FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Upstream genomics for downstream impact

Jesse Poland
Feed the Future Innovation Lab for Applied Wheat Genomics
Wheat Genetics Resource Center
Kansas State University

60%

Increase in demand for wheat by 2050

- 20%

Potential yield decrease from climate change

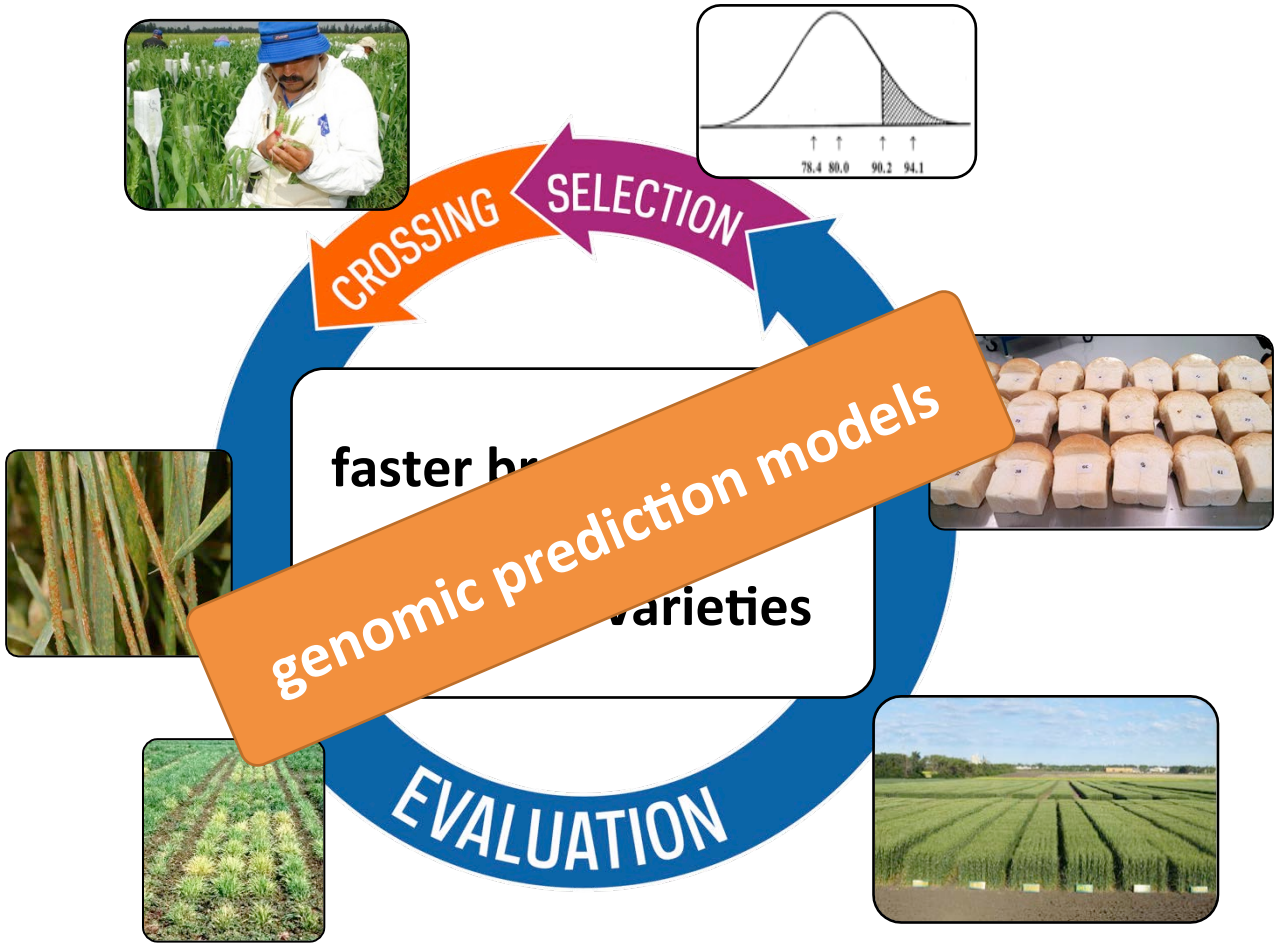
2%

Rate of gain needed to meet projections

