IECE 2025 Conference

The 2nd International Electronic Conference on Entomology

19–21 May 2025 | Online

MDPI

Modulations in Digestive Enzyme and Phosphatase Activities in *Trogoderma granarium* Larvae Following Exposure to Bifenthrin, Chlorpyrifos, and Their Combinations

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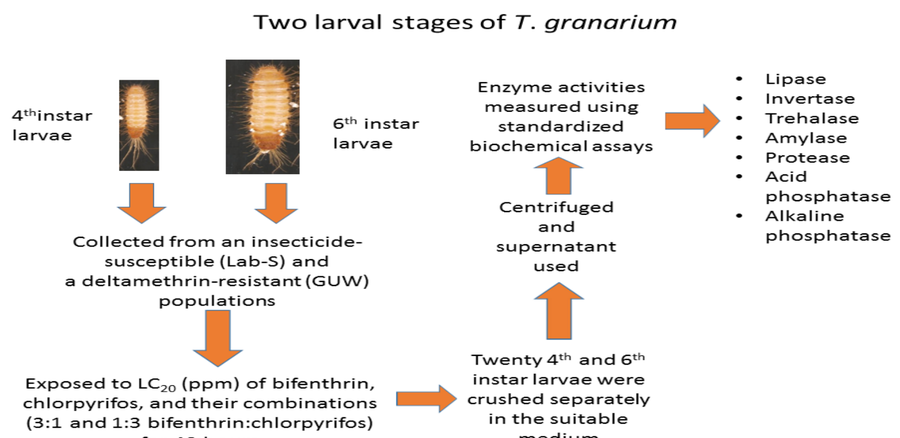
INTRODUCTION & AIM

- *Trogoderma granarium* larvae severely damage stored commodities, but resistance to common insecticides like deltamethrin and phosphine is a growing concern. Our previous research showed bifenthrin, chlorpyrifos and their combinations to be effective alternatives at low concentrations which may pose no threat to health and environment (Feroz et al., 2020a).
- This study investigates the impact of LC_{20}(ppm) of these neurotoxic insecticides on the digestive enzymes (lipase, invertase, trehalase, amylase and protease) and phosphatases (acid and alkaline phosphatases) of 4th and 6th instar larvae of *T. granarium* to uncover their secondary mechanisms of toxicity on nutritional physiology and xenobiotic detoxification.

METHOD

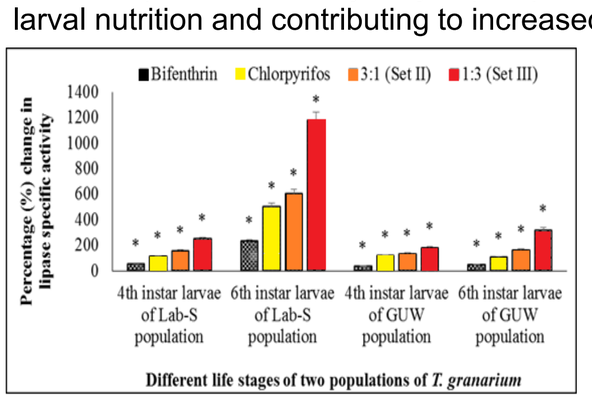


The LC_{20} values are mentioned in Feroz et al. (2020).

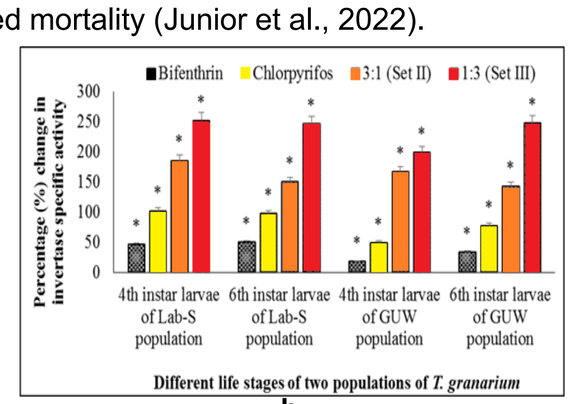
RESULTS & DISCUSSION

Digestive Enzymes

- **Increased Activity**:
  Lipase, invertase, trehalase, and amylase showed significantly elevated activity ($p \leq 0.05$) in treated larvae of *T. granarium* compared to controls (untreated) as shown in Figure 1(a,b,c,d).
  Elevated activity of these enzymes suggests a compensatory response to insecticide-induced stress, potentially disrupting nutrient absorption and metabolism
  This could lead to impaired growth and development in larvae (Filipovic et al., 2021).
- **Decreased Activity**:
  Protease activity decreased significantly in both populations (Fig.1e).
  Reduced protease activity may impair protein digestion, further compromising larval nutrition and contributing to increased mortality (Junior et al., 2022).



a



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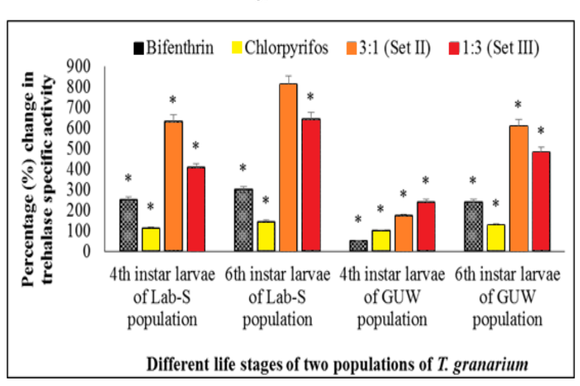

