WASHINGTON STATE UNIVERSITY

World Class. Face to Face.

Control of Stink bugs and Other Apple IPM Issues

Jay Brunner, Mike Doerr, and Keith Granger
WSU Tree Fruit Research and Extension Center
Wenatchee, WA

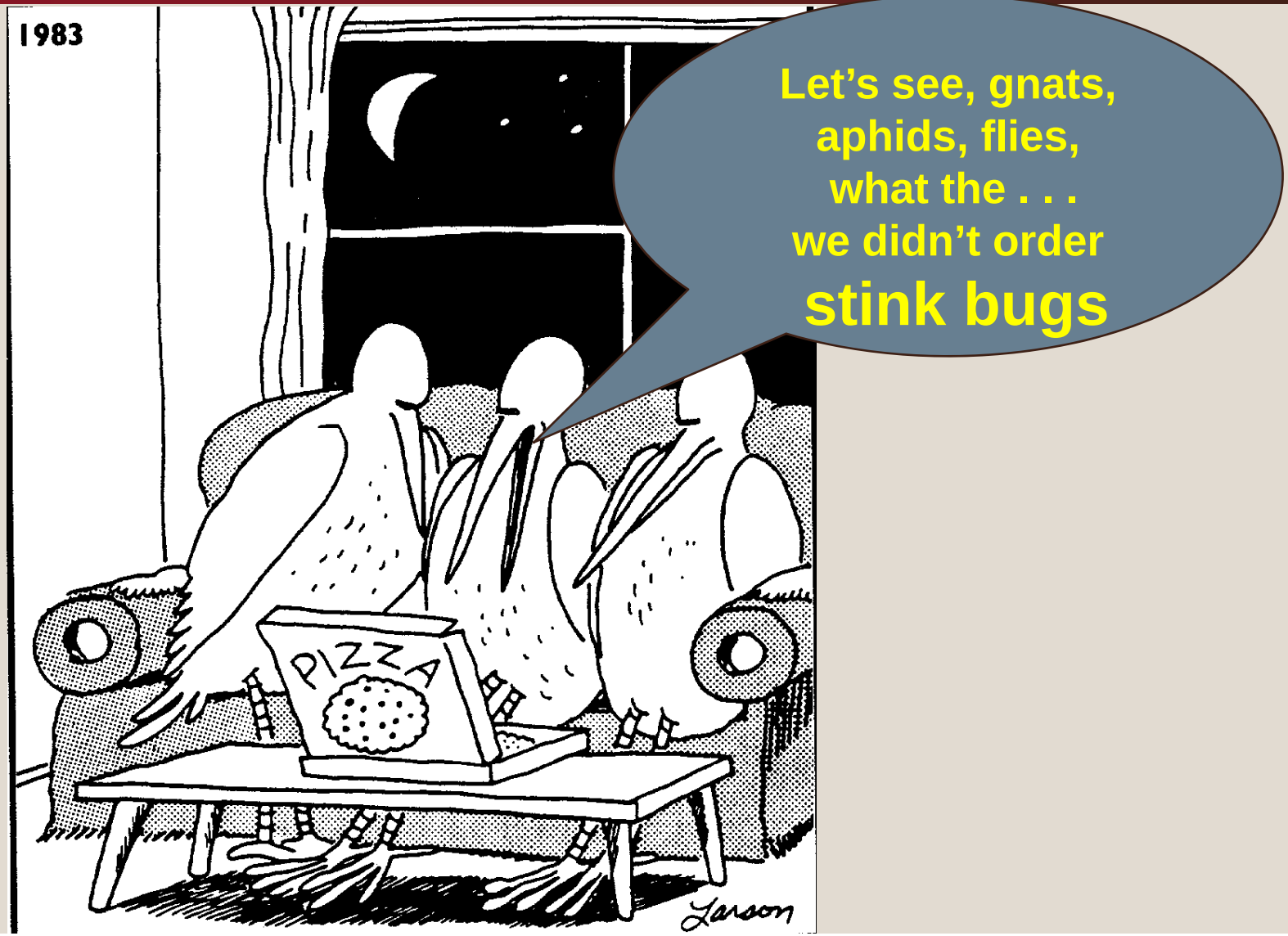
LIFE HISTORY | BEHAVIOR | MONITORING | CONTROL | NEW THREATS





WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: WHAT'S ON YOUR PIZZA?



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: WHO ARE THE PLAYERS?

Four species commonly found in WA orchards:

1. *Euschistus conspersus* (consperse stink bug)
   Most common, main pest of apples

2. *Chlorochroa sp. (C. ligata, C. sayi, C. uhleri)*
   Locally abundant, can be main pest in some areas

3. *Acrosternum hilare* (green soldier bug)
   Much larger than others, usually near riparian areas

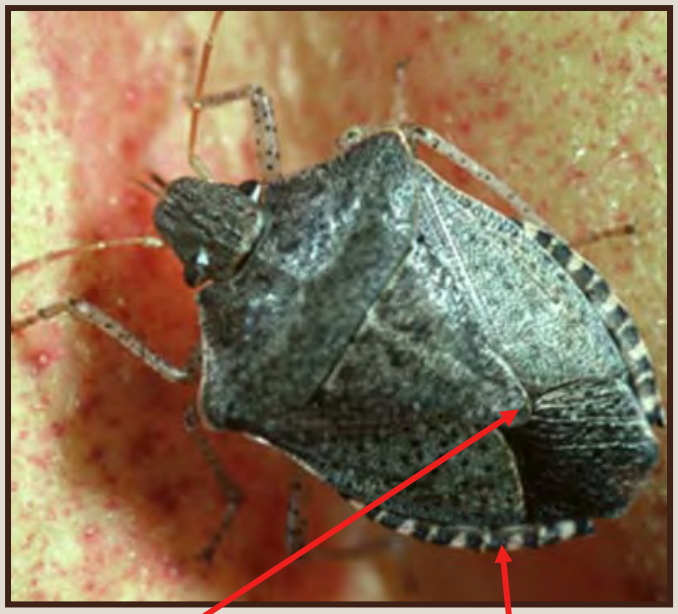
4. *Thyanta pallidovirens* (red-shouldered stink bug)
   Infrequently found in orchards

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: COMMON SPECIES

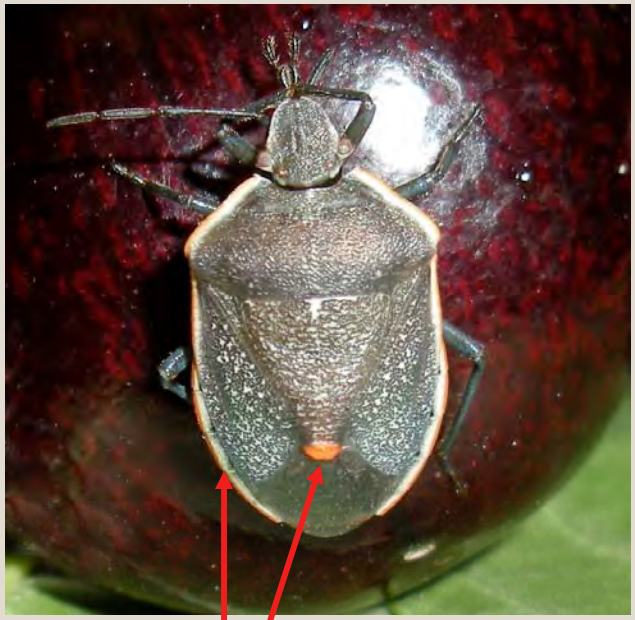
Euschistus conspersus

"consperse stink bug"



No spot - checkered margin

Chlorochroa ligata



Central spot - same color as margin

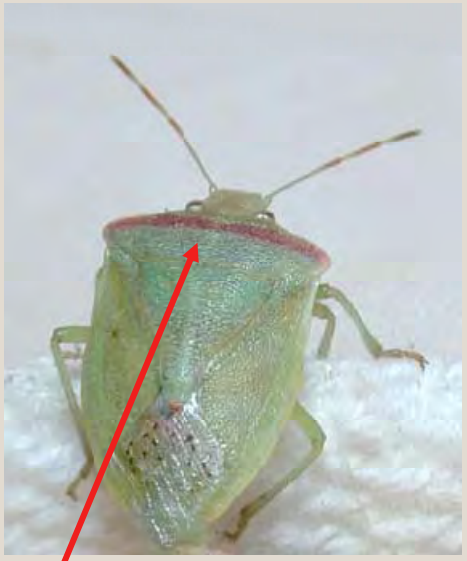
WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: COMMON SPECIES

