USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY19 Final Performance Progress Report
Due date: August 31, 2021

Cover Page

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Fiscal Year:	2019
USDA-ARS Agreement ID:	59-0206-8-212
USDA-ARS Agreement Title:	Using Chitosan Nanoparticles Targeting Fusarium and Mycotoxins during Malting
FY19 USDA-ARS Award Amount:	$ 29,097
Recipient Organization:	North Dakota State University Office of Grant & Contract Accouting NDSU Dept 3130, PO Box 6050 Fargo, ND 58108-0650
DUNS Number:	80-388-2299
EIN:	45-6002439
Recipient Identifying Number or Account Number:	FAR0030321
Project/Grant Reporting Period:	7/1/19 - 6/30/21
Reporting Period End Date:	6/30/2021

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
FST-R	Using Chitosan Nanoparticles Targeting Fusarium and Mycotoxins during Malting	$ 29,097
	FY19 Total ARS Award Amount	**$ 29,097**

Jiajia Rao

_____   08/18/2021
Principal Investigator   Date

FY19 Final Performance Progress Report
PI: Rao, Jiajia
USDA-ARS Agreement #: 59-0206-8-212
Reporting Period: 7/1/19 - 6/30/21

Project 1: *Using Chitosan Nanoparticles Targeting Fusarium and Mycotoxins during Malting*

1. **What are the major goals and objectives of the research project?**
    Goal One: Preparation, Characterization of Chitosan Nanoparticles
    Goal Two: Optimization of Antifungal and Antimycotoxigenic Efficacy in Vitro System
    Goal Three: Application of Chitosan Nanoparticles for Reducing Fusarium Infection and DON
    production during Micro Malting processing.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

    a) **What were the major activities?**
        Majority activities in goal one:
        - Three different molecular weight of chitosan (low molecular weight, medium weight and high molecular weight) coated lipid nanoparticles have been successfully fabricated using the electrostatic layer by layer deposition procedure.
        - The physiochemical properties of chitosan coating nanoparticles have been characterized.
        - chitosan coatings on the physical properties lecithin stabilized cinnamon oil-in-water emulsions was investigated
        Majority activities in goal two:
        - The antifungal activity of chitosan coated nanoparticles has been evaluated in terms of mycelial growth and spore germination
        - The mycotoxin inhibitory activity of chitosan coated nanoparticles has been investigated in rice culture
        - The influence of chitosan coatings on the antifungal efficacy and mycotoxin inhibitory activity of lecithin stabilized cinnamon oil-in-water emulsions was also investigated
        Because chitosan itself has very weak antifungal and mycotoxin inhibitory activity against Fusarium growth and deoxynivalenol production. Therefore, we did not apply abovementioned nanoparticle systems for Reducing Fusarium Infection and DON production during micro-malting processing.

    b) **What were the significant results?**
        - The 0.1 wt% Chitosan could be electrostatically deposited on lecithin stabilized emulsion droplets at pH 5;
        - In general, mycotoxin inhibitory activities of chitosan coatings on emulsion droplets were better than that of chitosan solutions;
        - Emulsions with 0.1 wt% high molecular weight chitosan and 0.1 wt% low molecular weight chitosan showed the highest activity in reducing the accumulation of 15ADON and 3ADON produced by F. graminearum isolate 124-1 and 125-1, respectively.

- There is synergistic effect between chitosan and cinnamon oil on inhibition of fusarium mycelia growth.
- However, the inhibition of fungal spore germination and mycotoxin are mainly attributed to cinnamon oil rather than chitosan.

c) **List key outcomes or other achievements.**
Results have been published in two peer reviewed journal and presented in several conferences.

3. **Was this research impacted by the COVID-19 pandemic (i.e. university shutdowns and/or restrictions, reduced or lack of support personnel, etc.)? If yes, please explain how this research was impacted or is continuing to be impacted.**

No, majority of research findings have been done right before the COVID-19.

4. **What opportunities for training and professional development has the project provided?**

One of visiting scientist obtained the professional development through participate this project, and found the faculty position.

