

2020 Hindsight on NABSEN

Thomas T Baldwin
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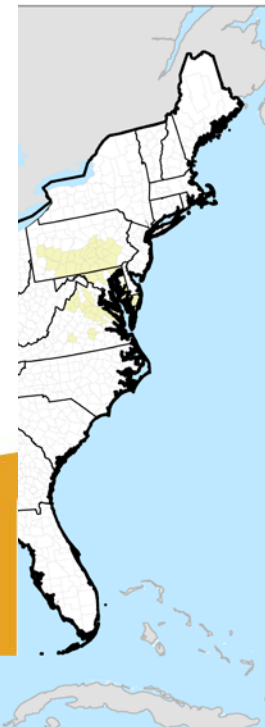
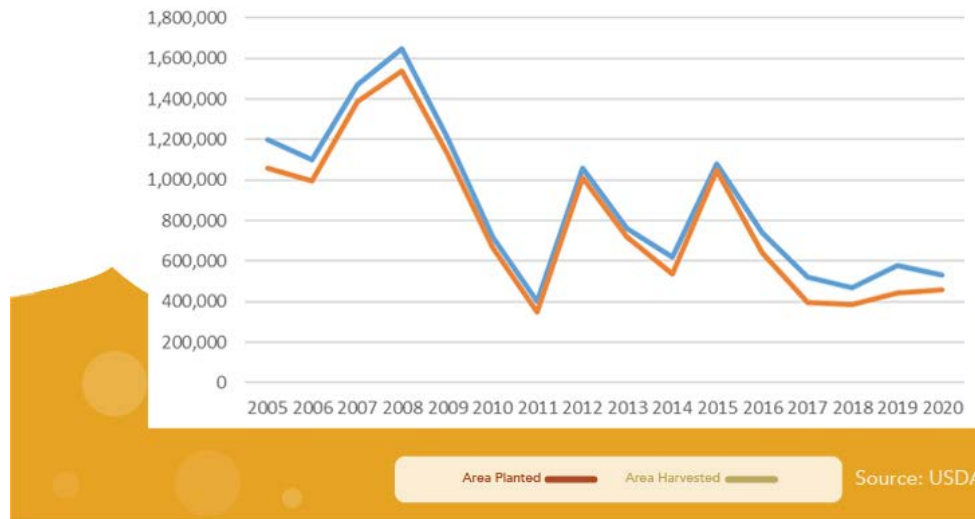




Barley Production



BARLEY PLANTED AND HARVESTED - NORTH DAKOTA



It used to be that people grew a lot of barley and wheat in the upper-eastern portion of the Midwest and out to the East Coast, but they don't do that anymore. Fusarium head blight drove them out. - Phil Bregitzer





North American Barley Scab Evaluation Nursery



Stephen Neate



Richard Horsley

From the beginning

- Started in 2002
- NABSEN coordinates multiple nurseries
- Misted & Dryland nurseries
- Longest running Scab evaluation nursery
- Evaluation of Public-private material

North American Barley Scab Evaluation Nursery



Robert Brueggeman Richard Horsley

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North American Barley Scab Evaluation Nursery

Locations

- Fargo & Langdon, ND



Pat Gross



North American Barley Scab Evaluation Nursery



Richard Horsley

Locations

- Fargo & Langdon, ND
- Osnabrock, ND

North American Barley Scab Evaluation Nursery

ABInBev



Marie
Timmerman



Austin Case

Locations

- Fargo & Langdon, ND
- Osnabrock, ND
- Casselton, ND

North American Barley Scab Evaluation Nursery



Ruth Dill-Macky



Kevin Smith

Locations

- Fargo & Langdon, ND
- Osnabrock, ND
- Casselton, ND
- St. Paul & Crookston, MN



North American Barley Scab Evaluation Nursery



Agriculture and
Agri-Food Canada



Ana Badea



James Tucker

Locations

- Fargo & Langdon, ND
- Osnabrock, ND
- Casselton, ND
- St. Paul & Crookston, MN
- Brandon, Manitoba

2020 Hindsight on NABSEN



- North Dakota: Fargo and Langdon are misted
- North Dakota: Castleton and Osnabrock are dryland
- Crookston and St. Paul in the US and Brandon, Manitoba in Canada are misted

2020 Hindsight on NABSEN



- Data from CYMMIT in Toluca, Mexico
 - Lead by Flavio Capettini
 - Included spray inoculation and point inoculation (Type II)
 - Ended in 2007 due to difficulty in getting disease

2020 Hindsight on NABSEN



- Elite barley lines from university cooperators and industry partners
- Lines are planted in short rows (1.2 m long) in a random controlled block design
- Corn spawn and/or macroconidia are used as inoculation (location dependent)
- FHB evaluation is determined at Feekes 11.2 growth stage (soft to mid-dough)
- Severity and DON are measured using a robust procedure to ensure uniformity

