Investigation into the biology and behavior of the three-cornered alfalfa hopper and their relationship with vineyards

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Serving Sonoma, Napa, Mendocino and Lake Counties

UC IPM | UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources | Integrated Pest Management Program



Phylogeny of Geminivirus Coat Protein Sequences and Digital PCR Aid in Identifying *Spissistilus festinus* as a Vector of Grapevine red blotch-associated virus

Bahder, B. W., F. G. Zalom, M. Jayanth, and M. R. Sudarshana. 2016. Phytopathology. 106(10): 1223-1230.



- *Spissistilus festinus* – Three-cornered alfalfa hopper (TCAH)
- Vector of GRBV
- Native to the US
- Studied predominantly on alfalfa, soybeans, and peanuts in the southern United States
- Previously considered only an incidental pest of grapevines due to girdling
- Very little was known about their association with grapes


What plant species serve as hosts for TCAH in vineyards?

Feeding and Reproductive Weed and Cover Crop Hosts

- Ten weed and ten cover crop plant species commonly found in vineyards were tested as feeding and reproductive hosts in no-choice tests with a standard in each run of the experiment
- Adult survival, girdling, and nymphal emergence were documented every 7 days for 4 weeks



Preto, C. R., M. R. Sudarshana, and F. G. Zalom. 2018. Feeding and reproductive hosts of *Spissistilus festinus* (Hemiptera: Membracidae) found in Californian vineyards. Journal of Economic Entomology. DOI: 10.1093/jee/toy236

Table 1: Weed species tested as feeding and reproductive hosts of *Spissistilus festinus*

Scientific Name	Common Name	Family	Girdles	Nymphs	% Survival[a] ± SEM
Acmispon americanus	Spanish clover	Fabaceae	Yes	Yes	91.7 ± 4.8
Taraxacum officinale	Dandelion	Asteraceae	Yes	Yes	70.8 ± 19.7
Lotus corniculatus	Birdsfoot trefoil	Fabaceae	No	Yes	58.3 ± 16.0
Poa pratensis	Kentucky bluegrass	Poaceae	Yes	No	25.0 ± 8.3
Senecio vulgaris	Common groundsel	Asteraceae	Yes	Yes	20.8 ± 15.8
Plantago lanceolate	Buckhorn plantain	Plantaginaceae	No	No	8.3 ± 4.8
Daucus carota	Wild carrot	Apiaceae	Yes	No	4.2 ± 4.2
Convolvulus arvensis	Field bindweed	Convolvulaceae	Yes	Yes	4.2 ± 4.2
Kickxia elatine	Sharppoint fluvellin	Plantaginaceae	No	No	0
Cynodon dactylon	Bermuda grass	Poaceae	No	No	0

[a] Survival of adults for first 2 weeks on plants

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Table 2: Cover crop species tested as feeding and reproductive hosts of *Spissistilus festinus*

Scientific Name	Common Name	Family	Girdles	Nymphs	% Survival[a] ± SEM
Pisum sativum	Magnus Peas	Fabaceae	Yes	Yes	91.7 ± 4.8
Vicia faba	Bell beans	Fabaceae	No	Yes	83.3 ± 11.8
Bromus hordeaceus	Blando brome	Poaceae	Yes	Yes	33.3 ± 6.8
Vicia benghalensis	Purple vetch	Fabaceae	Yes	Yes	30.2 ± 8.4
Medicago lupulina	Black medick	Fabaceae	Yes	Yes	25.0 ± 10.8
Trifolium subterraneum	Subterranean clover	Fabaceae	Yes	Yes	16.7 ± 11.8
Trifolium incarnatum	Crimson clover	Fabaceae	Yes	Yes	12.5 ± 4.2
Vicia villosa ssp. Varia	Woollypod vetch	Fabaceae	Yes	Yes	12.5 ± 4.2
Brassica sp.	Mustard	Brassicaceae	No	No	0
Avena sativa	California red oats	Poaceae	No	No	0

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Preference Testing



- Vineyard Weeds - field bindweed, Spanish clover, birdsfoot trefoil, dandelion, and purple vetch
- Cover Crops 1 - black medick, white Dutch clover, subterranean clover, woollypod vetch, and purple vetch
- Cover Crops 2 - blando brome, crimson clover, bell beans, magnus peas, and purple vetch

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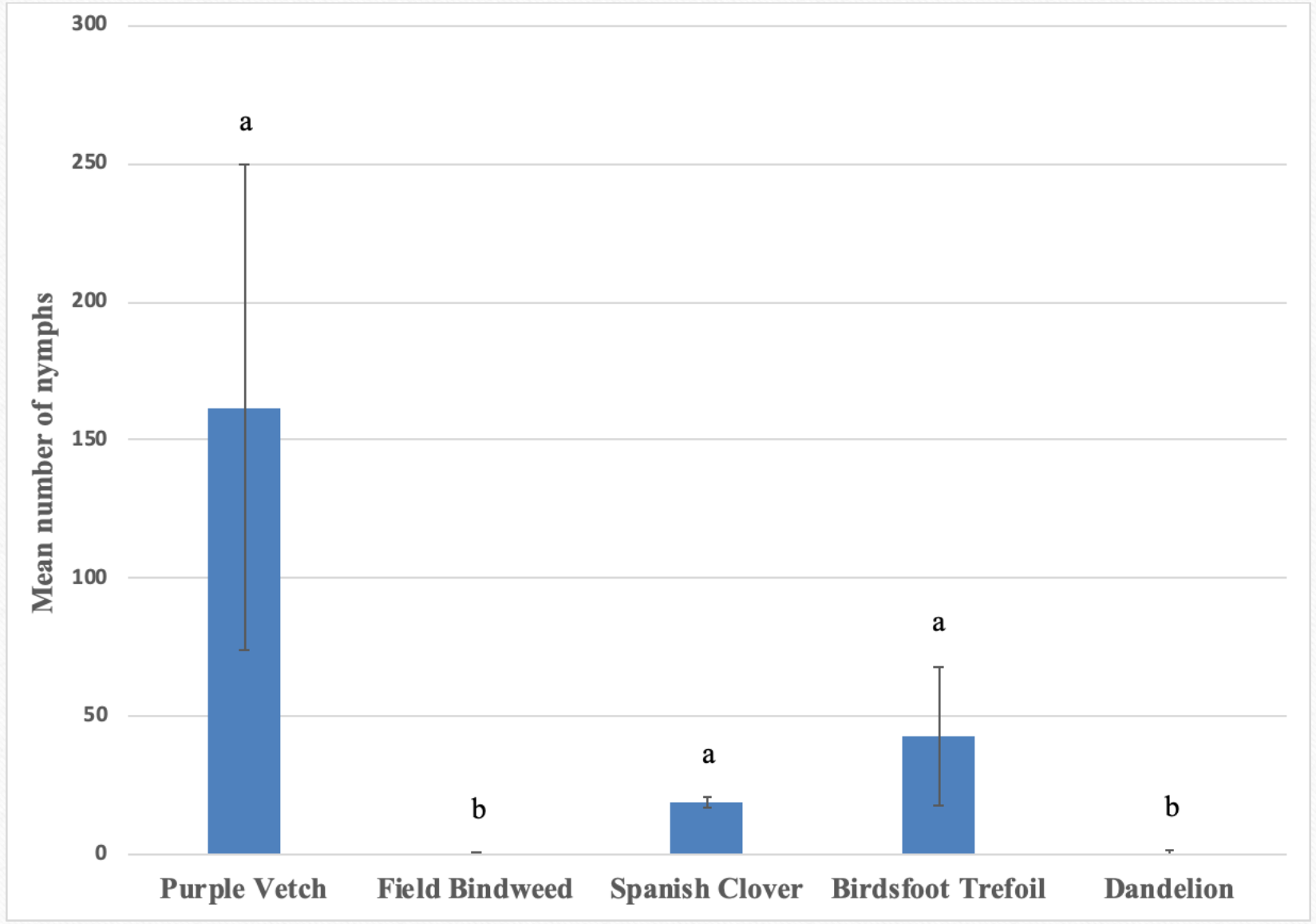

