Progress In Understanding Onion Bacterial Diseases

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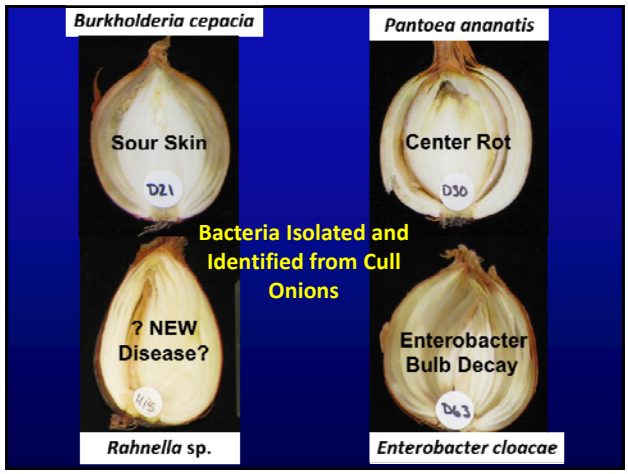
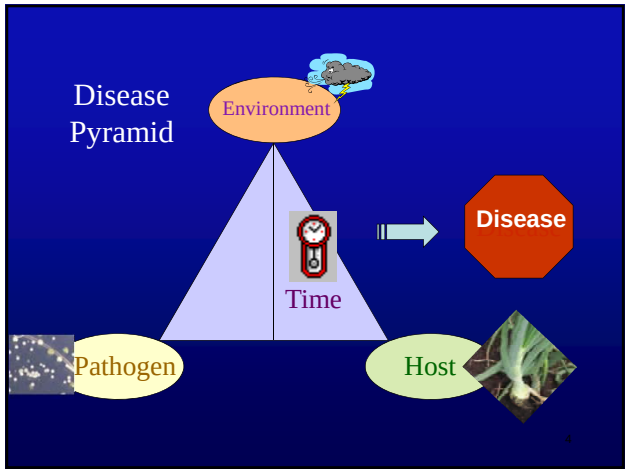
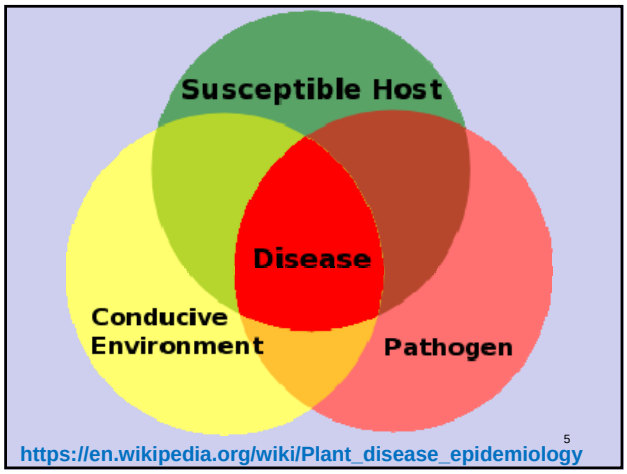
Cornell University



Progress In Understanding Onion Bacterial Diseases In 2015

- Similar Goals as for the last 6 years
- Two rather closely related goals:
  - Develop schemes for growers to reduce losses from bacterial rot
  - Determine how and why rot develops





https://en.wikipedia.org/wiki/Plant_disease_epidemiology

Progress In Understanding Onion Bacterial Diseases -- 2015

- What might growers do to reduce rot
  - **Consider the disease triangle**
    - **Alter Host Susceptibility?**
      - **Tested Acti-Gard**
    - **Attack the Pathogen**
      - **We will deal with this shortly**
    - **Manage the Weather**
      - **FORGET IT !**

Progress In Understanding Onion Bacterial Diseases -- 2015

- **What might growers do to reduce rot?**
- Onion pests and pathogens are generally managed by spraying
- How about spraying onions to reduce rot?
- No data indicate that ANY spray works!

