Nigerian Journal of Ecology (2001) 3: 1-9

ISSN: 1116-753X

Field resistance of selected rice cultivars to the African rice gall midge, *Orseolia oryzivora* (Harris and Gagne) in Southwestern Nigeria

[1*]Omoloye, A.A., [1]Odebiyi, J. A. and [2]Singh B.N.

[1]Department of Crop Protection and Environmental Biology, University of Ibadan, Nigeria
[2]West Africa Rice Development Association, IITA, PMB 5320, Ibadan, Nigeria.

Abstract: Field studies were conducted in 1993 and 1994 wet seasons under irrigated lowland condition at two endemic locations (Itoikin and Ibadan) in Southwestern Nigeria, to evaluate 113 rice cultivars for resistance to the African rice gall midge, *Orseolia oryzivora*. The test cultivars were subjected to natural infestation using completely randomized design in three replicates. Quantitative assessment of damage by percent field infestation and ranking according to the International Standard Evaluation System for Rice revealed that only the nine *Oryza glaberrima* cultivars; Tog 5860, Tog 6216, Tog 6472, Tog 6589, Tog 6597, Tog 6629, Tog 6630, Tog 6631 and Tog 7442 possessed various levels of resistance, while all the *O.sativa* cultivars were susceptible. However, the 20 next best *Oryza sativa* cultivars that ranked moderately susceptible were selected for further evaluation and mechanism of resistance studies to this insect in order to obtain *O.sativa* donors. It is recommended that effective field screening of rice lines for resistance to the AfRGM should assess percent infestation levels at maximum tillering stage using both Standard Evaluation System for rice and quantitative statistical assessment methods.

Key words: Resistant, Rice cultivars, susceptible, Infestation, *Orseolia oryzivora*

Introduction

Rice is probably the most important staple food in the world today (Hawksworth, 1984). In Nigeria, the consumption pattern has changed from an occasional diet to a household menu (Wada and Ekpo, 1997). A partial ban on rice importation in 1985 by the Nigerian government encouraged local production from 0.76million hectares in 1986 to 1.2million hectares in 1990 (Luh, 1991). Insects, diseases and water deficits are the major constraints to stable rice production world wide (Khush, 1985; Arraudeau and Harahap, 1986; Imolehin, 1987).

Among the major insect pests, the African rice gall midge (AfRGM), *Orseolia oryzivora* (Harris and Gagne) has become the most important causing enormous damage to lowland rice in Nigeria (Ukwungwu et al, 1989; Ukwungwu and Misari, 1997). Whereas a closely related species, *Orseolia oryzae* Wood and Mason is prevalent in Asiatic rice growing areas (Heinrichs, 1994); the AfRGM is morphologically distinct and geographically restricted to the African continent (Dale,1994).

Damage to the rice crop ranged from 45% to 100% in the endemic areas of Akwa-Ibom, Anambra, Benue, Cross-river, Ebonyi, Imo, Kaduna, Lagos, and Niger states (Ukwungwu and Joshi, 1992). The use of synthetic insecticides has not produced satisfactory control of the insect (Ukwungwu, 1985; Alam, 1985). Whereas breeding for resistance to the African rice gall midge, *Orseolia oryzivora* in Africa is still in infancy, a lot of resistant cultivars to the Asia gall-midge, *Orseolia oryzae* have been developed and released with success. Therefore the main thrust of management of this pest is breeding for resistance (Ukwungwu *et al*, 1990; Ukwungwu and Misari, 1997;). However, according to Singh *et al.* (1997) the first step to a meaningful varietal development programme is the identification of the mechanism of resistance in the host plant. Consequently, this study was initiated in collaboration with the West African rice Development Association (WARDA) to evaluate selected rice cultivars for resistance to the *Orseolia oryzivora* in the field with a view to selecting resistant donors for studies on mechanisms of resistance and management of this pest.

Materials and Methods

The test rice cultivars evaluated in this study were obtained from the WARDA liaison scientist at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. The test entries comprised 104 *Oryza sativa* L. and 9 *Oryza glaberrima* Steud. lines. The *O. sativa* lines were drawn from the 10th International Rice Gall-Midge Nurseries (IRGMN), 1992 (42 entries); Second Regional African rice gall-midge Observational Yield Trial (RARGMOYT), 1993 (44 entries) and the Second Regional African rice gall-midge Yield Trial

(RARGMYT). 1993 (12 entries). The *O. glaberrima* entries were Tog 5860, Tog 6216, Tog 6472, Tog 6589, Tog 6597, Tog 6629, Tog 6630, Tog 6631 and Tog 7442.

