Advances in breeding and genetics at USDA

Dr. Brent Hulke

Research Geneticist

Hulke laboratory effort

- Breeding and crop improvement – 60 % effort
  - Collaborating with many agronomists, pathologists, entomologists to make specific traits possible
- SNP research and doubled haploid – 40 % effort
  - Collaborating with Venki at BDI, Lili Qi, C.C. Jan to develop these technologies to help breeders

Announcing new releases!

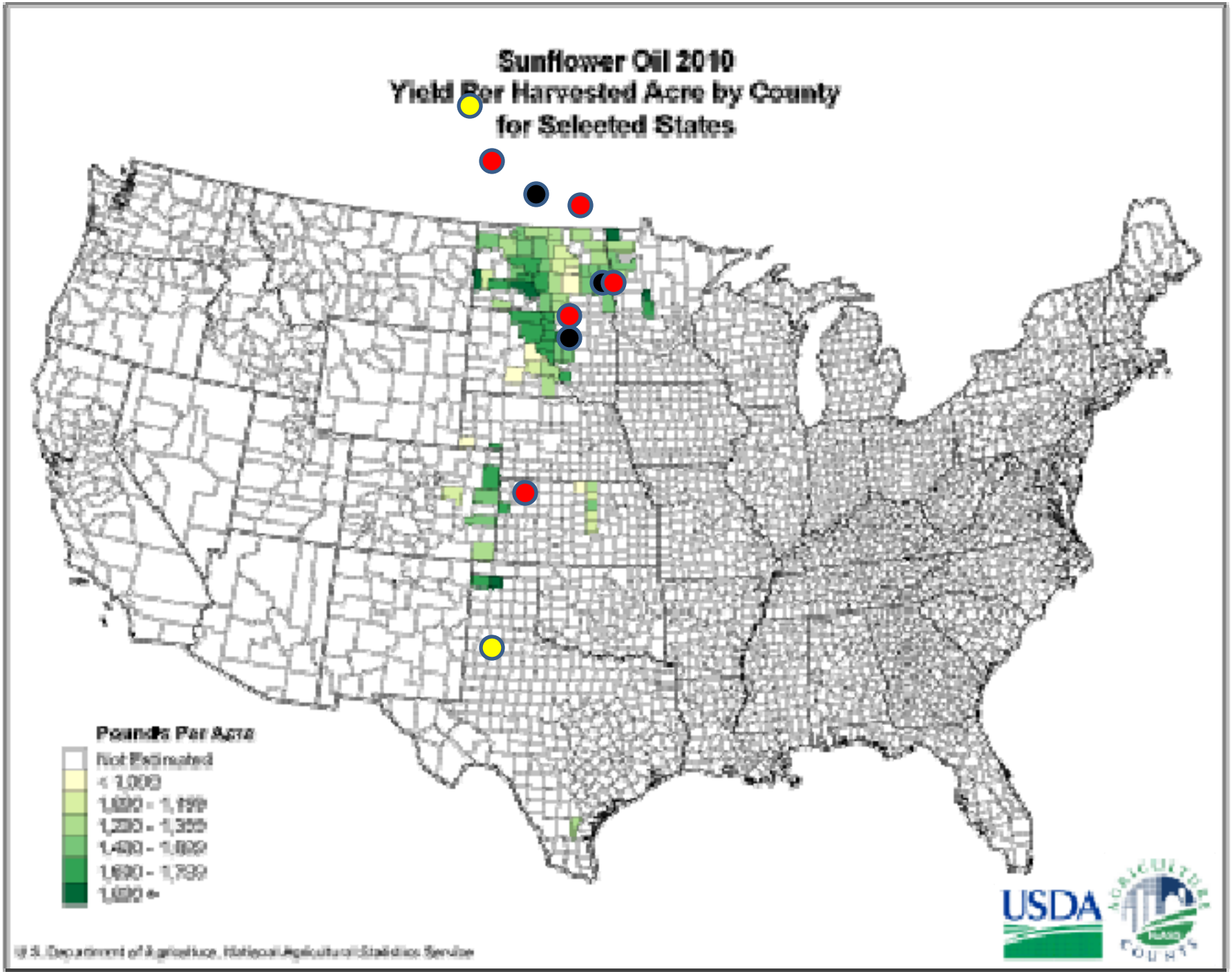
- RHA 472
  - R-line oilseed, Sclerotinia head rot resistant
- RHA 473
  - R-line oilseed, High oleic, Sclerotinia head rot resistant
- RHA 474
  - R-line oilseed, IMI resistant, Sclerotinia head rot resistant
- RHA 475
  - R-line oilseed, IMI resistant, Sclerotinia head rot resistant
- Available from NDSU seedstocks project

