Advancing carrot IPM: New tools for nematode and leafhopper control

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Factors Influencing Insect Pest Management
‘Environmental Concerns’

With increasing affluence domestically and globally, there are increasing concerns about pesticide usage and perceived environmental effects.

This has rapidly accelerated the shift to “softer” products and technologies – ‘sustainability’.

Pesticide Action Network
NORTH AMERICA

GREEN CHEMISTRY

OMRI
Organic Materials Review Institute

Factors Influencing Insect Pest Management
‘Food Safety’

Major food retailers are setting acceptable residue levels below those set by government regulatory agencies.

“No detectable residues” will be a competitive advantage for food retailers.

Older insecticides that do not meet these requirements are not being re-registered, resulting in increased use of novel Reduced-Risk (RR) insecticides

Improving Aster Yellows Management

The Challenge!

Increasing the sustainability, efficiency and profitability of carrot production…

- **Synthetic pyrethroids represent the backbone of ALH and AY management ($42 - $60 acre)**
- **New registrations and delivery systems offer promising alternatives ($18 – $24 acre) – ‘Reduced-Risk’**

Aster yellows

Disease incidence:
1%-15% in intensively managed carrot fields

Likely 80-100% if not managed

Variable symptoms: ***Above ground*** – leaf yellowing and reddening, twisting, witches' brooming; ***Below ground*** – stunted and malformed roots, adventitious root growth

Other crops affected: Lettuce, celery, cilantro, canola, parsnip, potato

Vector: Aster leafhopper (ALH)

Adult

Immature

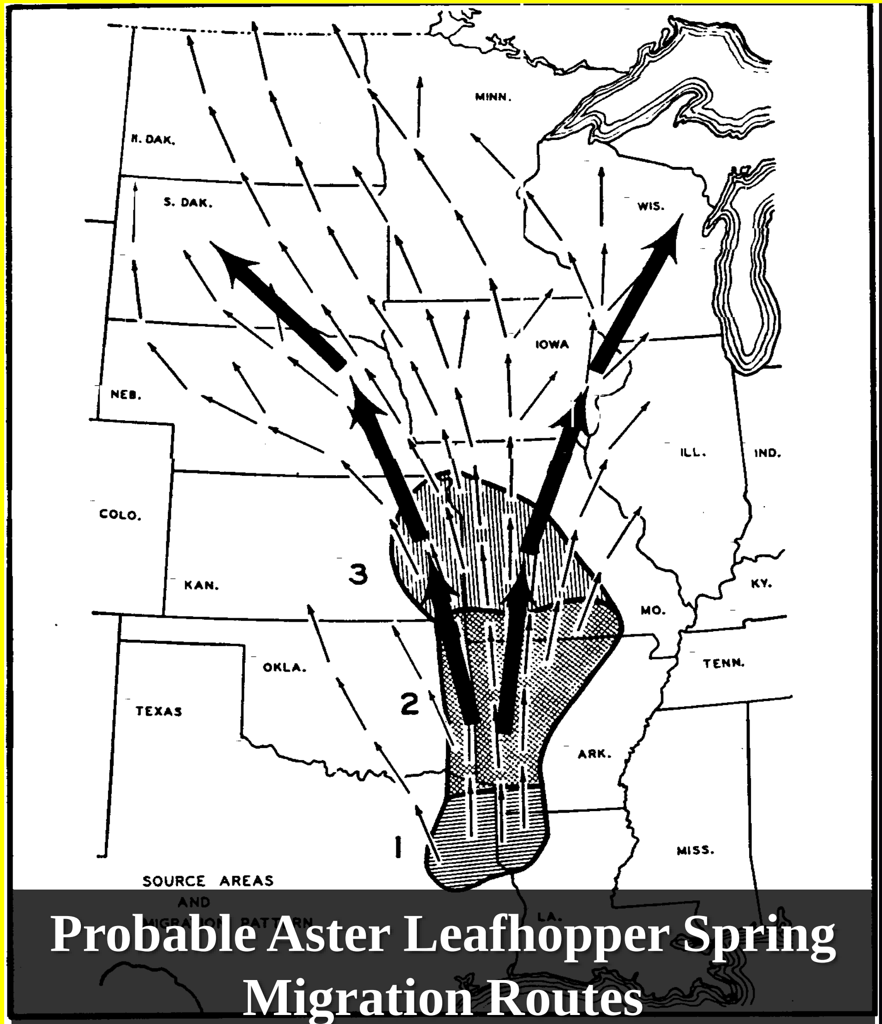
- *Macrosteles quadrilineatus* Forbes (Hemiptera: Cicadellidae)
- Approximately 4 mm long and weigh 1 mg (0.8 mg M; 1.2 mg F)
- Light greenish-yellow in color (seasonally variable)
- Widely distributed in the U.S.

Aster leafhopper migratory behavior

Early season migration of the ALH from the Gulf-states to the Upper Midwest

Migratory behavior together with the mode of transmission makes possible the movement of AYp over great distances

Chiykowski, L.N. and R.K. Chapman. 1965



Probable Aster Leafhopper Spring Migration Routes

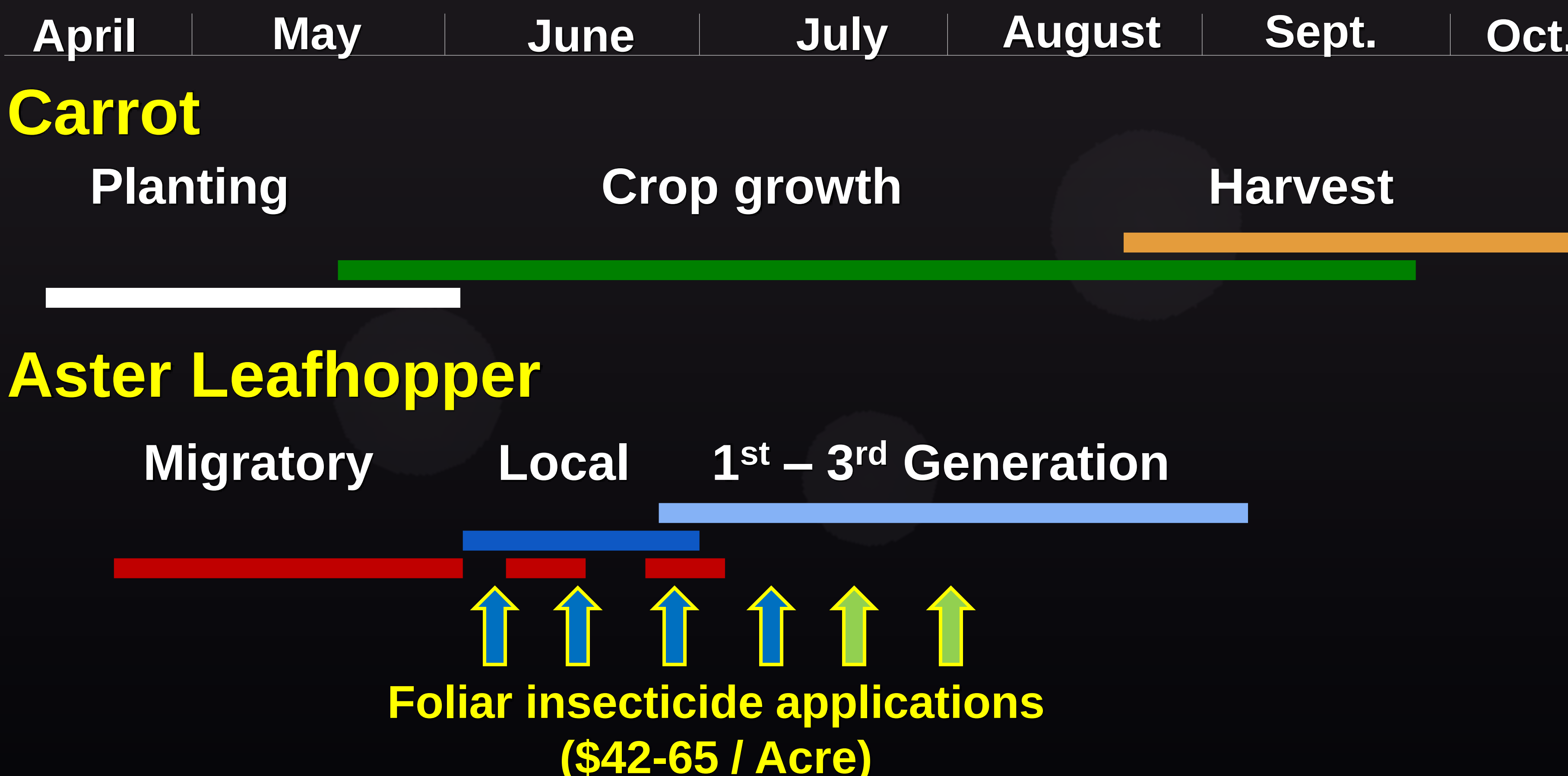
Carrot crop relative to ALH biology

Aster Leafhopper Management (Current)

Foliar insecticide applied when Aster Yellows Index (AYI) exceeds values of 50, 75 or 100:

- **AYI = % ALH infectivity * # ALH / 100 sweeps**

Carrot crop relative to ALH biology



Aster Leafhopper Management (Current):

Synthetic pyrethroids - backbone of AY control programs

Improving Aster Yellows Management

The Challenge!

