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Project Title: Engineering Scab Resistance in Wheat with Defense Signaling Genes.

PROJECT 1 ABSTRACT

(1 Page Limit)

Fusarium head blight (FHB), also known as scab has reemerged as a devastating disease of wheat and barley. *Fusarium graminearum* is the primary cause of scab. Gene-for-gene resistance has not been identified for scab. The best source of resistance against scab is a complex, quantitative trait derived from the spring wheat cultivar Sumai 3. Similar resistance is not available for durum. Biotechnology provides an alternative approach for developing scab resistant wheat. Our approach has been to utilize regulatory genes involved in plant defense mechanisms to engineer enhanced scab resistance. Regulatory genes offer the advantage that they can simultaneously modulate expression of multiple defense genes. Our USWBSI supported studies have identified salicylic acid (SA) as an important signaling molecule in plant defense to *F. graminearum*. Furthermore, these studies have documented the utility of the *Arabidopsis thaliana NPR1* gene (*AtNPR1*), a key regulator of SA signaling, in augmenting scab resistance in transgenic wheat. Our work with *Arabidopsis-F. graminearum* interaction has identified *Arabidopsis PAD4* (*AtPAD4*), which modulates SA signaling and the accumulation of antimicrobial metabolites, as another candidate gene for engineering scab resistance. In addition, *AtPAD4* is also involved in defense against aphids, which are vectors of plant viruses.

The specific objectives of this proposal are to: **(1) Continue field trial evaluation of the *Ubi1:AtNPR1* transgenic cv Bobwhite plants.** We propose to build on the encouraging results from our past field trials with the transgenic *Ubi1:AtNPR1* cv Bobwhite plants in Kansas, by replicating these trials in Minnesota. We will measure FHB disease index and DON levels in these trials. **(2) Continue our efforts to transform and characterize *AtNPR1* expressing durum and elite cultivars of hexaploid wheat.** We will continue our efforts to transform the *Ubi1:AtNPR1* construct into durum and elite cultivars of hexaploid wheat. In addition, we will evaluate transgene expression and scab resistance in the transgenic durum wheat plants that have already been generated and others that we hope to obtain during the remainder of fiscal year 2006. **(3) Engineer *AtPAD4* expression in wheat.** The *AtPAD4* cDNA will be cloned under the control of a maize *Ubi1* promoter, and the resulting *Ubi1:AtPAD4* construct will be transformed into hexaploid wheat. We will evaluate transgene expression and the level of the chimeric *AtPAD4* protein in the transgenic plants. In ensuing years, we will test scab resistance in promising lines.

Our ongoing and proposed projects are relevant to the BIOTECHNOLOGY initiatives of USWBSI, by promoting the transgenic testing of genes/signaling pathways for creating scab resistant germplasms.