What is Plant Breeding?

- Genetically manipulating plants to suit our needs

- **Objective:** Recover the best combination of genes for all important characteristics into one individual
Plant Breeding

• Must define objectives

• Must create genetic variation

• Must select upon that variation
Breeding Goals

Provide growers with new cultivars that maintain profitability, reduce risk, and lead to sustainable systems

— High yields, agronomically adapted
— Excellent end-use quality
— Genetic resistance to abiotic and biotic stress
— Consumer demand
WSU Wheat Breeding and Genetics

Challenges:
- Diverse production region
- Variable environments and stresses
- Crop management issues
- Increasing and evolving disease and insect pressures
- Increasing demands on end-use quality
Selection: same objective, new technology
Doubled Haploid Production
Can remove 1-2 years off breeding cycle
Can incorporate marker-selection while advancing
Cold Tolerance

Screening done both in the greenhouse and under field conditions.
Winter Wheat Research

March 3, 2017

April 7, 2017

May 3, 2017

CANOPEO

NDVI
Winter Wheat-Research

March 3, 2017  April 7, 2017  May 3, 2017

[Images showing different stages of winter wheat growth from March 3, 2017 to May 3, 2017]
Year 0
1000 crosses
Crossing selected on quality characteristics of parents

Year 1
1000 Plants

F₁

Year 2
900+ Populations
No quality screening done in F2 and F3 stage. Markers are run for known genes (grain protein content, gluten strength, disease resistance, etc)

F₂

Year 3
900+ Populations

F₃

Diagram:
- Model Training Cycle
- Genomic Selection
- Line Development Cycle
  - Advance lines with highest GEBV
  - Make crosses and advance generations
  - New Germplasm
- Genotype
- Train prediction model
- Advance lines informative for model improvement
- Test varieties and release
- Phenotype (lines have already been genotyped)
Each cropping system requires different attributes. For example, no-till systems prefer the straw to break down quickly, whereas conventional systems want slower straw breakdown to control erosion.
Drought Tolerance

- Majority of wheat grown under rainfed conditions
- Drought conditions very from year to year
- Mechanisms largely uncharacterized
Plant emergence from ~8 inches deep
Plant emergence from ~8 inches deep
High-throughput phenotyping for drought and heat tolerance as correlated with yield potential.
High-Throughput Phenotyping
USDA Grant Funding
What the eye can’t see or estimate!
From Greenhouse to Reality

Crossing

Trait Selection

New Cultivars

Consumers

Domestic and Export Markets

Pacific Northwest Farmers
Questions

Funding:
Washington State University
Washington Grain Commission
Vogel Endowment
Amen Foundation
USDA-NIFA