RESEARCH ON BACTERIAL DISEASE IN NEW YORK -- 2015

Tested Materials That *Theoretically* Might Reduce Bacteria Pathogens

Materials Known to Kill Bacteria

Materials That Possibly Could Kill Bacteria

Materials That Growers Feel Work to Reduce Rot

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Tested Possible Materials to Reduce Bacterial Rot

1. **Chloropicrin fumigation**
   a. Sites where growers had fumigated for weed control
   b. Assessed populations of *Burkholderia cepacia*
2. **TerraClean®5** (concentrated preparation of OxiDate®2)
   a. Seed furrow drench
3. **Vermicompost Extract** -- **Product of Worm Power; Avon NY**
   a. Seed furrow drench
   b. Transplant root dip
4. **"Pool Chlorine"**
   a. "Pool chlorine" (Active Ingredient: Sodium Hypochlorite) included with usual weekly fungicide/insecticide sprays

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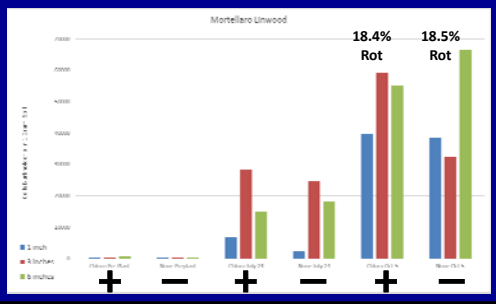
Tested Possible Tactics to Reduce Bacterial Rot

Chloropicrin fumigation



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Tested Possible Tactics to Reduce Bacterial Rot

TerraClean®5

Trial at DiSalvo Farms. TerraClean Drench at Seeding

- **Found very little *Burkholderia* in soil shortly after planting regardless of treatment.**
- **Low numbers early in the season similar to findings in chloropicrin studies.**
- **Rot data (from cutting dry-neck bulbs in the field):**
  - **TerraClean plot: 11/150 bulbs = 7.3% rot**
  - **NO TerraClean plot: 16/150 bulbs = 10.7% rot**

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Tested Possible Tactics to Reduce Bacterial Rot

Vermicompost Extract

Three trials carried out

1. **Dip Transplants before planting**
2. **Apply to furrow at seeding**
3. **Spray on plants throughout the season**

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Three trials carried out

1. **Dip Transplants before planting**
   - Vermicompost treated = 3.03% Rot
   - Control = 6.67% Rot
2. **Apply to furrow at seeding**
   - Vermicompost treated = 13.11% Rot
   - Control = 7.53% Rot
3. **Spray on plants throughout the season**
   - Results are not clear

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Tested Possible Tactics to Reduce Bacterial Rot

Pool Chlorine Trial by Rick Minkus and Kevin Besler

Sprayed Pool Chlorine with fungicides/insecticides throughout the season

- Assessed numbers of bacteria inside bulbs throughout the season
- Assessed rot at harvest

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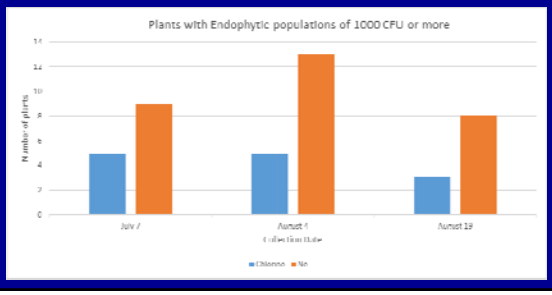
Tested Possible Tactics to Reduce Bacterial Rot

Pool Chlorine – Total Internal Bacteria



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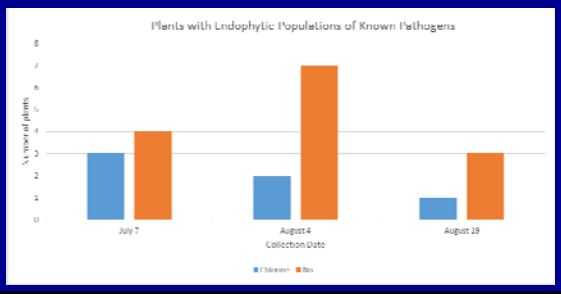
Tested Possible Tactics to Reduce Bacterial Rot

