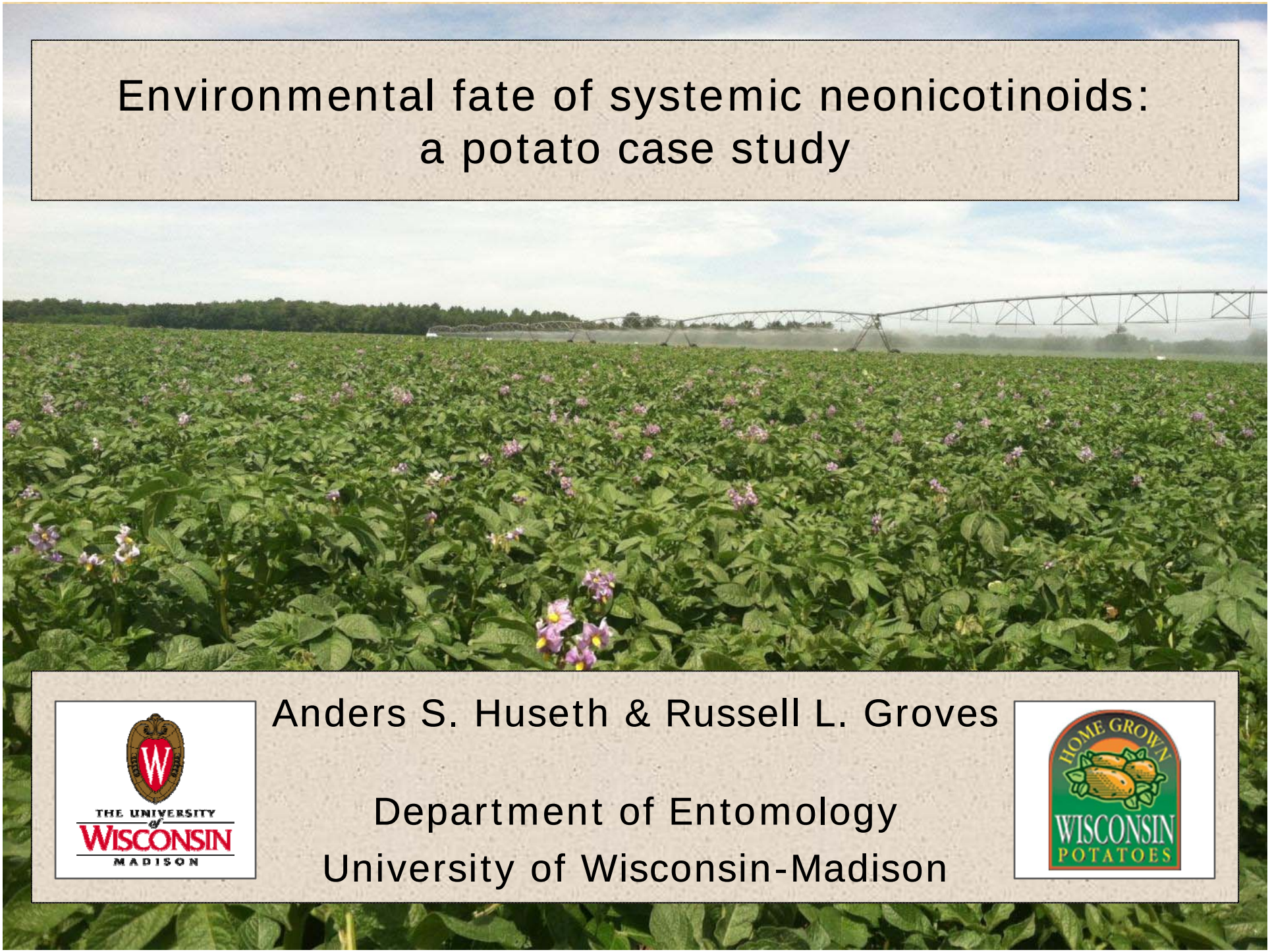
Environmental fate of systemic neonicotinoids: a potato case study



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Outline

Topic areas

- Specialty crops & potato production in Wisconsin
- Insect management in potato
- Current groundwater detections of neonicotinoids
- Potato case study

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Wisconsin's specialty crop industry

	Total Economic Activity (*in $ millions per year*)	Total Jobs	USDA-NASS 2011 National ranking
Vegetable & Fruit Production	**$1,092**	**9,900**	**-**
Potatoes	$349	2,770	3
Cranberries	$300	3,400	1
Sweet Corn	$83	660	3
Green Beans	$63	490	1
Carrots, Cucumbers & Onions	$28	220	2, 5, 10
Green Peas	$26	200	3
Ginseng	$16	130	1
Specialty Crop Processing	**$5,268**	**24,800**	
Total Impact	**$6,360**	**34,700**	

Production estimates based on 2006-2008 average farmgate values; processing estimates based on 2007 Economic census values. Note: sum of estimates many not equal total impact due to rounding.

