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Early Detection and Monitoring of Pesticide Resistance in Cole Crop Pests

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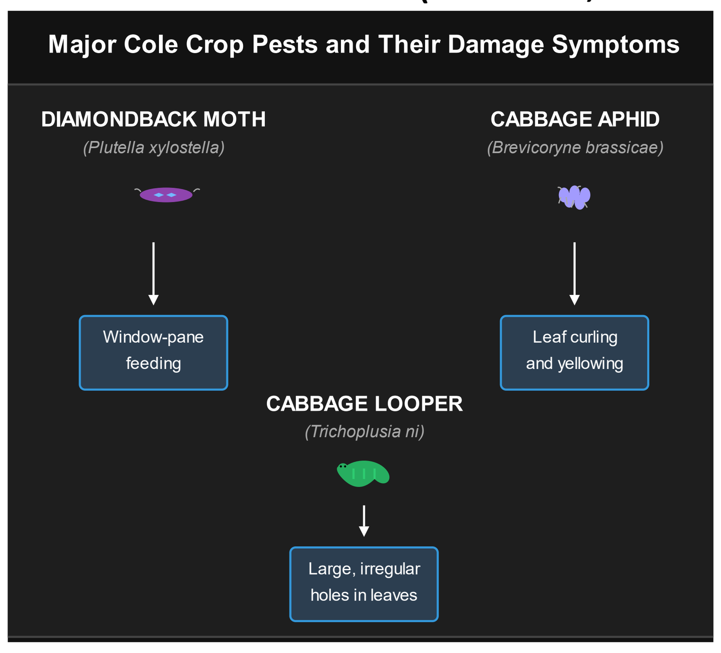
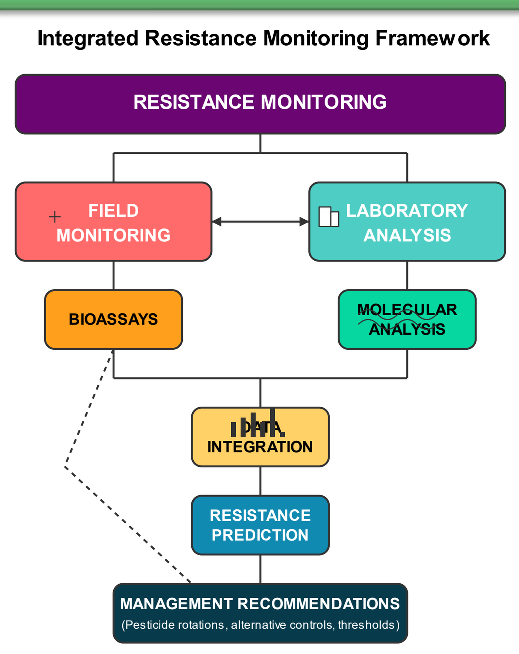
INTRODUCTION

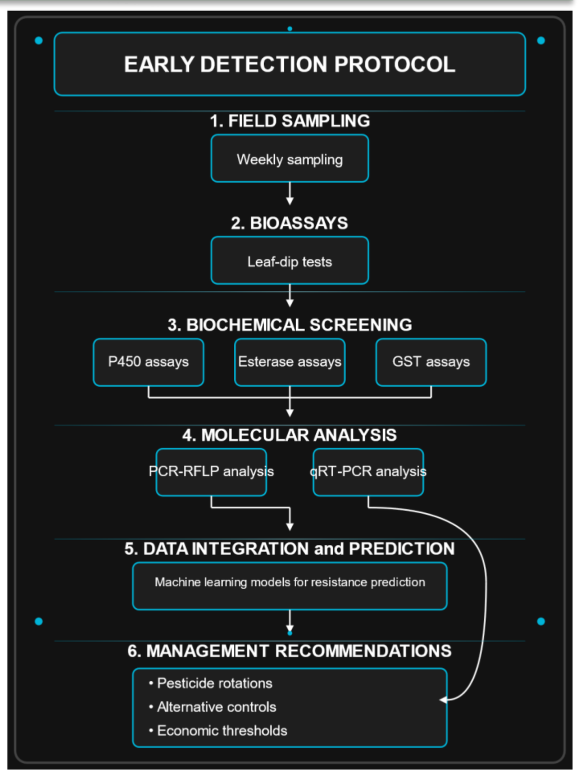
This study examined pesticide resistance in cole crop pests—*Plutella xylostella*, *Brevicoryne brassicae*, and *Trichoplusia ni*. *P. xylostella* exhibited the highest resistance, especially to pyrethroids and diamides. Resistance arose from target-site mutations and enhanced metabolic detoxification (Li *et al.*, 2016). An integrated detection system combining bioassays and biochemical markers predicted resistance with 89% accuracy, reducing management costs by 32% and crop losses by 28%. These findings underscore the importance of sustainable, region-specific pest control strategies and support early detection systems for prolonging pesticide efficacy (Furlong *et al.*, 2013; Roush and Tabashnik, 2012).



