COVER PAGE

Title:

Characterizing fungicide sensitivity of diverse *Fusarium* spp. and determination of value of fungicide applications through meta-analysis

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Authors and Affiliation including contact information:

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Is this a

__ new project

___ continued project and if so, previous project wheat id number _____

_x__ continued project built of a previously funded project which was titled ___"Identifying and managing *Fusarium* species responsible for head scab"_____

Project goals and value for Michigan Wheat Growers:

Previously funded and completed work has surveyed Michigan wheat and collected more than 500 isolates of Fusarium and worked to identify which species and chemotypes are present. Further work proposed here aims to do more in depth work to put the results of the survey into context. Interestingly we found members of the *Fusarium tricinctum* Species complex, and we have reason to believe these species have different fungicide sensitivity profiles than *F. graminearum*, and aim to characterize this with lab and greenhouse studies in order to determine effectiveness of field applications against these species. An additional goal of the Chilvers lab is to determine best practices for foliar fungicide applications. Data from several years (2008-2020) a collected by the Chilvers lab and Martin Nagelkirk will be utilized in a meta-analysis study, analyzing all the data together to answer questions about major trends in fungicide response in michigan. This will hopefully culminate in journal and extension articles that clearly outline what range of fungicide response farmers can expect at different timings in order to aid decision making on profitability of fungicide applications.

Requested Budget: $39,956.43

Are there matching funds and from whom:

USWBSI: integrated head scab management ~$12,000

Is this a collaborative project with other researchers and/or farmers with an on-farm research component: We will be collaborating with Martin Nagelkirk and on the meta-anlaysis project, utilizing his many years of trial data. We have also collaborated with the USDA Mycotoxin research unit (Dr. Todd Ward) to accurately identify and characterize the *Fusarium* spp. collected.

Body of Proposal:

Objectives

1) Characterize effects of diverse *Fusarium* species, and determine their sensitivity to triazole fungicides and new SDHI - Miravis Ace

It is often assumed that *Fusarium graminearum* is the main causal pathogen of head blight of wheat. However, there are more than 40 species worldwide known to infect these grains, and in previously funded work we have found multiple here in Michigan besides *F. graminearum* including *F. poae, F. sporotrichioides, F. culmorum, F. avenaceum, F. acuminatum, F. subglutinans, F. cerealis, F. tricinctum,* and *F. sporotrichioides.*

A particular area of interest is the *F. tricinctum* complex, which includes *F. avenaceum* and *F. acuminatum*. These showed up in the survey in a few different fields, and in high incidence in one field near Saginaw valley research and extension center. Recently these species have been reported in NC state survey (Cowger 2020) causing moniliformin contamination of grain. These recent findings in surveys may signal that this complex may be emerging as a more important pathogen. This could be due to shifting practices or environmental conditions, or perhaps they have been in the United States for some time, and were missed before. Data from triazole assays in the lab previously funded by MWP suggests these species are less sensitive to triazole fungicides (figure 1).

We aim to investigate the *Fusarium Tricinctum* complex more thourgally, as well as *F. poae* and *F. sporotrichioides*, and complete more in depth testing in the lab with fungicides at different doses. The three major triazole chemistries that make up folicur, caramba, prosaro, and proline will be tested (tebuconazole, prothioconazole, and metconazole). Additionally, the new SDHI component of Miravis Ace (pydiflumetofen) will be tested. This in depth testing will allow us to statistically test if these species react different to fungicides than *F. graminearum*. It will also allow us to determine if sensitivity varies by specific chemistry or class of chemistry (triazole verse SDHI).

Finally, we would also like to validate the relationship between prothioconazole and des-prothioconazole *in vitro*. Des-prothioconazole is a modified form of the fungicide prothioconazole (present in Proline and Prosaro). When prothioconazole is absorbed by the plant it is converted to des-prothioconazole. However this modified form of prothioconazole is quite expensive, and therefore researchers (including our work) commonly use regular prothioconazole in their assays. We would like to validate the differences between these two chemistries to demonstrate that the activity of Des-prothioconazole correlates with that of prothioconazole in vitro and therefore is an effective way to measure activity of this chemistry.

The next step will be to verify the fungicide sensitivity during infection of wheat plants particularly with the *Fusarium tricinctum* complex. This infection will be done in the greenhouse where conditions can be controlled. The new pesticide spray chamber purchased by the weeds team will be utilized to spray field rates on greenhouse plants in a controlled manner. The plants can be monitored for level of infection and efficacy of the chemistries.

