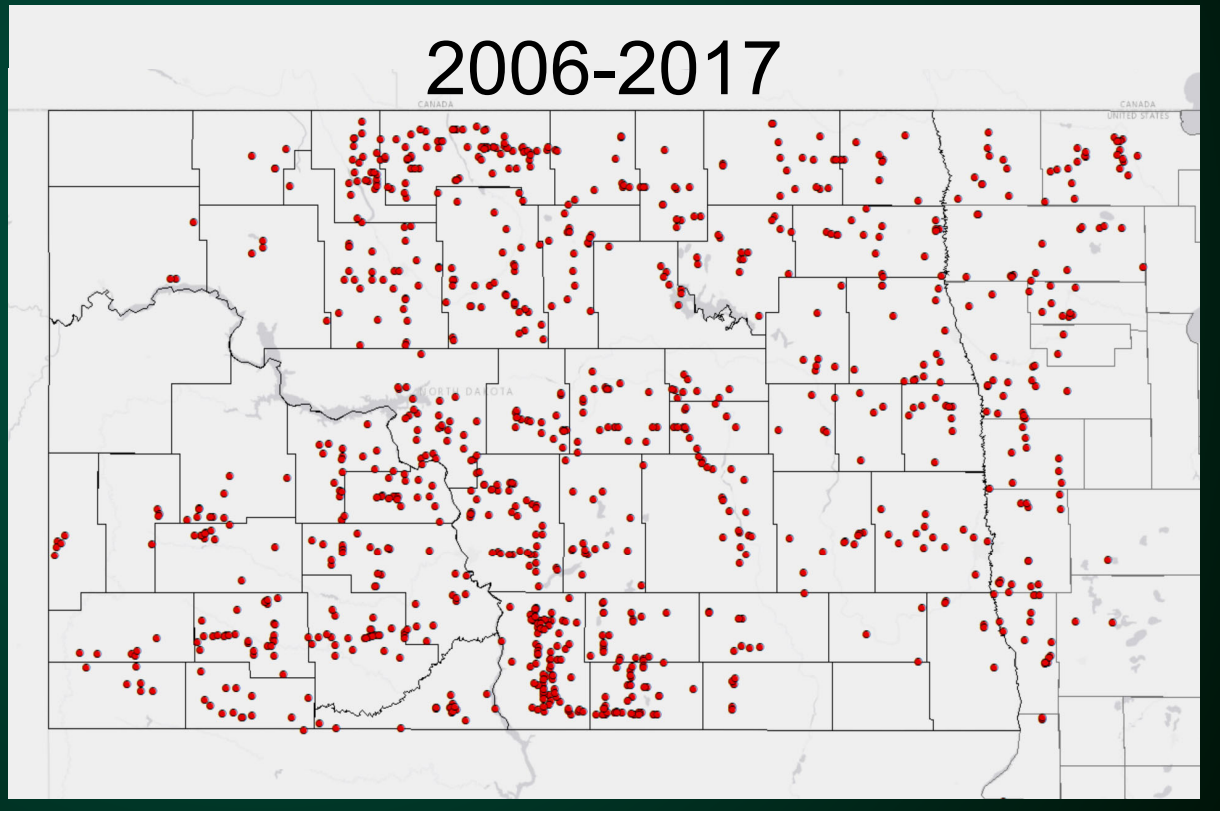
Analyses of NSA Survey Data Determining the Impact of Disease on Yield Components in ND and MN Sunflower Fields

Bryan Hansen[1], Andrew Friskop[1], Hans Kandel[2] and Sam Markell[1]

[1]Department of Plant Pathology, North Dakota State University, Fargo, ND;
[2]Department of Plant Sciences, North Dakota State University, Fargo, ND;

- 1003 surveyed fields in ND/MN
- Production practices
- Disease
- Insects
- Weeds
- Yield
- Factors limiting yield



Components Surveyed

Diseases

- Sclerotinia Wilt
- Sclerotinia Mid-stalk Rot
- Sclerotinia Head Rot
- Rhizopus
- Downy Mildew
- Phomopsis
- Phoma
- Charcoal Rot
- Verticillium
- Rust

Yield

- Harvestable Population
- Head Size
- Center Seed Set
- Seed Size
- Percent Good Seed
- Bird Damage*

- Yield

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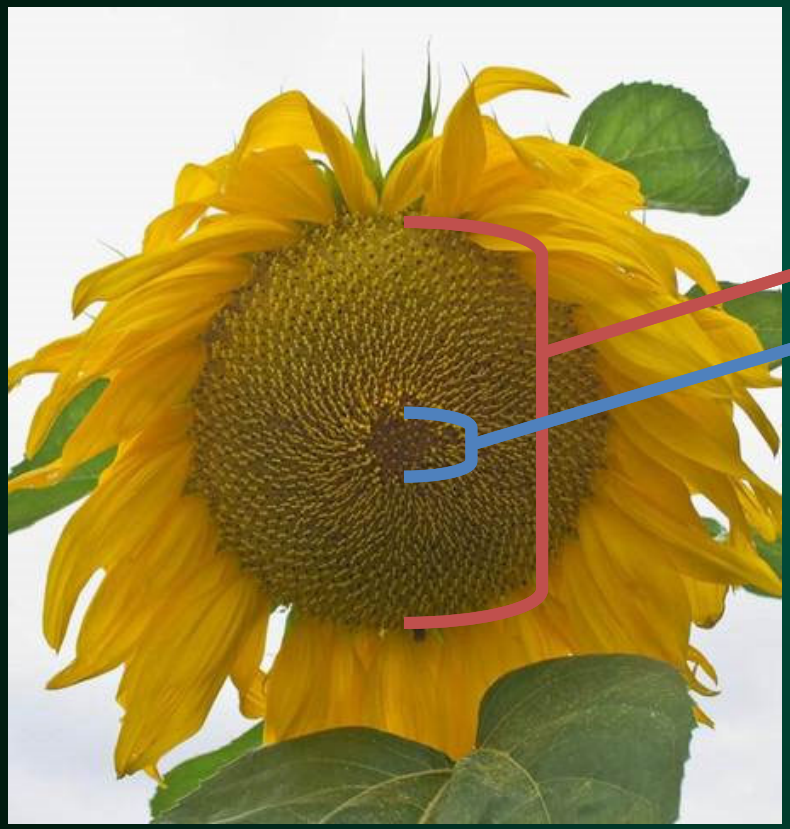

