UC CE | University of California
Agriculture and Natural Resources | Cooperative Extension

Update on Mite Management

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Quick review of predatory mite bioassays

- Incorporation requires knowledge & understanding of interactions with crop management practices
  - They are living breathing organisms
  - Environment can affect control efficacy
    - Temperature, humidity, prey & other food sources, crop type, pesticides

Lab Conditions

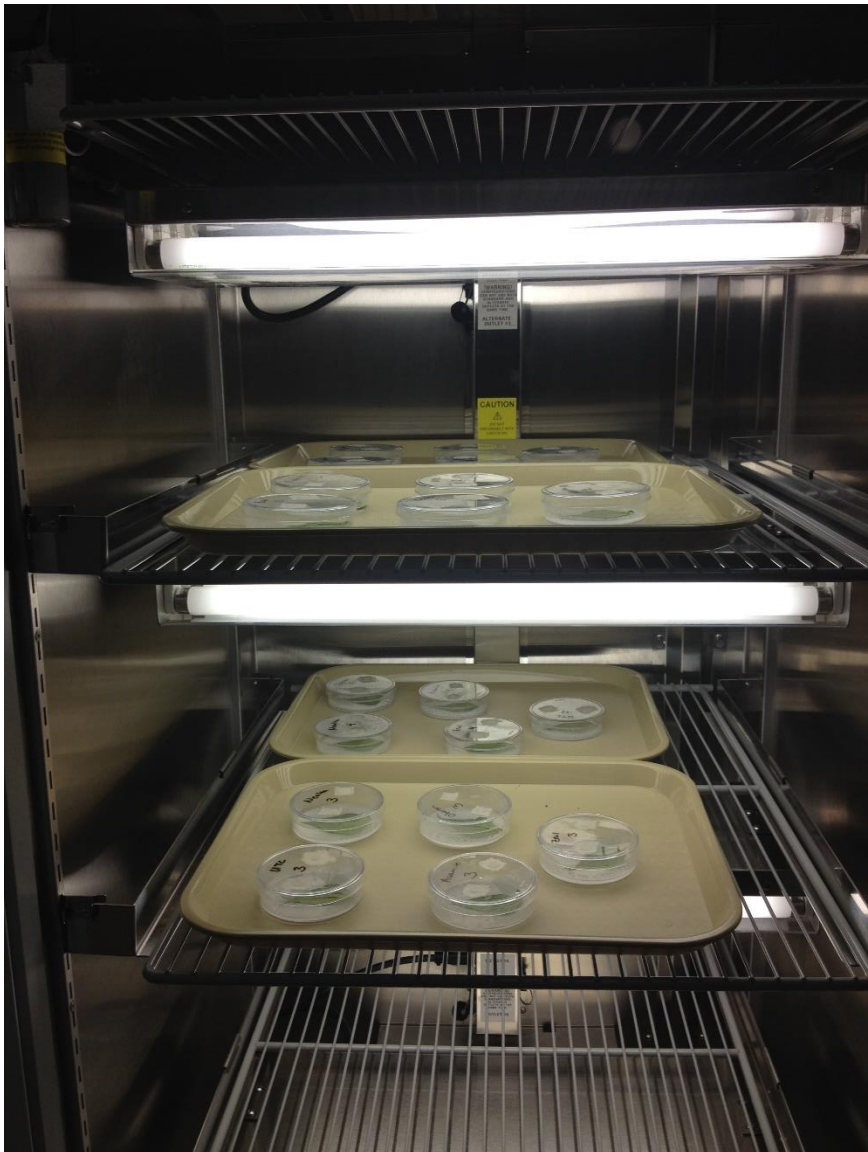
Temp: 80 °F ± 1 °F

% RH : 60-65%

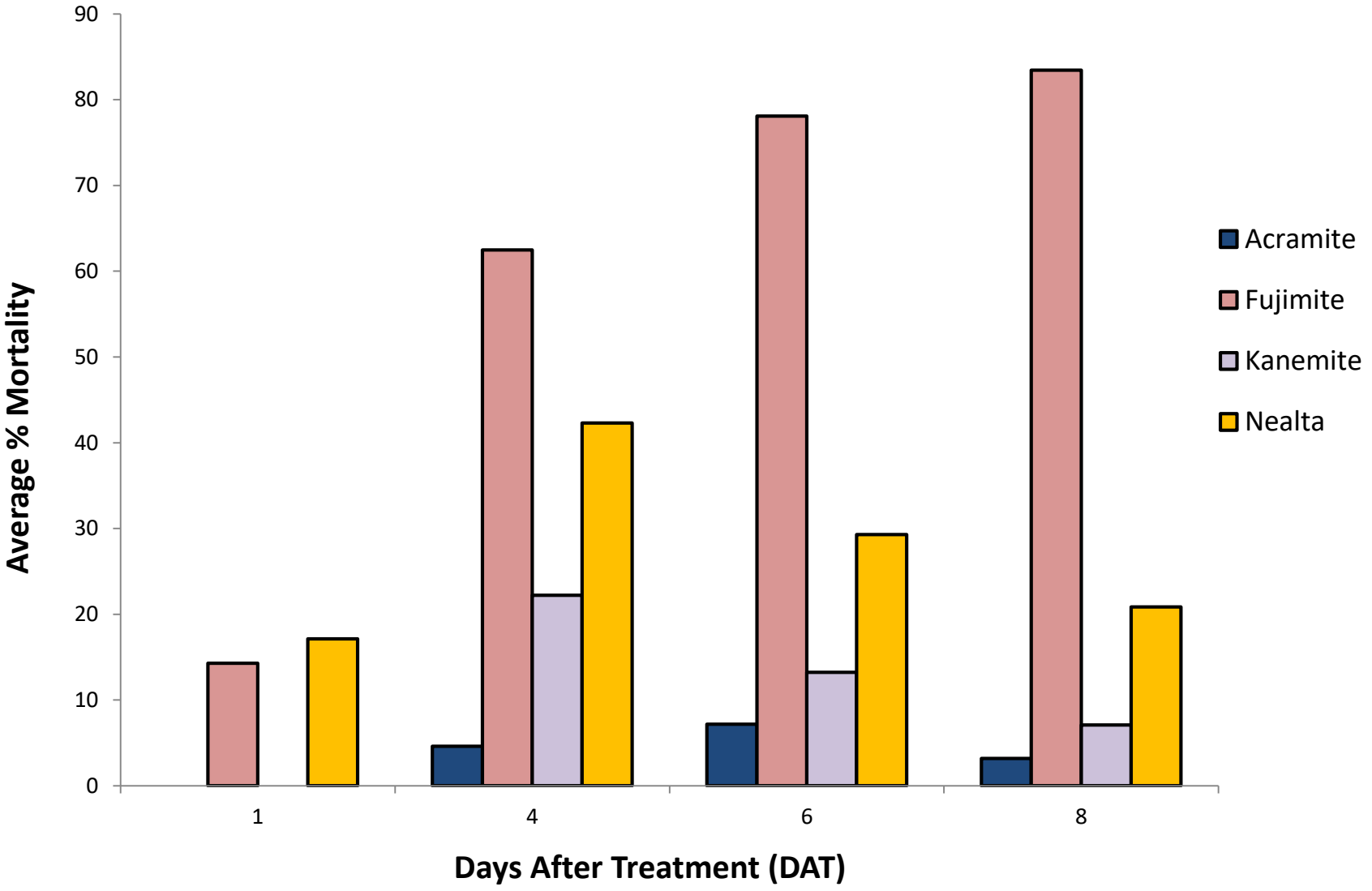
16:8 hr (L:D)

RCBD in Envir. Chamber

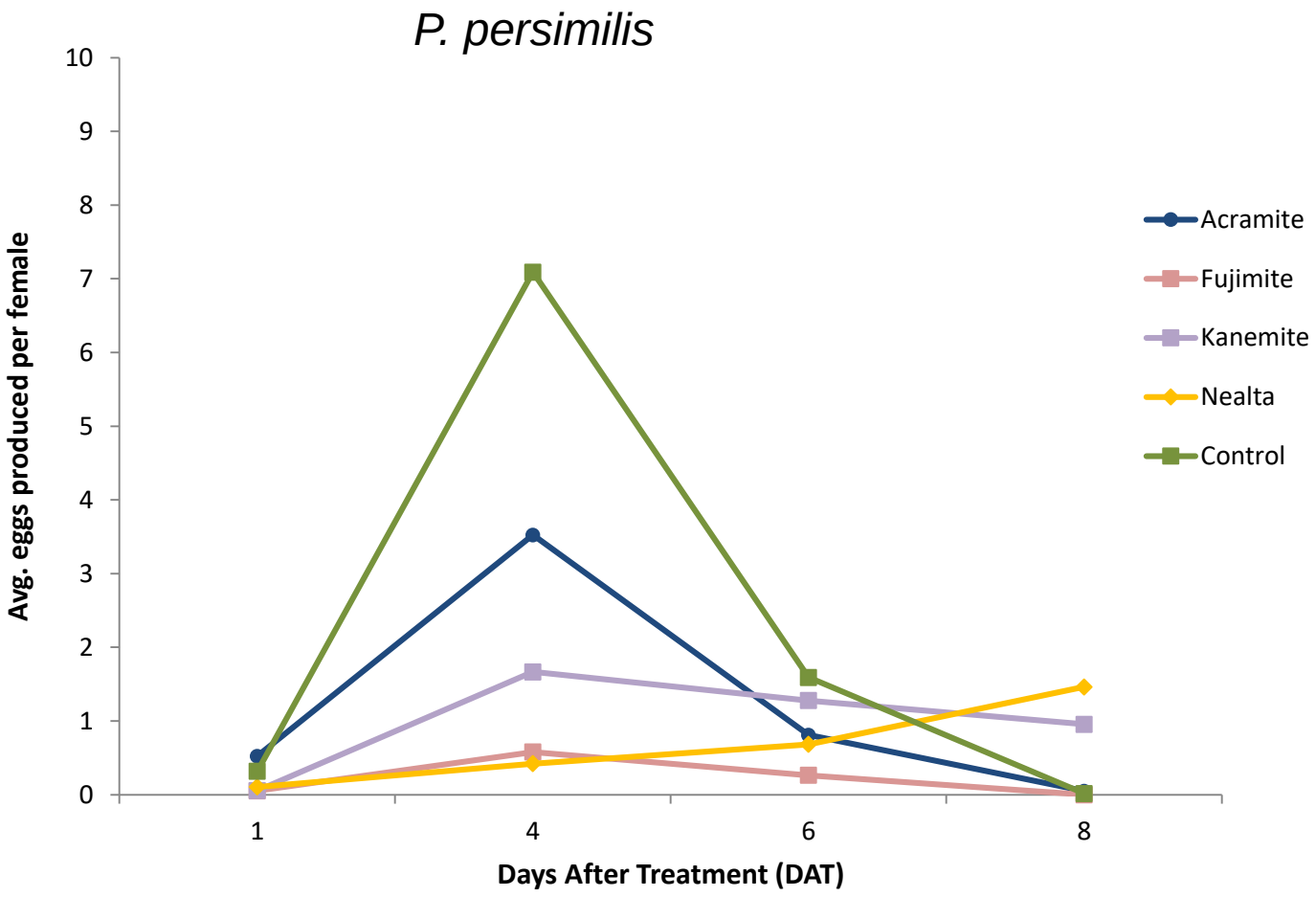
4 Reps



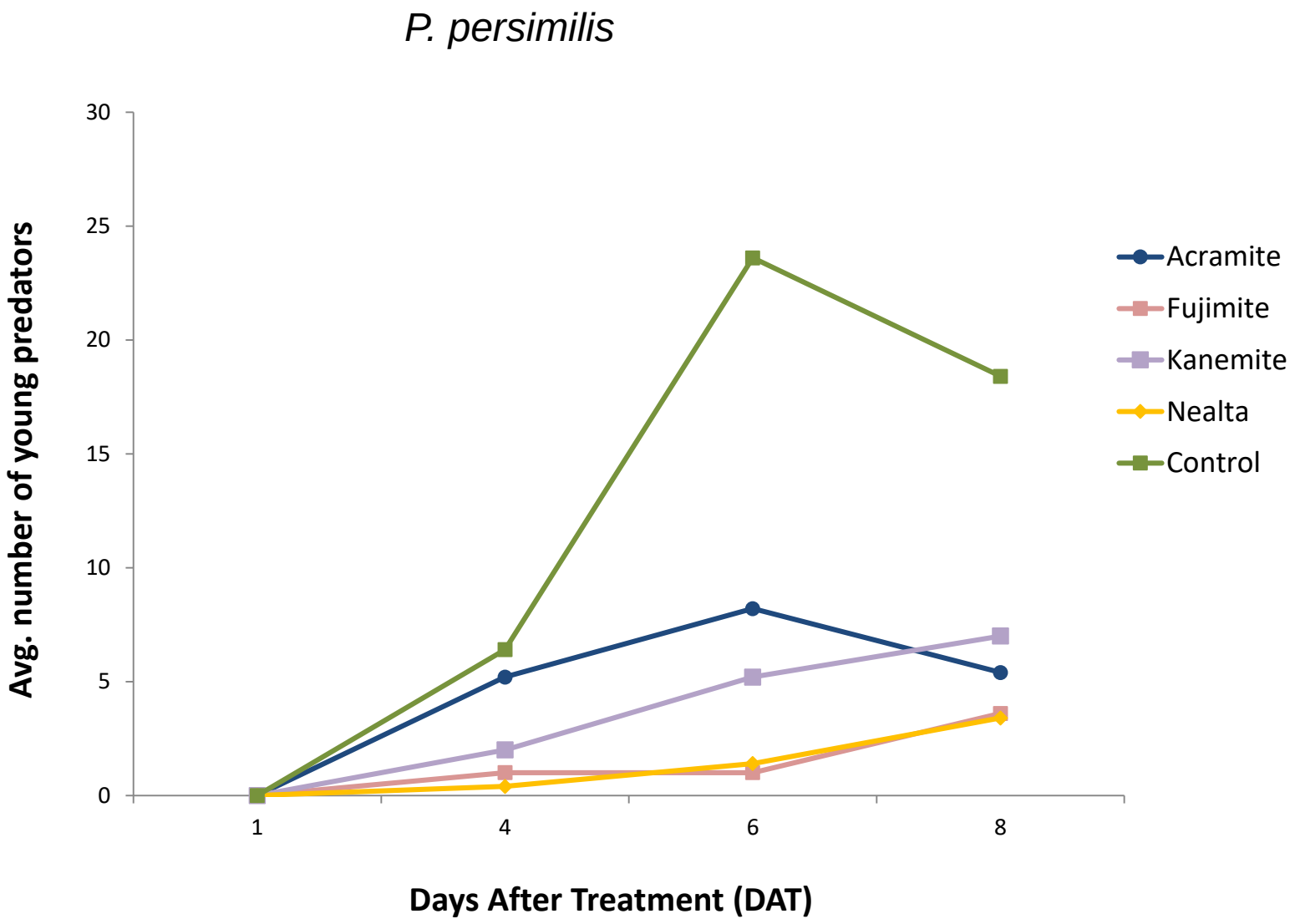
Corrected Percent Mortality (*P. persimilis*)



