

G x E Interaction in Sunflowers for the Northern Plains

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Multi-Environment Trials

Why do breeder's use them ?

- New hybrids are tested at several locations over several years
- Data is used to predict future hybrid performance
- Breeders want to know where a hybrid will fail
- Error goes down by increasing reps, locations and years

- HOWEVER
- Most of a program's time and money is spent here

- Programs need to use resources efficiently (yet maximize precision)

What is G x E Interaction

- If there is no interaction, then the best genotype in one environment will be superior in them all
- If an interaction is present, then a particular genotype will perform differently when placed in different environments

Objectives

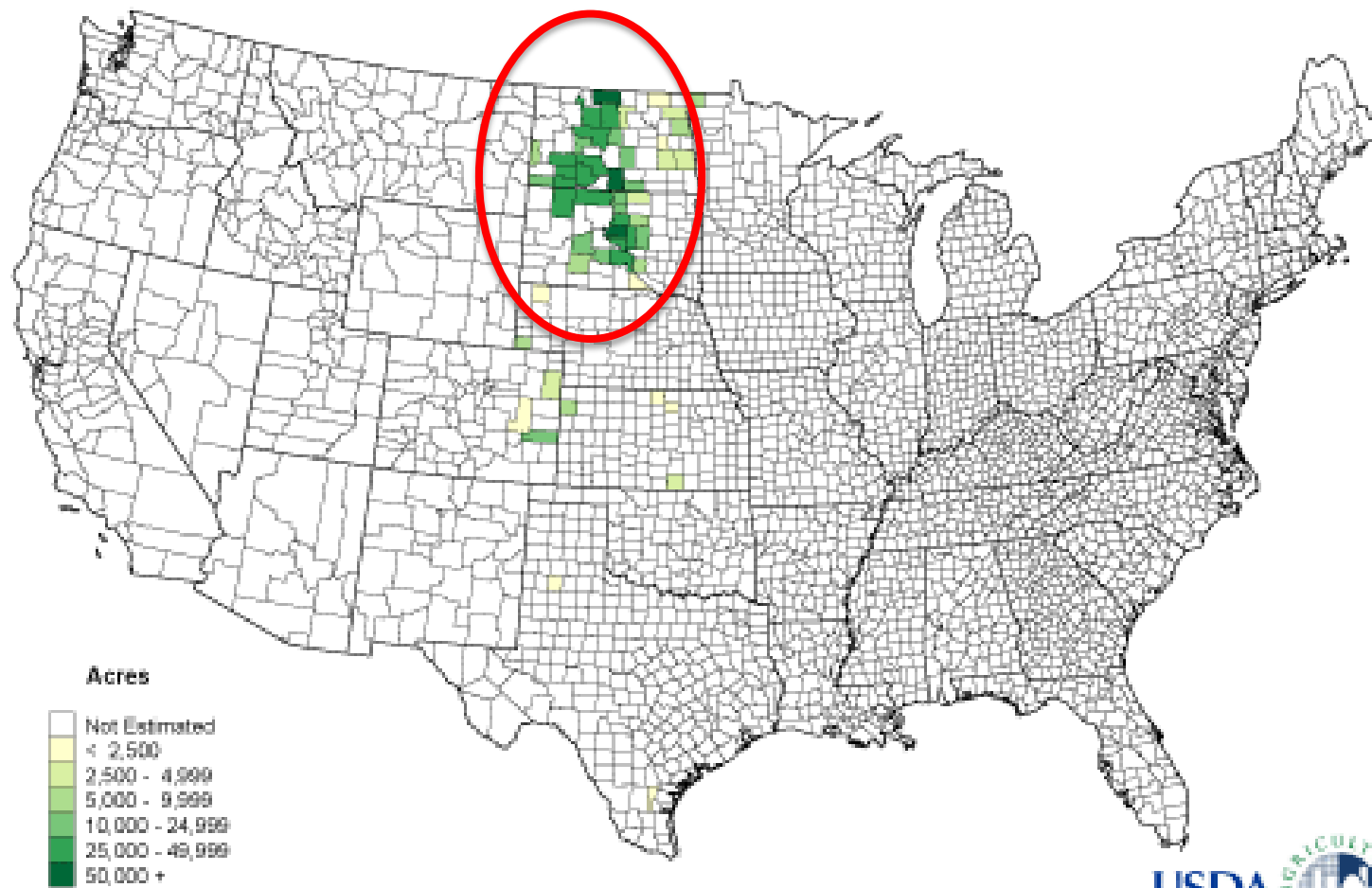
- Understand G x E in this region
 - Yield and Oil
 - Determine mega-environments

