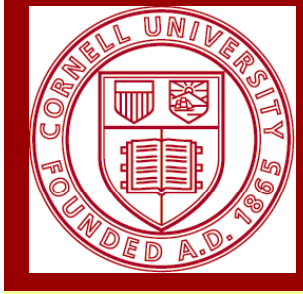

Cornell Cooperative Extension
Vegetable Program

Using Cultural Practices to Manage Bacterial Diseases and Increase Profitability of Fresh Market Onions in the Northeast United States

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Acknowledgements

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  - Eli Stoltzfus, Interlaken, NY
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  - NESARE Partnership Grant, 2009
  - NE-IPM Partnership Grant, 2010-2011

Issue

- Bacterial diseases of onions are an increasing threat to small-scale diversified fresh market growers in the Northeast United States

- If bacterial diseases of onions cannot be managed this industry will not be sustained or expanded.

Fresh Market Onions in NE US

- Expanding industry
- Small-scale intensive production
  - Grown on plastic mulch, beds 3 feet wide with drip irrigation
  - Exclusively grown from transplants: locally grown plugs, imported bare roots (TX, AZ)
  - Hand-harvested
  - 0.5 (or less) to 2.0 acres per farm
- Predominantly grown by very diversified "plain sect" farmers

Fresh Market Onions in NE US

Marketing

- Pennsylvania Simply Sweet Brand
- Produce Auctions (12 in PA, 4 in NY)
- Farmer's markets
- Roadside stands

Fresh Market Onions in NE US

PA Simply Sweet Onions:

	2008	2010	
No. growers	100	100+	
No. acres	200	300	***1.5x***
Value	$1.5 million	$2.5 million	***1.7x***

- In New York, there are 100-200 fresh market vegetable growers who grow onions.
- > $10,000 to $35,000 per acre

Fresh Market Onions in NE US

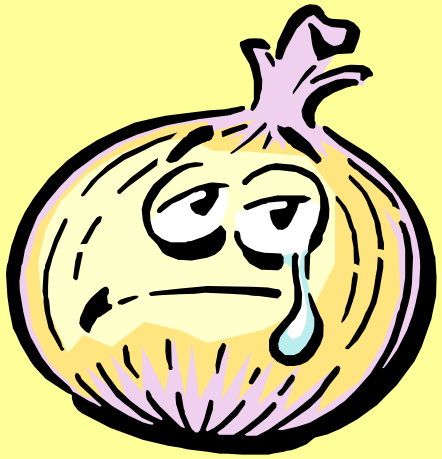
Increased market demand for fresh onions

- "Eat Local"/"locavore" craze (sell out of storage)
- In general, there is an increased demand for sweet onions grown in the Northeast 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 5 to 40+ % occur regularly.
- Growers harvest 2-3 weeks early, sacrificing size to avoid bacterial bulb rot



Bacterial Diseases of Onions

New York

- **Sour Skin** – *Burkholderia cepacea*

Pennsylvania

- **Center Rot** – *Pantoea agglomerans*
- **Soft Rot** - *Pectobacterium caratovora*

Bacterial Diseases of Onions

Others

- **Soft Rot** – *Erwinia carotovora* subsp. *carotovora, Pseudomonas marginalis*
- **Center Rot** – *Pantoea ananatis*
- **Leaf diseases** - *Xanthomonas axonopodis and Pseudomonas viridiflava*
- *Enterobacter cloaceae*

We are dealing with a complex!

Bacterial Diseases of Onions

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
- Bacterial diseases need to be controlled using an IPM program that incorporates cultural practices
  - Plant spacing
  - Mulch Type

How Does Plant Spacing Reduce Bacterial Decay?

???

Plant Spacing

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

Plant Spacing

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

- ***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**

Objective

To evaluate the effects of plant spacing on bacterial bulb decay, yield, bulb size and economic return in small-scale intensive onion production.

2009 Plant Spacing Trials

Interlaken, NY

Plant density (in^2/bulb)	Plant spacing (in)	No. rows /bed	No. plants /100 ft
24	4	4	1200
32	4	3	900
48	**8**	**4**	**600**
60	10	4	480
80	10	3	360

Variety: Nebula (yellow)

Silver plastic

New Holland, PA

Plant density (in^2/bulb)	Plant spacing (in)	No. rows /bed	No. plants /100 ft
24	4	4	1200
32	4	3	900
36	**6**	**4**	**800**
60	10	4	480
80	10	3	360

Variety: Candy (sweet)

