Identification of sources of resistance to drought, rice yellow mottle virus (RYMV) and African bacterial leaf blight (*Xanthomonas oryzae pv. Oryzae*) in African rice (*O. glaberrima)* and interspecific lines

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Introduction

The Africa Rice Center (WARDA) has created the first high yielding varieties between the two cultivated rice species: *Oryza glaberrima,* the African rice and *Oryza sativa,* the Asian rice. These interspecifics, bridging the genetic gap between the two species are called NERICA (NEw RICe for Africa). The NERICAs combine the superior traits from both parents but the development of new NERICAs more adapted to the major rice biotic and abiotic constraints is still a top priority for Sub-Saharan Africa (SSA).

This project aimed to develop new rice varieties for SSA by combining the power of genomic technology with a conventional phenotypic approach. We focused first on the characterization of *O. glaberrima* accessions and new interspecific lines for drought related traits, especially recovery ability and its association with yield, as well as traits for two major diseases (Rice Yellow Mottle Virus and Bacterial Leaf Blight) prevalent in rainfed environments. The use of genomic tools will then help to identify useful natural variation and search for new favorable alleles in glaberrima accessions and new interspecific lines for the future development of new NERICA lines.

Screening for drought tolerance

❖ Two field trials were conducted under upland conditions in Cotonou, Benin and Sikasso, Mali to characterize *O. glaberrima* accessions and new interspecific lines for their drought tolerance. 324 rice accessions comprising 212 *O. glaberrima* which include some RAMs (Riz Africain du Mali, collected in Northern Mali), 11 *O. sativa* and 101 interspecifics issued from crosses between most promising RAMs and *O. sativa* were subjected to 21 days of drought stress starting at 35 days after sowing (DAS). Control treatment was continuously irrigated throughout the trials. Agronomic traits, drought related characters and yield components were measured.

❖ Analysis of the data showed that:

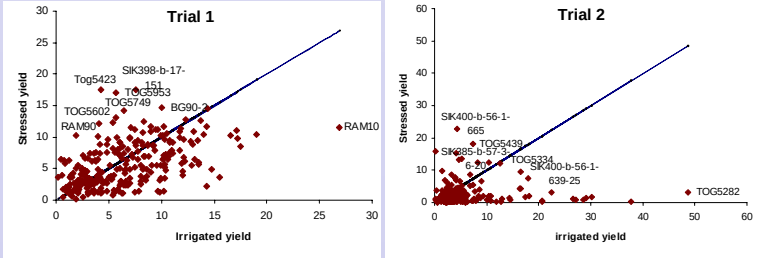
(1) The most discriminant parameters between the two water treatments (drought and irrigation) during both trials are SPAD, tiller number, plant height and leaf number.

TRIAL 1	Irrigated		Stressed			
Traits	mean	SD	mean	SD	Wilks' Lambda	Sig.
SPAD59	36.61	3.44	40.25	2.81	0.707	0.000
Height67	60.54	13.60	48.56	9.90	0.496	0.000
Leaf Number51	3.45	0.46	3.95	0.58	0.436	0.000
Yield	5.77	6.96	2.61	3.41	0.247	0.000

TRIAL 2	Irrigated		Stressed			
Traits	mean	SD	mean	SD	Wilks' Lambda	Sig.
Leaf Temp30	27.50	0.67	28.74	0.91	0.62	0.000
SPAD45	34.66	3.47	38.57	3.07	0.41	0.000
Tiller Number88	8.51	3.63	9.81	4.57	0.38	0.000
Leaf Number57	4.51	0.44	4.18	0.37	0.36	0.000
Leaf length77	39.32	10.82	41.73	8.51	0.35	0.006
Height44	51.41	13.49	47.23	12.47	0.32	0.000
Leaf width30	0.60	0.18	0.59	0.17	0.30	0.043

(2) Drought treatment had significant effects in the two trials. Average yield loss was 34.1%, ranging from 9.8% to 72.1%.

