

# SELECTING TOMATOES FOR THE HAWAIIAN GARDEN

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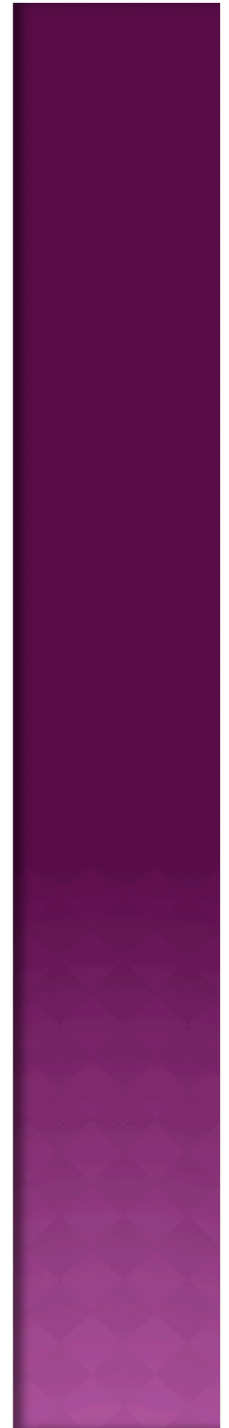
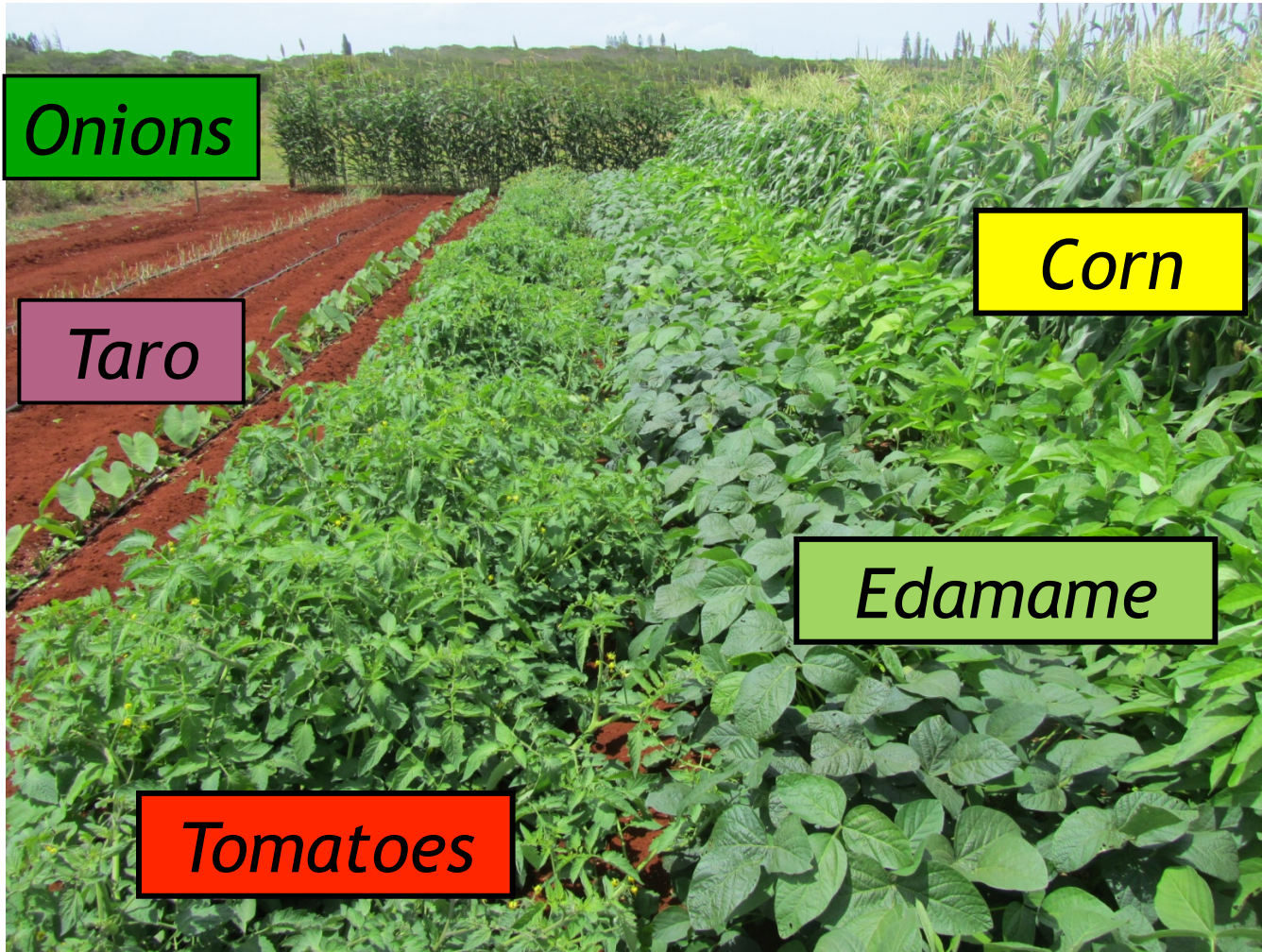
## THOUGHT FOR THE DAY

