs of the region either reflect on a particular plant or a group of plants. These folk songs sometimes give an indication of monsoon based on plant behavior. Some folk songs provide religious sentiments of the people with plants, whereas others provide its utility and importance. It can be said that folk songs are the real indication of culture, lifestyle and climatic scenario of the regions, Present article provide information on the plants in folk songs of tribals of Rajasthan state, India.

114. Hepatoprotective Effect of Trigonella Foenum Graceum Extract on Carbontetrachloride Induced Hepatotoxicity in Mice

Soma Banerjee[1]*, Sharmistha Naskar[1] and Anjan Biswas[2]

[1]Department of Biotechnology,
Heritage Institute of Technology
Anandapur, Kolkata-700 107, West Bengal.
[2]Department of Physiology,
Presidency College
Kolkata-700073, West Bengal

Keywords : *Antihepatotoxic effect, carbon tetrachloride, Trigonella foenum graceum, liver injury*

Trigonella foenum graceum is widely used in India an Ayurvedic medicine. In the present study the hepatoprotective effects of extracts of *Trigonella foenum graceum* (Family-leguminosae) seeds were investigated against carbon tetrachloride induced hepatocellular injury in mice. For the experiment healthy male mice (25-30 g body weight, 4-6 wk old) were used. A single dose of carbon tetrachloride (CCl_4, 0. 5 ml/kg in olive oil) was administered ip to induce hepatotoxicity and the plant extract at a dose of 0. 9 g/kg was administered orally. Animals were sacrificed 24 hours and 72 hours after the administration of CCl_4. Blood and liver tissue were collected for the assessment of serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total bilirubin (TB) and liver reduced glutathione level. The liver tissue was used for histopathological assessment of liver damage. Pre-treatment of mice were with the seed extract of *Trigonella foenum*

graceum (0. 9 g/kg) orally for 7 days significantly reduced serum levels of ALT (P<0. 01), AST (P<0. 01) and ALP (P<0. 001) enzymes by 50,10. 39, and 45. 65 per cent respectively and significantly increased (P<0. 001) the liver reduced glutathione level by 69. 91 per cent, 24 h after the administration of carbon tetrachloride. A marked improvement were observed in the enzyme activities and the liver reduced glutathione level in the *Trigonella foenum graceum* pre-treated mice 72 hours after the administration of carbon tetrachloride. Histopathological studies provided supportive evidence for the biochemical analysis. The results of the present study indicated that under the present experimental conditions, extract of *Trigonella foenum graceum* seeds showed hepatoprotective abilities against carbon tetrachloride induced liver damage in mice.

115. Plants in Folk Medicine of Bhilala Tribe of Budni, Madhya Pradesh

Ravi Upadhyay and N. N. Mehrotra*

Department of Botany Govt.
Narmada College, Hoshangabad.
*Central Drug Research Institute,
Lucknow.

Keywords : *Folk medicine, Bhilala, Budni, Madhya*

Budni is a small town situated on the Vindhyan foot hills in Sehore District of Madhya Pradesh. Several tribal communities like Gond, Korku, Mawase and Bhilala reside in this area. Bhilalas have migrated to Madhya Pradesh from Rajasthan. They have their own traditions distinct from the other tribal communities of this area. They use several plants and animals in their folk medicinal practices. In the present paper Ethno-medico-botany of twelve plants frequently used in various formulations have been reported. These plants are *Asparagus recemosus, Andrographis peniculata, Aegle marmelos, Boerhaavia diffusa, Bauhina verigata, Curcuma pseudomontana, Costus speciosus, Phyllanthus emblica, Pureia tuberosa, Terminalia arjuna, T. bellerica, T. chebula and Tinospora cordifolia.*

116. "Ayur Vista : The Splendour of Solanum Nigrum"

Shripathi Adiga H. MD (AYU) Ramya S Adiga BAMS, PHHM

Dept. of Ayurveda, KMC,
Manipal University, Manipal,
Udupi, Karnataka

Key words : *ayurveda, solanum nigraum, medicinal*

Ayurveda has described the medicinal, nutritive, culinary values of Solanum nigrum, apprehending it as *Kakamachi*. Classics explicate its external utility in inflammation, pain, skin ailments besides internal usage as a liver and cardio tonic, antipyretic, rejuvenator, neuroprotector, diuretic. etc. , which withal lacks thorough understanding. Researches shew that : a) flavonoids in it regulate anti-inflammatory and anticonvulsant activities, b) alkaloids posses pupil dilating property. c)Fruit extract concords antioxidant, antihyperlipidemic, antiulcerogenic activities and conquers U/4 cervical carcinoma growth. Rigorous study of the same is essential to accomplish WHO's catchword of primary health care through herbal drugs. This literary review proposes the same.

117. A Preliminary Screening of the Medicinal Plant *Desmodium Gyrans* used by Kani Tribes for Phytochemical, Wound Healing and Antimicrobial Properties

A. Kalirajan and A. J. A. Ranjitsingh

Sri Paramakalyani College,
Department of Advanced Zoology and Biotechnology
Alwarkurichi-627 412

Keywords : *Desmodium gyrans wound healing, medicinal plants, ethno medicine, antibacterial*

In the global research for traditional medicine, Folk medicines are given much importance. In the present study KaniTribes living in the Western Ghats were interviewed to get the details of rare medicinal plants. Most of the aged Tribes explained the magical healing power in the dancing plant *Desmodium gyrans*

(Tholunkanni). Hence a preliminary study was made on the phytochemical components, wound healing and antimicrobial properties. The result of the phytochemical study showed the presence of various phytoconstituents such as alkaloids, steroid, xanthoprotein, tannins and saponins. The extracts of *D. gyrans* was found to have good antimicrobial action against harmful pathogens such as *Vibrio cholerae,Escherichia coli* and *Staphylococcus aureus*. The wound healing activity of the extracts of *D. gyrans* indicated that the extract of this plant is having a high potential of wound healing activity and was comparatively higher than the standard drug, neomycin.

118. Documentation of Traditional Knowledge of Medicinal Plants with Bioprospecting Potential from Nanded District (Maharashtra)

V. B. Chavan and O. S. Rathor

P. G. Department of botany,
N. E. S. Science College.
Nanded-43105. (M.S.)

Keywards : *Ethno-medicinal plants, Nanded district, Bioprospecting potential.*

A Floristic survey of Nanded district of Maharastra was undertaken with a view to find out the ethno-medicinal potential which is the first step in Bioprospecting. 15 species belonging to 11 families of angiospermic plants used by local people for their health care system are enumerated in this work. This type of documentation with phytochemical information can be very much useful from the Bioprospecting point of view.

119. Phyto Resources of Satpura Region of Chindwara District : Madhya Pradesh

Omkar Bawistale, T. R Sahu and P. Sahu

Department of Botany,
Dr. H. S. Gour Cenral University
Sagar (M.P.)

Keywords : *Ethino Medicinal Plants, Antimalarial, Chhindwara District, M.P.*

Ethno medicinal survey was conducted in Satpura region with special references to Chhindwara District of Madhya Pradesh,India. This district is a forest district, Chhindwara district, has acquired importance because of its Geographical and Scenic beauty. Patalkot is a lovely landscape located at a depth of 1200-1500 feet in a valley, inhabited by Gonds, Bharia tribes and they are entirely dependent on forest on medication. Information on 15 plants pecies belongs to 15genera and 14families which are traditionally used as medicine to cure malaria was collected. The plant part used for traditional preparation and doses for administration are given in the present paper.

120. A Promising Herb to Treat Rheumatoid Arthritis

Manjunath, M. P. and Sreenath, K. P

Department of Botany,
Bangalore University,
Bangalore-560 056 Shiva

Keywords : *Enicostemma axillare, rheumatoid arthritis, medicinal plant*

The present paper deals with the traditional therapeutic use of *Enicostemma axillare* (Lam.) Raynal (Gentianaceae) from Kolar district of Karnataka State to treat rheumatoid arthritis. The plant is very rare in the district as well as in other districts of Karnataka State. It is a perennial herb with dull white flowers in each axil. The plant is very much use in folk medicine to treat various ailments including diabetes mellitus, rheumatism and cancer. It has potential antioxidants and antimicrobial properties due to swertiamarin, myristic acid, stearic acid, alkaloid and phenols. Therefore, an immediate measure is warranted to protect, conserve and propagate the endangered plant.

121. Folk Medicine used to Cure Diseases like Jaundice, Piles and Diabetes by Rural and Tribal peoples of West Singhbhum, Jharkhand (India)

Vishnu Shankar Sinha, Krishna Pyare[1] and Jagriti[2]

Department of Botany, Tata College, Chaibasa,
Jharkhand, India-833202
[1]Department of Botany K S College,
Seraikella, Jharkhand, India
[2]Department of Zoology,
Magadh University, Bodhgaya,
India-824234

Keywords : *Folkmedicine, Jaundice, Piles, Diabetes, West Singhbhum*

This paper reports on ethnomedicinal uses of 54 potential medicinal plants belong to 32 families of medicinal plants used for ailment of diseases like Piles, diabetes and Jaundice by tribes and rural peoples living in some villages situated in and around West Singhbhum. West Singhbhum Dist. Of Jharkhand state is located 22º-25 º 15' N latitude and 83 º-87 º 35' E longitude. It is 28th State of India was carved out of Bihar on 15th November, 2000. It is a height of about 245. 73 m above mean sea level. Average annual rain fall is about 1168 mm. Major rain fall occurred by shouth-west mansoon, summer shoots upto 44 ºC in the month of June and winter falls down upto 9ºC. The average relative humidity is about 56%. It is surrounded by five states viz. Bihar in north, Uttarpradesh in north-west, chattisgarh in west, Orissa in south and west Bengal in east. Survey conducting during 2008-2009 for spot collection, identification and ethno-medicinal enumeration of indigenous plants. The botanical name of plant species are arranged alphabetically with their families, local names, uses as herbal medicines. Our results revealed that some of the herbal medicines have been found to be very effective for the cure of the diseases like Piles, diabetes and Jaundice.

122. Conservation of Medicinal Plants and Traditional Knowledge for Enhancing Health and Livelihood Security

Shikha Mehra

Conservator of Forests,
Medicinal Plants,
Rajasthan

Keywords : *conservation, traditional knowledge, medicinal plants*

Under National Programme for promoting conservation of medicinal plant and traditional knowledge for enhancing health & livelihood security CCF-II project which was being implemented in Rajasthan. The work was done on the following three components.

S. No.	Project Components	Agency involved
1.	Establishment of MPCA networks in the state	Rajasthan Forest Department
2.	Rapid Threat Assessment	Rajasthan Forest Department & FRLHT
3.	Establishment of Home Herbal Gardens and Community Knowledge registers	Jagran jan Vikas Samiti Bedla, Udaipur

The first two components were implemented by the Rajasthan forest department were for the third component a local NGO Jagran jan Vikas Samiti Bedla, Udaipur was involved. Seven medicinal plants conservation areas were established in different district of Rajasthan for conservation of different species. These are *Boswellia serrata, Buchanania lanzan, Chlorophytum borivilianum, Commiphora wightii, Oroxylum,indicum, Tribulus rajasthanensis* The paper would be highlighting the various aspects of each of the seven MPCA apart from it the various activities under taken by Jagran jan Vikas Samiti Bedla, Udaipur will also be highlighted which includes establishment of home herbal gardens and community knowledge registered. This experience would go along way for conservation of *Tribulus rajasthanensis* critically endangered species *Oroxylum indicum, Commiphora wightii, Chlorophytum borivilianum, Buchanania lanzan* and many other medicinal plants.

123. Dye Extraction from Eriophyid Leaf Galls of *Quercus Leucotrichhphora*

Preeti Mishra, Vidya Patni and Uma Kant

Plant Pathology, Tissue culture and Biotechnology laboratory,
Department of Botany,
University of Rajasthan,
JLN Marg, Jaipur-302004

Keywords : *Extraction, Jute, Kalamkari, Myrobalan.*

Oaks (*Quercus* sp.) are susceptible to a wide diversity of gall-forming insects. When the insect pupates and leaves, the gall can be used as a dyestuff. Kalamkari unit's method (India) was followed for the extraction of dye. A dark brown dye was obtained from the leaf gall of *Quercus leucotrichophora* caused by *Eriophyes* sp. Three different types of cloths and three different types of yarns were used in the experiment to observe the strength of dye. Cotton-Jute (C-3) sample showed dark brown color with Myrobalan and Ferrous sulphate, yellowish, cream and purplish color with Potassium dichromate, Stannous chloride and aluminium sulphate respectively.

124. Ethnobotanical Knowledge of Plants used by Rural Community of Darna region of Nashik District in Maharashtra

V. R. Kakulte and Mrs. Shobha Jadhav*

Programme Officer, National Service Scheme,
*Department of Botany,
S. V. K. T. College, Deolali Camp,
Nashik-422401

Keywords : *Baidya, Herbal medicines, Indigenous knowledge, Ojhas.*

An ethno botanical survey on medicinal plants and their indigenous uses was carried out in Darna region of Nashik District in Maharashtra. These areas are floristically rich areas where plants of various categories are growing spontaneously in their natural habitat. The rural community of these region uses some of the plants

as medicine for the treatment of human ailments. In a floristic survey 31 ethno medicinal plants species belonging to 25 families were recorded from this region. These medicinal plants are listed in alphabetically order of Latin names, local names along with family & part used as medicine.

125. Holistic Approach Health for all Through 21 Herbal Drugs, used in India Since Vedic Period (5000-1600 B.C.)

R. K. Goel and Sanjay Kumar

Environmental Biology Laboratory,
University Department of Botany,
Magadh University,
Bodh-Gaya-824234 (Bihar)

Keywords : *India, Herbal Drugs, HAHA,*

The Indian subcontinent encompasses varied ecological regions in different climatic conditions. North-Eastern India has been recognized as one of the most diverse regions with respect to flora and fauna.

Obtaining drugs from plants has been a **traditional way in the Indian system of medicine.** It is rightly said that ancient wisdom has been and will remain the basis of modern medicine. The Ayurvedic system which is very well documented in ancient scriptures such as **Atherved** (1200 BC) **Charak** Samhita (1000 BC), **Sushrat** samhita (800 BC) is of great significance due to the rich biodiversity obtained in our country. Ayurvedic system should not be confused with folk medicines as it is based on sound scientific principles developed over hundreds of years of experimentation, careful observation of medicinal properties and the side effects associated with their use.

In the present communication a list of 21 plant species reported for various ailments like **cough** and **cold, fever,** piles, constipation, disorder of liver, spleen, heart, diabetes, hypertenson, arthritis, cancer, anaemia, warts etc. 21 plant species belong to 19 genera under 19 families (Dicot = 16, Monocot= 04 and, Gymno-sperm=01). Plants include wide range of habit groups (Herbs = 09, shrubs = 05, Tree = 07) the **edaphoclimatic** especialities have also been noted along with their life forms (Therophytes = 08, Hemicryptaphytes =02, Phanerophytes = 11) Plant

adaptabilities were also recorded (Xerophytes = 01, Mesophytes = 19, Hydrophytes =01), out of 21 plant species following are most common against several diseases eg. *Adhatoda Vasica* Nees for cough & cold (Acanthaceae), *Andrographis paniculata* (Burm f) wall ex Nees for fever and liver disorder, *Centella asiatica* (L) Urban used nervertonic (Apiaceae) *Curcuma domestica* Vol is a blood purifier (Zingiberaceae), and aphrodisiac properties (Euryalaceae). *Euryaleferox* Salisbury have spermatogenic *Gymnema sylvestris* (Retz) schult control the blood sugar (Asclepiadaceae), *Lallemantia royleana* Benth. (Lamiaceae) Poultice of seeds cures the boils without any surgery, *Psoralea corylifolia* L (Fabaceae) seeds are effective in **Leucoderma** and other skin diseases *Picrorhiza Kurrooa* Royle ex Benth (Scrophulariaceae) roots used as hepataprotective, *Rauvolfia serpentina* (L) Benth ex Kurz roots used as antihypertensive and as sedatives, fruits of *sapindus mukorossi* Gaertn is contraceptive, *Tribulus terrestris* L (Zygophyllaceae) used in Geneto-urinary disorders, *Tylophora, indica* (Burm f) Merr (Asclepiadaceas) used for treating asthma and bronchitis, whooping cough, *Urginea indica* (Roxb) Kunth, bulbs used for Rheumatism and *withania somnifera* (L) Dunal root powder used for general weakness. Besides these many more plants are available for treatment of various dreadful ailments, hence, there is a need for speedy, exploration and gathering of the information.

126. Economicial Applications of Medicinal Weeds as A Source of Income for Poor Agrarian Farmers in Semi-Arid Farming

Hans Dinesh

Department of Botany,
Governme

Keywords : *weeds, medicinally important, agarian Citrullus colocolusynthis, Convolvulus microphyllus, Corchorus depressus, Solanum nigrum and Tephrosia purpurea, economy and tribal.*

In the present communication very preliminary attempt has been made to evaluate the econoomical aspect of those medicinally important weed plants which are generally considered to be of no use by poor agrarian farmers. The comparative study of control and treated plots which were made in randomized block design showed the anticipated result of significant increase in seed yield for

all the three crop plants Viz. , Bajara 3. 7(±1. 325), Maize 4. 2 (±1. 113) and winter crop plant wheat 3. 3(±1. 222) and the treated plants showed the significant decrease in the seed yield Viz. , Bajara 3. 2(±0. 136), Maize 3. 5(±0. 115) and winter crop plant wheat 3. 0(±0. 042) for all the three crops plants. The brief account of traditional herbal remedies which are not known by the poor agrarian farmers, but are known only by the local rural and tribal people Viz. , Rabarii, Bhils,Nayak and Garasia and other minor communities of the district is collected and documented as a ready reckoner for all the scientist, researchers and also for the local poor agrarian farmers. Finally the very important and applied aspect of the study which implies to the selling of these medicinally important weed plant/parts Citrullus colocolusynthis (9-14/-), Convolvulus microphyllus (14-19/-), Corchorus depressus (10-15/-), Solanum nigrum (11-40/-) and Tephrosia purpurea (11-40/-) to increase their economy. Thus the triple utilization of the medicinally important weeds were achieved i. e 1) removing of weeds to increase the seed yield 2) medicinal use of the weeds and 3) to increase the economy by selling the whole weed plant and parts.

127. Studies on Medicinal Plants : in vitro Cytotoxic effect of Neem (*Azadirachta indica* A. Juss) on Human Cancer Cells

Vikas Sharma[1] and Madhulika Bhagat[2]

[1]Division of Biochemistry and Plant Physiology,
Faculty of Agriculture,
Sher-e-Kashmir University of Agricultural Sciences
and Technology of Jammu,
Main Campus Chatha,
Jammu-180009, J&K.
[2]School of Biotechnology,
University of Jammu,
Jammu-180006, J&K

Keywords : *Azadirachta indica, ELISA reader, SRB assay, ethanolic extract, cancer cells*

Medicinal plants are part and parcel of human society to combat diseases from the dawn of civilization. Neem is perhaps the most useful traditional medicinal plant

and is still regarded as “village dispensary” in India. It has been extensively used in Ayurveda, Unani and Homoeopathic medicine and has become a cynosure of modern medicine. Led by these considerations, 95% ethanolic extract from the stem-bark of the plant has been tested against human cancer cell lines. The antiproliferative SRB assay was performed to assess growth inhibition which estimates cell number indirectly by staining total cellular protein with the dye. Results demonstrate that the extract suppressed the growth of six human cancer cells, *viz*, COLO-205, HT-29, SW-620 (colon origin), HEP-2 (liver origin), IMR-32 (neuroblastoma origin) and DU-145 (prostate origin). The growth inhibition was observed in the range of 70-75% and this part of the plant can be further exploited to get better compounds that may have the potential to manage cancer.

