Trichothecene chemotypes of the FHB fungus in North America.

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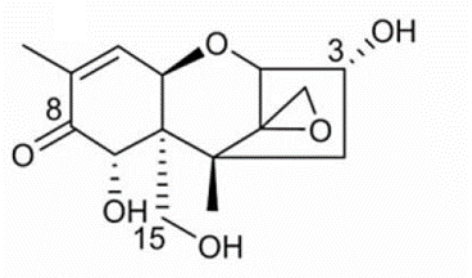
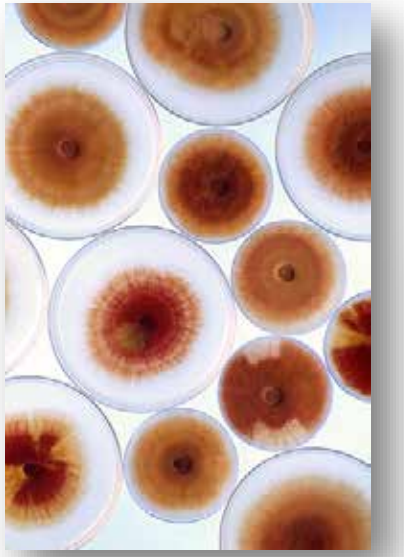
FHB, *Fusarium graminearum* and DON.

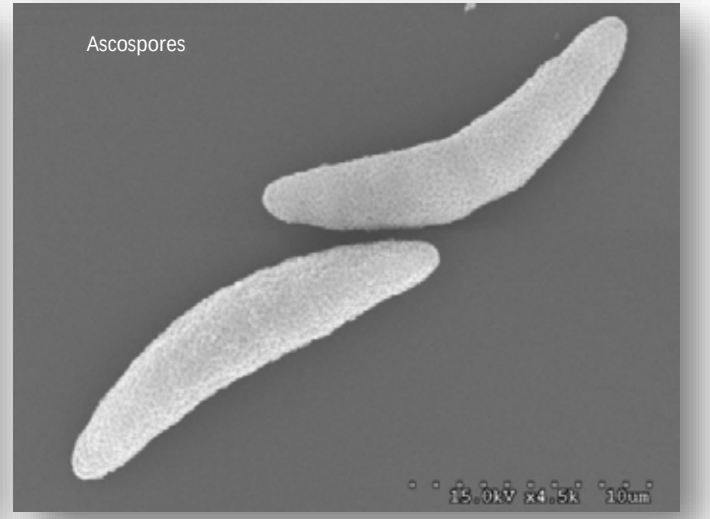
Fusarium head blight (scab)



DON



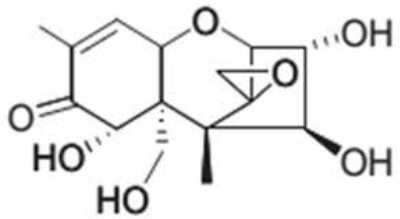
Fusarium graminearum



To be considered today…

- What types of trichothecenes are produced by the FHB pathogen in North America?
- What are the genetic and biochemical bases for the differences?
- How do the different trichothecenes vary biologically?
- Where are strains that produce different trichothecene types found and how have they changed over time?
- Why is this knowledge useful for developing FHB resistant plants?

Trichothecene types

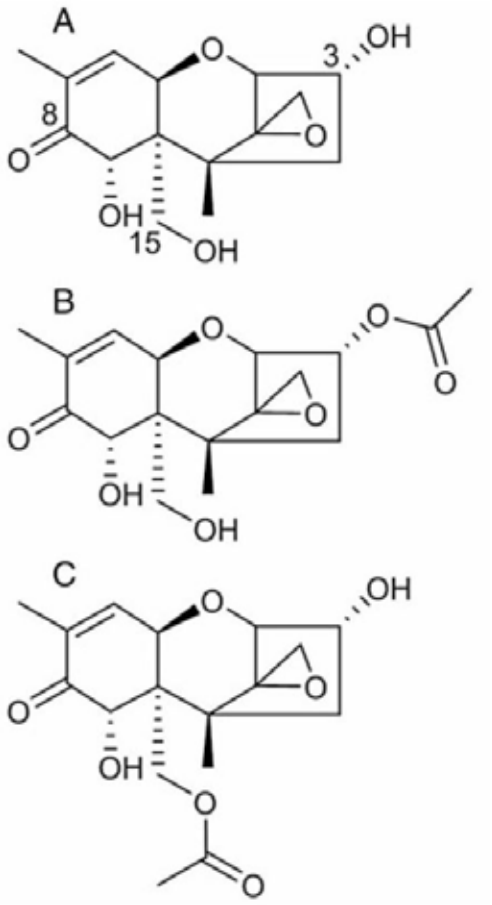


NIV

DON

3ADON

15ADON



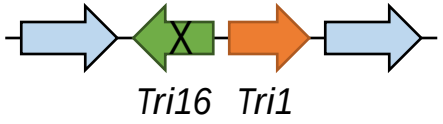
Varga et al., 2015. Environmental Microbiology doi:10.1111/1462-2920.12718

Trichothecene chemotypes

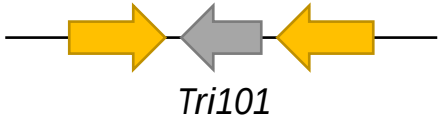
Strain (chemotype)	toxin	in culture (ppm)	in wheat (ppm)
PH-1 (15ADON)	DON	3	431
	15ADON	35	53
	3ADON	-	5
	total	38	489
00-500 (3ADON)	DON	3	647
	15ADON	-	8
	3ADON	32	96
	total	35	751
02-264 (NX-2)	NX-3	2	480
	NX-4	-	-
	NX-2	40	55
	total	42	535

