REPORT
of the
TOMATO GENETICS COOPERATIVE

Number 25  February, 1975

Department of Vegetable Crops
University of California
Davis, California 95616

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Cover design from mature leaf of bipinnata (bip)
c. 1/2 nat. size
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.

*** *** *** *** *** *** *** *** *** *** *** ***

On December 31, 1974 membership stood at 318 and the financial balance at $966.49, which continues to be a satisfactory level for meeting regular and contingency expenses.

The annual meeting was held at the University of Guelph on August 12, 1974 under auspices of the A. S. H. S. Minutes appear on a subsequent page. Arrangements have been made to hold the 1975 meeting in conjunction with the Tomato Breeders Round Table annual gathering in San Francisco.

In addition to the usual sections, this issue contains an Interim Report of the Linkage Committee, which was prepared partly in response to a request voiced at the 1974 Annual Meeting.

The TGC is highly fortunate again in benefiting from the services of Dora Hunt. Throughout the year she had full responsibility for membership, financial accounts, and other affairs in addition to editing this Report. For the skillful typing of the master copies we are indebted to Marta Hurtado. We deeply appreciate the services of Dora, Marta, and many others who assisted with TGC 25 and other TGC functions.

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

ANNOUNCEMENTS

We have been asked to call your attention to the following meetings.


Dr. G. P. Redei of the University of Missouri announces that the 7th annual Stadler Genetics Symposium will be held at Columbia Mo. April 18-19, 1975. Symposium speakers are E. Chargaff, R. B. Helling, O. L. Gamborg, R. Flavell, N. Sueoka, C. D. Miles, A. C. Wilson, G. B. Johnson, and D. E. Mettler. A detailed program can be obtained from Conferences and Short Courses, University of Missouri, 348 Hearnes, Columbia, Mo. 65201. Proceedings of this and previous Symposia are available; information concerning these can be obtained from Stadler Genetics Symposia, 117 Curtis Hall on the same campus.
MINUTES OF THE
ANNUAL MEETING OF TOMATO GENETICS COOPERATIVE

University of Guelph, Room 103 Arts Bldg. August 12, 1974, 4:15 P.M.

The 1974 annual meeting was held in conjunction with the 71st meeting of the American Society for Horticultural Science. Twelve members were present; Dr. L. Butler presided. The financial report of the organization transmitted though Dr. C. M. Rick showed that TGC had a balance of $725 and a membership of 303 of which 143 were from the USA.

A mini-report on the tax exempt status of the TGC was made.

The members present agreed on the continuation of the listing of graduate students' and associates' research in future TGC reports.

A query regarding the status of the activities of isogenic lines was made. It was mentioned that Dr. L. Darby and Dr. E. C. Tigchelaar were carrying on some work.

Another query was made re linkage group assignments and activities. After a short discussion the members in attendance suggested that a list of available linkage groups be mentioned in the "request for contributions to the TGC report" that is sent to the members by Dr. Rick in October.

The Coordinating Committee advised deferring this list to the Interim Report of the Linkage Committee appearing in this report.

The membership expressed their gratitude to Dr. Rick for the splendid job he is doing with the TGC Report. The membership also wished to express their gratitude and thanks to Dora Hunt for the fine work she is doing to get the TGC Report out each year.

No additional business was brought before the meeting.

S. Homma, Secretary pro tem.

ACTIVITIES

Canada, University of Toronto, Toronto

L. Butler: "I have been continuing the linkage work with chromosome 2 genes dpj, aa, are, and others which are not firmly placed. Most of these are now being prepared as three and four point test crosses which should finalize most of the present genes on this chromosome. The fruit size selection has been carried for another generation and there is good evidence that we have isolated two genes. Sandra Durish is looking at the cell number and cell sizes of these selections to elucidate the histological basis of inheritance."

United States, Auburn University, Auburn, Alabama


W. H. Greenleaf and C. M. Peterson: Ph.D. candidate Richard Shelby (June 1975) is doing thesis research on the nature of heat sterility in tomatoes.
INTERIM REPORT OF THE LINKAGE COMMITTEE

In response to several recent requests for information about linkage groups, we list the following current assignments:

1. Zobel
2. Butler
3. Whalen
4. Rick (pro tem. caretaker)
5. Reeves
6. Lachman
7. Rick
8. Kerr
9. Robinson
10. Robinson
11. Lachman
12.

Volunteers are solicited for the unassigned groups. Anyone wishing to take such work should correspond with Len Butler. For those who already have assignments and intend to do intensive linkage research on other assigned chromosomes, we request that you do such work cooperatively with the respective caretaker.
PART 1

RESEARCH NOTES

Butler, L.  Further linkage studies with aa and dpy.

Borgnino et al. (TGC 23:13) placed aa locus at 32 on 2L, and Philouze (TGC 24:17) found close linkage (1.7 units) between aa and ms-10 which is at 42 on 2L. These data are not consistent, and several 3-point test crosses are being made with stocks supplied by Philouze. In the meantime, F2 data of aa with other markers has been accumulating and tends to indicate that aa is not as close to q as was postulated. This is a pity as it would be convenient to have a seedling marker at this end of the chromosome.

Tight linkages of aa with Me (1.8) and Wo (3.3) and ms-10 (1.7) indicate that aa is in this segment of the chromosome. There is some other evidence which indicates that wo is between this segment and s, in fact the present wo s and s Me values have large errors. Further crosses with dpy have confirmed that it is close to ao at 59 on 2L but that there is 1-12% crossover. The reason for the lack of precision in this number is the result of both viability and classification difficulties. The crossover values dpy suf (8.7) and dpy Wo (15) would place the locus near ao. The testcross Wo dpy ++/+ ao suf has been made and should yield conclusive data on this point. It is interesting to note that +/-dpy genotypes can be recognized by the pleiotropic effect of dpy on ripening fruit.

Clark, S. A., and F. F. Angell A spontaneous lutescent mutant with creamy-white immature fruits.

A single mutant plant with yellow foliage was found in a planting of Md. 101. The mutant is similar to l and 1-2 except that the immature fruits are creamy-white rather than yellow and the foliage is not as deep yellow as 1-2. Transplants were somewhat weaker than standard plants, and they needed special care during the first month in the field. Thereafter, they were quite hardy and generally produced a good fruit yield. Increased yellowing of the mutant foliage was observed when nitrogen was deficient. Foliage color approximately equal to the original green color was obtained when excess nitrogen was applied to plants with yellow foliage. Crosses were made with 'C-28' and the results from studies of hybrid and segregating populations indicated single, recessive gene control of the mutant. Tests for allelism with l and 1-2 are in progress.

Clark, S. A., and F. F. Angell

Inheritance of superpuff.

Since 1969, several tomato plants bearing only hollow fruits have been found in Maryland. The condition, termed superpuff, mimics that described by Ness in 1895 for 'Terra Cotta' and by Young (TGC 7:16). Superpuff fruits are characterized by hollow locules (extremely puffy) and bell pepper fruit shape. The blossom scar is inverted, sometimes with a small hole at maturity. Distance between seed jelly and pericarp ranges from
Immature fruits are "checkered".

The superpuff mutant was crossed with 'Roma' and the F₁'s were superpuff, F₂'s segregated 133 superpuff: 14 non-puffy (15:1), and BC₁'s from (Roma x F₁) segregated 29 superpuff: 12 non-puffy (3:1). Thus, the superpuff characteristic is governed by two genes with duplicate dominant epistasis. The genes have been assigned the symbols Spf and Spf-2.

Dorosiev, L. A new line possessing a number of characters necessary in tomato hybrid seed production. [Submitted by A. Ognyanova]

The No. 158 line, sp, c, ex, ps, reported earlier (Dorosiev, TGC 24, 1974) was crossed to the mutant form possessing the aw gene. As a result, in F₂ was obtained the line No. 160, sp, c, ex, ps, aw, which has two closely linked genes ps and aw localized in the second chromosome.

The presence of the aw gene, causing lack of anthocyanin pigmentation, can be used as a supplementary gene-marker and reduces many times breeding work for transferring male sterility to standard varieties. In case line No. 160 is used, only the plants without anthocyanin can be grown up to anthesis in BCF₂. They represent only 25% of the whole breeding material and are almost all sterile.

Dorosiev, L. An interesting modification of John Baer ps sterility. [Submitted by A. Ognyanova]

Line No. 158, sp, c, ex, ps (Dorosiev, TGC 24, 1974) possessed the typical John Baer ps coalescence of petals and anthers and of anthers themselves. During the development of the line, several plants were obtained which deviated from the typical for ps flower structure.

These plants had only coalesced anthers, while the petals were free from the anthers and developed normally as in ps flowers. The investigations showed that these deviations from the typical John Baer ps type are hereditary. Thus the No. 159 line, sp, c, ex, ps, was obtained. It is of interest for hybrid seed production because the important drawback of the typical ps form, namely, the difficult artificial pollination is eliminated. Due to lack of coalescence of the petals and anthers and the presence of exserted stigma, no difficulties exist for artificial pollination. In case pollination is not effected, the No. 159 line is self-fertile, which is also a necessary trait of male sterile lines used in hybrid seed production.

