Sorghum back-cross nested association mapping populations and multiparental multi-environment statistical methodology to support breeding in West-Africa

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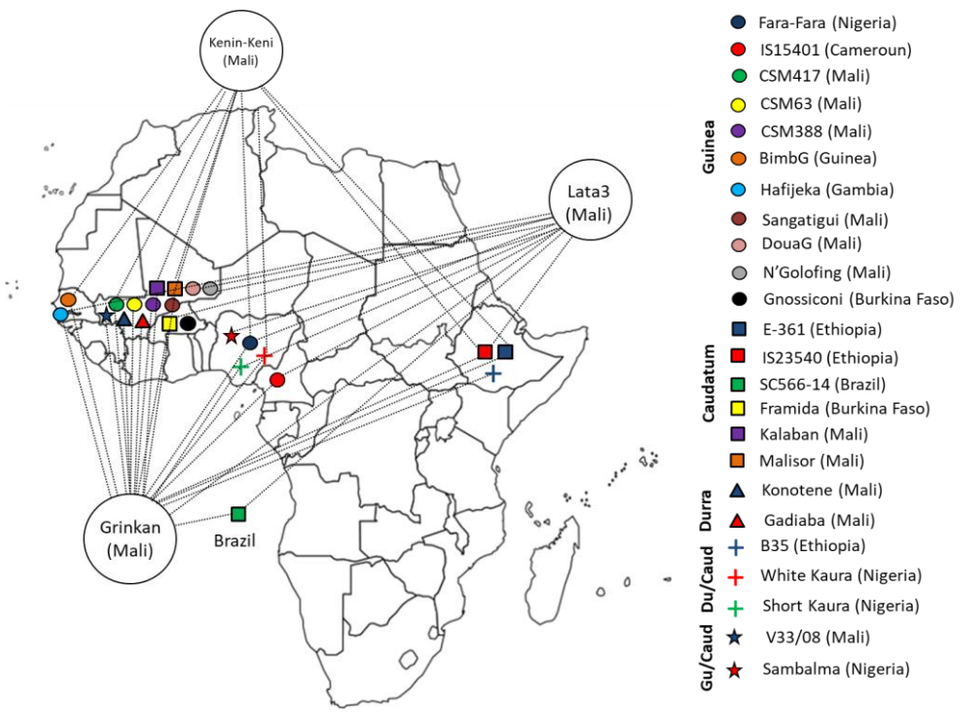
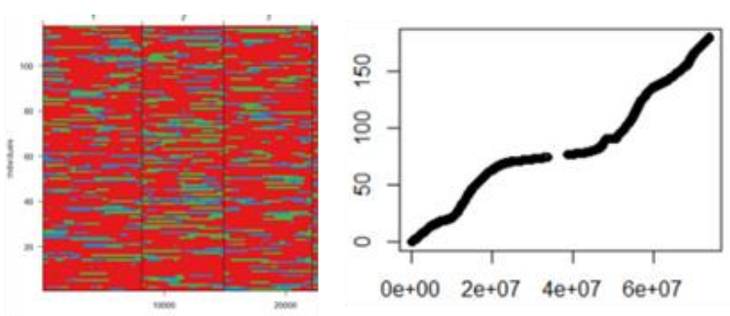
BCNAM populations: 41 crosses between central parent Grinkan, Kenin-Keni, and Lata3 (N=3901) and 24 donors parents with a wide diversity of traits.



