Onion Spacing and Mulch Type to Improve Quality and Profitability of Fresh Market Onions

Christy Hoepting,
Judson Reid & Katie Klotzbach
Cornell Cooperative Extension Vegetable Program
Jeff Stolzfus
Eastern Lancaster County School District

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  - Katie Klotzbach
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Fresh Market Onions

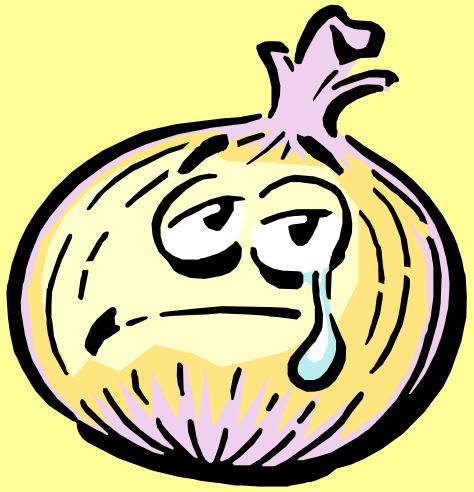
High Demand:

- Increased market demand for fresh onions
  - "Eat Local"/"locavore" craze (sell out of storage)
  - In general, there is an increased demand for sweet onions grown in the Eastern U.S. as an alternative to the high costs of shipping them from the west
  - PA broker has market to sell 3 times his current volume

Bacterial Diseases of Onions

Cause Serious Economic Losses:

- Especially in PA in sweet onions, losses of 30-45% occur regularly.
- In 2008, 34 growers in PA lost $140,000



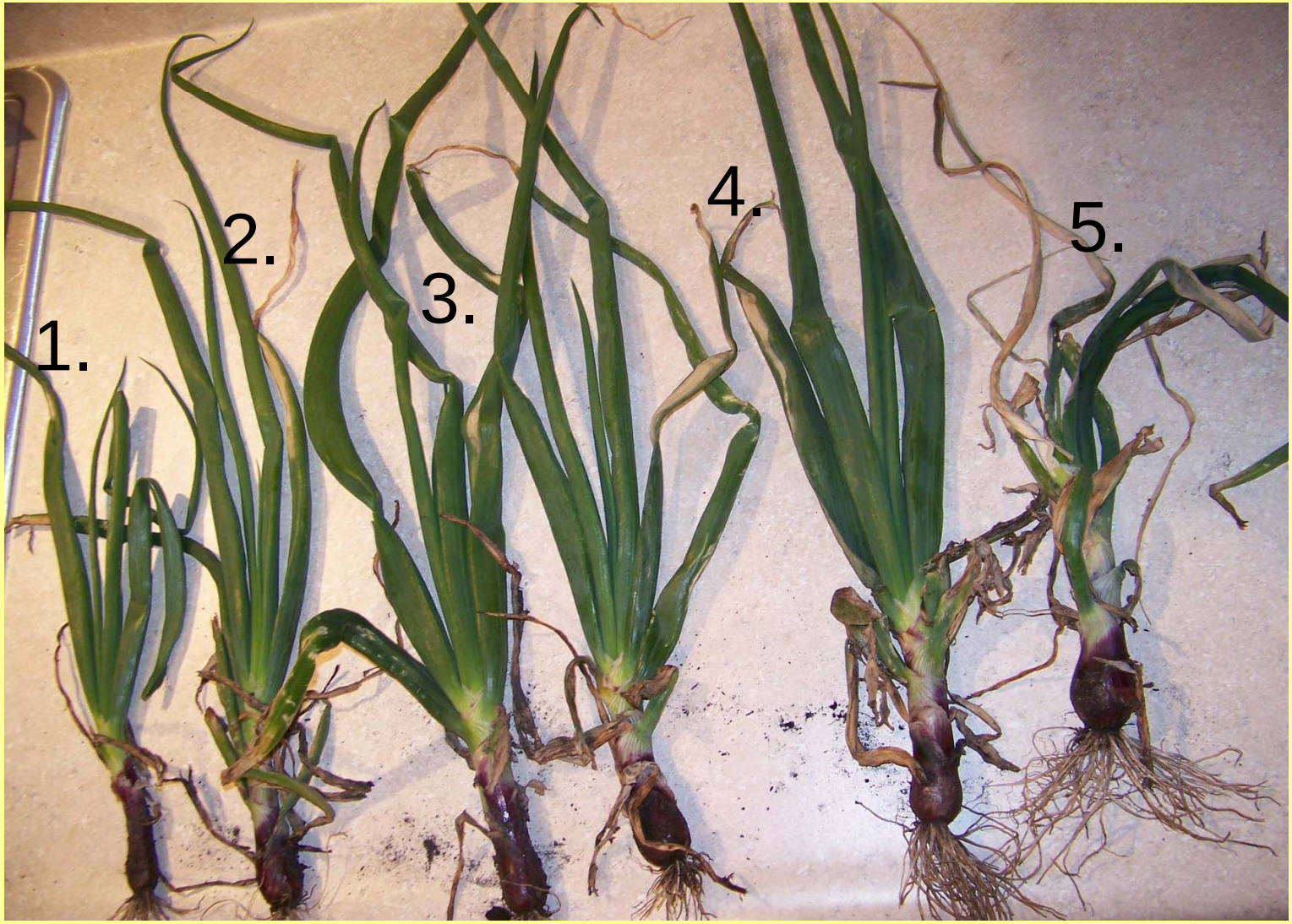
Bacterial Diseases of Onions

- Sour Skin – *Burkholderia cepacea**
- Soft Rot – *Erwinia carotovora* subsp. *carotovora, Pseudomonas marginalis, Pectobacterium caratovora*
- Center Rot – *Pantoea ananatis*, P. agglomerans, Xanthomonas axonopodis and Pseudomonas viridiflava*

*identified in New York, others in PA.

Bacterial Diseases of Onions

Bacterial Disease Progression



Bacterial Diseases of Onions - plant symptoms

Bacterial Diseases of Onions

How bacterial diseases get started:

- Bacteria persist in soil, water, crop debris, weeds, other crop hosts.
- Infection generally occurs through a wound (pelting rain, hail, thrips, herbicide injury, mechanical, etc.) when free water (rain, irrigation or flooding) causes water congestion in the host tissue.

Bacterial Diseases of Onions

Bacteria enter the plant:

1. Via contaminated water – during irrigation or splashing soil during heavy rainfall events, when it settles in the leaf axils.
2. Via wounds and aging tissue when foliage falls at maturity.
3. Directly through the green neck tissue when onions are topped during harvest.