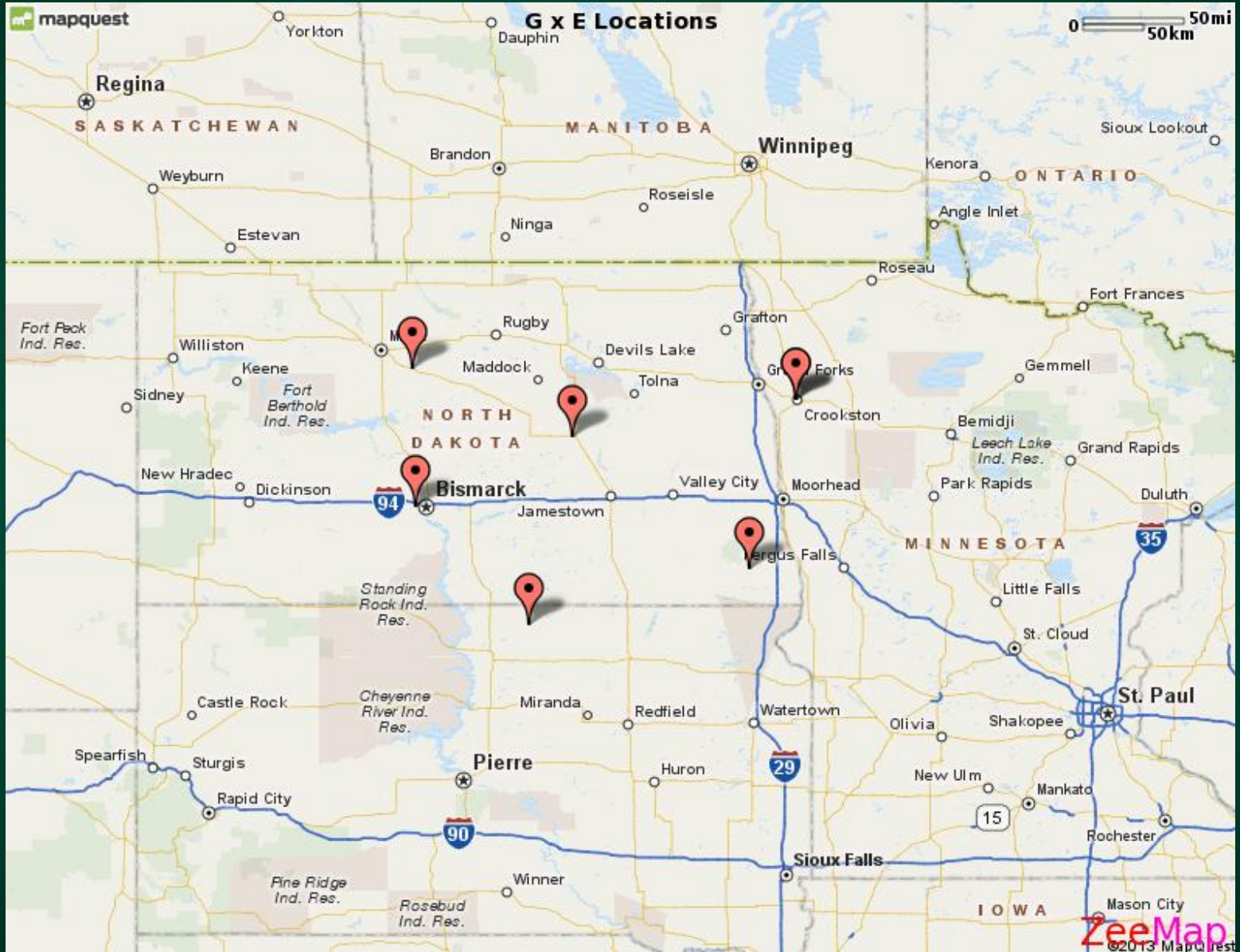


Impact

- Understanding the correlation among available sunflower testing environments
- Ability to optimize resources
- Provide a phenotypic dataset to evaluate genomic prediction models for future studies

Sunflower Oil 2012 Planted Acres by County for Selected States





Locations

Cultural

- No-till vs conventional
- Populations



Environmental

- Soil Type
- pH
- Rainfall
- Elevation



Materials and Methods

- 6 locations, 2 replications, 2 years
- USDA maintaining Velva, Mandan, Wyndmere and Eureka
- Carrington, NDSU
- Crookston, Winfield Solutions

