Biology & Biocontrol of Lewis spider mite (*Eotetranychus lewisi*), an emerging pest in strawberries

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Spider Mites

- Major recurring pest during both plantings in coastal California

- Problems associated with chemical control
  - *Resistance to miticides
  - Difficulty of applying miticides
  - Miticide residues on fruit

Twospotted spider mite (*Tetranychus urticae)*

- Usually the most abundant & damaging mite pest on strawberry

- Present in summer & fall berries

Recently, PCAs & growers began to notice a new mite emerging…

Lewis spider mite (*Eotetranychus lewisi*)

- Populations are increasing in Ventura County
  - Cane berries
  - Strawberry

Lewis Spider Mite
vs.
Twospotted (TSSM)

Twospotted spider mite (TSSM)

- Usually the most abundant & damaging mite pest on strawberry
- Multiple hosts (crops & ornamentals)
- Present in summer & fall berries
- ♀ Hibernates (Diapause) in the winter

Lewis spider mite (LSM)

- Multiple hosts (crops & ornamentals)
  - MAJOR pest of Poinsettias
  - Minor pest of citrus

- Becoming a major pest of raspberry & strawberry in Ventura Co.

- Present in fall or summer plantings (?)

- No hibernation (Diapause) period known

Damage

- Feed on the underside of leaves
  - Yellow mottling on topside
  - Necrosis on underside

- Webbing
  - Spreads mites
  - Attracts dust on the underside
  - Can change transpiration

- Reduction in fruit size & yield
- Heavy infestations cause stunting & leaf drop
- Can kill a stressed plant

	Lewis	TSSM
Spots	Multiple	One large spot on each side
Size	0.36mm	0.5mm

Lewis ♀ adult

Twospotted ♀ adult

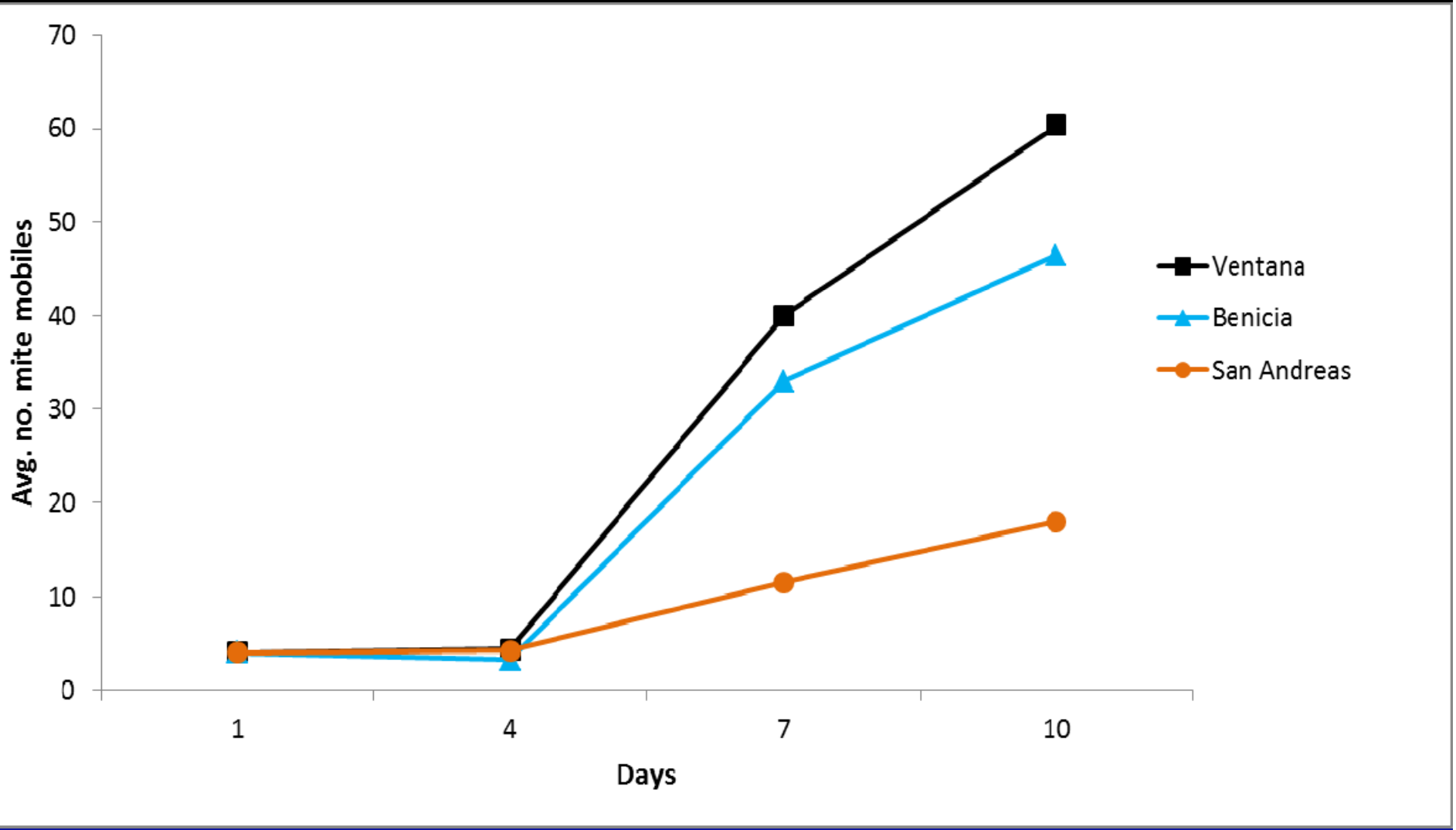
Zalom et al.

Lewis mite vs. twospotted spider mite development - different hosts

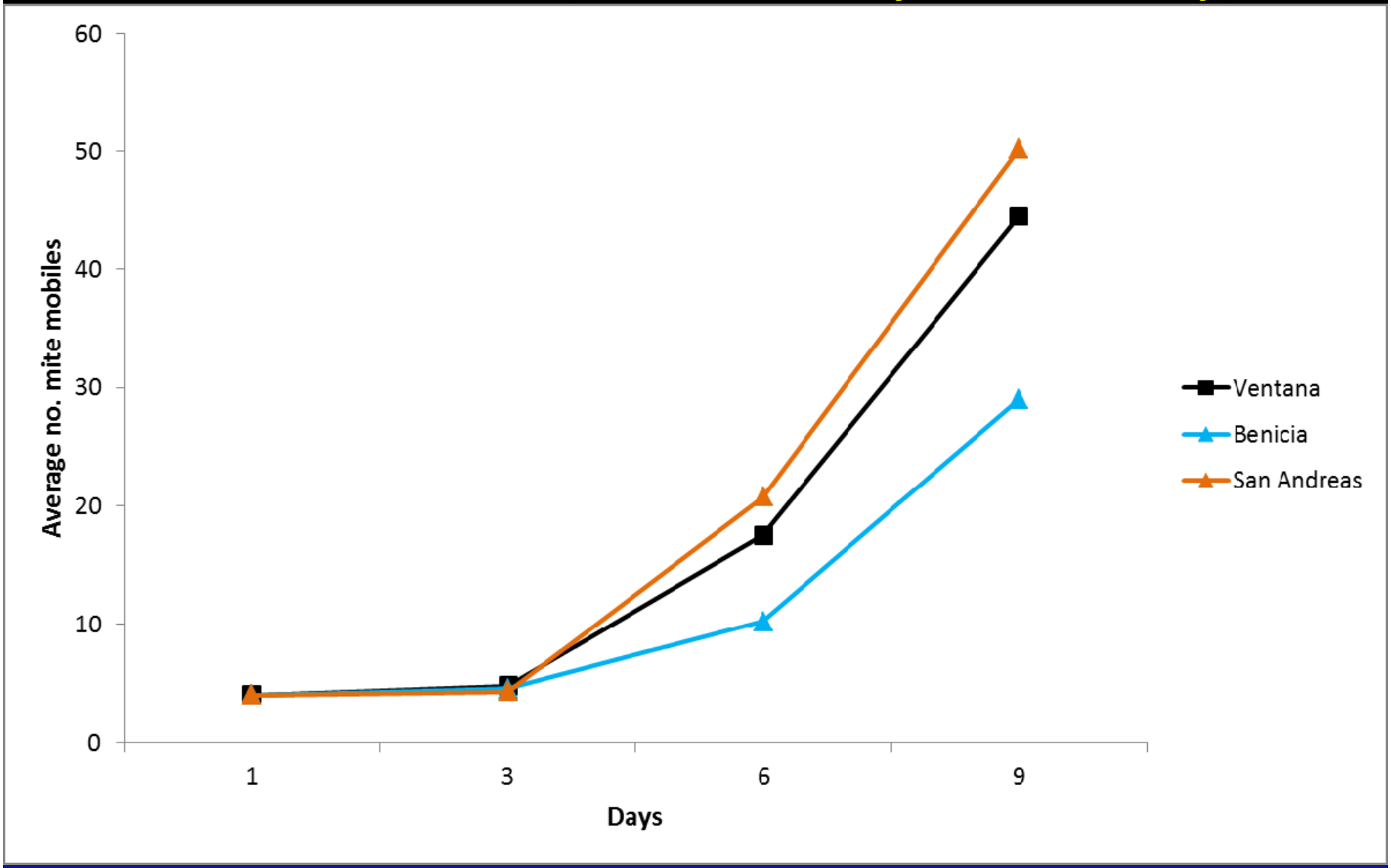
	Mean number of mites at temperatures (|C)								
	15 |C			20 |C			25 |C	
	Females	Males	Total	Females	Males	Total	Females	Males	Total
Castor bean									
T. urticae	0.33±0.57	0.0±0.0	0.33±0.57	7.33±4.61	2.66±2.08	10.00±6.24	13.00±4.35	4.33±2.51	17.33±6.65
E. lewisi	13.33±4.93	2.33±2.30	15.66±4.50	30.66±14.64	13.00±9.16	43.66±23.79	34.66±4.04	15.66±4.72	50.33±8.32
P =		0.0043			0.0768			0.0056	
Strawberry									
T. urticae				72.33±8.50	16.66±4.72	89.00±10.44	80.66±5.50	20.33±5.86	101.00±8.88
E. lewisi				11.33±3.21	3.33±1.15	14.66±4.72	17.33±4.72	2.33±0.57	19.66±4.93
P =		Not analyzed			0.0003			0.0002	

TSSM survives longer and produces more eggs on strawberry in cooler temps.

