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Short Communication

REACTION OF LOCAL AND IMPROVED CULTIVARS OF RICE TO IRON TOXICITY IN A RAINFED LOWLAND ECOLOGY AT EDOZHIGI, NIGERIA

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ABSTRACT
One hundred and nine rice varieties were screened for their reaction to iron toxicity. The trial was conducted at Edozhigi, Niger state in Gbako Local Government Area, in a natural field condition. The experiment was laid out in a randomized complete block design replicated three times. Entries were planted in single rows of 5m each at a spacing of 20 x20 cm. Iron toxicity scores were taken at 40 and 60 days after transplanting (DAT) for three years. The results showed that entries were more susceptible in the first year than in other years, and more resistant in the third year than in the other years. The overall mean for the three years showed that the scores were between 3 – 5 (moderately resistant to moderately susceptible reactions). However thirty two entries had scores of 1 and 2 at various scoring periods within the three years. Entries with lower scores at various times could be reevaluated to be used for iron toxicity prone areas.

Key words- bronzing, rice and Oryza spp

INTRODUCTION

Iron toxicity also known as bronzing, is a nutritional disorder of lowland rice associated with excess water-soluble iron. It is one of the most wide spread nutritional symptoms of lowland rice in the world (Audebert and Fofana, 2009). It appears on various soil types especially on acid surface soils (Ponnomperuma *et al.,* 1973; Beye *et al.*, 1975). According to Ponnomperuma, (1972), the conditions favorable for development of iron toxicity include, low pH, dryness of soil, high content of iron oxide, poor drainage and contiguity with ferruginous lateritic high land.

Iron toxicity is characterized by development of many small brown spots on the leaves, starting from the tips, which develops into a purple, reddish brown or yellow colour, followed by leaf drying. Roots of affected plants are dark brown, scanty and coarse. A high percentage of spikelet sterility occurs in very susceptible cultivars. Howler (1973) reported that bronzing symptoms are direct effect of iron toxicity and attributable to excessive absorption and accumulation of iron in the plant. Virmani, (1979) observed that the intensity of symptoms on four rice cultivars at Suakoko varied with the rice varieties, and reported that the rate of development of toxicity symptoms depended on the level of tolerance of a cultivar. Various methods have been proposed to reduce iron concentration in the soil, which include, drainage of the field, application of balanced nutrient and ridge planting (Singh *et al.,* 1997). However the use of resistant varieties is often advocated (Virmani, 1979; Singh *et al.,* 1997). Therefore this study was carried out to select promising cultivars to be used for hybridization programs and cultivation in soils with reported incidence of iron toxicity.

MATERIALS AND METHODS

One hundred and nine rice varieties were screened for three years in an iron toxicity prone rainfed lowland ecology at Edozhigi in Niger state, Nigeria. Edozhigi is located in latitude 9^{o} 05^{1}N and longitude 5^{0} 50^{1}E. The experiment was laid out in a randomized complete block design replicated three times. Each entry in a replicate was planted in a single row of 5 m length and spaced 20 cm x 20cm apart. The experimental plot was weeded thrice and NPK fertilizer was applied at the rate of 80: 40: 40 N_2; P_2O_5; K_20 kg/ha. Iron toxicity was scored by observing the bronzing effect on the leaves. This was done using the standard

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evaluation system for rice (IRRI, 1996). The scoring was taken at 40 and 60 days after transplanting. The rating was done as follows.

Scores	Rating
0	Highly resistant
1	Resistant
3	Moderately resistant
5	Moderately susceptible
7	Susceptible
9	Highly resistant

The varieties with FARO names are improved varieties from National Cereals Research Institute Badeggi, while the TOS lines are landraces collected from International Institute of Tropical Agriculture, the remaining are local varieties collected from farmers' field.

RESULT

The reaction of the entries at various dates in first, second and third years are presented in Fig 1. Only five entries had score of 1 in the first year at 60 DAT while in the second and third years more entries had a score of one. The highest was in 40 DAT in year 3 (thirteen entries). The score rate of one represents a resistant reaction. Most of the entries reacted to the toxicity at the rates of 3 and 5, that is, moderately resistant to moderately susceptible reaction. The highest was 60 entries in year 3 at 60 DAT (score rate of 3). Considering the score rate of 5 the highest number of entries was in year 1 at 40 DAT (63 entries). At susceptible level which is the score rate of 7 few entries reacted to the toxicity, 15 entries at year 1 (40 DAT) and no entry at year 2 at 40 DAT. Ten entries gave a score of 9 (highly susceptible) at 60 DAT year 1.

