

# Molecular Characterization of *Alternaria solani* from Manitoba

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Early Blight



Brown Spot



Botrytis



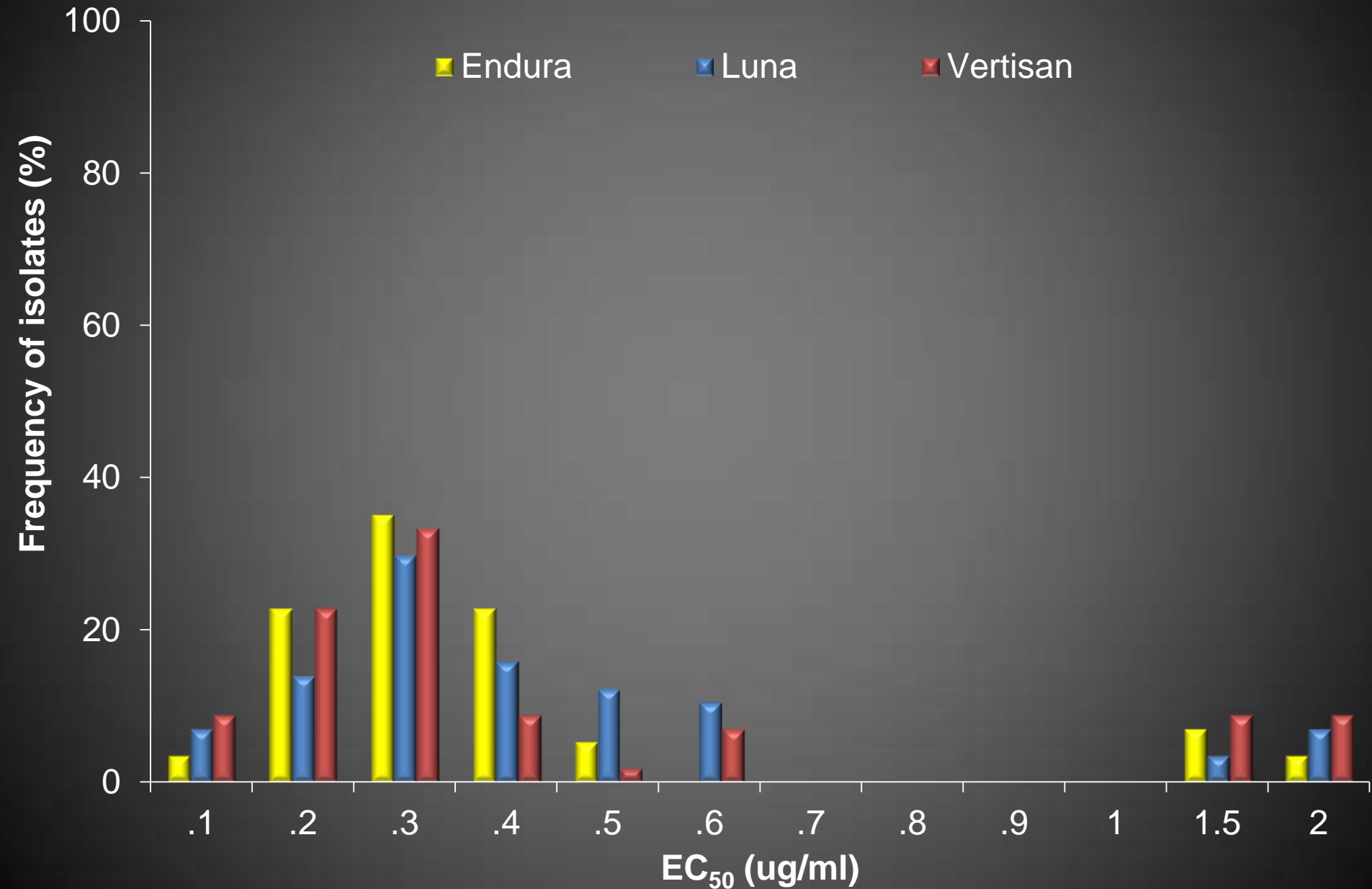
Black Dot

# History of Fungicide Resistance in *As*

- First QoI (strobilurin) fungicide (Quadris) registered on potato in 1999
- First QoI resistance in *A. solani* first reported in ND and NE in 2001 (Pasche, et al.)
- First SDHI fungicide (Endura) registered on potato in 2005
- Poor early blight disease control reported in 2009 in ID; 2010 in ND & NE (Wharton, et al.; Gudmestad, et al.)

