USDA-ARS/  
U.S. Wheat and Barley Scab Initiative  
FY14 Final Performance Report  
July 15, 2015

Cover Page

<table>
<thead>
<tr>
<th>PI:</th>
<th>Jin-Rong Xu</th>
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<tbody>
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<td>Institution:</td>
<td>Purdue University</td>
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| Fiscal Year: | FY14 |
| USDA-ARS Agreement ID: | 59-0200-3-009 |
| USDA-ARS Agreement Title: | Exploring Novel Approaches to Reduce the Impact of Fusarium Head Blight and DON. |
| FY14 USDA-ARS Award Amount: | $ 47,287 |

USWBSI Individual Project(s)

<table>
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<tr>
<th>USWBSI Research Category*</th>
<th>Project Title</th>
<th>ARS Award Amount</th>
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<tr>
<td>PBG</td>
<td>Different Roles of Two Beta-Tubulins in Fungicide Resistance and DON Production.</td>
<td>$ 47,287</td>
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<td><strong>FY14 Total ARS Award Amount</strong></td>
<td><strong>$ 47,287</strong></td>
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Principal Investigator: Jin-Rong Xu  
Date: 7-15-2015

* MGMT – FHB Management  
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain  
GDER – Gene Discovery & Engineering Resistance  
PBG – Pathogen Biology & Genetics  
EC-HQ – Executive Committee-Headquarters  
BAR-CP – Barley Coordinated Project  
DUR-CP – Durum Coordinated Project  
HWW-CP – Hard Winter Wheat Coordinated Project  
WES-CP – Western Coordinated Project  
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:  
   SPR – Spring Wheat Region  
   NWW – Northern Soft Winter Wheat Region  
   SWW – Southern Soft Red Winter Wheat Region
Project 1:  Different Roles of Two Beta-Tubulins in Fungicide Resistance and DON Production.

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

   The goal of this study is to characterize the functions of two beta-tubulin Tub1 and Tub2 in DON production and benzimidazole fungicide resistance. We have generated the TUB1-GFP and TUB2-mCherry transformants and showed that both Tub1- and Tub2-microtubules were sensitive to fungicide treatment but the latter was more sensitive. Unlike tub2 mutants, tub1 mutants were blocked in ascospore formation. Because fungicide resistance mutations in field isolates have only been identified in TUB2, we introduced the resistance mutation E198L into TUB1 in PH-1 and TUB2\textsuperscript{E198L} mutant. The resulting TUB1\textsuperscript{E198L} transformants had no significant changes but TUB1\textsuperscript{E198L} TUB2\textsuperscript{E198L} mutants were hyper-sensitive to benzimidazole fungicides. Nevertheless, these transformants with the E198L mutation in TUB1 were blocked in ascospore formation, and still respond to low dose of benzimidazole fungicides for stimulating DON production.

   In addition, we have generated transformants of PH-1, cpk1, fac1, tub1, and tub2 mutants expressing the TRI12-mCherry and TRI4-GFP constructs. The cpk1 and fac1 mutants were blocked in the toxisome formation but not intercalary hyphal swelling. Toxisome formation and mobilization in the other transformants have been examined under fluorescence microscope and will be carefully examined to determine their functions by confocal microscopy.

2. List the most important accomplishments and their impact (i.e. how are they being used) to minimize the threat of Fusarium Head Blight or to reduce mycotoxins. Complete both sections; repeat sections for each major accomplishment:

   **Accomplishment:**  Our data showed that TUB1 and TUB2 differed in sensitivity to benzimidazole fungicides. They also play different roles in hyphal growth, sexual reproduction, and sexual reproduction. More importantly, we found that fungicide resistance mutations in TUB1 had a significant cost effect by blocking ascospore formation. We also showed that the cAMP-PKA pathway is essential for toxisome formation.

   **Impact:**  Because the cAMP-PKA pathway is essential for toxisome formation, it should be a great molecular targets for disrupting DON production in *F. graminearum*. Mutants with fungicide resistance mutations in both TUB1 and TUB2 are blocked in sexual reproduction. Therefore, it is impossible for *F. graminearum* to become completely resistant to benzimidazole fungicides in nature due to the fitness cost associated TUB1 mutation on ascospore formation. (That may explain why MBC fungicides are still effective in controlling FHB after being used in some countries over 30 years)
Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY14 award period. The term “support” below includes any level of benefit to the student, ranging from full stipend plus tuition to the situation where the student’s stipend was paid from other funds, but who learned how to rate scab in a misted nursery paid for by the USWBSI, and anything in between.

1. Did any graduate students in your research program supported by funding from your USWBSI grant earn their MS degree during the FY14 award period?  No

   If yes, how many?

2. Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY14 award period?  No

   If yes, how many?

3. Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?  Yes

   If yes, how many?  Dr. Cong Jiang whom participated in this project has taken a faculty position in Northwest A&F University in China.

4. Have any post docs who worked for you during the FY14 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?  None

   If yes, how many?
Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI during the FY14 award period. List the release notice or publication. Briefly describe the level of FHB resistance. If not applicable because your grant did NOT include any VDHR-related projects, enter N/A below.

N/A

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 FY14 grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.


(Form – FPR14)