

Corn and wheat viruses in Ohio

Soft Wheat Quality Research Review
Conference

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03-20-2013

Impact of corn & wheat viruses in Ohio

CORN

- maize dwarf mosaic virus (MDMV) and maize chlorotic dwarf virus (MCDV) have been the most common viruses in OH
- Yield losses due to viruses were devastating in 1960s-1970s, control measures implemented

WHEAT

- Sporadic disease problems, dependent on weather and vector populations
- Many wheat viruses, few control measures: luteoviruses, wheat streak mosaic virus, soil-borne wheat mosaic virus, wheat spindle streak mosaic virus

Part I: Ohio wheat virus survey



- Ohio is the top U.S. producer of soft red winter wheat used for cakes, cookies, and crackers.

- Ohio Small Grains Marketing Program funded survey with co-PIs Pierce Paul and Feng Qu (OSU)

Experimental design:

Collected samples from each of 27 field locations in 14 Ohio counties, 2 fields/county except Wayne.

At each field, collected 4 samples:
2 wheat samples as symptomatic as possible

1 asymptomatic wheat sample

1 pool from adjacent non-wheat weedy grasses

Field selection: good, bad & ugly



Of 27 field sites, three were volunteer fields and two were adjacent planted/volunteer fields

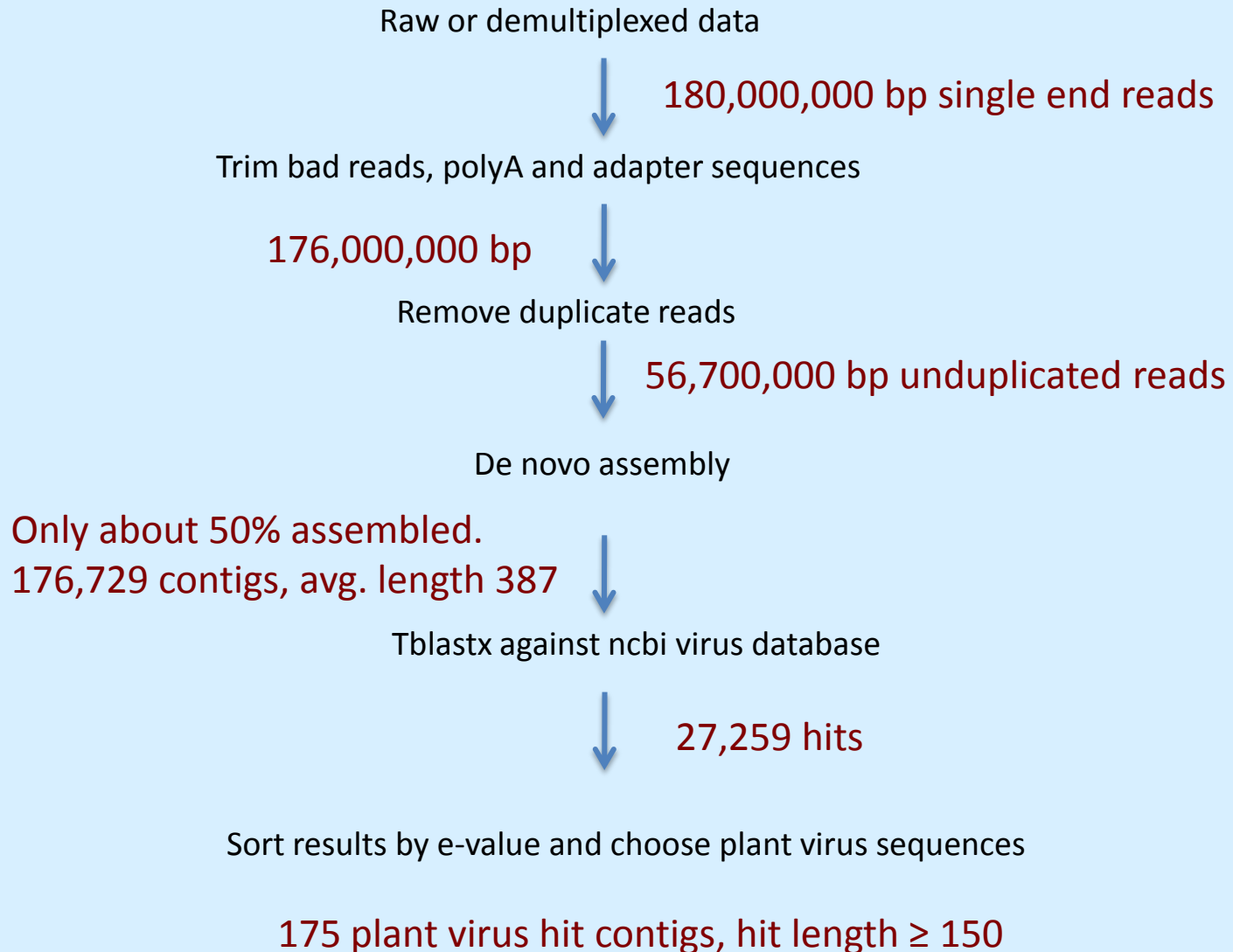
Virus-like symptoms



More potential virus symptoms



By the numbers: wheat virus survey



RT-PCR confirmation

RT	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Woo	+ctrl								
	W	G	W	G	W	G	W	G	W	G	W	G	W	G	W	G	W	G	W	G	W	G	W	G	W	G	W	G	W	G	W	G				
Luteo Gen. R			+				+				+				+					+				+								N/A				
BYDV GAV T			+				+				-				-?					-				-?								N/A				
BYDV GPV T			+				+				+				-					-													N/A			
BYDV MAV D&A			+				+				+				+					+				+									+			
BYDV PAS LS			+				-				-				-					+				-									N/A			
BYDV PAV D&A			+				+				+				+					+				+									+			
BYDV PAV T			+				+				+				+					+				+									+			
