

INSECTICIDE RESISTANCE MONITORING & THE ROLE OF NOVALURON ON TPB



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RESISTANCE MONITORING EFFORTS

Insect	Insecticide Brand Name	Insecticide Active Ingredient
Soybean Looper	Blackhawk	spinosad
	Intrepid	methoxyfenozide
	Prevathon	chlorantraniliprole
Tarnished Plant Bug	Centric	thiamethoxam
	Admire Pro	imidacloprid
	Transform	sulfoxaflor

SOYBEAN LOOPER ON:
BLACKHAWK (SPINOSAD)

State	Gen.	LC50 (ppm)	RR	LC90 (ppm)	RR
Lab		0.79 (0.31-1.34)	1	4.24 (2.67-8.06)	1
MS	F ₁	1.14 (0.92-1.41)	1.44	1.84 (1.48-2.81)	0.43
MS	F ₂	1.21 (0.89-1.48)	1.52	2.51 (2.03-3.52)	0.59
SC	F ₁	0.79 (0.27-1.40)	0.99	3.19 (1.83-6.95)	0.75
SC	F ₂	0.67 (0.37-0.95)	0.84	3.33 (2.29-6.45)	0.79
VA	F ₁	1.56 (0.96-2.33)	1.96	6.50 (3.92-19.38)	1.53
VA	F ₂	1.32 (0.89-1.77)	1.66	4.45 (3.12-8.36)	1.05

SOYBEAN LOOPER ON: INTREPID (METHOXYFENOZIDE)

State	Gen.	LC50 (ppm)	RR	LC90 (ppm)	RR
Lab		0.40 (0.09-0.94)	1	3.02 (1.32-9.50)	1
MS	F ₁	0.38 (0.12-0.73)	0.95	1.98 (1.01-10.60)	0.66
MS	F ₂	0.47 (0.30-0.65)	1.17	2.63 (1.79-4.62)	0.87
SC	F ₁	1.61 (0.75-2.53)	4.01	4.91 (3.05-15.77)	1.62
SC	F ₂	1.28 (0.91-1.70)	3.18	4.29 (3.05-7.27)	1.42
VA	F ₁	0.50 (0.24-0.84)	1.25	4.04 (2.57-7.01)	1.34
VA	F ₂	2.07 (1.50-2.81)	5.14	10.53 (6.98-19.26)	3.48
MS 10-11*		0.96 (0.47-1.61)	2.40	12.18 (6.82-30.03)	4.03

*Owen et al. 2013

SOYBEAN LOOPER ON:
PREVATHON (CHLORANTRANILIPROLE)

State	Gen.	LC50 (ppm)	RR	LC90 (ppm)	RR
Lab		0.147 (0.095-0.223)	1	0.554 (0.343-1.236)	1
MS	F ₁	0.089 (0.056-0.134)	0.60	0.316 (0.198-0.693)	0.57
MS	F ₂	0.099 (0.037-0.111)	0.67	0.416 (0.236-1.183)	0.75
SC	F ₁	0.035 (0.004-0.086)	0.24	0.205 (0.085-1.151)	0.37
SC	F ₂	0.133 (0.055-0.210)	0.91	0.432 (0.270-1.313)	0.78
VA	F ₁	0.134 (0.008-0.277)	0.91	0.858 (0.465-3.512)	1.55
VA	F ₂	0.471 (0.310-0.630)	3.21	1.244 (0.884-2.578)	2.24

TARNISHED PLANT BUG

Insecticide	Region	# Pop Tested	RR Range	# "Resistant" ^a
Admire (imidacloprid)	Delta	11	0.26 – 8.44	0 (0%)
	Hills	9	0.10 – 29.7	2 (22%)
	Overall	20	0.10 – 29.7	2 (10%)
Centric (thiamethoxam)	Delta	10	1.32 – 188.0	4 (40%)
	Hills	9	0.06 – 56.1	3 (33%)
	Overall	19	0.06 – 188.0	7 (37%)
Transform (sulfoxaflor)	Delta	9	0.62 – 18.8	3 (33%)
	Hills	10	0.70 – 37.3	3 (30%)
	Overall	19	0.62 – 37.3	6 (32%)