Bacteria enter and move through the plant in **green** tissue only, NOT necrotic tissue

Bacterial Diseases of Onions

Disease Cycle:

- Infection may occur at any time during the growing season – often plants do not show symptoms until after bulbing.
- Moves down leaf, through the neck and into bulb. Once in bulb, nothing you can do.
- Bacteria spread more rapidly in water-soaked tissue
- Wide temperature range (32 to 105 °F)
- Favored by excessive nitrogen fertilization

Chemical Tactics Have Failed

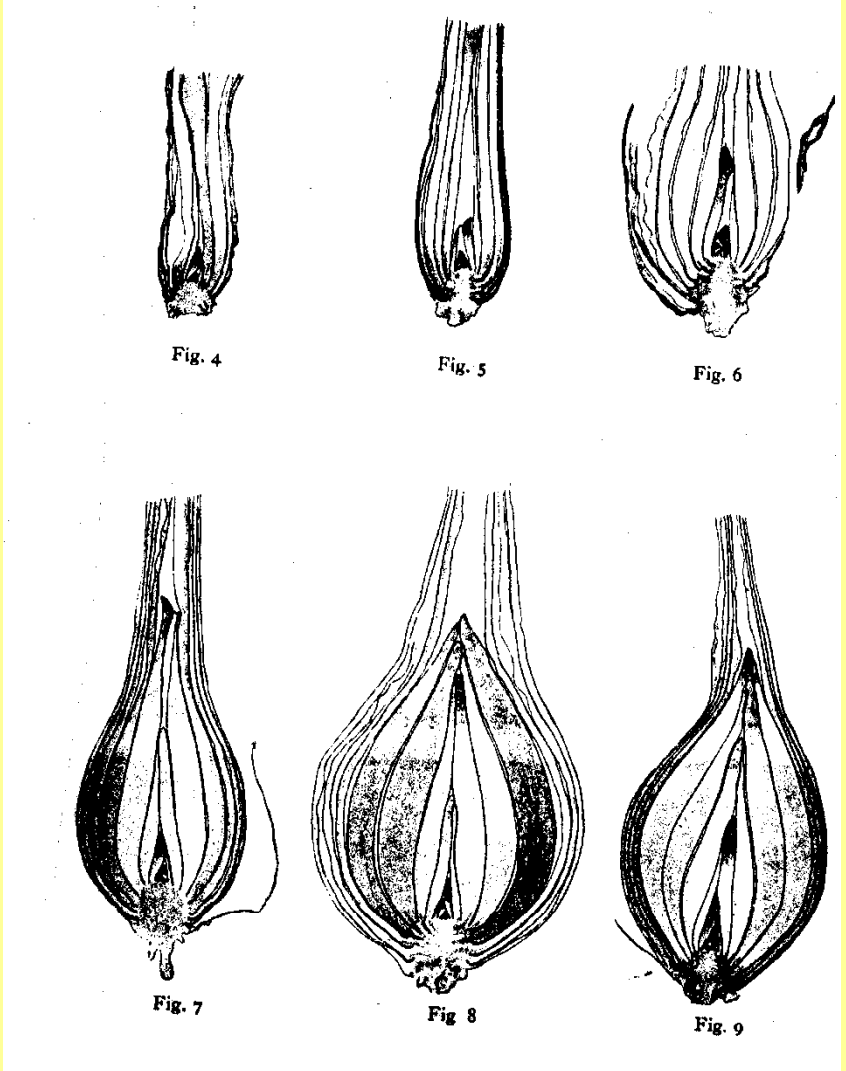
- Reports in PA of weekly sprays of various bactericides (copper, Oxidate, etc.) starting as early as 5-leaf stage (mid-May) and continuing until its PHI expires
  - Resulted in 30% bacterial rot
- If bactericides are to work, they need to be part of an IPM program that incorporates cultural practices
  - Plant spacing
  - Mulch Type

How Does Plant Spacing Reduce Bacterial Rot?

???

What is an onion plant?

- An onion plant is a collection of leaves + a root system
- As bulbs begin to form, the leaf bases of the youngest emerged leaves start to swell
- During bulbing, top growth is translocated into the bulb
- Large plants = large bulbs



How onions grow BIG

- Bulbing is triggered by daylength
  - The longest day of the year – June 21st

Bulbing is reversible!

- Plant cannot bulb and put on leaves at the same time

Rate of bulbing is affected by:

1. Temperature

- bulbing increases as temperatures increase
- Optimum: 70 - 81°F
- Plants do not grow when hot (>85 ˚F)

How onions grow BIG

Rate of bulbing is affected by:

2. Light Quality & Planting Density

- Infra-red light bouncing off neighboring plants increases bulbing
- ***Thick Stands*** – increase rate of bulbing at the expense of bulb size
- ***Thinned Stands*** – bulb formation slowed, take longer to mature, more leaf growth = thick necks

Plant Spacing

W I D E plant spacing results in:

- plants with very large, bushy foliage
- thick necks
- delayed or inhibited maturity

Plant Spacing

W I D E plant spacing is favorable for bacterial rots:

- ***Large plants, bushy leaves:*** hold water in leaf axils and whorls
  - Favor bacteria to entry into plant
- ***Thick necks:*** take longer to dry down, remain green and succulent
  - Bacteria spread from leaves into bulb
- ***Delayed maturity:*** interferes with proper lodging & curing of necks and bulbs
  - Bacteria spread from leaves into bulb

Narrow **plant spacing is less favorable for bacterial rots**

How Does Mulch Type Reduce Bacterial Disease?

Mulch Type

- Black plastic absorbs sunlight
  - Increase soil temperature
  - Promotes early crop growth in April & May
- During late-June, July, early-Aug, black plastic may be creating an environment that is
  - More favorable for bacterial growth
  - Less favorable for onion growth

Mulch Type

Alternative Mulch Types:

Reflective Metalic Silver Plastic:

- Cooler temperatures in heat of summer are:
  - Less favorable for development of bacterial disease
  - More favorable for growing big bulbs
  - Possibly at the expense of early plant growth in the spring
- Repels onion thrips to a degree
  - Thrips feeding can provide entry sites for bacterial pathogens

Mulch Type

Alternative Mulch Types:

- **Bare ground (no mulch)**
  - Cooler temperatures than black plastic
  - Weed control more challenging
- **Biodegradable black plastic:**
  - compromise between black plastic and bare ground
  - black plastic giving a push to early season growth and then giving way to cooler soil temperatures as it degrades

2009 Field Trials

Mulch study: New Holland, PA

- Black plastic (standard)
- Metalic silver plastic with black stripe
- Biodegradable black plastic
- Bare ground (no mulch)

