Wheat Improvement Team, WIT@OSU

Team Members

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Brian Arnall, Nutrient-use Efficiency, Plant and Soil Sciences

Charles Chen, Genomic Selection, Biochemistry and Molecular Biology

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Bob Hunger, Wheat Pathology, Entomology and Plant Pathology

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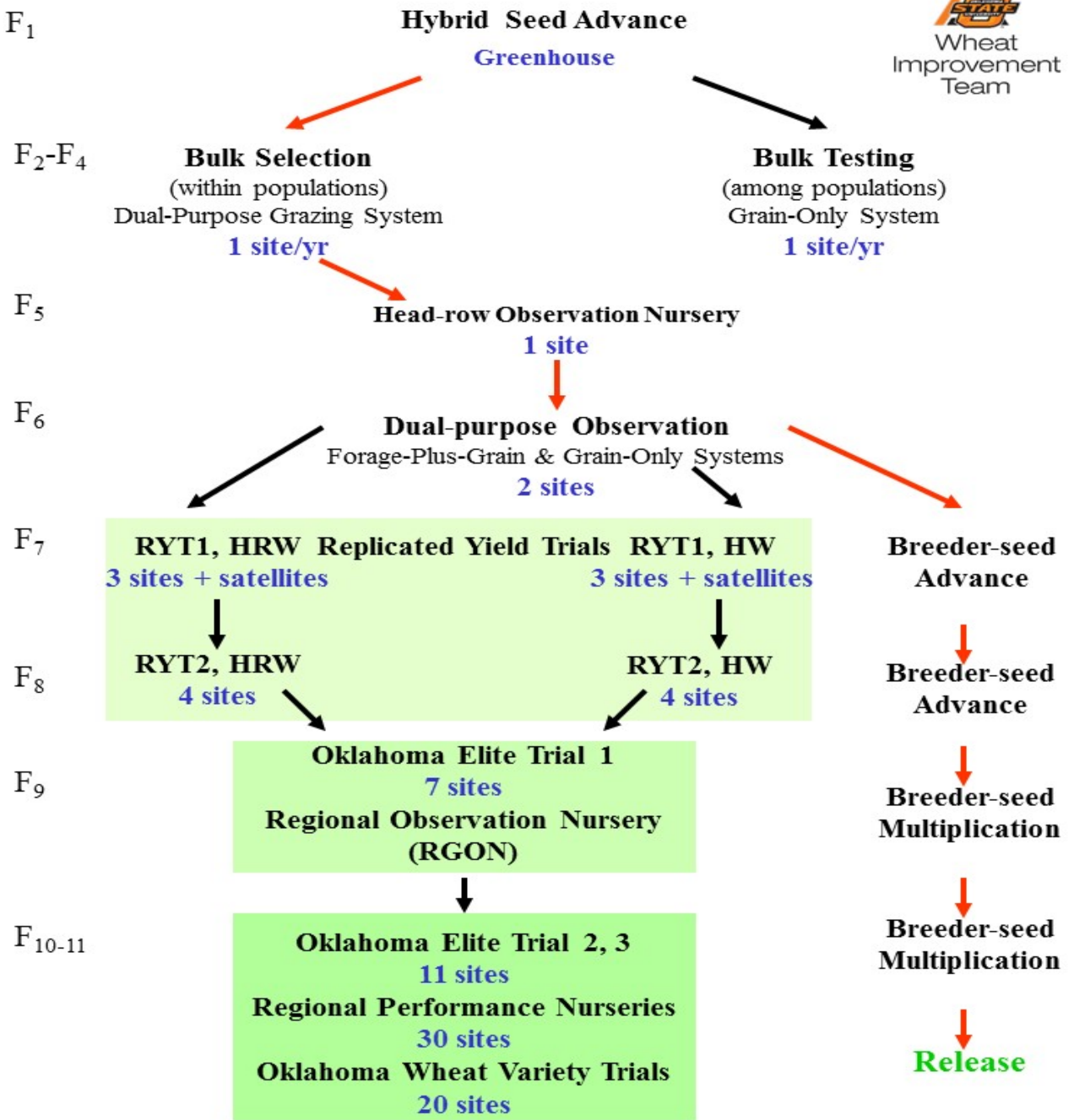
Xiangyang Xu, Aphid Resistance and Germplasm Introgression, USDA-ARS, Stillwater, Oklahoma

Liuling Yan, Wheat Molecular Genetics, Plant and Soil Sciences

HRW/HW Wheat Breeding Flow Chart



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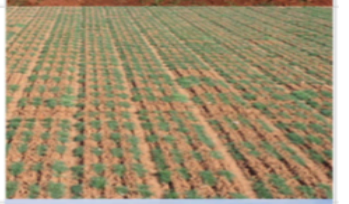
Graze n Grain™

