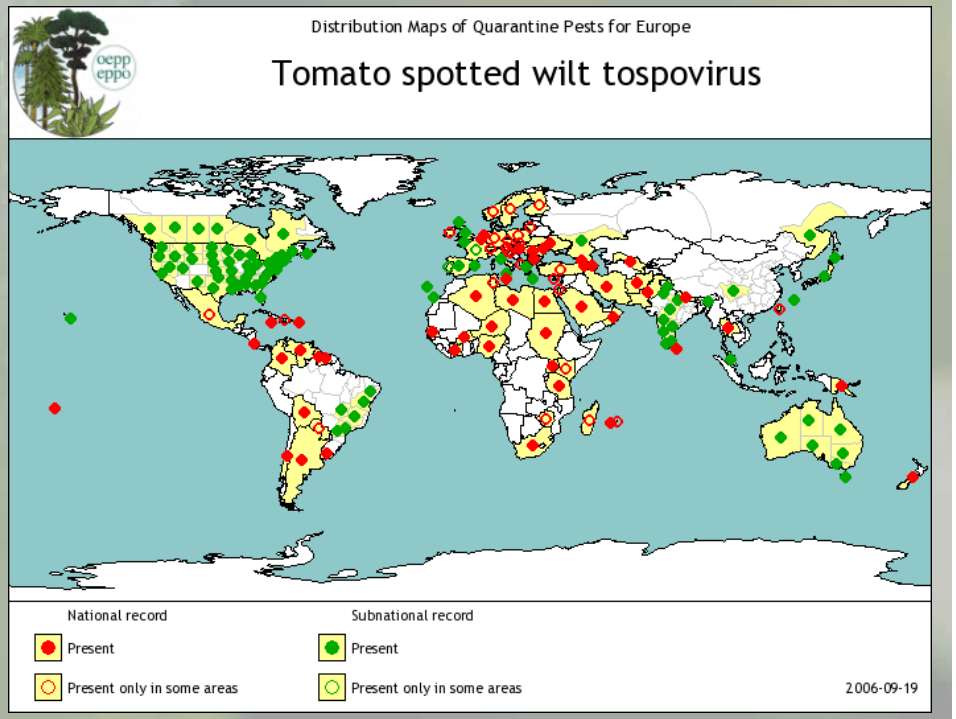
“Localization and Mapping of *Sw-7*, a *Tomato spotted wilt virus* Resistance Gene”

Mikel R. Stevens

John W. Scott, Keri Dockter, Derek O’Neil, and David Price

Tospoviruses

- Thrips are the vectors
- Over 1,000 species are infected
  - Both monocots and dicots
- Over 15 Tospovirus species have been identified



Control of TSWV in Tomato

- Limited success with pesticides
- Limited success with cultural practices

- Success with genetic engineering
  - Using viral genes inserted into the genome
    - Hampered by public acceptance

- Natural resistance

Reports of TSWV Resistance in Cultivated Tomato Lines

- **‘Pearl Harbor’** 1945
- **‘Ray de los Tempranos’** 1949
- **‘Manzana’** 1949
- **‘Anahu’** 1971
- **‘Stevens’** 1986
- **‘Platense’** and **‘Quil-Quil’** 1992

- *Sw-5* was identified in ‘Stevens’ and a Peto Seed line

- **Problem** “only *Sw-5* has provided broad – long lasting resistance”

Resistance in Related Wild Species

- Samuel et al., 1930 — *S. pimpinellifolium*
- Wenholz, 1939 — *S. peruvianum*
- Costa, 1944 — *S. habrochaites*
- Iizuka et al., 1993 — *S. chilense*
- Kumar et al., 1993 — *S. pennellii*

- *Sw-5* was derived from *S. peruvianum*

Reports of *Sw-5* "***Breaking Down***"

- Areas of the world
  - Italy
  - Spain
  - Hawaii
  - Australia
  - And other areas

S. chilense Resistance From LA 1938

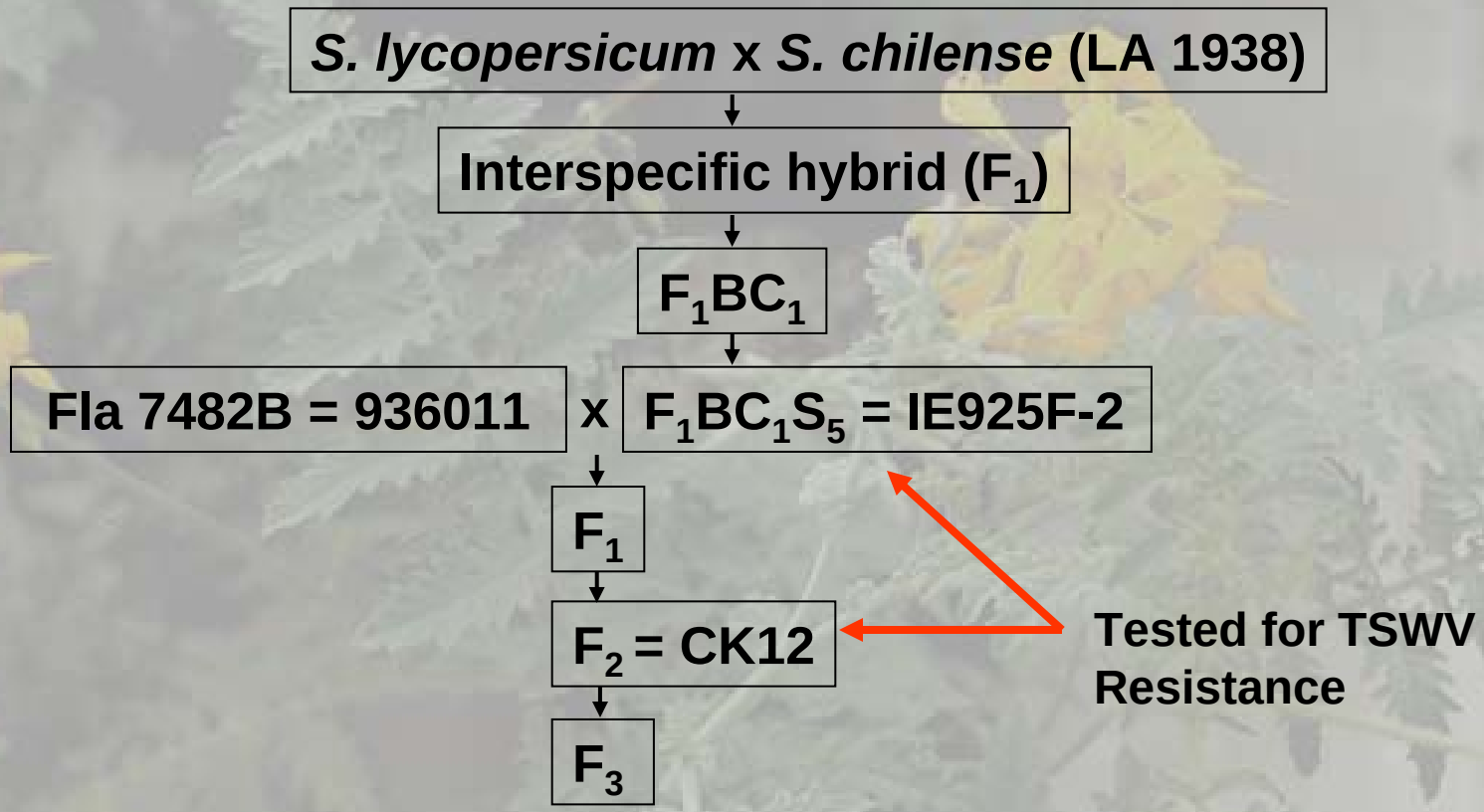
- Has been difficult to work with in the greenhouse:
  - Using artificial inoculation conditions
    - Reason – too severe – overwhelming – unknown for sure – ???
- However clear evidence of resistance in field conditions
  - South Africa
  - Hawaii
  - Panhandle of Florida/Southern Georgia
- **This *S. chilense* resistance is resistant to isolated that overcome *Sw-5***