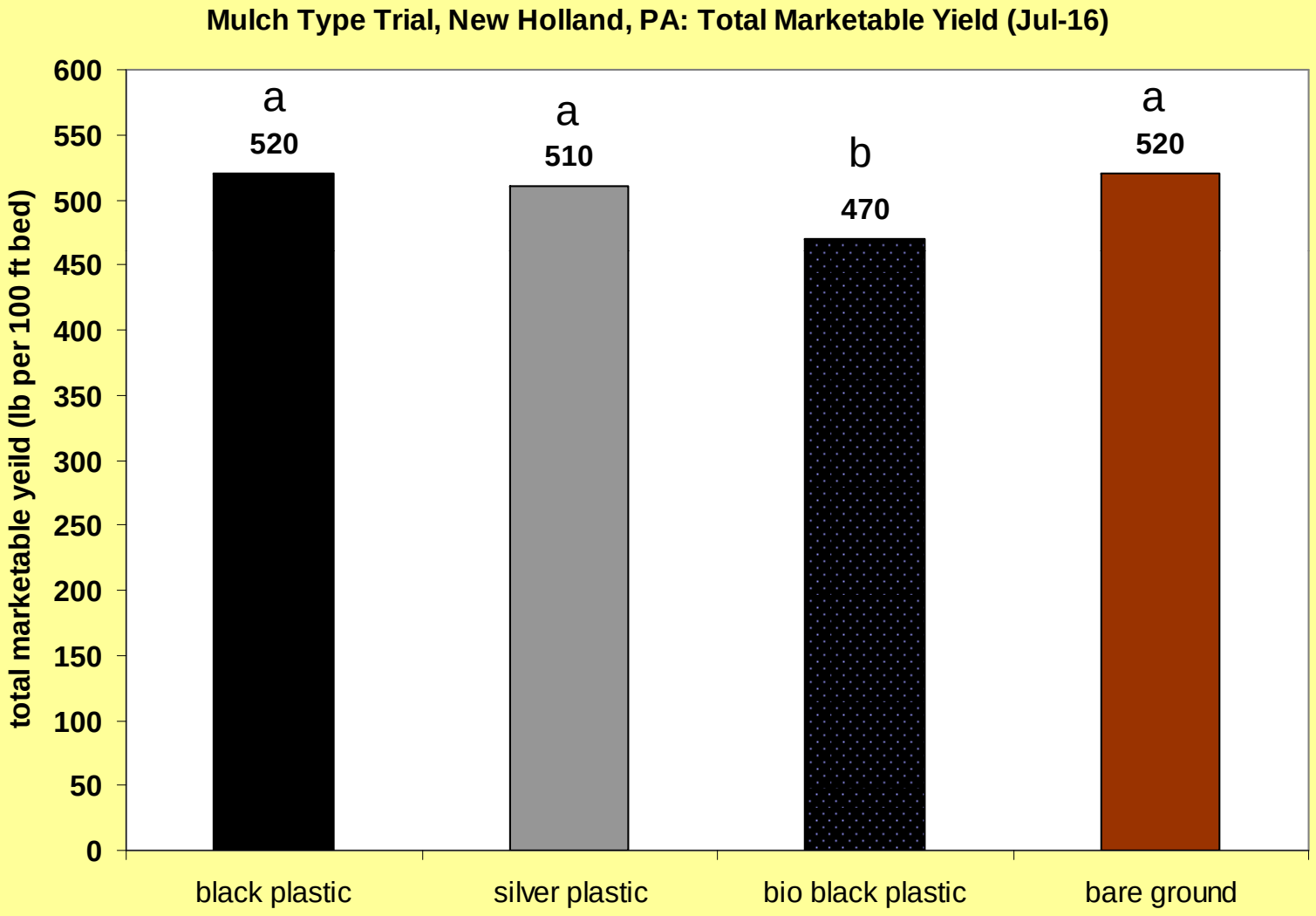
2009 Mulch Trial: New Holland, PA

36 inch^2 per bulb: 4 rows per bed, 6 inch plant spacing

2009 Mulch Trial

Collected soil temperature and moisture under each type of mulch and bare ground

Results: Mulch Trial total marketable yield



2009 Plant Spacing Trials

Objective:

- To evaluate whether narrow plant spacing or high density planting reduces incidence of bacterial rots of onions.

2009 Plant Spacing Trials

Interlaken, NY

Plant density (in^2/bulb)	No. rows /bed	Row spacing (in)	Plant spacing (in)
24	4	6	4
32	3	8	4
48	**4**	**6**	**8**
60	4	6	10
80	3	8	10

Variety: Nebula (yellow)

Silver plastic

New Holland, PA

Plant density (in^2/bulb)	No. rows /bed	Row spacing (in)	Plant spacing (in)
24	4	6	4
32	3	8	4
36	**4**	**6**	**6**
60	4	6	10
80	3	8	10

Variety: Candy (sweet)

