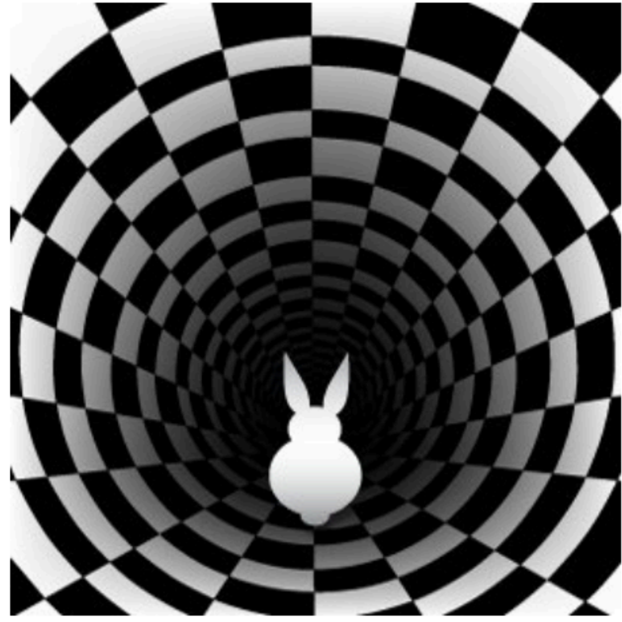


University of Idaho Extension

GOING DOWN THE RABBIT HOLE:

EFFECT OF CLIMATE CHANGE ON FHB AND SMALL GRAINS

Juliet Marshall
Tod Shelman
Margaret Moll
Suzette Arcibal Baldwin
Belayneh Yimer
Linda Jones
Martha Carillo
Rachel Patterson

(going) down the rabbit hole

DEFINITIONS AND SYNONYMS

PHRASE

DEFINITIONS 1

1. **used for referring to a situation that is strange, confusing, or illogical, and often hard to escape from**


What does it mean to go down the rabbit hole?
What does rabbit hole mean? Used especially in the phrase going **down the rabbit hole** or falling **down the rabbit hole**, a **rabbit hole** is a metaphor for something that transports someone into a wonderfully (or troublingly) surreal state or situation.

INTERMOUNTAIN WEST AND PNW ENVIRONMENT

AGRICULTURAL

SOCIAL (ORGANIC)

CLIMATE

IDAHO'S AGRICULTURAL STATUS

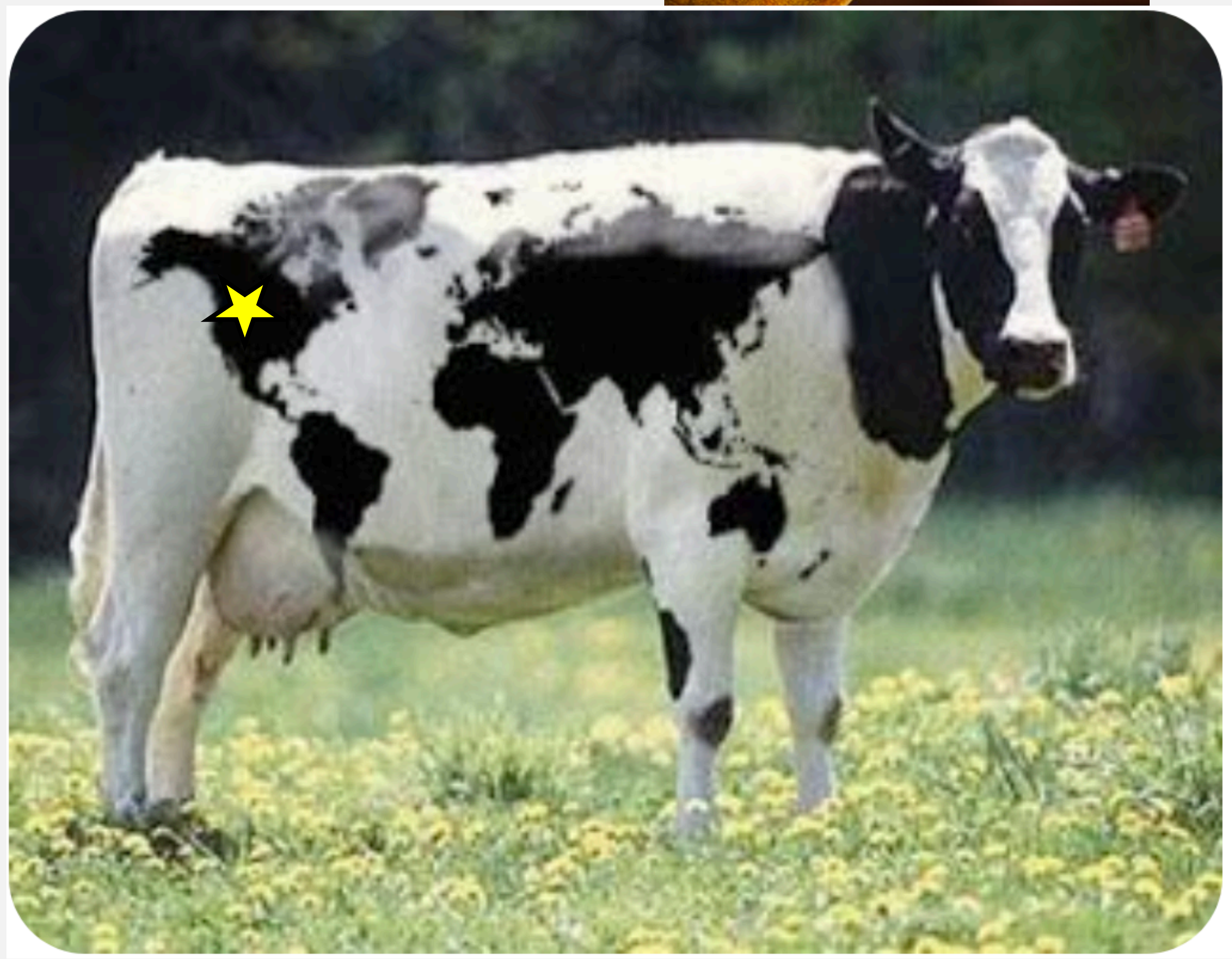
30% OF IDAHO'S ECONOMY IS DIRECTLY BASED ON AGRICULTURE

30% of Idaho's economy is directly based on Agriculture

- #1 in Trout production
- #1 in Potato (almost 1/3 of US crop)
- #1 in Malt Barley
- #5 in Wheat production
- #3 in Dairy production (milk)







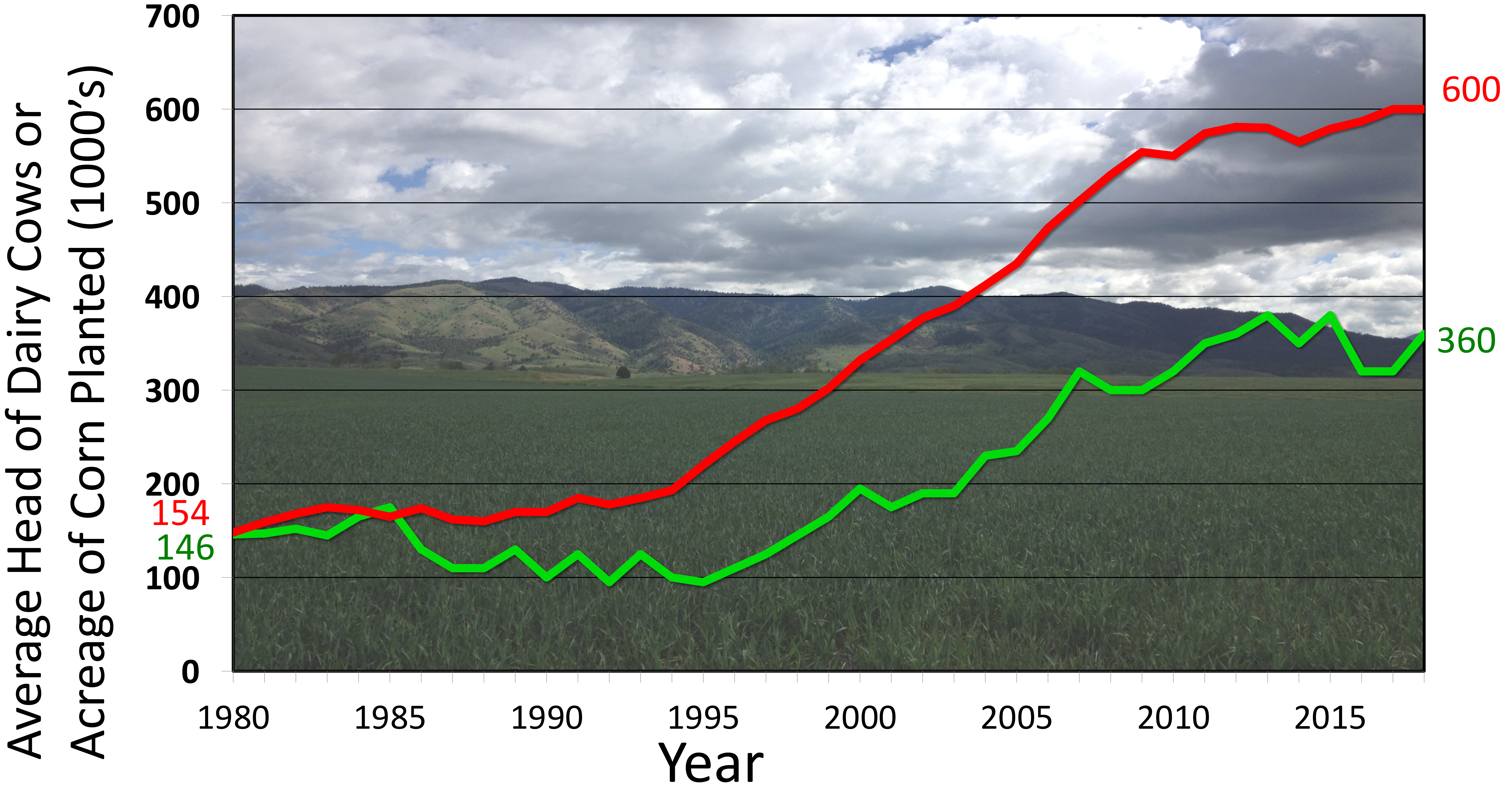
2700 ft to >6000 ft

830 m to >1800 m

CHANGING AGRICULTURAL ENVIRONMENTS FOR THE PNW FOR THE LAST 30 YEARS

- CROPPING SYSTEMS
- IRRIGATION
- CLIMATE

Crop Rotation – Corn and Dairy in Southern Idaho



AN INCONVENIENT CROP

FHB IN IDAHO: THEN AND NOW

F. graminearum

F. culmorum

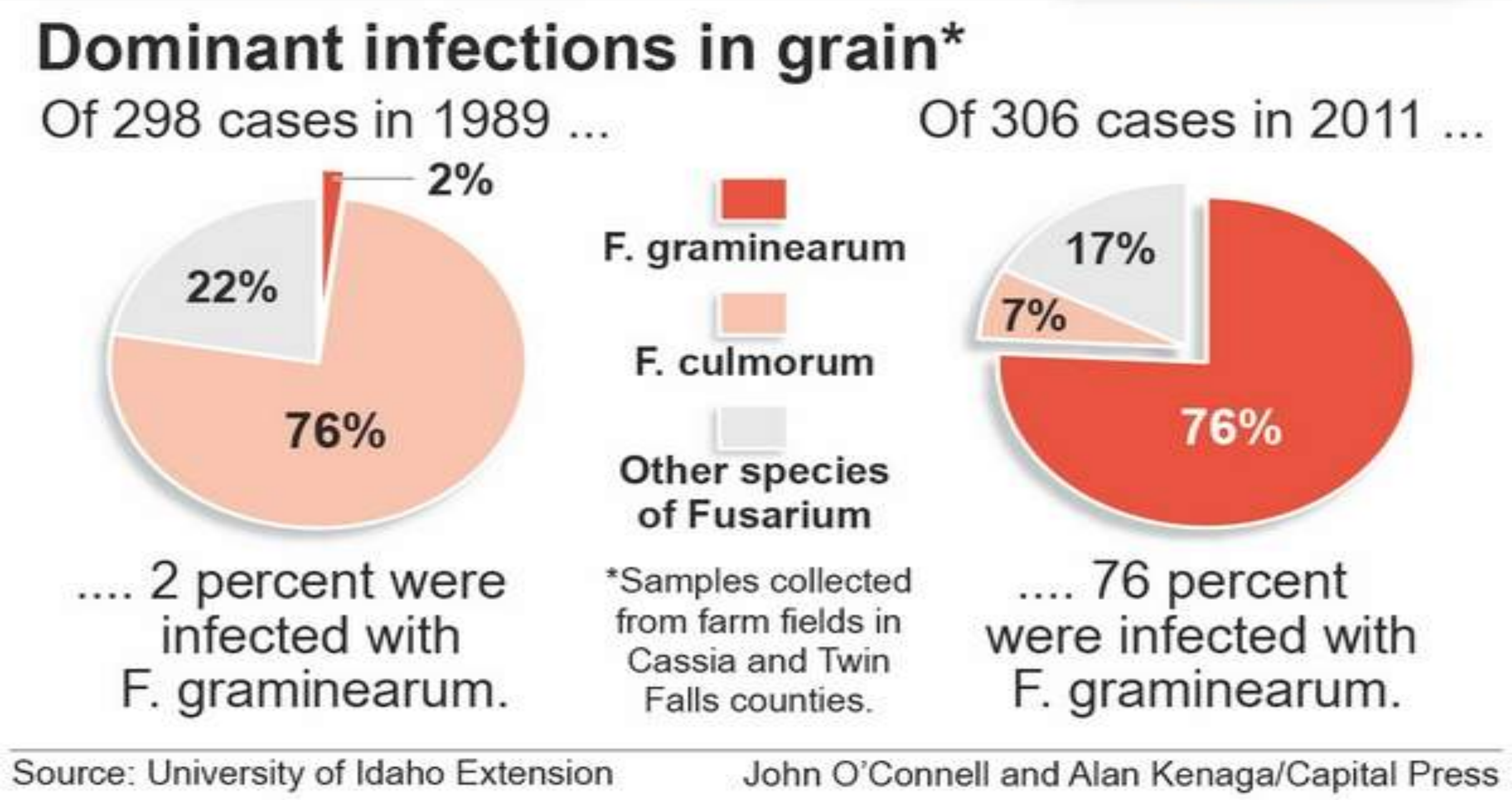
Plant Health Progress ◆ 2018 ◆ 19:125–127 https://doi.org/10.1094/PHP-10-17-0066-S

