Report

of the

Tomato Genetics Cooperative

Number 51 - September 2001

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Ithaca, NY 14853

Foreword

The Tomato Genetics Cooperative, initiated in 1951, is a group of researchers who share an interest in tomato genetics, and who have organized informally for the purpose of exchanging information, germplasm, and genetic stocks. The Report of the TGC is published annually and contains reports of work in progress by members, announcements, and updates on linkage maps and materials available. The research reports include work on diverse topics such as new traits or mutants isolated, new cultivars or germplasm developed, interspecific transfer of traits, studies of gene function or control and tissue culture. Relevant work on other Solanaceous species is encouraged as well.

Membership currently stands at approximately 200 from 30 countries. Requests for membership (US$15 plus $5 shipping if international) after November 1, 2001, should be sent to Dr. J.W. Scott, Gulf Coast Research and Education Center, 5007 60th Street East, Bradenton, FL, 34203, jwsc@mail.ifas.ufl.edu

Cover photo taken by Carl Jones: Anthocyanin expression in seedlings of nearly isogenic lines and allele tests: Left: Rutgers + (LA1090). Right: *hp-1* Rutgers (LA3004). Inset left: Allele test F1 *hp* San Marzano (LA3006) x *hp-1* Rutgers (LA3004). Inset right: F1 *hp* San Marzano (LA3006) x *hp-2*^{j} Moneymaker (LA4014). See Jones and Chetelat pp. 23-26.

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From the editor

Welcome to the 51th issue of the Tomato Genetics Cooperative Report! I have very important news. I have accepted a new position as the Director of Outreach for the Institute for Genomic Diversity, here at Cornell University. I am very pleased to have the opportunity to work on my interests in science education. However, I regret that I will not be able to continue as Editor of TGC. Nevertheless, I have good news: Dr. Jay Scott, of the Gulf Coast Research and Education Center in Florida, has agreed to take over management of TGC. I know that many of you are familiar with Dr. Scott and realize that he is a good choice for this. I will be transferring over all the related records, including account information for those of you who have paid ahead for future Reports. Therefore I expect a very smooth transition and thank Jay very much for his willingness to take over this long-standing tradition. As of November 1, 2001 the new contact information for TGC will be:

Dr. J.W. Scott
Gulf Coast Research and Education Center
5007 60th Street East
Bradenton, FL 34203
USA
email jwsc@mail.ifas.ufl.edu

Another item of news is in regards to making more of the old issues of TGC available online, for which I have had many requests (there are currently 19 issues available on the website). It's a very slow process as these date back to 1951 and thus are not, of course, available as a computer file. However, I have had some assistance recently in scanning in more issues, and we are currently past the halfway mark. I will make these available on the website as soon as possible, and we are continuing to scan more in.

http://genome.cornell.edu/tgc

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Special thanks to Laurie Hanley, Dottie Reeves and the members of Steve Tanksley's group at Cornell University for help with mailings, editing, and general support!

Tomato Breeders Round Table meeting

Dr. Mikel Stevens of Brigham Young University, Utah, will be organizing the next TBRT meeting. It is tentatively planned for the end of April, 2003 at Park City or the area near the Winter Olympic venues, in Utah. More details will be forthcoming. Contact information is below.

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Request for information from Jeannette Homeniuk

I am looking for information about my uncle, Peter Ewaniuk. He was a member of the Tomato Genetics Cooperative from about 1956 to 1993. Peter lived in southern California/southern Arizona area for a number of years. An article in the Rodale magazine from 1983 indicated that Peter had developed a new variety of tomato called AltaCee. He also had a seed company located in San Luis, Arizona called AltaSeeds. Peter passed away in November 1998.

Other that this, I know very little about him. If anyone knew my uncle Peter and is willing to contact me, I would very much appreciate it. I can be contacted via e-mail at:Jeannette.Homeniuk@gov.ab.ca

Jeannette Homeniuk

Remembering Dr. Alvin Reeves

A note from Mrs. Carol Reeves: Alvin passed away on May 5, 200l. He had been a member of TGC since he was a graduate student at the University of California at Davis where he received his PhD in 1968. His graduate work involved the cytogenetics of tomato, research which he continued for 7 years as a professor at the University of Arkansas. For the past 25 years he has conducted the potato breeding program for the University of Maine, but he continued as a member of the TGC so that he could keep in contact with tomato colleagues.

Announcement: USDA Funding for Tomato Germplasm Evaluation

Funding will again be available from the USDA, ARS in FY 2002 for evaluation of tomato germplasm. Relevant germplasm includes material currently maintained by the National Plant Germplasm System (NPGS) or destined for the NPGS. NPGS material includes the tomato collection maintained by USDA's Plant Genetic Resources Unit in Geneva, New York and the collection at the University of California, C.M. Rick Tomato Genetics Resource Center, Davis, California. Proposal guidelines are noted below.

All proposals will be evaluated on the national need for evaluation data, national and/or regional interest in the problem, scientific soundness and feasibility of the proposal, the likelihood of success, germplasm to be screened, and the likelihood that the data will be entered into the Germplasm Resources Information Network (GRIN) and freely shared with the user community. Proposals will be reviewed by the Tomato Crop Germplasm Committee (CGC) and applicable ad hoc reviewers and ranked in priority order for funding. Please be as realistic as possible in your request for funds, as the funds are limited. Funding for successful proposals has ranged from $5,000 to $25,000. All proposals and CGC prioritization are forwarded to USDA for a final decision on funding. While multiple year projects are welcomed, funding must be applied for each year and is subject to a progress review.

STANDARD EVALUATION PROPOSAL FORMAT FOR THE NPGS

I. Project title and name, title of evaluators.

II. Significance of the proposal to U.S. agriculture.

III. Outline of specific research to be conducted including the time frame involved - include the number of accessions to be evaluated.

IV. Funding requested, broken down item by item - no overhead charges are permitted.

V. Personnel

a. What type of personnel will be used to perform the research (e.g. ARS, State, or industry scientist, post doctoral, grad student, or other temporary help).

b. Where will personnel work and under whose supervision.

c. All proposals must be prepared as USDA Specific Cooperative Agreements (SCA). A USDA, ARS cooperator is required for an SCA. In most all cases, this cooperator will be the crop curator. Curators are active in germplasm acquisition and distribution and updating descriptor databases. Please work with the crop curator or CGC to identify an applicable ARS cooperator.

VI. Approximate resources contributed to the project by the cooperating institution (e.g. facilities, equipment and funds for salaries).

Evaluation data obtained will be described using CGC descriptors and codes when available and will be entered into GRIN by the crop curator. Funding for data entry into GRIN should be considered when developing proposals. Evaluation proposals covering several descriptors, such as a number of diseases, should give the cost and time frame for each descriptor along with the combined cost. Funding may only be available to cover one of the projects.

Submission deadline: Please submit electronic files (WordPerfect or MS Word) or 10 copies of your proposal by October 1, 2001 to:

stommelj@ba.ars.usda.gov

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CROP NEWS & MARKET REPORT – AUG. 29th., 2001

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ITALY : North Italy still runs well and most factories should reach their program, with a reduction of 3 to 6 % from 2 000. However, one can notice that, due to the very high temperature during day and night, fresh tomatoes, including late varieties ones, have ripened faster than expected and are already in a fragile state; this means that they are quite sensible to any rain … Most processors should stop production between Sept. 15th and 22nd. In the South, peeled tomatoes processors are still complaining but, as said in our previous report, we do not forecast such a big drop. Round tomatoes crop should be ok unless unfavourable conditions come and affect the end of the season.

REST OF E.U. : The situation has improved in Spain and in Portugal with factories now running at full capacity. There also, the quick ripening of tomatoes should shorten the crop, expected to stop by Sept. 20th,. Quality is fine but over-maturity could affect it in the coming weeks. It is now clear that, neither Spain, nor Portugal will not reach their expected volumes (less than 1.2 Millions for Spain against 1.35 Millions announced – 0.85 Millions for Portugal against 0.9 Millions). France is also short by 5 to 10 % and faces a similar problem as North Italy. Greece currently runs OK with high quality fresh tomatoes but should also be short of initial expectations.

USA : No improvement of the situation in California, to say the least : only 807 000 short tons processed on week ending Sept. 1st. (projected volume by PTAB report updated 27 July 2001 – against 929 000 tons last crop) which will take the total production at 5.04 Millions short tons; this is more than 1.93 Millions tons less than in 2000 and the gap keeps on increasing. Besides figures, reports from the fields are quite worrying : - factories closing on weekends due to lack of fruits, - factories having able to run at full capacity only one day so far, - agricultural specialists quite pessimistic about late maturity tomatoes.
This leads some professionals to forecast a production between 7.8 and 8.2 Millions tons only!

TURKEY : The news are not so good from Turkey either with an expected decrease in tomato supply as early as Sept. 7th. It is to be seen whether the estimation of 1 Million tons will be reached. Low level of plantation, poor weather conditions before the crop, plant diseases (with little if any fight from farmers lacking cash and water), lower yields and the financial crisis are the main reasons for this very short crop, the lowest in 10 years, except for 1997 (when plant illnesses had damaged tomatoes in large proportion).

CHINA : Sound and strong factories, paying cash their raw material such as Tuhne and Chalkis, are currently running fine, close to full capacity. But most of smaller units still run very slowly with many just reaching 50 % of capacity. There again, a sharp decrease soon in the supply of fresh tomatoes is feared. At this stage, we expect production to be around 50 % of 2000 volumes at 150 000 Mt. only.

TUNISIA : Crop estimates vary between 400 000 and 450 000 Mt. Against 650 000 Mt. Expected before the crop and more than 700 000 Mt.

BRIEF ON MARKET CONDITIONS:

- In Europe, factories with uncontracted products have either increased their prices or even withdrawn from the market. It is now widely agreed upon that prices will move higher. Question is by how much. This will greatly depend on abilities for processors to produce properly in September.
- As explained earlier, the financial crisis in Turkey makes it difficult to understand the local situation. Needs for cash push some factories to maintain cheap prices when others try to build up stocks for better prices ahead. Also, Turkish factories balance between producing for local market (quite attractive but requesting long term storage and financing) and export markets. Therefore, prices from Turkey are quite uncertain at this time.
- China is definitely on the way to a prices hike; big processors officially try to impose a high minimum price when smaller factories tend to sell goods for quick shipments. No hope for buyers to see prices even close to the bottom levels they experienced last crop.
- In the USA, most contracts are made on long term basis (on several years sometimes) and prices are less elastic than in the rest of the world. One East Coast trader reports that "Californian processors start to withdraw from the market and one seller is beginning to prorate his customers; but, surprisingly, market is still relatively soft with prices still around the same level at around 29 cents per Lb. For 30/32 HB in bins". Prices will go up but it is not sure whether the increase will be so high; it is now admitted that USA will import paste from foreign countries.
- Chile has already understood very well the world situation and will try to use their counter season position in the best way. Opening prices for 2002 crops are reported at 0.32 $ / Lb. FOB for 30/32 % HB.
- Although we have all learned to be cautious about alarmist processors warnings in the past, this crop will definitely be short and it is now quite clear that prices will go up. As said before, the question is when (a market price needs to be made by sellers and buyers together – for the moment, only sellers have increased their quotations) and by how much. This will not only depend on production; actual stocks at users' premises, consumption, exchange currency rates will also be determinant. After 2 difficult years, processors will try to maximize their revenues by taking advantage of the situation when buyers will use the numerous world market inefficiencies to suffer the less from the situation. One solution would be multi-year contracts (commonly used in the USA) to allow stable revenues to industries and less price fluctuations on raw materials for buyers.

Allelism test among high locule number tomato mutants and genetic mapping of the loci involved

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Lycopersicon esculentum fasciated stocks were assembled from TGRC (http://tgrc.ucdavis.edu/) in 1999. The stocks were characterized based on their average locule number (ALN) at anthesis and fruit maturity stages under field and greenhouse conditions. Based on a t-test ($p<0.05$) and a multiple comparison procedure that indicates which accession (s) carries the largest number of locules, accessions were classified into three groups. The first group (I) comprised accessions with the largest ALN (>10). The second group (II) comprised the accession LA2352 whose phenotype was variable depending on the environmental conditions: In 1999 greenhouse conditions the ALN for this accession was < 4 and in 1999 and 2000 field conditions ALN was >4. The third group (III) comprised accessions with an ALN > 4 but not > 10 (Table 1). Under greenhouse conditions, all F1 progenies obtained from crosses among accessions had a mutant phenotype except for F1s derived from crosses between LA2352 (group II) with LA0020, LA2349, and LA2595 (group III), whose ALN was <4. Under 2000 field conditions, F2 progenies derived from crosses with LA2352 showed wild type segregation (Table 2) indicating that at least two different complementation groups (genes) were present.

These loci probably correspond to *fasciated* and *locule number* described by early tomato geneticists (MacArthur, 1934; Yeager, 1937), which have recently been localized on the tomato molecular map on chromosomes 11 and 2 respectively (Lippman and Tanksley, 2001). The stocks LA2371 and LA2352 were chosen for mapping of these loci. The mutation in LA2371 maps at *fasciated* on the bottom of chromosome 11 and has a recessive gene action as expected. Mapping of the mutation carried by LA2352 will be performed in the 2001 field in Ithaca, NY.

The existence of allelic series for *fasciated* was also observed. A good example is the stock LA0767 of group I, first described by Rick (1965), which was semi-dominant with regard to non-fused (separated) carpels. An F2 population developed from a cross between introgression lines suitable for mapping at chromosome 11, (Eshed and Zamir, 1995) and LA0767 showed a reduction of > 96% in recombination frequency compared to crosses made with LA2371, which suggests that the mutation in LA0767 could be an inversion or a deletion. Different alleles of the same locus will be valuable for future cloning of the gene. Map-based cloning of *fasciated* is being performed as a prerequisite for the understanding of the molecular biology of the trait.

Table 1. 1999 classification of *L. esculentum fasciated* TGRC accessions based on their Average Locule (carpel) Number (ALN)

GROUP		
I *ALN>10	**II** ALN< or > 4	**III** ALN>4
LA0517		LA0014
LA0767		**LA0020**
LA0925		LA1113
LA1786	**LA2352****	**LA2349**
LA2367		LA2364
LA2371		**LA2595**
LA2452		LA2798
LA2799		

*ALN was calculated at $p<0.05$
** Stocks in bold were crossed with LA2352

Table 2. Summary of segregation analysis in the field of 2000

L. esculentum accession	Group	Number of plants WT	MT*	Allelic
LA2452	I	-	3	
LA2352	II	-	3	
LA0020	III	-	3	
LA2371	I	-	3	
LA 0767	I	-	3	
F2 LA2452XLA2352	I x II	8	42	-
F2 LA0020XLA2352	III x II	7	27	-
F2 LA2452XLA0020	I x III	-	50	+
F2 LA2371XLA2452	I x I	-	50	+
F2 LA0767XLA2452	I x I	-	50	+

*WT= wild type (ALN<4); MT= mutant (ALN>4) at $p<0.05$.

Literature cited:

Eshed Y, Zamir D (1995) An introgression line population of *Lycopersicon pennellii* in the cultivated tomato enables the identification and fine mapping of yield-associated QTLs. Genetics 141:1147-62

Lippman Z, Tanksley SD (2001) Dissecting the genetic pathway to extreme fruit size in tomato using a cross between the small-fruited wild species *Lycopersicon pimpinellifolium* and *L. esculentum* var. Giant Heirloom'. In press

MacArthur JW (1928) Linkage studies with the tomato. II. Three linkage groups. Genetics 13: 410-420

Rick CM (1965) A dominant allele at the *f* locus. TGC Report No 15 p. 50

Yeager AF (1937) Studies on the inheritance and development of fruit size and shape in the tomato. J Agric Res 55: 141-152

Introgression of the corresponding S-locus region of *chromosome 1* from *L. esculentum* into *L. hirsutum* and effects on reproduction

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The corresponding S-locus region of *chromosome 1* from *L. esculentum* (cv Vendor) was introgressed into *L. hirsutum* (LA1777) by backcrossing to study the effects on self-incompatibility and the unilateral breeding barrier. The initial interspecific hybrid was self-sterile (though male and female fertile), did not accept pollen from *L. esculentum*, but was compatible with pollen from the *L. hirsutum* parent. The hybrid was backcrossed to the *L. hirsutum* parent and offspring were selected for the *L. esculentum chromosome 1* region from RFLP markers *TG125* to *TG21* (approximately 8 cM). This region contains the self-incompatibility locus (S-locus) for the genus. Backcrossing and selection for this chromosome region was carried out for five generations. The selected plants remained self-sterile for all generations. A single BC5 individual was crossed to *L. esculentum* (cv Vendor) to create an interspecific hybrid that was homozygous for the *L. esculentum* region from *TG125* to *TG21*. This hybrid substitution line was self-fertile by controlled pollination and 70 seeds were collected and sown. Sixty seedlings emerged and 45 plants were established in the greenhouse.

