Cornell Cooperative Extension
Vegetable Program

Exploring the Relationship Between Nitrogen and Bacterial Diseases of Onions

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Cornell Cooperative Extension Vegetable Program

STOP THE ROT!!

Bacterial Diseases of Onions

Introduction

Management of bacterial diseases requires and IPM approach:

- Sanitation
- Variety selection
- Crop rotation & cover crops
- Induced resistance materials & bactericides
- Harvest & post-harvest technology
- Cultural practices
  - Planting configurations
  - **Reducing nitrogen**

Acknowledgements

Grower Cooperators!!

- 10 large-scale muck growers & 15 small-scale plastic onion growers
- especially, our champion field trial hosts:
  - Matt Mortellaro, Elba
  - Guy Smith, Triple G, Elba
  - Joe DiSalvio, Oswego

Funding Provided by:

- NEIPM Competitive Grant (Gugino, Beer & Hoepting)

Acknowledgements

Acknowledgements

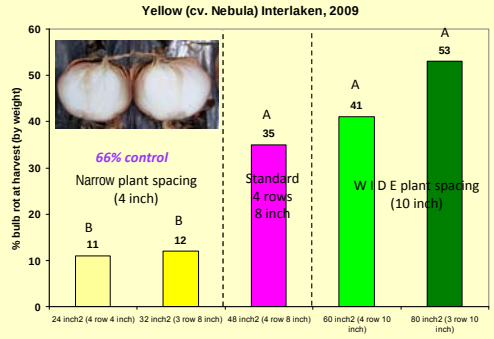
Program Assistants & Collaborators:

- Katie Klotzbach & Rebekah Edgell – CVP
- Jean Bonasera, Jo Ann Asselin & Ali Mohamed Zaid – Beer Lab
- Brian Nault & Cynthis Hsu – NYSAES Entomology

Reduced Plant Spacing & Mulch Type to Reduce Bacterial Bulb Rot

Funding provided by NESARE and NEIPM Partnership grants

Results: Onion Spacing Trial – % bacterial rot at harvest



Results: Onion Spacing Trial – % bacterial bulb rot at harvest

Grower Standard
36 inch^2: 6” x 4 rows

Results: Onion Spacing Trial – % bacterial bulb rot at harvest

Narrow Plant Spacing

24 inch^2: 4” x 4 rows

32 inch^2: 4” x 3 rows

Results: Onion Spacing Trial % bacterial bulb rot at harvest

WIDE Plant Spacing

60 inch^2: 10” x 4 rows

80 inch^2: 10” x 3 rows

Summary: Reduced Spacing Small-Scale

Narrowing plant spacing by 2 inches compared to the growers' standard:

- Significantly provided 44 to 66% control of bacterial bulb decay at harvest.
- Increased marketable yield by 120 to 220%.
- The economic return increased 1.1 to 5.5 times representing $45 to $258 more income per 100 feet of bed.
- **Does this work for large-scale production?**

Critical Observation

Bacterial disease trial located on a slope in a manured field

Rep 1 **83%**

Rep 2 **58%**

Rep 3 **17%**

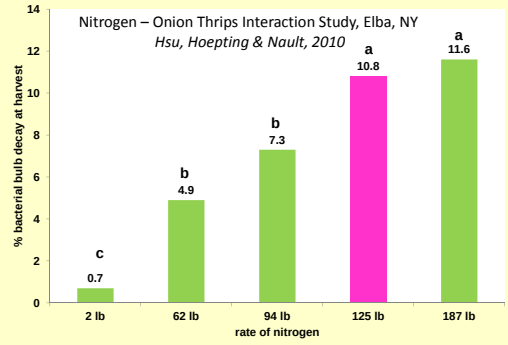
Rep 4 **0%**

Very Low soil N

Very High soil N

Presumably, nitrogen leached from the top of the slope to the bottom, where it favored bacterial disease.

Impact of Nitrogen on Bacterial Bulb Decay (% rot at harvest)



Does Elevated Nitrogen Increase Bacterial Decay?

2011 Large-Scale Field Trial, Oswego

Objectives:

1. Determine whether amount of **pre-plant nitrogen** affects bacterial diseases of onion.
2. Determine whether **plant spacing** (row-to-row, plant-to-plant and bulb area) affects bacterial diseases of onions.