The study was conducted under natural field infestation in two planting seasons. The first field screening was carried out at the WARDA out-station (Gall-midge endemic) experimental site, Itoikin, Lagos State, Nigeria during the 1993 wet season. This site is about 40 km south of Ijebu-ode (Latitude 6.83^{0}N, longitude 3.83^0 E,). The second was conducted in the 1994 wet season in two locations simultaneously at the WARDA out-station experimental site, Itoikin and the IITA, Ibadan, Nigeria. The Ibadan site is located on the Latitude 7.5^{0}N, longitude 3.90^0 E. The weather data for the two sites are presented in Table 1.

Before each screening, all test entries were subjected to a germination test. The cultivars that failed the test were heat-treated in an oven at 50°C for 72 hours to break the suspected seed dormancy. Thereafter the entries were seeded in the nursery in mid-June of each year of evaluation.

In the 1993 field Screening, all the 113 test cultivars were transplanted from the nursery at 21 days after seeding (DAS) in double rows of 5m length at the rate of one seedling per hill. Spacing was 20x20cm between and within rows. The experiment was laid out in three replicates using a completely randomized design. Two rows of each of the local susceptible (ITA 306) and partially resistant (Cisadane) checks were planted between every 10 rows of the test cultivars. Each replicate was bordered by five rows of the susceptible check to facilitate AfRGM population build-up for natural infestation. Inorganic fertilizer was applied at the rate of 40kg N, 40kgP_2O_5 and 40 kg K_2O as basal after transplanting. Top dressing of N each 20 kg/ha was applied at 20 DAT and 40 DAT after hand weeding. Field resistance was assessed by a count of total infested tillers (which is indicated by a cylindrical elongated galling of the shoot) at 25, 40 and 60 days after transplanting (DAT).

The damage scores were expressed as percentage field infestation per hill per entry and thereafter subjected to square-root transformation $(x + 1)^{1/2}$ before analysis of variance and mean separation by the least significant difference (LSD) at p=0.05 (Gomez and Gomez, 1984). The percentage field infestation per entry was also rated according to the International Standard Evaluation System (SES value) for rice (IRRI, 1988).

In the second field screening, a total of 53 promising cultivars consisting of nine *O.glaberrima* lines and 44 *O. sativa* lines selected from the 1993 field screening were re-evaluated simultaneously at the two sites (Itoikin and Ibadan) during the 1994 wet season. All establishment and other agronomic practices such as plot maintenance, fertilizer application and field data collection and analysis were as in the first field screening.

Results and Discussions

The test rice cultivars varied significantly ($p<0.05$) in their reaction to natural infestation of *Orseolia oryzivora* (Table 2 and 3). Symptoms of attack on all the infested cultivars were similar, characterized

Table 1: Weather data at the experimental sites in (June-September, 1993; 1994).

Month	Rainfall (mm)	Rainy-days/ month	Temperature (°C)		Relative humidity (%)	
			Min	Max	Min	Max
Itoikin 1993						
June	183.6	18	21.6	29.4	56	98
July	226.8	17	20.8	27.7	53	94
Aug.	154.3	12	21.1	27.2	52	92
Sept.	181.7	19	21.2	28.2	64	98
Itoikin 1994						
June	211.8	16	21.3	29.0	67	95
July	217.3	22	22.7	28.5	51	96
Aug.	147.6	16	22.0	33.6	56	92
Sept.	196.1	22	20.7	29.8	58	96
IITA 1994						
June	75.6	8	21.4	30.5	56	85
July	159.8	14	21.3	27.8	69	88
Aug.	72.5	13	21.4	28.2	66	87
Sept.	250.2	20	21.9	29.6	64	87

usually by an abnormal milky-whitish gall-like outgrowth on the shoot within which the larvae live, feed and develop. This shoot deformity has been described variously as 'Silver shoot gall' or 'Onion-leaf gall'. Each gall formed after infestation is a tiller loss because the tiller cannot produce panicle (Ukwungwu, 1984, 1985; Ukwungwu *et al*., 1989; Ukwungwu and Joshi, 1991). However, the rice plant cannot be attacked after panicle initiation.

