ASSESSMENT OF NINE (9) RICE GENOTYPES AGAINST AFRICA RICE GALL MIDGE (*OzioliaOryzivora*) INFESTATION IN NIGERIA

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Abstract
Worldwide there has been a growing interest in exploring host plant resistance for plant protection, thus these trials were conducted to assess level of resistance of some rice genotypes to Africa rice gall midge (*Ozioliaoryzivora*). The trial consisted of 9 entries where 7 were test genotypes and 2 were Check entries (FARO 44 and 67). The experiments were laid out in Randomized Complete Block Design (RCBD), replicated three (3) times. Data were collected on the following parameters Tiller count, Plant height (cm), days to 50% flowering, Panicle count, Grains per panicle, Grain yield and incidence of Africa rice gall midge. Collected data were subjected to analyses of variance (ANOVA) and significant means were separated using Least significant Difference (LSD) at $p<0.05$. The results show Brridhan74 had lowerincidence of Africa rice gall midge and higher grain yield. Whereas, Brridhan100 had higherincidence of Africa rice gall midge and lower grain yield. Thus, its concluded that Brridhan74 is moderately resistant toAfrica rice gall midge and can be use as component of integrated pest management in rice field insect pest control.

Key words: Rice Gall midge, tiller, incidence, genotype and resistance.

Introduction

Rice is the most eaten staple food all over the world, more than half of the global population depends on the rice as a major part of their diet. In fact, rice is considered a vital part of nutrition in much of Asia, America, Africa, and the Caribbean, and is estimated to provide more than one-fifth of the calories consumed worldwide by humans. The total world rice production for 2021 was 787,293,867 metric tonnes(F.A.O. 2021). Sequel to the growing importance of the crop, FAO estimated that annual rice production should be increased from 686 million metric tons in 2020 to meet the projected global demand of about 856 million metric tons by 2030 (F.A.O 2021 ; Udemezue, 2014). In Nigeria consumption had increased because of increased local production of the commodity. The consumption rate now is 7.9 million tones and the production rate has increased to 5.8 million tons per annum (RIFAN 2017). Rice is produced and used in several ways. The kernels are dissolved and used in the manufacture of glue. Rice starch is often incorporated into beers. Paints are made of powdered rice. The dried stems are usually component of animal feeds and also utilised in making straw hats and sandals (Linares, 2002). Rice is also believed to have medicinal properties and has been used in many countries for health curetive purposes. In the Philippines, polished rice residue is used as a source of Vitamin B to prevent and cure beri-beri, (Muzaffar *et al.,* 2005). The by-products of milling, including bran and rice polish (finely powdered bran and starch resulting from polishing), are sometimes used as livestock feed. Oil is processed from the bran for both food and industrial uses. Broken rice is used in brewing, distilling, and in the manufacture of starch and rice flour. Hulls are used for fuel, packing material, industrial grinding, fertilizer manufacture, and in the manufacture of an industrial chemical called furfural. The straw is used for feed, livestock bedding, roof thatching, mats, garments, packing material, and broom straws. Despite rice becoming an important cereal and staple food crop its production in Africa is still the lowest in the world and cannot meet the increasing demand for rice in many African countries (Hossain, 2006). Unless this situation is reversed, food dependency will increase in much of the continent. The production-consumption gap in this region is due to low yield of rice (AfricaRice, 2007). A wide range of constraints affect rice production in Nigeria mostly abiotic, biotic, socio-economic and management (Ngala 2013). The abiotic constraints include: drought, flooding and variable rainfall, extreme temperatures, salinity, acidity/alkalinity and poor soils, soil erosion and high phosphorus fixation. The biotic constraints include weeds, blast leaf spots, Nematodes are a serious problem in continuously mono cropped dry land rice fields (Coyne *et al.*, 2004). The major insect pests that attack rice include stem borers, leaf miners, root feed insects, rice hispa, birds and rodents (Cheseriek *et al.*, 2017).African rice gall midge, *Orseolia oryzivora*, is an important insect pest of rain-fed and irrigated lowland rice with documented occurrences in various African nations (Nwilene *et al*., 2006). In Nigeria, the midge is known to be endemic in the North-central and southeastern regions of the country (Ogah, *et al.* 2011). It causes up to 77% damage to rice tillers in these regions of the country (Nwilene *et al.* 2023) as well as yield losses of up to 80% in West Africa (Nwilene *et al*. 2006). The larval stage of the midge exhibits a destructive behavior by feeding inside the young tiller, leading to the development of a distinctive long tubular gall or silver shoot gall. The infested tillers suffer irreversible damage by impeding their growth potential and preventing them from reaching the panicle stage (Ukwungwu and Misari 1997; Ogah 2007; Echezona, and Umeh 2007). This underscores the critical threat posed by AfRGM to rice production systems, emphasizing the urgent necessity for implementing effective pest management strategies to mitigate its impact.