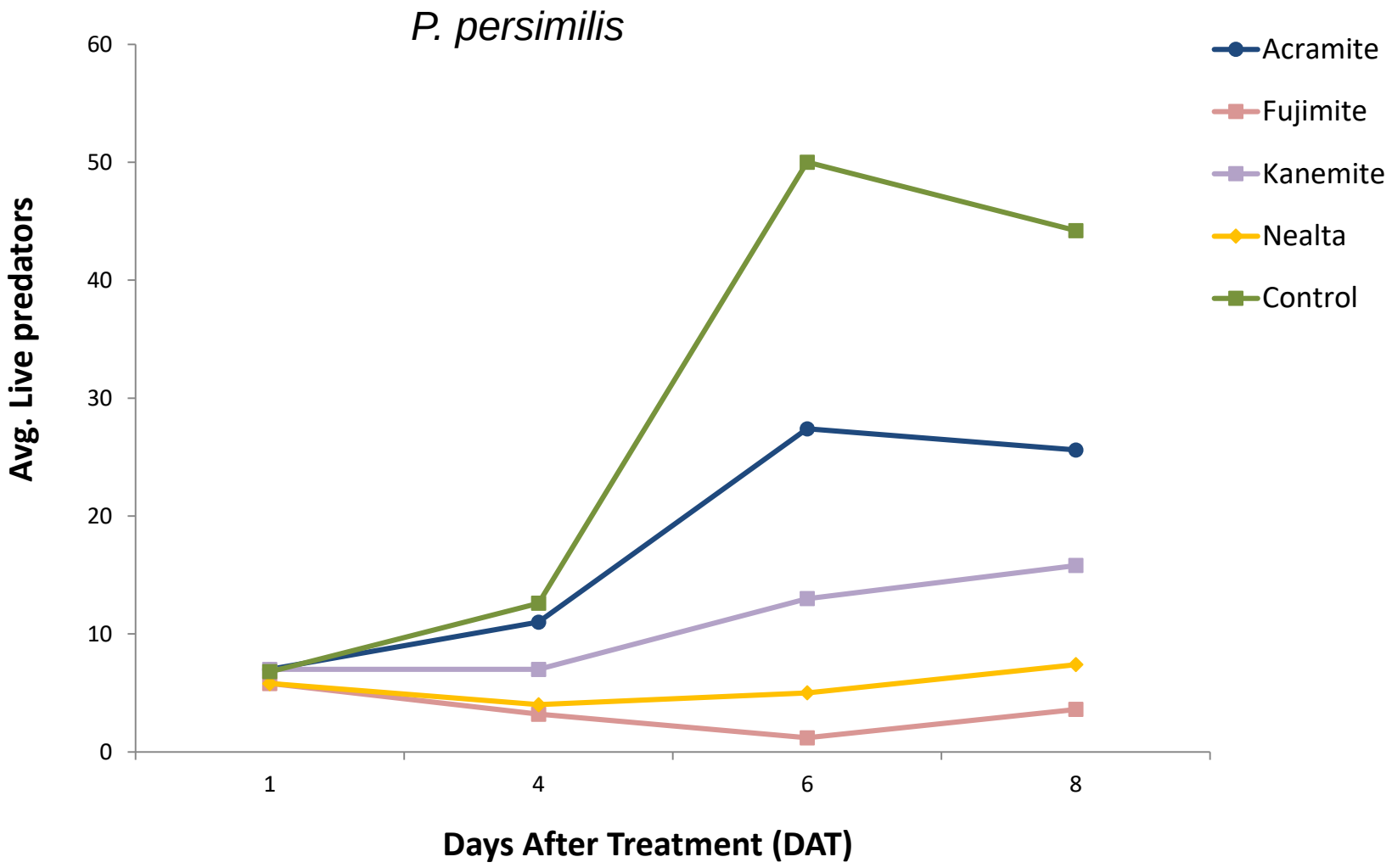
Fecundity (# eggs produced)



Fertility (# young produced)



Total live predators



Guidelines

Harsh on *P. persimilis*:

