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A new source of diversity for sorghum improvement?

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Background

Sorghum is considered a rainfed crop but it is also grown in the dry season: direct sowing in northern Senegal and transplanted after approximately 45 days of growth in the nursery in the Lake Chad Basin. The genetic diversity of these varieties of sorghum is not well known.

The objective of this study is therefore to evaluate this diversity of rainy season sorghum and dry season sorghum collected in Senegal and in the Lake Chad Basin; and to understand its organization.

Experiment

- ✓ The plant material studied includes 159 accessions covering 4 eco-seasonal types of sorghum defined on the basis of seasonality (rainy season, dry season) and eco-geographical zone (Senegal and Lake Chad Basin).
- ✓ The whole set of accessions was charcterized by Genotype by Sequencing using the ApeKI and MseI restriction enzyme.
- ✓ Filters were applied on the frequency of the minor allele (threshold was set to 0.018 to excluded alleles present in less than three individuals), the number of alleles, deletion insertion (indels) and the percentage of data present (max-missing=0.3 and 0.5).
- ✓ The genetic diversity of each population was estimated by evaluating its number of total alleles, its number of private alleles and its allelic richness.
- ✓ Principal Component Analysis was carried out to study the organization of the genetic diversity.

Result

❑ Sorghum genetic divergence (PCA)

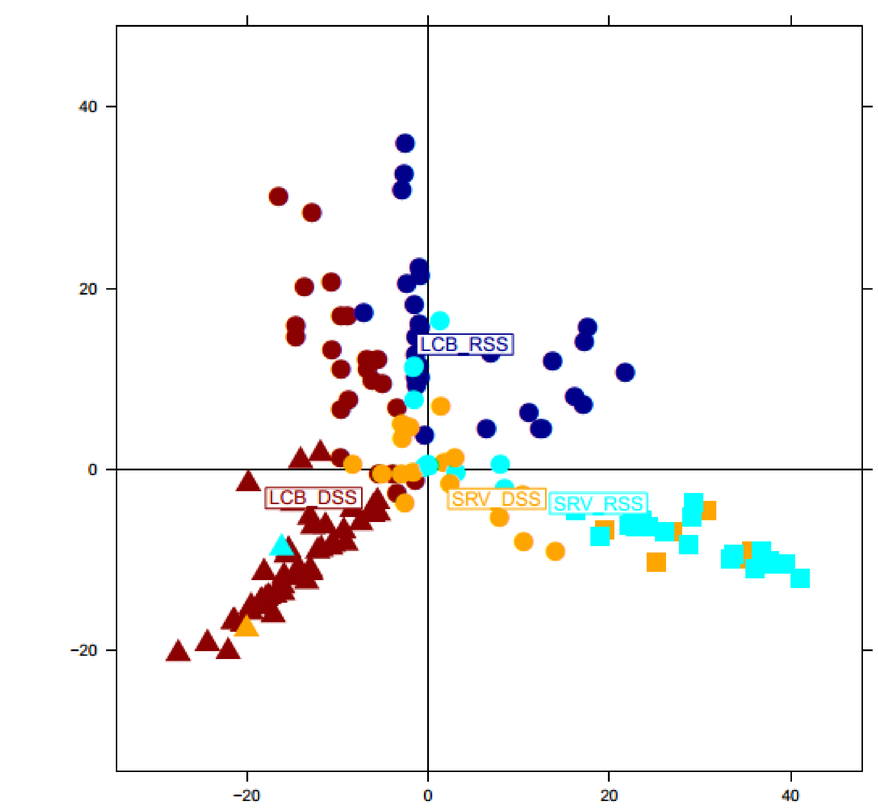


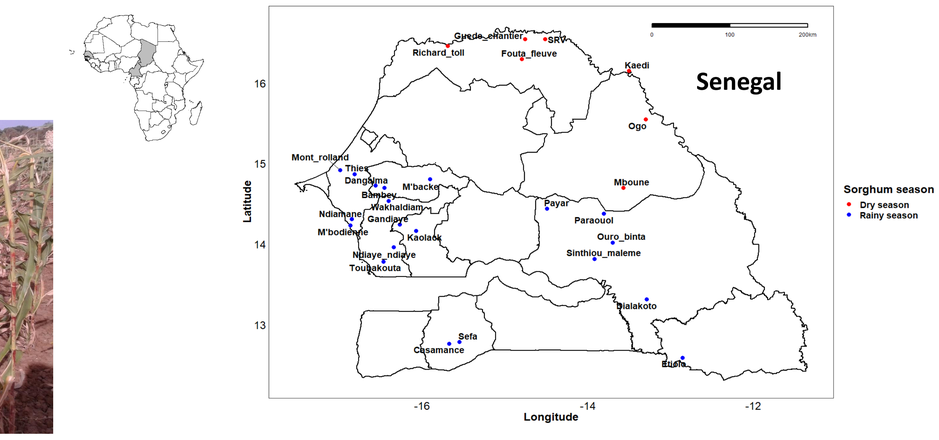
Fig. 3 Principal Component Analysis results based on GBS. 159 accessions from the four eco-seasonal types with 120 969 SNPs are plotted. Each dot represents an accession, colored according to its eco-seasonal types. Abbreviations: LCB DSS: Dry Season Sorghum from the Lake Chad Basin; LCB RSS: rainy season sorghum from the Lake Chad Basin; SRV DSS: dry season sorghum from the Senegal River Valley; SRV RSS: rainy season sorghum from the Senegal River Valley.

