

Viruses in Aphids



<http://bugguide.net/node/view/1195272>

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Research Problem

In what ways are insect predators influencing vector behavior and physiology, and what is the resulting impact on plant virus spread in agroecosystems?

Background:

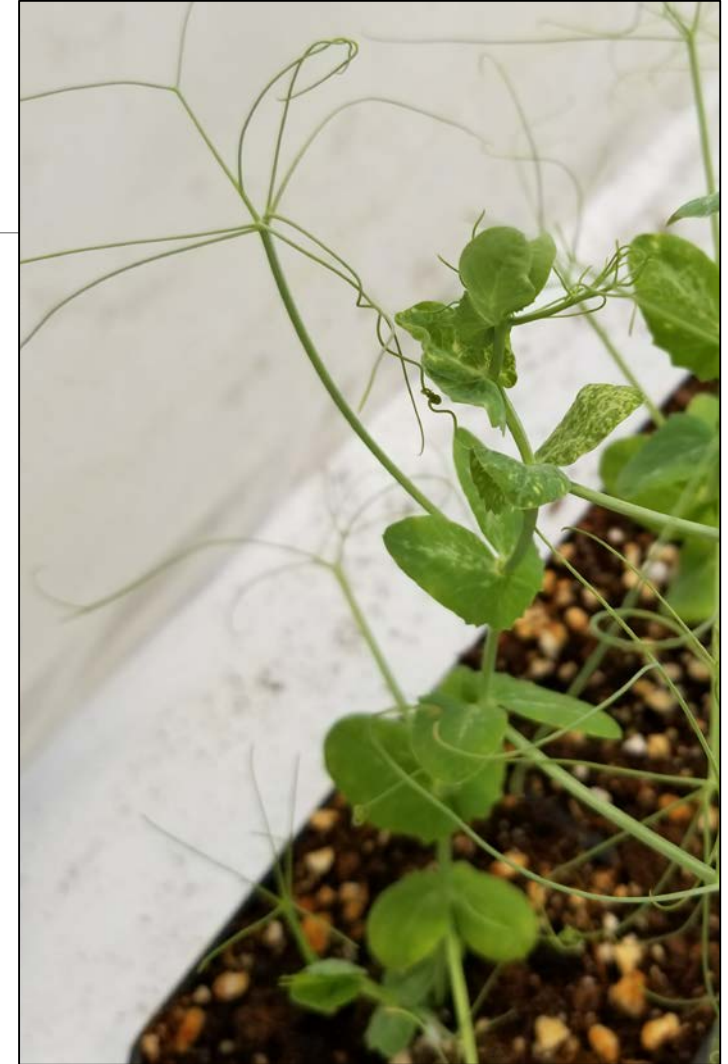
Pea aphids are major pests of legume crops

Vectors of Pea Enation Mosaic Virus (PEMV)

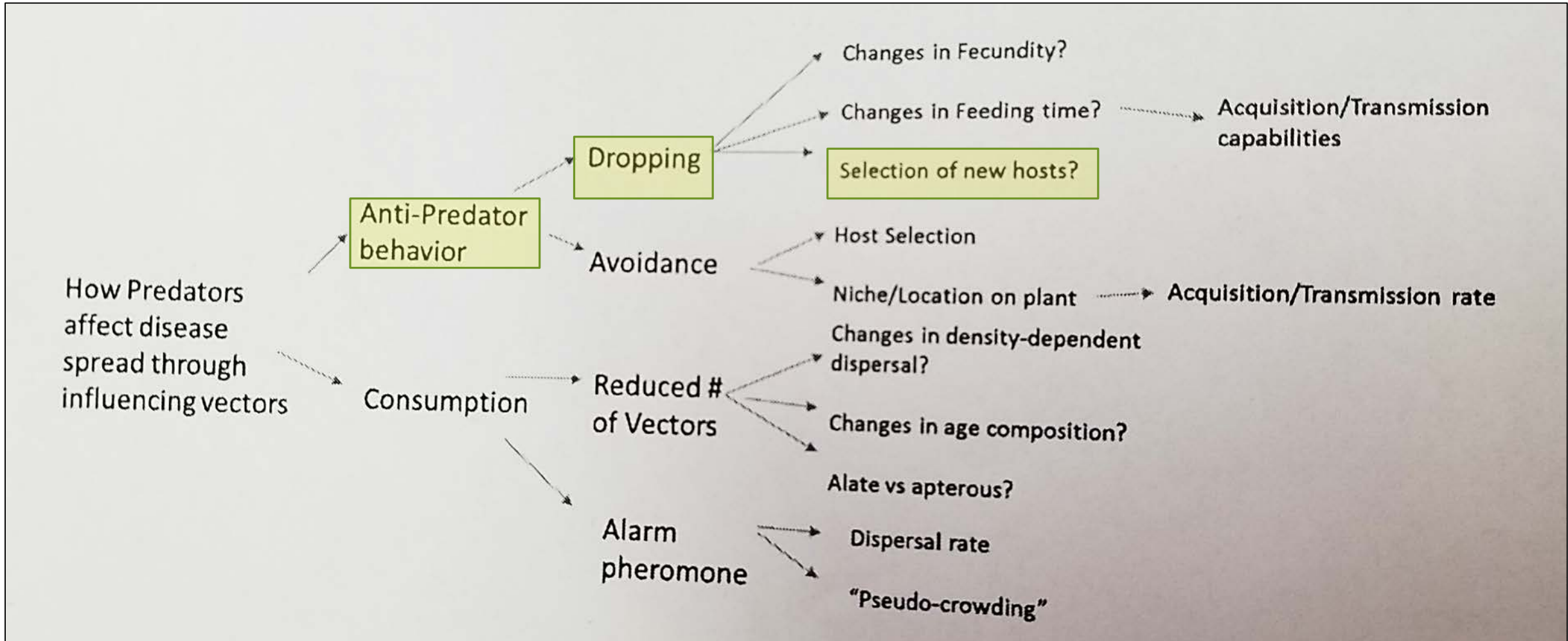
- **Can cause 40% yield loss during outbreak years (occur every 6-9 years)** (Clement et al., 2010)