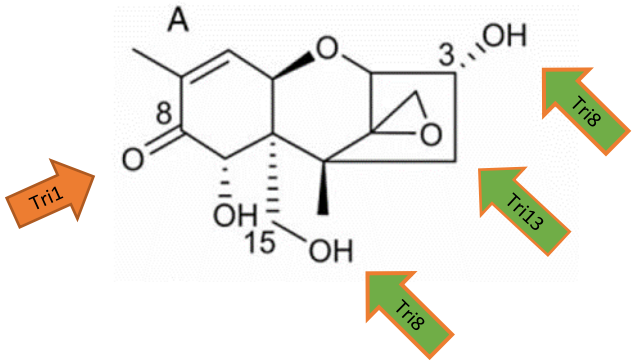
The genetic and biochemical basis for trichothecene chemotype variation in known.

Chromosome 1

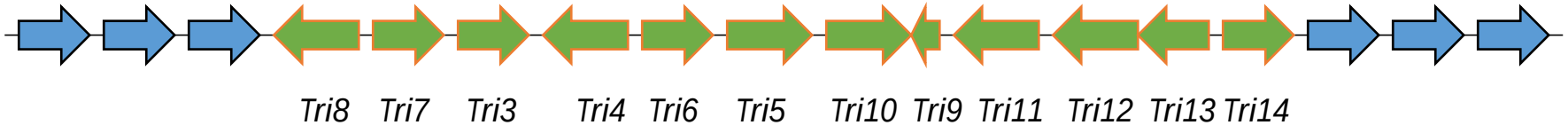


Chromosome 3





Chromosome 2



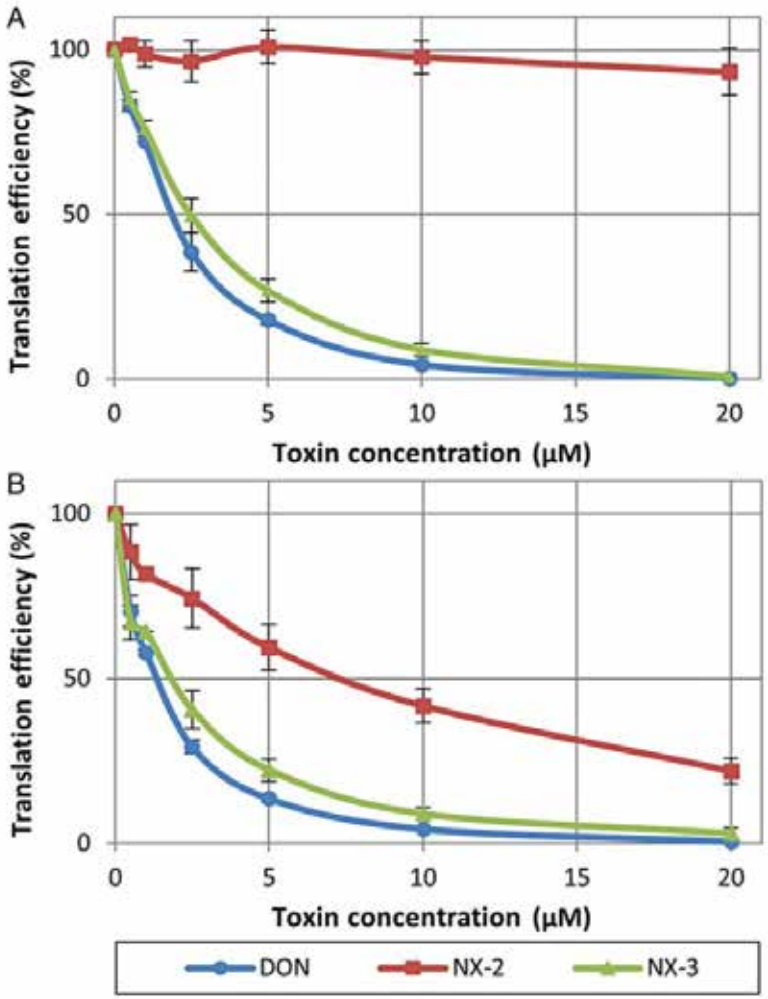
Tri8 Alexander et al. 2011. Fungal Genetics and Biology. 48: 485 – 495.

Tri1 Varga et al., 2015. Environmental Microbiology doi:10.1111/1462-2920.12718

Tri13 Lee et al., 2002. Applied Environmental Microbiology 68: 2148-2154; Brown et al., 2002. Fungal Genetics and Biology 36: 224–233.

Toxicity of trichothecenes differ

Protein synthesis inhibition assay:



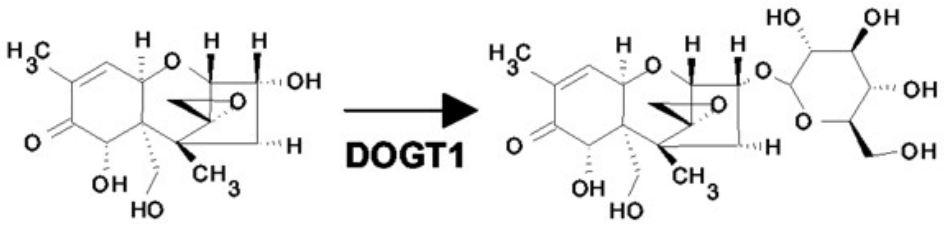
Rabbit reticulocyte

Wheat germ extract

Varga et al., 2015. Environmental Microbiology doi:10.1111/1462-2920.12718

Metabolism of toxin may depend on trichothecene type.

