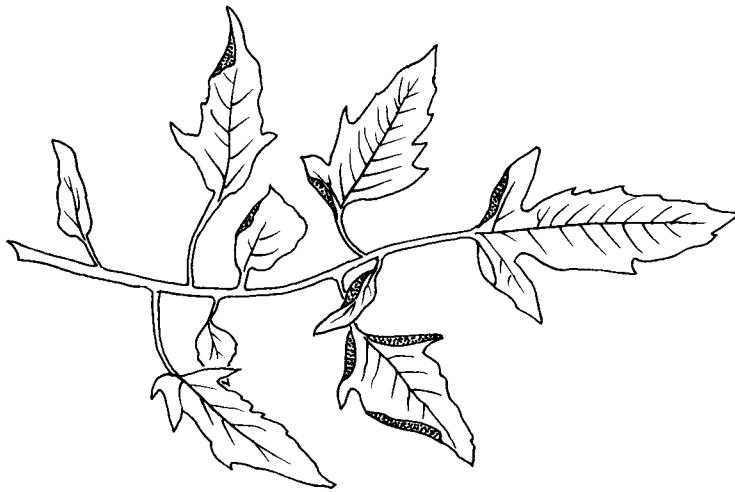


# REPORT of the TOMATO GENETICS COOPERATIVE



NUMBER 28

MAY 1978

DEPARTMENT OF VEGETABLE CROPS  
UNIVERSITY OF CALIFORNIA  
DAVIS, CALIFORNIA

This report is a medium of exchange among members of information and stock relating to tomato genetics. None of the information herein may be used in publications without consent of the respective authors.

## FOREWORD

The Tomato Genetics Cooperative is a group of workers who have a common interest in tomato genetics and who are organized informally for the purpose of exchanging information and stocks. Participation is voluntary, and costs of activities are met by assessments to members.

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As of December 31, 1977, TGC membership stood at 333, which, remarkably, is identical with the total of the previous year. The financial balance, \$1074.92, is substantially lower than the \$1251.54 one year earlier. Increased printing costs and higher postal charges are responsible for the difference. We hope that the increased member assessments started in October will offset these advancing costs.

The 1976 annual meeting was held in conjunction with the Tomato Breeders Round Table at Toronto, Canada on February 10. Minutes appear below. The 1978 meeting has been arranged again with the TBRT.

An extra feature of this Report is the first installment of an inventory of green-fruited tomato species, appearing as Appendix B. We are highly indebted to Miguel Holle for spearheading this massive project. A list of new genes reported since 1973 was intended for this Report but had to be postponed for various reasons. The many details incurred in this effort, the inventory, and other parts account for the delay in printing and distributing TGC 28.

We are again most grateful to the many willing workers who participated in preparing TGC 28. Dora Hunt again assumed full responsibility for memberships, financial accounts, and managing and editing this Report. Pat Pennell, Betty Perry, and Corky Wilkerson typed the master copies. Moira Tanaka did the art work. Paul Bosland and Randy Schuster assisted with the proof reading.

### Coordinating Committee

L. Butler	C. M. Rick, Chairman
S. Honma	Department of Vegetable Crops
G. B. Reynard	University of California
R. W. Robinson	Davis, California 95616

## ANNUAL MEETING

The 1977 meeting of the Tomato Genetics Cooperative was held under the auspices of the Tomato Breeders Round Table in Hotel Constellation, Toronto, Canada February 10, 1977 at 5 p.m., C. M. Rick presided. Although the exact number of members present could not be determined amongst those attending the Round Table sessions, the presence of at least 30 members was estimated. The TBRT thus continues to provide the best opportunity for assembling TGC members for the annual meeting.

Recent activities of the TGC were briefly reviewed by the Chairman. As of December 31, 1976, the financial balance was \$1251.54 and membership stood at 333.

The value of the section of TGC Reports on Bibliography of Papers in Tomato Genetics and Breeding was discussed. A show of hands revealed that 14 members used this section in their literature searches. This strong showing provides a useful consensus for continuation of the bibliography.

The Chairman outlined the NSF Grant recently approved for a Tomato Genetics Stock Center at Davis for the purpose of acquiring, maintaining, and distributing stocks of genetic interest. More information is presented in the Foreword of TGC Report #27. A brief discussion followed concerning the relationships of this Center with the TGC.

The meeting adjourned after the consummation of discussion and before the start of the customary happy hour.

C. M. Rick,  
Secretary pro tem.

## PART I

RESEARCH NOTES

Achkova-Valkova, Z., and P. Stoeva Bilateral hybridization of Lycopersicon peruvianum Mill. with some self-compatible species. (Submitted by C. Daskaloff)

The utilization of L. peruvianum as a female parent with self-compatible species from the genus Lycopersicon will give the opportunity to study the interaction of its cytoplasm with the genomes of these species. When the hy-

bridization is done at a diploid level, L. peruvianum manifests considerable or full reproductive isolation. That's why hybridization at heteroploid level with three self-compatible species manifesting certain instability in their interspecific reproductive relations - L. hirsutum f. glabratum, L. minutum and S. pennellii (Atico) - has been applied.

The hybridization has been carried out in the greenhouse in two directions so that each parent takes part as an autotetraploid and a diploid. An indispensable condition for successful hybridization is the use of unemasculated buds. In order to preclude self pollination, about 24 h after the pollination the bared stigma has been covered with a layer of dextrine glue. The hybrid character of the plants has been determined by the chromosome number ( $2n=36$ ) and some marked characteristics. Hybrid seeds have been obtained from the two directions of crossing on condition that L. peruvianum takes part as a diploid and its partner as a tetraploid. While the hybridization with L. minutum and S. pennellii is relatively easy (18.9 - 25.7 hybrid plants per 100 pollinated buds) hybridization with L. hirsutum f. glabratum is very difficult (2.1 - 2.4 hybrid plants per 100 pollinated buds). Phenotypically the sesquidiploids are diverted strongly towards the tetraploid parent. The fertility reaches up to 58%.

The sesquidiploid L. peruvianum ( $2n$ ) X L. hirsutum f. glabratum ( $4n$ ) was the first to be used for a bridge between L. peruvianum and other species because the work with it began earlier. The obtaining of  $F_2$  and  $BC_1$  was difficult. From 230 crosses with L. hirsutum f. glabratum 2 aneuploid plants with 25 and 26 chromosomes were obtained. The second backcross was easily obtained. The plants from  $BC_1$  with L. hirsutum f. glabratum failed to cross with L. esculentum but in hybridization with L. pimpinellifolium from 147 pollinated buds 75 plants were obtained. Their hybrid character was determined by the orange color of the fruits.  $F_1$  of this complex hybrid was crossed easily with L. esculentum (from 213 pollinated buds - 157 hybrid plants). The fruits of the new hybrid were red- or orange-colored with intermediate inheritance of fruit size.

Via the sesquidiploid L. peruvianum ( $2n$ ) X L. hirsutum f. glabratum ( $4n$ ) have been obtained  $BC_2$  with L. esculentum. With the progress of the backcrosses in the first two cases an increasing of pollen fertility has been observed. These data suggest that the appearance of cytoplasmic male sterility can hardly be expected. It is too early to speak about certain phenotypic manifestations of the combination between the cytoplasm of L. peruvianum and the genome of L. esculentum.

The work for hybridization of L. peruvianum with L. esculentum was done in the period from the end of 1974 'til the middle of 1977. This characterizes the method as relatively quick and efficient in investigation of the interrelations of the cytoplasm of L. peruvianum and the genomes of the self-compatible species from the genus Lycopersicon.

Allavena, A., and G. P. Soressi Tetraploid parthenocarpic fruitful tomatoes.

Tetraploid seeds from hand-pollination of polyploid shoots following colchicine treatment (0.5% emulsion) of pat/pat  $F_3$  seedlings

have been obtained. These self-fertilized seeds produced  $4N$  parthenocarpic plants as fruitful as the corresponding diploids. On the contrary the  $4N$  homozygous pat plants were almost completely sterile. Besides the  $4N$  parthenocarpic fruits were larger and heavier (30%) than the corresponding  $2N$ . In addition their soluble solids and pH did not significantly differ from the diploid pat/pat, while the ascorbic acid content was higher (20%). As the tetraploid tomatoes have not so far proved to be of economic importance mainly because of their reduced fertility, our data put in evidence the potential of the polyploidy coupled with the parthenocarp in tomato breeding.

Atanassova, B. Combining ability for style and anther length in a tomato diallel cross.

Inheritance of style and anther length in tomato  $F_1$  crosses is of great importance for hybrid seed production based on maternal lines with exerted stigma because these

characters are the main components determining the manifestation of longistly in  $F_1$  flowers. The observed fact that short style is associated with shorter pollen tube length does not always guarantee successful correction of longistly in  $F_1$  (TGC, 1976) imposed a study on the combining ability for these two components in an  $8 \times 8$  diallel cross including the following parental lines, form and cultivars: Rutgers-21, GCR-66, Red Cherry, line XXIV-13, Penelopa, line 7/3, L. pimpinellifolium-108 and L. hirsutum f. glabratum. Combining ability was estimated after Griffing (1956) method 2, model II.

Results obtained by the analysis of variance of and SCA for both components (Table 1) show that general, as well as specific, combining ability has a considerable effect on style and anther length variation. For both components GCA is much greater, which means that additive gene effects are greater than non-additive.

Data presented in Table 2 reveal that the choice of parental components can be based on GCA values. Line 7/3, which best corrects longistly in  $F_1$ , has lowest GCA value for style length, while GCR-66, which has the longest style and for which correction of longistly in its  $F_1$  crosses is almost impossible, has also the highest GCA values for this character.

Considering anther length, however, SCA should be studied because by data of parental GCA no prediction can be made of the heterosis effect which in some cases is of great importance for correcting  $F_1$  longistly.

Table 1. Analysis of variance of general combining ability (GCA) and specific combining ability (SCA) for style and anther length.

		Source of variation	Sum of squares	DF	Mean square	F emp.	F theor.	
							5%	1%
Style length	1975	GCA	107.94	7	15.42	514.00	2.12	2.90
		SCA	21.20	20	1.06	35.33	1.72	2.14
		Error	2.60	85	0.03			
	1976	GCA	80.96	7	11.57	1157.00	2.12	2.90
		SCA	13.00	20	0.65	65.00	1.72	2.14
		Error	0.91	85	0.01			
Anther length	1975	GCA	17.19	7	2.46	491.20	2.12	2.90
		SCA	11.22	20	0.56	112.20	1.72	2.14
		Error	0.40	85	0.005			
	1976	GCA	14.17	7	2.02	505.00	2.12	2.90
		SCA	9.21	20	0.46	115.00	1.72	2.14
		Error	0.31	85	0.004			

Table 2. Parental length of style and anther and general combining ability.

Parents	Style				Anther			
	length mm		GCA		length mm		GCA	
	1975	1976	1975	1976	1975	1976	1975	1976
Rutgers-21	10.2	10.6	+0.45	+0.51	18.2	8.1	+0.03	0.00
GCR-66	12.3	13.1	+1.44	+1.70	18.6	8.7	+0.19	+0.25
Red Cherry	7.4	7.4	-0.84	-0.99	6.2	6.0	-0.62	-0.98
Line XXIV-13	7.3	7.1	-0.65	-0.63	9.4	9.6	+0.62	+0.54
Penelopa	5.2	4.8	-1.04	-1.20	8.0	7.9	+0.10	+0.23
Line 7/3	6.7	6.4	-1.31	-1.50	7.9	7.8	-0.49	-0.41
<u>L. pimpinell.</u> 108	10.8	10.5	+0.84	+0.63	8.1	8.3	+0.02	-0.09
<u>L. hirs.</u> f. <u>glab.</u>	10.7	10.7	+1.09	+1.46	7.9	7.8	+0.53	+0.42

Avdeyev, Y. I., and T. V. Boeva Resistance  
of tomato to blossom-end rot.

The tomato blossom-end rot (BER) reduces  
early marketable yield of the tomato by 15-  
40 percent. In natural field conditions the

disease is not constant. A plot with an area of 400 square meters where annually 100 percent  
of plants of susceptible varieties are affected by BER has been found. The conditions of  
different years modified the intensity of BER, greater damage occurring in hot dry years. In  $F_1$   
hybrids from crossing susceptible variety Mashinny 1 with the resistant variety Gumbert, the  
resistance is not completely dominant (Table). In  $F_2$  the ratio of plants susceptible to BER to  
the others is from 1:40 to 1:60. It is supposed that the resistance to BER is caused by 2 or 4  
independent incompletely-dominant genes with additive effect. The genes causing the given  
type of resistance may be designated by the following symbol "Ber (Ber-2,...)".

Distribution of plants according to the degree of expression of BER in hybrid  
combination (Gumbert X Mashinny).

Varieties & hybrids 1975	Total plants	(% of fruits affected by BER)										% affected by BER	Ave am't frts affected by BER/plant	Ave intensity of BER (%)
		0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90			
Mashinny 1	76		1	1	8	21	22	11	6	5	1	100	30.05	45.50
Gumbert	45	38	7									15.6	0.22	0.70
$F_1$ (Gumbert x Mashinny 1)	80	12	17	14	6	1						85.0	3.87	7.89
$F_2$ (Gumbert x Mashinny 1)	119	62	42	12		1		2				47.9	1.99	3.32

Cappadocia, M., and J. A. Meyer In vitro  
culture of flower buds and anthers from  
the hybrid L. esculentum x L. peruvia-  
num.

With the aim of recovering haploid plants of  
tomatoes which combine different dosages of  
esculentum and peruvianum chromosomes,  
attempts have been made to culture on  
artificial media flower buds and anthers of

the self-incompatible interspecific diploid hybrid between L. esculentum cv. San Marzano and  
L. peruvianum (for a description of the hybrid, see de Nettancourt et al., 1974).

Intact floral buds and anthers with microspores in late mononuclear stage were placed on the basic medium of Murashige and Skoog (1962) with vitamins (Nitsch and Nitsch, 1969) and different dosages of NAA, GA<sub>3</sub> and 6BA. Sucrose (20 g/l) and agar (7 g/l) were added to the medium; pH was adjusted to 5.8. A number of pretreatments with 2-4 D (10 ppm) were carried out.

After 7 days of culture (dark, 27°C) several microspores in the cultured buds and anthers were found to contain more than 2 nuclei (up to 8 in certain cases). The proportion of polynucleated microspores was higher in material pretreated with 2-4 D. In some of the anthers pretreated with 2-4 D and exposed to photoperiodical light during two weeks (16h, 6000 lux) after 5 days of culture in darkness, microspores could be clearly observed to have evolved into globular embryos (up to 32 cells).

#### References

- Murashige, T. and F. Skoog, 1962. *Physiol. Plantarum* 15:473-497.  
 de Nettancourt, D., et al., 1974. *Theoretical and Applied Genetics* 44:278-288.  
 Nitsch, J. P., and C. Nitsch, 1969. *Science* 163:85-87.

Daskaloff, H., M. Konstantinova, and K. Moinova Inheritance of lycopene content in tomato fruits.

Analysis determining the lycopene content of tomato fruits in P<sub>1</sub>, P<sub>2</sub> and F<sub>1</sub> plants of a 6 x 6 (n<sup>2</sup>) diallel cross were made during the 1974-1977 period within the breeding program

for high quality tomatoes. Results obtained showed that lycopene content, which is controlled by genes regulating the ability for its synthesis, is a hereditary character and although influenced by environmental factors it is typical for each tomato species or cultivar.

Correlation relationships between lycopene content and the parental dominance indicator Wr + Vr prove that the parents with low lycopene content have a larger number of dominant genes, while the genes in parents with high lycopene content are mostly recessive (Table).

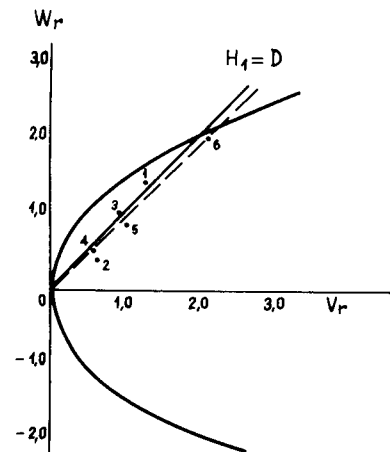
1975			1976			1977		
Parent*	Lycopene % mg	Wr + Vr	Parent*	Lycopene % mg	Wr + Vr	Parent*	Lycopene % mg	Wr + Vr
2	1.173	1.176	2	0.616	1.008	2	1.489	1.517
4	3.144	3.215	4	1.065	2.607	4	2.280	2.497
5	3.698	3.913	1	1.801	1.824	5	4.645	4.491
3	5.807	4.125	3	2.227	2.014	3	5.688	4.920
1	2.227	4.860	6	4.650	2.815	1	3.034	5.088
6	8.505	5.090	5	3.877	4.115	6	7.110	7.582

\* 1=Violet, 2=Caro red, 3=hp/hp, 4=Money maker, 5=Drouzba, 6=L. cheesmanii typicus.

The  $W_r + V_r$  graph for lycopene content inheritance shows that it is dominant. The parents are situated around the regression line (see fig.) according to their number of dominant or recessive genes.

The cultivars Caro red (2) and Moneymaker (4), which have a low lycopene content, possess the largest number of dominant genes, while *L. cheesmanii* typicus and the line Violet, the largest number of recessive genes. It is evident that low lycopene content is controlled by dominant genes.

Breeding for lycopene content is therefore comparatively slow and a component having a larger number of additive genes with high lycopene content should be included in the program.



Falavigna, A., and G. P. Soressi Birdsnest phenotypes as related with sundwarf genes.

An allelism test between mimic birdsnest phenotypes from different sources has been made. All the phenotypes considered are characterized by a progressive shortening of

internodes strictly dependent upon the intensity of sun light as the original sundwarf (sd) mutant.

No.	Name	Source	Genetic symbol (tentative)
317	Birdsnest-type	Butler--Canada	<u>sd-2</u> / <u>sd-2</u>
328	S. Marzano EMS	Soressi--Italy	<u>sd-2</u> / <u>sd-2</u>
387	Moneymaker-R	Monti--Italy	<u>sd-3</u> / <u>sd-2</u>
423	H-105	Lyall--Canada	<u>sd-2</u> / <u>sd-3</u>
429	Ottawa-60	Lyall--Canada	<u>sd-2</u> / <u>sd-2</u>
530	XP-1030	Asgrow--USA	<u>sd-2</u> / <u>sd-2</u>

The obtained  $F_1$  data, together with those of the  $F_2$ ,  $F_3$  and  $F_4$  progenies of the cross 429 x 387, evidence the existence of two sundwarf genes (sd-2, sd-3), the first of which is incompletely recessive, interacting with each other and with sp and br Mendelian factors. As a consequence of the environment and genetic background influences, the segregating progenies bring about a range of phenotypes going from the rosette to the nearly normal habit. The well known birdsnest phenotype (TGC, 1966) is then recognized due to the interaction of the genes sd-2, sp and br; the sd-2 gene is likely to be the same or an allele of the original sundwarf (sd) mutant. The checking of the allelism between sd and sd-2 phenotypes and the screening of the segregating progenies is in progress.

Kopliovitch, E., N. Kedar, and Nira Retig Genotypic and environmental effects on heat-necrosis of heterozygous TMV-"resistant" lines.

Methods. In most experiments the lower three leaves of plants at the fourth true leaf stage were inoculated with race O of the virus. After 24 h the plants were given temperature treatments of 32° or 35°C for

24 or 48 h. The disease index (D.I.) reflected the number of plants infected and the severity of infection, where 0=healthy, 1=1 to 10 systemic necrotic spots, 2=more than 10 necrotic spots,

and 4=newly developed leaves showing mosaic symptoms. The resistant material included the Tm-2<sup>a</sup> lines #96 (=Davis 70T82-1), #167 (Ohio R.M. 9), #151 (Momor 92, Montfavet, France) and the Tm-2 line #150 (Moperou 111, Montfavet). The susceptible material included #33 (Hotset), #2 (Hawaii), #20 (Ejlon, Israel) and three local breeding lines, WM, #15 and #47.

Reciprocal effect. Line #96 served as the resistant, #2 and #15 as susceptible parents. F<sub>1</sub> plants with the susceptible parents as female were found to be far more resistant to the heat treatment than the reciprocal combinations. Thus, the percentage of healthy plants was 33% (+/Tm-2<sup>a</sup>) and 17% (Tm-2<sup>a</sup>/+) in one experiment, 72% and 46%, respectively, in the second, and 61% and 25% in the third experiment.

Parental genotypes. Six F<sub>1</sub> crosses between a resistant Tm-2<sup>a</sup> female and 6 susceptible male parents showed little variation in resistance to the heat treatment. Similar results were obtained in two experiments with other Tm-2<sup>a</sup> lines as female parent. However, in one experiment, comparing three Tm-2<sup>a</sup> lines with a common susceptible male parent, the D.I. was significantly higher in the F<sub>1</sub> 96 x 20 (D.I. 3.67) than in F<sub>1</sub> 151 x 20 (1.83) or in F<sub>1</sub> 167 x 20 (1.54).

Heat-necrosis in Tm-2/+. After 48 h of heat treatment at 35° C no disease symptoms were observed in plants of 4 different Tm-2/+ hybrids with #150 as ♀. Even a prolonged heat treatment of 72 h gave a very low D.I., with 5% to 15% of the plants showing some disease symptoms.

Duration of heat treatment and cumulative effect. Plants of 5 different hybrids (Tm-2<sup>a</sup>/+) with #96 as female parent were inoculated and kept at 32° C for different time intervals before transfer to 20° C. With heat treatment for 24 or 48 h periods, 30% to 50% of the plants showed systemic necrosis, while all 10 h treated plants remained healthy. Similar results were obtained with #167 as female parent.

In the following experiment heat effects were not found to be cumulative even after 24 daily heat periods of 7 h. Inoculated plants were grown with a 12 h photoperiod for 24 days under a thermoperiod of 33° (7 h) and 20° (17 h). All of the 5 Tm-2<sup>a</sup>/+ hybrid combinations with #151 as the resistant female parent remained healthy, while controls receiving only a single 24 h heat treatment showed a high incidence of disease.

Heat treatment before inoculation. In all the above experiments, plants were heat-treated after inoculation. In order to test the reverse situation, F<sub>1</sub> plants 151 x 33 (Tm-2<sup>a</sup>/+) of different ages were kept for 48 h at 35° C before inoculation and immediately transferred to 25° C. The percentage of plants showing systemic necrosis was 25%, 0% and 0% with plants of the 1st, 2nd and 4th true leaf stage, respectively. Controls inoculated before the heat treatment reached a disease incidence of 75%. Thus, high temperature periods before inoculation caused systemic necrosis in very young seedlings only.

Laterrot, H., and F. Kaan Resistance to Corynebacterium michiganense of lines bred for resistance to Pseudomonas solanacearum.

In the last ten years, various tomato lines resistant to Pseudomonas solanacearum bred in tropical and subtropical stations were evaluated in Guadeloupe on soils infested by this pathogen. At the same time we have noted the reaction of these lines to Fusarium oxysporum f. sp. lycopersici pathotype 2 (artificial infection at the seedling stage) and to Corynebacterium (artificial field infection on adult flowering plants in Avignon). Our observations on relative resistance are reported in the Table. Thus 10 lines bred for P. solanacearum resistance which were confirmed for this character in Guadeloupe manifest a partial resistance to Fusarium pathotype 2. We mentioned this result for some of these lines in TGC 25 and in "Annales d'Amelioration des Plantes" 1977:27(1)25-34. We verified that all these lines are resistant to Fusarium pathotype 1 (gene I) and do not seem to have I-2 (a pathotype 2 resistance gene).

9 of these 10 lines manifest a partial resistance to C. michiganense. The resistance of Saturn and 72 TR 4.4. was mentioned by W. Henderson and S. Jenkins (North Carolina State University).



MR 4, given for Corynebacterium resistance, resists Pseudomonas and Fusarium 2. MR 4 and 72 TR 4.4. pedigrees are similar.

However, Plovdiv 8/12, bred for Corynebacterium resistance, does not show any resistance to Fusarium 2 and P. solanacearum.

So we conclude that this tropical material resistant to Pseudomonas and Plovdiv 8/12 do not have the same Corynebacterium resistance factors.

We presently are trying to consolidate these factors by recurrent selection of highly Corynebacterium resistant lines based on Plovdiv 8/12 from one side, 72 TR 4.4. and I.R.A.T. L3 from the other side.

