

UF/IFAS Extension

The Journey to Sustainability Begins with Education



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FL Vegetable Disease Resistance - Information and Opportunities -

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Outline

- **Available vegetable cultivars with disease resistance information**
 - UF/IFAS Resources
 - Additional Resources
- **Vegetable Disease Resistance Concepts**
- **Participatory Plant Breeding**

UF/IFAS Resources

- **EDIS – Online Publications on Vegetable Production & Diseases**
- **UF/IFAS Faculty – Gainesville campus**
 - **Plant Pathology Department**
 - **Horticultural Sciences Department**
 - **Entomology and Nematology Department**
 - **Center for Organic Agriculture**
- **UF/IFAS Faculty – county vegetable specialists**

EDIS Online Pub. Examples

- **EDIS, Vegetable Production Handbook for FL**
 - Includes varietal recommendations for production of specific vegetables
- **EDIS Pub. VH100 “Varieties of vegetables with resistance to disease”**
 - compiled for bean, broccoli, carrot, cabbage, cucumber, lettuce, melons, pepper, squash, sweet corn, tomato, and watermelon
 - information obtained from the seed companies
- **EDIS Pub. SP 103, Florida Vegetable Gardening Guide**
 - Tables w/ recommended cvs of cool & warm season crops

UF/IFAS Resources

- **UF/IFAS Research and Education Centers (REC)**
 - **13 locations, 1,000 faculty across 17 disciplines**
 - **plant breeders currently working in over 40 crop areas**
 - **44 cultivars released in 2007**
 - **variety trials by crop**
 - **disease occurrence reports and alerts by region**

UF/IFAS Online Newsletters

- **“Vegetarian Newsletter”**
 - A Vegetable Crops Extension Publication by UF Horticultural Sciences Department
- **“Extension Berry/Vegetable Times”**
 - By Gulf Coast Research and Education Center at Balm
- **“Southwest Florida Pest and Disease Hotline”**
 - By Hendry County Extension Office
 - Email alerts upon request

UF/IFAS Resources

- **County Extension Offices (Diagnosis Services)**
 - Master Gardener Help Desk
 - Plant Disease Clinic Network
 - Fee-based, plant sample services
 - 4 labs (Gainesville, Quincy, Immokolee, Homestead)
 - IPM specialists
- **Distance Diagnostic & Identification System (DDIS)**
 - digital image-based diagnosis
 - quick turn around time
 - statewide expert access

Observe a disorder or pest

START here



Take a digital picture

Report results to grower



The DDIS Process



Access the DDIS website



Send sample to a specialist



Online diagnosis by specialists



UF/IFAS REC Variety Trials

- **Everglades REC**
 - Lettuce, celery and sweet corn
- **Southwest REC**
 - Tomato, watermelon, pepper, squash
- **Gulf Coast REC**
 - Tomato, cabbage, cantalope, gourds, tropical pumpkin, watermelon, strawberry
- **West Florida REC**
 - Squash, zucchini, tomato, lima beans, sweet corn, watermelon
- **Hastings REC**
 - Potato, cabbage and onions
- **North Florida REC**
 - Hydroponic greenhouse vegetables, tomato, tropical corn, watermelon

Additional Variety Trials Resources

- **Seed company catalogs**
- **Outside state agriculture university research and variety trials**
- **USDA Germplasm Resources Information Network (GRIN)**
- **International agriculture research centers**
 - **AVRDC, The World Vegetable Center**

A Strategy of Disease Control

- Resistant or Tolerant Varieties -

Codes Used to Designate Diseases and Related Problems

ALS	= Angular Leaf Spot	LB	= Late Blight
AN	= Anthracnose	LR	= Leaf Roll
ASC	= Alternaria Stem Canker	MDMV	= Maize Dwarf Mosaic Virus
BLS	= Bacterial Leaf Spot	MMV	= Mild Mosaic Virus
BLRV	= Bean Leaf Roll Virus	NCLB	= Northern Corn Leaf Blight
BR	= Black Rot	NRKN	= Northern Root Knot
BS	= Black Speck		Nematode
BW	= Bacterial Wilt	PM	= Powdery Mildew
C	= Cold Tolerance	PVY	= Potato Virus Y
CBMV	= Common Bean Mosaic Virus	R	= Rust
CLS	= Cercospora Leaf Spot	RMV	= Rugose Mosaic Virus
CoMV	= Cowpea Mosaic Virus	S	= Smut
CMV	= Cucumber Mosaic Virus	Sc	= Scab
CR	= Common Rust	SCLB	= Southern Corn Leaf Blight
D	= Drought Tolerance	SL	= Speckle Leaf
DM	= Downy Mildew	SR	= Soil Rot
EB	= Early Blight	SRKN	= Southern Root Knot
F	= Fusarium		Nematode
FY	= Fusarium Yellows	SW	= Stewart's Wilt
GLS	= Gray Leaf Spot (Stemphylium)	TB	= Tip Burn
H	= Heat Tolerance	TLS	= Target Leaf Spot
HC	= Hard Core	TMV	= Tobacco Mosaic Virus
		V	= Verticillium