Acrosternum hilare
Green soldier bug

No red band
Approx. 3/4” long

Thyanta pallidovirens
Red-shouldered stink bug



Red ‘shoulder’ band
Approx. 3/8” long

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: LIFE HISTORY

Winter

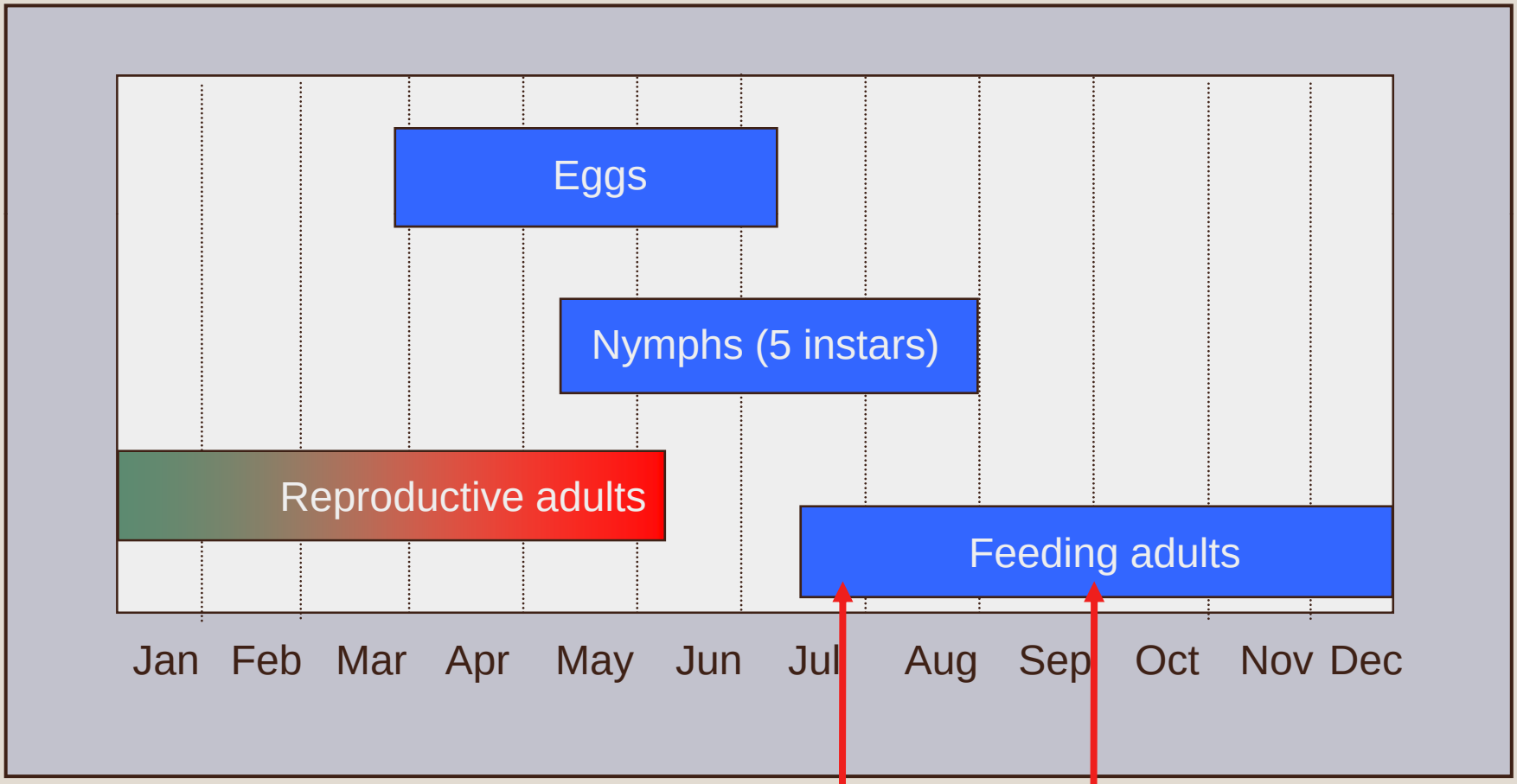
Spring

Summer

Fall

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: LIFE HISTORY

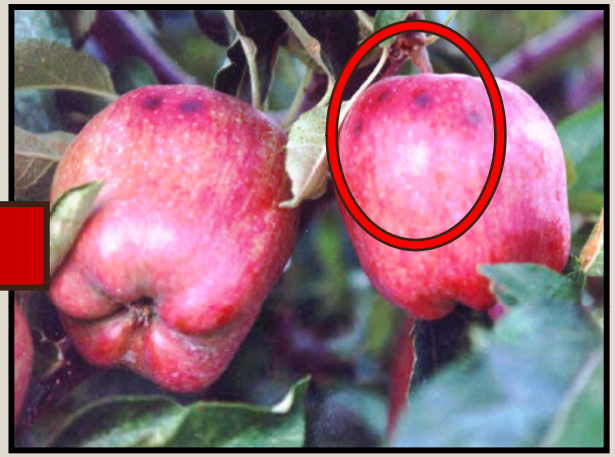


Damage occurs from mid- to late-summer

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: FRUIT INJURY

Cross-section through lesion shows conical discoloration of tissue (vs. bitter-pit)

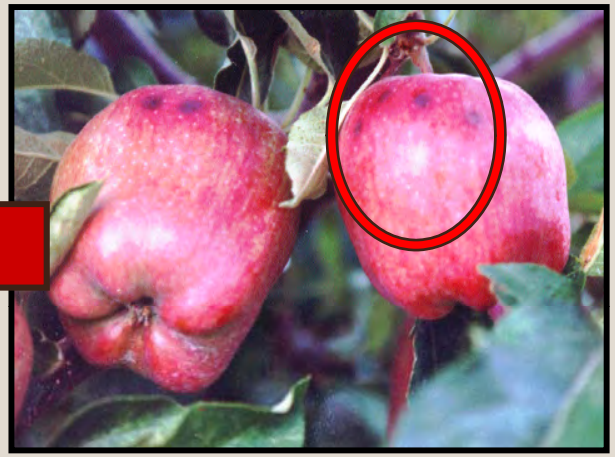


Red lesions visible on fruit surface within 24 h

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: FRUIT INJURY

Cross-section through lesion shows conical discoloration of tissue (vs. bitter-pit)



Red lesions visible on fruit surface within 24 h

Bitter pit symptom in cross-section

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: BEHAVIOR & HABITAT

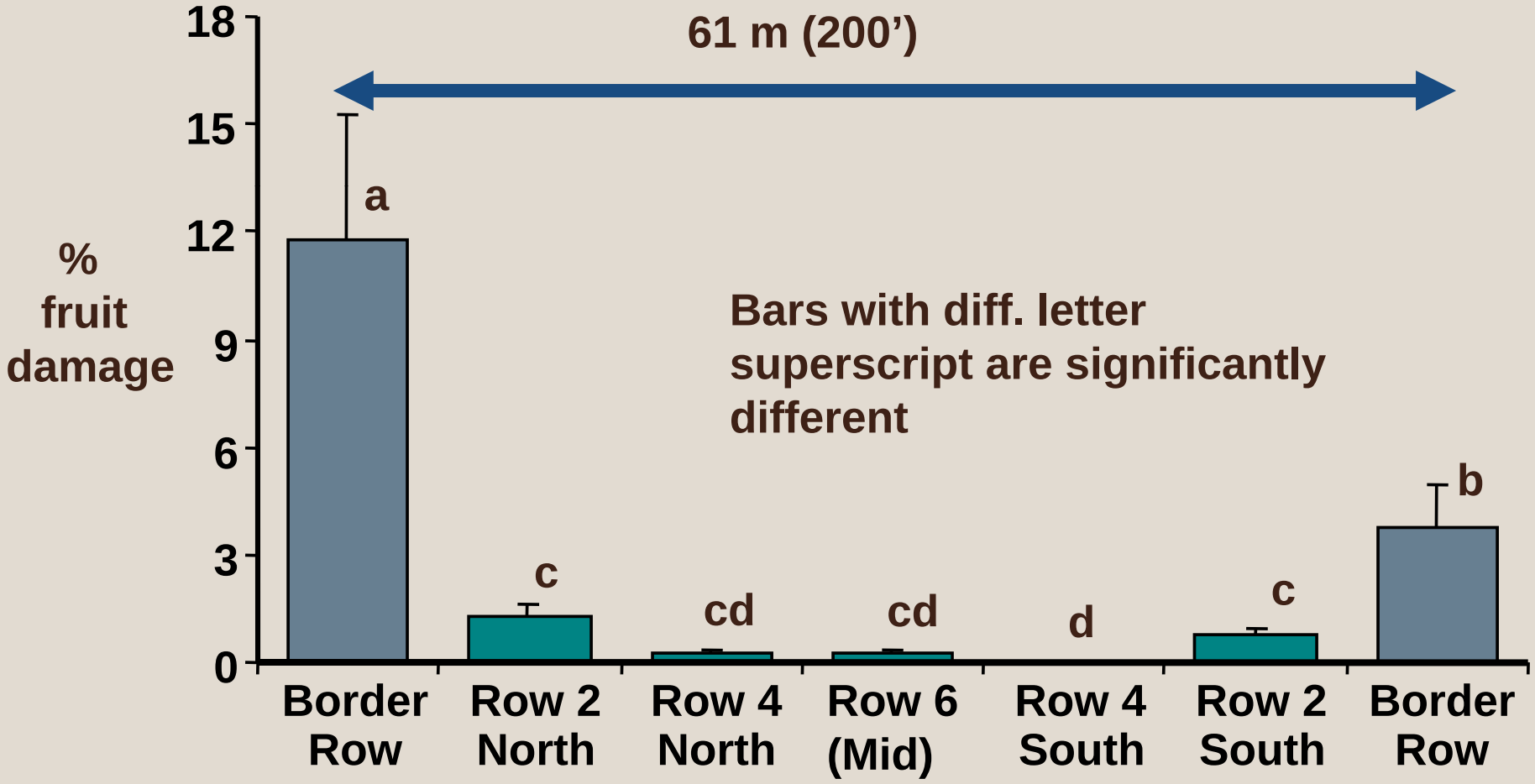
Research strongly indicates that stink bugs ***do not reproduce in orchards*** but reproduce outside of orchards in native plants.

