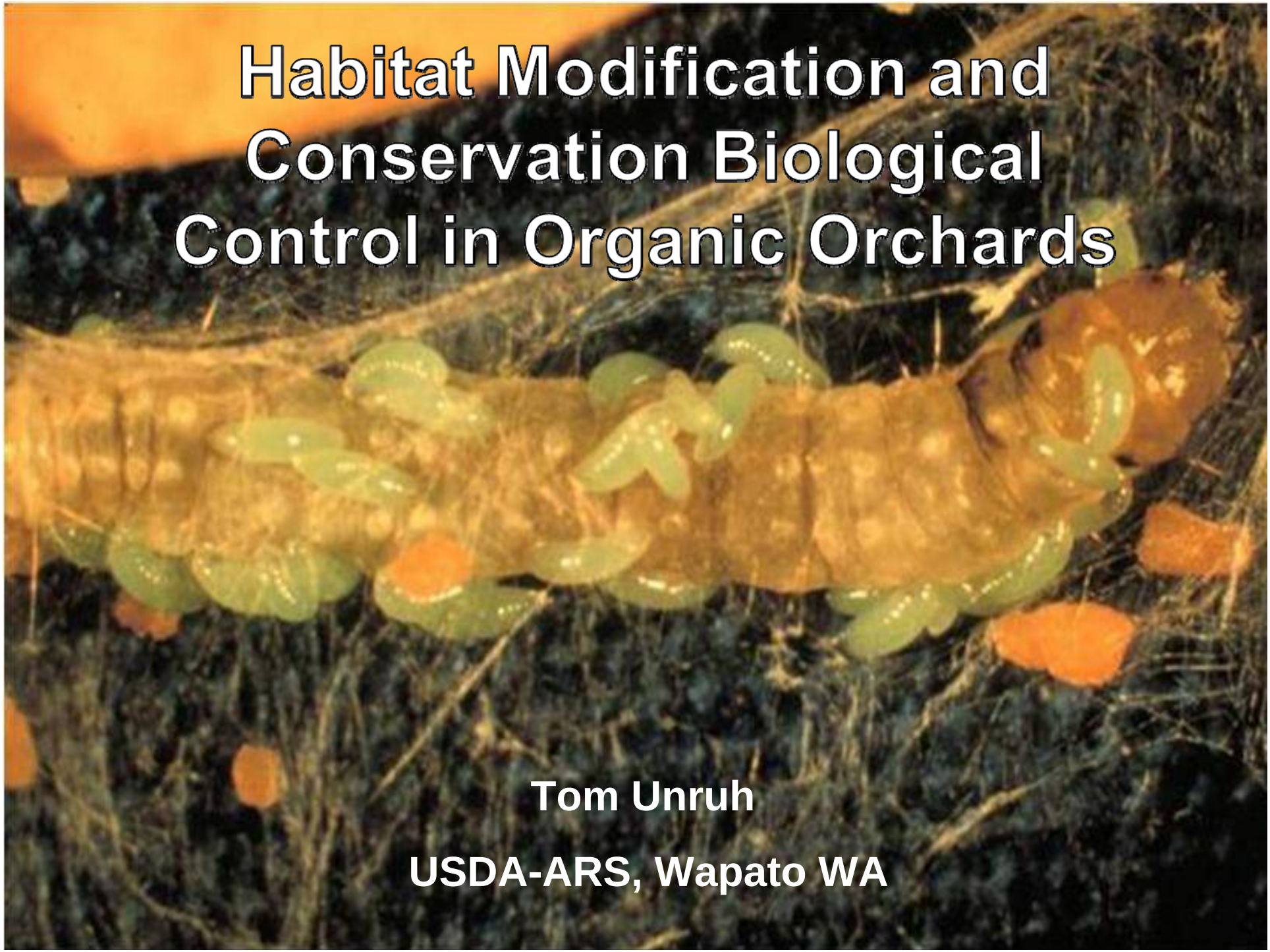


Habitat Modification and Conservation Biological Control in Organic Orchards

Tom Unruh

USDA-ARS, Wapato WA

Acknowledgements

Colleagues Bob Pfannenstiel, Jay Brunner and grower-horticulturalist Cathy Peters made this work possible. Laura Willett, Kelly Archer, Francisco De La Rosa, Jeff Upton, Brad Sainsbury and many others did the were indispensable technical help. Vince Jones provided dispersal/marking data; Dave Horton and Gene Miliczky provided general information on habitat modifications for predators and shared their hard-earned knowledge of the insect predators in orchards

Outline

- General introduction to Conservation biological control
- Our shrub-steppe and riparian habitat
- The rose-garden leafroller story
- Future studies on conservation biological control

Conservation Biological Control

1. **Provide alternate habitats for overwintering or off season**
2. **Provide alternate hosts or prey**
3. Reduce agricultural practices that disrupt biocontrol agents (dust abatement)
4. Improved pesticide practices to minimize disruption of biocontrol

Grower know that bio-control is better in orchards next to certain habitats.

Willow psyllid

Anthocoris antevolens

Dave Horton's work on *Anthocoris* predators

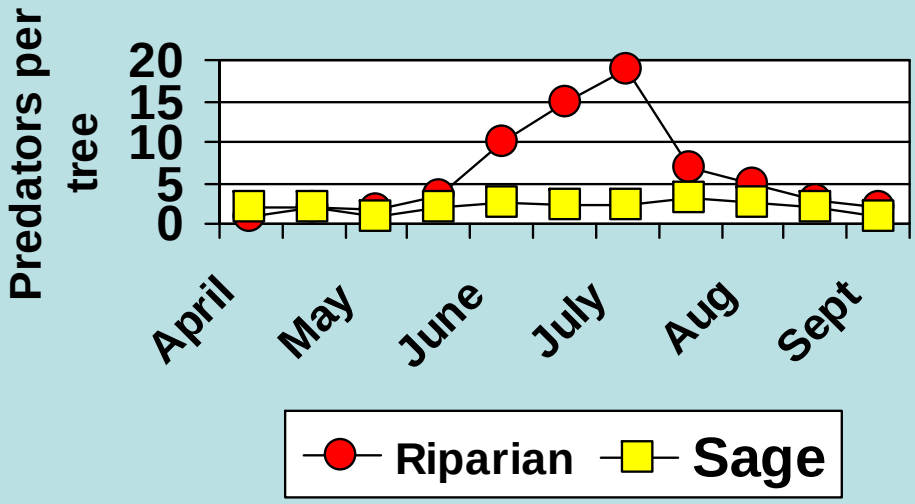
My own work on the wasp *Colpoclypeus florus* found attacking a non-pest in roses in riparian habitats

Wild rose adjacent to Yakima river

Colonization of potted trees

Riparian	Sage
Rose	Lupine
Cottonwood	Sage
Willow	Bitterbrush

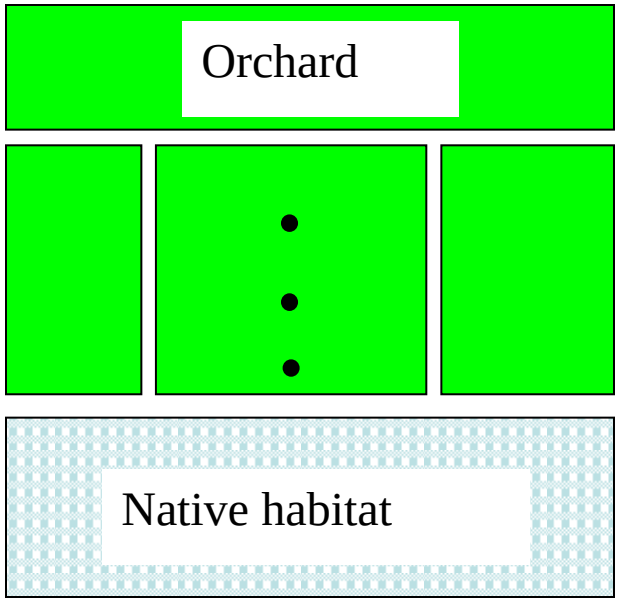
(From Rathman and Brunner)

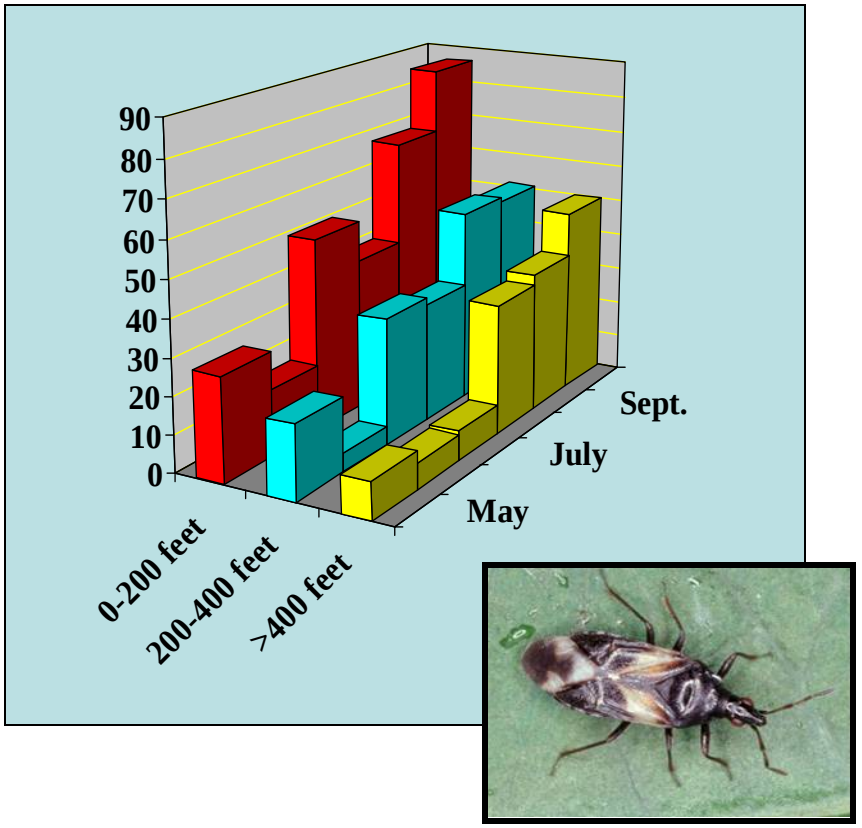


Predator types	Riparian	Sage
Mites	20%	0
Spiders	18%	65%
Beetles	5%	12%
Flies	27%	0
True bugs	10%	17%
Lacewings	20%	6%

Colonization of orchards

(from native habitat; Miliczky & Horton)





The problem

- Leafroller complex, especially *Choristoneura rosaceana,* OBLR, and *Pandemis limitata,* PLR, can damage more than 25% of a crop
- LR are often responsible for as much damage to the fruit as codling moth
- One or two pesticide applications are often used in conventional orchards
- There are many parasitoids that attack LRs but they may be unreliable in effecting control – especially in pesticide disrupted orchards

Oblique banded leafroller

The key players: *Colpoclypeus florus*

- Jay Brunner *C. florus* WA orchards in 1992
- It was collected in Italy and released in Ontario 1968 for control of Red-banded and Strawberry leafrollers
- It causes very low parasitism of the spring (overwintering cohort) of LR larvae both here and in Europe