Increasing the sustainability, efficiency and profitability of carrot production…

- **Synthetic pyrethroids represent the backbone of ALH and AY management ($42 - $60 acre)**
- **New registrations and delivery systems offer promising alternatives ($18 – $24 acre) – 'Reduced-Risk'**

- ***Can we improve our current management strategies?***
- ***Do we have all the tools that we need to manage this disease?***

Insecticides for Managing Carrot Pests

Recently Labeled in Wisconsin:

- Actara (thiamethoxam) – foliar
- Platinum (thiamethoxam) – in-furrow
- Admire Pro, Alias, etc. (imidacloprid) – in-furrow / foliar
- Gaucho (imidacloprid) – seed treatment
- Sepresto 75 WS (imidacloprid, clothianadin) – seed treatment

In the Pipeline:

- FarMore DI400&500 (spinosad, thiamethoxam) – seed trt
- Cruiser (thiamethoxam) – seed trt
- Benevia, Verimark (cyantraniliprole) – in-furrow, foliar, seed
- Entrust (spinosad) – seed treatment
- Avicta (*abamectin*, thiamethoxam) – seed treatment

Systemic Neonicotinyl Insecticides

Beneficial Attributes

- Broad spectrum
  - Leafhoppers, aphids
- Flexible
  - Row mark, furrow, seed, layby
- Long residual
  - Rate dependent
- Low toxicity
  - "EPA classified Reduced-Risk (RR)"

Disadvantages

- Same chemical class
- Resistance concerning

Approach to deploying new insecticide tools

Identify periods of "high risk" for spread of AY

- Historical pest scouting records (Pest Pros, Inc.)

Target control to periods of higher risk for AYp spread

-Use new reduced risk insecticides

Can we reduce the number of applications by targeting times of higher AY risk – Treatment Window?

Can the higher cost of novel, reduced risk, and less broad spectrum insecticides be offset by using fewer applications?

Detection of seasonal trends in AY risk

Methods were modified from Nault et. al. (2009). Environ. Entomology 38(5):1347-1359.

Pest Pros Inc., Plainfield, WI 54966 (http://www.pestprosinc.com)

Pest Pros Inc.

Our methods:

Sweep net and infectivity data averaged for each year, field, and date combination (7 and 14 years, respectively).

Data were standardized using random effects models and regression splines

Cubic polynomials were fit to the resulting "conditional" or "de-seasonalized" data (linear model)

Seasonal Trends: ALH Abundance

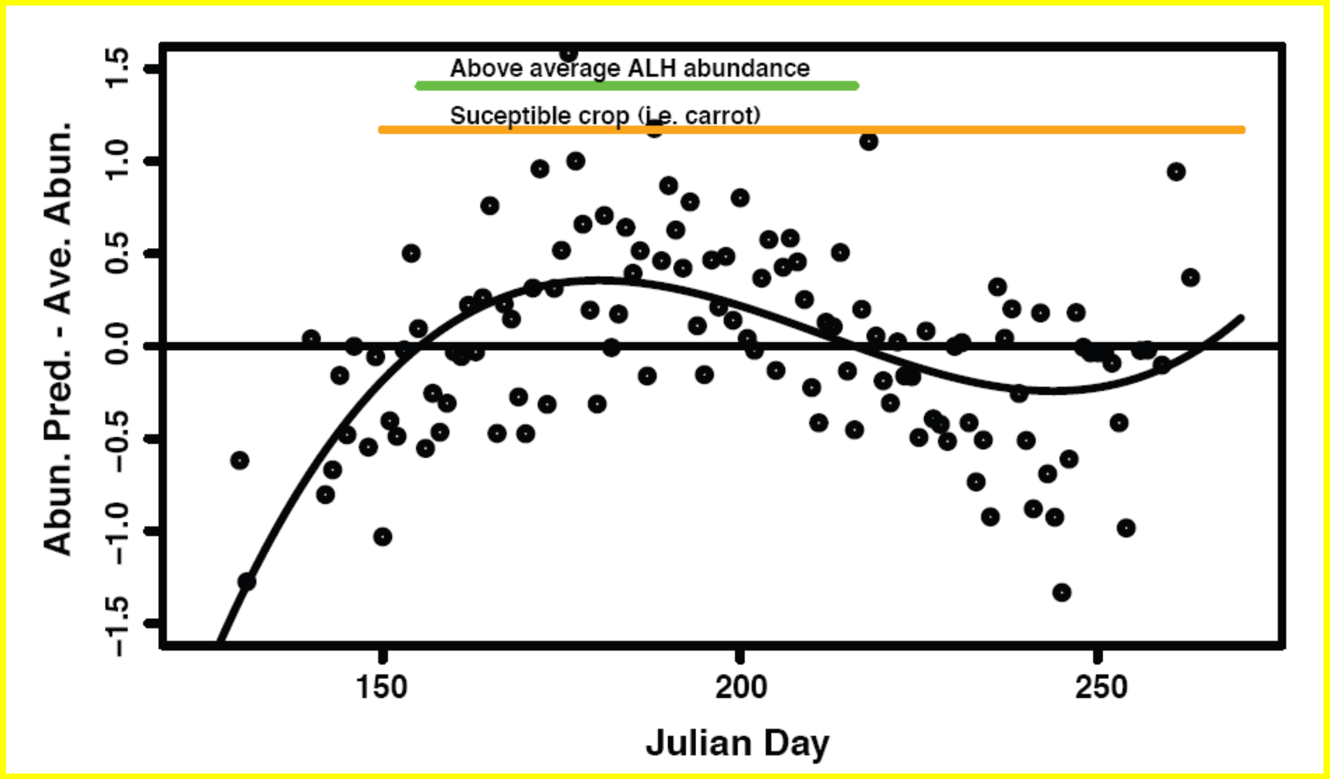
- Fit Random Effects model to data
- Model 'Best Linear Unbiased Predictors' vs. Julian date and fit cubic polynomial

Solve for S = 0

X_1: 155 (June 3)
X_2: 216 (August 3)
X_3: 265

Above average ALH catches between X1 and X2

"Risk Window"



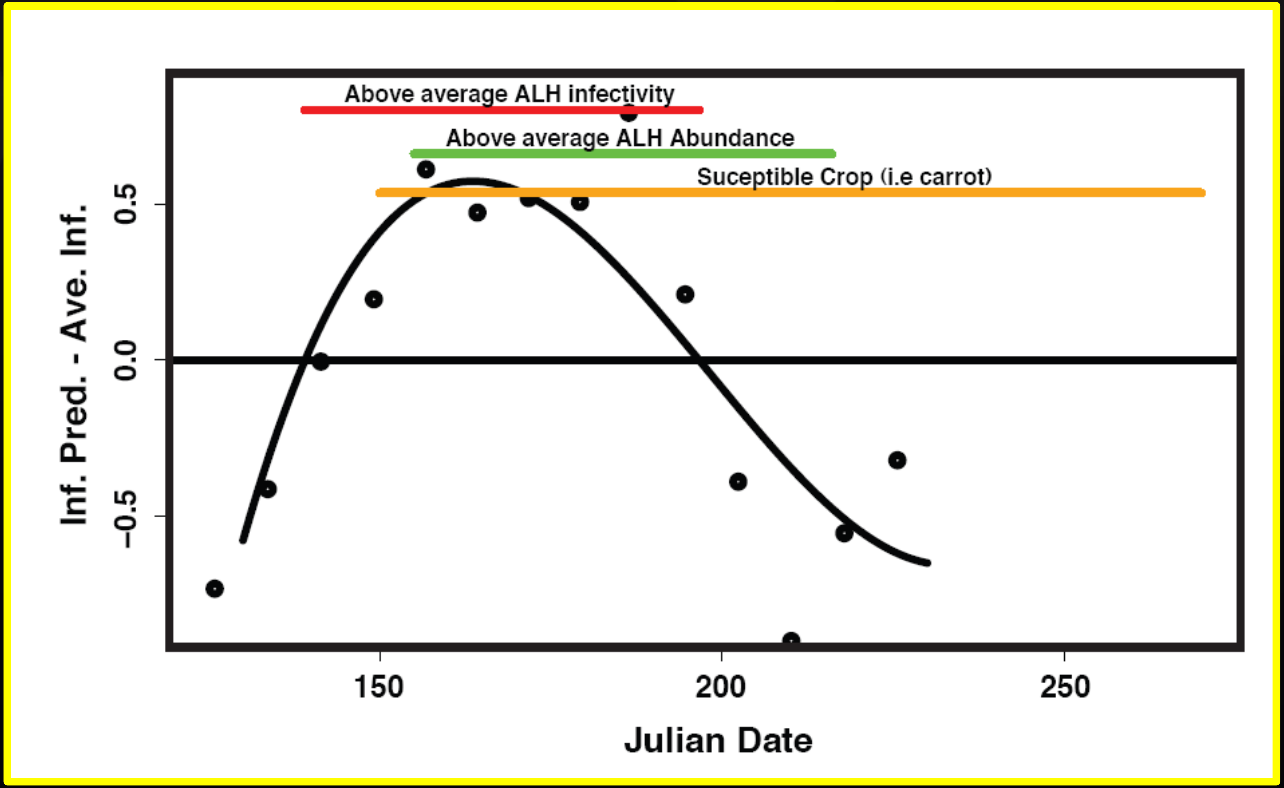
Seasonal trends: ALH infectivity

Using similar methodology to examine ALH infectivity

Above average ALH infectivity

X_1: 139 (May 18)
X_2: 197 (July 15)
X_3: 259

"Risk Window"