< 1%

Current rate of gain

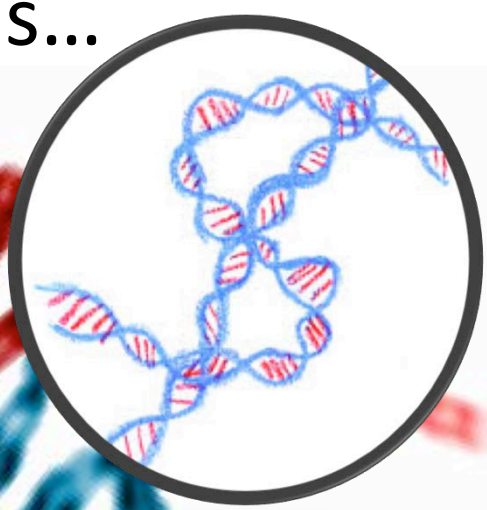
The Breeding Cycle



Genome … millions of A, C, T, and Gs…

21 chromosomes in wheat

90,000 genes in wheat



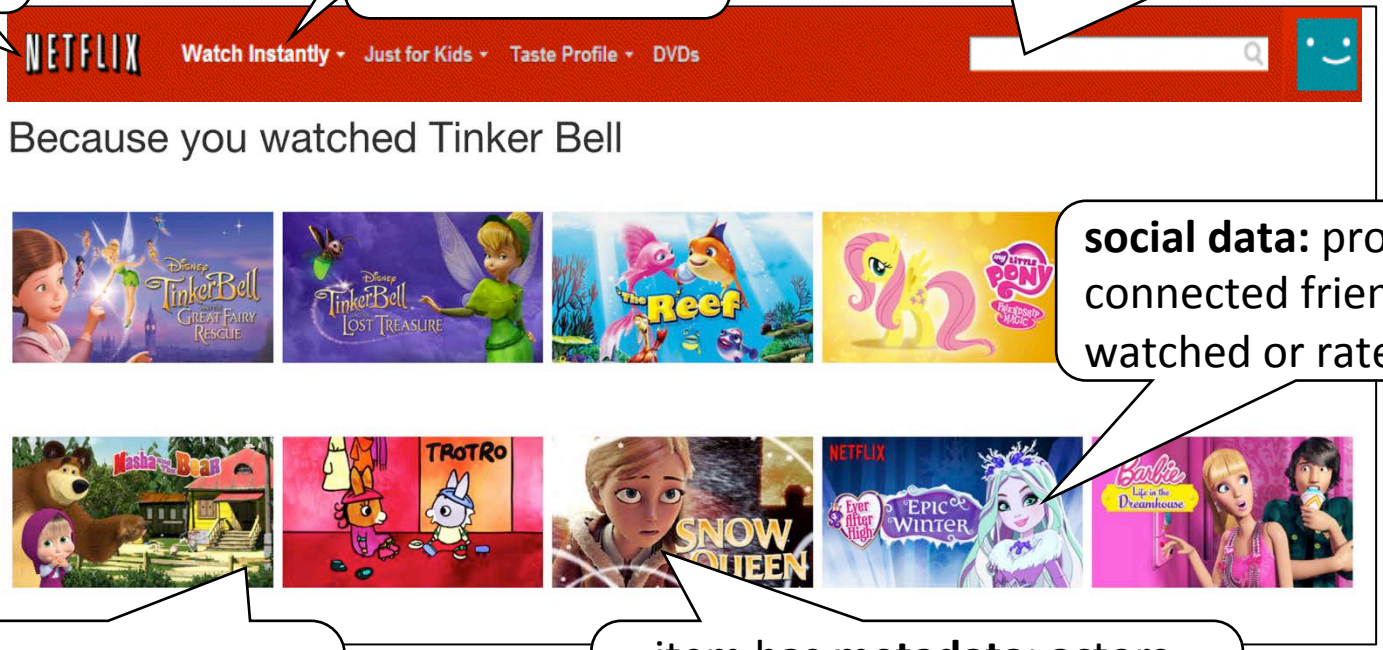
16,000,000,000 DNA base pairs in wheat

genomic information through DNA sequencing

75,000,000 subscribers

13,000+ titles at any given time!