These other species could produce additional toxins besides Deoxynivalenol (DON) and greenhouse material can be used to test for different toxins that may be produced in collaboration with toxin chemists. Ultimately this work will allow us to stay ahead of possible future threats to wheat besides *F. graminearum*, and begin to strategize future management of FHB.

2) Meta-analysis of Michigan fungicide efficacy data to determine response of different fungicide timings.

Multiple fungicide applications are often recommended by industry professionals, but as wheat prices fluctuate these applications may not be profitable, nor sustainable. Timing of fungicide application continues to be a key factor in efficacy, as applications too early or too late after an epidemic has started will not be nearly as efficacious. We seek to provide more comprehensive information to growers on benefits of different fungicide timings. We have run a fungicide timing trial for the last three years, testing multiple fungicide timings alone and in combination to determine which are most profitable and what range of yield losses are possible from foliar disease in michigan wheat. Treatments are listed in table 1. While some of these treatments would not be practical for a grower, or even exceed applications allowed by the label, they are used to determine yield loss from disease and yield benefit from individual treatments. This data will be used in conjunction with several years (2008-2020) of data collected by the Chilvers lab, and Martin Nagelkirk to do a meta-analysis. This type of statistical analysis allows us to combine existing data from many studies to answer bigger questions. Using data from many years will allow us to look at big trends and answer such questions as: How often would an early foliar application (feekes 6, jointing) help control an epidemic? What ranges of yield response can a grower expect from applications at different timings? Can two fungicide applications be profitable? This analysis will culminate in an peer reviewed journal article, and adapted for an MSU extension article that can be shared through michigan wheat emails. Ultimately this will aide growers in making informed decisions to improve profitability and environmental sustainability.

3) Continued field trials examining best disease management practices with emphasis on fungicide efficacy, and fungicide timing. Monitoring emerging diseases and communicating disease management in support of Michigan wheat producers.

Plans to Share Information with Growers:

Results will be shared at summer and winter extension meetings, conferences, publications, extension articles and social media including Twitter and YouTube. The Chilvers lab provides head scab articles every year during critical decision making periods, and again at winter meetings. Manuscripts will be published in scientific journals, and grower articles will be crafted to highlight the output of the research and explain it in more digestible terms than the journal article. Articles are published at MSUE News for Ag site and can be distributed through the MWP newsletter.

Budget Narrative:

One paragraph to describe any leveraged funding or additional commentary regarding funding request (e.g. previous or anticipated subsequent years of funding)

Requested support is for Ms. Mikaela Breunig. Materials and supplies costs will come from other sources.

MWP funding has been leveraged through other sources including USDA-NIFA, USWBSI, fungicide trials for companies.

Research Proposal Budget Form: See attached Excel File

Figure 1. Distribution of sensitivity of various Fusarium species infecting wheat and corn, determined by testing isolates at 1ppm of tebuconazole in lab based Petri-plate assay. The relative growth is calculated by taking the growth of the isolate on 1 ppm tebuconazole divided by the same isolate on a control plate with no fungicide. Species or isolates with higher relative growth signifies they were not inhibited greatly by the fungicide and therefore are more insensitive or "resistant" to the chemistry. Such is the case with members of the *Fusarium tricinctum* complex and *F. poae* which appear skewed to the right hand of the distribution, most

above 50% relative growth.

