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Performance Evaluation of 49 Rice Lines with Known Rice Blast Resistance Genes in Irrigated and Rain-Fed Areas

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Abstract

Rice blast caused by *Magnaporthe oryzae* is one of the major rice diseases in Burkina Faso with losses up to 77% under favorable disease conditions. For the management of this disease, the use of resistant cultivars remains the most economical, and most protective method for the environment. This study focuses on the evaluation of the resistance of 49 lines of rice resulting from crosses between popular cultivars of different countries of Sub-Sahara against blast. The experimental design used is a 7 x 7 Alpha lattice with 3 repetitions. The study was conducted in two rainfed sites (Farako-Bâ and Karfiguela) and two irrigated sites (Bagré and Tengrela) in Burkina Faso. The results showed that the rice genotypes developed the disease differently depending on their developmental stages and rice growing systems. In rainfed rice cultivation, 32 genotypes were resistant to leaf blast and 3 (AR-67, IR 130412 and CSR 36) were resistant to leaf and panicle blast. In irrigated conditions, 44 genotypes were resistant to leaf blast and 6 (TZLR-74, IR 133136-B, NERICA 4, NERICA 10, NERICA 11 and CSR 36) were resistant to leaf and panicle blast. The genotype (CSR 36) was disease resistant in both ecological conditions. The results of this study will make it possible to choose the best rice cultivars, tolerant or resistant to blast, and to identify the effective resistance genes in their genomes.

Keywords: Resistance; Genotype; Oryza sativa; Blast; Magnaporthe oryzae.

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1. Introduction

Rice (*Oryza sativa*) is the second most produced food grain in the world [1]. In 2019, world rice production reached 754 million tonnes [2]. In Burkina Faso, rice is the fourth most important cereal crop after sorghum, millet and maize, both in terms of area and production [3]. Its production is estimated at 376 thousand tonnes [4]. It remains one of the main consumer products and its demand is currently very high, increasing at a rate of 12% per year [5]. Among the rice varieties grown in Burkina Faso, four (4) stand out for their preference among producers and consumers. These are the varieties FKR60N, FKR62N of the NERICA type introduced by INERA in 2008, FKR84 or Orylux6 (officially introduced by INERA in 2019) and the variety FKR64 or TS2 introduced in 2006 by the Chinese cooperation [6]. The variety FKR62N has not only good resistance to blast, but also good productivity (5-7 t/ha) [7]. Despite the great efforts made by the researchers and the government to increase national production, rice growing in Burkina Faso continues to be confronted with numerous biotic constraints caused by pathogenic microorganisms (bacterial, viral and fungal) that significantly reduce yields. In fact, the main fungal disease affecting rice remains blast. This disease is caused by an ascomycete fungus called Magnaporthe oryzae, which attacks the aerial organs (leaves, stems and panicles). It affects both rainfed and irrigated rice grown with nitrogen inputs. Depending on the agro-system, blast can cause losses of up to 100% [8]. In Burina Faso, losses are estimated to be between 1 and 45%, or about 2 tonnes per hectare [9]. Several control methods are used given the constraints caused by blast. However, the use of resistant or tolerant varieties remains the most effective and the least expensive method given the socio-economic situation of farmers [10]. Therefore, there is a need for continuous renewal of rice varieties with durable resistance and acceptable agronomic performance. This study aims to contribute to the improvement of rice productivity in Burkina Faso through the introduction of new blast resistant genotypes.

2. Materials and Methods

2.1. Study Sites

The study was conducted in four sites : Farako-Bâ, Karfiguela and Bagré, Tengrela, in rainfed and irrigated rice production respectively. These sites are important areas for the production of rice. Fig 1 shows the study sites.

Fig-1. Map of study sites (www.google.fr, 11/05/2021)

2.2. Plant Material

The plant material used includes 49 rice lines from IRRI under the BBSRC project and from INERA. Resistant genes were introduced into these genotypes. The list of these genotypes is given in Table I below.

Table-1. List of genotypes used

N°	GENO-CODE	GENO-NAME	PEDIGREE	N°	GENO-CODE	GENO-NAME	PEDIGREE
1	Geno 3	AR-67	WITA 3	26	Geno 46	IR 130412	BASMATI 370 XWHD-IS-75-1-127
2	Geno 4	75-1-127	75-1-127	27	Geno 47	IR 133131-B	BASMATI 370 XWHD-IS-75-1-127
3	Geno 5	TZLR-74	TXD 306	28	Geno 48	IR 133133-B	NERICA 12 XCO39-A15
4	Geno 9	AR-47	WAB96-1-1	29	Geno 49	IR 133135-B	NERICA 12 XWHD-IS-75-1-127
5	Geno 11	NSFTV30	Chiem Chanh	30	Geno 51	IR 133132-B	NERICA 2 XCO39-A15
6	Geno 12	EN-10	IR 77713	31	Geno 52	IR 133136-B	NERICA 2 XWHD-IS-75-1-127
7	Geno 18	11-29	IRBLTA CP 1	32	Geno 54	Basmati 217	Basmati 217
8	Geno 19	AR-106	Ewinto Yibo	33	Geno 55	Basmati 370	Basmati 370
9	Geno 22	11-11	IRBLZT-T	34	Geno 56	NERICA12	NERICA12
10	Geno 23	11-30	IRBL 11-ZH	35	Geno 58	Komboka	Komboka
11	Geno 24	11-21	IRBL 7-M	36	Geno 59	NERICA 1	NERICA 1
12	Geno 26	NSFTV284	NSFTV284	37	Geno 59 H	NERICA1**	NERICA 1**
13	Geno 27	11-7	IRBLKP-K60	38	Geno 60	NERICA 4	NERICA 4
14	Geno 28	11-31	IRBLZ 5-CA ®	39	Geno 61	NERICA 10	NERICA 10