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- Which component of yield is being affected
- How much disease before you expect losses
- Where research efforts can be focused

Average Yield of Limiting Factors

Limiting Factor	Yield (lb/ac)	No of Obs	P-value
None	2169	66	--
Birds	1332	51	<.0001**
Disease	1787	118	<.0001**
Drought	1575	66	<.0001**
Drown-out	1854	8	0.0934
Hail	1490	10	<.0001**
Herbicide	1123	1	0.0377*
Insects	1587	15	<.0001**
Lodging	1731	54	<.0001**
Plant spacing	1729	98	<.0001**
Weeds	1847	31	0.0033**
Uneven growth	1466	9	<.0001**

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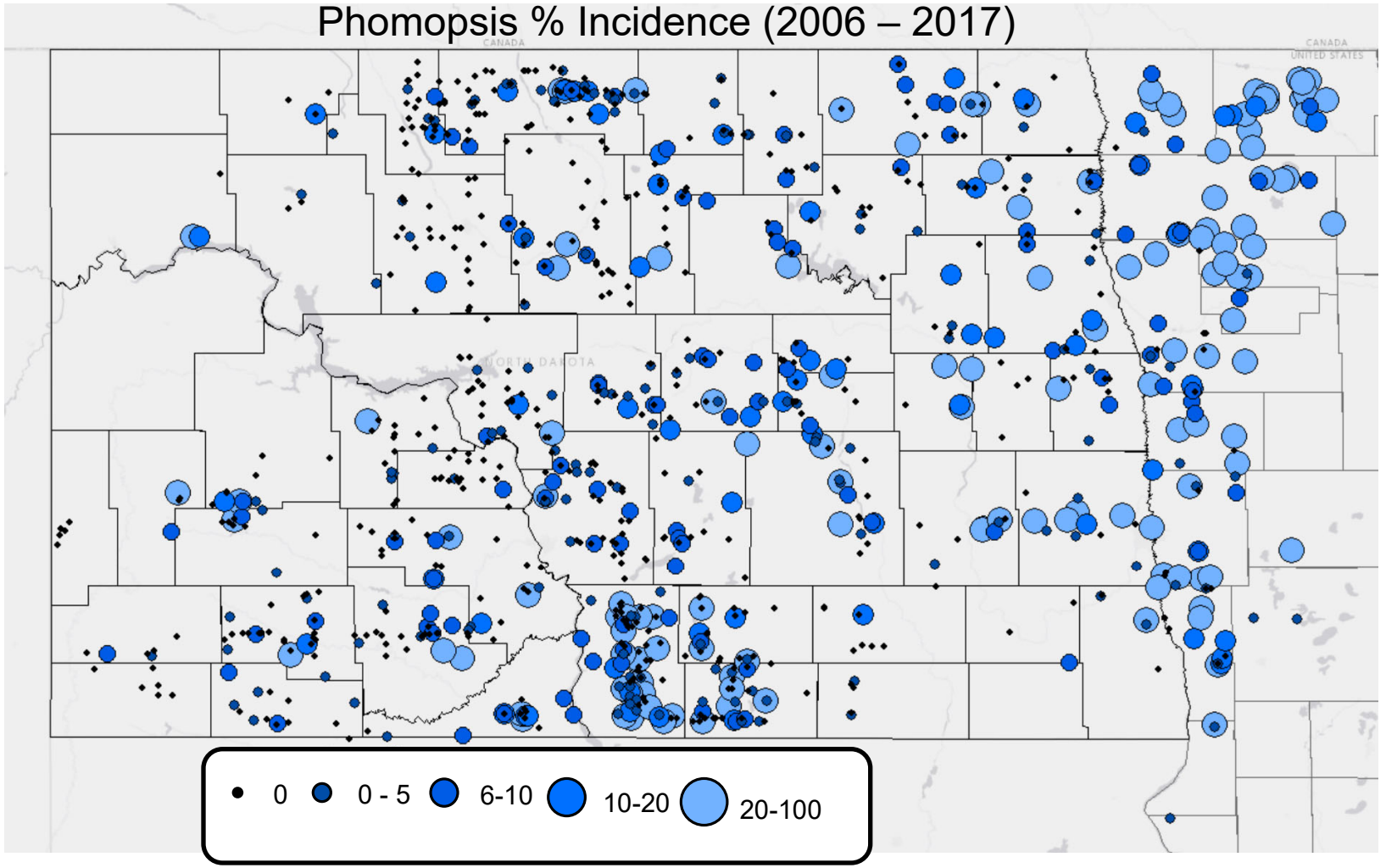
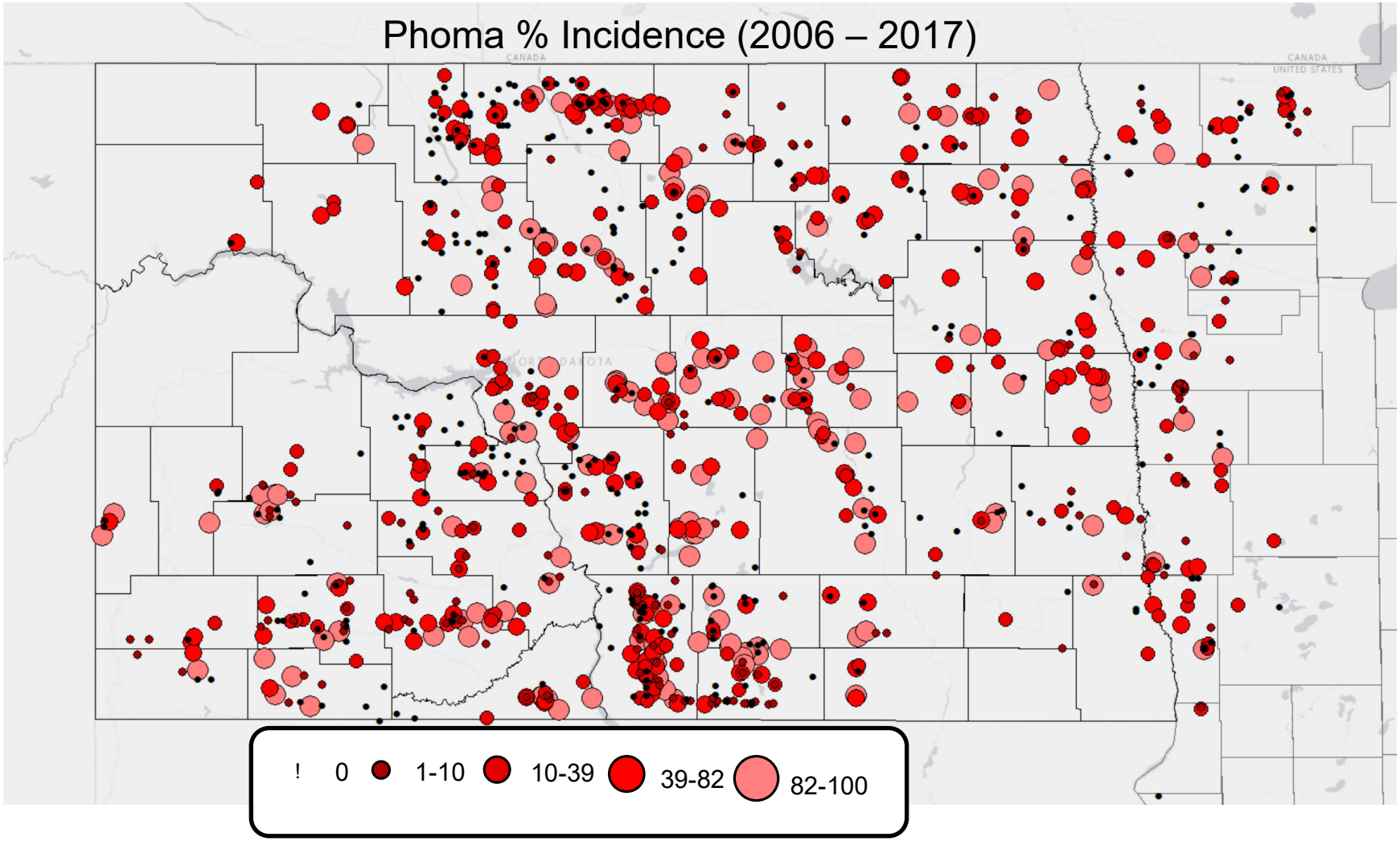
