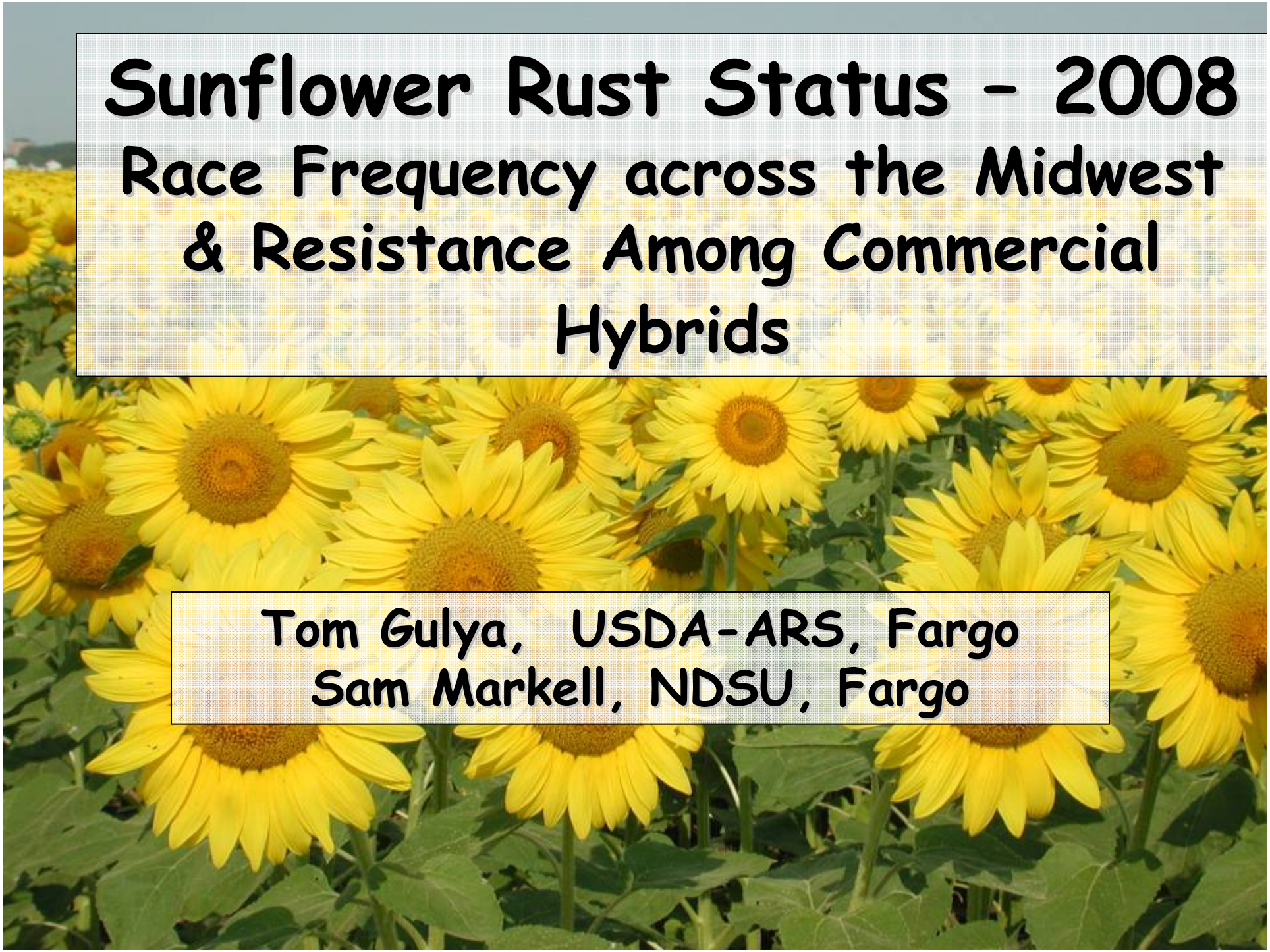
Sunflower Rust Status – 2008

Race Frequency across the Midwest & Resistance Among Commercial Hybrids



Tom Gulya, USDA-ARS, Fargo
Sam Markell, NDSU, Fargo

Changes in Sunflower Rust over the past five years

	2002	2003	2005	2006	2007	2008
Rust Incidence (% of fields)	**17%**	**44%**	**60%**	**68%**	**77%**	**62%**
% fields with economic levels (>3%)	**3.3%**	**5%**	**5%**	**17%**	**24%**	**14%**
# races found/ # samples	**3/5**	**12/10**	**21/36**	**5/5**	**25/192**	**31/92**

Disease incidence from the annual NSA survey (not done in 2004. Race IDs done by T. Gulya, S. Radi and M. Ramsett