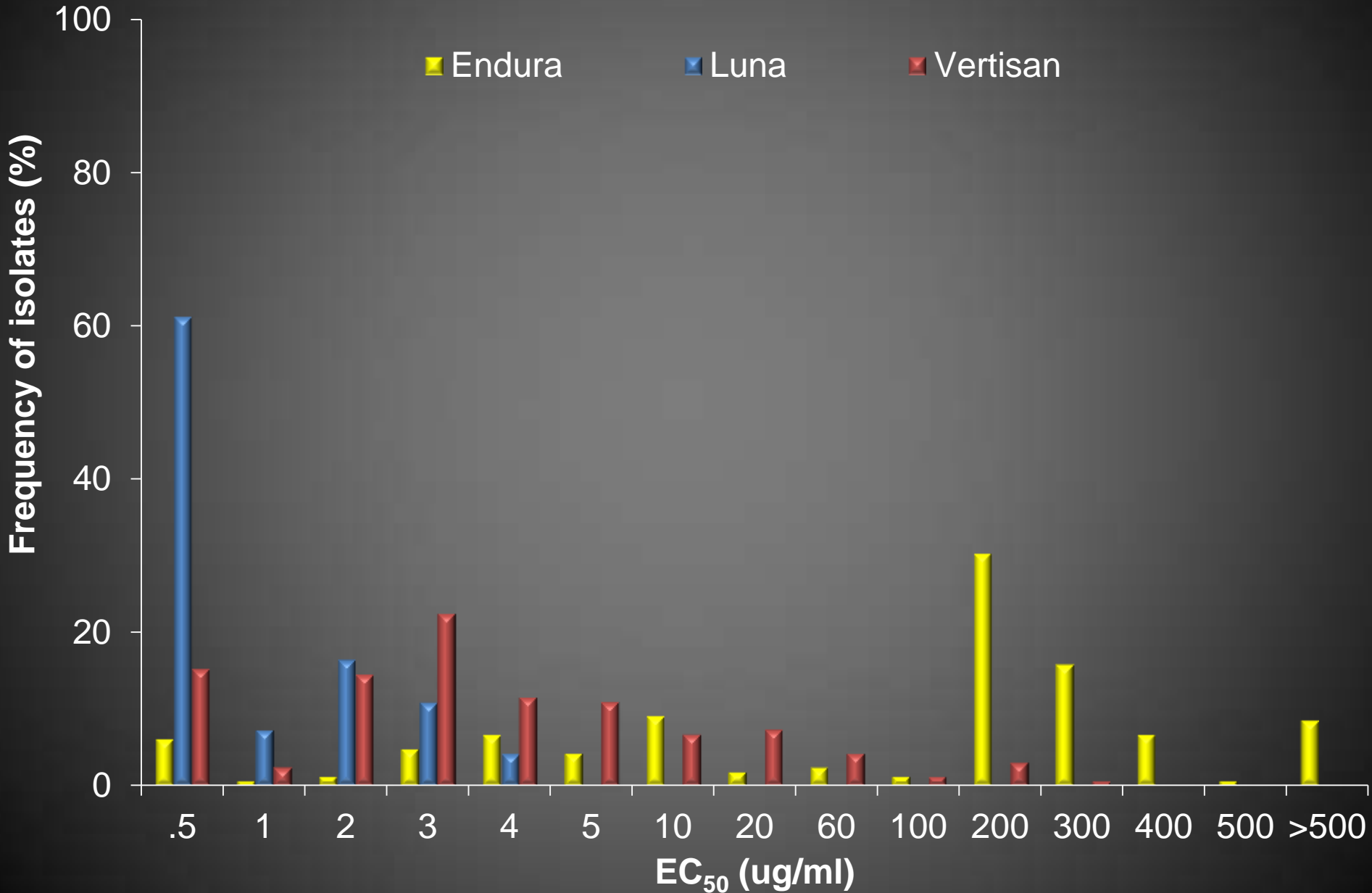
Baseline Sensitivity of *A.*  
*solani* to Endura, Luna &  
Vertisan