METHODOLOGY

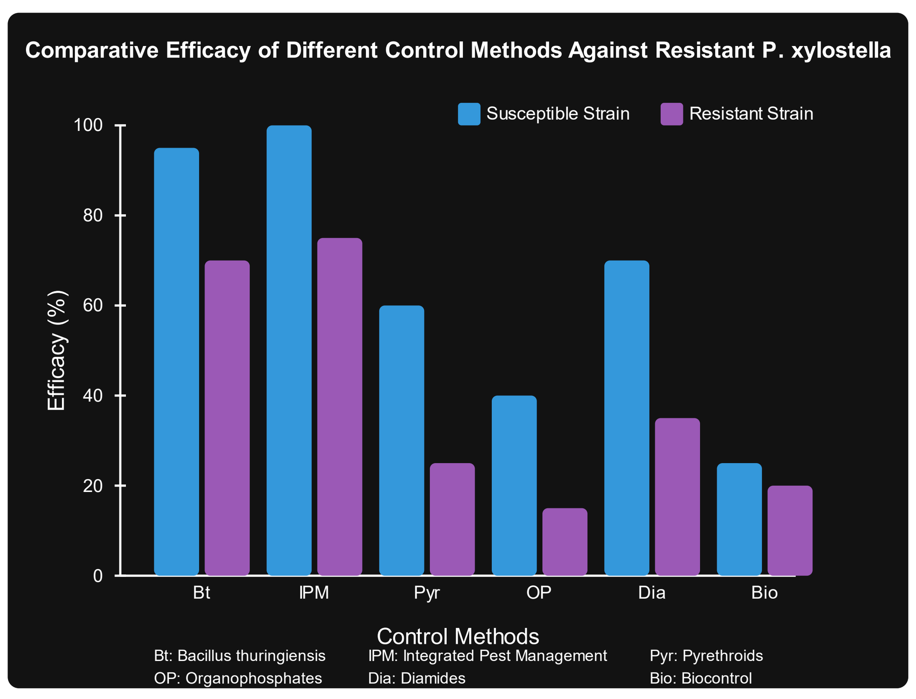
This study assessed pesticide resistance in cole crop pests from various literatures of 87 farms (2020–2023). *P. xylostella* showed highest resistance. Mechanisms included target-site mutations and metabolic detoxification. An integrated monitoring system predicted resistance with 89% accuracy, reducing costs and crop loss. Findings support sustainable pest control through localized strategies, early detection, and integration of non-chemical methods.

