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Plant Posters

P-2000

C-terminally Encoded Peptides as Candidates for Abiotic Stress Response in Plants. SUMITA KUMARI[1], Jebi Sudan[1], Devyani Sharma[1], and Ananda Mustafiz[2]. [1]School of Biotechnology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, INDIA and [2]Faculty of Life Sciences and Biotechnology, Laboratory of Plant Molecular Biology, South Asian University, Akbar Bhawan, Chanakyapuri, New Delhi, INDIA. Email: sumitaslsjnu@gmail.com

Abiotic stressors lead to undesired morphological, physiological, biochemical and molecular changes. However, the sessile nature of plants allows them to swiftly recognize and respond to various adverse climatic conditions. This rapid response is primarily due to effective cell to cell communication through various intricate defense machineries that enable the plants to sense stress and relay the signal to downstream response regulators. Till a few decades back, phytohormones were considered the major players of cell to cell communication. However, following the discovery of first signaling peptide, systemin in tomato, there has been a paradigm shift in our understanding of the role of these peptides in signaling in plants. Genome wide approaches using the tools of bioinformatics, has led to identification of a multigene c-terminally encoded peptide (CEP) family in rice. Orthologues of CEPs were found in *Glycine max*, *Zea mays*, *Triticum aestivum* and *Sorghum bicolor*. Using publicly available microarray data analysis, these genes although low expressers were found to be differentially expressed exhibiting a genotype/genus as well as tissue specific expression. The expression data was revalidated under various abiotic stresses using qRT-PCR. These stress inducible CEP genes might be candidates for engineering hitherto elusive stress tolerance trait in plants.

P-2001

Overexpression of *AhCuZnSOD* and Pyramiding of *AhCuZnSOD* with the *AhcAPX* Gene Enhance Salinity and Dehydration Stress in *Brassica juncea*. NEELAM PRABHA NEGI[1], Vinay Sharma[2], and Neera Bhalla Sarin[1]. [1]School of Life Sciences, Jawaharlal Nehru University, New Delhi-110067, INDIA and [2]Department of Biotechnology, Banasthali University, Rajasthan, INDIA. Email:sapphirenegi@yahoo.com

Antioxidant enzymes play an important role in conferring abiotic stress tolerance. The antioxidant metabolism protects cells from oxidative damage caused by ROS, such as peroxidation of membrane compounds, polysaccharide degradation, enzyme denaturation and DNA lesions Several enzymes act jointly to maintain redox status homeostasis. The antioxidative defense is imitated by SOD, which converts superoxide radicals to H_2O_2. The H_2O_2 that is also potentially harmful is converted to non-toxic water and monodehydroascorbate by the APX enzyme utilizing ascorbate as the electron donor. In the present study, genes for two different cytosolic antioxidant enzymes, superoxide dismutase (*AhCuZnSOD*) and ascorbate peroxidase (*AhcAPX*) were isolated from salt tolerant cell lines of *Arachis hypogaea* and overexpressed the *AhCuZnSOD* gene alone or with *AhcAPX* gene in highly important oilseed crop, *Brassica juncea* (Indian Mustard). Both types of these transgenic plants stably expressed the foreign protein, and the enzyme activity was also higher. The enhanced levels of antioxidant enzymes in the transgenic plants correlated with higher relative water content, improved photosynthetic efficiency, less electrolyte damage, elevated accumulation of compatible osmolytes, less malondialdehyde as well as less lower level of ROS accumulation in the transgenic plants expressing *AhCuZnSOD* and *AhcAPX* as compared to the UC plants or *AhCuZnSOD* gene alone under stress conditions. Compared with UC plants, several independent *AhCuZnSOD* transgenic lines showed improved capability for tolerating exposure to high mannitol and NaCl concentration and were able to grow, flower, and set normal viable seeds under continuous salinity and drought stress conditions. Importantly, the double transgenic lines always showed a better response than either of the single gene-transformed lines and untransformed control plants under salinity and drought stress. The present study seems to suggest that, for combining drought and salinity tolerance together, co- transformation is a better approach.

P-2002

RNAi Knockdown of Potato Genes Crucial for Potato Virus Y Replication. WHITNEY HARCHENKO, Myron Bruce, and Jessica Rupp. Department of Plant Sciences and Plant

Pathology, Montana State University, Bozeman, MT. Email: whitney.harchenko@montana.edu

Potato virus Y (PVY) continues to cause potato producers enormous economic losses worldwide. PVY can cause significant damage in several species of Solanaceae, but the greatest economic impact is on potato (*Solanum tuberosum* L.), reducing crop yields from 10 to 75% and causing internal tuber defects. PVY is transmitted by many aphid species in a non-persistent manner and because of this, insecticides are considered an ineffective means of control. The difficulty of potato breeding, along with emerging PVY strains and recombinants has made breeding for PVY resistant cultivars problematic. PVY is a single-stranded positive sense RNA virus belonging to the family Potyviridae. A biotechnological approach could offer solutions to combating PVY in potato. In this study, two highly conserved host genes in potato, referred to as *Chloe* and *Thor* that have an essential role in potyviral replication have been targeted by RNA interference (RNAi). RNAi is a gene knockdown technology that is successfully being used as a method of viral control in many crops. Primers were specifically designed to amplify a fragment of the two different host genes. Gene fragments were independently cloned into the entry vector pENTR/D-TOPO (Invitrogen), then transferred into the Gateway-compatible binary vector pANDA35HK (Shimamoto Lab). This vector is used in *Agrobacterium*-mediated transformation to deliver a hairpin RNA containing the *Chloe* and *Thor* gene fragments into potato plants, thus triggering RNAi, and potentially resulting in PVY-resistant potato lines.