FL Vegetable Disease Examples

- Bacterial Spot of Pepper Disease
- *Xanthomonas euvesicatoria* = bacterial pathogen
- one of the most serious problems facing Florida's pepper growers
- bacterium infects leaf and fruit



Leaf Symptoms



Whole Plant Symptoms



Fruit Symptoms

A Strategy of Disease Control

- Resistant or Tolerant Varieties -

<u>VEGETABLE</u>	<u>SEED COMPANY</u>	<u>VARIETY</u>	<u>DISEASE RESISTANCE OR TOLERANCE*</u>
Pepper	Abbott & Cobb	ACX 209	Bacterial Spot Race 1,2 and 3
		ACX 217	Bacterial Spot Race 2, PVY, TMV
		ACX 223	Bacterial Spot Race 1,2 and 3, TMV, PVY
		Summer Sweet #840	Bacterial Spot Race 2
		Summer Sweet #880	Bacterial Spot Race 1,2 and 3, TMV, PVY
		Summer Sweet #890	Bacterial Spot Race 1,2 and 3, TMV, PVY
		BHN 1	Phytophthora Root Rot*

A Strategy of Disease Control

- Resistant or Tolerant Varieties -

<u>VEGETABLE</u>	<u>SEED COMPANY</u>	<u>VARIETY</u>	<u>DISEASE RESISTANCE OR TOLERANCE*</u>
Pepper	Sakata Seeds	SPP 6112	Bacterial Spot Race 1,2 and 3
		SPP 7118	Bacterial Spot Race 1,2,3 and 5
		Spp 7603 (Jalapeno)	Bacterial Spot Race 1,2 and 3
		SXP 0990	TMV Race 0
		SXP 1031	TMV
		SXP 4045	TMV Race 0, PMMV Race 1 and 2
		Xena (Jalapeno)	TMV

Crop Disease Resistance

- Concepts -

- **Disease**

- an impairment of health or a condition of abnormal functioning and characterized by an identifiable group of signs or symptoms

