A THERMAL SUMMATION MODEL FOR NAVEL ORANGEWORM DEVELOPMENT IN WALNUTS

Mark Shelton and Kathy Kelley

ABSTRACT

Stanislaus and San Luis Obispo counties. Degree day (D°) accumulations were based on a lower developmental threshold of 55°F. Development of NOW from egg to adult in mummy walnuts required from 707 to 1498 D° in Stanislaus County and from 588 to 1224 D° in San Luis Obispo County. Peak moth emergence occurred from 850 to 1050 D° in Stanislaus County and from 1000 to 1200 D° in San Luis Obispo County. Daily mean high and low temperatures for the moth emergence periods were 86°F and 57°F, respectively, for Stanislaus County and 78°F and 51°F for San Luis Obispo County.

OBJECTIVES

1. To determine the heat unit accumulation required for development of NOW from egg to adult emergence in mummy walnuts, codling moth damaged nuts and walnut husk fly damaged nuts.

2. To develop thermal summation models to predict NOW development in and moth emergence from each walnut substrate.

PROCEDURES

Mummy Nut Experiment. Mummy walnuts were collected in February 1984 from a Payne orchard in Porterville. A lab culture of NOW was established at Cal Poly using a standard wheat bran larval diet. In early summer, groups of 10 NOW eggs were placed inside individual walnuts which were then caged in groups of 4 nuts. Inoculated walnuts were hung at approximately 6 foot height in the NSEW quadrants of 12 trees in each orchard. Thermographs were placed in the orchards to continuously monitor air temperature. Moth emergence was recorded at least three times per week after first moth emergence. The experiment was terminated after a two-week period with no further emergence.

Codling Moth Damaged Nuts. When walnuts in the San Luis Obispo orchard reached an average diameter of one-half inch, groups of 10 codling moth eggs were attached to each of four nut clusters in 12 trees. Nut clusters were enclosed on each tree with nylon mesh bags. When larval frass was evident on nut clusters, groups of 10 NOW eggs were placed on each cluster. NOW moth emergence was then monitored.

Walnut Husk Fly Damaged Nuts. Groups of 10 NOW eggs were placed on four clusters of walnut husk fly infested walnuts in 12 trees in San Luis Obispo. Each nut cluster was enclosed with a nylon mesh bag. NOW moth emergence was then monitored.

RESULTS

Mummy Nut Experiment. NOW moth emergence and temperature data varied considerably between the coastal and valley orchards (Table 1).
Degree day requirements for NOW development were within the range expected, based on similar work with NOW development in almonds. Total moth emergence in the San Luis Obispo orchard was lower than in Stanislaus County, due to a shorter season with temperatures in the optimum range for NOW development (80-90°F).

Codling Moth Damaged Nuts. Although codling moth larvae penetrated walnut husks, they failed to survive. Consequently no conclusions can be drawn on this experiment.

Walnut Husk Fly Damaged Nuts. NOW failed to develop in any nuts previously infested with walnut husk fly.

CONCLUSION

The preliminary data on NOW development in mummy walnuts should aid in development of a predictive thermal summation model. Further studies should clarify the first year's findings.

With some minor procedural changes, e.g., infestation of nuts with codling moth larvae instead of eggs, the study of NOW development in codling moth damaged walnuts should provide useful information.

It appears from the first year's work that walnut husk fly damage makes walnuts unsuitable for subsequent NOW infestation. Further study in coastal areas should clarify this.
Table 1. Navel Orangeworm Development in Mummy Nuts - 1985

<table>
<thead>
<tr>
<th>Orchard</th>
<th>Degree Days ($D^0$) to First Moth Emergence</th>
<th>Range of $D^0$ for Total Emergence</th>
<th>Peak Emergence $D^0$ Range</th>
<th>Mean Daily High/Low Temperature during Moth Emergence Period</th>
<th>Total No. Moths Emerged</th>
<th>Dates of Moth Emergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stanislaus</td>
<td>707</td>
<td>707 - 1498</td>
<td>850 - 1050</td>
<td>86°F/57°F</td>
<td>304</td>
<td>6/20 - 8/5</td>
</tr>
<tr>
<td>San Luis Obispo</td>
<td>588</td>
<td>588 - 1224</td>
<td>1000 - 1200</td>
<td>78°F/51°F</td>
<td>197</td>
<td>7/20 - 9/25</td>
</tr>
</tbody>
</table>