

**Annual Report of the USDA National Clonal Germplasm Repository for Citrus and Dates,  
(NCGRCD), Riverside, CA  
2015**

**John E. Preece, Robert Krueger and Manjunath Keremane  
Acting Research Leader, Curator & Plant Pathologist, NCGRCD, USDA-ARS, Riverside, CA  
92507  
Telephone: 530-752-6504 Fax 530-752-5974**

## **INTRODUCTION**

### **Mission**

The mission of the National Germplasm Repository for Citrus and Dates is to collect, maintain, evaluate, preserve, and distribute germplasm of citrus, dates, and related Aurantioideae genera and date palms and other Phoenix species. The achievement of this goal involves: 1) acquisition of the widest possible genetic diversity within citrus and dates to reduce genetic vulnerability in the future, 2) testing and treatment of accessions for pathogenic organisms, 3) maintenance of accessions in a protected, pest-free environment, 4) genetic, horticultural, and physiological characterization and evaluation of accessions, 5) establishment of an informational record for each accession covering acquisition, inventory, evaluation, and gene descriptor data, 6) distribution of germplasm to qualified researchers throughout the world, and 7) research into improved methods of collection, evaluation, propagation, preservation, and distribution.

### **Permanent/Term Federal Staff**

John Preece, Acting Research Leader/Horticulturist  
Robert Krueger, Curator/Horticulturist  
Manjunath Keremane, Plant Pathologist  
Vicki Newman, Biological Science Technician  
Brittany Moreland, Biological Science Technician  
Patricia Moore, Secretary  
Lee Gross, Agricultural Science Research Technician  
Ronak Patel, Biological Science Technician (term)  
Hyun Jung Park Kang, Biological Science Technician (term)

### **University grant funded laboratory technician**

Esteban Rodriguez

### **Student workers**

Cassi Chavez  
Edwin Colon  
Audrey Pongs  
Tony Sabri

## **Germplasm Holdings**

NCGRCD germplasm holdings as of 2014-12-31 are shown in Tables 1, 2, 3, and 4. Inventory did not increase much in the period 2013 – 2014. Most propagations were made to replace trees already in inventory. Not shown are the 102 pathogen isolates maintained under CDFA and APHIS permits. These are used for positive controls for our pathogen testing program. They are documented in GRIN, which is unusual within the NPGS.

## **Germplasm Acquisitions**

NCGRCD acquired 22 new citrus accessions in the period 2013 – 2014, 10 of which established (Table 5). Two new pathogen-tested accessions were received from Dr G Vidalakis, Citrus Clonal Protection Program, and incorporated into the protected, pathogen-tested collection. A quarantine item, US-942 (rootstock selection from USHRL), was acquired from DPI and is under quarantine although it should be clean. An unverified 'Rhars' date palm was received as a plant from Arizona State University.

A number of accessions were received from India. These were potentially HLB-resistant pummelos growing in southern India and collected by Dr M Keremane during a trip to that country. Unfortunately, the budwood collected was in poor condition and did not establish. However, several seedlings were established. Similarly, potentially HLB-resistant genotypes received as seed from Vietnam, *C. macroptera* received as seed from Australia, and 2 pummelos received as budwood for experimental purposes from the Philippines all arrived in the status of poorly preserved budwood and did not establish. The *C. macroptera* was imported again, and again arrived in poor condition; however, one of the two accessions appears to have established.

## **Germplasm Sanitation & Quarantine**

In addition to the two pathogen-tested accession received from CCP, NCGRCD released 35 accessions from quarantine after in-house processing (Table 6). These were also incorporated into the protected, pathogen-tested collection. Selected accessions will be planted in the field by CVC personnel for evaluation.

During the period 2013 – 2014, NCGRCD revised its quarantine/sanitation processing procedure. USDA-APHIS standards for interstate movement of citrus germplasm now require either shoot-tip grafting or thermotherapy. Formerly, biological indexing as required for quarantine release was performed after therapy and limited post-therapy testing. This has been revised so all required lab tests are performed before the release indexing. This should reduce the number of positives discovered during indexing and thus increase the overall efficiency of the process since the biological indexing is the most time and resource intensive step.

Using this protocol, 19 inventory items were screened with lab tests and 16 that tested negative in all lab tests were selected for the 2015 release index. These are shown in Table 7.

NCGRCD currently holds an additional 126 accessions in quarantine (Table 8). This includes self-quarantine, which means sanitation of existing germplasm accessions that are not importations. Nucleic acids have been extracted and lab tests have been conducted to determine which approach is necessary to clean up each accession. The NCGRCD seeks commentary regarding prioritization of these accessions for sanitation.

## Distributions

In the period 2013 – 2014, NCGRCD distributed 1200 order items to 227 requestors (Tables 9, 10). In terms of requestors, State personnel accounted for the largest group (24% of total requestors), with ARS personnel accounting for 19%, and international non-profit requestors accounting for 20%. In terms of order items, international non-profits accounted for 37% of the total order items distributed, whereas ARS accounted for 30% and State personnel for 15%. During the period 2013 – 2014, domestic requests accounted for approximately 2/3 of the total. This has been true for several years and is the opposite of previous patterns. This is mostly due to sending larger amounts of germplasm to Florida ARS personnel than in the past to support increased HLB research. In addition, more rootstock and indicator seeds are being supplied to US researchers as seed cannot be sourced in Florida due to APHIS restrictions. International distributions also include a fairly large proportion of rootstock and indicator seeds. Because NCGRCD budwood meets a high phytosanitary standard, distributions are often made to international certification or nursery groups. In addition, this was the first year an international distribution was made of pathogen positive material in order to enable establishment of a testing program in France. To complete the circle, more recently budwood of genotypes requested by the French national citrus genebank was sent to the program for testing. Domestic private individual (UIND) category orders accounted for 18% of the total requests and 7% of the order items sent. This category is basically hobbyists. NCGRCD has historically tried to accommodate these types of requests but this may change depending upon NPGS actions and possible increased work loads.

## Collection Rationalization

NCGRCD and CVC personnel cooperate in rationalization of the collections. One activity of note was a cooperative project with Prof Mikeal Roose, Dept of Botany & Plant Science, UC Riverside where graduate student Yoko Eck surveyed seedling populations from Baja California Sur with 9 SSR markers. This allowed us to eliminate some redundant inventory items. In addition to these seedlings, some pummelos in the CVC were surveyed along with some seed source citrons from China. We are taking these markers into account in addition to morphological, passport, and documentary observations to reduce the number of similarly named and probably redundant pummelo accessions.

## Propagation

In 2013 there were a total of 239 propagations of 194 different cultivars as follows:

Screenhouse replacement trees – 124  
Citrus Variety Collection replacement – 12  
CVC backup (2<sup>nd</sup> tree) – 83  
Positive replacements – 3  
New Accessions – 17

In 2014 there were a total of 449 trees of 186 different cultivars propagated as follows:

Screenhouse replacement trees – 89  
Citrus Variety Collection replacement – 47  
CVC backup (2<sup>nd</sup> tree) – 40  
Positive replacements – 2  
New Accessions – 43, some from released trees  
Australian *Microcitrus australasica* – 124

## **Databases**

NCGRCD maintains a local database in MS Access in addition to using the GRIN database. Both databases are up to date as far as accessions. Inventory is currently not maintained in the GRIN database; however inventory is current and up to date in the local database. The local database has management data used in a day-to-day basis and also contains quarantine and pathogen testing data. It is not clear at this time whether or not these observations can be maintained effectively in GRIN. Although inventory will probably be loaded into GRIN after the changeover to GRIN Global, it is possible that the local database will have to be maintained in addition. Local databases are also used for documentation of propagations, therapy procedures, etc.

The Curator has received training in the upcoming GRINGlobal system. However, this new system will probably present many challenges due to its unfamiliarity. Currently, the Curator is the only personnel with training in either GRIN Classic or GRINGlobal. The Technicians (V Newman, B Moreland) also assist in maintaining the local databases. Reliance solely on GRINGlobal would likely necessitate additional training for them as well as taking time from other activities. Adequate human resources devoted to databases is somewhat lacking at NCGRCD. Other Pacific West Area NCGRs no longer use a second database (Corvallis and Davis).

## **Facilities**

NCGRCD maintains Federal facilities on land located on the University of California, Riverside campus and leased from the University of California. The lease is currently expired (since 2011). Federal facilities include approximately 16,000 sq ft of screenhouse (used for maintenance of the protected, pathogen-tested collection); 6050 sq ft of greenhouse space (used for propagations and pathogen testing); 1372 sq ft of headhouse space (work and storage); 850 sq ft of lab space; 88 sq ft of office/storage space; and 480 sq ft office trailer. Approximately 7500 sq ft of UC greenhouses are also utilized. The UC greenhouses are used to maintain plants that are protected backups of trees in the CVC that are not backed up in the protected collection, and for quarantine of accessions held under APHIS/CDFR quarantine.

The last few years have seen extensive modification of the Federal facilities to meet APHIS standards for interstate movement of citrus nursery stock. This has mostly consisted of screening over external openings and extensive sealing. UC facilities have had some of these modifications put in place but do not meet the Federal standards as do the Federal facilities. The UC facilities were mostly built in the 1960's and so constant attention to maintenance is necessary. NCGRCD is currently negotiating use of a newer UC greenhouse, pending removal of plants belonging to retired faculty.

