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CHARACTERIZATION OF NEW RICE GENOTYPES FOR BLAST AND BROWN SPOT DISEASE RESISTANCE AND IRON-TOXICITY TOLERANCE IN BURKINA FASO

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ABSTRACT

Rice production in Burkina Faso is threatened by a number of abiotic and biotic constraints, including iron toxicity and main fungal diseases that limit the potential of cultivated varieties. The general objective of this study was to evaluate the performance of new rice genotypes against main biotic and abiotic stresses. A total of 08 genotypes were tested and allowed a Fisher block design with 03 replicates. Assessments focused on severity of iron toxicity, the severity and incidence of blast and brown spot diseases and agro-morphological traits. The GRS IR-6-S3-Y1-D genotype was the most sensitive to iron toxicity, while the Sahel 108, BF19AR006 and SV1CP genotypes were the most resistant. As for fungal diseases, severity scores ranged from 4.33 to 7.67 for blast and from 4.00 to 7.03 for brown spot disease while incidence rates were 88.33% and 81.67% for blast and brown spot disease respectively. Genotype IR93654-10-3-2-1-ARS-SALS was resistant to both blast and brown spot disease. Person's correlation matrix showed both positive and negative correlations between the various agro-morphological parameters and pathological traits. Hierarchical ascending classification showed that the SV1CP and IR93654-10-3-2-1-ARS-SALS genotypes performed better agronomically. with yields of over 7.000 kg/ha and showed good tolerance to iron toxicity, blast and brown spot disease.

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INTRODUCTION

In Burkina Faso, rice ranks fourth among the cereals produced (MAAH, 2021). It is a strategic crop due to its importance to the economy and its role in food security. However. it remains the country's leading cereal import, generating a significant outflow of foreign currency, expected to reach 107 billion CFA francs by 2025 (MAAH, 2021). Although production has risen from 113.724 tons in 2006 to 451.420 tons in 2020 (MAAH, 2021). It covers less than 50% of the population's food requirements. In addition, rice production faces biotic and abiotic constraints that impact on the performance of varieties. Abiotic constraints include drought, low temperatures, salinity and iron toxicity (Konate *et al.*, 2022). Iron toxicity is known to be the most widespread and severe nutritional disorder responsible for significant yield losses in lowlands and irrigated perimeters, In addition, some lowlands. although suitable for rice cultivation, have been abandoned by farmers because of their high levels of iron toxicity (Konate *et al.*, 2022). As for biotic constraints, we have fungal, bacterial and viral diseases, parasitic nematodes and weeds (Kassankogno *et al.*, 2016; Thio *et al.*, 2017; Sanou *et al.*, 2019). Among fungal diseases, blast and brown spot disease are the most damaging to rice cultivation in Burkina Faso (Kassankogno, 2022). They can cause yield losses ranging from 20 to 60% depending on the susceptibility of varieties used (Boka *et al.*, 2018). With the aim of contributing to the search for effective control methods against these diseases, several approaches are being considered, notably chemical control. However, this practice although effective, has major limitations as the products are expensive, out of the reach of traditional farmers and require considerable manpower. Varietal improvement appears to be the most sustainable and economically profitable method for farmers (Gnago *et al.*, 2017). The main objective of this study was to evaluate the performance of new rice genotypes in relation to the main stresses prevailing in Burkina Faso.

MATERIALS AND METHODS

Experimental Site

The study was carried out on the "hots plot" of irrigated rice-growing perimeter of Kou Valley. It is located in western Burkina Faso, 30 km north-west from Bobo Dioulasso in the rural commune of Bama. Geographical coordinates are precisely 4°22' west longitude, 11°22' north latitude and an altitude of 300 m. The climate of Kou Valley is South Sudanian. Rainfall is relatively abundant, ranging from 800 to 1.200 mm. Temperatures range from 17°C to 37°C in the dry season and from 20°C to 32°C in the wet season. Soil analyses carried out by Konaté (2012) and Traoré *et al.* (2016) have shown that the site is iron toxic, with values ranging from 14400 to 15675 mg/kg.

