

press cake mixed with either crude or refined almond oil than on those baited with press cake, alone, but the differences were not significant. Few eggs were deposited on traps baited with crude or refined oil alone, and the difference between these and unbaited traps was slight.

In 1983, we baited standard traps with five different proportions of crude almond oil to ground almond press cake by weight (0, 2, 5, 10, and 25 percent oil), using 15 grams of each bait. Traps were monitored from placement in an orchard on April 27 through June 1.

Significantly more eggs were deposited on traps baited with almond press cake and 10 and 25 percent crude almond oil than on those with press cake alone (table 3). Egg deposition did not change with the increase in oil from 10 to 25 percent. Baits containing more than 25 percent oil became very oily and difficult to handle and were not tested.

The fact that more eggs were deposited on traps when almond oil was added to the press cake in all experiments leads us to speculate that the oil contains an attractant and/or egg laying stimulant that is absent or less abundant in the press cake. The missing component may be more abundant in crude than in refined almond oil, since more eggs were deposited on traps baited with press cake and crude oil than on those baited with the cake and refined oil (table 2).

Bait longevity

We placed 10 standard egg traps baited with 15 grams of ground almond press cake and 10 percent crude almond oil in an orchard each week for eight consecutive weeks. After eight weeks, bait that had aged eight weeks was replaced with fresh bait every week. For the first eight weeks, we rerandomized the trap position once a week and, after that, rotated the position once a week. We placed the traps in the orchard on June 1 and monitored them through September 1.

Navel orangeworm populations were quite low during the first 10 weeks of this experiment, with 92 percent of the weekly trap catches from June 1 through August 11 averaging fewer than 1 egg per trap per night. Between August 17 and September 1 the number of eggs deposited increased; 50 percent of the weekly catches averaged more than 1.5 and 33 percent averaged more than 2.5 eggs per trap per night. Even at the higher egg-laying levels, there was no indication that bait of any one age was consistently more attractive than that of any other age. It thus appears that almond press cake with 10 percent crude almond oil will remain as biologically active as fresh bait for at least eight weeks.

Amount of bait

We baited standard egg traps with three amounts of ground almond press cake with 10 percent crude almond oil: 30 grams (to top of trap windows), 15 grams (middle of windows), and 10 grams (bottom of windows). Baited and empty traps placed in an orchard on June 9 were monitored through September 15.

The number of eggs deposited increased with increasing amounts of bait, from an average of 0.9 egg per trap per night at the 10-gram level, to 1.1 at 15 grams, to 1.3 at 30 grams. The unbaited traps had an average of 0 eggs trap per night.

The difference in egg counts between traps with 30 grams and those with 10 grams of bait was statistically significant ($p \leq 0.05$). The previous assumption that bait up to the middle of the trap windows would be most effective because of air flow through the windows does not appear to be correct. Instead, the amount of egg-

laying stimulant produced by the trap appears to be directly related to the amount of bait.

Trap comparisons

In 1984, we compared two types of egg traps: one was painted black, had added rough area above the trap windows, and was baited with 30 grams of ground almond press cake plus 10 percent crude almond oil by weight; the other was a standard trap baited with 15 grams of ground almond press cake. The study took place in two orchards in Kern County, two in Fresno County, one in San Joaquin County, and one in Butte County. We alternated 10 traps of each type down tree rows, skipping at least two trees between traps and one tree row between lines of traps. The 20 traps were placed in the orchards in late March or early April and monitored twice a week until pollinator harvest. The bait was changed once a week.

In all orchards, navel orangeworm females laid significantly more (1.3 to 2.7 times) eggs on the improved than on the standard traps. The average seasonal eggs per trap per night ranged from 1 to 4.8 on the standard traps and from 2 to 8.2 on the improved traps. Peak egg-laying periods were more discernible with the improved trap.

Conclusions

Effectiveness of the standard navel orangeworm egg trap increases with changes in color, texture, bait formulation, and amount of bait, most of which can be made easily and inexpensively. Spraying standard traps with black enamel paint increases egg laying and enhances the visibility of the light-colored eggs, thereby reducing counting time. The bait formulation of almond press cake and 10 percent crude almond oil should extend above the trap windows. A change in trap texture to extend the ridges above the windows is not recommended, since it would require significant time and expense and the ridges would make the trap more difficult to examine for eggs.

These improvements in the egg trap will permit more accurate determination of peak egg-laying and more rapid monitoring of traps.

Robert A. Van Steenwyk is Entomologist, Cooperative Extension, University of California, Berkeley; William W. Barnett is Area IPM Specialist, University of California Kearney Agricultural Center, Parlier; Walter J. Bentley is Farm Advisor, Kern County; Joseph H. Connell is Farm Advisor, Butte County; and Donald Rough is Farm Advisor, San Joaquin County.

The authors gratefully acknowledge the efforts of K. Valero, J. Grant, K. Lee, and K. Bubrig in the collection of field data and B. Barr and L. Barclay in data analysis. In 1983, trap colors were prepared and traps were painted by Dr. E.D. Owens of G.T.E. Laboratories Inc., Waltham, Massachusetts. This research was supported in part by the Almond Board of California.

TABLE 1. Navel orangeworm egg-laying on traps of various colors, Fresno, California, 1982

Color	Mean No. eggs/trap/night*
Black	11.4 a
Dark green	7.2 b
Blue	6.0 bc
Lime green	4.7 cd
Standard (clear)	3.3 de
Yellow	2.0 e

* Means followed by the same letter are not significantly different by Duncan's Multiple Range Test ($p \leq 0.05$). Treatments were replicated five times in a randomized complete block design.

TABLE 2. Navel orangeworm egg-laying on traps containing various baits, Fresno, 1982

Bait	Mean No. eggs/trap/night*
Almond press cake + crude almond oil	6.8 a
Almond press cake + refined almond oil	5.5 a
Almond press cake	4.1 ab
Bran formulation	2.6 bc
Crude almond oil	0.8 c
Refined almond oil	0.7 c
Unbaited	0.6 c

* Means followed by the same letter are not significantly different (DMRT, $P < 0.05$). Treatments were replicated five times in a randomized complete block design.

TABLE 3. Navel orangeworm egg-laying on traps baited with various percentages of crude almond oil to almond press cake, Fresno, 1983

Percentage crude almond oil to almond press cake	Mean No. eggs/trap/night*
25	4.0 a
10	4.0 a
5	3.2 ab
2	2.5 b
0	2.6 b

* Means followed by the same letter are not significantly different (DMRT, $P \leq 0.05$). Treatments were replicated 10 times in a randomized complete block design.