Apart from ARC 5984 (20297) and IR 43342-10-1-1-3-3 in which infestation were higher 25 DAT than at 40 DAT (Table 2) at the 1993 field screening, results indicated significant increase ($p<0.0$%) in infestation with age of plant at 40 DAT and 60 DAT. Reason for this could be migration of invading first instar larvae from the main tiller into the side tillers. The ideal site for field evaluation of rice cultivars for resistance to rice gall midges, *Orseolia* spp. is an endemic site where infestation levels are consistently high and perennial

Table 2: Percentage field infestation of 113 rice cultivars by the African rice gall midge, *Orseolia oryzivora* at Itoikin, Southwest Nigeria; 1993 wet season

Entry	25DAT		40DAT		60DAT	
	% tiller* infestation	SES ranking	% tiller* infestation	SES ranking	% tiller* infestation	SES ranking
1. TOG 5860	0	HR	0	HR	0	HR
2. TOG 6629	0	HR	0	HR	0	HR
3. TOG 6630	0	HR	0	HR	0	HR
4. TOG 6631	0	HR	0	HR	0	HR
5. TOG 6472	0	HR	0	HR	0	HR
6. TOG 6597	0	HR	0	HR	0	HR
7. TOG 6589	0	HR	0	HR	0	HR
8. TOG 6216	0	HR	0	HR	0	HR
9. TOG 7442	0	HR	0	HR	0	HR
10. HEERA	0.77	R	0	HR	0.00	HR
11. TI447	0	HR	2.33	MR	2.33	MR
12. PTB10	0	HR	2.07	MR	2.86	MR
13. TOX 3716-15-1-1	2.60	MR	4.67	MR	4.63	MR
14. ARC 6605	2.06	MR	4.90	MR	5.70	MR
15. TOX 3580-41-2-2-3-2	2.77	MR	6.08	MS	5.77	MR
16. VELLUTHACHERA	1.90	MR	4.23	MR	6.00	MS
17. TOX 3562-61-1-3-3	7.03	MS	6.60	MS	6.10	MS
18. SHAKTIMAN	0	HR	5.80	MR	6.13	S
19. SURAKSHA	2.86	MR	5.20	MR	6.47	MS
20. TARA	0.67	R	5.20	MR	6.60	MS
21. TOX 3566-6-1-1-2	0.67	R	7.40	MS	6.70	MS
22. W1263	0	HR	5.77	MR	6.80	MS
23. TOX 4093-17-1	0	HR	7.00	MS	7.00	MS
24. TOX 3264-78-3-1-1-3	6.19	MS	7.50	MS	7.40	MS
25. TOX 3070-18-1-1-3	4.37	MR	7.37	MS	7.53	MS
26. SHAKTI	0	HR	6.57	MS	7.63	MS
27. KSHIRA	3.7	MR	7.03	MS	7.63	MS
28. TOX 3971-34-1-2	3.80	MR	7.17	MS	7.87	MS
29. ARC 5984 Acc 20297	7.20	MS	6.17	MS	8.00	MS
30 TOX 3562-61-2-2-3-1	2.27	MR	8.13	MS	8.03	MS
31. TOX 3552-64-1-1-3	0.63	R	6.00	MS	8.03	MS
32. PHALGUNA	0	HR	6.30	MS	8.03	MS
33. TOX 3402-6-3-2-2	4.70	MR	7.17	MS	8.07	MS
34. NEELA	2.70	MR	6.50	MS	8.07	MS
35. BW 348-1	3.40	MR	7.10	MS	8.30	MS
36. TOX 3552-80-3-3-3	1.37	MR	7.33	MS	8.43	MS
37. SAMALEI	0	HR	7.57	MS	8.47	MS
38. TOX 3580-45-2-2-3	0.47	R	3.40	MR	8.53	MS
39. TOX 4109-11-3	5.73	MR	7.87	MS	8.57	MS
40. TOX 3580-47-1-3-2	2.34	MR	6.90	MS	8.57	MS
41. TOX 4136-26-1	5.50	MR	8.37	MR	8.73	MR
42. TOX 3552-109-2-1-3-2	1.67	MR	7.71	MR	8.78	MR
43. IR 4744-257-1-3	0	HR	9.20	MR	9.13	MR
44. TOX 4136-41-3	8.37	MR	9.87	MR	9.17	MR
45. TOX 4136-38-1	0	HR	11.17	S	9.37	MR
46. TI0 ACC 55147	3.70	MR	9.07	MR	9.43	MR