# In Vitro Sensitivity of Baseline *A. solani* isolates to SDHI Fungicides

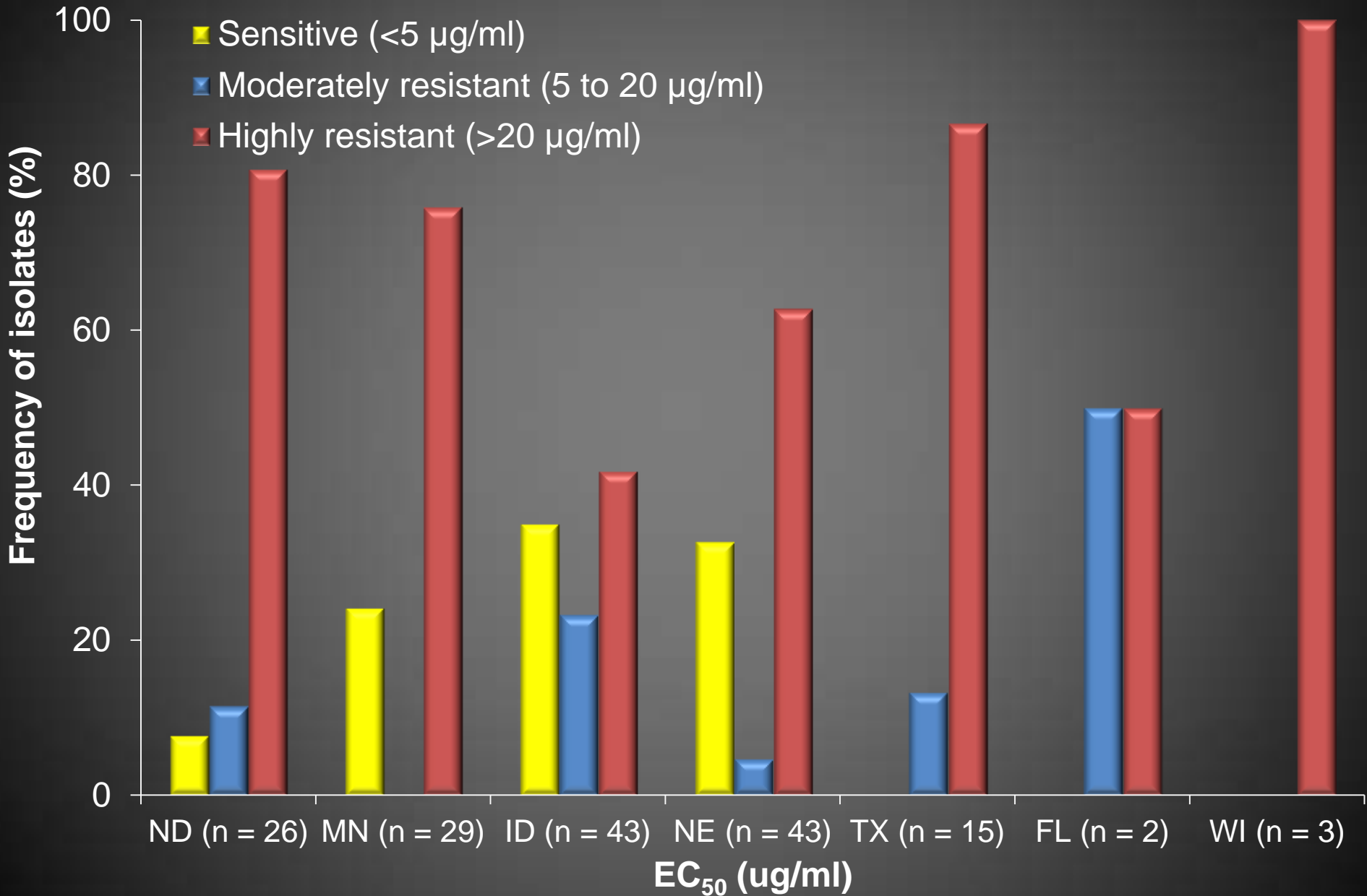


# In Vitro Assays- 2010 & 2011 *A. solani* isolates

# In Vitro