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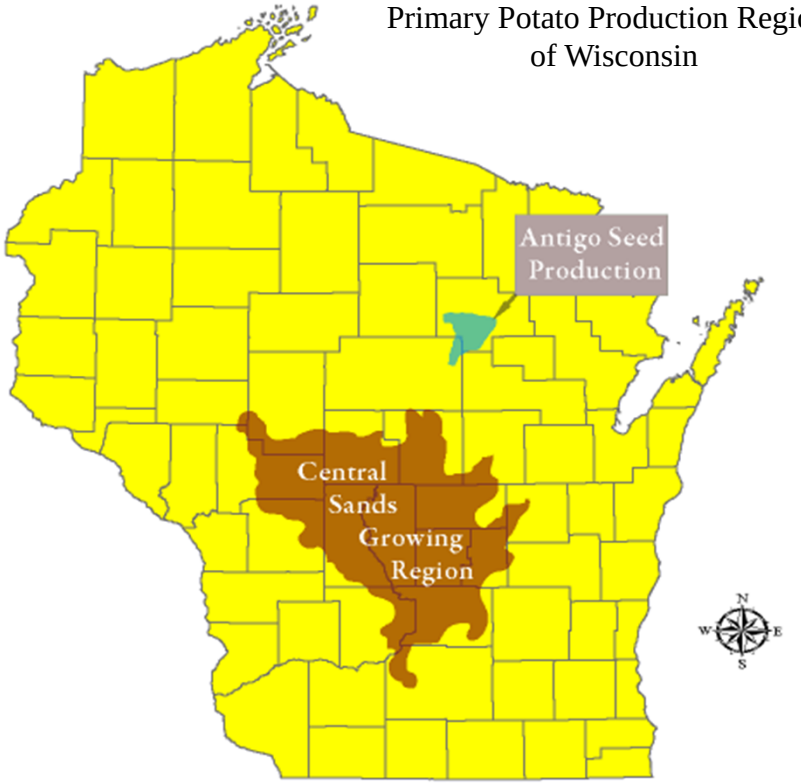
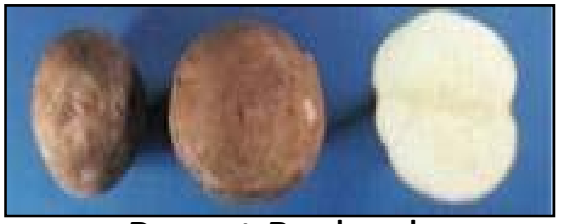
(Keene and Mitchell, 2010; USDA NASS 2011)

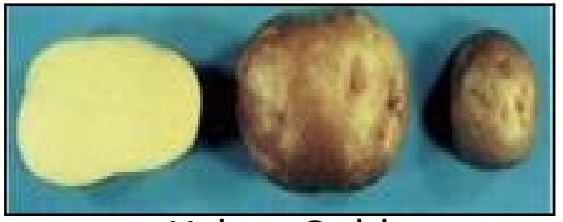
Potato production in Wisconsin

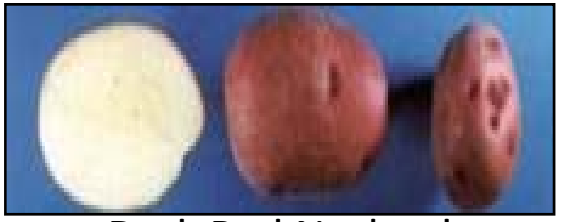
- ca. 63,500 acres annually, estimated 267 million dollars
- fresh, processed (chips/frozen), or seed potatoes

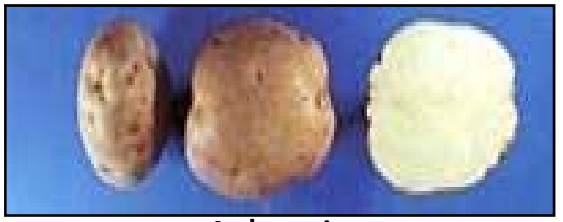


Major commercial varieties


Russet Burbank


Yukon Gold


Dark Red Norland


Atlantic

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Key pests of WI potato

Potato leafhopper
(*Empoasca fabae*)

Colorado potato beetle
(*Leptinotarsa decemlineata*)

Colonizing Aphids
(*Myzus persicae* &
Macrosiphium euphorbiae)

