

Rice Protection from Invertebrate Pests

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Integrated Pest Management of Rice

Invertebrate Pests

Cultural Controls

- Well-adapted varieties
- Weed management on levees
- Planting dates
- Winter flooding

Biological Control

- Parasitoids for armyworms, rice leafminer
- Predators that feed on mosquito larvae

Regulatory Controls

- Actions by state and federal agencies to keep pests out of California

Host Plant Resistance

- Not well-developed but some help

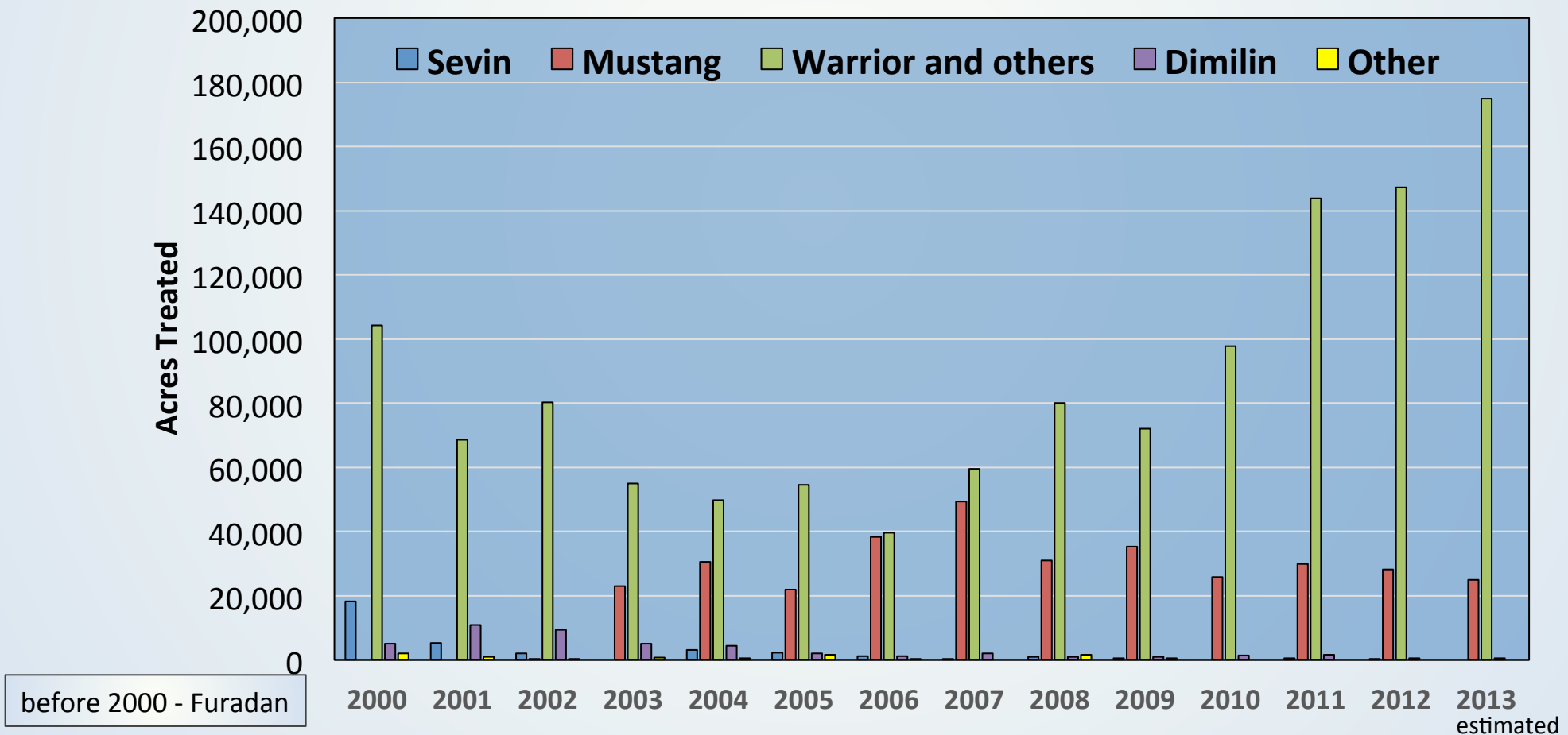
Pheromones

- None

Integrated Pest Management of Rice

Invertebrate Pests

Insecticides



Integrated Pest Management of Rice

Invertebrate Pests

at seeding to 3-
leaf stage – rice
leafminer, rice
water weevil

July to August -
armyworms

at seeding –
seed midge,
tadpole shrimp,
crayfish

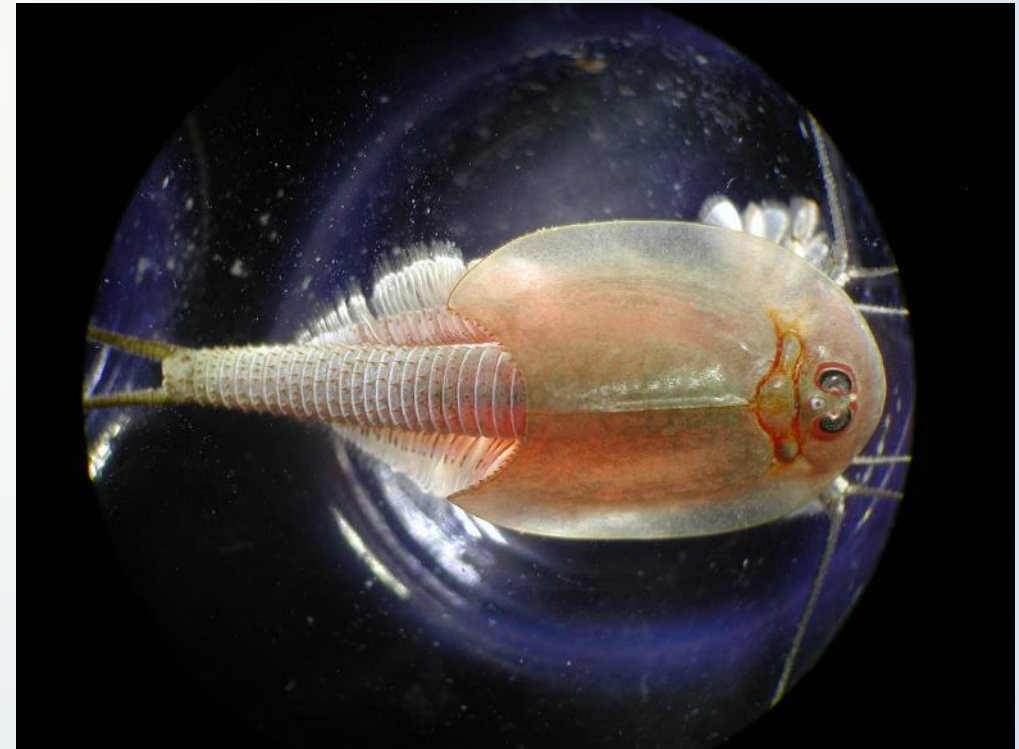


