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Rice Bacterial Leaf Blight in West Africa: Preliminary Studies on Disease in Farmers' Fields and Screening Released Varieties for Resistance to the Bacteria

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Abstract: As little information is available in Africa on *Xanthomonas oryzae* pv. *oryzae*, a highly destructive pathogen of rice, and its relationship with released rice varieties, a disease survey and samplings were carried out in Niger, Burkina Faso and Mali which indicated a wide spread of Bacterial Leaf Blight (BLB) in farmers' fields. Sixty pure BLB isolates cultures were obtained. Pathogenicity of 4 Malian isolates against four important rice varieties revealed differences in pathogenicity among isolates and in resistance of the varieties tested. The results obtained in these initial studies revealed the future research directions to increasing rice production in West Africa.

Key words: *Xanthomonas oryzae* pv. *oryzae*, rice, pathogenicity, disease incidence, resistance, West Africa, Bacterial Leaf Blight (BLB)

INTRODUCTION

Pyricularia grisea (Teleomorph: *Magnaporthe grisea*), *Rice Yellow Mottle Virus* (RYMV) and *Xanthomonas oryzae* pv. *oryzae* pathogens have been described as the major causal agents of rice diseases in Africa^[1,2]. Bacterial Leaf Blight (BLB), caused by *Xanthomonas oryzae* pv. *oryzae*, is a very destructive disease in Asia^[3] and was identified for the first time in Africa in the 1980s^[4,5]. In Asia, BLB has become a major disease after the introduction and widespread cultivation of high yielding but susceptible rice cultivars. Consequently, comprehensive studies on pathogen diversity were undertaken, which provided useful information on the population structure and resistance genes used in Asian breeding programs. However, little information is available on the pathogen population structure in Africa and its relationship with released rice varieties. This makes it very important to study the status of this bacterial disease in West African countries.

MATERIALS AND METHODS

In 2003, a comprehensive BLB disease survey and sampling were carried out in West African countries where it had been previously described^[4-6]. The survey was carried out in farmers' fields in different localities in Niger, Burkina Faso and Mali (Fig. 1) through a collaborative study undertaken by WARDA, National Agricultural Research Systems and IRD/University of Perpignan, France. The importance of BLB was assessed in terms of disease incidence.

Rice leaves infected by BLB were collected from various fields. Bacteria were isolated using Nutrient Agar medium^[3].

For biosafety reasons, only isolates collected from Mali were selected for pathological testing. Four isolates, MML-X003, MND-X004, MNG-X001 and MST-X005, originating from Molodo, N'Debougou, Nango and Niono experimental station respectively, were inoculated by the clipping technique^[7] to four varieties: two varieties