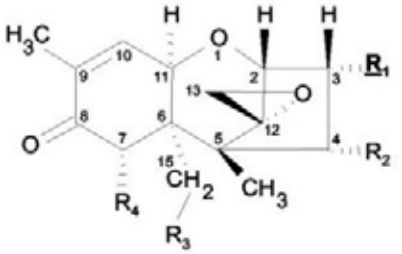
(A)



4-deoxynivalenol

3-ß-D-glucopyranosyl-
4-deoxynivalenol

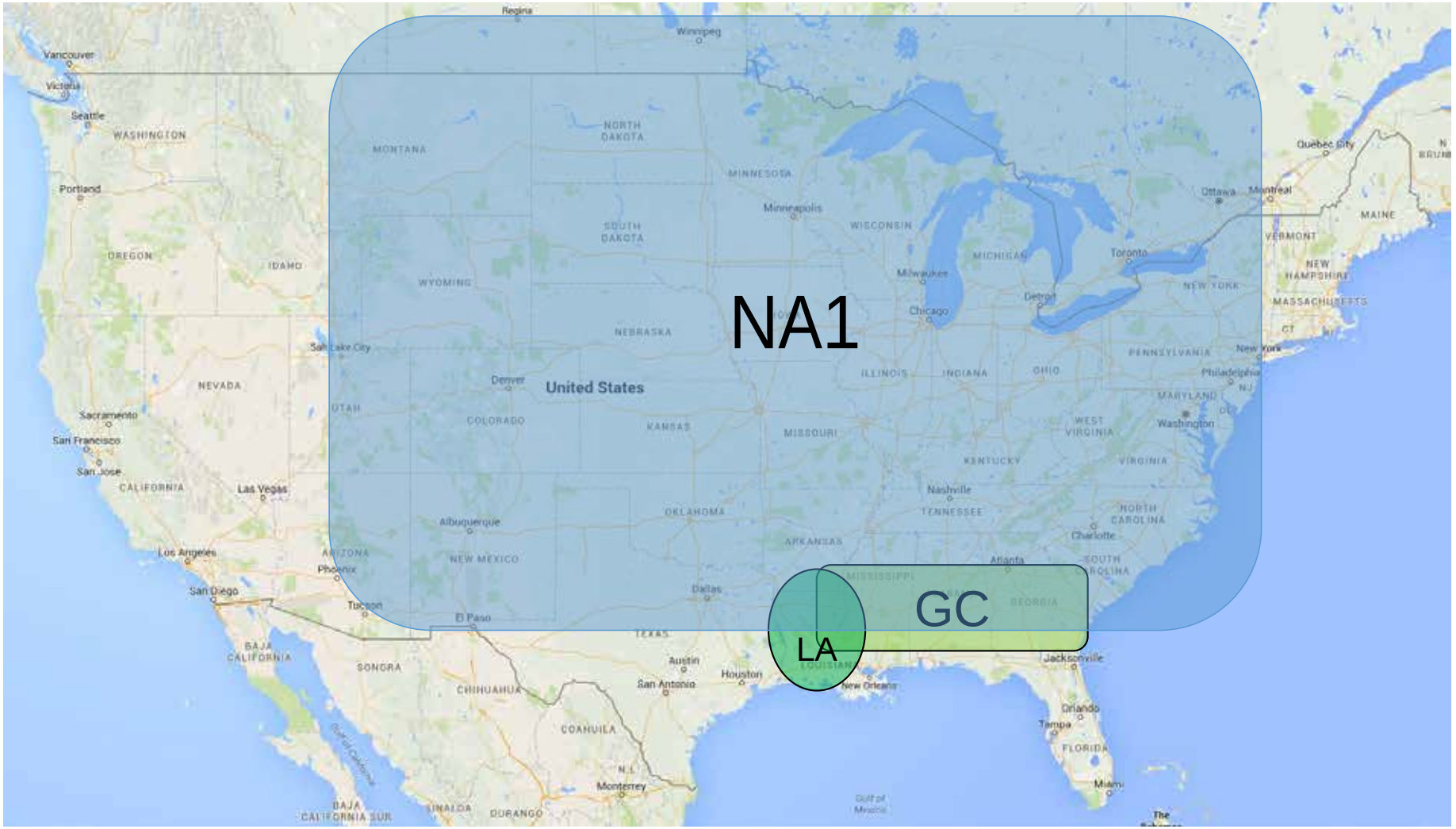
(A)



DOGT1-mediated resistance		R1	R2	R3	R4
DON	+	OH	H	OH	OH
NIV	-	OH	OH	OH	OH
15-ADON	+	OH	H	OAc	OH
3-ADON	-	OAc	H	OH	OH
TTC	-	H	OBe	H	H

Poppenberger, et al., 2003. Detoxification of the Fusarium mycotoxin deoxynivalenol by a UDP- glucosyltransferase from *Arabidopsis thaliana*. *J. Biol. Chem.* 278:47905-47914.

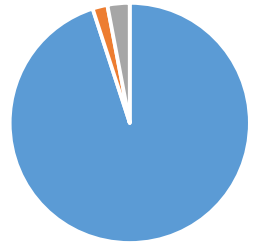
Trichothecene chemotype frequencies vary among genetic populations.