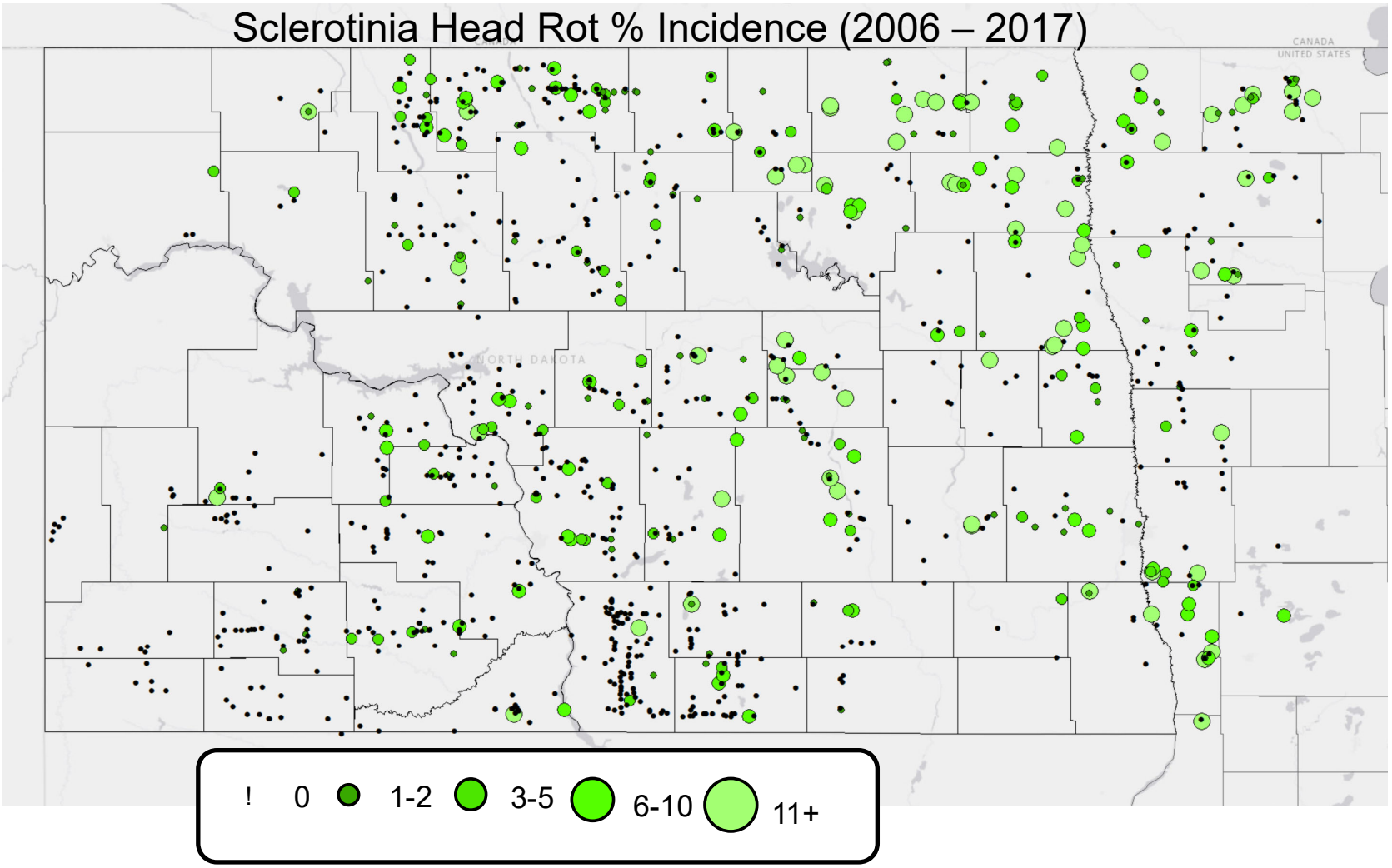
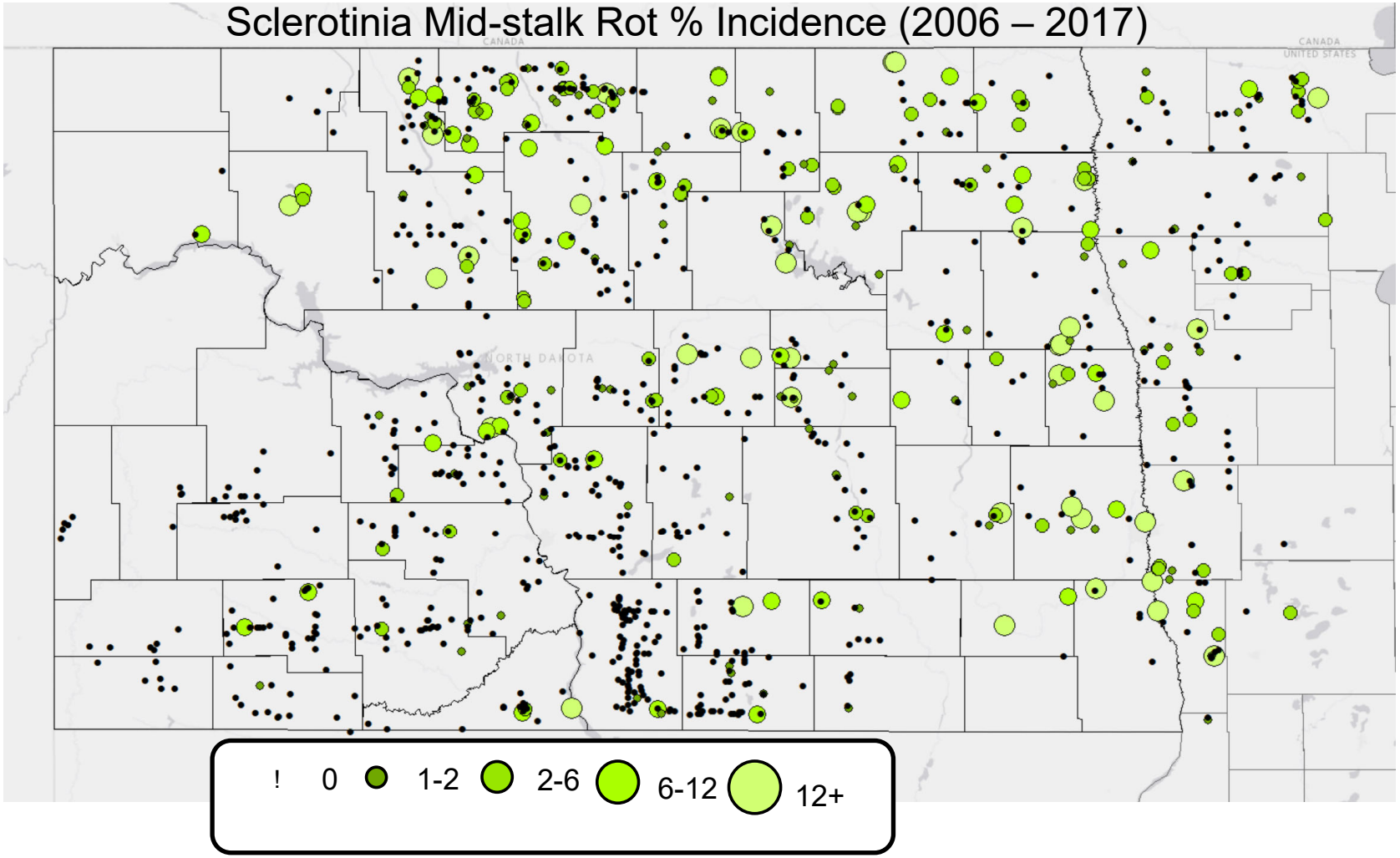
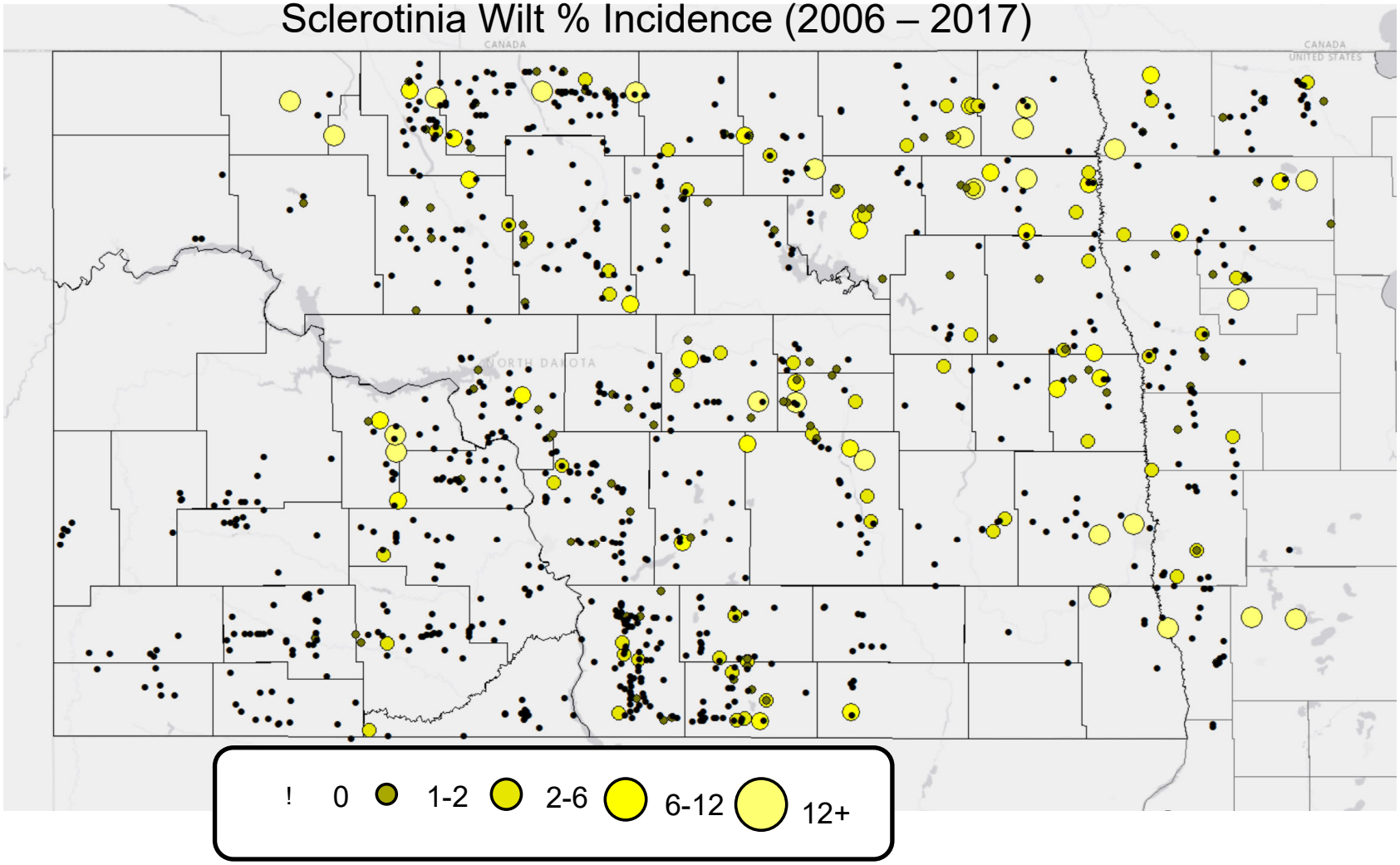
- Problem: Conditions favoring yield will often times also favor disease
- Solution: Integrate location & year into data


