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ASSESSMENT OF GENETIC VARIABILITY IN TRADITIONAL RICE VARIETIES BASED ON AGRO-MORPHOLOGICAL TRAITS AND IRON-ZINC CONTENT FOR CROP IMPROVEMENT

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ABSTRACT
Iron and Zinc deficiency is probably the most widespread micronutrient deficiencies in cereals. Since rice is the staple food for more than 50% of the population especially in developing countries, a lot of efforts are being made to enrich the nutritional status of rice to prevent malnutrition. The experimental material comprised of 50 traditional rice varieties and 7 popular rice varieties collected from different parts of Tamil Nadu raised in replicated plots during *Rabi* 14. The objective of this study is to study the variability among the biometrical traits along with Fe and Zn in traditional rice varieties, to estimate iron and zinc in the brown rice of 57 lines and to define its role in biofortification programme. The mean value of iron in the materials used in this study is 12.39 µg/g and zinc, 22.72 µg/g. The lowest concentration of iron was recorded in Kaivara samba and the lowest zinc in variety Karuthakar. Among the landraces, Kavuni had highest iron content of 29.85 µg/g and the land race Mallampunchan collected from Gudalur, Nilgiri district of Tamil Nadu has the highest zinc content of 40.45 µg/g. The values for PCV and GCV ranged from days to 50% flowering (12.53, 12.46%) to single plant yield (38.88, 38.66 % respectively). Heritability ranged from number of productive tillers/plant (79.00%) to days to 50 per cent flowering, no. of grains/panicle, Fe content, Zn content and single plant yield (99.00%). Genetic advance as per cent of mean ranged from days to 50 per cent flowering (25.53%) to single plant yield (79.19%). Among the commercial cultivated varieties; ADT 43 (30.9 µg/g) followed by TKM 9 (26.2 µg/g) have higher amount of zinc content and the varieties ADT 45 (15.5 µg/g) and ADT 43 (14.3 µg/g) have the considerably higher amount of iron content, so it can be proposed to eat these rice varieties to cope with iron and zinc deficiencies. Furthermore, among the screened materials, the genotypes having higher iron and zinc content can be used as a breeding material for biofortification process in future.

KEY WORDS: Rice, land races, bio-fortification, genetic variability.

INTRODUCTION

Rice is a staple food for millions of people and having great importance in food and nutritional security. Traditional rice varieties or landraces, have a high level of genetic heterogeneity compared to modern cultivars. Landraces comprise of the unique source for gene of high adaptability but are poor yielders. Therefore, it is an indispensable demand for varietal improvement in such situation. From poorest to richest person in this world consume rice in one or other form. In the last two decades, new research findings generated by the nutritionists have brought to light the importance of micronutrients, vitamins and proteins in maintaining good health, adequate growth and even acceptable levels of cognitive ability apart from the problem of protein energy malnutrition. The largest nutritional problems occurring both globally and in rice-consuming countries are: protein-energy malnutrition; and iron, iodine and vitamin A deficiency. Millions of children are affected by malnutrition, which contributes to half of the 10 million deaths per year of children under 5 years of age (Shrimpton *et al.*, 2001). The severe form of iron deficiency affects about 3.5 billion worldwide (Ahman *et al*., 2000). Overall, 39% of preschool children and 52% of pregnant woman are anemic; more than 90% of them are living in the developing countries. In infant and young children, it impairs immunity, reduces the physical growth and cognitive development; at school age it affects school performance and reduces activity levels; at adulthood, it reduces work capacity and decrease resistance to fatigue. In pregnant women, iron deficiency anemia is associated with an increased risk of pre-mature delivery, retarded growth of the fetus, low birth weight and increased risk that the new born baby die soon after birth. Anemia is the main cause of death during childbirth.

A challenge for Agricultural scientists is to feed the world population with nourishing food. On the other hand, expectations for higher grain productivity in the past, caused decreased content of micronutrients in grains. The issue of micronutrients deficiency is related with food and nutritional security. Micronutrients deficiencies are difficult to diagnose and consequently the problem is termed ‘hidden hunger’. Production of varieties containing high amounts of bioavailable Fe would improve Fe nutrition in regions where iron deficiency is prevalent. It is necessary to improve both the net Fe & Zn concentration and their bioavailability in rice grain for improving the Fe & Zn intake in populations dependent on rice as a staple food. Micronutrient malnutrition, and particularly Fe and Zn deficiency affect over three billion people worldwide, mostly in developing countries (Sperotto *et al.*, 2010). Biofortification, when applied to staple crops, such as rice, is a sustainable approach, provided that access to the technology in the form of seeds is unrestricted.