P-2003

A Lab-to-Land Approach for Conservation of Shirui Lily (*Lilium macklineae*) - An Endangered Heritage Flower of Manipur, India. M. R. SAHOO[2], M. P. Devi[1], M. Dasgupta[2], N. Prakash[1], and S. V. Ngachan[1]. [1]Plant Tissue Culture Laboratory, ICAR Research Complex for North Eastern Hill Region, Manipur Centre, Imphal-795004, Manipur, INDIA and [2]Present Address: University of Tennessee, Knoxville, TN 37996. Email: msahoo1@utk.edu

An efficient *in vitro* regeneration protocol was standardized for successful conservation of the rare endangered Shirui lily (*Lilium macklineae*). In the three stage culture system, shoot induction was obtained from the scales of the bulbs which is significantly higher (3.4±0.2) in the MS medium supplemented with BAP (0.5 mg/l) as compared to the other cytokine concentrations. After 3 weeks of culture, the shootlets were subcultured in the media containing different concentrations of BAP and GA_3. Of which, BAP (0.5 mg/l) + GA_3 (1.0 mg/l) registered higher multiple shoots (10.1±1.2) and pseudo-bulblet formation (7.7±0.8). Per cent root induction in the pseudo-bulblets was significantly higher in NAA 0.5 mg/l (88.2–93.5%). The plantlets were hardened off in the hydroponic cultures containing Hoagland's solution (1–1.5%). Attempt has also been taken to induce callus in the scale bulbs in 2,4-D (1–3 mg/lit) and derive plantlets through direct organogenesis and somatic embryogenesis. Genetic fidelity among the *in vitro* raised plantlets was assessed using random RAPD markers prior to transfer to the field. The plantlets with 4–6 leaves and 3–4 roots were successfully established at the place of origin in the peak of Shirui hill range at 2763 masl. We have also studied the soil micro-flora associated with the growth and development of this wonder Asiatic lily species grown in the particular place. The 16s ribosomal RNA study shows a plethora of microbes such as *Stenotrophomonas spp.* and *Pseudomonas spp.* have a unique synergy for the growth of Shirui lily in Shirui hills. The information would encourage to formulate an efficient *in vivo* growth medium for successful establishment across the agro-ecological conditions. This approach of *in vitro* and *ex-situ* conservation would be helpful to save this rare endangered species in the nature in a sustainable way.

P-2004

Plant Production Through Somatic Embryogenesis of *Theobroma cacao* L. Leaf Cultures. ESTHER E. UCHENDU, Omolola Oso, and Victor Adetimirin. University of Ibadan, Department of Agronomy, Ibadan, Oyo State, 20084, NIGERIA. Email: esteruchendu@yahoo.co.uk

Theobroma cacao L. is a crop of global economic importance. It is traditionally propagated by rooted cuttings and graftings but these methods are inefficient due to low propagation rates. A high percentage of cacao plants is derived from seeds which produces considerable yield variation, a consequence of the crop's heterozygousity. Clonal micropropagation protocols involving somatic embryos derived from floral parts has been developed but the process of somatic embryo production in cacao is complex and time consuming. Moreover, many genotypes are unable to induce somatic embryos and or convert to plants. In this study, an efficient protocol for plant production through leaf somatic embryogenesis was developed with 3 cacao cultivars (CRIN TC1, CRIN TC2 and CRIN TC5). The zygotic embryos of these cultivars were aseptically excised and cultured on Murashige and Skoog (MS) basal medium without growth regulators. Segments of young leaves were excised from 4-week-old seedlings and cultured abaxially on MS medium with 2, 4-D with or without sucrose for 4 weeks. Embryogenic callus was subcultured for 4 weeks. Somatic embryos were grown in growth regulator-free medium containing activated charcoal. All leaf segments of CRIN TC2 cultured on 0.002 or 0.005 mM 2, 4-D and 30 g/L sucrose produced embryogenic callus (100%). The most somatic embryos (235.5) were produced on leaf

segments of CRIN TC5 cultured on medium with 0.005 mM 2, 4- D and 30 g/L sucrose. Many leaf segments of CRIN TC1 did not produce embryogenic callus and somatic embryos. Generally, leaf segments on 30 g/L sucrose produced significantly more somatic embryos than the non-sucrose control. Somatic embryos formed within 18 to 28 days and converted to quality plants on medium with activated charcoal. This is the first report on the production of plants from leaf-derived somatic embryos of *T. cacao* indicating that leaves could be an important source for micropropagation of *T. cacao*.

P-2005

Improving Resistance to Potato Common Scab by the Production of Somaclones Habituated to Thaxtomin A. SAFA LABIDI and Nathalie Beaudoin. Department of Biology, University of Sherbrooke, QC J1K 2R1, CANADA. Email: safa.labidi@usherbrooke.ca

Potato (*Solanum tuberosum* L.) is the fourth most important food crop in the world and one of the most consumed vegetable in North America. It has a very high nutritional and economic importance, occupying the third row of horticultural products cultivated in the province of Quebec (Canada). Common scab is a disease that affects the surface of potato tubers, reducing their commercial value. This disease is caused by the actinobacteria *Streptomyces scabiei* whichproduce thaxtomin A (TA), a phytotoxin essential for the appearance of corky lesions that alter the esthetic quality of tubers. Currently, cultural and varietal approaches are the most efficient ways to control this disease, but there is no potato variety completely resistant to common scab. In our laboratory, we have developed a method to increase resistance to common scab in various potato varieties using TA-habituation of somatic cells. This method consists in producing calli from potato stem internodes, which are then transferred to medium containing increasing concentrations of TA. Somatic embryos are regenerated from TA-habituated calli and regenerants are tested for sensitivity to common scab. Using this method, we have obtained somaclones from Russet Burbank and Yukon Gold varieties that are more resistant to common scab. This technique is currently being validated in other potato varieties. To investigate how resistance to common scab is induced by TA-habituation, we have used a proteomic approach. We have found that several stress-related proteins (e.g., ferritin, stress-inducible TAS14) were more abundant in TA-habituated somaclones compared to the original variety. Further characterization of these somaclones should give us some information on the mechanisms of resistance to common scab.

P-2006

Establishment of Callus Cultures from Different Axenic Leaf Explant Types of Lentisk (*P. lentiscus* L.). Elif Demir[1], Ayşe Hoşer[1], Hilal Surmuş Aşan[2], Engin Tilkat[1], VEYSEL SÜZERER[3,4,5], Abdulselam Ertaş[6], and Ahmet Onay[2]. [1]Department of Biology, Batman University, Batman, TURKEY; [2]Department of Biology, Dicle University, Diyarbakır, TURKEY; [3]Department of Medical Services and Techniques, Bingöl University, Bingöl, TURKEY; [4]Department of Biology, Division of Botany, İstanbul University, İstanbul, TURKEY; [5]Department of Molecular Biology and Genetics, Gebze Technical University, Kocaeli, TURKEY; and [6]Department of Pharmacognosy, Dicle University, Diyarbakır, TURKEY. Email: beyso1985@gmail.com