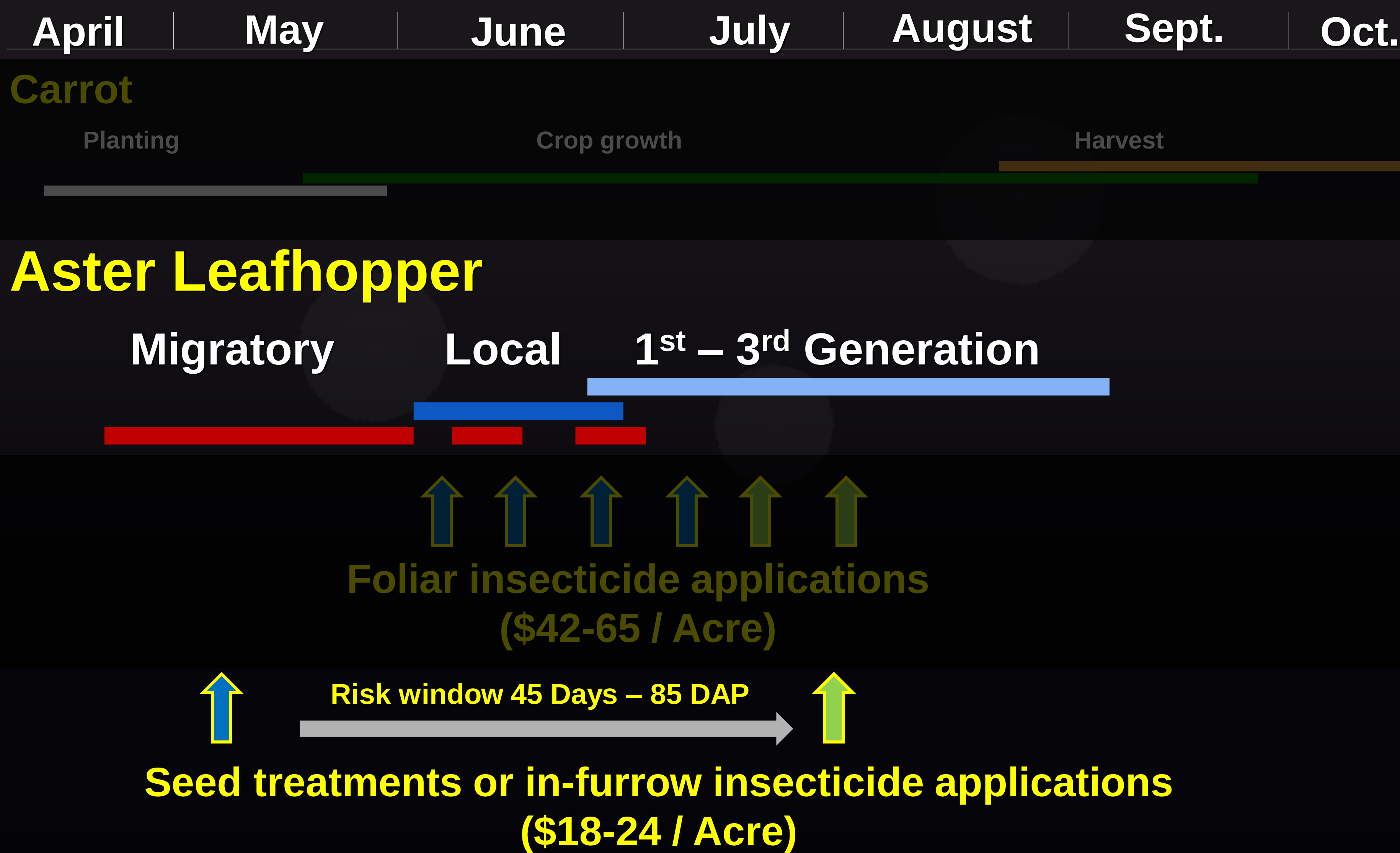
Defining the ‘Treatment Window’

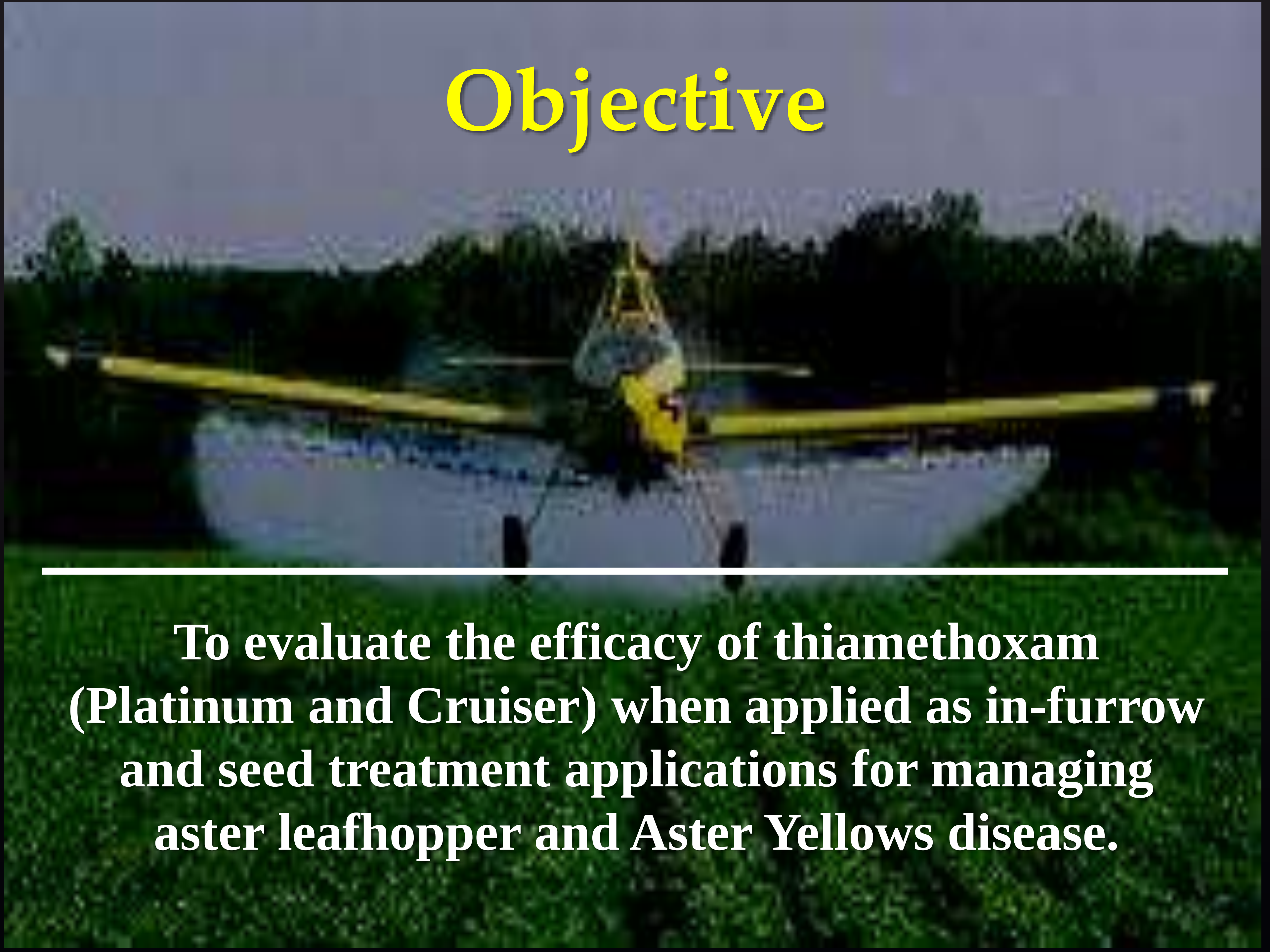
Can we reduce the number of applications by targeting times of higher AY risk – Treatment Window?