Cont'd

47. BG 402-2	7.63	MR	10.57	MR	9.63	MR
48. BG 334-2	9.40	MR	12.87	S	9.73	MR
49. TOX 4093-12-3	1.20	MR	15.20	S	9.80	MR
50. IR 19319-5-3-3-2-1	6.17	MS	12.17	S	9.83	MS
51. IR 4744-257-1-2	0	HR	9.97	MS	10.17	MS
52. CISADANE (PRC)*	0.92	R	8.93	MS	10.23	MS
53. BG 12-1 (ACC 50691)	2.63	MR	13.07	S	10.23	MS
54. IR 32876-31-2-2-2	4.67	MR	11.13	S	10.40	MS
55. TOX 3967-17-1-3	3.50	MR	9.70	MS	10.53	MS
56. ARC 5984	3.27	MR	15.17	S	10.53	MS
57. TOX 3257-86-2-1-3-2	9.97	MS	14.03	S	10.57	MS
58. IR 31868-64-2-3-3-3	6.30	MS	7.63	MS	10.80	MS
59. W1263 (ACC 1057)	3.77	MR	8.21	MS	10.83	MS
60. RD 9	7.70	MS	12.13	S	11.00	S
61. RP 1045-25-2-1	2.33	MR	10.90	MS	11.07	S
62. TOX 3876-58-1-3	1.83	MR	12.30	S	11.13	S
63. TOX 3876-53-1-1	1.57	MR	13.37	S	11.13	S
64. PTB 12 ACC 53430	1.70	MR	11.07	S	11.30	S
65. IR 43342-10-1-1-3-3	9.73	MS	7.07	MS	11.37	S
66. CR 57-1900	3.83	MR	4.17	MR	11.43	S
67. BNKBR 1031-3-3-6	0	HR	10.33	MR	11.50	S
68. RP 2068-18-2-9	2.43	MR	9.67	MR	11.60	S
69. SUREKHA Acc 64681	4.03	MR	11.63	S	11.93	S
70. RP 2068-18-29	0	HR	8.17	MS	11.97	S
71. IR 35366-28-3-1-2-2	3.20	MR	4.93	MR	12.00	S
72. ESWARAKORA	0.57	R	0.96	R	12.00	S
73. IR 37344 ACC 800	9.37	MS	17.23	HS	12.03	S
74. IR 44661-128-4-3	3.80	MS	9.80	MS	12.03	S
75. IR 4744-10-2-3	0	HR	12.67	HS	12.07	S
76. PTB 12 ACC 5900	5.47	MR	9.42	MS	12.13	S
77. S287 B-39-1-3	9.83	MS	11.38	HS	12.23	S
78. IR 44661-141-3-1-1-2	0	HR	8.47	MS	12.27	S
79. IR 28526-44-1-1	4.60	MR	10.60	MS	12.30	S
80. IR 4744-10-2-3	3.33	MR	14.47	HS	12.33	S
81. TOX 3921-29-2	4.73	MR	14.63	HS	12.40	S
82. TOX 3255-82-1-3-2	2.30	MR	13.59	HS	12.50	S
83. BANGLA ACC 61078	1.67	MR	3.73	MS	12.53	S
84. BKN 6806-46-60	1.60	MR	8.77	MS	12.53	S
85. PTB 18	6.33	MS	8.87	MS	12.80	S
86. CR 199-1	6.27	MS	9.87	MS	12.87	S
87. S512 B-199	0.73	R	12.17	S	13.03	S
88. TOX 4136-38-2	7.40	MS	13.30	S	13.17	S
89. 75 - 159	2.10	MR	11.13	S	13.30	S
90. RPW 6-17	7.00	MS	12.00	S	13.30	S
91. PTB10 Acc 6271	2.53	MR	7.40	MS	13.46	S
92. IR 39379-190-2-2-3-1	0	HR	12.43	S	13.50	S
93. CR 95-JR-721-3	2.87	MR	9.00	MS	13.53	S
94. TOX 3809-38-1	1.43	MR	13.63	S	13.57	S
95. PTB 12 Acc 19310	2.00	MR	8.20	MS	13.70	S
96. ITA 306	6.67	MS	12.46	S	13.73	S
97. TOX 3908-14-2	4.67	MR	12.33	S	13.77	S
98. ARC 10660 Acc 21026	4.93	MR	4.67	MR	13.93	S
99. TOX 3809-23-1	6.30	MS	11.61	S	13.97	S
100. TOX 4093-15-3	2.27	MR	15.88	S	14.20	S
101. TOX 3876-56-1-2	9.47	MS	16.20	S	14.43	S
102. TOX 3255-82-1-3-2	4.00	MR	18.23	S	14.43	S

