

Field Residual Toxicity of Verdepryn, Assail, and Imidan + Carbaryl on Codling Moth Larvae

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The codling moth (*Cydia pomonella*; CM) is a significant pest of apple orchards, with its impact varying across New England. While some growers report minimal infestations, others face severe damage leading to substantial yield losses. Under favorable environmental conditions, CM can complete multiple generations in a single growing season. The female moths lay eggs on developing apples, and upon hatching, the larvae burrow into the fruit (Figure 1), feeding on its flesh and seeds, ultimately reducing market quality and creating entry points for secondary infections caused by fungi and bacteria.



Figure 1. Codling moth damage

To control CM populations, growers predominantly rely on insecticides, with commonly used options including Assail (acetamiprid), Imidan (phosmet), and Verdepryn (cyclaniliprole), along with tank-mix applications of Imidan and Carbaryl. While these insecticides are known for their efficacy within the first 24 to 48 hours post-application, their longer-term residual toxicity remains under-researched, particularly under New England's increasingly erratic weather patterns over the past few years. This preliminary study aims to assess the persistence of Verdepryn, Assail, and Imidan + Carbaryl at 3 and 7 days after application, with a focus on their efficacy against CM larvae. The results will provide apple growers with crucial insights into

how these products perform under field conditions, ultimately aiding in improved pest management strategies.

Materials and Methods

Study Sites and Application Procedures. The study was conducted at two locations: the UMass Cold Spring Orchard (Belchertown, MA) and Red Apple Farm (Phillipston, MA). Three insecticide treatments were evaluated: Verdepryn at a rate of 11 oz/acre, Assail (acetamiprid) at its recommended rate, and a tank mix of Imidan (phosmet) at 2.3 lbs/acre with Carbaryl at 0.33 gallon/acre. The application was performed as follows: on May 13, 2024, two separate apple blocks at Cold Spring Orchard were treated with Verdepryn and Assail, respectively, while on May 24, 2024, an additional block at Red Apple Farm was treated with the Imidan + Carbaryl combination.

Insect Rearing and Experimental Design. Codling moth eggs were obtained and hatched from Benzoin Research Inc. Larvae were reared on a general noctuid artificial diet until they reached the appropriate developmental stages for testing. Second- and third-instar larvae were selected for bioassays to determine the residual effects of the three insecticide treatments (Verdepryn, Assail, and Imidan + Carbaryl) against the untreated control, at each time interval.

For the evaluation of residual toxicity, twigs were collected from treated apple trees at two time points: 3 days (May 16, 2024, at Cold Spring Orchard and May 27, 2024, at Red Apple Farm) and 7 days (May 20, 2024, at Cold Spring Orchard and May 30, 2024, at

Red Apple Farm). Additional twigs were taken from unsprayed trees to serve as controls. These twigs were transported in coolers to the laboratory and stored in a controlled environment before testing.

In the laboratory, each twig was placed in a 16 oz Pro-Kal deli container with perforated lids for airflow (Figure 2). CM larvae (2nd or 3rd instar) were introduced into the containers, with each receiving 12 larvae. Mortality assessments were conducted at 24 and 48 hours post-exposure. Each treatment was replicated six times for the Day 3 residual toxicity test and five times for the Day 7 test.



Figure 2. Insecticide-treated foliage wrapped in a moist paper towel and paraffin paper for codling moth larval exposure.

Weather Conditions.

In Belcher-town, where the Cold Spring Orchard is located, temperatures averaged 65.5°F, with cumulative rainfall of 1.02 inches at 3 days post-application and 1.1 inches at 7 days. At Red Apple Farm in Phillipston, temperatures averaged slightly higher at 65.5°F, with total rainfall measuring 1.5 inches at 3 days and 2.48 inches at 7 days. Given the known low rainfast properties of Imidan, this variable was particularly relevant to our study.

Results

Residual Toxicity at 3 Days Post-Application.