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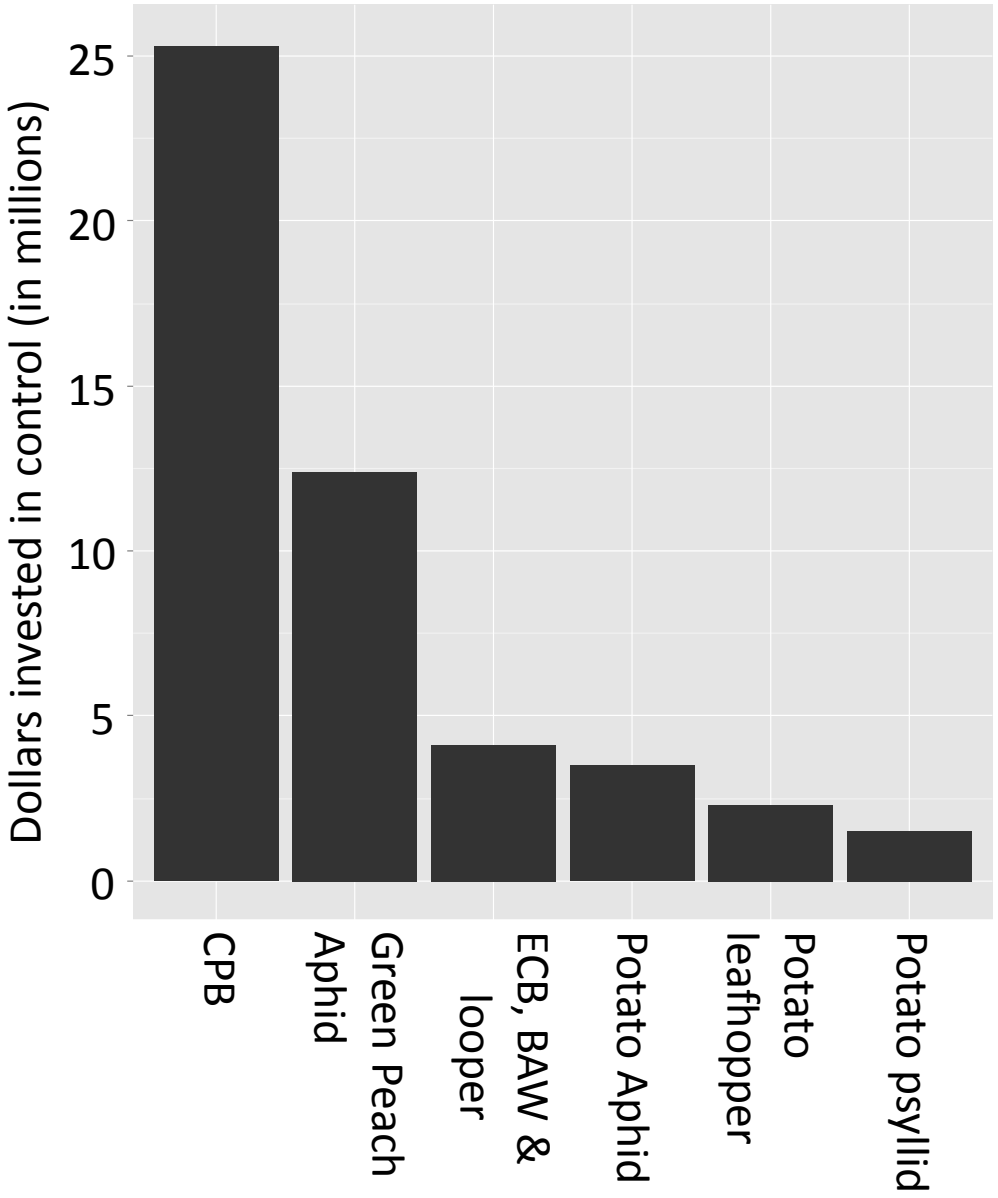
US insecticide market - potato

- Estimated $48 million spent in potatoes for insect control in 2010.

Potato pest management (ca. 1946)

R.K. Chapman, Racine, WI



(DuPont Crop Prot., Hector Portillo, Personal Comm.)

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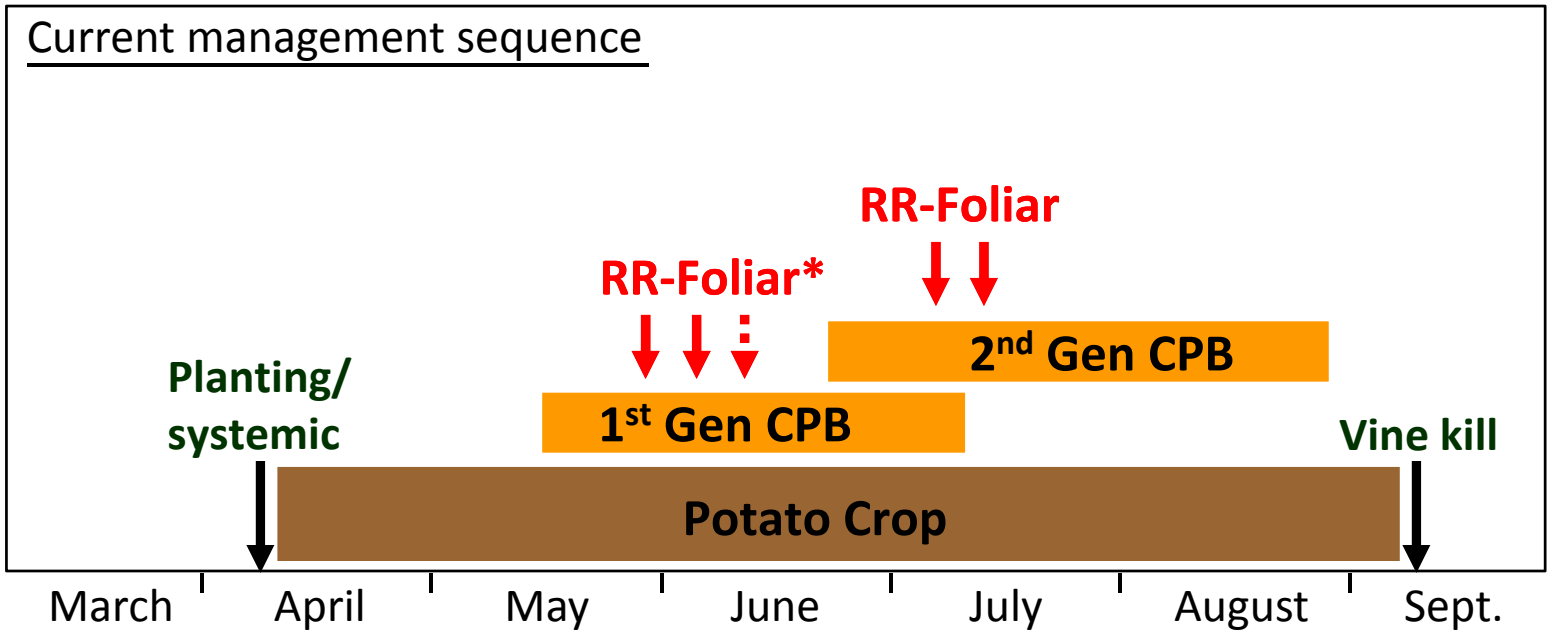
15 years of systemic neonicotinoid management