Can the higher cost of novel, reduced risk, and less broad spectrum insecticides be offset by using fewer applications?

	Open	Close	# Days
Susceptible carrot	May 25	Sept. 1	100
Aster Leafhopper	June 7	August 1	55
ALH infectivity	May 18	July 15	58
Overlap	June 7	July 15	40
Resitant Carrot (High infectivity)	June 18	July 8	20
Susceptible Carrot (High infectivity)	June 7	August 7	61

Carrot crop relative to ALH biology





Objective

To evaluate the efficacy of thiamethoxam (Platinum and Cruiser) when applied as in-furrow and seed treatment applications for managing aster leafhopper and Aster Yellows disease.

Products Evaluated for Managing Aster Leafhopper and Aster Yellows Disease of Carrot in WI, 2011

Product	Active Ingredient	Type*	Rate	
Untreated	--	--	--	
Cruiser 5FS	thiamethoxam	ST	0.1 mg a.i. / seed	cv. 'Enterprise'
Avicta	thiamethoxam & abamectin	ST	0.1 mg a.i. / seed 0.016 mg a.i. / seed	
Untreated	--	--	--	
Sepresto	clothianadin & imidacloprid	ST	0.068 mg a.i. / seed 0.023 mg a.i. / seed	cv. 'Maverick'
Sepresto / Votivo	clothianadin & imidacloprid *Bacillus firmus*	ST	0.068 mg a.i. / seed 0.023 mg a.i. / seed 1.5 X10^3 cfu / seed	
Vydate CLV	oxamyl	BR	2 gal / acre	
Asana XL (Standard)	esfenvalerate	F	5 appl @ 8.0 fl oz/acre	
Platinum 75SG	thiamethoxam	IF	4.01 fl oz / acre	cv. 'Canada'
Platinum 75 SG & Liquid Fertilizer	thiamethoxam	IF	4.01 fl oz / acre	

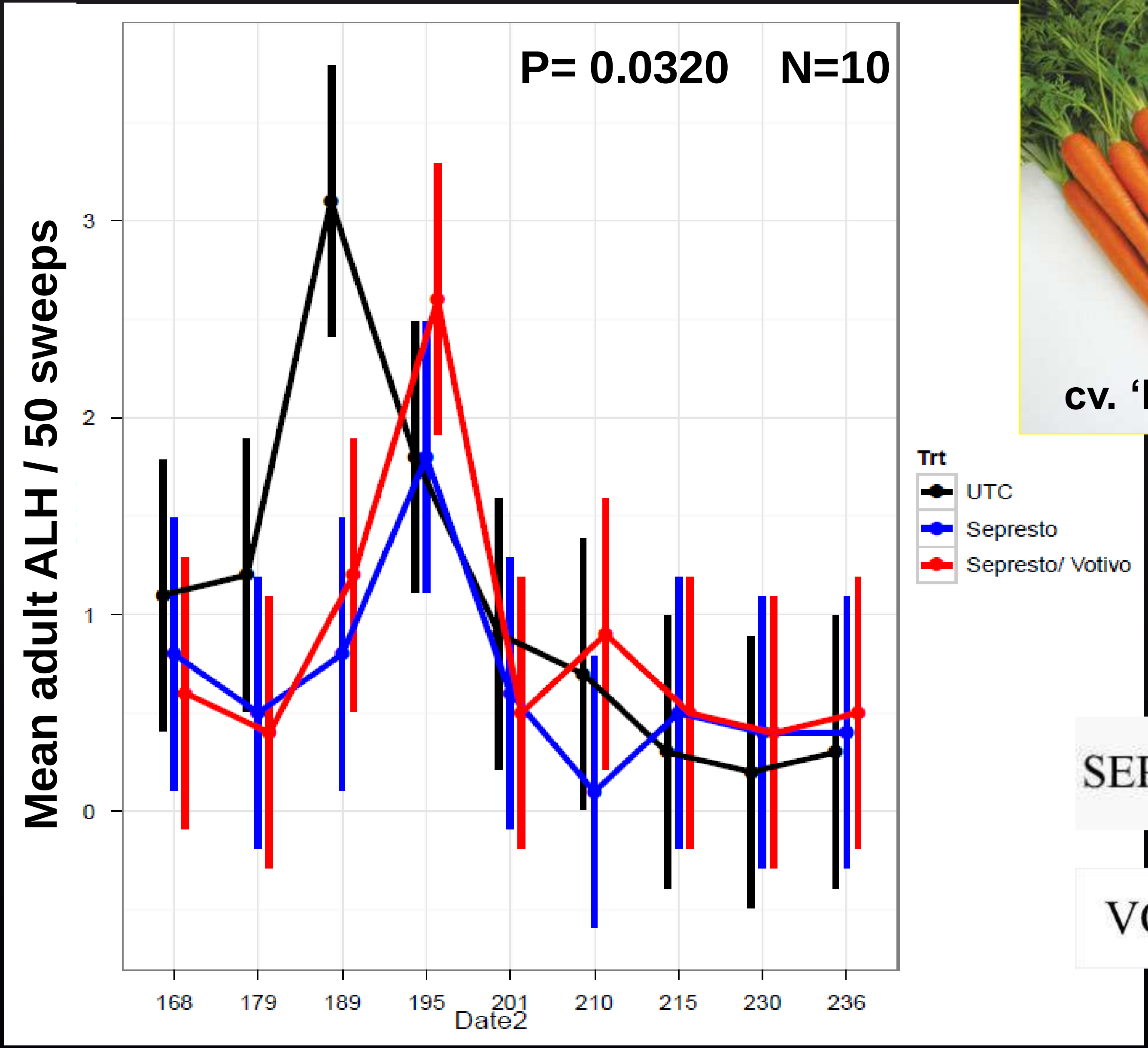
*ST = seed treatment; IF = in furrow application; BR = broadcast at-plant

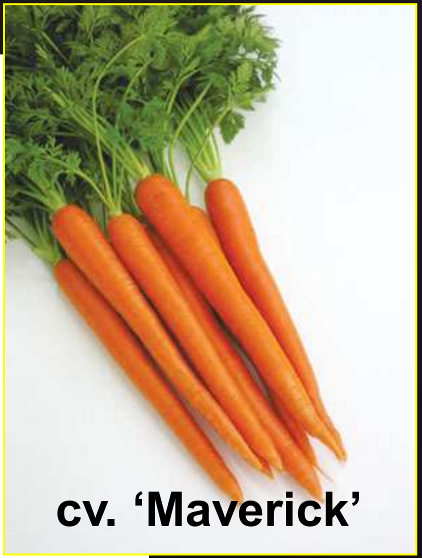
Products Evaluated for Managing Aster Leafhopper and Aster Yellows Disease of Carrot in WI, 2011

- **Large plot trials conducted on farm (~ 1/3 acre per trt x 3 trt x 3 locations; Many thanks to Miller Farms)**
- **Data collected: Weekly ALH abundance, Nematode counts (2 dates), Disease ratings (2 dates), yields, and root quality assessment.**

