Update on synthetic pyrethroid insecticide resistance in buffalo fly

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Introduction

Buffalo flies, *Haematobia irritans exigua*, are ranked as the number one economic pest of cattle in Australia costing the cattle industry $111.7M p.a. in production losses, and control measures contributing an additional $58.6M p.a. (Shephard *et al.,* 2022). Elevated resistance to synthetic pyrethroids in Queensland buffalo fly populations led to this study to investigate if new voltage gated sodium channel (VGSC) mutations might be involved.

Methods

Field collected buffalo flies were screened using chemical bioassays (Farnsworth 1997) to determine their resistance to α-cypermethrin and deltamethrin. Flies were categorised as Susceptible (dead after 2 hours at cypermethrin concentration 3.4 µg/cm^2; dead at deltamethrin concentration 0.20 µg/cm^2) or Resistant (alive after 20 hours at cypermethrin concentration 1433 µg/cm^2; alive at deltamethrin concentration 500 µg/cm^2 or higher). An additional category, Knockdown-Recovered (flies appearing to be dead or morbid at cypermethrin concentration 1433 µg/cm^2 but recovered) was created following observations of fly behaviour during bioassay testing. The DPI buffalo fly colony was sampled and RNA extracted (RNeasy Mini Kit, Qiagen) to sequence the VGSC gene. DNA was extracted from field collected flies using a DNeasy Blood and Tissue Kit (Qiagen) to screen for resistance-linked mutations using DNA primers developed in this study.

Results

The complete VGSC gene has been sequenced for buffalo fly and a putative new resistance mutation, *T929I*, was found in Domain II, subunit 5 of field collected resistant flies (Figure 1). A new class of resistance, knockdown recovery, has been observed in buffalo flies for the first time.

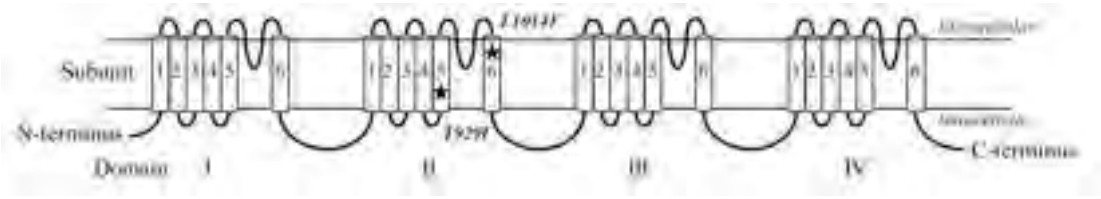

Figure 1. Buffalo fly voltage gated sodium channel gene with stars indicating the relative position of resistance mutations.

Discussion and conclusion

Mutations in the VGSC gene were found to explain 82% of cypermethrin and deltamethrin resistant flies. The *T929I* mutation has been shown to provide a synergistic enhancement to mutation *L1014F* in other insects and may be doing the same in buffalo fly. Knockdown-recovery in other insects has been linked to the elevated expression of detoxifying enzymes. This alternative pathway may explain how 18% of flies without VGSC resistance mutations survive high concentrations of insecticide. Developing a better understanding of insecticide resistance in buffalo fly will inform integrated pest management (IPM) strategies to enable the cattle industry to better control this economically significant pest.

References

Shephard R. et al. (2022) Final Report, Project B. AHE.0327, Meat and Livestock Australia Limited, Sydney, Australia.

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