Seeds of Discovery: A platform for enhanced use of genetic resources

Kevin Pixley, Sarah Hearne, Sukhwinder Singh
& many colleagues

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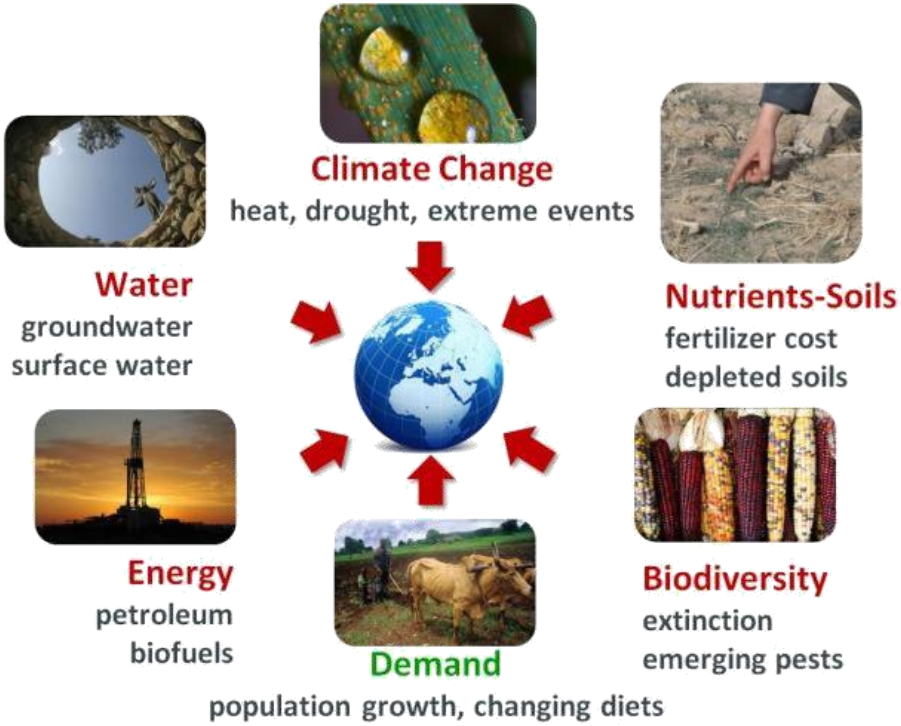
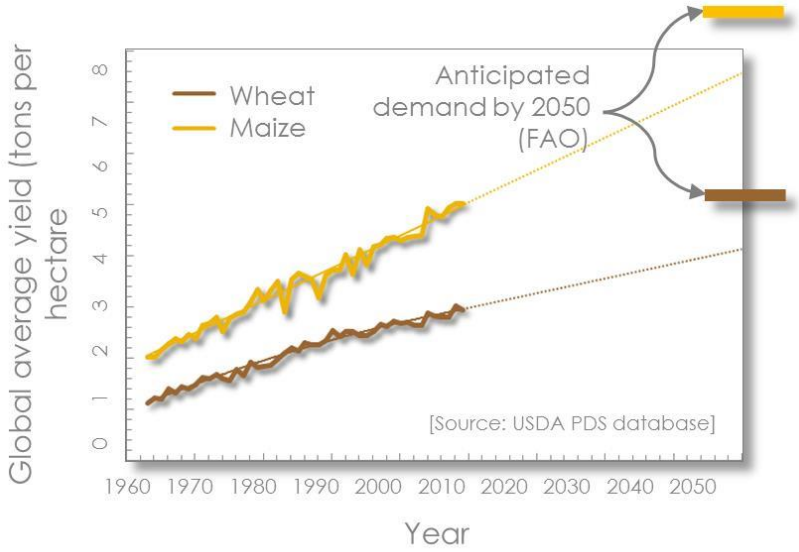
Converging Challenges to Global Food Security





"In the next 50 years we will need to produce as much food as has been consumed over our entire human history." Megan Clark, CSIRO CEO

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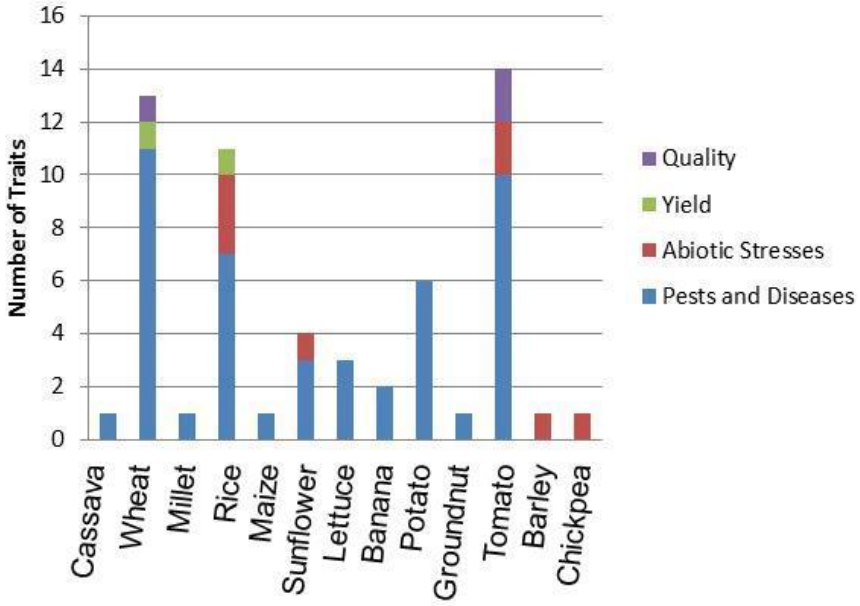
Vision of Success: the wealth contained in the world's genetic resources is 'unlocked' for breeders globally to make new varieties

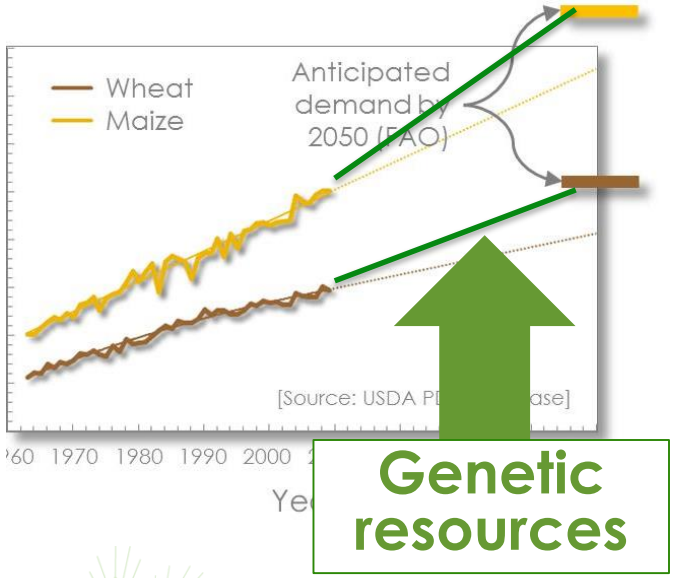
≈ 28,000 maize

≈ 150,000 wheat

Use of crop wild relatives in the past 20 years in released cultivars of 13 crops of international importance