Plant Material

The plant material consisted of eight (08) rice genotypes, including two (02) controls and six (06) new genotypes. The two controls were chosen for their productivity and their behaviour under known stresses (Table 1).

Table1. Characteristics of genotypes evaluated.

Genotype	Cycle(j)	Yield(t/ha)	Iron toxicity	Blast and brown spot disease	Origin
GRS IR-6-S3-Y1-D	Nd	Nd	Nd	Nd	AfricaRice
GSR IR1-1-Y4-Y1	Nd	Nd	Nd	Nd	AfricaRice
IR93654-10-3-2-1-ARS-SALS	Nd	Nd	Nd	Nd	AfricaRice
SV1CP	Nd	Nd	Nd	Nd	Burkina Faso
SV2CP	Nd	Nd	Nd	Nd	Burkina Faso
BF19AR006	Nd	Nd	Nd	Nd	AfricaRice
FKR64	120	8	S	S	Burkina Faso
Sahel 108	100	5 to 6	Nd	Nd	Senegal

Nd: Not determined.

Experimental Design

The experimental design is a randomized Fisher block with three replicates. Each repetition is subdivided into eight elementary plots. The replicates were spaced 1 m apart and the elementary plots 0.5 m apart. Each genotype was planted out in eight five-meter rows at 20 cm inter-row and inter-pod spacings respectively. The size of an elementary plot was 7.5 m^2 (5 m x 1.5 m). The total trial area was 263.5 m^2 (17 m x 15.5 m).

The nursery was set up close to the study plot. After digging and slurrying, around 25 g of seed of each genotype was broadcast. The nursery was regularly irrigated and maintained until planting. Soil preparation involved ploughing to a depth of around 20 cm. This was followed by slurrying and levelling operations. Planting took place on August 29, 2022. The nurseries were uprooted and transplanted in rows with 1 sprig per stake.

Irrigation was carried out as required. 200 kg/ha of NPK complex fertilizer (formulation 14-23-14) was broadcast during planting, 150 kg/ha of urea cover fertilizer (46% N) was divided into two applications. The first (50 kg/ha) was applied 15 days after planting and the second (100 kg/ha) 55 days after planting. In addition, two manual weeding operations were carried out at 14 and 50eme days after planting respectively.

Assessing the Severity of Iron Toxicity

Iron toxicity was assessed using the IRRI (2002) scale. Scores ranging from 0 to 9 were assigned to individual plots according to the degree of infection observed (Table 2).

Assessing the Incidence and Severity of Blast and Brown Spot Diseases

To assess the extent of fungal disease damage in rice plots, we looked at the severity and incidence of blast and brown spot disease. The method consisted in setting up five survey squares in each elementary plot and assigning a severity rating ranging from 1 to 9 in accordance with the IRRI (2002) scale (Table 3). Observations were made at 56th days after planting. Incidence was assessed for each individual plot by identifying the number of diseased plants out of the total number of plants. multiplied by one hundred.

Assessment of Agro-Morphological Traits

Evaluation of agro-mophological traits focused on nine (09) traits according to IRRI's standard evaluation system (2002). These are:

1. The number of tillers at 60 days after planting (NT60): this was carried out by hand-counting the number of tillers in each poquet at 60 days after planting.
2. Plant height (PH): this measurement was taken at plant maturity, using agraduated ruler. It was taken from the base of the plant to the tip of the tallest panicle;
3. Date of 50% flowering (CSF): this represents the number of days between sowing and heading. It is recorded when 50% of plants have reached the heading stage;
4. Date of maturity (DM): this corresponds to the number of days between sowing and plant maturity. It was noted when ¾ of the panicles had reached maturity;
5. Number of panicles (NP): this was determined before harvesting by manually counting the number of panicles per bunch;
6. Panicle length (PL): also measured at maturity, before harvesting;
7. Panicle weight (PW): weighed in the laboratory after harvest using an electronic balance;
8. 1000 kernel weight (1000G): estimated in the laboratory using a precision balance. after counting the kernels at 14% moisture content;
9. Yield (Yield): plot yield is obtained by harvesting the plots when 2/3 of the panicles are mature. The panicles are then threshed, dried and winnowed. Yields are assessed at 14% moisture content. Yield per hectare is obtained by extrapolation from plot grain yield.