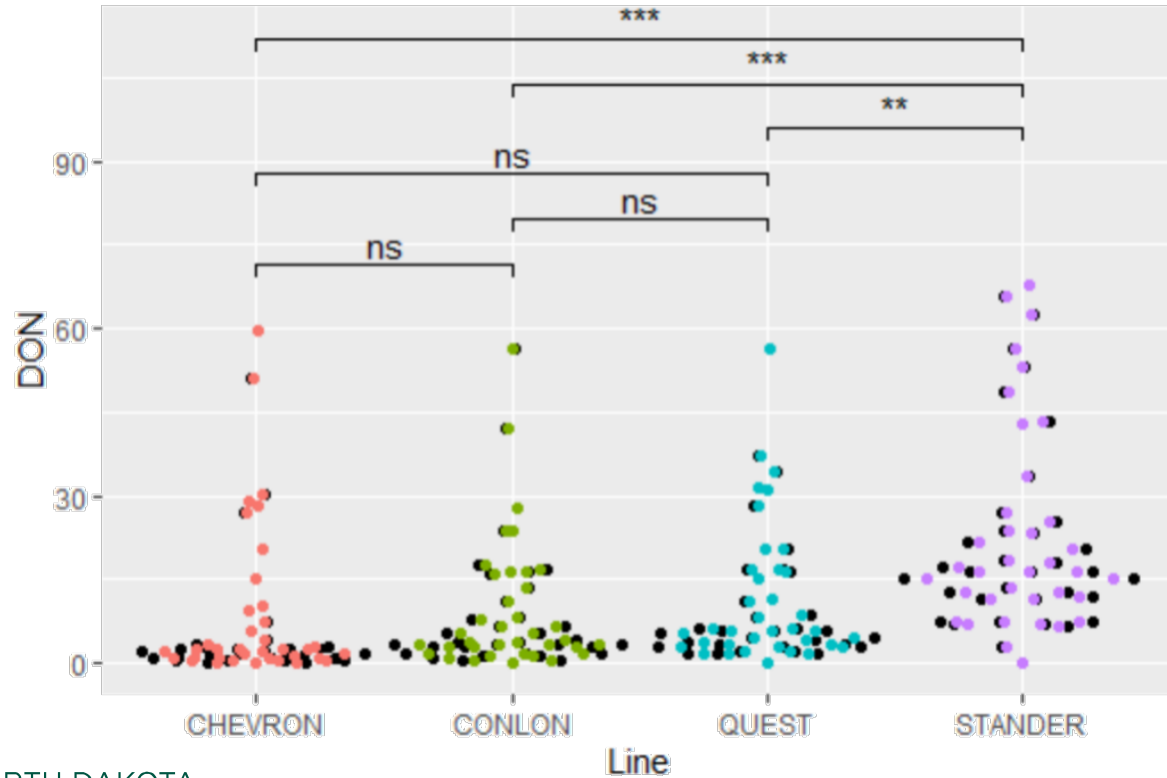
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- NABSEN 41 – 54 Lines
- Each line is planted in three replicates with consistent checks
- Standard six check: Conlon (2), Robust (2), Stander (6), Chevron (6), Quest (6)
- ND 2493 (replaced MN Bright)
- CI-4196 was dropped in 2009