^a 10 x average of lowest 6 LC₅₀ estimates for the insecticide

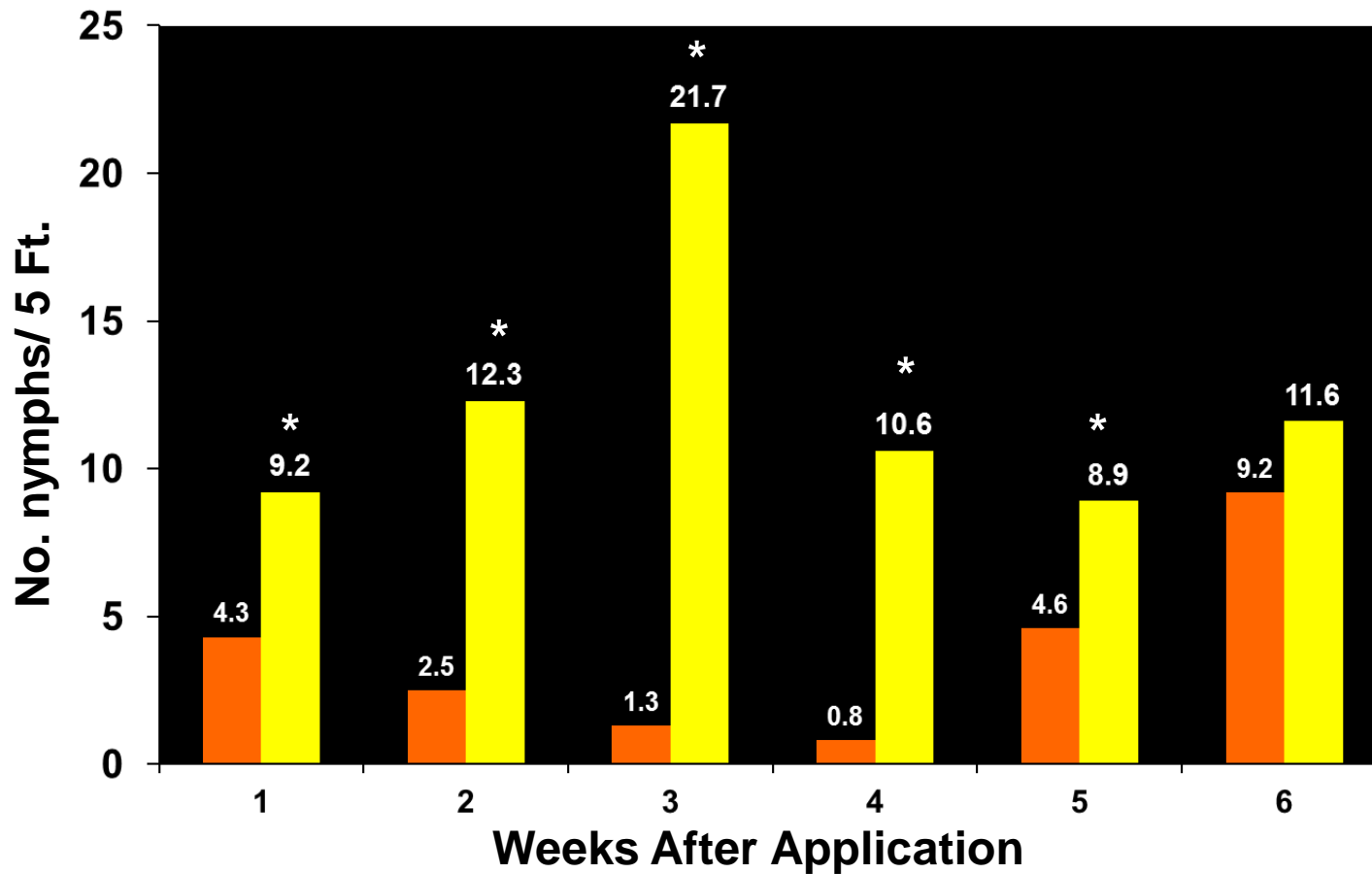
ASSAY CONCLUSIONS

- 2018 soybean looper populations crashed in the mid-South region during August, minimizing collections
- No tested soybean looper populations resistant ($RR > 5$) to any insecticides tested during 2018
- Likelihood of encountering resistant TPB populations: Centric > Transform > Admire
- Resistance to Centric slightly more prominent in the Delta than in the Hills regions, but highly variable in both regions