By the numbers

2,058	The number of segregating populations cycled through the **Graze*n* Grain®** breeding system at Okarche and Lahoma in 2018. The Altus location was a complete bust. About 30 percent of these populations were sufficiently inbred to allow extraction of experimental lines for eventual testing and selection. One segregating population usually generates 96 experimental lines.	
60,763	The number of first-generation F_5 experimental lines planted in 3-foot headrows. This number well exceeds our target for the VDP (55,000). Unfortunately, selection pressure was light in 2018 due to the absence of meaningful disease pressure. More than 2,500 of these lines were advanced for observation in conventional yield plots in 2018-2019.	
18,303	The number of second-generation fixed lines dedicated to our centerpiece breeding nursery in 2018, the Dual-Purpose Observation Nursery, and key turning point for lines borne out of the ***GrazenGrain®*** breeding system. Only those progeny superior for grazing persistence and grain-only yield potential are advanced for statewide yield testing. Eleven percent of these lines were HW.	
1,891	Doubled haploid lines produced outside of, and which circumvent, the conventional ***GrazenGrain®*** system. This breeding system relies mostly on elite parentage with high mean but low genetic variance. This portion of the line-evaluation program is increasing each year, but the highest proportion is not likely to exceed 25 percent so that long-term genetic gains are not sacrificed for short-term gains.	
9	Out of 25 Great Plains varieties preferred by one of the largest wheat milling enterprises in the U.S., nine were developed by WIT: Ruby Lee, Billings, Duster, Doublestop CL+, Bentley, Gallagher, Iba, Smith's Gold and Spirit Rider.	
17	Extraordinary number of candidate varieties advanced for seed increase by Oklahoma Foundation Seed Stocks in summer 2018.	
1 and only 1	Only one wheat team and one wheat variety development program, in the U.S. that focuses on adaptation to the wheat/stocker cattle enterprise, without losing sight of what steers wheat prices—quality. It does matter.	WIT

OSU Wheat Improvement	Selection pressure None → High	Molecular target	Trait Matrix Comments
Barley yellow dwarf virus		*Bdv1, Bdv2*	Field tolerance preferable
Fusarium head blight			
Karnal bunt			Unrealistic breeding target
Leaf rust		*Lr34E22,E11,E12*	APR, non-race specificity focus
Powdery mildew		*Pm3a*	
Septoria complex			Indirect approach via stay-green
Spindle streak mosaic virus			
Stem rust		In progress	Little seln pressure, if not for Ug99
Stripe rust		2A, 5A	Narrow marker scheme
Tan spot			Field screen under development
Wheat soilborne mosaic virus			Superior phenotyping capability
Wheat streak mosaic virus			Requires ELISA for differentiation
Bird cherry-oat aphid			Screen available but not implemented
Greenbug			Reliable screen available
Hessian fly			Field tolerance highly informative
Russian wheat aphid			Reliable screen available
Acid-soil tolerance (Aluminum)		*ALMT1 (SSR3A)*	Field tolerance imperative
Canopy architecture			
Coleoptile elongation			*Rht*-dependent; divert from *Rht1*
Development - FHS		*VRN-A1,+*	Stem elongation or "dormancy" release
Development - Heading		*PPD-D1*	*VRN-A1*, *VRN-D3* also relevant
Development - PM		*VRN-D3,+*	*VRN-A1*, *PPD-D1*; seed size
Drought or heat tolerance			Pressure will increase with efficiency
Early vigor			
Spring freeze tolerance			Tolerance or avoidance?
Grazing tolerance			Vegetative and reproductive indices
Plant height			Wide window if lodging is absent
Post-harvest dormancy		3AS, 4AL	Germination based on heat sensitivity
Pre-harvest sprout tolerance			Can be de-coupled from PHD
Stay-green			Balanced with maturity; all-inclusive
Straw strength			Balance with combineablity
Tillering capacity			Non-synchronous
Vegetative growth habit			Avoid highly prostrate or erect types
Winter hardiness			Must balance with fall biomass
Dough elasticity			Pending reliable measurement device
Dough extensibility			Attempting to balance with strength
Dough strength			Multiple components; mixograph mainly
Flour yield			Milling components more efficient
GS - HMW			
GS - LMW			Currently evaluating associations
Kernel hardness			Threshold selection
Kernel size			Threshold selection; mitigate with TW
Loaf/sedimentation volume			Threshold selection
PPO			Currently relevant only to white wheat
Protein content			Market-class appropriate
Test weight			Threshold selection
Tortilla quality			Need defined targets and relevant stds