Sensitivity of 2010 and 2011 *A. solani* isolates to SDHI Fungicides



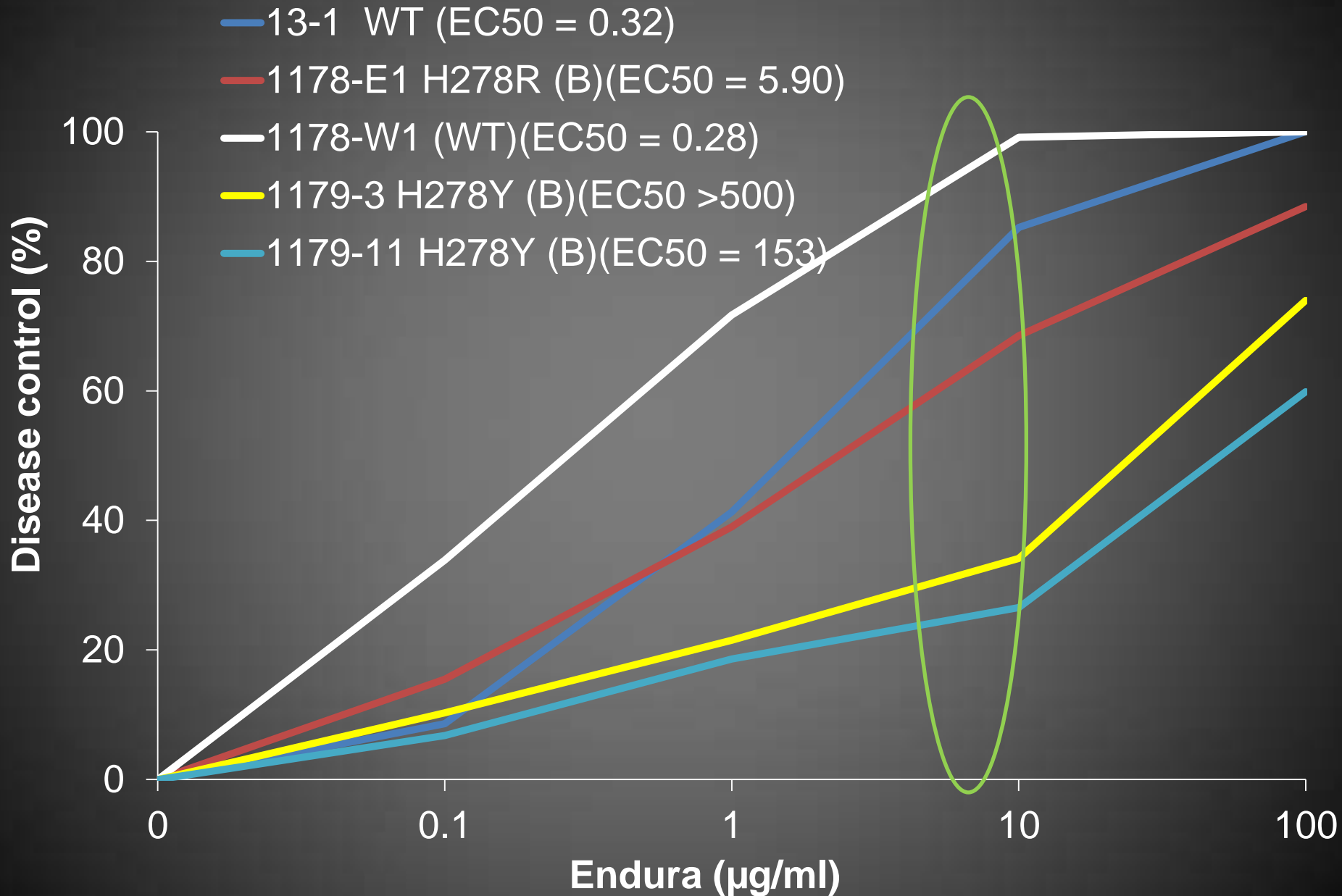
# In Vitro Sensitivity of 2010 and 2011 *A. solani* isolates to Endura