DIAMOND (NOVALURON)

- Chitin synthesis inhibitor
- Effective on TPB nymphs
- Long residual
- Does not kill adults
- May have sub-lethal effects on TPB adults (codling moth, Colorado potato beetle, plum curculio)
 - Primarily reduced egg hatch rate

LARGE BLOCK EVALUATION OF DIAMOND - 2010



Split growers fields (4 total), Diamond applied approx. 3rd week of squaring

EFFECTS OF NOVALURON ON ADULT TARNISHED PLANT BUGS

Treatment	Eggs laid/F	% Eggs hatched
M & F exposed	131.1a	3c
Male exposed	104.9a	30b
Female exposed	112.5a	6c
Control	117.5a	42a

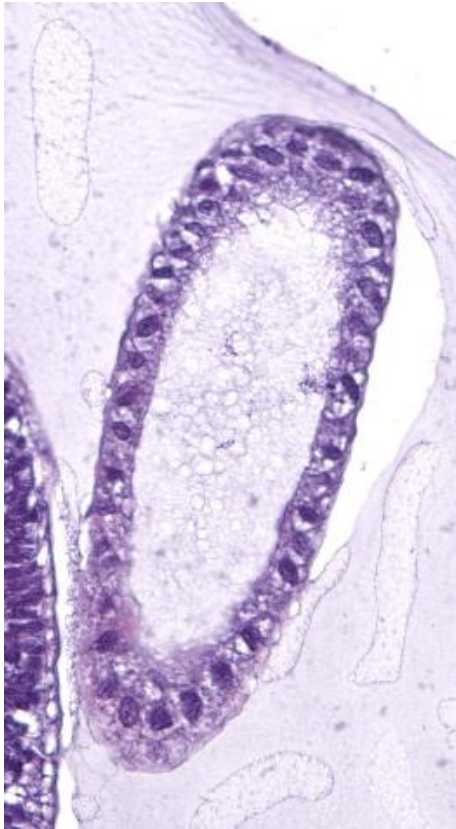
2-day exposure through diet packs on 3-5 day old adults. Eggs collected for 2 weeks following exposure.

IMPACT OF ADULT AGE WHEN TREATED

Age when treated	Eggs laid/F/day			% Hatch		
Day	4-6	7-10	11-31	4-6	7-10	11-31
Untreated Check	5.3a	14.1a	12.7a	56	46a	26a
1 D	0.0b	0.0b	0.0b	-	-	-
6 D	-	15.0a	10.5a	-	16b	0b
10 D	-	-	9.2a	-	-	6b

