Opportunities for Mutually Beneficial Agricultural Scientific Collaboration Between the United States and Uzbekistan

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Agricultural Research Service

Global Challenges for Agriculture

- Food Security: double food production by 2050
- Plant & Animal Protection: arthropods, pathogens, weeds
- Irrigation Water Availability: water use efficiency
- Sustainability: reducing environmental footprint
- Climate Change
- Safe and Nutritious Food

Challenges for Agriculture in Uzbekistan

- Heavy Reliance on Cotton
- Need for Diversification: grain, fodder and specialty crops.
- Irrigation Water Availability & Management

Advantages of Uzbek Agriculture

- Warm Climate
- Long Growing Season
- Ability to Irrigate

Genetics, Genomics, Breeding

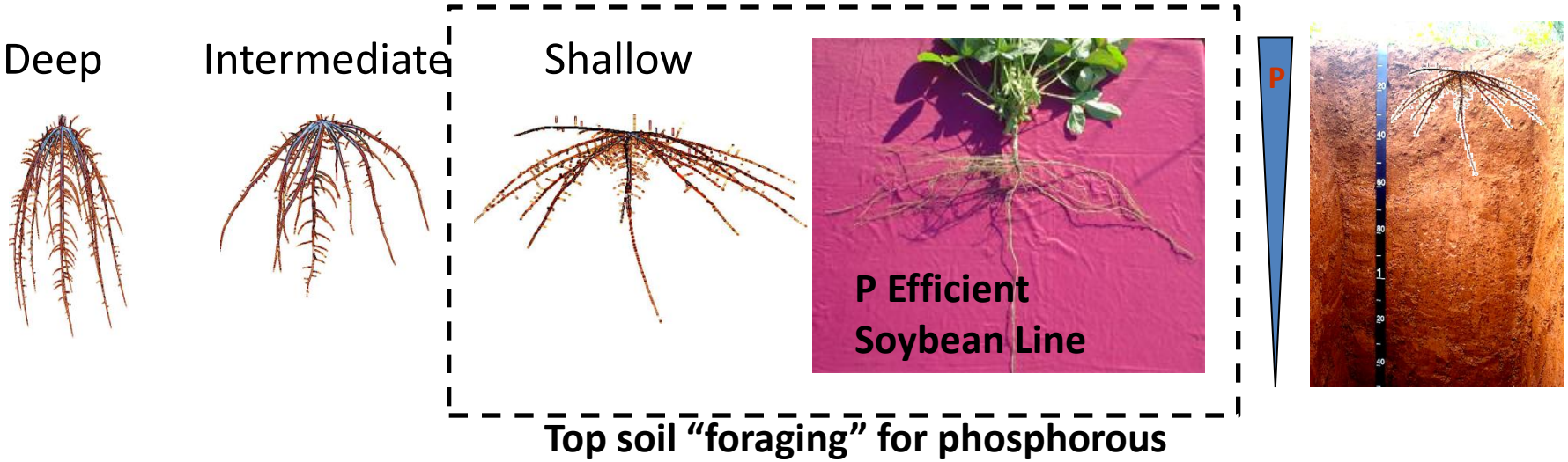
- Food Security.
- Plant & Animal Protection.
- Water use efficiency
- Reducing environmental footprint
- Climate Change
- Safe and Nutritious Food

Genetic Diversity for Crop Improvement

- Most agronomically important traits are due to the interaction of many genes, environmental signals and other factors.
- These “complex” traits determine yield, seed quality and many other characteristics of corn, wheat, and other major crops.
- PSNU scientists are developing genetic, genomic and statistical methods to increase the rate and efficiency of plant improvement.

Root **S**ystem **A**rchitecture Research
(led by Leon Kochian)

- Spatial distribution of roots in the soil profile plays an important role in the efficient acquisition of mineral nutrients and water.



