Duplication of the Phytoene Synthase Gene in the Carotenoid Biosynthetic Pathway of Watermelon

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Gene identification and characterization can be utilized for the identification of respective functions and their relationship to flesh color inheritance. Phytoene synthase (PSY), which converts two molecules of GGPP into phytoene, is the first committed step of the pathway. Previous phylogenetic analysis of PSY has indicated that PSY duplication is common in Poaceae, but rare in dicots. Degenerate PCR and RACE were used for PSY cloning. Three members of PSY gene family (PSY-A, PSY-B and PSY-C) were identified. PSY-A shared higher identity with PSY-C than PSY-B. PSYC shared 96% identity with melon PSY. PSY-C also showed a high homology with tomato PSY1, even higher than PSY-A and PSY-B. It showed a similar gene expression pattern, so we propose that PSY-C is a homologue to PSY1. RT-PCR analysis indicated that PSY-B has a different transcriptional behavior from PSY-A, similar to tomato PSY2. Therefore, PSY genes appear to be under different regulatory mechanisms. Deduced protein sequence of PSY1 or PSY2 between species has higher homology than between PSY1 and PSY2 within species. Phylogenetic analysis indicated that watermelon PSY gene family is very distantly related. Watermelon and carrot PSY gene families did not appear to cluster as closely as in Poaceae or tomato. This indicates that watermelon and carrot PSY genes are not conserved as much as PSY in tomato or Poaceae. There was no particular pattern in phylogenetic relationship of dicots. Poaceae PSY genes showed a clustering into a PSY1 group and PSY2 group. PSY duplication in watermelon provides additional evidence that PSY duplication may be a common phenomenon in dicots. They are likely to be duplicated evolutionarily a long time ago, possibly even prior to the evolution of monocot and dicot divergence.

Gene Expression Affecting Spider Mite Herbivory: A Comparison of Sulfur-dusted and Nondusted Grapevines

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Sulfur application is a common practice in viticulture fungus control. This application has been suspected to increase grape susceptibility to spider mites. We hypothesize that sulfur may initiate a pathway that increases spider mite infection. RNA was isolated from grape leaves with various sulfur applications. Evaluation of genes being expressed will allow us to determine if sulfur application is regulating grape leaf defense mechanisms.

Genetics of the Star Mutation in *Petunia ×hybrida*

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Differences in structural gene expression are responsible for a wide range of responses from human cancer to patterned flowers. Gene silencing is one of the ways in which gene expression is controlled. We have developed a model system to study gene silencing using a gene silencing mutation in *Petunia ×hybrida* (Star mutation) and the ability of certain viruses to reverse the silencing mutation. This model system was used to characterize how the Star flower color pattern was controlled.

Oral Session 31—

Citrus Crops Physiology/ Production

30 July 2006, 2:00—3:15 p.m. Southdown

Moderator: Kuo Tan Li

The Effects of Girdling on Root Respiration, Carbohydrate Concentration, and NaCl Uptake in Citrus Trees

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Carbohydrates are the energy source for most root activities, including membrane maintenance and osmotic adjustment. Yet, the relationship between root carbohydrate status and selective sodium chloride uptake remains unknown. The following study examined the effects of root carbohydrate starvation due to girdling on sodium and chloride uptake in mature citrus trees. Trees were girdled during the spring or during the autumn, when girdling is known to have more dramatic affects. In spring-girdled trees, 4 days after girdling, root total carbohydrate and starch decreased by 25% and 30%, respectively. The decrease in root carbohydrates was followed by a 20% reduction in root respiration rate. Based on root mineral analysis, spring-girdled trees were characterized by having 42% more sodium and 30% more chloride. The effects of girdling on shoot xylem sap mineral concentration were similar to trends in root mineral status; xylem sap from spring-girdled trees had 43% more sodium and 22% more chloride. Leaf chloride concentration measured 6 months after girdling was 74% higher in girdled trees and reached toxicity levels (0.65% vs. 0.37% dry mass, for girdled and nongirdled trees, respectively). The differences in leaf sodium, however, were nonsignificant (0.14% vs. 0.13% dry mass, for girdled and nongirdled trees, respectively). In autumn-girdled trees, the effects on leaf sodium and chloride concentration were more dramatic. Leaves from autumn-girdled trees (sampled 10 months later) had about two times more sodium and about five times more chloride in comparison to nongirdled trees (0.39 % vs. 0.20% dry mass sodium and 1.02% vs. 0.22% dry mass chloride, respectively). The above results link root carbohydrate status and selective sodium or chloride uptake in citrus trees.

Fine Root Growth in Late-season 'Valencia' Sweet Orange Trees Harvested by Trunk Shaker

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Mechanical harvesting using trunk shakers on late-season 'Valencia' sweet orange [*Citrus sinensis* (L.) Osb.] trees can remove young fruit for the next crop and occasionally cause root exposure or severe bark scuffing on the trunk. To evaluate the effects of these physical injuries on fine root growth and lifespan, we installed minirhizotrons in the root zone of 15-year-old fruiting 'Valencia' trees on Swingle citrumelo [*C. paradise* Macf. × *Poncirus trifoliate* (L.) Raf.] rootstocks. Images of roots against the minirhizotron tubes were captured biweekly with a custom-made video-DVD recorder system. Trees were harvested in early June by hand or with a linear-type trunk shaker in two consecutive years. Bark injury after trunk shaking was mimicked by removing part (42%) of the bark tissue from the main trunk with a sharp knife. Numbers of fine roots, root activity and lifespan as indexed by the color of the root, and the distribution of new fine roots after harvest were analyzed. Although root exposure was common with the normal operations during mechanical harvesting, few disturbances reached the major fine root zone. There was no clear correlation between root growth and trunk shaking with or without bark injury. The root system might benefit from less competition after the loss of young fruit from mechanical harvesting, as a greater availability of carbohydrates or other resources may compensate for any potential damage due to mechanical harvesting.