

Inhibition of acetylcholinesterase in the spotted lanternfly (*Lycorma delicatula*) by conventional carbamate insecticides

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Introduction

- The spotted lanternfly is an invasive insect that has become a pest across the eastern USA.
- Carbamate insecticides work by inhibiting an enzyme called acetylcholinesterase (AChE).
- All animals have AChE, so it is important to use insecticides carefully to target only the pest insect.
- The AChE protein structure in the spotted lanternfly and all its close relatives is not yet established.
- The half maximal inhibitory concentration (IC₅₀) for the spotted lanternfly is not yet established.

Objective: Determine an estimated IC₅₀ for 4 conventional insecticides (propoxur, aldicarb, carbosulfan, bendiocarb).

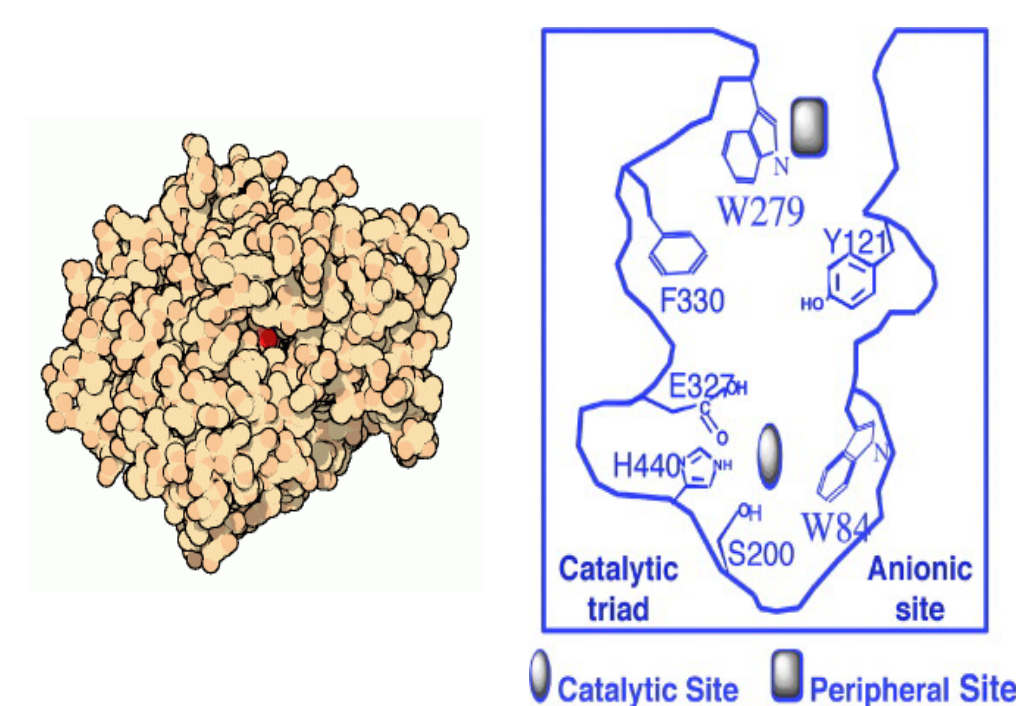


Figure 1: AChE structure¹ and active site²

Methods

- Live insects were collected from local areas, then frozen whole.
- Insect enzyme was extracted by homogenizing the tissue from the heads only (3-5 insects per plate).
- Various concentrations of each insecticide were created through serial dilutions.
- Used the Ellman assay to measure enzyme activity in a well plate. Each concentration had 3 replicates.
- Plates were read by a spectrophotometer for 30 minutes at 405 nanometers.
- Results analyzed with GraphPad Prism non-linear regression.

Results

Table 1: Estimated IC₅₀ (M) for each tested insecticide

Insecticide	Estimated IC ₅₀ (M)
Propoxur	Greater than 0.001
Aldicarb	7.527 x 10 ⁻⁷
Carbosulfan	0.007162
Bendiocarb	Greater than 0.001