Cont'd

103. TOX 3876-56-1-4	0.77	R	17.90	S	14.47	S
104. SUWEON	6.00	MR	14.65	S	14.47	S
105. TOX 3090-35-2-3-3	0	HR	14.03	S	14.50	S
106. ITA 312	1.77	MR	17.93	S	14.70	S
107. PTB 21 TEKHAN	2.10	MR	6.20	MS	14.97	S
108. BANGLA Acc 58876	10.7	MS	10.23	MS	15.03	S
109. RD4 (17132)'	1.23	MR	6.37	MS	15.03	S
110. IR8	3.47	MR	15.47	S	16.30	S
111. IR 43526-523-1-1	1.63	MR	11.73	S	16.40	S
112. TOX 3073-17-1-3-3-3	5.90	MR	19.98	S	16.80	S
113. MUEY-NAWNG 62M	1.63	MR	5.40	MR	17.07	S
LSD (0.05)	1.70		0.93		0.94	

*DAT = Days after transplanting

Analysis was based on transformed data $(X + 0.5)^{1/2}$

Ranking for field resistance using Standard Evaluation System for Rice (IRRI, 1988): 0% (No damage)= highly resistant (HR); <1% = Resistant (R); 1% -5% = moderately Resistant (MR); 6% -10% = moderately susceptible (MS); 11% - 25% =Susceptible (S); >25% = Highly susceptible (HS).

Table 3: Percentage field infestation of the African rice gall midge, *O. oryzivora* at two sites in Southwestern Nigeria;1994 wet season

S/N	ENTRY	IITA, Ibadan site						Itoikin site					
		25DAT*		40DAT		60 DAT		25DAT*		40DAT		60 DAT	
		% tiller infestation	SES ranking	% tiller infestation	SES ranking	% tiller infestatio	SES ranking	% tiller infestatio	SES ranking	% tiller infestation	SES ranking	% tiller infestation	SES ranking
1	Tog 5860	0	HR	0	H	0	HR	0	HR	0	HR	0	HR
2	Tog 6631	0	HR	0	HR	0	HR	0	HR	0	HR	0	HR
3	Tog 6629	0	HR	0	HR	0	HR	0	HR	0	HR	0	HR
4	Tog 6216	0	HR	0	HR	0	HR	0	HR	0	HR	0	HR
5	Tog 6472	0	HR	0	HR	0	HR	0	HR	0	HR	0	HR
6	Tog 6597	0	HR	0	HR	0	HR	0	HR	1.28	MR	1.28	MR
7	Tog 6630	0	HR	0	HR	0	HR	0	HR	1.68	MR	1.68	MR
8	Tog 7442	0	HR	0	HR	0	HR	0	HR	178	MR	178	MR
9	Tog 6589	0	HR	0	HR	0	HR	0	HR	1.68	MR	1.68	MR
10	BW 348-1	2.70	MR	4.33	MR	1.80	MR	4.56	MR	5.86	MS	5.86	MS
11	Shakti	0.63	R	1.93	MR	2.64	MR	3.44	MR	7.92	MS	7.92	MS
12	Heera	1.97	MR	-	-	7 86	MR	-	-	-	-	-	-
13	Kshira	2.47	MR	3.10	MR	1.26	MR	1.98	MR	7.97	MS	7.97	MS
14	T1447	1.53	MR	4.77	MR	1.89	MR	2.30	MR	9.01	MS	9.01	MS
15	Suraksha	3.63	MR	4.07	MR	2.90	MR	5.20	MR	7.98	MS	7.98	MS
16	Velluthachera	1.67	MR	3.03	MR	2.47	MR	6.33	MR	7.92	MS	7.92	MS
17	Tara	2.13	MR	4.50	MR	2.03	MR	6.40	MR	8.57	MS	8.57	MS
18	Samalei	3.3	MR	3.77	MR	1.3	MR	2.27	MR	8.54	MS	8.54	MS
19	Shaktiman	2.68	MR	4.0	MR	2.90	MR	5.83	MR	8.96	MS	8.96	MS
20	TOX 3580-41-2-2-3-2	0.68	R	2.93	MR	0.73	R	4.33	MR	8.86	MS	8.86	MS
21	Tox 4093-17-1	2.44	MR	3.30	MR	1.57	MR	3.70	MR	9.66	MS	9.66	MS
22	Neela	2.46	MR	3.00	MR	3.30	MR	5.00	MR	9.78	MS	9.78	MS
23	TOX 3552-80-3-3-3	1.80	MR	3.73	MR	1.40	MR	3.82	MR	9.85	MS	9.85	MS
24	W1263	2.68	MR	5.20	MR	2.50	MR	7.86	MS	10.26	MS	10.26	MS
25	ARC 5984 Acc20297	3.24	MR	4.33	MR.	2.73	MR	533	MR	10.54	MS	10.54	MS
26	ARC 6605	2.64	MR	5.20	MR	2.50	MR	6.22	MR	9.54	MS	9.54	MS
27	PTB 10	2.40	MR	3.63	MR	2.40	MR	5.84	MR	9.28	MS	9.28	MS
28	TOX 3716-15-1-1	1.67	MR	2.97	M	1.67	MR	7.98	MS	10.26	MS	10.26	MS
29	Tox 3402-6-3-2-2	1.90	MR	2.83	MR	1.90	MR	5.26	MS	10.66	MS	10.66	MS
30	Tox3552-64-1-1-3	1.80	MR	2.40	MR	1.80	MR	6.77	MS	13.09	S	13.09	S