Plant Health Survey

Survey of *Fusarium* Species Associated with Fusarium Head Blight of Spring Wheat (*Triticum aestivum*) in Southeastern Idaho

Kaitlyn M. Bissonnette, Department of Entomology, Plant Pathology, and Nematology, University of Idaho, Idaho Falls, 83402; **Philip Wharton** and **Jianli Chen,** Department of Entomology, Plant Pathology, and Nematology, University of Idaho, Aberdeen, 83210; and **Juliet M. Marshall,**† Department of Entomology, Plant Pathology, and Nematology, University of Idaho, Idaho Falls, 83402

Accepted for publication 2 March 2018.



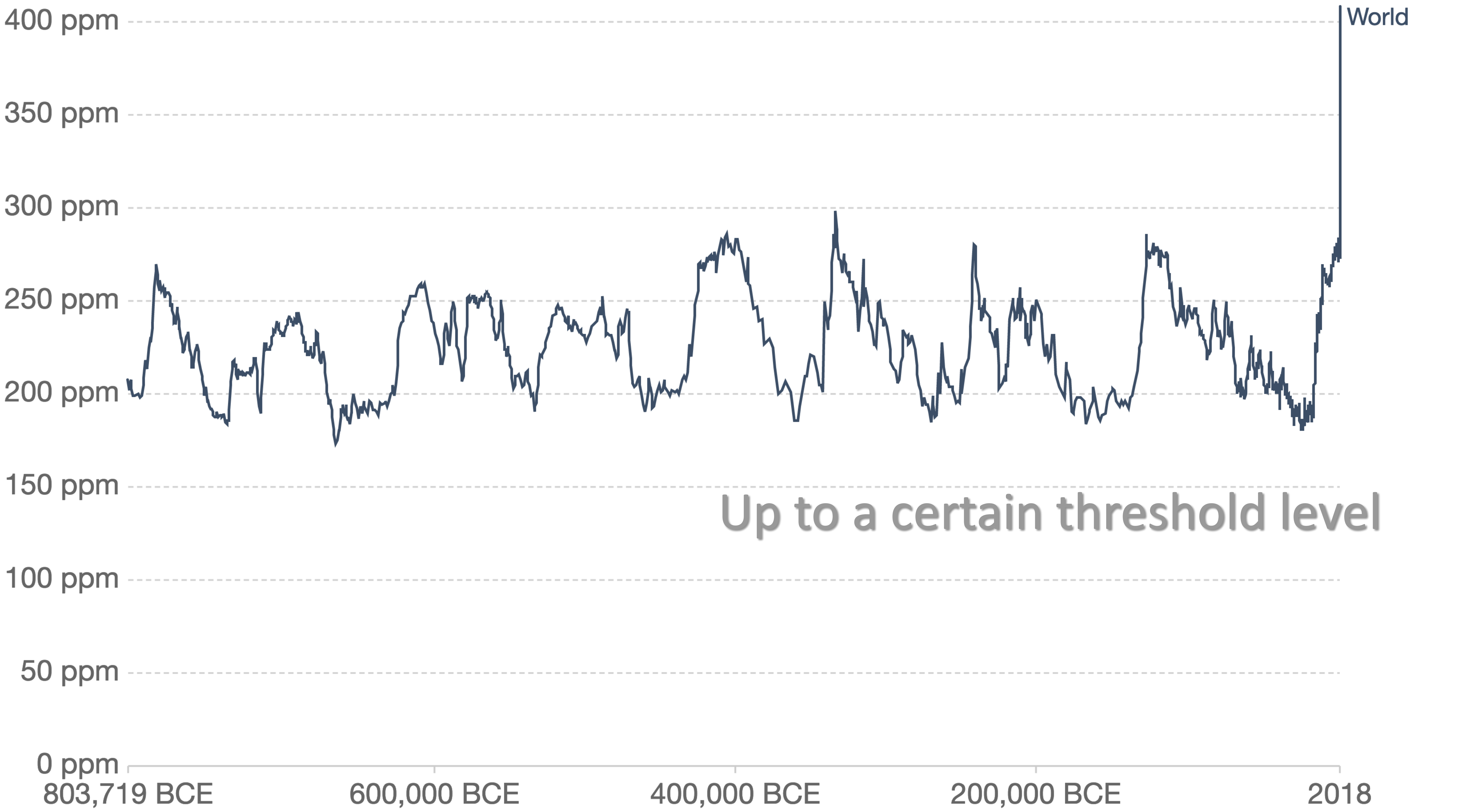
CLIMATE PREDICTION MODELS

CANADIAN CENTRE FOR CLIMATE MODELING AND ANALYSIS
HADLEY CENTRE IN THE UNITED KINGDOM
EPA WEBSITE ON GREENHOUSE GASES AND GLOBAL WARMING

Increasing CO_2
Greenhouse gases
Temperatures
Changing precipitation patterns

Atmospheric CO_2 concentration

Global average long-term atmospheric concentration of carbon dioxide (CO_2), measured in parts per million (ppm). Long-term trends in CO_2 concentrations can be measured at high-resolution using preserved air samples from ice cores.



Up to a certain threshold level

Source: EPICA Dome C CO_2 record (2015) & NOAA (2018)

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY

Atmospheric CO_2 concentration

Global average long-term atmospheric concentration of carbon dioxide (CO_2), measured in parts per million (ppm).

Our World in Data

- Should substantially INCREASE crop yields of: corn, cotton, soybeans, sorghum, barley, sugar beets, pastures and citrus

- Neutral or negative effects: wheat, rice, oats, hay, sugarcane, potatoes, and tomatoes

Up to a certain threshold level

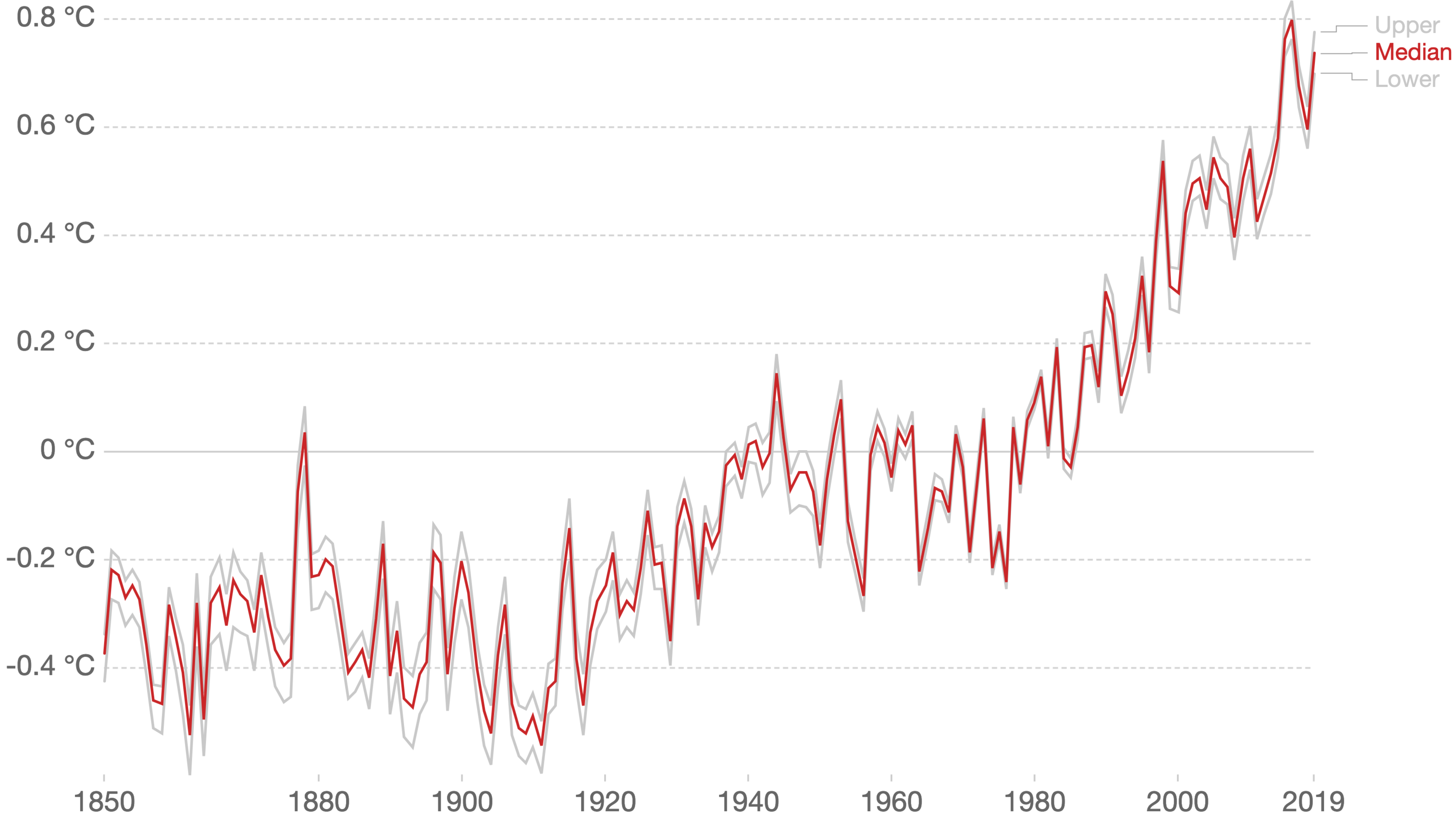
- Crop Quality! decreases in bread wheat

803,719 BCE | 600,000 BCE | 400,000 BCE | 200,000 BCE | 2018

Source: EPICA Dome C CO_2 record (2015) & NOAA (2018)

Average temperature anomaly, Global

Global average land-sea temperature anomaly relative to the 1961-1990 average temperature.