BYDV RMV D&A			+				-?				+				+					+				-?									+		poor primers	
BYDV SGV D&A			+				+				+				+					+				+									+			
CYDV RPV D&A			+				+				+				+					+				+									+		repeated.	
			-				-				-				-					-				-									-		ideal primers	
BSMV T			+				+				+				+					-				-								+		N/A		
HPV NP LS			-				+				+				-					-				+									+			
RGMV LS			+				-				-				+					+				-											N/A	
SBWMV D&A			-				-				-				-					+				-										+		
SCMV LS			-				-				-				-					-				-										+		
WSMV D&A			-				+				+				-					-				-										+		
WSSMV D&A			-				+				+				-					-				+										+		
Nad5 Ctrl			+				+				+				+					+				+										+		N/A

Primers were designed in house or used from:

Deb and Anderson (2008) J of Virol Methods 148:17-24,

Robertson et al (1991) J Gen Virol 72:1473-1477,

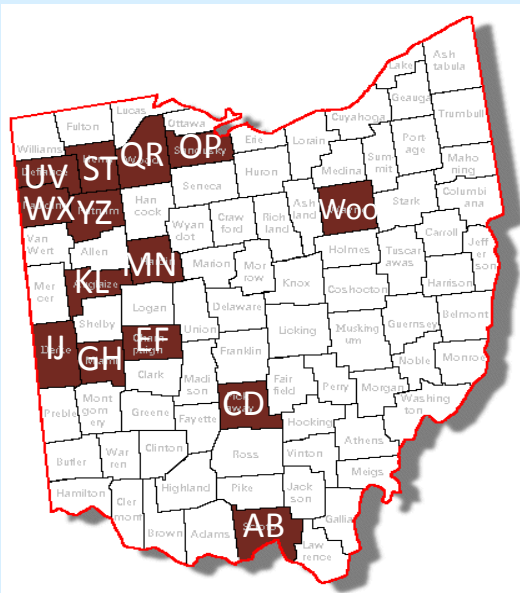
and Tao et al. (2012) Arch Virol 157:1261-1267.

Results summary

VIRUS sequence match (tblastx)	# of contigs	Avg. hit length (nt)	Transmission	Confirmed in wheat (RT-PCR)	Locations
Barley stripe mosaic virus (BSMV)	0	N/A	Seed	untested	B(weeds), G (weeds), O (weeds)
Barley yellow dwarf virus (BYDV; all strains)	33	318	Aphids	Yes	All
Brome mosaic virus (BMV)	5	1225	Unknown	Untested ^b	Untested
Cereal yellow dwarf virus (CYSDV; all strains)	25	593	Aphids	Yes	All
Oat necrotic mottle virus Type-NE	1	5328	Unknown	Untested ^a	Untested
Ryegrass mosaic virus (RGMV-AV)	4	1460	Eriophyid mite	Yes	C (weeds), D, N (weeds), S
Soil-borne wheat mosaic virus (SBWMV)	2	4642	Soil protozoan <i>Polymyxa graminis</i>	Yes	R, T
Sugarcane mosaic virus (SCMV)	2	243	Aphids	No	None
Wheat mosaic virus (WMoV; emaravirus) ^c	5	499	Eriophyid mite	Yes	H, K, W
Wheat streak mosaic virus (WSMV)	23	403	Eriophyid mite	Yes	E, K
Wheat yellow dwarf virus (WYDV)	2	250	Aphids	Untested	Untested

^bWheat is reported to be immune to this virus <http://www.dpvweb.net>.

^cIncludes all related virus (emaravirus) sequences since complete genome of High Plains virus is not yet reported.



