[21]

Efficiency of Different Culture Mediums and Explant Types of some *Citrus* Rootstocks on Somatic Embryogenesis

Kacar AY[1,3], Bicen B[2], Varol I[2], Yesiloglu T[1], Yildirim B[1], Simsek O[3], Tuzcu O[1], and Ollitrault P[4,5]

[1]Department of Horticulture, Faculty of Agriculture, University of Çukurova, 01330, Adana, Turkey; [2]Toros Agripark Biotechnology Laboratory Adana, Turkey; [3]Çukurova University, Institute of Basic and Applied Science, Biotechnology Department, Adana, Turkey, 01030; [4]CIRAD, UPR 75, TA50/PS4 Avenue Agropolis, TA A-75/02, 34398 Montpellier, Cedex 5, France; [5]Centro de Protection Vegetal y Biotechnologia, IVIA, Apartado Oficial, 46113 Moncada (Valencia), Spain, ykacar@cu.edu.tr

Callus induction, somatic embryogenesis and plant regeneration were obtained in ten different *Citrus* genotypes [*Citrus aurantium* L. (cv 'Tuzcu 891'), *Citrus aurantium* L. (cv 'Tuzcu 31-31'), *Citrus aurantium* L. (cv 'Gou Tou'), *Citrus sinensis* (L.) Osb. (cv 'Alanya Dilimli'), *Citrus reshni* Hort. ex.Tan. (cv 'Cyprus Cleopatra mandarine'), *Poncirus trifoliata* (L) Raf (cv 'Pomeroy'), *Citrus sinensis* (L) Osb. x *Poncirus trifoliata* (L) Raf. (cv 'Tuzcu M2 Citrange'), *Citrus sinensis* (L) Osb. x *Poncirus trifoliata* (L) Raf. (cv 'Carrizo Citrange'), *Citrus paradisi* Macf. x *Poncirus trifoliata* (L) Raf. (cv 'Swingle Citrumelo), *Citrus volkameriana* Tan.& Pasg. (cv 'CRC 01 Volkameriana') from style and ovule explants. Explants were cultured on different culture media. The nutrients of Murashige and Skoog medium (MS) and Murashige and Tucker (MT) vitamins supplemented with 500 mg/l Malt Extract (ME), with 1 mg/l 2, 4-D and three different concentration of BA (0, 0.5, 1 mg/l) were used for first year experiments. MS basal medium was used alone with ME and three different concentration of BA (1, 2, 3 mg/l) for style explants for the second year experiment. MS nutrients and MT vitamins with ME were used alone and 2, 4-D (1 mg/l) and BA (0, 0.5, 1 mg/l) used for ovule culture experiment for the second year experiments. Sucrose was used as a carbon source (50 g/l) for all experiments. The different genotypes showed different embryogenic frequency from style and ovule experiments. Percentages of style explants producing somatic embryos ranged from 0% (AREC Swingle Citrumelo, M2 Citrange, Volkameriana, Pomeroy trifoliate) to 100% (Gou Tou Sour Orange). Percentages of ovule explants producing somatic embryos ranged from 0% (Carrizo Citrange, Alanya Dilimli Sweet Orange, AREC Swingle Citrumelo) to 100% (Tuzcu 891 and Cleopatra Mandarine). About 4 weeks later somatic embryos developed into plantlets. Genetic stability of callus lines was determined by SSR markers.

[22]

A Consensus map Constructed with SSR and EST-SSR Markers Using Progeny Population from Sweet orange × tangor

Hong QB, Gong GZ, Peng ZC, Xiang SQ, Jiang D, and Lei TG

Citrus Research Institute, Chinese Academy of Agricultural Sciences, Chongqing 400712, China, qbhong@163.com

A consensus linkage map was constructed with a population of 68 progenies from Li 2 (sweet orange, *Citrus sinensis* (L.) Osb.) × Wan 2 (tangor, *C. unshiu* (Mark.) Marc. × *C. sinensis* (L.) Osb.). SSR and EST-SSR primers publicly available, together with EST-SSR newly generated in Citrus Research Institute, CAAS and Southwest University, were screened and used in the map construction. Mapping software JoinMap 3.0 was used for linkage analysis. In the Cross Pollinator (CP) mode with a LOD score at 3.0~5.0, 11 linkage groups were constructed. Of the 118 markers integrated, 60 were EST-SSR and 58 were SSR. The map covered 661 cM of the citrus genome. SSR and EST-SSR markers are evenly distributed among all linkage groups in general. Through comparison of a set of shared markers, six linkage groups were found to be co-linear with those in the newly published EST-SSR linkage map of Chen (2008). The results represent the first citrus extensive map which contains both SSR and EST-SSR markers built on a scion breeding group.