Georgieva R., Zl. Vulkova, and Sv. Slavov Determinate tomato lines with orange fruits and high β-carotene content.

Investigations carried out so far have shown that the B gene, which controls high β-carotene content and the sp gene controlling indeterminate plant growth in the tomato are closely linked on chromosome 6 (Ito and Currence, TGC 14:14, 1964; Chmielewski, TGC 15:28, 1965). For this reason no determinate tomato cultivars have been bred which are suitable for mechanical harvesting and have high β-carotene-content of the fruits.
Chmielewski (Genetica Polonica 9:97-124. 1968) reports a very low percent (0.12%) of crossing over between B and sp+ in lines derived from a L. esculentum x L. minutum cross. No other data in this field are known to us up to the present.

In our investigations we accomplished large scale hybridization work with L. esculentum, L. cheesemaniit var. minor, L. pinninellifolium Galápagos, L. minutum, L. hirsutum typicum, L. hirsutum var. glabratum, L. chilense, and Solanum pennellii.

The β-carotene observed in hybrid fruits was identified spectrophotometrically. The absorption spectra of the synthetic β-carotene (Fluka) and of the carotene extracted from fruits scanned from 350 to 700 nm on a recording Unicam SP 800 spectrophotometer demonstrated perfect coincidence of the peaks, which proves the identity of both substances.

The first determinate plants with orange fruits were obtained in F2-BC3 of the cross L. esculentum x S. pennellii and in F4-BC3 stable lines were already developed with a 4.620 to 6.700 mg % β-carotene content of the fruits (Table 1). The same was achieved in the F4-BC3 of the L. esculentum x L. chilense cross (Table 2) and in F3-BC2 of the L. esculentum x L.pinninellifolium. Galápagos cross.

Table 1. β-carotene and lycopene content* in the fruits of determinate, orange-fruited tomato lines from F4-BC3 of the L. esculentum x S. pennellii cross.

<table>
<thead>
<tr>
<th>Line No.</th>
<th>Solids %</th>
<th>β-carotene mg%</th>
<th>Lycopene mg%</th>
<th>Total β-carotene &amp; lycopene content mg%</th>
<th>β-carotene %</th>
</tr>
</thead>
<tbody>
<tr>
<td>71-34/28-45/30</td>
<td>7.78</td>
<td>4.620</td>
<td>0.824</td>
<td>5.444</td>
<td>84.9</td>
</tr>
<tr>
<td>71-34/28-45/34</td>
<td>9.00</td>
<td>5.775</td>
<td>0.780</td>
<td>6.555</td>
<td>88.1</td>
</tr>
<tr>
<td>71-34/28-45/57</td>
<td>8.38</td>
<td>6.700</td>
<td>1.230</td>
<td>7.930</td>
<td>84.5</td>
</tr>
<tr>
<td>71-34/28-45/63</td>
<td>6.52</td>
<td>6.610</td>
<td>0.630</td>
<td>7.240</td>
<td>91.3</td>
</tr>
<tr>
<td>71-34/28-40/65</td>
<td>7.11</td>
<td>5.420</td>
<td>0.500</td>
<td>5.920</td>
<td>91.5</td>
</tr>
</tbody>
</table>

*mg in 100 g fresh weight.

Table 2. β-carotene and lycopene content* in the fruits of determinate, orange-fruited tomato lines from F3-BC2 of the L. esculentum x L. chilense cross.

<table>
<thead>
<tr>
<th>Line No.</th>
<th>Solids %</th>
<th>β-carotene mg%</th>
<th>Lycopene mg%</th>
<th>Total β-carotene &amp; lycopene content mg%</th>
<th>β-carotene %</th>
</tr>
</thead>
<tbody>
<tr>
<td>67-94/2-13/32</td>
<td>8.02</td>
<td>3.620</td>
<td>0.600</td>
<td>4.220</td>
<td>85.8</td>
</tr>
<tr>
<td>67-94/2-13/43</td>
<td>7.27</td>
<td>4.520</td>
<td>0.420</td>
<td>4.940</td>
<td>91.5</td>
</tr>
<tr>
<td>67-94/2-13/73</td>
<td>6.95</td>
<td>3.980</td>
<td>0.270</td>
<td>4.250</td>
<td>93.6</td>
</tr>
<tr>
<td>67-94/2-29/51</td>
<td>8.67</td>
<td>4.250</td>
<td>0.635</td>
<td>4.885</td>
<td>91.3</td>
</tr>
</tbody>
</table>

*mg in 100 g fresh weight.
Gill, B. S., and C. F. Quirós Cyto- 
genetics of anaphase I equa- 
tional division in trisomic 
meiosis.

Anaphase I (AI) reductional division in trisomics may 
be of different kinds. The extra chromosome may go to 
the poles at random or stay 
on the equatorial plate as a laggard. Alternatively, it may divide by 
equational division (AI e.d.) and the two chromatids travel to the poles 
or stay in the center as laggards, resulting in most cases in the loss 
of both chromatids during Anaphase II. The premature division of uni- 
valents in AI is certainly one of the factors affecting the transmission 
rate of the extra chromosome in the trisomic. This breach in commitment 
to normal meiosis as such is of great cytogenetic interest.

Among the factors that could be considered responsible for the anomalous 
behavior of the univalent chromosome, the loss of pairing opportunity appears 
to be important. Another factor that could affect the degree of AI 
e.d. is the change in chromosome structure which exists in certain types 
of trisomies (i.e. telo- and secondary trisomies etc.). It would also 
be reasonable to assume that the tendency to divide precociously as a 
univalent is under genetic control. Lastly, it could be a completely 
random event subject to change under fluctuating environmental conditions 
(temperature, age of the plant, etc.) and independent of all the above 
factors.

In Table 1, we present the date on chromosome pairing and AI e.d. 
for the extra chromosome of eight primary trisomies. All the plants were 
grown in the greenhouse except for triplo-7 which was grown in the field. 
Among the primary trisomies, triplo-4, -5, -6, -10, and -12 show a 
fairly high degree of AI e.d. Triplo-12 with the highest rate (53.3%) 
has also the second highest degree of univalents in diakinesis (80.8%). 
The other primary trisomies, triplo-4, -6, and -10, with relatively high 
degrees of AI e.d. have also high rates of univalents. Apparently, for 
these trisomies there is a relationship between the association of the 
extra chromosome in diakinesis and the incidence of AI e.d. However, 
this relationship does not hold for triplo-3, -7, and -11. The last 
one, with the highest per cent of univalents at diakinesis (87.2%), 
shows only 7.1% AI e.d. This indicates that, in addition to pairing, 
structure and genetic change of the extra chromosome regulate its meiotic 
behavior. Triplo-7 is a special case since it was grown in the field 
and was subject to different environmental conditions than the other tri- 
somies studied.

Among the telo-trisomics, 2n+4L, 2n+7L, 2n+11L exhibit a high degree of 
AI e.d., and the latter also has a high frequency of univalents. Con- 
versely, 2n+3S, 2n+3L, and 2n+6L show zero or low values for AI e.d. 
High values of AI e.d. in primary trisomies do not guarantee high values 
for their respective telo- or secondary trisomies. This point is well 
illustrated for chromosome 11. In telo-2n+11L, AI e.d. is very high 
(60.5%) compared with the low values found for the respective primary 
(7.1%) and the secondary trisomic 11L*11L (0.0%). Rick and Gill (Canad. 
J. Genet. Cytol. 15:299-308, 1973) found that in 2n+*11L the *11L telo- 
arm has suffered a sizable deletion of the proximal heterochromatin. 
This situation strongly suggests the role of proximal heterochromatin 
for the proper functioning of the centromere. Similarly, telo-*7L 
shows high AI e.d. compared with triplo-7. Since the last one was grown
in the field, the environment cannot be discarded as one of the reasons for this disparity. Conversely, low values for telo- 3S and 3L correspond to low value for triplo-3, and high values for telo-4L also correspond to a reasonably high value for triplo-4.

All secondary trisomics exhibited a low degree of AI e.d. in contrast with the very high univalent rates at diakinesis. This relationship is expected because an isochromosome can pair with itself, increasing in this manner the univalent rate. It perhaps satisfies in this way the pairing requirement and interferes with the premature splitting of the chromatids, thereby leading toward a normal meiotic behavior.

Table 2 shows the heterogeneity $\chi^2$ values within each of the three types of trisomics for univalent rates at diakinesis and for AI e.d. values. In all cases significant $\chi^2$ values were found. The heterogeneity within each type indicates that each extra chromosome has a particular behavior independent of the trisomic group to which it belongs. Therefore, it can be concluded that the frequency of AI e.d. in the trisomic depends mainly on the genetic constitution of the extra chromosome expressed on the cell phenotype. Gross structural changes causing disjunction mechanical problems, such as the loss of proximal heterochromatin in telo-11L or self-pairing of the isochromosome in the secondary trisomics, can overcome the effect of the genetic factor. Although lack of association of the extra chromosome with its normal counterparts in diakinesis seems to affect the frequency of AI e.d., it can be overcome by the genetic constitution and chromosomal structure. Environmental influence on this phenomenon is also suspected.

