



# Spotted wing drosophila in North Carolina

## *2013 Update*

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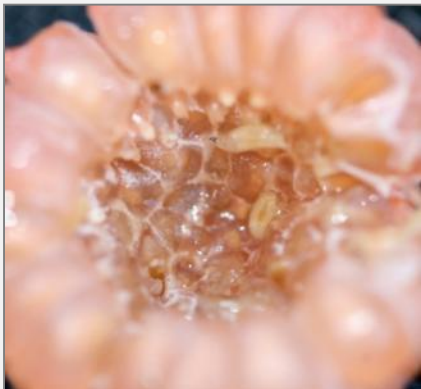
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# North Carolina host crops

## *2013 Impacts*



Significant infestation in caneberries (sprayed or unsprayed).



Blueberry infestation developed post harvest for southern highbush but was common during rabbiteye harvest & in processing fruit.



No reported infestation in commercially grown spring fruiting strawberries. Large infestation in research station plots. “Soft fruit” reported in day neutrals, SWD confirmed.



No reported infestation in commercially grown grapes. Grape berry moth damaged muscadines colonized by other *Drosophilidae*.

# North Carolina host crops

## *2013 Impacts*





# Activities

***Season-long management programs - Efficacy & Risks***

***Efficacy of unregistered insecticides***

***Effect of spray volume on insecticide efficacy***

***Novel management tactics***

***Effects of cold temperatures on immature SWD***

***Blueberry variety susceptibility***

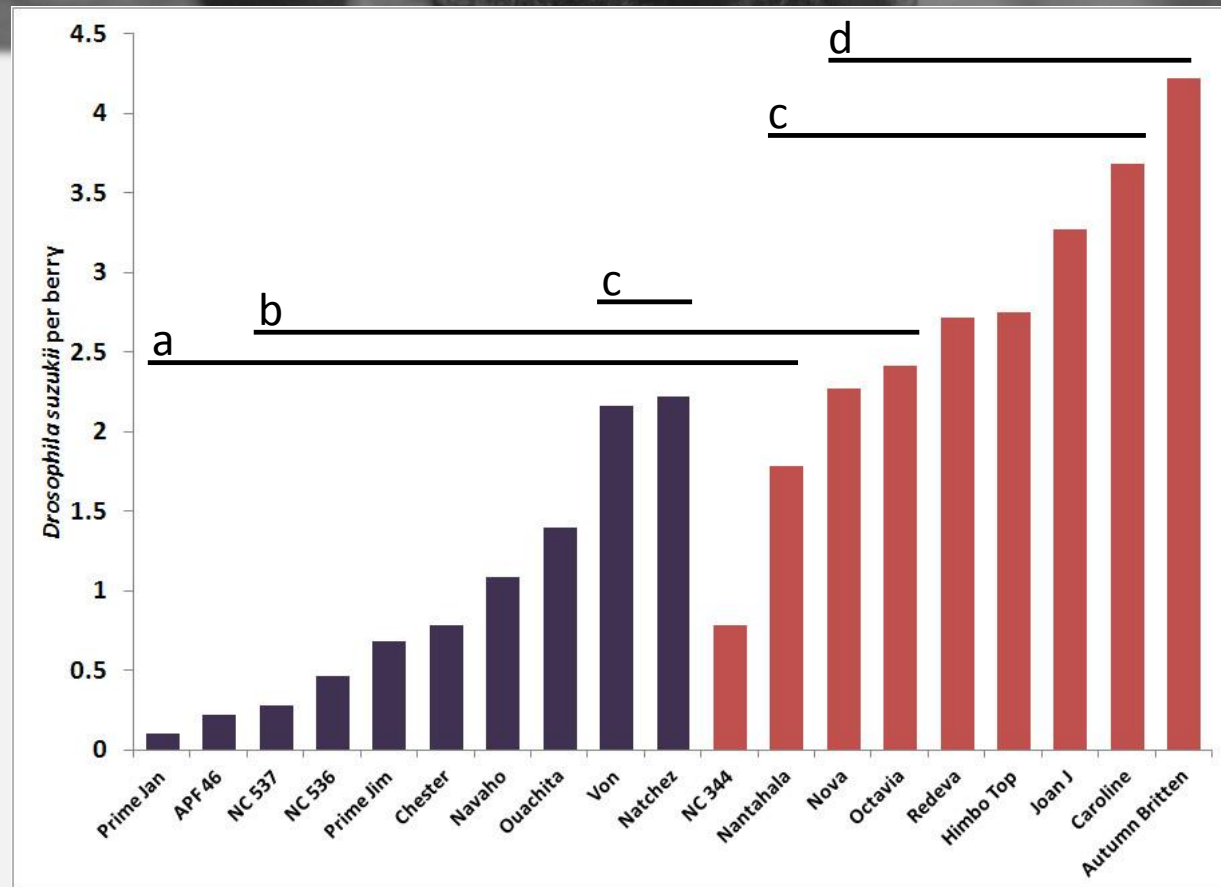
***Effects of diet on intraspecific competition***

***Local movement & infestation patterns***

# Host selection and utilization

Infestation rate differs between raspberry and blackberry varieties when flies have free choice (2010-2012)

The same pattern does not appear to hold for blueberries (2012-2013) or day neutral strawberries (2013)



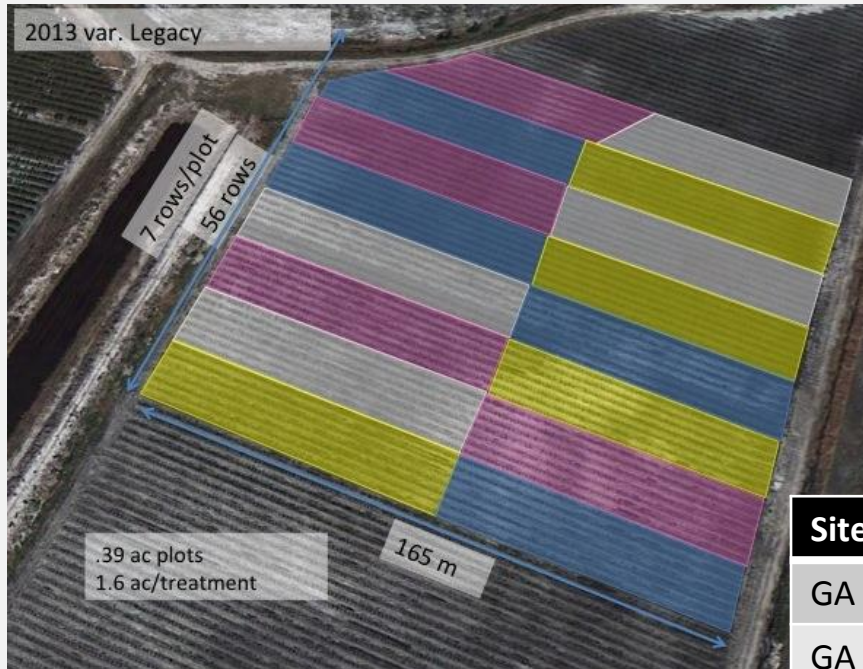
variety:  $F_{18,435}=2.28, p = 0.0021$ ; date, year random

