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Research Article

Screening of Rice Germplasms for Their Resistance against Sheath Rot Disease (*Sarocladium oryzae*) at Fogera, Ethiopia

Desalegn Yalew Fetene[1]*, Muluadam Birhan[1], Tekalign Zeleke[2]

[1]*Ethiopian Institute of Agricultural Research (EIAR), Fogera National Rice Research and Training Center, Ethiopia;* [2]*Ethiopian Institute of Agricultural Research (EIAR), Ambo Agricultural Research Center, Ethiopia*

ABSTRACT

Sheath rot of rice, *Sarocladium oryzae* [(Sawada) W. Gams & D. Hawksw], is currently regarded as one of the most serious rice diseases in Fogera plains. Varietal resistance is the most cost-effective and eco-friendly management strategy for the small-scale farmers. An investigation was conducted to identify resistant sources among rice germplasm introductions that could be employed in varietal development program. Eighty germplasms along four checks were evaluated in field trials for two years at two locations arranged in an augmented design. Results indicated that three immune germplasms (SCRID014-1-1-1-1, SCRID037-4-2-2-5-2 and YUNLU N0.33) were found to be suitable for resistant variety development. The remaining, germplasms were found to exhibit different levels of reactions, of which 27 resistant, 35 moderately resistant, 13 moderately susceptible and two susceptible, with PSI ranging between 1.48–56.17%. The immune germplasms perform better than the standard check varieties in all agronomic and phenological traits considered. Based on these results, the high yielder immune germplasms could be used to develop resistant varieties so as to meet the farmers' requirement, as far as rice production is concerned.

Keywords: Rice; Germplasm; Sheath rot; Screening; Immune; Resistant

INTRODUCTION

Sheath rot, caused by *Sarocladium oryzae* (Sawada) is one of the major diseases of rice. The pathogen mainly infects the upper most flag leaf sheaths that enclose the emerging young panicle during the boot stage. The lesions are oblong or irregular oval spot and usually expressed as a reddish-brown discoloration of the flag-leaf sheath. Early or severe infection affects the panicle so that it only partially emerges. The unmerged portion of the panicle rots, turning florets red-brown to dark brown. Grains from damaged panicles are discolored reddish-brown to dark brown and may not fill the affected grains, are known as chaffy grains and the disease is appropriately known as "empty head" and is familiar as "rice abortion" [1]. Moreover, the pathogen is mostly observed on the entire seed (about 46%) and on the lemma and/or palea (about 31%) [2].

Sheath rot is one of the most serious and devastating rice diseases in wetland rice growing regions [3]. The pathogen attacks flag leaf sheaths and grains and yield losses result mainly from poor panicle formation and exertion, spikelet sterility (80-100%), reduced grain filling, and losses in milling [4]. Quality is also affected as severe attacks lead to chaffy, discolored grains and affect viability and nutritional value of the grains followed by a decrease in the protein and starch contents of infected seeds [5]. Seeds from infected panicles become discolored and sterile, thereby reducing grain yield and quality significantly. Since the pathogen attacks the crop at maturity starting from panicle initiation stages; its impact is direct to minimize the crop yields. There was a yield loss report ranging from 20% to 85% in Taiwan and 30 to 80% in Vietnam, the Philippines and India [6]. Variability in yield loss depends upon prevailing favorable conditions under which rice is grown and the level of susceptibility of the grown cultivar [7].

In Ethiopia, diseases of rice in general, and sheath rot in particular is not well studied. This is because rice cultivation in the country is at infant stage, and that associated production constraints are not well known along with the fact that importance of diseases of newly introduced crops are expanding and manifesting them gradually with the time. However, now a day sheath rot becomes major rice disease especially in Fogera plains with prevalence, incidence and severity of 100, 47 and 44%, respectively (unpublished). Therefore, unless effective management measure is taken, the disease will cause high yield loss with the consequence that leads the rice crop to be out of production in the area. Thus, there is a need to establish

Correspondence to: Desalegn Yalew Fetene, Ethiopian Institute of Agricultural Research (EIAR), Fogera National Rice Research and Training Center, Ethiopia, Tel: 0911120107; E-mail: desalegnyalew@gmail.com

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appropriate management method to tackle the abovementioned problem.