Data Analysis

Analysis of variance and correlation analysis were performed using XLSTAT 2016 software to observe discriminating traits according to Fisher's test. The correlation matrix was also used to observe relationships between agronomic traits, iron toxicity scores and epidemiological parameters. Characters that are discriminating and only weakly correlated were used to group genotypes according to their stress behavior and agronomic performance.

Table 2. Iron toxicity severity rating scale IRRI (2002).

Notes	Effect of toxicity on leaves
0	Normal growth and tillering
1	Almost normal growth and tillering; reddish-brown spots or orange discoloration on olderleaf tips
3	Almost normal growth and tillering; yellowing of leaves and a reddish-brown, purple ororange color on the oldest leaves.
5	Delayed growth and tillering; many discolored leaves
7	Growth and tillering cease; most leaves are discoloured or dead
9	Almost all the plant's leaves are burnt and dried.

RESULTS

Behavior of Genotypes to Iron Toxicity

The iron toxicity severity scores for genotypes showed a significant difference at both 40th and 60th days after planting (Figure 1). On a scale of 0 to 9, iron toxicity severity scores ranged from 1 to 3 at 40th days. The GRS IR-6-S3-Y1-D and GRS IR1-1-Y4-Y1 genotype scored 3 while the SV1CP, SV2CP, BF19ER006 genotypes and the

FKR64 and SAHEL108 controls recorded 1 like severity score. At day 60 after planting, severity scores were higher with an average score of 5. The GRS IR-6-S3-Y1-D genotype was the most sensitive, with a score of 5 while the SV1CP, BF19AR006 and SAHEL108 genotypes were the most tolerant with a score of 1.

Table 3: Blast and brown spot diseases severity rating score (IRRI, 2002).

Notes	Diseased leaf area	Assessment
1	No symptoms	Immune (IM)
2	Less than 1% of sales	Very resistant (TR)
3	1 - 3%	Resistant (R)
4	4- 10%	Resistant (R)
5	11 - 15%	Moderately resistant (MR)
6	16 - 25%	Moderately sensitive (MS)
7	26 - 50%	Sensitive (S)
8	51 - 75%	Very sensitive (TS)
9	76 - 100%	Very sensitive (TS)