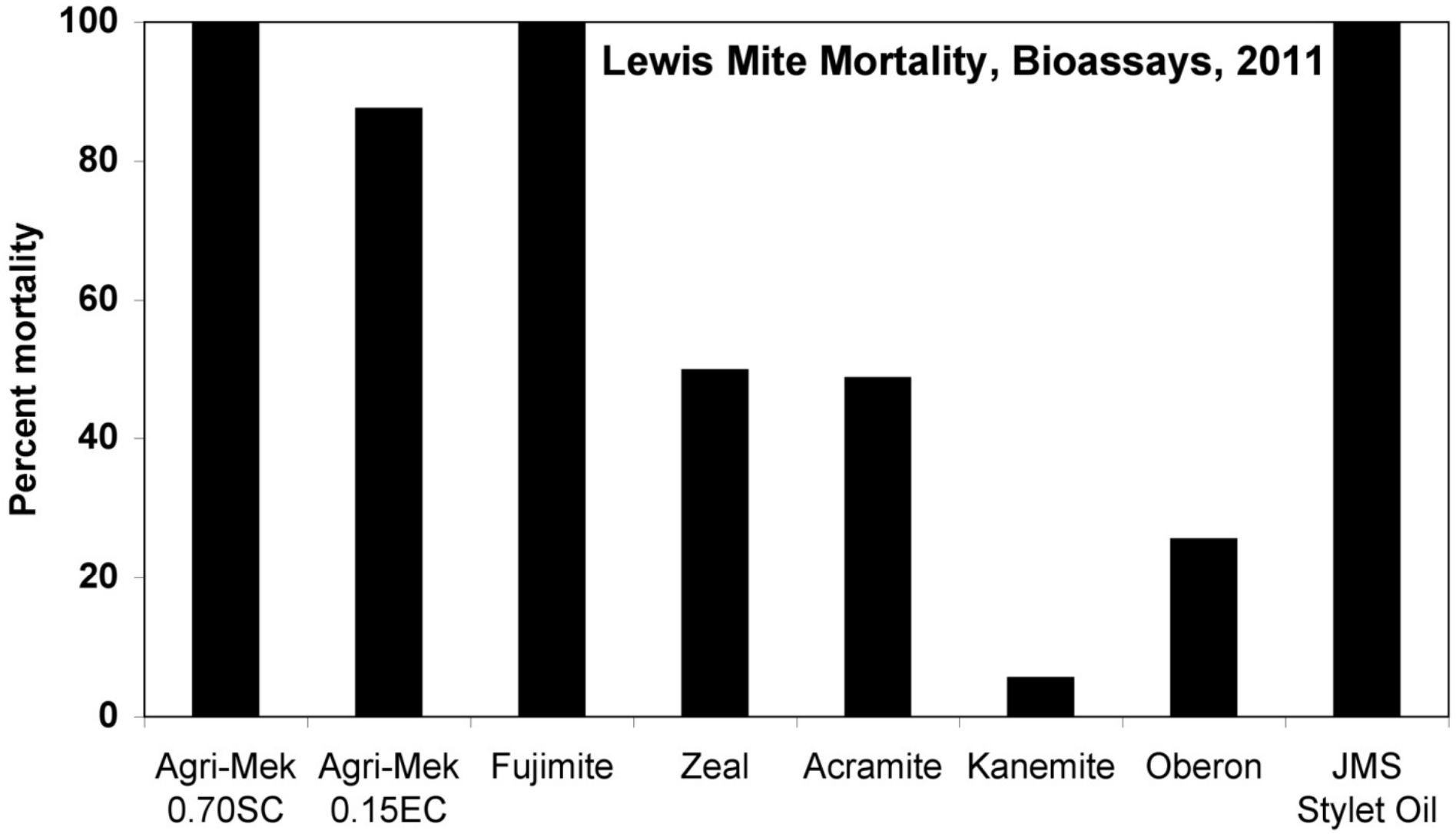
Lewis mobiles (strawberry host only)



TSSM mobiles (strawberry host only)



Previous lab bioassay results by Frank Zalom



What about biocontrol?

-*Phytoseiulus persimilis* is the commonly released predator for TSSM…

But it may not work for Lewis mite management

- Mites shifting from twospotted to Lewis
- How do you control this?

Goal:

-To figure out which predatory mite works best in management of Lewis mites

Methods

- Collected Lewis mites from the field
- Raised Lewis mite colony on clean strawberry leaves
- Ordered predatory mites
  - *Neoseiulus californicus*
  - *Neoseiulus fallacis*
  - *Amblyseius andersoni*
  - *Phytoseiulus Persimilis*

Elena M. Rhodes

- Collected Lewis mites from the field
- Raised Lewis mite colony on clean strawberry leaves
- Ordered predatory mites
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  - *Neoseiulus fallacis*
  - *Amblyseius andersoni*
  - *Phytoseiulus Persimilis*

Art Agnello, Cornell University

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  - *Neoseiulus fallacis*
  - *Amblyseius andersoni*
  - *Phytoseiulus Persimilis*

- Transferred 40 Lewis mites onto a new leaf
- Settle for one day

40

- Added 10 predators of a particular species per plate

10

40

- 4 plates per predator species
- 4 plates for control (no predators)