***Colpoclypeus florus* attacking OBLR**

***Colpoclypeus florus* larvae on OBLR**

The key players: *Ancylis comptana*

- *C. florus* overwinter on *Ancylis comptana* (SLR) on *Rosa woodsii*, *R. nutkana and* in strawberry gardens
- SLR overwinters as a large larva and is the main over wintering host for *C. florus.*
- Our pest LRs overwinter as small larvae that don't support *C. florus* overwintering
- Thus *C. florus* must leave orchards to find suitable overwintering hosts (=SLR) in surrounding landscapes

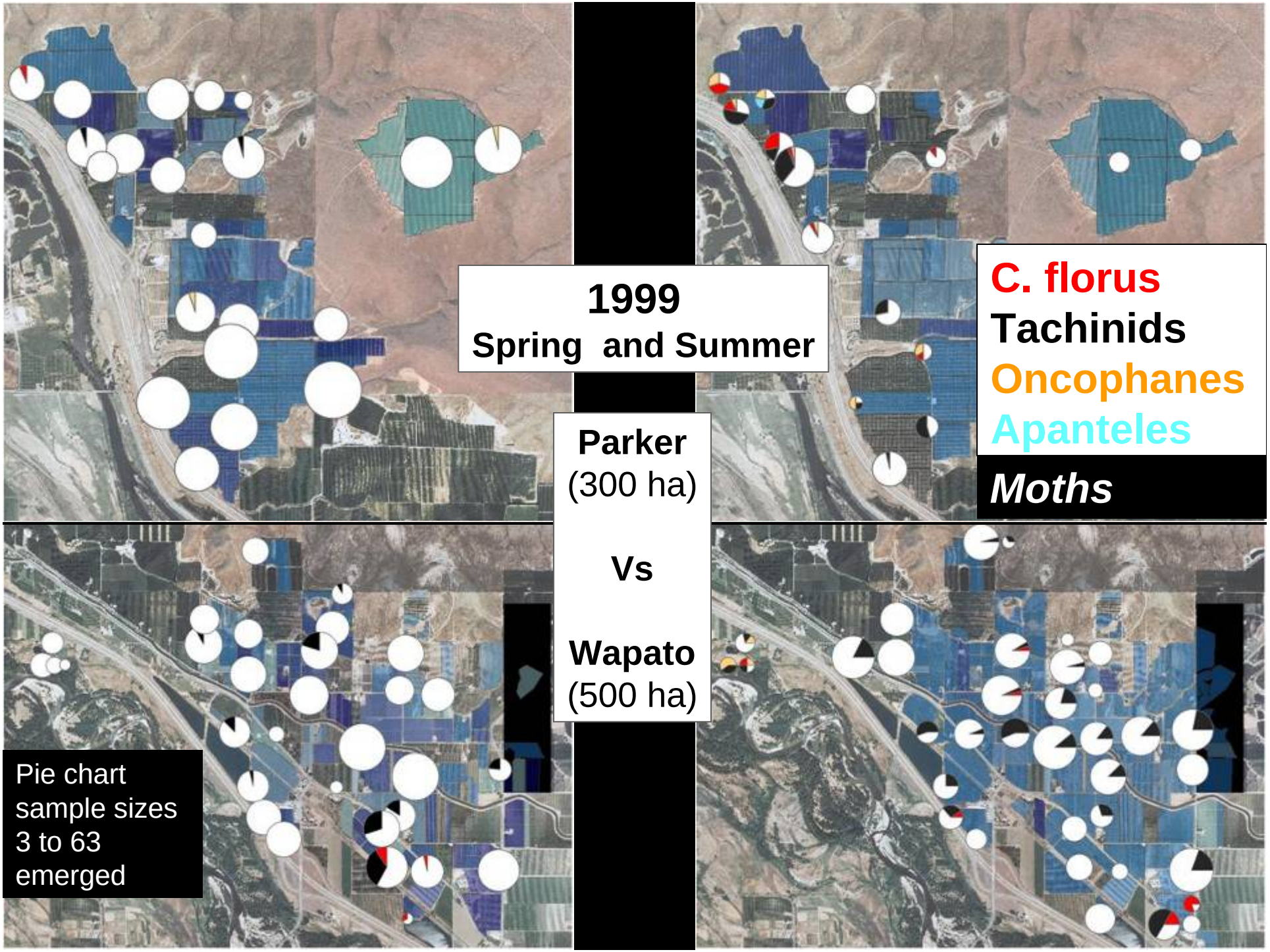
We hypothesized that we could increase parasitism by planting rose near to orchards

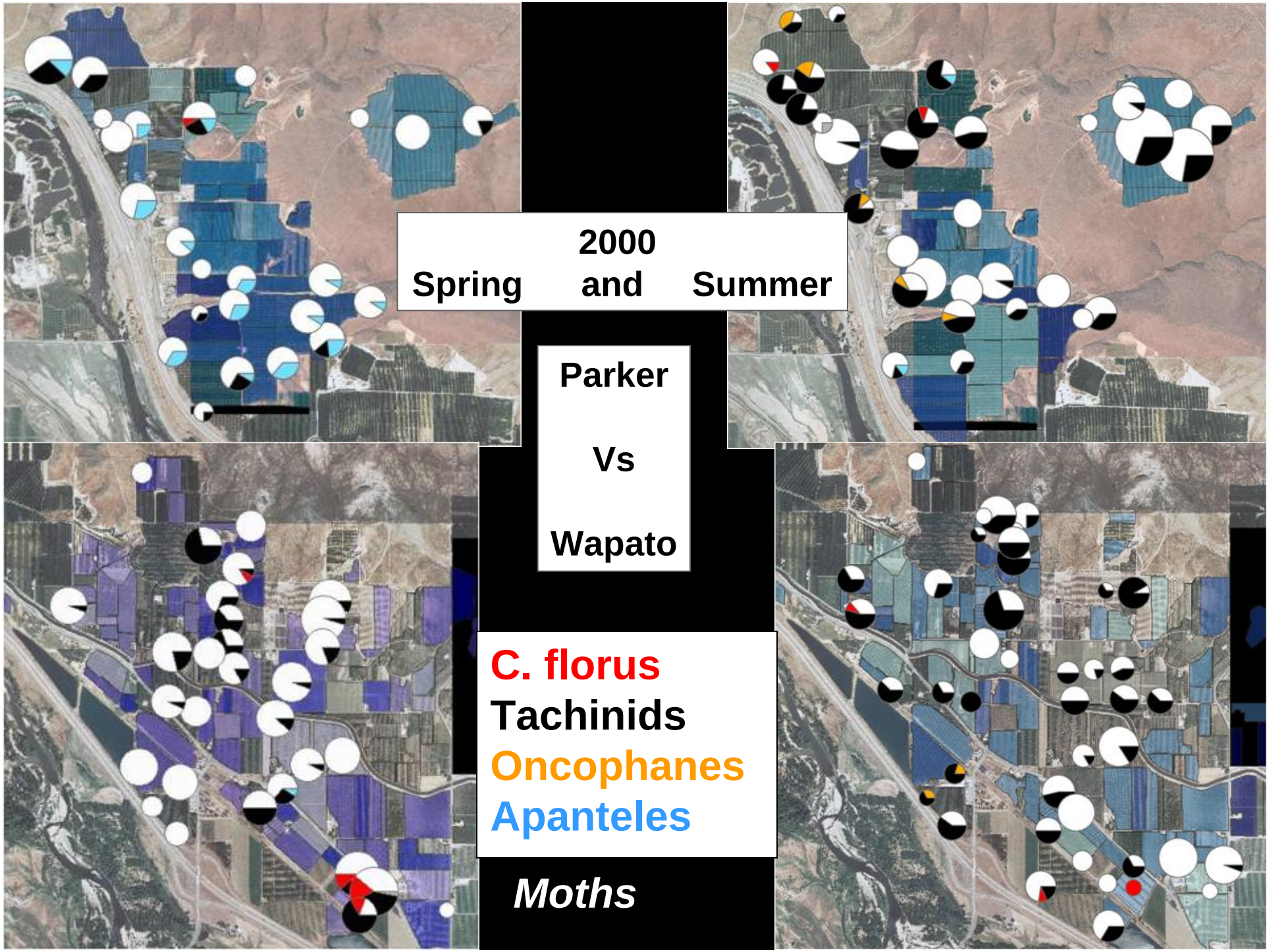
We tested this idea by:

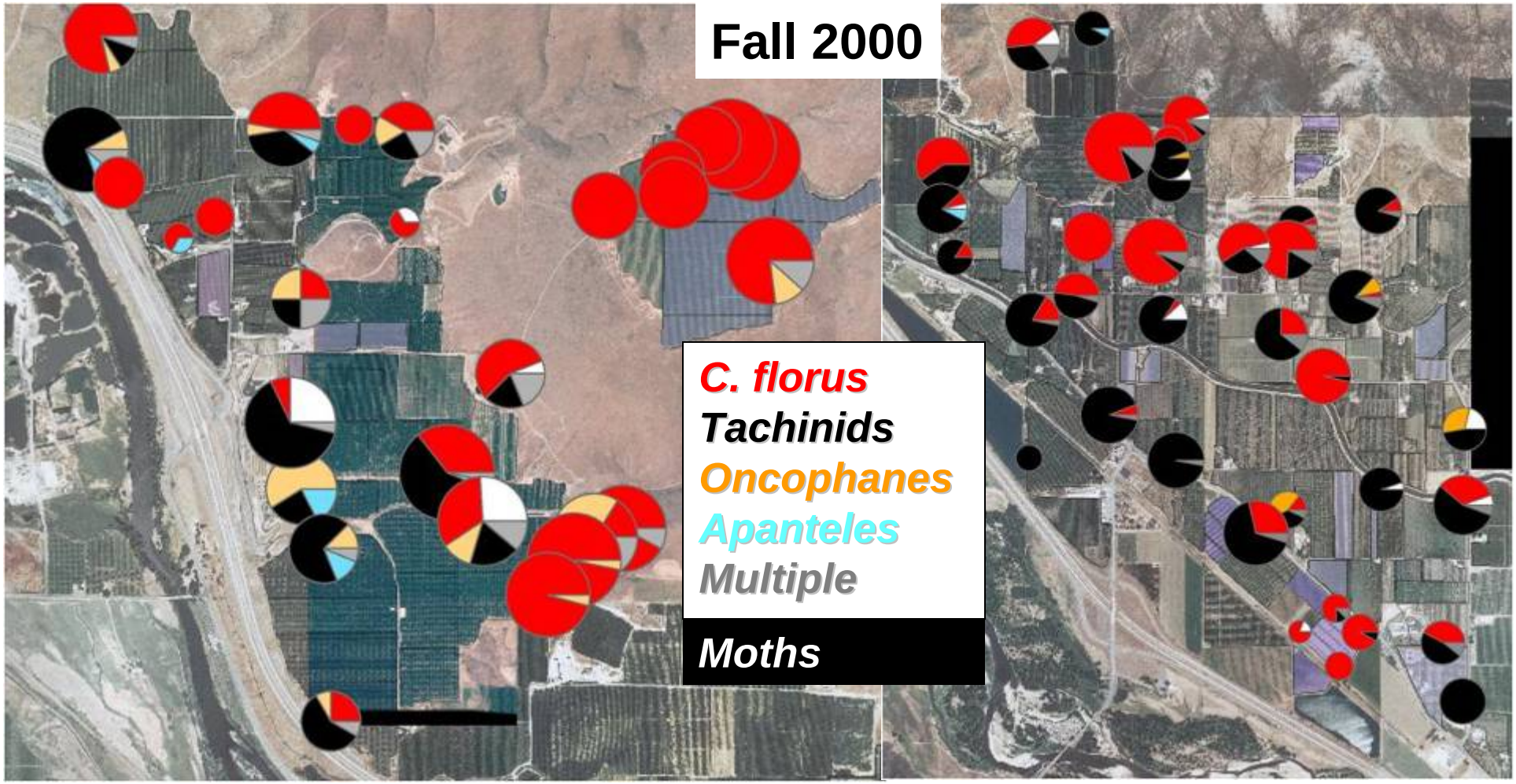
1) describing parasitism in a fairly typical landscape with distant riparian habitats

and

2) Then we planted rose and strawberry gardens in 4 spots in this landscape and observed