Table 1. Percentage of the extra chromosome as univalent in diakinesis and percentage of AI e.d. in primary, telo-, and secondary trisomics.

<table>
<thead>
<tr>
<th>Primary</th>
<th>Telo-</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>2n+ %</td>
<td>Univ. %</td>
<td>AI e.d. %</td>
</tr>
<tr>
<td>3S-3L</td>
<td>57.3</td>
<td>5.8</td>
</tr>
<tr>
<td>4S-4L</td>
<td>64.3</td>
<td>22.8</td>
</tr>
<tr>
<td>5S-5L</td>
<td>45.8</td>
<td>18.0</td>
</tr>
<tr>
<td>6S-6L</td>
<td>45.7</td>
<td>39.2</td>
</tr>
<tr>
<td>7S-7L</td>
<td>46.5</td>
<td>0.0</td>
</tr>
<tr>
<td>10S-10L</td>
<td>62.8</td>
<td>39.7</td>
</tr>
<tr>
<td>11S-11L</td>
<td>87.2</td>
<td>7.1</td>
</tr>
<tr>
<td>12S-12L</td>
<td>80.8</td>
<td>53.3</td>
</tr>
</tbody>
</table>
Table 2. Heterogeneity $\chi^2$ values for % univalent and for % AI e.d. in the primary, telo-, and secondary trisomics studied.

<table>
<thead>
<tr>
<th>Trisomic type</th>
<th>$\chi^2$ calculated</th>
<th>% Univalent</th>
<th>% AI e.d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>75.91***</td>
<td>143.66***</td>
<td></td>
</tr>
<tr>
<td>Telo-</td>
<td>67.92***</td>
<td>172.75***</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>7.50*</td>
<td>7.28*</td>
<td></td>
</tr>
</tbody>
</table>

*** .001 significance level.
* .05

Remarkably similar virescent effects were noticed when $fgv$ (fimbriate gold virescent) and $wv-3$ (white virescent-3) plants were grown in the greenhouse. Preliminary data indicate that both genes are located on chromosome 11S (F. Borgnino et al. TGC 24:7-8). An allele test was performed to determine if an identical locus governs the virescent characters.

Ten plants of an $fgv \times wv-3$ hybrid all displayed the wild phenotype. The reciprocal cross was not observed. This test, however, provides evidence that the virescence of the two mutants is indeed conditioned by different genes.

Kerr, E. A. Linkage relations of $afr$. Anthocyaninless fragile, $afr$, is a tiny, brittle, green plant with poor survival under field conditions. Most conclusions concerning linkage of mature plant characteristics must therefore be made on the basis of the normal plants. In tests over the last ten years no indications of linkage have been obtained with $y$, $d$, $v-wf$, $a$, $ma$, $ap-o-lna$, $lg-d$, $marm$, $u-h$, $a-f$. There were suggestions of linkage with $in$, $wt$ and especially $gs$, but these are believed attributable to differential survival of $in$ and incorrect classification of $wt$ and $gs$. Indications of linkage with $al$ and $gf$ (Table) suggest a location on chromosome 8 in the vicinity of $gf$. Scoring of $gf$ in the presence of $afr$ is very difficult because the tiny $afr$ fruits have green locular gel. This probably accounts for the excess of $afr - gf$ plants.

Table. $F_2$ Linkage data of $afr$ with genes on chromosome 8.

<table>
<thead>
<tr>
<th>Year and line</th>
<th>Tester</th>
<th>Phase</th>
<th>++</th>
<th>+ tester</th>
<th>$afr+$</th>
<th>$afr$ tester</th>
</tr>
</thead>
<tbody>
<tr>
<td>66 - 1178</td>
<td>$gf$</td>
<td>R</td>
<td>38</td>
<td>127</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>74 - 2011</td>
<td>$gf$</td>
<td>R</td>
<td>37</td>
<td>75</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>69 - 2001</td>
<td>$gf$</td>
<td>C</td>
<td>114</td>
<td>0</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>70 - 2001</td>
<td>$gf$</td>
<td>C</td>
<td>111</td>
<td>0</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>69 - 2001</td>
<td>$al$</td>
<td>R</td>
<td>74</td>
<td>37</td>
<td>----27-----</td>
<td></td>
</tr>
</tbody>
</table>
In TGC 9:44 Rick et al. reported F_2 data which suggested that Ve was likely linked with e at a distance of about 2.5 crossover units. No linkage was indicated with a, c, d, Wo, or Xa.

Ve ("VF36" and "VF65") was crossed with chromosome 4 marker ful-e-di and backcrossed to ful-e-di. Plants were inoculated with a single isolate and grown in a growth chamber. Plants were not scored until the control plants, "Moira" and marker ful-e-di, were showing unmistakeable signs of susceptibility. At this time it was difficult to score some of the small susceptible plants for ful, e, and di. A deficiency of mutant plants was recorded (Table). The crossovers for ful, e, and di were approximately those on the current linkage map, ful 40 e 23 di. The number of resistant and susceptible plants was almost a perfect 1:1 ratio but there was no evidence of linkage with any of the mutants. If the suggested 32.5 units between Ve and e were valid, there would have been very close linkage with ful or di. Further linkage studies with Ve are planned.

Table. Backcross data for Ve X ful-e-di.

<table>
<thead>
<tr>
<th>Gene pair</th>
<th>Co.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ve - ful</td>
<td>Ve + 70</td>
</tr>
<tr>
<td>Ve - e</td>
<td>Ve + 80</td>
</tr>
<tr>
<td>Ve - di</td>
<td>Ve + 76</td>
</tr>
<tr>
<td>ful - e</td>
<td>+ + 123</td>
</tr>
<tr>
<td>ful - di</td>
<td>+ + 102</td>
</tr>
<tr>
<td>e - di</td>
<td>+ + 138</td>
</tr>
</tbody>
</table>

Kerr, E. A., L. H. Lyall, and T. O. Graham A mutation to lutescent-2 in 'Fireball'. A lutescent plant appeared in a trial plot of 'Fireball' in 1960 at Collingwood, Ontario. It has now been assigned the number Ottawa 161, and seed is in the Plant Gene Resources storage at Ottawa. Ottawa 161, which is determinate, was crossed as seed parent with the original lutescent 'Longred' from which I-2 was derived. The F_1 was lutescent indeterminate like the pollen parent.

Popova-Konstantinova, M. Inheritance of fruit set percent in tomato interspecific F_1 crosses. The percent of fruit set was studied of the first three inflorescences in P_1, P_2 and F_1 of the varietal crosses Zarya x Komet and No. 10 x Bison and of the interspecific crosses of Zarya (L. esculentum) with L. esculentum v. pruniforme, L. esculentum v. pyriforme, L. pimpinellifolium, L. pimpinellifolium St. Cr. Galápagos, L. minutum, L. cheesmanii typicus, L. hirsutum f. glabratum and Solanum pennellii.

The results obtained showed that in regard to percent of fruit set
the species and varieties studied can be divided into four groups, namely:
group I - 90-100% fruit set; group II - 80-90%; group III - 40-80%; and group
IV - 0-40% (Table 1).

Least deviations in fruit set percent between the years were observed
for groups IV and I.

Overdominance was observed in the inheritance of the higher percent
of fruit set in all F1 interspecies crosses. The d/a parameter was higher
than 1 and the difference between F1 and the dominant parent was significant
(Table 2).

Table 1. Distribution of the species, varieties, and F1 in regard to percent
of fruit set.