(Euphytica 2007, 156:1-13)





Genetic resources

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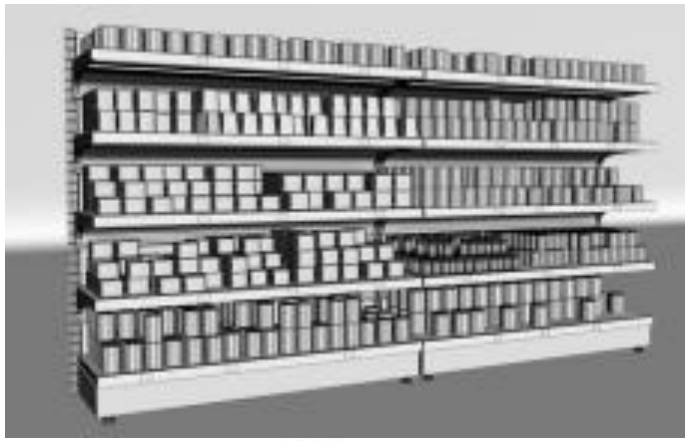
Challenges of Use

Lack of relevant information



High-density genetic profiles

Genomic characterization using DArTseq

- SNP and PAV markers

✓ 28,000 Maize

✓ 100,000 Wheat

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Field and laboratory phenotyping

Maize: >1.5m data points

Traits	Experiments
Abiotic stresses	heat
	drought
	low N
Biotic stresses	tar spot, ear rot, stalk rot, *Turcicum*, *Cercospora*, *MLN (MCMV & SCMV)*
Grain quality	hardness, starch, oil, amino acids, phenolics

Flowering
Plant, ear height
Stem, root lodging

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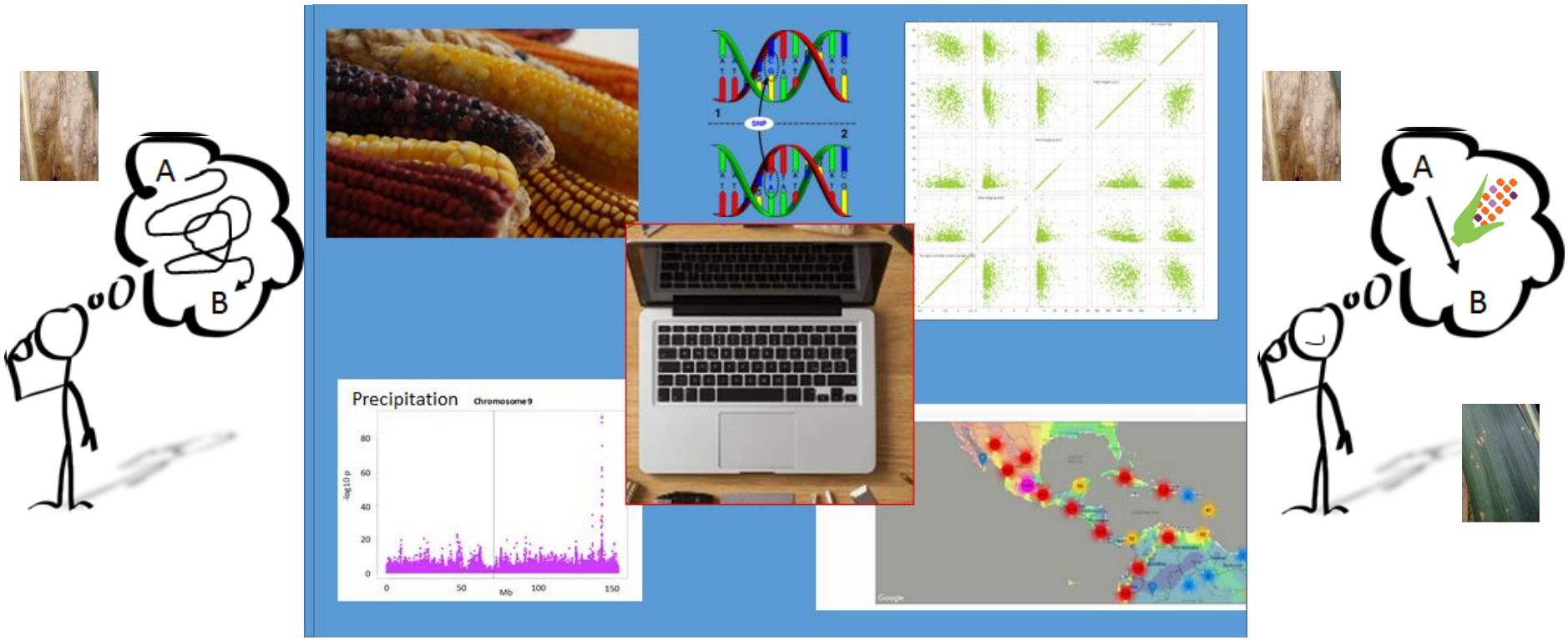
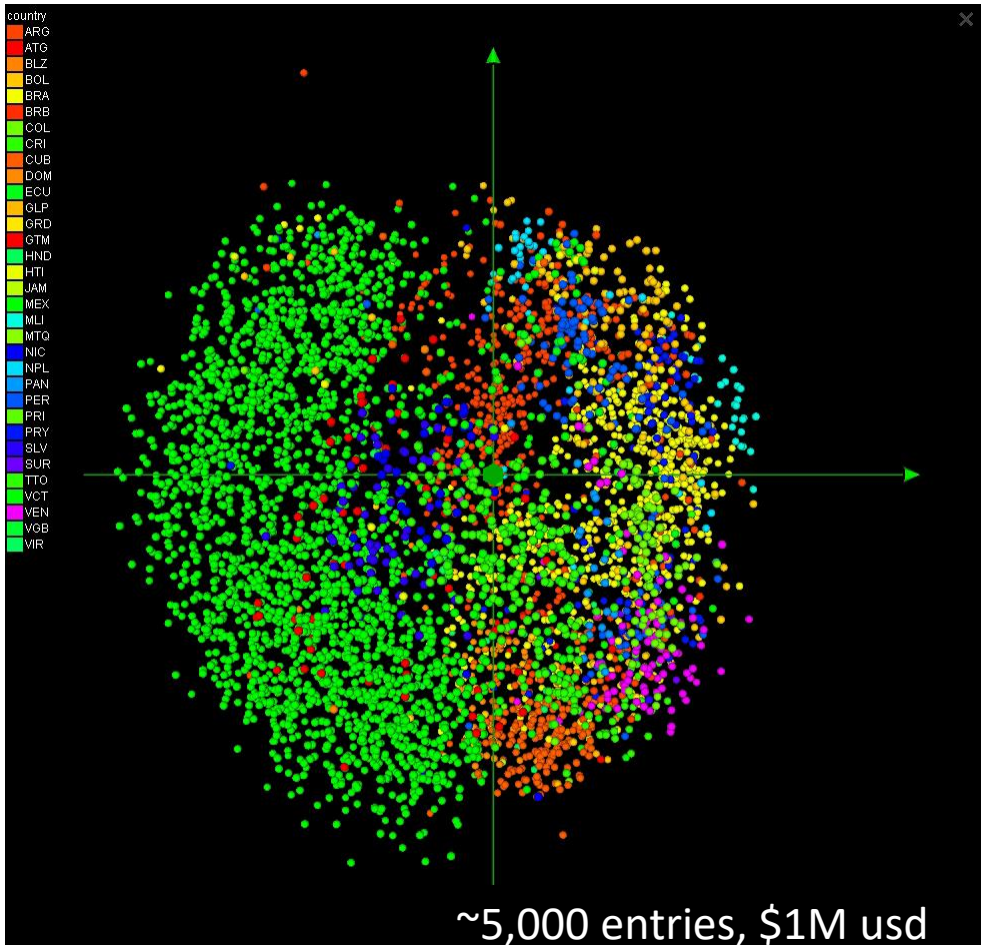
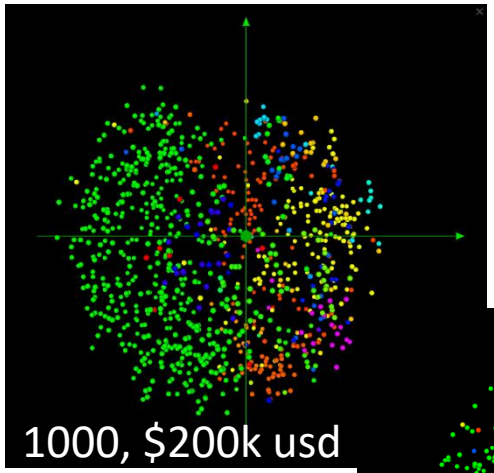
Tools for data analysis, visualization and use