S. chilense TSWV Resistance

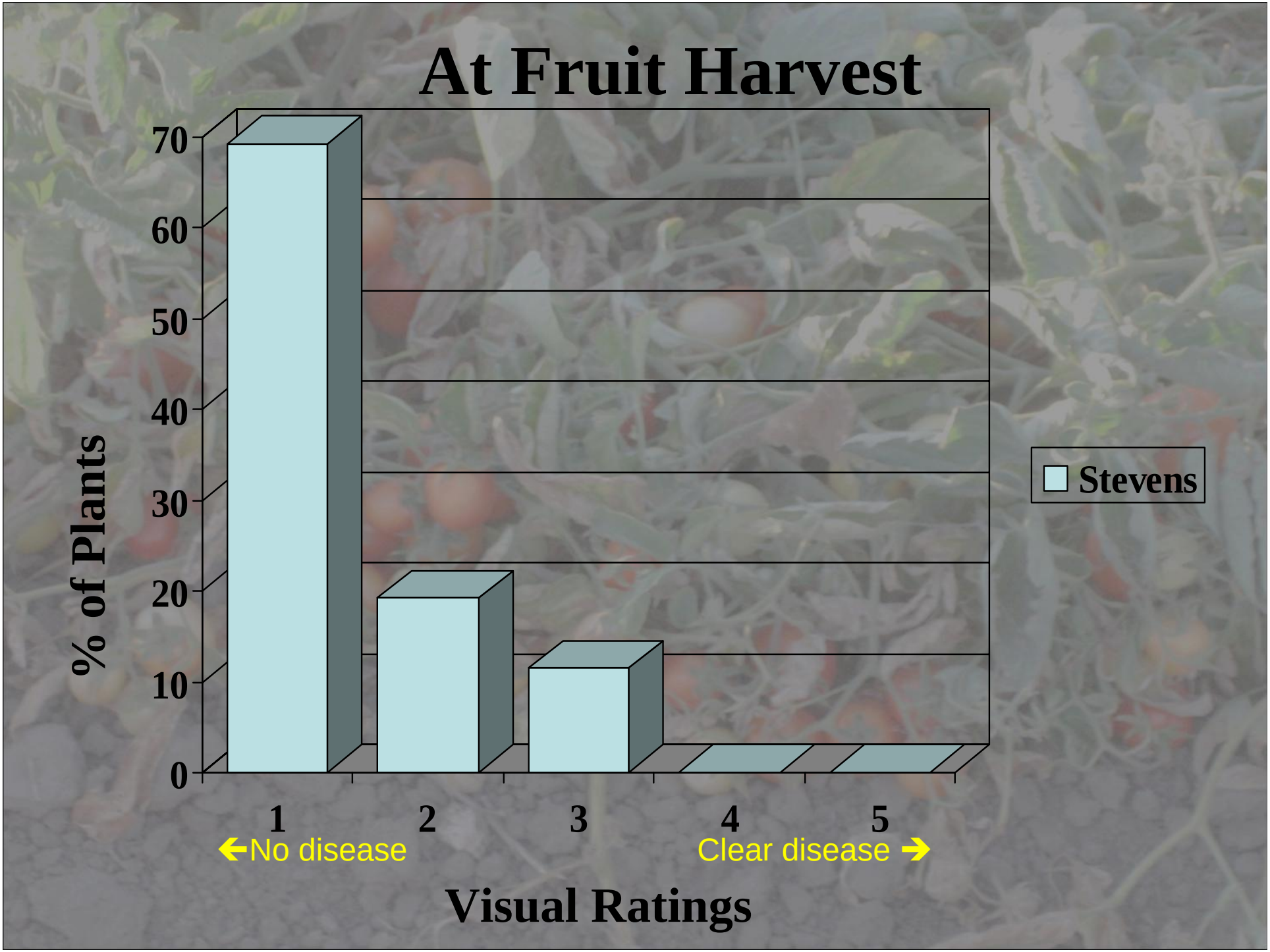
- New sources pedigree
  - *S. lycopersicum* x *S. chilense* (LA 1938)