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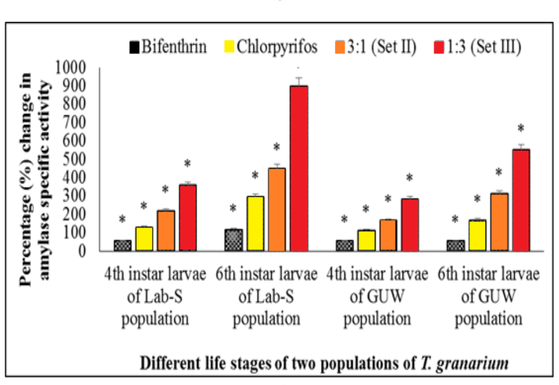

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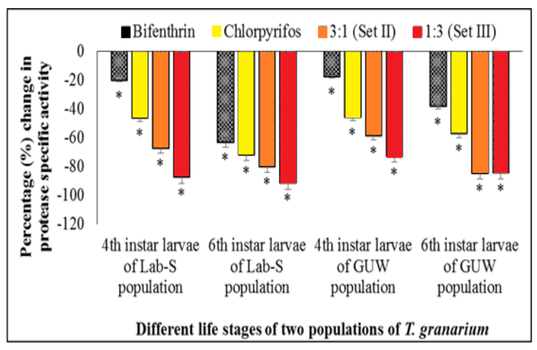
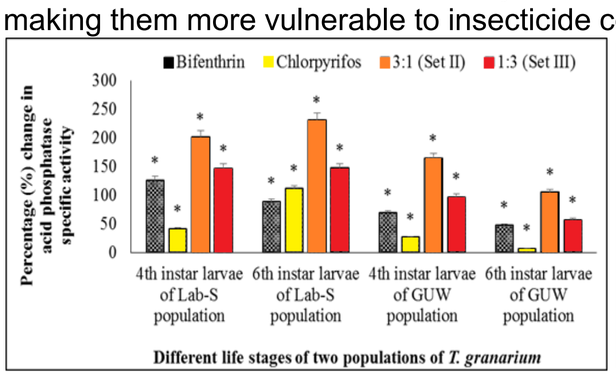


e

Figure 1: Effect of bifenthrin, chlorpyrifos and their different combinations on the activities of lipase (a), invertase (b), trehalase (c), amylase (d) and protease (e) in the fourth and sixth instar larvae of Lab-S and GUW populations with reference to their respective controls (*Significant at $p < 0.05$, Tukey's test).

2. Phosphatases

- **Acid Phosphatase**:
  Activity increased significantly in both Lab-S and GUW larvae (Fig.2a).
  Increased acid phosphatase activity may indicate enhanced detoxification efforts or cellular damage, as this enzyme is often associated with lysosomal activity and stress responses (Sajad et al., 2024).
- **Alkaline Phosphatase**:
  Figure 2b shows a decrease in alkaline phosphatase activity in GUW larvae and an increase in activity in Lab-S larvae, with the exception of some treatments in the sixth instar Lab-S larvae.
  The contrasting responses in alkaline phosphatase activity between resistant (GUW) and susceptible (Lab-S) populations suggest differences in detoxification mechanisms. Resistant larvae may have compromised detoxification pathways, making them more vulnerable to insecticide combinations (Ismail, 2020).



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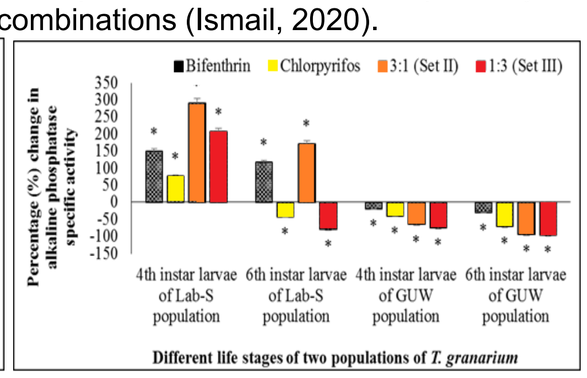

b

Figure 2: Effect of bifenthrin, chlorpyrifos and their different combinations on the activities of acid phosphatase (a) and alkaline phosphatase (b) in the fourth and sixth instar larvae of Lab-S and GUW populations with reference to their respective controls (*Significant at $p < 0.05$, Tukey's test).

CONCLUSION

- Bifenthrin, chlorpyrifos, and their combinations at LC_{20} levels disrupt digestive physiology, potentially impairing growth and increasing mortality in *T. granarium* larvae.
- Findings support the development of novel pest management strategies targeting digestive enzymes and phosphatases.
- Use of chlorpyrifos at low concentration is safe and effective, minimizing environmental and health risks while maintaining pest control efficacy.

FUTURE WORK / REFERENCES

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