members directly enter millions of **search terms**



social data: process what connected friends have watched or rated

several billion **ratings** from members + millions of new ratings a day

item has **metadata**: actors, director, genre, parental rating, and reviews

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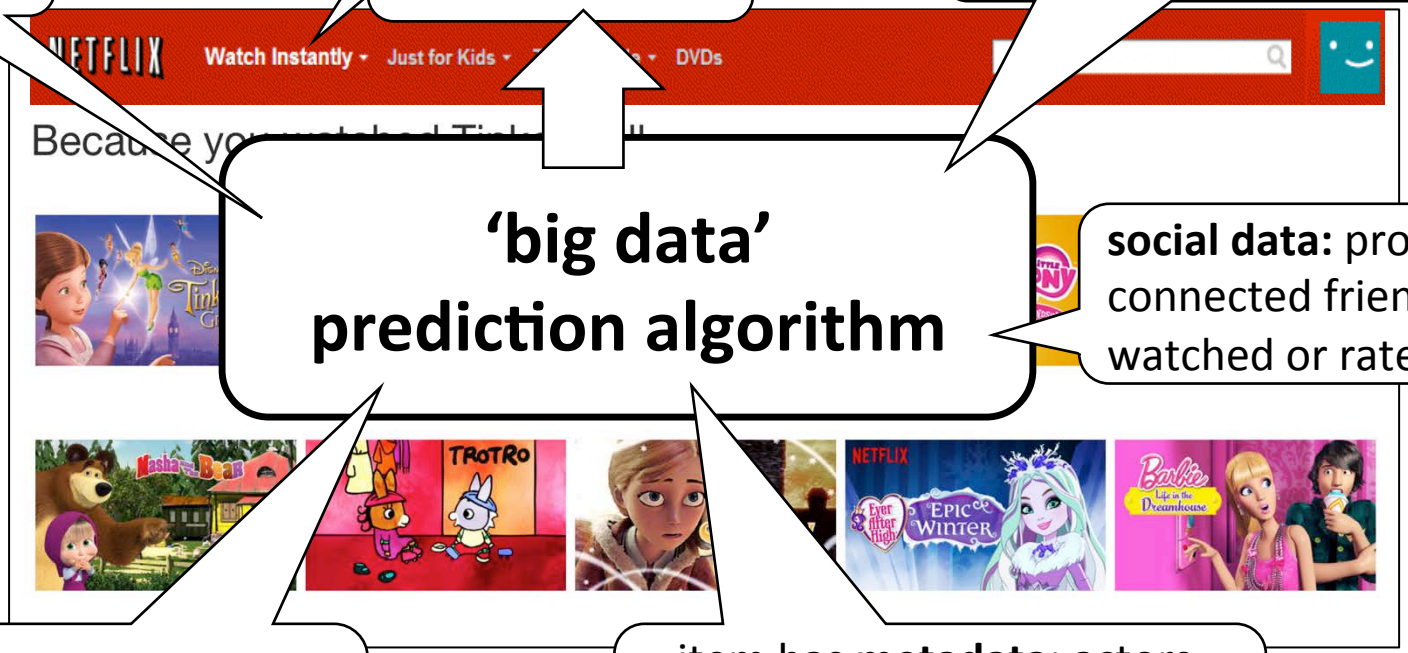

