

FY22 Performance Progress Report

Due date: July 26, 2023

Cover Page

USDA-ARS Agreement ID:	59-0206-2-093
USDA-ARS Agreement Title:	Fusarium Head Blight Management in Kansas
Principle Investigator (PI):	Kelsey Andersen Onofre
Institution:	Kansas State University
Institution UEI:	CFMMM5JM7HJ9
Fiscal Year:	2022
FY22 USDA-ARS Award Amount:	\$21,206
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Period of Performance:	May 1, 2022 – April 30, 2026
Reporting Period End Date:	April 30, 2023

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
MGMT IM-CP	Integrated management of Fusarium head blight in Kansas	\$21,206
FY22 Total ARS Award Amount		\$21,206

I am submitting this report as an: Annual Report

I certify to the best of my knowledge and belief that this report is correct and complete for performance of activities for the purposes set forth in the award documents.



Principal Investigator Signature

July 26th 2023

Date Report Submitted

† BAR-CP – Barley Coordinated Project
 DUR-CP – Durum Coordinated Project
 EC-HQ – Executive Committee-Headquarters
 FST-R – Food Safety & Toxicology (Research)
 FST-S – Food Safety & Toxicology (Service)
 GDER – Gene Discovery & Engineering Resistance
 HWW-CP – Hard Winter Wheat Coordinated Project

MGMT – FHB Management
 MGMT-IM – FHB Management – Integrated Management Coordinated Project
 PBG – Pathogen Biology & Genetics
 TSCI – Transformational Science
 VDHR – Variety Development & Uniform Nurseries
 NWW – Northern Soft Winter Wheat Region
 SPR – Spring Wheat Region
 SWW – Southern Soft Red Winter Wheat Region

Project 1: Integrated management of Fusarium head blight in Kansas

1. What are the major goals and objectives of the research project?

As a member of the IM-CP, the main objectives of our project in Kansas were the following:

- 1) Evaluate the integrated effects of fungicide treatment and genetic resistance on FHB and DON in hard red winter wheat in Kansas, with emphasis on new combinations of the fungicides, Prosaro Pro, and Sphaerex.
- 2) Compare the efficacy of Prosaro Pro and Sphaerex to Prosaro, Caramba, and Miravis Ace in Kansas.

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

Objective 1: Evaluate the integrated effects of fungicide treatment and genetic resistance on FHB and DON in hard red winter wheat in Kansas, with emphasis on new combinations of the fungicides, Prosaro Pro, and Sphaerex.

Major activities:

Field trials were established for the integrated management standard protocol in two locations in Kansas (Manhattan and Belleville) for the 2021-22 season. These locations represent two distinct wheat production environments. At each location, the treatments and experimental design followed the standard protocol released by the FHB MGMT CP. Field experiments will be established as a randomized complete block design with a split-plot arrangement with variety as the whole plot and fungicide treatment as the sub-plot. There were four replications of each treatment. Varieties consisted of three hard red winter wheat varieties with differing levels of resistance to FHB (WB4458 = S; Bob Dole = I; Zenda = MR).

During the 2021-22 growing season, experiments were planted on 7 Nov 2021 in Belleville, KS and on 18 Nov 2021 in Manhattan, KS. Unfortunately, due to unseasonable drought conditions in Kansas in 2022, the Manhattan, KS location was abandoned. The Belleville location was inoculated with a macroconidia suspension (100,000 spores/ml) at early Anthesis (Feekes 10.5.1). Fungicide treatments were applied with a CO₂ powered backpack sprayer at a pressure of 30 psi at 20 gal/A. The sprayer was equipped with three flat fan TT110015-VP nozzles 50 cm apart on a 100-cm-long boom. Visual ratings of disease severity, index, and incidence were taken by rating four clusters of 10-15 plants per plot (40-60 individual plants per plot). Plots were harvested with a small plot combine on 21 June 2022. After harvest, sub-samples of grain were visually rated for percent Fusarium-damaged kernels (FDK) and shipped to the mycotoxin testing laboratory in the Department of Plant Pathology at the University of Minnesota, St. Paul.

Results from 2021-22 were shared with the leadership of the IM-CP for further summary (Dr. Pierce Paul).

