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Madras Agric. J., 8 - 11 January, 1993

https://doi.org/10.29321/MAJ.10.A01617

TOLERANCE OF RICE VARIETIES TO HIGH ACTIVE IRON CONTENT IN SOIL

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Tolerance of eight rice varieties to iron toxicity was studied. Tolerant varieties did not show symptoms of bronzing whereas, the sensitive varieties were severely affected. The tolerant varieties produced high straw and grain yield were observed to be associated with high nutrient ratios of N/Fe, P/Fe, K/Fe, Ca/Fe, Mg/Fe and Mn/Fe whereas the susceptible varieties were characterised by low nutrient ratios in the tissue and grain. Effective measures too ameliorate iron toxicity include liming, drainage and good fertilizer management. Tolerant rice varieties can serve as an alternative if iron toxicity is not severe.

Iron toxicity may be suspected when a reddish or brown scum of $Fe(OH)_3$ is visible on soil surface. It has been frequently observed with a pH less than 5.0 when dry (Van Mensvoort *et al.*, 1985). Most of the soils with typical iron toxicity problems poss a relatively low exchange capacity are characterised by relatively weak saturation with bases (Ca, Mg) and are undersupplied with P and K (Ottow *et al.*, 1983).

A large number of small brown spots appear on rice leaves affected by iron toxicity. Some varieties fail to show any discolouration but growth is retarded (Jayawardena *et al.*, 1977). Iron toxicity has been reported to occur at varying Fe levels but generally the symptoms appear at 300-500 ppm. Different varieties of rice show strikingly different capacity to tolerate stress conditions due to non-toxicity. It is expected that understanding, exploitation and deliberate manipulations of the heritable characters of rice genotypes would lead to high productivity. In view of this a field study was conducted to study the tolerance of rice cultivars to iron toxicity and the influence of iron toxicity on yield and uptake of nutrients.

MATERIALS AND METHODS

Typical iron toxic soil high in active iron (which builds Fe^{2+} about 400-500 ppm) was identified at Agricultural Research Station, Ponnampet. The selected experimental site represents a field situation of a low land surrounded by hills and was characterised by a oily looking scum floating on inundation water. The nursery of eight cultivars of rice namely Mahsuri, SPM, Siyam Halas, Siyam Kuning, CSR4, Intan Gowri, Getu and Damodar was raised on sand/solution culture media. Twenty two day old seedlings were transplanted in the typical iron toxic soil. The varieties were replicated four times. All the intercultural operations and plant protection and fetilizer application schedules were adopted as per package of practices of the crop as and when necessary. The plant

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Table 1. Iron & manganese content and Straw and grain yield (t/ha) or rice varieties under high active iron in soil.

Character	Flowering state	Straw	Grain (t/ha)	Flowering state	Straw	Grain (t/ha)	Flowering state	Straw	Grain (t/ha)
Mahsuri (Tolerant check)	6.69	6.05	5.27	220	148	138	410	451	141
SHM	6.30	5.67	4.83	246	164	140	386	426	135
Siyam Halas (Susceptible check)	2.67	2.35	1.72	602	350	181	176	243	112
Siyam Kurning	3.43	3.02	2.27	576	328	179	218	281	114
CSR 4	5.41	4.84	4.02	286	197	142	361	381	130
Intan Gowri	4.75	4.26	3.50	335	232	156	320	370	124
Getu	4.59	4.07	3.22	515	316	177	260	307	118
Damodar	5.06	4.51	3.48	491	286	161	298	336	121

samples were collected, dried and stored in polythene bottles for chemical analysis.

Total iron of the soil was determined by wet digestion of soil (Hesse, 1971). The active iron of soil was determined using citrate buffer and sodium dithionate (Hesse, 1971). The plant samples were digested in triacid and P, K, Ca, Mg, Fe and Mn were determined. Nitrogen was determined using mocrokjeldahl assembly (Jackson 1973).

RESULTS AND DISCUSSION

The soil was acidic in nature, high in organic carban and also active iron. The texture of soil was sandy loam, low in supply of P, K, Ca and Mg.

The straw and grain yields are given in Table 1. The varieties Mahsuri and SHM were found to be tolerant to high active iron is soil and Mahsuri was supsrior to SHM. These varieties showed no bronzing and the yields were higher than the other varieties. The varieties CSR4, Intan Gowri, Damodar and Getu were moderately tolerant, showing mild symptoms of bronzing and stunted growth. The yields were less than those of Mahsuri and SHM. The varieties Siyam kuning and Siyam Halas were severely affected by bronzin which resulted in oor i l general there was a close relationship between the degree of brozing and yields of the varieties. Masun Yamanouchi *et al.*, (1982) indicated clear varietal differences in leaf tissue tolerance for iron toxicity. This was attributed to the control of influx of nutrient ions ixerted by major gene. Jayawardena *et al.* (1977) also noted marked differences amongst the varieties of rice towards tolerance to iron toxicity.