Panicle emergence
to grain fill – stink
bugs

Integrated Pest Management of Rice

Invertebrate Pests

at seeding – seed midge, **tadpole shrimp**, crayfish

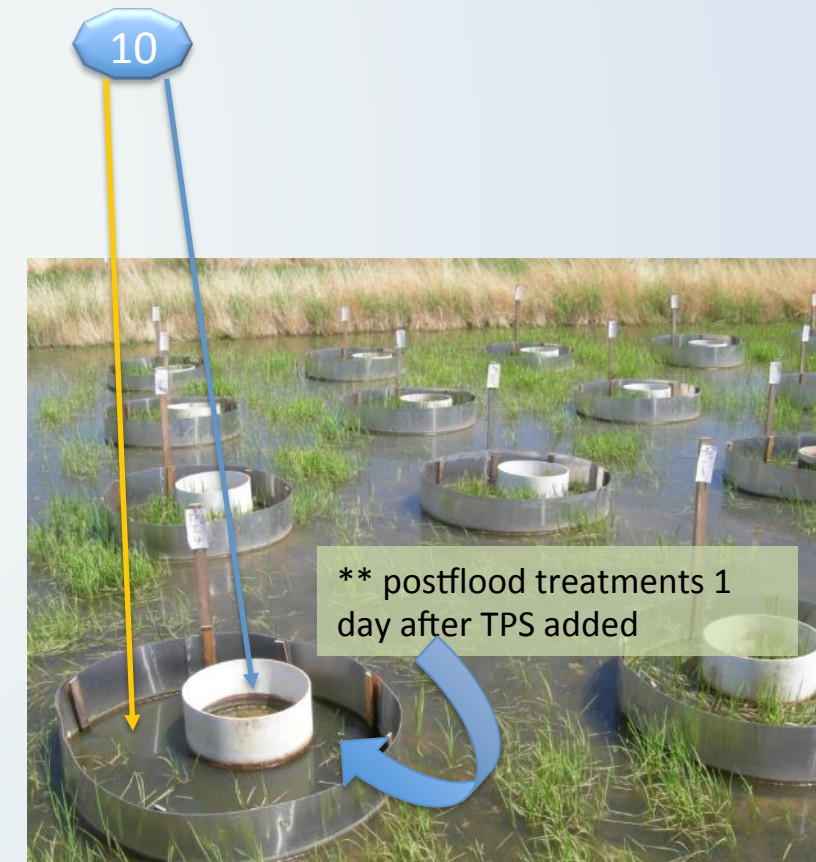


Integrated Pest Management of Rice

Invertebrate Pests

Product	Rate (lbs. AI/A)	Product per A (fl. oz.)	Timing
1. Untreated-no TPS	---	---	---
2. Belay 2.13 SC		4.5	Preflood
3. Coragen	0.1	2.46	Preflood
4. Belay 2.13 SC		4.5	early post-flood**
5. Coragen	0.1	2.46	early post-flood**
6. Dimilin 2L		8.0	early post-flood**
7. Untreated with TPS	---	---	---
8. Warrior II	0.04	2.56	early post-flood**
9. Warrior II	0.04	2.56	Preflood
10. Warrior II	0.04	2.56	Preflood and early post-flood**
11. A17469; A17960			seed treatment – at planting
12. Copper Sulfate	10 lbs./A		early post-flood**

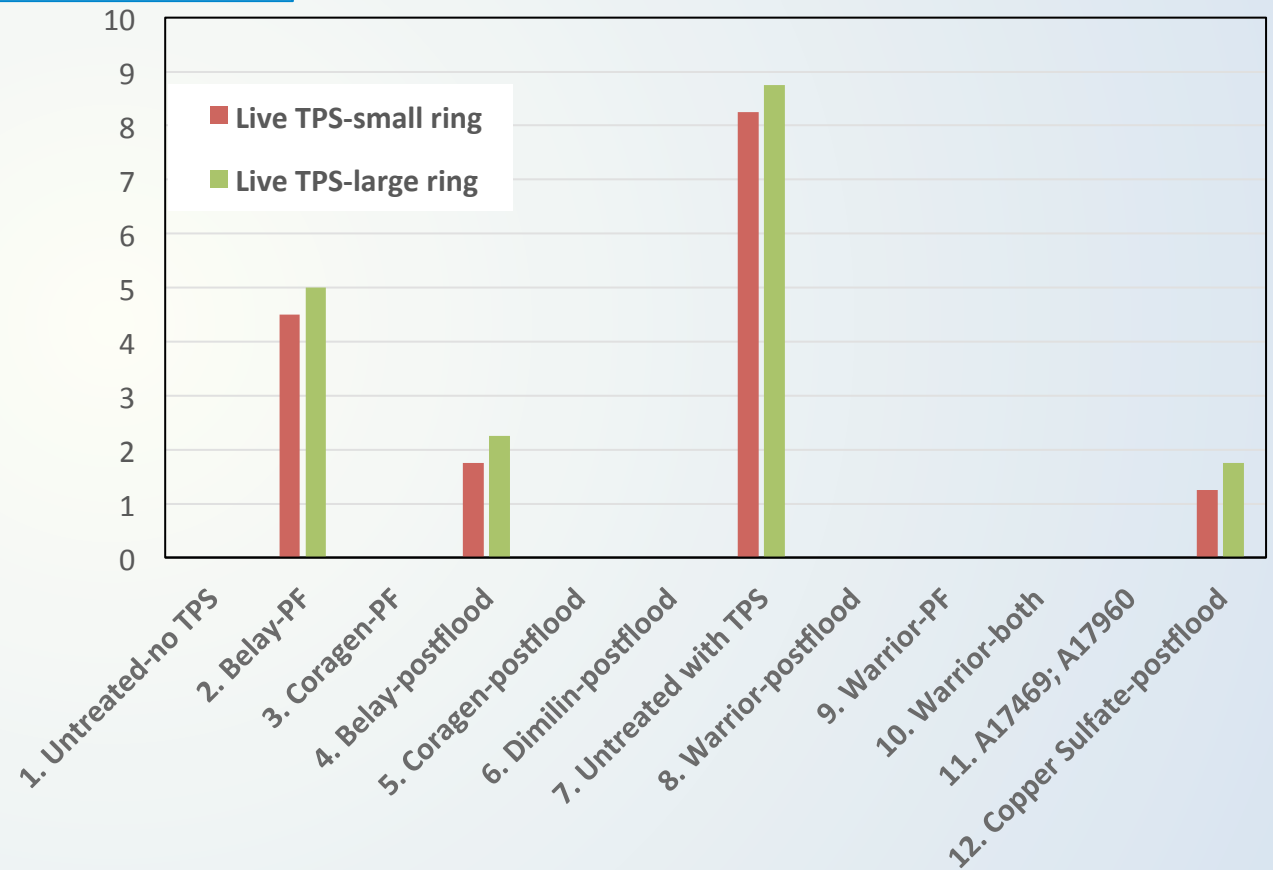
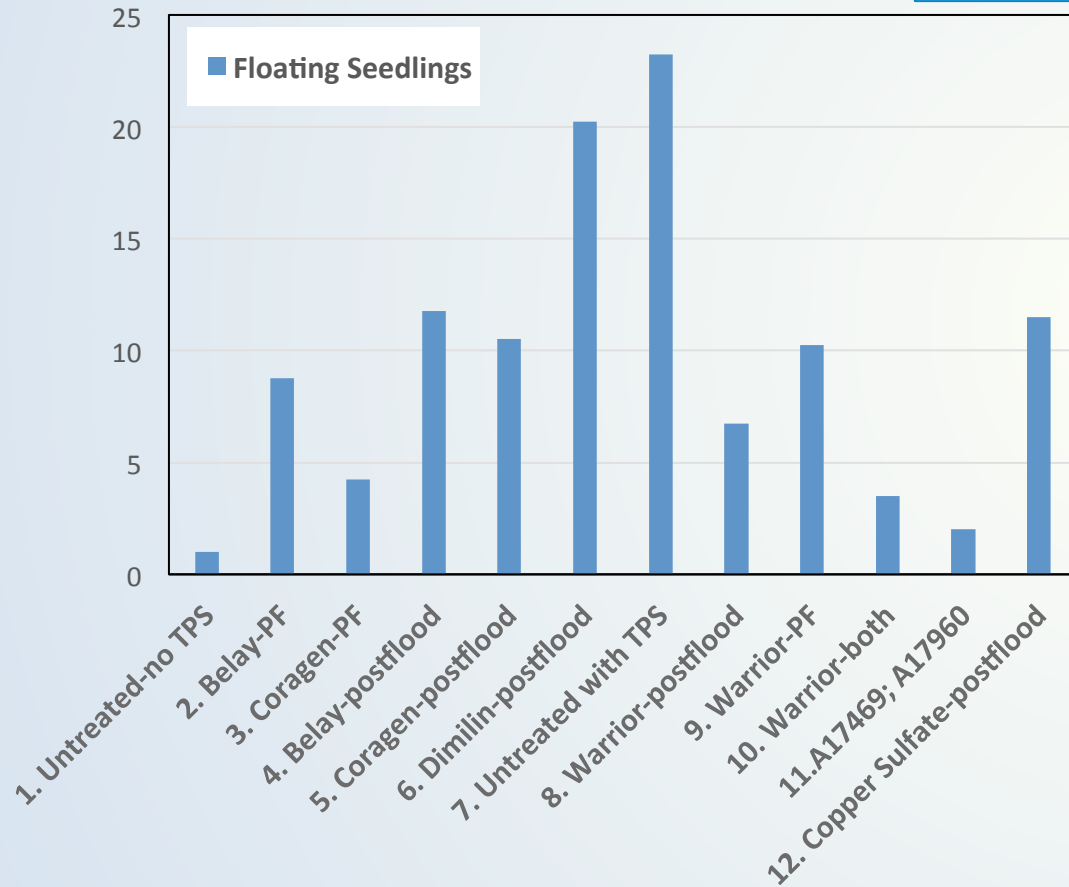
Tadpole Shrimp



