FINAL PROJECT REPORT

Project Title: Effect of neem on biology and behavior of pear psylla

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Total Project Funding: $15,000

Budget History (Fresh Pear/Processed Pear Committees):

Item	**Year 1:** (2008)
Salaries	$11,500
Benefits	$ 3,500
Supplies	
Total	$15,000

Restatement of Objectives:
Neem products are being used to manage pear psylla, with emphasis on controlling the summerform generations. These chemicals are thought to have any of several effects on pest psyllids, including growth regulator effects, deterrence, and direct mortality. However, good quantitative data establishing that these effects occur in a biologically meaningful way for pear psylla are limited. Objectives are to assess in laboratory assays the effects of neem on:

- egg and nymphal mortality
- egglaying preferences
- mating success, fecundity, and hatch of eggs deposited by treated females
- post-diapause development in winterforms

Significant Findings and Accomplishments

- Topical applications of Neemix 4.5 caused mortality of nymphs at the field rate and at twice the field rate; mortality rates fell between 20 and 40%.
- Storage of the mixed product led to reduced efficacy against nymphs.
- Topical applications had no effects on egg hatch.
- Topical treatment of virgin females or males did not affect subsequent mating, nor hatch of eggs deposited by mated females.
- Treated pear foliage received as many eggs as untreated foliage in preference tests.
- Treatment of diapausing winterforms with Neemix did not prompt ovarian development or mating.

Results and Discussion
All assays used Neemix 4.5 (Certis). Rate studies were done using the recommended concentration (10 oz/100 gallons water), as well as 2-times that rate (hereafter, 2x) and 0.5-times (0.5x) the recommended rate. Topical treatment of eggs and nymphs were done by misting approximately 0.5 ml of solution on 2-3 inch tall pear seedlings, infested with eggs or nymphs. Solutions were applied using a Nalgene hand-pump aerosol unit. Controls were misted with water.

- **Figure 1. Topical treatment of instar nymphs and eggs**. Early (I-II) instar nymphs, late (IV-V) instar nymphs, and eggs were misted with Neemix at one of three rates. Survival of nymphs and hatch of eggs were assessed at 1 and 2 weeks following treatment. ***Results***. Mortality of early instar nymphs approached 40% at the 2x rate and 20% at the recommended rate, at 2 weeks following treatment. Mortality in late instar nymphs was 20-30% in the 1x and 2x rates; little mortality was seen until the 2 week examination. Dead nymphs often had failed to molt correctly **(Figure 2)**, which is evidence of growth regulator effects.

  Effects of Neemix on egg hatch were modest at best **(Figure 1)**. These results appear to be consistent with studies on other insect species in failing to demonstrate effects on eggs.