Lady beetles are predators of aphids in agroecosystems

- Effects on Aphid dispersal (CE and NCE)



Research Problem Mapping: Experiment 1



Experiment 1 Goal:

To determine whether predator-induced aphid dropping can influence aphid host selection

Is there a predator-specific response?

Hypothesis

After predator exposure, dropped aphids will select nearby hosts in a way that will maximize virus transmission.

Infected aphids will select or remain on clean plants over infected plants.

Methods Experiment 1

- *A. pisum* colonies originated from individuals collected in Moscow, ID and were maintained on PEMV-infected *P. sativum*
- *H. convergens* were collected from the Pullman-Moscow area and stored at 4°C until use in experiments
- All plants used as PEMV sources were showing visible symptoms of PEMV infection
 - Tested with triple-sandwich Enzyme-Linked Immunosorbent Assays (ELISA)

Methods Experiment 1

- 250 pea plants planted
- 96 plants (48 virus, 48 clean) 3 weeks old
- ~50 used for inoculation of virus aphids for age standardization
- 90 plants inoculated for virus
 - Virus Inoculation: 3-5 infected aphids put on clean plants, left to establish for 24 hrs, then removed



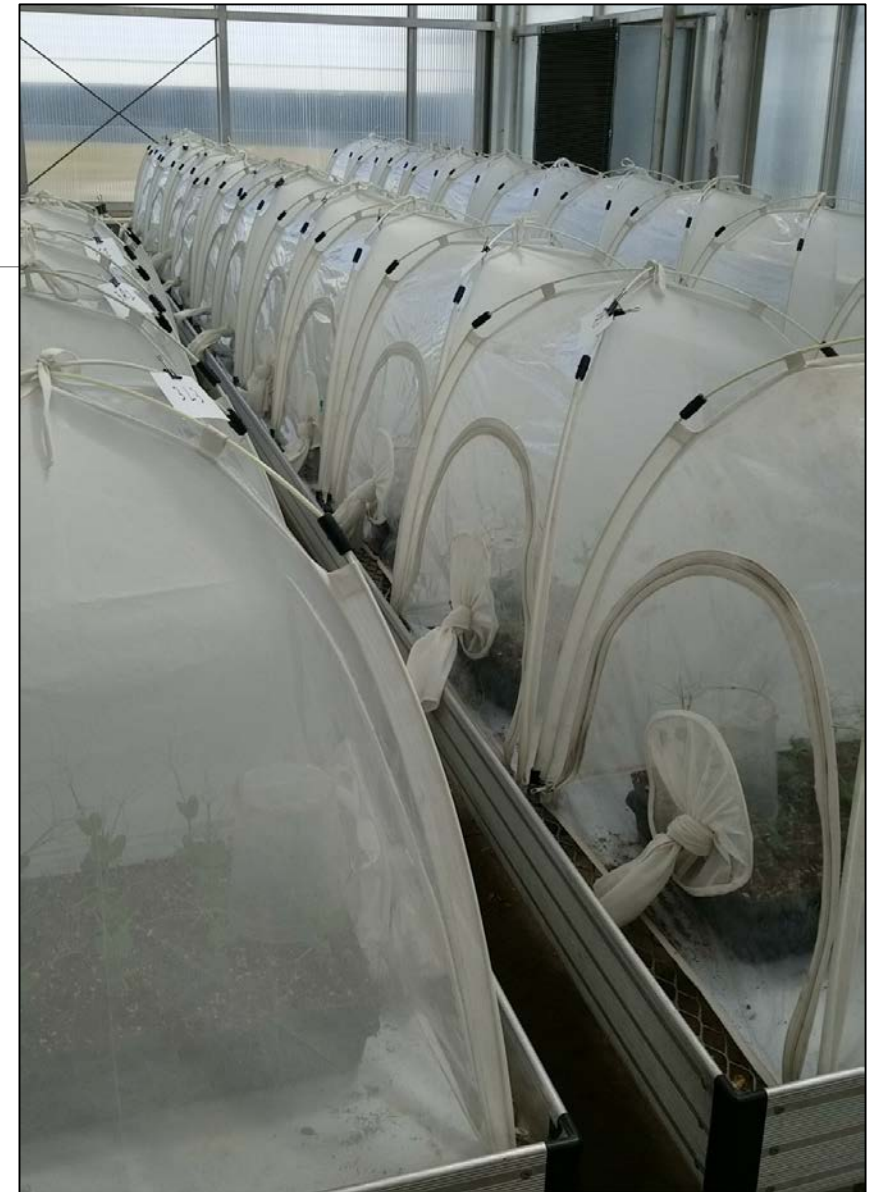
Methods Experiment 1

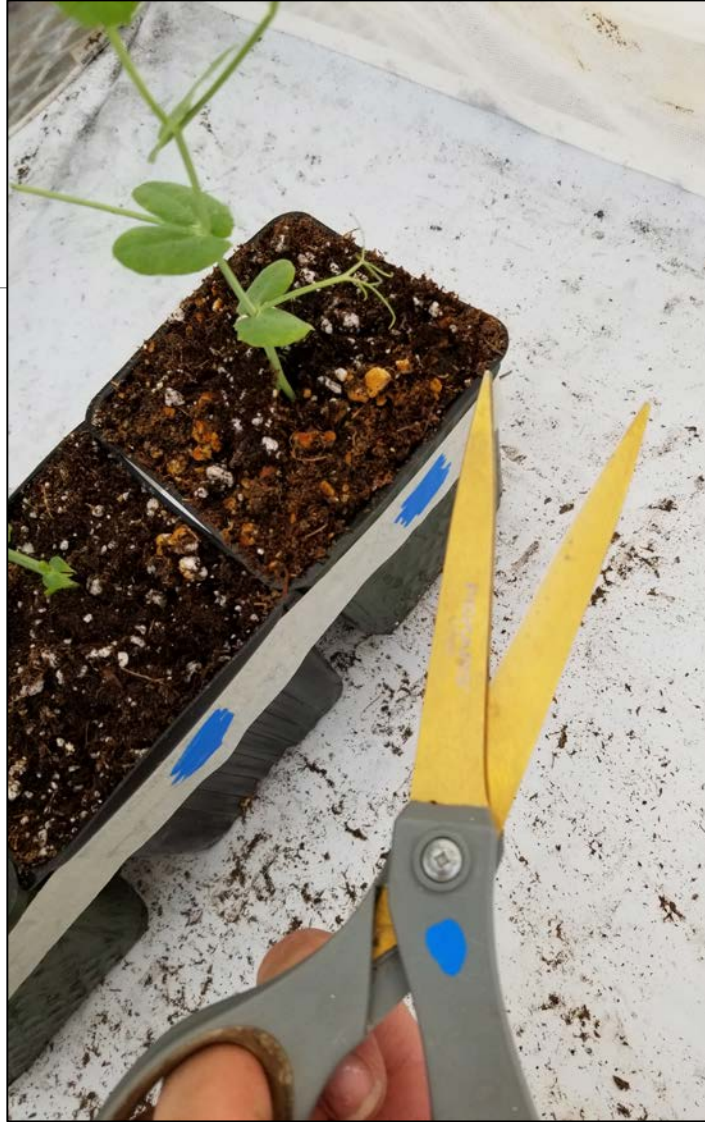


Four different treatments:

- Predator (P) or Plain Stick (S) to cause dropping
- Virus (V) or Clean (C) center plant
= PV, PC, SV, SC
- All plants have both clean and virus plant on randomized side
- 8 repetitions of each type (total of 32 bug dorms)

- Plants of similar size chosen
- Blue mark indicates virus plant
- All dorms labeled





Data Collection

- Let aphids establish for 45 minutes then expose to predator treatment
- Check at 1 hour, 3 hour, and 5 hour
- Record location of Aphid on plant
- Entire experiment was ran 3 times