Fujimite

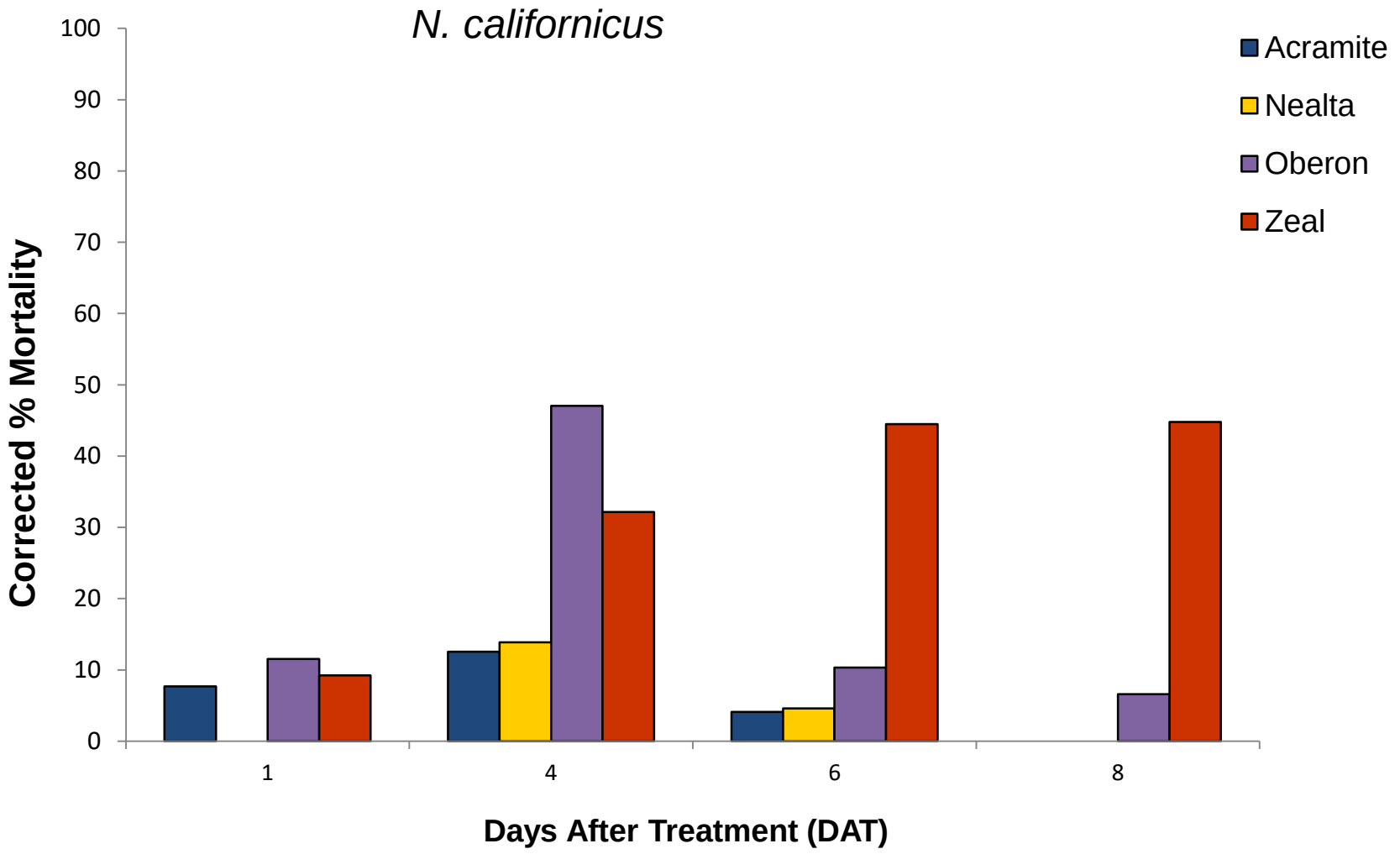
"So-so" on *P. persimilis:*

Nealta

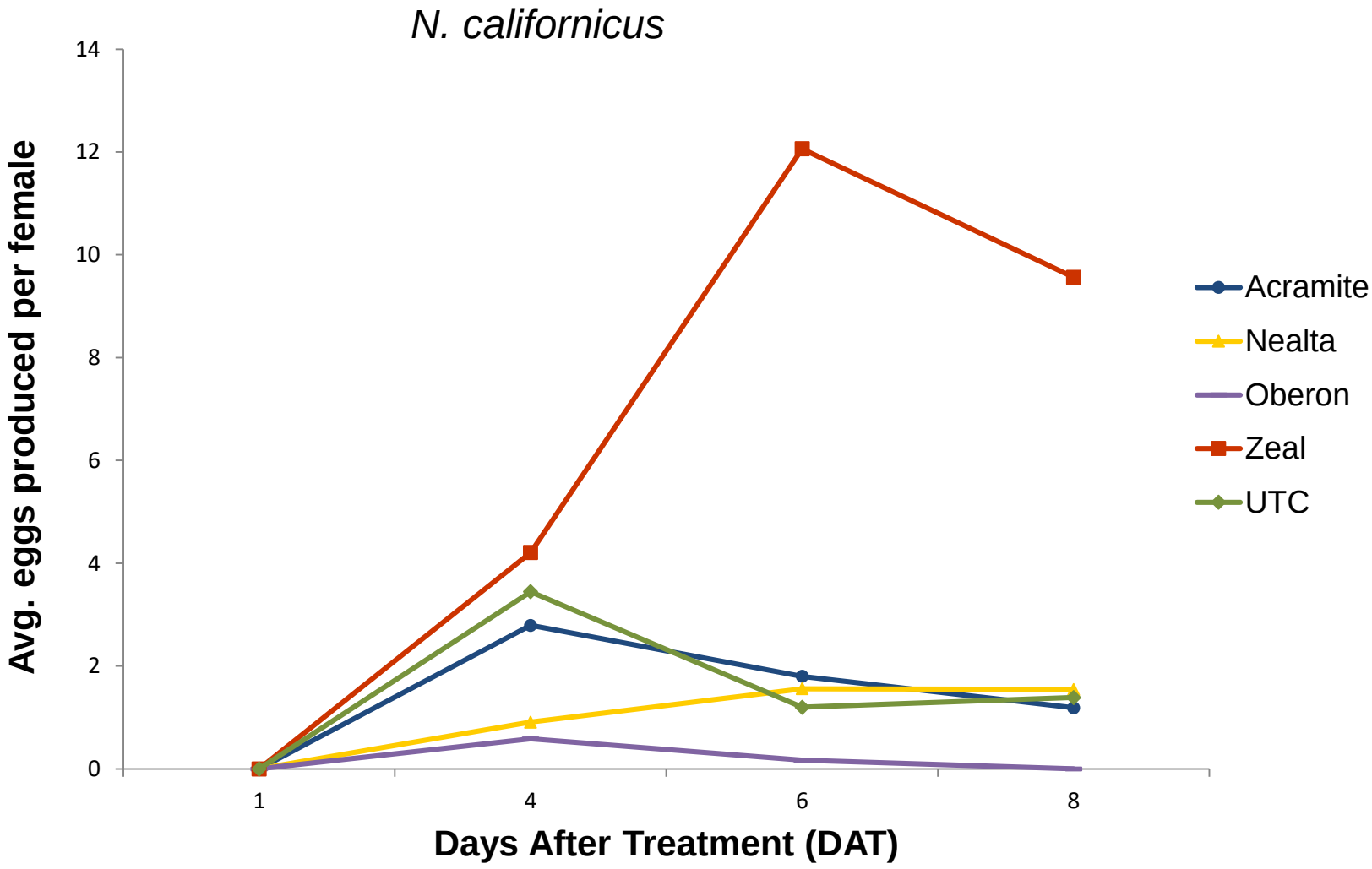
"Softer" on *P. persimilis:*

Acramite & Kanemite

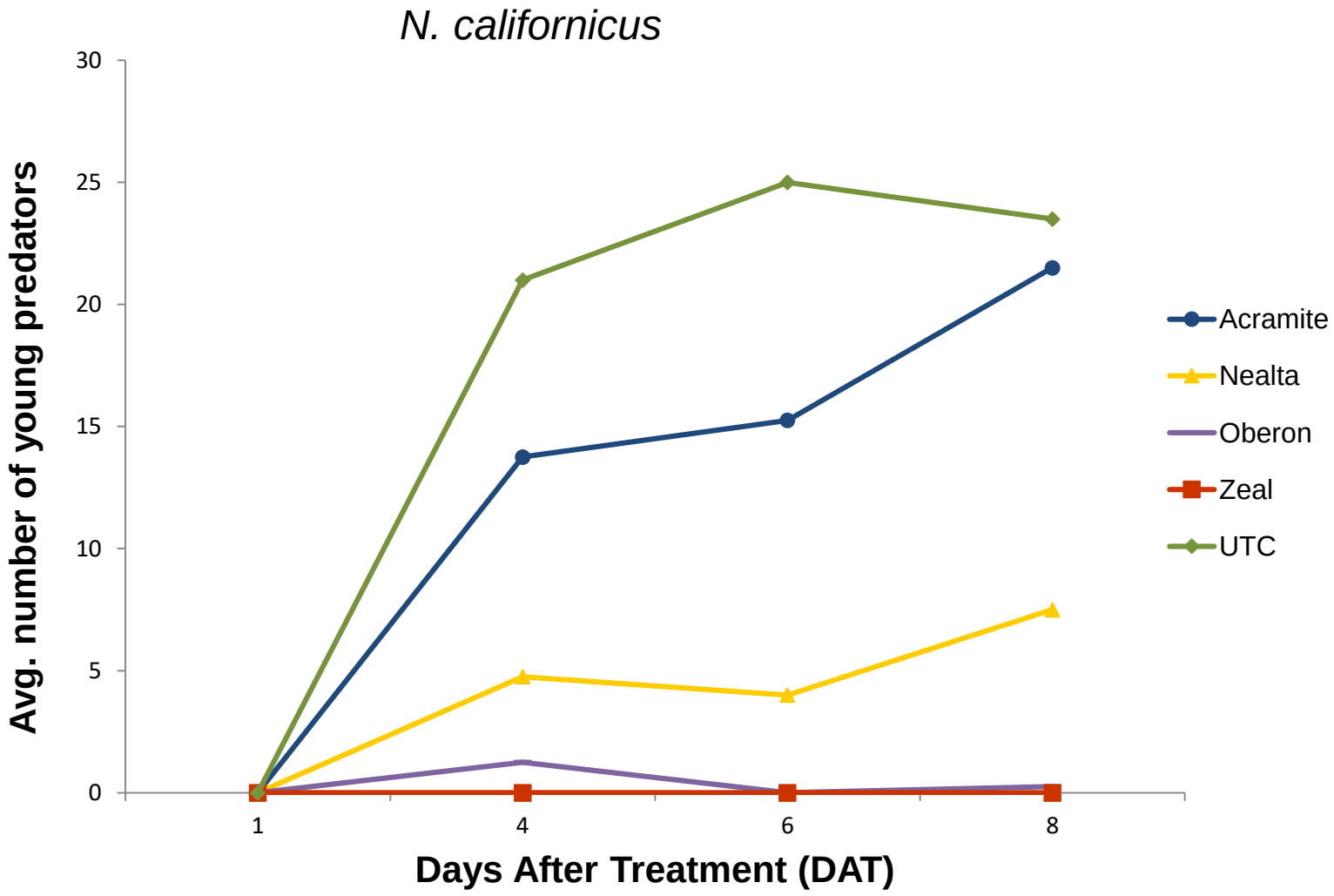
Corrected Percent Mortality (*N. californicus*)



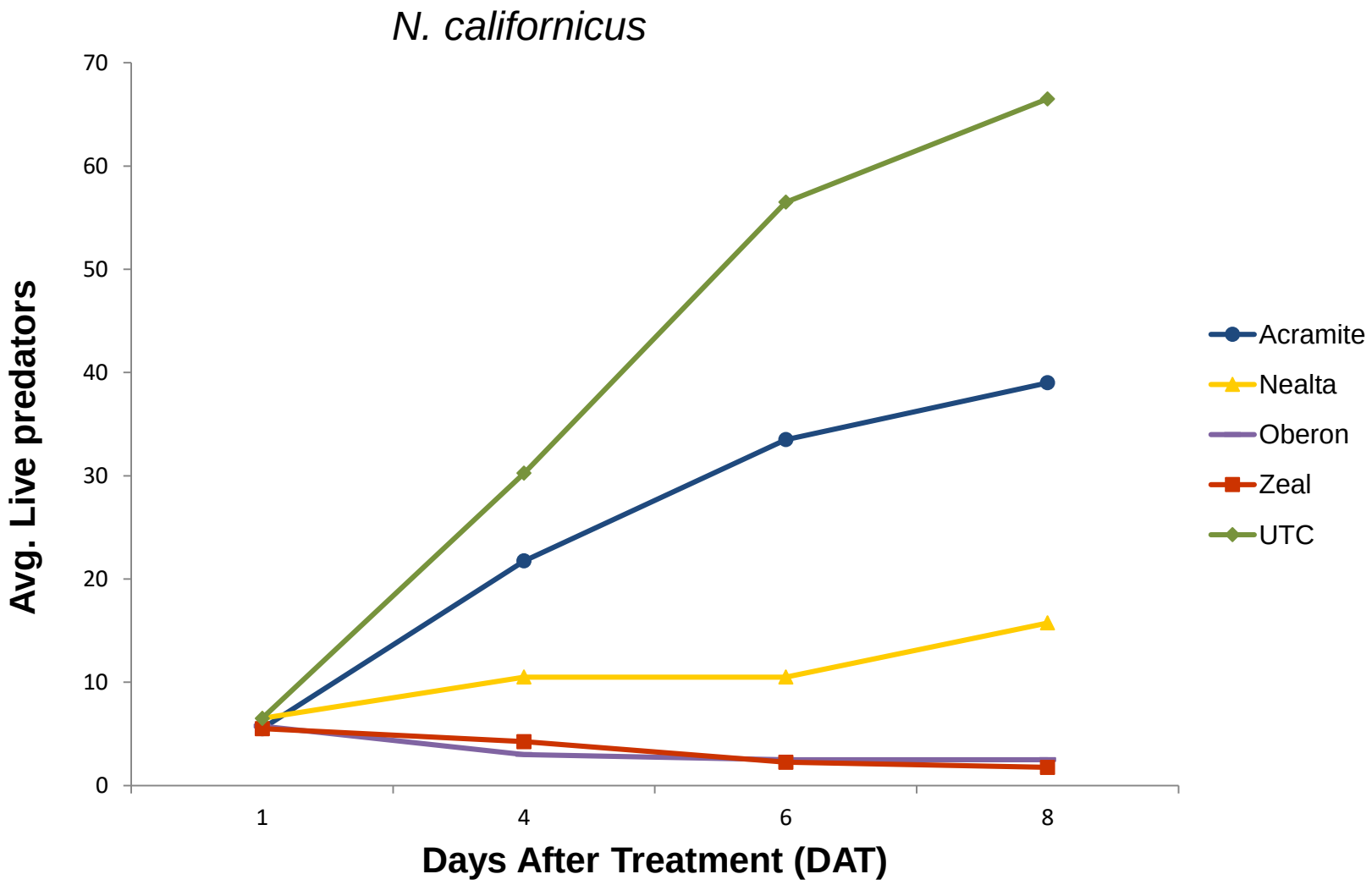
Fecundity (# eggs produced)



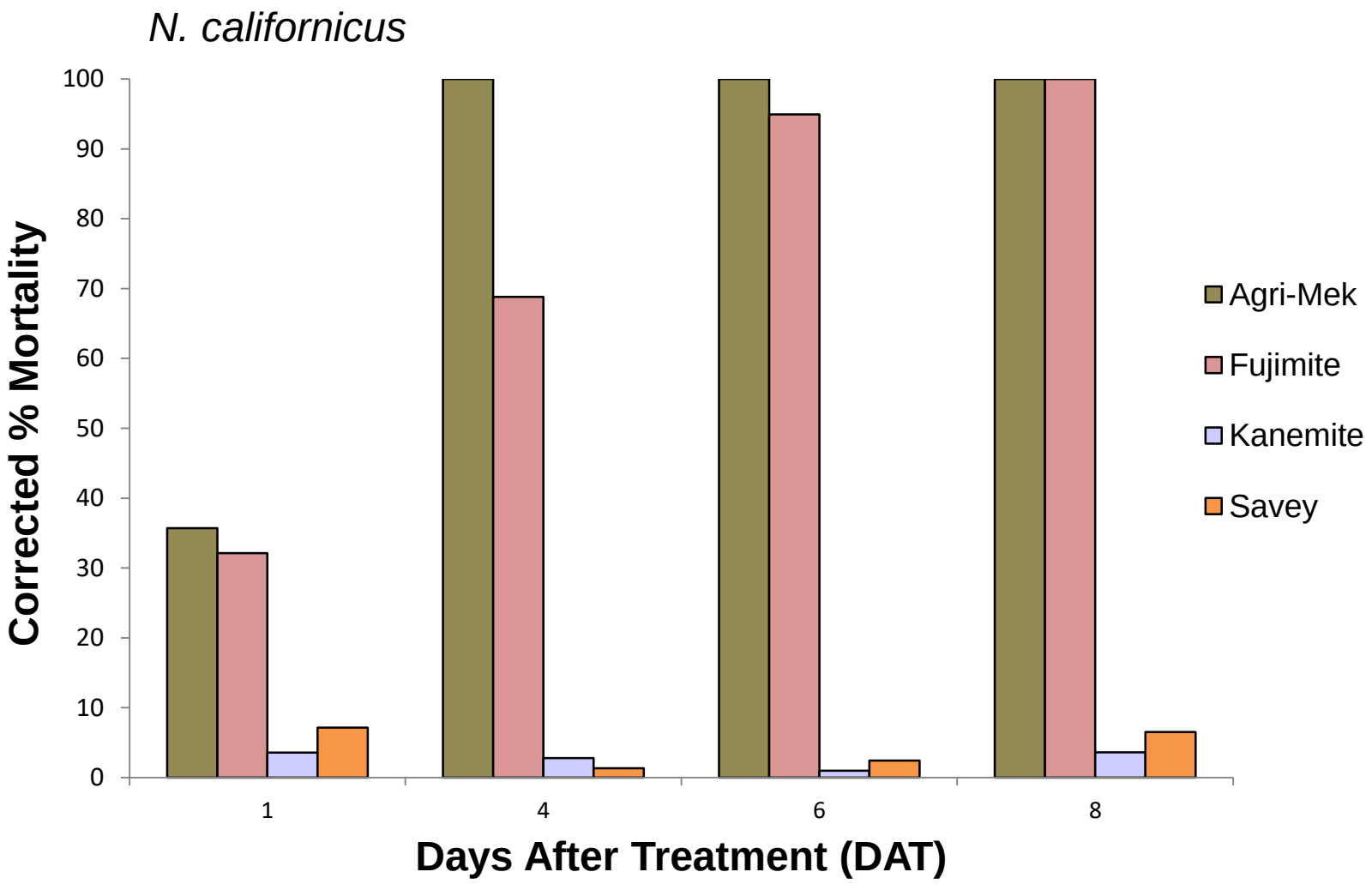
Fertility (# young produced)