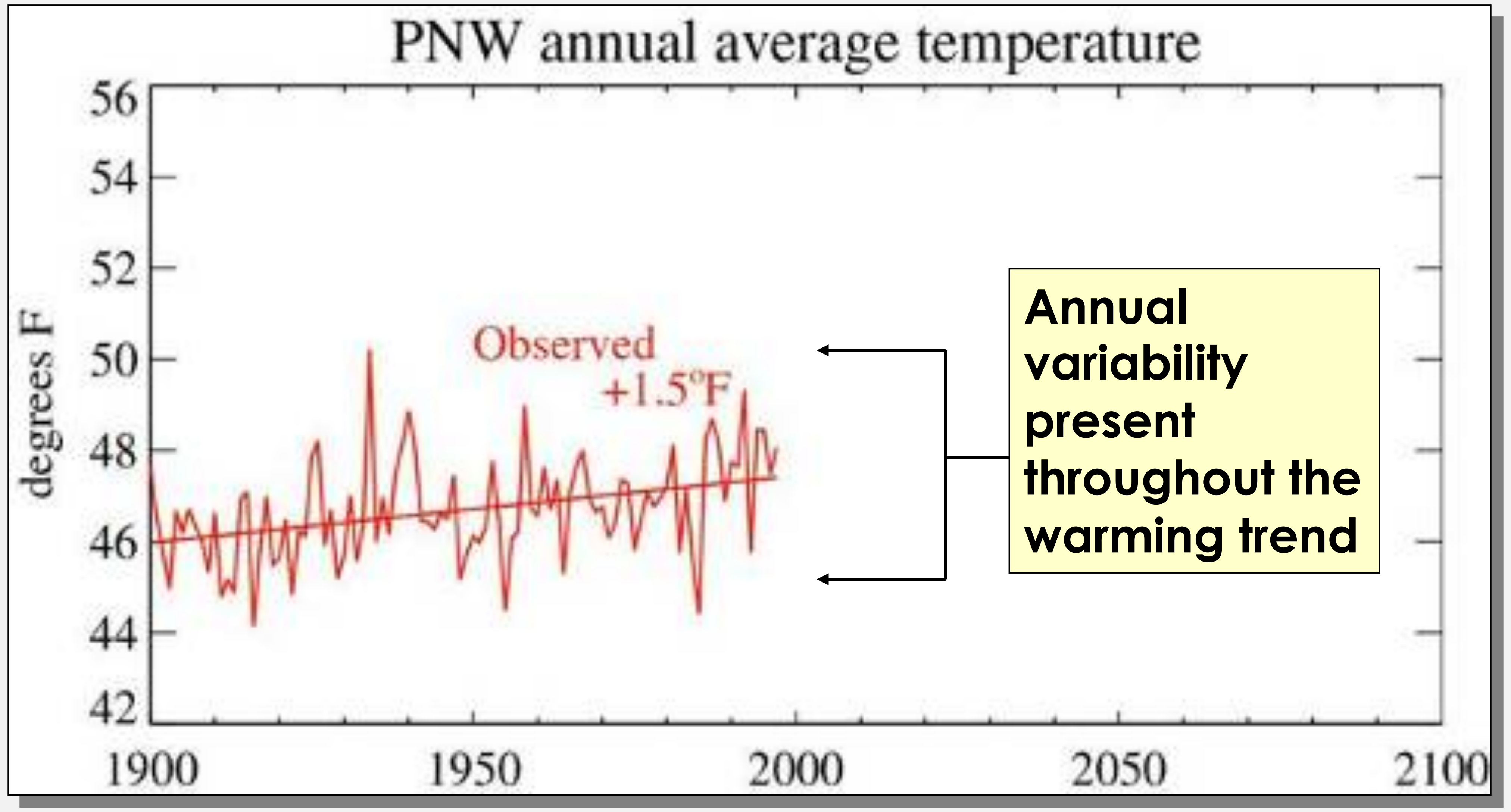
Source: Hadley Centre (HadCRUT4)

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions •

Note: The red line represents the median average temperature change, and grey lines represent the upper and lower 95% confidence intervals.

TEMPERATURE TRENDS BY STATION

Average annual temperature increased +1.5°F in the PNW during the 20th century



- *Almost every station shows warming*
- *Extreme cold conditions have become more rare*
- *Low temperatures rose faster than high temperatures*

TEMPERATURE TRENDS BY STATION

Average annual temperature increased +1.5°F in the PNW during the 20th century

- *Almost every station shows warming*
- *Extreme cold conditions have become more rare*
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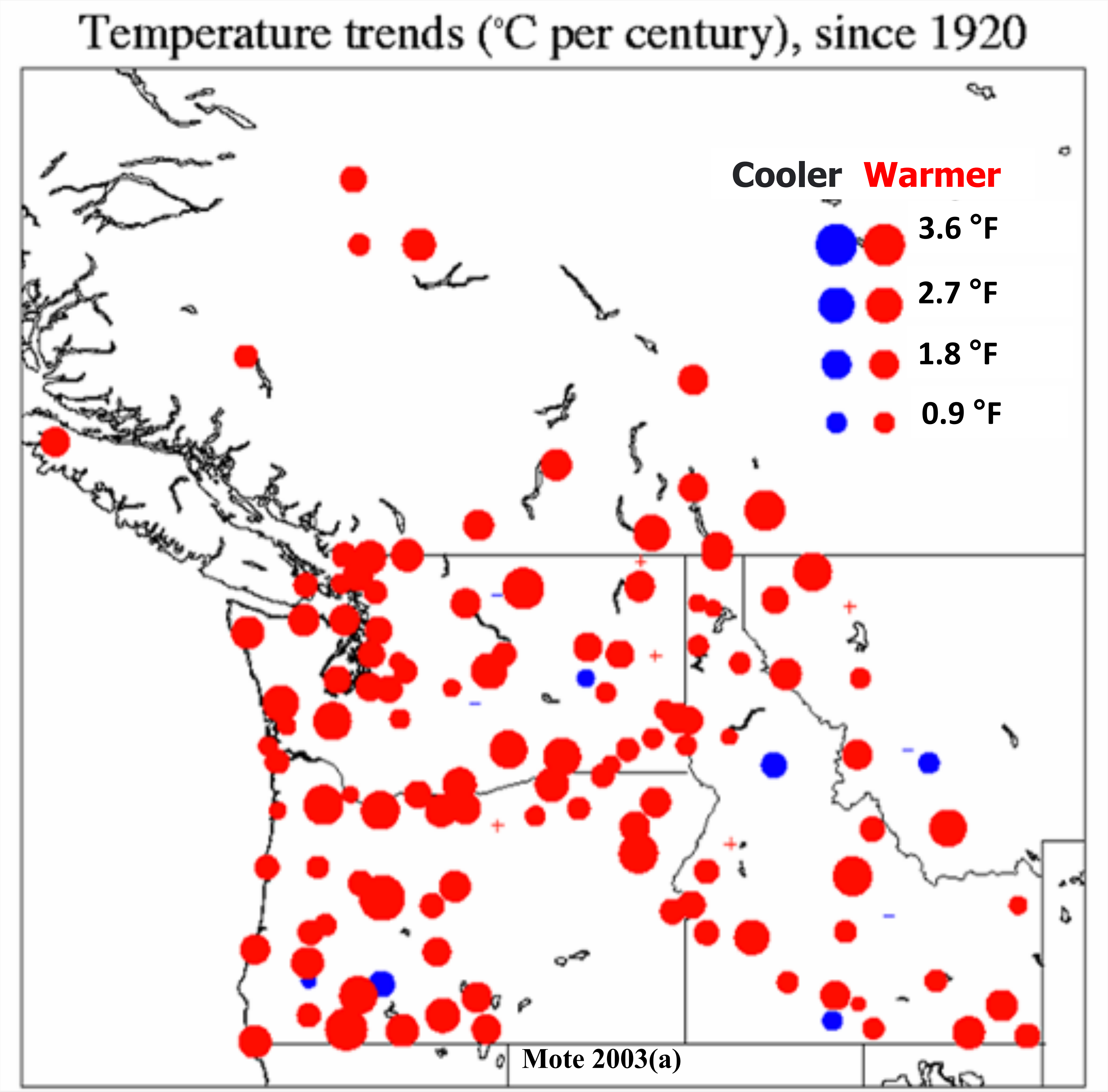
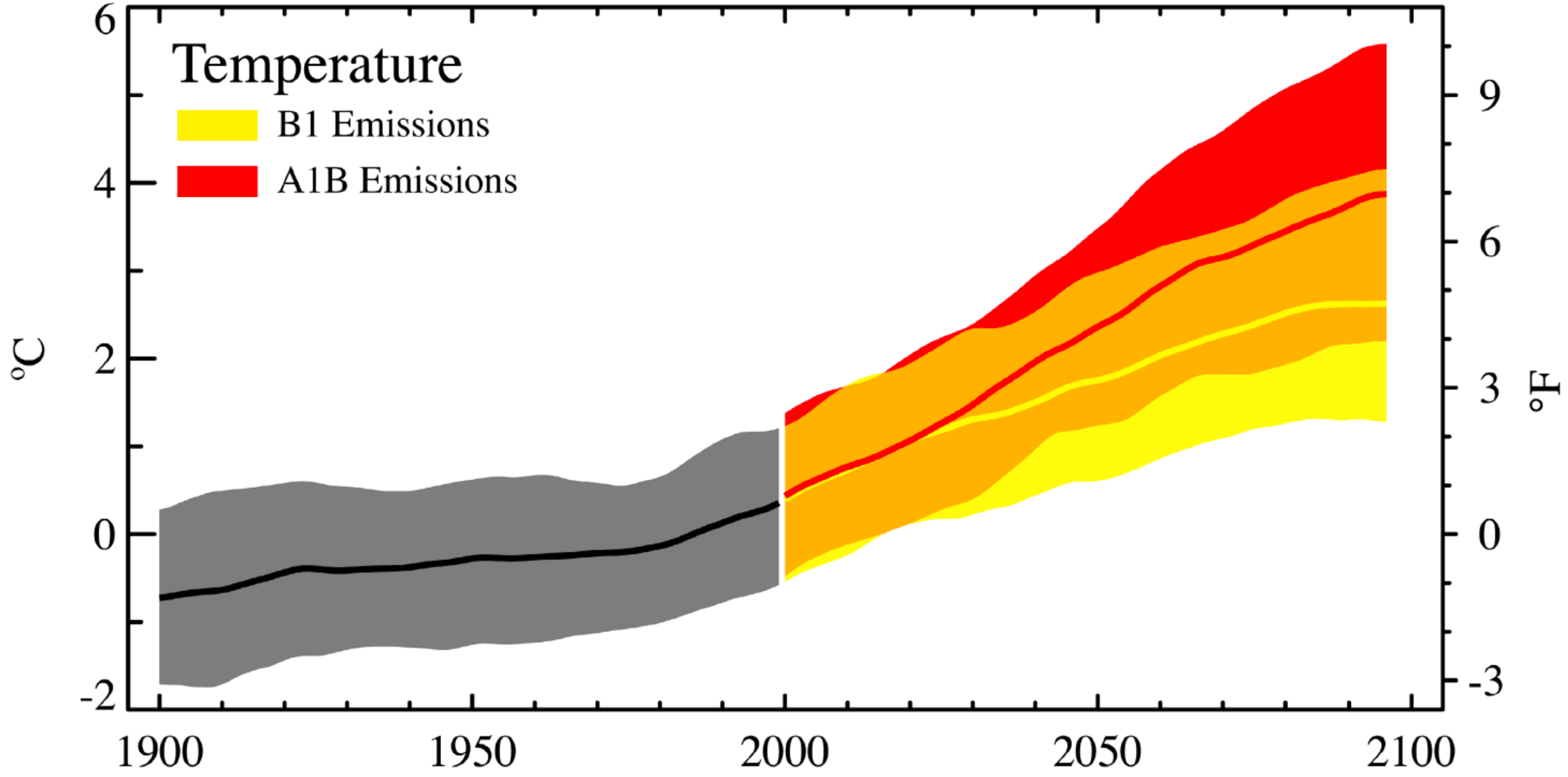


INCREASING TEMPERATURES

INCREASING UP TO 5°F IN THE PNW



INCREASING TEMPERATURES

INCREASING UP TO 5°F IN THE PNW

EFFECTS PRONOUNCED DURING THE WINTER AND DURING THE NIGHT

Expansion of growing season
Migration of crops to the north
Addition of crops to the rotation

THE WALL STREET JOURNAL.