Most sheath rot management practices in rice fields rely on integration of chemical control with cultural practices. However, according to Ayyadurai et al. [7] fungicide treatments are most of the time unsuccessful under farmers' conditions or are very expensive as well as harmful to the environment. In the same context, biological control has been of limited effect due to inconsistency of antagonists under field conditions [8]. Therefore, among the options, use of resistant varieties would offer a better management compared to other control strategies, as it is inexpensive and eco-friendly strategy to the environment [9,10]. Thus, the most sustainable solution is the development and deployment of resistant varieties. The resistant varieties also could be developed either through selection/screening or crossing [11]. A number of resistant varieties have been developed in different countries [12], but none of them has been developed and available in Ethiopia. Therefore, screening of introduced and available rice germplasms for their resistance against rice sheath rot is important to develop resistant varieties in Ethiopia particularly in Fogera plains.

The objective of this experiment was to evaluate the reaction of rice germplasms against sheath rot and identify resistant sources for future breeding purpose.

MATERIALS AND METHODS

Area description

The experiment was conducted at Fogera National Rice Research and Training Center during years 2017 – 2018 main cropping seasons in lowland ecosystem. Geographically the research center is located at latitude of 11° 58′ N and longitude of 37° 41′ E with an altitude of 1819 meter above sea level. The area receives average annual rainfall of 1230 mm with mean maximum and minimum temperatures of 12°C and 28°C, respectively

Experimental materials and design

In this experiment 80 rice germplasms, introduced from different countries to Ethiopia at different times, along four checks (three recently released rice varieties and one local cultivar) were screened against rice sheath rot in naturally infested fields. The experiment was arranged in augmented design with four blocks of non-replicated plots each containing 24 genotypes. Each genotype was sown in three rows of 2m long and 0.6m wide plot. All agronomic practices were applied uniformly for all plots [13].

Data collection and analysis

Information on agronomic data, disease data and all other necessary parameters were collected during the study period. Phenological and agronomic data were collected in plot bases while diseases data were collected from 10 pre tagged plants in each plot.

Disease incidence

It was assessed starting from the onset of the disease. It was recorded by counting the number of plants showing the symptom and dividing by the total number of plants assessed; then the results were expressed in percentage of disease incidence using the following formula.

$$DI(\%) = \frac{\text{Number of infected plants}}{\text{Total number of plants assessed}} \times 100$$

where: DI = disease incidence

Disease severity

The proportion of the infected tissue area to the total tissue area, was expressed by using the following formula.

$$DS(\%) = \frac{\text{Diseased area of the plant tissue}}{\text{Total area of the examined tissue}} \times 100$$

Where: DS = disease severity

The severity was scored four times with weekly interval starting from the onset of the disease. It was done by observing the effect of the disease on the proportional area of the examined plant and rated using 0 – 9 scale, developed by IRR as explained in Table 1.

The numerical values of the severity were further used for the calculation of the mean percent severity index (PSI) using the following formula as indicated by Wheeler.

$$PSI = \frac{\text{Sum of individual numerical ratings}}{\text{Total number of plants assessed} \times \text{Maximum disease score on scale}} \times 100$$

Based on their PSI values of reaction to the disease, the tested germplasms were classified as resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible using the Lalan Sharma et al. [14] standard as indicated in Table 2.

Since our objective was to identify sheath rot resistant germplasms through screening, statistical analysis and mean separation were performed for all germplasms and the result is presented here only for immune and resistant germplasms found in all blocks along checks. Statistical analysis was performed using Statistical Packages for Augmented Design (SPAD) and excel (Microsoft office version 2016) following standard and specific procedures applied during data analysis in augmented design experiments. Mean separation was also computed for traits which have significant differences among germplasms using LSD at 5% significant level as described in Gomez and Gomez [13].

i. To compare two germplasms (test culture) occurring at different blocks at 5% level of significance:

$$LSD\,5\% = t\,0.025(\mathit{error\ df.}) \times \sqrt{2 \times EMS(1+\frac{1}{c})}\ \sqrt{2 \times EMS(1+\frac{1}{c})}$$

where C = *number of checks*

ii. To compare a germplasm (test culture) with any check at 5% level of significance:

$$LSD\,5\% = t\,0.025(\mathit{error\ df.}) \times \sqrt{EMS(1+\frac{1}{b}+\frac{1}{c}+\frac{1}{bc})}$$

where b = number of blocks and C= number of checks

RESULTS AND DISCUSSION

Results from the combined analysis of variance for selected important agronomic, phenological and disease traits are presented in Table 3. Mean squares estimates from analysis of variance revealed that there were significant differences among genotypes for some traits and no significant interaction for some other traits (Table 3).