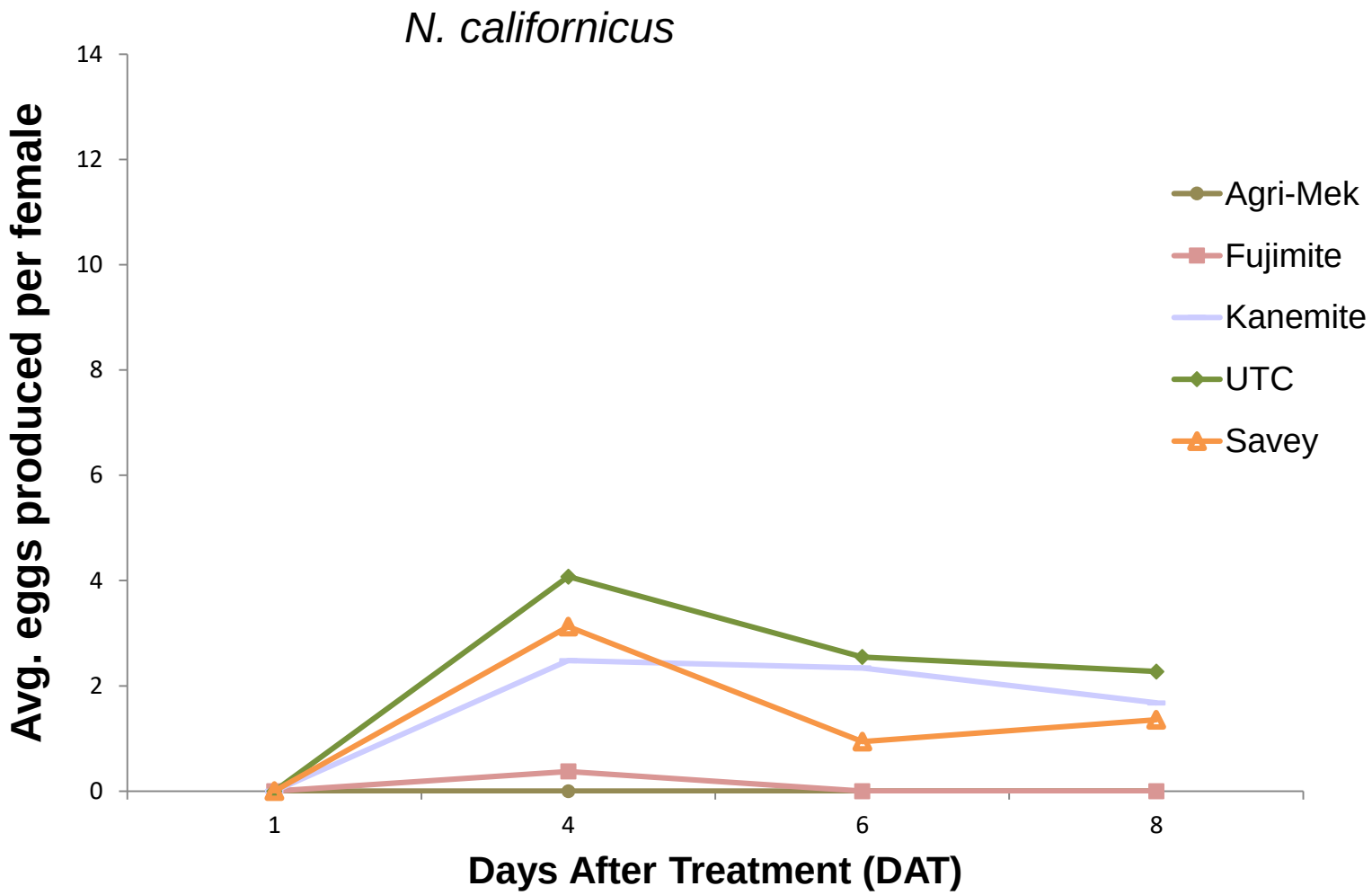
Number of live predators



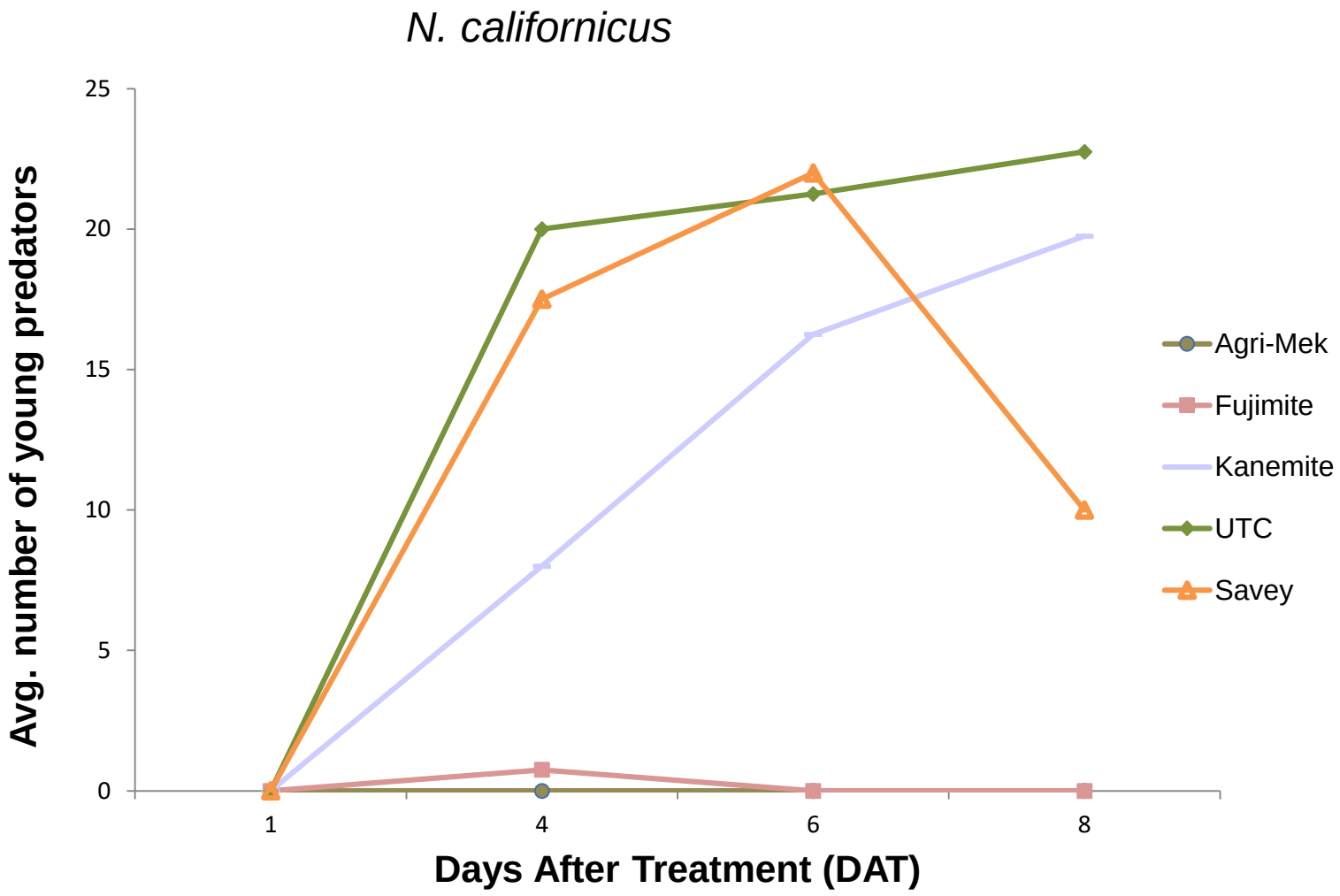
Corrected Percent Mortality



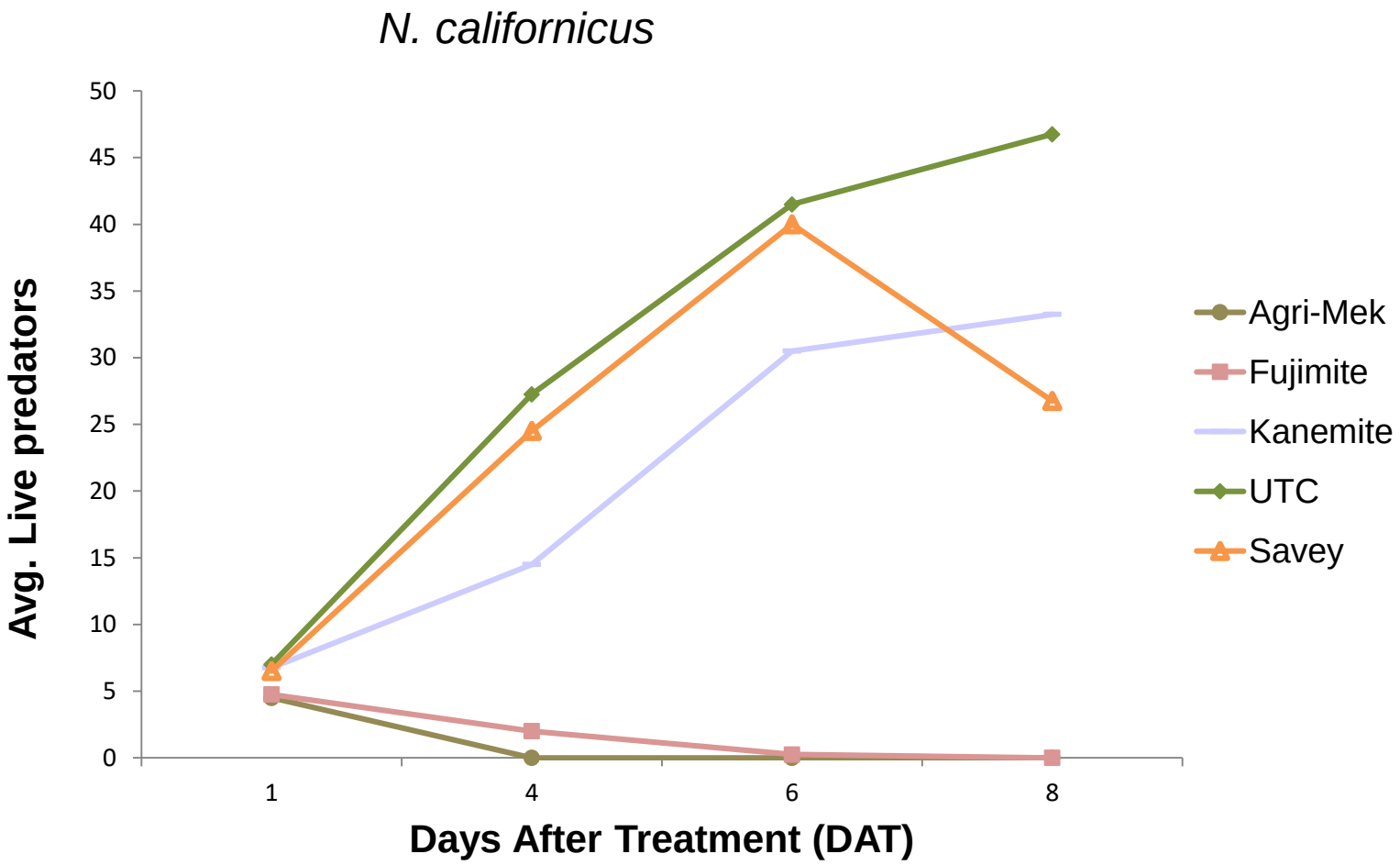
Fecundity (# eggs produced)



Fertility (# young produced)



Number of live predators



Guidelines

Harsh on *N. californicus*:

Zeal, Oberon, Fujimite, Agri-Mek

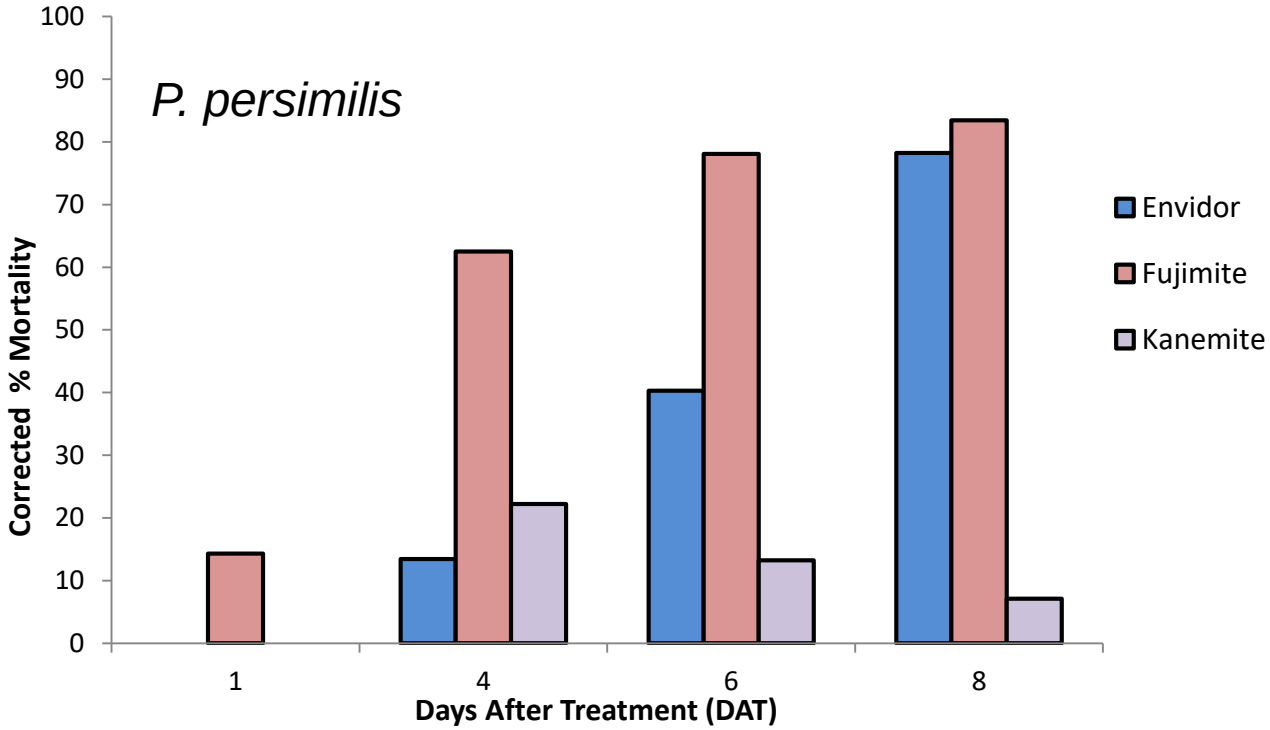
"So-So" on *N. californicus*:

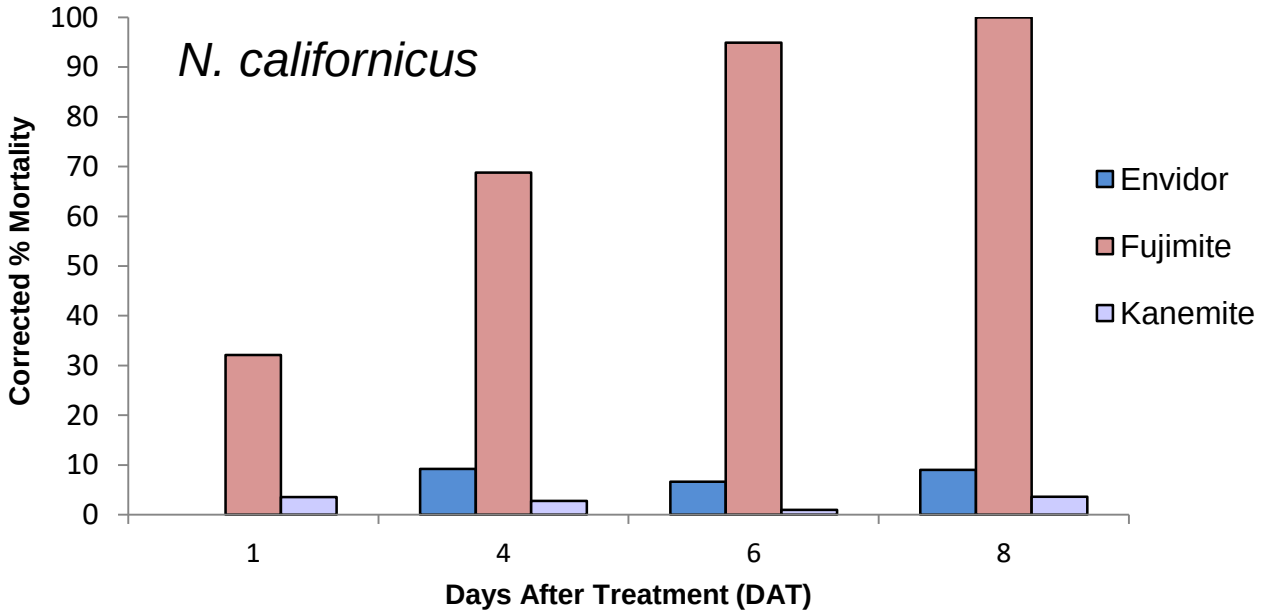
Kanemite, Nealta

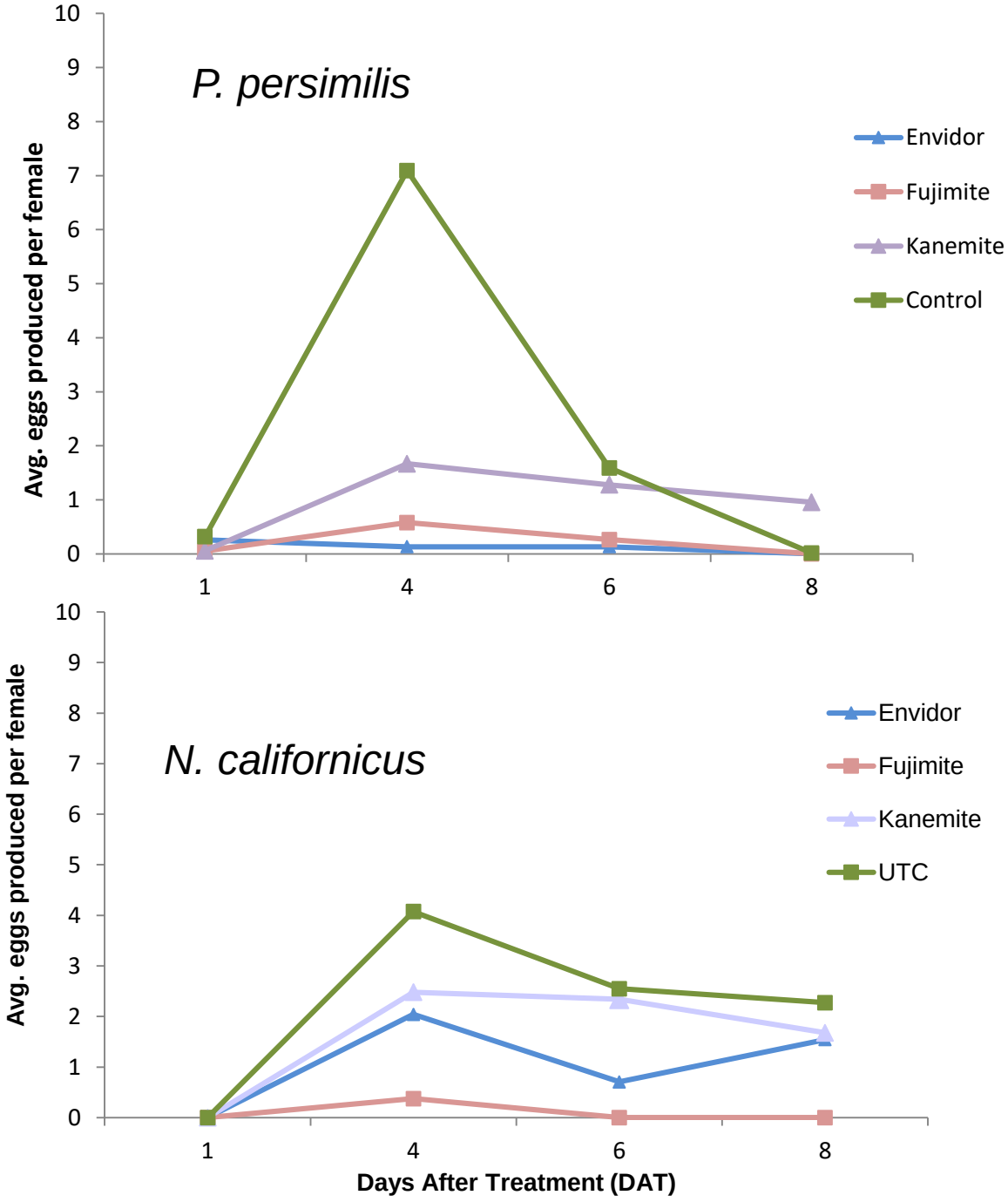
"Softer" on *N. californicus* :

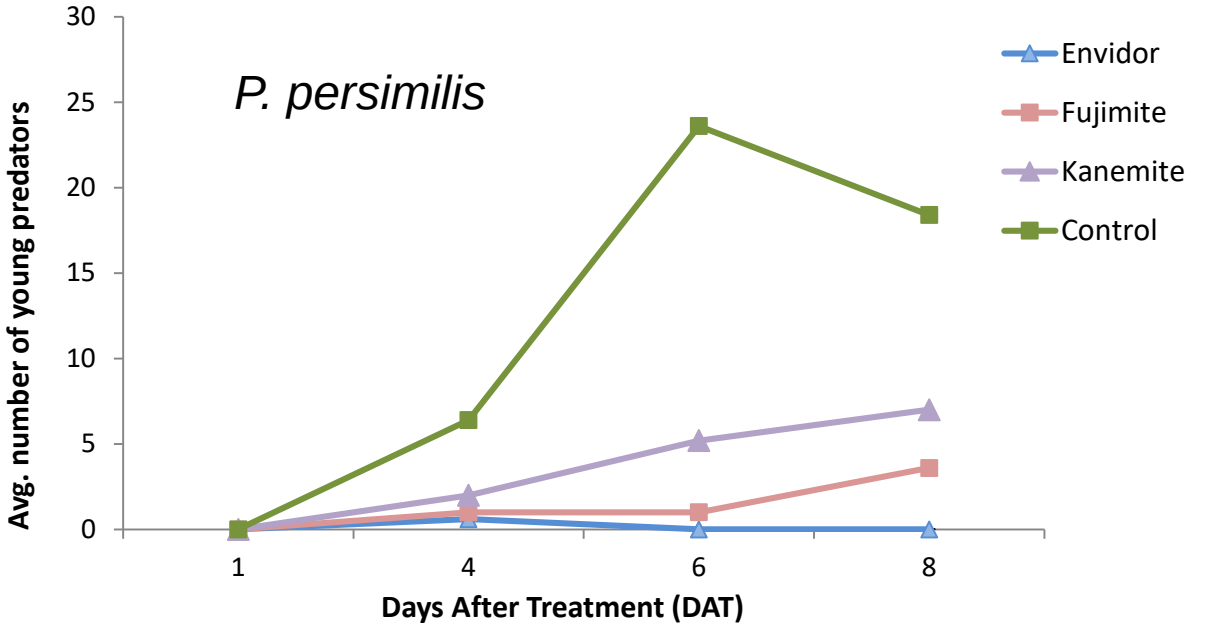
Acramite, Savey

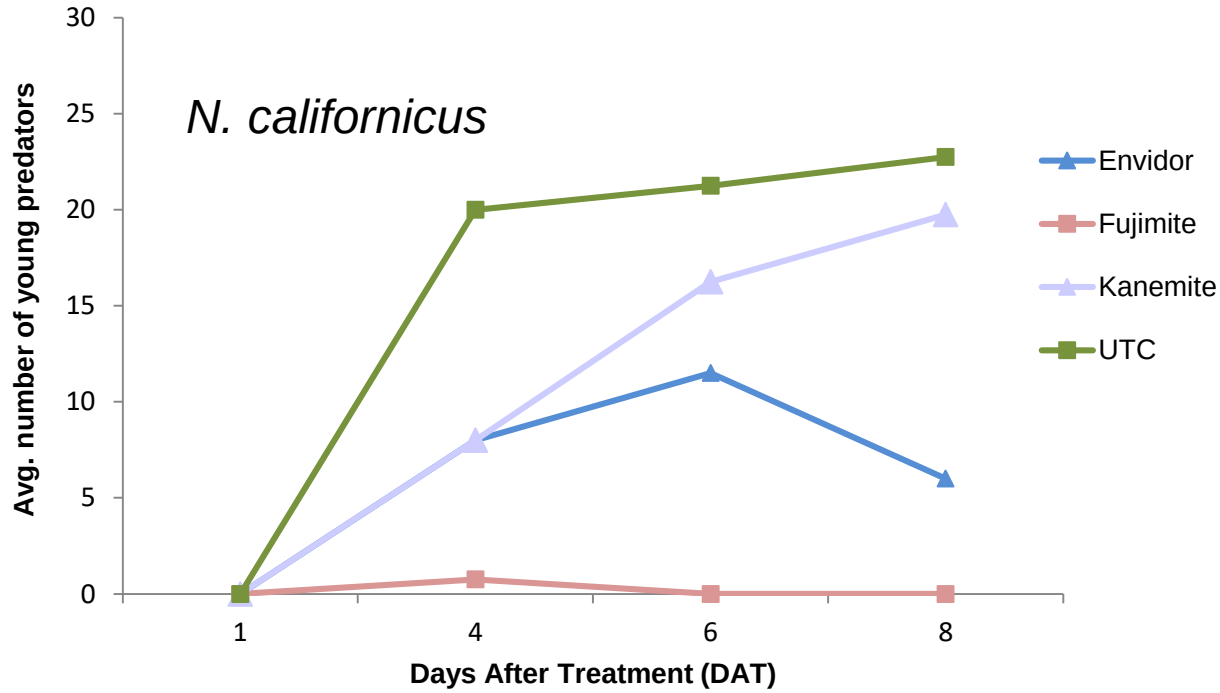
Comparing results between the 2 mites

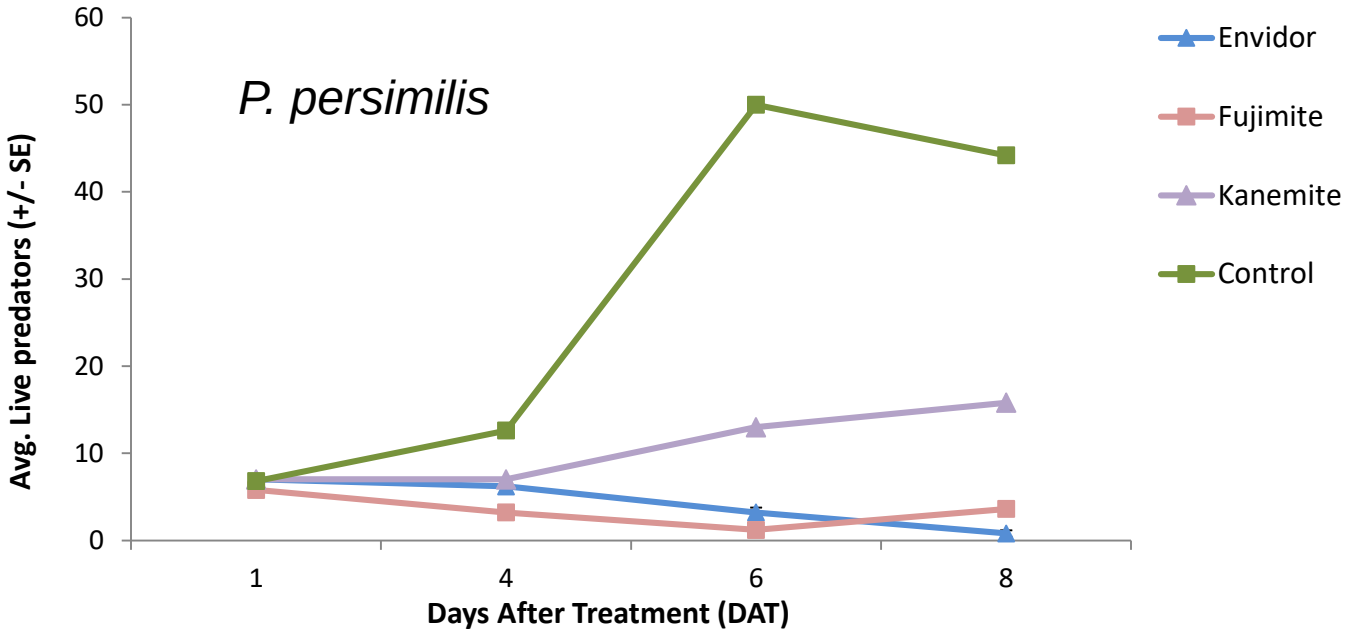

P. persimilis
Corrected % Mortality
100
90
80
70
60
50
40
30
20
10
0
1
4
6
8
Days After Treatment (DAT)
Envidor
Fujimite
Kanemite