Methodology

These trials were carried out under irrigated lowland ecology in 2021 cropping season at Birnin Kebbi (Kebbi state) and Guzan (Niger state) respectively.The trials consisted of 9 entries where 7 were test genotypes and 2 were Check entries (FARO 44 and 67). The experiments were laid out in Randomized Complete Block Design (RCBD), replicated three (3) times. Rice seeds were seeded in the nursery raised bed of 2m x 2m. Seedlings were maintained in nursery bed for 21 days when they were ready for transplanting. Transplanting was done at 1 seedling per hill in rows at spacing of 20 cm x 20 cm inter- and intra- plant spacing. Fertilizer was applied at the rate of 40 kg/ha of N, P_2O_5 and K_2O using NPK(15:15:15) as basal dressing while an additional 40kg/ha of N using urea was applied again at three weeks after transplanting. Weeding was done manually twice at 21 and 40 days after transplanting. Data were collected on the following parameters Tiller count, Plant height (cm), days to 50% flowering, Panicle count, Grains per panicle, Grain yield,assessing the incidence of damagedue to *Orzeoliaoryzivora* (tillers with galls) at 40 and 60 days after transplanting was done according to standard evaluation system of International Rice Research Institute (IRRI, 2003) by selecting ten tillers at random and the damage injury rates were calculated as follow:

$$\text{Incidence} = \frac{\text{No. of hills with galls}}{\text{Total no. of hills}} \times 100$$

Collected data were subjected to analyses of variance (ANOVA) Arcsine transformation was carried out on percentage tiller infestation prior to ANOVA (SAS, 2003). The significant means were separated using Least significant Difference (LSD) at $p<0.05$.

Results

Days to 50 % flowering

Table 1 shows that at both Kebbi and Guzan locations Brri dhan64 and Brri dhan72 attain 50 % flowering earlier compared to other genotypes. Whereas,FARO 67 and Butaroma-2 attend 50 % flowering latest. They attained 50 % flowering in both locations after 100 days. The remaining genotypesBrri dhan74, Brri dhan84, Brri dhan100, FARO 44, and Brri dhan62 are medium maturing.

Plant Height

There was significant variation in plant height among the 9 genotypes evaluated at $p<0.05$.Brri dhan72 and Faro 67 had the tallest plant height while, faro 44 had the shortest plant height among the 9 entries tested (Table1).