Zinc is required for metabolic activity of enzymes (as a cofactor) involved in repair brain function & replacement of body cells. It's essential for cell division & synthesis of DNA & proteins. Zinc is a mineral that promotes immunity, resistance to infection, and proper growth and development of the nervous system, and is integral to healthy pregnancy outcomes. 17.3% of the global population is at risk for zinc deficiency due to dietary inadequacy, though up to 30% of people are at risk in some regions of the world (Wessells *et al*., 2012). In addition to agronomical management, selecting genotypes with high efficiency of Fe and Zn accumulation in the endosperm and their bioavailability from existing germplasm collection may be an efficient and reliable way to deliver Fe nutrition benefits to farmers and local population (Prom-uthai *et al.*, 2006). There is approximately a fourfold difference in iron and zinc concentration, suggesting some genetic potential to increase the concentration of these micronutrients in rice grains. (Gregorio, 2002).

Exploiting the genetic variation in crop plants for micronutrient content is one of the most powerful tools to change the nutrient balance of a given diet on a large scale. The initial focus is on successfully breeding a rice variety containing higher absolute mineral content. The true test of the success of this strategy will be the bio-availability of the increased nutrient content. In order to achieve higher bio-availability, three approaches are possible: i) increase the concentration of the nutrient in the grain; ii) increase the percentage of bio-availability (by decreasing material which inhibits nutrient uptake); and iii) a combination of these two strategies (Graham *et al.*, 1997). Micronutrient-dense cultivars can be selected from within existing germplasm, or can be generated de novo through genetic modification. Plant breeders involved in breeding staple food crops with more Fe, Zn need to identify donor parents carrying the target traits. Once rice is biofortified with vital nutrients, the farmer can grow indefinitely without any additional input to produce nutrient packed rice grains in a sustainable way. This is also the only feasible way of reaching the malnourished population in India.

Perl's Prussian blue and DTZ staining method are standardized for Fe and Zn estimation respectively to conduct the initial screening of genotypes. Although these methods are simple and inexpensive but qualitative instead of quantitative. Iron and zinc concentrations in rice samples were also estimated by colorimetric method or by Atomic Absorption Spectrometry (AAS), X-ray Fluorescence (XRF) and Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). X-ray Fluorescence (XRF) and Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Colorimetric method is the qualitative method where as in quantitative methods, AAS and ICP-OES are destructive methods. The only non destructive method for the estimation of Iron and zinc concentrations is X-Ray florescence. In XRF, the preselected wavelength of incident X-rays expel an electron from the innermost orbit followed by the transfer of one of the electrons from the outermost orbit to innermost orbit leading to release of specific wavelength of X-rays. The energy of the emitted radiation is specific for a particular atom. Therefore, it is simultaneously identified and quantified by the detector.

Different types of X-ray spectrometry are used for analysis of mineral elements. Laboratory bench top Energy Dispersive X-ray Florescence (ED-XRF) is the most commonly used technique because of its precision and rapid and cost effective screening for the estimation of large number of samples (Paltridge *et al* ., 2012). Hence, this study was proposed to assess the variability in iron and zinc content in dehusked rice grains for its utilization in micronutrient biofortification program in a collection of 50 traditional rice varieties of diverse origin and seven popular varieties using ED-XRF method. This study will also help in the developing nutritionally improved rice cultivar and development of rice varieties with enhanced nutritional quality.

