MATING DISRUPTION FOR NAVEL ORANGEWORM IN CENTRAL CALIFORNIA: YEAR 3

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INTRODUCTION

The navel orangeworm, *Amyelois transitella* (Walker) (NOW), is the most important insect pest of almonds in California. Previous research, performed in the southern Central Valley of California with almonds of the varieties Nonpareil and Monterey, demonstrated that mating disruption can significantly reduce damage in almonds. The present study examines the effect of mating disruption on NOW fertility and damage in a different region, and under less stringent orchard sanitation and higher NOW abundance. Data are presented contrasting these effects on treatment and control plots following mating disruption treatments in 2009 and 2010 with data from these plots in 2008, when no mating disruption treatments were applied. The data for 2010 are preliminary, and harvest damage are not yet available.

APPROACH

The overall demonstration site, located in near Mendota in western Fresno County, comprised 2300 acres of almonds. Within this area we have established three blocks totaling 830 acres, as described in Table 1. Mating disruption treatment and control plots were designated in 2008 and insect samples were taken to develop pre-treatment data on NOW densities. Mating disruption treatments were applied the last week of April in 2009 and 2010. These treatments were applied as an "insecticide overlay"; i.e., both control and treatment plots received insecticide treatments timed at May 1, hull-split, and two weeks hull-split. Effects of mating disruption were examined using winter sampling (population density estimates) and early June sanitation surveys (census of mummies only), season-long monitoring with virgin female-baited traps (1 per 40 acres) and egg traps (1 per 2.5 acres), and harvest sampling.

SUMMARY AND CONCLUSIONS

Mummies per tree ranged from 100 to 600 in January 2009 and from 80 to 500 in January 2010. June sanitation survey indicated a substantial reduction of mummies, although the numbers of mummies per tree were still 1-10× the 2 mummies per tree recommended for winter sanitation targets. Estimates of mummies per tree infested with live NOW in January were on the order of 1-10 per tree. In contrast to the Kern County sites of previous research, where mummy density was far lower than typical, at this site mummies, and probably NOW density, were higher than typical for almonds in California.

During mating disruption treatment in 2009 and 2010, suppression of males was evident throughout the site (Table 2), but even more evident when comparing treatment and adjacent control plots. In 2009 a total of 9 males were captured in mating disruption treatment plots from May to October, and for 2010 no males have been captured in these plots as of mid-September. This constitutes a 99.5% suppression (compared to control plots) in 2009, and a suppression of >99.8% in 2010.

There was no significant difference between future treatment and control plots in 2008 in the increase in numbers of eggs per trap per week between the six week before and 11 weeks after May 1 (Table 3), demonstrating no overall bias due to plot location. In contrast, in 2009 and 2010 (when these periods were before and after initiation of mating disruption), there was a significant difference in the change of eggs/trap/week from the earlier to the later period, with eggs per trap per week increasing in control plots and decreasing in mating disruption plots (Table 3).

Harvest damage in 2008 and 2009 was under 1% in each of the first four varieties harvested (Fig. 1). However, there was a significant reversal between the pre-treatment year (2008) and the first treatment year of (2009), with more damage in future treatment plots in 2008 but more damage in control plots in 2009 in these first four varieties. There was heavier damage in Monterey compared to the other varieties in 2009, but not 2008. In 2009 there was significantly more damage in control than in treatment plots in all three blocks, whereas in 2008 there was no significant difference between damage in treatment and control plots (Fig. 2).

These data demonstrate that mating disruption for NOW can have impact on fertility and damage under the high-abundance conditions at this site. They also suggest that mating disruption may be particularly useful for protection of later-harvested varieties, where late insecticide treatments might interfere with the harvest of earlier varieties. Because of the proximity of the treatment and control plots, it is likely that the treatment effects described here are a conservative estimate of the reduction in damage by mating disruption.

Advantages of mating disruption for control of NOW in almonds include:

- No effect on non-target organisms; and potential reduction of insecticides and fumigants targeting NOW
- Potential reduction of NOW population abundance and NOW-associated aflatoxin
- Greater compatibility with harvest procedures compared to residual insecticides

Barriers to adaptation include:

- High price relative to residual insecticides
- Ability to predict NOW damage

Table 1. **Size of study blocks (acres), area planted in intermixed almond varieties Nonpareil-Monterey (NpMo) or Butte-Padre (BuPa), and area in mating disruption (MD) treatment and control plots**

		Variety Composition		Plot type	
Block No.	Size	Nonpareil-Monterey	Butte-Padre	Mating disruption	Control
1	240	160	80	120	120
2	320	200	120	200	120
3	270	160	110	75	195

Cultivars Nonpareil and Monterey were planted in interspersed rows, as were Butte and Padre.

