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Project Title: Biodegradable Nanomaterial-based Non-GMO RNAi Delivery for Controlling FHB Disease

PROJECT 1 ABSTRACT

(1 Page Limit)

Given the importance and adverse effects of FHB disease in wheat, caused by *Fusarium graminearum* (*Fg*), the overarching goal of this proposal is to develop and ultimately facilitate on-farm RNAi success. We aim to incorporate nanoparticles in our studies to identify target genes and developing methods to control FHB disease in wheat. This research uses a non-GMO gene silencing strategy to target those pathogen genes that are vital for survival, establishment, and growth and pathogenicity of the *Fg*. This is not creating genetically modified plants and rather is the topical administration of dsRNA to control pathogens, pests, and viruses, and is known as non-transformative delivery strategy, and have the advantage to enable targeting several pathogens and pests. Rapid degradation of dsRNA by encapsulating them into nanostructure delivery systems, such as dsRNA-chitosan conjugate formulations was shown to improve stability of dsRNA from endonucleases and uptake in a number of insect species. While several researchers identified pathogenic genes in *Fg*, this knowledge has yet to be used as proof of concept for creating resistance against FHB.

Specific objectives of this proposal are: 1) Design and develop scalable production of core-shell dsRNA-chitosan nanostructures for sustained release of dsRNA over two weeks in the plant; 2) Integration of designed dsRNA into core shell nanoparticles with uniform spray application process; 3) Silencing of candidate genes with nanoparticle-coated siRNA in *Fg*; 4) Assays for siRNA delivery and effects of two or more siRNA in *Fg*; 5) Determine accumulative effects of simultaneously silencing of two or more genes in *Fg*; 6) Gene prioritization and dsRNA design for applications on wheat; and 7) Treating FHB inoculated susceptible varieties with coated dsRNA design, and characterizing the efficacy of non-GMO gene silencing strategy.

Expected results. If genes can be efficiently silenced in *Fg* by nanoparticle delivery, the approach developed in this study will be a breakthrough in functional studies in *F. graminearum* and other fungal pathogens, and nanoparticles-delivery enhances the ability to examine function of many genes by silencing with siRNA oligos delivered. If spraying dsRNA on wheat is successful, that can lead to the development of a non-GMO and environmentally friendly method to control FHB, and later can be extended to other pests and pathogens. In addition, if successful, this strategy is versatile and can accommodate dsRNA designed for multiple pathogens as well, which is extremely important in lessening the use of agrochemicals and controlling other pests and pathogens that threaten wheat productivity in the US.