15	Geno 29	11-28	IRBLTA 2-RE	40	Geno 62	NERICA 11	NERICA 11
16	Geno 33	NSFTV32	Chondongji	41	Geno 63	CSR 36	CSR 36
17	Geno 34	NSFTV83	Kamenoo	42	CO39A15	CO39A15	CO39A15
18	Geno 35	NSFTV291	Toploea70/76	43	CO39A35	CO39A35	CO39A35
19	Geno 36	11-32	IRTP 16211 (LTH)	44	CO39A43	CO39A43	CO39A43
20	Geno 38	4798563	IR126184-1-1-1:C039-A56(C039*4/LUA NHEDEN:IREC16724-1	45	CO39A56	CO39A56	CO39A56
21	Geno 39	4798561	IR126182-1-1-1:C039-A35(C039*4/CIRAD 394:(1)	46	FKR19	FKR19	TOX728-1
22	Geno 41	4808819	IR130411:BASMATI217*2/WHD-IS-75-127	47	FKR62	FKR62	WAS122-IDSA-1-WAS-6-1
23	Geno 42	4808820	BASMATI370*2/WHD-1S-75-1-127	48	FKR64	FKR64	TS2
24	Geno 43	IR 133134-B	BASMATI 217 XCO39-A15	49	FKR84	FKR84	ORYLUX6
25	Geno 45	IR 133130-B	BASMATI 217 XWHD-IS-75-1-127				

2.3. Description of the Experimental Design

The experimental design used for genotype screening is a 7 x 7 alpha lattice with 3 replicates. It is a randomised incomplete block design with 49 entries.

Two infested strips of rice blast susceptible genotypes TS2 and CO39A56 were placed on either side of the elementary plots.

2.4. Soil Preparation, Sowing/Planting and Fertilisation

Plots were prepared by ploughing with animal traction, followed by mudding (in the case of irrigated plains) and planting. At the Farako-Bâ and Karfiguela sites, direct seeding was used for rainfed rice. At Bagré and Tengrela (irrigated rice), the seeds were first sown in a nursery before being transplanted. The infested strips were sown two weeks before sowing/transplanting in a continuous, uniform and linear manner and are not artificially inoculated in the trial. They consisted of the varieties TS2 and CO39A56, which are known to be susceptible to blast. Organic cattle manure was applied at a rate of 5 t/ha during the ploughing operation. The fertilisation rate was 150 kg/ha of urea (46 N). This was applied to the basal plots and infested strips 21 and 42 days after sowing.

2.5. Maintenance, Water Management and Harvesting

Weed control was carried out as needed (when weeds appeared). Daba was used. At 14 days after sowing (DAS), weeding was carried out on one plant per plot.

An anti-chenille insecticide, Emacot 050 WG (emamectin benzoate 50g/kg), was applied at a rate of 200g/ha.

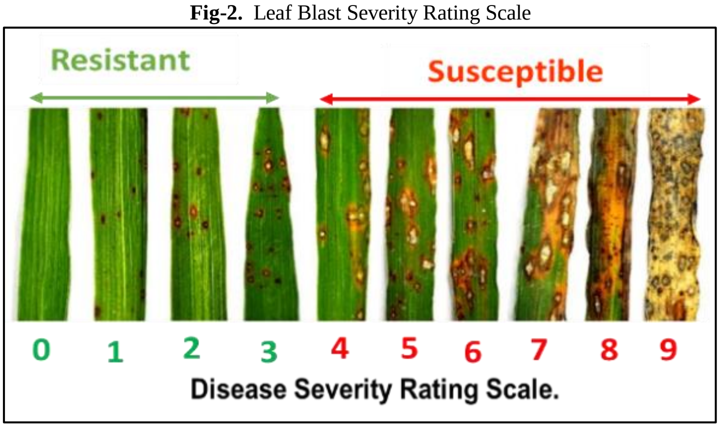
A supplementary irrigation system and bunds were also installed to manage water efficiently on the experimental plots during dry and wet periods to cope with water shortages. This water supply was based on the needs of the crop under irrigated conditions. This was done manually at grain maturity when 80% of the panicles were straw coloured.

2.6. Data Collection

2.6.1. Leaf Blast Assessment

The development of leaf blotch was monitored until maturity. For each plot, scoring was done on the middle plants, excluding the plants at each end of the row. Blast symptoms were scored using the visual scale of 0 to 9 established by IRRI [11] (Fig 2). Depending on the degree of attack on the plant, a score of 0 corresponds to no symptoms and 9 corresponds to plants that are completely attacked and stunted or dead.