Black plastic

Onion Spacing Trial, Interlaken, NY

Hole bunching tools

4 inch

6 inch

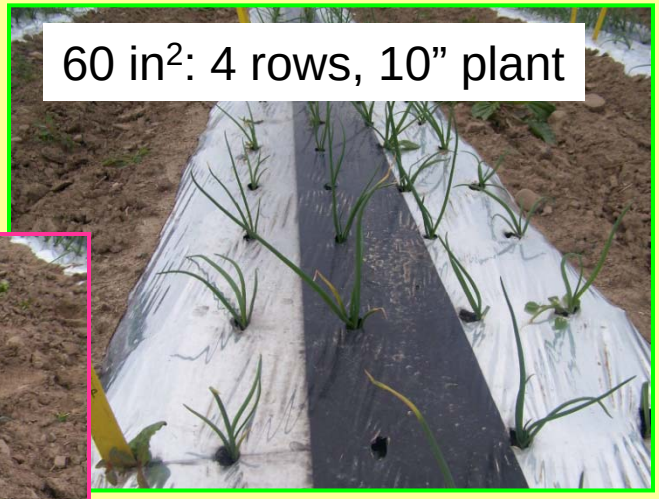
8 inch

10 inch

Onion Spacing Trial, Interlaken, NY

Eli Stolzfus, April 17, 2009

Onion Spacing Trial, Interlaken, NY