Thirty of these plants were tested for self-fertility, compatibility with *L. esculentum* pollen, and for compatibility with pollen from the *L. hirsutum* parent. All pollinations were done at least twice. Pollinations were considered compatible if developing fruit had what appeared to be normally developing seeds. Quantity and final quality of seed was not determined. Flowers pollinated with *L. esculentum* pollen were emasculated; those pollinated with *L. hirsutum* pollen were not. Eighteen plants did not set fruit or had fruit with poorly developed or no seed when self-pollinated. Nineteen plants pollinated with *L. esculentum* pollen did not set fruit or had fruit with poorly developed or no seed. Most plants that were self-sterile were also plants that would not accept *L. esculentum* pollen. There were a few exceptions but they were not tested further. In contrast, all plants pollinated with pollen from the *L. hirsutum* parent set well-developed fruit.

The forty five progeny of the substituted hybrid were examined for segregation of thirty RFLP markers (chromosome number in parentheses): *TG607* (1); *CT169, CT255, r45s* (2); *CT243, CT246, TG366, TG525* (3); *CD39, TG506* (4); *CD78, CT80a, TG60*, (5); *CD14, CT109, TG164, TG221, TG444* (6); *CT84, TG61* (7); *CT68, CT92, CT148* (8); *CD32a* (9); *CD32b, CT234, TG241, TG408* (10), *TG400* (11), *CT80b* (12). *Chromosome 6* markers *CD14* and *TG164* indicated that there was residual *L. esculentum* chromosome in the BC5 parent, otherwise all other markers were heterozygous in the substituted hybrid. Of these, five markers showed segregation distortion toward the *L. hirsutum* alleles (p 0.05): *TG607* on *chromosome 1*; *CD39* on *chromosome 4*; *CT68* on *chromosome 8*; *TG241* and *CD32b* on *chromosome 10*. There was no significant correlation of the inability to self-fertilize or failure to be fertilized with *L. esculentum* pollen and any of the markers tested.

These results suggest that when the chromosome region corresponding to the S-locus in *L. esculentum* is made homozygous in interspecific hybrids with *L. hirsutum*, fully self-fertile hybrids can be made. Although there is evidence of segregation distortion towards *L. hirsutum* alleles for five of the thirty RFLP markers examined, none indicate strong unilateral inhibition of pollen bearing *L. esculentum* alleles.

Fine mapping of stigma exsertion QTL *se2.1*

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Stigma exsertion was characterized as a quantitative trait resulting in herkogamy that separates anthers and stigma in the space within a tomato flower (Rick and Dempsey, 1969; Scott and George, 1980). Attempts were raised to use stigma exsertion for hybrid seed production (Scott and George, 1980; Levin *et al*., 1994), as well as for the evolutionary studies of the tomato mating system (Rick *et al*., 1978; Rick, 1982, Rick, 1995). *se2.1* is the major stigma exsertion QTL found in both *L. hirsutum* and *L. peruvianum* (Bernacchi and Tanksley, 1997; Fulton *et al*., 1997). In an effort to fine map the *se2.1* gene, an F2 population of 1535 individuals from the cross *L. esculentum* cv M82 x IL2-5 was used to screen recombinants between molecular marker TG469 and TG167. 123 recombinants were selected and their corresponding F3 progenies with a homozygous *L. pennellii* introgression region were screened. 50 RFLP markers (Tanksley *et al*, 1992; http://soldb.cit.cornell.edu) were used to determine the genotypes of each homozygous recombinant and to ensure that only single crossover events had occurred in the *L. pennellii* introgression region. The phenotypes of three F4 plants from each homozygous recombinant were analyzed in the summer in the field with a randomized block design.

Analysis revealed that *se2.1* is located in the chromosomal interval between RFLP markers T1301 and T662 (fig 1). Since two independent homozygous recombinants showed that the intermediate phenotype was different from the two parental controls, it is very likely that two closely linked genes reside in this chromosomal interval. Moreover, the change of style length is likely a function of the *se2.1* genes, because there is no significant difference between the stamen length of the recombinants and that of the controls.

Literature cited:

Bernacchi D and Tanksley SD (1997) An interspecific backcross of *Lycopersicon esculentum* X *L. hirsutum*: Linkage analysis and a QTL study of sexual compatibility factors and floral traits. Genetics 147: 861-877.

Fulton TM, Beck-Bunn T, Emmatty D, Eshed Y, Lopez J, Petiard V, Uhlig J, Zamir D, and Tanksley SD (1997) QTL analysis of an advanced backcross of *Lycopersicon peruvianum* to the cultivated tomato and comparisons with QTLs found in other wild species. Theor Appl Genet 95: 881-894.

Levin I, Cahaner A, Rabinowitch HD, and Elkind Y (1994) Effects of the *ms10* gene, polygenes and their interaction on pistil and anther-cone lengths in tomato flowers. Heredity 73: 72-77

Rick CM (1982) Genetic relationships between self-incompatibility and floral traits in the tomato species. Biol Zbl 101:185-198.

Rick CM (1995) Tomato. In *Evolution of crop plants*. Smartt J and Simmonds NW eds. Longman Scientific and Technical, New York. p.452-457.

Rick CM and Dempsey WH (1969) Position of the stigma in relation to fruit setting of he tomato. Bot Gaz 130: 180-186.

Rick CM, Holle M, and Thorp RW (1978) Rates of cross-pollination in *Lycopersicon pimpinellifolium*: Impact of genetic variation in floral characters. Plant Syst Evol 129: 31-44.

Scott JW and George WL (1978) Breeding and combining ability of heterostylous genotypes for hybrid seed production in *Lycopersicon esculentum* Mill. Euphytica 29: 135-144.

Figure 1, next page

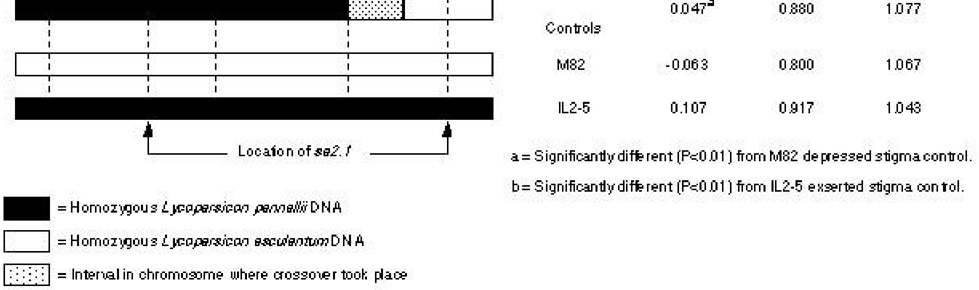

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Figure 1. Genetic localization of QTL *sa2.1* on tomato chromosome 2.

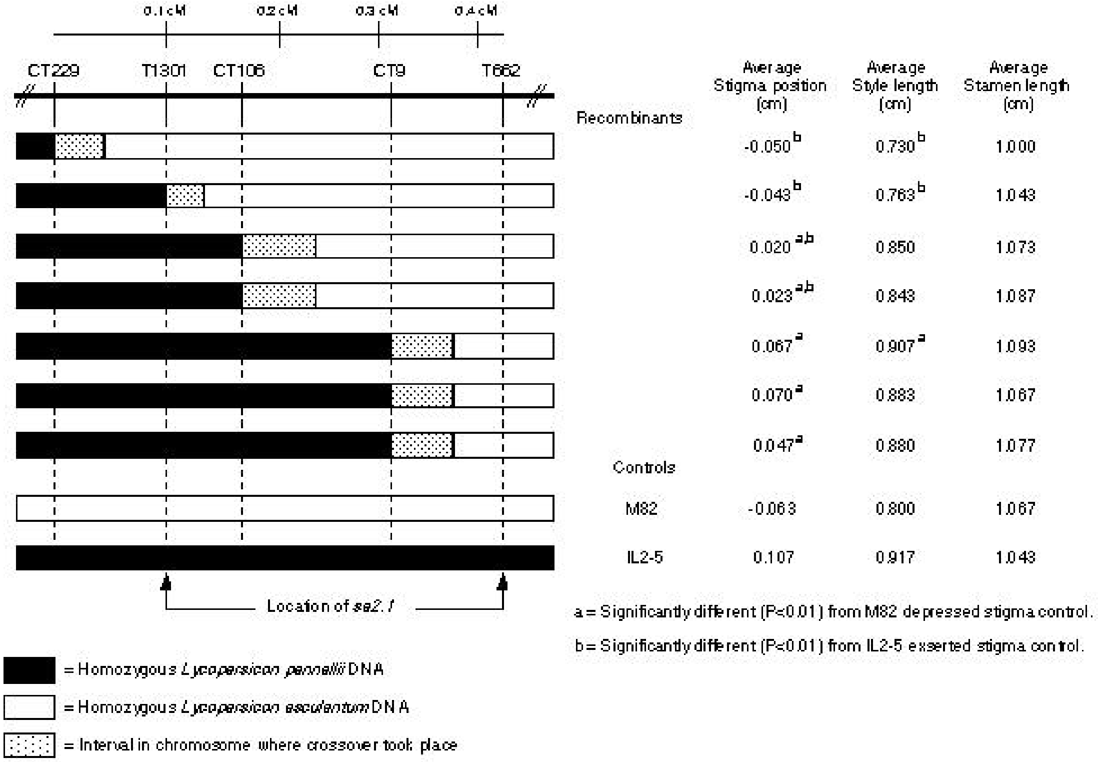

Figure 1. Genetic localization of QTL *sa2.1* on tomato chromosome 2.

An update of the Solanaceae Genome Network (SGN), http://soldb.cit.cornell.edu, and related work

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Solanaceae Genome Network (SGN, http://soldb.cit.cornell.edu) is a website designed to make accessible information related to Solanaceae and tools for comparative genomics. Following is an update of what is currently available and work in progress.

Sequences
Currently there are 211,655 EST sequences available (163,113 tomato, 6771 eggplant, 37,565 potato, and 4226 petunia). The EST sequences and relevant information (library source, contig membership, etc.) can be retrieved by an "EST search", and the sequences can then be translated into protein sequence or blasted to a number of databases. Available blastable databases include all of the tomato EST libraries (separate and combined), and *Arabidopsis* genomic or coding sequences. Approximately 200 RFLPs from the high-density tomato map (Tanksley et al 1992) have sequences available as well; more are in progress and will be posted as completed.

COS markers
1025 of the tomato ESTs have been selected conserved ortholog set (COS) markers (SGN, Fulton et al. in preparation). These are sequences that have a single TBLASTX match in *Arabidopsis*, thus have been conserved in sequence and copy number throughout the divergence of the two species, making them good candidates for orthologous genes. This preliminary set of COS markers are also available on SGN, along with information regarding annotation, map position and copy number in tomato, and their corresponding Arabidopsis counterparts.

Linkage maps
The most widely used tomato maps to date are the high density F2 map (Tanksley et al. 1992) and the Introgression Line (IL) map (Eshed et al. 1992). These are available on SGN, along with our new F2 map. This latter map (called the Tomato-*Arabidopsis* synteny map) includes more than 500 of the COS markers (see above) and thus will be useful in ascertaining the amount and level at which conservation of synteny exists between the two species, which will be the topic of an upcoming publication. All markers (including both ESTs and RFLPs) for which sequence information is available are directly linked to that information.

Future comparative genomics tools
Comparing large numbers of sequences from different species and analyzing this data in new (and perhaps unthought of) ways will require computational tools that are currently not available. To attempt to meet this need, we are in the process of generating new computational tools, such as a tool that can quickly parse through hundreds of thousands of BLAST results using variable criteria assigned by each individual user. We hope that this tool, and others, will become available on SGN in the near future.

References:

Eshed Y, M Abu-Abied, Y Saranga, D Zamir (1992) *Lycopersicon esculentum* lines containing small overlapping introgressions from *L. pennellii.* Theor Appl Genet 83:1027-1034.

Fulton T, van der Hoeven R, Eannetta NT, Tanksley SD (2001) Identification, analysis and utilization of Conserved Ortholog Set (COS) Markers for comparative genomics in higher plants. in preparation

Tanksley SD, Ganal MW, Prince J, de Vicente MC, Bonierbale MW, Broun P, Fulton TM, Giovannoni JJ, Grandillo S, Martin GM, Messeguer RM, Miller JC, Miller L, Paterson AH, Pineda O, Roder MS, Wing RA, Wu W and Young ND, 1992. High density molecular linkage maps of the tomato and potato genomes. Genetics 132: 1141-1160.

Prospects of usage of various sources of resistance to powdery mildew (*Oidium lycopersicum Che et Mass*) in tomato breeding

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Abstract.
Using the original system of the methods of estimation of tomato resistance to *Oidium lycopersicum* (Che et Mass) (Tereshonkova et al., 1999), we have carried out a screening of a set of wild tomato species, and a row of the simple and complex interspecific hybrids between the selected resistant forms and *L. esculentum*. To obtain a wider spectrum of forms the F1 hybrids of known genotypes, such as Krasnaja Strela F1, Grein F1and Lastochka F1 were used as culture parents in all crosses. The best results of resistance to *O. lycopersicum* in combination with valuable features were obtained in hybrids derived from crosses with lines developed from *L.cheesmanii* (large fruit), *L.pimpinellifolium* Red Currant (cherry fruit). But a high economic value (average level of field resistance) was also found in hybrids with cherry fruit *L.esculentum* x *(L.cheesmanii* f*. minor* x *L.esculentum* v*. cerasiforme)* and *(L.esculentum* x *L.humboldtii)* x *[L.esculentum* x *(L.cheesmanii* f*. minor* x *L.esculentum* v*. cerasiforme)*.

Introduction
Tomato powdery mildew (*Oidium lycopersicum* Che et Mass) is wide-spread in greenhouses of the European part of Russia, in Siberia, and also its occurrence has been registered on outdoor tomatoes. Our aim was to create the hybrids with resistance to this disease. Some accessions of wild *Lycopersicon* species, *L.hirsutum, L.pennellii, L.parviflorum, L.peruvianum*, were suggested as sources of resistance by Kozik (1993) Lindhout (1994), Cheng et al. (1997), and *L.hirsutum* by Laterrot et al (1997).

In our previous researches (Ignatova et al. 1996), various wild species, interspecies hybrids and F1 hybrids of a cultural type in terms of resistance to powdery mildew were investigated. They differed in a level of resistance. The presence of several donors of resistance to powdery mildew received from various sources allows using them in breeding of hybrids with various features. In this paper some characteristics of the various donors of resistance and methods of their usage in tomato breeding are presented.

Materials and methods
In our breeding program we have been using the following selected sources of resistance:

(L.esculentum x *L.cheesmanii* K3889*)*,
(L.esculentum x *L.pimpinellifolium* Red Current BP 10815*),*
L.hirsutum PL 247087,
(L.humboldii VIR 2884 x *L.esculentum)*
(L.esculentum x *L.hirsutum* v *.glabratum* VIR 4175
L.esculentum x *[L.cheesmanii* f*. minor* (VIR 3969) x *L.esculentum* v*. cerasiforme)]*
[(L.esculentum x *L.humboldtii)]* x *[L.esculentum* x *(L.cheesmanii* f *.minor VIR 3969)*x *L.esculentum* v*. cerasiforme)*
(Classification according Breshnev (1964))

As donors of good agronomic characters our best commercial hybrids Krasnaya Strela F1, Boomerang F1, Grein F1 were used. In 1993-1999 such breeding methods as backcrosses, pedigree and complex interspecific crosses were applied. _Tomato plants grown in plastic green-houses were artificial inoculated in their period of fruitage in July. During inoculations plants were sprayed with a population of *Oidium lycopersicum* collected from infected commercial tomato plants grown in greenhouses in the Moscow region. In addition to adult plant inoculation we've tested resistance of detached leaves in Petri dishes and detached lateral shoots under conditions of artificial inoculation (Tereshonkova et al. 1999). Resistance of plants was estimated using a scale 0-4 , where 0-1.5 characterize resistant plants and 2-4 characterize susceptible plants.

Results and discussion
During 1997-1999 selected resistant lines were derived from a row of crosses.

Table1.
Reaction of different accessions of tomato interspecific crosses to powdery mildew (*Oidium lycopersicum).*

Combination	Generation	Resistant accessions disease severity limits (scale 0-4)	%
L.esc x L.pimp. Red Currant BP 10815	S5BC1-S9BC1	0-1.5	71
L.esc x L. hir. glab VIR 4175	S4BC1-S6BC1	0-1.5	50
L.esc x L.humboldtii VIR 2884	S4BC1-S6BC1	0.5-1.5	75
L.esc x L.cheesmanii K3889	F5-F8	0-1.5	52
L.esc x (L.chees. f.*minor* VIR 3969*x L.esc v. cerasiforme)*	F3-F6	0.5-1.5-2.0	42.8
(L.esc x L.humb.) x [L.esc x (L.chees. f.*minor x L.esc* v. *erasiforme)]*	F1-F3	0.5-1.5-2.0	9
L.esc (susceptible check*)*	-	3.5-4.0	0

To obtain a wider spectrum of forms the F1 hybrids of known genotypes, such Krasnaja Strela F1, Grein F1 and Lastochka F1 were used as culture parents in all crosses with wild species. As a result of 7 years breeding with using different breeding methods we have received interesting lines of the above-mentioned combinations with various features. The resistance in the majority of combinations was stabilised in F7-9 generations, in some combinations further segregation was found. The lines differ in fruit features (shape, taste, size, colour, density), cluster forming, number of fruit in a cluster, and plant growth: determinant, indeterminant (sp/sp+). It is necessary to note that the resistance of the various donors has individual features that can be explained by the probable presence of gene - modifiers.