List of traits studied

- Work is mostly in oilseed with some ventures into confection
- Disease resistance
  - Sclerotinia and Phomopsis resistance
  - Downy mildew resistance – mostly stacking with Sclerotinia and other traits
  - Rust resistance stacked with Sclerotinia resistance
  - Early work on Verticillium resistance
- Early maturity sunflower

List of traits studied

- Insect resistance
  - Banded sunflower moth resistance
  - Red sunflower seed weevil resistance
  - Sunflower moth resistance
  - Stem weevil resistance
- Low Saturated fat
- Diversification of sunflower germplasm
- Perennial sunflower as a bird trap crop (see Mikey Kantar's poster)


Sunflower Oil 2010
Yield Per Harvested Acre by County
for Selected States
Pounds Per Acre
Not Estimated
< 1,000
1,000 - 1,199
1,200 - 1,399
1,400 - 1,599
1,600 - 1,799
1,800 +
USDA

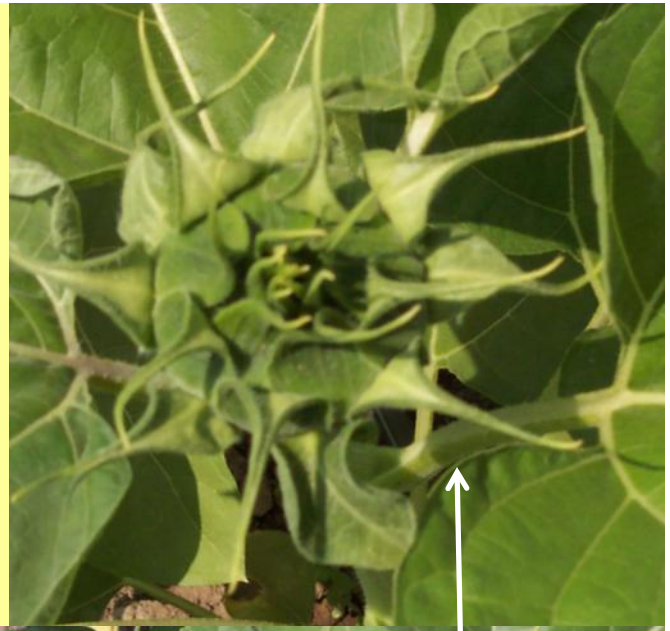
SNPs research

- Working on mapping SNPs currently w/ Lili and Venki at BDI
- Sclerotinia and Phomopsis mapping (see Zahirul Talukder's presentation)
- After SNPs are mapped, will also attempt to map traits commonly selected for in breeding programs using our large marker dataset and phenotypic information provided by cooperating companies

Doubled Haploid

- 4 techniques
  - Anther culture
  - Microspore culture from anthers
  - Foreign species pollen as inducer
  - Mutant stock pollen/ovule as inducer
- Still a work in progress

Typical petiole color for genetic stock = “wildtype”



Mutants without red color

Future directions

- Continue conventional breeding, bringing in new markers when traits are mapped to add efficiency
- In 2012, many important genes will be mapped by my lab, Lili Qi, and C.C. Jan, making this possible
- Beyond 2012, Move towards a more integrated approach to marker assisted selection called genomic selection – develop efficiencies already in corn
- Continue development of doubled haploid technology


140
130
120
110
100
90
80
70
60
1975
1980
1985
1990
1995
2000
2005
2010
YIELD (percent of 36 year average)
YEAR
NON-OIL SUN
y = 0.4673x - 831
R² = 0.1595
OILSEED SUN
y = 0.6888x - 1272.4
R² = 0.2653
SOYBEAN
y = 1.2903x - 2471
R² = 0.7812
CORN
y = 1.5929x - 3073.8
R² = 0.797
OIL
NON-OIL
SOY
CORN
Linear (OIL)
Linear (NON-OIL)
Linear (SOY)
Linear (CORN)

Thanks!

- National Sunflower Association
- National Sclerotinia Initiative
- Seed Companies who contributed to DH and Sclerotinia studies
- Titan Machinery for donating GPS equipment
- My crew: Dana Weiskopf and Arun Jani (emeriti), Zahirul Talukder, Mikey Kantar, Leanne Matthiesen, Alison Stone, and many undergraduate students