<table>
<thead>
<tr>
<th>Group</th>
<th>Species, variety, hybrid</th>
<th>Rank in the group</th>
<th>Percent of fruit set</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Zarya × L. cheesmanii</td>
<td>1</td>
<td>90.4</td>
</tr>
<tr>
<td></td>
<td>Zarya × L. pimpin. Sta.Cr. Galápagos</td>
<td>2</td>
<td>89.3</td>
</tr>
<tr>
<td></td>
<td>L. pimpin. × L. cheesmanii</td>
<td>3</td>
<td>89.0</td>
</tr>
<tr>
<td></td>
<td>Zarya × L. minutum</td>
<td>4</td>
<td>88.4</td>
</tr>
<tr>
<td></td>
<td>Zarya × L. pimpinellifolium</td>
<td>5</td>
<td>87.5</td>
</tr>
<tr>
<td></td>
<td>Zarya × L. escul. v. pruniforme</td>
<td>6</td>
<td>85.3</td>
</tr>
<tr>
<td>II</td>
<td>Zarya × L. escul. v. pyriforme</td>
<td>7</td>
<td>84.3</td>
</tr>
<tr>
<td></td>
<td>L. escul. v. pruniforme</td>
<td>8</td>
<td>83.4</td>
</tr>
<tr>
<td></td>
<td>Zarya × L. hirsutum f. glabratrum</td>
<td>9</td>
<td>83.2</td>
</tr>
<tr>
<td></td>
<td>No. 10</td>
<td>10</td>
<td>81.9</td>
</tr>
<tr>
<td></td>
<td>No. 10 × Bison</td>
<td>11</td>
<td>80.3</td>
</tr>
<tr>
<td></td>
<td>L. pimpinellifolium × L. minutum</td>
<td>12</td>
<td>80.3</td>
</tr>
<tr>
<td></td>
<td>L. escul. v. pyriforme</td>
<td>13</td>
<td>80.3</td>
</tr>
<tr>
<td>III</td>
<td>L. minutum</td>
<td>14</td>
<td>77.5</td>
</tr>
<tr>
<td></td>
<td>Komet</td>
<td>15</td>
<td>74.3</td>
</tr>
<tr>
<td></td>
<td>L. pimpinellifolium</td>
<td>16</td>
<td>72.3</td>
</tr>
<tr>
<td></td>
<td>Zarya × Komet</td>
<td>17</td>
<td>69.0</td>
</tr>
<tr>
<td></td>
<td>Zarya</td>
<td>18</td>
<td>50.8</td>
</tr>
<tr>
<td>IV</td>
<td>Zarya × Solanum pennellii</td>
<td>19</td>
<td>48.2</td>
</tr>
<tr>
<td></td>
<td>L. pimpinellifolium Sta. Cr. Galápagos</td>
<td>20</td>
<td>38.7</td>
</tr>
<tr>
<td></td>
<td>L. hirsutum f. glabratrum</td>
<td>21</td>
<td>38.6</td>
</tr>
<tr>
<td></td>
<td>L. cheesmanii typicus</td>
<td>22</td>
<td>38.4</td>
</tr>
<tr>
<td></td>
<td>Bison</td>
<td>23</td>
<td>37.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24</td>
<td>0.0</td>
</tr>
</tbody>
</table>
The CRA 66 line, a source of resistance to Pseudomonas solanacearum (Digat and Derieux, 1968. Proc. Caribbean Food Crops Soc. VI), is resistant to strains 1 and 2 of Fusarium. A study has been realized to define the relations between this resistance and the genes $I$ and $I-2$. The results of the artificial inoculation tests with a method we have described (Laterrot, 1973, Phytopath. Mediterr. 11) are reported in Tables 1 and 2. The absence of segregation in the $F_2$ and in the complex cross populations (Table 1)
shows that CRA 66 possesses the I allele. CRA 66 shows a level of resistance to strain 2 (Table 2) lower than that of Walter 742, but higher than the tolerance of Floradel reported by Crill et al. (1973 Plant Dis. Rep. 56, 8). The segregation observed in F2 does not permit to conclude if the resistance is controlled by I-2 with modifiers or by genes different from I-2. Most of the Pseudomonas resistant lines show such a level of resistance to pathotype 2 of Fusarium. It is the case for CRA 74 issued from CRA 66, Venus, Saturn, Hawaii 7750 and 7755 and IRAT 3.

Table 1. Relation between I and the resistance of CRA 66. Artificial inoculation with an isolate of pathotype 1 of Fusarium.

<table>
<thead>
<tr>
<th>Lines or crosses</th>
<th>Dead</th>
<th>Diseased</th>
<th>With brown vessels</th>
<th>Healthy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marmande ++</td>
<td></td>
<td>13</td>
<td>7</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Marporum I/I</td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Walter 742... I-2/I-2</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>CRA 66</td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>F2 Anahu (I/I) X CRA 66</td>
<td>-</td>
<td>-</td>
<td>160</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>F1 (Anahu X CRA 66) X Marmande</td>
<td>-</td>
<td>-</td>
<td>160</td>
<td>160</td>
<td>160</td>
</tr>
</tbody>
</table>

Table 2. Relation between I-2 and the resistance of CRA 66. Artificial inoculation with an isolate of pathotype 2 of Fusarium.

<table>
<thead>
<tr>
<th>Lines or crosses</th>
<th>Dead</th>
<th>Diseased</th>
<th>With brown vessels</th>
<th>Healthy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marmande ++</td>
<td></td>
<td>115</td>
<td>35</td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>Marporum I/I</td>
<td></td>
<td>68</td>
<td>14</td>
<td>6</td>
<td>88</td>
</tr>
<tr>
<td>Floradel I/I</td>
<td></td>
<td>28</td>
<td>45</td>
<td>7</td>
<td>80</td>
</tr>
<tr>
<td>Walter 742... I-2/I-2</td>
<td>-</td>
<td>-</td>
<td>140</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>CRA 66</td>
<td></td>
<td>3</td>
<td>17</td>
<td>159</td>
<td>179</td>
</tr>
<tr>
<td>F1 Walter 742 X CRA 66</td>
<td>-</td>
<td>-</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>F2 Walter 742 X CRA 66</td>
<td>10</td>
<td>34</td>
<td>395</td>
<td>439</td>
<td>439</td>
</tr>
</tbody>
</table>
Studies were undertaken to obtain more information on the effects of plant age, length of exposure to high temperature, and number of inoculations on the percentage of necrotic plants in tomatoes carrying the Tm-2\textsuperscript{a} gene of resistance of TMV. Tests were carried out in temperature-controlled climate chambers, using a virulent isolate of strain 0. The following genotypes were tested: Marmande (susceptible), Marmande Tm-2\textsuperscript{a}/Tm-2\textsuperscript{a} and the respective heterozygous F\textsubscript{1} hybrid Tm-2\textsuperscript{a}/+.

**Plant age at time of inoculation.** 10-, 20-, and 30-day-old plants of the above-mentioned groups which had been grown at 20°C were inoculated with TMV. The plants were then transferred to a chamber at 30°C for 8 weeks. Typical mosaic symptoms were obtained from diseased plants from the susceptible Marmande. Inoculated plants of Tm-2\textsuperscript{a}/Tm-2\textsuperscript{a} at all ages tested remained symptomless, whereas plants of Tm-2\textsuperscript{a}/+ gave 50 to 80% necrotic plants (Table).

Total percentage of necrotic plants in age groups 10 and 20 days was similar, and differed significantly (at the 5% level) from age group 30 days. It can be seen that necrotic plants first appeared in age group 10 days, and that the increase in necrosis incidence after inoculation was faster in this group than in age groups 20 and 30 days.

**Length of exposure to high temperature.** Tomato seedlings were grown at 20°C. When the first true leaves were at the expanding stage, the seedlings were inoculated with TMV and placed at 30°C for 3, 6, 10, and 20 days. They were then transferred to 20°C until the end of the trial. The final record was made 8 weeks after inoculation. Inoculated plants of Tm-2\textsuperscript{a}/+ held at 30°C for 3, 6, 10, and 20 days gave 35, 86, 90, and 88% necrotic plants, respectively. Plants of Tm-2\textsuperscript{a}/Tm-2\textsuperscript{a} held under the same conditions remained symptomless.

**Number of inoculations.** At 30°C, Tm-2\textsuperscript{a}/Tm-2\textsuperscript{a} and Tm-2\textsuperscript{a}/+ seedlings yielded 3 and 81% necrotic plants, respectively, following one inoculation with TMV; and 49 and 98% necrotic plants, respectively, following three inoculations. At 20°C, seedlings of both genotypes remained symptomless.

Table. Effect of plant age at time of inoculation on percentage of necrotic individuals in Tm-2\textsuperscript{a}/+ plants.*

<table>
<thead>
<tr>
<th>Plant age, days(^\dagger) development</th>
<th>State of development</th>
<th>Days after inoculation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>10 1st leaf</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>20 3rd leaf</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>30 5th leaf</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

* Cumulative percentage.
\(^\dagger\) At each age tested, 200 plants were inoculated.
Przewoźny, T. Effect of NMH on six varieties of tomato. [Submitted by E. Kesicki]

Susceptibility to NMH was studied in five self-pruning varieties of the tomato cultivated in Poland and in standard variety Marglobe. Five-hour treatment of seeds with NMH solutions had been preceded by soaking in distilled water for 15 h. A wide range of differences in the somatic injuries rate and in the point mutation frequency was found between varieties. The highest rate of somatic injuries was found in variety Nesthäckchen, the lowest, in variety Cold-set. Concentration giving higher somatic injuries rate was also found to give higher frequency of chlorophyll point mutations. Combinations with the highest frequency of chlorophyll mutations were used in the further work. From initial material, 211 forms differing in morphological and physiological characters were obtained. These mutants are being genetically examined.

Table. Response of tomato varieties to three concentrations of NMH.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Growth reduction %</th>
<th>Chlorophyll mutation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2mM</td>
<td>4mM</td>
</tr>
<tr>
<td>Cold-set</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Fireball</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>Jutr-enka</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Marglobe</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>Nesthäckchen</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td>Venture</td>
<td>6</td>
<td>11</td>
</tr>
</tbody>
</table>

Quirós, C. F., and D. Hughes A technique for sampling foliage volatiles in the tomato species.

Characterization of the volatiles involved in the plant odor may also prove to be useful for evolutionary studies and for determination of the role of these compounds in insect resistance.