Native plants known to produce stink bugs are mullein, bitter bush, wild rose, snow berry, and brambles.

Stink bugs can be in orchards in the spring as adults coming out of overwintering but most fruit injury occurs when ***adults migrate into orchards from native habitats in late summer***.

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: MOVE INTO ORCHARDS



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: PHEROMONES & MONITORING

Stink bugs communicate in two ways

- They produce **pheromones**
- They produce vibrations (**songs**)

Pheromones have been identified for several stink bug species

Pheromones can be produced by the male or female

Pheromones are either ***aggregation*** or ***sex***

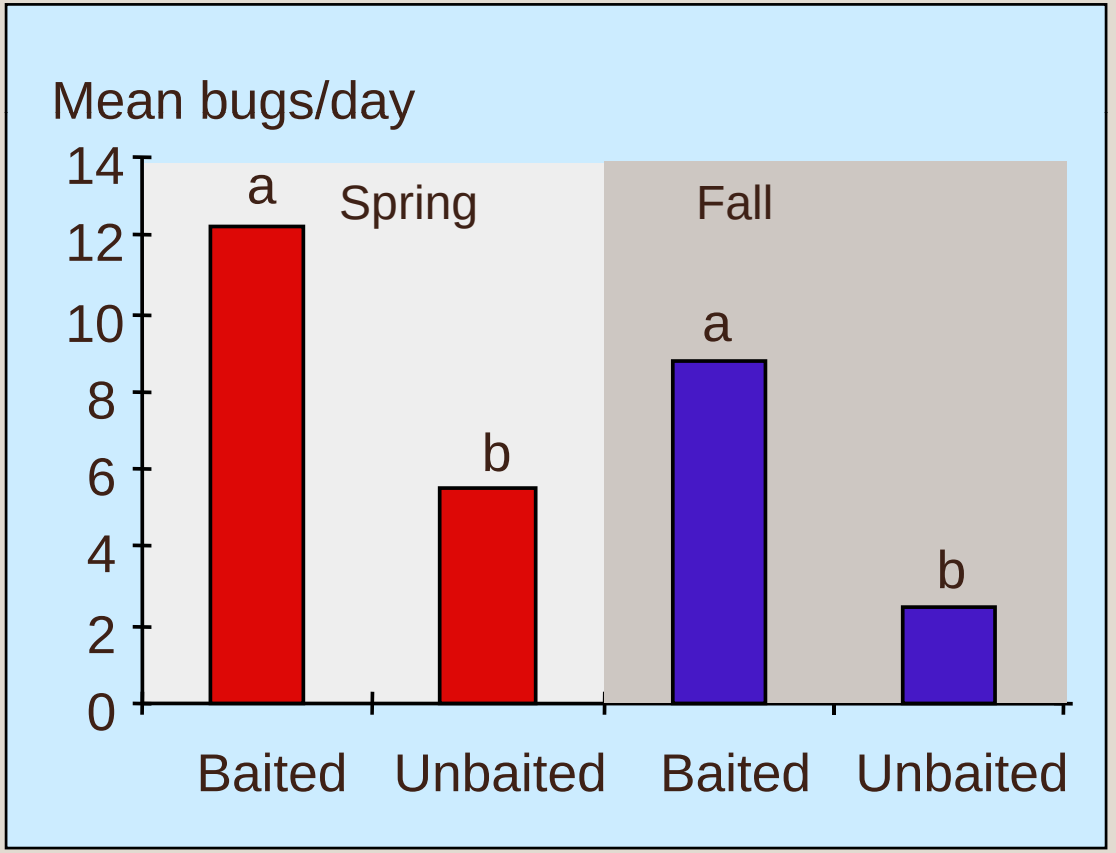
Aggregation pheromones attract both sexes plus immature stages (nymphs).

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: BEHAVIOR & MONITORING

Significant attraction of reproductively mature (spring) and feeding adults (fall)

Equal proportions of adult males and females collected on both baited and unbaited plants (50:50 sex ratio)



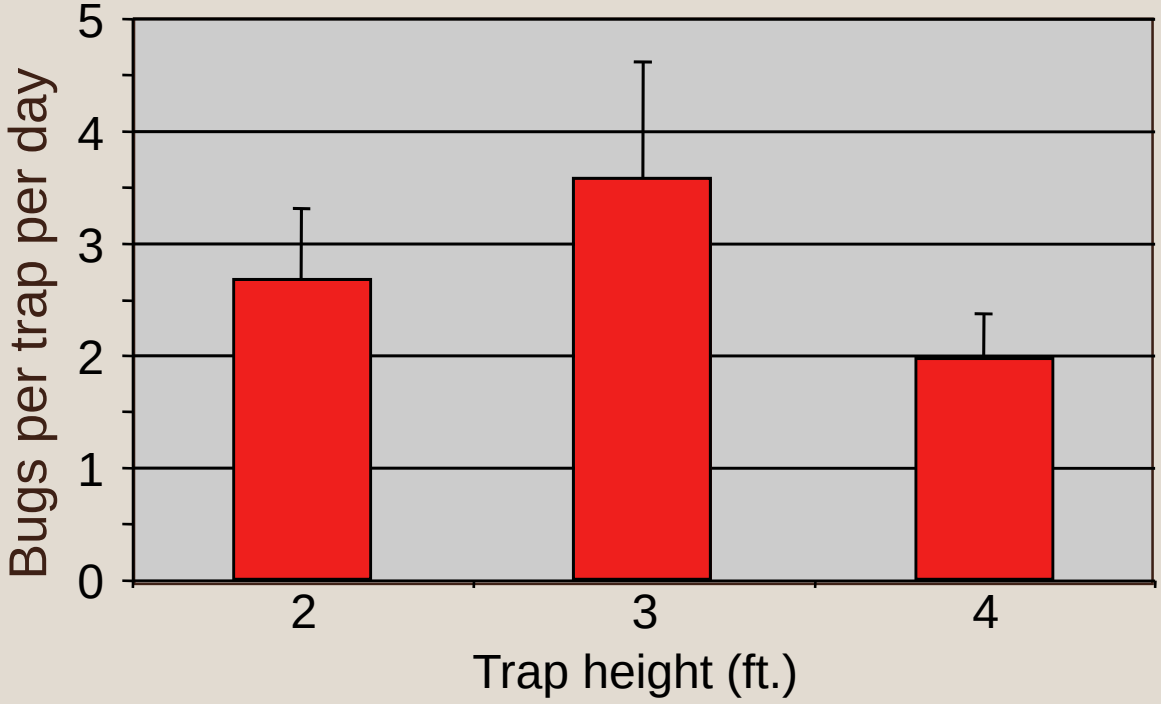
WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: MONITORING – TRAPS

Best trap for stink bugs is the pyramid type

2-4 bugs per day versus 2-4 bugs per week with other traps

No difference in bug capture based on height



Washington State University
World Class. Face to Face.