The result in table 1 shows the summary score for the three years. Thirty one of the entries showed a score of three which is moderately resistant. Most of these entries are farmers' varieties and land races. The remaining entries had scores of 4 and 5 which is moderately susceptible. None of the entries showed high susceptibility and high level of resistance when the mean data of the three years was considered.

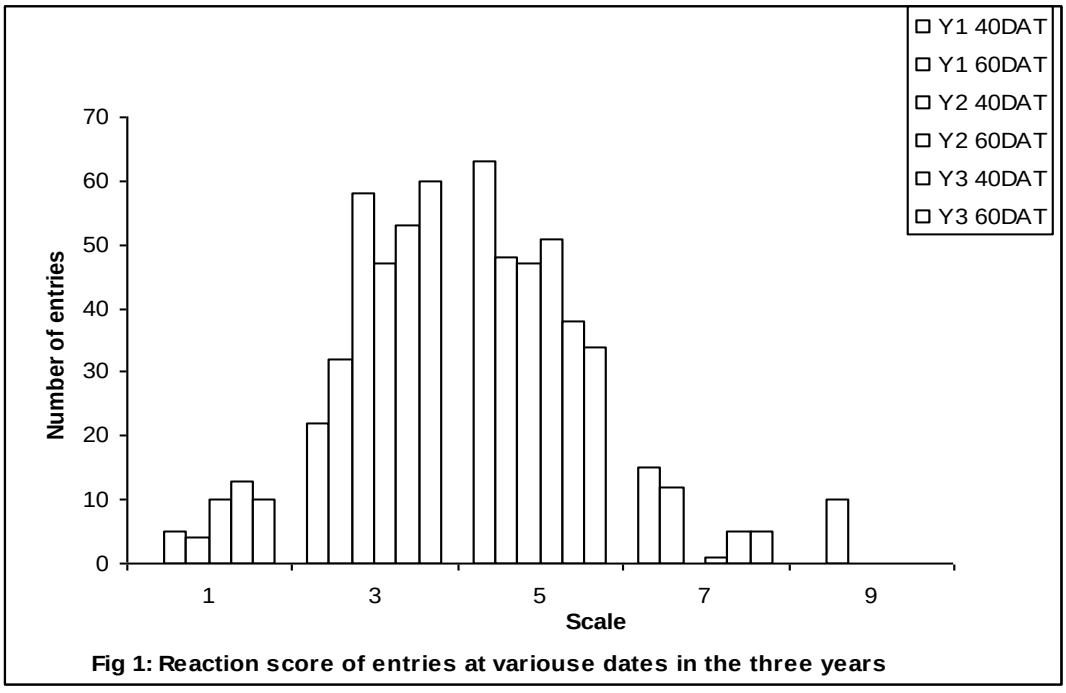

Fig 1: Reaction score of entries at variouse dates in the three years

Table 1: Reaction of rice varieties to iron toxicity, mean of three years

Scale	Name:
3	Kparazhikogi, Faro-sipi, Manbechi(Ed), Danboto, Manbekochi, Ladanchi, Ebangichi(Ed) Akpuruka, Faro-sipi Manbechi (Kb), Bokuchi,Gyanako,(Ch), Ebangichi (Gd), Nasara 2 Manbechi (Gz), Kparazhikogi, Janiri, Faro 17, Faro 22, Faro47, Faro 8, Faro 44, Faro 48 Faro46 Tos 7730, Tos 8081, Tos 8189, Tos 9285, Tos 14499, Tos 8163.
4	Tomawawagi, Toma, Gyanako, Philippines, Danmale, Gbagudu, Jufangi, Somazhigi, Shakuyagi, Ndawodzufangi, Shagari, Gyanako, Bisanleyaoklo, Eyewawagi, Ndachelegbo, Pasakunya, Bubanfari, Egwazawunkpa(Gz), Ebangichi(Ba), Sagannuwungi Ebangichi (Ku), Ebangichi (Gb), Egwazawunkpa (Do), Gargaza, Dokochi, Nnakashikpanti, Dubbu 1, Farnkuara, Kpuruga, HTA 60, Faro 1, Faro 32 Faro2, Faro 21 Faro10, Faro23, Faro34, Faro36, Faro15, Faro29, Faro50, Faro30, Faro39, Faro35, Faro28, Faro33, Faro 43, Faro 40, Faro19, Faro5, Tos8089, Tos12465, .
5	Nasara 1, Finniko, Ndachele Ndabissan Tomako, Gabachi, Mass, Jarankuara, Janiri, Egwazawunkpa(Ba), Dubbu 2, Nasara 2 Faro4, Faro31, Faro 12, Faro18, Faro38, Faro 51, NCRI1, Faro28, Faro13, Faro37, Faro 7, Faro 27, Faro20 Tos14519.