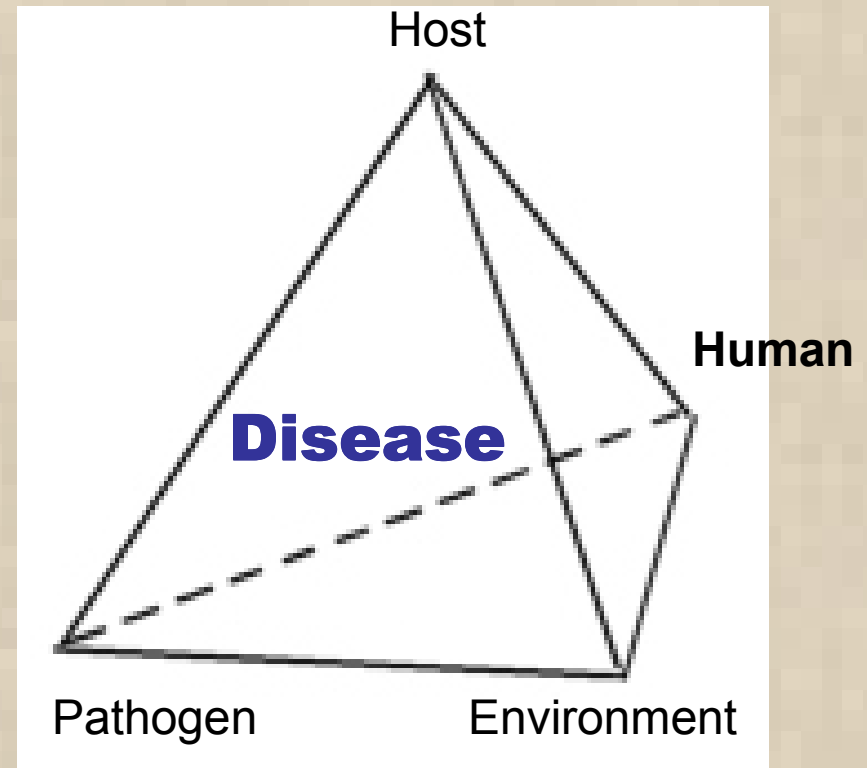
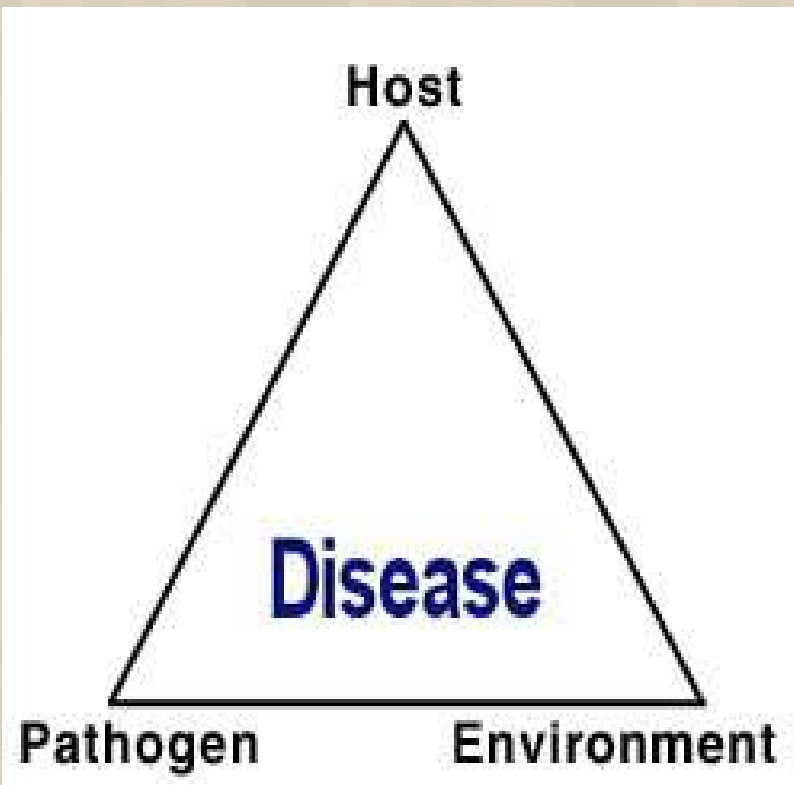
- “dis” – “ease”

- (lack of, not) – (condition of physical comfort or relief)

- **Pathology**

- science of diseases

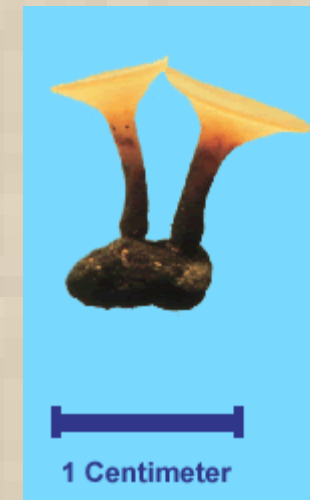
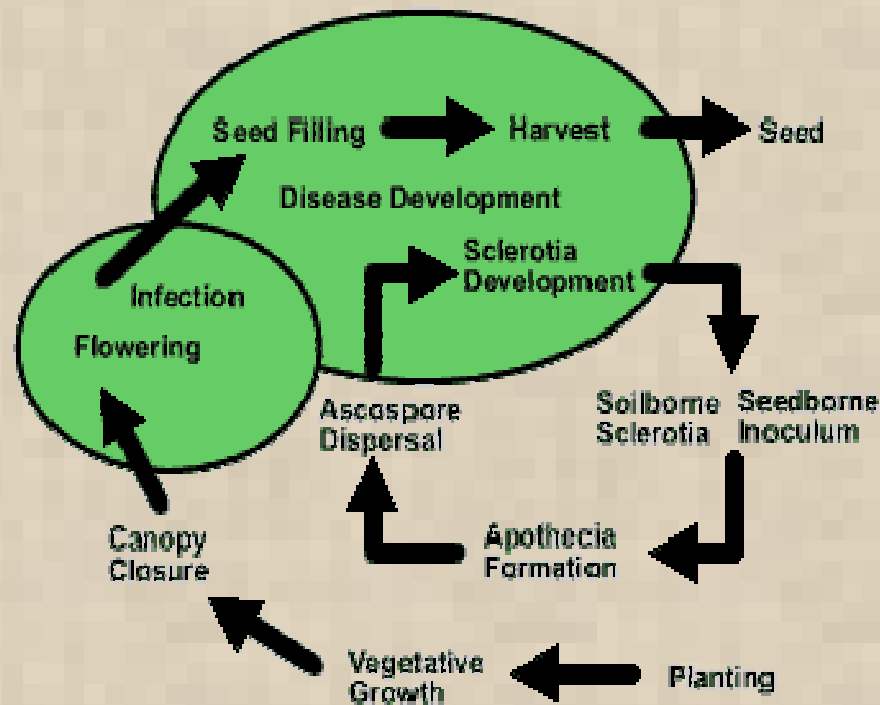
Plant Pathology Concepts