- Early generations managed with systemic neonicotinoids
- In-furrow systemic management on >85% of total WI acreage since 1995
- No products on the horizon with same spectrum of activity, ease of application, low non-target toxicity, or price per acre

- *Is widespread use over a long period of time a challenge for sound stewardship?*



*reduced-risk foliar application (rynaxypr, cyazypyr, spinetoram, novaluron, abamectin, spinosad)

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Groundwater management challenges

Water availability, Water quality

- Multiple users of the water resource
- Agriculture, Industry, communities, recreation

Is the resource sustainable?

- Climate, Irrigation, other factors

Complex solutions

- Involvement of all interested parties
- Growers, processors, communities, citizens, Government Agencies

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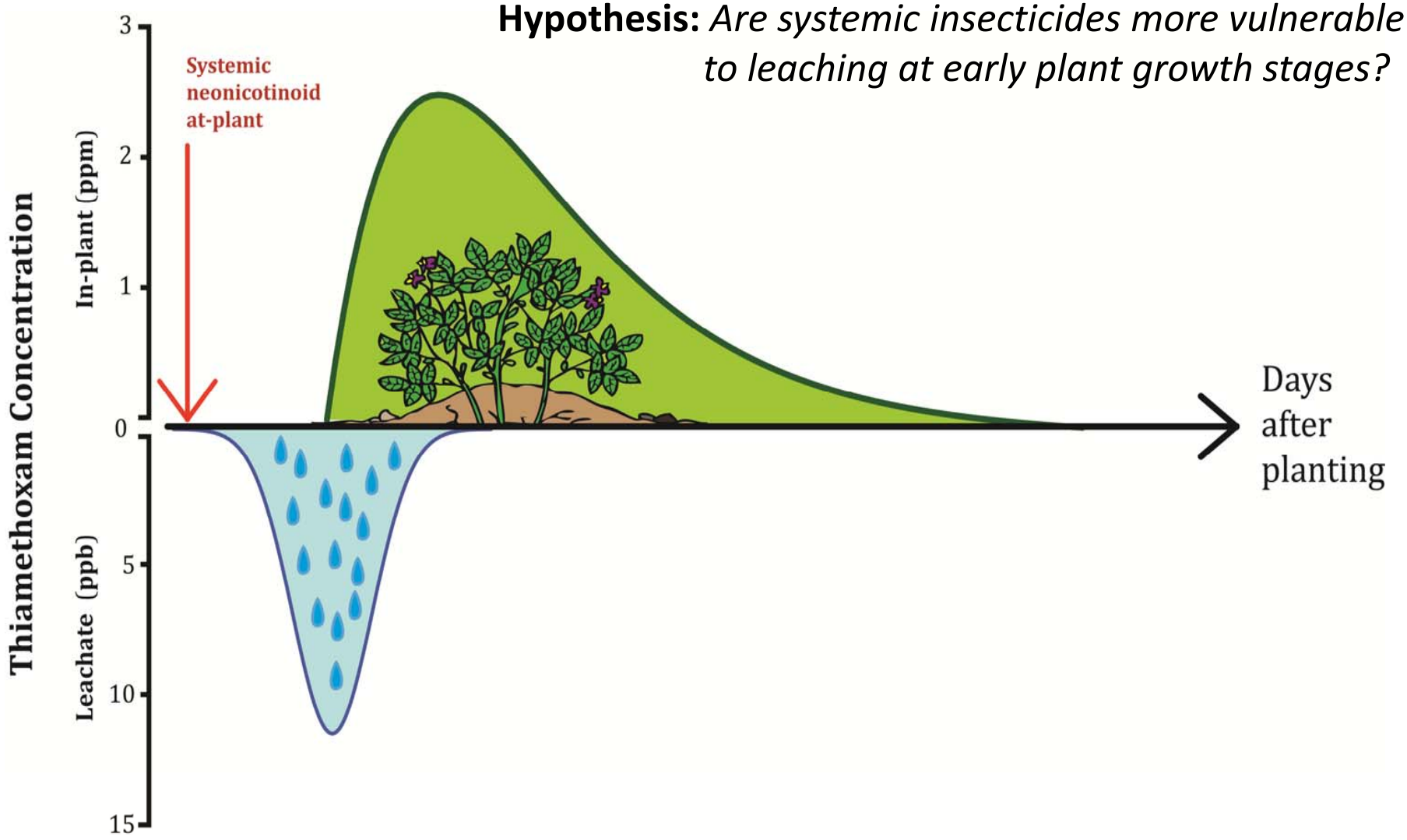
Well detections of thiamethoxam – WI DATCP

Location	Date(s)	Concentration (ppb)
Private well near Lone Rock	6/23/09 & 6/9/09	0.693-1.26
Private well near Arena	6/23/2008	0.656
Private well near Edgerton	11/2/2009	1.61
Monitoring well Adams County	2008 and 2009	0.82-8.93
Monitoring well Grant County	4/7/2008	1.25
Monitoring well Iowa County 1	2008 and 2009	0.784-2.04
Monitoring well Iowa County 2	2008 and 2009	0.671-2.85
Monitoring well Sauk County	2008 and 2009	1.47-3.66
Monitoring well Waushara County	8/19/08 & 12/1/08	0.638-0.704
Irrigation well Portage County 1	6/10/11 & 8/12/12	0.533-0.58
Irrigation well Portage County 2	7/10/2011	0.148
Irrigation well – Hancock Ag Research Station	7/10/2011	0.59

Are there risk windows for neonicotinoid loss?