A mission critical need is additional screenhouse space. The current screenhouse was divided (partitioned) in 2012. This will allow 1 tree of each accession to be maintained in a separate chamber, so breaching of one chamber will not compromise the entire collection. The screenhouse was scheduled to be rescreened in late 2013. Upon completion of re-screening of half of the structure, it was discovered there was a flaw in the screen used and it did not meet the APHIS standards. Negotiating with the installer and the screen manufacturer resulted in a delay of nearly a year in correcting the problem. In addition, the screen manufacturer would not stand behind the product so additional expense was incurred by the Government. Currently, with the new screen in place over half the structure, the entire

structure meets the APHIS standards but rescreening the additional half is critical and discussions are underway with focus on reviewing the specs before going forward.

Even more critically, the Federal greenhouse space is inadequate. There is very little room for additional expansion of the protected, pathogen-tested collection. It is absolutely imperative that this structure be expanded in the next few years as new accessions are cleaned, tested and released. A pad is available for an up to 60 foot (7,200 sq ft) expansion of the greenhouse.

### **Health, Safety, Environmental Management**

Biological Science Technician Brittany Moreland is the Collateral Duty Safety Officer for the Riverside Location (including the US Salinity Laboratory). In addition to routine safety duties and activities, in the 2013 – 2014 period a Biological Safety Inspection was coordinated with UCR, a Environmental Management System and Safety, Health, and Environmental Management audit was conducted with ARS, and the ARS Hazardous Material Sweep was completed. The NCGCRD fire alarm system was upgraded. The NCGRCD has had a recent fire inspection and all fire extinguishers were replaced. The fire inspection will now occur annually.

### **Laboratory testing of Germplasm accessions**

The laboratory is well equipped to conduct all required diagnostic tests including ELISA, conventional PCR, real time PCR, immunoblotting, and sequential PAGE. In the last few years, most of the assays have been adapted for high throughput extractions and testing. The lab is equipped with a beadbeater, lyophilizer, Robotic DNA extraction system, and two real time PCR machines that facilitate DNA extractions and real time PCR assays in a 96 well format. RNA extractions are still being conducted manually in single tubes. The laboratory has plans to acquire a digital PCR system in 2015 through a NIFA-SCRI grant. A 2-day demo of digital PCR was organized in 2014 at the Repository with about ten participants. The digital PCR would further help us detect low populations of pathogens and also serve as an additional tool for confirming questionable qPCR assays.

Facilities for shoot tip grafting and cryotherapy have been upgraded since 2012 when we added a separate tissue culture room with a large laminar flow hood and two growth chambers and a window air conditioner. Brittany Mooreland and Ronak Patel were trained in cryotherapy in the lab of G. Volk at NCGRP, Fort Collins, CO, and Remi Bonnard from the NCGRP lab came to Riverside for a week to continue the training. At present, we have acquired a total of four growth chambers for tissue culture work. We have lost two thermotherapy chambers in the last ten years, and acquired two new thermotherapy chambers in the last two years that are both are functioning well.

Our lab is certified as Biological Safety level II laboratory. We maintain permits to receive samples from the USDA cooperators in Fort Pierce, FL and Denver, CO. Our pathogen positive germplasm inventory contains several isolates of a large number of Citrus pathogens. In the last five years, we have cloned and sequenced more than 35 pathogen genome targets that are being maintained for use as positive controls in our collection. In some cases, the target sequences have been artificially synthesized and cloned and are being maintained for use as positive controls.

Several positive, negative and internal controls are used in most assays for quality control. At least two people always participate in the collection of samples and the labeling process.

Certain lab tests are conducted at various stages of accession, therapy and maintenance.

1. All “pathogen tested” plants in the protected facility are tested for the presence of CTV annually.
2. A portion of the plants from the protected facility are currently being tested annually for Exocortis and Cachexia by citron indexing followed by lab indexing. In the future, we propose to conduct this testing by direct testing of the source plants and avoid this additional citron indexing so that valuable greenhouse space can be utilized for indexing of quarantine materials for their release to the scientific community.
3. When a new accession is acquired, a minimum number of lab tests are conducted. More tests are conducted after the accession is established in our quarantine facility. These minimal tests guide the therapy strategy.
4. Multiple pathogen testing (MPT) includes real time PCR of about 18 DNA and RNA targets. At present, MPT of all accessions in our quarantine is being conducted.
5. MPT is also conducted after therapy and before biological indexing so that only negative plants are biologically indexed.
6. Since most lab tests are based on primers and biological diversity of pathogens may result in false negatives, multiple primer sets are used in some cases. As an example, we routinely use three primer pairs to test for *Citrus psorosis virus*.
7. MPT of accessions is conducted also after biological indexing is completed. At his “prerelease” stage, three additional tests are conducted; sequential PAGE assay for viroids, dsRNA analysis for viruses and detection of *Spiroplasma citri* by culturing. This assay requires the availability of inoculums in large quantities from graft inoculated citron plants.

**Shoot tip grafting:** Starting in 2012, we have significantly improved our tissue culture facilities as described above. In addition, Brittany Mooreland has been working on STG since 2011. Improved facilities and increased dedicated time to STG has resulted in significant increase in output (Fig.1 and Table 11).

**Thermotherapy:** As described earlier, the availability of functional thermotherapy chambers is the most critical factor in maximizing output. For the current year, we have two fully functional new chambers available. A list of all accessions that have been thermotherapied are listed in Table 12.

**Cryotherapy:** Budwood from greenhouse trees infected with CVEV, CTLV, CEVD and several trees with mixed infection of viroids were shipped to G. Volk at NCGRP, Fort Collins, CO for cryotherapy. Leaf tissue from regenerated plants was shipped back to Riverside for testing. A total of 424 samples have been shipped to Riverside of which testing has been completed for 200 and the rest are in the process of being tested.

In 2014, cryotherapy of plants with several isolates of CPV, CLBV, concave gum and CVEV were used for cryotherapy and a total of 44 plants were generated and are being maintained in the greenhouse. Both lab and greenhouse (biological indexing) testing of these trees are in progress.

**Release of accessions from Quarantine:** In 2014, 49 inventory items (trees) belonging to 35 accessions were released after completing therapy, biological indexing and all the required lab tests. An additional 16 accessions are in the process of biological indexing and are in line for release pending final results from both biological indexing and lab test results. A list of those 16 and a few others (being tested for repeat partial testing) are shown in Table 13.

**Pathogen Testing database:** Starting in 2011, the lab test results were maintained in a Microsoft Access database. In 2014, all available previous results were incorporated in to this database resulting in a total of about 30,000 test results by the end of 2014. A summary of different lab test results in the database are shown in the Table 14.

**Current known status of plants in quarantine:** A total of 22 accessions in the USDA quarantine and another 122 accessions in the CVC trees (out of about 560 re-quarantined CVC trees in 2010) were found to carry CTV (Table 15). Table 16 shows the current test results of most accessions in our USDA quarantine.

**Research activities:** A list of grants that are currently being funded is below. At present, one full time and another half time lab technician are supported by research grants.

1. Ramadugu, Keremane, Roose, Jenkins, Alabi and Smith 2/2015 to 2/2020 “Characterization of Liberibacter populations and development of field detection of HLB” \$1,770,000. USDA NIFA SCRI .
2. Ramadugu, Keremane, Lee, Roose, McCollum and Hall 01/2015 to 12/2017 “Evaluation hybrids of citrus relatives for HLB resistance/tolerance” \$220,000 Citrus research Board.
3. Lee, Ramadugu, McCollum and Keremane 04/2014 to 03/2016 “Early detection of HLB in nursery trees following psyllid infestations with ACP” \$119,900 California Citrus Nursery Advisory Board.
4. Ramadugu, Keremane and Roose. 01/2015 to 01/2016. “Development of rapid, field-deployable diagnostic assays for detection of all species of huanglongbing-associated Liberibacters”. \$26,000. California Citrus Nursery Advisory Board.
5. Ramadugu, Keremane, Duan, Roose, Lee, Stover and Hall 05/2013 to 04/2015 “Further characterization of HLB resistant clones of selected citrus varieties” \$170,000. Citrus Research and Development Foundation.
6. Lee, Keremane, Ramadugu and Stover 9/2012-6/2015 “Analyzing Liberibacter isolates undetectable by standard diagnostic methods in Florida” \$149,220. Citrus Research and Development Foundation.
7. Lee, Volk and McCollum. 2015-2017. Application of technologies to expedite cleaning of new accessions for use in Florida. \$180,000. Citrus Research and Development Foundation.

A brief summary of some research activities of 2014 are listed below.

### **Genetic analysis of citron (*Citrus medica* L.) using simple sequence repeats and single nucleotide polymorphisms.**

Citron (*Citrus medica* L.) is one of the three basic species of the genus *Citrus* L. that have contributed to the development of many commercial cultivars. We analyzed the genetic diversity of 47 citrons (32 fingered and non-fingered types from Yunnan Province, China; and 15 citrons of Mediterranean origin) to understand the relationships within the species. Identification and study of new citron germplasm and an understanding of genetic diversity may facilitate future breeding efforts. Genetic analysis was conducted using three types of data: 23 microsatellite markers, single nucleotide polymorphisms generated from sequences of a nuclear malate dehydrogenase gene and from sequences of a chloroplast ribosomal gene, *rps16*. Neighbor joining and maximum parsimony analyses were conducted with the microsatellite and single nucleotide polymorphism data. Citron was found to be monophyletic in all

three datasets. Population structure analysis clustered the 47 citrons into three distinct groups. The first group consisted of wild and hybrid common (non-fingered) citrons generally having locules, juice sacs and seeds within the fruit. The second cluster consisted mostly of fingered citrons that did not have any locules, juice sacs or seeds, and some non-fingered types with smaller locules and juice sacs, but with seeds. The third cluster consisted of citrons cultivated in the Mediterranean region. Net nucleotide distances between the clusters from population structure analysis indicated considerable diversity within the species. The analyses indicated the existence of three distinct groups of citrons. All accessions that clustered in groups I and II originated in China. The third cluster consisted of non-fingered citrons assumed to have been selected in the Mediterranean region. A citron-specific microsatellite marker was identified and characterized. We observed a high level of heterozygosity in certain citrons, contrary to previous reports.