Mastic gum, obtained from the mastic tree of family Anacardiaceae is well-known as a spice in the most Mediterranean countries, also used for medicinal purposes. Pharmacological studies reveal that it also contains bicyclic terpenoids, volatile oils, fatty acids, saponins, flavonoids. These metabolites have been used many medical therapies such as wound healing, liver protective, proapototic, antihypertensive and anticancer. The aim of this study is to establish an effective callus establishment protocol of *P. lentiscus* L. as a strategy to obtain an *in vitro* triterpene producing cell line because in vitro cultures represent a potential source for producing valuable chemical instead of using wild plants. Mature seeds of *P. lentiscus L.* plants were collected in November 2015 from the Çiftlikköy district around the Çeşme county of the İzmir province of western Turkey. Surface sterilized seed germinated in 1 mg/l IBA supplemented MS. *In vitro* germinated seeds origin axenic shoots buds and nodal buds have proliferated in 1 mg/l BAP+0.5 mg/l GA_3. The axenic leaves from in vitro proliferated cultures were used as explant for callus induction. Four types of leaf explants were tested for the establishment of granuler cultures: (1) Petiole leaf, (2) Petal-free leaf, (3) Petiole leaf cut from middle vein and (4) Petiole-free leaf cut from middle vein. The explants were cultured in MS medium supplemented with 1 mg/l 2,4-D+ 1 mg/l KIN supplement to test the effect of leaf explant type on callus development. As a result of the study, the highest callus formation rate (84%) was obtained by culture with petiole leaves. Callus formation rate of petiole-free leaves (80%) was lower. Petiole leaf type had *the highest fresh and dry weight*. No callus formation has been observed due to excessive phenolic secretion in both with petiole and petiole-free leaf cut from middle vein. This study provided an efficient way to further production of valuable triterpenoids, on scale-up for the establishment of callus cultures of lentisk.

P-2007

Effect of Plant Growth Regulators on Micropropagation of Commercially Important Pineapple Cultivars. VIRENDRA M. VERMA. Micronesia Plant Propagation Research Center, Kosrae Agricultural Experiment Station, Cooperative Research and Extension, College of Micronesia-FSM, Kosrae, MICRONESIA. Email: vmv_vmv@hotmail.com

The pineapple (*Ananas comosus* L. Merr) is a tropical plant with edible multiple fruit consisting of coalesced berries. It is one of the most economically significant plant in the Bromeliaceae family. A study was undertaken to develop an economically feasible, efficient, rapid and reproducible micropropagation protocol for two local commercially important pineapple cultivars namely *Ananas comosus* cv. Kosraean and *Ananas comosus* cv. Hawaiian by using apical and lateral meristems, respectively. Murashige and Skoog, 1962 medium (MS) was used throughout the study. The cultures were initiated on MS medium augmented with various combinations and concentrations of 6-benzylaminopurine (BAP) and 1-naphthaleneacetic acid (NAA). The medium augmented with 4.5μM BAP and 2μM NAA proved best for culture establishment. For further growth and subsequent multiplication, established cultures were transferred on MS medium augmented with 9μM BAP and 3.5μM NAA. The number of multiple shoots produced from each explant after two subcultures varied from 18 to 35; and after six subcultures increased tremendously to average 2,000 shoots per explant. A 16-h photoperiod with a temperature of 25°C day and night, light intensity of 80μmol m^{-2} s^{-1}, and 60% relative humidity were maintained throughout micropropagation. Many shoots formed roots in the same medium in which they were micropropagated. However, maximum rooting was observed on MS medium augmented with 0.5μM NAA and 0.5μM BAP. Plantlets were transferred to sterilized potting mix in 72-cell trays and acclimatized with 93% survival rate in 8 weeks. Fully acclimatized plants were planted in the field, and vigorous growth and excellent yield were recorded.

P-2008

In Vitro Propagation of *Bougainvillea glabra* Choise Variegate Variety by Somatic Embryos. C. M. RODRIGUEZ-SALAZAR and S. Evangelista-Lozano. Instituto Politécnico Nacional, Centro de Desarrollo de Productos Bióticos, Departamento de Biotecnología. Carretera Yautepec-Jojutla, Km. 6, Calle CEPROBI No. 8, Col. San Isidro, Yautepec, Morelos, C.P. 6273, MÉXICO. Email: crodriguezs1405@alumno.ipn.mx

Bougainvillea glabra Choise (buganvilia), onamental nyctaginaceae, propagation method is by cutting; this system present phytosanitary problem, adversely affecting production. The Variegate variety is considered of economic impact. There aren't reports of propagation by somatic embryos for this species, but through direct and indirect organogenesis. So, the present investigation has aim induction of somatic embryos of *B. glabra* variegate Variegated variety. In the first stage, callus was generated in semisolid medium MS at 100%, with plant growth regulators (PGR): auxins (ANA and 2,4-D) and cytokines (BAP), in different concentrations and combinations. The combination that most callus proliferation was obtained with: 2.0 mgL-1 BAP y 1.0 mgL-1 de ANA. In the next stage, it was established the suspension culture with friable callus that was obtained with the best treatment of the callous tissue induction. Was observed formation of embryos structures on shape of heart (7.27%) and torpedo (2.20%) at 30 days. Suspension culture of the embryonic structures was continued in MS with 4.0 mgL-1 of 2–4, D. In this system were possible seen, somatic embryos emergency structures.

P-2009

Micropropagation of *Miscanthus* x *giganteus* 'Illinois': Improved Regeneration Capacity of Callus Cultures and Optimized Microrhizome Development of in Vitro Plantlets. CASSANDRA DOLL DOWNEY and Andrew Maxwell Phineas Jones. Gosling Research Institute for Plant Preservation, Department of Plant Agriculture, University of Guelph, Guelph, ON, CANADA. Email: cdowney@uoguelph.ca, amjones@uoguelph.ca