DON samples have been shipped for the 2022-23 season so we anticipate that data will be delivered to Pierce Paul in late August 2023. For the 2022-23 season, plots were established in the same two locations in Kansas.

Significant Results:

During the 2021-22 season visual disease levels were very low in Belleville, KS with mean index (IND) values below 0.01% for the untreated check of the susceptible variety. DON values ranged from 0.00-0.12 ppm with the highest value being in the untreated check for the susceptible variety WB4458 and the lowest being for the untreated check for the MR variety Zenda. Yields at this location ranged from 86.9 bu/A to 97.6 bu/A.

Results from the 2022-23 season are still being summarized and will be reported during the next reporting period as the data was collected after April 30th 2023.

Key outcomes or other activities:

Unseasonably dry conditions in the region during the 2021-22 growing season negatively influenced the outcome of this trial. It well documented that high relative humidity around the flowering window is necessary for infection and symptom progression.

Objective 2: Compare the efficacy of Prosaro Pro and Sphaerex to Prosaro, Caramba, and Miravis Ace in Kansas.

Major activities:

Field trials were established for the standard protocol in two locations, Manhattan, KS and Parsons, KS in both the 2021-22. These locations represent two distinct wheat production environments. At each location, the treatments and experimental design followed the standard protocol released by the FHB MGMT CP. In Parsons, Kansas in 2021- 22 plots were planted on 5 October 2021 to the FHB susceptible hard red winter wheat variety 'KanMark'. Plots were 5 x 28 ft (5 rows/plot) with a seeding rate of 80 g per plot. Plots were arranged in a randomized complete block design with four replications. Plots were inoculated with *Fusarium graminearum* infested corn spawn (isolates X-3639 and Pt104) on 31 March 2022 and 7 April 2022 at a rate of 15 g per square meter per application. This location was mist irrigated regularly to the point of soil saturation to stimulate perithecia development on corn spawn. Fungicide treatments were applied with a CO₂-powered backpack sprayer at a pressure of 30 psi calibrated to 20 gal/A. The sprayer was equipped with three flat fan TT110015-VP nozzles spaced 50 cm apart on a 100 cm boom. Early anthesis treatments were applied on 6 May 2022 at early anthesis (Feekes 10.5.1) and second applications were made on 10 May 2022. Visual rating of disease severity (index) was evaluated on 23 May 2022 by rating four clusters of 10-15 plants per plot (40-60 individual plants per plot). Plots were harvested with a small plot combine on 29 June 2022. After harvest, sub-samples of grain were visually rated for percent Fusarium

damaged kernels (FDK) and shipped to the mycotoxin testing laboratory in the Department of Plant Pathology at the University of Minnesota, St. Paul.

The Manhattan, KS location was planted on 15 October 2021 to variety ‘KanMark’ was planted with plot sizes of 5 x 30 ft (5 rows/plot) with a seeding rate of 80 g per plot. Plots were inoculated with *Fusarium graminearum* infested corn spawn (isolates X-3639 and Pt104) on 11 April, 18 April, and 25 April 2022 at a rate of 10 g per square meter per application. This location was also mist irrigated regularly to the point of soil saturation to stimulate perithecia development on corn spawn. Fungicide treatments were applied as previously described on 14 May 2022 (Feekes 10.5.1) and subsequent applications were made 5 days later. Plots were harvested with a small plot combine on 21 June 2022. After harvest, sub-samples of grain were visually rated for percent *Fusarium*-damaged kernels (FDK) and shipped to the mycotoxin testing laboratory in the Department of Plant Pathology at the University of Minnesota, St. Paul.

Significant Results:

In 2021-22 at the Parsons, KS location yields (YLD) were not significantly different, although yields were numerically higher for all fungicide treatments than for the untreated check. Grain test weight was greater for all fungicide treatments than for the untreated check. The untreated check had the highest values of FHB index (IND, P-value = 0.0575) and DON (P-value = 0.213) when compared to Miravis Ace *fb* Prosaro Pro. The FHB index values for the treatment Miravis Ace *fb* Folicur were higher than expected, given the level of control observed in the Miravis Ace single application treatment.

Table 1. Means from the 2021-22 UFT trial in Parsons, Kansas.