‘big data’ prediction algorithm

social data: process what connected friends have watched or rated

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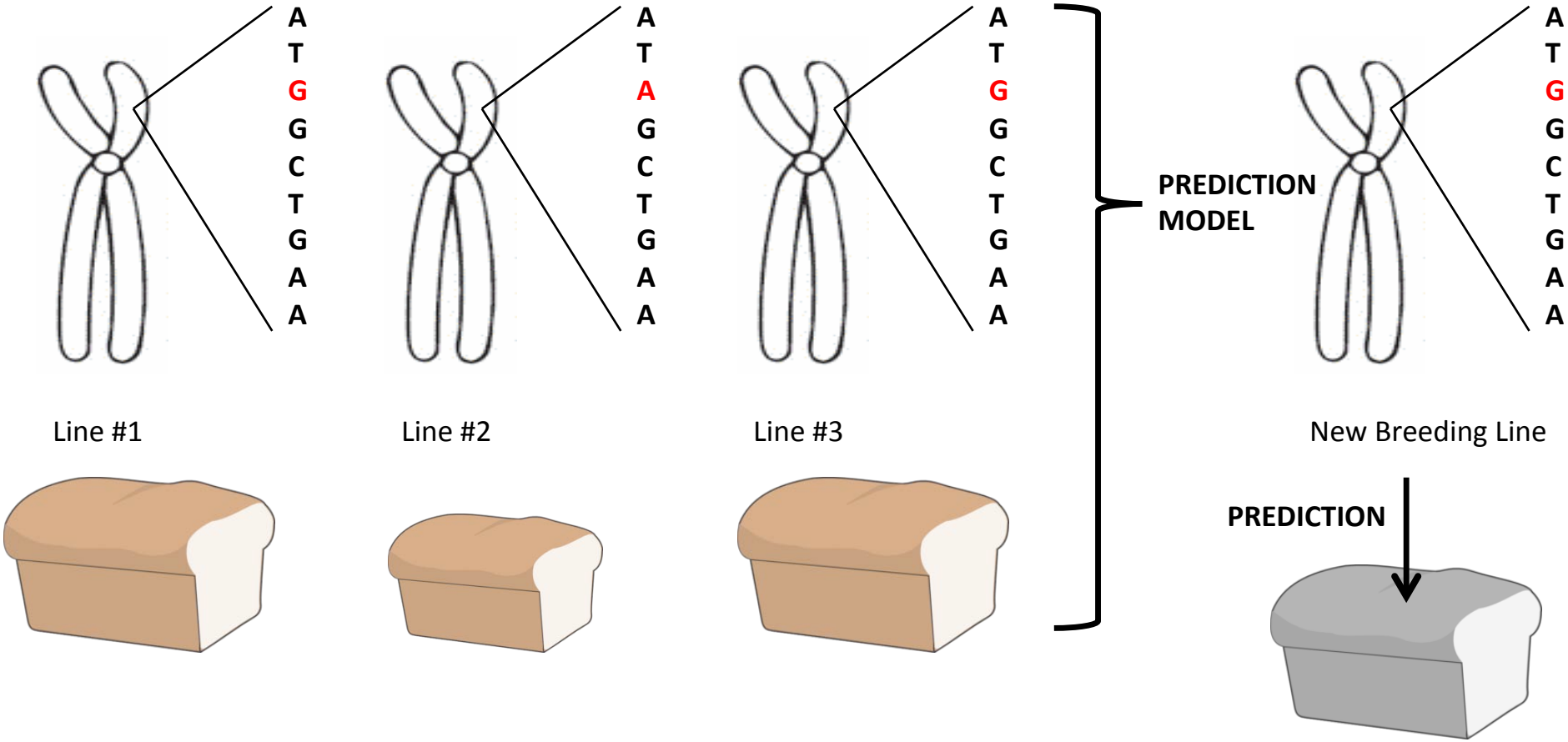
Genomic Prediction: Wheat Quality

Genomic prediction models….

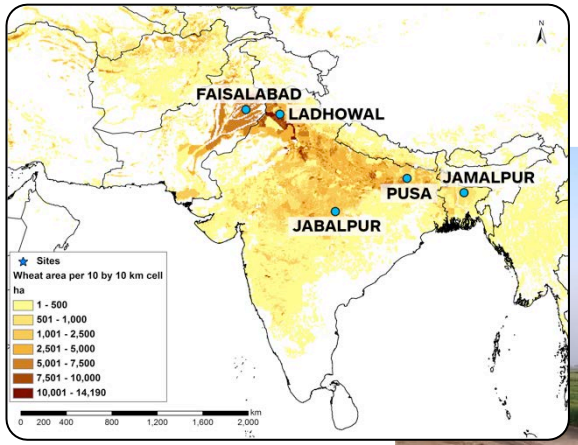


CIMMYT Bread Wheat Breeding
(CIMMYT: International Wheat Research Center)

Training set: elite breeding lines (n=5,520)

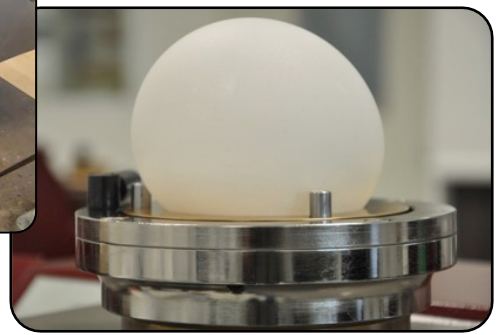
- Cycle 45-50 International Bread Wheat Screening Nursery
- Preliminary yield trials – Cd. Obregon, Mexico
- Milling and baking tests