Fig-2. Leaf Blast Severity Rating Scale



Source: IRRI (2002)

2.6.2. Assessment of Panicle Blast

Diseased and healthy stems were counted and the percentage of affected stems was calculated in relation to the total number of stems counted. Table 2 show the severity and incidence rating scale of panicle blast.

Table-2. Panicle blast incidence rating scale

Notes	Incidence of panicle blast disease	Resistance level
0	No symptoms	Good
1	Less than 5%	Good
3	5-10%	Goog
5	11-25%	Fair
7	26-50%	Susceptible
9	More than 50%	Susceptible

Source: IRRI [12]

2.6.3. Evaluation of the Evolution of the Blast Epidemic on Genotypes

The behaviour of the genotypes was evaluated in relation to the most aggressive races at the sites by means of the Area Under the Disease Progress Curve (AUDPC). This index represents the cumulative foliar disease incidence during the observation period induced by each genotype. It is used to judge the response of each genotype to those of the susceptible controls. The AUDPC was calculated according to the following formula of Shaner and Finney [13]:

$$\text{AUDPC} = \sum_{i}^{n-1}\left[\left(\frac{y_i + y_{i+1}}{2}\right)(t_{i+1} - t_i)\right]$$

Yi and Yi+1 are measures of the percentage of disease severity observed at times ti and ti+1 respectively;

(ti+1 - ti) is the time interval between two observations. According to Shaner and Finney [13], any cultivar with an AUDPC below 20 is considered resistant.

2.7. Statistical and Data Analysis

The data collected were entered and processed using an Excel spreadsheet. They were then subjected to an analysis of variance using XLSTAT pro software version 7.5.2 (2016).

The means of the scores were calculated and compared with those of the controls. The Student Newman-Keuls (SNK) test was used to compare and rank the means at the 5% threshold.

3. Results

3.1. Severity of Foliar Blast in Rainfed Rice and Irrigated Rice

At the Farako-Bâ site, three genotypes were susceptible (IRBLTA CP 1, Chondongji, CO39A56) ; seven genotypes were moderately susceptible (BASMATI370*2/WHD-1S-75-1-127 - BC1F2, CO39A35, IRBLZT-T, Kamenoo, CO39A43, IRBLZ 5-CA ®, TS2) and thirty-nine genotypes were resistant. At the Karfiguela site, seven genotypes were moderately susceptible (IRBLTA 2-RE, CO39A43, Basmati 217, BASMATI 217 XCO39-A15-BC1F2, TOX728-1, Chiem Chanh, TS2) and forty-two genotypes were resistant (Fig 3).

At both sites, two genotypes were moderately susceptible (CO39A43, TS2); and thirty-four genotypes were resistant (Fig 3). At the Bagré site, all forty-nine genotypes were resistant to leaf blight. At the Tengrela site, four genotypes (NSFTV284, TOX728-1, IRBLTA 2-RE, Chiem Chanh) were moderately susceptible while forty-five genotypes were resistant (Fig 4).

Figure-3. Foliar blast severity in rainfed rice production (Farako-Bâ and Karfiguela)