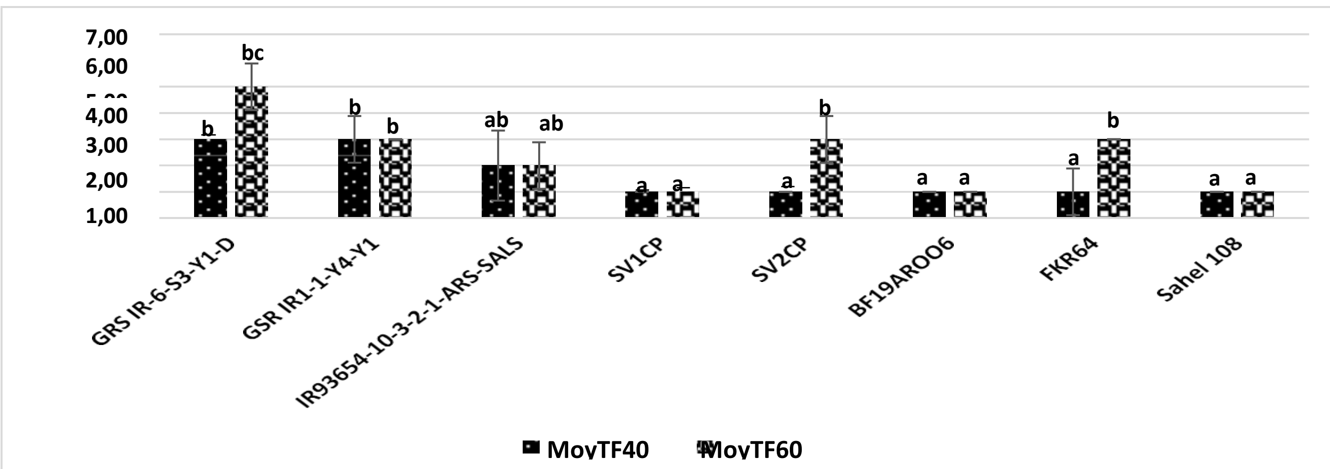

Figure 1. Average iron toxicity severity scores at 40th and 60th days after planting.

Severity and Incidence of Leaf Blast in Genotypes Tested

Analysis of variance showed that severity (Pr=0.003) and incidence (Pr=0.0001) of blast disease at 56 days after planting discriminated between genotypes at the 5% probability threshold (Table 4).

Severity scores ranged from 4 to 7.67. The GRS IR-6-S3-Y1-D genotype, Sahel 108 and FKR64 were the most susceptible with a score of 7 while the IR93654-10-3-2-1-ARS-SALS genotype was the most resistant with a score of 4. Disease incidence was ranged from 36 to 88% obtained respectively with the IR93654-10-3-2-1-ARS-SALS and GRS IR-6-S3-Y1-D genotypes.

Severity and Impact of Brown Spot Disease on Genotypes

Genotypes expressed themselves differently to the impact of brown spot disease. Analysis of variance showed significant differences between genotypes at the 5% probability level for severity (Pr = 0.011) and disease incidence (Pr = 0.008) as shown in Table 5. The GRS IR-6- S3-Y1-D genotype and the Sahel 108 control were the most susceptible with a severity score of 7 while the IR93654-10-3-2-1-ARS-SALS genotype was the most resistant with a score of 4. The control variety FKR64 and genotypes BF19AR006, SV2CP and SV1CP were moderately susceptible with scores of 6 and 5 respectively. In addition, the GRS IR-6-S3-Y1-D genotype and the Sahel 108 (check) had the highest incidence rates with at least 80% of diseased plants.The IR93654-10-3-2-1-ARS-SALS genotype recorded the lowest incidence rate of brown spot disease with an incidence rate of 30%.

Agro-Morphological Traits of Genotypes

The results of the analysis of variance and the mean values of the agro-morphological traits are shown in Table 6 below.

Number of Tillers at 60 Days after Planting

Analysis of variance showed that tillering discriminated (Pr=0.021) between genotypes at the 5% threshold. The number of tillers per cluster varied from 7 to 22 with an average of 14 tillers. The coefficient of variation was 28%. The IR93654-10-3-2-1-ARS-SALS genotype performed best with 20 tillers per bunch. The lowest (8 tillers per bunch) was obtained with the SV1CP hybrid. The FKR64 and Sahel 108 controls recorded 14 and 15 tillers per bunchrespectively (Table 6).

Table 4. Severity scores and incidence rates of blast on genotypes.

Genotypes	Severity BD	Incidence BD (%)	NR
GRS IR-6-S3-Y1-D	7.67 c	88.33 c	S
Sahel 108	7.33 bc	81.67 c	S
BF19AR006	5.00 ab	80.00 bc	MR
FKR64	7.00 bc	75.00 bc	S
GSR IR1-1-Y4-Y1	6.33 abc	75.00 bc	MS
SV2CP	7.00 bc	81.67 c	S
SV1CP	5.00 ab	51.67 ab	MR
IR93654-10-3-2-1-ARS-SALS	4.33 a	36.67 a	R
Pr > F	0.003	0.0001	
Sign	**	***	

Sev_BD: Severity of blast disease at 56 days; Incid_BD(%): Incidence of blast at 56 days; Pr: Probability; Sign: Significance; NR: Level of Resistance; S: Susceptible; MS: Moderately Susceptible; MR: Moderately Resistant; R: Resistant; *: Significant; **: Highly Significant;

Table 5. Severity and incidence of brown spot disease on genotypes.