1999
Spring and Summer
Parker
(300 ha)
Vs
Wapato
(500 ha)
C. florus
Tachinids
Oncophanes
Apanteles
Moths
Pie chart sample sizes 3 to 63 emerged


Spring
2000
and
Summer
Parker
Vs
Wapato
C. florus
Tachinids
Oncophanes
Apanteles
Moths

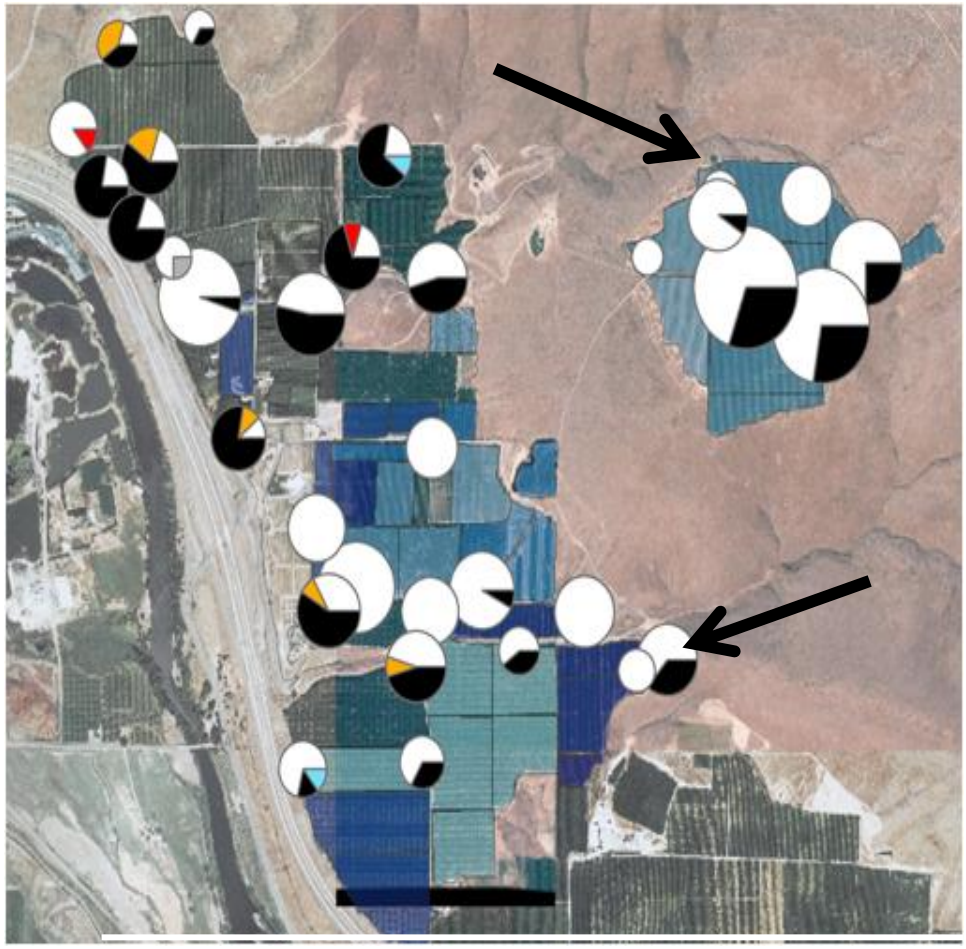


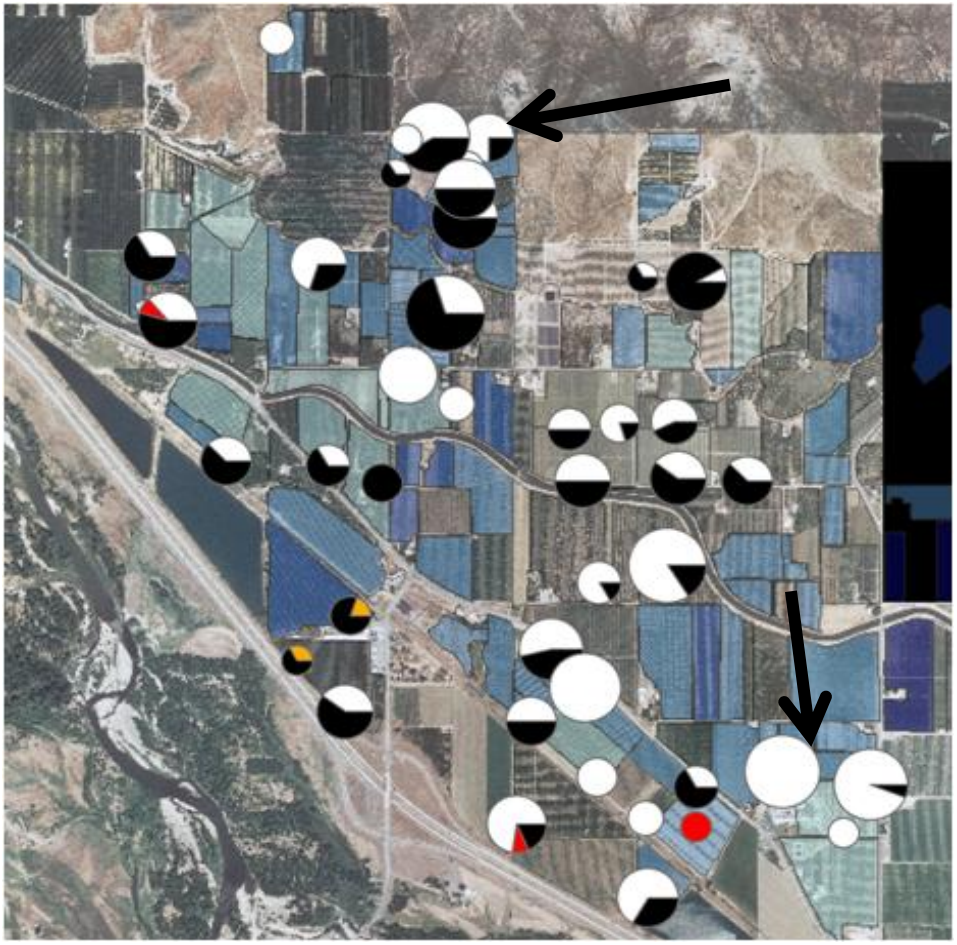
Late September when no suitable sized hosts occur in orchards or the grass-sage habitat, *C. florus* was abundant and heavily parasitized the 4th instar OBLR-infested potted trees we deployed. If SLR occurred in this area they would be attacked in fall.

Messages from landscape study
(based on mixed model ANOVA)

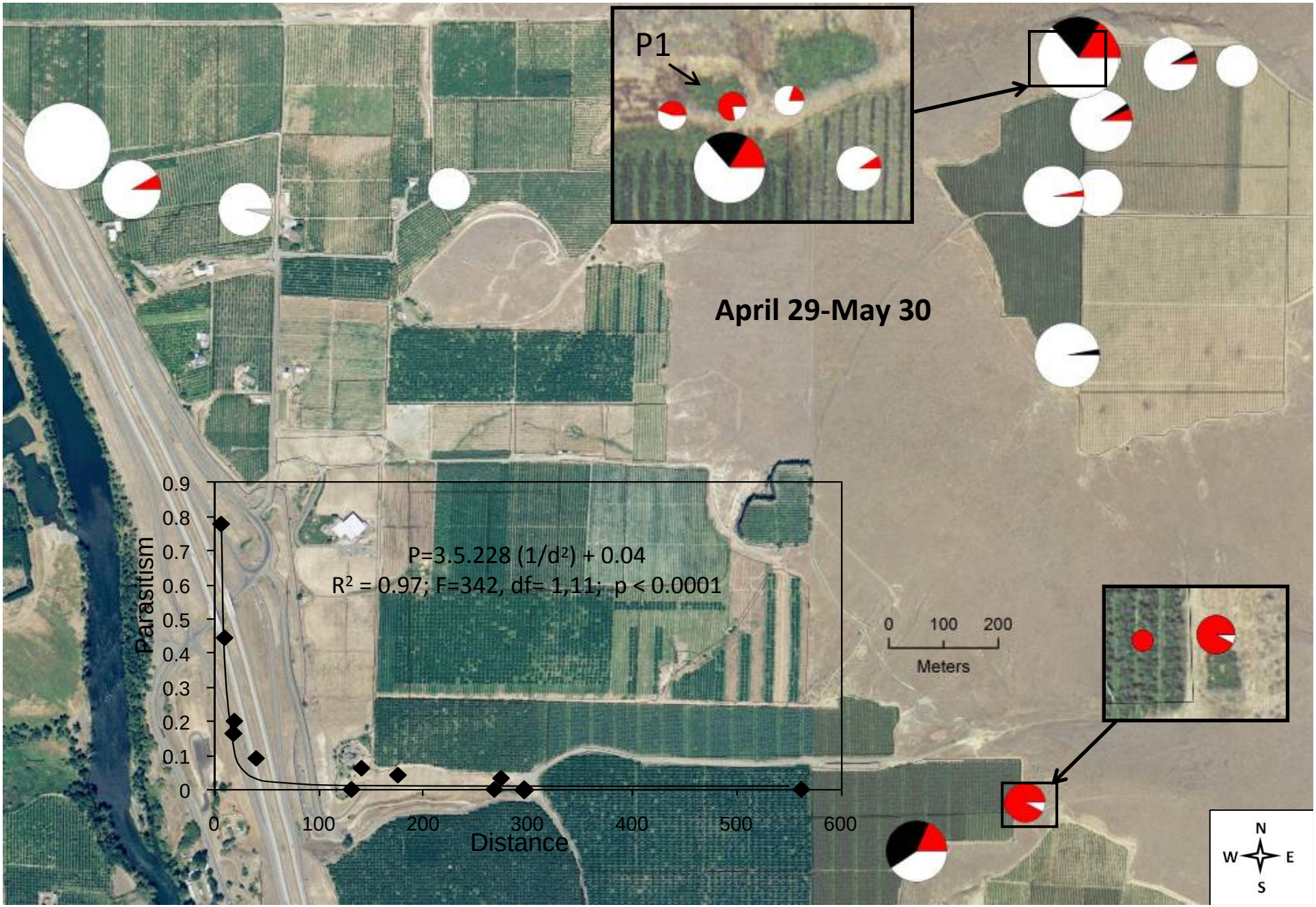
- 10 % parasitism in spring and 35% in summer (all species of parasitoids)
- Tachinids were the dominant parasitoids
- Parasitism by *C florus* was higher the closer to riparian habitats
- We identified areas, particularly those distant from the Yakima River, where no parasitism by *C. florus* was observed in two consecutive years
- ***Here was where we planted gardens***