Mean Adult Aster Leafhoppers Captured / Sweep

Hancock, WI 2011

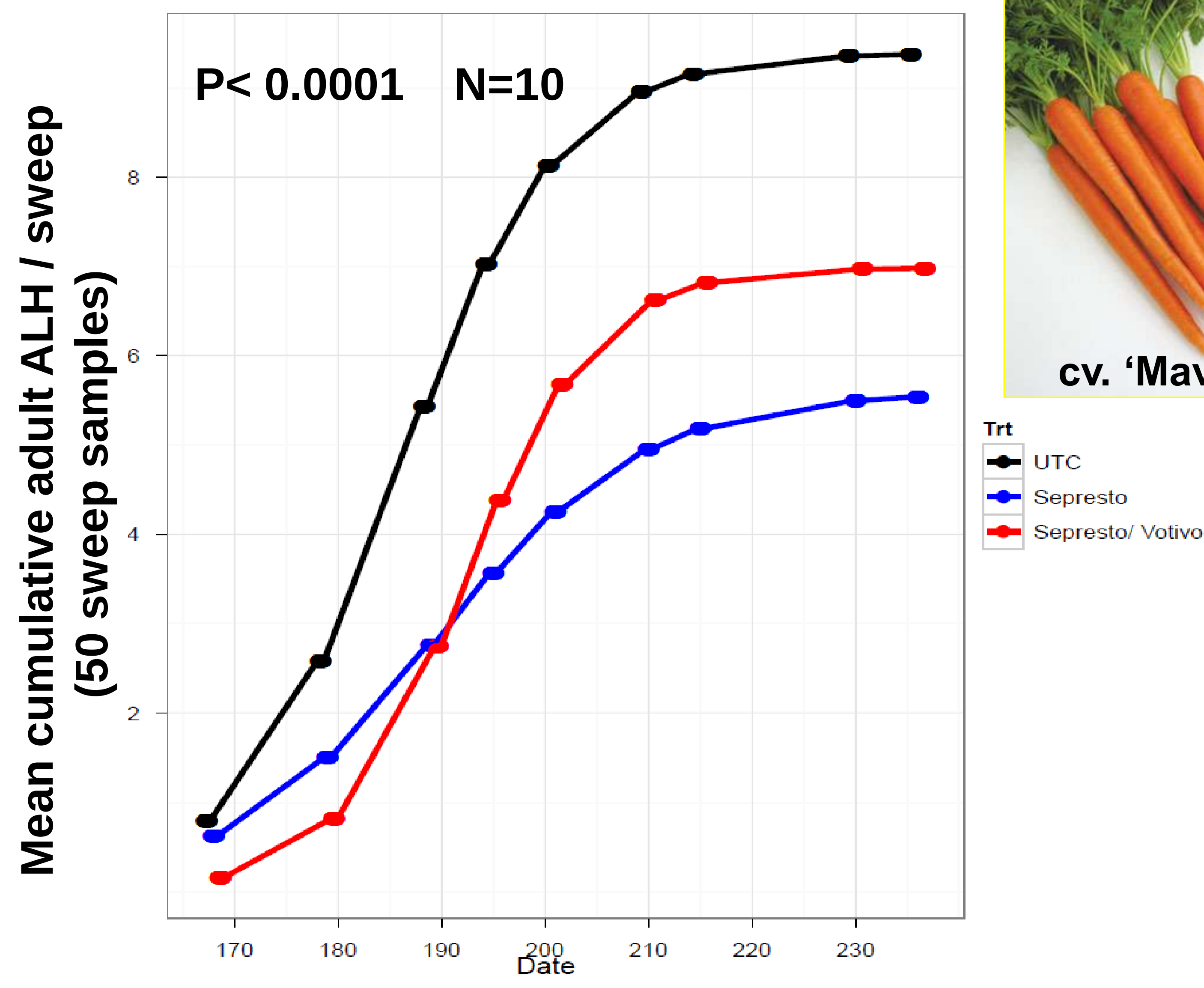


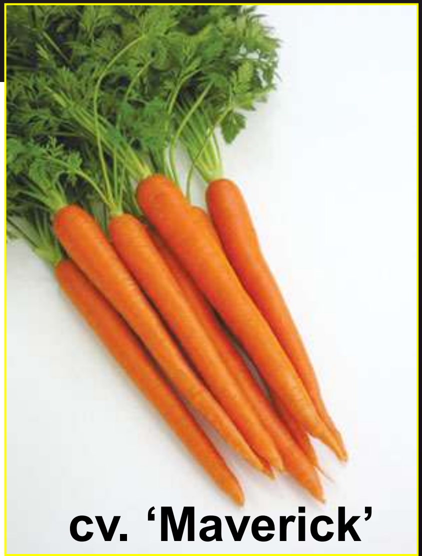


SEPRESTO

VOTIVO

Mean Cumulative Adult Aster Leafhoppers Captured / Sweep Hancock, WI 2011





Mean Adult Aster Leafhoppers Captured / Sweep

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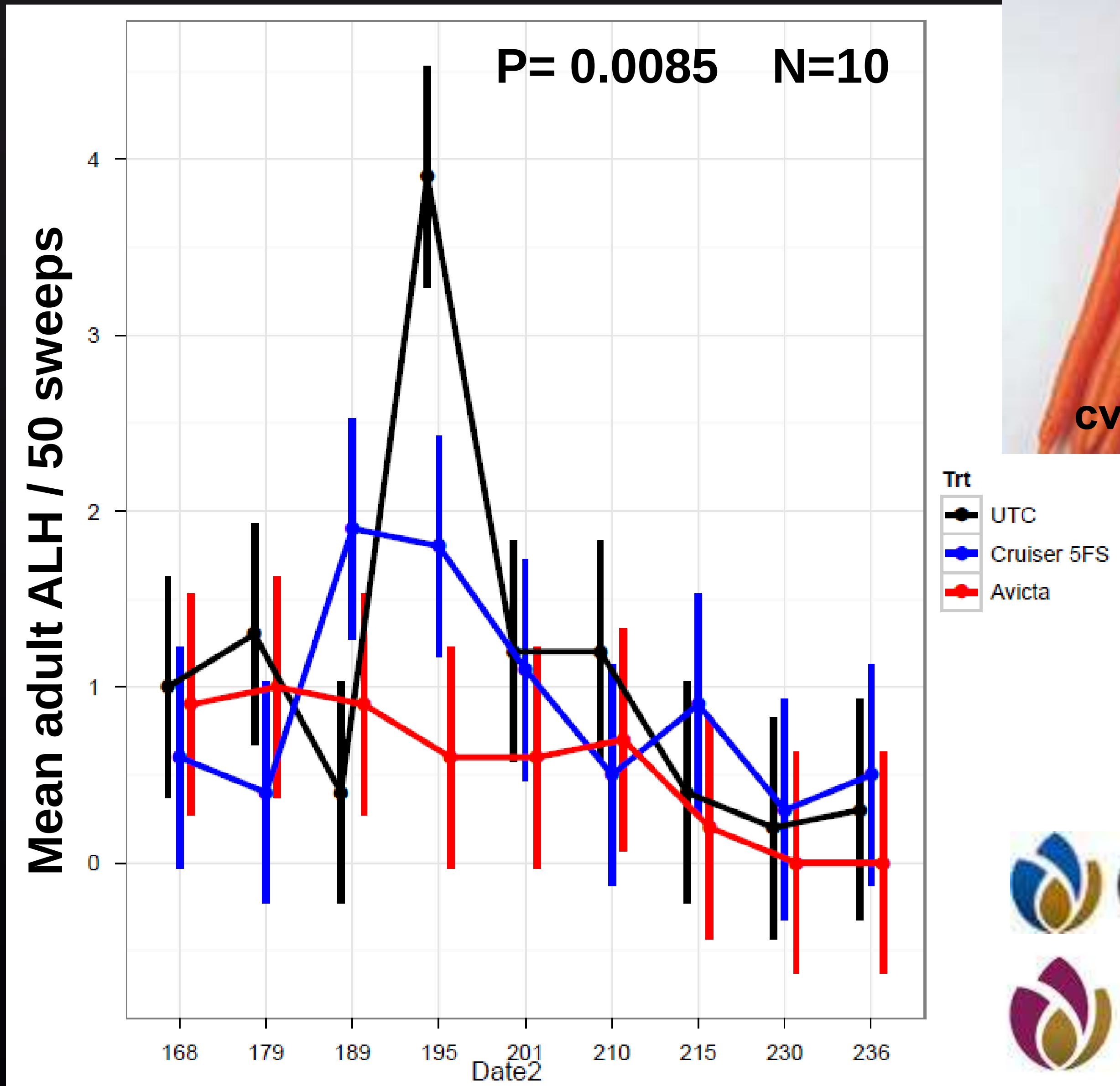
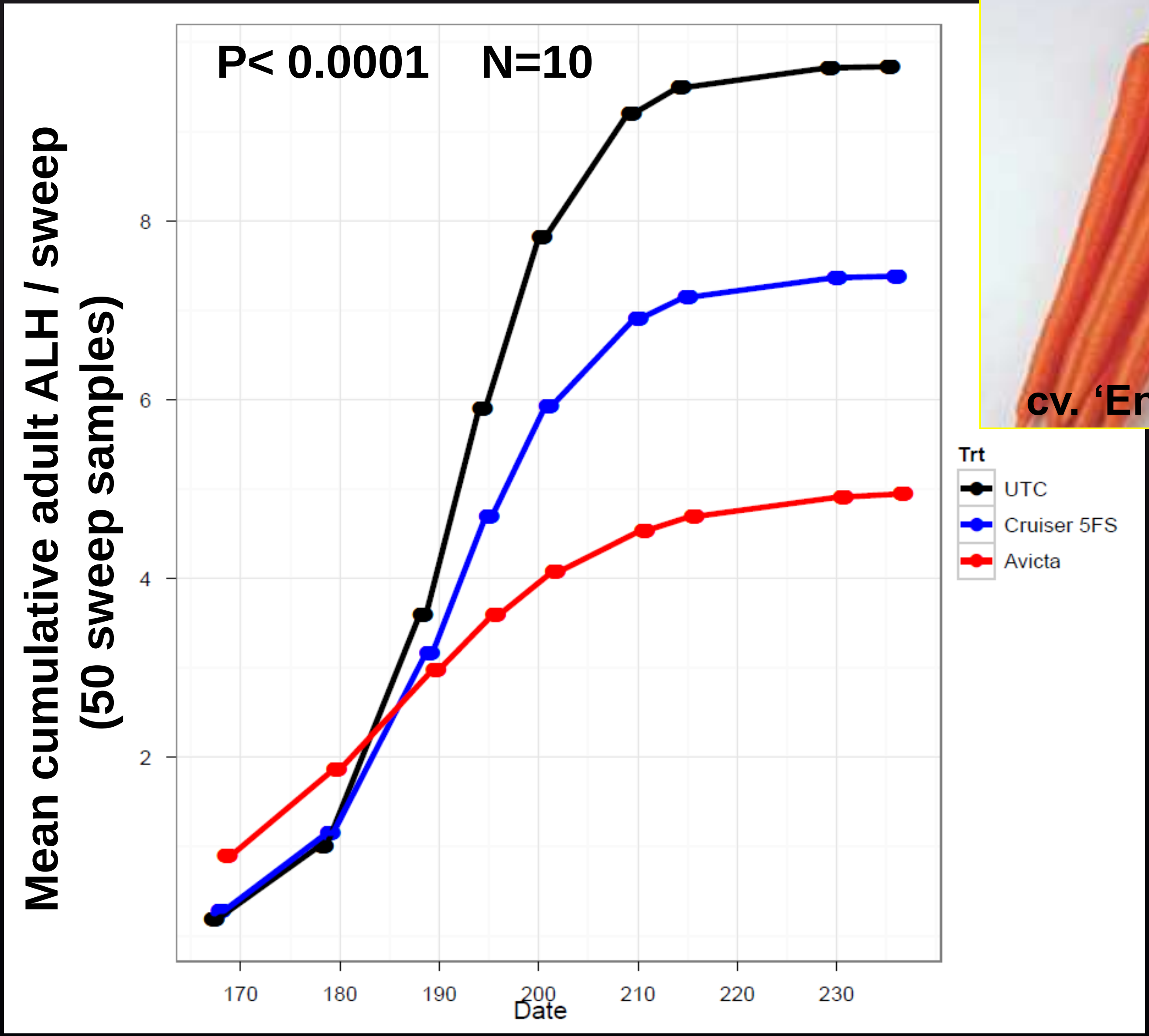