128. Ethnobotanical Studies of Nalanda District

Damodar Singh and Kumud Kumari

P. G. Departmentof Botany,
Nalanda College, Biharsharif,
Nalanda-803101

Keywords : *Ethnobotany, Ethnomedicine, Nalanda*

This Ethnobotanial study was conducted in Nalanda district which is located on the map between 24°57' & 25° 27' North latitude and 85°10' & 85°56' East longitude covering an area of about 2367 sq kms. Nature has been bountiful to this region in producing such diverse condition as tropical subtropical & temperature regions through a complex interplay of ecological varients. The paper deals with the ethnobotanical information on plant species obtained through field surveys & taxonomic identification of plants which are exploited for various purposes.

129. Drugs for Future - Medicinal Plants of Asia

David Paul Raj R. S., Sharon Koshy and Nancy Cherian

Department of Biotechnology,
School of Biotechnology and Health Sciences,
Karunya University, Coimbatore-641114

Keywords : *multivariate diseases, pharmacological investigation, human health.*

The flora of the world contains many herbal plants which are used as medicines to treat multivariate diseases. Over 80% of the world population depends on the herbal medicines for their health care needs. Looking globally, there is a considerable interest to find cure from nature. We all know that in some sense there *are* drugs awaiting discovery in nature and especially in medicinal plants. The medicinal flora of the Asia-Pacific region embodies a virtually untapped reserve of original molecules which await isolation, and chemical and pharmacological investigation. Such development may also deliver a valuable asset for local people, who can then benefit from the exploitation of their natural resources. Furthermore, some of these plants are endangered species, and documentation of their potential usefulness may help to ensure their conservation, and perhaps even lead to programmes for sustainable development. The question that grips us is, *why*? Why are these drugs undiscovered in spite of enormous technical achievements? If the scientific techniques of pharmacological evaluations are so well mastered, it is natural to expect an increasing number of important drugs discovered from plants, thus improving human health drastically. Instead, we observe that cancers and microbial infections are still life threatening. This work is an exploration of 200 and more medicinal plants of Asia with drugs for future.

130. Ethics in Biodiversity Conservation : Case Studies from Garhwal Himalaya, India

Nazir A. Pala, A. K. Negi, Yogesh Gokhale* and N. P. Todaria

Department of Forestry,
HNB Garhwal University,
Srinagar Garhwal-246174, Uttarakhand.
*The Energy and Resources Institute (TERI),
Habitat Place,
New Delhi-110003

Keywords : *Himalaya, conservation, ethnic, sacred, biodiversity, global warming*

The land scape of Garhwal Himalaya is occupied by number of holy shrines practiced by different ethnic and social groups. Rituals, taboos and folklores have

been different kind of conservation practices in this area for conservation of natural resources. Bugyals (alpine meadows), sacred forests, sacred groves and sacred water bodies are different types of landscapes are being preserved on ethnic, social, cultural and religious grounds. Almost every forest has got a centrally located temple, by which all area around the temple is considered sacred. Different varieties of plants are conserved on different myths associated with them. The present study which was carried out in Hariyali Devi and Nagdev sacred forests of Garhwal Himalaya describes the role of local deities in conservation of economically important plants as source of wild edible food, non timber forest products like medicinal plants, dyes, fibers, gum and resins in most of the Sacred Natural Sites. The important medicinal plants which are useful for different diseases like blood diseases, cancer, malaria, snake bite, cut wounds etc. are also present in these landscapes. With the increased impact of industrialization, urbanization and sanskritization the plant wealth losses is at peak in these areas. So these sacred landscapes can serve as *in situ* conservation models of economically important plants of human welfare which will ultimately conserve our biodiversity and help in reducing the global warming.

131. Investigation of Immunomodulatory Property of *Bacopa monnieri* using *in vitro* Model

Hanumant Singh Rathore, Lakshmi Janakranjan, Jothi kritika Ashoken and B. S. Lakshmi*

Centre for Biotechnology,
Anna University, Chennai-25

Keywords : *Human polymorphonuclear leukocytes, bacopa monnieri, anti-inflamamtory.*

There are many synthetic drugs available in the market for inflammation namely NSAIDs such as Indomethacin, Diclofenac, selective COX-2 inhibitors and corticosteroids. However, they suffer from serious drawbacks, like weak activity or undesirable side effects. Plants, on the other hand, have proven time and again to be a great source of anti-inflammatory lead molecules, and have

been used by traditional practitioners of medicine for a long time. The present study aims to bridge the gap, in the knowledge base between the theory and practice, in the use of Brahmi as an anti-inflammatory formulation.

In this regard, *Bacopa monnieri* (BM) - Brahmi, a medicinal plant of immense significance was assessed for biological activity using *in vitro* assays on Polymorphonuclear leukocytes (PMNs) and Peripheral Blood Mononuclear Cells (PBMCs). The inhibition of mitogen induced lymphocyte proliferation and inhibition of cytochalasin B and formyl-Met-Leu-Phe (CB/fMLP) induced de-granulation of PMN was used to study the anti-inflammatory potential of various fractions of the plant. Further analysis was used to characterize these fractions (methanol, ethyl acetate, chloroform, chloroform-methanol, aqueous basic). The extracts were screened for cytotoxicity using 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) and put through further secondary assays like gene level analysis using polymerase chain reaction (PCR) to shed light on its mechanistic action. The activity of chloroform fraction seems to be enriched upon fractionation, which is reflected in its 10 fold lower IC50 value, both in the Lymphocyte proliferation assay (LPA) and Myeloperoxidase (MPO) assay. Analysis of Reactive Oxygen Species (ROS) scavenging activity using 1,1-diphenyl-2,2-picrylhydrazyl (DPPH) assay and Toll-Like Receptor 4 (TLR4) gene expression analysis shows that the difference in the constituents between the chloroform and ethyl acetate fractions lies in the absence of carbohydrates of the chloroform fraction, it was inferred that glycosylation of the molecules tend to reduce their anti-inflammatory activity, but is required for their TLR-4 inhibition. Loss of the carbohydrate moieties, also seem to increase the cytotoxicity of the molecules. Again, the NFkB inhibitory activity is enriched in the chloroform fraction, with comparable activities, between the 100ìg/ml of ethyl acetate fraction and 50ìg/ml of the chloroform fraction. Since, the anti-inflamamtory effect of BM in lymphocyte signaling had been studied; it was checked for possible anti-inflammatory effect of the plant in neutrophil inflammation models, including the CXCR2 and IL8 mRNA expression. A stability of neutrophil was observed in BM. Based on the cellular level investigation and cytotoxicity profiling, *Bacopa monnieri* could be a good source for potential anti-inflammatory, anti-oxidant molecules.

132. Potential of Plants of Astrological Importance in Mass Afforestation Programme

Sanjay Sood
Conservator of forests,
Hamirpur H.P

Keywords : *Afforestation, astrology, medicinal value, sacred groves*

The Indian society has always given great emphasis on the importance of plants since time immemorial. Ancient scriptures of India contain various mentions regarding the importance of plants. These scriptures apart from mentioning the general importance of plants have also laid emphasis on the astrological importance of plants. Religious texts like Narad Puran, Sarda Tilak, Matasya Puran, Padam Puran, Shrimad Bhagwat etc have highlighted the astrological importance of trees. These religious scriptures contain references regarding specific plant for different zodiac signs and different planets etc. Various trees assigned to different zodiac signs are *Pterocarpus marsupium for* Aries, *Alstonia scholaris* for Taurus, *Michelia Champaca* for Gemini, *Saraca indica* for Cancer, *Steriospermum seuviolens* for Leo, *Mangifera indica* for Virgo, *Mimusops elengi* for Libra, *Butea monosperma* for Scorpio, *Bombax ceiba* for Sagittarius, *Dalbergia sissoo* for Capricorn, *Anthocephalus cadamba* for Aquarius, *Aegle mamelos* for Pisces. These religious texts also mentions regarding the concept of Nav Grah and mentions a specific plant for nine planets like *Calotropis procera* for Sun, *Butea monosperma* for Moon, *Acacia catechu* for Mars, *Achyranthes aspera* for Mercury, *Ficus religiosa* for Jupiter, *Ficus glomerata* for Venus, *Prosopis cineraria* for Saturn, *Cynodon dactylon* for Rahu, *Desmostachya bipinnata* for Ketu. These plants apart from having astrological importance also have great medicinal value. Awareness of the people about the importance of these plants can be of great help for involving people in mass afforestation programmes. The sacred groves which have degenerated over a period of time can also be regenerated through plantation of these trees through people participation. Such activities will be of great help in water conservation and eco-tourism activities.

133. Early Assessment of Half -sib Progenies of Selected Plus Trees of *Acacia mangium*

Tara Chand* A. Thakur, S. Bordoloi, R. Kumar and N. Ravi

Division of Biotechnology and Genetics
Rain Forest Research Institute,
Jorhat, Assam-785 001

Keywords : *Acacia mangium, plus trees, genetic variability, phenotype.*

A. mangium is one of the important plantation species in the South East Asia. The species is successfully grown for pulpwood on 6 to 8 year rotations in Sabah (Malaysia) and Sumatra (Indonesia) and can be grown for saw logs following proper silvicultural prescriptions on a longer rotation of 15-20 years. It generally produces a clear bole more than half of its height. Its wood is classified as light hardwood with good machining properties. Solid wood makes attractive furniture and cabinets, moldings and door and window components. It can be used as decorative veneer, laminated veneer lumber, particle-board and medium density fiber board. Exploitation of genetic variability in the available population is essential for success of any breeding programme. By selecting superior phenotypes or plus trees from population and subsequent progeny trial of selected plus tree gives a base of genetic improvement programme. This study presents the early variability of plus trees progenies in the nursery which were selected from a provenance trial established in 1999 at Deovan, Rain Forest Research Institute Jorhat. Progenies of 16 families were raised in nursery for early assessment of promising selections which could be used in future improvement programme. Significant differences in height and diameter growth were observed among families under the study.

134. Nutracenticals – Mushrooms as a Potential Source

Isha Sai and R. Basava Raju

Deptt. Of Biosciences, Sri Sathya Sai University
Ananatpur Womens Campus,
Ananatpur AP.

Keywords : *Nutracenticals, mushrooms, Immunomodulates.*

During the last two decades mushrooms have gained significant importance as nutracenticals. Different mushroom varieties have been used since time immemorial in the Chinese system of medicine. The modern research in ethnomycology confirms as substantiate this traditional knowledge and find mushrooms to be useful as immunomodulators, health potentiaters, effective against HIV, canser, diabetes and many diseases considered to be incureable till now. They posess rare immunoacids, elements like Selinum, hi fibre contents, very less sugar but very high protein contents. Mushrooms like *Ganoderma lucidum, Agaricus blazeii* and *Grifola frondesa* have revolutionized the industry dealing with nutracetical formulations. India with vast variety of mushrooms can provide many more species with better nutracetical potential if concerted efforts are made.

V. PLANT CYTOGENETICS AND MOLECULAR BIOLOGY

135. Development of Species Level DNA Passport of Medicinal Plants in Apocynaceae Family

Pradosh Mahadani and Sankar K Ghosh

Department of Biotechnology,
Assam University,
Silchar-788011

Keyword : *Medicinal Plant, Apocynaceae, DNA passport, matK, Indels, DNA barcoding*

India possesses a long heritage of using numerous medicinal and aromatic plants (MAPs) for health care. Amongst these, Apocynaceae has long been used as traditional medicines for hypertonic, stomach ulcer, fever, asthma, whooping cough etc in northeast India. In our study, the *matK* sequences within and among the Apocynaceae family have shown indels in multiple of three and reduced the chance of frameshift mutation. Indels can be used as qualitative molecular markers depending upon the size, position and influence of open reading frame. Chemically conserved amino acid replacement property of matK protein caused by mutations factors, such as the transition-transversion ratio, A+T bais rather than selectional forces. Species level identification of Apocynaceae plants are

possible using the partial *matK* sequences (Nt. 520-1278), which is comparable to that of the full-length sequences. This information would be useful in providing diagnostics for rapid and easier identification of species in mixture of raw drug trade and may.

136. Variability Studies of Fruit and Seed Characteristics in Jatropha Curcas L. in Himachal Pradesh

Sandeep Sharma and Arun Kumar

Himalayan Forest Research Institute,
Shimla-171009

Keyword : *Variability, Seed Characteristics, Genetic advance, Genetic gain, Jatropha curcas*

Jatropha curcas L. as biodiesel plant can prove very important to Indian economy owing to continuously increasing energy demand. The seeds of this plant yield oil suitable as bio-fuel for diesel engine. Jatropha plants found to grow at various places in Himachal Pradesh at different altitudinal/ microhabitat conditions in their wild state. The present study was conducted to determine the variation in fruit and seed characteristics in eleven phenotypic superior plants of *Jatropha curcas* selected under Department of Biotechnology (DBT) funded project during 2008-09. The studies conducted through the estimation of range, mean, phenotypic and genotypic coefficients of variability, heritability, genetic advance and genetic gain. Significant variations were recorded in all the studied parameters. The extent of variations in no. of seeds/fruit, shell weight and seed weight was higher as compared to fruit width, seed width, fruit length and seed length. Shell weight gave comparable values for genotypic and phenotypic variations and coefficient of variability indicating that this parameter is under genetic control. High broad sense heritability and moderate genetic gain per cent in shell weight and seed length indicate additive gene action. Owing to high heritability in seed length (79. 04%), shell weight (78. 24%), fruit length (66. 61%), fruit width (66. 33%) and seed weight (47. 55%), there is a scope for considerable genetic gain through individual plant selection. On an average individual Jatropha plant selection namely T_1 (IC# 569376) and T_5 (IC# 569380) were found to be the best on the basis of fruit and seed morphological characteristics.

137. Meiotic studies in *Heteropogon contortus* (L.) Beauv. ex Roem. et Schult

B. Sharma and S. Sharma

Department of Biotechnology,
IAMR Collage,
Ghaziabad, U.P.

Keyword : *Meiosis, chiasmate, Pollen Fertility*

The genus *Heteropogon* Pers. (systematic position : Poaceae; Panicoideae; Andropogonodae; Andropogoneae; Andropogoninae) has seven species distributed throughout the tropical region. The species grow on dry places, often on poor soils. Several species of the Graminaceous genera, *Heteropogon*, were presently analysed cytologically in detail. This article deals with the male meiosis in six collections of *H. Contortous*. The chromosomes configuration observed were univalents, bivalents, trivalents and quadrivalents. In all the collections the frequency of bivalents was much higher than Is, IIIs and IVs. Most of the bivalents was of rod-shaped. Further, the collections were more or less similar in possessing the amount of total meiotic anomalies, meiotic anomalies during first and second meiotic divisions, chiasmata per PMC, pollen fertility, pollen diameter and number of pollen per anther. In addition to microspore tetrads, diads, triads and pentad were reported in both collections.

138. Characterization of Amylase from an Obligate Thermophile – Thermoactinomyces vulgaris

Archana Singh and Ved Pal Singh

Applied Microbiology and Biotechnology Laboratory,
Department of Botany University of Delhi,
Delhi-110 007

Keywords : *Amylase, wild type, mutant,thermoactinomyces, vulgaris*

Amylase finds a wide range of applications in starch-based industries, i. e. , baking, brewing, distillery. The wild-type and mutant strains of *Thermoactinomyces*

vulgaris were screened for the production of amylase, using 1% soluble starch. The maximum production of amylase was observed after 12 h of incubation at 50ºC in wild-type (1227) and mutant strains (1261 and 1286) of *T. vulgaris*. The amylase was found to be optimally active at 75ºC and pH 6. 0 in wild-type strain 1227 and mutant strain 1261; while the temperature and pH optima this enzyme in mutant strain 1286 of *T. vulgaris* were found to be 65ºC and 5. 0, respectively. The wild-type strain (1227) prefers soluble starch, whereas corn starch was found to be a better substrate for amylase activity in the mutant strains 1261 and 1286. Among the metal ions tested, Mn^{2+} was most stimulatory, while Hg^{2+} was most inhibitory to the activity of amylase in wild-type and mutant strains of *T. vulgaris*.

139. Genetic Diversity Analysis and Population Structure in Pongamia Pinnata using TE-AFLP Markers

Shyam Sundar Sharma, Madan Singh Negi and Shashi Bhushan Tripathi

The Energy and Resources Institute
India Habitat Centre, Lodhi Road,
New Delhi-110 003

Keywords : *Pongamia pinnata. TE-AFLP. Genetic diversity*

A total of 277 accessions of *Pongamia pinnata* selected from different localities of NCT of Delhi and other states were characterized using Three Endonuclease Amplified Fragment Length Polymorphism (TE-AFLP) markers. Six TE-AFLP primer combinations generated a total of 334 bands of which 214 (63. 71%) were polymorphic. Diversity analysis using Jaccard's coefficient showed a high level of overall diversity (D_J = 0.32). Population structure analysis assigned the accessions to 24 different populations. The high level of genetic diversity detected in *P. pinnata* suggests that these urban tree stands have adequate diversity which can provide enough options for selection of trees with high seed yield and oil content.

140. Genetic Diversity Assessment of the Promising Natural Variants of Tea Identified for Yield and Quality by DNA Marker

Jibu Thomas[1], Amarchand Chordia[2], R. Raj Kumar[2] and A. K. A Mandal[2]

[1]Department of Biotechnology,
Karunya University, Karunya Nagar,
Coimbatore-641114
[2]UPASI Tea Research Foundation,
Tea Research Institute, Nirar Dam BPO,
Valparai-642127, Coimbatore District

Keywords : *Tea, germplasm, screening, genetic diversity*

Tea is a highly heterozygous perennial crop and most of the present day cultivars have been released by the selection methods. Natural variants remain to be the promising source of germplasm collection. Tea growing regions of Anamallais in south India was subjected to selection of promising natural variants. Primary selection had been carried out based on the visual examination, performance during adverse conditions and followed by evaluation under unique growing condition under the recommended cultural practices. About 700 accessions were shortlisted from the filed and their nursery performances were documented. Based on the nursery performance about 300 accessions were field planted. Yield performances of these accessions were monitored for one pruning cycle and the accessions contributed a mean yield of 3500 kg MT/year alone have been shortlisted and used for downstream applications. Since, the quality of the tea is relied on the flavanol content, the identified accessions were subjected to catechin and its fraction analysis using HPLC. Since the morphological characteristics are influenced by environmentals factors identifying the natural variants based on the morphology may be misleading. In this regard, the promising shortlisted accessions in terms of yield and quality were subjected to DNA fingerprinting to document the genetic diversity existed among the accessions using RAPD using 25 set of primers thereby ascertaining the gene pool of tea germplasm. Results indicated a wide diversity among the shortlisted clones in terms or quality as well as yield was noticed. Thus the present study identified the elite genotypes with quality and yield as traits that can be explored for commercial exploitation.

141. Genetic Diversity Studies of Aegle Marmelos (Linn.) Correa in Sri Sathya Sai Taluk of Ananthapur District

Vennel Raj and R. Basavaraju

Department of Biosciences
Sri Sathya Sai Institute of Higher Learning
Prashanthi Nilayam, Puttaprthy,
Ananthapur District, A.P.-515134

Keywords : *Aegle marmelos, medicinal traits, morphology, RAPDs*

Aegle marmelos is an ancient sacred tree of India, belonging to family Rutaceae. It is one of the most important medicinal plants with innumerable medicinal traits. The tree has been exploited to such a great extent in the past, that now the tree is listed as a threatened species in the Red Data Book. Sri Sathya Sai Taluk, situated to the south of Ananthapur town has got plenty of *Aegle marmelos* trees growing wildly in five different reserve forest regions of this area. Seven populations of *Aegle marmelos* trees were identified from these unexplored regions to study the Genetic diversity. About 60 mature trees identified were studied in detail their macro and micro morphological characters before short listing them to 40 for genetic diversity studies using RAPD (Random Amplified polymorphic DNA) molecular marker technique.