SIGN IN

JOIN NOW

PRICE OF CLIMATE

A Warming Climate Brings New Crops to Frigid Zones

Longer growing seasons help lead northern farmers to plow up forests for crops such as corn that were once hard to grow in chilly territories

A Bayer researcher readies a combine to harvest test plots of corn in Manitoba, Canada, in October. TIM SMITH FOR THE WALL STREET JOURNAL

By *Jacob Bunge*

Nov. 25, 2018 12:59 p.m. ET

https://www.wsj.com/articles/a-warming-climate-brings-new-crops-to-frigid-zones-1543168786


La Crête
Canadian Shield
Rocky Mountains
Butte Telford #2
© 2018 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
US Dept of State Geographer
Google Earth
59°37'51.24" N 126°24'51.87" W elev 4295 ft eye alt 3289.35 mi

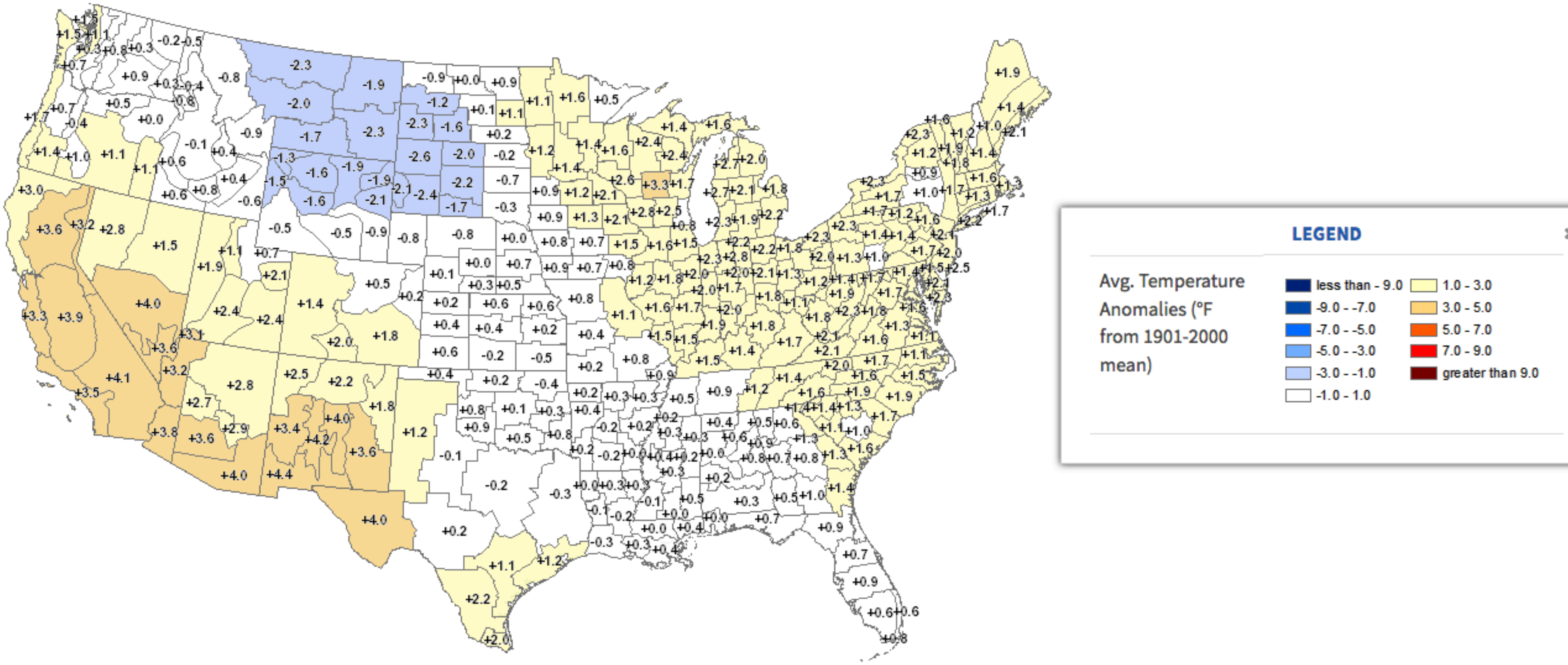
INCREASING TEMPERATURES

INCREASING UP TO 5°F IN THE PNW

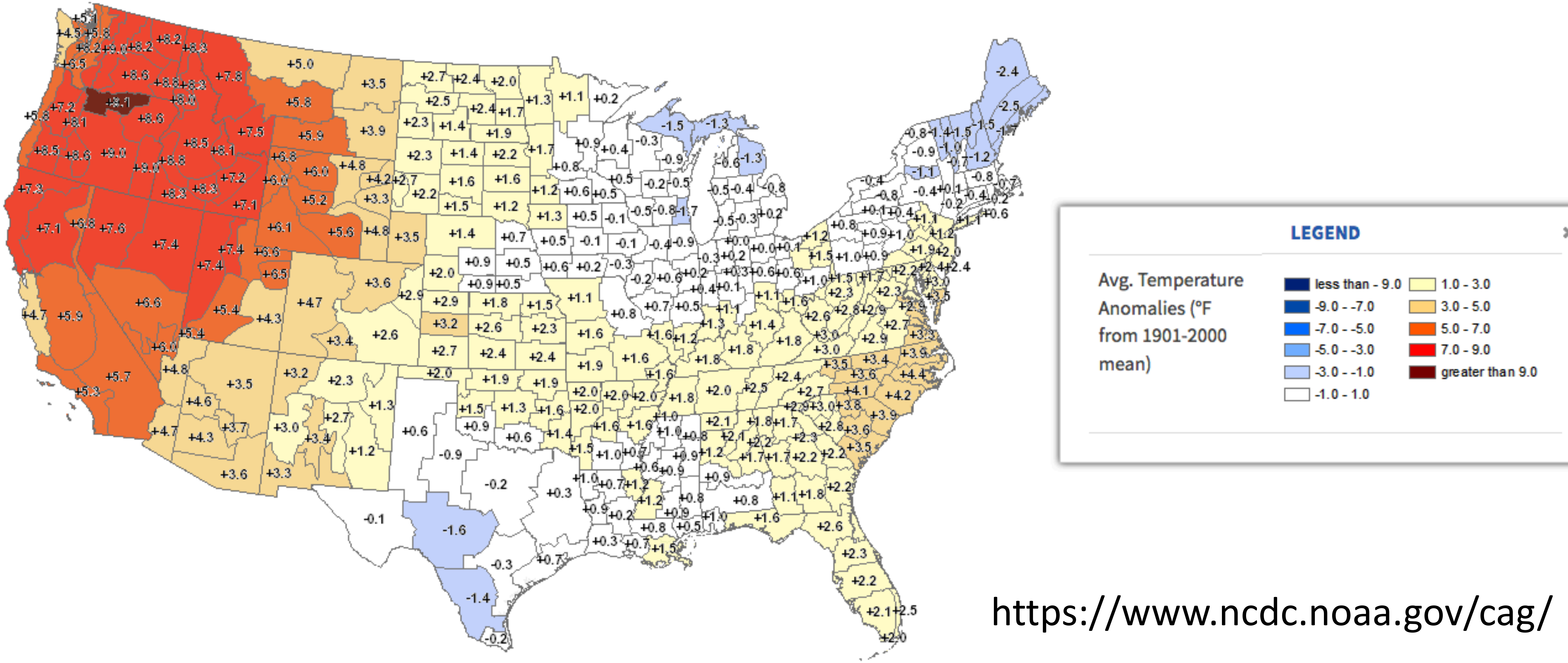
EFFECTS PRONOUNCED DURING THE WINTER AND DURING THE NIGHT

Increased variability associated with unpredictable anomalies

2014 TEMPERATURE ANOMALIES JUNE



2015 TEMPERATURE ANOMALIES JUNE



https://www.ncdc.noaa.gov/cag/

ENVIRONMENTAL DIFFERENCES BETWEEN YEARS

year		Min Temp	Max Temp	Mean Temp	Mean Humidity	Mean Dew point	Average Wind speed	Average Wind gusts
2015	wheat	45.7	84.3	65.3	60.1	47.9	5.5	22.8
2014	wheat	42.8	75.0	58.3	68.6	46.1	5.9	23.2
2015	barley	47.2	87.2	67.2	61.5	50.1	4.6	18.9
2014	barley	43.6	78.3	60.7	66.9	47.1	5.0	20.4

Average temperature data at flowering plus 10 days following at the Idaho Falls Extension variety trial locations

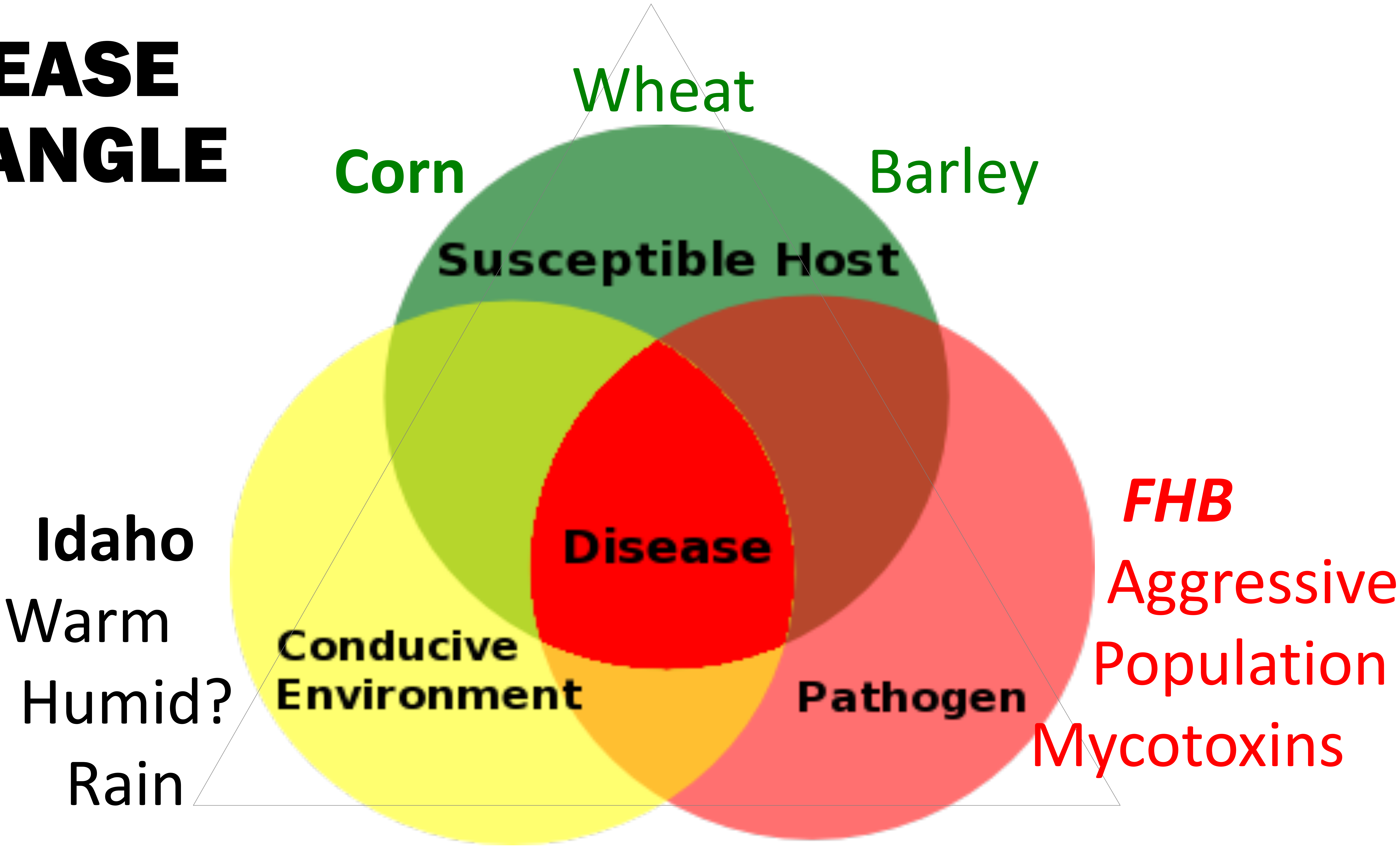
ENVIRONMENTAL DIFFERENCES BETWEEN YEARS

year		Min Temp	Max Temp	Mean Temp	Mean Humidity	Mean Dew point	Average Wind speed	Average Wind gusts
2015	wheat	45.7	84.3	65.3	60.1	47.9	5.5	22.8
2014	wheat	42.8	75.0	58.3	68.6	46.1	5.9	23.2
	difference	2.9	9.2	7.0	-8.5	1.8	-0.4	-0.5
2015	barley	47.2	87.2	67.2	61.5	50.1	4.6	18.9
2014	barley	43.6	78.3	60.7	66.9	47.1	5.0	20.4
	difference	3.6	8.9	6.5	-5.4	3.0	-0.4	-1.5

Average temperature data at flowering plus 10 days following at the Idaho Falls Extension variety trial locations