Genotypes	Severity BSD56	Incidence BSD56 (%)	NR
GRS IR-6-S3-Y1-D	7.03 b	81.67 b	S
BF19AR006	6.67 ab	70.00 ab	MS
GSR IR1-1-Y4-Y1	5.33 ab	61.67 ab	MR
Sahel 108	7.00 b	80.00 b	S
SV2CP	6.33 ab	78.33 b	MS
FKR64	5.67 ab	60.00 ab	MR
IR93654-10-3-2-1-ARS-SALS	4.00 a	30.00 a	R
SV1CP	5.00 ab	51.67 ab	MR
Pr > F	0.011	0.008	
Sign	*	**	

Sev_BSD56: Severity of brown spot disease at 56 days after planting; Incid_BSD56: Incidence ofbrown spot disease at 56 days after planting; NR: Level of resistance; R: Resistant; S: Susceptible; MR: Moderately resistant; MS: Moderately susceptible; Pr: Probability; Sign: Significance; *: Significant; **: Highlysignificant.

Plant Height at Maturity

Plant height at maturity discriminates between the genotypes evaluated (Pr < 0.0001). Plant height at maturity averaged 91.5 cm. The coefficient of variation was relatively low (10%). The lowest average plant height (79.3 cm) was obtained with the GRS IR-6-S3-Y1-D genotype. The SV1CP genotype recorded the highest mean plant height at 106.6 cm. The FKR64 and Sahel 108 controls recorded mean plant heights of 91.2 and 98.9 cm respectively (Table 6).

Date of 50% Flowering and Maturity

Analysis of variance for date of 50% flowering and maturity cycles showed a significant difference between genotypes for these traits with probabilities of 0.006 and 0.007 respectively. On average, genotypes seeded at 88 days and reached maturity at 118 days. The SV2CP genotype was the earliest with 86 and 116 days as date of 50% flowering and maturity respectively. However, SV1CP was late with a semi-epiposition cycle of 92 days and a semi-maturity cycle of 122 days.

Panicle Length and Weight per Cluster

Panicle length and weight discriminate between genotypes. On average. a panicle measures 24 cm and weighs 3.48 g. The minimum lengths were 19.54 and 27.36 cm. Weights varied from 2.59 to 5.43 g. The GRS IR-6-S3-Y1-D genotype had the shortest panicles while the FKR64 genotype had the longest. The Sahel 108 control and the GRS IR-6-S3-Y1-D genotype had the lowest panicle weights of 2.98g and 2.81g respectively while SV1CP genotype recorded the heaviest panicles (5.02g).

1000-Grain Weight

The 1000-grain weight of the genotypes was also significant (<0.0001). The coefficient of variation was low at 6%. Average weight performance was 24.48 g. The SV1CP genotype performed best (27.83 g). The lowest weights (23.37 g) were observed with the FKR64 and Sahel 108 controls.

Yield

Yield also discriminates (Pr=0.01) between genotypes. Values ranged from 3920 to 8690 kg/ha with a coefficient of variation of 20%. On average, the genotypes performed well with 6215.83 kg/ha. The best yields were obtained by the BF19AR006 and IR93654-10-3-2-1-ARS-SALS genotypes with 7406 and 7705 kg/ha respectively. The FKR64 control recorded the lowest yield (4541 kg/ha).

Table 6. Results of analysis of variance for agro -morphological traits.