Line	Bred from	Breeder	Reaction to:**		
			<u>Pseudo-</u> <u>monas</u>	<u>Fusari-</u> <u>um 2</u>	<u>Coryne-</u> <u>bacterium</u>
Carette	CRA 66 (= OTB 2 ?)	Kaan (Guadeloupe, France)	R	RRR	RR
53.RC	"	"	RR	RRR	RR
Venus	L. <u>esculentum</u> var. <u>cerasiforme</u> (PI 129.080, Columbia) and L. <u>esculentum</u> var. <u>pyriforme</u> (Beltsville 3814, Puerto Rico)	Henderson (North Carolina, U.S.A.)	R	RR	R
Saturn		"	R	RR	R
72 TR 4.4.		"	RR	RRR	RR
74 TR 10		"	R	RR	R
I.R.A.T. L3	Complex hybrid including <u>L. pimpinellifolium</u>	Daly (I.R.A.T., Martinique, France)	RR	RRR	RRR
Farako-Ba	(University of Puerto-Rico)	D'Arondel des Hayes (Upper Volta)	RR	RR	R
Kewalo*	<u>L. pimpinellifolium</u> PI 127805A (Peru)	Gilbert (Hawaii, USA)	R	R	S
Hawaii* 7996	?	Gilbert (Hawaii, USA)	RRR	RR	RR
MR 4	Same as 72 TR 4.4.	Forster, Echandi, (North Carolina, USA)	RR	RRR	RR
Plovdiv 8/12	<u>L. pimpinellifolium</u>	Elenkov (Maritza Institute, Bulgaria)	S	S	RR
Monalbo	susceptible check	Laterott (I.N.R.A., Avignon, France)	S	S	S

\* sp. lines.

\*\* RRR - outstanding resistance, RR - good resistance, R - fair resistance, S - susceptibility.

Maksoud, M. A., A. A. M. Omar, and M. Marwan. Effect of the aurea gene on some chemical activities in leaves.

The direct role of chlorophyll as a chelator of solar energy and a catalyst in carbohydrate synthesis has been established. The Aurea mutant used in this study was discovered and described

by A. Persson (1959), who selected it after X-ray treatment of soaked seeds with 10,000 R. A variegated XI plant appeared which had Aurea as a ground color with green and lighter patches occurring in it. The progeny of this plant segregated in the ratio of 1 green (++) : 2 Aurea (A+) : 1 Yellow (AA)\*. The yellow seedlings appeared to develop no chlorophyll and later died. The heterozygote was as vigorous as the normal, but could be recognized immediately by its pale green color.

The objective of the presented experiments was to study, mainly, the indirect roles of chlorophyll. Thus, normal green plants, Aurea mutants, graft hybrid combinations between them and Aurea mutants sprayed with different growth regulators (biweekly throughout their life) were used in a pot experiment. The leaves were used for the chemical analyses.

Seedlings: In the Aurea and yellow mutants, gene A reduced the concentration of chlorophylls (a) and (b) in the same 3:1 ratio of their presence in the normal green. The change from the normal genotype (++) to the other mutant types (A+) and (AA), showed that the two A genes were unequal in their subtractive effect for each chlorophyll type.

Mature Plants: Chlorophyll content was higher at this stage than in the seedlings. However, relative to the normal green, the concentration of both chlorophylls was reduced in the Aurea mutant by the A gene in the same 3:1 ratio.

#### After fruit setting

Ungrafted: Chlorophyll content was the lowest of all developmental stages. Meanwhile, the reduction in the concentration of chlorophylls in the Aurea, relative to the normal green, was still in the 3:1 ratio. Average number of chloroplasts per guard cell, catalase activity, and C/N ratio were lower in the Aurea than in the normal green, however, protein content was lower in the latter than in the former. The persistence of the 3:1 ratio between chlorophyll types during all the developmental stages, in both the normal green and the Aurea, implied that the mutation from gene + to A probably slowed down the conversion rate of the precursor to chlorophyll (b), rather than of chlorophyll (b) to (a).

Graft hybrids: Chlorophyll content, chloroplast number, catalase activity, and C/N ratios were intermediate between the respective values for the ungrafted normal green and Aurea. Such a result was attributed to the interaction between genotypically different vegetative tissues when grafted. Relative to the respective ungrafted types, graft or stock, the normal green accumulated more nitrogen, while the Aurea accumulated less nitrogen. The fluctuations in the nitrogen content were significant, while those in sugar were non-significant. Consequently, the two genotypes unequally reciprocated influence, with nitrogen as the limiting factor for the differences in the C/N ratios amongst the graft hybrids. That the ungrafted Aurea had more protein but less sugar than the ungrafted normal green indicated that sugar concentration seemed to be the limiting factor for catalase activity. However, despite the apparent linear proportionality between the activity of that enzyme and the concentration of sugar, the probability that this proportionality might have been subject to nitrogen toxicity in the graft hybrids, as in the ungrafted Aurea, should not be excluded.

Sprayed Aurea: Chlorophyll concentrations, and chlorophyll numbers were intermediate between the corresponding values in the normal green and the Aurea. However, the ratio between chlorophylls (a) and (b) fitted 3:1. Noteworthy, was that although sterol, vitamin C, methionine, and sucrose effectively increased the number of chloroplasts, they were not as effective in increasing chlorophyll concentration, a result indicating the non-association between chloroplast number of multiplication and chlorophyll concentration or synthesis.

\* Symbols do not refer to any standard mutant. In all respects, Persson's mutant mimics Xantha (Xa).

Palmieri, S., P. Martiniello, and G. P. Soressi Chlorophyll and carotene content in high pigment and green flesh fruits.

Fruits of the hp, hp-2 and gf mutants, six days after the turning stage, were analyzed by liquid chromatography for chlorophyll and carotene content in comparison with the normal (+/+) ones.

The hp-2 fruits show the highest lycopene and  $\beta$ -carotene content (respectively 2 and 3 times the normal). The chlorophyll level reaches the maximum in hp-2 and gf fruits. Possibly in these two mutants the chlorophyll pigment is not similarly distributed in the mesocarp and exocarp of the fruit and evolves in different ways.

Genotype	Background	BC gener.	Dry weight %	carotenoids ( $\mu\text{g/g d.w.}$ )							
				phytof.	$\beta$ -car.	$\xi$ -car.	$\gamma$ -car.	neuro spor.	proly copene	lyco-pene	lycopene/ $\beta$ -carotene
+/+	S. Marzano	-	5.87	97.73	74.79	traces	12.78	2.21	4.77	889.27	11.8
<u>hp/hp</u>	"	BC <sub>1</sub> S <sub>4</sub>	5.48	81.57	181.93	1.09	25.55	n.d.	31.75	969.89	5.3
<u>hp2/hp2</u>	"	BC <sub>1</sub> S <sub>1</sub>	5.87	69.85	250.42	13.40	29.30	20.95	96.08	1913.46	7.6
<u>gf/gf</u>	"	BC <sub>1</sub> S <sub>4</sub>	7.50	34.40	89.60	9.20	16.53	39.73	-	1131.20	12.6

Palmieri, S., P. Martiniello, and G. P. Soressi Effect of some never ripe genes on carotene and chlorophyll content of the fruit.

The nor<sup>2</sup>, nor<sup>3</sup>, Nr and rin mutants affect both the pigment synthesis and the ripening process of the fruit. On the basis of liquid chromatography and photometric analysis in all mutant fruits, except nor<sup>3</sup>, 6-8 days after

the turning stage, the lycopene synthesis appears slowed down, and the  $\alpha$ - and  $\beta$ -carotene content has not yet reached the maximum value; besides the  $\beta$ -carotene content seems higher than normal. The presence of  $\alpha$ - and  $\beta$ -carotene, notwithstanding the lycopene synthesis generally reduced or completely lacking as in rin/rin fruit, leads to the hypothesis of their synthesis being independent from the lycopene as a substrate. The provitamin A of the mutant berries, when completely ripe, proximates the content of the test. Studies on the determination of the  $\alpha$ -carotene content are in progress.

Parker, P. F. A survey of low temperature germination.

A total of 110 cultivars were tested over a range of temperatures from 10°C to 25°C, using two replicates at each temperature. Li-

imited cabinet space necessitated sequential sowings using an outdoor cultivar 'First-in-the-Field' (A. 5102 Asmer Seeds Limited).

The table gives those cultivars that performed best in relation to the control. Anovar of the control for the two characteristics 'days from sowing to germination' and 'duration of germination' showed significant differences between sowings; for this reason the figures for the control are included with each experiment.

Further studies relating to repeatability both within and between accessions, selection for, and genetic analysis of the L.T.G. characteristic are in progress.

ANOVAR of control (5102) from different experiments at 10°C.

## A. Days to start of germination

	S.S.	D.F.	M.S.	V.R.
Var.	686.75	7	98.17	33.14***
Block	6.25	1	6.25	2.11
Error	20.75	7	2.96	
Total	713.75	15		

## B. Duration of germination (days)

	S.S.	D.F.	M.S.	V.R.
Var.	312.00	7	44.57	15.80***
Block	6.25	1	6.25	2.11
Error	19.75	7	2.85	
Total	318.25	15		

Student-Newman-Keule, Multiple Range Test K=8 q=4.99\*, 6.26\*\*

A  
Expt. No. 9 4 5 6 8 3 7 2  
17 28 29.5 29.5 30 31 37 41

B  
Expt. No. 2 7 6 4 9 3 8 5  
16 16 18 19 23 23 23 30

## Summary of L.T.G. (10%)

Expt. No.	Cultivar*	Days to start	Duration of germination (days)	Final %
(2)	5102	41	16	70
	L. pimpinellifolium 'Johannisbeer'	28	13	95
(3)	5102	31	23	90
	'Garden'	25	29	95
	'Merveille de Marches'	15	26	85
(4)	5102	28	19	100
	'Cold Set'	17	15	95
	'Earlinorth'	20	12	90
	'Open Air'	17	11	95
	'Rheinlands Ruhm' (frost resistant)	19	14	95
(5)	5102	29	30	80
	'Oldmoucke Nizke'	25	10	95
	'Precoce de Chatem'	26	12	95
(6)	5102	29	18	95
	var. Columbianum (Bolivia)	25	13	95
	var. Bukasovii (Bolivia)	24	14	100
	'Chrestensens Edelrot'	20	11	100
	'Fructu Aromato'	20	12	95
	'Mikado Violettrote'	23	7	100
(7)	5102	37	16	100
	'Earliana'	27	14	95
	'First-in-the-Field'	27	11	100
	'Penn's State Earliana'	29	10	90
(8)	5102	30	23	95
	'Jubilee Orange'	23	12	100
(9)	5102	17	23	74
	'Gardeners Delight'	23	13	85
	'Outdoor Girl'	20	11	100
	'Sub-Artic Plenty'	16	20	75

\*All cultivars except the last three were obtained from Zentralinstitut für Genetik und Kulturpflanzenforschung, Gatersleben, D.D.R. Thompson & Morgan Limited supplied the remainder.

Pecaut, P., J. Philouze A sha-pat line obtained by natural mutation.

producing non-parthenocarpic fruits. Montfavet 191 possesses the flower characteristic shown by the sha (short anthers) mutant described by Soressi (TGC 20:59) and reveals an ability to develop parthenocarpic fruits similar to the pat (parthenocarpic) mutant described by Soressi (TGC 25:22). Montfavet 191 was crossed with the sha-pat material (stock 2524) provided by Soressi. The  $F_1$  hybrid had flowers with abnormal stamens and developed parthenocarpic fruits. So Montfavet 191 is sha-pat.

We have, however, a few remarks to make:

1. Our obtaining sha and pat mutations simultaneously in the same line is surprising. We were unsuccessful in obtaining the short anther and parthenocarpic characters in separate lines, as Soressi was able to do (TGC 25:22).
2. Expression of the short anther character is variable according to genotype and environmental conditions. For example the stamens of the 2524 stock are shorter than those of Montfavet 191. The stamen length of a sha-pat plant may vary during the flowering period, the stamens sometimes taking on a quasi normal appearance.
3. Our sha-pat material and Soressi's sha-pat stock 2524 show an important amount of female sterility. It is very difficult to obtain seeds from both materials either by self-pollination or by pollination with sha-pat pollen, even in favorable environmental conditions. However, sha-pat pollen has normal fertilizing power.

Philouze, J. Percentage of selfing. . . (see p. 13.)

Philouze, J., and B. Maisonneuve Heredity of the natural ability to set parthenocarpic fruits in a German line.

Line 75/59 received from Reimann-Philipp (West Germany) shows a natural ability to set normal-looking parthenocarpic fruits. We screened parthenocarpic and non-parthenocarpic plants in the same manner as in the study of Severianin (TGC 28:12).

The  $F_1$  hybrids between 75/59 and two non-parthenocarpic varieties, Moneymaker and Apedice, were studied. The fruits of the two  $F_1$  hybrids were not parthenocarpic. The parthenocarpic character of 75/59 is therefore recessive.

Allelism tests were made with two different parthenocarpic lines: Montfavet 191 (France) is sha-pat (TGC 28:12) and Severianin (USSR) is pat-2 (TGC 28:12).

The fruits of the two  $F_1$  hybrids 75/59 x Severianin and 75/59 x Montfavet 191 were not parthenocarpic, so neither the pat allele nor the pat-2 allele is responsible for parthenocarpy in 75/59.

At present we are studying offspring from the Moneymaker x 75/59 cross to determine how many loci are responsible for parthenocarpy in 75/59.

In favorable environmental conditions female fertility in 75/59 is quite normal, as in the case of Severianin, and its pollen has normal fertilizing power.

Philouze, J., and B. Maisonneuve Heredity of the natural ability to set parthenocarpic fruits in the soviet variety Severianin.

The soviet variety Severianin was bred by N. Solovjova at the Gribovskja Experimental Vegetable Selection Station near Moscow. This variety is remarkable for its natural ability to set normal-looking parthenocarpic

fruits. In our study we screened parthenocarpic and non-parthenocarpic plants by emasculating flowers before the pollen was mature and by omitting pollination. Under these conditions the fruits of the parthenocarpic plants developed, whereas no fruit was borne by the non-parthenocarpic plants.

We studied the  $F_1$  hybrids between Severianin and two non-parthenocarpic varieties, Moneymaker and Apedice (one of our breeding lines). The fruits of the two  $F_1$  hybrids were not parthenocarpic. The parthenocarpic character of Severianin is therefore recessive.

We did the allelism test on Montfavet 191, a sha-pat line (TGC 28:12). The fruits of the  $F_1$  hybrid were not parthenocarpic, so the pat allele is not responsible for parthenocarp in Severianin.

We studied the offspring of crosses Moneymaker x Severianin and Severianin x Apedice. The results are given in the table below.

	Number of plants			$\chi^2$	
	Total	with parthe- nocarpic fruits	with non- partheno- carpic fruits	hypothe- sis 3:1 ( $F_2$ ) 1:1 (BC)	Probability P
<u>Glasshouse—Spring 1977</u>					
$F_1$ Moneymaker x Severianin	3	0	3	-	
$F_2$ Moneymaker x Severianin	60	13	47	0.36	0.50 P 0.60
BC (Moneymaker x Severianin) x Moneymaker	3	0	3	-	
Moneymaker	3	0	3	-	
Severianin	4	4	0	-	
<u>Open field—Summer 1977</u>					
$F_1$ Moneymaker x Severianin	5	0	5	-	
$F_2$ Moneymaker x Severianin	60	20	40	2.23	0.10 P 0.20
BC (Moneymaker x Severianin) x Severianin	30	14	16	0.13	0.70 P 0.80
BC (Moneymaker x Severianin) x Moneymaker	5	0	5	-	
Moneymaker	5	0	5	-	
Severianin	5	5	0	-	
$F_1$ Severianin x Apedice	5	0	5	-	
$F_2$ Severianin x Apedice)	60	10	50	2.23	0.10 P 0.20
BC (Severianin x Apedice) x Severianin	30	19	11	2.13	9.10 P 0.20
BC (Severianin x Apedice) Apedice	5	0	5	-	
Apedice	5	0	5	-	

We can conclude from the data shown in the table that, in Severianin, parthenocarp is controlled by a recessive allele. We propose the symbol pat-2 for the locus of this allele.

The parthenocarp in Severianin seems to us to be worth using in breeding programs. In favourable environmental conditions female fertility in Severianin is quite normal (contrary to the sha-pat lines we experimented with, (TGC 28:12) and pat-2 pollen has normal fertilizing power.

Philouze, J. Percentage of selfing in a female ps-2 line used for the production of hybrid seeds.

In France we are now exploiting on a large scale, for the production of commercial hybrid seeds, the male sterility of ms-35, the locus of which is linked to the aa (anthocyanin absent) locus (TGC 24:17). However, we found it of interest to check whether it was possible in

our conditions to use the positional sterility controlled by the ps-2 allele. Maintenance of a ps-2 line is very easy by self-pollination.

The experiment was conducted in the open field in 1977. The flowers of 10 plants of a ps-2 c (potato leaf) line bred in Montfavet were emasculated on June 15th and 22nd, and on July 1st. Petals and stamens of flowers in full bloom were removed by hand. Pollination with c pollen was done immediately after emasculation. The fruits were harvested and the seeds extracted fruit by fruit and sowed so that the percentage of c seedlings originating from selfing of the female line could be determined.

Table 1. Total results.

Date of emasculatation and pollination	Number of harvested fruits	Number of seedlings			Percentage of <u>c</u> seedlings
		<u>c</u> <sup>+</sup>	<u>c</u>	total	
June 15th	44	1397	1	1398	0.1
June 22nd	45	1223	190	1413	13.4
July 1st	32	1429	29	1458	2.0
Total	121	4049	220	4269	5.2

13 fruits, that is to say 10.7% of harvested fruits, contained seeds from which we obtained at least one c seedling. The proportion of c<sup>+</sup> and c seedlings for each of the 13 fruits is given in the Table 2.

Table 2. Results fruit by fruit.

Date of emasculatation and pollination	Number of seedlings			Percentage of <u>c</u> seedlings
	<u>c</u> <sup>+</sup>	<u>c</u>	total	
June 15th	42	1	43	2
June 22nd	0	32	32	100
	21	2	23	9
	2	11	13	85
	0	39	39	100
	0	31	31	100
	0	51	51	100
	3	23	26	88
	37	1	38	3
July 1st	43	1	44	2
	0	4	4	100
	9	22	31	71
	82	2	84	2

5.2% of the seeds originate from self-pollination of the female parent. (We obtained 4.5% selfing in 1976 in a similar experiment but without fruit by fruit extraction of the seeds). The best part of this percentage was obtained from a few fruits which yielded 100% seeds issuing from self-pollination. The frequency with which these fruits were obtained at certain times during the flowering period was high.

However, it is impossible to conclude from our data to what extent dehiscence of the stamens of ps-2 flowers is encouraged by emasculation and to what extent it occurs naturally and independently of the latter operation (due to wind, dry weather etc.).

Rao, R. N., and Panuganti N. Rao A highly sterile unstable tetraploid of tomato.

Among the colchicine induced tetraploids of tomato var. Marglobe, one showed low multivalent formation at diakinesis (average frequency of 1.1 quadrivalents per cell), but meiotic abnormalities like multipolar spindles (1-5 with varying number of chromosomes in each) at metaphase I, laggards at anaphase I and several groups (up to 4) of chromosomes at telophase I etc. were found in most of the cells. Pollen sterility was very high (85.00%). Whether similar irregularities also occurred on the female side leading to sterility could not be ascertained as the plant was growing and flowering in the field in April-May with rising summer temperatures resulting in flower abscission despite pollinations with normal tetraploids. In the diploids and other tetraploids also growing in the same period, fruiting was found to be scanty, though meiosis in PMC's was normal with good pollen fertility. The type of meiotic abnormalities found in the sterile tetraploid is apparently an indication of its instability and tendency towards breakdown into lower levels of ploidy.

Rao, R. N., and Panaganti N. Rao A purple stigma variant in Lycopersicon glandulosum.

One plant in a population of L. glandulosum (seeds obtained from Plant Introduction Centre, Indian Agricultural Research Institute, New Delhi; Acc. No. EC 66003, Ex U.S.A.) raised through open pollinated seed for three generations here in Botany Experimental Field Station showed purple coloration of the stigma. This is evident even at the bud stage and persists till withering of the stigma. Other characters associated with this color variation are the prominent exsertion of the style (largely due to the down-curling of the sterile tip of the staminal cone), shorter staminal cone, and reduction in diameter of the open flowers. Compared to normal sibling plants, the overall length of the style is actually shorter but it is more exposed only due to the shorter anther column. The magnitude of differences in all these characters between the variant individual and the normal siblings is given in table below. The nature of association of these characters with coloration of the stigma is under investigation.

Differences in size between the purple stigma variant and sibling plants (cm).

Character	Variant	Normal
Style length	1.14 $\pm$ 0.0210	1.17 $\pm$ 0.0160
Anther cone length**	0.69 $\pm$ 0.0232	1.00 $\pm$ 0.0222
Exserted portion of the style**	0.41 $\pm$ 0.0208	0.11 $\pm$ 0.0077
Floral diameter**	1.94 $\pm$ 0.0839	3.20 $\pm$ 0.0489

\*\*Differences significant at 1% level.



Reeves, A. F. Location of af and sd on chromosome 5.

Two of the mutants previously assigned to chromosome 5 have been located at or near position 14 on the chromosome map. The  $F_2$  data presented here show no recombination between sun dwarf (sd) and the anthocyaninless mutant af. Both show linkage with mc at 13 or 14 cM in two-point tests. In a four-point test, af showed linkage of equal intensity with mc and tf, although the presence of another anthocyanin mutant in the mc-tf-wt stock makes interpretation of the data difficult. The data of Rick *et al.* (TGC 20:52-54) showing a distance of 26 units between af and tf support the location of af between mc and tf and expand the map by 9 units.

Combination	++	+t	m+	mt	T	$\chi^2$	cM
sd-mc	85	49	48	1	183	19.8***	13
sd-af	115	75	46	0	232	21.8***	0
af-mc	108	57	41	1	207	15.6***	14
af-mc	79	45	74	16	214	7.9**	36.6
af-tf	86	38	77	13	214	6.7**	36.6
af-wt	112	12	80	10	214	0.01	--

Rick, C. M. More new mutants at old loci.

Over the past few years we have accumulated more mutants that have proved to be allelic to standard loci. All of this series were induced by EMS seed treatment. Since they are presumably isogenic with their respective parent lines, they might be useful for various kinds of studies on the genetics and physiology of such single gene effects. Seeds are available to interested workers for all mutants except the hl allele 3-95. I prefer not to attach new symbols to these because they are exact mimics of the specified alleles. Any of them should be symbolized if in the future it were to be used extensively and/or phenotypic differences were to be discovered. The parental lines are designated in the following list by these symbols: MM (Moneymaker), VF 36 (LA490), VFNTCh (LA1221, a short-internoded, multiply-resistant cherry line bred by Dr. P. G. Smith).

One point of interest in this work is that all except one (3-620) of the complete anthocyanin deficiencies has proved to be allelic to one of the 11 previously reported loci. This experience suggests that nearly all of the loci for this phenotype have been discovered.

<u>a</u>	3-414 (VF36)	<u>d<sup>x</sup></u>	3-421 (VF36)
<u>ah</u>	3-343 (MM), 3-607 (VFNTCh)	<u>dgt</u>	3-108 (VF36)
<u>aw</u>	3-121 (VF36), 3-603 (VFNTCh)	<u>e</u>	3-616 (VFNTCh)
<u>bip</u>	3-602 (VFNTCh)	<u>hl</u>	3-95 (VF36, no viable seeds), 3-126 (VF36, 3-605 (VFNTCh)
<u>bls</u>	3-619 (VFNTCh)		
<u>c</u>	3-45 (MM), 3-604, 3-609 (both VFNTCh)	<u>tl</u>	3-101, 3-114, 3-116 (all VF36)
<u>d<sup>cr</sup></u>	3-422, 3-435 (both VF36)		

Rick, C. M., and P. Bosland Allele tests with dominants that are homozygous inviable.

Testing for allelism between dominant mutants that are not viable (i.e., do not reach flowering stage) poses some difficult problems. Allele tests are simplest with recessive

mutants because conclusive complementation tests can be made in the  $F_1$ . With dominant genes that are homozygous viable, the  $F_2$  test is necessary. But with such genes as La, Lpg, Wo, and Xa, no direct test will work. Heterozygotes between these genes and mimic mutants are presumably inviable because they have a double dose of the genes in question. Lacking viable heterozygotes with one dose each of the tester and the new mutation, the essential  $F_2$  cannot be produced.

An alternate, indirect approach is to make a linkage test to approximate the locus of the new mutant. This method yields conclusive results if the new mutant is independent or sufficiently distant from the tester to yield recombinants; but if no recombinants are obtained, the problem of tight linkage vs. allelism cannot be resolved.

We recently encountered such a problem with a new Lanceolate-like mutant (3-305) obtained from Ir. G. J. Hilderling of Wageningen, who had induced it in cv. MoneyMaker by EMS treatment and submitted it to the TGC New Mutant Program. This mutant is a near perfect mimic of La in all observed respects. 1) It is dominant; 2) it is homozygous inviable; 3) the mutant homozygotes show the same range of phenotypes — "reduced, modified, and narrow" — known in La/La; 4) viability of the heterozygote is reduced: it appears in subnormal ratios; 5) the heterozygote phenotype is identical in respect to: precocity, excessive branching, and slender plant parts; although leaves tend to be unlobed or few-lobed, the extent of lobing exceeds that of  $+/\text{La}$ . Further, in crosses with La, no double heterozygotes were obtained, all  $F_2$  progenies segregating in the same fashion as for  $+/\text{La}$ .

