FINAL REPORT

PROJECT TITLE: Chemical ecology of pear psylla

PI: David Horton
ORGANIZATION: USDA-ARS, Yakima Agric. Research Lab., Wapato, WA
509-454-5639
horton@yarl.ars.usda.gov

CO-PI: Pete Landolt
USDA-ARS, Yakima Agric. Research Lab., Wapato, WA

OBJECTIVES:

Determine whether there are volatile chemicals emitted by psylla and/or the host plant that could explain the aggregated distribution of adult psylla in the orchard. The objectives were revised somewhat to emphasize the role of psylla-emitted volatiles, particularly as they affect male:female interactions.

SIGNIFICANT FINDINGS:

Behavioral tests and assays with a Y-tube olfactometer were done to determine whether chemical volatiles might be involved in mate-finding by winterform pear psylla. The studies included a series of choice tests in which two pear shoots (differing in whether they had been exposed previously to pear psylla) were paired in arenas, and winterform psylla were allowed to choose between shoots. The choice tests were followed by olfactometer trials to determine if volatile chemicals were involved in the choices.

Choice tests:

- Male psylla preferentially accumulated on a pear shoot hosting a female psylla versus a clean shoot not having a female;
- Male psylla preferentially accumulated on a psylla-free shoot that had previously been exposed to egglaying females for 24 hours versus a clean shoot not previously exposed to psylla;
- Male psylla preferentially accumulated on a psylla-free shoot previously infested with egglaying females versus a psylla-free shoot previously infested with males;
- Female psylla presented with male-treated shoots paired with female-treated shoots showed no preferences.

Olfactometer trials:

- Male psylla were preferentially attracted to volatiles from shoots that had previously been infested with egglaying females versus clean shoots;
- Male psylla were preferentially attracted to volatiles from shoots infested with egglaying females versus clean shoots;
- Male psylla were preferentially attracted to volatiles from shoots infested with egglaying females versus shoots previously infested with females but with females removed.

Interpretation of results:

- The choice tests showed that shoots retained chemical cues associated with the female or her eggs (even after she had been removed from the shoot) that were attractive to males;
- Volatile chemicals emitted from the female, from female infested shoots, or from newly deposited eggs were attractive to males (from olfactometer assays).

RESULTS AND DISCUSSION:

All assays used field-collected shoots and winterform pear psylla. Shoots and psylla were collected between late January and mid-February, and kept refrigerated until use. The assays were done beginning in late January and ending the last week of March.

Choice Test Assays. All assays used paired shoots in 8 inch diameter circular arenas. Cut ends of the shoots were placed in water.

1. Do males accumulate on shoots hosting a female? *Methods*. A single female was placed on one shoot and allowed to settle for 24 hours. The shoot was paired with an uninfested shoot. Ten males were added to the arena, and their locations checked 2 hours later. *Results*. The males accumulated on the shoot that was hosting the female (**Figure 1**; 20 assays, each assay [bar] based upon 10 males). *Interpretation*. Females produced either (or both) short-distance or long-distance attractants (which could be visual, chemical, or acoustic in function) which led to accumulation of males on the shoot hosting the female. Or, female activity on the shoot made the shoot more attractive to males due to (possibly) chemical changes in the shoot induced by the female.

2. Do males accumulate on shoots previously exposed to egglaying females? *Methods.* A shoot exposed for 24 hours to five post-diapause females was paired with a control shoot not previously exposed to psylla; the females were removed from the test shoot just before beginning the assay. Ten males were added to the arena, and their locations determined 2 hours later. *Results.* Fifteen assays were done. The males accumulated on the shoot previously exposed to the females (Figure 2). *Interpretation.* Shoots previously exposed to females retained some cues associated with the female or her eggs that were attractive to males. The cues could be chemical products emitted by the females and somehow retained on the surface of the pear shoot.

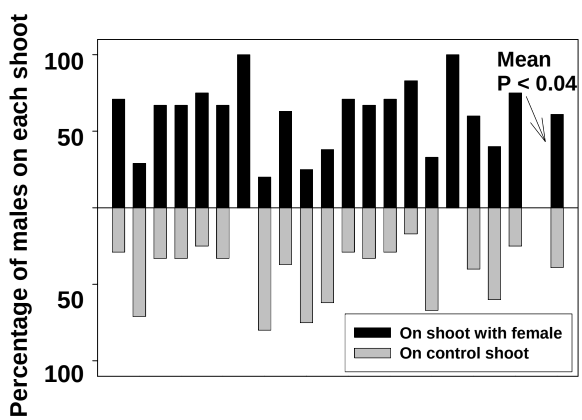

Figure 1. Percentage of males accumulating on shoot hosting the female (black shading) vs shoot that was female-free (gray shading). Each bar based upon 10 males.

3. Do males accumulate on shoots previously exposed to females versus shoots previously exposed to males? *Methods.* The methods are the same as used in assay 2, except that the test shoot (exposed to 5 females) was paired with a shoot previously exposed to 5 males, rather than paired with a clean shoot. *Results.* Fifteen assays were done. Males accumulated on the shoots previously exposed to females (Figure 3). *Interpretation.* The results noted in assay 2, in which males accumulated on shoots previously infested by females, were not due to a generalized response by males to previous infestation by psylla, but rather were due to a specific response by males to previous infestation by female psylla.