Agent of High Plains disease in Ohio



Positive samples



Transmitted to sweet corn in the lab

Miami, Auglaize, and Paulding county samples positive. Paulding and part of Auglaize plots were volunteer wheat.

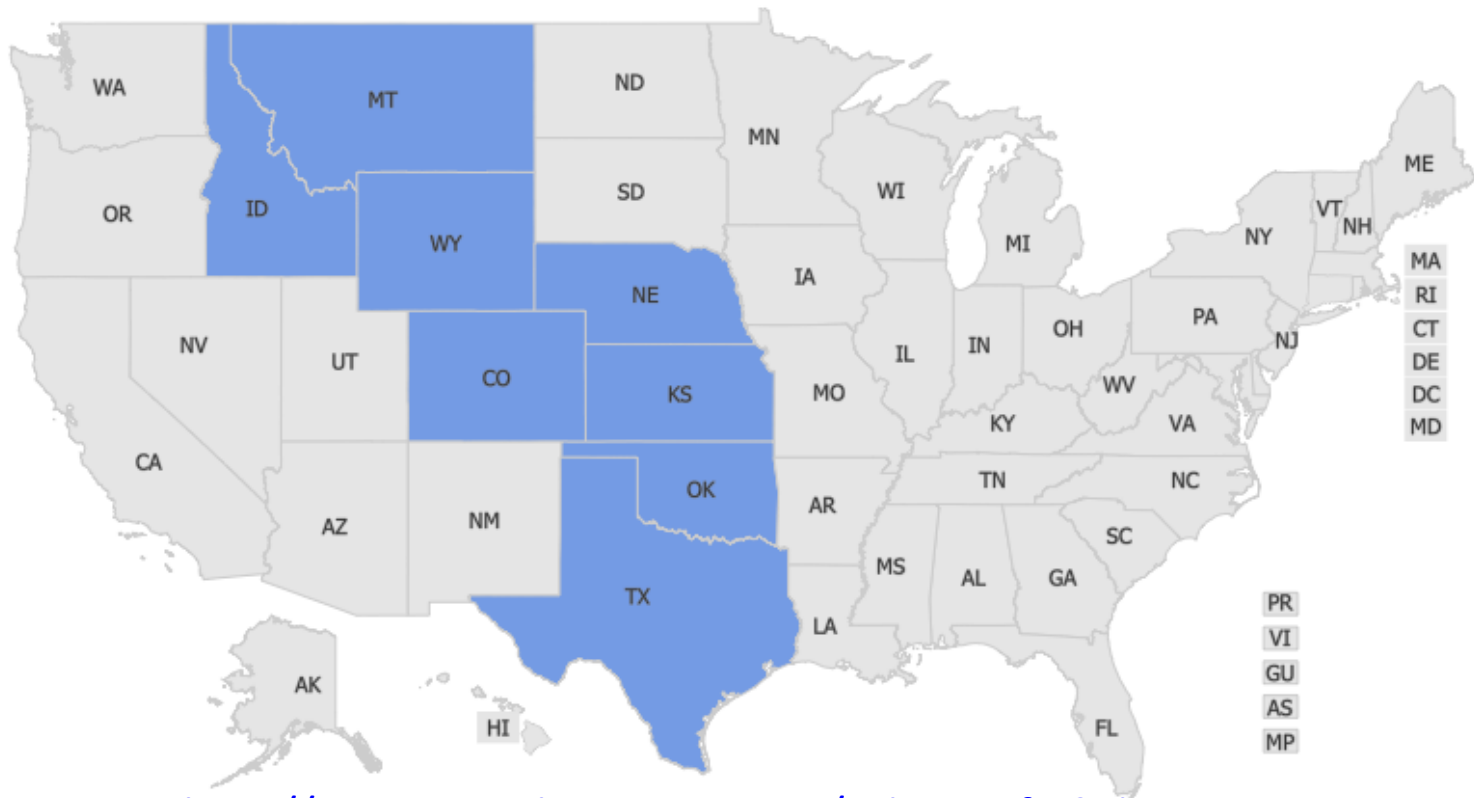
Wheat mosaic virus (High Plains virus)

High Plains Virus (HPV)

Taxonomic Rank: Viruses: Unassigned Viruses: Unassigned Viruses: Unassigned viruses: Uncharacterised virus