10

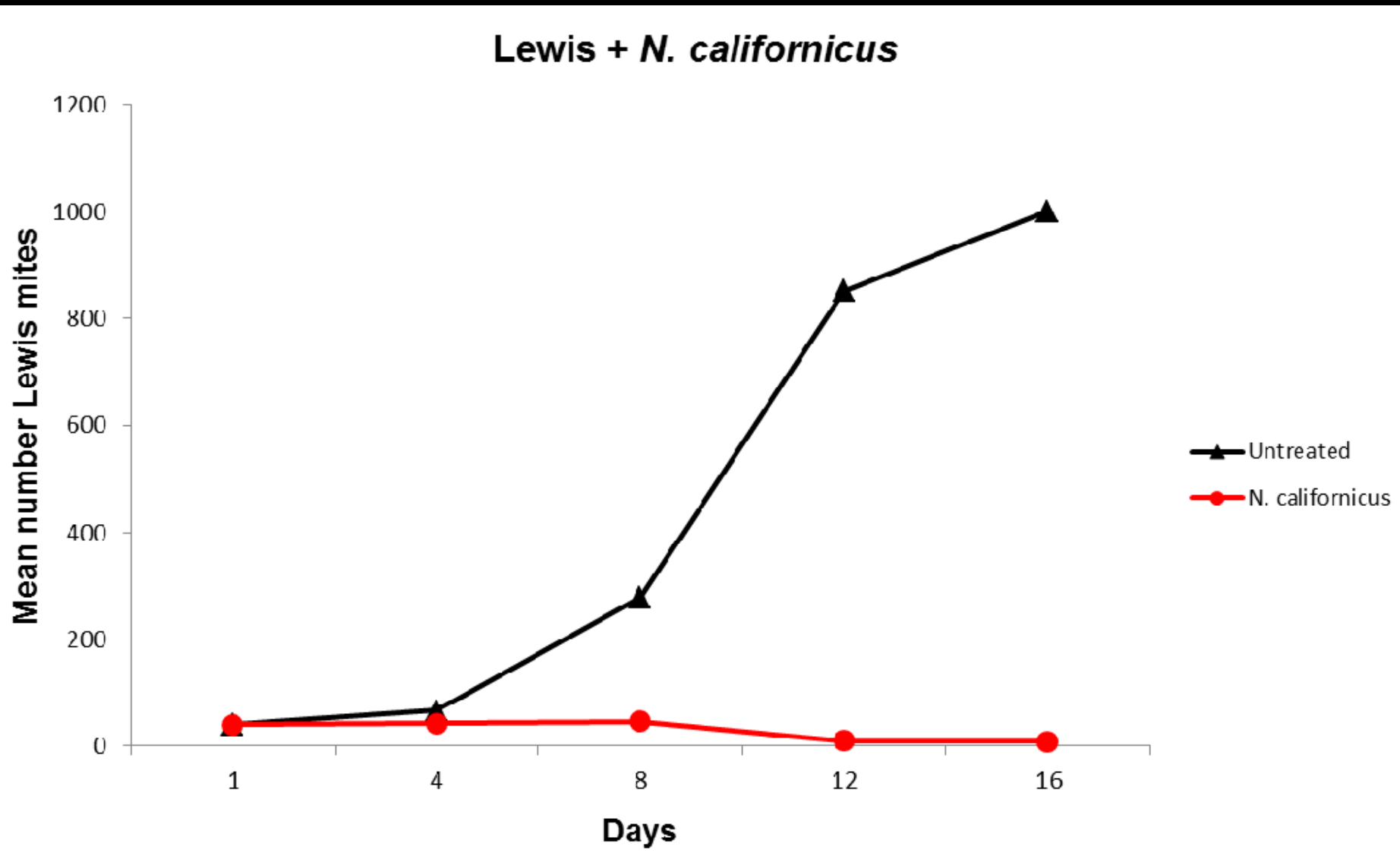
40

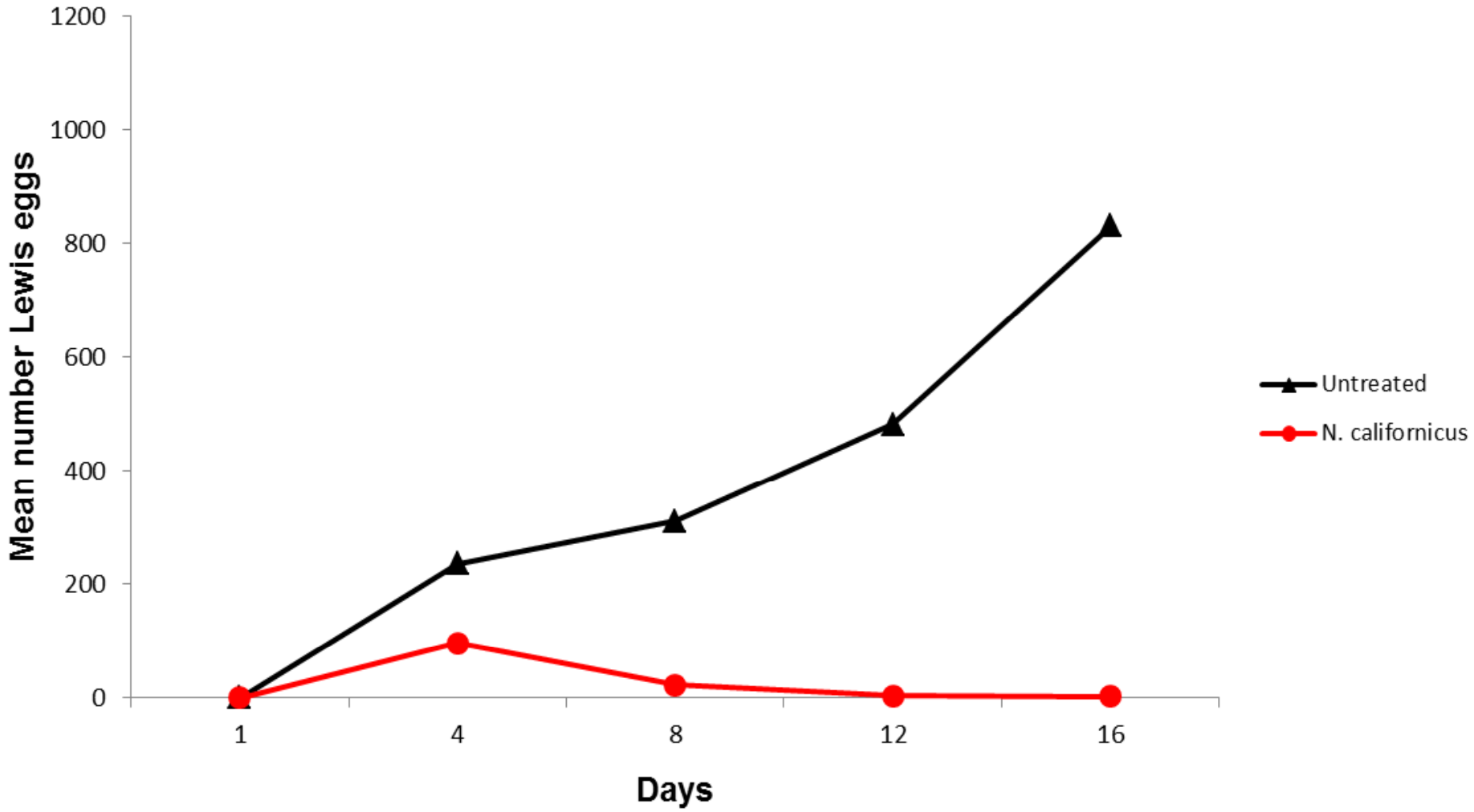
x4

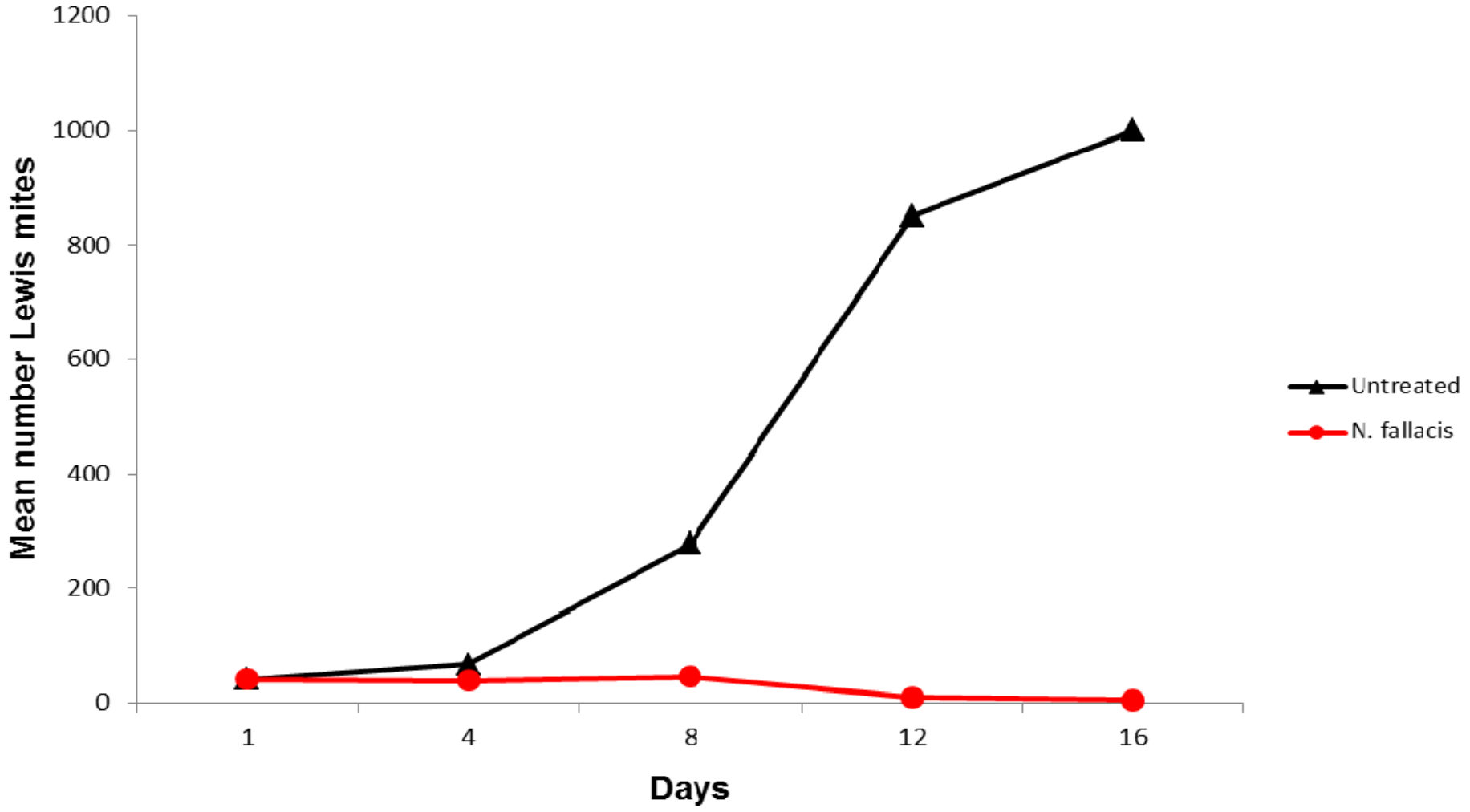
- Lab conditions: 18:6 (day:night), ~75 ºF, ~52% RH

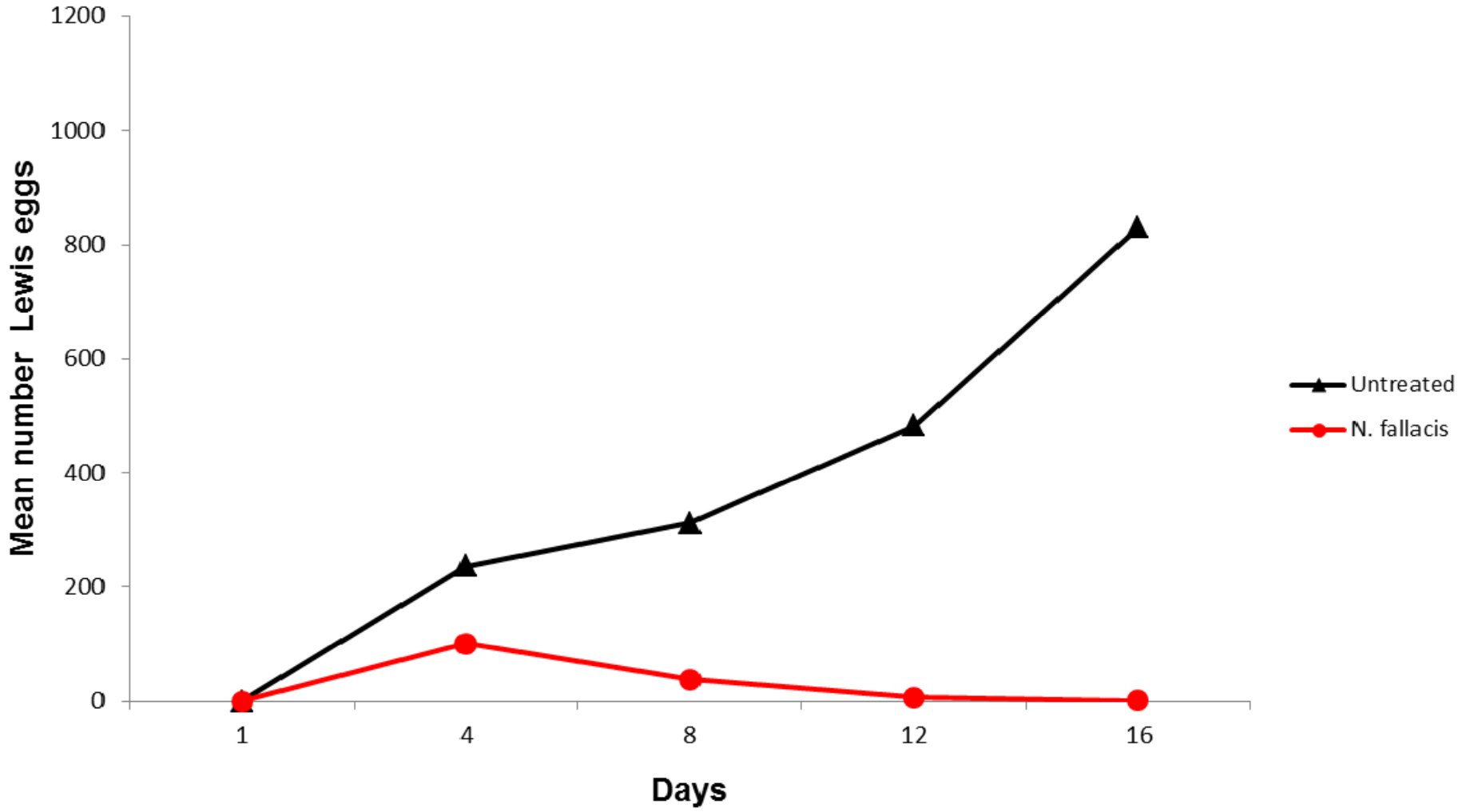
- Counted number of Lewis mite mobiles & eggs every 4th day for 2 weeks