Black plastic

Onion Spacing Trial, Interlaken, NY

Hole bunching tools

4 inch

6 inch

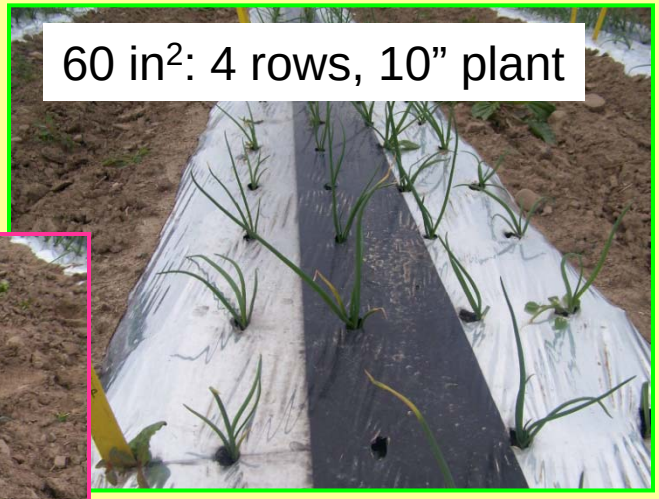
8 inch

10 inch

Onion Spacing Trial, Interlaken, NY

Eli Stolzfus, April 17, 2009

Onion Spacing Trial, Interlaken, NY

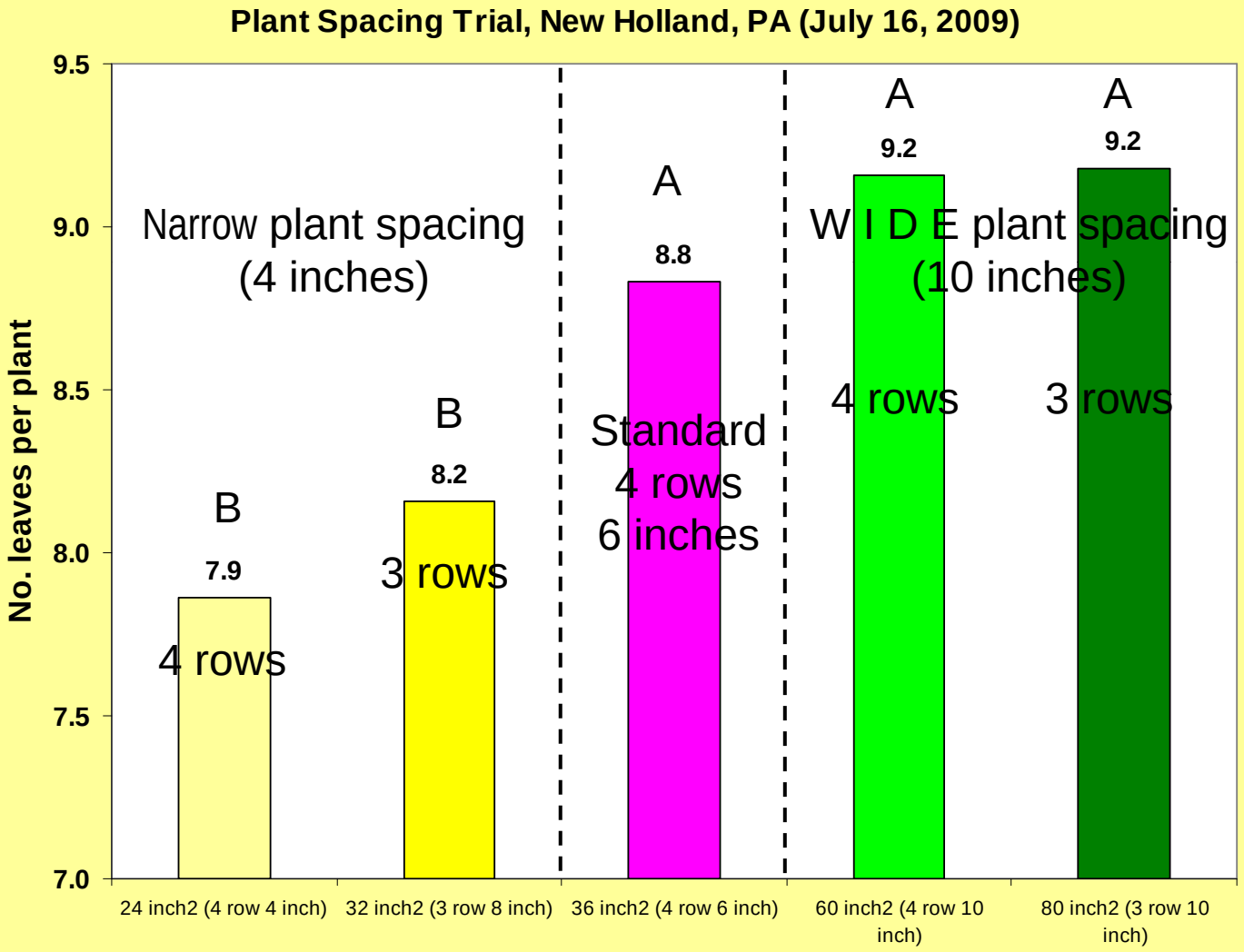


June 1, 2009

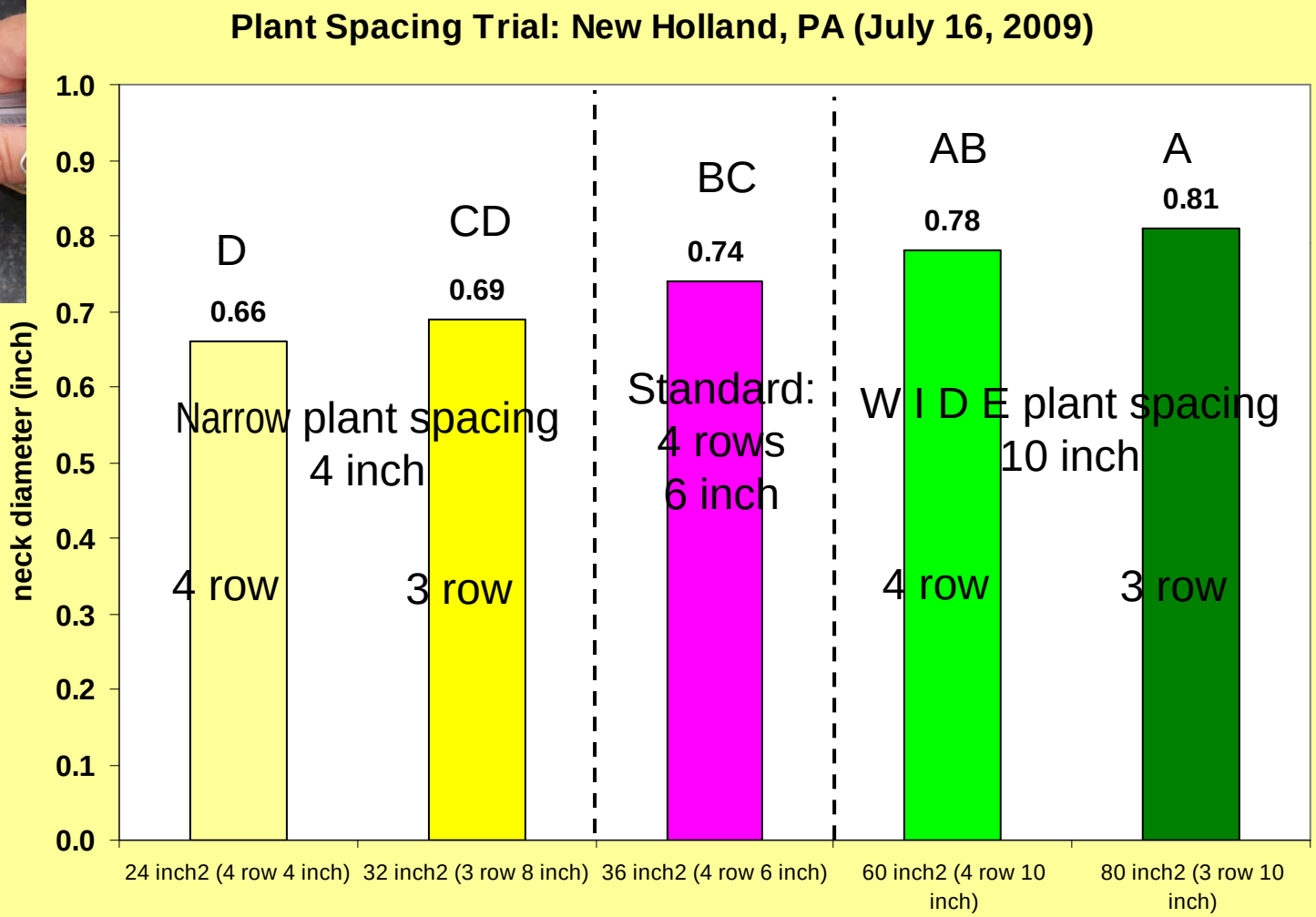
Narrow plant spacing

W I D E plant spacing

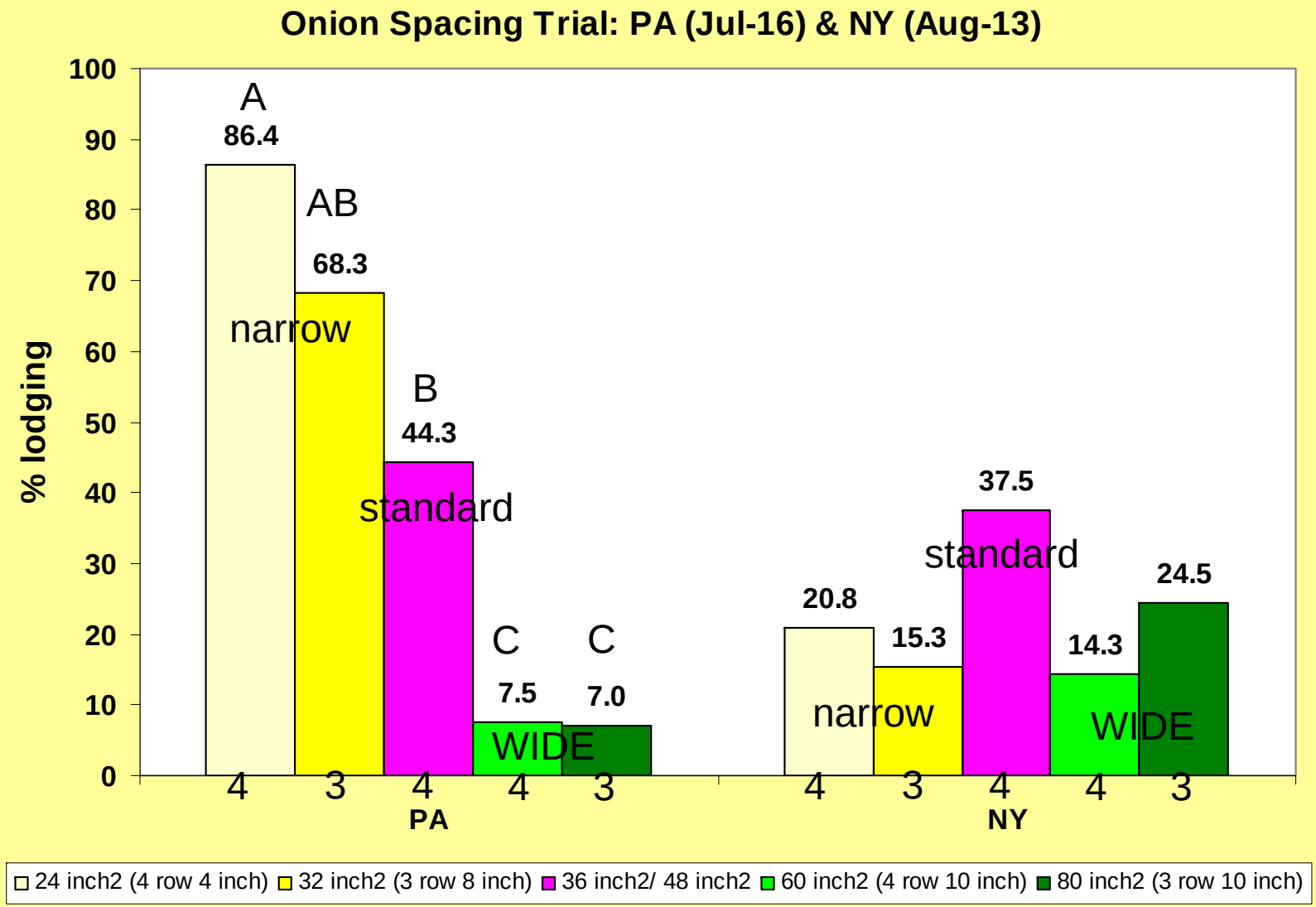
Results: Onion Spacing Trial – Plant Size: # leaves