Tiller number

It is observed that the tillering capacity of the 9 genotypes assessed were not similar. The highest tiller per meter square was obtained in plots where Brri dhan100 were planted and was significantly higher than tiller number of other assessed genotypes.While, the lowest tiller per meter square was obtained in plots planted with Brri dhan64 (Table 1)

Table 1;**Number of days to 50% flowering, plant height and tiller number at kebbi and Guzan in 2021 dry season**

Designation	No. of days to 50%flowering Kebbi	Guzan	Mean	Plant Height(cm) Kebbi	Guzan	Mean	No tiller/M^2 Kebbi	Guzan	Mean
Brridhan62	95.4	76	91	115.7	76.7	98.5	578.5	335	457
Brridhan64	90.0	70	81	122.9	86.5	101.7	475.0	220	348
Brridhan72	93.0	71	91	129.5	110.4	100.2	583.3	308	445
Brridhan74	93.4	78	93	107.0	83.7	66.1	625.0	272	448
Brridhan84	94.7	77	91	111.3	88.7	75.8	566.7	240	403
Brridhan100	95.3	76	91	116.8	85.1	82.5	616.7	348	483
Butaroma-2	106.3	80	98	107.7	87.6	84.1	566.7	260	413
Faro44	93.4	86	101	104.7	82.7	76.6	625.0	267	446
Faro67	106.3	102	102	109.7	117.8	89.1	641.7	280	461
5%LSD	**3.3**	**4.2**	**3.7**	**5.3**	**10.1**	**3.03**	**95.5**	**58.5**	**77.0**
CV %	**1.8**	**3.0**	**2.4**	**2.6**	**6.4**	**4.34**	**9.3**	**12.0**	**10.7**

Panicle per Meter Square

Table 2 shows that there was significant difference in panicle per meter squareat 5 % level of probability among the tested genotypes. Although, Brridhan74 and FARO 67 had higher mean panicle per meter square, the variation of panicle per meter square among the nine evaluated genotypes followed this order Brri dhan74 = FARO 67 = Brridhan 100 = FARO 44 < = Butaroma-2= Brridhan84 = Brridhan72 >Brridhan64 = Brridhan62.

Grain Yield

Also Brridhan74 had the highest grain yield in both Kebbi and Guzan locations with grain mean weight of 9404kg/ha. However, Brridhan62 had the lowest grain yield in both locations with grain mean weight of 7033.50kg/ha.

1000 Grain Weight

The mean 1000 grain weight was also significantly higher in plots planted with Brridhan74 and FARO 44. Whereas, the lowest 1000 grain weight was obtained in plots planted with Brridhan100.

Table 2; **Number of panicle/m2, grain yield, panicle length and 1000 grain weight at kebbi and Guzan in 2021 dry season**

	No of Panicle/M2			**Grain yield(kg/ha)**			**1000 grain Weight**		
Designation	**Kebbi**	**Guzan**	**Mean**	**Kebbi**	**Guzan**	**Mean**	**Kebbi**	**Guzan**	**Mean**
Brridhan62	456.7	130	293	8795	5272	7033	24.5	30.0	22.3
Brridhan64	416.7	180	298	9333	5748	7541	23.7	23.3	23.5
Brridhan72	550.0	203	377	9444	7030	8237	23.7	30.0	26.8
Brridhan74	625.0	282	448	11778	6546	9162	27.3	26.7	27.0
Brridhan84	541.7	225	383	9861	6075	7968	19.7	26.7	23.2
Brridhan100	533.3	232	407	9346	6007	7644	17.7	20.0	23.8
Butaroma-2	550.0	233	392	9472	6732	8102	24.3	20.0	22.2
Faro44	575.0	264	425	8917	6372	7698	24.3	30.0	27.2
Faro67	616.7	225	421	10250	6120	8185	23.7	26.7	25.2
5%LSD	**88.8**	**56.0**	**72.4**	**1133.9**	**787.3**	**960.6**	**1.7**	**7.0**	**4.3**
CV %	**9.2**	**14.8**	**12.0**	**6.6**	**7.3**	**7.0**	**4.1**	**15.5**	**9.8**

Number of Filled Grains

At both locations (Kebbi and Kuzan) Brridhan72 and Brridhan64 had higher number of grains per panicle compared to rest entries and the lowest number of grains per panicle was obtained from plots planted with Brridhan 74 (Table 30)

Gall midge at 40 and 60 Days

Table 3 shows that at both locations (Kebbi and Guzan) and days after transplanting (40 and 60 Days) there was higher number of Africa rice gall midge on FARO 67, Brridhan 74 and Brridhan 72. Whereas, the lowest number of Africa rice gall midge were found in plots planted with Brridhan 64 and Brridhan 62.

