Minutes from Tomato CGC meeting on January 28, 2016 on a Conference Call

Meeting Attendees:

- Rich Ozminkowski Jr
- Barbara Liedl
- Gary Kinard
- Joanne Labate
- Larry Robertson
- Felix Serquen
- David Francis
- Roger Chetelat
- John Stommel
- Jim Augustine
- Jasmine Lopez
- Sam Hutton
- Dilip Panthee
- John Snyder

Not present: Jit Baral, Majid Foolad

The meeting was called to order at 12:35 pm ET by Rich Ozminkowski, Chair

1. **Review of minutes from Tomato CGC meeting at 45th Tomato Breeders Roundtable**: Minutes from the last meeting in Asheville September 15, 2014 were reviewed and no changes were necessary.

2. **Germplasm priority list**: The group was polled to assessed if we should update the priority listed developed in 2014. David Francis suggested that creating a crop vulnerability statement is more important than working on the priority list at this point. He also suggested that the crop vulnerability statement could generate changes for the priority list. Industry stakeholders supported this recommendation.

3. **NGRL - (Kinard):** The 2016 report from the NGRL was provided to the group and highlights of the report were given. Gary Kinard, who helps coordinate the germplasm committees, thanked the group for their help to the NPGL.

    a. Status of GRIN Global: The launch of GRIN Global occurred November 30, 2015 with a reasonably smooth transition from GRIN Classic. Web security for the "dot" gov site pushed back the release date. There have been some issues reported, but the resources for the fixes and the added security protocols that needed to be put in place to make sure that no new vulnerability were introduced will reduce the ability to fix identified problems quickly. Thus the NGRL has asked for our indulgence with them during the process of working out the bugs in the system because of this new process. Rich Ozminkowski noted that during the CGC Chairs meeting in the fall they saw a demonstration of GRIN Global and felt that it has more useable features that had not been available previously. NPGL is looking to offer this demonstration in the future for members of CGC and others that would be interested.

b. Crop Vulnerability Statement: Gary Kinard urged the group to work on developing this report as it is useful for not only our group but also would be useful to the NPGL. He offered the template that NPGL has developed and also suggested we look at what the apple CGC has published and what the leafy greens CGC is working to publish. Kinard will send the apple report as an example.

c. Germplasm Requests: The group discussed how germplasm requests are tracked and how long it takes to get them fulfilled. Previous versions of GRIN provided a confirmation list and a contact person for any questions. The seed requests are processed in the order received, but time to fulfill them varies based on staff availability. Roger Chetelat has considered providing a turnaround time for requests which would vary based on it being domestic vs. international. David Francis spoke for NAPB and their work with ASTA to highlight the groups concerns about the ability for curators to be able to fulfill their primary mission of curating and supplying materials to stakeholders. Francis also expressed concern the work was drifting more towards research, a different mission

d. Germplasm Exploration: An update on the status of germplasm exploration projects was provided by Gary Kinard. Roger Chetelat said it was unlikely anyone could get any Solanum material from Ecuador or Peru. Peru does not have a germplasm center or any germplasm research. Ecuador has more collaboration and research on tomatoes. In both cases, materials from these countries can only come out for research purposes and cannot be distributed. He is still waiting on adding material collected for research from a 2009 exploration that is currently at CIP but not being maintained. Chile was mentioned as a possible location to collect, but there was no pressing need to re-collect there at this time. The lack of permission is due partly to national policies in Peru and Ecuador and it is affected by the US position on the treaties and does influence their cooperation (e.g. CBD not being ratified by Congress). Roger Chetelat pointed out in some cases the TGRC has accessions that no longer exist in the countries they were originally collected in. Thus, the group felt that maintenance of the existing collection is much more important given our inability to collect. Rich Ozminkowski suggested that this should be included in the crop vulnerability statement. The group discussed that while we do have collections from these areas that does not mean that we have maintained the genetic diversity. So if possible, it would be good to be able to recollect. Gary Kinard suggested that we consider other places we might not have considered collecting and having their office work to get an exploration trip requested which may take years.