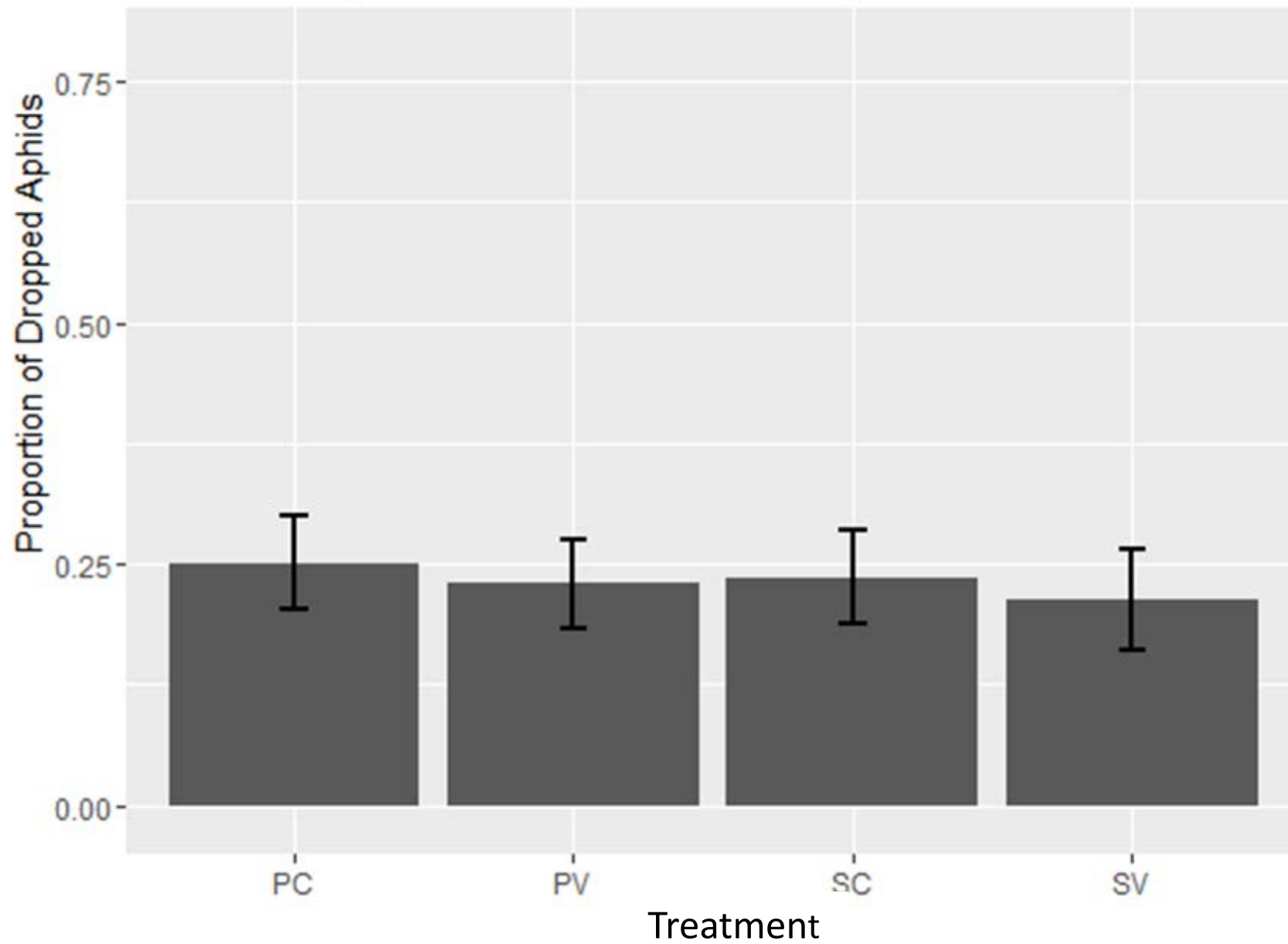


Data

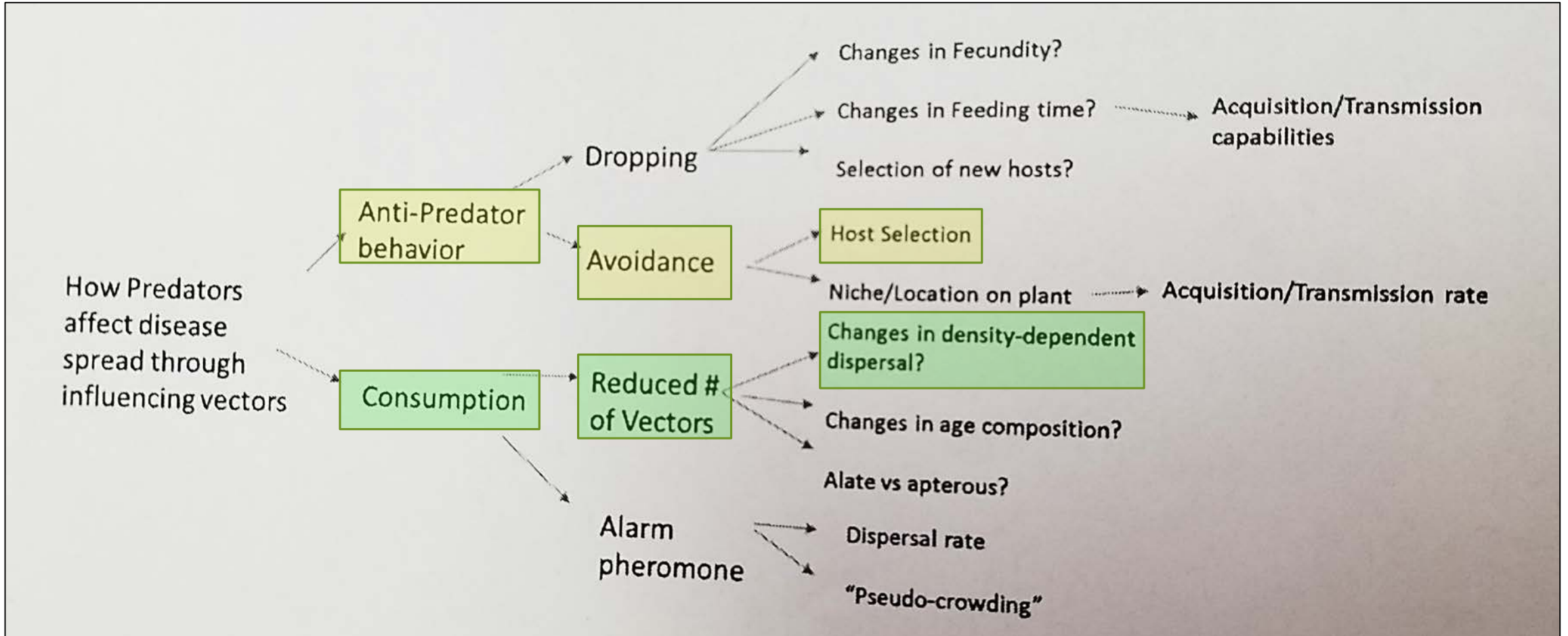
	Df	Sum Sq	Mean Sq	F value	Pr(>F)
as. factor(Drop. Treat)	1	0.005	0.00520	0.098	0.754
as. factor(Source)	1	0.010	0.01010	0.191	0.663
as. factor(Drop. Treat) : as. factor(Source)	1	0.000	0.00001	0.000	0.991
Residuals	84	4.432	0.05277		

The P-values (highlighted) are super high, meaning nothing was significant between any of the treatments.

Proportion of Aphids choosing Alternate Host



Experiment 2 Goals



Methods Experiment 2

- 576 clean plants needed (32 bug dorms with 1 tray 18 in each)