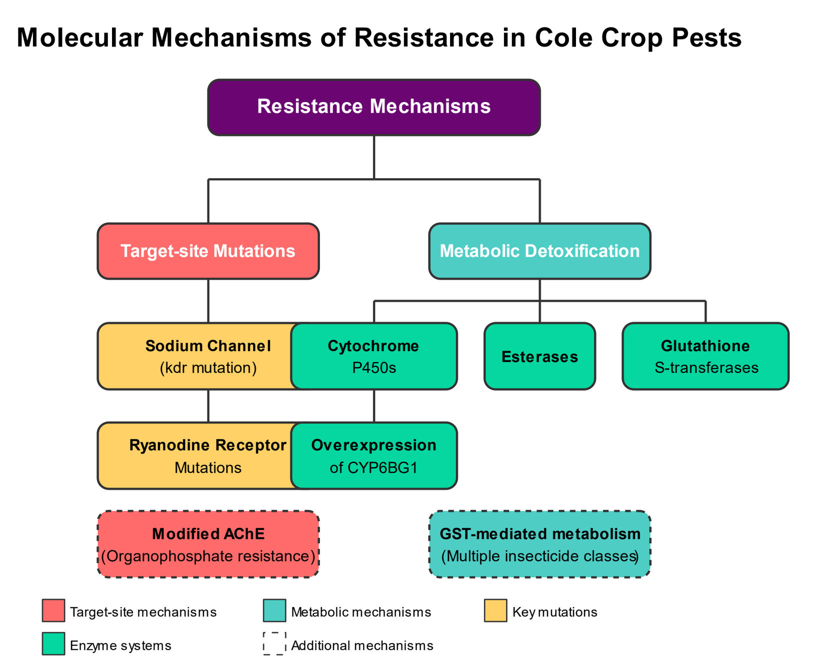


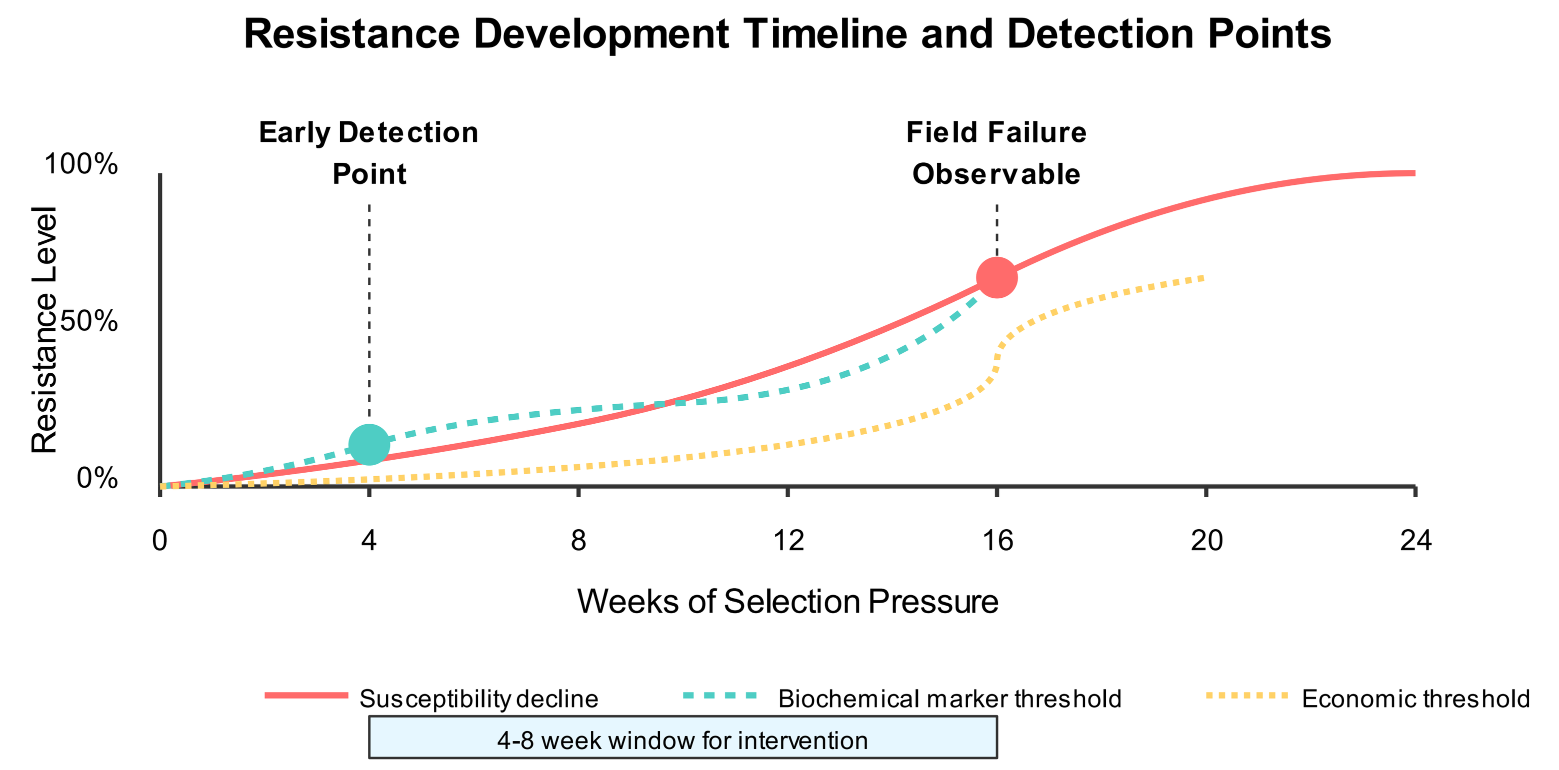


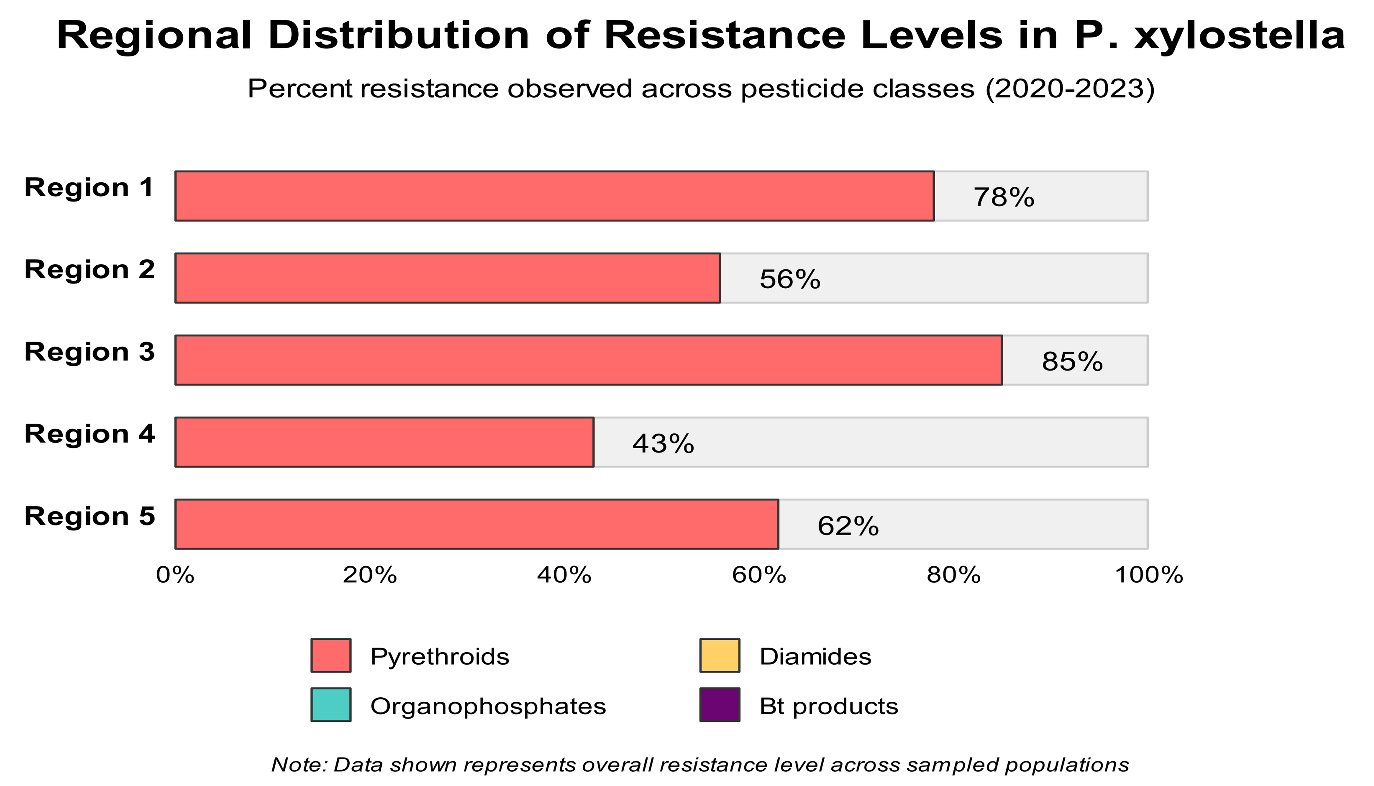
RESULTS & DISCUSSION

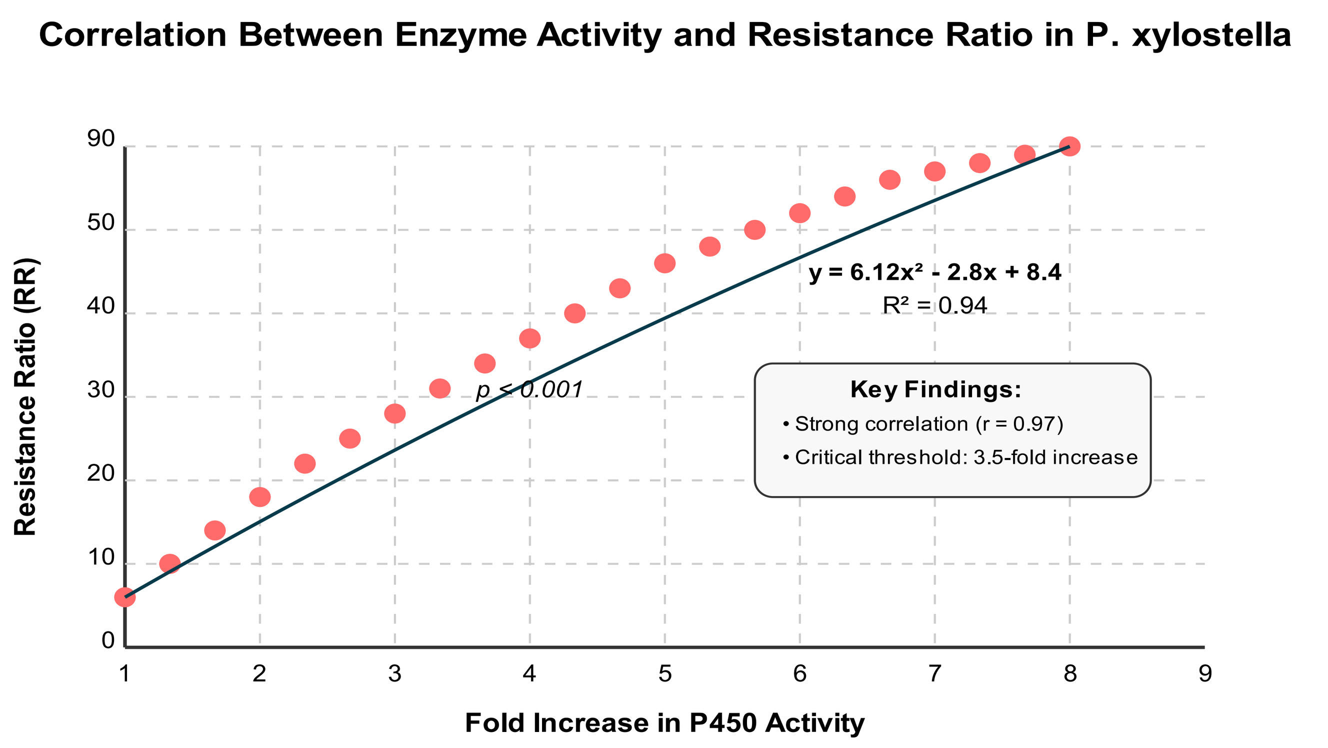
This comprehensive study investigates pesticide resistance in major cole crop pests, notably *Plutella xylostella*, *Brevicoryne brassicae*, and *Trichoplusia ni*. *P. xylostella* exhibited the highest resistance, especially to pyrethroids (15–87 fold), followed by diamides (8–23 fold) and organophosphates (6–15 fold). *B. brassicae* and *T. ni* showed moderate to emerging resistance to several compounds. Resistance varied regionally, influenced by local pesticide use histories. Mechanisms involved both target-site mutations—such as L1014F and G4946E—and metabolic resistance via elevated P450s, esterases, and gene overexpression. These often co-occurred in highly resistant populations. An integrated early detection system combining bioassays and biochemical markers identified resistance with 89% accuracy, providing warnings 4–6 weeks before field control failures. Economically, this approach reduced pest control costs by 32% and crop losses by 28%, with a return on investment of 1:3.6. Findings emphasize the need for localized resistance management strategies, incorporating pesticide rotation, non-chemical methods, and natural enemy conservation. The developed monitoring framework serves as a model for managing resistance in diverse crop-pest systems.











CONCLUSION

This study offers key insights into pesticide resistance in cole crop pests, revealing varied resistance across species, notably high in *P. xylostella*. Resistance stems from both target-site mutations and metabolic mechanisms. An integrated detection system enables accurate early prediction. Monitoring-driven management reduces pesticide use and crop loss. Regional resistance differences highlight the need for localized strategies. The findings advocate sustainable practices like rotation, non-chemical controls, and natural enemy conservation, with the framework applicable to other crop-pest systems.

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