A total of 15 random decamer primers were made use for RAPD assay of which ten provided clear, reproducible and unambiguous band pattern. In total 107 amplicons were scored from these studies providing an average of 9. 72 bands per primer. Out of 107 bands scored, 72 proved to be polymorphic (67. 29%) and hence proved informative. OPN 5 with 88. 89% polymorphism proved to be the efficient one out of all the primers followed by G1 with 84. 62% and OPN 8 with 83. 3%. The binary matrix generated using the information of bands scored helped in calculating Jaccard's similarity coefficient. This similarity index was then used to construct phenograms based on Unweighed Pair Group Method of Arithmetic Averages (UPGMA) using NTSYS-pc programme. The phonograms obtained thus reveled that genotypes among populations have variations but not that far related as they appear from their

morphological traits studies. In addition to genetic diversity studies all the identified trees fruit polysaccharides contents were also estimated in order to assess their nutraceutical potential. Polysaccharides which play very important role as immunomodulators, cellular recognition, drug delivery vehicles, inhibitors etc. have gained lot of importance in recent years. Elite trees were identified by comparing the results and efforts were made to micropropagate them using tissue culture techniques.

142. Exploration of Intraspecific Cytomorphological Diversity in *Agrimonia eupatoria* L. (Rosaceae) from Western Himalayas (India)

Sanjeev Kumar, Syed Mudassir Jeelani*, Savita Rani, Santosh Kumari and Raghbir Chand Gupta

Department of Botany,
Punjabi University,
Patiala 147 002, Punjab

Keywords : *Agrimonia eupatoria, cytotypes, meiotic abnormalities, morphovariants, Himalayas.*

Agrimonia eupatoria L., a medicinally important species of the family Rosaceae, presently has been reported with euploid series and is being cytologically worked out for the first time from three separate areas as Kashmir (Jammu & Kashmir) and districts Kangra and Sirmaur (Himachal Pradesh) of Western Himalayas from India. Presently investigated cytotypes with n=14 and n=28 are in conformity with the earlier chromosome number reports of the species from different parts of world. Interestingly, a new cytotype from Kashmir with chromosomal count of n=42 has been reported for the first time on world-wide basis. On comparison, these cytotypes (n=14, 28, 42) show significant variations in relation to morphology as well as geographical distribution in the Western Himalayas. Further, intra population variability has been observed in different accessions of hexaploid cytotype in the form of B-chromosomes, abnormal meiotic course or aberrant type of flower morphology.

143. Antioxidant Properties in Flower Galls of Pongamia Pinnata

G. Santhosh, Malepu. Swamy, B. E. Ravishankar and S. Sundara Rajan

Department of Biotechnology,
Kuvempu University, Shimoga-577451
Dr. S. G. Reddy College,
Bangalore-560071

Keywords : *DPPH, Nitric oxide, superoxide, anti oxidant.*

The Pongamia pinnata has been widely used as a medicinal plant in ayurvedic system of medicine. Most degradative diseasesthat affect huminity have their origin in deletericious free radical reaction. Most of the available anti oxidant are synthetic in nature and there is growing demandfor plantbaseddrugs,. lnthe presentstudy,the HexaneandMethanol extractofflower galls of Pongamia pinnata, was evaluated for anti qxidant activity. The plant extract test for different free radical scavenging activity against 1, 1-Diphenyl-2-picryl hydrazyl. (DPPH),Nitric oxide and super oxide radicals. The hexane extracts of galls Pongamia pinnata has shown strong scavenging activity against DPPH radical with ICsobeing0. 56mgJml. This scavenging was found to be dose dependant. The Hexane extract also shown greater potent in scavenging super oxide radicals than that of the Methanol extract. The ICsovalue Hexane extract is 0. 56mgjml. When compare to methanolextract,whit ICsovalues0. 250mgjml. Thesc avenging activity of nitric oxide radicals with ICsovaluesof 0. 400mgjml of Hexane extract clearly indicates its importance as a potent source for anti-inflammatory agents. All these result indicate that the Hexaneextract of Pongamia pinnata can be a good source for biological active principle and thereby support the Ethno medical useof this plant in various system of traditional medicine.

144. Genetic Diversity Studies in Vanda Testaceae, an Epiphytic Orchid from South India by using Molecular Markers

Ramudu, J. and Khasim, S. M.*

Department of Botany & Microbiology
Acharya Nagarjuna University
Nagarjunanagar, Guntur-522 510

Keywords : *Vanda testacea, SDS-PAGE, RAPD analysis, genetic diversity*

Molecular and morphological analysis of genetic diversity was investigated by using SDS-PAGE and RAPD markers in Vanda testaceae (Lindl.) Rchb. f. , an epiphytic orchid from Southern India. Plant collected from three geographical areas (Ooty, Nallamalai and Araku valley) show variation in their morphological and molecular characters. The stomata are paracytic type and hypostomatic in distribution. A low stomatal frequency and an extensive lignification on the inner walls of the innermost layer of velamen and on the outerwalls of exodermal cells were recorded in population located in Nallamalai forests (Andhra Pradesh) as compared to Ooty (Tamil Nadu) and Araku (Andhra Pradesh). It is interpreted to be associated with the conservation of water. RAPD and protein profile data indicate the inter population diversity. This can be attributed to the ecological and climatic conditions prevailing in the three reference sites in Southern India.

145. Karyological Studies of Aegle Marmelos (Bael)

Hemlata Kumari, Rania Y. K. Tiwary and Raffish Kumar

Department of Botany,
V. K. S. Unlversity, Ara

Keywords : *Cytology, Karyotype of Bael*

Aegle marmelos belongs to family Rutaceae which is highly medicinal plant used in treatment of diarrhoea and also used by diabetic patient. The use of herbal medicines for the treatment of diabetic patient has gain ed importance throughout the world. That is why there is an increased demand to use the natural products with antidiabetic activity associated with Insulin. Somatic chromosome number 21}=18 has been recorded in most of the populations. However, variations are also recorded. The total chromatin length indicated that chromo-somes are symmetrical in nature which indicates that the species has established itself very well to the climatic situation. The symmetry of karyotype appears to

be associated with important innovation in morphology and breeding system of this species. This study also provides interesting materials for biosyst~matic studies.

146. Assessment of Genetic Variability and Identification of Cultivar Specific Molecular Markers among Maintainer and Restorer lines of Hybrid rice (*Oryza sativa* L.)

R. Nirmala, Lipi Mukherjee, K. Kamalnath Reddy, A. D. Gnanesh and H. E. Shashidhar

Barwale Foundation Research and Training Center,
#8-2-703, AG Heights,
Banjara Hills,
Hyderabad-50004

Keywords : *Genetic Variability, Hybrid rice, DNA markers*

Genetic variability analysis among elite hybrid rice parental lines was carried out using simple sequence repeats(SSR) based DNA marker technology. Out of hundred SSR markers screened among seven maintainer lines and five restorer lines, sixty eight (63%) were found to be polymorphic. A total of203 alleles with an average of3. 2 alleles per loci were recorded as 1-0 data set (presence-l and absence-O) and used for genetic distance analysis using NTSYS software program. Cluster analysis of fingerprint data revealed the genetic similarity co efficient of aout 70-87% among the lines used in this analysis and distingllished maintainer and restorer lines. However, two restorer lines namely IR40750 and BR-827-35 were clustered with the maintainer line gene pool indicated the genetic similarity of these lines with the maintainers. Most of the primer sets have generated fingerprint markers for all maintainer and restorer lines used in this study which would be useful in their hybrid detection as well as genome mapping of their trait of interest. This experiment has demonstrated that the SSR markers are useful tool for genetic variability analysis as well as cultivar identification.

147. Oxidative DNA Damage Protective Acitvity of *Aegle marmelos* Methanol Leaf Extract

K. Sarath Chandra Kumar[2], V. R. N. V. Hanuman B[2], S. Sundara Rajan[2], B. E. Ravi Shankar[1] and Harsha kashyap[2]

[1]School of Graduate studies, Jain University, Bangalore-560002

[2]Dr. S. G. Reddy College, Bangalore-560071

Keywords : *Aegle marmelos, DNA protective acitivity, Methanol extract, Anti-oxidant*

Aegle marmelos L corr. is an important medicinal plant of India. Leaves, fruits, stem and roots of *Aegle marmelos* are used in ethno medicine. Oxidative DNA damage is caused by oxygen derived species which are more common in aerobic CellsAnd this type of damages is called as oxidative DNA damage. Prevention of DNA from Damageis very important because it controls the activity of cell and also it may avoid unnecessary mutations in such cells. Antioxidants are the main weapons to fight.

148. Oxidative DNA Damage Protectiveacitvitv of Chloroform and Methanol Extractof Gallsof Rhus Succedanea

V. Swetha[2],V. Sampurna[2], B. E. Ravi Shankara[1], S. Sundara Rajan[2] and Y. LRamachandra[1]

[1]Department of Biotechnology, Kuvempu University, Shimoga-577451

[2]Dr. S. G. Reddycollege, Bangalore-560071

Keywords : *Rhus succedanea, karkatasringi, chloroform extract, methanol*

Extract, anti-DNAdamage, oxidative DNAdamage, anti-oxidant. Rhus succedanea is a deciduous tree and its galls have been used as substitute for

karkatsringi, an important plant based product which has importance in Ayurveda. Extract of Rhussuccedanea galls are prepared in chloroform and methanol. In the present study the DNA damage protection was evaluated using the methanol and chloroform extracts. The test was conducted to check the anti-DNA damage activity induced by hydrogen peroxide, tertiary Butyl alcohol. The test revealed that the chloroform extract showed around 80-90% of DNAdamage protection at a concentration of 10 mg/ml, in comparision with methanol extract which showed around 50-60% of DNA damage protection at a concentration of 10 mg/ml, as against the standard anti-oxidant BHA. The test revealed that the chloroform and methanol extracts of this plant can be used in the prevention of DNAdamage, there by suggesting the use of the gall extracts of Rhus succedanea as an effective bio-protective antioxidant to cellular components.

149. Cytological Studies in two Natural Populations of *eclipta alba*

Ranjay Kumar Tiwary, Hemlata Kumari and Rajesh Kumar

Department of Botany,
V. K. S. University, Ara

Keywords : *Meiotic Chromosome Study, Eclipta alba (LJ Hassk populations*

The study of Meiotic Chromosome variability is one of the important tool for understanding the treands in chromosome evolution. Eclipta alba (L.) Hassk is a member of family Asteraceae growing throughout the plains of India. The meiotic chromosome number n=11 has been recorded in both populations. Detailed Meiotic behavior, chromosomal associations, Chiasma frequency and pollen analysis have been studied. Role of chiasma frequency on breeding system has been traced. The trends found in Chiasma frequency of two populations indicate greater reproductive efficiency which is characteristic feature of a weed.

Natural antioxidants are more potent and safe to use when compared o synthetic antioxidants. Aegle marmelos is one such plant which is a potent antioxidant. In present study, the DNA damage protection was evaluated using

methanol extract of Aegle marmelos. The test was conducted to check the anti DNA damage activity induced by Hydrogen peroxide, tertiary butyl alcohol and ferric chloride-ascorbic acid. The test revealed that the methanol extract showed around3040% of DNA damage protection,at a concentration of 10mg/rol against the standard antioxidant BHA.

150. Insilco Analysis of Upstream DNA Sequences to the Probable Binding Sites of 10 miRNA in Rice

Mohd. Faheem Khan, Rajender Singh and A. K. Jaitly

Dept. of Plant Science,
M. J. P. Rohilkhand University
Bareilly
Bioinformatics Centre, IVRI,
Izatnagar Bareilly

Keywords : *UpmiRNA, RiceMicroRNA*

Upstream DNA sequences are very significant in reveling the properties of the sequence, not only they set signals for various proteins to bind there but also help in locating hidden sequences and their properties like TATA and CAAT box etc. Repetitive elements which are involved directly or indirectly for binding the specific miRNA to the target DNA. The main emphasis of this Research and whole idea behind this kind of work is to find out upstream DNA sequences which carry hidden properties like Railway signals and track sign board which can alert the drivers that how the way is ahead. Micro RNAs are of approximately 21-nucleotides long and play very significant role in gene regulation in variety of genes of different organisms. We developed perl based software which extracts the upstream DNA sequences to the possible binding sites of miRNAs. These extracted sequences may contain the signals about how the miRNA selected for the specific binding sites in Genome. We analyzed the upstream DNA sequences to the binding sites of miRNA in rice genome with help of developed software. It was observed that there are some small sequences which are very frequently present in the genome and these may be the signals for miRNAs to bind at the specific site in rice genome.

151. Selection of High Psoralen Yielding Clone of Psoralea Corylifolia and Evaluation of Genetic Diversity among different Genotypes from India using RAPD

Siva Prasad K. Chetri, Kuldeep Sharma and Veena Agrawal

Department of Botany,
University of Delhi,
Delhi-110007

Keywords : *Psoralea corylifolia, Psoralen, Genotype, Genetic diversity, Polymorphism*

Psoralea corylifolia, is one of the important medicinal plants widely employed as an anti cancerous agent against leukemia and other cancer cell lines. HPLC analysis of the seeds of eight genotypes procured from six states of India was carried out to select the high-yielding clone of *P. corylifolia*. Genotype from Sirohi region yielded the optimum amount (4760 mg/g fresh wt) of psoralen followed by Sirsa and Khari Babli. Assessment of the genetic diversity of the eight genotypes of *Psoralea corylifolia* through RAPD markers was also done. Of the 40 random primers used, 6 developed reproducible amplification banding patterns of 86 polymorphic bands out of 112 bands scored, accounting for 77% polymorphism across the genotypes. Three primers, viz. VAA01, VAA03, and VAA04 generated 100% polymorphic patterns. The PIC value was highest for the primer VAA04 (0. 49). The statistical analysis of the pair-wise similarity index was evaluated through Jaccard's coefficient of similarity and the inter-relationship amongst the eight genotypes through UPGMA cluster analysis which revealed three distinct clusters of genotypes of *P. corylifolia*.

152. An Approach to Establish Inbreeding Tolerant base Population in Maize (*Zea mays* L.)

Prem Kumar and Yugeshwar Singh*

Crop Research Station,
Bahraich, U. P

Keywords : *Hybrid maize, inbreeding, tolerance, performance index, F2 generation*

Hybrid maize breeding is dependent upon the extraction of good andVigorous in breds from the source populations. However, progress is impeded more often owing to chromc in breeding depression. The present investigation aimed to form. an inbreeding tolerant base population through the use of the genetic parameter of inbreeding depression (ID). In this endeavour, the nine crosses which showed non-significant inbreeding depression with better mean performance in the F2generation were selected to constitute the base population for an important trait namely performance index (PI).

153. Chromosomal Changes in Node Explants During in Vitro Growth in Jute (CorchorusolitoriusL. varietyJRO-632)

P. K. Ghosh and A. Chatterjee

CSB CSR&Tl Berhampore-742101,
Murshidabad, West Bengal.
Centre of Advanced Study in Cell and Ghromosome Research,
Department of Botany, University of Calcutta,
3. 5, Ballygunge Circular Road
Calcutta-700047

Keywords : *Node, Chromosome,_Corchorus olztorlus~Auxms,Cytoklruns.*

The node of jute plants *(Corchorus olitorius* L. variety JRO-632). were grown m IIIvitro cultured aseptically on 20 ml solid nutrient. . medium Murashige and. Skoog's(1962)(MS) and Schenk and Hildebrandt's(1972)(SH) media were tried withvarious combinations and concentrations of different auxins(NAA,IAA,IBA and 2,4-Dusedseparately 0,01. 70'mgiL to 0. 3500 mgIL) and cytokines (BAP,Kn used separately. o. 1400mg/L to 3. 3000 mgIL,coconut milk 10-35%(VN). It has been observed that the callus growing in medium containing NAA. revealed different. degrees of ploidy. and mitotic abnormalities such as stickiness, clumping, d. iplo-chro. matids and spindle disturbances fromthe early stage and the mitotic index was also recorded. The frequency of chromosomal abnormalities gradually increases with the age of the callus tissues increaseS. A comparison bf the cytology of the callus. growing in NAA and th~ regenerating callus growing inJBA revealed differences in the rate of division aridmitoti~ ab normalitiesd. Callu. s growirig in

NAA showed a comparatively lower rate of division and higher rate of mitotic abnormalities, while that growing in IBA exhibited just the opposite effcct. !t appears that NAA has a distinct role to play in influencing Karyological instabilities and m~toticrate of cells and also observed the role of different hormones in inducing karyological changes during in vitro growth. The object of the present investigation was that to find out the role of different constituents of the medium in controlling in vitro growth and the karyological changes which they induce during organogenesis and callus formation of jute node explants*(Corchorus o/itorius* L. Variety JRO-632.

154. Cytomorphological Diversity in some Members of Gamopetalae from District Kangra (H.P)

Santosh Bala and **R. C. Gupta

Department of Botany,
Punjabi University
Patiala-147002, Punjab

Keywords : *B-chromosome, boraginaceae, cytomorphotypes, gentianaceae, Kangra, morphotypes, verbenaceae.*

Chromosome counts for the 13 species in 9 genera including 20 accessions have been made for the first time on the unexplored plants from district Kangra (H. P.). The first ever chromosome counts have been made in three species : *Gentiana pedicellata var. pedicallata* (n=9), *Gentiana argentea var. albescens* (n=10) and *Gentiana aprica* (n=10). Two new chromosome counts made for one species from India : *Verbena officinalis* (n=6, 7). New euploid cytotypes are reported in three species : *Anchusa ovata* (2n=2x=18), *Myosotis sylvatica* (2n=4x=36) and *Verbena bonariensis* (2n=6x=42 and 2n=8x=56). Supernumerary or B-chromosomes have been found in *Vitex negundo* with 2n=32+0-2B. Three cyto-morphotypes differs in flower color : pure pink (n=7) and pure white (n=6) are reported in *Verbena officinalis.* Morphotypes with variation in flower colors : bright blue (n=12) and pure white (n=12) have been found in *Cynoglossum furcatum*; whitish-blue (n=22) and whitish-pink (n=22) in *Trichodesma indicum*; and blue (n=10), and white colored flowers in *Gentiana aprica.* Further, different accessions of species of *Canscora diffusa, Cynoglossum furcatum,*

Gentiana pedicellata, Gentiana pedicellata var. pedicallata, Gentiana aprica, Lantana camara, and *Trichodesma indicum* showed variation in meiotic behavior. In this paper detailed analysis on these cytomorphological variabilities will be discussed.

155. Molecular Identification of Citrus species of Northeast India using trnH-psbA Sequences

D. Nath[1], D. Baishya, P. Mahadani, M. M. Das[2], P. R. Ghosh[3], M. J. Bhattacharjee and S. K. Ghosh*

Department of Biotechnology,
Assam University,
Silchar-788011
Gandhi Institute of Biological Science,
Orissa
G C College, Silchar,
Assam- Presenting author
West Bengal University of Animal & Fishery Science,
Kolkata

Keywords : *Citrus sp, trnH-psbA, DNA barcoding, phylogenetic tree, Northeast India*

Many varieties of *Citrus* species are found in Northeast India with economic and medicinal importance. Correct identification of the species is crucial for usage as medicine, but traditional taxonomy is sometimes unable to identify correct species. Species identification of *Citrus* species is conducted by phylogenetic analysis of DNA sequences of the non-coding *trnH-psbA* regions of chloroplast DNA, as it has been proposed as plant barcode sequence. The efficiency of these regions to serve as potential DNA barcoding candidates is examined. The *trnH-psbA* show promise as DNA barcode candidate but has certain limitations. The phylogenetic tree analysis shows that *trnH-psbA* region is capable of discriminating both inter and intra species variations very well.