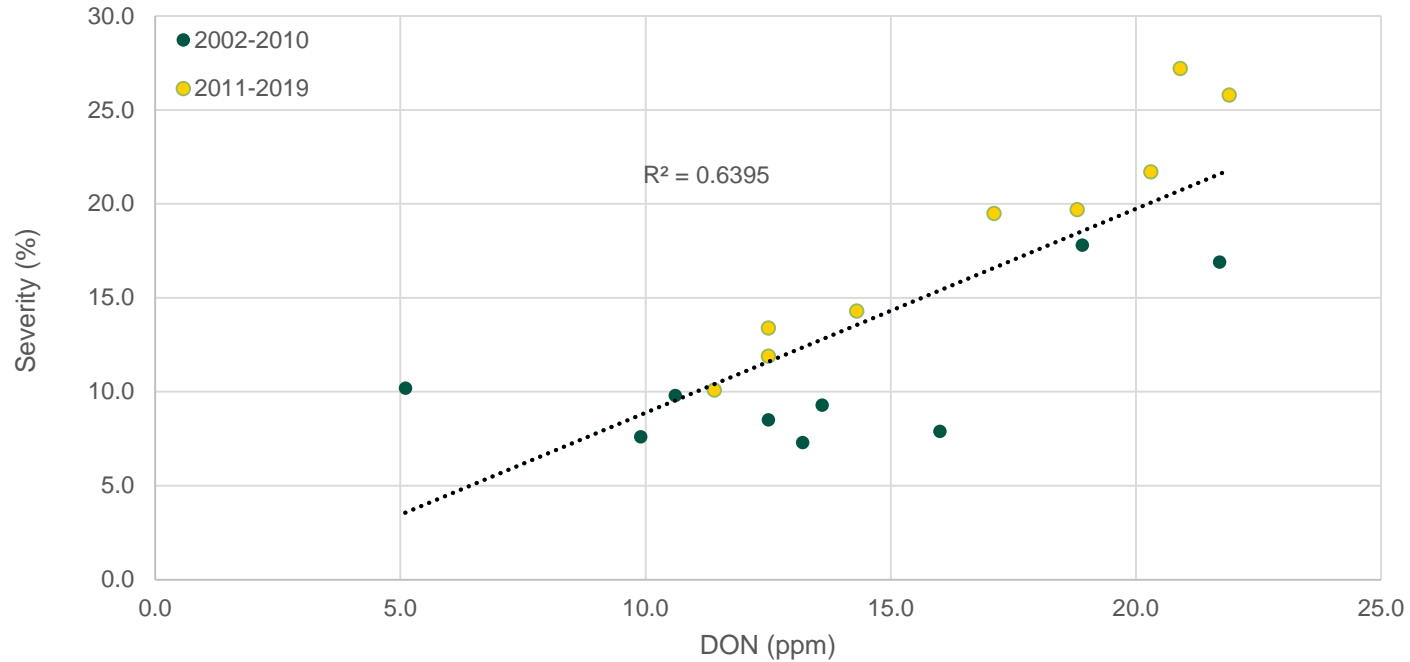
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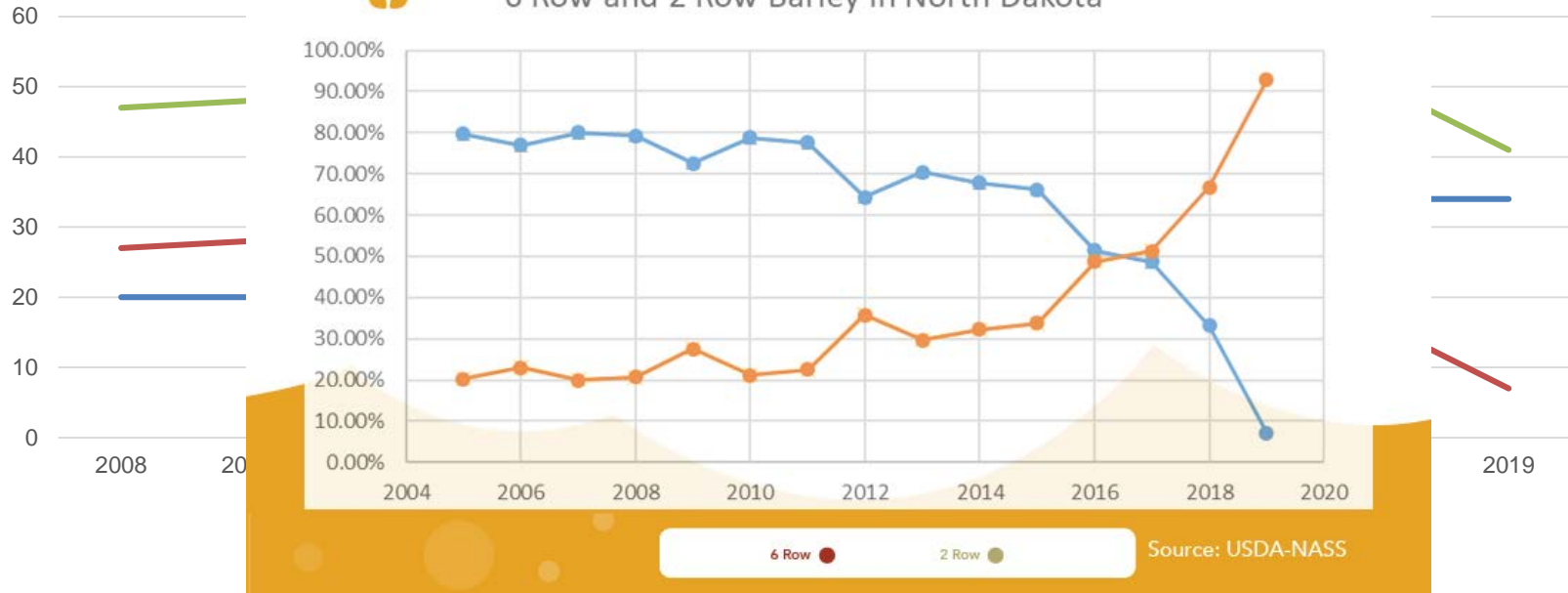
Possible improvements for getting better disease?