- 15 aphids placed on center plant front row with mesh cup over to prevent spread
- Aphid # checked on host plant at 24 hours, cup removed, and predator treatment placed
- Predator treatment: Lethal, Risk, and Control



Experiment 2

- Lethal: lady beetles able to consume aphids
- Risk: Lady beetles with mouth glued shut using clear nail polish
- Control: No predator treatment

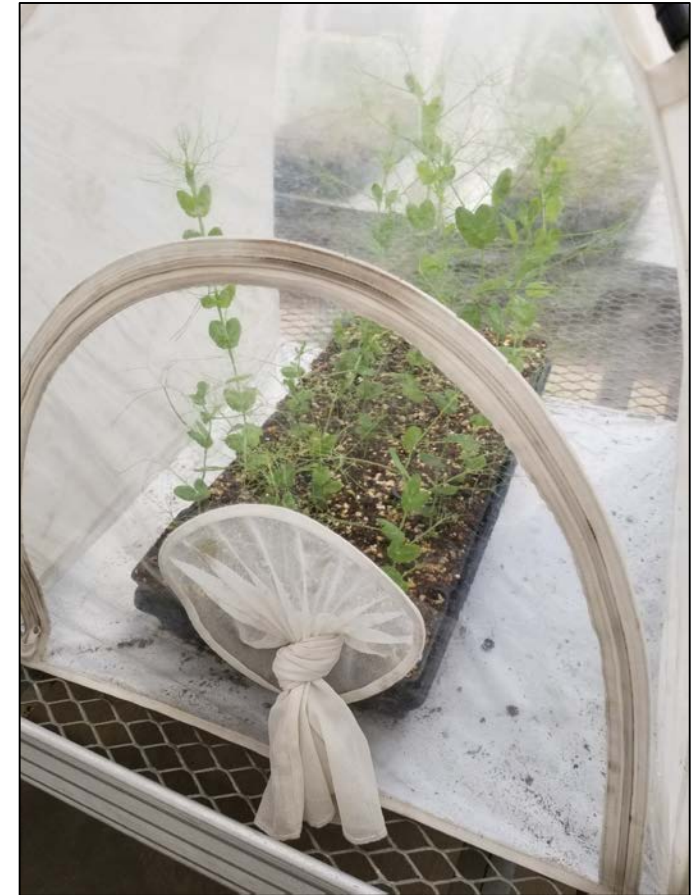
H. convergens individuals were treated as “Risk” or “Lethal” according to methods in Kersch-Becker & Thaler (2015).