Year	Total in Yield Trial	Quality Tested & Genotyped
2010	4,956	250
2011	6,685	995
2012	10,196	850
2013	9,436	886
2014	7,672	1,114
2015	8,872	1,425
Total	47,817	5,520

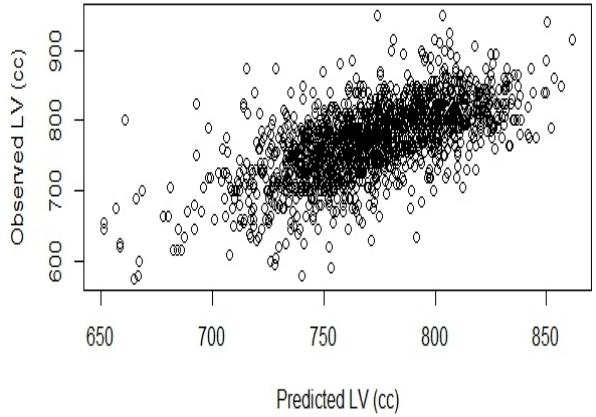


Wheat quality measurements

- Grain
  - thousand kernel weight
  - protein content
  - hardness
- Milling
  - flour protein
  - flour yield
- Dough
  - mixograph
  - alveograph
- Baking
  - loaf volume