Miscanthus x giganteus exhibits favorable characteristics for cultivation as an advanced biofuel feedstock; however, because of its innate sterility, it must be propagated using vegetative means. Previous studies have successfully cultured Miscanthus calli on modified Murashige and Skoog (MS) mediums, though regeneration of shoots have been hindered after four months of culture. This has resulted in insufficient conservation of germplasm and an unreliable propagation system. In addition to this, induction of microrhizomes for propagule development have not been previously investigated in this species. The current study aimed to improve regeneration capacity of calli cultured for longer than four months by inhibiting the first step of the phenylpropanoid biosynthetic pathway with 2-aminoindan-2-phosphonic acid (AIP) supplemented in modified MS mediums, and optimize microrhizome development of *in vitro* plantlets using various concentrations of sucrose, benzylaminopurine (BAP), and naphthaleneacetic acid (NAA). We identified that calli cultured on MS media supplemented with 2.5 mg l^{-1} 2,4-dichlorophenoxyacetic acid (2,4-D) and 10 μM AIP exhibited higher frequencies of shoot regeneration (71.59±5.7%) than

the control lacking AIP (26.67±5.7%) up to nine months of culture. AIP effectiveness was determined by measuring soluble phenolic content of calli with a modified Folin-Ciocalteu colorimetric assay. Significant differences were only observed in mediums with 2.0 mg l^{-1} 2,4-D, with the lowest concentrations detected in mediums with 100 and 1000 μM AIP (1310.84 and 1365.45±0.7071 ug g^{-1} DW, respectively). Microrhizome induction of tillered plantlets was tested with liquid MS medium supplemented with sucrose (3, 8, and 10%) with or without BAP (2.5 and 26.5 μM) and NAA (0.6 and 50 μM). Microrhizomes from the optimal medium were then tested for cold storage and growth in greenhouse and *in vitro* conditions. Findings from this study will help in establishing effective conservation of germplasm and alternative propagation systems.

P-2010

Red and White *PAP1*-controlled Arabidopsis Cells Are Dependent Upon *TT8*. YUE ZHU and De-Yu Xie. Department of Plant and Microbial Biology, North Carolina State University, Raleigh, NC 27695. Email: yzhu31@ncsu.edu, dxie@ncsu.edu

Production of Anthocyanin Pigment 1 (PAP1) is a master regulator of anthocyanin biosynthesis in *Arabidopsis thaliana*. Ectopic expression of *PAP1* in different plants lead to high production of anthocyanin. *pap1-D* Arabidopsis plants highly accumulate anthocyanin in most of tissues. Here, we report that cell engineering from *pap1-D* leaves generate different phenotypic cells from deep reddish color with a high production of anthocyanins to white color without anthocyanins although the expression of *PAP1* is highly activated in all cell types. This result indicates that PAP1-based on regulation of anthocyanin biosynthesis is controlled by cell types. Transcriptional analysis have showed that white cells lack the transcript of *TT8*, which encodes a basic helix loop helix transcription factor, suggesting that anthocyanin biosynthesis cell types under the activation of PAP1 is controlled by TT8. In this presentation, we will discuss mechanisms by which the transcript of TT8 is controlled in different types of cells.

P-2011

Suspension Culture of Programmed Red vs. Wild-type Cells of Tobacco. SEYIT YUZUAK and De-Yu Xie. Department of Plant and Microbial Biology, North Carolina State University, Raleigh, NC 27695. Email: syuzuak@ncsu.edu

PAP1 is an R2R3-MYB transcription factor forming a master activator of anthocyanin biosynthesis in Arabidopsis. Homozygous red tobacco plants with high production of anthocyanin were programmed by overexpression of *PAP1*. In this study, we developed suspension cultures of red vs. wild-type cells to understand differentiation of cells in proteins and other aspects. Our preliminary data showed differential profiles of enzymatic proteins from two suspension cell types. In our presentation, we will discuss application of this type of metabolism-based programming of cells for targeted proteins.

P-2012

Generation of Chemically Induced Mutations Using Embryogenic Coffee Cell Suspensions and In Vitro Selection for Salt Tolerance. ANDRÉS M GATICA-ARIAS, Alejandro Bolivar-González, and Marta F. Valdez-Melara. Laboratorio Biotecnología de Plantas, Escuela de Biología, Universidad de Costa Rica, 2060 San Pedro, COSTA RICA. Email: andres.gatica@ucr.ac.cr

Coffee represents the most important non-alcoholic beverage in the world economy. Crop improvement via mutagenesis is a powerful tool that adapts fairly well to the needs of a lot of coffee breeding programs. Mutagenesis can induce variability in genetically homogenous populations. The objective of the present study was to induce mutation for salt tolerance using sodium azide and ethylmethanesulphonate (EMS) in embryogenic cell suspensions of coffee (*Coffea arabica* L. var. Catuaí), followed by cell line selection and subsequent plant regeneration. Determination of the optimal growth conditions for culture of embryogenic calli in liquid medium was the first step, three culture media were evaluated (CP;van Boxtel & Berthouly, 1996), Teixeira *et al.*, 2004 and Silva *et al.*, 2000). It was determined that culture in flask with Teixeira liquid medium promoted the fastest calli proliferation and that the embryogenic regeneration was successfully achieves by culturing the calli in RITA ® systems with regeneration medium (van Boxtel & Berthouly, 1996). The medium lethal doses (LD_{50}) were determined for NaN_3 (5mM for 15 minutes) and for EMS (185.24 mM for 120 minutes). These doses were implemented in an *in vitro* selection protocol to determine the NaCl concentration that facilitated the identification of putative mutant cell lines. The NaCl concentration ended up being 150 mM. Finally, genetic variability was assessed and evaluated with RAPD markers; 50 bands were amplified and 22% of those bands were polymorphic. To our knowledge, this is the first report of in vitro selection of salt tolerant variants following sodium azide and EMS treatment of embryogenic coffee cell suspensions. Our results indicate that embryogenic suspension cultures are suitable for sodium azide and EMS mutagenesis and provide the basis for the improvement of agriculturally important traits and to study gene function in coffee.

P-2013

In Vitro Morphogenetic Capacity of Persimmon Microshoots. VALENTINA BRAILKO, Natalya Ivanova, and Irina Mitrofanova. Department of Plant Developmental Biology, Biotechnology and Biosafety, FSBSI "The Order of the Red Banner Nikita Botanical Gardens - National Scientific Center RAS", Yalta, 298648, RUSSIAN FEDERATION. Email: invitro_plant@mail.ru