For the linkage test, 3-305 was crossed with our standard linkage tester for chromosome 7 with the markers var--not. The  $F_2$  data are:

+	+	+	13	3-305	+	+	76
+	+	not	38	3-305	+	not	22
+	var	+	25	3-305	var	+	23
+	var	not	7	3-305	var	not	4

The contingency  $\chi^2$  between 3-305 and var is 6.25\* and that between 3-305 and not is 23.3\*\*\*. Clearly, 3-305, like La, is situated somewhere on chromosome 7. The values are not satisfactory for computing distances; in fact, the great deficiency of 3-305's obstructs the use of any standard linkage computation. For this kind of situation we prefer to use an empirical curve for the proportion of the tester gene frequency amongst non-Lanceolate progeny — for example,

$$\frac{(+ \text{ var})}{(+ \text{ var}) + (+ +)}$$

As the crossover distance decreases, the value of this proportion approaches 1.00. When this estimate is applied to our data, a value of 38 units is estimated for 3-305--var, and 27 units for the 3-305--not interval. Therefore, to the extent that La lies closer to not than to var, these data suggest that 3-305 might be allelic with La, but obviously much better tests are needed. We are currently attempting a testcross for this purpose.

Schmidt, Hannelore, and Volker Schmidt  
Tests of allelism for ms-15, ms-26, and  
ms-33. (Submitted by R. Hagemann)

The male sterile mutants ms-15, ms-26, and ms-33 can be normalized with gibberellic acid ( $GA_3$ ) (TGC 26:17) so that self-pollination is possible. Normalized plants genetically homo-

zygous male sterile) were used as the male parents in the following crosses.

Parents	Number of crosses	Offspring
(1) <u>ms-15</u> x <u>ms-26</u>	6	sterile
(2) <u>ms-15</u> x <u>ms-33</u>	8	fertile
(3) <u>ms-26</u> x <u>ms-15</u>	2	sterile
(4) <u>ms-26</u> x <u>ms-33</u>	4	fertile
(5) <u>ms-33</u> x <u>ms-15</u>	10	fertile
(6) <u>ms-33</u> x <u>ms-26</u>	9	fertile

It has been reported that ms-15 is localized on chromosome 2 at position 62 (TGC 8:25). The mutant ms-26 has been localized on chromosome 2 without a detailed determination of its position. The results of our crosses now prove that ms-15 and ms-26 are allelic.

Although ms-33 is on chromosome 6 and there is no allelism with ms-15 and ms-26, in offsprings of (2) (4) (5) and (6), some plants with small and markedly reduced anthers occur. This is not the case in simple heterozygotes of each of the three mutants.

Because in all three mutants the reduced level of  $GA_3$  seems to be the cause of anther reduction and pollen sterility, we assume that there is some interaction between these non-allelic mutant loci.

Schmidt, Volker Test of allelism for ms-38  
and ms-40. (Submitted by R.  
Hagemann)

The mode of meiotic degeneration in the male sterile mutants ms-38 and ms-40 is very similar. Therefore they have been crossed to test whether they may be allelic.

	fertile	sterile	ratio
<u>ms-38/ms-38</u> x <u>ms-40/+</u>	18	22	1:1
<u>ms-40/ms-40</u> x <u>ms-38/+</u>	8	12	1:1

The segregation in a 1:1 ratio demonstrates allelism between ms-38 and ms-40.

Stamova, L., and M. Yordanov A new gene  
for resistance to Cladosporium fulvum  
derived from L. chilense.

As reported previously (TGC 25, 1975) in progenies of crosses with L. chilense we found resistance to races of the group C of Cladosporium fulvum. The genetic studies of

this resistance showed that it is controlled by a single dominant gene.

The factor for resistance originating from L. chilense was compared in tests for allelism with three other sources of resistance to the same race (2.3.4) - PI 187002 (gene Cf-5) and two Dutch accessions (63280 and 64316) of L. cheesmanii received from Miss I. Boukema. The Dutch sources often show after inoculation restricted sterile mycelium, while the line 4 of the cross with L. chilense indicates complete resistance.

The results from the allelic tests showed that the gene from L. chilense was non-allelic to the gene Cf-5, as well as to the resistant factors originating from the Dutch accessions of L. cheesmanii.

Cross	Number of plants with rating*					$\chi^2$
	1	2	3	4	5	
4/4 x ++	-	-	-	-	40	
4/4 x ++ ⊗	21	-	-	-	67	0.05
4/4 x Cf-5/Cf-5 ⊗	6	-	6	4	75	0.02
4/4 x Cf-5/Cf-5 x ++	34	-	20	7	70	0.06
4/4 x 63280/63280 ⊗	10	8	-	10	85	1.30
4/4 x 63280/63280 x ++	33	22	6	4	54	0.47
4/4 x 64316/64316 ⊗	7	19	5	5	67	0.08
4/4 x 64316/64316 x ++	33	30	-	-	33	4.49

\* 5 = no visible indication of infection; 4 = small chlorotic flecks, no sporulation; 3 = restricted sterile mycelium; 2 = a few, delayed sporulation, 1 = abundant sporulation.

⊗ = F<sub>2</sub> population.

A dash denotes nil.

Stamova, L., and M. Yordanov Genetic study of the genes for resistance to Cladosporium fulvum derived from L. cheesmanii.

In progenies of the cross Bison x L. cheesmanii (pimpinellifolium form Galapagos-29) obtained by A. Ognyanova, the lines 107 and 112, homozygous resistant to races of the C group of Cladosporium fulvum, were

selected. The investigations showed that the complete resistance of these lines is controlled by single dominant genes.

The data from the allelic test carried out with these two lines, PI 187002 (gene Cf-5), the Dutch accessions of L. cheesmanii (63280 and 64316) and the line 4 from the cross with L. chilense showed that in the progenies of the above mentioned cross were found two genes for complete resistance to races of group C of Cladosporium fulvum. The gene from line 107 is allelic to Cf-5 and non-allelic to factors controlling resistance in the Dutch accessions. The gene from line 112 is non-allelic to the gene Cf-5. The genes from the lines 107 and 112 are non-allelic to the gene in line 4, derived from L. chilense.

Cross	Number of plants with rating*					$\chi^2$
	1	2	3	4	5	
107/107 x ++	-	-	-	-	36	
107/107 x ++ ⊗	19	-	-	-	65	0.25
107/107 x Cf-5/Cf-5 ⊗	-	-	8	14	87	
107/107 x Cf-5/Cf-5 x ++	-	-	50	36	38	
107/107 x 63280/63280 ⊗	7	-	18	45	36	0.02
107/107 x 63280/63280 x ++	40	-	30	20	22	6.85
107/107 x 64316/64316 ⊗	8	-	14	27	62	2.23
107/107 x 64316/64316 x ++	21	-	15	25	31	0.22
112/112 x ++	-	-	-	-	42	
112/112 x ++ ⊗	23	-	-	-	75	0.12
112/112 x Cf-5/Cf-5 ⊗	8	-	67	9	27	0.17
112/112 x Cf-5/Cf-5 x ++	31	-	-	7	69	0.89
4/4 x 112/112 ⊗	9	-	-	1	83	1.86
4/4 x 112/112 x ++	33	-	-	2	68	2.72

\* 5 = no visible indication of infection; 4 = small chlorotic flecks, no sporulation; 3 = restricted sterile mycelium; 2 = a few, delayed sporulation; 1 = abundant sporulation.

⊗ = F<sub>2</sub> population. A dash denotes nil.

Tanksley, S. D. Linkage of the genes coding for alcohol dehydrogenase and phosphoglucomutase.

Starch gel electrophoresis of extracts from germinating seeds has allowed determination of linkage for the genes coding for the enzymes alcohol dehydrogenase and phosphoglucomutase.

For each enzyme, activity has been determined for only a single locus.  $F_1$  hybrids between Solanum pennellii LA 716 and Lycopersicon esculentum cv. VF 36 were backcrossed to the esculentum parent and the genotypes of the resulting seeds were determined.

		Adh		
		+	+/p	total
Pgm	+	63	5	68
	+/p	1	46	47
total		64	51	115

+ = L. esculentum allele; p = S. pennellii allele

$\chi^2$  (for independent assortment) = 92.36\*\*, 3 df

Based on these data the two genes appear to be 6/115 or 5 map units apart. Segregation data from crosses as wide as L. esculentum x S. pennellii have been shown to give linkage values less than those from strict L. esculentum x L. esculentum crosses. Therefore the distance between the genes might not be so small as 5 map units. The undeniable conclusion is that the two genes are linked and probably lie within a short distance of each other. This is especially interesting since the enzymes for which they code are both present in germinating seeds in high concentrations and both presumably function sequentially in the same metabolic pathway converting starch (storage carbohydrate) to ethanol with the concomitant release of ATP. At this point the evolutionary or regulatory significance of this linkage is only conjectural.

Tigchelaar, E. C., and R. J. Barman Linkage of the non-ripening (nor) and uniform ripening (u) genes.

In our initial description of the non-ripening (nor) mutant (Tigchelaar et al., TGC 23, 1973), preliminary evidence from  $F_2$  data suggested repulsion phase linkage with the

uniform ripening gene u on chromosome 10. Testcross data (u<sup>+</sup>/nor/u/nor x u/nor/u/nor) has confirmed that nor is approximately 3.5 map units from u (Table). This close repulsion phase linkage has provided a convenient method to identify nor heterozygotes in  $F_2$ .

Table. Linkage relations of nor and u from test cross (u<sup>+</sup>/nor/u/nor x u/nor/u/nor) analysis.

Genotype	Observed	Expected*
<u>u</u> <sup>+</sup> - <u>nor</u> <sup>+</sup> -	3	50
<u>u</u> <sup>+</sup> - <u>nor</u> <u>nor</u>	99	50
<u>u</u> <u>u</u> <u>nor</u> <sup>+</sup> -	94	50
<u>u</u> <u>u</u> <u>nor</u> <u>nor</u>	4	50

\*Assuming independence of u and nor.

PART IISTOCK LISTSTOCKS AVAILABLE

Tomato Genetics Stock Center  
 Department of Vegetable Crops  
 University of California, Davis, CA 95616

As the second installment of our stock inventory, the following list of 607 gene stocks is presented for the convenience of TGC members and other interested scientists. Some of these have been accumulated as needed for our research program; others were voluntarily submitted to the Center; additional items were sought to round out the collection. Although viable seeds of each accession are available, the supply of certain items is limited by low viability or poor reproductivity. The lines are true-breeding except for male steriles, other inherited sterilities, dominants that are homozygous inviable, etc., which are propagated via heterozygotes. For genes listed with several stock numbers, most of the numbers refer to combinations with other genes. In such groups, the non-combinant stock, which is available for nearly all genes, is listed first. A complete listing of such combination stocks and their component genes will be prepared for TGC 29. Also deferred until TGC 29 is a list of our isozyme stocks. Additional information concerning the origin and other aspects of the stocks listed below can be furnished on request.

Symbol	Name	Stock number
a	anthocyaninless	LA13, 982, 1113, and many other combinations
	(EMS-induced alleles)	3-414, 3-415
aa	anthocyanin absent	LA1194, 1525
acr	acroxantha	LA933
ad	alternaria resistance	LA1783
adp	adpressa	LA661, 882
adu	adusta	LA934
ae (a <sub>332</sub> )	entirely anthocyaninless	LA1048, 1191, 1491, 1665, 1666
aeg	aegrota	LA537
af (a <sub>325</sub> )	anthocyanin-free	LA1049, 1444
afe	afertilis	LA935
afl (af)	albifolium	LA658, 911, 989, 1073, 2-367
ag	anthocyanin gainer	LA177, 1192, 1445, and other combinations
ah (ao)	Hoffman's anthocyaninless	LA260, 983, 1164, and other combinations
	(spontaneous alleles)	LA352, 983
	(induced alleles)	LA343, 3-302
ai (a <sub>342</sub> )	incomplete anthocyanin	LA1484
ai <sup>2</sup> (am, a <sub>340</sub> )	incomplete anthocyanin <sup>2</sup>	LA1485
al (a <sub>2</sub> )	anthocyanin loser	LA14, 897, 1179, 1443 and other combinations
alb	albescent	LA807, 893, 1111, 1177, 1181, 1182

Symbol	Name	Stock number
alu	alutacea	LA838
an (an <sup>1</sup> , an <sup>2</sup> , ca)	anantha	LA536
ap	apetalous	2-9
apl	applanata	LA662
apn	albo-punctata	3-105
ar	arrecta	LA537
are	anthocyanin reduced	LA1526; 3-73
as-3	asynaptic-3	2-101
as-5	asynaptic-5	2-149
as-6	asynaptic-6	2-167
at	apricot	LA215, 347, 499
atn (at)	attenuata	LA587
atv	atroviolacium	LA797, 801
au(ls) (au, brac)	aurea(ls)	LA538, 641, 775, 783, 878
autl	Torrey Lyon's aurea	2-655A; LA1184, 1185, 1186, 1431, 1490, 1529, 1530
aud	auroid	LA1008, 1171
aut	aureata	LA1067, 1175
auv	aureate virescent	3-75
avi	albovirens	LA936
aw (aba, ab, a <sub>179</sub> )	without anthocyanin	LA271, 514, 790, 900, and other combinations
	(EMS-induced allele)	3-121
B	Beta-carotene	LA316, 647
bc (bi)	bicolor	LA588
bi	bifurcate inflorescence	LA1786
bip	bipinnata	LA663
bk	beaked	LA330, 986
Bk-2	Beaked-2	LA1787
bl	blind	LA59, 189
bls (alm)	baby lea syndrome	LA1004, 1071, 1175, 1180, 1195, 1430
br	brachytic	LA52, 136, 190, 296, 1221
bs	brown seed	LA1157, 1492
bs-2	brown seed-2	LA1788
bu	bushy	LA167, 897, 1179, 1666, and other combinations
bu <sup>ab</sup> (fru) (fru <sup>ab</sup> )	fruticosa <sup>abbreviata</sup>	LA549
bu <sup>cin</sup> (cin)	compact inflorescence	LA1437
bul	bullata	LA589
c	potato leaf	LA13, 904, 1178, 1189, 1441, and many other combinations
	(radiation induced allele)	3-345
car	carinata	LA539
cfa	conferta	LA832
cg	congesta	LA831
ch	chartreuse	2-253; LA345, 497
ci	cincta	LA938
cjf	conjunctiflora	LA1056
Cl	Cleistogamous	2-84

Symbol	Name	Stock number
cl-2	cleistogamous-2	LA189; 2-185
cla	clara	LA540
clau	clausa	LA591, 917, 1445, and other combinations
(ff, vc)	(spontaneous alleles)	2-505, LA509, 896
cm	curly mottled	LA272, 312, 347, 499, 990, 994
cn (ca)	cana	LA590, 1101, 1170
co	cochlearis	LA592, 1107, 1173, 1490, 1529
coa	corrotundata	LA940, 1178, 1441
com	complicata	LA664, 914, 991, 992, 1530
con	convalescens	LA541, 909, 987, 1105, 1170
cor	coriacea	LA666
cpa	composita	LA833
cpt	compact	LA718; 2-377
Cri	Crispa	LA667
Crk	Crinkled	LA1050, 1176
cru	corrupta	LA941
cta	contaminata	LA939
Cu	Curl	LA325, 344
cur	curvifolia	LA668, 1070, 1105
cv (cu)	curvata	LA593
cv <sup>2</sup> (acu)	curvata <sup>2</sup>	LA660
cva	conversa	LA665
cvl	convoluta	LA830
Cvx	Convexa	LA1151
d	dwarf	LA313, 13, 789, 986, 1444, and many other combinations
(rob <sup>imm</sup> )	(X-ray induced allele)	LA571
dcr (rob <sup>crisp</sup> )	dwarf <sup>crispata</sup>	LA570
	(EMS-induced alleles)	3-420, 422
dx	dwarf <sup>extreme</sup>	LA160
	(EMS-induced allele)	3-421
d-2 (rob <sub>2</sub> ) (rob II)	dwarf-2	LA625, 1527
dc	decomposita	LA819
dd	double dwarf	LA810
deb	debilis	LA542, 788, 882, 995, 1104
dec	decumbens	LA669
def	deformis	LA543
Del	Delta	LA1051
deli	deliquescent	LA595
dep	deprimata	LA544
depa	depauperata	LA596
det	detrimentosa	LA670
det <sup>2</sup>	detrimentosa <sup>2</sup>	LA820
dgt (lz-3)	diageotropica	LA1093, 1529, 1530, 1665, and other combinations
di	divergens	LA599, 917, 1166, 1445, and other combinations
dil	diluta	LA545, 777



Symbol	Name	Stock number
dim	diminuta	LA597
dis	discolor	LA598
div	divaricata	LA671, 880
dl	dialytic	2-69; LA879, 1179, 1666, and other combinations
dlb	dilabens	LA829
dm (d <sub>2</sub> )	dwarf modifier	LA14
dmt	diminutiva	3-7
dps	diospyros	LA1016
dpy	dumpy	LA811, 1167, 1168
ds	dwarf sterile	2-247
dt	dilatata	LA828
dv	dwarf virescent	LA155, 156, 201, 286, 287, 298, 300, 302, 308
e (b)	entire	LA159, 784, 885, 917, and other combinations
ele	elegans	LA546, 723
ele <sup>2</sup> (ang)	elegans <sup>2</sup>	LA586
elu	eluta	LA547
em	emortus	LA827
ep	easy peeling	LA1158, 1159
er	erecta	LA600
era	eramosa	LA850, 1082
ete	extenuata	LA942
ex	exserted stigma	2-191; LA139, 200
exa	expassa	LA853
exl (ex)	exilis	LA601
exs	excedens	LA852
f	fasciated fruit	LA14, 88, 167, 312, 507, 761, 925, 1113
f <sup>D</sup>	fasciated-dominant	LA767
fa	falsiflora	LA854
fcf	fucatifolia	LA945
fd	flecked dwarf	LA873, 1111, 1171,
fe	fertilis	LA672
fgv	fimbriate gold virescent	LA1143
fir	firma	LA602
fla	flavescens	LA548
flc	flacca	LA673, 1083
fld	flaccid	LA943
fli	filiform inflorescence	LA1790
fr	frugalis	LA674
frg	fragilis	LA864, 1188
fsc (dkv)	fuscatinervis	LA872, 1106
fu	fusiformis	LA605
fua	fucata	LA944
fug	fulgida	LA946
ful	fulgens	LA550, 784, 917, 921, and other combinations
ful <sup>2</sup>	fulgens <sup>2</sup>	LA843
ful-3	fulgens-3	LA1495

Symbol	Name	Stock number
Fw	Furrowed	LA192
ga	galbina	LA836
gas	gamosepala	LA947, 1173
Ge <sup>C</sup>	Gamete eliminator- Condine Red	LA533
Ge <sup>P</sup>	Gamete eliminator-Pearson	LA1187
gf	green flesh	LA507, 508
gh (ab)	ghost	LA295, 646, 647
gl	glauca	LA675
glau	glaucescens	LA606
glb	globularis	LA677
glc	glaucophylla	LA676
glf	globiformis	LA948
glg	galápagos light green	LA1059, 1442
glo	globosa	LA551
glo <sup>2</sup>	globosa <sup>2</sup>	LA612
(inx)		
(intro)		
glu	glutinosa	LA842
Gp	Gamete promoter	LA1791
gq	grotesque	LA137, 138; 2-181, 2-509
gra	gracilis	LA607
grc	gracillama	LA950
grf	grandifructa	LA951
grl	gracilenta	LA949
gs	green stripe	LA212, 296
h (H)	hairs absent	LA14, 154, 328, 780, and other combinations
he	heteroidea	LA679
Hero	Resistance to potato eelworm	LA1792
hg	heterogemma	LA837
hi	hilara	LA952
hl	hairless	LA291, 925, 982, 1441, and other combinations
	(EMS-induced alleles)	3-95, 3-126
hl <sup>2</sup> (cal)	hairless <sup>2</sup>	LA937
hp (hp <sub>1</sub> hp <sub>2</sub> , bs, dr)	high pigment	LA279, 769, 875, 876, 1664
Hr	Hirsute	LA895
Hrt	Hirtum	LA501, 720, 796
ht	hastate	LA638, 912, 913, 1038, 2-295
hy	homogeneous yellow	LA1142, 1192
ic	inclinata	LA682, 683
icn	incana	LA1009, 1110, 1166, 1445, 1487, 1536
ics	incisifolia	LA1054
id	indehiscens	LA684
ig	ignava	LA608, 923, 996, 1083
im	impatiens	LA863
imb	imbecilla	LA552, 724

Symbol	Name	Stock number
imp <sup>dia</sup>	impedita <sup>distincta</sup>	LA680
imp <sup>eg</sup>	impedita <sup>exigua</sup>	LA681
in	indiga	LA610
ina	inflexa	LA840
inc	incurva	LA609
inf	infirma	LA553
ini	inquieta	LA953, 1488
ino	involuta	LA954
ins	inconstans	LA841
int	integerrima	LA611
inv	invalida	LA554, 1186, 1529, 1530, and other combinations
Ip	Intense pigment	LA1500, 1563
irr	irregularis	LA613
ita	inquinata	LA839
j (lf)	jointless	LA14, 30, 925, 1113, and other combinations
j-2	jointless-2	LA315, 345, 497
j-2 <sup>in</sup>	jointless-2 <sup>incomplete</sup>	LA756
Jau	Jaundiced	LA719, 770, 894, 985
jug	jugata	LA555
jug <sup>2</sup>	jugata <sup>2</sup>	LA834
l (g)	lutescent	LA13, 983, 1179, 1666, and many other combinations
	(spontaneous alleles)	2-491, 2-611, 2-613
l <sup>2</sup> (1, rub)	lutescent <sup>2</sup>	LA572
l-2 (1-3, l <sub>2</sub> )	lutescent-2	LA642, 643, 1002
La	Lanceolate	LA335, 653, 717, 785, 788, 882, 923, 924, 1172
lae	laesa	LA685
lap	lamprochlora	LA955
lat	lata	LA556
le	lombiformis	LA956
lep	leprosa	LA957
lg (lme)	light-green	LA759, 760, 814, 1002, 1156, 1172, 1197
lg-5 (lm)	light green-5	LA757, 796, 808, 814, 1061, 1172
(fy)		
(yt)		
Ln	Lanata	3-71; LA1430, 1663
lop	longipes	LA958
Lpg	Lapageria	LA893; 2-561
ls	lateral suppressor	LA329, 769
lt	laeta	LA835
ltf	latifolia	3-35A
lu	luteola	LA686
luc	lucida	LA557
lur	lurida	LA959
lut	lutea	LA558, 728, 907, 1112
Lx	Lax	LA505, 769
lyr	lyrate	LA763, 764
m	mottled	LA157, 789, 900, and other combinations

Symbol	Name	Stock number
m-2 (mo) (md)	mottled-2	LA651, 773, 802, 904, 905, 1165
ma	macrocarpa	LA687
mac	maculata	LA960
mad	marcida	LA961
mar	marcescens	LA688, 884
marm	marmarata	LA559, 1001, 1164, 1446, and other combinations
marm <sup>2</sup>	marmarata <sup>2</sup>	LA844
mc	macrocalyx	LA159, 512
mcn	maculonecrotic	3-45, 3-46
Me	Mouse ears	LA324, 639, 715, 778, 789, 790
med	mediocris	LA962
mel	melongenoida	LA963
mgn	marginal necrotic	3-25, 3-26
Mi	<u>Meloidogyne incognita</u> resistance	LA655, 656
mic	microcarpa	LA845
mn (mi)	minuta	LA614
mnt	miniature	LA892, 1109
mon	monstrosa	LA615
mor	morata	LA848
mps	miniature phosphorus syndrome	LA519
ms	male-sterile	2-1
ms-2	male-sterile-2	2-31; LA291, 322, 340, 341, 711, 712, 798, 802, 803
ms-3	male-sterile-3	2-32
ms-4	male-sterile-4	2-33
ms-5	male-sterile-5	2-39; LA84, 138
ms-6	male-sterile-6	2-44
ms-7	male-sterile-7	2-89
ms-8	male-sterile-8	2-98
ms-9	male-sterile-9	2-121
ms-10	male-sterile-10	2-132; LA199, 293, 771
ms-10 <sup>35</sup> (35)	male-sterile-10 <sup>35</sup>	2-517
ms-11	male-sterile-11	2-152
ms-12	male-sterile-12	2-161
ms-14	male-sterile-14	2-175
ms-15	male-sterile-15	2-193
ms-15 <sup>26</sup>	male-sterile-15 <sup>26</sup>	2-327
ms-16	male-sterile-16	LA62, 318, 320, 323
ms-17	male-sterile-17	2-225, 2-342
ms-18	male-sterile-18	2-233, LA290
ms-23	male-sterile-23	2-273
ms-24	male-sterile-24	2-277
ms-25	male-sterile-25	2-313
ms-27	male-sterile-27	2-331
ms-28	male-sterile-28	2-355
ms-29	male-sterile-29	2-423
ms-30	male-sterile-30	2-455