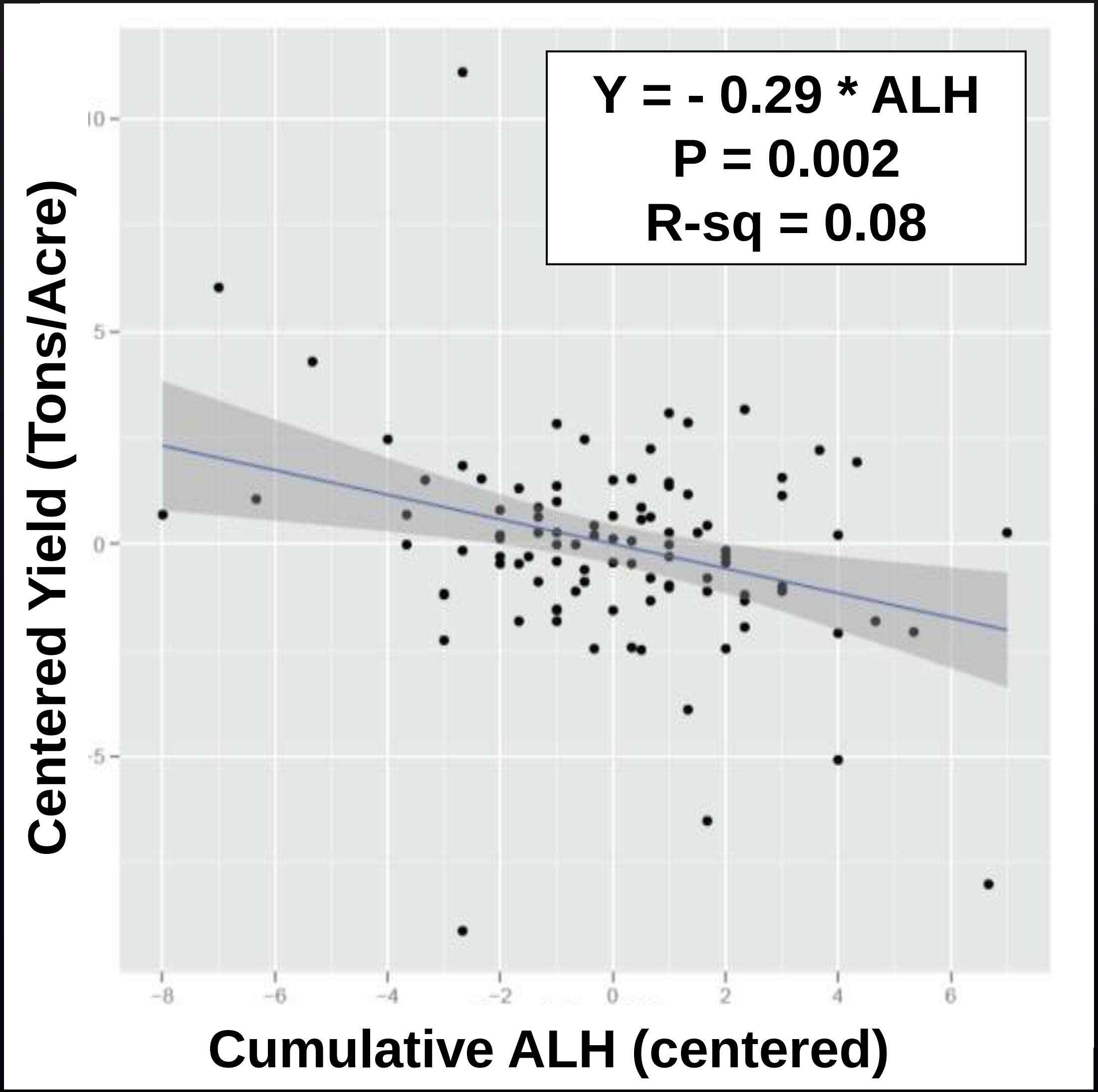
Cruiser®

Avicta®

Mean Cumulative Adult Aster Leafhoppers Captured / Sweep Hancock, WI 2011



Cumulative adult ALH relate to yield: all locations combined



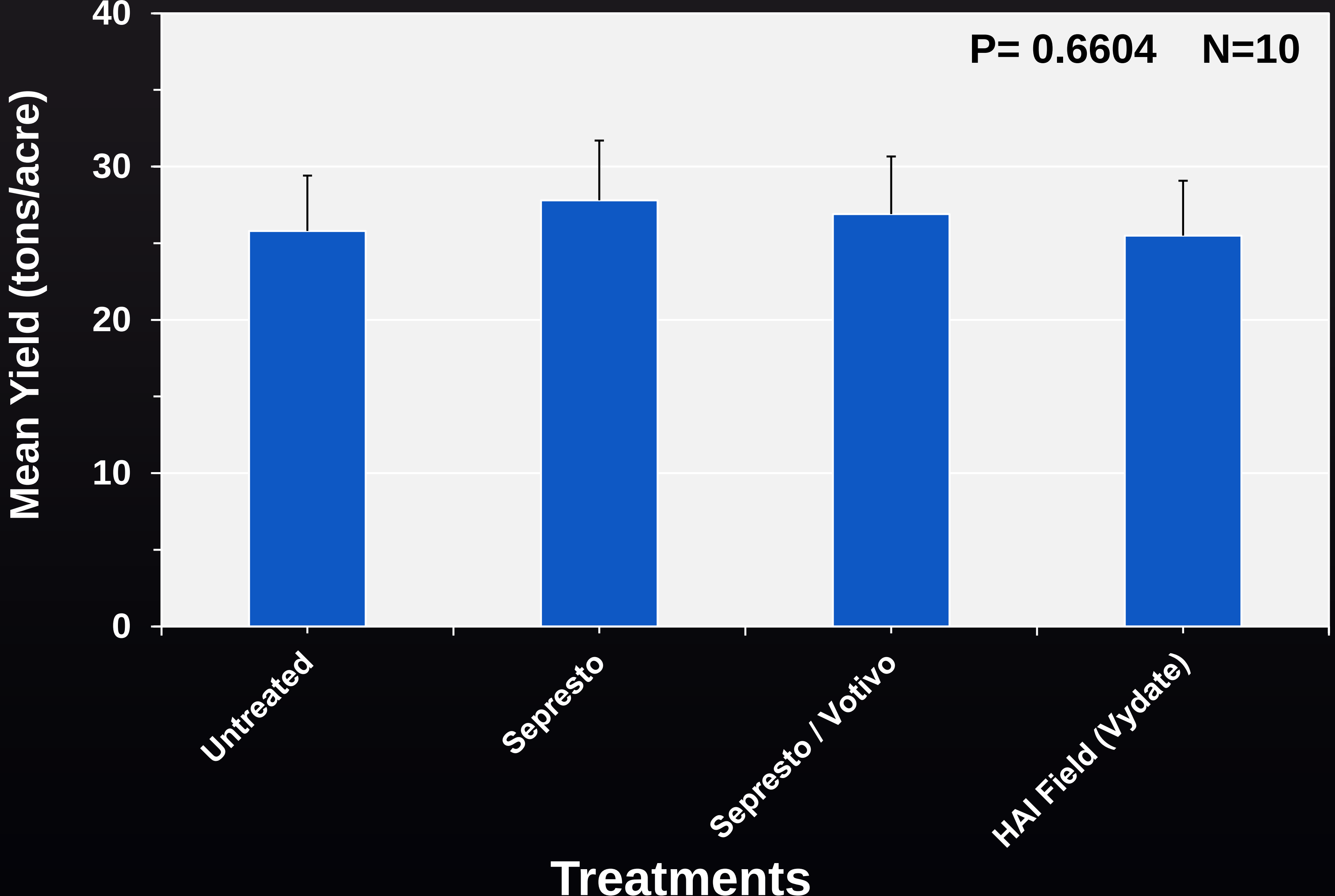
Data were centered for each location, treatment and block combination.