- Initially selected for geminivirus resistance in Florida
  - Jay Scott

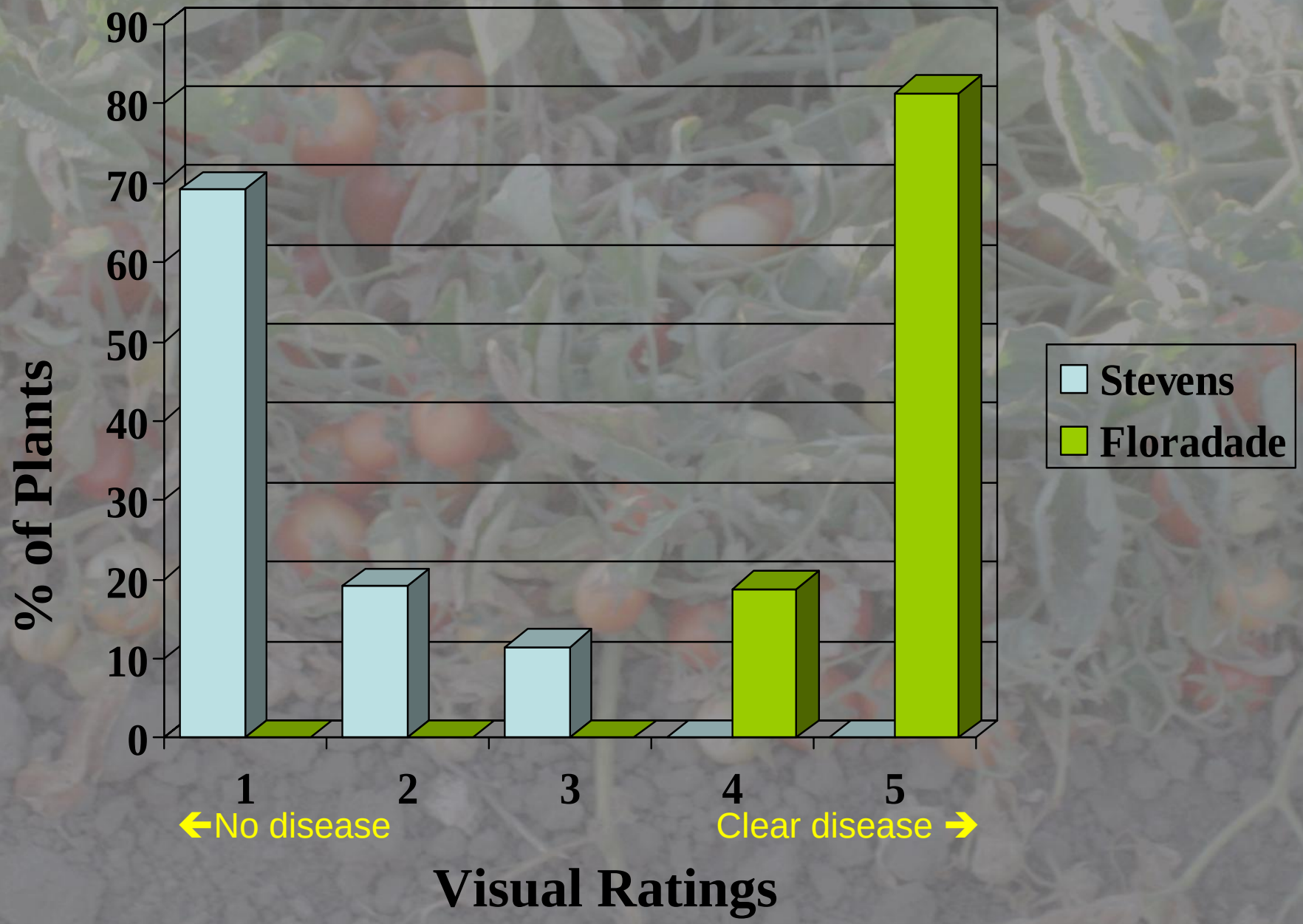
CK12 Pedigree



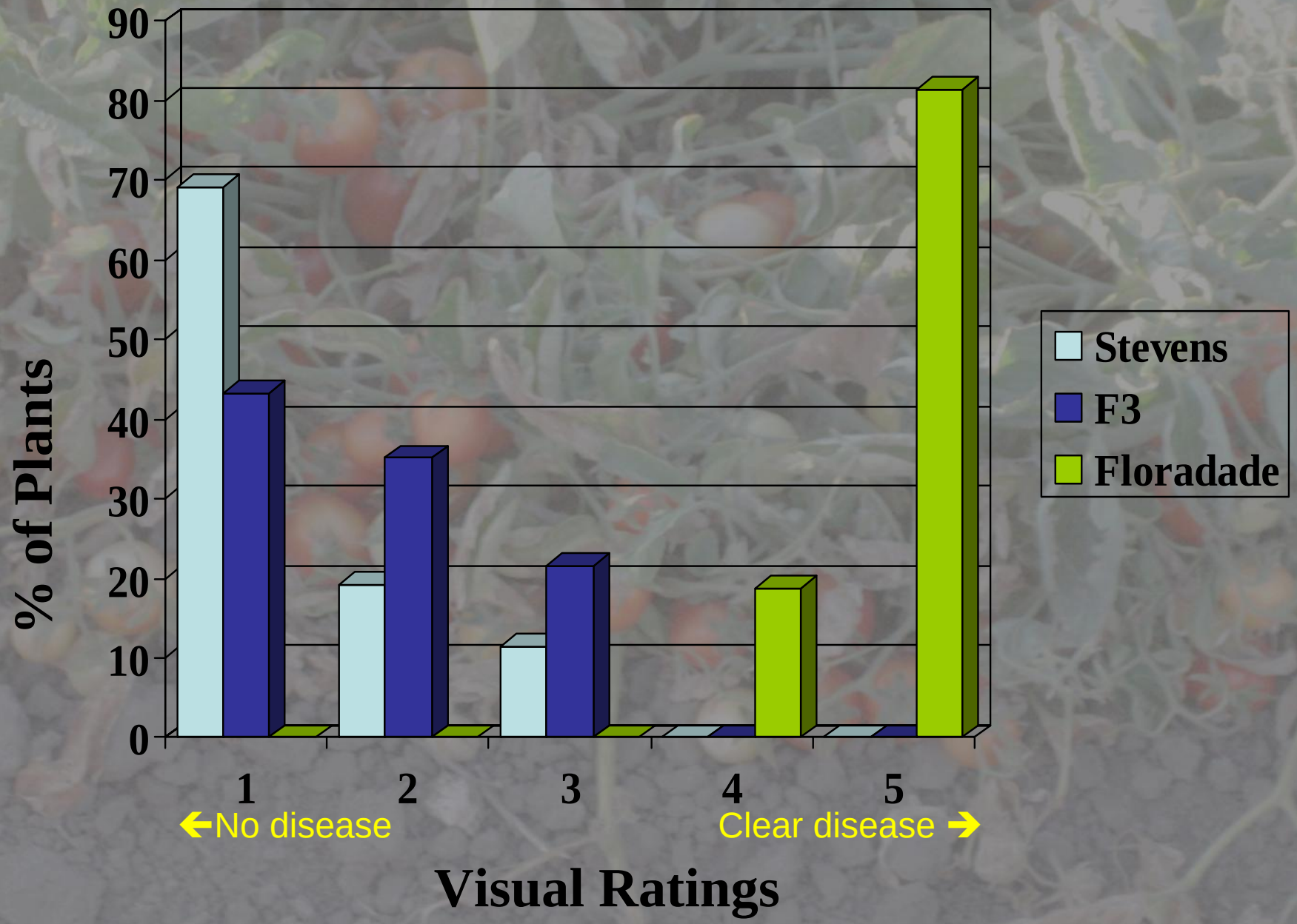
Seed from four F_3 lines were sent to the Cape area of South Africa