156. Selection of High Psoralen Yielding Clone of Psoralea Corylifolia and Evaluation of Genetic Diversity among different Genotypes from India using RAPD

Siva Prasad K. Chetri, Kuldeep Sharma and Veena Agrawal

Department of Botany,
University of Delhi,
Delhi-110007

Keywords : *Psoralea corylifolia, Psoralen, Genotype, Genetic diversity, Polymorphism, primers*

Psoralea corylifolia, is one of the important medicinal plants widely employed as an anti cancerous agent against leukemia and other cancer cell lines. HPLC analysis of the seeds of eight genotypes procured from six states of India was carried out to select the high-yielding clone of *P. corylifolia*. Genotype from Sirohi region yielded the optimum amount (4760 mg/g fresh wt) of psoralen followed by Sirsa and Khari Babli. Assessment of the genetic diversity of the eight genotypes of *Psoralea corylifolia* through RAPD markers was also done. Of the 40 random primers used, 6 developed reproducible amplification banding patterns of 86 polymorphic bands out of 112 bands scored, accounting for 77% polymorphism across the genotypes. Three primers, viz. VAA01, VAA03, and VAA04 generated 100% polymorphic patterns. The PIC value was highest for the primer VAA04 (0. 49). The statistical analysis of the pair-wise similarity index was evaluated through Jaccard's coefficient of similarity and the inter-relationship amongst the eight genotypes through UPGMA cluster analysis which revealed three distinct clusters of genotypes of *P. corylifolia*. se as DNA passport data for medicinal plants of Apocynaceae of varying length and sequences from the Indian potato cultivars.

157. Molecular cloning and characterization of patatin gene promoters from the Indian potato cultivars

Niranjan Das*, Raghavendra Aminedi and Vandana Balain

Department of Biotechnology & Environmental Sciences,
Thapar University, Patiala

Keywords : *Potato, PCR, patatin genes, 5'-flanking regions*

Patatins (~ 40 kDa) are major constituents of tuber proteins in potato (*Solanum tuberosum* L.) encoded by multigene family. Based on the differences in the 5'-UTR, patatin genes are grouped into two classes : Class-I and Class-II. Class-I genes encode the majority of tuber patatins, while Class-II genes are expressed at a lower level in both tubers and roots. In this study, Polymerase chain reaction (PCR) followed by cloning and sequencing approaches were employed to explore the potato genetic resources. We isolated and characterized a number of patatin genes belonging to both Class-I & Class II comprising mostly the 5' flanking regions i. e., promoters.

158. Differential Expression of Proteases in the Wild-type and Auxotrophic Mutant Strains of Thermoactinomyces vulgaris

Vivek Kumar Kedia, Nellie Laisram and Ved Pal Singh

Applied Microbiology and Biotechnology Laboratory,
Department of Botany,
University of Delhi,
Delhi-110 007

Keywords : *Proteases, thermophilic bacteria, ProIV isoenzymes, T. vulgaris*

Proteases are an important class of enzymes and constitute more than 59% of the total industrial enzyme market. Proteases secreted from thermophilic bacteria can be used in a wide range of industrial applications. Screening for protease producing ability in *T. vulgaris* was tested in the medium containing casein as a substrate. The wild-type strain, 1227 showed a specific activity of 20. 95 U/mg protein, while 1261, 1278, 1279 and 1286 showed their specific activities of 21. 12, 30. 1, 18. 46 and 17. 49 U/mg protein, respectively. These observations indicated that the mutant strain 1278 exhibited maximum protease activity as comapared to all other strains of *T. vulgaris* tested. Investigations on the is

oenzyme patterns of protease of wild-type and mutant strains of *T. vulgaris* revealed the presence of four is oenzymes of protease in this obligate the rmophile. The protease isoenzymes were designated as ProI, ProII, ProIII and ProIV with their R_f values of 0. 15, 0. 39, 0. 59 and 0. 61, respectively. The wild-type strain 1227 (with genotype *nic*$^+$ *thi*$^+$*ura*$^+$ *str-s*) of *T. vulgaris* showed the presence of only one isoenzyme (ProIV), while the mutant strain 1286 (*thi*$^-$ *str-s*) exhibited ProI, ProII and ProIV isoenzymes. The mutant strain 1279 (*nic*$^-$ *ura*$^-$ *str-r*) contained isoenzymes ProII and ProIV, whereas strain 1278 (*thi*$^-$ *ura*$^-$ *str-r*) exhibited ProI and ProII. The mutant strain 1261 (*nic*$^-$ *thi*$^-$ *str-r*) had ProII, ProIII and ProIV isoenzymes of extracellular protease.

159. Status of Genetic Diversity in Indian Jatropha Accessions as Revealed by AFLP and Microsatellite Markers

Pratima Sinha, Madan Singh Negi and Shashi Bhushan Tripathi

The Energy and Resources Institute,
IHC Complex, Lodhi Road,
New Delhi

Keywords : *Jatropha curcas, biodiesel, microsatellites.*

Genetic diversity analysis was carried out using AFLP markers in 96 accessions of *J. curcas* sampled from different states. Five AFLP primer combinations generated 280 bands with 35 (12. 5%) polymorphic bands. Data analysis based on Jaccard's coefficient revealed an extremely low genetic diversity ranging from 0. 96 to 1. AFLP and microsatellite analysis carried on progeny arrays of 6 geographically diverse accessions revealed extremely high homozygosity and absence of genetic outcrossing. The low genetic diversity is expected have serious implications in genetic improvement initiatives of *Jatropha*. The results points out towards the need for increasing the genetic base of Indian *J. curcas* germplasm through introduction of diverse genotypes, inter- specific crosses and induced mutagenesis.

160. Oxidative DNA Damage Protectiveacitvitv of Chloroform and Methanol Extractof Galls of Rhus Succedanea

V. Swetha[2], V. Sampurna[2], B. E. Ravi Shankara[1], S. Sundara Rajan[2] and Y. L. Ramachandra[1]

[1]Department of Biotechnology,
Kuvempu University, Shimoga-577451
[2]Dr. S. G. Reddycollege, Bangalore-560071

Keywords : *Rhus succedanea, karkatasringi, chloroform extract,methanol extract, anti-DNAdamage,*

Rhus succedanea is a deciduous tree and its galls have been used as substitute for karkatsringi, an important plant based product which has importance in Ayurveda. Extract of Rhussuccedanea galls are prepared in chloroform and methanol. In the present study the DNAdamage protection was evaluated using themethanol and chloroform extracts. The test was conducted to check the anti-DNA damage activity induced by hydrogen peroxide, tertiary Butyl alcohol. The test revealed that the chloroform extract showedaround 80-90% of DNAdamage protection at a concentration of 10 mg/ml, in comparision with methanol extract which showed around 50-60% of DNA damage protection at a concentration of 10 mg/ml, as against the standard anti-oxidant BHA. The test revealed that the chloroform and methanol extracts of this plant can be used in the prevention of DNAdamage, there by suggesting the use of the gall extracts of Rhus succedanea as an effective bio-protective antioxidant to cellular components.

161. Variations in Adaptability and Performance of Provenances of Neem (*Azadirachta Indica* A. Juss) In International Provenance Trial at Jaipur, India

***N. Ravi, U. K. Tomar, S. K. Sharma, Tarachand and P. H. Chawhaan**

Biotechnology and Genetics Division,
Rain Forest Research Institute,
Jorhat, Assam

Keywords : *Azadirachta indica A. Juss, provenances*

The performance of 18 provenances in the international provenance trial of Neem located at Jaipur, India was assessed for its adaptability, growth, seed parameters and oil yield at the age of 10 years. Of these 18 provenances three were from Thailand, two from Nepal, one each from Laos, Myanmar and Tanzania and 10 from India. Significant variations were found among the survival and growth performance of the provenances. Survival varied from >10 to 67% amongst the international provenances and >10% to 78% in the Indian provenances. The provenance from Lamahi Dang (Nepal) could not survive in the hot extreme climate which prevails in the trial location. Good growth performance in terms of height and DBH were observed in Geta provenance (Nepal) and Kulapachra, Sagar, Ghatti Subramaniya (India) whereas all other provenances performed below the test average. No variation is observed in the flowering period of the international and Indian provenances. Considerable variation was observed in the flower fruit ratio (0. 15 to 0. 31 with the mean of 0. 22), seed size, weight and oil content. The provenances from Chamwino (Tanzania) and Ramanaguda, Annur, Mandore and local seed sources from India had oil content of more than 40% and the rest of the provenances had oil between the ranges of 36 to 40%. The variations which exists among the provenances in terms of growth, seed characters and oil contents with no variations in the flowering period gives ample scope for further improvement programme.

VI. PLANT PHYSIOLOGY, BIOCHEMISTRY AND TISSUE CULTURE

162. Soil Organic Carbon Pool under different Forest Types in Himachal Pradesh

Vijender P. Panwar[1] and M. K. Gupta[2]

[1]Himalayan Forest Research Institute, Shimla

[2]Forest Research Institute, Dehradun

Keywords : *SOC, Carbon pool, mitigation potential, carbon sequestration, Himalayan forest*

A study was conducted to estimate the organic carbon pool in the soils under different forest types in Himachal Pradesh. SOC pool was also estimated in all

forests sub group types available in H P. Maximum pool was in the soils under Moist alpine scrub (73. 26 t ha^{-1}) followed by Himalayan moist temperate forests (55.20 t ha^{-1}), Himalayan dry temperate forests (47. 61 t ha^{-1}), Sub alpine forests (45.67 t ha^{-1}) and the least was under Tropical dry deciduous forests (36. 04 t ha^{-1}). Moist alpine forests have maximum mitigation potential (2. 03) and the least was in Tropical dry deciduous forests (1. 00). Maximum share was occupied by Moist alpine scrub (28 %) followed by Himalayan Moist Temperate Forests (21 %), Himalayan Dry Temperate Forests (19 %), Sub Alpine Forests (18 %) and the least was occupied by Tropical dry deciduous forests (14 %). SOC pool under Moist Alpine Forests was statistically significantly different from the SOC pool under Himalayan Moist Temperate forests, Himalayan Dry Temperate Forests, Sub Alpine Forests and Tropical Dry Deciduous Forests.

163. An Efficient Micropropagation Protocol of an Elite Clone EC-353508 of Artemisia annua L., an Important Antimalarial Plant

Gaurav Sharma, Siva P. K. Chetri, Vinay Shankar and Veena Agrawal

Department of Botany,
University of Delhi,
Delhi-110007

Keywords : *Artemisia annua L., Adventitious shoots, 2iP (2-isopentenyl adenine), NAA (naphthalene acetic acid), Soilrite, Acclimatization*

An efficient *in vitro* propagation system for an elite clone EC-353508 of *Artemisia annua* L., an important antimalarial drug plant has been developed. **The best organogenic response, was obtained when nodal explants were cultured onto MS medium supplemented with 10** µM 2-isopentenyl adenine (2iP). An average of 17. 7±0. 88 shoots with an average shoot length of 5. 25±0. 17 (cm) was differentiated per explant within 30 days of inoculation. Excised *in vitro* shoots organised roots in cent percent cultures in two weeks on ½ MS basal medium containing 5 µM á-naphthalene acetic acid (NAA). The plantlets were gradually hardened and transferred to sterile garden soil : soilrite (1 :1) for acclimatization where they flowered and set seeds. This is the first report of efficient and cost effective protocol for direct shoot multiplication from nodal explants in *Artemisia annua*.

164. Phytotoxicity of Heavy Metal Stress on Morphogenesis in Antimalarial Medicinal herb Spilanthes calva L. and its Reversal through Glutathione.

Vinay Shankar, Veena T. and Veena Agrawal

Department of Botany,
University of Delhi,
Delhi-110007

Keywords : *Spilanthes calva, phytotoxicity, glutathione, phytochelatins, morphogenesis, reversal.*

Nodal explants of *Spilanthes calva* were subjected to different concentrations of various heavy metals like AS_2O_3, $CuSO_4$, $ZnSO_4$ and $Pb(NO_3)_2$, respectively. The optimum morphogenic response in terms of average shoot number (4. 66± 0. 05) and shoot length (4. 55 ± 0. 68 c. m) was seen in control (MS basal + 10 µM BA). A sharp decline in average shoot number and shoot length was observed under heavy metals. Zn proved least inhibitory, whereas Pb was found to be most toxic amongst all. To overcome the inhibitory effect of lead, different concentrations (1, 5, 10 and 20 mg/l) of Glutahione, a phytochelating agent was tried. Significant reversal in terms of average number of shoot (4. 78 ± 0. 81) and shoot length (4. 41 ± 0. 54) were observed in 10 mg/l glutathione treated explants.

165. Effect of Biotic and Abiotic Elicitor for Secondary Metabolite Production in Adhathoda vasica

Jain Simmi, Jain Manish Kumar, Dixit V. K*. and Gupta U. S.

Department of Biotechnology,
*Dept. of Pharmaceutical sciences
Dr. H. S. Gour University,
Sagar, MP

Keywords : *Plant cell cultures; secondary metabolites; biosynthetic pathways; elicitation;*

Plant cell and tissue cultures can be established routinely under sterile conditions from explants, such as plant leaves, petioles, buds etc for both

multiplication and extraction of secondary metabolites. In such cases, strategies to improve the production of secondary metabolites must be considered. One of the main problems encountered is the lack of basic knowledge of the biosynthetic routes, and mechanisms responsible for the production of plant metabolites. Where the productivity of the desired metabolites is limited by the lack of particular precursors, biotransformation using an exogenous supply of biosynthetic precursors, genetic manipulation and metabolic engineering may improve the accumulation of compounds. Elicitors, compounds triggering the formation of secondary metabolites, are used and they can be biotic and abiotic. Natural elicitors include polysaccharides such as Yeast Extract and chitosan, which are also used in the immobilization and permeabilization of plant cells. The present work highlights the nature, applications, perspective and scale up methods for the production of valuable secondary metabolites *in vitro*. The over all effect of elicitors on the production of vasicine in suspension culture of *A. vasica* in decreasing order is given as under :

Methyl jasmonate > yeast extract > chitosan> sodium salicylate > ascorbic acid.

166. Quantitative Estimation of Some Enzymes in Insect induced Stem Galls of Salvadora persica L.

Swati Joshi and Suman Lata Sharma

Plant Pathology, Tissue Culture and Biotechnology Laboratory,
Department of Botany,
University of Rajasth,
Jaipur-302004, Rajasthan

Keywords : *Salvadora persica, galls, quantitative, enzymes.*

Galls are the abnormal outgrowths produced by the host organism usually in response to the presence of another living organism. *Salvadora persica* L. is a tree of great economic importance. Tender twigs are used for making toothpastes, commonly known as Miswak. The objective of the present study was quantitative estimation of some enzymes in insect induced stem galls and normal stem of *Salvadora persica*. By using biochemical technique, alteration in localization and

quantity of enzymes due to insect attack was observed. The enzymes assayed were polyphenol oxidase, peroxidase, α-amylase and invertase activity compared to normal tissues. Galls showed significantly higher amounts of polyphenol oxidase peroxidase, alpha-amylase and invertase enzyme activity as compared to the normal counterparts.

167. Rapid Micropropagation of Fire Flamed Bush [*Woodfordia fruticosa* (Linn.) Kurz.] through Nodal Andshoot Tip Culture

Neha Grover and Vidya Patni

Plant Pathology,
Tissue Culture and Biotechnology Laboratory,
Department of Botany,
University of Rajasthan,
Jaipur-302055

Keywords : *High frequency, Regeneration; Woodfordia fruticosa; Tissue culture.*

An efficient rapid *in vitro* regeneration protocol was developed for *Woodfordia fruticosa* (Linn.) Kurz. , a wild threatened medicinal ornamental shrub, which is in need to be conserved, by tissue culture techniques. The plants were regenerated from young nodal segments and shoot tips. Shoot tips were the best explants for direct organogenesis and nodal segments were used as explants for indirect organogenesis. Maximum number of multiple shoots was obtained from nodal segment explants on MS medium supplemented with (0. 2-2. 5 mg/l) BAP with 95% shoot regeneration response. Maximum shoot height of 9-11 cms was achieved. The excised shoots were cultured on MS medium with various concentrations and combinations of auxins for rooting. The best response in rooting was observed on half-strength medium supplemented with (0. 2-1. 5 mg/l) IBA. Rooted plants were hardened in earthen pots containing sterile sand before transferring to the main field This is a rapid, reproducible protocol for large scale propagation of this rare, much- used medicinal, beautiful, ornamental, threatened plant species and its ex-situ conservation. And also the qualitative analysis of the secondary metabolites have been done and preliminary screening for bioactive principles is in progress.

168. Virus Free Plants through Meristem Tip Culture in Chill (*Capsicum annuum* L.)

Rishi kesh Meena, Kavi Gour and Vidya Patni

Plant pathology,
Tissue culture and Biotechnology Laboratory,
Department of Botany,
University of Rajasthan,
Jaipur-302004

Keywords : *Chilli leaf curl virus; geminivirus; PCR; In vitro; virus free chilli*

Chilli plants infected with leaf curl virus (geminivirus) are characterized by vein clearing, upward curling, deformation of leaves stunting of plants and abscission of flower buds. The virus was identified as chilli leaf curl virus (CLCV) on the basis of mechanical inoculation on *Nicotiana tabacum* and *Chenopodium quinoa* and by PCR. MS medium amended with BAP (3. 0mg/l) and IAA (3. 0mg/l) was used for shoot proliferation. A maximum of 34. 26±0. 06 number of shoots was obtained. Elongated shoots were rooted on 1/2 MS supplemented with IBA (2. 0 mg/l) and 2% activated charcoal. Regenerated plants gave negative results for CLCV by PCR with specific primers. Virus free chilli plants (80%) were obtained from optimum size (0. 5 mm) of meristem tips. Virus indexing by PCR was found to be a reliable method for confirmation of CLC virus free nature of the regenerated plantlets. This is the first report of geminivirus-free chilli plants production through meristem tip cultureolidated key to all the taxa reported from the study area has been given.

169. In Vitro Multiple Shoot Induction from Nodal Stem explants of *Cochlospermum religiosum* (L.) – an Endangered Medicinal Plant

Alok Sharma and Payal Lodha

Plant Pathology and Plant Tissue Culture Laboratory,
Department of Botany,
University of Rajasthan, Jaipur

Keywords : *Cochlospermum religiosum, cytokinins, endangered*

Cochlospermum religiosum (L.) is extensively used in Ayurvedic medicines and other uses. Every part of this plant is used medicinally. According to the survey of (UNDP) (CAMP), 2007, 39 medicinal plants of Rajasthan have been Red listed. Out of these, *Cochlospermum religiosum* is one of the critically endangered medicinal plant. This plant is thermogenic, sedative and used in cough, diarrhea, dysentery, pharyngitis, gonorrhea, syphilis and trachoma. It is also used for its anti inflammatory activity in Siddha Drug 'Kalnar Parpam'. Gum katira is used as a cheap gelling agent for plant tissue culture and has wide application in pharmaceutical and food industries. During the present investigation shoot tip and nodal segment were used for tissue culture studies. The shoots were initiated on MS medium supplemented with BAP (1-2 mg/litter). Further observations of multiple shoot proliferation by using different cytokinins are in progress.

170. Nutrient Optimization of Sugarcane in Periyar-Vaigai Command Area of Tamil Nadu

S. Sheeba, A. Bhaskaran* and A. R. Mohamed Haroon

Dept. of Soil and Environment,
Agricultural College and Research Institute, Madurai
Tamil Nadu Agricultural University,
Sugarcane Breeding Institute,
Coimbatore, Tamil Nadu

Keywords : *Sugarcane, Nutrients, Optimization, Maximum yield*

Sugarcane is one of the most important cash crops in India. It produces huge biomass and hence removes a substantial quantity of plant nutrients from the soil. Keeping this in view, Integrated Nutrient Management was adopted to avert the problem of nutrient mining in sugarcane growing areas and to optimize the major nutrients for sustainable sugarcane production. For optimizing N, P, K, Zn and Fe for sugarcane, a field experiment was conducted during 2005-2006 at P. C. Patty village of Theni district, with the variety Co 86032, by employing treatment combinations of four levels of N, P and K *i. e.*, 0, 75, 100 and 125 per cent recommended dose of fertilizer without and with recommended level of $ZnSO_4$, $FeSO_4$, vermicompost and *Azophos.* Graded levels of NPK application with IPNM

practices favourably influenced the cane yield. The yield obtained ranged from 76. 5 to 142 t ha^{-1}. The highest cane yield (142 t ha^{-1}) was recorded in the treatment that received N @ 340 kg ha^{-1} along with the recommended dose of P, K, $ZnSO_4$, $FeSO_4$, vermicompost and *Azophos*. Biometric characteristics *viz.*, number of millable cane, length and girth of millable cane, number of internodes and length of internodes in millable cane were higher in 340 kg N ha^{-1} application which was on par with recommended dose of N (275 kg ha^{-1}). The N, P, K, Zn and Fe contents increased with increasing levels of N, P and K along with recommended dose of $ZnSO_4$, $FeSO_4$, vermicompost and *Azophos*. With the advancement of crop growth stages, the nutrient content decreased progressively. The major fertilizer nutrient levels were optimized using Mitcherlich – Bray equation and targeted yield concept. The maximum yield (A) of 160 t ha^{-1} was arrived through least square function using the yield data. N, P and K requirement at different soil test values for achieving the target yield of 155 t ha^{-1} was yield maximum (A) was 160 t ha^{-1}.