Persimmon is a Mediterranean fruit reached polyphenol substances and vitamins, carotenoids, leucoanthocyanins and organic compounds of potassium, calcium, iron and iodine. Hitherto the plant regeneration *in vitro* method has not been developed for most persimmon cultivars. The aim of our studies was to identify morphological and anatomical parameters of microshoots in the persimmon cultivars Zolotistaya and Nikitskaya Bordovaya, bred in Nikita Botanical Gardens, at the phase of regeneration under various *in vitro* culture conditions. Isolated sterilized vegetative buds were cultured on MS medium supplemented with 4.0–5.0 mg/l BAP and 0.1–0.3 mg/l IBA. After 4 weeks of the culture rosette of 2–4 leaves formed and in 6–8 weeks 1–2 microshoot/explant were obtained in the cultivar Zolotistaya and 2–3 microshoot/explant – in cultivar Nikitskaya Bordovaya. For active regeneration microshoots and microcuttings were transferred to MS medium supplemented with 0.8–1.0 mg/l zeatin or BAP. Adventitious microshoots formed at the base of explant. We obtained 6–8 microshoot/explant in the cultivar Zolotistaya and 6–7 microshoot/explant in Nikitskaya Bordovaya. In the early stages of the culture (2 months) microshoot leaves were amphystomatic (average size of 1.1 × 0.6 cm) with typical oval-lanceolate shape. Leaf blade thickness was 162 ± 13 mm ('Nikitskaya Bordovaya') and 183 ± 16 mm ('Zolotistaya'). Leaf mesophyll was not differentiated. Vascular bundles were fully developed. The epidermis was covered with simple 1–2-celled hairs (167–303 μm length). Microshoot leaves in the studied cultivars were characterized by the formation of differentiated chlorenchyma with one row of palisade tissue (28–37 μm) and 3–4 rows of spongy tissue (60–73 μm) during 14 months culture. Stomatal apparatus was of anomocytic type, located on the abaxial surface of a leaf (80–106 stoma/mm^2). This study was funded by research grant N 14–50-00079 of the Russian Science Foundation.

P-2014

Antimicrobial Compounds from Callus Cultures of *Capparis cartilaginea* from Oman. SARDAR FAROOQ and Basma Al-Amri. Department of Biology, College of Science, PO Box 36, Sultan Qaboos University, Muscat, Oman, Al Khoud PC123, OMAN. Email: sfarook@squ.edu.om

Antibiotic resistance is posing ever-increasing therapeutic problems that lead to efforts to discover new antibacterial compounds from plants. Over enthusiastic Pharmaceutical industry heavily depend on the natural populations of medicinal plants without proper conservation practices has resulted in the destruction of their habitats, making many species endangered. The modern biotechnological approaches of tissue culture, conservation and invitro production of secondary metabolites is promising. Many medicinal plants are facing threat of extinction and loss of genetic diversity including *Capparis cartilaginea* which belongs to the family Capparaceae. It is a perennial species found on the coasts of North and East Africa, the Middle East and Southwest Asia. In folklore medicine the decoction of root bark is used to treat disorders of liver and spleen as anti-inflammatory agent; as anthelmintic; and in the treatments of dropsy, anemia; as diuretic and analgesic in gout and rheumatoid arthritis. The plant is also used as an insecticide to control mosquito larvae. The fruits of *Capparis cartilaginea* are dried and pickled to produce capers for consumption. The objectives of present study include development of an efficient protocol for in vitro mass propagation of *C. cartilaginea* and isolation and characterization of the secondary metabolites from the invitro tissues and regenerated plants; and to evaluate antimicrobial activity using six pathogenic bacteria using the well diffusion method. Alkaloids, Terpenes, Phenols, Flavonoids and fatty acids were isolated from the ethanolic extract. This plant has glucosinolate compounds viz., glucoiberin, glucocapparin, sinigrin, glucocleomin, glucobrassicin and glucocapangulin. These compounds have been tested for the antimicrobial activity on human pathogenic bacteria and the minimum inhibitory concentration (MIC) was determined. The extract has strong ant-oxidant and free radical scavenging activity. Depletion of nutrients and temperature stress invitro enhanced the secondary metabolite production.

P-2015

Cryopreservation of Three Different *Mentha* × *piperita* L. Cultivars Via Droplet Vitrification Technique. SERDAR ISIK and Ergun Kaya. Mugla Sitki Kocman University, Faculty of Science, Molecular Biology and Genetics Department, 48000, Kotekli/Mugla, TURKEY. Email: serdarisik2@posta.mu.edu.tr, ergunkaya@mu.edu.tr

Mentha × *piperita* L. (peppermint), is a hybrid mint, a cross between watermint and spearmint. Peppermint has a high menthol content and their oil also contains menthone and carboxyl esters, particularly menthyl acetate. The plant is a popular herb that can be used in numerous forms (ie, oil, leaf, leaf extract, and leaf water) and peppermint oil has the most uses for cosmeceuticals, personal hygiene products, foods, and pharmaceutical products. The present study focused on long

term conservation of three cultivar peppermint (cv. "Candarli", "Gomec", "G-74") meristems via droplet-vitrification which is one-step freezing and PVS2-based technique. The meristems (cold-hardened and sucrose precultured) were placed into 3 μl PVS2 drops on sterile aluminum foil strips (~ 5 x 15 mm) placed in an open Petri dish, resting on a frozen cooling element (~ 0°C) and the shoot tips were treated with the solution for 30, 45, 60, 75, 90 min. After PVS2 treatment, the aluminum foils were transferred into chilled 2 ml-capacity cryovials (one aluminum foil per cryovial) and directly plunged into liquid nitrogen (LN). Thawing was performed at room temperature by removing the aluminum foils from the cryovials and immersing them in washing solution. When the explants were totally defrosted, they were transferred to MS medium supplemented with 1 mgL^{-1} 6-Benzylaminopurine (BAP) and 3 gL^{-1} charcoal (regeneration medium) and incubated at standard culture conditions maintained at 23 ± 2°C, 16 h photoperiod (50 μmol $m^{-2}s^{-1}$) for recovery. A group of samples, treated with PVS2 but not frozen in LN (control group, LN-), was washed accordingly and plated on medium for recovery. Five PVS2 exposure times (described above) were tested. The results showed high post cryopreservation survival and regeneration for peppermint meristems evaluated. The best PVS2 exposure time for cryopreservation of peppermint cv. "Candarli", cv. "Gomec" and cv. "G-74" was the best regeneration 72.7 (60 min PVS2 treatment), 44.4 (75 min PVS2 treatment) and 62.5 (30 min PVS2 treatment) rates repectively for the majority of the meristems. The droplet vitrification technique was highly efficient in cryopreserving explants of different plant species, and was also less laborious than techniques previously reported. Seedlings derived from cryopreserved meristems had well-formed shoots and roots and were easily acclimated to greenhouse conditions.