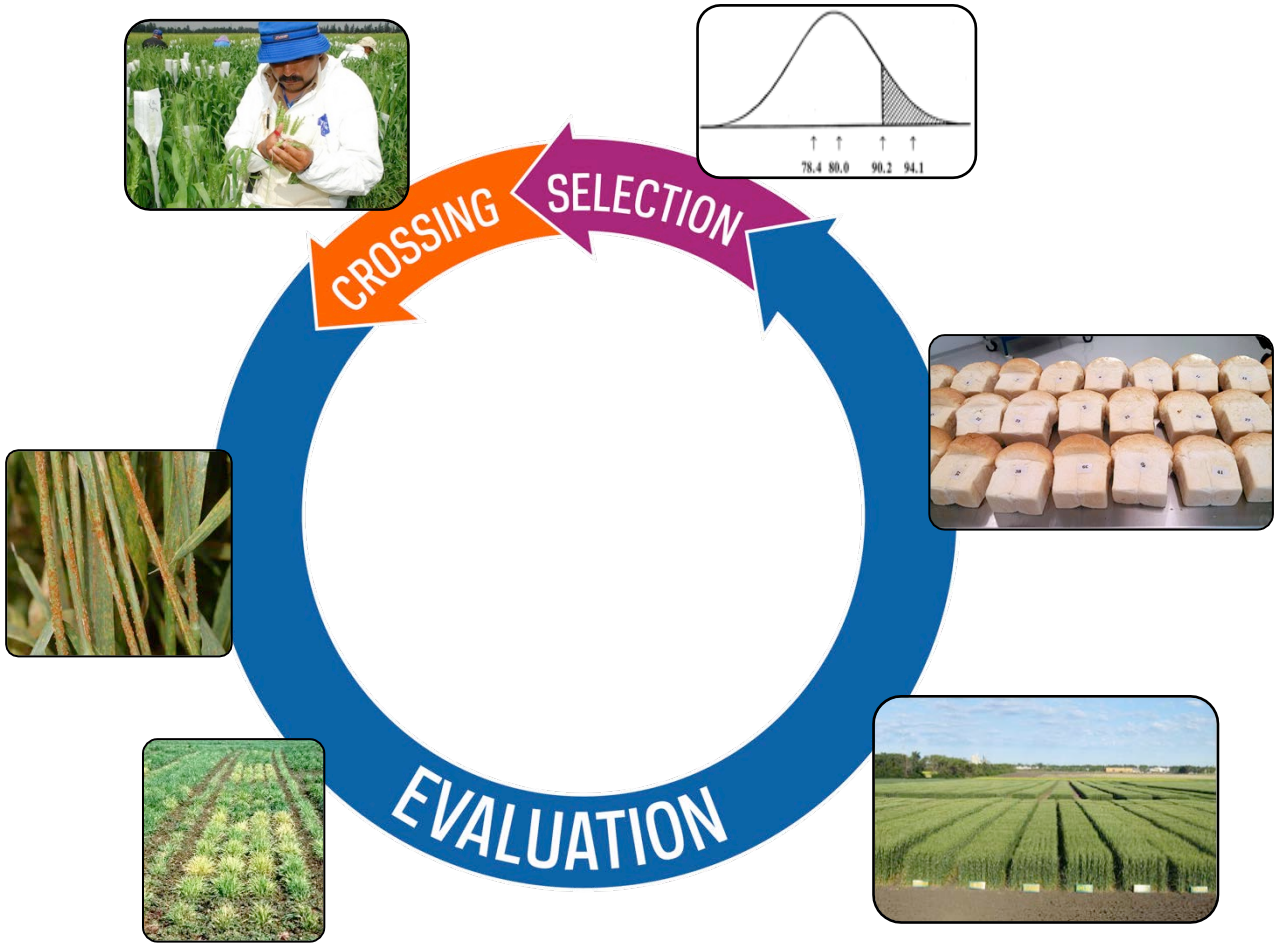
Prediction of wheat quality



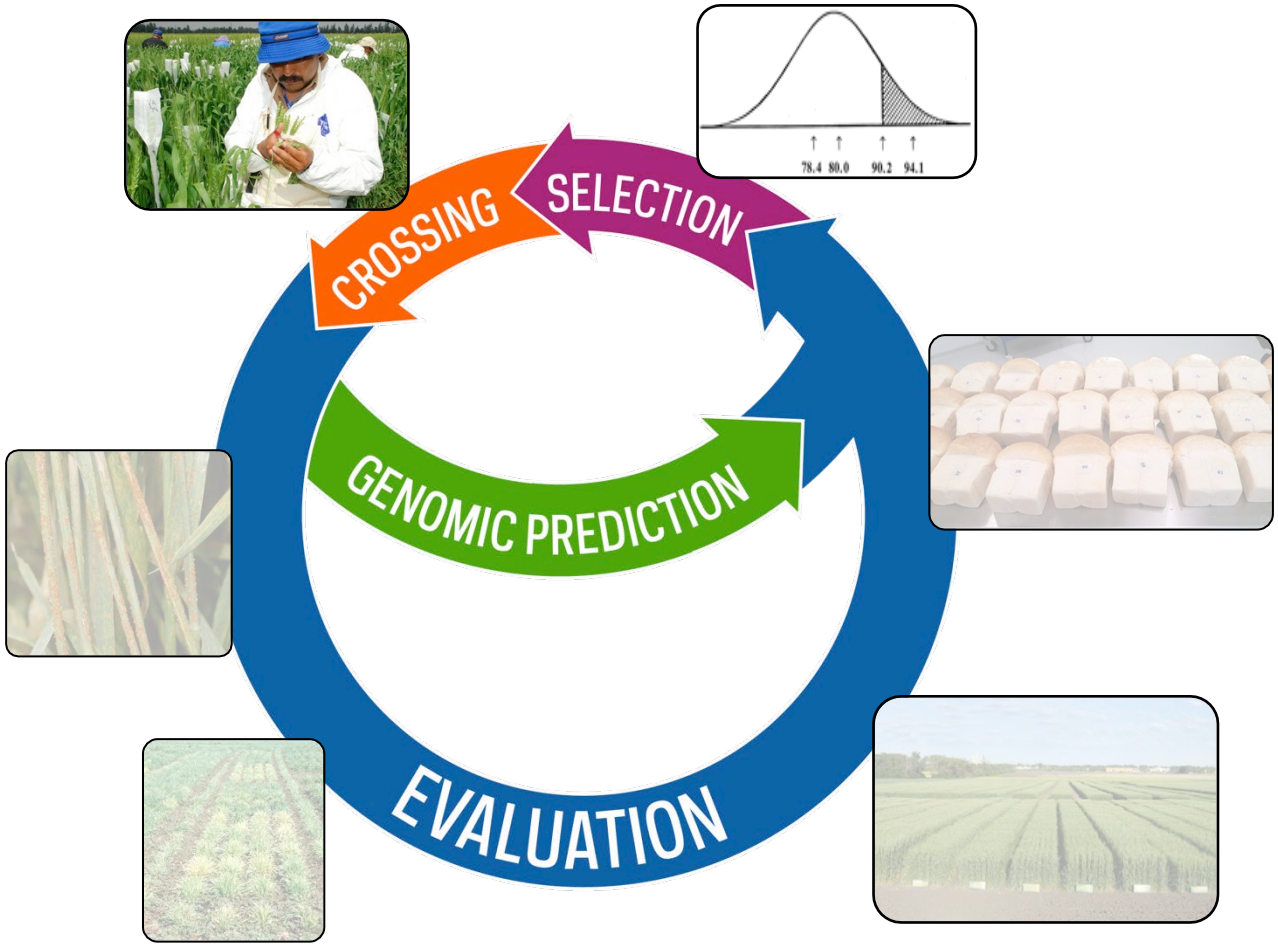
TRAIT	PREDICTION ACCURACY (r)
Test Weight	0.725***
Grain Hardness	0.513***
Grain Protein	0.630***
Flour Protein	0.604***
Flour SDS	0.666***
Mixograph Mix Time	0.718***
Alveograph W	0.697***
Alveograph P/L	0.476***
Loaf Volume	0.638***