# Season-long management programs

Treatment Number	Weekly rotation of Materials		
1. Export: Export “friendly”, maximum modes of action (MOA)	Imidan	phosmet	OP (1B)
	Malathion 8F	malathion	OP (1B)
	Delegate	spinetoram	spinosyn (5)
	Danitol	fenpropathrin	pyrethroid (3A)
2. ShortPHI: Short Preharvest Interval (1d PHI)	Mustang Max	zeta-cypermethrin	pyrethroid (3A)
	Malathion 8F	malathion	OP (1B)
3. Red.Risk: EPA Reduced Risk/OP Alternatives	Delegate	spinetoram	spinosyn (5)
	GA: Exirel	cyantraniliprole	ryanodine (28)
	NC: Assail	acetamiprid	neonicotinoid (4A)
4. UTC: Untreated Control			

# Season-long management programs

## *Experimental design*



Sites	Farms	Acres	Reps.	Varieties
GA 1	Commercial	1.8	4	Mixed highbush
GA 2	Research	3.2	4	Rabbiteye: Brightwell, Climax, Powderblue
NC 1	Commercial	12	3	Highbush: Duke
NC 2	Commercial	6.4	4	Highbush: Legacy

# Data collection

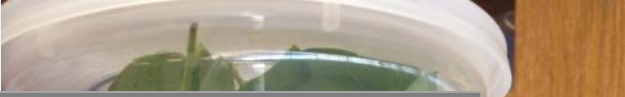
- Monitor impacts of *D. suzukii*
  - Adult trap captures, weekly
  - Larval infestation, weekly
- Pesticide residues, 7DAT
  - Analysis by GA Dept of Ag
- Bioassays: 0DAT & 7DAT
  - 5m + 5f flies
  - checked 1, 3, 5d for survival






# Data collection

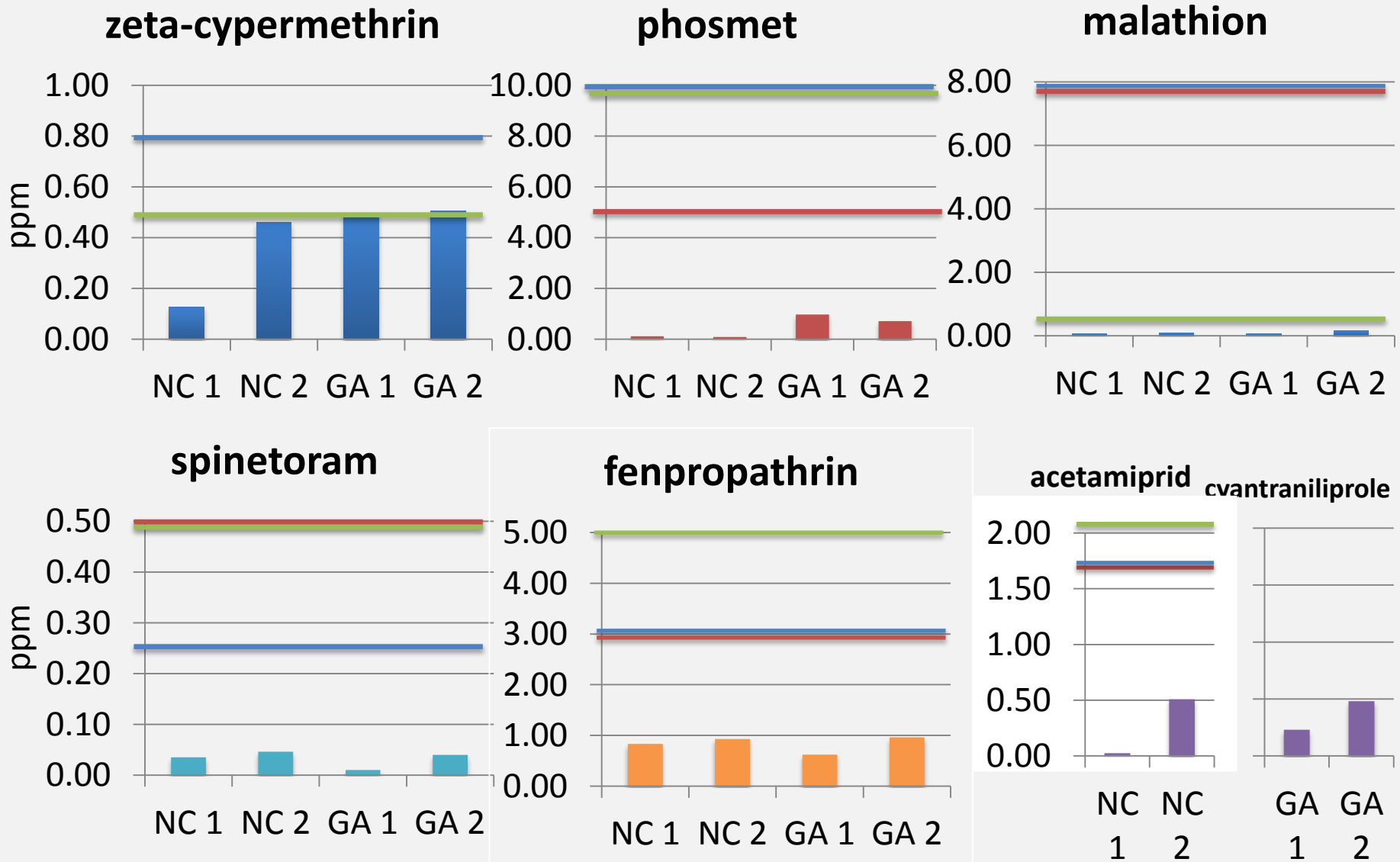
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No significant mortality was observed in any treatments when bioassays were collected 7DAT