The technique presented here is based on the procedure used by Trel and Jennings for the determination of volatile compounds in ripening bananas (Agric. and Food Chem. 20:189-192, 1972). Some modifications have been incorporated for adaptation to tomato plants. This technique consists basically of enclosing the plant to be sampled in a hermetic chamber through which pre-purified air from a laboratory or greenhouse air outlet is circulated. It then passes through a Porapak Q trap to collect the foliage volatiles for at least 24 hours (length of time depending on the species). In this way the plant is minimally disturbed, avoiding the danger of contamination due to the extraction procedure. Other advantages of this method are its simplicity, its non-destructive nature, and the small amount of material needed compared with the conventional distillation method (Soost, R.K. et al. Proc. A.S.H.S. 92:568-571. 1968).
Materials

1) Air purifier (Fig. 1, a). A cylinder of 20 cm long and 2 cm diameter was fashioned from standard plumbing fittings and was filled with Molecular Sieve between glass wool plugs, the upper half with type 5A, the lower half with 13X. This filter was permanently connected to the air outlet. A similar device was employed for the nitrogen used in the process (Jennings, W. Personal Communication).

2) Sample chamber (Fig. 1, b). Consisting of a plexiglass tube 85 cm long and 13.9 cm diameter, the sample chamber was open at the lower end and sealed at the top with a plexiglass sheet provided with 2 holes for the air circulation tubes.

3) Plant material. Some of the plants sampled were grown in cylindric gallon cans of slightly larger diam than the chamber. The open end of the latter was inserted in this can and the gaps were tightly packed with soil using a flat stick or other suitable tool.

With plants grown in the field, 4 to 6 healthy branches about 80 cm long were loosely tied together and placed in the chamber. The stems at the lower end were immersed in a beaker of water which was submerged in a gallon can filled with soil. The open end of the chamber rested on, and was similarly sealed by, this soil. The samples were replaced by fresh material after each 48 hr run.

4) Volatiles trap (Fig. 1, c). This trap consisted of a 12 cm long X 15 mm diam glass tube with a piece of glass tubing 4 cm long X 5 mm diam welded to each end. This container was filled with 100-120
mesh Porapak Q between glass wool plugs. The trap was conditioned for 24 hr at 180°C by passing through it pre-purified nitrogen at a flow of 300 cc/min.

5) Miscellaneous. Two pieces of Teflon tubing 1/8" O.D. were used for air circulation. One measuring about 3 m long carried the air from the source. This piece passed all the way down through the length of the chamber. The second piece of about 50 cm long was the exhaust for the air carrying the volatiles. It was connected by a Swagelok union to the trap. Both tubes were fastened to the top of the chamber through bored rubber stoppers.

Operating procedure

The air circulated through the foliage at 100-150 cc/min and was collected in the trap. To avoid the drying of the plant, it was heavily watered before the operation. When the plant was sampled for more than 48 hr, water was added every 2 days by removing from the top of the chamber 1 of the rubber stoppers. During the running, the Porapak Q trap was kept in a horizontal position and was heated to 25-30°C with heating tape to avoid condensation. However, this precaution did not prove necessary.

The length of collecting time varied from species to species. For L. hirsutum, a 24-48 hr run was sufficient, and it was not necessary to replace fresh samples. For L. esculentum and the other species, 4-7 days was necessary, depending, however, on the size and development of the plants as well as the amount of eluted volatiles desired. We have collected volatiles from L. hirsutum f. typicum and f. glabratum, L. esculentum cv. Red Cherry, and L. peruvianum f. glandulosum.

When the collection was ended, the trap was removed and pre-purified nitrogen was passed through it at room temperature for 30 min to remove the air and most of the water. For flushing out the volatiles the trap was reversed so that the end containing the volatiles became the exhaust end. The trap was put in a 1 cu ft incubator provided with 2 small holes in the lateral walls through which the nitrogen and exhaust lines passed. The exhaust end of the trap which protruded from the incubator wall was fitted with a glass capillary tube (made by stretching a Pasteur pipette under the flame) and sealed with Teflon tape. This capillary was chilled with Dry Ice and the trap was heated in the incubator to 100°C and flushed out for 1 hr with nitrogen flowing at 200 cc/min. The capillary tube was then flame sealed and stored at 0°C until analyzed. After this procedure, the trap was ready to be reused.

Regarding the amounts of volatiles collected, a plant of L. hirsutum yielded about 15 to 20 microliters, the other species sampled yielded about 2-5 microliters. When using branches from the field, however, L. esculentum yielded about 15-20 microliters. For gas chromatography analysis, good resolution was obtained with a stainless steel column 6.2 m long X 1/8" O.D. packed with 5% Carbowax 20 M on 80 mesh Chromosorb W (DMCS treated). Each run was temperature programmed for 75-200°C, 4°C/min. Samples of 1-2 microliters were injected. (All the materials used except the plexiglass tubing and the heating tape are available from Supelco, Inc. Supelco Park, Bellefonte, Penn. 16823).
The studies pioneered by Chmielewski and his colleagues (TGC 12:21, 13:10-11, 15:28-29; Genet. Polon. 3:253-264, 7:31-39, 9:97-124) revealed that 'L. minutum' is a genetically isolated and morphologically distinct entity that deserves specific status. Since the time of his research a considerable amount of data has been accumulated to substantiate his thesis and to reveal phylogenetic differentiation between minutum accessions. Much more has been learned concerning the ecology and distribution of the species from new collections and from observations in the native habitat. Further, compatibility tests have been made and alloyme surveys conducted on all available living accessions. On the basis of all such tests, two entities are readily distinguished.

All living accessions (16), although agreeing to a remarkable extent in most gross morphological characters (leaf type, fruit size, shape, and color, foliage aroma, etc.) and having similar distributions (intermontane Peru), differ markedly in floral dimensions. Our first accessions have reduced inflorescences and tiny flowers with stigmas exserted slightly or not at all; we designate this type as 'Chavinillo' after the site of the first collection. We later received an accession (LA 1028) collected at Casinchihuia by Ilitis and Ugent which differs in its much larger inflorescences and flowers with considerably exserted stigmas. In late 1970, Martha Rick, M. H., and C. M. R. had the opportunity of observing this complex in its native region in Depts. Ayacucho and Apurimac, where both forms are sympatric. Without exception, no intermediat~ types were observed either in the wild or in extensive progenies grown at Davis. The degree of genetic isolation between the two types must be rather formidable because they are not only sympatric, but also intermingle in at least three populations.

According to compatibility tests, it is possible to produce F₁ hybrids from both direct and reciprocal crosses between Chavinillo and Casinchihuia (both are self-fertile). The F₁ hybrids show full pollen fertility and produce seeds abundantly after selfing. Great difficulty is experienced, however, in germinating seeds; consequently we have examined very few F₂ plants. Although germination per se might constitute a strong genetic barrier, we believe that the different natural mating systems effectively obstruct gene exchange. The evidence for our conclusion comes from the alloyme survey.

Space does not permit a detailed account of the electrophoretic studies. In essence, both types agree at a number of loci for alleles that appear to be unique amongst tomato species. The two differ completely for alleles of Got-3 and to a partial degree for alleles at six other loci. In most of the latter cases, Chavinillo is constant for one allele, which is always possessed, among others, by Casinchihuia. The remarkable constancy of Chavinillo at the individual, populational, and total level must reflect strict autogamy — a conclusion amply supported by floral morphology and natural pollination mechanism. In contrast, Casinchihuia exhibits considerable heterozygosity, and other intrapopulational polymorph, as well as regional diversity at 7 of the 14 tested loci. From the available evidence, it appears that Casinchihuia is amply outcrossed and is probably the ancestral type from which Chavinillo evolved via the isolation mechanism of autogamy. These findings have obvious bearing on methods of stock maintenance and testing of accessions for their germ plasm potential.
Robinson, R. W., and E. Kowalewski

Transgressive segregation for frost tolerance in interspecific crosses with the tomato.

An early frost in the fall of 1972 brought a premature end to the tomato season in New York, sharply reducing yield since all but the very earliest varieties had a large proportion of immature fruit when they were killed by frost. All of the numerous varieties being tested were killed when the temperature dropped to \(-3^\circ C\), but some F2 segregants of interspecific crosses survived this and several subsequent frosts.

For more than a decade, a search had been made at Geneve, N. Y. for a source of frost tolerance, but previously without success. In some years male sterile and other unfruitful plants escaped injury from very light frosts, and occasionally plants with heavy vine cover would survive when only their upper layer of leaves were killed, but none appeared practical for breeding a frost tolerant tomato. They were unsuitable in yield or plant habit and were not able to survive temperatures as low as occurred in the fall of 1972.

The frost tolerant plants found in 1972 were in F2 populations of crosses of L. esculentum with L. hirsutum, L. glandulosum and Solanum penellii. The most promising selections were from crosses with L. hirsutum. All parental species were killed by the frost, as were each of the interspecific F1 hybrids. The small proportion of F2 survivors suggested that frost tolerance is recessive, of complex inheritance, and resulting from transgressive segregation.