On average, an increase of 1 ALH resulted in a 0.3 T/A decrease in yield.

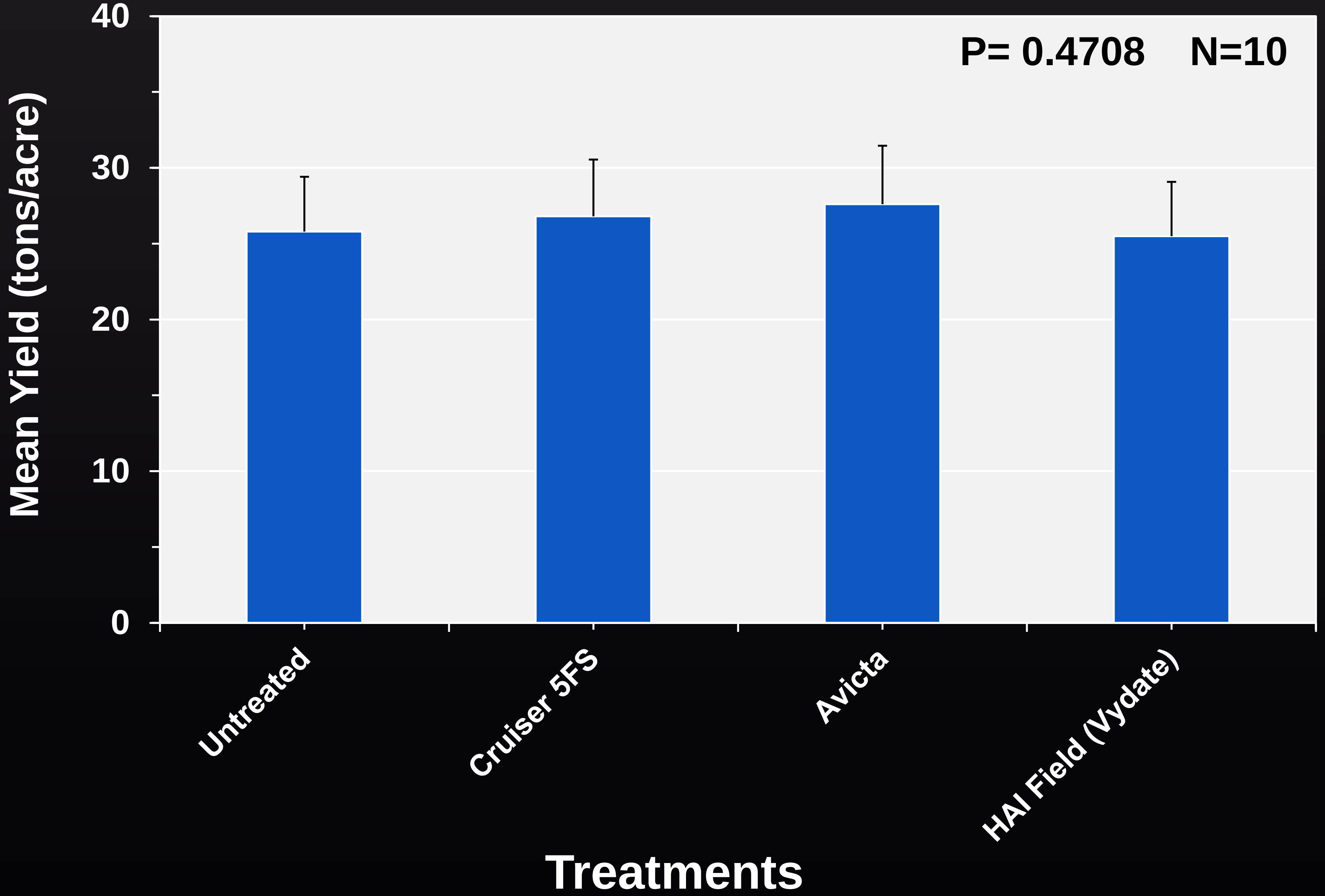
Trend was largely driven by data from a single location where there was more insect pressure throughout the season.

Mean Yield (Tons/ Acre)
Bayer - Nunhems Treatments

Hancock, WI 2011



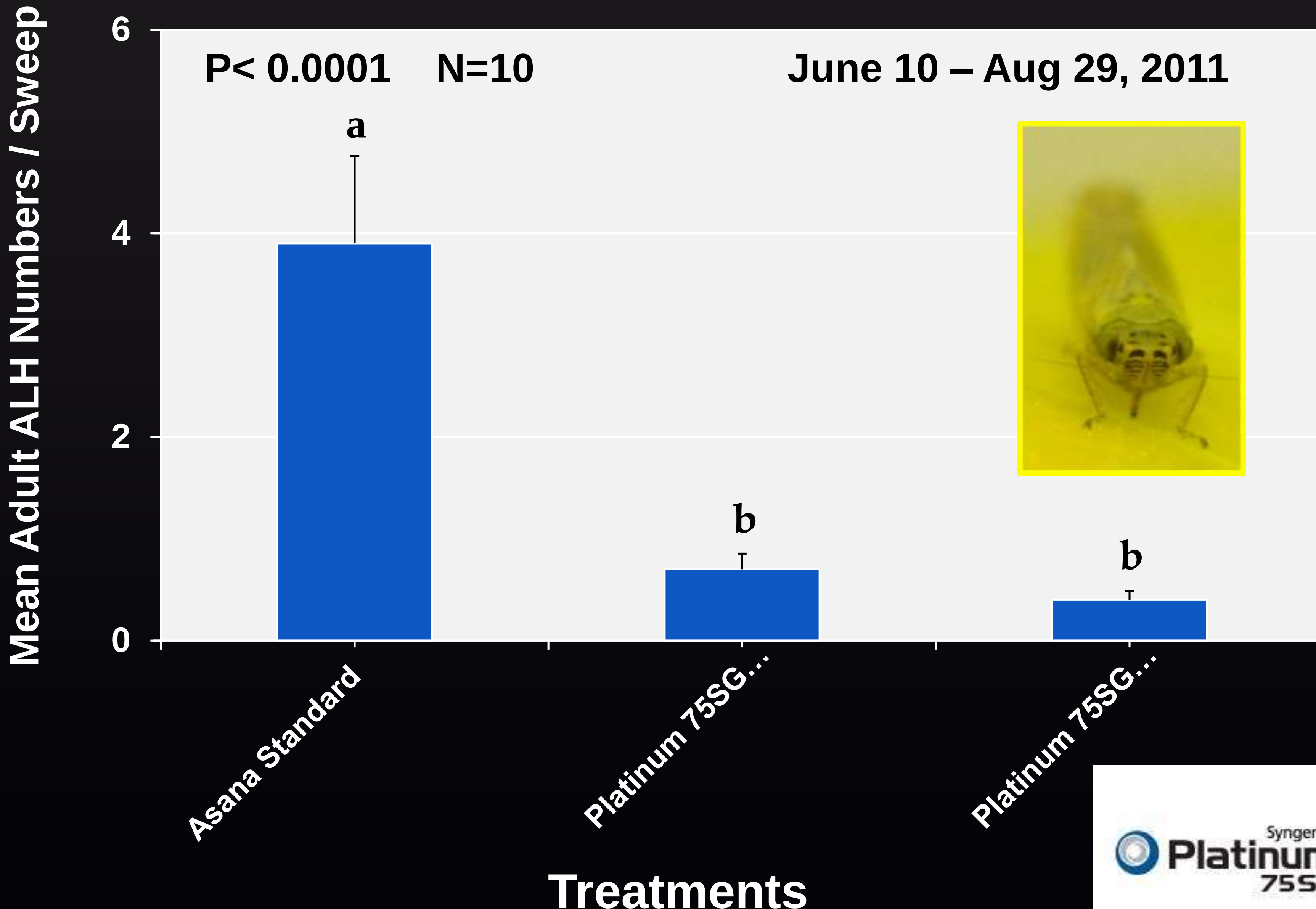
Mean Yield (Tons/ Acre)
Syngenta Treatments Hancock, WI 2011