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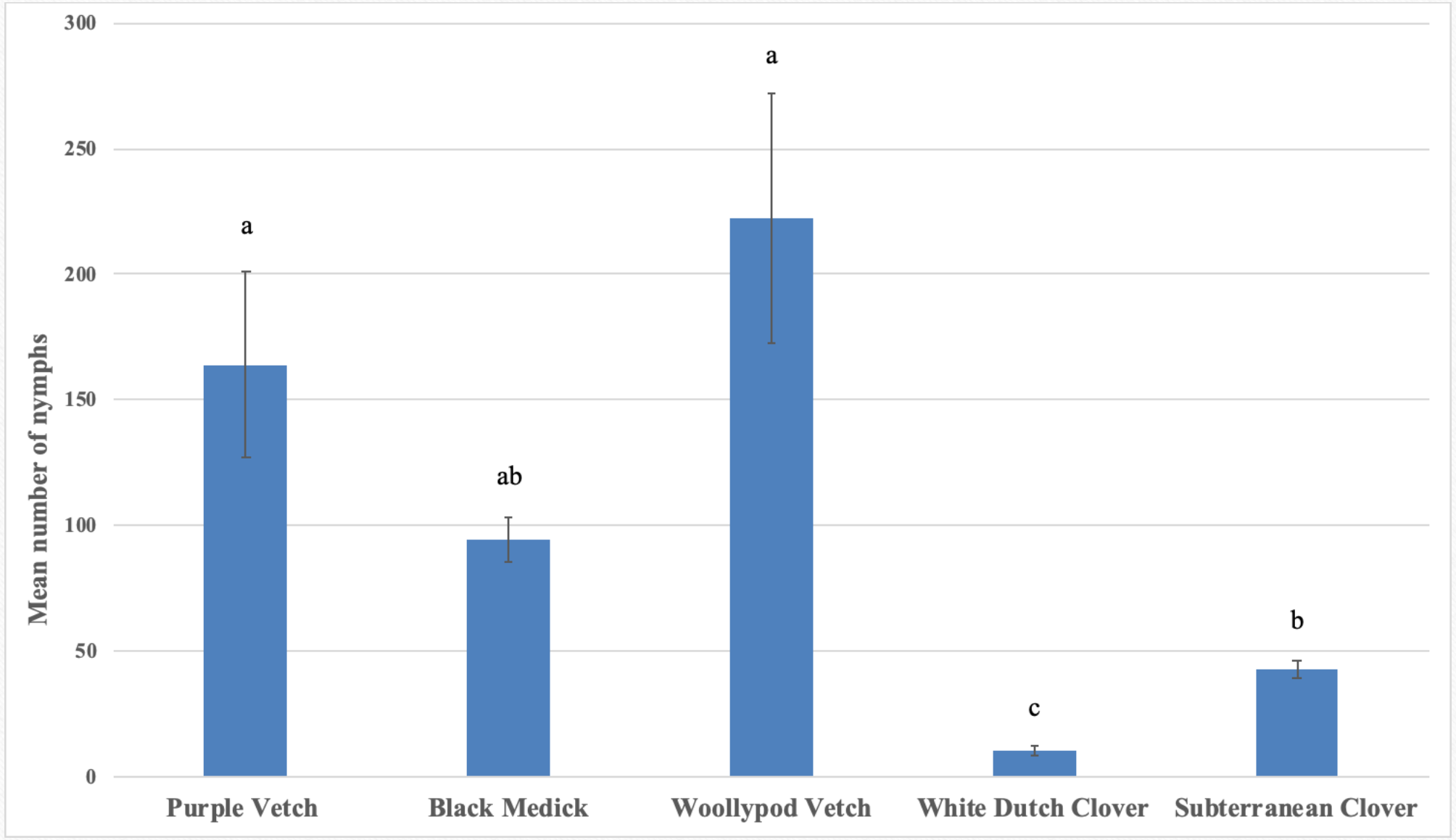

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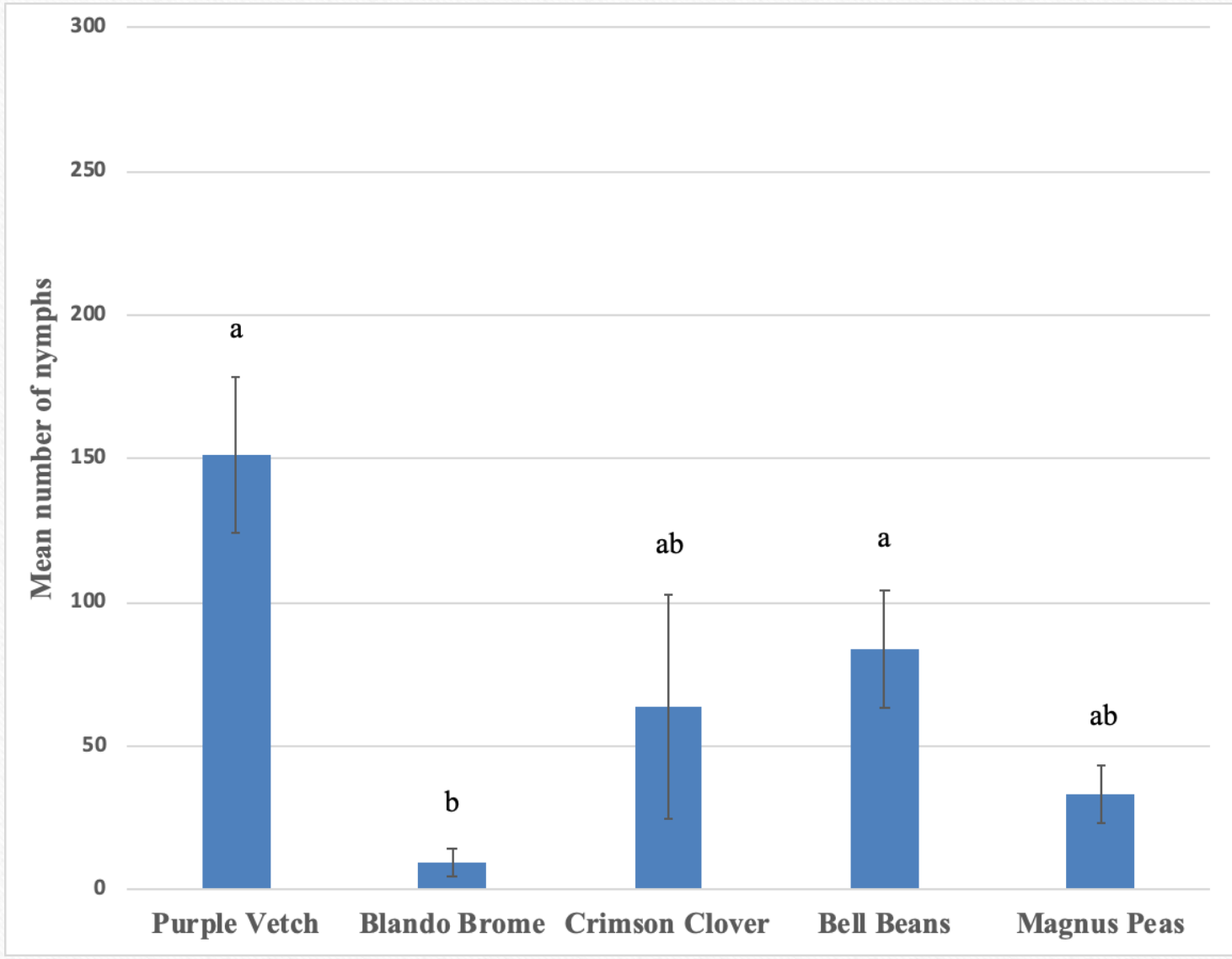