Results: Onion Spacing Trial – Plant Size: neck diameter

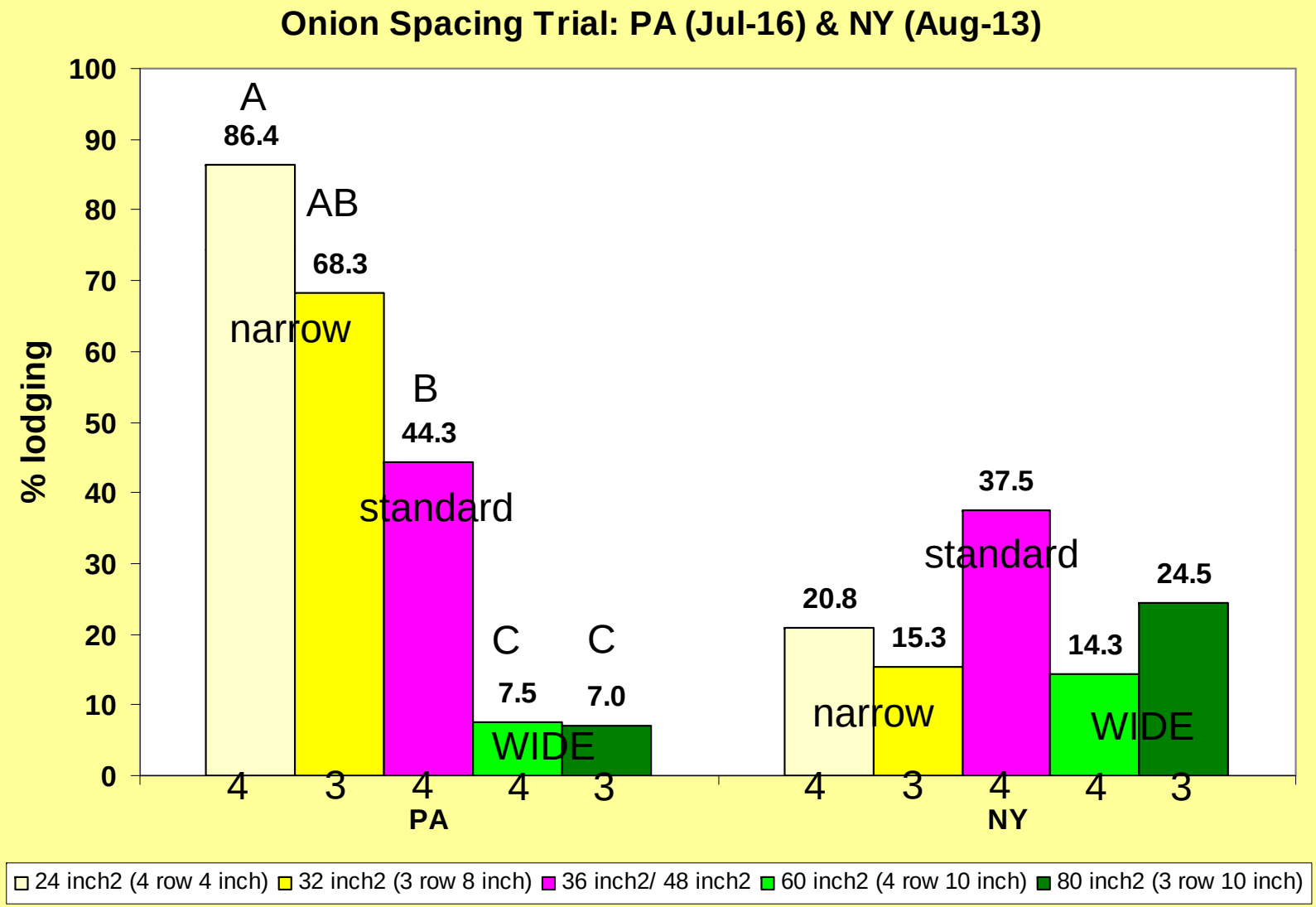


Results: Onion Spacing Trial – Maturity: % lodging

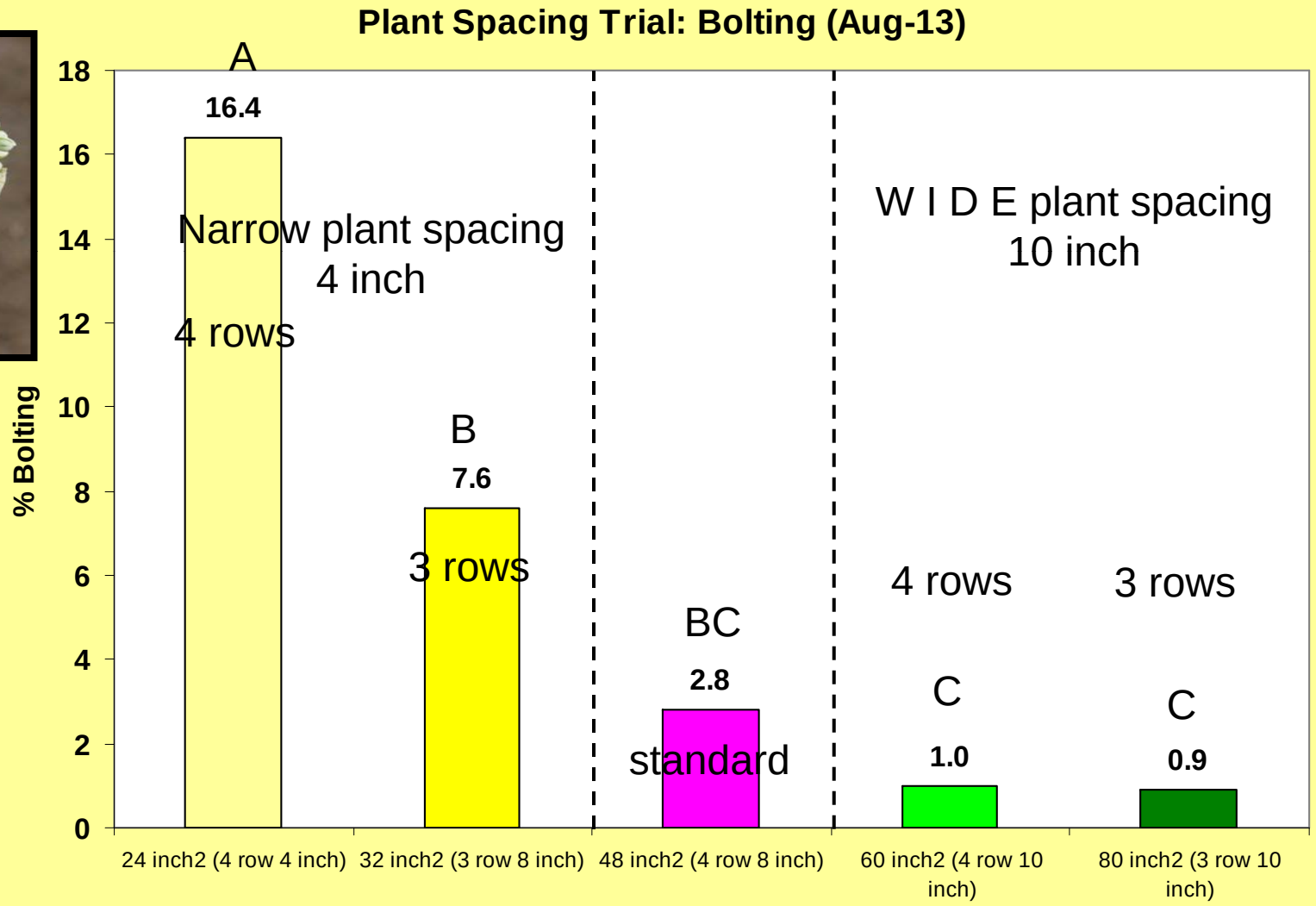


Results: Onion Spacing Trial – Maturity: % lodging

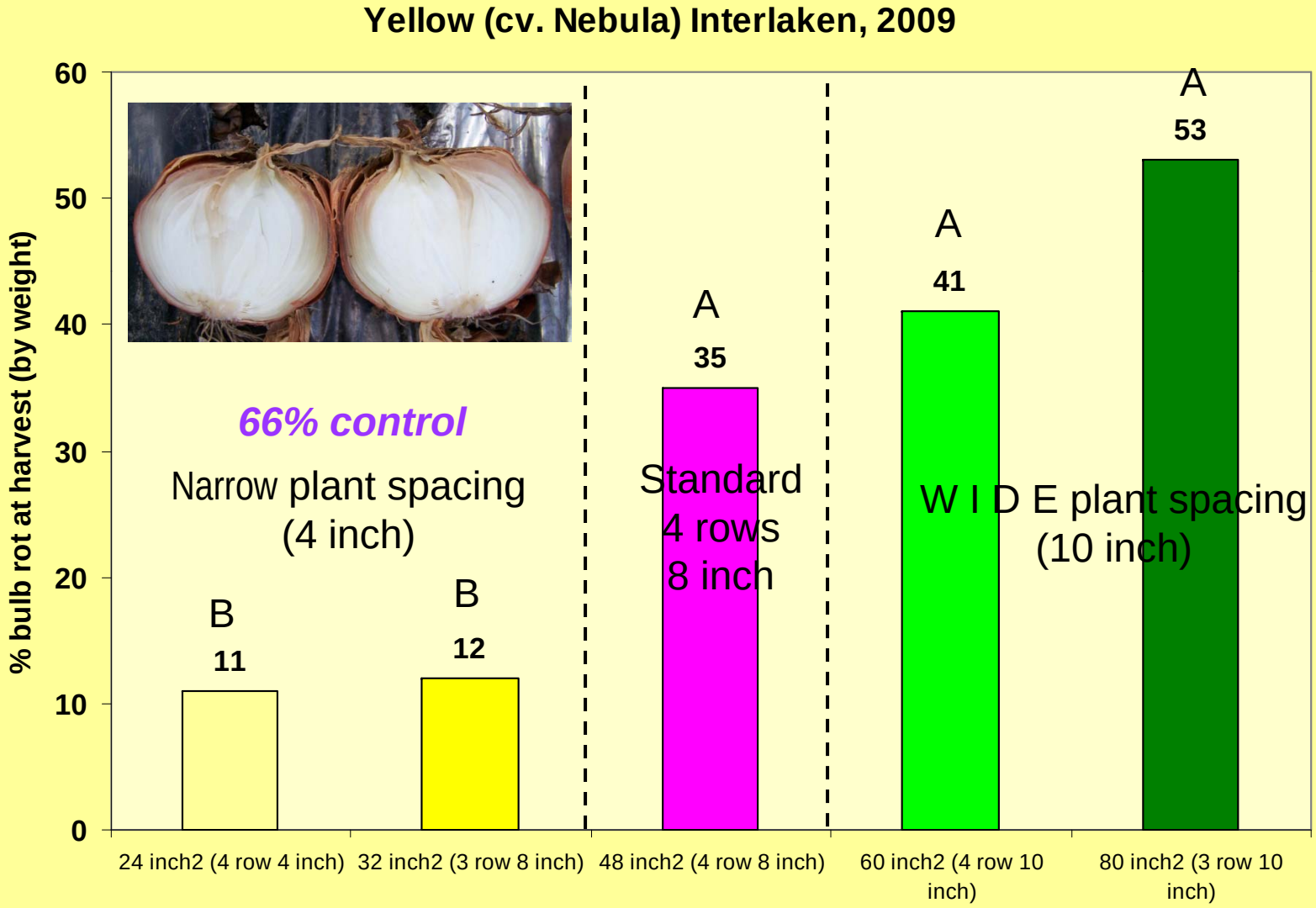
Results: Onion Spacing Trial – Maturity: % lodging



Results: Onion Spacing Trial – Maturity: % bolting



Results: Onion Spacing Trial – % bacterial rot at harvest

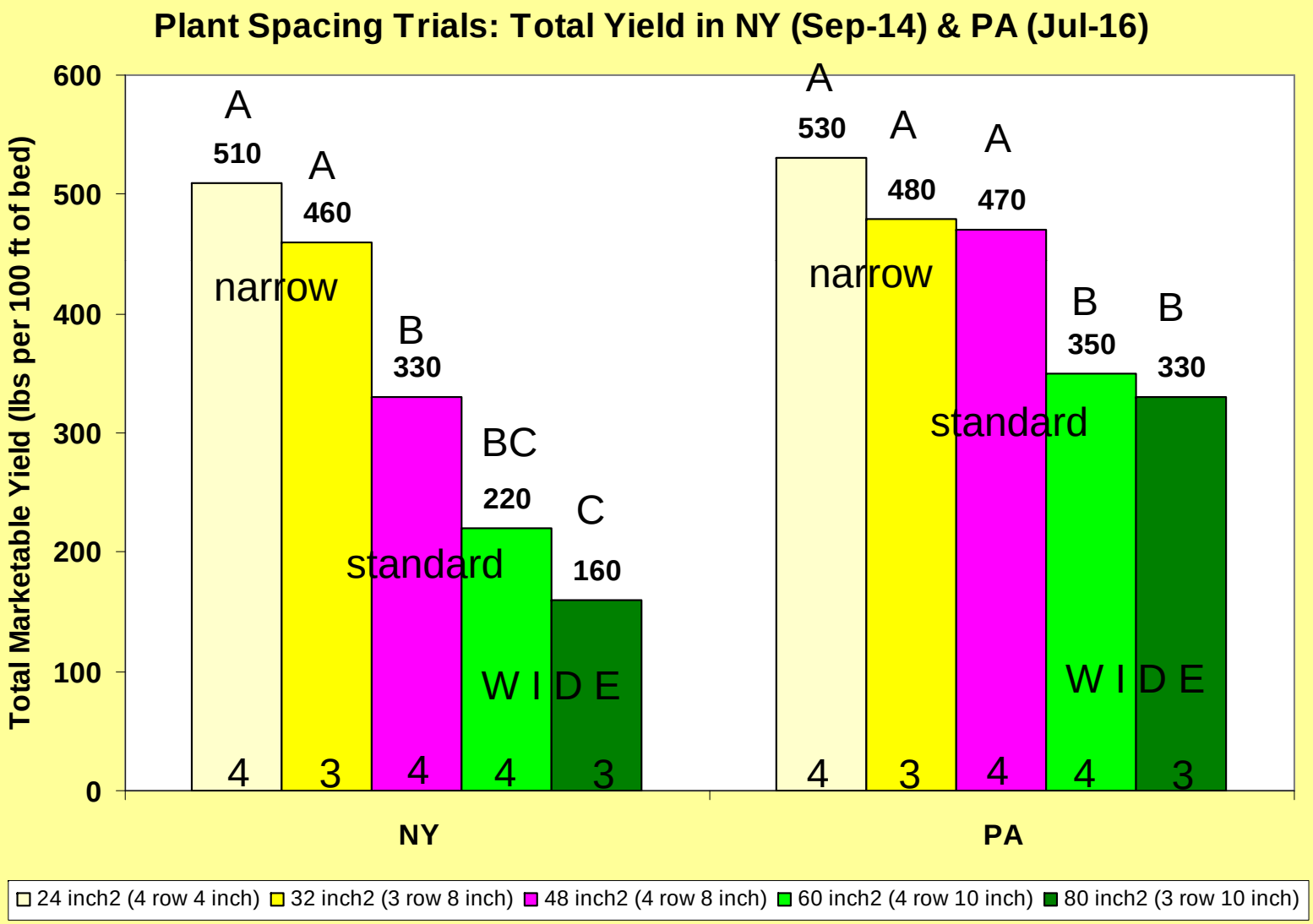


Results: Onion Spacing Trial – % bacterial rot at harvest

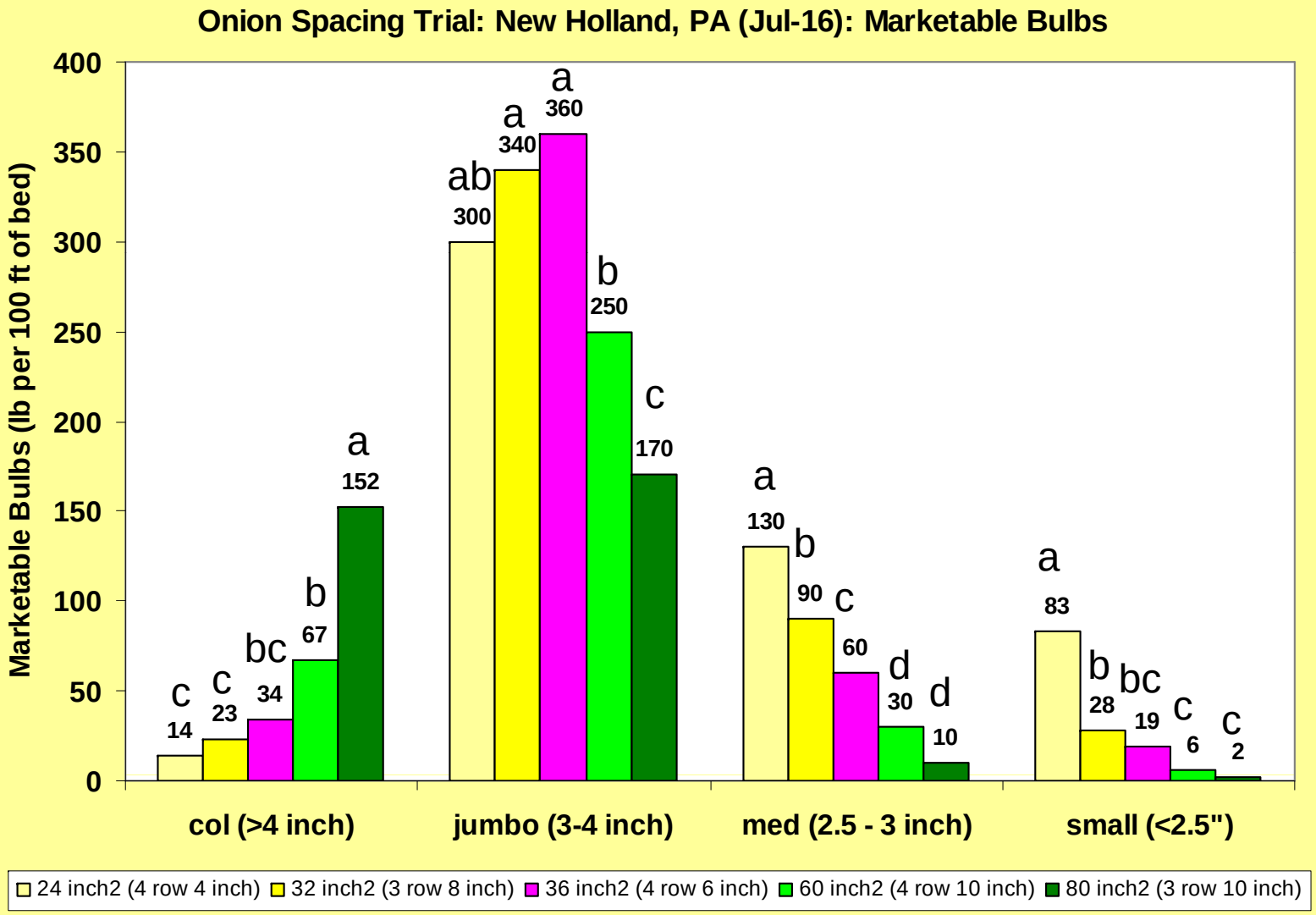
Bacterial disease caused by Sour Skin (*Burkholderia cepacia*) and center rot (*Pantoea ananatis*) pathogens

Results: Onion Spacing Trial – Yield and Bulb Size

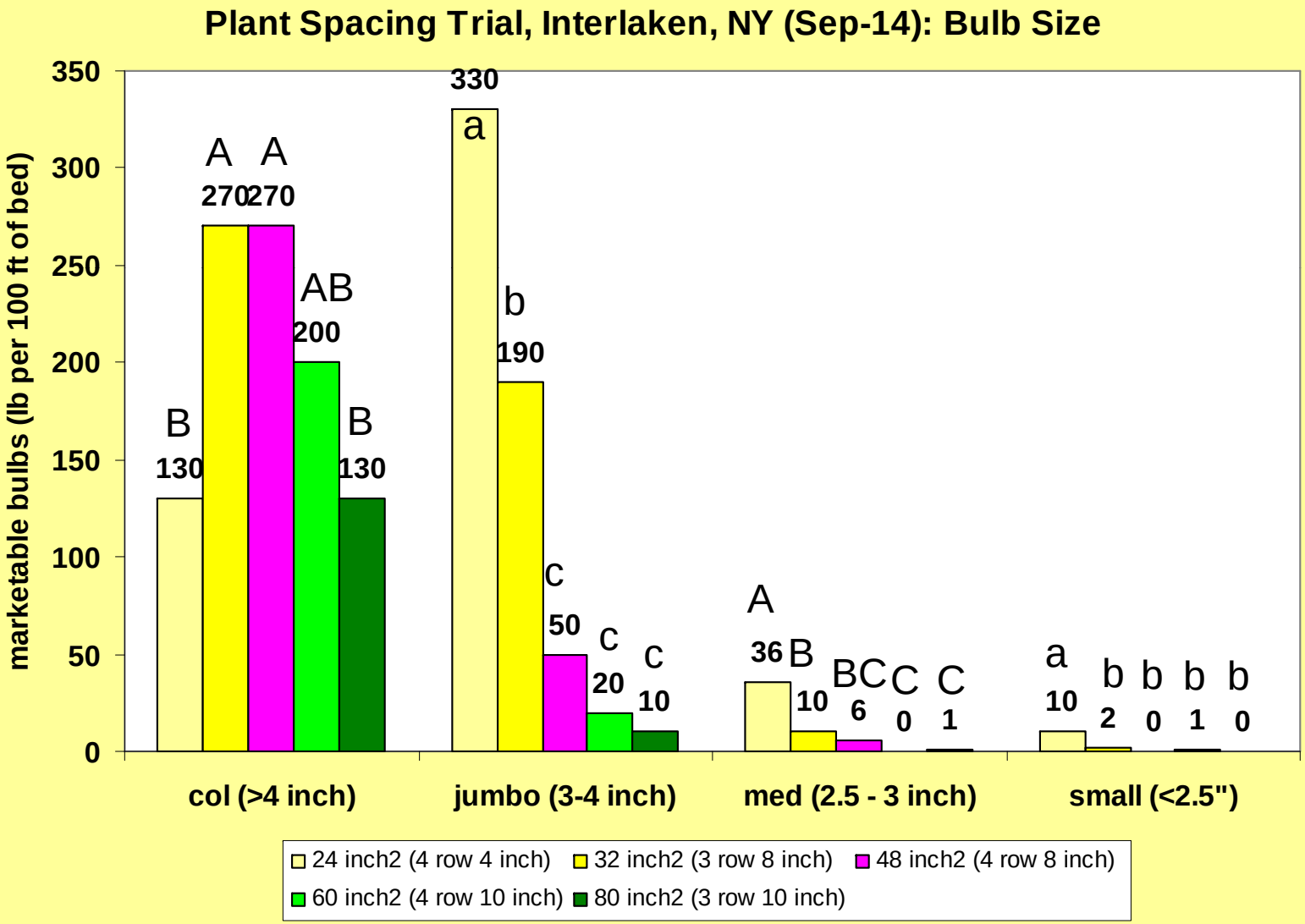
Results: Onion Spacing Trial – Total Marketable Yield