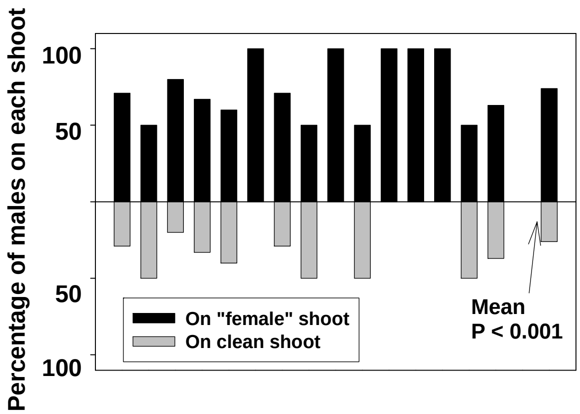

Figure 2. Percentage of males accumulating on shoot previously exposed to females (black shading) vs clean shoot (gray shading). Each bar based upon 10 males.

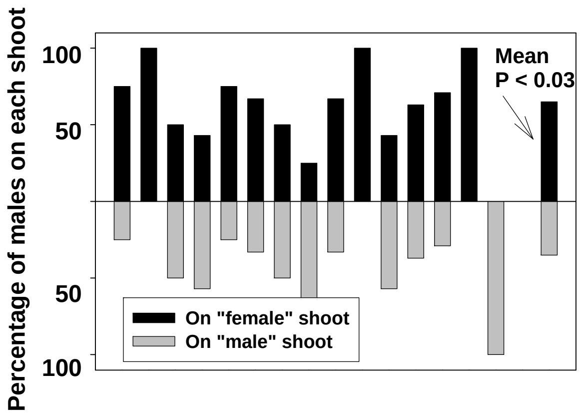

Figure 3. Percentage of males accumulating on shoot previously exposed to females (black shading) vs shoot previously exposed to males (gray shading). Each bar based upon 10 males.

4. Do females accumulate on shoots previously exposed to males versus shoots previously exposed to females? *Methods.* Methods are the same as in assay 3, except that females were assayed instead of males. *Results.* Fifteen assays were done, and female choice was random (Figure 4). *Interpretation*. There is no evidence that previous exposure of a shoot to male psylla was either less or more attractive to females than shoots previously exposed to female psylla.

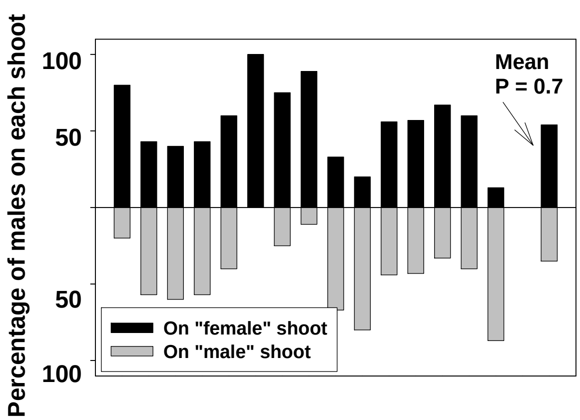

Figure 4. Percentage of females accumulating on shoot previously exposed to females (black shading) vs shoot previously exposed to males (gray shading). Each bar based upon 10 females.

Y-tube Olfactometer Assays. *Methods.* Male winterform psylla were allowed to freely choose between two arms of an olfactometer: one arm connected to a volatile source hypothesized to be attractive to psylla; and, a second arm connected to a control source of volatiles. Three assays were conducted. Each assay included 6 replications. Each replication consists of the results for 10 males, run one-at-a-time (thus, each assay included data for 60 males).

5. Are males preferentially attracted to volatiles from shoots previously exposed for 24 hours to post-diapause females (following which females are removed) versus clean shoots?

6. Are males preferentially attracted to volatiles from female-infested shoots versus psylla-free shoots?

7. Are males preferentially attracted to female-infested shoots versus shoots previously exposed to females?

Results. In assay #5, males were preferentially attracted to volatiles from shoots previously infested with females (63%) versus clean shoots (37%). In assay #6, males were preferentially attracted to shoots hosting post-diapause females (68%), versus female-free shoots (32%). In assay #7, males were preferentially attracted to shoots hosting females (75%) versus shoots previously exposed to females (25%). All P-values are less than 0.05.

Interpretation. Female-infested shoots and shoots previously exposed to post-diapause females attracted males. Males were apparently responding to volatile chemicals. The source of the chemical cues is unclear, and could include female psylla, her eggs, or some change in the shoot associated with activities of the female. Assay #7 suggests that cues associated with females were more effective than cues associated with just egg-laden shoots.

CONCLUSIONS:

We now have evidence that male winterform psylla are attracted by volatile chemicals emitted from female-infested pear shoots and from psylla-free shoots that had previously been infested with females. These results suggest that male psylla are attracted by chemicals emitted by females, by chemicals emitted by shoots previously occupied by egglaying females, or by chemicals emitted by eggs newly deposited on shoots (or, by a combination of these sources). The male response was stronger to female-infested shoots than to egg-laden, female-free but previously infested shoots, and we interpret this result as evidence that female winterform psylla emit a chemical attractant.

BUDGET:

Project title: Chemical ecology of pear psylla

PI's: David Horton and Pete Landolt
Project duration: 2002-2004
Project total (years): $20,230

Item	Year 1 (2002)	Year 2 (2003)	Year 3 (2004)
Salaries	15,600	0	0
Benefits (30%)	4,630	0	0
Total	20,230	0	0

Funding was used to partially support a GS-5 term technician, who conducted many of the behavioral assays summarized here. The funds were spent in FY 2004.