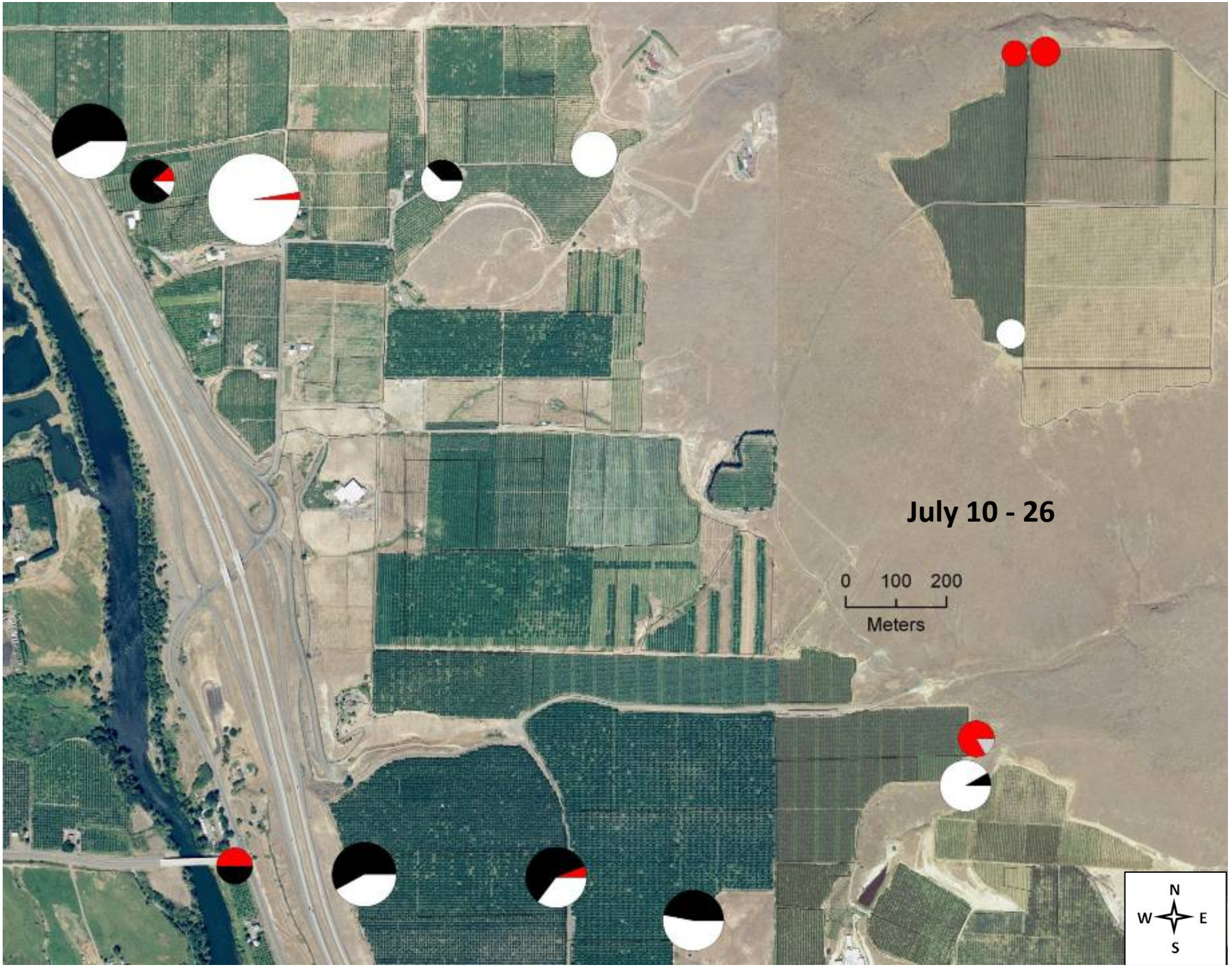
Then we planted rose gardens

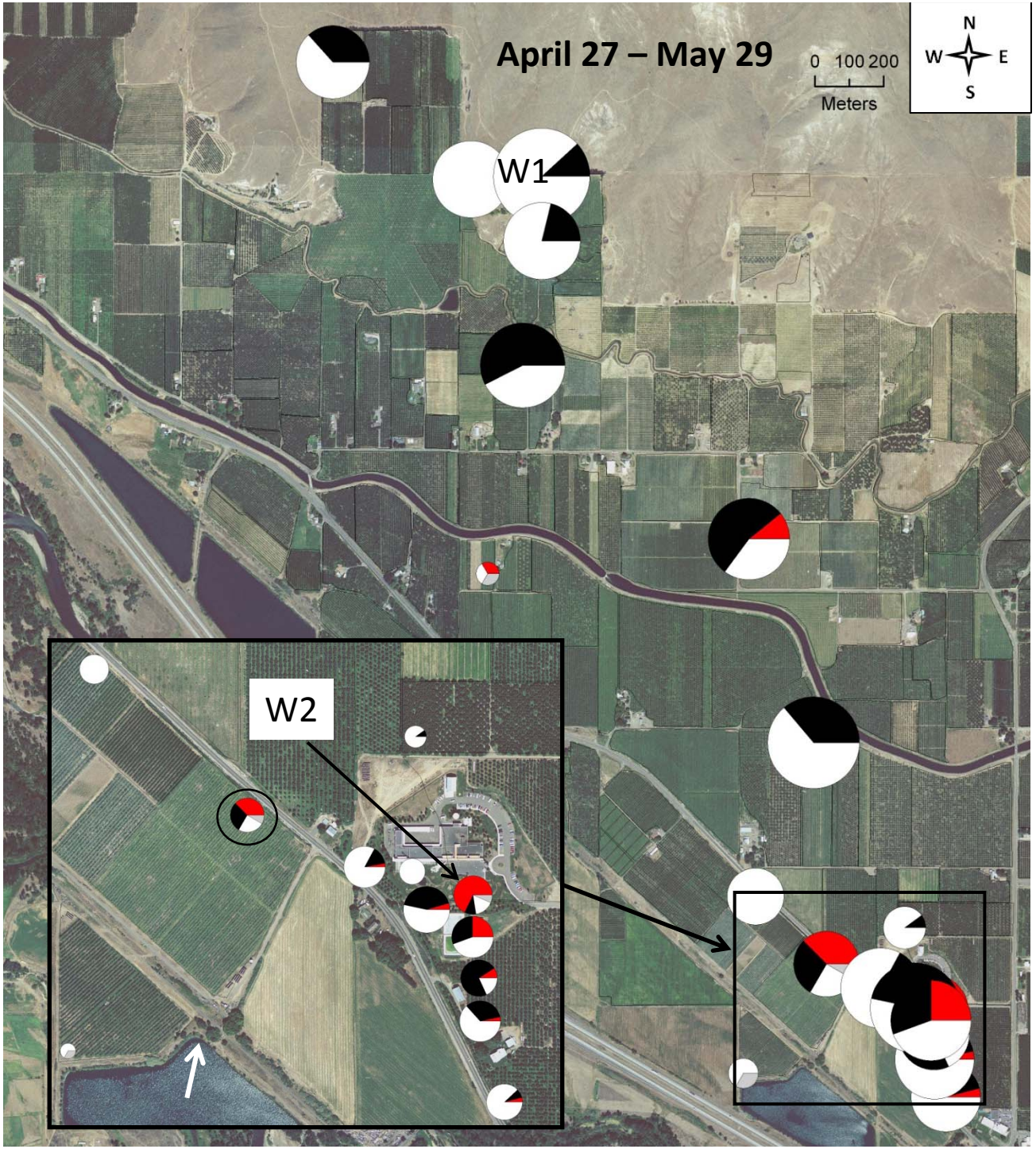


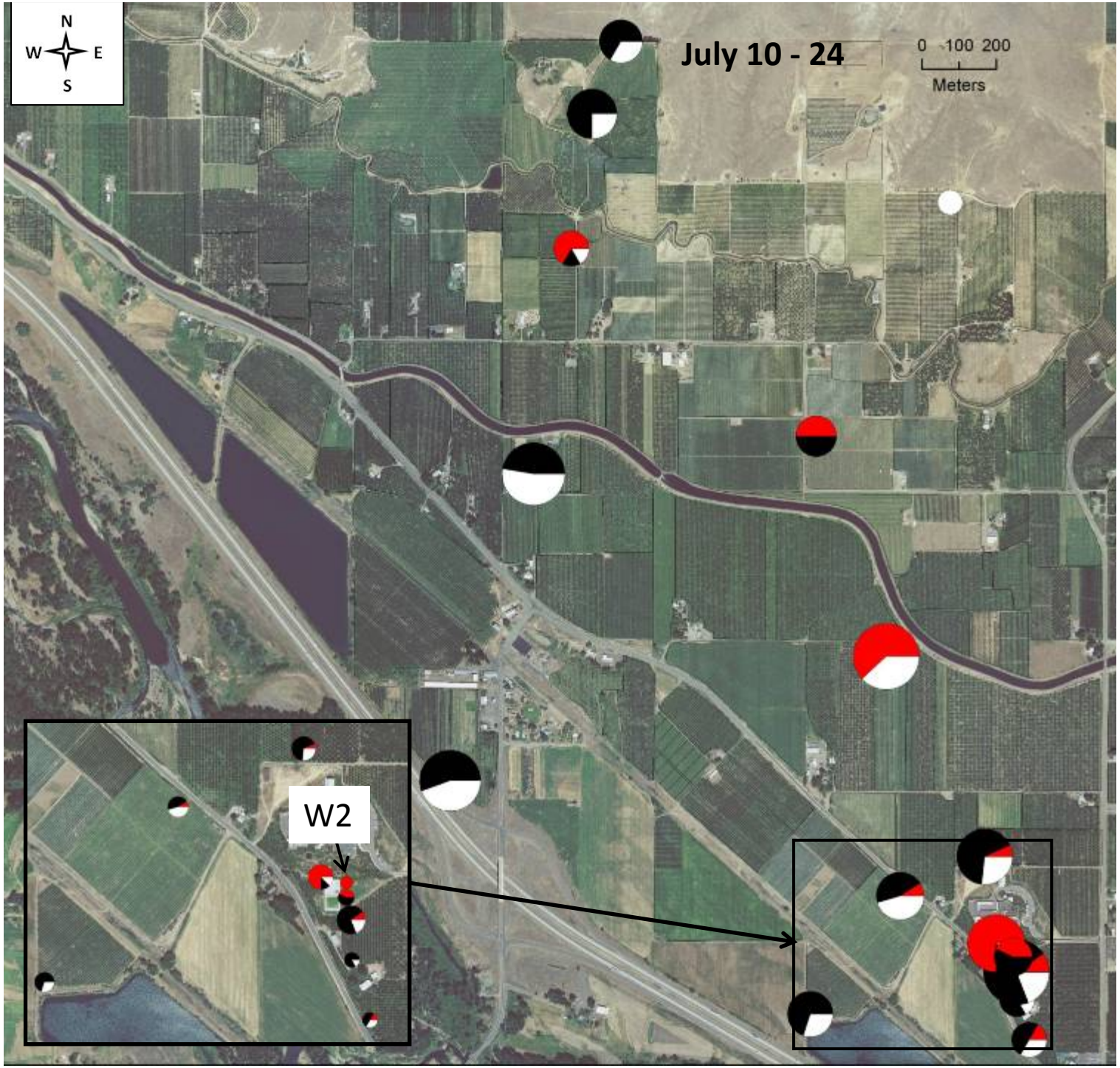


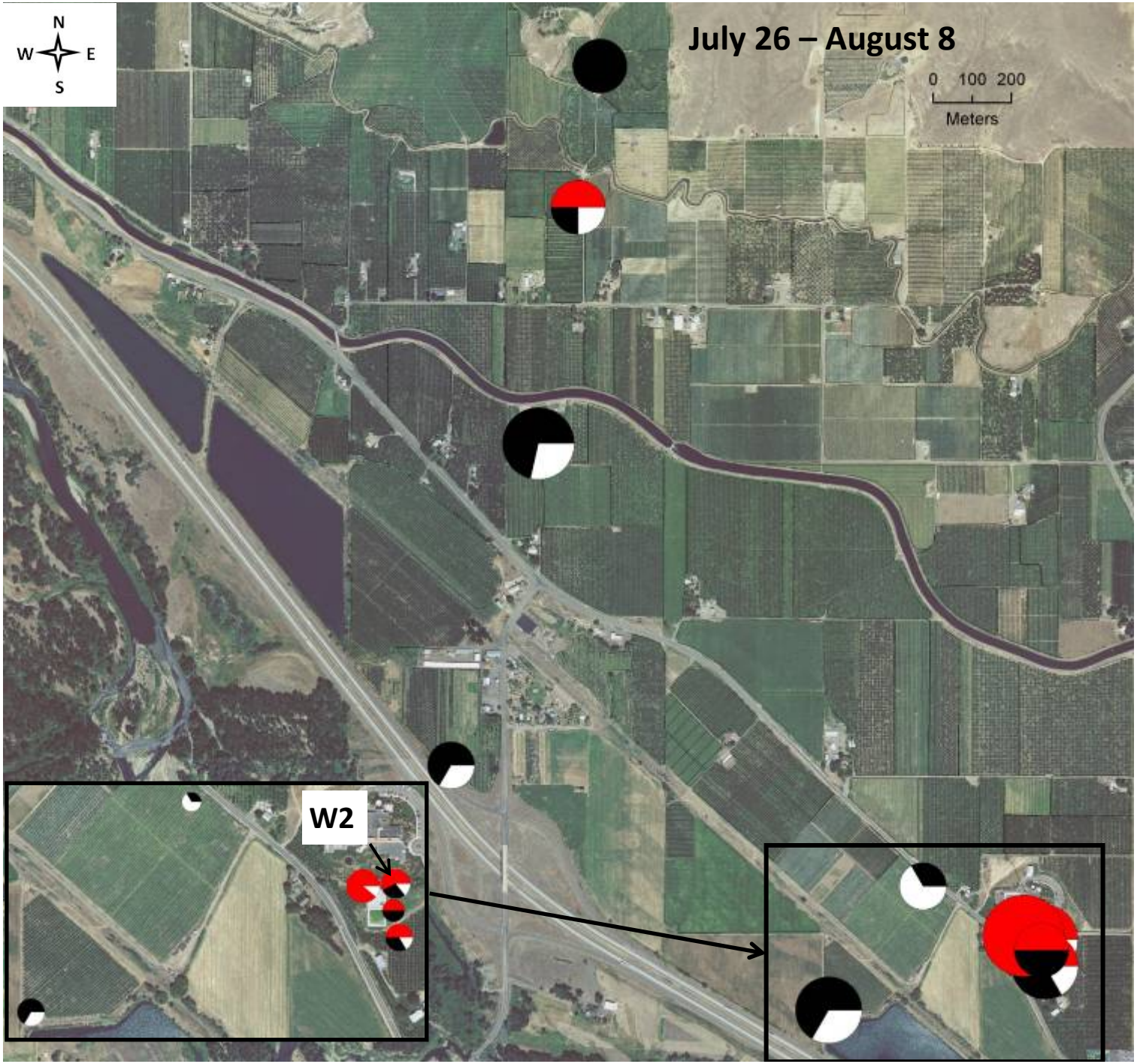

PLATH ORCHARD
UPPER PLATH
10-22-03

