Oligonucleotide and dsRNA Suppression of Fall Armyworm: A Global Pest

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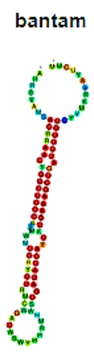
ABSTRACT:

We designed an antisense oligo and dsRNA that causes significantly morbidity of Fall Armyworm, FAW, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae).

The FAW occurs in virtually all states East of the Rocky Mountains. While an annual threat to crops cross the southern U.S. its range extends globally, found in West Africa; most of sub-Saharan Africa in 2017; India in 2018; and across South-East Asia and China in 2019.

With no suitable treatments the FAW continues to be a global menace.

This study reports on the successful design of two gene targeting biopesticides: double-strand RNA (dsRNA), and Antisense oligonucleotide- 2′-O-methylated (2′**O-M**e), that target the *bantam*- microRNA.



The *bantam* microRNA works in the epithelial cells where it regulates the growth of dendrites in sensory neurons{1}. The *Hippo signaling pathway* also tends to be directly linked with the *bantam* microRNA as it regulates it to control the functionality of cell proliferation and survival {2,3}.

Disruption of the miRNA-bantam in Asian citrus psyllid also caused significant mortality{4}(Hunter & Lopez 2020).

Suppression of the *bantam* miRNA in FAW larvae causes incomplete molting, thus resulting in 100% morbidity. Death of early-stage caterpillars resulted in no adult emergence. When the product was applied as topically applied to leaves of sweet corn seedlings, or fed in leaf pieces after absorbing the biopesticides, ingestion by caterpillars caused significant larval mortality and the few emergent adults had deformities (wings, legs, antennae) dying shortly after emergence (**100% mortality**). The effectiveness of the oligo treatment warranted submission for patenting, and the gene target has now been identified in other important lepidopteran pests and several new oligos are in development.

Figure 1. Demonstrating the significantly improved RNAi using Modified nucleotide in the dsRNA- *bantam* caused a greater percentage of incomplete pupation of *Spodoptera frugiperda*. All treated *Spodoptera* pupae died (**B**). Mock treated Control larvae progressed through pupation with no observed deformities or mortalities (**A**). All control pupae emerged to adults.

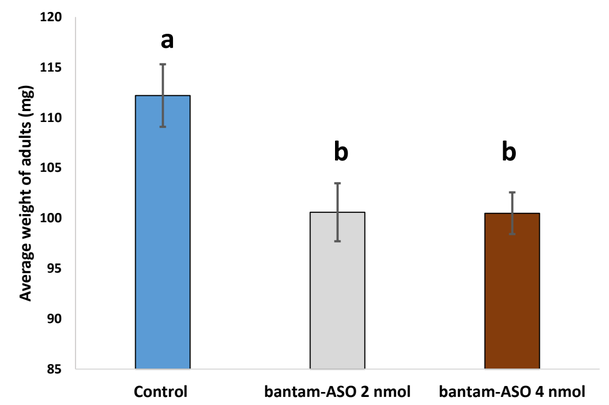


Figure 2. Down-regulation of *bantam* miRNA resulted in reduced body growth. Control adults weighed 112.2 mg, whereas larvae treated with 2 nmol and 4 nmol *bantam*-ASO weighed 100.6 and 100.5 mg, respectively. Differences in mass were determined to be statistically significant when analyzed *via* one-way ANOVA ($p < 0.0001$).

Figure 3. *bantam*-ASO caused wing deformities in adult *S. frugiperda.* Control adults show no signs of curled or deformed wings (A-C). Treated 4 nmol *bantam*-ASO adults show severe wing deformities and curling of the antennae (D-F)[100% mortality]. Treated 2 nmol *bantam*-ASO adults displayed similar distorted wing and appendage phenotypes[100% mortality].

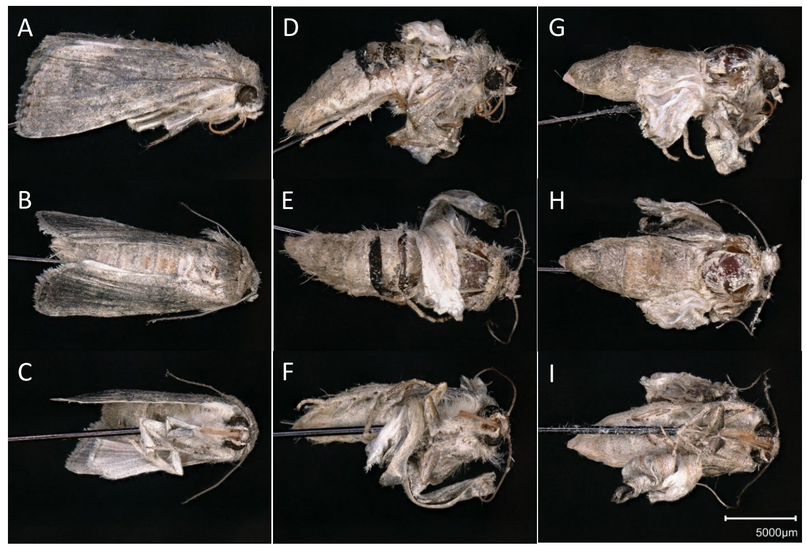
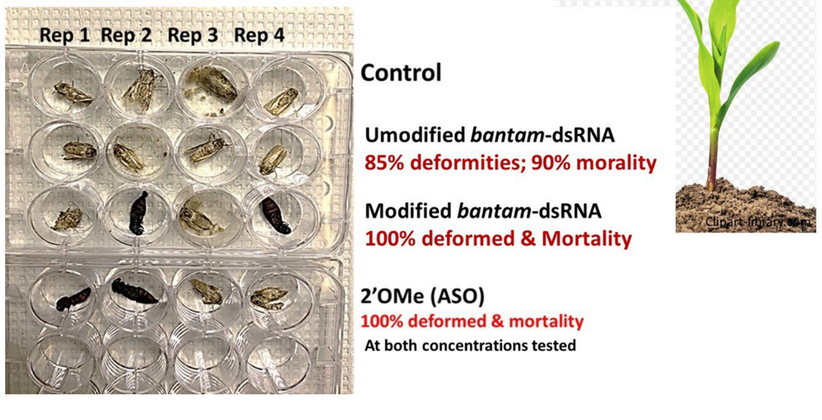


Figure 4. Ingestion of *bantam*-ASO or -dsRNA as Larvae Outcomes



SUMMARY:

Biopesticides like dsRNA and Antisense oligo can *significantly suppress* insect fitness and survival.

Biopesticide commercialization would provide treatments of global pests like the Fall Armyworm and Cut worm, as well as hemipteran pests like the Asian citrus psyllid vector of Huanglongbing

Acknowledgments to*: Maria T. Gonzalez, Biological Science Technician, USDA,ARS, USHRL, Ft. Pierce, FL*

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*2. Peng HW, Slattery M, Mann RS (2009). "Transcription factor choice in the Hippo signaling pathway: homothorax and yorkie regulation of the microRNA bantam in the progenitor domain of the Drosophila eye imaginal disc". Genes Dev. **23** (19): 2307–19. doi:10.1101/gad.1820009. PMC 2758742. PMID 19762509.*

*3. Thompson BJ, Cohen SM (2006). "The Hippo pathway regulates the bantam microRNA to control cell proliferation and apoptosis in Drosophila". Cell. **126** (4): 767–74. doi:10.1016/j.cell.2006.07.013. PMID 16923395.*

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