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Two non-reproductive cover crop hosts found…but growers needed more options


Two non-reproductive cover crop hosts found…but growers needed more options
We tested 15 more commonly planted cover crops

Table 1: Cover crop species tested as feeding and reproductive hosts for *Spissistilus festinus*

Scientific Name	Common Name	Family	Girdles	Nymphs[a]	% Survival[b] ± SEM
Fagopyrum esculentum	Buckwheat	Polygonaceae	Yes	Yes	96.7 ± 3.7
Triticum x secale	Trios Triticale	Poaceae	Yes	Yes	86.7 ± 3.7
Sorghum sudanense	Piper Sudangrass	Poaceae	Yes	No	76.7 ± 7.5
Secale cereale	Winter Ryegrain	Poaceae	Yes	No	73.3 ± 9.5
Lolium multiflorum	Annual Ryegrass	Poaceae	Yes	Yes	73.3 ± 4.6
Hordeum vulgare	Barley UC 937	Poaceae	Yes	No	63.3 ± 14.9
Raphanus sativus	Daikon Radish	Brassicaceae	No	No	63.3 ± 10.9
Vicia benghalensis	Purple Vetch	Fabaceae	Yes	Yes	60.0 ± 21.6
Trifolium alexandrinum	Berseem Clover	Fabaceae	Yes	Yes	20.0 ± 7.0
Lolium perenne	Perennial Ryegrass	Poaceae	No	No	3.3 ± 3.7
Vulpia myuros var. hirsuta	Zorro Fescue	Poaceae	No	Yes	0
Dactylis glomerata	Orchard Grass	Poaceae	No	No	0
Festuca rubra	Creeping Red Fescue	Poaceae	No	No	0
Festuca arundinacea	Fawn Tall Fescue	Poaceae	No	No	0
Festuca ovina spp. duriuscula	Hard Fescue	Poaceae	No	No	0
Eschscholzia californica	California Poppy	Papaveraceae	No	No	0

[a] Oviposition was indicated by nymph emergence

[b] Survival of adults for first 2 weeks on plants

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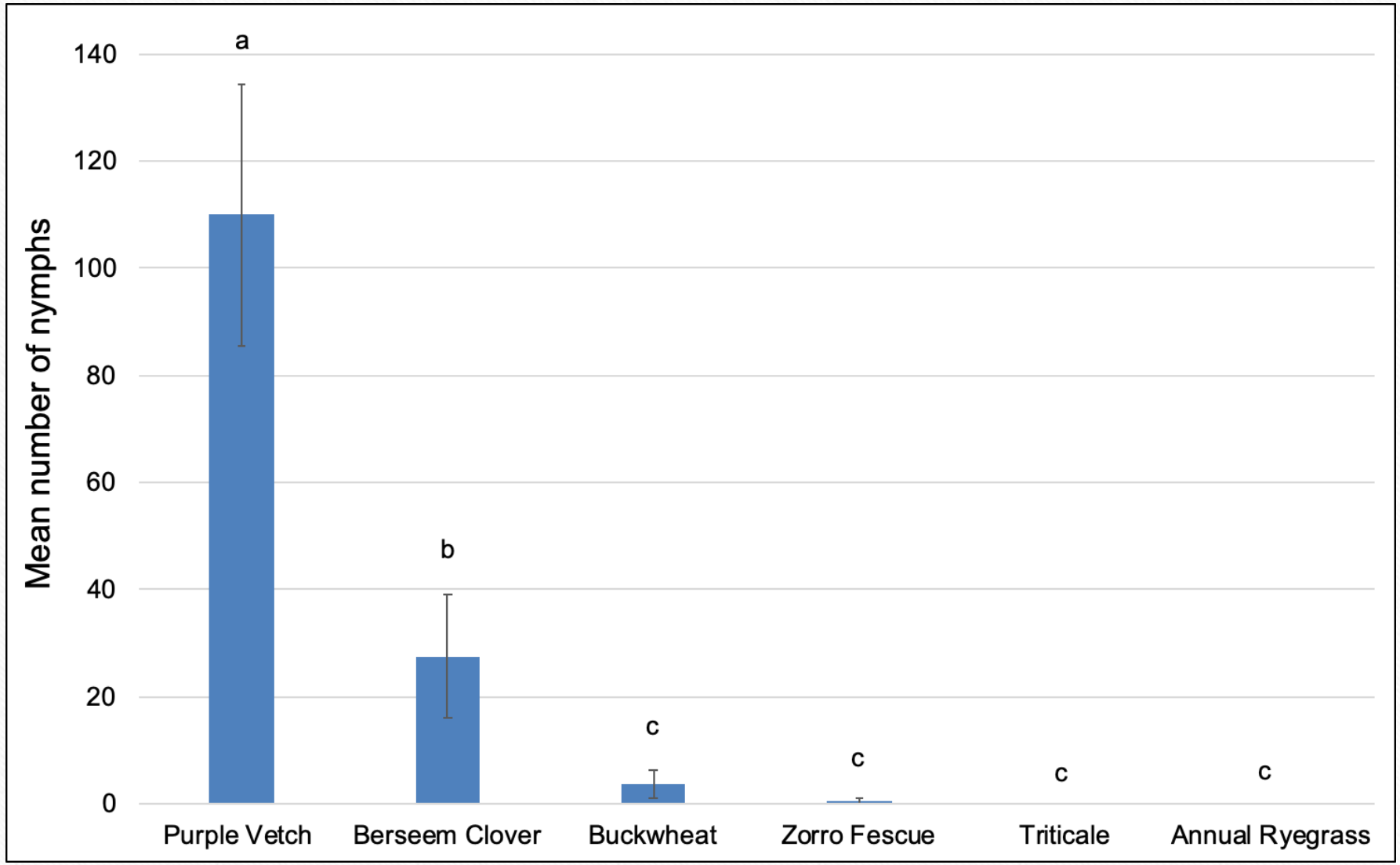

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Are grapevines a reproductive host?