IMPACT OF NOVALURON ON DEVELOPING EGGS

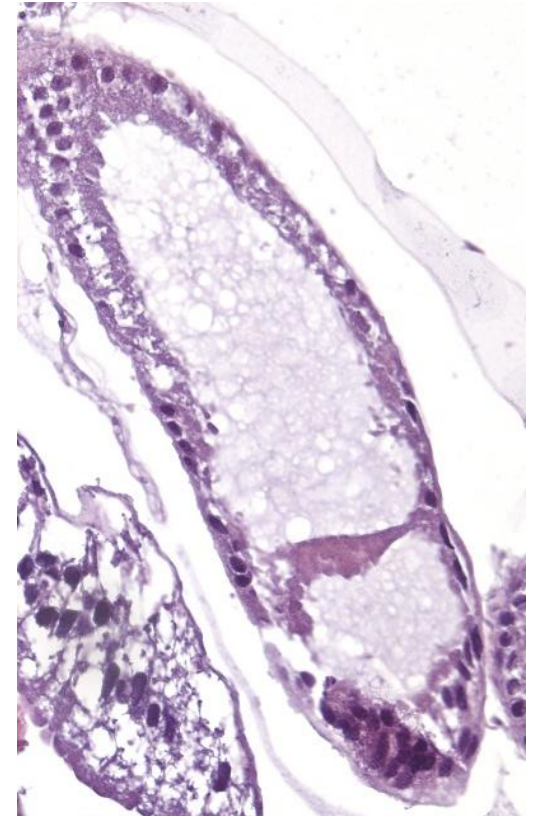
Untreated



Treated

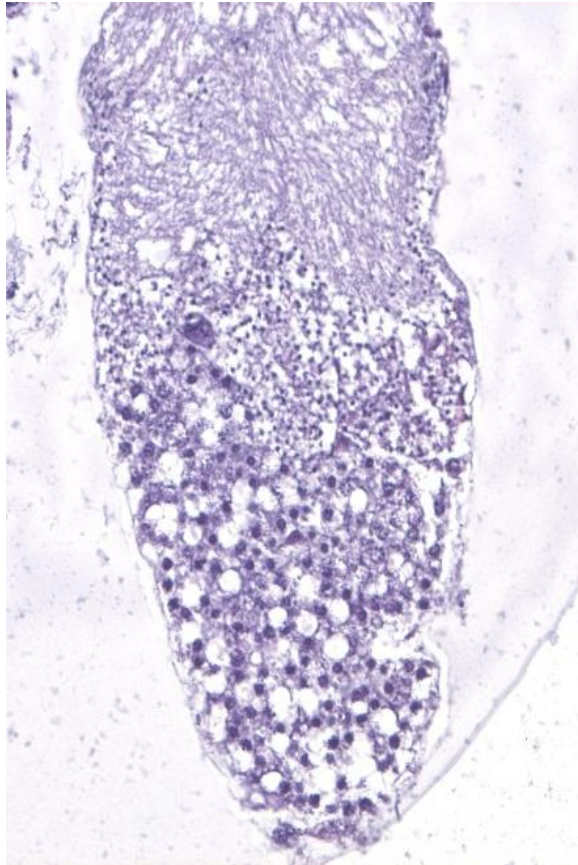


Treated

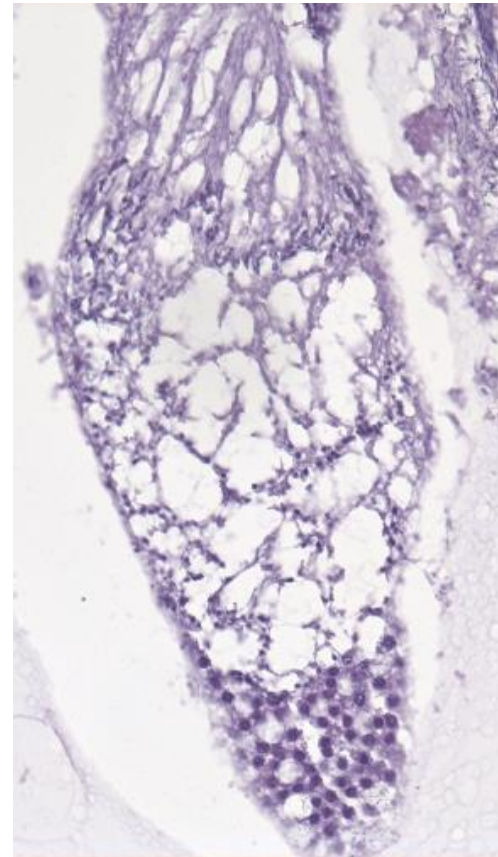


IMPACT OF NOVALURON ON OVARIES

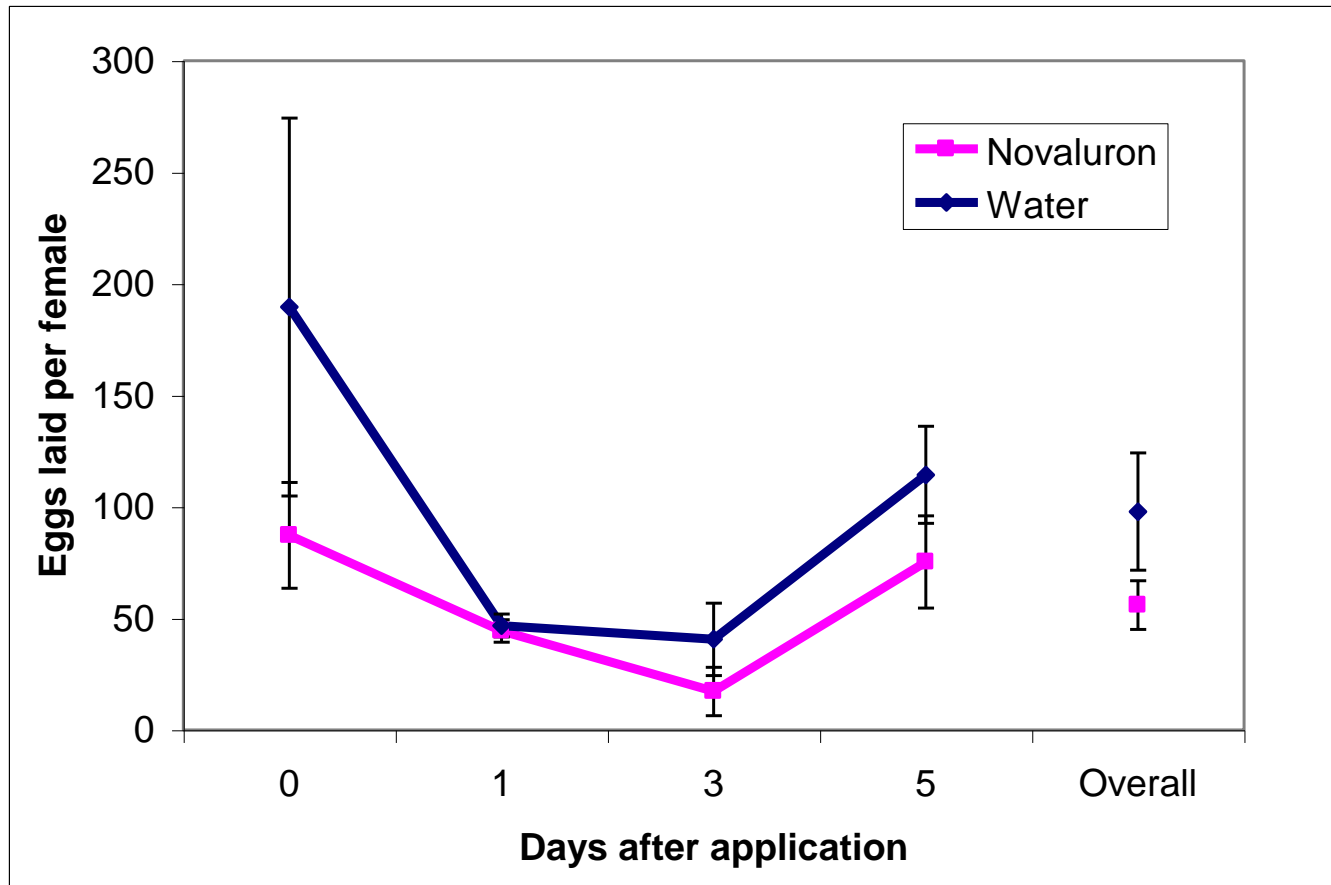
Untreated



Treated

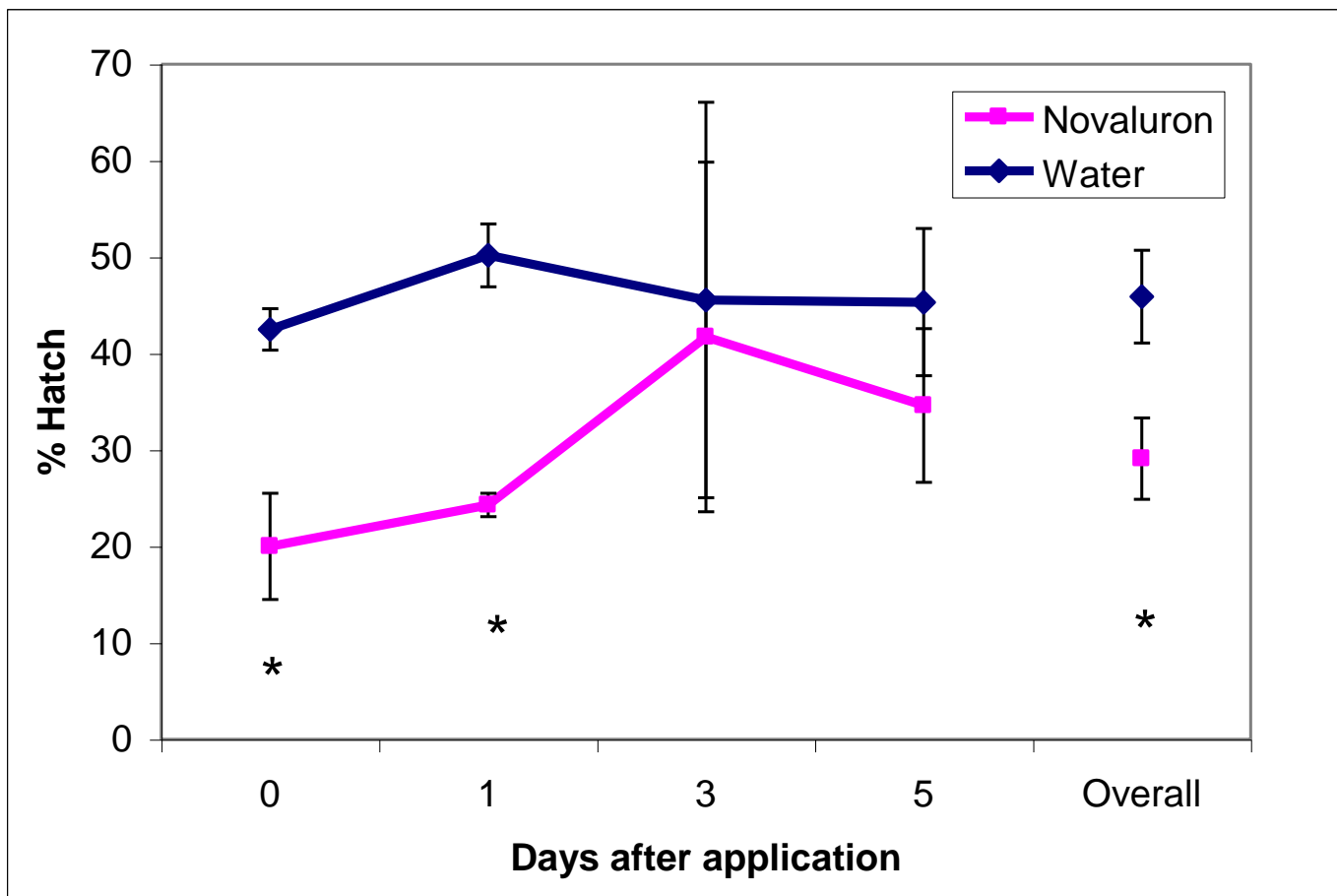


GREENHOUSE RESULTS: OVIPOSITION



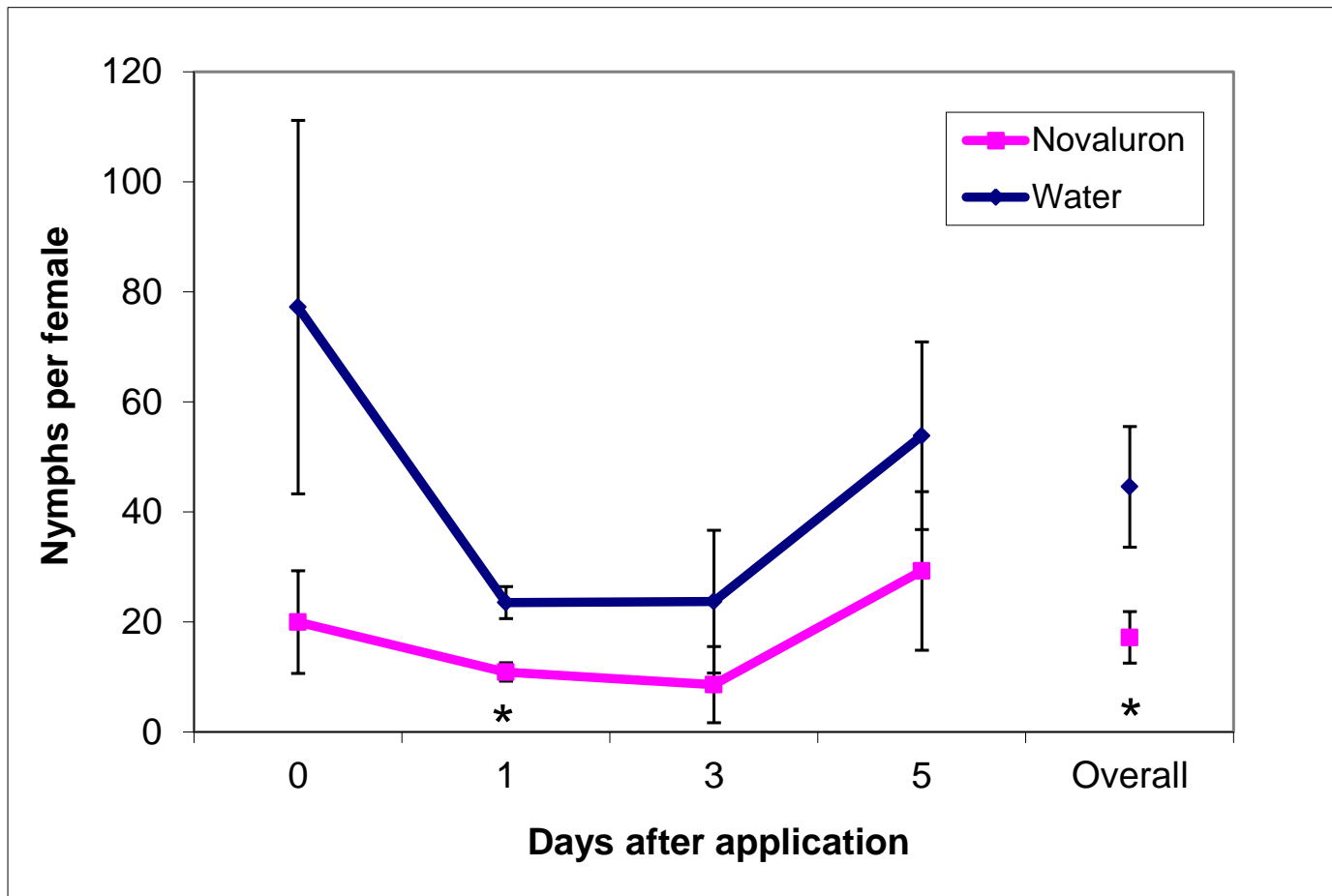
No significant differences