4. **TGRC Report – (Chetelat)**: The 2015 annual progress report was provided (attached). Highlights were provided from Roger Chetelat. No new accessions were added in 2015. Of the 3,833 accessions maintained by TGRC, 1,762 were grown during the year. TGRC is moving the collection to storage in foil pouches stored at -18^{o}C to maintain long-term seed viability. They do not currently have a -20^{o}C walk-in freezer for storage but are looking for funding. The addition of this would provide 25-year expectation on seed longevity. They are also working with using zeolite beads to reduce the moisture content of seeds, but there is no research to identify if this helps with seed longevity. Currently the seed supply used for seed requests are stored at 5^{o}C, which is less than ideal. Last year was a record year for seed distribution with 7,093 seed samples representing 2,384

unique accessions distributed in response to 356 requests in 31 countries. The prior high distribution was in 2006 of only 6,000, illustrating the importance of this collection to the community both within and outside of the United States. Documentation changes at TGRC involved mostly internal improvements. This included new images, seed lots and quantities of seed. They have linked their phytosanitary numbers to seed lots to facilitate online requests for phytosanitary certificates. They have also added a new mapping feature to plot accessions of all species within a given region on the website. TGRC has a number of projects that are externally funded, but it was noted that the Federal cutbacks have affected TGRC. In prior years, TGRC received $60,000 per year but that has been cut to $60,000 for three years. Currently, the USDA funds support about 10% of the yearly budget, excluding the curator's salary. They are working to raise the endowment to provide funding, but the majority of these requests have focused on organizations in California. Florida and the international groups have not been directly requested to support the endowment. The seed industry has been less supportive compared to the processors and growers. Finally, it was noted that the 2016 Solanaceae Genomics meeting will be in Davis, CA Sept 12-16, 2016 (http://solgenomics2016.ucdavis.edu/). When asked on the state of the germplasm collection at TGRC, Dr. Chetelat responded that it is good, but not strong.

5. **PRGU Report (Robertson/Labate):** The 2015 PGRU report is attached and highlights were provided. PGRU conserves 6,600 accessions and almost all are backed-up with seed available for distribution. Last year they lost all of the lines planted for regeneration due to flooding three times. They do however, plan to plant these lines out in 2016 field season. Another ongoing problem is staffing as the station is down three people, which limits their ability to do their basic mission of conserving and distributing germplasm. Currently existing staff has had to do their own jobs and help fill in the holes left from lack of staff. This limited their ability to fulfill seed requests with a minimum of 4-5 week delays. End of year funds were passed from PGRU sent $25,000 through a cooperative agreement to TGRC. Research highlights were provided by Joanne Labate who highlighted a publication on chemical traits for 10 accessions, which are part of the core collection. Additional data on other accessions from the core are currently being analyzed. Rich Ozminkowski asked Larry Robertson the state of the PGRU collection at this time and was told that the state of our germplasm collection is in pretty good shape even given the low level regeneration because the majority of the collection is backed up at Fort Collins and seed are available for distribution.

6. **Membership Request**: Rich Ozminkowski had been approached by Sue Peters that Bayer has a new tomato pre-breeder (Donna Harris) who might be interested in participating in the CGC and he asked the group how they felt about this addition. The group was supportive of the idea of a new member, but it was suggested that with their lack of knowledge about the crop their ability to help with the work load of the committee was limited, and that the committee size seemed appropriate at this time. Instead, it was suggested that we visit with her at the TBRT in March to determine if they are interested in participating in the CGC.

7. **Grant Requests**: Rich Ozminkowski said he has not received any proposals for the current RFA which are due to him on Feb 2nd. David Francis brought up the fact that the amount of funding for evaluation proposals available to the CGCs has not changed in 25 years and the funds available are too low to be useful and require too much effort for the small amount. Several of the group pointed

out that if we want germplasm to evaluated we need enough funds over a longer time to make this a feasible option. There was a discussion on whether or not USDA employees could apply for this funding. The group was supportive of this and asked Gary Kinard to find out if this is possible. Sam Hutton's report from the last evaluation project the Tomato CGC received was submitted to the group.

8. **Crop Vulnerability Statement:** The group felt having a Crop Vulnerability Statement would be helpful, but acknowledge that it would take time to develop. David Francis suggested looking at the apple version which was published and Rich Ozminkowski offered to supply the file to anyone you did not have it. The subcommittee established at the 2014 CGC meeting, and others, will convene at the March, 2015 TBRT to begin discussion on the CVS.

9. **TBRT:** The 46th Tomato Breeders Roundtable will be held in Santo Domingo March 13-16, 2016. Several members affirmed their attendance including David Francis, Jasmine Lopez, Sam Hutton, Dilip Panthee, and Rich Ozminkowski are attending meeting.

The meeting was adjourned at 2:00 pm ET.

Respectfully submitted by B. E. Liedl

Tomato Germplasm Conservation at the
Plant Genetic Resources Unit – Geneva, NY

January, 2016
Teleconference Call

Currently, there are 6,600 accessions of 13 *Solanum* species conserved at the Northeast Regional Plant Introduction Station located at the PGRU, Geneva, New York (Table 1). This includes 927 accessions which have been transferred to Geneva from the National Center for Germplasm Conservation to consolidate the tomato germplasm collection. 1423 accessions that previously had only G or NSSL accession numbers have been assigned PI accession numbers and the only G accession numbers are accessions that have been recently received and are in the process of being regenerated. Accessions that were considered duplicate accessions have been inactivated with the accession they are duplicates of marked in the germplasm database so that users can access the representative sample of the accession; this includes 239 PI accession numbers, 51 G accession numbers, and 225 NSL accession numbers. The new taxonomic classification system for tomato has been implemented in GRIN and is reflected in Table 1.