Results: Onion Spacing Trial – bulb size at harvest



Results: Onion Spacing Trial – bulb size at harvest



Results: Onion Spacing Trial – economic return

Variable Rate (PA)

- Small - $0.20/lb
- Medium - $0.40/lb
- Jumbo - $0.50/lb
- Colossal - $0.55/lb

- Cannot sell more than 30% small + medium

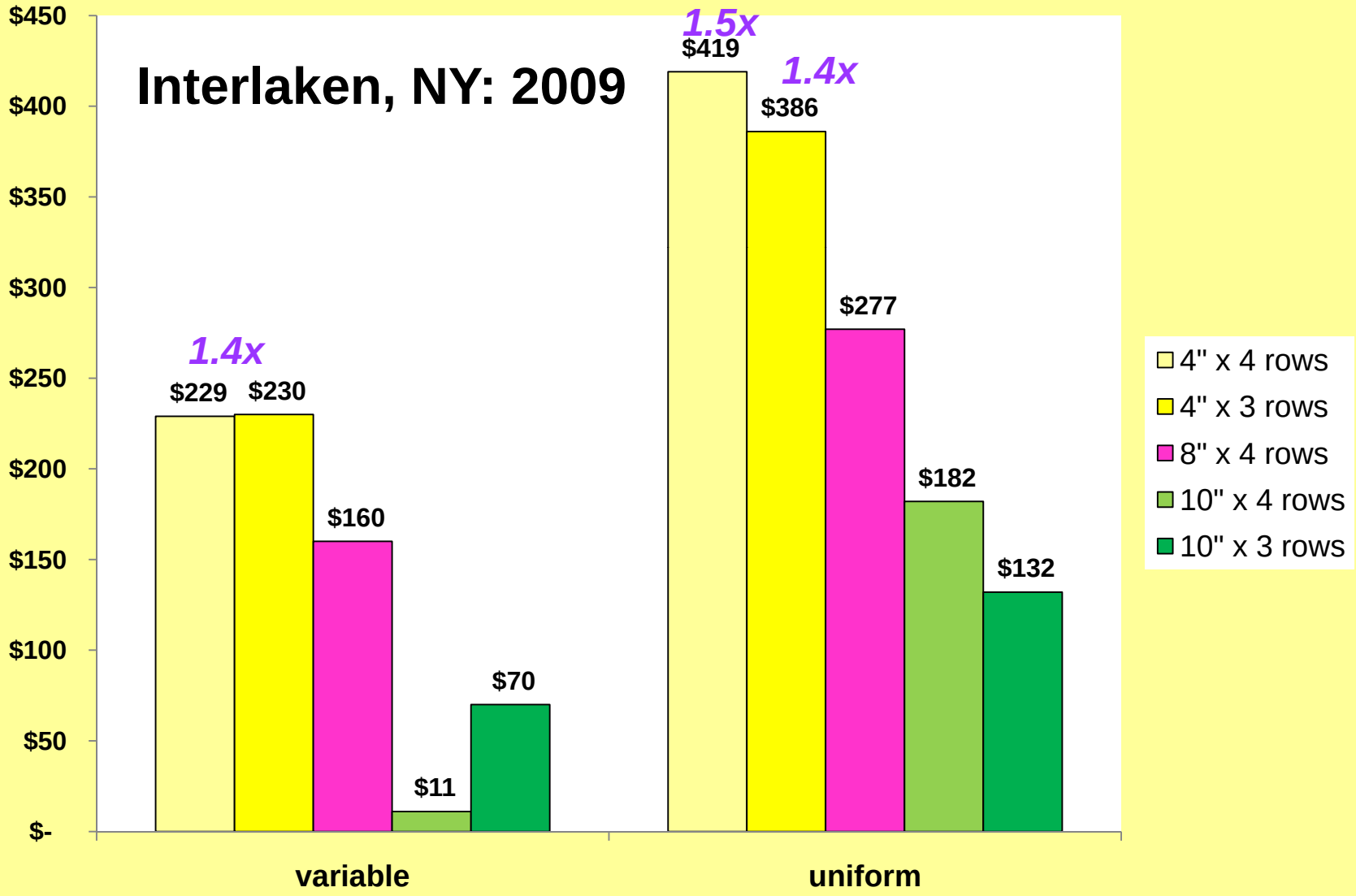
- **Cost of imported bare root transplants:** $0.02/plant

Uniform Rate (NY)

- $0.90/lb
- Cannot sell smalls
- **Cost of locally grown plug transplants:** $0.03 per plant

No. of transplants per 100 ft of bed	
4” x 4 rows	1200
4” x 3 rows	900
8” x 4 rows	600
10” x 4 rows	480
10” x 3 rows	360

Results: Onion Spacing Trial – economic return



Summary

- Wider plant spacing (i.e. 8 inches or more) results in:
  - Plants with more leaves and bushy top growth
  - thicker necks
  - Delayed or inhibited maturity
  - Bigger bulbs
  - Increased bacterial bulb 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

- Prove technique:
  - in different growing seasons (i.e. hot & dry)
  - different bacterial diseases (other than sour skin)
- Does the bolting issue repeat?
- Try 6 inch plant spacing in NY

2010 Plant Spacing Trials

Interlaken, NY

New!

Plant density (in^2/bulb)	Plant spacing (in)	No. rows /bed	No. plants /100 ft
24	4	4	1200
32	4	3	900
36	6	4	800
48	6	3	600
48	**8**	**4**	**600**
64	8	3	450

Variety: Candy (sweet)

Silver plastic

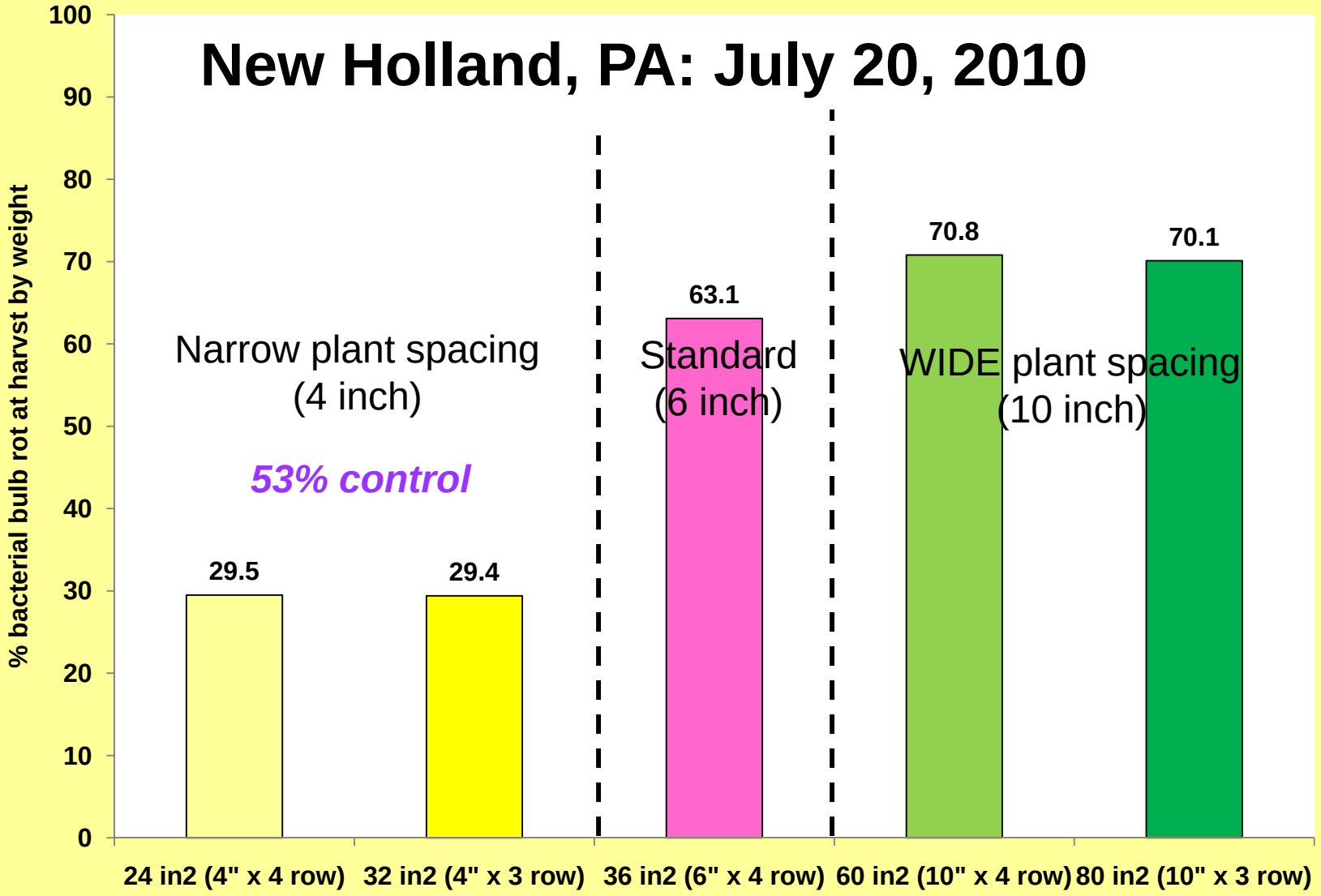
New Holland, PA

Plant density (in^2/bulb)	Plant spacing (in)	No. rows /bed	No. plants /100 ft
24	4	4	1200
32	4	3	900
36	**6**	**4**	**800**
60	10	4	480
80	10	3	360

Variety: Candy (sweet)

Black plastic

Results: Onion Spacing Trial
% bacterial bulb rot at harvest



Results: Onion Spacing Trial
4 % bacterial bulb rot at harvest

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

Results: Onion Spacing Trial
4 % 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