#### **Field detection system:**

In collaboration with Diagenetix, inc., we have developed a rapid field detection system based on isothermal loop-mediated amplification technique for easy detection of CLAS from psyllid vectors. The research was published in Crop Protection journal. The title of the article is “A rapid field detection system for citrus huanglongbing associated ‘Candidatus Liberibacter asiaticus’ from the psyllid vector, *Diaphorina citri* Kuwayama and its implications in disease management”.

#### **HLB resistance:**

A four year field trial on HLB resistance was conducted in Pico’s farm, Fort Pierce, Florida using about 100 accessions from our Germplasm. These accessions were selected to represent the genetic diversity of the collection of germplasm in the Citrus Variety Collection, Riverside. About 8-10 plants from each of the 108 accessions were planted as seedlings in Fort Pierce fields in an area where natural infection would occur because of psyllid feeding. These plants were monitored for four years and HLB tolerance/resistance data was collected. In this field test, in addition to citrus, many citrus relatives in the family Aurantioideae were also included. We observed good levels of resistance/ tolerance in the Australian genera.

To validate the field trial, we are currently conducting HLB tolerance/resistance studies under greenhouse conditions in Florida. The plants were challenged with psyllid feeding under no-choice conditions. We are currently conducting analysis of these plants to understand the basis of HLB tolerance in the sub-family Aurantioideae (CRDF grant entitled “Further characterization of HLB resistant clones of selected citrus varieties”).

Since there is sexual compatibility between certain genera related to citrus, we conducted wide crosses between citrus and other genera. The objective of this breeding program is two-fold: to understand the basis of disease resistance by doing molecular analysis of susceptible and tolerant plants. Secondly, to generate HLB tolerant citrus hybrids that can be used in future breeding programs to breed diseases tolerant cultivars. In two years, we performed over 2000 intergeneric crosses and collected seeds from the successful pollinations. The hybrid seeds obtained from crossing mandarins with Australian citrus types are now being challenged with the HLB pathogen to evaluate possible disease resistance (CRB grant entitled “Evaluation of hybrids of citrus and citrus relatives for huanglongbing tolerance/resistance”).

#### **Discovery of a new species of Liberibacter:**

A new species of Liberibacter associated with both psyllids and citrus plants was discovered from Colombia. The new species was tentatively named, *Candidatus Liberibacter caribbeanus*.



## Publications:

1. Manjunath L. Keremane, Chandrika Ramadugu, Esteban Rodriguez, Ryo Kubota, Scott Shibata, David G. Hall, Mikeal L. Roose, Daniel Jenkins and Richard F. Lee. 2015. [A rapid field detection system for citrus huanglongbing associated 'Candidatus Liberibacter asiaticus' from the psyllid vector, \*Diaphorina citri\* Kuwayama and its implications in disease management](#). Crop Protection 68:41-48. doi:10.1016/j.cropro.2014.10.026
2. W. Shen, S.E. Halbert, E. Dickstein, Manjunath L. Keremane, M.M. Shimwela, A.H.C. van Bruggen, 2013. [Occurrence and in-grove distribution of citrus huanglongbing in north central Florida](#). Journal of Plant Pathology 95(2):359-369.
3. Ramadugu, C., Pfeil, B.E., Keremane, M.L., Lee, R.F., Maureira-Butler, I.J. and Roose, M.L., 2013. [A Six Nuclear Gene Phylogeny of Citrus \(Rutaceae\) Taking into Account Hybridization and Lineage Sorting](#). PLOS One 8(7): e68410.
4. Muhammad F. Razi, Manjunath L. Keremane, Chandrika Ramadugu, Mikeal Roose, Iqar A. Khan and Richard F. Lee. [Detection of Citrus huanglongbing associated 'Candidatus Liberibacter asiaticus' in Citrus and \*Diaphorina citri\* in Pakistan, seasonal variability and implications on disease management](#). Phytopathology 104: 257-268.
5. Richard F. Lee and Manjunath L. Keremane, 2013. [Mild strain cross protection of tristeza: a review of research to protect against decline on sour orange in Florida](#). Front. Microbiol. 4:259. doi: 10.3389/fmicb.2013.00259

Table 1. Accessions and inventory maintained at NCGRCD

		Accessions	Inventory
Total		1748	6327
	<i>Citrus</i> & related taxa	1613	5583
	<i>Citrus</i> spp	1224	4248
	<i>Phoenix</i> spp	135	727

Table 2. Aurantioideae accessions maintained at NCGRCD

Species	Group	Accessions
Total		1613
<i>Citrus</i> spp		1224
<i>Citrus sinensis</i>	Total	248
	Blood orange	23
	Navel orange	81
	Sweet orange and hybrids	107
	Valencia orange	37
<i>Citrus aurantium</i> and hybrids	Sour orange and hybrids	64
<i>Citrus limon</i> and hybrids	Lemon and hybrids	146
<i>Citrus aurantiifolia</i> and hybrids	Lime and hybrids	40
<i>Citrus medica</i> and hybrids	Citron and hybrids	112
<i>Citrus maxima</i> and hybrids	Pummelo and hybrids	125
<i>Citrus paradisi</i> and hybrids	Grapefruit and hybrids	60
<i>Citrus madurensis</i> and hybrids	Calamondin and hybrids	3
<i>Citrus reticulata</i> and hybrids	Mandarins and hybrids	220
<i>Citrus</i> spp and hybrids	Papedas and hybrids	30
<i>Fortunella</i> spp and hybrids	Kumquats and hybrids	30
<i>Microcitrus</i> spp	Total	30
	<i>M australasica</i>	10
	<i>M australis</i>	7
	Other <i>Microcitrus</i> spp	2
<i>Poncirus</i> spp and hybrids	Trifoliates and hybrids	143
	<i>Poncirus</i> spp	83
	Citrange	24
	Other trifoliolate hybrids	36
Other Aurantioideae taxa		71
	<i>Aegle marmelos</i>	1
	<i>Aeglopsis chevalieri</i>	1
	<i>Afraegle</i> spp (2)	2
	<i>Atalantia</i> spp (4 spp)	6
	<i>Balsamocitrus daweei</i>	1
	<i>Bergera koenigii</i>	4
	<i>Citropsis</i> spp (4 spp)	4
	<i>Clausena</i> spp (4 spp)	7

	<i>Clymenia polyandra</i>	1
	<i>Eremocitrus glauca</i> and hybrid	2
	<i>Feroniella oblata</i>	1
	<i>Glycosmis</i> spp (4 spp)	5
	<i>Limnocitrus littoralis</i>	1
	<i>Merrillia caloxylon</i>	1
	<i>Micromelum minutum</i>	1
	<i>Murraya paniculata</i>	4
	<i>Naringi crenulata</i>	1
	<i>Oxanthera neo-caledonica</i>	1
	<i>Pamburus missionis</i>	2
	<i>Paramygnia</i> spp (2 spp)	2
	<i>Pleiospermium</i> spp (2 spp)	2
	<i>Severinia buxifolia</i>	10
	<i>Severinia disticha</i>	2
	<i>Swinglea glutinosa</i>	2
	<i>Triphasia trifolia</i>	2
	<i>Wenzelia dolichoophylla</i>	1
Rutaceae (not Aurantioideae)	<i>Esenbeckia, Ruta, Vepris, Zanthoxylum</i>	6

Table 3. *Phoenix* accessions maintained at NCGRCD

		Accessions
Total		133
<i>P dactylifera</i>		118
	Named Old World female cv	28
	Named New World female cv	9
	Superior male selections	5
	Backcrossed male accessions	30
	Hybrid "Breeding Lines"	17
	Baja California Sur seedlings	10
	Miscellaneous unverified	19
<i>P acaulis</i>	seed source	1
<i>P canariensis</i> OPS	seed source	1
<i>P hanceana</i> OPS	seed source	2
<i>P paludosa</i> OPS	seed source	1
<i>P reclinata</i>	1 clonal, 1 seed source	2
<i>P roebelinii</i>		3
<i>P slyvestris</i>		5

Table 4. Citrus accessions and inventory maintained at different sites

	Accessions	Inventory
Total	1224	5583
Citrus Variety Collection	1042	1883
Protected (pathogen tested)	528	1059
GH (Riverside)	780	1358
Quarantine	126	254
CVARS	79	240
SCFS	56	104

Table 5. Germplasm acquisitions 2013 – 2014.