Table 1. Tomato germplasm conserved at the Plant Genetic Resources Unit located at Geneva, NY

Species	Accessions	Backup
arcanum	4	3
cheesmaniae	7	6
chilense	1	1
chmielewskii	7	7
corneliomulleri	13	12
galapagense	5	5
habrochaites	63	40
neorickii	1	1
pennellii	10	4
peruvianum	122	96
pimpinellifolium	231	227
lycopersicum	5964	5795
subsect. lycopersicon hybr.	158	158
subsect. lycopersicon spp.	14	3
TOTAL	**6600**	**6358**

Characterization for the minimal descriptor list and digital imaging of the germplasm accessions has been incorporated as part of the regeneration process. In 2013 58 and in 2014 60 accessions were characterized with digital images of fruit and foliage also taken. In addition, these accessions were evaluated using the Tomato Analyzer Program.

From 2010 through 2015 we have regenerated 525 cultivated tomato accessions; most of these were newly transferred accessions and accessions collected as part of the tomato core collection. Essentially all cultivated tomato accessions are now available for distribution. Funds were

obtained to support the Assistance Cooperative Agreement with the Tomato Genetic Resources Center at the University of California-Davis for one more year with $25,000 funds. Over the past three years this agreement has been used to distribute $60,000 to TGRC. Distribution of the tomato germplasm collection at PGRU for the past five years is given in Tables 2 and 3 (accessions and samples). An average of 1371 accessions has been distributed over the past three years. The majority of the *Solanum* accessions distributed have been *Solanum lycopersicum.*

Table 2. Distribution of tomato germplasm accessions at PGRU for 2011 through 2015

Species	**2011**	**2012**	**2013**	**2014**	**2015**	**Ave.**
arcanum	3	4	2	2	3	3
cheesmaniae	6	5	2	2	6	4
chilense	1	1	1	1	1	1
chmielewskii	7	7	3	5	5	5
corneliomulleri	13	12	4	4	8	8
galapagense	4	4	3	4	4	4
habrochaites	46	52	9	19	13	28
neorickii	1	1	1	0	1	1
pennellii	5	5	2	3	5	4
peruvianum	94	112	10	12	41	54
pimpinellifolium	220	211	45	21	44	108
lycopersicum	5561	5148	1085	883	1842	2904
subsect. lycopersicon hybr.	156	155	4	43	16	75
subsect. lycopersicon spp.	5	14	0	0	2	4
Total	6122	5731	1171	999	1991	3203

2014-2015 Tomato and research highlights at PGRU

1) Breksa III, A.P., L.D. Robertson, J.A. Labate, B.A. King, D.E. King. 2015. Physicochemical and morphological variation in tomato fruit: implications for improved quality, size and shape components. J Food Comp. Anal. 42:16-25.

We are in the process of publishing analyzing a study that

- characterized a diverse set of 52 historic U.S.A. tomato varieties for fruit quality (antioxidants, sugars, acids, Vitamin C and color), size and morphological (size and shape) variables using replicated trials across two environments
- evaluated the reproducibility of assays for organic acids, carbohydrates and antioxidants in cryopreserved samples of homogenized fruit
- estimated effects due to genotype, environment and their interaction on fruit quality and morphological variables
- provided insight into which traits distinguished the varieties and as to whether these traits were interrelated, correlated or predictive of each other
- discovered which traits are tractable for crop improvement based on their heritability, relationships and ease of assay
- currently we are analyzing cation data to determine relationships among accessions and decades.

2) A core set of 190 PGRU tomato accessions was genotyped using GBS. These originated from 31 countries. Discovered ~36,000 SNPs. Applied these criteria: 1) high quality genotype score (GQ = 98), 2) SNP site was scored in a minimum of 10% of DNA samples, and 3) minor allele was represented at least three times. Identified 3,713 high quality, mapped SNPs. Estimated genetic distances and performed cluster analysis. Preliminary results - a set of seven processing lines clustered together, four of six San Marzano accessions clustered together, *S. pimpinellifolium* and G 33075 (T932 from Italy) clustered together. Results are available by request if anyone would like to review them.