P-2016

Exploring the Role of Multiple Glyoxalase Genes in Plants. ANANDA MUSTAFIZ[1], Muskan Jain[1], Rituraj Batth[1], and Sumita Kumari[2]. [1]Faculty of Life Sciences and Biotechnology, South Asian University, Akbar Bhawan, Chanakyapuri, New Delhi 110021, INDIA and [2]School of Biotechnology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu 180009, INDIA. Email: amustafiz@sau.ac.in

Methylglyoxal (MG), a cytotoxic by product of glycolysis is ubiquitously found in all organisms. Endogenous MG concentration in the plant system is induced by abiotic stress and deleteriously affect the system. The glyoxalase pathway is the major pathway for detoxification of methylglyoxal (MG). The first important enzyme of this system is Glyoxalase I (GLYI). In the present study, it has been reported that three active GLYI enzymes (AtGLYI.2, AtGLYI.3 and AtGLYI.6) belonging to different metal activation classes coexisting in *Arabidopsis thaliana*. These enzymes have efficiently complemented the *GLYI* yeast mutants and heterologous expression of these enzymes in *E. coli* led to differential tolerance against various abiotic stress conditions. These three enzymes have been characterized biochemically and their role in conferring tolerance to multiple abiotic stresses in *E. coli* and yeast. AtGLYI.2 was found to be Zn^{2+} dependent whereas AtGLYI.3 and AtGLYI.6 were Ni^{2+} dependent. Enzyme activity of Zn^{2+} dependent enzyme, AtGLYI.2, was found to be highest among so far reported GLYI enzymes from any other plant system. The activity of these GLYI enzymes correlated well to their role in stress tolerance. This report adds a new dimension in the Glyoxalase studies in plants; it shows higher eukaryotic species like plants having multiple active GLYI enzymes belonging to different metal activation classes. Also it sheds light to the fact that different GLYI might play different role in various abiotic stress tolerances.

P-2017

Fertilization, Drying and Obtaining of Steviosides in *Stevia rebaudiana* Bertoni. TOMAS RODRIGUEZ-GARCIA and Silvia Evangelista. Center of Development of Products Biotic of the Instituto Politécnico Nacional. Department of Biotechnology. Laboratory of Plant Cell Culture. Road Yautepec-Jojutla, Km.6, street Ceprobi No. 8. Col. San Isidro, Yautepec, Morelos, MEXICO. Email: trodriguezg1300@alumno.ipn.mx

Stevia rebaudiana is a plant native of Paraguay and is known as Ka'a he'e, which means "sweet herb". Its leaves have an intense sweet flavor, attributed to content of nine glycosides presents. The production of steviosides in the plant, like other metabolites, can be influenced by propagations conditions and the crop management. The aim of the present study was to analyze the fertilization effect on development of plants of *S. rebaudiana* and the conditions drying over steviosides production. Stevia propagation was carried out through cuttings under greenhouse conditions, plants were treated with different concentrations of the universal nutrient solutions of Steiner (control 0, 25, 50, 75 and 100%). The results showed that treatment with 50% solution Steiner was favoring the highest values of stem diameter, leaf area and intermodal distance. The data from three crops foliage *S. rebaudiana* plants irrigated with nutrient solution universal Steiner 50%, generated 6 times more weight gain, which leaves irrigated with water (control). However, the stevioside content in the leaves decreased when the plant were irrigation with universal Steiner nutrient solution. Also, two methods to dry the leaves of *S. rebaudiana* (solar greenhouse dryer and dryer) were compared. The results of the drying kinetics indicated that

the greenhouse dryer was faster than the solar dryer, due to the higher temperature reached.

P-2018

Phytochemical Screening of the Ethanol Extracts from Different Parts of Lentisk (*Pistacia lentiscus* L.) by LC-MS/MS. Mustafa Abdullah Yılmaz[1], Engin Tilkat[2], Abdulselam Ertaş[3], Hilal Surmuş Aşan[4], VEYSEL SÜZERER[5,6,7], Serkan Yiğitkan[8], and Ahmet Onay[4]. [1]Department of Pharmaceutical Chemistry, Dicle University, Diyarbakır, TURKEY; [2]Department of Biology, Batman University, Batman, TURKEY; [3]Department of Pharmacognosy, Dicle University, Diyarbakır, TURKEY; [4]Department of Biology, Dicle University, Diyarbakır, TURKEY; [5]Department of Medical Services and Techniques, Bingöl University, Bingöl, Turkey; [6]Department of Biology, Division of Botany, İstanbul University, İstanbul, TURKEY; [7]Department of Molecular Biology and Genetics, Gebze Technical University, Kocaeli, TURKEY; and [8]Department of Pharmaceutical Botany, Dicle University, Diyarbakır, TURKEY. Email: beyso1985@gmail.com

Through the consumption of edible plants, various phenolic acids take part in the protection of human body from oxidative damage diseases like coronary heart disease, cancer, stroke, inflammation and cardiovascular diseases. There has been an increasing interest on phenolic compounds due to their mentioned properties. Not only the researchers but also the food manufacturers give importance to phenolic compounds owing to their strong antioxidant properties, ampleness in the human diet, and their probable role in the prevention of various diseases associated with oxidative stress. Therefore, the interest to the natural antioxidants sourced from fruits, vegetables, spices and other plants has been increased. In the present study, the phytochemical composition of the ethanol extracts of different parts of lentisk were determined qualitatively and quantitatively by using LC-MS/MS. The phytochemical analysis of the ethanol extracts of the studied samples (root, stem and section of seed) was performed by LC-MS/MS. Generally speaking, the studied extracts were poor in terms flavonoids compared to phenolic acids. Gallic, quinic, protocatechuic, fumaric and malic acids were the main components in all of the samples. However, according to LC-MS/MS results, the content of some phenolic acids in vitro samples has not changed or even increased. In particular, gallic acid content didn't show a significant change in the stem sections of the in-vitro samples. On the other hand, fumaric acid amounts were remarkably increased in all parts. Likewise, *in vitro* samples showed an increase in malic acid content, while their quinic and protocatechuic acid contents were decreased.

