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PROJECT 1 ABSTRACT
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Our long-term goal is to develop wheat plants, which exhibit enhanced and broad-spectrum resistance to Fusarium head blight (scab). Scab has re-emerged as a devastating disease in wheat and barley, severely limiting productivity. In the US, annual losses of wheat to scab have ranged between $ 200-400 million, at times reaching $ 1 billion. Biotechnology offers an alternative approach for rapidly developing scab resistant wheat. In the past, overexpression of individual defense genes has offered limited success against scab. These studies demonstrate that to develop wheat with broad-spectrum resistance to scab, multiple defense genes will need to be simultaneously expressed. This offers many challenges. However, regulatory genes that control expression of multiple defense genes could overcome these difficulties. The *NPR1* gene which coordinates expression of defense genes in *Arabidopsis thaliana* and it wheat ortholog, *WhNPR1*, are regulatory genes that offer promise in developing plants with resistance to fungal diseases. Preliminary evidence gathered by us shows that overexpression of NPR1 enhances resistance to fungal disease in transgenic wheat. In addition, expression of the wheat NPR1-like gene, *WhNPR1*, which has been cloned by us, is activated in flag leaves and spikes of infected plants, suggesting its involvement in defense against scab.

Our specific objectives for the first year of this proposal are to: **(i)** Determine the efficacy of NPR1 overexpression on scab resistance in wheat. We have generated transgenic wheat plants that overexpress the Arabidopsis NPR1 gene and exhibit resistance to leaf blotch. We will evaluate scab resistance in the T_3 generation of these lines, to identify lines with enhanced resistance to scab. **(ii)** Generate transgenic lines overexpressing the wheat *WhNPR1* gene. Considering that this is a wheat gene, which will interact better with other components in wheat cells, we expect it to be more effective in enhancing resistance. The *WhNPR1* gene will be expressed under control of the maize *ubi1* promoter plus intron and transformed into wheat. Particle bombardment technology will be used to transform wheat. Transgenic lines overexpressing different levels of WhNPR1 will be identified and characterized by RNA blot and western blot for expression of the *ubi1:WhNPR1* chimeric RNA and protein. In subsequent years we will evaluate progeny of *ubi1:WhNPR1* overexpressers and *WhNPR1* silenced lines for resistance to scab. Promising lines exhibiting durable resistance in subsequent generations will eventually be propagated for introduction into the existing breeding programs at KSU. If successful in wheat, similar strategies could be applied to develop scab resistant barley germplasm.