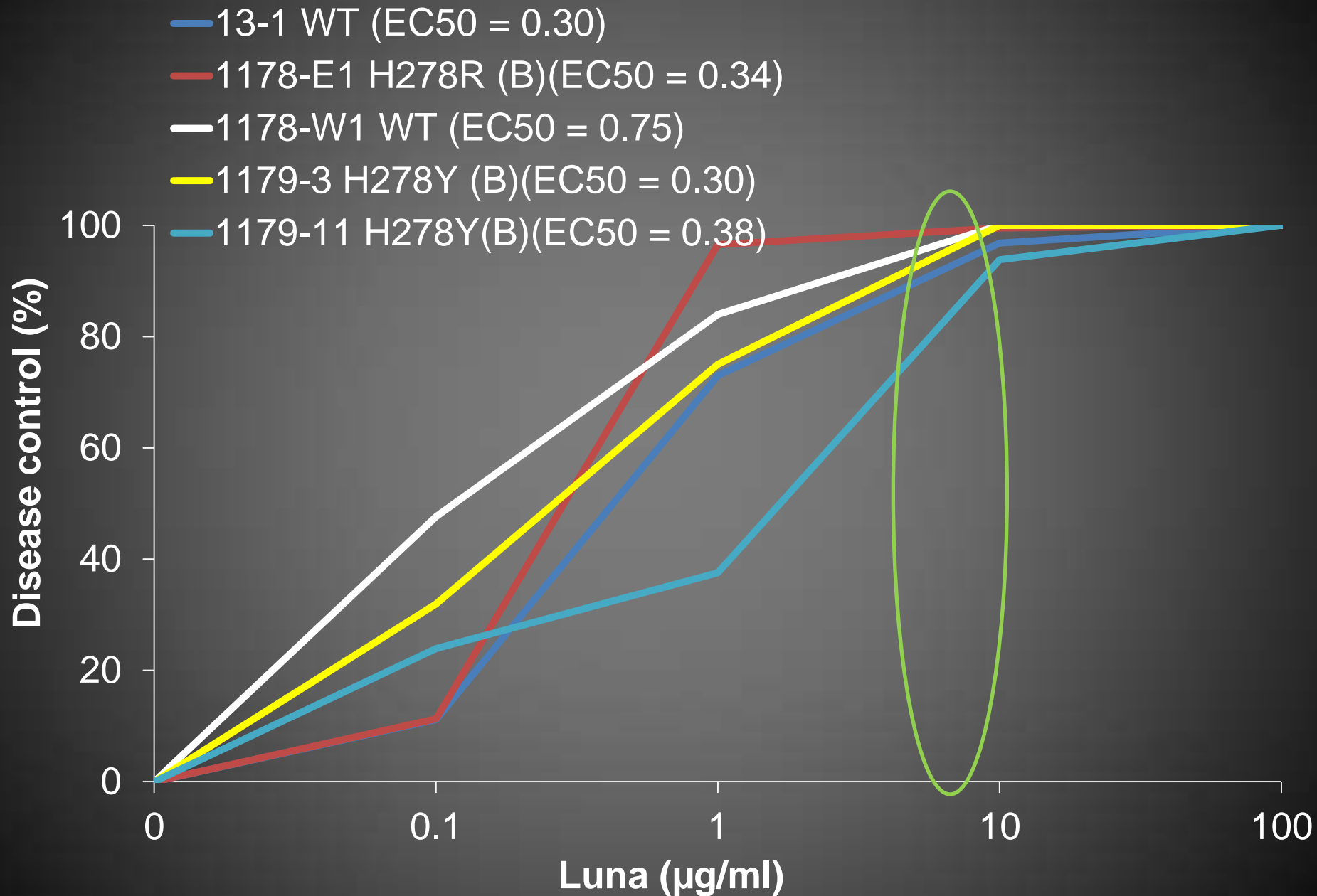


# Impact of Endura Resistance on Disease Control

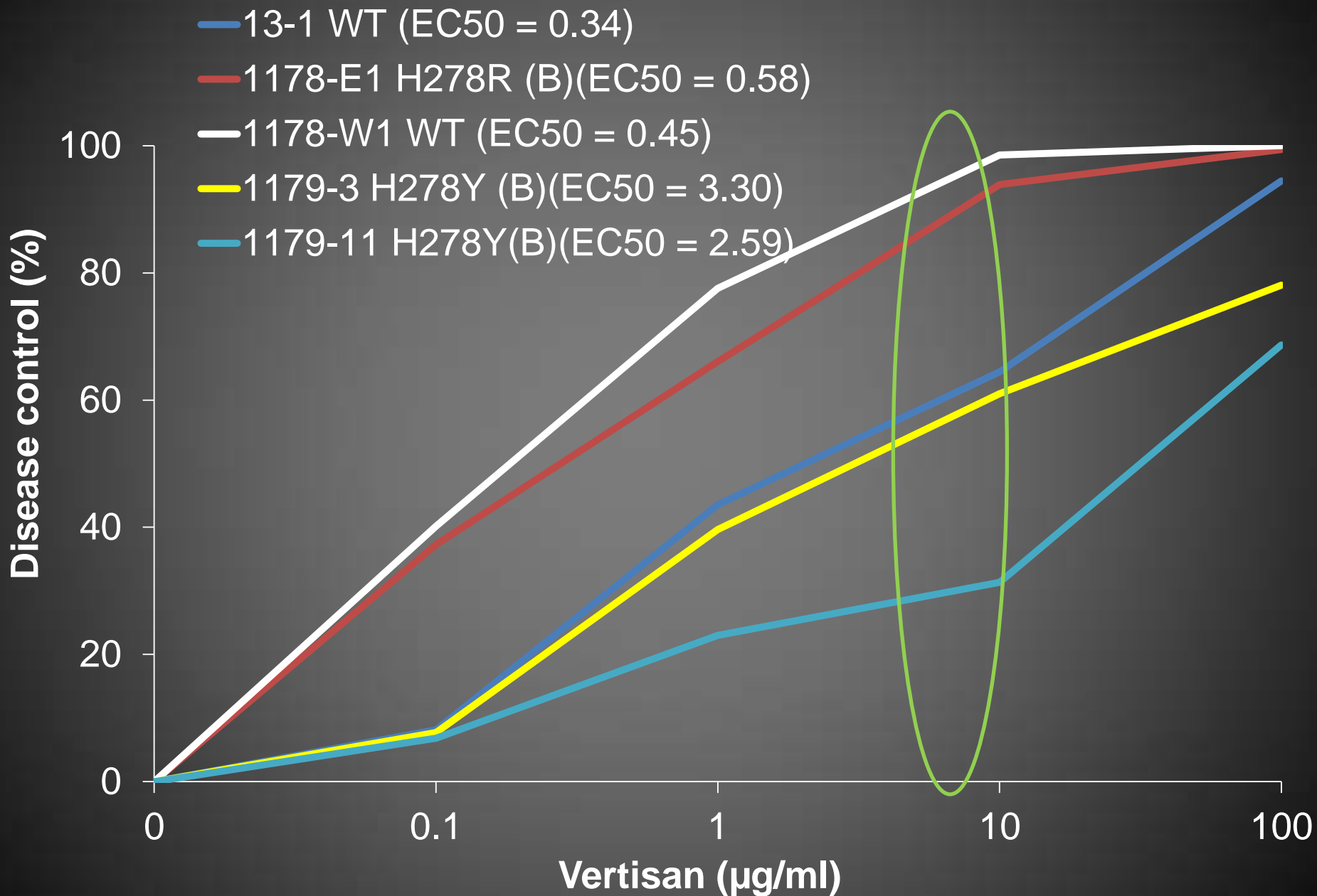
# Sensitivity of *A. solani* Isolates *In Vivo*