Integrated Pest Management of Rice

Invertebrate Pests

Tadpole Shrimp



Integrated Pest Management of Rice

Invertebrate Pests

at seeding to 3-leaf stage – rice water weevil



Integrated Pest Management of Rice

Invertebrate Pests

at seeding to 3-leaf stage – rice water weevil



RWW management – “insecticides”

- ring study
- small plot study
- greenhouse biological insecticide study
- silicon augmentation
- impact of treatments on mosquito management



RWW management – winter flooding

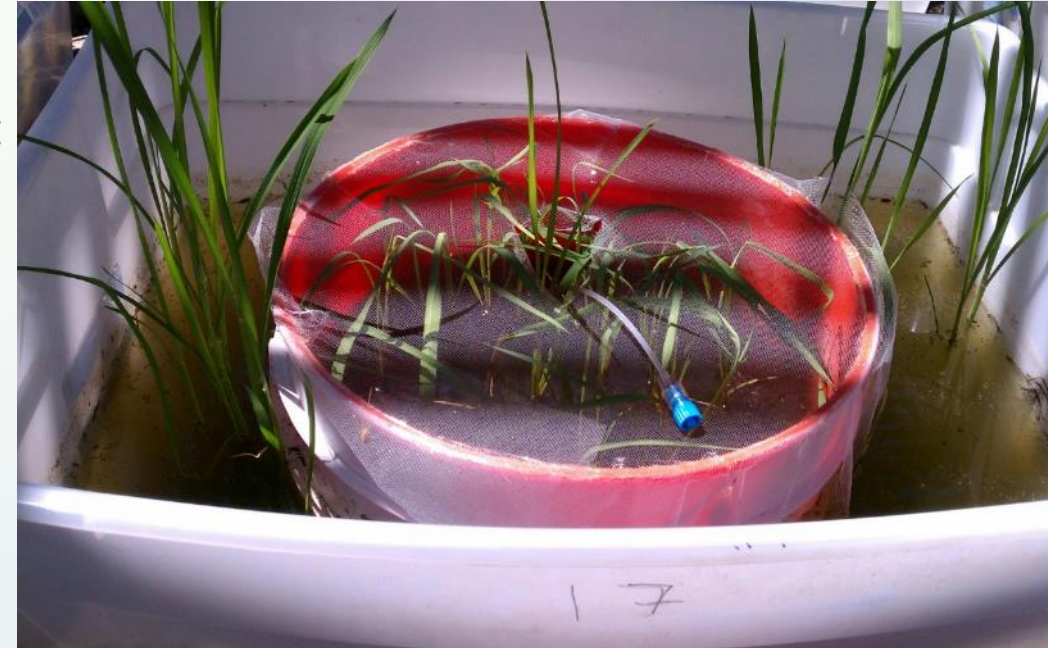


Rice variety response to RWW

- multiple variety comparison
- detailed M-202 and M-206 study



RWW genetics



Integrated Pest Management of Rice Invertebrate Pests

at seeding to 3-leaf stage – rice water weevil

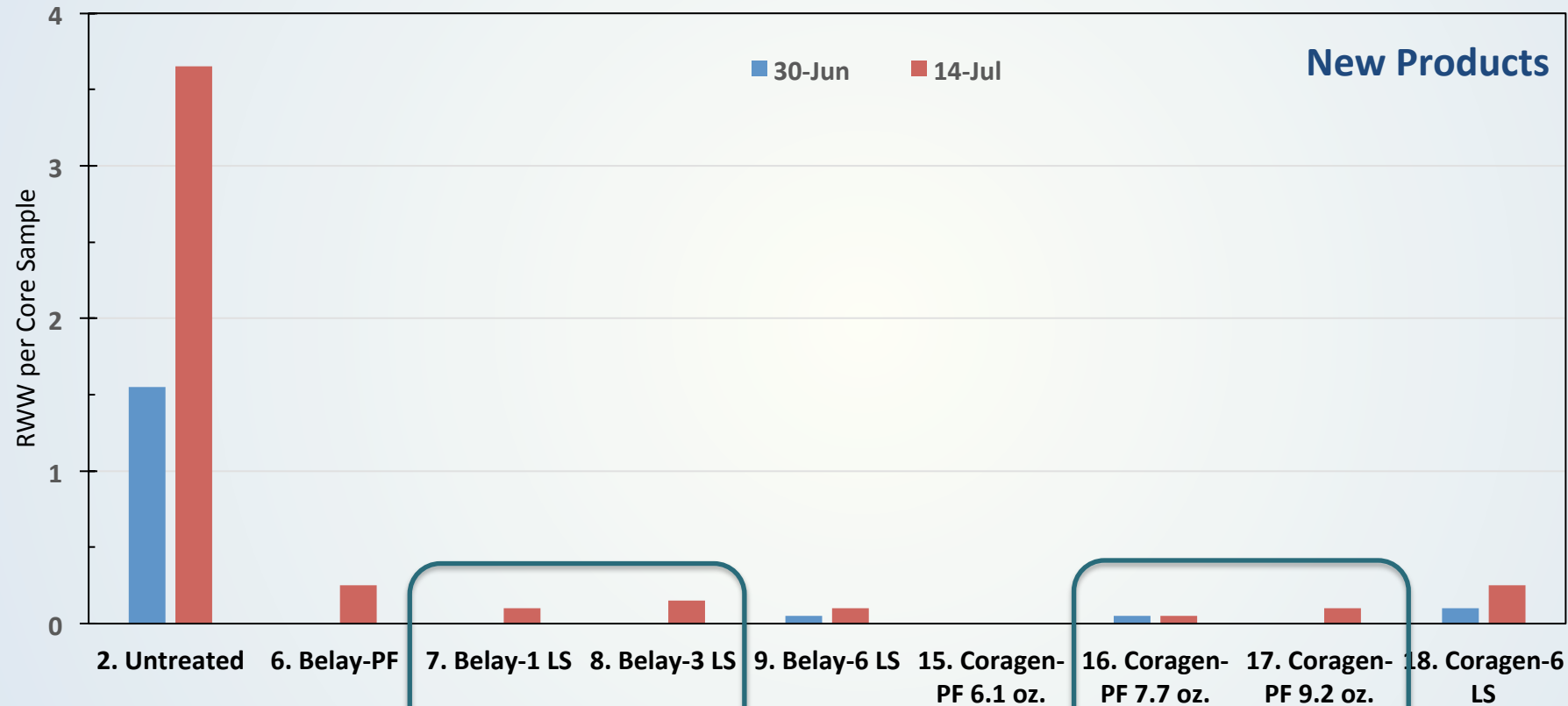


Product	Rate (lbs. AI/A)	Product per A (fl. oz.)	Timing
1. Dimilin 2L	0.125	8	2-3 leaf
2. Untreated	---	---	---
3. Warrior II	0.04	2.56	PF
4. Warrior II	0.04	2.56	1-2 leaf
5. Warrior II	0.04	2.56	2-3 leaf
6. Belay 2.13 SC		4.5	PF
7. Belay 2.13 SC		4.5	1-2 leaf
8. Belay 2.13 SC		4.5	2-3 leaf
9. Belay 2.13 SC		5.5	5-6 leaf
10. Mustang	0.05	4.3	2-3 leaf
11. Mustang	0.05	4.3	PF
12. <i>Bacillus thuringiensis</i> spp <i>galleriae</i>		4 lbs.	PF
13. <i>Bacillus thuringiensis</i> spp <i>galleriae</i>		4 lbs.	1-2 leaf
14. Declare	0.02	2.05	2-3 leaf
15. Coragen	0.08	6.1	PF
16. Coragen	0.1	7.7	PF
17. Coragen	0.12	9.2	PF
18. Coragen	0.12	9.2	5-6 leaf
19. A9382; A9459; A12050			seed treatment
20. A17469			seed treatment
21. A17469; A17960			seed treatment
22. A17469			seed treatment
23. A17960			seed treatment
24. A17469; A17960			seed treatment
25. A9382; A9459; A12050; STP15201			seed treatment
26. A9382; A9459; A12050; STP22245			seed treatment

Integrated Pest Management of Rice Invertebrate Pests

at seeding to 3-leaf stage – rice water weevil

RWW management – “insecticides”