❑ Genomic diversity of sorghum eco-seasonal types

	N	A_T	A_R	Ap
All	159	241 938	-	-
LCB DSS	73	191 960	**1.1051**	12 301
LCB RSS	30	181 864	1.1240	7 599
SRV DSS	22	185 341	**1.1289**	5 501
SRV RSS	34	196 079	1.1360	13 060

Genomic diversity of sorghum panel (159 accessions) with respect to eco-seasonal types . N: sample size, A_T: total number of alleles, A_R: allelic richness and Ap: Number of private alleles.

Fig. 1 Dry season sorghum



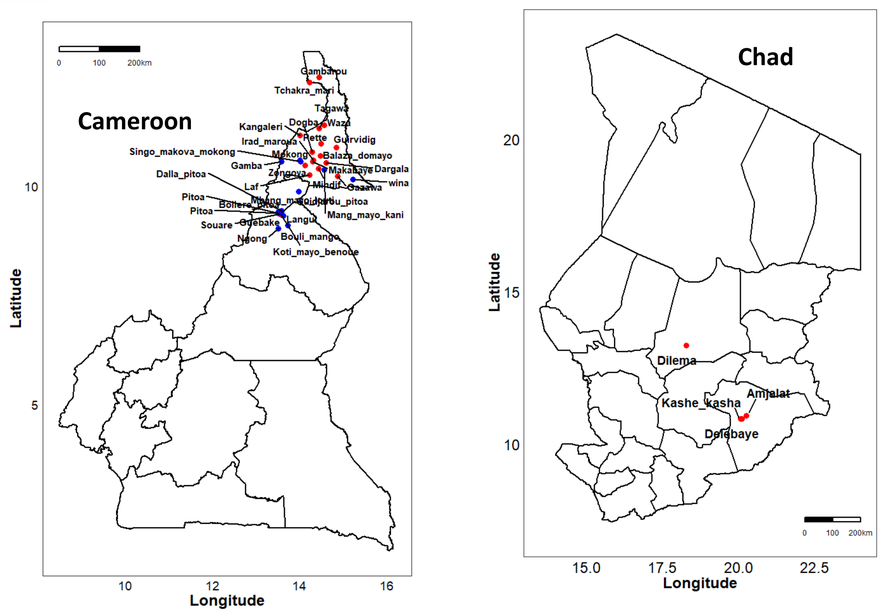


Fig. 2 Geographic distribution of accessions. The color of the points indicates the seasonality of sorghum sampling in that location

Synthesis

- ➢ This organization of the diversity reflects the influence of seasonality and geographical origin of sorghum accessions (Deu et al., 2008)
- ➢ Two third of dry season sorghum accessions from Lake Chad basin formed a separate group onto the PCA plan, suggesting a high differentiation from the three other eco-seasonal types.
- ➢ Dry season sorghum accessions in the two regions (Lake Chad Basin and Senegal River Valley) have low allele richness compared to rainfed sorghum.
- ➢ Can dry season sorghum be used to improve rainy season sorghum for drought resistance, given its adaptive traits for dry-season cultivation?

Future work

- ➢ Because PCA is not based on a genetic model, to assess genomic structure based on genetic assumptions and models, Bayesian analysis with ADMIXTURE software will be performed.
- ➢ Detection tests will be developed with these data to identify loci that have been selected during the seasonal diversification process of sorghum

Reference

Deu, M., Sagnard, F., Chantereau, J., Calatayud, C., Hérault, D., Mariac, C., Pham, J.-L., Vigouroux, Y., Kapran, I., Traore, P.S., et al. (2008). Niger-wide assessment of in situ sorghum genetic diversity with microsatellite markers. Theoretical and Applied Genetics 116: 903–913.