*“The ultimate goal of farming is not the growing of crops, but the cultivation and perfection of human beings.”*

**Masanobu Fukuoka**  
*One Straw Revolution*



# TOMATOES ARE AN ESSENTIAL HAWAIIAN GARDEN VEGETABLE



# VEGETABLES FROM MY GARDEN



# TOMATO'S ROLE IN THE CIRCLE OF LIFE

- ◉ Second most consumed vegetable behind its cousin, the potato.
- ◉ Essential element in salads, the red in the greens.
- ◉ Important in sauces, stews, pasta, and ketchup.
- ◉ Under intensive production, tomatoes can yield >100,000 lbs/A

# **Why Save Seeds?**



## ELIOT COLEMAN QUOTE #1

***“Seeds are the spark of the farm operation, and the more control the grower can exert, the more dependable the system will be”***



## ELIOT COLEMAN QUOTE #2

***“For most crops, the vigor and viability of seed grown under careful cultural practices of this production system will far excel seeds that are purchased.”***



## ELIOT COLEMAN QUOTE #3

***“I doubt that the direction of present-day seed breeding, selection, and genetic manipulation is favorable to the producer of high quality vegetables ...”***



## PUTTING IT ALL TOGETHER ...

Grow your own seed:

- ⦿ For better control of your garden or farm.
- ⦿ For better seed quality and vigor.
- ⦿ For your specific environment and needs because no one else will grow them for you.

# ORIGINS

- ◉ Tomato, *Lycopersicon esculentum* is native to the tropical Americas, from Mexico to Chile.
- ◉ Dozens of wild *Lycopersicon* species occupying many environmental niches, from the mountain to the shore
- ◉ Vital in transferring genes for fruit quality, pest and disease resistance, and environmental adaptability into the modern tomato.

# PLANT TYPES

- ◉ Determinate (bush) - concentrated harvest, short harvesting period. Field production. Ground culture. More wind resistant.
- ◉ Indeterminate (trellis) - Greenhouse; harvest over long period. High yields, high labor. Usually pruned to a single stem. Susceptible to wind. Can be grown on the ground but unwieldy.

# DETERMINATE (BUSH) GRAPE TOMATOES SUGARY & ARIA



# INDETERMINATE TOMATO LOVE SONG



# PEST RESISTANCE

- ◉ Tomato has the genetic potential to create a cultivar with resistance to most of the diseases of a specific locale, although some are problematic and difficult to control. i.e. Late blight.
- ◉ Man's bad farming habits create ideal conditions for some diseases. i.e. no crop rotation, incremental plantings, lack of crop-free periods. Imposing a crop-free period is one strategy to keep a disease at low levels. i.e. Spotted wilt virus