Phomopsis % Incidence (2006 – 2017)
CANADA
CANADA
UNITED STATES
NORTH DAKOTA
0
0 - 5
6-10
10-20
20-100

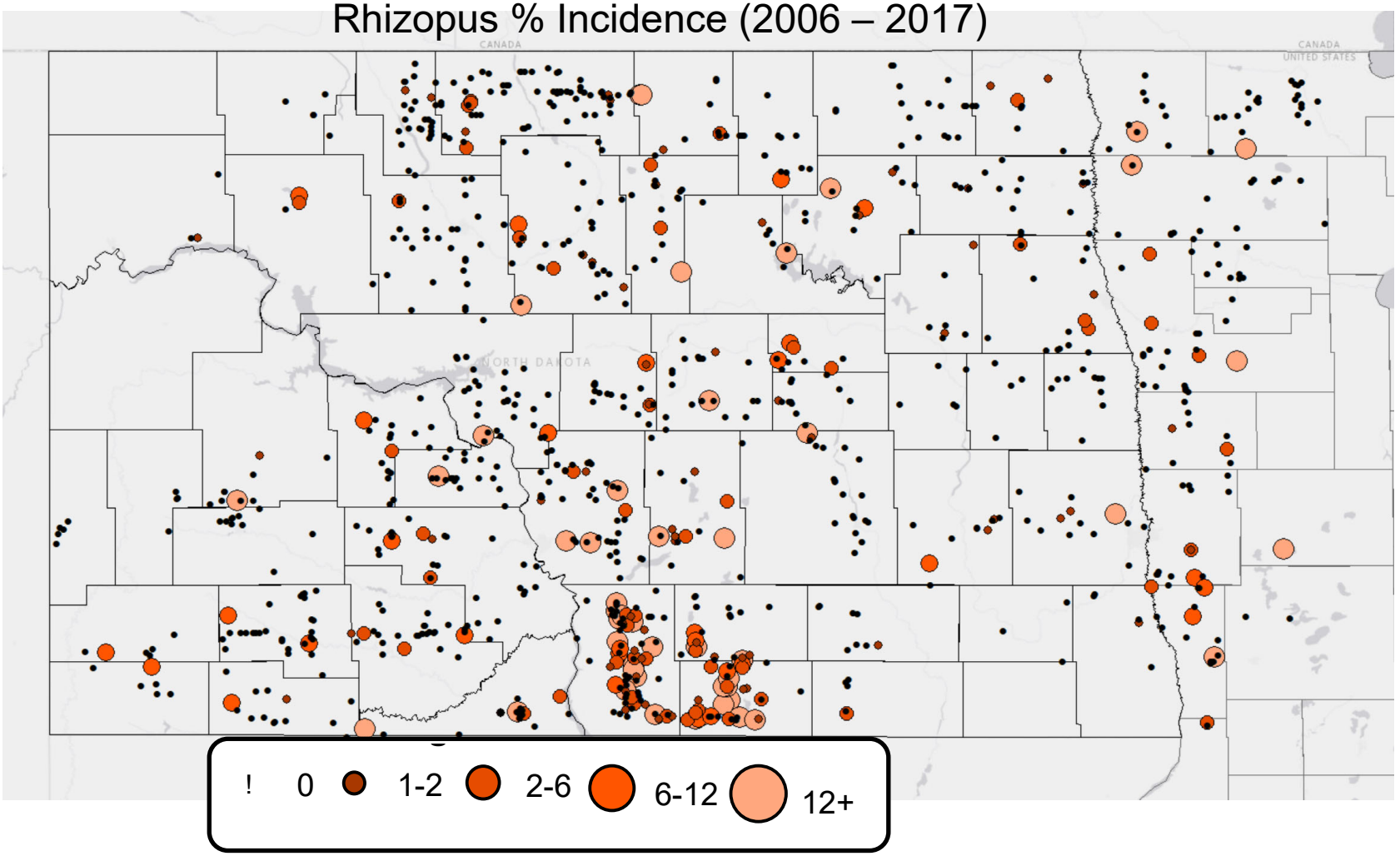

Phoma % Incidence (2006 – 2017)
CANADA
CANADA
UNITED STATES
! 0
1-10
10-39
39-82
82-100


Sclerotinia Head Rot % Incidence (2006 – 2017)
CANADA
UNITED STATES
NORTH DAKOTA
! 0 1-2 3-5 6-10 11+