The earliest stability of resistance was established in a combination *L.esculentum x L.pimpinellifolium* (Red Currant BP 10815). Milotay (1997) noted *L.pimpinellifolium Red Currant* as a possible source of resistance. In our case, the line 1724/131298 was characterised by a high degree of resistance such as hypersensitivity. Symptoms under conditions of artificial inoculation were the localised necrotic lesions with chloroses on edge of the spots. Under conditions of natural inoculation the visual symptoms of a disease were absent, however chlorotic lesions were observed. Similar phenomenon was also observed in the absence of infection. This feature and resistance seemed to be connected. The distinctive features of the given line were the beautiful compact clusters with fruits of a diameter 3-3.5 cm, with a dark shoulder and dense consistence.

L.hirsutum is reported as the most resistant and widely used source of resistance to *O. Lycopersicum* in breeding programs in many papers (Kozik (1993), Lindhout et al (1994), Laterrot et al (1997). In our investigation samples received from crossings with *L.hirsutum* were characterised by the large range of various forms. The fruits were yellow, orange and green; from 3 up to 20 fruits in a cluster; the shape of fruits was diverse. The samples gave high resistance based on hypersensitivity. Samples *L.hirsutum*, even though resistant, seemed to be a complex population in which there were susceptible forms.

A crossing with *L.parviflorum*was suggested by Lindhout (1994) as a source of immunity. The resistance based on hypersensitivity was seen in the offspring, but the hybrids were of a wild type and consequently were not of interest for breeding. The most interesting in terms of introduction of resistance were the combinations with *L.cheesmanii* and *L.humboldtii*. According to our data several small genes probably caused their resistance and the opportunity of creating hybrids of a cultural type was much higher than using of other donors.

Samples selected from various generations of a combination *L.esculentum* x *L.humboldtii* VIR 2884 did not give stable resistance with artificial inoculation, however 75 % of the samples showed field resistance (1.5-2 scores when disease severity of the susceptible control was 4). Use of this donor of resistance in crosses with samples with moderate resistance resulted in the stabilisation of hybrid resistance. Important characters were beautiful shape and colour of fruits 3-3,5 cm in diameter. These donors improved the shape of fruits in crossings. The line possesses high resistance of fruits to late blight as well.

In sample 175/98 derived from the combinations *L.esculentum* x *L.cheesmanii* K3889 the resistance was stabilised in F8-9 generations of individual selection. The resistance of seedlings under the artificial inoculation by spraying with spores' suspension was characterised by development of lesions up to level 1.5 marks with average sporulation and following localisation and necroses of the lesion. Under conditions of natural inoculation symptoms were absent or were shown small yellow spots with necroses. In a few samples the feature of genetic necroses was noted. Some samples had fruits 4.5-6 cm in diameter, with a delicate taste. It was characterised by good combining ability.

Use of such sources as *L.hirsutum, L.parviflorum* is complicated because of the incompatibility barrier and difficulty of creation of hybrids with *L.esculentum*. The hybrids with *L.cheesmanii, L.pimpinellifolium, L. humboldtii* were moreconvenient for breeding work.
The best results on resistance to *O. Lycopersicum* in a combination with valuable features were obtained with hybrids derived from crosses with lines derived from *L.cheesmanii* (large fruit), *L.pimpinellifolium* Red Currant (cherry fruit). But a high economic value (average level of field resistance) was also seen in hybrids *L.esculentum* x *[L.cheesmanii f.minor* x *L.esculentum* v*. Cerasiforme]* and *(L.esculentum* x *L.humboldtii)* x *[L.esculentum x (L.cheesmanii* f*. minor* x *L.esculentum* v*. cerasiforme)]*.

References

Breshnev D.D. 1964. Tomatoes., Leningad.

Cheng H.C., Biesheuvel J., Groot T., Niks R., Lindhout P.,1997. 13th Meeting of the EUCARPIA tomato Working Group; Jerusalem (ISR), 1997, Abstracts: 54

Ignatova S.I., Tereshonkova T.A., Gorshkova N.S., 1996. Istochniki ustojchivosty tomata k nastojaschey muchnistoy rose. Tezisy dokladov nauchno-prakticheskoy konferencii, Tiraspol, Russia,23-26 ijulja, 1996: 44

Laterrot, H., 1997. Genetic control of the tomato pathogens. Present situation and hopes for the future. 13th Meeting of the EUCARPIA tomato Working Group; Jerusalem (ISR), 1997.Abstracts: 42

Lindhout P., Pet G., van der Beek H.,1994. Screening wild species for resistance to powdery mildew(Oidium lycopersicum). Euphytica 72:43-49

Kozik,E., 1993.Resistance to powdery mildew " Oidium lycopersici" in tomato. TGC Report.43:26

Milotay P.Dormanns-Simon E. Powdery mildew on tomato in hungary and some possible sources of resistance.- 13th Meeting of the EUCARPIA tomato Working Group; Jerusalem (ISR), 1997.Abstracts: 60

Ignatova S.I., Tereshonkova T.A., Gorshkova N.S., 1996. Istochniki ustojchivosty tomata k nastojaschey muchnistoy rose. Tezisy dokladov nauchno-prakticheskoy konferencii, Tiraspol, Russia,23-26 ijulja, 1996: 44

Tereshonkova T.A, Ignatova S.I., Gorshkova N.S., 1999 Tomato breeding for resistance to powdery mildew (Oidium lycopersicum Cook & Mass).-Part1.Proc.6thInt.ISHS Symp. On Processing Tomato, Acta Hort.487,ISHS, p.317-322

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Allele Tests of High Pigment Genotypes Using Root Anthocyanin Expression

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Numerous studies have examined the carotenoid content and genetics of high pigment tomatoes. The C.M. Rick Tomato Genetics Resource Center (TGRC) maintains accessions with *hp-1, $hp\text{-}1^w$, hp-2* and $hp\text{-}2^j$, as well as *dg* and *Ip.* Historically, the nomenclature of the high pigment mutants has been somewhat confusing. Thompson (1955) originally proposed that an interaction of two recessive genes (hp_1 and hp_2) was required for the high pigment phenotype. Thompson et al (1962) later modified this to a single gene, *hp.* Soressi (1975) described *hp-2,* a phenotypically similar mutation induced by EMS in cv San Marzano, which was not an allele of the original *hp.* (Note that Thompson (1955) used subscript hp_1 and hp_2, and there is no indication that the orignal high pigment tomato studied, Webb Special, contains *hp-2.*) Mochizuki and Kamimura (1986; 1985) used seedlings grown under yellow film to test the allelism of *hp,* hp_1, hp_2 and *dg* and concluded they were all mutations at the same locus. The distinction between *hp* ,and hp_1 in the Mochizuki and Kamimura (1986; 1985) study is unclear. Van Tuinen et al. (1997) suggested that *hp-1* be used for *hp.* Recent studies however have clarified that *hp-1* and *hp-2* are separate loci with *hp-1* located on chromosome 2 (Yen et al., 1997) and *hp-2* located on chromosome 1 (Van Tuinen et al., 1997).

Kerr (1965) described a method using anthocyanin expression in the hypocotyl of seedlings below the soil line to identify high pigment plants at the seedling stage. We attempted to utilize this approach to confirm the genotype and allelic relationships of some high pigment accessions in our collection. We observed anthocyanin in some high pigment lines using this approach, however results were inconsistent. We subsequently developed a method in which consistent anthocyanin expression in the roots of high pigment plants is observed (See cover figure). Seeds were sown on germination paper (Steel blue germination blotter, Anchor Paper St Paul, MN) in clear plastic germination boxes (4” x 4” x 1 ¼” Hoffman Mfg. Albany, OR) and incubated under constant illumination (General Electric Plant and Aquarium Bulb F40PL/AQ) at 25° C. Exposure to light appears to increase anthocyanin expression in the roots of high pigment genotypes. We utilized the presence/absence of anthocyanin in the roots of 1 week to 10 day old seedlings to score plants as high pigment or normal (Tables 1 & 2). Approximately 20 plants each of parent and F_1 progeny were evaluated by this method. All plants within each accession or cross were consistent for presence or absence of anthocyanin. We observed that root anthocyanin co-segregated as expected with shorter hypocotyl length in F_2 seedlings of wild type x *hp-1* crosses. We found this method to be a reliable, rapid, low cost way to identify seedlings homozygous for the high pigment genotype.

The results of our allele tests were mostly consistent with expectations based on the reported genotype of each line (Table 2). We confirmed previous reports (Van Tuinen, 1996; Van Tuinen et al., 1997) that $hp\text{-}1^w$ is an allele of *hp-1* and that $hp\text{-}2^j$ is an allele of *hp-2*. In addition our crosses with LA3006 the high pigment San Marzano line, indicate it carries an allele of *hp-2* rather than *hp-1* as previously thought (See cover figure). San Marzano is the original background of the *hp-2* mutation, however Palmieri (1978) had reported carotenoid levels for both *hp* and *hp-2* in a San Marzano background and it was unclear which mutation LA3006 contained.

F_1 progeny of *hp-1* x *dg* Manapal crosses (C. Jones unpublished data) do not exhibit the high pigment phenotype in the field. F_2 progeny of these crosses scored using this method segregated for anthocyanin in the roots (39 normal: 46 high pigment). While the data are very near the cutoff for rejecting the hypothesis of fit to a 9:7 ratio ($\chi^2_{(9:7)}$= 3.70 p=0.054) they are much more compatible with the hypothesis of two genes being involved rather than one. The recovery of wild type plants in the F2 generation confirms that *hp-1* and *dg* are separate loci. These results are consistent with those of Jarret et al (1984). In contrast Mochizuki and Kamimura (1986) found *hp-1* and *dg* to be allelic, however the source of putative hp stocks was not indicated. Allele tests between *dg* and *hp-2* are underway.

We did not observe anthocyanin in the roots of LA3011 *dg* Walter (Table 1), although these seedlings were consistently shorter than those of LA3465 cv Walter. HPLC analysis of fruit from LA3011 has shown it does not have significantly higher carotenoid content than wild type 'Walter' (Jones, 2000)

The genotypes of these stocks as recorded in the TGRC database (http://tgrc.ucdavis.edu) have been updated to reflect the results presented herein. The gene symbol of *hp* accessions in the database has been changed to *hp-1.*

Literature Cited

Jarret, R. L., Sayama, H., and Tigchelaar, E. C. 1984. Pleiotropic effects associated with the chlorophyll intensifier mutations *high pigment* and *dark green* in tomato. J. Amer. Soc. Hort. Sci. *109*, 873-878.

Jones, C. M. 2000. Evaluation of carotenoids and anthocyanins in high pigment, processing, heirloom and anthocyanin fruit tomatoes. M.S. Thesis, Oregon State University, Corvallis.

Kerr, E. A. 1965. Identification of high-pigment tomatoes in the seedling stage. Canadian J. of Pl. Sci. *45*, 104-105.

Mochizuki, T., and Kamimura, S. 1986. Allelism test of high pigment phenotypes by the yellow film method. TGC *36*, 15.

Mochizuki, T., and Kamimura, S. 1985. Photoselective method for selection of *hp* at the seedling stage. TGC *35*, 12-13.

Palmieri, S., Martiniello, P., and Soressi, G. P. 1978. Chlorophyll and carotene content in *high pigment* and *green flesh* fruits. TGC *28*, 10.

Soressi, G. P. 1975. New spontaneous or chemically induced fruit ripening tomato mutants. TGC *25*, 21-22.

Thompson, A. E., Hepler, R. W., and Kerr, E. A. 1962. Clarification of the inheritance of high total carotenoid pigments in the tomato. Proc. Amer. Soc. Hort. Sci. *81*, 434-431.

Van Tuinen, A. 1996. Genetic analysis of photomorphogenic mutants in tomato. PhD Dissertation Wageningen Agic. Univ. The Netherlands.

Van Tuinen, A., Cordonnier-Pratt, M., Pratt, L. H., Verkerk, R., Koorneef, M., and Zabel, P. 1997. The mapping of phytochrome genes and photomorphogenic mutants of tomato. TAG *94*, 115-122.

Yen, H. C., Shelton, B. A., Howard, L. R., Lee, S., Vrebalov, J., and Giovannoni, J. J. 1997. The tomato *high-pigment (hp)* locus maps to chromosome 2 and influences plastome copy number and fruit quality. TAG *95*, 1069-1079.

Table 1. Root anthocyanin expression in high pigment accessions.

LA#	**Reported Genotype**	**Background**	**Anthocyanin in Roots**		**Genotype deduced from allele test.**
			Obs.	**Expd.**	
LA1090	+	Rutgers	N	N	+
LA3008	+	San Marzano	N	N	+
LA3122	+	Vendor	N	N	+
LA4011	+	GT	N	N	+
LA3465	+	Walter	N	N	+
LA3004	*hp-1*	Rutgers	Y	Y	*hp-1*
LA0279	*hp-1*	Webb Special	Y	Y	*hp-1*
LA3006	*hp-1*	San Marzano	Y	Y	***hp-2***
LA4013	*hp-2*	Moneymaker	Y	Y	*hp-2*
LA4014	*hp-2*^{j}	Moneymaker	Y	Y	*hp-2*^{j}
LA3005	*dg*	Manapal	Y	Y	*dg*
LA3011	*dg*	Walter	N	**Y**	+?

Table 2, next page

Table 2. Root anthocyanin expression in F_1 progeny of high pigment allele test.

LA# / Reported Genotype / Background						**Anthocyanin in Roots**		**Genotype deduced from allele test.**	
Female			**Male**			**Obs.**	**Expd.**	***hp-1***	***hp-2***
LA0279	*hp-1*	Webb Special	LA3029	+	Vendor	N	N	+/*hp-1*	
LA0279	*hp-1*	Webb Special	LA3004	*hp-1*	Rutgers	Y	Y	*hp-1/hp-1*	
LA0279	*hp-1*	Webb Special	LA3006	*hp-1*	San Marzano	N	**Y**	+/*hp-1*	+/*hp-*
LA0279	*hp-1*	Webb Special	LA4012	*hp-1*^{W}	GT	Y	Y	*hp-1/hp-1*^{W}	
LA0279	*hp-1*	Webb Special	LA4013	*hp-2*	Moneymaker	N	N	+/*hp-1*	+/*hp-2*
LA3004	*hp-1*	Rutgers	LA3029	+	Vendor	N	N	+/*hp-1*	
LA3004	*hp-1*	Rutgers	LA3006	*hp-1*	San Marzano	N	**Y**	+/*hp-1,*	+/*hp-2*
LA3004	*hp-1*	Rutgers	LA4012	*hp-1*^{W}	GT	Y	Y	*hp1/hp-1*^{W}	
LA3004	*hp-1*	Rutgers	LA4013	*hp-2*	Moneymaker	N	N	+/*hp-1*	+/*hp-2*
LA3006	*hp-1*	San Marzano	LA3029	+	Vendor	N	N		+/*hp-2*
LA3006	*hp-1*	San Marzano	LA0279	*hp-1*	Webb Special	N	**Y**	+/*hp-1,*	+/*hp-2*
LA3006	*hp-1*	San Marzano	LA4012	*hp-1*	Rutgers	N	**Y**	+/*hp-1,*	+/*hp-2*
LA3006	*hp-1*	San Marzano	LA3004	*hp-1*^{W}	GT	N	**Y**	+/*hp-1*^{W}	+/*hp-2*
LA3006	*hp-1*	San Marzano	LA4014	*hp-2*^{j}	Moneymaker	Y	**N**		*hp-2/hp-2*^{j}
LA4012	*hp-1*^{W}	GT	LA3029	+	Vendor	N	N	+/*hp-1*^{W}	
LA4012	*hp-1*^{W}	GT	LA3004	*hp-1-*	Rutgers	Y	Y	*hp1/hp-1*^{W}	
LA4012	*hp-1*^{W}	GT	LA3006	*hp-1*	San Marzano	N	**Y**	+/*hp-1*^{W}	+/*hp-2*
LA4011	+	GT	LA3029	+	Vendor	N	N	+/+	
LA4011	+	GT	LA3006	*hp-1*	San Marzano	N	N		+/*hp-2*
LA4011	+	GT	LA3004	*hp-1*	Rutgers	N	N	+/*hp-1*	
LA4011	+	GT	LA4013	*hp-2*	Moneymaker	N	N		+/*hp-2*
LA4014	*hp-2*^{j}	Moneymaker	LA3029	+	Vendor	N	N		+/*hp-2*^{j}
LA4014	*hp-2*^{j}	Moneymaker	LA3004	*hp-1*	Rutgers	N	N	+/*hp-1,*	+/*hp-2*^{j}
LA4014	*hp-2*^{j}	Moneymaker	LA3006	*hp-1*	San Marzano	Y	**N**		*hp-2/hp-2*^{j}

Molecular mapping of the *Am* gene conferring resistance to Alfalfa Mosaic Virus (AMV) in tomato

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Am is a dominant gene derived from *Lycopersicon hirsutum* f. *glabratum* PI134417 conferring resistance to necrotic and non necrotic isolates of Alfalfa mosaic virus (AMV), belonging to subgroup I and II (Parrella *et al*., 1998; Parrella *et al*., 2000).