Testing *Vitis vinifera* as a reproductive host of TCAH



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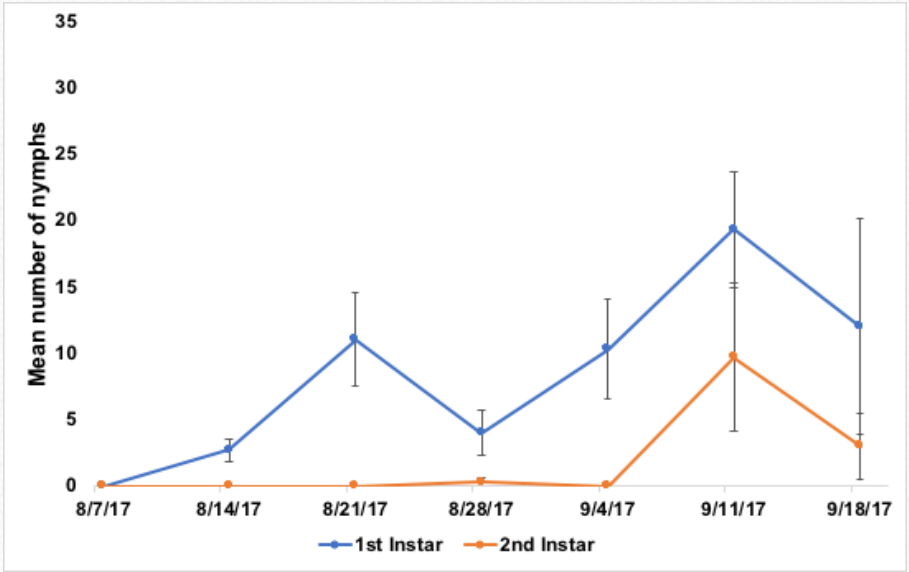
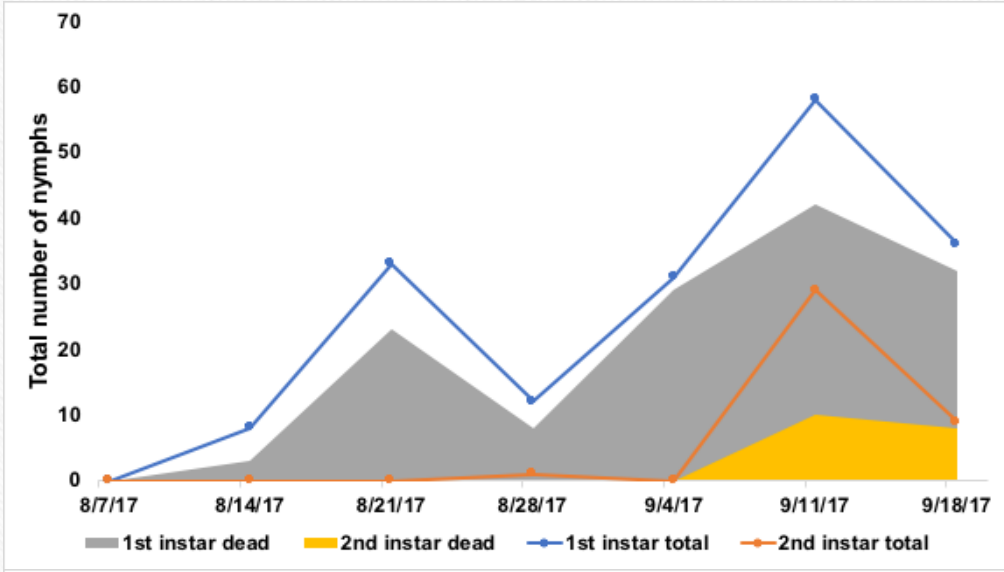
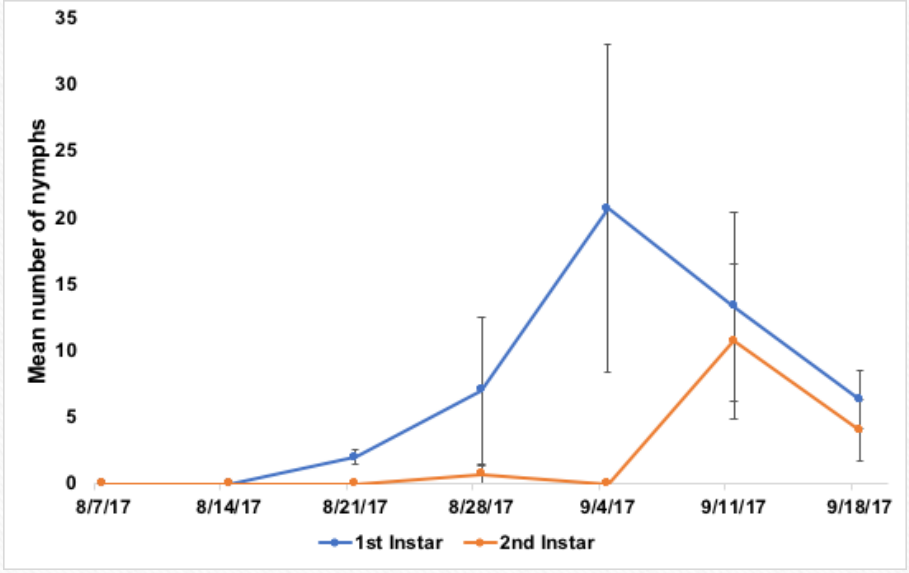

Mean number of nymphs
35
30
25
20
15
10
5
0
8/7/17
8/14/17
8/21/17
8/28/17
9/4/17
9/11/17
9/18/17
1st Instar
2nd Instar


Total number of nymphs
70
60
50
40
30
20
10
0
8/7/17
8/14/17
8/21/17
8/28/17
9/4/17
9/11/17
9/18/17
1st instar dead
2nd instar dead
1st instar total
2nd instar total

B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5
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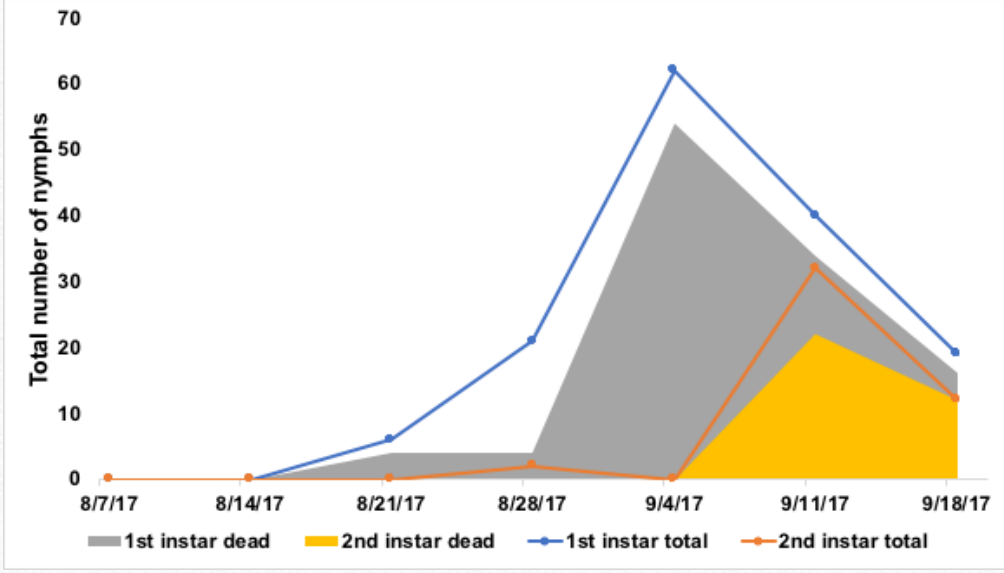
8/14/17
8/21/17
8/28/17
9/4/17
9/11/17
9/18/17
1st Instar
2nd Instar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8/21/17
8/28/17
9/4/17
9/11/17
9/18/17
1st instar dead
2nd instar dead
1st instar total
2nd instar total

How many generations do TCAH have in the vineyard?

Is there a weak point in their life cycle that can be exploited for control?

Do TCAH overwinter in the vineyard?

What is there spatial distribution?

If not, when do they arrive and leave?