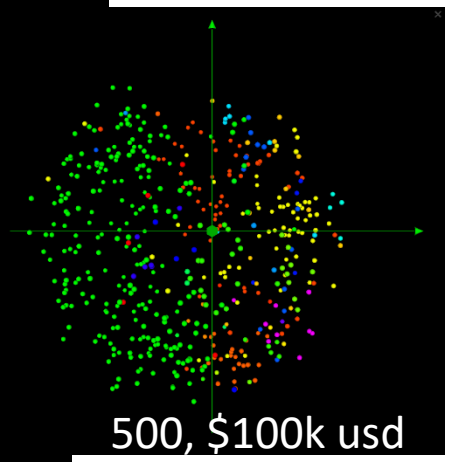


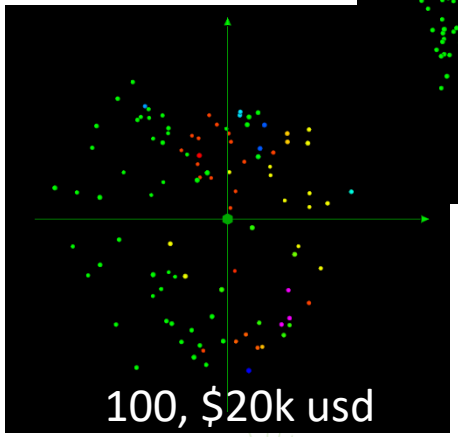
A “Satellite Navigation” system for diversity