The tolerant varieties were characterised by higher nutrient ratios than the susceptible varieties. Also the tolerant varieties recorded low uptake values of Fe and high uptake values of Mn as compared to the susceptible varieties. Thus higher influx of Fe in the tissue was found to upset the nutritional status of the plants, thereby resulting in low nutrient ratios in the tissue. Potassium influences the permeability of root membranes. When there is an under-supply of K an accumulation of low molecular weight carbohydrates and soluble N-compounds occurs as a result of deficient synthetic process (Jones and Lunt, 1967; Ismunadji, 1976). Together with increased membrane permeability (unfavourable K/Ca ratio) availability of low molecular weight compounds results in increased exudation by the roots into the rhizosphere. In particular

Table 2. Mineral nutrient ratios (with respect to iron in rice varieties under high active iron in soil)

Variety	Nutrient ratios in relations to iron					
	Nitrogen N/Fe	Phosphorus P/Fe	Potasium K/Fe	Calcium Ca/Fe	Mangnesium Mg/Fe	Manganese Mn/Fe
FLOWERING STAGE						
Mahsuri (Tolerant check)	82.27	18.31	67.27	23.18	14.09	1.86
SHM	76.66	16.66	60.41	19.58	12.50	1.61
Siyam Halas (Susceptible check)	34.20	5.08	20.09	4.48	1.66	0.29
Siyam Kuning	34.89	5.38	21.87	3.81	1.91	0.38
CSR 4	65.73	12.09	47.90	16.08	8.74	1.26
Intan Gowri	58.21	11.01	39.70	12.23	6.26	0.95
Getu	38.25	6.58	25.04	6.01	3.30	0.50
Damodar	40.12	6.35	26.88	7.73	3.66	0.61
HARVEST STAGE						
Mahsuri (Tolerant check)	78.39	21.35	122.97	43.24	16.89	3.05
SHM	71.95	18.84	107.92	37.80	14.63	2.60
Siyam Halas (Susceptible check)	38.28	6.31	35.42	8.85	2.28	0.69
Siayam Kuning	40.54	7.56	40.24	8.53	3.05	0.86
CSR 4	60.91	14.11	82.74	27.91	10.66	1.93
Intan Gowri	53.01	13.06	65.08	22.41	8.62	1.59
Getu	40.51	8.54	45.89	11.39	4.74	0.97
Damoder	43.71	8.77	52.09	14.33	5.94	1.17
GRAIN						
Mahsuri (Tolerant check)	87.67	15.65	33.33	15.94	12.31	1.02
SHM	89.28	15.07	29.28	14.28	10.71	0.96
Siyam Halas (Susceptible check)	74.58	7.73	10.49	4.97	3.31	0.60
Siyam Kuning	74.30	8.26	13.40	4.46	3.92	0.64
CSR 4	86.61	12.11	26.76	13.38	9.85	0.91
Intan Gowri	82.05	13.14	19.23	9.61	7.05	0.79
Getu	73.44	8.75	14.68	6.78	4.51	0.66
Damodar	79.50	9.31	18.63	8.07	6.21	0.75

in rice varieties with a relatively high K, P and Ca requirement increased reduction of Fe (III) oxides occurs at the root surface (Trollnier, 1973). This increased availability of Fe^{+2} resulted in uncontrolled influx of Fe^{+2} in senstitive varieties.

McHargue (1945) reported that if Mn is deficient there will be excess of active ferrous iron since Mn is associated with the oxidation of Fe^{2+} iron to inactive iron. Hence the restricted uptake of iron associated with high uptake of other nutrients particularly K, Mn and maintenance of high nutrient ratios in plant enables them to tolerate the stress conditions in an ideal way.

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Madras Agric. J., 11-13 January, 1993

EFFECT OF INTERCROP ON THE INCIDENCE OF GROUNDNUT LEAFMINER

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ABSTRACT

Influence of the intercropping system on the incidence of groundnut leaf miner. Significantly less number of leaf miner larvae per metre row, comparatively more percentage of parasitism by Goniozus sp. and less percentage of leaflet damage (41.3%) in groundnut and cumbu intercropping system at 4:1 ratio. In additiion, the groundnut cumbu intercropping system recorded 4.7 per cent increased net return when compared to the pure crop of groundnut.

The groundnut leaf miner, *Aproaerema modicella* Deventer is one of the major pests causing considerable yield losses in groundnut even 40 to 70 per cent pod yield in Tamil Nadu. The attack of this pest is further aggravated under rainfed and prolonged drought condition. The recent trend in the changing agriculture is the cultivation of more than one crop simultaneously to avoid crop losses and combat problem of pest and disease susceptibility (Kavimani *et al.*, 1989). Associated crops provide more diversity of food source for predators and parasites (Risch, 1979).

METERIALS AND METHODS

In the present study, five intercrops were evaluated against the groundnut leafminer compared with pure groundnut crop as control. Four rows of groundnut variety Co1