USDA-ARS / USWBSI
FY03 Final Performance Report (approx. May 03 – April 04)
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Cover Page

PI:	**Jyoti Shah**
Institution:	**Kansas State University**
Address:	**Department of Biology** **303 Ackert Hall** **Manhattan, KS 66506**
E-mail:	**shah@ksu.edu**
Phone:	**785-532-6360**
Fax:	**785-532-6653**
Year:	**FY2003 (approx. May 03 – April 04)**
FY03 ARS SCA ID:	**58-5430-3-315**
FY03 ARS Agreement Title:	**Enhancing Scab Resistance in Wheat by Overexpressing Wheat and Arabidopsis NPRI.**
FY03 ARS Award Amount:	**$ 62,269**

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Adjusted Award Amount
BIO	Enhancing Scab Resistance in Wheat by Overexpressing Wheat and Arabidopsis NPR1.	$ 62,269
	Total Amount Recommended	**$ 62,269**

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Principal Investigator Date

* BIO – Biotechnology
CBC – Chemical & Biological Control
EDM – Epidemiology & Disease Management
FSTU – Food Safety, Toxicology, & Utilization
GIE – Germplasm Introduction & Enhancement
VDUN – Variety Development & Uniform Nurseries

Project 1: ***Enhancing Scab Resistance in Wheat by Overexpressing Wheat and Arabidopsis NPR1.***

1. What major problem or issue is being resolved and how are you resolving it?

Scab has re-emerged as a devastating disease of wheat and barley. In the US, annual loss of wheat to scab averages between $ 200-400 million; at times having reached $ 1 billion. Multiple strategies are required to combat scab. Biotechnology provides a promising approach for rapidly developing scab resistant wheat. Past studies involving over-expression of individual defense genes have met with limited success. These studies have suggested that to develop wheat with broad-spectrum resistance to scab, multiple defense genes will need to be simultaneously expressed. This offers many challenges. However, a regulatory gene like the Arabidopsis *NPR1* gene, which controls expression of multiple defense genes, could overcome these difficulties. In Arabidopsis and rice, constitutive expression of *NPR1* confers enhanced resistance to pathogens. We have used the Arabidopsis *NPR1* gene to enhance scab resistance in wheat; transgenic wheat plants, which constitutively express the NPR1 gene from the ubiquitously expressed maize *Ubi1* promoter have been generated and tested for scab resistance. In addition, we have cloned the wheat homolog (WhNPR1) of the Arabidopsis NPR1. Expression of *WhNPR1* is activated in flag leaves and spikes of infected plants, suggesting its possible involvement in defense against scab. In the future, the *WhNPR1* gene will be used to enhance scab resistance in wheat.

2. What were the most significant accomplishments?

A. Type II resistance to scab was observed in two independently derived transgenic wheat (Bobwhite) lines, which constitutively express the Arabidopsis *NPR1* gene from the maize *Ubi1* promoter. T1, T2 and T3 progeny have been analyzed for these lines. Northern and RT-PCR analysis confirm that the transgene is stably expressed in these two lines. Furthermore, segregation analysis confirms that the type II resistance observed in these plants is indeed associated with the expression of the *Ubi1:AtNPR1* transgene. No obvious growth or developmental defects were observed in the transgenic progeny derived from the line 125, which has been characterized in greater detail. These results allow us to draw the following conclusions:
   1. The NPR1 gene is an excellent candidate for enhancing scab resistance in wheat.
   2. Since constitutive expression of *AtNPR1*, a dicot regulatory gene, is sufficient to enhance scab resistance in wheat, the downstream signaling cascade involving NPR1 must be conserved between dicots and monocots.

B. The wheat homolog of Arabidopsis and rice *NPR1* genes has been cloned. Expression of *WhNPR1* is induced in flag leaves and spikes of infected plants. Thus WhNPR1 provides another candidate gene for enhancing scab resistance in wheat.

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in you grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Publications:

Makandar, R., Trick, H., and Shah, J. Constitutive expression of the Arabidopsis NPR1 gene confers scab resistance in wheat. (Manuscript in preparation for submission to The Plant Journal).

Presentations:

Makandar, R., Trick, H. and Shah, J. (2003) NPR1: a candidate to enhance broad spectrum scab resistance in wheat. National Fusarium Head Blight Forum, Minneapolis, Minnesota.