#	TREATMENT	RATE	IND (%)	YLD (BU/A)	DON (ppm)	FDK (%)	Test Weight
1	Untreated check	...	18.75 a	21.9	6.2 a	8.3	51.0 d
2	Prosaro - A	6.5	7.5 bc	21.6	3.5 cbd	2.5	53.2 bc
3	Caramba - A	13.5	12.8 ba	23.9	4.2 cb	3.0	52.6 c
4	Miravis Ace - A	13.7	7.0 bc	26.4	3.6 cbd	2.5	54.0 ab
5	Prosaro Pro - A	10.3	12.5 abc	23.7	4.2 cb	4.0	52.7 c
6	Sphaerex - A	7.3	10.3 bc	24.6	3.1 ced	3.0	53.8 ab
7	Miravis Ace <i>fb</i> Prosaro Pro	13.7/10.3	5.5 c	24.9	2.3 e	3.0	54.6 a
8	Miravis Ace <i>fb</i> Sphaerex	13.7/7.3	8.0 bc	26.2	2.8 ed	1.8	54.5 a
9	Miravis Ace <i>fb</i> Tebuconazole	13.7/4	12.0 abc	25.1	4.6 b	5.8	53.5 bc
p-value			0.0575	0.1196	0.0213	0.0522	<0.0001

Results from the 2021-22 season at the Manhattan, KS location indicated that the effect of treatment on grain yield was significant, with all fungicide treatment resulting in significantly higher yields than the untreated control (Table 2). The Miravis Ace *fb* Prosaro Pro resulted in the highest mean grain yield 42.02 bu/A but this was not significantly different than the Miravis Ace *fb* Sphaerex treatment. The untreated check had the numerically lowest test weight but this was not significantly different than the fungicide

treatments. There was a significant effect of treatment on IND, DON, and FDK. All fungicides significantly decreased IND when compared to the untreated check.

Table 2. Means from the 2021-22 UFT trial in Manhattan, Kansas.

#	TREATMENT	RATE	IND (%)	YLD (BU/A)	DON (ppm)	FDK (%)	Test Weight
1	Untreated check	...	25.6 a	20.14 e	15.24 a	46.00 a	37.94
2	Prosaro - A	6.5	15.6 b	26.61 de	15.34 a	35.00 ab	42.58
3	Caramba - A	13.5	13.7 cb	27.12 d	10.24 bc	26.00 bcd	44.00
4	Miravis Ace - A	13.7	12.5 cb	32.28 dc	11.68 ab	26.00 bcd	43.84
5	Prosaro Pro - A	10.3	12.1 cbd	30.62 dc	10.24 bc	24.00 bcd	47.50
6	Sphaerex - A	7.3	15.7 b	28.22 d	11.92 ab	31.00 abc	44.48
7	Miravis Ace fb Prosaro Pro	13.7/10.3	7.0 d	42.02 a	7.30 c	13.00 d	45.24
	Miravis Ace fb Sphaerex	13.7/7.3	8.6 cd	41.31 ab	9.74 cb	16.60 cd	45.44
8	Miravis Ace fb Tebuconazole	13.7/4	10.4 cbd	34.84 bc	10.18 cb	18.00 cd	47.24
p-value			<0.0001	<0.0001	0.0026	0.0071	0.24

Results from the 2022-23 season are still being summarized and will be reported during the next reporting period as the data was collected after April 30th 2023.

Key outcomes or other activities:

The results of the UFT trials at both locations in 2021-22 will provide valuable insights on the efficacy of these products, particularly when applied successively during flowering.