Symbol	Name	Stock number
ms-31	male-sterile-31	2-461; LA778, 878, 900, 902, 904, 1113, 1179, 1180
ms-32	male-sterile-32	LA359; 1492, 1493
ms-33	male-sterile-33	2-511; LA901, 903, 905, 1114
ms-34	male-sterile-34	2-513
ms-38	male-sterile-38	2-39
ms-38 <sup>40</sup>	male-sterile-38 <sup>40</sup>	2-553, LA899
ms-39	male-sterile-39	2-549
mt	midget	LA282
mta	mutata	LA965
mts	mortalis	LA849
mu	multinervis	LA690
mua	multifurcata	LA851, 1177, 1182
muf	multifolia	LA689, 891
mult	multiflora	LA560
mup	multiplicata	LA846
mut	mutabilis	LA866
muv-2 (mus)	multivalens-2	LA964
mux	multiplex	LA847
na	nana	LA561
nc	narrow cotyledons	LA170
neg	neglecta	LA562, 729, 781, 881, 1488
ni	nitida	LA616
nor	non-ripening	LA1793
not	notabilis	LA617, 924, 997, 1072, 1103, 1104, 1164
Nr	Never ripe	LA162, 297
nv	netted virescent	LA786, 1000
o	ovate	LA330, 754, 986
O <sup>1</sup> (ol)	Oval <sup>1</sup>	LA271
ob	obscura	LA691
obl	oblate fruit	LA1159
oc	ochroleuca	LA692
Od	Odorless	LA292, 347, 499, 1018
og	old gold	LA294, 348, 500
og <sup>c</sup> (Crn, Cr, crn-2, cr <sub>2</sub> )	old gold <sup>crimson</sup>	LA806
oli	olivacea	LA693
op	opaca	LA618
opa	opacata	LA966
os	oligosperma	LA868
ovi	oviformis	LA967
p	peach	LA157, 330, 754, 986
pa-2 (pa)	parva-2	LA970
pal	pallida	LA563
par	parca	LA969
pas	pallescent	LA968
pau	pauper	LA877
pcv	polychrome variegated	LA1199, 1528
pdc	pudica	3-47, 3-48
pds	phosphorus deficiency syndrome	LA813, 1189, 1190

Symbol	Name	Stock number
pe	sticky peel	LA759, 1002
pen	pendens	LA694
per	perviridis	LA564, 908, 910, 985, 1003
pet	penetrabile	LA971
pi	pistillate	2-137
pic	picta	LA620
pl	perlucida	LA867
pla	plana	LA695, 1100
pli	plicata	LA696, 987
pm	praematura	LA855
Pn	Punctate	LA812, 998
pol	polylopha	LA697
pp	polyphylla	LA860
pr	propeller	LA326, 907
prc	procumbens	LA698
pro	procera	LA565, 730, 803
prt	protea	LA972
prun	prunoidea	LA566, 726
ps (va)	positional sterile (spontaneous allele)	LA63, 169, 511, 471 2-303
pst	persistent style	LA136, 190, 296; 2-5
pt-4	pseudo-triplo-4	LA892, 2-413
ptb	protuberant	LA1017, 1018
pu (pul)	pulvinata	LA621
pu-2	pulvinata-2	LA973
pum	pumila	LA567, 883, 1001
pun	punctata	LA974
pur	purilla	LA568
px	praecox	LA856
r	yellow flesh	LA13, 508, and other combinations
	(spontaneous alleles)	2-141, LA353
ra	rava	LA569
ra <sup>2</sup> (gri)	rava <sup>2</sup>	LA678, 902, 917, and other combinations
re	reptans	LA624
rela	relaxata	LA622
rep	repens	LA623
res	restricta	LA824, 1084, 1085
ri	ridged	LA1794
ria	rigidula	LA825, 1078
ria <sup>2</sup>	rigidula <sup>2</sup>	LA975
rig	rigida	LA699
rig <sup>2</sup> (pca)	rigida <sup>2</sup>	LA822
rin	ripening inhibitor	LA1795
roa	rotundata	LA976
rot	rotundifolia	LA700
Rs	Rootless	LA1796, 1797, 1798
rtd	retarded dwarf	LA1058
ru	ruptilis	LA626, 988, 1070
rust	rustica	LA573

Symbol	Name	Stock number
rv	reticulate virescent	LA285, 299, 648, 779
rv-3	reticulate virescent-3	3-33
rvt	red vascular tissue	LA1799
s	compound inflorescence	LA330, 986
sa	sphacelata	LA865
sar	squarrulosa	LA978
scf	scurfy	LA767, 1186, 1491, 1529, 1530, 1665, and other combinations
scl	seasonal chlorotic lethal	LA1007
sd	sundwarf	LA15, 140
Se	Septoria resistance	LA1800
sem	semiglobosa	LA701
ses	semisterilis	LA826
sf	solanifolia	2-311, LA497, 1180, 1182, 1430, and other combinations
sfa	sufflaminata	LA862
si	sinuata	LA702, 993
sit	sitiens	LA574
sl	stamenless	LA269
sl-2	stamenless-2	LA1801
slx	serrate lax leaf	LA503, 801, 893
Sm	Stemphyllium resistance	LA1902
sp	self-pruning	LA31, 154, 201, 302, 308, 336, 875, 876, 895
spa	sparsa	LA703, 805, 922, 1191, 1491
spe	splendida	LA977
sph	sphaerica	LA704
spl	splendens	LA821
spl-4	splendens-4	LA1060
squa	squarrosa	LA627
sr	slender stem	LA1803, 1804, 1805
st	sterile	LA334
ste	sterilis	LA705
stri	stricta	LA575
sua	suffusa	LA707
sub	subtilis	LA576
suc	succedanea	LA706
suf	sufflava	LA577, 732
sy	sunny	LA741, 1071, 1430, and other combinations
(ye)	(spontaneous allele)	LA1434
syv	spotted yellow virescent	LA1096
t	tangerine	LA30, 159, 328, 1002, and other combinations
t <sup>v</sup>	tangerine <sup>virescent</sup>	LA351, 649, 711, 794, 1487
ta	tarda	LA708
tab	tabescens	LA629, 1102
te	terminata	LA861
tem	tempestiva	LA979
ten	tenuis	LA578, 1086

Symbol	Name	Stock number
ti	tiny plant	LA1806, 1807, 1808
tf (ct)	trifoliate	LA64, 512, 1444, and other combinations
(tri)	(X-ray induced allele)	LA579
tl	thiaminless	LA758, 879, 1081
	(EMS-induced alleles)	3-114, 3-116
tmf	terminating flower	LA1534
to	torosa	LA709
to <sup>2</sup>	torosa <sup>2</sup>	LA980
tp	tripinnate leaf	LA895, 999
tr	truncata	LA710
trs	tristis	3-57
u	uniform ripening	LA31, 642, 1022, and other combinations
u <sup>G</sup>	Galápagos uniform ripening	LA1020
uf	uniflora	LA1055, 1200
ug (u <sub>2</sub> )	uniform gray-green	LA21, 297
um	umbrosa	LA630, 995, 996, 997, 1072, 1082
uni	unicaulis	LA580
va <sup>dec</sup>	varia <sup>decolorata</sup>	LA581
va <sup>virg</sup>	varia <sup>virgata</sup>	LA582, 776
var	variabilis	LA583, 908, 1103, 1164, 1446
Ve	<u>Verticillium</u> resistance	LA490
ven	venosa	LA584, 787, 888, 890
ver	versicolor	LA632, 994, 1074, 1075, 1076
ves-2 (vf)	versiformis-2	LA859, 1078, 1079, 1080, 1489
vg	vegetative	LA140; 2-171
vga	virgulta	LA858
vi	villous	LA759, 760
vio	violacea	LA633
vir	viridis	LA585
vit	vitiosa	LA634
vlg	virescent light green	3-128
vms	variable male-sterile	LA312, 720, 796; 2-219
vo	virescent orange	LA1435
vra	viridula	LA857
vrđ	viroid	LA1005
w	wiry	LA257, 274
w-3 (w <sub>2</sub> )	wiry-3 (Leslie)	LA1498
w-4	wiry-4	LA1077; 2-237
wd	wilty dwarf	2-110; LA137, 884
wf	white flower	LA23, 159, 644, and other combinations
Wo	Wooly	LA53, 85, 298, 637, 648
Wo <sup>m</sup>	Morgan's Wooly	LA258, 715, 986, 1663, and many other combinations
Wo <sup>v</sup>	van Wert's Wooly	LA1531



Symbol	Name	Stock number
wt	wilty	LA14, 30, 285, 512, and other combinations
wv	white virescent	LA659, 727, 768, 790, 1163, 1444, 1526
wv-2	white virescent-2	LA1150
wv-3	white virescent-3	LA1432
Xa	Xanthophyllic	LA158, 283, 298, 328, 637
y	colorless fruit epidermis	LA13, 330, and other combinations
yg-4 (yl, yg <sub>333</sub> )	yellow-green-4	LA738, 740
yg-6	yellow-green-6	LA1486
yv	yellow virescent	LA55, 773, 802, 879, and many other combinations
yv <sup>2</sup> (vel <sup>2</sup> )	yellow virescent <sup>2</sup>	LA981

## ERRATA

TGC Report #27, 1977

## 1. Stock list p. 37

LA 1689 should read LA 1649

## 2. Research note p. 19

Title of the article: Abnormal meiosis in tomato

The second sentence should read: "Until the mid-diakinesis stage, meiosis was perfectly normal and as the stage passes through to metaphase I, dissociation of some of the bivalents into univalents as well as congregation of chromosomes into chromatin clumps were observed."

PART IIIADDITIONS AND CORRECTIONS TO THE  
LIST OF MEMBERS

(Last complete Directory in TGC #27)

Balgooyen, Bruce, Northrup King Co., Stanton, MN 55081  
Biblioteka Periodika, 69. Balgarska Akademia Na Naukite, Ul. 7. Noemvri, 1, Sofia,  
Bulgaria  
Bohn, G.W., 1094 Klish Way, Del Mar, CA 92014  
Cuartero-Z., J., C.S.I.C., Estacion Esperimental "La Mayora", Algarrobo-Costa  
(Malaga), Spain  
DeBonte, Lorin R., Jr., Botany Department, Miami University, Oxford, OH 45056  
Durand, Yves, Mas Saint-Pierre, 13210 Saint Remy de Provence, France  
Emmaty, Davy A., 13737 Middletown Pike, Bowling Green, OH 43402  
Ewaniuk, Peter, 605 W. Wahl Road, El Centro, CA 92243  
Fernandez-N., Enrique N., Department of Plant Pathology, University of Wisconsin,  
Madison, WI 53706  
Firoozabady, Ebrahim, Department of Vegetable Crops, University of California,  
Davis, CA 95616  
Fobes, Jon, Department of Horticulture, MSU, East Lansing, MI 48824  
Gill, Bikram S., University of Florida, Ag. Res. & Educ. Ctr., Belle Glade,  
U.S. Sugarcane Field Station, Canal Point, FL 33438  
Graham, K. M., Department of Biology, Nat. Univ. of Malaysia, Jalan Pantai Bara,  
Kuala Lumpur 22-12, Malaysia  
Grant, W. F., Genetics Laboratory, Macdonald Campus of McGill University, Ste. Anne  
de Bellevue, Quebec, HOA 1C0, Canada  
Hagan, W. L., Del Monte Corp., Agricultural Res. Ctr., PO Box 36, San Leandro, CA  
Kubo, Sinkichi, Kirin Brewery Co., Ltd., 26-1, Jingumae 6, Shibuya-Ku, Tokyo,  
Japan, 150  
Loiselle, Roland, Agriculture Canada, Ottawa Research Station, Ottawa, Ontario,  
Canada K1A 0C6  
Miami University Library, Periodical Order, Oxford, OH 45056  
Okie, W. R., Department of Horticultural Science, N.C. State Univ., Raleigh, NC 27607  
Parker, Paul F., Botany Laboratory, University of Leicester, University Road,  
Leicester, LE1 7RH, England  
Petrescu, Corneliu, Bd. Pacii 170, Bloc 40, sc. 1, ap 18, sect 7, Bucarest, Romania  
Quiros, Carlos F., University de Sherbrooke, Centre Hospitalier Universitaire  
Sherbrooke, Quebec 11H 5N4  
Ramadan, Mahmoud M., Department of Vegetable Crops, University of California, Davis  
Ramirez, Jose G., Campo Agricala Experimental, Apdo Postal #112, Celaya, Guanajuato  
Mexico  
Rao, R. S., Head, Botany Department, Andhra University, Waltair 530 003, India  
Rieman, Robert W., Pan American Seed Co., 8605 17th Ave., N.W. Bradenton, FL 33505  
Valenzuela, Juan, Facultad de Agronomia, Casilla 537, Chillán, Chile  
Weinheimer, W. H., FMC Corp., Seed Dept., Agricultural Chemical Division, PO Box 2508,  
El Macero, California 95618  
Young, Harold W., Lembago Penelitan Hortikultura, Lambang, Indonesia  
Zerpa, Dora M. de, Catedra de Genética, Facultad de Agronomica, Maracay, Venezuela  
Zwaan, Rijk, Zaadteelt en Zaadhandel, Burgemeester Crezeelaan 40, Postbus 40,  
De Lier, Holland

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PART VFINANCIAL STATEMENT

January 1, 1977 - December 31, 1977

		<u>Total</u>
<u>Balance from 1976</u>		\$1,251.54
<u>Receipts</u>		
Assessments	604.74	
Sale of back issues	119.50	
NSF Grant funds for publishing stock list	<u>148.20</u>	<u>872.44</u>
		2,123.98
<u>Expenditures</u>		
Printing Report #27	716.15	
Postage	284.20	
Envelopes	25.88	
Fasteners	20.33	
Xeroxing bibliography	2.00	
Bank charge for foreign check	<u>.50</u>	<u>1,049.06</u>
<u>Balance</u>		\$1,074.92

MEMBERSHIP STATUS

(to December 31, 1977)

Assessments paid for	1977	121
	1978	154
	1979	79
	1980	10
	1981	4
	1982	3
	1983	1
	1984	1
	1985	1
	1986	1
	1988	<u>1</u>
Total		333

## APPENDIX A

Interim Report of the Committee on Varietal Pedigrees 1977

Listing of previous report: TGC 9:1959 - an attached supplement between pages 36 and 37. TGC 11:36-51, 1961. TGC 16:53-67, 1966. TGC 18:64-71, 1968. TGC 19:39-45, 1969. TGC 20:79-86, 1970. TGC 21:61-64, 1971. TGC 22:47-52, 1972. TGC 23:49-56, 1973. TGC 24:46-52, 1974. TGC 25:36-41, 1975. TGC 26:33-38, 1976. TGC 27:59-68, 1977.

COMMITTEE ON VARIETAL PEDIGREES

Alexander, L. J.  
Andrasfalvy, András (Hungary)  
Angell, F. F.  
Báldy, B. (Hungary)  
Cirulli, M. (Italy)  
Crill, J. P.  
Darby, L. A. (England)  
Daskaloff, C. (Bulgaria)  
Frankel, Rafael (Israel)  
Frazier, W. A.  
Gabelman, W. H.  
Gilbert, J. C.  
Graham, T. O.

Groszmann, H. (Australia)  
Hernandez, T. P.  
Honma, Shigemi  
John, C. A.  
Kooistra, E. (Holland)  
Lambeth, V. N. (Chairman)  
Leeper, Paul  
Pecaut, M. (France)  
Robinson, R. W.  
Sumeghy, J. B. (Australia)  
Tomes, M. L.

Tomato Pedigrees, Characteristics, and  
Reference Publications

Berry, S.Z. and W.A. Gould. 1977. 'Ohio 736' Tomato. HortScience 12(2):169.

OHIO 736

Pedigree

Heinz 1630 x VF 145B-7879

$F_3$  x Campbell 28

Ohio 2070

---

Ohio 736

Characteristics:

Fruit: Small red globe (3 oz. or 85 g), u, firm, resistant to radial and concentric cracking, good field storage. Small core, excellent processing qualities.

Plant: Small sp, I, Ve, adapted to machine harvest.

Processing tomato, especially coreless whole-pack.

Early (Campbell 28), for machine or hand harvest in Midwest.

Burgis, D.S., J.P. Crill, N.C. Hayslip, P.H. Everett and J.J. Augustine. 1977. Walter PF, A selection of the 'Walter' variety with reduced incidence of fruit pox and gold fleck. Fla. Agric. Expt. Sta. Circ. S-249.

WALTER PF (Line 740985-3)

Pedigree:

Selection of Walter. (see TGC 19:40)

Characteristics:

Fruit: Similar to Walter but with less fruit pox and fleck.

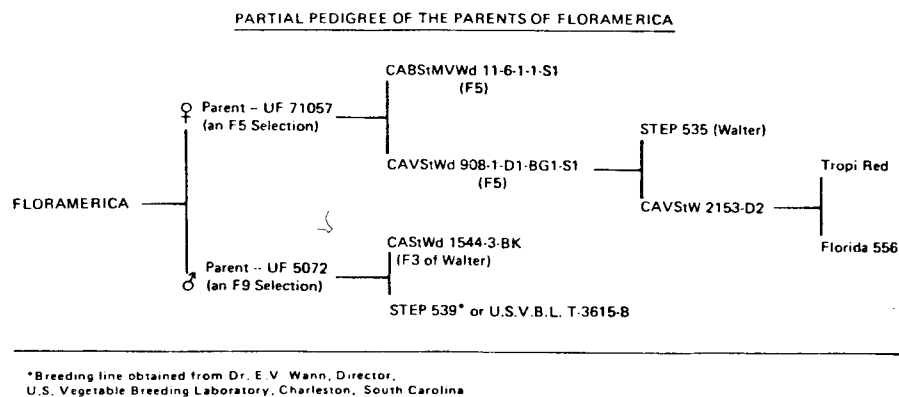
Plant: sp +, Sm, graywall, fusarium (races 1 & 2)

Walter is dominant commercial variety grown in Florida.

Crill, Pat, H.H. Bryan, P.H. Everett, J.A. Bartz, J.P. Jones and R.F. Matthews. 1977. Floramerica, a widely adapted, multiple disease resistant, fresh market tomato. Fla. Agr. Expt. Sta. Circ. S-248.

### FLORAMERICA (Florida Hybrid)

Pedigree:



### Characteristics:

Fruit: Large (6-11 oz.), dark red globe, smooth green shoulders, mean fruit quality attributes: pH 4.25, soluble solids 5.6%, titratable acidity (CAE) 0.47%, ascorbic acid 15.9 mg/100 g, beta carotene 0.36 mg/100 g.

Plant: Vigorous determinate (sp) of medium maturity.

### Disease resistance and tolerance:

Monogenic resistance to fusarium (races 1 & 2), Sm, Cf and crown rot.

Tolerance to early blight, Ve, TMV blossom-end rot and bacterial soft rot.

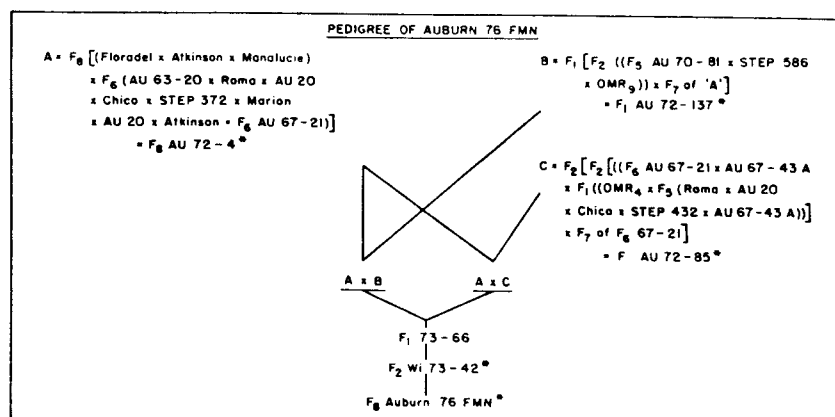
Free of following genetic diseases and disorders: fruit pox, gold fleck, autogenous necrosis, catface, black shoulder, concentric cracking.

Extremely wide range of adaptability. Fruit firmness adequate for home garden, roadside market, and "U-Pick" operations but requires special handling for shipping trade.

Greenleaf, W.H., J.L. Turner and K.S. Rymal. 1977. Auburn 76FMN, a fusarium wilt, tobacco mosaic virus, root-knot nematode resistant tomato variety. Auburn Agric. Expt. Sta. Circ. 235.

### AUBURN 76FMN

Pedigree:



N.B.  $F_1$  AU 63-20(Mi/Mi) has a complex pedigree, similar to that of Atkinson, involving Pearson S,  $F_4$  (Ala No. 1 x 15B-1), Hawaii AES 4521(Mi/Mi), Kokomo, Rutgers, STEP 174 (USDA), and STEP 381 (S.C. AES). AU 67-43 A (Mi/Mi), a processing type breeding line was  $F_4$  (Campbell Soup Co., L. W. Schaible heirseed lines No. 783 or 788 x Roma x Au 20) x Chico. Heat tolerance in the Schaible lines derives from the Philippine tomato variety Narcarlang. AU 70-81 (Mi/Mi) is  $F_1$  (P. I. 273444 (Compact fruited determinate 'Birdsnest' type from Professor T. O. Graham, University of Guelph, Canada) x 67-43 A).

\*Numbers with asterisks are superior selections.

### Characteristics:

~ Fruit: red, deep oblate, 4.3-5.6 oz. ug, smooth, crack resistant. Quality attributes: pH 4.0-4.4, soluble solids 4.4-5.2% total acidity 0.42%, ascorbic acid 27 mg/100 g.

Plant: sp +, I, Tm<sub>2</sub>, Mi, vigorous.

Medium early cultivar for home gardens and market.

Breeding line for multiple disease resistance.

Hills, W. A. 1977. Nematode resistant tomato Patriot.

U.S.D.A. ARS Vegetable Laboratory Release Notice dated 5/19/77.

PATRIOT (T3810, STEP 626)

Pedigree:

```

Purdue - 68-119-1  x  S5 A-1 (BC to Supermarket)
  sp, OgC OgC          |          Mi
                      |
                    Patriot (F10)
  
```

Characteristics:

Fruit: Slightly oblate red fruits, 150 g. crimson (Og<sup>C</sup>) above average crack resistance, color, smoothness and quality. Fruit quality attributes similar to Homestead and Walter.

Plants:

sp, I, Sm, Mi, field tolerance to early blight  
Main season, nematode-resistant, home-garden.  
cultivar. Possibly too soft for shipping.

Lambeth, V. N. 1977. Origin and release of tomato line 31-St-29 and hybrid SHOW-ME. Mo. Agric. Expt. Sta. Res. Bul. 1024.

31-St-29

Pedigree:

```

Glamour  x  NY55-542 (Cornell)
        |
Mo. Line 89-3-60-1  x  VFN-8 (California)
                    |
                Mo. Line 31-St-29 (F6)
  
```

Characteristics:

Fruit: Red globe, 6+ oz., ug, tolerant radial and concentric cracking.

Plant: sp+, moderate foliage density, I

Genetic stock in pedigreed breeding programs and parent for hybrids.

## SHOW-ME

## Pedigree:

$F_1$  of Fla. 1011 x Mo. 31-St-29

## Characteristics:

Fruit: Blocky red fruits, 7 oz. ug, very firm, tolerant to radial and concentric cracking and bursting; quality attributes: pH 4.25, CAE 0.44%, Brix 5.8%.

Plants: sp+, I, Sm, early blight, moderate to heavy foliage density.

Early midseason, firm market type.

Home garden and canning, good vine storage.

Martin, M.W. 1977. Naming and release of four tomato varieties, ROZA, Columbia, Rowpac and Saladmaster. U.S.D.A. ARS (Western Region) and Washington Agricultural Expt. Sta. release.

ROZA (CVF 2054, CVF 2748)

## Pedigree:

Selection from  $C_5$  x VF145-21-4

## Characteristics:

Fruit: red, deep oblate, ug, 0.27 lb., firm, good slicer high vitamin C, holds well on vine.

Plants: Small, open sp, sets well under adverse conditions; prolific (40-50 T/A); Ve, I, curly top.

Fresh market and home gardens in Western states where curly top is prevalent. Hand pick only.

COLUMBIA (CVF 2054, CVF 2722)

## Pedigree:

Selection from  $C_5$  x VF 145-21-4

## Characteristics:

Fruit: Larger than ROZA (0.31 lb.) otherwise similar.

Plants: Similar to ROZA but less curly top resistance; Ve, I.

Large fruited home and fresh market type for Western states.