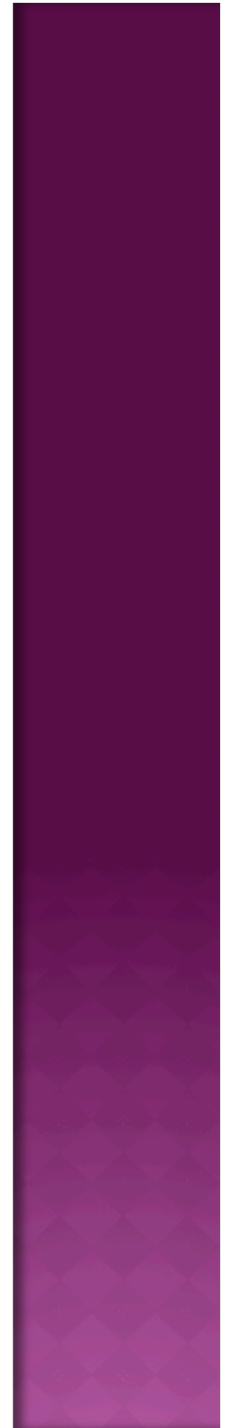
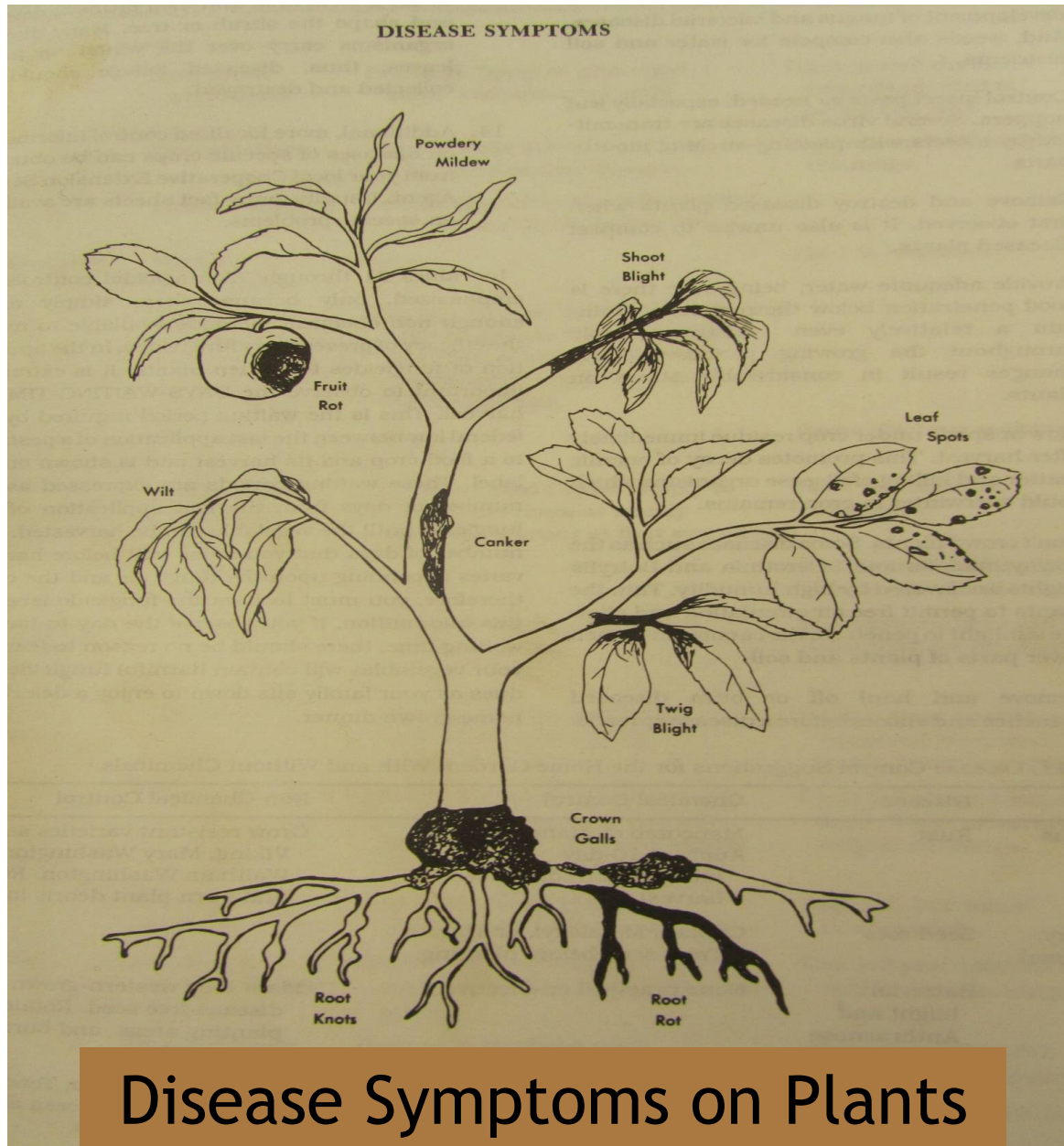
# BASIS OF RESISTANCE

- ◉ *L. peruvianum* - early blight, leaf mold, fusarium wilt, septoria leaf spot, nematodes
- ◉ *L. hirsutum* - early blight, bacterial speck, root-knot nematodes, natural insecticide, hairs create physical barrier for insects/mites
- ◉ *L. pimpinellifolium* (currant)- bacterial wilt, fusarium wilt
- ◉ *L. cerasiforme* - short stigma = less out-crossing, more true-to-type, heat tolerant
- ◉ *L. cheesemanii* - heat & salt tolerance, high vitamin C, jointless pedicels
- ◉ *L. chilense* - tomato yellow leaf curl virus



## BASIS OF SELECTION

Each seedling is an individual with the potential to possess genes unique from its siblings. Genes will be expressed under certain conditions. i.e. heat stress, low input, disease pressures, heavy rains, high clay soil, low day & night temperature differential, high humidity, etc.



# DISEASES OF TOMATO IN HAWAII

- ◉ Tomato Yellow Leaf Curl Virus - NEW
- ◉ Pepper Mottle Virus - old, but recently ID'd
- ◉ Tomato Spotted Wilt Virus
- ◉ Tobacco Mosaic Virus
- ◉ Early Blight & Stem Canker - Alternaria
- ◉ Late Blight - Phytophthora
- ◉ Leaf Mold - Fulvia
- ◉ Stemphylium - Grey Leaf Spot
- ◉ Fusarium & Verticillium Wilt
- ◉ Root-Knot Nematodes
- ◉ And many more...