Diversity panels for breeders

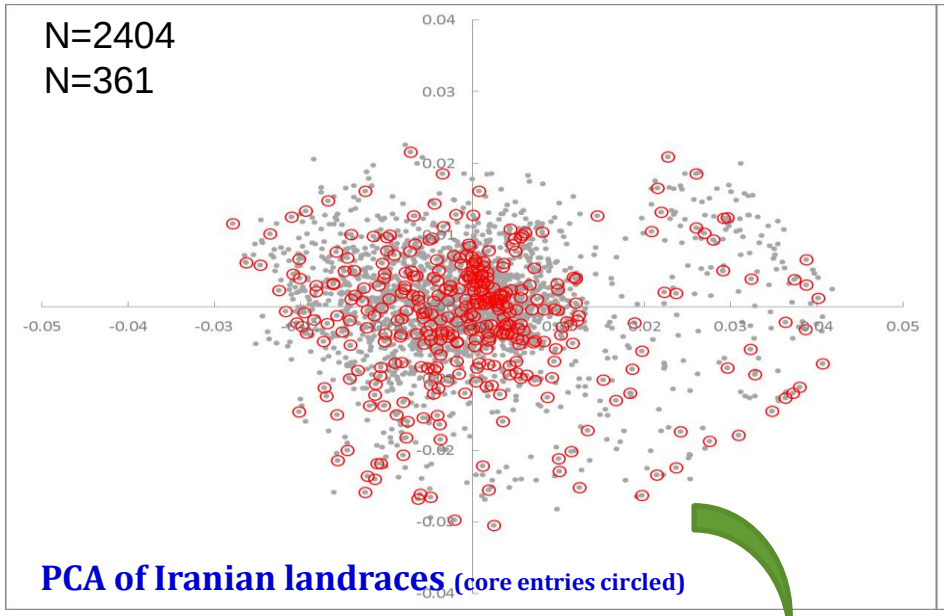


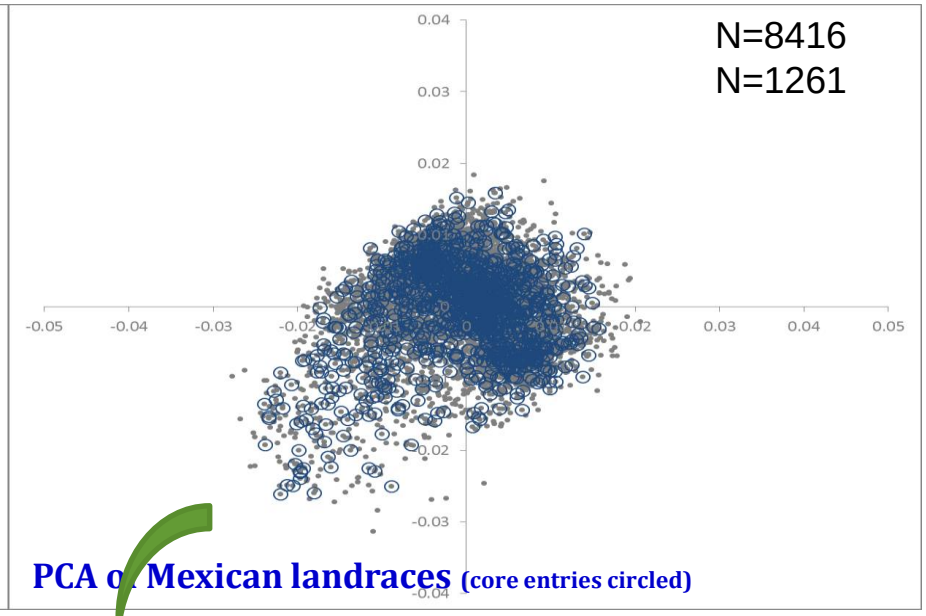






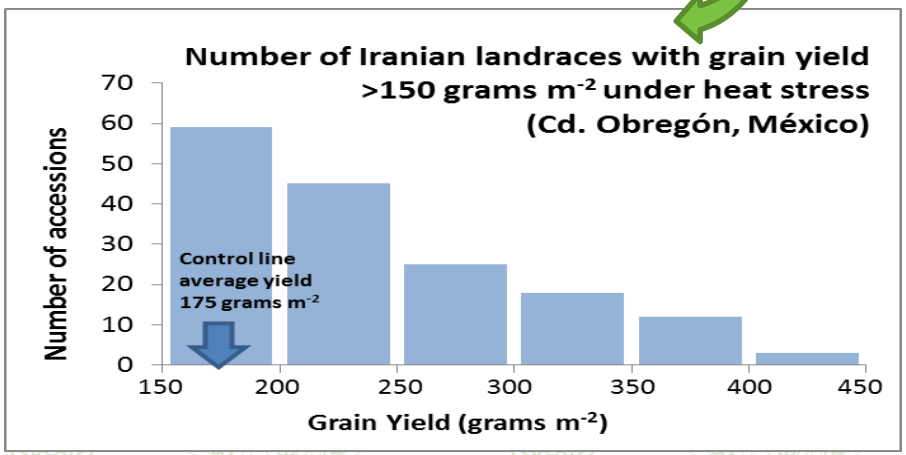
Core sets of wheat landraces

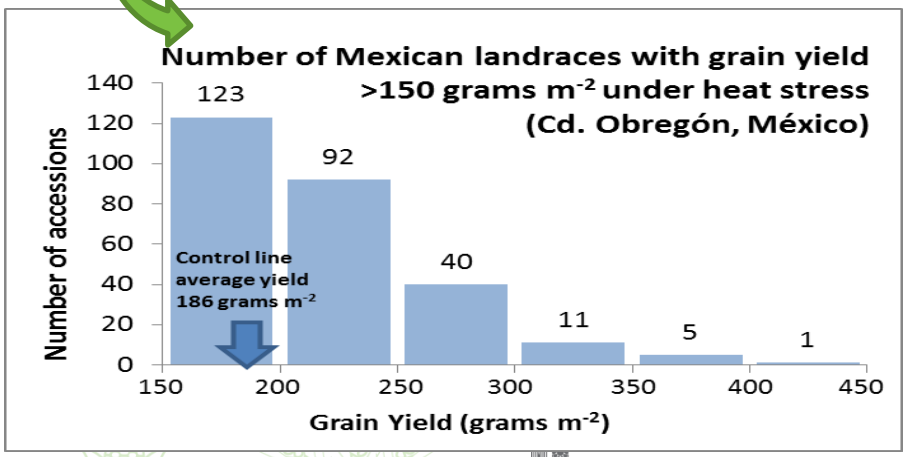




7%

3%





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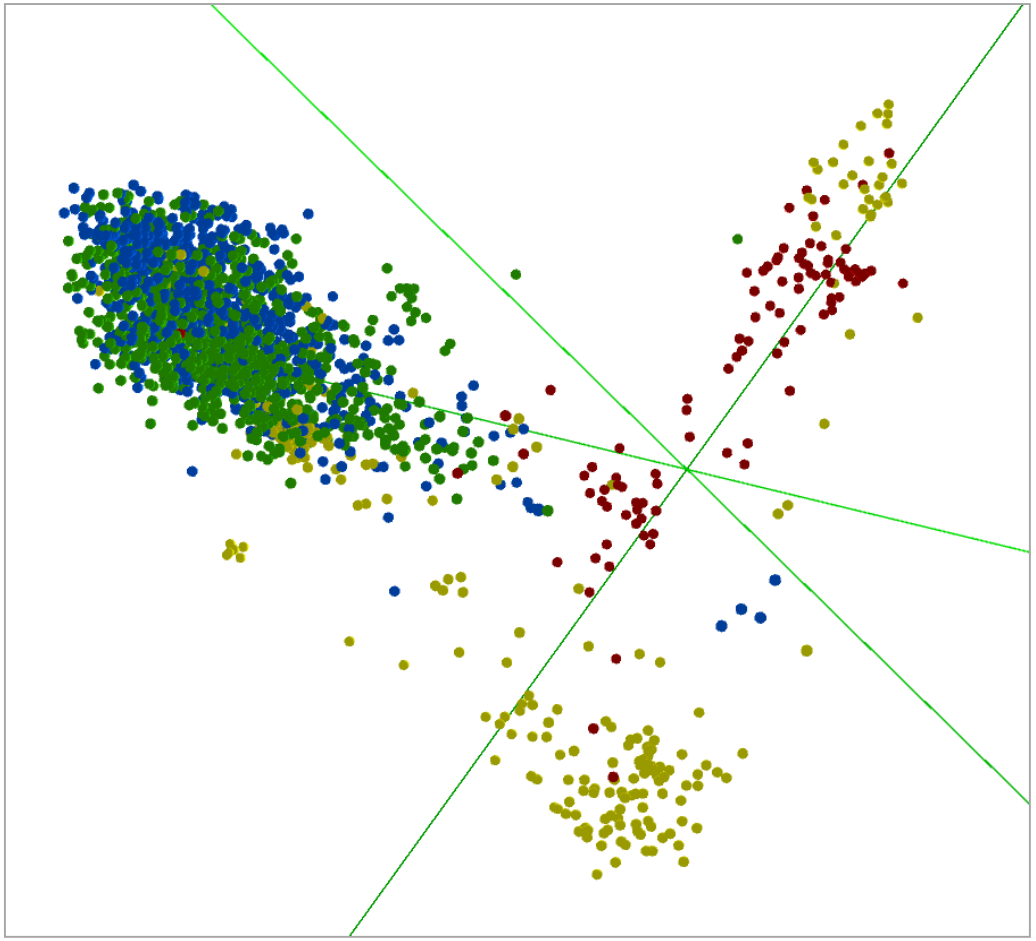
Exploring genetic resources for heat-adaptive traits (wheat)

