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Cover Page Illustration : *In planta* transformation of peanut, sunflower and safflower (see Rohini and Rao, pp 161-169 for details); SOD, POX and APX during development of tomato (see Ahn et al., pp 241-249 for details).

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Research Support for Developing Abiotic Stress Tolerant Transgenics

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Characterization of Viruses Attacking Cyanobacteria

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In Planta Strategy for Gene Transfer into Plants : Embryo Transformation

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Tissue culture-plant regeneration has been an indispensable and integral part of transgenic technology. Nevertheless, realization of whole plant transformants has been a problem in a large number of crop species as these plants have proven to be highly recalcitrant *in vitro*. Consequently, strategies are being evolved wherein the tissue culture component is eliminated in the procedure. These are mostly *in planta* methods. This review presents one such *in planta* method demonstrated to transform three important recalcitrant crops viz., sunflower, safflower and peanut. The method essentially involves infection of embryos (young seedlings) with *Agrobacterium* and allowing the seedling to grow into a mature plant. The T_0 and T_1 generation plants are later subjected to analysis for the presence of transgenes. This method is not only tissue culture-independent but also is genotype-independent and permits screening of a large number of transformants in a short span of time. Tissue culture-induced variations are also avoided. The utilization of the strategy reported may help future efforts in designing transformation procedures for other difficult-to-regenerate plant species.

Molecular Analysis of Somatic Embryogenesis : An Overview[H]

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Somatic embryogenesis (SE) was discovered in the 50's and it has viewed as a promissory tool for massive propagation of commercial crops and as a potential model to study cellular differentiation in plants. The first evidence of differential gene expression during SE came in the 80's and up to date a large number of genes, whose expression varies during the induction and development of somatic embryos, have been cloned and studied. The objective of the present review is to show a molecular analysis of somatic embryogenesis paying special attention to three fundamental stages : (i) the onset, where reported results suggest the existence of a signalization/reception process leading the somatic cell to a reprogramming toward a new embryogenetic program, (ii) the transition of embryos through the characteristic stages where organ are formed and the body plan is established and (iii) maturation where a large number of LEA and ABA-regulated genes have been cloned and studied. Finally, an analysis of other cloned genes, as those coding for heat shock proteins that can help to form a somatic embryo, is presented and some basic unexplored aspect of somatic embryogenesis are discussed.

Parallels Between Plants and Animals in the Production and Molecular Targets of Nitric Oxide

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Considerable evidence that nitric oxide (NO) and its derivatives play major roles in mammals has led to an interest in the actions of these molecules in plant metabolism. The ubiquitous distribution of nitric oxide synthases (NOS) in mammalian cells has stimulated the search for an equivalent enzyme in plants. NOS-like activity has been found in many plants and NO has been shown to influence various developmental processes and to have a role in plant defense responses against pathogens. Several of the major NO targets characterized in animals also have found similar actions in plants. These results indicate that NO is a fundamental signaling molecule for plant metabolism, as it is in animals.

Abiotic Stress Tolerant Transgenics in the Days of Genomics and Proteomics

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J. Watson and F.C. Crick gave the famous double helix model of DNA structure almost fifty years ago. The science of molecular biology has made tremendous progress ever since. Transgenic research is making ripples all over the globe since 1980s. 1990 onwards, genomics wave that aims at determining nucleotide sequence of all the genes in an organism, has swept the shores of molecular biology science. Now is the time to characterize how each and every gene functions through the burgeoning science of proteomics. Plant abiotic stress research has been greatly benefited by these developments. A large number of genes and proteins that mediate plant abiotic stress responses have been identified. However, it has also been felt that a vast network of control mechanisms mediates the stress responses and the unveiling of this complexity can alone give us complete understanding of the mechanisms of stress tolerance. While there are a large number of reports showing production of abiotic stress tolerant transgenics, none of the abiotic stress tolerant transgenic plants has come close to field-trials. Future lies in more basic discoveries so that laboratory-results can be subjected to field-evaluations. In this article, we discuss how the modern genomics and proteomics sciences can help in identifying genes important for tolerance to abiotic stresses.

Nitrogen-Sulfur Interactions in Plants

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Nitrogen and sulfur are the vital macronutrients required for plant growth and development. Sulfur requirement and metabolism are closely related to nitrogen nutrition and vice versa. N and S though present in fixed relative proportions in plant tissue, can serve as a guide to indicate S status of the plant. A positive interaction between both the nutrients results in higher yield, biomass and protein levels as reported in *Brassica* species. Sulfur deficiency depresses the activity of several enzymes. Sulfur, is an essential part of various cellular components such as amino acids, coenzymes and phytochelatins.