2008 Sunflower Rust Study (Year 2)
Objectives:

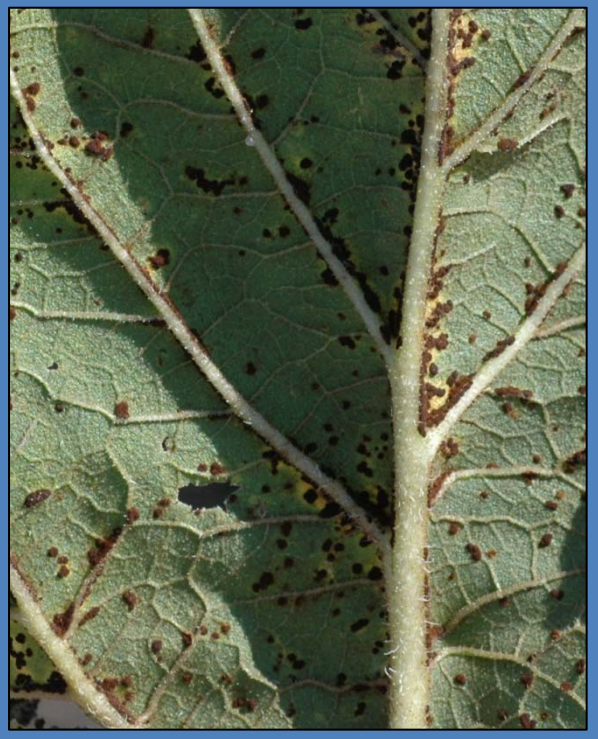
- Collect rust & identify races
- Compare races from Northern Plains
  vs. Central High Plains
- Contrast races from wild sunflower vs.
  from cultivated sunflower
- Compare races over 2-3 year period
- Evaluate commercial hybrids for resistance to predominant race(s)

Basic biology of sunflower rust

- Rust fungus has five spore stages (and symptoms/signs very different)
- Completes life cycle entirely on sunflower (does NOT need alternate host)
- Rust spores overwinter in infected plant debris
- First infection usually on volunteers and wild sunflowers
- Rust spores can blow up from South (100’s of miles)