At Fruit Harvest
70
60
50
40
30
20
10
0
% of Plants
1
2
3
4
5
←No disease
Clear disease →
Visual Ratings
Stevens

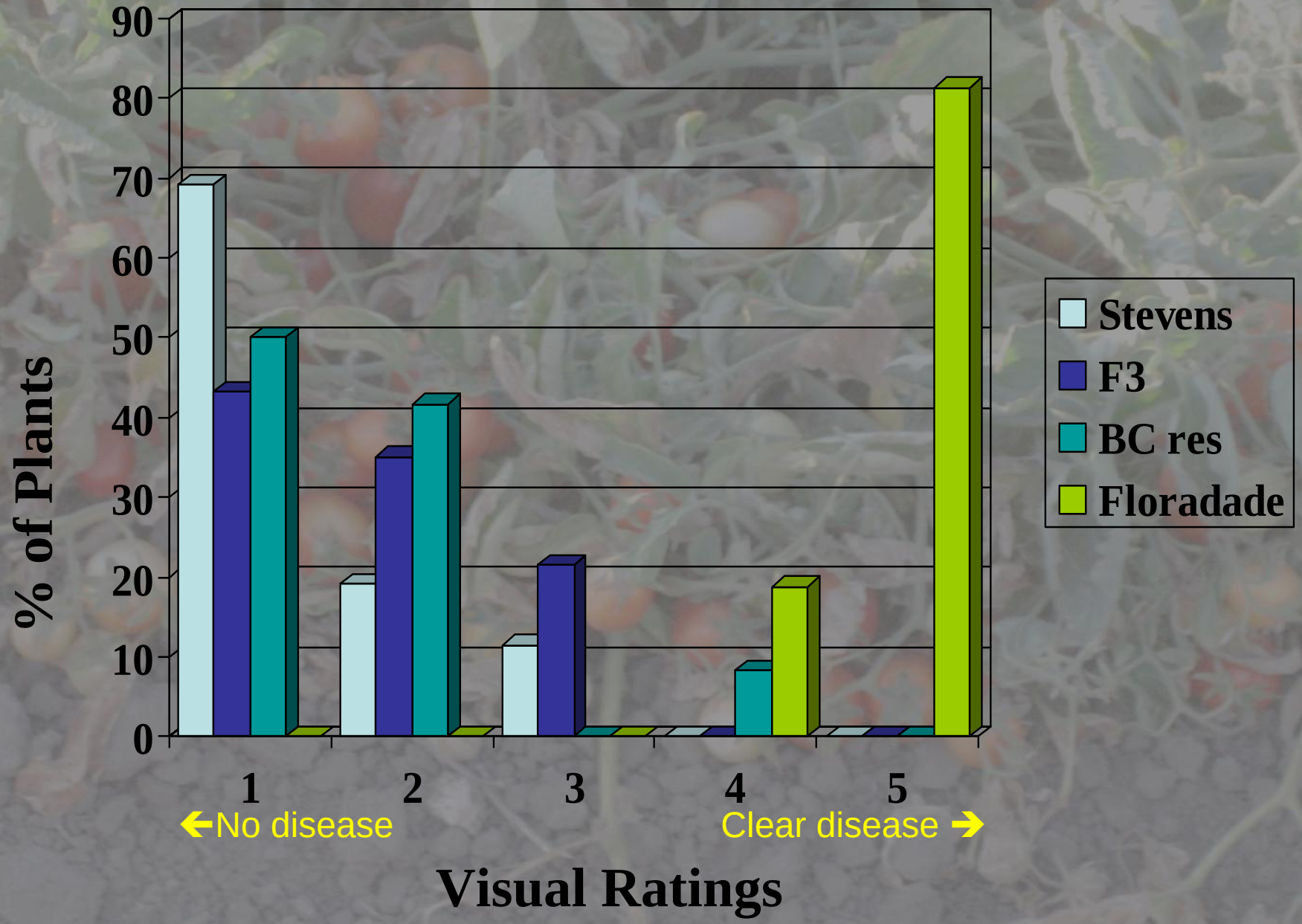
At Fruit Harvest

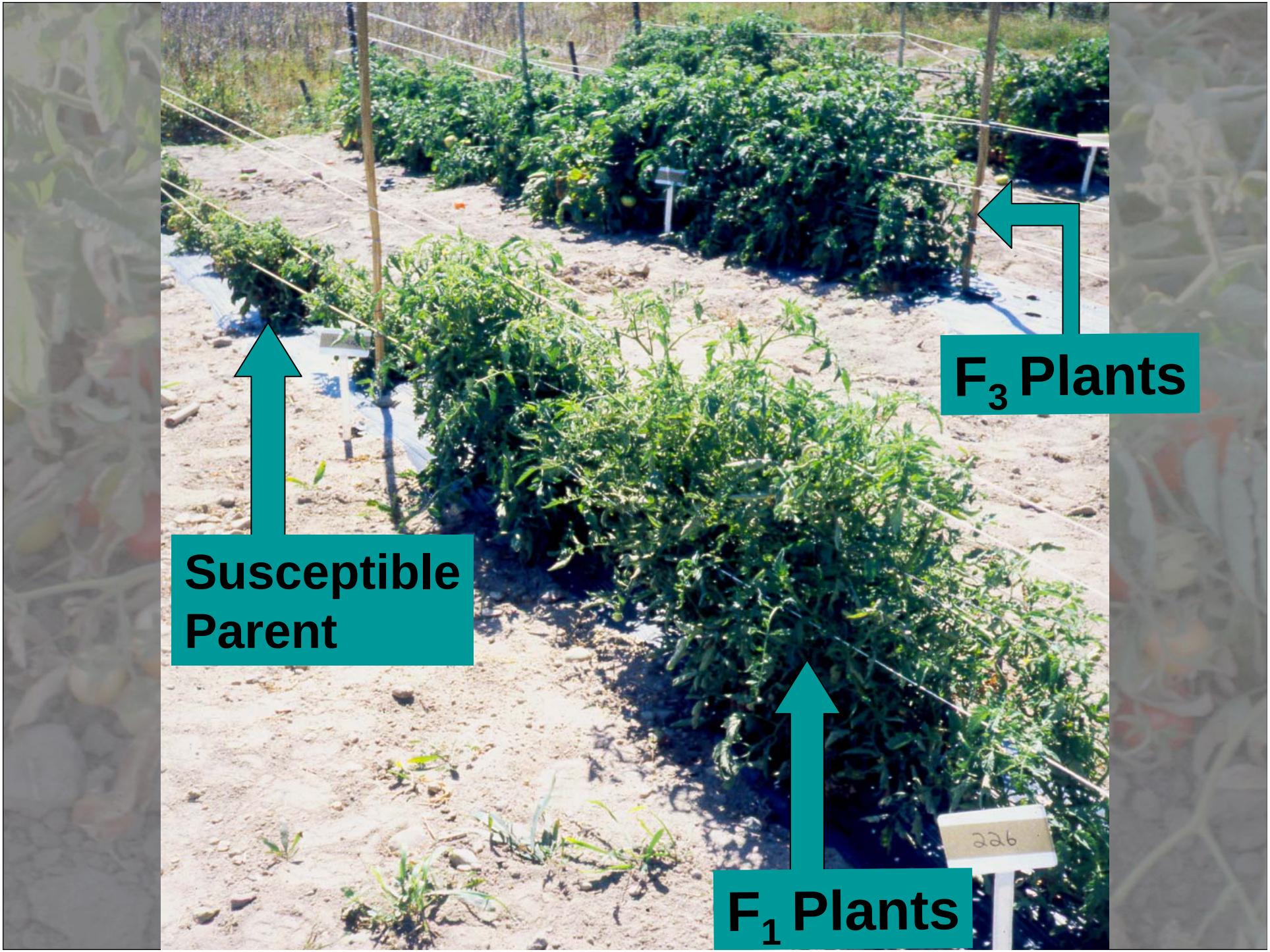


At Fruit Harvest

