USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY06 Final Performance Report (approx. May 06 – April 07)
July 16, 2007

Cover Page

PI:	Nilgun Tumer
Institution:	Rutgers, The State University of New Jersey
Address:	Biotech Center - Cook College Biotech Center 59 Dudley Rd. New Brunswick, NJ 08901-8520
E-mail:	tumer@aesop.rutgers.edu
Phone:	732-932-8165 x215
Fax:	732-932-6535
Fiscal Year:	2006
USDA-ARS Agreement ID:	59-0790-6-069
USDA-ARS Agreement Title:	Modification of the Ribosomal Target to Enhance Resistance to Trichothecene Mycotoxins.
FY06 ARS Award Amount:	$ 48,404

USWBSI Individual Project(s)

USWBSI Research Area*	Project Title	ARS Award Amount
GET	Modification of the Ribosomal Target to Enhance Resistance to Trichothecene Mycotoxins.	$ 48,404
	Total Award Amount	**$ 48,404**

_____

Principal Investigator Date

* CBCC – Chemical, Biological & Cultural Control
EEDF – Etiology, Epidemiology & Disease Forecasting
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GET – Genetic Engineering & Transformation
HGR – Host Genetics Resources
HGG – Host Genetics & Genomics
PGG – Pathogen Genetics & Genomics
VDUN – Variety Development & Uniform Nurseries

Project 1: *Modification of the Ribosomal Target to Enhance Resistance to Trichothecene Mycotoxins.*

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

The major problem addressed in this project is to determine if resistance to Fusarium Head Blight (FHB) can be achieved in transgenic wheat plants by expressing DON resistant forms of the yeast ribosomal protein L3 genes.

2. List the most important accomplishment and its impact (how is it being used?). Complete all three sections (repeat sections for each major accomplishment):

Accomplishment:

The most important accomplishment is that we have produced transgenic wheat plants expressing a truncated form of the yeast L3 gene (L3Δ) that are resistant to FHB and accumulate significantly lower levels of DON. FHB is a devastating disease worldwide, caused mainly by *Fusarium graminearum*. The *Fusarium*-infected grain is contaminated with potent mycotoxins, especially deoxynivalenol (DON), which poses a great threat to human and animal health. There are very limited sources of genetic resistance available against this devastating disease. Our group has demonstrated that ribosomal protein L3 is the target of DON and identified a truncated form of yeast L3 (L3Δ) that confers a high level of resistance to DON. During this grant period, we have demonstrated that expression of the yeast L3Δ in transgenic wheat plants confers resistance to FHB and leads to a significant reduction in DON levels. The susceptible spring wheat cultivar, Bobwhite was transformed with the yeast L3Δ under the control of the barley floret-specific *Lem1* or the maize constitutive *Ubi1* promoter. Seeds from the homozygous lines containing each construct were able to germinate on media containing DON, unlike the seeds of the wild type Bobwhite plants. To determine if these lines were resistant to FHB, five different homozygous lines were evaluated for resistance to FHB in greenhouse tests by inoculating a single spikelet at the central node of the main spike of each plant with a macroconidial spore suspension of *F. graminearum*. All spikelets of inoculated wild type plants turned brown at 21 days after the inoculation. In contrast, only the inoculated spikelets of the transgenic lines turned brown; the uninoculated spikelets remained green in most of the transgenic plants. The disease severity was reduced by 48-56% in four different transgenic wheat lines compared to the untransformed Bobwhite plants. The reduction in disease severity correlated well with the level of expression of L3Δ mRNA. These results demonstrated that transgenic wheat plants expressing the yeast L3Δ showed improved resistance to FHB over the untransformed Bobwhite plants. To determine if resistance to FHB would result in a reduction in DON levels, the mature kernels above and below the inoculated spikelets were analyzed for DON levels. There was a 63-76% reduction in DON levels in the four different FHB resistant transgenic lines. The DON levels in one transgenic line were lower than the DON levels in the resistant line, Alsen.

Impact:

This is the first time that FHB resistance has been shown in transgenic wheat plants by expressing a modified form of the ribosomal protein L3 gene. Our results also provide the

first evidence that resistance to DON correlates with resistance to FHB and results in reduced accumulation of DON in transgenic wheat plants.

As a result of that accomplishment, what does your particular clientele, the scientific community, and agriculture as a whole have now that they didn't have before?

The transgenic wheat lines could be used as breeding material for introduction of the FHB resistance into elite wheat cultivars or breeding lines.

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 the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Publications

Di, R.**,** A. Blechl, R. Dill-Macky, A. Tortora, and N. E. Tumer. 2007. Expression of the N-terminal 99 amino acids of yeast ribosomal protein L3 in transgenic wheat confers resistance to *Fusarium* head blight. Mol. Plant Breeding 5:283.

Di, R., and N. E. Tumer. 2005. Expression of a truncated form of ribosomal protein L3 confers resistance to pokeweed antiviral protein and the *Fusarium* mycotoxin deoxynivalenol. Mol Plant Microbe Interact **18:**762-70.

Oral presentations in conferences

Di, R.**,** A. Blechl, R. Dill-Macky, A. Tortora, and N. E. Tumer. 2007. Expression of the N-terminal 99 amino acids of yeast ribosomal protein L3 in transgenic wheat confers resistance to *Fusarium* head blight. The 2nd International Conference of Plant Molecular Breeding, Hainan, China.

Di, R., Blechl, A., Dill-Macky, R., Tortora, A. and Tumer, N. E. 2006. Expression of a truncated form of ribosomal protein L3 in transgenic wheat confers resistance to Deoxynivalenol and Fusarium Head Blight. Proceedings of the 2006 National Fusarium Head Blight Forum, Research Triangle Park, North Carolina Dec. 10-12, 2006, Abstract 5.

R. Di and N. E. Tumer 2005. Expression of a truncated form of ribosomal protein L3 confers resistance to pokeweed antiviral protein. American Society for Virology 24th Annual Meeting, The Pennsylvania State University, University Park, Pennsylvania. June 18-22. Abstract No. 29-1.

Manuscripts in preparation

Di, R.**,** and N. E. Tumer. The N-terminal 99 amino acids of yeast ribosomal protein L3 reduce the toxicity of pokeweed antiviral protein in *Saccharomyces cerevisiae.*

Patent Applications

Tumer, N. E. and R. Di. Sept. 8, 2005. Transgenic tobacco plants expressing truncated proteins L3 and pokeweed antiviral protein are resistant to trichothecene fungal toxins. U.S. Application #11/010,795.