Materials and Methods

- **RCBD**
 - Each rep as a lattice
 - 169 treatments total
 - 13 units per incomplete block
- **2012**
 - 79 A-line from the USDA since 1970 x 2 R-line testers (373 & 377)
 - 7 treatments are commercial hybrids
 - 4 are modern hybrids currently used in the USDA
- **2013**
 - 8 additional commercial hybrids

Environmental Adversity

- 2012
 - All environments harvested
 - Excessive wind in Minot
- 2013
 - Wyndmere received detrimental hail
 - SD location damaging winds
 - Mandan early season snow (disease pressure)
 - Minot had excessive winds and rainfall
- Notes taken when needed

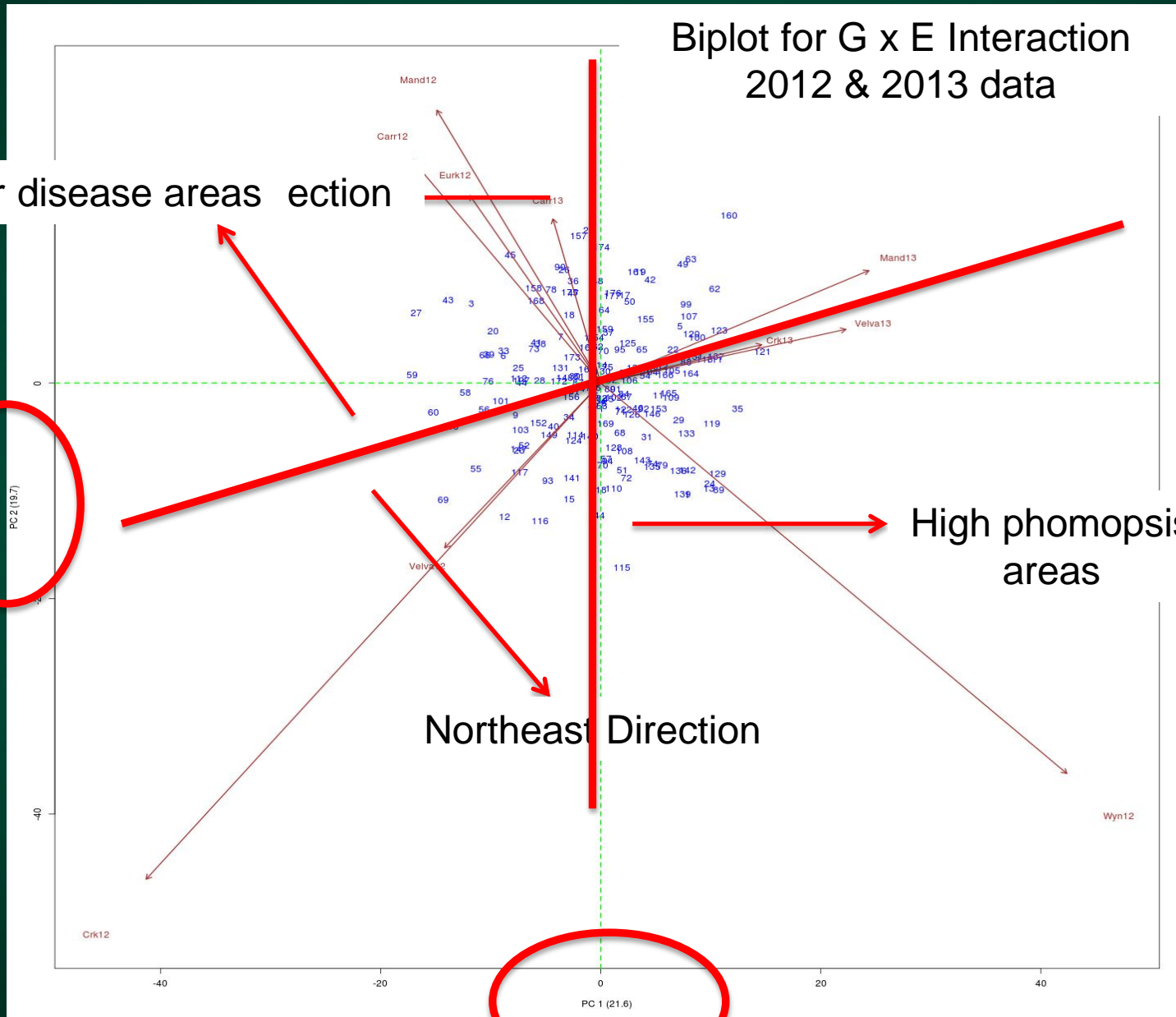


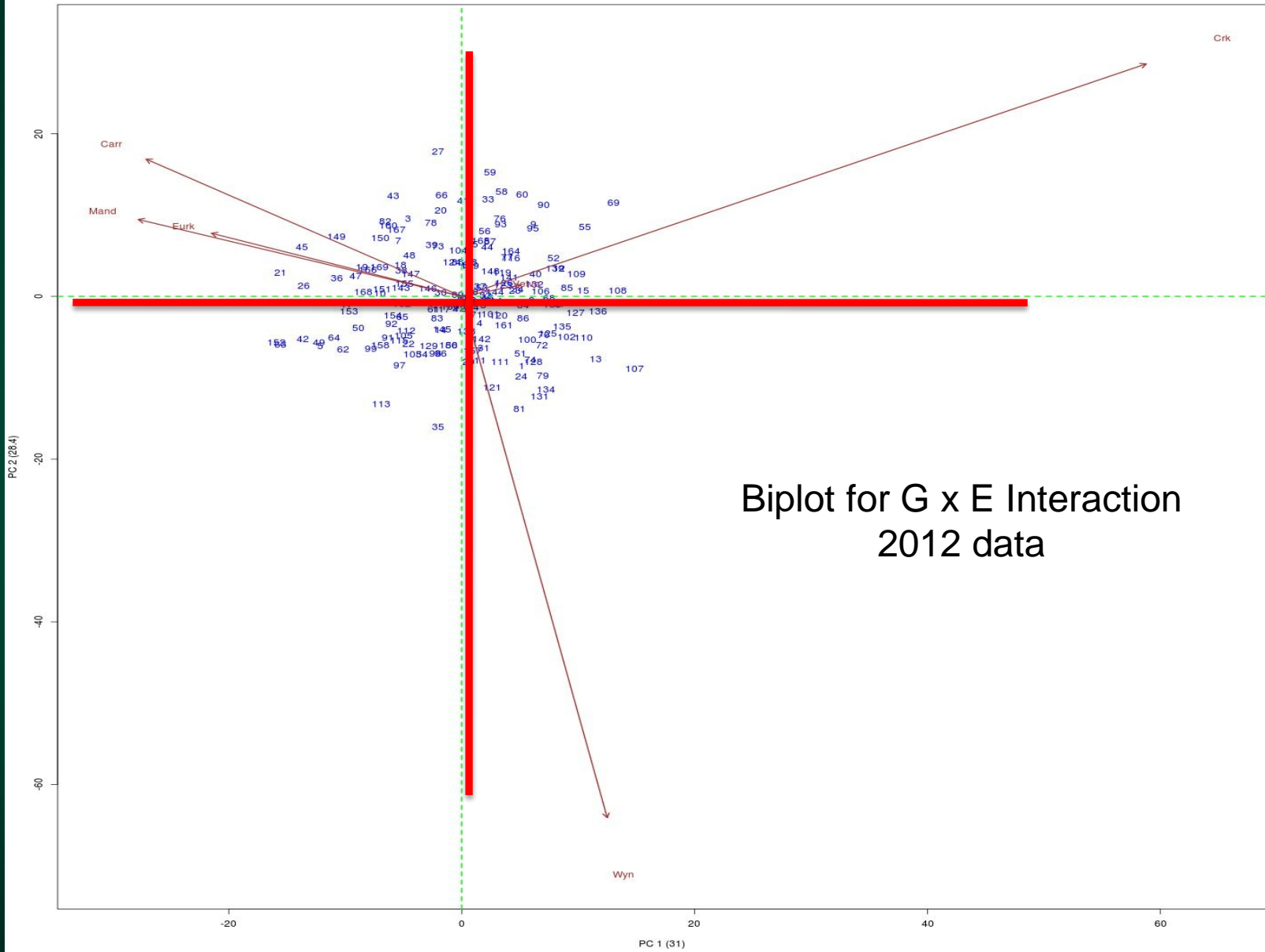
Biplot for G x E Interaction 2012 & 2013 data