Root **S**ystem **A**rchitecture in low P soils

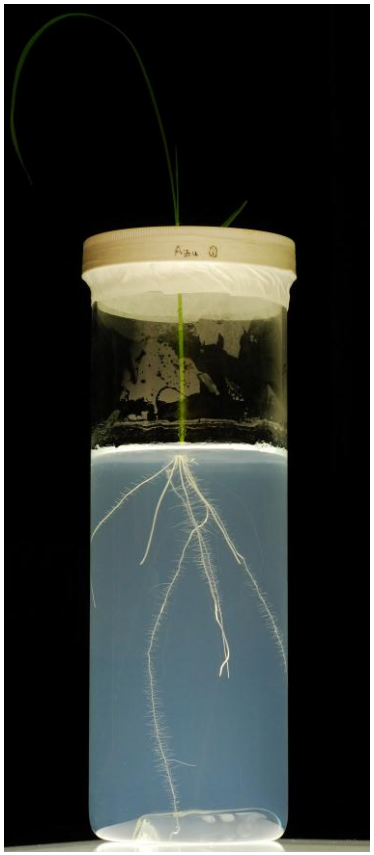
Root System Architecture Research

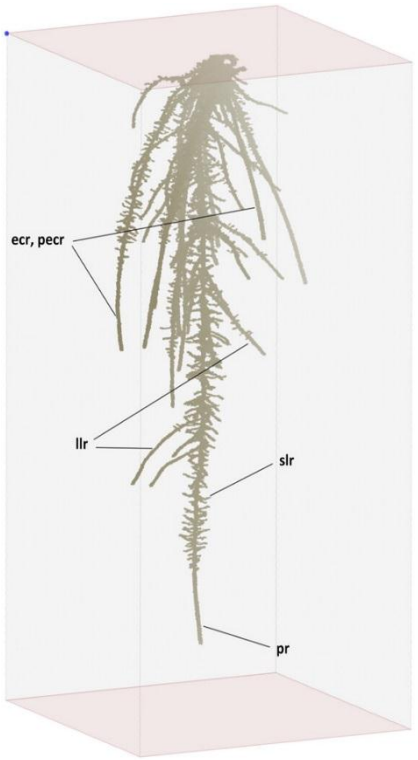
- Understanding of the genetic basis of **R**oot **S**ystem **A**rchitecture (RSA)

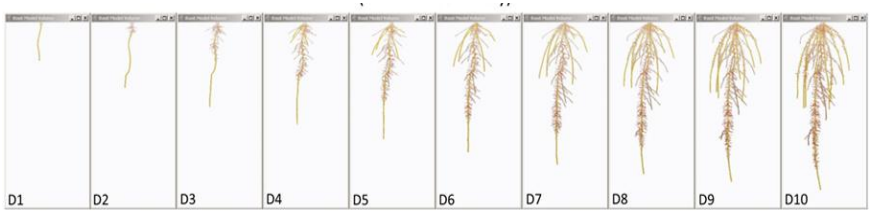
Gellan Gum Growth System and 3D Imaging Platform

- A non-invasive plant growth and 3D imaging system **to investigate the natural variation of root traits.**

- **3D reconstructions and quantification of approx. 20 different RSA traits** under controlled conditions in gel-based media







- Roots imaged at different time intervals (days) to capture dynamic growth parameters.

Understanding Nutrient Uptake

- People and animals only absorb a bioavailable fraction of the nutrients and minerals from the food they consume.
- PSNU scientists have developed lab-based assays to efficiently screen foods for bioavailable iron and other nutrients.
- This reduces the reliance on animal testing while increasing our capacity to examine and potentially enhance the nutritional quality of many different foods.