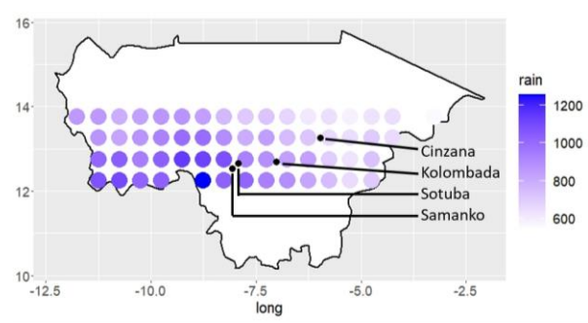
Parents	Race	Origin	Kp3	PH	Maturity	Specific advantage
Fara-Fara	Guinea	Nigeria	+	+	+	Geographic and intra-racial diversity
E36-1	Caudatum	Ethiopia	-	-	av	Drought tolerance
IS15401	Guinea	Cameroon	+	+	+	Striga, low-P, midge res., grain quality
IS23540	Caudatum	Ethiopia	-	-	av	Sweet stem
B35	Durra/Caud.	Ethiopia	-	-	-	Drought tolerance
Konotene	Durra	Mali	-	+	+	Grain weight
SC566-14	Caudatum	Brazil	-	-	-	Aluminium tolerance
Framida	Caudatum	Burkina F.	-	-	+	Striga tolerance
CSM417	Guinea	Mali	+	+	+	Grain quality and adaptation
CSM63	Guinea	Mali	-	av	-	Precocity
CSM388	Guinea	Mali	+	+	+	Grain quality and adaptation
Gadiaba	Durra	Mali	+	+	+	Grain weight
W. Kaura	Durra/Caud.	Nigeria	+	-	+	Racial diversity
V33/08	Caud./Guinea	Mali	av	av	+	Productivity and Grain quality
Kalaban	Caudatum	Mali	-	-	av	
Malisor	Caudatum	Mali	+	-	-	Head bug resistance
BimbG	Guinea	Guinea	+	+	+	Grain quality, photoperiod sensitivity
Hafijeka	Guinea	Gambia	+	+	+	Grain quality
S. Kaura	Durra/Caud.	Nigeria	+	+	+	Productivity, Stover quality
Sangatigui	Guinea	Mali	av	av	av	Intra-racial diversity and vitreous grain
Grinkan	Caud./Guinea	Mali	av	av	av	Racial diversity
DouaG	Guinea	Mali	+	+	+	Low-P adaptation
Gnossiconi	Guinea	Burkina F.	av	av	av	Grain and panicle traits
Ngolofing	Guinea	Mali	+	+	av	Grain and panicle traits
Sambalma	Caud./Guinea	Nigeria	+	+	+	Grain and panicle traits, Al tolerance

Genotyping data



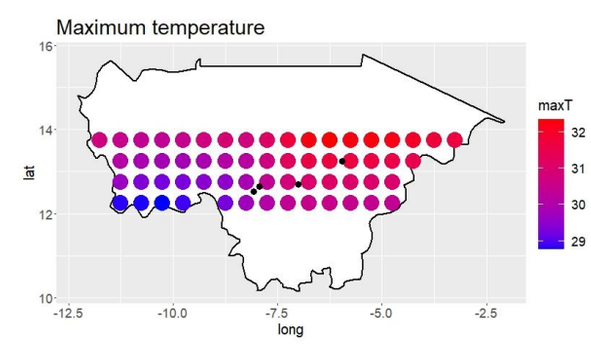
GBS data -> 51'545 SNPs -> 1 map

Phenotyping data



19 env (Loc x sowing D x P trt)

Envirotyping data

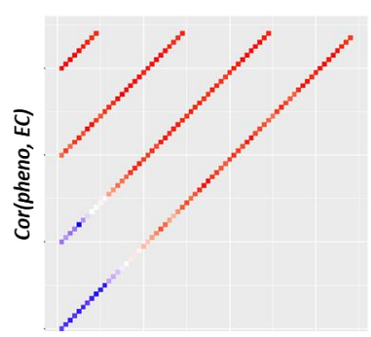


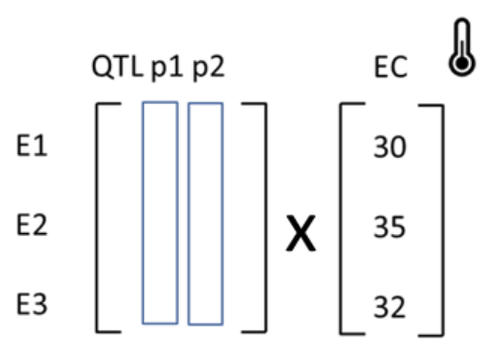
15 environmental covariates

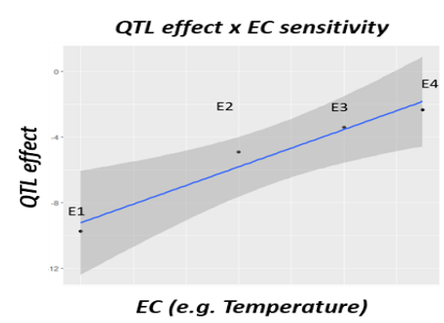
Statistical models

$$\underline{y}_{icj} = \mu + e_j + c_{cj} + x_{ia} * \beta_{aj} + \underline{ge}_{icj} + \underline{\epsilon}_{icj}$$