CV	Group	Accession No	Source	Status
Tacoy	pummelo	RRUT 516	Philippines (BD)	Did not establish
Magallanes	pummelo	RRUT 515	Philippines (BD)	Did not establish
Thimmaiah1	pummelo	RRUT 517	India (BD)	Did not establish
Thimmaiah2	pummelo	RRUT 518	India (BD)	Did not establish
MTS-1	pummelo	RRUT 519	India (BD)	Did not establish
Cariappa-CM1	mandarin	RRUT 520	India (BD)	Did not establish
Cariappa1	pummelo	RRUT 521	India (BD)	Did not establish
Cariappa-CM2	mandarin	RRUT 522	India (BD)	Did not establish
Cariappa2	pummelo	RRUT 523	India (BD)	Active (quarantine)
Cariappa-CM3	mandarin	RRUT 524	India (BD)	Did not establish
Cariappa3	pummelo	RRUT 525	India (BD)	Did not establish
Vani Akella 1	lime	RRUT 526	India (BD)	Did not establish
Thimmaiah1	pummelo	RSD 2013001	India (SD)	Active (self-quar)
Thimmaiah2	pummelo	RSD 2013002	India (SD)	Active (self-quar)
Cariappa3	pummelo	RSD 2013003	India (SD)	Active (self-quar)
Early St Ann	satsuma	RCRC 4240	LA via CCPP (BD)	Active, pathogen tested
Santa Teresa	lemon	RRUT 529	CA via CCPP (BD)	Active, pathogen tested
Red	mandarin	RSD 2013005	Vietnam (SD)	Did not establish
Red	pummelo	RSD 2013004	Vietnam (SD)	Did not establish
Melanesian (PNG)	papeda	RRUT 520	Australia (SD)	Did not establish
Melanesian (New Caledonia)	papeda	RRUT 521	Australia (SD)	Did not establish
US-942	citrandarin	RRUT 532	USHRL via DPI (BD)	Active (quarantine)
Rhars	date palm	RPHO 46	ASU	Active (inverified)

Table 6. Accessions released from quarantine after in-house NCGRCD processing, 2013 – 2014.

CULTIVAR	Accession No	GROUP	QTYPE
Cooper	RRUT 183	navel orange	STATE
Fuju (1-10-17)	RRUT 152	mandarin	INTL
Gardner	RRUT 187	sweet orange	STATE
Genova EEA Tucuman	RRUT 334	lemon	INTL
Gioia Tauro	PI 230622	sweet orange	STATE
Haploid Clemenules	RRUT 459	clementine mandarin	INTL
John King	RRUT 320	mandarin	STATE
LB8-9	RRUT 483	mandarin hybrid	STATE
Malta (Maltaise Sanguine)	PI 654873	blood orange	SELF
Midsweet	RRUT 186	sweet orange	STATE
Murcott nearly seedless	RRUT 189	tangor	STATE
Palazzelli	RRUT 460	mandarin hybrid	INTL
Pursha Lime	RRUT 142	lime hybrid	SELF
Roble	RRUT 486	sweet orange	STATE
Succari	RRUT 182	sweet orange	STATE
Sunstar	RRUT 180	sweet orange	STATE
Tresca	RRUT 190	sweet orange	STATE
un-named lemon (?) ex-Nepal	RRUT 156	lemon	INTL
un-named lemon (?) ex-Nepal	RRUT 158	lemon	INTL
un-named sweet orange (?) ex-Nepal	RRUT 159	sweet orange	INTL
un-named sweet orange (?) ex-Nepal	RRUT 163	sweet orange	INTL
US Furr-ST	RRUT 484	mandarin hybrid	STATE
US-802	RRUT 383	citrumelo	STATE
US-812	RRUT 201	citrange	STATE
US-852	RRUT 219	trifoliolate hybrid	STATE
USDA 1-105-106	RRUT 374	mandarin hybrid	STATE
USDA 1-42-65	RRUT 380	mandarin hybrid	STATE
USDA 1-43-21	RRUT 369	mandarin hybrid	STATE
USDA 1-74-15	RRUT 226	mandarin hybrid	STATE
USDA 10-8	RRUT 181	sweet orange	STATE
Vaniglia acidless	RRUT 456	lemon	INTL
Variegated Tahiti	RRUT 457	Lime	INTL
Webber Shaddock	RCRC 4233	pummelo	SELF
Willits	RRUT 204	citrange	STATE
Wilson	RRUT 37	lemon	STATE

Table 7. Release candidates being indexed for release in Fall, 2015.

indexno	CULTIVAR	GROUP	Accessio No
I2015001	Amoa 8	tangor	RRUT 455
I2015002	Bergamotto Fantastico	sour orange hybrid	RRUT 387
I2015003	Bidwell's Bar	sweet orange	RRUT 140
I2015004	Collins-Hibbert	sweet orange	RRUT 36
I2015005	Daoxian wild orange	mandarin	RRUT 191
I2015006	Horned	Sour orange	RRUT 454
I2015007	Melanesian papeda	papeda	RRUT 192
I2015008	Ordubad	lemon	RRUT 511
I2015009	Salò	Citron	RRUT 453
I2015010	un-named lemon (?)	lemon	RRUT 160
I2015011	un-named lemon (?)	lemon	RRUT 161
I2015012	un-named lemon (?)	lemon	RRUT 162
I2015013	un-named lemon (?)	lemon	RRUT 165
I2015014	Variegated	citron	RRUT 311
I2015015	Bitters Newhall	navel orange	RCRC 4228
I2015016	USDA 1-22-32	mandarin hybrid	RRUT 382

Table 8. Accessions held in quarantine.

CULTIVAR	Accession No	GROUP	QTYPE
'lemon pummelo' ex-western Yunnan (OPS)	RRUT 107	lemon	INTL
'Limon pummelo' ex-Reili County nucellar	RRUT 84	lemon hybrid	INTL
Amoa 8	RRUT 455	tangor	INTL
Bahianinha Monte Parnazo	RRUT 184	navel orange	STATE
Bahianinha Piracicaba	PI 133261	navel orange	STATE
Bahman Persian #2 nucellar	PI 658374	lime - sweet lime	SELF
Baiju nucellar	RRUT 76	mandarin	SELF
Bearss	RRUT 443	lemon	STATE
Beibeiyu (15-3)	RRUT 153	pummelo	INTL
Bergamotto Fantastico	RRUT 387	sour orange hybrid	INTL
Bidwell's Bar	RRUT 140	sweet orange	SELF
Bitters Newhall	RCRC 4228	navel orange	SELF
Cami	RRUT 386	mandarin hybrid	INTL
Campeona	RRUT 393	mandarin	INTL
Canaliculata di Palermo	RRUT 222	lemon	INTL
Caoju (1-18-47)	RRUT 151	mandarin	INTL
Caoshixiangju (1-11-12)	RRUT 150	mandarin	INTL
Cariappa-CM3	RRUT 524	mandarin	INTL

Cariappa-pummelo2	RRUT 523	pummelo	INTL
Cariappa-pummelo2	RSD 2013002	pummelo	INTL
Cariappa-pummelo3	RSD 2013003	pummelo	INTL
Clementine X Murcott (C54-4-2)	RRUT 167	mandarin	STATE
Clementine X Orlando (F-6-9-10)	RRUT 166	mandarin	STATE
Collins-Hibbert	RRUT 36	sweet orange	SELF
Consolei (OPS)	RSD 2000003	sour orange	INTL
Corniculata (OPS)	RRUT 119	sour orange	INTL
Corsican	PI 539421	citron	SELF
Corsican	PI 539422	citron	SELF
Daoxian wild orange	RRUT 191	mandarin	INTL
Dayap	RRUT 35	lime	SELF
Diamante	PI 539423	citron	STATE
Dona Adelina	RRUT 451	sweet lime	STATE
Etonia citrange nucellar	RRUT 481	citrange	SELF
Etrog	PI 539425	citron	SELF
Foerster "mutant" nucellar	RRUT 89	sour orange	STATE
Fuju nucellar	RRUT 82	mandarin	INTL
Fumin Evergreen trifoliolate (OPS)	RSD 1998001	trifoliolate	INTL
Fuming evergreen trifoliolate	RRUT 178	trifoliolate	INTL
Gainesville 71	RRUT 388	trifoliolate	STATE
Gaojiantou Mitong nucellar	RRUT 77	mandarin	INTL
Garcia-Yanez	RRUT 449	sweet lime	STATE
Gou Tou Xiang Yuan (B)	RRUT 321	sour orange	INTL
Goutoucheng (4-1)	RRUT 149	sour orange	INTL
H-56	PI 539241	tangor	SELF
Hamlin 1-4-1	RRUT 442	sweet orange	STATE
Hawaiian	RRUT 143	pummelo	SELF
Hongju nucellar	RRUT 74	mandarin	INTL
Horned	RRUT 454	Sour orange	INTL
Huangguogan #1 nucellar	RRUT 106	tangor	INTL
Huangguogan nucellar	RRUT 83	tangor	INTL
Hudson #1 (4N)	RRUT 385	grapefruit	STATE
Hyuganatsu-mikan	PI 280540	pummelo	STATE
Italian pink-fleshed variegated	RRUT 452	lemon	INTL
Iwaikan	RRUT 173	pummeo	STATE
Kuharske	RRUT 439	citrange	STATE
Limequat	RRUT 146	lime hybrid	SELF
Ling Mung	RRUT 174	rangpur	STATE
Little Sweetie	RRUT 113	sweet lemon	SELF
Local lime 2-8 ex-Reili County (OPS)	RRUT 85	lime	INTL
Local lime ex-Xiaochenhang nucellar	RRUT 86	lime hybrid	INTL
Long huang kat	RRUT 177	mandarin	STATE
M'guerqueb	PI 265834	citron	STATE
Man Ju (OPS)	RRUT 104	mandarin	INTL
Mediterranean nucellar	RRUT 90	blood orange	STATE