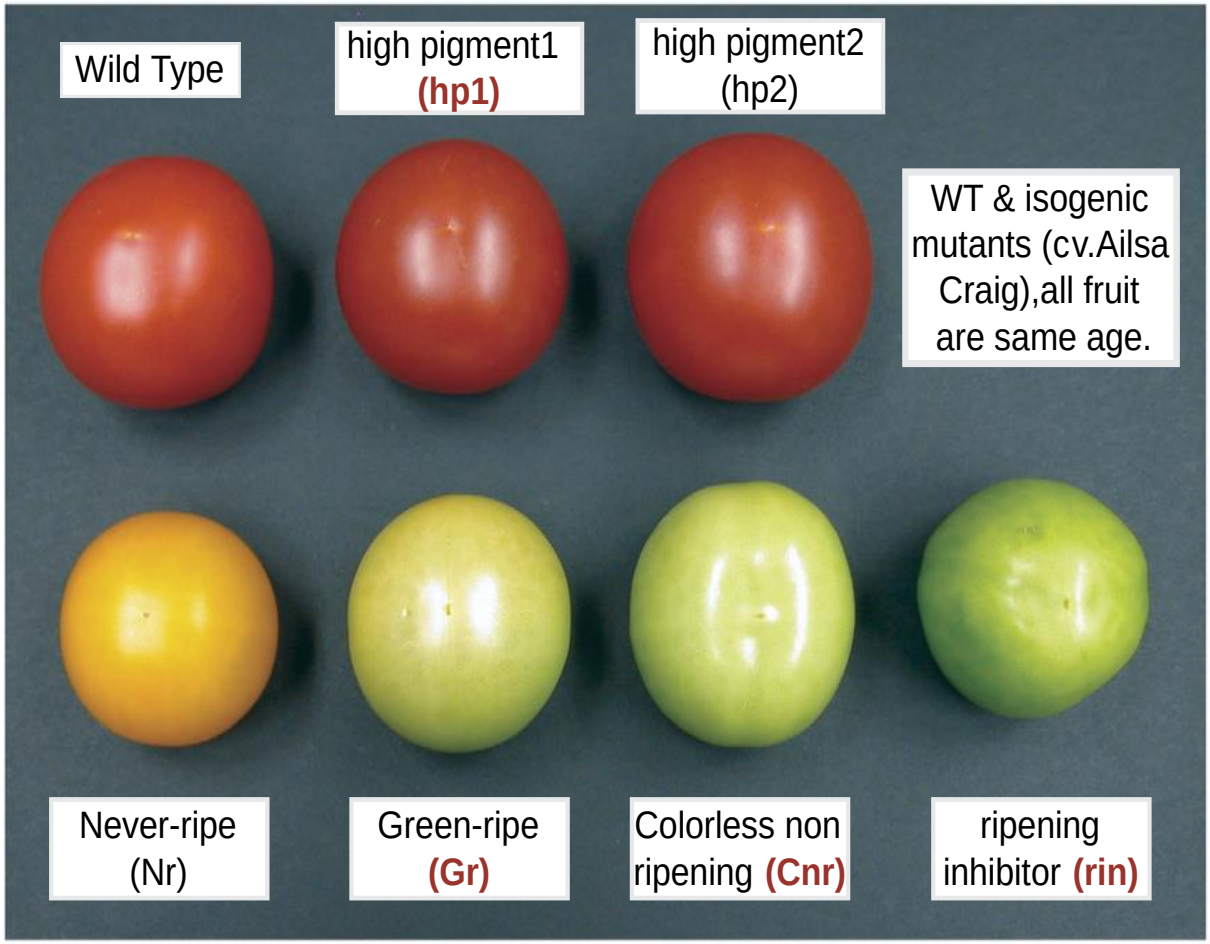
From plant...

...to product...

...with our assay...

...for the consumer.

Optimizing Fruit Nutritional Quality

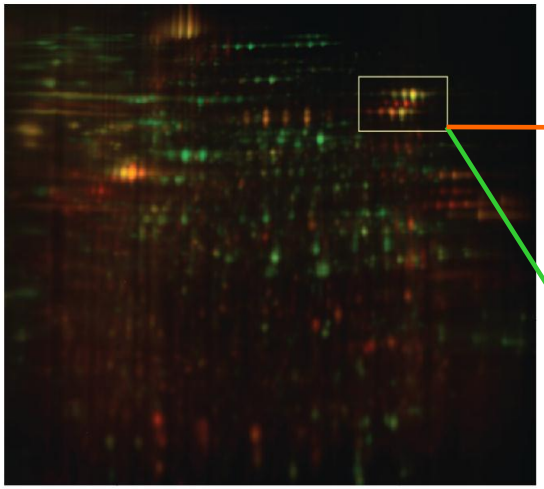


- PSNU scientists have made breakthroughs by identifying major determinants for fruit quality, composition and value in tomato.

