Ambient Almond Volatiles As Attractants for Navel Orangeworm Monitoring

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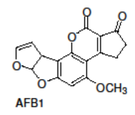
Project Goals:



AFB1

- Reduce aflatoxin contamination
  - *Aspergillus flavus* and *A. parasiticus*
- Monitor and control navel orangeworm
  - Lepidoptera: Pyralidae
  - *Amyelois transitella*
  - Larvae are vector for aspergilli
- California host plants
  - Almonds, Pistachios, Walnuts, Figs
- Host plant volatiles as semiochemicals?

Navel Orangeworm:

"Control of NOW has been stated as one of the top priorities for the almond industry…"

- California Almonds
  - 80% World
  - 100% U.S.
- Approaching $2 billion
- $23-47 million due to aflatoxin
- Eluded effective control

Navel Orangeworm:

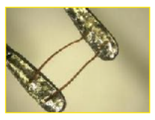
Current Monitoring & Control

- Monitoring
  - Traps baited with
    - Virgin female *A. transitella*
    - Almond meal, standard
- Control
  - Mating disruption treatments
    - ♀ Sex pheromone aldehydic component
    - Four-component blend progress
- Hindered by stability and/or commercial applicability

Host Plant Volatiles:

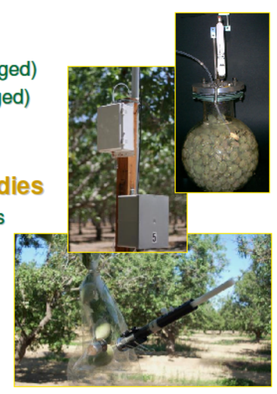
Kairomonal Considerations?

- Premise:
  - *A. transitella* attracted to damaged almonds
- Analyze volatiles corresponding to damage
  - Collect and identify volatiles
  - Perform bioassays to determine activity
    - Electroantennography
    - Field trappings



Host Plant Volatiles:

- Volatile Collections
  - *Ex situ* (damaged and undamaged)
  - *In situ* (damaged and undamaged)
  - Ambient orchard emissions
  - Fungal contaminated kernels
- EAG and field trapping studies
  - Components and simple blends
  - Two-year period ('09-'10)
  - Blends developed
    - Blend A
    - Blend B
    - Blend C



Field Trapping Results:

- Experimental Design
  - Delta traps
  - Nalgene bottles (8 mL), 1.5 mm hole, cotton plugs
  - 400 mg/2 mL blend components
  - 2 x 1 week intervals
  - May, June, July, August
  - 2011 growing season
  - N=10, zero captures across all removed
  - One-way ANOVA, Fisher LSD pairwise

Field Trapping Results:

Table 1 Mean captures per trap per week of male and female *A. transitella* moths in traps baited with almond-based blends, Kern County, CA, 2011

Trap Interval	Treatment	Moths Captured: *A. transitella*	Female	Male
May	Blend A	1.60 ± 0.60 a	0.60 ± 0.25	1.00 ± 0.63
1st flight	Blend B	0.60 ± 0.40 a,b	0.40 ± 0.25	0.20 ± 0.20
	Blend C	1.40 ± 0.51 a	0.80 ± 0.20	0.60 ± 0.40
	Meal	0.20 ± 0.20 b	0.20 ± 0.20	0
	Blank	0 b	0	0
		F=3.10, df:4,20; *P*=0.039	F=2.50, df:4,20; *P*=0.075	F=1.57, df:4,20; *P*=0.222

Field Trapping Results:

Table 1 Mean captures per trap per week of male and female *A. transitella* moths in traps baited with almond-based blends, Kern County, CA, 2011

Trap Interval	Treatment	Moths Captured: *A. transitella*	Female	Male
June	Blend A	1.14 ± 0.26 a	0.43 ± 0.20 a	0.71 ± 0.29
2nd flight	Blend B	0.57 ± 0.30 a,b	0.14 ± 0.14 a,b	0.43 ± 0.30
	Blend C	0.29 ± 0.29 b	0 b	0.29 ± 0.29
	Meal	0 b	0 b	0
	Blank	0 b	0 b	0
		F=4.80, df:4,30; *P*=0.004	F=2.83, df:4,30; *P*=0.042	F=1.82, df:4,30; *P*=0.150

Field Trapping Results:

Table 1 Mean captures per trap per week of male and female *A. transitella* moths in traps baited with almond-based blends, Kern County, CA, 2011

Trap Interval	Treatment	Moths Captured: *A. transitella*	Female	Male
July	Blend A	2.00 ± 0.58 a	0.44 ± 0.24 b	1.56 ± 0.63 a
2nd flight	Blend B	2.33 ± 0.91 a	0.67 ± 0.29 a,b	1.67 ± 0.76 a
	Blend C	2.11 ± 0.72 a	1.22 ± 0.47 a	0.89 ± 0.35 a,b
	Meal	0.22 ± 0.22 b	0.11 ± 0.11 b	0.11 ± 0.11 b
	Blank	0.11 ± 0.11 b	0.11 ± 0.11 b	0 b
		F=3.43, df:4,40; *P*=0.017	F=2.79, df:4,40; *P*=0.039	F=2.74, df:4,40; *P*=0.042

Field Trapping Results:

Table 1 Mean captures per trap per week of male and female *A. transitella* moths in traps baited with almond-based blends, Kern County, CA, 2011

Trap Interval	Treatment	Moths Captured: *A. transitella*	Female	Male
August	Blend A	1.14 ± 0.40 a	0.71 ± 0.42	0.43 ± 0.20 a,b
3rd flight	Blend B	0.14 ± 0.14 b	0	0.14 ± 0.14 b
	Blend C	1.00 ± 0.31 a	0.14 ± 0.14	0.86 ± 0.26 a
	Meal	0.14 ± 0.14 b	0.14 ± 0.14	0 b
	Blank	0 b	0	0 b
		F=4.88, df:4,30; *P*=0.004	F=2.02, df:4,30; *P*=0.118	F=5.13, df:4,30; *P*=0.003

Field Trapping Results:

Table 1 Mean captures per trap per week of male and female *A. transitella* moths in traps baited with almond-based blends, Kern County, CA, 2011

Trap Interval	Treatment	Moths Captured: *A. transitella*	Female	Male
Overall	Blend A	1.50 ± 0.24 a	0.54 ± 0.14 a	0.96 ± 0.25 a
	Blend B	1.04 ± 0.35 a	0.32 ± 0.12 a,b	0.71 ± 0.28 a
	Blend C	1.25 ± 0.29 a	0.57 ± 0.18 a	0.68 ± 0.16 a
	Meal	0.14 ± 0.09 b	0.11 ± 0.06 b	0.04 ± 0.04 b
	Blank	0.04 ± 0.04 b	0.04 ± 0.04 b	0 b
		F=8.11, df:4,135; *P*<0.001	F=4.16, df:4,135; *P*=0.003	F=5.60, df:4,135; *P*<0.001

Field Trapping Results:

Total	Treatment	Moths Captured: *A. transitella*	Female	Male
	Blend A	42	15	27
	Blend B	29	9	20
	Blend C	35	16	19
	Meal	4	3	1
	Blank	1	1	0

Summary:

- Kairomonal-Based Blends:
  - More effective than current standard, Almond Meal
  - Blends A & C captured more female *A. transitella* than Almond Meal
  - Higher capture numbers and consistency of Blends A & C present an opportunity for a kairomonal-based monitoring approach
  - Commercial use needs more optimization
  - Highlights progress in an otherwise elusive insect pest

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