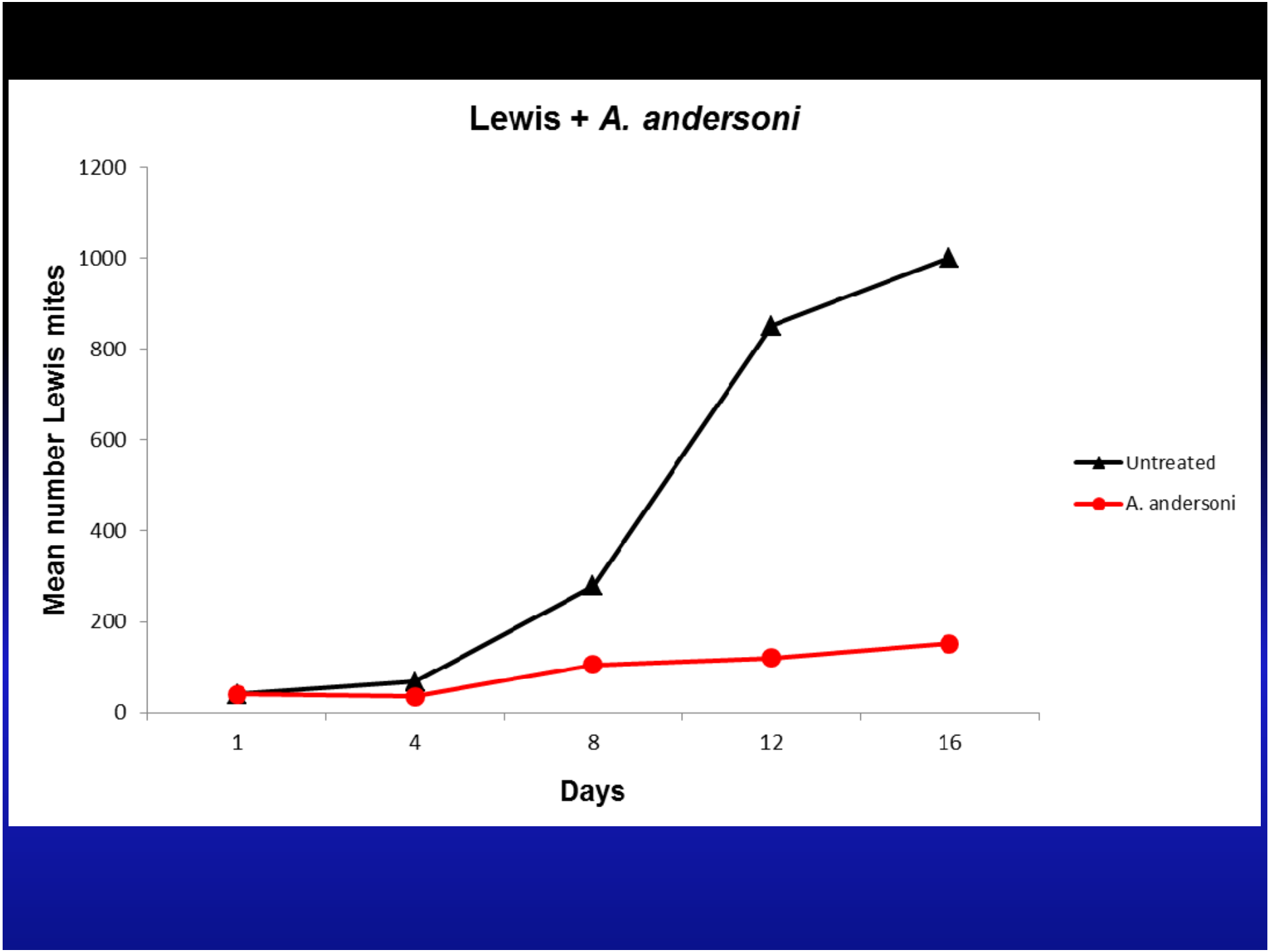
P. persimilis would not feed on Lewis spider mites & starved to death. Excluded from the analysis.

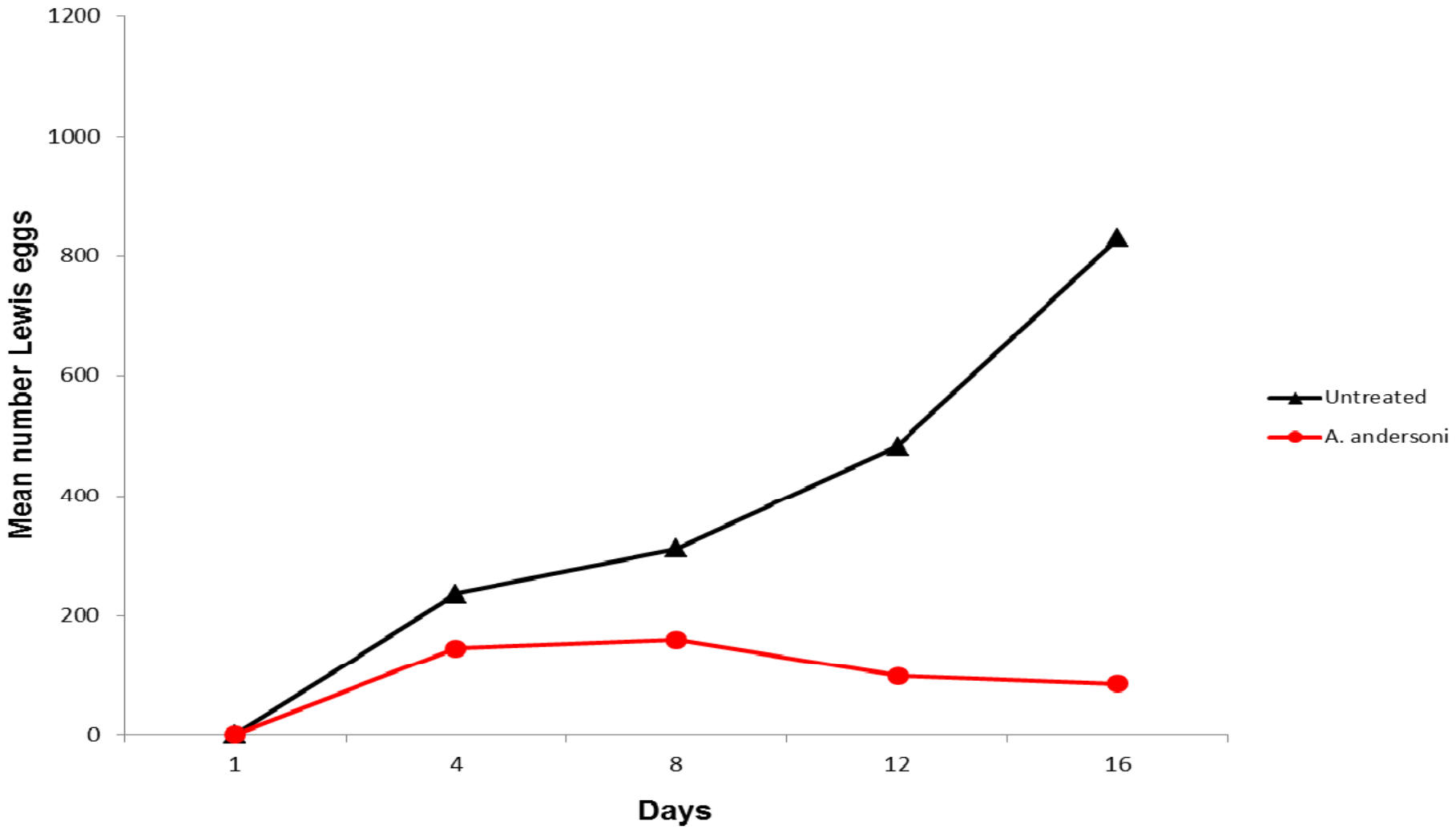

Lewis + N. californicus
Mean number Lewis mites
1200
1000
800
600
400
200
0
1
4
8
12
16
Days
Untreated
N. californicus


Lewis + N. californicus
Mean number Lewis eggs
1200
1000
800
600
400
200
0
1
4
8
12
16
Days
Untreated
N. californicus


Lewis + N. fallacis
Mean number Lewis mites
1200
1000
800
600
400
200
0
1
4
8
12
16
Days
Untreated
N. fallacis


Lewis + N. fallacis
Mean number Lewis eggs
1200
1000
800
600
400
200
0
1
4
8
12
16
Days
Untreated
N. fallacis


Lewis + A. andersoni
Mean number Lewis mites
1200
1000
800
600
400
200
0
1
4
8
12
16
Days
Untreated
A. andersoni


Lewis + A. andersoni
Mean number Lewis eggs
1200
1000
800
600
400
200
0
1
4
8
12
16
Days
Untreated
A. andersoni

Overall all 3 predatory mites can control Lewis mites…

N. fallacis attacking Lewis mite

But what happens when you have both twospotted & Lewis mites?