Hypothesis: *Are systemic insecticides more vulnerable to leaching at early plant growth stages?*



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Objective

Document the in-plant expression patterns and environmental fate of thiamethoxam applied through four delivery methods in potato.

Methods:

- Five insecticide treatments (In-furrow, seed treatment, impregnated horticultural gel, foliar, & untreated treatments)
- Colorado potato beetle counts
- Commercial potato field under standard management practices
- Leaf tissue measurement with enzyme-linked immunosorbent assay (ELISA)
- Thiamethoxam measurement in collected water (leachate) samples with liquid chromatography-mass spectrometry (LCMS)

foliar

seed treatment

in-furrow

impregnated gel

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Insecticide impregnated horticultural gels

Insecticide solution

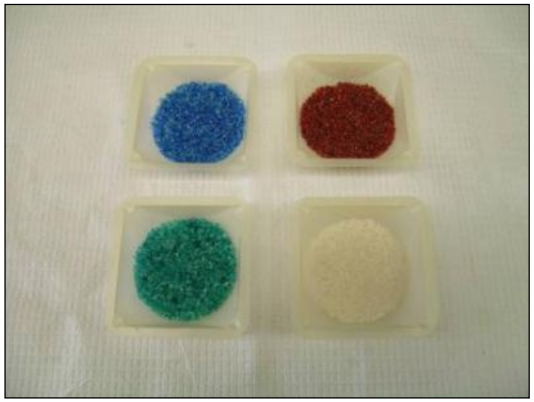
Syngenta Platinum 75SG

MIX

Horticultural gel

Vacuum dry

Dry impregnated gel



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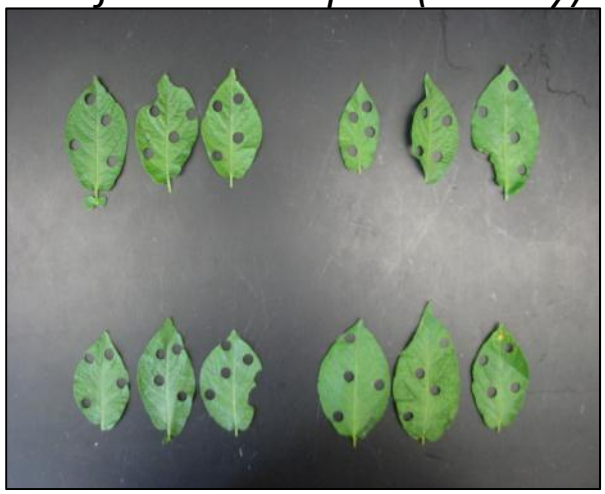
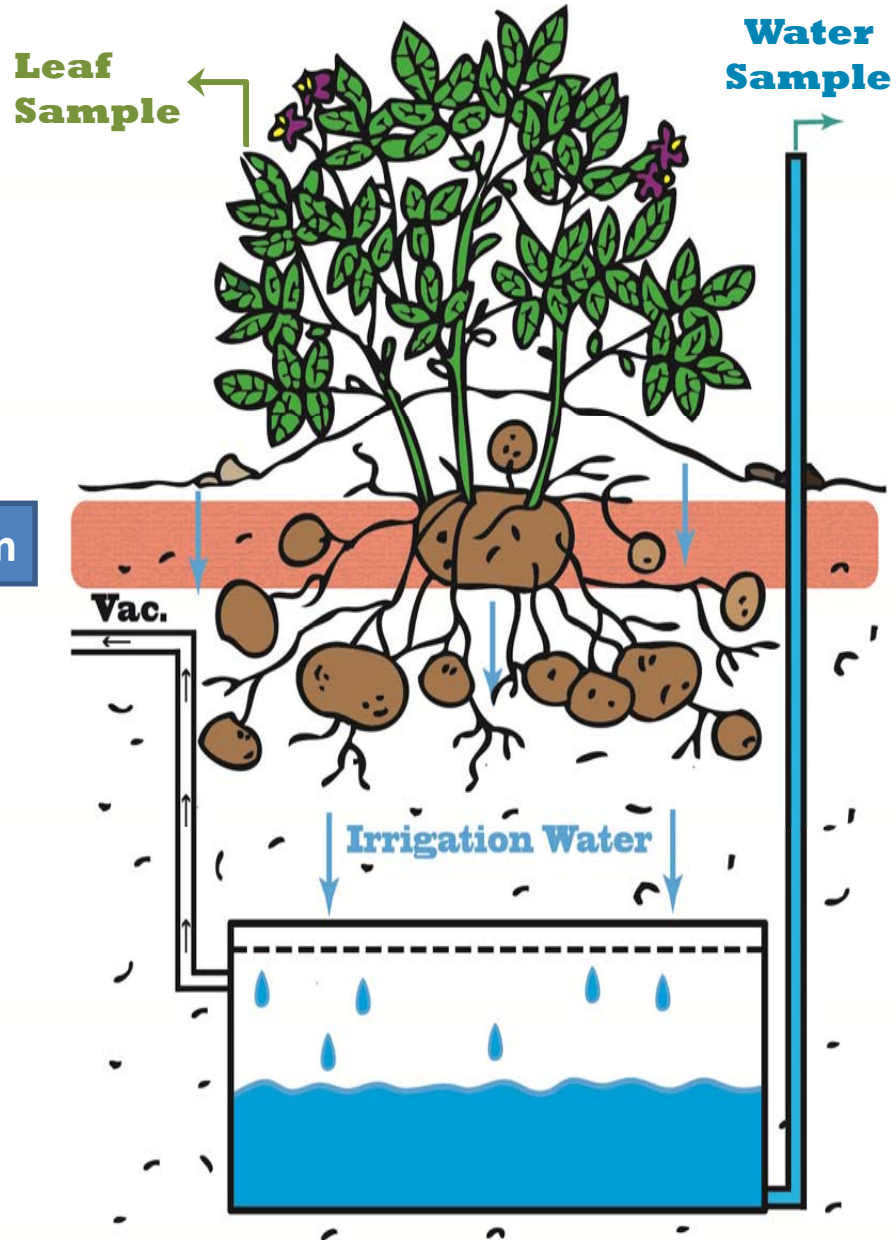
Systemic neonicotinoid movement in potato