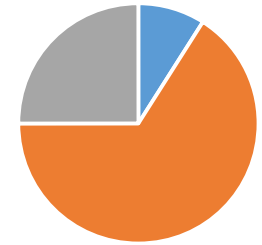
Gale et al. 2011. Phytopathology 101:124-134. Strains from 2001-2007.

Populations

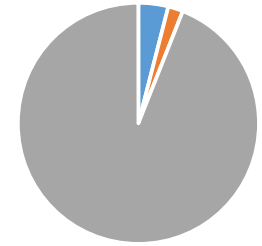
NA1



GC

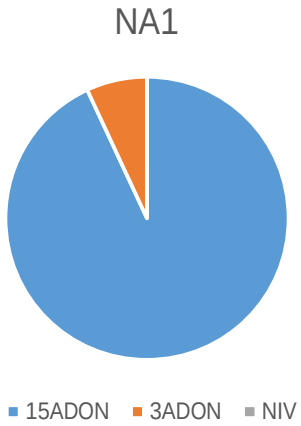


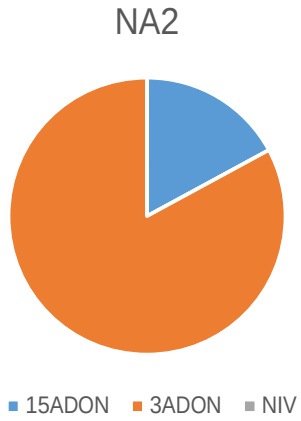
LA



NA1 and NA2 populations differ in chemotype frequency and other fitness attributes.

Populations





Strains from MN, SD and ND collected 2003-2004.

Burlakoti et al., 2011; Foroud et al., 2012; Gilbert et al, 2010; Puri and Zhong, 2010; Von der Ohe et al., 2010; Ward et al., 2008.

Trichothecene type frequencies change over time.

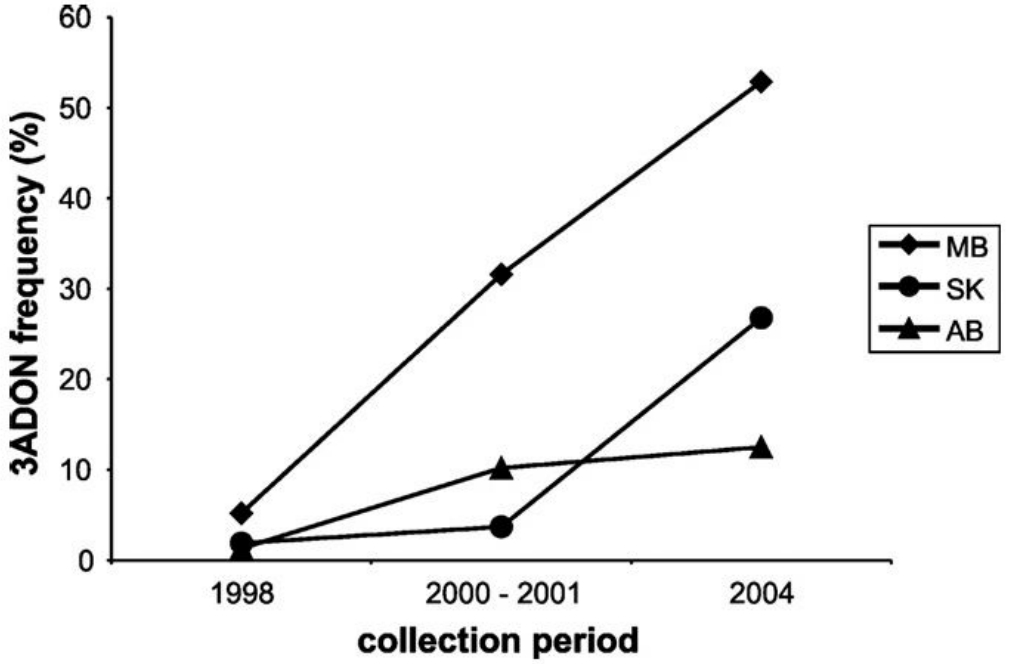
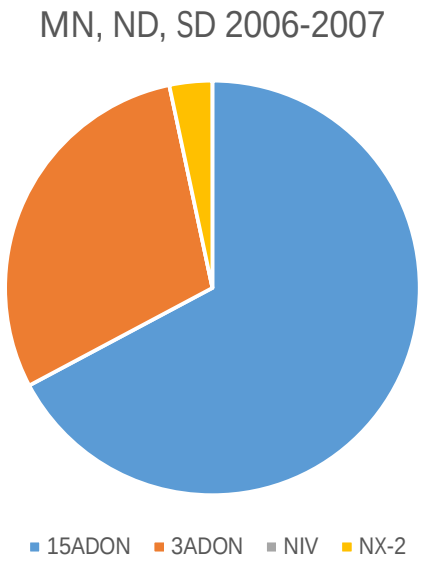


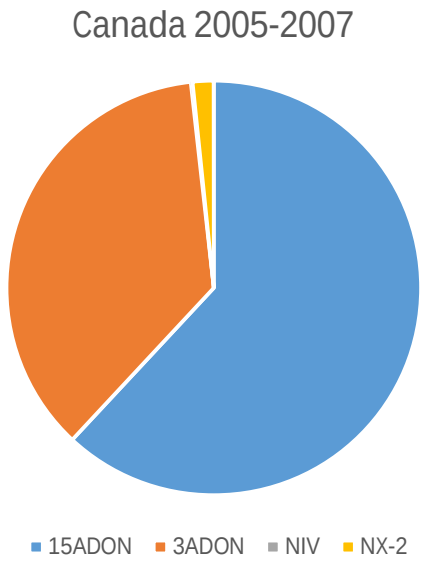
Fig. 2. 3ADON chemotype frequencies among *F. graminearum* isolates collected from the western Canadian provinces of Manitoba (MB), Saskatchewan (SK), and Alberta (AB) between 1998 and 2004.