Our small-scale trial results suggest that **≥ 36 inch²** significantly **increases bacterial rot**.

Plant Spacing in Large-Scale Onion Production

transplants

Seeding Rate (# per ft)	In-row plant spacing (inch)	Row spacing (inch)	Area per bulb (inch²)	Plant pop'n (plants/A)
3	4	15	60	104,544
3	4	7.5	30	209,088
2.5	5	6	30	217,800

Plant Spacing in Large-Scale Onion Production

Seeding Rate (# per ft)	In-row plant spacing (inch)	Row spacing 2 rows /bed (inch)	Area per bulb (inch^2)	Plant pop'n (plants/A)
7.5	1.6	12 (bed) 20 (btwn beds)	**19.2** (bed) **32** (btwn)	251,308
5.0	2.4	12 (bed) 20 (btwn beds)	28 (bed) 48 (btwn)	167,538
10	1.2	12 (bed) 20 (btwn beds)	14.4 (bed) 24 (btwn)	335,076
5.0	2.4	**6 (bed) = 3 rows** 20 (btwn beds)	14.1 (bed) 48 (btwn)	251,308

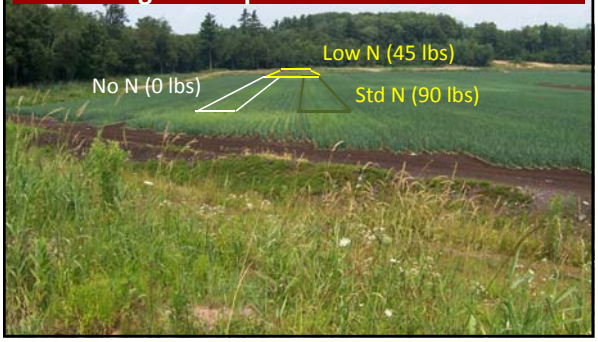
Reduced plant spacing & nitrogen bacterial field trial: large-scale production on muck

Treatments:

- **Seeding Rates:**
  - Standard: 7.5 seeds per foot (251,308 plants/A)
  - Narrow: 10 seeds per foot (335,076 plants/A)
  - Wide: 5 seeds per foot (167,538 plants/A)
- **Nitrogen Rates:**
  - Standard: 90 lbs per acre
  - Low: 45 lbs per acre
  - None: 0 lbs per acre
- **Varieties:**
  - Nebula
  - Prince

Reduced plant spacing & nitrogen bacterial field trial: large-scale production on muck

Reduced plant spacing & nitrogen bacterial field trial: large-scale production on muck



Nitrogen by Planting Density Trial: Measured Soil & Tissue Nitrogen

Beer & Hoepting 2011

ppm	2-leaf (June 10)		7-9 leaf (July 20)			
Nitrogen Applied	NO3	PMN	NO3	PMN	Tissue Prince (%N)	Tissue Nebula (%N)
None (0 lbs)	373	24	188	14	2.5	2.9
Low (45 lbs)	251	25	176	11	2.3	2.5
Std (90 lbs)	759	47	367	14	4.6	3.1

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Harvest Results

Harvest Results

At harvest:

- 0.44% bacterial rot!
- 44 out of 9854 bulbs

Where did all the rot go?

Harvest Results

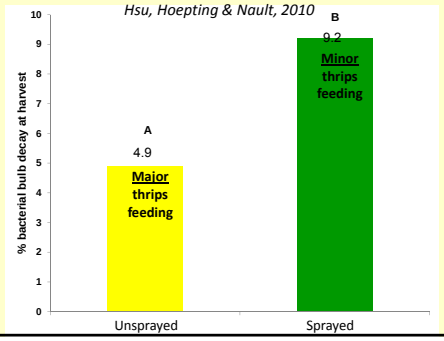
Where did all the rot go?

- Weather?
  - –2011 dry in July
- Crop rotation?
  - –2009 – onions (30% rot); 2010 – lettuce
- Reduced nitrogen?
  - –2009 – 140 lbs; 2011 – 90 lbs
- No adjuvants?