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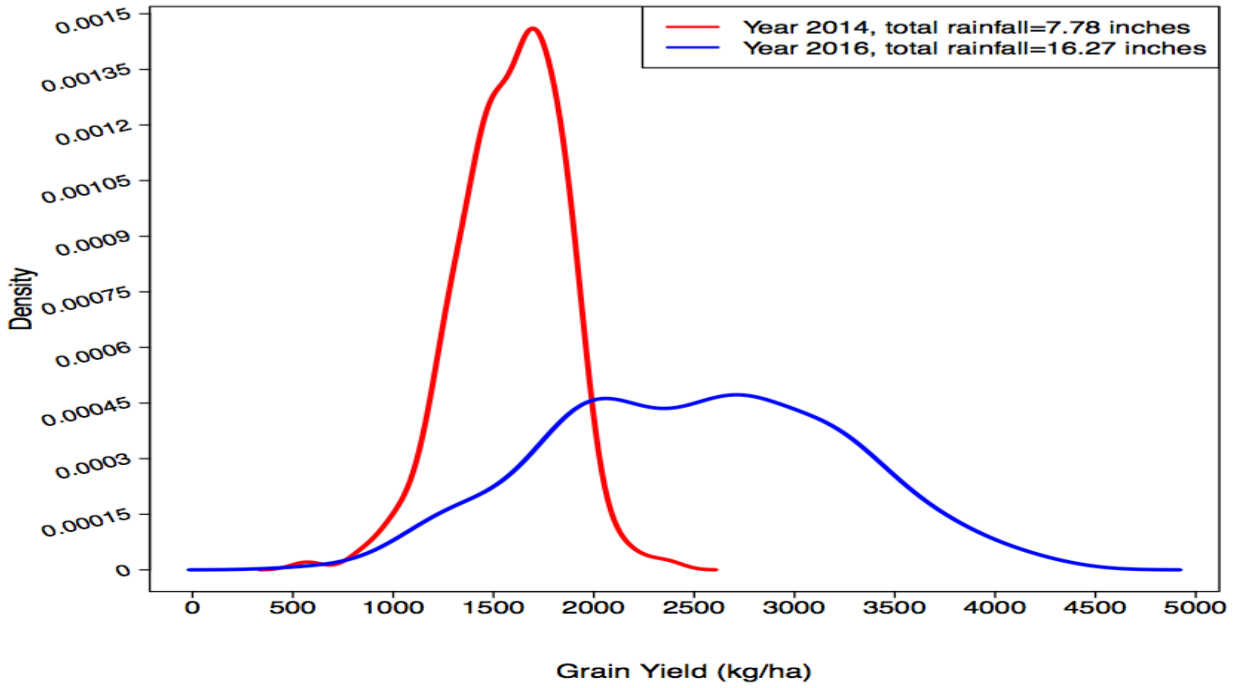

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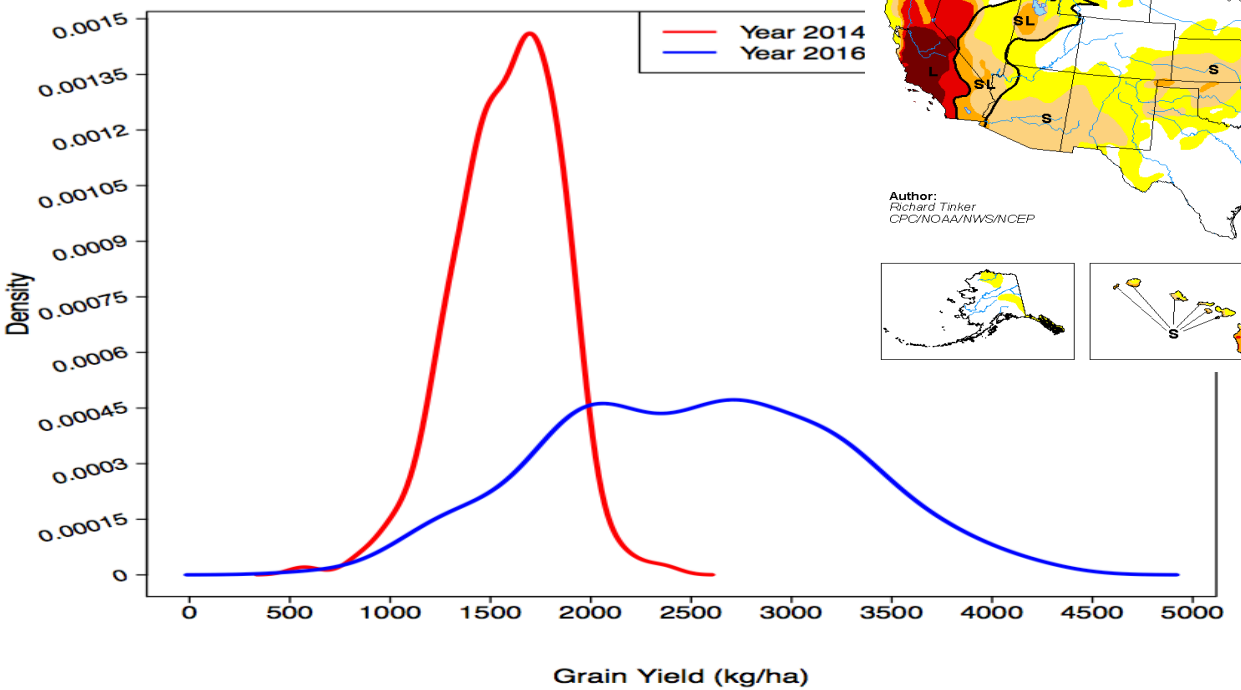