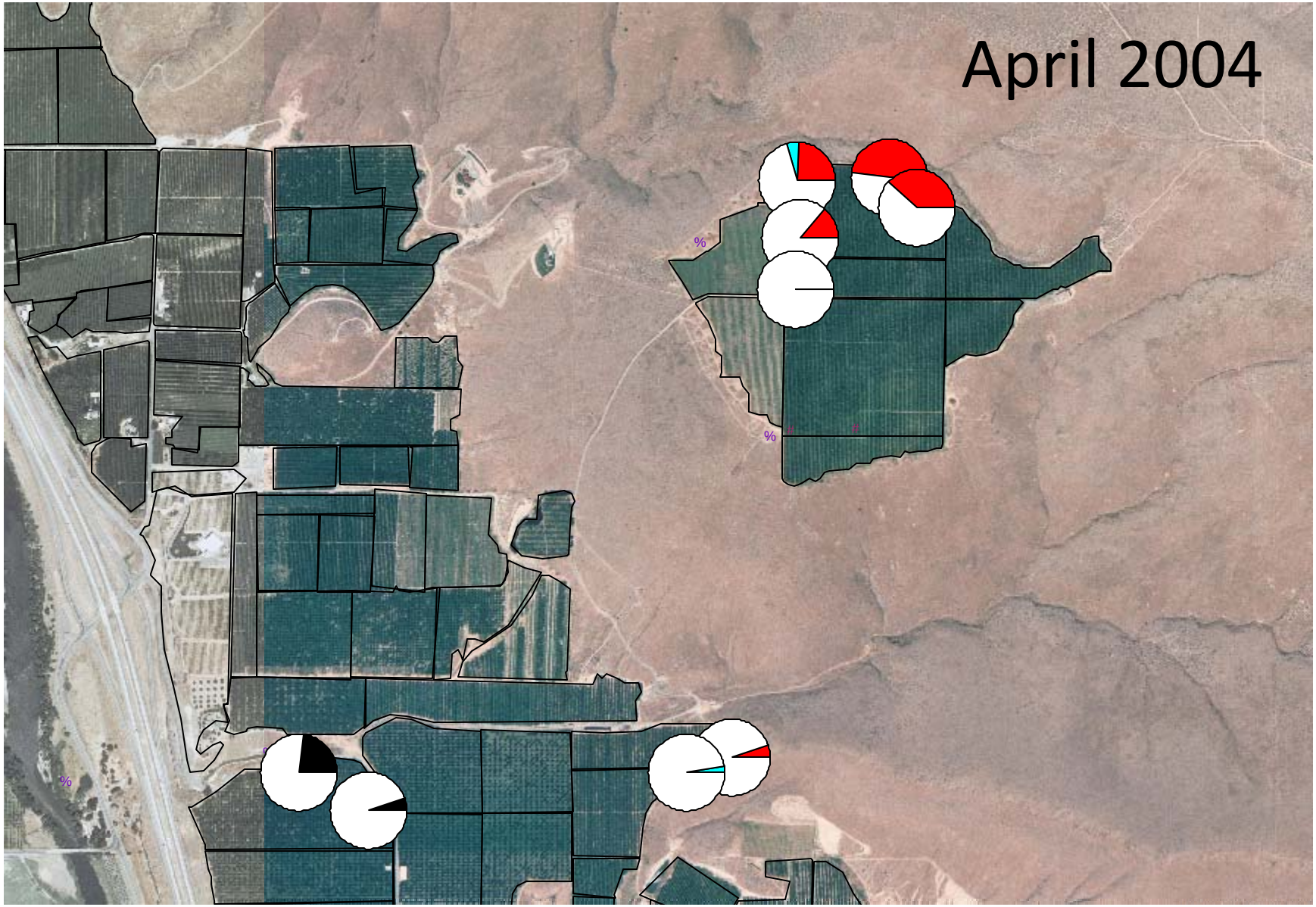

P1
April 29-May 30
Parasitism
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
P=3.5.228 (1/d²) + 0.04
R² = 0.97; F=342, df= 1,11; p < 0.0001
0
100
200
300
400
500
600
Distance
0
100
200
Meters
N
W
E
S