NAPIS Code: FVHPVAA

Distribution



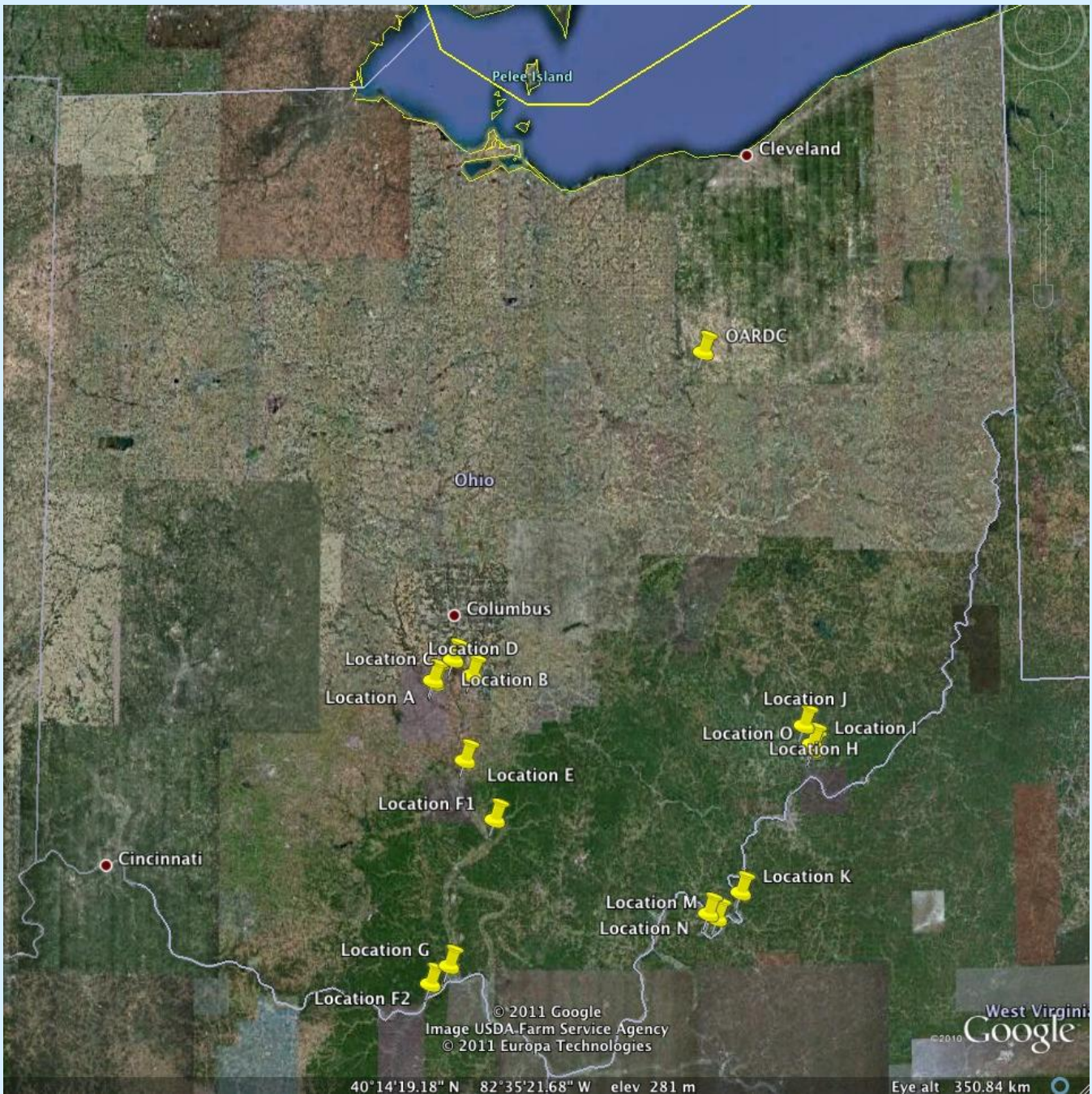
<http://www.prevalentviruses.org/subject.cfm?id=14592>

Part II: Ohio corn viruses, MDMV and MCDV



Project goals:

- Determine whether MCDV and MDMV are still found in Johnsongrass, sweet corn, and field corn
- Collect materials that can be used to assess the sequence diversity of viruses.