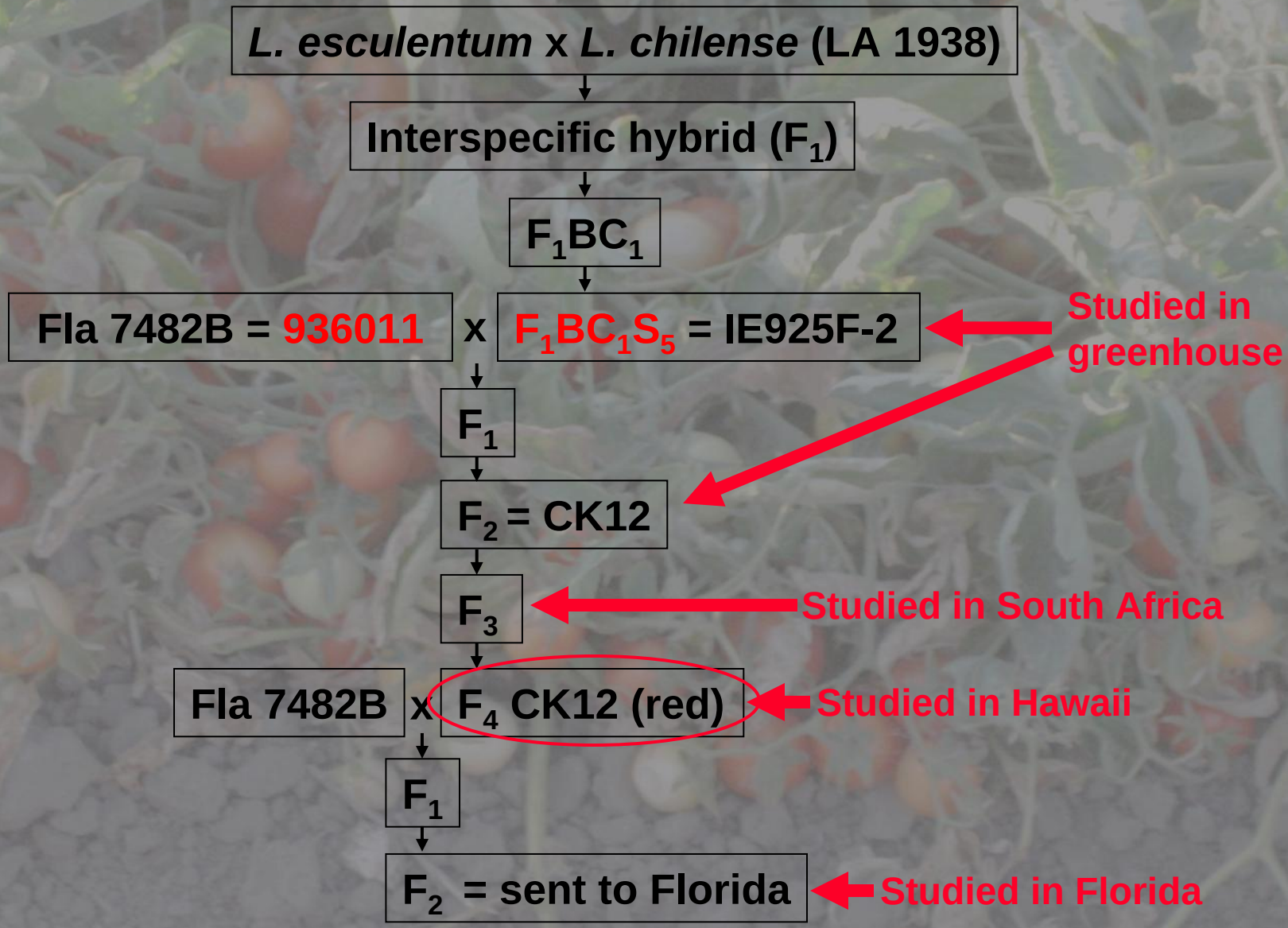


At Fruit Harvest




Susceptible Parent
F_3 Plants
F_1 Plants

CK12 Pedigree

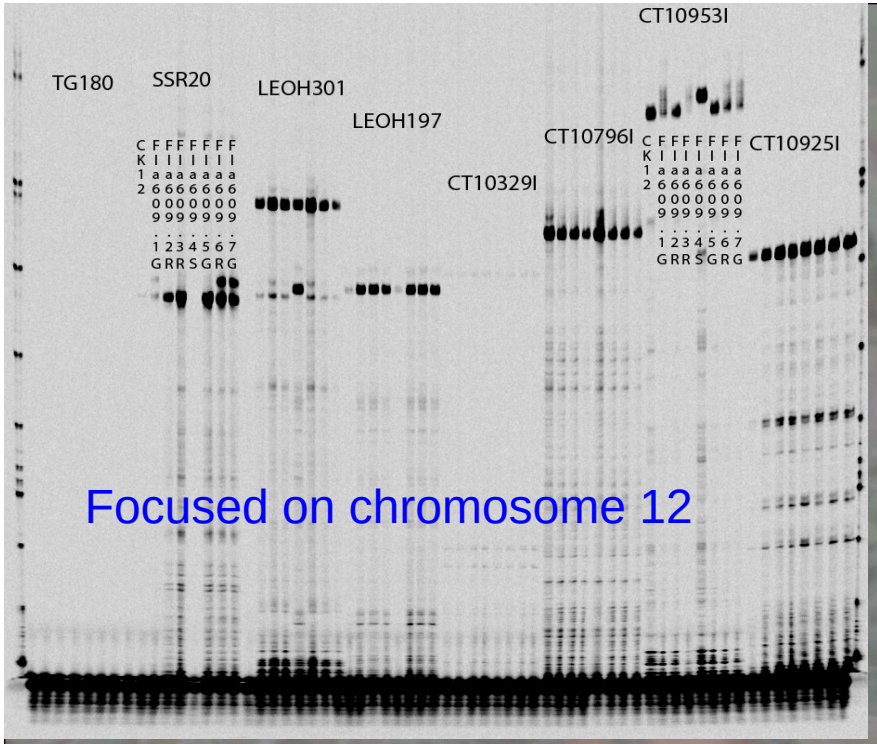


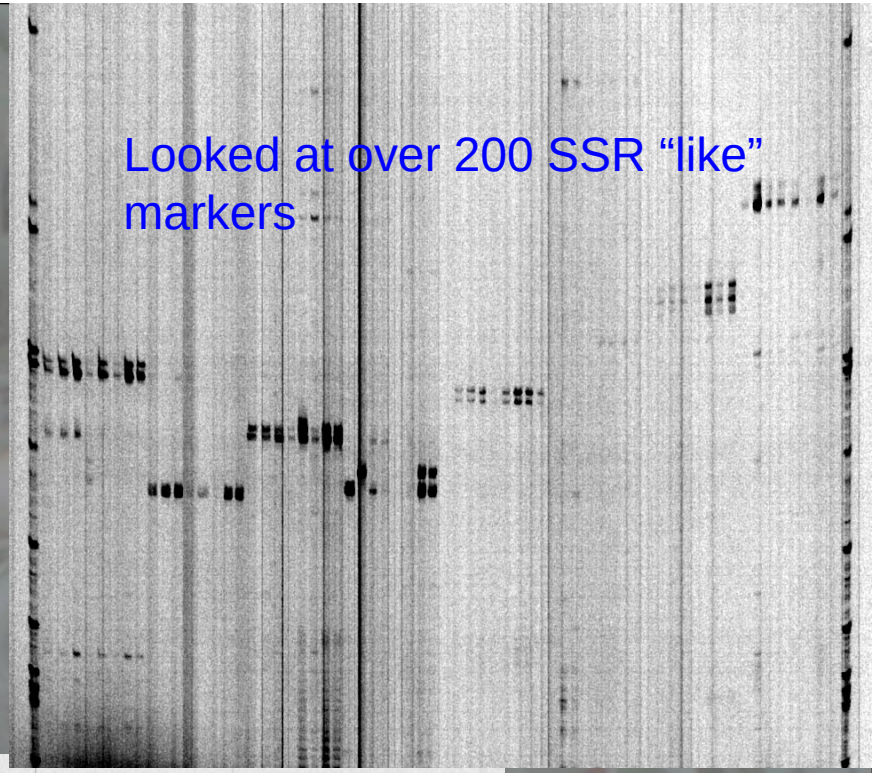
Elucidating *Sw-7* Inheritance

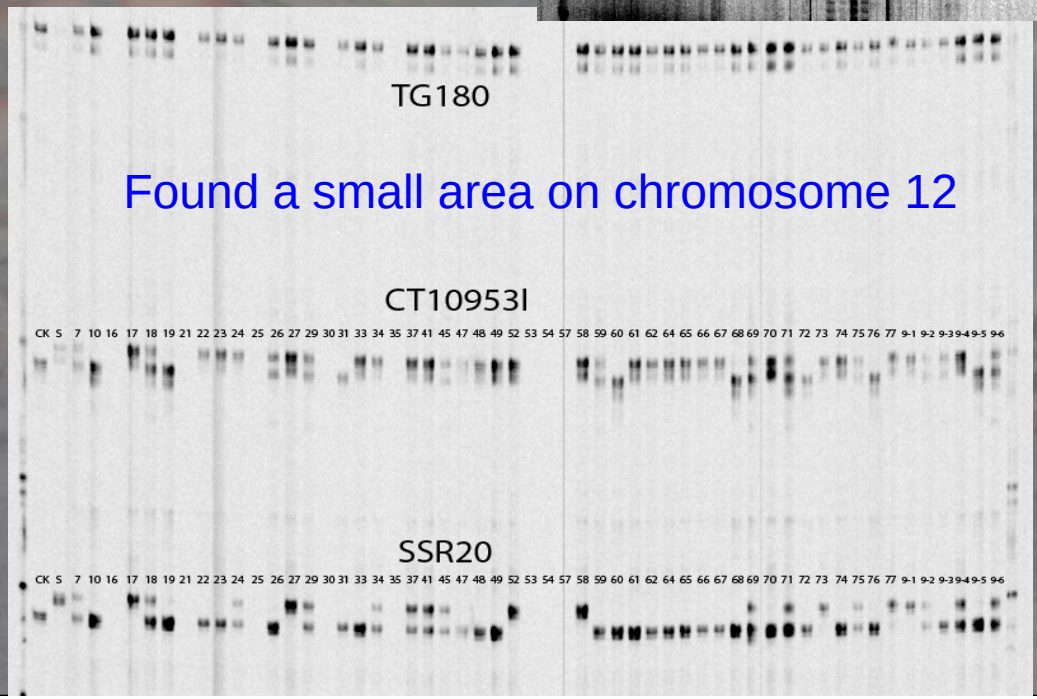
- Field and greenhouse studies demonstrated a single dominant gene
  - Greenhouse studies used a TSWV isolate that overcomes *Sw-5*
  - Suggested name "*Sw-7*"
  - Florida field studies clearly demonstrated that *Sw-5* and *Sw-7* were not allelic