With the aim to identify molecular markers linked to the *Am* gene, 'bulked segregant analysis' (BSA) (Michelmore *et al*., 1991) combined with AFLP markers (Vos *et al*., 1995) were applied to a set of 120 BC1 plants between the susceptible *L. hirsutum* accession PI 247087 and the resistant accession PI134417. The same BC1 plants were evaluated for resistance/susceptibility after mechanical inoculation with the AMV strain Lye-80.

Among the 109 *Hind*III-*Mse*I primer combinations (primers with three selective nucleotides) screened on the susceptible and resistant DNA pools, five were found to produce AFLP markers linked at less than 10 cM from the *Am* gene (Fig. 1). One primer combination (H35/M47) detecting the same polymorphism (fragment with the same molecular weight) between the parental lines of the *L. hirsutum* introgression lines population (Monforte and Tanksley 2001) and *L. hirsutum* PI134417 and PI247087 was used to assign the *Am* gene to a tomato chromosome. Three introgression lines, carrying a *L. hirsutum* fragment belonging to the chromosome 6 (IL-TA1559, IL-TA1546 and IL-TA1545) showed polymorphism suggesting that the *Am* is located to the tomato chromosome 6.

In order to confirm the map location of *Am*, RFLP analysis with 3 tomato probes from the tomato chromosome 6 (TG352, TG232 and CT21) was conducted on the 120 BC1 plants. The *Am* gene was mapped on the short arm of the chromosome 6, 3 cM distal to CT21 and TG232, in the cluster of dominant resistant genes including *Mi*, *Meu*, *Cf-2*, *Cf-9*, *Ol-1* and the major effect QTLs *Ty-1* and *Bw-5*.

Literature cited :

Michelmore R. W., I. Paran, R. V. Kesseli, 1991. Proc. Natl. Acad. Sci. USA, 88:9828-9832.
Monforte A. J. and S. D. Tanksley, 2001. Theor. Appl. Genet., *in press*.
Parrella G., H. Laterrot, K. Gebre Selassie, G. Marchoux, 1998. Jour. of Plant Path., 80:241-243.
Parrella G., C. Lanave, G. Marchoux, M.M. Finetti Sialer, A. DI Franco, D. Gallitelli, 2000. Arch. of Virol., 145:2659-2667.

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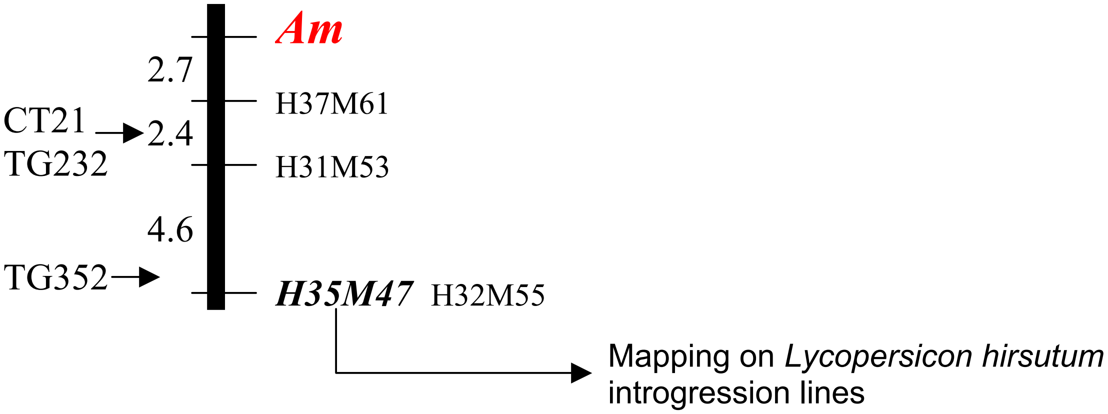
Vos P., R. Hogers, M. Bleeker, M. Reijans, T. van de Lee, M. Hornes, A. Fritjers, J. Pot, J. Peleman, M., Kuiper, M. Zabeau, 1995. Nucl. Acids Res., 23:4407-4414.

Figure 1: AFLP and RFLP mapping of the *Am* gene.



Tomato (*Lycopersicon esculentum,* Mill.) plant regeneration in absence of exogenous growth regulators

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Development of an *in vitro* regeneration system without exogenous growth regulators is important for genetic manipulations of particular plant species (Herrera-Estrella, 1999). The objective of the present work was to obtain tomato regenerated plants independently of exogenous growth regulators in the culture medium.

Dried mature seeds of tomato (*Lycopersicon esculentum,* Mill.) from five cultivars were used as the source of explants. After sterilization, the seeds were sown on filter paper that had been wetted with sterilized water and precultured for zero to three days in the light at 25^{o}C. Precultured seeds were cut into two parts (Ezura 1993); the portion consisting of the proximal part of the hypocotyls of the embryo was cultured on Murashigue and Skoog (MS) medium (1962), with 30 g.L^{-1} commercial sugar, 2g.L^{-1} gel rite, mio-inositol 100 mg.L^{-1}, thiamine 4 mg.L^{-1} and pH adjusted to 5,7 before sterilizing by autoclave at 121^{0}C. The number of regenerated adventitious shoots were counted for three weeks (Table 1). The elongated shoots were excised individually from the explants and subcultured on MS medium for rooting. The plantlets were transplanted into pots with a mixture of litonite and soil (1:1) for growing under greenhouse conditions. All experiments were repeated twice.

The percentage of explants with adventitious shoots ranged from 15 to 69% at the third week (Table 1). At the same time the adventitious shoots were excised for rooting and the calluses subcultivated on fresh medium to obtain more adventitious shoots. The Amalia cv. shoots scored for up to 2.8 two weeks after the first subculture.

Morphological characteristics of regenerated and nonregenerated plants and fruits were similar; on the other hand, forty regenerated plants showed no variations in chromosome number.
The advantages of this regeneration method are: it does not employ exogenous growth regulators, it has feasible handling, and also regenerated plants are obtained in a short time.

Literature cited:

Ezura, H.; Nishimiya, S.; Kasumi, M. (1993). Efficient regeneration of plant independent of exogeneous growth regulators in bell pepper (*Capsicum annumm,* L.). Plant Cell Reports 12:676-680.

Herrera-Estrella, L. (1999). Plant genetic transformation: technology and applications. In: Métodos en Biología Molécular Vegetal. First International INIA-Carrillanca Workshop and Course on Plant Biothecnology. 58-65p.

Murashige, T. and Skoog, F. (1962). A revised medium for rapid growth and biassays with the tobacco tissues cultures. Physiol. Plantarum.15: 473-497.

Table 1, next page

Table 1. Differences in the ability to form adventitious buds and shoots among several tomato cultivars at the third week.

Cultivar	**Percentage of shooted explants**	**Shoot number / explant**
Campbell 28	69 a	1.45 b
Amalia	54 ab	1.50 b
Lignon	69 a	1.55 b
Rilia	15 b	1.57 b
Floradel	54 ab	1.88 a
ESx±	0.01***	0.06**

Resistance of tomato lines to races of *Xanthomonas vesicatoria*

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Bacterial spot of tomato caused by *Xanthomonas vesicatoria* (Xv) is one of the most important diseases in regions of high temperature and frequent rainfalls (Pohronezny and Volin, 1983). Three pathotypes (XvT), (XvP) and (XvPT) were distinguished (Riche and Ditapongpich, 1991).Tomato (XvT) and pepper-tomato (XvPT) pathotypes were established in Bulgaria (Bogatsevska and Sotirova, 1992). Strains of XvT pathotype are further divided into a number of races (Wang et al., 1990). Three races of Xv are known (Bouzar et al., 1994). Race T1 and race T3 were identified in Bulgaria (Bogatsevska and Sotirova, 2000). Race T3 has predominated during recent years. Antibacterial compounds and mixtures containing cooper are not efficient during the period of hot and rainy weather (Gitaitis et al.).The development of resistant lines or varieties is the most promising method for control of disease on plants.

Breeding tomato lines obtained by hybridization with wild tomato species were tested for resistance to race T1 and T3 of Xv. The XvT – race T1 strain Xvt – 12 isolate from the root of Amaranthus caudatus and race T3 strain 19/1 isolate from tomato were used for inoculation. The bacteria was grown on potato sacharose agar media for 36-48h.The inoculum was prepared by removing the bacteria from the plate, suspending it in water and diluting to 10^8 cfu/concentration.Tomato plants at 5-6 true leaf stage were inoculated by vacuum infiltration method (Bogatsevska, 1988). The infiltrated plants were grown in greenhouse at temperature 22-25°C. Each plant was calculated by the 5-range scale of Sotirova and Beleva (1975): 0 - lack of symptoms; 1 – 1 to 10 spots per plant; 2 – 11 to 20 spots per plant; 3 – 21 to 50 spots per plant; 4 – more than 50 spots per plant. The average degree of disease (x) was calculated. 30 –50 plants of each line were tested for resistance to race T1 and T3, respectively.

A series of lines were tested for resistance to race T1 and T3 of Xv. The data is presented in Table 1. All lines were infected by race T1 and T3 but they responded with different degrees of the disease. Three lines showed a low degree of disease (0.4-0.7) to race T1. The number of healthy plants is higher with infiltration with race T3 compared to race T1. Among all lines only line 380 manifested a very low degree of disease (0.03), and five lines (363, 381, 389, 392 and 399) have a degree of disease from 0.4 to 0.97 to race T3. Most lines demonstrated a high degree of disease to both races T1 (1.7-3.11) and T3 (1.2-2.11). Lines differing in degree of disease could be classified as followed:

Highly resistant	0.01 – 0.09
Resistant	0.1 - 0.99
Susceptible	0.1 - 1.99
Very susceptible	2.0 - 3.11

Our investigation showed that lines infiltrated with race T3 demonstrated a lower degree of disease compared to race T1. Lines resistant to race T3 are susceptible to race T1 and lines resistant to race T1 are susceptible to race T3. Lines resistant to both races were not observed. It is very important to combine resistance to both races in one genotype. Breeding of genotypes combining resistance to race T1 as well as to T3 is needed to determine the mode of inheritance of the resistance to race T1 and T3.

The resistant lines were distinguished with valuable biological and agronomic characters. They possessed abundant pollen production and a high percentage of fruit set in unfavorable conditions. Lines resistant either to race T1 or to race T3 deserve attention. They could be used in breeding programs for developing tomato variety resistant to races of *Xanthomonas vesicatoria*.

Table 1. Tomato lines resistant to races of *Xanthomonas vesicatoria*

Lines	Races					
	T1			T3		
	N*	Nhp**	X***	N*	Nhp**	X***
241	30	14	0.40	30	6	2.0
242	35	15	0.70	30	0	2.2
250	30	14	0.50	30	0	1.7
362	40	2	2.80	30	12	1.4
363	40	6	1.85	44	22	0.95
364	42	0	2.71	30	7	1.73
366	34	6	1.88	30	2	2.20
372	40	2	2.35	40	18	1.25
378	48	4	2.25	30	8	1.63
380	24	0	2.96	30	29	0.03
381	30	8	1.70	30	22	0.40
382	40	0	2.40	40	0	2,50
383	30	4	2.03	50	18	1.20
384	25	0	2.92	48	14	1.58
385	25	0	2.76	31	4	2.26
386	36	0	2.44	30	11	1.73
387	48	4	2.42	46	2	2.08
388	40	0	2.65	30	9	1.47
389	44	4	2.09	30	13	0.97
390	40	0	3.05	44	12	1.32
391	34	0	2.71	48	6	2.13
392	46	0	2.48	42	22	0.95
393	25	3	1.60	40	14	1.90
394	36	0	3.11	32	6	2.59
395	36	0	2.33	30	14	1.17
396	44	0	2.73	31	15	1.00
398	48	4	2.04	42	8	1.52
399	50	12	1.76	40	24	0.80
400	46	0	2.09	48	4	2.08
401	46	0	2.65	42	0	1.76
402	40	2	2.75	40	8	1.55
404	44	6	1.95	30	10	1.50

N *– total number of plants
Nhp **– number of healthy plants
x*** – average degree of disease

Literature cited

Bogatsevska, N.. 1988. Plant Science, 25:91-96
Bogatsevska . N. and Sotirova, V. 2000. Genetics and Breeding (in press),
Bogatsevska and Sotirova. 1992. TGC Report, 42:11-12
Bouzar, H., Jones, J.B., Stall. R.E., 1994. Phytopathology, 81:663-67
Gitaitis, R., MacCarter, S. and Jones, J. 1992. Plant Dis., 76:651-656.
Pohronezny, K. and Volin, R.B. 1993. HortScience, 18:69-70
Riche, D. and Ditapongpith, D. 1991. Plant Dis. 75:733-736
Sotirova, V. and Beleva, L. C,R,Acad. Agricoture, 2:43-47
Wang, J,F., Jones J.B., Scott, J.W., and Stall, R,E. 1990. Phytopathology, 80:1070

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Comparison of the frequency and distribution of chiasmata in diploid and tetraploid forms of *Lycopersicon pimpinellifolium*

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The number of chromosomes (to geneticists, units of linkage) is the important value determining, among others, the extent of free combination of genetical factors in meiosis. It is accepted that polyploidy leads to an increase of the genetical variability in a population (Zhuchenko, 1988). Autopolyploids are featured by the presence in their genome of two or more identical sets of homological pairs of chromosomes. A number of authors have reported that at the stage of autotetraploidy, compared to the diploid organisms the chiasmata frequency does not increase twofold constantly, but multiplies by a coefficient dependent on the species (MacCollum, 1958; Wallace, Callow 1995).

For the purpose of comparison we took the species *Lycopersicon pimpinellifolium* 2n=24 and its autotetraploid 2n=48. The investigation of the frequency and distribution of chiasmata was carried out with the use of temporary squashed preparations obtained from anthers where the pollen mother cells was at the stage of diakinesis. The material was dyed with acetocarmine. The temporary squashed preparations were prepared in the saturated solution of chloralhydrate. The observations and microphotography were carried out with use of microscope with phase contrast "Axiophot" (Opton) at the magnification of: objective lens 100x, eye-piece lens 2.5x. The cells with non-damaged cellular cell walls and all chromosomes clearly visible were photographed for purpose of detailed analysis of chiasmata frequency and distribution.

In the diploid *L. pimpinellifolium*, one can observe a strict bivalentical association in diakinesis, i.e., the entire absence of poly- and univalents. In the instance of the autotetraploid analogue, in the contrary, during the analysis of the pollen mother cells at the stage of diakinesis were observed not only bivalents, but also univalents and various types of quadrivalents (Table1).

Table 1. Frequency of occurrence of violations in diakinesis in 48-chromosomes species

Cases encountered	**Number of cells**	**%**
All bivalents	17	40.4
22 bivalents and 1 closed quadrivalent	8	19.0
22 bivalents and 1 open chain quadrivalent	6	14.3
20 bivalents and 2 closed quadrivalents	3	7.1
20 bivalents, 1closed quadrivalent and 1 open chain quadrivalent	6	14.3
21 bivalents, 2 univalents and 1open chain quadrivalent	1	2.38
19 bivalents, 2 univalents and 2 closed quadrivalents	1	2.38
Total	42	100

It was found that 7% of chromosomes are joined in quadrivalents. Compared to the tetraploids of the other species, it is a very small value. Furthermore, 40% of the analyzed cells contain only bivalents. Even at the stage of tetraploid the bivalentical association holds.

The determined frequency and distribution of chiasmata in *L. pimpinellifolium* and its autotetraploid are as follows:

Table 2. Chiasmata frequency in *L. pimpinellifolium* and its autotetraploid

Object	**Chiasmata frequency per whole genome**	**Distal chiasmata frequency**	**Interstitial chiasmata frequency**
L. pimpinellifolium 2n=48	32.6 ± 0.4	29.05 ± 0.46	3.55 ± 0.23
L. pimpinellifolium 2n=24	19.87 ± 0.18	16.14 ± 0.22	3.75 ± 0.11

The number of chiasmata increased, with a change from di- to tetraploid, as little as by 64%, number of distal chiasmata — by 81%, as long as the number of interstitial chiasmata remained generally the same; that means that the chiasmata frequency calculated per bivalent decreased. The frequency of distal chiasmata per bivalent decreased by two times, and the distal location of the major part of the chiasmata (i.e., of cross-overs) results in the tendency that all genes located in the middle part of the chromosome keep the initial order and thus behave, to a certain extent, as a supergene.

Thus, the twofold increase in the number of chromosomes in tomato leads to a change in the general level of crossing-over and to redistribution of exchanges along the chromosome and generally, to the decrease in number of crossing-overs and a rapid decrease in the number of interstitial chiasmata per bivalent.

Literature cited:

MacCollum G.D. (1958). Comparative studies of chromosome pairing in natural and induced tetraploid Dactylis. Chromosoma, 9, 571-605.

Zhuchenko A.A (1988) Adaptive potential of cultivated plants (genetic and ecological bases). Cisinau, "Shtiinza", 768pp.

Wallace A.J. and Callow R.S. (1995). Meiotic variation in an intergenomic autopolyploid series. I. Chiasmata frequency. Genome, 38, 1, 122-131.