Lower disease areas

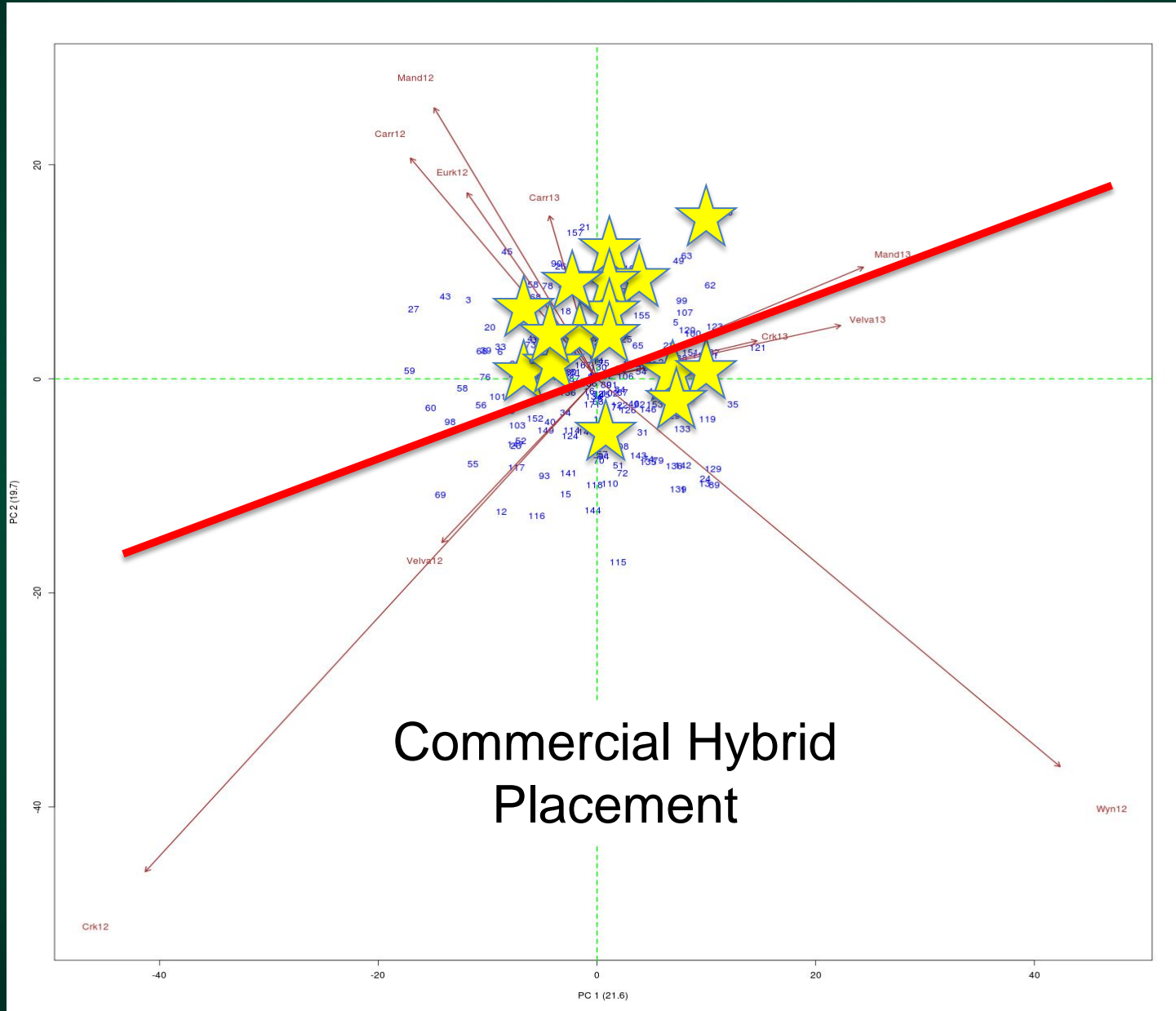
High phomopsis areas

Northeast Direction





Biplot for G x E Interaction
2012 data



Commercial Hybrid Placement

Conclusions

- Half the genetic variability was independent of environment
- The other half is in $G \times E$
- Of 10 environments, the 2 main principal components were photoperiod and geography
- Many of the commercial hybrids are trending towards the southwestern environment
- The USDA hybrids tends to trend towards the northeastern

Work in Progress

- Still working on oil data
 - NMR machine is getting calibrated
- Pearson Correlations run between the principal components and environmental factors such as precipitation and bird damage
- After some of these correlations are done some conclusions may be changed

Thank you!

- National Sunflower Association
- National Sclerotinia Initiative
- Dr. Brent Hulke
- Leanne Matthiesen, Chris Misar, summer students
- Paul Gregor, Winfield Solutions
- Dr. David Archer, USDA – Mandan
- Dr. Eric Eriksmoen, NDSU - Minot
- Jeremy Klumper – Nuseed
- Dr. Mike Ostlie, NDSU – Carrington
- Curt Lee – Agrotech, Velva
- David Grenz – Eureka
- Todd and Arnold Woodbury - Wyndmere