Elite lines:
ESWYT- Blue
SAWYT - Green



Tolerant Landraces:
Iranian : Red
Mexican : Yellow

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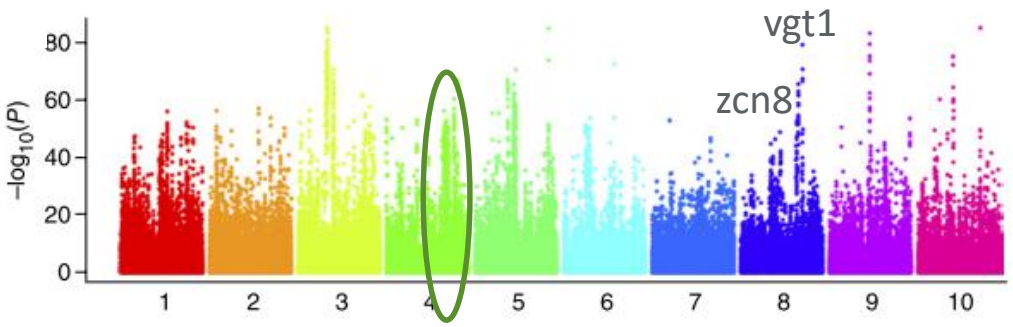
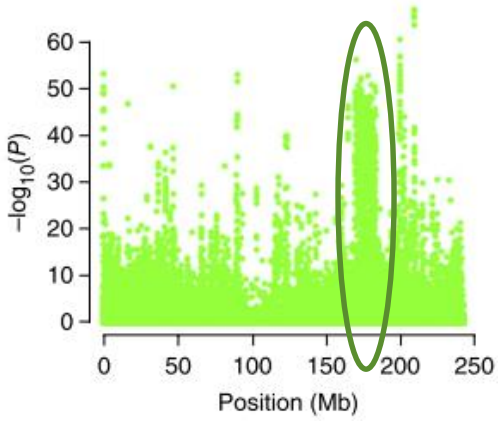
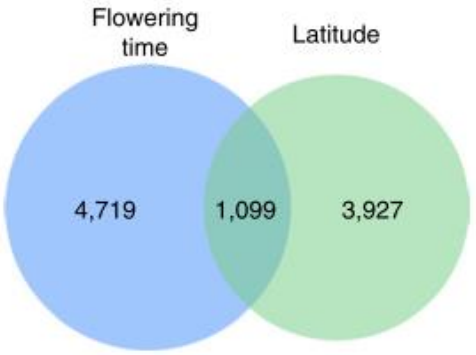
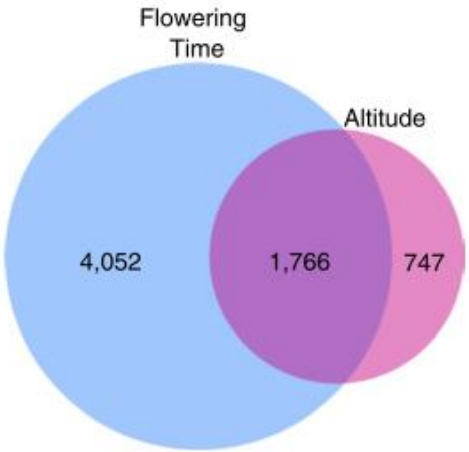
GWAS: Flowering and broad adaptation (maize)



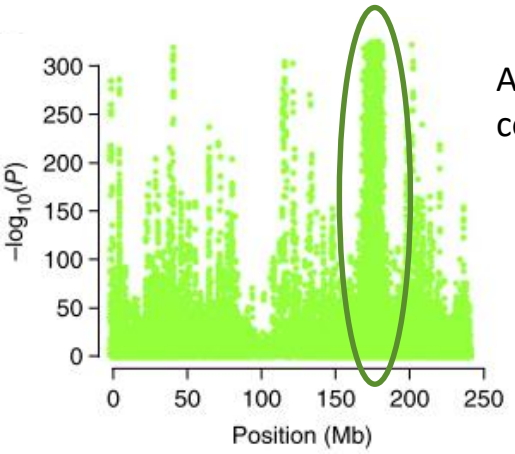


Days to anthesis





Inv4m



Altitude of collection

Romero et al. Nat Gen 2017

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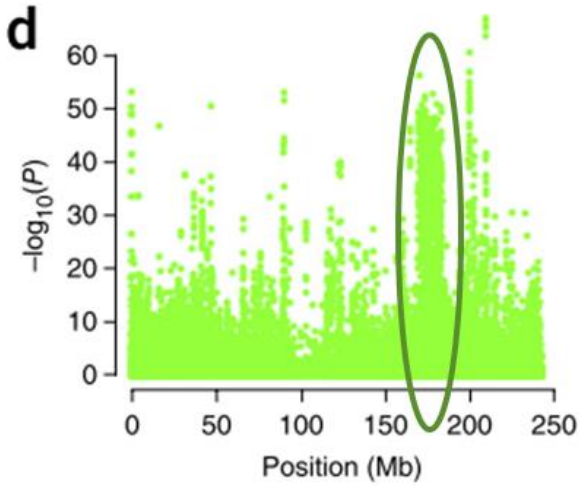
Inv4m locus 4 - additive effect



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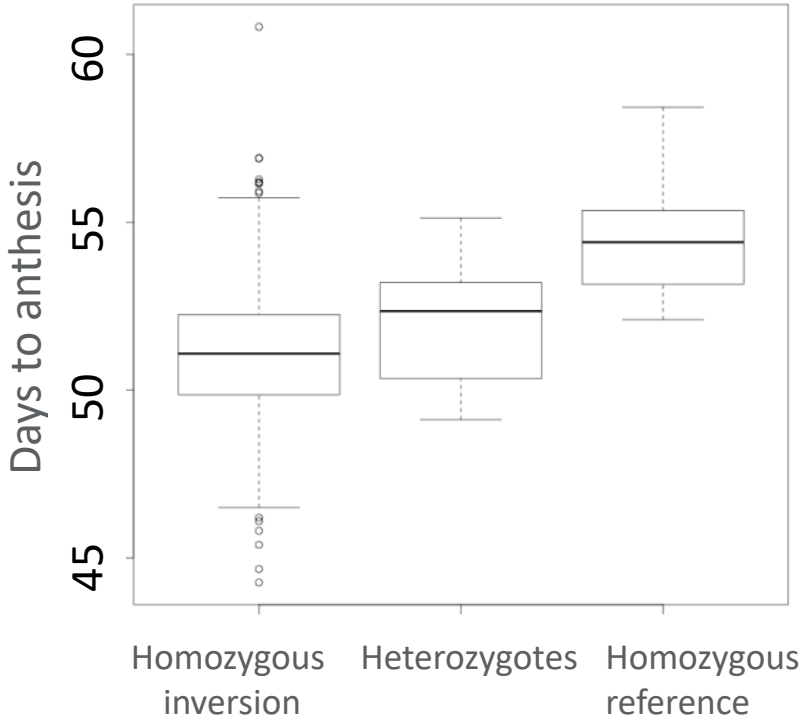