Pelee Island

Cleveland

OARDC

Ohio

Columbus

Location C

Location D

Location B

Location A

Location J

Location O

Location I

Location H

Location E

Location F1

Cincinnati

Location K

Location M

Location N

Location G

Location F2

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Image USDA Farm Service Agency
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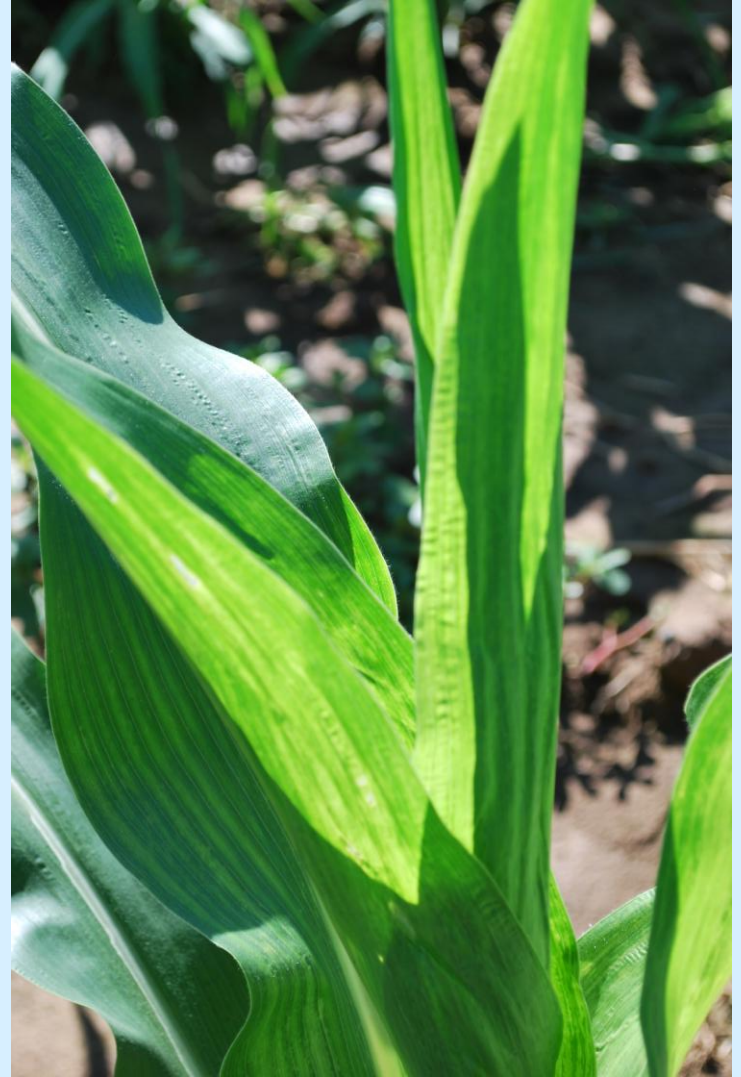
West Virginia
© 2010 Google