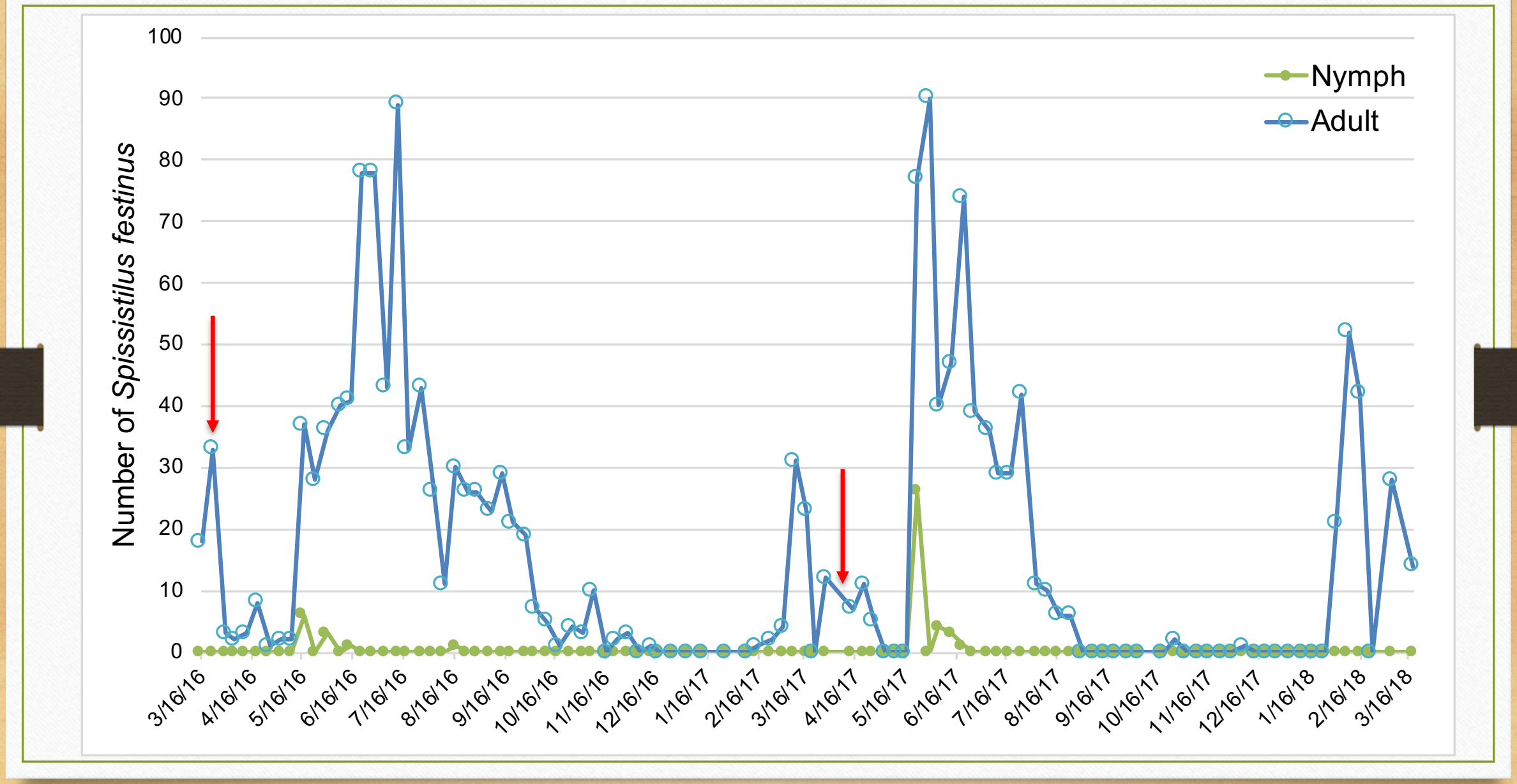
When do they girdle grapevines?

What attracts TCAH into the vineyard?

When do TCAH acquire the virus?

Seasonal dynamics of TCAH in the vineyard





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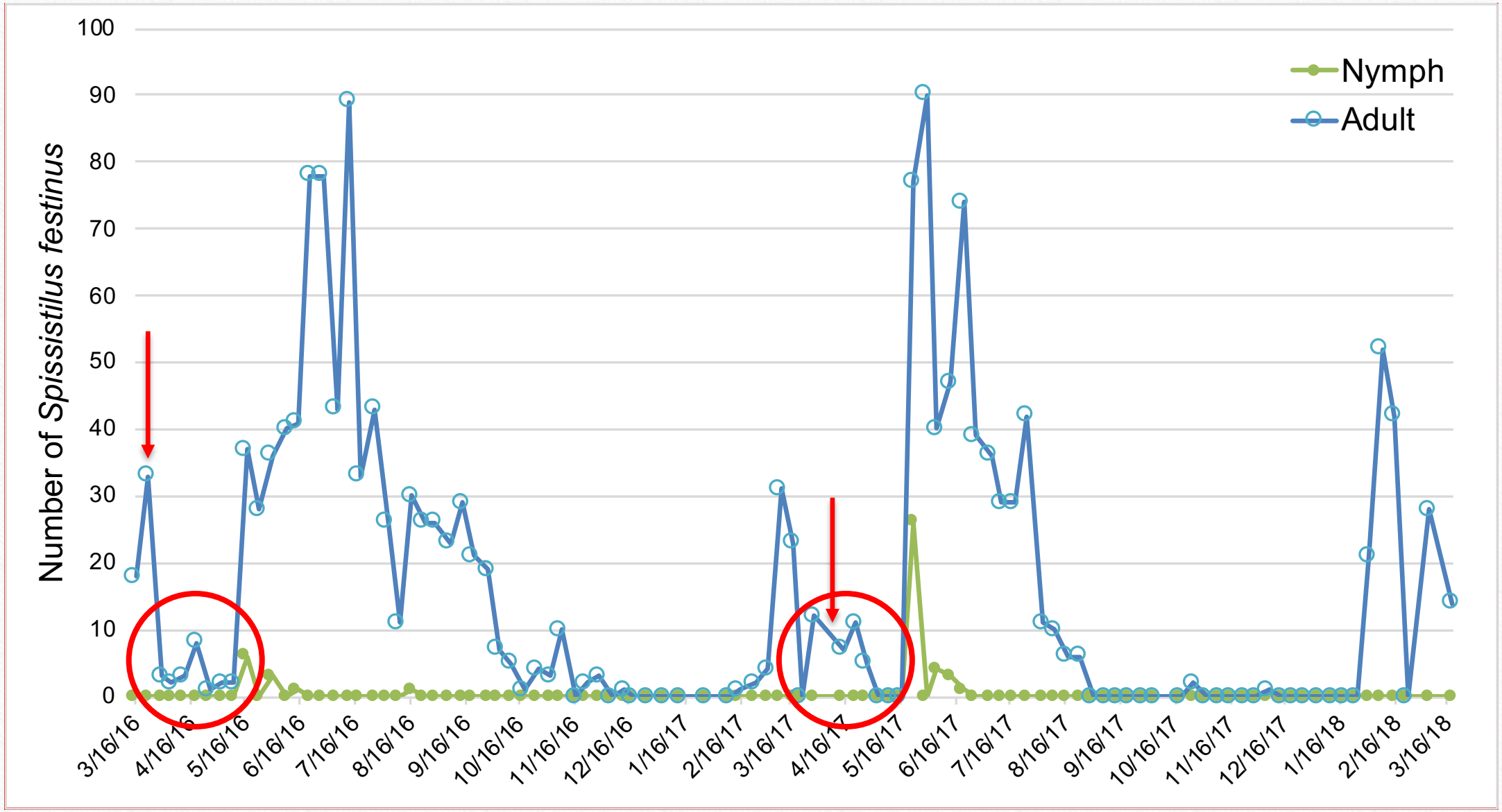