Aecia
Rarely observed
Occurs in spring

Uredia
Dusty Rust Spores
All summer long



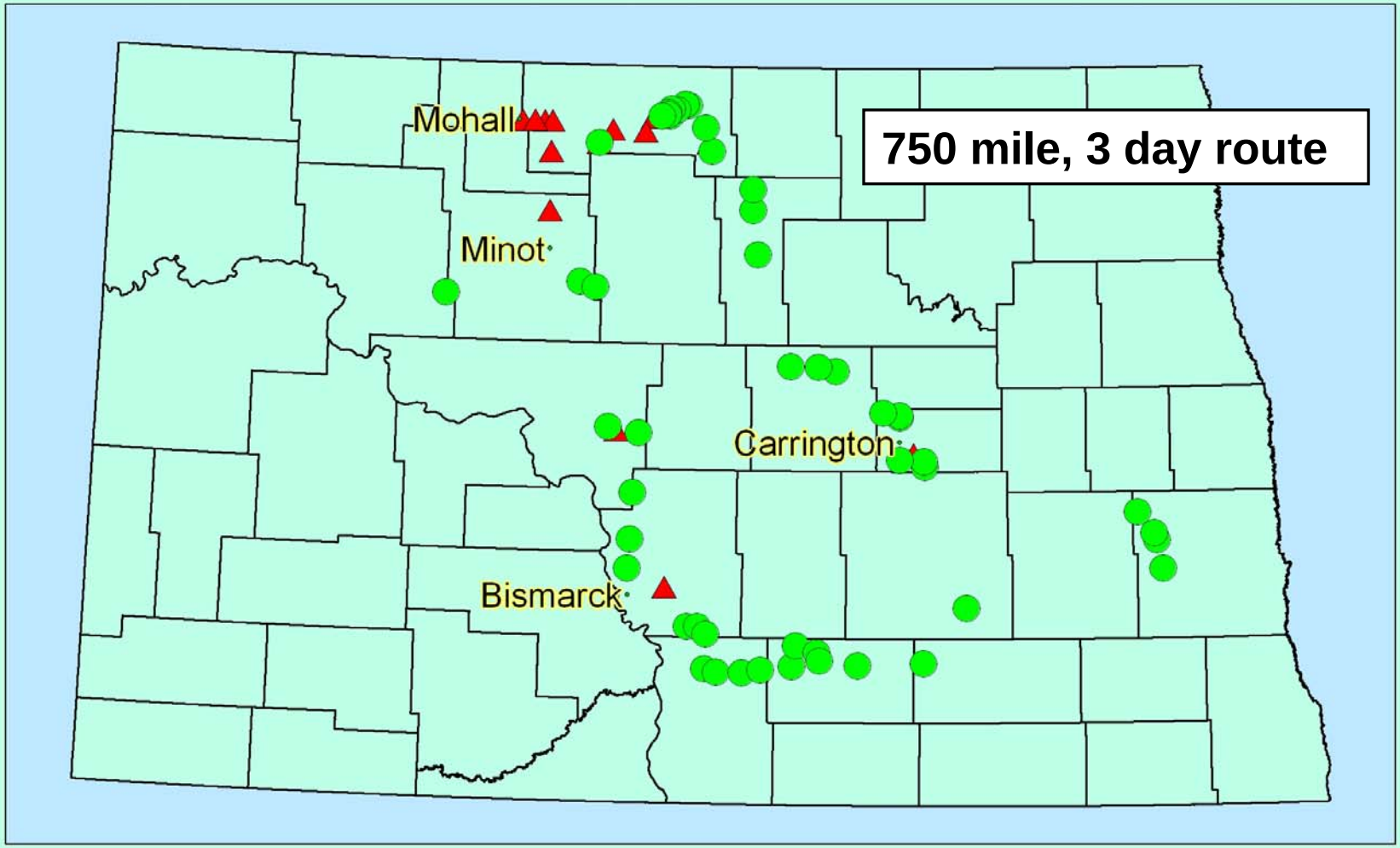
Telia
Black Pustules
Fall and Winter

2008 Rust Survey Trips

1) July 22-24, ND – 750 miles, 15 samples
2) Aug. 17-22, KS/CO - 1450 mi, 78 samples
3) Sept. 3-4, ND/SD - 740 miles, 29 samples
4) Sept. 24-26, SD - 710 miles, 39 samples
5) Sept. 15 & 18, MN - 690 miles, 6 samples

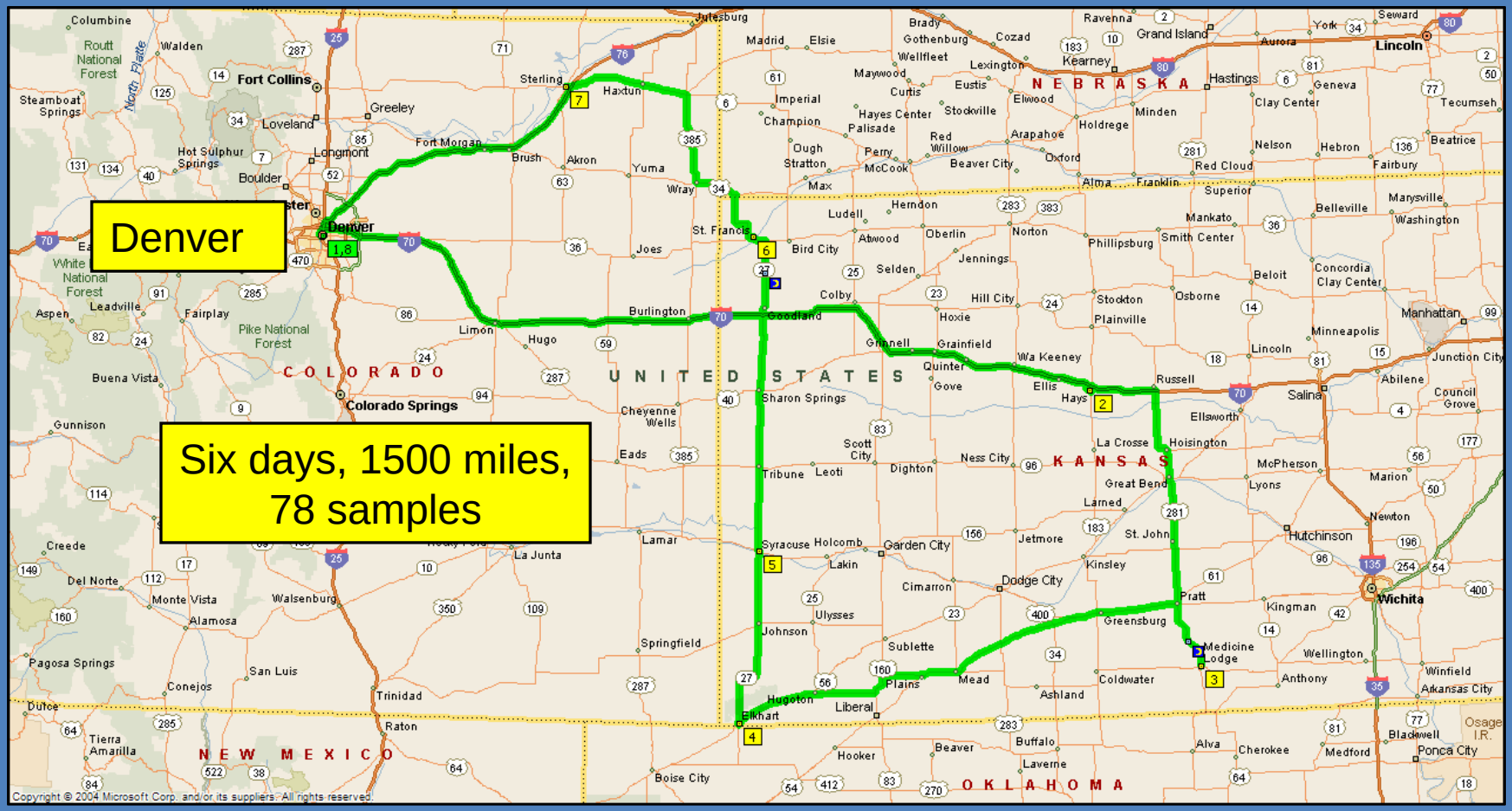
- **Total: 4350 miles, 16 days, 164 samples**
- *Other samples sent in from ND, IA, IL, TX to **total over 200***