MATERIALS & METHODS

Experimental design, materials and growing conditions

The experiment was laid out at Tamil Nadu Rice Research Institute, Aduthurai, Tamil Nadu during the season *Rabi* 2014. The experimental material comprised of 50 traditional rice varieties and 7 popular rice varieties collected from different parts of Tamil Nadu were used in this study (Table 1). Seedlings at 25 days after sowing were transplanted into the main field. Each entry was planted in two rows each having ten plants with a inter row spacing of 20 cm and intra row spacing of 20 cm. The experiment was laid out in randomized block design with two replications. Genotypes were grown as under irrigated condition and standard crop production and crop protection practices were followed. Data on days to 50% flowering (DFF), plant height (PH), panicle length (PL), productive tillers per plant (PT), number of grains per panicle (NG), single plant yield (SPY) were recorded and the seeds harvested from these lines were dehusked using lab dehusker for grain iron content (Fe), grain zinc content (Zn) estimation.

Iron and Zinc Content Estimation

EDXRF (OXFORD Instruments X-Supreme 8000) was performed in Indian Institute of Rice Research, Hyderabad using an Oxford Instruments X-supreme 8000 which has 10 place auto sampler. Dehusked rice was cleaned for broken and debris and 5g of each sample was weighed and transferred to sample cups. The sample cups were gently shaken for uniform distribution of samples and kept for analysis. For each set of sample, it has taken 3.1 minutes which included 60s acquisition time for the separate Zn and Fe conditions as well as 66s 'dead time' during which the XRF will establish each measurement condition. Scans were conducted in sample cups assembled from 21 mm diameter and the cup combined with polypropylene inner cups was sealed at one end with 4 µm Poly-4 XRF sample film. Concentration was expressed in microgram per gram (µg/g).

TABLE 1. List of Germplasm used in the study

G. No.	Genotypes	Parentage	G. No.	Genotypes	Parentage
RG 1	Jaya	Land race	RG 30	Karudan samba	Land race
RG 2	Chinnapunchai	Land race	RG 31	Sura kuruvai	Land race
RG 3	Varisurian	Land race	RG 32	Sivapu kavuni	Land race
RG 4	Thaiching	Land race	RG 33	Kaivara samba	Land race
RG 5	Kurakat	Land race	RG 34	Norungan	Land race
RG 6	IR 20 red	Land race	RG 35	Kallurundai kar	Land race
RG 7	Adukar	Land race	RG 36	Lalat	Land race
RG 8	Kalyani	Land race	RG 37	White ponni	Land race
RG 9	Mandamaranellu	Land race	RG 38	Sivappukuruvikar	Land race
RG 10	Kalaya	Land race	RG 39	Kattu ponni	Land race
RG 11	Kothandan	Land race	RG 40	Kattaikar	Land race
RG 12	Athira 1	Land race	RG 41	Poongar	Land race
RG 13	Chinthamani	Land race	RG 42	Purple puttu	Land race
RG 14	Kadaikannan	Land race	RG 43	Murungankar	Land race
RG 15	Kayamma	Land race	RG 44	Nootripathu	Land race
RG 16	TKM 9		RG 45	Uppumilagai	Land race
RG 17	ADT 45	IR 50/ADT 37	RG 46	Vellaichithiraikar	Land race
RG 18	ADT 43	IR 50/White ponni	RG 47	Sivapuchithiraikar	Land race
RG 19	ADT 41		RG 48	Kavuni	Land race
RG 20	Thondi	Land race	RG 49	Karutha kar	Land race
RG 21	Mallampunchan	Land race	RG 50	Kallundai	Land race
RG 22	Manulayan	Land race	RG 51	Mohini samba	Land race
RG 23	Maranellu	Land race	RG 52	Sayasree	Land race
RG 24	GEB 24	Spontaneous mutant	RG 53	Kaakrathan	Land race
RG 25	Jeeragasamba	Land race	RG 54	I. Sambamasuri	-
RG 26	Swarna	Land race	RG 55	IR 64	IR 5657-33-2-1/ IR 2061
RG 27	Mappilai samba	Land race	RG 56	BPT 5204	
RG 28	Thangan kar	Land race	RG 57	Mattaikar	Land race
RG 29	Illupaipu samba	Land race			

The mean data for each character individually was subjected to statistical analysis. Standard statistical procedures were used for the analysis of mean variance, genotypic and phenotypic coefficients of variation (Burton, 1952), heritability (Lush, 1940) and genetic advance.