Reaction of the tested genotypes to rice sheath rots disease

Classification of the host reaction based on their PSI value according to Lalan Sharma et al. [14] rating scale revealed that the tested genotypes had different reaction to the disease. Among 80 germplasms, three genotypes were immune, 27 resistant, 35 moderately resistant, 13 moderately susceptible and two germplasms were susceptible. There were no any sheath rot symptoms observed in the immune germplasms. While, among the 27 resistant genotypes the lowest PSI value (1.48%) was scored on the Hangamchal followed by WAS 161-B-6-B-B-1-B (NERICA-L-38) with PSI value of 2.22%. On the other hand, three genotypes *viz.* CHOMRONG, IR 83222-F11-200 and Saegyejinmi scored the highest PSI value (10% each), though they are within the resistant group. Moreover, the susceptible germplasms such as Trakya and SCRID091-15-2-2-1-1 scored the highest PIS value of 50.15 and 54.56%, respectively. While all the rest germplasms were either moderately resistant or moderately susceptible with the PSI value ranging from 11.48 to 39.17% (Table 4).

Similar study was conducted by Jakkuva using 44 genotypes and got different reaction levels among the tested genotypes. The results of this study revealed that out of the 44 genotypes, none was found immune. Whereas, two, sixteen, fourteen, seven and about five genotypes, respectively, showed highly resistant, resistant, moderately resistant, moderately susceptible and susceptible reactions (Figure 1).

Similarly, classification of host reaction based on their PSI value revealed that the check varieties had variable response to the disease. Among the four check varieties, two of them (Erib and Wanzaye) were resistant while Idget was moderately resistant and X-jigna was moderately susceptible (Table 5).

Table 1: IRRI standard evaluation system for rice sheath rot severity rating scales (0 – 9) and descriptions.

Scale/ grade	Description
0	No lesion/spot on flag leaf sheath.
1	Spots visible on the tillers upon very careful examination (<1% flag leaf sheath area covered).
3	Spots visible on the tillers upon careful examination (1-5% flag leaf sheath area covered).
5	Spots easily visible on the tillers (6-25% flag leaf sheath area covered).
7	Spots present on almost whole the tillers parts (26-50% flag leaf sheath area covered) damage conspicuous.
9	Spots very common on whole the tillers parts (51-100% flag leaf sheath area covered), death of plants common, damage directly reduce severe yield loss.

Table 2: Percent severity index (PSI) and Host reaction (HR) to rice sheath rot disease.

Percent severity index (PSI)	Host reaction (HR)
0%	Immune
1-10%	Resistant
11-25%	Moderately resistant
25-50%	Moderately susceptible
50-75%	Susceptible
76-100%	Highly susceptible

Table 3: Mean square estimates from analysis of variance (ANOVA) for selected traits across blocks.

Sources of variation	DF	PH (cm)	PL (cm)	NFGPP	NETPP	DM	PSI %	TGW (g)	GY (kg/ha)
Unadjusted Block (b-1)	3	611.65	8.46	361.41	4.00	469.45	234.76	55.49	2580646.00
Adjusted entries (c+g-1)	83	114.61	1.50	131.47	1.04	28.50	137.70	13.17	948483.95
Unadjusted entries (c+g-1)	83	136.39	1.72	143.09	1.14	45.07	145.69	15.00	1030999.00
Among controls/Check (c-1)	3	221.47**	1.49 ns	102.96 ns	3.06 *	12.77 ns	622.68 **	37.99 **	4013079.14**
Among Test genotypes (g-1)	79	107.64**	1.50 ns	133.95 *	0.97 ns	27.93 ns	120.83 **	11.93 ns	843148.88 ns
Test genotype * check	1	344.21**	1.05 ns	21.53 ns	0.42 ns	120.97 *	15.81 *	37.12 *	76169.78 ns
Error (c-1) (b-1)	9	13.68	0.61	44.57	0.61	13.14	3.36	5.47	326574.81
Total (N-1)	95								
CV%		4.92	4.42	9.62	13.27	2.56	11.35	7.50	12.99

DF=Degree of Freedom, CV=Coefficient of Variation In Percent, PH=Plant Height in Centimeter, PL=Panicle Length in Centimeter, NFGPP=Number of Filled Grains per Panicle, NFTPP=Number of Fertile Tillers per Plant, DM=Days to Maturity, PSI=Percent Severity Index, HR=Host Reaction, R=Resistant, I=Immune, TWG=Thousand Grains Weight in Gram, GY=Grain Yield in kg/ha, **Significantly different at 1% level of significance, *Significantly different at 5% level of significance, ns=No significant difference.