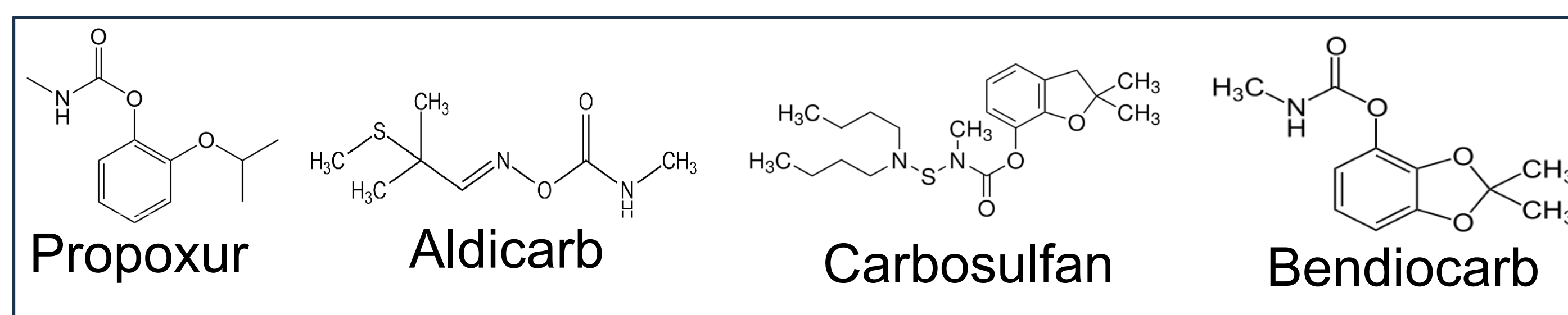


Figure 2: Insecticide molecular structures³

Aldicarb (inhibitor) vs Spotted Lanternfly AChE

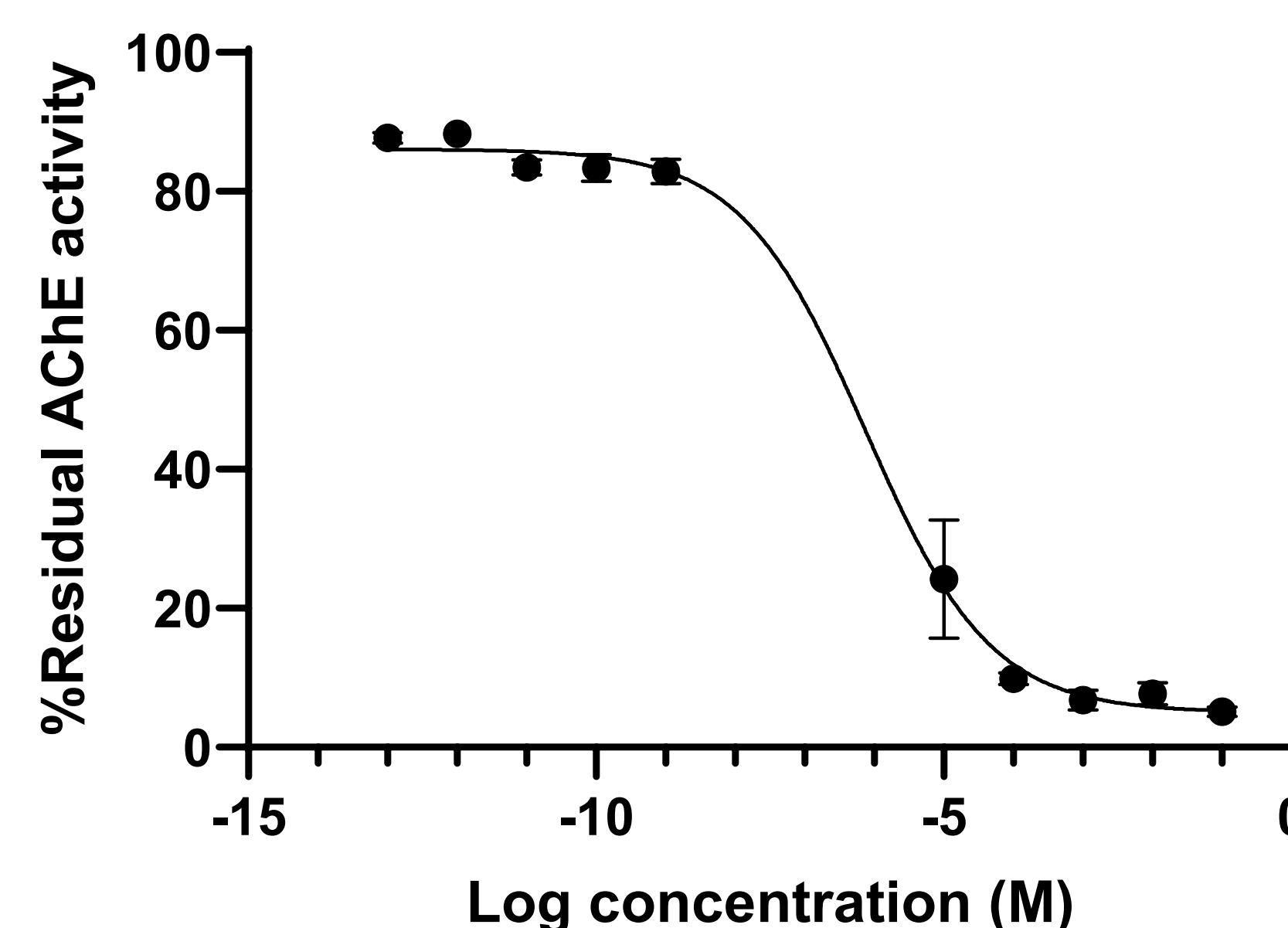


Figure 3: Aldicarb concentration and % AChE residual activity



Figure 4: Example of a well plate

Black = neg. control
White = pos. control
Red = propoxur
Green = aldicarb
Blue = carbosulfan
Purple = bendiocarb