RESULTS & DISCUSSION

Knowledge on nature and magnitude of genotypic and phenotypic variability present in any crop species plays an important role in formulating successful breeding programmes. Genetic variability is very important to exert the untapped genetic potential and for the sustainability of small farmers. Despite low yield the land races are highly instable for its yield potential. Since rice is the staple food for more than 50% of the population especially in developing countries, a lot of efforts are being made to enrich the nutritional status of rice to prevent malnutrition. In this study, the mean values indicated the considerable variation for all biometrical traits (Table 2).

TABLE 2. Mean performance of traditional and promising rice varieties for biometrical traits and Fe and Zn content

Sl. No.	GENOTYPES	DFF (days)	PH (cm)	NPT (no.)	PL (cm)	NG (no.)	FE (µg/g)	ZN (µg/g)	SPY (g)
1	JAYA	90.50	80.50	21.50	24.70	108.50	12.30	33.85*	20.29
2	CHINNAPUNCHAI	83.50	115.50	16.00	25.00	88.00	10.80	31.85*	20.50
3	VARISURIAN	112.50*	110.00	15.00	29.30*	126.50*	12.50	31.60*	16.93
4	THAICHING	83.00	105.00	19.00	24.70	112.50	13.20	28.95	15.16
5	KURAKAT	93.50	91.50	15.00	27.00	137.50*	11.50	33.40*	22.51
6	IR 20 RED	112.50*	93.00	21.50	26.00	143.50*	11.95	27.80*	47.64*
7	ADUKAN	91.00	75.00	17.00	25.30	91.50	13.95	34.60*	20.59
8	KALYANI	94.00	80.50	15.50	24.10	106.00	11.60	36.15*	28.68*
9	MANDAMARANELLU	88.50	120.50*	13.00	27.10	88.00	11.45	30.95	21.00
10	KALAYA	88.50	115.50	17.50	26.60	88.50	13.00	27.95*	22.50
11	KOTHANDAN	99.00*	67.00	30.00*	19.00	96.00	12.35	35.80*	36.68*
12	ATHIRA 1	88.50	91.00	21.00	25.50	107.50	12.65	28.45*	53.81*
13	CHINTHAMANI	86.50	98.50	16.00	20.50	87.50	12.95	29.55*	20.00
14	KADAI KANNAN	88.00	105.50	13.50	26.70	98.00	13.40	29.90*	26.77
15	KAYAMMA	86.00	104.00	17.50	23.60	103.50	13.45	30.20*	22.67
16	TKM 9	79.00	70.50	16.50	22.25	108.50	14.10	26.30*	26.50
17	ADT (R) 45	82.50	65.50	11.50	19.50	102.50	15.65	19.55	35.76*
18	ADT 43	85.50	65.00	14.00	22.35	163.00*	14.65	30.95*	38.79*
19	ADT 41	83.50	69.50	16.50	21.20	150.00	12.75	24.25*	30.00
20	THONDI	86.00	120.00	22.50	23.50	119.00	11.50	32.95*	23.65