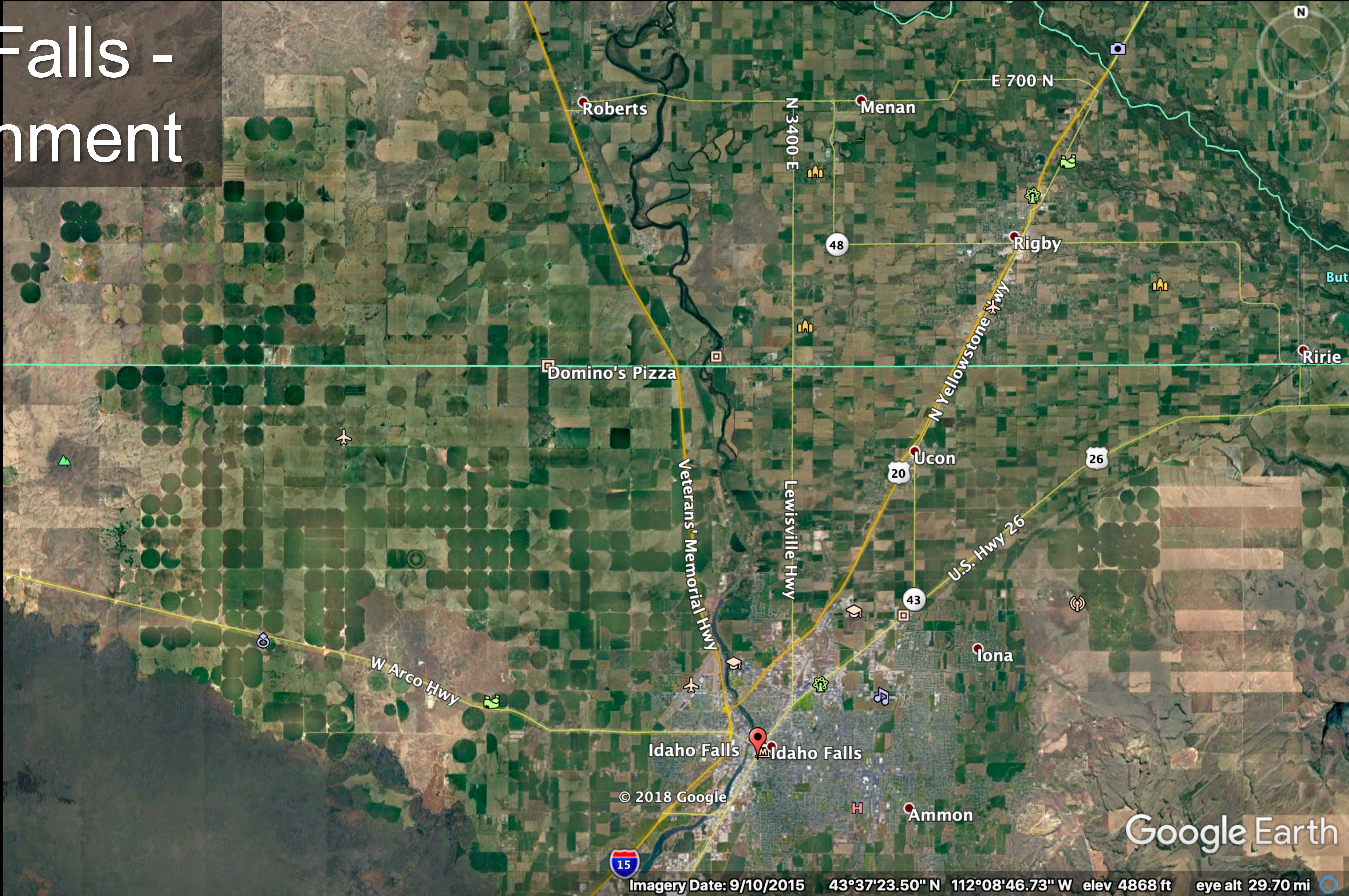
Growing Degree Days (GDD) 2015-2020

DISEASE TRIANGLE

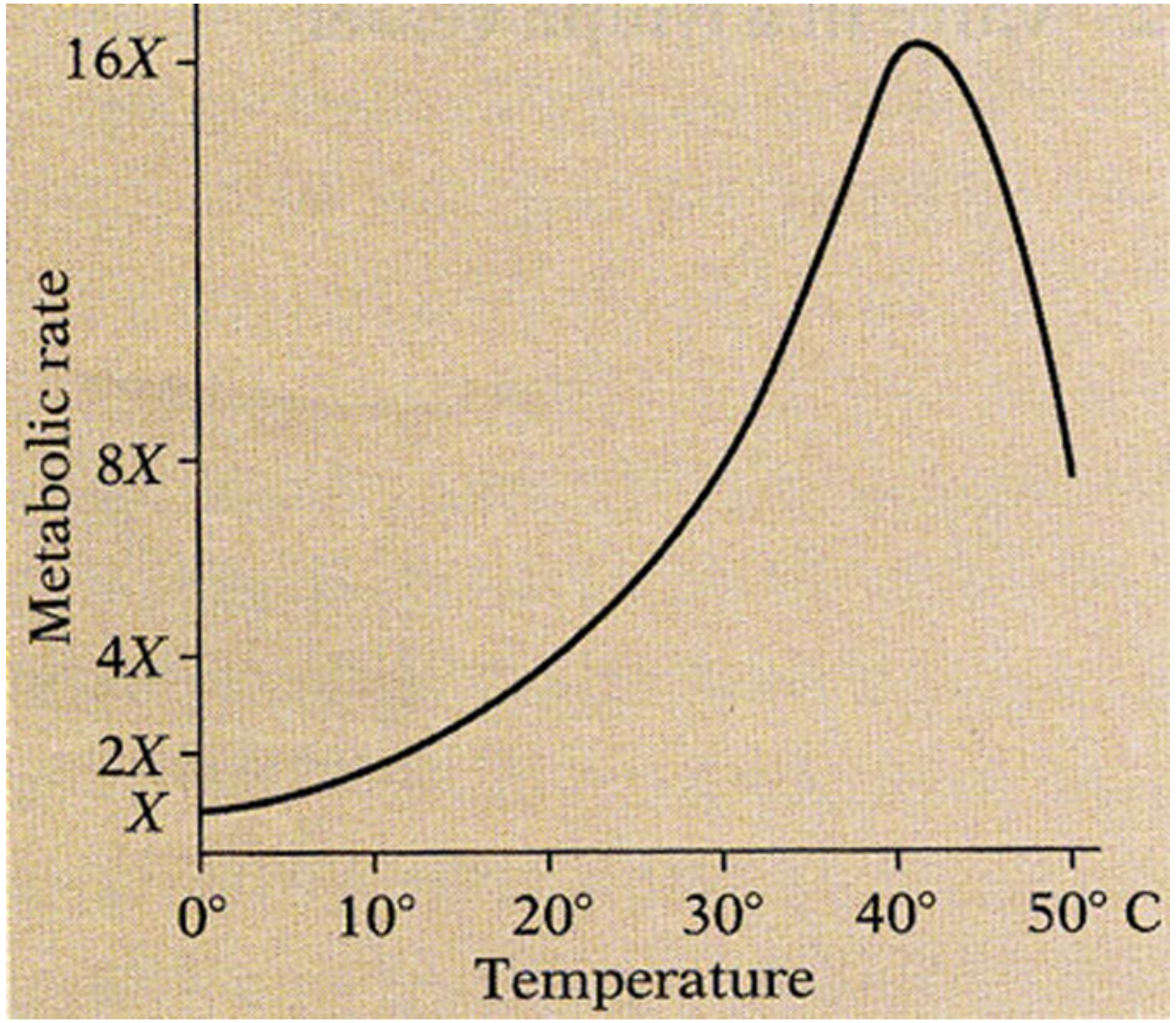


teedandbrown.com/disease-triangle/

Idaho Falls - Environment



The relationship between metabolic rate and temperature is often expressed as Q_{10}, which measures the rate increase for each 10° rise in temperature.



Metabolic rates often have a Q10 of around 2. If the metabolic rate of an animal at 0° is X, then at 10° the rate would be 2X, at 20°, 4X, etc. Notice that the rate increases more and more rapidly as the temperature increases.

2018

2018

Increased emphasis on screening winter varieties of wheat and barley

DETERMINING FUSARIUM HEAD BLIGHT RESISTANCE OF SPRING BARLEY IN IDAHO

Suzette Arcibal Baldwin[1], Belayneh Yimer[1], Thomas Baldwin[2], Yanhong Dong[3] and Juliet Marshall[1]
[1]University of Idaho, Department of Entomology, Plant Pathology and Nematology, Aberdeen, ID
[2]North Dakota State University, Department of Plant Pathology, Fargo, ND, and [3]University of Minnesota, Department of Plant Pathology, St. Paul, MN

INTRODUCTION

Idaho is currently the nation's top barley producing state and one of the best environments to produce excellent quality, disease and toxin-free barley. There had previously been no concerted effort to determine levels of susceptibility to Fusarium head blight (FHB) in the state since deoxynivalenol (DON) levels mostly have remained below detectable levels or below 0.5 ppm. For the first time in 2015, however, unacceptable levels of DON were detected in commercial barley production in Eastern Idaho. Area producers need to know the variety response to FHB infection under the unique irrigated production conditions in southern Idaho. With the support of U.S. Wheat and Barley Scab Initiative (USWBSI), spring barley lines have been evaluated for FHB resistance at Aberdeen, ID since 2014. A second screening location was established at Kimberly, ID in 2019.

Our specific objectives at these two locations are to:

1) determine the degree of resistance that exists in currently grown varieties and advanced lines to local isolates of *Fusarium graminearum*, and
2) provide DON data to regional breeders and growers to increase the ability to select the best varieties for breeding and crop production.

Table 1. Range of FHB Index (IND) and deoxynivalenol (DON) values.

Location	n	IND (%)		DON (ppm)	
		Min	Max	Min	Max
Aberdeen	69	0.2	37.4	1.6	20.4
Kimberly	65	>0.1	39.8	3.6	58.3

Table 2. Analysis of variance (ANOVA) of FHB Index (IND) and deoxynivalenol (DON).

Location	df	IND		DON	
		F	*P*	F	*P*
Aberdeen	68	2.49	0.0004	2.58	0.002
Kimberly	64	4.92	<.0001	6.66	<.0001

Table 3. Comparison of Pearson Correlations (r) of FHB Index and DON with transformed FHB Index values (arcIND) and DON (logDON).

Pearson Correlation (r)		Aberdeen	Kimberly
IND	DON	0.51	0.63
arcIND	logDON	0.58	0.64

Fig. 1. Fusarium head blight of spring barley (PI383933).

MATERIALS AND METHODS

- **Locations:** University of Idaho Aberdeen Research and Extension Center, Aberdeen, ID; USDA-ARS Northwest Irrigation and Soils Research, Kimberly, ID
- **Planting dates:** 02 May 2019 (Aberdeen) and 21 March 2019 (Kimberly)
- **Experimental design:** Randomized complete block design (RCBD) with 2 replications
- **Corn spawn inoculation:** Infected kernels (30 g/m^2) were applied ~3 weeks before head emergence of the earliest heading varieties.
- **Conidial inoculation:** Spore suspensions (total concentration of 100,000 macroconidia/ml) were applied with a CO_2 backpack sprayer at 40 psi walking 1 ft/sec. Up to three times applications were made one week apart starting at head emergence (Feekes 10.5) of the earliest heading varieties.
- **Irrigation:** Aside from regular irrigation, fine mist sprinkler systems were used to irrigate barley plots from the time of the start of initial spray inoculation until end of disease ratings.
- **FHB evaluation:** Barley plots were evaluated for severity and incidence at soft dough (Feekes 11.2). The FHB Index was calculated as IND = (Incidence x Severity) / 100.
- **Deoxynivalenol (DON) analysis:** Subsamples of harvested grain were sent to Univ. of Minnesota DON Testing Lab.
- **Data analysis:** GLIMMIX procedure in SAS (v. 9.4)

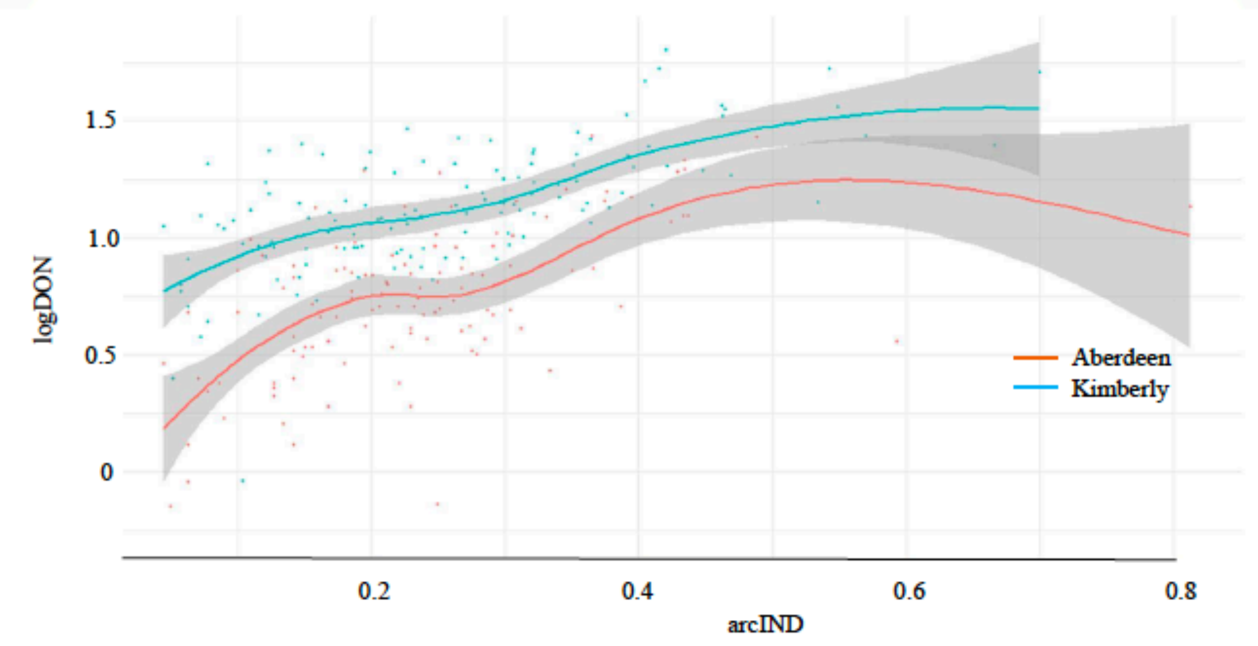


Fig. 2. Correlation plot of log10-transformed deoxynivalenol (logDON) and arcsine-transformed FHB Index (arcIND).