A *L. esculentum* x *L. pennellii* backcross recombinant inbred population

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We have been developing a recombinant inbred population of tomato derived from a *L. esculentum* x *L. pennellii* backcross. The goal is to have a population that (i) is permanent, (ii) can be grown from seed (rather than tissue culture), (iii) is highly polymorphic for molecular markers and (iv) provides high mapping resolution with a small number of lines. The population is thus designed to be complementary to other *L. esculentum* x *L. pennellii* mapping resources, such as the population of overlapping introgression lines developed by Eshed and Zamir (1995) and an F2 population, recently developed by Tanksley and colleagues (unpublished), which is being immortalized by tissue culture.

The parents of the present population are *Lycopersicon esculentum* E6203 and a self-compatible accession of *L. pennellii* (LA716). Following a backcross of the F1 into E6203 and two generations of selfing, individuals were genotyped for 119 RFLP markers spanning all 12 chromosomes at roughly even intervals. All RFLP markers had been mapped on a previous F2 population (Tanksley *et. al.* 1992) and the majority have also been mapped in the new F2 population mentioned above. Each individual backcross line has been fixed for segregating loci over the course of three subsequent generations by marker-assisted selection (MAS). In addition to accelerating the fixation of segregating loci, MAS has been used to maximize the mapping resolution of the population as a whole, using specialized software designed for that purpose (Vision *et al.* 2000, D. Brown, unpublished). The lines have been re-genotyped for 112 markers in the current, fifth backcross, generation. Only a small number of heterozygous loci still remain.

Of the 100 original backcross lines, 67 were lost due to reduced levels of germination, seedling survival and fertility in the advanced selfing generations. In the 2nd selfing generation, survival to flowering and total seed set were measured. There were inverse correlations between (i) the proportion of markers homozygous for the LA716 alleles and (ii) the number of crossovers on all 12 chromosomes with both measured traits.

The current population shows striking transgressive segregation for a variety of morphological traits, including stature, fruit color, and leaf morphology. Provided the majority of true-breeding lines prove to be fertile, the final population of 25-30 lines should be of interest for the rapid assignment of both molecular markers and genes of major phenotypic effect to chromosomal intervals of 5-10 cM.

Literature Cited:

Eshed Y and D Zamir (1995) An introgression line population of *Lycopersicon pennellii* in the cultivated tomato enables the identification and fine mapping of yield associated QTL. Genetics 141:1147-1162.

Tanksley SD, MW Ganal, JP Prince, MC de Vicente, MW Bonierbale, P Broun, TM Fulton, JJ Giovannoni, S Grandillo, GB Martin, R Messeguer, JC Miller, L Miller, AH Paterson, O Pineda, MS Röder, RA Wing, W Wu and ND Young (1992) High density molecular linkage maps of the tomato and potato genomes. Genetics 132:1141-1160.

Vision, TJ, DG Brown, DB Shmoys, RT Durrett and SD Tanksley (2000) Selective mapping: a strategy for optimizing the construction of high-density linkage maps. Genetics 155:407-420.

Revised List of Wild Species Stocks

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The following list of 1,131 available accessions of wild *Lycopersicon* and related *Solanum* species is a revision of the previous list issued in TGC 48 (1998). Extinct or temporarily unavailable accessions have been dropped and new collections have been added. Recent additions to this list include the following items: *L. esculentum* var. *cerasiforme* populations collected by D. de Zerpa in Venezuela, *L. cheesmanii* and *L. pimpinellifolium* from the Galapagos Islands (J.W. Rick), *L. hirsutum* f. *glabratum* from Ecuador (M. Coffey), *L. peruvianum*, *L. pimpinellifolium*, and *L. hirsutum* from Peru (M. Holle), *L. parviflorum* from Ecuador (F. Nuez), *L. peruvianum* and *L. pimpinellifolium* selections resistant to CMV and TYLCV, respectively (C. Caranta, A. Moretti), and *S. lycopersicoides* and *S. juglandifolium* PI lines transferred from the USDA.

All accessions have been grown for seed increase at UC-Davis and seed samples are available for research purposes. Accessions of the outcrossing species (or races) are regenerated in such a way as to maintain intrapopulation genetic variation, and may segregate for traits of interest, therefore larger seed samples are provided. Our seed supplies of the four *Solanum* spp. tend to be limited, yet small samples will be provided to interested researchers. Members of the core collections for each species are identified below with an asterisk in order to assist selection of specific accessions for seed requests.

Detailed passport information on each accession can be obtained from our website (http://tgrc.ucdavis.edu), with additional information available on request. Latitude and longitude coordinates for wild populations are currently being recorded in the TGRC database; to date, the coordinates of all collections from Chile have been entered, and work on Peru and other countries is in progress.

For other types of accessions, see TGRC stock lists published in TGC vol.s 49 (Monogenic Stocks), and 50 (Miscellaneous Stocks).

Acc. No.	Site	Dept. / Prov.	Country
L. cheesmanii (39 accessions)			
LA0166*	Santa Cruz: Barranco, N of Punta	Galapagos Islands	Ecuador
LA0421*	San Cristobal: cliff E of Wreck Bay	Galapagos Islands	Ecuador
LA0422	San Cristobal: Wreck Bay	Galapagos Islands	Ecuador
LA0428	Santa Cruz: trail Bellavista to Miconia Zone	Galapagos Islands	Ecuador
LA0429*	Santa Cruz: crater in highlands	Galapagos Islands	Ecuador
LA0434	Santa Cruz: Rambech Trail	Galapagos Islands	Ecuador
LA0437	Isabela: ponds N of Villamil	Galapagos Islands	Ecuador
LA0521	Fernandina: inside Crater	Galapagos Islands	Ecuador
LA0522	Fernandina: outer slopes	Galapagos Islands	Ecuador
LA0524	Isabela: Punta Essex	Galapagos Islands	Ecuador
LA0528B	Santa Cruz: Academy Bay	Galapagos Islands	Ecuador
LA0529	Fernandina: crater	Galapagos Islands	Ecuador

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA0531*	Baltra: Barranco slope, N side	Galapagos Islands	Ecuador
LA0746*	Isabela: Punta Essex	Galapagos Islands	Ecuador
LA0749*	Fernandina: N side	Galapagos Islands	Ecuador
LA0927	Santa Cruz: Academy Bay	Galapagos Islands	Ecuador
LA0932	Isabela: Tagus Cove	Galapagos Islands	Ecuador
LA1035	Fernandina: low elevation	Galapagos Islands	Ecuador
LA1036*	Isabela: far N end	Galapagos Islands	Ecuador
LA1037	Isabela: Alcedo E slope	Galapagos Islands	Ecuador
LA1040	San Cristobal: Caleta Toruga	Galapagos Islands	Ecuador
LA1041	Santa Cruz: El Cascajo	Galapagos Islands	Ecuador
LA1042	Isabela: Cerro Santo Tomas	Galapagos Islands	Ecuador
LA1043	Isabela: Cerro Santo Tomas	Galapagos Islands	Ecuador
LA1138	Isabela: E of Cerro Azul	Galapagos Islands	Ecuador
LA1139	Isabela: W of Cerro Azul	Galapagos Islands	Ecuador
LA1402	Fernandina: W of Punta Espinoza	Galapagos Islands	Ecuador
LA1404	Fernandina: W flank caldera	Galapagos Islands	Ecuador
LA1406*	Fernandina: SW rim caldera	Galapagos Islands	Ecuador
LA1407	Fernandina: caldera, NW bench	Galapagos Islands	Ecuador
LA1409	Isabela: Punta Albermarle	Galapagos Islands	Ecuador
LA1412*	San Cristobal: opposite Isla Lobos	Galapagos Islands	Ecuador
LA1414	Isabela: Cerro Azul	Galapagos Islands	Ecuador
LA1427	Fernandina: WSW rim of caldera	Galapagos Islands	Ecuador
LA1447	Santa Cruz: Charles Darwin Station-Punta	Galapagos Islands	Ecuador
LA1448	Santa Cruz: Puerto Ayora, Pelican Bay	Galapagos Islands	Ecuador
LA1449	Santa Cruz: Charles Darwin Station,	Galapagos Islands	Ecuador
LA1450*	Isabela: Bahia San Pedro	Galapagos Islands	Ecuador
LA3124	Santa Fe: near E landing	Galapagos Islands	Ecuador

L. cheesmanii* f. *minor (30 accessions)

LA0317*	Bartolome	Galapagos Islands	Ecuador
LA0426	Bartolome: E of landing	Galapagos Islands	Ecuador
LA0436*	Isabela: Villamil	Galapagos Islands	Ecuador
LA0438	Isabela: coast at Villamil	Galapagos Islands	Ecuador
LA0480A	Isabela: Cowley Bay	Galapagos Islands	Ecuador
LA0483	Fernandina: inside crater	Galapagos Islands	Ecuador
LA0526*	Pinta: W side	Galapagos Islands	Ecuador
LA0527	Bartolome: W side, Tower Bay	Galapagos Islands	Ecuador
LA0528	Santa Cruz: Academy Bay	Galapagos Islands	Ecuador

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA0530	Fernandina: crater	Galapagos Islands	Ecuador
LA0532	Pinzon: NW side	Galapagos Islands	Ecuador
LA0747	Santiago: Cape Trenton	Galapagos Islands	Ecuador
LA0748	Santiago: E Trenton Island	Galapagos Islands	Ecuador
LA0929	Isabela: Punta Flores	Galapagos Islands	Ecuador
LA0930	Isabela: Cabo Tortuga	Galapagos Islands	Ecuador
LA1039	Isabela: Cape Berkeley	Galapagos Islands	Ecuador
LA1044	Bartolome	Galapagos Islands	Ecuador
LA1136*	Gardner-near-Floreana Islet	Galapagos Islands	Ecuador
LA1137*	Rabida: N side	Galapagos Islands	Ecuador
LA1141*	Santiago: N crater	Galapagos Islands	Ecuador
LA1400	Isabela: N of Punta Tortuga	Galapagos Islands	Ecuador
LA1401*	Isabela: N of Punta Tortuga	Galapagos Islands	Ecuador
LA1403	Fernandina: W of Punta Espinoza	Galapagos Islands	Ecuador
LA1408	Isabela: SW volcano, Cape Berkeley	Galapagos Islands	Ecuador
LA1410*	Isabela: Punta Ecuador	Galapagos Islands	Ecuador
LA1411	Santiago: N James Bay	Galapagos Islands	Ecuador
LA1452	Isabela: E slope Volcan Alcedo	Galapagos Islands	Ecuador
LA1508	Corona del Diablo (near Floreana)	Galapagos Islands	Ecuador
LA1627	Isabela: Tagus Cove	Galapagos Islands	Ecuador
LA3909	Bartolome: tourist landing	Galapagos Islands	Ecuador

L. chilense (83 accessions)

Acc. No.	Site	Dept. / Prov.	Country
LA0130	Moquegua	Moquegua	Peru
LA0294	Tacna	Tacna	Peru
LA0456	Clemesi	Moquegua	Peru
LA0458	Tacna	Tacna	Peru
LA0460	Palca	Tacna	Peru
LA0470	Taltal	Antofagasta	Chile
LA1029	Moquegua	Moquegua	Peru
LA1030	Tarata Rd.	Tacna	Peru
LA1782	Quebrada de Acari	Arequipa	Peru
LA1917	Llauta (4x)	Ica	Peru
LA1930	Quebrada Calapampa	Arequipa	Peru
LA1932*	Minas de Acari	Arequipa	Peru
LA1938*	Quebrada Salsipuedes	Arequipa	Peru
LA1958*	Pampa de la Clemesi	Arequipa	Peru
LA1959	Huaico Moquegua	Moquegua	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1960*	Rio Osmore	Moquegua	Peru
LA1961	Toquepala	Tacna	Peru
LA1963*	Rio Caplina	Tacna	Peru
LA1965*	Causiri	Tacna	Peru
LA1967*	Pachia, Rio Caplina	Tacna	Peru
LA1968	Cause seco	Tacna	Peru
LA1969*	Estique Pampa	Tacna	Peru
LA1970	Tarata	Tacna	Peru
LA1971*	Palquilla	Tacna	Peru
LA1972	Rio Sama	Tacna	Peru
LA2404	Arica to Tignamar	Tarapaca	Chile
LA2405	Tignamar	Tarapaca	Chile
LA2406	Arica to Putre	Tarapaca	Chile
LA2731	Moquella	Tarapaca	Chile
LA2737	Yala-yala	Tarapaca	Chile
LA2739	Cruce Nama a Camina	Tarapaca	Chile
LA2746	Asentamiento-18	Tarapaca	Chile
LA2747	Alta Azapa	Tarapaca	Chile
LA2748*	Soledad	Antofagasta	Chile
LA2749	Punta Blanca	Antofagasta	Chile
LA2750*	Mina La Despreciada	Antofagasta	Chile
LA2751	Pachica (Rio Tarapaca)	Tarapaca	Chile
LA2753	Laonzana	Tarapaca	Chile
LA2754	E of Huara, Km 63-65	Tarapaca	Chile
LA2755*	Banos de Chusmisa	Tarapaca	Chile
LA2757	E of Huara, Km 66	Tarapaca	Chile
LA2759*	N of Mamina	Tarapaca	Chile
LA2762	Quebrada Mamina-Parca	Tarapaca	Chile
LA2764	Codpa	Tarapaca	Chile
LA2765	Timar	Tarapaca	Chile
LA2767*	Chitita	Tarapaca	Chile
LA2768	Empalme Codpa	Tarapaca	Chile
LA2771	Above Poconchile	Tarapaca	Chile
LA2773*	Zapahuira	Tarapaca	Chile
LA2774	Socorama	Tarapaca	Chile
LA2778*	Chapiquina	Tarapaca	Chile
LA2779	Cimentario Belen	Tarapaca	Chile
LA2780	Belen to Lupica	Tarapaca	Chile
LA2879*	San Roque de Peine	Antofagasta	Chile
LA2880	Quebrada Tilopozo	Antofagasta	Chile

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2882	Camar	Antofagasta	Chile
LA2884*	Ayaviri	Antofagasta	Chile
LA2887	Quebrada Bandurria	Antofagasta	Chile
LA2888	Loma Paposo	Antofagasta	Chile
LA2891	Taltal	Antofagasta	Chile
LA2930*	Quebrada Taltal	Antofagasta	Chile
LA2931*	Guatacondo	Tarapaca	Chile
LA2932	Quebrada Gatico, Mina Escalera	Antofagasta	Chile
LA2946	Guatacondo	Tarapaca	Chile
LA2949	Chusmisa	Tarapaca	Chile
LA2952	Camiña	Tarapaca	Chile
LA2955	Quistagama	Tarapaca	Chile
LA2980	Yacango	Moquegua	Peru
LA2981A	Torata to Chilligua	Moquegua	Peru
LA3111	Tarata outskirts	Tacna	Peru
LA3112	Estique Pampa	Tacna	Peru
LA3113	Apacheta	Tacna	Peru
LA3114	Quilla	Tacna	Peru
LA3115	28 Km E of Tacna	Tacna	Peru
LA3153	Torata-Omate	Moquegua	Peru
LA3155	Otora-Puente Jahuay	Moquegua	Peru
LA3355	Cacique de Ara	Tacna	Peru
LA3356	W of Tacna	Tacna	Peru
LA3357	Irrigacion Magollo	Tacna	Peru
LA3358	Rio Arunta, Cono Sur	Tacna	Peru
LA3784	Rio Chaparra	Arequipa	Peru
LA3785	Terras Blancas	Arequipa	Peru
LA3786	Alta Chaparra	Arequipa	Peru

L. chmielewskii (27 accessions)

Acc. No.	Site	Dept. / Prov.	Country
LA1028*	Casinchihua	Apurimac	Peru
LA1306*	Tambo	Ayacucho	Peru
LA1316*	Ocros	Ayacucho	Peru
LA1317*	Hacienda Pajonal	Ayacucho	Peru
LA1318*	Auquibamba	Apurimac	Peru
LA1325*	Puente Cunyac	Apurimac	Peru
LA1327	Soracata	Apurimac	Peru
LA1330	Hacienda Francisco	Apurimac	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2639B	Puente Cunyac	Apurimac	Peru
LA2663*	Tujtohaiya	Cusco	Peru
LA2677*	Huayapacha #1	Cusco	Peru
LA2678	Huayapacha #2	Cusco	Peru
LA2679	Huayapacha #3	Cusco	Peru
LA2680*	Puente Apurimac #1	Cusco	Peru
LA2681	Puente Apurimac #2	Cusco	Peru
LA2695*	Chihuanpampa	Cusco	Peru
LA3642	Ankukunka	Cusco	Peru
LA3643	Colcha	Cusco	Peru
LA3644	Puente Tincoj	Cusco	Peru
LA3645	Boca del Rio Velille	Cusco	Peru
LA3648	Huallapachaca	Apurimac	Peru
LA3653	Matara	Apurimac	Peru
LA3654	Casinchigua to Chacoche	Apurimac	Peru
LA3656	Chalhuani	Apurimac	Peru
LA3658	Occobamba	Apurimac	Peru
LA3661	Pampotampa	Apurimac	Peru
LA3662	Huancarpuquio	Apurimac	Peru