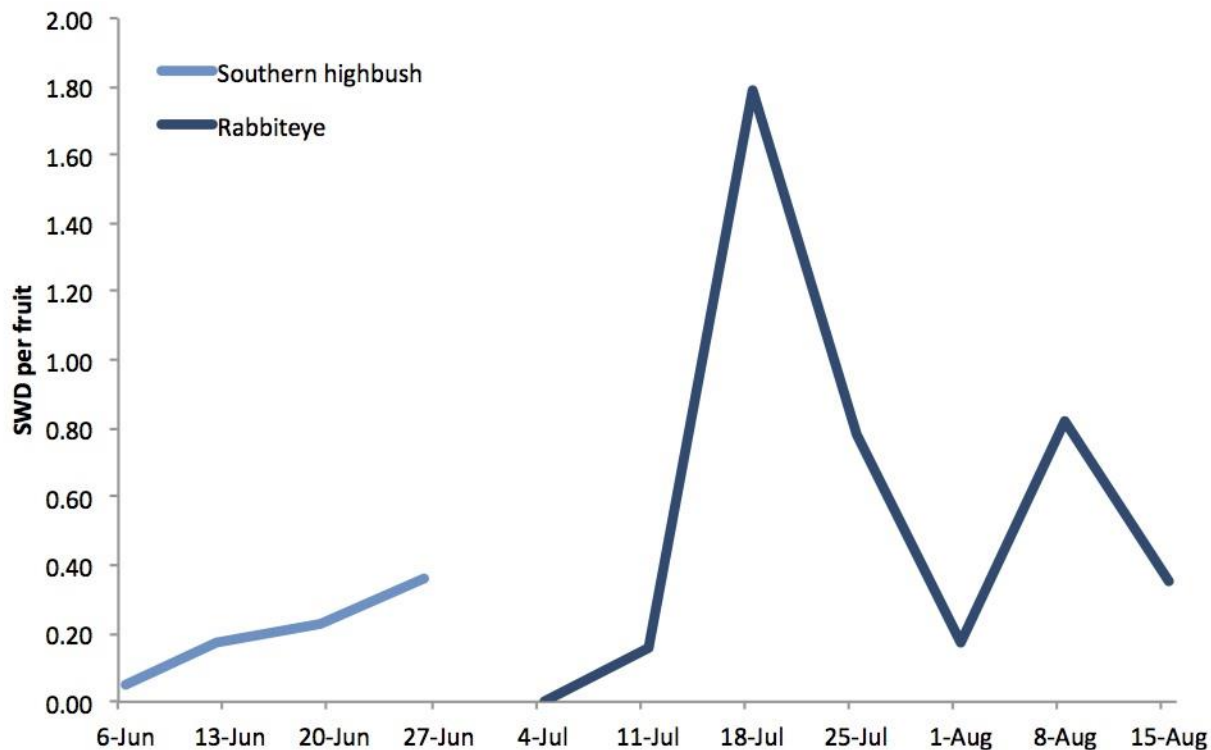


# Maximum observed pesticide residues



# Season-long management programs

## *Efficacy & Risks*



Observed infestation (field and laboratory) in 7 SHB and 4 RE varieties

No significant differences in infestation in the field

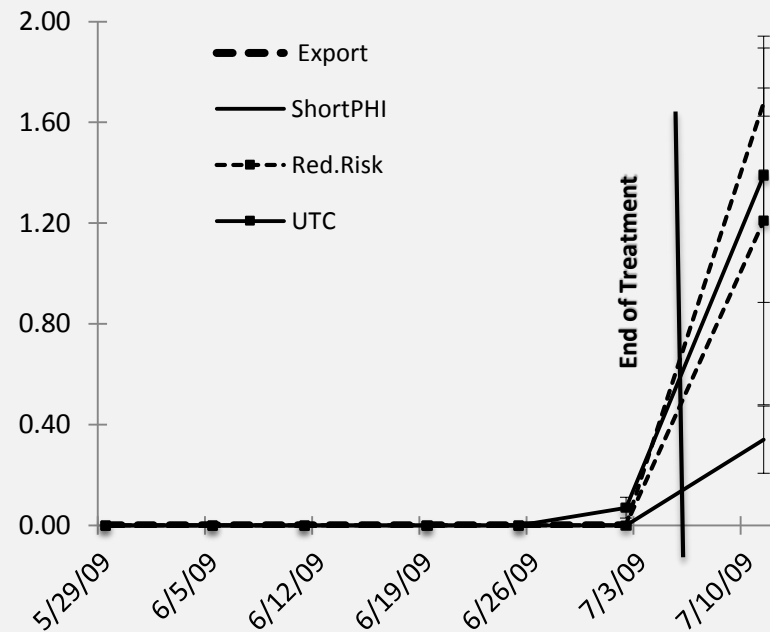
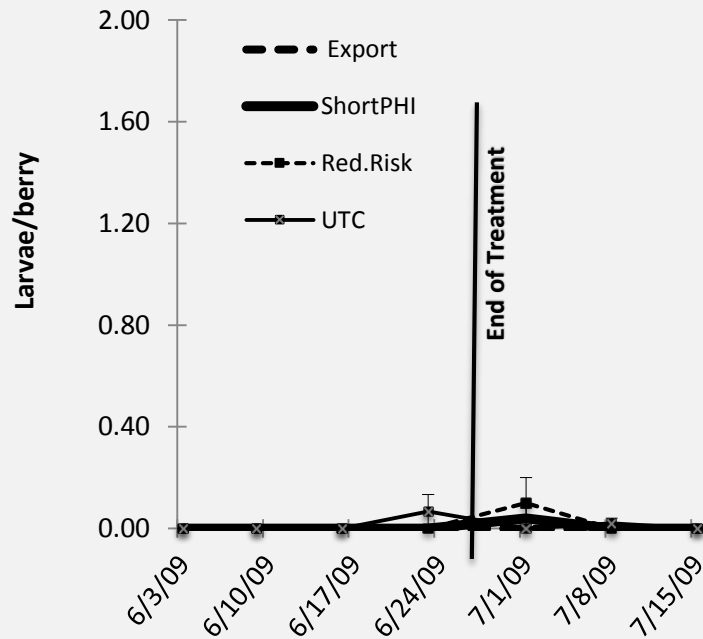
No significant differences in oviposition or developmental success in laboratory

