POST HARVEST USE OF BIOLOGICAL AND CHEMICAL AGENTS TO CONTROL NAVEL ORANGEWORM

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The navel orangeworm (NOW, *Amyelois transitella* Walker) is a multivoltine scavenger on fallen or damaged fruits and nuts and can also attack undamaged nuts. Since its arrival in California's Central Valley in the late 1940's, commercially grown almonds, pistachios, figs and walnuts have been infested by NOW and this moth is currently a primary pest of almonds and pistachios in California. This moth overwinters in the previous season's unharvested crop (mummies) and development occurs sporadically through the winter and spring when temperatures exceed the lower threshold of 55° F. Adults emerge from the mummies on the ground and in the trees (first flight) and these females lay their eggs on other mummies to continue the life cycle. When this second wave emerges (second flight), females oviposit on mummies or the new crop nuts as they become available.

Orchard sanitation during the winter months is an important practice for NOW control in almonds and pistachios. Eliminating mummies destroys overwintering insects and reduces the number of nuts available for oviposition by the first flight of NOW. Mummy almonds are destroyed on the ground by flail mowing while mummy pistachios are disked into the soil of the drive rows. Sanitation is more successful for almonds than pistachios because almonds are smashed by flail mowing while pistachios cannot be smashed because their shell is too tough. Hundreds of thousands of pistachios per acre remain on the ground and serve as a resource for NOW. A biological agent, entomopathogenic nematodes, can play a role in reducing the overwintering population in pistachios, because infective juvenile nematodes seek out infested nuts on the ground and kill the larvae inside. A collaborative research project involving USDA researchers at the San Joaquin Valley Agricultural Sciences Center, Parlier, CA, the Yakima Agricultural Research Laboratory, Wapato, WA, and industry, demonstrated that the insect pathogenic nematode species, *Steinernema carpocapsae*, applied at field rates in small plot studies in late February through early April could control NOW (Siegel *et al*. 2004, 2006a). The efficacy of this nematode was confirmed in large plot (400 acres) studies conducted in Madera County during late February and early March (Siegel *et al*. 2006b).

A new procedure that focused on quantifying adult emergence from mummies was developed to evaluate nematode efficacy in the large plot trials. Mummies were collected from orchard berms, placed in net-covered 5 gallon buckets and incubated at 77°F. All adults that emerged were counted, their incubation time recorded, and population reduction calculated by comparing the difference in adult density between treated and control plots. This technique was used in a second study evaluating winter mortality. Approximately 70,000 mummies were collected in December 2004 and February 2005 and the degree-days accumulated by the adults were projected forward from the date the mummies were collected. Emergence began March 31 and ended on July 14, 2005 (Figure 1). Published NOW development rates were used (Seaman and Barnes 1984, Sanderson *et al.* 1989) to predict the onset and duration of the remaining flights of NOW for Madera County, using the average degree-day accumulation for the past six years. These flight curves (Figure 2) indicated that the cutoff dates for adult emergence in Madera County were September 23-28. Eggs laid after these dates will hatch and contribute to the overwintering population. We hypothesized that a pesticide application made after September 28 targeting eggs and neonate larvae should significantly reduce the overwintering population.

This hypothesis was tested in field trials in Madera County using a new persistent insect growth regulator, Intrepid® (methoxyfenozide) combined with the pyrethroid insecticide, Permethrin®. Pesticide applications were made at two ranches located in central (AgriWorld) and southern (S&J Ranch) Madera County on October 6, 2005. Intrepid® was applied at 22 oz/acre and Permethrin® at 14 oz/acre to 18 acres in AgriWorld. Intrepid® was applied at 16 oz/acre and Permethrin® at 12 oz/acre to 21 acres in S&J Ranch. A similar number of acres served as controls at each ranch. A total of 70,085 mummies were collected from AgriWorld and 101,093 mummies were collected from S&J Ranch six weeks after treatment; the mummies were incubated as described above. Adult emergence was reduced by 81.5% at S&J Ranch and by 55.8% at AgriWorld. These results compare favorably to the efficacy of insecticide treatments applied during the growing season. This experiment will be repeated in October 2006 and additional experiments combining insecticides with nematodes will be conducted.

References

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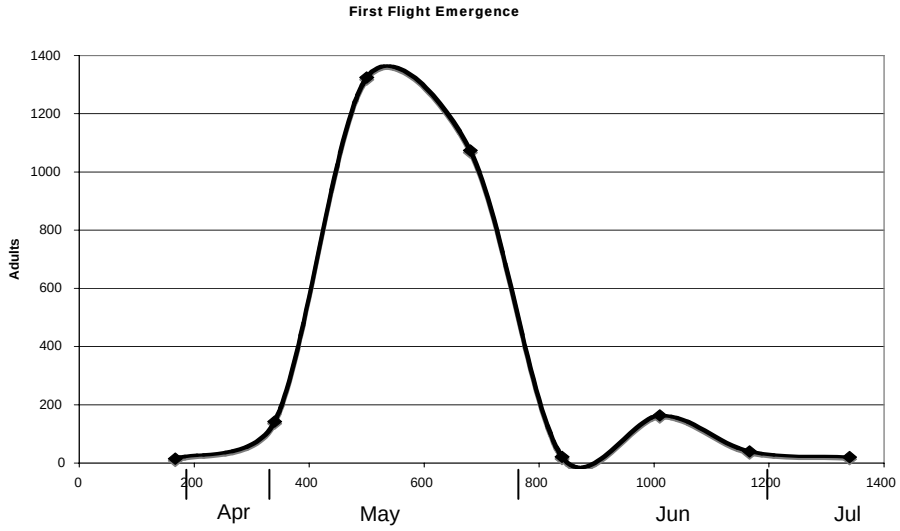

Figure 1. Predicted emergence of Navel Orangeworm in Madera County, 2005.

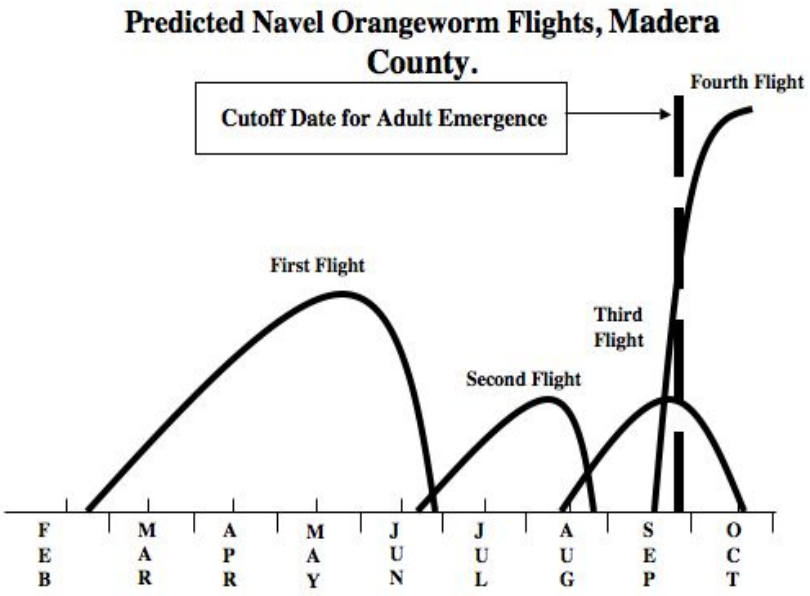

Figure 2. Predicted flights of Navel Orangeworm in Madera County, 2005.