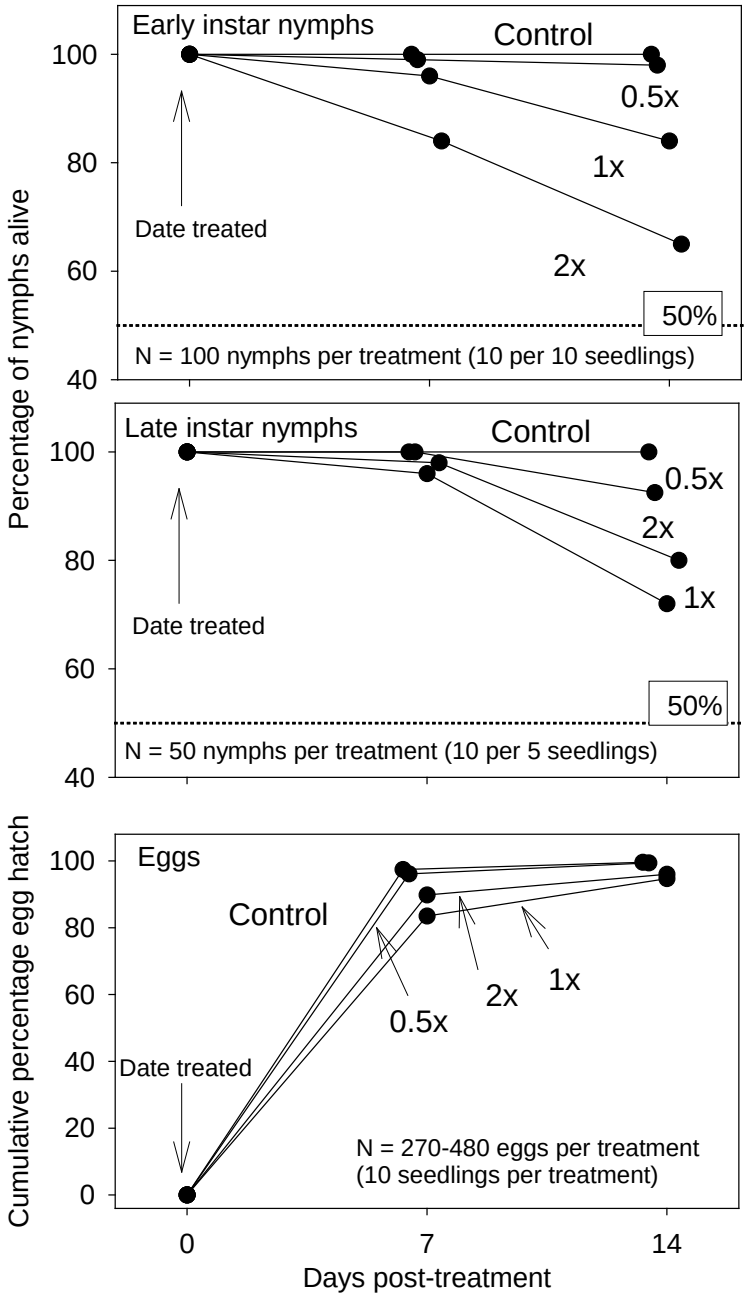


Figure 1. Effects of topical application on immature psylla.

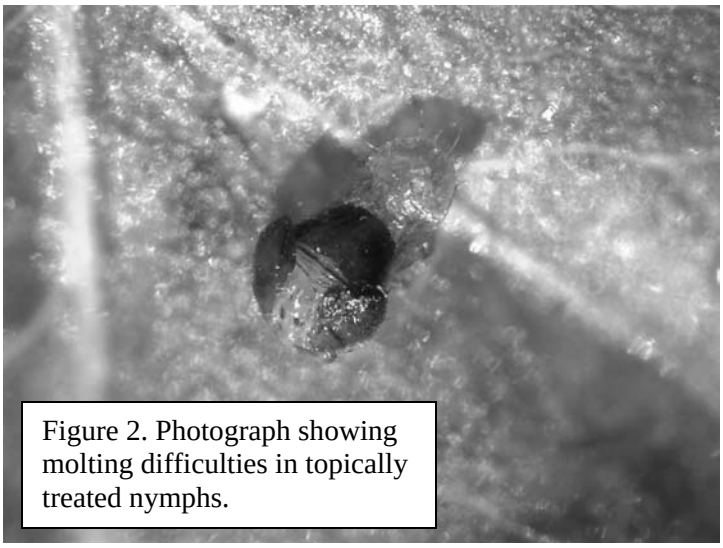


Figure 2. Photograph showing molting difficulties in topically treated nymphs.

- **Figure 3. Comparison of freshly mixed product with stored product**. Late instar nymphs were misted with Neemix at one of 3 rates. The solutions included freshly mixed product and a mixed solution that had been stored for 1 month at room temperature in a darkened cabinet. ***Results.*** Mortality approached 20% at the higher rates for the freshly mixed solution. Storage of the mixed solution for one month appears to have reduced its efficacy (consistent with warning on product label).