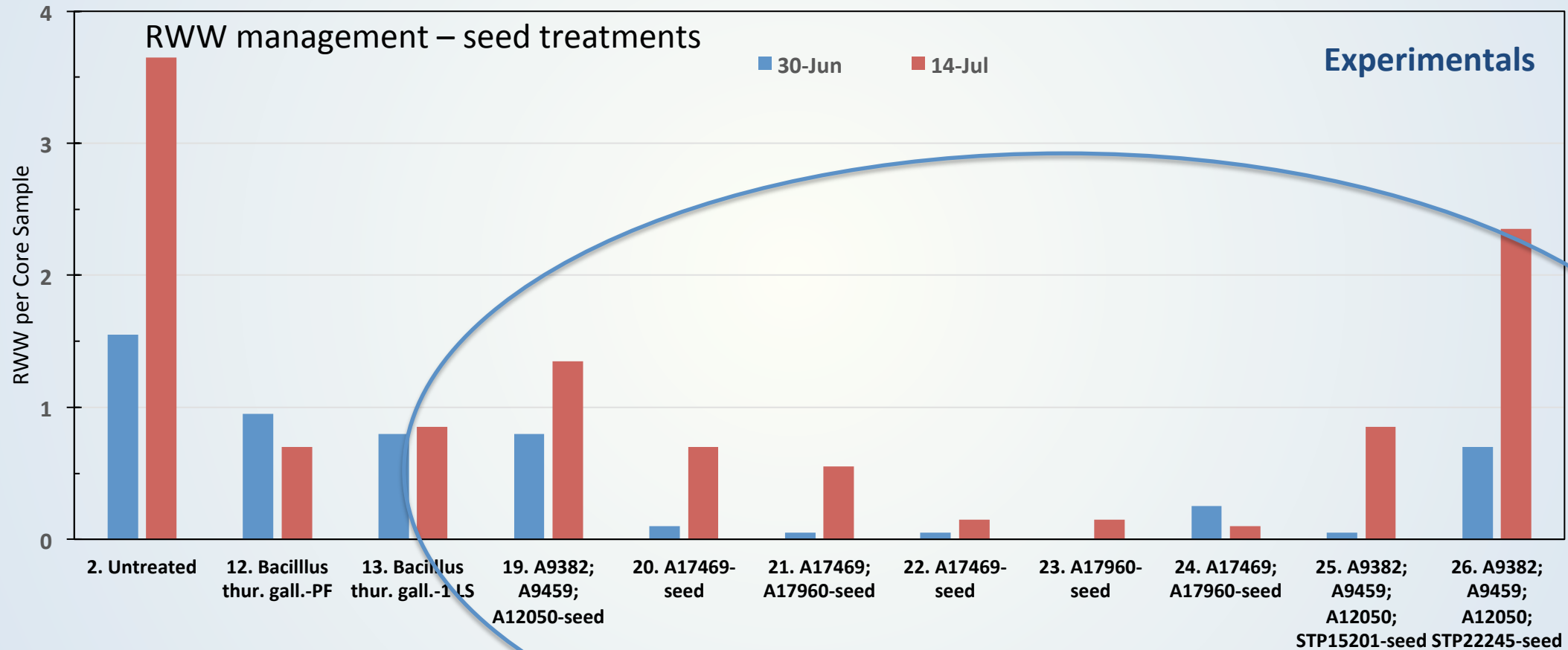


Registered – post-flood timing

Registered (2016?) – pre flood timing

Integrated Pest Management of Rice Invertebrate Pests

at seeding to 3-leaf stage – rice water weevil



Integrated Pest Management of Rice

Invertebrate Pests

at seeding to 3-leaf stage – rice water weevil



RWW management – “insecticides”

- Belay®
 - registered Fall 2013
 - optimal timing is post-flood - ~2 leaf stage
- Coragen®
 - pursuing Special Local Needs (24c) label
 - could potentially be approved in time for 2015 season rather than in 2016 as currently projected
 - registered in southern U.S. rice as a seed treatment
 - in CA would be used preflood

Integrated Pest Management of Rice Invertebrate Pests

at seeding to 3-leaf stage – rice water weevil



RWW management – “insecticides”

- greenhouse biological insecticide study
- *Bacillus thuringiensis* spp *galleriae*

“The Btg granular formulation (Phy-4-12) performed as well as the leading pyrethroid (lambda-cyhalothrin) in use in California in our greenhouse and field trials.”



Integrated Pest Management of Rice

Invertebrate Pests

**at seeding to 3-
leaf stage** – rice
water weevil

July to August -
armyworms

at seeding -
midge, tadpole
shrimp, crayfish



**Panicle emergence
to grain fill** – stink
bugs

Integrated Pest Management of Rice Invertebrate Pests

Stink Bugs - Why so many problems?

- most are difficult to kill with insecticides
- using more selective products
- not easily exposed to insecticides as they hide
- most wide host range
- more riparian habitats, weedy areas
- move indoors for winter
- crawl into tight spaces – perfect for “hitchhiking”
- global travel



- Rice Stink Bug – important pest of rice in southern U.S.
- not in California

Integrated Pest Management of Rice

Invertebrate Pests

Panicle emergence to grain fill – stink bugs

– reports from one rice production area in Sacramento Valley of some pecky rice

- low level but consistently seen
- we searched for insect-related cause
- found few Redshouldered stink bugs
- one report from Mississippi of this species feeding on rice
- also reported in a 1965 publication as injuring rice in 1939



Integrated Pest Management of Rice

Invertebrate Pests

Redshouldered stink bugs

- pest of tomatoes and other crops
- prefers grasses
- becoming more common and appearing longer in season
- did two studies in rice in 2013 and expanded these in 2014



Integrated Pest Management of Rice Invertebrate Pests

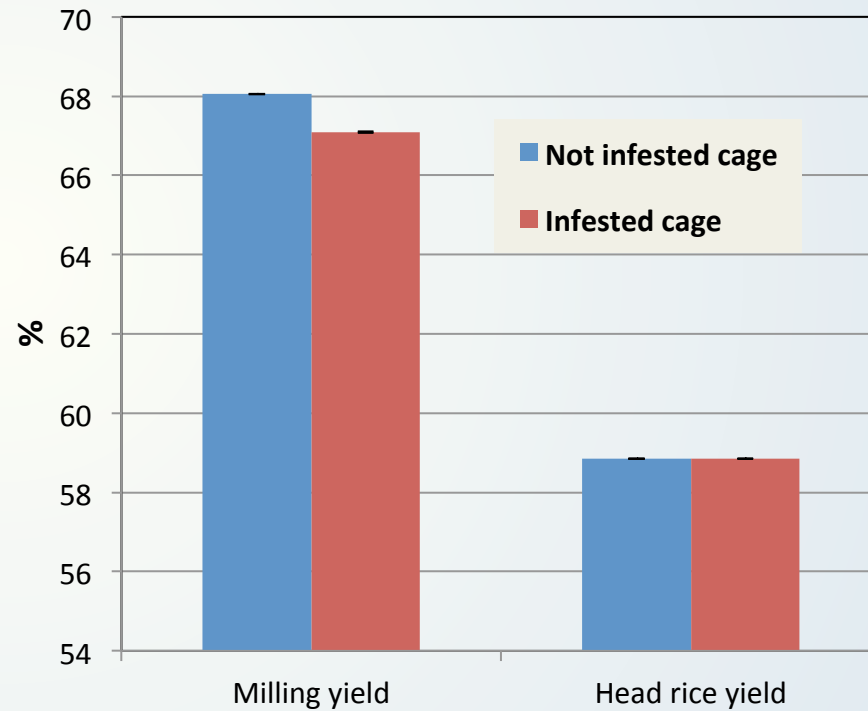
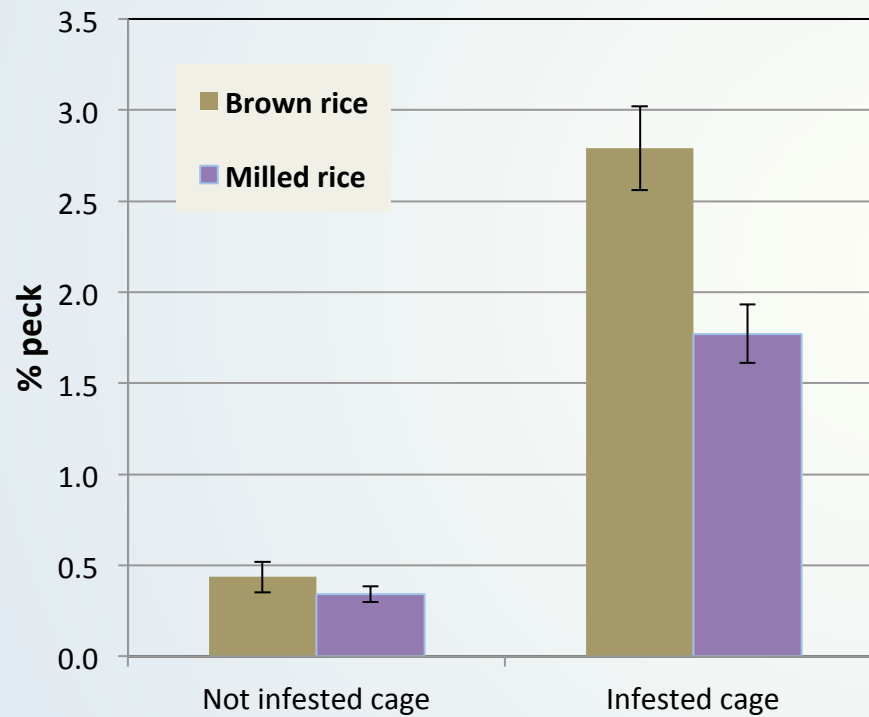
redshouldered stink bugs