# TOMATO YELLOW LEAF CURL VIRUS



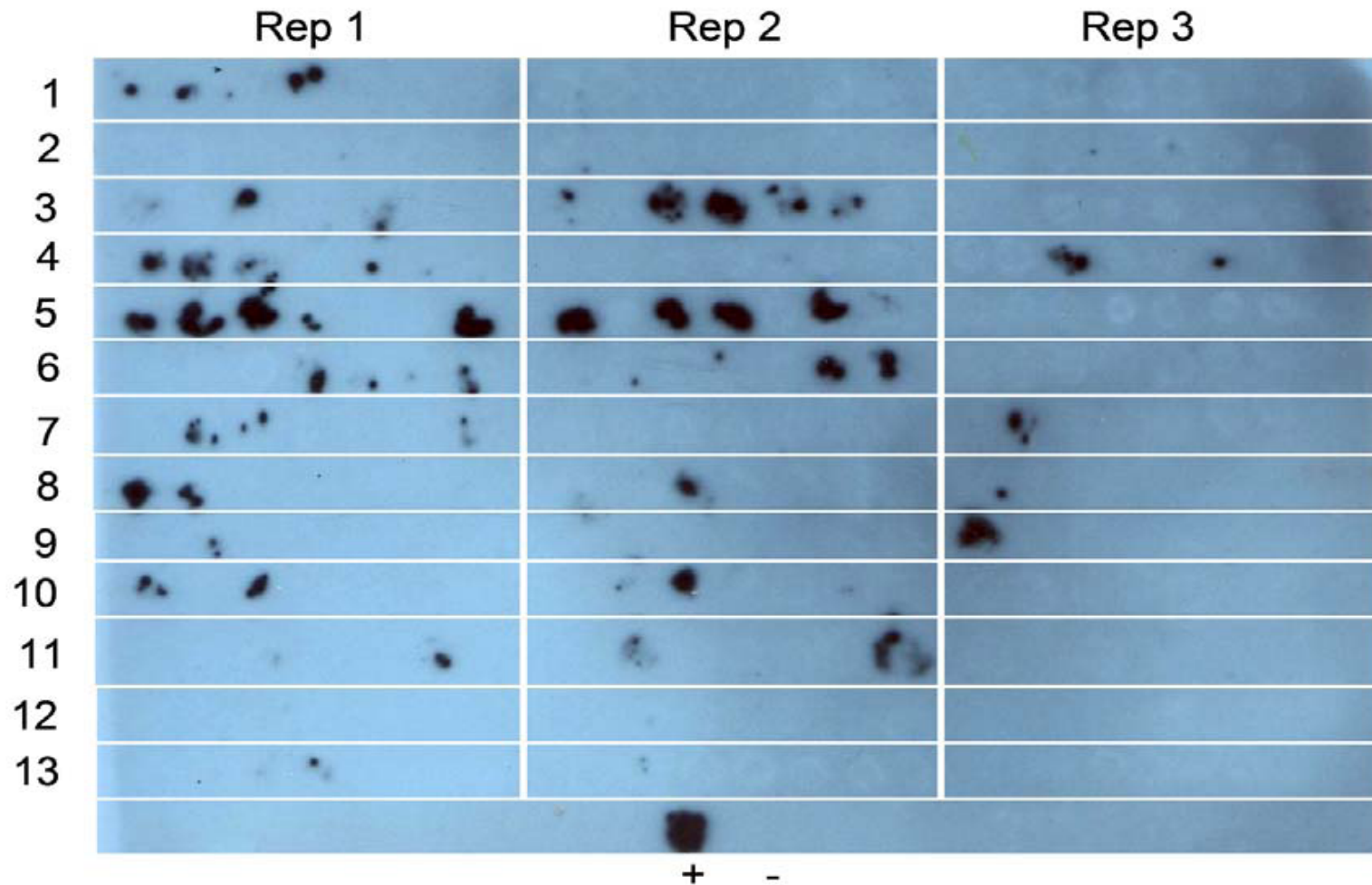
# NEW TYLCV-RESISTANT LINES



**TOMATO TSWV/TYLCV RESISTANCE TRIAL**  
**UH CTAHR POAMOHO EXP STAT. - OCT 2011**  
**MELZER, SUGANO, FUKUDA, RADOVICH, UYEDA, TEVES, MIGITA**

<b>#</b>	<b>Variety</b>	<b>Source</b>	<b>Fruit</b>
1	VT-60783	Zeraim Gedera	Globe
2	<b>72767</b>	<b>Nirit</b>	<b>Grape</b>
3	8466	Nirit	Roma
4	Felicity	Hazera	Cherry
5	Olivia	Hazera	Grape
6	Ofri	Hazera	Globe
7	72835	Nirit	Baby Roma
8	72061	Nirit	Globe
9	72205	Nirit	Globe
10	Tymothy	Hazera	Cherry
11	VT-60773	Zeraim Gedera	Globe
12	<b>7105</b>	<b>Nirit</b>	<b>Globe</b>
13	HA-46204	Hazera	Baby Roma