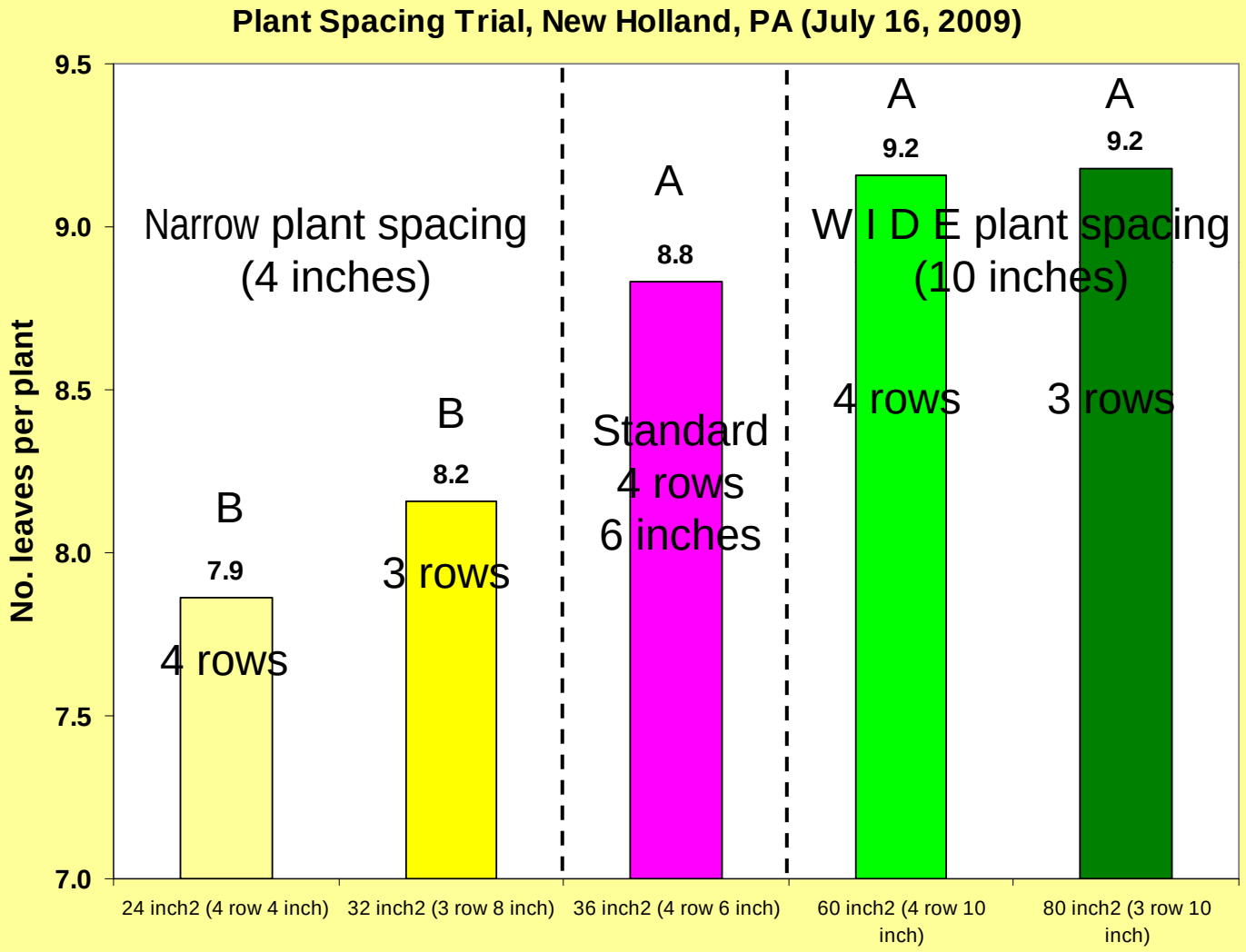


June 1, 2009

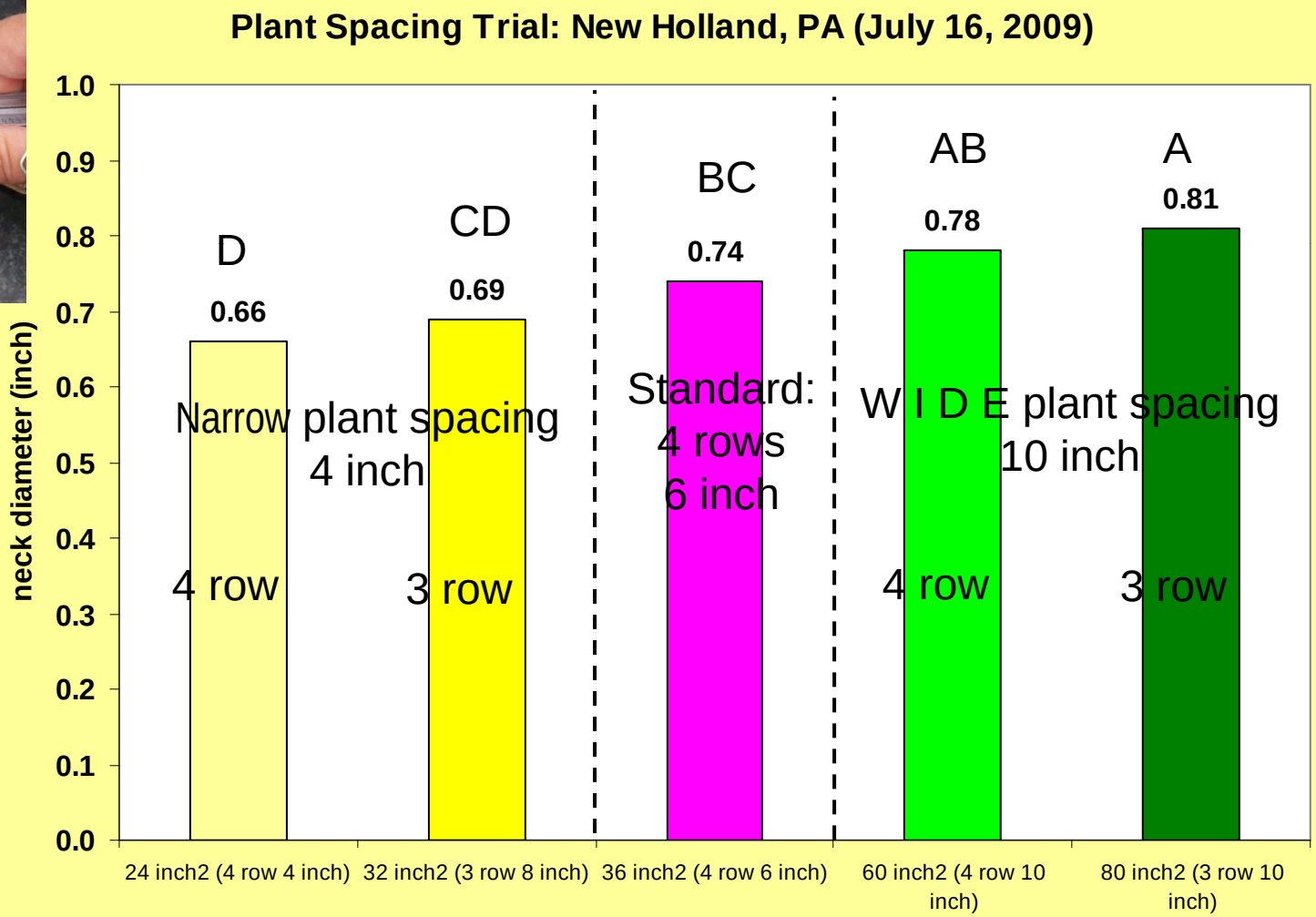
Narrow plant spacing

W I D E plant spacing

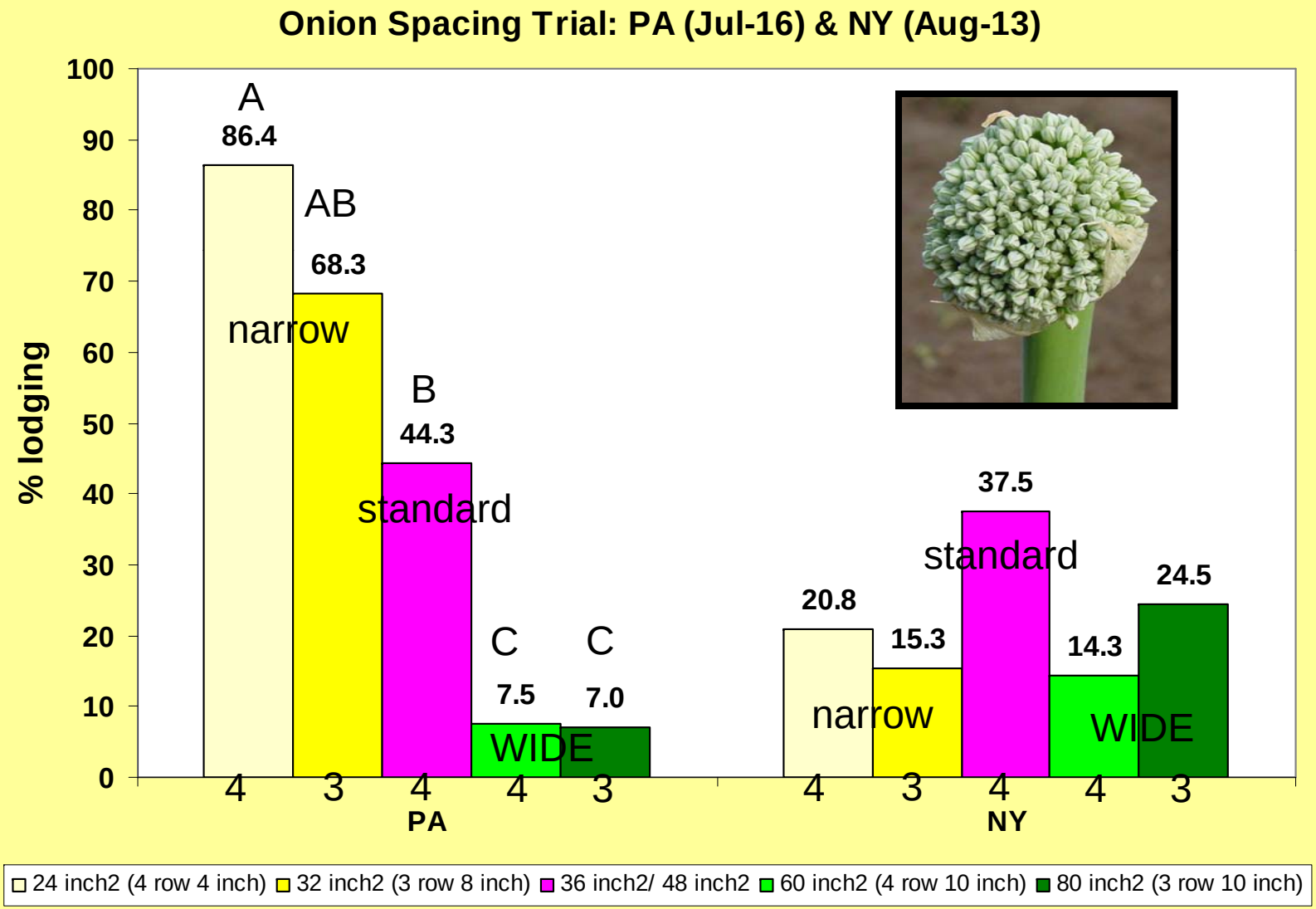
Results: Onion Spacing Trial – Plant Size: # leaves