	Cont'd												
31	Cisadane	1.34	MR	3.93	MR	13.14	S	2. 3	MR	7.33	MS	12.47	S
32	Tox 3580-45	1.86	MR	2.60	MR	14.27	S	1.97	MR	8.93	MS	14.12	S
33	Tox 3580-47-1-3-2	1.23	MR	1.83	MR	14.89	S	3.64	MR	7.67	MS	12.89	S
34	Tox 3971-34-1-2	1.27	MR	4.57	MR	15.55	S	2.46	MR	5.67	MS	13.55	S
35	Agani	0.37	HR	2.37	MR	16.12	S	4.26	MR	7.65	MS	12.09	S
36	Tox 3264-78-3-1-1-1-3	1.10	MR	10.66	S	16.2	S	1.56	MR	8.66	MS	15.58	S
37	Tox 3552-109-2-1-3-2	1.26	MR	11.74	S	16.36	S	3.78	MR	9.74	MS	16.36	S
38	ITA 306	5.40	MR	6.17	MS	16.58	S	5.40	MR	6.20	MS	16.78	S
39	Tox 4109-11-3	2.00	MR	2.60	MR	16.94	S	2.24	MR	13.60	S	19.56	S
40	Phalguna	3.10	MR	3.20	MR	17.08	S	4.66	MR	11.66	S	21.98	S
41	Tox 4136-26-1	2.30	MR	2.73	MR	17.17	S	6.24	MR	15.57	S	22.08	S
42	Tox 3870-18-1-1-3	1.57	MR	2.70	MR	17.45	S	4.82	MR	12.66	S	25.68	HS
43	Tox 3921-7-1	1.10	MR	2.03	MR	17.51	S	5.64	MR	12.68	S	26.94	HS
44	Tox 3562-61-2-2-3-1	0.83	HR	3.13	MR	18.10	S	6.46	HR	14.83	S	17.58	S
45	Tox 3566-6-1-1-2	1.37	MR	12.03	S	18.13	S	4.68	MR	12.60	S	28.24	HS
46	Tox 3552-82-1-3-2	2.20	MR	3.67	MR	20.05	S	4.88	MR	16.93	S	27.66	S
	LSD (0.05)	2.77		2.34		0.78		77		2.34		0.78	

Analysis was based on transformed data (X + 0.5) $^{1/2}$

Ranking for field resistance using Standard Evaluation System for Rice (IRRI, 1988): 0% (No damage)= highly resistant (HR); <1% = Resistant (R); 1% -5% = moderately Resistant (MR); 6% -10% = moderately susceptible (MS); 11% - 25% =Susceptible (S); >25% = Highly susceptible (HS).

