

Chemical Control/New Products

FIELD AND LABORATORY TESTS OF NEW INSECTICIDES AGAINST THE APPLE
MAGGOT

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Keywords: apple maggot, *Rhagoletis pomonella*, apples, Spintor, Spinosad, Thiacloprid, Calypso, Imidacloprid, Provado, Indoxacarb, Avaunt, Pyriproxyfen, Esteem, Thiamethoxam, Actara, laboratory bioassays

Organophosphate insecticides, particularly azinphosmethyl and phosmet, have been used almost exclusively to control the apple maggot, *Rhagoletis pomonella* (Walsh), in apple orchards throughout the northeastern United States during the last 20-30 years. These materials are highly effective, relatively inexpensive, and also have broad spectrum activity against other apple insect pests that may also be present in orchards during July and August when apple maggot adults are active. Unfortunately, because of the current review of organophosphate insecticides under the FQPA regulations, it appears likely that many organophosphate insecticides will either be removed from registration for use on apples or the usage patterns of any remaining materials will be altered to prevent late season use. Because of these potential problems with the future registration of organophosphates, both laboratory and field tests have been conducted during the last several years to evaluate the effectiveness of several new insecticides against this pest: Spintor, Thiacloprid, Imidacloprid, Indoxacarb, Pyriproxyfen, and Thiamethoxam.

Because of the effectiveness of current chemical control strategies, most NY apple orchards do not have indigenous populations of apple maggots. However, many commercial orchards are located in close proximity to feral apple trees that are continually infested with high populations of apple maggots that frequently immigrate into the outside border rows during late July, August, and early September. In order to prevent fruit injury in high risk orchards next to unsprayed sources of apple maggot flies, insecticides must be able to rapidly kill or deter oviposition of gravid female flies immigrating into border rows of apple trees in commercial orchards. Since it is often difficult to find experimental sites with apple trees that are uniformly heavily infested with apple maggot flies, we have developed laboratory bioassays to monitor the toxicity of surface deposits of insecticides to apple maggot adults and to compare the ability of compounds to prevent or reduce oviposition of gravid females.

Laboratory Bioassays. Delicious apples were dipped for 20 seconds in aqueous solutions of formulated insecticides (if necessary surfactants were added according to manufacturer recommendations) and allowed to dry for 1-2 hours. Control apples were dipped into water. From 1-5 gravid female flies (approximately 20 days old) were then placed in an inverted clear plastic cup containing a treated apple, a sugar cube, and an upright vial of water plugged with a cotton wick. After 48 hours, the mortality of flies was assessed (flies unable to remain upright were classified as dead), and oviposition punctures were counted on the apples. A small sample of punctures (5-10/fruit) was dissected to monitor actual oviposition in the fruit in case some compounds deterred oviposition but had no effect on fruit puncturing.

Approximately 50 to 60 flies were exposed to a range of 5 to 6 concentrations of each compound tested. During the test, bioassay containers were kept in a controlled environmental chamber at 74°F, 16:8 (L:D photoperiod) and ca. 50% relative humidity.

Field Tests. Compounds were tested in a research orchard of McIntosh and Cortland apples that had a moderate infestation of flies. Materials were applied as dilute sprays with a hand sprayer to treatments replicated 4 times on single tree plots arranged in a RCB design and separated by unsprayed buffer trees. Treatments were applied initially about 10 days after fly emergence and thereafter on 7-14 day intervals until the end of the season. At harvest, 200 apples were collected from each tree and examined for apple maggot punctures and internal larval trails. Percentages of damaged and clean fruit were transformed arcsine (\sqrt{X}) prior to analysis. Treatment means were subjected to a Fisher's Protected LSD Test ($P < 0.05$).

Results—Laboratory Bioassays. Indoxacarb was tested at the following concentrations (ppm): 1, 10, 100, and 1000. Only the highest concentration (1000 ppm), which killed 74.5% of the flies, was toxic. The percentages of reduction in oviposition ranged from 11.5% at 1 ppm to 80.4% at the highest dosage. Thiacloprid was tested at 0.1, 0.32, 1, 3.2, 10, 32, and 100 ppm. None of these dosages killed more than 12% of the flies, and the percentages in reduction of oviposition ranged from 25.1 to 89.0 at the highest rate tested. Spintor was tested at 3.2, 10, 32, 100 and 316 ppm. In contrast to Indoxacarb and Thiacloprid, Spintor was quite toxic to adults, and all rates tested except the 3.2 ppm dosage killed >90% of the flies within 48 hours. The two highest rates of Spintor (100 and 316 ppm) reduced oviposition, respectively, by 83 and 98%. Imidacloprid was moderately toxic to flies in the laboratory, and the highest rate tested (11 ppm) killed about 53% of the flies. This compound inhibited oviposition by 73, 83, 83, 83, and 95%, respectively, at concentrations of 0.1, 0.35, 1.1, 3.5 and 11 ppm. The effect of adding sugar (sucrose) to water solutions of Imidacloprid was also tested in the laboratory. Higher concentrations of sugar (5 or 10%) greatly increased the effectiveness of a low dosage of Imidacloprid in inhibiting oviposition, but had no effect on toxicity to the flies.

Results—Field Trials. The addition of various concentrations of sugar and Nu-Lure bait did not statistically increase the effectiveness of either Imidacloprid or Spintor. During two years of trials, Imidacloprid applied at two-week intervals throughout the summer was never as effective as an azinphosmethyl standard in protecting fruit and sometimes failed to reduce damage levels below that observed in untreated check plots. Spintor treatments applied at two week intervals usually had 1-2% more damaged fruit than organophosphate standard treatments, although the differences were often not statistically significant. Weekly sprays of Spintor were as effective as Phosmet standard treatments, even when low rates were applied. Indoxacarb and Thiacloprid applied at two-week intervals were as effective in protecting fruit as the organophosphate standards. In trials conducted in 1999, Thiamethoxam and Pyriproxyfen, applied at two-week intervals during July and August, did not reduce apple maggot damage below levels in untreated check plots.