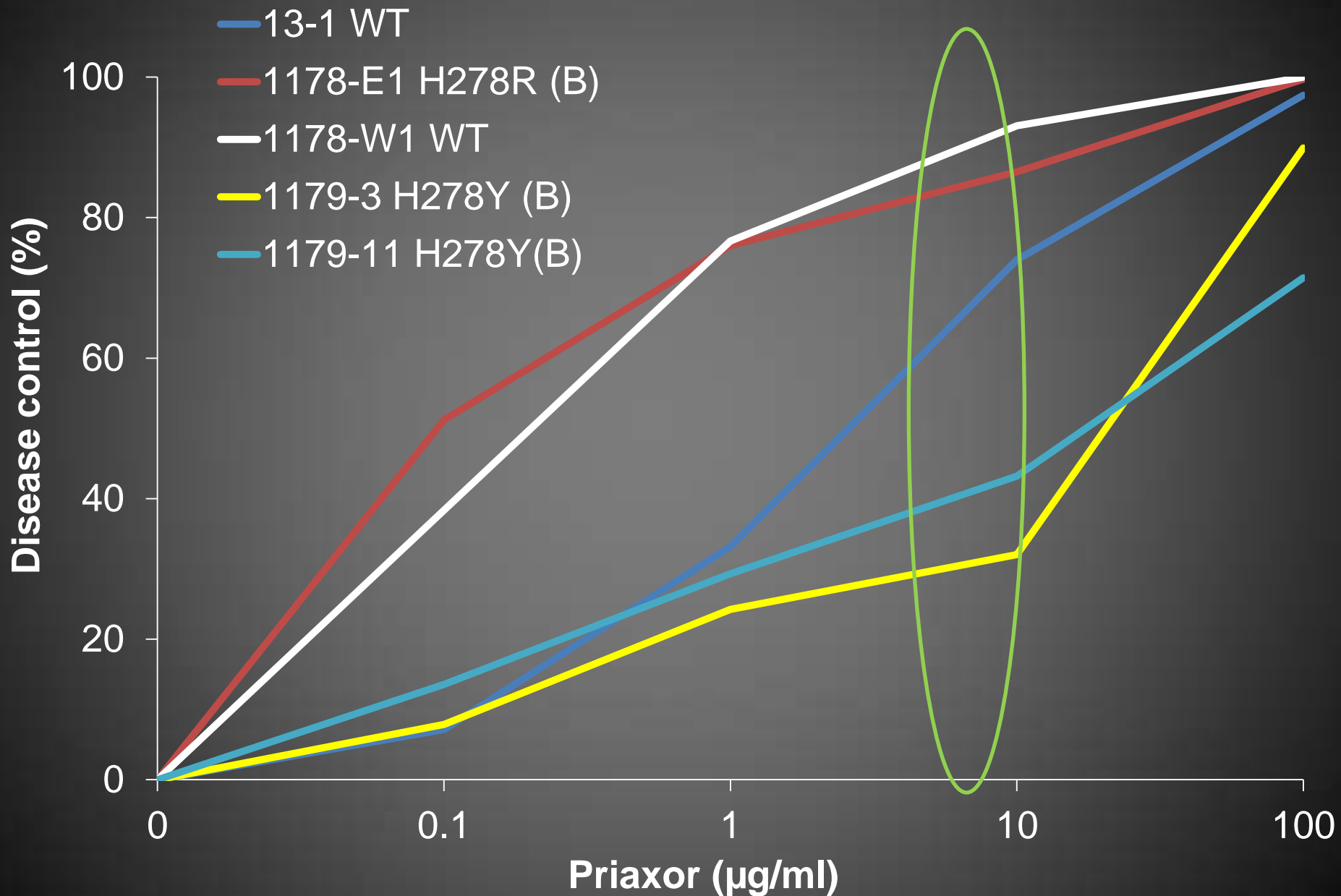
# Sensitivity of *A. solani* Isolates *In Vivo*



# Sensitivity of *A. solani* Isolates *In Vivo*



# Sensitivity of *A. solani* Isolates *In Vivo*



Characterization of  
SDHI Mutation Genes  
in *Alternaria solani*

# SDHI Resistance Mutation Genes

- We have characterized five mutation genes in *A. solani* (Mallik et al. 2014):
  - **H278Y** in SDHB gene- very high resistance to Endura
  - **H278R** in SDHB gene- moderate resistance to Endura
  - **H134R** in SDHC gene- high resistance to Endura
  - **H133R** in SDHD gene- very high resistance to Endura
  - **D123E** in SDHD gene- very high resistance to Endura