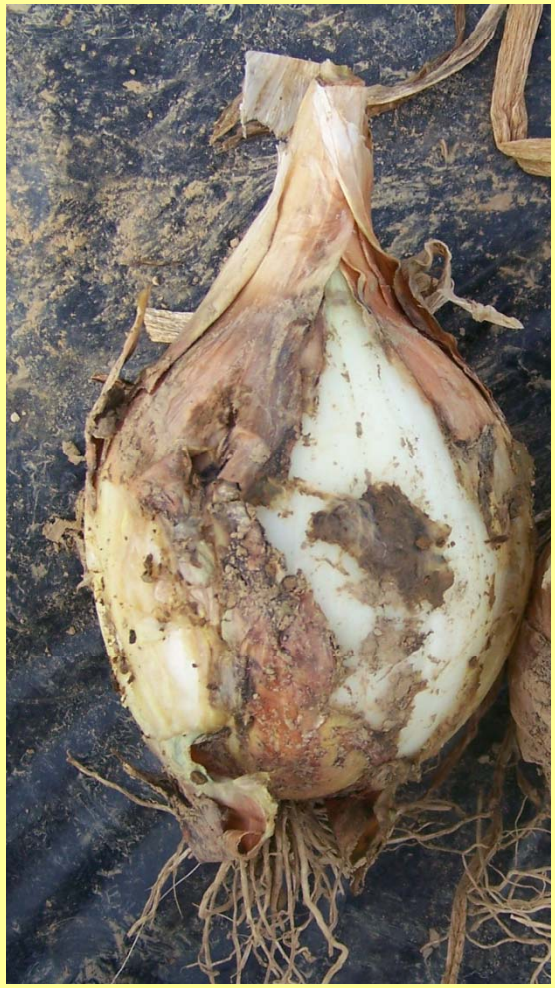
WIDE Plant Spacing

60 inch^2: 10” x 4 rows

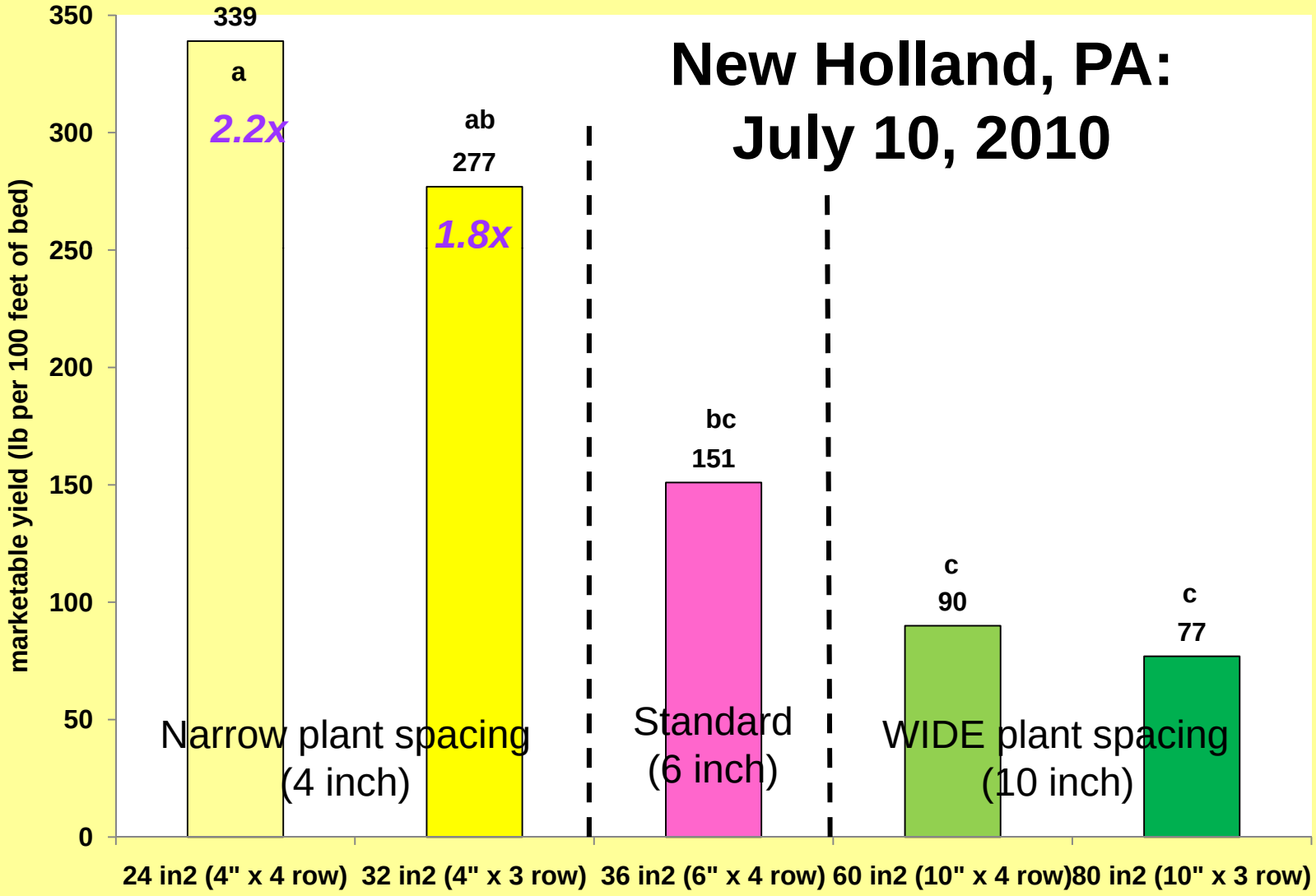
80 inch^2: 10” x 3 rows

Results: Onion Spacing Trial bacterial bulb rot at harvest

- Soft rot pathogens:
  - *Pectobacterium carotovora*
  - *Pseudomonas marginalis*
- Center Rot:
  - *Pantoea agglomerans*
- Minor Sour Skin:
  - *Burkholderia cepacia*