- placed four redshouldered stink bugs in a cage over plants in milk stage and left until maturity; replaced weekly (Luis Espino)



Grain Quality

redshouldered stink bug cage study



Grain Quality

redshouldered stink bugs

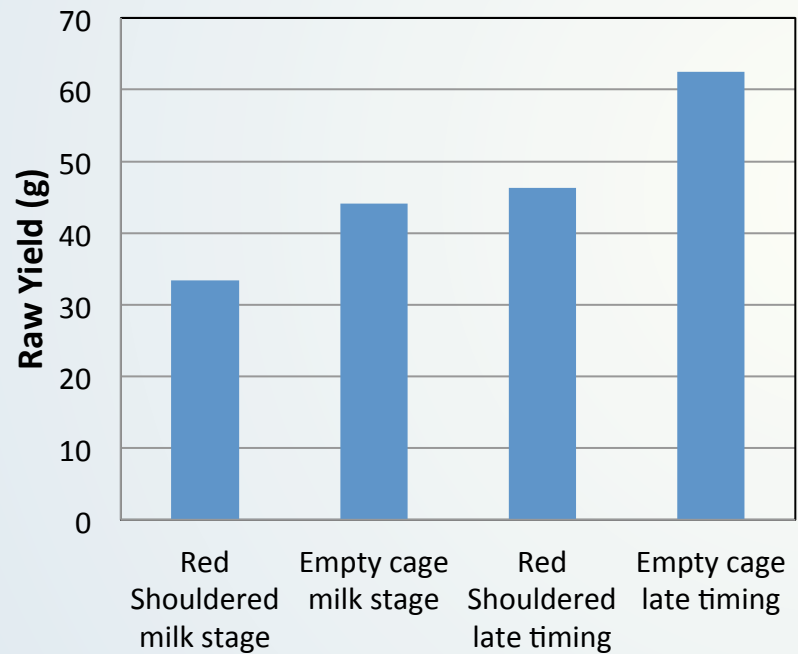
- second study
- placed two red-shouldered stink bugs in a cage over a panicle
 - a.) in milk stage and
 - b.) in dough stage
- left until maturity (Godfrey)



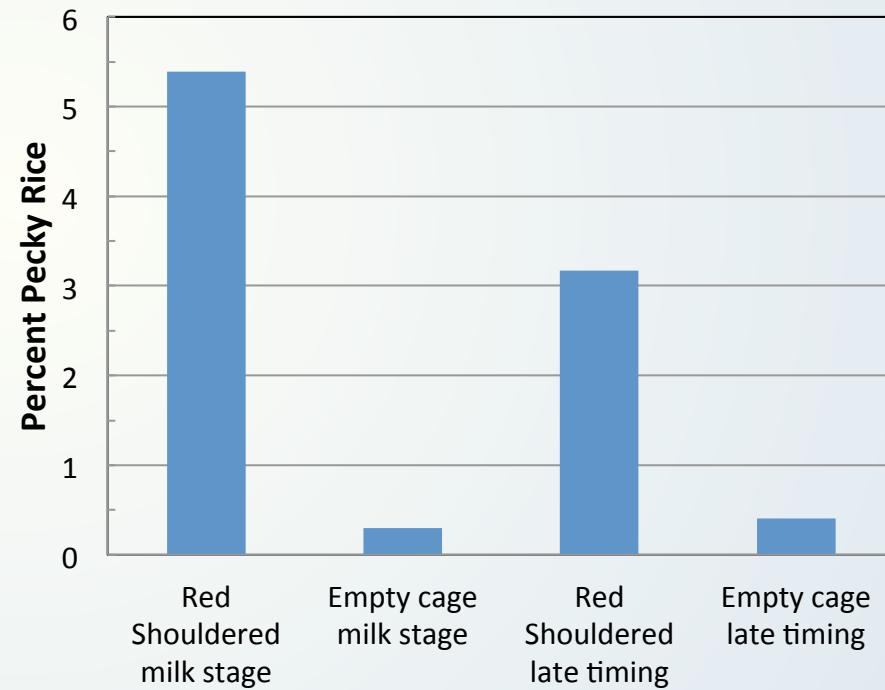
Grain Quality

redshouldered stink bug panicle study

Grain Yield from 15 Panicles



Percentage of Pecky Rice



Grain Quality

redshouldered stink bug panicle study - 2014



boot, milk, and dough stage infestations

Variety	% Grain Loss	% Pecky Rice
M-202	32-60	1.4 – 2.8
M-206	16-20	0.7 – 4.9
Calmochi-101	11-23	1.4 – 5.2
Calhikari-202	0-44	2.8 – 3.6
S-102	20-53	2.0 – 3.1
L-206	2-59	0 – 5.3

Grain Quality

redshouldered stink bug panicle study - 2014

- also looked at consperse stink bug and southern green stink bug - would they damage rice
- they did as well

Southern green stink bug

Consperse stink bug

redshouldered stink bug



Grain Quality

- Surveyed 49 rice fields in Sacramento Valley rice for stink bugs in Sept.
- Fields with higher stink bug numbers
 - weedy fields (grassy weeds)
 - fields near riparian habitat
 - fields in areas with more crop diversity (row crops)
- nightshade and wild tomatillos
- Johnson grass and sprangletop