[23]

Impact of a New Nucleo-cytoplasmic Composition on the Citrus Fruit Quality

Bassene JB[1], Berti L[2], Fanciullino AL[1], Dhuique-Mayer C[3], Carcouet E[4], Morillon R[1-5], Ollitrault P[1-5], and Froelicher Y[1]

[1]CIRAD UPR Multiplication végétative, F-20230 San Giuliano, France; [2]Université de Corse, UMR CNRS 6134, Laboratoire Biochimie et Biologie Moléculaire du Végétal, Quartier Grossetti, BP 52, F-20250 Corte, France; [3]CIRAD, UMR Qualisud, F-34398 Montpellier Cedex 5, France; [4]INRA , UR GEQA, San Giuliano, F-20230 San Giuliano, France; [5]IVIA 46113 - Moncada - Valencia España. froelicher@cirad.fr

Organic acids, sugars and carotenoids are implied in the fruit quality. A cybrid has been obtained by symmetric protoplast fusion between Willow leaf mandarin (*Citrus deliciosa* Ten.) and Eureka lemon (*Citrus limon* (L.) Burm.). The cybrid possessed nuclear genome and chloroplasts of Eureka lemon plus mitochondria from Willow leaf mandarin. Impact of new mitochondria on the internal fruit quality has been studied. Organic acids, sugars and carotenoids were quantified by HPLC on fruit pulp of Willow leaf mandarin, Eureka lemon and the cybrid. Compounds identified in cybrid fruit pulp were compared

to those from fruits of his two diploid parents. The cybrid was found to be very close to lemon parent in biosynthesis of components involved in *citrus* fruit quality (Organic acids, sugars and carotenoids) although the presence of Willow leaf mandarin mitochondria in the cybrid cells. The results obtained confirm that the main genetic information for sugars, organic acids and carotenoids biosynthesis are contained in the nucleus. No significant difference is observed in sugars and carotenoid pulp fruit between the cybrid and the lemon but the organic acids level are slightly modified in quantity in the cybrid probably because of a nucleo-mitochondria interaction. Cybridisation should be used in citrus as a strategy to breed specific traits associated with mitochondrial genomes such as male sterility without affecting the main organoleptic and nutritional qualities.

[24]

Systemic Acquired Resistance (SAR) in Citrus: Genetic Transformation with SAR Genes to Combat Huanglongbing and Canker

Dutt M., Barthe G, and Grosser JW

Citrus Research and Education Center, University of Florida/IFAS, 700 Experiment Station Road, Lake Alfred, FL 33850 USA, manjul@ufl.edu

Systemic acquired resistance (SAR) is the activation of a plant's defense mechanism leading to the induction of an enduring systemic resistance to subsequent infection. It is widely known that salicylic acid (SA) is a major component in the signal transduction pathways and plays a key role to stimulate SAR leading to the development of a systemic resistance in plants to a wide range of pathogens. It can be hoped that induction of SAR in citrus following an initial infection by pathogens, including the gram negative bacteria responsible for HLB or canker will result in the development of immunity that would immunize the plant from subsequent disease infections. We have cloned several SAR genes, including the *Arabidopsis* NPR1 gene and the tobacco Salicylic Acid Binding Protein 2 (SABP2) gene and have constitutively expressed them into citrus plants via *Agrobacterium* mediated transformation. Genetically modified plants containing the genes driven by a phloem specific *Arabidopsis* sucrose synthase promoter have also been produced. Several of these plants are being multiplied for disease resistance studies.

Oral Presentations S8–Citrus Economics & Trade Abst#25–30

[25]

The Production and Price Effects of Citrus Greening in Sao Paulo and Florida on the World Orange Juice Market

Spreen TH[1], Brown MG[2], Jauregui C[1], and Lee JY

[1]Food and Resource Economics Department, University of Florida, Gainesville, [2]Florida Department of Citrus, Gainesville, FL, USA, tspreen@ufl.edu; jonqying@ufl.edu

Sao Paulo, Brazil and Florida, United States are dominant suppliers of orange juice to the world market. Collectively, these two regions account for over 80 percent of world orange juice production. Citrus greening (aka Huanglongbing) has recently been discovered into both states. Citrus greening is a particularly devastating disease which has had profound effect on commercial citrus production in parts of Asia and Africa. The purpose of this paper is to assess the possible consequences of citrus greening on future citrus production in Sao Paulo and Florida with particular interest on processed orange production. Given the importance of these two regions to world orange juice supply, supply shocks resulting from citrus greening will have implications for world orange juice prices. The analysis will be conducted using a model of the world orange juice market that has been jointly developed by the University of Florida and the Florida Department of Citrus. The model includes endogenous production of oranges in Sao Paulo and Florida and delineates the United States, the European Union, Canada, and the rest of the world as major demand regions. Differentiated demand equations for not-from-concentrate and from concentrate orange juice in the United States and Canada have been estimated. The model is cast as a spatial equilibrium model that also encompasses tariffs and transportation costs across supply and demand regions. The impact of citrus greening is incorporated into the model through increased tree mortality. As the actual effect of the presence of greening on tree mortality in Sao Paulo and Florida is not yet known, several alternative scenarios are considered. Given that the price impact of citrus greening may be large, discussion is also provided on the plausibility of new supply areas for orange juice.

[26]

Changes of Chinese Citrus Import and Export Pattern and Efficiency after Access to WTO

Qi CJ, and Zhang Y