

**USDA-ARS/  
U.S. Wheat and Barley Scab Initiative  
FY05 Final Performance Report (approx. May 05 – April 06)  
July 14, 2006**

**Cover Page**

<b>PI:</b>	<b>Elias Elias</b>
<b>Institution:</b>	<b>North Dakota State University</b>
<b>Address:</b>	<b>Department of Plant Sciences 166 Loftsgard Hall Box 5051 Fargo, ND 58105-5051</b>
<b>E-mail:</b>	<b>elias.elias@ndsu.nodak.edu</b>
<b>Phone:</b>	<b>701-231-8159</b>
<b>Fax:</b>	<b>701-231-8474</b>
<b>Fiscal Year:</b>	<b>2005</b>
<b>FY05 ARS Agreement ID:</b>	<b>59-0790-4-098</b>
<b>Agreement Title:</b>	<b>Identify and Develop Durum Wheat Resistant to Fusarium Head Blight.</b>
<b>FY05 ARS Award Amount:</b>	<b>\$ 132,728</b>

**USWBSI Individual Project(s)**

<b>USWBSI Research Area *</b>	<b>Project Title</b>	<b>ARS Adjusted Award Amount</b>
GIE	Identify Sources of Resistance to Fusarium Head Blight in Durum Wheat.	\$ 40,000
VDUN	Development of Durum Wheat Resistant to Fusarium Head Blight.	\$ 92,728
	<b>Total Award Amount</b>	<b>\$ 132,728</b>

\_\_\_\_\_  
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: *Identify Sources of Resistance to Fusarium Head Blight in Durum Wheat.*****1. What major problem or issue is being resolved and how are you resolving it?**

Durum Wheat is very susceptible to Fusarium head blight (FHB) caused by the fungus *Fusarium graminearum Schwabe* (teleomorph *Gibberella Zeae* (Schw.) Petch. Sources of resistance to FHB in durum wheat that are equivalent to the Chinese spring wheat Sumai 3 are not available yet. Our objective is to identify sources of resistance that can be utilized by durum plant breeders to develop FHB resistant cultivars. There are 6000 durum wheat accessions at the National small grain Collection, Aberdeen, ID that are available for evaluating for FHB resistance. We are in the process of evaluating these accessions in field nurseries in China and greenhouses in North Dakota. In addition to these we are evaluating germplasm from the International Center of Agricultural Research in the Dry Areas (ICARDA) and International Maize and Wheat Improvement Center (CIMMYT).

**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:**

In 2005-2006 China screening nursery, we evaluated 902 durum wheat accessions from the world collection. Several accessions were identified to have disease severity less than 27%. These lines will be re-evaluated in 2006-07 either in the greenhouse or the field.

We have identified five Tunisian lines to have resistance to FHB. A diversity study was conducted using 130 markers across the A and B genomes of 20 lines which include the resistant lines as well as susceptible lines from Tunisia and other hexaploid and tetraploid cultivars. The resistant line Tunisian 7 appears to be significantly different from the other Tunisian lines. The remaining resistant lines Tunisian 18, 34, 36, and 108 were in different clusters. The Susceptible Tunisian lines were clustered together with the exception of one line that was clustered with the resistant Tunisian line 36. We developed nine populations from crossing and backcrossing durum cultivars to the Tunisian lines. Some of these populations were developed using the double haploid breeding system. Part of these populations will be used to identify QTL'(s) associated with FHB resistance in the five lines. The other parts of these populations were advanced in New Zealand to be used for screening and developing durum cultivars resistant to FHB.

We obtained 14 durum experimental lines from CIMMYT that have moderate level of FHB type II resistant. Two lines maintained their resistance when they were evaluated in the Fall 2004. These two lines are being used as parents in the crossing block. We also obtained 85 durum experimental lines from CIMMYT that have moderate level of Type II resistance. We screened these lines in the Spring 2005 greenhouses. Thirty-three lines that had Type II disease severity less than 30% were selected for further evaluations in the Spring or Fall 2006 greenhouses.

**Impact:**

Any resistant germplasm that is identified above could potentially lead into the development of FHB resistant durum cultivars. Resistant durum cultivars will generate million of dollars to the farm economy in the Midwest and will insure the stability of the durum industry in the United States.

**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 five Tunisian lines that we have identified to have resistance to FHB are being shared with breeders working on developing FHB resistant durum cultivars.

**Project 2:** *Development of Durum Wheat Resistant to Fusarium Head Blight.*

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

Fusarium head blight (FHB) caused by the fungus *Fusarium graminearum* Schwabe (telomorph *Gibberella zea* (Schwein.) Petch. has been seriously attacking durum wheat. Since 1993, it is estimated that FHB has cost over \$3 billion in direct and indirect losses in North Dakota. Although fungicides may reduce FHB, using genetic resistance is the most environmentally safe and economical way to control the disease. The objective of this project is to incorporate identified sources of resistance into the currently susceptible durum wheat germplasm in order to develop resistant cultivars.

**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:**

● ***Cultivar release:***

The experimental line D971511 was identified to have Fusarium head blight resistance similar to the cultivar Belzer with much higher test weight. Based on three years average D971511 had 43% Type II disease severity which was lower than the most grown cultivars Ben (78%), Lebsock (71%), and Mountrail (68%). The source of resistance is not from Sumai 3 or Langdon *dicoccoides* 3A substitution line. D971511 was released on June, 2005 as the cultivar Divide.

● ***Sumai 3 and Wangshuibai sources of resistance:***

- 200 lines were evaluated in the Advanced Yield Trials
- 860 lines were evaluated in the Preliminary Yield Trials
- 16 populations were screened in the field and greenhouses

● ***Langdon dicoccoides 3A source of resistance:***

- Three resistant lines were evaluated in the 2005 Advanced Yield Trial

**Impact:**

The above developed material is the only known improved durum germplasm with Fusarium head blight resistance. This germplasm is vital for the survival of the Midwest durum producers. Since the Midwest produces over 75% of the US durum, this germplasm has a major impact on the pasta industry and the US economy. Divide, based on its FHB resistance and yield advantage and if were to replace 30% of the acreage of the current grown cultivars in the Midwest it would

FY05 (approx. May 05 – April 06)

FY05 Final Performance Report

PI: Elias, Elias

ARS Agreement #: 59-0790-4-098

generate at current prices and with average yield \$6.0 million additional income annually for durum growers in the Midwest.

**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 producers of North Dakota have a durum cultivar (Divide) that has a moderate level of resistance to FHB.

FY05 (approx. May 05 – April 06)

FY05 Final Performance Report

PI: Elias, Elias

ARS Agreement #: 59-0790-4-098

**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.**

Breeding effort to develop Fusarium head blight resistant durum wheat in North Dakota. *In* The 2005 National Fusarium Head Blight Forum, Milwaukee City Center, Milwaukee, WI, 11-13 December, 2005.