- Wetter soil
- Putting out corn inoculum sooner
- Change of corn inoculation preparation

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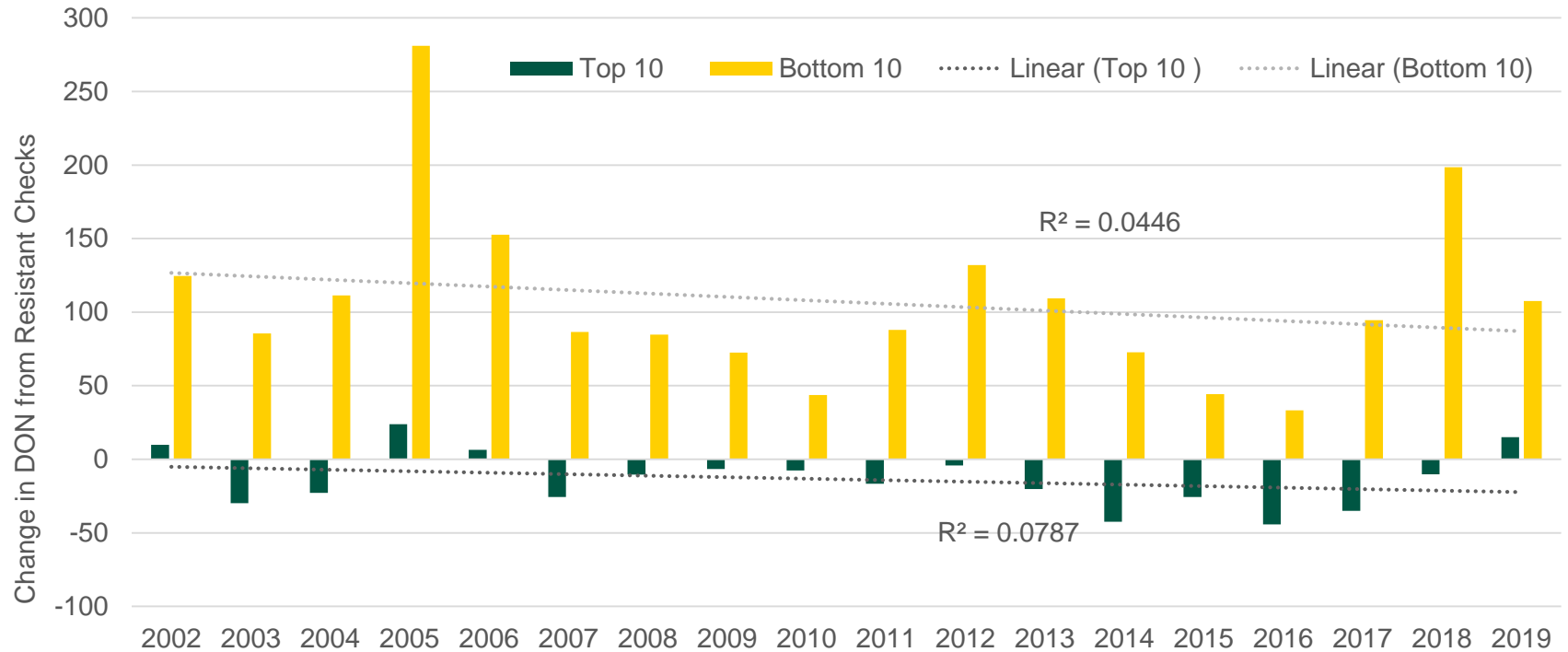