Impact of Nitrogen on Bacterial Bulb Decay (% rot at harvest)

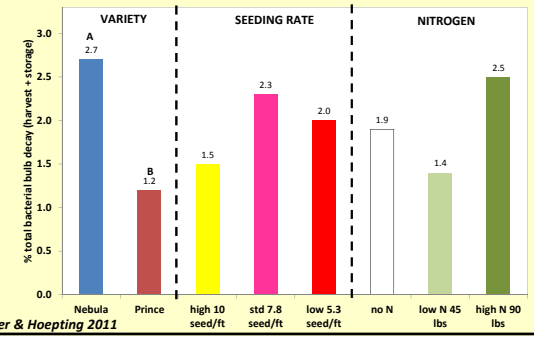
Nitrogen – Onion Thrips Interaction Study, Elba, NY

Hsu, Hoepting & Nault, 2010



Nitrogen by Planting Density Trial: Bacterial Bulb Decay

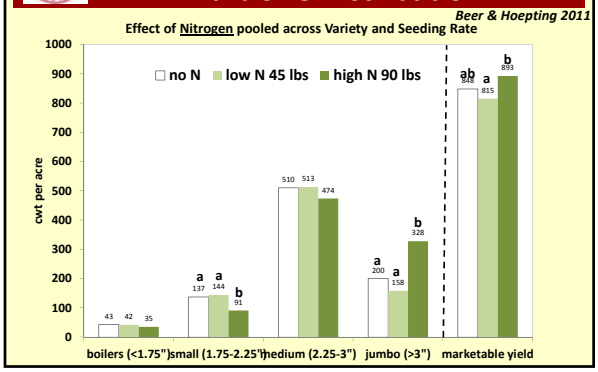
Effect of Variety, Seeding Rate and Nitrogen on Bacterial Bulb Decay



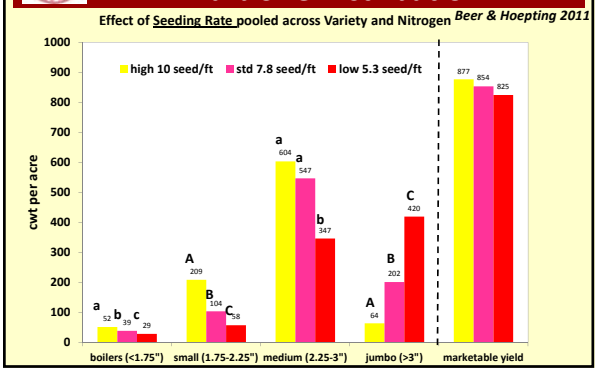
Beer & Hoepting 2011

Yield & Bulb Size

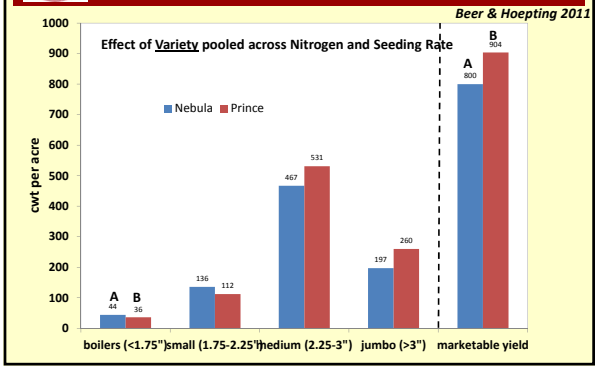
Nitrogen by Planting Density Trial: Bulb Size Distribution



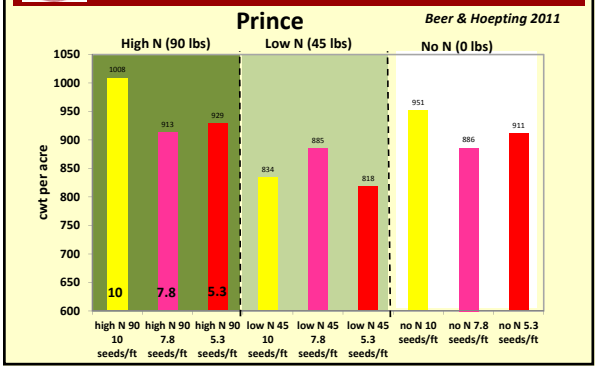
Nitrogen by Planting Density Trial: Bulb Size Distribution