Data Collection

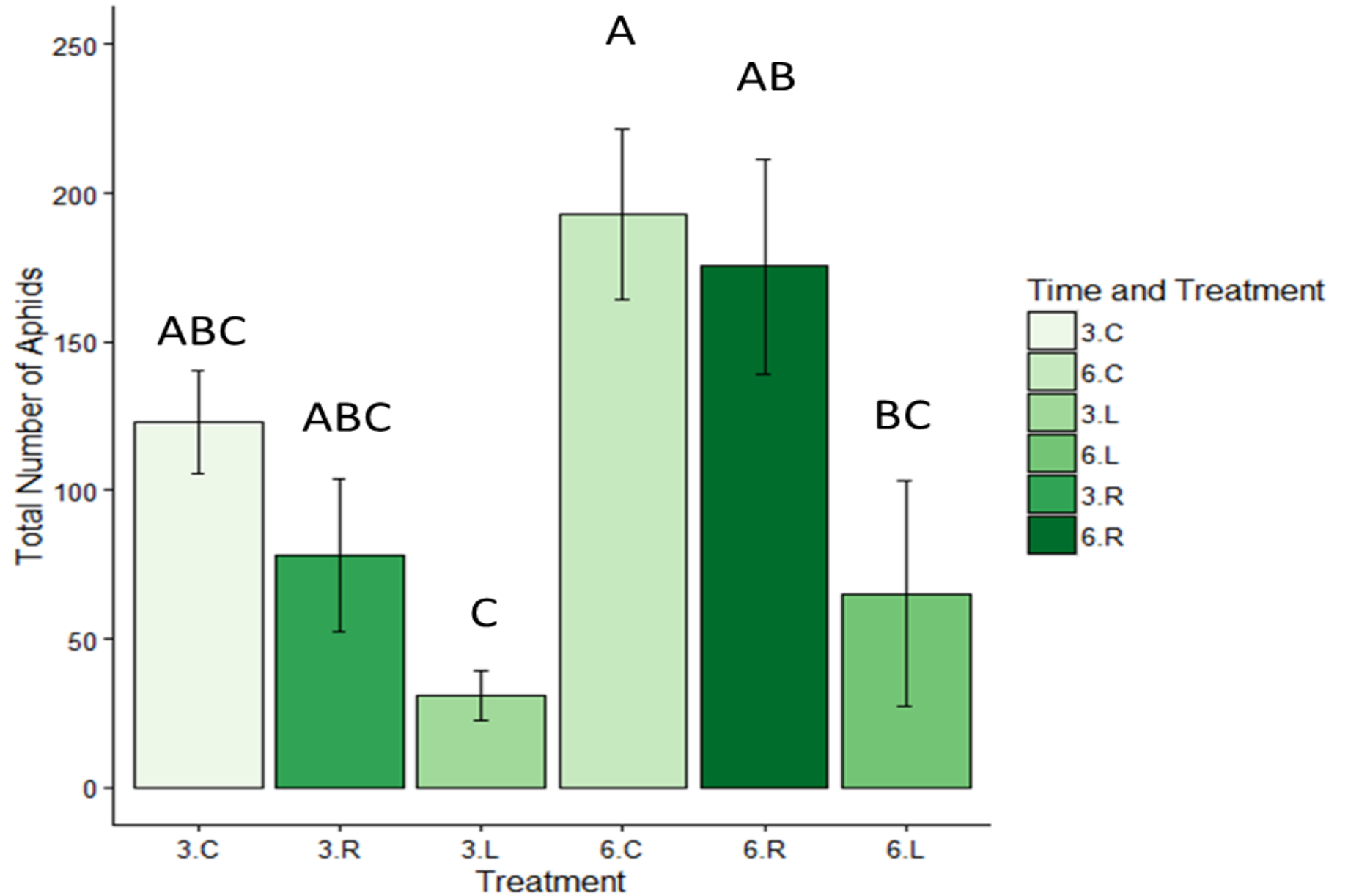
- Half plants checked after 3 days and the rest after 6 days
- All 18 plants in each dorm checked for aphids
- All aphids removed after counting and pesticide was applied