2008 July Sunflower Rust Survey

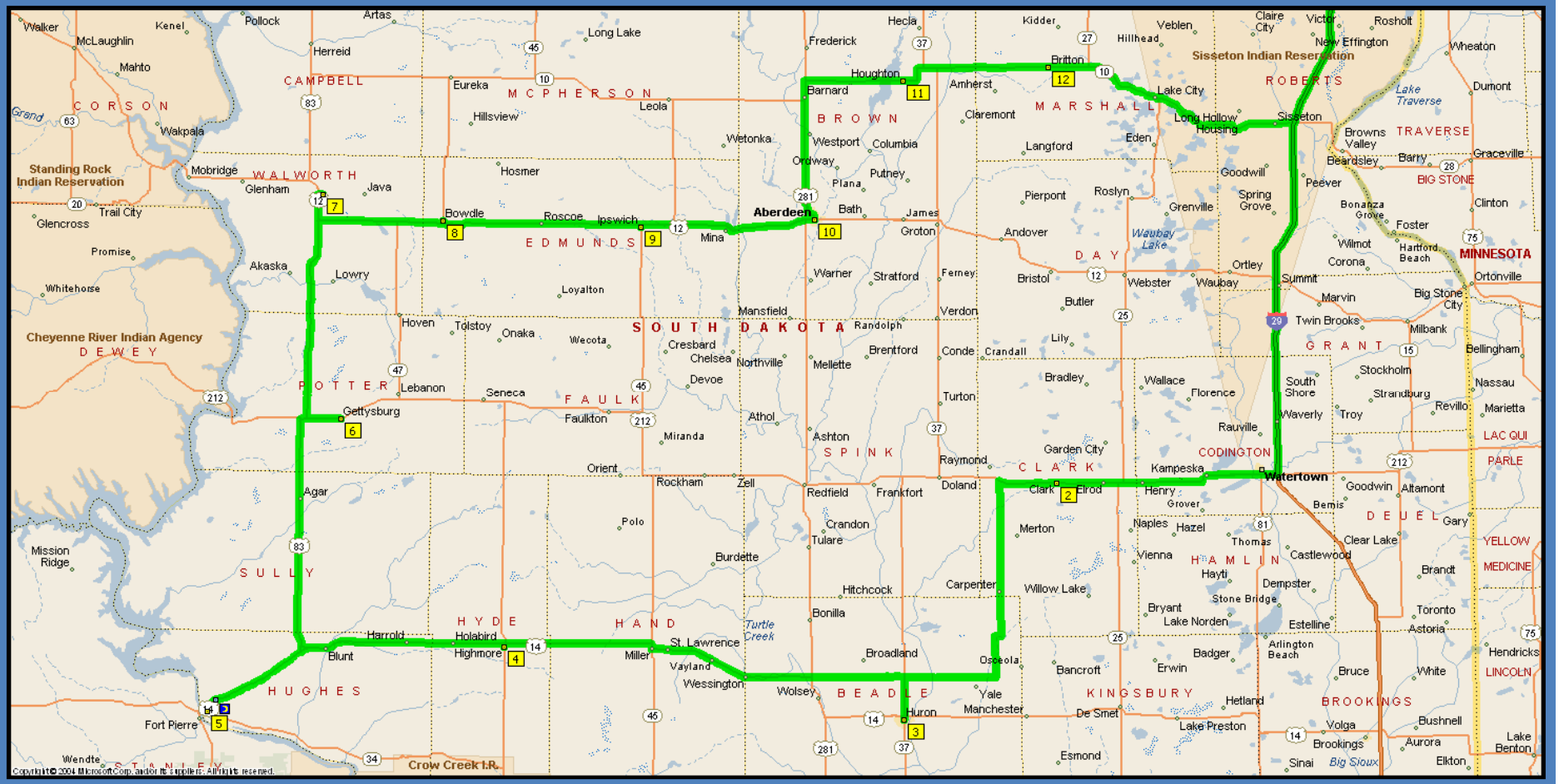


Survey Data Collected By:
Dr. Tom Gulya, USDA Sunflower Unit
Date: July 22-24, 2008