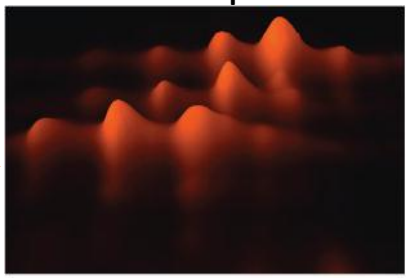
- Key genes increase bioactive pigments (HP1) or decrease production and distribution costs so as to deliver high quality, lower cost food to American consumers (RIN, NOR).

Plant Pigments and Human Health

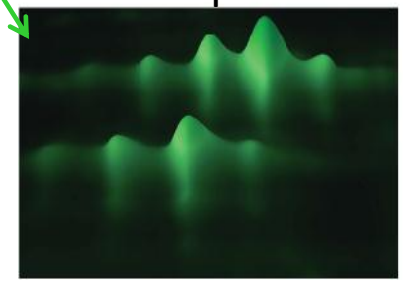
Proteomic analysis of tomato plastids by 2D-DIGE.



chromoplasts



leucoplasts



- PSNU scientists using advanced technologies, including proteomics, have discovered genetic factors that regulate pigment accumulation in vegetable crops.

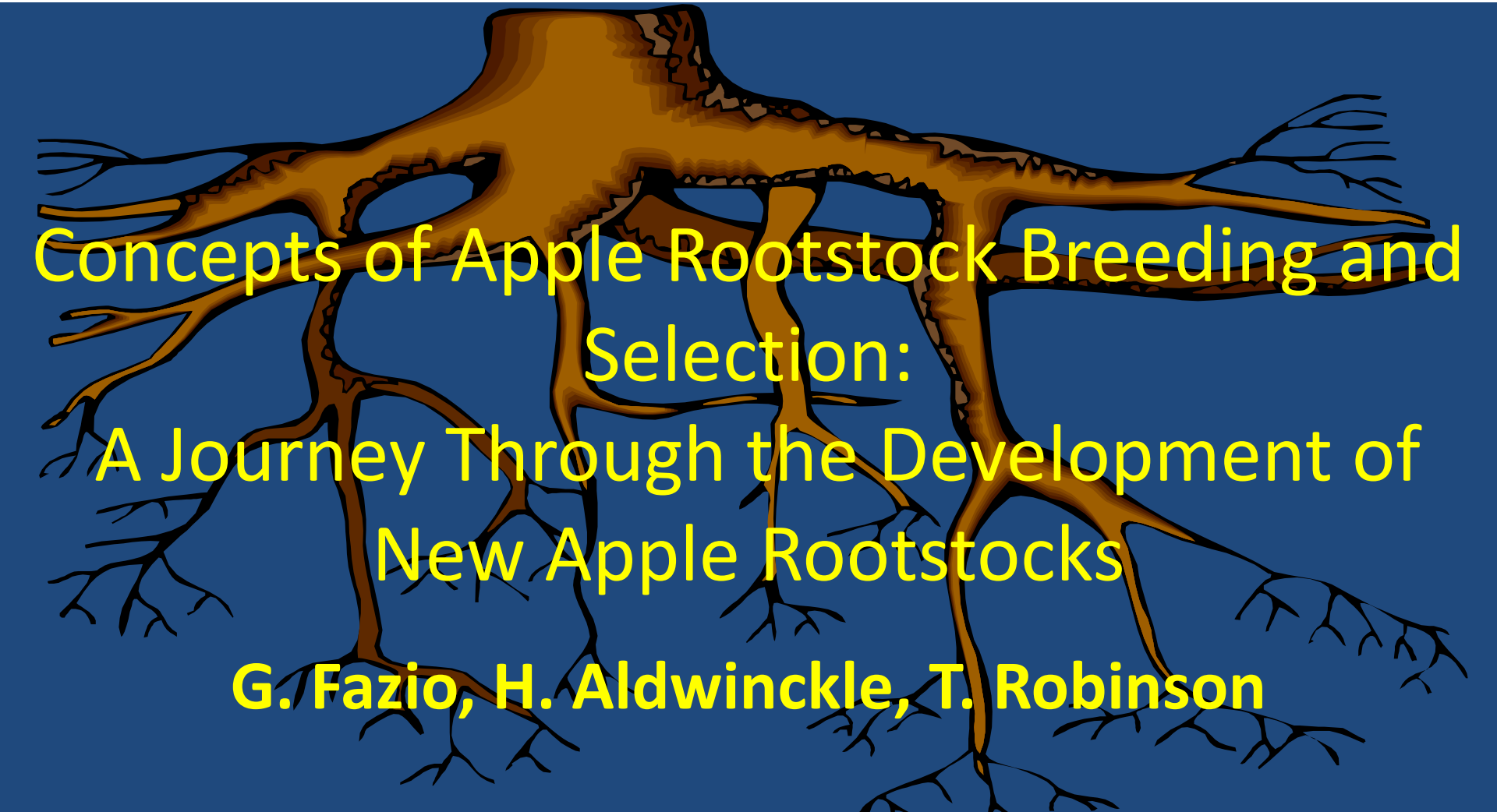
- This information can be used to make new varieties with increased levels of health promoting compounds like carotenoids, anthocyanins, and other bioactive compounds.