(3) The comparison of grain yield under drought and control treatment showed that some of the accessions (named in the graphs below) are able to maintain a high yield under drought conditions



Grain yield under drought and irrigated conditions

(4) Recovery ability based on the scoring after rewatering showed no great difference between species in these conditions of screening.

	10days before end		End of stress		Recovery 3 days		Recovery 7 days		Recovery 10 days	
Species	Rolling	Burning	Rolling	Burning	Burning	Recovery	Burning	Recovery	Burning	Recovery
Glaberrima	7	2	9	3	3	1	2	1	3	1
Interspecifc	6	1	9	3	3	1	3	1	3	1
Sativa	7	1	9	3	3	1	2	1	3	1

Based on these results, five *O. glaberrima* and two interspecific lines could be selected as potentially drought tolerant.

Screening for RYMV resistance

RYMV symptoms at vegetative stage

255 representative *O. glaberrima* accessions screened with B 27 isolate (**S1**, WARDA)

104 Resistant accessions (no symptoms + negative ELISA)

Symptoms on leaf

Screening with BF1 isolate (**S2**) (More agressive than B27)
- Symptoms scored from 1 to 9 (AUSPC)
- virus content determined by ELISA

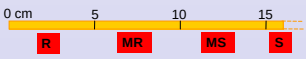
21 Resistant accessions confirmed
- 7 accessions with *Rymv*1-3 resistant allele
- 1 accessions with *Rymv*1-4 resistant allele
- **13 accessions with a new resistant gene ≠ from *Rymv1***

Screening for BLB resistance

❖A set of 47 *Oryza glaberrima* accessions were screened under controlled conditions (28ºC and 80% of relative humidity) in a greenhouse with four *Xanthomonas oryzae pv. Oryzae* (*Xoo*) strains: 3 African strains and 1 Asian, as control. BAI3 (race 1) and BAI4 (race 2) are from Burkina Faso, MAI1 (race 3) from Mali and PXO86 (race2) is from Philippines. Inoculation of the plants was done following the leaf clipping method five weeks after germination. Disease scoring was assessed by the measurement of the length of the lesion 21 days after inoculation.

Plant inoculation

Evaluation of symptoms



❖ Based on the length of the lesion, **9** accessions were identified as resistant to MAI1 while PXO86 induced **12** resistance reactions. **None** of the accessions tested was resistant to BAI3 and BAI4.

	MAI1	BAI3	BAI4	PXO86
Resistant (R)	**9 accessions** TOG6356; TOG5284 TOG6206; TOG7020 TOG6238; TOG6202 CG 14; TOG6195 and TOG6308	0	0	**12 accessions** TOG5294; TOG6195 TOG7020; CG14; IG02 TOG6231; TOG5810 TOG5284; TOG7173 TOG5675; TOG5882 and TOG5620
Moderately resistant (MR)	25	2	1	24
Moderately susceptible (MS)	4	10	13	6
Susceptible (S)	9	35	33	5

Conclusions & Future Prospect

The results presented here assessed the importance of *O. glaberrima* species as reservoir of useful genes for the tolerance/resistance to biotic and abiotic stresses. Among the accessions screened, 7 were identified as drought tolerant, 21 as resistant to RYMV and 12 as resistant to BLB. A new putative gene of resistance to RYMV is also identified. All these new sources of tolerance/resistance constitute promising parents of breeding programs for the creation of new interspecifics, new NERICAs.

The following of this work will be (1) the continuation of BLB screening in order to find resistance against BAI3 and BAI4;
(2) the molecular characterization of the promising accessions/lines using microsatellite markers in order to identify QTL/genes associated with drought tolerance traits in *O. glaberrima* and interspecifics;
(3) the validation of the existing markers developed for BLB and RYMV on interspecific lines and accessions;
(4) the selection of new NERICA lines well adapted to rainfed environments of SSA which will be available for distribution regionally.