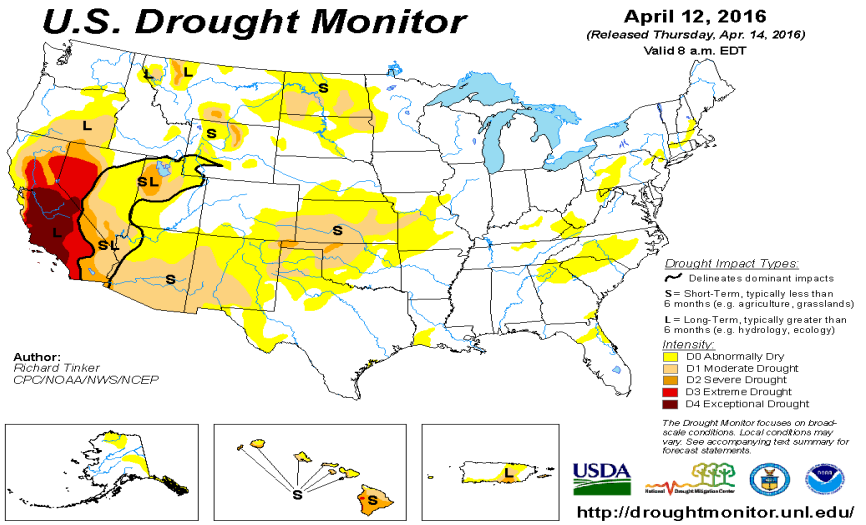

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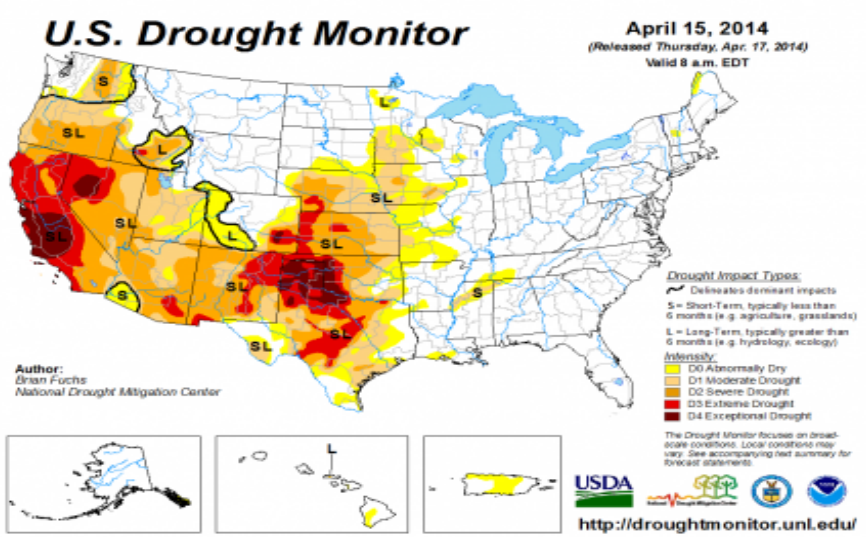