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

This project has provided professional development for several students, post-docs, a research associate and visiting scholar. For example:

Karina Stott (a Research Associate who left K-State in March 2023) oversaw inoculum production and culture maintenance, critical components of this project. In the 2021-22 and 2022-23 seasons, Karina was primarily responsible for maintaining isolates of *Fusarium graminearum* and preparing mung bean and carrot agars for production of macroconidia and ascospores, respectively. She trained **Angel Detrinidad** (a MS student in my program) on these techniques and Angel was able to oversee preparation in her absence. He was also able, with training and guidance from the PIs to assist with inoculations and fungicide applications. This was a great learning opportunity as a supplement to his graduate projects and overall goals of applied plant pathology. **Dr. Raissa Debacker Moura** (a post-doctoral fellow working with PI Onofre) oversaw corn inoculum production and was trained by the PIs on fungicide rate calculations, calibration, and application through the course of this project. Along with Angel, **Jennifer Abshire** (MS student in PI Andersen Onofre’s lab) and **Claudio Dias da Silva Jr.** (PhD student with PI Andersen Onofre) were also trained on taking

incidence and severity field ratings, critical skills for plant pathologists. Through the course of this project, three visiting scholars were able to assist and be mentored, learning about field trial design, treatment applications, data collection and data analysis (**Felipe Ramos Montalvao, Melissa Cassou Trindade, Daniel Gallas**). Finally, **Dr. Sylvia Moraes** (a postdoctoral fellow working with PI Andersen Onofre) worked on reporting the UFT data in our experiment station reports and also worked to summarize a long-term data set (not yet published). In total, that is eight individuals who received training and professional development opportunities from this project.

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

As FHB is of increasing concern in Kansas, results from this work was directly incorporated into several extension/outreach talks in FY22 including:

- 1) K-State East Central Experiment Field Day. Ottawa, KS. Aug 17th 2022 Topic: How do wheat fungicides fit into wheat production in eastern Kansas (with a focus on FHM management). Attendees: 75.
- 2) K-State Pesticide Applicator Recertification. Salina, KS Nov 9th 2022. Topic: Practical management of Fusarium head blight in Kansas (head scab). 87 Attendees.
- 3) Kansas Agribusiness Retailers Association Winter CPU. Manhattan, Kansas December 8th 2022. Topic: Practical management of FHB in Kansas. Attendees: 50 in person + 25 online
- 4) Wheat disease field day. Manhattan, KS. June 6th 2023. Topic: USWBSI Uniform Fungicide trial for FHB management. Attendees: 53.
- 5) Electronic newsletters: Fusarium head blight outlook and fungicide recommendations. May 18th, 2023. https://eupdate.agronomy.ksu.edu/article_new/fusarium-head-blight-outlook-and-fungicide-recommendations-544-7.
- 6) Radio: Agriculture Today. May 23rd 2023. Topic: Fusarium head blight outlook for 2023 and fungicide considerations.

Publications, Conference Papers, and Presentations

Please include a listing of all your publications/presentations about your FHB work that were a result of funding from your FY22 grant award. Only citations for publications published (submitted or accepted) or presentations presented during the **award period** should be included.

Did you publish/submit or present anything during this award period May 1, 2022 – April 30, 2023?

- Yes, I've included the citation reference in listing(s) below.
 No, I have nothing to report.

Journal publications as a result of FY22 award

List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Include any peer-reviewed publication in the periodically published proceedings of a scientific society, a conference, or the like.

Identify for each publication: Author(s); title; journal; volume; year; page numbers; status of publication (published [include DOI#]; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Books or other non-periodical, one-time publications as a result of FY22 award

Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like.

Identify for each one-time publication: Author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (book, thesis, or dissertation, other); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).

Other publications, conference papers and presentations as a result of FY22 award

Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication.

Moraes, S. R.G.; Pedreira, B. C., Sassenrath, G F.; De Wolf, E ; Onofre, R B.; and **Andersen Onofre, K.** (2023) "Fungicide Efficacy on Fusarium Head Blight of Hard Red Winter Wheat in Parsons, KS," Kansas Agricultural Experiment Station Research Reports: Vol. 9: Iss. 2.
<https://doi.org/10.4148/2378-5977.8439>

Andersen Onofre, K., De Wolf, E., Bucker Moraes, W., and Paul, P.A. (2022). MGMT coordinated project overview and Kansas perspective. Proceedings of the 2022 National Fusarium Head Blight Forum; Tampa, FL. December 4-6, 2022. Conference Talk. Retrieved from: <https://scabusa.org/forum/2022/2022NFHBForumProceedings.pdf>

Andersen Onofre, K. and De Wolf, E. D. 2023. Foliar fungicide efficacy ratings for wheat disease management 2021. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. Pub No. EP-130.