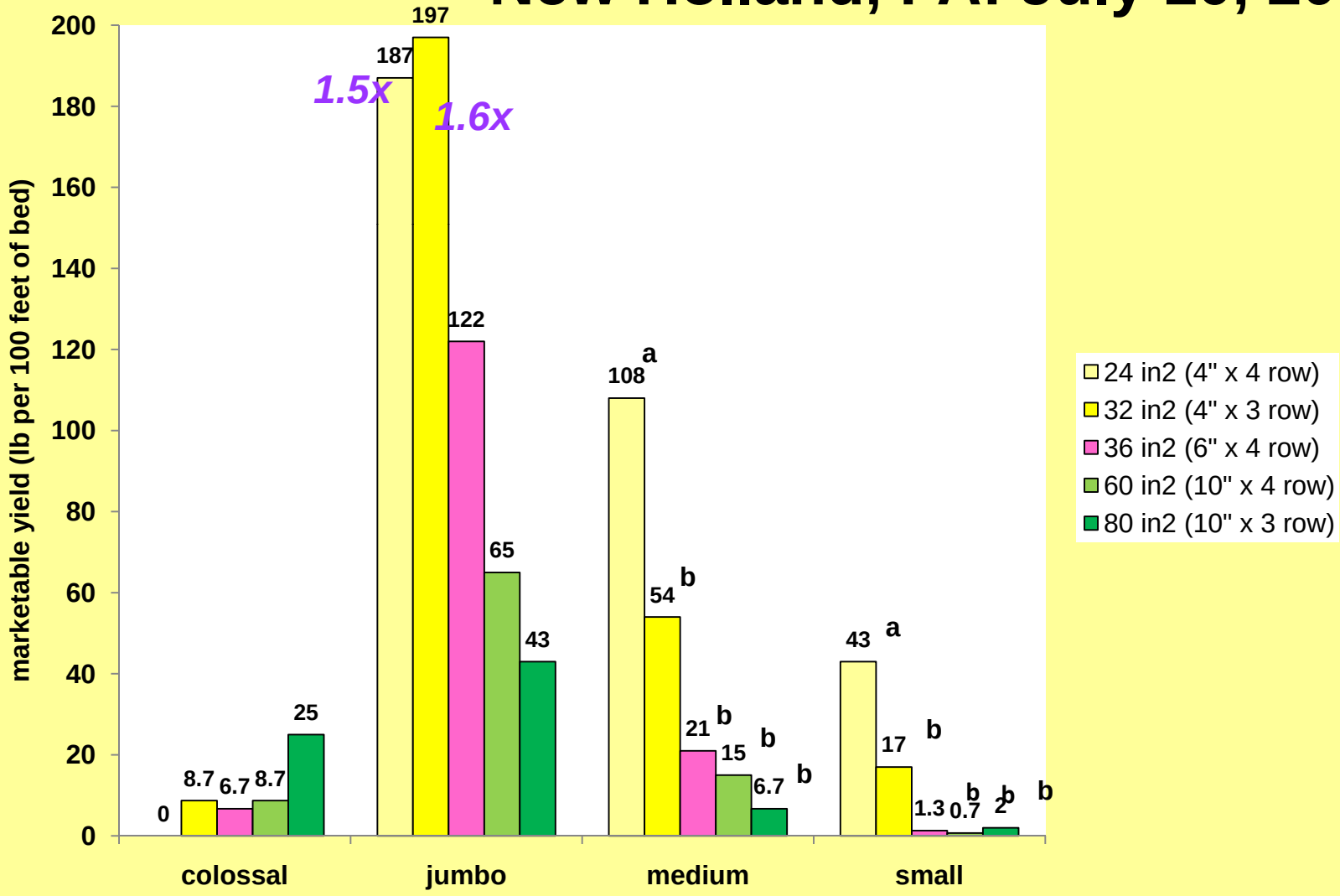


Results: Onion Spacing Trial – total marketable yield

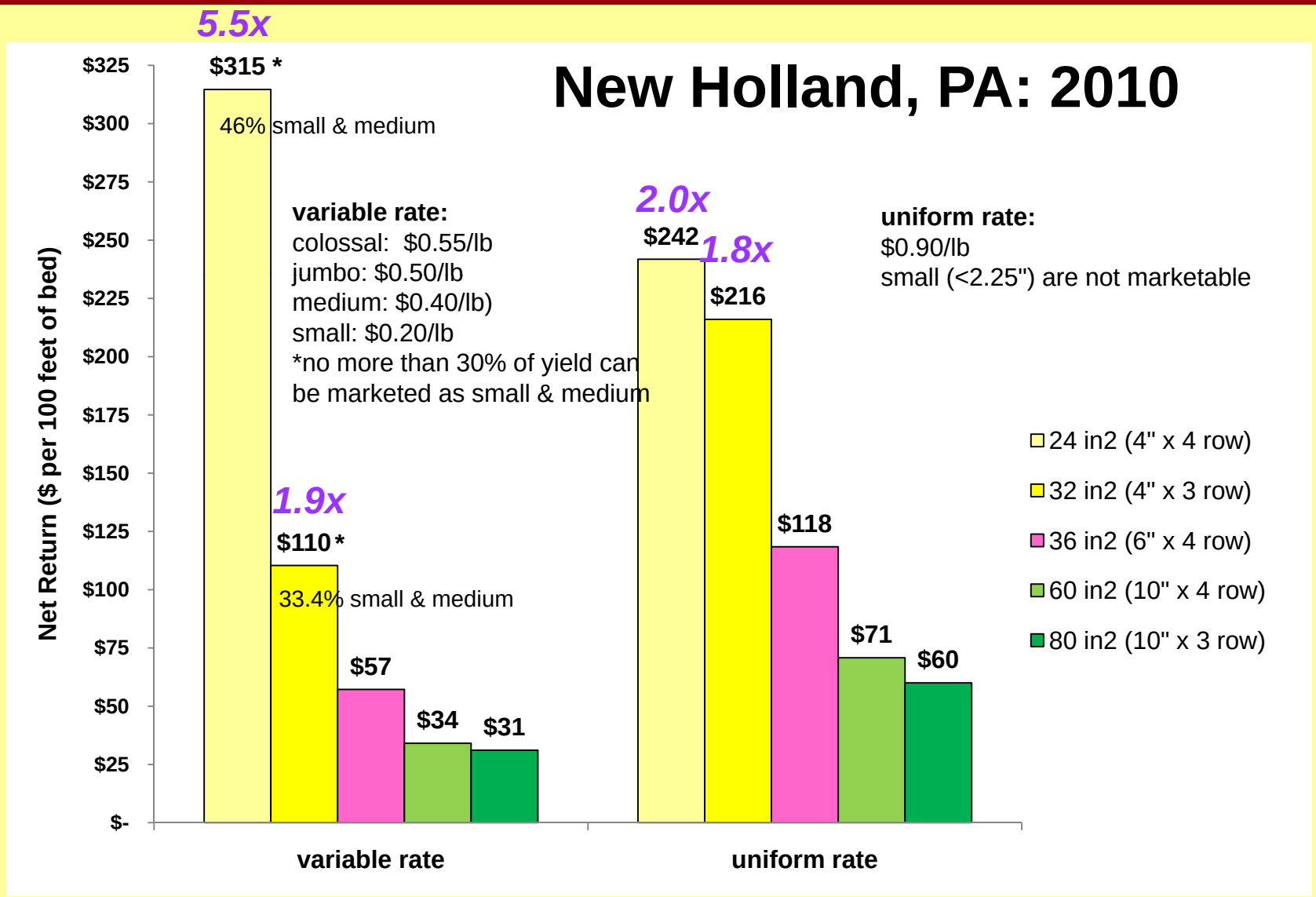


Results: Onion Spacing Trial – bulb size at harvest

New Holland, PA: July 10, 2010

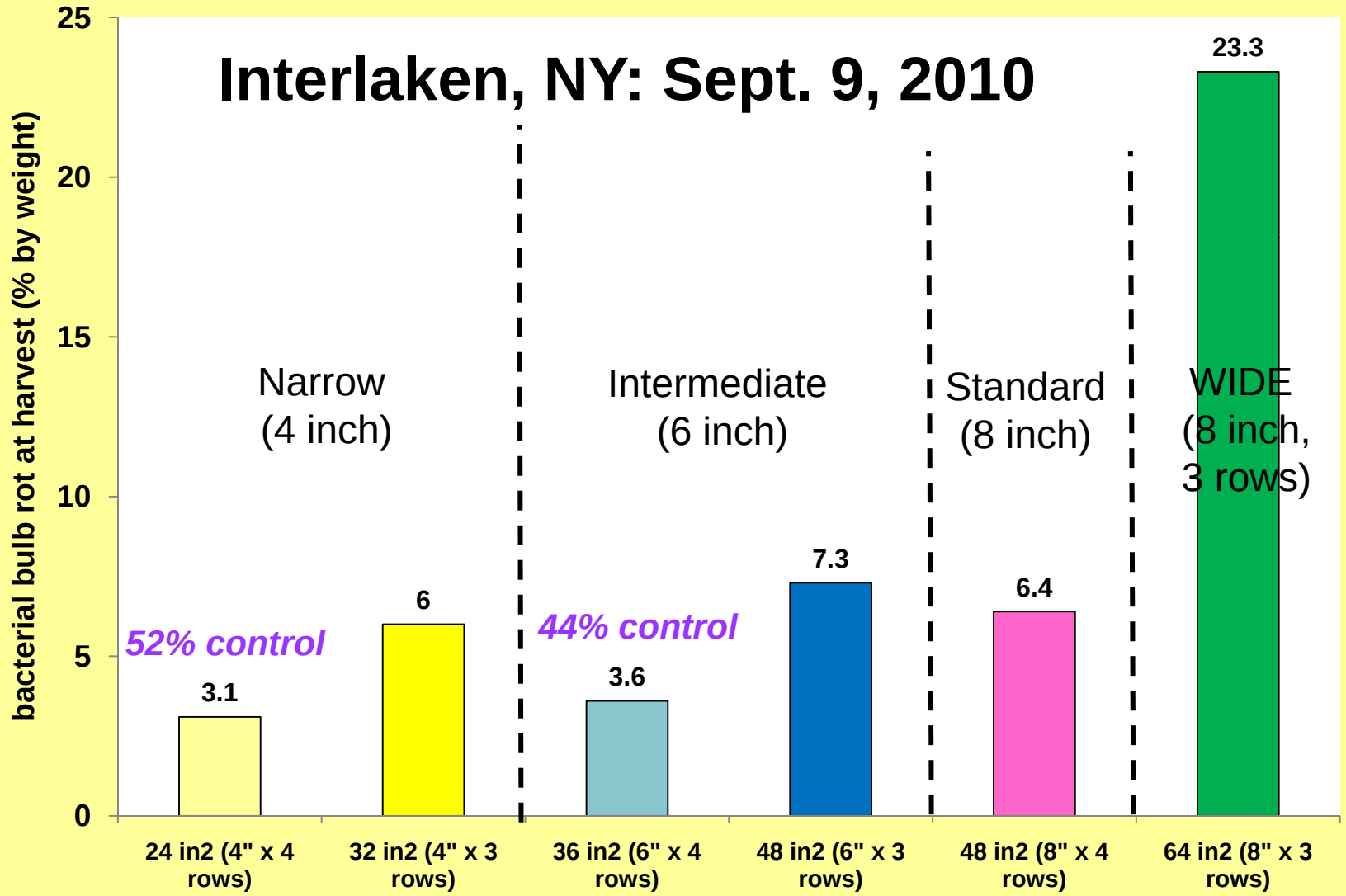


Results: Onion Spacing Trial – economic return

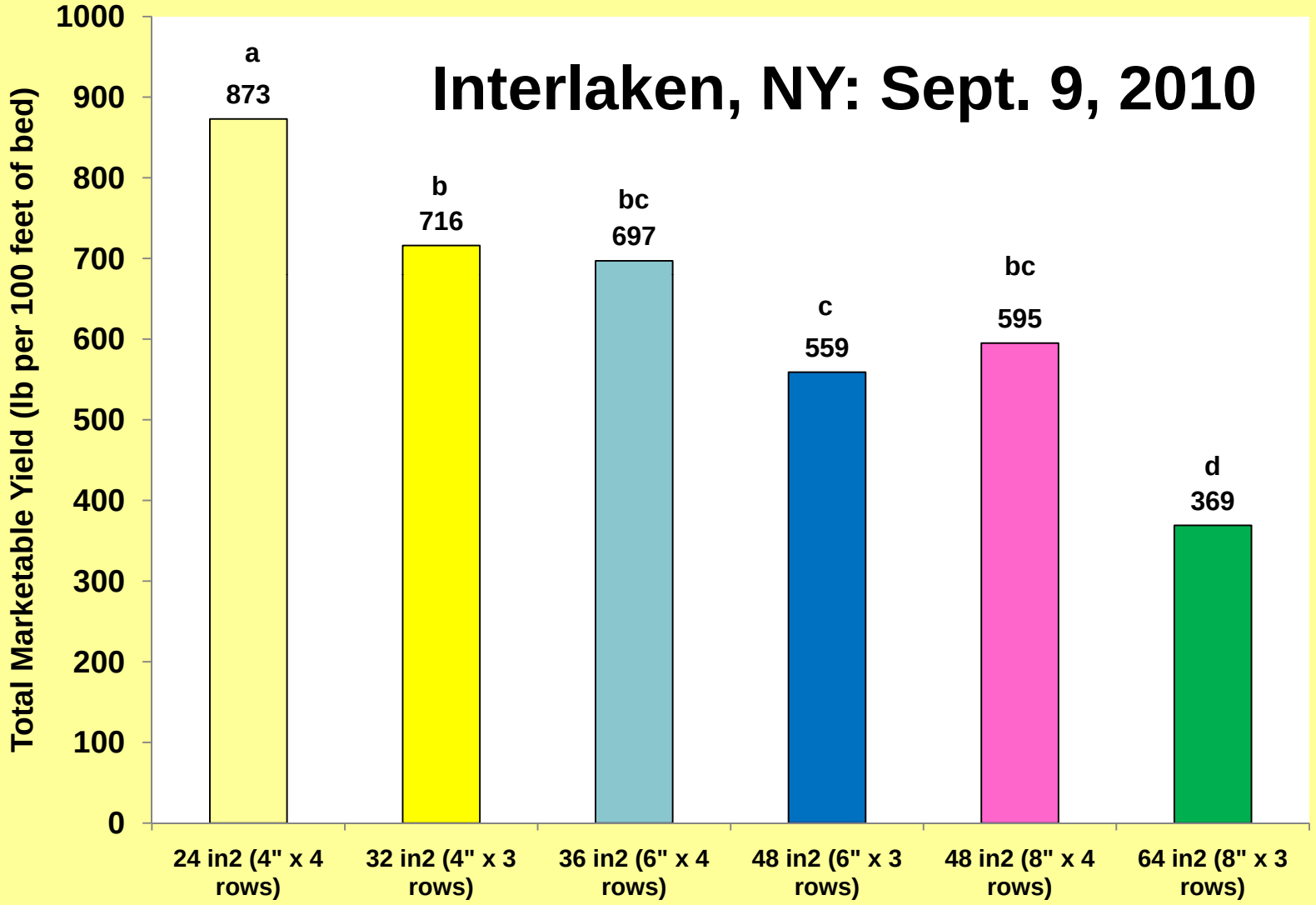


Results: Onion Spacing Trial Interlaken, 2010

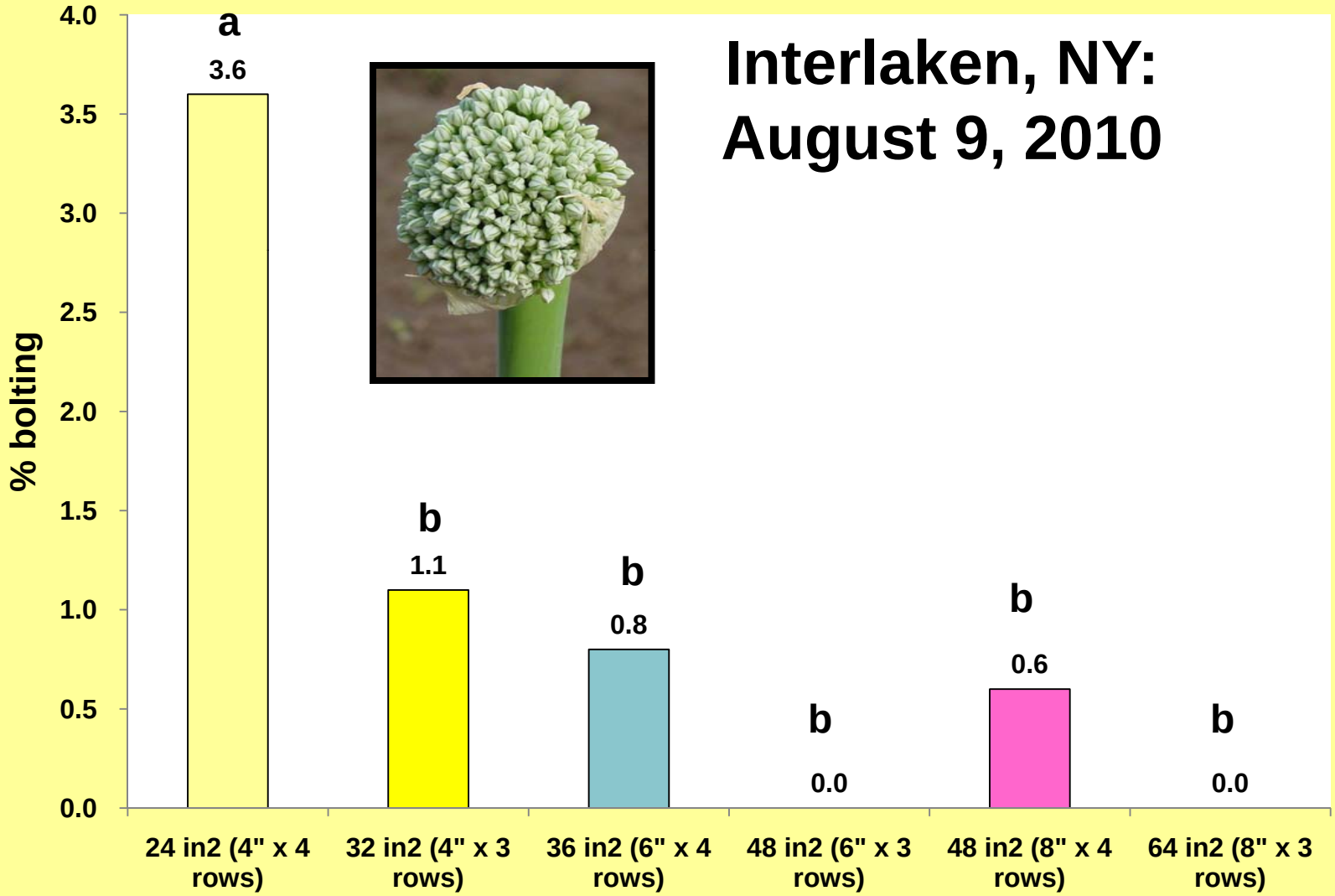
Results: Onion Spacing Trial
% bacterial bulb rot at harvest



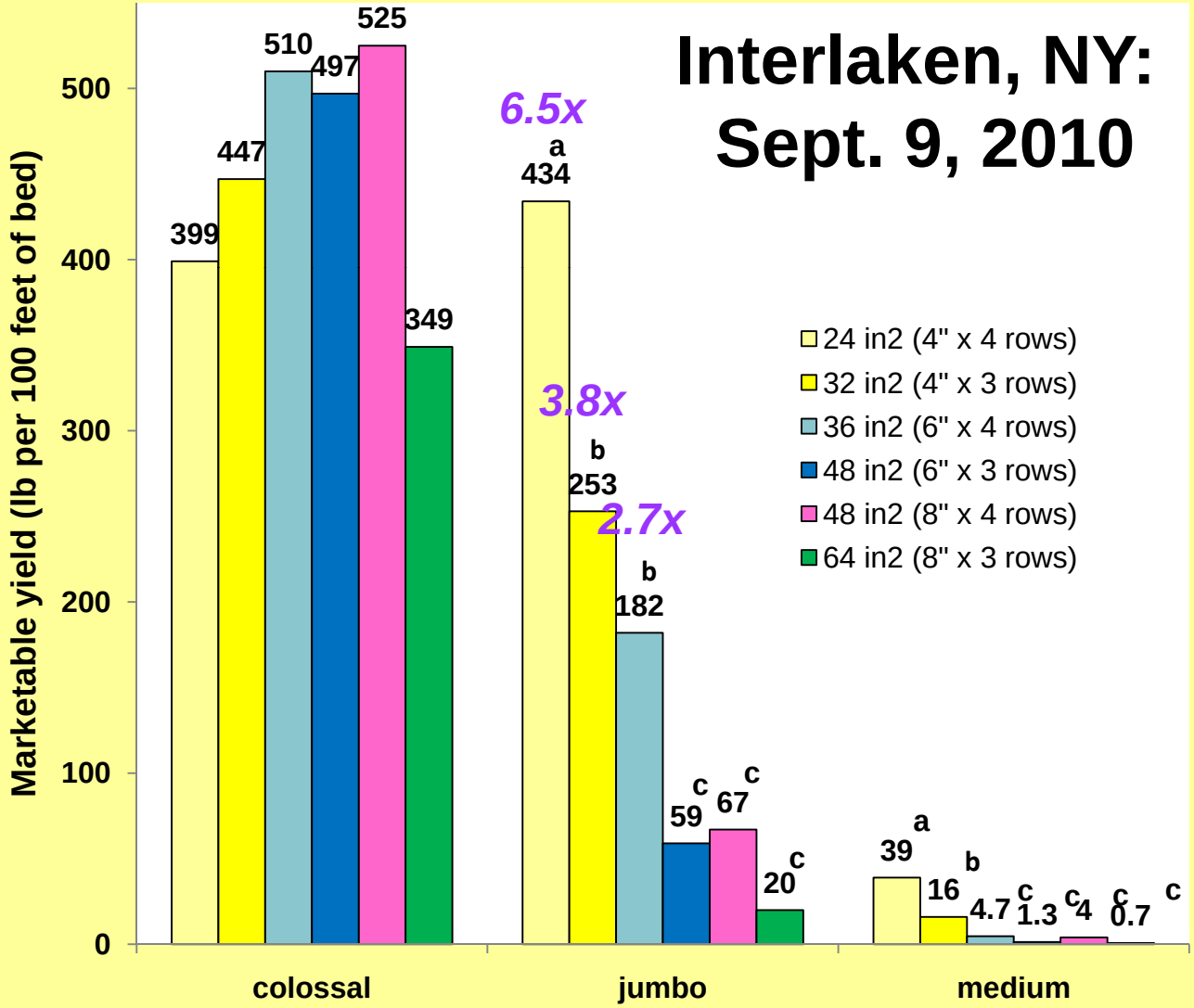
Results: Onion Spacing Trial – total marketable yield