Table 2: Best selection for iron toxicity for the three years

Year	Date of score	Varieties	Score
1	40DAT	Landanchi	2
		Toma	2
		Gyanako	2
		Gbagudo	2
		Manbekochi	2
		Dubbu 2	2
		Faro 11	2
		Faro 16	2
2	40 DAT	Tomawawagi	1
		Danboto	1
		Bubanfari	1
		Ebangichi (Gz)	1
	60 DAT	Nasara	1
		Manbechi (Gz)	1
		Kparazhikogi	1
		HTA 60	1
		Faro 8	1
		Faro 48	1
		Faro 51	1
		Faro 27	1
		Faro 5	1
3	40 DAT	Philippines	1
		Ebangichi (Ed)	1
		Danmale	1
		Ebangichi (KK)	1
		Manbechi (ED)	1
		Akpuruka	1
		Manbechi (Gz)	1
		HTA 60	1
		Faro 10	1
		Faro 34	1
		Faro 15	1

Entries with best reaction to iron toxicity are shown in Table 2. These reactions ranged between 1-2. More selections were made in 2002 compared to other years. More of local varieties featured among the selected materials than the improved, with no landrace in this table. Common entries for the years include Kparazhikogi, Bubanfari, Manbekochi, Danboto, Manbechi (GZ) and Manbechi (Ed).

DISCUSSION

This study has indicated low rate of scoring for iron among these varieties. Varietal responses are between 3-5 when the three years is considered together. In all the scores the local varieties were found to be better than the improved varieties in terms of their reaction to the stress. According to WARDA, (2001-2002) traditional varieties that are being grown and selected by farmers for many years tend to have a measurable level of iron toxicity tolerance. They discovered that an improved variety like Bouake 189 cultivated in Cote d'Ivoire is more susceptible. This agrees with the findings in this study where most of the local varieties had a score of 3 compared to improved varieties with a score of 5. It has been identified that 60% of the lowland rice grown in West and Central Africa may be at risk from iron toxicity (WARDA, 2001-2002). Average yield loss due to iron toxicity amounts to 50%, and could range from 10 to 100%. This suggests a serious production constraint to farmers.

REFERENCES.

Audebert A and Fofana M (2009). Rice yield gaps due to iron toxicity in West Africa. J. Agronomy and Crop Science. pp 66-76

Beye, G., M. Toure., and G. Auriel (1975). Acid sulphate Soils of West Africa: Problems of their management for Agriculture use. *IRRI. Rice Res. Cant*. Los Banos Philippines pp.10

Howler, R.H. (1973) Iron- induced oranging desease of rice in relation to physiological changes in a flooded oxisol soil Sc. Soc. Am. Proc. 37. 898-903 IRRI, (1996). Standard Evaluation system for Rice IRRI, Los Banos Philippines pp52.

Ponnamperuma, F.N.(1972). The chemistry of submerged soils. *Adv. Agron*. 24:29-96

Ponnamperuma, F. N., T.Attanandana, and G. Beye (1973); Ameriolation of three acid surface salts for lowland rice pp 391-406 in H.Dost ed. *Acid sulfate soils proceeding of international symposium ILRI publ*. 18 vol 2 Wageningen.

Singh, B., S. Fagade., M.N Ukwungwu., C. Williams., S.S. Jagtap., O. Oladimeji., A. Efisue and O.Okhiavebie (1997). Rice growing env. and biophysical constraint in rice agro. ecological zones of Nigeria. *Met J.* 2 (1) 35-44.

Virmani, S.S.(1979) Breeding rice for tolerance to iron toxicity. In WARDA proceedings of the second varietal improvement seminar, Monrovia Liberia, pp156-172

WARDA, (2001-2002): West Africa Rice Development Association Annual Report. Bouake Coted'lvoire, pp103.