CORNELL UNIVERSITY

New York State Agricultural Experiment Station

USDA ARS

Geneva Breeding Programs

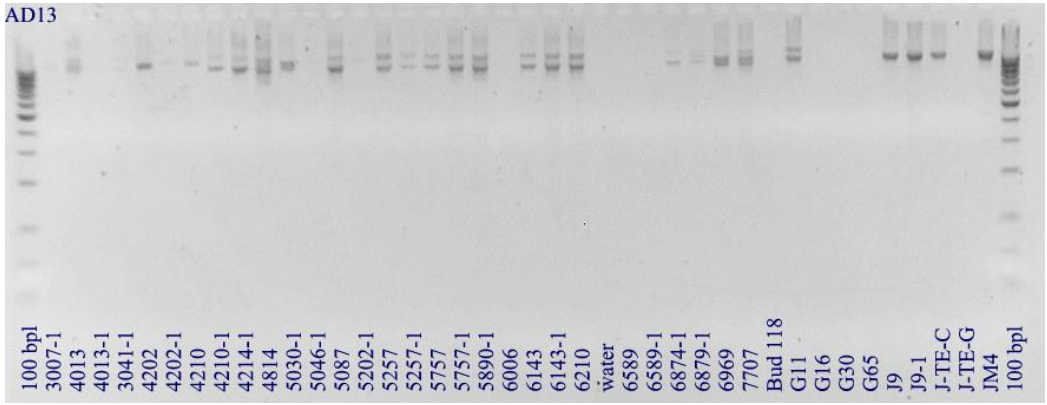


Concepts of Apple Rootstock Breeding and Selection:
A Journey Through the Development of New Apple Rootstocks