(Heinrichs et al., 1985). High rainfall, high humidity, good nitrogen application from either organic or inorganic sources and non-application of pesticides favour population build-up and high field infestation of the AfRGM, *Orseolia oryzivora* (Ukwungwu, 1984, 1985; Ukwungwu *et al.*, 1989; Ukwungwu and Joshi, 1991; Umeh *et al.*, 1992; Singh *et al.*, 1997). These favourable conditions were ensured for the field experiments. In addition, the weather conditions were also favourable for field infestation of the test cultivars at the screening sites. Ambient temperatures were relatively low both at the WARDA out-station experimental site, Itoikin in 1993 (24.7± 3.5°C) and in 1994 (26.0± 4.3°C); and at IITA, Ibadan in 1994 (25.3± 3.8°C). Rainfall was high both in quantity (>558mm) and frequency. At the WARDA out-station site, Itoikin; rainfall totaled 746.4 mm in 1993 and 772.8 mm in 1994 but was lower comparatively at the IITA, Ibadan site (558.1mm) during the period of the field screening. However, good irrigation facilities at the two sites in addition to favourable weather conditions provided the required high humidity.

The percentage field infestation of *O.glaberrima* entries (Tog series) by AfRGM were consistently lower ($p<0.05$) than the *O. sativa* entries (all other cultivars) at the two field screenings. In the 1993 evaluation, all the nine *O.glaberrima* lines and Heera; *an O.sativa* cultivar were not attacked (SES ranking = HR). Five cultivars; T1447, PTБ10, Tox 3716-15-1-1, ARC 6605 and Tox 3580-41-2-2-3-2 were rated moderately resistant (SES ranking =MR). 44 other cultivars with different levels of infestation were rated moderately susceptible (SES ranking = MS). All other cultivars with greater than 11% field infestation were rated susceptible and therefore rejected for further evaluation (IRRI, 1988). In the 1994 field screening, the resistance rankings of the test entries were consistent for the two sites (Table 3). Field infestation ranged between 0-28% (Itoikin site) and 0-20.1% (IITA, Ibadan site). However, unlike the first field screening in which the *O.glaberrima* lines were not attacked; Only Tog 5860 was completely resistant to infestation (SES ranking = HR). Percentage field infestation of other *O.glaberrima* lines were significantly lower ($p<0.05$) than all *O. sativa* lines. Although there were slight differences between percent field infestations of each test cultivar at the two locations (for example, percent infestation in Bw 348-1 < Shakti < Heera < T1447 < Suraksha < Velluthachera < Tara < Samalei < Tox 3580-41-2-2-3-2 < Tox 4093-17-1 < Neela at the Ibadan site whereas at the WARDA out-station experimental site, Itoikin; resistance ranking was Bw 348-1 > Tox 4093-17-1> Shakti > Heera > T1447 > Velluthachera > Suraksha > Tara > Samalei > Tox 3580-41-2-2-3-2 > Neela) there was no difference in the SES resistance ranking (MS) for all the cultivars. On this basis, only the nine *O.glaberrima* cultivars with resistance ranking; HR and R were selected as field resistant donors. This result indicates the great potential of *O.glaberrima* rice in the management of this pest. Reason for this could be that since both *O.glaberrima* rice and the AfRGM *O. oryzivora* are natives to Africa, they may have co-evolved with development of various resistance factors in the process (Ng *et al.*, 1991; Dale.1994). However, 20 *O. sativa* cultivars with less than 11% field infestation (MS) were also selected for further evaluation along with the *O. glaberrima* lines for mechanism of resistance studies since no resistance has been found yet among *O. sativa* cultivars to the AfRGM, *O. oryzivora* to date (Ukwungwu *et al.*, 1998).

Acknowledgement

This study was supported by a fellowship provided by the African Development Bank through the West African Rice Development Association (WARDA) to the first author. The International Institute of Tropical Agriculture, Ibadan, Nigeria provided institutional support. Messrs Olusegun Okhidievbe and Bayo Kehinde provided technical assistance.

References

Alam, M.S. 1985 Insect pest of rice and their control. Pages 120-131, in: *Proceedings of the National workshop on rice production Strategies* in Nigeria by C.O. Oputa, J.S. Nanda and R.C chaudharry (Eds). Federal Agricultural Coordinating Unit; Ibadan Nigeria.