What are the interactions between Lewis & twospotted spider mite?

Do the predatory mites prefer one over the other?

- Transferred
    - 20 Lewis + 20 twospotted

- Settle for 1 day

20

20

- Added 10 predators of a particular species per plate

10

20

20

10

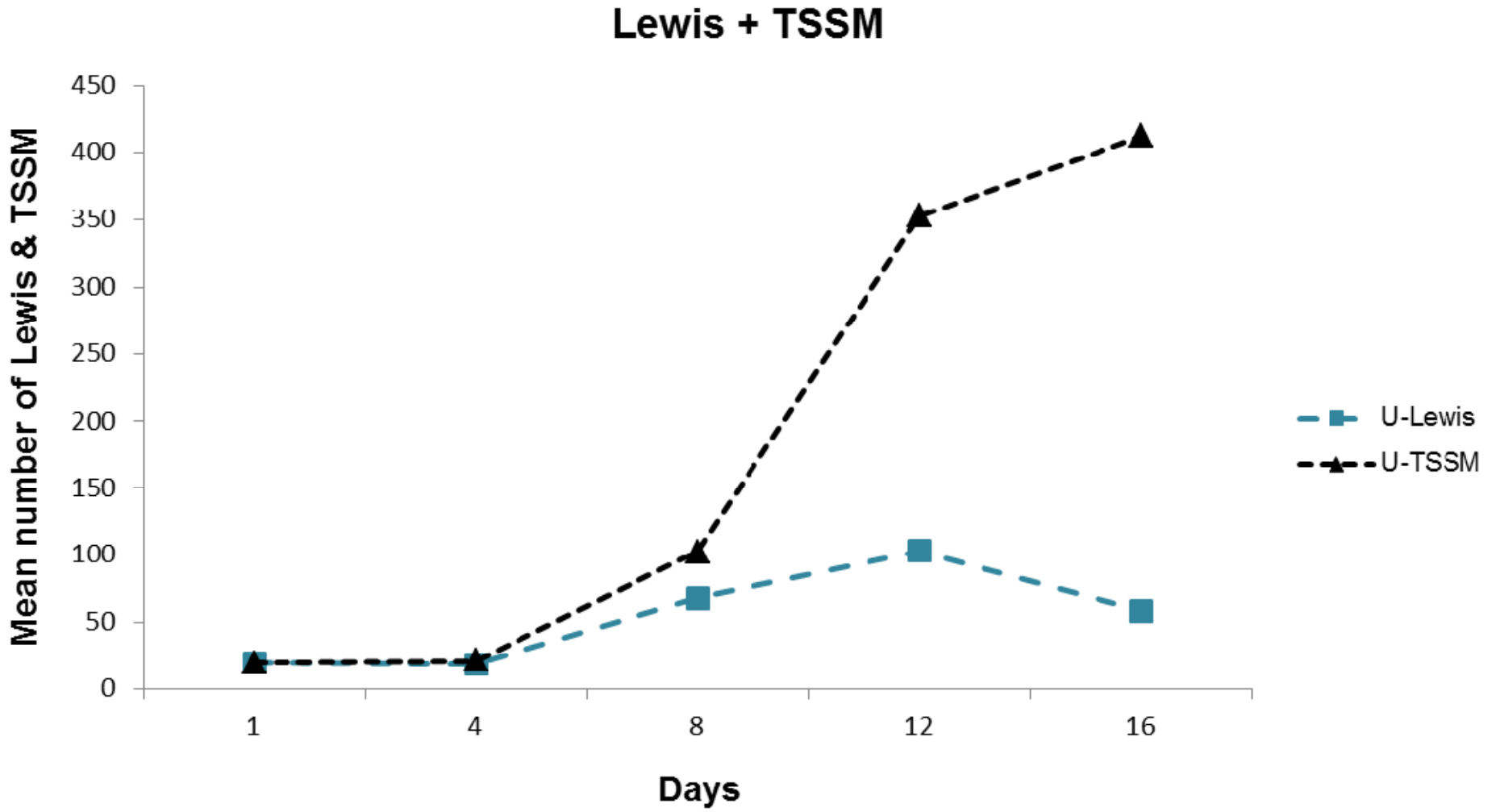
20

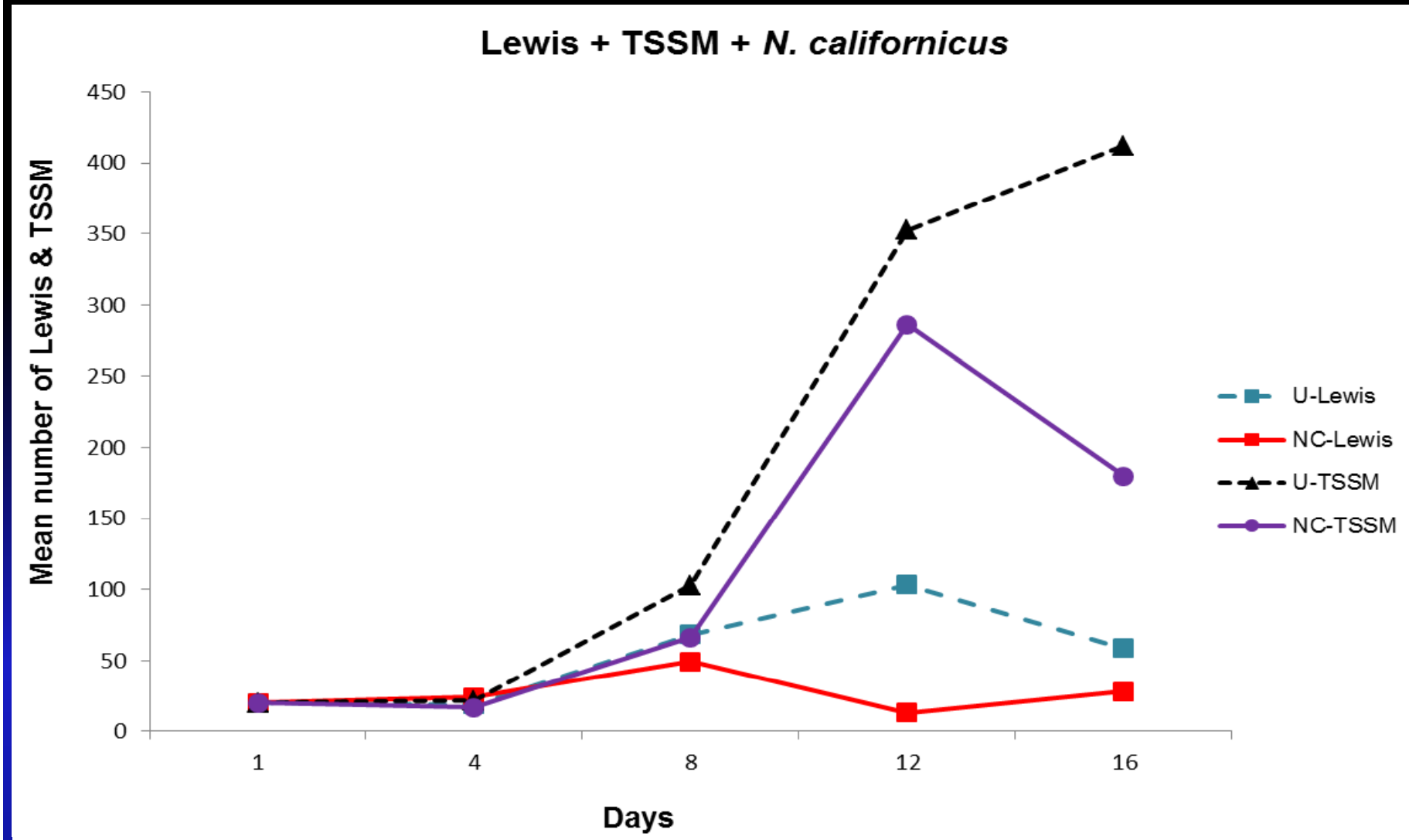
20

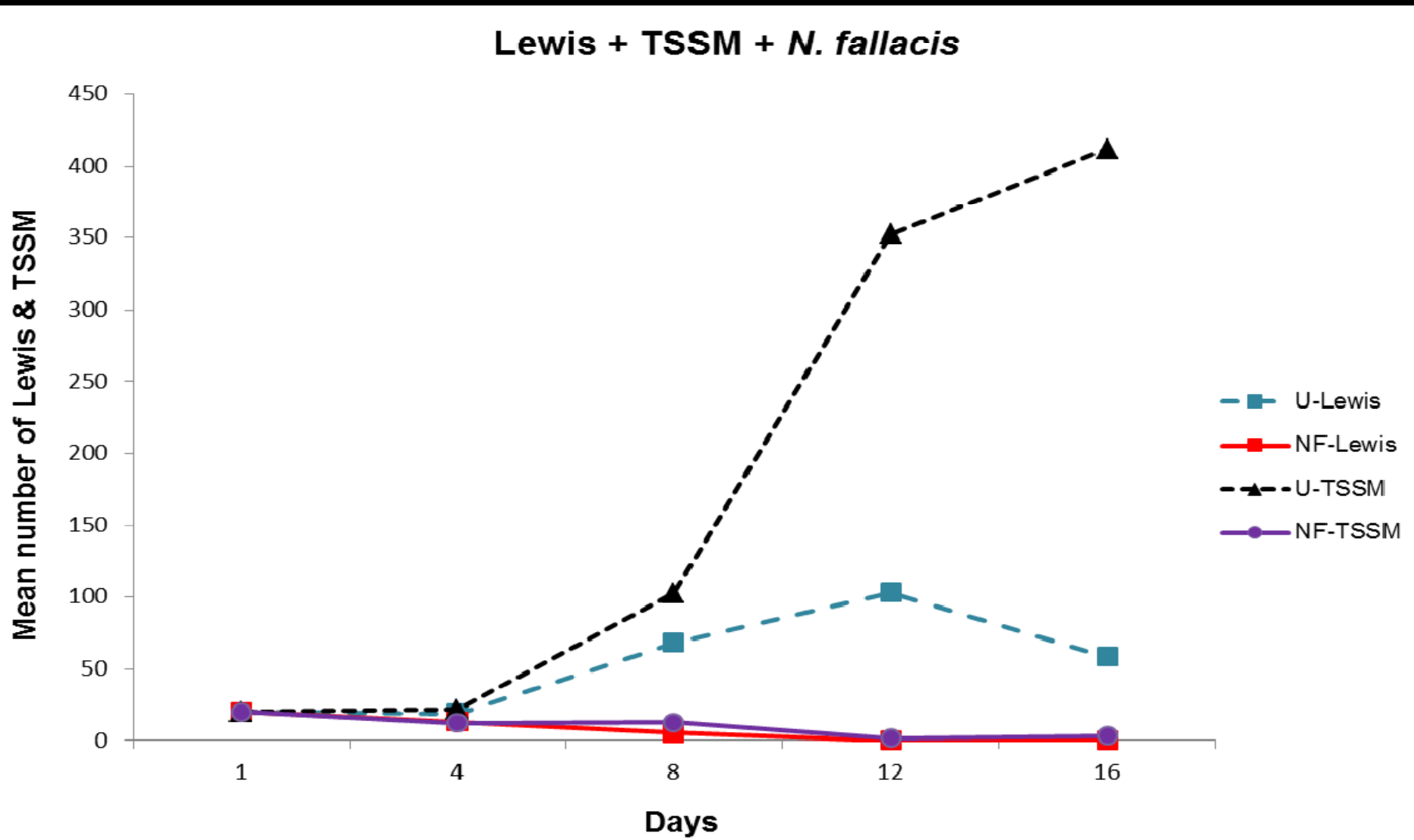
x4

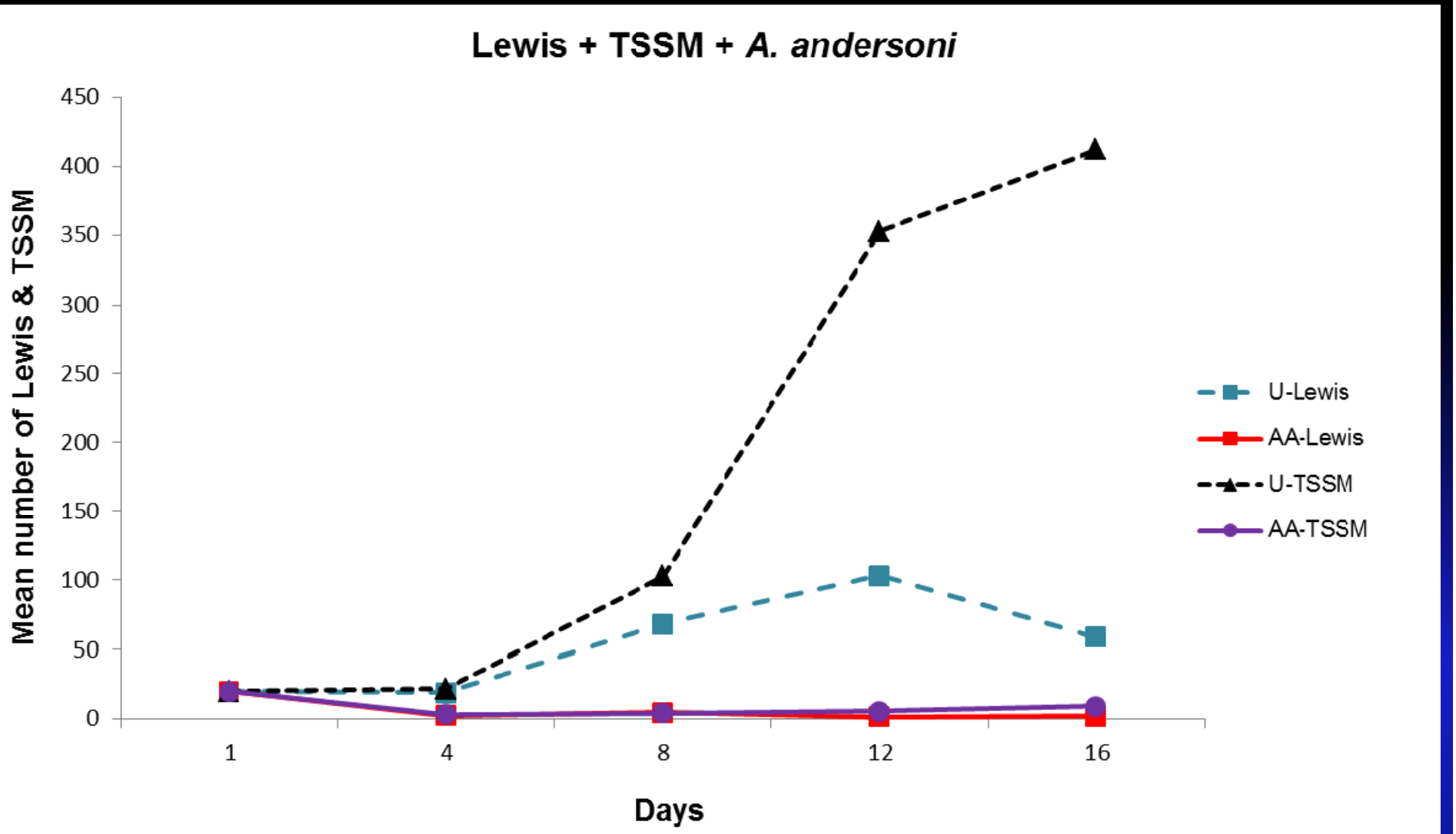
- Lab conditions: 18:6 (day:night), ~75 ºF, ~52% RH

- Counted number of Lewis & TSSM mobiles every 4th day for 2 weeks


Lewis + TSSM
Mean number of Lewis & TSSM
450
400
350
300
250
200
150
100
50
0
1
4
8
12
16
Days
U-Lewis
U-TSSM


Lewis + TSSM + N. californicus
Mean number of Lewis & TSSM
450
400
350
300
250
200
150
100
50
0
1
4
8
12
16
Days
U-Lewis
NC-Lewis
U-TSSM
NC-TSSM


Lewis + TSSM + N. fallacis
Mean number of Lewis & TSSM
450
400
350
300
250
200
150
100
50
0
1
4
8
12
16
Days
U-Lewis
NF-Lewis
U-TSSM
NF-TSSM