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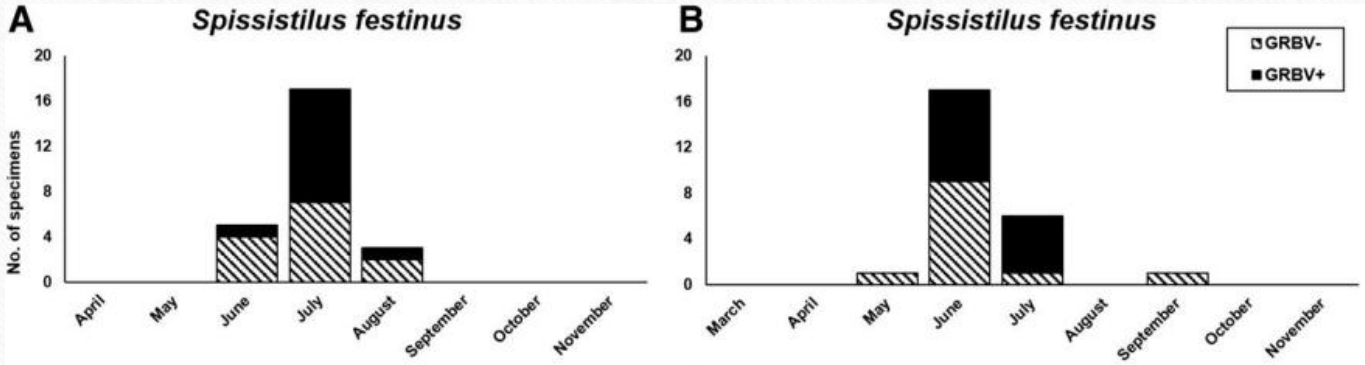

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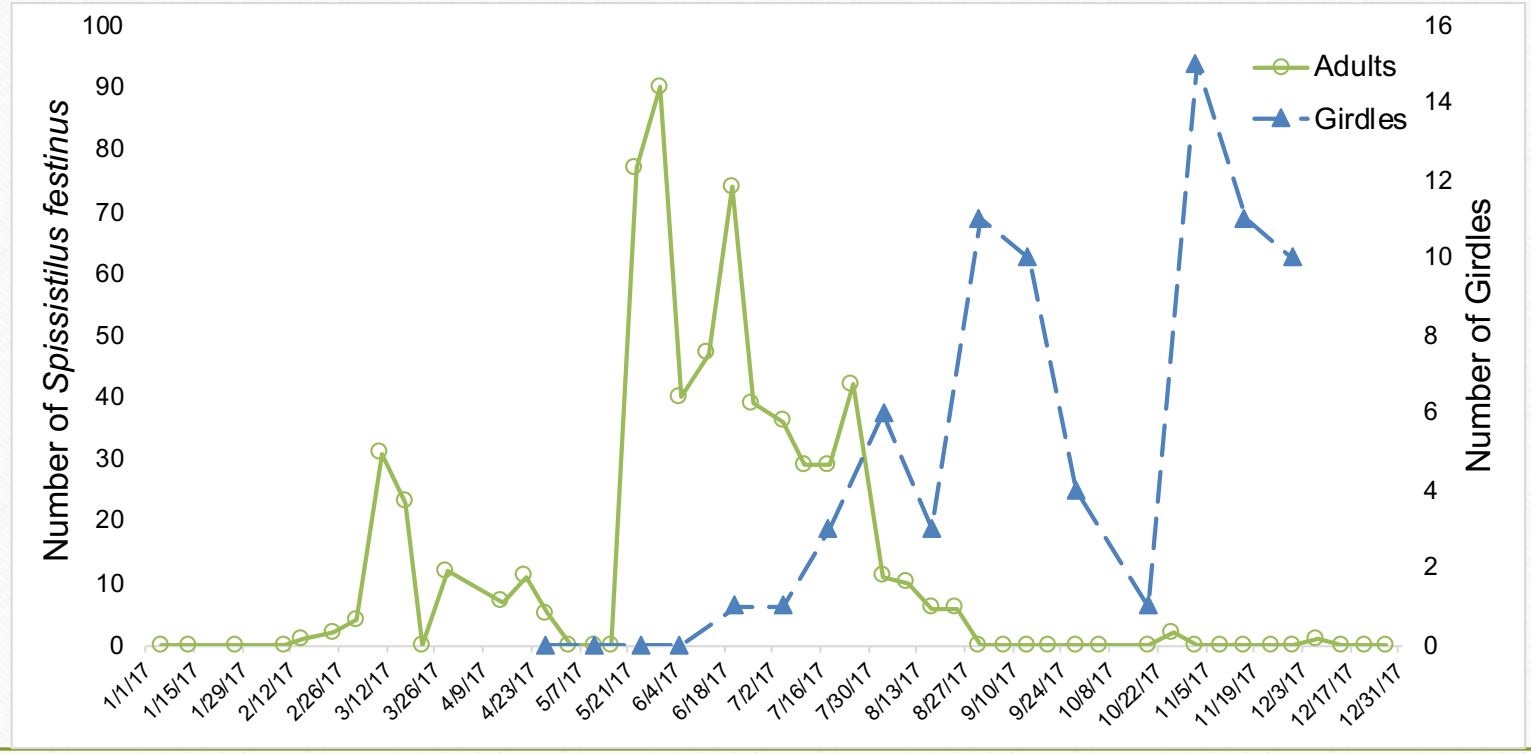

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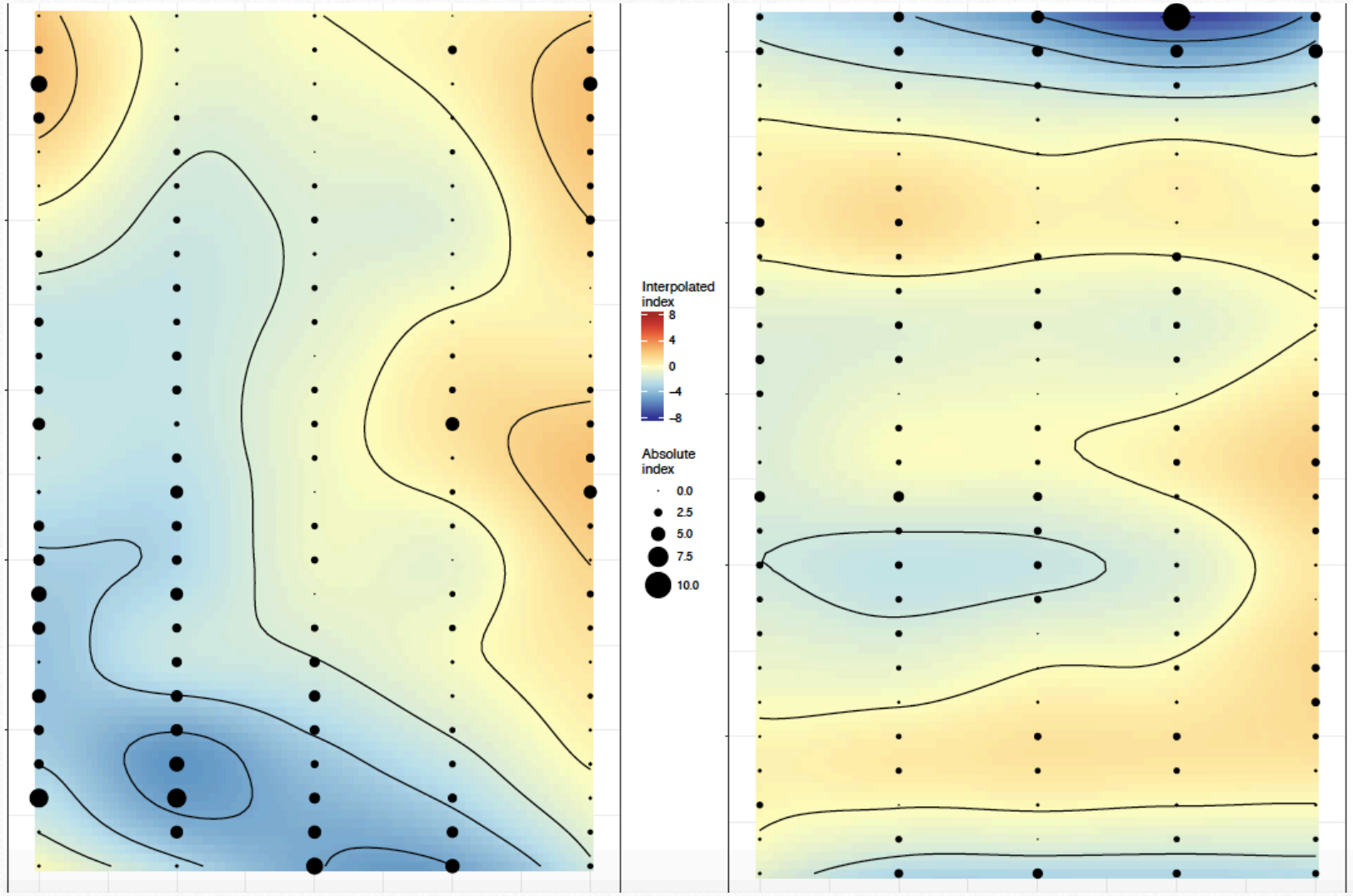

2016

2017

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What if you are a no-till vineyard, plant leguminous cover crops for Nitrogen, and are concerned about Grapevine red blotch disease in your vineyard?