STINK BUGS: MONITORING – TRAPS

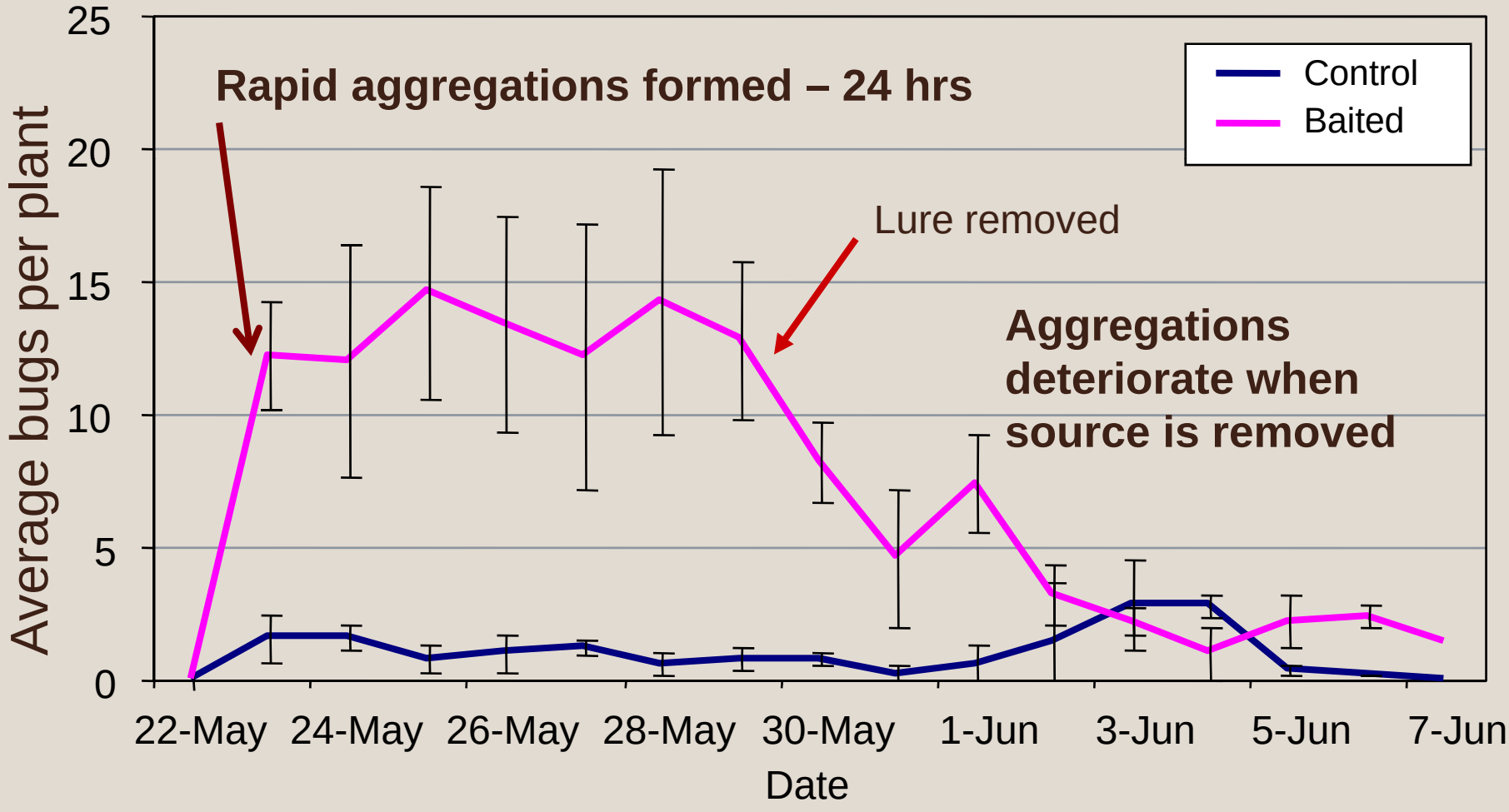
Best trap for stink bugs is the pyramid type

No difference in capture based on height

Commercial traps are not rigid enough for many situations

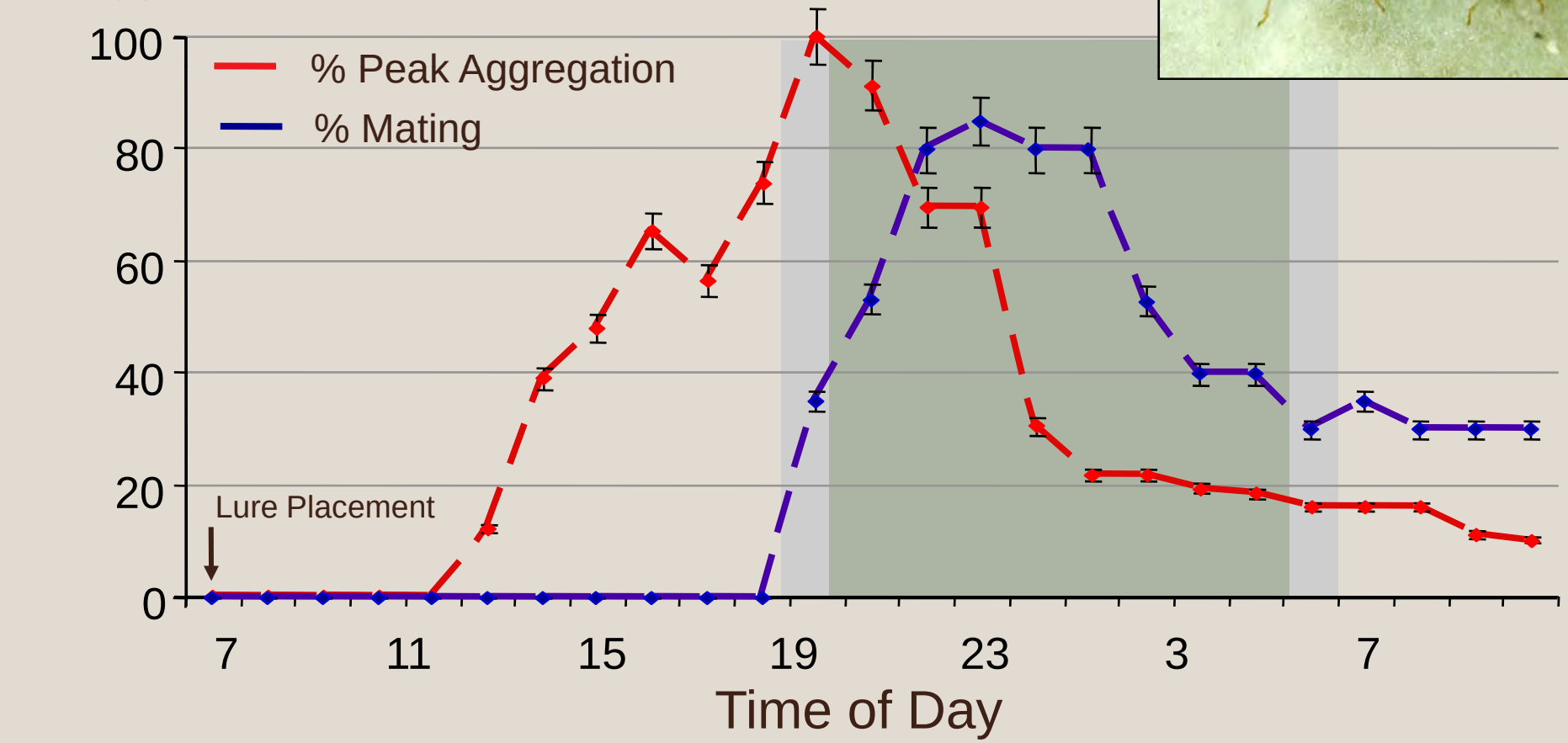
WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: PHEROMONES



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

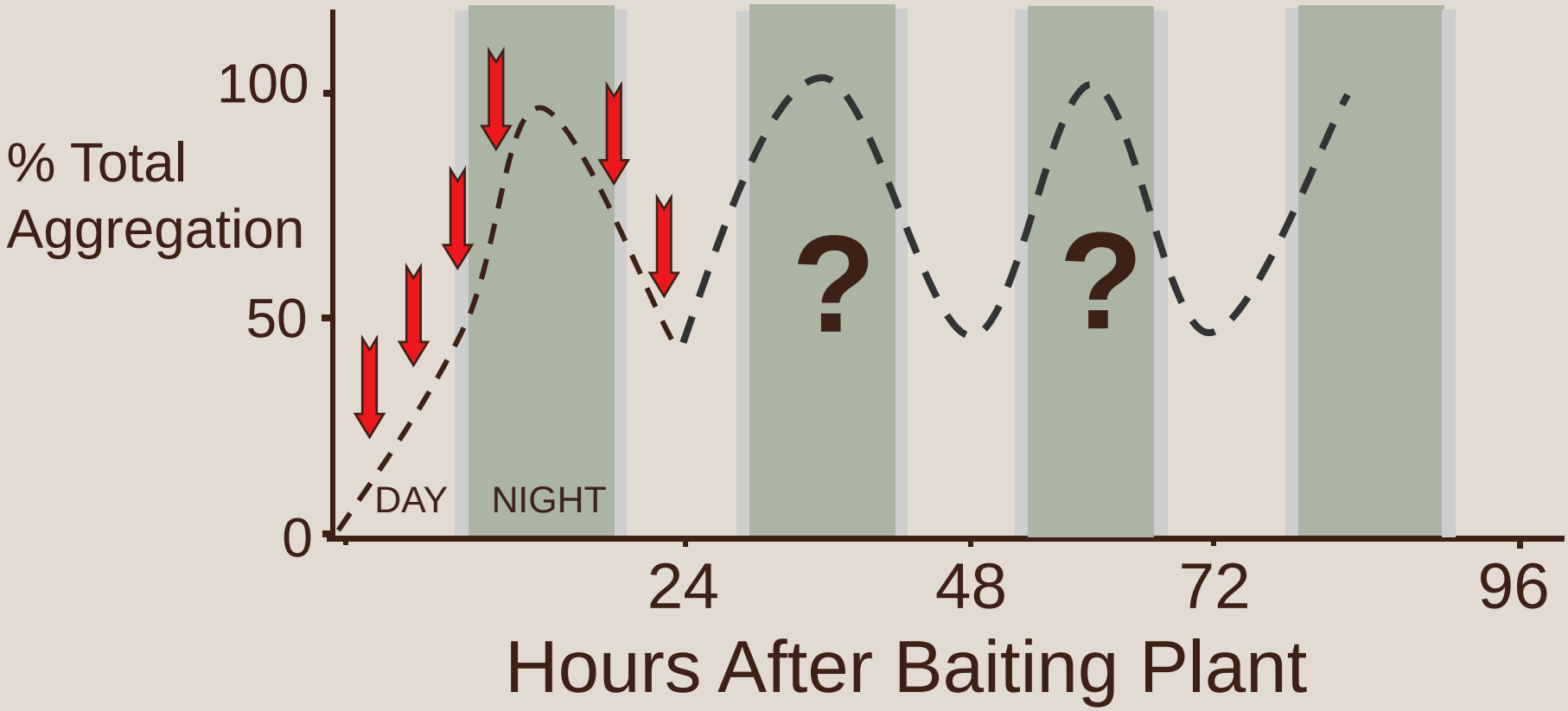
STINK BUGS: AGGREGATION AND MATING BEHAVIOR