Table 4: Mean percent severity index value and host reaction of rice germplasms against rice sheath rot disease.

S/n	Name of genotypes	PSI %	Reaction	S/n	Name of genotypes	PSI %	Reaction
1	Aromatic-1	9.85	R	41	IR74052-184-3-3	21.57	MR
2	Edirne	4.44	R	42	YUNJING 23	15.19	MR
3	Halilbey	23.56	MR	43	WAB502-8-5-1	16.3	MR
4	Osmancik-97	16.48	MR	44	PSBRC44	15.56	MR
5	Trakya	50.15	S	45	WAB376-B-10-H3	24.07	MR
6	Tunca	20.74	MR	46	IR 83222-F11-167	24.81	MR
7	Suitou Chuukanbohon Nou 11	3.33	R	47	IR 83222-F11-18	25.74	MS
8	Condai	12.13	MR	48	IR 83222-F11-200	10	R
9	Pepita	11.48	MR	49	IR 83222-F11-209	21.11	MR
10	Saegyejinmi	10	R	50	IR 83222-F11-66	5.56	R
11	Lunyuki	7.04	R	51	IR76999-52-1-3-2	5.56	R
12	Hangamchal	1.48	R	52	IR 83249-F9-29	8.52	R
13	Hawaghaelo-2	15.26	MR	53	STEJAREE 45	22.7	MR
14	Namcheobyeo	18.04	MR	54	CHOMRONG	10	R
15	Samgangbyeo	34.07	MS	55	WAB880-1-38-20-17-P1-HB	20.19	MR
16	SCRID091-10-1-3-2-5	21.78	MR	56	IRAT112	26.48	MS
17	SCRID091-15-2-2-1-1	54.56	S	57	WAS 161-B-6-B-B-1-B (NERICA-L-38)	2.22	R
18	SCRID091-18-1-5-4-4	12.22	MR	58	IR 83372-B-B-115-4	8.52	R
19	SCRID091-20-2-2-4-4	16.85	MR	59	IR 83377-B-B-93-3	12.59	MR
20	SCRID091-24-3-2-2-3	36.3	MS	60	IR 83383-B-B-141-2	25.19	MS
21	SCRID090-60-1-1-2-4	38.78	MS	61	IR 83372-B-B-115-3	31.11	MS
22	SCRID090-72-3-1-3-5	25.65	MS	62	IR80420-B-22-2	19.26	MR
23	SCRID090-164-2-1-2-1	6.78	R	63	IR80463-B-39-3	15.19	MR
24	SCRID090-177-2-4-3-4	20.93	MR	64	IR 72768-8-1-1	6.67	R
25	SCRID090-18-1-2-2-1	9.89	R	65	IR 75518-18-1-2-B	19.26	MR
26	SCRID091-20-3-1-3-4	39.17	MS	66	IR 75518-84-1-1-B	8.52	R
27	SCRID122-5-2-1-1-3	17.78	MR	67	YUNLU N0.33	0	I
28	SCRID122-13-1-1-4-3	28.52	MS	68	IR 81047-B-106-2-4	27.78	MS
29	SCRID186-72-1-1-2	34.44	MS	69	WAS 161-B-6-B-1 (NERICA-L-36)	5.19	R
30	SCRID198-73-5-1-3	10.74	MR	70	ARCCU16Bar-13-2-16-2-1-1	3.33	R
31	SCRID079-1-5-4-2	20.74	MR	71	Yungeng 44	7.78	R
32	EXP304	14.81	MR	72	Yungeng 45	8.15	R
33	FOFIFA 171	8.89	R	73	Yungeng 38	5.63	R
34	FOFIFA 172	17.22	MR	74	Fengdao 23	6.3	R
35	FOFIFA 167	3.33	R	75	KB-2	9.26	R
36	HR 17512-11-2-3-1-4-2-3	15.93	MR	76	Songgeng9	20.74	MR
37	SCRID014-1-1-1-1	0	I	77	P-28	14	MR
38	SCRID019-1-1-1-1-2	4.44	R	78	P-38	4.44	R
39	SCRID037-4-2-2-5-2	0	I	79	Li Jing 9	15.56	MR
40	SCRID113-3-5-3-5-4	5.56	R	80	Li Jing 11	16.67	MR