# Season-long management programs

## *Efficacy & Risks*

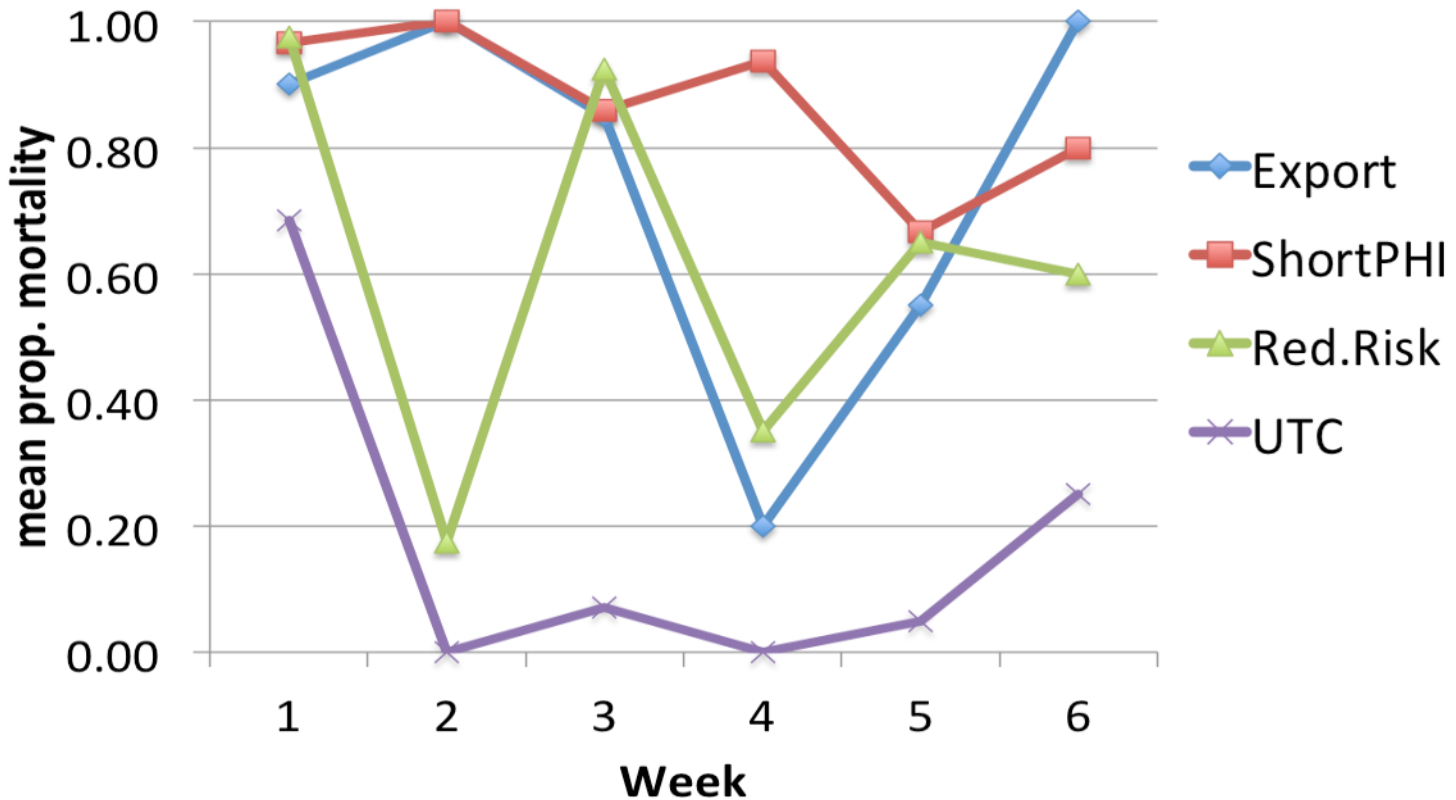
NC Site 1

NC Site 2



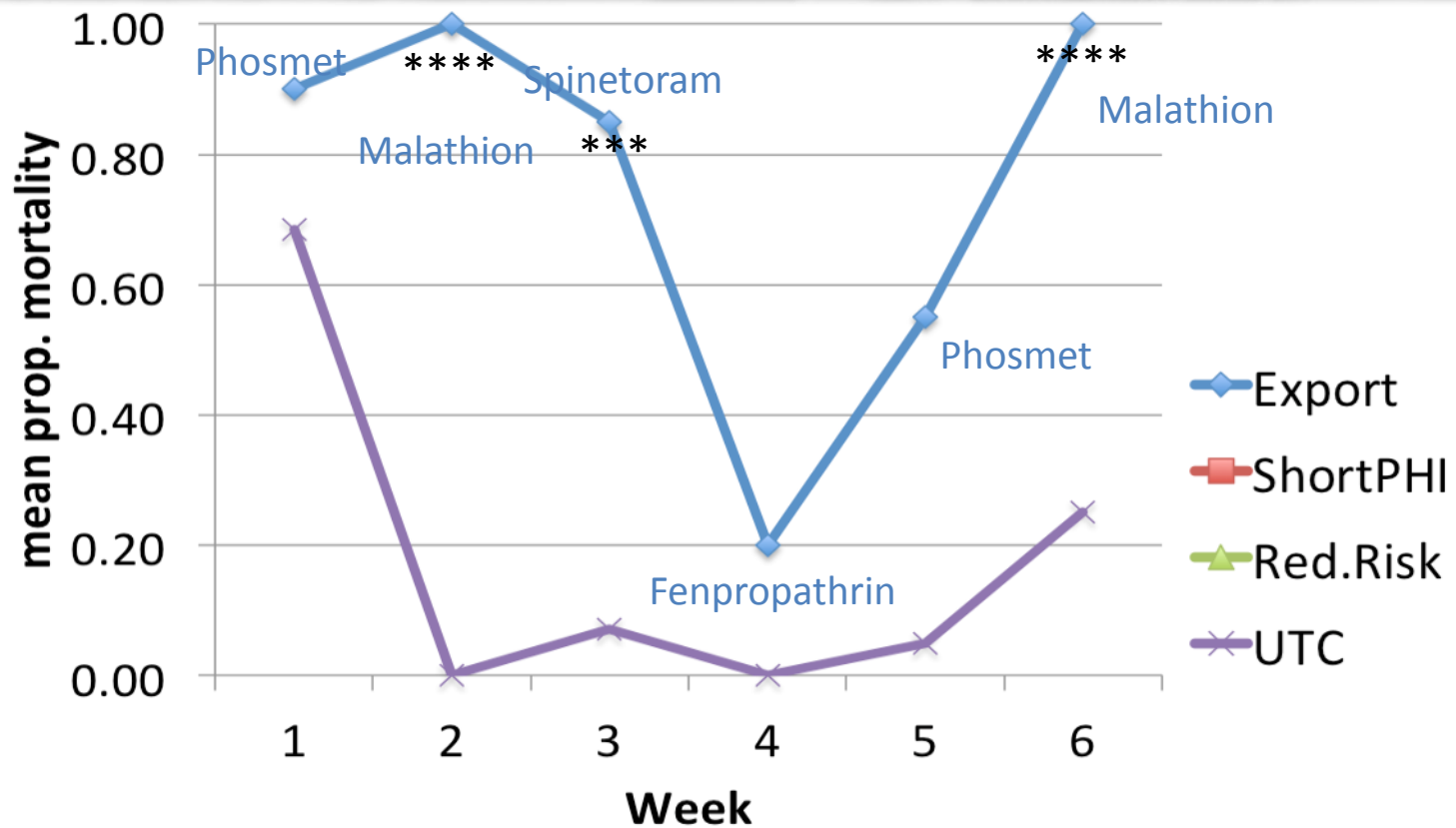
# Season-long management programs

## *NC Site 2 – Female bioassay mortality*



# Season-long management programs

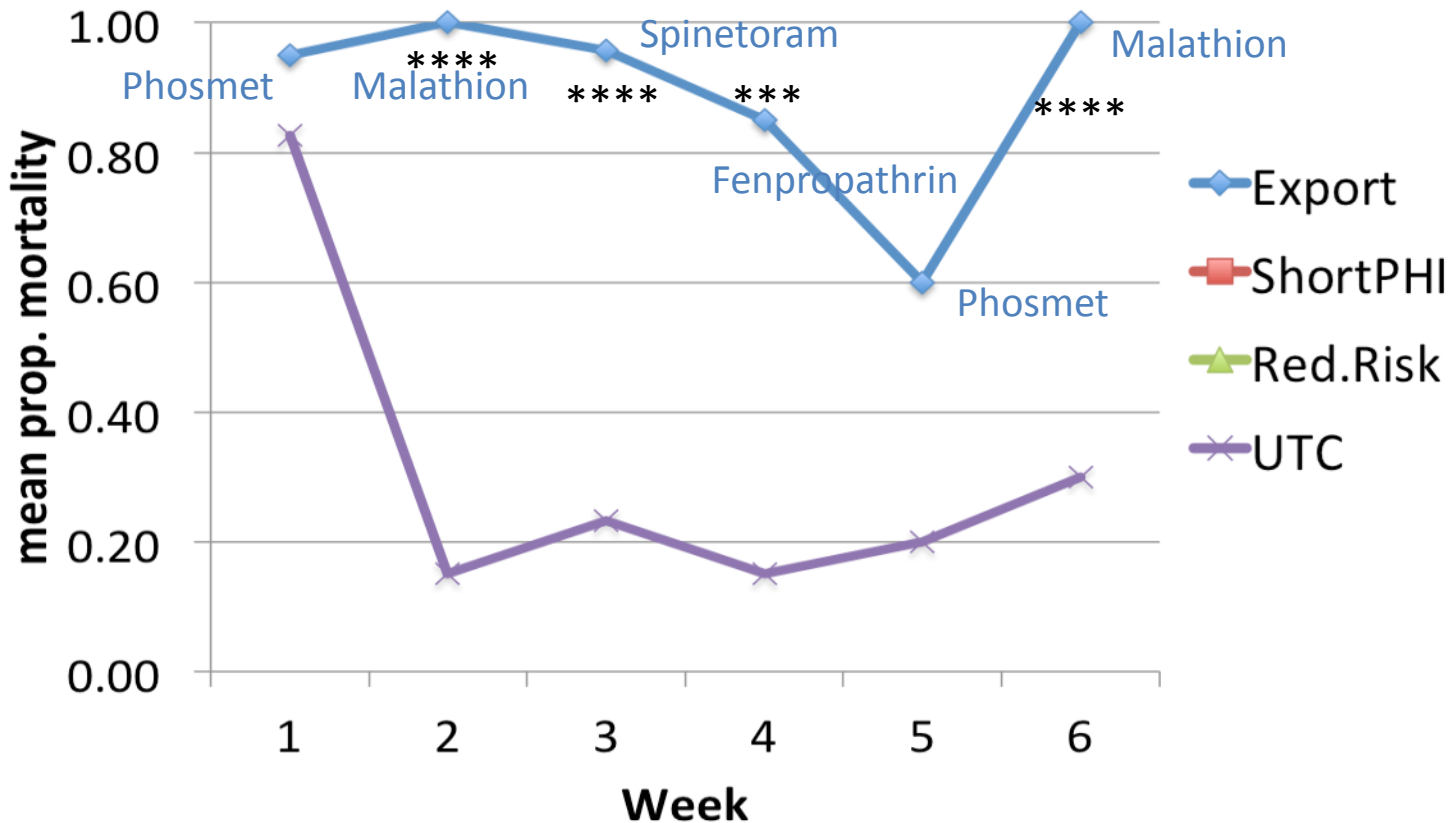
## NC Site 2 – Females Export



\* Indicates significant difference between treatment and control

# Season-long management programs

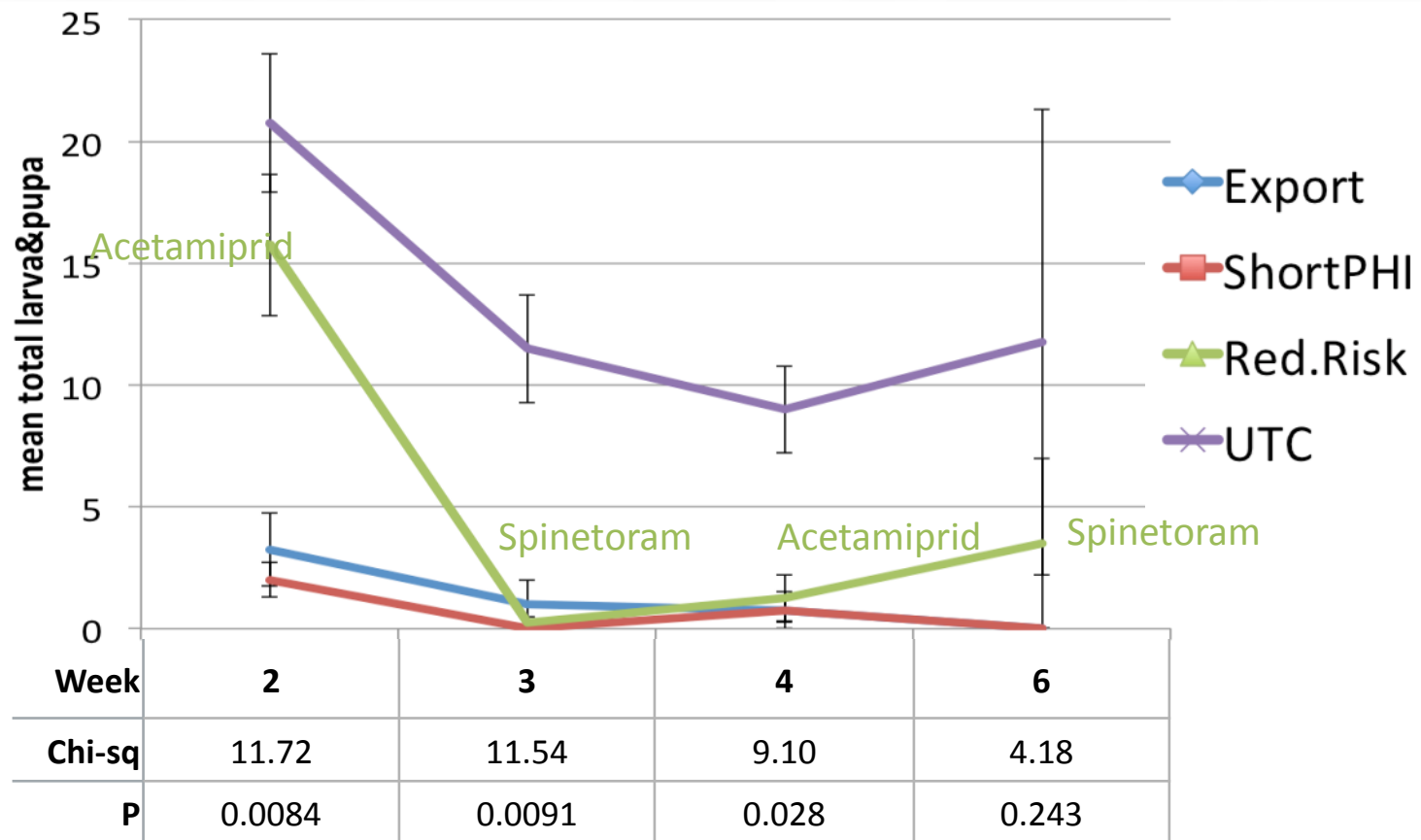