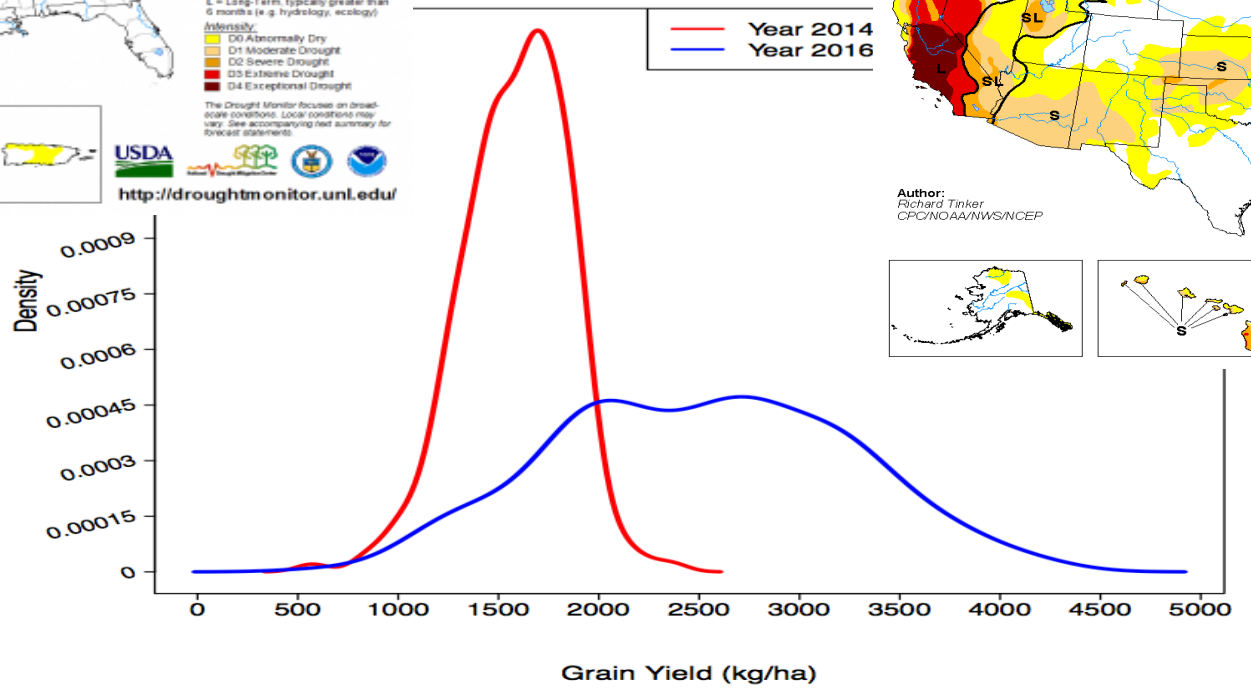

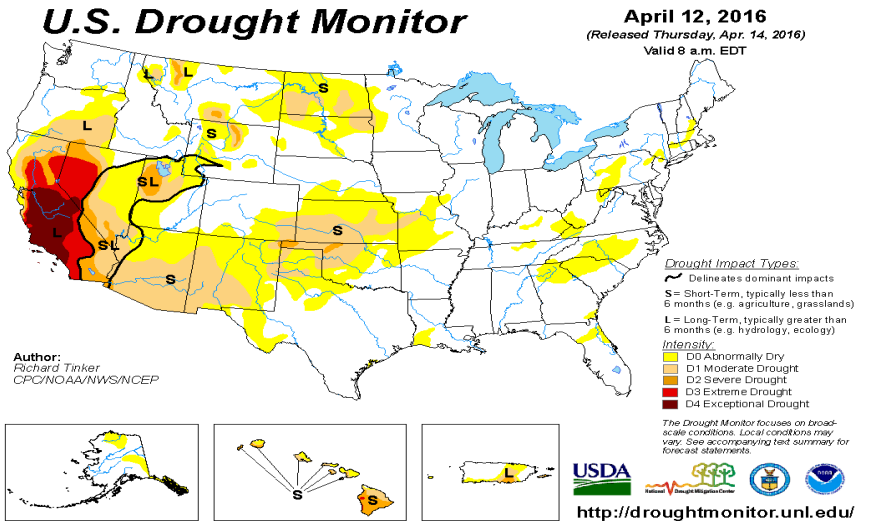

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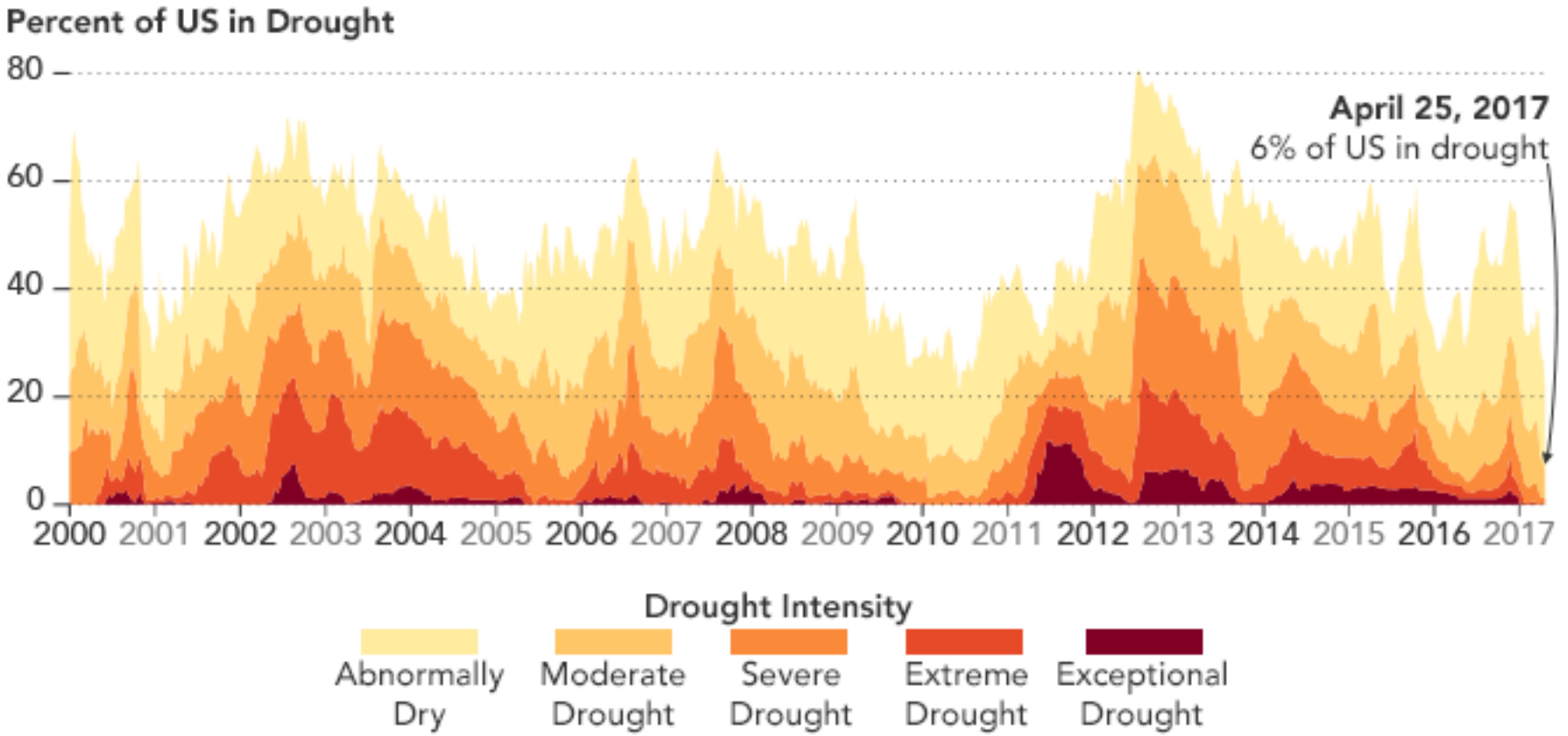