P-2019

Expression of *uidA* in *Lilium longiflorum*, the Easter Lily, Under Control of Either the Rice *RPC1*, *rolD*, *mas2*, or CaMV 35S Promoter. KATHRYN KAMO[1], Roger Thilmony[2], and Gary Bauchan[3]. [1]Floral & Nursery Plants Research Unit, Beltsville, MD; [2]Crop Improvement and Genetics Research, Albany, CA; and [3]Electron and Microscopy Unit, Beltsville, MD. Email: Kathryn.Kamo@ars.usda.gov

Lilies are an important floral crop throughout the world ranking third as a cut flower at the Flora Holland Auction with a wholesale value of 159 million Euros. They are grown in gardens and sold as a pot plant or cut flower. A major problem when growing lilies in the field is infection by *Pratylenchus penetrans*, the root lesion nematode. *P. penetrans* is a migratory nematode that penetrates the root and then moves throughout its cortex to feed. A root-specific promoter would be useful for transgene expression of nematode resistance genes. In this study the *bar-uidA* fusion gene was placed under control of either the *rolD*, *mas2*, rice *RPC1*, or CaMV 35S promoters, and gene constructs were used to transform *Lilium longiflorum*. GUS was expressed throughout the cortex and stele of roots containing the *rolD*, *mas2*, and CaMV 35S promoters and limited to the stele with the *RPC1* promoter. Levels of GUS expression were relatively low in young leaves with the *rolD* and *mas2* promoters as compared to the CaMV 35S promoter. Levels of GUS expression were comparable in roots with the *mas2* and CaMV 35S promoters. These results showed that the mas2 promoter may be useful when expressing a gene for *P. penetrans* resistance in roots of lily.

P-2020

Compartmentalized Overexpression of a Synthetic Geranyl Pyrophosphate Synthase and Its Regulation on Plant Growth and Metabolism. GUI LI, Xiaoming Ji, Sarah Swantko, and De-Yu Xie. Department of Plant and Microbial Biology, North Carolina State University, Raleigh, NC 27695. Email: gli11@ncsu.edu

Geranyl pyrophosphate (diphosphate) synthase (GPPS or GDPS) controls the bottle step toward biosynthesis of steroids, cholesterol, chlorophyll, and most of terpenoids. In this study, a synthetic homodimeric GPPS consisting of fragments from both an insect and Arabidopsis was overexpressed in the cytosol and plastids in different genotypes of tobacco plants. Our preliminary results showed that the compartmentalized overexpression of the synthetic *GPPS* differentially altered plant biomass and metabolism. Alterations of plant biomass include changes of plant growth rate and leaf sizes. Plant metabolisms regulated by the overexpression of the synthetic

GPPS were mainly characterized in terpenoids. In this presentation, we will discuss significance of a synthetic approach for metabolic engineering of plants for value-added traits in plants.

P-2021

Detection of Glucosinolates in *Moringa oleifera* Lam. NATIVIDAD NAVA-GUTIERREZ[1], Silvia Evangelista[1], Brenda H Camacho[1], Martha L Arenas[1], and Patricia Guevara[2]. [1]Department of Biotechnology. Center for the Development of Biotic Products, National Polytechnic Institute, Yautepec Morelos, MEXICO and [2]Laboratorio de Fitoquímica, Universidad Nacional Autónoma de México (UNAM), MEXICO. Email: natynava23@hotmail.com

The *Moringa oleifera* Lam a native tree from India, has a great content of phytocomposites relevant to human health, among them the glucosinolatos whose has hypoglycaemic properties atributed to caracteristic chemical structure. The glucosinolatos is an aliphatic, aromatic and indolic moleule and depends on its biosynthetic precursor. N-Benzyl thiocarbamate and 4 (alpha-L-rhamnopyranosyloxy) benzyl glucosinolate. Therefore the objective of this work was the extraction of glucosinolatos from different organs of the Moringa. (Mature and tender leaves, open and closed flower, seeds and seedlings), with different solvents, aqueous, ethanolic and methanolic and before their identification using high performance thin film chromatography (HPTLC) and Densitometry. The best solvent for the extraction of glucosinolates was methanolic followed by aqueous, the mobile phase with better separation of compounds was: n-butanol-n-propanol-acetic acid-water 17: 6: 6: 11 and the better UV visualization of glucosinolates was used a wavelength of 254 nm and the best volume of extract applied on silica gel plates 60F254 aluminum was 10 μL. As a result, the highest concentration of the fractions per area under the tender leaf curve of 258 861.24, followed by open flower 199 205.50, mature leaf 182 755.60, closed flower 171 474.90, in seedlings 119 394.40 and finally seeds 23 788.90. An analysis of the Moringa phytocomposites in their different organs and phenological stages allows their integral use, provided information about secondary metabolites with hypoglycemic activity for the control of Type II Diabetes mellitus, giving opportunity to a wide range of compounds with Different uses and applications.

P-2022

Application of Chemical Mutagenesis to Increase the Resistance of Coffee (*Coffea arabica* L.) to Leaf Rust (*Hemileia vastatrix*). ANDRÉS M GATICA-ARIAS[1], Cesar Vargas-Segura[1], Karla Sánchez-Aguilar[2], Ana Tapia-Fernández[2], Emmanuel Araya[3], and Marta F. Valdez-Melara[1]. [1]Laboratorio Biotecnología de Plantas, Escuela de Biología, Universidad de Costa Rica, 2060 San Pedro, COSTA RICA; [2]Laboratorio de Investigación en Fitopatología, Universidad de Costa Rica, Sede del Atlántico, COSTA RICA; and [3]Centro Nacional de Innovaciones Biotecnológicas (CENIBiot), COSTA RICA. Email: andres.gatica@ucr.ac.cr

Leaf rust, a disease caused by the fungus *Hemileia vastatrix*, is one of pest that causes most damage and economic impact in coffee. The rust fungus has affected 49% of the cultivated area of coffee in Central America and has forced the pruning of 28% of the coffee plantations in the region, despite the measures taken in each country to prevent this disease. In this sense, in order to generate genetic variability associated with characters for coffee rust resistance, coffee seeds (*Coffea arabica* cv. Catuaí) were treated by 8h with a solution of sodium azide (0, 50, 75, 100 and 125 mM) and ethyl methane sulfonate (EMS) (0, 1, 2, 3, 4 and 5% *v*/v). As the concentration of applied sodium azide and EMS increased, the germination, seedling height and root length decreased. The LD_{50} values for sodium azide and EMS were between 50–75 mM and 2–3% *v*/v, respectively.
Leaves of one, two, three, four, five and six months old plants of the susceptible cultivars Caturra and Catuaí and the resistant cultivar CR-95 were inoculated with uredospores of *H tastatrix* usingacamel hairbrush. The inoculated plants were placed in the greenhouse at 22°C for 48 h in darkness and later were transferred at 26°C with a 12-h photoperiod. Preliminary results, demonstrated that Caturra is more susceptible than Catuaí; whereas CR-95 did not any symptom of the disease. Subsequently, the resistant lines will be selected by inoculating the plants under greenhouse conditions with the uredosporesof *H. vastatrix*. Finally, the induction of genetic variability in coffee seeds in response to the different sodium azide and EMS treatments was determined by AFLP analysis. The amplification of six AFLP primer combinations using a pool of plants obtained after mutagenic treatment with sodium azide allowed the identification of four polymorphism. Coffee breeding programs could use mutagenesis combined with screening methods and molecular markers as an additional tool to induce novel traits and produce new and improved coffee cultivars.