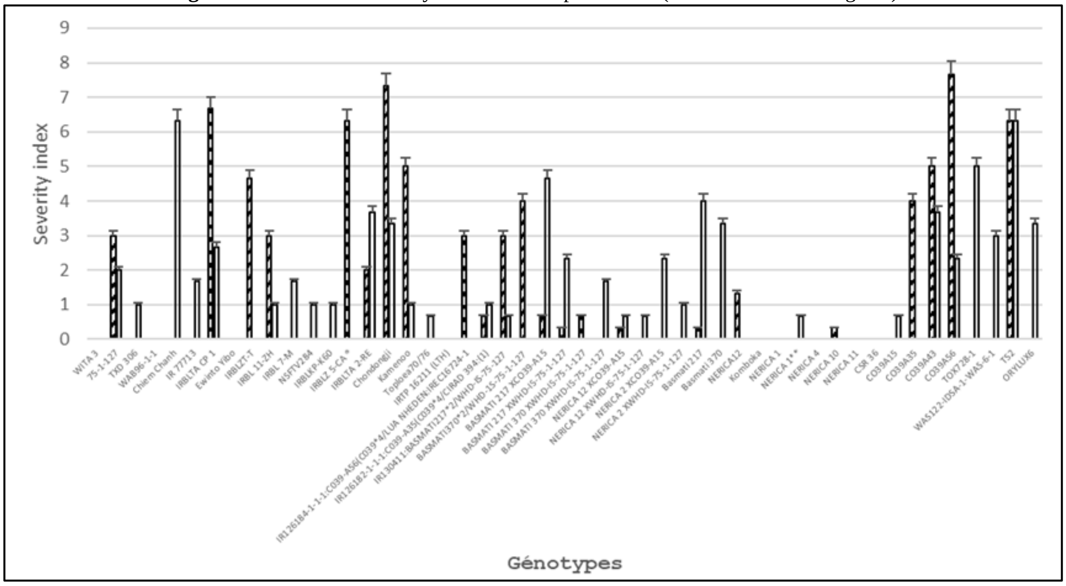
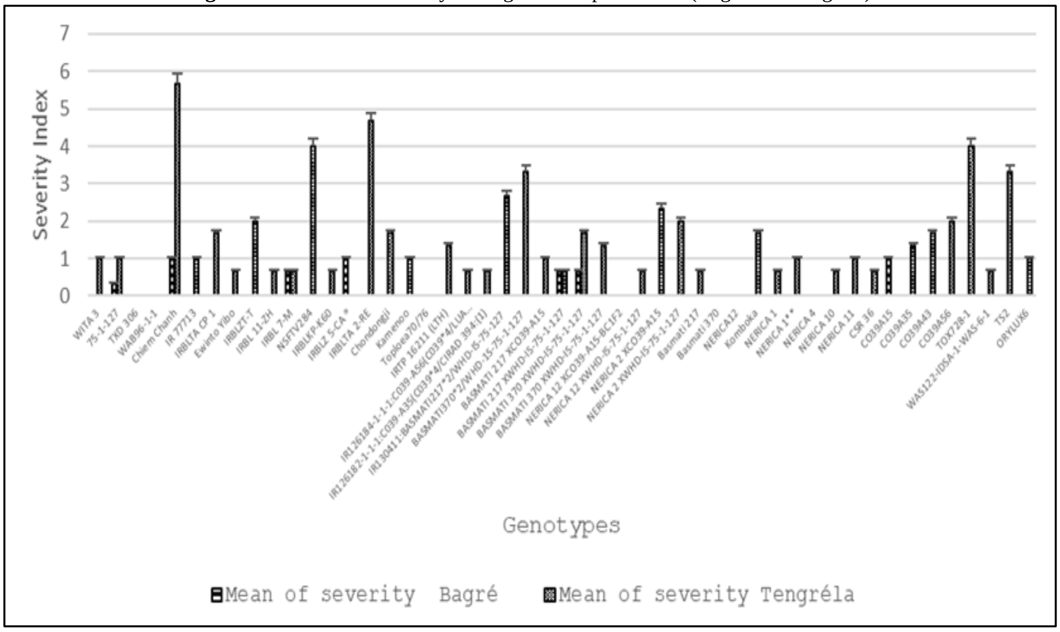


Figure-4. Foliar blast severity in irrigated rice production (Bagre and Tengrela)



3.2. Area Under Disease Development (AUDPC) in Rainfed Rice and Irrigated Rice

The histograms in Fig 5 show the cumulative AUDPC for the different observation dates at the Farako-Bâ and Karfiguela sites. At the Farako-Bâ site, the highest indices were recorded by six genotypes (IRBLTA CP 1, CO39A43, IRBLZ 5-CA ®, TS2, Kamenoo, CO39A56), while forty-three genotypes had the lowest indices. At the Karfiguela site, the highest scores were recorded by six genotypes (BASMATI 217 XCO39-A15-BC1F2, IRBLTA CP 1, Chondongji, TS2, TOX728-1, Chiem Chanh), while the lowest scores were recorded by forty-three genotypes. At both sites, two genotypes (IRBLTA CP 1 and TS2) had the highest scores while thirty-nine genotypes had the lowest scores.

At the Bagré site, forty-nine genotypes had low indices. At the Tengrela site, the highest scores were recorded by two genotypes (IRBLTA 2-RE and Chiem Chanh), while the lowest scores were recorded by forty-seven genotypes **(**Fig 6)

Fig-5. AUDPC of foliar blast in ***in* rainfed rice production *(***Farako-Bâ and Karfiguela)