Largest effect on flowering documented to date: 3 days

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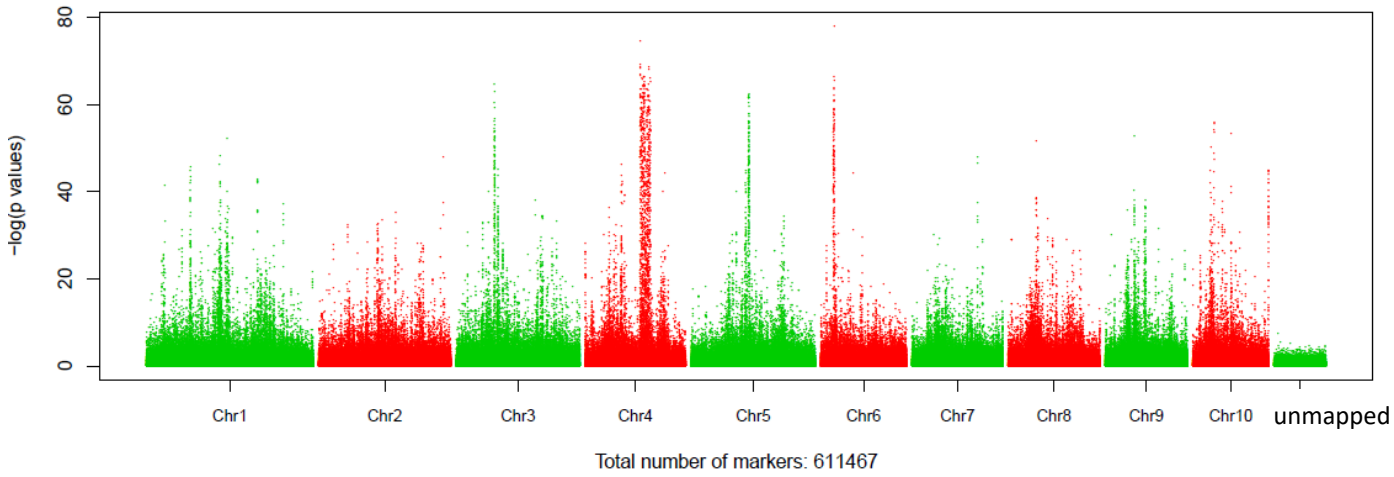
Can apply to many traits: Grain protein content (maize)



What's next?

DArTseq

GWAS phen

GS model, validated with FT, PH

Predict Bank materials

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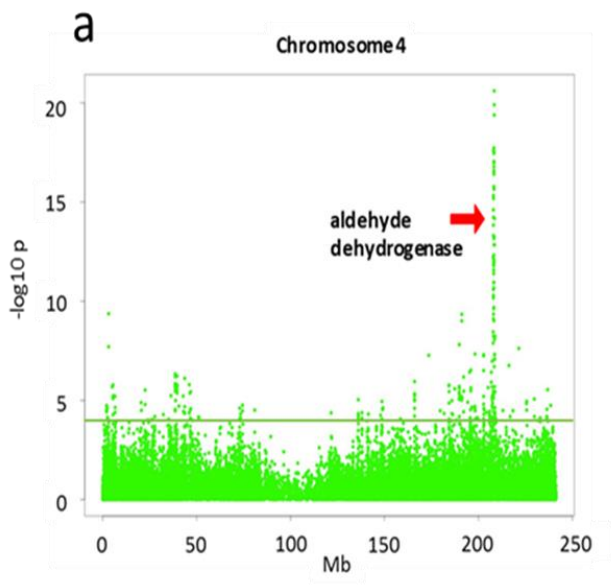
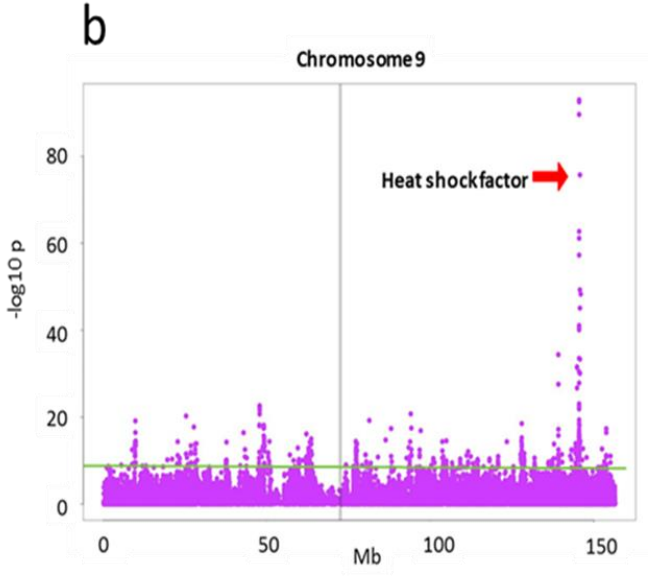
Environmental GWAS (maize)

Environmental GWAS using GBS 500k markers

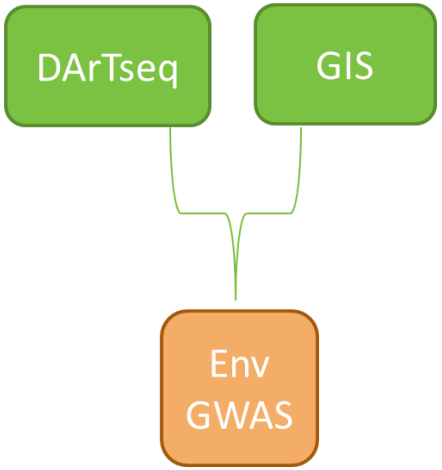
Soil pH



6-month precipitation



What's next?