## NC Site 2 – Males Export



\* Indicates significant difference between treatment and control

# Season-long management programs

## NC Site 2 – Bioassay fruit infestation







# Spray volume effects on efficacy

9 DAT

Material and rate per acre	Spray volume (per acre)	Proportion of SWD dead					
		1 DAI		3 DAI		5 DAI	
		Males <sup>1</sup>	Females <sup>1,2</sup>	Males	Females	Males <sup>2</sup>	Females
Malathion 8F, 2.5 pt	2-5 gal	0.35 bc	0.25 ab	0.90 a	0.65 ab	0.90 ab	0.75 ab
Malathion 8F, 2.5 pt	5 gal	0.80 a	0.26 ab	0.90 a	0.69 ab	1.00 a	0.95 ab
Malathion 8F, 2.5 pt	25 gal	0.73 ab	0.40 a	0.80 a	0.60 abc	0.93 ab	0.80 ab
Malathion 8F, 2.5 pt	50 gal	0.75 ab	0.31 a	0.95 a	0.73 a	1.00 a	1.00 a
Mustang Max, 4.3 fl oz	2-5 gal	0.55 abc	0.27 ab	0.60 ab	0.27 abc	0.60 ab	0.35 bc
Mustang Max, 4.3 fl oz	50 gal	0.20 c	0.00 c	0.25 b	0.00 c	0.40 ab	0.10 c
Untreated control (6)		0.13 c	0.00 bc	0.13 b	0.00 bc	0.13 b	0.07 c
	F	3.64	2.89	9.00	5.16	3.88	7.54
	df	6,16	6,16	6,16	6,16	6,16	6,16
	p	0.0180	0.0417	0.0002	0.0040	0.0139	0.0006