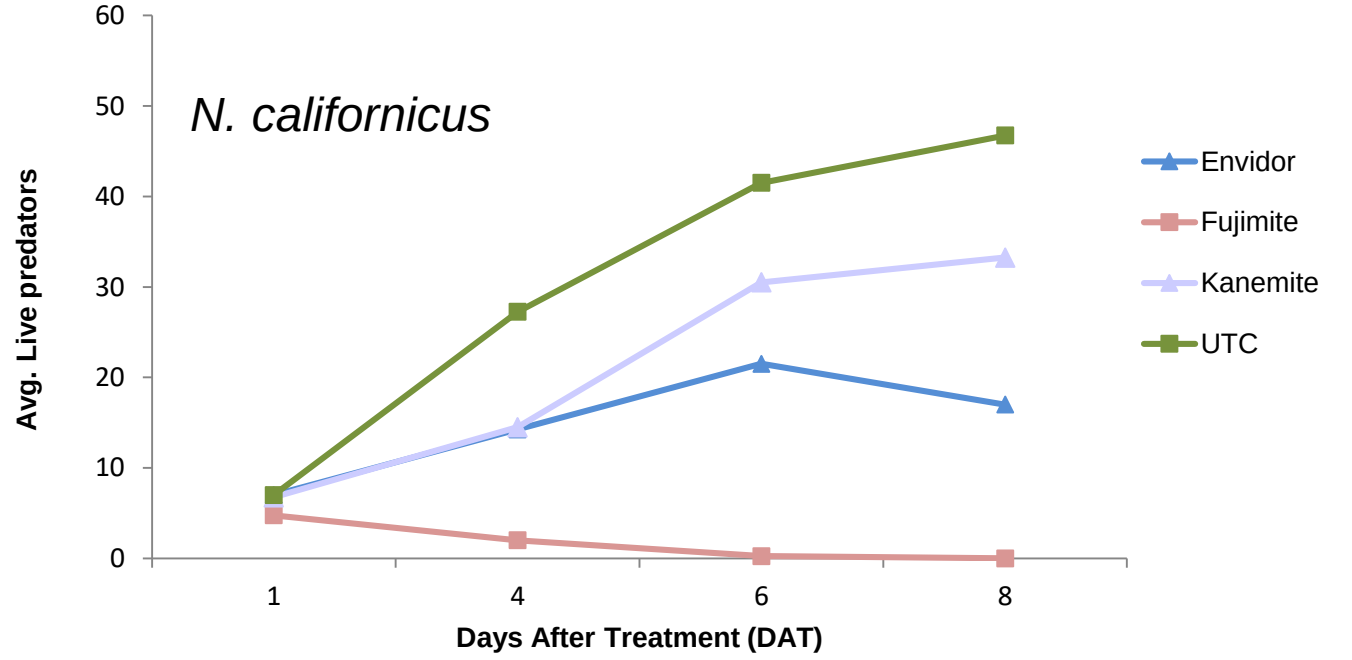

N. californicus
Corrected % Mortality
100
90
80
70
60
50
40
30
20
10
0
1
4
6
8
Days After Treatment (DAT)
Envidor
Fujimite
Kanemite

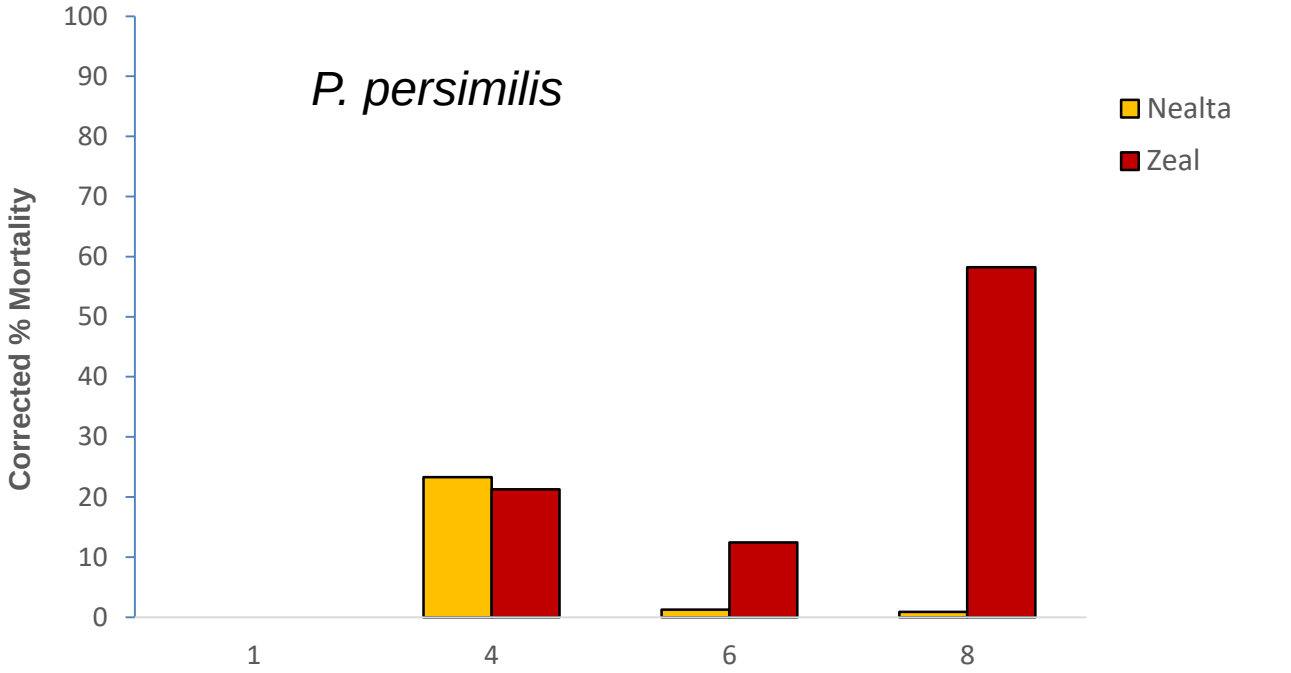

P. persimilis
Avg. eggs produced per female
10
9
8
7
6
5
4
3
2
1
0
1
4
6
8
Envidor
Fujimite
Kanemite
Control
N. californicus
Avg. eggs produced per female
Envidor
Fujimite
Kanemite
UTC
Days After Treatment (DAT)

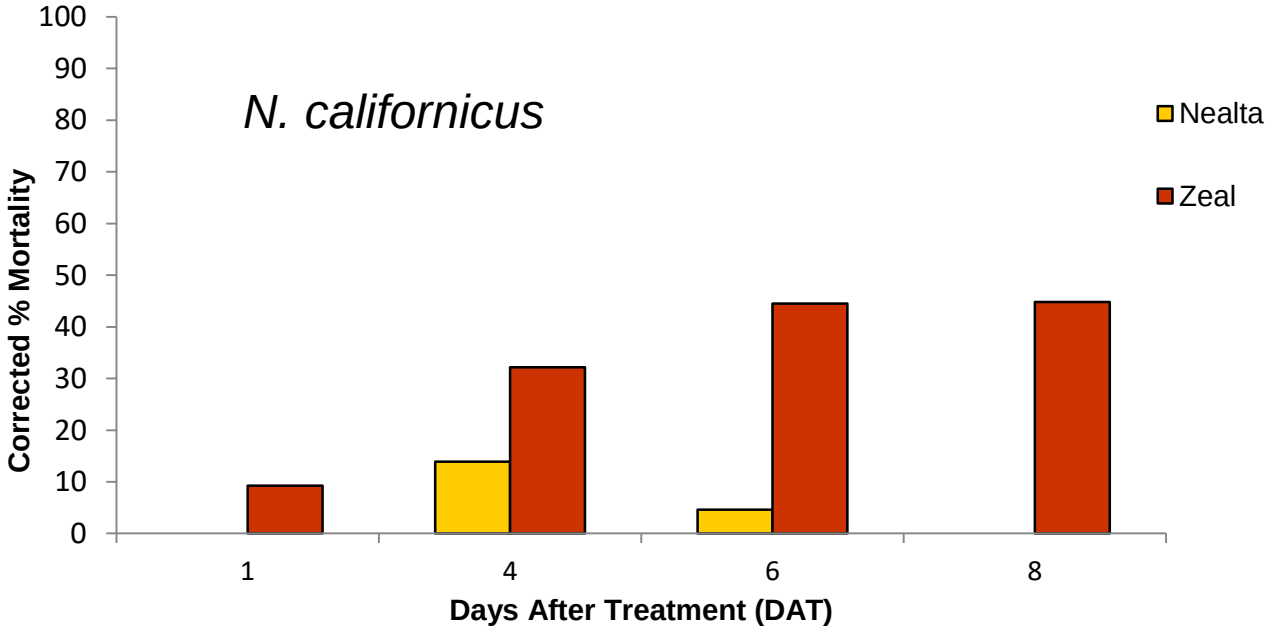

P. persimilis
Avg. number of young predators
30
25
20
15
10
5
0
1
4
6
8
Days After Treatment (DAT)
Envidor
Fujimite
Kanemite
Control

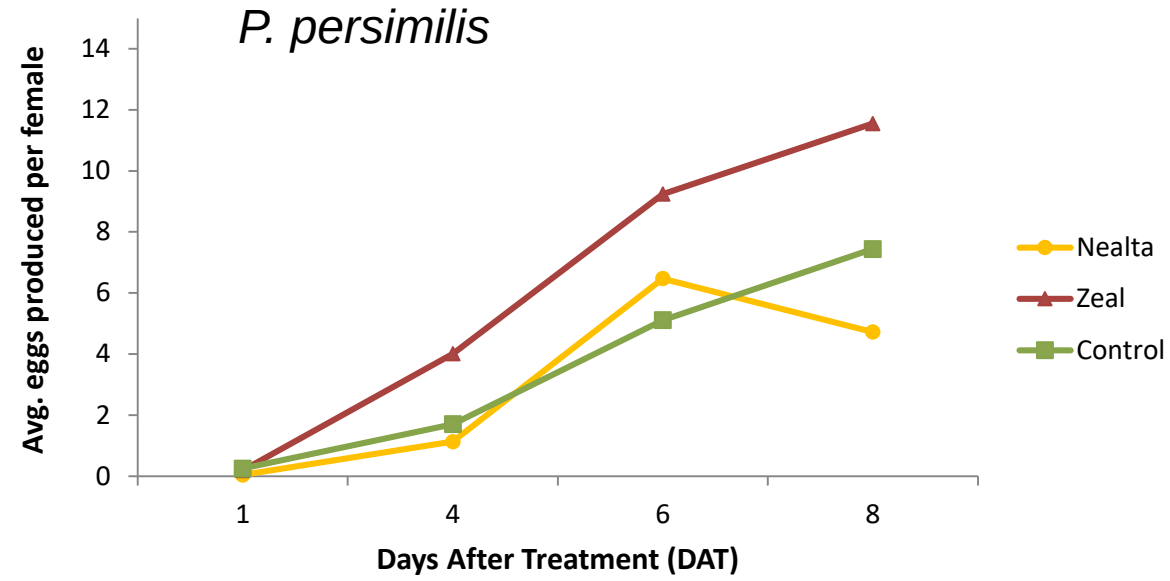

N. californicus
Avg. number of young predators
30
25
20
15
10
5
0
1
4
6
8
Days After Treatment (DAT)
Envidor
Fujimite
Kanemite
UTC

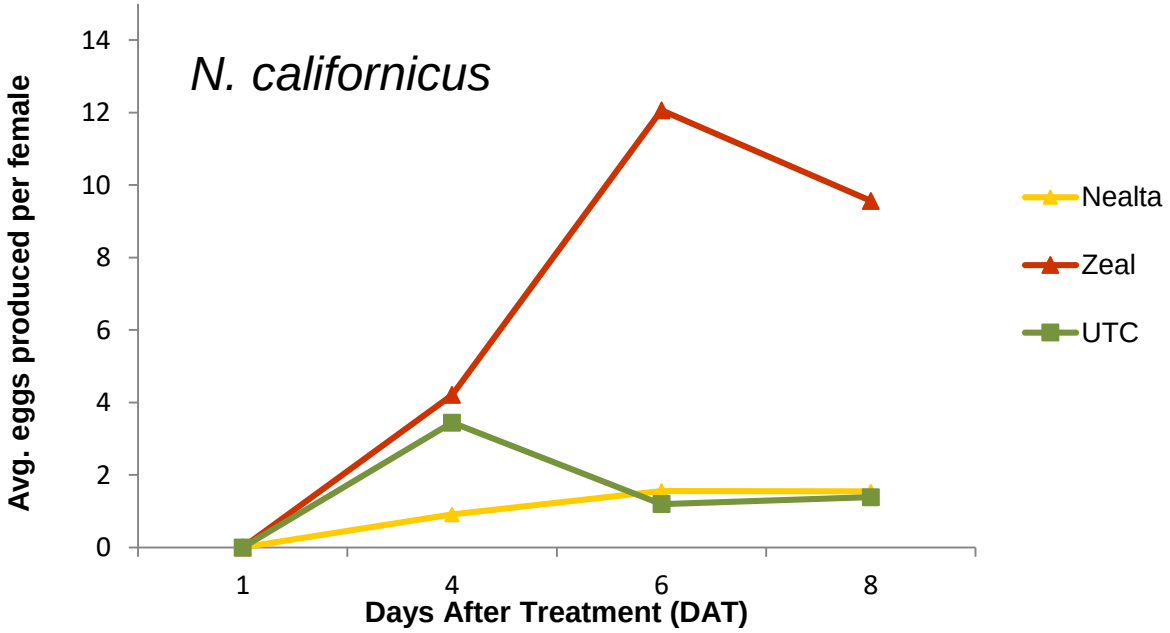

P. persimilis
Avg. Live predators (+/- SE)
60
50
40
30
20
10
0
1
4
6
8
Days After Treatment (DAT)
Envidor
Fujimite
Kanemite
Control