By using the Mitcherlich-Bray equation, physical and economic optimum of N, P and K were computed and the results revealed that the applied N and K levels were found to be equal to that of recommended dose. However, it seems to be higher for P as compared to recommended dose. The fertilizer recommendations by fertilizer prescription equation for 155 t ha^{-1} of yield target were found to be more than that of blanket fertilizer recommendation.

171. Effect of Sucrose and Chlorocholine Chloride on in Vitro Production of Microtubers in the Potato Cultivars

Raghavendra Aminedi, Hitaishi Khandal and Niranjan Das*

Deptt. of Biotechnology & Environmental Sciences,
Thapar University,
Patiala-147004

Keywords : *Potato, microtuber, sucrose, chlorocholine chloride (CCC)*

Production of potato microtubers *in vitro* is an important aspect of crop biotechnology. As reported in the literature, media formulations usually include 8%

sucrose, 10 mg/l N^6-benzyl adenine (BA) and 500 mg/l chlorocholine chloride (CCC) for induction of mirotubers in different potato cultivars. Here, we focused mainly on some of the Indian potato cultivars along with exotic cultivar Desiree to study the effect of varying sucrose concentrations *viz.* 8%, 6% & 4% w/v and CCC on microtuberization at 20°C. Varying response was noted among the cultivars in terms of average weight, tuber yield, average diameter, color and texture of the microtubers. Our data clearly suggest that separate media formulations are to be adopted for individual potato cultivars.

172. Effect of Varying Concentrations of Cytokinin, N6 -benzyladenine on Microtuberization in the Potato Cultivars

Niranjan Das*, Richa Kapoor, Mahiti Gupta and Raghavendra Aminedi

Department of Biotechnology & Environmental Sciences,
Thapar University,
Patiala-147004

Keywords : *Potato, microtuber, N^6–benzyladenine*

In vitro microtuberization of potato is a complex process, influenced by a number of parameters such as nutritional factors, growth regulating substances, temperature and photoperiod apart from individual genotypes of the cultivars. Various cytokinins, especially N^6-benzyladenine (BA) is known to stimulate microtuber production. Usually, microtuberization induction medium includes 10 mg/l N^6-benzyladenine(BA) as reported in the literature. In this study, varying concentrations of BA *viz.* 0. 0, 0. 5, 1. 0, 2. 0 & 10 mg/l were used to see the response of some Indian potato cultivars at 20°C. Microtuber production was not affected in some of the potato cultivars at very low BA concentrations, even without supplement of BA. The results suggest that potato cultivars possibly vary with regard to endogenous level of cytokinins.

173. Role of Salicylic acid and Ethephon on the Activities of Nitrogen Metabolism in Cenchrus setigerus (CAZRI-76) grown in vivo

Premlata Singariya[1] and Krishan Kumar Mourya[2]

Laboratary of Tissue Culture and Secondary Metabolites,
Department of Botany,
University of Rajasthan,
Jaipur-302004
Animal Husbandry Department,
Pahari (Bhratpar) Rajasthan

Keywords : *Cenchrus setigerus, ethephon, salicylic acid, nitrate reductase, glutamine synthetase, glutamate dehydrogenase, glutamate synthase*

Cenchrus setigerus is a drought hardy perennial grass, which forms clumps at the base. This grass primarily used for permanent pasture. It is valuable stand over feed in low rain fall areas and for erosion control in arid and semi arid land. For *in vivo* studies seeds were shown in pots, three to four plants were selected for further studies. Different concentrations of salicylic acid 100, 200mg/L and ethephon (an ethylene releasing compound) 240, 960mg/L were used in two week old plants. Each treatment was comprised of 500ml of different concentration of Plant Growth Regulator's. Pots treated with water served as control. Leaf sample were collected after 5 days of second treatment for estimation of enzymes- nitrate reductase (NR), glutamine synthetase (GS), glutamate dehydrogenase (GDH), glutamate synthase (GOGAT) and protein content. Plants treated with different concentration of salicylic acid showed increase activity of NR, GDH, GOGAT and soluble protein content with respect to control. A significant enhancement of GS, GDH, GOGAT activities and soluble protein content were observed in plants treated with (ethephon 240mg/L). Maximum increase in GS activity was observed in plants treated with ethephon240 mg/L and high activities of GDH, GOGAT, NR and soluble protein content was observed in plants treated with salicylic acid (200 mg/L). In general, both salicylic acid and ethephon greatly modulate the activities of enzymes of nitrogen metabolism in *C. setigerus* CAZRI-76).

174. The Effect of Sewage Water and Growth Regulators on Physical and Biochemical Parameters of Wheat (*Triticum aestivum* L.)

Ram Kumar Sagar, Chandra Shekhar Kumar and Dr. J. N. Maurya

Cell and Molecular Biology Lab,
Department of Plant Science,
M. J. P. Rohilkhand University,
Bareilly-243006, U.P.

Keywords : *Sewage water, Irrigation, Growth regulators.*

Field experiments were conducted to see the impact of sewage water alone & along with growth regulators (Auxin, Gibberelins & Cytokinin) on wheat. The Sewage water & growth regulators used at two conc. 50%, 100% & 10ppm, 20ppm respectively. Result showed that application of sewage water along with 20ppm growth regulators stimulate the physical parameter such as plant height, no. of tillers, leaf area, no. of ear/head, grains/ head, 1000 grains weight as well as production of wheat as compared with tap water. The application of 100% sewage water with 20ppm growth regulators also increased biochemical parameters such as total Nitrogen, Nitrate reductase activity, Chlorophyll and carotenoid contents in leaves & protein in grains. The study may help in developing strategy for reuse of sewage water for irrigation purpose.

175. Evaluation of Metabolic Changes and Oxidative Stress response in Young Tea (Camellia sinensis) to Drought

Jibu Thomas[1], D. Shalini[2] and R. Raj Kumar[2]

[1]Department of Biotechnology,
Karunya University, Karunya Nagar,
Coimbatore 641114
[2]UPASI Tea Research Foundation,
Tea Research Institute, Nirar Dam BPO,
Valparai 642127, Coimbatore District

Keywords : *Tea, oxidative stress, antioxidant enzymes, drought*

Pot culture study was conducted to evaluate the oxidative stress responses in two cultivars of tea (*Camallia sinensis)*. In this regard, cultivars with evident drought response characters, drought tolerant (UPASI-9) and drought susceptible (TRF-1) were subjected to drought stress by moisture withdrawal. The treatments included watering 100 ml/pot i. every day (T1), ii. once in alternate day (T2), iii. once in three days (T3)and iv. once in six days (T4). Increase in the moisture stress had inverse relation with the content of total polyphenols, catechins and amino acids in the experiment. Proline accumulation was higher in both UPASI-9 and TRF-1 with increase in moisture stress with drought susceptible clone accumulating more proline. The antioxidant enzymes peroxidise (PO), ascorbate peroxidase (APOX), glutathione reducatase (GR), catalase (CAT) showed varioation with response to varying degrees of drought. Physiological attributes, chlorophyll fluorescence (Fv/ Fm), stomatal conductance (Gs) were low in the drought affected plants while diffusion resistance (r) revealed increased values. Among the cultivars, drought susceptible ones revealed higher reduction in the content of metabolites in response to severity of drought. Results indicated that the antioxidant defences appear to provide protection against oxidative damage in plants grown under un-favorable conditions. Thus the study concludes that survival under drought stress condition in tea depends on the plant's ability to perceive the stimulus and transmit the signals to initiate various physiological changes which determines the basis of tolerance and susceptibility.

176. Insolinotropic and Glucose uptake effects of *Pongamia pinnata* Flower extract

Dandamudi Rajesh Babu[1], Raj kumar D[2], Pranav Kumar Prabhakar[3], Vijayalakshmi Venkatesan[2], Mukesh Doble[3] and G. Nageswara Raoa*

[1]Department of Chemistry,
Sri Sathya Sai University,
Prasanthi Nilayam, Anantapur
Andhra Pradesh-515134
[2]Department of Biochemistry/stem cell lab,
National institute of Nutrition,
Hyderabad, Andhra Pradesh
[3]Department of Biotechnology, IIT Madras,
Chennai-600 036

Keywords : *Diabet, metabolic disorder insulinotropic*

Diabetes mellitus (DM), one of the most prevalent metabolic disorders worldwide, is characterized by hyperglycemia associated with the impairment in insulin secretion and/or insulin action or both. Evaluation of the plant products for treating DM is of interest to many scientists as they contain many bioactive compounds with therapeutic potential. Present study analyses the Insulin secretogoguery effect of the ethanolic extract of *Pongamia pinnata* in the primary islet cell cultures and uptake of 2-deoxyglucose (2DG) by 3T3-L1 adipocyte. Viability studies showed that the ethanolic extract of *Pongamia pinnata* flowers is not toxic to the islets even at 1mg/ml concentration. Further, the ethanol extracts of *Pongamia pinnata* flowers evoked significant insulin secretion both at basal and with challenge in a dose dependent manner. The extract also enhanced the uptake of 2DG in a similar manner. The 2DG uptake increased by 3. 01 fold at 500µg/ml concentration of the extract. The ability of *Pongamia pinnata* flowers to induce insulin secretion and also enhance the uptake of 2DG suggests the insulinotrophic effects and underlines its beneficial effects in the management of diabetes.

177. Zingiber Officinale Roscoe Alone and in Combination with a-tocopherol protect the Kidney against Iornoxicam-induced Acute Renal Failure

Soumendra Darbar, Nilendra Chatterjee,
Tapas Kumar Chattaraj and Tapan Kumar Pal

Bioequivalence Study Centre,
Department of Pharmaceutical Technology,
Jadavpur University,
Kolkata-700032

Keywords : *Antioxidant, Free radicals, Nephrotoxicity, Lornoxicam, Zingiber officinale*

Non-steroidal anti-inflammatory drugs (NSAIDs) are the most common prescription medicine in India, also freely available over-the-counter (OTC).

Unfortunately, one of the main side effects of NSAID administration is renal function damage. NSAID are accountable for 7% of all cases of acute renal failure and for 37% incidents of drug-associated acute renal failure. Oxidative stress due to abnormal production of reactive oxygen molecules (ROM) is believed to be involved in the etiology of toxicities of many xenobiotics. Evidences suggested that ROM is involved in the nephrotoxicity of a widely used nonsteroidal anti-inflammatory drug, lornoxicam. The nephroprotective effects of ethanol extract of *Zingiber officinale* alone and in combination with vitamin E (á-tocopherol) were evaluated using lornoxicam (90 mg/kg body wt. , i. p) induced acute renal damage in mice. The serum urea and creatinine levels in the lornoxicam alone treated group were significantly elevated ($P<0.001$) with respect to normal group of animals. The levels were reduced in the *Z. officinale* (250 and 500 mg/kg, orally) plus diclofnac sodium, vitamin E (250 mg/kg) plus lornoxicam, and *Z. officinale* (250 mg/kg) with vitamin E plus lornoxicam treated groups. The renal antioxidant enzymes such as superoxide dismutase (SOD, catalase (CAT), glutathione peroxidase (GPx) activities and level of reduced glutathione (GSH) were declined; level of malondialdehyde (MDA) was elevated in the lornoxicam alone treated group. The activities of SOD, CAT, GPx and level of GSH were elevated and level of MDA declined significantly ($P<0.05$) in the *Z. officinale* (250 and 500 mg/kg) plus lornoxicam and *Z. officinale* (250 mg/kg) with vitamin E plus lornoxicam treated groups. The protective effect of *Z. officinale* (250 mg/kg) was found to be better than that of vitamin E (250 mg/kg body wt). The results also demonstrated that combination of *Z. officinale* (250 mg/kg) with vitamin E(250 mg/kg body wt) showed a better protection compared to their 250 mg/kg alone treated groups. Moreover, *Z. officinale* along with Vitamin E prevented serum and tissue protein alteration as well as DNA fragmentation as compared with the groups treated with diclofenac alone. In the histopathological observation, kidney damage induced by lornoxicam was markedly improved in *Z. officinale* treated rats. The study concluded that ethanol extract of *Z. officinale* alone and in combination with vitamin E partially ameliorated lornoxicam-induced nephrotoxicity. This protection is mediated either by preventing the lornoxicam-induced decline of renal antioxidant defense system or by their direct free radical scavenging activity.

178. Response of Nitrogen doses on Niomass production and growth Dynamics in Five Rice (*Oryza sativa* L.) Genotypes under Field Grown Condition

Hukum Singh[1], Amit Verma[2], Rajesh Kumar and Desha Meena[3]

Department of Plant Physiology,
[1]Department of Biochemistry,
College of Basic Sciences and Humanities,
G. B. Pant University of Agriculture and Technology,
Pantnagar, Uttarakhand-263 145
[2]Department of Botany, Bareilly College Bareilly,
Bareilly, Uttar Pradesh-243 005
[3]Plant Biotechnology Division,
Institute of Forest Genetics and Tree Breeding,
Coimbatore, Tamil Nadu-641 002

Keywords : *Rice, nitrogen, height, leaves, biomass accumulation and growth.*

Nitrogen is the key nutrient element limiting the yield and growth of crop. A field experiment was conduct during rainy season of 2008 and 2009. The objective of this study was to evaluate the response of different doses of nitrogen fertilizer on biomass production and growth dynamics of rice crop. The experimental site was The Dr. N. E. Borlaug's crop research centre, G. B. Pant University of Agricultural and Technology Pantnagar, Uttarakhand, India. Five rice genotypes namely KRH-2, Vasumati, Tulsi, Kasturi and Krishna Hamsa were taken as experimental material. The fertilizer urea was used as a nitrogenous source and 0, 50, 100 and 200N kg/ha of nitrogen fertilizer was sprouted in the field. The biomass accumulation and plant growth were recorded at the time of active tillering, maximum tillering and flowering stage. The plant height, number of leaves and biomass accumulation (culm weight, leaves weight, shoot weight and total dry matter) was simultaneously enhanced with nitrogen doses. The calculated results showed that the maximum plant height was gained by Vasumati at active tillering and flowering stages but minimum for Krishna Hamsa during active tillering and for Tulsi at flowering stage. The maximum number of leaves was calculated at flowering stage for KRH-2 followed by Tulsi, Vasumati, Krishna Hamsa and Kasturi. Overall, the rice genotype KRH-2 was found

superior in terms of plant height, number of leaves and biomass accumulation. This study will be helpful in future for selection of high nitrogen efficient rice genotype for better biomass production and plant growth development.

179. Germination Viability of Seed, Buffering Properties of the Root Respiration and Formation by Using Humic Acid

Deshmukhe V. B*, Bhosle S. B, Patil R. K and Gomare K. S.
Department of Biotechnology
College of Computer Science & Information Tech., Latur

Keywords : *Humic acid, Pea Nut, Soparatedin*

Humicadd helpsto increases germination, viability of seed buffering propertiesof soil and root respiration and-formation. Humic substances promote the conversion of a number of elements. in to forms available to plants. Humic acid increasesseed formation. Liquidhumic acid or granules are taken with different concentration applied to the field of pea nut. Then every two weeks up to the flowering of plant and after two weeks height of plant is taken. tocompare the growth of plant. Then observe the fruiting body. ef. plant. then. proceed to check. the nutritional value of pea nut with. Comparing to control plant seed. By using humic acid at Concentration 4000PPM plant growth is increased also colour of plant found to be greenish with proper growth with comparing. the control. After gel electrophoresis different DNA bands are observed at different. concentration.

180. Bioactivity of Crude Extracts of Clerodendruminerme and Leucus Aspera using Brine Shrimp Lethality Assay

V. Naga Rajani, E. Radhika, S. Sundara and Rajanand Priya Garuda
D. S. G. Reddy College,
Domlur, Bangalore-560071

Keywords : *Clerodendrum inerme, Leucus aspera, brine shrimp lethality*

Brine shrimp lethality assay is very useful in pharmacological Evalution of plants for the dentification of lead compounds which can leads to the development

of novel and safe medicinal agents. The ethino pharmacologically important medicinal plants can be evaluated for brine shrimp lethality as say before they used as general bio as say to test plantdrugs for pharmacological activity. In the present study aqueous and methanolic extract of Clerodendruminerme and Leucus as per a were screened for their cytotoxicity using brine shrimp lethality test. The results indicated that the methanolic extract of Leucus as per a exhibited potent brine shrimp lethality than the other extract. The aqueous extract of both the plants are similar in their potency and they are less potent than methanoliclic extracts. The aqueous extract. of Clerodendruminerme (leaves) is having more brine shrimp lethality than the aqueous extract of Leucus aspera. The present study supports that brine shrimp bio assay is simple reliable and convenient method for assessment of bioactivity of medicinal plants and lend support for their use in traditional medicine.

181. Calcium Content of Fruites and Vegetables

Vinti Davar and Shweta Saini

Deptt. of Foods & Nutrition (Home science)
Kurukshetra University,
Kurukshetra, Haryana

Keywords : *Calcium content, fruits, vegetables*

There are a limited number of studies available on the nutritional value of calcium content of fruits and vegetables commonly available and consumed in Haryana. An investigation was thus made into the calcium content of sixteen such fruits and vegetables. The samples were first digested to remove organic constituents, the calcium was then analyzed using Atomic Absorption Spectrop~otometry. The results indicate that amaranth (cholai), lotus stem, raisins, spinach and curry leaves contain high calcium content. The vegetables are by far richer in calcium content when compared to fruits. Increased consumption of local fruits and vegetables with high calcium would be useful in improving the daily calcium intake.

182. Influence of Osmotic Stress on Capsaicin Biosynthesis in Cell Suspension Cultures of Capsicum Chinense Jacq. cv. Naga King Chili

Mechuselie Kehie, Suman Kumaria and Pramod Tandon

Plant Biotechnology Laboratory,
Department of Botany,
Centre for Advanced Studies,
North-Eastern Hill University,
Shillong-793022

Keywords : *Capsicum; Capsaicin; Naga King Chili; Osmotic stress*

The influence of osmotic stress on capsaicin biosynthesis was investigated in cell suspension cultures of *Capsicum chinense* Jacq. cv. Naga King Chili, the world's hottest chili native to North Eastern India more particularly to Nagaland. Various concentration of either sucrose or mannitol significantly affected capsaicin biosynthesis in the suspension cultures, and the maximum capsaicin accumulation of 3037. 4 ìg g^{-1} fresh weight was obtained on day 25 in Murashige and Skoog (MS) containing 87. 64 mM Sucrose. Stoichiometric analysis with different combinations of sucrose and non sugar osmotic agent (NaCl) showed that osmotic stress was an important factor for enhancing capsaicin biosynthesis in cell suspension cultures of *C. chinense.* The highest capsaicin content of 5701. 6 ìg g^{-1} f. wt was recorded on day 15 in cultures grown in MS medium containing 87. 64 mM sucrose + 40 mM NaCl. Osmotic stress treatment at 160 mM NaCl resulted in lowering capsaicin accumulation and separation of cell wall from their cytoplasm, under microscopic observation.