21	MALLAM PUNCHAN	94.00	113.50	19.50	24.00	93.00	13.80*	40.45*	25.45
22	MANULAYAN	94.00	148.50*	12.00	25.85	97.50	11.95	26.60*	20.77
23	MARANELLU	111.00*	126.50*	19.00	28.10*	100.50	11.70	25.75*	18.38
24	GEB 24	105.50*	124.00*	20.50	30.25*	123.50*	11.95	18.45	23.00
25	JEERAGASAMBA	111.50*	135.00*	28.50*	30.85*	153.00*	15.90	15.85	23.61
26	SWARNA	101.00*	79.00	32.00*	22.25	142.50	18.60*	24.70*	26.60
27	MAPPILAI SAMBA	114.00*	130.50*	17.00	25.75	112.50	8.65	19.75	27.57
28	THANGAN KAR	92.50	127.00*	19.00	22.25	102.00	7.90	22.15	17.25
29	ILLUPAIPU SAMBA	119.00*	119.50*	13.50	20.75	109.00	13.65*	18.95	18.85
30	KARUDAN SAMBA	113.50*	146.00*	8.00	28.75*	117.50	7.70	22.85	25.00
31	SURA KURUVAI	85.50	141.50*	11.00	27.25	105.50	10.75	27.80*	23.69
32	SIVAPU KAVUNI	90.50	138.50*	28.00*	30.60*	253.00*	10.80	19.45	31.37*
33	KAIVARA SAMBA	91.50	139.00*	20.00	29.05*	98.00	7.10	22.95	52.01*
34	NORUNGAN	87.00	100.50	12.50	25.60	123.50*	9.10	20.35	21.68
35	KALLURUNDAI KAR	88.50	81.50	13.50	15.50	133.50*	12.95*	14.45	20.66
36	WHITE PONNI	107.00*	88.50	13.50	12.50	135.00*	14.90	24.80*	30.00*
37	SIVAPPUKURUVIKAR	85.50	141.50*	11.00	27.25	105.50	8.85	14.30	23.69
38	KATTU PONNI	86.50	100.50	12.50	21.50	130.00*	10.75	17.55	21.88
39	KATTAI KAR	90.50	134.50*	20.50	30.50*	94.00	9.60	11.75	15.65
40	POONGAR	92.50	127.00	19.00	22.25	102.00	9.55	17.35	17.25
41	PURPLE PUTTU	81.50	115.50	11.50	26.25	106.50	11.90	13.30	19.57
42	MURUNGAN KAR	82.50	95.50	12.00	24.95	121.50*	10.10	12.30	15.43
43	NOOTRIPATHU	83.00	114.50	13.50	23.65	87.50	8.50	14.65	14.68
44	UPPUMILAGAI	115.50*	125.50*	11.50	26.25	96.50	9.80	19.90	26.65
45	VELLAICHITHIRAIKAR	92.50	108.50	23.00	17.85	99.00	12.55	20.45	22.50
46	SIVAPUCHITHIRAIKAR	82.50	90.50	18.50	16.10	104.00	10.45	16.75	19.76
47	KAVUNI	89.00	137.50*	14.00	25.75	113.50	29.85*	13.55	20.80
48	BARMA KAVUNI	111.00*	136.50*	22.50	29.25	115.00	21.70*	15.60	26.93
49	VELLAI KAVUNI	89.00	133.50*	15.50	27.75	123.50*	25.20*	15.50	26.34
50	KARUTHA KAR	85.50	106.00	14.00	23.25	112.50	9.35	9.95	21.00
51	KALLUNDAI	110.50*	131.00*	13.60	27.10	100.00	8.65	14.30	21.58
52	MOHINI SAMBA	85.00	75.50	24.50*	18.10	88.50	11.50	13.95	25.78
53	SAYASREE	123.00*	130.50*	21.50	26.10	165.50*	12.20	12.95	52.55*
54	KAAKRATHAN	116.00*	128.50*	32.50*	30.50	156.00*	7.45	13.75	59.65*
55	KALLUNDAIKAR	88.50	81.50	13.50	15.50	133.50*	11.35	21.55	20.66
56	BPT 5204	106.00*	75.50	32.50*	21.25	95.50	11.90	20.65	39.88*
57	MATTAIKAR	85.00	82.50	11.00	19.60	108.50	11.65	14.70	20.16
MEAN		94.54	107.97	17.64	24.28	115.51	12.39	22.72	26.12
SEd		1.23	3.90	2.83	1.67	2.94	0.30	0.20	1.08
CD (5%)		2.48	7.82	5.66	3.34	5.88	0.60	0.40	2.16