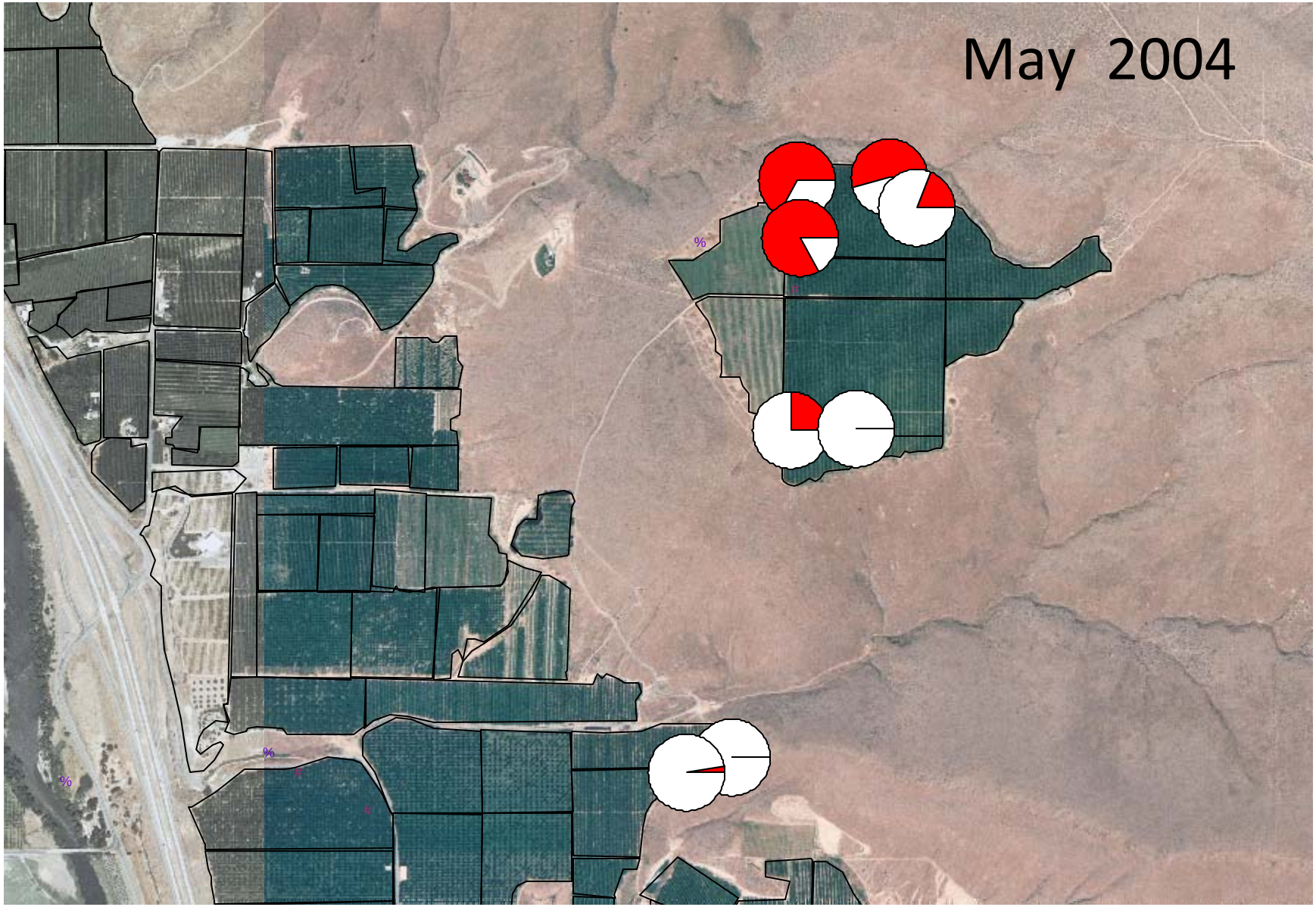

July 10 - 26
0 100 200
Meters
N
W E
S

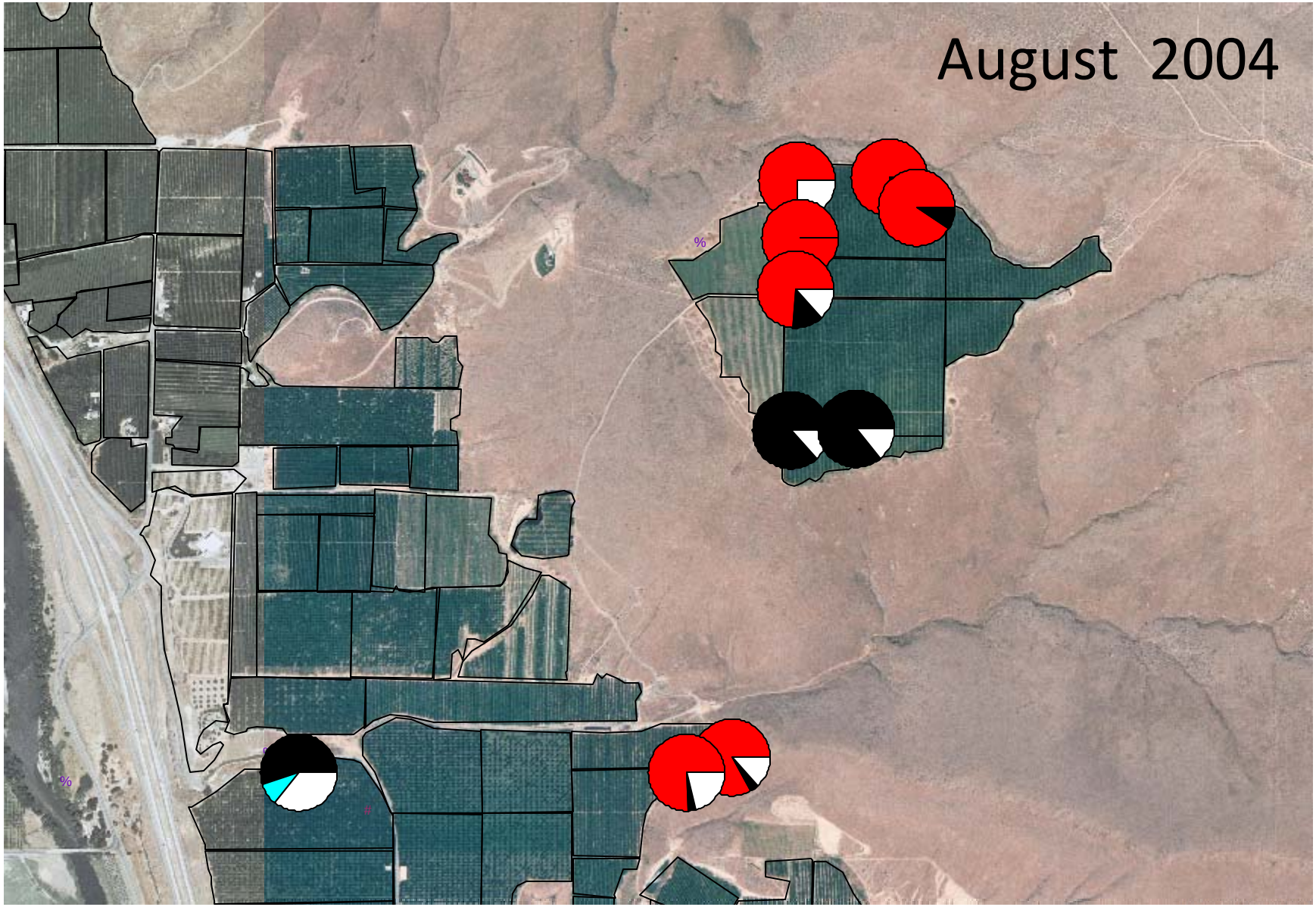

April 27 – May 29
0 100 200
Meters
N
W
E
S
W1
W2

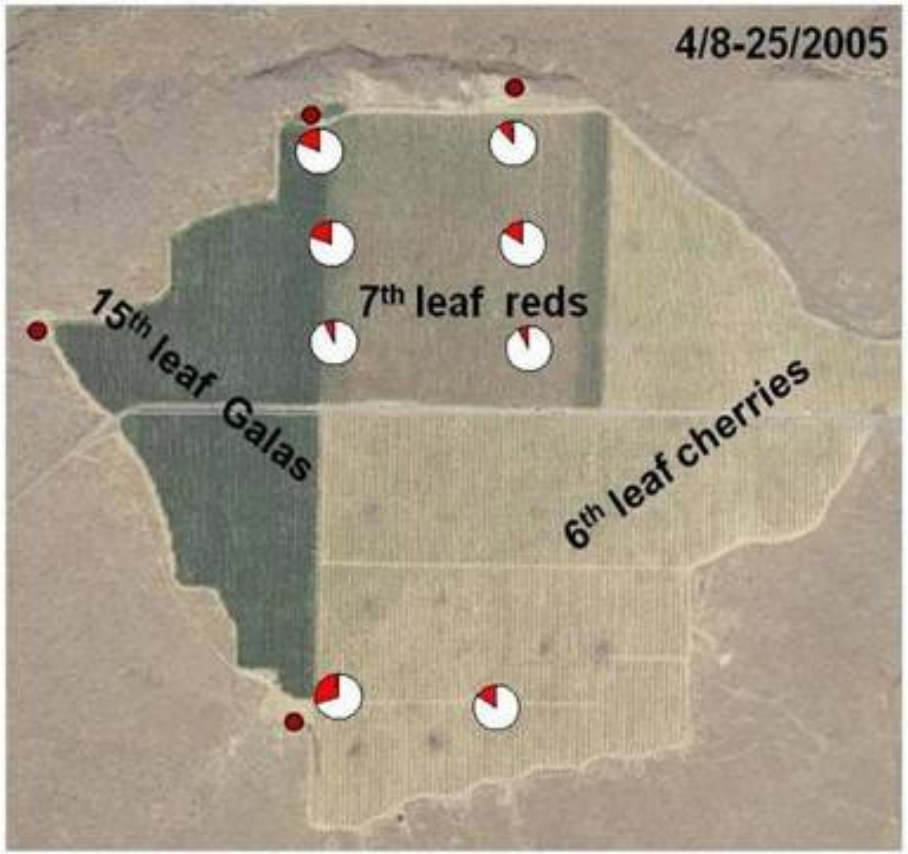

N
W
E
S
July 10 - 24
0 100 200
Meters
W2

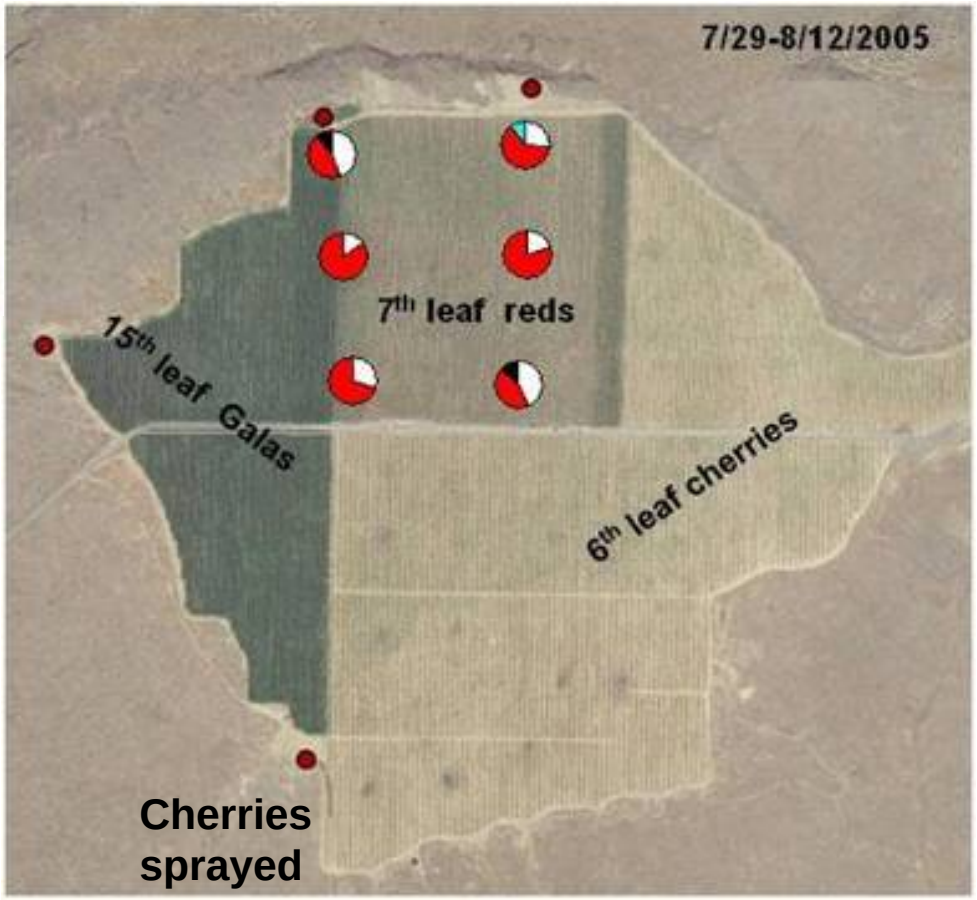

N
W
E
S
July 26 – August 8
0 100 200
Meters
W2


April 2004


May 2004


August 2004





Similar patterns seen in 2002, 2003 and some grower sites.