Table 3; **Number of filled grains/panicle, Number of grains/panicle and Gall midge incidence at kebbi and Guzan in 2021 dry season**

Designation	**No. of Grain/panicle**		**Gall midge at 40Days**		**Gall Midge at 60 Days**	
	Kebbi	**Guzan**	**Kebbi**	**Guzan**	**Kebbi**	**Guzan**
Brridhan62	255.6	245.6	5.9	8.3	7.9	8.1
Brridhan64	259.9	245.3	3.3	4.5	5.1	6.1
Brridhan72	265.3	256.3	8.0	11.2	8.5	9.5
Brridhan74	126.7	116.7	3.5	6.5	6.5	5.5
Brridhan84	157.7	150.7	6.6	4.7	8.6	8.0
Brridhan100	199.7	149.7	9.1	10.4	10.2	10.2
Butaroma-2	180.2	190.0	6.3	9.0	7.8	7.7
FARO 44	149.5	144.3	7.7	7.6	8.7	7.7
FARO 67	229.7	221.0	8.9	12.4	8.4	9.4
5%LSD	**7.1**	**6.2**	**2.2**	**8.7**	**3.1**	**2.9**
CV %	**1.9**	**1.9**	**20.2**	**27.1**	**22.2**	**24.0**

Discussion

Variationsobserved in tillering capacityamong the genotypes evaluated.may be attributed to their inherent trait This suggest that the significant difference in tiller count among the tested genotypes were due to inherent trait, not as a result of influence ofAfrican rice gall midge (*OrseoliaOryzivora)* infestation. Lower Africa Gall midgefound onRice plots whereBrridhan 64 and Brridhan 62were plantedis an indication that some genotypes are resistant to infestation of African rice gall midge (*OrseoliaOryzivora)* and thus can be incorporated in integrated approach of managing African rice gall midge (*OrseoliaOryzivora)* in rice fields. This confirms earlier finding of (Wada *et. al.* 2012) who remarked that FARO51 is moderately resistant variety to African rice gall midge (*Orseolia. Oryzivora)* and can be utilized along spraying of insecticide in integrated pest management.The trend of Africa rice Gall midge's (*Orseolia. Oryzivora)* incidence also show that there is build up at later age of rice growth than the earlier stages as the highest incidence and severity was found at 61 DAT, this is indicating that the infestation of Africa rice Gall midge's (*Orseolia. Oryzivora)* on rice is not age specific as incidence was noted as early as 21 DAT and continues till 63 DAT thus control measure have to be throughout the vegetative stage.Higher tillers observed in Brridhan100 and FARO 67 may be due to its susceptibility to infestation and damage by African rice gall midge (*Orseolia. Oryzivora).* It seemed that the ability to compensate, was induced by damage to the primary tillers; hence, compensation was higher in susceptible genotypes (Brridhan100 andFARO 67), This is in line with earlier finding of (Ogah *et al.*, 2012), who reported that gall initiation that mostly takes place at the early vegetative stage of the rice growth stimulates tillering. However, this profuse tillering due to infestation results in stunting, bushy appearance of rice plant and affect yield (Nwilene *et al*., 2006). The grain yield in susceptible genotypeBrridhan100 can be attributed to higher incidence and severity of African rice gall midge (*Orseolia. oryzivora).* This validates the findings of (IRRI 2000) that any tiller that is attacked by African rice gall midge (*Orseolia. oryzivora)* is irreversibly damaged and can't produce panicle and also in line with the findings of (Souleymane *et al.,* 2016). Who observed that one per cent of tillers damaged by African rice gall midge (*Orseolia. Oryzivora)* in rice fields resulted in 2% grain yield loss

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