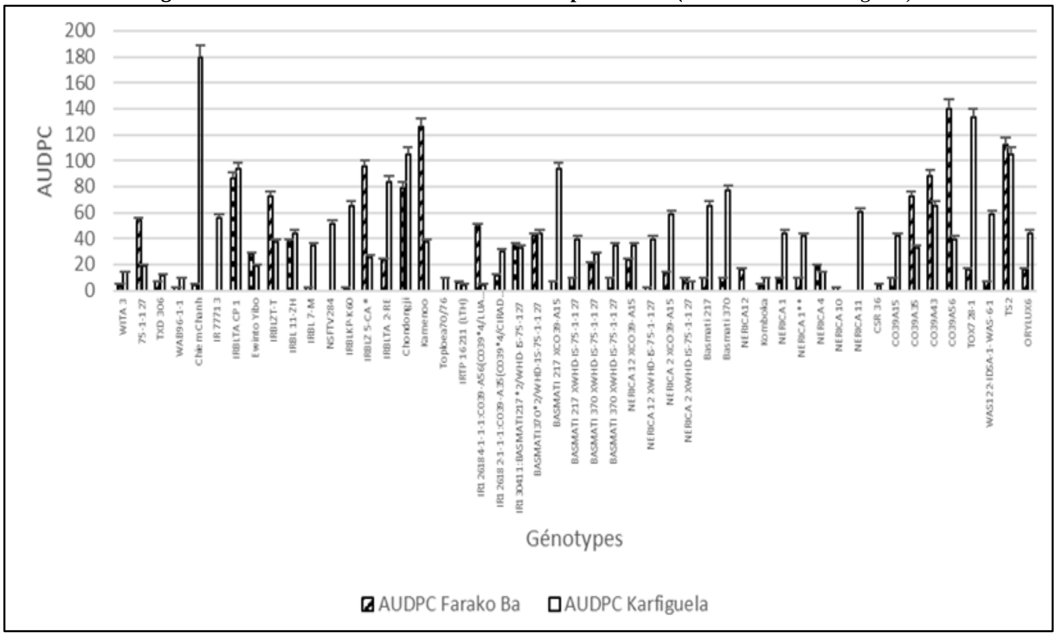
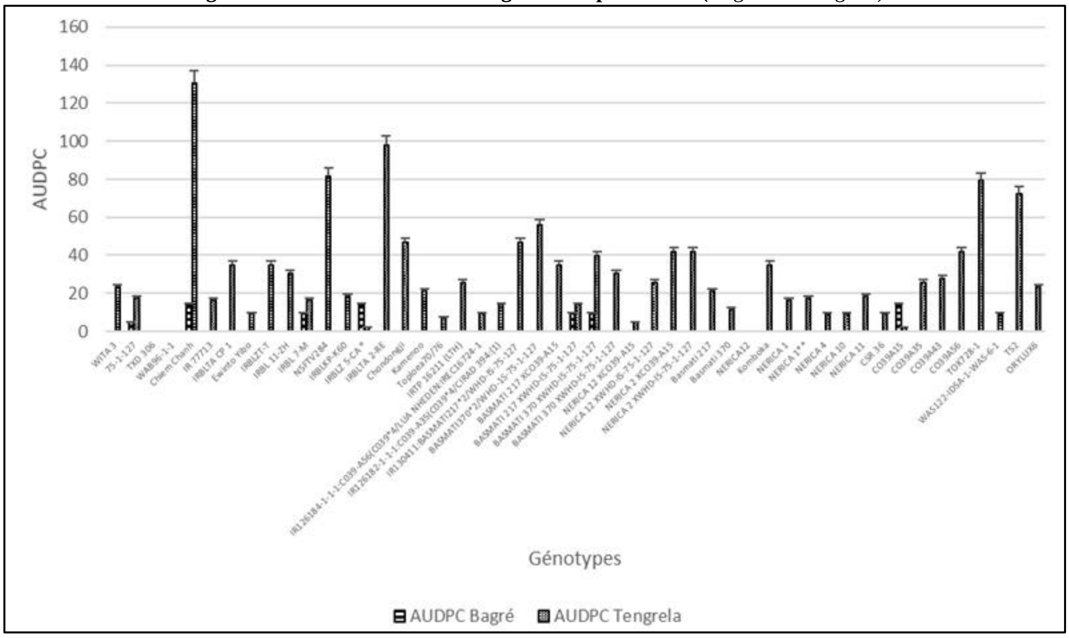


Fig-6. AUDPC of foliar blast in **irrigated rice production *(***Bagré and Tengrela)



3.3. Severity of Panicle Blast in Rainfed Rice and Irrigated Rice

Fig 7 shows histograms of the average severity of rice blast in rainfed rice at Farako-Bâ and Karfiguela. At the Farako-Bâ site, twelve genotypes were susceptible to blast, while twenty-seven genotypes were resistant. At Karfiguela, thirteen genotypes were susceptible to blast and seven genotypes were resistant to blast (CSR 36, WITA 3, CO39A56, BASMATI 370 XWHD-IS-75-1-127-BC1F2, NERICA 11, Toploea70/76, TS2).

At the Bagré site, six genotypes were susceptible to blast (Chondongji, IR130411: BASMATI217*2/WHD-IS-75-127 - BC1F2, IRTP 16211 (LTH), IRBLZT-T, CO39A35, Ewinto Yibo), while forty-three genotypes were resistant. At the Tengrela site, thirty-one (31) genotypes were susceptible to blast and ten genotypes were resistant to blast (NERICA 1**, NERICA 10, WAS122-IDSA-1-WAS-6-1, TXD 306, NERICA 2 XWHD-IS-75-1-127-BC1F2, NERICA 12, NERICA 4, NERICA 11, CSR 36, TS2) (Fig 8).