	Fields	Positive
Butte	9	4
Colusa	10	4
Glenn	10	1
Sutter	10	3
Yolo	5	3
Yuba	5	0

Mostly red-shouldered stink bug

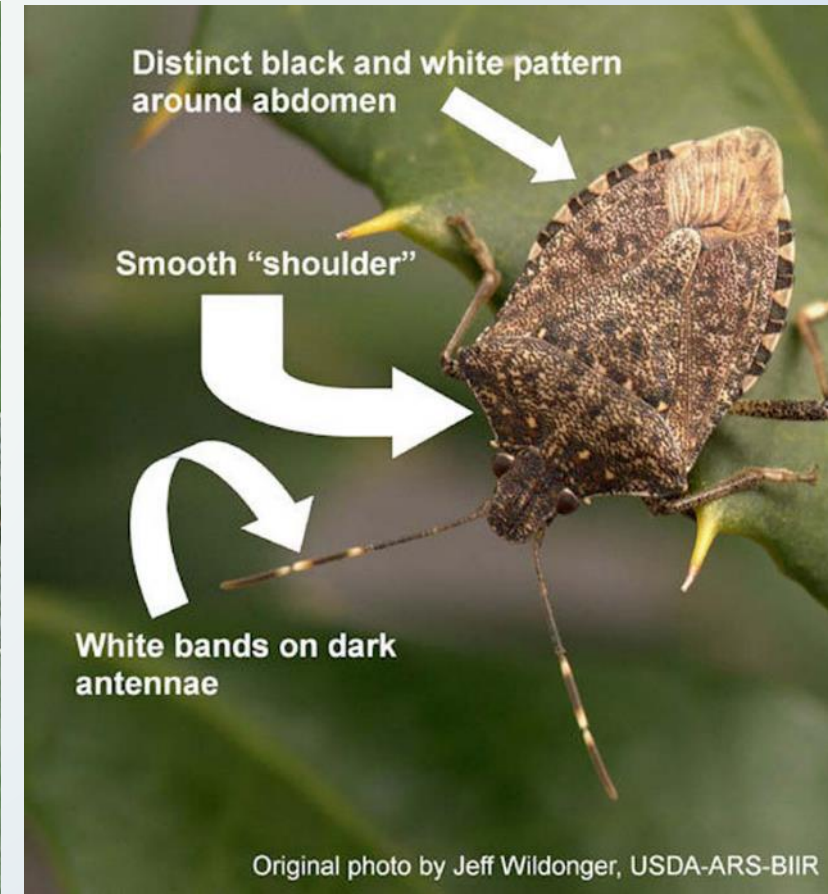
Grain Quality