Nitrogen by Planting Density Trial: Bulb Size Distribution



Nitrogen by Seeding Rate: Marketable Yield



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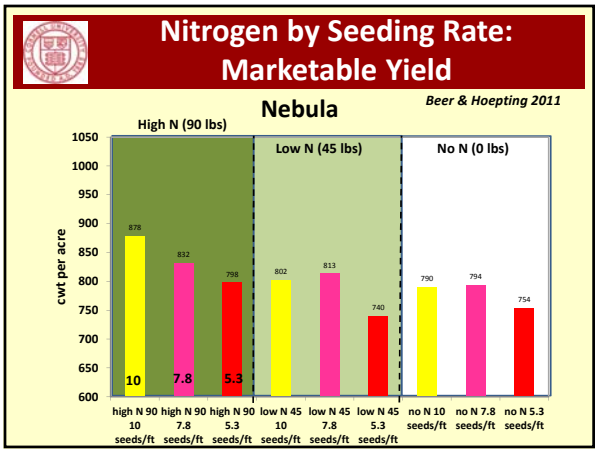


Nitrogen by Planting Density Trial: Summary

Nitrogen:

- Soil and plant tissue tests showed no differences between 0 and 45 lbs of added N. 90 lbs of added N had about 2x levels of N.
- There was a trend towards higher incidence of bacterial bulb decay with 90 lbs N
- No significant differences occurred among 0, 45 and 90 lbs added N for total marketable yield

Nitrogen by Planting Density Trial: Summary

Nitrogen:

- Achieving 754 to 951 cwt per acre with zero added nitrogen confirms preliminary soil tests showing potentially minerizable nitrogen (PMN) was VERY HIGH and definitely adequate.
- 90 lbs per acre gave significantly 2x more jumbo weight and significantly lower boiler and small weight
- 90 lbs N per acre is lower than standard grower practices, which is 120 to 140 lbs per acre

Nitrogen by Planting Density Trial: Summary

Seeding Density:

- There was a numerical trend towards the highest planting density having the lowest incidence of bacterial bulb decay
- No significant differences in marketable yield
- Lowest seeding density yielded 2x and 6.7x higher jumbo weight than 7.8 and 10 seeds per foot, respectively.
  - If you give onions the space, they will take it and get big (N was not a limiting factor at this site)

Nitrogen by Planting Density Trial: Summary

Seeding Density:

- Higher seeding densities (7.8 & 10) had significantly more mediums, smalls and boilers than 5.3 seeds per foot
  - Jumbos sell for a higher price and sometimes it is had to sell a large proportion of smalls
- In both varieties, a slight increase in yield was only observed with the 90 lb rate of N in the highest planting density.

Nitrogen by Planting Density Trial: Summary

Variety:

- Nebula had significantly 2x more bacterial bulb decay than Prince
  - Variety was the most important factor for bacterial bulb decay
- Prince had significantly higher marketable yield than Nebula
- No significant differences occurred among size classes, except Nebula had significantly more boilers than Prince

Nitrogen by Planting Density Trial: Final Thoughts

- Results from this trial suggest that there is opportunity for muck onion growers to reduce their N inputs and still achieve excellent yields
  - Pay more attention to soil testing (i.e. spring PMN)
- It would be worthwhile to continue to investigate the effect of nitrogen on yield and bacterial bulb decay
  - Include a high N treatment
- It would be interesting to get a read on the effect of seeding density on bacterial bulb decay in a trial with higher levels of bacterial disease
- Relative susceptibility of varieties to bacterial bulb decay warrants further study

Observational Study

Objective:

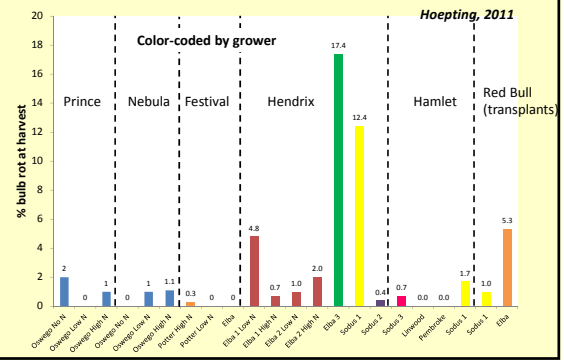
Identify factors associated with bacterial disease incidence in commercial onion fields in order to facilitate the development of an integrated pest management program for onion bacterial diseases in the Northeast region.