All the fifty seven genotypes consisting traditional and popular rice varieties were analyzed for biometrical traits and iron and zinc concentration in brown rice (by XRF method). Among the land races, Illupaipusamba (119.40 days) was the late flowering and Purple puttu (81.50 days) was the early flowering genotype. With regard to plant height among the genotypes, Manulayan was found to be the tallest (148.50 cm) and the variety ADT 43 (65.00 cm) was the shortest. Among the 57 genotypes studied, Karudan samba recorded the lowest number of productive tillers per plant (8.00) while Kakkarathan (32.50) showed the highest number of productive tillers. Among the land races, highest panicle length was recorded by Seeragasamba (30.85 cm) and the lowest by Kalluraindaikar (15.50 cm) and the highest number of filled grains per panicle was recorded by Sivappukavuni (253.00) and the lowest by Nootripathu (87.50). Among the land races, maximum single plant yield was recorded in Kakkarathan (59.65 g) and minimum in Nootripathu (14.68 g). The undesirable characters of these landraces were tall growing, late flowering and lodging type. Iron and Zinc deficiency is probably the most widespread micronutrient deficiencies in cereals. A large genetic variation for grain iron and zinc has been observed in different germplasm of rice and maize and it was exploited in breeding programs. Gregorio has screened rice lines in IRRI germplasm for high iron and zinc content. Among a subset of 1,138 samples analyzed, iron concentrations ranged from 6.3 to 24.4 µg/g, and for zinc, the range was 15.3–58.4 µg/g19. From this study, Iron concentration ranged from 7.1 µg/g to 29.85 µg/g and zinc concentration from 9.95 µg/g to 40.45 µg/g (Fig 1). The mean value of iron in the materials used in this study is 12.39 µg/g and zinc, 22.72 µg/g. The lowest concentration of iron was recorded in Kaivara samba and the lowest zinc in variety Karuthakar. Among the landraces, Kavuni had highest iron content of 29.85 µg/g and the land race Mallampunchan collected from Gudalur, Nilgiri district of Tamil Nadu has the highest zinc content of 40.45 µg/g. Roy and Sharma has screened 84 landraces for iron and zinc content. Iron content varied between 0.25 µg/g to 34.8 µg/g and Zinc content from 0.85 µg/g to 195.3 µg/g. Local cultivar Swetonunia had highest iron content of 34.8 µg/g followed by the other cultivars Gobindobhog 3.1 µg/g, and Attey 2.05 µg/g. In popular rice varieties, ADT (R) 45 (IR 50/ADT 37) has higher iron content (15.65 µg/g) and ADT 43 has the higher zinc content (30.95 µg/g) (Fig 2). The genotypes with the zinc content of 0–12 µg/g (3 genotypes) was categorized under low zinc content, 23 genotypes with the zinc content from 12.1 to 20 µg/g was grouped in moderate category and the genotypes (29 genotypes) with more than >20 µg/g was placed in high category (Fig 3). Vishnuvarthini *et al.*, 2014 estimated iron and zinc in the brown rice of 192 germplasm lines and to define its role in biofortification programme and reported that the landrace Nootripathu had higher iron content of 13.3 µg/g and Vadakathi Samba has higher zinc content (27.6 µg/g).