RESULTS

- Spring barley varieties are vulnerable to Fusarium head blight (FHB) and deoxynivalenol (DON) contamination under inoculated, irrigated environments in Southern Idaho.
- Maximum IND and DON values were ~ 40% and >50 ppm (Table 1).
- IND and DON significantly differed among barley varieties per location at α=0.05 (Table 2).
- Measures of IND and DON were moderate at both locations. Pearson correlation (r) of IND and DON slightly improved with data transformation of IND to arcIND and DON to logDON. (Table 3).
- Most varieties had higher IND and DON **levels** in Kimberly than in Aberdeen (Figs. 2 and 3).
- DON levels of varieties planted in both locations are shown in Fig. 3. The median DON values were 13.2 ppm and 5.5. ppm in Kimberly and Aberdeen, respectively.
- DON content of most varieties exceeded acceptable levels for malt and food (<1 ppm) and feed (<5 ppm) consumption. There were only two varieties (CDC Copeland and Far15-52A) that consistently had DON levels <5 ppm at both locations.
- We will continue to monitor FHB levels and screen for FHB resistance of spring barley in Aberdeen and Kimberly.
- Disease ratings and weather data will be used to develop FHB prediction models that will aid local growers in managing FHB and DON risk in Idaho.

Acknowledgment and Disclaimer
This material is based upon work supported by the U.S. Department of Agriculture, under Agreement No. 59-2050-8-013. This is a cooperative project with the U.S. Wheat & Barley Scab Initiative.
Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

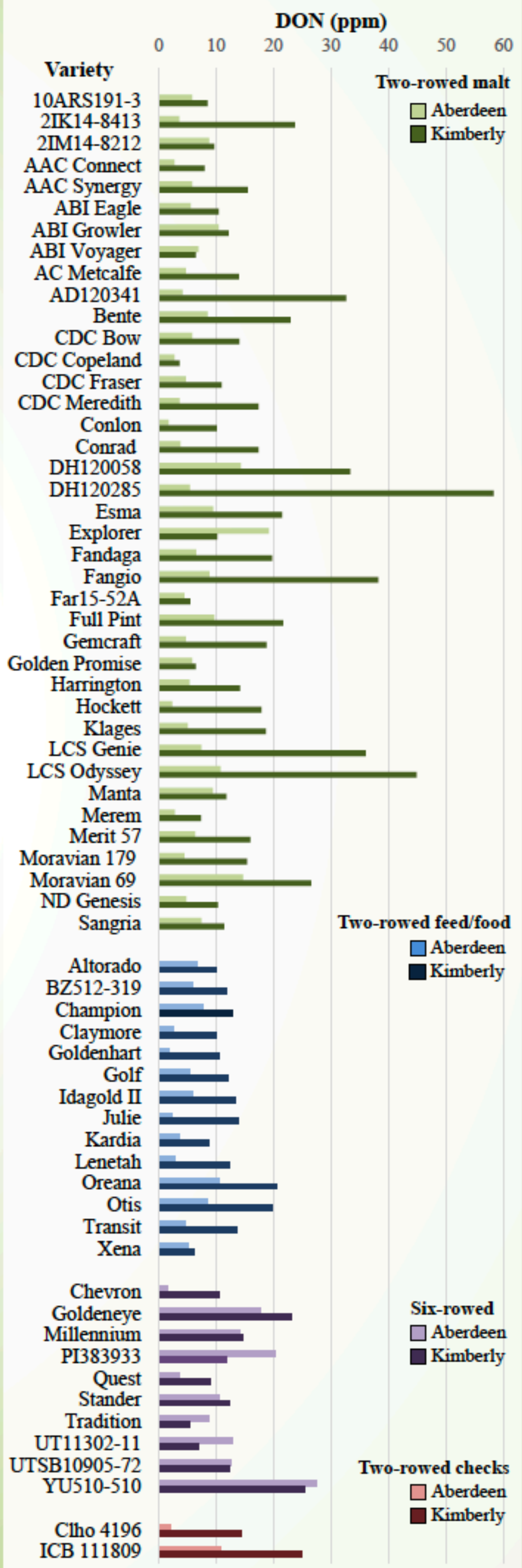
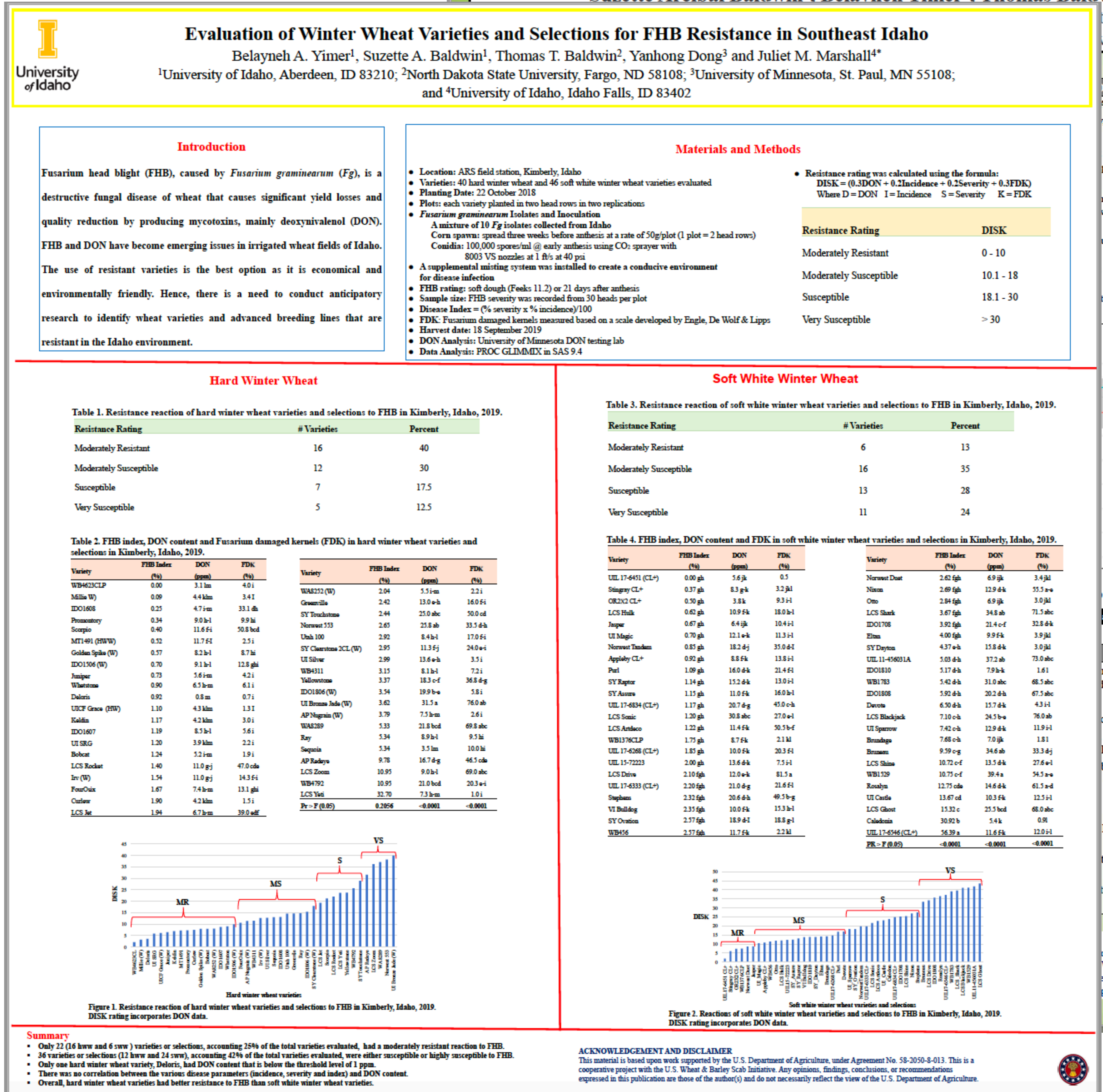
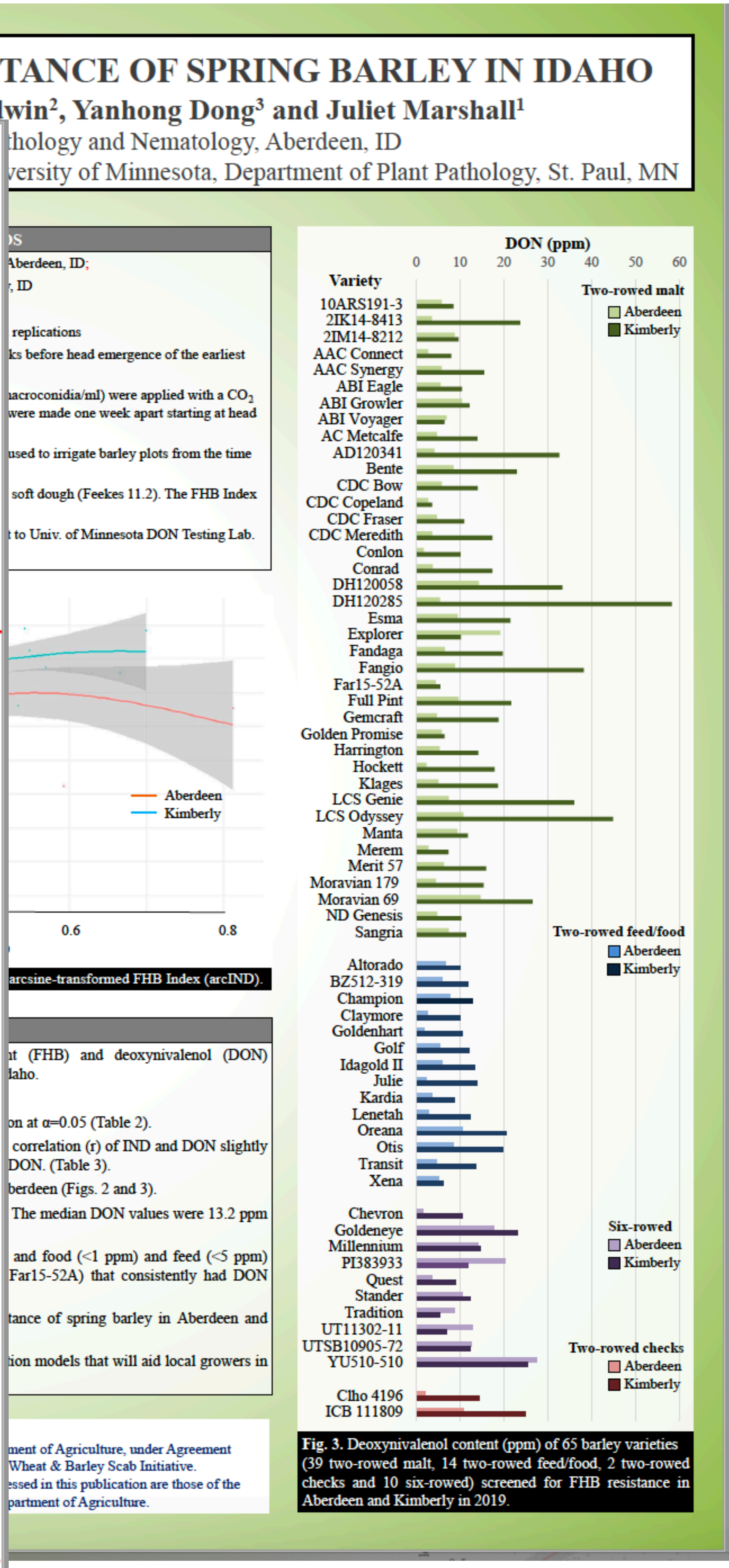


Fig. 3. Deoxynivalenol content (ppm) of 65 barley varieties (39 two-rowed malt, 14 two-rowed feed/food, 2 two-rowed checks and 10 six-rowed) screened for FHB resistance in Aberdeen and Kimberly in 2019.