Ward et al., 2008. Fungal Genet. Biol. 45: 473–484

Trichothecene type frequencies.



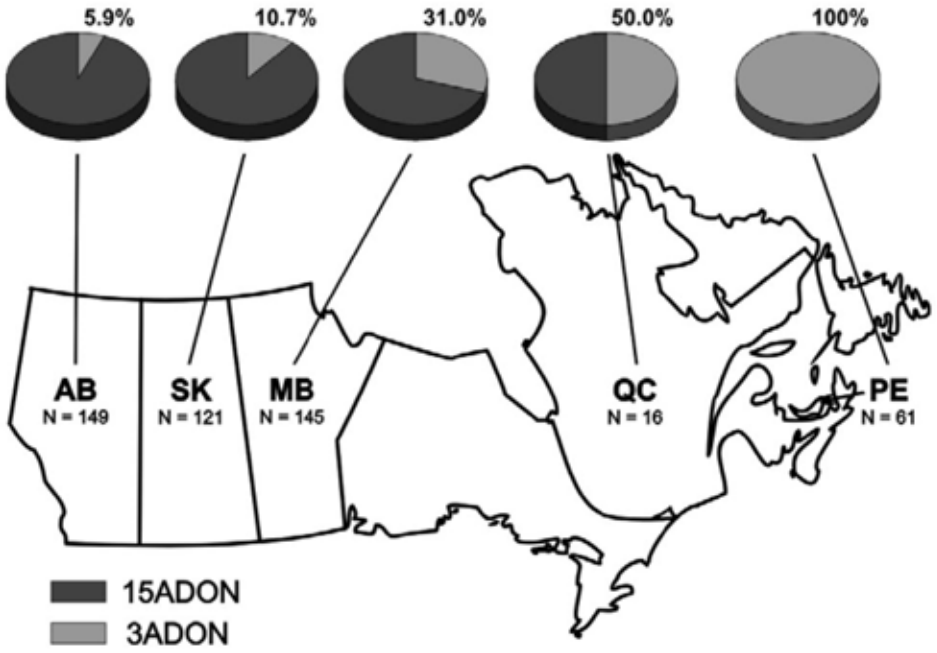
Liang et al., 2014. Fungal Genetics and Biology 73: 83-92.



Kelly et al., 2015. Fungal Genet. Biol. 82:22–31

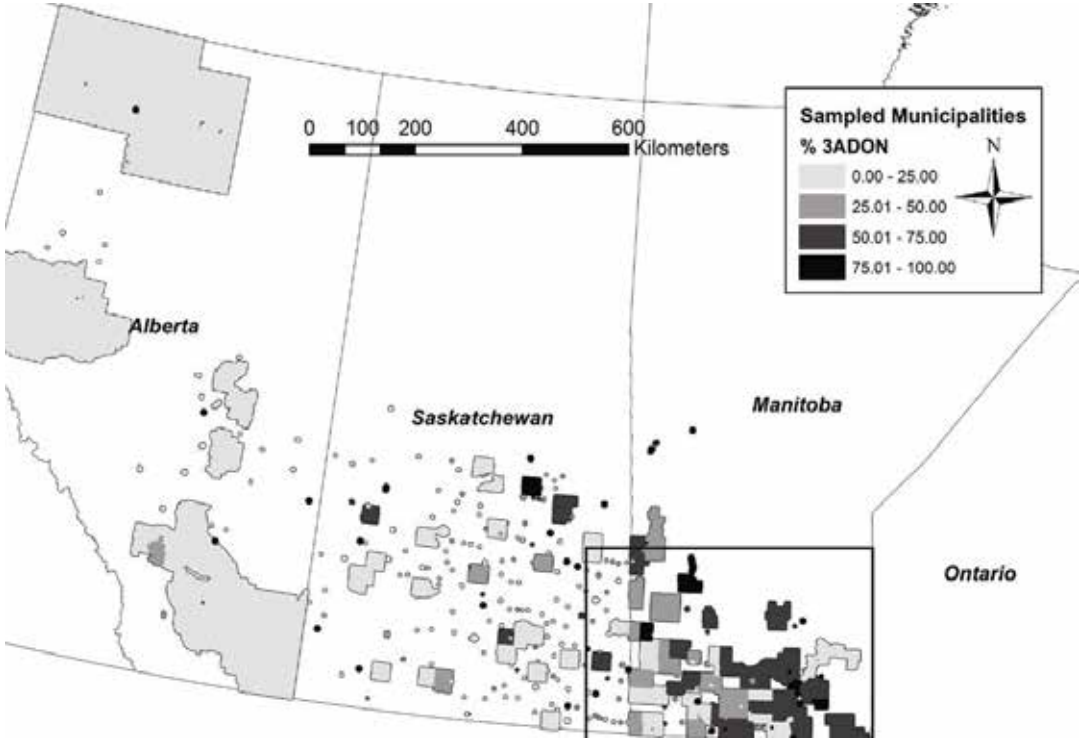
Trichothecene type frequencies differ spatially.