Genotypes	NT60	PH	CSF	DM	NP	PL	PW	1000G	Yield
SV1CP	8 a	106.8 d	92 b	122 b	8	23.63 b	5.02 b	27.83 b	6807 ab
BF19AR006	15 ab	91.5 abc	88 ab	118 ab	12	24.27 b	3.24 a	24.7 a	7406 b
IR93654-10-3-2-1-ARS-SALS	15 ab	98.9 cd	90 ab	120 ab	14	23.74 b	3.04 a	24 a	7705 b
FKR64	12 ab	95.3 bcd	91 ab	121 ab	10	25.39 bc	3.37 a	23.37 a	4541 a
GSR IR1-1-Y4-Y1	14 ab	91.2 abc	87 ab	117 ab	10	24 b	3.04 a	24.47 a	5986 ab
SV2CP	20 b	82.3 ab	86 a	116 a	11	23.58 b	4.33 b	24.27 a	5858 ab
Sahel 108	14 ab	86.8 abc	86 a	116 a	12	26.67 c	2.98 a	23.37 a	6109 ab
GRS IR-6-S3-Y1-D	16 ab	79.3 a	88 ab	118 ab	12	20.75 a	2.81 a	23.83 a	5314 ab
Min	7	74	86	116	7	19.54	2.59	22.2	3920
Max	22	111.3	92	122	16	27.36	5.43	29.3	8690
Avg	14	91.5	88	118	11	24	3.48	24.48	6215.83
CV (%)	28	10	2	2.9	20	7	22	6	20
Pr > F	0.021	<0.0001	0.006	0.007	0.170	<0.0001	<0.0001	<0.0001	0.01
Sign	*	***	**	**	Ns	***	***	***	*

Min: Minimum value; Max: Maximum value; Avg: Mean; CV: Coefficient of variation; F: Fisher's F; **N**T60: number of tillers at 60 days after planting; PH: plant height; NP: Number of panicles; CSF: date of 50% flowering; DM: date of maturity; PL: Panicle Length; PW: Panicle Weight; 1000G: 1000 Grain Weight; Yield: Yield; Pr: Probability; Sign: Significance; **: Highly significant; ***: Very highly significant; Ns: Not significant

Relationship between Agro-Morphological Traits Pathological variables and iron toxicity

Table 7 summarizes the relationships between the parameters assessed. There are positive and negative correlations between these parameters. Thus, tillering at 60 days after plantingand the number of panicles at maturity are positively and significantly (r=0.88) correlated. Similarly, severity of blast and brown spot disease at 56 days after planting were positively and significantly correlated. There were also significant negative correlations between tillering and panicle weight with a coefficient r= - 0.85.

Hierarchical ascending classification of genotypes

Yield, date to 50% flowering and date of maturity, plant height, blast disease severity and iron toxicity scores were used to group the genotypes into three (03) groups (Figure2). Table 8 shows the characteristics of these groups. Group 1: average plant height of 94 cm, a date of maturity of 118 days and an average yield of 6019 kg/ha and of blast-susceptible and iron- toxicity-tolerant genotypes. It includes the BF19AR006 genotype and the FKR64 and SAHEL108 check varieties. Group 2 comprising the SV1CP and IR93654-10-3-2-1-ARS-SALS genotypes. It is characterized by an average yield of 7256 kg/ha, plant height of 94 cm and date of maturity of 121 days. This group is made up of genotypes resistant to iron toxicity and blast. Group 3 genotypes - SV2CP. GSR IR1-1-Y4-Y1 and GRS IR-6-S3-Y1-D - have an average yield of 5619 kg/ha, average plant height of 87 cm and a semi-mature cycle of 117 days. It is mainly comprising genotypes tolerant to iron toxicity and susceptible to blast.

Table 7. Relationship between agronomical and pathological related traits.

Variables	NT60	PH	NP	CSF	DM	PL	PW	1000G	Yield	TF60	BSD	BD
NT60	1											
PH	-0.809	1										
NP	0.886	-0.609	1									
CSF	-0.129	0.097	-0.308	1								
DM	-0.129	0.097	-0.308	0.900	1							
PL	-0.126	0.508	-0.060	-0.130	-0.130	1						
PW	-0.854	0.769	-0.650	0.326	0.326	-0.020	1					
1000G	-0.647	0.612	-0.634	0.512	0.512	-0.198	0.799	1				
Yield	0.260	0.087	0.361	0.117	0.117	0.015	0.106	0.393	1			
TF60	0.108	-0.484	0.162	-0.466	-0.466	-0.644	-0.055	-0.225	-0.205	1		
BSD	-0.046	-0.014	0.091	-0.626	-0.626	-0.091	-0.262	-0.346	-0.421	0.134	1	
BD	-0.054	-0.113	0.016	-0.617	-0.617	0.011	-0.348	-0.524	-0.646	0.172	0.930	1