L. esculentum* var. *cerasiforme (275 accessions)

LA0168		New Caledonia	Fr. Oceania
LA0292*	Santa Cruz	Galapagos Islands	Ecuador
LA0349	(Unknown origin)		
LA0475	Sucua	Morona-Santiago	Ecuador
LA0476	Sucua	Morona-Santiago	Ecuador
LA1025*	Oahu: Wahiawa	Hawaii	USA
LA1203	Ciudad Vieja		Guatemala
LA1204*	Quetzaltenango		Guatemala
LA1205	Copan		Honduras
LA1206*	Copan Ruins		Honduras
LA1207			Mexico
LA1208	Sierra Nevada		Colombia
LA1209			Colombia
LA1226	Sucua	Morona-Santiago	Ecuador
LA1227	Sucua	Morona-Santiago	Ecuador
LA1228*	Macas, San Jacinto de los Monos	Morona-Santiago	Ecuador
LA1229	Macas Plaza	Morona-Santiago	Ecuador
LA1230	Macas	Morona-Santiago	Ecuador

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1231*	Tena	Napo	Ecuador
LA1247	La Toma	Loja	Ecuador
LA1268*	Chaclacayo	Lima	Peru
LA1286*	San Martin de Pangoa	Junin	Peru
LA1287	Fundo Ileana #1	Junin	Peru
LA1289	Fundo Ileana #3	Junin	Peru
LA1290	Mazamari	Junin	Peru
LA1291	Satipo Granja	Junin	Peru
LA1307*	Hotel Oasis, San Francisco	Ayacucho	Peru
LA1308	San Francisco	Ayacucho	Peru
LA1310	Hacienda Santa Rosa	Ayacucho	Peru
LA1311	Santa Rosa Puebla (19 subunits)	Ayacucho	Peru
LA1312*	Paisanato (2 subunits)	Cusco	Peru
LA1314*	Granja Pichari	Cusco	Peru
LA1320*	Hacienda Carmen	Apurimac	Peru
LA1323*	Pfacchayoc	Cusco	Peru
LA1324	Hacienda Potrero, Quillabamba	Cusco	Peru
LA1328	Rio Pachachaca	Apurimac	Peru
LA1334	Pescaderos	Arequipa	Peru
LA1338*	Puyo	Napo	Ecuador
LA1372	Santa Eulalia	Lima	Peru
LA1385*	Quincemil	Cusco	Peru
LA1386	Balsas	Amazonas	Peru
LA1387	Quincemil	Cusco	Peru
LA1388*	San Ramon	Junin	Peru
LA1420*	Lago Agrio	Napo	Ecuador
LA1421	Santa Cecilia	Napo	Ecuador
LA1423	Near Santo Domingo	Pichincha	Ecuador
LA1425*	Villa Hermosa	Cauca	Colombia
LA1426	Cali	Cauca	Colombia
LA1428	La Estancilla	Manabi	Ecuador
LA1429*	La Estancilla	Manabi	Ecuador
LA1453*	Kauai: Poipu	Hawaii	USA
LA1454			Mexico
LA1455	Gral Teran	Nuevo Leon	Mexico
LA1456*	Papantla	Vera Cruz	Mexico
LA1457	Tehuacan	Puebla	Mexico
LA1458	Huachinango	Puebla	Mexico
LA1461*	University Philippines, Los Banos		Philippines
LA1464*	El Progreso, Yoro		Honduras

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1465	Taladro, Comayagua		Honduras
LA1467	Cali	Cauca	Colombia
LA1468	Fte. Casa, Cali	Cauca	Colombia
LA1479	Sucua	Morona-Santiago	Ecuador
LA1480	Sucua	Morona-Santiago	Ecuador
LA1481	Sucua	Morona-Santiago	Ecuador
LA1482*	Segamat		Malaysia
LA1483*	Trujillo		Saipan
LA1509*	Tawan	Sabah	Borneo
LA1510			Mexico
LA1511*	Siete Lagoas	Minas Gerais	Brazil
LA1512	Lago de Llopango		El Salvador
LA1540	Cali to Popayan	Cauca	Colombia
LA1542*	Turrialba		Costa Rica
LA1543*	Upper Parana		Brazil
LA1545	Becan Ruins	Campeche	Mexico
LA1546	Papantla	Vera Cruz	Mexico
LA1548	Fundo Liliana	Junin	Peru
LA1549	Chontabamba	Pasco	Peru
LA1569	Jalapa	Vera Cruz	Mexico
LA1574	Nana	Lima	Peru
LA1619	Pichanaki	Junin	Peru
LA1620*	Castro Alves	Bahia	Brazil
LA1621	Rio Venados	Hidalgo	Mexico
LA1622*	Lusaka		Zambia
LA1623	Muna	Yucatan	Mexico
LA1632	Puerto Maldonado	Madre de Dios	Peru
LA1654	Tarapoto	San Martin	Peru
LA1655	Tarapoto	San Martin	Peru
LA1662	El Ejido	Merida	Venezuela
LA1667	Cali	Cauca	Colombia
LA1668	Acapulco	Guerrero	Mexico
LA1673	Nana	Lima	Peru
LA1701	Trujillo	La Libertad	Peru
LA1703	Rio Tamesi	Tamaulipas	Mexico
LA1704	Rio Tamesi	Tamaulipas	Mexico
LA1709	Desvio Yojoa		Honduras
LA1710	Cariare	Limon	Costa Rica
LA1711	Zamorano		Honduras
LA1712	Pejibaye		Costa Rica

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1713	CATIE, Turrialba		Costa Rica
LA1909	Quillabamba	Cusco	Peru
LA1953	La Curva	Arequipa	Peru
LA2076	Naranjitos		Bolivia
LA2077	Paco, Coroica	La Paz	Bolivia
LA2078*	Mosardas	Rio Grande de Sol	Brazil
LA2079	Maui: Kihei	Hawaii	USA
LA2080	Maui: Kihei	Hawaii	USA
LA2081	Maui: Kihei	Hawaii	USA
LA2082	Arenal Valley		Honduras
LA2085	Kempton Park		S. Africa
LA2095*	La Cidra	Loja	Ecuador
LA2121	Yacuambi - Guadalupe	Zamora-Chinchipe	Ecuador
LA2122	Yacuambi - Guadalupe (4 subunits)	Zamora-Chinchipe	Ecuador
LA2123	La Saquea (2 subunits)	Zamora-Chinchipe	Ecuador
LA2126	El Dorado (4 subunits)	Zamora-Chinchipe	Ecuador
LA2127	Zumbi	Zamora-Chinchipe	Ecuador
LA2129	San Roque	Zamora-Chinchipe	Ecuador
LA2130	Gualaquiza	Zamora-Chinchipe	Ecuador
LA2131*	Bomboiza	Zamora-Chinchipe	Ecuador
LA2132	Chuchumbetza	Zamora-Chinchipe	Ecuador
LA2135	Limon	Santiago-Morona	Ecuador
LA2136	Bella Union	Santiago-Morona	Ecuador
LA2137*	Tayusa	Santiago-Morona	Ecuador
LA2138	Chinimpini (2 subunits)	Santiago-Morona	Ecuador
LA2139	Logrono (2 subunits)	Santiago-Morona	Ecuador
LA2140	Huambi (3 subunits)	Santiago-Morona	Ecuador
LA2141	Rio Blanco	Santiago-Morona	Ecuador
LA2142	Cambanaca	Santiago-Morona	Ecuador
LA2143	Nuevo Rosario	Santiago-Morona	Ecuador
LA2177	San Ignacio (5 subunits)	Cajamarca	Peru
LA2205	Santa Rosa de Mirador (2 subunits)	San Martin	Peru
LA2308*	San Francisco	San Martin	Peru
LA2312	Jumbilla #1	Amazonas	Peru
LA2313	Jumbilla #2	Amazonas	Peru
LA2392*	Jakarta		Indonesia
LA2393	Mercedes Canton Hoja Ancha	Guanacaste	Costa Rica
LA2394	San Rafael de Hoja Ancha	Guanacaste	Costa Rica
LA2402*	Florianopolis	Santa Catarina	Brazil
LA2411	Yanamayo	Puno	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2587	(4x)		
LA2616	Naranjillo	Huanuco	Peru
LA2617	El Oropel	Huanuco	Peru
LA2618	Santa Lucia, Tulumayo	Huanuco	Peru
LA2619*	Caseria San Augustin	Loreto	Peru
LA2620	La Divisoria	Loreto	Peru
LA2621	3 de Octubre	Loreto	Peru
LA2624	Umashbamba	Cusco	Peru
LA2625	Chilcachaca	Cusco	Peru
LA2626	Santa Ana	Cusco	Peru
LA2627	Pacchac-chico	Cusco	Peru
LA2628	Echarate	Cusco	Peru
LA2629	Echarate	Cusco	Peru
LA2630	Calzana	Cusco	Peru
LA2631	Chontachayoc	Cusco	Peru
LA2632	Maranura	Cusco	Peru
LA2633	Huayopata	Cusco	Peru
LA2635	Huayopata	Cusco	Peru
LA2636	Sicre	Cusco	Peru
LA2637	Sicre	Cusco	Peru
LA2640	Molinopata-Abancay	Apurimac	Peru
LA2642	Molinopata-Abancay	Apurimac	Peru
LA2643	Bellavista-Abancay	Apurimac	Peru
LA2660	San Ignacio de Moxos	Beni	Bolivia
LA2664	Yanahuana	Puno	Peru
LA2665	San Juan del Oro	Puno	Peru
LA2666	San Juan del Oro	Puno	Peru
LA2667	Pajchani	Puno	Peru
LA2668	Cruz Playa	Puno	Peru
LA2669	Huayvaruni #1	Puno	Peru
LA2670*	Huayvaruni #2	Puno	Peru
LA2671	San Juan del Oro (Escuela)	Puno	Peru
LA2673	Chuntopata	Puno	Peru
LA2674	Huairurune	Puno	Peru
LA2675*	Casahuiri	Puno	Peru
LA2683	Consuelo	Cusco	Peru
LA2684	Patria	Cusco	Peru
LA2685	Gavitana	Madre de Dios	Peru
LA2686	Yunguyo	Madre de Dios	Peru
LA2687	Mansilla	Madre de Dios	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2688*	Santa Cruz, near Shintuyo #1	Madre de Dios	Peru
LA2689	Santa Cruz, near Shintuyo #2	Madre de Dios	Peru
LA2690	Atalaya	Cusco	Peru
LA2691	Rio Pilcopata	Cusco	Peru
LA2692	Pilcopata #1	Cusco	Peru
LA2693	Pilcopata #2	Cusco	Peru
LA2694	Aguasantas	Cusco	Peru
LA2696	El Paramillo, La Union	Valle	Colombia
LA2697	Mata de Cana, El Dovio	Valle	Colombia
LA2698	La Esperanza de Belgica	Valle	Colombia
LA2700	Aoti, Satipo	Junin	Peru
LA2702	Kandy #1		Sri Lanka
LA2703*	Kandy #2		Sri Lanka
LA2709*	Bidadi, Bangalore	Karnataka	India
LA2710*	Porto Firme		Brazil
LA2782	El Volcan #1 - Pajarito	Antioquia	Colombia
LA2783*	El Volcan #2 - Titiribi	Antioquia	Colombia
LA2784	La Queronte	Antioquia	Colombia
LA2785	El Bosque	Antioquia	Colombia
LA2786	Andes #1	Antioquia	Colombia
LA2787	Andes #2	Antioquia	Colombia
LA2789	Canaveral	Antioquia	Colombia
LA2790	Buenos Aires	Antioquia	Colombia
LA2791	Rio Frio	Antioquia	Colombia
LA2792	Tamesis	Antioquia	Colombia
LA2793	La Mesa	Antioquia	Colombia
LA2794	El Libano	Antioquia	Colombia
LA2795	Camilo	Antioquia	Colombia
LA2807	Taypiplaya	Yungas	Bolivia
LA2811	Cerro Huayrapampa	Apurimac	Peru
LA2814	Ccascani, Sandia	Puno	Peru
LA2841	Chinuna	Amazonas	Peru
LA2842	Santa Rita	San Martin	Peru
LA2843	Moyobamba	San Martin	Peru
LA2844	Shanhoa	San Martin	Peru
LA2845*	Mercado Moyobamba	San Martin	Peru
LA2871*	Chamaca	Sud Yungas	Bolivia
LA2873	Lote Pablo Luna #2	Sud Yungas	Bolivia
LA2874	Playa Ancha	Sud Yungas	Bolivia
LA2933	Jipijapa	Manabi	Ecuador

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2977	Belen	Beni	Bolivia
LA2978	Belen	Beni	Bolivia
LA3123	Santa Cruz: summit	Galapagos Islands	Ecuador
LA3135	Pinal del Jigue	Holguin	Cuba
LA3136	Arroyo Rico	Holguin	Cuba
LA3137	Pinares de Mayari	Holguin	Cuba
LA3138	El Quemada	Holguin	Cuba
LA3139	San Pedro de Cananova	Holguin	Cuba
LA3140	Los Platanos	Holguin	Cuba
LA3141	Guira de Melena	La Habana	Cuba
LA3158	Los Mochis	Sinaloa	Mexico
LA3159	Los Mochis	Sinaloa	Mexico
LA3160	Los Mochis	Sinaloa	Mexico
LA3161	Los Mochis	Sinaloa	Mexico
LA3162	N of Copan		Honduras
LA3452	CATIE, Turrialba	Turrialba	Costa Rica
LA3623	Tablones	Manabi	Ecuador
LA3633			Ghana
LA3652	Matara	Apurimac	Peru
LA3842	El Limon Aragua		Venezuela
LA3844	Algarrobito	Guarico	Venezuela

L. hirsutum (76 accessions)

LA0094	Canta-Yangas	Lima	Peru
LA0361*	Canta	Lima	Peru
LA0386	Cajamarca	Cajamarca	Peru
LA0387	Santa Apolonia	Cajamarca	Peru
LA1033	Hacienda Taulis	Lambayeque	Peru
LA1295	Surco	Lima	Peru
LA1298	Yaso	Lima	Peru
LA1347*	Empalme Otusco	La Libertad	Peru
LA1352	Rupe	Cajamarca	Peru
LA1353*	Contumaza	Cajamarca	Peru
LA1354	Contumaza to Cascas	Cajamarca	Peru
LA1361*	Pariacoto	Ancash	Peru
LA1362	Chacchan	Ancash	Peru
LA1363*	Alta Fortaleza	Ancash	Peru
LA1366	Cajacay	Ancash	Peru
LA1378	Navan	Lima	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1391	Bagua to Olmos	Cajamarca	Peru
LA1392	Huaraz to Casma	Ancash	Peru
LA1393	Caraz	Ancash	Peru
LA1557	Rio Huara	Lima	Peru
LA1559	Desvio Huamantanga	Lima	Peru
LA1560*	Matucana	Lima	Peru
LA1648	Above Yaso	Lima	Peru
LA1681	Mushka	Lima	Peru
LA1691	Yauyos	Lima	Peru
LA1695	Cacachuhuasin, Canete	Lima	Peru
LA1696	Huanchuy-Cacra	Lima	Peru
LA1717	Sopalache	Piura	Peru
LA1718	Huancabamba	Piura	Peru
LA1721*	Ticrapo Viejo	Huancavelica	Peru
LA1731*	Rio San Juan	Huancavelica	Peru
LA1736	Pucutay	Piura	Peru
LA1737	Cashacoto	Piura	Peru
LA1738	Desfiladero	Piura	Peru
LA1739	W of Canchaque	Piura	Peru
LA1740*	W of Huancabamba	Piura	Peru
LA1741	Sondorillo	Piura	Peru
LA1753	Surco	Lima	Peru
LA1764	W of Canta	Lima	Peru
LA1772	W of Canta	Lima	Peru
LA1775	Rio Casma	Ancash	Peru
LA1777*	Rio Casma	Ancash	Peru
LA1778	Rio Casma	Ancash	Peru
LA1779	Rio Casma	Ancash	Peru
LA1918*	Llauta	Ica	Peru
LA1927	Ocobamba	Ica	Peru
LA1928*	Ocana	Ica	Peru
LA1978	Colca	Ancash	Peru
LA1980	Desvio Huambo	Ancash	Peru
LA2155*	Maydasbamba	Cajamarca	Peru
LA2156	Ingenio Montan	Cajamarca	Peru
LA2158*	Rio Chotano	Cajamarca	Peru
LA2159	Atonpampa	Cajamarca	Peru
LA2167*	Cementerio Cajamarca	Cajamarca	Peru
LA2171	El Molino	Piura	Peru
LA2196	Caclic	Amazonas	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2204*	Balsapata	Amazonas	Peru
LA2314	San Francisco	Amazonas	Peru
LA2321	Chirico	Amazonas	Peru
LA2324	Leimebamba	Amazonas	Peru
LA2329*	Aricapampa	La Libertad	Peru
LA2409*	Miraflores (Yauyos)	Lima	Peru
LA2552	Las Flores	Cajamarca	Peru
LA2556	Puente Moche	La Libertad	Peru
LA2567	Quita	Ancash	Peru
LA2574	Cullaspungro	Ancash	Peru
LA2648	Santo Domingo	Piura	Peru
LA2650*	Ayabaca	Piura	Peru
LA2651	Puente Tordopa	Piura	Peru
LA2722	Puente Auca	Lima	Peru
LA2812	Lambayeque	Lambayeque	Peru
LA2975	Coltao	Ancash	Peru
LA2976	Huangra	Ancash	Peru
LA3794	Alta Fortaleza	Ancash	Peru
LA3796	Anca, Marca	Ancash	Peru
LA3854	Llaguen	Chicama	Peru