Agro morphological characteristics of immune and resistant germplasms

The mean performance of different germplasms occurring across different blocks is given in Table 5. The following characteristics were based on the data generated in sheath rot resistance screening experiment. Most of the immune and resistant germplasm had better agronomic and morphological performance as compared with the checks in all aspects, while some of them had equal or less agronomic and better resistance performance with checks. This is evidence that resistance and yield response are sometimes having inverse relation. Therefore, the resistant genotypes can be used as source of resistant gene(s) for crossing purpose with high yielding but susceptible varieties.

Among the 27 resistant germplasms, the highest yield was scored on Fengdao 23 (6462.50 kg h^{-1}), followed by Yungeng 38 (6301.02 kg h^{-1}), Yungeng 45 (6249.05 kg h^{-1}) and SCRID019-1-1-1-1-2 (6102.02 kg h^{-1}) as compared with other resistant and immune germplasms. In addition, these genotypes also had moderate performance in other agronomic, phenological and morphological traits (Table 6).

Similarly, of the three immune germplasms, namely SCRID014-1-1-1-1, SCRID037-4-2-2-5-2 and YUNLU N0.33, the highest yield (5974.11 kg h^{-1}) was scored on SCRID014-1-1-1-1

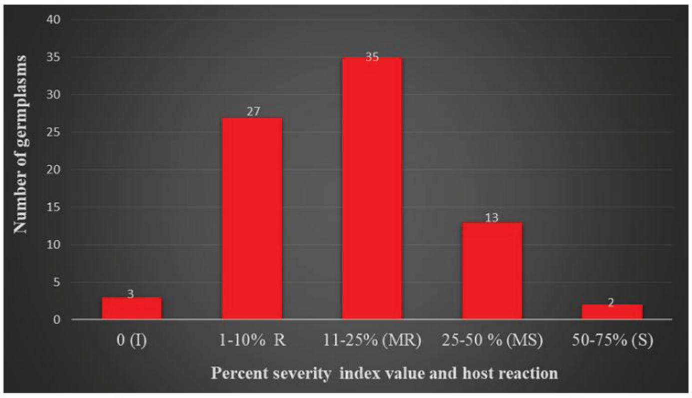

Figure 1: Reactions of 80 rice germplasms against sheath rot disease.

Table 5: Mean percent severity index value and host reaction of the check rice varieties against rice sheath rot at Fogera.

S/n	Name the check variety	PSI %	Reaction
1	Erib	5.83	R
2	Idget	20.90	MR
3	Wanzaye	4.074	R
4	X-jigna	30.13	MS

Table 6: Mean values of agro morphological traits of selected immune and resistant germplasms occurring at different blocks.