Melanesian papeda	RRUT 192	papeda	INTL
Mesero	PI 209862	lemon	SELF
Nan Feng Mi Ju (OPS)	RSD 2002003	mandarin	INTL
New Zealand Grapefruit	PI 539464	grapefruit	SELF
Nin Kat	PI 433265	mandarin	STATE
Nine Pound	RRUT 485	lemon	STATE
Old Indian	RCRC 4211	lemon	SELF
Orange	RRUT 487	lemon	STATE
Ordubad	RRUT 511	lemon	INTL
Pomo d'Adamo nucellar	RRUT 138	lemon	INTL
Pon tri DPI-50-7-6	RRUT 441	trifoliolate	STATE
pummelo #1 ex-Sichuan	RRUT 196	pummelo	INTL
pummelo #2 ex-Sichuan	RRUT 197	pummelo	INTL
pummelo #3 ex-Sichuan	RRUT 198	pummelo	INTL
Red ling mung	RRUT 176	rangpur	STATE
Red Mexican	RRUT 170	grapefruit	STATE
Rico #6	RRUT 169	sweet orange	STATE
Ruby 4N	RRUT 31	blood orange	STATE
Salò	RRUT 453	Citron	INTL
Sarah #2	RRUT 172	sweet orange	STATE
Seville	PI 539169	sour orange	SELF
Shamel	RRUT 148	tangor	STATE
Shatianyou (2-1)	RRUT 154	pummelo	INTL
Shekwasha X Koethen (C61-252)	RRUT 168	mandarin	STATE
Suanju nucellar	RRUT 81	mandarin	INTL
Sunki	RRUT 444	mandarin	STATE
Swingle	RRUT 188	tangelo	STATE
Temecula Sweet	RRUT 463	mandarin	STATE
Temple 4N	RRUT 32	tangor	STATE
Thimmaiah1	RSD 2013001	pummelo	INTL
Tomango	RRUT 175	sweet orange	STATE
Tonkan nucellar	RRUT 91	tangor	STATE
Tung kum	RRUT 185	mandarin	STATE
Umatilla	RRUT 445	tangor	STATE
un-named lemon (?) ex-Nepal	RRUT 160	lemon	INTL
un-named lemon (?) ex-Nepal	RRUT 161	lemon	INTL
un-named lemon (?) ex-Nepal	RRUT 162	lemon	INTL
un-named lemon (?) ex-Nepal	RRUT 165	lemon	INTL
un-named sweet orange (?) ex-Nepal	RRUT 157	sweet orange	INTL
un-named trifoliolate ex-Beibei	RRUT 155	trifoliolate	INTL
US Early Pride	RRUT 389	mandarin hybrid	STATE
US-897	RRUT 384	trifoliolate hybrid	STATE
US-942	RRUT 532	citrandarin	STATE
USDA 1-22-32	RRUT 382	mandarin hybrid	STATE
USDA 1-25-1	RRUT 375	mandarin hybrid	STATE
USDA 1-42-70	RRUT 372	mandarin hybrid	STATE

USDA 1-46-30	RRUT 371	mandarin hybrid	STATE
USDA 1-49-105	RRUT 377	mandarin hybrid	STATE
USDA 5-51-2	RRUT 448	mandarin hybrid	STATE
USDA 5-8-122	RRUT 447	mandarin hybrid	STATE
USDA 6-2-53	RRUT 446	mandarin hybrid	STATE
USDA Navel 1-N	RRUT 390	navel orange	STATE
USDA Navel 2-C	RRUT 391	navel orange	STATE
USDA Navel 3-S	RRUT 392	navel orange	STATE
Valencia seedless	RRUT 394	valencia orange	INTL
Valencia SPB-1-14-19	RRUT 440	valencia orange	STATE
Variant citradia	RRUT 171	trifoliolate hybrid	STATE
Variegated	RRUT 311	citron	INTL
Vecino	RRUT 450	sweet lime	STATE
Xiangchen (OPS)	RRUT 100	papeda hybrid	INTL
Yemen	PI 539434	citron	STATE
Yuzuquat	RRUT 49	kumquat hybrid	STATE

Table 9. NCGRCD number of orders distributed 2013 – 2014.

**NPGS Summary Report for Orders for Site RIV**

**in Type: DI**

**01/01/2013 to**

**12/31/2014**

**Germplasm at Seed and Clonal Repositories**

Site	UARS	UFED	STA	UCOM	UPRU	UIND	UAID	INT	FGEN	FCOM	FPRU	FIND	Total	Percent
RIV	44	0	55	11	15	40	0	0	3	4	46	9	227	100.0 %
<b>Totals:</b>	<b>44</b>	<b>0</b>	<b>55</b>	<b>11</b>	<b>15</b>	<b>40</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>4</b>	<b>46</b>	<b>9</b>	<b>227</b>	<b>100.0 %</b>

**Percent of total :**

19.4 %    .0 %    24.2 %    4.8 %    6.6 %    17.6 %    .0 %    .0%    1.3 %    1.8 %    20.3 %    4.0 %    100.0 %

- FCOM** - Foreign commercial company
- FGEN** - Foreign genebank/genetic resources unit
- FIND** - Foreign individual no affiliation
- FPRU** - Foreign non-commercial organization
- INT** - CGIAR International Agr. Res. Center
- STA** - U.S. state agencies and all universities
- UAID** - US Agency for International Development
- UARS** - Agricultural Research Service
- UCOM** - U.S. commercial company
- UFED** - U.S. federal agency (not AID or ARS)
- UIND** - U.S. individual no affiliation
- UPRU** - U.S. non-profit organizations

Table 10. NCGRCD number of order items distributed (budwood or seed), 2013 – 2014.

**NPGS Summary Report for Order Items for Site RIV                    in Type : DI**

01/01/2013 to 12/31/2014

**Germplasm at Seed and Clonal Repositories**

Site	UARS	UFED	STA	UCOM	UPRU	UIND	UAID	INT	FGEN	FCOM	FPRU	FIND	Total	Percent
RIV	362	0	175	23	49	84	0	0	32	7	440	28	1200	100.0 %
<b>Totals:</b>	<b>362</b>	<b>0</b>	<b>175</b>	<b>23</b>	<b>49</b>	<b>84</b>	<b>0</b>	<b>0</b>	<b>32</b>	<b>7</b>	<b>440</b>	<b>28</b>	<b>1200</b>	<b>100.0%</b>

**Percent of total :**

	30.2 %	.0 %	14.6 %	1.9 %	4.1 %	7.0 %	.0 %	.0%	2.7 %	.6 %	36.7 %	2.3 %	100.0 %
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- FCOM** - Foreign commercial company
- FGEN** - Foreign genebank/genetic resources unit
- FIND** - Foreign individual no affiliation
- FPRU** - Foreign non-commercial organization
- INT** - CGIAR International Agr. Res. Center
- STA** - U.S. state agencies and all universities
- UAID** - US Agency for International Development
- UARS** - Agricultural Research Service
- UCOM** - U.S. commercial company
- UFED** - U.S. federal agency (not AID or ARS)
- UIND** - U.S. individual no affiliation
- UPRU** - U.S. non-profit organizations

Table 11. Details of accessions for which the shoot tip grafting process has been successfully completed and those in progress (2015), their quarantine status and lab test status. Note that blight tests are conducted only for selected accessions and analysis for dsRNA, sPAGE and culturing for *Spiroplasma citri* are conducted just prior to release after the citron index is completed and all other tests are negative. MPT indicates multiple pathogen testing for 18 different targets and for internal controls.

STG#	ACNO	Qstatus	STG	CULTIVAR	SOURCE	Blight	DSRNA	SPAGE	CULT	MPT
1	36	H	2000	Collins-Hibbert						P
2	140	H	2000	Bidwell's Bar						P
3	156	R	2010	un-named lemon (?) ex-Nepal			NEG	NEG	NEG	C
4	456	R	2010	Vaniglia acidless	CEVD		NEG	NEG	NEG	C
5	457	R	2010	Variegated Tahiti			NEG	NEG	NEG	C
6	386	H	2010	Cami	CTV		NEG	NEG	NEG	C
7	158	R	2011	un-named lemon (?) ex-Nepal	CTV		NEG	NEG	NEG	C
8	160	H	2011	un-named lemon (?) ex-Nepal					NEG	C
9	162	H	2011	un-named lemon (?) ex-Nepal					NEG	C
10	455	H	2011	Amoa 8			NEG			C
11	159	R	2011	un-named sweet orange (?) ex-Nepal			NEG	NEG	NEG	C
12	334	R	2011	Genova EEA Tucuman			NEG	NEG	NEG	C
13	393	H	2011	Campeona	CTV		NEG	NEG	NEG	C
14	311	H	2012	Variegated						C
15	163	R	2012	un-named sweet orange (?) ex-Nepal	CTV		NEG	NEG	NEG	C
16	161	H	2013	un-named lemon (?) ex-Nepal						P
17	165	H	2013	un-named lemon (?) ex-Nepal						P
18	387	H	2013	Bergamotto Fantastico	CTV		NEG			C
19	453	H	2013	Salò			NEG			C
20	454	H	2013	Horned			NEG			C
21	511	H	2013	Ordubad						P
22	113	H	2014	Little Sweetie						P
23	150	H	2014	Caoshixiangju (1-11- 12)	CTV					P
24	153	H	2014	Beibeiyou (15-3)					NEG	P
25	157	H	2014	un-named sweet orange (?) ex-Nepal						P
26	175	H	2014	Tomango					NEG	P
27	177	H	2014	Long huang kat						P
28	178	H	2014	Fuming evergreen trifoliolate						P