Plant Pathology Concepts

- **Hosts**
 - resistant vs tolerant to disease
- **Pathogens**
 - fungi, bacteria, viruses, mycoplasmas, nematodes
 - specific vs generalist
- **Environment**
 - moisture, temperature, wind, sunlight, nutrition and soil quality
- **Human**
 - management, breeding

Plant Pathology Concepts



Life Cycle White Mold (*Sclerotinia sclerotiorum*) of Soybeans

FL Vegetable Disease Examples

- *Sclerotinia sclerotiorum* = fungal pathogen
 - >360 different host plant species
 - 61 different common names
 - **white mold** (beans), **watery soft rot** (cabbage), **drop** (lettuce), **stem rot** (potato and tomato), and **nesting** (post-harvest disease of bean)



Lettuce



Tomato

Plant Pathology Concepts

- **Resistance and/or tolerance for one disease in a variety is limited:**
 - **does not necessarily transfer to other diseases**
 - **does not necessarily remain over time**

Bacterial Spot of Pepper Disease History Example in FL

- 10 races of the bacterium identified
- **geographic specificity first commonly observed**
- prior to 1989, race 2 was predominant in South Florida
- **In 1989-90, release of cv w/ gene resistance to race 2 caused a shift to race 1 virulence**
- In 1997-98, release of cv with gene resistance to races 1,2,& 3 caused a shift to race 6

(Cont) Bacterial Spot of Pepper Disease History Example in FL

- **current cvs based on a "pyramid" or "stack" several resistance genes within the same pepper variety**
- **race 6 continues to cause of mostly late-season outbreaks on cultivars with resistance-gene pyramids**
- **serious impacts could result from race 6 if outbreaks of this race begin early in the crop cycle**

(Cont) Bacterial Spot of Pepper Disease History Example in FL

- **this situation, in which pathogen races appear that defeat resistance genes incorporated into commercial cultivars, is quite frustrating**
- **developing cultivars resistant to various races of *X. euvesicatoria* is a never-ending battle, which plant pathologists are ultimately doomed to lose.**

Participatory Plant Breeding

- **Why not depend on conventional crop breeding programs?**
 - **Trials not done on sustainable and diversified agroecosystems**
 - **“Minor crops” not covered**
 - **Costs and patent restrictions of commercial cultivars**
 - **Site specific conditions**

Participatory Plant Breeding

- **Raoul Robinson**
 - **“Return to Resistance” book**
 - **“Horizontal genetic resistance” approach**
 - **Open-pollinated varieties-based**
 - **Equitable access-based**
 - **Workshops organized for “plant breeding clubs”**
 - **Is there interest in FL?**

Horizontal Resistance Definition

- Horizontal resistance is multi-gene compared to vertical resistance which is single-gene based.
- **Vertical resistance requires a 'good source' of resistance, which does not always occur**
- It is possible to breed for horizontal resistance to any pest or disease, using only susceptible parents and by exposing new varieties to every available pest and disease in an organic growing environment

(Cont.) Horizontal Resistance Definition

- **Horizontal resistance is a quantitative variable, and it exhibits every degree of difference between a minimum and a maximum.**
- **Horizontal resistance is durable resistance. It never breaks down to new strains of the pest or disease, as does vertical resistance. This means that the breeding is cumulative. A good cultivar need never be replaced, except with a better cultivar.**

Horizontal Resistance Process

- 1) You get seeds from the breeding pool, and grow them out with full exposure to pests and diseases. Most of the plants can be allowed to die, so only the best get cross-pollinated.
- 2) You give some of your resulting seeds back to the breeding pool, and they are mixed with everyone else's results for the next generation.