# SDHI Resistance

- In original 2010 & 2011 surveys ~72% As isolates resistant to SDHIs, but resistance occurred in “pockets”
- Some farms or regions had resistance to Endura, others did not
- For example, W-NE did not have resistance, but it was widespread in E-NE
- In ND, resistance widespread in central portion, but not in SE or NE portion of state



# SDHI Resistance Mutation Genes

- Mutations in SDHB gene (H278Y & H278R) are most common in USA and evenly distributed
- Most of the mutations in SDHC gene (H134R) found in ND (80%), remainder in ID
- Most of the mutations in SDHD gene (H133R) found in ID (90%), remainder in ND
- The D123E in SDHD gene was very rare, only one isolate found in original survey but is very worrisome as it may convey reduced sensitivity to Luna T ( $EC_{50}=2.89 \mu\text{g/ml}$ )

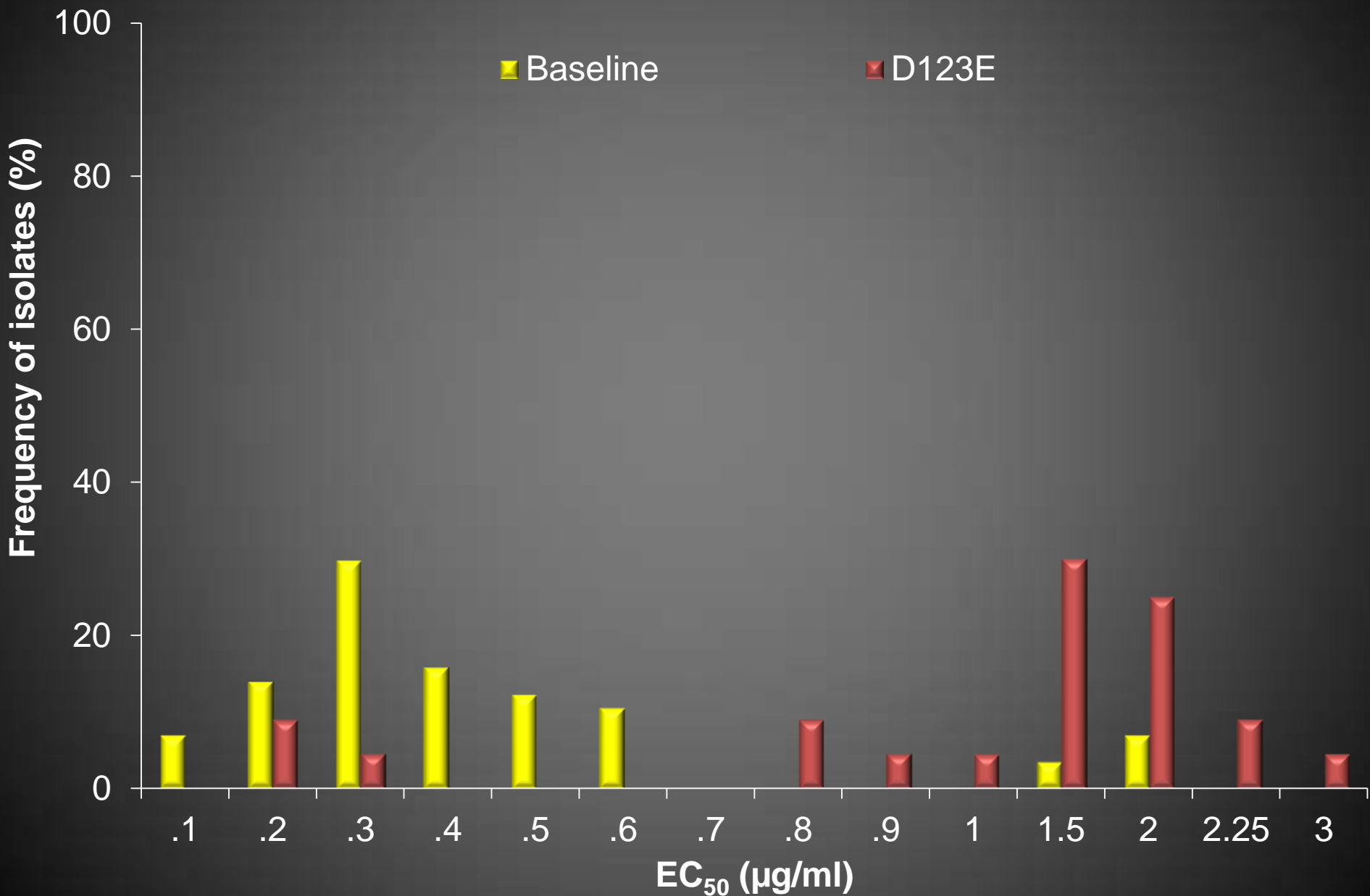
# SDHI Resistance in ND & MB- 2013

Frequency of SDHI Resistance Mutation in Each State/Province