At three days post-application, some differences in CM larval mortality were observed among treatments. At 24 hours post-exposure, Assail, Verdepryn, and Imidan + Carbaryl exhibited similar mortality rates. By 48 hours, however, Imidan + Carbaryl displayed the highest mortality rate at 97%, followed closely by Assail (93%) and Verdepryn (84.7%) (Figure 3). No mortality was recorded in the untreated control group. Imidan and Carbaryl, 3 days old, exhibited the

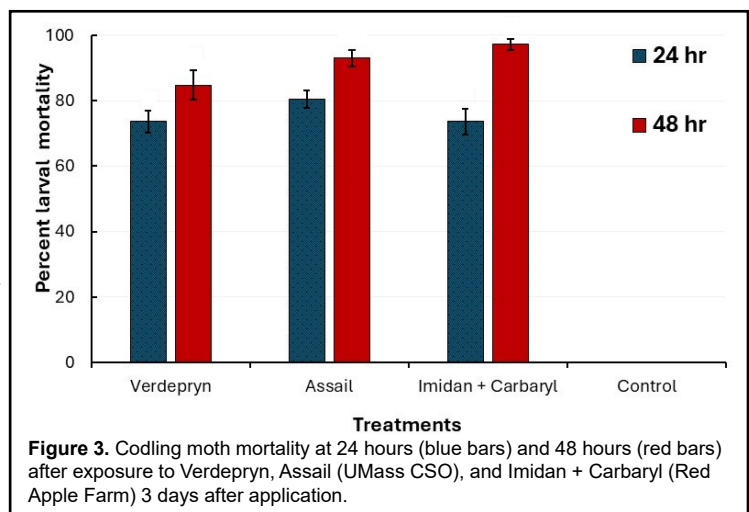
strongest residual toxicity after 48 hours.

Residual Toxicity at 7 Days Post-Application. At seven days post-application, the residual toxicity of all three treatments declined, but Imidan + Carbaryl continued to provide the highest level of control. Mortality rates for CM larvae remained at 55% after 24 hours of exposure and increased to 73.3% at 48 hours. In contrast, Verdepryn and Assail exhibited lower mortality rates, indicating reduced persistence. As in the 3-day assessment, no mortality was observed in the control group, reaffirming the effectiveness of the tested insecticides in providing CM control (Figure 4).

Overall, these findings confirm that while all three insecticides retained some level of residual toxicity after seven days, Imidan + Carbaryl provided the most prolonged and effective control of CM larvae.

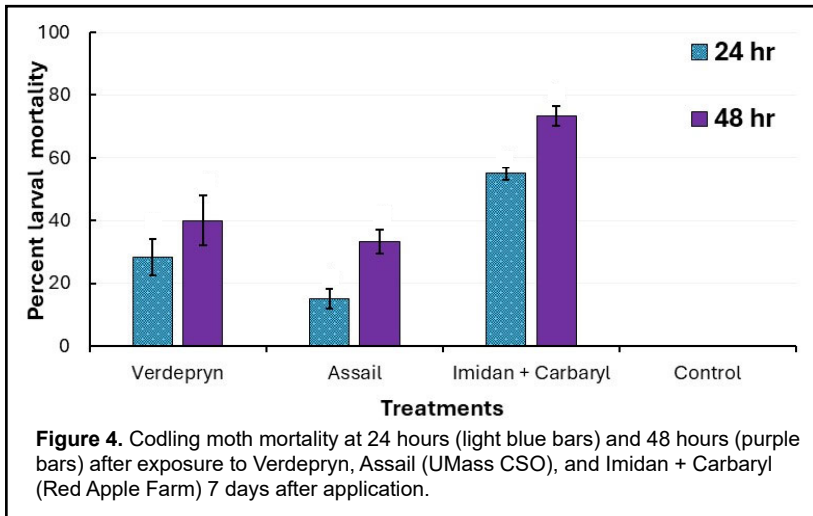
Conclusions

This preliminary study provides valuable insights into the residual toxicity of three commonly used insecticides—Verdepryn, Assail, and Imidan + Carbaryl—against CM larvae. Results demonstrate



that all three products provide effective control within the first 24–48 hours of application. However, Imidan + Carbaryl exhibited the longest-lasting residual toxicity, maintaining significant larval mortality even after seven days, despite the higher rainfall observed in Phillipston.

These findings suggest that while Assail and Verdepryn may provide strong short-term efficacy, Imidan + Car-



proving orchard management strategies in New England. A more comprehensive study will be conducted throughout the 2025 growing season.

Acknowledgements

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baryl offers a more prolonged effect, making it a viable option for long-term CM management. Understanding the residual efficacy of these insecticides under varying environmental conditions can help apple growers make more informed pest control decisions, ultimately im-

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