ROWPAC (CVF 2054, CVF 2791, CVF 2792)

Pedigree:

Selection from C<sub>5</sub> x VF 145-21-4

Characteristics:

Fruit: Smaller than ROZA (0.24 lb.) firm, good processing qualities, holds well on vine, concentrates ripening.

Plants: Similar to ROZA, matures fruit a week earlier. Direct seed only.

Home garden and machine-harvest processing.

SALADMASTER (CVF 27)

Pedigree:

Selection of L. humifusum x L. esculentum

Characteristics:

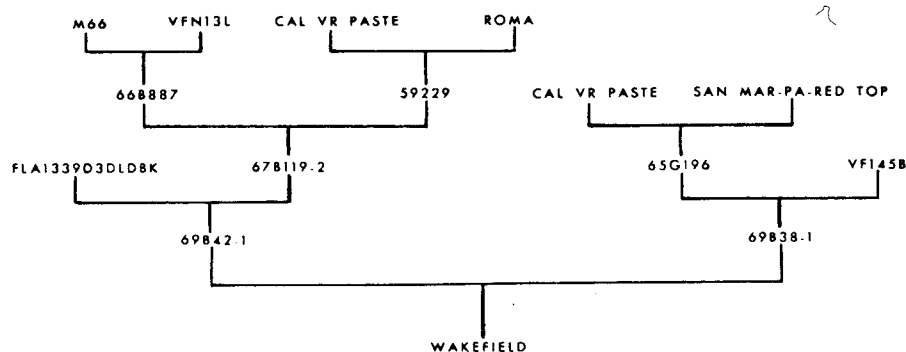
Fruit: Egg-shaped, red, 0.08 lb/fruit, firm, no core, stems easily, good color, top quality holds well on vine.

Plants: Large sp, normal leaf type, very good fruit setting ability. Ve, I, very resistant curly top.

Home garden "salad type", genetic stock for breeding machine harvested processing types.

Stoner, A.K. 1977. 'Wakefield' tomato.  
HortScience 12(5):507.

WAKEFIELD (75B13, 76B142)



Characteristics:

Fruit: Deep round red fruit averaging 2.4-3.0 oz. (71-85 g), firm, crack and burst resistant, small core quality attributes: pH 4.33, CAE 0.45%, soluble solids 6.0%.

Plants: sp, conc. flowering and fruit set, Sm, I, Ve, tolerant to air pollutants.

Processing; especially whole pack. Machine-harvestable. Early maturity (84-89 days transplanting to once-over harvest).

Adapted to Eastern U.S.

## APPENDIX B

CATALOG OF COLLECTIONS OF GREEN-FRUITED Lycopersicon SPECIESAND Solanum pennellii FOUND IN WATERSHEDS OF PERÚM. Holle<sup>1</sup>, C. M. Rick<sup>2</sup>, and D. G. Hunt<sup>2</sup>

(first of two-part series)

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1. Present address: Dept. de Suelos y Cultivos, CATIE, Turrialba, Costa Rica.

2. Dept. of Vegetable Crops, University of California, Davis.

## INTRODUCTION

The present work brings together a catalog of the herbarium and seed collections of the green-fruited species of Lycopersicon and the related Solanum pennellii. The latter is included because it behaves in all biosystematic respects as a species of Lycopersicon. The authors have used the notes available from herbarium sheets and collecting expeditions together with their personal experiences in the western part of South America. The material is presented in two ways: first by species (Tables 1-4), and second, by geographical locations (Tables 5-44). It is hoped that this will help workers to see how the available seed represent the geographic distribution of the different species and also help future collectors to decide what areas to explore.

Some of the more important observations and publications are mentioned, but no attempt has been made to include reference to all the research on these species. Information about the useful characters of the species may be obtained from North Central Plant Introduction Station, Ames, Iowa 50010, USA. The following works have been cited:

Lanjouw, Joseph, 1954-to date Index herbariorum; a guide to the location and contents of the world's public herbaria (Utrecht, International Bureau for Plant Taxonomy and Nomenclature of the International Association for Plant Taxonomy) agent: Chronica Botanica Co., Waltham, Mass.

Martin, Franklin W., 1963 Distribution and relationships of incompatibility barriers in the Lycopersicon hirsutum Humb. and Bonpl. complex. *Evolution* 17:519-528.

Muller, C. H., 1940 A revision of the genus Lycopersicon. USDA Misc. Publ. 382.

Rick, C. M., 1963 Barriers to interbreeding in Lycopersicon peruvianum. *Evolution* 17:216-232.

Weberbauer, August, 1936 Phytogeography of the Peruvian Andes: 1:13-31. In *Flora of Perú* by James Frances Macbride. Field Museum of Natural History . . . Publication 351, Botanical series vol. XIII.

In the second part of the catalog, the information for each watershed includes:

- a. A discussion of the general characteristics of the watershed and/or specific observations of the species found there. Special emphasis has been given to any unique features of the area or material.
- b. A table with the species name, the site name, the altitude of the site (as recorded by collector), name of the collector(s), date of collection, existence of herbarium specimen, availability of seed, population size where original collection was taken, and identification number.
- c. A map that includes several watersheds with symbols indicating the approximate location of the sites of the species listed.

In Tables 1-4 (Part I), the following symbols denote:

PI - Plant Introduction Number of the United States Dept. of Agriculture

LA - accession number of C. M. Rick, Dept. of Vegetable Crops, Univ. of Calif., Davis

DHUNA - acc. number, Dept. de Horticultura, Universidad Nacional Agraria, Lima, Peru

H - acc. number of J. Hawkes, Dept. of Botany, Univ. of Birmingham, Birmingham, England

In Tables 5-44 (Part II) the symbols explained above are followed by the collector's number (e.g. LA126); the other symbols designate the herbaria where specimens are housed, and in this case the identifying number precedes the symbol (e.g. 9129 USM). With the exception of two private herbaria -- OCH (Carlos Ochoa, International Potato Center, Apartado 5969, La Molina, Lima, Perú); R (C. M. Rick, Dept. of Vegetable Crops, Univ. of Calif., Davis) -- the symbols designate public herbaria of the world and are listed in Index Herbariorum (see Lanjouw 1954). It should be noted that for most of the LA accessions of Rick, unmounted herbarium species are available; also that a few of the Rick collections have SAL accession numbers.

## ACKNOWLEDGEMENTS

This work, started in 1970, is based on published data, examination of herbarium and live specimens in Perú and the United States, and trips by two of the authors in all the watersheds described for Perú. A large part of the work was done during the sabbatical year of the senior author at the University of California at Davis in 1974-75. Acknowledgements are due to innumerable persons and institutions -- only a few can be mentioned here.

## In Perú:

Dr. Ramón Ferreyra, Museo Historia Natural Javier Prado, Universidad Nacional Mayor de San Marcos, Lima, Perú.

Ing. Carlos Ochoa, Profesor Principal, Universidad Nacional Agraria, La Molina, Perú.

Dr. Julio López Guillen and J. Soukup, Herbario, Instituto de Recursos Naturales, Programa Académico de Farmacia, Universidad Nacional Mayor de San Marcos, Lima, Perú.

Dr. Abundio Sagastegui, Herbario Truxillensis, Universidad Nacional de Trujillo, Trujillo, Perú.

## In the United States:

Dr. Elizabeth McClintock, California Academy of Sciences, San Francisco, California.

Dr. William D'Arcy, Missouri Botanical Garden, St. Louis, Missouri.

Dr. Johnnie Gentry, Oklahoma State University, Stillwater, Oklahoma (formerly Field Museum of Natural History, Chicago, Illinois).

Dr. Lincoln Constance, University of California, Berkeley, California.

Special thanks are due the Guggenheim Foundation for financial support during the senior author's fellowship when the bulk of the data was collected and organized.

## I. OBSERVATIONS FROM COLLECTORS' DATA SUMMARIZED BY SPECIES

The information recorded here was found on labels of herbarium sheets, in notebooks of CMR, and from personal recollections of the sites where specimens were found.

All the data from one site have been treated as a single observation and have been tabulated for each watershed. A site is designated by the name or position of a geographic point where the collection or accession was found. The sites for each watershed are listed in Tables 5 - 44. The correctness of reported altitudes has not been confirmed.

Ecological conditions of the site are approximated from the collection data and known soil characteristics. Habitat preferences and relative abundance are also indicated by notations on the species association and population size. Seed data as tabulated permit estimates of the age of the plant. The time of collection correlates stage of growth with moisture conditions in the area. Such data can be analyzed further in future comparisons with yearly moisture records, especially for watersheds that have a short season of available moisture and for the species L. peruvianum, L. chilense, and Solanum pennellii which are found in dry washes that are very erratic in water supply. Appearance in "loma" situations also indicate conditions that favor such plant formations and can be correlated with available weather records for nearby watersheds. The loma formation is typical of the western coast of South America from northern Perú to central Chile. The plants growing there are supported by water condensed from coastal fogs. The altitudes recorded here can be related to the plant formations in Weberbauer's classification for Perú.

- a. L. hirsutum (Table 1). The area of distribution is divided into four main regions. Considering the western slopes of the Andes, we agree with Weberbauer's view that the Jequetepeque River marks an important north-south transitional zone. Starting from the north, there are three areas on the western slope and one on the eastern.

1. The Chira-Jequetepeque region.

Table 1. Summary of collection data for L. hirsutum in each watershed (1818-1976).

Watersheds	Range of years collected	Range of altitudes (m)	Month seed collected	Collec- tion sites	Sites with seed	Sources of seed
INTERIOR						
Marañón	1937-1974	1800-3400	My, Jl, Sp, Dc	15	6	PI, LA
Eastern tributaries	1962-1974	1850-3400	none	5	none	none
Western tributaries	1938-1966	1800-2900	My, Mr	4	1	LA
Cajamarca	1937-1956	2700-3000	Sp, Dc	2	2	PI, LA
Huancabamba	1964-1974	2300-2460	Jl	3	3	PI
COASTAL						
Ecuador	1818-1974	200-2700	Mr, Jl, Aq, Sp,	17	12	PI, LA
Perú						
Tumbes	-	-	-	-	-	-
Chira	1952	1800	none	1	none	none
Piura	1948-1974	500-1500	Mr, Jl	2	2	PI, DHUNA
Olmos	1953-1964	600-2000	Sp	1	1	LA
Reque-Chancay	1952-1956	500-1000	none	2	none	none
Zaña	1874	2700±	none	1	none	none
Jequetepeque	1956-1970	2100-2700	Ag, Sp, Dc	3	3	PI, LA
Chicama	1868-1970	1200-2580	Ag, Dc	5	3	LA
"Lomas"	1949-1953	450-720	none	2	none	none
Moche	1937-1970	1625-2800	Fb, Dc	6	3	PI, LA
Virú	-	-	-	-	-	-
Chao	-	-	-	-	-	-
Santa	1962-1969	2000-2280	Dc	2	1	DHUNA
Nepeña	-	-	-	-	-	-
Casma	1922-1975	1490-3700	Ot, Dc	4	3	LA, DHUNA
Huarmey	-	-	-	-	-	-
Culebras	-	-	-	-	-	-
Fortaleza	1949-1970	2220-3080	Dc, Ja	4	3	LA, DHUNA
Pativilca	1952	2400	none	1	none	none
Supe	1939	2010	none	1	none	none
Huaura	1950-1970	1200-2400	Dc	2	1	LA
Huaral	1970-1973	2300-3000	Sp	2	1	DHUNA
Chillón	1925-1973	1500-2942	Ag-Dc, Fb	11	6	PI, LA, DHUNA
Quisquichaca	1972-1973	1650-3400	none	3	none	none
Rímac	1948-1973	2000-2250	Sp-Nv	2	2	LA, DHUNA
Lurín	1970	1600±	Sp, Ot, Nv	1	1	LA, DHUNA
Chilca	-	-	-	-	-	-
Mala	-	-	-	-	-	-
Asia	-	-	-	-	-	-
Cañete	1952-1976	-	-	-	-	LA, DHUNA
Topará	-	-	-	-	-	-
Chincha	1972	2200±	Je	1	1	none
Pisco	1976	3000±	Je	1	1	LA, DHUNA

Table 2. Summary of collection data for L. chilense in each watershed (1836-1964).

Watersheds	Range of years collected	Range of altitudes (m)	Month seed collected	Collec- tion sites	Sites with seed	Sources of seed
Río Lomas	1911	900-1000	none	1	none	none
"Lomas" Chala-Camaná	1800-1958	300-400	Nv	2	1	LA
Vítor/Siguas	1925-1943	2200-3000	Ja	5	2	PI, LA
Tambo	1919-1956	10-1300±	Dc, Ja, Ap	2	2	PI, LA
Moquegua	1925-1964	700-1800	Dc, Fb, Mr	5	2	PI, LA
Sama	1938-1957	300-700	Fb, Mr	2	2	LA
Tacna	1922-1964	470-2900	Nv, Dc, Mr, Ap	7	5	PI, LA
Chile	1836-1957	30-1200±	Ja, Mr	11	5	PI, LA

2. The Chicama and nearby lomas. Despite the small number of collections, this region is distinctive in two features -- the endemic ecological conditions of the Cascas-Contumazá area and the only loma collections known for the species.
  3. The Moche-Pisco region. Here three gaps can be detected in collections: one between the Moche and the Santa, another between the Casma and the Fortaleza, and the third between the Lurín and the Cañete. The reasons for the gaps seem to be: (a) the rivers do not have enough moisture to sustain growth at the altitude preferred by the species; (b) they have not been explored sufficiently in favorable years; and (c) the populations are usually very small.
  4. The Marañon region. East of the Andean divide, only the Marañon River and its tributaries have yielded hirsutum accessions. We have arbitrarily divided the collections into two subgroups: (a) the collections of the Huancabamba and Cajamarca Rivers, which are closely related to those of the Piura and Jequetepeque watersheds, respectively; and (b) specimens from tributaries that flow directly into the Marañon. Identification of the latter group is of doubtful reliability because the locations are isolated and scattered and because no seed is available to permit the growing of test cultures. The situation should be cleared up by a collecting expedition into this highly complicated and poorly understood vegetational area.
- f. glabratum extends southward from Ecuador to Olmos ( $6^{\circ}$  south latitude) in the Chira-Jequetepeque region and is found from 500 to 2700 m. The fruit seems to be available in the last part of winter and early spring (Aug.-Oct.), and plants spread along hillsides in the usual quebrada situations in the presence of abundant shrubby vegetation. In the Chancay-Jequetepeque area, conditions are drier, vegetation is sparse, and f. typicum starts to appear.
- b. L. chilense (Table 2). This species is present in the exceedingly arid region of southern Perú from Chaparra to Tacna and along the northern coast of Chile. Populations are tiny north of Moquegua, but southward they tend to be larger. Seed collections were made in the November through April season which corresponds to the "rainy season" in normal years. Since this period is too short for vegetative growth (from the perennial "stumps"), flowering, and seed production, the collection of a good seed supply in a given year indicated that sufficient moisture was received in the previous year. In fact, mature fruits have been collected two years after the last recorded rainfall.
- The altitude ranges can be roughly divided into three levels: (1) sea level to 1800 m; (2) 2200-2500; and (3) 2800-3000. Good data for vegetation associations are not available; one good reason is that several sites have been described as extremely dry desert situations where very few other plants survive. One sympatry reported is with L. peruvianum in lomas of Tambo at 500 to 1300 m and another with yellow-flowered Solanum lycopersicoides at Palca, Caplina watershed, 2500 m.
- The sites are very dry and stony with sandy situations in washes (quebradas) for half of the collections; and for the other half, they are roadsides (500, 1000-1500, and 2900 m) or hillsides (1000-1400, and 3000 m).
- c. L. peruvianum (Table 3). In the overall analysis of collectors' data, this species is divided into four geographic categories: (1) the loma collections, (2) the region from Ecuador to the Reque-Chancay watersheds, (3) the coastal type and the "mountain races" from the Jequetepeque to the Nazca Rivers, and (4) the area of peruvianum/chilense sympatry from Río Lomas to northern Chile. These apparently natural divisions are based mainly on the data reviewed and the crossability relations developed by Rick (1963; summary in his fig. 4).
- L. peruvianum has been collected since 1788 (Ruiz and Pavón, Rímac watershed) and is still found today in old and new sites. It is rare north of the Jequetepeque and has not been collected in such short valleys as Virú, Chao, Nepeña, and in a gap between the Pisco and Nazca drainages. In southern Perú it gradually disappears as L. chilense completely replaces it in the Moquegua, Sama, and Caplina watersheds. In northernmost Chile (Arica) both species are found; southward only L. chilense has been reported.

Table 3. Summary of collection data for *L. peruvianum* in each watershed from north to south (1778-1976).

Watersheds	Range of years collected	Range of altitudes (m)	Month seed collected	Collection sites	Sites with seed	Sources of seed
Ecuador	1974	330	Jl	1	1	PI
Tumbes	1972	0	none	1	none	none
Chira	-	-	-	-	-	-
Piura	1954-1972	50-2000 <sup>±</sup>	Jl	2	1	DHUNA
Olmos	-	-	-	-	-	-
Reque-Chancay	1956-1970	1000-1200 <sup>±</sup>	Dc	2	1	LA
Zaña	-	-	-	-	-	-
Jequetepeque	1937-1971	800-2800	Je, Ag, Sp, Dc	10	9	PI, LA, DHUNA
Chicama	1953-1956	1200-2000	Ag	3	1	PI, LA
"Lomas" Chicama-Moche	1948-1957	200-750	Dc	3	1	PI, LA
Moche	1937-1970	1500-2900	Dc, Fb	6	3	PI, LA
Virú	-	-	-	-	-	-
Chao	-	-	-	-	-	-
Santa	1970	2800	none	2	none	none
Nepeña	-	-	-	-	-	-
Casma	1960-1972	200-2000	Je, Ag, Dc	4	3	PI, LA, DHUNA
Culebras	1937-1956	70-300 <sup>±</sup>	Ag, Dc	1	1	PI, LA
Huarmey	1938-1971	50-2000	Dc	4	1	none
Fortaleza	1949-1974	20-2920	Jl, Dc, Ja	6	4	PI, LA
Pativilca	1952-1975	200-3200	Jl	3	2	DHUNA
Supe	1948-1956	100	Ag, Dc, Ja	1	1	LA
Huaura	1948-1972	1200-2400	Sp, Dc, Fb	5	5	LA, DHUNA
"Lomas" Huaura-Huaral	1944-1972	200-400	Je, Nv	4	2	PI, DHUNA
Huaral (2 forks)	1970-1974	500-3000	Ag-Ot	6	5	LA, DHUNA
"Lomas" Huaral-Chillón	1937-1949	0-200	Dc	4	1	PI, LA
Chillón	1937-1973	750-3000	Ag-Fb, Ap	16	11	PI, LA, DHUNA
Quisquichaca	1972-1973	16-2450	none	3	none	none
Rímac	1778-1974	0-3300	Je, Fb	50	28	PI, LA, DHUNA
Metropolitan area	1778-1973	0-250	Ot, Nv, Ja	7	3	PI, LA, DHUNA
Lomas	1874-1973	100-500	none	3	none	none
Lower drainage	1947-1973	300-850	Je-Sp, Nv-Dc	9	6	LA, DHUNA
Middle drainage	1874-1973	800-2600	Ag-Nv, Fb	17	9	PI, LA, DHUNA
Upper drainage	1937-1974	2389-3300	Ag-Dc	7	6	PI, LA, DHUNA
Sta. Eulalia	1935-1973	950-2000	Je, Dc, Ja	7	4	LA, DHUNA
Lurín	1953-1973	10-2000 <sup>±</sup>	Ot	7	3	LA
Chilca	1948-1973	50-400	Nv	2	1	LA
Mala	1965	100	none	1	none	none
Asia/Lomas	1948-1975	50-1200	Ot, Dc, Fb	4	3	LA, DHUNA
Cañete	-	-	-	-	-	-
Topará	1971-1976	450-600	My, Ag, Fb	3	3	DHUNA
Chincha	1956-1975	100-1200 <sup>±</sup>	Sp, Dc, Ap	2	2	LA, DHUNA
Pisco	1951-1970	100-2960	Ot, Dc	4	2	LA
Ica	-	-	-	-	-	-
Río Grande	-	-	-	-	-	-
Palpa	-	-	-	-	-	-
El Ingenio	-	-	-	-	-	-
Nazca	1949-1975	480-2400	Nv, Mr	3	1	PI, LA, DHUNA
Río Lomas	-	-	-	-	-	-
"Lomas" and valleys between Chala-Camaná	1883-1975	0-1600	Mr, Jl, Ag, Nv, Dc	8	4	PI, LA, DHUNA
Vítor/Siguas	1863-1975	2000-3000	Ag, Dc	11	2	LA, DHUNA
Tambo	1925-1972	3-1300	Dc	4	2	LA
Moquegua	-	-	-	-	-	-
Sama	1957	500 <sup>±</sup>	none	1	none	none
Tacna	-	-	-	-	-	-
Chile	1914-1957	-	Ja	3	3	LA

At the northern end of the range, it is highly doubtful whether the peruvianum range extends into Ecuador. Presumed collections of this species, including Blood and Tremelling's PI 129150 & 129151 (west of Guayaquil) and Winters and Clark's PI 390516-390518 (vicinity of Jipijapa) have been positively identified as L. hirsutum f. glabratum.

The coastal type of group 3 is fairly uniform with the exception of collections from the Chilca-Topará district, which differ from others in highly compound and more canescent leaves and condensed inflorescences. This exceptional race shows peculiar crossing affinities with northern mountain races like Otuzco and var. humifusum and L. chilense (Rick 1963). The coastal type is well exemplified by the Culebras accessions (PI 126944-126946, LA372, 374). Except for the aforementioned Chilca-Topará race, no striking genetic or morphological differences have been detected to date between Culebras and Nazca (fig. 1). The plants are generally found as weeds in populations of one to hundreds in fields of sandy or sandy loam soil. A few specimens have been collected in dry washes after huaycos (avalanches of stones and mud) or after a normal rainy season. In the latter sites they are commonly sympatric, but usually in lower, slightly moister positions, indicating a certain similarity in moisture and drainage requirements. As weeds, the plants can be found at any time of the year depending on the irrigation regime.

The mountain races of L. peruvianum, found 1200 m and higher, are based on genetic relations and phenotypic observations (Rick 1963), which always have to be taken with much care in working with this species. The watersheds are divided into three groups as follows:

Well-established "mountain race"	Watershed		
	Material collected is:		
	too scarce	too recent	
var. <u>humifusum</u>	(Jequetepeque)	(Chicama)	(Huaaura)
" <u>Otuzco</u> "	(Moche)	(Santa)	(Huaral) *
" <u>Cajacay</u> "	(Fortaleza)	(Huarney)	(Lurín) *
" <u>glandulosum</u> "	(Chillón, Rímac, Asia, Omas)	(Pativilca)	(Cañete) *
" <u>Arequipa</u> "	(Vitor)		(S. Juan) *
			(Pisco) *
			(Nazca) *

\* Phenotypically var. glandulosum.

Except for var. humifusum, which is usually found in populations of a few individuals, the other "good" races usually consist of many plants at different sites over an altitude range of 750-1200 m at the lower limit and 2000-3000 m at the upper limit. Sympatry with L. hirsutum is common between 1200 and 2500 m; with S. pennellii, at around 1200 m from the Casma to the Pisco. Cohabitation with L. pimpinellifolium is often observed at the lower elevations. Specific plant associations are mentioned by collectors for only 30 sites. The associations stated more than once are: Loaza spp. (13% of the cases); Jatropha and Heliotropium (10%); and Zinnia and Onoseris albicans (7%).

General vegetational data are presented for 50 sites. The situations vary from no vegetation or dormant vegetation (two cases), association with grasses, Compositae, or a yellow-flowered legume (three cases each), with cacti (six cases), and as a weed (six cases). It is safe to generalize that the main characteristic of peruvianum habitats is dry to medium dry conditions, which are specifically mentioned in 50% of the sites.

- d. Solanum pennellii (Table 4). Seed collections have been mainly successful from October to December and only two sites above 1600 m have been recorded: Tingo-Pacaraos (Huaral) at 2300 m and km 70 road to Canta (Chillón) at 1800 m.