FIGURE 1. Iron and Zinc content in 57 genotypes

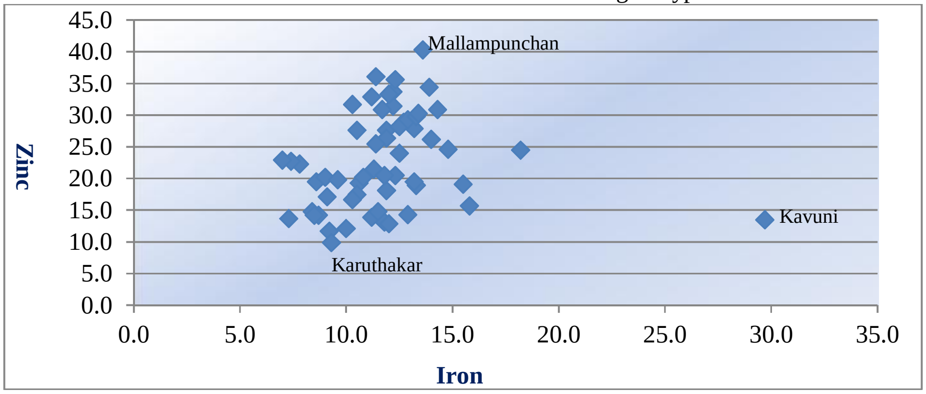


FIGURE 2. Variation in Iron content

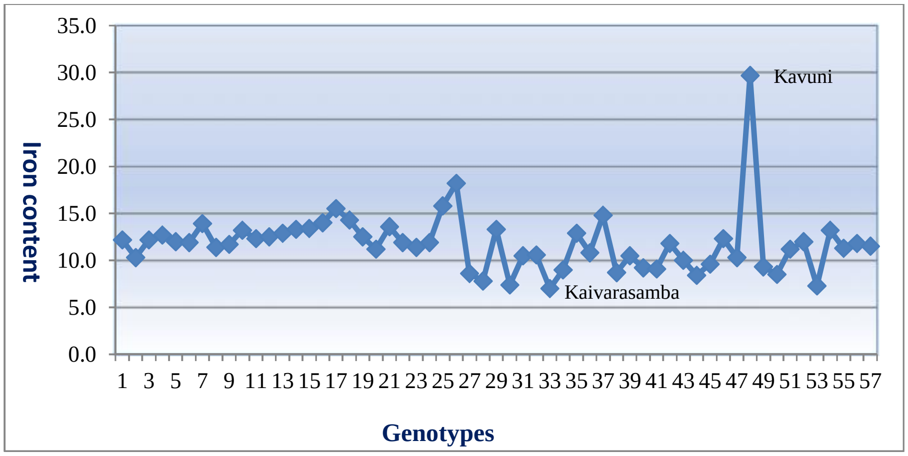
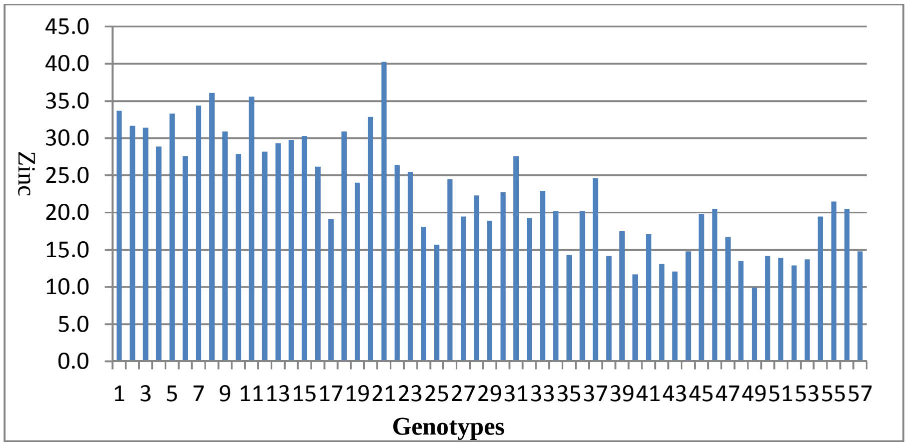


FIGURE 3. Variation in Zinc content



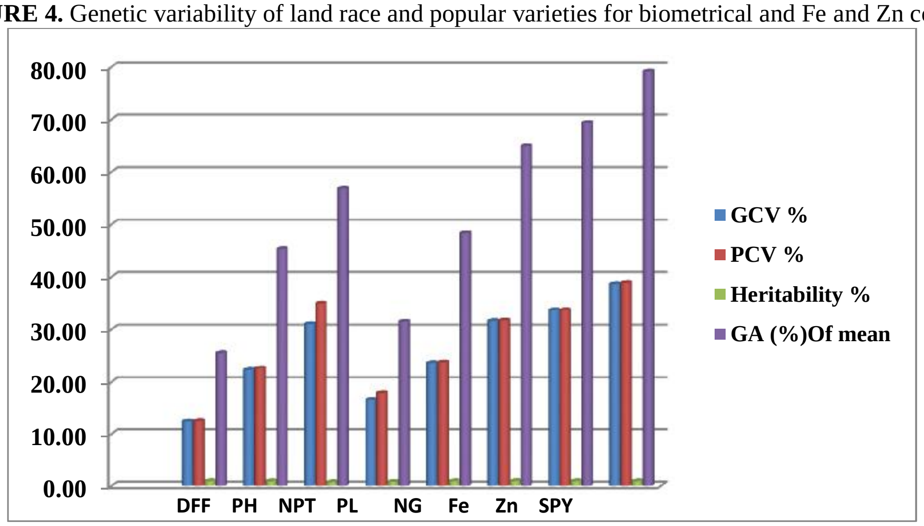
The estimates of phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance as per cent of mean for the traits under study are furnished in table 3 and fig 4. Estimates of the amount of variability for different characters and their heritable components available in the population are essential for dynamic and efficient plant breeding. In general phenotypic coefficients of variation were higher than the genotypic coefficients of variation. Heritability gives the information on the magnitude of quantitative characters, while genetic advance will be helpful in calculating suitable selection procedures.