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

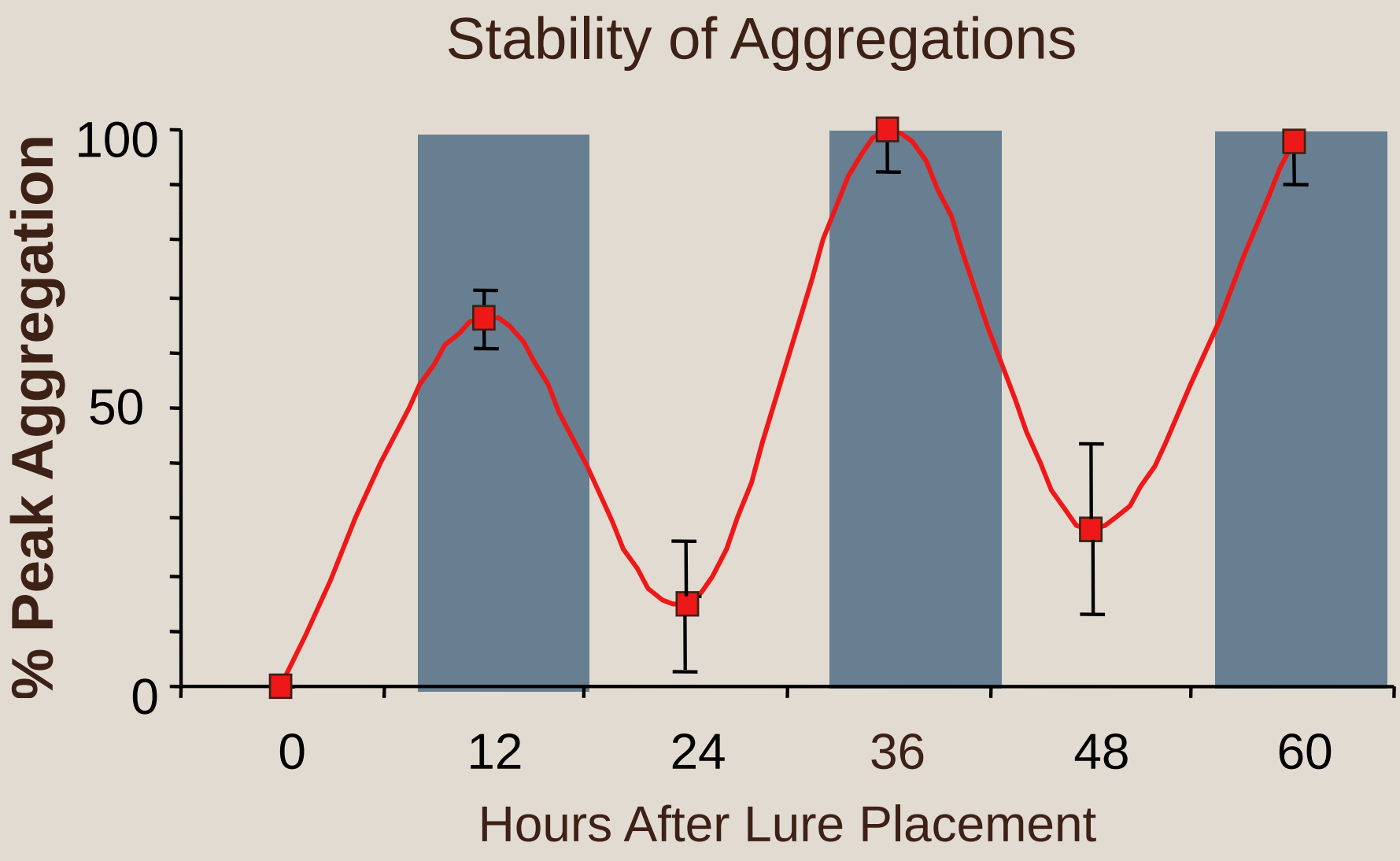
STINK BUGS: BEHAVIOR – AGGREGATIONS

Previous counts of aggregations made during daylight hours only…



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: BEHAVIOR – AGGREGATIONS



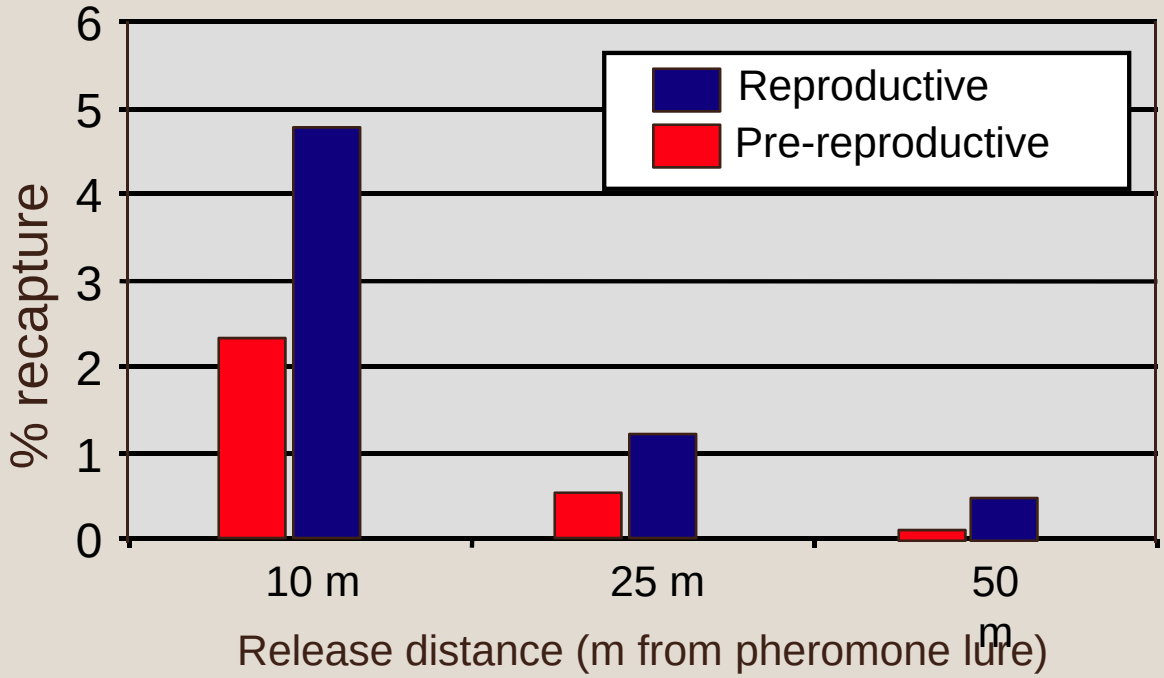
WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: BEHAVIOR & PHEORMONES

Methods:

mark/recapture of adult bugs in both spring and summer generations

bugs released at 10, 25, 50 m from baited plants with 300 bugs per distance x 4 reps



daily survey and ***removal*** of bugs on baited plant

Shows that bugs do not move great distances to find an aggregation pheromone source – a close range cue.