183. Role of Growth Regulators in Callus Establishment and Differentiation In Naringi Crenulata (Roxb.) Nicolson

Neelam Singh, Mukesh Kumar Meena and Vidya Patni

Plant Pathology, Tissue Culture and Biotechnology Laboratory,
Department of Botany,
University of Rajasthan,
Jaipur-302004

Keywords : *Naringi crenulata, organogenesis, callus, differentiation*

A protocol for callus establishment and differentiation in *Naringi crenulata* (Roxb.) Nicolson medicinally potent plant, has been developed by regulating the auxin-cytokinin ratio in basal media, source of explants and physiological state of the tissue in culture. Among the various explants (leaf/shoot tip/nodal segment) tried, leaf explants proved to be the best. The ideal medium for callus induction and establishment was MS medium supplemented with NAA (0. 5-5. 0 mg/ l) in combination with BAP (0. 5- 5. 0 mg/l). Maximum number of shoot buds through callus differentiation was achieved on MS medium supplemented with BAP (2. 0- 5. 0 mg/l) and NAA (0. 1-1. 0 mg/l). Elongation and further development of shoot buds into shoots was achieved on MS medium fortified with BAP (0. 1-1. 0 mg/l) & Kn (0. 5 - 5. 0 mg/l). *In vitro* rooting of shoots was achieved on ½ strength MS medium supplemented with indole-3-butyric acid (IBA). Best rooting was achieved on ½ strength MS medium supplemented with 1. 0 mg/l indole-3- butyric acid (IBA). So, this protocol can be used for the rapid regeneration of *Naringi crenulata* through indirect organogenesis using a wide range of explants.

184. The Impact of Cadmium on Seed Germination, Seedling Growth and Antioxidant Enzymes in Pea (Pisum sativum sp.)

Shahida Hamid, Sanjay Kumar and Munna Singh.

Department of Botany,
Faculty of Science,
University of Lucknow,
Lucknow-226007

Keywords : *Seed germination,cadmium,*

In the present study, a novel approach has been made to evaluate the effect of cadmium in pea in terms of germination, seedling growth, pigment's development and relevant enzymes activity. Pea (***Pisum sativum sp***.), an important pulse crop consumed by humans, was selected as a test plant. During the present investigation, pea seeds were grown in petridishes on filter paper in triplicate containing different concentrations of cadmium viz. 0. 5, 1. 0, 2. 0, 4. 0 and 8.

0 mM respectively. Changes in the physiological and biochemical activities were observed. At the high concentration of cadmium germination percentage was decreased as compared to control. I also showed considerable reduction in plumule length, radical length along with the number of lateral roots. The fresh weight, dry weight and moisture contents were also found reduced with higher concentration of cadmium. Declined pigment contents were noticed under the influence of higher cadmium concentration. Amylase activity was found to be gradually reduced at all concentration of cadmium. There was a marked increase in catalase and peroxidase activity by the application of test chemical was observed in different concentrations of cadmium. The results suggest that activities of peroxidase, catalase of pea seedlings are inhibited under cadmium stress affecting their growth.

185. Biochemical Changes during the Development and Ripening of Muskmelon (Cucumis Melo L.)

Soumya. V. Menon and T. V. Ramana. Rao*

B. R. Doshi School of Biosciences,
Sardar Patel University Vallabh Vidyanagar,
Gujarat-388120

Keywords : *fruit ripening, muskmelon, sugars, sucrose phosphate synthase*

Sugar accumulation is the major process which determines the quality of muskmelon fruit. Changes in the sugars (reducing, non-reducing and total) and starch and the enzymes related to starch hydrolysis as well as sugar metabolic enzymes were measured. Sugar accumulation was concomitant with the starch hydrolysis during the fully ripe stage of the muskmelon fruit. Sugar metabolizing enzymes, sucrose phosphate synthase (SPS) (EC 2. 4. 1. 14) activity was maximum (0. 019µmol/h/mg protein) in the mature stage while sucrose synthase (SS) (EC 2. 4. 1. 13) activity was maximum (0. 343µmol/h/mg protein) in the pre-mature stage. The activities of acid and neutral invertases (EC 3. 2. 1. 26) were very low compared to the sucrose synthase enzyme but exhibited high activity in the mature stage. The results indicate that SPS and SS are the determinants of sucrose accumulation in melon fruit. However the declined activity of acid and neutral invertases showed that they function in fruit maturation.

186. Impact of Postharvest Treatments and Packaging on Enzymes of Sweet Pepper (*Capsicum annum* l.) in different Storage Conditions

Khilana K. Shah, Neeta B. Gol and T. V. Ramana Rao*

B. R. Doshi School of Biosciences,
Sardar Patel University Vallabh
Vidyanagar-388 120, Gujarat

Keywords : *Capsicum annum, postharvest, treatment, storage, peppers*

The influences of salicylic acid and calcium chloride treatments on sweet pepper fruits packaged in plastic (polythene) bags and stored at 28°C and 4°C were evaluated at 0, 9 and 18 days of storage period. The activities of cell wall modifying enzymes such as polygalacturonase, pectin methyl esterase, cellulase, â-galactosidase and antioxidant enzymes like peroxidase, catalase and ascorbic acid oxidase were elucidated in the fruits of experimental sets and they were compared with that of control set. The higher activities of scavenger antioxidant enzymes, including peroxidase and catalase in the treated peppers at the 18 days storage period is probably due to the effect of salicylic acid and calcium chloride. The data of the present study may be an indicative that the high peroxidase activity and low activity of cell wall degrading enzymes, such as polygalacturonase, pectin methyl esterase, cellulase, â-galactosidase in the treated peppers might have been associated with a high integrity of the cell membrane and few changes in the cell wall constituents, which contributed to high levels of brittleness and firmness in the peppers during storage. Thus it may be concluded that the salicylic acid treatment may aid in delaying the softening process, while retaining the nutritional quality, of sweet pepper more than that of calcium chloride treatment.

187. Efficient In vitro Regeneration System using whole Seed Explants in Indian Cultivar of Lentil (Lens culinaris Medik.) Compatible to Agrobacterium Tumifaciens Mediated Transformation.

Rajan Chopra, Aparna Prabhakar, Netrapal Singh Shekhawat and Raman Saini*

Department of Biotechnology,
Kurukshetra University,
Kurukshetra-136119

Keywords : *Agrobacterim tumifaciens; In vitro regeneration; lentil; Lens culinaris; sonication; vacuum infiltration; whole seed explants.*

The present study reports efficient regeneration protocol of Indian cvs. of lentil, compatible to *Agrobacterium* mediated transformation using whole seed explants. The decoated seeds cultured on regeneration medium consisting of MS salts, B5 vitamins supplemented with different concentrations of 6-benzylaminopurine and Thidiazuron individually. Medium fortified with Thidiazuron (5ìM) were found best responsive and produced multiple shoots with average 8 shoots per explants in 95% of the cultures. Root induction was observed in 40% of shoots on rooting medium containing half strength MS salts and full vitamins supplemented with 2. 5ìM IBA. Regenerated plantlets were established in soil with 90% survival rate and grown to maturity. The explants were found to be competent for transformation using some novel parameters like sonication and vacuum infiltration assisted *Agrobacterium* mediated transformation showing very good transient GUS activity in the whole embryonic axis.

188. Lipase-catalyzed Esterification of Isopropyl Alcohol with Ferulic acid in an Organic Medium

Kumar Ashok and Kanwar Shamsher Singh*

Department of Biotechnology,
Himachal Pradesh University,
Shimla-171 005

Keywords : *Silica, glutaraldehyde, immobilized lipase, isopropyl ferulate, molecular sieves, esterification.*

Biocatalysis in organic solvents has emerged as an area of systematic research and industrial development fuelled mainly by the demand of newer chemicals and pharmaceuticals. Dimethyl sulfoxide (DMSO) was adopted as organic solvent in the synthesis of isopropyl ferulate catalyzed by silica-immobilized lipase. The key parameters such as molar ratio of reactants, reaction time/ temperature, pH, pre-incubation with salt ions and use of molecular sieves were further investigated to find their effects on the ester synthesis. Silica-bound lipase pretreated with 1% glutaraldehyde showed maximum activity at a temperature of

45^{o}C and pH 8.5. In a short period of 3 h, ferulic acid and isopropanol in the ratio 25 mM : 100 mM at 45^{o}C yielded 84% of isopropyl ferulate under shaking at 150 rev/min. Gas liquid chromatography analysis showed 84. 5% yield of isopropyl ferulate by using 12.5 mg/ml immobilized enzyme The byproduct of esterification reaction (H_2O) was removed by adding molecular sieves. Ca^{2+}, Fe^{2+} and Cd^{2+} ions showed a rise in the yield of isopropyl ferulate, whereas Co^{2+}, Zn^{2+}, Mg^{2+} and Mn^{2+} had mild inhibitory effect. The cumulative influence of selected metal ions (Ca^{2+}, Fe^{2+} and Cd^{2+}) at varying concentration in the presence of molecular sieves was investigated. The highest yield of isopropyl ferulate could attain 90.5% with 3 mM Ca^{2+}exposed bound biocatalyst in the presence of 100 mg/ml molecular sieves. The silica-bound lipase yielded 33% efficacy after 6th repetitive cycle of esterification. Ferulic acid is an ester linked to plant cell wall constituents especially to arabinoxylans and lignin's. It has the maximum UV absorption at 322 nm which falls between the UVB and UVA region and hence can be used as a potential UV-absorbing substance for skin protection against sunlight. Ferulic acid exhibits low solubility in both aqueous and organic phases. It is unstable at high temperatures where it undergoes oxidation. The main aim of this work was to explore the potential of silica-bound lipase to perform synthesis of isopropyl ferulate in an organic medium. However, it is well known that esterification and hydrolytic activities do not agree with each other as the requirements and reaction rates are completely different for these two reactions. Hence there is a need to optimize various reaction parameters for the synthesis of the ethyl ester of ferulic acid using immobilized lipase.

189. Isolation of Lipase Producing Bacterial Strain TS-2 and Optimization of Production and Reaction Conditions

Surender Kumar and Reena Gupta*

*Department of Biotechnology,
Himachal Pradesh University,
Shimla-171005

Keywords : *Strain TS-2, screening, lipase, optimization, production.*

A Gram positive, spherical shaped bacterial strain designated as strain TS-2 producing extracellular lipase was isolated from tatapani soil sample after

primary screening of 80 isolates on tributyrin containing nutrient agar plates and further secondary screening of 30 lipase producing bacterial strains isolated from various sources. After the optimization of production and reaction conditions, it was found that strain TS-2 gave a maximum lipase activity in nutrient broth media when 5% (v/v) of a 24 h old inoculum was used at 55ºC under shaking conditions (150 rpm) for 36 h at pH 7. 5. Yeast extract (0. 3% w/v) and mustard oil (1. 5% v/v) used as nitrogen and carbon source respectively, were found to be best suited for optimal lipase production. The optimal activity given by the enzyme was at temperature of 55ºC in Tris-HCl buffer pH 8. 5 when incubated for 10 minutes. The lipase enzyme produced by strain TS-2 was found to be thermostable at 55ºC and pH stable at pH 7. 5. At the end of optimization of production and reaction conditions a 1. 88 fold increase in the lipase activity was achieved.

190. Nitrile Degrading Activity of a Thermophilic Bacterium Isolated from Manikaran Hot Spring in Himachal Pradesh

Mehta P. K., Bhatia S. K., Bhatia R. K., Kumar V. and Bhalla T. C.*

Department of Biotechnology
HPU Shimla-05

Keywords : *Nitrile hydratases, nitrilase, thermophile, thermo stability*

Nitrile degrading enzymes catalyze the degradation of nitriles to the corresponding amides and acids. Lot of work has been carried out on nitrile degrading organisms, and some of them have been used industrially as biocatalysts for production of amides and acids. Nitrile degrading organisms have been found in various types of bacteria such as *Rhodococcus, Pseudomonas, Aspergillus, Nocardia, Brevibacterium.* The nitrile degrading mesophilic organism hitherto reported have not found to be not satisfactory catalysis because of their relatively low thermostability. In the present studies a number of bacterial isolates were isolated from hot springs of Himachal Pradesh (Manikarn, Tattapani, Vashisht and Khir Ganga) to find a novel thermostable nitrile degrading organism. Isolate MN-70, a versatile nitrile-amide degrading bacteria has been

isolated from Manikaran hot springs of Himachal Pradesh. MN-70 exhibited nitrile degrading activity without addition of inducers, indicating that the nitrile degrading enzyme is constitutive. It has the ability of degradation of benzonitrile to form benzamide and benzoic acid at optimal temperature of 60°C and no inactivation of enzyme was detected even after incubation at 70°C for 5 h. This isolate grows on isobutyronitrile, adiponitrile, propionitrile, 2-cyanopyridine, 3-cyanopyridine, 4-cyanopyridine, malanomide, thioacetamide, cyanamide and ?-Caprolactam as sole nitrogen source in minimal media. The half life of nitrile degrading enzyme activity in whole cell was 90 min at 75°C. Nitrile degrading enzyme systems were significantly more thermostable in whole-cell preparations as compared to their mesophilic counterparts. The versatility of this strain in the hydrolysis of various nitriles and amides makes it a potential biocatalyst in organic synthesis.

191. Microbiological and Biochemical Characterization of Chhang - An Indigenous Rice Beer of Lahaul Valley of Himachal Pradesh

Thakur N., Angmo K. and Bhalla T. C.*

Department of Biotechnology,
Himachal Pradesh University,
Shimla-171005

Keywords : *Channg, phab, phagli, Saccharomyces cerevisiae, Leuconostoc, lactic acid bacteria.*

Chhang is a popular indigenous fermented alcoholic beverage among the tribals of Lahaul and Spiti district of Himachal Pradesh. It is commonly prepared and served during various festive occasions like *Phagli* (traditional New Year of *Lahaulis),* marriage ceremonies and winter months. *Chhang* is prepared by solid-state fermentation of cooked rice using traditional inoculum '*Phab'* (dried solid cakes). The objective of this study was to identify the micro flora and to identify their role in fermentation during *Chhang* preparation. The fermentation process was predominated by yeasts and Lactic acid bacteria (LAB) with initial numbers (CFU/g) of $1x10^4$ and 1. $6x10^5$ respectively which gradually increased

to 5. $2x10^6$ and $1x10^8$ on the 8^{th} day of fermentation. The predominant yeast was identified as *Saccharomyces cerevisiae*, however, *Candida* spp were also found in the *Chang* during the initial phase of fermentation. Though cottony mould like yeast was also present in the beginning of the fermentation. *Saccharomyces cerevisiae*, Lactic acid bacteria and *Leuconostoc* sp. were predominant till the end of fermentation. The pH of *Chhang* declined slowly from 6. 2 to 3. 4 in 8 days. On the other hand, titrable acidity (as % lactic acid) increased from 0. 48% to 2. 5% at the end of *Chhang* fermentation. Alcohol was produced and content reached as high as 11% (v/v) by the end of 12^{th} day of fermentation. Biochemical analysis revealed that the protein content and total sugars were 15. 1% (w/w) and 17% (w/w) on the 8^{th} day of *Chhang* fermentation. The starch content decreased to 9. 5% (w/w) at the end of fermentation. The maximum protease and amylase activities recorded in *Chhang* during fermentation were 0. 04 and 0. 98 units respectively. Nutritional analysis revealed that riboflavin content (B_2) in *Chhang* increased.

192. Effect of Auxins on Internodal Segments of *Buddleja madagascariensis* Lam

Hemant Sharma* and B. D. Vashistha

Department of Botany,
Kurukshetra University,
Kurukshetra-136 119, Haryana

Keywords : *Auxins internodal madagascarientis*

Effects of two auxins (2, 4-D and NAA) have been studied on the regenerative potential of internodal explants in *Buddleja madagascariensis* under *in vitro* conditions. Internodal segments were inoculated on MS medium supplemented with different concentrations of 2,4-D and NAA (0. 5, 1. 0, 2. 0 and 4. 0 mg/l). Cultures raised on MS basal medium without any growth regulator served as control. Internodal segments did not give any response in control cultures. Internodal explants produced callus at all the four concentrations of 2,4-D and NAA on MS medium. Callus was initiated at 0. 5 mg/l of 2,4-D and NAA and the amount

increased up to 1 mg/l and decreased at higher levels. Good amount of callus was observed at 0. 5 and 1 mg/l 2,4-D and NAA while moderate and poor amount of callus were observed at 2. 0 and 4. 0 mg/l 2,4-D and NAA. The callus was green, compact and rough. Of the two growth regulators, NAA proved better than 2,4-D for callusing.

193. *Nardostachys jatamansi* (a traditional medicinal plant) Exhibits *in vitro* Cytotoxic Effect Against four Human Cancer Cell Lines via its 95% Ethanolic Extract

Vikas Sharma

Division of Biochemistry and Plant Physiology,
Faculty of Agriculture, SKUAST,
Main Campus Chatha,
Jammu-180009, J&K

Keywords : *Nardostachys jatamansi, antitumour compounds, ELISA reader, SRB assay, ethanolic extract, cancer cells.*

A wide variety of biological activities from medicinal plants have recently been reported, in addition to their traditional medicinal effects. In particular, it is well established that ethno medicinal plants are useful sources of clinically relevant antitumour compounds. The present research work was carried out to exploit the leaves of *Nardostachys jatamansi* against human cancer cells by means of SRB assay. The cell growth is measured on ELISA reader after staining with sulforhodamine B dye which binds to basic amino acid residues in TCA fixed cells. The growth inhibition of 70% or more was considered active. Three different extracts, (95% ethanolic, 50% ethanolic, hot water) were prepared and tested against four human cancer cell lines, *viz, C*OLO-205, SW-620 (colon origin), HeLa (cervical origin) and NCI-H23 (lung origin) at the concentration of 100µg/ml. The 95% ethanolic extract showed significant *in vitro* cytotoxic activity against all the human cancer cells and growth inhibition was observed in the range of 71-93%. The other two extracts (50% ethanolic and hot water) did not exhibit such type of growth inhibitory potential against human cancer cells. This particular extract can be further exploited against human cancer cells to get active ingredient (s) for the treatment of cancer.

194. Morphogenetic Response of Adhatoda vasica Nees in the *in vitro* Studies

Sai Murali, R. S., Krishna Bhat, K. and R. Basavaraju

Department of Biosciences,
Sri Sathya Sai Institute of Higher Learning,
Prasanthi Nilayam-515 134

Chronic diseases like asthma, TB and bronchitis are rapidly affecting the whole of humanity and the various drugs administered against these ailments have deleterious side effects. *Adhatoda vasica* is an indigenous shrub of India used in various schools of medicine since ages. The plant material is used against a gamut of diseases, particularly the pulmonary ailments. Since there is an ever increasing demand for this plant by the pharmaceutical companies it is imperative to design a protocol for *in vitro* propagation of this plant which assists in the continuous supply of plant material for industrial use. The present work was undertaken to meet this end. The *in vitro* morphogenetic response of nodal explants of *Adhatoda vasica* was studied with MS medium fortified with Plant Growth Regulators via. Auxins : IAA, NAA, IBA, 2, 4-D; Cytokinins : BAP, Ad and KN, individually and together at various concentrations. The effect of different concentrations of BAP showed establishment, and among all the concentrations 1 mg L^{-1} and 2 mg L^{-1} showed better response. The effect of NAA 0. 05 mg L^{-1} showed better establishment than 0. 1 mg L^{-1}. Callus growth was also obtained with this treatment. Kn showed a significant morphogenetic response in the establishment and proliferation of shoots. Combination treatments for establishment of the nodal explants revealed good results. Especially NAA 0. 05 mg L^{-1} and BAP 0. 1 mg L^{-1}; NAA 0. 05 mg L^{-1} + BAP 0. 1 mg L^{-1} + Kn 0. 1 mg L^{-1}, BAP 0. 2 mg L^{-1} + NAA 0. 1 mg L^{-1}, showed better results over the other combinations. On sub culturing the explants in the multiplication medium containing BAP 0. 4 mg L^{-1} + NAA 0. 1 mg L^{-1} and NAA 0. 05 mg/L + BAP 1. 0 mg/L produced multiple shoots up to 9. The elongation was obtained in the medium with BAP 0. 6 mg L^{-1}, measuring 6 cm, which was transferred to rooting medium with IBA 0. 5 mg L^{-1}. While the combination of NAA 0. 05 mg L^{-1} + Kn 1. 0 mg L^{-1} showed significant elongation of leaves and petioles. *In vitro* rooting was observed with different concentrations of IBA. Among all the concentrations used 0. 5 mg L^{-1} alone showed significant root induction, prolif-

eration, and elongation. Rooted shootlets were transferred for hardening in plastic pots containing the mixture of sand, soil and vermin compost in the ratio of 1 :1 :1 provided with Knops solution. These pots were placed in the plant growth chamber with temperature of 23^0 C and Humidity 85%. Callogenesis was observed with 2, 4-D, KN, NAA, BAP and GA_3 in combinations. NAA 0. 05 mg L^{-1} and BAP 0. 1 mg L^{-1}; NAA 0. 05 mg L^{-1} + BAP 0. 1 mg L^{-1}+ Kn; NAA 0. 05 mg L^{-1} + BAP 1. 0 mg L^{-1}; 2, 4- D 1 mg L^{-1} showed significant callus initiation and proliferation than other concentrations used. The results revealed that BAP was ideal for good establishment individually and also in combination with NAA and KN. BAP in combination with NAA was found effective for multiplication. Individual treatment of BAP elicited good elongation. IBA was found to induce the initiation and proliferation of roots.