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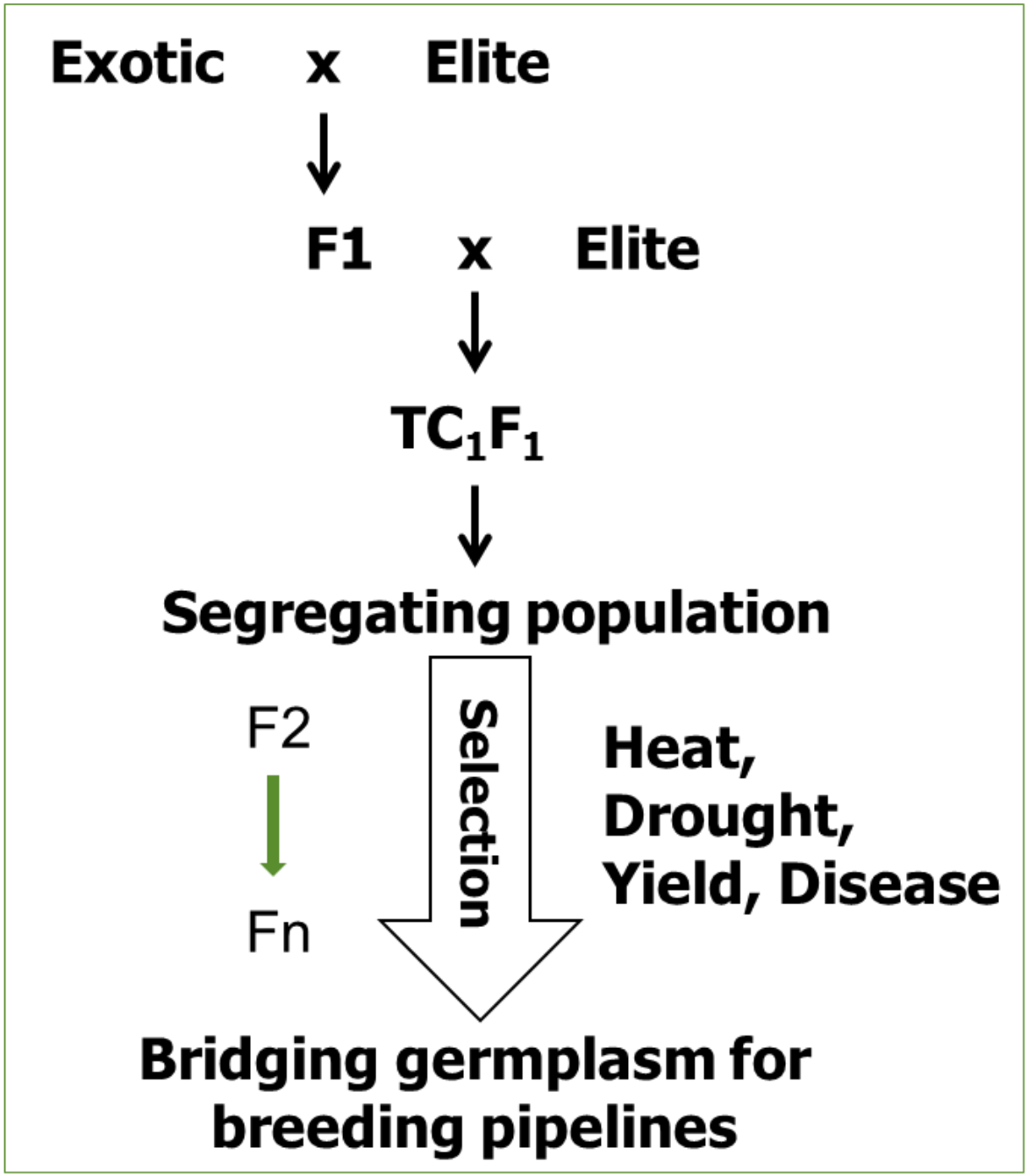
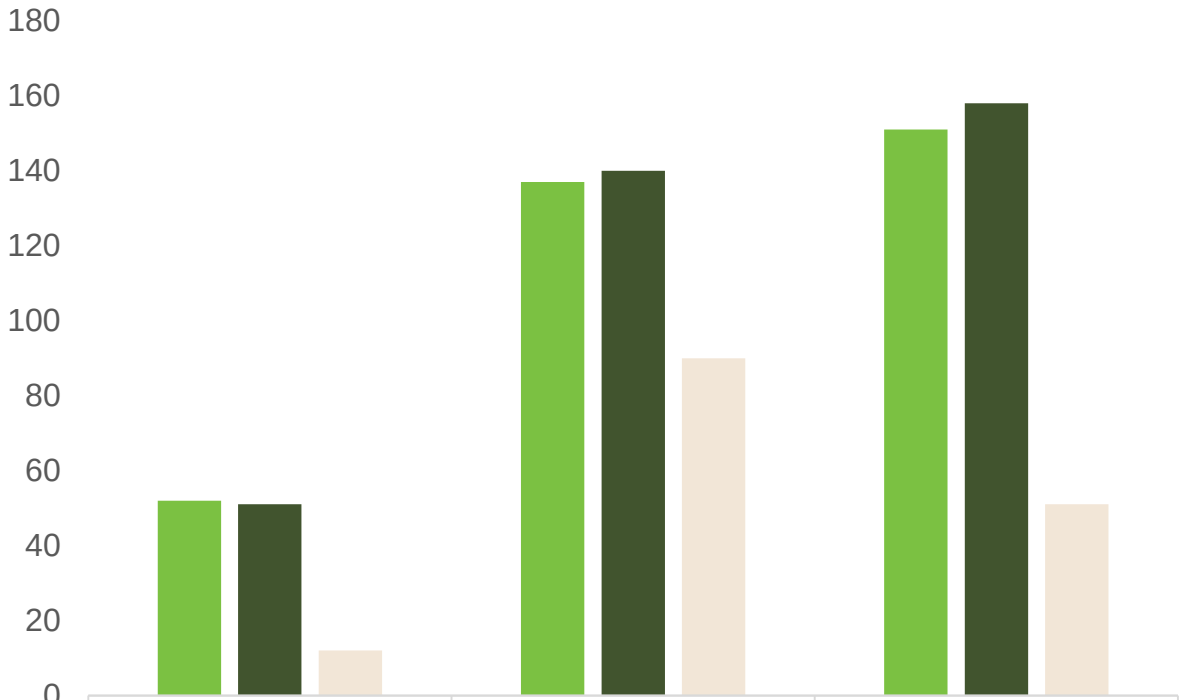
Pre-breeding: broadening the genetic base of elite wheat



Total number of haplotypes / genome
(134 wheat pre-breeding lines)



	Elite	Exotic	Prebreed
A-Genome	52	137	151
B-Genome	51	140	158
D-Genome	12	90	51

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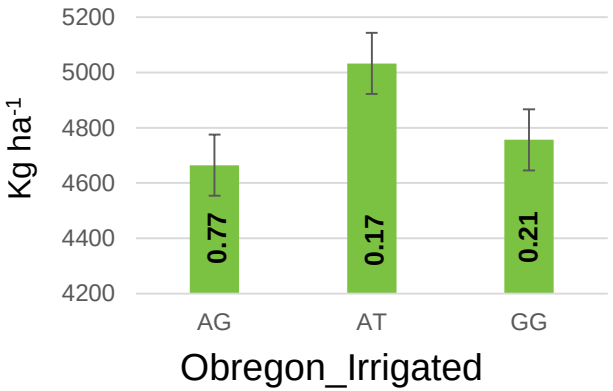
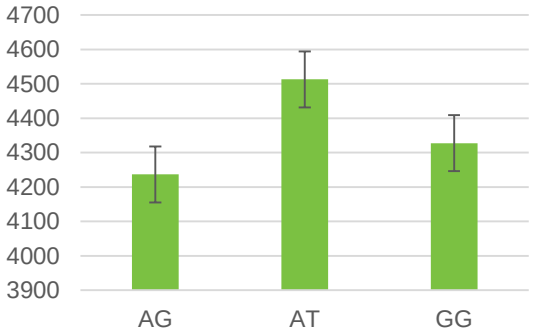
Exotic-contributed haplotypes associated with grain yield (134 wheat pre-breeding lines)

Haplotype 1.28 (1A)