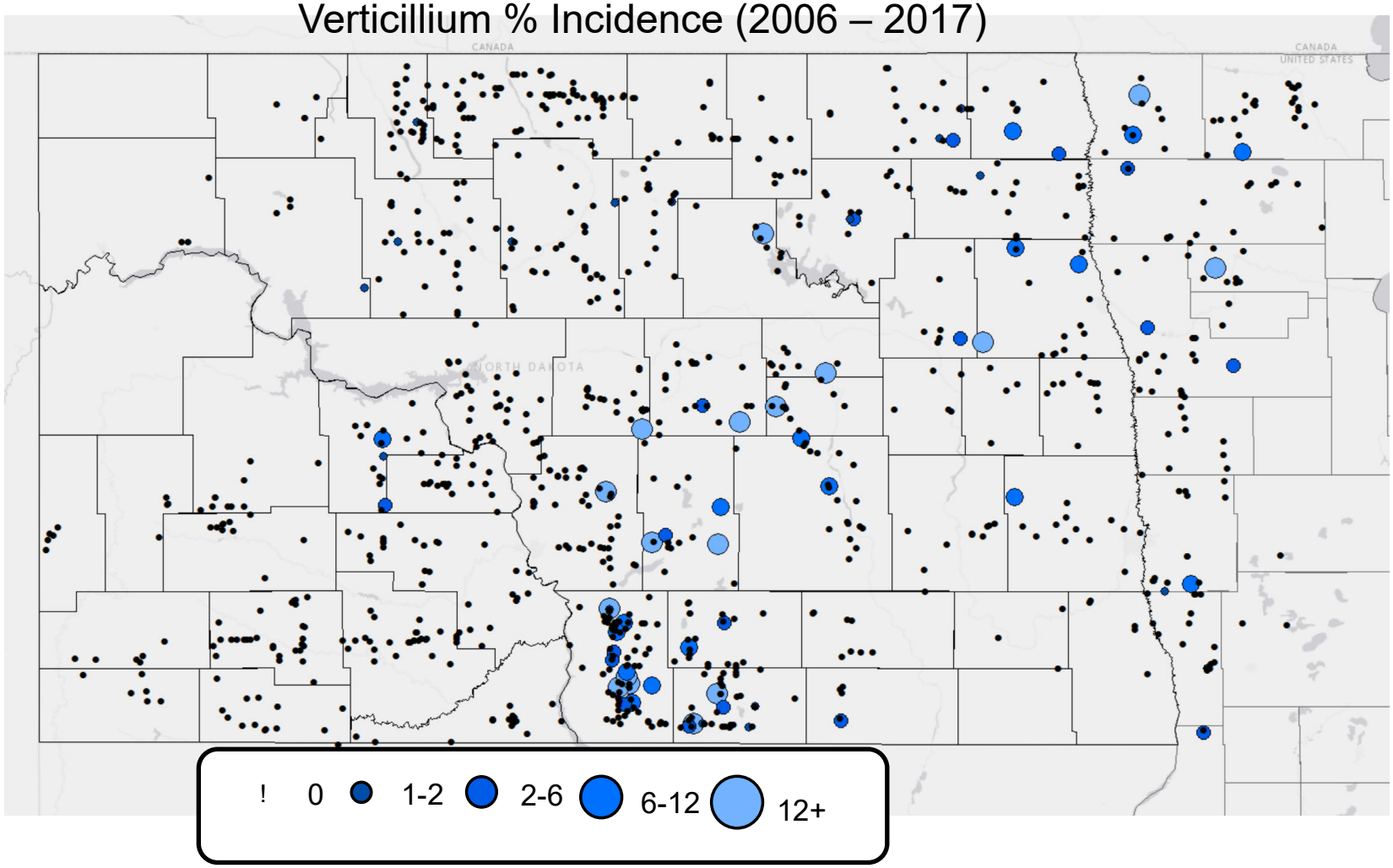

Sclerotinia Mid-stalk Rot % Incidence (2006 – 2017)
CANADA
UNITED STATES
NORTH DAKOTA
! 0 1-2 2-6 6-12 12+


Sclerotinia Wilt % Incidence (2006 – 2017)
CANADA
CANADA
UNITED STATES
NORTH DAKOTA
! 0
1-2
2-6
6-12
12+

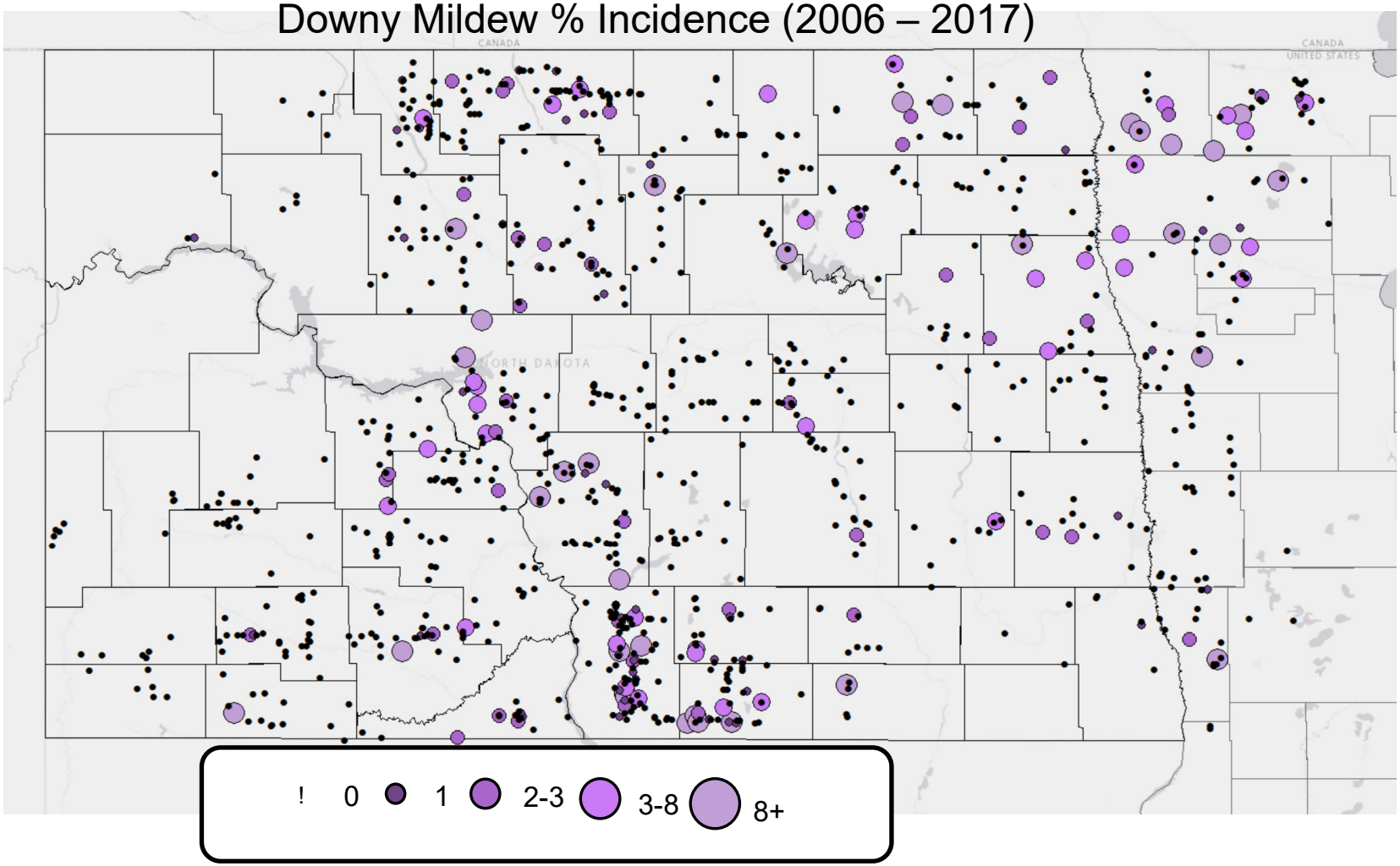
Rhizopus % Incidence (2006 – 2017)