The first frost of the following season was not cold enough to harm any tomato varieties in the field. The temperature recorded in the weather station was 0°F and likely was colder near the ground level by the tomato plants, but none of the Lycopersicon species was injured. Some F2 segregants from L. esculentum X L. glandulosum, however, were killed by frost. Evidently transgressive segregation frost tolerance had occurred once again, but this time plants more susceptible to frost than either parent occurred whereas plants more tolerant to frost than either parent had been found the previous year.

It was confirmed in 1974 that derivatives of interspecific crosses have a promising degree of frost tolerance. A large assortment of breeding material was tested, including species collected by C. M. Rick at elevations of 2,000 meters. The best degree of tolerance to a frost of -6°F was by the progeny of the L. esculentum X L. hirsutum selections that were frost tolerant in 1972.

Frost tolerance has also been evaluated in growth chambers. Super cooling of the plants occurred before injury resulted at constant temperatures of \(-3^\circ C\) and lower. Breeding lines tolerant to frost in the field appeared to have a greater extent of super cooling than normal tomatoes before the formation of ice in their plant tissues.
Previous researchers have found that stigma position is controlled by 1 to several genes.

Such studies have been limited to crosses between heterostylous lines and lines in which the stigma is only slightly inserted within the anther cone. More recently, tomato lines with extremely inserted stigmas have been produced by irradiation with thermal neutrons. We investigated the inheritance of stigma position in these lines with the idea that fruit set may be improved by altering stigma position through breeding.

The tomato flower was divided into 7 regions to facilitate rapid classification of stigma position (Fig. 1). Position 3 is located at the end of the anther cone while position 4 lies at the juncture between the fertile and sterile anther tissue. Position 3 to 4 is considered standard and contains many commercial cultivars in which the stigmas are in the region of 3 to 3.5. Positions 1 and 2 are exserted, Position 1, more than 3 mm beyond the end of the anther cone and Position 2, less than 3 mm. Flowers in which the stigma is located in the region of the fertile anther tissue are termed inserted. Position 6 is located midway between Position 4 and the ovary while Position 5 is midway between Positions 4 and 6. Position 7 is midway between Position 6 and the ovary. These positions are further fractionated to produce a continuous gradation of stigma positions.

The stigma positions of the parentals are listed in Table 1. Inheritance of stigma position was studied in the crosses standard × exserted, standard × inserted, and exserted × inserted. Dominance coefficients and estimates of the number of loci involved in control of stigma position from 3 field-grown crosses are presented in Table 2. Data from 2 greenhouse-grown and 1 other field-grown cross support these results.

These results (Table 2) suggest that about 9 loci control stigma position in these materials. It appears that the standard line (Campbell 28) and the exserted Line 78 contain the same allele and the inserted Line 7 an alternative allele at 6 of these loci. However, each of these three lines contains a unique allele at each of the other 3 loci.

Seed supplies of the inserted parentals are currently limited but should be available by fall 1975 from W. L. George, Jr.

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**Figure 1.** The seven stigma positions used to classify tomato flowers. Arrow indicates the juncture between the fertile (left) and sterile (right) anther tissue.
Table 1. Stigma positions of the parental lines under 1973 winter greenhouse conditions.

<table>
<thead>
<tr>
<th>Parental</th>
<th>Stigma position ± S.E.</th>
<th>Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campbell 28</td>
<td>3.52 ± 0.02</td>
<td>Standard</td>
</tr>
<tr>
<td>Ohio M-R 13</td>
<td>3.44 ± 0.04</td>
<td>Standard</td>
</tr>
<tr>
<td>Ohio W-R 25</td>
<td>3.00 ± 0.20</td>
<td>Standard</td>
</tr>
<tr>
<td>Line 78</td>
<td>1.00 ± 0.00</td>
<td>Exserted</td>
</tr>
<tr>
<td>Line 5</td>
<td>6.62 ± 0.29</td>
<td>Inserted</td>
</tr>
<tr>
<td>Line 7</td>
<td>6.57 ± 0.22</td>
<td>Inserted</td>
</tr>
<tr>
<td>Line 8</td>
<td>5.38 ± 0.03</td>
<td>Inserted</td>
</tr>
<tr>
<td>Line 9</td>
<td>4.00 ± 0.04</td>
<td>Inserted</td>
</tr>
</tbody>
</table>

Table 2. Inheritance of stigma position of 3 crosses grown under 1974 summer field conditions.

<table>
<thead>
<tr>
<th>Cross</th>
<th>Stigma position of F1 ± S.E.</th>
<th>Dominance coefficient</th>
<th>Estimated loci</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campbell 28 X Line 78*</td>
<td>2.54 ± 0.04</td>
<td>0.56</td>
<td>2.97</td>
</tr>
<tr>
<td>Campbell 28 X Line 7*</td>
<td>3.51 ± 0.02</td>
<td>0.96</td>
<td>9.31</td>
</tr>
<tr>
<td>Line 78 X Line 7†</td>
<td>2.66 ± 0.04</td>
<td>0.76</td>
<td>8.20</td>
</tr>
</tbody>
</table>

* Size of segregating populations was 300 F2 and 140 BC plants.
† Size of segregating populations was 240 F2 and 100 BC plants.

Soressi, G. P. New spontaneous or chemically-induced fruit-ripening tomato mutants.

"da serbo" i.e. a local type frequently grown in home gardens of Campania and Apulia regions. The fruits, because of their very long shelf life, are preserved and eaten during winter. This phenotype has proved to be controlled by a genetic factor, apparently, in fact not completely, recessive because the heterozygous fruits are in some way distinguishable from both the homozygous ones. On the basis of F1 and backcross progenies this mutant appeared to be allelic (possibly the same) to the nor one recently described by Tigchelaar et al. (TGC 23).

nor² (non ripening fruit). This mutant phenotype was collected in southern Italy during 1968. It is a tomato tomato type "Tondo liscio di Pescara". The ripe fruit appears like nor² except for a slightly more pink-coloured pericarp and a less strong skin. The allelism test (F1 and BC1) showed the mutant to be controlled by a recessive gene allelic to the nor². Because of the peculiar fruit phenotype we need to check the segregation ratios further.

hp-² (high pigment). This mutant phenotype, mimic to the previous one described (hp), enhances all the pigments of the green and red mature fruits. When the green shoulder trait is present, the hp-²/hp-² unripe fruit is...
completely dark green like a pepper fruit. Test of allelism indicates this phenotype to be controlled by a single recessive gene non-allelic with hp. It was EMS-induced (0.8%, 25°C, 48 h) in S. Marzano type (cv. Garim). All these fruit-ripening mutants prove to be very interesting from both the theoretical and practical points of view.

Soressi, G. P., and F. Salamini
A monomendelian gene inducing parthenocarpic fruits.

The chemically induced mutant short anthers (sha) (TGC 20) was originally characterized by semi-sterility and by bearing a high percentage of parthenocarpic fruits. This second feature seemed to be a pleiotropic effect of a single recessive gene. The subsequent extensive analysis of wide F2 segregating progenies gave evidence of the existence of a second recessive gene, linked with sha, clearly responsible for the early ovary development without pollination and fertilization. The symbol proposed for this new genetic factor is pat (parthenocarpic fruit).

On the basis of the preliminary F2 data, the crossover value between sha and pat is about 0.12%. It is unlikely the two traits result from a double mutation event; possibly the short anther phenotype made easier the discovery of the gene for parthenocarpy likely preexisting in the stock under experiment, cv. Roma.

Stamova, L., M. Yordanov, Z.
Stoyanova New sources of Cladosporium fulvum Cooke resistance.

The search for new sources of leaf mould resistance in the tomato is of exceptional importance because of the great variability of physiological races of the fungus Cladosporium fulvum Cke.

During the past two years the breeding material at disposal in the Maritsa Vegetable Crops Institute - Plovdiv, including 160 hybrids derived from crosses of L. esculentum with L. hirsutum, L. minutum, L. pimpinellifolium Sta Cruz and L. chilense, was tested for resistance to the different Cladosporium fulvum races. In a progeny of the L. esculentum cv. Ace X L. chilense cross, resistance to the new races of the C group (races 1, 2, 4 and 2, 3, 4) was observed. From a total of 120 plants, 80 proved resistant and 40, highly susceptible.

The mode of inheritance of the C. fulvum resistance observed in L. chilense is being studied.

The possibility of using L. chilense as a source of C. fulvum resistance has a great significance for tomato breeding because the same species is also a carrier of resistance to other diseases such as TMV, Corky root and Leveillula taurica.

Trinklein, D. H., and V. N. Lambeth
Heritability of blossom-end rot.

Blossom-end rot (BER) of tomato, a physiological disorder involving Ca metabolism, was shown by Greenleaf and Adams (J. ASHS 94:248-250, 1969) to be genetically controlled in several Auburn University breeding lines. Differences in tolerance and susceptibility to BER also have been noted among Mo. AES breeding lines for many years.
In 1973 a six-parent diallel field study provided additional data on BER heritability (Tables 1 and 2). Griffing's Method I—Design I (fixed effects model) was used for data analysis. BER incidence refers to % fruit with lesions; severity reflected number and size of lesions.