29	197	H	2014	pummelo #2 ex-Sichuan						P
30	222	H	2014	Canaliculata di Palermo						P
31	321	H	2014	Gou Tou Xiang Yuan (B)						P
32	389	H	2014	US Early Pride	CTV	NEG				P
33	440	H	2014	Valencia SPB-1-14-19		NEG				P
34	442	H	2014	Hamlin 1-4-1		NEG				P
35	443	H	2014	Bearss		NEG				P
36	452	H	2014	Italian pink-fleshed variegated						P
37	4211	H	2014	Old Indian						P
38	209862	H	2014	Messero						P
39	265834	H	2014	M'guerqueb		NEG	NEG	NEG		C
40	149	H	2015	Goutoucheng (4-1)	CTV					P
41	151	H	2015	Caoju (1-18-47)	CTV					P
42	154	H	2015	Shatianyong (2-1)					NEG	P
43	167	H	2015	Clementine X Murcott (C54-4-2)						P
44	168	H	2015	Shekwasha X Koethen (C61-252)						P
45	169	H	2015	Rico #6						P
46	170	H	2015	Red Mexican					NEG	C
47	196	H	2015	pummelo #1 ex-Sichuan						P
48	198	H	2015	pummelo #3 ex-Sichuan						P
49	388	H	2015	Gainesville 71	CTV	NEG				P
50	433265	H	2015	Nin Kat		NEG				P
51	658374	H	2015	Bahman Persian #2 nucellar						P
52	1998001	H	2015	Fumin Evergreen trifoliolate (OPS)						P

Table 12. Details of 42 accessions that underwent thermotherapy, their current of quarantine status, and lab tests. The list includes seven additional accessions that were received from other programs (Florida DPI and IVIA Spain) that have already been shoot tip grafted. The progress of thermotherapy is affected by the availability of functional thermo chambers, with our current capacity about four accessions can be therapied every three months.

Number	ACNO	Qstatus	Thermo	CULTIVAR	SOURCE	Blight	DSRNA	SPAGE	CULT	MPT
1	37	R	2000	Wilson			NEG	NEG	NEG	C
2	187	R	2000	Gardner	CTV	NEG	NEG	NEG	NEG	C
3	186	R	2003	Midsweet	CTV	NEG	NEG	NEG	NEG	C
4	189	R	2003	Murcott nearly seedless	CTV	NEG	NEG	NEG	NEG	C
5	190	R	2003	Tresca	CTV	NEG	NEG	NEG	NEG	C
6	654873	R	2003	Malta (Maltaise Sanguine)	CTV		NEG	NEG	NEG	C
7	181	R	2006	USDA 10-8		NEG	NEG	NEG	NEG	C
8	201	R	2006	US-812		NEG	NEG	NEG	NEG	C
9	219	R	2006	US-852		NEG	NEG	NEG	NEG	C
10	320	R	2006	John King		NEG	NEG	NEG	NEG	C
11	142	R	2007	Pursha Lime			NEG	NEG	NEG	C
12	152	R	2007	Fuju (1-10-17)	CTV		NEG	NEG	NEG	C
13	158	R	2007	un-named lemon (?) ex-Nepal	CTV		NEG	NEG	NEG	C
14	163	R	2007	un-named sweet orange (?) ex-Nepal	CTV		NEG	NEG	NEG	C
15	170	H	2007	Red Mexican					NEG	C
16	180	R	2007	Sunstar		NEG	NEG	NEG	NEG	C
17	182	R	2007	Succari	CTV	NEG	NEG	NEG	NEG	C
18	183	R	2007	Cooper		NEG	NEG	NEG	NEG	C
19	204	R	2007	Willits		NEG	NEG	NEG	NEG	C
20	226	R	2007	USDA 1-74-15		NEG	NEG	NEG	NEG	C
21	334	R	2007	Genova EEA Tucuman			NEG	NEG	NEG	C
22	4228	H	2007	Bitters Newhall	CTV		NEG	NEG	NEG	C
23	4233	R	2007	Webber Shaddock			NEG	NEG	NEG	C
24	230622	R	2007	Gioia Tauro		NEG	NEG	NEG	NEG	C
25	383	R	2009	US-802		NEG	NEG	NEG	NEG	C
26	384	H	2009	US-897		NEG	NEG			C
27	369	R	2010	USDA 1-43-21	CTV	NEG	NEG	NEG	NEG	C
28	374	R	2010	USDA 1-105-106		NEG	NEG	NEG	NEG	C
29	380	R	2010	USDA 1-42-65		NEG	NEG	NEG	NEG	C
30	382	H	2010	USDA 1-22-32	CTV	NEG				P
31	173	H	2014	Iwaikan					NEG	P
32	371	H	2014	USDA 1-46-30		NEG				P
33	372	H	2014	USDA 1-42-70	CTV	NEG				P
34	375	H	2014	USDA 1-25-1		NEG				P
35	390	H	2014	USDA Navel 1-N	CTV	NEG				P



36	446	H	2014	USDA 6-2-53		NEG				P
37	447	H	2014	USDA 5-8-122		NEG				P
38	448	H	2014	USDA 5-51-2		NEG				P
39	481	H	2014	Etonia citrange nucellar						P
40	439	H	2015	Kuharske						P
41	280540	H	2015	Hyuganatsu-mikan					NEG	P
42	539169	H	2015	Seville						P
43	483	R	DPI	LB8-9		NEG	NEG	NEG	NEG	C
44	484	R	DPI	US Furr-ST		NEG	NEG	NEG	NEG	C
45	486	R	DPI	Roble		NEG	NEG	NEG	NEG	C
46	191	H	IVIA	Daoxian wild orange						P
47	192	H	IVIA	Melanesian papeda						P
48	459	R	IVIA	Haploid Clemenules			NEG	NEG	NEG	C
49	460	R	IVIA	Palazzelli			NEG	NEG	NEG	C

Table 13. Details of accessions currently in biological indexing.

No.	ACNO	Qstatus	STG	TH	CULTIVAR	SOURCE	blight	DSRNA	SPAGE	CULT	CTV	LAS	LAF	LAM	CLBV	CPV	CTLV	CEVD	GI	GII	GIII	GIV	GV	GVI	XYLELLA	PhPLSM	SC	
1	160	H	2014		un-named lemon (?) ex-Nepal					NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
2	162	H	2014		un-named lemon (?) ex-Nepal					NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
3	311	H	2014		Variiegated						NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
4	384	H		2009	US-897		NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
5	386	H	2014		Cami	CTV POS		NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
6	387	H	2014		Bergamotto Fantastico	CTV POS		NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
7	393	H	2014		Campeona	CTV POS		NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
8	453	H	2014		Salò			NEG			NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
9	454	H	2014		Horned			NEG			NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
10	455	H	2014		Amoa 8			NEG			NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
11	4228	H		2007	Bitters Newhall	CTV POS		NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
12	36	H	2000		Collins-Hibbert						NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG				
13	140	H	2000		Bidwell's Bar						NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG				
14	161	H	2014		un-named lemon (?) ex-Nepal						NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG				
15	165	H	2014		un-named lemon (?) ex-Nepal						NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG				
16	168	H	2014		Shekwasha X Koethen (C61-252)						NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG				
17	169	H	2014		Rico #6						NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG				
18	191	H		IVIA	Daoxian wild orange						NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG				
19	192	H		IVIA	Melanesian papeda						NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG				
20	382	H		2010	USDA 1-22-32	CTV POS	NEG				POS	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG				
21	511	H	2014		Ordubad						NEG	NEG			NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG

Table 14. A summary of all the lab tests of citrus germplasm inventory items in the present database. In 2014, the lab pathogen tests databases of 2011-2014 (about 12,000 test results) along with all available results from previous years were assembled into a single database containing about 28,000 test results (not including those without an inventory number, and various controls used). While the test results of 2011-14 are nearly complete, the previous results are nowhere near completion.

<b>Number</b>	<b>Target</b>	<b>#Tests</b>	<b>2014</b>
1	BLIGHT	126	104
2	Ca. L. afrcanus	166	152
3	Ca. L. americanus	166	152
	<i>Candidatus Liberibacter</i>		
4	asiaticus	2474	173
5	<i>Citrus Exocortis viroid</i>	233	131
6	<i>Citrus leaf blotch virus</i>	1085	135
7	<i>Citrus psorosis virus</i>	236	66
8	Citrus tatter leaf virus	135	135
9	<i>Citrus tristeza virus</i>	20621	1524
10	Citrus viroid Group I	156	135
11	Citrus viroid Group II	300	131
12	Citrus viroid Group II	300	131
13	Citrus viroid Group III	135	135
14	Citrus viroid Group IV	135	135
15	Citrus viroid Group V	135	135
16	Citrus viroid Group VI	135	135
	Cytoplasmic citrus leprosis		
17	virus	1214	0
18	DSRNA	60	45
19	PHYTOPLASMA	283	283
20	sPAGE	45	39
21	<i>Spiroplasma citri</i>	701	298
22	<i>Spiroplasma citri</i> culture	56	17
23	<i>Xylella</i>	355	142
	total	<b>29252</b>	<b>6347</b>

Table 15. A list of 151 accessions in quarantine that are positive for *Citrus tristeza virus*. A total of 23 accessions out of 154 in the quarantine and another 129 out of 560 accessions that were taken from the UCR CVC as “pre-psyllid invasion” propagations in quarantine greenhouses were positive for CTV.