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

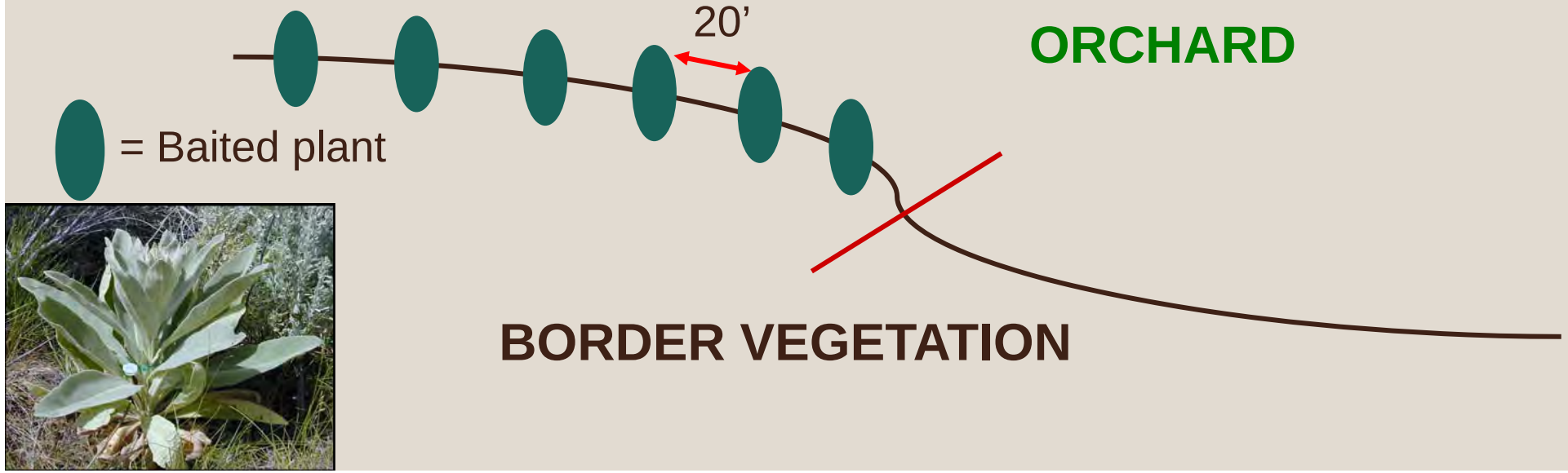
STINK BUGS: PHEROMONES AND CONTROL

Attract-and-kill:

Lures placed on mullein plants at 20’ intervals along orchard borders

Alternate baited/sprayed (Carzol with handgun) blocks with unbaited/unsprayed blocks (400’ sections)

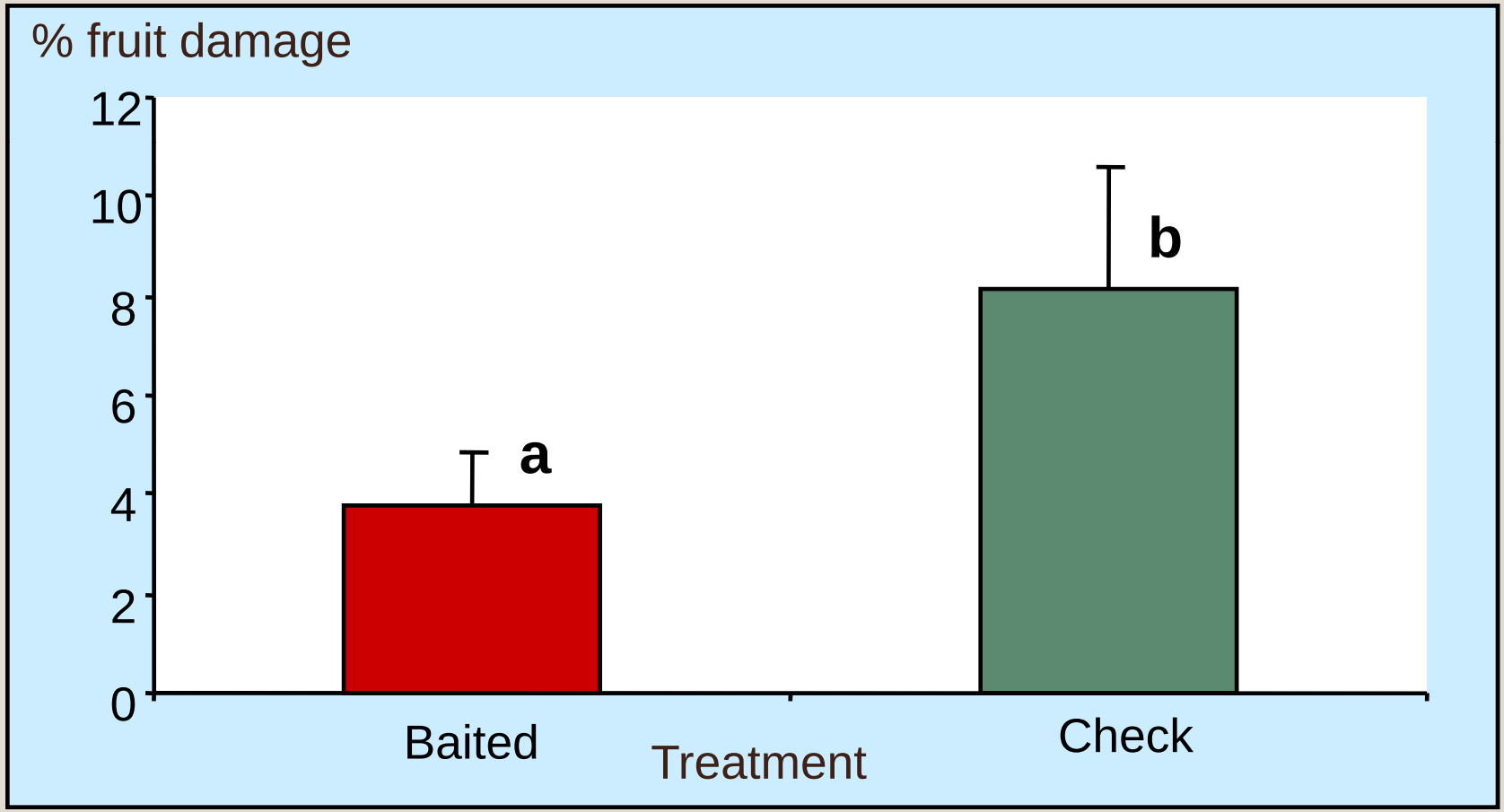
Four orchards were treated then sampled at harvest for injury



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: PHEROMONES AND CONTROL – RESULTS

Harvest Damage: 50% reduction in fruit injury



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: Insecticide efficacy – *E. conspersus*

Topical application to adult bugs

		Corrected percent mortality			
Insecticide	Rate/100 gal	24h	48h	72h	120h
Assail 70WP	1 oz	4	4	4	46
Avaunt 30WDG	1.5 oz	0	0	0	0
Carzol 92SP	6 oz	12	35	64	74
Danitol 2.4EC	4.8 fl.oz	98	98	98	98
Thiodan 50WP	1 lb.	12	42	59	91
Warrior T 1SC	1 oz	64	96	96	96

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: Insecticide efficacy – *E. conspersus*

Topical application to adult bugs

		Corrected percent mortality			
insecticide	Rate/100 gal	24h	48h	72h	120h
Assail 70WP	1 oz	4	4	4	46
Avaunt 30WDG	1.5 oz	0	0	0	0
Carzol 92SP	6 oz	12	35	64	74
Danitol 2.4EC	4.8 fl.oz	98	98	98	98
Thiodan 50WP	1 lb.	12	42	59	91
Warrior T 1SC	1 oz	64	96	96	96

Mortality from exposure to bugs on leaves

		Corrected percent mortality			
insecticide	Rate/100 gal	24h	48h	72h	120h
Carzol 92SP	6 oz	12	13	16	16
Danitol 2.4EC	4.8 fl.oz	76	84	89	92
Thiodan 50WP	1 lb.	84	84	100	100
Warrior T 1SC	1 oz	16	21	21	23