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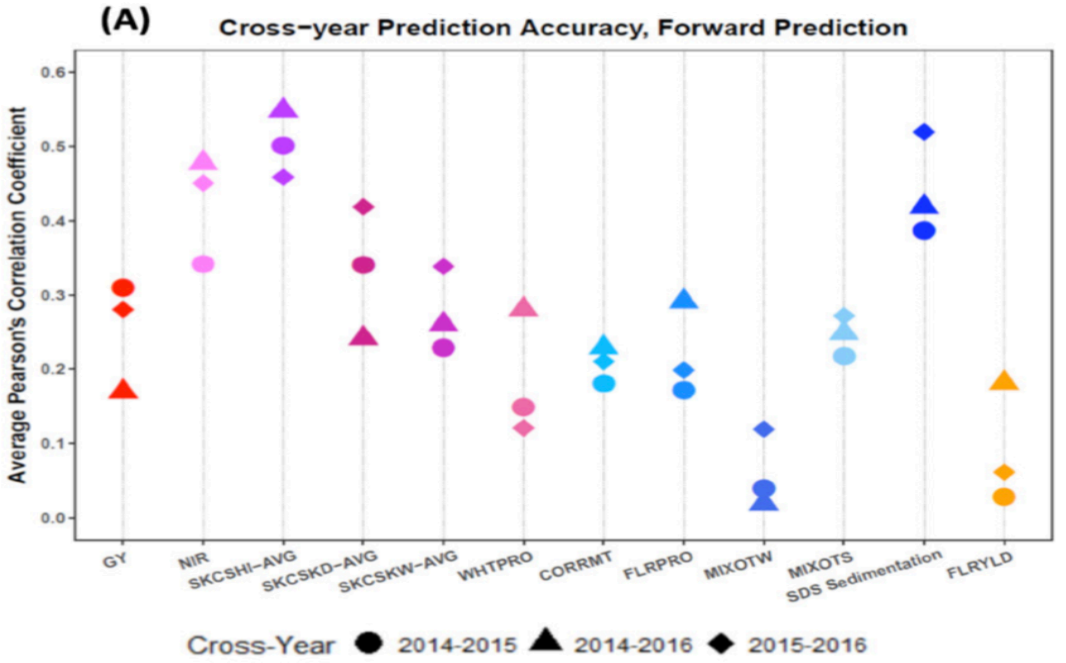