Percentage of Harvested Area of
6 Row and 2 Row Barley in North Dakota



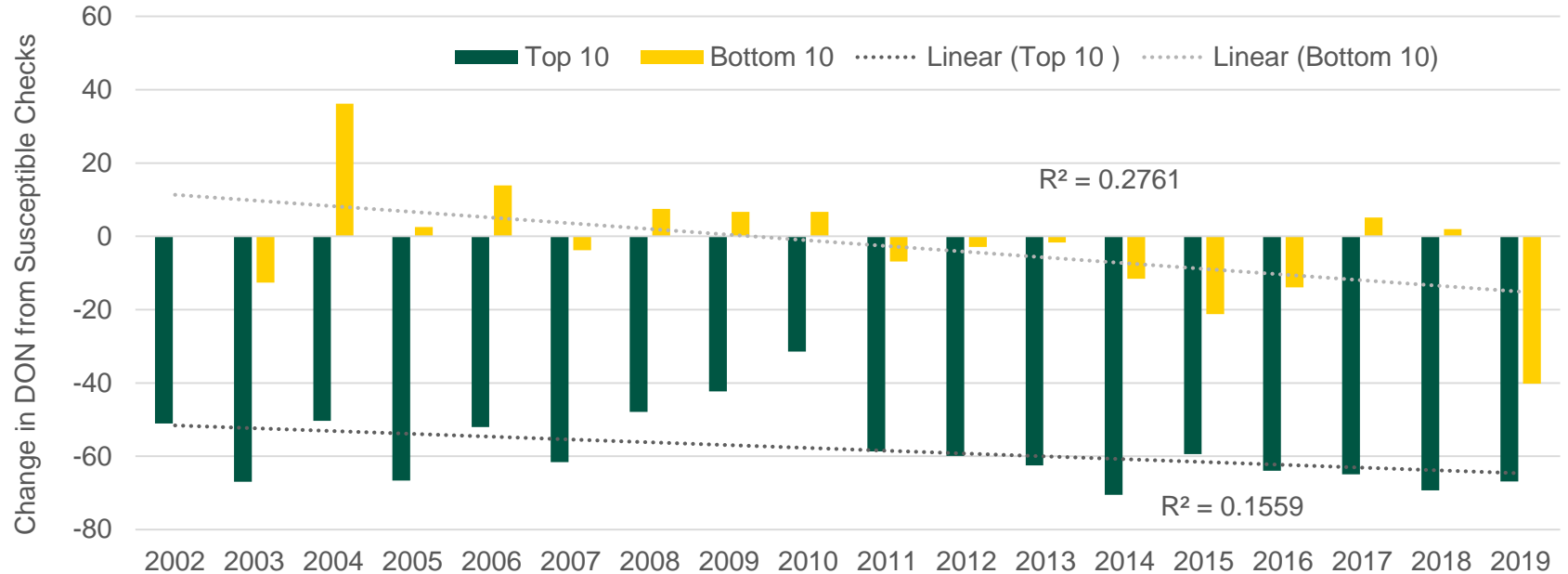


2020 Hindsight on NABSEN





2020 Hindsight on NABSEN



2019

**NORTH AMERICAN BARLEY SCAB EVALUATION NURSERY
(NABSEN) REPORT**

***Patrick Gross**

Department of Plant Pathology North Dakota State University

***address all enquiries regarding this report to Patrick Gross, address enclosed**

2020 Hindsight on NABSEN

Summary

- Continues to evaluate scab in elite barley lines to aid malt barley breeders
- An increase in disease pressure is notably higher in recent decades
- There has been progress in breeding resistance to scab and DON aided by NABSEN when comparing data from historic checks

NABSEN 2021



Thomas T Baldwin



Fusarium Head Blight Biomass in Spring Barley Comparing 2018 to 2019 in U.S. Nurseries

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2020 National Fusarium Head Blight Forum
Barley Coordinated Projects

Introduction

FHB (Fusarium head blight) caused by *Fusarium graminearum* is one of the devastating diseases of cereals specially for barley, wheat and oats and has a negative impact in North American economy of about multibillion-dollar loss (Nagnje et al. 2004). FHB produced DON (deoxynivalenol) that has caused great concern for barley industry and stakeholders. To develop FHB resistant cultivars through selection based on disease severity is not very effective to lock the resistance. Additionally, scoring for FHB is difficult and time consuming. So, breeders are looking an approach to identify selection technique that will lead to more accurate, higher-heritability selection. For this reason, most barley breeders rely mostly on the amount of DON accumulation in the harvested grain. However, this does not provide a measurement of infection and aspects of resistance could be missing when only DON is considered. Measuring biomass by quantitative PCR will provide a level of infectivity apart from DON. In our study spring barley samples from 2018 and 2019 national FHB nurseries were evaluated for DON, severity rating and biomass. The objective of this study was to investigate the utility of q-PCR estimation of *Fusarium graminearum* to see if this is better method to score infection severity and has true level of infectivity compared to biomass.

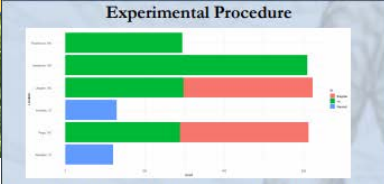


Figure 1. Count of Barley Samples from each Nursery & each PI tested for Biomass and DON across US national FHB nurseries in 2019. A total of 2,390 spring barley were grown at the Aberdeen location and tested for Biomass. The samples were sent ground to the NDSU Barley DON Testing Lab for measurements of DON.