redshouldered stink bugs



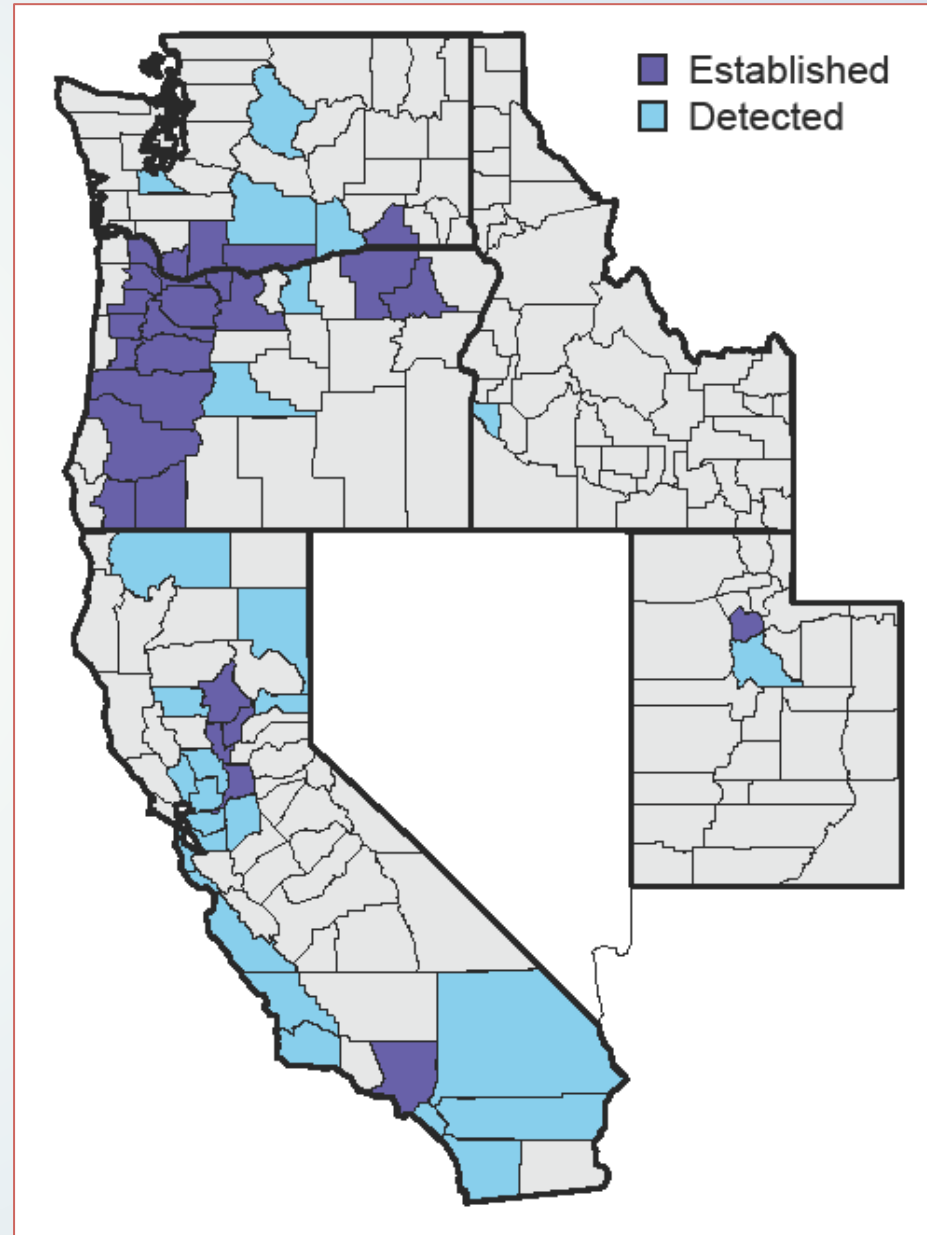
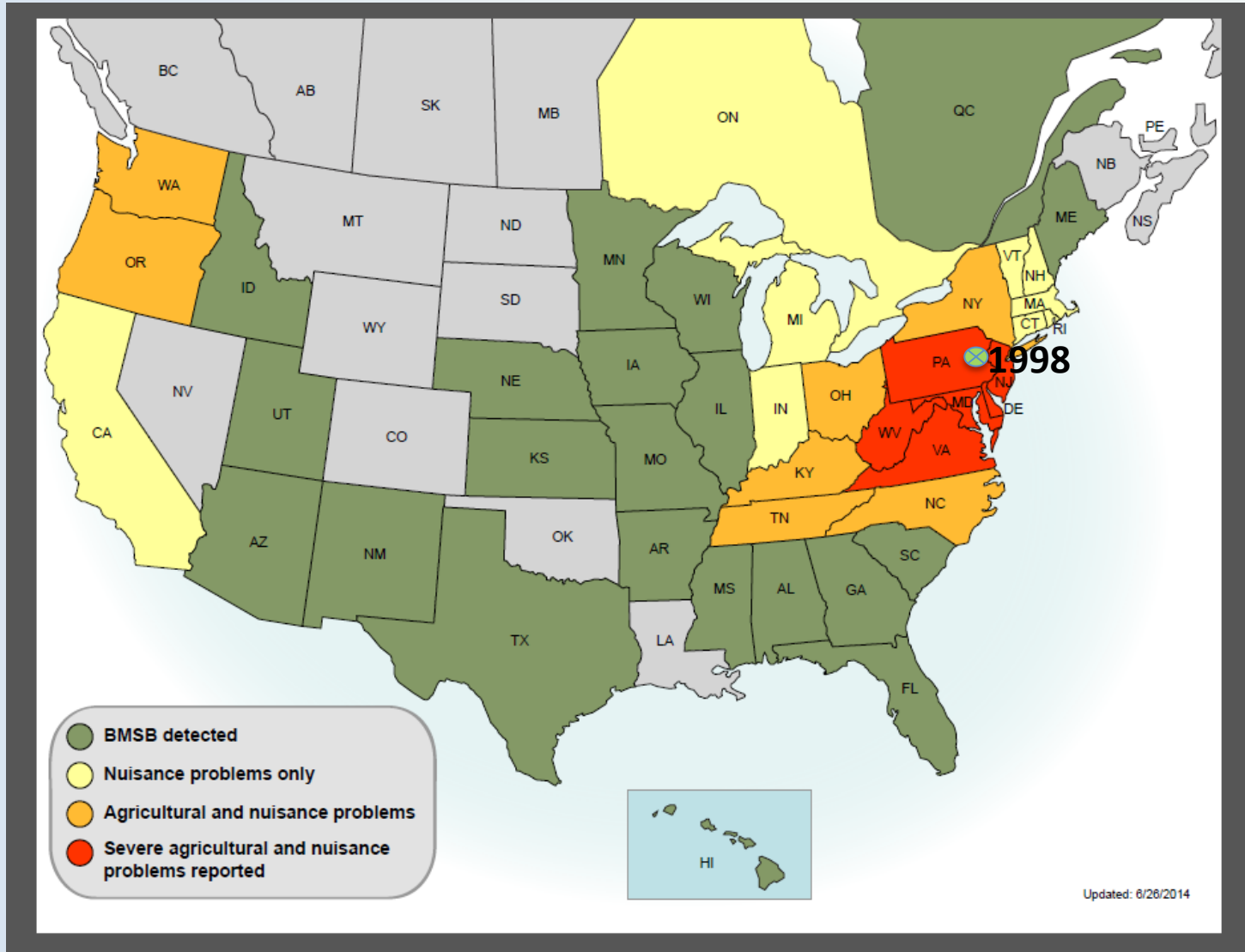
Integrated Pest Management of Rice Invertebrate Pests