Results: Onion Spacing Trial – Plant Size: neck diameter

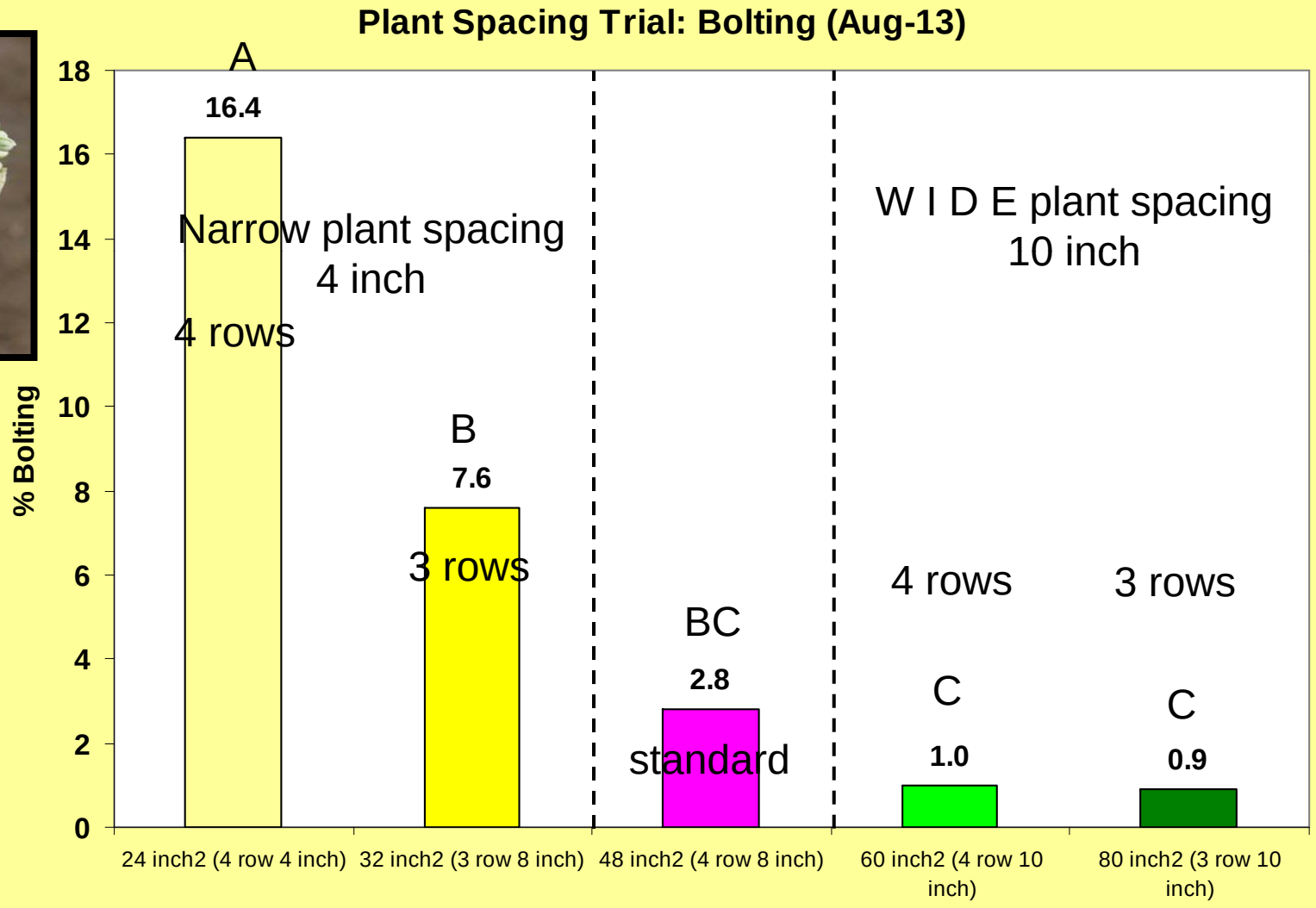


Results: Onion Spacing Trial – Maturity: % lodging



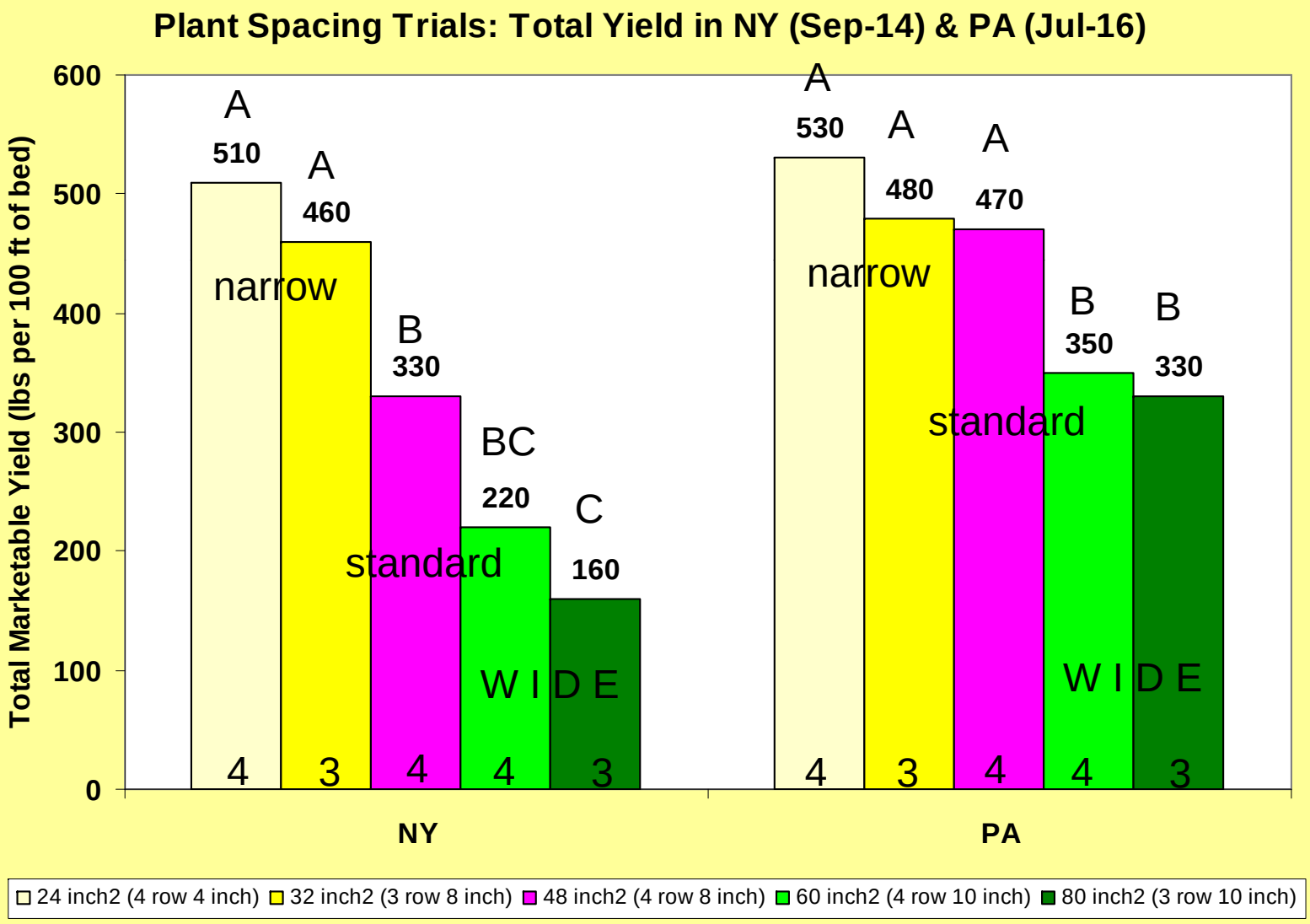
Results: Onion Spacing Trial – Maturity: % lodging