# Unregistered material efficacy

*0 DAT*

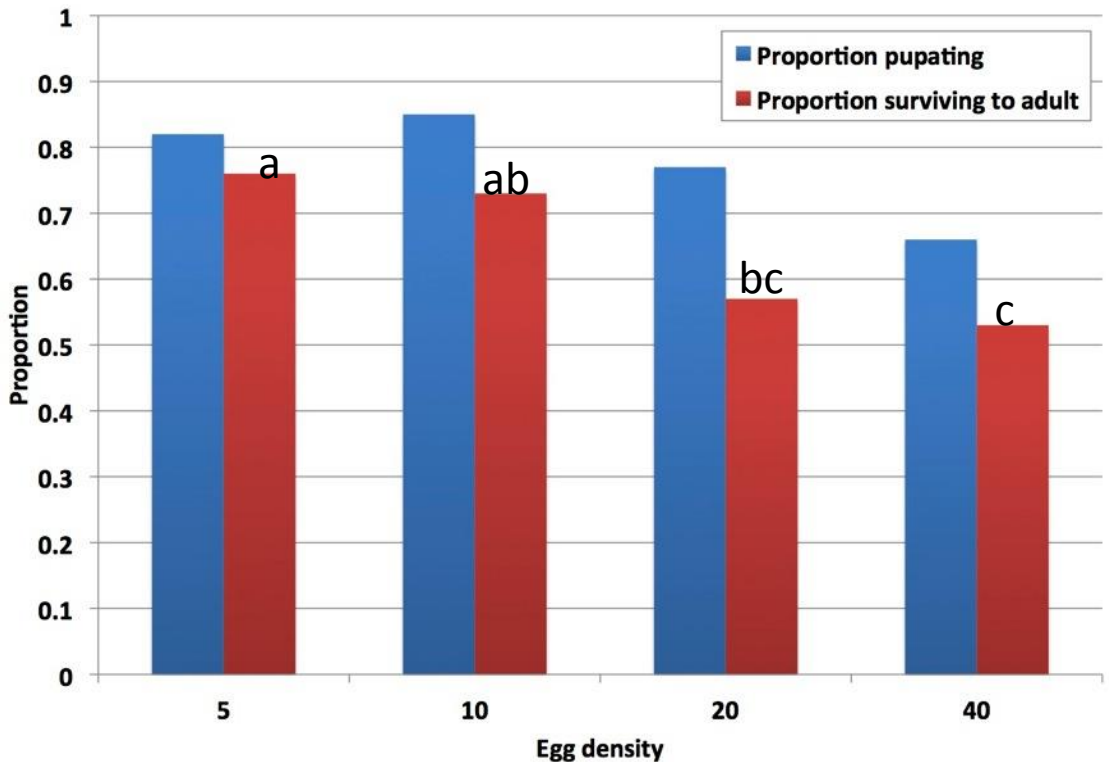
Materials	Rates	Application frequency <sup>1</sup>	Proportion of SWD dead <sup>2</sup>					
			0 DAI		3 DAI		5 DAI	
			Males	Females	Males	Females	Males	Females
Apta + DyneAmic	21 fl oz + 0.125% v/v	7 days	0.20 bcd	0.08 b	0.20 bcd	0.10 c	0.23 b	0.10 d
Apta + DyneAmic	24 fl oz + 0.125% v/v	7 days	0.10 cd	0.08 b	0.15 cd	0.10 c	0.18 b	0.15 d
Apta + DyneAmic	21 fl oz + 0.125% v/v	10 days	0.15 cd	0.13 b	0.20 bcd	0.20 bc	0.23 b	0.25 bcd
Apta + DyneAmic	24 fl oz + 0.125% v/v	10 days	0.15 cd	0.08 b	0.13 d	0.15 bc	0.15 b	0.15 d
HGW10SE + DyneAmic	13.5 fl oz + 0.25% v/v	7 days	0.29 bcd	0.33 ab	0.58 abc	0.48 bc	0.70 a	0.66 ab
HGW10SE + DyneAmic	16.9 fl oz + 0.25% v/v	7 days	0.52 bcd	0.33 ab	0.66 a	0.51 abc	0.78 a	0.65 abc
HGW10SE + DyneAmic	20.5 fl oz + 0.25% v/v	7 days	0.42 bc	0.36 ab	0.61 ab	0.56 ab	0.83 a	0.70 a
Delegate	6 oz	7 days	0.86 a	0.64 a	0.91 a	0.93 a	0.96 a	1.00 a
UTC	NA	NA	0.05 d	0.13 b	0.13 d	0.20 bc	0.13 b	0.23 cd
		F	11.98	5.15	10.22	10.03	12.09	13.11
		df	8, 27	8, 27	8, 27	8, 27	8, 27	8, 27
		p	<0.0001	0.0006	<0.0001	<0.0001	<0.0001	<0.0001

# Unregistered material efficacy

## 7-10 DAT

Materials	Rates	Application frequency <sup>1</sup>	Proportion of SWD dead <sup>2</sup>					
			0 DAI		3 DAI		5 DAI	
			Males	Females	Males	Females	Males	Females
Apta + DyneAmic	21 fl oz + 0.125% v/v	7 days	0.27 ab	0.00	0.15	0.10	0.15	0.05
Apta + DyneAmic	24 fl oz + 0.125% v/v	7 days	0.00 b	0.00	0.00	0.05	0.00	0.05
Apta + DyneAmic	21 fl oz + 0.125% v/v	10 days	0.32 ab	0.27	0.20	0.15	0.20	0.15
Apta + DyneAmic	24 fl oz + 0.125% v/v	10 days	0.58 a	0.49	0.30	0.40	0.45	0.50
HGW10SE + DyneAmic	13.5 fl oz + 0.25% v/v	7 days	0.11 ab	0.27	0.20	0.20	0.30	0.20
HGW10SE + DyneAmic	16.9 fl oz + 0.25% v/v	7 days	0.00 b	0.00	0.05	0.05	0.05	0.10
HGW10SE + DyneAmic	20.5 fl oz + 0.25% v/v	7 days	0.40 ab	0.32	0.28	0.32	0.39	0.32
Delegate	6 oz	7 days	0.00 b	0.11	0.05	0.05	0.05	0.10
UTC	NA	NA	0.00 b	0.11	0.00	0.10	0.00	0.05
		F	3.10	1.89	1.91	1.56	2.35	1.94
		df	8, 27	8, 24	8, 24	8, 24	8, 24	8, 24
		p	0.0130	0.1080	0.1050	0.1895	0.0504	0.0996