195. Phytosterol Production in Suspension Cultures of *Acacia nilotica* (Linn.)

Padmasri Govindarajan and D. V. L. Sarada

Department of Biotechnology,
School of Bioengineering, SRM University,
Kattankulathur, Chennai-603203, Tamil Nadu

Keywords : *Acacia nilotica, Mimosaceae, Phytosterol, Gamborg's medium*

The present study describes the effect of light conditions and pH on the production of phytosterols in suspension cultures of *Acacia nilotica*. Callus cultures were initiated from leaf explants of *Acacia nilotica* on B5 (Gamborg) medium amended with four different concentrations of 2,4-D, NAA and IBA namely, 0. 25, 0. 5, 1. 0 and 2. 0 mg/L in combination with Kinetin and BA at 0. 5mg/L at 16 :8 photoperiod and 25ºC. Profuse callus was initiated at NAA (2. 0mg/L) and BA (0. 5mg/L). The callus was transferred to B5 liquid medium amended with NAA (2. 0mg/L) and BA (0. 5mg/L). Experiments were carried out under continuous light, in dark and at different pH, namely 3. 7, 4. 2, 5. 6, 6. 5. The effect of pH was studied at 16 : 8 light dark cycle. Biomass and Phytosterol production in the suspension cultures were quantified upto a period of 21 days at regular intervals. Production of phytosterols was high in dark grown cultures when compared to

cultures grown in continuous light. Maximum phytosterol production was observed at pH 5. 6. In the light and dark grown cultures there existed a direct correlation between biomass and phytosterol production which was not the case in cultures grown at different pH.

196. Establishment of an in vitro Grafting system for Rose

Shubham Chakravarty[1], Sankarshan Sen[1] and Siraj Datta

AJC Bose Laboratory for Plant Biotechnology,
School of Biotechnology and Life Sciences,
Haldia Institute of Technology, Haldia,
West Bengal-721657

Keywords : *Micro propagation, Micro grafting, Rosa hybrida, Coir*

The major limitation in the cultivation of Rose is that, the elite cultivars are of significantly less vigor when grown on their own roots. On the other hand, when Rose is propagated by the traditional *ex vitro* budding or grafting techniques, disease-free shoot and root stocks, suitable for grafting, are not sufficiently available. Therefore, the key to propagate a large number of Rose plants of sufficient viability relies on the establishment of a suitable *in vitro* grafting system for Rose. In order to develop an efficient micro grafting protocol for Rose, various aspects of *in vitro* grafting in Rose were studied using four different varieties of Rose. First, the four types of Rose, which included three elite cultivars, *Rosa hybrida* cv Sanjith, *Rosa hybrida* cv Revolution X Bicolette, *Rosa hybrida* cv East-West and a suitable root stock, *Rosa multiflora*, were micro propagated to produce disease-free plants, suitable for grafting, in large numbers. Then each of the three elite cultivars were grafted *in vitro* onto the root stock and the parameters like shoot-root combination, scion and root stock age and length were studied to increase the efficiency of micro grafting. The survival of grafts was higher when *Rosa hybrida* cv Sanjith and *Rosa hybrida* cv East-West were grafted onto *Rosa multiflora* than when *Rosa hybrida* cv Revolution X Bicolette was grafted onto the same root stock. Scion size size of 0. 6–1. 5 cm

197. Enhancing Xanthophyll Extraction From Marigold Petals by Pre Treatment with Cellulolytic Enzymes Obtained Fro Aspergillusniger

Sneha Dutta, Sounlk Kundu, Rubina Islam,
Pramit Bhattacharjee, Anwesha Saha and K. Sarkar

Department of Microbiology St. Xavier's College
30, Mother Teresa Sanni
Kolkata-700016. West Bengal

Keywords : *Xanthophyll, cellulase, lignocelluloses, biomass, marigold petals, Citrate buffer.*

Xanthophyll is an accessory pigment present in majority of Asteraceae flower petals. The untreated petals when extracted without using cellulolytic enzymes,yields 44% of Carotenoids; whereas recovery obtained on cellulolytic treatment results in more than. 85% extraction. Experimental findings reveal marigold petals effectively pre-treated with cellulolytic enzyme obtained from *Aspergillusniger* has enhanced the rate of extraction. *A. nige r*MTCCno. 404was propagated in plates containing Potato DextroseAg~ medium. Agar discs were cut trom the actively growing plates using a sterile cork borer and inoculated in to Potato Dextrose Broth medium and incubated for 5-6 days at 25°C. The floating mycelia mat was filtered using preweighed Whatmann filter paper no. 41 and the biomass dried at 80°C for 24 hours. 100ml of the filtrate collected, was subjected to centrifugation at 5000 rpm for 15 minutes till a clear Supernatant was obtained,and then concentrated using 100 grams of ammonium sulphate salt under magnetic stirring effect. The mixture was again centrifugedto carry salting out and the pellets obtained were collected separately. The pellets were subjected to dialysis, initially with distilled water and then using O. IM citrate buffer thrice. Finally 120 ml of the concentrated enzymewas used to treat 10 grams of fresh marigold petals placed on a rotary shakerat 175rpm for 24 hours. This treatment facilitates he release of bound xanthophyll pigment alongwith other carotenoids. The treated petals are now ready to be used for commercial xanthophyll (oleo resin) production.

198. Phytohormonal Optimization for Callus Induction in Phaseo/U. Fjaureus Using *In Vitro* Grown Explants

Afrin Jahan, *Sonali Majumdar, *Mohd. Kamran Khan, *Taru Sharma and Pragati Misra, KP. Lal and Pradeep K. Shukla

*Departmentof Molecularand Cellular Engineering,
Department of Tissue Engineering,
Jacob School of Biotechnology and Bioengineering,
Department of Biological Sciences,
School of Basic Sciences,
Sam Higginbottom Institute of Agriculture,
Technology and Sciences, Naini,
Allahabad-211007

Phaseolus aureus or green gram is one of the it TIp6riantpulse crops in India. It is protein rich staple food. It is particularlyrich in leucine,phenylalanine. lysine. valineandisoleucineandcontainsabout 25% proteins. It supplies protein to the vegetarian population of the country. Green gram also plays an important role in sustaining soil fertility by improving soil physical properties and fixing atmospheric nitrogen. *In vitro* culture is used to multiply the plants with novel properties, such as those have been genetically modified or breed through conventional plant breeding approaches. *In vitro* culture is also a part of an economy including pharmaceutical, food and biotechnology industries. An experiment was conducted to optimize the phytohormone combinations and concentrations for callus induction in *Phaseo/us ollreus* using *in vitro* grown explants. The results showed that the best callusing was observed in MS media containing2,4-0 (1. 5 ppm) + NAA (I ppm) + Kinetin (0. 5 ppm) and *GA3* (0. 5 ppm). Callus so obtainedwas bright greencolour, friable and granular in appearance. The MS media supplementedwith NAA (2 ppm) + Kinetin (0. 5 ppm) arid GA3 (0. 5 ppm) showed the poorest callus induction. The good quality calli were further subculturedon different media. The MS mediac ontaining 2,4-D (0. 5 ppm) + BAP (3 ppm) andGA3 (0. 5 ppm) was found to be the best for sub culturing and produced bright green coloured callus which Was further selected for somatic embryo genesis.

199. Variation for Salt Tolerance Attributes In Csrio (Salt Tolerant, Indica) X Taraori Basmati Derived Recombinant Inbred Lines

Vinita Bhankar[l], Sunita Jain[2]*and Rajinder Kumar Jain[1]

[1]Oepartment of Biochemistry,
CCS Haryana Agricultural University,
Hisar-125004
[2]Bioinfonnatics Section,
CCS Haryana Agricultural University,
Hisar-125004
Department of Biotechnology and Molecular Biology,
CCS Haryana Agricultural University,
Hisar-125004

Keywords : *Basmati, linkage mapping, recombinant inbred lines, rice, salt tolerance.*

A population of 208 recombinant inbred lines (RILs) derived from a cross between CSRI0 (salt tolerant, *indica)* and Taraori Basmati (HBCI9) was evaluated for various salt-tolerance attributes in a hydroponic culture system using Yoshida nutrient solution containing 0 and 50 mM NaCI. Large variation was observed in CSRI0 x Taraori Basmati RILs for shoot length (18. 4-45. 1 cm), root length (5. 8-34. 5 cm), fresh weight (0. 319-1. 276 g), dry weight (0. 083-0. 288 g), Na+/IC ratio (0. 033-0. 472), relative water content (RWC, 56. 1-91. 6%) and osmotic potential (-0. 80 to -5. 72) in 35-day-old seedlings. The data was used to calculate salinity tolerant indices and mean salinity score (on 1-9 scale; lower scale state for salt tolerance). The overall mean salinity score of the CSRIO x HBC19 RILs ranged from 1. 5 to 8. 5 with a mean value of 4. 349 :1 :0. 089. Data on salt stress injuries including shoot tip burning, yellowing of leaves and leaf curling showed CSRI0 as highly tolerant (score 1. 5) and HBC19 as highly sensitive (score 8. S); the score of RILs ranged between 1 and 9 with a mean value of 4. 211 :i :0. 110. Three of the RILs showed transgressive segregation for salt tolerance. The results Showed large variability for various salt tolerance attributes in the RIL population and hence it can be used further for linkage mapping and QTL analysis.

200. Application of 12 Hours Pre-Soaking Seed Treatment with Wolffia Arrhiza Extracts on Mature Plants Growth and Productivity of Rajmash Plant

Amit Tiwari
Department of Botany,
D. B. S. College, Kanpur

Keywords : *Wolffia arrhiza weeds*

Wolffia arrhiza is one of the noxious aquatic weeds of India. The duckweeds have been, rated among ten major noxious weeds causing major problems in more then forty six districts, out of their total occurrence in 77 districts in India. It grows luxuriantly in Kanpur and its adjoining area. The biological productivity of this aquatic weed is massive which remains seldom used for any fruitful purpose. There are reports of utilization of duckweed as bio fertilizer supplement in Indian agriculture. But there is *p. o* report concerned with use of wolffia arrhiza extracts to increase growth and productivity of Rajmash crop. The 12 hours soaked seeds with wolffia arrhiza extract of Rajmash were significantly increased the flowers per plant, pods per plant, seed per pod, pod length, seed weight per plant, and weight of 100 Seeds as compared to control. Results are statistically significant at 5% error probability.

201. Hydrazine Hydrate Induced Palmate Leaf Muantan I N Jute (Corchorusolitoriusl.)

P. K. Ghosh and A. Chatterjee
CSB; CSR&TI. Berhampore, Muirshidabad; West Bengal.
Centre. of Advanced Stpdy in Cell and Chrormosome Research,
Department of Botany, University of Calcutta,
35, Bal1ygurnge Circular Road
Calcutta-7000 19

Keyword : *Corchorus olitorius. L. Chromosome, Palmate Ieaf, Hydrazine Hydfate*

Pre soaked seeds of jute *(Corchorusolitbrius* L. Variety. JRO. -632) w. ere treated with. 0. 5% Hydrazine Hydrate(HH) for 6 hours. Pamate leaf

mutants were. Screened in M3inl contrast to the norma l looking fruit plants. A number. of yield component parameters were recorded including plant height, basal diameter, plant spread, root. length, pod per plant, seeds per pod, pod length /breadth ratio, number of primary branches number of secondary branches. leaf angle branching angle, first flowering date 100. flowering date to salduiatiop. ”pe~6entage of pollen sterility an4. weight of 100 seeds which Were found to vary from the conttol plant. Chromosome alaysis revea1ed aberrations like stickiness fragmentation polyplpidy clumping, laggard and bridge formation etc.

202. Plant Regeneration from Shoot Tip explants of *Citrullus colocynthis* (Linn.) Schrad. –An Important Medicinal Herb

Mahesh Chand Meena, Ramraj Meena and U. Kant

Plant pathology, Tissue culture and Biotechnology Laboratory,
Department of Botany,
University of Rajasthan,
Jaipur-302004

Keywords : *Citrullus colocynthis, Medicinal Plant, Regeneration, Shoot tip*

A high frequency and rapid regeneration protocol was developed from shoot tip explants of *Citrullus colocynthis* on MS medium supplemented with BAP (0. 5 mg/l) and NAA (0. 5 mg/l). Highest number of shoots (23. 0 ± 0. 567) was obtained on MS medium containing BAP (0. 5 mg/l) and NAA (0. 5 mg/ l). The regenerated shoots were further elongated on same medium. *In vitro* shoots were excised from shoot clumps and transferred to rooting medium containing IBA (4. 0 mg/l) with 0. 2% activated charcoal. The rooted plants were hardened in polycups containing sterile soil and vermiculate and finally well established in the field; survival rate was 60%. This is the first report of direct *in vitro* plantlet regeneration in *Citrullus colocynthis* from shoot tip explant.

203. Sewage Water Irrigation : Impacts on Physical and Biochemical Parameters of Wheat (*Triticum aestivum* L.).

Chandra Shekhar Kumar, R. K. Sagar and J. N Maurya

Cell and Molecular Biology Lab,
Department of Plant Science,
M. J. P. Rohilkhand University,
Bareilly-243006, U.P.

Keywords : *Sewage water, Wheat, Biochemical parameters*

A field experiment was conducted to study the physical and biochemical parameters of winter wheat (*Triticum aestivum* L.) variety PBW-343 grown under sewage water collected from Bareilly city (U. P) India. The effect of sewage water was analysed by measuring various physiochemical parameters. Crop irrigated with 100% sewage water showed increased number of tillers, leaf area per plant, no. of ears and seed yield per plant as compared to control. 50% sewage water irrigation also increased the growth of crop compared to tap water (control) irrigation, but increase was less than 100% sewage water. Various biochemical parameters such as Chlorophyll, Carotenoid, Protein and Proline were analysed. There was a significant increase in Chlorophyll and Protein content in wheat plant irrigated with 100% sewage water as compared to 50% sewage water and control. Carotenoid and Proline enhanced to a greater extent when wheat was irrigated with 100% sewage water as compared to control. The study reflects that sewage water can be reused for irrigation purpose in agriculture.

204. Economizing Tissue Culture Technology through Standardized Low Cost Media Component Alternatives

Tarun Kant, Ashok Parmar and Vinod Singh Gour

Biotechnology Laboratory, FGTB Division,
Arid Forest Research Institute,
New Pali Road, Jodhpur

Keywords : *microshoots, Balanites aegyptiaca*

In vitro mass propagation has been a well established technique that is capable of producing large scale quality planting material with reproducibility and efficiency. However, owing to intensive use of skilled manpower, electricity, high grade chemicals and reagents etc. , the tissue culture technology proves expensive. And many a times, high per plant cost of tissue cultured plants reduces its acceptability. Of the media components, the gelling agents such as agar contribute 70% of the cost. Therefore, agar is the major component to be replaced to reduce. Several attempts have been made to reduce the cost of tissue culture media components using low cost alternatives to agar (gelling agent) and sucrose (carbon source). Isabgol-husk, guar gum and sago powder were used as low cost gelling alternatives and table sugar, raw sugar and jaggary were tested as low cost carbon sources in tissue culture media. We have tested these low cost alternatives during *in vitro rooting* of microshoots of two plants of arid and semi-arid regions of India -*Balanites aegyptiaca* and *Phyllanthus emblica*. Gelling agent alternatives used were- sago powder, guar gum and isabgol husk that solidify media at 15. 0% (w/v), 5. 0% (w/v) and 5. 0% (w/v) respectively. In presence of isabgol, rooting response in micro shoots of *Balanites* aegyptiaca was found to be equivalent to that of agar and application of isabgol husk can reduce the cost of gelling agents per unit media by over 40%. Moreover, it has been found that table sugar can be used for *in vitro* rooting of both the species at commercial scale. As far as gelling agents is concerned isabgol was found to be a suitable gelling agent for rooting with equally good rooting response as that of agar.

205. Seed Germination and Berberine Content in *Berberis aristata* DC., growing in Himachal Pradesh, India

Rajasekaran, Nilay Kumar and Joginder Singh

Himalayan Forest Research Institute,
Shimla, Himachal Pradesh-171 009

Keywords : *Berberine, seed germination, Berberis aristata, HPLC*

Berberis aristata DC. (Family : Berberidaceae; Hindi : Daruharida, Rasaut; English : Indian Barberry) is one of the high medicinal value species of temperate areas. It is mostly found growing wild in the sub-Himalayan tract at altitude

ranging from 2,150 to 2,800 meters. Rasaut (also called rasaunt or rasanjana) is a useful concentrated extract obtained from roots of this plant and is used in curing many human ailments. Moreover, the plant has hepatoprotective, antiturnour, sedative and wound healing properties. The chief constituent of the roots and stem bark of B. aristata is an alkaloid Berberine, which is reported to be I responsible for most of the biological activity of the plant. A study was conducted to identify high berberine yielding plants/populations and to assess the seed germination potential of the plant growing in Himachal Pradesh. Berberine content was estimated using High Performance Liquid Chromatography (HPLC). The chemical analysis showed maximum berberine content of 2. 81 per cent in sample No. 30 collected from Shimla district. Effect of different treatments on seed germination of the plant was also studied under laboratory conditions. The seed germination studies revealed that maximum germination (93. 50%) was recorded in seeds treated with hot water fot 24 hours. In this paper variation in berberine content and seed germination potential of B. aristata growing in Himachal Pradesh have been discussed.

206. A Comparison of Bacterial Cell Wall Disruption Techniques for the Xtraction of Intracellular Enzyme

Wamik Azmi* and Sarita

Department of Biotechnology,
Himachal Pradesh University,
Summer Hill, Shimla,
Himachal Pradesh-171005

Keywords : *L-asparaginase, Erwinia carotovora MTCC1428, cell disruption, sonication.*

Disintegration of microbial cells is a necessary first step for the purification or extraction of intracellular enzymes and organelles. With increasing use of intracellular microbial materials in industry and medicine, the cell disruption unit operation is gaining in importance. L-asparaginase (E. C. 3. 5. 1. 1.) is a therapeutic enzyme and extensively used in the treatment of acute lymphoblastic leukemia. L-asparaginase is widely distributed among microorganisms, plants and animals. Due to the difficult extraction procedure to obtain the enzyme from plants and animals,

microorganisms have proved to be better alternative for the large scale production of L-asparaginase as they can be cultured easily and the extraction of enzyme is also easy. L-asparaginase obtained from bacterial culture *Erwinia carotovora* MTCC 1428 is an intracellular enzyme, hence cell disruption is mandatory to release the enzyme for further purification. It was required to select a method of cell lysis which causes least loss in enzyme activity with maximum recovery. Cells of *E. carotovora* were lysed by different physical (vortex, motor and pestle, sonicator, bead beater), chemical (alkali lysis, acetone powder, guanidine-HCl and triton X-100) and enzymatic (lysozyme) methods. It was found that out of all methods tested, enzyme release was found to be the best when cells were disrupted by sonication. Specific activity of enzyme was found to be 1. 19 U/mg which was the maximum among all the methods tried, the loss was also minimum(25%) in this case.