What if you are a no-till vineyard, plant leguminous cover crops for Nitrogen, and are concerned about Grapevine red blotch disease in your vineyard?
Kill the cover crop with steam
Can we use biocontrol?



Hippodamia convergens adults



Cryptolaemus montrouzieri larvae



Cryptolaemus montrouzieri adults



Zelus renardii nymphs



Sympherobius barberi adults



Chrysoperla rufilabris larvae



Convergent ladybird beetle



Mealybug destroyer larvae



Mealybug destroyer adults



Assassin bug nymphs



Brown lacewing adults

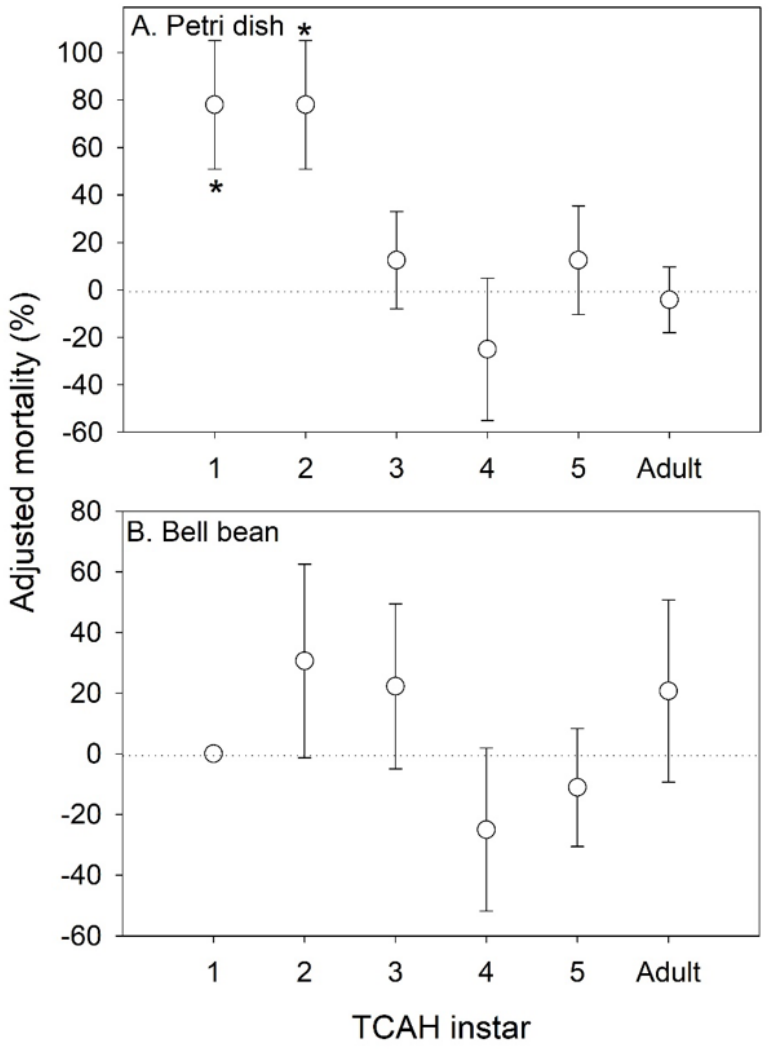


Green lacewing larvae



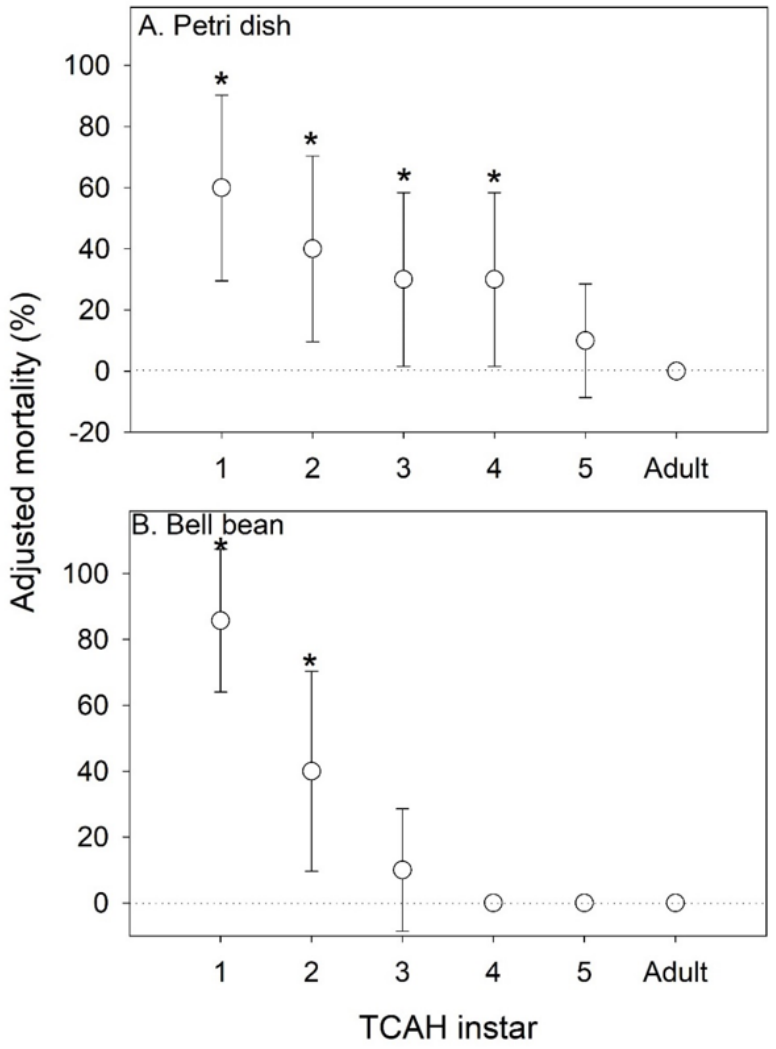


No statistically significant predation of the 5 immature stages and adults of the three-cornered alfalfa hopper by these commercially available predators