Plants 1 week after pesticide treatment

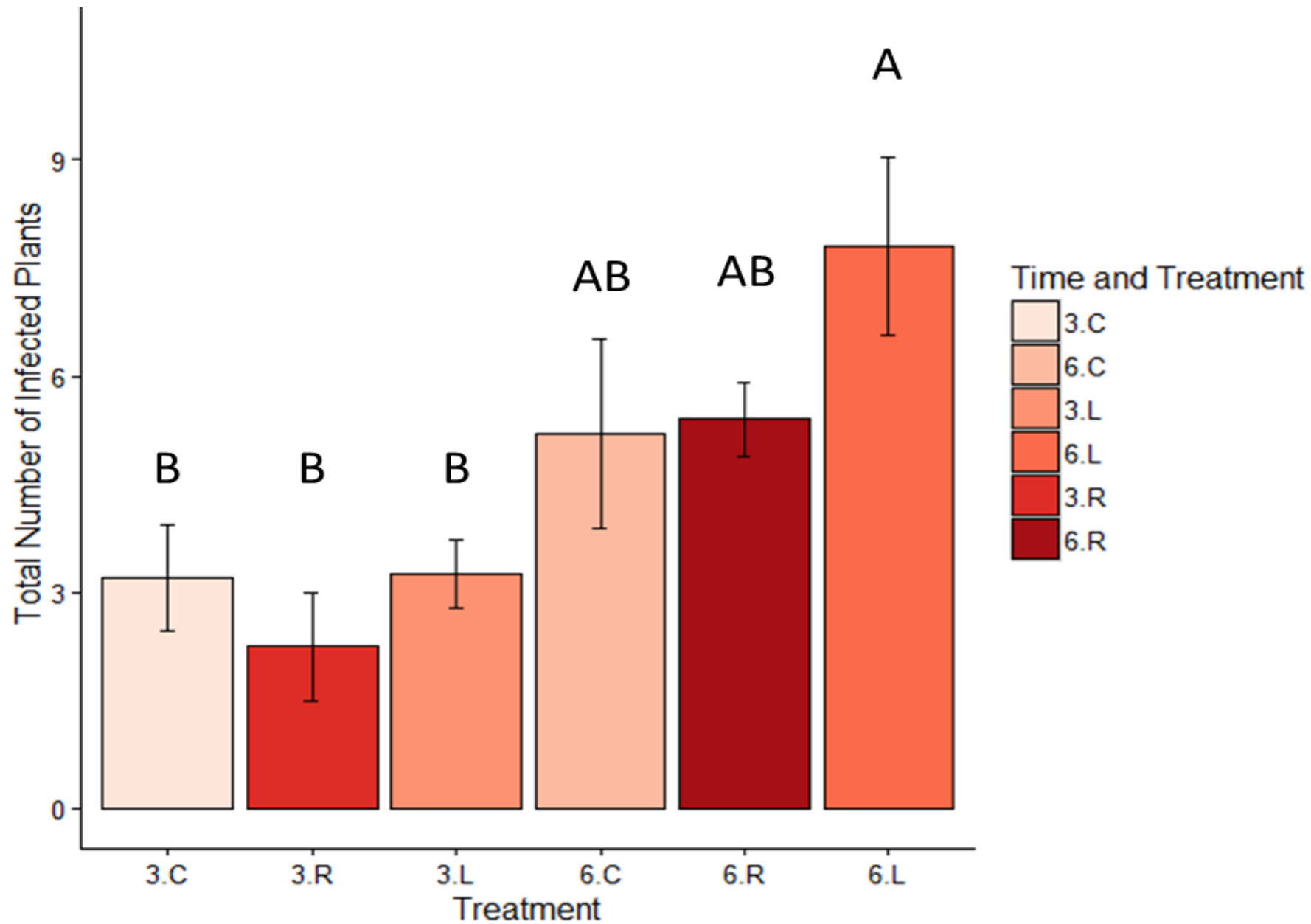
- PEMV infected plants obviously different
- One plant from each row sampled & tested with ELISA to verify PEMV observations