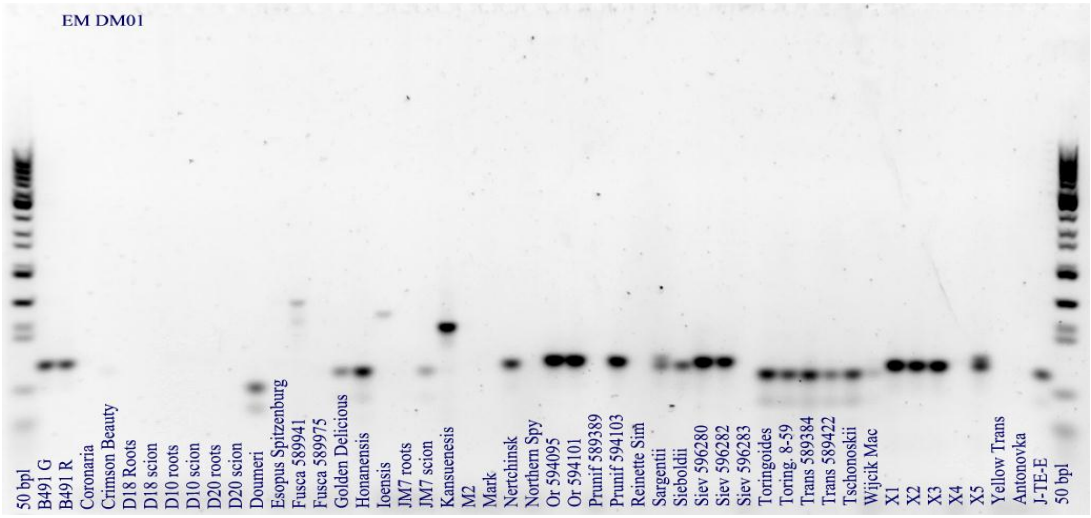
G. Fazio, H. Aldwinckle, T. Robinson

Criteria for Parent Selection – Phenotype and Molecular Markers

- Dwarfing
- Precocity
- Disease Resistance
  - Fire Blight
  - Phytopthora
  - Powdery Mildew
  - Apple Scab
- Yield and Field Performance
- “New” Gene Pools



AD13 SCAR scab marker (Boudichevskaia et al. 2006)



EM M01 SCAR powdery mildew marker (Evans et al. 2003)

Genetic engineering of PPV resistance

'HoneySweet' plum highly resistant to plum pox virus is in the process of release. This work has provided a unique and powerful defense against this exotic invasive disease, and can be applied other stone fruit crops.

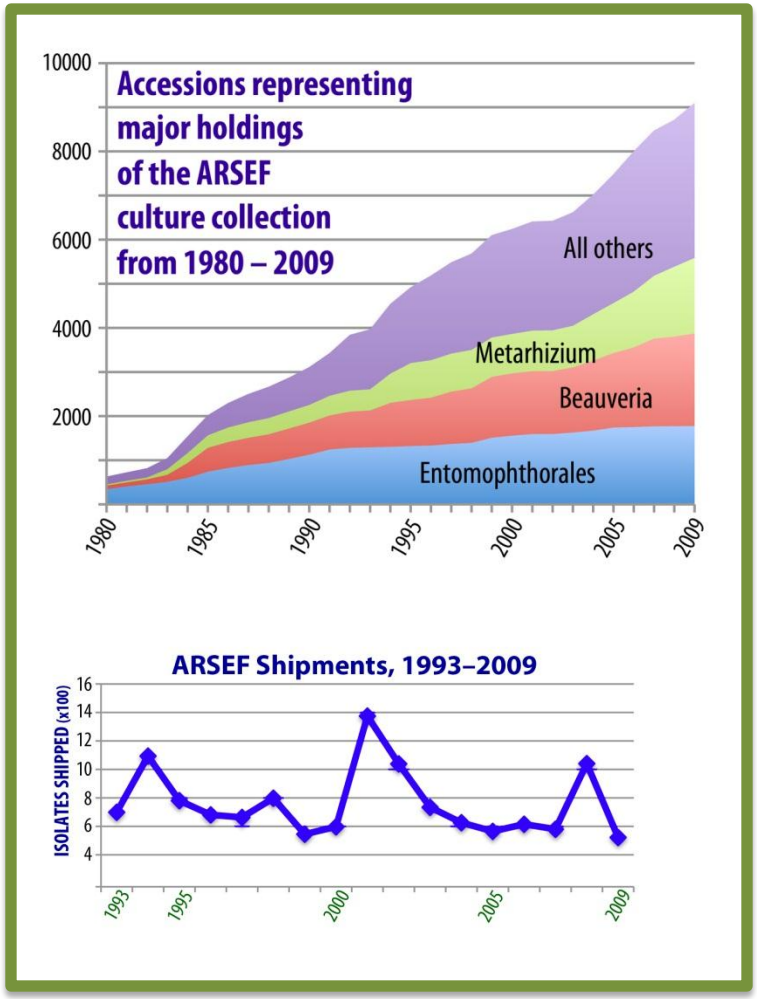
BIOLOGICAL CONTROL

- Food Security.
- Plant & Animal Protection.
- Reducing environmental footprint
- Safe and Nutritious Food

ARSEF - ARS Collection of Entomopathogenic Fungi
World's largest collection of insect pathogenic fungi

- Housed in Ithaca, NY
- Over 10,000 accessions
- 650 taxa
- Over 1,200 insect hosts
- Over 1,900 world-wide collection locations
- Used for screening for promising strains
- Used as resource for new chemistries