Table 3. Distribution of tomato germplasm samples at PGRU for 2011 through 2015

Genus/Species	2011	2012	2013	2014	2015	Total
arcanum	3	4	2	2	4	15
cheesmaniae	8	14	3	2	15	42
chilense	2	1	1	1	1	6
chmielewskii	10	18	3	5	7	43
corneliomulleri	14	27	5	4	8	58
galapagense	5	10	4	6	9	34
habrochaites	64	72	13	29	26	204
neorickii	2	4	1	0	2	9
pennellii	15	10	4	3	8	40
peruvianum	118	225	20	17	59	439
pimpinellifolium	231	349	52	23	62	717
lycopersicum	6985	6852	1612	1193	2737	19,379
subsect. lycopersicon hybr.	200	183	5	48	18	454
subsect. lycopersicon spp.	8	16	0	0	2	26
TOTAL	7665	7785	1725	1333	2958	21,466

GRIN:

With 2016 the new version of GRIN has been rolled out: GRIN-Global. The website now gives more options and a different look for searching for germplasm accessions.

C.M. Rick Tomato Genetics Resource Center

Progress Report for CGC Conference Call 1/28/2016

Acquisitions. The TGRC acquired no new accessions in 2015. We recovered one accession of *S. cheesmanii* that had formerly been listed as 'inactive'. Obsolete or redundant accessions were dropped. The current total of number of accessions maintained by the TGRC is 3,833.

Maintenance and Evaluation. A total of 1,762 cultures were grown for various purposes, of which 492 were for seed increase (85 of which were of wild species) and 661 for germination tests. Progeny tests were performed on 141 stocks of segregating mutants (e.g. male steriles, homozygous lethals, etc) or various lines with unexpected phenotypes. 170 stocks were grown for introgression of the *S. sitiens* genome. Other stocks were grown for research on interspecific reproductive barriers. Newly regenerated seed lots were split, with one sample stored at 5° C to use for filling seed requests, the other stored in sealed pouches at -18° C to better maintain long term seed viability. Backup samples of 239 seed lots were submitted to the USDA Natl. Center for Genetic Resources Preservation in Colorado, and 70 were sent to the Svalbard Global Seed Vault in Norway.

Distribution and Utilization. A total of 7,093 seed samples representing 2,384 unique accessions were distributed in response to 356 requests from 259 researchers and breeders in 31 countries; at least 18 purely informational requests were also answered. The overall utilization rate was 185% (i.e. number of samples distributed relative to the number of active accessions), an exceedingly high activity for any genebank, and proof that our collection is heavily used. Information provided by recipients indicates our stocks continue to be used to support a wide variety of research and breeding projects. Our annual literature search again uncovered a large number of publications mentioning use of our stocks.

Documentation. Data on accessions, genes, images, seed inventory and seed requests were regularly updated. New images, with captions, were added. New seed lots were inventoried, and the quantities of seed available in existing seed lots was updated to reflect current supply. Our database was modified in various ways to improve internal record keeping and work flow. We now link PQ numbers to seed lot information to facilitate online requests for phytosanitary certificates for large requests. A revised list of miscellaneous genetic stocks was published in the Tomato Genetics Cooperative Report (http://tgc.ifas.ufl.edu).

Research. The TGRC continued research on the mechanisms of interspecific reproductive barriers and on introgression of the *S. sitiens* genome. We published a paper on the cloning of a major pollen incompatibility gene, *ui1.1*, and submitted a paper on natural variation for pollen incompatibility genes in *S. habrochaites*. We published a method for hybridizing cultivated tomato with *S. sitiens,* a potential source of tolerance to low temperatures, drought and salinity. (Strong crossing barriers had previously been deterred use of this species for tomato improvement.) We further advanced a set of breeding lines representing the genome of *S. sitiens* in a cultivated tomato background. Our goal is to develop a set of 'introgression lines' – prebred stocks containing defined chromosome segments from the donor genome – that will provide the first breeder friendly germplasm resources for this wild species.

Publications:

Chetelat, R. T. (2015) Revised list of wild species stocks. TGC Report 65.

Roger T. Chetelat (2015). Overcoming sterility and unilateral incompatibility of *Solanum lycopersicum* × *S. sitiens* hybrids. *Euphytica* 207: 319-330.

Li, W. and R. T. Chetelat (2015). Unilateral incompatibility gene *ui1.1* encodes an S-locus F-box protein expressed in pollen of *Solanum* species. *PNAS* 112: 4417-4422

Baek, Y.S., P.A. Covey, J. J. Petersen, R. T. Chetelat, B. McClure and P. A. Bedinger (2015). Testing the SI × SC rule: Pollen–pistil interactions in interspecific crosses between members of the tomato clade (*Solanum* section *Lycopersicon*, Solanaceae). *Am. J. Bot*. 102: 1-10.