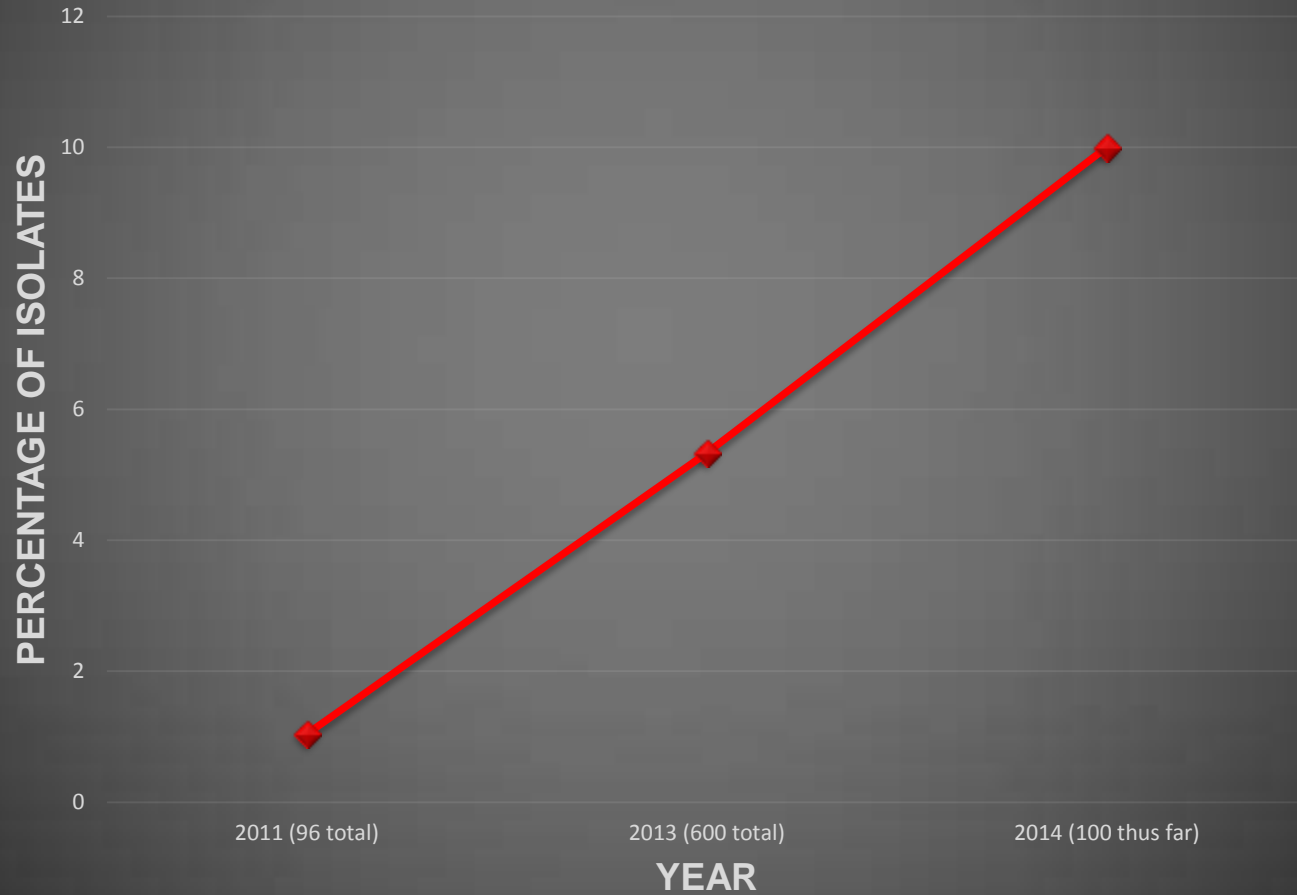
State/ Province	F129L (QoI)	H278Y (VHR) %	H278R (MR) %	H134R (HR) %	H133R (VHR) %	D123E (VHR) %	Sensitive Endura %
ND	93	14	17	64	4	0	1
MB	98	11	19	11	1	4	50
USA*	88	18	13	50	14	4	1

\* States sampled includes, CO, ID, IL, MI, MN, ND, NE, NM, TX, WI, WA

# *In Vitro* Sensitivity of *A. solani* isolates possessing the D123E mutation to Luna T



# Percentage of *A. solani* isolates possessing the D123E mutation collected by year



# Summary of SDHI Resistance

- SDHI resistance in *A. solani* first reported in ID in 2009, subsequently detected in ND, NE, MN, TX, & WI in 2010 and 2011, MB in 2013
- In the USA, >90% of *A. solani* isolates tested have some level of resistance to boscalid; 50% in MB
- SDHI resistance in *As* is conveyed by one of five different mutations
- Each point mutation appears to convey resistance to Endura, to some degree to Vertisan and Priaxor, but not to Luna