(Cont.) Horizontal Resistance Process

- 3) The process is repeated for as many generations as necessary to get high levels of horizontal resistance – and every other desirable trait – which usually takes around six or seven generations to reach a maximum.

Participatory Plant Breeding Example Program

- Organic Seed Partnership
 - Originated from “Public Seed Initiative” Project
 - **National trialing network**
 - Farmers as breeders, selectors and evaluators
 - **Supported by regional research centers in 6 states (not FL yet)**
 - Germplasm originates from local small businesses
 - **Marketed with partner small seed companies**

Participatory Plant Breeding Example Program

- **Organic Seed Partnership**
 - Cornell University
 - Several small seed companies
 - Organic farmers
- **Results**
 - **Since 2001, released 15 vegetable cvs**
 - Squash, arrugula, potatoes, tomatoes, peppers
 - Example: Bush Delicata – powdery mildew resistant “sweet potato” squash (now sold by Johnny’s Select Seeds)

(Cont.) Participatory Plant Breeding Example Program

- **Organic Seed Partnership**
- **Available cvs & training have been offered to SWFSFN for farm trails**
 - **Cucumber, melon, onion, pepper, summer squash, tomato, winter squash**
- **Requires signed Materials Transfer Agreement by each grower**
- **An excellent opportunity for a initial SWFSFN cooperative project ?!**

References

- **APSnet, “The Disease Triangle: plant pathological paradigm revisited”**
<http://www.apsnet.org/education/InstructorCommunication/TeachingArticles/Francl/>
- **EDIS, UF/IFAS**
 - **Distance Diagnostic and Identification System (DDIS) : A New Tool for Extension Diagnostics**
<http://edis.ifas.ufl.edu/DDIS4>
 - **Florida Extension Plant Disease Clinic Network**
<http://edis.ifas.ufl.edu/SR007>
 - **“Sclerotinia Diseases of Vegetable and Field Crops in Florida”**
<http://edis.ifas.ufl.edu/VH015>
 - **“Varieties of Vegetables with Resistance to Disease”**
<http://edis.ifas.ufl.edu/VH100>
 - **“Vegetable Diseases Caused by *Phytophthora capsici* in Florida**
<http://edis.ifas.ufl.edu/VH045>
- **Just for Growers, “Soybean White Mold Life Cycle”**
http://www.soybeans.umn.edu/crop/diseases/whitemold/white_mold_life.htm
- **Robinson, R., “Return to Resistance”, ShareBooks website**
http://www.sharebooks.ca/ebooks_by_author2.php?author=Robinson%2C+Raoul+A
- **SWFREC, Plant Pathology Department**
<http://swfrec.ifas.ufl.edu/plant/index.htm>
- **Univ. of Tennessee Extension, “Disease Resistance in Recommended Vegetable Varieties for Home Gardens”**
<http://www.utextension.utk.edu/publications/spfiles/SP277-K.pdf>

Online Resources

- ATTRA, “Resource Guide to Organic & Sustainable Vegetable Production”
<http://attra.ncat.org/attra-pub/vegetable-guide.html>
- AVRDC, The World Vegetable Center
<http://www.avrdc.org/>
- Consultant Group for International Agriculture Research
<http://www.cgiar.org/>
- EDIS, UF/IFAS
<http://edis.ifas.ufl.edu/index.html>
- Organic Seed Alliance
<http://www.seedalliance.org/index.php?page=Home>
- Participatory Plant Breeding
<http://www.prgaprogram.org/index.php?module=htmlpages&func=display&pid=9>
- Seed Savers Exchange
<http://www.seedsavers.org/>

Online Resources

- UF/IFAS Center for Organic Research
<http://organic.ifas.ufl.edu/>
- UF/IFAS Distance Diagnostic & Identification Center
<http://ddis.ifas.ufl.edu/ddisx/home.jsp>
- UF/IFAS Research & Education Centers
<http://research.ifas.ufl.edu/recs.html>
- UF Horticultural Science Department
<http://www.hos.ufl.edu/>
- UF Plant Pathology Department
<http://plantpath.ifas.ufl.edu/>
- USDA Agricultural Library “ Diseases, Pests & Weeds”
http://riley.nal.usda.gov/nal_display/index.php?info_center=8&tax_level=2&tax_subject=7&topic_id=1060
- USDA Germplasm Resources Information Network
<http://www.ars-grin.gov/>
- Vegetable MD Online
<http://vegetablemdonline.ppath.cornell.edu/cropindex.htm>

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