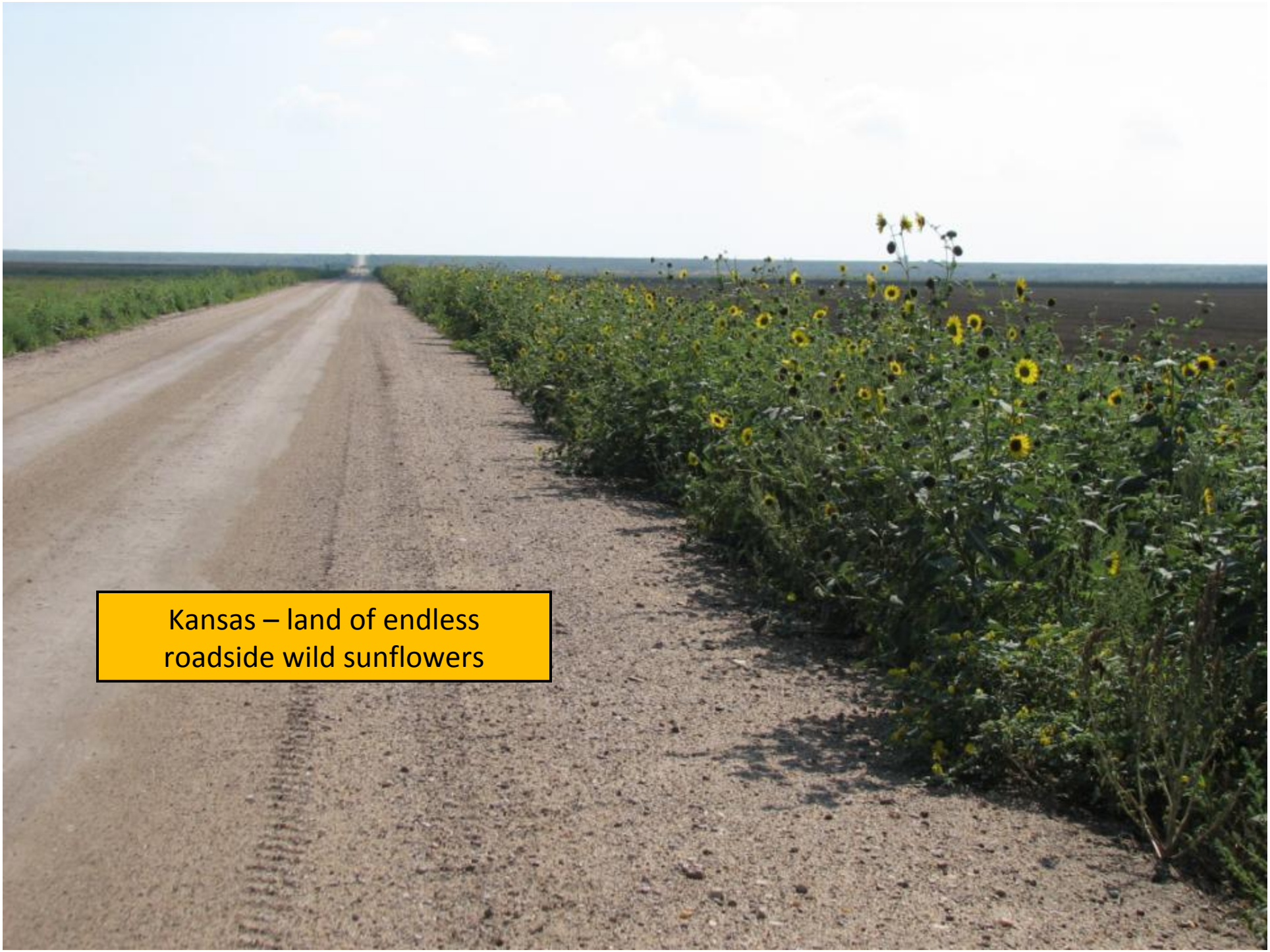
2008 Route through CO-KS to collect sunflower rust



2008 Route through South Dakota to collect Sunflower Rust




Finding sunflower fields in ND and SD easy – more of a challenge in parts of Kansas and Colorado


Kansas – land of endless
roadside wild sunflowers


Another undisturbed site – oil storage tank (KS)
Helianthus annuus


Gravel and sand pit – good habitat for both *H. annuus* and *H. petiolaris*

Undisturbed roadside habitat
Helianthus petiolaris

Materials & Methods

- Collect rust samples from wild and cultivated sunflower (record GPS, disease incidence)
- Remove rust from diseased leaves & store
- Inoculate susceptible plants in greenhouse to produce fresh, viable spores (1, 2 or 3 cycles)
- Inoculate set of nine rust differential lines to identify races