Table 2. Males per trap per week (mean ± SE, n = 21) for periods of March-April and May-October, 2008—2010

		Period	
Year	MD Applied May 1?	March-April	May-October
2008	No	47 ± 2.4a	26 ± 2.2
2009	Yes	50 ± 2.3a	3 ± 1.0
2010	Yes	29 ± 2.1b	1 ± 0.8

March-April means followed by different letters are significantly different (ANOVA, P > 0.001). Significantly fewer males were captured in May-October 2009 and 2010 compared to 2008 (Kruskal-Wallis with Dunn test for multiple comparisons, P < 0.001). Data for 2010 May-October include up to the first week in September.

Table 3. Change in eggs per trap per week between the pre-application period (March and April) and the post-application period (May-July) in the presence of mating disruption and in the pre-treatment baseline year in which mating disruption was not applied

		Change in eggs/trap/week		
Year	Mating disruption applied?	Comparison plots	Mating disruption plots	$F_{1,328}$
2008	No	11.0 ± 1.1	10.4 ± 0.9	2.07
2009	Yes	2.6 ± 1.3	-4.9 ± 1.0	7.14**
2010	Yes	4.0 ± 1.1	-4.1 ± 0.7	29.28***

Significance of difference between comparison and mating disruption plots: **P < 0.01, ***P < 0.001 (ANOVA)

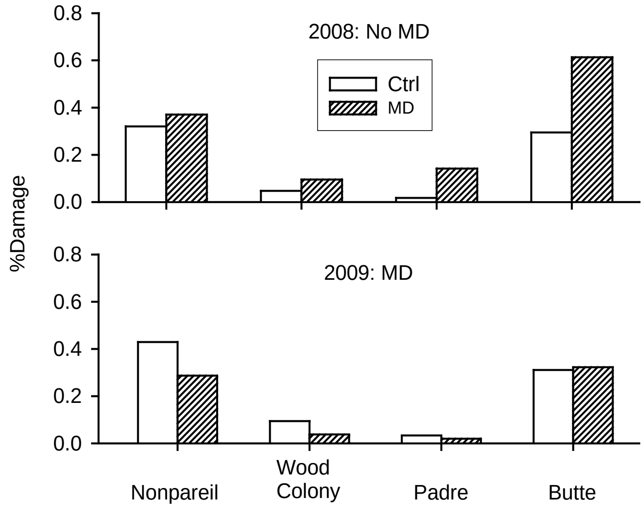

Figure 1. NOW damage to almonds (mean and SE) at time harvest from control (Ctrl) and mating disruption (MD) plots in 2008 (above, no mating disruption treatment to treatment plots) and 2009 (below, mating disruption applied to treatment plots continuously after 1 May) in Nonpareil, Wood Colony, Padre, and Butte almonds. Varieties are presented in the order of harvest. There was an overall reversal of damage between control and mating disruption plots in 2008 v. 2009 (generalized linear mixed model, P<0.001)

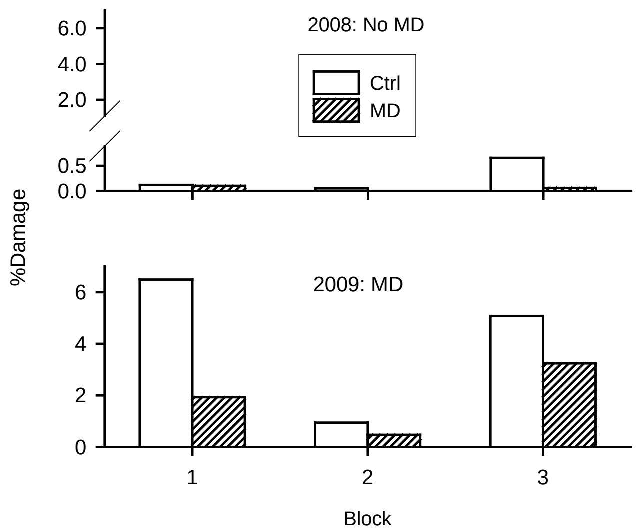

Figure 2. Harvest damage by NOW in Monterey (the last almond variety harvested) from mating disruption (MD) and control (Ctrl) plots in 2008 and 2009. There was significantly more damage in control than in mating disruption plots in block in 2009 (generalized linear mixed model, P<0.05), but not in 2008.