

Standard and Commercial Formulations for Navel Orangeworm Pheromone



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The navel orangeworm (**NOW**, *Amyelois transitella* Walker) is a well known multivoltine pest of almonds (plus figs, pistachios, walnuts and pomegranates) that appeared in California's Central Valley in the late 1940's; currently it is the primary pest of almonds and pistachios in California. A dramatic expansion of both almond and pistachio plantings (during 1995-2004), to over 251,000 hectares of almonds and 50,000 hectares of pistachios in California has coincided with their increased demand and value (ca. \$2.92 billion in 2005) which has led to an increased demand to reduce NOW damage.

Monitoring insect pests with sex pheromone-baited traps has become a fairly standard practice in US agriculture, and scientists at the USDA, ARS have been involved in identifying the sex pheromone for NOW since the late 1970's. The primary sex pheromone component (Coffelt et al. 1979) however, is not very attractive to NOW males by itself (Kuenen et al. 2001). Numerous years of study funded by the Almond Board of California, the California Pistachio Commission/California Pistachio Research Board and Suterra, LLC have led to the elucidation of a four component sex pheromone blend that is as attractive as female pheromone glands (Kuenen et al. 2010) and the attractiveness of only these four components was subsequently verified by a joint UCR/ARS study (Kanno et al. 2010.)

Preliminary field trials confirmed that the 4-component blend could capture as many or more NOW males than females (Figure 1); however, it can be seen from this data that lure effectiveness declined rapidly during the 4-day test, compared to increased trap catch by female-baited traps, even during the cool, short days of October. Subsequent field tests by Kuenen and Millar (unpublished) could only replicate trap capture equivalent to female baited traps for 1-to-2 days in the summer even though more than 10 formulations were tested.

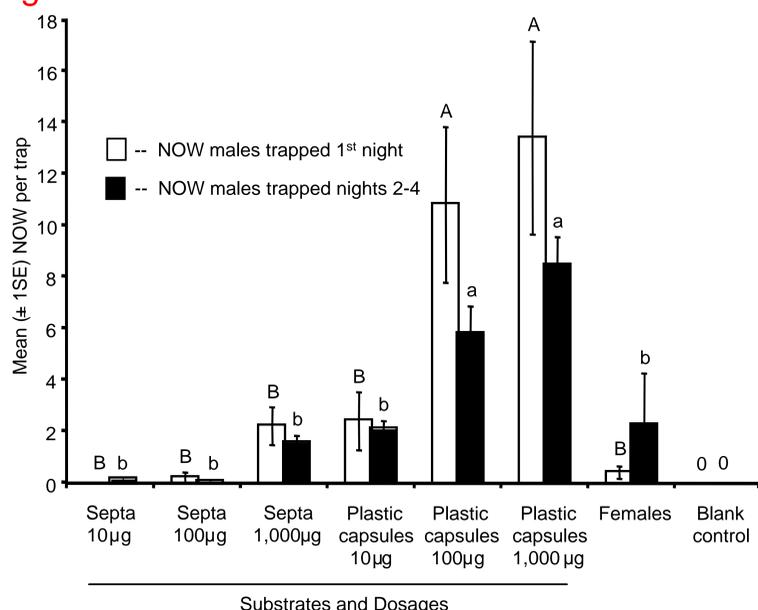


The pheromone components emitted by NOW females are unstable under field conditions due to their chemical structure (conjugated dienes) and the terminal aldehyde moiety of the main component (likely to form trimers). Our approach to developing a field lure for monitoring NOW, in the currently funded study, is to use purified pheromone components placed on various "standard" and commercial formulation materials that have been thoroughly cleaned by chemical and/or physical means. The volatiles emitted by candidate lures will be assessed and compared to those released by female moths. Progressive loss of activity (ability to capture males) is expected and change in compound release ratios will be correlated with changes in ability of lures to trap male NOW. An early field check to see if this approach was valid with standard laboratory lure formulations (septa and plastic capsules) was conducted in August 2010 (Figure 2) where we noted that traps with chemically cleaned grey rubber septa captured as many males as female-baited traps. The septa were cleaned by Soxhlet extraction and the pheromone compounds were combined with chemical stabilizers against isomerization and UV degradation. A more systematic approach in laboratory wind tunnels is underway, and 2011 field tests are planned.