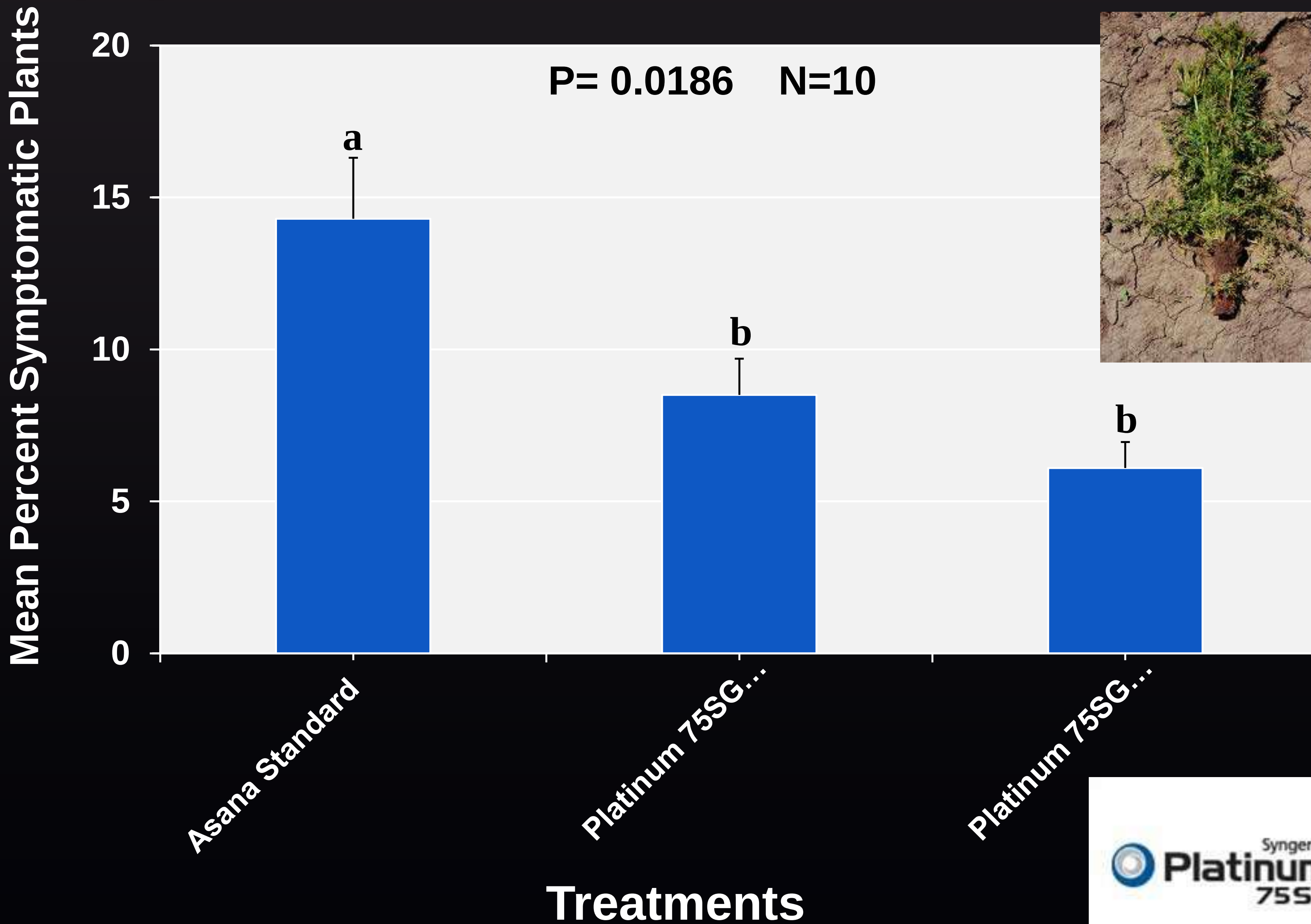
Mean Counts Root Lesion Nematode Bayer – Nunhems Treatments Hancock, WI 2011

Mean Adult ALH Numbers – Syngenta In-Furrow Treatments

Hancock, WI 2011

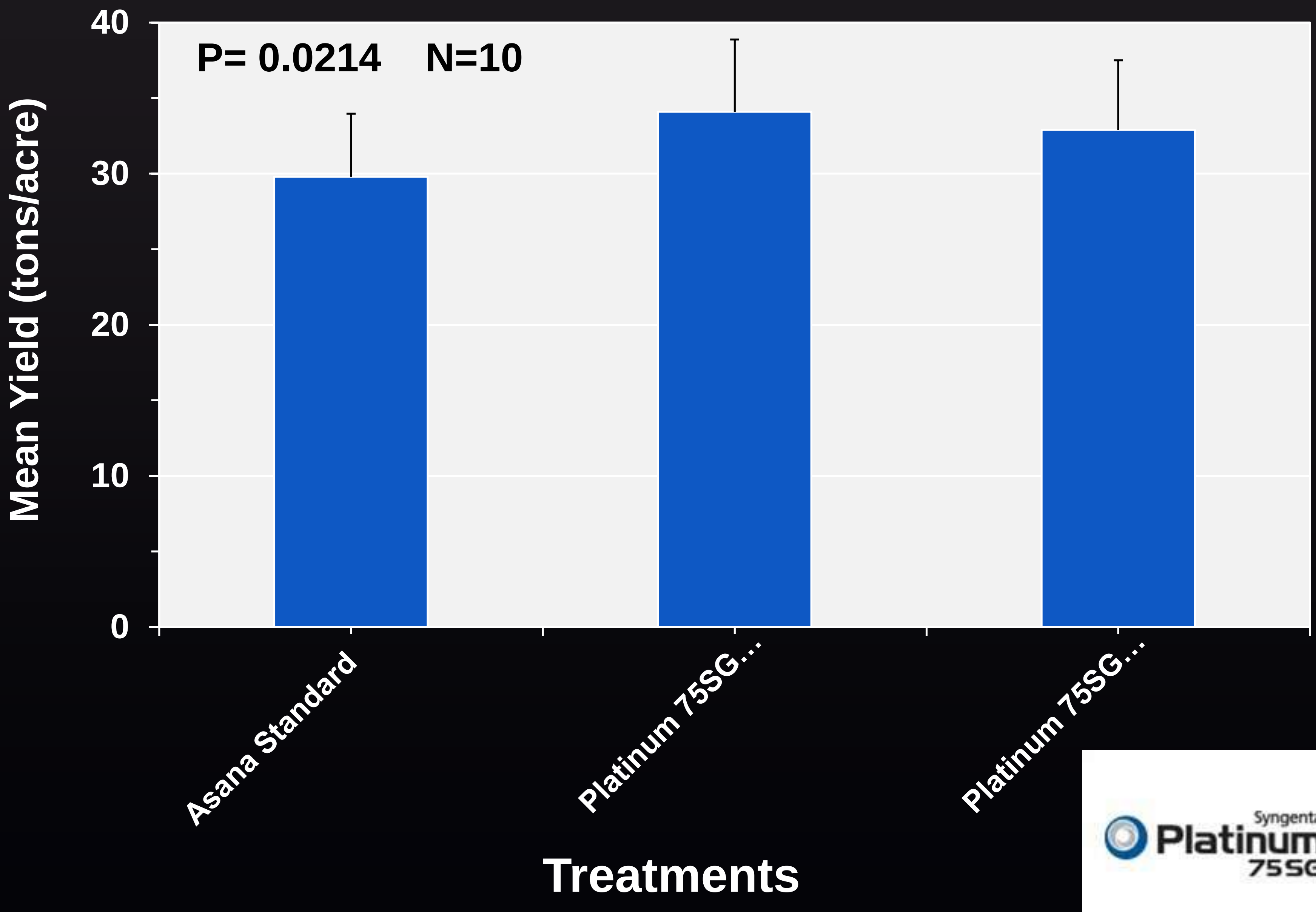


Mean Percent Symptomatic Plants
Syngenta In-Furrow Treatments Hancock, WI 2011



Syngenta Platinum. 75SG

Mean Yield (Tons/ Acre)
Syngenta In-Furrow Treatments Hancock, WI 2011



Syngenta Platinum 75SG

Overall summary: refining the AYI

Advance our basic understanding of the epidemiology of aster yellows in Wisconsin towards the development and implementation of a comprehensive management plan

- **Incorporate biological information about the AY disease system improve on-farm AY management decisions**

- **Utilize available and emerging information and technologies in the context of management to:**

  - **I) Ensure AYp detection is accurate and reflects biology –** ***Reduce unwarranted sprays***
  - **II) Identify trends in AY risk –** ***Target control to high AY risk periods, offset high costs of new "softer" chemistries***
  - **III) Advance predictive tools to address sporadic risks –** ***allows advanced preparation for ALH infestations to mitigate yield loss***

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Shiprock Farms
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Patrykus Farms
Guth Farms
Kincaid Farms

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