Figure 2. Spring and Winter Barley Analyzed in 2019. In addition to the (2,390) spring barley samples, 902 winter barley samples were analyzed for comparison. The winter barley come from PI Marshall and Bretzger and were planted in MI, Holly, VA and Kimberly ID in the field the previous year, and in Aberdeen ID as hill plot transplants.

DNA extraction

An established protocol has been used to measure the biomass which shown detail of 2019 National Fusarium Head Blight Forum poster. Usually, the infected barley heads were finely ground a 1/8" Mill with a 20 mesh screen and separated at least 1 gram for DON testing and ~50 mg was extracted in 96 well Plant/Fungi DNA Isolation Kit™ (Norgen BioLabs)

Quantitative PCR

Fusarium graminearum biomass was estimated using primers Tr5QF (TGAGGGATGTTGGATTGAGCAGTAG) and Tr5QR (TGCTTCGGC-TCATCAAAACAGCT) from Bhalan et al., 2007 (MPMI 20:627-636). DNA was diluted to 15ng/ul for qPCR analysis using SsoFast™ Supermix kit (Bio-Rad). A highly susceptible barley line (Yuma 2017) and a mixture of *F. rubrum*/*F. graminearum* DNA in a ratio (1:1) were combined to generate a standard curve in each of the qPCR plate. For details (see National Fusarium Head Blight Forum Proceedings p. 102-105)

Acknowledgments

This work was supported by the USDA-ARS Project 2050-21000-034-040 and by the US Wheat and Barley Scab Initiative projects FY18-BA-003 and FY18-BA-014. We thank our cooperators for testing our materials including DON analysis: Paul Schwarz, NDSU

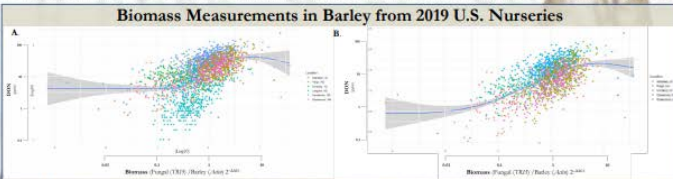


Figure 3. Biomass - DON relationship in 2019 Spring Barley ($R^2 = 0.3047$) and adjusted ($R^2 = 0.3487$). To determine the relationship between measured Biomass and DON a residual plot was constructed with a fitted line to report the coefficient of determination (R^2). Viewing the data in plot (A), PI Ha's barley lines from Langdon, ND deviates from the trend of biomass-DON from the other nurseries. Separating those lines from the analysis increases the R^2 and changes the fitted line (B) Due to this observation the nursery was separated in further analysis and should be inquired as to why that material responded differently.

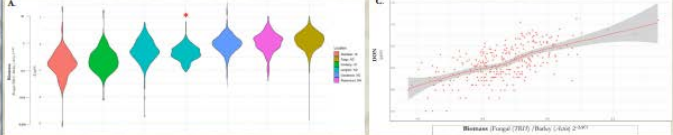
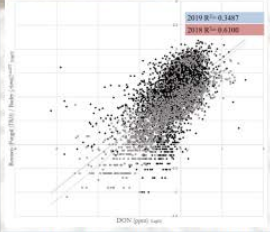


Figure 4. Biomass & DON Levels by Nursery in 2019. The biomass levels of individual nurseries is shown (A), and ranged for a Log10 of -3 to 1. This is expressed as a ratios of fungal to barley DNA. The range of DON is shown (B), and ranges from 0.1 to 100 ppm. PI Ha's Langdon material was separated (*) and the difference is noted in the level of measured DON, but does not appear different from the levels of biomass compared PI Bretzger's material from the same nursery. A residual plot (C) of the material in question shows an R^2 of 0.3891. This is constant with other nurseries, but has a lower slope than the other nurseries constant with lower levels of DON and higher biomass.

Comparison of Biomass in Spring Barley from U.S. Nurseries 2018 to 2019



Nursery	2018 (R^2)	2019 (R^2)
Kimberly, ID	x	0.2696
Aberdeen, ID	0.7215	0.0443
Langdon, ND	0.402	0.1552
Fargo, ND	0.2152	0.3919
Rosemount, MN	0.2902	0.4953
Osnabrock, ND	0.3256	0.3458
Ithaca, NY	0.6211	x

Figure 5. Biomass & DON Levels for Spring Barley in 2018 and 2019 & Table 1. Coefficient of Determination for Spring Barley Nurseries. Overall R^2 for 2019 was lower from those measured in 2018. Biomass levels and DON levels preliminarily appear higher in 2019 than 2018 (data not shown). By nursery, R^2 was lower for most nurseries in 2019, except Fargo, ND and Rosemount, MN. Some data discrepancies could not be resolved for Aberdeen, ID for the creation of this data analysis and is likely why Aberdeen, ID had a significant drop in R^2 . Likely, the data discrepancy is affecting the overall R^2 as well.