Pool Chlorine – Internal Pathogens



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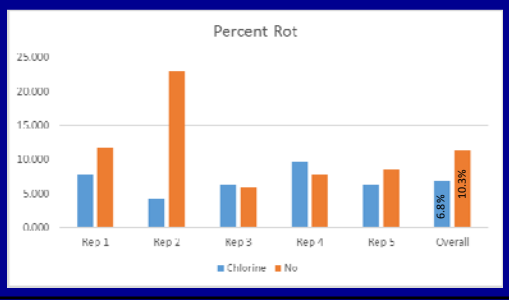
Tested Possible Tactics to Reduce Bacterial Rot

Pool Chlorine – Rot Data



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Tested Possible Tactics to Reduce Bacterial Rot

Pool Chlorine – Yield and Growth Info

Yield Estimate: PLUS 22%

Growth Time: 2 weeks more before lodging

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Summary of Tested Tactics

- Chloropicrin fumigation
  - NO EFFECT ON ROT
  - NO EFFECT ON POPULATIONS OF *Burkholderia cepacia* IN SOIL
- TerraClean®5, (concentrated preparation of OxiDate®2)
  - SMALL EFFECT ON ROT; COST EFFECTIVENESS IN QUESTION?
- Vermicompost Extract
  - TRANSPLANT DIP: SOME REDUCTION IN ROT; RE-TEST NEEDED
  - Seed furrow application: NO EFFECT ON ROT
- Pool Chlorine (One Trial Only)
  - SOME REDUCTION IN ROT; MUCH MORE RE-TESTING NEEDED
  - SUBSTANTIAL INCREASE IN YIELD -- A BIG PLUS

Etiology of Bacterial Rot in Onion

- When do growers encounter rot?
  - Generally at harvest or after storage
  - But, astute observers often see evidence earlier
  - We set out to determine when and how by following the development of rot in the three major growing areas

RESEARCH ON BACTERIAL DISEASE IN NEW YORK -- 2015

Determine when during the growing season onions become:

a. Infected by *Pantoea ananatis, Enterobacter cloacae* and *Burkholderia cepacia;*
b. Infested by *P. ananatis, E. cloacae* and *B. cepacia;*
c. Susceptible to infection by *P. ananatis, E. cloacae* and *B. cepacia*.

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- Seasonal Development of Bacterial Infection
  - The Big Three – The main concern
  - *Burkholderia cepacia, Enterobacter cloacae* and *Pantoea ananatis*
- Collected plants periodically during the growing season
  - Observed for symptoms of bacterial decay
  - Assessed endophytic bacteria in NON-symptomatic bulbs
  - Hypothesized that endophytic bacteria are indicative of rot at harvest

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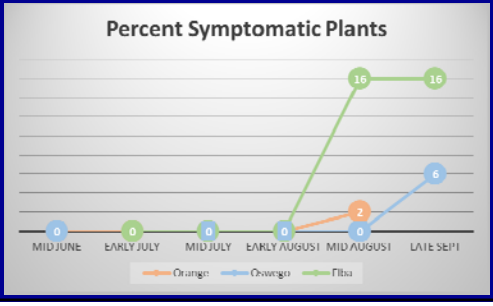
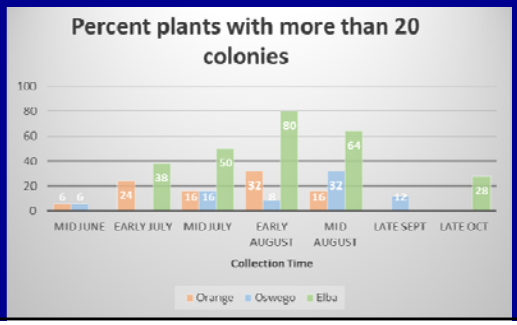
Determine when onions become INFECTED by *P. ananatis*, *E. cloacae* and *Burkholderia* species