Results: Onion Spacing Trial – Maturity: % bolting

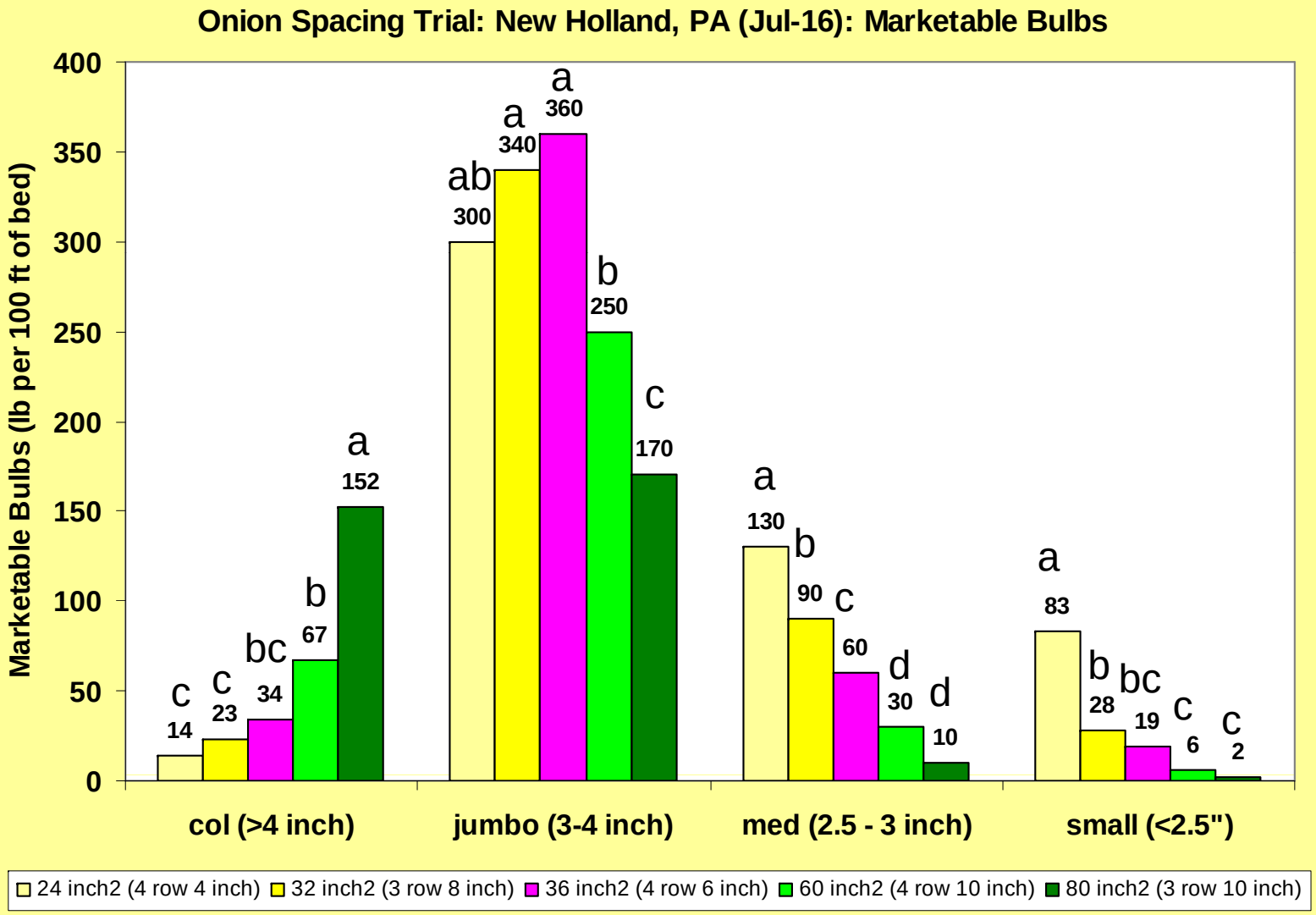


Results: Onion Spacing Trial – Yield and Bulb Size

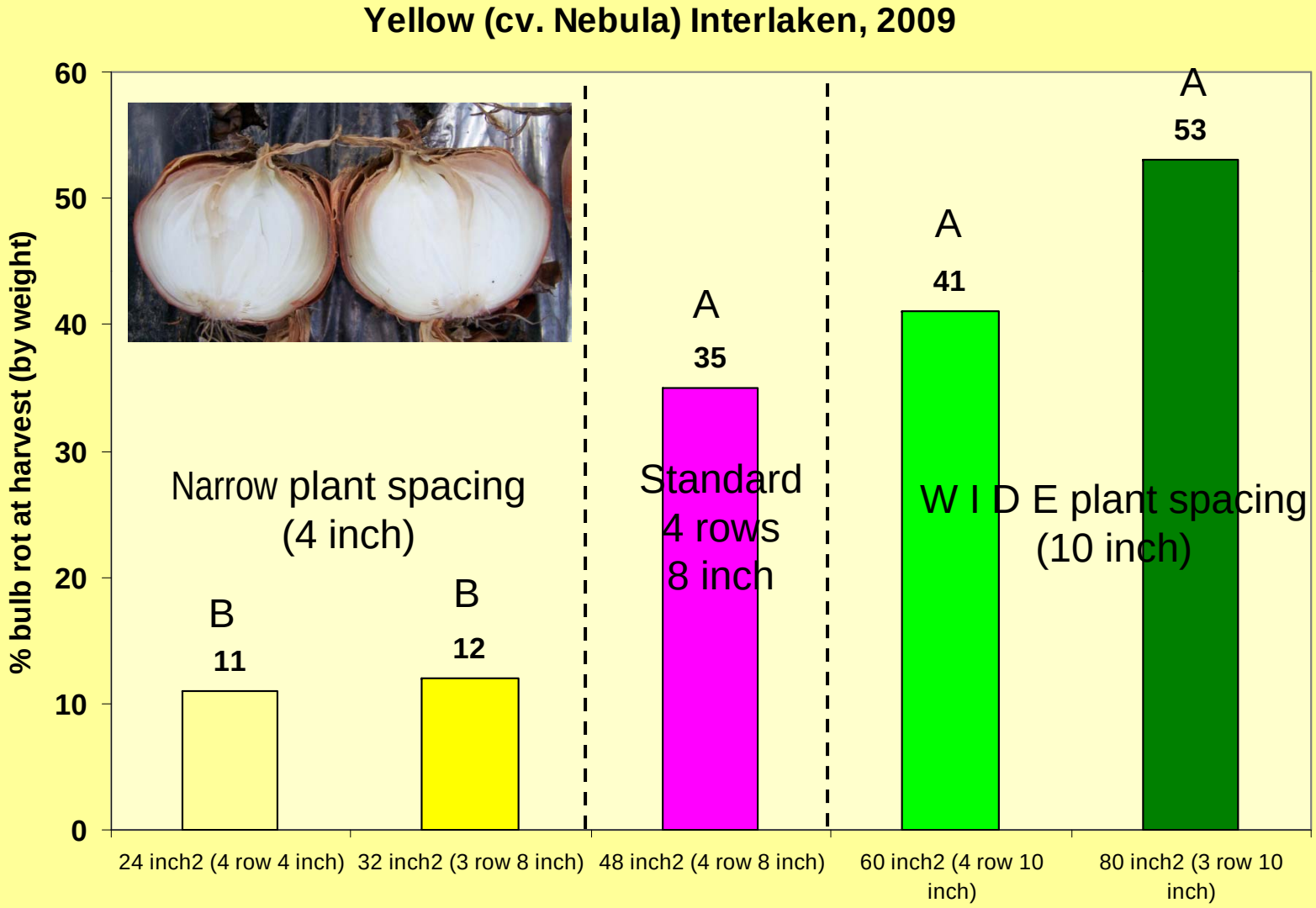
Results: Onion Spacing Trial – Total Marketable Yield