BECKMAN The Leading Name in Centrifugation

Race Coding, using 9 Standardized Differentials

Old, numbered races	***1***	***2***	***3***					***4***	
New coded races	***100***	***500***	***300***	***324***	***334***	***336***	***377***	***704***	***777***
Susc (1)	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CM90 (2)			**S**	**S**	**S**	**S**	**S**	**S**	**S**
CM29 (4)		**S**						**S**	**S**
P-386 (1)					**S**	**S**	**S**		**S**
HAR-1 (2)				**S**	**S**	**S**	**S**		**S**
HAR-2 (4)							**S**		**S**
HAR-3 (1)							**S**		**S**
HAR-4 (2)						**S**	**S**		**S**
HAR-5 (4)				**S**	**S**	**S**	**S**	**S**	**S**
# lines infected	**1**	**2**	**2**	**4**	**5**	**6**	**8**	**4**	**9**

Sampling Results and Processing

- Approx. 200 samples collected from five separate trips, from early July to late September
- Will require ~ 500 separate plantings to finish race identification, and will take from October until March (six months) to finish.
- Spores will be stored in liquid nitrogen for future studies.

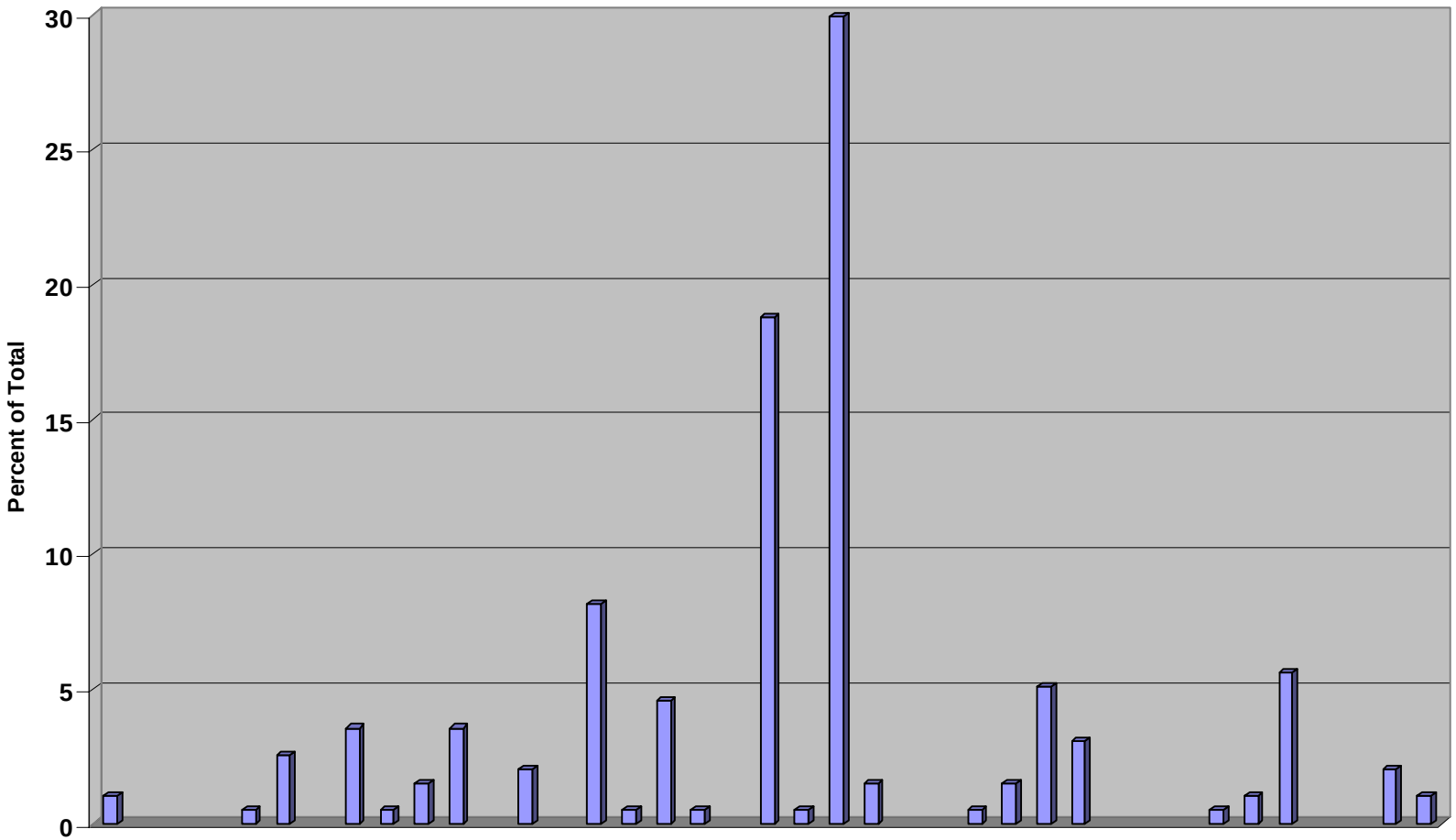
2008 Rust Comments:

- Rust appeared earlier than normal, with high incidence in Renville & Bottineau counties
- The aecial stage (large orange clusters of pustules) was VERY prevalent, and persisted from early June until early August