Increased emphasis on screening winter varieties of wheat and barley





Management of FHB and DON Using Fungicides and Host Resistance in Hard Spring Wheat in Idaho

University of Idaho

Belayneh A. Yimer[1], Suzette Arcibal Baldwin[1], Yanhong Dong[2] and Juliet M. Marshall[3]*

[1]University of Idaho, Aberdeen, ID 83210; [2]University of Minnesota, St. Paul, MN 55108; and [3]University of Idaho, Idaho Falls, ID 83402

Introduction

Fusarium head blight (FHB) and deoxynivalenol (DON) have become emerging issues in irrigated wheat fields of the Intermountain West/Idaho. The threat of FHB and DON is increasing with an increase in corn production in the region/state. Hence, there is a need to develop management practices that can minimize the impact of FHB on grain yield and quality, and practices that can keep DON content in grains below the threshold level. Currently, there are a few triazole fungicides (e.g. Prosaro and Caramba) that are established for FHB and DON management. Testing additional fungicides such as the new DMI-succinate dehydrogenase fungicide Miravis Ace (propiconazole + pydiflumetofen) for FHB and DON management may provide additional choices for producers and better fungicide resistance management.

Objectives

1. Evaluate the integrated effects of fungicide treatment and genetic resistance on FHB and DON in irrigated hard spring wheat in Idaho, with emphasis on a new fungicide Miravis Ace (IM).
2. Compare the efficacy of Miravis Ace when applied at heading or at anthesis to that of standard anthesis application of Prosaro or Caramba (UFT)

Materials and Methods

- **Location:** Aberdeen R & E Center, University of Idaho
- **Planting Date:** 03 May 2019
- **Experimental Design:** RCBD with four replications
- **Fungicide application:** CO_2 backpack sprayer with paired 8001 VS nozzles mounted at a 45-degree forward and backward angle, and calibrated at 20 gal/A
- **Inoculum concentration:** 100,000 spores/ml
- **Inoculation Timing:** 24-36 hours after the anthesis fungicide application
- **Inoculum Application:** CO_2 sprayer with 8003 VS nozzles at 1 ft/s and at 40 psi
- **FHB rating:** soft dough (FGS 11.2)
- **Sample size:** 20 heads per plot (from the five center rows) for a total of 100 heads per plot
- **Harvest date:** 18 September 2019
- **DON Analysis:** University of Minnesota DON testing lab
- **Data Analysis:** PROC GLIMMIX in SAS 9.4

Integrated Management Study

Table 1. Varieties used in the Integrated Management Study

Variety	Class	Resistance	Flowering	Rating
Kelse	Hard red	Susceptible (S)	July 8	July 30
LCS Star	Hard white	Moderately Susceptible (MS)	July 8	July 30
IDO1602S	Hard white		July 8	July 30
Rollag	Hard red	Moderately Resistant (MR)	July 8	July 30

Table 2. Fungicide treatments used in the Integrated Management Study

Fungicide		Rate	Timing
UT	Untreated check	--	--
PA	Prosaro	6.5 fl oz/A	Anthesis
MA	Miravis Ace	13.7 fl oz/A	Anthesis
MH	Miravis Ace	13.7 fl oz/A	Heading
PN	Prosaro, non-inoculated (NI)	6.5 fl oz/A	Anthesis
UN	Untreated, non-inoculated (NI)	--	--

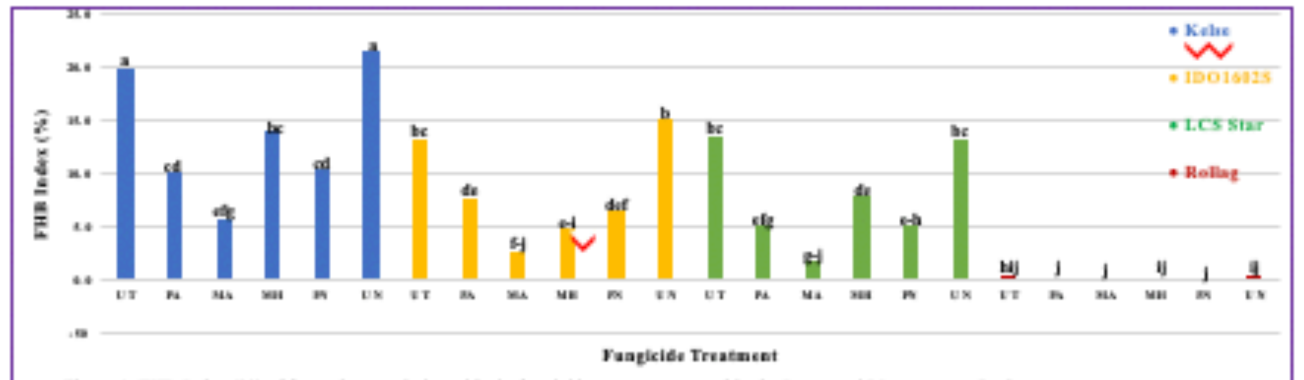


Figure 1. FHB Index (%) of four wheat varieties with six fungicide treatments tested in the Integrated Management Study

Table 3. Effect of variety and fungicide treatment on yield, test weight (TW), Fusarium-damaged kernels (FDK) and deoxynivalenol (DON)

Variable		Yield (bu/A)	TW (lb/bu)	FDK (%)
Variety				
	Kelse	102.5 b	59.9 c	0.6 a
	IDO1602S	99.5 b	58.6 b	1.5 b
	LCS Star	109.3 a	57.7 d	0.7 b
	Rollag	104.9 ab	61.0 a	0.1 c
	P-value	0.0391	<.0001	<.0001
Fungicide Treatment				
UT	Untreated check	100.5 b	58.6 c	1.2 a
PA	Prosaro at A	104.2 a	59.6 b	0.6 bc
MA	Miravis Ace at A	105.8 a	60.0 a	0.4 c
MH	Miravis Ace at H	104.7 a	59.5 b	0.5 bc
PA	Prosaro at A, non-inoculated	106.4 a	59.4 b	0.6 bc
UN	Untreated, non-inoculated	102.7 ab	58.8 c	1.1 a
	P-value	0.0303	<.0001	<.0001

Results

Fungicide Treatment:

- All fungicide treatments significantly reduced FHB incidence, index, FDK, DON, and increased yield and TW compared to untreated checks
- Among fungicides, Miravis applied at anthesis resulted in the lowest incidence, index, and the highest TW. However, yield, FDK and DON did not differ (Table 3).

Varietal Effect:

- Differences in FHB incidence and index, yield, TW, FDK and DON were significant.
- Among varieties, the moderately resistant (MR) variety "Rollag" had significantly the lowest incidence, index, FDK and DON, and the highest TW.
- The susceptible (S) variety "Kelse" had the highest disease parameters and the lowest yield. LCS Star had the lowest TW (Table 3).

Fungicide x Variety Interaction:

- There was significant FxV interaction for incidence, index, TW and DON, but not for yield and FDK
- All fungicides reduced FHB incidence and index significantly compared to the untreated check except on variety "Rollag"
- All untreated plots (except Rollag) had DON above the threshold level (1.5 – 2.4 ppm). Application of fungicides on the susceptible and moderately susceptible varieties reduced DON below the threshold level (0.5 – 1.0 ppm) except Miravis Ace at heading (1.2 – 1.3 ppm)
- Rollag had the lowest incidence, index, FDK and DON; and application of fungicides did not significantly reduce FHB related parameters on this variety

Conclusion

IM

- The use of S (Kelse) and MS (IDO1602S & LCS Star) varieties were not enough to reduce DON below the 1ppm threshold level.
- Application of Miravis Ace at anthesis on the susceptible and moderately susceptible varieties reduced DON below 1ppm.
- Application of Miravis Ace at heading was not effective in managing FHB and DON.
- The use of MR variety (Rollag) alone was effective in managing FHB and DON, hence no need of applying fungicides on this variety under Idaho conditions.

UFT

- Application of Miravis Ace or combined applications of Miravis Ace with Prosaro and Caramba was effective in reducing FHB incidence and index.
- All fungicide treatments reduced DON content below the threshold level.
- At a low FHB risk, application of fungicides did not have significant effects on yield.

Uniform Fungicide Trial (UFT)

Table 4. Effect of fungicides on yield and quality of hard red spring wheat in Idaho, 2019

Fungicide Treatment		Rate	Timing	Yield (bu/A)	TW (lb/bu)	FDK (%)	DON (ppm)
UT	Untreated check	--	--	96.2	58.6 cd	1.2 a	1.03 a
PA	Prosaro	6.5 fl oz/A	Anthesis	92.6	58.9 bcd	0.6 bc	0.35 b
CA	Caramba	13.5 fl oz/A	Anthesis	92.0	58.3 d	1.0 ab	0.56 b
MH	Miravis Ace	13.7 fl oz/A	Heading	100.3	59.6 ab	1.0 ab	0.93 a
MA	Miravis Ace	13.7 fl oz/A	Anthesis	99.6	59.1 abc	0.5 c	0.49 b
MP	Miravis Ace + Prosaro	13.7 fl oz/A + 6.5 fl oz/A	Anthesis (A) A + 7 days	97.5	59.4 ab	0.5 c	0.39 bc
MC	Miravis Ace + Caramba	13.7 fl oz/A + 13.5 fl oz/A	Anthesis (A) A + 7 days	94.5	59.7 a	0.5 c	0.15 c
			P-value	0.157ns	0.0118*	0.003*	<.0001*

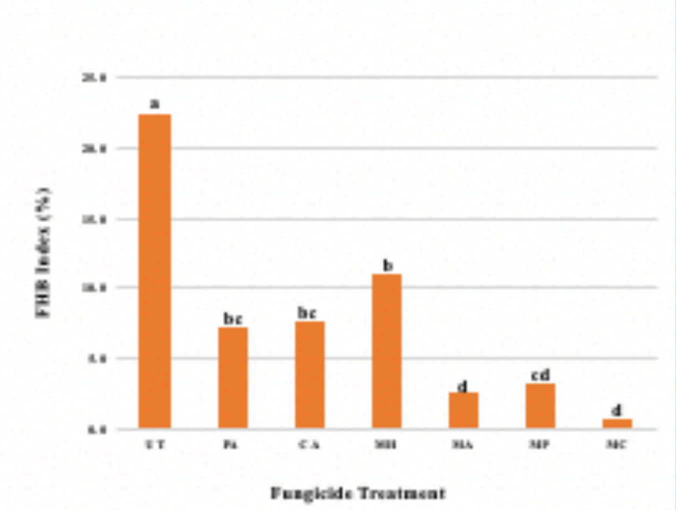


Figure 3. FHB index (%) of plots treated with fungicides compared to the untreated check in the UFT in Idaho, 2019

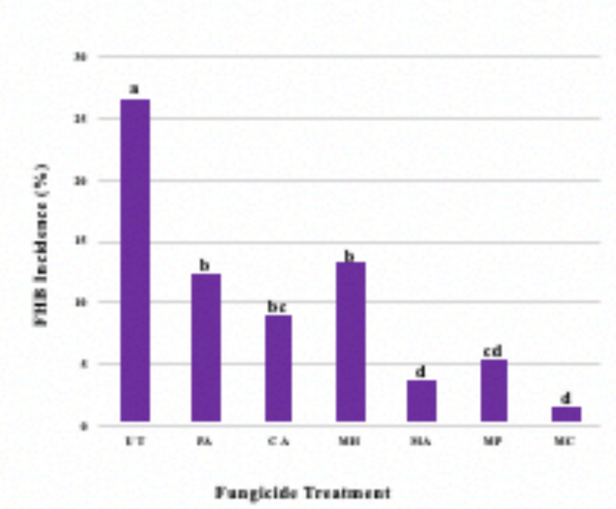


Figure 4. FHB incidence (%) of plots treated with fungicides compared to the untreated check in the UFT in Idaho, 2019

Results:

- Fungicide treatment had significant effect on all FHB and host parameters except yield
- Untreated check plots had the highest incidence, index, FDK and DON
- Combined application of Miravis Ace with Caramba resulted in the lowest incidence, index, FDK and DON, but was not statistically significant from application of Miravis Ace at anthesis or combined application of Miravis with Prosaro alone (Table 4)