1984- 2004



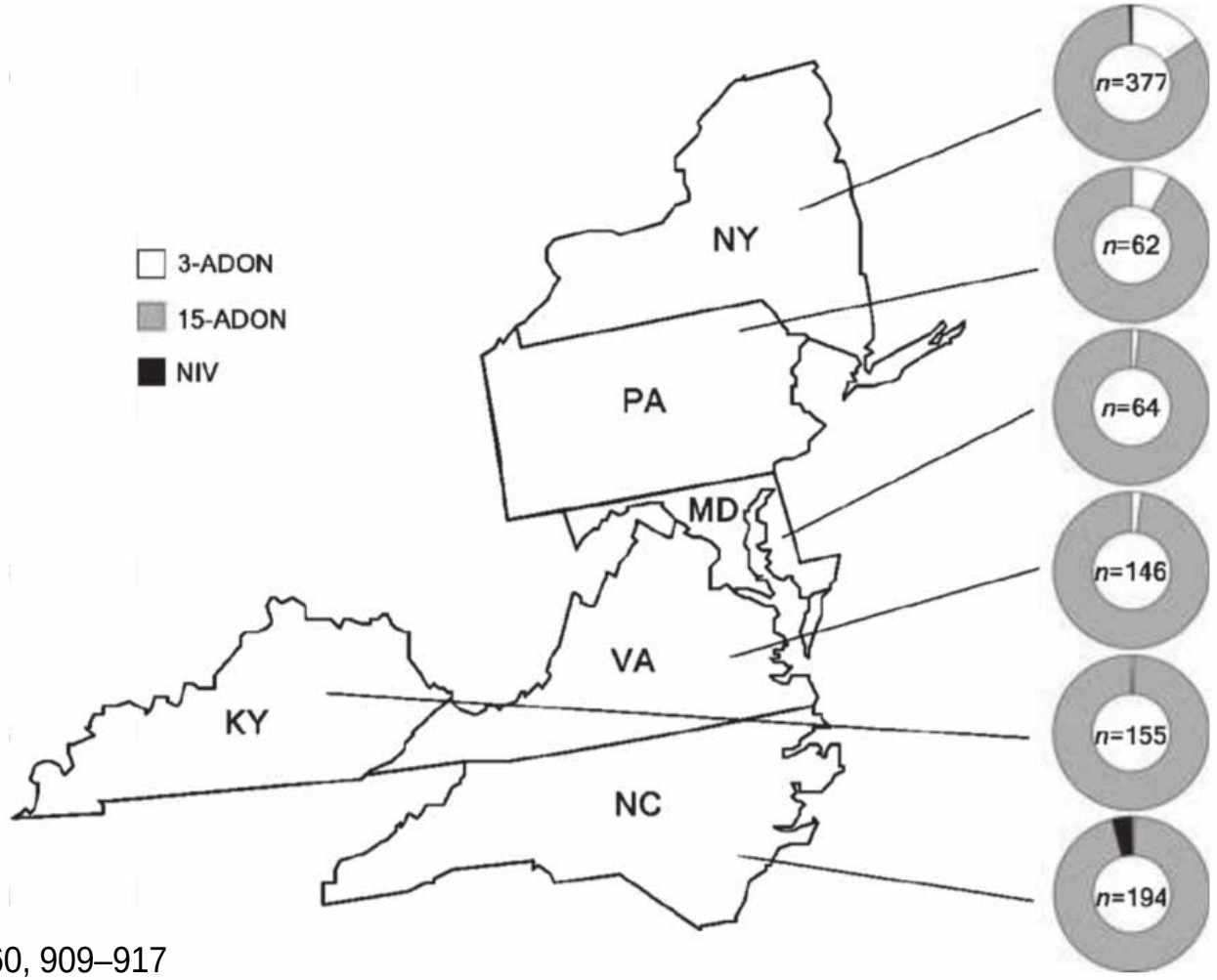
Ward et al., 2008. Fungal Genet. Biol. 45: 473–484.