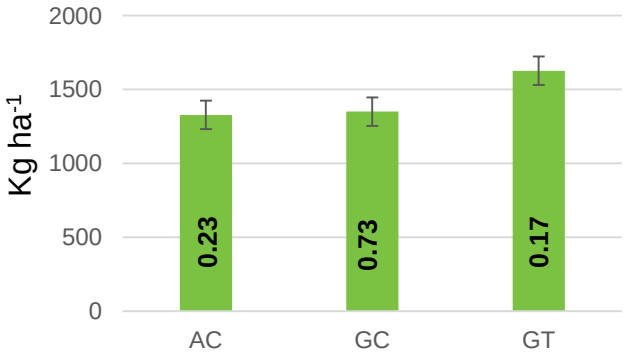


Obregon_Irrigated

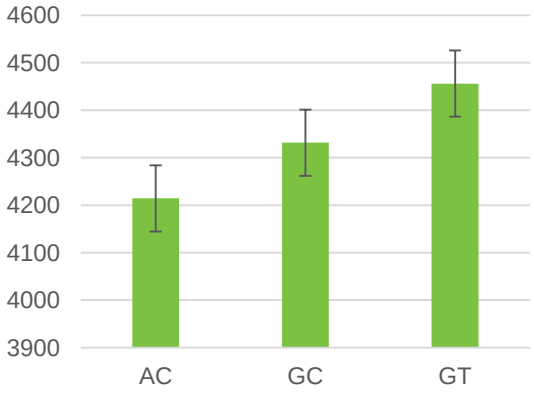


IIWBR, Karnal _Drought stress

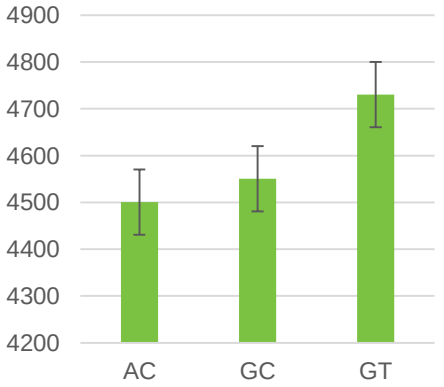
Haplotype 18.1 (6D)



Obregon_Heat stress



IIWBR, Karnal_Drought stress



IIWBR Karnal_Irrigated

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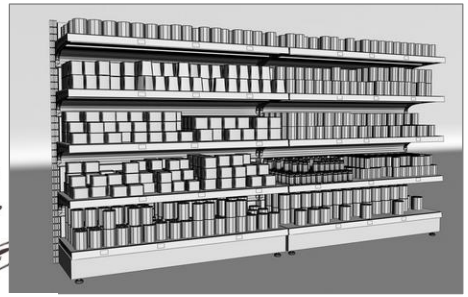
Vision: Efficient and Equitable Use of Genetic Diversity

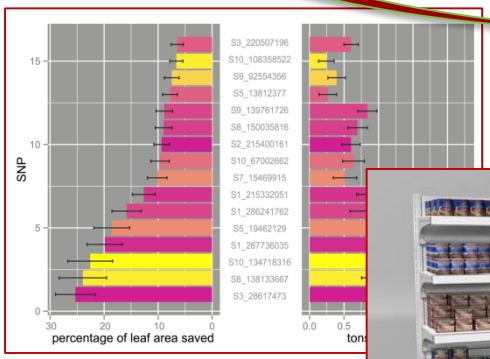
?



Before SeeD

With SeeD

Maize Molecular Atlas



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Thanks to a strong network of partners!

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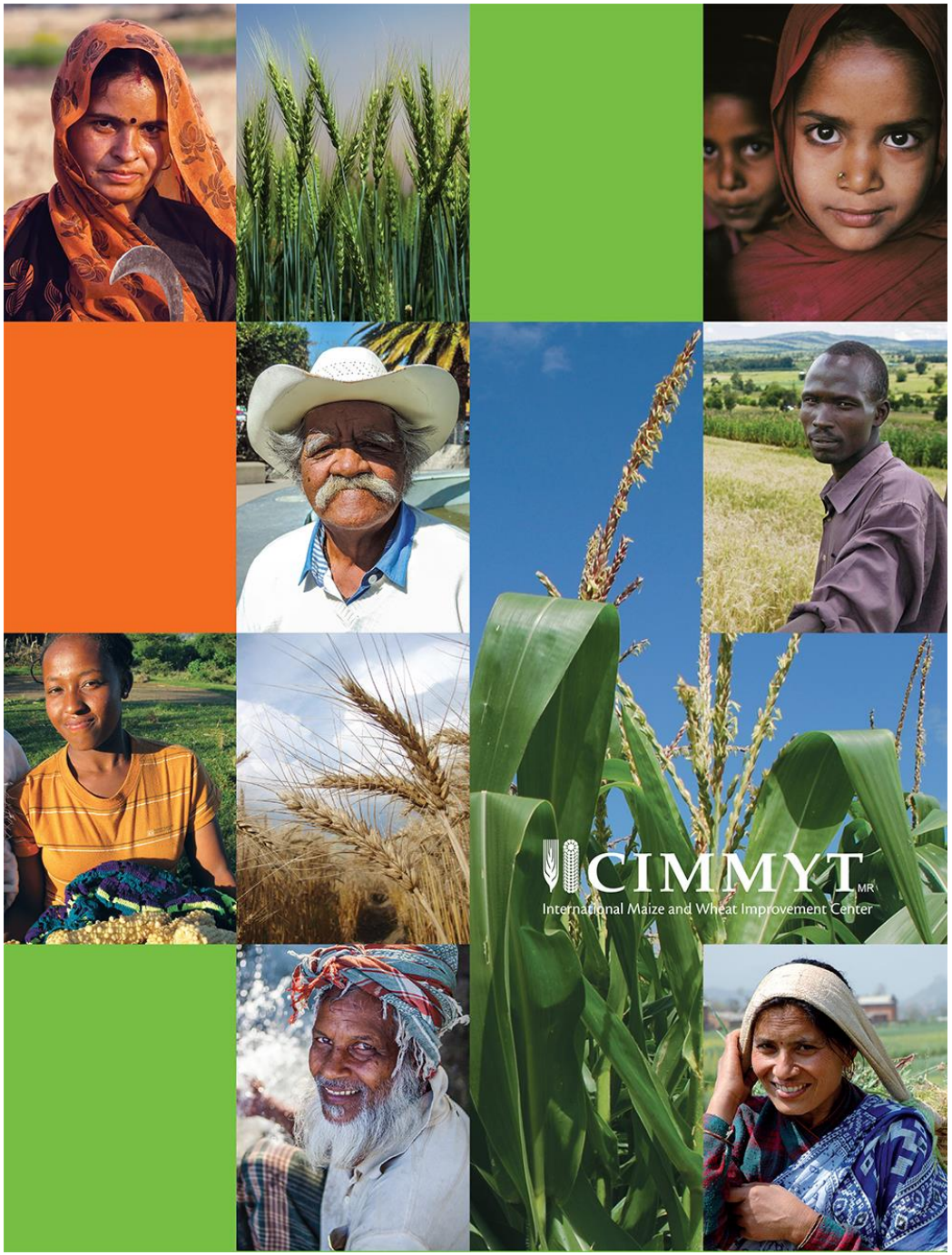

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