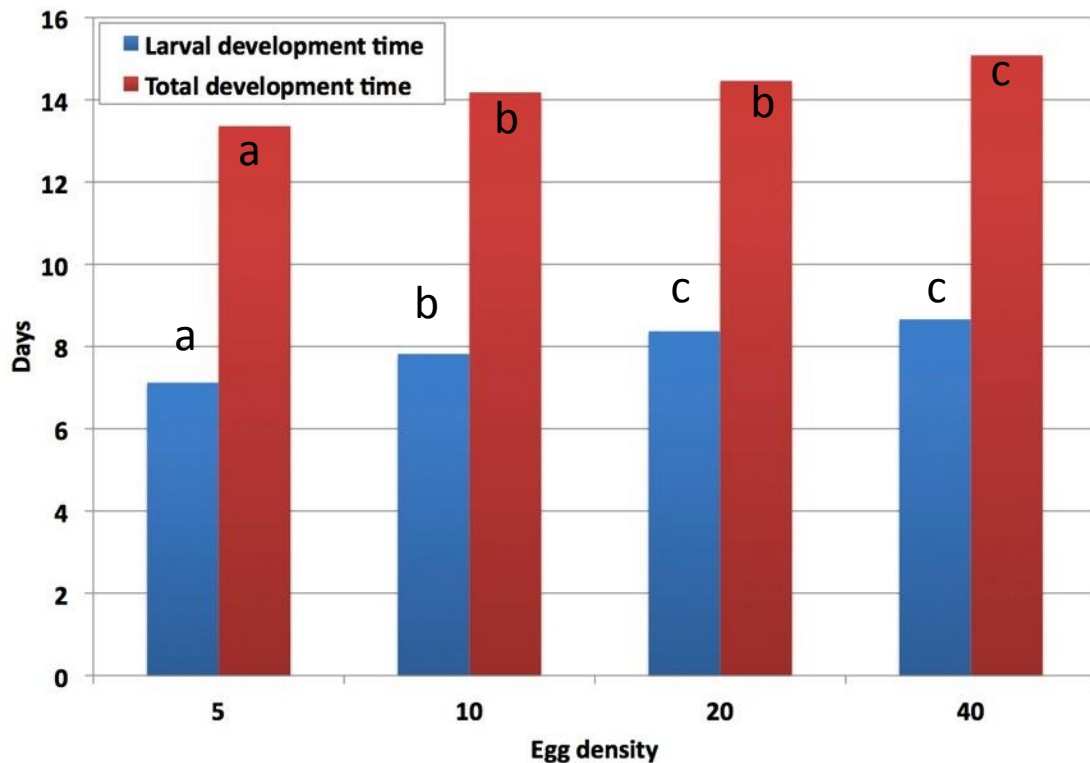
# Effects of diet on intraspecific competition



In artificial diets, performance suffers as density increases

$$F_{df} = 6.25_{3,26}, p = 0.0024$$

# Effects of diet on intraspecific competition



Larvae:  $F_{df} = 42.44_{3,25}$ ,  $p < 0.0001$

Total:  $F_{df} = 32.82_{3,27}$ ,  $p < 0.0001$

In artificial diets, performance suffers as density increases

Fruit observations

Larvae consistently performed better in raspberries despite densities of up to 3.5 eggs/g fruit

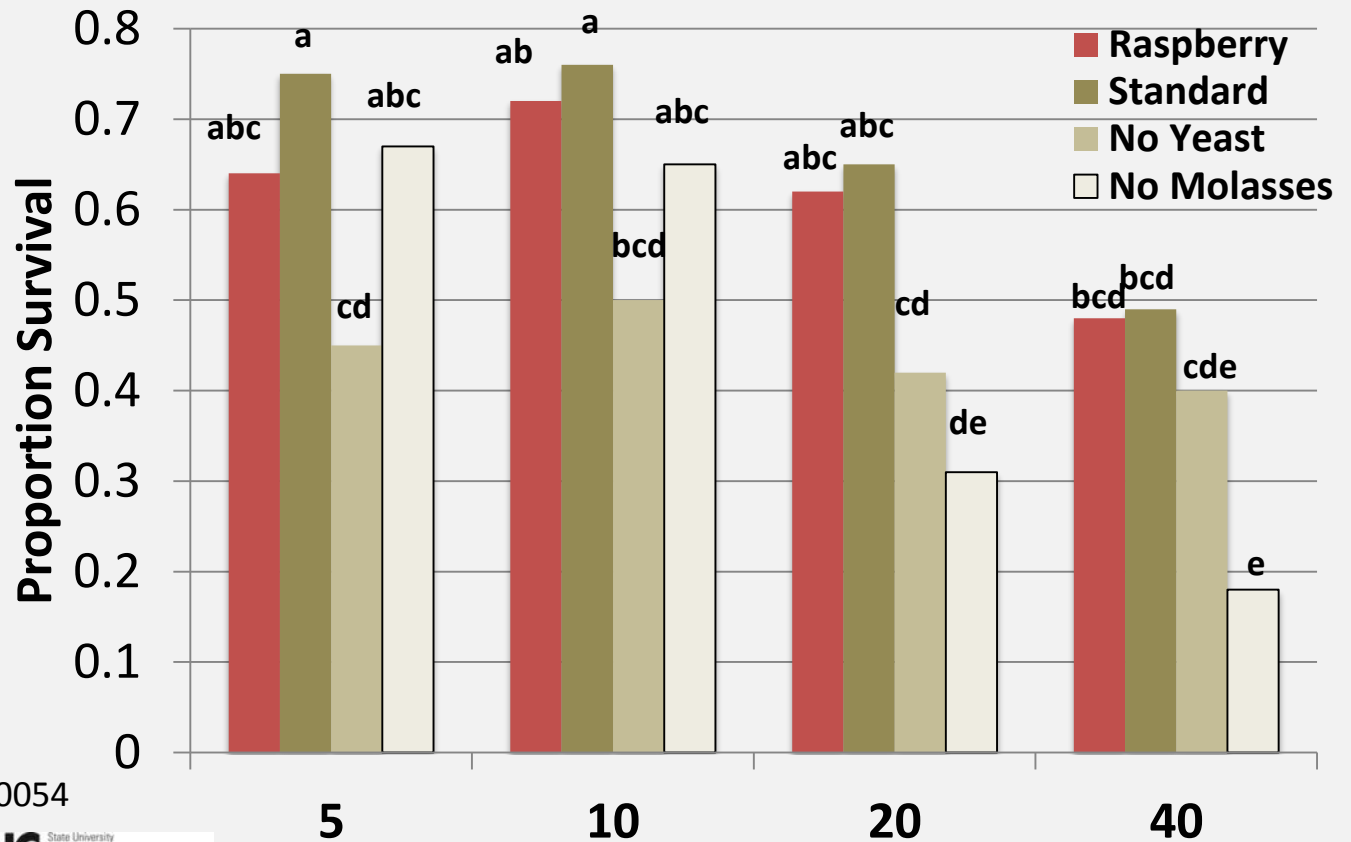
(40 larvae/10 ml = 3/g diet)

# Effects of diet on intraspecific competition

Survival reduced in poor quality diets

Competition more acute in low carbohydrate diets

Standard diets and raspberry comparable



Diet\*Eggs:  $F_{9,403} = 2.65$ ,  $p = 0.0054$

# Effects of diet on intraspecific competition

Development time extended in poor quality diets

More acute in low amino acid diets

Standard diets and raspberry comparable

Total Development Time