1998- 2007



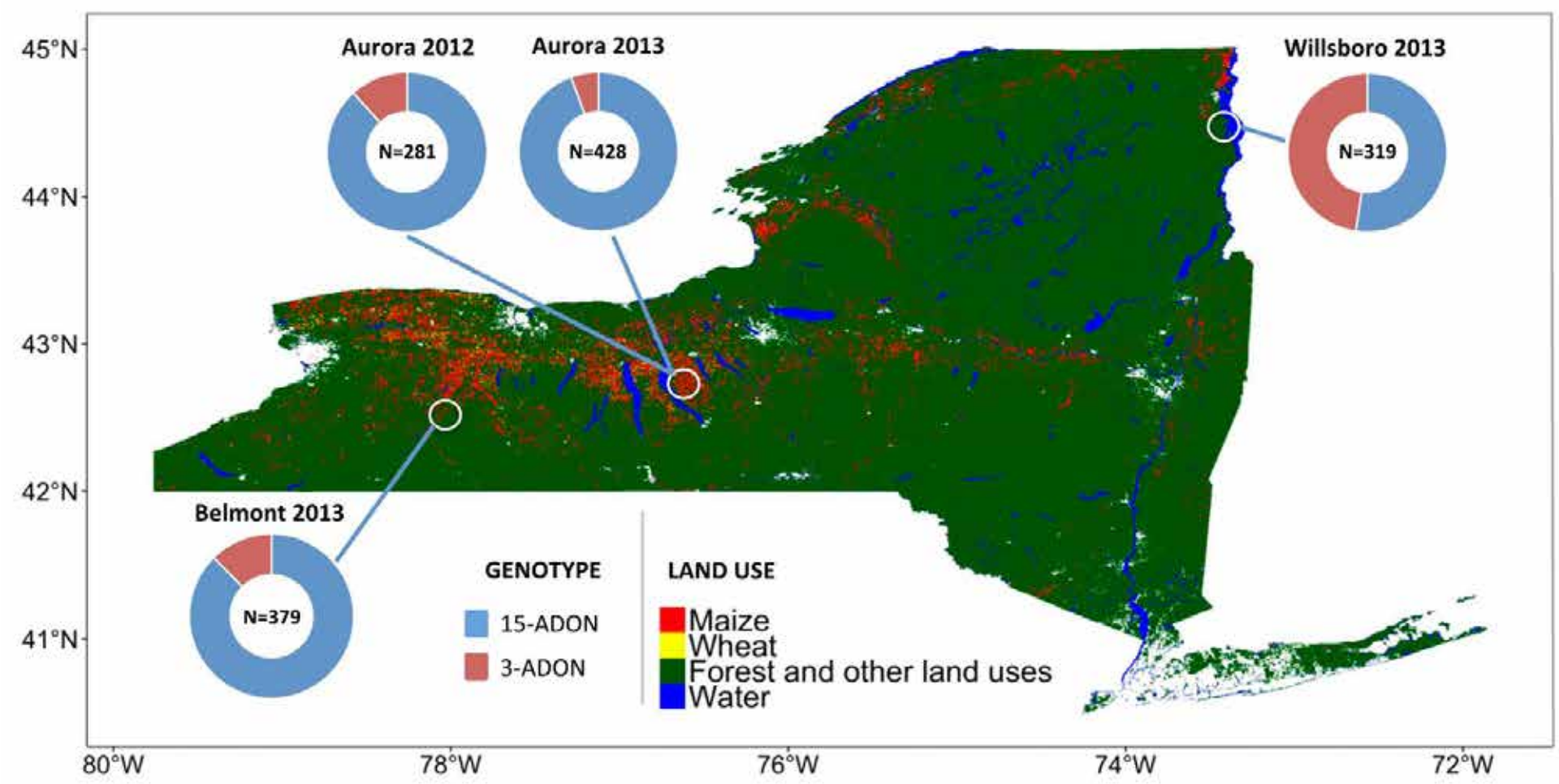
Kelly et al., 2015. Fungal Genet. Biol. 82:22–31

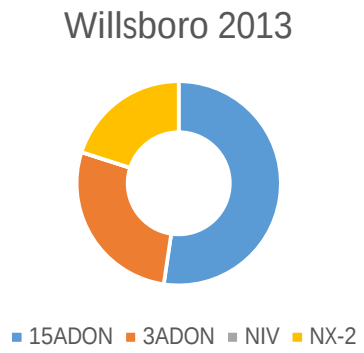
Trichothecene type frequency in the Eastern U.S. in 2006