GREENHOUSE RESULTS: HATCH RATE



* significant difference

GREENHOUSE RESULTS



* significant difference at $\alpha=0.05$

IMPACT ON ADULT FIELD POPULATIONS

Site	Treatment	Eggs/F/day	Hatch Rate	Nymphs/F/day
TN- 2012	Untreated	4.10	51%	2.11
	Novaluron	4.25	26%	1.10
AR- 2017	Untreated	2.24	48%	1.08
	Novaluron	1.11	33%	0.36
MS Delta 2017	Untreated	1.43	33%	0.47
	Novaluron	1.33	26%	0.34
Overall (12 sites)	Untreated	3.05	35%	1.07
	Novaluron	2.74	31%	0.85

TPB collected 24-48 hr after application on cotton or mustard.
Eggs and nymphs counted for 2-3 wks after collection.

NOVALURON CONCLUSIONS

- Oviposition rate affected when female is exposed to novaluron within 1 day of adult emergence.
- Egg hatch rate impacted by novaluron whenever female is exposed and lasts rest of life.
- Novaluron has a detrimental physiological effect on early egg development.
- Novaluron reduces yolk protein storage in ovaries.
- Field exposure to residues within 24 h of application reduces hatch rate.
- Impact from open field application variable, but some reduction in nymph production mostly observed (ave. 20% reduction).

ACKNOWLEDGMENTS

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- Numerous research technicians and student workers who conducted most of the assays