- Brown marmorated stink bug (BMSB)
- had to do work in Contained Research Facility
- colony of BMSB in quarantine



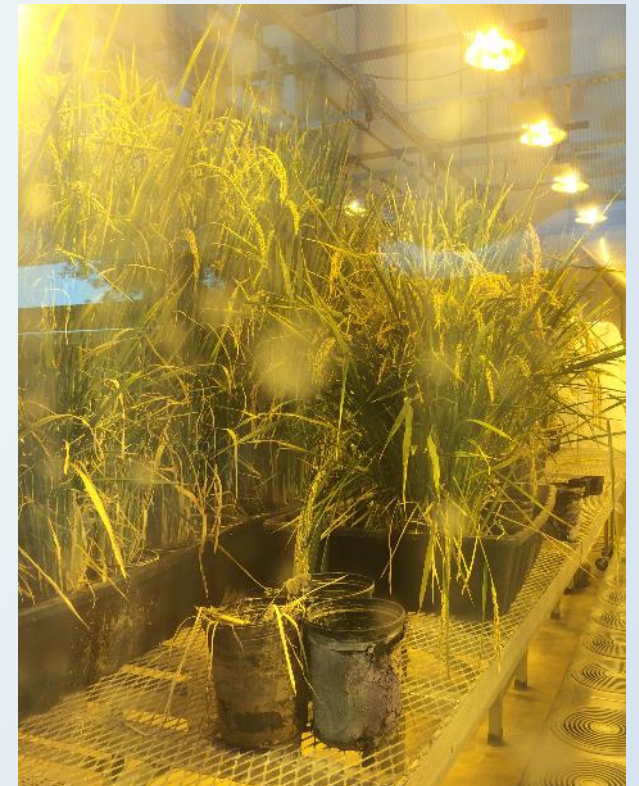
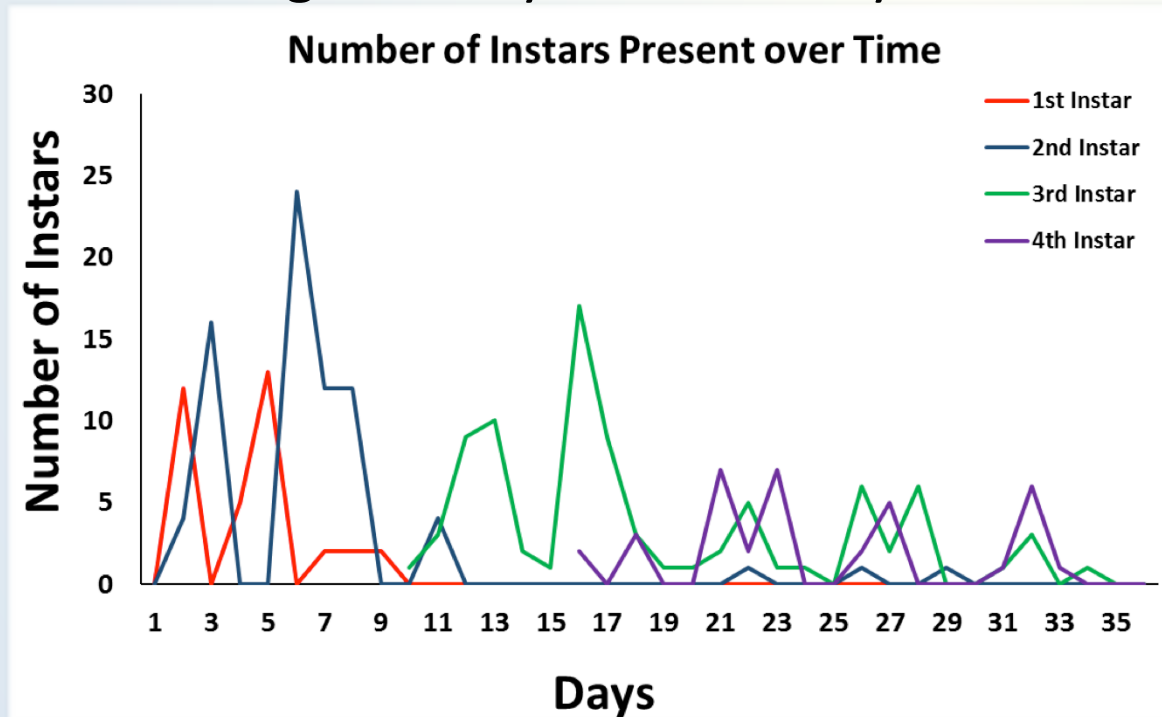
Integrated Pest Management of Rice Invertebrate Pests

Brown Marmorated Stink Bug



Integrated Pest Management of Rice Invertebrate Pests

- Brown marmorated stink bug (BMSB)
- did reproduce on rice
- could not look at yield and panicle/kernel damage
- will examine kernel damage in laboratory study
- starting a colony in laboratory



Integrated Pest Management of Rice Invertebrate Pests

- Brown marmorated stink bug (BMSB)
- Specialty rice from North Carolina coastal area
- Few hundred acres grown by Hmong farmers
- Significant damage
- Damage similar to rice stink bug



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- well-adapted varieties
- weed management on levees
- planting dates

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Host Plant Resistance

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Pheromones

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Insecticides