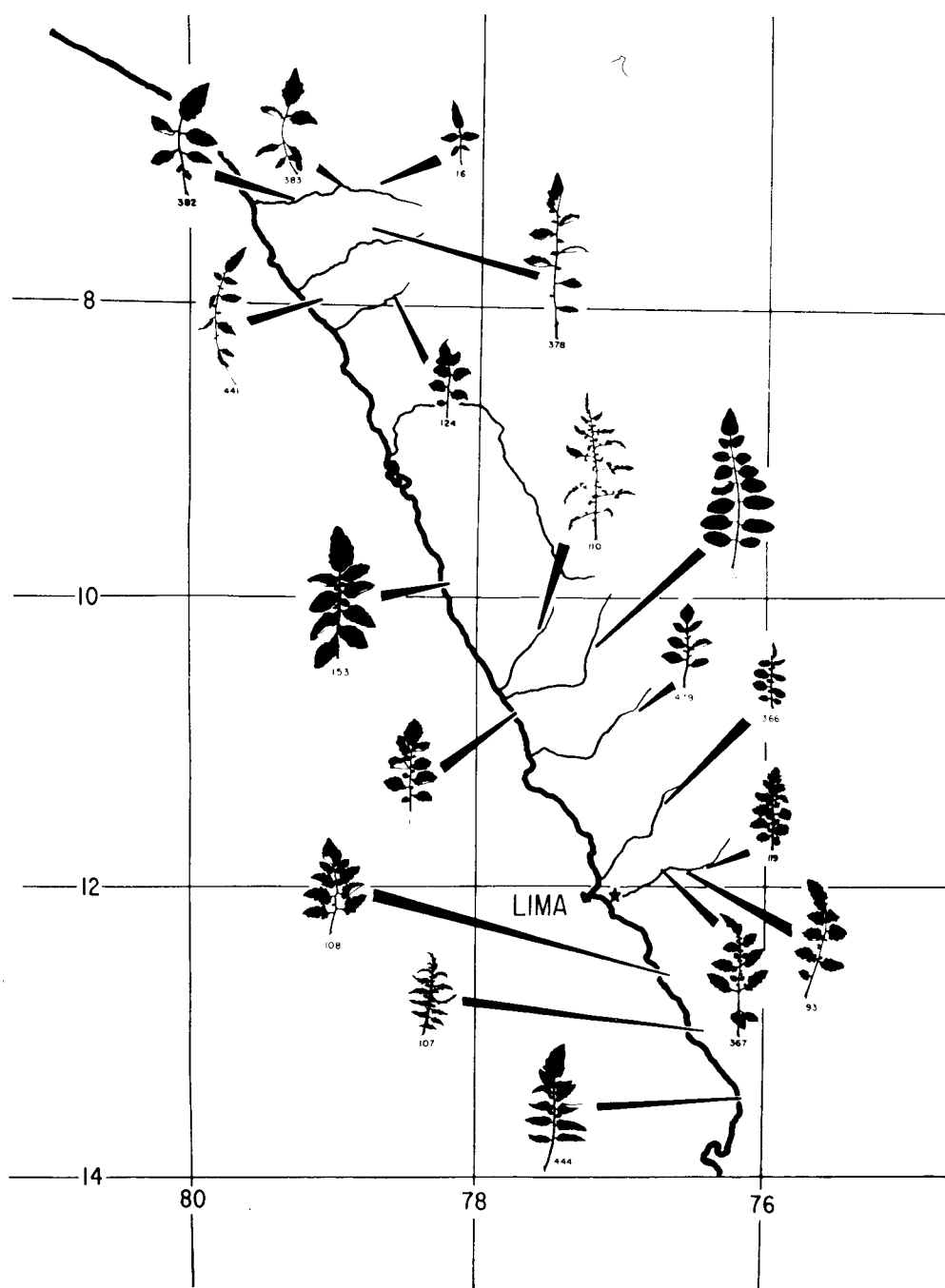


Fig. 1. Representative leaf types of coastal and mountain races of *L. peruvianum* from central and northern Perú.

Table 4. Summary of collection data for Solanum pennellii in each watershed from north to south (1923-1976).

Watersheds	Range of years collected	Range of altitudes (m)	Month seed collected	Collection sites	Sites with seed	Sources of seed
Chicama	1957-1972	600-2000 <sup>±</sup>	Ot	3	2	none
"Lomas" Chicama to Moche	-	-	-	-	-	-
Moche	-	-	-	-	-	-
Virú	-	-	-	-	-	-
Chao	-	-	-	-	-	-
Santa	1972	800-1000	Ot	1	1	LA, DHUNA
Nepaña	1970	600	Dc	1	1	LA
Casma	1975	200-600 <sup>±</sup>	Ot	2	1	DHUNA
Culebras	-	-	-	-	-	-
Huarmey	-	-	-	-	-	-
Fortaleza	-	-	-	-	-	-
Pativilca	-	-	-	-	-	-
Supe	-	-	-	-	-	-
Huaura	1970-1972	1000 <sup>±</sup>	Sp, Nv, Dc	2*	2	LA, DHUNA
"Lomas" Huaura-Huaral	1961-1972	150-300 <sup>±</sup>	Ot, Nv	2	1	DHUNA
Huaral	1970-1971	850-2300	Ot	5	4	LA
Chillón	1948-1971	800-1800 <sup>±</sup>	Ot, Ja	4	3	LA, H
Rímac	1923-1970	800-1400	Dc	4	1	LA
Lurín	1970-1972	10-1600 <sup>±</sup>	Ot, Nv	3	1	LA
Chilca	-	-	-	-	-	-
Mala	-	-	-	-	-	-
Asia/Lomas	-	-	-	-	-	-
Cañete	-	-	-	-	-	-
Topará	1976	500 <sup>±</sup>	Fb	1	1	DHUNA
Chincha	1975	1200 <sup>±</sup>	Sp	1	1	DHUNA
Pisco	1970	700-1550	Ot	2	2	LA
Ica	-	-	-	-	-	-
Río Grande	-	-	-	-	-	-
Palpa	-	-	-	-	-	-
El Ingenio/Nazca	1959-1975	500-600	Jy, Dc	2	2	LA, DHUNA, H
Río Lomas	-	-	-	-	-	-
"Lomas" Chala-Camaná	1955	50-300	-	2	1	PI, LA

\* Probably one site.

Two types of sites are typical for this species. One, along the coast in "huayco" (flash flood) situations from 50 to 700 m in soils that are sandy loam or clay in texture. The other more common location is roadsides, mountain slopes, and washes (up to 1600 m) that drain into valleys of the Pacific watersheds. The latter sites are sandy to stony with rocks normally present. Most sites are extremely or very dry -- a striking feature now being exploited in a drought-tolerance improvement program (Rick, unpublished).

The most common associate of S. pennellii is Loaza spp., particularly between 500 and 1200 m elevation; in fact, these Loaza spp. are so consistent as indicator plants that they have seldom failed to lead to useful seed collection of S. pennellii. Columnar cacti are common from 600-1000 m in the northern part of the distribution from Chicama to Chillon. An unidentified yellow-flowered legume is the characteristic companion plant. Another association to be verified is a Mirabilis-like species (Nyctaginaceae) mentioned twice in collections north of Huaura. Sympatry with L. peruvianum has been recorded several times from Huaura to Pisco, 500-1600 m. L. hirsutum has been found only at Espíritu Santa (Lurín watershed). The only instance of S. pennellii as the dominant vegetation element is Sayán-Churín (DHUNA 1001, 1013), where it was observed on a mountainside after the rainy season of 1972. L. pimpinellifolium was also present here in the lower slopes above the irrigation ditches and close to the pennellii plants.

## II. DESCRIPTION OF THE COLLECTIONS ARRANGED BY WATERSHEDS AND LOMAS

### 1. Watersheds: Tumbes, Chira, and Piura (Table 5, fig. 2)

The two northernmost watersheds on the coast of Perú (Tumbes and Chira) have their origins in Ecuador. They belong to the zone of transition to tropical conditions and the rivers have water the year around. The Tumbes watershed has not been well collected with regards to Lycopersicon spp. As shown in Table 5, only one herbarium specimen, L. peruvianum, is included Expedition for 1974 in western South America) collected accessions of the red-fruited L. pimpinellifolium from this area. Since there is a planned project for irrigation and development of the Puyango (Ecuador)-Tumbes (Perú) area during 1976-1986, there is danger of major disturbance of this natural habitat.

The Chira watershed is one of the largest of the Peruvian coast if the tropical area that corresponds to Ecuador is included. Like Tumbes, it also has a year-around water supply and is not well known floristically. The valley can be divided into 2 basic areas: a) a desert coast delta (0-300 m) with a very narrow (2-4 kms on each side) vegetation strip along the river which is dedicated to irrigated farming (Pima cotton, citrus, coconuts, rice, bananas); and b) a transition zone from dry through annual intermittent rain flora to tropical southern Ecuador conditions where cattle grazing is the most common activity. This area ranges from 300 to 2500 m.

The Piura river basin can be divided into two distinct zones: a) the desert zone, where the river flows west from Chulucanas for approximately 150 km; and b) the mountain zone starting in the Chulucanas-Morropón area at 500-1000 m and ending in Huarmaca at 2500 m.

This valley has an intermittent water supply based on varied rainfall that occurs between December and April. While the mountain zone gets yearly rains, the desert has fewer rainy years but these usually produce a very profuse annual flora that can support cattle for 2 to 3 dry years. The river dries up usually around the Chulucanas area; but at the Quebrada de San Francisco, water from the Quiroz river (Chira basin) was diverted into the Piura in 1954. In 1976 another diversion from the Chira was finished. Thus, natural and farming conditions are changing, and it is possible that the area below the continuous water source now has a mixed vegetation from the two basins. The main crops in the middle and lower sections are long-staple cotton, corn and sorghum; and in the higher watershed, rice, cotton, fruits (mango, citrus, avocado) and coffee. This is the only coastal valley where cattle can be raised on pastures based on the intermittent desert vegetation.

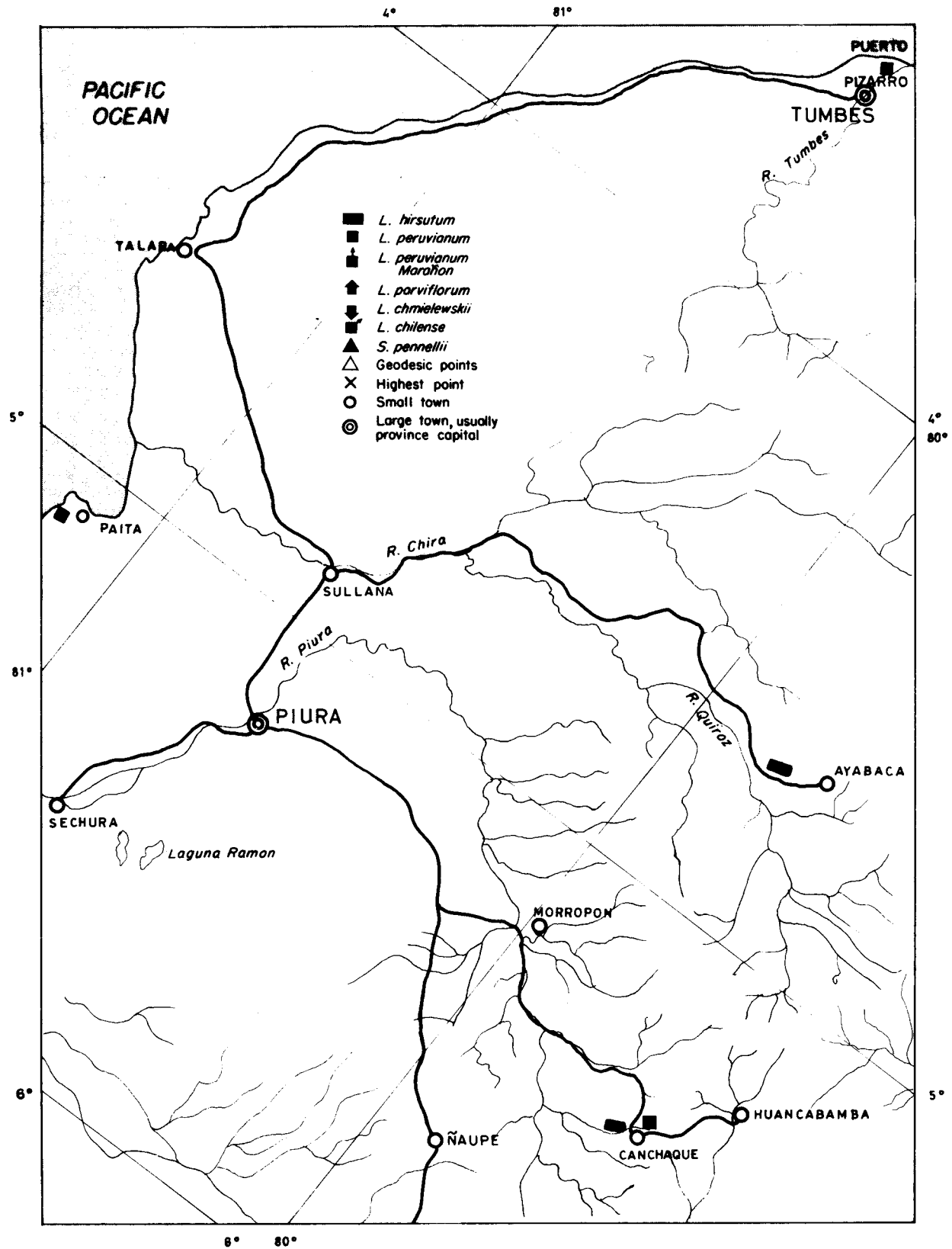


Fig. 2 Watersheds: Tumbes, Chira and Piura.

Table 5. Herbarium specimens and seed accessions of green-fruited *Lycopersicon* species collected in the Tumbes, Chira, and Piura watersheds (1948-1974).

Watershed Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
Watershed: TUMBES							
<i>L. peruvianum</i> Puerto Pizarro	0	E.Cerrate	Ot1972	+	-	-	4956 USM
Watershed: CHIRA							
<i>L. hirsutum</i> Ayabaca-Rio Quiroz**	1800	C.Ochoa	Je1952	+	-	-	1767 OCH,LM,F
Watershed: PIURA							
<i>L. peruvianum</i> El Horadar (Paita)	50 <sup>†</sup>	D.Baumann	Jl1972	?	+	sev'l	DHUNA 1080,1082
Palambra*	2000 <sup>±</sup>	J.Soukup	Ag1954	+	-	-	4288 US
<i>L. hirsutum</i> Piura	-	V.L.Guzman	-	-	-	-	LA165
Serran-Canchaque**	500-600	R.Ferreyra	My1955	+	-	-	10786 USM
La Filadera	800 <sup>±</sup>	P.G.Smith et al.	Mr1955	-	+ <sup>†</sup>	sev'l	DHUNA153
Canchaque	700	H.Winters & R.Clark	Jl1974	+	+	-	PI390658
Canchaque**	900-1000	R.Ferreyra	Mr1948	+	-	-	3154 USM,US
Palambra-Faique	1400-1500	R.Ferreyra et al.	My1955	+	-	-	No # USM

\* Determined as *L. glandulosum* Ch. Muller.\*\* var. *glabratum*.

† Viability doubtful; could probably be replaced by PI390658.

Table 6. Herbarium specimens and seed accessions of green-fruited *Lycopersicon* species collected in the Lambayeque area: Olmos, Chancay-Reque, Saña watersheds (1874-1970).

Watershed Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
Watershed: OLMOS							
<i>L. hirsutum</i> Olmos-Abra de Porculla							
" (km 16)	600	R.Ferreyra	Ap1953	+	-	-	9129 USM
" (km 20)	700-800	"	"	+	-	-	9138 USM
" (km 28)	1050	P.C.Hutchison, J.K.Wright	Mr1964	+	-	sev'l	4428 USM,UCB,US, NY,F
" (km 15-32)	600-2000	C.M.Rick	Sp1956	+	+	sev'l	LA399 USM
Watershed: CHANCAY-REQUE							
<i>L. peruvianum</i> Hda. Carrizal	1000 <sup>±</sup>	C.M.Rick	Sp1956	+	-	one	SAL148 USM,R
Chauna	1200 <sup>±</sup>	"	Dcl970	+	+	sev'l	LA1350
<i>L. hirsutum</i> Salas	500	C.Ochoa	My1952	+	-	-	1957 OCH,F*
Hda. Carrizal	1000 <sup>±</sup>	C.M.Rick	Sp1956	+	-	few	SAL147 R
Watershed: SAÑA							
Monte Nanchó (San Gregorio)	2700 <sup>±</sup>	A.Raimondi	1874	+	-	-	3186,3243 USM
Nanchó	-	"	1874	+	-	-	3077 USM

\* Not seen by authors.

### Observations on Lycopersicon spp.

a. Desert area: The only species common in this area seems to be L. pimpinellifolium found in the usual situation: irrigation ditches, cultivated lands, or in the rainy years in areas along the fences intermingled with the natural desert vegetation that springs up in the area during such years (e.g. 1972). There is a 1972 collection of L. peruvianum (DHUNA 1080) from near the coast. This is the northernmost site for this species.

b. Mountain zone: This zone is typical of any Peruvian valley of the northern region having a little more moisture than the southern part. A few populations of L. hirsutum have been reported in this area. Forma glabratum possibly reaches its southern limits here, although none of the accessions that we have grown conform well with Muller's (1940) concept. The altitude range for this species is between approximately 900 and 2500 m. Two collections, La Filadera (1966) and Clark (1974), are of doubtful determination, as glandulosum and peruvianum are the denominations used by the collectors, respectively.

Collections in the Piura valley are meager. It is included in the Chira-Tumbes-Puyango complex which has rarely been visited "taxonomically" and which should produce some valuable material since the change in climatic, altitudinal, and ecological relations into typical Ecuadorean and tropical conditions finds its transition zone here. This area is also important for understanding the position of material in the Marañon drainage. Three possible connections exist between the latter and the coast: 1) Olmos-Jaen (Abra Porculla), 2) San Juan-Cajamarca (Abra Gaviñán), and 3) Chiquian-Huanuco.

The amount of L. pimpinellifolium in the lower and middle Piura basin, Sechura desert, and Pampa de Olmos is probably the largest known, since it covers about 15,000 square kms. There are collections from each of these vast surfaces but the definite plans for disturbance by man through the Olmos, Chira-Piura, and Puyango-Tumbes irrigation projects makes the need for collecting urgent, especially since it can be done only in one of those "rare" years when the desert region gets sufficient moisture for good seed germination and development of flowers and fruits.

## 2. Watersheds in the Lambayeque area: Olmos, La Leche, Chancay, Reque and Sana (Table 6, fig. 2, 3)

The Olmos is loosely separated from the Piura watershed by the Ñaupe mountains (altitude not more than 500 m) and meets the Huancabamba-Marañon eastern drainage at the Abra de Porculla (the lowest pass in the northern Andes of Perú). This makes the watershed separation pretty much academic from the point of view of interchange of plant material. A detailed floristic study of the area is thus justified to support such an interchange.

The area from Rio La Leche to Rio Reque on the other hand does form more of a unit. It is one vegetational complex in the lower part, especially since the completion of the Tinajones irrigation project. The upper drainages are separate, the Reque going much deeper into the Andes and having a much larger size than the La Leche. Seasonal rains in the mountains during November through April define the river flow modified now through the Tinajones dam at Chongoyape and the corresponding irrigation and drainage project. The Pampas de Olmos to the north and coastal areas in the valleys have sporadic rains in every 2 out of 5-7 years.

Predominant crops are rice and chick-peas (Cicer spp.) in rotation and sugar cane. Fruits such as grapes, mango, avocado and miscellaneous species (mamey, ciruela (Spondia spp.) are found in home plantings. Some cotton (cv. del Cerro) and maize are grown throughout the region.

### Observations on Lycopersicon spp.

The populations of L. pimpinellifolium are abundant especially from Mochumi north; the other species have been collected rarely.

Worthy of mention is L. hirsutum of Abra de Porculla and Hda. Carrizal (between Chongoyape and Llama). These populations should be collected again and studied in terms of their relationship to those of the Ecuadorian and Marañon basins. The migration possibilities here are real due to the above mentioned low altitude of the Andes at this point. In addition,

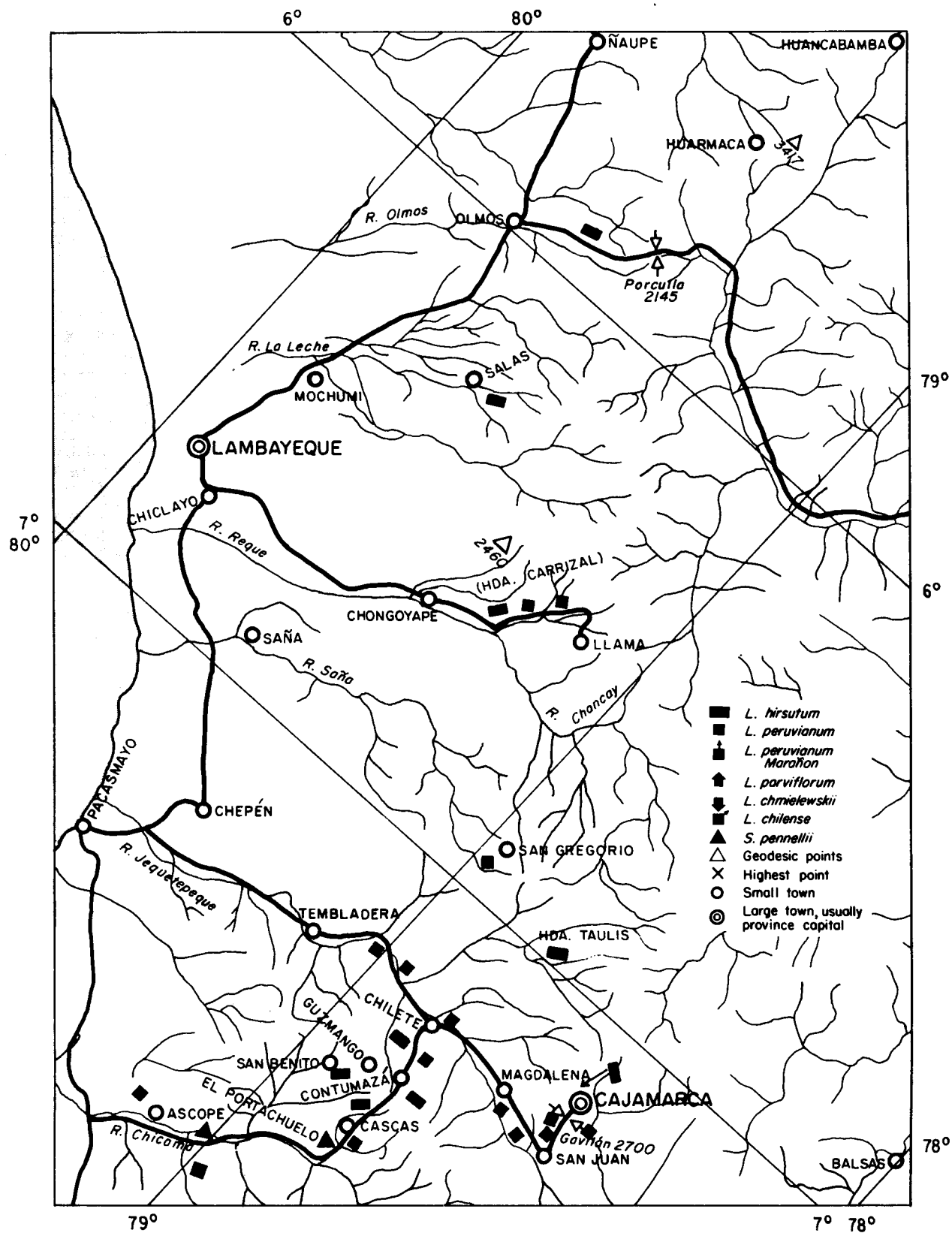


Fig. 3 Watersheds: Lambayeque area: Olmos, La Leche, Chancay, Reque, Saña; and Jequetepeque and Chicama.

Rick's field notes mention the accession Hda. Carrizal as typical northern Peru hirsutum, but the Abra de Porculla collection is described as "odor not typical and organs smaller than normal." Again this may indicate transition types and interbreeding with other populations. The presence of parrot swarms all over this area is a distribution factor that should be studied here as well as in the Ayacucho-Pampas-Apurimac complex of L. chmielewski and L. parviflorum.

The collections from Saña are noteworthy because they have been made only by Raymondi in 1874 when a route through this valley to and from Cajamarca was apparently common but is seldom used today. A recent collection would be useful since the whole region from Trujillo to Chiclayo is transitional in vegetation.

### 3. Watershed: Jequetepeque (Table 7, fig. 3)

The Jequetepeque river is intermediate in length (about like the Cañete). The amount of water is relatively small and seasonal, there being no water in the lower part during the June to November period. In the ascent of the valley the first 1800 m is gained gradually, the next 1000 in 60 kms while the rest of the climb is very rapid. The two tributaries that form the Jequetepeque start near the town of Cajamarca. At the city itself a river of the same name originates which drains into the Crisnejas, and farther on into the Marañon, thus it belongs to the eastern side of the Andes (fig. 4). The Abra here (Gavilan) is at 2800 m. This area needs to be included in the study of inter-divide migration of green-fruited species.

In the Jequetepeque, the two ecological zones characteristic of western Andean drainages are unusually well defined. It is the first watershed to display vegetation of the northern desert type (including "sapote" and algarrobo") in its coastal section. The lower delta has a fair amount of highly developed rice cultivation, but little area for L. pimpinellifolium to develop. This species extends along the river up to 1500 m (Magdalena). The quebrada of the upper zone is long, narrow, and dry, with characteristic xerophytic vegetation (cactus species) and at its upper reaches changes to a very steep ascent to the pass (Abra Gavilan), which opens into the Cajamarca Valley.