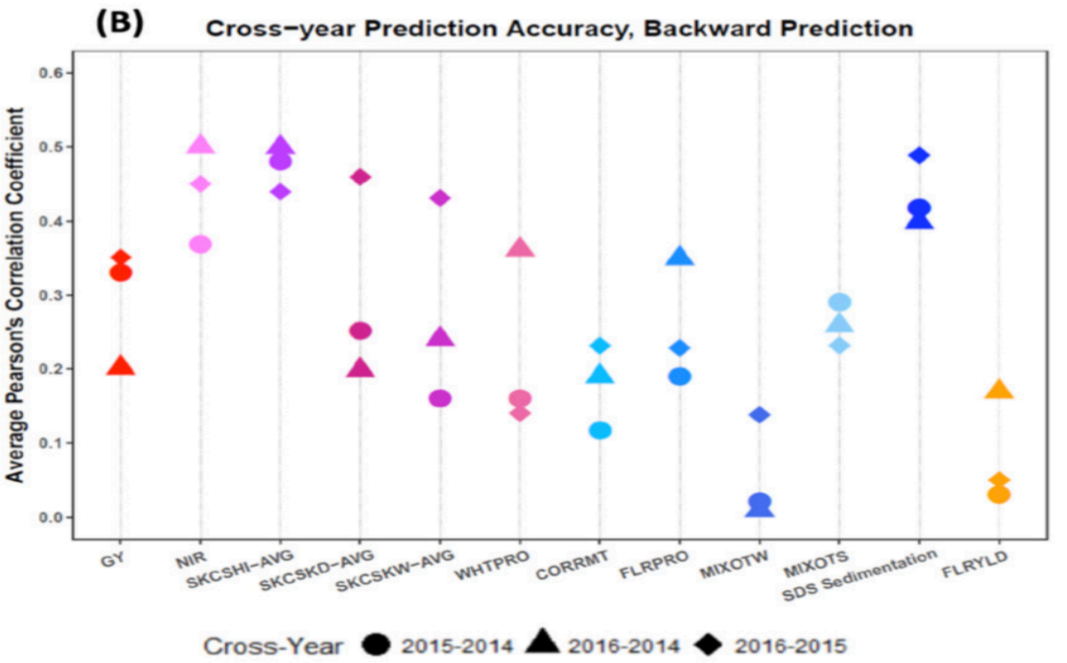
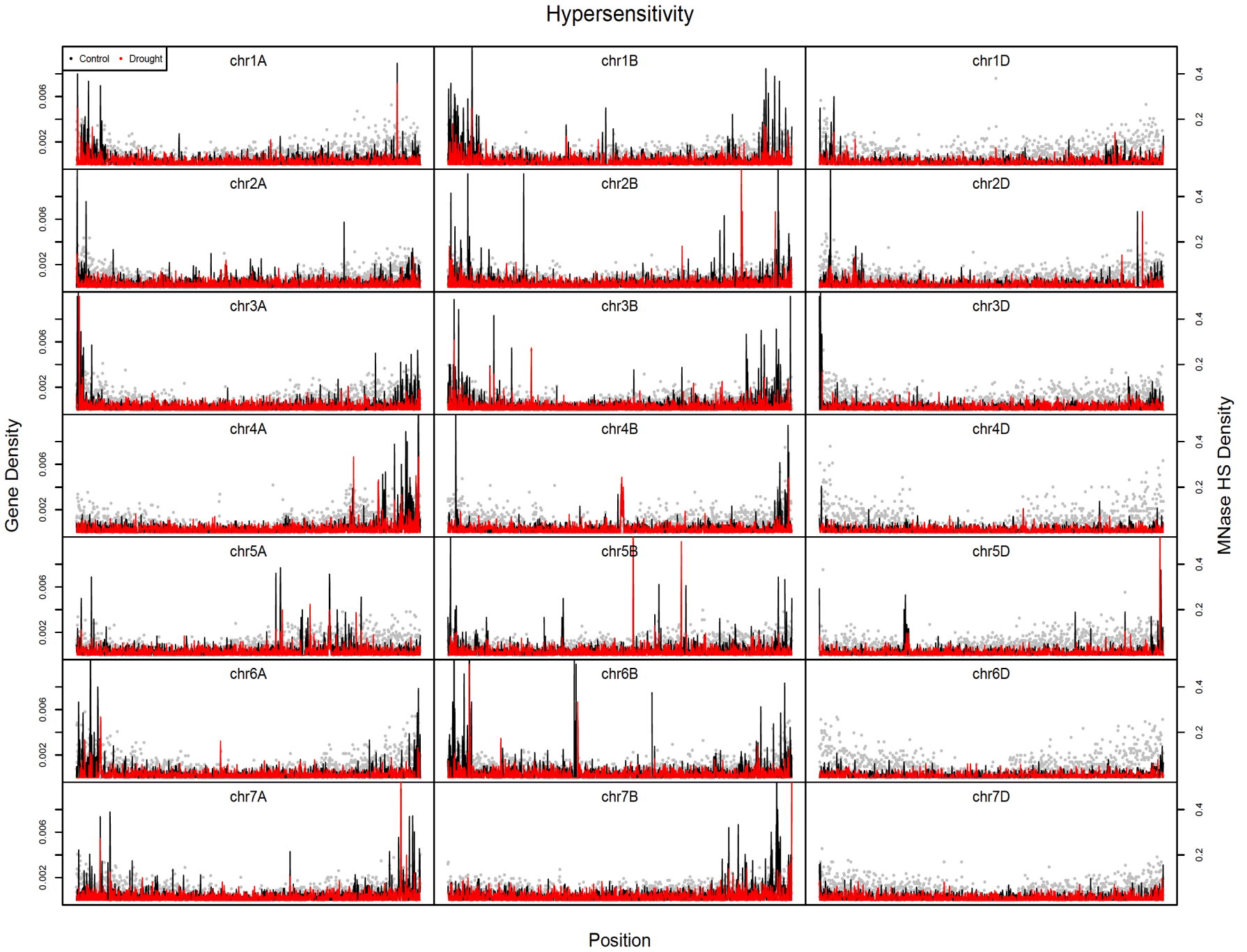