Table 1. Parental performance and GCA estimates for BER.

<table>
<thead>
<tr>
<th>Parental line</th>
<th>Parental performance</th>
<th>GCA estimates</th>
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<tbody>
<tr>
<td></td>
<td>Incidence</td>
<td>Severity</td>
</tr>
<tr>
<td>Mo. 76-1-60-8</td>
<td>35.35</td>
<td>1.10</td>
</tr>
<tr>
<td>Mosage</td>
<td>2.78</td>
<td>0.07</td>
</tr>
<tr>
<td>Floralou</td>
<td>0.65</td>
<td>0.01</td>
</tr>
<tr>
<td>PI 283953</td>
<td>0.62</td>
<td>0.01</td>
</tr>
<tr>
<td>Vogue</td>
<td>0.20</td>
<td>0.004</td>
</tr>
<tr>
<td>PI 118785</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>LSD AxB (P=.05)</td>
<td>0.90</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Table 2. Specific performance of F1 and reciprocal F1 hybrids for % BER.

<table>
<thead>
<tr>
<th></th>
<th>Mo. 76-1-60-8</th>
<th>Vogue</th>
<th>PI 283953</th>
<th>Floralou</th>
<th>Mosage</th>
<th>PI 118785</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mo. 76-1-60-8</td>
<td>--</td>
<td>2.18</td>
<td>4.85</td>
<td>3.05</td>
<td>19.04</td>
<td>3.77</td>
</tr>
<tr>
<td>Vogue</td>
<td>1.47</td>
<td>--</td>
<td>0.00</td>
<td>0.43</td>
<td>0.47</td>
<td>0.12</td>
</tr>
<tr>
<td>PI 283953</td>
<td>6.22</td>
<td>0.35</td>
<td>--</td>
<td>1.23</td>
<td>1.85</td>
<td>0.13</td>
</tr>
<tr>
<td>Floralou</td>
<td>0.83</td>
<td>0.00</td>
<td>0.13</td>
<td>--</td>
<td>0.54</td>
<td>0.30</td>
</tr>
<tr>
<td>Mosage</td>
<td>11.80</td>
<td>0.68</td>
<td>1.11</td>
<td>0.10</td>
<td>--</td>
<td>0.78</td>
</tr>
<tr>
<td>PI 118785</td>
<td>2.51</td>
<td>0.14</td>
<td>0.11</td>
<td>0.05</td>
<td>0.63</td>
<td>--</td>
</tr>
<tr>
<td>LSD AxB (P=.05)</td>
<td>= 1.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The parental lines vary greatly in susceptibility or tolerance by both criteria of measurement. Mo. 76-1-60-8 and Mosage were highly susceptible; PI 118785, a small-fruited introduction from Venezuela, was highly tolerant. Tolerance or susceptibility was readily transmitted to the progeny, as shown in both general combining ability (GCA) and specific performance of the F1's. In an accompanying study, the regression of genotype for fruit ripening trait versus BER incidence suggested that susceptibility is additive-ly inherited.

Whalen, R. H. A useful chromosome 8 mutant. A new chlorophyll mutant, designated yellow-green-8, \((yg-8)\) appeared in the M2 generation following EMS treatment of cv. 'Red Cherry' seeds. Leaves of seedlings are bright yellow, and classification is excellent even in the cotyledon stage. It is recessive and homozygous viable.
The results of F₂ repulsion linkage tests of yg-8 with other seedling mutants are given in the table. The contingency chi-squares were homogeneous over all families of each cross. Strong linkage with ae on chromosome 8 is indicated. The ae - yg-8 distance is about 19 map units by the product method. The F₂ transmission of yg-8 was about 25% in half the crosses and about 15% in the others.

Table. F₂ repulsion linkage tests of yg-8 and other seedling mutants.

<table>
<thead>
<tr>
<th>Tester mutant</th>
<th>++</th>
<th>+t</th>
<th>yg-8 t</th>
<th>yg-8 t</th>
<th>Total</th>
<th>Adj. cont.</th>
<th>Chi square</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>360</td>
<td>91</td>
<td>63</td>
<td>21</td>
<td>535</td>
<td>0.7</td>
<td></td>
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<tr>
<td>aa</td>
<td>700</td>
<td>224</td>
<td>232</td>
<td>71</td>
<td>1227</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>ae</td>
<td>364</td>
<td>190</td>
<td>94</td>
<td>4</td>
<td>652</td>
<td>0.0</td>
<td>34.9**</td>
</tr>
<tr>
<td>af</td>
<td>337</td>
<td>103</td>
<td>68</td>
<td>22</td>
<td>530</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>ag</td>
<td>239</td>
<td>76</td>
<td>81</td>
<td>20</td>
<td>416</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>ah</td>
<td>416</td>
<td>129</td>
<td>75</td>
<td>29</td>
<td>649</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>aos</td>
<td>488</td>
<td>110</td>
<td>167</td>
<td>36</td>
<td>801</td>
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<tr>
<td>bts</td>
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<td>37</td>
<td>14</td>
<td>419</td>
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</tr>
<tr>
<td>c</td>
<td>352</td>
<td>99</td>
<td>60</td>
<td>24</td>
<td>535</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>348</td>
<td>103</td>
<td>60</td>
<td>24</td>
<td>535</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>207</td>
<td>62</td>
<td>45</td>
<td>8</td>
<td>322</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>hl</td>
<td>358</td>
<td>93</td>
<td>68</td>
<td>16</td>
<td>535</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Me</td>
<td>79</td>
<td>279</td>
<td>16</td>
<td>49</td>
<td>423</td>
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<td>41</td>
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<td>419</td>
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<tr>
<td>sn</td>
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<td>96</td>
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<td>102</td>
<td>67</td>
<td>23</td>
<td>530</td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>

Hybrid material derived from a L. esculentum cv. Ace X L. chilense cross was grown in 1972-73 under conditions of late glass house production. On a naturally infected background, individual plants showed very high Leveillula taurica resistance. The progenies of the selected resistant plants were sown in 1974 and inoculated with a spore suspension. The infection degree was recorded 25 days after inoculation.

Two of the 16 progenies inoculated proved homozygous resistant while in the remaining 14, segregation and varying degrees of infection were observed.

Studies on the type of resistance and the mode of inheritance are still in progress.
PART II

ADDITIONS AND CORRECTIONS TO THE
LIST OF MEMBERS

(Last complete Directory in TGC #24)

Adachi, Taiji, Inst. of Plant Breeding, Fac. of Agriculture, Miyazaki Univ.
Miyazaki, 880, Japan

Anagnostakis, Sandra L., Genetics Dept., Conn. Agric. Exp. Sta., Box 1106,
New Haven, CT 06504

Atanassova, B., Inst. of Genetics & Plant Breeding, Sofia 13, Bulgaria

Andersen, W. Ralph, Dept. of Botany, BYU, Provo, UT 84602

Andrasfalvy, András, Hort. Res. Inst., 1775 Budapest XXII. Park u 2-4,
Hungary

Angell, Frederick, A. L. Castle, Inc., P. O. Box 279, Hollister, CA 95023

Asian Veg. Res. & Dev. Center Library, P. O. Box 42, Shanhua, Tainan, 741,
Taiwan, Republic of China

Bessey, Paul M., Dept. of Horticulture, 325H Bio. Sci. East, Univ. of
Arizona, Tucson, AR 85721

Breidenbach, R. W., Dept. of Agronomy, Univ. of Calif., Davis, CA 95616

British Library, Lending Div., Accessions Dept., Boston Spa, Wetherby,
Yorkshire LS23 7BQ, England

Cadregar, Carl, Jos. Harris Co., Inc., Moreton Farms, Rochester, NY 14624

CAIA, S.A.R.L., P. O. Box 20, Elvas, Portugal

Clark, Sharron A., 3224 Oak Flat Road, San Jose, CA 95131

Clayberg, Carl, Dept. of Horticulture, Kansas State Univ., Manhattan,
KS 66502

Contant, R. B., Faculty of Agric. Univ. of Nairobi, P. O. Box 30197,
Nairobi, Kenya

Costa, C. P. da, Dept. of Genetics, Sao Paulo Univ., Caixa Postal 83,
Piracicaba, Sao Paulo 13.400, Brazil

Creech, Roy G., Mississippi State Univ. Dept. of Agronomy, P. O. Box
5248, MS 39762

Duesing, John H., Yale Univ., Dept. Biology, Osborn Memorial Labs, New
Haven, CT 06520

Embassy of Israel, Washington, D. C. 20008

Emery, George C., 420 Martin St., Sun Prairie, WI 53590

Ewaniuk, Peter, 511 1/2 E. Jasper Rd., Heber, CA 92249

Farkas, J., Veg. Crops Res. Inst., P. O. Box 116, 6001 Kecskemét, Hungary

Fuqua, Mack C., TAMU Agric. Res. & Ext. Center, Drawer E., Overton, TX 75684

Geise, C. E., Del Monte Corp., P. O. Box 36, San Leandro, CA 94577

Gill, Bikram Singh, Microbiology Dept. Wash. Univ. School of Medicine,
Box 8093, St. Louis, MO 63110