Fig-7. Severity indices of panicle blast in rainfed rice in Farako-Bâ and Karfiguela

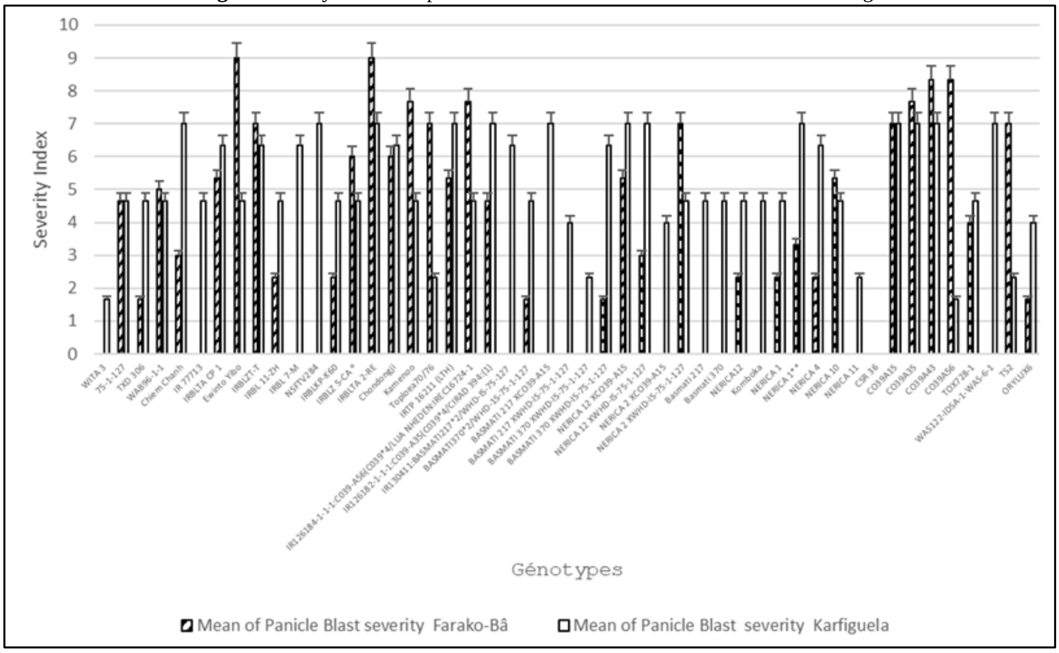
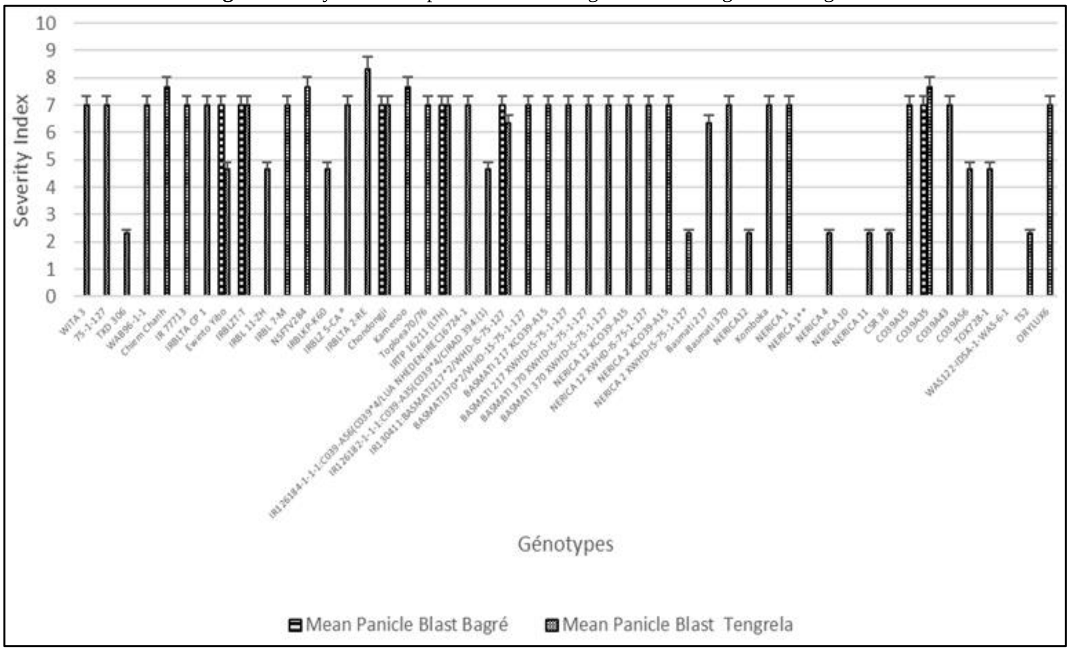


Fig-8. Severity indices of panicle blast in irrigated rice in Bagré and Tengrela



3.4. Level of Resistance of Genotypes to Leaf and Panicle Blast

Table 3 below shows the level of resistance to leaf and panicle blast of the different genotypes tested. The table shows that five genotypes (WITA 3, BASMATI 370 XWHD-IS-75-127-BC1F2, NERICA 11, CSR 36 and TXD 306) and nine genotypes (NERICA 2 XWHD-IS-75-127-BC1F2, NERICA 12, NERICA 1**, NERICA 4, NERICA 10, NERICA 11, CSR 36, WAS122-IDSA-1-WAS-6-1, TS2) were resistant to both leaf and panicle blast in rainfed and irrigated rice, respectively. Genotype CO39A43 was susceptible in rainfed rice. However, some genotypes were resistant to leaf blast but susceptible to panicle blast.

Also, out of the four locations, two genotypes (NERICA 11 and CSR 36) were resistant.