Soybean Cultivation : A Panacea for Soil Fertility and Sustainable Productivity

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Soybean (*Glycine max*. (L) Merrill is important oil seed crop of the world. Off late, its potential has been recognized in India too. However, the productivity of soybean in India is far below the world average. A number of factors like lack of R & D support for legume and oil seed crop, non-availability of region specific soybean varieties, and poor plant population in field, poor fertility of soil etc. has been identified for the poor yield of soybean. Following an integrated plant nutrition management (IPNM) strategy, comprising of application of organic carbon in the form of soil conditioner, bio-fertilizers and plant growth regulators, the productivity of soybean can be increased and sustained. The IPNM approach is cost effective and environment friendly also.

Changes in Phenylalanine Ammonia Lyase, Tyrosine Ammonia Lyase and Lipoxygenase Activities in the Leaves of *Brassica juncea* L. Infected with *Albugo candida*

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Activities of phenylalanine ammonia lyase, tyrosine ammonia lyase and lipoxygenase were assayed at different intervals of interaction between *Albugo candida* and leaf tissues of a susceptible (Varuna) and resistant (RH781 and RC781) cultivars of *Brassica juncea* L. Activities of phenylalanine ammonia lyase, tyrosine ammonia lyase and lipoxygenase increased in response to *Albugo candida* infection in all the cultivars; the increase in the activities was significantly higher in RH781 and RC781 compared to Varuna. The study shows the involvement of these enzymes in host resistant expression.

Changes in Antioxidant Enzyme Activities during Tomato Fruit Development

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Changes in activities of antioxidant enzymes such as superoxide dismutase (SOD), peroxidase (POX), and ascorbate peroxidase (APX) from cherry tomato fruit (*Lycopersicon esculentum* Mill. cv. Favorita) were determined during fruit development at the young, the intermediate, the mature green, the orange and the red stages. Activities of SOD and POX were the highest at the orange stage and were the lowest at the red stage. The enzyme activities were nearly similar at the initial stages of development from the young stage until mature green stage, increased rapidly at the orange stage, and decreased at the red stage. By contrast, APX activity was the highest at the red stage and was the lowest at the mature green stage. These results were also verified by Native PAGE and enzyme activity staining of the gels. Three isozymes of SOD were detected. The staining intensities of the two slow-migrating isozymes were nearly the same at all developmental stages. The third fast-migrating isozyme was present at the young, intermediate and mature green stages, but declined considerably at the orange and red stages. Peroxidase activity was localized in two isozymes, a major fast-migrating isozyme and a minor slow- migrating enzyme. The staining intensity of both these isozymes at all stages was nearly the same. APX was characterized by two isozymes, a minor, fast-migrating isozyme and a highly intense, slow-migrating enzyme. The staining intensity of the slow-migrating isozyme increased considerably during the orange and red stages, in parallel with the activity estimations. The maintenance of these enzyme activities during the ripening stages may potentially help in the detoxification of active oxygen species that are generated during catabolic activities and maintain the quality of fruit longer.

Protease Activity and Development in *Daucus carota* and *Trifolium repens* Hairy Roots in Culture Media Containing Different Nitrogen Sources and Levels

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Studies on roots genetically transformed by inoculation with *Agrobacterium rhizogenes* (hairy roots) are steadily increasing, but further investigations are needed about the establishment and metabolism of these roots in different culture media. To evaluate the development and metabolism of transgenic *Daucus carota* L. (carrot) and *Trifolium repens* L. (clover) roots, an experiment was carried out using four culture media, containing different nitrogen sources and levels, i.e., minimum medium (MM), MS medium, medium containing ammonium citrate, and medium containing urea. The media were poured onto Petri dishes and a 2.5 cm root fragment was added. Fresh root weight and content of free Amino-N, nitrate, ammonium and soluble sugar, and protease activity were determined. MM and MS (media containing inorganic N) were those which most favoured the growth and fresh weight of the two species of hairy roots. MS favoured the greatest accumulation of free amino-N, nitrate and ammonium in both roots. The media containing organic N sources induced a greater accumulation of soluble sugar and protein. The media containing N in the inorganic form of NO_3^- or associated with NH_4^+ presented better results for the propagation of these roots. However, the highest protease activity occurred in MS medium, which presented a larger amount of N, especially because of its elevated NH_4^+ content, a fact suggesting a possible situation of stress that may have been responsible for the lower root growth in this medium compared to MM. On the basis of the results observed, we conclude that the most appropriate medium for the culture of the carrot and clover hairy roots is MM, despite its lower N content compared to MS.