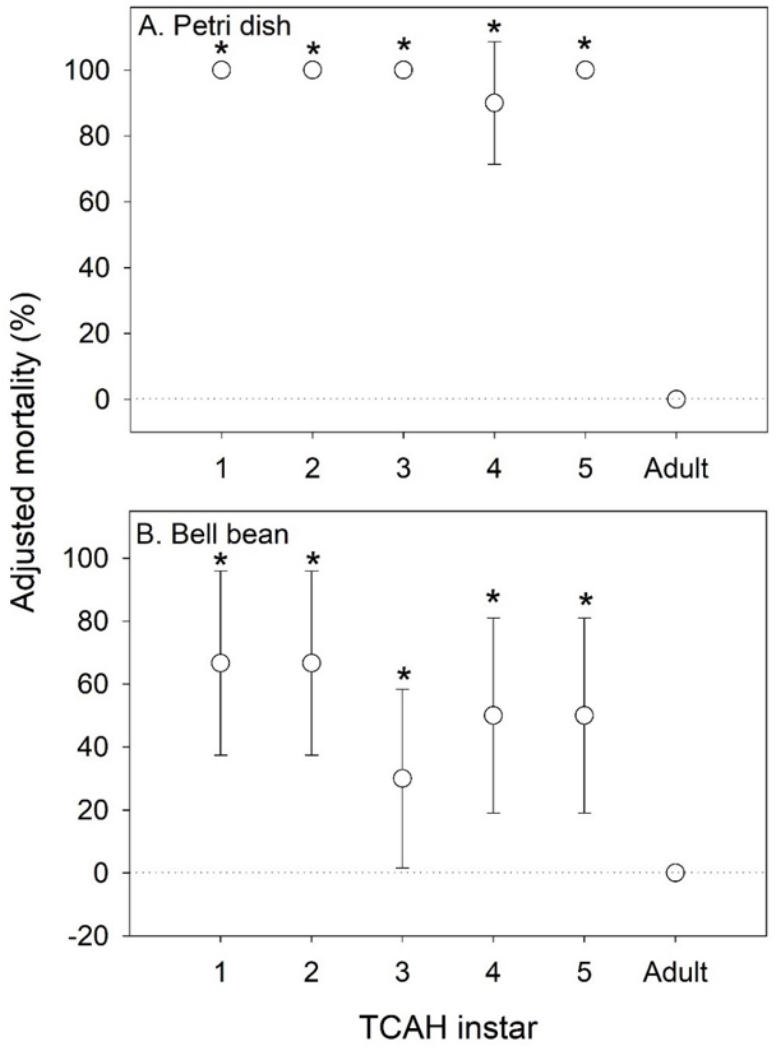


Assassin bug nymphs
(*Zelus renardii*)





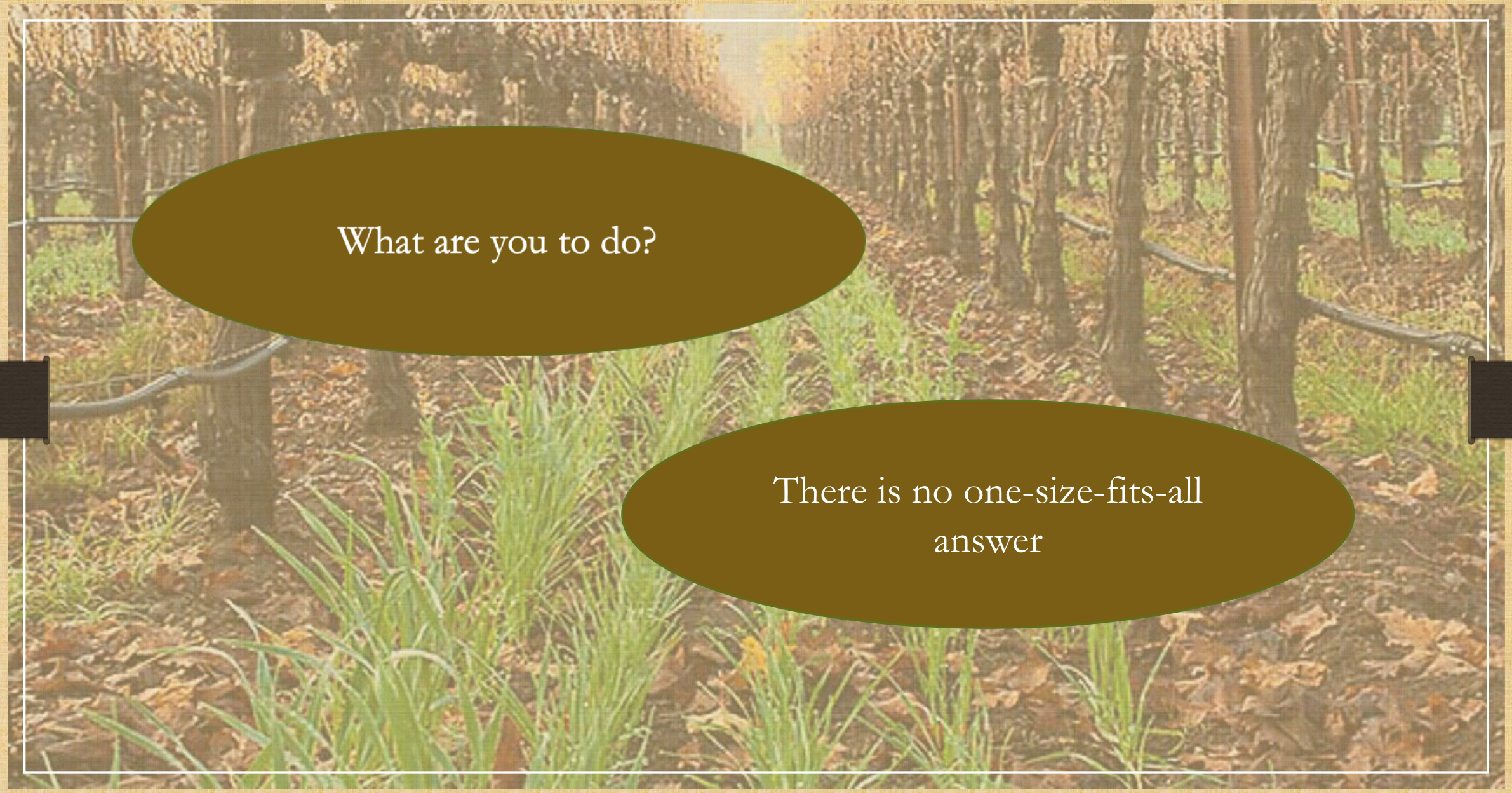
Convergent ladybird beetle adults (*Hippodamia convergens*)





Green lacewing larvae
(*Chrysoperla rufilabris*)


What are you to do?


What are you to do?
There is no one-size-fits-all answer

- What is your GRBD pressure? Do you have red blotch and if so, to what degree? Is it spreading in your vineyard?
- Do you have three-cornered alfalfa hopper?
- Are you rogueing infected vines?
- Is your vineyard secluded from other vineyards or do you have neighboring vineyards? Do your neighbors have red blotch?
- Is your vineyard near planted legumes such as an alfalfa field?
- Do you plant a cover crop and if so, what are your reasons for planting a cover crop? Nitrogen? Weed competition? Erosion control?
- Does your resident vegetation include leguminous weeds?
- Do you till under your cover crop or resident vegetation in spring?

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Research

Arthropods in Relation to Plant Disease

Feeding and Reproductive Hosts of *Spissistilus festinus* (Say) (Hemiptera: Membracidae) Found in Californian Vineyards

Cindy R. Preto,[1,3] Mysore R. Sudarshana,[2] and Frank G. Zalom[1]

Journal of Insect Science, (2018) 18(6): 20; 1–7
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Short Communication

Vitis vinifera (Vitales: Vitaceae) as a Reproductive Host of *Spissistilus festinus* (Hemiptera: Membracidae)

Cindy R. Preto,[1,3] Mysore R. Sudarshana,[2] Michael L. Bollinger,[1] and Frank G. Zalom[1]

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Research

Ecology and Behavior

Seasonal Dynamics of *Spissistilus festinus* (Hemiptera: Membracidae) in a Californian Vineyard

Cindy R. Preto,[1,4] Brian W. Bahder,[2] Emily N. Bick,[1] Mysore R. Sudarshana,[3] and Frank G. Zalom[1]

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Research Article

Identification of Non-Host Cover Crops of the Three-Cornered Alfalfa Hopper (*Spissistilus festinus*)

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