Winter vs. Spring Barley in 2019



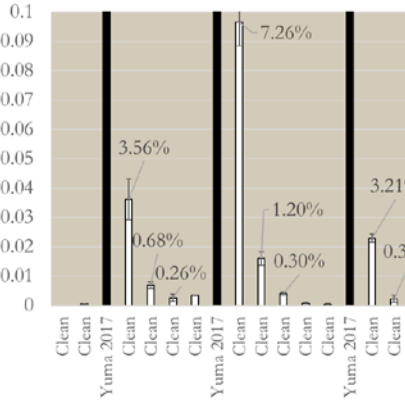
Conclusions

- Biomass is still a useful measurement tool for FHB infection. Most severity ratings have a Coefficient of determination to DON of <0.1 (data not shown)
- Correlations of biomass to DON are variable between nurseries and were lower than in 2018, combined and individually.
- Performing a sole sourced grind did not noticeably improve the Coefficient of determination is expected from last years data.
- Increasing observations. Observing the lower than expected DON data from the measured biomass of PE Ha material from Langdon, ND in 2019 could discover important finding or should taken into consideration for using the data

Whole

Grinding

Biomass (Fungal (*TRI5*) - Barle

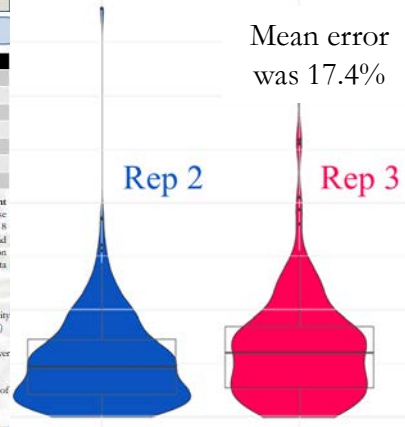


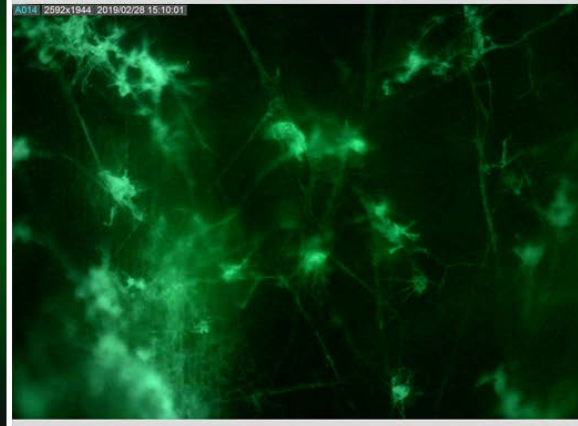
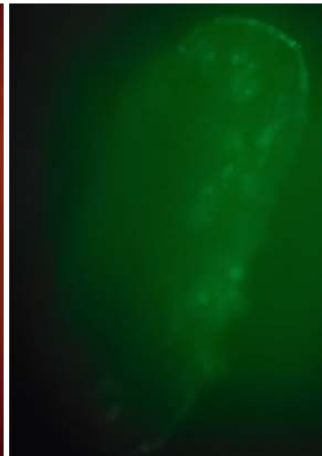
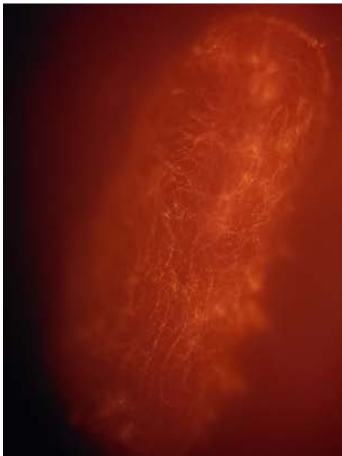
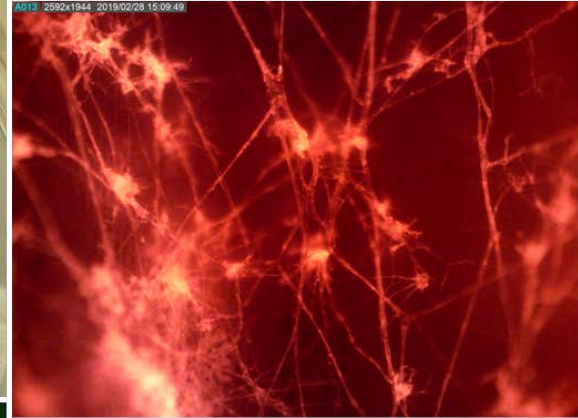
mass

Biomass³
(qPCR)