C. florus movement studies by Vince Jones

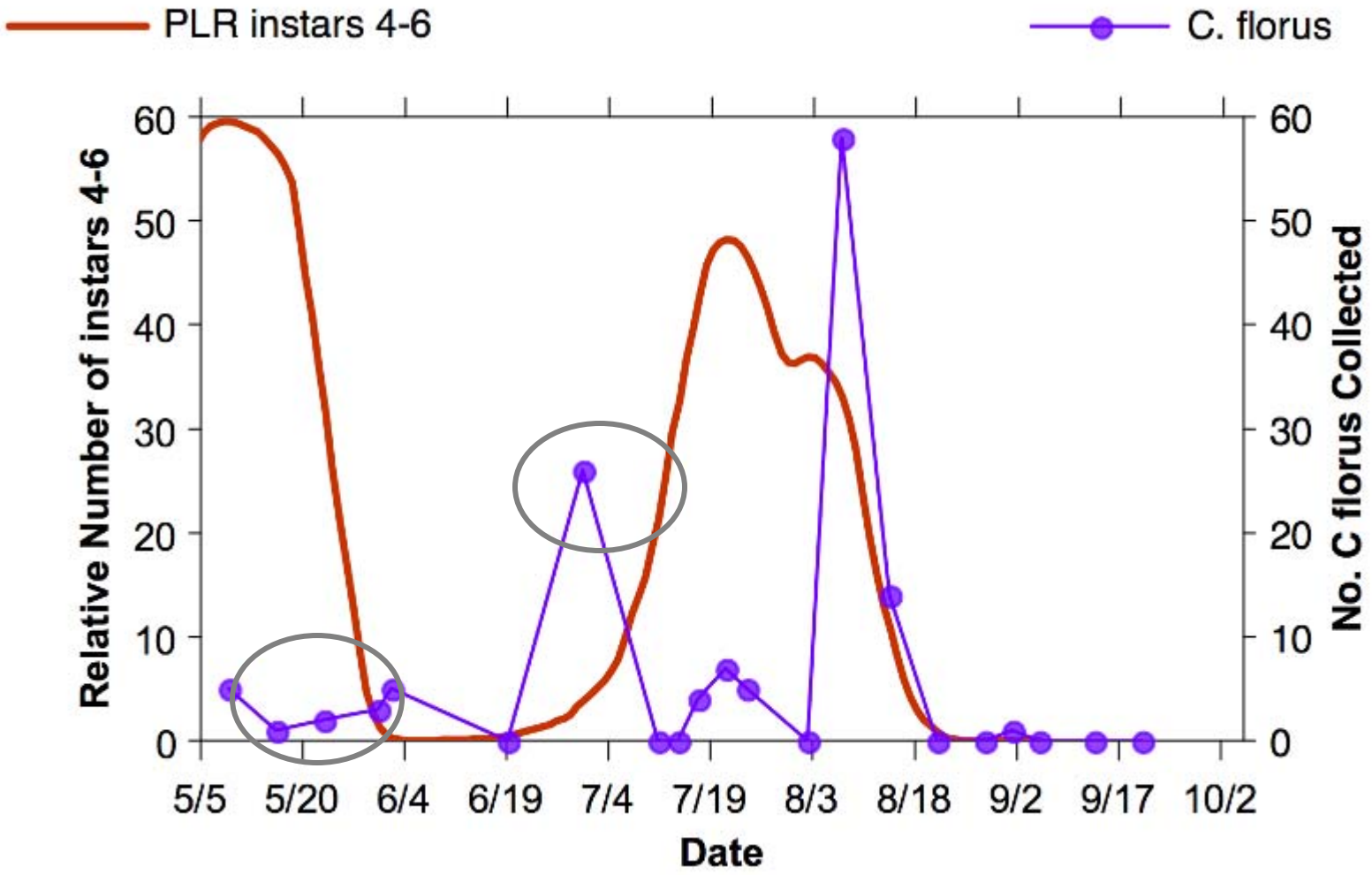
Objective

One natural question is what is the area of influence (“active space”) of a rose/strawberry garden needed to bolster parasitism of leaf rollers.

- Covered parts of gardens with netting and dusted plants and netting with soy flour
- Collected parasitoids in the orchard using traps
- Ran ELISA tests from Early May to Late August

A final demonstration of gardens as the source of this parasitism

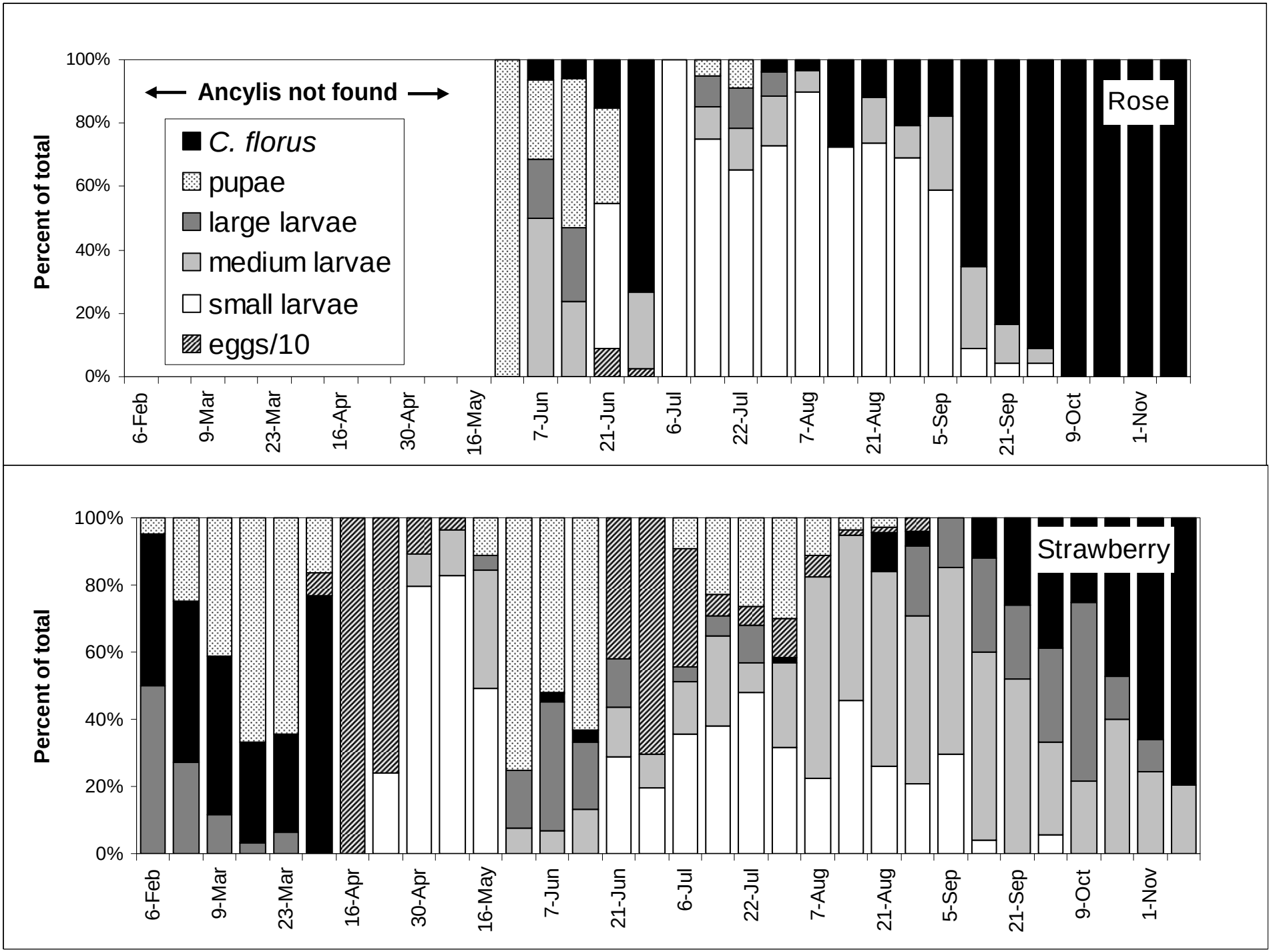
Asynchrony of *C. florus* and PLR ?