S/n	Genotype	PH (cm)	PL (cm)	NFGPP	NFTPP	DM	PSI %	HR	TGW (g)	GY (kg/ha)
1	Aromatic-1	64.73	16.73	64.29	6.87	140.33	9.85	R	34.73	3211.94
2	Edirne	69.27	16.67	63.71	8.00	128.00	4.44	R	31.98	4239.27
3	Suitou Chuukanbohon Nou 11	80.20	18.13	74.47	4.67	137.33	3.33	R	32.97	4272.01
4	Saegyejinmi	62.93	16.73	74.44	5.27	144.00	10.00	R	26.24	3189.59
5	Lunyuki	79.27	16.33	71.40	5.07	144.33	7.04	R	30.47	2395.36
6	Hangamchal	75.60	16.87	73.07	4.27	137.00	1.48	R	34.79	3840.01
7	SCRID090-164-2-1-2-1	91.33	17.87	72.29	5.73	137.00	6.78	R	33.11	4748.68
8	SCRID090-18-1-2-2-1	79.80	17.60	60.93	4.33	137.00	9.89	R	36.20	4439.29
9	FOFIFA 171	79.00	17.20	61.64	5.07	141.00	8.89	R	33.87	4774.28
10	FOFIFA 167	88.20	15.53	54.62	5.67	133.67	3.33	R	31.18	5501.32
11	SCRID014-1-1-1-1	92.00	17.33	76.56	7.00	139.67	0.00	I	27.13	5974.11
12	SCRID019-1-1-1-1-2	90.13	17.13	69.53	7.00	140.00	4.44	R	28.40	6102.02
13	SCRID037-4-2-2-5-2	87.73	16.93	82.24	7.13	140.00	0.00	I	28.63	5528.59
14	SCRID113-3-5-3-5-4	84.93	17.53	62.22	6.53	137.33	5.56	R	37.54	4813.07
15	IR 83222-F11-200	63.53	16.93	58.27	6.87	141.67	10.00	R	28.29	4644.31
16	IR 83222-F11-66	84.40	18.40	81.51	5.33	147.00	5.56	R	30.10	4547.39
17	IR76999-52-1-3-2	59.93	17.73	60.00	7.60	150.67	5.56	R	26.08	4966.75
18	CHOMRONG	83.80	17.60	51.04	6.75	133.67	10.00	R	34.28	4138.48
19	WAS 161-B-6-B-B-1-B (NERICA-L-38)	59.33	18.53	58.58	5.47	150.67	2.22	R	25.84	4076.84
20	IR 72768-8-1-1	59.13	18.73	71.24	6.13	152.00	6.67	R	27.85	4575.27
21	IR 75518-84-1-1-B	75.13	18.13	53.47	5.73	155.67	8.52	R	31.19	1917.42
22	YUNLU N0.33	85.47	19.20	86.22	5.27	146.67	0.00	I	32.77	5024.36
23	WAS 161-B-6-B-1 (NERICA-L-36)	54.40	17.87	60.40	5.93	149.67	5.19	R	29.35	3024.07
24	Yungeng 44	85.73	20.60	94.24	5.07	144.00	7.78	R	30.24	5977.10
25	Yungeng 45	83.40	21.20	109.98	4.73	145.67	8.15	R	32.37	6249.05
26	Yungeng 38	72.27	17.27	77.98	8.13	147.67	5.63	R	30.74	6301.02
27	Fengdao 23	78.00	18.60	85.73	5.27	146.00	6.30	R	29.41	6462.50
28	KB-2	68.80	18.13	76.51	5.80	142.67	9.26	R	27.22	3942.43
29	Songgeng9	74.13	17.70	57.78	5.80	147.67	2.59	R	32.13	5987.47
30	P-38	69.93	18.20	66.09	6.47	143.67	8.52	R	28.02	3894.43
	Adjusted grand mean	74.58	17.67	69.52	5.91	141.93	16.27		30.96	4388.60

LSD 5%	12.45	2.60	23.25	2.65	11.76	6.49		32.84	2043.57
CV%	4.92	4.42	9.62	13.27	2.56	11.35		7.50	12.99

*PH=Plant height in Centimeter, PL=Panicle Length in Centimeter, NFGPP=Number of Filled Grains per Panicle, NFTPP=Number of Fertile Tillers per Plant, DM=Days to Maturity, PSI=Percent Severity Index, HR=Host Reaction, R=Resistant, I=Immune, TWG=Thousand Grains Weight in Gram, GY=Grain Yield in kg/ha

Table 7: Mean values of agro morphological traits of selected immune germplasms along checks.

S/n	Genotype	PH (cm)	PL (cm)	NFGPP	NFTPP	DM	PSI %	HR	TGW (g)	GY (kg/ha)
1	Erib	69.82	17.45	69.34	5.18	138.67	5.83	R	30.44	5027.10
2	Idget	77.28	17.87	66.60	4.82	141.08	20.90	MR	35.09	3825.47
3	X-jigna	85.70	18.82	74.70	6.60	139.67	30.13	MS	29.38	3426.44
4	Wanzaye	84.88	17.62	62.62	6.37	136.83	4.07	R	35.29	5563.33
5	SCRID014-1-1-1-1	92.00	17.33	76.56	7.00	139.67	0.00	I	27.13	5974.11
6	SCRID037-4-2-2-5-2	87.73	16.93	82.24	7.13	140.00	0.00	I	28.63	5528.59
7	YUNLU N0.33	85.47	19.20	86.22	5.27	146.67	0.00	I	32.77	5024.36
Adjusted grand mean		74.58	17.67	69.52	5.91	141.93	16.27		30.96	4388.60
LSD 5%		5.91	1.23	11.03	1.26	5.58	3.08		15.58	969.35
CV%		4.92	4.42	9.62	13.27	2.56	11.35		7.50	12.99