The values for PCV and GCV ranged from days to 50% flowering (12.53, 12.46 %) to single plant yield (38.88, 38.66 % respectively). The moderate PCV and GCV were recorded for days to 50 per cent flowering and panicle length. The genotypic and phenotypic coefficients of variation indicated the extent of variability for different traits. Those results are in conformity with those of by Chimmili (2012) and Savitha and Ushakumari (2015). High heritability coupled with low genetic advance, low heritability with high genetic advance or low heritability and low genetic advance offer less scope for selection, as they were more influence by environmental and accounted for non-additive gene effects. High heritability coupled with high genetic advance is indicated of greater proportion of additive genetic advance and consequently a high genetic advance is expected for selection (Singh and Rai, 1981). The characters having high heritability with low genetic advance as per cent of mean appeared to be controlled by non-additive gene action and selection for such characters may not be effective (Singh and Singh 2007). The genotypes recorded high heritability values for all the characters under study. Heritability ranged from number of productive tillers/plant (79.00%) to days to 50 per cent flowering, no. of grains/panicle, Fe content, Zn content and single plant yield (99.00%). Genetic advance as per cent of mean ranged from days to 50 per cent flowering (25.53 %) to single plant yield (79.19 %). Single plant yield recorded the highest genetic advance followed by Zn content, Fe content, number of productive tillers per plant and number of grains/panicle. High genetic advance indicated that these characters are governed by additive genes and selection will be rewarding for improvement of study. The above findings support the results of Chimmili (2012) and Savitha and Ushakumari (2015).

TABLE 3. Genetic variability parameters of traditional and promising rice varieties for biometrical traits and Fe and Zn content in rice

Character	Range	GCV %	PCV %	ECV %	Heritability%	GA (%)of mean
Days to 50%flowering (DFF)	79.00-119.00	12.46	12.53	1.31	99.00	25.53
Plant height (PH)	65.00-148.50	22.32	22.61	3.61	97.00	45.39
No. of productive tillers/plant (NPT)	8.00-32.50	31.06	34.95	16.02	79.00	56.87
Panicle length (PL)	15.50-30.85	16.55	17.92	6.87	85.00	31.49
No. of grains/panicle (NG)	87.50-253.00	23.60	23.74	2.54	99.00	48.34
Fe content (Fe)	7.10-29.85	31.61	31.70	2.42	99.00	64.93
Zn content (Zn)	9.95-40.43	33.70	33.72	0.88	99.00	69.41
Single plant yield (SPY)	14.68-59.65	38.66	38.88	4.13	99.00	79.19

FIGURE 4. Genetic variability of land race and popular varieties for biometrical and Fe and Zn content



CONCLUSION

Traditional rice varieties or land races have a high level of genetic heterogeneity compared to modern improved rice cultivars. The genetic improvement in traditional land races of rice is possible through selection exercised for those characters which showed high values of phenotypic coefficient of variation and genotypic coefficient of variation, heritability and genetic advance. This will provide an opportunity to select better recombinants for variability for these characters in the future generations. However, characters predominantly controlled by additive gene action would be conventional breeding methods. This will also help modern breeding programs to plan crosses to incorporate this variability into the genetic background of elite traditional rice landraces, which in turn will generate new nutritional and medicinal properties rich improved rice cultivars. Screening of germplasm for micronutrients is the initial step of biofortification. In this study 57 genotypes were screened to identify iron and zinc rich traditional rice in Tamil Nadu. The local landrace, Kavuni had the highest (29.7 µg/g) iron concentration whereas Mallampunchan had the highest amount of zinc concentration (40.3µg/g). Among the commercial cultivated varieties; ADT 43 (30.9 µg/g) followed by TKM 9 (26.2 µg/g) have higher amount of zinc content and the varieties ADT 45 (15.5 µg/g) and ADT 43 (14.3 µg/g) have the considerably higher amount of iron content, so it can be proposed to eat these rice varieties to cope with iron and zinc deficiencies. Furthermore, among the screened materials, the genotypes having higher iron and zinc content can be used as a breeding material for biofortification process in future.

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