References

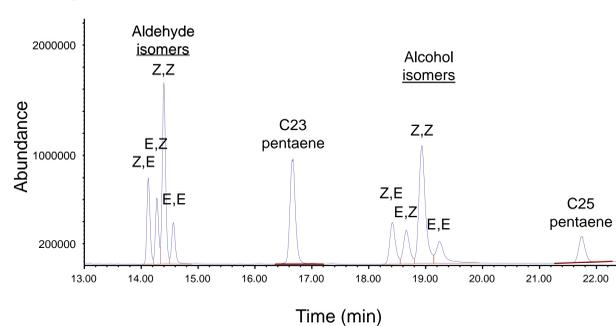
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Figure 1

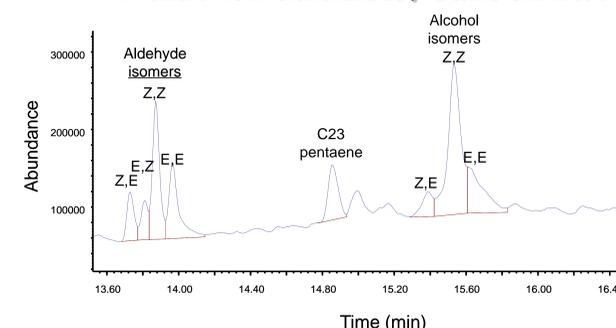


Trap captures of male navel orangeworm using lures consisting of gray rubber septa & plastic capsules loaded with three doses of the four-component pheromone blend (Z11,Z13-16:Ald; Z11,Z13-16:OH; Z11,E13-16:OH; 3Z,6Z,9Z,12Z,15Z-23:H (100;100;5;5) with female-baited positive control traps; tests were conducted 19 - 24 October, 2005. Bars surmounted with different letters are significantly different ($P < 0.05$).

Synthetic NOW Pheromone & Isomers; GC/MS SIM Mode



1 Female NOW Gland Extract; GC/MS SIM Mode



180 Minutes Female NOW Volatiles GC-FID

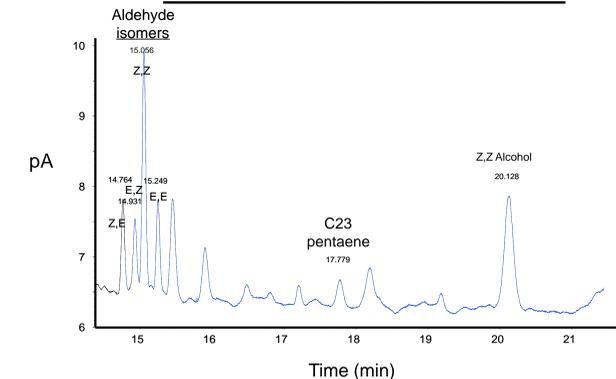
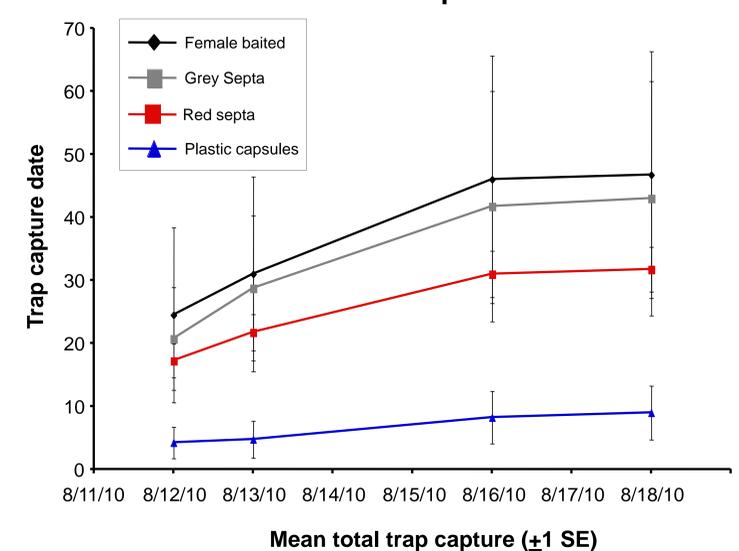


Figure 2 NOW trap capture - August 12-18, 2010
Female baits vs. cleaned pheromone releasers



Trap captures of male navel orangeworm using lures consisting of unmated female NOW, grey rubber septa, red rubber septa or plastic capsules loaded with 1mg of the four-component pheromone blend (Z11,Z13-16:Ald; Z11,Z13-16:OH; Z11,E13-16:OH; 3Z,6Z,9Z,12Z,15Z-23:H (100;100;5;5) with female-baited positive control traps; tests were conducted August, 2010.