$$V\begin{bmatrix} y_{i11} \\ y_{i'21} \\ y_{i12} \\ y_{i'22} \\ y_{i13} \\ y_{i'23} \end{bmatrix} = \begin{bmatrix} \sigma_g^2+\sigma_\epsilon^2 & 0 & \sigma_g^2 & 0 & \sigma_g^2 & 0 \\ 0 & \sigma_g^2+\sigma_\epsilon^2 & 0 & \sigma_g^2 & 0 & \sigma_g^2 \\ \sigma_g^2 & 0 & \sigma_g^2+\sigma_\epsilon^2 & 0 & \sigma_g^2 & 0 \\ 0 & \sigma_g^2 & 0 & \sigma_g^2+\sigma_\epsilon^2 & 0 & \sigma_g^2 \\ \sigma_g^2 & 0 & \sigma_g^2 & 0 & \sigma_g^2+\sigma_\epsilon^2 & 0 \\ 0 & \sigma_g^2 & 0 & \sigma_g^2 & 0 & \sigma_g^2+\sigma_\epsilon^2 \end{bmatrix}$$

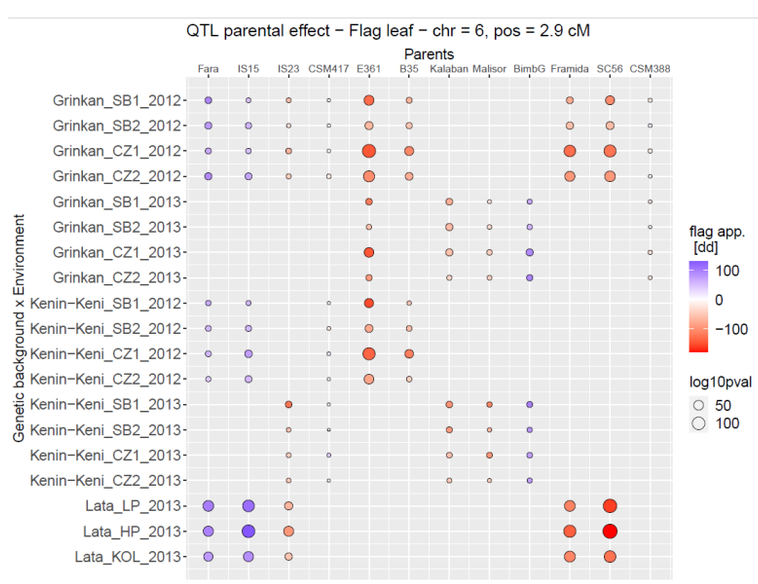


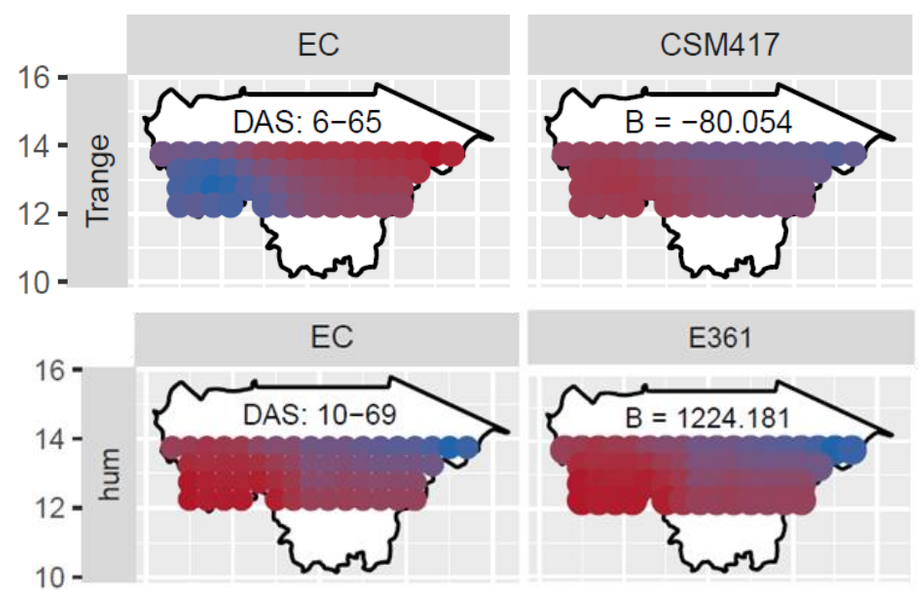




Multi-parent multi-environment QTL detection with extension to estimate the QTLxEC effect.

QTL parental effects projections in the environment





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