Up to Tembladera (500 m) rice is almost the only crop, then the typical "quebrada" mixture of corn, fruits (avocado, banana, mango, grapes, apple), beans, locotau, peas, etc. in small plots (1-5 ha) is found.

#### Observations on Lycopersicon spp.

a. L. peruvianum is found here in two forms, var. typicum and var. humifusum. The particular relationship of humifusum with other L. peruvianum populations has been described by Rick (1963). It appears that var. humifusum is the mountain race of the Jequetepeque watershed.

b. L. hirsutum has been found where the needed humid conditions prevail (Rupe, LA 1352); only the typicum form appears here.

### 4. Watershed: Chicama (Table 8, fig. 3, 4)

The river Chicama is intermediate in size with two areas to be distinguished: 1) the large delta almost exclusively planted to sugar cane; and 2) an upper mountainous section with the peculiar ecology of endemic flora composed mainly of humid-loving plants such as Lycopersicon hirsutum, a yellow-flowered Solanum, Fuchsia spp., and Irodea spp. L. peruvianum is not very common while L. hirsutum is a dominant feature of the Contumaza-Cascas area and was collected here in 1875 by Raimondi. Solanum pennellii occurs here in its northernmost limit. Unfortunately, the seed collected has not provided material for study of the relation of these populations to others of the species.



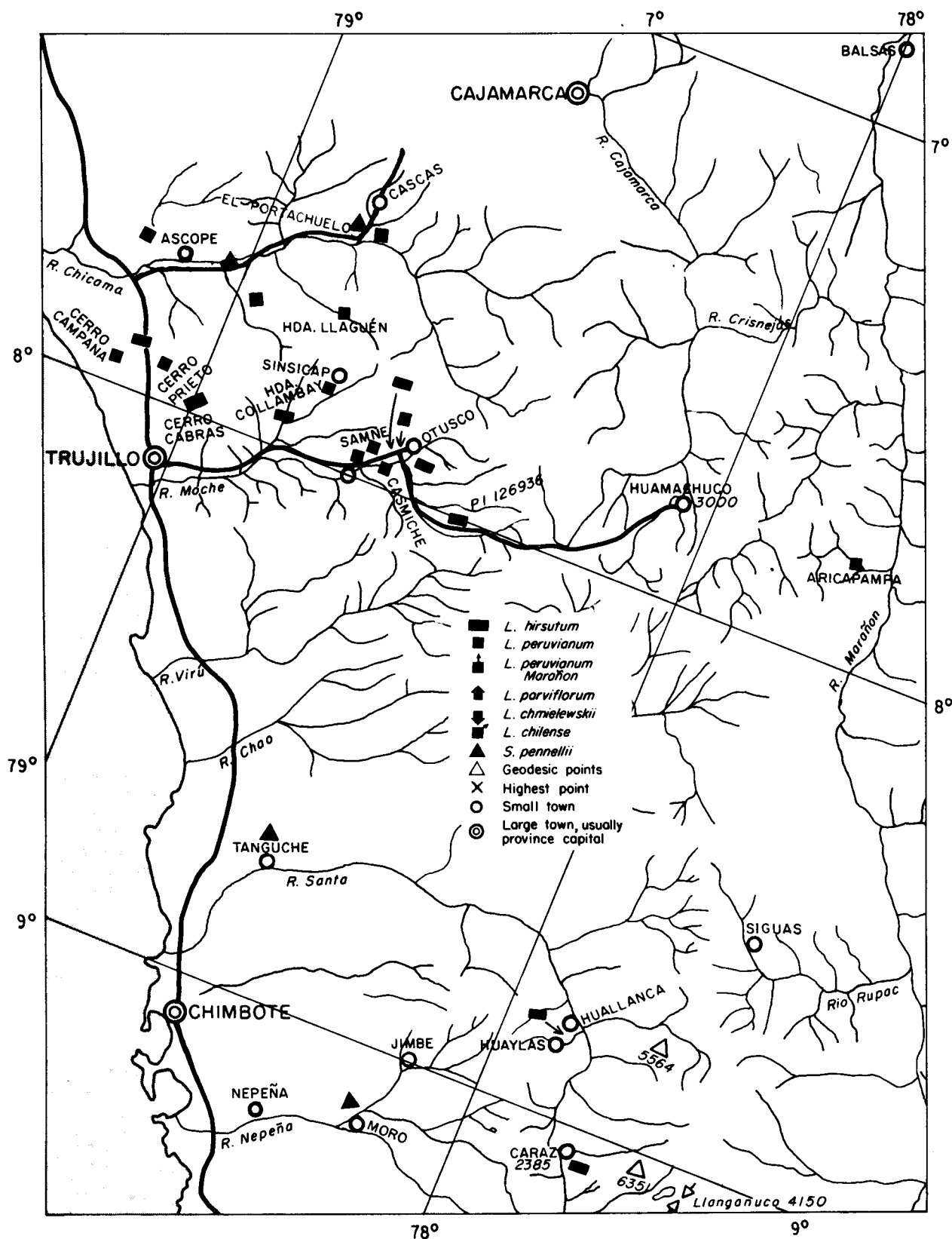


Fig. 4 Loma area between Río Chicama and Río Moche. Watersheds: Chicama, Moche, Santa and Nepeña.

Table 7. Herbarium specimens and seed accessions of green-fruited Lycopersicon species collected in the Jequetepeque watershed (1937-1971).

Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
<u>L. peruvianum</u>							
Vista Alegre							
(45-64 km)**	800	C.M.Rick	Ag1956	+	+	1	LA382
Vista Alegre-Chilete							
(64 km)*	800	"	"	+	+	1	LA382,PI251314
Llallán (78 km)	1000	"	Sp1956	+	+	2	LA392
Chilete (80 km)	1000	D.Baumann	Sp1971	-	+	-	DHUNA981
" (95 km)	884	D.V.Ugent	Jel1970	+	-	few	5523 US,F
" (105 km)*	-	R.Ferreyra	Ap1948	+	-	-	3336 USM
Rope	2000	C.M.Rick	Dcl1970	+	+	many	La1351
Magdalena*	1200±	"	Sp1956	+	+	2	LA390
"	1500±	D.S.Correll	Jel1960	-	+	-	PI266376
"	1600±	D.Baumann	Sp1971	-	+	-	DHUNA982
Magdalena-San Juan*	1800±	Blood & Tremmelling	Dcl1937	+	+	few	PI 127829,LA16; 40370 USNA†
" "	1840±	D.Ugent	Jel1963	+	-	-	5388 US
San Juan (140 km)*	2800	Blood & Trem.	Dcl1937	+	+	few	PI 127828
" *	2000	C.Ochoa	Myl1952	+	-	-	LA252;1497 OCH
" *	2200±	C.M.Rick	Ag1956	+	+	many	LA385
Abra Gavilán*	2500±	"	Sp1956	+	+	2	LA389
Chiquidan*	2800	C.Ochoa	Myl1952	+	-	-	1476 OCH,F
<u>L. hirsutum</u>							
Rope	2100	C.M.Rick	Dcl1970	+	+	sev'l	LA1352
Abra Gavilán	2700±	"	Sp1956	+	+	sev'l	LA388 USM
Hda. Taulis	-	P.C.Hutchison, K.von Bismark	Ag1964	+	+	few	PI308182,LA1033 US,F,UCB

\* var. humifusum; type collection of variety.

\*\* Kilometers east of junction with PanAmerican Highway North.

† Type collection of var. humifusum.Table 8. Herbarium specimens and seed accessions of green-fruited Lycopersicon species and Solanum pennellii collected in the Chicama watershed (1868-1972).

Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
<u>L. peruvianum</u>							
Cascas	1200	C.M.Rick	Ag1956	+	+	many	LA378,PI251307
Hda. Llagén	1500	N.Angulo	Dcl1953	+	-	-	2053 HUT
San Polo	2000±	A.Müller	Fb1972	+	-	-	1426 SMF
et al.							
<u>L. hirsutum</u>							
Cascas	1200	C.M.Rick	Ag1956	+	+	many	LA377
Contumazá-Cascas	-	A.Raimondi	Myl1875	+	-	few	1489,7951 A+B, 8250,12662 USM
" "	-	C.M.Rick	Dcl1970	+	+	many	LA1354
Contumazá	2650	C.M.Rick	Dcl1970	+	+	many	LA1353
Guzmango	2680	A.Sagástegui	Jel1962	+	-	-	3903 HUT
Palmaval y Buenavista	-	A.Raimondi	1868	+	-	-	2101 USM
<u>Solanum pennellii</u>							
El Portachuelo	600	A.López	Ot1957	-	-	sev'l	1270
Ascope-San Benito*	600-900	A.López	Ot1957	-	-	-	
Puente Polluco	2000±	A.Müller	Fb1972	+	-	-	1522 SMF
et al.							

\* Determination doubtful.

## 5. Lomas of the Chicama-Moche area

(Table 9, fig. 4)

These "loma" formations located in mountains close to the coast between the Chicama and Moche watersheds have vegetation between 200 and 400 m during the foggy season (June-October) when the fog lasts long enough in any one year.

Observations on the Lycopersicon spp.

The Cerro Campana population of L. peruvianum has been extensively studied. It is an annual with long straggling growth and is classified as a single inflorescence type intermediate between var. humifusum of Jequetepeque and the rest of the southern populations (Rick 1963). The L. hirsutum populations found here are at the lowest altitude we know of. No crossing studies have been made since only herbarium specimens are available at this time.

## 6. Watershed: Moche

(Table 10, fig. 4)

This watershed is of intermediate size having a fairly small delta. The agricultural land is being encroached upon by the city of Trujillo. The water supply is restricted since the river does not carry water year around but from Dec.-Jan. to July-September.

Observations on Lycopersicon spp.

L. peruvianum is fairly common above 1500 m. It seems to behave as a particular mountain race (LA124) as evidenced by its crossability with var. humifusum from the nearby Jequetepeque watershed (Rick 1963). It should be noted that on the lower delta (non loma) there have been no collections even though this area has probably been often visited by botanists. Cultivation of the area for some time may be the cause for this disappearance since ecologically the conditions seem favorable. In the lower part of the next three watersheds -- Virú, Chao and Santa -- L. peruvianum has not yet been found.

L. hirsutum is quite abundant in the 1800 to 2500 m altitude range, which is its normal zone of dispersal.

## 7. Watershed: Santa

(Table 11, fig. 4)

This is one of the few rivers having a year around water supply. The area west of the mountain range is relatively small in comparison with the south-to-north intermountain run between the "Cordillera Blanca" and "Negra" -- the zone called the "Callejón de Huaylas." The western area is cut off from the upper Santa by the narrow "Cañon del Pato", a feature which prevents the movement of propagative material by sheep or birds, for example, from one side to the other. The current transformation of a railroad track into a road will make access to the area much easier.

The lower part of the valley has been observed more or less carefully, while the intermediate area has not been well collected. The upper Santa in the Callejón appears to belong to a high interandean ecology which is exemplified by the few L. hirsutum specimens found there, however, these populations have not been studied genetically. The significance of this gap of 200 kms along the coast from the Moche to the Casma needs careful study.

One specimen of L. peruvianum has been reported close to Mancos (Smith and Blas, No. 4889) and one at Colcabamba (J. Lopez G., No. 1796).

Solanum pennellii appears in the Santa (Tanguché) and in the Nepeña (Moro) watersheds as very rare plants in typical locations for the species -- extremely dry "huayco" sites. Seed is available from both collections.

## 8. Watershed: Nepeña

(Table 11, fig. 4, 5)

The Nepeña is a very short river whose upper part is "quebrada"-like and the lower part, a fairly flat land that supports principally a large sugar cane operation. Only S. pennellii of the

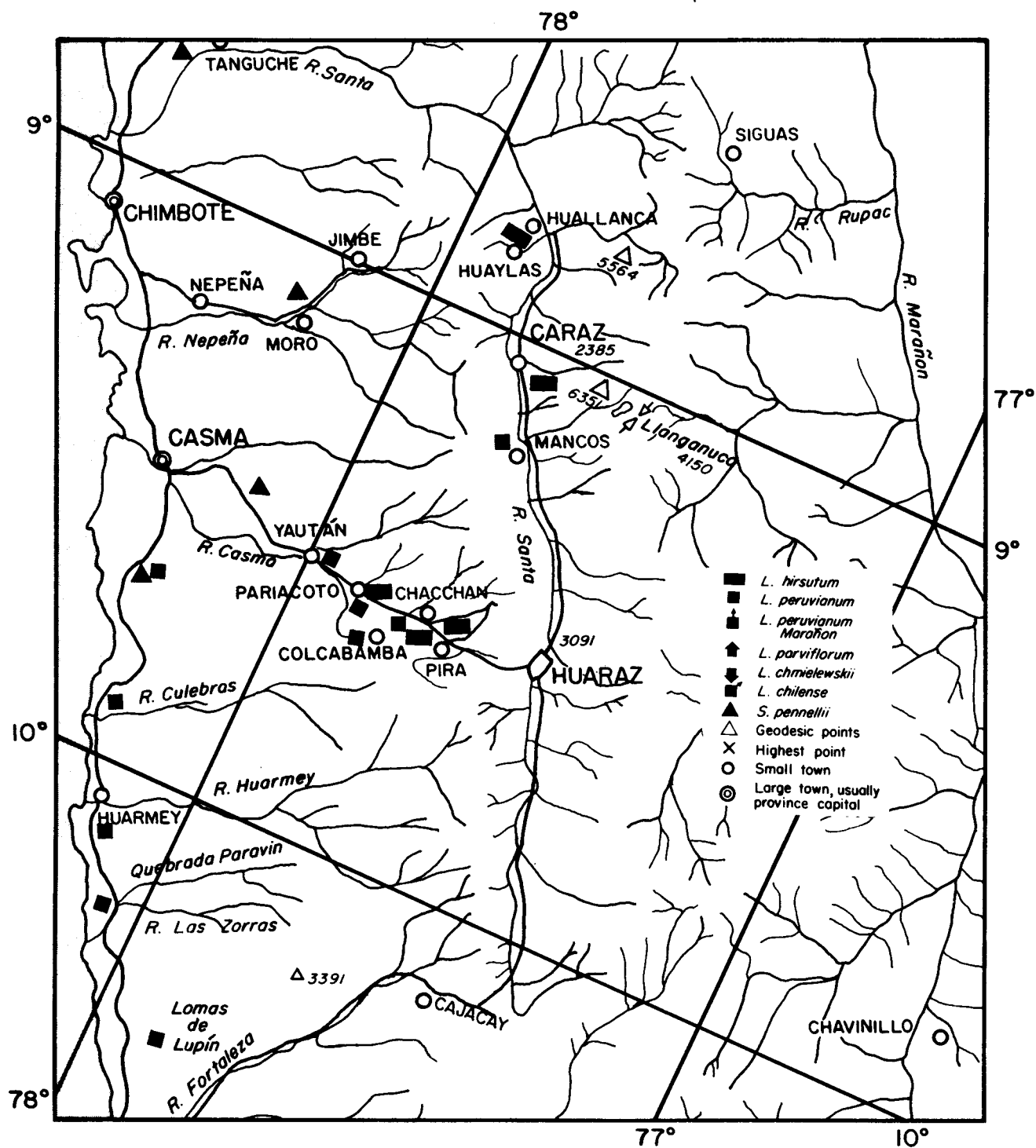


Fig. 5 Watersheds: Santa, Nepeña, Casma, Culebras, Huarmey and Las Zorras.

Table 9. Herbarium specimens and seed accessions of green-fruited Lycopersicon species collected in the "lomas" between the Chicama and Moche watersheds (1948-1957).

Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
<u>L. peruvianum</u>							
Cerro Prieto	250	N.Angulo	Ag1949	+	-	-	1018 HUT
Cerro Chuputur	450	N.Angulo & A.Lopez	Ag1949	+	-	-	1179 HUT
Cerro Campana	675	A.Lopez	Sp1948	+	-	-	1260 HUT
"	460	N.Angulo	Je1950	+	-	-	SAL239 ; 1236 HUT
"	450	C.Ochoa	Sp1952	+	-	-	1820 OCH, LM
"	400-500	R.Ferreyra	Ag1952	+	-	-	8610 USM
"	200-700	C.M.Rick	Dc1956	+	+	sev'l	LA441, PI251312
"	750	P.C.Hutchison	Sp1957	+	-	-	1356 UCB
<u>L. hirsutum</u>							
Cerro Campana	530	N.Angulo	Ag1949	+	-	-	707 HUT
"	720	N.Angulo	Je1950	+	-	-	1232 HUT
"	720	N.Angulo	Ot1953	+	-	-	2027 HUT
Cerro Cabras	450	A.Lopez	Ag1950	+	-	-	495 HUT, SMF

Table 10. Herbarium specimens and seed accessions of green-fruited Lycopersicon species collected in the Moche watershed (L937-1970).

Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
<u>L. peruvianum</u>							
Samne	2000	Blood & Tremmelling	Dc1937	+	+	-	PI 126935
"	1740	C.Ochoa	My1952	+	-	-	1425 OCH
Above Samne	1500-1600	R.Ferreyra	My1960	+	-	-	14088 USM
Casmiche	1800-2000	C.M.Rick	Dc1970	+	+	many	LA1346
"	"	O.Velarde	Nv1950	+	-	-	No # SMF (15952)
Sinsicap-Yerba Buena	1700	C.N.Ridoutt	Dc1952	+	-	-	1886 HUT
Plaza Pampa	1800	H.deCevalasco	Jl1953	+	-	-	No # USM
Otuzco	1800-2900	C.M.Rick	Fb1948	+	+	sev'l	LA124
<u>L. hirsutum</u>							
Hda. Collambay	1815	C.N.Ridoutt & M.Vargas	Ag1953	+	-	-	2247 HUT
Samne	2200	C.M.Rick	Fb1949	+	+	many	LA123
Samne-Otuzco	1625	A.Lopez	Dc1948	+	-	-	374 HUT
"	1800±	N.Angulo	Fb1949	+	-	-	472 HUT
"	2300	C.M.Rick	Nv1949	+	-	-	473 HUT
San Chicón	2500	J.Hawkes	Mr1964	+	-	sev'l	H2402
Rio Moche	2675	N.Angulo	Je1950	+	-	-	938 HUT
Otuzco (Empalme)	2100-2300	C.M.Rick	Dc1970	+	+	sev'l	LA1347
Otuzco-Huamachuco	2800	Blood & Tremmelling	Dc1937	+	+	-	PI 126936

Table 11. Herbarium specimens and seed accessions of green-fruited Lycopersicon species and Solanum pennellii collected in the Santa and Nepeña watersheds (1962-1972).

Watershed Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
Watershed: SANTA							
<u>L. peruvianum</u> Mancos*	-	C.E.Smith & J. Blas	Apr1970	+	-	-	4889 F,USM
<u>L. hirsutum</u> Huaylas-Callejón	200-2100	R.Ferreyra	Jel1962	+	-	-	14593 USM
Caraz	2280	J.González, et al.	Dcl1969	+	-	one	DHUNA789
<u>Solanum pennellii</u>							
Desvío a Tanguche	800-1000	E.Puente	Otl1972	-	+	one	DHUNA1007, LA1524
Watershed: NEPEÑA							
<u>Solanum pennellii</u> Moro	600	C.M.Rick	Dcl1970	+	+	one	LA1356

Table 12. Herbarium specimens and seed accessions of green-fruited Lycopersicon species and Solanum pennellii collected in the Casma watershed (1922-1975).

Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
<u>L. peruvianum</u>							
PanAm. North (km 249)+200		E.Cerrate	Jll1972	+	-	-	5179 USM
Yaután	750	C.M.Rick	Dcl1970	+	+	many	LA1358
Pariacoto	1200	D.S.Correll	Jel1960	+	+	-	PI266377
"	1490	C.M.Rick	Dcl1970	+	+	many	LA1360
Huaraz-Casma	1500-2000	G.Buschbeck & M.Holle	Ag1963	-	+	sev'l	DHUNA101
Chacchan	2100	M.Holle, et al.	Sp1975	-	+	sev'l	DHUNA1332
Colcabamba	2800	J.Lopez	Mr1970	+	-	-	1976 SMF
<u>L. hirsutum</u>							
Huaraz-Casma Road*	1500,2080, 3000,3120	M.Holle, et al.	Dcl1969	-	+	many	DHUNA788a)b)c)d)
Pariacoto	1490	C.M.Rick	Dcl1970	+	+	many	LA1361
Chacchan	2100-2300	C.M.Rick	Dcl1970	+	+	many	LA1362, DHUNA1341
"	2400	J.MacBride & Featherstone	Otl1922	+	-	sev'l	2553 F
Puente Pira-Toclla	3080-3150	E.Proaño	Fb1949	+	-	-	No # USM**
Punta Cayllán (close to...)	3600-3700	R.Ferreyra	My1961	+	-	-	14399 USM**
<u>Solanum pennellii</u>							
PanAm. North (km 249)	200†	E.Cerrate	Jel1972	+	-	-	5161 USM
Casma-Yaután	600†	M.Holle	Otl1975	-	+	one	DHUNA1335

\* Collection of seed was made at each altitude. Many plants at each altitude.

\*\* Seed available from an expedition by E. Vallejos (1976), University of California, Department of Vegetable Crops, Davis, California 95616.

typical coastal form has been found under a very dry situation along the road from Moro to Jimbe.

9. Watershed: Casma  
(Table 12, fig. 5)

The entrance to the riverbed above the delta area around the city of Casma is made by crossing a large dry creek on the northern side of the Río Grande-Casma and then dropping into Yaután (approximately 800 m). The vegetation and farming from here to Chacchan (2700 m) is typical of the "quebrada" situations in the western side of the Andes. The main crops are corn, cassava, bananas, papaya, and avocado. In most years there is a regular flow of water from December to June, but the lower part around Casma is dry during the rest of the months.

Observations on Lycopersicon spp.

L. pimpinellifolium is common as a weed in cultivated fields and along stone fences from Yaután to Pariacoto (1300 m). L. peruvianum with very small and finely divided leaflets is found from 800 m (Yaután) to 3000 m (above Chacchan) while L. hirsutum var. typicum is the predominant species especially from Pariacoto to 3300 m (desvío to Pira). In several cases the two species are intermingled and thus sympatric through their common distribution. No evidence of intermediate forms has been detected. Solanum pennellii has also been collected in typical dry wash situations between Casma and Yaután.

10. Watersheds: Culebras, Huarmey and Las Zorras  
(Table 13, fig. 5)

All three of these rivers are short and sporadic especially "Las Zorras" which could be better considered a "huayco." Only L. peruvianum has been collected and with the exception of Yaucapampa (Ochoa and Luna, No. 2968) all the accessions and specimens came from sites very close to the PanAmerican Highway. The Culebras populations have been extensively studied and used and serve as a standard of the typical coastal L. peruvianum (Rick 1963).

It may be useful to undertake a thorough search for accessions in this area to ascertain if we have another "gap" such as the one between Moche and Casma, or if it is just a matter of not having been collected thoroughly up to the time of this catalog.

11. Watershed: Fortaleza  
(Table 14, fig. 6)

The Fortaleza river is intermediate in size with a fair amount of water throughout the year. The lower part is in sugar cane while the middle is typically dry and narrow, and the upper part has the common sierra combination of corn, cereals and potatoes.

Observations on Lycopersicon spp.

L. peruvianum and L. hirsutum var. typicum are found pretty much sympatric throughout their distribution range in this watershed. No L. peruvianum has been collected below 2000 m. This may be an oversight or an influence of modern agriculture (herbicide schedules) followed by sugar cane production which has eradicated these species in the lower drainage.

The L. peruvianum from this drainage can be considered a separate mountain race as shown by its distinct features (fig. 1) and by its crossing relations (LA 110, LA 1364, LA 1365, Rick 1963).

