The Mosquito Intelligent Terminator is designed and optimized to be an ecological and environmentally friendly mosquito pesticide. The Terminator is an engineered E. coli secreting crystal proteins isolated from Bacillus thuringiensis to kill mosquito larvae, or commonly known as wrigglers. These crystal proteins are toxic to certain types of mosquitoes only and are not pathogenic to mammals. We designed a low-temperature release genetic circuit expressing high levels of crystal proteins at room temperature only, thus production does not occur at incubation temperature (37°C). In order to make an environmentally safe insecticide, our design also incorporates a genetic circuit controlling the population size of E. coli, thus a surplus will never exist as E. coli population is self-maintained within the system (Fig. 1). Our design may potentially serve as a promising pest control solution in the future.

Fig. 1. Termini can be sprayed into foul water which is the wrigglers’ habitat. When wriggler eats the Termini, it will die.

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This system can be modeled by differential equations as follows.

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\begin{align*}
\frac{dTetR}{dt} &= \alpha_{TetR} - \gamma_{TetR} \cdot [TetR] - d(t) \cdot [GFP] \\
\frac{d[GFP]}{dt} &= \alpha_{GFP} \cdot [TetR]^n - \gamma_{GFP} \cdot [GFP] - d(t) \cdot [GFP]
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The model equations present interesting mathematical properties that can be used to explore how qualitative features of the genetic circuit depend on reaction parameters (Fig. 7).

Fig. 7. Simulated results (line) of the dynamic model successfully approximated the behavior of our low-temperature release system.

Fig. 8. Using least squares estimation from experimental data, the relative translation activity of this RBS (BBa_K115002) at 25°C, 30°C, 37°C and 40°C can be quantitative by our model equations.

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