Cultural control of navel orangeworm in almond orchards

Curtis E. Engle ☐ Martin M. Barnes

The navel orangeworm overwinters primarily in the larval stage in mummy almonds that remain in the trees or on the ground after harvest. In the spring, moths emerge and lay eggs on the mummy nuts in the trees, and these nuts provide the principal food source of the first-generation larvae. Moths of this generation emerge to infest the current year's almond crop during the hullsplit period. Infestations may reach as high as 30 to 50 percent.

Many growers rely on insecticides to control navel orangeworms, but larvicidal sprays provide only 50 percent control. Dr. Charles E. Curtis (U.S. Department of Agriculture) in earlier experiments demonstrated that mummy removal (orchard sanitation), combined with relatively early harvest, can reduce infestation at harvest by as much as 50 percent. Early harvest has been established as an important feature of cultural control of the navel orangeworm, because a new generation of moths begins to emerge at the time the crop matures, and infestation increases daily.

We conducted studies to obtain quantitative data on orchard sanitation and navel orangeworm infestation at harvest. The information would provide growers with a goal in orchard removal of mummies — that is, the level of removal necessary for effective cultural control combined with early harvest.

Methods

In the winters of 1980 and 1981, we selected 15 almond orchards in the McFarland-Richgrove areas of Kern and Tulare counties for their relative isolation (300 to 1,200 feet) from neighboring sources of navel orangeworm, *Amyelois transitella* Walker. In each 9- to 12-year-old orchard we chose a 50-acre corner plot, within which the corner section of 3.5 to 5 acres became a subplot for determining the degree to which sanitation should be practiced. The subplot received no insecticide applications for navel orangeworm.

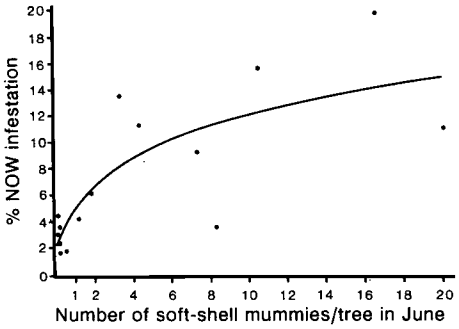
Each year, mummy nuts were counted on each soft-shelled almond tree in the subplots. Mummies of the Mission variety were not included, because samples showed that they did not harbor a significant number of larvae in the trial orchards. Mummies were also counted in the remaining 45 acres of the adjacent buffer plots. If mummy nuts in the buffer exceeded those of the subplot, some were removed by hand poling in 1980. In 1981, mummies in the adjacent buffer plots were reduced by hand poling regardless of the number found. Mummy counts were made in each subplot from midwinter to hullsplit during both seasons. Such an estimate is essential so that one can forecast with some accuracy the expected drop after a sanitation program has begun. Mummy counts also provided the basis for determining a sampling procedure — that is, how many trees should be counted to assess the level of sanitation reached.

All but one of the 45-acre buffer plots received an azinphosmethyl (Guthion) spray in the spring to further reduce emergence of navel orangeworm moths and subsequent invasion of the test area from the buffer zone. One was not treated, because it had an exceptionally low mummy count. Just before spring moth emergence in late March, fallen nuts were mechanically flailed in the orchards to reduce them as a navel orangeworm source.

Nuts were harvested when hullsplit averaged 95 to 100 percent at the 4- to 6-foot level. Trees were poled after harvest to ensure an unbiased sample of the entire crop. At harvest, 200 nuts were sampled from each of 20 Nonpareil trees in the center of each subplot. Infestation was determined by hand hulling, because commercial hulling under-estimates field infestation.

Results

Based on the two seasons' data, approximately one soft-shell mummy or less per tree in June relates to 1.6 to 4.5 percent infestation by navel orangeworm at an early harvest. Even with the expected variation due to other factors, chiefly differential levels of infestation in mummies, there is a correlation of 0.72 ($P = <0.01$) between mummy count in June and infestation at harvest. The most conservative data indicate that, from a postsanitation level in February of two per tree, natural mummy fall would result in an average of one mummy per tree in June. The average postsanitation mummy drop from February to June in 1980 was 55 percent. In 1981 the postsanitation mummy drop averaged 80 percent from February to June. Hence, a grower should aim for a level of two soft-shell mummy nuts or less per tree after orchards are cleaned in winter. The results of the statistical study for sampling show that the number of soft-shell mummies left after sanitation may be determined within 20 percent of the real value and at a 90 percent confidence level by counting mummies on two soft-shell trees per acre.



June mummy count is correlated with navel orangeworm infestation at harvest. Up to one mummy relates to 1.6-4.5% infestation.

To provide for management of navel orangeworm based solely on orchard sanitation and early harvest, we therefore suggest the following:

☐ Isolation. Under the conditions of these trials, the average isolation from sources of navel orangeworm infestation, such as citrus, walnuts, and other almond orchards, was 1,000 feet.

☐ Mummy threshold. Clean the almond orchard by February 1 to an average of two mummies or less per tree (expecting a postsanitation mummy drop of at least 50 percent).

☐ Sampling. To estimate the level of sanitation reached, count soft-shell mummies on two trees per acre.

☐ Flail grounded mummies. Blow mummies off berms and flail before March 15.

☐ Early harvest. Harvest at 95 to 100 percent hullsplit measured at the 4- to 6-foot level on the tree.

If these requirements cannot be met, the pest manager should consider augmenting the navel orangeworm control program with insecticides.

Curtis E. Engle is former Research Assistant, and Martin M. Barnes is Professor, Department of Entomology, University of California, Riverside.