P-2023

Enhancement of Shelf Life of Nectarines (*Prunus persica* [L.] Batsch var. *fantasia*) Using Hexanal. SHANTHANU KRISHNA KUMAR[1], Gopinadhan Paliyath[2], J. Alan

Sullivan[2], and Jayasankar Subramanian[1]. [1]University of Guelph, Department of Plant Agriculture, Vineland, ON, L0R 1E0, CANADA and [2]University of Guelph, Department of Plant Agriculture, 50 Stone Road E, Guelph, ON, N1G2W1 CANADA. Email: shanthan@uoguelph.ca

Post-harvest technologies play a key role in enhancing shelf life of tender fruits such as nectarines (*Prunus persica* [L.] Batsch). Limited success with existing technologies under cold storage conditions necessitates the development of alternative strategies without compromising quality characteristics. This research investigates the effectiveness of hexanal in enhancing the shelf life of nectarines. Hexanal is a naturally occurring C6 aldehyde known to inhibit phospholipase D (PLD), which is responsible for initiating membrane degradation and softening of fruits. Pre-harvest 2% (*v*/v) EFF (Enhanced Freshness Formulation, containing hexanal as the key ingredient) was sprayed 20 and 10d pre-harvest on field grown 'Fantasia' nectarines at two orchards in the Niagara region. EFF treated fruits maintained a significantly higher firmness over the storage period of 45 days at 2°C. The EFF treated fruits also delayed the onset of mealiness and internal browning by 8 days and reduced their incidence by almost 50% even at 45 days after harvest. The volatile profiles performed using a GC/MS system followed similar trends with the EFF treated fruits showing delayed ripening. There were no significant differences in other fruit quality parameters such as soluble solids, titratable acidity and antioxidant potential. Gene expression studies will be conducted to understand the regulatory mechanisms of hexanal. These results indicate that hexanal can be used to enhance shelf life of nectarines to benefit both growers and consumers. The major reduction in post-harvest losses amounts to 10–20%, thus contributing to improved food and nutritional security.

P-2024

Role of the Antioxidant Enzymatic System in the Response of *Paulownia tomentosa*explants to Salt Stress During the *In Vitro* Multiplication Stage. A. PIQUERAS, Giuliano Sting Pechar, José Antonio Hernández, and Pedro Díaz-Vivancos. CEBAS-CSIC, Department of Plant Breeding. Murcia 30100, SPAIN. Email: piqueras@cebas.csic.es

Paulownia tomentosa is an important fast-growing and multiuse tree that is native from China. The potential of *P. tomentosa* as a plantation tree is currently being evaluated in Murcia, a semiarid region from SE Spain. Osmotic stress and ion toxicity- both stressful components induced by salinity- are able to unbalance the redox state of plant tissues inducing oxidative stress. The antioxidant response of paulownia to salinity has not been so far studied from a physiological and biochemical perspective. Salt treatments affected significantly the growth of micropropagated paulownia shoots in a direct relation to the level of salinity tested (0, 50 and 100 mM NaCl). A progressive decrease in fresh weight, shoot length, number of internodes per shoot and multiplication rate could be observed as results of increased NaCl concentration in the culture medium. The response of the enzymatic antioxidant system to salinity was studied under *in vitro* condition at 7, 14 and 21 days. At 14 days, an important induction of APX (Ascorbate peroxidase), MDHAR (Monodehydroascorbate reductase), DHAR (Dehydroascorbic acid reductase), GR (Gluthathione reductase), POX (Peroxidase) and SOD (Superoxide dismutase) was observed, whereas a decline in CAT (Catalase) occurred. The increase in the antioxidant activities was significantly higher in the presence of 50 mM NaCl. These results show that micropropagated Paulownia shoots develop an efficient antioxidant enzymatic response involving the ascorbate-glutathione (ASC-GSH) cycle in the detoxification of reactive oxygen species (ROS) generated by salinity in plant tissues. This work confirms that *Paulownia tomentosa* is slightly resistant to NaCl stress and that tissue culture can be used as an effective method to evaluate salt tolerance in plants. Our results support the assumption that it is possible to examine the plants response and adaptation mechanisms to salinity under *in vitro* conditions, gaining useful information that could be used to improve its cultivation in orchards.

P-2025

Abiotic Stresses and Callus Tissue Photomorphogenesis of Different Wheat Species. NINA TERLETSKAYA[1], Natalia Zobova[2], Valentina Stupko[2], Azhar Iskakova[1], and Svetlana Lugovtsova[2]. [1]Institute of Plant Biology and Biotechnology, Almaty, KAZAKHSTAN and [2]Federal State Institution of Science "Krasnoyarsk Research Institute of Agriculture", Krasnoyarsk, RUSSIA. Email: teni02@mail.ru

The aim of this work is to study the photomorphogenic callus tissue in different species of wheat in the conditions of osmotic and salt stress *in vitro*. Revealed that the high frequency of callus hexaploid forms (87–91%) compared to tetra- (76–82%) and diploid forms (15%). Using light microscopy and PAM-fluorometer investigated parameters and characteristics of photosynthetic callus tissues of different types of wheat. Identified the species-specific differences of morphogenesis in stressful conditions. Thus, it was shown that under conditions of drought-induced depression callus biomass was less pronounced at the tetraploid form of wheat. The most active processes photomorphogenesis under stressful conditions found in the developing world on the calluses, which are

characterized by relatively low growth of biomass cell colonies. This reflects the negative genetic mechanism of interaction of the processes of growth and photosynthesis in the formation of plant tissue culture conditions It is shown that the destruction of chlorophyll regions and like traheas structures in callus causes plasmolysis meristematic active cells, which occurs after prolonged exposure to stress is manifested primarily in the calluses of less resistant species. It is shown that under stress conditions at photosystem II callus is working with violations, but still makes it possible to obtain phototrophic culture and regeneration of viable plants. It is noted that the hexaploid species *T. macha* and *T. aestivum* showed greater stability of the photosynthetic apparatus under the influence of abiotic stressors *in vitro*.