5. **How have the results been disseminated to communities of interest?**

Results have been presented in several conferences as listed below
- Dianhui Wu, Jian Lu, Jiajia Rao. Electrostatic deposition of chitosan on lecithin stabilized emulsion inhibits mycotoxin production in fusarium graminearum. 2018 AOCS Annual Meeting & Expo, Minneapolis, MN.
- Dianhui Wu, Jian Lu, Jiajia Rao. Chitosan coatings on lecithin-stabilized emulsions to inhibit mycotoxin production by Fusarium graminearum. 2018 Brewing Summit, San Diego, CA.
- Dianhui Wu, Jian Lu, Jiajia Rao. Influence of nonionic and ionic surfactants on the antifungal and mycotoxin inhibitory efficacy of cinnamon oil nanoemulsions. 2nd Mycokey international conference, Wuhan, China, 2018.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the **FY19 award period (7/1/19 - 6/30/21)**. 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 FY19 award period?**
   ☐Yes   ☒No   ☐ Not Applicable
   If yes, how many? Click to enter number here.

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY19 award period?**
   ☐Yes   ☒No   ☐ Not Applicable
   If yes, how many? Click to enter number here.

3. **Have any post docs who worked for you during the FY19 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**
   ☒Yes   ☐No   ☐ Not Applicable
   If yes, how many? 1

4. **Have any post docs who worked for you during the FY19 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**
   ☐Yes   ☒No   ☐ Not Applicable
   If yes, how many? Click to enter number here.

Release of Germplasm/Cultivars

Instructions: In the table below, list all germplasm and/or cultivars released with <u>full or partial</u> support through the USWBSI during the **FY19 award period (7/1/19 - 6/30/21)**. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations.

NOTE: Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.

Name of Germplasm/Cultivar	Grain Class	FHB Resistance	FHB Rating (0-9)	Year Released
Not applicable to this project.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
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Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year
Click here to enter text.	Select Grain Class	Select what represents your most resistant check	Enter as text 0-9 rating	Select Year

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

(Form – FPPR19)

Publications, Conference Papers, and Presentations

Instructions: Refer to the FPR_Instructions for detailed more instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY19 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period (7/1/19 - 6/30/21)** should be included. If you did not publish/submit or present anything, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each citation, you **must** indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in the publication/ presentation. See example below for a poster presentation with an abstract:

> Z.J. Winn, R. Acharya, J. Lyerly, G. Brown-Guedira, C. Cowger, C. Griffey, J. Fitzgerald, R.E. Mason and J.P. Murphy. 2020. "Mapping of Fusarium Head Blight Resistance in NC13-20076 Soft Red Winter Wheat." In: S. Canty, A. Hoffstetter, and R. Dill-Macky (Eds.), *Proceedings of the 2020 National Fusarium Head Blight Forum (*p. 12.), Virtual; December 7-11. Online: https://scabusa.org/pdfs/NFHBF20_Proceedings.pdf.
> Status: Abstract Published and Poster Presented
> Acknowledgement of Federal Support: YES (Abstract and Poster)

Journal publications.

Dianhui Wu, Jian Lu, Shaobin Zhong, Paul Schwarz, Bingcan Chen, **Jiajia Rao**. Influence of nonionic and ionic surfactants on the antifungal and mycotoxin inhibitory efficacy of cinnamon oil nanoemulsions. *Food & Function*, 2019, 10, 2817-2828.
Status: Published
 Acknowledgement of Federal Support: YES

Dianhui Wu, Jian Lu, Shaobin Zhong, Paul Schwarz, Bingcan Chen, **Jiajia Rao**. Physical stability, antifungal and mycotoxin inhibitory activities of lecithin stabilized cinnamon oil emulsions in the presence of chitosan. *LWT,* 2019, 106: 98-104.
Status: Published
Acknowledgement of Federal Support: YES

Dianhui Wu, Jing Wan, Jian Lu, Xingguo Wang, Shaobin Zhong, Paul Schwarz, Bingcan Chen, **Jiajia Rao.** Chitosan coatings on lecithin stabilized emulsions inhibit mycotoxin production by Fusarium pathogens. Food Control, 2018, 92:276-285.
Status: Published
Acknowledgement of Federal Support: YES

Books or other non-periodical, one-time publications.

 None

(Form – FPPR19)