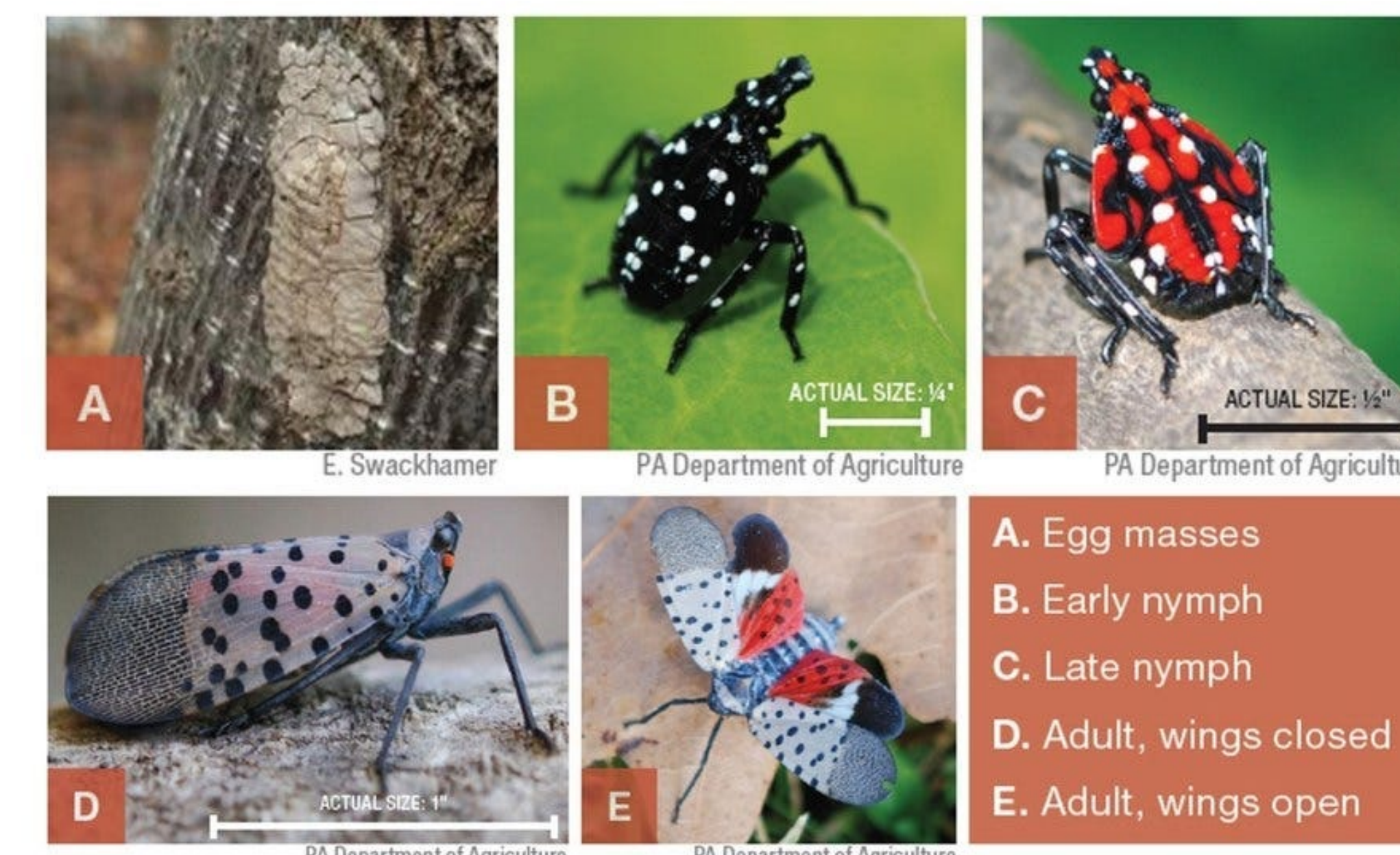


Figure 5: Spotted lanternfly life stages⁴

Key findings

- Propoxur and bendiocarb have an IC₅₀ > 0.001 M.
- Aldicarb and carbosulfan had smaller values, with aldicarb having the smallest IC₅₀.
- Aldicarb may have a stronger impact because it is a smaller molecule.
 - This is consistent with other AChE models. The active site is very deep which makes it easier for small molecules to enter.

Future recommendations:

- Repeat the experiment with a wider range of concentrations and/or a wider range of insecticides.
- Sequence AChE for the spotted lanternfly and its relatives to determine amino acid differences.
 - This could also help explain why one insecticide is more effective than another.
- Test different life stages of the spotted lanternfly (nymphs were used for these experiments).

References

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