Breeding for *Sw-7* in Florida

- 70+ F_3 lines (selected for resistance at F_2) were field screened
  - 48 were selected for to use for marker work

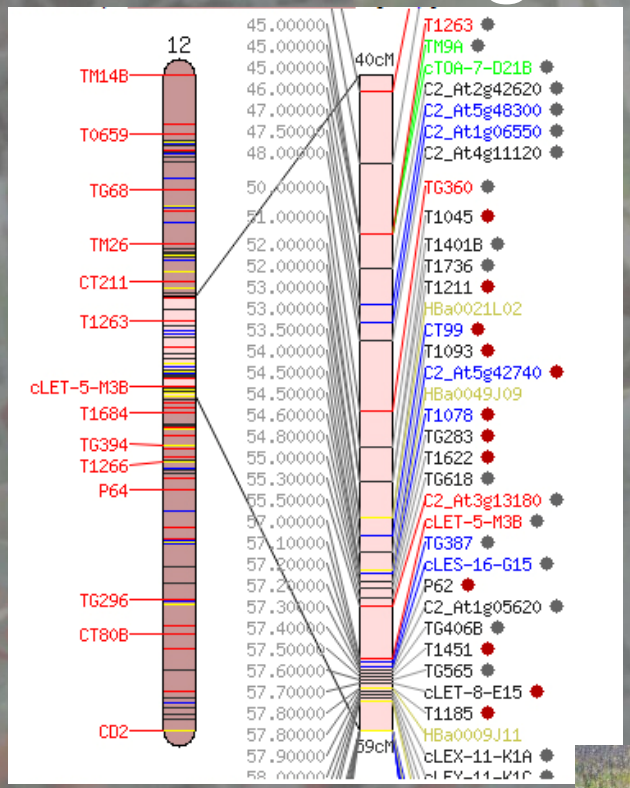

CT10953I
TG180
SSR20
LEOH301
LEOH197
CT10796I
CT10925I
CT10329I
Focused on chromosome 12


Looked at over 200 SSR “like” markers


TG180
Found a small area on chromosome 12
CT10953I
SSR20

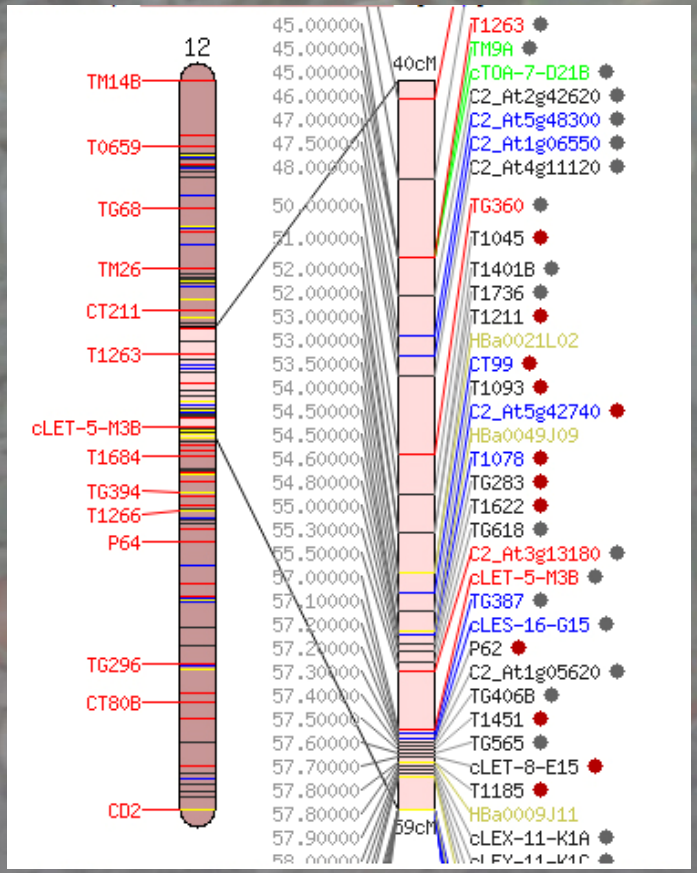
Progress Towards Locating *Sw-7*

- Data suggest *Sw-7* is between
  - 40 (C2_AT4g16710) and 59 (CT189)
    - ExPEN 2000 map
  - Chromosome 12
- This introgression segregates 100% with *Sw-7* resistance



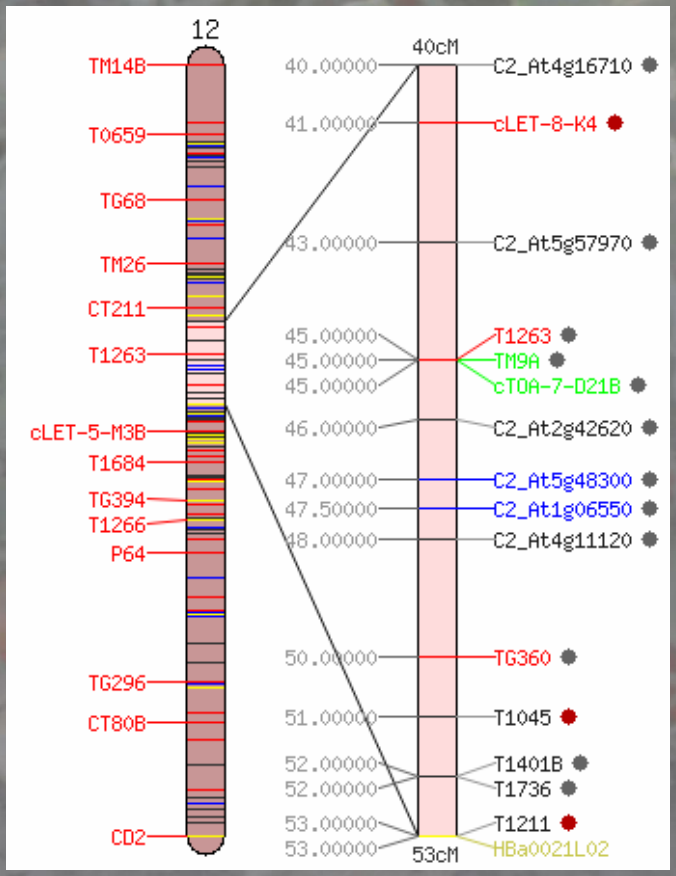
So what do we know about this area?