Leaf tissue samples (Weekly)



Leachate samples (Monthly)

Thiamethoxam



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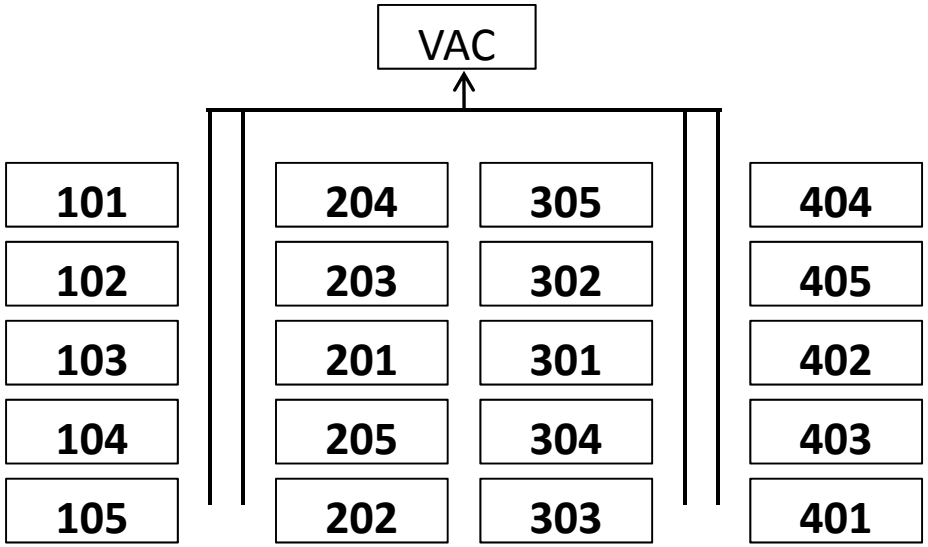
Lysimeter installation & plot design (2011 & 2012)



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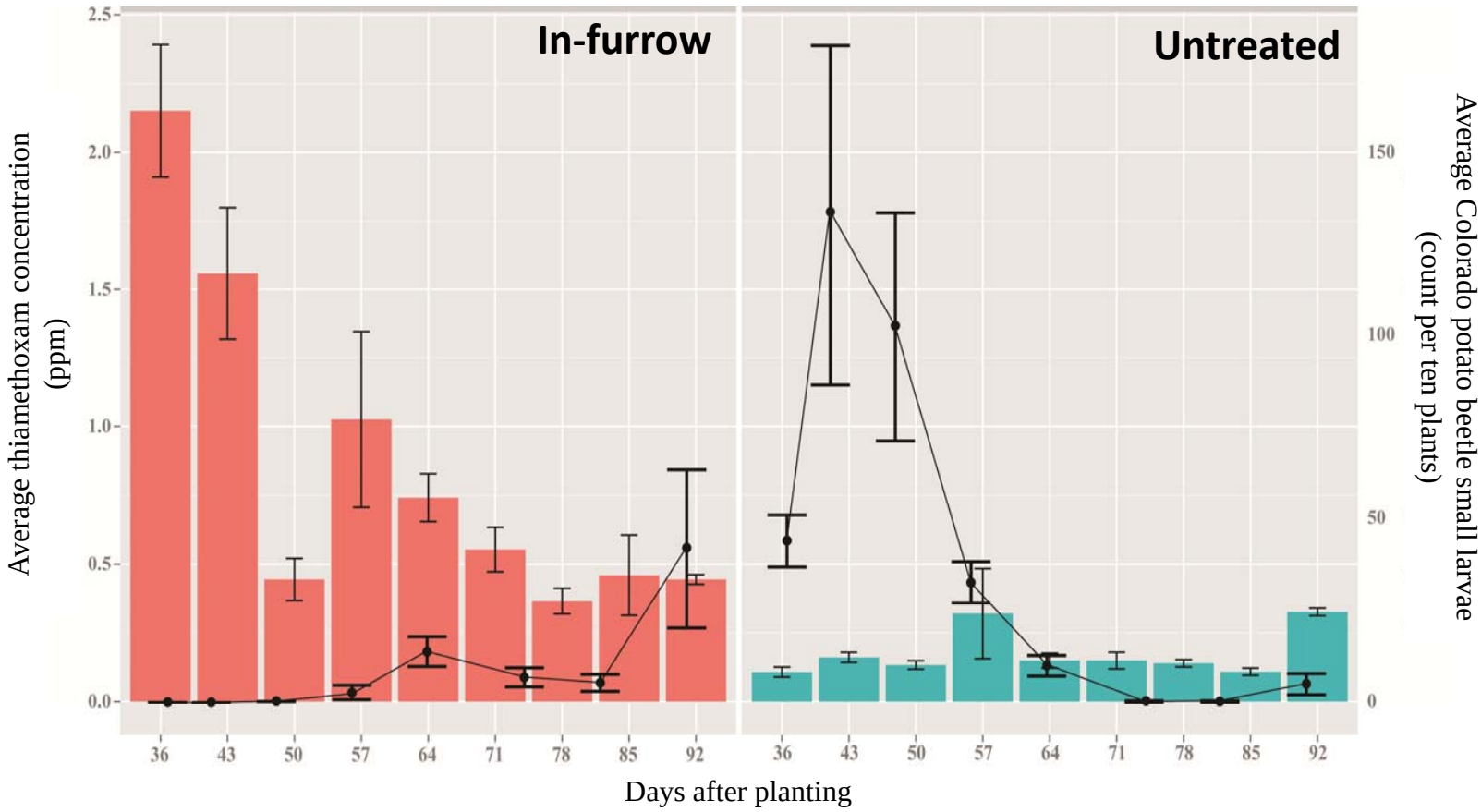
In-plant concentration (2011)