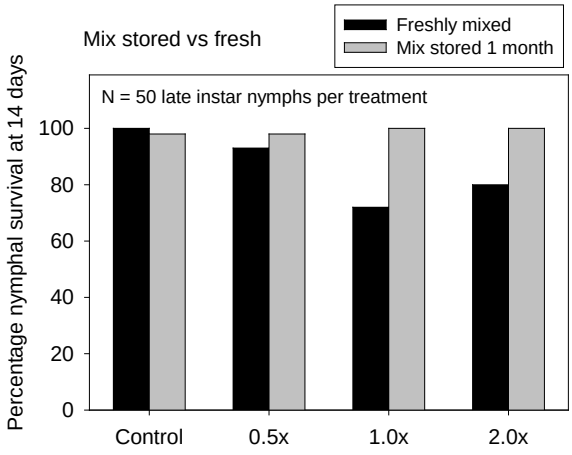


Figure 3. Freshly mixed vs mixed and stored product.

- **Figure 4. Topical treatment of adults and effects on mating and hatch of eggs.** Virgin summerforms were obtained from culture and treated either with Neemix (1x) or left untreated. Males and females were then combined in cages containing clean seedlings as one of 4 treatments: control females + control males; control females + treated males; treated females + control males; treated females + treated males. Females were then pulled from all containers at 4 and 7 days, and dissected to determine mating status. Additional females were moved to clean pear seedlings and allowed to oviposit; egg hatch was monitored. ***Results.*** By seven days, all females had been mated, indicating that treatment by neem did not affect either female attractiveness to males or male ability to inseminate females. Hatch rates of eggs deposited by treated or untreated females, mated with treated or untreated males, approached 90% in all mating combinations.

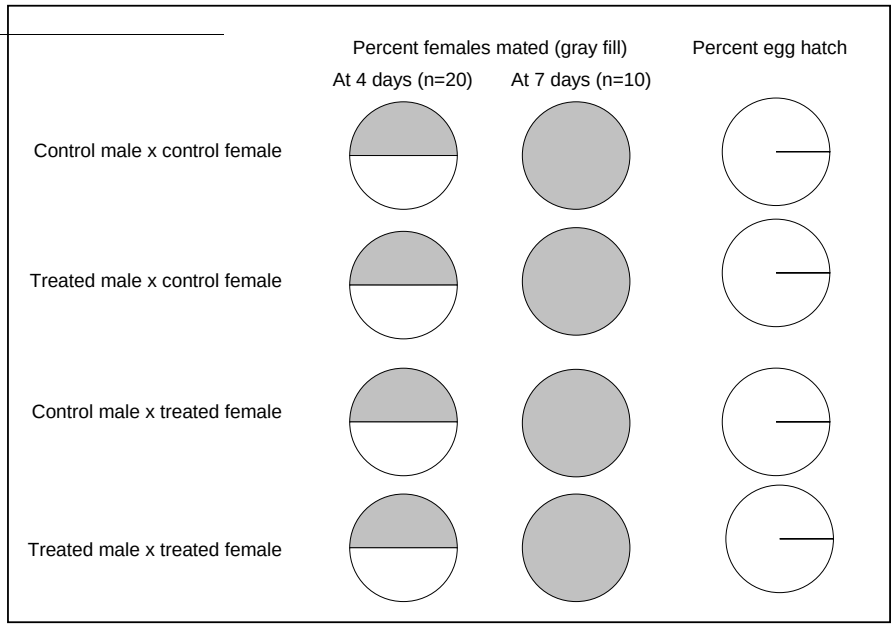


Figure 4. Effects on mating and hatch of eggs deposited by treated females.

- **Figure 5. Topical treatment of adults and effects on fecundity.** Six treated and six untreated females (from previous assay) were collected and set-up individually with males on untreated seedlings. The females were allowed to oviposit for 7 days. After 7 days, eggs were counted. ***Results.*** 7-day egglaying rates were identical by treated and untreated females.