CTV#	LOCATION	CRC	ACNO	RRUT	CULTIVAR	GENUS	SPECIES
1	GH 1603-12-W	0	463	463	Temecula Sweet	Citrus	reticulata
2	GH 1603-11-W	0	448	448	USDA 5-51-2	Citrus	hybrid
3	GH 1603-07-E	0	444	444	Sunki	Citrus	sunki
4	GH 1603-12-W	0	440	440	Valencia SPB-1-14-19	Citrus	sinensis
5	GH 36-09	0	393	393	Campeona	Citrus	reticulata
6	GH 1603-05-W	0	392	392	Navel 3-5	Citrus	sinensis
7	GH 1603-03-W	0	391	391	Navel 2C	Citrus	sinensis
8	GH 1603-03-W	0	390	390	Navel 1-N	Citrus	sinensis
9	GH 1603-11-E	0	389	389	USDA 1-62-122	Citrus	reticulata
10	GH 1603-11-E	0	382	382	USDA 1-22-32	Citrus	reticulata
11	GH 1603-09-W	0	381	381	USDA 1-37-12	Citrus	reticulata
12	GH 1603-11-E	0	377	377	USDA 1-49-105	Citrus	reticulata
13	GH 1603-07-W	0	374	374	USDA 1-105-106	Citrus	reticulata
14	GH 1603-07-W	0	372	372	USDA 1-42-70	Citrus	reticulata
15	GH 1603-09-W	0	369	369	USDA 1-43-21	Citrus	reticulata
16	GH 36-04	0	178	178	Fuming Evergreen Trifoliolate	Poncirus	polyandra
17	GH A-14	0	156	156	Citrus limon	Citrus	limon
18	GH 36-04	0	152	152	Fuju (1-10-17)	Citrus	reticulata
19	GH 36-01	0	151	151	Caoju (1-18-47)	Citrus	reticulata
20	GH 36-01	0	150	150	Caoshixiangju (1-11-12)	Citrus	reticulata
21	GH 36-05	0	149	149	Goutoucheng (4-1)	Citrus	aurantium
22	GH 36-03	0	163	163	Citrus sinensis	Citrus	sinensis
23	GH 1603-02-E	0	133261		Bahianinha Piracicaba	Citrus	sinensis
24	GH 1623-04-S	138	539413		Indian	Citrus	medica
25	GH 1623-04-S	138	539414		Indian	Citrus	medica
26	GH 1623-04-S	275	539813		Savage	X Citroncirus	sp.
27	GH 1623-04-S	292	539602		Homosassa	Citrus	sinensis
28	GH 1623-04-S	303	539456		King	Citrus	nobilis
29	GH 1623-04-S	314	539662		Hart's Late	Citrus	sinensis
30	GH 1623-04-S	363	539285		unnamed	Citrus	limettioides
31	GH 1623-04-S	366	539615		Star	Citrus	sinensis
32	GH 1623-04-N	432	539250		Cabuyao	Citrus	hystrix
33	GH 1623-04-N	448	539407		Moanalua	Citrus	maxima
34	GH 1623-04-N	570	539668		Hart's Tardiff	Citrus	sinensis
35	GH 1623-04-N	591	539650		St. Michael Paperrind	Citrus	sinensis

36	GH 1623-04-N	596	539488		Imperial	Citrus	paradisi
37	GH 1623-04-N	602	13005		Dancy (Weshart)	Citrus	tangerina
38	GH 1623-04-N	609	539583		McFadden	Citrus	sinensis
39	GH 1623-06-S	693	539237		Orogold	Citrus	hybrid
40	GH 1623-06-S	760	539177		Citrus vulgaris	Citrus	aurantium
41	GH 1623-06-S	767	539449		Webber's Weeping Philippine hybrid	Citrus	montana
42	GH 1623-06-S	956	539585		Washington Seedy	Citrus	sinensis
43	GH 1623-06-S	1045	37782		Laranja Selecta	Citrus	sinensis
44	GH 1623-06-S	1106	539588		Koethen	Citrus	sinensis
45	GH 1623-06-S	1203	539558		Vari	Citrus	sinensis
46	GH 1623-06-N	1222	539257		Mazoe	Citrus	jambhiri
47	GH 1623-06-N	1241	539559		Parent Washington	Citrus	sinensis
48	GH 1623-06-N	1441	539809		Rusk	X Citroncirus	sp.
49	GH 1623-06-N	1456	539693		Kalpi	Citrus	webberi
50	GH 1623-05-N	1481	539411		Lemelo	Citrus	maxima
51	GH 1623-05-N	1485	539740		Sydney Hybrid	Microcitrus	hybrid
52	GH 1623-05-N	1512	539589		Bidwell's Bar	Citrus	sinensis
53	GH 1623-05-N	1693	539590		Bessie	Citrus	sinensis
54	GH 1623-05-N	1696	539591		Homosassa	Citrus	sinensis
55	GH 1623-05-N	1795	539415		Corsican	Citrus	medica
56	GH 1623-05-N	1813	539152		West Indian	Citrus	aurantiifolia
57	GH 1623-05-N	2011	539695		San Jacinto	Citrus	x tangelo
58	GH 1623-05-N	2188	539153		Stow #7	Citrus	aurantiifolia
59	GH 1623-05-S	2316	539192		Citrus excelsa	Citrus	excelsa
60	GH 1623-05-S	2320	539346		Winged Lime	Citrus	longispina
61	GH 1623-05-S	2323	539287		India	Citrus	limon
62	GH 1623-05-S	2325	539258		South African	Citrus	jambhiri
63	GH 1623-05-S	2338	539364		unnamed	Citrus	maxima
64	GH 1623-03-N	2343	539368		Philippine	Citrus	maxima
65	GH 1623-03-N	2369	539592		East Highlands	Citrus	sinensis
66	GH 1623-03-N	2373	539593		Dalandan	Citrus	sinensis
67	GH 1623-03-N	2376	539494		Tien Chieh	Citrus	reticulata
68	GH 1623-03-N	2427	539187		Davao	Citrus	davaoensis
69	GH 1623-03-S	2439	539801		Eremolemon	X Citremocitrus	sp.
70	GH 1623-03-S	2449	539154		Everglade	Citrus	aurantiifolia
71	GH 1623-03-S	2450	539155		India	Citrus	aurantiifolia
72	GH 1623-03-S	2454	539248		Citrus hystrix	Citrus	hystrix
73	GH 1623-03-S	2458	539205		Perrine	Citrus	hybrid
74	GH 1623-03-S	2459	539206		unnamed	Citrus	hybrid
75	GH 1623-03-S	2543	539699		Sexton	Citrus	x tangelo

76	GH 1623-03-S	2544	539290		Indian	Citrus	limon
77	GH 1623-03-S	2550	539595		Wetumpka	Citrus	sinensis
78	GH 1627-02-S	2560	600633		Early	Citrus	x tangelo
79	GH 1627-02-S	2588	539680		Nansho daidai	Citrus	taiwanica
80	GH 1627-02-S	2590	539495		Tien Chieh	Citrus	reticulata
81	GH 1627-02-S	2602	539596		Diller	Citrus	sinensis
82	GH 1627-02-S	2606	539704		Sunrise	Citrus	x tangelo
83	GH 1627-02-S	2609	539705		Sacaton	Citrus	x tangelo
84	GH 1627-02-S	2618	539839		Citrandarín	X Citroncirus	sp.
85	GH 1627-02-S	2689	539654		San Marino	Citrus	sinensis
86	GH 1627-02-N	2692	14007		Timkat	Citrus	oleocarpa
87	GH 1627-02-N	2710	539189		Shekwasha	Citrus	depressa
88	GH 1627-02-N	2784	539466		Jochimsen	Citrus	paradisi
89	GH 1627-02-N	2787	149429		Williams	Citrus	x tangelo
90	GH 1627-02-N	2788	149430		Sunshine	Citrus	x tangelo
91	GH 1627-02-N	2802	539598		Argentina	Citrus	sinensis
92	GH 1627-02-N	2847	105957		Yemen	Citrus	medica
93	GH 1627-04-S	2865	150917		Uvalde	X Citroncirus	sp.
94	GH 1627-04-S	2867	539215		Calashu	Citrus	hybrid
95	GH 1627-04-S	2892	539194		Citrus excelsa	Citrus	excelsa
96	GH 1627-04-S	3017	539565		Gillette	Citrus	sinensis
97	GH 1627-04-S	3022	539501		Frua	Citrus	reticulata
98	GH 1627-04-N	3052	230987		Citrus latipes	Citrus	latipes
99	GH 1627-04-N	3060	539259		unnamed	Citrus	jambhiri
100	GH 1627-04-N	3063	539260		Jullundri Khatti	Citrus	jambhiri
101	GH 1627-04-N	3069	539802		Warren Limequat	X Citrofortunella	sp.
102	GH 1627-04-N	3070	539213		India	Citrus	hybrid
103	GH 1627-04-N	3072	539212		Addanimma	Citrus	hybrid
104	GH 1627-04-N	3083	539603		Sathgudi	Citrus	sinensis
105	GH 1627-06-S	3085	539502		Szinkom	Citrus	reticulata
106	GH 1627-06-S	3093	539278		unnamed	Citrus	limetta
107	GH 1627-06-S	3103	539249		Citrus hystrix	Citrus	hystrix
108	GH 1627-06-S	3146	539713		Citrus yuko	Citrus	yuko
109	GH 1627-06-S	3147	539276		Citrus leiocarpa	Citrus	leiocarpa
110	GH 1627-06-S	3148	539669		Citrus sinograndis	Citrus	sinograndis
111	GH 1627-06-S	3150	539679		Citrus tachibana	Citrus	tachibana
112	GH 1627-06-S	3152	238796		Dobla Fina	Citrus	sinensis
113	GH 1627-06-S	3154	230834		unnamed	Citrus	hybrid
114	GH 1627-06-N	3173	235991		Citrus assamensis	Citrus	assamensis
115	GH 1627-06-N	3174	230626		Un-named, ex-Morocco	Citrus	medica