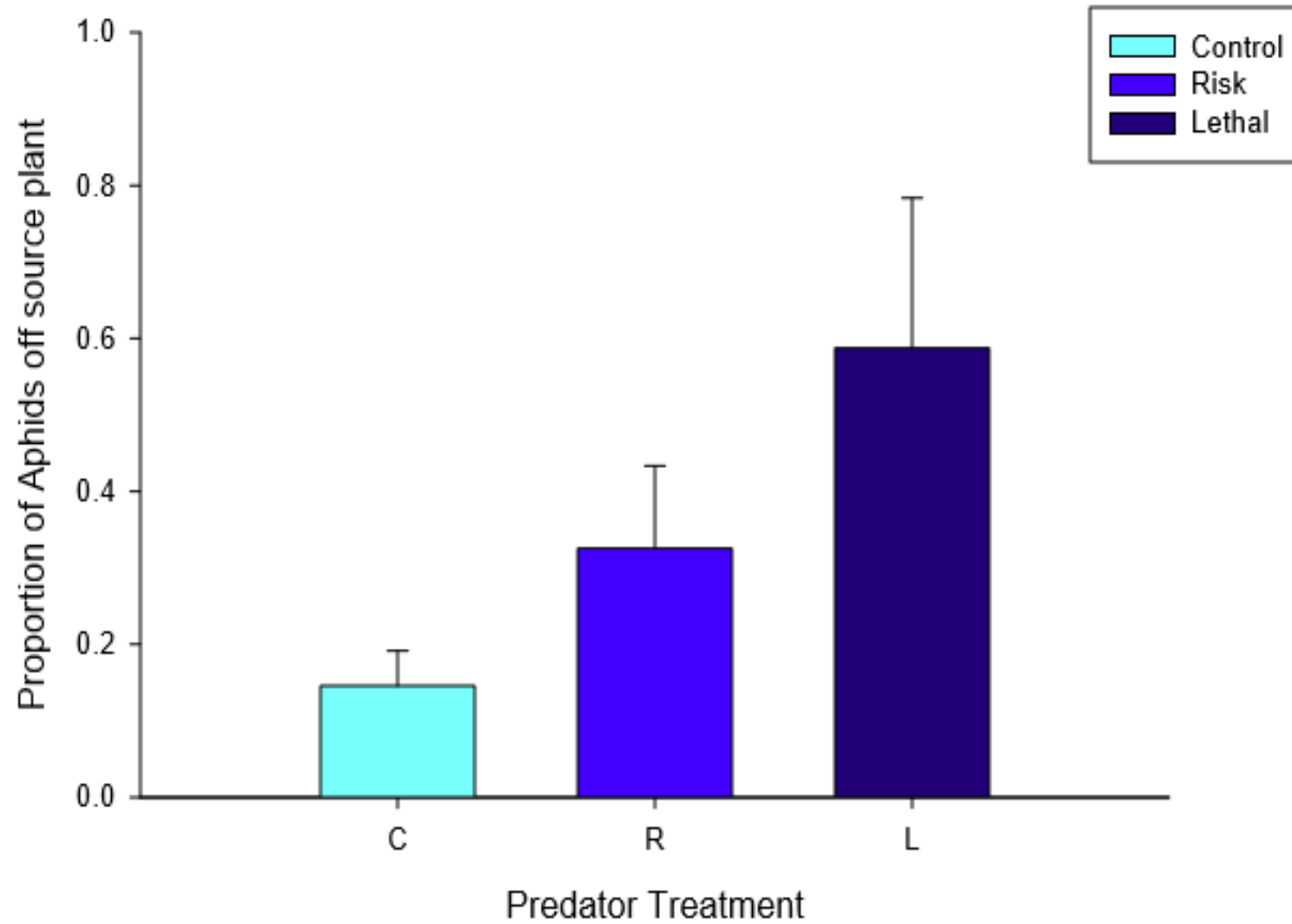
Number of Aphids



Infected Plants



Aphid Movement off Source Plant



Conclusions

- When presented with a predator and caused to drop, aphids select new host 25% of the time
 - This is impacted by other predators in nature like ground beetles
- Lethal Lady beetles caused the highest percentage of both virus infection and aphid movement
 - Although aphids decrease, virus is spreading faster than in control
- Risk Lady beetles caused higher proportion of aphid movement than the control

Acknowledgements

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Extension Project

- Informational Flyer on Common Aphid Predators in the Palouse Region
- Meant for farmers in the Palouse region

Big Eye Bug, Family Geocoridae
<http://bugguide.net/node/view/10272>

Common Aphid Predators in the Palouse Region

Lady Beetle: Coccinella septempunctata
<http://www.istockphoto.com/photos/ladybug>

Lady Beetle: Hippodamia convergens
<http://outfitoc.bisociads.com/coleopt/Hippodamia>

Lady Beetle: Harmonia axyridis
<http://www.ladybuglady.com/Harmonia-axyridis>

Nabis Bugs, Nabidae, also called Damsel Bugs
<http://bugguide.net/node/view/139324>

Carabidae Family: Ground Beetles
<http://bugguide.net/node/view/57700>

Aphidius ervi: Parasitoid Wasp
<http://bugguide.net/node/view/57700>

REACCH Internship, Regional Approach to Climate Change