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RNA interference technology for eco-sustainable mosquito control

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Background

The control of disease vector insects, such as mosquitoes, is mainly based on the use of chemical insecticides. However, they have two major limitations: 1) they can easily accumulate in the biotic and abiotic components of ecosystems, being harmful to the environment and non-target fauna; 2) their effectiveness is threatened by the emergence of resistance in target species. Therefore, developing more eco-compatible control strategies to curb these issues becomes of paramount importance.

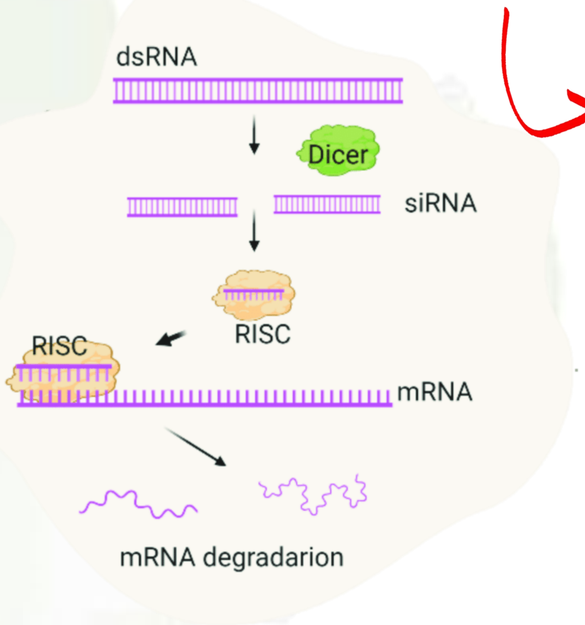


Figure 1. Schematization of RNAi pathway [2].

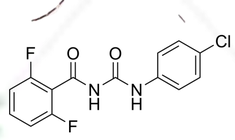
RNA interference (RNAi)

Technique based on the use of short dsRNA (double-stranded RNA) fragments that interfere with gene expression through inhibition of complementary mRNAs, during or after transcription. This mechanism can be exploited to selectively silence genes essential for insect physiology, causing mortality, or genes associated with resistance, increasing the susceptibility of individuals to a given insecticide [1].

Objective

To evaluate the efficacy of an RNAi-based approach in increasing susceptibility to the insecticide diflubenzuron (DFB) in the mosquito *Culex pipiens*

Study system



Insecticide: Diflubenzuron → larvicide; it acts by inhibiting chitin synthesis
Resistance to DFB has been identified in Italian, Turkish, and French populations of *Cx. pipiens* [3,4,5]

RNAi target gene: chitin synthase 1 (*chs*1), the target of DFB

Methods

Gene inhibition bioassays on *Cx. pipiens* larvae with dsRNA molecules and insecticide.

Results and Discussion

✓ 15% mortality increase in the DFB + dsRNA *chs*1 treatment, compared with DFB alone

Our results suggest a synergistic effect of RNAi when combined with insecticide. Although these are preliminary results, they identify this approach as a valuable tool for eco-friendlier control of *Cx. pipiens* and of other vector species. Indeed, it would allow:

- ✓ to reduce the doses of insecticide, limiting the environmental impact and the risk of resistance emergence;
- ✓ to develop a species- and gene-specific control tool, reducing the impact on non-target fauna.

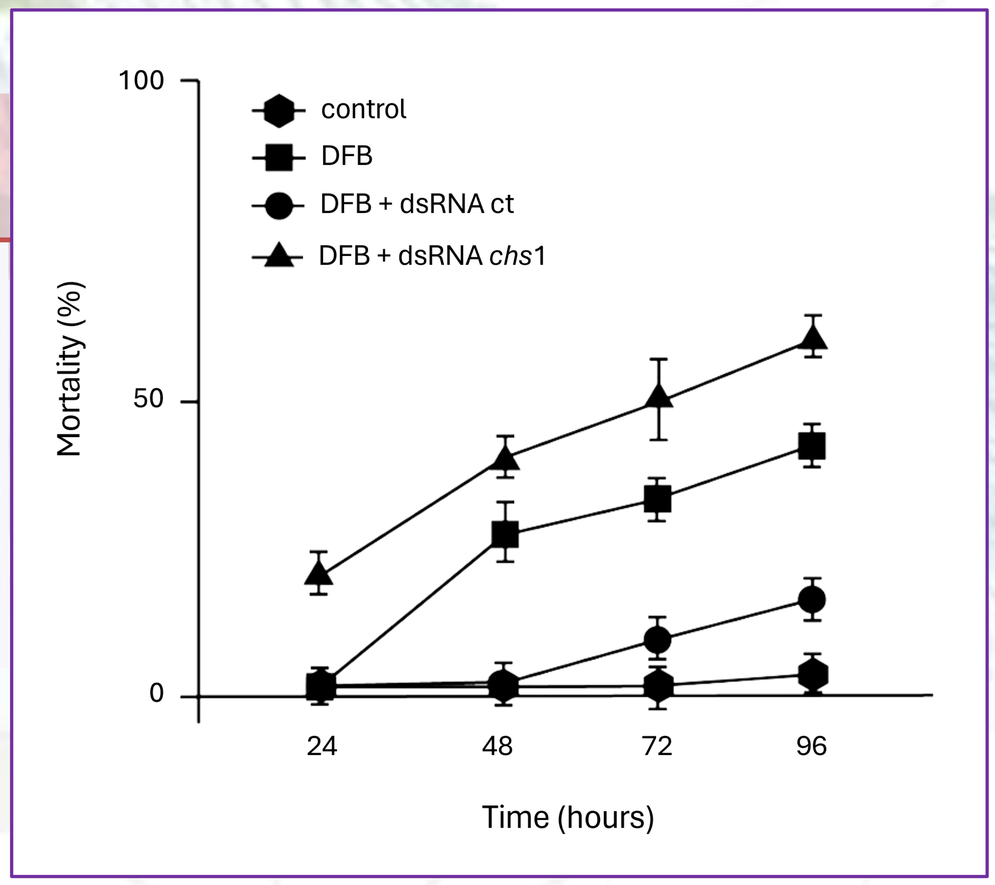


Figure 2. Observed mortality in the different treatments after 24, 48, 72, and 96 hours. DFB = 0.05 mg/L; dsRNA ct = control sequence, 1µg/ml; dsRNA *chs*1 = target sequence, 1µg/ml.

References

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[2] Golubeva T.S. et al. 2021. Molecules 26(3):701
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[5] Fotakis et al. 2020. PLoS Negl Trop Dis 14(5): e0008284

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