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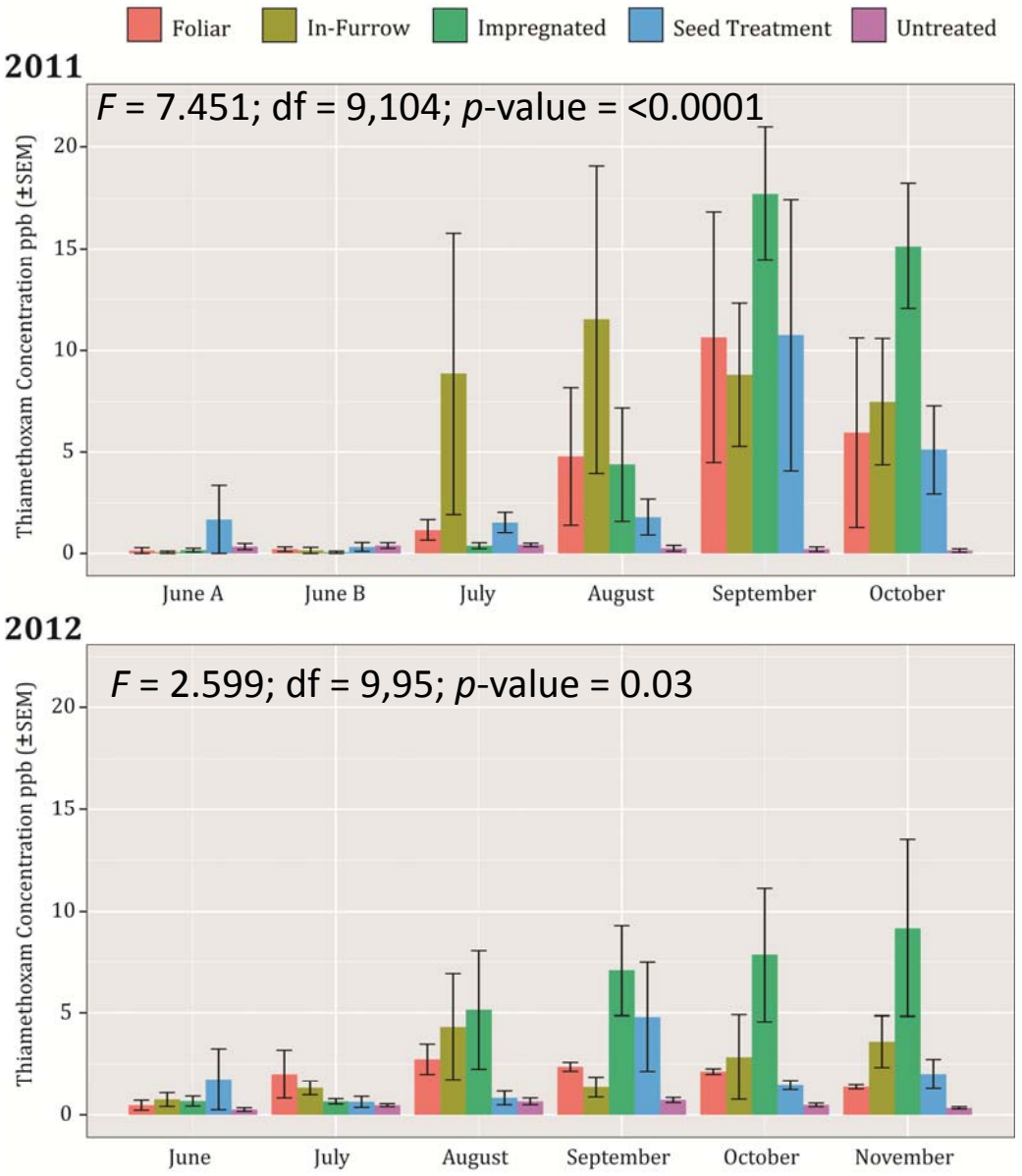
Leachate concentration – Repeated measures ANOVA