40°14'19.18" N 82°35'21.68" W elev 281 m

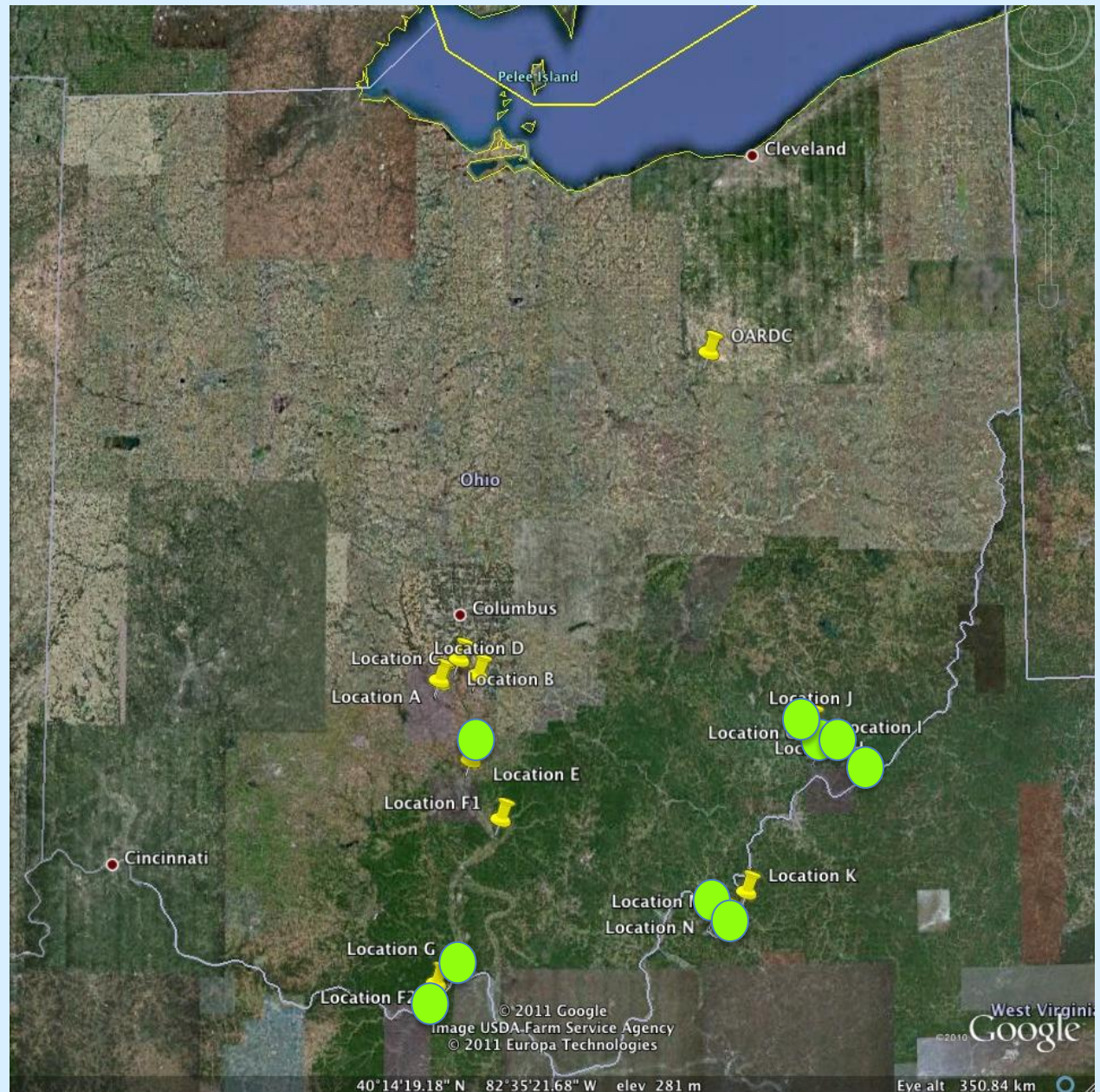
Eye alt 350.84 km

Virus Symptoms

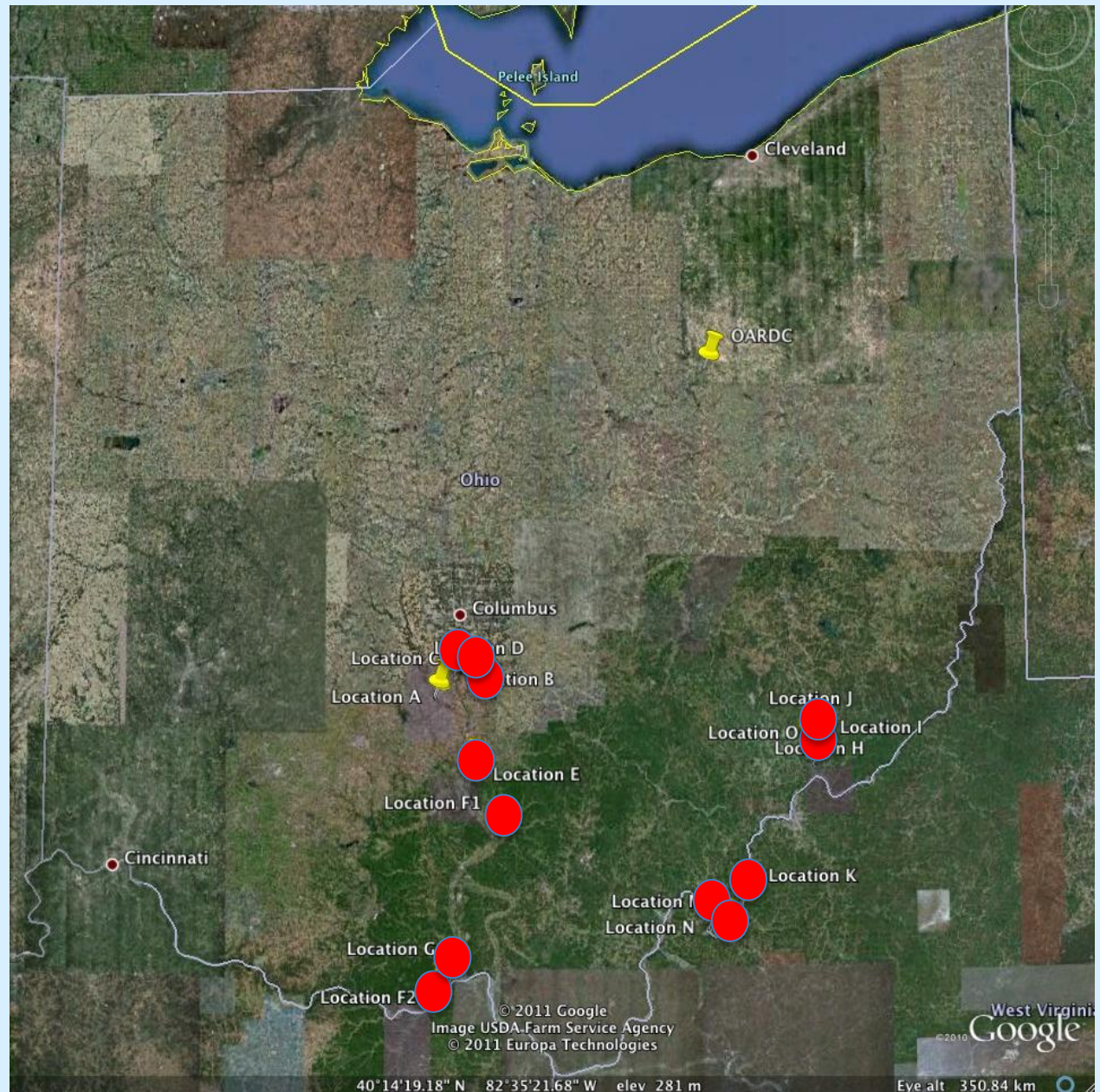
Sweet corn in Ashville



MCDV distribution



MDMV distribution



2011
ELISA
results

Site	Near	MCDV	MDMV-A	Sweet corn	Field corn	Johnsongrass
A	Darbyville	0/2	0/2	0	1	1
B	Darbyville	0/6	2/6	0	1	5 (2 infected MDMV)
C	Darbyville	0/8	5/8	0	2	6 (5 infected MDMV)
D	Ashville	0/10	8/10	2 (both MDMV)	0	8 (6 infected MDMV)
E	207x23	1/4	2/4	0	0	4 (none co-infected)
F1	Chillicothe	0/3	1/3	0	1	2
F2	Friendship	9/11	5/11	0	1	11 (5 MCDV only, 2 MDMV only, 4 co-infected)
G	Friendship	2/13	4/13	5 (2 MDMV)	0	8 (2 MCDV only, 2 MDMV only)
H	Marietta	0/10	9/10	7 (6 MDMV)	0	3 (all MDMV)
I	Marietta	1/10	10/10	3 (all MDMV)	0	7 (6 MDMV only, 1 co-infected)