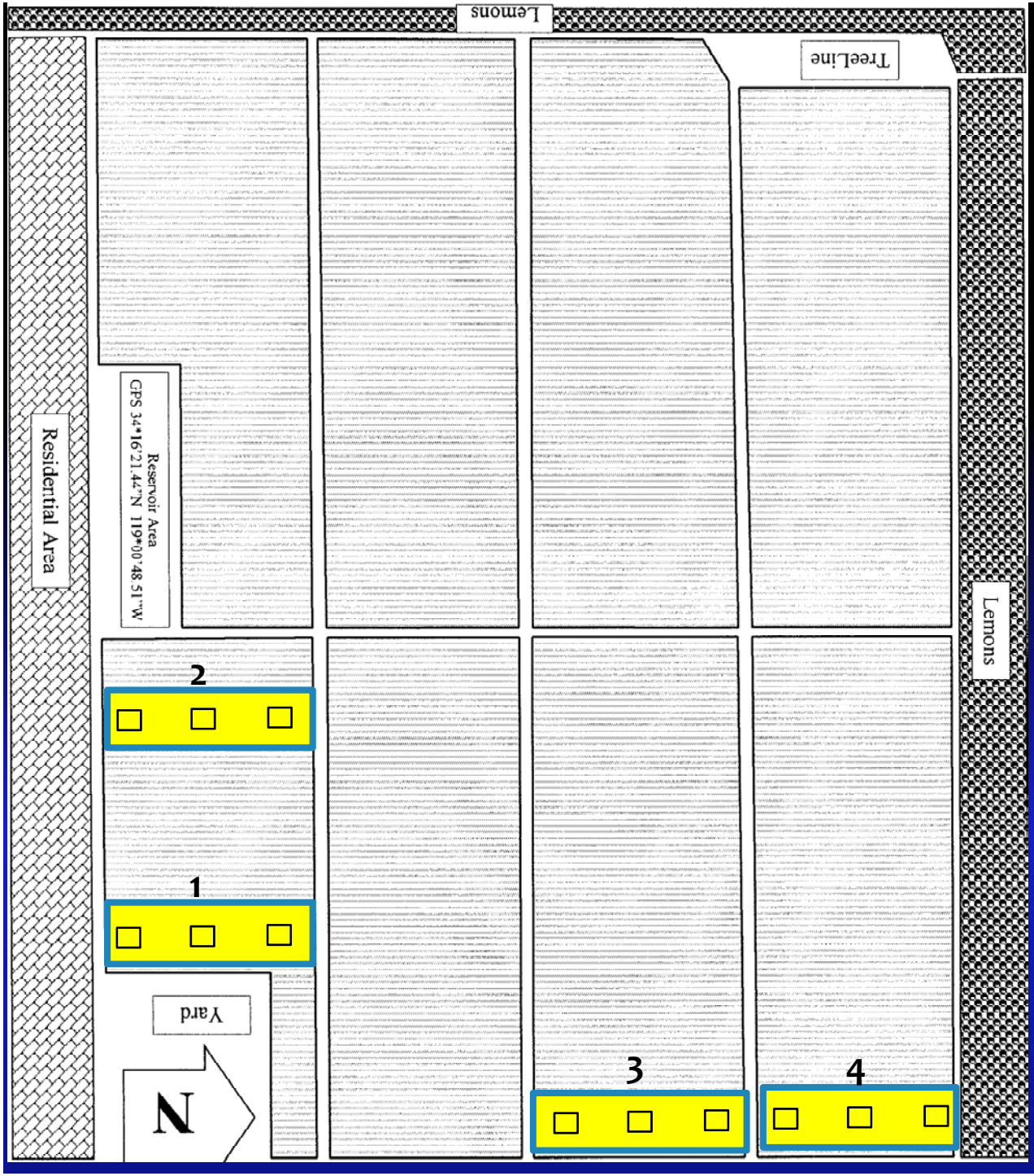

Lewis + TSSM + A. andersoni
Mean number of Lewis & TSSM
450
400
350
300
250
200
150
100
50
0
1
4
8
12
16
Days
U-Lewis
AA-Lewis
U-TSSM
AA-TSSM

How will they behave in the field?

- Environmental variability
- Spatial variability

Methods

- Sampled fields with both mite species present
  - Organic field (fall berries)
- 4 replications per treatment (1 bed per rep)
  - *A. andersoni*
  - *N. californicus*
  - *N. fallacis*
  - Grower Standard (*P. persimilis* + *N. californicus*)



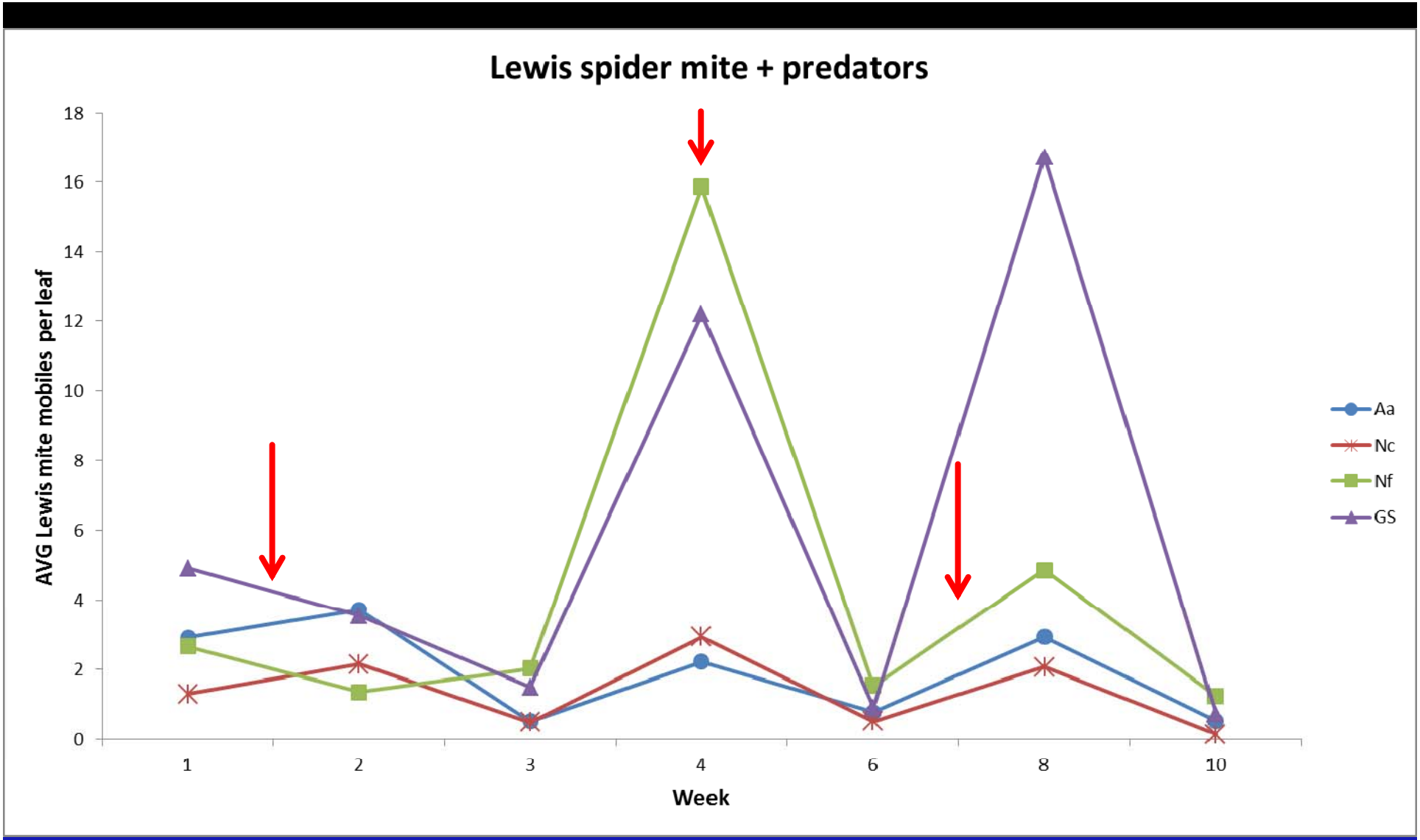
1 bed per treatment (AVG size: ~300ft x 4ft wide)

Each treatment separated by 4 beds

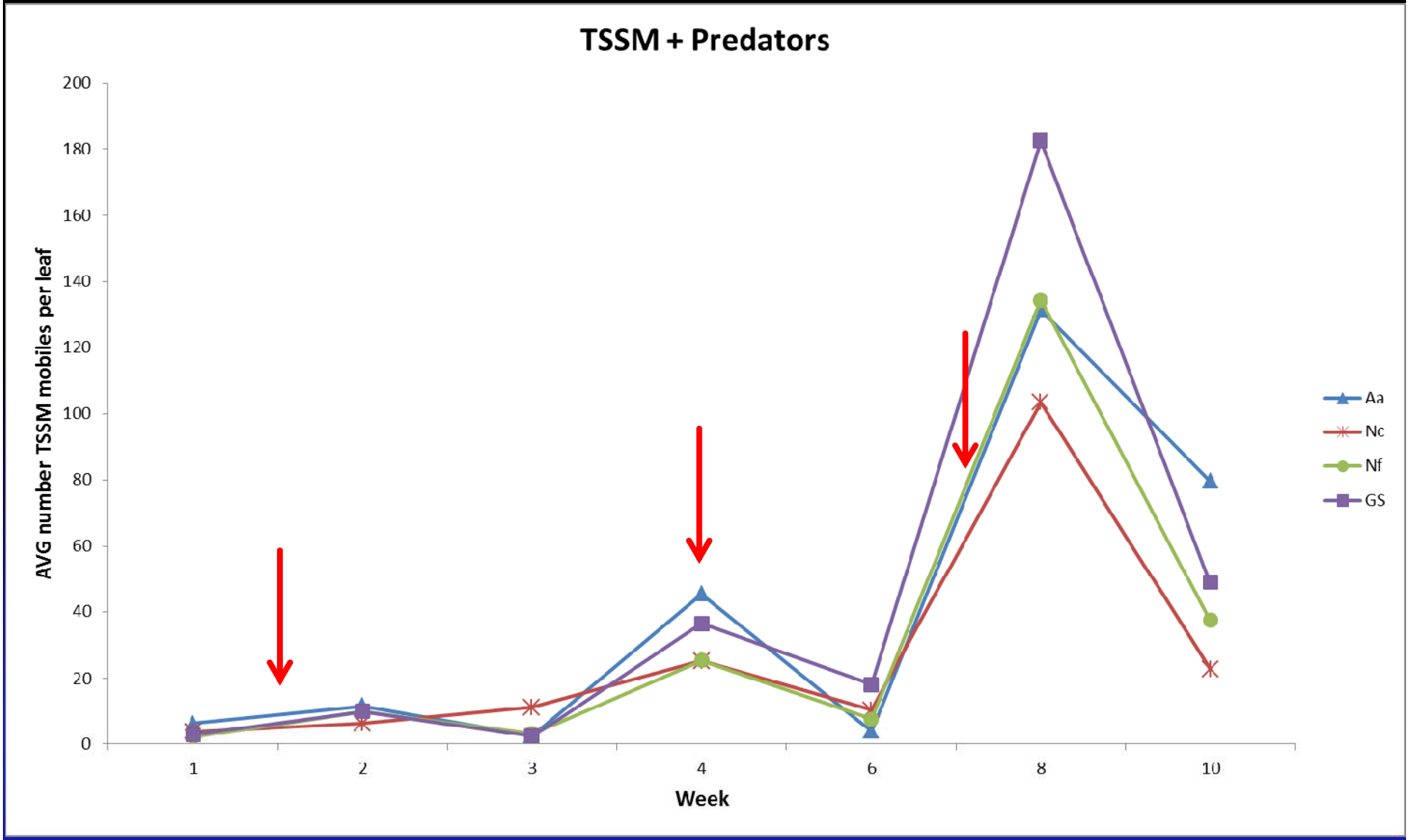
3 subplots

All beds were sprayed with Grandevo (MBI)