Table-3. Level of resistance of genotypes to leaf and panicle blast by location according to rice production type

Pedigree	rainfed rice				irrigated rice			
	Foliar severity Farako -Bâ	**Panicle severity Farako-Bâ**	**Foliar severity Karfiguela**	**Panicle severity Karfiguela**	**Foliar severity Bagré**	**Panicle severity Bagré**	**Foliar severity Tengrela**	**Panicle severity Tengrela**
WITA 3	R	R	R	R	R	R	R	S
75-1-127	R	S	R	S	R	R	R	S
TXD 306	R	R	R	S	R	R	R	R
WAB96-1-1	R	S	R	S	R	R	R	S
Chiem Chanh	R	R	S	S	R	R	S	S
IR 77713	R	R	R	S	R	R	R	S
IRBLTA CP 1	S	S	R	S	R	R	R	S
Ewinto Yibo	R	S	R	S	R	S	R	S
IRBLZT-T	S	S	R	S	R	S	R	S
IRBL 11-ZH	R	R	R	S	R	R	R	S
IRBL 7-M	R	R	R	S	R	R	R	S
NSFTV284	R	R	R	S	R	R	S	S
IRBLKP-K60	R	R	R	S	R	R	R	S
IRBLZ 5-CA ®	S	S	R	S	R	R	R	S
IRBLTA 2-RE	R	S	S	S	R	R	S	S
Chondongji	S	S	R	S	R	S	R	S
Kamenoo	S	S	R	S	R	R	R	S
Toploea70/76	R	S	R	R	R	R	R	S
IRTP 16211 (LTH)	R	S	R	S	R	S	R	S
IR126184-1-1-1:C039-A56(C039*4/LUA NHEDEN:IREC16724-1	R	S	R	S	R	R	R	S
IR126182-1-1-1:C039-A35(C039*4/CIRAD 394:(1)	R	S	R	S	R	R	R	S
IR130411:BASMATI217*2/WHD-IS-75-127	R	R	R	S	R	S	R	S
BASMATI370*2/WHD-1S-75-1-127	S	R	R	S	R	R	R	S
BASMATI 217 XCO39-A15	R	R	S	S	R	R	R	S
BASMATI 217 XWHD-IS-75-1-127	R	R	R	S	R	R	R	S
BASMATI 370 XWHD-IS-75-1-127	R	R	R	R	R	R	R	S
BASMATI 370 XWHD-IS-75-1-127	R	R	R	S	R	R	R	S
NERICA 12 XCO39-A15	R	S	R	S	R	R	R	S
NERICA 12 XWHD-IS-75-1-127	R	R	R	S	R	R	R	S
NERICA 2 XCO39-A15	R	R	R	S	R	R	R	S
NERICA 2 XWHD-IS-75-1-127	R	S	R	S	R	R	R	R
Basmati 217	R	R	S	S	R	R	R	S
Basmati 370	R	R	R	S	R	R	R	S
NERICA12	R	R	R	S	R	R	R	R
Komboka	R	R	R	S	R	R	R	S
NERICA 1	R	R	R	S	R	R	R	S
NERICA 1**	R	R	R	S	R	R	R	R
NERICA 4	R	R	R	S	R	R	R	R

NERICA 10	R	S	R	S	R	R	R	R
NERICA 11	R	R	R	R	R	R	R	R
CSR 36	R	R	R	R	R	R	R	R
CO39A15	R	S	R	S	R	R	R	S
CO39A35	S	S	R	S	R	S	R	S
CO39A43	S	S	S	S	R	R	R	S
CO39A56	S	S	R	R	R	R	R	S
TOX728-1	R	S	S	S	R	R	S	S
WAS122-IDSA-1-WAS-6-1	R	R	R	S	R	R	R	R
TS2	S	S	S	R	R	R	R	R
ORYLUX6	R	R	R	S	R	R	R	S

Average Leaf Severity Farako-Bâ Average panicle severity Farako-Bâ Average leaf severity Karfiguela verage panicle severity Karfiguela Average leaf severity Bagré Average panicle severity Bagre Average leaf severity Tengrela Average panicle severity Tengrela R: Resistant; S: Susceptible

4. Discussion

4.1. Level of Resistance of Genotypes to Leaf Blast

Monitoring the development of leaf blast has shown that the intensity of the disease varies between genotypes. The evaluation of the severity of leaf blast in rainfed rice (Farako-Bâ; Karfiguela) and irrigated rice (Bagré, Tengrela) showed that the rice genotypes developed the disease differently depending on their developmental stages and rice growing systems.

In rainfed rice, thirty-four (34) genotypes showed good levels of resistance to foliar disease in both sites, while two (02) genotypes (TS2 and CO39A43) were susceptible. In irrigated rice, forty-five (45) genotypes showed good levels of resistance in both locations.

