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Project ID: FY21-LI-008
ARS Agreement #: *New*

Research Category: TSCI
Duration of Award: 1 Year

Project Title: Transfer *Fhb7* to Barley through CRISPR-mediated Targeted Gene Insertion

PROJECT 1 ABSTRACT

(1 Page Limit)

Fusarium head blight (FHB; scab) is a devastating disease in barley and wheat. Significant progress has been made in understanding and improving host resistance in wheat with molecular cloning of the major QTL *Fhb1* and *Fhb7*, but the barley research lagged mainly due to the lack of high-resistant genotypes, which makes it very difficult to effectively control FHB and DON contamination. Thus, there is an urgent need for a *breakthrough* in gene discovery and germplasm development for the high level of FHB resistance and a great capacity to detoxify DON in barley using *transformative* approaches.

Use of wheat genes to breed barley FHB resistance is the road not taken because strong reproductive barriers prevent gene transfer from wheat to barley via wide hybridization. Considering that *Fhb7* detoxifies DON, we **hypothesize** that *Fhb7* can also contribute greatly to barley FHB resistance. Taking the advantage of our ongoing work on *Fhb7* and CRISPR-based genome editing in wheat, we propose to transfer *Fhb7* to barley through CRISPR-mediated targeted gene insertion as a proof of concept with three **objectives**:

1) Generate transgenic barley expressing the CRISPR/Cas9 and the donor *Fhb7,*
2) Evaluate the *Fhb7* function in transgenic barley, and
3) Screen the transgenic plants for targeted *Fhb7* insertion events.

As required by the EC, we will focus on Objective 1 only in FY21 to develop three pairs of plasmids pCRISPR and pDONOR, co-transform them into barley, and generate transgenic plants. The success of this project will open a completely new path to improve barley FHB resistance and reduce DON accumulation in particular. Thus, the proposed research is **transformative and significant.** It aligns well with the priorities of several USWBSI programs, including GDER, VDHR, and BAR-CP, and serves our **long-term goal** to improve FHB resistance of barley and wheat using CRISPR-based approaches.

As a team of expertise in gene discovery, germplasm, breeding, pathology, and genome editing, we have the materials, resources, and tools in place or progress. At the completion of this project, we **expect to deliver** a package of new knowledge of *Fhb7* function in barley FHB resistance and DON detoxification and a panel of *Fhb7*-insertion lines as novel germplasm. These results will have a **positive impact** on barley production and the brewery industry, **benefiting** barley growers and beer consumers.