

Agreement: REIMBURSABLE 58-6618-9-203

Source of funds: New Varieties Development and Management Corporation

Project: METHODS FOR REDUCING SEEDLING JUVENILITY IN CITRUS

Principle Investigator: Ed Stover, USDA, ARS, USHRL, Ft. Pierce FL

C0-PIs: Kim Bowman and Greg McCollum, USDA, ARS, USHRL, Ft. Pierce FL

Juvenility in citrus seedlings is a major impediment to rapid selection and utilization of improved citrus cultivars. Seedlings will typically not produce significant amounts of fruit until they are 6+ years of age. This makes it necessary to maintain large numbers of plants for many years before they can be evaluated. The purpose of this project is to implement and refine methods for accelerating flowering and fruiting in citrus to permit earlier evaluation of fruit quality and enhance both efficiency and rapidity of developing improved citrus varieties. Funds were requested from the New Varieties Development and Management Corporation to provide salaries for technical assistance in an effort to expedite the evaluation of promising citrus scion selections with the goal of making them available to the citrus industry as rapidly as possible.

Technicians (3 individuals all less than 0.5 FTE contribute to this project) were hired to maintain plants in greenhouses, establish plantings on the seedling juvenility reduction trellis (built using FY08 NVDMC funds), and train plants on the trellis using prescribed methods. Funds were not available until December 2008 and the risk of freeze injury was too great to plant until late winter. The decision to delay planting was wise as in February 2009, the Leesburg farm experienced its most severe freeze since 1989. Fortunately, the freeze made apparent that the juvenility reduction trellis is on the highest and warmest section of the farm.

In April 2009, over 2500 citrus trees were planted on the juvenility reduction trellis and have been grown with optimal nutrition, microsprinkler irrigation and aggressive weed control. They are thriving. 2300 Swingle liners were planted, to develop "mature" rootstocks for grafting with priority hybrids next year. These liners were planted beneath a vertical training wire, were tied to the trellis, and are being allowed to freely grow except that no shoots are permitted in the lower two feet. This strategy should permit growth of the largest plants possible in the shortest time, while still providing clean trunks for budding.

210 plants were established to test components of the reported juvenility reduction system. There is no published report on this system, components have not been tested for their individual contribution to success and some represent very substantial commitments to hand labor and cost. For example, if thorn removal provides little or no contribution to maturation, then elimination of this step would permit inclusion of many more seedlings in the rapid maturation process. This

be assessed for flowering, fruitset, and fruit quality traits in 2010. Also included were seedlings of Sun Chu Sha mandarin, Duncan grapefruit and Ridge Pineapple sweet orange, and mature budwood-sourced Sun Chu Sha and Hirado Buntan pummelo, all grafted onto US-812. There are six plants of each budwood source (hybrid seedlings and standards for comparison) and one plant of each is being subjected to the following treatments:

#### Treatments

- 1) control, not trained, left with empty space on either side to minimize crowding, will “hedge” to maintain 3’ width in-row
- 2) trained to single shoot upright
- 3) trained to single shoot upright, girdled in Dec of 2009
- 4) trained to single shoot upright, treated with paclobutrazol at 2.5 g /plant in Dec of 2009
- 5) trained to single shoot upright, all thorns removed 2X/ week
- 6) trained to single shoot upright, all thorns removed 2X/ week, girdled in Dec of 2009

Plants of each budwood source are adjoining each other in the trellis and individual treatment assignments were randomized within each group. Time required for managing each treatment is being assessed. It is our expectation that for most sets of hybrids in an ongoing breeding program with a full pipeline of variability at all stages in assessment and development, the additional cost of accelerating flowering will not be justifiable, since it will reduce the number of hybrids which can be assessed. We propose that accelerating ability to evaluate fruit quality will be of greatest value if the material tested is expected to have urgently needed properties such as resistance to a priority disease (i.e transgenics resistant to HLB) or utilize a new parent expected to open critical marketing opportunities.

An additional 59 Clementine x Hirado Buntan pummelo seedlings on US-812, for which there was only one plant of each, are planted onto the trellis and are being managed using the full juvenility reduction treatment. Two thousand additional seedlings (Clementine x Orlando, Clementine x Robinson, Lee x Nova, Lee x Orlando, Robinson x Clementine), will be planted in the juvenility trellis in the summer of 2009 as own-rooted plants, but otherwise subjected to the full juvenility reduction treatment.

All Clementine x Hirado Buntan pummelo and Hirado Buntan pummelo x Clementine hybrids were maintained in the greenhouse prior to planting and required extensive care and training to prepare them for field planting. The decision was made to use to use the remaining replicated Clementine x Hirado Buntan pummelo and Hirado Buntan pummelo x Clementine hybrids to test several other hypotheses of vital importance to citrus improvement. These 228 hybrids (more than 1000 plants) are planted in five randomized complete blocks at the Leesburg farm (one plant of each unique hybrid in each of the blocks) representing a range of elevations. These will be grown at five foot spacings in the row and will be untrained as has been traditional in citrus hybrid evaluation. The main experiment (not funded by NVDMC, but representing a departure from the original plan and therefore described here), will determine the value of replicating stage 1 trials of new hybrids. Does use of multiple plants to reduce influence of genotype x environment interactions permit better identification of elite selections, or is it better to test more individual hybrids? One block includes 183 both own-rooted and US-812-budded plants for a separate experiment (fully contained within the larger experiment which will use only data from the US-812 grafted trees) assessing value of grafting vs. own-rooted evaluation. Does reduction in “rootstock function” variability by grafting new seedlings rather than using own-rooted material justify

**Expected benefits of NVDMC-funded effort:**

Methods for rapid evaluation of fruit quality will be established to enhance throughput of the citrus breeding program and accelerate release of useful varieties to the US citrus industry.

Swingle rootstock will be established for accelerating maturity of transgenic citrus by grafting in 2010.

Hirado Buntan pummelo x Clementine hybrids will be identified for inclusion in advanced replicated evaluations. Hirado Buntan pummelo x Clementine hybrids selected for elimination will be cut, providing US-812 rootstock for the next round of seedlings.

By identifying the contribution of individual cultural practices we can determine what combination will permit maximum efficiency and throughput. Use of paclobutrazol will be far less laborious than thorn removal and/or girdling, and if similarly effective, will be an attractive alternative. This research will permit immediate application of identified procedures, with confidence that the labor expended will be well-invested.