J	Lowell	0/2	0/2	0	3	0
K	Portland	0/10	5/10	7 (2 MDMV)	0	5 (3 MDMV)
L	unknown	1/2	1/2	0	0	2 (none co-infected)
M	Letart Falls	1/10	2/10	4	0	6 (1 MDMV only, 1 co-infected)
N	Letart Falls	1/4	1/4	0	0	4 (none co-infected)
O	Racine	4/4	2/4	0	0	4 (all MCDV, 2 co-infected)
P	Marietta	4/8	8/8	0	2 (2 MDMV)	6 (all MDMV, 4 co-infected)
	TOTAL:	24/118	60/118	30	12	86

2012 ELISA results

Insects trapped (A. = Aphids ; G. = Graminella) and ELISA data for *MDMV-A*, *MCDV*, *SCMV*, *P. stewartii* in Sweet corn, Johnsongrass and field corn samples (2012)

*No field found

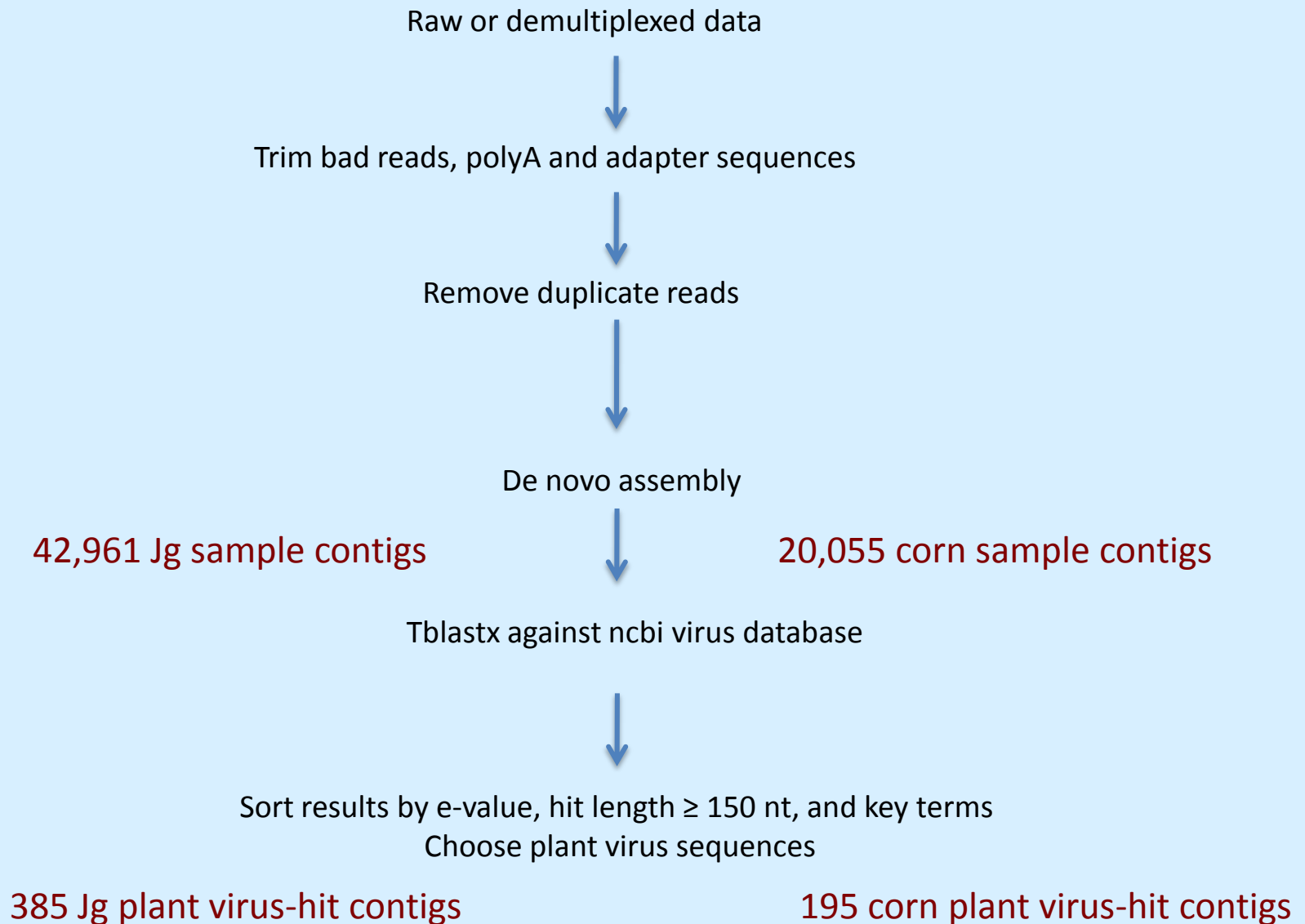
Table 2: Insects trapped (A. = Aphids ; G. = Graminella) and ELISA data for *MDMV-A*, *MCDV*, *SCMV*, *P. stewartii* in Sweet corn, Johnsongrass and field corn samples (2012)