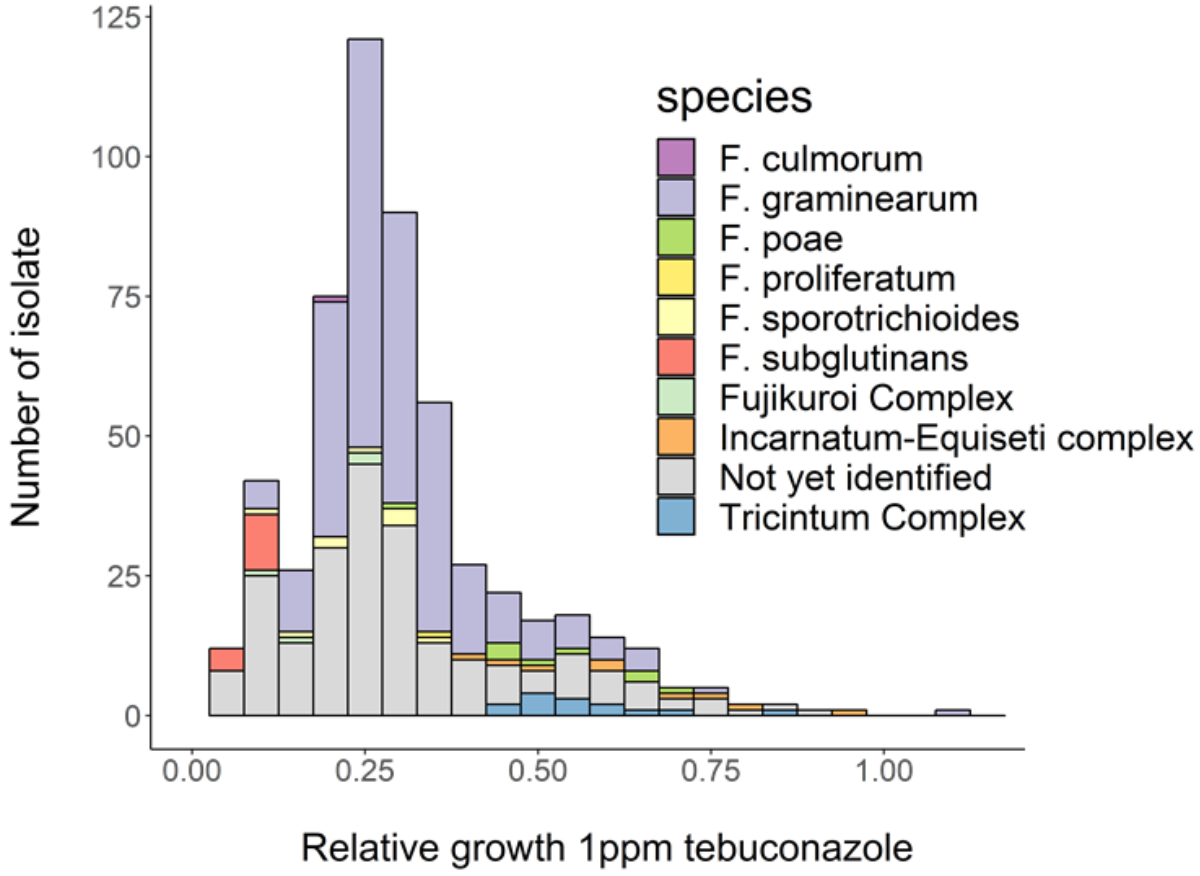

Table 1. Treatments included in fungicide timing experiment (2017-2020) to investigate optimal foliar fungicide timing

Treatment	Timings
1	Untreated
2	T1 (Fks ⅝) (Prosaro 6.5 floz)
3	T2 (Fks 9) (Prosaro 6.5 floz)
4	T3 (Fks 10.5.1) (Prosaro 6.5 floz)

5	T3.5 (5-7 days after flowering) (Prosaro 6.5 floz)
6	T1 + T3 (Prosaro 6.5 floz)
7	T2 + T3 (Prosaro 6.5 floz)
8	T1 + T2 + T3 (Prosaro 6.5 floz)
9	T1 (Stratego YLD 4 fl oz)+ T3 (Prosaro 6.5 floz)

Michigan Wheat Program FY 20-21 Funding

PI(s):

PROJECT START DATE: **PROJECT END DATE:**

SPONSOR CODE: 019725

TITLE:

PROPOSAL DEVELOPMENT #:

Project Budget				
A. Personnel Wages	**FY 20-21**	**FY 21-22**	**Non-MWP Funds****	**Source****
Research associates/post-docs/on-call/technical				
Fringe associated*				
Graduate students				
Fringe associated*				
Undergraduate students				
Fringe associated (summer work)*				
B. Non-expendable equipment (attach explanation)				
C. Materials, supplies & publications				
D. Travel				
E. Other direct costs (attach explanation, list of items and individual costs).				
Grand Total	$ -	$ -	$ -	

Note: Address budget justification and matching funds within proposal.

*** MSU fringe rate information available at https://www.cga.msu.edu**

****Identify both sources and amounts of non-MWP funds in these two columns.**

Indicate if sources are secured or requested.

AgBioResearch Internal Reporting ONLY

Plot fee Detail designated for MSHS, MAC and MCC RFP's.
List station(s) and acre(s) for project work

Plot Fees**	**FY**	**FY**	**FY**
Station 1:			
Station 1 Estimated Acres:			
Station 1 Total $ Estimate:			
Station 2:			
Station 2 Estimated Acres:			
Station 2 Total $ Estimate:			
Station 3:			
Station 3 Estimated Acres:			
Station 3 Total $ Estimate:			
TOTAL ESTIMATED FUNDS:	$ -		

****Plot fees will be reviewed for funding by the Michigan Tree Fruit Commission**