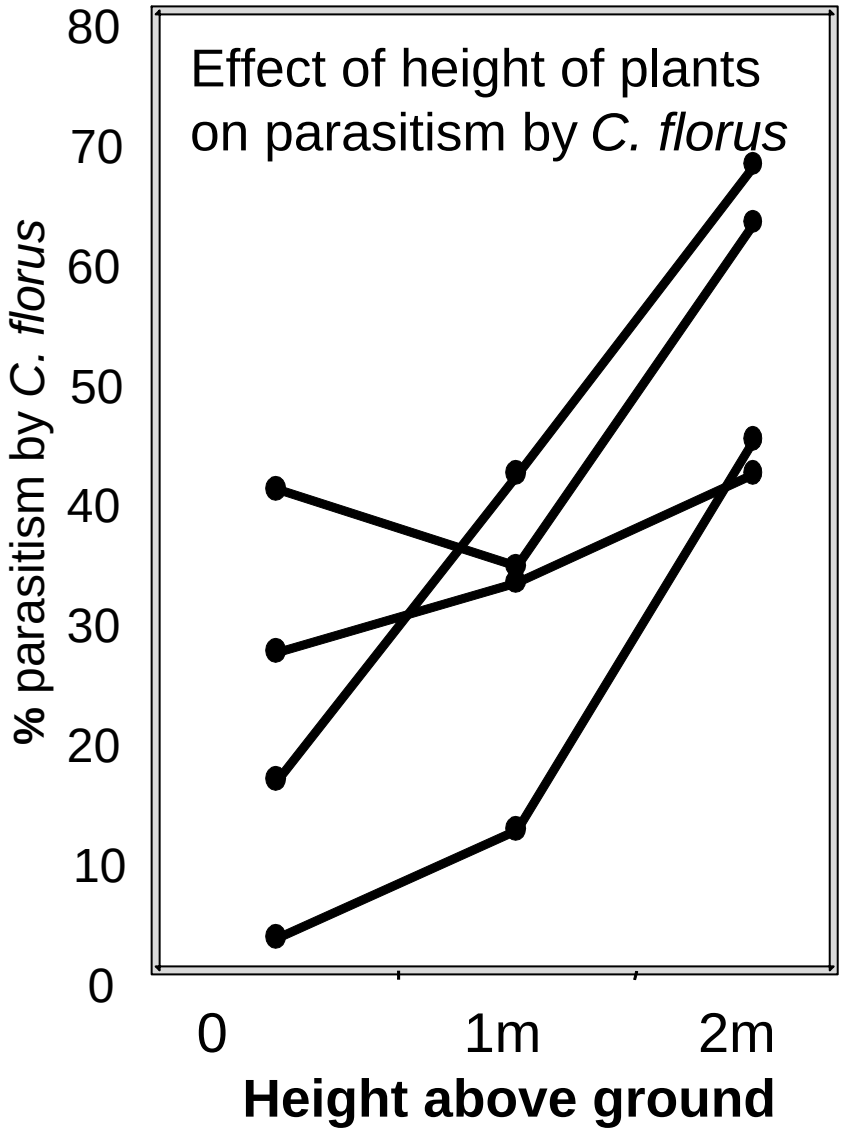
Conclusions from marking study

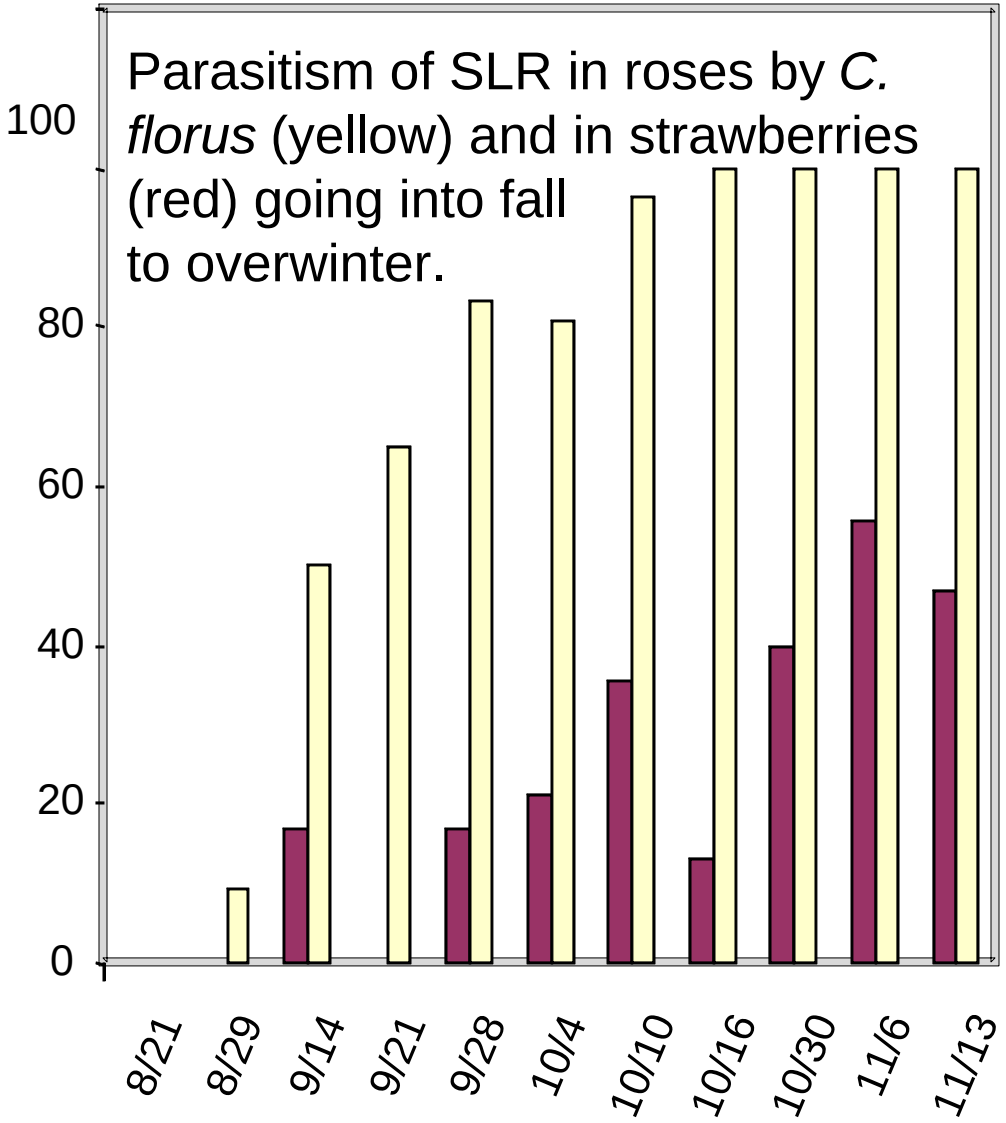
- We didn’t get out in front of the dispersal capacity of wasps
- Captured at 45 m of 50 m maximum distance in 2005 and 90 m with maximum trap distance of 95 m in 2006
- Phenology of captures were episodic and suggests the timing of *C. florus* dispersal into orchards may be suboptimal

So what is happening in the gardens?
How well can they serve this role of provisioning wasps to control leafrollers in orchards?

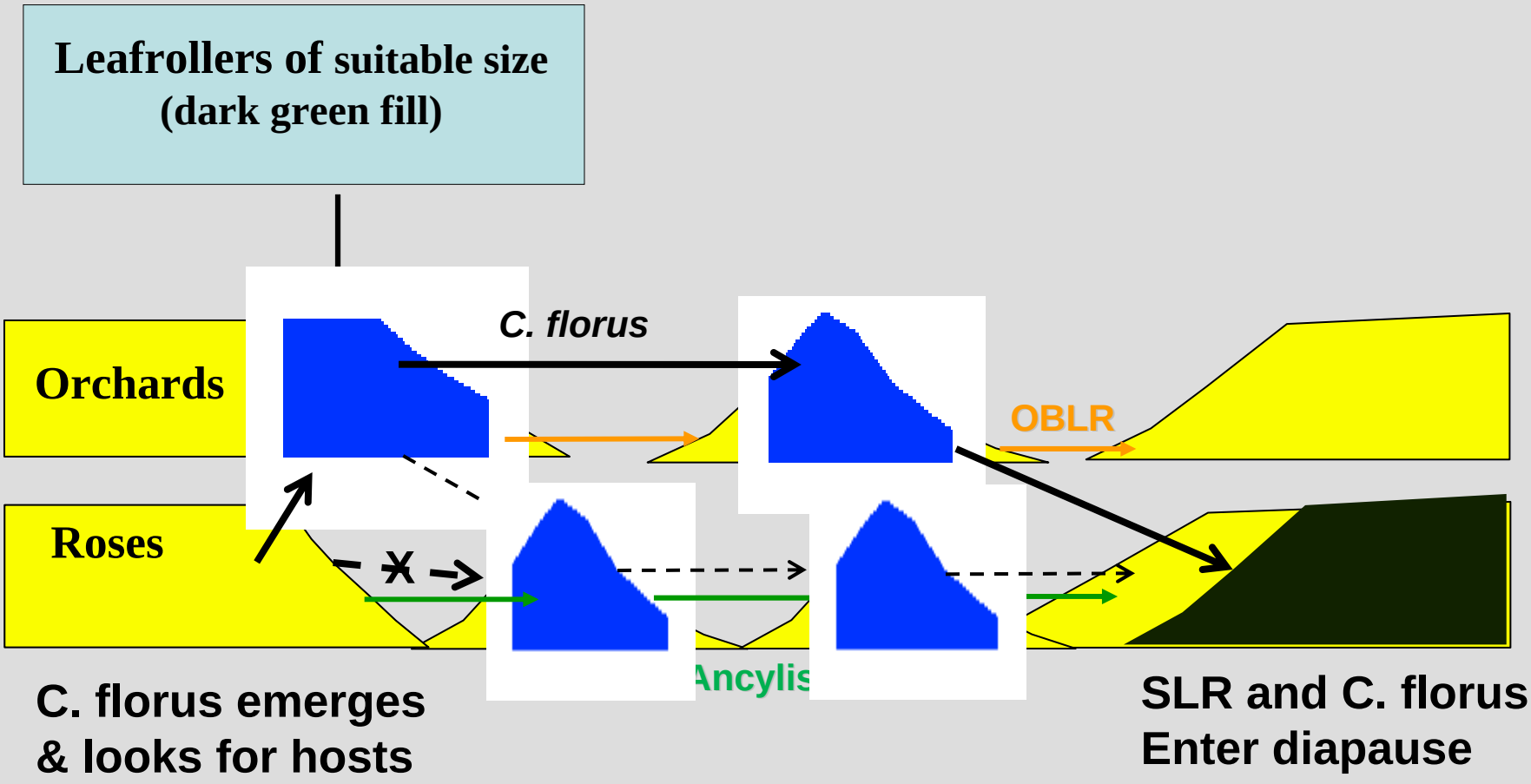

Ancylis not found
C. florus
pupae
large larvae
medium larvae
small larvae
eggs/10
Percent of total
100%
80%
60%
40%
20%
0%
Rose
Strawberry
6-Feb
9-Mar
23-Mar
16-Apr
30-Apr
16-May
7-Jun
21-Jun
6-Jul
22-Jul
7-Aug
21-Aug
5-Sep
21-Sep
9-Oct
1-Nov

2006


Effect of height of plants on parasitism by *C. florus*
% parasitism by *C. florus*
80
70
60
50
40
30
20
10
0
0
1m
2m
Height above ground


Parasitism of SLR in roses by *C. florus* (yellow) and in strawberries (red) going into fall to overwinter.
100
80
60
40
20
0
8/21
8/29
9/14
9/21
9/28
10/4
10/10
10/16
10/30
11/6
11/13

Revised phenology of OBLR and SLR larval stages in orchards and nearby rose/strawberry patches



Rose study conclusions

- Parasitism by *C. florus* may be enhanced with rose/strawberry gardens
- Relatively small gardens can have a large effect
- In most areas strawberries are needed to keep providing SLR
- Roses and strawberries should be separated from one another by dry habitat

What other surrounding habitats should we consider?

- Several other 2nd pests may be enhanced by riparian plants if fostered adjacent to orchards
  - Aphid complex, pear psylla, mealybug, and again leafrollers
- What trees and shrubs may enhance generalist predators?
  - Planting of wildlife-friendly habitats being sponsored by the NRCS represents one opportunity
- Which plants should we avoid?
- Dave Horton, Gene Miliczky and I have been working with NRCS to develop a plant list that will enhance biological control

Common name	Habit, hardiness, growth	Host/prey/ other	Caution / bloom /other values
multifloral rose	shrub, hardy, fast	aphids, **leafrollers**	invasive/May/mowable
thin leaf alder	Small tree, hardy, fast	aphids, **leafrollers**	/early spring/ nitrogen fixing
Scouler's willow	sm-tree, v. hardy, fast	aphids**,** leafrollers, **psyllids**	/early spring/browse
antelope bitterbrush	shrub, very hardy, mod. slow	aphids, leafrollers, **psyllids**	hard to establish/ early spring/browse
buckwheat sulf, rock, snow	forb, hardy, fast	aphids, psyllids, **Floral subsidy**	Hardy/spring-summer/ avail.seed
Alyssum	Annual, moderate, fast	**Floral subsidy**	May need to reseed often/late spring-summer/avail.seed
strawberry	forb, hardy, mod	aphid, **leafroller**	needs weed control, thirsty/na/ eat fruit

Thanks to WAHORT, Dain and Nick

for arranging for me to speak

and you …. for listening patiently!

Questions?