Taxonomically widespread group occurring in more than 100 genera



http://www.ars.usda.gov/Main/docs.htm?docid=12125

Current BIIR Projects

Agrilus planipennis
Emerald ash borer

Lygus & other
Mirid plant bugs

Anoplophora glabripennis
Asian long-horned beetle

Halyomorpha halys
Brown marmorated stink bug

Aphis glycines
Soybean aphid

MODELING; REMOTE SENSING; DATA PROCESSING; BIG DATA

- Food Security.
- Water use efficiency
- Reducing environmental footprint
- Climate Change
- Safe and Nutritious Food

Predictive Microbiology

Dr. Vijay Juneja

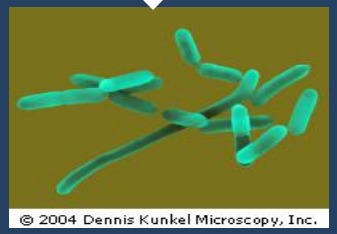
Dr. Andy Hwang

Dr. Lihan Huang

ERRC

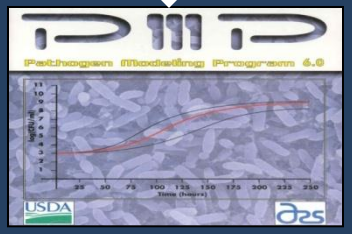
Predictive Microbiology Information Portal

Regulations



- Final Rule on *Listeria monocytogenes* in RTE Meat and Poultry Products
- "Zero Tolerance" Policy

Models



Useful Links

FSIS

AMI Foundation

CDC
SAFER • HEALTHIER • PEOPLE™

Wireless sensor network monitors crop canopy for automatic irrigation scheduling

GPS unit-

Wireless sensors (circled)

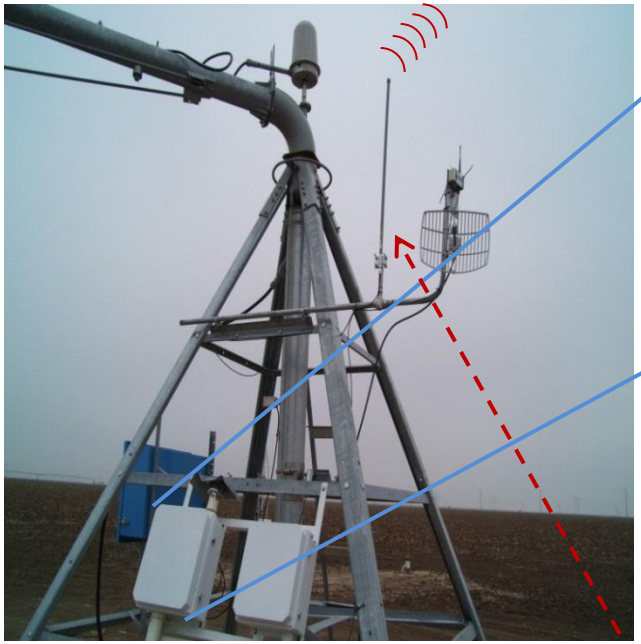
On center pivot irrigation system

Embedded computer for wireless data acquisition and pivot control

Canopy temperature is calculated using a scaling procedure based on one-time-of-day measurements from the moving wireless infrared thermometers on the irrigation lateral

Wireless Sensor Network System- data collection is centralized at the pivot point

900 MHz ⟷



Embedded computer at pivot point

Weather station

2.4 GHz- Zigbee protocol

Moving IRTs on pivot

Stationary wireless IRT in field over well-watered crop

Future Technology Advances

- Soil water sensing
  - Cheaper, wireless, more distributed, more accurate
  - Better second and third party support
- Plant sensing
  - Cover fraction, abiotic & biotic stresses, wireless
  - Using moving irrigation systems & aerial/satellite platforms
  - Routine mapping of fields in near real-time
  - Decision support systems available – easy to use
- State-wide and regional weather/ET networks
  - Improved access to data
  - Better coverage
  - Better use of satellite data

High Saline and Sodic Site
San Joaquin Valley, California

After tiled-Drained Installed and Irrigated

Thick Stand of Bermuda grass

Questions?