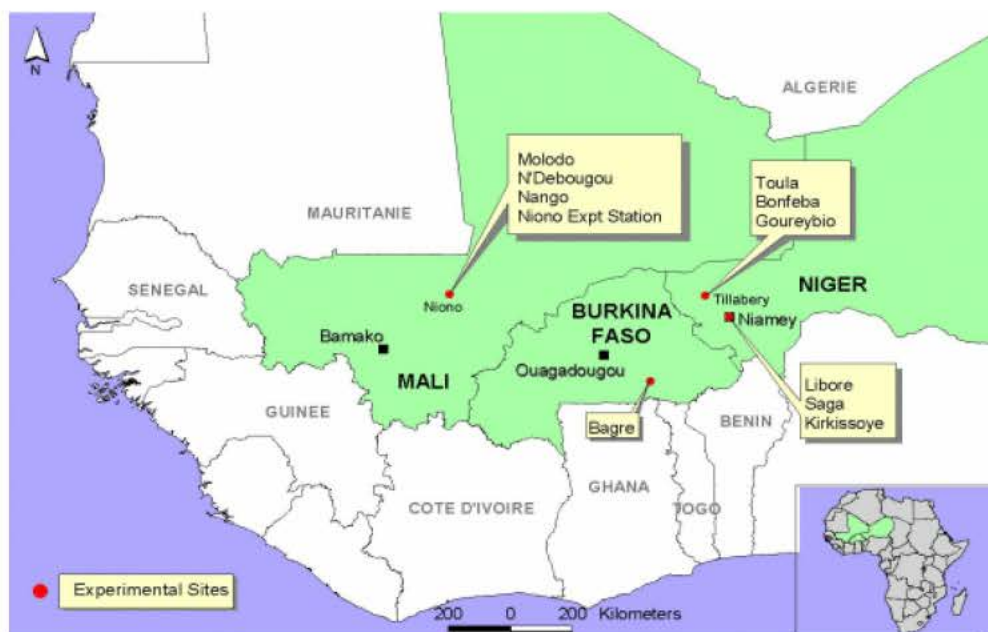


Fig. 1: Collection sites for BLB samples

popular in West Africa (BG 90-2 and Bouaké 189) and two interspecific lines (NERICA 1 and NERICA 4) in a greenhouse to evaluate their pathogenicity.

RESULTS AND DISCUSSION

Both RYMV and BLB frequently occurred in the same plant. Ninety-eight BLB leaf samples were collected from different localities in Niger, Burkina Faso and Mali. Disease incidence ranged from 70 - 85%, indicating a wide spread of BLB in farmers' fields. Sixty pure isolates of BLB were cultured from the 98 BLB samples collected. Out of these 60 isolates, 34 were from Niger, 14 from Burkina Faso and 12 from Mali. All the 60 pure BLB isolates are currently preserved at -20°C in 50% glycerol.

The pathogenicity of the selected four BLB isolates was evaluated by their different degree of virulence on the rice varieties^[8]. MNG-X001 isolate was completely non-pathogenic while MND-X004 and MST-X005 showed some mild pathogenicity and MML-X003 was highly virulent (Table 1). Moreover, NERICA 1 displayed a high level of resistance to BLB across all isolates.

The study reveal that BLB is an important rice disease in irrigated rice ecosystems in West Africa, mainly in Sahelian and soudano-sahelian countries. The characterization of the structure of the virulent population of *Xanthomonas oryzae* pv. *oryzae* towards rice lines with a known gene of resistance will provide useful information

for selection and deployment of cultivars with durable resistance. The comprehensive genetic studies conducted mainly in Asia enabled the description of 21 resistance genes and the identification of varieties carrying them, including near isogenic lines^[3,9-14]. Using the knowledge provided by these studies, it would be easy to analyse the BLB pathogen population in Africa and its relationship with local and improved cultivars, to investigate sources of resistance to the African BLB population, and to investigate the possibility of transferring the resistance genes identified into elite materials through marker-assisted and participatory varietal selections.

Preliminary studies of 26 isolates through DNA fingerprinting using RFLP analyses and rep-PCR indicated that South American strains are closely related to Asian strains while the African strains form two clearly distinct groups^[15]. These studies of limited sample size need to be extended to a larger collection of strains for a better understanding of the BLB population structure in Africa. Besides, genetic analysis of resistance in rice and the pathogenicity of the causal bacterium have not been conducted as extensively in Africa as in Asia. Thus, it will be very important to undertake an intensive survey of BLB in hot spots in West Africa in order to obtain information on disease epidemics, geographical distributions of pathogenic races, and their relationship with lineages identified through molecular tools. This approach will provide useful information on integrated

Table 1: Pathogenicity of 4 BLB isolates from Mali on 2 interspecific cultivars and 2 popular varieties

N/S	Name	Varieties tested	Reaction to BLB isolates *			
		Characteristics	1	2	3	4
1	NERICA 1	Interspecific (<i>Oryza sativa</i> x <i>O. glaberrima</i>)	-	-	-	-
2	NERICA 4	Interspecific (<i>Oryza sativa</i> x <i>O. glaberrima</i>)	+	+	-	-
3	BG 90-2	popular variety in Mali	+	+	-	+
4	Bouake 189	popular variety in Cote d'Ivoire	+	-	-	+

- = No BLB symptom; + = Presence of BLB symptom, * 1 = MML-X003; 2 = MND-X004; 3 = MNG-X001; 4 = MST-X005

management of BLB through sustainable deployment of resistant varieties and development of suitable breeding strategies based on identification of donors for resistance to the African BLB population among WARDA *Oryza glaberrima*, interspecific NERICAs and intraspecific collections.

The results obtained in these initial studies have been vital in revealing the current status, the required future research directions and the threat posed by BLB disease to increasing rice production in West Africa.

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