Results: Onion Spacing Trial – bulb size at harvest



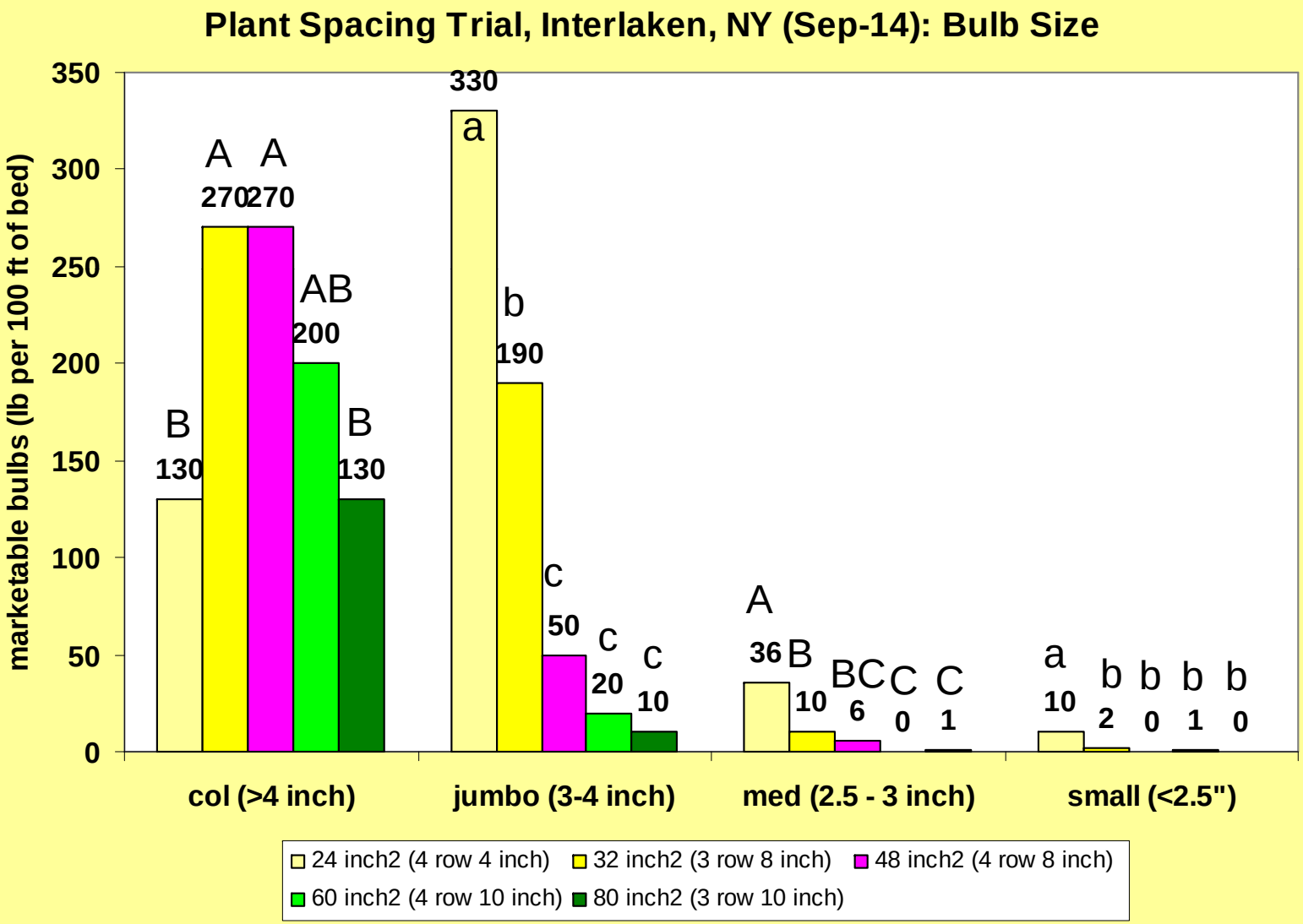
Results: Onion Spacing Trial – % bacterial rot at harvest



Results: Onion Spacing Trial – % bacterial rot at harvest

Bacterial disease caused by Sour Skin (*Burkholderia cepacia*) and center rot (*Pantoea ananatis*) pathogens

Results: Onion Spacing Trial – bulb size at harvest



Results: Onion Spacing Trial – economic return

Yellow onions (cv. Nebula), Interlaken, NY, 2009.

Plant Spacing			Total Marketable Yield (lb per 100 ft of bed)	Economic return ($ per 100 ft of bed)			
Planting density (in^2/bulb)	No. rows /bed	Plant spacing (inch)		Gross	Cost of transplants	NET	
24	4	4	510 a	$459	$40.50	$419	*1.5x*
32	3	4	460 a	$414	$30.38	$386	*1.4x*
48	**4**	**8**	**330 b**	**$297**	**$20.25**	**$277**	
60	4	10	220 bc	$198	$16.20	$182	
80	3	10	160 c	$144	$12.15	$132	

Price of onions: $0.90 per lb. ***Cost of transplants:*** $1.35 for 40 plants or $0.03375 per plant. ***No. plants per 100 ft of bed:*** **24 in^2** – 1200; **32 in^2** - 900; **48 in^2** – 600; **60 in^2** – 480; **80 in^2** – 360. All other expenses equal.

Results: Onion Spacing Trial economic return (variable prices)

Yellow onions (cv. Nebula), Interlaken, NY, 2009.

Planting density (in^2/bulb)	$ per size class (per 100 ft of bed)				Economic Return ($ per 100 ft of bed)		
	Small$ 0.20/lb	Medium $0.40/lb	Jumbo $0.50/lb	Colossal $0.55/lb	Gross	Cost of transplants	NET
24	$2.00	$14.40	$165	$71.50	$253	$24	$229
32	$0.40	$4.00	$95	$148.50	$248	$18	$230
48	**$0**	**$2.40**	**$25**	**$148.50**	**$176**	**$16**	**$160**
60	$0.20	$0	$10	$110	$120	$9.60	$111
80	$0	$0.40	$5	$71.50	$77	$7.20	$70

1.4x

Cost of transplants: $0.02 per plant (bare roots). ***No. plants per 100 ft of bed:*** **24 in^2** – 1200; **32 in^2** - 900; **48 in^2** – 800; **60 in^2** – 480; **80 in^2** – 360.
All other expenses equal.

Summary

- Wider plant spacing (i.e. 10 inches or more) results in:
  - Plants with more leaves and bushy top growth
  - thicker necks
  - Delayed or inhibited maturity
  - Bigger bulbs
  - Increased bacterial rots
- **Reducing plant spacing from 8 inches to 4 inches reduced bacterial disease from 36% to 12%, a value of up to $142 per 100 ft bed**

Future Research

1. Repeat plant spacing trial in PA

   (test under conditions favorable for bacterial disease)
2. Repeat mulch trial in PA
3. Another plant spacing trial in NY
   - Plant spacing: 4, 6, 8 inch with 3 & 4 rows
4. Interaction study (plant spacing & mulch combinations)

Recommendations

- If bacterial rot is an economic problem on your farm, try narrower plant spacing (i.e. 4 inch) on a small scale.
  - Wait until we have more years of conclusive data before going large-scale
  - Prove technique in a hot dry summer, different bacterial diseases, onions grown for different markets
  - Bolting issue?
- Practice good sanitation – remove culls from fields
- Cut back on nitrogen after bulbing

Questions?

STOP THE ROT!!

Let us know if you are interested in trying narrow plant spacing this summer!