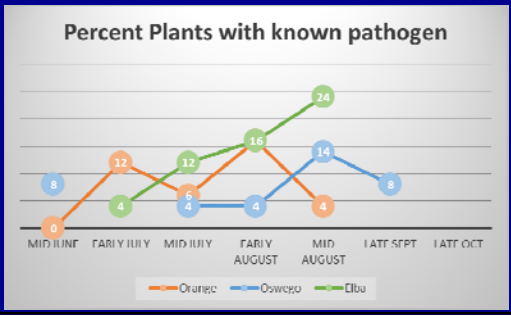
RESEARCH ON BACTERIAL DISEASE IN NEW YORK – 2015

Determine when during the growing season onions become INFESTED with significant numbers of bacteria



RESEARCH ON BACTERIAL DISEASE IN NEW YORK – 2015

Determine when onions become INFESTED with *P. ananatis*, *E. cloacae* and *Burkholderia* species



RESEARCH ON BACTERIAL DISEASE IN NEW YORK – 2015

Determine when onions become SUSCEPTIBLE TO INFECTION by *P. ananatis*, *E. cloacae* and *Burkholderia* species

"Clean" plants were produced in an controlled environment chamber. Beginning at the 4-leaf stage, plants were harvested and inoculated by injection with one of the three pathogens. Symptoms were assessed when noted externally or after incubating for 14 days.

B. cepacia

4-leaf stage plants are susceptible to both *B. cepacia* and *P. ananatis*. These photos were taken 4 days after inoculation.

P. ananatis

RESEARCH ON BACTERIAL DISEASE IN NEW YORK – 2015

Determine when onions become SUSCEPTIBLE TO INFECTION by *P. ananatis*, *E. cloacae* and *Burkholderia* species

At the 6-leaf stage, only 1 of 9 plants inoculated with *E. cloacae* developed symptoms 14 days after inoculation.

Inoculations with *E. cloacae* are on-going.

RESEARCH ON BACTERIAL DISEASE IN ONIONS

Progress on Other Aspects of Bacterial Diseases

- **Understanding Factors Affecting Bacterial Disease Development [Under Controlled Lab Conditions]**
  - **Temperature, Relative Humidity, Leaf Age, Organ Inoculated, Wounding, Bacterium**
- **Developed specific PCR primers to ID the Big Three**
  - **See Poster in the Hall**
  - **Makes ID of the Big Three more Effective and Efficient**
- **Perfected efficient system to reliably identify bacteria associated with onions**
- **Developed techniques to test endophytes as possible biocontrol strains**

RESEARCH UNDER CONSIDERATION FOR 2016 Tentative – For Discussion

1. **Substantial Field Testing of Sodium Hypochlorite Sprays to Reduce Rot**
   a. Grower spraying in all important onion growing areas for rot reduction and yield effect
   b. Zero-in on the details of sanitizing sprays of sodium hypochlorite -Timing, concentrations, compatibility
2. **Test Transplant Dip with Vermicompost Extract**
3. **Define Factors Affecting Development of Bacterial Diseases of Onions**
   1. Temperature, Relative Humidity, Leaf Age, Organ Inoculated, Wounding, Bacterium, Other?
4. **YOUR IDEAS?**

Recent Support of the Bacterial Disease Program

Providers of Essential Funding

- Cornell University Agricultural Experiment Station (W2008 NIFA)
- Section of Plant Pathology and Plant-Microbe Biology
- Cornell Research Foundation (Royalties from Inventions)
- Specialty Crops Block Grants (NYS Agriculture & Markets)
- NYS Onion Research and Development Program

- Cooperative and Collaborative Onion Growers

Progress Through Interaction and Cooperation