Sarah Battenfield, KSU

The Breeding Cycle



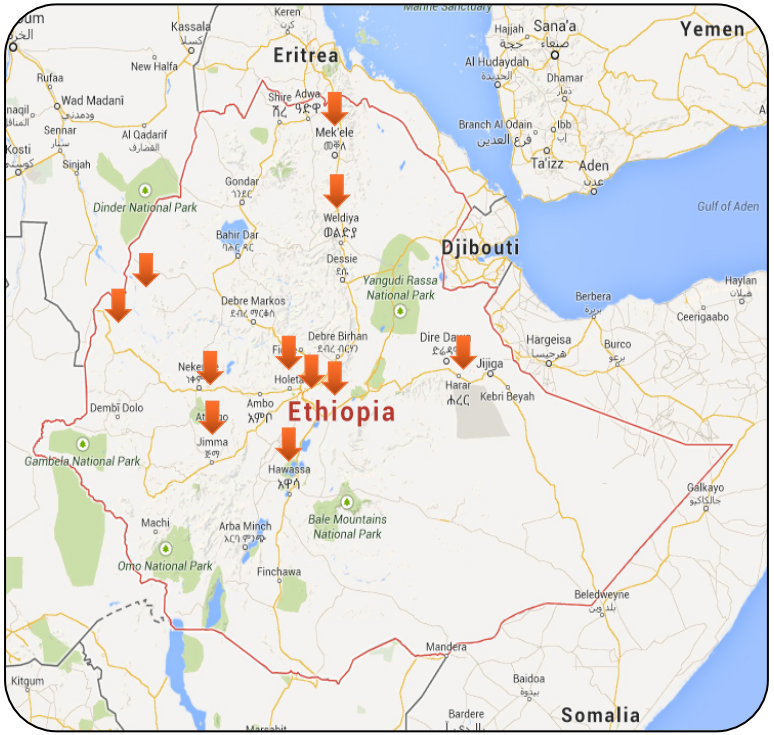
(accelerating) The Breeding Cycle



not just for wheat….

Collaborative Research on Sorghum and Millet

Sorghum Genomics for Breeding



Common Germplasm Evaluation Activity of 2200 +/- lines with genotyping in 2016-18

Ejeta – Striga and drought

Tesso – Quality traits and yield

Mengiste – Disease resistance

Phenotyping varieties, elite, landraces, Sudanian materials, wild relatives with goal of genotyping and genomics-enabled breeding platform

KANSAS STATE UNIVERSITY
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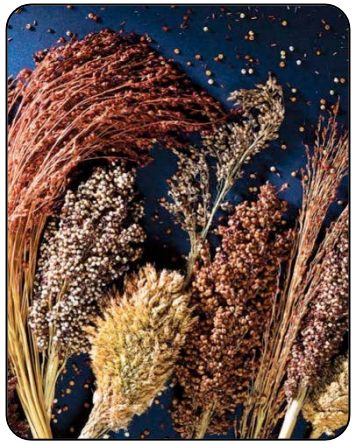
Collaborative Research on Sorghum and Millet