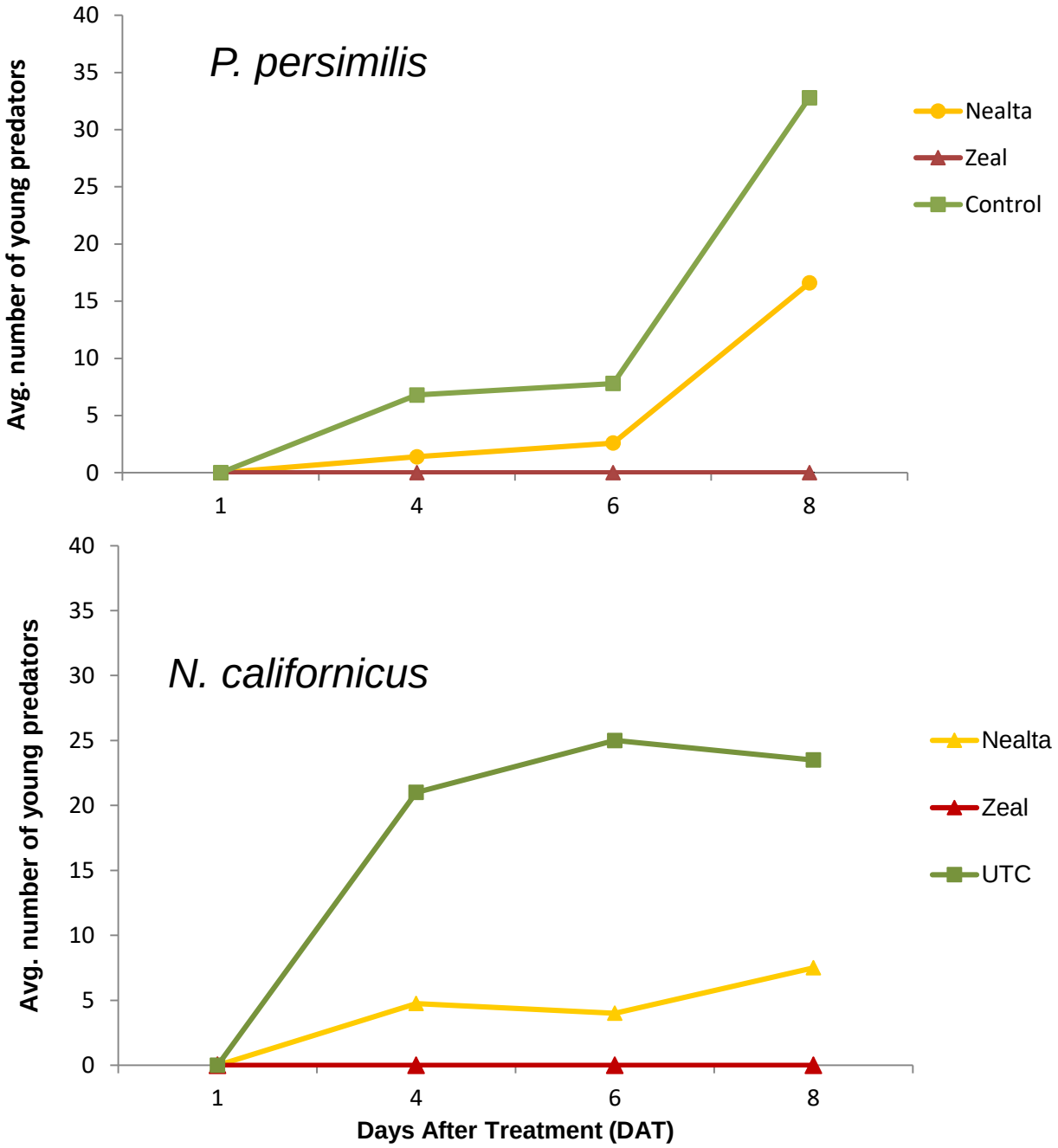

N. californicus
Avg. Live predators
60
50
40
30
20
10
0
1
4
6
8
Days After Treatment (DAT)
Envidor
Fujimite
Kanemite
UTC

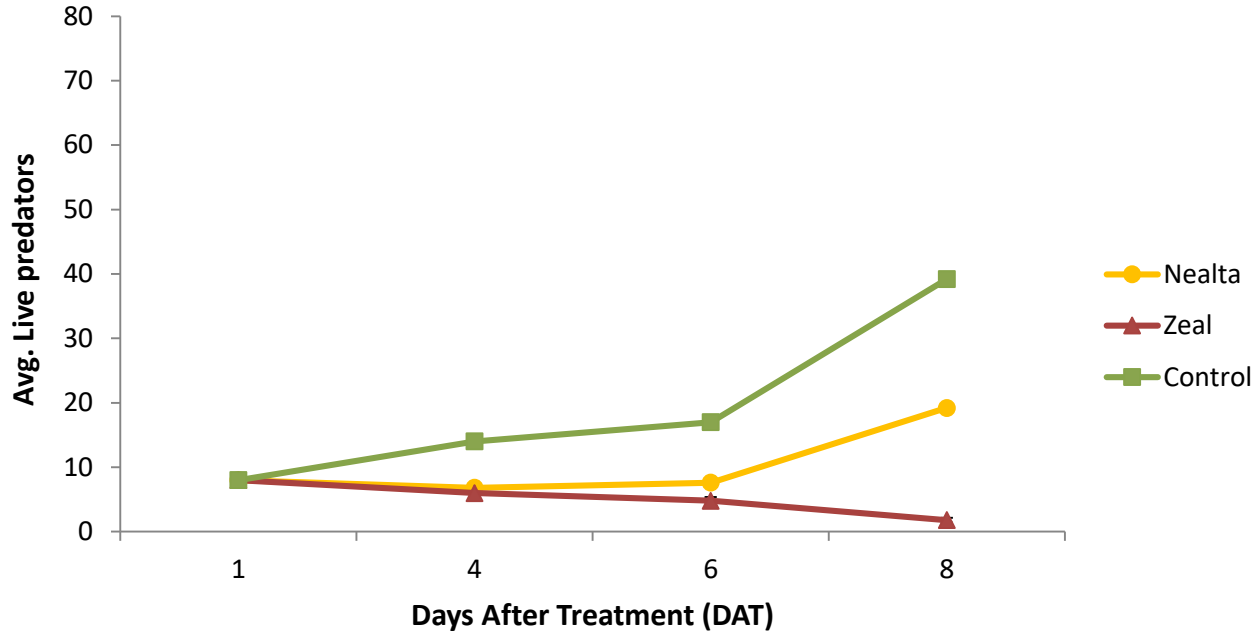

P. persimilis
Corrected % Mortality
100
90
80
70
60
50
40
30
20
10
0
1
4
6
8
Nealta
Zeal

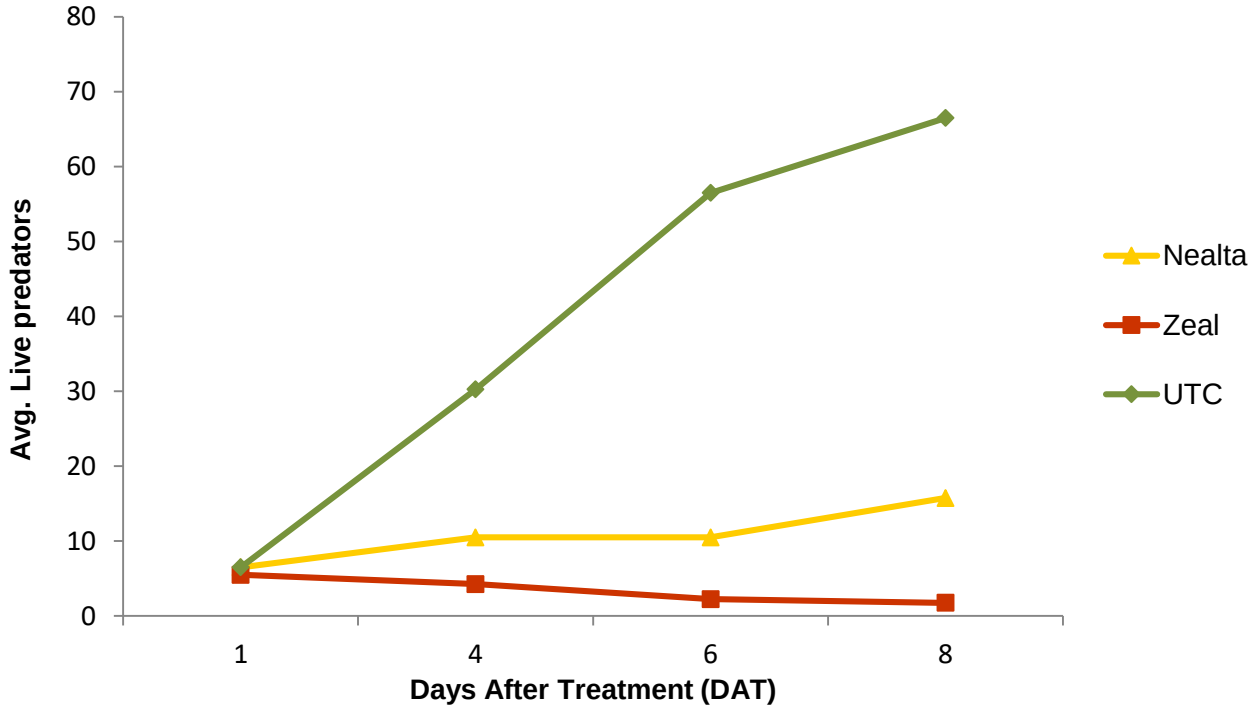

N. californicus
Corrected % Mortality
100
90
80
70
60
50
40
30
20
10
0
1
4
6
8
Days After Treatment (DAT)
Nealta
Zeal


P. persimilis
Avg. eggs produced per female
14
12
10
8
6
4
2
0
1
4
6
8
Days After Treatment (DAT)
Nealta
Zeal
Control


N. californicus
Avg. eggs produced per female
14
12
10
8
6
4
2
0
1
4
6
8
Days After Treatment (DAT)
Nealta
Zeal
UTC


P. persimilis
Avg. number of young predators
40
35
30
25
20
15
10
5
0
1
4
6
8
Nealta
Zeal
Control
N. californicus
Avg. number of young predators
40
35
30
25
20
15
10
5
0
1
4
6
8
Days After Treatment (DAT)
Nealta
Zeal
UTC


80
70
60
50
40
30
20
10
0
Avg. Live predators
1
4
6
8
Days After Treatment (DAT)
Nealta
Zeal
Control


80
70
60
50
40
30
20
10
0
Avg. Live predators
1
4
6
8
Days After Treatment (DAT)
Nealta
Zeal
UTC

Major mite pest

Twospotted spider mite

- No. 1 pest in Ventura Co. strawberry production
- Has >1,100 known hosts
- Known to be resistant to >94 unique insecticide/acaricide a.i's in >468 cases world wide
- Field control failures with some acaricides

What promotes resistance?

Biological factors:

- Rapid development rate
- High reproduction potential
- Arrhenotokous reproduction
- Webbing ⟹ high dispersal rate

Environmental factors:

- Extensive exposure to acaricides
- Lack of coverage
- Year-round food source

How do they become resistant?

- Behavioral: Detect & avoid the toxin
- Decreased cuticular penetration
  - Genes (*pen*) modify cuticle to decrease penetration of contact insecticides
- Higher sequestration/metabolic detoxification
  - Increased enzymes
- ★ Reduced target insensitivity
  - Target site insensitivity/altered target-site insensitivity

Methods

- Populations of TSSM collected from conventional & organic berry fields
  - Oxnard, Watsonville, Elkhorn Slough, Salinas
  - Collected mites from strawberry, raspberry, & blackberry fields
- Mites sorted (TSSM only) & placed on bean plants to grow colony

Methods

- Dose response bioassays performed with Potter Spray Tower
  - Placed 10 adult gravid female TSSM on a leaf disc
  - Mites sprayed with serial dilutions of each acaricide tested
  - Mortality evaluated 24 HAT
- Temperature: 77 °F ± 1 °F
- 16:8 hr (L:D)

Methods

- Ovicidal acaricide (Savey) treated differently
  - TSSM females allowed to lay eggs on leaf disc for 24hrs, then removed
  - Number of eggs counted & sprayed
  - Mortality occurs when eggs fail to hatch 4-5 DAT
  - Eggs are most susceptible to acaricides when newly hatched.