207. Nitric Oxide Modulates Specific Steps of Auxin-induced Adventitious Rooting in Sunflower

Sunita Yadav* and Satish C. Bhatla

Laboratory of Plant Physiology and Biochemistry;
Department of Botany; University of Delhi;
North Campus; Delhi-110007

Keywords : *Adventitious roots, nitric oxide, auxin, sunflower*

Auxin-mediated adventitious root (AR) formation from the basal ends of hypocotyls segments in Sunflower (*Helianthus annuus* L. cv. Morden) exhibits nitric oxide (NO)-dependent and NO-independent roles of auxin in this developmental process. Root induction phase is evident within 1d (24 h) in the interfascicular parenchyma while NO accumulation in the interfascicular cells 2 d after indole-3-acetic acid (IAA) treatment highlights the involvement of NO during root initiation phase. Thus, adventitious root induction is strictly auxin-dependent though initiation and extension phases involve an interaction of auxin and NO. Treatment of hypocotyl explants with 10 µM 1-napthylphthlamic acid (NPA), an inhibitor of polar auxin transport, lead to suppression of adventitious roots and a complete abolition of NO-associated fluorescence. Use of an actin

depolymerizing agent, Latrunculin B (Lat B) also lead to substantial inhibition of IAA-induced AR response and NO accumulation in the responding cells. Evidence for changes in temporal and spatial expression of endogenous NO in the adventitious root differentiating zone at various stages of development has been monitored by fluorescence microscopy, using DAF-2DA as the probe in presence of various pharmacological treatments. Quantitation of total NO level and NO content due to putative NOS activity has been undertaken in hypocotyl explants subjected to AR stimulatory and inhibitory treatments. Aminoguanidine (an inhibitor of inducible nitric oxide synthase) brought about a reduction in total NO content, indicating a significant contribution of the activity of putative NOS in endogenous NO accumulation. Thus, evidence for a linkage between IAA and NO during AR formation has been established.

208. Sodium Chloride Stress Induces Nitric Oxide Accumulation in Root Tips and Oil Body surface Accompanying Slower Oleosin Degradation in Sunflower Seedlings

Anisha David* and Satish C. Bhatla

Plant Physiology and Biochemistry Laboratory,
Department of Botany, University of Delhi,
North Campus, Delhi 110007

Keywords : *Salt stress, nitric oxide, sunflower, putative nitric oxide synthase activity, oleosin*

Present work highlights the involvement of endogenous nitric oxide (NO) in sodium chloride (NaCl)-induced inhibition of seedling growth in sunflower (*Helianthus annuus* L. cv. Morden). The growth response is dependent on NaCl concentration to which seedlings are exposed, they being tolerant to 40 mM NaCl and showing a reduction in root extension growth and its proliferation at 120 mM NaCl. NaCl sensitivity of sunflower seedlings accompanies a 4-fold increase in Na^+/K^+ ratio in roots (as compared to that in cotyledons) and a rapid transport of Na^+ to the cotyledons, thereby enhancing Na^+/K^+ ratio in the cotyledons, in order to tolerate sodium toxicity by the growing seedling. A transient increase in endogenous NO content, primarily contributed by putative NOS activity in roots

of 4 d old seedlings subjected to NaCl stress and the relative reduction in Na^+/K^+ ratio after 4 d, indicates that NO regulates Na^+ accumulation, probably by affecting the associated transporter proteins. Root tips exhibit an early and transient enhanced expression of 4,5-diaminofluorescein diacetate (DAF-2DA) positive NO signal in the cells of columella, epidermis and meristematic zone in presence of 120 mM NaCl. NO-associated fluorescence in mitochondria in the root tips has been probed using the fluorescent probe- Mito Tracker. Isolated oil bodies from 2 d old seedling cotyledons and those within intact protoplast exhibit enhanced NO signal in response to 120 mM NaCl treatment, coinciding with a greater retention of principal oil body membrane proteins i. e. oleosins. This indicates a relationship between salinity stress and NO-induced prolongation of oil body mobilization during seed germination. Abolition of DAF positive fluorescence by the application of specific NO scavenger 2-phenyl-4,4,5,5-tetramethyllimidazoline-1-oxyl-3-oxide (PTIO) authenticates the presence of endogenous NO. These novel findings provide evidence for a possible protective role of NO during proteolytic degradation of oleosins prior to/accompanying lipolysis.

VII. ENVIRONMENTAL BIOLOGY

209. Analysis of Soil from Crude Oil Effected Area of Moran to Study the growth of some Medicinal Plants

Bhanu Prova Saikia

Department of Botany,
Moran College, Sivasagar,
Assam-785670

Keywords : *Soil analysis, medicinal plants, growth characters, crud oil*

Soil is a natural medium for plant growth which provides mechanical support and essential nutrients and water to plants. Soil is an extremely complex medium. It is composed of particles of variable size, shape and chemical composition. Soil system is indeed very complex and dynamic; undergoing continuous change and the rates of such changes being influenced by various environmental factors. All the

soil has the common components like the mineral matter, the soil organism and the organic matter, water and soil atmosphere. Moreover each soil has its distinctive flora as well as fauna of bacteria, fungi, algae, and nematodes etc. The soil may affect the growth characters of a plant like seed germination, size and shape of stem, leaf, woodiness of stem, flower and fruit development, root system etc. Different physical and chemical properties of soil are responsible for the growth of plants in different habitats. During the study medicinal plants like *Phyllanthus fraternus, Alternanthera sessilis, Eclipta alba* etc were found to grow in the crud oil effected area vigorously. The physico chemical properties like soil colour, texture, bulk-dencity, PH, porocity, organic matter, NPK, etc. were analyzed to see the effect of soil nutrients on the growth of different medicinal plants in the study area.

210. Exploitation of fungi for biological management of Water hyacinth

Anita Chouksey and Ranu Singh
Mata Gujri Women's College,
Jabalpur (M.P.)

Keywords : *Water hyacinth, weed, Alternaria alternata, Curvularia lunata*

Water hyacinth (*Eichhornia crassipes*) (Mart.) Solms. Laubach is considered one of the world's worst weeds invading lakes, ponds, canals and rivers. During periodical survey of various water bodies of Jabalpur to documents the fungal pathogens of water hyacinth, a total of 30 fungi were recovered from infected and diseased parts of water hyacinth out of which 22 were pathogenic. Among these *Alternaria alternata, Cercospora rodmanii, Curvularia lunata, Rhizoctonia solani, Alternaria eichhorniae* incited severe infection and caused drastic damage to the weed while few others viz. *Fusarium oxysporum, Drechslera indica, Phoma sp. , Sclerotium* sp. , *Fusarium equiseti, Fusarium solani, Curvularia clavatum, Colletotrichum gleosporioides, Colletotrichum dematium, Helminthosporium sp.* , caused mild diseases to water hyacinth. Several other fungi viz. *Fusarium moniliforme,, Aspergillus clavatus, Aspergillus flavus, Aspergillus nidulans, Aspergillus niger, Penicillium nigricans,*

Cephalosporium Sp. , Penicillium oxalicum, totally failed to incite any diseases to the weed to identify the locality to conserve the population of this rare plant group. Hence, present investigation focused on identification, utility and conservation of *Caralluma.*

211. Augmentative Biological Control of Mealy Bug, Maconellicoccus Hirsutus Causing Tukra in Mulberry Through Ecological Approaches

***K. Sathya prasad, A. S. Aruna, K. Vinutha and M. A. Shekhar**

Basic Seed Farm, NSSO,
Central Silk Board, C/o Govt. Silk farm,
Nagamangala, Mandya Dist. Karnataka.
Pest Management Laboratory,
Central Sericultural Research and Training Institute,
Srirampura, Mysore

Keywords : *Biocontrol, mealybuck, tukra, pesticide*

The mulberry, *Morus spp*. the sole food of the silk worm *Bombyx mori* experiences a considerable yield loss due to pest attack. Among the various pests that infest mulberry, the mealy bug *Maconellicoccus hirsutus* occupies key pest status among the sap suckers causing a leaf yield loss of about 4500 kg/ha/yr. Of the various management strategies viz. , mechanical, chemical and biocontrol and IPM against mealy bug, biological control plays a pivotal role in the management of mulberry pests as the use of toxic chemical pesticides is not encouraged in mulberry crop system owing to high sensitivity of the silkworm to these chemicals besides causing pollution and effect on non target species such as natural enemies. However, for a effective augmentative biological control a continuos abvailability of the natural enemies need to made available in the crop system. Hence, in the present study four crops *viz., Hibiscus cannabinus,, Gliricidia sepium Abelmoschus esculantus* and *Solanum lycopersicum* were selected as intercrops to provide a niche for the pest and natural enemy colonization. The population of *Cryptolaemous montrouzieri* was significantly

more on *H. cannabinus* (2. 76±0. 57) followed by *A. esculantus* (1. 76±0. 20) and least on *G. sepium* (0. 43±0. 06). Further, the predator number was significantly higher on mulberry without intercrop (1. 23±0. 19) as against mulberry with trap crops.

212. Effect of Stone Crusher Dust Pollutionon Biomass and Productivity of Seasame

D. D. Pandey, Kiran Panday, *S. N. Prasad Sinha and **S. N. Prasad

P. G. Dept. of Botany, Nalanda College,
Biharsharif, Nalanda,
Bihar-803101
*G. D. M. College, Harnaut,
Nalanda, Bihar-803110
**Department of Botany,
Shershah College, Sasaram,
Bihar-821 115

Keywords : *Stone crusher dust, biomass, productivity, sesame (Sesamum indicum).*

The study area was confined to the seasame situated in the prevailing wind direction of stone crusher area of Koderma, Jharkhand to know the effect of stone crusher dust pollutioon on biomass and productivity of seasame (*Sesamum indicum*). The biomass and productivity was found to be higher at each sampling date of the control sesame plant than polluted ones. A maximum reduction of 22. 01% of total biomass was recorded at the age of 135 days.

213. An Exponentional Solution for Removing the Pollution from Waste Water of Different Site

Chandra Prabha, Shiv Dayal and A. K Jaitly

Microbiology Lab., Plant Science Department
M. J. P. Rohilkhand University
Bareilly, U. P.-243006

Keywords : *Thermophilic fungi, heavy metals, organic matter (X) pH in water analysis (Y)*

Water pollution is a major problem of the world, which can turn our precious earth into abyss; this waste water contains so many pollutants like inorganic and organic matter. This organic matter is used as nutrient by fungal sp. Thermophilic fungi was isolated by direct and dilution method. This waste water decreases the pH of water; population was increase with high organic matter per-cent, about neutral pH and low salinity. So we will try to explain such a problem mathematically exponential method, which will eliminate the pollution from earth.

214. Environmental Protection and the Role of Youth

Preeti Verma and Archana Verma

Department of Botany,
Government Autonomous Girls P. G. College of Excellence
Sagar (M.P)-470-003

Keywords : *Environment Protection, Youth, Awareness, Environment Education.*

The present paper focuses on the issue of the role of youth in environment protection. In the past decades, calls for environmental protection have emerged from different parts of society, from civic action groups to members of the community. The effective enforcement averts the possibility of these laws as merely ceremonial at the most and be treated as mere suggestions for those who appear to have encountered environmental dilemmas on their normal day-to-day functions. For the purposes of this paper, the foreign countries to be regarded will include many countries.

215. Physico-Chemical Analysis of Ground Water Quality of Chaibasa, West Singhbhum, Jharkhand, India, with special reference to Iron

****Nandjee Kumar, Vishnu Shankar Sinhaand***
and Arbind Prasad Pandit

P G Dept. of Botany, Tata College,
Chaibasa-833202
*P G Dept. of Chemistry, Tata College,
Chaibasa -833202
**Department of Botany,
Magadh University,
Bodh-Gaya-824234

Keywords : *Groundwater, Physico-chemical parameter, Water quality, Dissolved oxygen, Tropical region.*

The Area under study, Chaibasa is situated in the West Singhbhum of Jharkhand State (22°-25°15' N latitude and 83°-87°**35'** E longitude), which is characterised by gentle to moderately steep slopes. The study area lies in the tropical region with hot summer and cold winter with 1168 mm annual rainfall. The present study deals with physico-chemical parameter of groundwaters of five different area of Chaibasa town*i. e.* Tambo Chowk (S_1), Mahulsai (S_2), Post Office Chowk (S_3), AmlaTola (S_4) and Near Railway Station (S_5). The groundwater parameters such as temp. , pH, turbidity, electrical conductivity, alkalinity, dissolved oxygen, biochemical oxygen demand (BOD), total hardness, calcium, magnesium, phosphate, sulphate, nitrate and iron were estimated in the samples to evaluate their quality). The physico-chemical characteristics of the groundwater samples were determined by standard methods (APHA, 1989). The temperature, pH and EC were measured by using portable meters. The other parameters such as alkalinity, dissolved oxygen, biochemical oxygen demand, total hardness, calcium, magnesium, phosphate, sulphate, nitrate and iron were estimated by volumetric and spectrophotometer methods. Our result revealed that concentration of DO, BOD, Total hardness, Calcium are within permissible limits and alkalinity, phosphate are negligible in comparison to permissible limits whereas the concentration of iron is high near to upper permissible limits. Thus it is clear that the water quality is suitable for both drinking and irrigation process.

216. Productivity, Energetics and Nutrient Budget of Mustard Crop under Varying Weeding Conditions

S. N. Chakhaiyar

Ecology Lab. University Deptt. of Botany,
Magadh University,
Bodh-Gaya-824234

Keywords : *Weed, Crop, Competition*

Crop plants vary greatly in their ability to compete with the associated weeds. The nature of competition in crop plant ecosystem depends upon the competitive abilities of the species and varieties of crop and the nature of weeds with respect to the seasonal and annual cycles. Weeds growing together with crops compete for available moisture, nutrients, light, space and carbon dioxide, thus seriously affect the yield. "Competition as pointed out by Harper(1957a) between weed and crops may be very severe if it were not weeds would be little nuisance" The principles involved in competition, its nature and also its economic aspects have, therefore received considerable attention of scientists notably Harper(1961), Knake and Slife(1962), Nelson and Nyland(l962),Friesen(1978,79), Chakhaiyar(1981). The present study includes biomass, productivity, s" energetics and mineral status of Mustard and the weeds under three \ ecological treatments with special reference to *Chenopodium album* L. and *Cyperus rotundus*

217. Role of Women in Environmental Protection

Nidhi Patearia and Archna Verma

Department of Botany,
Govt. Auto. Girls P. G. College of Excellence,
Sagar (M.P)

Keywords : *Women, prakriti, shakti, environmental sciences.*

Women Symbolize 'Prakriti' means 'Nature' in Indian Philosophy. She creates and nurtures the creation to bloom. She signifies 'shakti' - the power that drives the system. True, that the status of Indian women has eroded significantly since the

vedic times. Nevertheless, 20th century saw reawakening and a steady upswing, which is largely attributable to spread of Education and social reforms. Given this backdrop the objective of the site is to bring into focus through observed and researched facts and figures how modern day women contribute to the process of enviroI1Illentallysound development. Conversely, it tries to map the impact of environmentalproblems of women. This site is not an advocacy forum for furtherance of Women's cause and their rights. Women's participation in the formulation, planning and execution of environmental policy continues to be low. At the same time, the international community has recognized that without women's full participation, sustainable development cannot be achieved.

218. LIBS of Black Mustard oilseed (*Brassica juncea*) for Heavy Metal Detection Irrigated with Industrial Effluents

Rahul Agrawal[2], G. K. Rai[2], A. K. Pathak[1] and A. K. Rai1*[1]

[1]Departments of Physics,
University of Allahabad,
Allahabad-211 002
[2]Centre of Food technology,
University of Allahabad,
Allahabad-211 002

Keywords : *LIBS, Black Mustard, Chromium, lead.*

In recent years, research has been focused on accumulation of heavy metals in food plants. Laser induced breakdown spectroscopy (LIBS) is a novel technique for on line monitoring of elements present in trace or higher amount in any type of material. LIBS technique has been applied for the analysis of Heavy metals present in the black mustard in view of the requirement of quality control of food as Good Agriculture Practices (GAP) and effects of industrial effluents on food plants. LIBS spectra of oil seed samples have been recorded in the spectral region range 200-500 nm. Several elements like calcium (Ca), magnesium (Mg), iron (Fe), titanium (Ti), sodium (Na), potassium (K), lead (Pb), chromium (Cr). In addition to this, spectral signature of lighter elements like carbon (C), hydrogen (H), nitrogen (N) and oxygen (O) are also detected in oilseed samples.

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VI

LIST OF PAST SECTIONAL PRESIDENTS

PAST SECTIONAL PRESIDENTS

Plant Sciences

Pramod Tandon	(2010)	K. S. Bilgrami	(1987)
S. M. Paul Khurana	(2009)	L. P. Mall	(1986)
S. V. S. Chauhan	(2008)	Syamapada Sen	(1985)
S. M. Reddy	(2007)	Deepesh N. De	(1984)
S. P. Vij	(2006)	M. S. Chennaveeraiah	(1983)
R. C. Rajak	(2005)	T. N. Khoshoo	(1982)
C. M. Govil	(2004)	V. R. Dnyansagar	(1981)
P. S. Bisen	(2003)	H. Y. Mohan Ram	(1980)
Botany		S. B. Saksena	(1979)
C. Manoharachary	(2002)	D. D. Pant	(1978)
G. N. Bhattacharya	(2001)	K. K. Nanda	(1977)
Uma Kant	(2000)	K. S. Thind	(1976)
S. K. Hasija	(1999)	C. V. Subramanian	(1975)
A. K. Koul	(1998)	R. N. Singh	(1974)
R. S. Mehrotra	(1997)	A. K. Sharma	(1973)
S. C. Pandeya	(1996)	R. P. Roy	(1972)
C. P. Malik	(1995)	B. M. Joshi	(1971)
Dalbir Singh	(1994)	V. Puri	(1970)
R. S. Dwivedi	(1993)	H. K. Baruah	(1969)
R. M. Pai	(1992)	P. N. Nandi	(1968)
G. P. Agarwal	(1991)	R. N. Tandon	(1967)
Y. D. Tiagi	(1990)	T. S. Mahabale	(1966)
R. P. Purkayastha	(1989)	Father H. Satapau	(1965-1964)
S. S. Bir	(1988)	S. M. Sircar	(1963)

J. Venkataswarlu (1962)
P. N. Mehra (1961)
S. K. Pande (1960)
R. Misra (1959)
T. S. Sadasivan (1958)
S. N. Das Gupta (1957)
M. Sayeeduddin (1956)
J. C. Sen Gupta (1955)
B. C. Kundu (1954)
R. K. Saksena (1953)
S. Ramanujam (1952)
B. B. Mundkur (1951)
P. Maheswari (1950)
M. S. Randhawa (1949)
K. A. Chaudhury (1948)
A. C. Joshi (1947)
B. P. Pal (1946)
G. P. Majumdar (1945)
T. S. Sabnis (1944)
K. Biswas (1943)
J. C. Sen Gupta (1942)
Shri Ranjan (1941)
Y. Bharadwaja (1940)
Krishnadas Bagchee (1939)
B. Sahni (1938)
M. G. Champion (1937)
S. R. Bose (1936)
J. M. Mitter (1935)
R. H. Dastur (1934)
S. L. Ghose (1933)
Haraprasad Chaudhuri (1932)
T. Ekambaram (1931)
P. Parija (1930)
K. C. Menta (1929)
M. P. Parthasarathy Iyengar (1928)
M. A. Sampath Kumaran (1927)
E. Blatter (1926)
R. S. Inamdar (1925)
S. P. Agharkar (1924)
W. Dudgeon (1922)
S. Milligan (1921)

Agriculture and Applied Botany

D. Clouston (1920)
G. F. Keatinge (1919)

Botany

W. Burns (1920)

Pure Botany

S. R. Kashyap (1919)

Botany

R. S. Hole (1918)
Rao Bahadur K. Ranga Achari (1917)
A. Howard (1916)
C. A. Barber (1915)
C. C. Calder (1914)