- There are 46 markers found in the area
- Over half are above 55 cM
- Some not easy to work with



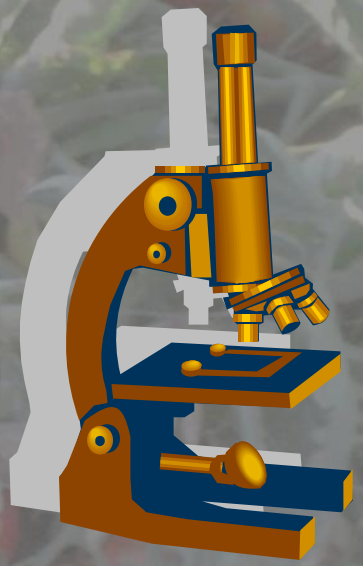
Scrutiny of the Area

- Using the 48 F_3 lines
  - Data suggested *Sw-7* was near 50 cM area
- But then when more markers near that area were checked…
  - Things did not add up



HUM…

- So we took another F_2 population segregating for *Sw-7*
  - No deliberate selection pressure
  - It's purpose was to map this region with *Sw-7* present



What did we Learn???

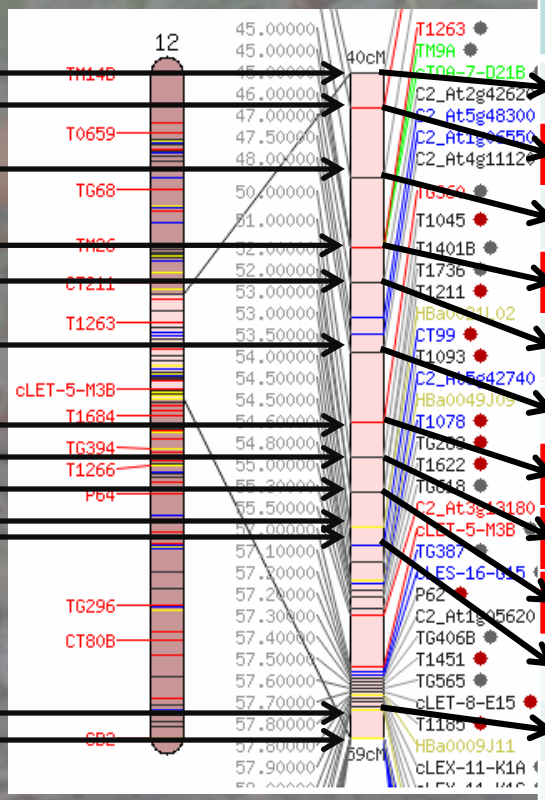
F_2 Population

S Parent

R Parent

Marker

Found on the Ohio Tomato Mapping Resource Database Chromosome 12 at 29.9 Mapping Units



Marker	X^2	Locus
cLET-8-K4	3.64	41.0
C2_At5g57970	92.81****	43.0
T1263	2.81	45.0
C2_At2g42620	145.55****	46.0
C2_At4G11120	2.03	48.0
TG360	0.47	50.0
T1045	141.51****	51.0
T1736	30.85****	52.0
T1211	141.51****	53.0
CT-99	1.38	53.5
SSR20	0.79	58.2
SL10953i	2.03	???

What About 48 F_3 Lines From Florida and These Markers?

- Markers with some resistance testing to-date
  - T1263
  - C2At_g42G1120 ***
  - TG360
  - T1045
  - T1736
  - T211**
  - CT-99***
  - SSR20*
  - SL 10953i*

Marker	X^2	Locus
cLET-8-K4	3.64	41.0
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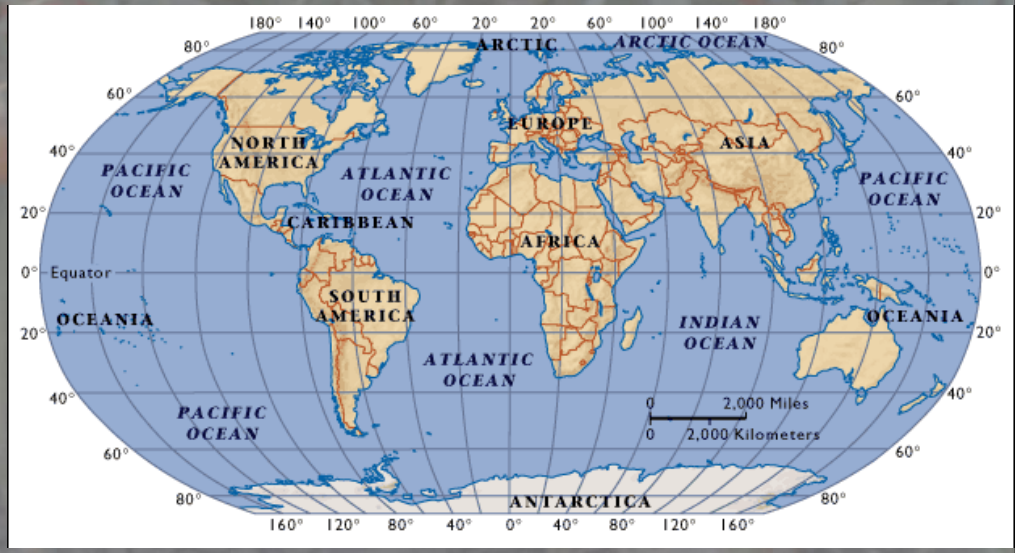
T1736	30.85****	52.0
T1211	141.51****	53.0
CT-99	1.38	53.5
SSR20	0.79	58.2
SL10953i	2.03	???

The rest have insufficient or unreliable data to even “intimate” relationships to *Sw-7*

Importance of Field Trials

- Difficult to work with in artificial inoculation trials
- Need to understand “fitness” of resistance
- Determine effectiveness to unusual isolates (strains) of TSWV
  - Examples:
    - Australia
    - Taiwan
    - Italy
    - South Africa



Develop Commercially Ready Lines

Thanks To The Assistance Of:

- Key undergraduates
  - Fred Memmott
  - David Price
    - Outstand Undergraduate Oral Presentation at the National ASHS Meetings (Phoenix, AZ) in 2007
  - Derek O'Neil
  - Keri Dockter
- And Many others