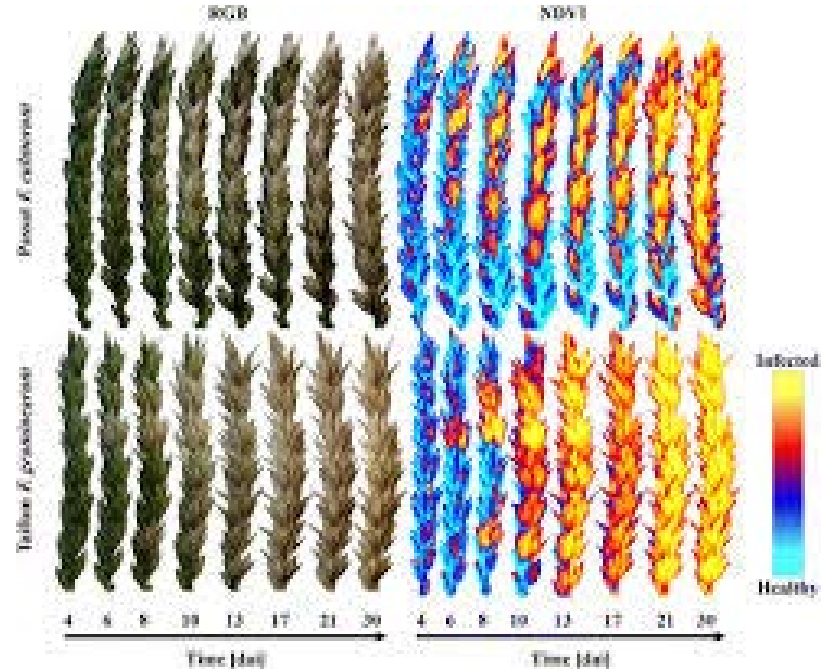
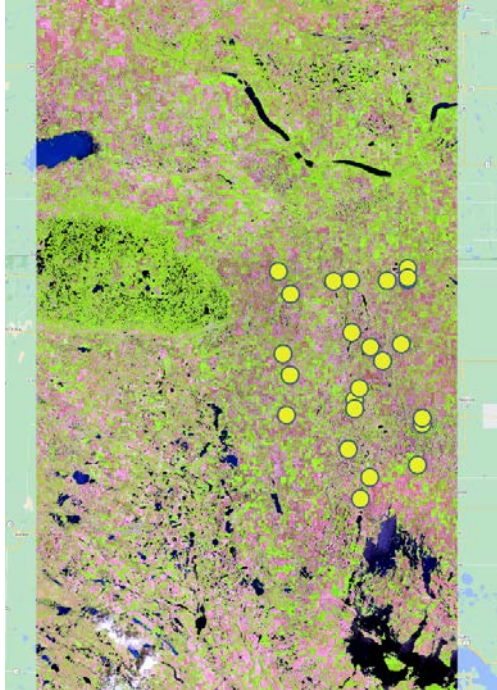
qPCR

Mean error was 17.4%

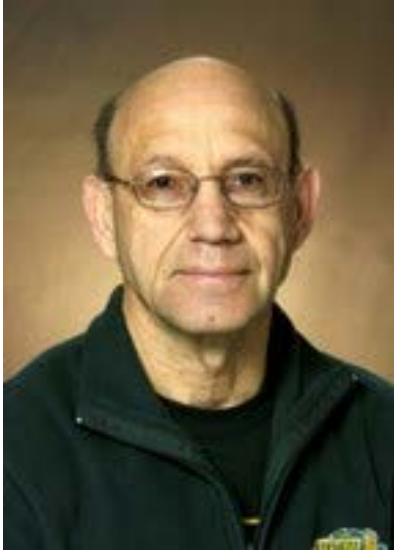




Remote Sensing and Hyperspectral Imaging



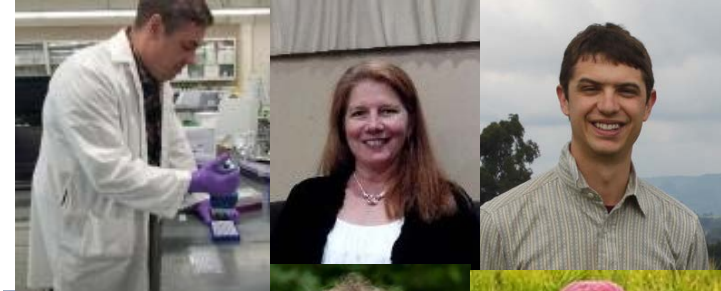
Thank you!



Pat Gross



U.S. Wheat & Barley
Scab Initiative



Special Thanks and Remembrance of

Phil Bregitzer

Friend and Mentor



Questions?