2008 Rust Race ID's

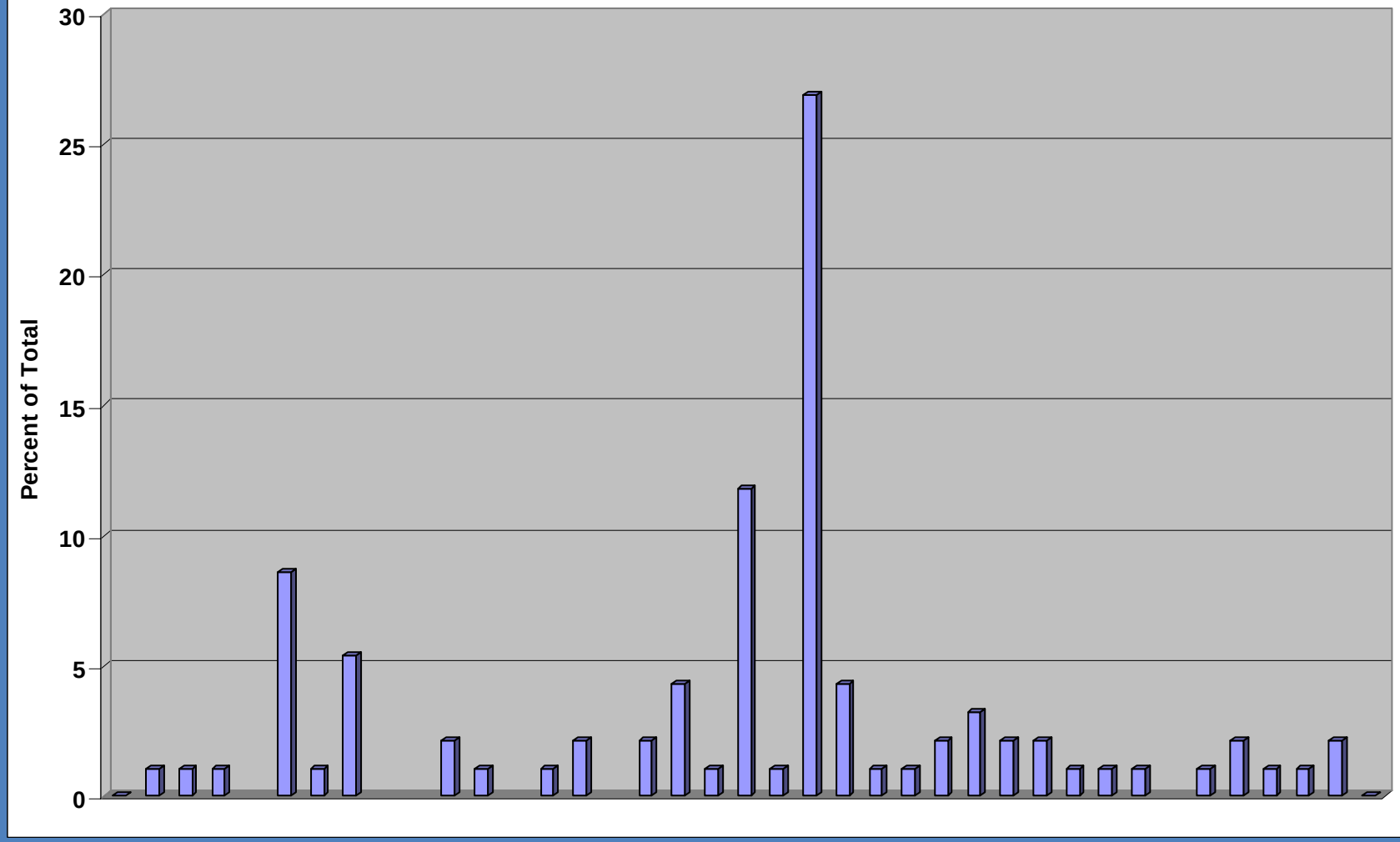
- 92 of 200 samples processed – **31 races**
- In 2007, 192 samples yielded **25 races**
- Over both years, a **total of 39 races** were characterized – with 17 races in common to both years.
- Two races (***334 and 336***) were dominant in both years – comprising 49% in 2007 and 39% in 2008.

2007 Rust Race Identification



25 races found in 197 samples. 334 and 336 predominant

2008 Rust Race Identification



31 races found in 92 samples (100 more) - 334 and 336 again dominant

Which genes (differential lines) are resistant to the majority of races?