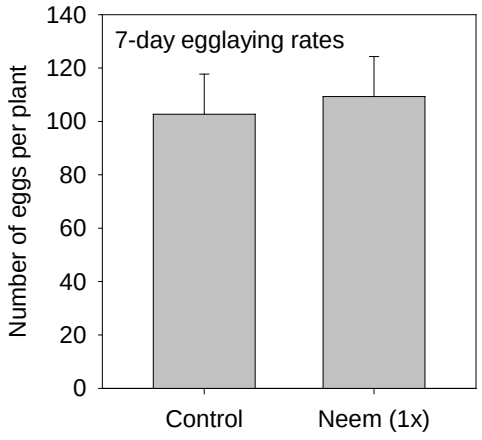
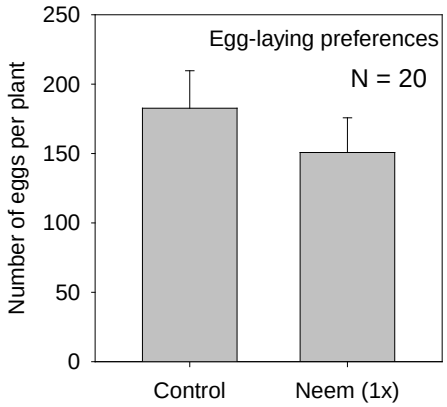


Figure 5. Effects on fecundity of topically treated females.

- **Figure 6. Egglaying preferences.** Paired clean and Neemix-treated (1x) pear seedlings were placed in small cages. Ten females were added to each cage and allowed to oviposit for 24 hours. At the end of 24 hours, numbers of eggs on each seedling were determined. ***Results.*** There was but a slight (statistically non-significant) preference for the control seedlings, indicating Neemix had no strong oviposition deterrence.

Figure 6. Effects on egglaying preferences.



- **Table 1. Post-diapause development.** Winterforms were collected from the field on 3 dates (Oct. 8, Oct. 28, Nov. 18). Half of the insects were moved to treated (1x Neemix) pear seedlings; the other half were left untreated. Psylla were left on the plants for 48 hours, and then moved onto clean seedlings (long-day conditions, 72^{o} F). Fifteen females were then removed from both treatments on each of 3 days following exposure to Neemix: 3 days, 6 days, and 9 days. The insects were dissected for ovarian scores (0=fully immature, 5=mature) and spermatophore numbers. ***Results***. Neemix had no effects on ovarian development or spermatophore numbers. Both control and treated insects remained in diapause through 6 days. I conclude that Neemix failed to prompt early termination of diapause.

TABLE 1. Effects of product on post-diapause development (ovary maturation and mating).

Date collected from field	Treatment	Ovarian scores				Spermatophore numbers		
		3 days	6 days	9 days		3 days	6 days	9 days
Oct 8	Control	0	0-1	0-1		0	0	0
	Neem	0-1	0-1	0-1		0	0	0
Oct 28	Control	0-1	0-1	0-1		0	0	0
	Neem	0-1	0-1	0-1		0	0	0
Nov 18	Control	0-1	0-1	0-3 (1.2)		0	0	0
	Neem	0-1	0-1	0-3 (1.3)		0	0	0

EXECUTIVE SUMMARY

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SUMMARY
Effects of Neem products on different life stages of pear psylla were assessed. The following table summarizes effects seen in these assays:

Eggs	No effects on hatch of topically treated eggs
Nymphs	20-40% mortality of topically treated nymphs after 14 days, apparently due to difficulties in molting by treated insects
Adults	1. Topical treatment of adults had no effects on mating success 2. Eggs deposited by topically treated females hatched successfully 3. Topical treatment of adults had no effects on fecundity 4. Treatment of foliage with Neemix did not deter egglaying 5. Neemix did not cause premature termination of diapause in winterforms