Arraudeau, M. and Harahap, Z. 1986. Relevant upland rice breeding objectives. Pages 189-197, In: *Proceedings of the symposium on progress in upland rice research,* IRRI, Los Banos Philippines.

Dale, D. (1994). Insect pests of the rice plant their biology and ecology. Pages 363- 394, In: Biology and management of rice insects by E.A. Heinrichs (ed). Wiley: IRRI

Harris, K M and Gagne R.J. 1982. Description of the African rice gall midge *Orseolia oryzivora* sp.n. with comparative notes on the Asian rice gall midge *O. oryzae* w-m (Diptera: Ceccidomyiidae) *Bulletin of Entomological Research* 72:467-472.

Heinrichs, E.A. (1994). Host plant resistance Pages 517-694, in: *Biology and management of rice insects* by E.A. Heinrichs (ed). Wiley: IRRI

Heinrichs, E.A.; Medrano, F.G and H.R Rapusas 1985. *Genetic for resistance in rice*. IRRI los Banos; Philippines 356 pp.

Imolehin, E.D.,1987. Occurence of major foliar disease of upland rice in Nigeria. *Nigeria Agric. J.* **22**,48-55

Khush, G.S. 1985. Rice varietal improvement. Pages 111-126, in: *Proceedings of the 16th session of International Rice Commission* 10-14 June,1985, Los Banos, Laguna, Philippines.

Luh, B.S. (1991). Rice production Vol. 1(ed) New York: AVI - Nostrand Reinhold. 656pp

Ng, N. Q.; Chang, T.T.; Vaughan, D.A. and Zuno-Alto Veros, C. 1991. African rice diversity: Conservation and prospects for crop improvement. Pages 213-227; in: *Crop Genetic Resources of Africa Volume II* (Edited by N. Q. Ng, P.Perino, F. Attere and H. Zedan) IITA, Ibadan, Nigeria.

Ukwungwu, M.N and Joshi, R.C. 1992. The distribution of the African rice gall midge, *Orseolia oryzivora* Harris and Gagne and its parasitoids in Nigeria. *Tropical pest management* 38 (3): 241-244

Ukwungwu, M.N, 1985a. Effects of insecticides and varietal resistance on stem borers. *International Rice Research Newsletter* 10 (6): 120

Ukwungwu, M.N. 1985b. Effects of nitrogen and carbofuran on gall midge and white stem borer (SB) infestation in Nigeria. *International Rice Research Newsletter* 10 (6): 19

Ukwungwu, M.N. 1987a. Effect of spacing and nitrogen fertilizer on infestation by the rice gall midge *Orseolia oryzivora* H&G in Nigeria. *Tropical Pest Management* 33:164-165

Ukwungwu, M.N. 1987b. Influence of age of crop and time of planting on gall midge incidence. *International Rice Research Newsletter* 12 (3): 34 – 35

Ukwungwu, M.N. and Misari, S.M. 1997. Management of the African rice gall midge, *Orseolia oryzivora* Harris and Gagne, in Nigeria. *African Journal of Plant Protection* Vol.7 pp.27-34

Ukwungwu, M.N., Alam M.S. and K. Zan 1984. Incidence of gall midge *Orseolia oryziwora* H&6 in Edizhigi, Nigeria. *International Rice Research Newsletter*, 9(3): 21

Ukwungwu, M.N., Williams C. T. and Okhidievbe, O. 1998. Screening of African rice, *Oryza glaberimma* Steud, for resistance to the African rice gall midge, *Orseolia oryziwora* Harris & Gagne. *Insect Science and its Application* 18 (2) :167-170

Ukwungwu, M.N., Winslow, M.D. and John, V.T. 1989. Severe outbreak of gall midge *Orseolia oryziwora* H&G in the savannah zone of Nigeria. *International Rice Research Newsletter* 14(4): 36-37

Umeh, E.D.N, R. C. Joshi and M.N Ukwungwu 1992. Biology, Status and management of rice insect pests in Nigeria. *Crop Protection* 11:408-413.

Wada, A.C. and E.J.A. Ekpo 1997. responses of twenty upland rice lines to blast disease in natural and artificial inoculation tests in the field. *African Journal of Plant Protection* Vol.7 pp.83-93

***Corresponding author:** Dr. A.A. Omoloye
<bayoomoloye@yahoo.com>