12. Watershed: Pativilca  
(Table 14, fig. 6)

Although this is one of the largest coastal watersheds in size and inland depth, the collections of Lycopersicon are scarce. The main reason seems to be its lack of accessible roads and the confusion caused by the fact that the lower drainages of the Fortaleza and the Pativilca are in fact one with no restrictions on migration and movement between them. This area deserves a thorough collecting expedition since there are indications of the distribution of

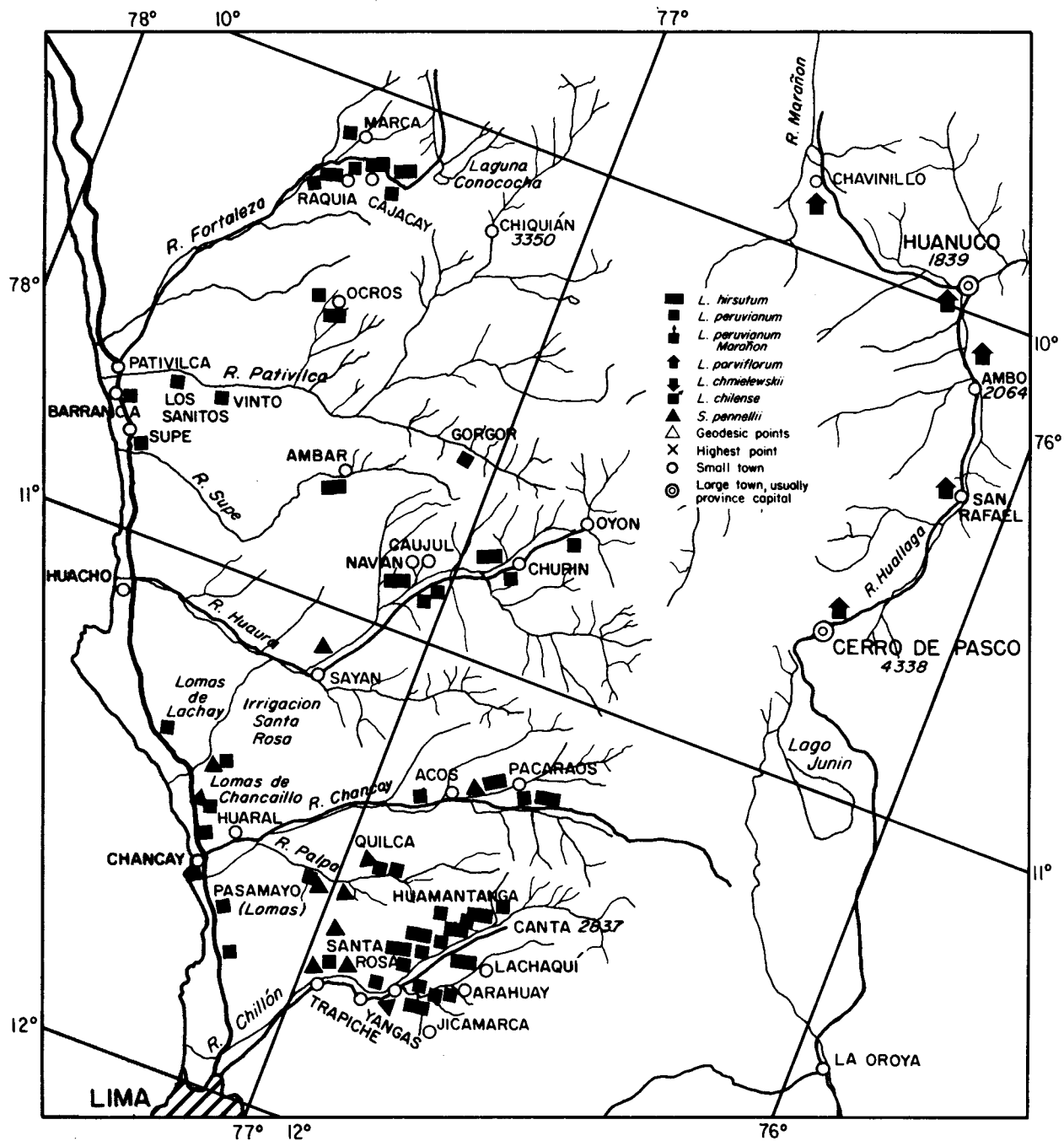


Fig. 6 Watersheds: Fortalezas, Pativilca, Supe-Huaura, Huaral-Chancay, Chillón, and parts of Huallaga and Marañón. Lomas between Río Huaura and Río Huaral, and Río Chancay and Río Chillón.



Table 13. Herbarium specimens and seed accessions of Lycopersicon peruvianum collected in the Culebras and Huarney watersheds (1937-1965).

Watershed Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
Watershed: CULEBRAS							
Culebras	70-100	Blood & Tremmelling	Dcl937	+	+	sev'l	PI126944-126946
Culebras #1	300±	C.M.Rick	Ag1956	+	+	sev'l	LA372
Culebras #2	300	C.M.Rick	Ag1956	+	+	many	LA374, PI251306
Watershed: HUARMEY							
PanAm.North (km 224)	50	M.Holle	Dcl965	-	*	1	DHUNA110
Lomas de Lupín	350-400	R.Ferreyra	Dcl958	+	-	-	13536 USM
"	400-500	R.Ferreyra	Jl1959	+	-	-	13794 USM
Watershed: QUEBRADA PARAVIN							
Las Zorras	100	H.E.Stork, et al.	Sp1938	+	-	-	9194 USNA,UCB
Yaucapampa**	2000	C.Ochoa & D. Luna	Ap1971	+	-	-	2968 OCH

\* Seed collection dead.

\*\* Not included in Fig. 5.

Table 14. Herbarium specimens and seed accessions of green-fruited Lycopersicon species collected in the Fortaleza and Pativilca watersheds (1949-1976).

Watershed: Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
Watershed FORTALEZA							
<u>L. peruvianum</u>							
Fortaleza Valley	2100-2300	R.Ferreyra	Jel966	+	-	few	16885 USM
"	-	H.Winters & R.Clark	Jl1974	+	+	one	PI390664
Cajacay	2300	C.M.Rick	Jal949	+	+	sev'l	LA110
Marca (Marahuay)	2400	J.Gomez	Ag1964	+	-	few	134 USM
Caranquillo	2450	C.M.Rick	Dcl970	+	+	many	LA1365
Raquia	2500	C.Ochoa	My1952	+	-	-	1414 OCH
Alta Fortaleza	2920	C.M.Rick	Dcl970	+	+	many	LA1364
<u>L. hirsutum</u>							
Pativilca-Huaraz Rd.	2220	M.Holle, et al.	Dcl969	-	+	sev'l	DHUNA790
Cajacay	2500	C.M.Rick	Jal949	+	+	few	LA112
"	2300	C.M.Rick	Dcl970	+	+	few	LA1366
Raquia	2500	C.Ochoa	My1952	+	-	-	1415 OCH
Alta Fortaleza	3080	C.M.Rick	Dcl970	+	+	few	LA1363
Watershed: PATIVILCA							
<u>L. peruvianum</u>							
Fundo Los Sanitos	200	M.Holle	Jl1971	-	+	sev'l	DHUNA968
Vinto	400	M.Holle & D.Nakama	Ap1976	+	-	sev'l	DHUNA
Quebrada de Ocros	2400	C.Ochoa	My1952	+	-	-	1412 OCH
Gorgor	3000	A.Urbizagás-tegui	Jl1975	-	+	one	DHUNA1340
<u>L. hirsutum</u>							
Quebrada de Ocros	2400	C.Ochoa	My1952	+	-	-	1410 OCH

\* Seed no longer available.

Lycopersicon spp. as illustrated by Ocos (Ochoa, No. 1410 and 1412) and Gorgor (Urbizagastegui, DHUNA 1340); besides, the peculiarities shown by the Fortaleza collections of L. peruvianum warrant a study of its relations with nearby material.

13. Watershed: Supe-Huaura  
(Table 15, fig. 6)

Observations on Lycopersicon spp.

Although Lycopersicon peruvianum is found in the lower Supe, it is notable that the lower Huaura (up to 1200 m) lacks this species. This may be an example of the observation that Lycopersicon species as weeds are poor competitors and soon disappear as modern agricultural techniques enter a valley. In this case though it happens that L. pimpinellifolium has still been collected recently in the lower, intensively developed agricultural area. The upper L. peruvianum samples are fairly recent, but they seem to belong to the typical coastal form that prevails from here to the Rímac.

Several sites of small populations of L. hirsutum var. typicum have been detected, but only one seed collection is available (Navan, LA 1378). The relation of this population to other watersheds is yet to be determined. The rather sparse distribution of plants of this species is typical in all the area south to Pisco, its southernmost limit. One has to go into the nearby "quebradas" with more moist conditions to find individual specimens which usually are of great size.

The collections of Solanum pennellii near Sayan (DHUNA 1001, LA 1376) were on a mountain side where this was nearly the dominant species in 1972, an especially rainy year at this altitude. This dominance is highly unusual since S. pennellii is very sparsely distributed in normal situations. The site's other peculiarity was the presence of L. pimpinellifolium as a sympatric plant. This situation is unique in the experience of the authors.

14. General Description of the Watersheds from Huaura to Rímac  
(fig. 6)

A general description for the Huaura, Huaral-Chancay, Chillón and Rímac watersheds is given since the agricultural and ecological characteristics are similar. In all cases the delta and middle drainages are fairly large, while above 1200 m the valleys narrow conspicuously to canyons, and above 2200 m a typical "sierra" situation begins. Rainfall patterns can be divided into three types: 1) foggy mist producing "loma" growth from 200 to 800 m; 2) dry sunny desert from 1100-1800; and 3) temperate conditions with moderate rainfall and vegetative cover subject to more overcast.

The main crops are cotton (Tanguis variety), coastal corn hybrids, vegetable crops, winter potatoes (April through October), oranges and mandarins in the lower area; temperate fruit trees in the middle valley; and small grains, corn varieties, and potatoes from October through April.

15. Lomas Between the Huaura and Huaral Watersheds  
(Table 16, fig. 6)

The "lomas" of this area are some of the most conspicuous and common of the central coast of Perú. During some years they develop an annual vegetation that can carry up to 10,000 head of livestock (cattle, goats, and horses). L. peruvianum is usually found in the rocky crevices on the sides of the hills, while Solanum pennellii appears only in the dry washes in the years when summer rains are frequent (e.g. 1972).

16. Watershed: Huaral-Chancay; and Lomas between Chancay and Chillón Watersheds  
(Table 17, fig. 6)

In this watershed the drainage is divided into two forks. The southern one is a large "quebrada" in that has water during three to four months each year and some permanent agriculture in the form of peach and apple orchards above 500 m. No L. hirsutum apparently appears here because it is very dry up to the altitude where it joins with the northern fork.

Table 15. Herbarium specimens and seed accessions of green-fruited Lycopersicon species and Solanum pennellii in the Supe and Huaura watersheds (1939-1972).

Watershed Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
Watershed: SUPE							
<u>L. peruvianum</u>							
Río Supe	100	C.M.Rick	Dcl948	-	+	-	LA102
"	100	C.M.Rick	Jal949	+	+	sev'l	LA111
Supe	100	C.M.Rick	Ag1956	+	+	few	LA371
<u>L. hirsutum</u>							
Ambar	2010	M.E.Stork	Ap1939	+	-	few	11463 USNA,UCB
Watershed: HUAURA							
<u>L. peruvianum</u>							
Navan	±1200	C.M.Rick	Dcl970	+	+	sev'l	LA1377
Caujul	±1500	C.M.Rick	Dcl970	+	+	sev'l	LA1379
"	"	M.Holle	Sp1972	-	+	sev'l	DHUNA1012
Río Churín	±1800	M.Holle	Sp1972	-	+	1	DHUNA1010
"	±2000	M.Holle	Sp1972	-	+	1	DHUNA1014
Ayarpongo	2400	M.Holle	Sp1972	-	+	sev'l	DHUNA1011
Churín-Oyón	2400	C.M.Rick	Fbl957	+	+	sev'l	LA479
"	2300-2400	R.Ferreyra	Mr1948	+	-	-	3537 USM
"	"	"	My1948	+	-	-	3547 USM,US
<u>L. hirsutum</u>							
Navan	±1200	C.M.Rick	Dcl970	+	+	1	LA1378
Churín	2100-2200	R.Ferreyra	Ag1950	+	-	-	8016 USM
"	2400	C.M.Rick	Fbl957	+	-	1	SAL236
<u>Solanum pennellii</u>							
Sayán	±1000	C.M.Rick	Dcl970	+	+	many	LA1376
Sayán-Churín	±1000	M.Holle & H. Young	Sp, Nv1972	-	+	many	DHUNA1001,1013

Table 16. Herbarium specimens and seed accessions of Lycopersicon peruvianum and Solanum pennellii in the "lomas" area between the Huaura and Huaral watersheds (1944-1972).

Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
<u>L. peruvianum</u>							
Desvío Santa Rosa	±300	H.Young & M.Holle	Nv1972	-	+	few	DHUNA1002,1004, LA1518
Domas de Doña María	±200	C.M.Rick	Dcl948	+	-	sev'l	SAL26
"	±200	D.S.Correll	Jel1960	+	+	-	PI266375
Lomas de Lachay	300	C.A.Ridoutt	Jel1944	+	-	few	14508,14497 USM
"	300	R.Ferreyra	Jl1948	+	-	few	3844 USM,US
"	300-440	E.Cerrate	Ot1951	+	-	-	855 USM
Lomas de Chancayllo	250-300	R.Ferreyra	Nv1965	+	-	-	16604 USM
<u>Solanum pennellii</u>							
Lomas de Chancayllo	150-250	R.Ferreyra	Mr1961	+	-	-	14235 USM
Desvío Santa Rosa	±300	M.Holle & H.Young	Ot, Nv1972	-	+	few	DHUNA1003,1009

Table 17. Herbarium specimens and seed accessions of green-fruited Lycopersicon species and Solanum pennellii in the northern fork (Huaral River Basin) and southern fork ("quebrada") of the Huaral-Chancay watershed (1970-1974).

Watershed Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
NORTHERN FORK (Huaral River Basin)							
<u>L. peruvianum</u>							
San Juan	2800-2900	R. Ferreyra	My1974	+	-	-	18348 USM
Huaral-Cerro de Pasco (km 85)	2500-3000	D. Baumann	Sp1973	-	+	few	DHUNA1146, LA1554
<u>L. hirsutum</u>							
Pacaraos (Road to...) 2300		J. Soukup & J. López G.	Mr1970	+	-	-	No # SFM(11071)
Huaral-Cerro de Pasco (km 84)	2500-3000	D. Baumann	Sp1973	-	+	few	DHUNA1148, LA1557
<u>Solanum pennellii</u>							
Tingo-Pacaraos	2300	J. López G.	Mr1970	+	-	-	No # SFM(11044)
SOUTHERN FORK ("Quebrada")							
<u>L. peruvianum</u>							
Pisquillo	500-600	C.M. Rick	Ot1970	+	+	many	LA1270
Horcón	600-700	C.M. Rick	Ot1970	+	+	sev'l	LA1271
Cayán	800	M. Holle	Ag1971	-	+	sev'l	DHUNA970
Pacaibamba	1440	C.M. Rick	Ot1970	+	+	sev'l	LA1274
<u>Solanum pennellii</u>							
Quilca Road Junction	700	C.M. Rick	Ot1970	+	+	sev'l	LA1275
Quilca-Trapiche summit*	1380	C.M. Rick	Ot1970	+	+	sev'l	LA1276
Pisaquera	1000	C.M. Rick	Ot1970	+	+	sev'l	LA1272
Cayán	1000±	C.M. Rick	Ot1970	+	+	sev'l	LA1273
"LOMAS" between the HUARAL and CHANCAY and CHILLÓN watersheds							
<u>L. peruvianum</u>							
Chancay**	100	Blood & Tremmelling 88	Dc1937	-	-	sev'l	PI 126930, LA223
"	100	C.M. Rick	Nv1948	-	-	sev'l	SAL20
Pasamayo (Ocean Bluffs)	0-200	Blood & Trem. 77	Dc1937	+	-	-	40444 USNA
" **	30	Blood & Trem. 83	Dc1937	+	+	few	PI 126926
" **	30	Blood & Trem. 85	Dc1937	+	+	few	PI 126928
" **	30	Blood & Trem. 86	Dc1937	+	+	many	PI 126929
Ancón-Chancay (km 45)†	100	C.M. Rick	Ja1949	+	-	few	SAL36

\* Border of medium to lower Huaral-Chancay watershed at Quilca and Chillón watershed at Trapiche.

\*\* Said to have been collected in field, so it probably belongs to Chancay-Huaral river lower delta and not to "loma" formation.

All the seed accessions from this watershed are very recent and have not been studied in depth, but there is no reason to believe they belong to a different group from the species typical of the region.

The "lomas" area between the lower Río Chillón and the Río Chancay is quite large. Blood and Tremmelling collected in 1937 along the road here but the descriptions of the collecting sites do not clarify whether the locations are strictly "loma" conditions or belong to the lower delta area to the city of Chancay where the land holding goes under the name "Pasamayo." This name, Pasamayo, applies also to the "lomas" of the area.

17. Watershed: Chillón  
(Tables 18-20, fig. 6)

Observations on Lycopersicon spp.

This watershed has been extensively collected because of its easy accessibility from Lima. Seed from it is available and has been studied more than from the Rímac. The L. peruvianum is of the glandulosum form and common above 1000 m where the valley closes and a dry climate is general. No collections are recorded below Trapiche for reasons not clear to the authors. Typical rocky and stony places are common sites for single plants or populations of 50 or more. August through December is the best period to collect seed.

S. pennellii has recently been collected. Similar to the next northern group (Quilca), it has been found sympatric with L. peruvianum in all 4 localities reported (Trapiche, Pucará, Sta. Rosa de Quives, and km 70 Lima-Canta).

L. hirsutum has been studied by Martin (1963) and self-fertile and sterile forms are available of var. typicum. Seed collections of this species seem more common during the September through December dry season that follows the strong growth promoted by the summer rains.

Table 18. Herbarium specimens and seed accessions of Lycopersicon peruvianum in the Rio Chilloñ watershed (1937-1975).

Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
Trapiche (Quebrada)	800	C.M.Rick	Ot1970	+	+	sev'l	LA1278
"	750	J.Hawkes	Jal971	+	+	"	H 4102
Santa Rosa de Quives	200-1000	O.Velarde	My1948	+	-	-	871 US
"	1200	C.M.Rick	Ot1970	+	+	sev'l	LA1300
Below Yaso	1450	J.Hawkes	Ap1964	+	+	-	H 2459
Yaso	±1500	M.Holle	Jl1975	-	+	sev'l	DHUNA1321
Río Chilloñ Road	1580	C.Burga et al.	Dcl969	-	+	sev'l	DHUNA777
17 km below Canta	±1600	C.M.Rick	Ag1956	+	+	sev'l	LA362
Yapan-Pte. San José	1700	J.Hawkes	Ap1964	+	+	sev'l	H 2448
14 km below Canta	±1800	C.M.Rick	Ag1956	+	+	sev'l	LA363
Yangas-Canta	±1800	B & T N°18	Nv1937	+	-	few	PI 126442
"	±1800	B & T N°15	Nv1937	+	+	-	PI 126439
"	±1800	B & T N°14	Nv1937	+	-	1	PI 126438
"	±1800	B & T N°16	Nv1937	+	+	sev'l	PI 126440
Lima-Canta (km 100)	±2100	D.Baumann	Sp1973	-	+	few	DHUNA1145
Yangas-Canta	±2000	B & T N°17	Nv1937	+	+	-	PI 126441
12 km below Canta	±2000	C.M.Rick	Ag1956	+	+	sev'l	LA365
"	±2000	C.M.Rick	Ag1956	+	+	1	LA366, PI251302
Desvío a Huaman- tanga	±2000	A.Müller et al.	My1971	+	-	-	285 SMF
9 km below Canta	2100	C.M.Rick	Ag1956	+	+	many	PI251301, LA364
Puente Verde	2200	J.Hawkes	Ap1964	+	-	-	H 2461
Near Río Canta	2200	B & T 24	Nv1937	+	+	-	PI 126448
San Buenaventura	2300	J.López G.	Nv1973	+	-	-	2181 SMF
Lima-Canta (km 78)	2500-2600	O.Velarde	Sp1948	+	-	-	SMF9701
Obrajillo	-	Wilkes expedit'n	-	+	-	-	73907 US, Gray
Obrajillo (km 103)	2500-2600	O.Velarde	My1948	+	-	-	939 US, SMF
Canta-Obrajillo	2700	C.Ochoa	Mr1951	+	-	-	1135 OCH
Lima-Canta (km 103)	2500-2600	O.Velarde	My1948	+	-	-	924 US
Canta	2500-2600	J.López G.	Nv1973	+	-	many	2192, 2204 SMF
4 km below Canta	2560	C.Burga et al.	Dcl969	-	+	sev'l	DHUNA781
Lima-Canta (km 108)	2700	C.M.Rick	Fbl949	+	+	many	LA96, PI 199380
West of Canta	2800	B & T 19	Nv1937	+	+	many	PI 126443
Canta	2942	J.Soukup	Ap1945	+	-	-	2802 US
"	2900-3000	G.Vilcapoma	My1973	+	-	-	182 USM
Yangas to Canta*	1400-3000	C.M.Rick	Ot1948	+	+	sev'l	LA93, LA96

\* In this collection 7 altitudes above sea level are included.

Table 19. Herbarium specimens and seed accessions of *Lycopersicon hirsutum* in the Chillón watershed (1925-1975).

Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
Below Canta (km 18)	±1500	C.M.Rick	Ag1956	+	-	-	LA361
Sta.Rosa de Quives	200-1000	O.Velarde	My1948	+	-	1	876 US
Sta.Rosa de Quives	1800	G.Vilcapoma	Ag1972	+	-	-	88 USM
Above Yaso	1600	J.Hawkes	Ap1964	+	-	1	H2460
"	1600	M.Holle	Jl1975	+	+	sev'l	DHUNA1323
"	1600	C.M.Rick	Ot1970	+	-	many	LA1298
Lima-Canta (km 92)	±1600	C.M.Rick	Ot1948	+	+	sev'l	LA94
Lima-Canta	1820	C.Burga et al.	Dcl969	+	+	-	DHUNA778
Lima-Canta (km 98)	±2000	D.Baumann	Sp1973	-	+	-	DHUNA1149
Desvío a Huamantanga	±2000	D.Baumann	Sp1973	-	+	few	DHUNA1150,1151
Lima-Canta	2060	C.Burga et al.	Dcl969	-	+	-	DHUNA779
Below Canta (km 10)	±1800-2100	C.M.Rick	Fb1949	+	+	sev'l	PI 199381, LA95
Along road to Yaso*	2100	B & T 26	Nv1937	+	+	sev'l	PI 126449
Puente San José	2110	J.Hawkes	Ap1964	+	-	sev'l	H2449
Lima-Canta	2160	C.Burga et al.	Dcl969	-	+	-	DHUNA780
Below Canta (5 km)	2200	C.M.Rick	Ag1956	+	+	1	PI251303, LA360
Below Obrajillo	2400	F.W.Pennell	Je1925	+	-	sev'l	14431 FM
Along Río Canta	2270	B & T 23	Nv1937	+	-	-	PI 126447
"	2270	B & T 22	Nv1937	+	+	-	PI 126446
"	2270	B & T 21	Nv1937	+	+	few	PI 126445
La Florida	2400	R.Ferreyra	My1974	+	-	-	18421 USM
Near Canta	2200-2500	R.Ferreyra	My1950	+	-	-	7266 USM, US
"	2500	R.Ferreyra	Ja1952	+	-	-	8116 USM
"	2500	N.Esposto	1937	+	-	-	USM
Canta	2500-2600	O.Velarde	My1948	+	-	-	9699 SMF
Obrajillo	2500-2600	O.Velarde	My1948	+	-	few	947 SMF, US
West of Río Canta	2700	B & T 20	Nv1937	+	+	1	PI 126444
Canta	2942	J.Soukup	Ap1945	+	-	few	2826 US

\* f. *glabratum*?Table 20. Herbarium specimens and seed accessions of *Solanum pennellii* in the Chillón watershed and green-fruited *Lycopersicon* species of the Quisquichaca Tributary (1948-1973).

Watershed Species & Site	Altitude (m)	Collector(s)	Date coll.	Herb. spec.	Seed	No. of plants	Identification number
Watershed: CHILLON							
<i>Solanum pennellii</i>							
Trapiche	800	P.C.Hutchison	Ag1957	+	-	few	1013 US, UCB
"	800	C.M.Rick	Ot1970	+	+	sev'l	LA1277
"	800	J.Hawkes	Ja1971	+	+	-	H1045
Pucará	1000	C.M.Rick	Ot1970	+	+	few	LA1297
Sta. Rosa de Quives	1200	C.M.Rick	Ot1970	+	+	-	LA1299
"	200-1000	O.Velarde	My1948	+	-	-	872 US, SMF
"	1300-1400	R.Ferreyra	Ap1953	+	-	few	9007 USM
Lima-Canta (km 70)	1800±	A.Müller et al.	My1971	+	-	-	215 SMF
QUISQUICHACA Tributary							
<i>L. peruvianum</i>							
Huarhuar	2100	G.Vilcapoma	Ag1972	+	-	-	79 USM
Licahuasi	1600	P.&A.Gutte et al.	My1973	+	-	-	594 SMF
Arahuay	2450	J.López G.	My 1973	+	-	-	2062 SMF
<i>L. hirsutum</i>							
Licahuasi	1650	P.&A.Gutte et al.	My1973	+	-	1	593 SMF
"	1650	J.López G.	My1973	+	-	-	2055 SMF
Puente Collo-Arahuay	2800	G.Vilcapoma	Mr1973	+	-	-	143 USM
Lachaqui	3400	G.Vilcapoma	Ot1972	+	-	-	107 USM