The differences in leaf blast behaviour may be explained by the different environmental factors or by the existence of a genotypic difference between the genotypes used in our experiment. According to Lepoivre [14], the behaviour of a host plant population towards a pathogen is determined by the genotype of these plants. Resistant genotypes have genes that slow down the development of the epidemic and thus keep the parasite pressure at a low level. Susceptible genotypes, on the other hand, lack resistance genes and are therefore unable to slow the development of the epidemic. Comparing the two types of rice cultivation, we found that irrigated rice genotypes were the most resistant to leaf blast, while rainfed rice genotypes were susceptible. In fact, periods of drought favour the development of the epidemic and the arrival of rainfall allows the spread of spores, leading to an explosion of the disease. These results are consistent with those of Kassankogno [7], who also concluded that disease expression on genotypes is important in rainfed rice.

The incidence of the disease, expressed by the area under the disease progression curve (AUDPC) variable. The genotypes able to slow disease progression are those able to limit the overall severity of the disease, as expressed by a low AUDPC. In rainfed rice, at both locations, thirty-nine (39) genotypes had low indices. In irrigated rice, forty-seven (47) genotypes had low scores at both sites. This means that these genotypes were able to suppress the leaf blight strains. On the other hand, the highest scores were obtained by genotypes CO39A56, TS2, Kamenoo at Farako-Bâ and TOX728-1, Chiem Chanh at Karfiguela (rainfed) and Chiem Chanh at Tengrela (irrigated). The susceptibility of these genotypes can be explained by the appearance of new strains of M. oryzae capable of circumventing the resistance of these genotypes through the adaptation phenomenon reported by Bouet, *et al.* [15]. These results confirm the findings of Séré, *et al.* [9], who showed that there is pathogenic diversity between isolates from different rice ecosystems and that this pathogenic diversity is an essential factor in determining the population structure of the pathogen under study.

4.2. Degree of Resistance of the Genotypes to Blast

The evaluation of the severity of blast at heading and maturity showed a different response of the genotypes. Genotypes with good resistance to blast were CSR 36, WITA 3, BASMATI 370 XWHD-IS-75-127-BC1F2, NERICA 11 in rainfed rice and NERICA 1**, NERICA 10, WAS122-IDSA-1-WAS-6-1, TXD 306, NERICA 2 XWHD-IS-75-127-BC1F2, NERICA12, NERICA 4, NERICA 11, CSR 36, TS2 in irrigated rice. While the genotypes susceptible to panicle blast were CO39A15, CO39A35, CO39A43, IRBLTA 2-RE in rainfed rice and Chondongji, IRTP 16211 (LTH), IRBLZT-T, CO39A35 in irrigated rice.

When comparing the severity scores in the different types of rice crops, the results indicate that the disease is more severe in rainfed rice than in irrigated rice. This is consistent with the findings of Kassankogno [7], who also concluded that rainfed rice was more affected than other rice crops. Similarly, Séré [16], found that blast was particularly dangerous in rainfed rice, although it also caused significant damage to lowland and irrigated rice in Burkina Faso.

4.3. Resistance of Genotypes to Leaf and Panicle Blast

In rainfed rice cultivation, 32 genotypes were resistant to leaf blast and 03 (AR-67, IR 130412 and CSR 36) were resistant to leaf and panicle blast. In irrigated conditions, 44 genotypes were resistant to leaf blast and 06 (TZLR-74, IR 133136-B, NERICA 4, NERICA 10, NERICA 11 and CSR 36) were resistant to leaf and panicle blast. Some genotypes were resistant to leaf blast but susceptible to panicle blast.

According to Louvel [17] , the leaf and the panicle are two organs with different anatomy. This anatomical difference leads to a different response of the plant to leaf and panicle blight. It is possible that the leaves of some genotypes are more resistant to blight than the panicles.

This could explain the difference in the resistance of these genotypes to leaf and panicle diseases. Louvel [17], Bonman [18] also observed differences in the susceptibility of certain genotypes to leaf and panicle blast. Bonmann, *et al.* [19] studied the behaviour of some rice varieties against blast in two different locations (Korea and the Philippines) from 1987 to 1989. This work showed that IR 66 was susceptible to leaf blast and resistant to panicle blast in the Philippines. Mbodj, *et al.* [20] carried out work on resistance to blast in some Casamance irrigated rice varieties. The results of this study highlighted the difference in susceptibility of varieties IR 13538-48-2, ITA 231, IR 3259-P5 and Br 61-2b-58 to leaf and panicle blight. This result is also in line with our observations. According to Mbodj, *et al.* [20], the difference in susceptibility to the different stages of blast is due to a difference in the composition of the dominant races of Pyricularia oryzae on the leaves and panicles.

5. Conclusions

This study evaluated the behaviour of 49 rice genotypes with respect to leaf and panicle blast in rainfed (Farako-Bâ, Karfiguela) and irrigated (Bagré, Tengrela) rice production systems.

The results allowed the identification of genotypes AR-67, IR 130412 and CSR 36 resistant to leaf and panicle blast in rainfed rice. Under irrigated conditions, the genotypes TZLR-74, IR 133136-B, NERICA 4, NERICA 10, NERICA 11 and CSR 36 were resistant to leaf and panicle blast. The CSR 36 genotype was the only one resistant to the disease in both ecologies.

Rice genotypes or hybrids introgressed with known rice blast resistance genes identified will be used for popularisation among rice farmers and also as potential breeders of partial resistance in varietal improvement programmes.

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