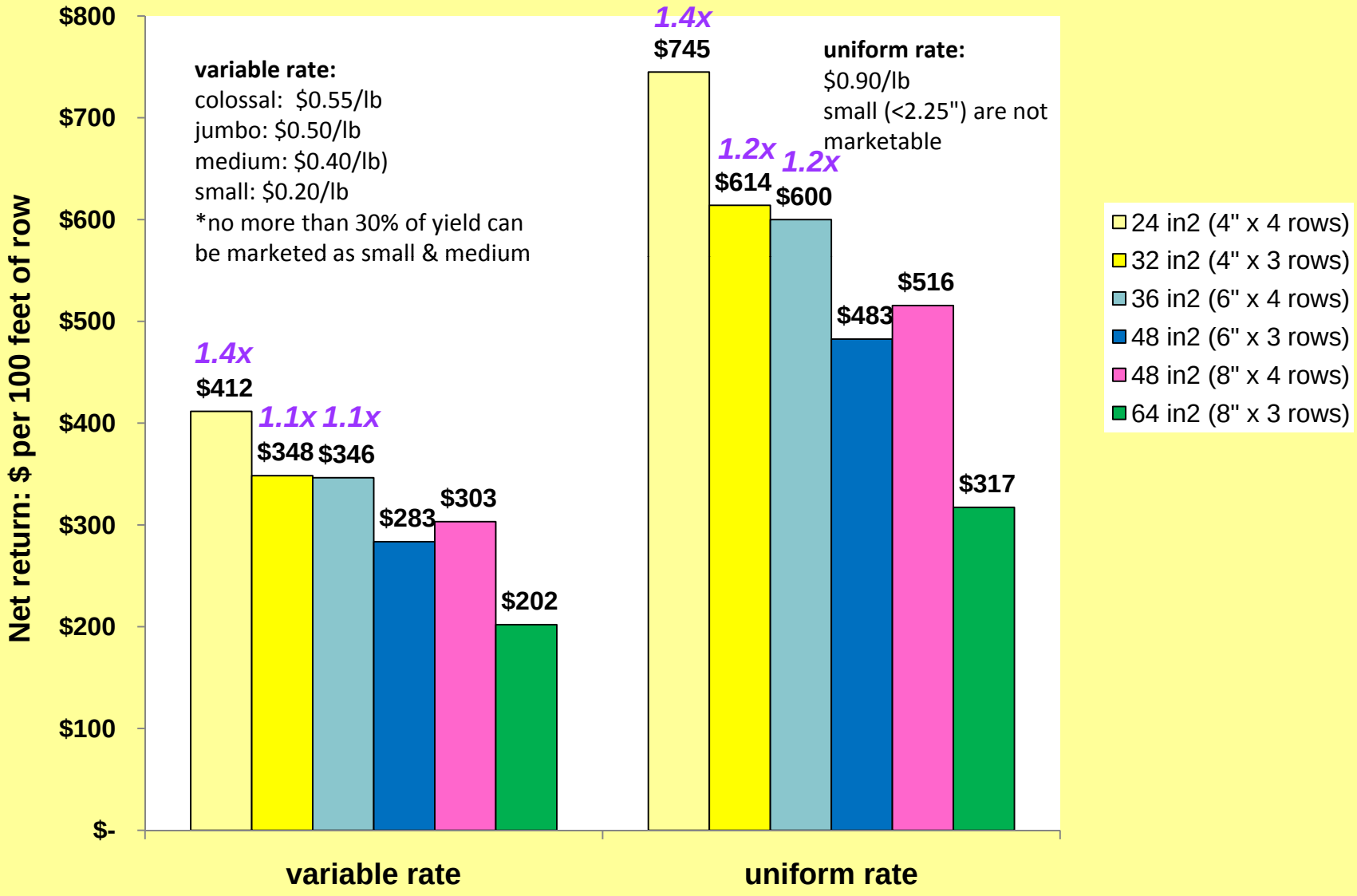
Results: Onion Spacing Trial – % bolting



Results: Onion Spacing Trial – bulb size at harvest



Results: Onion Spacing Trial – economic return



Summary

Compared to the standard spacing, narrow (4”) plant spacing had:

- plants with fewer leaves, thinner necks that matured earlier
- Less bacterial bulb decay at harvest
  - 44-66% control
- Increased marketable yield due to increased jumbo weight, and higher economic return
- Be aware of higher small & medium weight and bolting with 4 rows per bed

Recommendation

4” plant spacing, 3 rows per bed

- Reduced bacterial disease
- Increased yield, without risk of too many medium and small bulbs
- Reduced risk of bolting
- Grower specific

How Does Mulch Type Reduce Bacterial Decay?

Mulch Type

- Onion growth is favored by:
- moderate temperatures:
  - no growth below 43°F
  - no growth above 81°F

- Black plastic absorbs sunlight
  - Increase soil temperature
  - Promotes early crop growth in April & May

Mulch Type

- 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
- Daily high temperature at the soil line was 10 ˚F cooler in reflective silver mulch compared to black plastic (Reid, 2007)

Mulch Type

Alternative Mulch Types:

Reflective Metallic 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 may 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

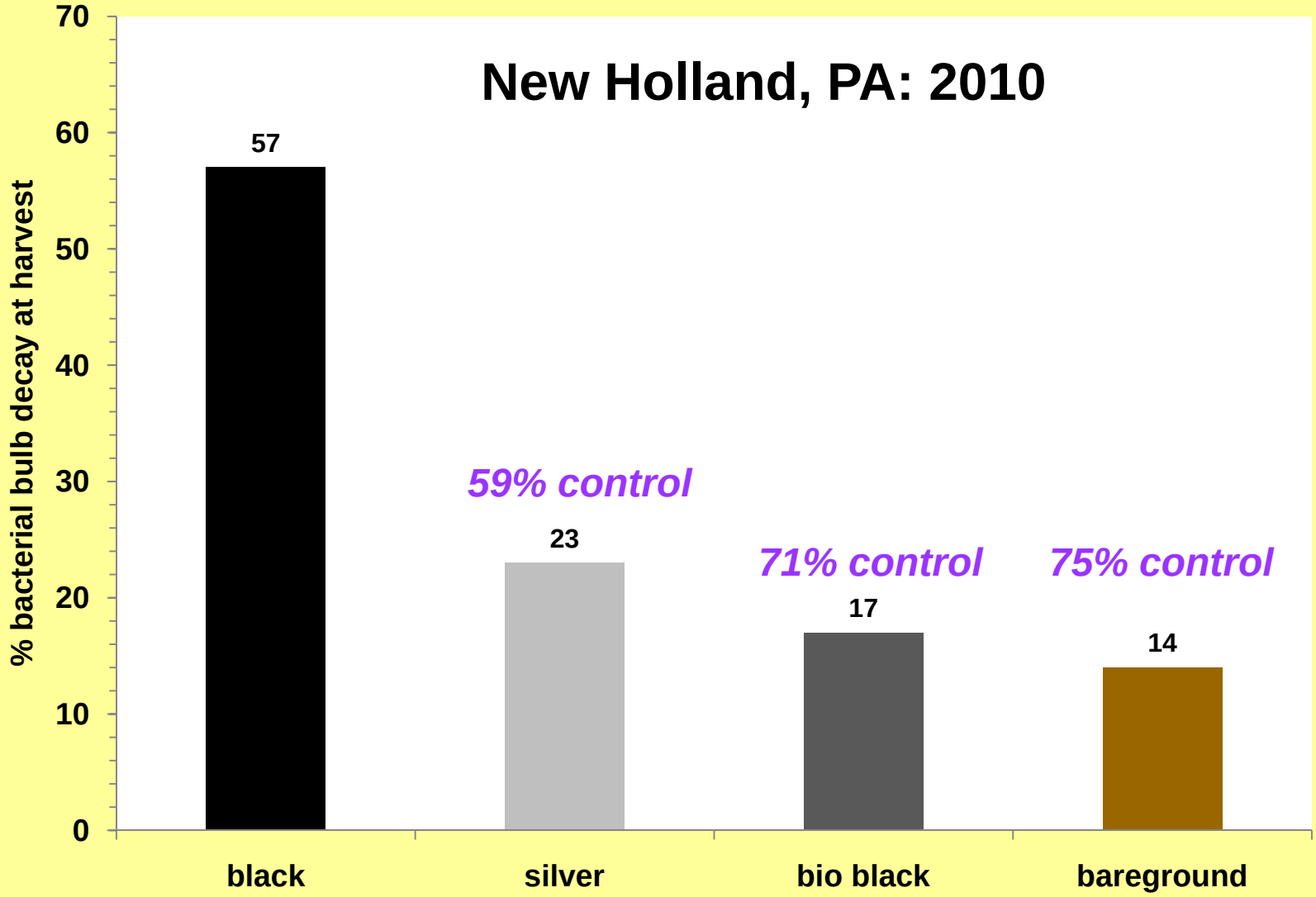
2009 & 2010 Mulch Trials

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

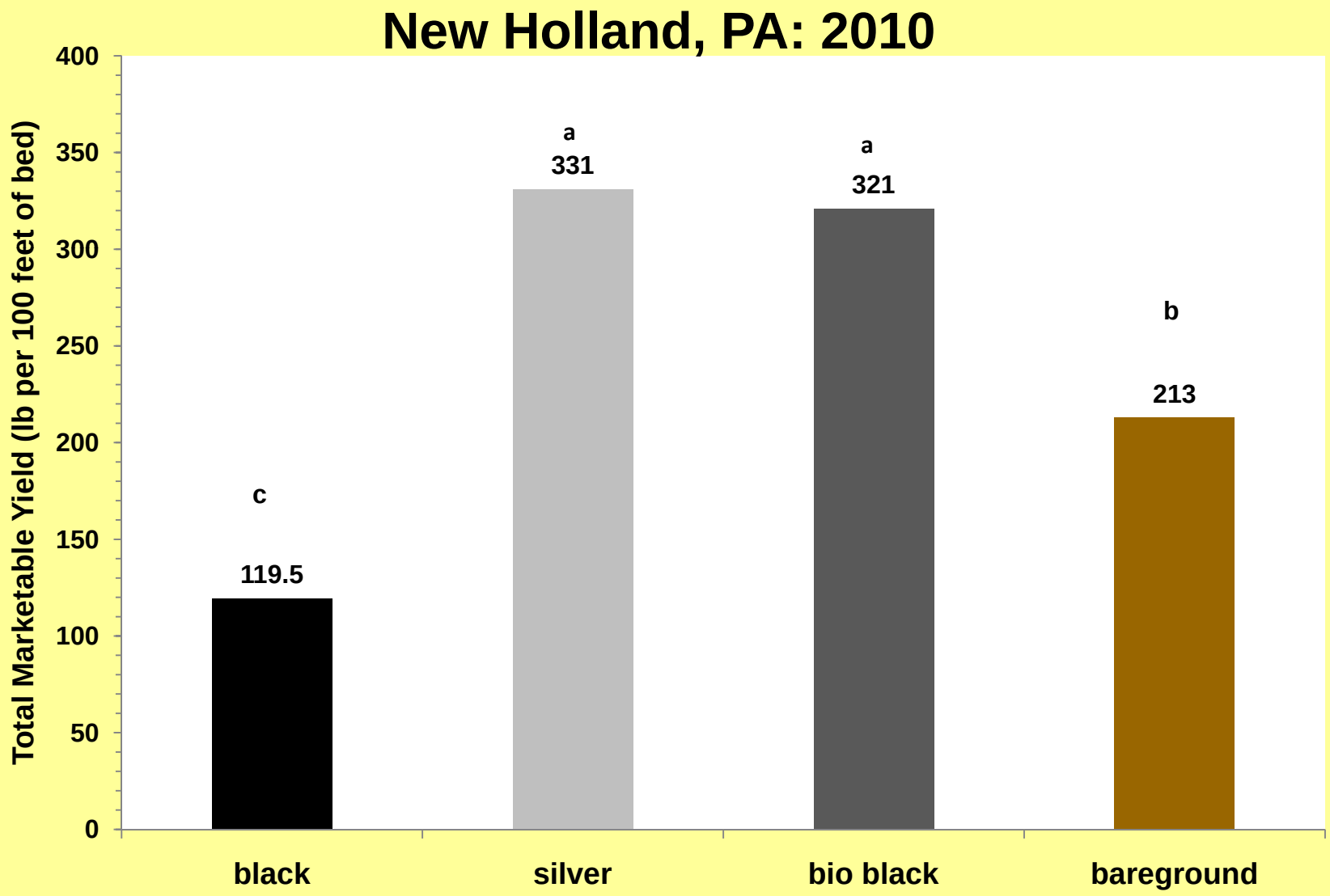
Results: 2010 Mulch Trial Plant size

New Holland, PA: July 20, 2010		
	No. leaves /plant	Neck diameter (inch)
Black (standard)	9.7	0.49 b
Silver	10.1	0.65 a
Black Biodegradable	10.4	0.63 a
Bare ground	9.9	0.61 a

