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FINAL REPORT
Volatile Constituents and Navel Orangeworm Control
W. Jennings, J. Settlage, R. E. Rice and R. Jones
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## 1. Objectives

Isolation and identification of volatile constituents from various host materials (almonds) and attractants (e.g. wheat bran bait). Ultimate objective, synthetic (or cheaper natural) attractants that could serve as baits, or lead to indiscriminate egg positioning.

## Interpretive Summary

Because the female NOW is known to fly upwind into a food source, it seems logical to assume that she homes on volatiles emitted by that food source. Extensive studies based on high resolution fused silica capillary gas chromatography and mass spectrometry have successfully identified a large number of volatile constituents of sound almonds, infested almonds, NOW larval frass, wheat bran baits and almond press cake. Many of these fractions have been shown to possess biolgical activity, but inconsistent behavior on the part of the moth makes the bioassay step the weak point of these determinations. A number of synthetic attractants have been formulated on the basis of these results, and several have been shown to possess considerable biological activity; these studies are continuing (vide infra).

## Experimental Procedure

Volatiles from the material under study have been isolated by techniques that ranged from simultaneous steam distillation-extraction to liquid carbon dioxide extraction to long-term headspace trapping. Recombined fractions of the (e.g.) press cake volatiles remain strongly attractive, indicating that our techniques of isolation do not destroy the attractive principle(s). Various fractions and combinations of fractions have been subjected to bioassay, as evaluated by egg counts, under laboratory conditions. Identifications have been based largely on mass spectrometric patterns, confirmed with gas chromatographic retention data. A large number of individual compounds have also been subjected to bioassay.

## Results

Perhaps 150 compounds have been isolated and identified from these various materials; many of them occur in all attractants investigated. While many possess attractiveness for the NOW, none appear to be as attractive as the intact press cake. It must be emphasized that intercomparisons of the attractiveness remain the weak point of this study, in that participation of the NOW is required, and our evaluations are based on egg counts. The behavior of the NOW is frequently inconsistent and requires many replications for statisical

validity; part of this may relate to the fact that all of the factors that influence egg laying activity may not be recognized. These may include shifts of barometric pressure or humidity changes that portend weather conditions that would be hazardous to egg survival.

Results from this study are far too lengthy and comprehensive for direct incorporation into this report. They have been compiled in detail in the Ph. D. Thesis of Mr. Settlage, which is now in final preparation. A copy of the bound thesis will be forwarded to the Almond Board as soon as it is available.

## Discussion

That portion of this project that has concerned Professor Jennings and Mr. Settlage--the isolation and identification of volatile constituents--has been completed. Based on the results obtained, a number of synthetic formulations have been prepared. Residual monies will be transferred to the direct control of Dr. Rice at Parlier, to enable him to supervise the continuation of laboratory and field bioassays of these mixtures.

## Publications

Two papers based on the results of Dr. Lieu, an earlier participant in these studies, have been submitted for publiaction; it is anticipated that at least one and possibly two additional publications will result from Mr. Settlage's efforts.

## Acknowledgement

As I close this project, I would like to thank the Almond Board for their support, both moral and monetary; in particular I heve appreciated working with Dale Morrison and Bob Curtis, and I have enjoyed my association with growers and other researchers on these problems. Even though, as soon as the fund transfer has been completed, I will no longer have any official connection with the research program of the Almond Board, I will be happy to lend whatever support I can to their continuing research, and future research conferences.

Walter Jennings