Enzymatic and Polypeptide Variation in *Polygonum* Species Grown at Different Altitudes in Garhwal Himalaya

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Polypeptides profile and enzymes viz. acid phosphatase and peroxidase were analyzed in three *Polygonum* species during six months acclimatization at three different altitudes in Garhwal Himalaya. Among the *species* studied, *P. amplexicaule* showed adaptability at all the three altitudes, which may be due to constant presence of many identical molecular weight polypeptides at different altitudes and acid phosphatase activity. However, peroxidase did not respond uniformly in respect to altitude in any specific species. All the species showed some positive changes to acclimatization at the altitude of Mastura (1700m). While, at Srinagar (550m), *P. macrophyllum* and *P. rumicifolium* does not respond adaptability beyond four and five months of growth respectively.

Seed Protein Profiles and Phylogenetic Relationships in the Genus *Lens*

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The genetic diversity and phylogenetic affinities among lentils were investigated by analysing seed protein profiles on SDS-gels in global accessions representing both wild and cultivated genotypes. Seed protein polymorphism being a conservative and species-specific trait, the relationships based on Jaccard's dissimilarity indices could grossly aggregate the lentil taxa into three major groups represented as (a) *L.c.* ssp. *culinaris* and *L.c.* ssp. *orientalis* (b) *L. nigricans* and *L. ervoides* and (c) *L. odemensis* in between the above two groups. The present study also supported *L.c.* ssp. *orientalis* as the probable progenitor of cultivated lentils.

Influence of Different Agroclimatic Zones on Algalization in Different Rice Cultivars in Twin State of Northern India i.e. Uttar Pradesh and Uttaranchal

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Field trials on blue green algae biofertilizers in Kharif paddy were conducted during 9 successive years in 9 agroclimatic zones of the Uttar Pradesh and Uttaranchal covering 41 rice cultivars. Out of 8503 field trials conducted, response of 3563 field trials could be obtained. The maximum increase in grain yield was obtained in North-East plain zone (3.74 q/ha) followed by Bhabhar and Tarai zone (3.45 q/ha), where annual rainfall is received maximum in the state (1300-1450 mm) during South West monsoon (July-September), while minimum increase in paddy yield was noted in South Western Semi-Arid zone where rainfall is minimum (620-750 mm). Likewise, both the agroclimatic zones (North East Plain and Bhabhar and Tarai), where maximum increase in yield was recorded, are of subhumid climate. Other agroclimatic zones, where climate is semi arid, showed less increase in yield due to BGA inoculation. Thus Bhabhar and Tarai and North East Plain zone were proven to be more suitable for BGA use. When the yield data of paddy with and without BGA were arranged variety wise, it showed that high yielding and scented varieties of Basmati were responded well in term of grain yield in the same fashion as far as replacement of chemical N is concerned. It may also be noted that a variety responded differently in different agroclimatic zone towards BGA inoculation. Maximum enhancement in grain yield was noted in variety Saryu-52 in Bhabhar and Tarai, Mid Western Plain and Vindhya zones, in variety Saket-4 in South Western Semi Arid, Bundelkhand and North East Plain zones, in variety Indrasan in the Central Plain zone and in variety Pant-4 in the Eastern Plain zone.

Rapid *in vitro* Propagation of *Rauvolfia tetraphylla* L. - An Endangered Medicinal Plant

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A rapid and efficient protocol for *in vitro* propagation of *Rauvolfia tetraphylla* L. - an endangered medicinal plant, through multiple shoot formation from nodal segments has been developed. Optimum multiple shoot formation was standardized on MS (Murashige and Skoog, 1962) medium supplemented with BA (10 µM) + NAA (0.5 µM) which showed the highest shoot regeneration frequency (80%) and number (13.5 ± 0.50) of shoots per nodal explant. The microshoots showed 100% rooting with 5-12 roots per shoot when transferred to plant growth regulator-free medium following 16 days initial incubation on a medium containing 150 µM indolebutyric acid. The rooted plantlets were successfully transferred to soil.