Schmale et al., 2011. Plant Pathology 60, 909–917

Chemotype frequencies in New York

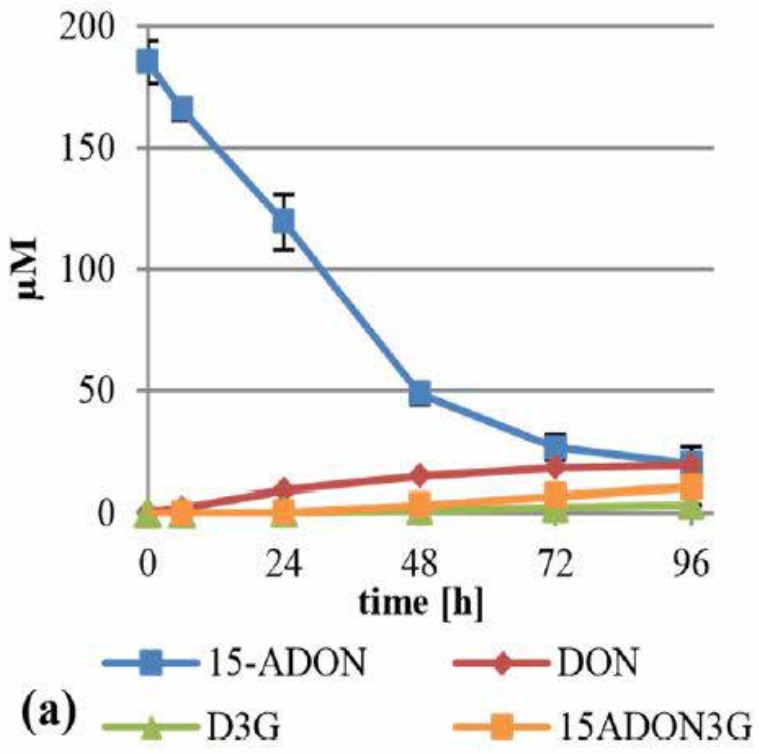




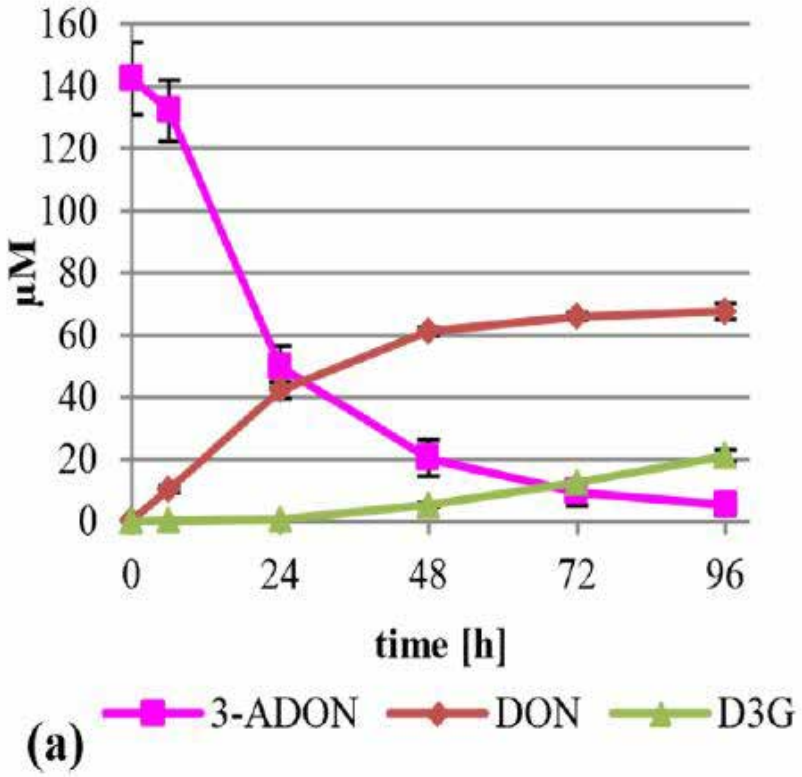
Kuhnem et al., 2015. Phytopathology 105: 695- 699.

Metabolism of trichothecene by wheat depends on trichothecene type.

15ADON



3ADON



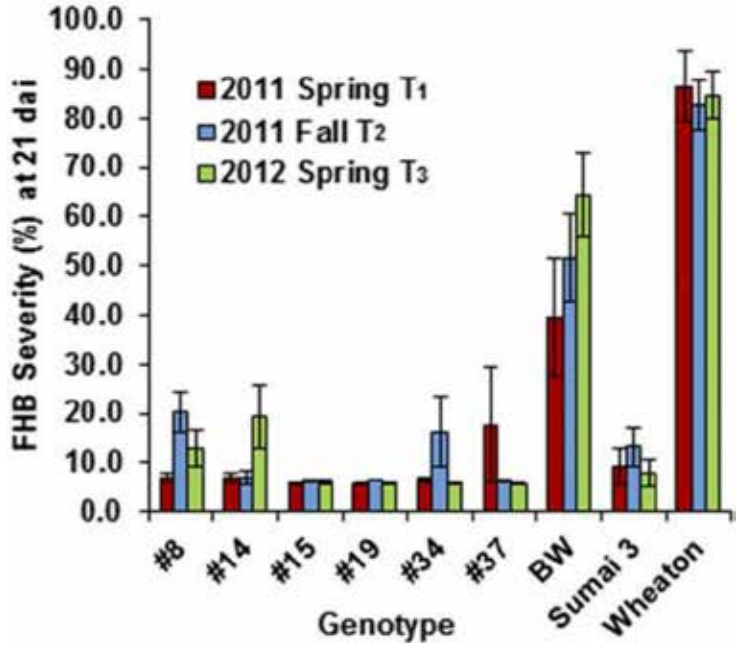
Schmeitzl, et al., 2015. The metabolic fate of deoxynivalenol and its acetylated derivatives in a wheat suspension culture. Toxins 7: 3112-3126.

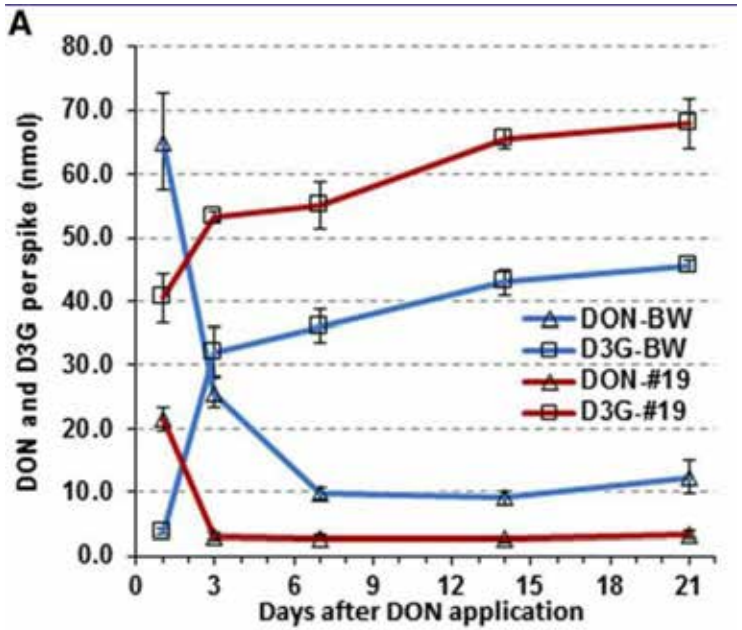
Transgenic resistance directed toward DON

Transgenic Wheat Expressing a Barley UDP-Glucosyltransferase Detoxifies Deoxynivalenol and Provides High Levels of Resistance to *Fusarium graminearum*

Xin LI,[1] Sanghyun Shin,[2] Shane Heinen,[2] Ruth Dill-Macky,[3] Franz Berthiller,[4] Natalya Nersesian,[5] Thomas Clemente,[5] Susan McCormick,[5] and Gary J. Muehlbauer[1,2]

See Poster #20





Li et al., 2015. MPMI 28:1237–1246.

What we need to know…

- What trichothecenes currently are made by FHB pathogens in the field?
- How do wheat and barley metabolize different trichothecene types?
- How do trichothecene-directed resistance mechanisms work on different trichothecene types?

Thanks to…

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Scab Initiative

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