# TYLCV VIRUS RESISTANCE TISSUE BLOT TEST



Nirit  
72835





# TOMATO INSECTS AND ARTHROPODS

- ◉ Spider mites
- ◉ Serpentine Leaf Miner
- ◉ Corn Ear Worm
- ◉ Russet mites
- ◉ Tomato Pinworm
- ◉ Fruits flies - mediteranean (higher elevation), oriental, melon
- ◉ Tomato Hawk Moth

# COMMERCIAL BREEDING CONSIDERATIONS

## Evaluate Fruit Quality:

Shape

Firmness

Color

Shoulder shape

Shoulder color

Gel color

Core size

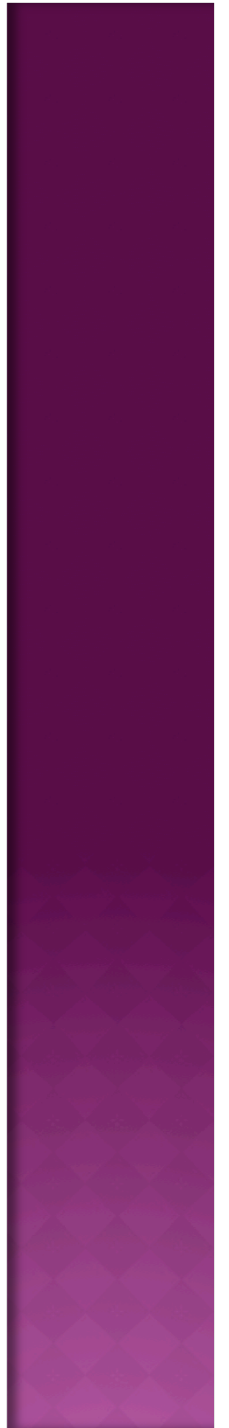
Wall thickness

Taste

Pedicel type

Blossom end

Stem end



# GREEN SHOULDERS



# Fruit Cluster Types



# BRANCHING CLUSTERS



# DEFECTS TO AVOID IN TOMATO BREEDING

- ◉ Cracking - concentric & radial
- ◉ Cat-facing
- ◉ Puffiness
- ◉ Sun scald
- ◉ Blossom-end rot
- ◉ Zipper fruits
- ◉ Nipple tips - in most commercial fruits

# BREEDING CONSIDERATIONS

- Plant: canopy (sun scald), habit (determinate and indeterminate), internode spacing, size
- Disease Resistance: fungus, bacteria, virus, physiological
- Other: nutrition, pesticide-free, organic vs. conventional

# REGIONAL BREEDING

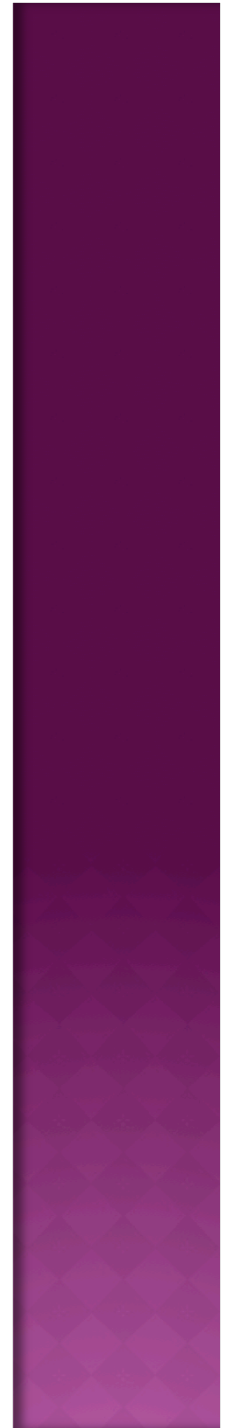
## Southern Tomato Exchange Program (STEP)

- ◉ Each state bred for their own problems. Over 25 colleges involved.
- ◉ Accessions from other states included in side-by-side tests held in each state.
- ◉ ID unrelated accessions that complement each other. i.e. Crossing a disease-resistant line with a high fruit quality line.
- ◉ Hawaii was one of the leaders due to year-round selection/breeding
- ◉ STEP ended in the 1990's.
- ◉ Few active tomato breeding programs left - Florida, North Carolina, Oregon, Penn State, Ohio State, Michigan State, UC Davis, Cornell, others.



‘INDIGO ROSE’

JIM MYERS - OREGON STATE



# BREEDING PRIORITIES

- Priorities constantly changing. Trends include nutrition. Breeders attempt to combine quality and disease resistance into one compact plant.
- Regional breeding, but should be more site-specific, especially in Hawaii. Many site-specific problems in Hawaii due to diverse climate and conditions, even between islands.
- Pest resistance: Focus on breeding for crop loss, and identify cultivars with resistance to your local problems.