Sorghum Genomics for Breeding

Improving sorghum adaptation in West Africa with genomics-enabled breeding

Principal Investigator: *Dr. Geoffrey Morris - Kansas State University*

Collaborating institutions: *CIRAD, ISRA, CERAAS, CNRA, ICRISAT, INRAN, LSDS HALAL*



Sorghum trait development pipeline for improved food and feed value

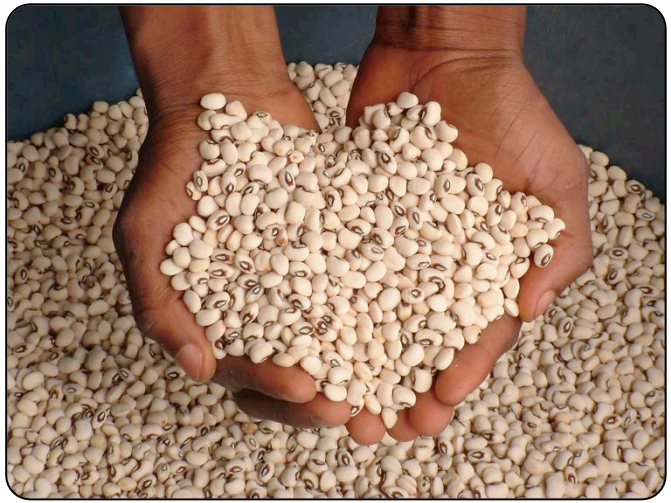
Principal Investigator: *Dr. Mitchell Tuinstra – Purdue University*

Collaborating institutions: *INRAN, ITA, CERAAS, ISRA, CNRA*

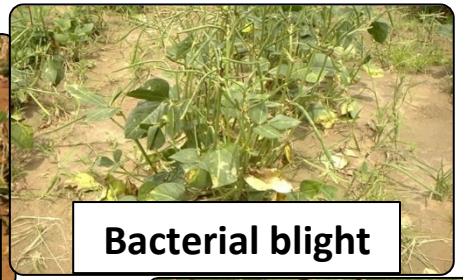
Cowpea Genomics

Innovation Lab for Climate Resilient Cowpea

Dr. Timothy Close, UC Riverside

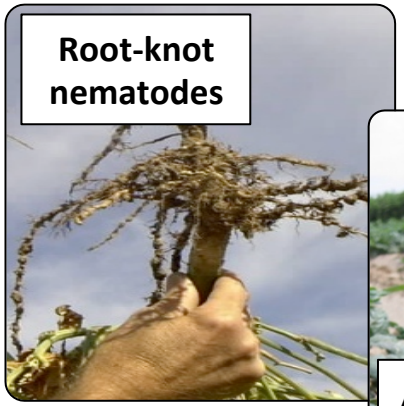


Drought

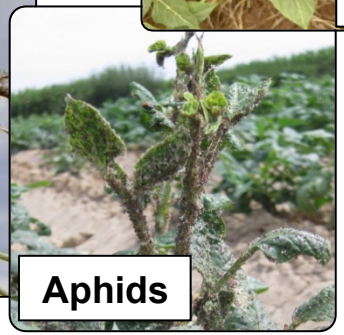


Bacterial blight

Viruses



Root-knot nematodes



Aphids

Genomics assisted breeding in Burkina Faso

Feed the Future Innovation Lab for Collaborative Research on Peanut Productivity and Mycotoxin Control
University of Georgia

Feed the Future Innovation Lab for Climate-Resilient Beans
Penn State University

Feed the Future Innovation Lab for Climate-Resilient Chickpea
University of California, Davis

Feed the Future Innovation Lab for Climate-Resilient Sorghum
University of Georgia

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
Michigan State University

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Feed the Future Innovation Lab for Genomics to Improve Poultry
University of California, Davis

Feed the Future Innovation Lab for Climate-Resilient Cowpea
University of California, Riverside

Feed the Future Innovation Lab for Collaborative Research on Sorghum and Millet
Kansas State University

Feed the Future Innovation Lab for Climate-Resilient Millet
University of California, Davis

Feed the Future Innovation Lab for Climate-Resilient Wheat
Washington State University

Feed the Future Innovation Lab for Collaborative Research on Aquaculture & Fisheries
Oregon State University