*No field found

#	Near	Insects trapped		Johnson Grass				Sweet corn				Field corn				Total samples per location
				<i>MDMV-A</i>	<i>MCDV</i>	<i>SCMV</i>	<i>P. stewartii</i>	<i>MDMV-A</i>	<i>MCDV</i>	<i>SCMV</i>	<i>P. stewartii</i>	<i>MDMV-A</i>	<i>MCDV</i>	<i>SCMV</i>	<i>P. stewartii</i>	
		A	G													
AA	Darbyville	-	-	0/1	0/1	1/1	0/1	*								1
BB	Ashville	-	-	0/1	0/1	0/1	1/1	0/3	0/3	0/3	0/3					4
CC	Ashville	-	+	2/2	1/2	1/2	0/2	3/3	0/3	1/3	0/3					5
DD	Waterly	-	-	1/1	1/1	0/1		*								1
EE	Waterly	-	+	1/1	1/1	0/1	0/1	2/3	0/3	0/3	0/3					4
FF	Friendship	-	+	5/8	0/8	0/8	0/8	*								8
GG	Friendship	+	-	No symptoms found				4/9	0/9	0/9	0/9					9
HH	Whealersburg	+	+	3/5	2/5	0/5	0/5	4/5	1/5	0/5	0/5					10
II	Whealersburg	+	-	1/1	1/1	0/1	0/1	7/7	0/7	0/7	0/7					8
JJ	Marietta	+	-	3/3	1/3	0/3	0/3	8/8	0/8	0/8	0/8					11
KK	Marietta	-	+	1/2	0/2	0/2	0/2	9/9	0/9	0/9	0/9					11
LL	Coal Run	-	-	0/2	0/2	0/2	0/2	*				3/6	0/6	0/6	0/6	8
MM	Portland	-	+	2/3	0/3	0/3	0/3	6/7	0/7	0/7	0/7					10
NN	Letart Falls	-	+	1/3	1/3	2/3	0/3	0/2	0/2	0/2	0/2					5
Total infected samples				12/33	8/33	1/33	1/33	42/56	1/56	1/56	0/56	3/6	0/6	0/6	0/6	95

Table by R. Teplier, ,2012

By the numbers: Ohio corn & Johnsongrass



Acknowledgements

Redinbaugh:

Louie

ce Paul

g Qu

e Todd

k Jones

g-qin Miao

ar Umanzor

néle Teplier

en Willie

ela Strock

a Morales

n Cassone

nga Wjeratne

a Wjeratne

C

e Dorrance



Funding:

USDA-ARS

Ohio Small Grains Marketing Program

Field sampling:

Ohio growers

Mike Estadt

Hal Kneen

Eric Barrett



Acknowledgements:

Mark Jones

Jane Todd

Edgar Umanzor

Chris Nacci

Rachéle Teplier

Mike Estadt

Hal Kneen

Eric Barrett

Dr. Ray Louie

Ohio Corn Growers

RNA-Seq & Bioinformatics:

Bryan Cassone

MCIC: Saranga & Asela Wjeratne

Anne Dorrance

OSU RNA-Sequencing