- *CM29 (old Canadian line) confers resistance to 90% of 300 rust isolates tested in 2007 and 2008.*
- *HAR2 confers resistance to 86% of isolates*
- *HAR3 confers resistance to 88%*
- **CM29 + HAR3 confer resistance to 99%**
- **CM29 + HAR2 confer resistance to 98%**
- **HAR2 + HAR3 confer resistance to 97%**
- *CM29, HAR2 + HAR3 confer resistance to 99.5%*

Results and Discussion

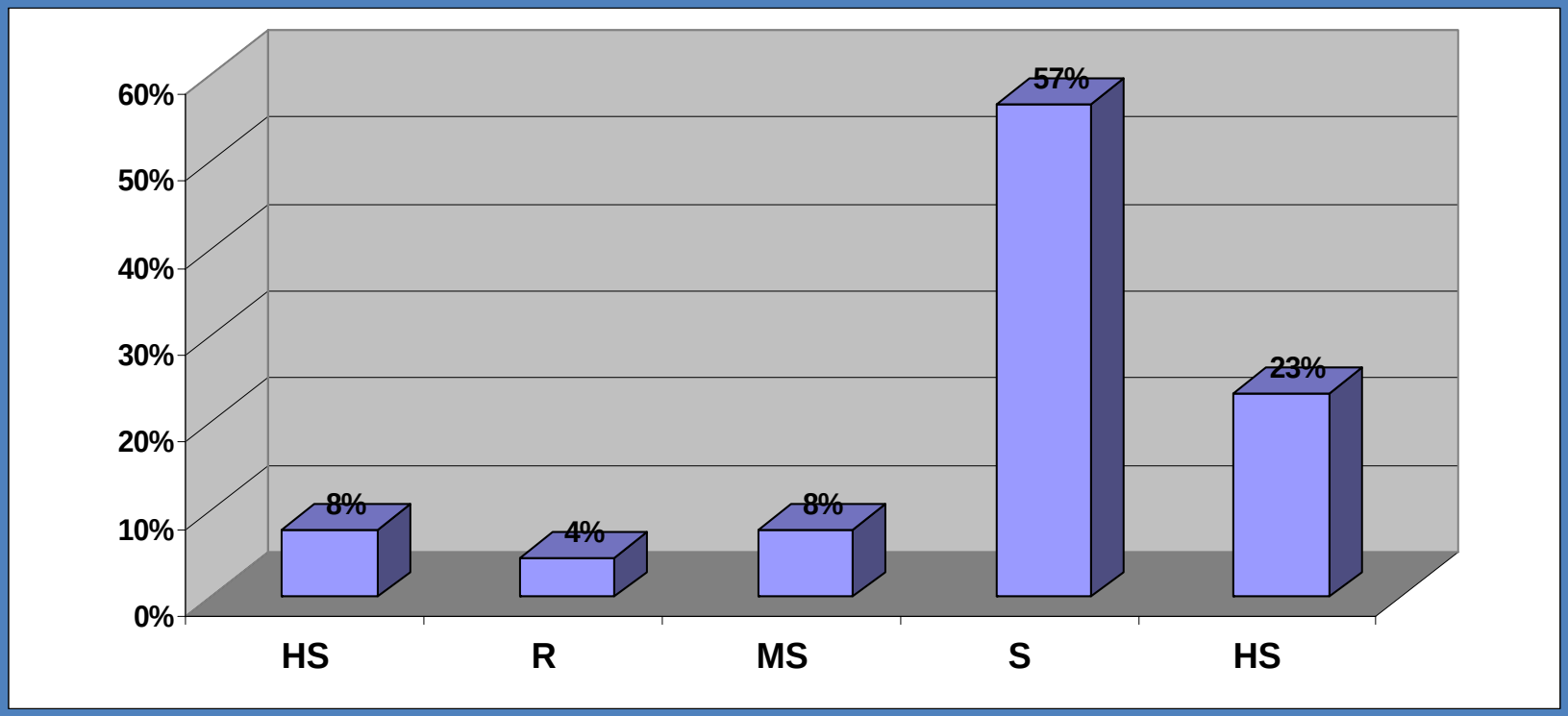
- Races on wilds/cultivated are similar
  - No reservoir of 'new' races on wilds
- Races in from KS/CO same as from ND/SD/MN
  - Breeding in Northern Great Plains should effectively identify germplasm which will also be resistant in Central High Plains
  - But …. Are Texas races different (only few samples in last 2 years)

Hybrid Screening for Rust Resistance

- Same entries as for Sclerotinia trial submission process
- 93 entries - 14 companies
- Race 336
  - More prevalent race

Hybrid Screening Results

- 7 entries rated ‘highly resistant’ and 4 as ‘resistant’ based on pustule coverage (< 0.5%). None rated as immune.
- 88% of hybrids rated as MS, S or Highly Susceptible



Conclusions

- Multitude of rust races exist, BUT two races make up bulk
- Rust found in High Plains of CO/KS very similar to that found in Dakotas
- Less known on rust in other areas of the country (i.e Texas)
- Rust continues to increase in incidence and close rotations foster early rust development
- Majority of commercial hybrids SUSCEPTIBLE to predominant races
- Genes are available to combat rust, and pyramiding TWO genes would confer resistance to 99% of rust, and delay evolution of new races (proposed research for NDSU graduate student working with USDA unit)


Thank You