Hedde, L., Les Graines Caillard, 84 - Sarrians, France


Howes, Paul B., Univ. of Mass., Dept. Plant & Soil Sciences, Amherst, MA 01002

INIA, Estación Experimental Agronómica, Biblioteca, Casilla Correo 8, La
Consulta, Mendoza, Argentina

IITA, Librarian, P. M. B. 5320, Ibadan, Nigeria

John, C. A., 103 Colonial Dr., Cleveland, MS 38732

Kramer, Thomas, Peto Italiana S. r. l., Casella Postale 173, 43100 Parma,
Italy
Leski, Bogdan, Dept. of Plant Pathology, 26/30 Kakowiecka St., Warsaw, Poland.
Lyall, L. H., Res. Station, Agriculture Canada, Res. Branch, Ottawa, Ontario, Canada K1A 0C6
Lopez-L, Fidel, Depto. de Hortalizas, CIAS, Apdo. Postal 356, Culiacan, Sin. Mexico
Marwan, M., Dept. of Genetics, Fac. of Agric., Ain Shams Univ. Shoubra, El Kheime, Cairo, Egypt
McComb, J. A., Dept. of Environmental & Life Sciences, Murdoch Univ., Murdoch, Western Australia 6153
Mowe, B. L., Sembawang Field Exp. Station, 10 1/2 ms Sembawang Rd., Singapore 26, Malaya
Popova-Konstantinova, M., Inst. of Genetics & Plant Breeding, Sofia 13, Bulgaria
Rendon-Poblete, M. C. Edgar, INIA, Depto. de Hortalizas, Apartado 112, Celaya, Gto., Mexico
Stamova, Lilyana, Maritsa Institute for Vegetable Crops, Povdiv, Bulgaria
Stilwell, Martin R., Av. Principal de Miraflores, Lote 120 - 4o Esq., Algés, Portugal
Tarhan Kitabevi (Tarhan Bookstore), Bayindir Sokak 17, Yenisehir Ankara, Turkey
Villareal, Ruben L., Asian Veg. Res. Dev. Center, P. O. Box 42, Shanhua, Tainan 741, Taiwan, Rep. of China
Wilson, Geo. F., Int. Inst. of Tropical Agric., Oyo R., P. M. B. 5320, Ibadan, Nigeria
Zobel, Richard W., Monsanto Co., 800 N. Lindbergh Blvd., St. Louis, MO 63166

PART III
STOCK LIST

(See TCG #22 for last list)

Stocks desired

McComb, J. A. cv. Johannesfeuer seed
Dept. Environmental & Life Sciences
Murdoch University
Murdoch, Western Australia 6153
PART IV

BIBLIOGRAPHY OF PAPERS ON TOMATO GENETICS AND BREEDING

Published in 1973


Brezhnev, D. D., 1973 [Development of new stamenless tomato lines which can be used for hybridization.] \textit{S-kh. Biol.} 8(6):903-907. [Russian; English summary]


Cerchez, N., 1973 [Research on the relations between the male parent and hybrid progeny in tomato.] Cercetai Agronomice în Moldova (1973) 6 (January/March): 91-98. From Abstracts of Romanian Scientific and Technical Literature (1973) 6(3). Abst. 1875. [Romanian]


Khafizov, R., 1973 [Tomato mutants with a high dry-matter content in the fruit.] Kartofel' i Ovoeshki No. 11:31. [Russian]


Popov, V. V., 1973 [Comparative cytogenetics of genus Lycopersicon Tourn.] Sel'skokhoz Biol. 8(1):33-41. [Russian; English summary]


PAPERS OMITTED IN PRECEDING BIBLIOGRAPHIES

1970


1971


Gareev, M. E., 1971  [Induced genome mutations in the tomato.] KyrgSSR Ittimber Akad. Kabanary No. 5, 53-59 from Referativnyi Zhurnal (1972) 2.55.75.  [Methods of obtaining haploids (using irradiated pollen) and tetraploids are described.] [Russian]


1972


Turkov, V., and V. Nushikyan, 1972 [Induced mutagenesis in tomatoes.] In Indutsirovany. mutagenez u rast. Tallin, Estonian SSR. pp.246-251. [Russian; English summary]

Yakovleva, I., 1972 [Induced dominant mutations of tomato and their importance in breeding.] In Indutsirovany. mutagenez u rast. Tallin, Estonian SSR. 252-260. [Russian; English summary]
PART V
FINANCIAL STATEMENT
Jan. 1, 1974 - Dec. 31, 1974

Balance from 1973

Receipts

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<th>Description</th>
<th>Amount</th>
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<td>Sale of back issues</td>
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<td><strong>$621.00</strong></td>
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<td><strong>$1458.34</strong></td>
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Expenditures

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MEMBERSHIP STATUS
(to Dec. 31, 1974)

<table>
<thead>
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<th>Year</th>
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<td>131</td>
</tr>
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<td>40</td>
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<td>1</td>
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<tr>
<td></td>
<td><strong>318</strong></td>
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</table>
APPENDIX

Interim Report of the Committee on Varietal Pedigrees 1974


COMMITTEE ON VARIETAL PEDIGREES

Alexander, L. J.
Andrasfalvy, Andras (Hungary)
Angell, F. F.
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)
Lana, E. P.
Leeper, Paul
Balny, B. (Hungary)
Odlan, M. L.
Pecaut, M. (France)
Peto, Howard B.
Robinson, R. W.
Sumeghy, J. B. (Australia)
Tomes, M. L.
Doucet, Roger. 1974. Station de Recherches Agricoles, St-Hyacinthe, Quebec release notice.

PRECOCIBEC (DO-118)
Pedigree:

Alpha 5 x PI250432-45-5

Characteristics:

- very early, cold setting ability, medium sized firm fruits, early market type.

MASKABEC (DO-157S6)
Pedigree:

(Alpha 5 x PI250432-45-5) x Canabec

Characteristics:

- early, cold setting ability, medium sized fruits, very red.

YORKBEC (DO-331S4)
Pedigree:

New Yorker x PI263726-24-1

Characteristics:

- early - midseason, medium sized fruits, good quality, heavy cropper.

(continued)
USABEC (DO-331\textsubscript{S\textscript{2}})

Pedigree:

New Yorker x PI263726-24-1.

Characteristics:

\textit{sp, u, cr}, early mid-season, medium sized fruits, good quality, very heavy cropper.

ITABEC (DO-332\textsubscript{S})

Pedigree:

\( \text{(Alpha 5 x PI250432-45-5) x I}_{12}\text{S}_{8}. \)

\textit{I}_{12}\text{S}_{8} is a selection of breeding line S63D-1, F\textsubscript{3} from Smithfield Experimental Farm, Trenton, Ontario.

Characteristics:

\textit{sp, u}, early, medium-late fruits of good quality, heavy cropper.

KEWALO (Hawaii Selection 7959)
Pedigree:

L. pimpinellifolium (Jusl.) Mill.
P.I. 127805A

Sel. 5808-2 x Anahu

Backcross selections selfed and selected over 15 year period.

Sel. 7959 (KEWALO)
(7 gen. from backcross)

Characteristics:

sp. u, I, Sw^a, Sm, Mi, bacterial wilt resistance at moderate temperature (below 27 C.) No bitterness. Parental stock for multiple disease resistant F_1 hybrids having bacterial wilt resistance in both parents.


MAC PINK
Pedigree:

Unnamed pink P_1 x Homestead

Coldset x 50-B-8

MAC PINK

Characteristics:

sp. u, y, high early yield, fresh market type.

MELFORT
Pedigree:

Backcross Morden BB3 x Earlinorth

Characteristics:

sp., u(?), earlier and superior fruit quality to Mustang, home garden type for Canadian Prairie Provinces.

BOOSTER
Pedigree:

Backcross Morden BB3 x Earlinorth.

Characteristics:

sp., fruit larger and more crack resistant than those of Rocket, early home garden type for Canadian Prairie Provinces.

PEMBINA
Pedigree:

Backcross Earlinorth x Morden BB3.

Characteristics:

sp., earlier, more productive and smoother than Starfire. Suitable for "tube-type" packaging.


USDA Line T3691-228 (STEP 608)
Pedigree:

\[ F_6 \left( \text{Rutgers x Carlton's Imperator} \right) \times \text{Campbell Soup KC109} \ ] \times \text{Florida 407-D3-D2} 

(continued)
Characteristics:

SP, I, Sm, ad, i, conc. maturity, machine harvestable. Fruit 4-5 oz., firm, excellent quality.


USDA Line T3790-339.
Pedigree:

F₄ (High Crimson x Illinois Acc. 1252-hp) x Purdue 68-119-1.

Characteristics:

SP tolerant Sm, early blight, market type. Fruit 4-5 oz., hp, O₉, double normal carotenoid content.