- Delivery method main effect is significant in both seasons
- Month of sampling is significant in both seasons
- No large rain events until late in the season



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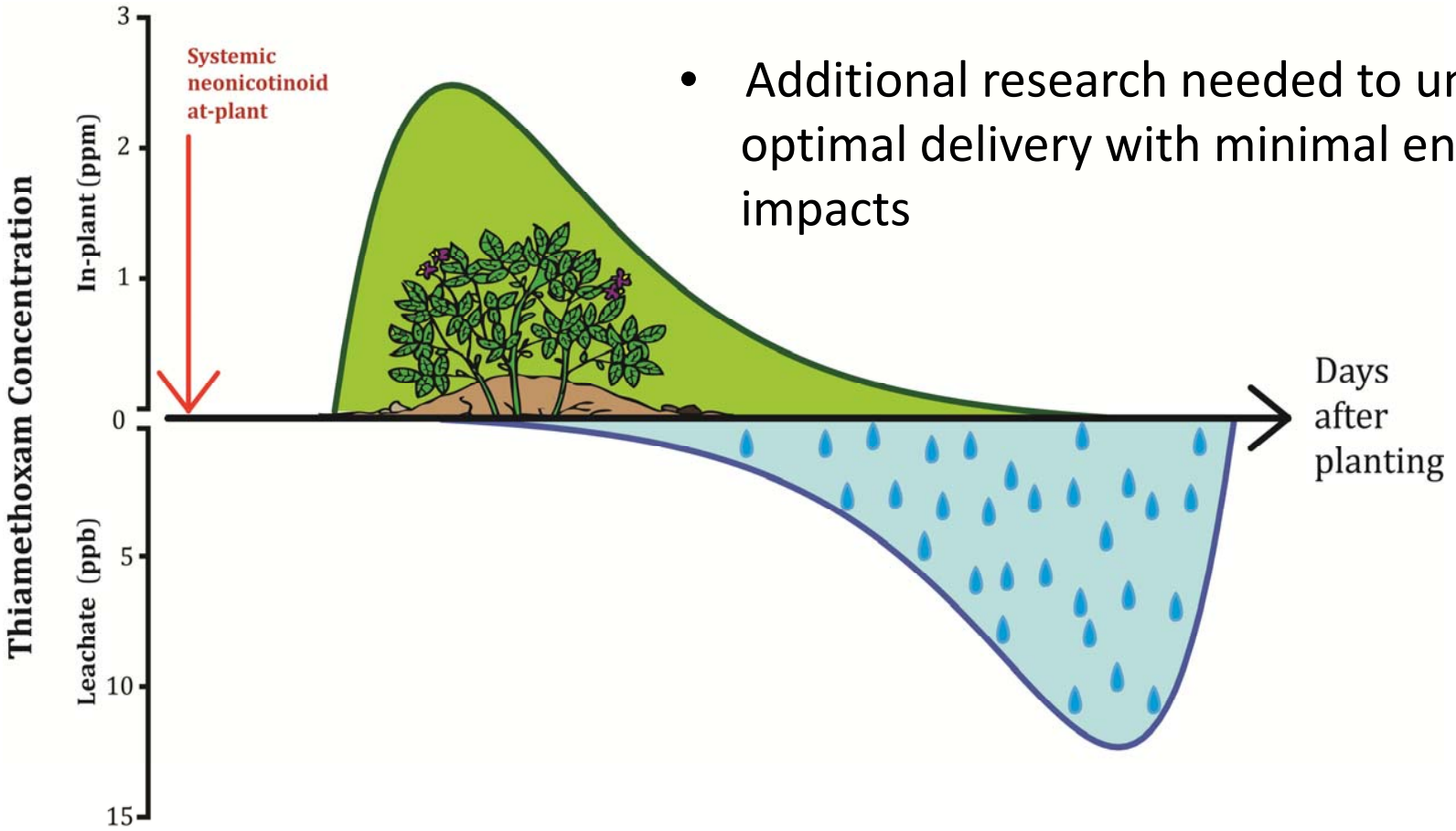
Summary

- Insecticide delivery method matters for both in-plant expression and leaching potential
  - More water soluble systemic chemistries in the pipeline
  - Additional research needed to understand optimal delivery with minimal environmental impacts



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Acknowledgements

People

- Cooperating growers
- Duane Maatz & Wisconsin Potato and Vegetable Association
- WI-DATCP
- Ken Frost & Scott Chapman
- Groves Lab

Funding

- National Potato Council. FY09-12 State Cooperative Potato Research Program
- NCR-SARE – Graduate Student Project GNC10-121
- R. Keith Chapman and Jeffery A. Wyman – Wisconsin Distinguished Fellowship in Vegetable Entomology 2010
- Wisconsin Potato Industry Board – Wisconsin Distinguished Fellowship 2009 & 2011
- National Potato Council Graduate Scholarship 2011