L. hirsutum* f. *glabratum (41 accessions)

LA0407*	Mirador, Guayaquil	Guayas	Ecuador
LA1223*	Alausi	Chimborazo	Ecuador
LA1252	Loja	Loja	Ecuador
LA1253	Pueblo Nuevo-Landangue	Loja	Ecuador
LA1255	Pedistal	Loja	Ecuador
LA1264	Bucay	Chimborazo	Ecuador
LA1265	Rio Chimbo	Chimborazo	Ecuador
LA1266*	Pallatanga	Chimborazo	Ecuador
LA1624*	Jipijapa	Manabi	Ecuador
LA1625	S of Jipijapa	Manabi	Ecuador
LA2092	Chinuko	Chimborazo	Ecuador
LA2098*	Sabianga	Loja	Ecuador
LA2099	Sabianga to Sozorango	Loja	Ecuador
LA2100	Sozorango	Loja	Ecuador
LA2101	Cariamanga	Loja	Ecuador
LA2103*	Lansaca	Loja	Ecuador
LA2104	Pena Negra	Loja	Ecuador

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2105	Jardin Botanico, Loja	Loja	Ecuador
LA2106	Yambra	Loja	Ecuador
LA2107	Los Lirios	Loja	Ecuador
LA2108	Anganumo	Loja	Ecuador
LA2109*	Yangana #1	Loja	Ecuador
LA2110	Yangana #2	Loja	Ecuador
LA2114	San Juan	Loja	Ecuador
LA2115	Pucala	Loja	Ecuador
LA2116	Las Juntas	Loja	Ecuador
LA2119*	Saraguro	Loja	Ecuador
LA2124	Cumbaratza	Zamora-Chinchipe	Ecuador
LA2128*	Zumbi	Zamora-Chinchipe	Ecuador
LA2144	Chanchan	Chimborazo	Ecuador
LA2174*	Rio Chinchipe	Cajamarca	Peru
LA2175	Timbaruca	Cajamarca	Peru
LA2855	Mollinomuna	Loja	Ecuador
LA2860*	Cariamanga	Loja	Ecuador
LA2861	Las Juntas	Loja	Ecuador
LA2863	Macara	Loja	Ecuador
LA2864	Sozorango	Loja	Ecuador
LA2869	Matola-La Toma	Loja	Ecuador
LA3862	Purunuma	Loja	Ecuador
LA3863	Sozoranga	Loja	Ecuador
LA3864	Yangana	Loja	Ecuador
L. parviflorum (53 accessions)			
LA0247*	Chavinillo	Huanuco	Peru
LA0735	Huanuco-Cerro de Pasco	Huanuco	Peru
LA1319	Abancay	Apurimac	Peru
LA1321	Curahuasi	Apurimac	Peru
LA1322*	Limatambo	Cusco	Peru
LA1326	Rio Pachachaca	Apurimac	Peru
LA1329*	Yaca	Apurimac	Peru
LA1626A*	Mouth of Rio Rupac	Ancash	Peru
LA1716*	Huancabamba	Piura	Peru
LA2072	Huanuco	Huanuco	Peru
LA2073	Huanuco, N of San Rafael	Huanuco	Peru
LA2074	Huanuco	Huanuco	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2075	Huanuco	Huanuco	Peru
LA2113*	La Toma	Loja	Ecuador
LA2133*	Ona	Azuay	Ecuador
LA2190*	Tialango	Amazonas	Peru
LA2191	Campamento Ingenio	Amazonas	Peru
LA2192	Pedro Ruiz	Amazonas	Peru
LA2193	Churuja	Amazonas	Peru
LA2194	Chachapoyas West	Amazonas	Peru
LA2195	Caclic	Amazonas	Peru
LA2197	Luya	Amazonas	Peru
LA2198	Chachapoyas East	Amazonas	Peru
LA2200*	Choipiaco	Amazonas	Peru
LA2201	Pipus	Amazonas	Peru
LA2202	Tingobamba	Amazonas	Peru
LA2315	Sargento	Amazonas	Peru
LA2317	Zuta	Amazonas	Peru
LA2318	Lima Tambo	Amazonas	Peru
LA2319*	Chirico	Amazonas	Peru
LA2325*	Above Balsas	Amazonas	Peru
LA2403	Wandobamba	Huanuco	Peru
LA2613	Matichico-San Rafael	Huanuco	Peru
LA2614	San Rafael	Huanuco	Peru
LA2615	Ayancocho	Huanuco	Peru
LA2639A	Cunyac-Curahuasi	Apurimac	Peru
LA2641	Nacchera-Abancay	Apurimac	Peru
LA2727	Ona	Azuay	Ecuador
LA2847	Suyubamba	Amazonas	Peru
LA2848	W of Pedro Ruiz	Amazonas	Peru
LA2862	Saraguro-Cuenca	Azuay	Ecuador
LA2865	Rio Leon	Azuay	Ecuador
LA2913	Uchucyaco	Huanuco	Peru
LA2917*	Chullchaca	Ancash	Peru
LA3651	Matara	Apurimac	Peru
LA3655	Casinchigua-Chacache	Apurimac	Peru
LA3657	Casinchigua-Pichirhua	Apurimac	Peru
LA3660	Murashaya	Apurimac	Peru
LA3793	Huariaca to San Rafael	Huanuco	Peru
LA4020	Gonozabal	Loja	Ecuador
LA4021	Guancarcucho	Azuay	Ecuador

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA4022	Pueblo Nuevo	Azuay	Ecuador
LA4023	Paute	Azuay	Ecuador

L. pennellii (40 accessions)

Acc. No.	Site	Dept. / Prov.	Country
LA0716*	Atico	Arequipa	Peru
LA0751	Sisacaya	Lima	Peru
LA1272*	Pisaquera	Lima	Peru
LA1273	Cayan	Lima	Peru
LA1275	Quilca road junction	Lima	Peru
LA1277*	Trapiche	Lima	Peru
LA1282*	Sisacaya	Lima	Peru
LA1297	Pucara	Lima	Peru
LA1299	Santa Rosa de Quives	Lima	Peru
LA1303	Pampano	Huancavelica	Peru
LA1340*	Capillucas	Lima	Peru
LA1356	Moro	Ancash	Peru
LA1367*	Santa Eulalia	Lima	Peru
LA1376	Sayan	Lima	Peru
LA1515	Sayan to Churin	Lima	Peru
LA1522*	Quintay	Lima	Peru
LA1649	Molina (El Ingenio valley)	Ica	Peru
LA1656*	Marca to Chincha	Ica	Peru
LA1657	Buena Vista to Yautan	Ancash	Peru
LA1674*	Toparilla Canyon	Lima	Peru
LA1693	Quebrada Machurango	Lima	Peru
LA1724	La Quinga	Ica	Peru
LA1732*	Rio San Juan	Huancavelica	Peru
LA1733	Rio Canete, Km 75	Lima	Peru
LA1734	Rio Canete, Km 85	Lima	Peru
LA1735	Rio Canete, Km 87	Lima	Peru
LA1809	El Horador	Piura	Peru
LA1940	Rio Atico, Km 26	Arequipa	Peru
LA1941	Rio Atico, Km 41	Arequipa	Peru
LA1942	Rio Atico, Km 54	Arequipa	Peru
LA1943	Rio Atico, Km 61	Arequipa	Peru
LA1946*	Caraveli	Arequipa	Peru
LA2560*	Santa-Huaraz	Ancash	Peru
LA2580*	Valle de Casma	Ancash	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2657	Bayovar	Piura	Peru
LA2963*	Acoy	Arequipa	Peru
LA3635	Omas	Lima	Peru
LA3788	Rio Atico, Km 10	Arequipa	Peru
LA3789	Rio Atico, Km 26	Arequipa	Peru
LA3791	Caraveli	Arequipa	Peru

L. pennellii* var*. puberulum (8 accessions)

Acc. No.	Site	Dept. / Prov.	Country
LA0750	Ica to Nazca	Ica	Peru
LA1302*	Quita Sol	Ica	Peru
LA1911	Locari	Ica	Peru
LA1912	Cerro Locari	Ica	Peru
LA1920*	Cachiruma	Ayacucho	Peru
LA1926	Agua Perdida	Ica	Peru
LA3665	Rio Santa Cruz	Ica	Peru
LA3778	Palpa to Nazca	Ica	Peru

L. peruvianum (155 accessions)

Acc. No.	Site	Dept. / Prov.	Country
LA0098	Chilca	Lima	Peru
LA0103*	Cajamarquilla	Lima	Peru
LA0107*	Hacienda San Isidro	Lima	Peru
LA0110	Cajacay	Ancash	Peru
LA0111	Supe	Lima	Peru
LA0153*	Culebras	Ancash	Peru
LA0370	Hacienda Huampani	Lima	Peru
LA0371	Supe	Lima	Peru
LA0372	Culebras #1	Ancash	Peru
LA0374	Culebras #2	Ancash	Peru
LA0378	Cascas	Cajamarca	Peru
LA0392	Llallan	Cajamarca	Peru
LA0441*	Cerro Campana	La Libertad	Peru
LA0444*	Chincha #1	Ica	Peru
LA0445	Chincha #2	Ica	Peru
LA0446*	Atiquipa	Arequipa	Peru
LA0448	Chala	Arequipa	Peru
LA0451	Arequipa	Arequipa	Peru
LA0453	Yura	Arequipa	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA0454	Tambo	Arequipa	Peru
LA0455	Tambo	Arequipa	Peru
LA0462	Sobraya	Tarapaca	Chile
LA0464	Hacienda Rosario	Tarapaca	Chile
LA0752*	Sisacaya	Lima	Peru
LA1027		Cajamarca	Peru
LA1031	Balsas	Amazonas	Peru
LA1032	Aricapampa	La Libertad	Peru
LA1133	Huachipa	Lima	Peru
LA1161	Huachipa	Lima	Peru
LA1270	Pisiquillo	Lima	Peru
LA1271	Horcon	Lima	Peru
LA1274*	Pacaibamba	Lima	Peru
LA1278	Trapiche	Lima	Peru
LA1281	Sisacaya	Lima	Peru
LA1300	Santa Rosa de Quives	Lima	Peru
LA1304	Pampano	Huancavelica	Peru
LA1305*	Ticrapo	Huancavelica	Peru
LA1331*	Nazca	Ica	Peru
LA1333	Loma Camana	Arequipa	Peru
LA1336*	Atico	Arequipa	Peru
LA1337	Atiquipa	Arequipa	Peru
LA1339*	Capillucas	Lima	Peru
LA1346*	Casmiche	La Libertad	Peru
LA1350	Chauna	Cajamarca	Peru
LA1351	Rupe	Cajamarca	Peru
LA1358	Yautan	Ancash	Peru
LA1360*	Pariacoto	Ancash	Peru
LA1364*	Alta Fortaleza	Ancash	Peru
LA1365*	Caranquilloc	Ancash	Peru
LA1368	San Jose de Palla	Lima	Peru
LA1369	San Geronimo	Lima	Peru
LA1373	Asia	Lima	Peru
LA1377	Navan	Lima	Peru
LA1379	Caujul	Lima	Peru
LA1394	Balsas	Amazonas	Peru
LA1395	Chachapoyas	Amazonas	Peru
LA1396	Balsas (Chachapoyas)	Amazonas	Peru
LA1473	Callahuanca, Santa Eulalia	Lima	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1474*	Lomas de Camana	Arequipa	Peru
LA1475	Fundo 'Los Anitos'	Lima	Peru
LA1513	Atiquipa	Arequipa	Peru
LA1517	Irrigacion Santa Rosa	Lima	Peru
LA1537	(self-fertile selection)		
LA1554	Rio Huaura	Lima	Peru
LA1556	Hacienda Higuereto	Lima	Peru
LA1609	Asia - El Pinon	Lima	Peru
LA1616	La Molina, La Rinconada	Lima	Peru
LA1626*	Mouth of Rio Rupac	Ancash	Peru
LA1647*	Huadquina, Topara	Ica	Peru
LA1653	Uchumayo, Arequipa	Arequipa	Peru
LA1675	Toparilla Canyon	Lima	Peru
LA1677*	Fundo Huadquina to Topara	Lima	Peru
LA1692	Putinza	Lima	Peru
LA1694	Cacachuhuasin	Lima	Peru
LA1708*	Chamaya to Jaen	Cajamarca	Peru
LA1744	Putinza	Lima	Peru
LA1910*	Tambillo	Huancavelica	Peru
LA1913	Tinguiayog	Ica	Peru
LA1929	La Yapana	Ica	Peru
LA1935	Lomas de Atiquipa	Arequipa	Peru
LA1937*	Quebrada Torrecillas	Arequipa	Peru
LA1944	Rio Atico	Arequipa	Peru
LA1945*	Caraveli	Arequipa	Peru
LA1947	Puerto Atico	Arequipa	Peru
LA1949	Las Calaveritas	Arequipa	Peru
LA1951	Ocona	Arequipa	Peru
LA1954*	Mollendo	Arequipa	Peru
LA1955	Matarani	Arequipa	Peru
LA1973*	Yura	Arequipa	Peru
LA1975	Desvio Santo Domingo	Lima	Peru
LA1977	Orcocoto	Lima	Peru
LA1981	Vocatoma	Ancash	Peru
LA1982*	Huallanca	Ancash	Peru
LA1983	Rio Manta	Ancash	Peru
LA1984*	Otuzco	La Libertad	Peru
LA1985	Casmiche	La Libertad	Peru
LA1989	(self-fertile, bilaterally compat. with *L. esculentum*)		
LA2068	Chasquitambo	Ancash	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2157	Tunel Chotano	Cajamarca	Peru
LA2163*	Cochabamba to Yamaluc	Cajamarca	Peru
LA2164	Yamaluc	Cajamarca	Peru
LA2172*	Cuyca	Cajamarca	Peru
LA2185*	Pongo de Rentema	Amazonas	Peru
LA2326*	Above Balsas	Amazonas	Peru
LA2327	Aguas Calientes	Cajamarca	Peru
LA2328*	Aricapampa	La Libertad	Peru
LA2330	Chagual	La Libertad	Peru
LA2331	Agallapampa	La Libertad	Peru
LA2333	Casmiche	La Libertad	Peru
LA2388	Cochabamba to Huambos	Cajamarca	Peru
LA2553*	Balconcillo-San Marcos	Cajamarca	Peru
LA2555	Mariscal Castilla	La Libertad	Peru
LA2561	Huallanca	Ancash	Peru
LA2562	Huallanca	Ancash	Peru
LA2563	Canon del Pato	Ancash	Peru
LA2565	Potrero de Pomacocha	Ancash	Peru
LA2566	Cullachaca Pomacocha-Llamellin	Ancash	Peru
LA2573	Valle de Casma	Ancash	Peru
LA2575	Valle de Casma	Ancash	Peru
LA2581	Chacarilla (4x)	Tarapaca	Chile
LA2717	Chilca	Lima	Peru
LA2721	Putinza	Lima	Peru
LA2724	Huaynilla	Lima	Peru
LA2732*	Moquella	Tarapaca	Chile
LA2742	Camarones-Guancarane	Tarapaca	Chile
LA2744*	Sobraya (Azapa)	Tarapaca	Chile
LA2745	Pan de Azucar (Azapa)	Tarapaca	Chile
LA2770	Lluta	Tarapaca	Chile
LA2808*	Huaylas	Ancash	Peru
LA2809	Huaylas	Ancash	Peru
LA2834	Hacienda Asiento	Ica	Peru
LA2900	(aphid resistant selection)		
LA2959	Chaca-Vitor	Tarapaca	Chile
LA2962	Echancay	Arequipa	Peru
LA2964	Quebrada de Burros	Tacna	Peru
LA2981B	Torata to Chilligua	Moquegua	Peru
LA3154	Otora - Puente Jahuay	Moquegua	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA3156	Omate Valley	Moquegua	Peru
LA3218	Quebrada Guerrero	Arequipa	Peru
LA3219	Catarindo	Arequipa	Peru
LA3220	Cocachacra -Quebrada Cachendo	Arequipa	Peru
LA3636	Coayllo	Lima	Peru
LA3637	Coayllo	Lima	Peru
LA3639	Ccatac	Lima	Peru
LA3640	Mexico City		Mexico
LA3664	Nazca grade	Ica	Peru
LA3666	La Yapa	Ica	Peru
LA3781	Quebrada Oscollo	Arequipa	Peru
LA3787	Alta Chaparra	Arequipa	Peru
LA3790	Caraveli	Arequipa	Peru
LA3795	Alta Fortaleza	Ancash	Peru
LA3797	Anca, Marca	Ancash	Peru
LA3799	Río Pativilca	Ancash	Peru
LA3858	Canta	Lima	Peru
LA3900	(CMV tolerant slection)		