## HAWAII'S UNIQUE SITUATION

- A year-round breeding season is a major advantage for breeding tomatoes.
- Hawaii is also a breeding ground for new disease arrivals, such as Tomato Yellow Leaf Curl Virus and the recent identification of Pepper Mottle Virus, creating a moving target in identifying adapted cultivars.

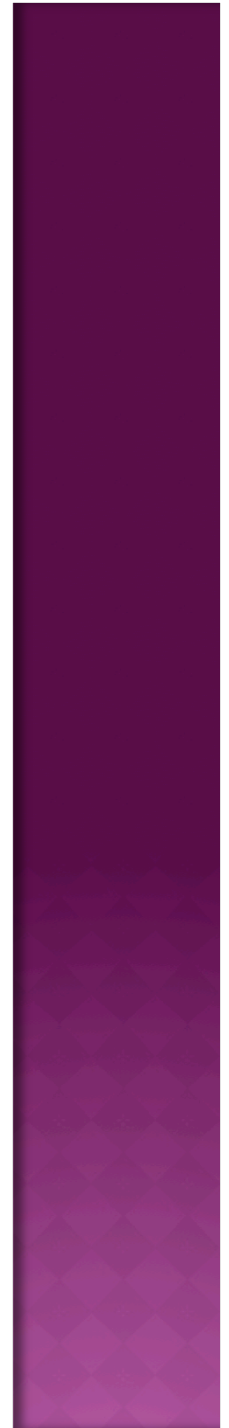
# MAJOR CHALLENGES IN BREEDING

- Good genes tightly linked to bad genes, especially in wild tomato.
- Both Root-knot nematode and Tobacco Mosaic Resistance tied to concentric cracking.
- May have to plant thousands of seedlings before you can find one with only the favorable gene.
- Many breeders have avoided breeding for resistance to these two diseases.

# ADDITIONAL CHALLENGES IN BREEDING

- New cultivars must be able to produce as much as older cultivars when disease is not present.
- Must address all problems or no improvement. Still have to control diseases.
- Disease resistance is usually derived from wild lines, and when breeding, brings deficiencies back into the mix.

# DR. JIM GILBERT PLANT PATHOLOGIST AND BREEDER



# ROOT-KNOT NEMATODES



# BREEDING TODAY

Breeding has become more complicated:

- ⦿ Not enough time to find one good gene at a time.
- ⦿ Using genetic markers to find a mass of good genes. A good tomato must have many good genes, not just a few.
- ⦿ Finding two parents with four good genes from each parent will give you eight good genes in a hybrid. However, some diseases require resistance from both parents. i.e. TMV.



# HAWAII'S SITUATION

Our needs are very unique. We have diverse climates, over 140 soil types, and a year-round growing season with year-round pests. Our crops face extremes; drought, heat, heavy rain, and high humidity, creating conditions for diseases of all kinds. Critical that cultivars be acclimated to high night temperatures if grown in low lands.



# DIVERSITY OF HAWAII GROWERS

There are commercial conventional growers, commercial organic growers, and very diverse home gardeners. Each group seeks something different in a tomato cultivar. Some are driven by the market they supply, or their own growing conditions, artificial or natural. Each has different priorities in what they want from a cultivar.



# WHAT DOES THE COMMERCIAL HAWAII FARMER WANT

- ◉ Yield - high pack-out and grade-out \$\$\$
- ◉ Concentrated set (field production) \$\$\$
- ◉ Sustained production (greenhouse) \$\$\$
- ◉ Pest and Disease Resistance \$\$\$
- ◉ Vigor-fast germination & quick growth \$\$\$
- ◉ Shelf-life/Standability: non-cracking, firm fruit, Rough Handling \$\$\$
- ◉ Appearance - glossy, appealing to the eye \$\$\$

# GARDENERS CONSIDERATIONS

- ◉ Nutrition
- ◉ Eating Quality - balance of sweet & sour
- ◉ Harvest over long period of time
- ◉ High genetic variability - can select for resistance to problems, seed can be saved
- ◉ Multiple Disease resistance
- ◉ Efficiency in fertilizer use - not high input
- ◉ Large Root System - ability to withstand stress, late maturing
- ◉ Adaptable to Tropical Conditions - heat, rain, warm nights

# WHAT IS THE IDEAL GARDEN TOMATO?

- ◉ Nutrient rich fruit
- ◉ Excellent taste - explodes in your mouth!
- ◉ Late maturing - produce a large scavenging root system to sustain plant over a long fruiting season - 3+ months
- ◉ Utilizes nutrients efficiently = low input
- ◉ Adapted to tropical conditions: Heat & rain
- ◉ Resistance to many diseases found in Hawaii - V,F123,N,T,A,TYLCV
- ◉ Vigorous growth/genetic variability
- ◉ Uniformity not important