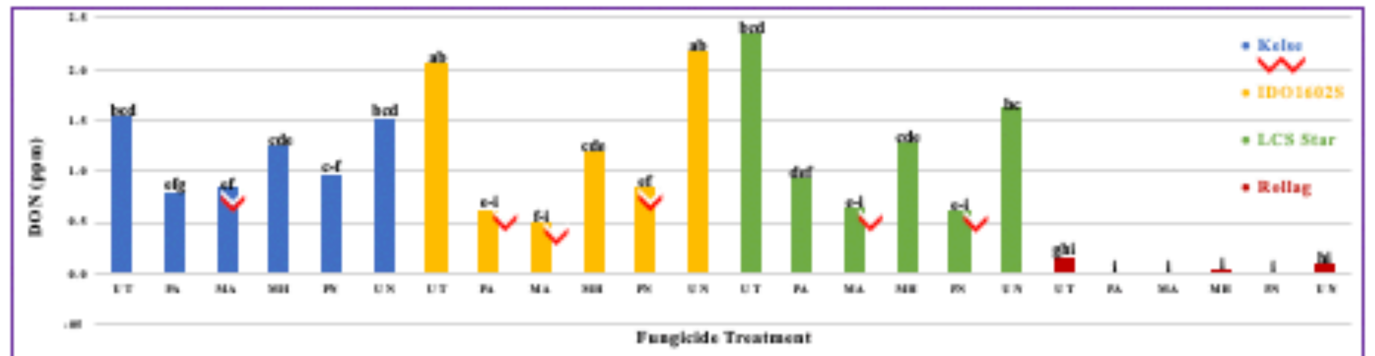


Figure 2. DON content of four wheat varieties with six fungicide treatments tested in the Integrated Management Study in Idaho, 2019

ACKNOWLEDGEMENT AND DISCLAIMER

This material is based upon work supported by the U.S. Department of Agriculture, under Agreement No. 58-2050-8-013. This is a cooperative project with the U.S. Wheat & Barley Scab Initiative. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

FUSARIUM HEAD BLIGHT RESISTANCE OF SPRING BARLEY IN IDAHO

...cibal Baldwin[1], Belayneh Yimer[1], Thomas Baldwin[2], Yanhong Dong[3] and Juliet Marshall[1]

...thology and Nematology, Aberdeen, ID

...versity of Minnesota, Department of Plant Pathology, St. Paul, MN

... Resistance in Southeast Idaho

... Dong[3] and Juliet M. Marshall[4]*

[3]University of Minnesota, St. Paul, MN 55108;

...aterials and Methods

...aluated

...plot = 2 head rows)

...ronment

...Engle, De Wolf & Lipps

- Resistance rating was calculated using the formula: DISK = (0.3DON + 0.2Incidence + 0.2Severity + 0.3FDK) Where D = DON I = Incidence S = Severity K = FDK

Resistance Rating	DISK
Moderately Resistant	0 - 10
Moderately Susceptible	10.1 - 18
Susceptible	18.1 - 30
Very Susceptible	> 30

...Aberdeen, ID;

... ID

... replications

...ks before head emergence of the earliest

...acroconidia/ml) were applied with a CO_2 ...were made one week apart starting at head

...used to irrigate barley plots from the time

... soft dough (Feekes 11.2). The FHB Index

... to Univ. of Minnesota DON Testing Lab.

Soft White Winter Wheat

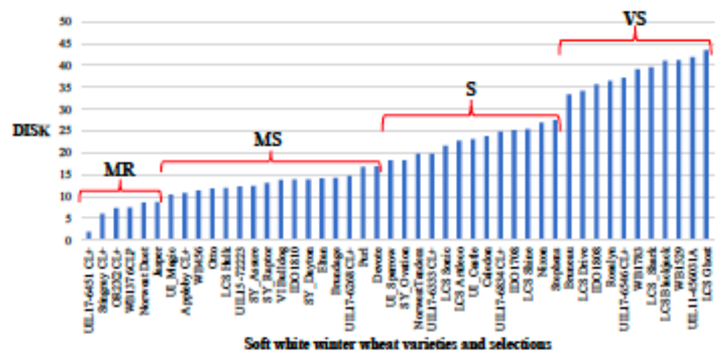
...reaction of soft white winter wheat varieties and selections to FHB in Kimberly, Idaho, 2019.

	# Varieties	Percent
	6	13
...le	16	35
	13	28
	11	24

...DON content and FDK in soft white winter wheat varieties and selections in Kimberly, Idaho, 2019.

...B Index (%)	DON (ppm)	FDK (%)
...0.00 gh	5.6 jk	0.5
...0.37 gh	8.3 g-k	3.2 jkl
...0.50 gh	3.8 k	9.3 i-l
...0.62 gh	10.9 f-k	18.0 h-l
...0.67 gh	6.4 ijk	10.4 i-l
...0.70 gh	12.1 e-k	11.3 i-l
...0.85 gh	18.2 d-j	35.0 d-I
...0.92 gh	8.8 f-k	13.8 i-l
...1.09 gh	16.0 d-k	21.4 f-l
...1.14 gh	15.2 d-k	13.0 i-l
...1.15 gh	11.0 f-k	16.0 h-l
...1.17 gh	20.7 d-g	45.0 c-h
...1.20 gh	30.8 abc	27.0 e-l
...1.22 gh	11.4 f-k	50.5 b-f
...1.75 gh	8.7 f-k	2.1 kl
...1.85 gh	10.0 f-k	20.3 f-l
...2.00 gh	13.6 d-k	7.5 i-l
...2.10 fgh	12.0 e-k	81.5 a
...2.20 fgh	21.0 d-g	21.6 f-l
...2.32 fgh	20.6 d-h	49.5 b-g
...2.35 fgh	10.0 f-k	15.3 h-l
...2.57 fgh	18.9 d-I	18.8 g-l
...2.57 fgh	11.7 f-k	2.2 kl

Variety	FHB Index (%)	DON (ppm)	FDK (%)
Norwest Duet	2.62 fgh	6.9 ijk	3.4 jkl
Nixon	2.69 fgh	12.9 d-k	55.5 a-e
Otto	2.84 fgh	6.9 ijk	3.0 jkl
LCS Shark	3.67 fgh	34.8 ab	71.5 abc
IDO1708	3.92 fgh	21.4 c-f	32.8 d-k
Eltan	4.00 fgh	9.9 f-k	3.9 jkl
SY Dayton	4.37 e-h	15.8 d-k	3.0 jkl
UIL 11-456031A	5.03 d-h	37.2 ab	73.0 abc
IDO1810	5.17 d-h	7.9 h-k	1.6 l
WB1783	5.42 d-h	31.0 abc	68.5 abc
IDO1808	5.92 d-h	20.2 d-h	67.5 abc
Devote	6.50 d-h	15.7 d-k	4.3 i-l
LCS Blackjack	7.10 c-h	24.5 b-e	76.0 ab
UI Sparrow	7.42 c-h	12.9 d-k	11.9 i-l
Brundage	7.68 c-h	7.0 ijk	1.8 l
Bruneau	9.59 c-g	34.6 ab	33.3 d-j
LCS Shine	10.72 c-f	13.5 d-k	27.6 e-l
WB1529	10.75 c-f	39.4 a	54.5 a-e
Rosalyn	12.75 cde	14.6 d-k	61.5 a-d
UI Castle	13.67 cd	10.3 f-k	12.5 i-l
LCS Ghost	15.32 c	25.5 bcd	68.0 abc
Caledonia	30.92 b	5.4 k	0.9 l
UIL 17-6546 (CL+)	56.39 a	11.6 f-k	12.0 i-l
PR > F (0.05)	<0.0001	<0.0001	<0.0001



...e 2. Reactions of soft white winter wheat varieties and selections to FHB in Kimberly, Idaho, 2019. ...rating incorporates DON data.

...DISCLAIMER

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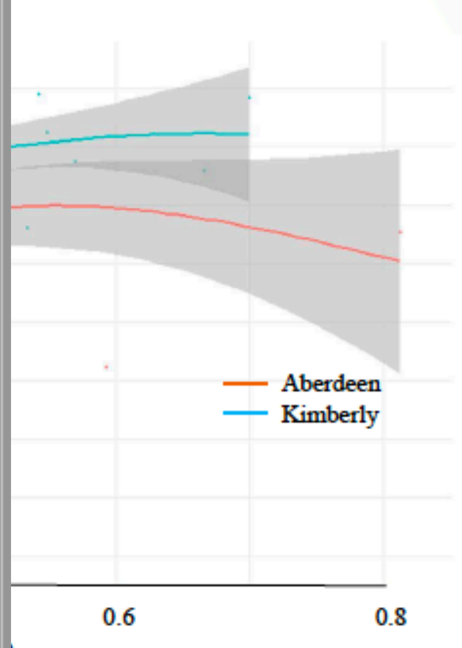

...arcsine-transformed FHB Index (arcIND).

...nt (FHB) and deoxynivalenol (DON) ...daho.

...on at α=0.05 (Table 2).

... correlation (r) of IND and DON slightly ...DON. (Table 3).

...berdeen (Figs. 2 and 3).

The median DON values were 13.2 ppm

... and food (<1 ppm) and feed (<5 ppm) ...Far15-52A) that consistently had DON

...tance of spring barley in Aberdeen and

...tion models that will aid local growers in

...ment of Agriculture, under Agreement ...Wheat & Barley Scab Initiative. ...essed in this publication are those of the ...partment of Agriculture.

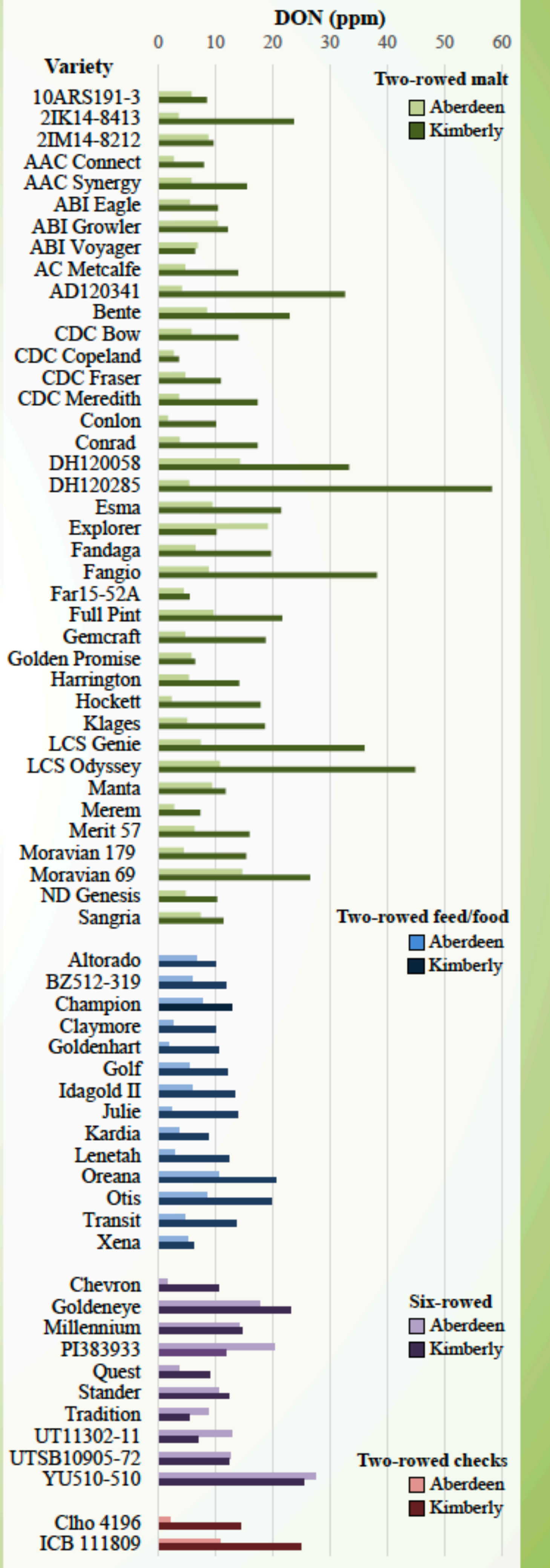

Fig. 3. Deoxynivalenol content (ppm) of 65 barley varieties (39 two-rowed malt, 14 two-rowed feed/food, 2 two-rowed checks and 10 six-rowed) screened for FHB resistance in Aberdeen and Kimberly in 2019.

7:56

HOT CAKE

Another Victim of Global Warming: The Great British Bake Off

Increasing summer temperatures are proving a menace to butter, chocolates, and baked Alaska.

KATE YODER

12.05.20 08:12 AM

Natural Disasters
Environmental Damage
Food Insecurity
Social Unrest
Increased Crime

- Increased Crop stress
- Change in crop response to pathogens
- Pathogen / microbial response
  - to CO_2
  - to temperature
  - to moisture

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University of Minnesota — Driven to Discover℠

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Dr. Gongshe Hu

Dr. Kathy Klos

Kathy Satterfield

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Ohio State University

Dr. Pierce Paul

Dr. Jorge Salgado

The Ohio State University

Kansas State University

Dr. Erick de Wolfe

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North Dakota State University

Dr. Andrew Friskop

Dr. Tom Baldwin

NDSU North Dakota State University

Thank you,

Dr. Phil Bregitzer