116	GH 1627-06-N	3175	213349	Un-named, ex-India	Citrus	sp.
117	GH 1627-06-N	3181	539604	Ruvel	Citrus	sinensis
118	GH 1627-06-N	3183	539242	Mency	Citrus	nobilis
119	GH 1627-08-S	3225	539348	Citrus maderaspatana	Citrus	maderaspatana
120	GH 1627-08-S	3239	254732	unnamed	Citrus	reticulata
121	GH 1627-08-S	3242	218019	Vaccaro	Citrus	sinensis
122	GH 1627-08-S	3245	539607	Capucin	Citrus	sinensis
123	GH 1627-08-S	3246	105009	Cadena Punchosa	Citrus	sinensis
124	GH 1627-08-S	3249	123983	Espagnole sans pepins	Citrus	sinensis
125	GH 1627-08-S	3251	539608	Khailily	Citrus	sinensis
126	GH 1627-08-N	3260	254779	Soh niamtra	Citrus	reticulata
127	GH 1627-08-N	3261	539296	Soh synteng	Citrus	limon
128	GH 1627-08-N	3297	539684	Citrus tardiva	Citrus	tardiva
129	GH 1627-08-N	3300	241118	Wild	Citrus	limon
130	GH 1627-08-N	3326	539505	Scarlet Emperor	Citrus	reticulata
131	GH 1627-08-N	3328	539504	Solid Scarlet	Citrus	reticulata
132	GH 1627-10-S	3329	539506	Richard's Special	Citrus	reticulata
133	GH 1627-10-S	3331	539708	Sacaton	Citrus	x tangelo
134	GH 1627-10-S	3336	539817	unnamed	X Citroncirus	sp.
135	GH 1627-10-S	3339	539663	Werley	Citrus	sinensis
136	GH 1627-10-S	3354	539573	Dry	Citrus	sinensis
137	GH 1627-10-S	3367	105006	Mandarine Sanguine	Citrus	reticulata
138	GH 1627-10-S	3373	105008	Precoce de Valence	Citrus	sinensis
139	GH 1627-10-S	3385	539262	Florida "A"	Citrus	jambhiri
140	GH 1627-10-S	3386	539263	Estes	Citrus	jambhiri
141	GH 1627-01-S	3388	539299	Femminello Ovale	Citrus	limon
142	GH 1627-01-S	3401	539548	Sanguine Grosse Ronde	Citrus	sinensis
143	GH 1627-01-S	3403	262347	Aziza	Citrus	sinensis
144	GH 1627-01-S	3405	263547	Mandarinette	Citrus	reticulata
145	GH 1627-01-S	3464	539686	Citrus tengu	Citrus	tengu
146	GH 1627-01-N	3474	539255	Citrus intermedia	Citrus	intermedia
147	GH 1603-04-W	3520	539421	Corsican	Citrus	medica
148	GH 1603-04-E	3521	539422	Corsican	Citrus	medica
149	GH 1603-04-E	3522	539423	Diamante	Citrus	medica
150	GH 1603-05-E	3526	539425	Etrog	Citrus	medica
151	GH 1603-10-E	3536	539434	Yemen	Citrus	medica

Table 16. Pathogen status of plants in quarantine but not yet therapied.

ACNO	CULTIVAR	CTV_ELISA	LIBERI	CEVD	GII	GIII	GIV	CTV	CPV	CTLV
31	Ruby 4N	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
32	Temple 4N	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
49	Yuzuquat	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
74	Hongju nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
76	Baiju nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
77	Gaojiantou Mitong nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
81	Suanju nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
82	Fuju nucellar	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
83	Huangguogan nucellar	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
84	'Limon pummelo' ex-Reili County nucellar	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
85	Local lime 2-8 ex-Reili County (OPS)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
86	Local lime ex-Xiaochenghang nucellar	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
89	Foerster "mutant" nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
90	Mediterranean nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
91	Tonkan nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
100	Xiangchen (OPS)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
104	Man Ju (OPS)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
106	Huangguogan #1 nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
107	'lemon pummelo' ex-western Yunnan (OPS)	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
113	Little Sweetie	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
119	Corniculata (OPS)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
138	Pomo d'Adamo nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
143	Hawaiian	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
146	Limequat	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
148	Shamel	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
149	Goutoucheng (4-1)	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
150	Caoshixiangju (1-11-12)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
151	Caoju (1-18-47)	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
153	Beibeiyou (15-3)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
154	Shatianyou (2-1)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
155	un-named trifoliolate ex-Beibei	NEG	NEG	NEG	POS	NEG		NEG	NEG	NEG
157	un-named sweet orange (?) ex-Nepal	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
161	un-named lemon (?) ex-Nepal	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
165	un-named lemon (?) ex-Nepal	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
166	Clementine X Orlando (F-6-9-10)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
167	Clementine X Murcott (C54-4-2)	NEG	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG



ACNO	CULTIVAR	CTV_ELISA	LIBERI	CEVD	GII	GIII	GIV	CTV	CPV	CTLV
168	Shekwasha X Koethen (C61-252)	NEG	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG
169	Rico #6	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
171	Variant citradia	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
172	Sarah #2	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
173	Iwaikan	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
174	Ling Mung	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
175	Tomango	NEG	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG
176	Red ling mung	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
177	Long huang kat	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
178	Fuming evergreen trifoliolate	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
178	Fuming evergreen trifoliolate	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
184	Bahianinha Monte Parnazo	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
185	Tung kum	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
188	Swingle	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
196	pummelo #1 ex-Sichuan	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
197	pummelo #2 ex-Sichuan	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
198	pummelo #3 ex-Sichuan	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
222	Canaliculata di Palermo	NEG	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG
311	Variegated	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
321	Gou Tou Xiang Yuan (B)	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
371	USDA 1-46-30	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
372	USDA 1-42-70	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
375	USDA 1-25-1	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
377	USDA 1-49-105	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
382	USDA 1-22-32	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
385	Hudson #1 (4N)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
387	Bergamotto Fantastico	NEG	NEG	NEG	NEG	NEG		NEG	NEG	NEG
388	Gainesville 71	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
389	US Early Pride	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
390	USDA Navel 1-N	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
391	USDA Navel 2-C	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
392	USDA Navel 3-S	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
393	Campeona	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
394	Valencia seedless	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
439	Kuharske	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
440	Valencia SPB-1-14-19	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
441	Pon tri DPI-50-7-6	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
442	Hamlin 1-4-1	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
443	Bearss	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
444	Sunki	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
445	Umatilla	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
446	USDA 6-2-53	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
447	USDA 5-8-122	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
448	USDA 5-51-2	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
449	Garcia-Yanez	NEG	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG
450	Vecino	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
451	Dona Adelina	NEG	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG

ACNO	CULTIVAR	CTV_ELISA	LIBERI	CEVD	GII	GIII	GIV	CTV	CPV	CTLV
452	Italian pink-fleshed variegated	NEG	NEG	NEG	POS	NEG		NEG	NEG	NEG
453	Salò	NEG	NEG	NEG	POS	NEG	NEG	NEG	NEG	NEG
454	Horned	NEG	NEG	NEG	POS	POS	NEG	NEG	NEG	NEG
133261	Bahianinha Piracicaba	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
209862	Mesero	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
265834	M'guerqueb	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
280540	Hyuganatsu-mikan	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
433265	Nin Kat	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
539169	Seville	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
539241	H-56	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
539421	Corsican	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
539422	Corsican	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
539423	Diamante	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
539425	Etrog	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
539434	Yemen	POS	NEG	NEG	NEG	NEG	NEG	POS	NEG	NEG
539464	New Zealand Grapefruit	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
600635	Afraegle gabonensis	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
658374	Bahman Persian #2 nucellar	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
1998001	Fumin Evergreen trifoliolate (OPS)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG
2000003	Consolei (OPS)	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG	NEG

**Figure. 1.** A graph showing number of accessions successfully therapied through shoot tip grafting (STG) by year. In 2012-13, elaborate facilities were obtained for STG which include a room dedicated for STG and cryotherapy with window air conditioner, a large laminar flow hood, a good Leica stereo microscope, and a total of four growth chambers and others.