# SELECTING VARIETIES

## E. Coleman's List of Priorities (Modified):

- Eating Quality
- Pest Resistance
- Performance
- Ease of Harvest
- Ease of Cleaning
- Nutrition
- Appearance
- Vigor
- Standability
- Adaptability
- Convenience
- Marketability

# SORTING TOMATOES FOR RIPENESS



# BREAKING F1 HYBRIDS

A novel way to develop disease-resistant inbred for your area:

- Save the seeds from a F1. Take fruits from several fruits instead of one. More variability since F1's are segregating for certain resistance.
- Plant at less-than-ideal times to express genes, then select. If disease is not present, may not capture resistance.
- Great for finding resistance to new diseases, such as TYLCV



# NEMATODE-RESISTANT TOMATOES

- ◉ Celebrity F1
- ◉ Milagro F1
- ◉ Better Boy F1
- ◉ Pik Red F1
- ◉ Golden Girl F1
- ◉ Healani
- ◉ Kewalo
- ◉ Apero (cherry)
- ◉ Beaufort F1 (rootstock)
- ◉ Viva Italia F1 (roma)
- ◉ Carnival F1
- ◉ Empire F1
- ◉ Big Beef F1
- ◉ Goliath F1
- ◉ Lemon Boy F1
- ◉ Anahu
- ◉ Abe Lincoln
- ◉ Favorita (cherry)
- ◉ Maxifort F1 (rootstock)
- ◉ Sunoma F1 (roma)

***See Cornell disease resistant tomato list:***

**http://**

**vegetablemdonline.ppath.cornell.edu/Tables/ TomatoTable.html**

# IDEAS ON FIELD TRIALS...

- ◉ Allows you to identify superior cultivars for your area for that season.
- ◉ Will show you what diseases you have in the area for that season.
- ◉ Will only tell you which cultivars grow well in that season or time slot.
- ◉ Keep the best and use to compare to new ones next season.
- ◉ Train your eyes to the intricacies of the different characteristics.
- ◉ Invite your friends to help evaluate. Everyone sees things differently.
- ◉ Know what you're looking for.

# MY FIELD TRIALS - MAY 2012



# SUMMER TRIALS - MAY 2012

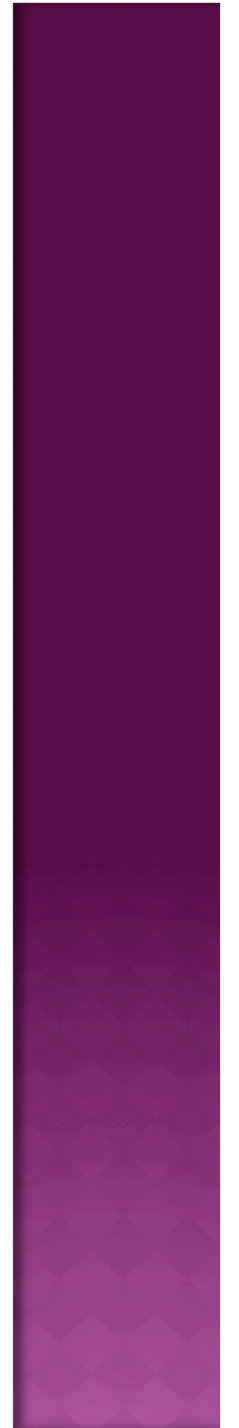
- ◉ Juliet - KY, large red grape, 30 g
- ◉ Aria -KY, orange grape, semi-determinate, 16 g
- ◉ Pink Beauty - DP, pink grape, 15g
- ◉ 72767 - Nirit, Cherry, 20-30g, TYLCV, V, F123, TMV, N
- ◉ Love Song - Hazera, 30 gr, V,F1,F2,ToMV,Mj,Pst,Ff.
- ◉ First Love - Hazera, round 10-14 gr. V,F1,ToMV,Pst
- ◉ Vittoria - Hazera, fruit 25mm x 50mm, 17-22 gr. V, F1, Mj, Pst, Sl
- ◉ Hanipssok 601 - Korea
- ◉ 72835 - Nirit, Roma, 30-40g, VFNT, TYLCV, FCRR, C5
- ◉ Olivia - Hazera, red grape, VF123, TMV
- ◉ Golden Gem - KY, yellow oblong cherry
- ◉ Summer Sweet - KY, grape 15g



## TRIAL CHALLENGES

- Powdery mildew - 1 cultivar
- Russet mite - many
- Corn earworm - low populations (Dipel)
- Magnesium deficiency - high density planting
- Blossom-end rot - kona weather, high temperatures, water mgmt.