GY: grain yield
NIR: near infrared kernel hardness
SKCSHI-AVG: singe kernel characterization system kernel hardness, average value of 300 kernels
SKCSKD-AVG: singe kernel characterization system kernel diameter, average value of 300 kernels
SKCSKW-AVG: singe kernel characterization system kernel weight, average value of 300 kernels
WHTPRO: wheat protein adjusted for 12% moisture
CORRMT: corrected mix time
FLRPRO: flour protein adjusted for 14% moisture
MIXOTW: mixograph tail width
MIXOTS: mixograph tolerance score
SDS Sedimentation: adjusted sodium dodecyl sulphate sedimentation values
FLRYLD: corrected flour yield adjusted for 14% moisture


Hypersensitivity
Control
Drought
chr1A
chr1B
chr1D
chr2A
chr2B
chr2D
chr3A
chr3B
chr3D
chr4A
chr4B
chr4D
chr5A
chr5B
chr5D
chr6A
chr6B
chr6D
chr7A
chr7B
chr7D
0.002
0.006
0.2
0.4
Gene Density
MNase HS Density
Position

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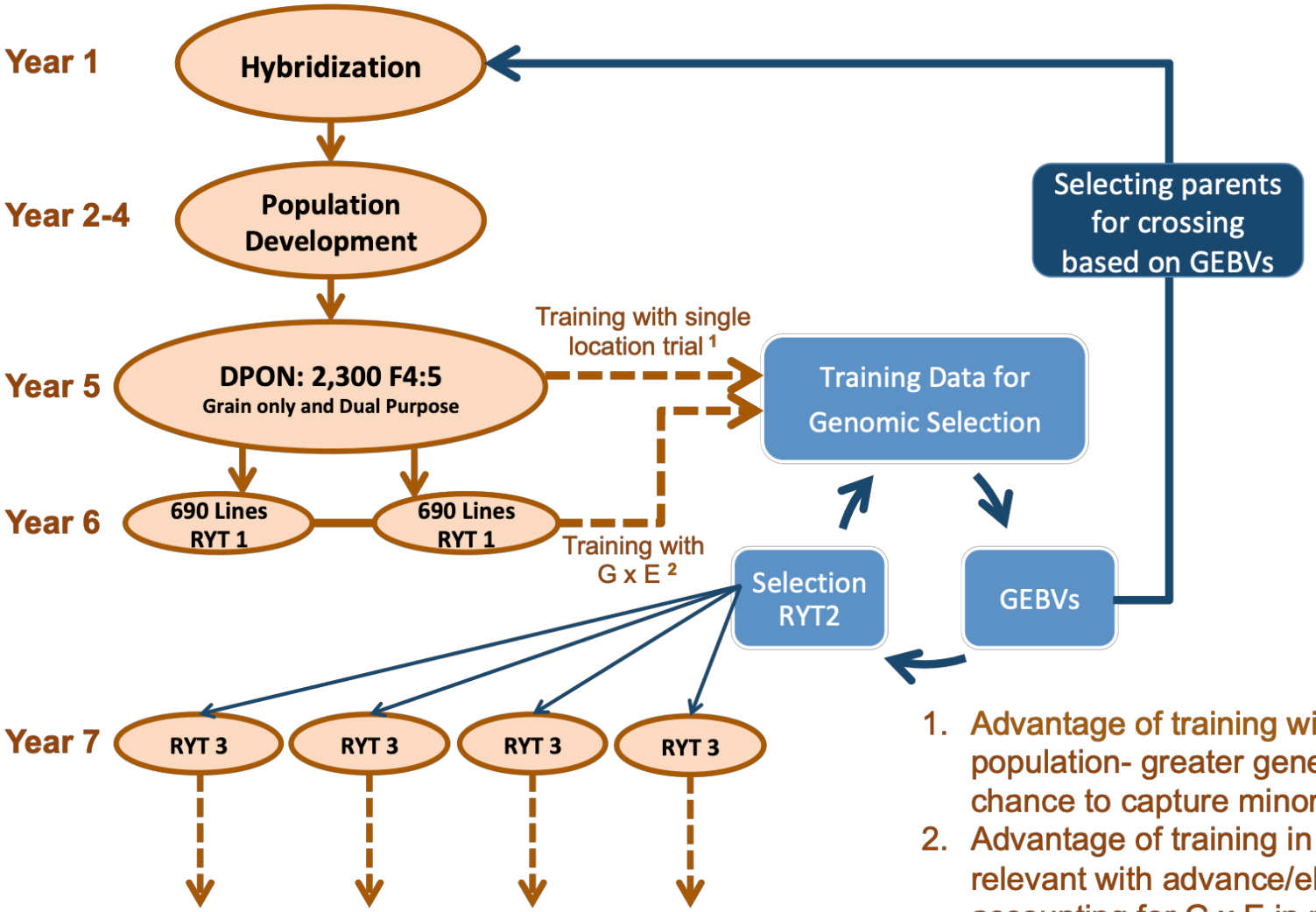

1. Advantage of training with a large population- greater genetic diversity, higher chance to capture minor QTLs
2. Advantage of training in RYTs- more relevant with advance/elite varieties and accounting for G x E in multiple location yield trials