L. peruvianum* f. *glandulosum (13 accessions)

LA0364	9 Km W of Canta	Lima	Peru
LA0366	12 Km W of Canta	Lima	Peru
LA1283	Santa Cruz de Laya	Lima	Peru
LA1284	Espiritu Santo	Lima	Peru
LA1292*	San Mateo	Lima	Peru
LA1293	Matucana	Lima	Peru
LA1294	Surco	Lima	Peru
LA1296	Tornamesa	Lima	Peru
LA1551	Rimac Valley, Km 71	Lima	Peru
LA1552	Rimac Valley, Km 93	Lima	Peru
LA1646	Yaso	Lima	Peru
LA1722	Ticrapo Viejo	Huancavelica	Peru
LA1723	La Quinga	Ica	Peru

L. peruvianum* var. *humifusum (11 accessions)

LA0385	San Juan	Cajamarca	Peru
LA0389	Abra Gavilan	Cajamarca	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2150	Puente Muyuno	Cajamarca	Peru
LA2151	Morochupa	Cajamarca	Peru
LA2152*	San Juan #1	Cajamarca	Peru
LA2153	San Juan #2	Cajamarca	Peru
LA2334	San Juan	Cajamarca	Peru
LA2548	La Muyuna	Cajamarca	Peru
LA2550	El Tingo, Chorpampa	Cajamarca	Peru
LA2582	San Juan (4x)	Cajamarca	Peru
LA2583	(4x)		

L. pimpinellifolium (247 accessions)

Acc. No.	Site	Dept. / Prov.	Country
LA0100	La Cantuta	Lima	Peru
LA0114	Pacasmayo	La Libertad	Peru
LA0121	Trujillo	La Libertad	Peru
LA0122	Poroto	La Libertad	Peru
LA0369	La Cantuta	Lima	Peru
LA0373*	Culebras #1	Ancash	Peru
LA0375	Culebras #2	Ancash	Peru
LA0376	Chiclin	La Libertad	Peru
LA0381	Pongo	La Libertad	Peru
LA0384	Chilete	Cajamarca	Peru
LA0391	Magdalena	Cajamarca	Peru
LA0397	Hacienda Tuman	Lambayeque	Peru
LA0398	Hacienda Carrizal	Piura	Peru
LA0400*	Hacienda Buenos Aires	Piura	Peru
LA0411*	Pichilingue	Los Rios	Ecuador
LA0412	Pichilingue	Los Rios	Ecuador
LA0413	Cerecita	Guayas	Ecuador
LA0417*	Puna	Guayas	Ecuador
LA0418	Daule	Guayas	Ecuador
LA0420	El Empalme	Guayas	Ecuador
LA0442*	Sechin	Ancash	Peru
LA0443	Pichilingue	Los Rios	Ecuador
LA0480	Hacienda Santa Inez	Ica	Peru
LA0722	Trujillo	La Libertad	Peru
LA0753	Lurin	Lima	Peru
LA1236	Tinelandia, Santo Domingo	Pichincha	Ecuador
LA1237*	Atacames	Esmeraldas	Ecuador

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1242	Los Sapos	Guayas	Ecuador
LA1243	Co-op Carmela	Guayas	Ecuador
LA1245*	Santa Rosa	El Oro	Ecuador
LA1246*	La Toma	Loja	Ecuador
LA1248	Hacienda Monterrey	Loja	Ecuador
LA1256	Naranjal	Guayas	Ecuador
LA1257	Las Mercedes	Guayas	Ecuador
LA1258	Voluntario de Dios	Guayas	Ecuador
LA1259	Catarama	Los Rios	Ecuador
LA1260	Pueblo Viejo	Los Rios	Ecuador
LA1261*	Babahoyo	Los Rios	Ecuador
LA1262	Milagro Empalme	Guayas	Ecuador
LA1263	Barranco Chico	Guayas	Ecuador
LA1269	Pisiquillo	Lima	Peru
LA1279*	Cieneguilla	Lima	Peru
LA1280	Chontay	Lima	Peru
LA1301*	Hacienda San Ignacio	Ica	Peru
LA1332	Nazca	Ica	Peru
LA1335*	Pescaderos	Arequipa	Peru
LA1341	Huampani	Lima	Peru
LA1342	Casma	Ancash	Peru
LA1343	Puente Chao	La Libertad	Peru
LA1344	Laredo	La Libertad	Peru
LA1345	Samne	La Libertad	Peru
LA1348	Pacasmayo	La Libertad	Peru
LA1349	Cuculi	Lambayeque	Peru
LA1355	Nepena	Ancash	Peru
LA1357	Jimbe	Ancash	Peru
LA1359	La Crau	Ancash	Peru
LA1370	San Jose de Palla	Lima	Peru
LA1371*	Santa Eulalia	Lima	Peru
LA1374	Ingenio	Ica	Peru
LA1375*	San Vicente de Canete	Lima	Peru
LA1380	Chanchape	Piura	Peru
LA1381	Naupe	Piura	Peru
LA1382	Chachapoyas-Balsas	Amazonas	Peru
LA1383	Chachapoyas-Bagua	Amazonas	Peru
LA1384	Quebrada Parca (Chilca)	Lima	Peru
LA1416	Las Delicias	Pichincha	Ecuador
LA1466	Chongoyape	Lambayeque	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1469	El Pilar, Olmos	Lambayeque	Peru
LA1470	Motupe to Desvio Olmos - Bagua	Lambayeque	Peru
LA1471	Motupe to Jayanca	Lambayeque	Peru
LA1472	Quebrada Topara	Lima	Peru
LA1478*	Santo Tome (Pabur)	Piura	Peru
LA1514	Huaura-Sayan-Churin	Lima	Peru
LA1519	Vitarte	Lima	Peru
LA1520	Huaura-Sayan-Churin	Lima	Peru
LA1521*	El Pinon, Asia	Lima	Peru
LA1547*	Chota to El Angel	Carchi	Ecuador
LA1561	San Eusebio	Lima	Peru
LA1562	Cieneguilla	Lima	Peru
LA1571	San Jose de Palle	Lima	Peru
LA1572	Hacienda Huampani	Lima	Peru
LA1573	Nana	Lima	Peru
LA1575	Huaycan	Lima	Peru
LA1576*	Manchay Alta	Lima	Peru
LA1577	Cartavio	La Libertad	Peru
LA1578*	Santa Marta	La Libertad	Peru
LA1579	Colegio Punto Cuatro #1	Lambayeque	Peru
LA1580	Colegio Punto Cuatro #2	Lambayeque	Peru
LA1581	Punto Cuatro	Lambayeque	Peru
LA1582*	Motupe	Lambayeque	Peru
LA1583	Tierra de la Vieja	Lambayeque	Peru
LA1584*	Jayanca to La Vina	Lambayeque	Peru
LA1585	Cuculi	Lambayeque	Peru
LA1586*	Zana, San Nicolas	La Libertad	Peru
LA1587	San Pedro de Lloc	La Libertad	Peru
LA1588	Laredo to Barraza	La Libertad	Peru
LA1589	Viru to Galunga	La Libertad	Peru
LA1590*	Viru to Tomaval	La Libertad	Peru
LA1591	Ascope	La Libertad	Peru
LA1592	Moche	La Libertad	Peru
LA1593*	Puente Chao	La Libertad	Peru
LA1594	Cerro Sechin	Ancash	Peru
LA1595	Nepena to Samanco	Ancash	Peru
LA1596	Santa to La Rinconada	Ancash	Peru
LA1597	Rio Casma	Ancash	Peru
LA1598	Culebras to La Victoria	Ancash	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1599*	Huarmey	Ancash	Peru
LA1600	Las Zorras	Ancash	Peru
LA1601	La Providencia	Ancash	Peru
LA1602*	Rio Chillon to Punchauca	Lima	Peru
LA1603	Quilca	Lima	Peru
LA1604	Horcon	Lima	Peru
LA1605	Canete - San Antonio	Lima	Peru
LA1606*	Tambo de Mora	Ica	Peru
LA1607	Canete - La Victoria	Lima	Peru
LA1608	Canete - San Luis	Lima	Peru
LA1610	Asia - El Pinon	Lima	Peru
LA1611	Rio Mala	Lima	Peru
LA1612	Rio Chilca	Lima	Peru
LA1613	Santa Eusebia	Lima	Peru
LA1614	Pampa Chumbes	Lima	Peru
LA1615	Piura to Simbala	Piura	Peru
LA1617*	Tumbes South	Tumbes	Peru
LA1618	Tumbes North	Tumbes	Peru
LA1628	Huanchaco	La Libertad	Peru
LA1629	Miraflores to Costa Verde	Lima	Peru
LA1630	Fundo La Palma	Ica	Peru
LA1631	Planta Envasadora San Fernando	La Libertad	Peru
LA1633	Co-op Huayna Capac	Ica	Peru
LA1634	Fundo Bogotalla #1	Ica	Peru
LA1635	Fundo Bogotalla #2	Ica	Peru
LA1636	Laran	Ica	Peru
LA1637	La Calera	Ica	Peru
LA1638	Fundo El Portillo	Lima	Peru
LA1645	Miraflores to Quebrada Armendariz	Lima	Peru
LA1651	La Molina	Lima	Peru
LA1652	Cienguilla	Lima	Peru
LA1659*	Pariacoto	Ancash	Peru
LA1660	Yautan to Pariacoto	Ancash	Peru
LA1661	Esquina de Asia	Lima	Peru
LA1670	Rio Sama	Tacna	Peru
LA1676	Fundo Huadquina to Topara	Ica	Peru
LA1678	San Juan Lucumo de Topara	Ica	Peru
LA1679	Tambo de Mora	Ica	Peru
LA1680	La Encanada	Lima	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA1682	Montalban	Lima	Peru
LA1683*	Miramar	Piura	Peru
LA1684	Chulucanas	Piura	Peru
LA1685	Marcavelica	Piura	Peru
LA1686	Valle Hermosa #1	Piura	Peru
LA1687	Valle Hermoso #2	Piura	Peru
LA1688	Pedregal	Piura	Peru
LA1689*	Piura, Castilla #1	Piura	Peru
LA1690	Piura, Castilla #2	Piura	Peru
LA1697	Hacienda Santa Anita	Lima	Peru
LA1719	East of Arenillas	El Oro	Ecuador
LA1720	Yautan	Ancash	Peru
LA1728	Rio San Juan	Ica	Peru
LA1729	Rio San Juan	Ica	Peru
LA1742	Olmos - Marquina	Lambayeque	Peru
LA1781	Bahia de Caraquez	Manabi	Ecuador
LA1921	Majarena	Ica	Peru
LA1923	Cabildo	Ica	Peru
LA1924*	Piedras Gordas	Ica	Peru
LA1925	Pangaravi	Ica	Peru
LA1933	Jaqui	Arequipa	Peru
LA1936	Huancalpa	Arequipa	Peru
LA1950	Pescadores	Arequipa	Peru
LA1987	Viru-Fundo Luis Enrique	La Libertad	Peru
LA1992	Pishicato	Lima	Peru
LA1993	Chicama Valley (?)	Lima	Peru
LA2093	La Union	El Oro	Ecuador
LA2096	Playa	Loja	Ecuador
LA2097	Macara	Loja	Ecuador
LA2102*	El Lucero	Loja	Ecuador
LA2112	Hacienda Monterrey	Loja	Ecuador
LA2145	Juan Montalvo	Los Rios	Ecuador
LA2146	Limoncarro	Lambayeque	Peru
LA2147	Yube	Lambayeque	Peru
LA2149	Puente Muyuno	Cajamarca	Peru
LA2170	Pai Pai	Lambayeque	Peru
LA2173*	Cruz de Huaiquillo	Cajamarca	Peru
LA2176	Timbaruca	Cajamarca	Peru
LA2178	Tororume	Cajamarca	Peru
LA2179	Tamboripa-La Manga	Cajamarca	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2180	La Coipa	Cajamarca	Peru
LA2181*	Balsahuaico	Cajamarca	Peru
LA2182	Cumba	Amazonas	Peru
LA2183*	Corral Quemado	Amazonas	Peru
LA2184	Bagua	Amazonas	Peru
LA2186	El Salao	Amazonas	Peru
LA2187	La Caldera	Amazonas	Peru
LA2188	Machugal #1	Amazonas	Peru
LA2189	Machugal #2	Amazonas	Peru
LA2335	(4x)		
LA2336	(*r*, 4x)		
LA2340	(4x)		
LA2341	(4x)		
LA2345	(autodiploid)		
LA2346	(autodiploid)		
LA2347	(autodiploid)		
LA2348	(*l, x*)		
LA2389	Tembladera	Cajamarca	Peru
LA2390	Chungal	Cajamarca	Peru
LA2391	Chungal to Monte Grande	Cajamarca	Peru
LA2401*	Moxeque	Ancash	Peru
LA2412	Fundo Don Javier, Chilca	Lima	Peru
LA2533*	Lomas de Latillo	Lima	Peru
LA2576	Valle de Casma	Ancash	Peru
LA2578	Tuturo	Ancash	Peru
LA2585	(4x)		
LA2645	Desvio Chulucanas-Morropon	Piura	Peru
LA2646	Chalaco	Piura	Peru
LA2647	Morropon-Chalaco	Piura	Peru
LA2652	Sullana	Piura	Peru
LA2653	San Francisco de Chocan	Piura	Peru
LA2655	La Huaca to Sullana	Piura	Peru
LA2656	Suarez	Tumbes	Peru
LA2659	Campus of U.N. de Piura	Piura	Peru
LA2718	Chilca	Lima	Peru
LA2725	Tambo Colorado	Ica	Peru
LA2831	Rio Nazca	Ica	Peru
LA2832	Chichictara	Ica	Peru
LA2833	Hacienda Asiento	Ica	Peru

*member of core collection

Acc. No.	Site	Dept. / Prov.	Country
LA2836	Fundo Pongo	Ica	Peru
LA2839	Tialango	Amazonas	Peru
LA2840	Santa Hilarion de Tomaque	Amazonas	Peru
LA2850	Santa Rosa	Manabi	Ecuador
LA2851	Carcel Montecristi	Manabi	Ecuador
LA2852*	Cirsto Rey de Charapoto	Manabi	Ecuador
LA2853	Experiment Station, Portoviejo	Manabi	Ecuador
LA2854	Jipijapa	Manabi	Ecuador
LA2857	Isabela: Villamil	Galapagos Islands	Ecuador
LA2866	Via a Amaluza	Loja	Ecuador
LA2914A	La Castellana	Lima	Peru
LA2914B	La Castellana	Lima	Peru
LA2915	Remanso de Olmos	Lambayeque	Peru
LA2966	La Molina	Lima	Peru
LA2974	Huaca del Sol	La Libertad	Peru
LA2982	Chilca #1	Lima	Peru
LA2983	Chilca #2	Lima	Peru
LA3468	La Molina Vieja	Lima	Peru
LA3634	Santa Rosa de Asia	Lima	Peru
LA3638	Ccatac	Lima	Peru
LA3798	Río Pativilca	Ancash	Peru
LA3852	Atinchik, Pachacamac	Lima	Peru
LA3859	(TYLCV resistand selection)		

S. juglandifolium (7 accessions)

Acc. No.	Site	Dept. / Prov.	Country
LA2120	Sabanilla	Zamora-Chinchipe	Ecuador
LA2134	Tinajillas	Zamora-Chinchipe	Ecuador
LA2788	Quebrada la Buena	Antioquia	Colombia
LA3323	Manuel Cornejo Astorga		Ecuador
LA3324	Sabanillas		Ecuador
LA3325	Cordillera de los Huacamayos	Morona Santiago	Ecuador
LA3326	San Ysidro de Yungilla	Chimborazo	Ecuador

S. lycopersicoides (16 accessions)

Acc. No.	Site	Dept. / Prov.	Country
LA0461	Palca	Tacna	Peru
LA1964	Chupapalca	Tacna	Peru

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Acc. No.	Site	Dept. / Prov.	Country
LA1990	Palca	Tacna	Peru
LA2385	Chupapalca to Ingenio	Tacna	Peru
LA2386	Chupapalca	Tacna	Peru
LA2387	Lago Aricota	Tacna	Peru
LA2407	Arica-Putre	Tarapaca	Chile
LA2408	Above Putre	Tarapaca	Chile
LA2730	Moquella	Tarapaca	Chile
LA2772	Zapahuira	Tarapaca	Chile
LA2776	Catarata Perquejeque	Tarapaca	Chile
LA2777	Putre	Tarapaca	Chile
LA2781	Desvio a Putre	Tarapaca	Chile
LA2951	Quistagama	Tarapaca	Chile
LA4018	Lago Aricota	Tacna	Peru
LA4019	Causiri	Tacna	Peru
S. ochranthum (4 accessions)			
LA2118	San Lucas	Loja	Ecuador
LA2166	Rocoto-Pacopampa	Cajamarca	Peru
LA2682	Chinchaypuyo	Cusco	Peru
LA3650	Choquemaray	Apurimac	Peru
S. sitiens (5 accessions)			
LA1974	Chuquicamata	Antofagasta	Chile
LA2876	Chuquicamata	Antofagasta	Chile
LA2877	El Crucero	Antofagasta	Chile
LA2878	Mina La Exotica	Antofagasta	Chile
LA2885	Caracoles	Antofagasta	Chile

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