# POWDERY MILDEW



# RUSSET MITE = BRONZE STEMS





# RUSSET MITE SYMPTOMS



# BLOSSOM-END ROT (BOTTOM RIGHT)



## TAKE HOME MESSAGE

- ◉ Know diseases prevalent in your area.
- ◉ Many tomato varieties may have resistance to common diseases, especially those developed at universities.
- ◉ When selecting a variety, look for tomatoes having resistance to many diseases. (VFNTA designation)
- ◉ Exchange varieties with neighbors and friends, and compare these for adaptation.
- ◉ When a new disease comes in, some varieties grown in Hawaii may already have resistance.

# SEED PRODUCTION - UH CTAHR VOLCANO RESEARCH STATION



# HEALANI TOMATO

Resistance to:

- Tobacco Mosaic Virus
- Root-knot nematodes
- Vascular browning from still, wet weather
- Fusarium Wilt
- Stemphylium
- Alternaria
- Others

# HEALANI TOMATO



# HYDROPONIC MEDIA



# GREEN ONION SEED - KOBA

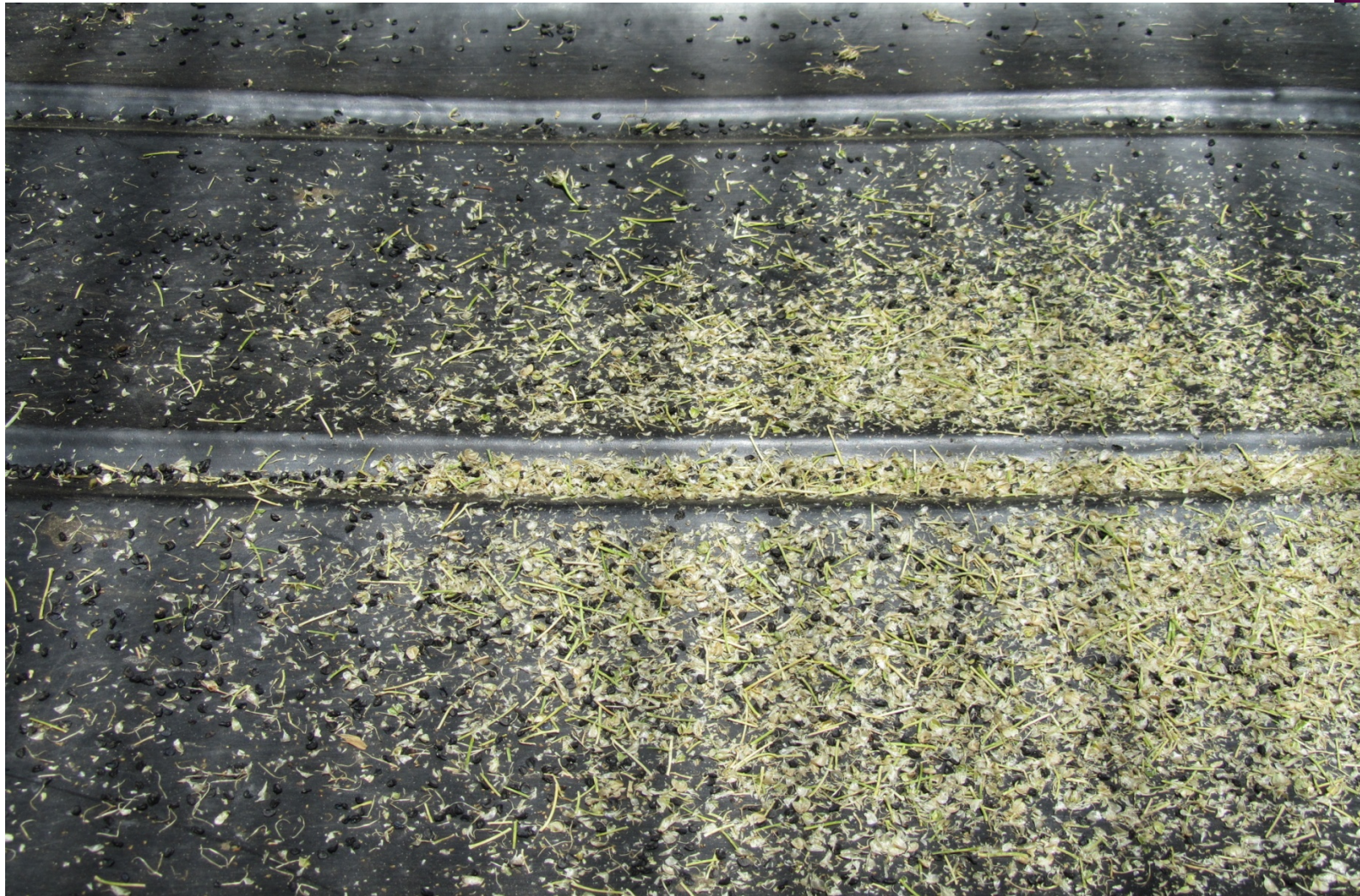




# GREEN ONION SEED



# KOBA GREEN ONION SEED



# HAPPY SEED SAVING !



**The End**