Results: 2010 Mulch Trial
% Bacterial Bulb Decay



Results: 2010 Mulch Trial Marketable Yield

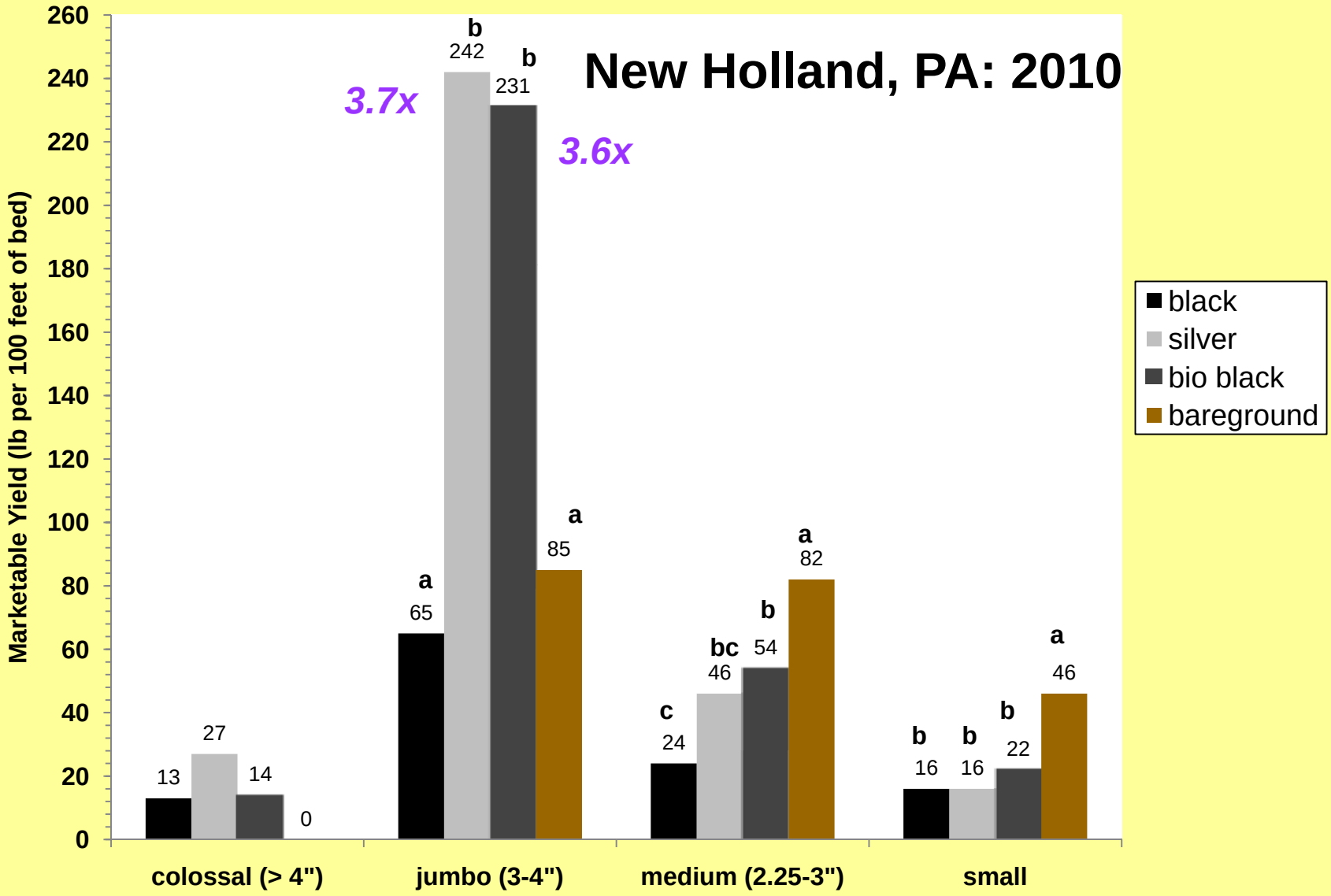


2010 Mulch Trial at Harvest
July 20, 2010

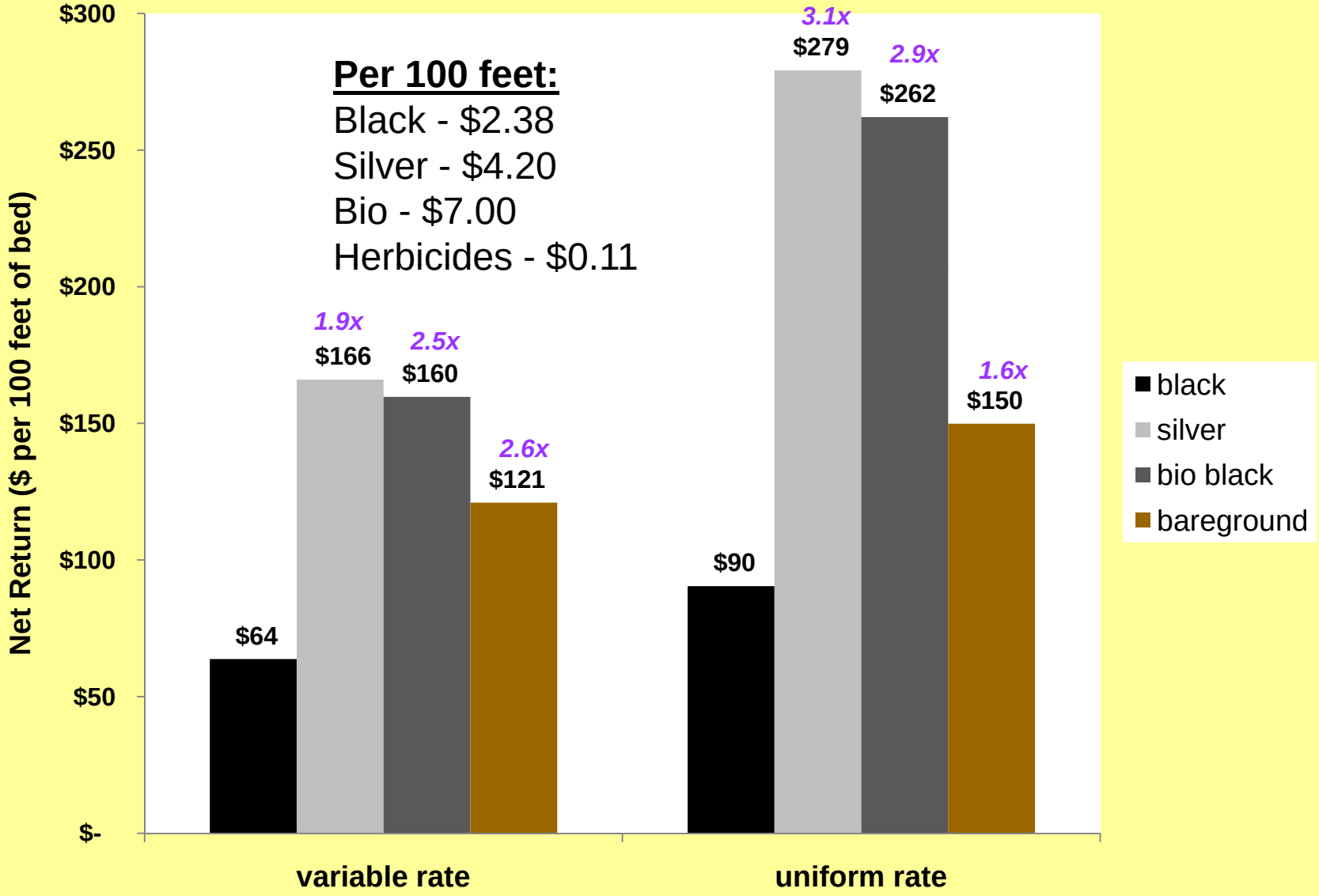
2010 Mulch Trial at Harvest
July 20, 2010


KEITH URBAN

Results: 2010 Mulch Trial Bulb Size



Results: 2010 Mulch Trial Economic Return



Summary

Alternatives to black plastic:

- provided 59% to 75% control of bacterial bulb decay
- Had higher marketable yield and economic return
- Silver and biodegradable black plastic had higher jumbo weight
- Bare ground had significantly higher small and medium weight (weed competition)

Black plastic needs to be replaced!

Next Steps

STOP THE ROT!!

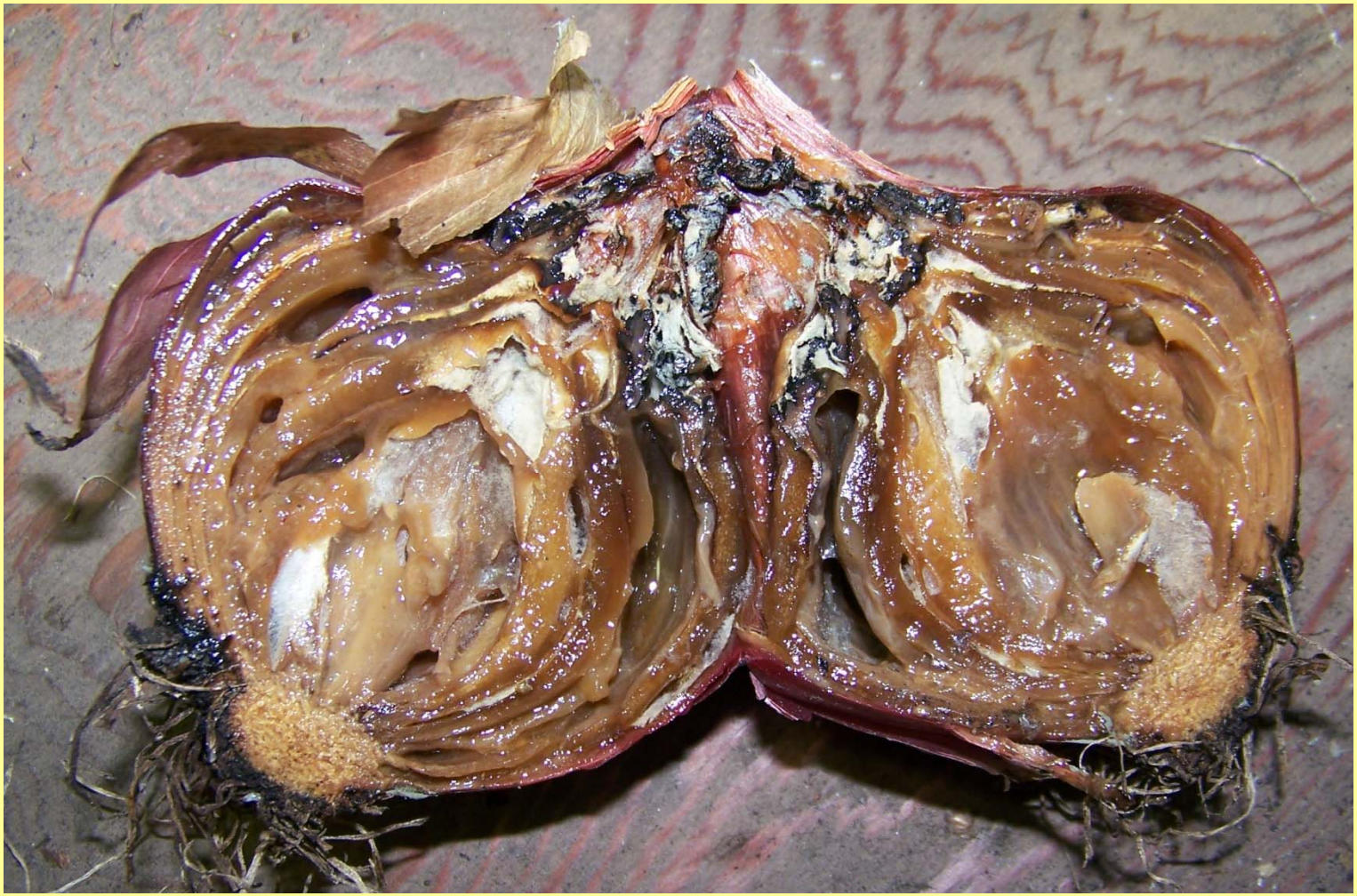
Demonstration and grower adoption of narrow plant spacing

Next Steps

- Alternative mulches will be studied further to elucidate which performs the best during different growing seasons
- Mulch and narrow spacing combo studies
- Investigate relationship between nitrogen fertility and bacterial diseases
- Develop a comprehensive IPM program for bacterial diseases of onion

The future is bright!

Questions?



The most disgusting rotten onion I've ever seen!