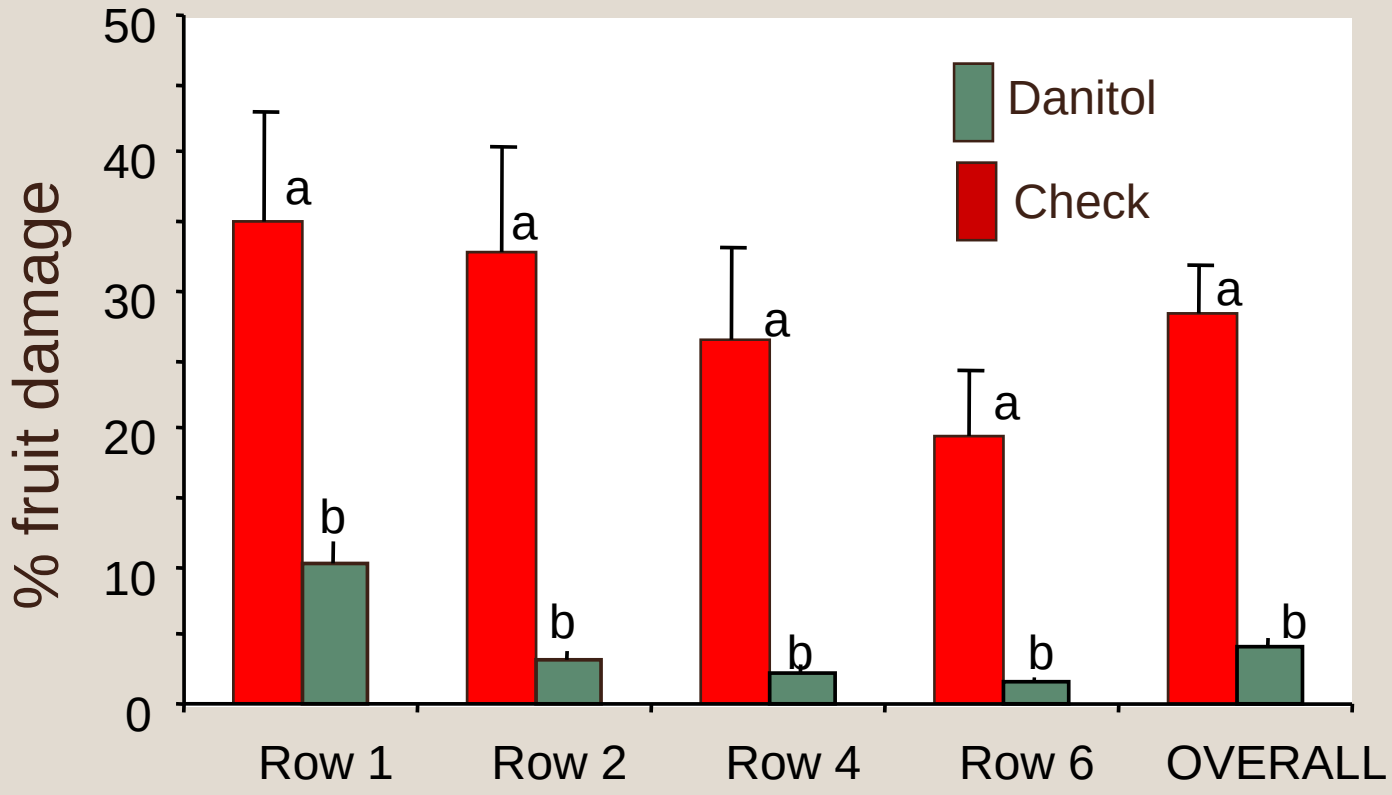
WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: CHEMICAL CONTROL

Two applications of Danitol at label rates to orchard rows 1-6

Paired with untreated check in same orchard

Fruit damage assessed at harvest

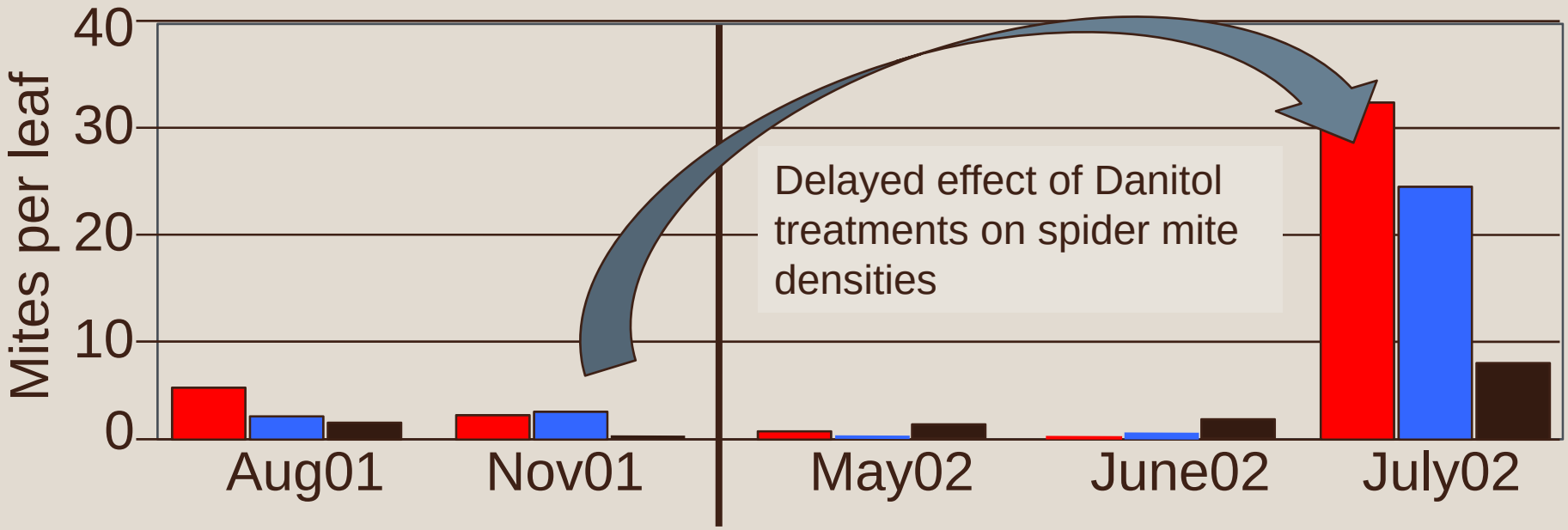


WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: NEGATIVE IMPACTS OF PYRETHROID USE

Danitol treatments applied in July 2001 for stink bug control

Mite samples taken in Aug, Nov 2001 and May, June and July 2002.



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: *C. LIGATA* ON CHERRY IN 2008

In 2008 a serious problem was identified in late cherries at high elevations near Chelan.

High levels of direct fruit injury was reported.

All of the stink bugs found in bins were *C. ligata*, not *E. conspersus* that had been typical of this area previously.

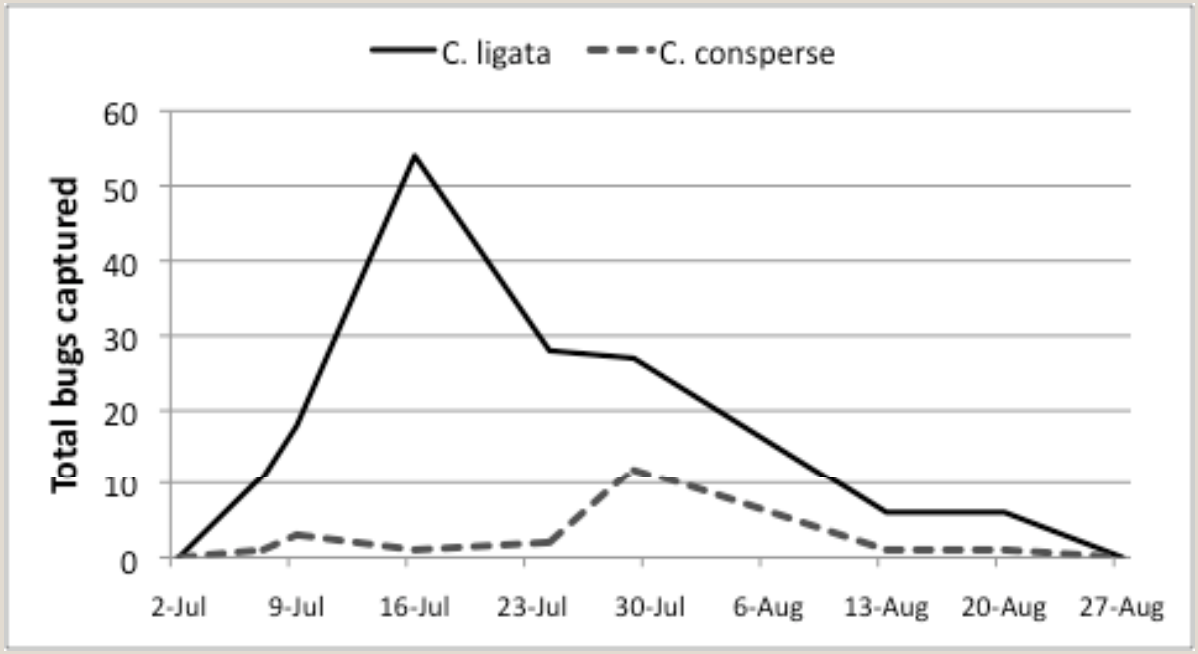
WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: C. LIGATA PHEROMONE RESULTS

Collaboration with Dr. Jocelyn Millar, UC Riverside, *C. ligata* pheromone was provided for monitoring in 2009.

Captured *C. ligata* in traps baited with its pheromone.

Low levels of *E. conspersus* were captured in *C. ligata* baited pheromone traps.



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

STINK BUGS: NEW PEST?

Brown Marmorated Stink Bug

- Native to Asia
- Recent finds in OR
  - Is a nuisance pest, especially in Portland area
  - Congregates on houses like boxelder bug
  - No reports of fruit damage in OR
- Reasons for Concern
  - Pennsylvania reports worst pest ever on peach
  - Virginia and West Virginia increasing problem
  - Potential pest of all tree fruit

Washington State University
World Class. Face to Face.