Methods

- L_{c50} & L_{c90} calculated for each acaricide
  - Lethal Concentration: amount required to kill 50% & 90% of the population

- Baseline levels of susceptibility established with naïve TSSM colony

Abbott's formula

$$\text{Corrected \%} = \left(1 - \frac{\text{n in T after treatment}}{\text{n in Co after treatment}}\right) * 100$$

Where : n = Insect population , T = treated , Co = control

Methods

Resistance Ratios (RR)

$RR = L_{ct} / L_{cn}$

$L_{ct} = L_{c50}$ or L_{c90} of treatment population

$L_{cn} = L_{c50}$ or L_{c90} of naïve population

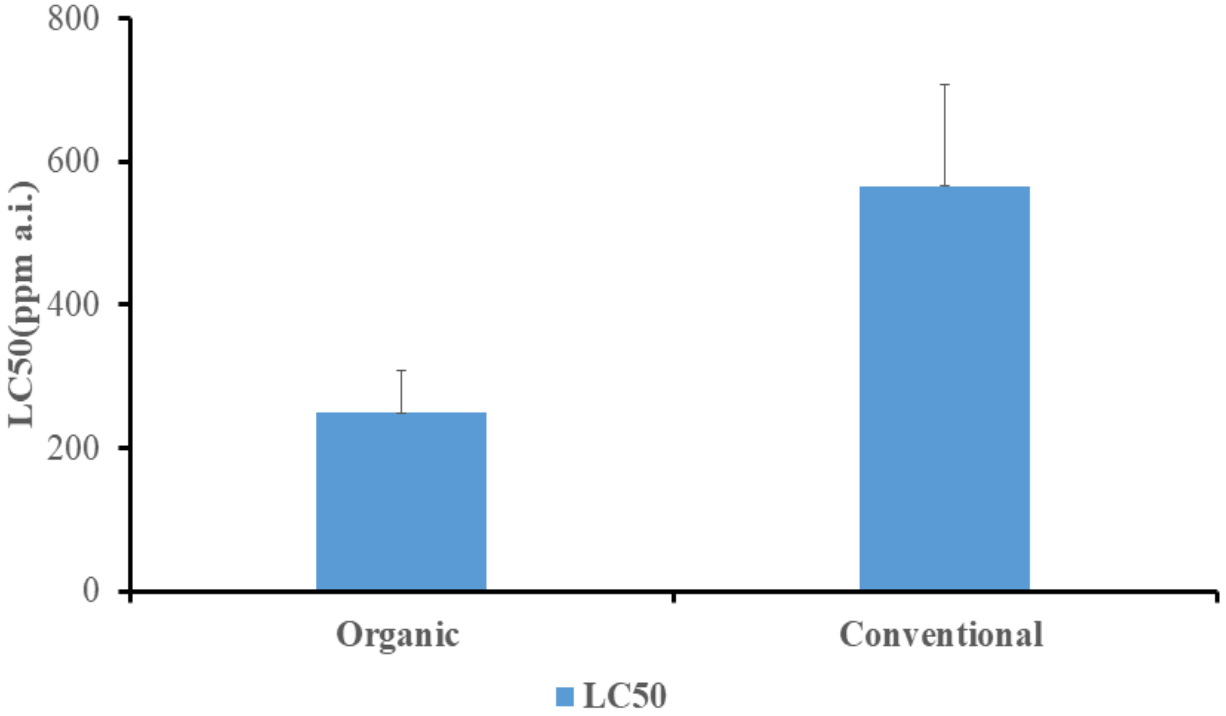
Susceptible	Moderately resistant	Highly resistant
RR ≤ 10	RR 10 - 100	RR >100

Toxicity to Acramite (Bifenazate)

Population	% Mort	N	LC50(95% CI) ppm a.i	RR50	LC90(95% CI) ppm a.i	RR90	χ^2 (df)
Susceptible WA	100	2195	0.82(0.79-0.85)	1	5.9(3.8-9.6)	1	12(18)
Oxnard 1 Conv SB	56.3	202	493.8(340-870)	602.2	4000(1581-25135)	678	6.6(10)
Oxnard 2 Organic SB	85.6	186	218(177-266)	265.9	576(444-876)	97.6	5.6(10)
Oxnard 3 Organic RB	90.5	184	116.2(81-151)	141.5	518(362-955)	87.8	2.2(10)
Oxnard 4 Conv RB	80	185	199(150-2630	242.7	929(596-2107)	157.5	3.1(10)
Salinas 1 Conv SB	57.2	228	404(271-813)	492.7	5634(1948-94645)	954.9	4.6(10)
Wat 1 Organic SB	66.6	240	298(225-443)	363.4	3167(1465-17734)	536.8	1.6(10)
Elkhorn 1 Organic SB	94.8	193	97(52-136))	118.3	557(361-1392)	94.4	4.9(10)
Elkhorn 2 Conv SB	46	236	761(470-2283)	928.1	16262(4163-29990)	2756.3	3.6(10)

Susceptible	Moderately resistant	Highly resistant
RR ≤ 10	RR 10 - 100	RR >100

Toxicity to Acramite (Bifenazate)



Population	% Mort	LC50(95% CI) ppm a.i	RR50
Oxnard 2 Organic SB	85.6	218(177-266)	265.9
Wat 1 Organic SB	66.6	298(225-443)	363.4
Elkhorn 1 Organic SB	94.8	97(52-136))	118.3
Oxnard 1 Conv SB	56.3	493.8(340-870)	602.2
Salinas 1 Conv SB	57.2	404(271-813)	492.7
Elkhorn 2 Conv SB	46	761(470-2283)	928.1

Toxicity to Savey (Hexythiazox)

Population	% Mort[a]	N	LC50(95% CI) ppm a.i	RR_{50}	LC_{90}(95% CI) ppm a.i	RR_{90}	χ^2 (df)
Susceptible, WA	100	656	2.2(1.0-4.5)	1	64.7(24.5-395.7)	1	71.6(13)
Oxnard 1 Conv SB	48.7	315	1190(399.7-13465)	541	>>	>>	3.8(10)
Oxnard 2 Organic SB	82.8	283	43.1(15.9-127)	19.6	11257(2053-59791)	174	13.3(10)
Oxnard 3 Organic RB	83.4	301	64.8(37-111)	29.5	2029(856-8352)	31.4	8.4(10)
Oxnard 4 Conv RB	64.1	296	189.1(93-532)	86	42325(6884-173481)	654.2	7.4(10)
Salinas 1 Conv SB	77.6	236	829(425-1674)	376.8	4207(1308-38157)	65	3.4(10)
Wat 2 Organic BB	84.9	250	43.7(22.6-84.7)	19.9	3335.8(1013.8-29929)	51.6	7.7(10)
Elkhorn 1 Organic SB	78.2	256	143.7(56.4-465)	65.3	9328(1756-854447)	144.2	10.8(10)
Elkhorn 2 Conv SB	75.1	314	204.8(119-343)	93.10909	3531(1439-25271)	54.6	5.7(10)

Susceptible

RR ≤ 10

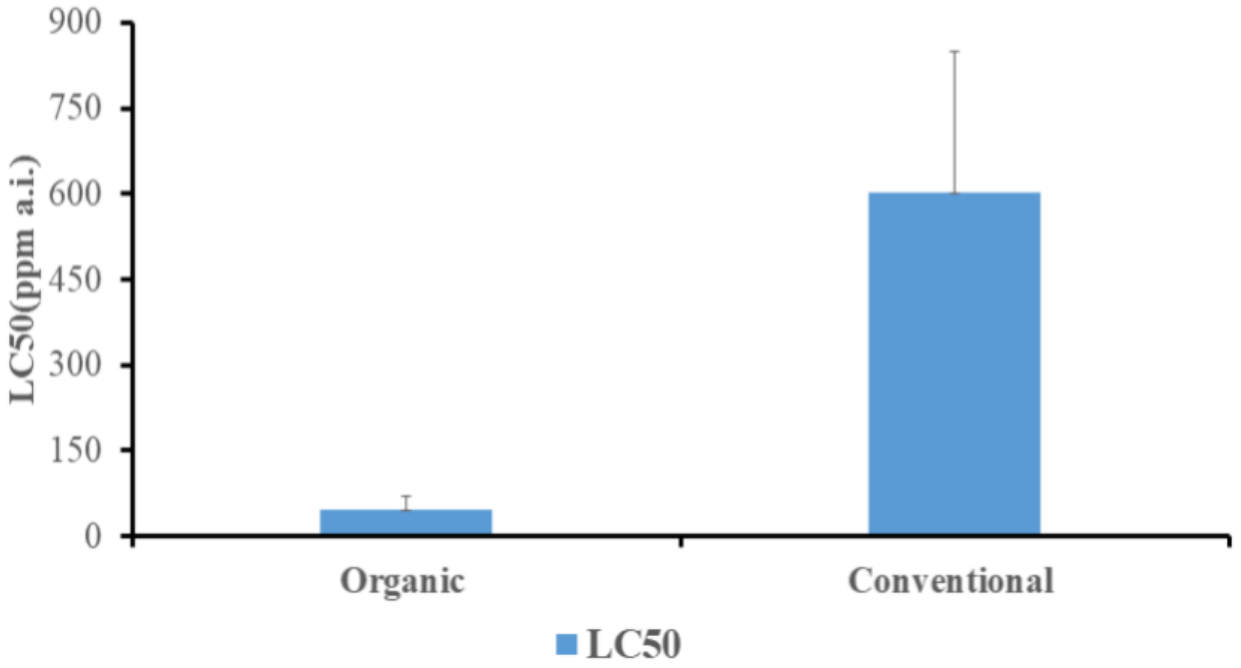
Moderately resistant

RR 10 - 100

Highly resistant

RR >100

Toxicity to Savey (Hexythiazox)



Population	% Mort[a]	LC50(95% CI) ppm a.i	RR_{50}
Oxnard 2 Organic SB	82.8	43.1(15.9-127)	19.6
Elkhorn 1 Organic SB	78.2	143.7(56.4-465)	65.3
Oxnard 1 Conv SB	48.7	1190(399.7-13465)	541
Salinas 1 Conv SB	77.6	829(425-1674)	376.8
Elkhorn 2 Conv SB	75.1	204.8(119-343)	93.10909

Toxicity to Agri-Mek (Abamectin)

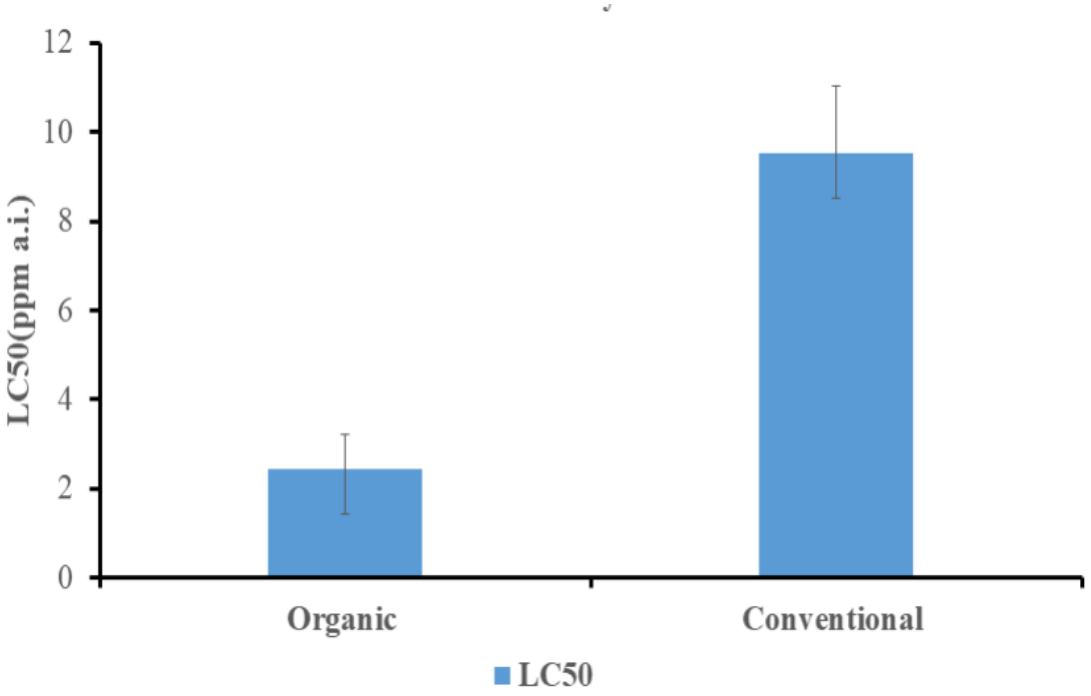
Population	% Mortality[a]	N	Slope±SE	LC50(95% CI) ppm a.i	RR50	LC90(95% CI) ppm a.i	RR90	χ^2 (df)
Susceptible, WA	100	241	1.4±0.2	0.8(0.5-1.3)	1	6.7(4.2-13.4)	1	6.2(16)
Oxnard 1 Conv SB	60	270	1.65±0.3	7.8(5.8-10.4)	9.8	46.2(27.5-127.4)	6.9	3.8(13)
Oxnard 2 Organic SB	72	235	1.1±0.2	2.2(1.2-3.8)	2.8	31.9(15.4-124.8)	4.8	18.6(13)
Oxnard 4 Conv RB	61.4	280	1.3±0.2	7.7(4.5-14.6)	9.6	72.3(29.8-361.2)	10.8	26.2(13)
Salinas 1 Conv SB	60.8	259	1.9±0.6	8.5(6.3-16.1)	10.6	39.7(19.1-219.7)	5.9	1.7(10)
Wat 1 Organic SB	89	351	0.78±0.12	1.0(0.25-2.1)	1.3	44.2(14.4-364.6)	6.6	21.5(10)
Wat 2 Organic BB	83.7	239	0.98±0.12	1.6(0.89-2.5)	2	40.5(20.6-115.7)	6.0	5.7(10)
Elkhorn 1 Organic SB	85.5	274	3.4±0.4	4.9(4.0-5.9)	6.1	11.7(9.4-16.3)	1.8	6.9(13)
Elkhorn 2 Conv SB	44.5	253	1.5±0.5	14.1(9.5-41.8)	17.6	98.4(31.8-272.6)	14.7	8.7(10)

Susceptible
RR ≤ 10

Moderately resistant
RR 10 - 100

Highly resistant
RR >100

Toxicity to Agri-Mek (Abamectin)



Population	% Mortality[a]	LC50(95% CI) ppm a.i	RR50
Oxnard 2 Organic SB	72	2.2(1.2-3.8)	2.8
Wat 1 Organic SB	89	1.0(0.25-2.1)	1.3
Elkhorn 1 Organic SB	85.5	4.9(4.0-5.9)	6.1
Oxnard 1 Conv SB	60	7.8(5.8-10.4)	9.8
Oxnard 4 Conv RB	61.4	7.7(4.5-14.6)	9.6
Salinas 1 Conv SB	60.8	8.5(6.3-16.1)	10.6
Elkhorn 2 Conv SB	44.5	14.1(9.5-41.8)	17.6

Summary

- Knowing effects of acaricides on predatory mites can help with more successful incorporation
- IPM programs need to be updated to reflect resistant TSSM populations
- Knowing the ‘where & to what’ can help design a more effective mite management program

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