NT60: number of tillers at 60 days after planting; PH: plant height; NP: Number of panicles; CSF: date of 50% flowering; DM: date of maturity; PL: Panicle Length; PW: Panicle Weight; 1000G: 1000 Grain Weight; Yield: Yield; TF60: Iron toxicity at 60 days; BSP: Brown spot disease at 56 days after planting; BD: blast disease at 56 days after planting;

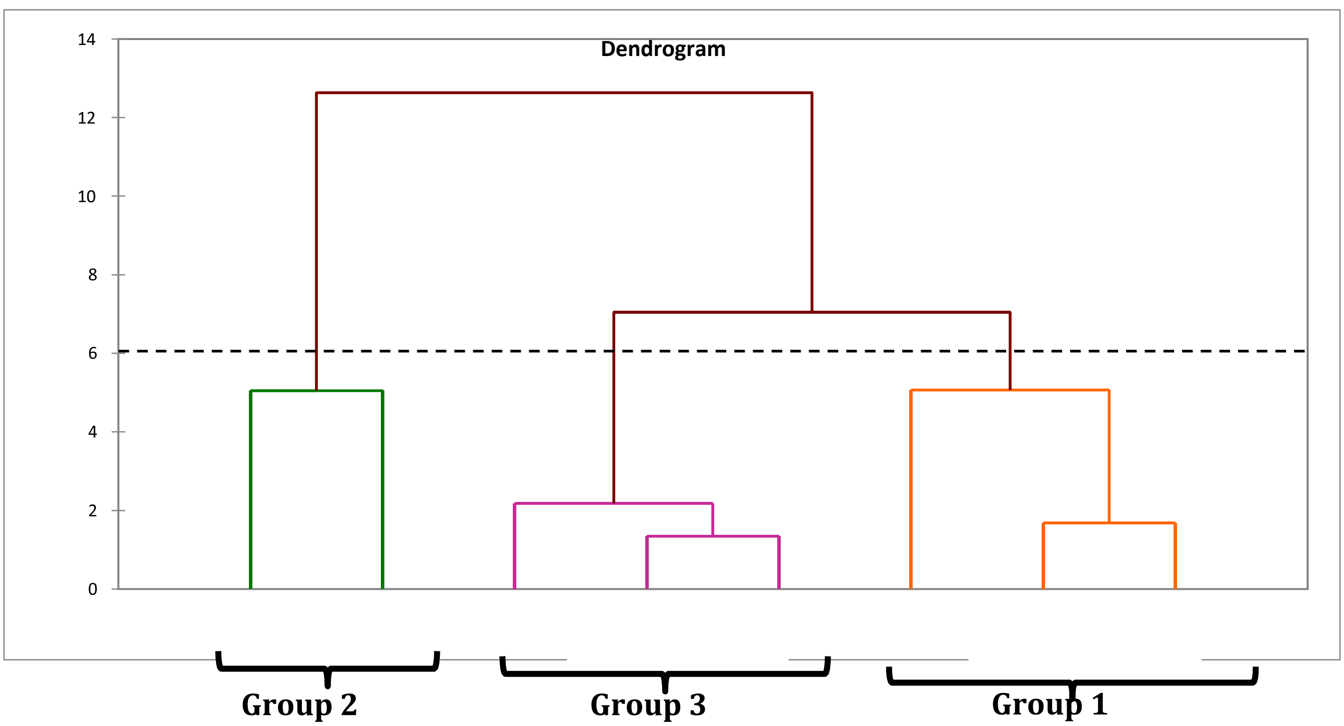

Figure 2. Distribution of genotypes according to their performance agronomic and pathological.

Table 8. Characteristics of groups generated by hierarchical ascending classification ofgenotypes.