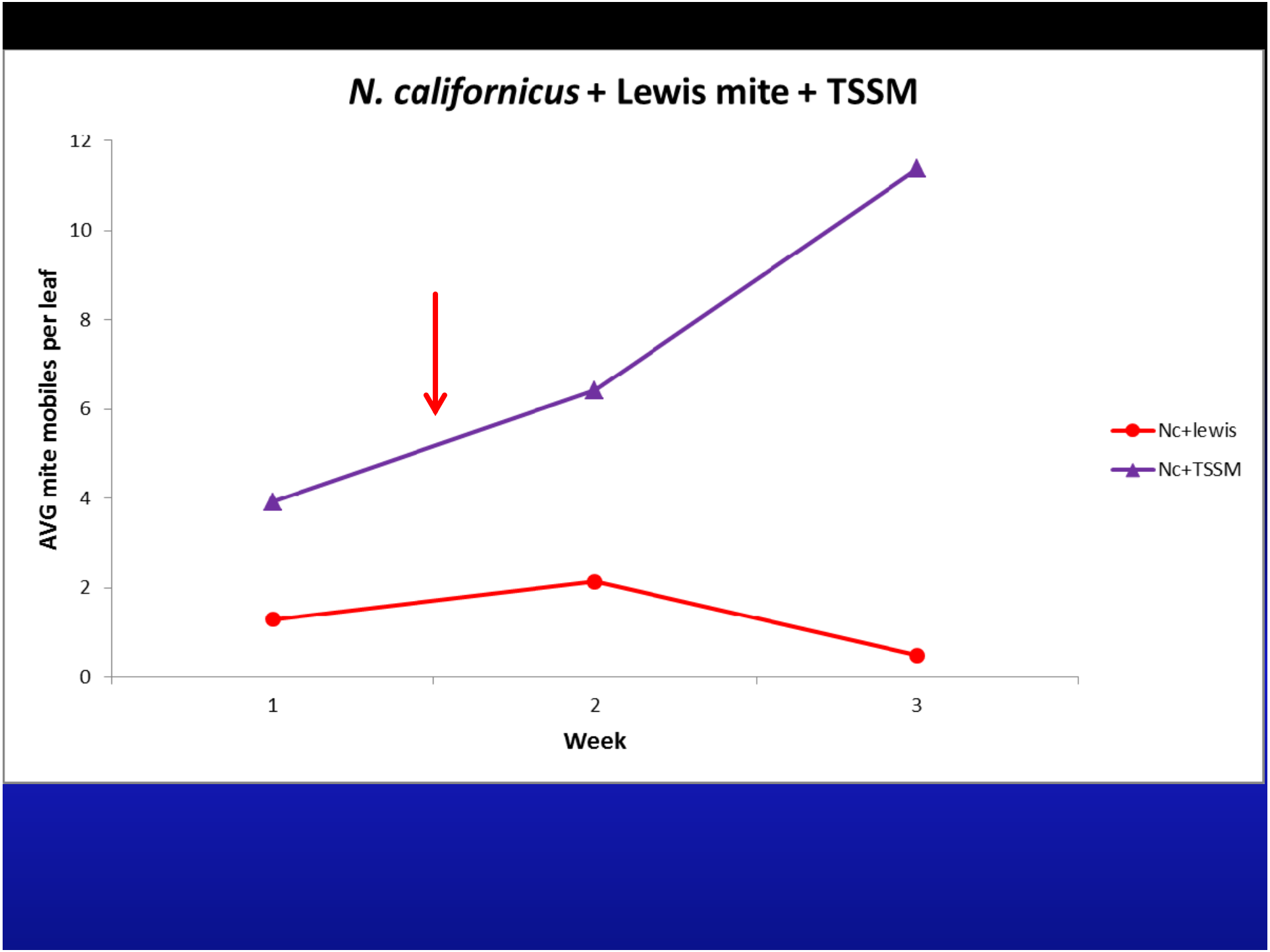
- Collected 6 mid-tier trifoliates from each subplot per rep
  - 72 trifoliates per treatment = 288 total
- Counted number of Lewis &TSSM mobiles & eggs every week for 10 weeks (Feb – April 2013)
- Counted the number of predators
- Baseline Count of Lewis & TSSM mobiles
- Released at a rate of 25,000 per acre (equivalent to what the grower was releasing)

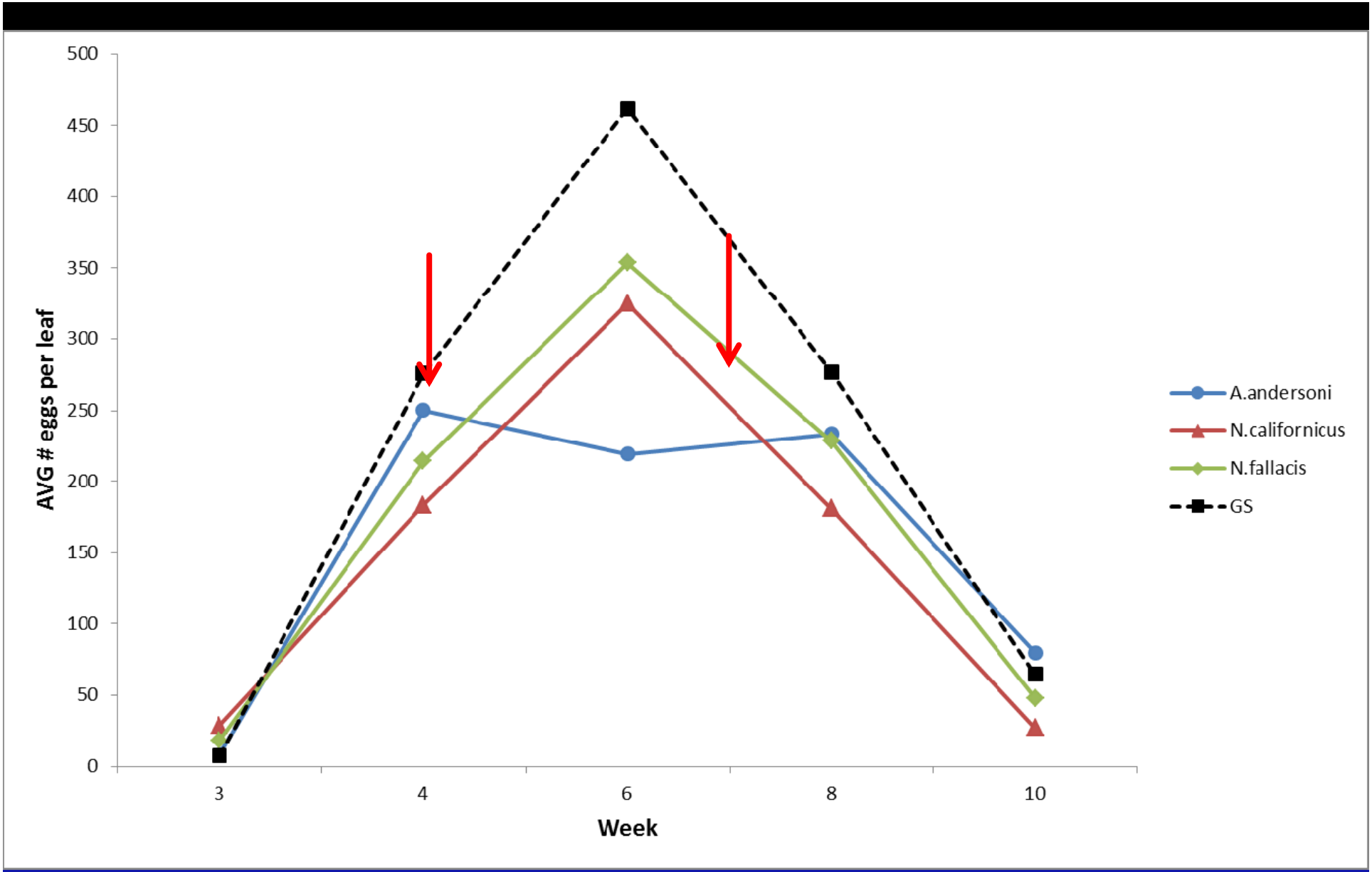


No sig. difference between treatments
Repeated measures ANOVA: $p = 0.715$



No sig. difference between treatments
Repeated measures ANOVA: $p = 0.926$


N. californicus + Lewis mite + TSSM
AVG mite mobiles per leaf
12
10
8
6
4
2
0
1
2
3
Week
Nc+lewis
Nc+TSSM



No sig. difference between treatments
Repeated measures ANOVA: $p = 0.972$

Recommended predatory mites for…

TSSM **ONLY**

P. persimilis

N. fallacis

A. andersoni

N. californicus

Lewis **ONLY**

P. persimilis

N. fallacis

A. andersoni

N. californicus

Lewis

+

TSSM

N. fallacis

A. andersoni

P. persimilis

N. californicus

- To implement the best IPM program
  - Scout your fields
  - Properly ID your mites
  - Apply the best control for your situation

Acknowledgements

Frank Zalom & his lab (UC Davis)
Dan Cahn & Sally Gray (Syngenta Bioline)
Brett Chandler (Associates Insectary)
California Strawberry Commission
Success Valley Farms
Paul Penza
Jaime Lopez

Total spider mites counted:

99,261

Total eggs counted:

250,843