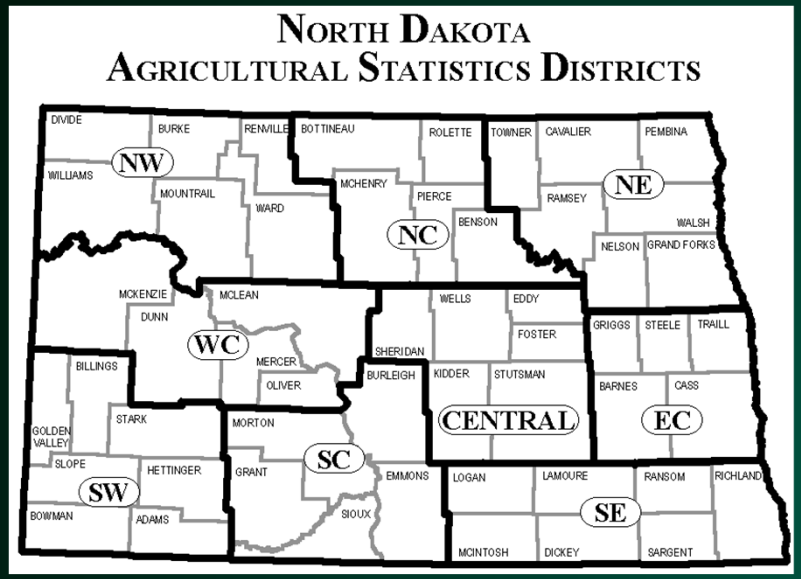


Verticillium % Incidence (2006 – 2017)



Downy Mildew % Incidence (2006 – 2017)





- Separate data into regions based on USDA Ag Districts
- Separate by year

Step Two

- Integrating location & year into data
- Proc GLIMMIX
  - Fixed variable
    - Incidence
  - Random variable
    - Region
    - Year
    - Incidence*Region
    - Incidence*Year
    - Region*Year
    - Incidence*Region*Year

Step Two

- Yield data was standardized on the region*year average
  - Yield was not represented as lb/ac but rather a percentage of the region's average that year, for example
  - "A 3% decrease in yield was observed per each unit increase in disease"

Example:

Field No.	lb/ac		Average		% of Average
Field 1	1788	÷	1623	=	110
Field 2	1576	÷	1623	=	97
Field 3	1855	÷	1623	=	114
Field 4	1491	÷	1623	=	92

Effect of Disease Incidence on Yield Standardized on the Region*Year Mean for Fields Indicating Disease as Yield-Limiting

Disease	Yield Parameter Estimate	p-value
Sclerotinia Wilt	-0.22%	0.1541
Sclerotinia Mid-stalk	-0.04%	0.8432
Sclerotinia Head Rot	-0.17%	0.416
Rhizopus	-0.35%	0.0594
Downy Mildew	-0.37%	0.2451
Phomopsis	-0.14%	0.0276
Phoma	0.01%	0.7933
Verticillium	0.07%	0.7099
Charcoal Rot	-0.57%	0.2127
Rust	-0.57%	0.5516
Model p-value	0.2614	
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2. A 0.22% yield loss is observed for each % increase in Sclerotinia wilt incidence
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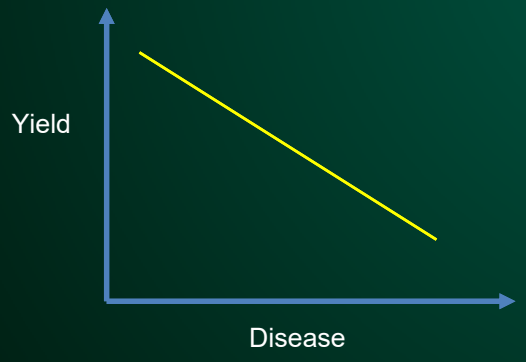
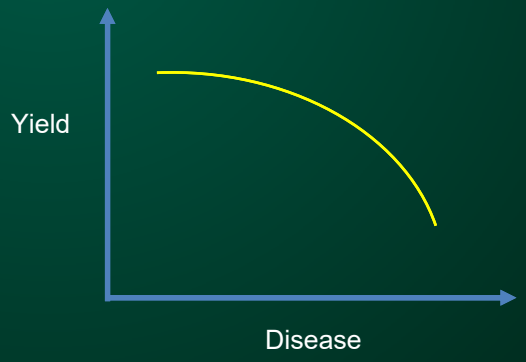
3. Analyses including yield components (e.g. seed size) were also nonsignificant/low fitness (not shown)

Next Step

- Regions and years take into account cool/warm or wet/dry differences…to an extent
- Yield is affected differently when multiple diseases are present
- Are disease-yield relationships linear





Conclusion

- Considerable analyses have been done
  - Disease is limiting yield
  - Simple relationships are unclear
  - Complex models are next step
- Maps show areas at risk