Groups	PH (cm)	CSF (j)	Yield (Kg/ha)	TF60	BD
Group 1	94	118	6019	1	7
Group 2	94	121	7256	1	4
Group 3	87	117	5719	3	7

PH: plant height; CSF: date of 50% flowering; Yield: Yield; TF60: Iron toxicity at 60 days; BSP: BD: blast disease at 56 days after planting.

DISCUSSION

The genotypes did not react in the same way to iron toxicity, which explains the variation in scores observed. Score 1 observed with the SV1CP, BF19AR006 and SAHEL108 genotypes, would mean that they were tolerant to iron toxicity. This difference in reaction between genotypes under toxic conditions was also observed by Konate *et al.* (2022) and Barry (2020). These authors stated that rice plants react differently to iron toxicity. In addition, the significant differences in severity and incidence scores for blast and brown spot diseases reveal that genotypes behave differently towards the two diseases. These results could be attributable both to the varietal effect and to the environmental effect. Indeed, genotypic diversity within different genotypes would explain the diversity of reaction of genotypes to these diseases. Lepoivre P. (1989) report that hosts plant reaction to a pathogen is determined by genotype. This would explain the susceptibility of GRS IR-6-S3-Y1-D and sahel108 genotypes and the tolerance of SV1CP and IR93654-10-3-2-1-ARS-SALS genotypes to both fungal diseases. However, the behavior of genotypes could also be linked to the environment. In this respect, the work of Kassankogno (2022) indicated that the high diversity within the population of *Magnaporthe grisea, the* causal agent of blast disease, could be linked to the effect of the environment which favors pathogen diversity. Climatic factors such as temperature and relative humidity influence the expression of aggressiveness in strains of *Bipolaris oryzae, the* causal agent of brown spot disease (Wonni *et al.*, 2014). Analyses of agro-mophological traits showed that there was variability between genotypes tested. FKR64 check variety is known for its agronomic profitability, with a yield of over 8000kg/ha. However, under iron toxicity conditions and disease pressure, this genotype recorded a relatively low yield of 4.000 kg/ha. Iron toxicity and fungal diseases would therefore have an unfavorable effect on agronomic performance of genotypes. Audebert (2006) has shown that iron toxicity causes significant yield losses in rice, depending on the susceptibility of the genotypes. Tian *et al.* (2014) report that these diseases lead to leaf desiccation followed by a reduction in photosynthetic intensity, with yield losses of up to 100% depending on genotype susceptibility, environmental conditions and cultural practices.

Analysis of the correlation matrix revealed a positive and significant correlation between the severity of brown spot disease and that of blast. These results suggest that these two fungal diseases are co-infected on rice. Thus, Joseph (2020) revealed that in natural growing conditions, environmental and technical factors are not under exclusive control,which could favor the transport and simultaneous appearance of several pathogens on the samecrop.

Hierarchical ascending classification distinguished and selected group 2 genotypes as the best performers. These genotypes achieved the highest yields and were less affected by iron toxicity and the two fungal diseases. They are therefore tolerant and have developed physiological and/or genetic mechanisms that enable them to mitigate the damage caused by these stresses.

CONCLUSION

The aim of this study was to evaluate the performance of new rice genotypes against the main stresses affecting in Burkina Faso. Analyses showed that genotypes differed in terms of iron toxicity tolerance and also in the severity and incidence of blast and brown spot diseases. Genotypes BF19AR006, SV1CP and the Sahel 108 check variety were tolerant to iron toxicity with a severity score of 1. Similarly, genotypes SV1CP and IR93654-10-3-2-1-ARS-SALS showed the least severe symptoms and the lowest incidence of blast and brown spot diseases. The hierarchical ascending classification made it possible to distinguish the genotypes in group 2, consisting of SV1CP and IR93654-10-3-2-1-ARS-SALS as being the best performing from an agronomic point of view and resistant to iron toxicity the biotic and both fungal diseases.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest regarding the publication of this paper.

AUTHORS CONTRIBUTIONS

All the authors have contributed equally to the research and compiling the data as well as editing the manuscript.

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