Observational Study

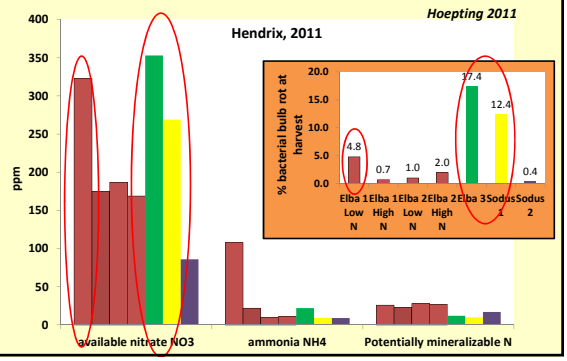
Approach:

1. **Intensive small-plot surveys of commercial fields**
   - 22 fields in NY (direct seeded (2 transplants) muck: 6 varieties, 7 growers
   - 29 fields in PA (small-scale production: Candy transplants on plastic)
   - 3 sub-plots per field
   - Soil & tissue samples, planting configurations, plant size, thrips, field history, yield, bacterial rot, etc.
2. **Replicated on-farm component research trials**
   - Nitrogen rate study (piggy-back with Brian & Simon)

Observational Study: Bulb Decay at Harvest



Observational Study: Nitrogen vs. Bulb Decay at Harvest



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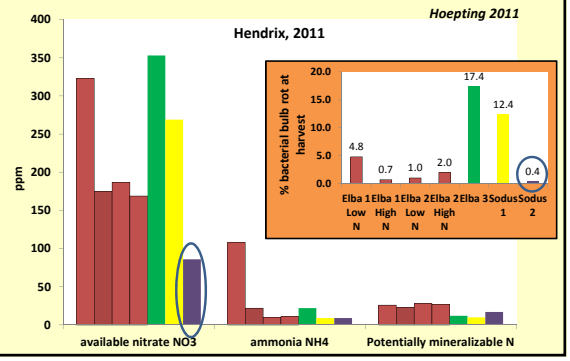
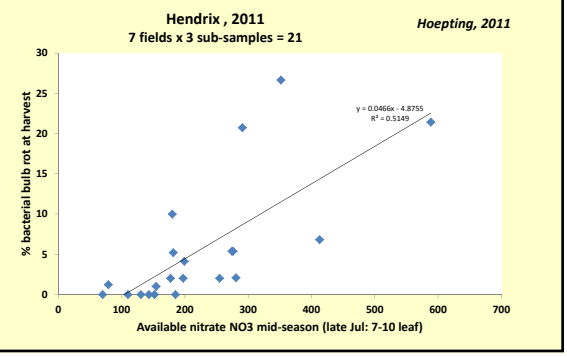
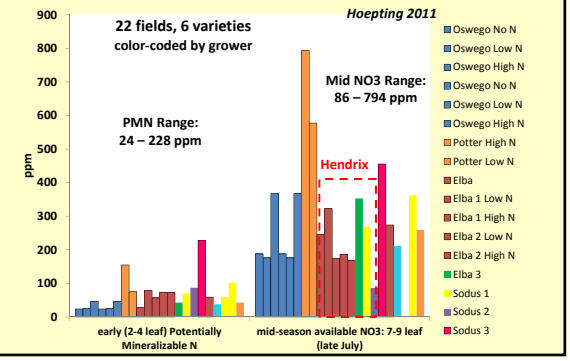


Obs. Study: Mid-Season Available N vs. Bulb Decay at Harvest



Observational Study: Soil Nitrogen



Observational Study: Replicated Small-Plot Nitrogen Rate Study

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~ 4% bacterial bulb rot at harvest

Next Steps

- Storage evaluation of all trials
- Analyze and mine the data
  - Identify factors driving bacterial rot
- Repeat in 2011:
  - Observational study
  - Component studies

Questions?

STOP THE ROT!!