as compared with other immune germplasms and almost nearly equal with high yielder resistant germplasms. Moreover, SCRID014-1-1-1-1 was superior over the check varieties and other immune germplasms in all other traits. While SCRID037-4-2-2-5-2 was performed almost as equal as Wanzaye variety and superior than other check varieties and the immune germplasm YUNLU N0. 33, which performs better than Idget and X-jigna varieties (Table 7).

It is clear from Table 7 that the immune genotypes gave high yield ranging from 5024.36 to 5974.11 kg h^{-1}, and no disease developed on them as compared with the checks. In addition, they had better plant height (ranging 85.47 – 92 cm), panicle length (16.93 – 19.20 cm), field grains per panicle (76.62 – 86.22) and fertile tiller per plant (5.27 – 7.13) (Table 7), which all have direct contribution for yield increment. On the contrary, the moderately resistant and moderately susceptible checks (Idget and X-jigna, respectively) had less performance in the above-mentioned traits compared with the immune genotypes. In fact, when a genotype is susceptible and attacked by sheath rot disease, it tends to give short plant height, short panicle length (un-emerged panicle) and chaffy grains, leading to yield reduction [1]. Lalan Sharma et al. [14] also reported that, the dwarf varieties appeared to be more prone to sheath rot because of their shortened internodes and poor exertion of the panicle from the flag leaf sheath.

Genotypes resistant to diseases, high yielder and good with other agronomic traits are of great interest for researchers as well as rice producers. In cognizant of this, the result of this study gave promising genotypes possessing traits of good agricultural importance (high yielder and disease resistance) like SCRID014-1-1-1-1 (Table 7), which the existing varieties do not have.

This result is in line with the findings of Simon [4], who screened 64 rice genotypes and observed different level of resistance among the genotypes, of which six genotypes were found to be resistant to the disease. Such types of genotypes served as sources of qualified variety development so as to ensure the satisfaction of rice producers to get high yield and high net return.

High net return is achieved by growing varieties having disease resistance, high yielder and with high market value or high consumer satisfaction. Unfortunately, the available varieties in Ethiopia lack either one or two of these important traits. Moreover, farmers in Fogera plain repeatedly reported that the market demanded cultivar 'X-jigna' is severely attacked by sheath rot disease. It is, therefore, hopped that the current study will alleviate this problem if the identified good traits possessed by genotype 'SCRID014-1-1-1-1 is properly used as a resistant donor parent to cross with the white color and market demanded X- jigna cultivar.

CONCLUSION AND RECOMMENDATIONS

The aim of this study was to screen rice germplasms for their resistance against sheath rot, one of the most important rice diseases that seriously threaten rice productivity in Fogera plains. Because of the fact that rice cultivation is relatively recent to Ethiopia, more research had not so far been done in the country towards the control of this disease. Genetic improvement of locally adapted cultivars through breeding for resistance to this economic disease would be the most sustainable and cost-effective strategy to tackle the threat caused by the disease. To this end, identifying sources of resistance among introduced germplasm was the first major step forward and results from this study revealed that 30 germplasms had different levels of resistance to sheath rot (3 immunes and 27 resistant).

Moreover, among the three genotypes found to be immune, genotype 'SCRID014-1-1-1-1' is more yielder than the newly released high yielder and resistant check, Wanzaye. Thus, it is possible to conclude that this genotype can be considered as both resistant and high yielder candidate variety for release having passed through verification and demonstration. Therefore, SCRID014-1-1-1-1 will be promoted for national variety verification trial along standard checks for the next cropping season.

Generally, all the three immune germplasms will be considered the best sources of resistant genes for sheath rot as far as varietal improvement is concerned especially since they are already adapted to most of Fogera's lowland rice growing ecosystems. Moreover, the 27 genotypes found resistant to sheath rot are additional source increasing the chance of broadening the genetic bases of rice as far as developing sustainable, better resistant and high yielder varieties.

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