STINK BUGS: WHO IS WINNING?

We know a lot about stink bug biology and behavior

Stink bugs represent a real challenge to soft IPM programs

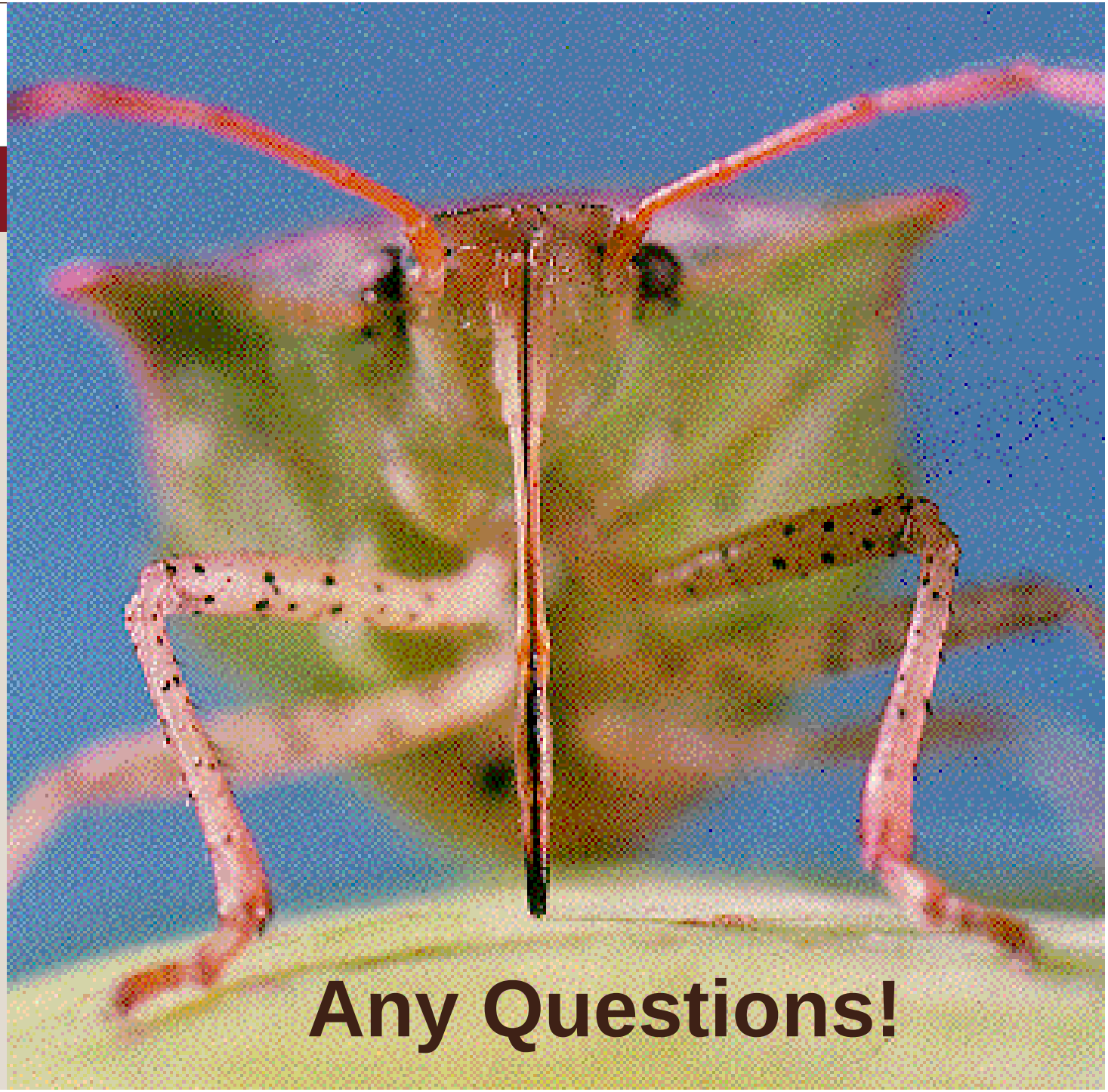
Monitoring stink bugs needs more research

No proven soft options for control of stink bugs at this time.

Proposed research can provide some new answers

WASHINGTON STATE UNIVERSITY

World Class. Face to Face.



WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Guthion (Azinphos-methyl) Phase-out Schedule

2007	limit of 4 lb ai/a
2008-2009	limit of 3 lb ai/a
2010	limit of 2 lb ai/a
2011-2012	limit of 1.5 lb ai/a

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Pest Management Transition Project (http://pmtp.wsu.edu/)

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Codling Moth Management with New Insecticides

- Lots of "good" products, but none "Excellent"
- Can get excellent CM control –
- Must use with mating disruption and multi-tactic approach

Keys are

- Good Timing & Good Coverage!

Product	Efficacy	Residual
Assail (L)	Good	14-17d
Calypso (L)	Good	14-17d
Delegate (L)	Very Good	14d
Intrepid (O/L)	Fair	14d
Altacor (O/L)	Very Good	14-17d
Rimon (O)	Good	14d
Esteem (O)	Good	10-14d
Virus (L)	Fair	7-10d
Oil (O)	Fair	Topical Only
Belt (L)	Fair	14d

Washington State University
World Class. Face to Face.

Leafroller Management with New Insecticides

- Lots of good products
- Know what to expect when using
- Fast? or Slow?
- CM eggs?

Product	Efficacy	Speed
Proclaim	Excellent	Very Fast
Success	Excellent*	Fast
Delegate	Excellent	Fast
Intrepid	Good*	Moderate
Altacor	Excellent	Moderate
Belt	Excellent	Moderate
Rimon	Good	Slow
Esteem	Good	Slow / Del'd
Bt	Good	Slow

* Some populations of leafroller are resistant to this product.

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

New codling moth model (no biofix) add 175 dd to totals used in the past

Targets & Treatments

SJS, LR Mite eggs	LR (larva) LR&CM (egg)	CM (egg)	CM (larva)	CM (larva)	CM (larva)
Delayed dormant	Petal fall 225-275 DD	375 DD	1st cover 425 DD	Delayed 1st cover 525 DD	2nd cover 625-675 DD
Oil Lorsban	Proclaim Success Delegate Belt Bt OR Altacor Intrepid Rimon Esteem		Delegate (Entrust) Altacor Assail Calypso Intrepid virus		Delegate (Entrust) Altacor Assail Calypso Intrepid virus Will likely need a 3rd cover

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

New codling moth model (no biofix) add 175 dd to totals used in the past

Targets & Treatments

SJS, LR Mite eggs	LR (larva) LR&CM (egg)	CM (egg)	CM (larva)	CM (larva)	CM (larva)
Delayed dormant	Petal fall 225-275 DD	375 DD	1st cover 425 DD	Delayed 1st cover 525 DD	2nd cover 625-675 DD
Oil Lorsban	Proclaim Success Delegate Belt Bt OR Altacor Intrepid Rimon Esteem			Delegate (Entrust) Altacor Assail Calypso Intrepid virus	Delegate (Entrust) Altacor Assail Calypso Intrepid virus Will likely NOT need a 3rd cover

Insecticide	Chemical name	Group No.	Codling Moth		leafroller
			ovicidal	larvicidal	larvicidal
Intrepid	methoxyfenozide	18A	X	X	X
Esteem	pyriproxyfen	7C	X		X
Rimon	novaluron	15	X		X
Altacor	rynaxypyr	28	X	X	X
Belt	flubendiamide	28			X
Assail	acetamiprid	4	X	X	
Calypso	thiacloprid	4	X	X	
Success	spinosad	5		X	X
Delegate	spinetoram	5		X	X
Proclaim	emamectin benzoate	6		X	X
HMO	oil	---	X		
CM virus	virus	---		X	
Bt	Bacillus thuringiensis	11A			X

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Principles of a sound apple IPM program

Core of an apple IPM program is use of ***mating disruption*** for management of codling moth

- Reduces number of supplemental insecticides
- Reduces long term costs
- Provides for more stable IPM system

Utilize ovicidal activity of new products when controlling LR

Take advantage of delayed first cover to stretch residues, if needed

New information in being developed on the risk of new insecticides to natural enemies – use as part of an IPM program to conserve biological control agents

Avoid overuse of new insecticides to delay resistance

WASHINGTON STATE UNIVERSITY
World Class. Face to Face.

Principles of a sound apple IPM program

Resistance Management Principles

- Do not use (or expose) the same class of insecticide against consecutive generations of a pest.
- Class 28 product concerns
  - **Altacor** (chlorantraniliprole)
  - **Belt** (flubendiamide)
  - **Volium Xpress** (chlorantraniliprole + lambda-cyhalothrin)
  - **Volium Flexi** (chlorantraniliprole + thimethoxam)
- **All contain a class 28 insecticide so care must be taken to recognize the risk of overusing these products**